Resource and Timber Supply Analysis
Healthy Pine Strategy

An Amendment to the Detailed Forest Management Plan (2003) for Canfor FMA 9900037 to Incorporate Strategies for Mountain Pine Beetle Control

Timberline
Natural Resource Group

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Timberline
Natural Resource Group

March 27, 2009

Dwight Weeks, RPFT
Canadian Forest Products Limited
9401 – 108 Street
Postal Bag 100
Grande Prairie, AB
T8V 3A3

SUBJECT: MPB DFMP Amendment – Resource and Timber Supply Analysis

With this letter I am delivering the report "*Resource and Timber Supply Analysis – Healthy Pine Strategy*" that describes the work completed and the results generated by Timberline Natural Resource Group in support of the amendment to Canfor's 2003 "*Detailed Forest Management Plan - FMA9900037*".

This work has been completed either by me or under my direct supervision.

I have reviewed the *Alberta Forest Management Planning Standard V4.1 (April 2006)* and certify that this analysis complies with the guidelines provided in that document. Specifically, our work falls under the following headings listed under Annex, Section 2.1:

v. Forecasting (timber supply analysis) – for appraisal

vi. Harvest planning (spatial harvest sequence) – for appraisal

Respectfully,

Jerry Miehm, RPF
Senior Resource Analyst
RPF #2782 (British Columbia)

REGISTERED PROFESSIONAL FORESTER
PROVINCE OF BRITISH COLUMBIA
JERRY MIEHM
NO. 2782

(Jerry Miehm, RPF Seal Affixed on Original)

Suite 401, 958 West 8th Ave., Vancouver, BC V5Z 1E5 Tel (604) 733-0731 Fax (604) 733-0634
www.timberline.ca

EXECUTIVE SUMMARY

In the summer of 2006, significant flights of mountain pine beetle (*Dendroctonus ponderosae Hopkins)* infected a large area of lodgepole pine stands in northwestern Alberta, including Canadian Forest Products Ltd. (Canfor's) Forest Management Agreement (FMA) 9900037 and quota tenures. Alberta Sustainable Resource Development (ASRD) responded to the threat by developing a *Mountain Pine Beetle Action Plan for Alberta* (ASRD, 2007a) that described both short and long-term strategies for dealing with the outbreak. Canfor conducted a new Resource and Timber Supply Analysis (RSTA) and completed an amendment to the approved 2003 Detailed Forest Management Plan (DFMP) to support ASRD's strategy and to guide its own operations.

Using ASRD's *Interpretive Bulletin: Planning Mountain Pine Beetle Response Operations ver. 2.6* (ASRD, 2006a) as a guide, many different scenarios were examined utilizing the forest estate model, COMPLAN. Three of them (and a sensitivity analysis) are presented:

- **Status Quo: MPB1** - The preferred management scenario from the 2003 DFMP, updated to reflect harvesting up to 2007. A sensitivity analysis was also completed to estimate the impact that widespread MPB mortality would have on coniferous harvest levels if no effort is made in the short term to reduce risk by preferentially harvesting stands that are susceptible to MBP attack;
- **Healthy Pine: MPB2** - Focused harvest in pine stands for 15 years in order to reduce the risk and level of pine mortality in the event of an MPB outbreak. However, no pine mortality is assumed. Original 2003 DFMP cover constraints were not enforced for the first 15 years, but no harvesting was permitted within the caribou primary intactness area for that period. Original 2003 DFMP cover constraints are enforced from that point onward; and
- **Disaster: MPB3** - Focused harvesting in pine stands for 15 years in order to reduce the risk and level of pine mortality in the event of an MPB outbreak. ASRD pine mortality assumptions applied at year 15 of the simulation. Original 2003 DFMP cover constraints were not enforced for the first 15 years, but no harvesting within the caribou primary intactness area was permitted for that period. Original 2003 DFMP cover constraints are enforced from that point onward.

Results from the modelling were evaluated to select the preferred forest management alternative (PFMA), namely the Healthy Pine Scenario (MPB2). The PFMA balances social, environmental and economic values, recognizing that trade offs are necessary between MPB management objectives, legal requirements and commitments to maintain other resource values.

The Healthy Pine Scenario (MPB2) was selected for the following reasons:

- It significantly reduces the area of MPB-susceptible pine, which is primary objective of the ASRD Mountain Pine Beetle Action Plan (ASRD, 2007a). Focusing on pine harvest during the fifteen-year plan creates a spatial timber harvesting sequence that creates a healthy forest that is more resistant to MPB outbreaks;
- Average coniferous harvest level for the fifteen-year plan is 715,000 m^3/ year. This represents a coniferous harvest uplift of approximately ten percent, as compared to

the average of 650,000 m^3/ year presented in the 2003 DFMP (640,000 m^3/ year initially rising to 670,000 m^3/ year in 2019). For the balance of the 200-year planning horizon, the long term coniferous harvest level identified within the 2003 DFMP (670,000 m^3/ year) is still achievable and sustainable;

- Deciduous timber allocations are maintained under this scenario for the entire 200-year planning horizon. Average annual deciduous volume allocations for the fifteen-year plan (2007-2021) were established at 513,261 m^3/ year to account for deciduous carryovers. For the remainder of the 200-year planning horizon (2022 – 2206) the objective was to achieve an average annual deciduous volume allocation of 453,712 m^3/ year;
- Protection of watershed resources effectively throughout the 200-year planning horizon at levels similar to those presented in the 2003 DFMP;
- Achievement of objectives for other non-timber resources such as species of management concern (woodland caribou, trumpeter swan and grizzly bear), and
- Achievement of Canfor's Sustainable Forest Management Plan (2005) objectives to the greatest extent possible, while recognizing and countering the effects of the MPB outbreak.

Spatial harvest sequences were developed for both coniferous and deciduous species and are presented in the RTSA. Ainsworth and Tolko played the leading role in establishing priority areas for harvest.

Public involvement is a primary principle in development of the Healthy Pine Strategy (HPS) and the Forest Management Advisory Committee (FMAC) is an integral part of the planning process. The three above-mentioned scenarios were presented and discussed by the Committee at the November 19, 2008 meeting. The Committee understood the material presented and accepted the rationale for the selected PFMA (FMAC Nov. 19, 2008 minutes).

1 INTRODUCTION

1.1 Background

In the summer of 2006 significant flights of mountain pine beetle (*Dendroctonus ponderosae Hopkins*) infected a large area of lodgepole pine stands in northwestern Alberta, including Canadian Forest Products Ltd. (Canfor) FMA area 9900037 (Figure 1) and quota tenures. Approximately forty percent of the approved coniferous AAC for Canfor's FMA area 99000037 is comprised of lodgepole pine, which is now under threat.

ASRD responded to the threat by developing a *Mountain Pine Beetle Action Plan for Alberta* (ASRD, 2007a). One strategy within that document focuses on decreasing MPB spread and outbreak potential by reducing the area of MPB susceptible stands. In response to ASRD's action plan, Canfor commenced development of an amendment to its approved 2003 Detailed Forest Management Plan (Canfor, 2003). ASRD's *Interpretive Bulletin: Planning Mountain Pine Beetle Response Operations ver. 2.6* (ASRD, 2006a) provided the direction for development of the amendment:

"*The goal is to reduce the area of susceptible pine stands in Rank* 1[1] and *Rank* 2[2] *categories in the Sustained Yield Unit (SYU) to 25% of that projected in the currently approved DFMP at a point twenty years in the future*."

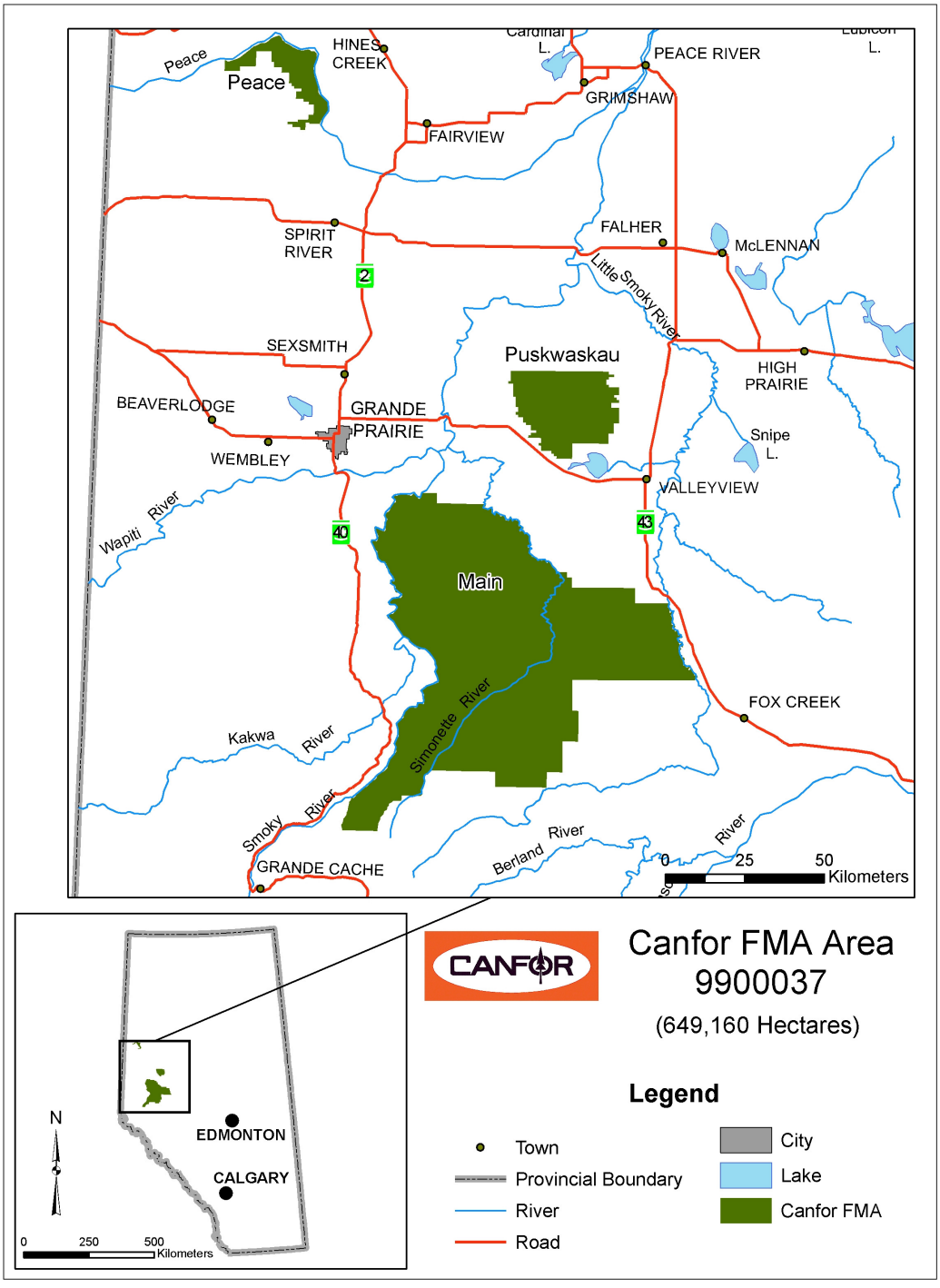
The *Resource and Timber Supply Analysis (RTSA)* that was completed during the 2003 DFMP process was rerun in order to help develop a strategy and harvest sequence that meets ASRD's objectives. This document – entitled "Healthy Pine Strategy" – presents the results of that analysis.

Ainsworth Lumber Company Ltd. (Ainsworth) and Tolko Industries Ltd. (Tolko) have deciduous timber allocations within the FMA area. Their respective deciduous allocation areas can be seen in Appendix B, Map 3. This analysis could not have been successfully completed without direct consultation with and input from both of these companies. Both companies were provided with statistics on deciduous timber availability by timber supply compartment, and they reviewed both the coniferous and deciduous fifteen-year harvest sequences. Their feedback was incorporated into the final version of the deciduous harvest sequence.

[1] Rank 1 stands are the highest priority for susceptibility reduction. These stands provide the best habitat for MPB to produce brood and spread MPB to other stands.

[2] Rank 2 stands are also important, but because of their lower pine content, lower suitability and/or greater distance from existing MPB populations, they are a lower priority.

Figure 1. Location of FMA area 9900037



1.2 Process

The first step in achieving the ASRD objective was the development of a Prevention Strategy in accordance with the ASRD *Interpretive Bulletin* (ASRD, 2006a) that would make the pine forest less susceptible to MPB attack by altering the age class structure. The following steps were taken:

- Assign a susceptibility rating to each stand in the inventory database;
- Assign a harvest priority to each stand base on its susceptibility, yield group and height;
- Summarize area and volume by timber supply compartment and harvest priority;
- For each of three five-year periods beginning in 2007, assign harvest volume targets for each timber supply compartment based on volumes of available susceptible pine, ASRD targets and operational logistics;
- Run the forest estate model (COMPLAN) to generate a fifteen-year conifer harvest sequence;
- Review fifteen-year coniferous harvest flows;
- Establish deciduous harvest targets, by timber supply compartment, for each of three five-year periods beginning in 2007;
- Run the forest estate model to generate a fifteen-year deciduous harvest sequence; and
- With input from deciduous operators, review and finalize the fifteen-year plan for both coniferous and deciduous harvest.

This fifteen-year plan served as a starting point for two of the three management scenarios that have been considered in selecting the preferred forest management alternative (PFMA).

1.3 Modelling Scenarios

Timberline Natural Resource Group Ltd. (TNRG) was retained to provide forest estate modelling services and analytical support. Under the direction of Canfor, TNRG completed numerous sensitivity analyses. These were evaluated and further analyses were formulated. Those most relevant to the selection of the PFMA are presented here.

The ASRD *Interpretive Bulletin* (ASRD, 2006a) mandates that three management scenarios be run and compared. These scenarios are the:

1) DFMP Status Quo;
2) MPB Healthy Pine Scenario; and
3) MBP Disaster Scenario.

The updated Resource and Timber Supply Analysis evaluates the magnitude of the MPB outbreak on timber supply and other forest values and presents the results in Section 4 of this document. The results are presented in graphical and tabular format, and are discussed in detail. The selection of the PFMA is documented in Section 5.

1.4 Non-Timber Resources

In compliance with ASRD requirements and in addition to timber resources, the RTSA addresses habitat considerations for species of special concern – woodland caribou, grizzly bear, bull trout and trumpeter swan. Canfor has also elected to report on the CSA indicators and targets established for its *Sustainable Forest Management Plan (SFMP)* published in 2005 (Canfor, 2005a) such as landscape metrics and watershed indicators. Section 6 documents the results of this assessment.

1.5 Public Involvement

Public involvement is a primary principle in development of the Healthy Pine Strategy (HPS) and the Forest Management Advisory Committee (FMAC) is an integral part of the planning process. The three above-mentioned scenarios were presented and discussed by the Committee at the November 19, 2008 meeting. The Committee understood the material presented and accepted the rationale for the selected PFMA (FMAC Nov. 19, 2008 minutes).

2 MODELLING METHODOLOGY

The approach to forest estate modelling taken for this analysis is similar in all respects to the approach followed for the 2003 DFMP. Input spatial data was amended to reflect changes that have since occurred on the landbase, but the basic forest cover, yield curves, and other model parameters are essentially unchanged. Any changes to input data that have been made followed the guidance of Annex 1 of the *Alberta Forest Management Planning Standard* (AFMPS) (ASRD, 2006b).

2.1 Forest Estate Model

A forest estate model has been used to forecast the outcome of different management alternatives and MPB mortality assumptions. COMPLAN is a spatially-based forest simulation model owned by TNRG and used for timber supply analyses. It was released in 1994, and has been used for forest planning in B.C., Alberta and other jurisdictions ever since. COMPLAN uses an iterative approach to establish periodic harvest levels that can vary over time. Users are able to set harvest levels that the model will try to reach within the cover constraints established. COMPLAN schedules harvests at the individual block level subject to adjacency (green-up) and non-timber resource constraints (cover constraints), and provides output data describing harvesting, growing stock level and other resource values.

The starting year for all forest estate model runs in the current RTSA is 1997 – the same starting year used in the analysis for the 2003 DFMP.

2.2 Model Inputs

The FMA area consists of 649,160 hectares of forested land contained in three separate parcels within Forest Management Unit (FMU) G15 (Appendix B, Map 1). For administrative purposes the parcels are identified as the Peace, Puskwaskau and Main.

The spatial data set created for the 2003 DFMP RTSA (Canfor, 2003) was the starting point for this analysis. The creation of that dataset is described in detail in Section 6.2.1 of the 2003 DFMP. This 2003 DFMP database was updated to reflect actual harvesting and other changes that have occurred up to 2007.

2.2.1 Changes from 2003 DFMP

Updated information for a number of Geographic Information System (GIS) data coverages was used in the preparation of the spatial dataset for this amendment. These coverages were overlaid with the 2003 GIS resultant to generate a single coverage that contains the required information from each of the input coverages. Descriptions of the updated spatial data used for this analysis are provided in the following sections.

2.2.1.1 Existing Harvest Areas

A coverage containing historical harvest areas was used to provide harvest updates to the forest inventory from 1998 to 2006. These were scheduled for harvest by COMPLAN in the year that they were actually harvested.

2.2.1.2 Proposed Harvest Areas

The annual operating plan (AOP) coverage of harvest areas was used to prioritize harvest beginning in 2007. These AOP blocks did not have specific harvest years assigned to them, but rather were harvested as soon as volume was required from the timber supply compartment in which they fell. All AOP blocks were harvested within the period of the fifteen-year plan. Since the configuration of these blocks (and the blocks that were already harvested) was different from the 2003 DFMP, the AOP reserve coverage was also updated and incorporated into the resultant.

2.2.1.3 Timber Supply Compartments

Forty-one timber supply compartments were included in the overlay. These boundaries form logical compartments were used in the Resource and Timber Supply Analysis for geographic harvest prioritization. The timber supply compartments are shown in Appendix B, Map 2.

2.2.1.4 Deciduous Stands

For the 2003 DFMP, areas of deciduous that were not allocated were removed from the net landbase. That area has not been excluded for this analysis. All deciduous stands were assumed to be allocated to deciduous operators, and were included in the timber harvesting landbase unless excluded for some other reason.

2.2.1.5 Roads not in the AVI

Not all roads are delineated as polygons in the Alberta Vegetation Inventory (AVI). To account for non-productive area in road rights-of-way, polygons were created by buffering a line map of roads by 10 metres each side of the centerline. The area with these buffers was removed from the net landbase.

2.2.1.6 Trumpeter Swan Sites

Alberta Sustainable Resource Development Fish and Wildlife supplied a map of the trumpeter swan sites for this analysis. A 200-metre buffer was created around any water body containing nesting sites. Areas within these buffers were considered unavailable for harvest and were removed from the net landbase. The trumpeter swan sites are shown in Appendix B, Map 6.

2.2.1.7 Watercourse Buffers

Canfor created an update coverage with buffer polygons generated around riparian features. Buffer widths used corresponded to the operating ground rules, but were modified in some cases when harvest blocks were established. Areas within these riparian buffers were considered unavailable for harvest.

2.2.1.8 Woodland Caribou

The extent of Caribou Area within the FMA area remains unchanged since the 2003 DFMP (Appendix B, Map 4). However, members of the Foothills Landscape Management Forum developed a new habitat designation – 'Caribou Primary Intactness Area' which was submitted to the West Central Alberta Caribou

Landscape Planning Team and adopted for this analysis (WCACLPT, 2008). It distinguishes between the broader habitat area, and the portion that will remain 'intact' for various lengths of time depending on the forest company involved. A coverage defining its limits has been included in the new resultant. The caribou primary intactness area within Canfor's FMA area is shown in Appendix B, Map 5.

2.2.2 Timber Harvesting Landbase (THLB)

The FMA area covers a total area of 649,160 hectares. A stepwise netdown procedure was used to determine the net landbase available for timber harvesting of 486,730 hectares. This represents an increase in the THLB area of 12,537 hectares as compared to the 2003 DFMP. This is due in part to changes in the spatial data (reserves) and in part to changes in the netdown procedure. In the last RTSA, significant areas of non-allocated deciduous and birch were excluded, but they have been retained for this analysis. The resulting THLB is 486,730 hectares. The landbase summary in Table 1 shows the results of the netdown process.

Appendix A provides a description of each of the netdown categories in the table.

Table 1. Landbase Summary

TNRG-RSTASourceData.xls
T001

Classification	Area (ha)	Area (ha)	% of Total Area	% of Forested Area
Total landbase		**649,160.0**	**100%**	
Reductions for non-forest				
Natural Non-vegetated	12,960.0		2.0%	
Anthropogenic Non-vegetated	4,937.0		0.8%	
Anthropogenic Vegetated	4,945.7		0.8%	
Non-forest Vegetated	32,799.9		5.1%	
Roads not in AVI	5,584.9		0.9%	
Total non-forest reductions	61,227.6	61,227.6	9.4%	
Total Forested Landbase		**587,932.4**	**90.6%**	**100%**
Reductions to forested landbase				
Forested Steep Slope	10,514.7		1.6%	1.8%
Forested Slump	42.5		0.0%	0.0%
Gravesites	5.2		0.0%	0.0%
DRS	317.7		0.0%	0.1%
Rare Physical Environments	6,164.5		0.9%	1.0%
Trumpeter Swan Sites	1,915.3		0.3%	0.3%
Watercourse Buffers	36,735.7		5.7%	6.2%
Low Productive –Yield Group 13	25,829.4		4.0%	4.4%
Height/ Age Yield Group 12	17,759.2		2.7%	3.0%
Height/ Age Other Conifer	649.2		0.1%	0.1%
AOP Reserve Areas	1,269.1		0.2%	0.2%
Total reductions to forested landbase	101,202.4	101,202.4	15.6%	17.2%
Timber Harvesting Landbase		**486,730.0**	**75.0%**	**82.8%**

Source: Timberline compiled data

2.3 Modelling Approach

2.3.1 Modelling Parameters

As noted above, the approach to modelling undertaken for this analysis is the same as the approach used for the 2003 DFMP. Input data was updated, but modelling parameters remained the same except in instances where they were specifically modified to deal with MPB and related harvest scheduling issues. For clarity, the following issues were modelled as per the 2003 DFMP:

- The same yield curves were used, and all stands maintained their yield curve assignments unless they had been harvested since the last analysis (in which case they were moved to their assigned regenerating yield curve);
- Adjacency rules based on either green-up height (for most coniferous and deciduous blocks) or age (30 years between blocks in the caribou habitat area) were applied between adjacent blocks;
- Seral stage distributions were applied at the FMA area, parcel (Main, Puskwaskau and Peace – shown in Appendix B, Map 2) and natural region (Boreal Forest and Foothills – shown in Appendix B, Map 9) levels by applying cover constraints;
- Cover constraints were applied to limit the rate of harvest in caribou habitat by managing the seral stage distribution; and
- Cover constraints applied to the H60 portion of watersheds in an effort to limit water yield increases.

In the short-term (fifteen years), model limits designed to safeguard other SFMP 2005 objectives were relaxed to allow for focused harvesting in pine to reduce MPB risk. After the fifteen-year plan, it is assumed that MPB risk reduction is achieved and the model cover constraints for other resource values are once again enforced.

Quotas[3] that were used in the 2003 analysis to create the coniferous and deciduous harvest sequence have been dropped (for the Status Quo Scenario) or modified to implement the Prevention Strategy required by the ASRD *Interpretive Bulletin* (ASRD, 2006a) for the other scenarios. Quotas that were applied to balance deciduous harvest flow in the long term are contingent on the coniferous harvest flow and have been updated accordingly.

2.3.2 Pine Mortality Assumptions

The primary objective of this analysis is to provide information that is useful in developing a response to the MPB outbreak. As such, assumptions were made regarding the impact of MPB attack on stand volumes for those modelling scenarios where pine mortality is assumed (the Disaster Scenario, and for a sensitivity analysis of the Status Quo Scenario). The document *Timber Supply Analysis Criteria for the Mountain Pine Beetle Disaster Scenario Evaluation* (ASRD, unpublished) was used for guidance. Any pine stands that are not harvested in the first fifteen years are treated as follows:

[3] Quotas are mechanism used in COMPLAN to focus harvesting in particular geographic areas or forest types.

1) For stands with greater than 60% pine content, assume entire stand mortality (mortality applies to stands that are 20 years and older). The stand remains on the same yield curve, but the age is set to zero and a 15-year regeneration lag is applied.

2) For stands with 60% pine content or less, the approved yield curves from the 2003 DFMP are reduced to remove the pine content, on a proportionate basis, and the stand continues to grow at its current age. No assumption is made for stand release due to opening of the canopy caused by the pine mortality.

2.3.3 Harvest Priority and Fifteen-Year Plan

The best management tool available to limit the risk and extent of an MPB outbreak is the focused harvesting of susceptible pine stands. Canfor planners have prepared such a plan whose objective is to reduce the area of MPB susceptible pine stands within the ASRD-mandated period of twenty years. Preliminary analyses indicated that the target growing stock reductions could be accomplished within a fifteen-year timeframe. A fifteen-year plan that meets that objective was prepared. The steps taken to produce this plan were:

1) Summarize the pine volume that is currently available for harvest, and that will become available (reach minimum harvest age) within the next fifteen years. Break this volume down by timber supply compartment.

2) Establish conifer harvest volumes for each timber supply compartment (Appendix B, Map 2), with the objective of significantly reducing the area of susceptible pine stands. This step was completed by Canfor planners to evaluate if quotas would be available operationally. Enter these quotas into COMPLAN.

3) Set block harvest priorities so that those stands most susceptible to MPB attack are harvested first, subject to operational constraints. Susceptibility for a given stand is based on four variables: relative proportion of susceptible pine basal area in the stand, age of dominant and co-dominant live pine, density of the stand, and the climatic suitability of the stand. This resulted in a stand susceptibility index (SSI) of between 0 and 100. A harvest priority was assigned to each stand based on its SSI, yield group and height, according to Table 2 to Table 4. Harvest priority was established as:

   Harvest Priority Ranking = stand susceptibility index (SSI) + yield group index + stand height index

   With the provision that harvest priority ranking for “All Other” yield groups as indicated in Table 3 was set at zero. Stands with the highest harvest priority ranking are harvested first. Appendix B, Map 10 shows the resulting distribution of harvest priority ranking across the FMA area. Finally, harvest priority ranking was increased to 10 for any stands in established annual operating plan (AOP) blocks.

4) Modify COMPLAN run parameters so that no cover or adjacency constraints are enforced, and make all deciduous stands unavailable for harvest. Run COMPLAN for a fifteen-year time frame.

Table 2. Harvest Priority for MPB Susceptibility

TNRG-RSTASourceData.xls
T002

MPB Risk	SSI Range	SSI Priority
None	0	0
Low	1-25	1
Medium	26-49	2
High	50+	3

Source: Timberline compiled data

Table 3. Harvest Priority for Yield Group (YG)

TNRG-RSTASourceData.xls
T003

Yield Group	Species Compostion	Yield Group Priority
8	Pl/PlFb+(H)	4
9	PlAw/AwPl	3
10	PlLSb+Others	2
11	PlSw/SwPl+(H)	3
14	SbPl/SbSw/SbFb	1
All Others		0

Source: Timberline compiled data

Table 4. Harvest Priority by Stand Height

TNRG-RSTASourceData.xls
T004

Height Range	Height Priority
0-12	0
12-14	1
14-17	2
17+	3

Source: Timberline compiled data

5) Map the resulting harvest schedule colour-coded for three five-year periods. Review the results and adjust quotas where necessary. Repeat this step until an acceptable fifteen-year conifer harvest sequence is established. The resulting fifteen-year coniferous harvest sequence is shown in Appendix B, Map11.

6) Summarize the results. Tabulate coniferous and incidental deciduous volume harvested by timber supply compartment and five-year period.

7) Establish deciduous targets by timber supply compartment and five-year period. These targets include an allowance for carry-over from previous years. Modify COMPLAN run parameters to make coniferous stands other than those in the

fifteen-year plan unavailable for harvest. Run COMPLAN to harvest deciduous volume for fifteen years.

8) Summarize and map both the coniferous and deciduous harvest sequence and review with deciduous operators. Modify the deciduous sequence where necessary and repeat Step 7. The resulting fifteen-year deciduous harvest sequence is shown in Appendix B, Map 12.

9) Map the final fifteen-year plan, and update COMPLAN input files so this sequence can be used as a starting point for the management alternatives that require it. The final combined fifteen-year plan is shown in Appendix B, Map 13.

The fifteen-year plan developed by this process was the starting point for both scenarios MPB2 and MPB3 (these scenarios are described in Sections 3.4.2 and 3.4.3).

3 MPB SCENARIOS AND ALTERNATIVES

Canadian Forest Products Ltd. (Canfor) is committed to managing the resources within the company's tenures in compliance with all national and provincial laws, legislation and regulations. Canfor's documents define its commitments to sustainable forest management and include Canfor's *Environment Policy* (Canfor, 2008a) *and Forestry Principles* (Canfor, 1999). In preparing an amendment to the 2003 DFMP that addresses the risk of a serious MPB outbreak and consequent widespread pine mortality, Canfor has relied on all relevant ASRD MPB documents for strategic direction.

Canfor has considered several forest management alternatives and MPB outbreak scenarios while preparing this DFMP amendment. The management alternatives were evaluated in the Resource and Timber Supply Analysis by a series of COMPLAN runs. An effort has been made to select a strategy that balances the need to mitigate the economic impact of the MPB while protecting other resource values to the greatest extent possible.

The objective of the timber supply analysis was to identify the preferred forest management alternative that will replace the strategy selected and implemented by the 2003 DFMP, and to maintain deciduous allocations over the entire planning horizon. Three scenarios were modelled – Status Quo (with a sensitivity analysis), Healthy Pine and Disaster (Table 5).

Table 5. Management Alternatives Considered

TNRG-RSTASourceData.xls
T005

Scenario Name	Scenario Reference	Description
Status Quo	MPB1	The preferred management scenario from the 2003 DFMP, updated to reflect harvesting up to 2007. A sensitivity analysis was also completed to estimate the impact that widespread MPB mortality would have on coniferous harvest levels if no effort is made in the short term to reduce risk by preferentially harvesting stands that are susceptible to MBP attack.
Healthy Pine	MPB2	Focused harvest in pine stands for 15 years in order to reduce the risk and level of pine mortality in the event of an MPB outbreak. However, no pine mortality is assumed. Original 2003 DFMP cover constraints were not enforced for the first 15 years, but no harvesting was permitted within caribou primary intactness area for that period. Original 2003 DFMP cover constraints are enforced from that point onward.
Disaster	MPB3	Focused harvesting in pine stands for 15 years in order to reduce the risk and level of pine mortality in the event of an MPB outbreak. ASRD pine mortality assumptions applied at year 15 of the simulation. Original 2003 DFMP cover constraints were not enforced for the first 15 years, but no harvesting within caribou primary intactness area was permitted for that period. Original 2003 DFMP cover constraints are enforced from that point onward.

Source: Timberline compiled data

3.1 Pertinent Government Legislation, Policies and Plans

The analysis for this amendment was guided by the procedures laid out in the *Alberta Forest Management Planning Standard*, *Version 4.1* dated April 2006 (ASRD, 2006b). In addition, the work has been guided by the ASRD *Mountain Pine Beetle Management Strategy* (ASRD, 2007b), with specific reference to the *Mountain Pine Beetle Action Plan for Alberta* (ASRD, 2007a) and the I*nterpretive Bulletin: Planning Mountain Pine Beetle Response Operations ver. 2.6* (ASRD, 2006a).

3.2 Modelling Objectives

The forest estate model was set up so that harvest levels could be evaluated and SFMP 2005 targets updated and modelled. These objectives must be balanced against the immediate requirement to address the MPB outbreak.

3.2.1 Long-term Wood Flow Objectives

The long-term wood flow objective was to achieve the coniferous harvest levels established by the 2003 DFMP, and to provide volume allocations to deciduous operators while meeting the environmental objectives that are laid out in the SFMP 2005 and summarized below. Particular attention was paid to the medium- and long-term wood flow impacts of widespread MPB mortality – and the short-term harvesting strategies undertaken to minimize this risk.

3.2.2 Short-term Wood Flow Objectives

Short-term objectives differed between the Status Quo Scenario and the other two scenarios. For the Status Quo Scenario, the objective was to confirm that the coniferous and deciduous supply is sustainable based on harvesting that has actually occurred since the last analysis.

For the Healthy Pine and Disaster Scenarios, a fifteen-year spatial harvest plan that identified both coniferous and deciduous volume was prepared. The main objective of this plan (with respect to the conifer harvest) was to reduce susceptible pine volume in the growing stock to a level that is 75% of the level that would have resulted from the pursuit of the 2003 DFMP preferred management scenario. Section 2.3.3 describes in detail the methodology for prioritizing pine-leading stands for harvesting. For deciduous, the objective was to balance pure and incidental volumes and distribute them in an operationally realistic way across timber supply compartments and each of the three five-year planning periods.

In the short-term (fifteen years), model limits designed to safeguard SFMP 2005 objectives were relaxed to allow for focused harvesting in pine to reduce MPB risk. After the fifteen-year plan, it is assumed that MPB risk reduction is achieved and the model cover constraints for other resource values are once again enforced

3.2.3 Wildlife Habitat

Objectives were developed in the 2003 DFMP to conserve ecosystem diversity by maintaining a variety of communities and ecosystems that naturally occur within the FMA area. A variety of species are included within the current RTSA, specifically woodland caribou, trumpeter swan, bull trout and grizzly bear.

3.2.3.1 Woodland Caribou (*Rangifer tarandus*)

Habitat cover constraints and adjacency rules have been applied within the Resource and Timber Supply Analysis to forested stands within the Caribou Area as follows:

- No more than 25% of the area can be in pioneer or young seral condition;
- No less than 15% of the area can be in old seral stage;
- Maximum opening size of 1,000 ha; and
- 30 year green-up applies.

No harvesting was permitted in the caribou primary intactness area for the period of the fifteen-year plan (Appendix B, Map 5). In addition, sensitivity analyses were

run to forecast the impact on long-term timber flow or removing the caribou primary intactness area portion of the caribou habitat area from the net landbase.

3.2.3.2 Grizzly Bear (*Ursus arctos*)

Grizzly bear habitat was not modelled however Canfor monitors the impact on grizzly bear habitat using a target to limit non-reclaimed roads (open roads[4]), over a five year period, to no more than 0.6 lineal km/ km^2. Road density results for grizzly bear are presented in Section 6.6.

3.2.3.3 Trumpeter Swan (*Cygnus buccinator*)

Two hundred meter "no harvest" buffers are maintained around identified trumpeter swan areas to protect nesting sites. An updated map of known nesting sites has been incorporated into this analysis (See Appendix B, Map 6). These areas have been removed from the net landbase and are not available for harvesting.

3.2.4 Watershed Resources

The protection of watersheds involves both water yield and water quality. This contributes to the overall conservation of water resources within the FMA area. Water yield increases can be directly modelled, however equivalent clearcut area (ECA[5]) is often used as a surrogate. For the current analysis, ECA targets were used to limit harvesting within a defined watershed where total vegetated cover removal will not exceed 40% ECA above the H60[6].

3.2.4.1 Water Yield

Water yield refers to streamflow quantity and timing, which is a key determinant of the energy available for erosion, transport and deposition of sediment within channels. Streamflow is a key component in determining the morphology of channels, with implications for the quality and quantity of fish habitat. Water yield is an important component in determining the availability and suitability of water for beneficial uses including human consumption. Water yield quantity and timing can be altered by compaction or disturbance of the ground surface, as with roads and

[4] Open roads are those held under Licences of Occupation (LOC), oil and gas roads held under mineral surface leases (MSL), and non-reclaimed forestry roads, including all temporary roads that have not received final clearance. These roads are used to access timber but are not required for permanent access. They are reclaimed after the initial silviculture treatment is completed or if they are not required for silviculture access the roads are reclaimed immediately after hauling is completed. When harvest areas receive final clearance, reclaimed roads within or tributary to the blocks, will not be included in the calculation.

[5] Equivalent clearcut area (ECA) refers to an area that has been harvested, cleared or burned. The ECA index, expressed as a percentage, describes an area of regenerated growth in terms of its hydrological equivalence to a clearcut. As the area regenerates and growth develops, the hydrological impact is reduced. ECA is a primary factor considered in an evaluation of the potential effect of past and proposed forest harvesting on water yield. ECA is expressed as a percent of watershed area.

[6] H60 is the elevation above which 60% of the watershed lies. The watershed area above the H60 is considered as the source area for the major snowmelt peak flows.

skid trails. Water yield is also affected by vegetation growth or removal. Water yield generally increases after timber harvest through a reduction in transpiration and precipitation interception losses. Removal of the forest canopy also affects snow accumulation and melt processes, often resulting in an increase in snowpack accumulation and melt rates, thereby increasing runoff rate and volume. Canfor monitors water yield via Target (3.2) 2a.1.1 as presented in the SFMP 2005. Water yield increases have been modelled using the ECA-Alberta model developed by Uldis Silins at the University of Alberta. The model provides a framework for evaluation of hydrological effects of forest practices with modest input data requirements. Canfor has elected to evaluate the ten watersheds that exhibit the greatest increase in ECA at the end of the fifteen-year plan. Results are contained within Section 6.5.

3.2.4.2 ECA in Bull Trout Watersheds

The total bull trout area identified within the FMA area is 242,828 hectares distributed over 163 watersheds. This represents 37% of the total FMA area. Bull trout habitat is dependent on the amount of vegetated cover within a watershed. Vegetated cover removal must be controlled to maintain adequate habitat. As a result, ECA has been chosen for monitoring bull trout watersheds. Results are contained within Section 6.2. Appendix B, Map 7 shows the location of bull trout watersheds.

3.2.4.3 Equivalent Clearcut Area

Equivalent clearcut area (ECA) refers to an area that has been harvested or cleared. The ECA index, expressed as a percentage, describes an area of regenerated growth in terms of its hydrological equivalence to a clearcut. As the area regenerates and growth develops, the hydrological impact is reduced. For this analysis, ECA was calculated for the H60 portion of watersheds. That area is considered to be the source area for the major snowmelt peak flows. Results are contained within Section 4.

3.2.5 Seral Stage

Seral stage distribution enables timber harvests to be planned in order to maintain a full range of successional habitats for wildlife and ecosystem types over the long-term. This contributes to the conservation of ecosystem diversity throughout the landscape and addresses ecosystem condition and productivity and soil and water conservation.

Five seral stages are defined for use in this analysis. Table 6 outlines the breast height age by yield group that was used to define these seral stages. Seral stage distribution targets were defined at the following levels:

- Entire FMA area;
- Puskwaskau Parcel;
- Peace Parcel; and
- Main Parcel.

The Foothills Natural Region and Boreal Forest Natural Region are only included as supplementary information (Appendix B, Map 9).

Table 6. Breast Height Age Ranges for Seral Stages

TNRG-RSTASourceData.xls
T006

Yield Group	Pioneer	Young	Mature	Over Mature	Old	Species	Years to BH
1	0	1-20	21-70	71-110	110+	AW	6
2	0	1-20	21-70	71-110	110+	AW	6
3	0	1-40	41-80	81-120	120+	SW	15
4	0	1-20	21-70	71-110	110+	BW	6
5	0	1-40	41-100	101-120	120+	FB	15
6	0	1-40	41-80	81-120	120+	SW	15
7	0	1-20	21-80	81-110	110+	PB	6
8	0	1-40	41-80	81-120	120+	PL	10
9	0	1-30	31-70	71-120	120+	PL	10
10	0	1-40	41-90	91-120	120+	PL	10
11	0	1-40	41-90	91-120	120+	PL	10
12	0	1-50	51-130	131-150	150+	SB	20
13	0	1-50	51-140	141-160	160+	SB	20
14	0	1-40	41-100	101-130	130+	SB	20
15	0	1-40	41-90	91-120	120+	SW	15
16	0	1-40	41-90	91-120	120+	SW	15
17	0	1-40	41-90	91-120	120+	SW	15

Source: Timberline compiled data

Within the SFMP 2005, the Forest Management Advisory Committee (FMAC) established Objective (1.1) 1a and Indicator (1.1) 1a.1 to monitor seral stages at key points in time. Under the current analysis these key points in time are, 2007, 2009, 2019, 2049, 2099 and 2199. The FMA area is managed such that all current ecosystems are represented on the landscape (FMA area) at natural levels. Seral stages were selected as an indicator to access achievement of that landscape objective. The results are presented in Section 6.1.

3.3 Management Alternatives Considered

The challenge for this analysis is to formulate and test alternatives that provide useful information to Canfor planners in selecting the best strategy to deal with the impact of the MPB outbreak. That, in turn, requires alternative predictions about the future. Two questions are central to defining these possible futures:

1) How severe and widespread will pine mortality be as a result of the MPB outbreak?
2) Should Canfor continue with the management strategy described in the 2003 DFMP, or adjust harvest levels and priorities to reduce the level of mature pine in the growing stock?

A cross tabulation of these questions defines four management alternatives to be modelled, as shown in Table 7.

Table 7. Management Alternatives

TNRG-RSTASourceData.xls
T007

	Severity of MPB-Caused Pine Mortality	
Initial Harvest Level	**None**	**Widespread**
2003 DFMP	MPB1	Sensitivity Run
Focused Pine Harvest	MPB2	MPB3

Source: Timberline compiled data

Three of these scenarios have been modelled in detail and are described in Section 3.4. The remaining alternative was run as a sensitivity analysis against MPB1.

3.4 Timber Supply Scenarios

As per ASRD's *Interpretive Bulletin* (ASRD, 2006a) the three scenarios described in the following sections were modelled in COMPLAN to identify and validate the proposed management strategy. Refer to Sections 4.1, 4.2 and 4.3 for the results.

3.4.1 Status Quo Scenario

This scenario was run based on the strategy described in the 2003 DFMP. The 'Status Quo' run (MPB1) was simply an update of the spatial data. Actual harvesting up to 2007 was incorporated, as well as updated information for road, watercourse and swan buffers, and AOP reserves. All other model parameters – harvest levels, yield curves, cover constraints, adjacency/ aggregation rules and reporting periods – were left unchanged. The purpose of this run is to demonstrate that Canfor's operations to date are in line with the approved 2003 DFMP. It confirmed that the proposed harvest levels for coniferous and deciduous volume are still achievable, and that objectives for non-timber resource values are being met. The run parameters were:

- 200-year simulation time horizon;
- "Hardwire" actual harvesting up to 2007;
- Enable all 2003 DFMP cover constraints described in Section 2.3.1;
- Set coniferous harvest requests to 2003 DFMP levels;
- Use 2003 compartment quotas to achieve deciduous volumes; and
- Assume no MPB mortality.

A sensitivity analysis was also conducted on this scenario. It was designed to test the impact of pine mortality if the 2003 DFMP management strategy is continued. The result is briefly discussed in Section 4.1.7. It is only considered as a variation of the Status Quo Scenario, so full tabular and graphical results have not been included.

All data and modelling parameters were held constant for the sensitivity analysis, with one major exception: massive pine mortality was assumed after year fifteen of the

simulation (2022). The purpose of this sensitivity analysis is to show the impact on medium and long-term harvest levels of removing all of the pine from the forest inventory without attempting to implement the Prevention Strategy described in ASRD's *Interpretive Bulletin* (ASRD, 2006a).

3.4.2 Healthy Pine Scenario

The second scenario (MPB2) assumes that Canfor will adjust its harvest plans to capture as much pine volume as practical before it is killed by the MPB and rendered unusable. The first step in this process was the preparation of a spatial fifteen-year plan (see Section 2.3.3) for both coniferous and deciduous volume. Cover constraints were relaxed for this period so as to permit the harvesting of priority pine stands. At the end of the fifteen-year period, cover constraints were turned back on and the remainder of the 200-year planning horizon was simulated.

Three separate COMPLAN runs were needed to model this scenario:

- Run 1: Establish conifer fifteen-year plan;
  - Run simulation for fifteen years;
  - Disable all 2003 DFMP cover constraints described in Section 2.3.1;
  - Restrict harvesting in the caribou primary intactness area for the fifteen-year plan;
  - Make all deciduous and all non-MPB-susceptible coniferous stands unavailable for harvest;
  - Apply Canfor-specified coniferous quotas and availability restrictions by timber supply compartment;
  - Don't increase the short term harvest level by more than 25%; and
  - Harvest AOP blocks first from each timber supply compartment.

- Run 2: Establish deciduous fifteen-year plan; and
  - Run simulation for fifteen years;
  - "Hardwire" fifteen-year plan from Run 1;
  - Enable all 2003 DFMP cover constraints described in Section 2.3.1;
  - Make coniferous stands unavailable for harvest; and
  - Apply Canfor-specified deciduous harvest levels by timber supply compartment.

- Run 3: Determine long-term harvest level.
  - Run simulation for 200 years;
  - Hardwire fifteen-year plans from Run 1 and Run 2;
  - Enable all 2003 DFMP cover constraints;
  - Allow harvesting in caribou primary intactness area after fifteen-year plan;

- Implement quotas for all deciduous compartments;
- Determine long-term sustainable coniferous harvest level; and
- Don't allow the long term level to fall by more than 10%.

3.4.3 Disaster Scenario

The third and final scenario (MPB3) was designed to model the combination of focused pine harvest and widespread MPB mortality. This scenario uses the fifteen-year plan (Section 2.3.3) and then enforces cover constraints for the remainder of the planning horizon – the same as for scenario MPB2. The difference with this scenario is that widespread pine mortality is modelled, and the affected volume is considered to be unrecoverable after fifteen years. The pine mortality guidelines provided in the ASRD *Interpretive Bulletin* (ASRD, 2006a) have been used. Pure pine stands are killed (the age is reset to zero) and mixed pine stands have their pine volume removed.

Runs 1 and 2 from the Healthy Pine Scenario do not need to be repeated, but Run 3 is modified as follows:

- Update volume for pine stands not logged in the fifteen-year plan;
  - for stands > 60% pine, reset age to -35, volume to zero
  - stands <= 60% pine – kill the pine component:
    - reduce inventory volume by pine percent;
    - if inventory volume is zero, calculate dummy volume; and
    - do not adjust age.
- Determine long-term sustainable coniferous harvest level; and
- Don't allow the long-term level to fall by more than 10%.

3.5 Deciduous Timber Allocation

Although the focus of the HPS is primarily on pine, an opportunity presented itself to update deciduous allocations to current status. Deciduous allocations have changed since the approval of the 2003 DFMP (November 2003) due to deciduous harvest, as follows:

- Some deciduous stands, scheduled for harvest in the 2003 DFMP, were not utilized by deciduous companies thereby invalidating the sequence;
- The actual harvest of deciduous was lower resulting in ASRD recalculating and re-issuing carryovers of deciduous allocations to deciduous companies; and
- The amount of incidental deciduous generated from coniferous harvest differs. Average annual deciduous volume allocations were utilized within COMPLAN as follows (Table 8).

Average annual deciduous volume allocations for the fifteen-year plan (2007 - 2021) were established at 513,261 m^3/ year to account for the above-mentioned carryovers.

For the remainder of the 200-year planning horizon (2022 – 2206) the objective was to achieve an average annual deciduous volume allocation of 453,712 m^3/ year. Allocations were managed within COMPLAN through an iterative process of establishing incidental deciduous volumes generated from coniferous harvest and then the remainder coming from deciduous harvest priority stands. Deciduous harvest levels were maintained for the entire planning horizon. Ainsworth and Tolko took a leading role in establishing deciduous harvest priority areas and providing input for the fifteen-year plan as described in Section 2.3.3

Table 8. Deciduous Volume Allocation

TNRG-RSTASourceData.xls
T008

Period	Average Annual Deciduous Volume Allocation (m^3/ year)
2007-2021	513,261
2022-2206	453,712

Source: Timberline compiled data

4 RESULTS

The results of the COMPLAN runs to model each of the scenarios considered are presented in the following sections.

COMPLAN applies quotas and schedules harvesting based on planning periods defined by the user. Future forest inventory reports are generated for the first year of each period. For the Status Quo Scenario, these periods were established to coincide with the period used for the 2003 DFMP base case scenario so that quotas used to set the long term deciduous harvest flow could be applied. Ten-year periods were used for most of the planning horizon. The harvest periods for the Healthy Pine and Disaster Scenarios were set beginning in 2007: four five-year periods followed by ten-year periods for the remainder of the planning horizon. Consequently, the periods used for the Status Quo Scenario are offset by two years from the periods used in the other two scenarios. For instance, the planning period 2049-2058 in the Status Quo Scenario corresponds most closely to 2047 - 2056 in the other two scenarios.

4.1 Status Quo Scenario – MPB1

The Status Quo Scenario evaluates the outcome of continuing the 2003 DFMP harvest strategy. This scenario updates the 2003 preferred alternative for actual harvesting to date (2007), and for the other spatial data changes noted in Section 2.2.1.

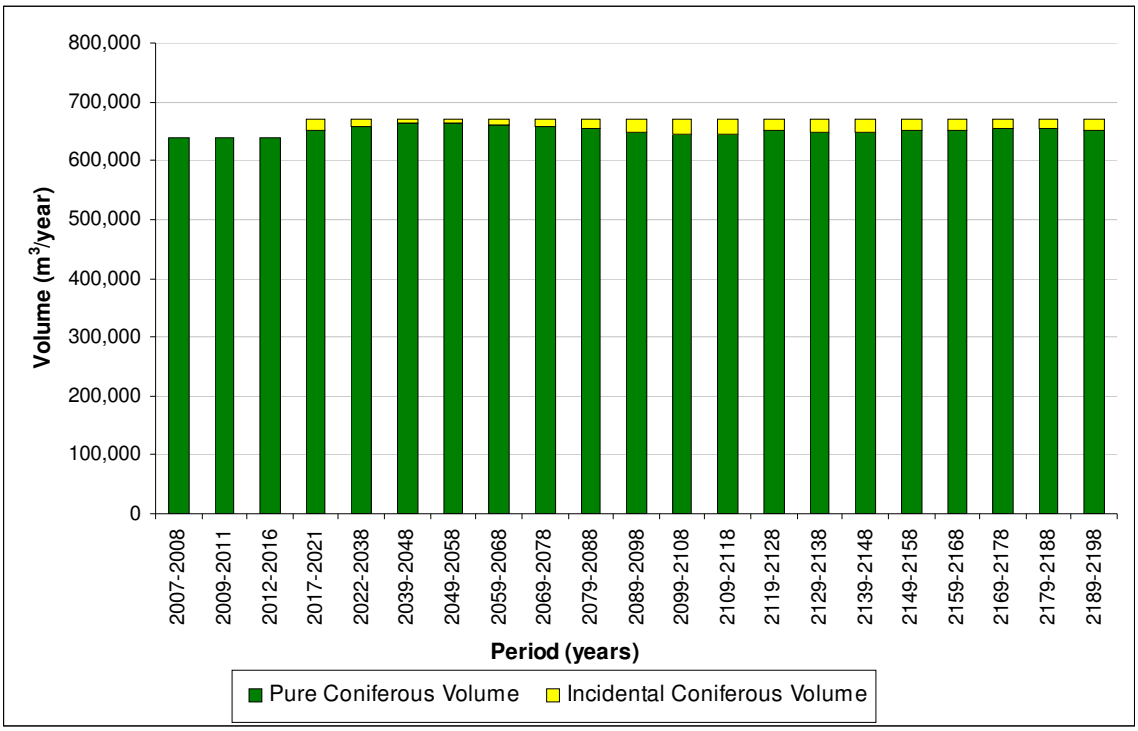
A sensitivity analysis was also conducted for this scenario. It was designed to test the impact of pine mortality if the 2003 DFMP management strategy is continued. The result is briefly discussed in Section 4.1.7. It is only considered as a variation of the Status Quo Scenario, so full tabular and graphical results have not been included.

4.1.1 Timber Harvest

The coniferous harvest level established in the 2003 DFMP can still be achieved. The level starts at 640,000 m^3/ year and increases to 670,000 m^3/ year in 2017. These results are shown in Figure 2 and Table 9. The increase in incidental conifer volume in the final period of the planning horizon is anomalous and not consistent with the 2003 DFMP result, but does not impact any decisions that must be made about responses to the MPB outbreak.

Figure 2. Status Quo Scenario: Coniferous Harvest Flow

TNRG-RSTASourceData.xls
F002



Source: Timberline compiled data

Table 9. Status Quo Scenario: Coniferous Harvest Flow

TNRG-RSTASourceData.xls
T009

Period	Coniferous Volume (m^3/ year)		
	Pure	Incidental	Total
2007-2008	637,333	2,657	639,990
2009-2011	637,350	2,642	639,992
2012-2016	637,968	2,029	639,998
2017-2021	652,473	17,523	669,996
2022-2038	658,452	11,541	669,993
2039-2048	662,708	7,289	669,996
2049-2058	663,955	6,043	669,998
2059-2068	660,814	9,181	669,995
2069-2078	657,663	12,331	669,994
2079-2088	654,968	15,025	669,993
2089-2098	648,588	21,407	669,994
2099-2108	646,475	23,520	669,995
2109-2118	644,033	25,930	669,963
2119-2128	651,750	18,227	669,976
2129-2138	649,720	20,271	669,990
2139-2148	648,806	21,187	669,993
2149-2158	651,129	18,865	669,994
2159-2168	651,893	18,102	669,996
2169-2178	654,845	15,150	669,995
2179-2188	653,998	15,994	669,992
2189-2198	651,688	18,307	669,994

Source: Timberline compiled data

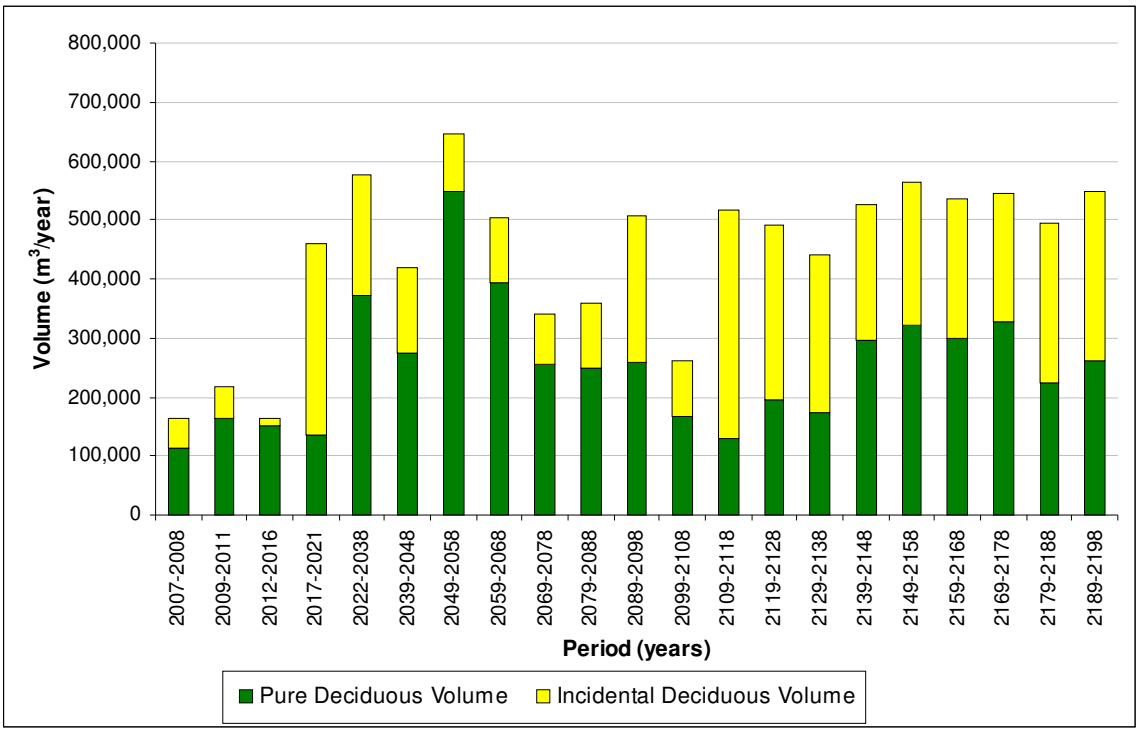
Deciduous harvest levels are sustainable, on average, over the planning horizon. However, the same modelling quotas that were used to balance the harvest between periods and moderate swings in incidental volume levels could not be applied here because:

- They are contingent upon and sensitive to the coniferous harvest sequence, which has changed due to actual harvesting that has taken place; and
- They were assigned based on the 2003 Operational Subunits, which have been replaced in this analysis by timber supply compartments (Appendix B, Map 2).

The variability apparent in Figure 3 and Table 10 could be reduced through a trial and error process and repeated forest estate model runs. This, in fact, was done for the next two scenarios.

Figure 3. Status Quo Scenario: Deciduous Harvest Flow

TNRG-RSTASourceData.xls
F003



Source: Timberline compiled data

Table 10. Status Quo Scenario: Deciduous Harvest Flow

TNRG-RSTASourceData.xls
T010

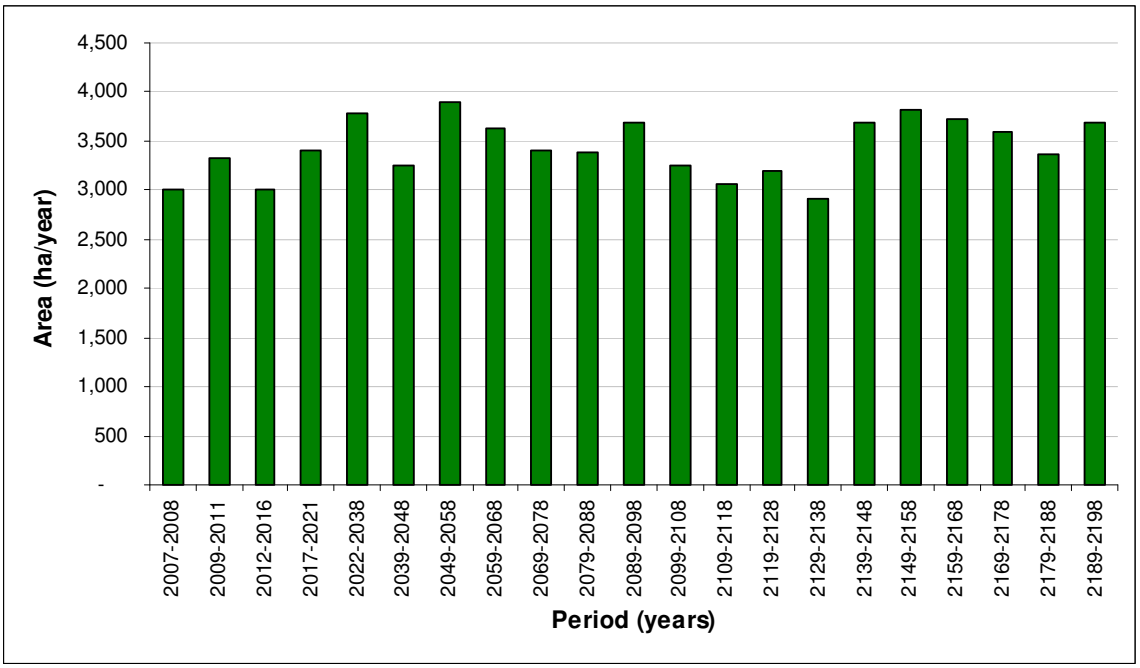
Period	Deciduous Volume (m^3/ year)		
	Pure	Incidental	Total
2007-2008	114,737	47,510	162,246
2009-2011	163,020	53,917	216,937
2012-2016	150,195	12,321	162,516
2017-2021	134,490	324,245	458,734
2022-2038	370,130	206,534	576,663
2039-2048	273,438	144,773	418,211
2049-2058	547,575	98,372	645,947
2059-2068	392,429	112,293	504,722
2069-2078	255,177	83,943	339,120
2079-2088	248,178	111,629	359,807
2089-2098	258,202	249,565	507,767
2099-2108	166,761	93,495	260,256
2109-2118	128,949	388,994	517,943
2119-2128	195,741	294,106	489,847
2129-2138	172,650	268,843	441,493
2139-2148	296,532	228,015	524,547
2149-2158	321,953	240,630	562,584
2159-2168	299,480	234,705	534,185
2169-2178	328,490	215,470	543,960
2179-2188	223,879	271,764	495,643
2189-2198	261,934	285,766	547,700

Source: Timberline compiled data

The annual area harvested in coniferous priority types is slightly more variable as was the case for the 2003 DFMP (see Figure 4 and Table 11), but the average over the long term is not significantly different.

Figure 4. Status Quo Scenario: Annual Area Harvested in Coniferous Priority Types

TNRG-RSTASourceData.xls
F004



Source: Timberline compiled data

Table 11. Status Quo Scenario: Annual Area Harvested and Average Volume per Hectare in Coniferous Priority Types

TNRG-RSTASourceData.xls
T011

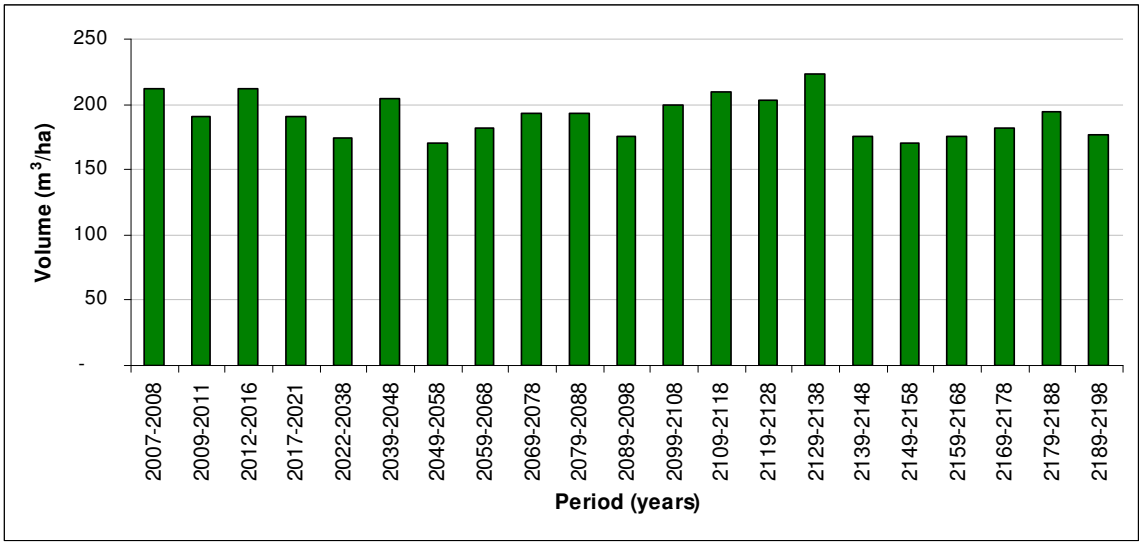
Period	Area (ha)	Average Volume (m^3/ ha)	Period	Area (ha)	Average Volume (m^3/ ha)
2007-2008	3,001	212	2099-2108	3,243	199
2009-2011	3,335	191	2109-2118	3,066	210
2012-2016	3,011	212	2119-2128	3,199	204
2017-2021	3,411	191	2129-2138	2,909	223
2022-2038	3,781	174	2139-2148	3,688	176
2039-2048	3,245	204	2149-2158	3,815	171
2049-2058	3,899	170	2159-2168	3,724	175
2059-2068	3,623	182	2169-2178	3,590	182
2069-2078	3,395	194	2179-2188	3,369	194
2079-2088	3,388	193	2189-2198	3,692	177
2089-2098	3,688	176			

Source: Timberline compiled data

The pattern of average volume per hectare is also slightly more variable, but still quite similar on average to the 2003 DFMP (Figure 5).

Figure 5. Status Quo Scenario: Average Volume per Hectare in Coniferous Priority Types

TNRG-RSTASourceData.xls
F005

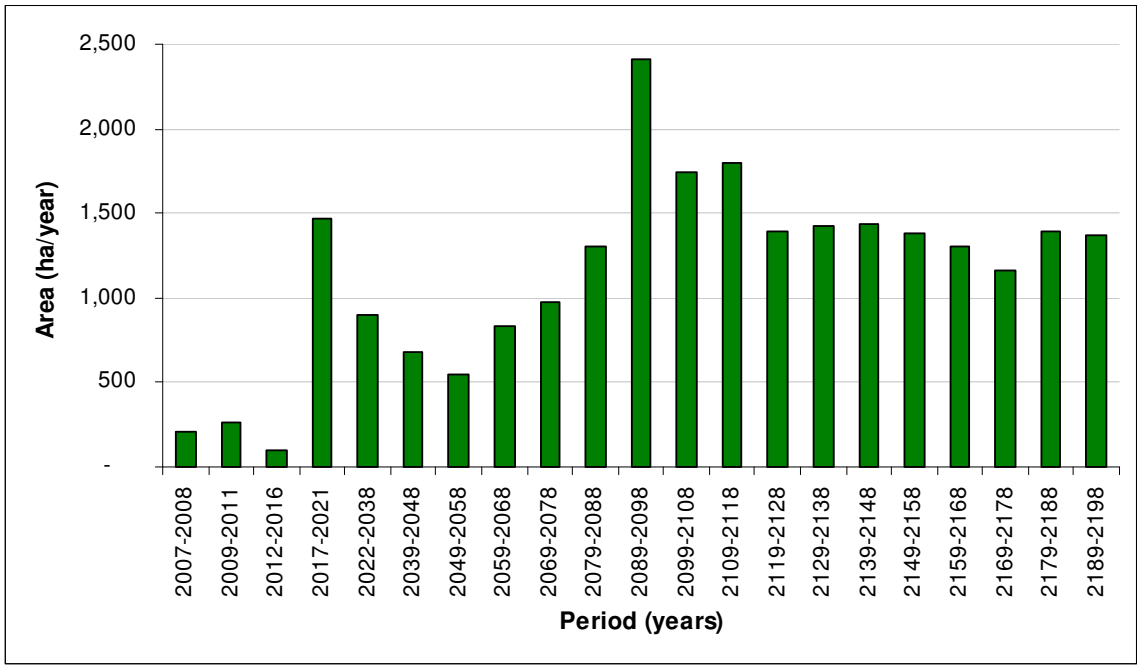


Source: Timberline compiled data

For most of the planning horizon, the area harvested in deciduous priority types resembles the pattern presented in the 2003 DFMP. The notable exception occurs over the first ten years, when much of the harvest requirement is filled by incidental deciduous volume from coniferous priority stands. This leads to only a small area being harvested in deciduous priority types over that period.

Figure 6. Status Quo Scenario: Annual Area Harvested in Deciduous Priority Types

TNRG-RSTASourceData.xls
F006



Source: Timberline compiled data

The average volume per hectare harvested in deciduous priority types is much more variable than was the case in the 2003 DFMP (Figure 7 and Table 12). The broad pattern, however, is not dissimilar, with slightly higher volumes per hectare being realized near the beginning and end of the planning horizon.

Table 12. Status Quo Scenario: Annual Area Harvested and Average Volume per Hectare in Deciduous Priority Types

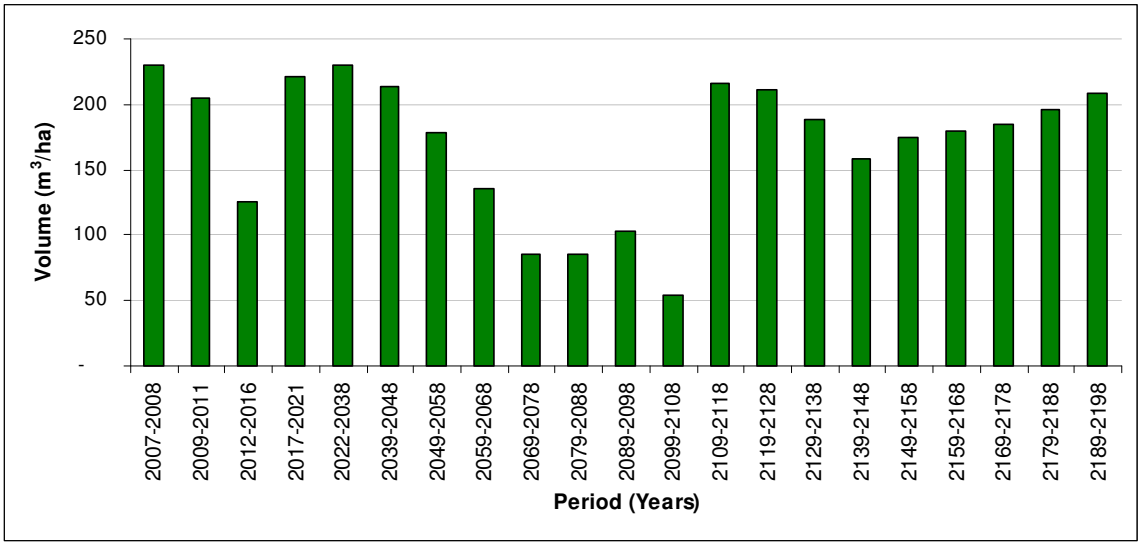
TNRG-RSTASourceData.xls
T012

Period	Area (ha)	Average Volume (m^3/ ha)	Period	Area (ha)	Average Volume (m^3/ ha)
2007-2008	206	230	2099-2108	1,738	54
2009-2011	264	204	2109-2118	1,796	217
2012-2016	98	125	2119-2128	1,392	211
2017-2021	1,468	221	2129-2138	1,423	189
2022-2038	898	230	2139-2148	1,437	159
2039-2048	677	214	2149-2158	1,376	175
2049-2058	553	178	2159-2168	1,306	180
2059-2068	830	135	2169-2178	1,164	185
2069-2078	978	86	2179-2188	1,389	196
2079-2088	1,309	85	2189-2198	1,372	208
2089-2098	2,410	104			

Source: Timberline compiled data

Figure 7. Status Quo Scenario: Average Volume per Hectare in Deciduous Priority Types

TNRG-RSTASourceData.xls
F007

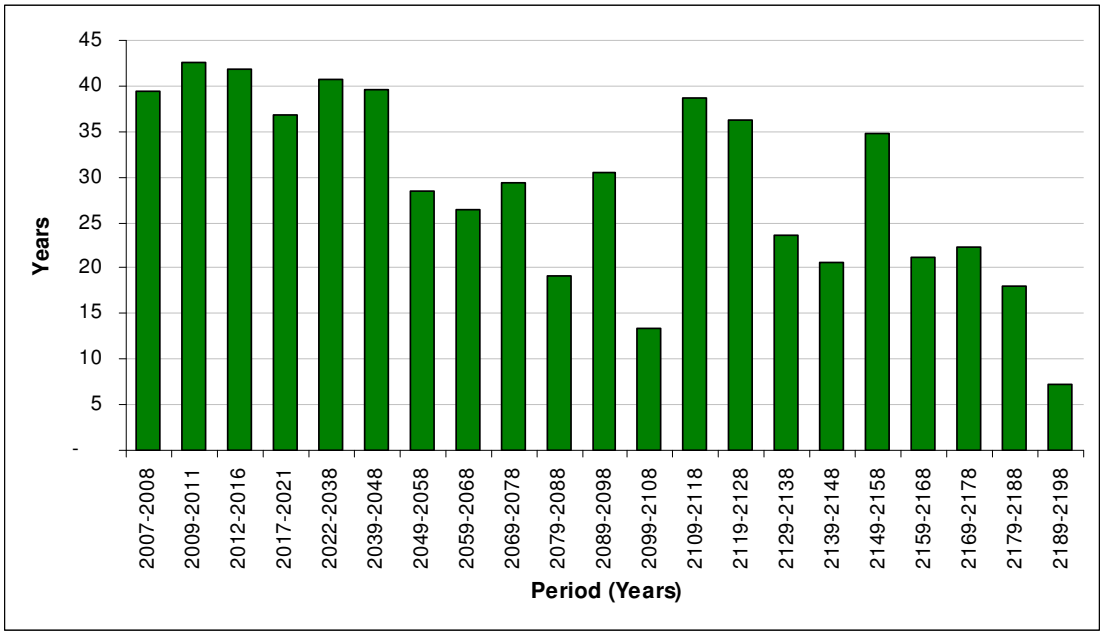


Source: Timberline compiled data

Figure 8 and Figure 9 provide both an indication of average harvest age and a sense of the stability of the growing stock by showing the average years above minimum harvest age (MHA) at which coniferous and deciduous stands are harvested. These results do not significantly depart from those presented in the 2003 DFMP. Deciduous stands peak at a higher age in the midterm due to the greater number of deciduous stands that are incorporated in the timber harvesting landbase (THLB).

Figure 8. Status Quo Scenario: Years Above Minimum Harvest Age for Coniferous Stands

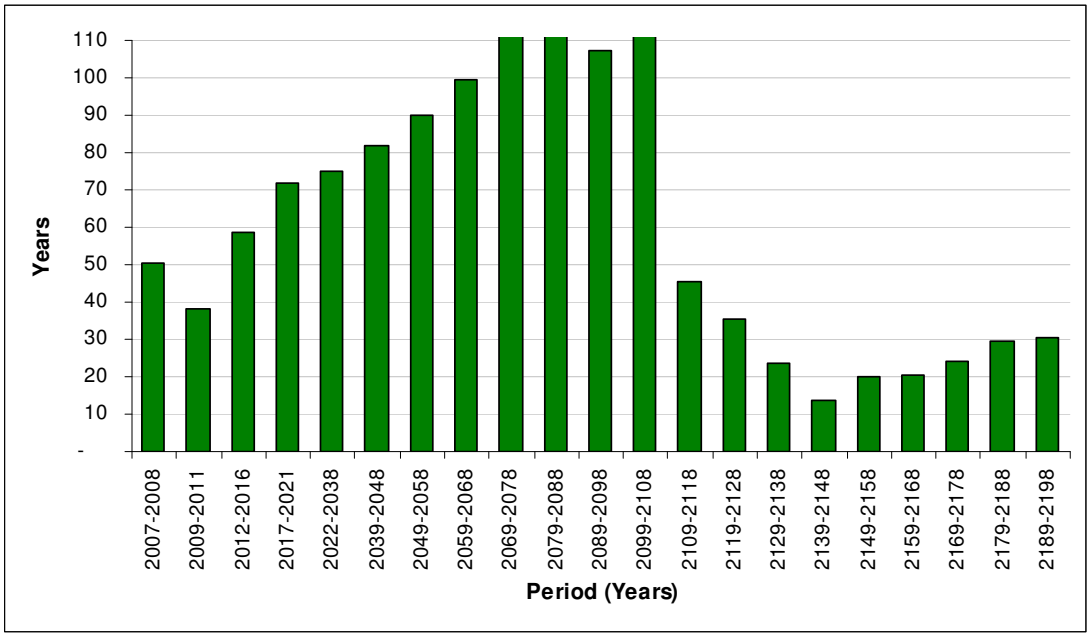
TNRG-RSTASourceData.xls
F008



Source: Timberline compiled data

Figure 9. Status Quo Scenario: Years Above Minimum Harvest Age for Deciduous Priority Stands

TNRG-RSTASourceData.xls
F009



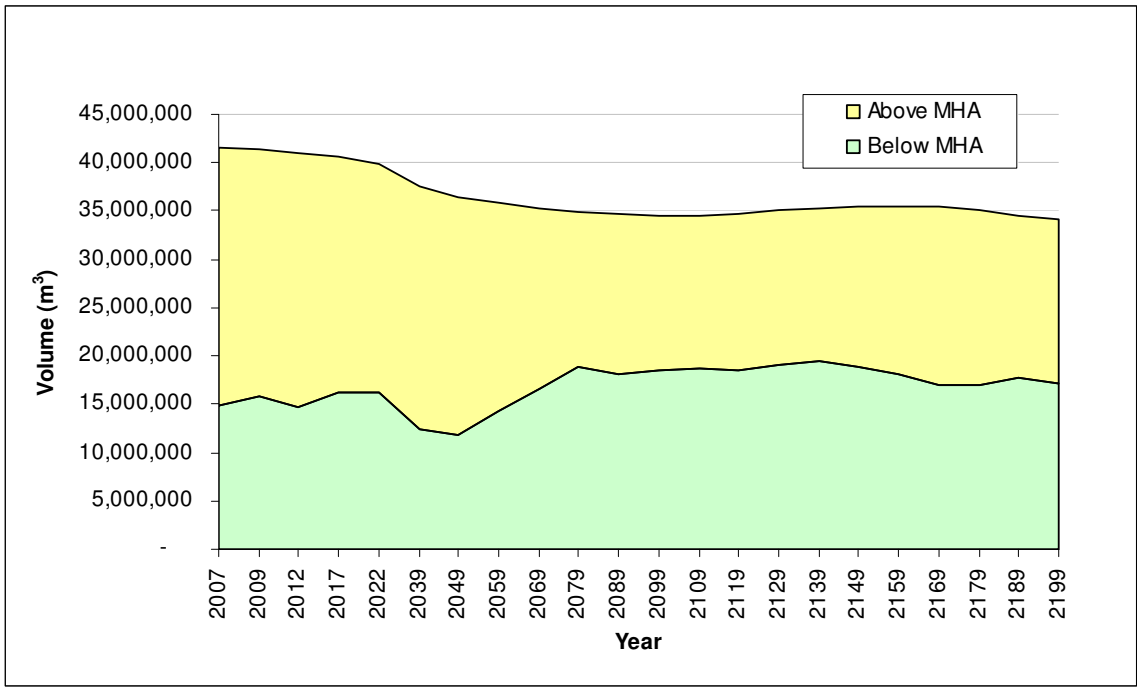
Source: Timberline compiled data

4.1.2 Inventory

Coniferous growing stock levels match the 2003 DFMP very closely as shown in Figure 10 and Table 13.

Figure 10. Status Quo Scenario: Coniferous Standing Inventory Volume

TNRG-RSTASourceData.xls
F010



Source: Timberline compiled data

Table 13. Status Quo Scenario: Coniferous Standing Inventory Volume

TNRG-RSTASourceData.xls
T013

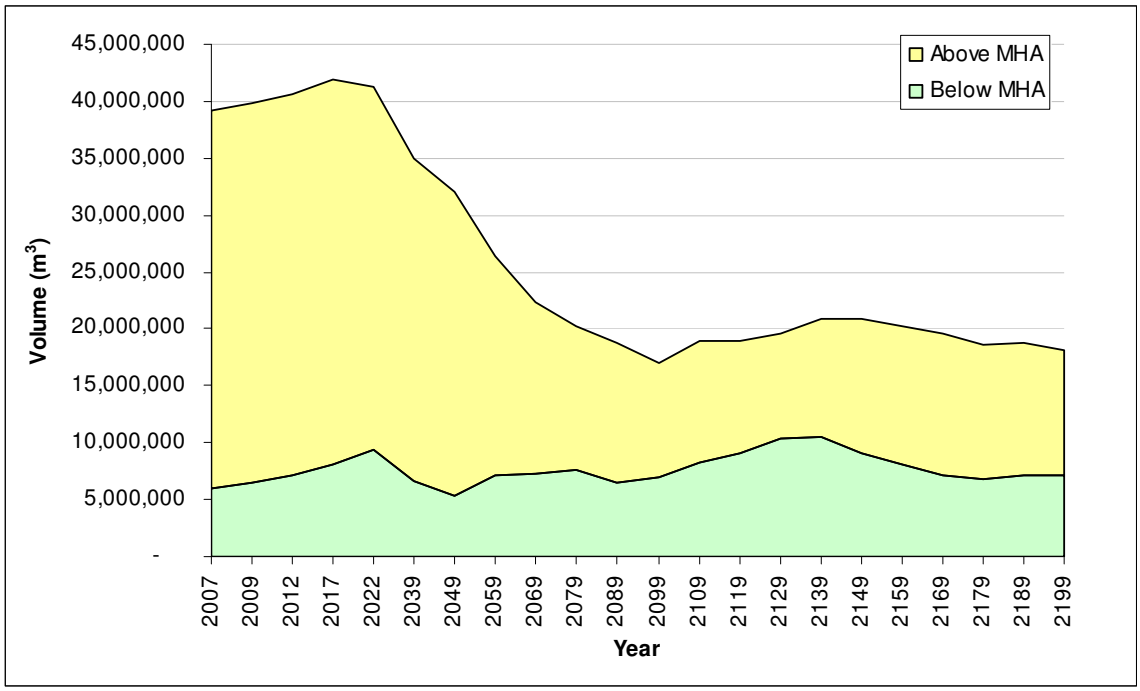
	Coniferous Volume (m^3)	
Year	Above Minimum Harvest Age	Below Minimum Harvest Age
2007	26,597,111	14,911,969
2009	25,593,748	15,737,157
2012	26,424,361	14,625,793
2017	24,381,127	16,157,495
2022	23,656,541	16,174,868
2039	25,204,923	12,415,552
2049	24,667,244	11,846,634
2059	21,384,863	14,385,257
2069	18,567,625	16,655,549
2079	15,942,695	18,931,612
2089	16,624,464	18,019,809
2099	16,034,619	18,532,209
2109	15,785,876	18,771,598
2119	16,154,095	18,514,357
2129	15,918,943	19,134,623
2139	15,848,549	19,418,298
2149	16,505,107	18,921,887
2159	17,305,915	18,142,402
2169	18,517,905	16,878,053
2179	18,167,090	17,006,044
2189	16,726,713	17,784,376
2199	16,970,540	17,186,130

Source: Timberline compiled data

Deciduous growing stock patterns are also similar, although the total volume reaches a slightly higher level (exceeding 40 million cubic metres) due to the slightly larger deciduous net landbase used in this analysis. However, the level matches the 2003 DFMP level in the long term. Figure 11 and Table 14 show the pattern.

Figure 11. Status Quo Scenario: Deciduous Standing Inventory Volume

TNRG-RSTASourceData.xls
F011



Source: Timberline compiled data

Table 14. Status Quo Scenario: Deciduous Standing Inventory Volume

TNRG-RSTASourceData.xls
T014

	Deciduous Volume (m^3)	
Year	Above MHA	Below MHA
2007	33,141,227	5,994,811
2009	33,251,927	6,509,939
2012	33,422,327	7,130,135
2017	33,822,062	8,107,608
2022	31,954,960	9,310,563
2039	28,396,731	6,604,241
2049	26,627,375	5,418,990
2059	19,314,292	7,116,199
2069	14,987,444	7,311,967
2079	12,726,064	7,543,030
2089	12,325,224	6,425,853
2099	10,032,179	6,979,383
2109	10,670,032	8,335,349
2119	9,978,332	9,026,549
2129	9,368,308	10,282,602
2139	10,344,601	10,508,219
2149	11,830,641	8,995,856
2159	12,248,763	8,036,171
2169	12,525,210	7,070,364
2179	11,859,130	6,826,070
2189	11,610,199	7,130,858
2199	11,048,201	7,049,164

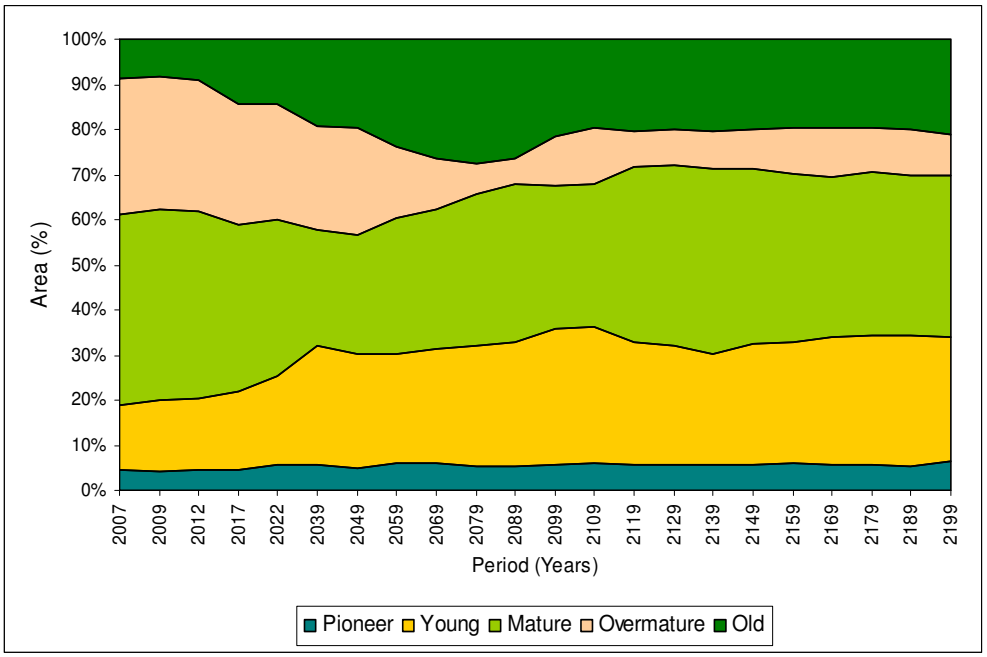
Source: Timberline compiled data

4.1.3 Seral Stage

Seral stage patterns across the FMA area, within individual parcels, natural regions (Appendix B, Map 9) and the Caribou Area (Appendix B, Map 4), are roughly similar to those seen in the 2003 DFMP. Figure 12 to Figure 18 show these results.

Figure 12. Status Quo Scenario: Seral Stage Distribution – FMA area

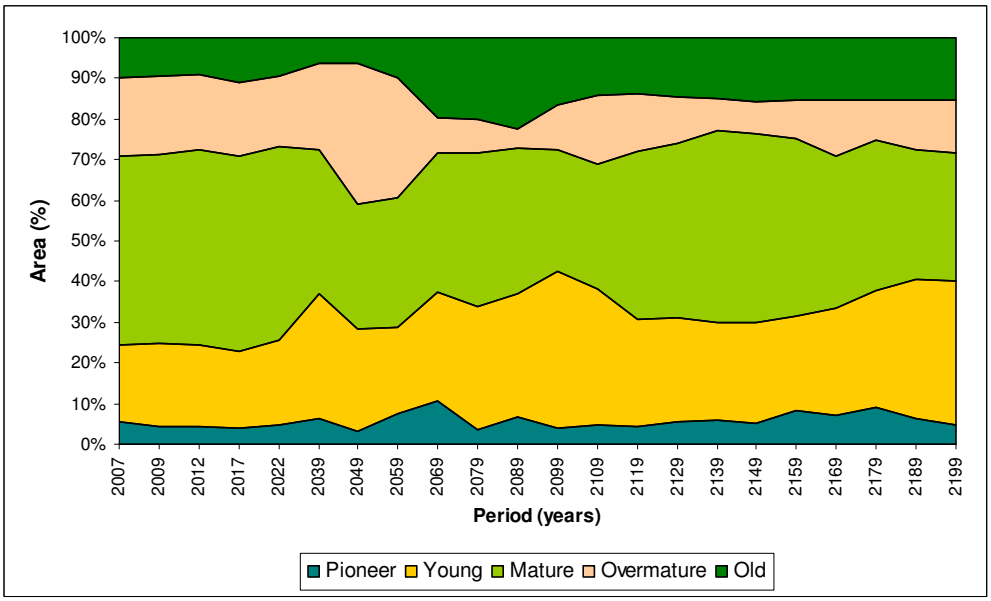
TNRG-RSTASourceData.xls
F012



Source: Timberline compiled data

Figure 13. Status Quo Scenario: Seral Stage Distribution – Puskwaskau Parcel

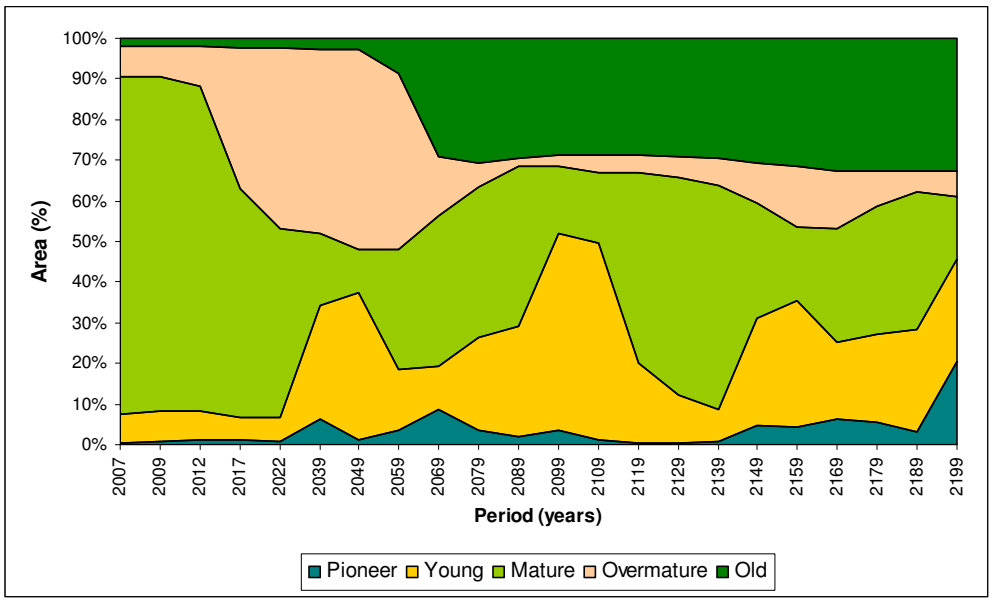
TNRG-RSTASourceData.xls
F013



Source: Timberline compiled data

Figure 14. Status Quo Scenario: Seral Stage Distribution – Peace Parcel

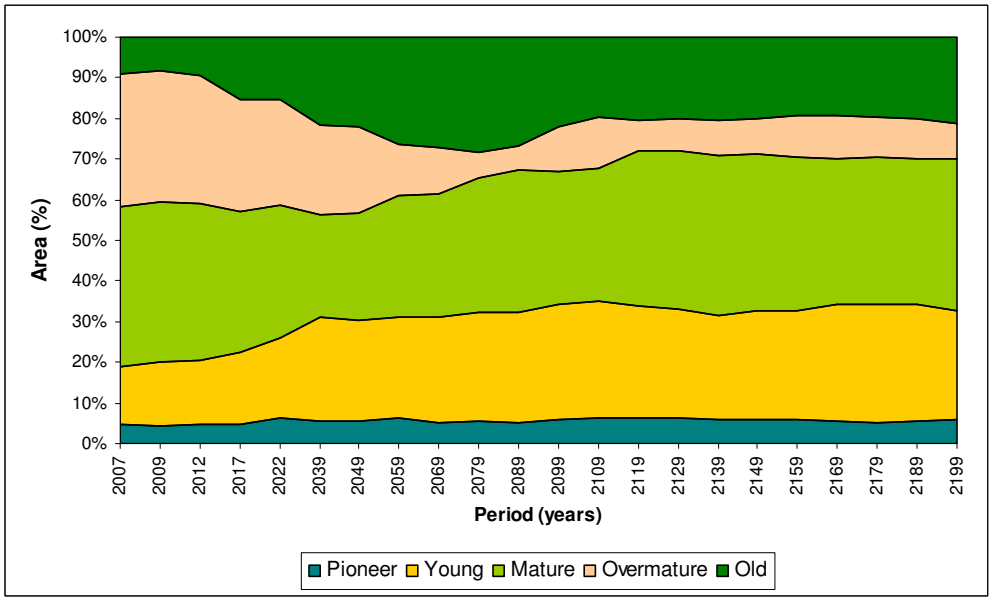
TNRG-RSTASourceData.xls
F014



Source: Timberline compiled data

Figure 15. Status Quo Scenario: Seral Stage Distribution – Main Parcel

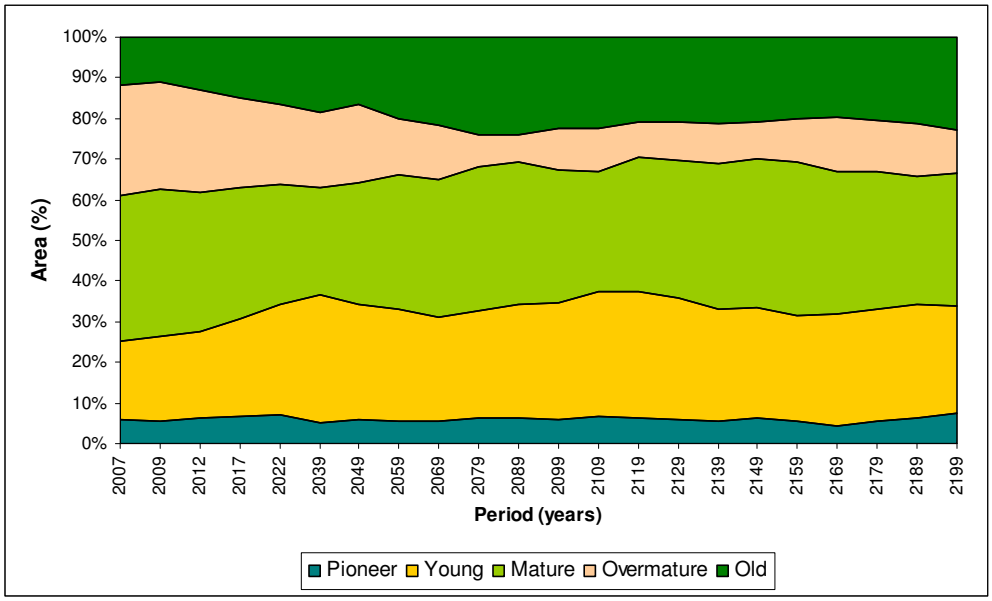
TNRG-RSTASourceData.xls
F015



Source: Timberline compiled data

Figure 16. Status Quo Scenario: Seral Stage Distribution – Foothills Natural Region

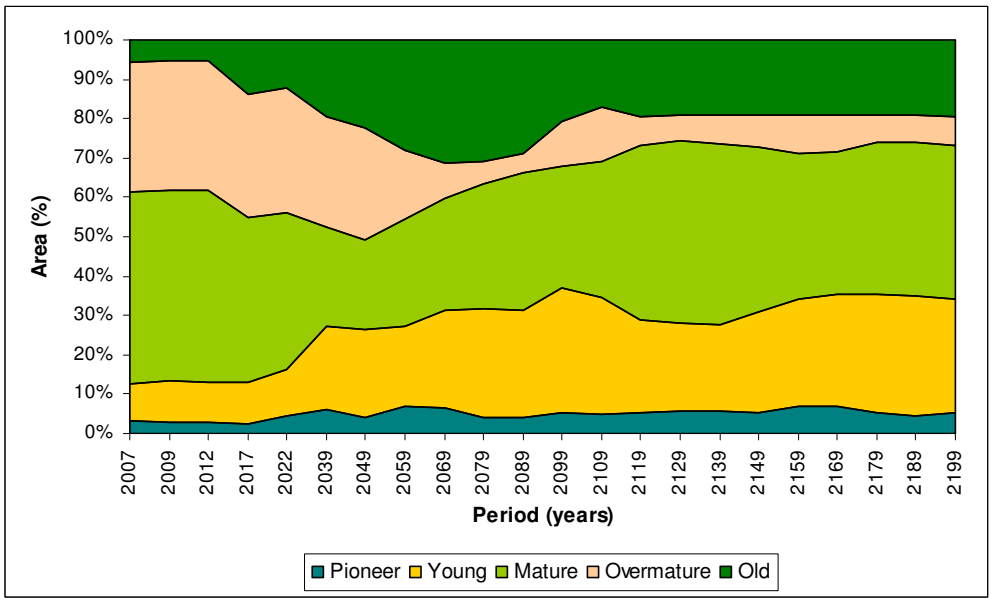
TNRG-RSTASourceData.xls
F016



Source: Timberline compiled data

Figure 17. Status Quo Scenario: Seral Stage Distribution – Boreal Forest Natural Region

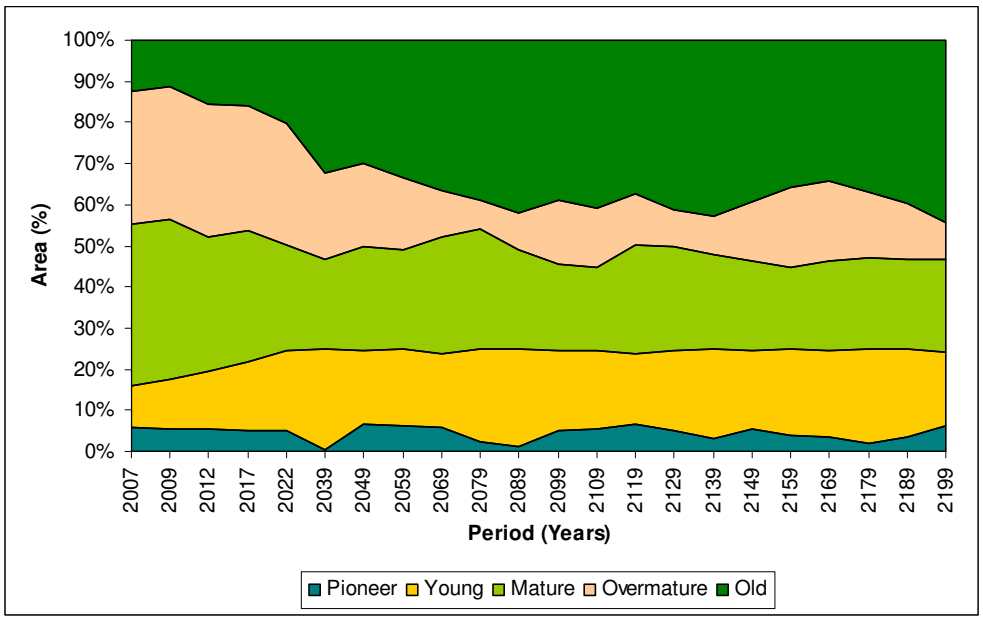
TNRG-RSTASourceData.xls
F017



Source: Timberline compiled data

Figure 18. Status Quo Scenario: Seral Stage Distribution - Caribou Area

TNRG-RSTASourceData.xls
F018



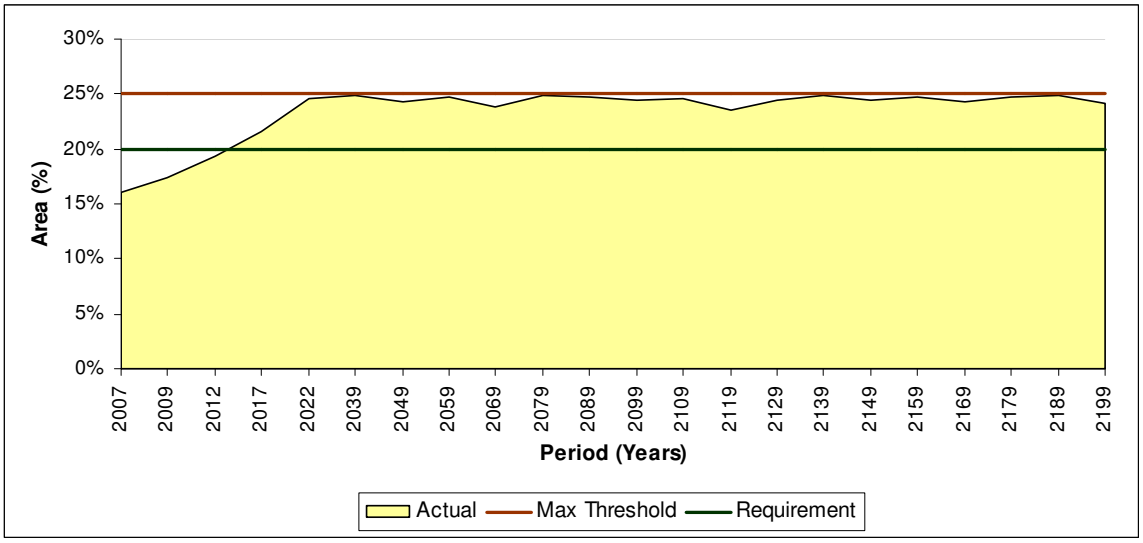
Source: Timberline compiled data

4.1.4 Woodland Caribou

Seral stage levels have been set to limit the rate of harvest in the Caribou Area (Appendix B, Map 4) in order to maintain sufficient habitat. A 25% limit has been placed on the proportion of the area that can be in pioneer/ young seral stages. As with the 2003 DFMP, this limit is first reached at about 2022, but never surpassed. Figure 19 shows this result.

Figure 19. Status Quo Scenario: Pioneer and Young Seral Stage Habitat in the Caribou Area

TNRG-RSTASourceData.xls
F019

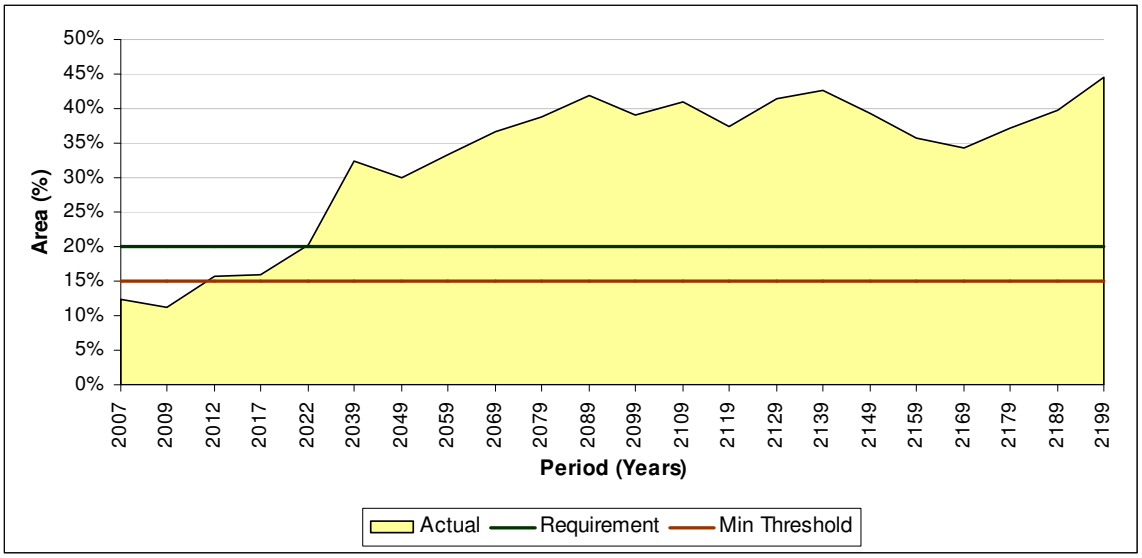


Source: Timberline compiled data

A minimum requirement of 20% old seral is also enforced. It is not achieved at the start of the planning horizon, and is not constraining in the long-term, as Figure 20 shows. It is first met at about 2024, as was the case in the 2003 DFMP analysis.

Figure 20. Status Quo Scenario: Old Seral Stage Habitat in the Caribou Area

TNRG-RSTASourceData.xls
F020



Source: Timberline compiled data

4.1.5 Water Yield

Water yield increases can be directly modelled, however equivalent clearcut area (ECA[7]) is often used as a surrogate. For the current analysis, ECA % was used to limit harvesting within a defined watershed such that total vegetated cover removal does not exceed 40% ECA above the H60[8]. To minimize the risk of significant impacts on watershed resources, operational performance measured against ECA is monitored annually as part of the DFMP/ AOP validation process[9].

Canfor monitors water yield via Target (3.2) 2a.1.1 as presented in the SFMP 2005. Water yield increases are modelled using the ECA-Alberta model developed by Uldis Silins at the University of Alberta. The model provides a framework for evaluation of hydrological effects of forest practices with modest input data requirements. Canfor has elected to evaluate the ten watersheds that exhibit the greatest increase in ECA at the

[7] Equivalent clearcut area (ECA) refers to an area that has been harvested, cleared or burned. The ECA index, expressed as a percentage, describes an area of regenerated growth in terms of its hydrological equivalence to a clearcut. As the area regenerates and growth develops, the hydrological impact is reduced. ECA is a primary factor considered in an evaluation of the potential effect of past and proposed forest harvesting on water yield. ECA is expressed as a percent of watershed area.

[8] H60 is the elevation above which 60% of the watershed lies. The watershed area above the H60 is considered as the source area for the major snowmelt peak flows.

[9] This procedure is performed annually to demonstrate that current harvesting operations are consistent with the objectives of the 2003 DFMP.

end of the fifteen-year plan (2022) and to present results only for the Healthy Pine Scenario (see Section 6.5).

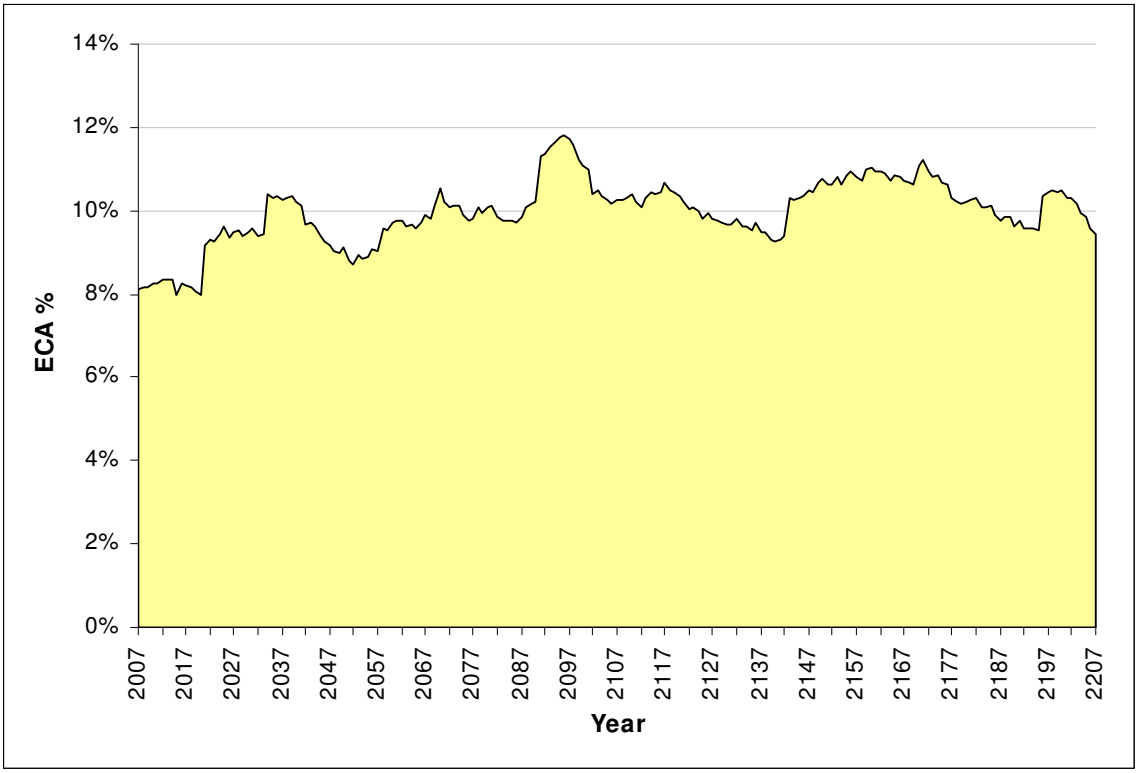
Complete ECA results for the Healthy Pine Scenario, for the H60 portion of each watershed, can be found in Appendix C.

4.1.6 Equivalent Clearcut Area

For the Status Quo Scenario, the impact of harvesting on watershed resources remains low throughout the 200-year planning horizon and the area-weighted ECA % for the FMA area exhibits only minor variation. Figure 21 shows how the ECA, compiled for the H60 portion of each watershed and averaged for the FMA area, varies over the planning horizon. Over the long term, it averages approximately ten percent.

Figure 21. Status Quo Scenario: ECA Percent for the FMA area Above the H60 Line

TNRG-RSTASourceData.xls
F911



Source: Timberline compiled data

4.1.7 Sensitivity Analysis – MPB Mortality

A sensitivity analysis was completed to estimate the impact that widespread MPB mortality would have on coniferous harvest levels if no effort is made in the short term to reduce risk by preferentially harvesting stands that are susceptible to MBP attack. If the 2003 DFMP harvest strategy is pursued until 2022, and pine mortality is assumed at that

point, the conifer harvest level must be reduced to 520,000 m^3/ year for approximately ninety years, beginning in 2022.

4.2 Healthy Pine Scenario – MPB2

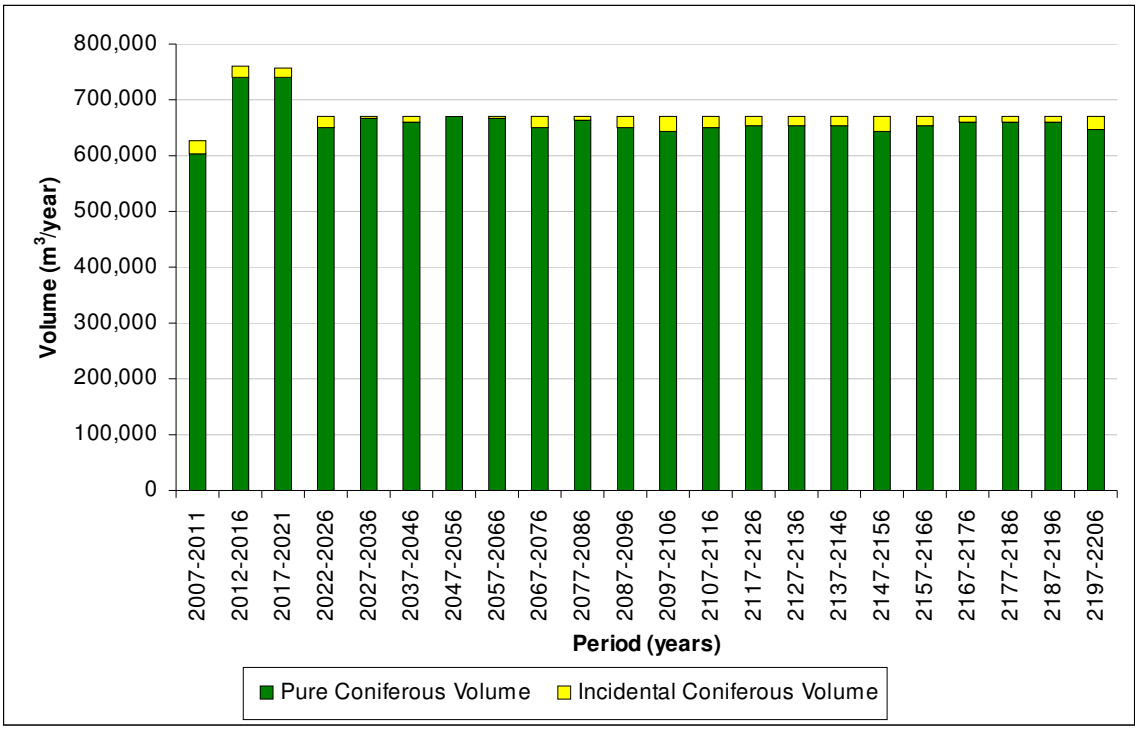
This scenario begins with three five-year periods of harvesting focused in pine stands designed to reduce the volume lost to MPB mortality and limit the extent of the outbreak. Results for the Healthy Pine Scenario are discussed in the following sections.

4.2.1 Timber Harvest

The harvest levels for the first fifteen years of the Healthy Pine Scenario were established by the fifteen-year plan. After that time, attempts were made to find the highest non-declining even flow harvest level (for conifer volume) that could be sustained until the end of the planning horizon. A harvest level of 670,000 m^3/ year is attainable for the entire 200-year planning horizon. Incidental coniferous volume is relatively small with less than 25,000 m^3/ year being generated from deciduous priority stands. Figure 22 and Table 15 show the conifer harvest flow from both coniferous and deciduous priority types.

Figure 22. Healthy Pine Scenario: Coniferous Harvest Flow

TNRG-RSTASourceData.xls
F025



Source: Timberline compiled data

Table 15. Healthy Pine Scenario: Coniferous Harvest Flow

TNRG-RSTASourceData.xls
T015

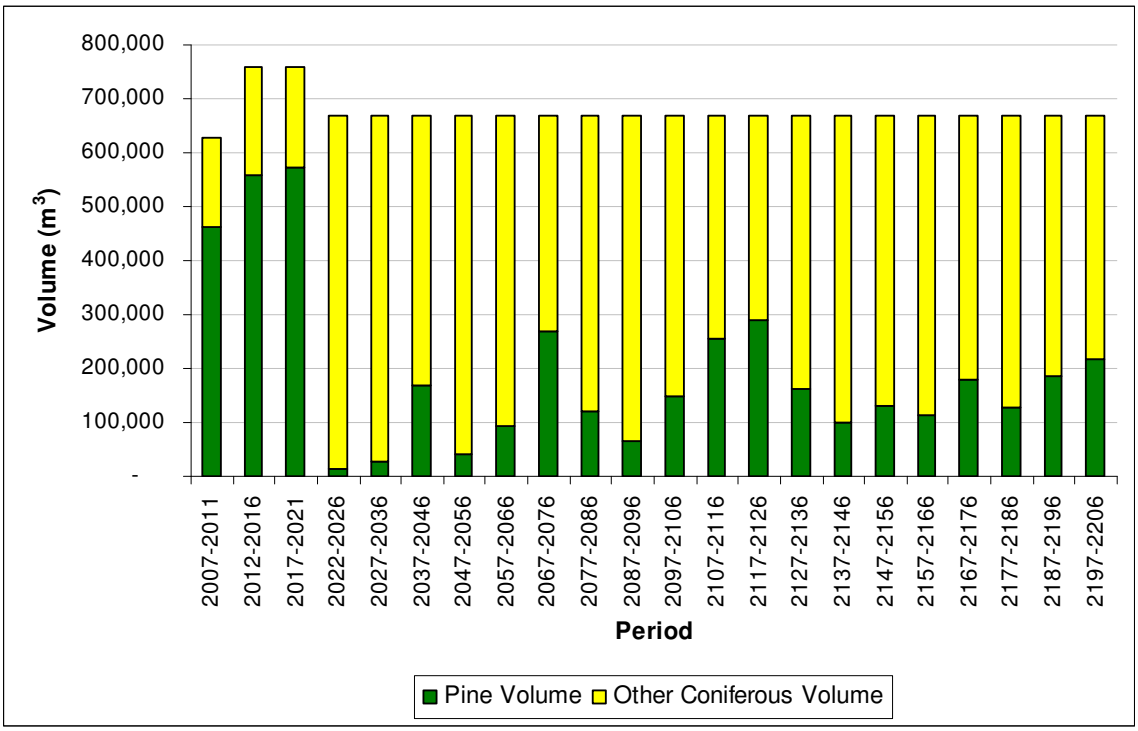
Period	Coniferous Volume (m^3/ year)		
	Pure	Incidental	Total
2007-2011	602,654	25,118	627,772
2012-2016	739,585	19,798	759,384
2017-2021	739,402	18,306	757,708
2022-2026	650,477	19,523	670,000
2027-2036	666,520	3,480	670,000
2037-2046	661,342	8,658	670,000
2047-2056	669,883	117	670,000
2057-2066	666,628	3,372	670,000
2067-2076	648,867	21,133	670,000
2077-2086	662,089	7,911	670,000
2087-2096	648,386	21,614	670,000
2097-2106	644,581	25,419	670,000
2107-2116	650,370	19,630	670,000
2117-2126	653,704	16,296	670,000
2127-2136	652,949	17,051	670,000
2137-2146	651,736	18,264	670,000
2147-2156	643,643	26,357	670,000
2157-2166	651,821	18,179	670,000
2167-2176	660,616	9,384	670,000
2177-2186	659,572	10,428	670,000
2187-2196	658,355	11,645	670,000
2197-2206	647,479	22,520	670,000

Source: Timberline compiled data

The proportion of the harvest that is pine is a key factor in evaluating management alternatives. Figure 23 shows the pine component of the coniferous harvest flow. Pine volume is a significant component of the coniferous harvest flow for the period of the fifteen-year plan. After that, if falls off significantly as most of the remaining pine is unavailable for harvesting due to watershed and caribou habitat cover constraints. As these constraints are satisfied by regenerating stands, this pine volume slowly becomes available for harvest.

Figure 23. Healthy Pine Scenario: Pine Component of Coniferous Harvest

TNRG-RSTASourceData.xls
F026



Source: Timberline compiled data

Initial deciduous harvest levels are also established by the fifteen-year plan.

Although the primary objective of this modelling exercise is development of a harvest schedule that reduces risk from MPB, from the onset an opportunity presented itself to model deciduous harvest flow based on deciduous allocations that have been updated to current status. Deciduous allocations have changed since the approval of the 2003 DFMP (November 2003) due to deciduous harvest, as follows:

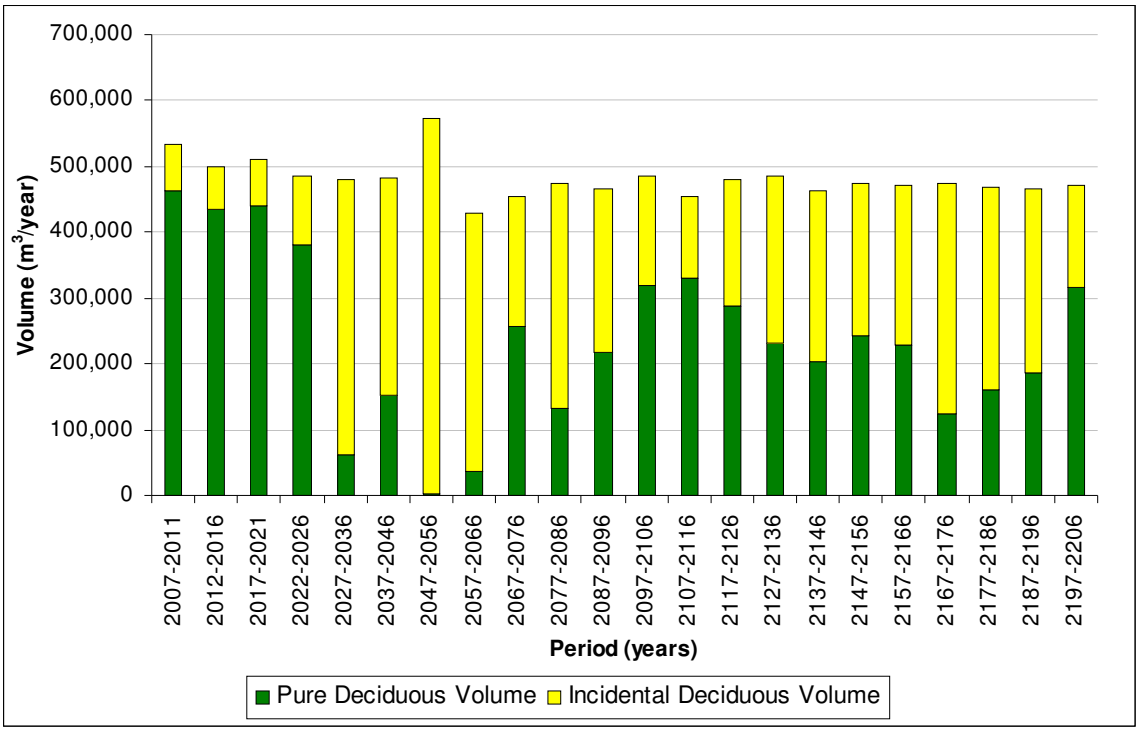
- Some deciduous stands, scheduled for harvest in the 2003 DFMP, were not utilized by deciduous companies thereby invalidating the sequence;
- The actual harvest of deciduous was lower resulting in ASRD recalculating and re-issuing carryovers of deciduous allocations to deciduous companies; and
- The amount of incidental deciduous generated from coniferous harvest differs.

The objective for modelling deciduous was to maintain deciduous allocations as reasonably possible. Average annual deciduous volume allocations for the fifteen-year plan (2007 - 2021) were maintained at 513,261 m^3/ year to account for the above-mentioned carryovers. For the remainder of the 200-year planning horizon (2022 – 2206) an average annual deciduous volume allocation of 453,712 m^3/ year was utilized.

Allocations were managed within COMPLAN through an iterative process of establishing incidental deciduous volumes generated from coniferous harvest and then the remainder coming from deciduous harvest priority stands. Deciduous harvest levels are much more reliant on incidental volume generated from the harvesting of coniferous priority stands. While the incidental volume change is significant over the entire planning horizon, the transition from period to period is gradual. There is a significant jump in incidental volume at year 2027 when pine stands and mixed stands with a significant pine component have been harvested and operations move into other forest types. This is most noticeable from 2047 to 2056, when the entire deciduous allocation comes from conifer priority types. These results are summarized in Figure 24 and Table 16.

Figure 24. Healthy Pine Scenario: Deciduous Harvest Flow

TNRG-RSTASourceData.xls
F027



Source: Timberline compiled data

Table 16. Healthy Pine Scenario: Deciduous Harvest Flow

TNRG-RSTASourceData.xls
T016

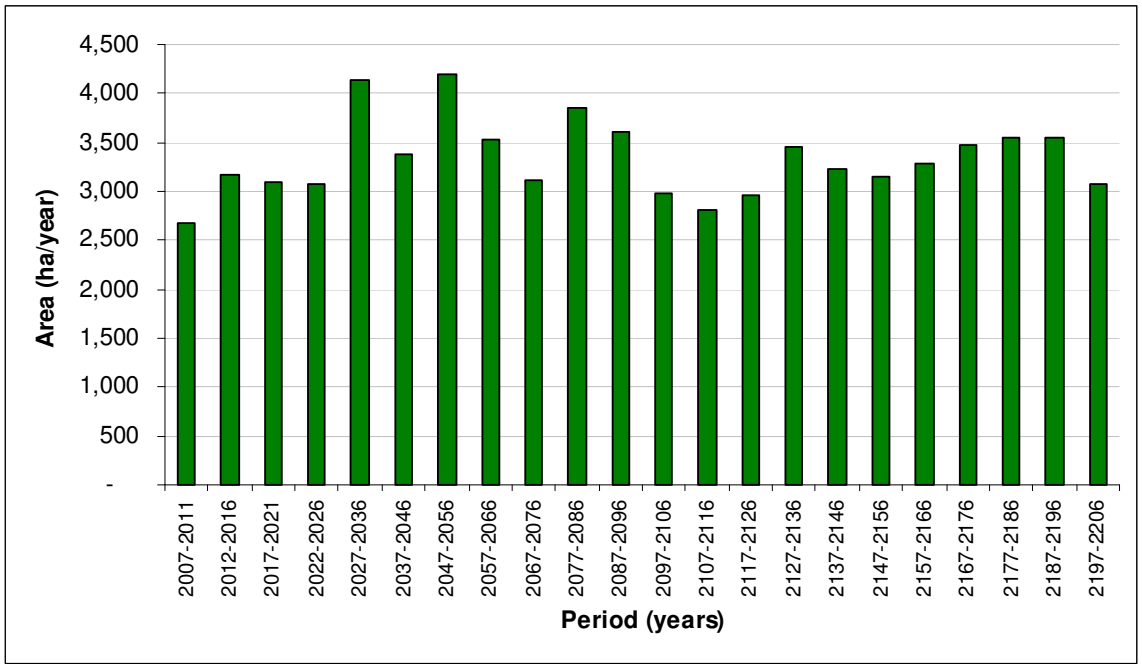
Period	Deciduous Volume (m^3/ year)		
	Pure	Incidental	Total
2007-2011	69,800	462,481	532,281
2012-2016	63,002	435,867	498,869
2017-2021	71,496	440,737	512,233
2022-2026	106,285	379,893	486,178
2027-2036	416,443	63,283	479,726
2037-2046	330,687	151,531	482,218
2047-2056	572,728	1,531	574,259
2057-2066	391,879	35,832	427,711
2067-2076	198,728	256,978	455,706
2077-2086	341,661	131,678	473,338
2087-2096	247,981	217,231	465,213
2097-2106	166,310	320,037	486,347
2107-2116	126,041	328,916	454,957
2117-2126	192,171	287,894	480,066
2127-2136	255,281	231,199	486,480
2137-2146	260,884	202,174	463,057
2147-2156	229,461	243,406	472,867
2157-2166	242,520	228,200	470,721
2167-2176	349,005	125,155	474,160
2177-2186	309,374	159,646	469,020
2187-2196	279,313	185,322	464,635
2197-2206	153,546	317,531	471,077

Source: Timberline compiled data

The area harvested in coniferous priority types climbs noticeably after 2026; in spite of the fact that the volume harvested annually decreases somewhat from the level in the fifteen-year plan. Figure 25 and Table 17 show the variation in area harvested over the entire planning horizon. The final few decades show a pattern similar to the 2003 DFMP, but until that point the area harvested is more variable period-to-period.

Figure 25. Healthy Pine Scenario: Annual Area Harvested in Coniferous Priority Types

TNRG-RSTASourceData.xls
F028



Source: Timberline compiled data

Table 17. Healthy Pine Scenario: Annual Area Harvested and Average Volume Per Hectare in Coniferous Priority Types

TNRG-RSTASourceData.xls
T017

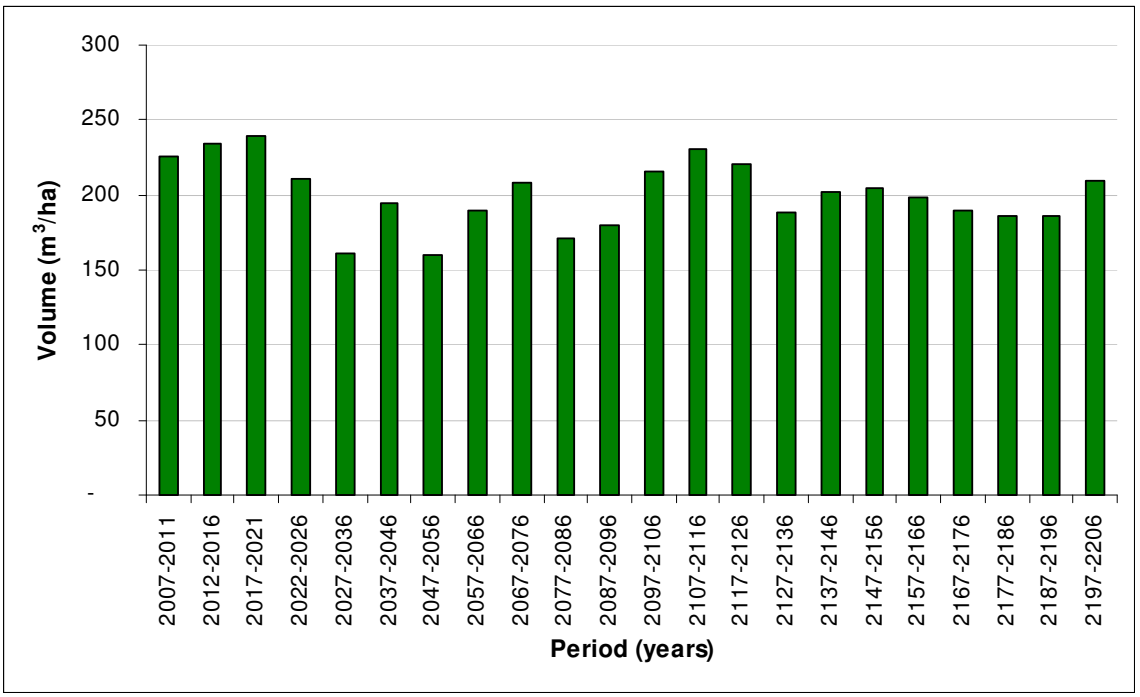
Period	Area (ha)	Average Volume (m^3/ ha)	Period	Area (ha)	Average Volume (m^3/ ha)
2007-2011	2,669	226	2097-2106	2,987	216
2012-2016	3,165	234	2107-2116	2,815	231
2017-2021	3,091	239	2117-2126	2,967	220
2022-2026	3,081	211	2127-2136	3,465	188
2027-2036	4,146	161	2137-2146	3,226	202
2037-2046	3,389	195	2147-2156	3,142	205
2047-2056	4,202	159	2157-2166	3,280	199
2057-2066	3,523	189	2167-2176	3,474	190
2067-2076	3,111	209	2177-2186	3,543	186
2077-2086	3,861	171	2187-2196	3,550	185
2087-2096	3,601	180	2197-2206	3,083	210

Source: Timberline compiled data

A similar pattern occurs with average volume per hectare harvested. For the period of the fifteen-year plan, the average harvested coniferous volume per hectare is approximately 233 m^3/ ha. For the next fifteen years, the average volume drops to 186 m^3/ ha. It is maintained at approximately this level for the next 60 years, though it is variable, before stabilizing just above 200 m^3/ ha in the long term, as shown in Table 17 and Figure 26.

Figure 26. Healthy Pine Scenario: Average Volume Per Hectare in Coniferous Priority Types

TNRG-RSTASourceData.xls
F029

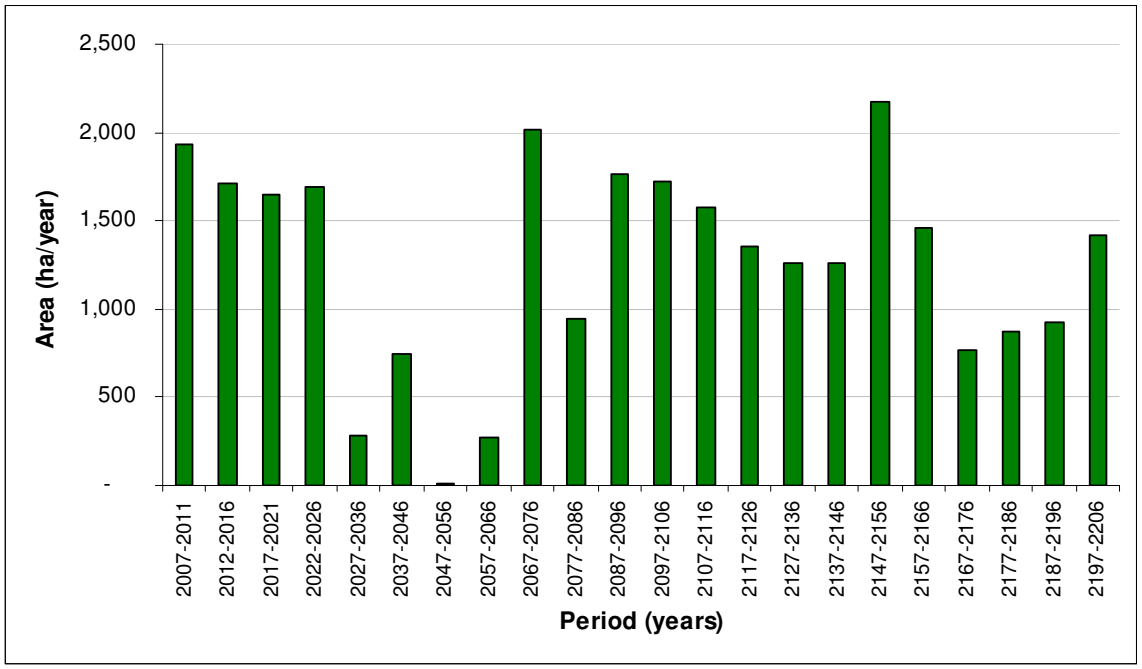


Source: Timberline compiled data

Figure 27 and Table 18 show that there is significantly more variation in the area harvested in deciduous priority types. In fact, the variation is noticeably larger than was the case for the 2003 DFMP, though the overall pattern is similar. Very little area is harvested in deciduous priority types in the medium term from 2027 to 2066. During this period most of the required deciduous allocation comes from coniferous priority types. With most of the pine stands either previously harvested of killed by MPB, conifer harvesting moves into mixed-wood types and generates significant amounts of incidental deciduous volume. This reduces the need for harvesting in deciduous types to meet the allocated volumes.

Figure 27. Healthy Pine Scenario: Annual Area Harvested in Deciduous Priority Types

TNRG-RSTASourceData.xls
F030



Source: Timberline compiled data

Table 18. Healthy Pine Scenario: Annual Area Harvested and Average Volume Per Hectare in Deciduous Priority Types

TNRG-RSTASourceData.xls
T018

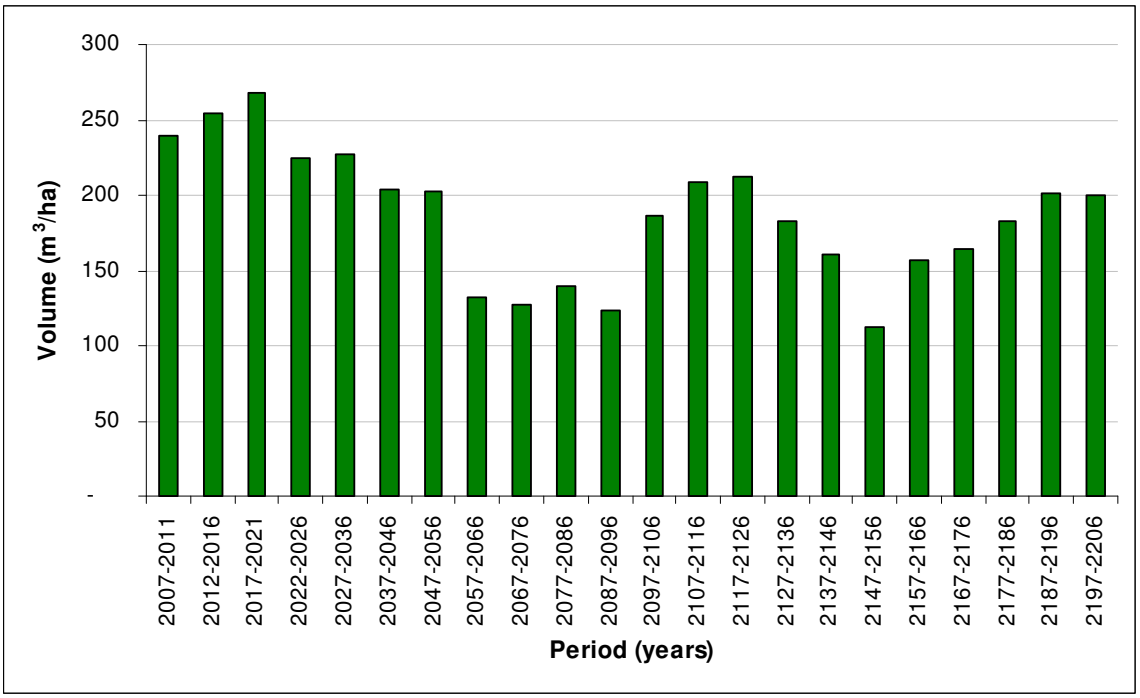
Period	Area (ha)	Average Volume (m^3/ ha)	Period	Area (ha)	Average Volume (m^3/ ha)
2007-2011	1,931	239	2097-2106	1,718	186
2012-2016	1,710	255	2107-2116	1,576	209
2017-2021	1,645	268	2117-2126	1,355	212
2022-2026	1,690	225	2127-2136	1,261	183
2027-2036	279	227	2137-2146	1,257	161
2037-2046	745	204	2147-2156	2,176	112
2047-2056	8	203	2157-2166	1,460	156
2057-2066	273	131	2167-2176	764	164
2067-2076	2,018	127	2177-2186	876	182
2077-2086	942	140	2187-2196	922	201
2087-2096	1,761	123	2197-2206	1,587	200

Source: Timberline compiled data

The average volume per hectare is initially high, approaching and passing 250 m^3/ ha by the end of the fifteen-year plan. After that, the average volume falls steadily, as harvesting progresses into older stands that are in a state of volume decline. It reaches a minimum of about 130 m^3/ ha from 2057 to 2096, before rebounding to a long-term average of 180 m^3/ ha. Figure 28 shows this pattern.

Figure 28. Healthy Pine Scenario: Average Volume Per Hectare in Deciduous Priority Types

TNRG-RSTASourceData.xls
F031

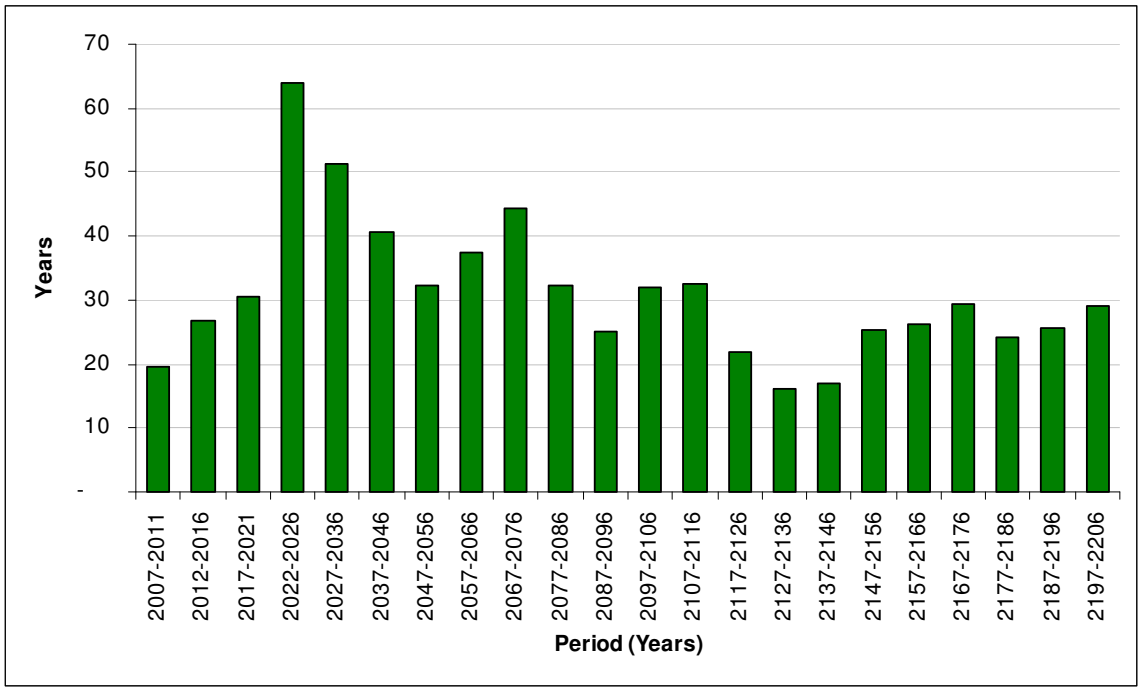


Source: Timberline compiled data

Figure 29 shows that, by focusing on harvest of pine stands for the first fifteen years, older stands are left unharvested. Following the fifteen-year plan, these (non-pine) stands become available, resulting in a significant increase in average harvest age. The average harvest age decreases from this point, stabilizing at about 27 years above minimum harvest age (MHA) in the long term. The average harvest age never reaches the minimum age because the non-timber resource objectives have the effect of increasing the real rotation age by delaying the availability of stands to meet these other objectives.

Figure 29. Healthy Pine Scenario: Years Above Minimum Harvest Age for Coniferous Stands

TNRG-RSTASourceData.xls
F032

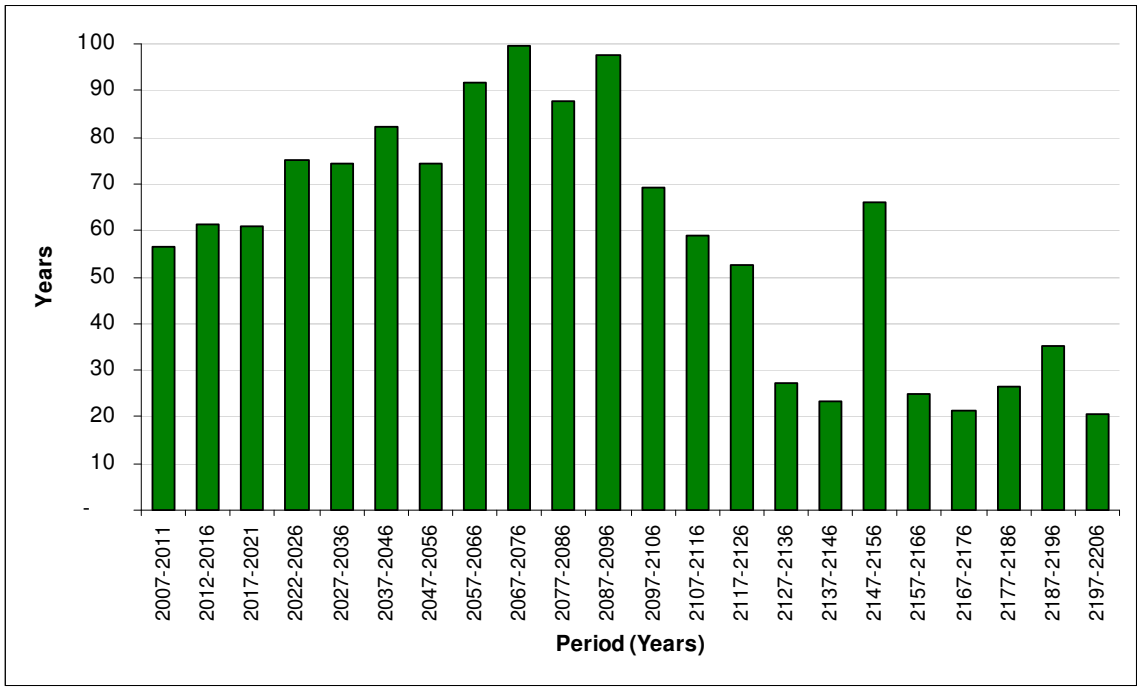


Source: Timberline compiled data

Figure 30 shows that the average deciduous harvest age reaches its peak between 2067 and 2096, which is approximately when the average volume per hectare for deciduous priorities reaches its minimum. This indicates that the primary factor driving the lower volume per hectare at that point is the harvesting of older timber, which is losing volume due to stand breakup. Later on in the planning horizon there is better correlation between the minimum harvest age and higher per-hectare volumes once overmature stands have all been harvested.

Figure 30. Healthy Pine Scenario: Years Above Minimum Harvest Age for Deciduous Priority Stands

TNRG-RSTASourceData.xls
F033



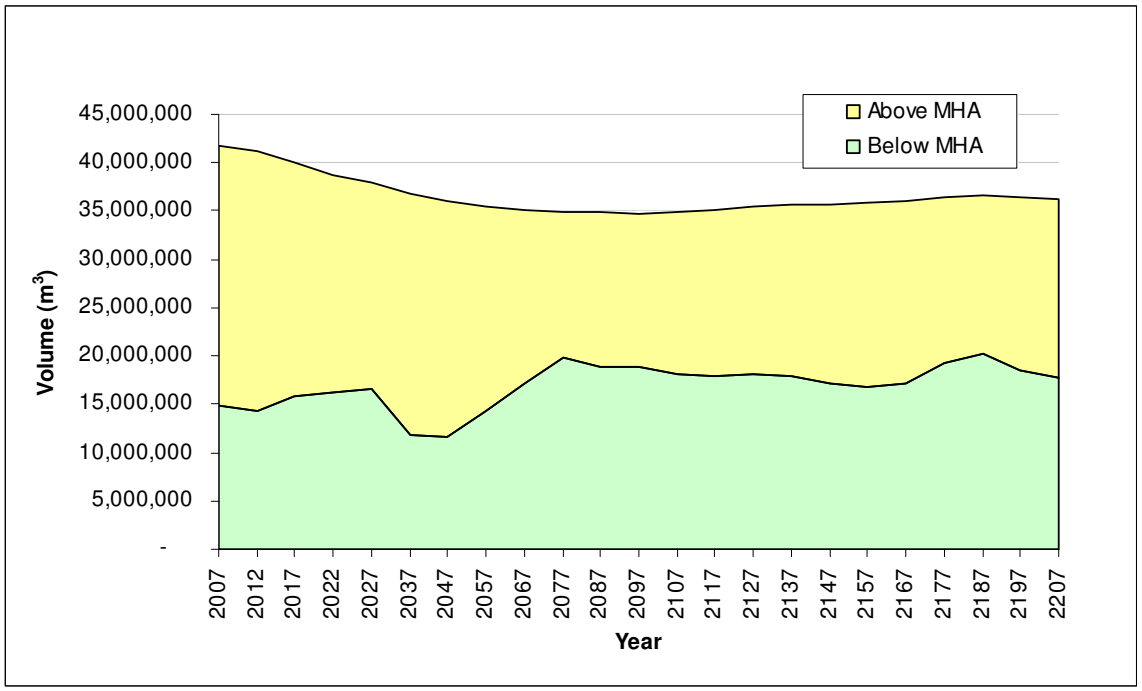
Source: Timberline compiled data

4.2.2 Inventory

The coniferous standing inventory volume follows a typical pattern for a wood supply with a well-dispersed age class distribution. Figure 31 and Table 19 show that the available standing volume declines slightly as the existing growing stock of older, high volume stands is harvested. It then settles to a constant rate as the age class distribution becomes more balanced. The growing stock of stands above minimum harvest age (MHA) is reasonably stable around 18,000,000 cubic metres.

Figure 31. Healthy Pine Scenario: Coniferous Standing Inventory Volume

TNRG-RSTASourceData.xls
F034



Source: Timberline compiled data

Table 19. Healthy Pine Scenario: Coniferous Standing Inventory Volume

TNRG-RSTASourceData.xls
T019

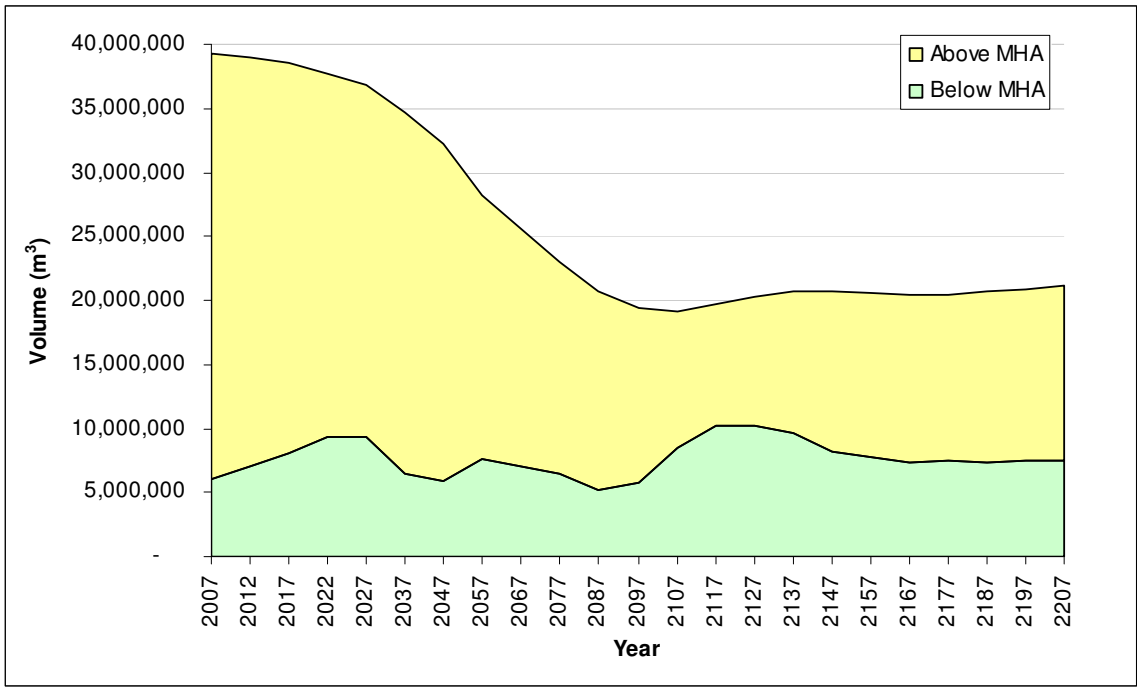
	Coniferous Volume (m^3)	
Year	Above MHA	Below MHA
2007	26,758,926	14,922,007
2012	26,951,862	14,288,209
2017	24,290,862	15,735,317
2022	22,643,573	16,139,139
2027	21,366,735	16,646,714
2037	24,892,948	11,874,899
2047	24,368,252	11,590,030
2057	21,146,682	14,350,617
2067	18,054,392	17,122,963
2077	15,210,246	19,760,260
2087	15,995,057	18,881,603
2097	15,972,349	18,820,706
2107	16,785,399	18,134,045
2117	17,172,944	17,968,382
2127	17,317,912	18,133,031
2137	17,785,286	17,861,906
2147	18,595,123	17,089,214
2157	19,017,392	16,805,235
2167	18,957,336	17,125,280
2177	17,136,371	19,255,840
2187	16,255,152	20,279,158
2197	17,923,818	18,546,915
2207	18,453,757	17,773,514

Source: Timberline compiled data

The pattern for the deciduous standing inventory shows differs from that for the coniferous inventory. There is a sharp decline in total deciduous growing stock levels, as shown in Figure 32 and Table 20. This is due in part to harvesting and in part to the high proportion of stands that are mature and in a state of decline. This pattern is consistent with the results for the 2003 DFMP analysis.

Figure 32. Healthy Pine Scenario: Deciduous Standing Inventory Volume

TNRG-RSTASourceData.xls
F035



Source: Timberline compiled data

Table 20. Healthy Pine Scenario: Deciduous Standing Inventory Volume

TNRG-RSTASourceData.xls
T020

	Deciduous Volume (m^3)	
Year	Above MHA	Below MHA
2007	33,234,004	5,997,021
2012	31,836,566	7,088,302
2017	30,559,073	8,070,528
2022	28,369,887	9,319,860
2027	27,464,658	9,405,903
2037	28,235,548	6,453,473
2047	26,343,660	5,834,986
2057	20,640,162	7,632,602
2067	18,458,019	7,110,260
2077	16,566,780	6,420,752
2087	15,526,160	5,134,277
2097	13,620,231	5,734,466
2107	10,673,393	8,464,303
2117	9,566,408	10,155,985
2127	10,073,202	10,250,525
2137	11,039,473	9,625,790
2147	12,542,750	8,202,439
2157	12,666,946	7,837,471
2167	13,092,220	7,278,217
2177	12,993,368	7,424,019
2187	13,273,210	7,384,596
2197	13,395,011	7,501,990
2207	13,571,308	7,545,392

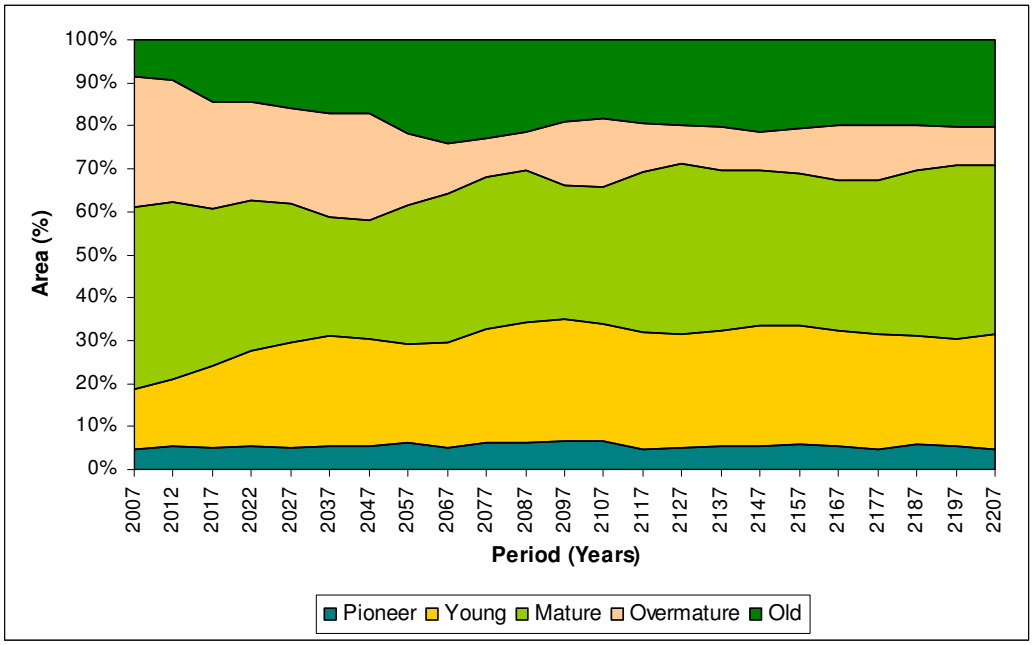
Source: Timberline compiled data

4.2.3 Seral Stage

Seral stage distribution targets are met throughout the time horizon with the exception of the “old” seral stage target, which cannot be met in several instances at the beginning of the planning horizon. This is due to the fact that there is not enough old seral timber at the beginning of the planning horizon and stands must be recruited and temporarily removed from the Timber Harvesting Landbase (THLB) so that they can age and contribute to this requirement. The seral stage distribution graphs (Figure 33 through Figure 39) show that the amount of old seral stage has the greatest increase in the areas where harvest is most restricted. The patterns are roughly similar to the corresponding graphs in the 2003 DMFP RTSA. The Peace Parcel is the exception – this analysis shows significantly less old seral in this unit at the end of the planning horizon.

Figure 33. Healthy Pine Scenario: Seral Stage Distribution – FMA area

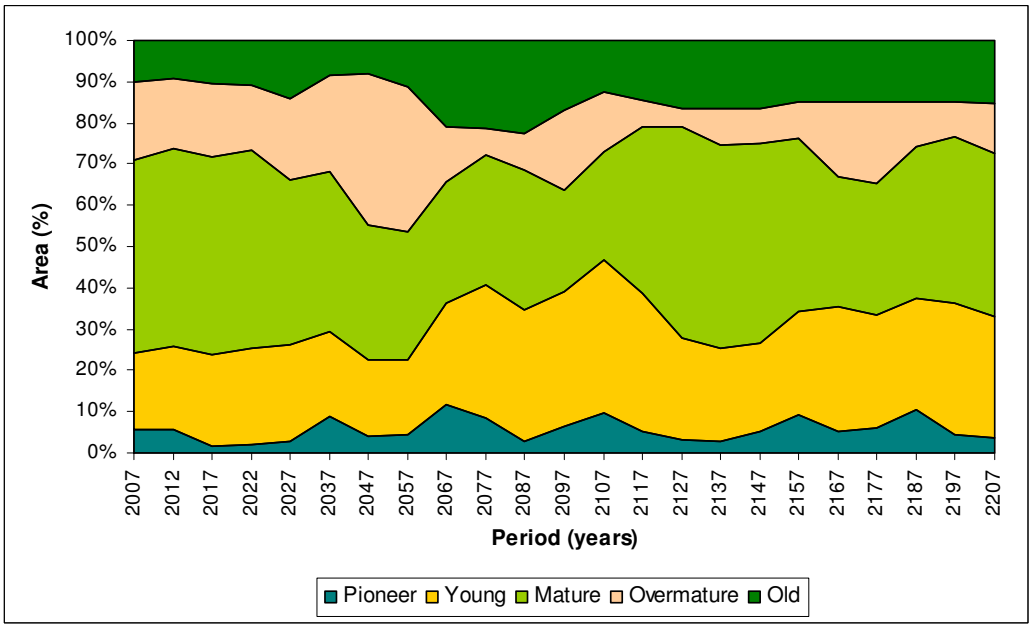
TNRG-RSTASourceData.xls
F036



Source: Timberline compiled data

Figure 34. Healthy Pine Scenario: Seral Stage Distribution – Puskwaskau Parcel

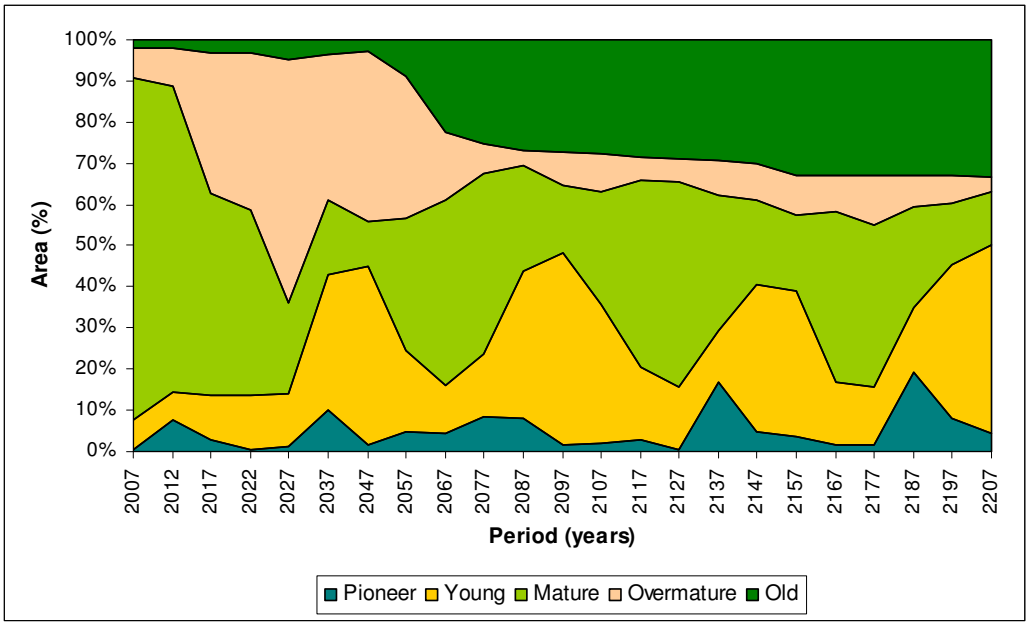
TNRG-RSTASourceData.xls
F037



Source: Timberline compiled data

Figure 35. Healthy Pine Scenario: Seral Stage Distribution – Peace Parcel

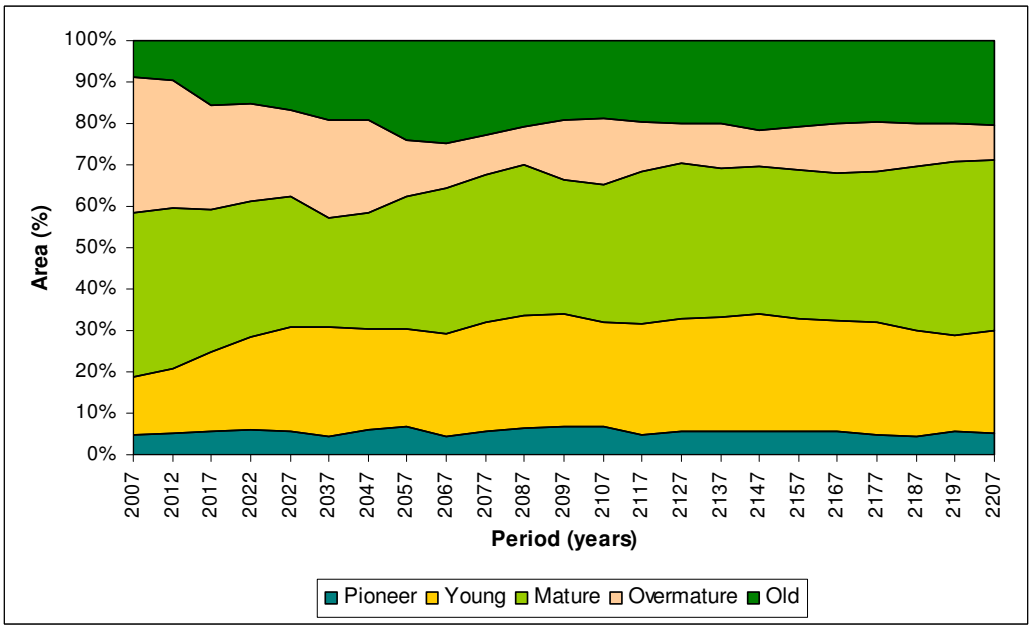
TNRG-RSTASourceData.xls
F038



Source: Timberline compiled data

Figure 36. Healthy Pine Scenario: Seral Stage Distribution – Main Parcel

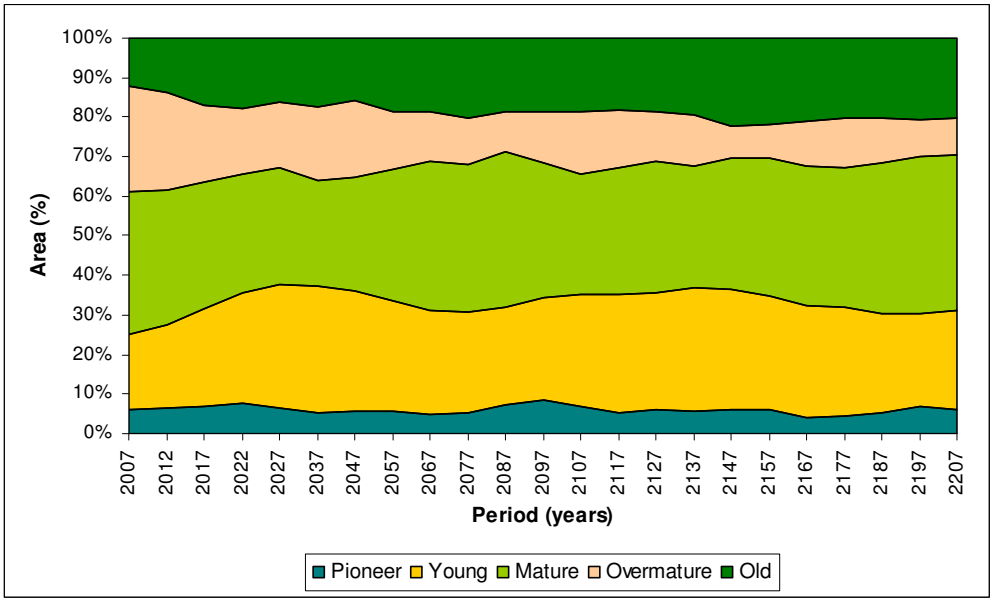
TNRG-RSTASourceData.xls
F039



Source: Timberline compiled data

Figure 37. Healthy Pine Scenario: Seral Stage Distribution – Foothills Natural Region

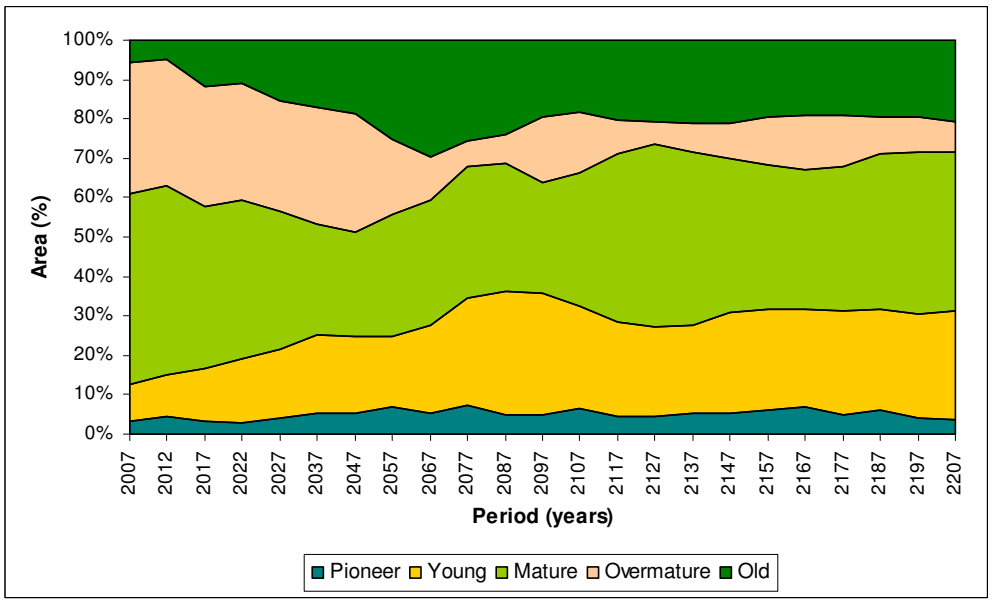
TNRG-RSTASourceData.xls
F040



Source: Timberline compiled data

Figure 38. Healthy Pine Scenario: Seral Stage Distribution – Boreal Forest Natural Region

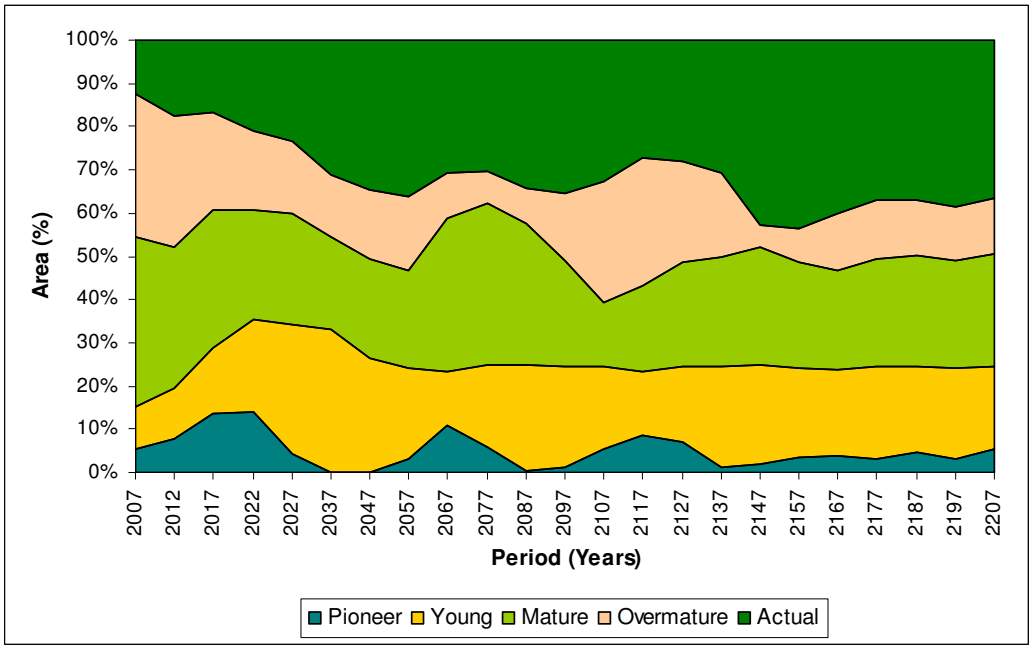
TNRG-RSTASourceData.xls
F041



Source: Timberline compiled data

Figure 39. Healthy Pine Scenario: Seral Stage Distribution - Caribou Area

TNRG-RSTASourceData.xls
F042



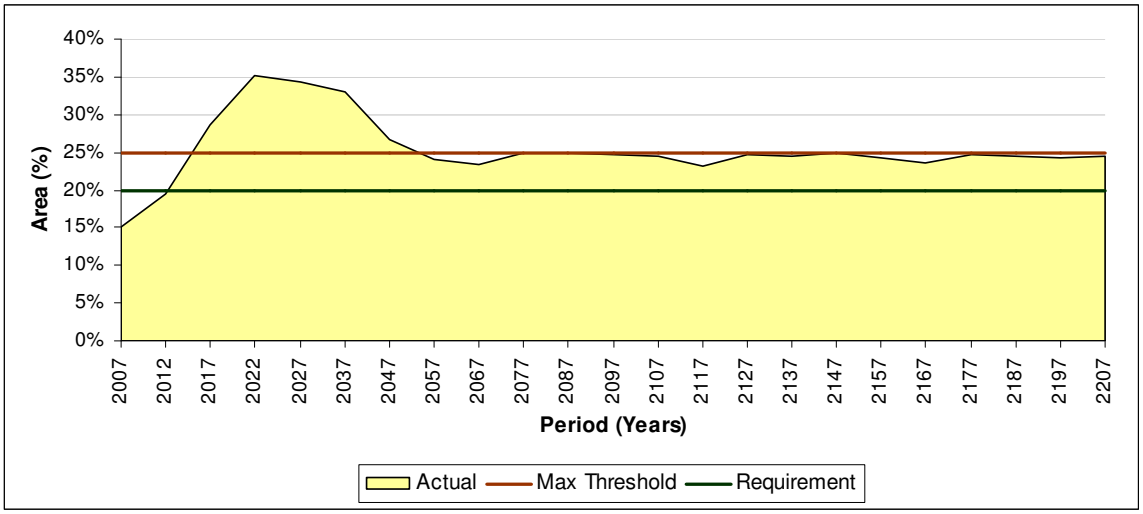
Source: Timberline compiled data

4.2.4 Caribou Habitat

Figure 40 shows that the limitation on the combination of the pioneer and young seral stages in caribou habitat is exceeded during the term of the fifteen-year plan. This is due to the fact that this cover constraint is not enforced initially so that pine stands can be harvested. Beginning in 2022 the cover constraint is turned back on, and the situation immediately begins to improve. By 2037 the area in pioneer and young seral is again within prescribed limits.

Figure 40. Healthy Pine Scenario: Pioneer and Young Seral Stage Habitat in the Caribou Area

TNRG-RSTASourceData.xls
F043

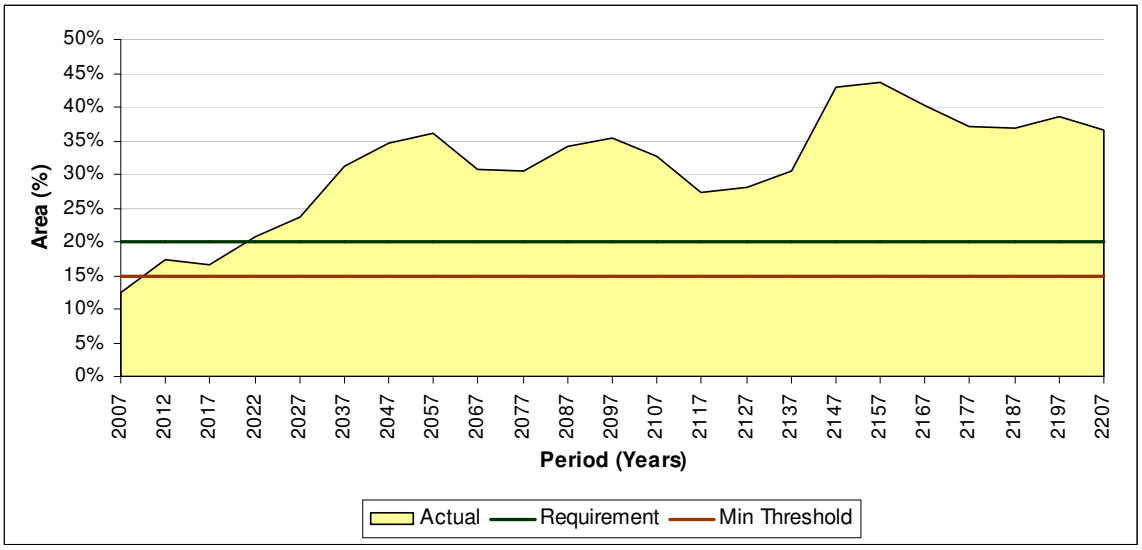


Source: Timberline compiled data

The requirement for old seral stage as part of the caribou habitat management is exceeded by a significant degree by the end of the planning horizon as shown in Figure 41. This result is quite similar to the 2003 DFMP analysis. This indicates that the pioneer and young seral cover constraints have a much greater impact on harvest that the old seral stage requirement. Focusing on pine harvest does not have the expected negative impact on old seral in the short term, because no blocks are scheduled in the caribou primary intactness area (Appendix B, Map 5) until after 2021.

Figure 41. Healthy Pine Scenario: Old Seral Stage Habitat in the Caribou Area

TNRG-RSTASourceData.xls
F044



Source: Timberline compiled data

4.2.5 Water Yield

Water yield increases can be directly modelled, however equivalent clearcut area (ECA) is often used as a surrogate. For the current analysis, ECA % was used to limit harvesting within a defined watershed such that total vegetated cover removal does not exceed 40% ECA above the H60. To minimize the risk of significant impacts on watershed resources, operational performance measured against ECA is monitored annually as part of the DFMP/ AOP validation process.

Canfor monitors water yield via Target (3.2) 2a.1.1 as presented in the SFMP 2005. Water yield increases are modelled using the ECA-Alberta model developed by Uldis Silins at the University of Alberta. The model provides a framework for evaluation of hydrological effects of forest practices with modest input data requirements. Canfor has elected to evaluate the ten watersheds that exhibit the greatest increase in ECA at the end of the fifteen-year plan (2022) and to present results only for the Healthy Pine Scenario (see Section 6.5).

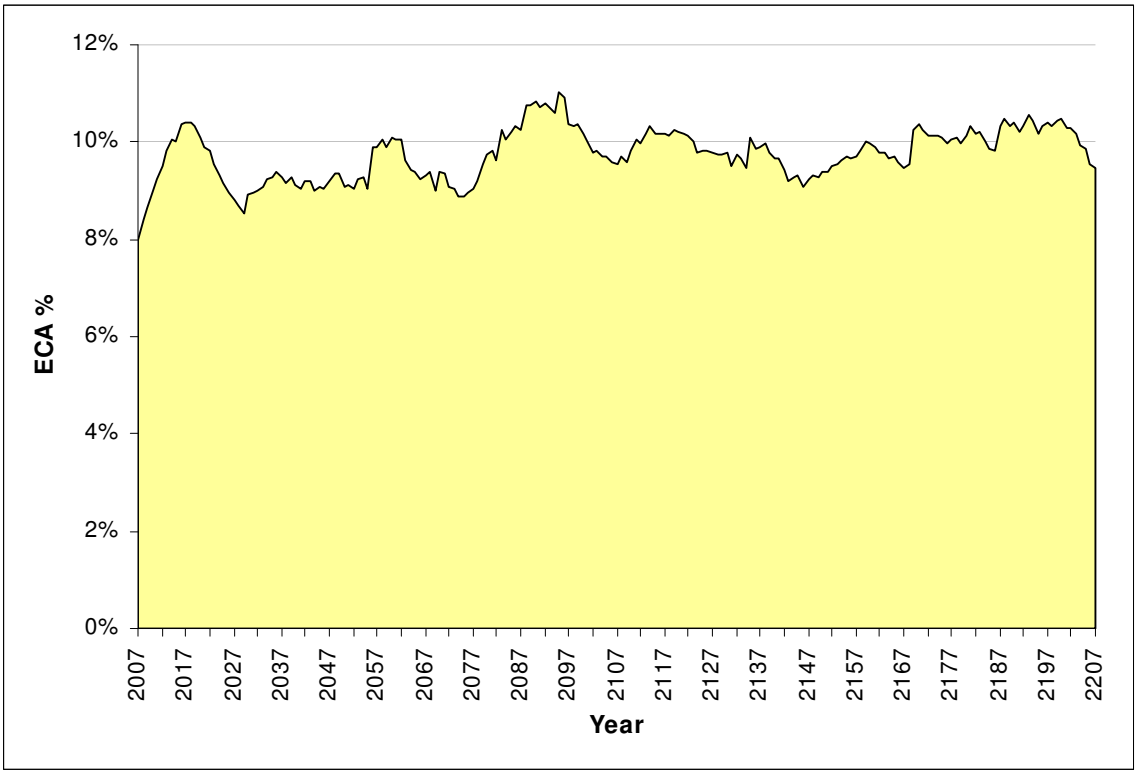
Complete ECA results for the Healthy Pine Scenario, for the H60 portion of each watershed, can be found in Appendix C.

4.2.6 Equivalent Clearcut Area

For the Healthy Pine Scenario, the impact of harvesting on watershed resources remains low throughout the 200-year planning horizon. The area-weighted ECA % closely emulates that of the Status Quo Scenario (Figure 42) in that it averages approximately ten percent over the long term.

Figure 42. Healthy Pine Scenario: ECA Percent for the FMA area Above the H60 Line

TNRG-RSTASourceData.xls
F912



Source: Timberline compiled data

4.3 Disaster Scenario – MPB3

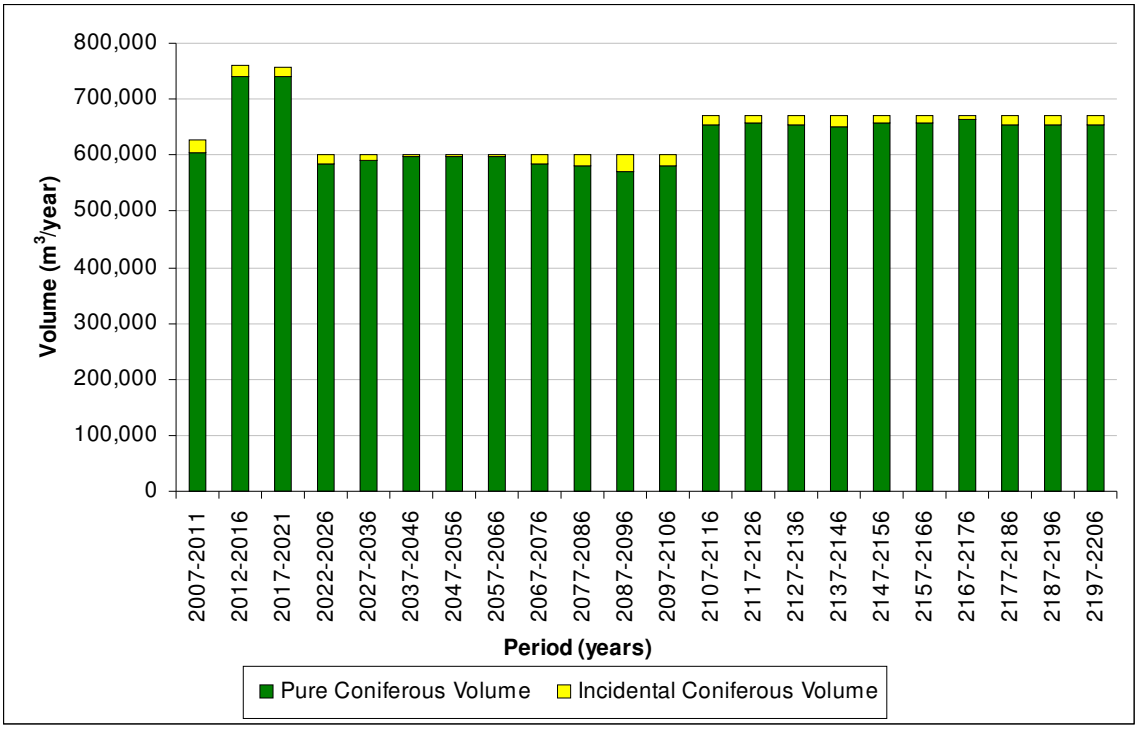
Results for the Disaster Scenario are discussed in the following sections.

4.3.1 Timber Harvest

The harvest flow for the first fifteen years of the planning horizon is the same as for the Healthy Pine Scenario (MPB2). The same MPB risk reduction strategy is applied in each scenario, resulting in identical fifteen-year plans. Following the fifteen-year plan however, the harvest level must be significantly reduced to compensate for the significant pine mortality that is assumed in this scenario. It falls to 600,000 m^3/ year, and remains at that level until 2016. After that point the harvest can be increased to the long-term level found in the 2003 DFMP: 670,000 m^3/ year. Figure 43 and Table 21 show the resulting coniferous harvest flow.

Figure 43. Disaster Scenario: Coniferous Harvest Flow

TNRG-RSTASourceData.xls
F049



Source: Timberline compiled data

Table 21. Disaster Scenario: Coniferous Harvest Flow

TNRG-RSTASourceData.xls
T021

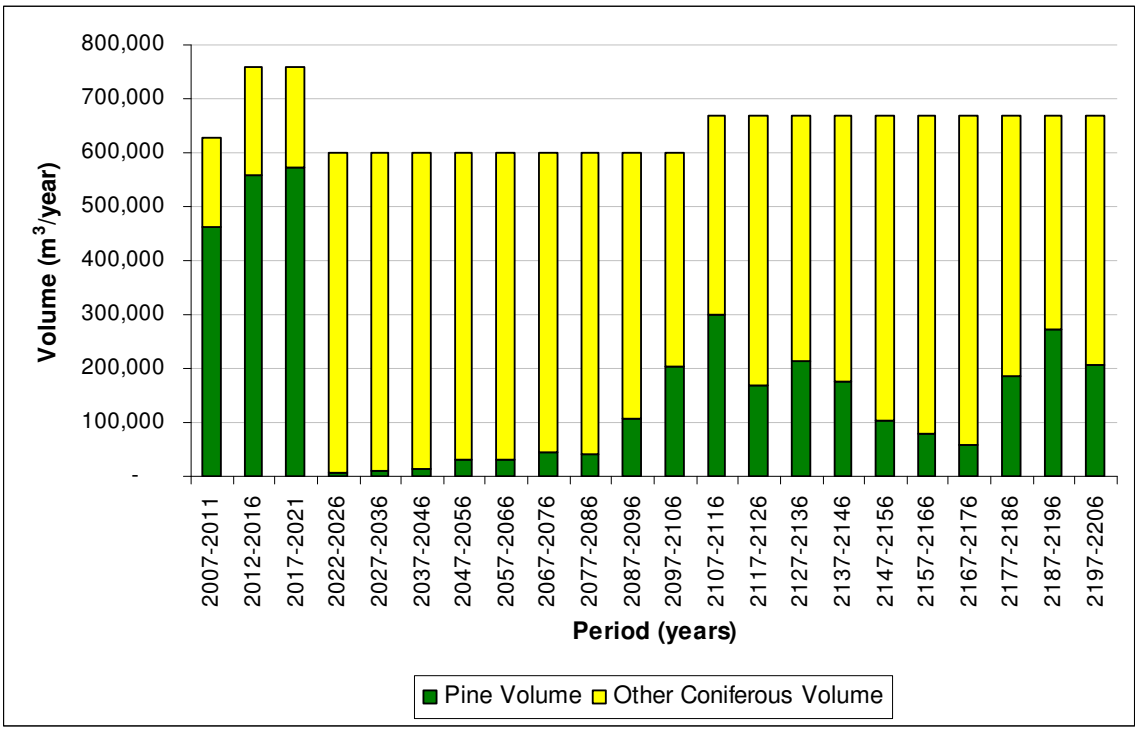
Period	Coniferous Volume (m^3/ year)		
	Pure	Incidental	Total
2007-2011	602,654	25,118	627,772
2012-2016	739,585	19,798	759,384
2017-2021	739,402	18,306	757,708
2022-2026	585,477	14,523	600,000
2027-2036	590,729	9,271	600,000
2037-2046	596,139	3,861	600,000
2047-2056	599,172	828	600,000
2057-2066	596,709	3,291	600,000
2067-2076	583,723	16,277	600,000
2077-2086	580,043	19,957	600,000
2087-2096	572,385	27,615	600,000
2097-2106	579,995	20,005	600,000
2107-2116	653,098	16,902	670,000
2117-2126	658,753	11,247	670,000
2127-2136	653,065	16,935	670,000
2137-2146	649,199	20,801	670,000
2147-2156	655,662	14,338	670,000
2157-2166	656,088	13,912	670,000
2167-2176	662,815	7,185	670,000
2177-2186	653,118	16,882	670,000
2187-2196	655,416	14,584	670,000
2197-2206	655,602	14,398	670,000

Source: Timberline compiled data

As was the case for the Healthy Pine Scenario (Figure 22), pine volume makes up most of the coniferous harvest flow for the first fifteen years. Widespread pine mortality is assumed in 2022, so very little pine is available for harvest from that point onward until regenerating pine stands become available.

Figure 44. Disaster Scenario: Pine Component of Coniferous Harvest

TNRG-RSTASourceData.xls
F050

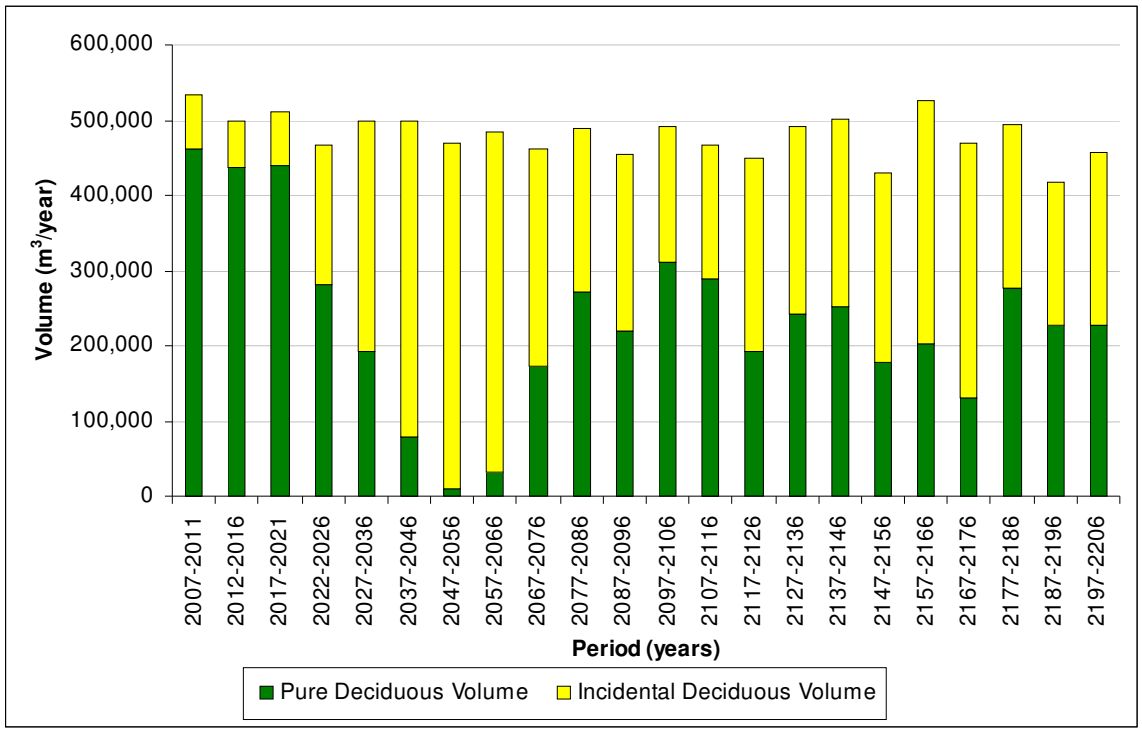


Source: Timberline compiled data

The deciduous harvest flow for the Disaster Scenario is not significantly different from that for the Healthy Pine Scenario. In both cases the allocation can be achieved over the long term. Variations in harvest levels between periods result from the modelling difficulty of balancing deciduous volume while the forest estate model schedules coniferous volume. Figure 45 and Table 22 show the harvest flow, and the proportion of the deciduous volume that comes from coniferous and deciduous-leading stands.

Figure 45. Disaster Scenario: Deciduous Harvest Flow

TNRG-RSTASourceData.xls
F051



Source: Timberline compiled data

Table 22. Disaster Scenario: Deciduous Harvest Flow

TNRG-RSTASourceData.xls
T022

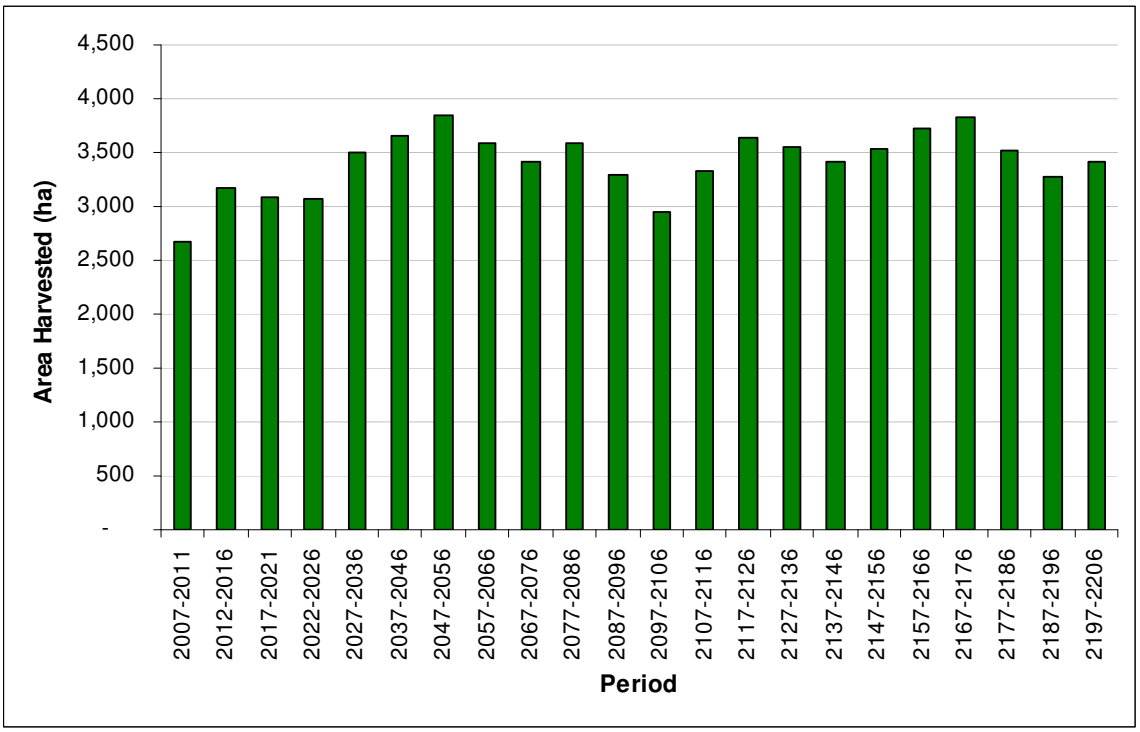
Period	Deciduous Volume (m^3/ year)		
	Pure	Incidental	Total
2007-2011	69,800	462,481	532,281
2012-2016	63,002	435,867	498,869
2017-2021	71,496	440,737	512,233
2022-2026	184,962	282,685	467,647
2027-2036	306,183	191,669	497,852
2037-2046	419,775	78,368	498,143
2047-2056	458,490	10,821	469,311
2057-2066	453,017	31,658	484,674
2067-2076	288,285	172,737	461,022
2077-2086	216,883	271,267	488,150
2087-2096	234,356	220,259	454,615
2097-2106	180,844	310,750	491,593
2107-2116	176,664	288,977	465,641
2117-2126	256,223	193,563	449,786
2127-2136	247,877	242,814	490,691
2137-2146	249,297	251,839	501,136
2147-2156	250,821	178,879	429,701
2157-2166	321,898	203,602	525,501
2167-2176	339,709	130,607	470,316
2177-2186	217,782	275,566	493,348
2187-2196	189,591	226,744	416,335
2197-2206	229,401	227,843	457,244

Source: Timberline compiled data

The annual area harvested in coniferous stands is low for the period of the fifteen-year plan when pine stands are being targeted for harvest. It increases beginning in 2027, and from that point onwards exhibits a pattern similar to that seen in the 2003 DFMP. Figure 46 and Table 23 show the variation in area harvested over the entire planning horizon.

Figure 46. Disaster Scenario: Annual Area Harvested in Coniferous Priority Types

TNRG-RSTASourceData.xls
F052



Source: Timberline compiled data

Table 23. Disaster Scenario: Annual Area Harvested and Average Volume Per Hectare in Coniferous Priority Types

TNRG-RSTASourceData.xls
T023

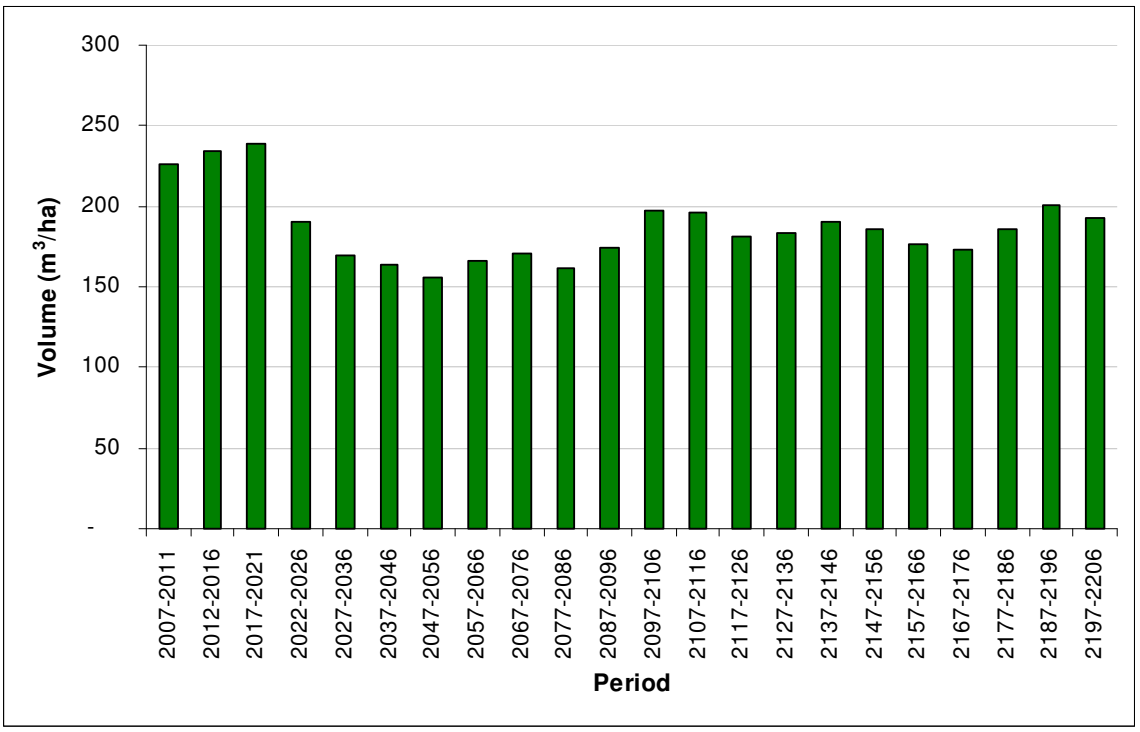
Period	Area (ha)	Average Volume (m^3/ ha)	Period	Area (ha)	Average Volume (m^3/ ha)
2007-2011	2,669	226	2097-2106	2,947	197
2012-2016	3,165	234	2107-2116	3,331	196
2017-2021	3,091	239	2117-2126	3,642	181
2022-2026	3,069	191	2127-2136	3,553	184
2027-2036	3,494	169	2137-2146	3,408	190
2037-2046	3,648	163	2147-2156	3,534	186
2047-2056	3,849	156	2157-2166	3,726	176
2057-2066	3,588	166	2167-2176	3,822	173
2067-2076	3,413	171	2177-2186	3,524	185
2077-2086	3,578	162	2187-2196	3,273	200
2087-2096	3,292	174	2197-2206	3,411	192

Source: Timberline compiled data

Volume per hectare harvested is consistent with the pattern seen for area harvested. Volumes are higher for the period of the fifteen-year plan (approximately 230 m^3/ ha), and fall to below 200 m^3/ ha thereafter, reaching a minimum of 156 m^3/ ha between 2047 and 2056. The long-term average volume is similar to the 2003 DFMP. Figure 47 shows this pattern.

Figure 47. Disaster Scenario: Average Volume Per Hectare in Coniferous Priority Types

TNRG-RSTASourceData.xls
F053

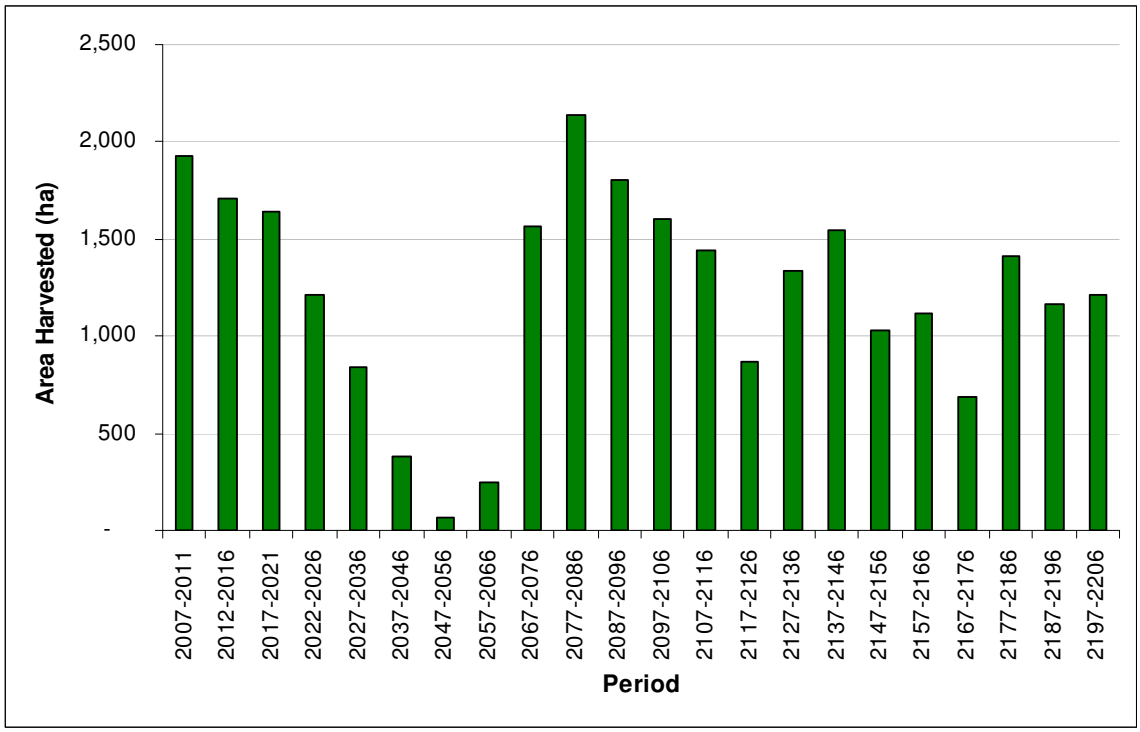


Source: Timberline compiled data

As with the Healthy Pine Scenario, area harvested in deciduous priority types is much more variable. This is due to the changing proportion of the deciduous harvest that is captured as incidental volume from coniferous-leading stands. From 2047 to 2056, most deciduous volume harvested originates from coniferous stands, so the area harvested in deciduous types is very small. Figure 48 shows the variation in deciduous area harvested over the planning horizon.

Figure 48. Disaster Scenario: Annual Area Harvested in Deciduous Priority Types

TNRG-RSTASourceData.xls
F054



Source: Timberline compiled data

Table 24 also shows this pattern, along with the average volume per hectare harvested.

Table 24. Disaster Scenario: Annual Area Harvested and Average Volume Per Hectare in Deciduous Priority Types

TNRG-RSTASourceData.xls
T024

Period	Area (ha)	Average Volume (m^3/ ha)	Period	Area (ha)	Average Volume (m^3/ ha)
2007-2011	1,931	239	2097-2106	1,606	193
2012-2016	1,710	255	2107-2116	1,439	201
2017-2021	1,645	268	2117-2126	872	222
2022-2026	1,214	233	2127-2136	1,340	181
2027-2036	842	228	2137-2146	1,544	163
2037-2046	377	208	2147-2156	1,029	174
2047-2056	67	162	2157-2166	1,119	182
2057-2066	250	127	2167-2176	689	189
2067-2076	1,568	110	2177-2186	1,407	196
2077-2086	2,138	127	2187-2196	1,163	195
2087-2096	1,801	122	2197-2206	1,215	188

Source: Timberline compiled data

Figure 49. Disaster Scenario: Average Volume Per Hectare in Deciduous Priority Types

TNRG-RSTASourceData.xls
F055

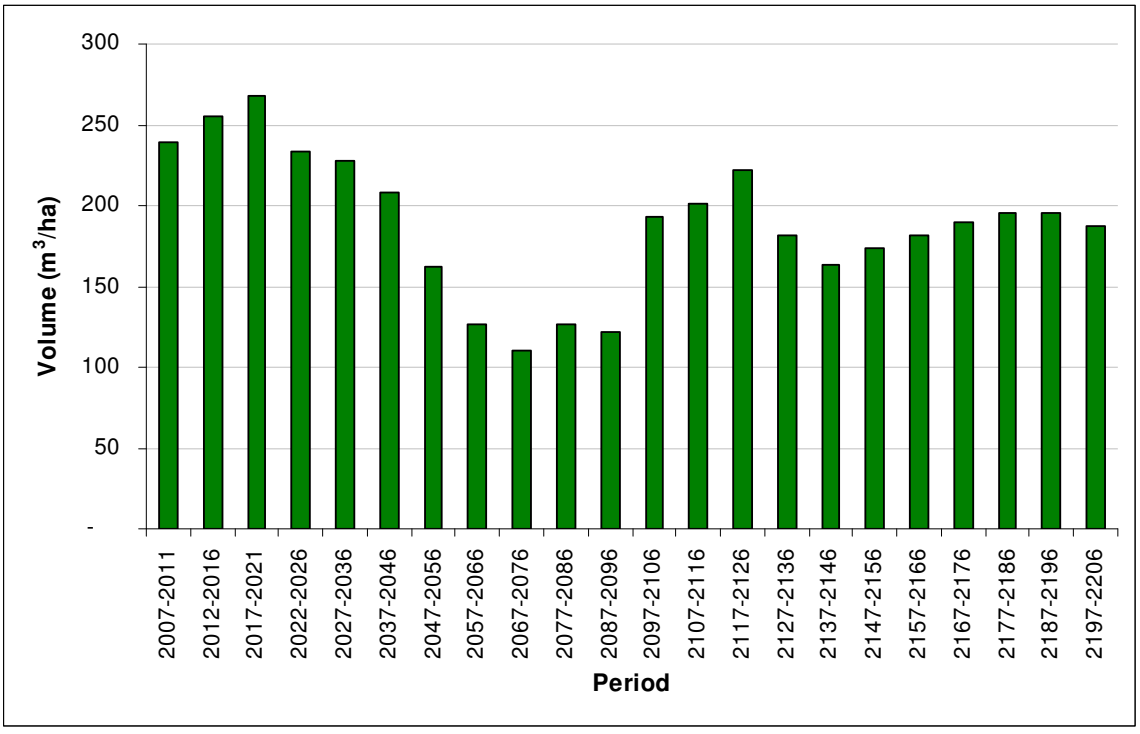
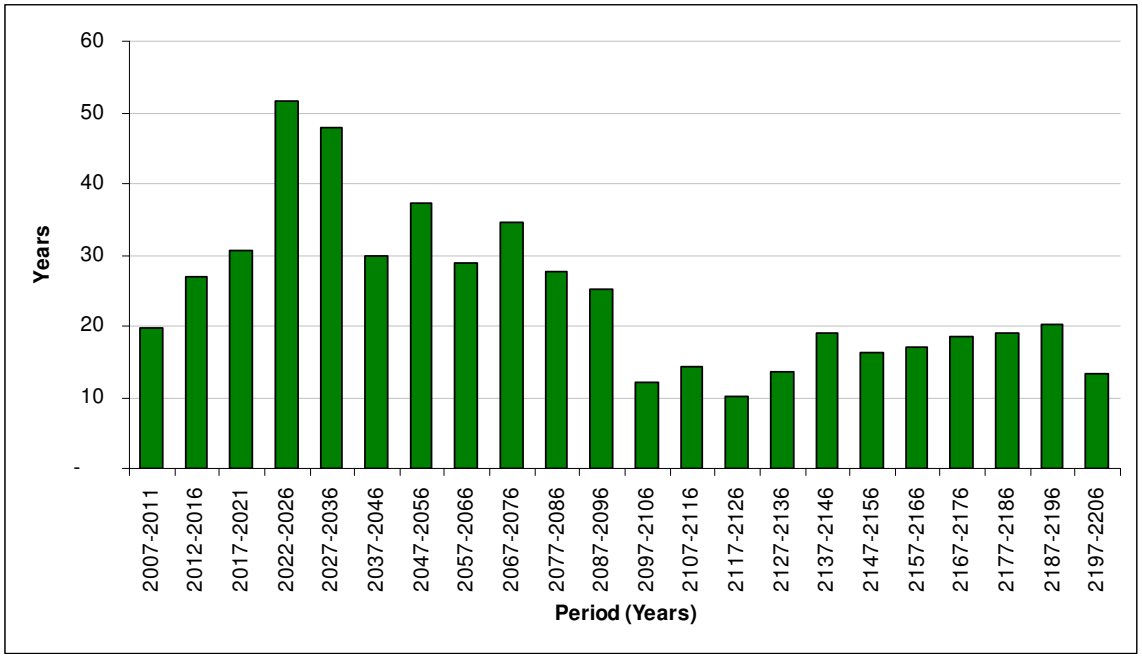


Figure 50 and Figure 51 show the harvest age patterns for coniferous and deciduous types respectively. As with the Healthy Pine Scenario, average harvest age is lower for the fifteen-year plan while focused harvesting occurs in pine stands. Since harvesting in deciduous priority types is not significantly impacted by MPB issues, the harvest age pattern is similar to the Healthy Pine Scenario (and to the 2003 DFMP).

Figure 50. Disaster Scenario: Years Above Minimum Harvest Age for Coniferous Stands

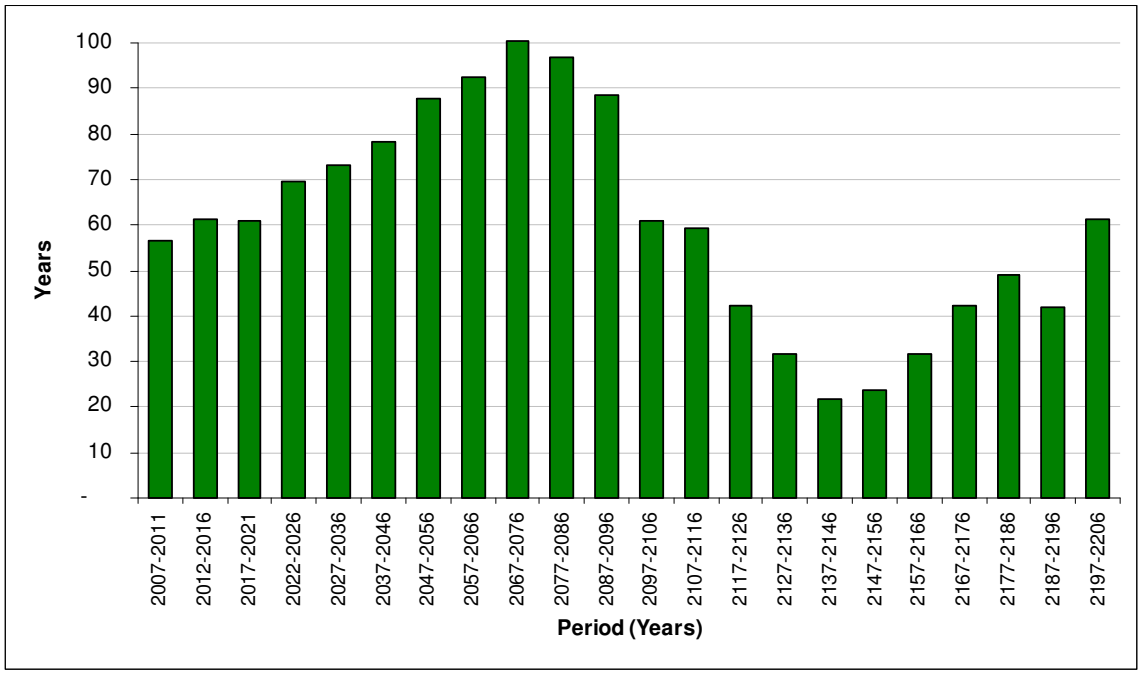
TNRG-RSTASourceData.xls
F056



Source: Timberline compiled data

Figure 51. Disaster Scenario: Years Above Minimum Harvest Age for Deciduous Priority Stands

TNRG-RSTASourceData.xls
F057



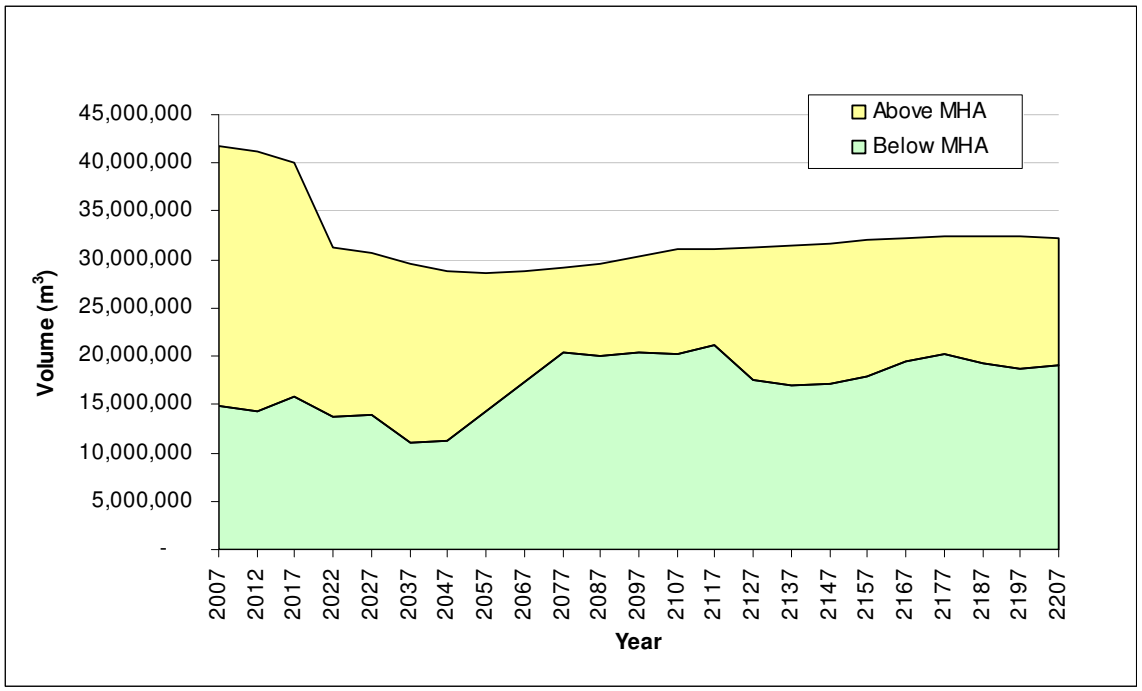
Source: Timberline compiled data

4.3.2 Inventory

The coniferous growing stock pattern for the Disaster Scenario shows the impact of the assumed pine mortality at year 2022. Long-term growing stock levels recover to 30 million cubic metres – slightly lower than the level for the Healthy Pine Scenario. Figure 52 and Table 25 show the variation in coniferous growing stock over the planning horizon.

Figure 52. Disaster Scenario: Coniferous Standing Inventory Volume

TNRG-RSTASourceData.xls
F058



Source: Timberline compiled data

Table 25. Disaster Scenario: Coniferous Standing Inventory Volume

TNRG-RSTASourceData.xls
T025

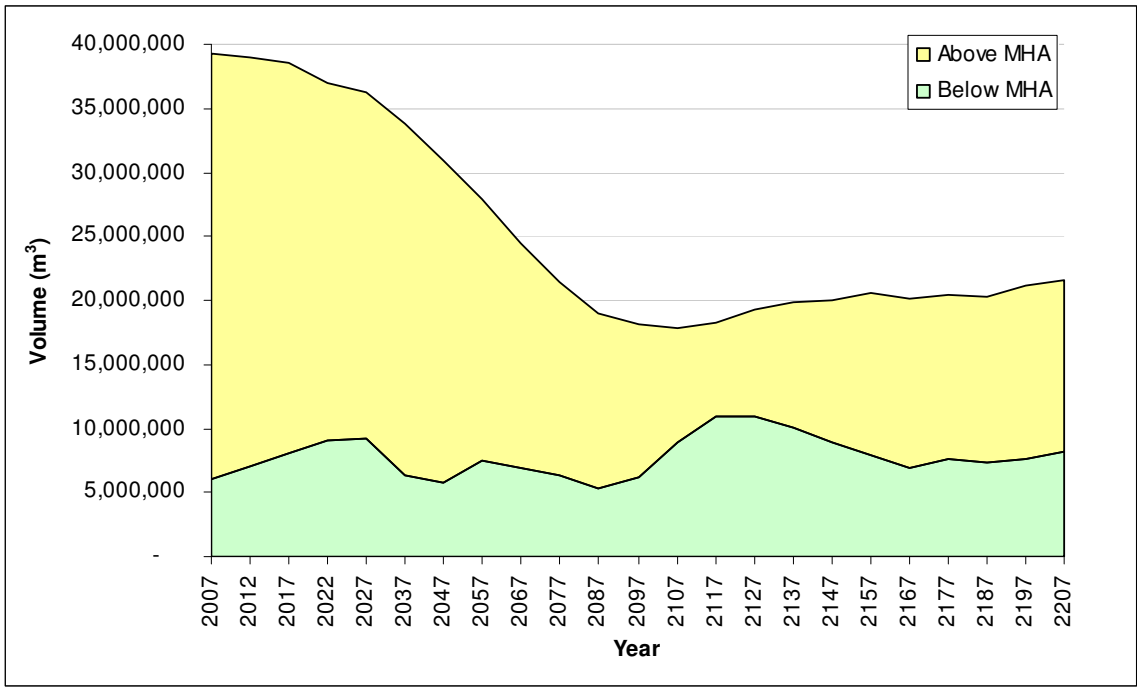
	Coniferous Volume (m^3)	
Year	Above MHA	Below MHA
2007	26,758,926	14,922,007
2012	26,951,862	14,288,209
2017	24,290,862	15,735,317
2022	17,705,997	13,652,846
2027	16,669,203	13,983,794
2037	18,459,533	11,007,247
2047	17,510,028	11,232,102
2057	14,248,030	14,353,682
2067	11,375,742	17,379,162
2077	8,803,481	20,417,331
2087	9,492,229	20,057,033
2097	9,887,663	20,470,885
2107	10,918,015	20,123,478
2117	9,951,219	21,166,805
2127	13,747,620	17,533,489
2137	14,576,340	16,952,670
2147	14,546,244	17,191,534
2157	14,064,249	18,010,831
2167	12,933,490	19,367,159
2177	12,174,561	20,273,132
2187	13,186,181	19,323,139
2197	13,761,841	18,743,702
2207	13,151,633	19,149,692

Source: Timberline compiled data

The variation in deciduous growing stock levels over time (shown in Figure 53 and Table 26) does not differ significantly from the Healthy Pine Scenario.

Figure 53. Disaster Scenario: Deciduous Standing Inventory Volume

TNRG-RSTASourceData.xls
F059



Source: Timberline compiled data

Table 26. Disaster Scenario: Deciduous Standing Inventory Volume

TNRG-RSTASourceData.xls
T026

	Deciduous Volume (m^3)	
Year	Above MHA	Below MHA
2007	33,234,004	5,997,021
2012	31,836,566	7,088,302
2017	30,559,073	8,070,528
2022	27,950,562	9,066,810
2027	27,082,001	9,149,209
2037	27,411,820	6,366,845
2047	25,128,921	5,795,378
2057	20,383,790	7,545,965
2067	17,495,736	6,941,785
2077	15,132,032	6,337,543
2087	13,732,795	5,318,030
2097	12,015,331	6,173,918
2107	9,014,615	8,855,115
2117	7,321,105	11,006,529
2127	8,372,103	10,946,060
2137	9,869,234	10,018,244
2147	10,965,617	8,978,983
2157	12,605,663	7,968,998
2167	13,245,513	6,925,679
2177	12,720,778	7,641,512
2187	12,989,876	7,368,175
2197	13,497,533	7,637,510
2207	13,414,027	8,166,271

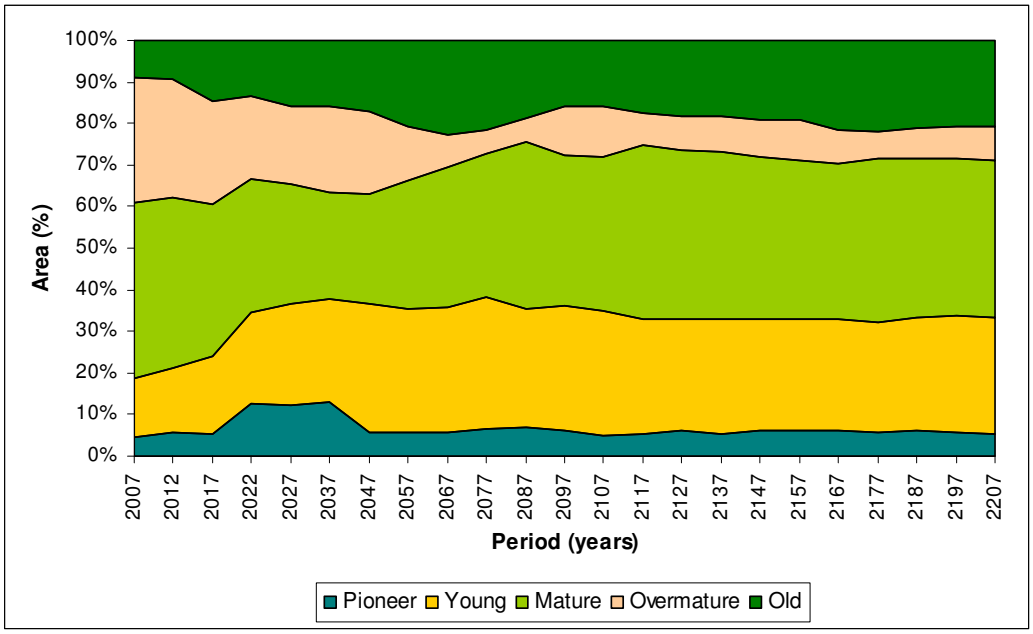
Source: Timberline compiled data

4.3.3 Seral Stage

Seral stage distributions for the FMA area, each parcel, for the Boreal Forest and Foothills natural regions and the Caribou Area, are shown in Figure 54 to Figure 59. These graphs exhibit similar patterns to the corresponding graphs for the Healthy Pine Scenario over the long term. In the shorter term however, and specifically at year 2022, the impact of the modelled MPB mortality is obvious by a marked increase in the amount of pioneer seral stage area in both natural regions and all parcels. This is most noticeable for the Foothills Natural Region and the Main Parcel. At the same point there is a corresponding reduction in mature, overmature and old seral stages.

Figure 54. Disaster Scenario: Seral Stage Distribution – FMA area

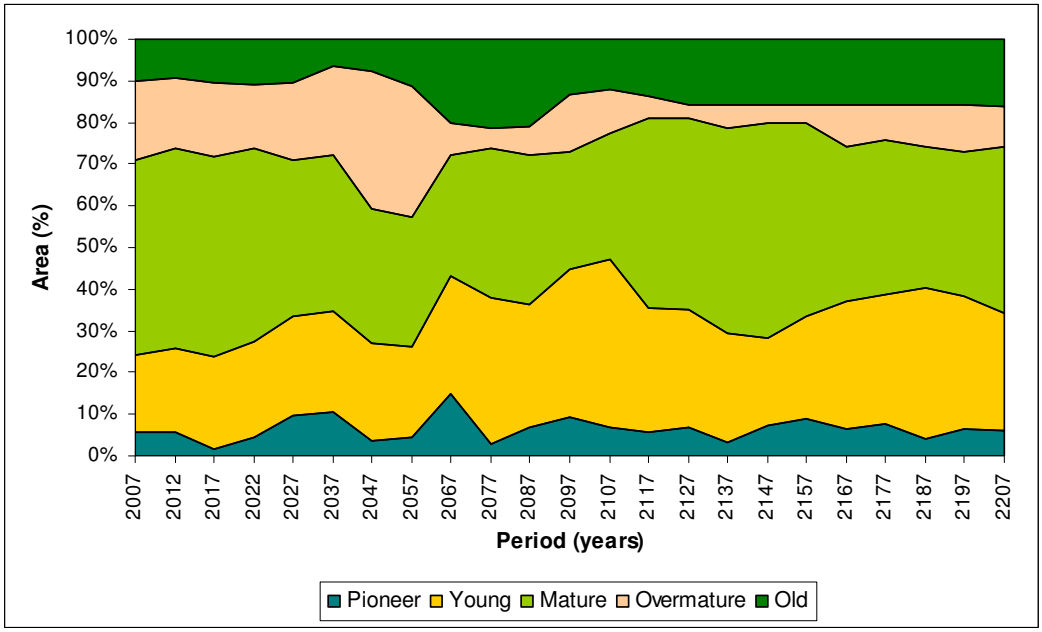
TNRG-RSTASourceData.xls
F060



Source: Timberline compiled data

Figure 55. Disaster Scenario: Seral Stage Distribution – Puskwaskau Parcel

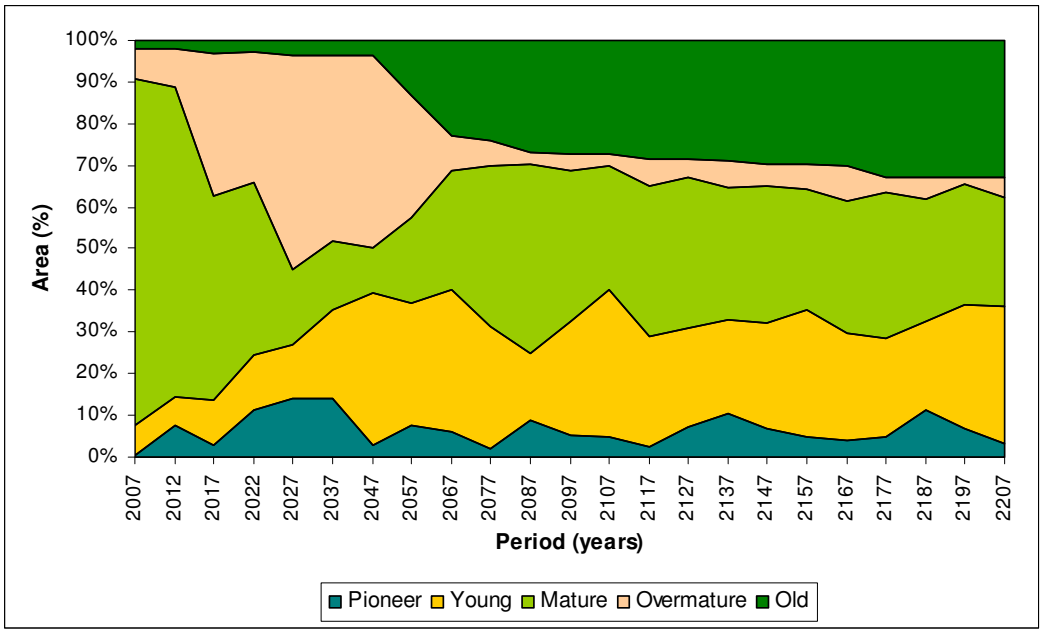
TNRG-RSTASourceData.xls
F061



Source: Timberline compiled data

Figure 56. Disaster Scenario: Seral Stage Distribution – Peace Parcel

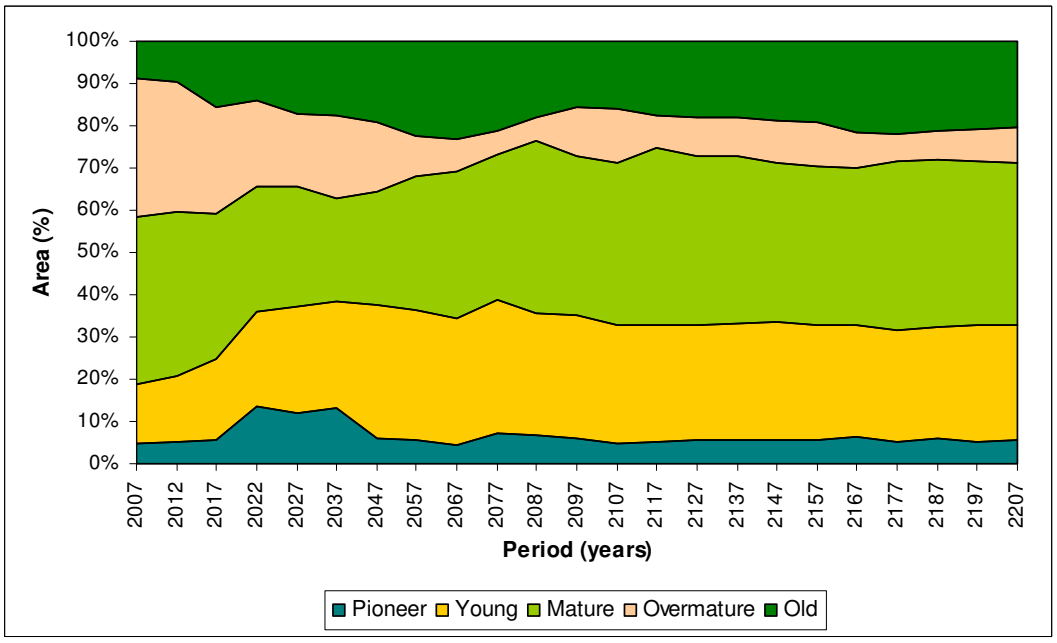
TNRG-RSTASourceData.xls
F062



Source: Timberline compiled data

Figure 57. Disaster Scenario: Seral Stage Distribution – Main Parcel

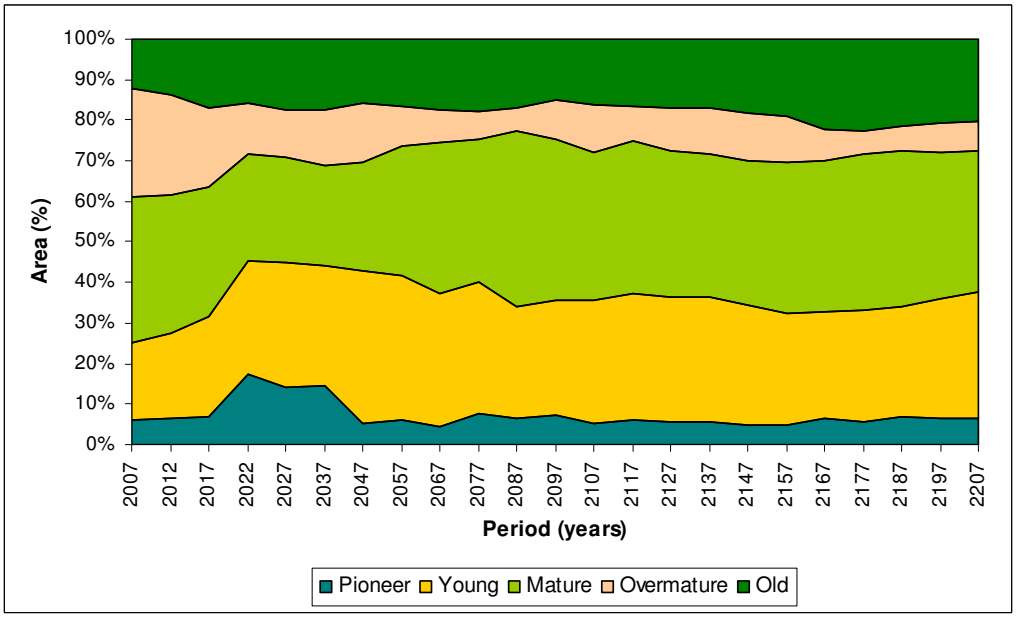
TNRG-RSTASourceData.xls
F063



Source: Timberline compiled data

Figure 58. Disaster Scenario: Seral Stage Distribution – Foothills Natural Region

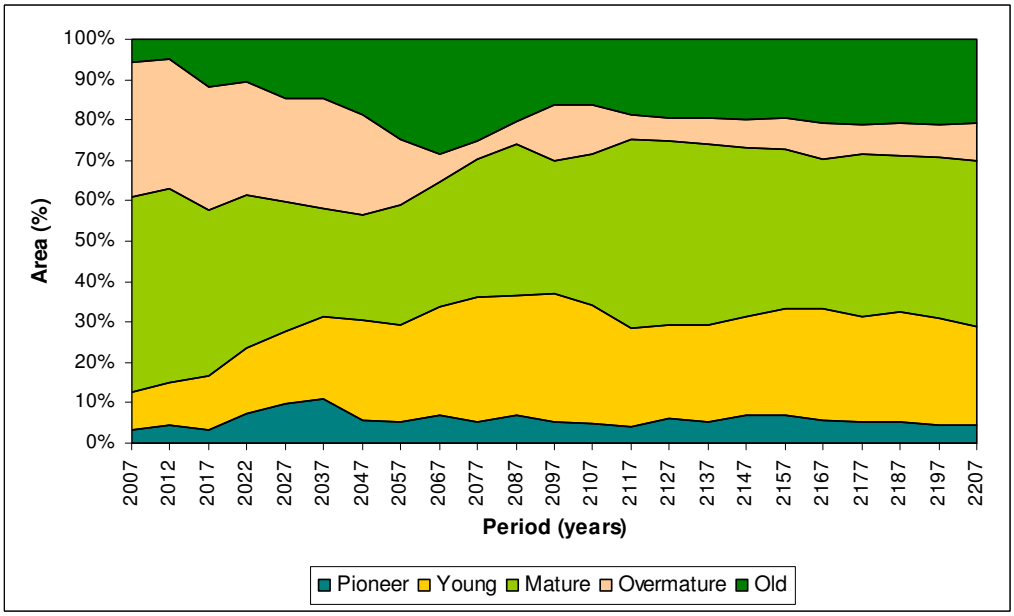
TNRG-RSTASourceData.xls
F064



Source: Timberline compiled data

Figure 59. Disaster Scenario: Seral Stage Distribution – Boreal Forest Natural Region

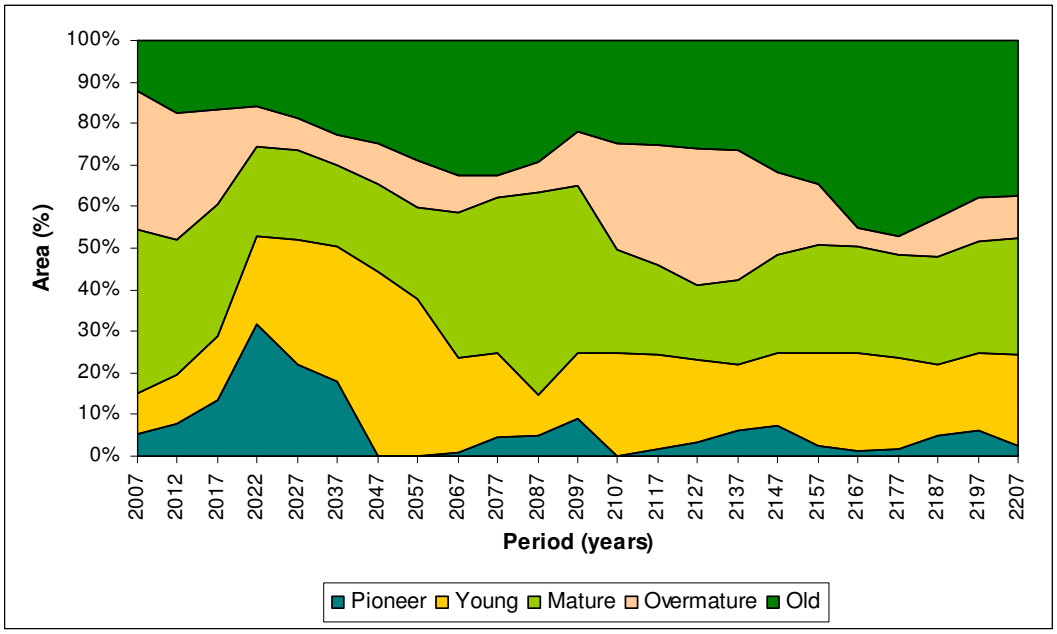
TNRG-RSTASourceData.xls
F065



Source: Timberline compiled data

Figure 60. Disaster Scenario: Seral Stage Distribution - Caribou Area

TNRG-RSTASourceData.xls
F066



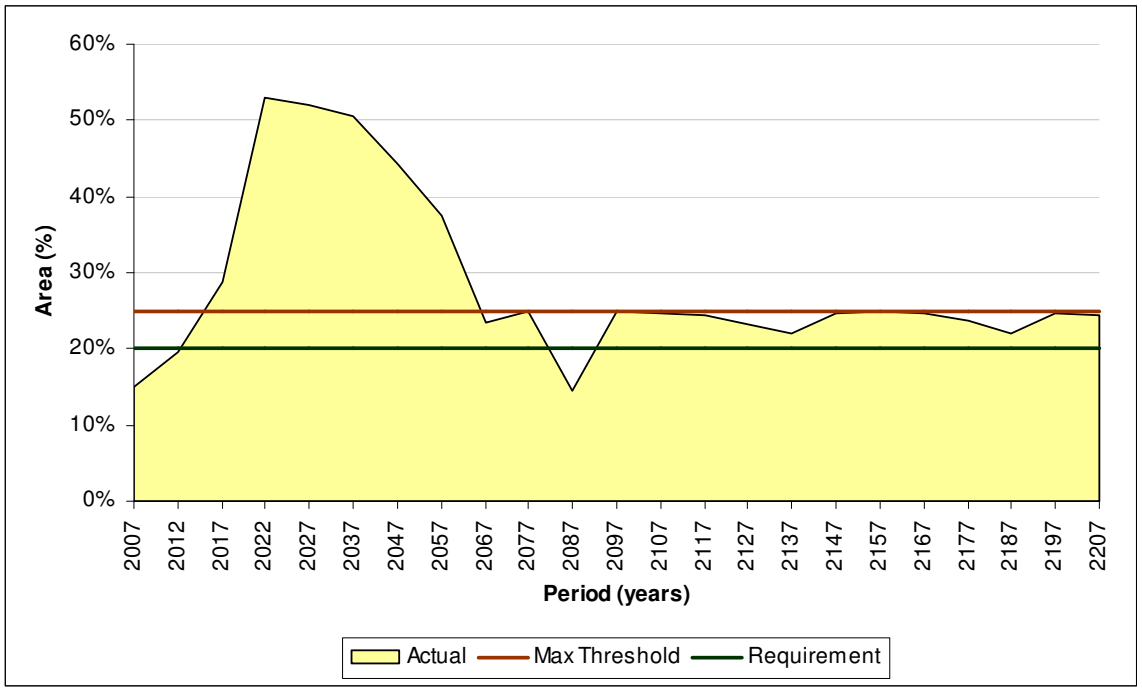
Source: Timberline compiled data

4.3.4 Caribou Habitat

Since the overlap between caribou habitat areas and susceptible pine stands is significant, the impact of the assumed MPB-induced mortality on the seral stage distribution of the Caribou Area is significant. The limit on pioneer and young seral stage area is not violated in the Status Quo Scenario, but is significantly exceeded in the Healthy Pine Scenario due to focused harvesting in pines stands, and is even further exceeded in this case because of the mortality that occurs in pine stands that remain unharvested after fifteen years. The limit is not met until 2067 – ten years later than is the case for the Healthy Pine Scenario. Figure 61 shows this result.

Figure 61. Disaster Scenario: Pioneer and Young Seral Stage Habitat in the Caribou Area

TNRG-RSTASourceData.xls
F067

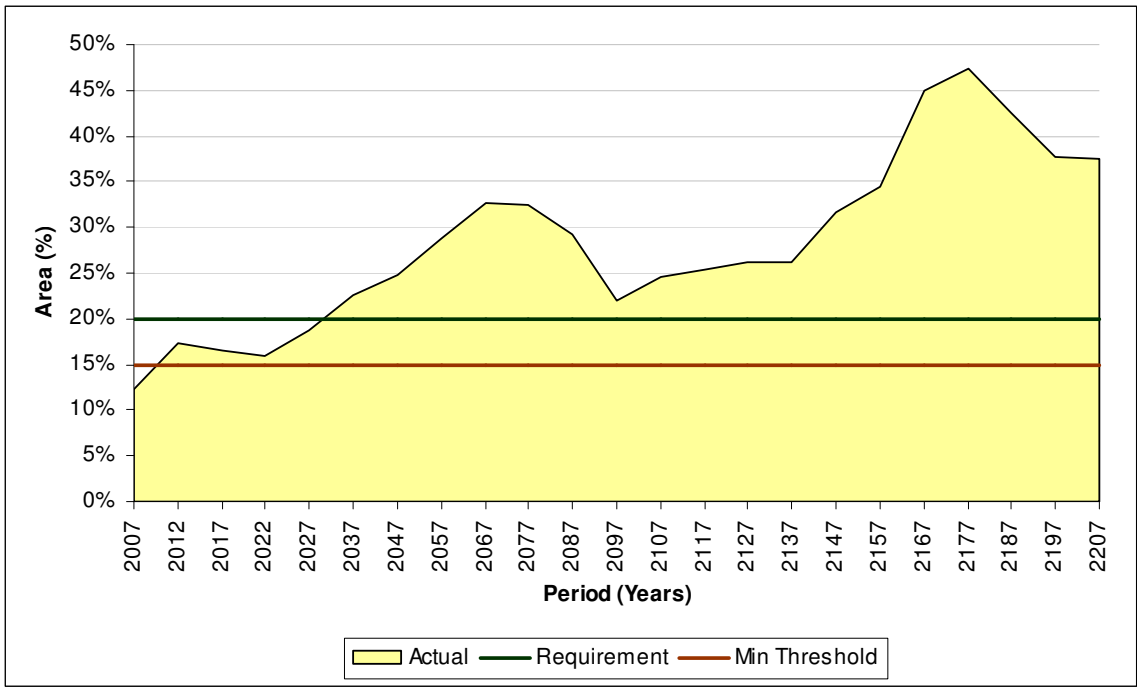


Source: Timberline compiled data

The impact on the old seral target is not as obvious, but MPB mortality delays the date at which this limit is met by approximately ten years also, as shown in Figure 62.

Figure 62. Disaster Scenario: Old Seral Stage Habitat in the Caribou Area

TNRG-RSTASourceData.xls
F068



Source: Timberline compiled data

4.3.5 Water Yield

Water yield increases can be directly modelled, however equivalent clearcut area (ECA) is often used as a surrogate. For the current analysis, ECA % was used to limit harvesting within a defined watershed such that total vegetated cover removal does not exceed 40% ECA above the H60. To minimize the risk of significant impacts on watershed resources, operational performance measured against ECA is monitored annually as part of the DFMP/ AOP validation process.

Canfor monitors water yield via Target (3.2) 2a.1.1 as presented in the SFMP 2005. Water yield increases are modelled using the ECA-Alberta model developed by Uldis Silins at the University of Alberta. The model provides a framework for evaluation of hydrological effects of forest practices with modest input data requirements. Canfor has elected to evaluate the ten watersheds that exhibit the greatest increase in ECA at the end of the fifteen-year plan (2022) and to present results only for the Healthy Pine Scenario (see Section 6.5).

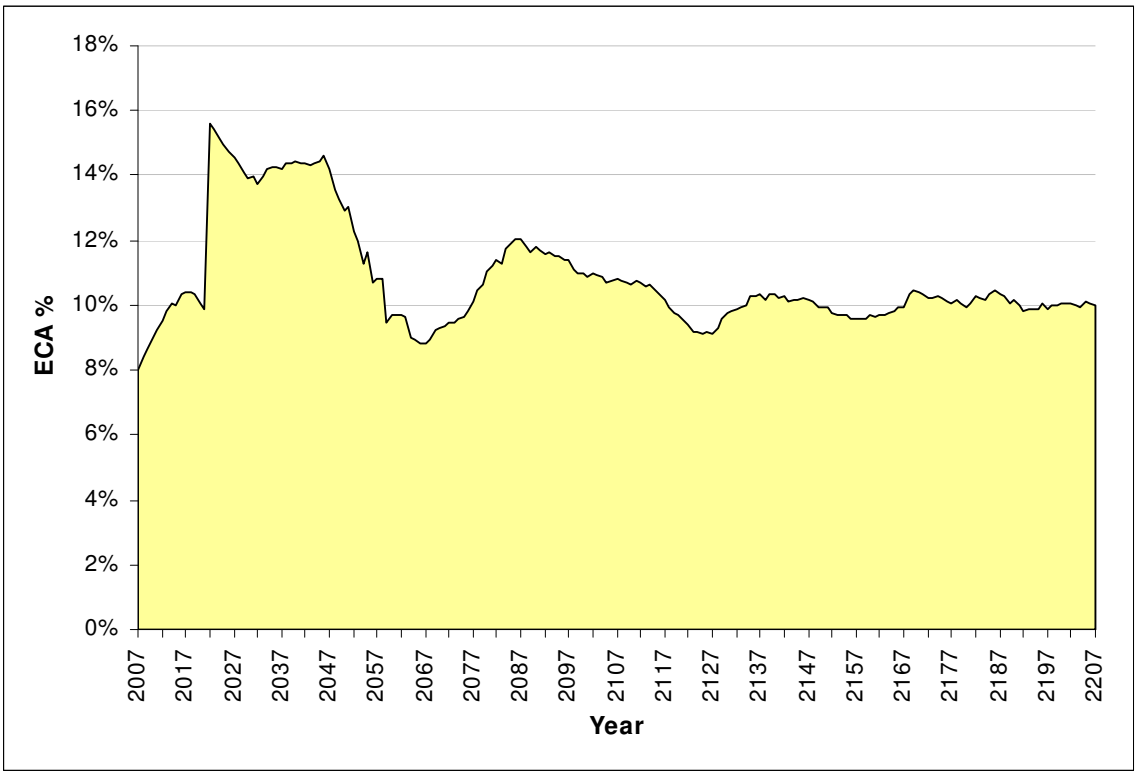
Complete ECA results for the Healthy Pine Scenario, for the H60 portion of each watershed, can be found in Appendix C.

4.3.6 Equivalent Clearcut Area

For the Disaster Scenario, the combined impact of harvesting and assumed MPB mortality on watershed resources is significantly higher than the Status Quo and Healthy Pine scenarios for the period 2022 to 2057. After that point in time it more closely emulates the other scenarios (Figure 63).

Figure 63. Disaster Scenario: ECA Percent for the FMA area Above the H60 Line

TNRG-RSTASourceData.xls
F913



Source: Timberline compiled data

5 SELECTION OF PREFERRED FOREST MANAGEMENT ALTERNATIVE (PFMA)

The eventual extent and severity of the MPB outbreak cannot be known with certainty. However, strategic and operational decisions need to be made with the best available information and forecasts. To support this, several alternative timber supply scenarios have been run. The results were summarized and examined, and further runs were defined and completed. Three of those alternatives were previously presented in Section 4.

Five principles have guided the formulation of these alternatives and the selection of a preferred forest management alternative (PFMA):

1) Reduction of the MPB-susceptible growing stock as directed by ASRD;
2) Recovery to the coniferous harvest level established by the 2003 DFMP (670,000 m^3/ year) in the medium to long term;
3) Achievement of targets identified within Canfor's SFMP 2005 to the greatest extent possible, while recognizing and countering the effects of the MPB outbreak;
4) Incorporation of the latest information and scientific data regarding caribou habitat and the caribou primary intactness area; and
5) Attainment of the deciduous allocations, reasonably balanced over the planning horizon.

The Healthy Pine Scenario (MPB2) has been selected as the preferred forest management alternative (PFMA) for the following reasons:

- It follows ASRD guidelines for risk reduction of MPB-susceptible volume, but does not assume that pine mortality actually occurs;
- Only a moderate increase in short-term harvest levels is needed to achieve a significant reduction in risk. Average coniferous harvest level for the fifteen-year plan is 715,000 m^3/ year. This represents a coniferous harvest uplift of approximately ten percent, as compared to the average of 650,000 m^3/ year presented in the 2003 DFMP (640,000 m^3/ year initially rising to 670,000 m^3/ year in 2019);
- The highest priority stands within each timber supply compartment are harvested earliest in the planning horizon;
- The spatial timber harvesting sequence for coniferous stands creates a healthy forest that is more resistant to MPB outbreaks;
- With the PFMA, a long-term coniferous harvest level of 670,000 m^3/ year – the level determined by the 2003 DFMP – can be met beginning at the end for the fifteen-year plan. No mid term reduction in coniferous AAC is needed to compensate for the higher initial harvest levels implemented to reduce the area of MPB-susceptible pine stands;
- Allocations to deciduous operators can be met throughout the entire planning

horizon. Average annual deciduous volume allocations for the fifteen-year plan (2007 - 2021) were established at 513,261 m3/ year to account for deciduous carryovers. For the remainder of the 200-year planning horizon (2022 – 2206) the deciduous volume allocation of 453,712 m^3/ year was met;

- It protects watershed resources effectively throughout the 200-year planning horizon at levels similar to those presented in the 2003 DFMP;
- It achieves the objectives for other non-timber resources such as species of management concern (woodland caribou, trumpeter swan and grizzly bear); and
- It achieves Canfor's Sustainable Forest Management Plan (2005) objectives to the greatest extent possible, while recognizing and countering the effects of the MPB outbreak.

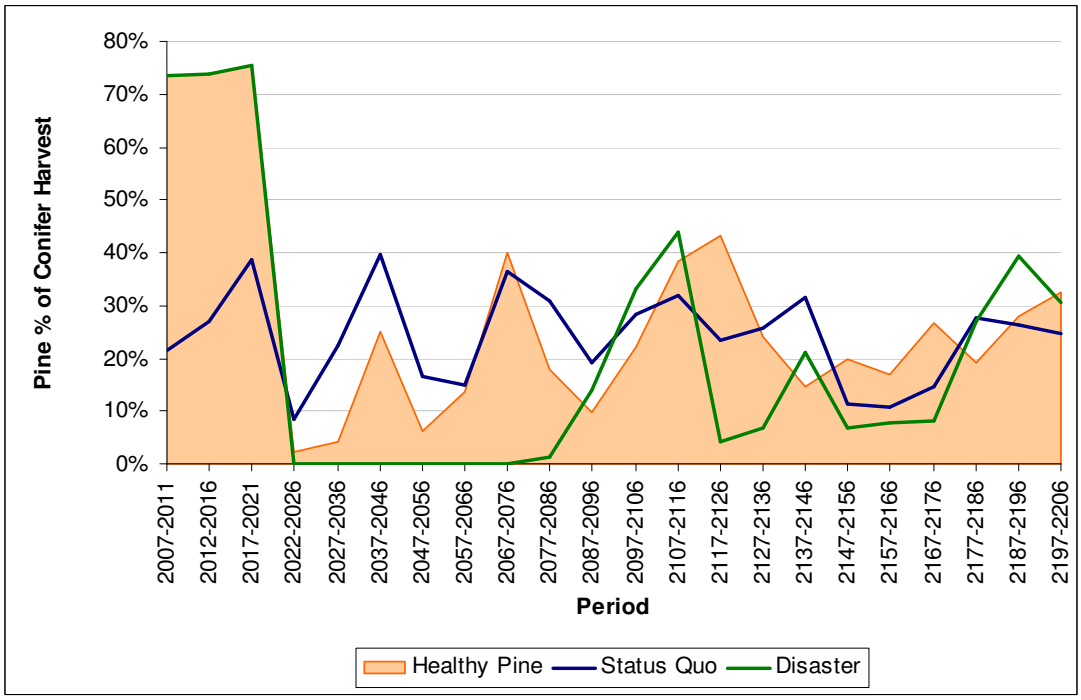
5.1 Reduction of MPB Susceptible Stands

The primary objective of the PFMA is a reduction of the area of MPB susceptible pine stands and the Healthy Pine Scenario achieves that by focusing harvest in those stands. Figure 64 shows that the Healthy Pine Scenario harvests significantly more pine over the course of the fifteen-year plan (2007 – 2021) than would be harvested under the Status Quo Scenario.

Although the Disaster Scenario also reduces susceptible pine area in the fifteen-year plan, it is less effective as a management strategy because MPB mortality kills all remaining pine, so no pine is available for harvest for over fifty years (2022 – 2086).

Figure 64. Pine as a Percent of the Total Conifer Harvest

TNRG-RSTASourceData.xls
F073



Source: Timberline compiled data

The medium-term shortfall in pine is less pronounced for the Healthy Pine Scenario. Though pine still exists in the growing stock at the end of the fifteen-year plan, it is unavailable due to watershed cover constraints. All cover constraints from the 2003 DFMP were applied once the fifteen-year plan is complete in order to conserve other resource values.

ASRD set targets for the reduction of susceptible pine stands (ASRD 2007a). To achieve those targets, Canfor implemented a harvest priority ranking system (HPRS) that ranks stands on the basis of stand susceptibility index (SSI), species composition (as indicated by yield group) and height. The HPRS assigned a value of between zero and ten to each stand (Section 2.3.3 describes this system in detail). Stands with the highest harvest priority were harvested first within each timber supply compartment.

Table 27 shows that, by focusing harvest in pine stands, the Healthy Pine Scenario achieves the ASRD susceptibility targets in terms of reducing the amount of susceptible pine in the growing stock (as measured in hectares). As indicated in the table for the Status Quo Scenario, approximately half (24,874 hectares of 50,962 hectares total) of the susceptible pine stands are in the two highest Harvest Priority categories (9 and 10). The Healthy Pine Scenario schedules 77% of this area for harvest.

Table 27. Healthy Pine Scenario Risk Reduction (as of 2022)

TNRG-RSTASourceData.xls
T027

Harvest Priority at Least:	Susecptible Area at 2022 Per Status Quo Scenario (ha)	Susceptible Area Reduced by Healthy Pine Scenario (ha)	% Area Reduction
10	14,771	13,151	89%
9	24,874	19,232	77%
8	37,211	27,617	74%
7	40,877	29,113	71%
6	45,678	30,144	66%
5	50,640	33,643	66%
4	50,962	33,761	66%

Notes:

The areas given in the table for each scenario are cumulative beginning from the top of the table. The Status Quo column shows the amount of pine area at or above the Harvest Priority listed in the leftmost column. The Healthy Pine column show the amount of susceptible area that is reduced by this strategy.

Source: Timberline compiled data

5.2 Coniferous AAC

The coniferous annual allowable cut (AAC) from the PFMA represents a ten percent uplift (over the 2003 DFMP) for the fifteen-year period beginning in 2007. Under the 2003 DFMP, the coniferous harvest level was 640,000 m^3/ year until 2016. Beginning in 2017, it increased to 670,000 m^3/ year. The average harvest over the fifteen-year period would be 650,000 m^3/ year under the Status Quo Scenario. Under the PFMA, the average annual coniferous harvest for the next fifteen years will be 715,000 m^3/ year. Refer to Figure 22 for a graphical representation.

5.3 Deciduous Allocation

Under the Healthy Pine Scenario, deciduous allocations are achievable. Refer to Section 4.2.1.

5.4 Spatial Harvest Sequence

Development of the fifteen-year harvest sequence for the PFMA (Healthy Pine Scenario) is described in Section 2.3.3 and it is presented for both coniferous and deciduous species in Appendix B, Maps 12 to 14. Canfor operational planners and deciduous operators have reviewed this sequence and feel that it is acceptable and operationally realistic (personal comm.) The coniferous and deciduous harvest volumes generated by the sequence are summarized by timber supply compartment in Table 28.

Table 28. Fifteen-Year Plan Harvest Volume

TNRG-RSTASourceData.xls
T915

	Coniferous Volume Harvested (m^3)			Deciduous Volume Harvested (m^3)		
Timber Supply Compartment	Pure	Incidental	Total	Pure	Incidental	Total
DN1Heniger	69,968	39	70,007	341	6,894	7,236
DN24CA	310,993	14	311,007	264	31,780	32,044
DN2NE	320,947	54	321,000	568	58,868	59,437
DN3NE	213,556	338	213,893	1,533	29,157	30,690
DN3SW	274,992	50	275,042	771	30,316	31,088
DN45Split	262,962	203	263,165	2,029	36,467	38,496
DN5SE	215,248		215,248		10,522	10,522
DN5SW	355,556	58	355,613	1,105	23,037	24,142
DS1North		10	10	200		200
DS1South	237,032	31	237,062	292	20,953	21,245
DS2Caribou						
DS2North	877,408	76	877,484	886	42,883	43,769
DS2North-Int						
DS2NW	134,866	20	134,886	304	10,684	10,988
DS3North	386,256	17	386,272	226	36,565	36,791
DS3South	255,445	27	255,472	386	13,909	14,296
DS3South-Int						
E81East	138,111		138,111		10,361	10,361
E81West	246,004		246,004		16,980	16,980
E82JimBob	93,356		93,356		6,055	6,055
E82South	181,144		181,144		11,225	11,225
E83A	429,948		429,948		24,762	24,762
E84NE	46,949		46,949		2,650	2,650
E84Norris	111,960		111,960		8,192	8,192
E84NW	168,493		168,493		10,785	10,785
E84SE	46,383		46,383		3,000	3,000
E85Bolton	65,771		65,771		4,274	4,274
E85Elevator	100,191		100,191		3,998	3,998
EN1North	63,039	16,024	79,063	657,239	10,722	667,961
EN1South		26,587	26,587	681,581		681,581
EN2Dunes						
EN3East						
EN3West		6,554	6,554	274,440		274,440
EN4A	37,072	15,518	52,590	343,986	14,322	358,308
EN5A	15,645	13,673	29,317	395,260	2,107	397,367
ES1A	112,145	33,230	145,375	791,761	22,220	813,981
ES23Split	328,397	2,564	330,961	55,518	36,396	91,914
ES2NW	255,171	788	255,959	11,021	67,901	78,922
ES3Mysery	187,716	906	188,622	26,298	19,808	46,106
ES3South	214,328	252	214,580	5,562	12,133	17,695
LAT1East	16,507	164	16,671	3,942	2,273	6,215
LAT1Jackfish	72,275	7,640	79,915	212,849	11,356	224,206
LAT1North		28,818	28,818	667,023		667,023
LAT1SW	45,450	9,738	55,188	202,950	14,832	217,782
LAT2East	12,261	7	12,267	70	4,757	4,827
LAT2West	131,256	1	131,257	39	12,832	12,871
LAT3NE	111,420	993	112,413	16,698	4,113	20,811
LAT3NW	72,531	2,058	74,588	44,857	9,165	54,022
LAT3South	35,816	1,845	37,661	43,004	1,497	44,501
PEACE1A						
PEACE3A	451,129		451,129		53,028	53,028
PEACE3Park						
PUSKEast	13,464	41,591	55,055	596,385	1,135	597,521
PUSKWest	23,750	29,687	53,437	489,394	3,883	493,277
SIM1A	30,512	37	30,549	588	5,369	5,957
SIM2North	167	17,765	17,931	371,618	101	371,719
SIM2South	172,420	22,917	195,337	270,947	29,082	300,029
SIM3A	503,234	7,544	510,778	68,852	46,946	115,799
SIM4East	124,201	6,531	130,731	110,762	9,452	120,213
SIM4North	15,054	43	15,097	115	4,340	4,455
SIM4West	145,212	26	145,238	255	11,250	11,505
SimTower	323,565	95	323,660	1,364	21,546	22,910
SMOKY13FPan	170,685	5,791	176,476	93,648	29,178	122,826
SMOKY1NE	213,887	2,207	216,094	45,289	14,654	59,943
SMOKY1South	73,769	602	74,371	10,791	10,153	20,944
SMOKY2A	117,016	1,442	118,459	28,006	14,782	42,788
SMOKY3S	117,506	7,808	125,314	109,601	11,351	120,952
SMOKY45Split	380,317	346	380,662	1,306	38,867	40,173
SMOKY6Camp10	135,804	3,370	139,173	53,261	6,257	59,518
SMOKY6South	141,947	19	141,966	238	9,363	9,602

Source: Timberline compiled data

6 CSA REPORTING

In 2005, Canfor's Sustainable Forest Management Plan (SFMP 2005) was certified to CSA-Z809-02. A major component of that plan is the values, objectives, targets and indicators (VOITs) developed by the Forest Management Advisory Committee to provide local relevance to the plan. Data for five SFMP 2005 targets have been updated based on the RTSA results and are reported in the following sections.

Although Grizzly bear habitat is not currently a component of the SFMP 2005, it is reported in this section to meet an ASRD requirement to report on grizzly bear habitat.

6.1 Seral Stage

(1.1) Critical Element

An ecosystem consists of plants, animals and microorganisms interacting with their physical and climatic environment in a given area (CCFM, 1997). Ecosystems are dynamic; the processes of disturbance and renewal determine their composition.

(1.1) 1 Value
All natural ecosystems are important on the landscape

Maintaining representation of a full range of ecosystem types is a widely accepted strategy to conserve ecosystem diversity and it is suggested for landscapes managed for forestry (Wells *et al* , 2003).

(1.1) 1a Objective
All current ecosystems are represented on the landscape at natural levels

(1.1) 1a.1 Indicator
Area (%) in each seral stage

Seral stage distribution is important for the conservation of ecosystem diversity because it enables timber harvests to be planned so as to maintain a full range of successional habitats for wildlife and ecosystem types over the long-term (CCFM, 1997). Seral stages are defined by the age of the stand at breast height for different yield groups (Table 29).

Seral stage is a surrogate measurement, which reflects the status of the forest resource regarding ecosystem diversity. In maintaining the biodiversity and the recycling of life sustaining elements, it is important that the impacts of forest management on seral stage distribution be within the natural range of variability. The seral stage indicator offers a means to assess the results of forest management on the age structure, species composition and relative amount of wildlife habitat on the landscape.

Table 29. Breast Height Age Ranges for Seral Stages

TNRG-RSTASourceData.xls
T920

Yield Group	Description	Pioneer	Young	Mature	Over mature	Old	Species	Years to Breast Height (BH)
1	AW+(S) - AB	0	1-20	21-70	71-110	110+	AW	6
2	AW+(S) - CD	0	1-20	21-70	71-110	110+	AW	6
3	AWSW/PBSW/BWSW	0	1-40	41-80	81-120	120+	SW	15
4	BW/BWAW+(S)	0	1-20	21-70	71-110	110+	BW	6
5	FB+OTH	0	1-40	41-100	101-120	120+	FB	15
6	H+(S)/S	0	1-40	41-80	81-120	120+	SW	15
7	PB+(S)	0	1-20	21-80	81-110	110+	PB	6
8	PL/PLFB+(H)	0	1-40	41-80	81-120	120+	PL	10
9	PLAW/AWPL	0	1-30	31-70	71-120	120+	PL	10
10	PLSB+OTH	0	1-40	41-90	91-120	120+	PL	10
11	PLSW/SWPL+(H)	0	1-40	41-90	91-120	120+	PL	10
12	SBLT/LTSB(G,M,F)	0	1-50	51-130	131-150	150+	SB	20
13	SBLT/LTSB(U)	0	1-50	51-140	141-160	160+	SB	20
14	SBPL/SBSW/SBFB	0	1-40	41-100	101-130	130+	SB	20
15	SW/SWFB+(H) - AB	0	1-40	41-90	91-120	120+	SW	15
16	SW/SWFB+(H) - CD	0	1-40	41-90	91-120	120+	SW	15
17	SWAW/SWAWPL	0	1-40	41-90	91-120	120+	SW	15

Note: Ages are breast height age
AW = Aspen FB = Balsam Fir SW = White Spruce PB = Balsam Poplar BW = White Birch
PL = Lodgepole Pine SB = Black Spruce LT = Tamarack

Source: Canfor, 2003

(1.1) 1a.1.1 Target
100% of the seral stages will meet the 2009 projections

The target seral stage distribution is one that approximates the expected distribution created by fire within the Foothills and Boreal Forest natural regions within the FMA area (Figure 65). The natural disturbance regime was forecast using a theoretical fire-return interval (ORM, 2000).

- **Acceptable variance**

Seral stage distribution will be ± 20% of the 2009 projections as indicated in the approved 2003 DFMP (Figure 66 to Figure 71).

- **Current status**

The percent variance to the 2009 projections (Table 30) all meet the acceptable variance with the exception of:

- pioneer in the Peace Parcel. The primary reason for this discrepancy is that the 2003 DFMP anticipated little harvesting for this area up to 2009. When the MPB infested the parcel, harvesting was shifted there to address the infestation, resulting in more pioneer seral stage.
- overmature in the Puskwaskau Parcel. Since there is comparatively less pine in the parcel, harvesting was shifted to the Peace Parcel, resulting in less harvesting than was forecast in the 2003 DFMP and an excess of overmature timber.

Table 30 also shows the current 2007 status. The area of each seral stage by year in the FMA area and the Peace, Puskwaskau and Main parcels is provided in Table 31 to Table 34.

The characteristics of older forests provide biodiversity and important habitat for a number of species. Therefore, it is important to manage for old growth attributes at various levels; stand, landscape and forest. The current area (2007) of old seral stage is indicated in Table 37.

Figure 66 to Figure 71 indicate the present and forecast distributions for the FMA area and the Peace, Puskwaskau and Main parcels as compared to expected natural distributions. The range of natural disturbance is represented by the red “I beam” and the green bar represents the current or projected distributions. The observed differences between the target and forecasts are caused primarily by fire prevention and control and by anthropogenic disturbances.

Figure 65. Natural Regions within the FMA area

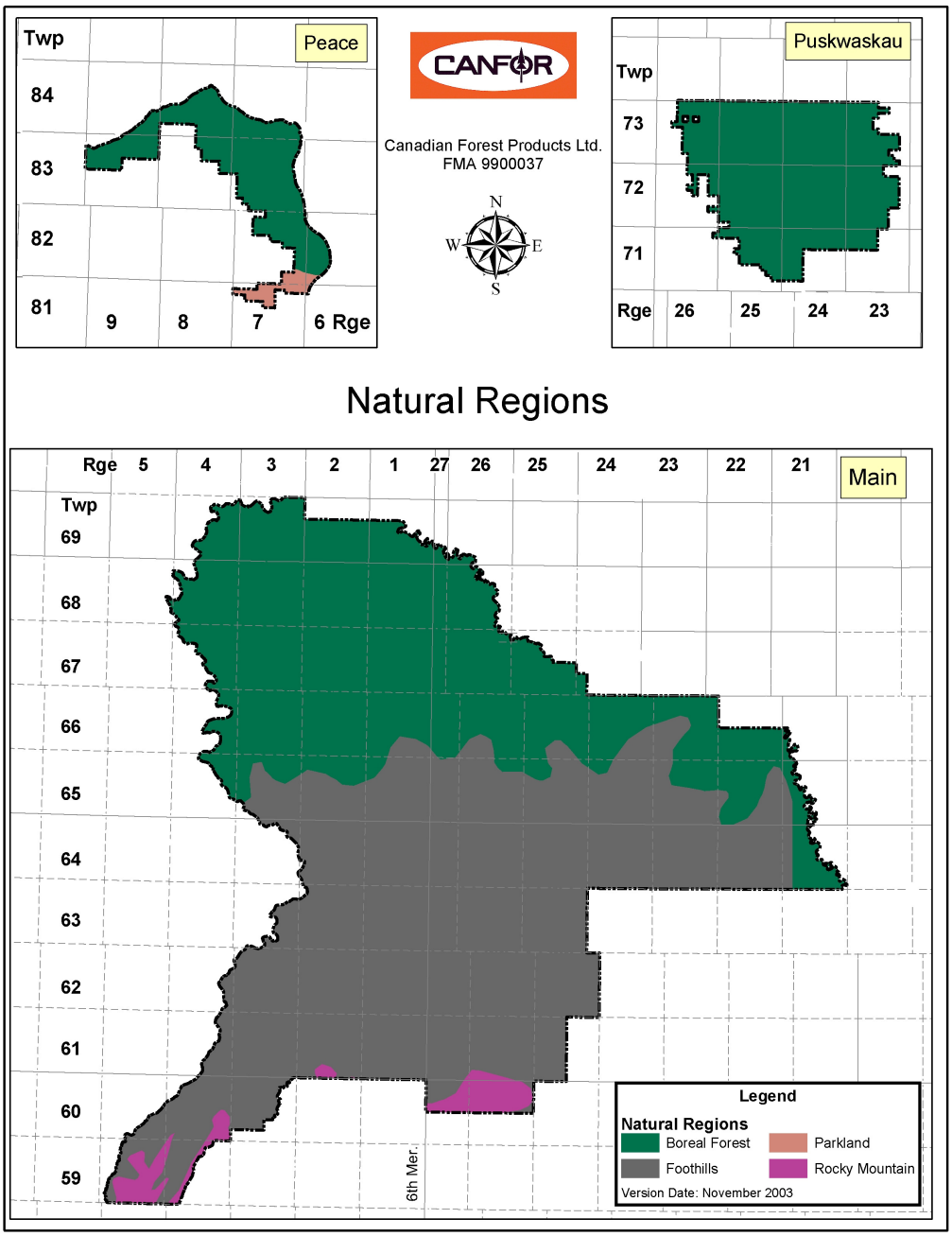


Table 30. Percent Variance to 2009 Projections

TNRG-RSTASourceData.xls
T028

		Seral Stage				
Parcel	Year	Pioneer (1)	Young (2)	Mature (3)	Overmature (4)	Old (5)
FMA	2007	-17%	-15%	-2%	10%	16%
	2009	-12%	-7%	-3%	6%	12%
Peace	2007	-11%	-4%	0%	1%	9%
	2009	786%	0%	-3%	0%	9%
Puskwaskau	2007	6%	-19%	-4%	25%	19%
	2009	-18%	-11%	-4%	25%	13%
Main	2007	-19%	-14%	-2%	9%	15%
	2009	-13%	-6%	-2%	5%	11%

Source: Timberline compiled data

The high percentage variance for pioneer seral stage in the Peace Parcel (786%) is due to the fact that little harvesting was planned for this parcel when the 2003 DFMP was prepared. Based on the harvest sequence developed at that time, only 73 hectares was expected to be in a pioneer seral condition in 2009. Current harvesting plans will result in 649 hectares being in a pioneer seral condition. This represents a 786% increase relative to the 2003 DFMP forecast for 2009.

Table 31. Seral Stage Distribution for the FMA area

TNRG-RSTASourceData.xls
T029

	Area (ha) in each Seral Stage					
Year	Pioneer (1)	Young (2)	Mature (3)	Overmature (4)	Old (5)	Total Forested Area
2007	27,227	83,098	249,400	177,076	51,132	587,932
2009	28,935	90,670	248,171	170,832	49,325	587,932
2019	30,622	119,847	216,578	140,459	80,427	587,932
2049	42,028	168,879	169,524	119,630	87,871	587,932
2099	34,020	148,785	204,335	85,983	114,810	587,932
2199	34,077	155,062	196,457	39,461	162,874	587,932

Source: Timberline compiled data

Table 32. Seral Stage Distribution for the Peace Parcel

TNRG-RSTASourceData.xls
T030

	Area (ha) in each Seral Stage					
Year	Pioneer (1)	Young (2)	Mature (3)	Overmature (4)	Old (5)	Total Forested Area
2007	65	1,861	21,544	1,919	511	25,901
2009	652	1,929	20,915	1,897	508	25,901
2019	262	3,285	12,703	8,844	807	25,901
2049	3,523	8,835	2,857	9,767	918	25,901
2099	579	8,227	7,592	2,447	7,056	25,901
2199	5,083	4,524	6,811	984	8,498	25,901

Source: Timberline compiled data

Table 33. Seral Stage Distribution for the Puskwaskau Parcel

TNRG-RSTASourceData.xls
T031

	Area (ha) in each Seral Stage					
Year	Pioneer (1)	Young (2)	Mature (3)	Ovemature (4)	Old (5)	Total Forested Area
2007	3,478	11,726	29,682	12,085	6,234	63,205
2009	2,689	12,822	29,673	12,072	5,949	63,205
2019	858	14,627	30,417	10,679	6,623	63,205
2049	4,795	9,522	21,246	21,332	6,310	63,205
2099	2,253	19,153	16,796	11,685	13,319	63,205
2199	1,937	19,955	25,112	4,065	12,137	63,205

Source: Timberline compiled data

Table 34. Seral Stage Distribution for the Main Parcel

TNRG-RSTASourceData.xls
T032

	Area (ha) in each Seral Stage					
Year	Pioneer (1)	Young (2)	Mature (3)	Ovemature (4)	Old (5)	Total Forested Area
2007	23,683	69,511	198,173	163,072	44,388	498,827
2009	25,595	75,919	197,583	156,863	42,868	498,827
2019	29,502	101,935	173,458	120,936	72,996	498,827
2049	33,710	150,522	145,422	88,531	80,642	498,827
2099	31,188	121,406	179,947	71,851	94,435	498,827
2199	27,058	130,584	164,534	34,412	142,239	498,827

Source: Timberline compiled data

Table 35. Seral Stage Distribution for the Foothills Natural Region

TNRG-RSTASourceData.xls
T033

	Area (ha) in each Seral Stage					
Year	Pioneer (1)	Young (2)	Mature (3)	Overmature (4)	Old (5)	Total Forested Area
2007	17,799	56,497	105,955	79,827	35,295	295,374
2009	17,623	60,939	105,833	76,617	34,361	295,374
2019	21,321	76,708	95,183	53,352	48,810	295,374
2049	14,158	91,651	88,354	47,610	53,599	295,374
2099	21,799	84,443	96,221	37,082	55,828	295,374
2199	19,117	88,934	104,076	16,699	66,547	295,374

Source: Timberline compiled data

Table 36. Seral Stage Distribution for the Boreal Forest Natural Region

TNRG-RSTASourceData.xls
T034

	Area (ha) in each Seral Stage					
Year	Pioneer (1)	Young (2)	Mature (3)	Overmature (4)	Old (5)	Total Forested Area
2007	9,490	27,421	143,402	98,301	16,325	294,939
2009	11,252	30,634	142,303	95,291	15,458	294,939
2019	9,181	43,939	121,339	87,893	32,588	294,939
2049	27,705	76,619	81,900	72,237	36,479	294,939
2099	12,087	63,758	107,319	49,875	61,901	294,939
2199	14,827	65,519	91,609	22,607	100,378	294,939

Source: Timberline compiled data

Table 37. Percent of Current Forested Landbase in Old Seral Stage

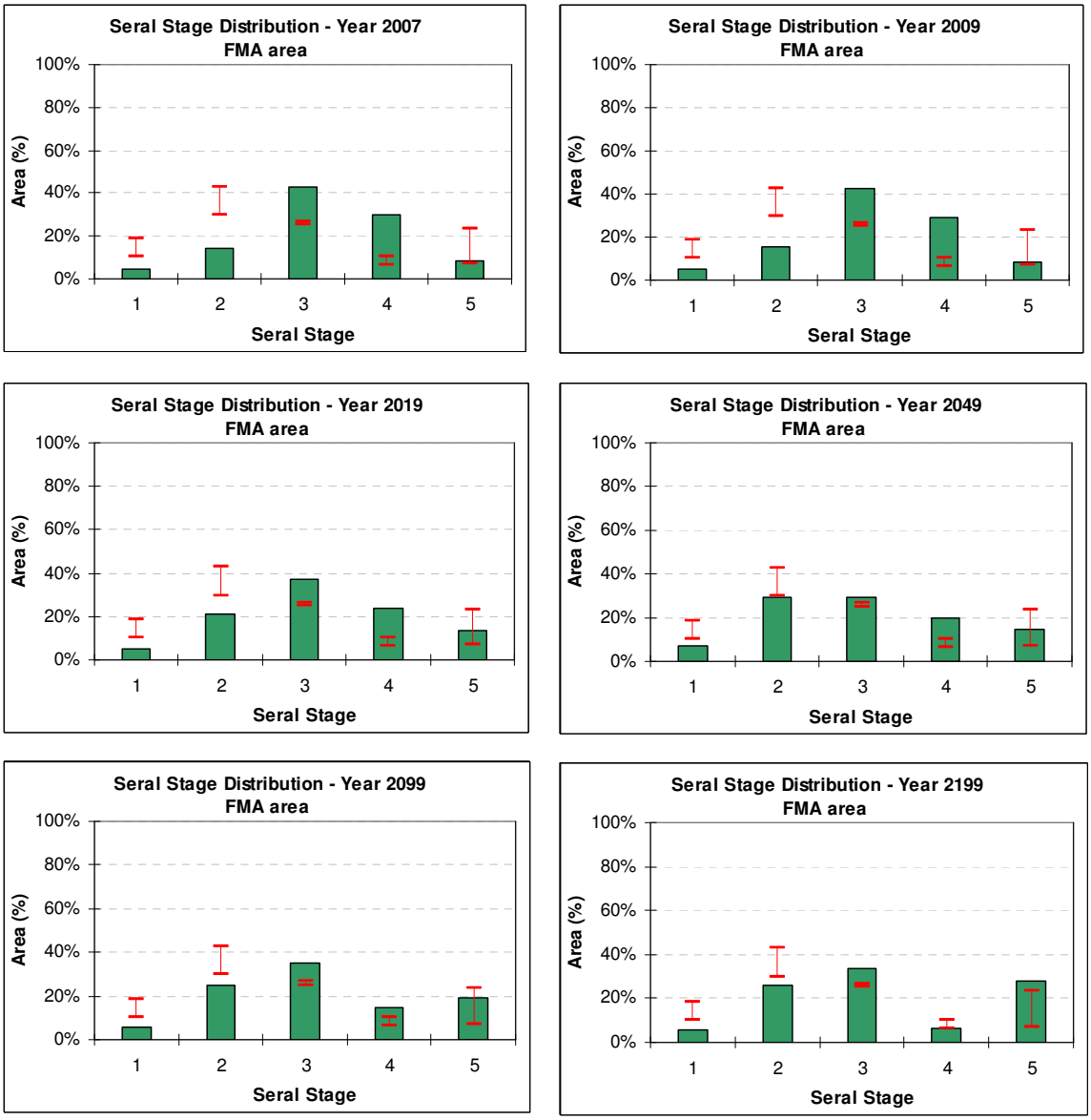
TNRG-RSTASourceData.xls
T035

Parcel	Area in Old Seral (ha)	Total Forested Area (ha)	% of Area in Old Seral Stage	% Natural Disturbance Range
FMA	51,132	587,932	8.7%	7.0 - 23.4
Peace	511	25,901	2.0%	3.8 - 21.4
Puskwaskau	6,234	63,205	9.9%	3.8 - 21.5
Main	44,388	498,827	8.9%	7.6 - 23.7

Source: Timberline compiled data

Figure 66. Seral Stage Distribution[10] within the FMA area

TNRG-RSTASourceData.xls
F076

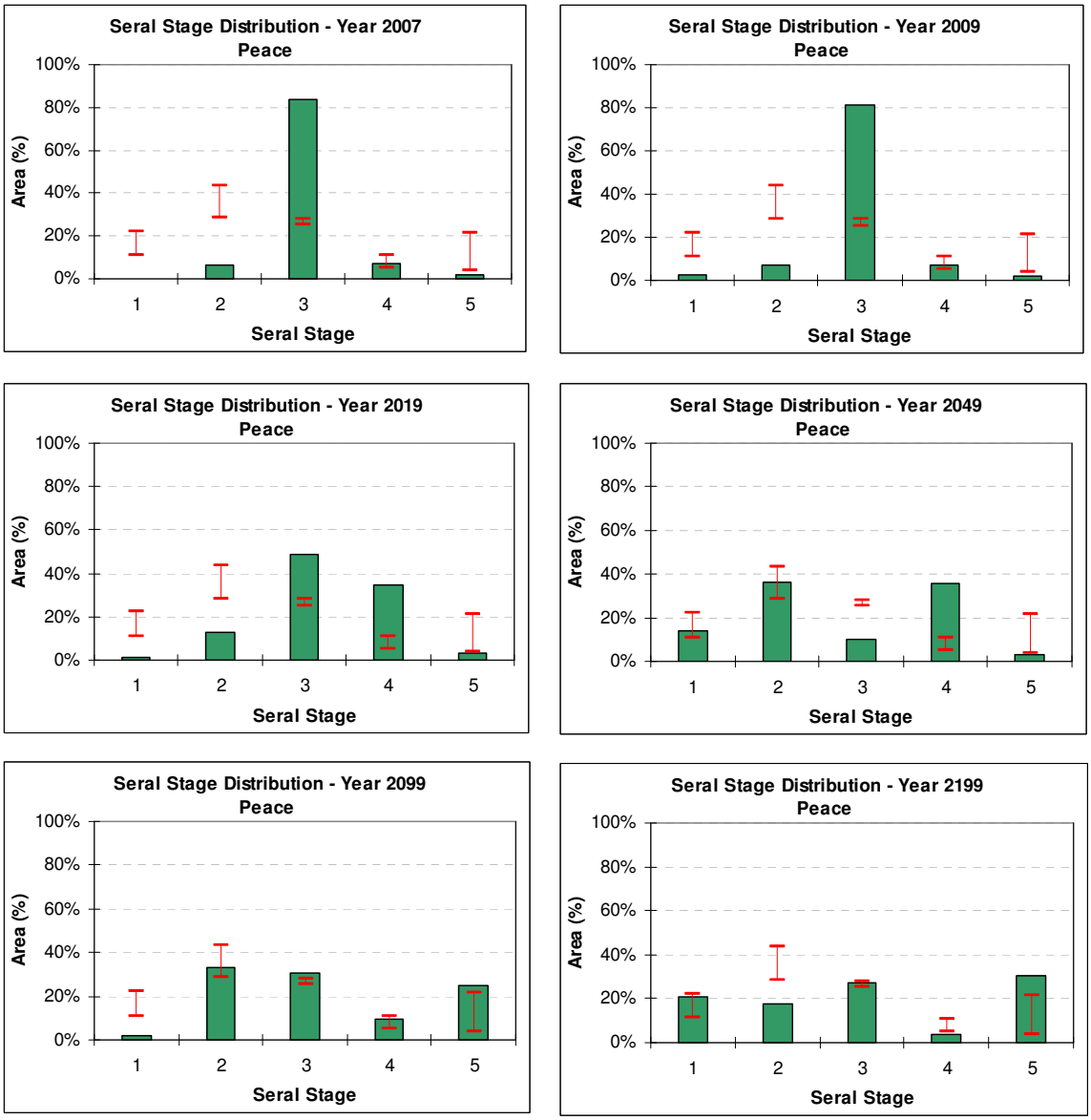


Source: Timberline compiled data

[10] 1=Pioneer, 2=Young, 3=Mature, 4=Overmature, 5=Old

Figure 67. Seral Stage Distribution[11] within the Peace Parcel

TNRG-RSTASourceData.xls
F077

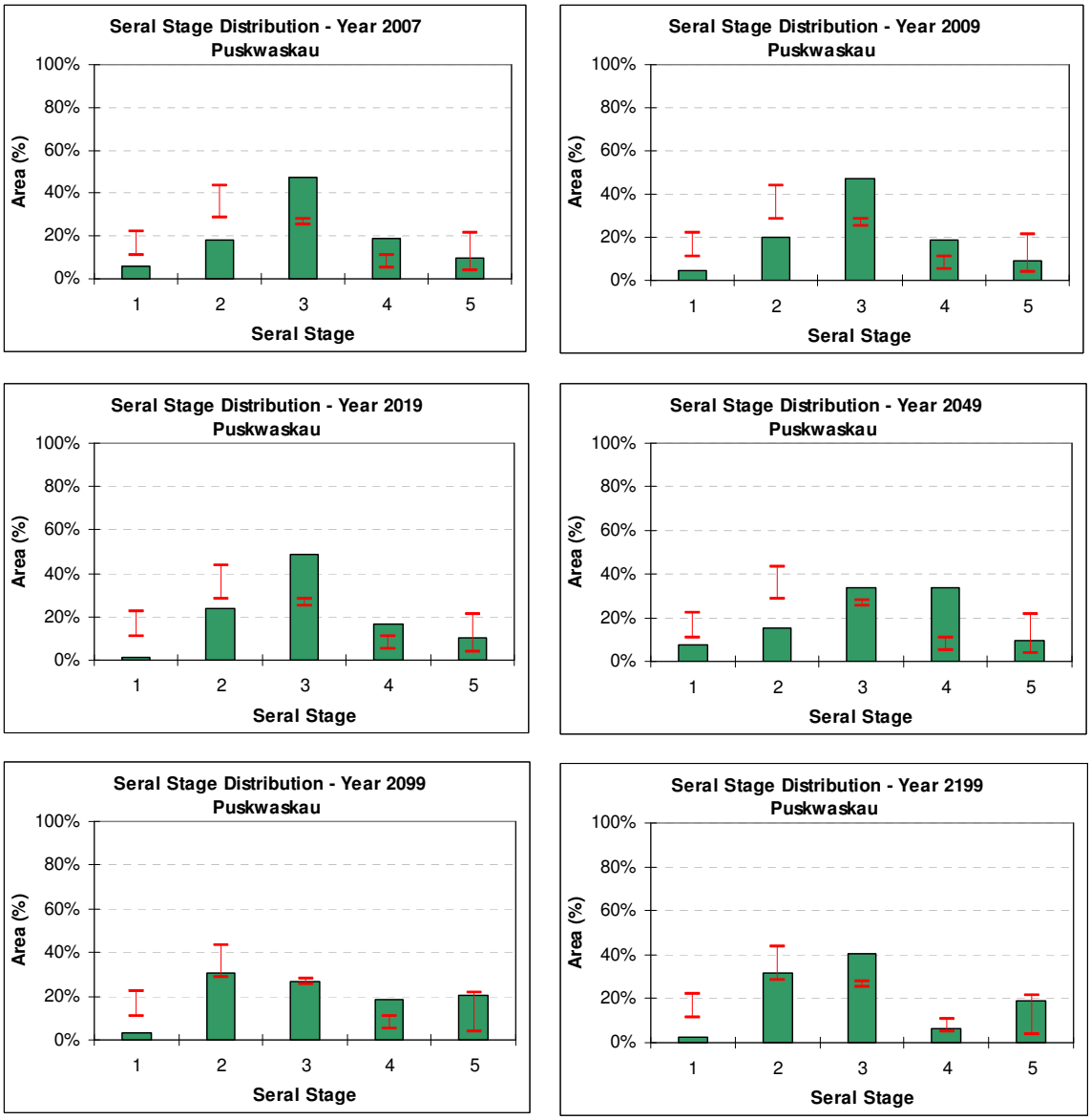


Source: Timberline compiled data

[11] 1=Pioneer, 2=Young, 3=Mature, 4=Overmature, 5=Old

Figure 68. Seral Stage Distribution[12] within the Puskwaskau Parcel

TNRG-RSTASourceData.xls
F078

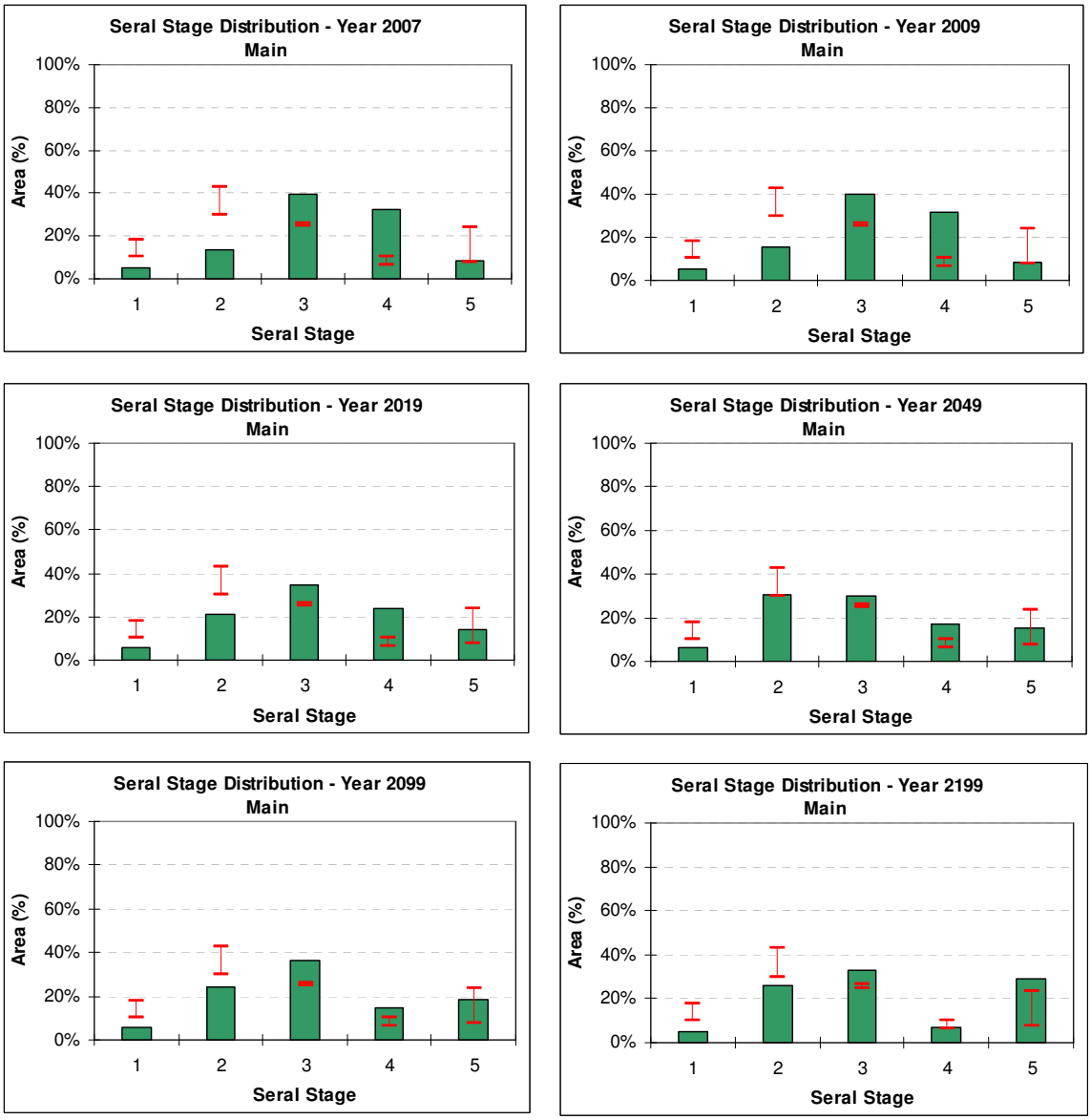


Source: Timberline compiled data

[12] 1=Pioneer, 2=Young, 3=Mature, 4=Overmature, 5=Old

Figure 69. Seral Stage Distribution[13] within the Main Parcel

TNRG-RSTASourceData.xls
F079

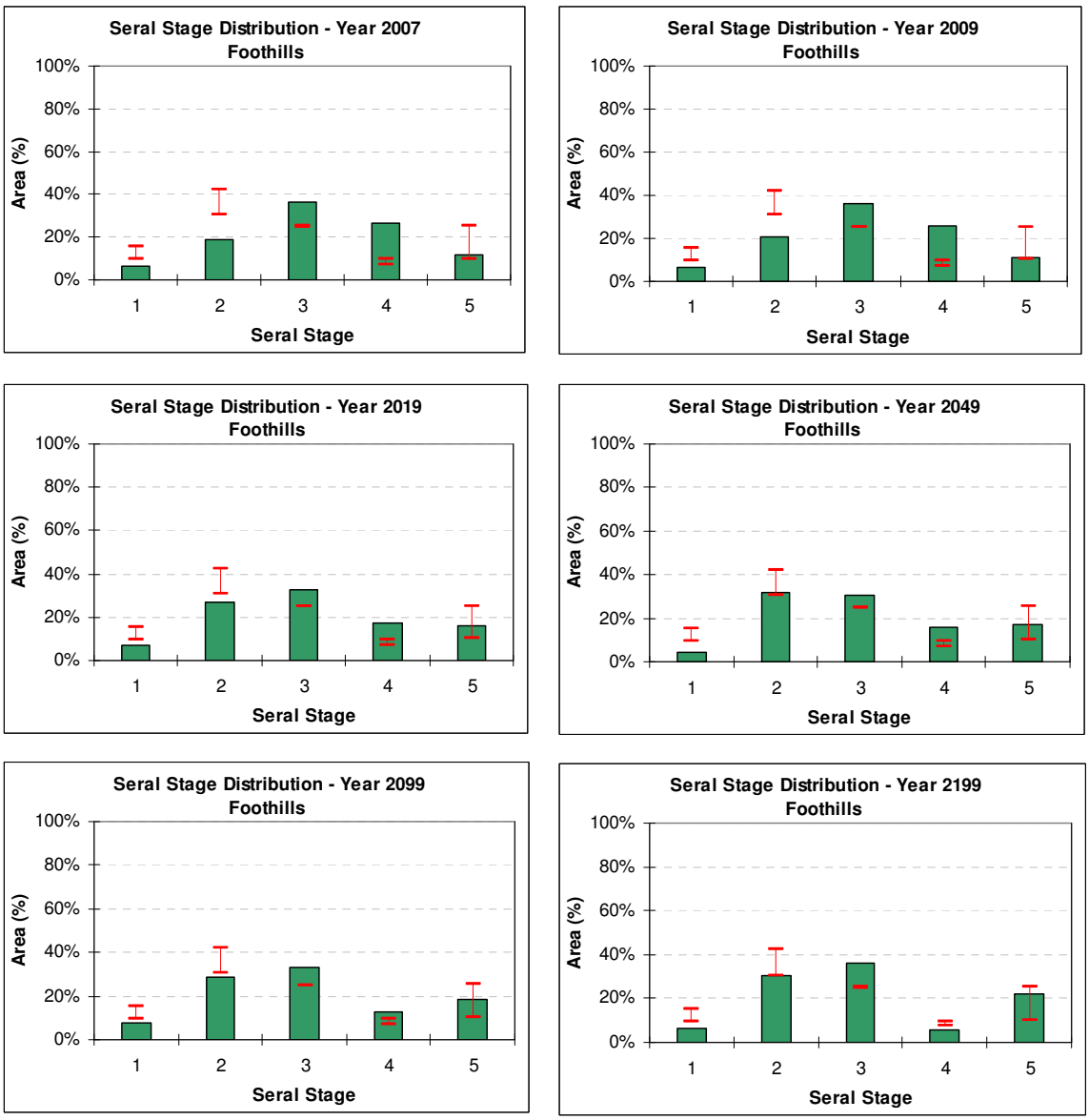


Source: Timberline compiled data

[13] 1=Pioneer, 2=Young, 3=Mature, 4=Overmature, 5=Old

Figure 70. Seral Stage Distribution[14] within the Foothills Natural Region

TNRG-RSTASourceData.xls
F080

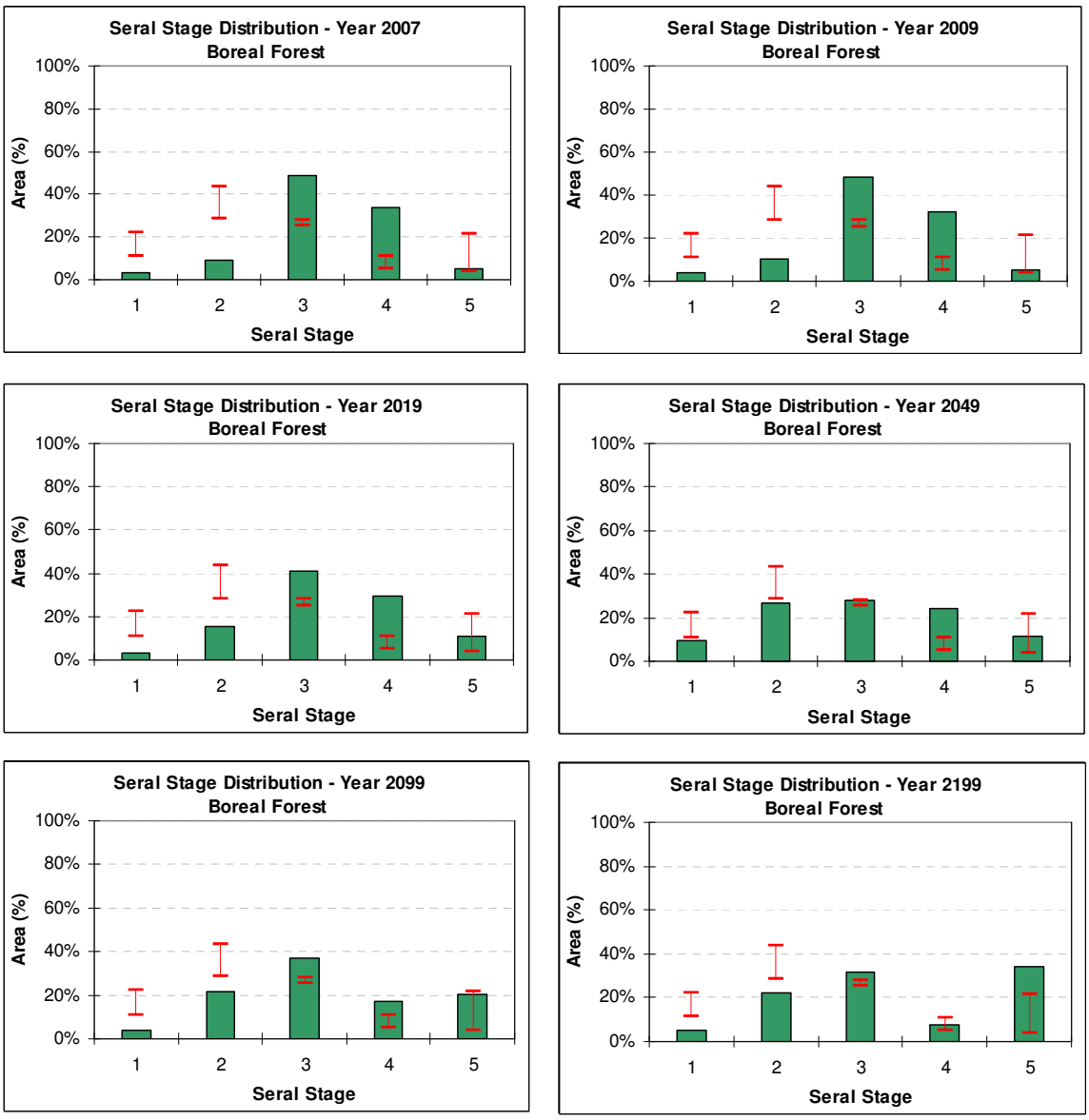


Source: Timberline compiled data

[14] 1=Pioneer, 2=Young, 3=Mature, 4=Overmature, 5=Old

Figure 71. Seral Stage Distribution[15] within the Boreal Forest Natural Region

TNRG-RSTASourceData.xls
F081



Source: Timberline compiled data

[15] 1=Pioneer, 2=Young, 3=Mature, 4=Overmature, 5=Old

- **Forecasting assumptions and analytical methods**

Seral stage distributions under a natural fire regime were modelled by using a theoretical fire-return interval (ORM, 2000). The amount of area in each seral stage in the FMA area and the Peace, Puskwaskau, and Main parcels has been forecasted on the landbase for key points in time (Figure 66 to Figure 71). The key points in time are for years 2007 (current), 2009, 2019, 2049, 2099, and 2199. It is assumed these time periods provide a reasonable picture of the variability of seral stage over time.

- **Forest management activities**

The management strategy is to work towards meeting the acceptable variance for those areas not currently achieving the target. This could be accomplished, for example, by deferring harvest of old and overmature seral stages until sufficient area of old seral stage is available to achieve the acceptable variance.

- **Strategy and implementation schedule**

All future harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP. If conditions change, an adaptive management approach will be utilized to address these changes.

- **Monitoring procedure (monitoring results against forecasts)**

The amount of area of each seral stage that is on the landscape will be compared to the expected natural distributions for 2009 and reported in the *Annual Performance Monitoring Report*.

- **Linkages to DFMP and Annual Operating Plan**

All new harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP.

6.2 Bull Trout

(1.2) Critical Element

Species Diversity

Conserve species diversity by ensuring that habitats for the native species found on the DFA are maintained through time.

Species diversity refers to the variety of plants and animals in a particular area. An important component of sustainable forest management is ensuring that a population of species is not put at risk as a result of forest harvesting or regeneration (CCFM, 1997). In order to make responsible, sound, and effective decisions a resource manager must have an integrated management system that is designed to acquire and organize the knowledge used to facilitate a decision making process (Wildlife Working Group, 1991). The importance of baseline data

for this type of management system and subsequent decision-making cannot be overstressed. This data is an essential element behind Canfor's commitment to ecologically based management as outlined in *Canfor's Forestry Principles* (Canfor, 1999).

(1.2) 1. Value
Through time all current habitats are represented

Coarse filter management postulates that if habitat is maintained and available for selected wildlife indicator species, it is assumed that a wide range of habitat conditions suitable for many other species will be available (Rempel *et al,* 2004).

Canfor has taken a coarse filter approach for moose (*Alces alces*), American marten (*Martes americana*), pileated woodpecker (*Dryocopus pileatus*) and barred owl (*Strix varia*).

A fine-filter approach[16] was utilized for management of woodland caribou (*Rangifer tarandus caribou*), trumpeter swan (*Cygnus buccinator*) and grizzly bear (*Ursus arctos*).habitat.

Bull trout habitat has been evaluated using equivalent clearcut area (ECA), as presented in "Target (1.2) 1a.2.1".

(1.2) 1a Objective
Current species diversity is maintained on the landscape

A component of biodiversity monitoring is to follow species or groups to determine whether they face long-term changes in distribution. How populations of species are affected by environmental change is key to assessing the impact of human activities (CCFM, 1997).

(1.2) 1a.2 Indicator
Number of bull trout watersheds with ≥ 35% Equivalent Clearcut Area (ECA) above the H60[17] elevation

Fish habitat is dependent on water yield (quantity and timing of run-off) and water quality, which is, in part, dependent on the amount of vegetated cover within a watershed. If too much forest cover is removed at one time, the resultant water yield increases may affect aquatic habitat.

[16] A species-by-species approach

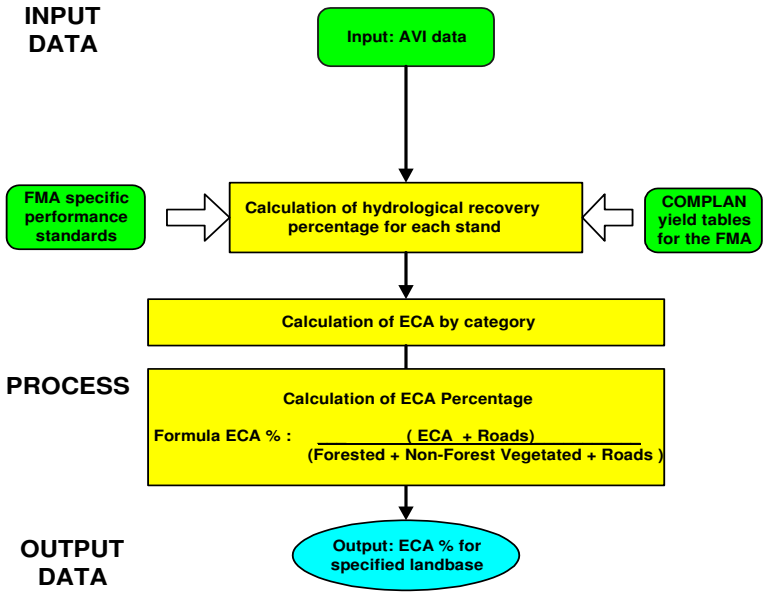
[17] H60 is the elevation above which 60% of the watershed lies (the watershed area above the H60 is considered as the source area for the major snowmelt peak flows).

(1.2) 1a.2.1 Target

Annually, zero bull trout watersheds with ≥ 35% equivalent clearcut area (ECA) above the H60 elevation.

Water yield increases can be directly modelled, but equivalent clearcut area is often used as a surrogate. ECA is defined as an area that has been harvested, cleared or burned. It is a primary factor considered in evaluation of the potential effect of past and proposed forest harvesting on water yield. The process for calculation of ECA is provided in Figure 72.

Figure 72. Overview Process for Calculating ECA %



- **Acceptable variance**

The acceptable variance is for no more than 5 (3%) of the watersheds in the bull trout area to exceed 35% ECA above the H60 elevation.

- **Current status**

The total bull trout area within the FMA area (Figure 73) is 242,828 hectares (37% of the total FMA area) and contains 163 watersheds.

The H60 line has been determined for all watersheds, which have been aggregated to a minimum of 500 hectares in the bull trout area (see Appendix B, Map 8).

As Table 38 indicates, only watershed #2057 exceeds the target in 2007. Although watersheds #4257 and #5642 exceeded the target in 1999, both have recovered sufficiently so they now meet the target (Appendix C).

Watersheds that are above the target ECA of 35% are flagged for evaluation (refer to *Forecasting assumptions and analytical methods* below for a description of the procedure).

Table 38. Watersheds Above the ECA of 35%

TNRG-RSTASourceData.xls
T036

Watershed ID	1999 ECA %	2007 ECA %
2057	48	39
4257	36	20
5642	37	34

Source: Timberline compiled data

- **Forecasting assumptions and analytical methods**

It is assumed that streamflow maxima will not adversely impact the ecosystem if no more than 20 - 40% of the total vegetated cover is removed within the area above the H60 within a defined watershed.

Each year the ECA % is calculated prior to submission of the annual operating plan.

Figure 73. Bull Trout Watersheds within the FMA area

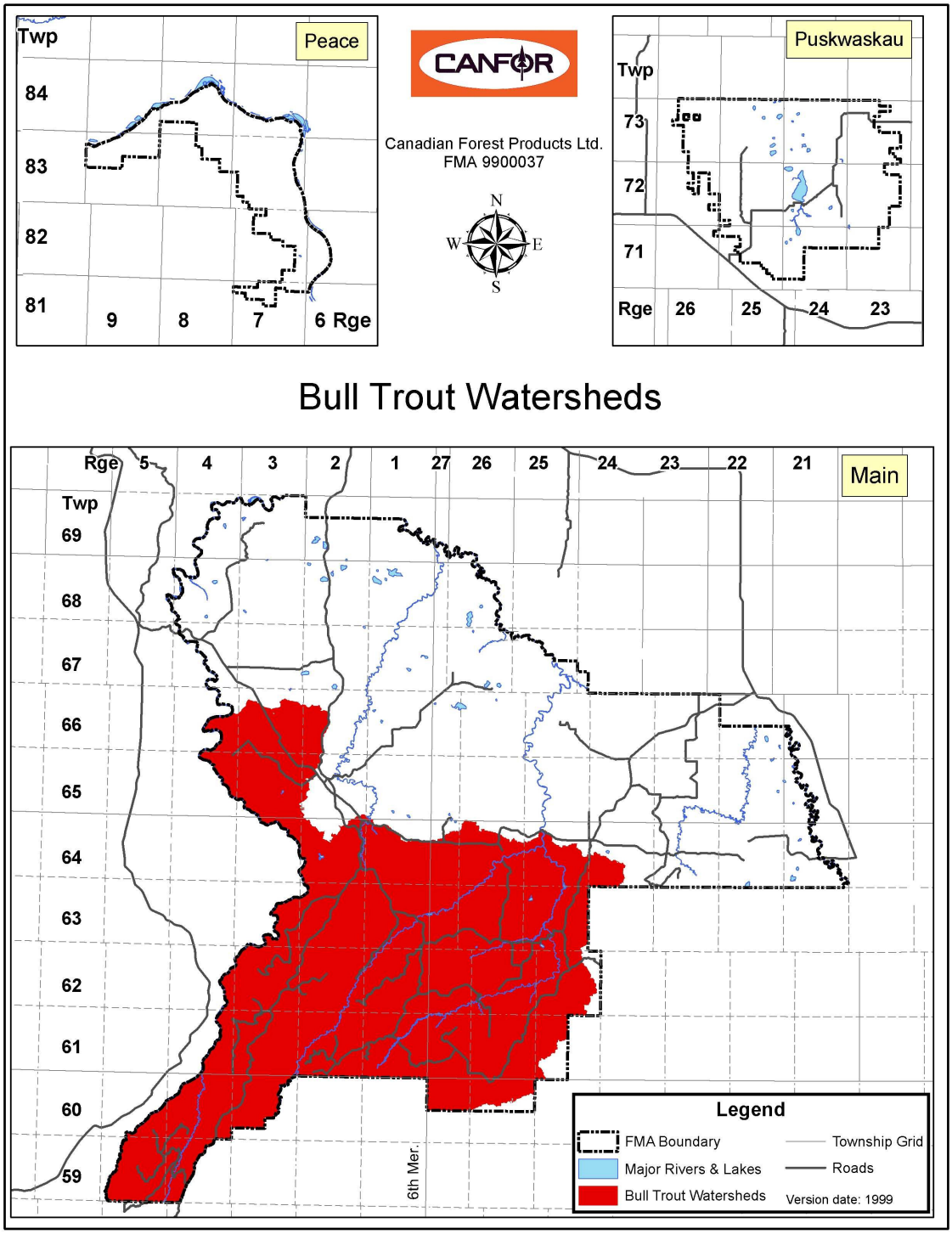
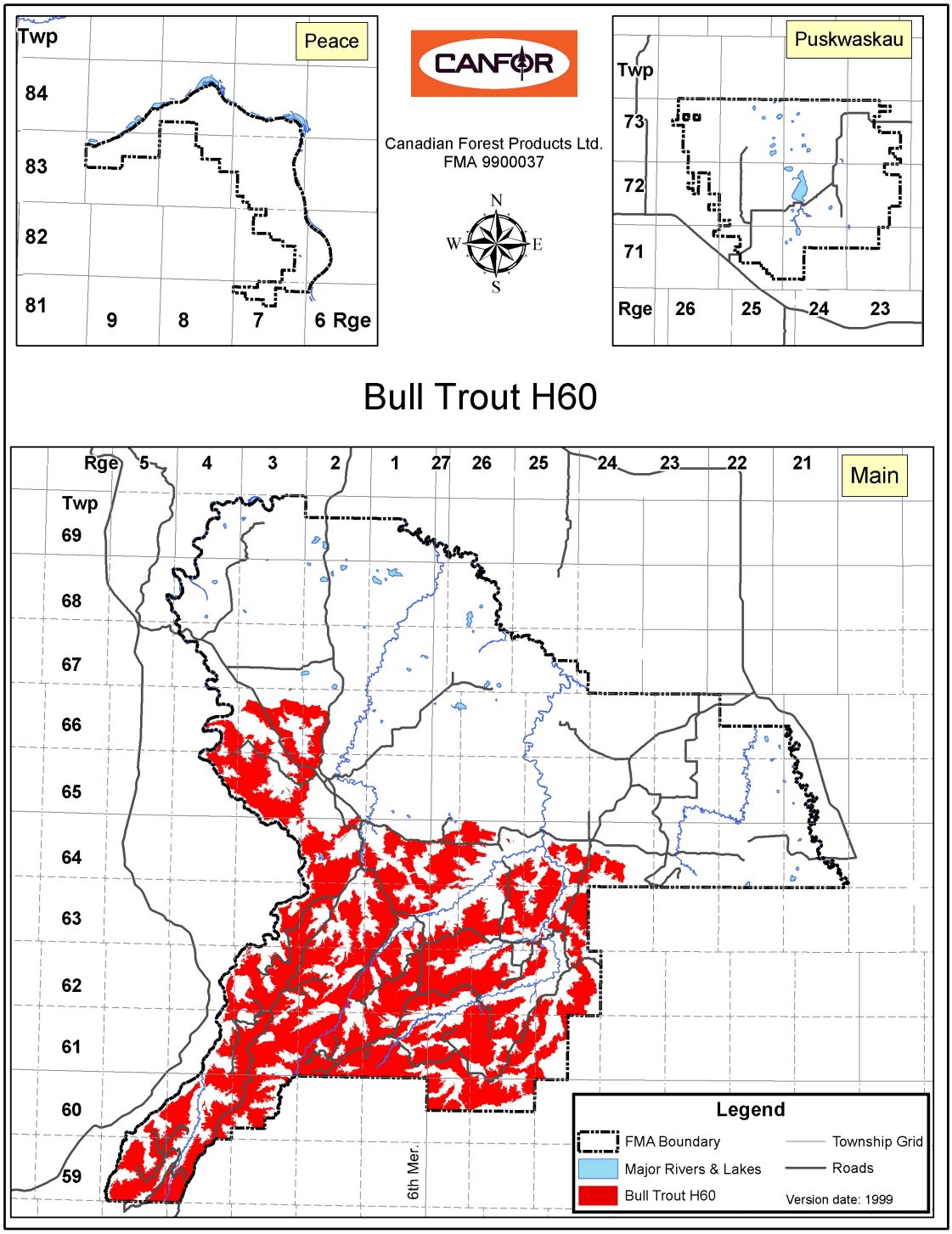


Figure 74. H60 Area within the Bull Trout Area



- **Forest management activities**

ECA values have been calculated and the data utilized in preparation of the annual operating plan.

- **Strategy and implementation schedule**

The strategy is to continue to utilize ECA % as a method to evaluate the extent of forest harvesting in bull trout watersheds. Canfor will evaluate those watersheds above the ECA threshold and determine if any mitigation strategies can be implimented to reduce the immediate impacts, including but not limited to:

- Prompt deactivation;
- Prompt reforestation;
- Evaluating water quality concern rating[18] values; and
- Delaying vegetation management activities.

- **Monitoring procedure (monitoring results against forecasts)**

Each year prior to AOP submission, ECA values will be recalculated and watersheds with ECA above the H60 elevation of greater than 35% flagged for evaluation. The resultant data will be reported in the *Annual Performance Monitoring Report*.

- **Linkages to DFMP and Annual Operating Plan**

All new harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP.

6.3 Woodland Caribou and Trumpeter Swan

(1.2) 1a.3 Indicator
Percentage of habitat for endangered[19] or threatened[20] vertebrate species over time

Woodland caribou and trumpeter swan ranges encompass portions of the FMA area. Woodland caribou are currently listed as '*at risk*[21]' in Alberta and '*threatened*' under the *Alberta Wildlife Act* and the federal *Species at Risk Act* (SARA). Trumpeter swan are classified as 'threatened' under the *Alberta Wildlife Act* and considered *"not at risk"* overall in Canada under SARA.

[18] Water quality concern rating (WQCR) is the ranking system developed by P. Beaudry & Associates Ltd. based on the concept that the impact of stream crossings on water quality can be reduced through effective erosion and sediment control practices, and that this can be evaluated and scored using a field-based assessment. There are 5 concern classes - none, low, moderate, high and very high.

[19] 'Endangered' - any species facing imminent extirpation or extinction.

[20] 'Threatened' - any species likely to become endangered if limiting factors are not reversed.

[21] 'At Risk' - any species known to be 'At Risk' after formal detailed status assessment and designation as 'Endangered' or 'Threatened'.

The purpose of the federal and provincial Acts is to prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and encourage the management of other species to prevent them from becoming at risk.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), comprised of an independent body of experts, assesses and identifies potential species at risk. COSEWIC assesses and classifies a wildlife species as extinct; extirpated; endangered; threatened; special concern; data deficient or not at risk. COSEWIC provides its report to the Minister of the Environment and the Canadian Endangered Species Conservation Council, and a copy is included in the Public Registry. The Federal Minister of the Environment must respond to a COSEWIC assessment within 90 days. Within nine months, the government makes a decision about whether or not to add the species to the List of Wildlife Species at Risk in SARA. When a species is on or added to the List of Wildlife Species at Risk, extirpated, endangered or threatened species and their residences have:

- Immediate protection on federal lands (except for those species in the territories that go through the safety net process described below);
- Immediate protection if they are an aquatic species;
- Immediate protection if they are a migratory bird; and
- Protection through a safety net process if they are any species in a province or territory.

Recovery strategies and action plans, which must include the identification of critical habitat for the species and management plans, are published in the Public Registry.

At the provincial level, the evaluation of the status of species at risk in Alberta relies upon the activities of the Endangered Species Conservation Committee (ESCC) and its scientific arm, the Scientific Subcommittee, both created under the auspices of the *Wildlife Act* in 1998. Using information contained in detailed status reports, the Scientific Subcommittee of the ESCC assesses what the risk of extinction or extirpation is for Alberta species that have been identified as potentially at risk through the General Status process. The Scientific Subcommittee evaluation is presented to the ESCC, which then decides what recommendations to make to the Minister of Sustainable Resource Development concerning the legal designation (e.g. ‘endangered’ or ‘threatened’), as well as management and recovery of a species.

(1.2) 1a.3.1 Target

Woodland caribou: no more than 20% of the area in pioneer or young seral condition and at least 20% of the area in old seral condition at key points in time

Trumpeter swan: to buffer 100% of identified trumpeter swan lakes with a 200 m no harvest buffer (reported annually)

- **Acceptable variance**

Woodland Caribou

To achieve the 2019 projections, the acceptable variance in 2009 for pioneer/ young seral condition will be ≤ 18% of the area and for old seral condition will be ≥ 11% of the area.

For 2019 and beyond, the acceptable variance for the pioneer/ young seral condition will be no more than 25% of the area. The acceptable variance for the old seral condition will be no less than 15% of the area.

Trumpeter Swan

The acceptable variance is zero

- **Current status**

Woodland Caribou

There are portions of two woodland caribou (Figure 75) herds within the FMA area including the A La Peche and the Little Smoky. Their total combined ranges comprise 466,373 hectares (A La Peche 198,578 hectares and Little Smoky 267,735). Approximately 70,225 hectares (15%) of the combined ranges are located within the FMA area (Figure 76).

Canfor deferred harvesting and road construction activities in the Caribou Area commencing May 1, 2005 and terminating April 30, 2009. The Company has commited to defer harvesting in the caribou primary intactness area (Figure 76) for a period of fifteen years (from 2007 to 2021).

Table 39 represents the current and projected status for pioneer/ young and old seral stages for the period 1999 to 2199. The present age class structure (2007) does not meet the 20% old seral condition however over time the forest will continue to age and the target will be achieved in 2021.

Figure 75. Woodland Caribou

Woodland caribou ranges comprise 70,225 ha. within the FMA area.

Source: Photo by C. Rohner

Table 39. Percentage of Pioneer/ Young and Old Seral Stages in the Caribou Area

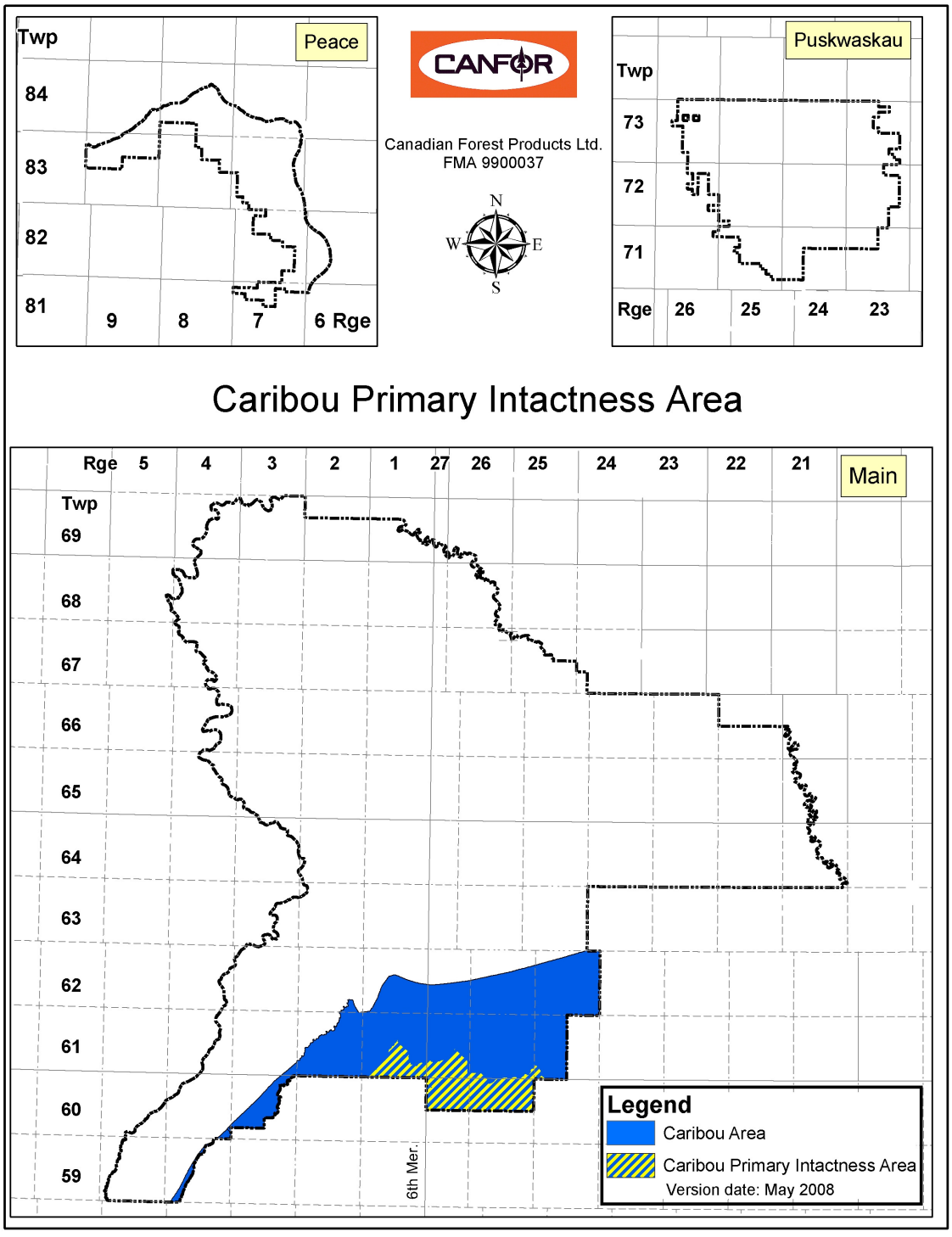
TNRG-RSTASourceData.xls
T038

Year	Pioneer/Young (%)	Old (%)
1999	13%	10%
2007	15%	12%
2009	16%	12%
2019	31%	16%
2049	26%	35%
2099	25%	35%
2199	24%	39%

Source: Timberline compiled data

- Canfor will not establish additional caribou targets until the government has endorsed recommended objectives and strategies through the process established in the *Alberta Woodland Caribou Recovery Plan 2004/ 05 - 2013/ 14* (ASRD, 2005). The Company will however, continue to be an active member of the Foothills Landscape Management Forum (FLMF) (formerly Caribou Landscape Management Association) comprised of members from the forest industry, oil and gas sector and one Aboriginal group. Initially, the focus of the Foothills Landscape Management Forum was minimizing industrial footprint within the habitats of the Little Smoky and A La Peche caribou ranges. Over time the FLMF has evolved and is involved in projects that facilitate integrated land management between all forest and energy companies who develop along the foothills of Alberta's forests.

Figure 76. Woodland Caribou Ranges within the FMA area



Trumpeter Swan

Trumpeter swans (Figure 77) are sensitive to human disturbance, and human activity in breeding areas may decrease survival of eggs or cygnets. Trumpeter swans that are disturbed may not nest or may abandon an existing nest. Therefore, the breeding population continues to be dependant on current management practices and habitat protection.

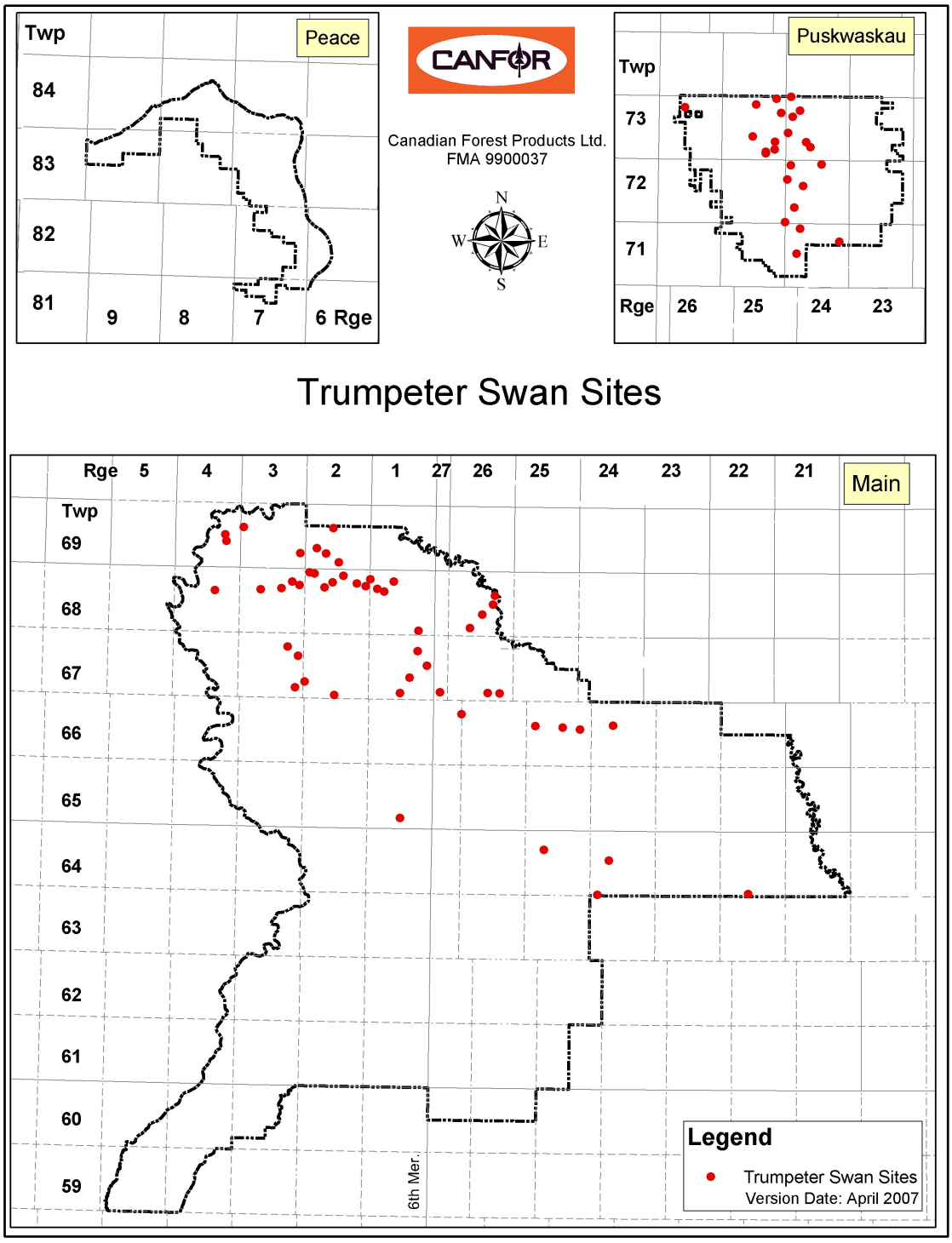
The *Operating Ground Rules* (ASRD, 2008a) and *The Recommended Land Use Guidelines for Trumpeter Swan Habitat in Alberta* (ASRD, 2001), provides background, intent, and specific direction for managing industrial work near trumpeter swan breeding wetlands

Figure 77. Trumpeter Swan

The number of sites identified as lakes occupied by breeding birds (i.e. pairs with young) will vary over the years depending on climatic conditions and condition of the wetland or lake.

Locations of breeding wetlands are depicted on the provincial land use referral maps. Alberta Sustainable Resource Development (ASRD) updated the NW1 Smoky Land Management Referral Map in 2007 to show current trumpeter swan nesting sites (Figure 78). That updated information has been used for this analysis in determining the timber harvesting landbase (THLB).

Figure 78. Trumpeter Swan Sites



- **Forecasting assumptions and analytical methods**

Woodland Caribou

The constraints indicated in the target were used in the current *Resource and Timber Supply Analysis* and the results indicate that habitat conditions for woodland caribou are not adversely impacted by Canfor's operations.

Forecasting assumptions and analytical methods will be guided by Foothills Landscape Management Forum initiatives, West Central Alberta Caribou Landscape Plan (WCACLPT, 2008) and the recommendations regarding that plan prepared by the Alberta Caribou Committee Governance Board (July 10, 2008) (ACCGB, 2008)

Trumpeter Swan

Buffer areas will be maintained, unless changes are recommended or approved by Alberta Sustainable Resource Development.

- **Forest management activities**

Woodland Caribou

Canfor will continue to be an active member of the FLMF and support recommended caribou initiatives. In accordance with its *Caribou Habitat Management Commitments* (Appendix 7, Canfor, 2008b) Canfor deferred harvesting and road construction activities in the Caribou Area commencing May 1, 2005 and terminating April 30, 2009. Canfor has also made a commitment to defer harvesting in the caribou primary intactness area for a period of fifteen years (until 2022).

Trumpeter Swan

Two hundred meters of "no harvest" buffers are maintained around identified trumpeter swan areas to protect nesting sites, unless changes are recommended or approved by the ASRD.

- **Strategy and implementation schedule**

Woodland Caribou

The strategy is as follows:

- Adhere to the *Caribou Habitat Management Commitments* (Appendix 7, Canfor, 2008b)
- Continue an adaptive approach to caribou habitat management. As more information becomes available incorporate it into the planning process;
- Restrict harvest in the caribou primary intactness area for the fifteen-year plan.
- Continue to actively work with oil and gas companies that are operating within the caribou herd areas to reduce impacts on caribou habitat;
- Data resulting from the FLMF and other research programs will be evaluated and, if appropriate, be used to enhance forest management within the Caribou Area; and

- Canfor will participate in projects endorsed by the FLMF that apply to the FMA area.

Trumpeter Swan
Canfor will not conduct harvesting activities near known sites. Protection of identified nesting sites has been implemented and will be maintained.

- **Monitoring procedure (monitoring results against forecasts)**

Woodland Caribou
Canfor will monitor the HPS cover constraints against all submitted harvest plans within the Caribou Area.

The progress made in achieving the 2009 projections will be evaluated and presented in the *Annual Performance Monitoring Report*.

Trumpeter Swan
Each year, the presence of nest sites will be verified and included in the annual operating plan. Any new nest sites will be incorporated into future plans.

- **Linkages to DFMP and Annual Operating Plan**

All new harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP.

6.4 Landscape Metrics

(1.3) Critical Element

Genetic Diversity
Conserve genetic diversity by maintaining the variation of genes within species.

Genetic diversity is the basis for the variety of species and ecosystems. It enables organisms to respond to environmental change and shape the ecosystems in which they live. Distribution of genes is dynamic as individuals and populations respond to such factors as weather, food availability and predators (CCFM, 1997).

(1.3) 1 Value
Respect the natural genetic diversity

Conserving genetic diversity is key to ensuring that species retain their capacity to evolve and adapt to change.

(1.3) 1a Objective
Genetic diversity will be maintained on the landscape

Maintenance of landscape structure will help manage the distribution and abundance of wildlife species and thereby it is anticipated to maintain genetic diversity. The spatial properties or "structure" of landscapes can be used as a surrogate measure of landscape level biodiversity values. To maintain the biodiversity of an area, land managers are challenged with managing landscapes to emulate the patterns and dynamics of natural landscape mosaics. Thus, the quantitative basis for measuring the structure of landscapes is a prerequisite for ecosystem-based forest management. Quantitative measures are required to establish objectives for landscape structure and evaluate the effects of management options on ecosystem values.

Quantifying landscape structure with the use of landscape metrics has the advantage that change in pattern can be documented and trends can be established.

At the landscape level, there are a number of important factors relating to the conservation of genetic diversity of wildlife species:

- Landscape structure is defined by landscape composition and spatial configuration;
- Landscape composition is generally described by seral stage distribution (habitat type) and patch size distribution (habitat size); and
- Configuration is represented by fragmentation, connectivity and patch shape.

Fragmentation is measured by mean patch size (MPS). Connectivity is quantified using the mean nearest neighbour distance (MNND). MNND describes the spatial context of a habitat patch in relation to its neighbours by increasing with increasing distance between patches. Patch shape is measured by the area-weighted mean shape index (AWMSI). AWMSI measures the perimeter-to-area ratio for a patch type or landscape using comparisons of patches to a standard shape. The distribution of patch sizes is reported by size classes: 0 - 100 hectares, 100 - 500 hectares and 500+ hectares.

Mean Patch Size (MPS) and patch size distribution, Mean Nearest Neighbour Distance (MNND) and Area Weighted Mean Shape Index (AWMSI) have been selected as the means of quantifying the relative change in the level of fragmentation, connectivity and shape complexity in the FMA area. These quantitative measures cannot be looked at in isolation, they must be evaluated together to decide if landscape level biodiversity will be adversely affected or not.

(1.3) 1a.1 Indicator
Mean patch size (MPS) (ha)

Mean patch size (MPS) together with patch size distribution in various seral stage classes provide an insight into the level of fragmentation of the forest land. Forest patches are created by natural disturbance (wind, fire, pests etc.) and through harvesting activities. Over an entire rotation, forest management activities can alter

the distribution and size of patches by fragmenting the landscape beyond the limits of natural variability. Many of the landscape level bird studies report mean patch size to be an effective indicator of incidence and reproductive output (Edenius and Sjoberg 1997; Roberts and Norment 1999).

Mean patch size (MPS) must not be evaluated in isolation but with careful examination of other landscape fragmentation metrics.

The FMA area has a relatively short history of harvesting, therefore the majority of the forested landbase is still in fire-origin (natural) stands. Fire suppression since the 1950's in Alberta also limited the number and size of natural disturbances. As the increase of harvesting activities will continually create new early (young) seral patches, it is important that fragmentation be closely monitored.

(1.3) 1a.1.1 Target

The MPS (ha) for 2009 will not fall below the MPS forecast for each reporting unit

MPS was forecasted for the FMA area and each parcel at key points in time (2007, 2009, 2019, 2049, 2099 and 2199). Comparing the 2007 MPS data to the 2009 projection provides an indication of how well harvest plans are achieving the 2009 forecast. The assumption is that if the 2009 forecast is achieved it is likely that all the forecasts at key points in time will also be achieved (Figure 79).

- **Acceptable variance**

Mean Patch Sizes will not fall below 15% of the area of the 2009 MPS forecast for the FMA area and the Peace, Puskwaskau and Main parcels as indicated by the solid lines in Figure 79.

- **Current status**

Figure 79 presents the MPS at key points in time for the FMA area and the Peace, Puskwaskau and Main parcels.

MPS (mean patch size) at the landscape level is near 40 hectares for all reported units with the exception of Peace Parcel, where MPS is approximately 80 ha. This is attributed to the smaller size of the area, which has large patches of mature forest.

- **Forecasting assumptions and analytical methods**

As mentioned in the Indicator, MPS was selected as a measure of fragmentation. Harvest area sizes and harvest area aggregation strategies influence the MPS. Figure 79 shows that the MPS decreases to slightly below the calculated limit over time for the FMA area.

- **Forest management activities**

Future spatial planning at the landscape level will be used to make adjustments to the harvesting plans to achieve the desired level of landscape structure is maintained at key points in time.

- **Strategy and implementation schedule**

All future harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP. If conditions

change, an adaptive management approach will be utilized to address these changes.

- **Monitoring procedure (monitoring results against forecasts)**

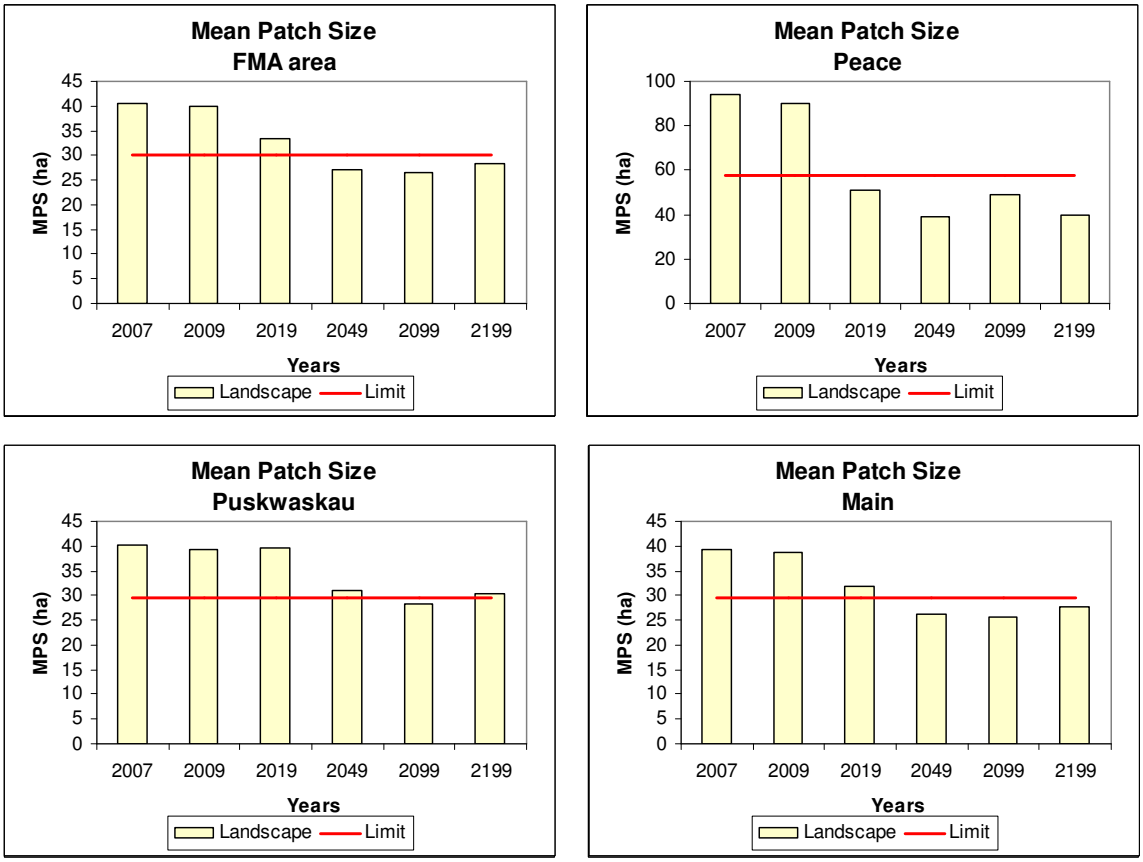
The amount of area of each mean patch size that is on the landscape will be compared to the expected natural distributions for 2009 and reported in the *Annual Performance Monitoring Report*.

- **Linkages to DFMP and Annual Operating Plan**

All new harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP.

Figure 79. Mean Patch Size for FMA area and the Peace, Puskwaskau and Main Parcels

TNRG-RSTASourceData.xls
F089



Source: Timberline compiled data

(1.3) 1a.2 Indicator
Mean nearest neighbour distance (MNND) (m)

Mean Nearest Neighbour Distance (MNND) describes the proximity of forest patches thus providing a quantitative measure of connectivity (Schumaker 1996; With 1999). Connectivity is a complementary measure of the degree to which forest patches can be considered joined together on the basis of a minimum acceptable separation distance. The connectivity (distance) of habitat patches is extremely important for large animals like moose and caribou, two of the indicator species in the FMA area.

MNND must not be evaluated in isolation but with careful examination of other landscape fragmentation metrics.

(1.3) 1a.2.1 Target
The mean nearest neighbour distance (MNND) for 2009 will not exceed the MNND forecast

MNND was forcasted for the FMA area and each parcel at key points in time (2007, 2009, 2019, 2049, 2099 and 2199). Comparing the 2007 MNND data to the 2009 projection provides an indication of how well harvest plans are achieving the 2009 forecast. The assumption is that if the 2009 forecast is achieved it is likely that all the forecasts at key points in time will also be achieved (Figure 80).

- **Acceptable variance**

MNND will not exceed +15% of the 2009 forecast for the FMA area and the Peace, Puskwaskau and Main parcels as indicated in Figure 80.

- **Current status**

Current status refers to the conditions observed for the year 2007. Figure 80 presents the MNND for the FMA area and the Peace, Puskwaskau and Main parcels.

MNND at the landscape level is approximately 200 metres for all reported parcels with the exception of Peace Parcel where the MNND varies between 300 and 375 metres over time. This is attributed to the smaller size of this parcel and its mean patch size and fragmentation.

- **Forecasting assumptions and analytical methods**

The extent of the landscape affects the calculation of MNND because it only considers patches within the specified search radius of the focal patch that are also within the landscape boundary. The severity of this problem can be reduced if the landscape is increased relative to the average patch size and/ or the search radius is decreased. More critically, the worthiness of the MNND is limited by the definition of the search radius.

Figure 80 presents the MNND at key points in time for the entire FMA area and the Peace, Puskwaskau and Main parcels.

The MNND is below the established target for the FMA area at all times. However, in 2007 and 2009 MNND for the Peace Parcel exceeds the established upper limit. This is likely related to the relatively small size of the Peace Parcel.

- **Forest management activities**

Future spatial planning at the landscape level will be used to make adjustments to the harvesting plans to achieve the desired level of landscape structure is maintained at key points in time.

- **Strategy and implementation schedule**

All future harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP. If conditions change, an adaptive management approach will be utilized to address these changes.

- **Monitoring procedure (monitoring results against forecasts)**

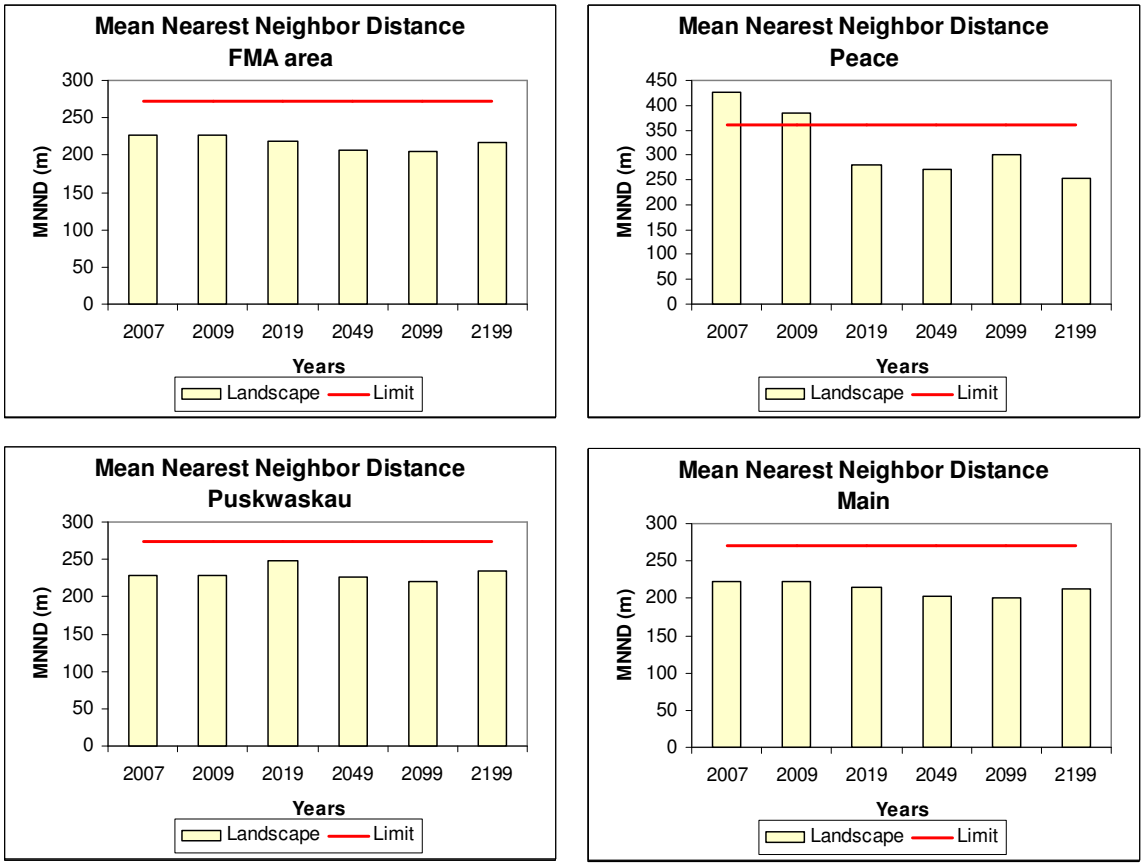
Mean nearest neighbour distance on the landscape will be compared to 2009 and reported in the *Annual Performance Monitoring Report*.

- **Linkages to DFMP and Annual Operating Plan**

All new harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP.

Figure 80. Mean Nearest Neighbour Distance for FMA area and the Peace, Puskwaskau, and Main Parcels

TNRG-RSTASourceData.xls
F090



Source: Timberline compiled data

(1.3) 1a.3 Indicator
Area weighted mean shape index (AWMSI)

Area-Weighted Mean Shape Index (AWMSI) provides a measure of patch shape complexity based on the perimeter-to-area ratio. The complexity of patch shapes in combination with the area of the shapes can influence many ecological processes. Small mammal migration, woody plant colonization and animal foraging strategies are influenced by patch shape. Many ecological effects attributed to the complexity of shape are actually related to "edge effects"[22]. In addition, shape influences the operability and economics of forest harvesting. For example, elongated harvest areas require more road construction than compact harvest areas and thus are more costly. Mapped cutblocks are generally simple in shape and usually somewhat rectangular. Where this is the case, the lack of measured complexity can be compensated operationally by feathering edges, variable retention and harvest area design and layout to create more edges relative to area.

AWMSI must not be evaluated in isolation but with careful examination of other landscape fragmentation metrics.

(1.3) 1a.3.1 Target
The AWMSI for 2009 will not fall below the AWMSI forecast

AWMSI was forcasted for the FMA area and each parcel at key points in time (2007, 2009, 2019, 2049, 2099 and 2199). Comparing the 2007 AWMSI data to the 2009 projection provides an indication of how well harvest plans are achieving the 2009 forecast. The assumption is that if the 2009 forecast is achieved it is likely that all the forecasts at key points in time will also be achieved (Figure 81).

- **Acceptable variance**

AWMSI (area-weighted mean shape index) will not decrease by –15% of the 2009 forecast for the FMA area and the Peace, Puskwaskau and Main parcels as indicated in Figure 81.

- **Current status**

Current status refers to the conditions observed for the year 2007. Figure 81 presents the AWMSI at key points in time for the FMA area and the Peace, Puskwaskau and Main parcels.

The AWMSI decreases from approximately 10 to 6.5 over time for the FMA area. Each of the parcels roughly follows this pattern, with decreases beginning after 2019 and settling at a value between 5.0 and 6.5 in the long term.

[22] Edges between forests of dramatically different structure or composition often have different microclimatic environments than interior habitats. These microclimatic differences, such as changes in wind and light intensity alter disturbance rates and vegetation composition and structure can alter habitats and the dynamics of species that are dependent on these habitats. Some species prefer edge habitats; others are indifferent while still others are adversely affected by edges.

- **Forecasting assumptions and analytical methods**

The observed trend in Figure 81 suggests that landscape level shape complexity decreases over time. However, the projected shape complexity remains above the minimum lower limit throughout the entire planning period and for all harvest areas.

- **Forest management activities**

Future spatial planning at the landscape level will be used to make adjustments to the harvesting plans to achieve the desired level of landscape structure is maintained at key points in time.

- **Strategy and implementation schedule**

All future harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP. If conditions change, an adaptive management approach will be utilized to address these changes.

- **Monitoring procedure (monitoring results against forecasts)**

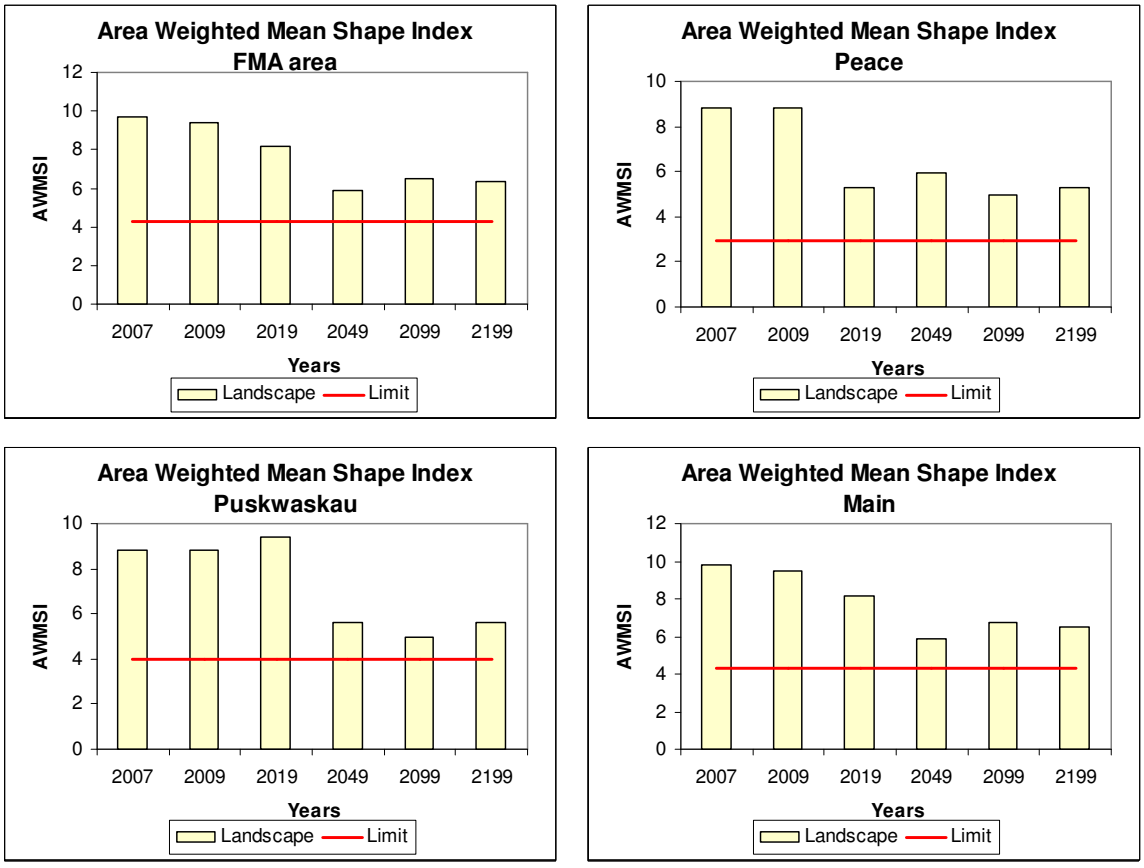
The area-weighted mean shape index on the landscape will be compared to 2009 and reported in the annual *Annual Performance Monitoring Report.*

- **Linkages to DFMP and Annual Operating Plan**

All new harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP.

Figure 81. Area-Weighted Mean Shape Index for FMA area and the Peace, Puskwaskau and Main Parcels

TNRG-RSTASourceData.xls
F091



Source: Timberline compiled data

(1.3) 1a.4 Indicator
Percentage of total area by patch size class

The distribution of patch sizes is reported by 0 - 100 ha, 100 - 500 hectares and 500+ hectare classes. These classes were defined based on extensive literature review and the maximum 500-hectare aggregation rule.

Patch size distribution must not be evaluated in isolation but with careful examination of other landscape fragmentation metrics.

(1.3) 1a.4.1 Target
100% of the total area by patch size class will meet the 2009 forecast

Target patch size distributions were derived for the Boreal Forest and Foothills natural regions based on theoretical fire-return intervals (ORM, 2000). Targets for the Boreal Forest Natural Region were derived from measured patch size classes of four 20-year periods of unmanaged forests (Delong and Tanner, 1996); while targets for the Foothills Natural Region were based on the distribution of patch sizes in historical pre-suppression air photos of the Foothills Model Forest in Hinton, Alberta (Andison, 1997). The targets for the reporting units (FMA area and the Peace, Puskwaskau and Main parcels) are weighted based on the proportion of areas in the Boreal Forest and Foothills natural regions (Table 40).

Table 40. Theoretical Fire-Return Interval Patch Size (Area %)

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Table 29

Reporting Units	1–100 ha		100–500 ha		500+ ha	
	LL	UL	LL	UL	LL	UL
FMA Area	10	16	14	25	53	82
Peace	14	23	13	25	52	73
Puskwaskau	14	23	13	25	52	73
Main	9	15	14	25	53	83
Notes: LL= Lower Limit; UL= Upper Limit						

Source: ORM compiled data

- **Acceptable variance**

The acceptable variance is to be within ±10% of the 2009 forecast.

- **Current status**

Figure 82 to Figure 85 present the distribution of patch sizes at key points in time (2007, 2009, 2019, 2049, 2099 and 2199) for the FMA area and the Peace, Puskwaskau and Main parcels, including the most current data (2007). The range of natural disturbance is represented by the red “I beam” and the blue bar represents the current or projected distributions.

Except for Peace Parcel, smaller patch sizes (0 - 100 ha) at both the FMA area and parcel levels are greater than the historical range for the entire planning horizon. Peace is within or close to the historical range for smaller patch sizes for all planning periods; however it has a shortage of

mid-size (100-500 ha) patches in the short and medium term. The other parcels have mid-size (100-500 ha) patch area percentages that are within or close to historical ranges. The Peace Parcel has almost 80% of the area in patch sizes that are greater than 500 ha, which is within the calculated historical range.

The other parcels, on the other hand, have 500+ hectares area percentages that are less than the historical range. The main reason for this is the application of a 500 hectares harvest area aggregation rule within the AAC analysis (Canfor, 2003). The number of large patches will decrease over time due to the harvesting that limits the aggregated harvest area size at 500 hectares.

- **Forecasting assumptions and analytical methods**

The evaluation of the landscape structure will help determine the present land condition and understand and evaluate any future landscape changes resultant from the proposed management decisions. A brief summary of the methodology for determining the landscape values follows and a full description is contained within the ORM report (ORM, 2001). The landscape structure values were developed in a two-phase process:

- GIS processing to create coverages and grids for the spatial files; and
- GIS output processing and *FRAGSTATS*[23] calculations.

The final phase is to produce landscape reports containing the information discussed within this section (refer to Figure 82 to Figure 85).

- **Forest management activities**

Analysis of the results shows that it is difficult to achieve the distribution of patch sizes as defined based on the theoretical fire-return intervals when this objective is considered secondary to other constraints in the *Resource And Timber Supply Analysis* (Canfor, 2003). More specifically, adjacency/ green-up rules and the maximum harvest area aggregation of 500 hectares (1,000 hectares in the Caribou Area) will likely constrain achievement of the target distribution of patch sizes.

The general trend for the is that the proportion of mid-size (100 - 500 ha) patches increases and the proportion of large (500+ ha) patches decreases, while the proportion of small patches begins in the high 20% range and stablizes in the mid thirties.

Figure 82 to Figure 85 present the distribution of patch sizes at key points in time for the FMA area and its parcels.

- **Strategy and implementation schedule**

All future harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP. If conditions

[23] *FRAGSTATS* is a landscape pattern analysis program developed at the Oregon State University

change, an adaptive management approach will be utilized to address these changes.

- **Monitoring procedure (monitoring results against forecasts)**

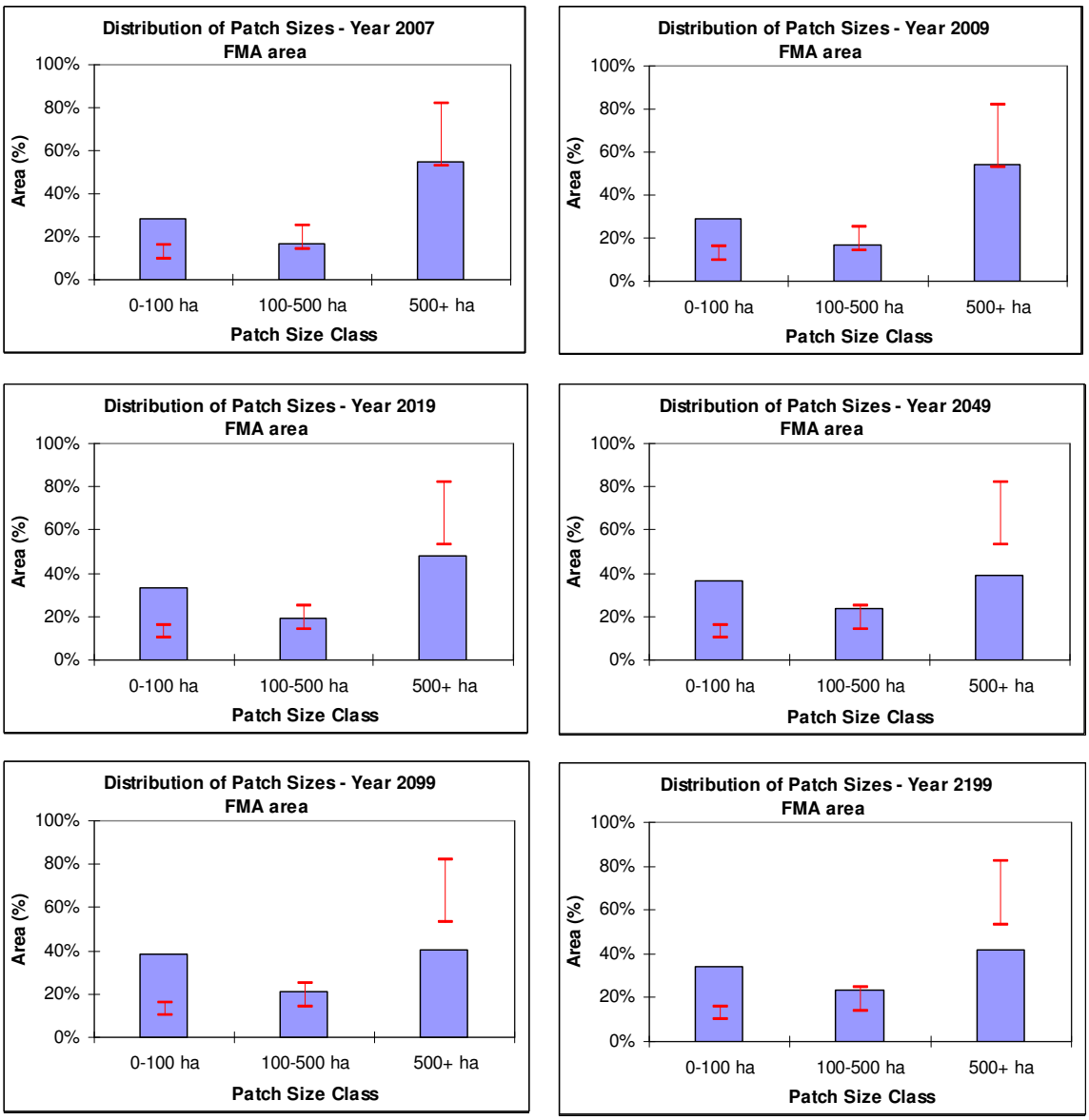
The distribution of patch sizes on the landscape will be compared to 2009 and reported in the annual *Annual Performance Monitoring Report*.

- **Linkages to DFMP and Annual Operating Plan**

All new harvesting plans will follow the strategic direction as outlined in the Healthy Pine Strategy amendment to the 2003 DFMP.

Figure 82. FMA area Distribution of Patch Size

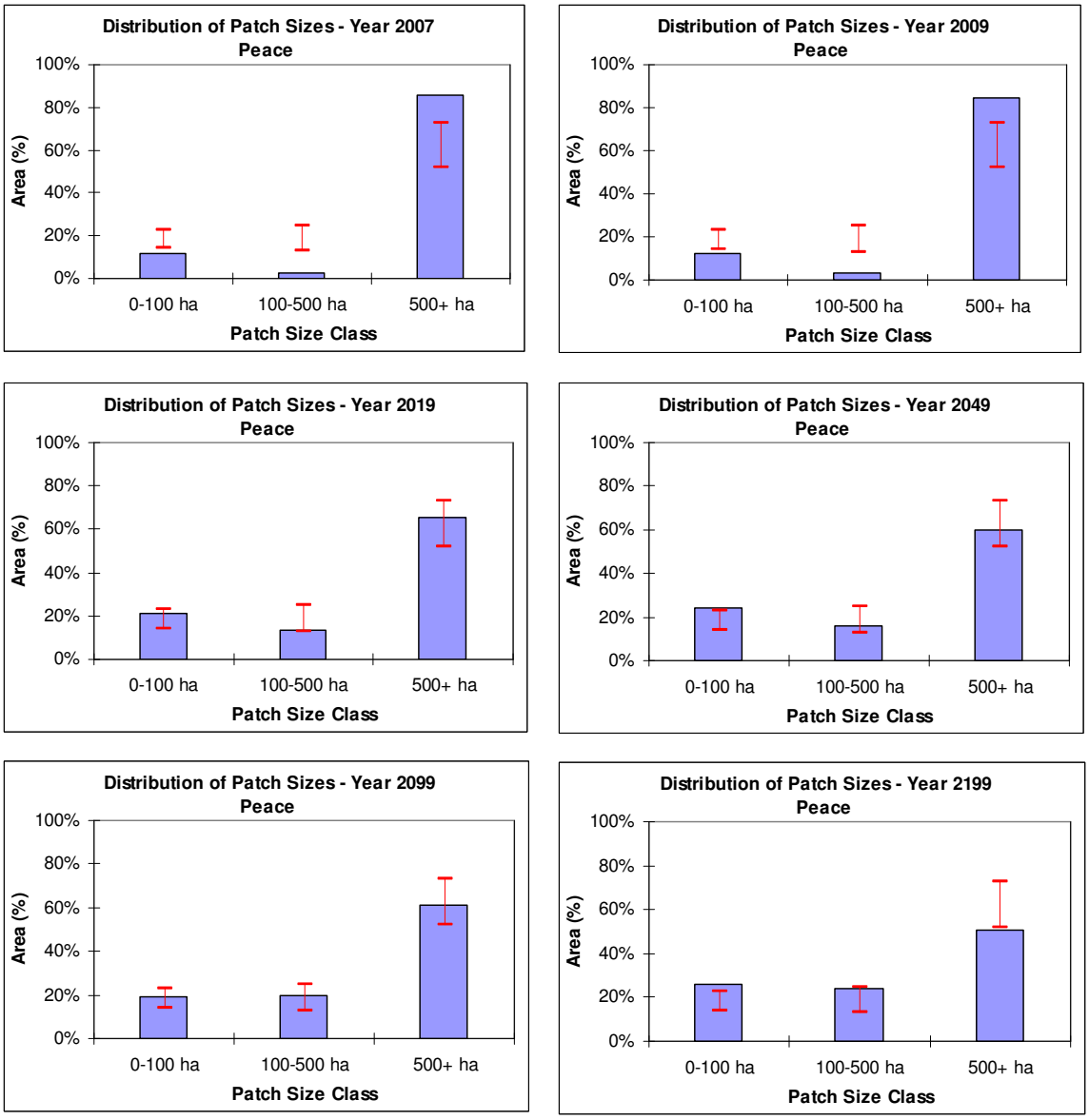
TNRG-RSTASourceData.xls
F092



Source: Timberline compiled data

Figure 83. Peace Parcel Distribution of Patch Size

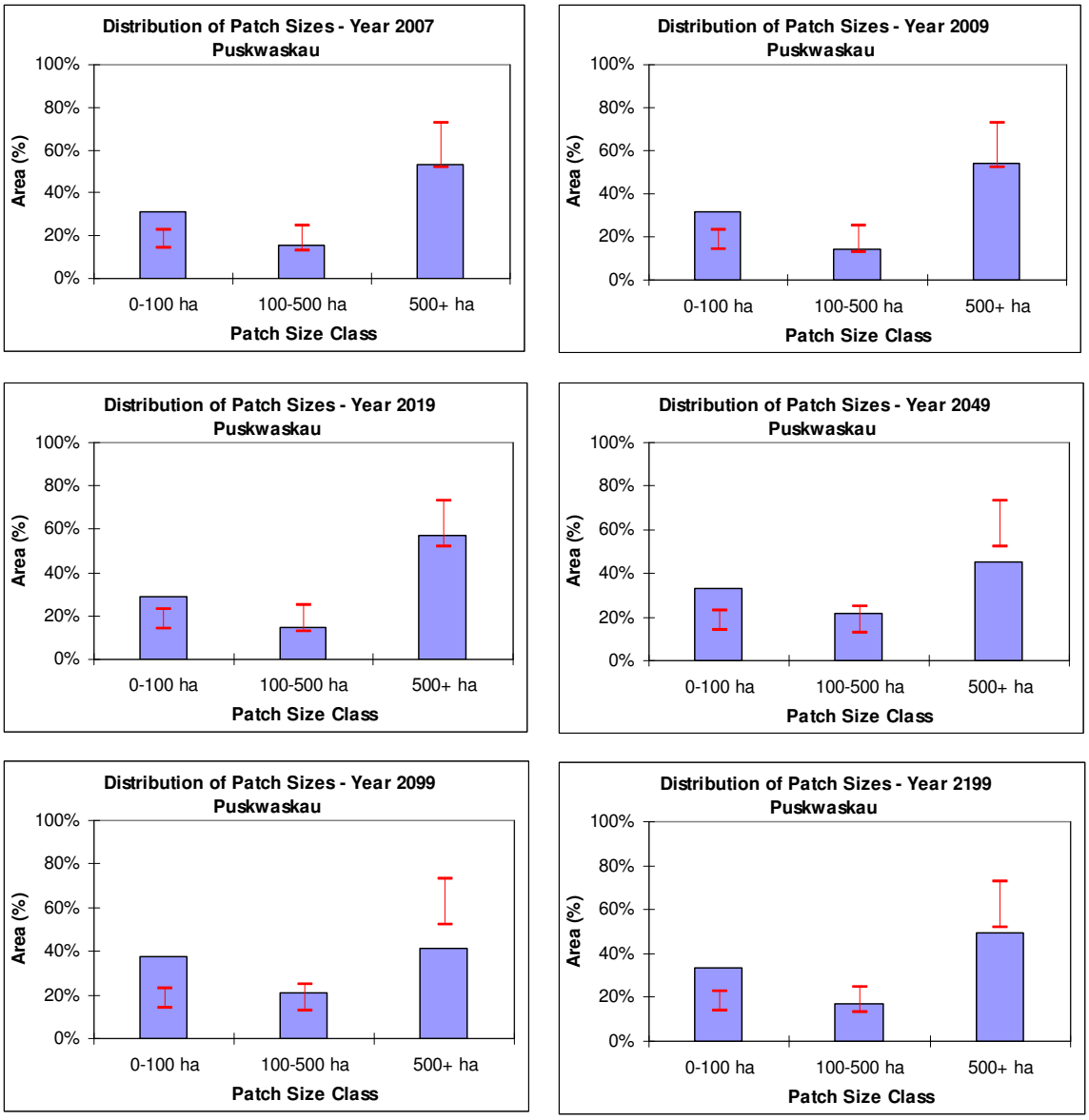
TNRG-RSTASourceData.xls
F093



Source: Timberline compiled data

Figure 84. Puskwaskau Parcel Distribution of Patch Size

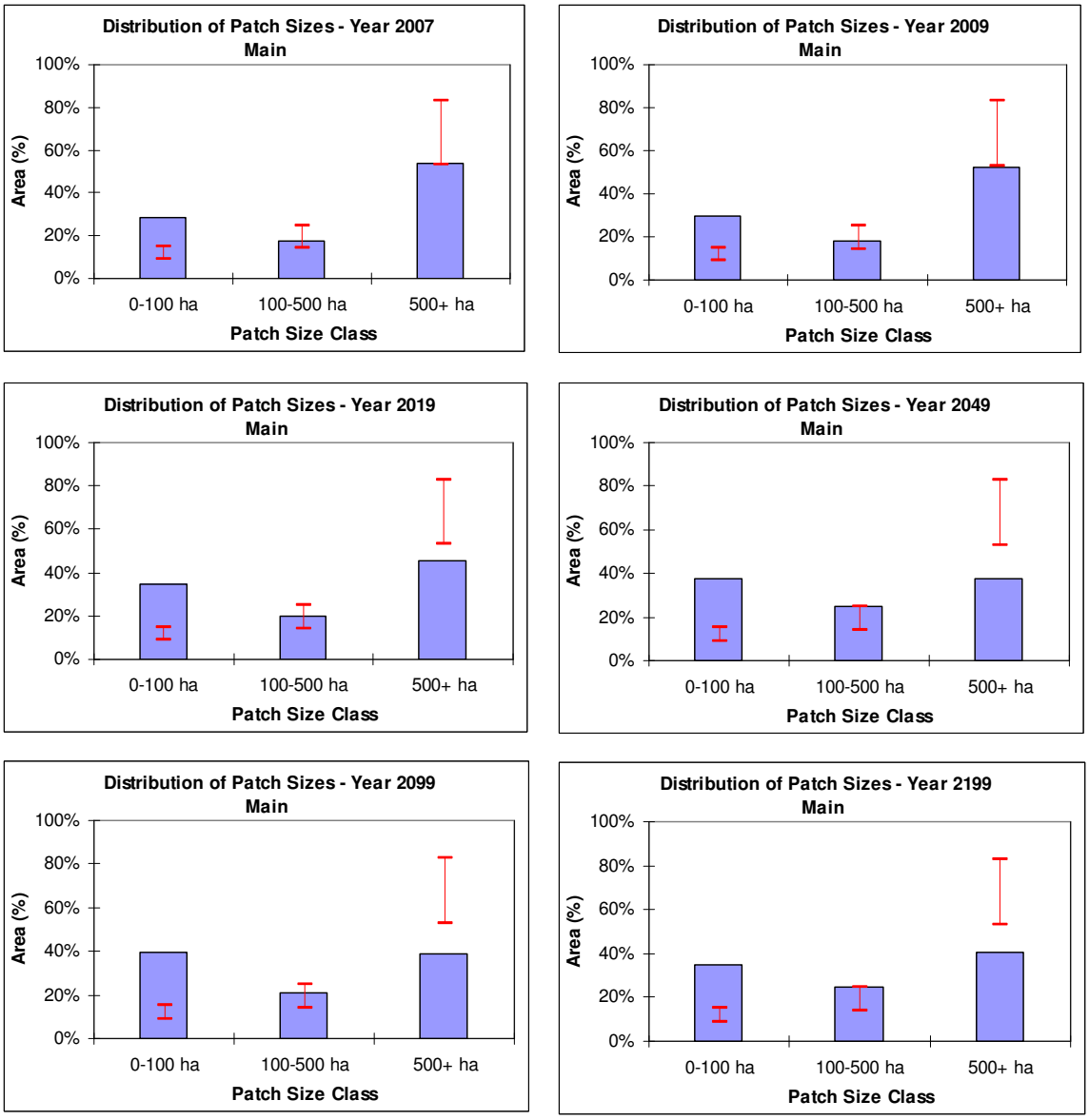
TNRG-RSTASourceData.xls
F094



Source: Timberline compiled data

Figure 85. Main Parcel Distribution of Patch Size

TNRG-RSTASourceData.xls
F095



Source: Timberline compiled data

6.5 Average Water Yield

(3.2) Critical Element

Water Quality and Quantity
Conserve water resources by maintaining water quality and quantity.

Forests play an important role in intercepting and cleaning fresh water supplies that are essential to human and wildlife populations. Natural fluctuations in the quality and quantity of water occur as a result of annual and seasonal variations in precipitation and temperature. Fires, insects and disease can naturally impact the chemical composition and flow rates within watersheds. Man has influenced soil and water by harvesting and by clearing land for settlements, agriculture and oil and gas.

(3.2) 2 Value
Water quantity

Stream flow is usually discussed in terms of water yield, which includes both quantity and timing. It is a key determinant of the energy available for erosion, transport, and deposition of sediment within channels. It is also a key component in determining the morphology of channels, with implications for the quality and quantity of fish habitat. Finally, it is an important component in determining the availability and suitability of water for beneficial uses.

(3.2) 2a Objective
Water quantity will be maintained

(3.2) 2a.1 Indicator
Percentage of sampled watersheds that are in conformance with the average water yield increase limit indicated in the Operating Ground Rules

The *Operating Ground Rules* (ORG) (ASRD, 2008a) paragraph 6.02 recommends that predicted water yields do not exceed 15%.

Water yield refers to streamflow quantity and timing. Water yield can be altered by compaction or disturbance of the ground surface, as with roads and skid trails or by vegetation growth or removal. It generally increases after timber harvest through a reduction in transpiration and precipitation interception losses. Removal of forest canopy also affects snow accumulation and melt processes, often resulting in an increase in snowpack accumulation and melt rates, thereby increasing runoff rate and volume. As the forest regenerates, the forest canopy develops, re-establishing the interception and transpiration processes (hydrological recovery).

(3.2) 2a.1.1 Target
100% of sampled watersheds are in conformance with the average water yield increase limit of 15% as indicated in the Operating Ground Rules (reported annually)

- **Acceptable variance**

Total forest cover removal within a defined watershed will not cause an increase in annual average water yield of greater than 20% for a minimum of 10 of the highest equivalent clearcut area (ECA) watersheds in the FMA area.

- **Current status**

Canfor adheres to Section 4.1 of the *Operating Ground Rules* (ASRD, 2008a) regarding percent removal of merchantable timber. The ground rules are designed to minimize the impact of harvesting on watersheds, wildlife, aesthetics and site productivity.

ECA calculations for the approved 2003 DFMP (Canfor, 2003) and HPS Amendment were made using a stand height-based hydrological recovery model. Individual stands were assumed to have achieved full hydrological recovery[24] when they reached five metres in height. Harvesting is restricted such that ECA does not exceed 40% for the portion of each watershed above the H60 line[25]. A limit of 35% was used for those watersheds supporting bull trout populations. Direct estimation of water yields is not part of this approach.

The Forest Management Advisory Committee (FMAC) identified a need to determine the affect of forest cover removal on water yield and the above-mentioned target was developed. As a result, Canfor will be adhering to this target by continuing to model ECA as a surrogate for water yield. In addition, Canfor is committed to remaining informed of new research being conducted for this topic.

- **Forecasting assumptions and analytical methods**

The Alberta-ECA Model[26], developed by Dr Uldis Silins at the University of Alberta, evaluates the effect of past disturbances on stream flow in a watershed and projects cumulative effect (net combined effect) of past harvesting and natural disturbances. The potential impacts of proposed future harvesting can be determined by using the output from the forest estate models as input to the Alberta-ECA model. Water yield increases over a specific baseline (long-term averages) are calculated based on the

[24] Hydrological recovery takes into account the initial percentage of crown removal and the recovery through re-growth of vegetation since the initial disturbance.

[25] H60 is the elevation above which 60% of the watershed lies (the watershed area above the H60 is considered as the source area for the major snowmelt peak flows).

[26] http:www.cefm.rr.ualberta.ca/Research_Notes/Research%20Note%2007-03

input variables described below. Results for each watershed are determined in individual computer runs.

Inputs:

- Mean annual precipitation levels (mm). Long-term values for each watershed were obtained from Alberta Environment's Map of Mean Annual Precipitation with data based on 1971 - 2000 climate data from Environment Canada, Alberta Environment and the U.S. National Climate Data Center http:/ / www.climate.weatheroffice.ec.gc.ca/ climate_normals/ index_e.html.
- Long-term mean annual water yield (mm) for each watershed was obtained from the Water Survey of Canada, Atmospheric Services of Environment Canada who maintains a database (HYDAT) of archived hydrometric data obtained from 1,200 monitoring stations situated across Canada. Two stations within the vicinity of the Forest Management Agreement area were selected to represent the potential differing streamflow conditions found within the FMA area (Table 41):

Table 41. Monitoring Stations

SFMP Tables Master.xls
Table 36

Station Name	Station No.
Deep Valley Ck. near Valleyview, AB.	07GF008
Simonette River near Goodwin, AB.	07GF001

Source: Timberline 2005 complied data

Historical data that was missing was eliminated for this exercise so that approximately 10 years of data was used for each station. Also one of the stations had only seasonal data (May – October) so readings were extrapolated for the missing months. Sample data had to be converted from m^3/ s into mm for the model.

Assumptions:

The Alberta-ECA model bases the hydrologic recovery of forest stands on volume. The age at maximum volume growth rate is assumed to represent age at full hydrologic utilization. All forest growth information built into the model is based on Alberta Phase III provincial average growth and yield data for unmanaged (fire-origin) stands.

Results:

Table 42 indicates there are four watersheds that exceed the 15% target and one of those exceeds the acceptable variance of 20% water yield increase. The base year used for this calculation is 2022 – the year that shows the highest ECA impacts due to the focused harvesting of pine. After completion of the fifteen-year plan orginal cover constraints are enabled. All watersheds that exceed are put on track to recover before any new harvesting is to occur.

Table 42. Average Water Yield Increase (%) for 10 Sampled Watersheds – 2022

TNRG-RSTASourceData.xls
T040

Sampled Watershed	ECA (%)	Water Yield Increase (%)
8027	55.6%	22.7%
7214	40.7%	16.4%
7179	38.7%	17.5%
7232	37.6%	9.2%
8351	37.2%	15.1%
7816	34.3%	6.2%
1589	34.2%	12.2%
7509	30.4%	14.8%
2670	30.1%	11.1%
7443	18.1%	8.2%

Source: Timberline compiled data

- **Forest management activities**

Any new harvest plans will be evaluated using the Alberta-ECA model to evaluate water yield increases. A sample of 10 watersheds with the highest ECAs, as computed using the 2003 DFMP methodology (Canfor, 2003), will be run through the Alberta-ECA model to determine water yield increase.

The focused harvest of pine during the fifteen-year plan causes some water yield increases to exceed the target. ECA values will be routinely monitored as part of the annual operating plan (AOP) process and AOP harvest areas may be modified or deleted to respect the ECA limits.

- **Strategy and implementation schedule**

The Alberta-ECA model will be used to determine the rate of harvest limits within watersheds the next time it is necessary to recompile the harvest sequencing. At that time, the ECA level that results in water yield increases of >20% for each of the 10 highest ECA will be determined. Canfor will evaluate those watersheds above the ECA threshold and determine if any mitigation strategies can be implimented to reduce the immediate impacts, including but not limited to:

- Prompt deactivation;
- Prompt reforestation;
- Evaluating water quality concern rating values; and
- Delaying vegetation management activities.

- **Monitoring procedure (monitoring results against forecasts)**

The harvest sequence and any associated changes will continue to be monitored yearly in order to evaluate hydrological effects of forest cover removal by using the modelling procedure previously discussed. As better

data and new research concerning hydrological recovery become available, it will be incorporated into the water yield modelling procedure.

The percentage of the sampled watersheds that are in conformance with the annual average water yield target will be complied and reported in the *Annual Performance Monitoring Report*.

♦ **Linkages to DFMP and Annual Operating Plan**

The target supports water quality, watershed protection and bull trout habitat objectives in the Healthy Pine Strategy amendment to the 2003 DFMP.

6.6 Grizzly Bear

The *Alberta Grizzly Bear Recovery Plan 2008 - 2013* (ASRD, 2008b) states:

"In 2002, the Endangered Species Conservation Committee recommended that the Alberta grizzly bear population be designated as 'Threatened'. This recommendation was based on the grizzly bear's small population size, slow reproductive rate, limited immigration from populations outside Alberta, and increasing human activity on the landscape. Based on recent estimates of grizzly bear mortality rates, there is concern that the population may be in decline.

The amount of human use in an area, which is usually related to amount of access, can affect grizzly bear health and survival. Grizzly bear mortality has been correlated with road density; more roads usually equate to more human use. Ruediger, (1996) suggested that high road densities could create mortality sinks for grizzly bears, and in the northern east slopes, grizzly bear survival rates decreased with increasing road densities (Stenhouse et al., 2003). Grizzly bears may avoid areas of extremely high human use because of the disturbance (Nielsen et al., 2004).

Open route densities at or below 0.6 km/ km^2 in high quality grizzly bear habitat designated as Grizzly Bear Priority Areas (GPAs), and open route densities at or below 1.2 km/ km^2 in all remaining grizzly bear range have been adopted by jurisdictions in the USA for the purpose of grizzly bear conservation. . Open routes are roads and trails (including seismic lines) on which motorized travel is possible and permissible (tracking this also contributes to our understanding of the overall human footprint). Because human use of access is difficult to measure, open route densities are recommended as a surrogate for amount of human use."

In its SFMP 2005, Canfor established an objective to maintain forests on the landscape using open[27] (non-reclaimed[28]) road densities. Target (4.2) 2a.1.1 was established to monitor achievement of that objective. That objective can also be used to monitor the impact of forest management on grizzly bear habitat.

[27] Open roads are those held under Licenses of Occupation (LOC), oil and gas roads held under mineral surface leases (MSL), and non-reclaimed forestry roads, including all temporary roads that have not received final clearance.

[28] These roads are used to access timber but are not required for permanent access. They are reclaimed after the initial silviculture treatment is completed or if they are not required for silviculture access the road is reclaimed immediately after hauling is completed. When harvest areas receive final clearance, reclaimed roads within or tributary to the blocks, will not be included in the calculation.

Target

To have no more than 0.6 lineal km/ km^2 in open (non-reclaimed) roads over a 5-year period, for each FMA parcel (Peace, Puskwaskau and Main)

The impact of road density is important in several aspects. The first and most significant is fragmentation of landscapes and habitats. Road construction results in habitat loss and creates barriers between remaining habitats on both sides of the road. The numbers of animals killed by vehicles is related to the traffic density (ASRD, 2008b).

Regular road maintenance, access management and integrated land management with energy sector companies, including road deactivation and access restriction, can mitigate some of the negative impacts of roads.

- **Acceptable variance**

  The acceptable variance is a maximum of 0.7 km/ km^2 for the FMA area and each individual parcel.

- **Current status**

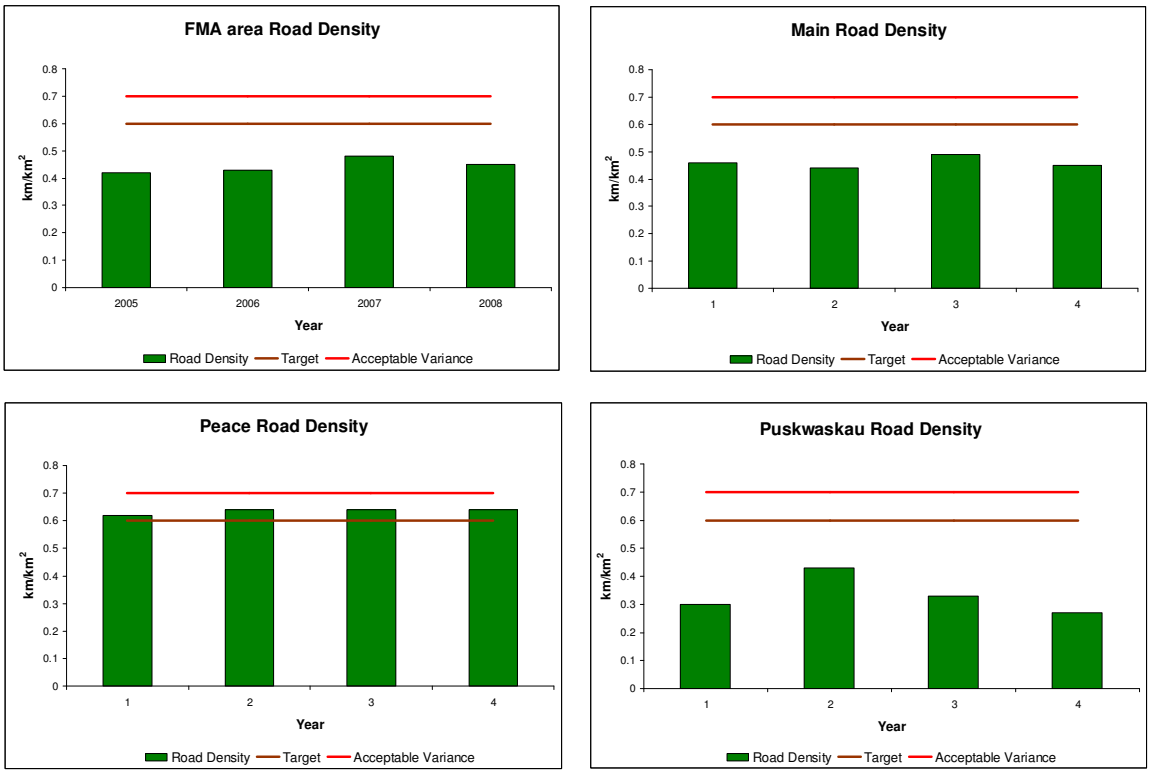
  According to the September 24, 2008 Draft Core and Secondary Grizzly Bear Conservation Boundaries much of the Main Parcel of the FMA area is within the Seconday Grizzly Bear Conservation Area[29]
  http://srd.alberta.ca/fishwildlife/wildlifeinalberta/grizzlybearmanagement/default.aspx.

  Open road densities in the FMA area and individual parcels are provided in Figure 86. Canfor has been monitoring road densities since 2005 and the acceptable variance for the FMA area and the Peace, Puskwaskau and Main parcels has been achieved since that time.

[29] Areas of good habitat, reflecting the broader range of grizzly bears

Figure 86. Open Road Densities within the FMA area

TNRG-RSTASourceData.xls
F096



Source: Canfor compiled data

- **Forest management activities**

Canfor works cooperatively with the energy sector to minimize road densities. To date, Canfor has signed Integrated Land Management Memoranda of Understanding (MOU) with Suncor and Conoco Phillips (formerly Burlington Resources Canada Ltd.) to integrate the planning and operational activities of both parties. Canfor is currently working to establish memoranda with two additional energy companies operating on the FMA area.

- **Strategy and implementation schedule**

Canfor will increase its efforts to minimize road densities by communicating road density targets to other resource industries.

- **Monitoring procedure (monitoring results against forecasts)**

Three activities will be monitored to achieve the target:

- The amount of open road (km/ km^2) in a given year;
- The number of signed Integrated Land Management Memoranda of Understanding; and

- Canfor's continued involvement in Foothills Landscape Management Forum (FLMF) initiatives, including roads; which are one of the FLMF's primary priorities.

The Roads Module of Canfor's forestry system and the non-routed road GIS coverage will be utilized to produce the required report. The road database will be updated annually. Canfor's Land Use Coordinator will report all cancelled LOCs and Canfor's Operational Supervisors will report all deactived temporary roads to the Woodlands Information Management group, who then will generate the required reports.

The resultant data (km/ km^2) will be reported in the *Annual Performance Monitoring Report*.

♦ **Linkages to DFMP and Annual Operating Plan**

This is a new indicator and it is not presently a component of the approved SFMP 2005. It is based on Target (4.2) 2a.1.1 presented therein.

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8 GLOSSARY

Adaptive Management
An iterative and deliberate process of applying principles of scientific investigation to design and implementation in order to better understand the ecosystem and reduce the key uncertainties and as a basis for continuously refining the program/ project design and operation.

Age Class
The classification of different stands in a forest, or trees in a stand, into a series of ages (e.g., 1 to 20 years might be Age Class 1, 21 to 40 might be Age Class 2, and so on).

ASRD
Alberta Sustainable Resource Development is the provincial department responsible for the management of the forests of the province.

Alberta Vegetation Inventory (AVI) Update
The maintenance of an approved AVI coverage by mapping the changes that occur to the AVI as a result of anthropogenic (e.g. timber harvesting, or land use activities) or natural disturbance, re-vegetation by planting or natural means, or the growth and/or succession of stands of trees or other vegetation, using approved AVI classification and mapping standards.

Annual Allowable Cut (AAC)
The volume of timber that can be harvested under sustained-yield management in any one year, as stipulated in the pertinent approved forest management pan. In Alberta it is the quadrant cut divided by the number of years in the quadrant, usually five.

Annual Operating Plan (AOP)
A plan prepared and submitted by the forest operator each year. An AOP approved by Alberta provide the authorization to harvest. The AOP is a requirement of the Timber Management Regulation.

Buffers (or buffer zone)
An area or edge of a protected area that has land-use controls that only allows activities compatible with the objectives of the protected area. The objective of the buffer zone is to provide added protection for the core reserve area.

Coniferous
Cone bearing trees with needle or scale-like leaves belonging to the botanical group Gymnospermae.

COMPLAN
COMPLAN is a spatially based forest simulation model, developed by Olympic Resource Management that has been used for timber supply analyses since 1994. COMPLAN uses an iterative approach to establish periodic harvest levels that can vary over time. Users are able to set harvest levels that the model will try to reach within the constraints established. COMPLAN schedules harvests at the individual block or stand level subject to adjacency (green-up) and non-timber resource constraints (cover constraints).

COMPLAN uses a hierarchical data structure that takes advantage of a compartmental management approach to spatial data organization.

Cover Constraints
The restriction, limiting, or regulation of an activity, quality or state of being to predetermined or prescribed course of action or inaction. Constraints can be a result of policies or political will; management direction, attitudes and perceptions; or budget, time personnel and data availability limitations; or more typically, a complex interaction of all these factors.

Detailed Forest Management Plan (DFMP)
A long-term plan used to outline higher-level management objectives, sustainability and timber production assumptions for a Forest Management Agreement.

DFMP/ AOP Validation
The 2003 DFMP strategies, directives and objectives are used to guide Annual Operational Plans (AOP). Since it is difficult to capture all of the nuances of the natural world, it is likely changes to operational plans will occur. These changes are compared to the 2003 DFMP to confirm that those objectives are achieved. Annual Operational Plans are validated using the process summarized below:

- DFMP resultant data is used as the initiation point;
- Static resultant is created;
- AOP is inputted;
- COMPLAN is run;
- Outputs are generated; and
- Reports are developed to validate DFMP objectives.

Deciduous
Trees belonging to the botanical group *Angiospermae* with broad leaves, usually these trees shed their leaves annually.

Equivalent Clearcut Area (ECA)
This refers to an area that has been harvested, cleared or burned. The ECA index, expressed as a percentage, describes an area of regenerated growth in terms of its hydrological equivalence to a clearcut. As the area regenerates and growth develops, the hydrological impact is reduced. ECA is a primary factor considered in an evaluation of the potential effect of past and proposed forest harvesting on water yield. ECA is expressed as a percent of watershed area.

Fifteen-Year Plan
The fifteen-year plan prepared for the Healthy Pine Strategy is the spatially explicit harvest sequence that is output by COMPLAN for the first fifteen years of the planning horizon from 2007 to 2021. It was generated using through a combination of quotas and block-level harvest priorities that were provided by Canfor planners.

FMA
A legal agreement signed between a private forest company and the Province of Alberta. It defines the rights, responsibilities, and constraints that apply to a specified area of

forest for the purpose of removing timber for commercial purposes. The forested area to which the agreement applies is called the FMA area. The FMA area may comprise one or several Forest Management Units (FMUs) (*see* Forest Management Units).

FMAC
A committee comprised of local stakeholder groups who are directly affected by or who have an interest in the management of the forest resources. This committee has been formed to review Canfor's harvest plans and to identify issues of concern.

Forest Management Unit (FMU)
An administrative unit of forest land designated by the Minister, as authorized under Section 14(1) of *Forest Act*.

Green-up Period
The time needed to re-establish vegetation after a disturbance. Specific green-up periods may be established to satisfy visual objectives or hydrological requirements, or as a means of ensuring re-establishment of vegetation (for silviculture, wildlife habitat or hydrological reasons) before adjacent stands can be harvested.

Growing Stock
The trees growing in a forest or stand, usually measured as number of trees or volume per unit area.

H60
H60 is the elevation above which 60% of the watershed lies (the watershed area above the H60 line).

Harvest Level
A volume or area of timber determined through timber supply analysis available for harvest on an annual sustainable basis within a Defined Forest Area (DFA). A harvest level is not an annual allowable cut (AAC) unless approved by the Minister.

Interpretive Bulletin
Document issued from time to time by Alberta describing protocols, standards, methods or other applicable to forest management planning.

License Of Occupation (LOC)
A disposition issued by Alberta authorizing occupation of a linear corridor, often for an access road.

Monitoring
The continued checking of output of a system to detect shortcoming of the model. "Growth and yield monitoring" is the process of comparing the observed to the predicted growth and yield for a stand or forest area.

Mountain Pine Beetle
The mountain pine beetle, *Dendroctonus ponderosae Hopkins*, is a species of bark beetle native to the forests of western North America. It has a hard black shell and measures about 5 millimetres, about the size of a grain of rice. They are a pest of Lodgepole Pine, which they kill by boring through the bark into the phloem layer on which they feed and in which eggs are laid.

Minimum Harvest Age (MHA)
The youngest age at which a stand is available to be harvested. These ages vary by yield curve and by natural subregion, and can be found in Table 14 of Appendix 3 of the 2003 DFMP.

Netdown
The process of identifying the net landbase, which is the number of hectares of forestland that actually contribute to the allowable annual cut. Areas and/ or volumes are sequentially deleted or reduced from the gross landbase for a number of considerations, including private ownership, non- forest or non-productive, environmentally sensitive, unmerchantable, and inaccessible.

Non-reclaimed roads
Open roads are those held under Licences of Occupation (LOC), oil and gas roads held under mineral surface leases (MSL), and non-reclaimed forestry roads, including all temporary roads that have not received final

Old Seral
A forest of mature or overmature timber that is beyond its peak growing period. For the purposes of this document, the term old seral has been replaced with old seral stage to be consistent with the 2003 Detailed Forest Management Plan (DFMP) terminology.

Open Roads
Open roads are those held under Licenses of Occupation (LOC), oil and gas roads held under mineral surface leases (MSL), and non-reclaimed forestry roads, including all temporary roads that have not received final clearance.

Patch
A specific area wherein relatively homogeneous environmental conditions occur. Boundaries are defined by measurable changes in one or several environmental variables.

Preferred Forest Management Alternative (PFMA)
The timber supply scenario and associated cover constraints and schedules that best meet the objectives of Canfor and ASRD for the FMA area.

Prevention Strategy
The objective of the Prevention Strategy is to decrease MPB spread and outbreak potential by reducing the area of MPB susceptible pine stands.

Pine Harvest Priority
Pine Harvest Priority is calculated based on SSI, Yield Group and stand height. The calculation results in a priority ranking between 0 and 10. This ranking is the primary consideration in scheduling blocks for harvest in the fifteen-year plan.

Planning Horizon
The length of time over which a series of defined management actions occurs. For the purposes of modelling -200 years.

Quota
The timber quota is a share of the allowable cut of timber within a forest management unit. Quotas are also a mechanism used in COMPLAN to focus harvesting in particular geographic areas or forest types.

Rank 1
Rank 1 stands are the highest priority for susceptibility reduction. These stands provide the best habitat for MPB to produce brood and spread MPB to other stands.

Rank 2
Rank 2 stands are also important, but because of their lower pine content, lower suitability and/ or greater distance from existing MPB populations, they are a lower priority.

Resource and Timber Supply Analysis (RTSA)
Calculations/ computer models with built-in assumptions regarding forest growth patterns, used to determine the annual allowable cut.

Rotation
The period of years required to establish and grown even-aged timber crops to a specified condition of maturity.

Sensitivity Analysis
An analytical procedure in which the value of one or more parameters is varied; the changes that this produces are analyzed in a series of iterative evaluations. If a small change in a parameter results in a proportionately larger change in the results, the results are said to be sensitive to the parameter.

Seral Stages
A stage in forest succession. A series of plant community conditions that develop during ecological succession from a major disturbance to the climax stage. Most common characteristics/ classifications include tree species and age.

Spatial Harvest Sequence (SHS)
A stand level map depicting forest stands scheduled for timber harvesting that are feasible to be operated by the organization.

Stand Susceptibility Index (SSI)
SSI is a measure of a stand's capacity to produce beetles (i.e. new populations of MPB in the next year) in the event it is attached, however it does not serve as an indicator of the probability that the stand will be attached. The index is use to set priorities for MPB control and prevention activities. The Alberta Stand Susceptibility Index (ASSI) is a model used to rank susceptible stands. ASRD has directed that Rank 1 and Rank 2 stands be reduced by 75%. Refer to Rank 1 and Rank 2 definitions.

Sustainable Forest Management
Management to maintain and enhance the long-term health of forest ecosystems, while providing ecological, economic, social and cultural opportunities for the benefit of present and future generations.

Timber Harvest Planning and Operating Ground Rules
Standards for operational planning and field practices that must be measurable and auditable and based forest management plan objectives.

Timber Supply Compartment
A subsection of an FMA area for which operational plans are developed.

Water Quality Concern Rating
Water quality concern rating (WQCR) is the ranking system developed by P. Beaudry & Associates Ltd. based on the concept that the impact of stream crossings on water quality can be reduced through effective erosion and sediment control practices, and that this can be evaluated and scored using a field-based assessment. There are 5 concern classes - none, low, moderate, high and very high.

Water Yield
A drainage basin's total yield of liquid water during some period of time.

Yield Curve
Graphical representation of a yield table.

Yield
In timber management, the volume of wood available for harvest at the end of a rotation period, usually measured as unit volume per unit area (e.g., cubic metres per hectare) or the amount of output actually harvested and usable (e.g., volume of timber extracted).

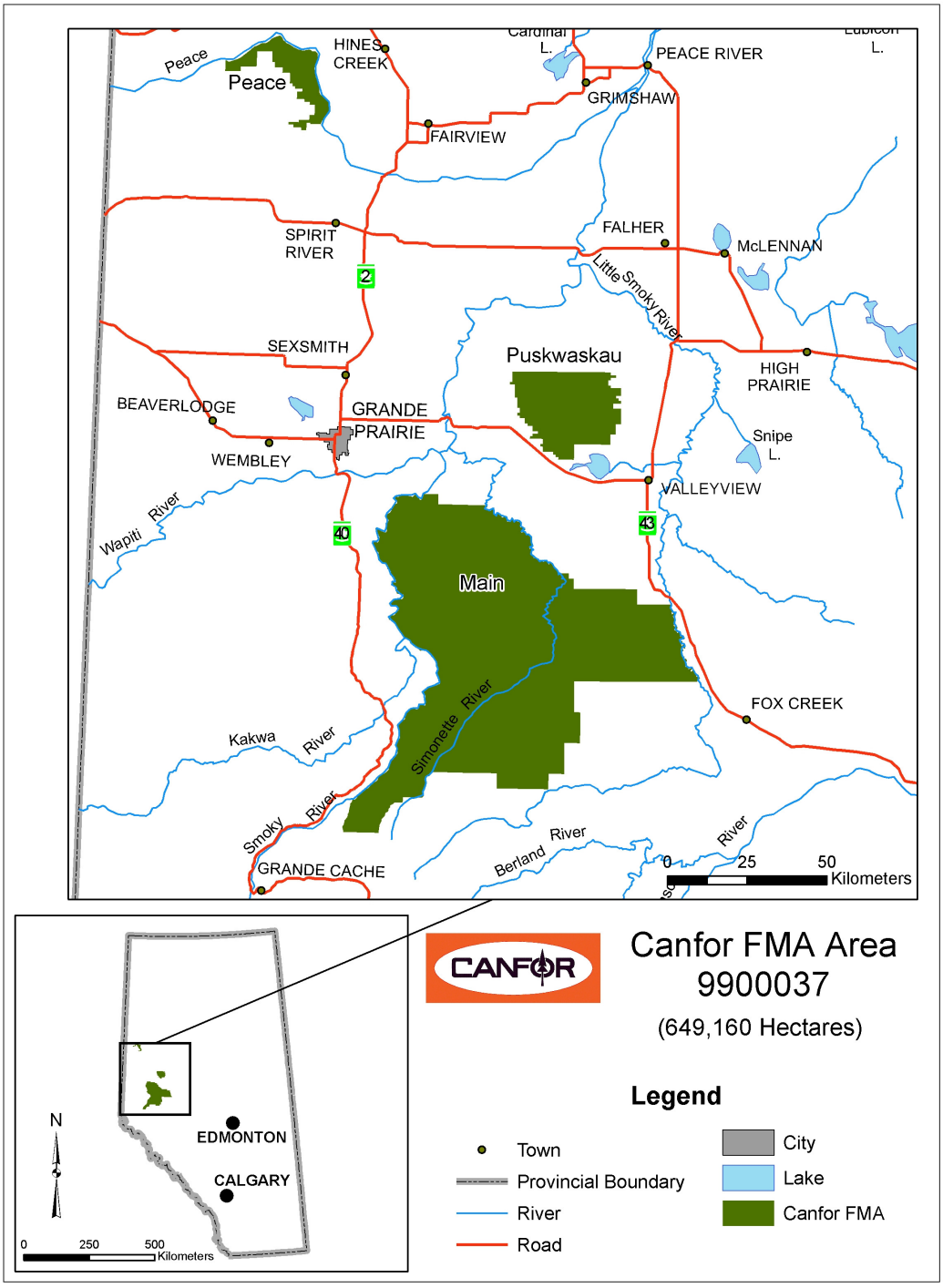
Yield Table
In its simplest form, a plot of expected fibre yield in terms of volume per unit area against stand age. The basic plot produces a normal yield table that assumes the site is fully stocked or has a normal stand density.

Appendix A - Landbase Netdown Criteria

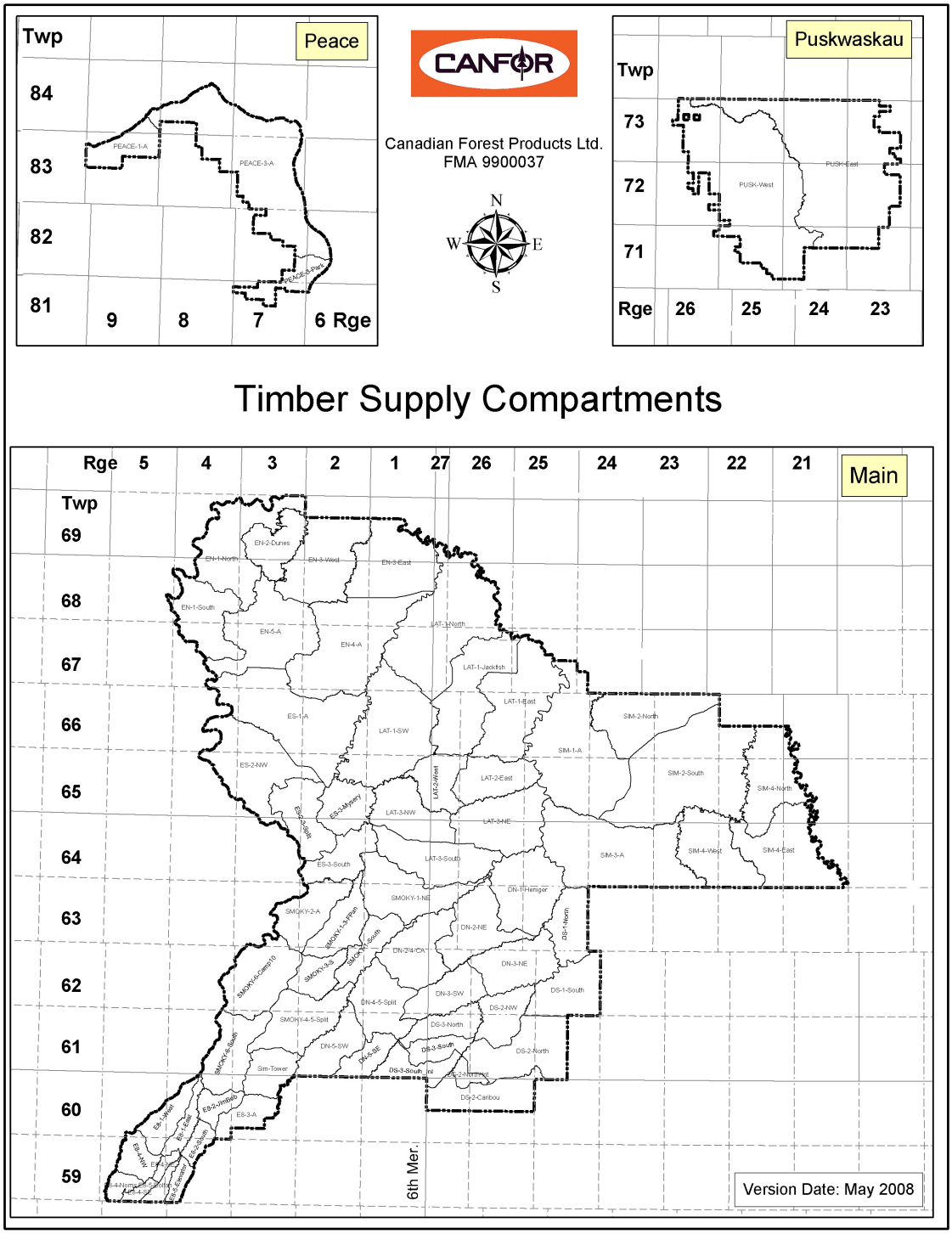
Netdown Category	Description
Natural non-vegetated	Includes water features, exposed rock and sand
Anthropogenic non-vegetated	Includes rural residential, industrial development
Anthropogenic vegetated	Includes agriculture, rights-of-way, wellsites, pits etc.
Non-forest vegetated	Shrubland, grassland, etc - less than 6% treed
Roads not in AVI	Polygons generated by buffering 10 metres either side of the centerline for all roads
Forested Steep Slope	Slopes too steep for forest management operations, with merchantable tree cover
Forested Slump	Areas where land has shifted and is not stable for forest management operations
Gravesites	Known archaeological grave sites were buffered with a 100-metre buffer. These buffers are considered to be unavailable for harvest.
DRS	Government landbase deletions
Rare Physical Environments	Cactus Creek, Fourth Creek, Peace River Dunvegan, Sand Dunes
Trumpeter Swan Sites	Buffers (100 metres) around trumpeter swan nesting sites
Watercourse buffers	Buffers around streams and lakes, according to Operating Ground Rules
Low Productive –Yield Group 13	Black spruce leading stands with low productivity
Height/ Age Yield Group 12	Stands in Yield Group 12 older than 80 years and below 16 metres in height
Height/ Age Other Confer	Stands in all other conifer Yield Groups older than 80 years and below 13 metres in height
AOP Reserve Areas	The addition of stands classified as AOP reserve areas were removed from the THLB. These are polygons classified within the new AOP coverage as AOP blocks with a reserve status

Appendix B - Reference Maps

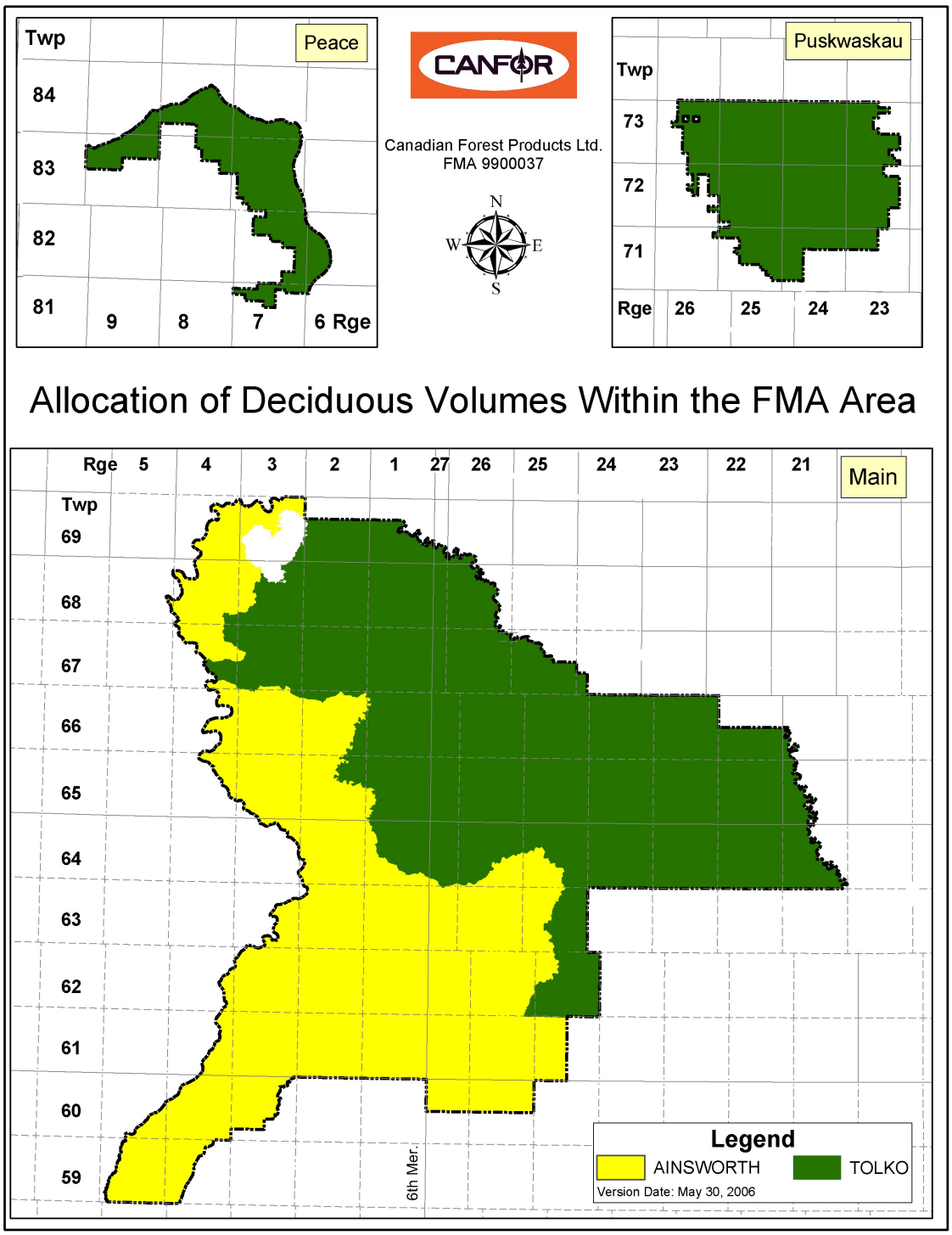
Map 1 - FMA 9900037 Location



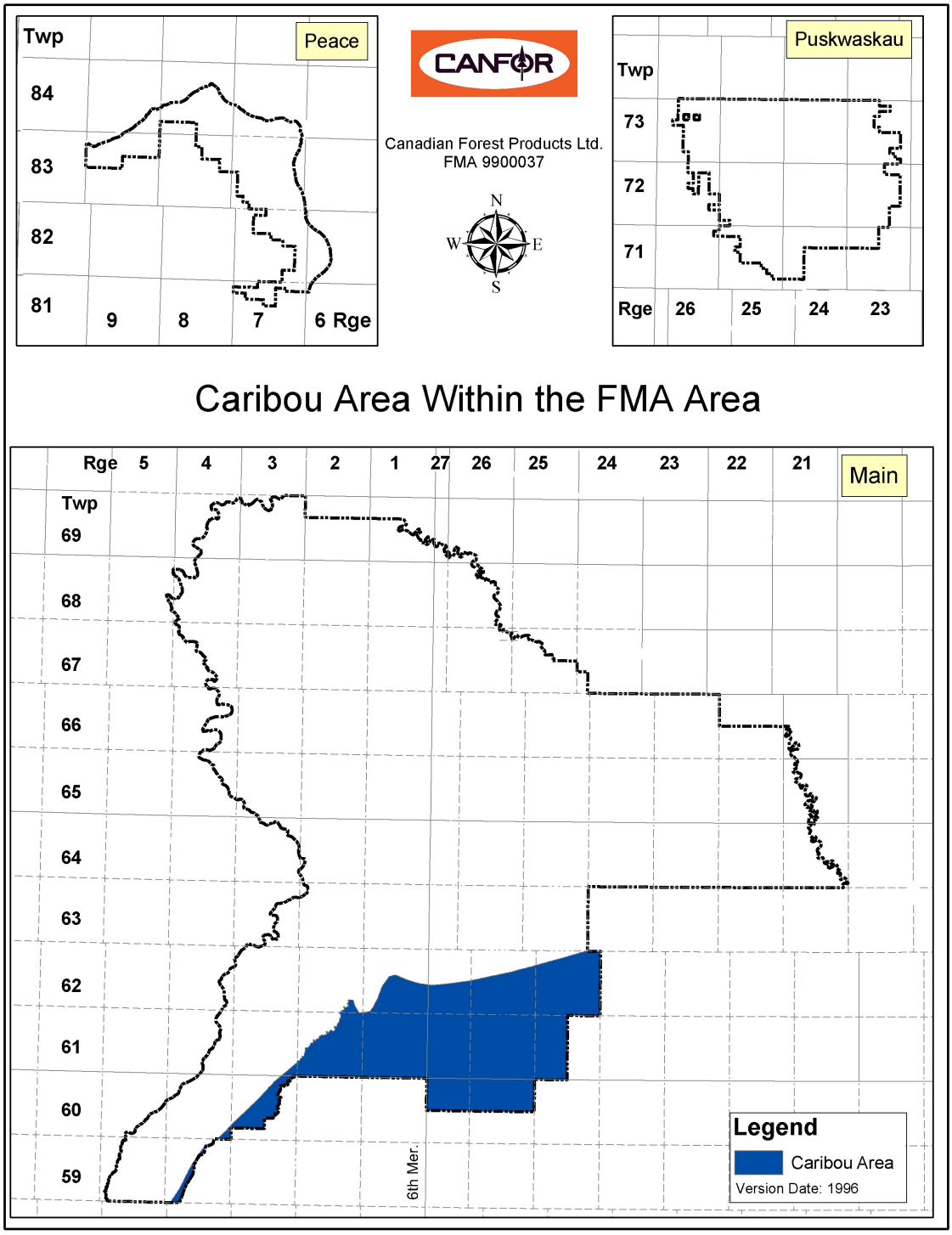
Map 2 - Timber Supply Compartments



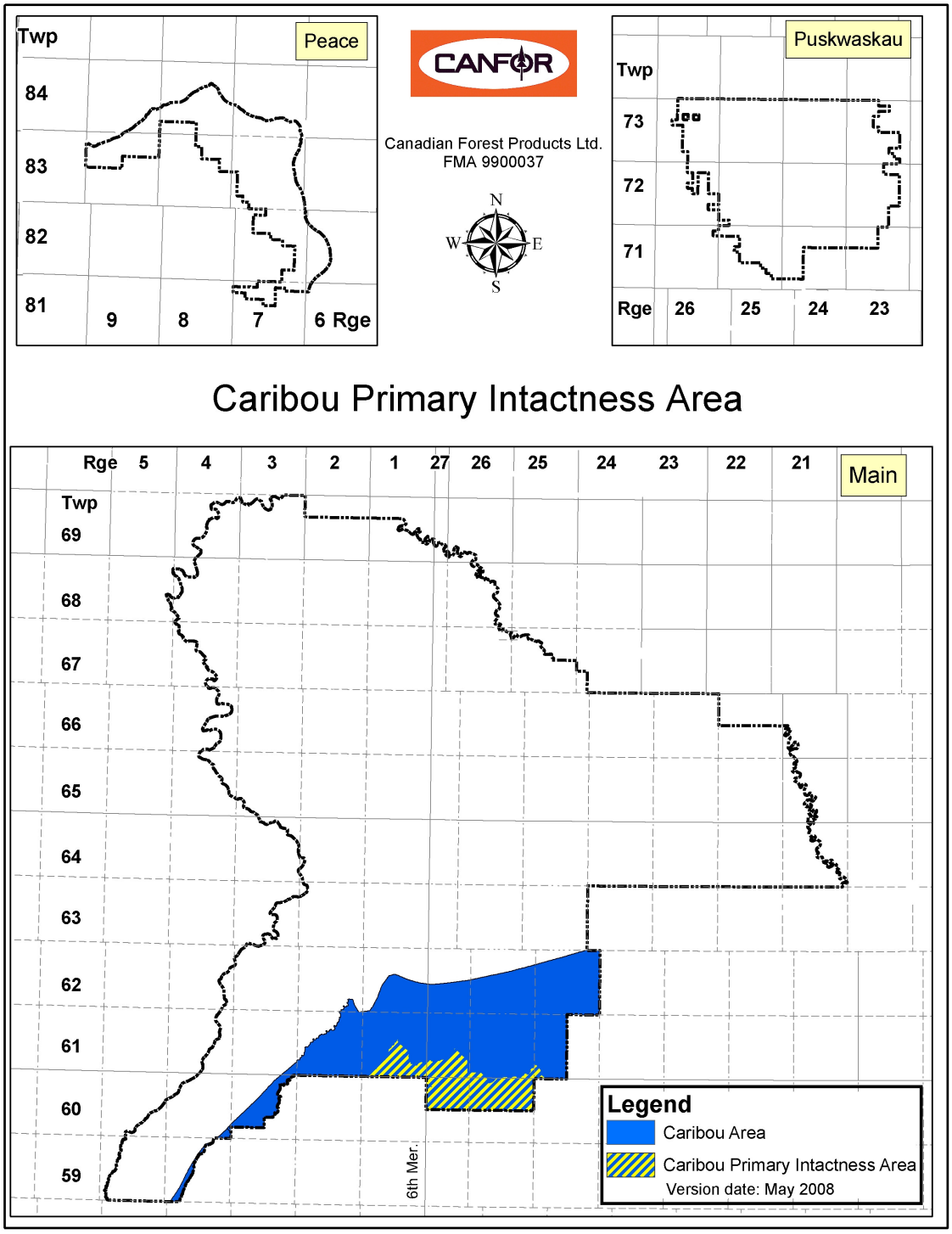
Map 3 - FMA Deciduous Allocation Areas



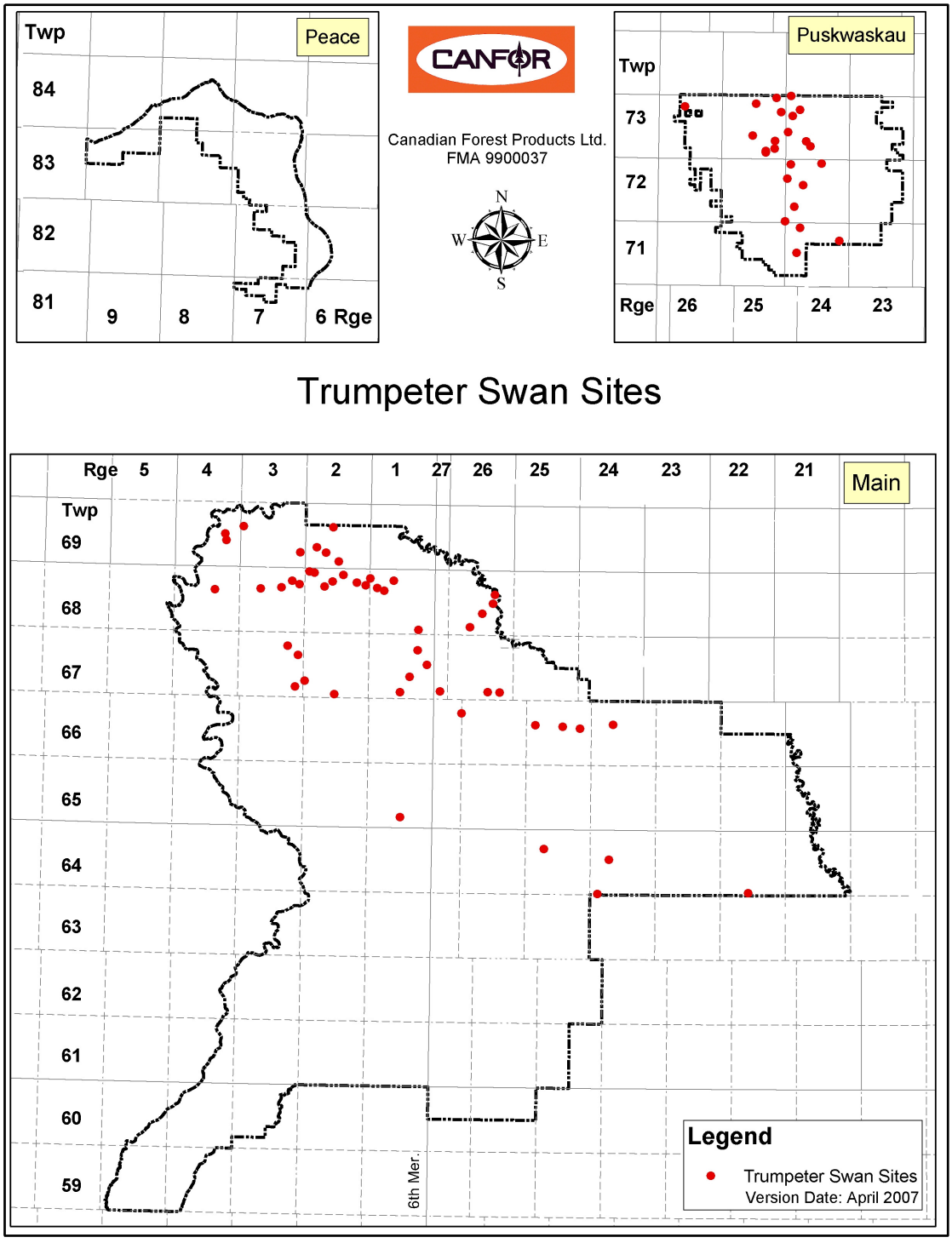
Map 4 - Caribou Area



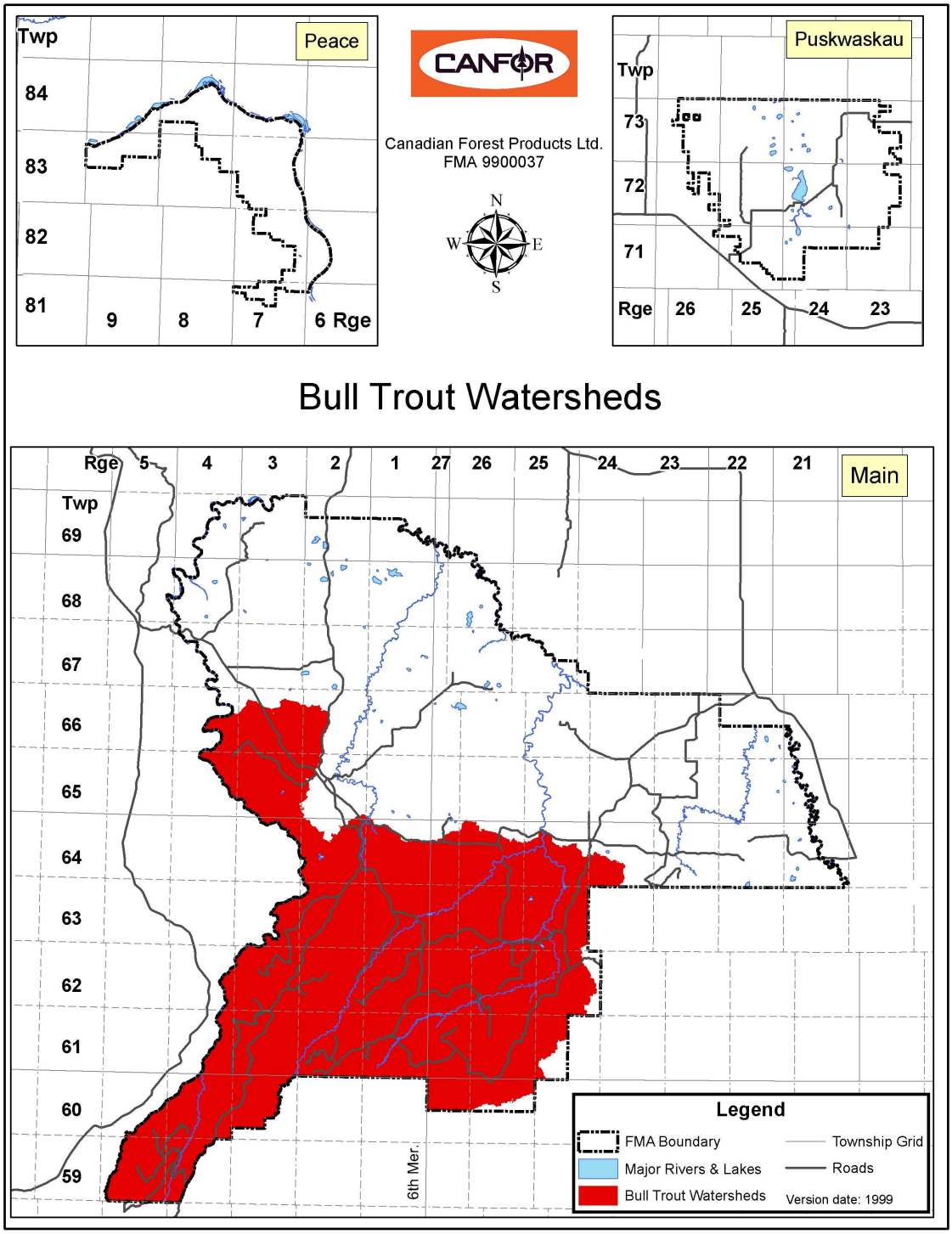
Map 5 - Caribou Primary Intactness Area



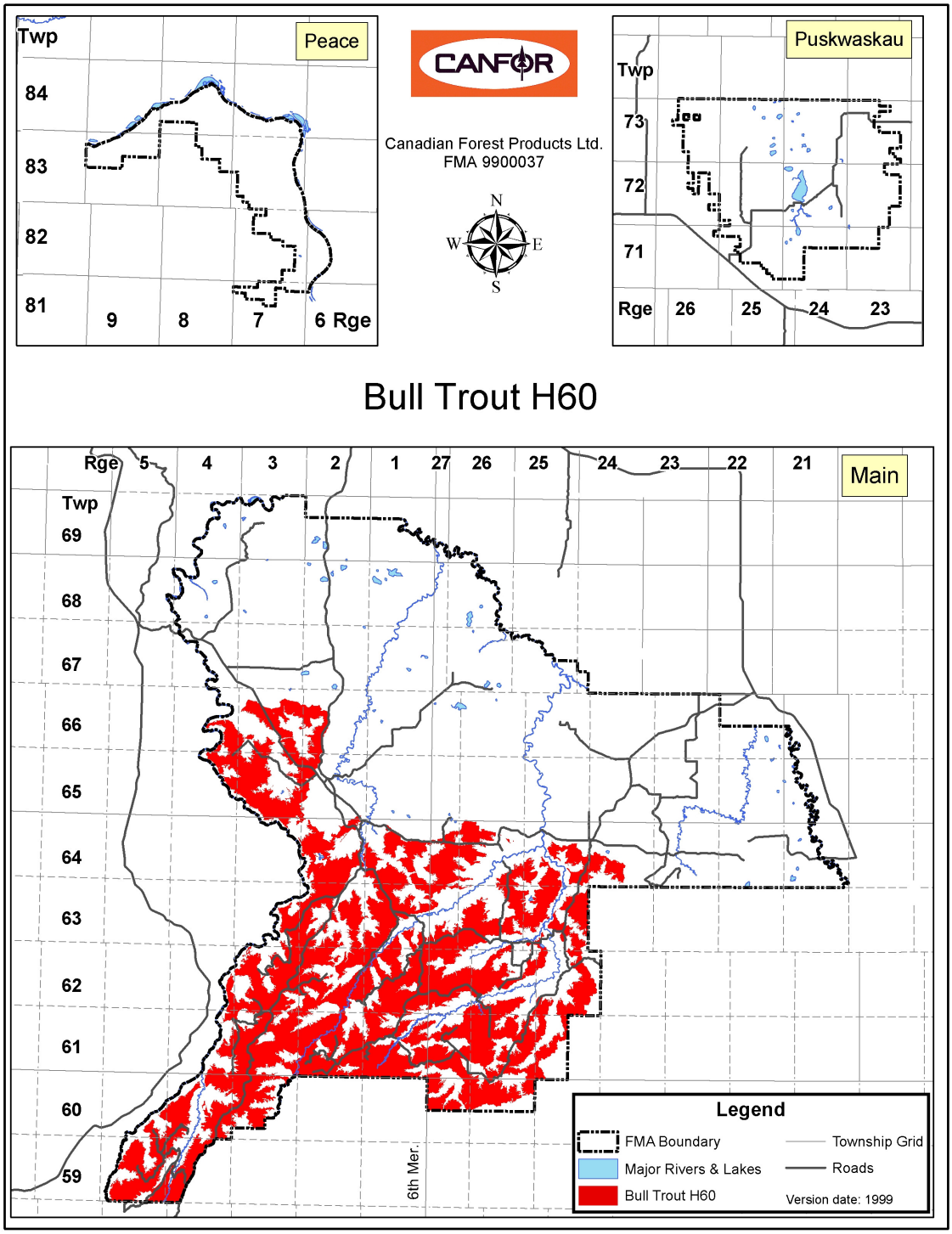
Map 6 - Trumpeter Swan Sites



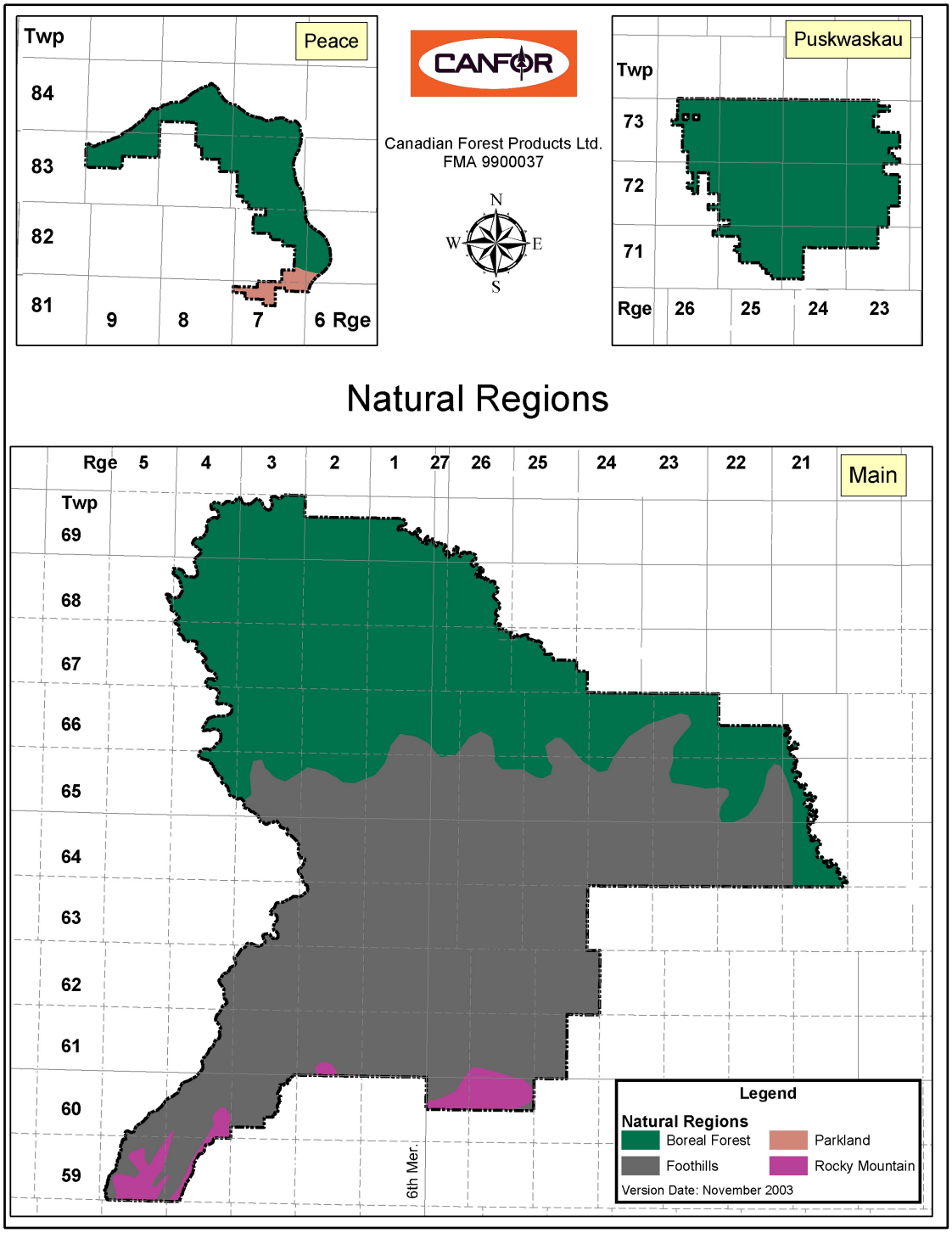
Map 7 - Bull Trout Watersheds



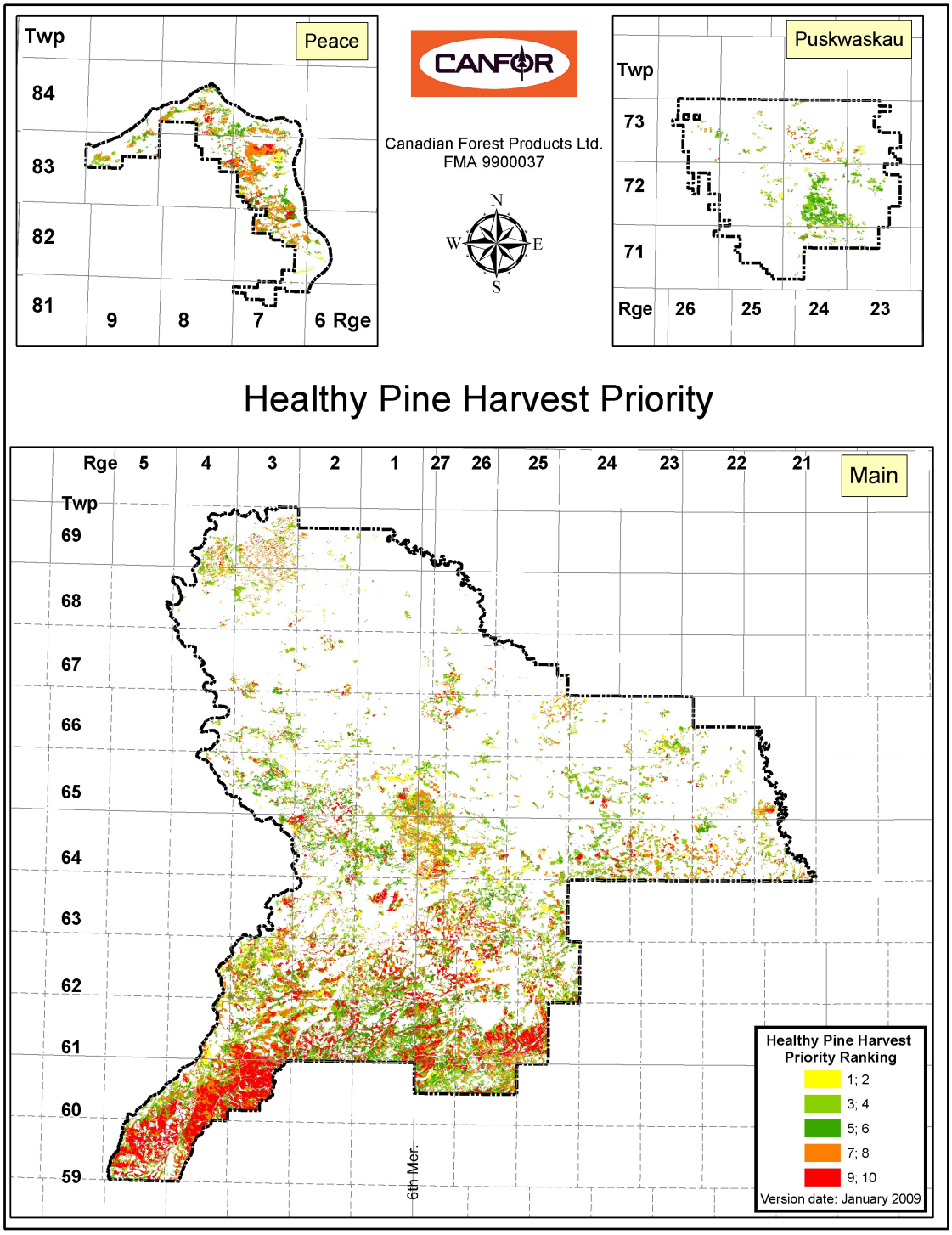
Map 8 - H60 Area in Bull Trout Watersheds



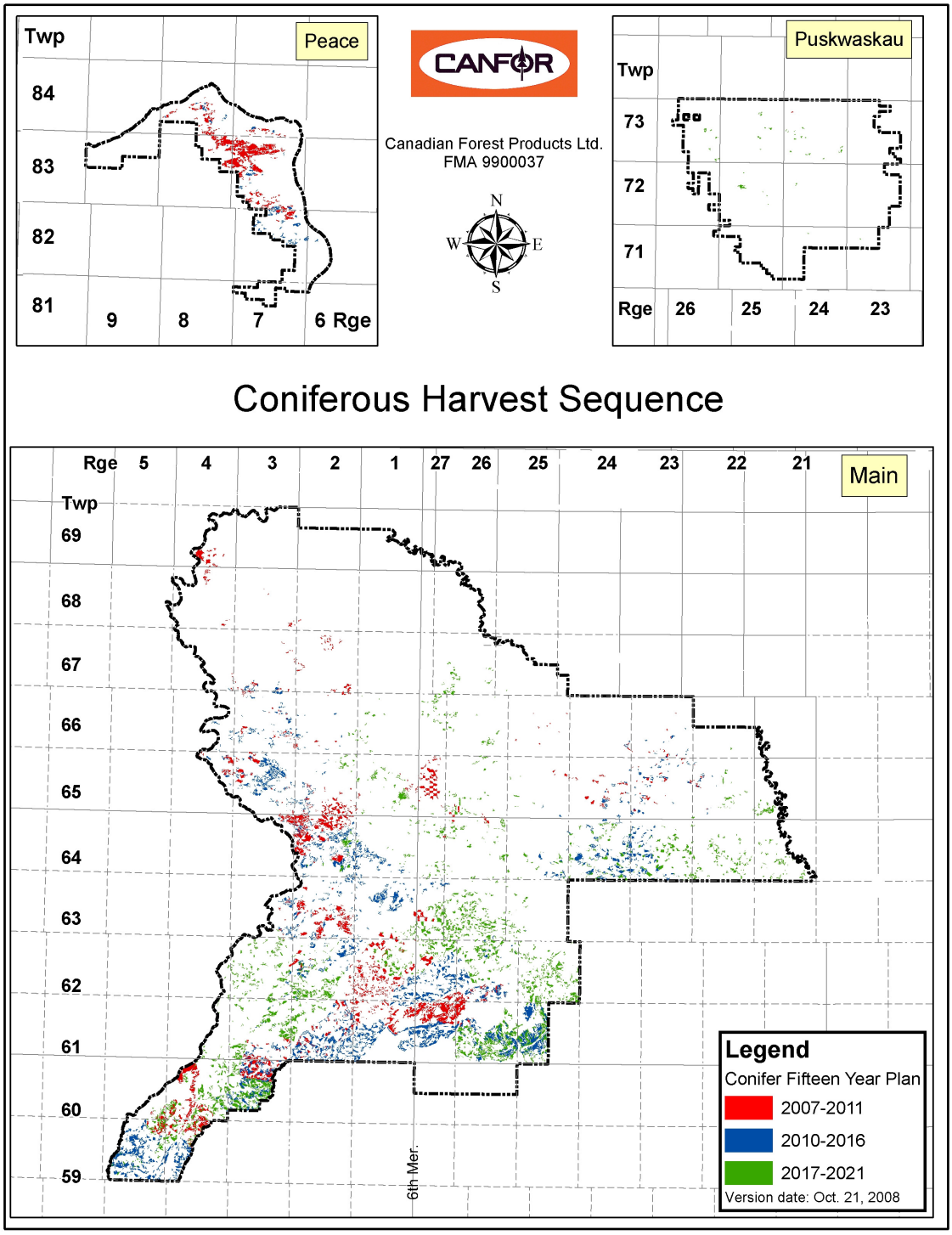
Map 9 - Natural Regions



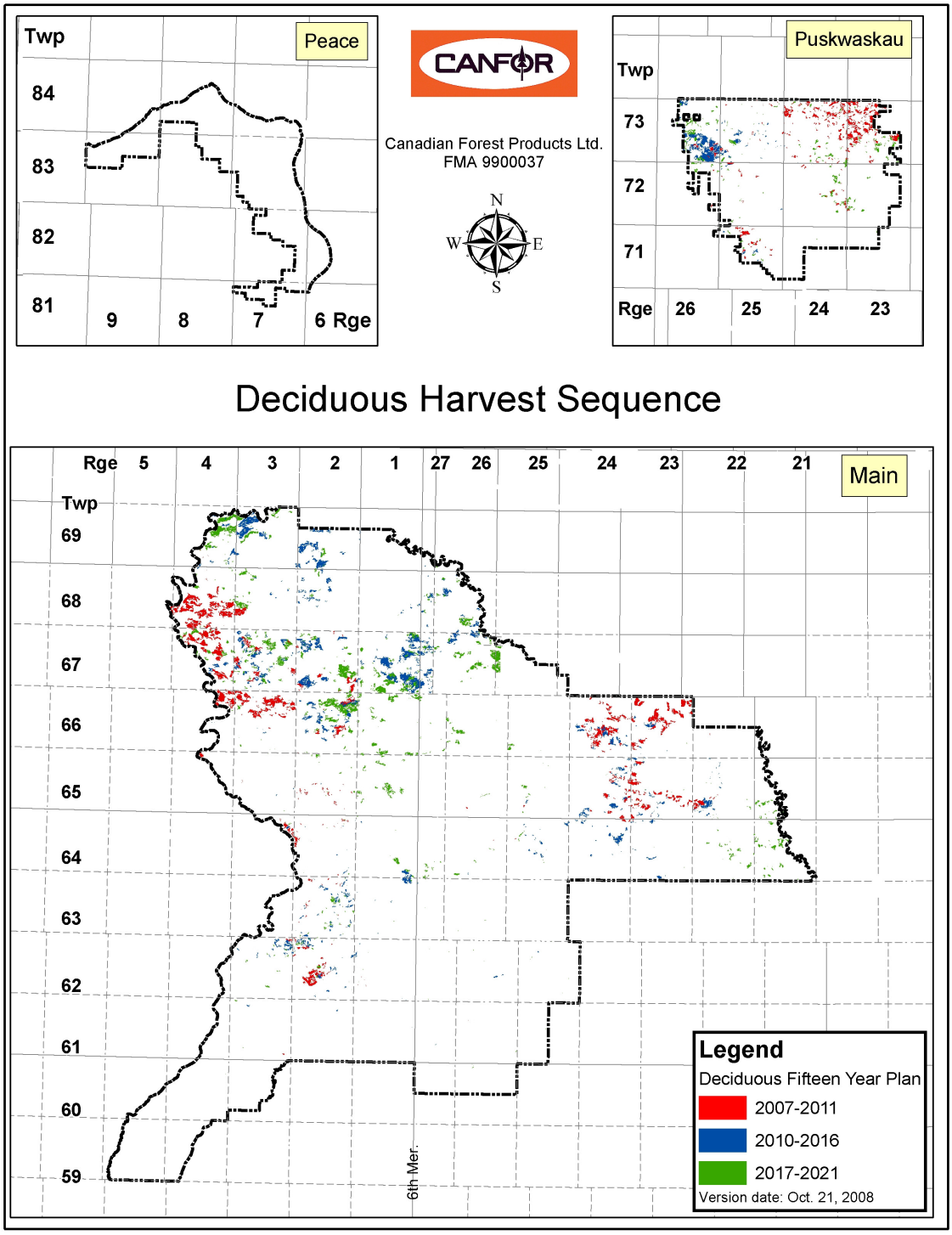
Map 10 - Healthy Pine Harvest Priority



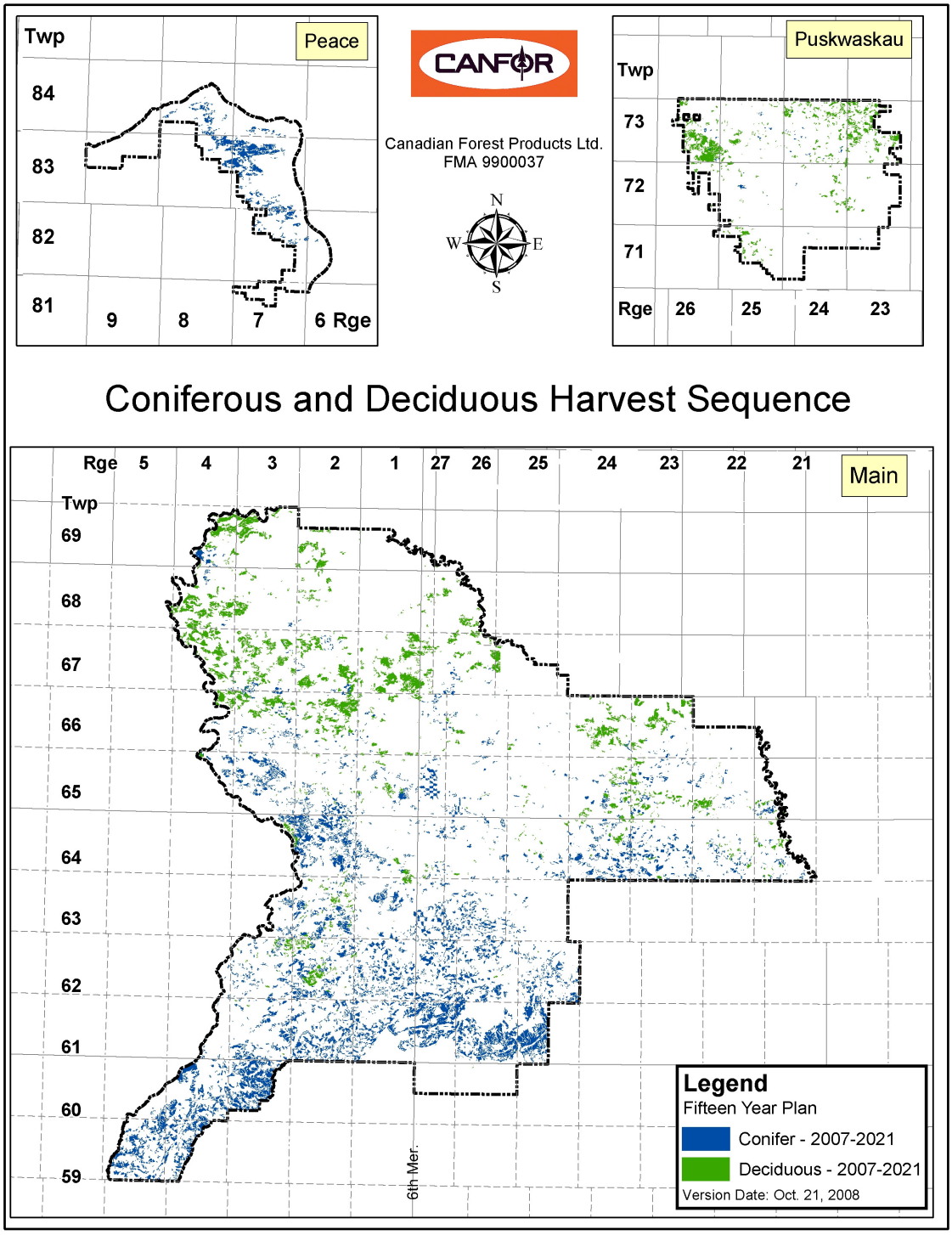
Map 11 - Coniferous Harvest Sequence



Map 12 - Deciduous Harvest Sequence



Map 13 - Coniferous and Deciduous Harvest Sequence



Appendix C - Equivalent Clearcut Area Detail (Above H60 - From COMPLAN)

Watershed	ECA % Above the H60 Line							
	2007	2022	2027	2032	2037	2042	2047	2052
1	2.2%	8.7%	6.1%	5.0%	5.2%	6.1%	7.6%	10.7%
9	17.5%	8.3%	7.6%	15.9%	21.0%	22.9%	18.3%	11.7%
15	0.0%	6.0%	1.1%	18.0%	34.9%	17.8%	4.1%	0.7%
27	0.0%	4.1%	1.7%	0.5%	1.3%	1.9%	2.9%	5.3%
31	0.0%	6.1%	2.9%	0.2%	0.3%	0.4%	0.3%	0.9%
33	1.4%	6.1%	9.1%	10.1%	10.4%	12.1%	9.7%	6.6%
45	5.6%	22.2%	13.6%	10.3%	8.3%	11.4%	11.6%	10.0%
49	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
64	23.3%	13.0%	3.6%	7.4%	10.4%	11.2%	12.3%	8.6%
68	0.0%	5.2%	1.0%	13.8%	15.3%	7.4%	1.5%	2.2%
73	8.4%	5.2%	4.1%	11.5%	16.2%	16.6%	18.9%	17.0%
101	28.1%	8.5%	8.8%	9.9%	12.4%	15.1%	16.8%	13.1%
106	0.0%	4.9%	4.4%	2.0%	1.5%	2.6%	3.1%	3.7%
125	0.0%	6.9%	4.3%	4.3%	5.2%	5.6%	7.1%	7.8%
127	0.0%	14.9%	8.0%	3.5%	1.2%	3.2%	3.7%	7.0%
128	10.2%	0.7%	2.4%	4.4%	8.7%	12.4%	11.6%	10.1%
145	14.4%	11.3%	4.8%	7.6%	8.8%	9.0%	7.7%	5.5%
147	8.3%	6.2%	5.4%	6.9%	6.9%	6.1%	4.7%	2.8%
155	9.9%	20.1%	6.0%	6.4%	6.2%	10.1%	9.8%	10.1%
157	2.8%	21.0%	7.9%	3.8%	7.3%	9.5%	7.8%	4.6%
181	0.0%	11.9%	22.5%	17.4%	12.8%	9.4%	8.3%	8.1%
231	0.0%	14.9%	17.5%	14.2%	15.8%	20.0%	15.8%	7.8%
268	0.2%	9.3%	4.9%	15.5%	26.1%	17.2%	4.2%	2.2%
299	26.9%	11.1%	8.9%	11.9%	20.4%	23.0%	21.4%	15.6%
320	5.6%	14.6%	9.3%	7.6%	9.2%	7.8%	12.0%	10.4%
332	11.2%	22.8%	15.3%	12.3%	12.0%	8.5%	9.1%	7.0%
336	8.1%	3.8%	2.8%	6.6%	26.0%	26.4%	22.4%	14.7%
351	4.2%	4.9%	4.2%	17.5%	30.6%	20.0%	9.5%	5.6%
377	0.1%	0.0%	0.0%	5.0%	16.7%	11.3%	3.6%	1.0%
397	13.7%	9.1%	6.0%	9.3%	10.1%	8.5%	12.8%	18.1%
406	5.8%	7.2%	10.3%	6.8%	4.3%	3.9%	11.5%	23.3%
409	12.1%	8.4%	7.2%	6.4%	8.5%	14.2%	12.0%	8.8%
411	0.0%	0.0%	0.0%	37.4%	35.6%	23.6%	3.8%	0.7%
438	7.0%	19.1%	7.9%	16.4%	8.6%	4.6%	12.2%	15.3%
440	4.1%	17.9%	7.7%	8.3%	6.7%	3.7%	2.4%	2.5%
445	0.2%	12.9%	5.6%	2.7%	2.3%	2.0%	1.4%	1.3%
447	10.4%	5.4%	5.9%	3.9%	4.6%	4.2%	3.1%	1.8%
457	9.7%	3.2%	3.4%	5.8%	12.8%	13.3%	12.7%	13.4%
461	6.2%	7.7%	6.2%	12.4%	12.8%	9.1%	8.8%	11.5%
462	27.6%	23.0%	22.8%	24.7%	20.1%	16.5%	15.7%	14.1%
468	0.8%	3.0%	2.0%	9.5%	18.8%	29.3%	11.2%	5.3%
472	12.3%	5.8%	4.3%	8.5%	14.8%	11.2%	14.1%	15.1%
475	0.8%	8.2%	6.3%	3.3%	3.2%	3.6%	4.2%	3.8%
478	0.2%	0.4%	0.5%	1.0%	1.8%	2.0%	1.8%	1.6%
480	4.9%	0.8%	3.6%	4.4%	6.1%	10.4%	11.0%	14.8%
498	17.0%	8.2%	10.1%	8.3%	20.5%	20.5%	17.6%	14.2%
515	0.0%	8.0%	3.2%	16.9%	27.1%	29.1%	35.2%	32.6%

Watershed	ECA % Above the H60 Line							
	2007	2022	2027	2032	2037	2042	2047	2052
527	7.0%	0.1%	1.2%	1.1%	1.4%	1.2%	2.6%	7.2%
533	16.9%	17.9%	14.2%	35.9%	37.4%	35.8%	34.3%	25.6%
534	4.9%	2.9%	4.9%	4.3%	7.9%	7.2%	6.6%	7.8%
536	3.8%	0.7%	2.3%	7.3%	11.3%	10.4%	8.3%	9.5%
539	7.8%	15.0%	12.6%	15.6%	15.7%	12.6%	11.9%	8.6%
565	19.0%	4.9%	1.5%	6.2%	6.9%	6.8%	7.8%	7.9%
583	0.0%	10.4%	4.4%	24.0%	35.0%	32.9%	32.3%	23.6%
586	1.2%	1.0%	2.9%	3.2%	5.2%	8.5%	10.4%	14.5%
595	5.4%	7.1%	9.6%	10.8%	16.2%	14.1%	13.3%	11.7%
643	16.0%	4.5%	3.9%	5.8%	13.8%	13.9%	11.8%	8.1%
645	19.2%	3.3%	3.2%	14.4%	39.6%	38.6%	30.7%	18.9%
646	12.7%	10.4%	10.5%	9.9%	7.4%	5.5%	3.1%	1.1%
656	23.3%	2.8%	4.5%	14.7%	18.0%	17.4%	15.0%	11.1%
670	23.6%	17.5%	6.5%	5.5%	4.6%	4.9%	3.2%	1.8%
696	0.3%	24.8%	10.4%	2.3%	3.7%	3.1%	4.6%	3.6%
697	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%
727	13.2%	3.6%	4.3%	10.1%	20.1%	17.9%	13.5%	11.4%
729	27.9%	2.9%	3.6%	4.1%	17.6%	17.9%	16.5%	11.7%
769	0.0%	0.0%	0.1%	0.2%	0.3%	0.3%	0.2%	6.3%
771	2.5%	1.0%	0.7%	0.3%	0.4%	0.3%	0.5%	1.5%
807	0.0%	9.9%	7.8%	5.1%	9.3%	13.5%	19.8%	17.3%
817	10.6%	2.0%	2.3%	3.4%	5.3%	5.5%	8.5%	7.1%
827	6.8%	4.4%	4.2%	4.0%	5.5%	7.1%	7.5%	6.6%
855	2.1%	1.6%	3.5%	15.5%	18.3%	15.7%	15.0%	13.8%
913	2.9%	12.9%	8.5%	9.1%	9.0%	9.6%	10.4%	9.5%
915	5.2%	13.0%	9.3%	6.8%	4.9%	6.0%	6.0%	6.8%
965	7.9%	4.2%	4.6%	3.4%	2.7%	2.1%	7.6%	7.7%
1035	7.6%	5.7%	8.7%	12.9%	11.1%	9.9%	13.6%	12.1%
1101	1.4%	4.0%	4.4%	5.4%	2.9%	5.3%	5.7%	4.0%
1120	1.5%	12.2%	12.0%	8.7%	3.7%	2.6%	2.1%	3.1%
1137	3.5%	2.6%	3.1%	3.1%	2.4%	3.2%	6.2%	5.9%
1261	8.5%	0.9%	1.4%	2.5%	2.8%	8.7%	13.6%	15.1%
1289	17.2%	1.3%	1.3%	7.1%	6.5%	8.6%	9.9%	10.3%
1310	16.7%	0.8%	0.8%	0.6%	0.4%	4.8%	7.5%	6.4%
1320	4.6%	0.2%	0.2%	2.5%	2.8%	3.8%	7.6%	8.7%
1378	5.3%	17.6%	22.4%	22.5%	16.3%	15.9%	26.0%	26.1%
1426	0.0%	9.1%	22.2%	32.4%	26.3%	24.9%	17.2%	8.1%
1466	0.8%	13.8%	28.7%	30.6%	24.1%	26.4%	33.2%	26.6%
1496	0.0%	20.6%	20.6%	18.2%	10.6%	30.2%	39.0%	33.2%
1500	0.0%	20.1%	20.2%	16.9%	12.0%	30.2%	40.6%	34.2%
1563	17.6%	25.0%	21.8%	15.3%	9.2%	9.7%	14.0%	13.3%
1589	9.3%	41.2%	29.3%	21.2%	9.9%	3.3%	7.1%	6.9%
1692	23.9%	27.0%	14.9%	12.9%	7.3%	10.5%	15.8%	13.7%
1704	0.0%	29.5%	21.0%	9.3%	3.6%	15.2%	28.6%	25.8%
1775	37.8%	33.5%	13.2%	8.5%	3.1%	1.2%	3.4%	3.3%
1846	28.4%	27.2%	23.8%	17.8%	15.2%	11.6%	14.6%	11.3%
1863	23.2%	21.7%	15.0%	9.3%	5.6%	15.9%	25.6%	21.7%

Watershed	ECA % Above the H60 Line							
	2007	2022	2027	2032	2037	2042	2047	2052
1938	14.6%	31.1%	27.1%	18.9%	15.2%	12.5%	16.4%	12.5%
1943	15.4%	29.0%	26.7%	22.2%	18.9%	15.5%	17.7%	13.3%
2057	38.8%	15.2%	18.4%	15.6%	11.5%	7.7%	5.5%	3.7%
2237	0.0%	1.4%	0.9%	1.2%	1.5%	1.7%	2.6%	3.7%
2256	0.0%	12.9%	6.3%	1.1%	0.4%	0.7%	5.3%	4.0%
2260	0.0%	4.4%	2.4%	0.9%	0.1%	0.5%	0.6%	5.0%
2270	0.0%	0.0%	0.0%	0.0%	0.2%	1.5%	6.1%	5.1%
2296	6.5%	15.9%	15.5%	11.3%	12.7%	9.3%	7.4%	5.7%
2299	2.9%	10.7%	16.1%	14.7%	19.6%	16.7%	16.4%	7.8%
2316	8.0%	4.7%	10.2%	11.8%	13.5%	19.4%	12.7%	8.3%
2357	0.0%	0.0%	0.0%	0.0%	0.4%	0.4%	0.3%	3.0%
2371	0.0%	0.0%	0.0%	0.5%	0.4%	0.1%	0.0%	0.1%
2380	7.3%	2.8%	5.9%	8.3%	8.5%	9.8%	10.5%	11.4%
2382	3.8%	10.7%	7.7%	8.0%	7.6%	8.2%	8.5%	12.0%
2402	0.0%	0.0%	0.0%	0.0%	1.0%	1.8%	3.5%	2.7%
2439	0.8%	0.8%	0.2%	0.9%	1.8%	1.9%	5.4%	19.5%
2514	4.8%	26.7%	8.8%	1.4%	4.4%	4.7%	13.3%	9.9%
2525	0.4%	5.0%	3.8%	2.5%	2.2%	1.6%	7.1%	16.1%
2555	6.9%	10.2%	8.5%	6.4%	7.7%	6.7%	9.0%	8.0%
2561	3.8%	3.5%	3.7%	4.0%	5.4%	6.4%	12.2%	19.3%
2596	0.0%	9.8%	4.1%	2.1%	1.3%	3.4%	11.8%	9.1%
2652	2.6%	2.0%	4.0%	3.7%	4.0%	5.2%	5.6%	10.4%
2670	0.0%	34.4%	18.3%	2.3%	0.8%	0.8%	0.7%	0.8%
2684	0.3%	25.8%	24.7%	17.4%	7.4%	3.2%	6.2%	7.2%
2693	4.3%	0.0%	0.1%	1.9%	5.1%	7.1%	6.6%	6.3%
2720	0.2%	19.2%	8.7%	2.0%	7.0%	8.6%	10.1%	12.9%
2723	6.0%	1.2%	4.0%	4.8%	4.6%	9.2%	17.1%	28.8%
2769	3.5%	0.4%	4.0%	5.2%	7.3%	8.8%	8.8%	11.4%
2772	0.2%	13.7%	19.1%	25.0%	15.3%	11.1%	5.3%	2.7%
2781	4.7%	0.8%	15.7%	13.3%	8.2%	3.9%	7.7%	9.9%
2793	5.7%	11.8%	5.3%	4.0%	6.8%	6.7%	7.8%	10.9%
2796	13.1%	4.5%	3.7%	5.4%	11.8%	13.2%	12.5%	8.9%
2799	3.6%	0.7%	6.4%	10.8%	10.6%	12.4%	18.6%	14.9%
2810	19.2%	4.4%	9.8%	12.9%	17.9%	17.5%	15.4%	9.3%
2825	1.5%	0.3%	3.5%	4.4%	3.7%	4.5%	5.1%	12.2%
2858	0.5%	3.8%	5.4%	6.8%	10.9%	11.1%	15.6%	17.4%
2942	0.3%	1.3%	2.9%	5.1%	8.3%	10.0%	17.8%	24.9%
2946	7.2%	1.6%	3.7%	9.3%	10.2%	12.5%	22.6%	19.4%
3031	3.9%	2.8%	7.4%	8.1%	9.1%	7.6%	16.7%	23.1%
3118	0.2%	6.8%	8.9%	5.6%	5.0%	4.9%	6.4%	14.3%
3135	4.3%	0.5%	11.9%	12.8%	9.6%	8.1%	10.1%	10.0%
3259	1.1%	0.0%	3.4%	15.7%	20.0%	15.7%	16.4%	22.2%
3287	0.6%	4.3%	7.8%	5.8%	5.8%	4.7%	4.0%	17.5%
3295	1.5%	0.6%	3.3%	11.4%	13.4%	9.6%	9.4%	8.0%
3369	12.9%	3.6%	17.8%	11.6%	11.2%	12.9%	12.3%	18.5%
3388	1.1%	4.9%	5.5%	11.7%	20.1%	11.1%	5.4%	13.0%
3473	3.2%	10.5%	4.5%	7.5%	11.3%	11.0%	11.1%	11.9%

Watershed	ECA % Above the H60 Line							
	2007	2022	2027	2032	2037	2042	2047	2052
3508	5.1%	3.4%	2.3%	2.3%	2.9%	3.1%	3.9%	5.9%
3513	17.5%	5.0%	9.1%	8.2%	17.9%	23.0%	22.2%	19.5%
3523	22.8%	11.8%	3.3%	1.6%	1.9%	2.7%	6.5%	5.2%
3535	8.1%	15.2%	5.3%	1.7%	1.0%	0.9%	4.3%	5.9%
3542	0.1%	12.4%	11.4%	11.0%	8.0%	8.2%	9.9%	19.8%
3551	1.9%	0.2%	3.9%	5.0%	4.3%	3.9%	5.5%	9.8%
3650	2.6%	3.0%	2.7%	5.7%	7.7%	6.7%	6.0%	5.5%
3701	15.5%	2.4%	8.2%	13.8%	14.8%	14.9%	10.8%	11.4%
3734	13.8%	7.3%	11.4%	10.5%	10.2%	11.5%	10.4%	11.8%
3746	1.5%	0.1%	0.1%	2.5%	3.6%	3.9%	3.5%	4.1%
3858	0.5%	6.8%	7.6%	15.1%	13.5%	12.9%	13.2%	16.8%
3890	2.9%	3.9%	5.1%	4.9%	3.6%	2.4%	2.3%	1.8%
3937	2.8%	7.9%	6.7%	6.3%	5.1%	6.3%	6.6%	5.0%
3957	18.4%	12.8%	8.3%	4.9%	3.7%	4.0%	5.6%	5.2%
3972	14.6%	9.5%	6.7%	3.8%	2.7%	1.8%	1.2%	0.8%
4042	4.5%	12.9%	12.6%	9.1%	3.9%	3.2%	4.7%	3.7%
4098	0.1%	0.2%	0.2%	0.6%	1.8%	1.9%	1.7%	1.2%
4108	23.1%	10.1%	5.1%	3.2%	2.1%	1.2%	0.6%	0.8%
4111	8.9%	16.2%	15.3%	13.8%	10.3%	8.7%	7.9%	6.6%
4117	11.0%	2.0%	2.2%	5.0%	6.9%	9.0%	14.5%	14.2%
4120	11.4%	4.5%	3.6%	4.4%	3.3%	9.4%	9.0%	8.6%
4174	8.2%	14.5%	15.7%	13.8%	11.9%	8.9%	10.4%	7.4%
4186	6.9%	0.0%	2.2%	7.4%	8.1%	7.5%	8.2%	6.9%
4203	5.8%	0.0%	4.2%	12.6%	11.9%	11.8%	12.1%	7.2%
4237	8.0%	3.3%	1.5%	3.4%	3.3%	3.3%	8.3%	11.0%
4257	19.6%	6.4%	4.4%	3.5%	5.8%	4.8%	3.3%	1.0%
4265	21.9%	7.5%	4.3%	2.4%	1.3%	0.3%	0.5%	0.6%
4311	2.7%	0.0%	0.2%	3.1%	3.2%	3.4%	2.8%	1.7%
4316	0.3%	6.8%	7.8%	4.9%	4.9%	4.3%	6.6%	5.0%
4318	3.0%	0.0%	0.9%	1.0%	2.5%	2.8%	4.5%	6.0%
4319	0.0%	9.3%	8.5%	5.4%	1.9%	1.1%	15.6%	14.5%
4374	4.1%	11.9%	8.3%	2.6%	4.3%	4.8%	6.6%	11.5%
4378	13.7%	17.5%	16.2%	13.9%	8.9%	10.2%	10.4%	7.5%
4382	1.0%	5.5%	4.3%	3.9%	2.5%	2.9%	7.8%	9.6%
4414	3.9%	10.9%	8.5%	6.1%	4.7%	6.8%	6.9%	11.6%
4484	3.0%	2.3%	4.3%	5.9%	5.0%	7.8%	17.0%	29.4%
4492	0.3%	6.1%	4.5%	3.2%	4.9%	8.6%	10.5%	10.4%
4502	11.1%	6.0%	14.3%	24.0%	23.2%	21.5%	17.7%	9.4%
4509	18.4%	20.8%	20.2%	12.2%	12.0%	9.7%	8.6%	5.4%
4539	1.4%	9.5%	7.1%	7.2%	8.2%	12.9%	13.0%	12.2%
4557	5.5%	20.3%	13.0%	8.5%	7.4%	8.2%	11.2%	12.5%
4687	3.2%	1.3%	1.7%	1.6%	1.1%	3.5%	5.9%	7.1%
4702	8.0%	11.7%	13.6%	18.5%	15.4%	11.2%	10.2%	6.3%
4743	23.8%	18.2%	16.8%	14.5%	10.2%	11.2%	9.9%	10.1%
4773	11.0%	0.7%	1.7%	8.2%	7.4%	18.0%	21.8%	16.6%
4776	0.0%	16.0%	11.4%	6.5%	5.3%	5.5%	7.2%	10.6%
4826	32.4%	19.5%	18.3%	20.2%	15.2%	13.3%	14.2%	11.2%

Watershed	ECA % Above the H60 Line							
	2007	2022	2027	2032	2037	2042	2047	2052
4846	28.9%	17.3%	16.9%	22.1%	17.9%	11.9%	8.3%	4.5%
4864	0.0%	11.9%	9.6%	6.7%	7.6%	10.0%	8.8%	8.3%
4868	0.9%	9.4%	7.6%	11.8%	12.6%	14.9%	17.4%	17.1%
4877	25.9%	20.7%	9.4%	8.2%	6.6%	8.6%	9.2%	9.9%
4908	18.0%	18.0%	10.4%	7.2%	7.7%	10.5%	10.2%	9.4%
4909	22.0%	10.4%	6.1%	6.6%	6.4%	9.7%	12.8%	12.6%
4955	0.4%	24.7%	16.5%	9.7%	11.9%	15.7%	16.4%	12.0%
4995	9.6%	3.4%	4.8%	6.7%	5.5%	15.9%	25.4%	22.4%
5006	10.1%	22.5%	13.5%	6.9%	2.8%	0.7%	0.2%	0.7%
5060	2.2%	0.5%	12.1%	15.5%	15.9%	35.8%	34.6%	30.0%
5087	0.1%	24.9%	15.9%	7.7%	8.6%	16.0%	20.4%	18.9%
5099	6.4%	6.8%	11.1%	10.2%	6.8%	7.8%	8.0%	6.7%
5123	33.0%	13.3%	9.4%	12.0%	12.0%	10.7%	14.4%	12.4%
5125	32.2%	23.8%	19.6%	14.8%	9.0%	3.9%	4.2%	3.4%
5197	13.3%	15.0%	16.5%	11.8%	8.0%	6.0%	5.7%	4.4%
5227	2.6%	0.1%	1.1%	3.3%	3.0%	8.6%	11.8%	10.3%
5274	8.7%	17.3%	17.6%	10.6%	4.1%	2.3%	7.0%	6.2%
5340	33.3%	9.4%	3.7%	1.4%	1.1%	3.8%	4.4%	4.1%
5382	17.3%	7.7%	5.9%	3.9%	1.3%	0.0%	0.0%	1.4%
5392	18.4%	16.7%	23.5%	15.0%	6.1%	3.8%	4.3%	3.4%
5397	11.3%	12.5%	13.6%	14.8%	17.1%	24.3%	18.8%	13.3%
5578	20.8%	21.2%	14.8%	9.0%	8.6%	6.6%	4.8%	3.0%
5599	21.7%	9.9%	11.7%	12.4%	9.5%	14.5%	16.7%	13.5%
5642	33.8%	12.7%	9.3%	5.1%	0.9%	0.0%	0.0%	0.7%
5654	0.0%	18.2%	29.6%	26.8%	21.4%	15.3%	12.5%	9.4%
5676	17.9%	10.0%	7.5%	3.3%	0.5%	0.0%	0.0%	0.9%
5703	14.8%	12.9%	10.7%	7.7%	3.7%	2.3%	1.8%	1.2%
5729	26.9%	25.0%	17.9%	11.9%	8.7%	5.8%	6.7%	5.6%
5783	10.6%	14.3%	10.2%	5.9%	3.8%	3.4%	3.5%	2.5%
5803	6.1%	22.1%	16.5%	12.1%	8.4%	6.8%	8.7%	8.0%
5844	10.8%	8.6%	5.0%	2.8%	0.6%	0.1%	0.0%	2.7%
5907	12.5%	14.3%	7.8%	4.4%	0.4%	0.1%	0.0%	0.4%
6006	8.0%	13.2%	10.2%	5.5%	1.7%	0.2%	0.0%	0.7%
6181	12.5%	19.2%	9.7%	5.4%	2.7%	2.1%	2.5%	2.1%
6182	11.9%	13.1%	9.4%	4.7%	1.4%	0.2%	0.1%	0.1%
6306	29.3%	23.4%	14.1%	5.2%	2.6%	0.6%	0.0%	0.1%
6397	25.6%	23.0%	15.5%	7.5%	2.5%	0.7%	0.2%	0.2%
6408	8.1%	19.3%	16.2%	9.4%	4.2%	0.5%	0.0%	0.0%
6432	5.5%	17.2%	11.6%	8.6%	2.9%	8.0%	13.8%	13.6%
6482	6.9%	16.8%	16.8%	14.2%	8.8%	7.4%	5.3%	4.8%
6483	11.7%	17.6%	11.2%	5.7%	1.3%	0.2%	0.0%	0.1%
6524	24.0%	18.1%	20.7%	17.9%	11.6%	6.5%	9.0%	8.3%
6558	13.5%	8.6%	7.3%	5.0%	2.5%	0.7%	0.3%	4.9%
6632	25.9%	20.0%	15.2%	7.4%	3.2%	0.9%	0.1%	0.0%
6637	16.1%	16.8%	10.1%	5.4%	0.6%	0.3%	0.0%	0.0%
6674	11.5%	14.8%	14.7%	15.9%	13.4%	8.8%	7.8%	6.4%
6703	15.4%	14.7%	16.1%	13.4%	6.9%	8.9%	8.5%	6.5%

Watershed	ECA % Above the H60 Line							
	2007	2022	2027	2032	2037	2042	2047	2052
6751	17.4%	13.8%	9.4%	5.3%	1.8%	0.4%	0.0%	0.0%
6803	11.7%	11.5%	7.4%	1.5%	0.1%	0.0%	0.0%	0.0%
6806	0.0%	30.4%	27.4%	19.4%	8.0%	1.6%	0.1%	0.0%
6819	0.8%	2.3%	1.4%	0.7%	0.1%	0.0%	0.0%	0.0%
6833	7.3%	9.8%	8.2%	6.7%	4.3%	1.8%	1.8%	0.9%
6865	0.0%	6.9%	6.8%	5.1%	2.1%	0.0%	0.0%	0.0%
6979	0.0%	7.4%	4.7%	1.8%	0.0%	0.0%	0.0%	0.0%
7092	14.4%	1.4%	2.8%	4.8%	6.2%	5.8%	5.5%	4.0%
7157	9.4%	19.2%	16.4%	11.2%	6.5%	3.0%	0.0%	0.0%
7179	16.2%	37.4%	29.0%	22.8%	12.7%	3.6%	0.7%	0.2%
7214	0.0%	49.5%	44.5%	33.4%	14.0%	4.1%	0.1%	0.0%
7216	0.0%	8.5%	7.7%	4.3%	1.8%	0.1%	0.0%	0.0%
7218	0.0%	16.2%	14.8%	9.7%	4.8%	1.6%	0.1%	0.0%
7232	0.0%	36.7%	28.2%	15.9%	2.3%	0.0%	0.0%	0.0%
7259	15.2%	26.3%	18.9%	10.0%	2.0%	0.3%	0.2%	0.1%
7262	26.8%	29.1%	22.1%	13.1%	3.3%	0.5%	0.2%	0.1%
7420	8.3%	3.7%	2.8%	3.5%	2.6%	15.0%	18.7%	15.1%
7443	16.0%	37.1%	28.6%	20.9%	11.0%	3.7%	0.0%	0.3%
7509	0.0%	34.6%	33.0%	25.9%	13.9%	5.9%	0.2%	0.6%
7532	1.7%	0.9%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
7555	10.0%	28.5%	20.8%	10.8%	2.5%	0.2%	0.1%	0.0%
7576	0.0%	2.4%	2.0%	1.2%	0.5%	0.0%	0.0%	0.0%
7592	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
7615	0.0%	2.8%	2.3%	1.4%	0.2%	0.0%	0.0%	0.0%
7658	18.2%	24.9%	14.6%	7.2%	2.2%	11.1%	21.9%	19.4%
7659	0.0%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
7816	0.0%	46.8%	34.0%	14.2%	3.9%	10.3%	15.3%	12.4%
7855	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
7964	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
8027	0.0%	49.4%	45.9%	34.0%	15.3%	5.7%	8.5%	7.8%
8324	0.4%	15.4%	14.8%	12.0%	6.6%	8.2%	19.3%	17.7%
8351	0.0%	35.0%	32.7%	22.1%	10.7%	5.8%	14.6%	13.8%
8820	8.8%	5.9%	2.5%	2.4%	8.5%	9.9%	9.9%	7.1%
8895	6.0%	2.9%	4.1%	5.7%	8.7%	14.8%	14.8%	15.7%
8926	10.5%	4.8%	3.6%	4.6%	5.9%	8.5%	13.3%	13.1%
9183	3.3%	1.5%	1.1%	1.9%	2.4%	10.1%	12.9%	22.1%
9226	14.1%	5.8%	6.0%	9.8%	13.9%	12.2%	11.6%	8.7%
9228	6.5%	6.4%	6.9%	9.3%	12.0%	14.3%	14.6%	15.3%
9296	3.0%	6.9%	6.1%	8.1%	14.1%	13.1%	10.3%	13.5%
9467	3.8%	0.6%	2.0%	2.6%	3.0%	5.3%	7.7%	9.7%
9494	7.0%	10.6%	14.8%	17.5%	17.0%	16.9%	10.6%	9.5%
9560	21.3%	19.2%	16.4%	12.4%	17.6%	15.4%	11.6%	8.5%
9604	22.1%	13.1%	16.9%	17.3%	20.8%	19.9%	14.6%	6.5%
9676	19.6%	13.3%	6.2%	8.4%	15.3%	17.6%	16.9%	14.3%
9685	6.3%	9.8%	17.7%	17.2%	22.8%	21.1%	17.1%	31.1%
9693	20.4%	19.0%	27.8%	25.5%	27.5%	23.5%	17.2%	8.6%
9704	8.9%	2.1%	6.5%	10.0%	17.2%	38.6%	34.2%	22.7%

Watershed	ECA % Above the H60 Line							
	2007	2022	2027	2032	2037	2042	2047	2052
9726	16.7%	9.4%	15.5%	18.0%	20.5%	21.3%	15.5%	7.1%
9908	17.8%	9.1%	11.6%	10.1%	17.0%	18.7%	16.9%	7.0%
9964	21.1%	23.8%	21.2%	13.4%	10.4%	7.7%	6.1%	6.7%
10003	33.3%	29.0%	30.0%	19.6%	17.3%	13.0%	6.8%	3.3%
10052	14.8%	6.8%	11.8%	16.5%	18.5%	27.8%	23.8%	12.9%
10264	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10277	10.1%	4.0%	5.4%	5.5%	7.6%	8.5%	11.6%	14.1%
10293	0.0%	0.0%	2.4%	3.7%	3.2%	3.5%	5.2%	13.1%
10363	1.1%	7.7%	8.0%	6.3%	3.5%	5.9%	11.0%	14.6%
10388	6.9%	2.1%	3.7%	3.9%	4.6%	13.2%	12.8%	13.1%
10413	1.0%	5.6%	6.1%	4.8%	3.6%	14.1%	17.3%	32.5%
10440	8.7%	3.9%	14.5%	15.1%	14.3%	11.9%	10.2%	8.9%
10725	0.0%	25.0%	22.0%	15.7%	6.3%	1.2%	0.0%	0.0%
10773	5.9%	22.4%	15.4%	16.6%	8.9%	24.9%	29.3%	23.6%