**Hinton Wood Products**
**A division of West Fraser Mills**
**Forest Management Agreement**
**FMA 8800025**
**O.C. 565/2007**

# Mountain Pine Beetle Forest Management Plan
# Technical Report #3
# - Annual Allowable Cut Projection-

**April 30, 2010**

# Table of Contents

## List of Figures

## List of Tables

# 1 Introduction

Hinton Wood Products (a division of West Fraser Mills Ltd) renewed its Forest Management Agreement (FMA) effective May 1, 2008 (O.C. 565/2007). The entire management area is close to a million hectares in size and is located in west-central Alberta (Figure 1). This diverse area is comprised of five natural sub-regions: Upper Foothills, Lower Foothills, Montane, Sub-Alpine and Alpine (listed in order of prevalence).

Eighty percent of the FMA forested area consists of pure coniferous stands, with the remaining 20% consisting of pure deciduous stands (~8%) and mixedwoods (~12%). Lodgepole Pine contributes approximately 65% of the total merchantable volume within the FMA. Therefore, the expanding mountain pine beetle (MPB) infestation being observed across west-central Alberta (during the autumn of 2009) make an MPB forest management plan (FMP) amendment critical for the Hinton Wood Products (HWP) FMA.

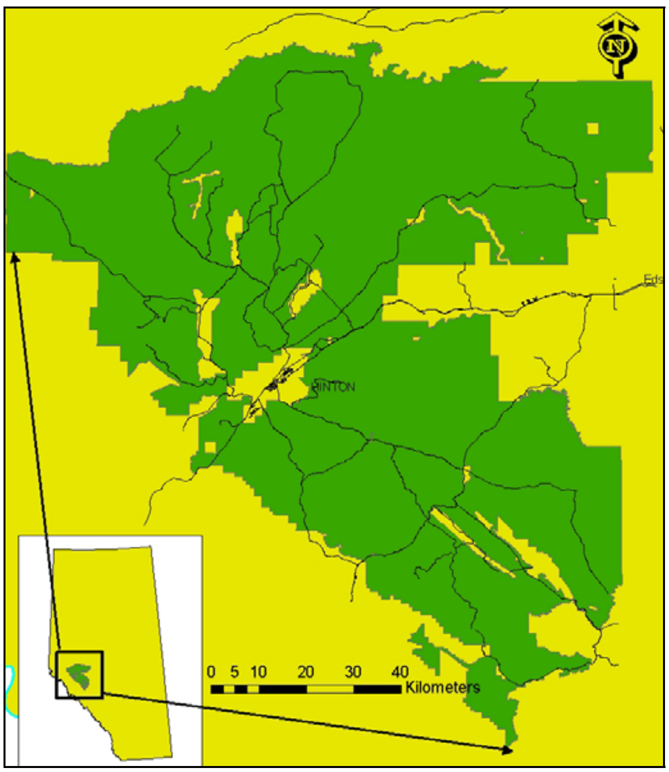


**Figure 1. HWP forest management Area (Green) within Alberta**

This report is the third volume in a series of three technical reports undertaken as part of the HWP MPB FMP amendment. This report makes extensive use of the results from the first two reports in the series *Landbase Classification* and *Yield Projections*.

This *Annual Allowable Cut Projection* report has four objectives:

1. Propose a new annual allowable cut (AAC) for the Hinton FMA in accordance with the healthy pine strategy as outlined by *Alberta Sustainable Resource Development*;

2. Provide an overview of the methodology and assumptions used to derive the *Preferred Pine Management Scenario* (PPMS);
3. Propose a 10-year spatial harvest sequence (SHS) that comports with the PPMS.
4. Assess the potential impacts on key non-timber values.

## 1.1 Software Tools

The timber supply analysis was completed through linear program modeling by using the *Remsoft Spatial Planning System (2009.09)* and *Mosek 6.0(x64)* as the LP solver. *Microsoft Excel2002* and *FoxPro 9.0* were used intermittently for simple data tasks and error checking.

# 2 Data and Methods

The input landbase shapefile used in the TSA was *Final_2009TSAINPUT* (see *Technical Report #1 - Landbase Classification* for a full discussion). To improve the model efficiency all polygons with an area less than <0.0001 in size were ignored; which resulted in 1.3ha of total area (0.3ha of contributing area) being ignored in the TSA.

## 2.1 Landbase Classification Inputs

A total of thirteen landbase attribute themes were used in the TSA models (see Section 6.4 *[PFMS_SPAT] & [PFMS_NONSPAT]*):

**Theme 1: Working Circle and Compartment**

Only operationally specified compartments were opened for harvest during the first 10 years of the planning horizon. The specified compartments were then closed in 2018 and the compartments previously closed were opened. After twenty years (starting in 2028) all compartments were assumed open for harvest. The first 10-years of sequenced blocks make up the spatial harvest sequence (SHS). A summary of SHS volumes by compartment is located in Table 11.

**Theme 2: Special Management Areas**

Special management areas have been identified within the FMA (by HWP) as locations potentially requiring additional consideration during harvest assessments. These sites include:

- **High elevation sheep and goat SMA**
    - Total area= 1,300ha
    - Contributing area = 238ha
    - Area sequenced within the first decade = 0ha
    - Any special requirements in this area will be handled at the operational level. No special TSA constraints or restrictions were applied.
- **Pinto Creek Mountain Goat SMA**
    - Total area= 3,106ha
    - Contributing area = 2,715ha
    - Area sequenced within the first decade = 193ha
    - Any special requirements in this area will be handled at the operational level. No special TSA constraints or restrictions were applied.
- **Trumpeter Swan Lake SMA**
    - Total area= 1,042ha
    - Contributing area = 315ha
    - Area sequenced within the first decade = 172.7ha
    - During the landbase classification trumpeter swan lakes were buffered by 200m and designated as non-contributing (passive) landbase. Only a small portion of the SMA is outside the buffered area and within the contributing landbase. Any additional special requirements in this area will be handled at the operational level.
- **Woodland Caribou SMA**
    - Total area= 54,264ha
    - Contributing area = 35,833ha
    - Area sequenced within the first decade = 0ha
    - The management intent is to defer any harvesting within this SMA until the end of 2017 timber year. From a model formulation standpoint, a spatial

LOCK of 10 years was applied to these areas. The deferral does not preclude HWP from engaging in salvage or pine management within this SMA.

**Theme 3: Summer versus winter only access**

All areas within the FMA were designated as either summer or winter-only access. This theme was used to track the summer ground harvest rate for the *Preferred Forest Management Strategy* (PFMS). This was **not a model constraint**.

**Theme 4: Mountain pine beetle risk ranking**

The MPB stand risk ranking was used in the TSA model to force an increased harvest rate in 1 and 2 stands (especially pine dominated stands).

**Theme 5: High value identifier**

If a stand had an AVI height call of 19m+ tall it was identified as likely having high fiber value. **This theme was not used as a constraint** but was used for information purposes only.

**Theme 6: Yield strata**

All stands were assigned to a yield stratum which provides the link between landbase classification and yield projections. Yield strata assignments were also used to ensure aggressive sequencing of pure pine stands within the first 20 years of the planning horizon.

**Theme 7: Stand regeneration Status**

All stands were assigned to a regeneration status to track the origin status (fire origin, fully-stocked managed, or low-stocked managed) of all stands through the planning horizon. This theme was also used to implement regeneration lag into the model (upon harvest a proportion of each yield strata was assigned to *NSR* status (Section 2.3.2)).

**Theme 8: Contributing versus passive landbase**

All stands were assigned to either the contributing or passive landbase. This theme did not change throughout the entire planning horizon.

**Theme 9: Polygon contains a cutline identifier**

As described in *Technical Report #1 - Landbase Classification* the TSA model input layer (*Final_2009TSAINPUT*) accounted for cutlines and seismic lines as an area reduction within each individual polygon. This allowed for an overall a drop in the number of polygons within the spatial file, while the contributing landbase stayed the same. This theme was used to track the presence of cutlines or seismic lines within polygons. Initially the purpose was to model cutline and seismic line reclamation after harvest. However, due to time constraints this was not implemented in the TSA models. The AAC impacts of reclamation will be investigated more fully in the 2014 plan. **This theme was not used in the TSA**.

**Theme 10: Regeneration declaration of pre-blocks**

The base date for the plan is May 1, 2008; thus a number of modeled pre-blocks have been harvested and have been assigned to a regenerated yield stratum. In the vast majority of cases the regenerated yield strata aligned with the standard transition matrix (Table 3); however in a few instances (276ha) this is not the case (Table 4). Theme 10 was implemented to ensure that blocks were modeled to regenerate to the declared yield stratum.

**Theme 11: Landbase designation**

All pure coniferous and mixedwood stands were modeled to be managed to maximize coniferous volume; only pure deciduous were modeled to maximize deciduous volume. This distinction influenced stand sequenced by way of compartment sequencing and minimum harvest ages.

**Theme 12: AVI pine composition 70% or higher**

This theme was used to track stands that have 70% or more pine composition (AVI based). This information was **only used in the *Disaster* scenario TSA** to kill non-salvaged stands.

**Theme 13: AVI non-pine coniferous composition 40% or higher**

Similar to theme 12, this theme was used to track stands that have 40% or more non-pine coniferous composition (AVI based). This information **was not used in the TSA**.

## 2.1.1 Assigning pre-blocks

During the landbase classification (*Technical Report #1 – Landbase Classification*) all available planned blocks were cut into the net landbase. Since that time HWP planners have surveyed additional planned blocks. These new planned blocks were included in the TSA input file *[final_2009TSAinput]* by a *polygon selection method* (no additional GIS work was done to physically cut the boundaries into the net landbase). If a new planned block included 50% or more of the area of a polygon within the contributing landbase then the entire polygon (within the contributing landbase) was assumed to be planned for harvest (Figure 2). While there were some individual block outages, this method was successful in realistically representing the planned block boundary in most instances. The total actual area of additional planned blocks was 2,972.2ha which resulted in a total of 2,812.5ha of planned blocks after the *polygon selection method* was completed. The deviations caused by this method will be assessed through variance tracking.

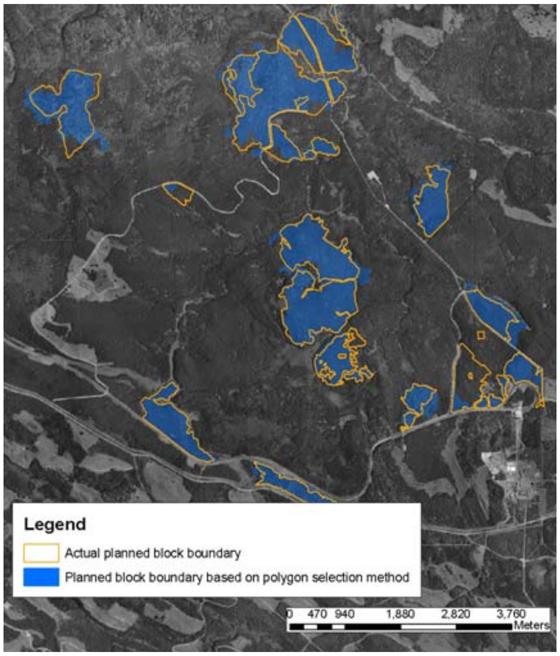


**Figure 2. Actual planned block boundaries compared to planned boundaries as defined through the "polygon selection method".**

### 2.1.2 Sequencing Susceptible Pine

The Hinton FMA has a high prevalence of mature to over-mature pine volume (Figure 12). A major goal of the PPMS was to reduce this highly susceptible area on the FMA. This was accomplished by direct operational planning and by allowing the TSA software (*STANLEY*) to sequence only stands with both of the following attributes (over the first 20 years of the planning horizon):

- Must have an MPB Risk Ranking of 1 or 2 *[theme 4]*

And

- Must have a high pine species composition, identified by yield strata *[theme 6]*:
    - E_B8_GH
    - E_B8_GL
    - E_B8_MH
    - E_B8_ML

These harvest restrictions were not applied to pure deciduous stands.

## 2.2 Yield Projection Inputs

The selected yield curves align with the FMA's sawlog management emphasis.

### 2.2.1 Utilization Standards

Yields in the model were based on the coniferous and deciduous yield curves from *Technical Report #2 - Yield Projections (Appendix 1)*. The utilization standards used:

**Coniferous**

- 15/11 utilization standard
- 15cm stump
- tree length harvesting
- minimum merchantable length = 3.76m (empirical); 3.66m (GYPSY-based)
- volumes were reported in one of three species groups:
    - PL_VOL includes Pl only
    - SW_VOL includes Sw, Se, Fb, Fa, and Fd
    - SB_VOL includes SB only
- Tamarack (Lt) was considered unmerchantable
- Dead trees contributed no merchantable volume

**Deciduous**

- 15/10 utilization standard
- 15cm stump
- volumes reported as total deciduous merchantable volume:
    - DEC_VOL includes both Aw and Pb volume
- Birch (Bw) was considered unmerchantable
- Dead trees contributed no merchantable volume
- Empirical curves
    - cut-to-length harvesting

  - o target length = 2.56m
  - o minimum merchantable length = 1.78m
- GYPSY curves
  - o tree length harvesting
  - o minimum merchantable length = 3.66m

### 2.2.2 Cull Deductions

Cull deductions were not applied to any yield strata in *Technical Report #2 - Yield Projections (Section 6)*. Rather a percentage cull reduction was applied to each yield curve within the TSA model.

Coniferous cull reduction = 5%
Deciduous cull reduction = 13.2%

### 2.2.3 Deciduous Mortality

During empirical curve development, losses due to mortality were accounted for as dead trees did not contribute any merchantable volume. However due to a lack of plots in deciduous-dominated stands aged 140+ years, the acceleration in deciduous mortality is potentially under-represented in older stands. Therefore, a conservative approach was taken and an age-based mortality constant (Huang 1999) was applied to the deciduous volumes of all empirical based curves (Table 1). A deciduous volume reduction was not applied to GYPSY based curves as the model accounts for deciduous mortality.

**Table 1. Estimated rate of deciduous volume retention due to mortality**

| Stand Age (yrs) | 0 to 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 | 155 | 160 | 165 | 170 | 175 | 180+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Deciduous Volume Retention Rate | 1.000 | 0.980 | 0.941 | 0.884 | 0.814 | 0.732 | 0.644 | 0.544 | 0.465 | 0.382 | 0.305 | 0.238 | 0.181 | 0.134 | 0.096 | 0.068 | 0.046 |

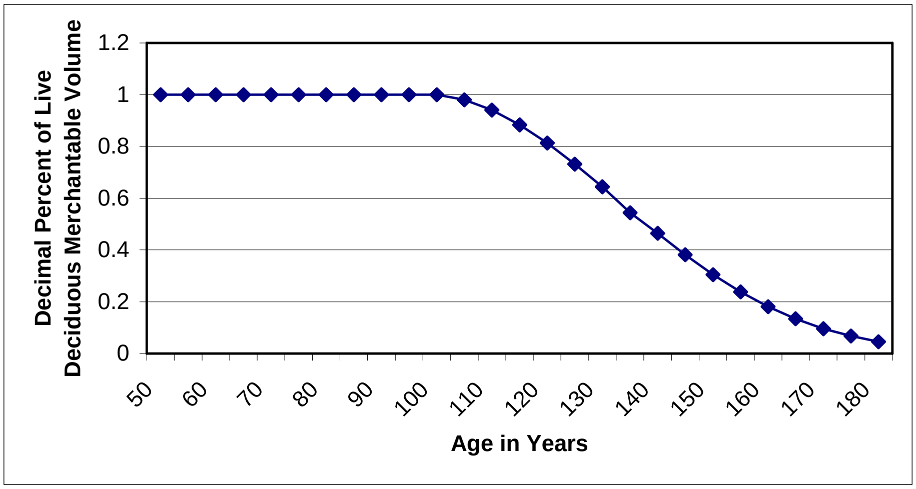


**Figure 3. Estimated rate of deciduous volume retention versus stand age**

### 2.2.4 Low stocking yield modifier

An October 30, 2009 letter from SRD titled *Regenerating landbase – ARIS records validation* described the process to proportionally reduce volume projections for managed stands with a performance survey total stocking between 50% and 80% (hereafter called "low stocking blocks"). The *Alberta Regeneration Survey Manual* defines 80%+ stocking as a fully stocked stand; therefore an adjustment ratio was calculated for each stand as follows:

Block adjustment ratio = Total performance survey stocking / 80

The mean-area-weighted block adjustment ratio for each yield stratum was then calculated (Table 2). Volume retention for low stocked stands averaged closed to 80% in all yield strata (with a range of 70% to 90%). Therefore, a simple 0.8 adjustment factor (block retains 80% of the volume of a fully stocked stand) was applied to all low stocking blocks in the TSA.

**Table 2. Mean low stocking adjustment ratio by yield stratum (weighted by block area)**

| Yield Strata | Area (ha) | Mean performance survey stocking | Mean low stocking adjustment ratio (rounded down) |
|---|---|---|---|
| E_B1_XL | 6.1 | 71.1 | 0.8 |
| E_B2_XX | 55.8 | 66.2 | 0.8 |
| E_B3_XX | 1.7 | 58.3 | 0.7 |
| E_B9_XX | 1.7 | 66.3 | 0.8 |
| G_B4_XX | 10.9 | 72.5 | 0.9 |
| G_B5_XX | 49.7 | 75.6 | 0.9 |
| G_B7_XX | 253.7 | 64.6 | 0.8 |
| G_B8_XX | 1,332.8 | 70.4 | 0.8 |

### 2.2.5 Piece Size

Piece size projections were developed for each yield strata in the TSA. A detailed discussion of the development methodology is available in section 6.2 of *Technical Report #2 - Yield Projections*. Cull deductions were applied equally across all piece sizes.

## 2.3 Model Assumptions

- Planning Horizon = 200 years
- Minimum Polygon Size = 0.0001ha
- Model Start Date = May 1, 2008
- Entire FMA (which is the defined forest area) was modeled as a single sustained yield unit (SYU).
- As in the 1999 FMP separate FMU AACs were not calculated.
- Model Period Length = 5 years
- Minimum Harvest Age for Pure deciduous stands = 60 years (12 periods)
- Minimum Harvest Age for Mixedwoods and Pure Coniferous stands = 80 years (16 periods)

- Death Age for Mixedwoods and Pure Coniferous Stands = 320 years
- Death Age for Pure Deciduous Stands = 220 years

### 2.3.1 Model Objective and Constraints

There were two main objectives in the TSA models:

1. Maximize total (coniferous + deciduous) merchantable volume harvested over the entire planning horizon. In the TSA model this was the objective function.
2. Aggressively reduce the area of the most MPB susceptible pine stands over the first 20 years of the planning horizon. In the TSA model this was done by allowing the model to only sequence the most at risk rank 1 and 2 stands with the highest pine composition (Section 2.1.2).

Constraint #1 – Even-flow total coniferous and deciduous AAC

The total (primary + incidental) AAC for both coniferous and deciduous species were constrained to fluctuate within a maximum of +/- 5% of the *planning stretch* AAC. *Planning stretch* refers to the time period over which the AAC is averaged. When an accelerated cut was not being proposed: the planning stretch AAC = the mean planning horizon AAC. When an accelerated cut was proposed (as in PPMS) then the planning horizon is divided into two planning stretches (accelerated cut and post accelerated cut). Additionally planning stretches are also further divided by spatial versus aspatial planning (see Appendix 6.3 for details).

Constraint #2 – Non-declining coniferous and deciduous growing stock

Coniferous growing stock (for stands 80+ years old) and deciduous growing stock (for stands 60+ years old) levels were constrained to be non-declining over the last 50 years of the planning horizon.

Constraint #3 – 300,000 $m^3$/yr of coniferous volume from the Marlboro working circle

A "loose" constraint was implemented to force 300,000 $m^3$/yr of coniferous volume from the Marlboro working circle. This was done to ensure that significant volume was removed from the Marlboro working circle as it was the hardest MPB attacked region on the FMA as of April 2010.

## 2.3.2 Transition Matrix and Regeneration Lag Assumptions

All harvesting was modeled as a clear cut with each stand being regenerated based on the standard transition matrix (Table 3). The only exceptions were for a small area of operationally planned blocks with a silviculture declaration (Table 4). In the TSA model any blocks harvested or planned after May 1, 2008 were incorporated into the model as uncut pre-blocks. In a relatively small number of instances (273.6ha), these blocks had a declaration that did not match the standard transition matrix (Table 3). These deviations had two primary causes: 1) slivers caused by deviations between planned block and AVI polygon boundaries; or 2) the planned block was located (according to AVI) between two or more stand types (Figure 4).

All stands were assumed to regenerate to fully stocked status. Performance survey data from 2006, 2007, and 2008 were used to calculate a mean regeneration lag for each yield stratum (see

*Technical Report #2 - Yield Projections* for more detail). Regeneration lags were not applied to the yield curves directly but were included within the TSA model as a transition multiplier. Each harvested yield type was modeled so that a proportion of the area was assigned to a 5 year regeneration lag (the other portion of the stand was assigned a regeneration lag of zero).

Proportion of stand with a 5yr regen lag = Regen. Lag from Table 3 / 5

To account for regeneration lag on blocks cut prior to the 2008 start date. A total of 2 years was subtracted from the total stand age (regeneration lag rounded to the nearest year) for each stand assigned to one of the GYPSY based growth curves (G_B4_XX, G_B5_XX, G_B7_XX, and G_B8_XX). Two years was not added to stands assigned to an empirical based curve because the yield projections were derived from plot data that was assumed to have an origin age that was equal to the AVI inventory age. However, in the TSA model as stands were harvested a regeneration lag (Table 3) was applied to all yield strata (empirical and GYPSY based).

The overall reason for handling regeneration lag within the TSA model was to prevent site growth from being confounded with administrative decisions (as is the situation when regeneration lags are embedded within yield curves). The TSA regeneration lag approach allows for much greater model flexibility.

If a stand died before being harvested, the entire stand was assigned to a 10 year (2 period) regeneration lag and re-assigned to a modest yield stratum. For example, when a high density pure deciduous stand *(E_B1_XH)* died it was re-assigned to a low density pure deciduous yield curve *(E_B1_XL)*.

**Table 3. Yield strata standard transition matrix*: Area by yield strata in 2008 and 2027**

| Harvest Yield Strata & Description | Regen. Lag (years) | Regen. Yield Strata | Harvest yield strata areas (ha) | | |
|---|---|---|---|---|---|
| | | | At the start of planning horizon in 2008 | At the end of the 20 year accelerated harvest in 2027 | Change |
| **E_B1_XL**<br>Pure D, All sites, A or B crown closure | 1.57 | E_B1_XH | 11,257 | 6,009 | -5,248 |
| **E_B1_XH**<br>Pure D, All sites, C or D crown closure | 1.57 | E_B1_XH | 36,975 | 43,222 | 6,247 |
| **E_B2_XX**<br>DC (PL), All sites, All crown closures | 1.55 | E_B2_XX | 17,195 | 17,235 | 40 |
| **E_B3_XX**<br>DC (Spruce/Fir), All sites, All crown closures | 2.37 | E_B3_XX | 14,244 | 14,292 | 48 |
| **E_B4_XX†**<br>CD (Spruce/Fir), All sites, All crown closures | 1.72 | G_B4_XX | 9,239 | 8,674 | -564 |
| **E_B5_XX**<br>CD (PL), All sites, All crown closures | 2.19 | G_B5_XX | 21,057 | 18,949 | -2,109 |
| **E_B7_MX**<br>Pure C (SW/FB), Medium site, All crown closures | 2.37 | G_B7_XX | 43,671 | 43,558 | -113 |
| **E_B7_GL**<br>Pure C (SW/FB), Good site, A or B crown closure | | | 11,766 | 10,933 | -833 |
| **E_B7_GH**<br>Pure C (SW/FB), Good site, C or D crown closure | | | 6,866 | 6,315 | -551 |
| **E_B8_ML**<br>Pure C (PL), Medium site, A or B crown closure | 2.04 | G_B8_XX | 38,092 | 22,034 | -16,057 |
| **E_B8_MH**<br>Pure C (PL), Medium site, C or D crown closure | | | 131,841 | 80,175 | -51,666 |
| **E_B8_GL**<br>Pure C (PL), Good site, A or B crown closure | | | 33,808 | 24,531 | -9,277 |
| **E_B8_GH**<br>Pure C (PL), Good site, C or D crown closure | | | 103,589 | 71,192 | -32,398 |
| **E_B9_XX**<br>Pure C (SB), All sites, All crown closures | 2 | E_B9_XX | 8,074 | 8,454 | 380 |

| Harvest Yield Strata & Description | Regen. Lag (years) | Regen. Yield Strata | Harvest yield strata areas (ha) | | |
|---|---|---|---|---|---|
| | | | At the start of planning horizon in 2008 | At the end of the 20 year accelerated harvest in 2027 | Change |
| **E_UN_DM and Fin_base10=1** Understory Managed: Pure D , All sites, All crown closures | 1.57 | E_B1_XH | 2,997 | 1,884 | -1,113 |
| **E_UN_DM and Fin_base10=2** Understory Managed: DC (PL) , All sites, All crown closures | 1.55 | E_B2_XX | 1,132 | 1,108 | -23 |
| **E_UN_DM and Fin_base10=3** Understory Managed: Pure DC (Spruce/Fir), All sites, All crown closures | 2.37 | E_B3_XX | 5,394 | 5,360 | -34 |
| **E_UN_DM and Fin_base10=4 or 6†** Understory Managed: Pure CD (Spruce/Fir), All sites, All crown closures | 1.72 | G_B4_XX | 5,470 | 5,444 | -26 |
| **E_UN_DM and Fin_base10=5** Understory Managed: Pure CD (PL), All sites, All crown closures | 2.19 | G_B5_XX | 850 | 838 | -12 |
| **E_UN_CX and Fin_base10=7** Understory Managed: Pure C (SW/FB), All sites, All crown closures | 2.37 | G_B7_XX | 32,033 | 31,663 | -370 |
| **E_UN_CX and Fin_base10=8** Understory Managed: Pure C (PL), All sites, All crown closures | 2.04 | G_B8_XX | 11,980 | 11,390 | -590 |
| **E_UN_CX and Fin_base10=9** Understory Managed: Pure C (SB), All sites, All crown closures | 2 | E_B9_XX | 7,942 | 7,560 | -382 |
| **G_B4_XX** GYPSY based: CD (Spruce/Fir)†, All sites, All crown closures | 1.72 | G_B4_XX | 2,315 | 2,952 | 637 |
| **G_B5_XX** GYPSY based: Pure CD (PL), All sites, All crown closures | 2.19 | G_B5_XX | 3,424 | 5,527 | 2,103 |
| **G_B7_XX** GYPSY Based: Pure C (SW/FB), All sites, All crown closures | 2.37 | G_B7_XX | 12,336 | 14,223 | 1,887 |
| **G_B8_XX** GYPSY Based: Pure C (PL), All sites, All crown closures | 2.04 | G_B8_XX | 76,615 | 186,640 | 110,025 |
| **Total** | | | **650,162** | **650,162** | |

* - Standard transitions were always used except when a strata declaration was present for a planned block (see Table 4)
† - Base10 strata 4 and 6 were combined

**Table 4. Planned Blocks with a declared yield strata different than the standard transition matrix**

| Harvest Yield Strata | Declared Regeneration Yield Strata | Area (ha) |
|---|---|---|
| E_B1_XH | E_B2_XX | 6.8 |
| | E_B3_XX | 72.1 |
| | G_B4_XX | 18.1 |
| | G_B5_XX | 2.2 |
| | G_B7_XX | 2.9 |
| | G_B8_XX | 8.1 |
| E_B1_XL | E_B3_XX | 0.1 |
| | G_B7_XX | 22.5 |
| E_B2_XX | G_B5_XX | 3.1 |
| | G_B8_XX | 6.5 |
| E_B3_XX | E_B1_XH | 21.2 |
| | G_B4_XX | 34.4 |
| | G_B7_XX | 1.9 |
| | G_B8_XX | 3.9 |
| E_B4_XX | G_B7_XX | 4.3 |
| E_B5_XX | E_B2_XX | 19.7 |
| | G_B8_XX | 15.3 |
| E_B7_GH | G_B8_XX | 0.6 |
| E_B7_GL | E_B1_XH | 0.1 |

| Harvest Yield Strata | Declared Regeneration Yield Strata | Area (ha) |
|---|---|---|
| | E_B3_XX | 5.3 |
| | G_B8_XX | 5.3 |
| E_B7_MX | G_B8_XX | < 0.1 |
| E_B8_GH | E_B2_XX | < 0.1 |
| | G_B5_XX | 11.9 |
| E_B8_GL | E_B1_XH | 0.5 |
| E_B9_XX | E_B3_XX | 0.2 |
| | G_B4_XX | < 0.1 |
| | G_B8_XX | 1.1 |
| E_UN_CX | E_B1_XH | 0.5 |
| | E_B3_XX | < 0.1 |
| | G_B4_XX | < 0.1 |
| E_UN_DM | G_B7_XX | < 0.1 |
| | G_B8_XX | 7.7 |
| **Total** | | **276.3** |

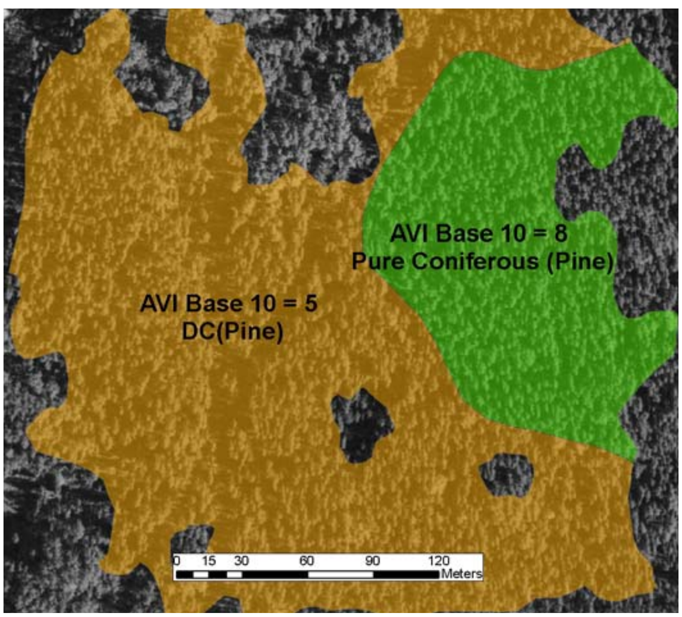


**Figure 4. Planned block that does not align with the standard transition matrix – (block has been declared to be entirely regenerated to a pure pine yield strata (Base10=8))**

## 2.4 Harvest Deferrals

Two types of harvest deferrals were included in the TSA model:

Harvest Deferral #1 – Woodland Caribou Special Management Area
Harvesting within the Woodland Caribou SMA ***[theme6= '****WOODL'****]*** was deferred until 2018 (in Woodstock this is a two year lock: *_LOCK 2*).

Harvest Deferral #2 – Residual Patches

*Technical Report #1 – Landbase Classification (Section 2.1.4 and 2.6.1.2)* describes a process of identifying residual patches. To prevent residual patches from being immediately sequenced for harvest, all residual patches were assigned to a 30 year harvest deferral (*6 period _Lock*).

## 2.5 Spatial Constraints

The model development included a 70 year spatial allocation of coniferous landbase blocks (pure coniferous and mixedwoods) and 60 year spatial allocation of deciduous landbase blocks. This process allows for the impacts of spatial landbase interactions to be assessed. The first 10 years (2 periods) of spatially allocated blocks represents HWP's proposed spatial harvest sequence (SHS).

Spatial attributes:

- Coniferous Spatial Harvest Sequence Planning Horizon = 70 years
- Deciduous Spatial Harvest Sequence Planning Horizon = 60 years
- Adjacency Distance = 50m – selected to ensure that computer generated blocks did not cross small permanent water courses
- No Green-up Period – to better reflect natural disturbance harvesting
- Multi-period blocks were allowed – to better reflect natural disturbance harvesting

# 3 Results

The preferred pine management strategy (PPMS) was developed by examining the results from several TSA models (see Appendix 6.1 for a full discussion of the PPMS selection process). A major management goal of this plan was to reduce the area of MPB susceptible pine stands and secondarily to correct some of the current age class imbalances across the FMA (Figure 12). The chosen PPMS quickens this process by proposing a twenty year accelerated cut while safeguarding the economic and environmental sustainability of the FMA.

## 3.1 Preferred Pine Management Strategy

The *final projected* (FP) AAC levels of the PPMS incorporates a 70 year coniferous and a 60 year deciduous spatial harvest sequence. The last 130 years of the coniferous planning horizon and the last 140 years of the deciduous planning horizon are based on aspatial projections. This process (as outlined in the *Alberta Planning Standard*) allows for confidence that the PPMS is a sustainable strategy.

The accelerated coniferous AAC from 2008 to 2027 was project at 1,766,576m$^3$/year (Figure 5). Starting in 2028 a coniferous AAC reduction to 1,399,724m$^3$/year is expected. This is a modest dropdown, as it is a spatially allocated AAC that is just 10.2% below the aspatial baseline even-flow coniferous AAC of 1,558,269 m$^3$/year (run B2: Table 6). The deciduous AAC from 2008 to 2027 was project at 249,831m$^3$/year. The MPB strategy results in very little deciduous AAC uplift during the accelerated cut because the vast majority of harvesting occurs in pine dominated stands (Figure 5). The strict avoidance of mixedwood stands over the first twenty years of the planning horizon results in little deciduous volume being harvested off the coniferous landbase (Figure 6).

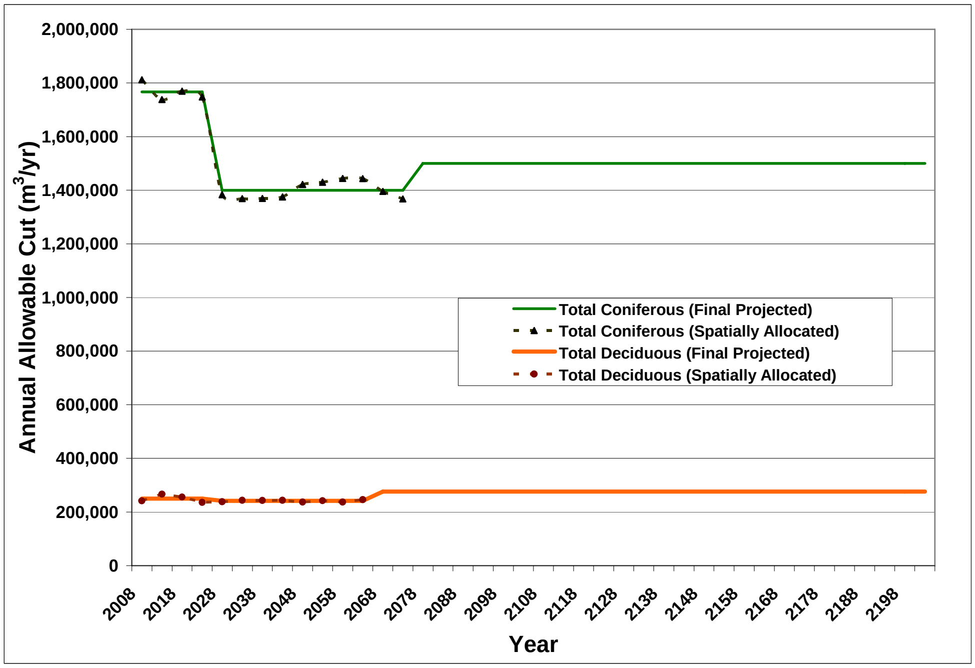


**Figure 5. PPMS final projected AAC over the planning horizon**

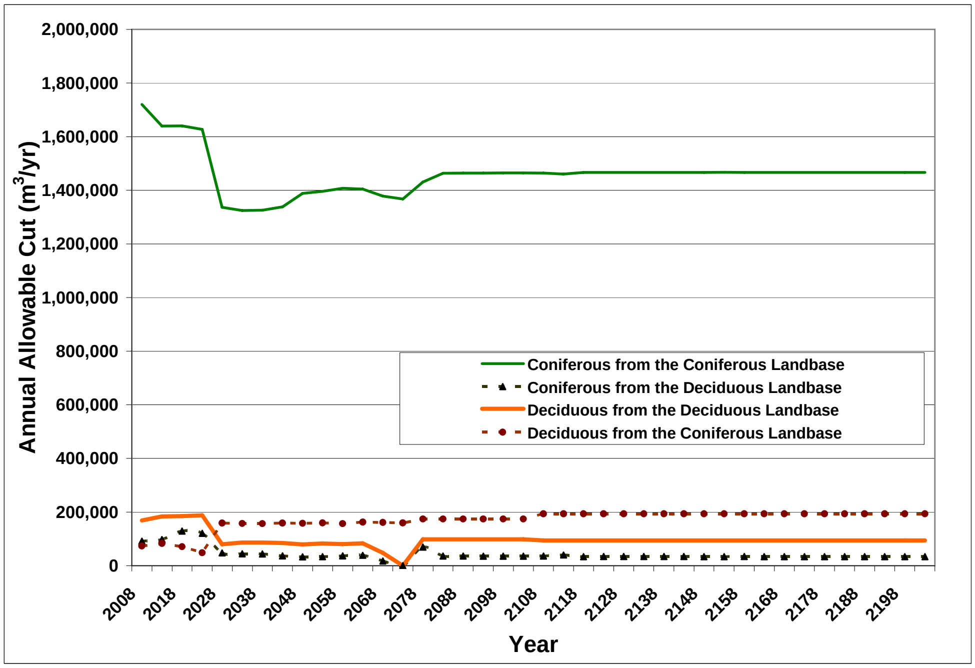


**Figure 6. Coniferous and deciduous landbase contributions to the final projected AAC**

## 3.2 Future Forest Attributes

The PPMS strategy provides future forest attributes consistent with what is desired with a MPB forest management plan amendment:

- During the accelerated cut period (2008 to 2027) the vast majority of coniferous volume is obtained from pine dominated stands (Figure 7). Upon completion of the accelerated cut, a 15 year period (2028 to 2042) begins where few pine dominated stands are harvested. This overall trend is still discernable when volume by individual species types are examined (Figure 8); but it is not as strong. Significant pine volumes are still projected to be harvested off the non-pine dominated stands during the 15 year period. During a MPB epidemic it is unlikely that these trees will remain uninfected. This strongly suggests that during the 20 year accelerated cut, non-pine coniferous pockets within pure pine stands should not be harvested (when feasible). This variance causing practice will provide critical volume to mitigate the post-MPB AAC downfall and will hopefully sustain the economic future of the FMA.
- The PPMS significantly decreases the area of highest pine-dominated rank 1 and 2 susceptible stands (based on current composition). Over the accelerated cut period the area of pine dominated rank 1 and 2 stands drops from 164,834ha to 76,487ha; a drop of over 50% in 20 years (Figure 9).
- The total FMA growing stock (especially pine) decreases during the accelerated cut (2008 to 2027) (Figure 10). After 2043 the total growing stock on the FMA remains constant. However, for harvest age stands (80+ years for pure coniferous and mixedwood, 60+ for deciduous) the downward growing stock trend continues until the pine stands harvested during the accelerated cut period reach the minimum harvest age of 80 years old (Figure 11). With density management it is expected that some of these

regenerating stands should be merchantable prior to the current fire-origin based 80 year minimum harvest age.

- The Hinton FMA currently has a high percentage of mature to over-mature age class forest (Figure 12). This age class distribution tends to make the FMA more vulnerable to insect and disease impacts. After 20 years of the PPMS, the age class distribution is more balanced (Figure 13).

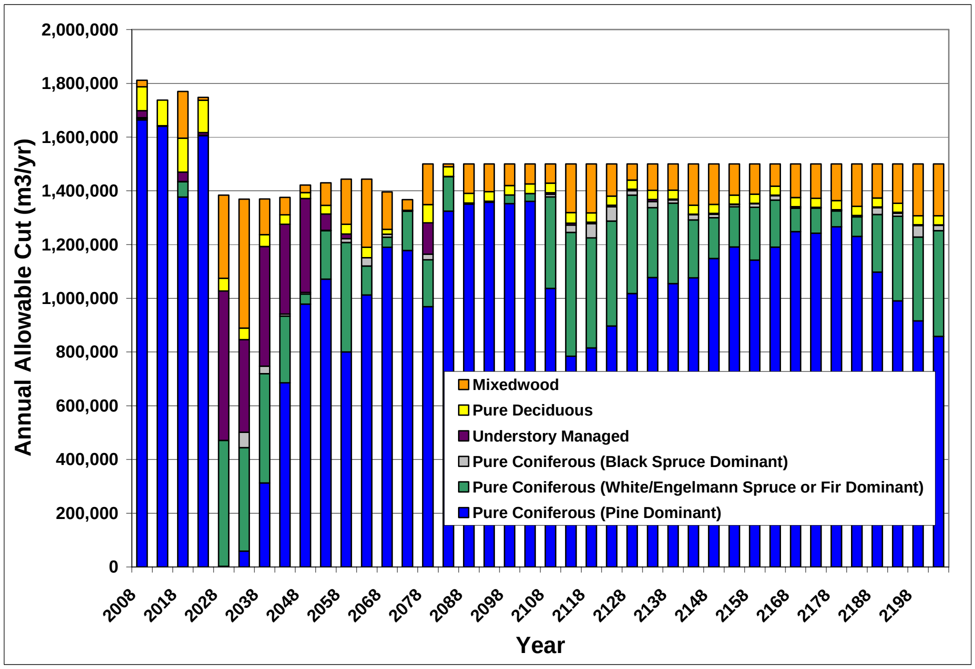


**Figure 7. PPMS stand type contributions to the coniferous AAC**

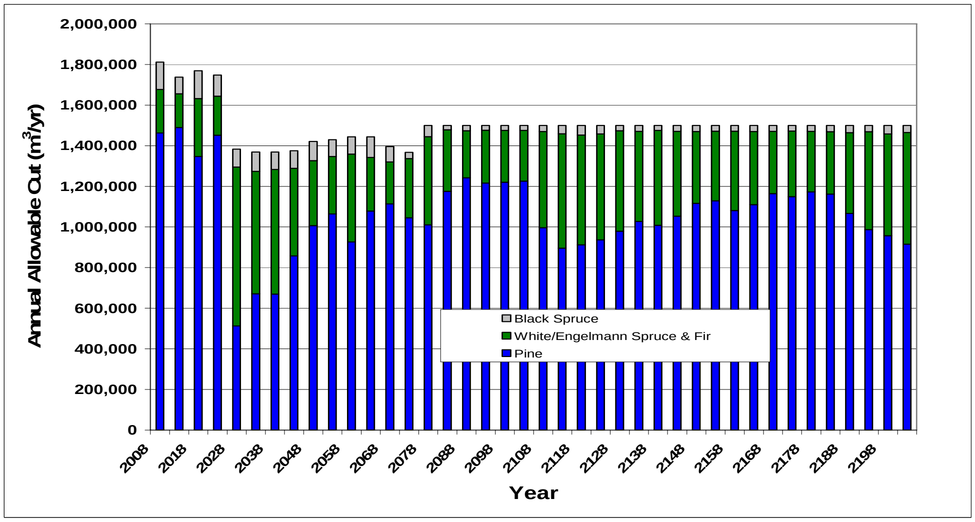


**Figure 8. PPMS contribution by species to the coniferous AAC**

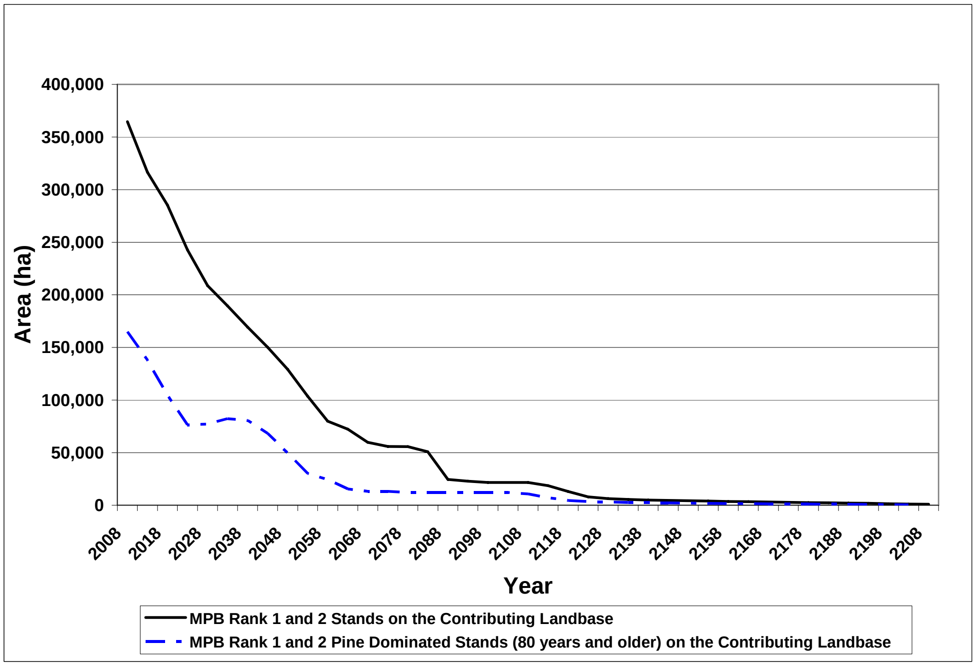


**Figure 9. PPMS change in MPB Rank 1 and 2 stands within the contributing landbase**

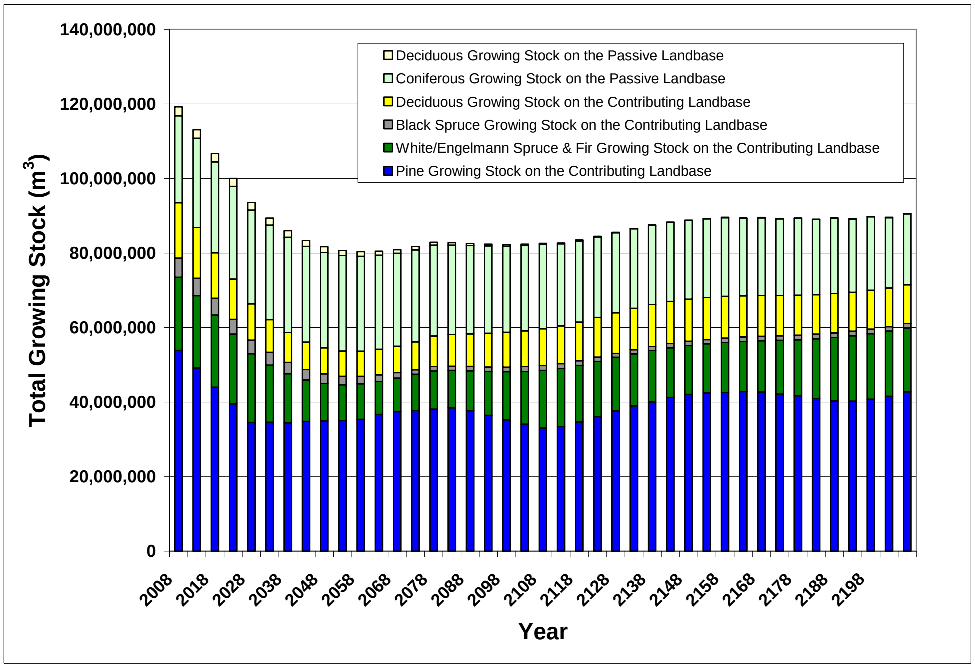


**Figure 10. PPMS change in total growing stock**

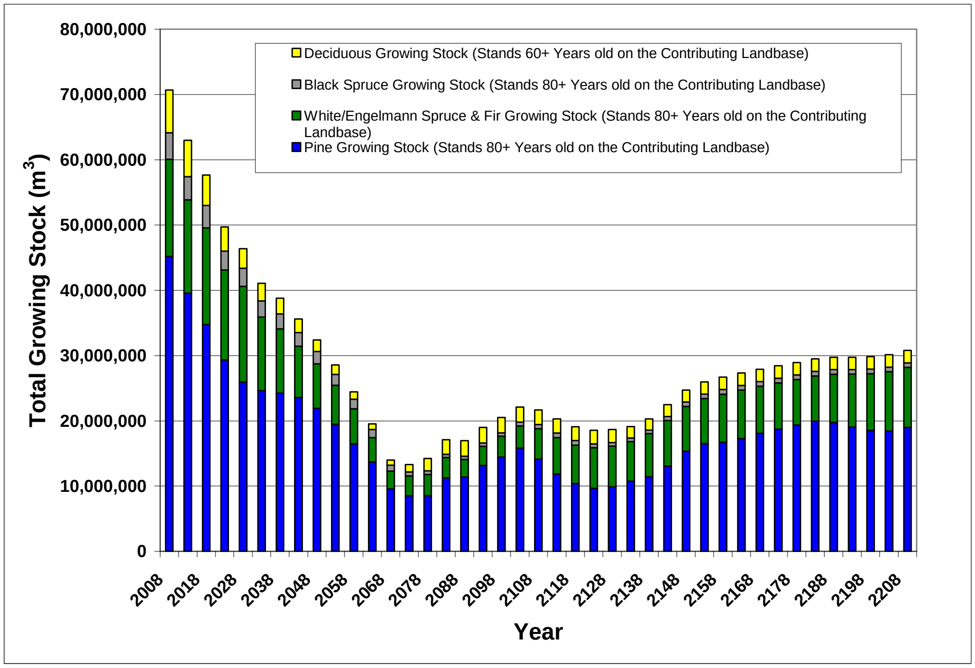


**Figure 11. PPMS change in total growing stock for stands that meet the minimum harvest age requirement (80+ for pure coniferous and mixedwoods; 60+ for pure deciduous).**

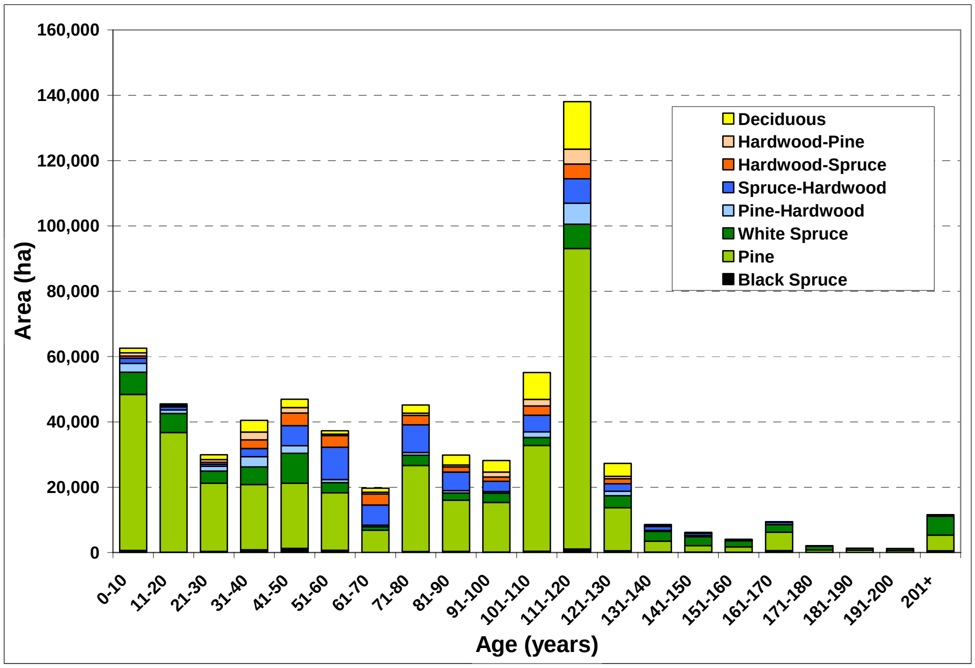


**Figure 12. Age class distribution at the base date (2008)**

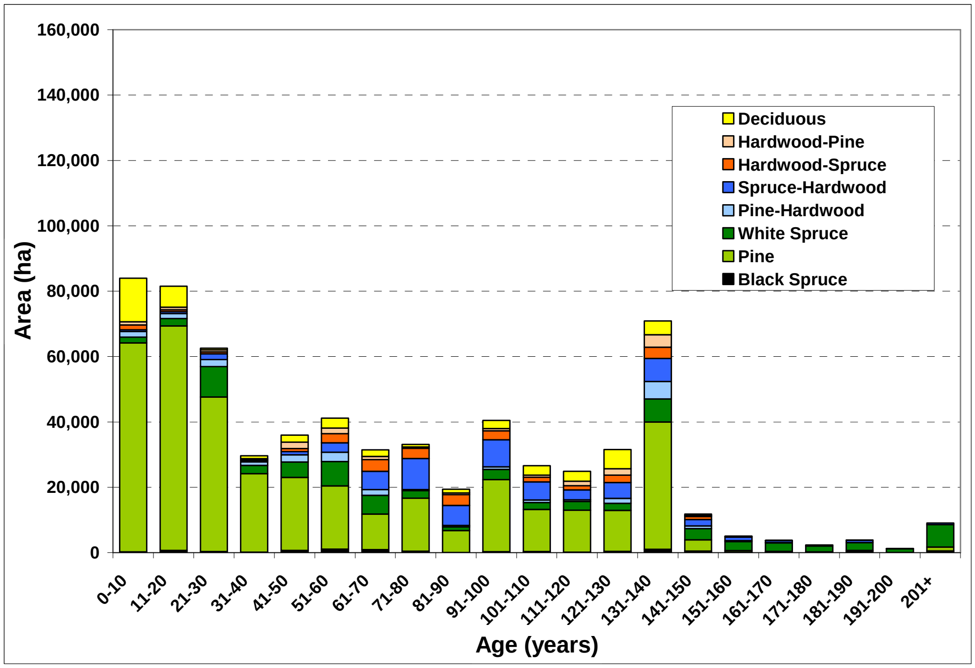


**Figure 13. PPMS age class distribution in 2027**

## 3.3 PPMS yield strata transitions through time

The accelerated cut period produces a significant shift within the pine yield strata grouping from fire origin to managed status (Figure 14). No significant shifts are projected in any other yield groupings. A yield strata shift begins in 2023 when understory managed stands are heavily harvested because understory managed stands are regenerated to the yield strata type that is best represented by the current stand understory. Aside from the harvest of understory managed stands, the area distribution of each yield grouping (Black spruce, Pine, White spruce – fir, Mixedwoods, and Deciduous) remains constant throughout the planning horizon.

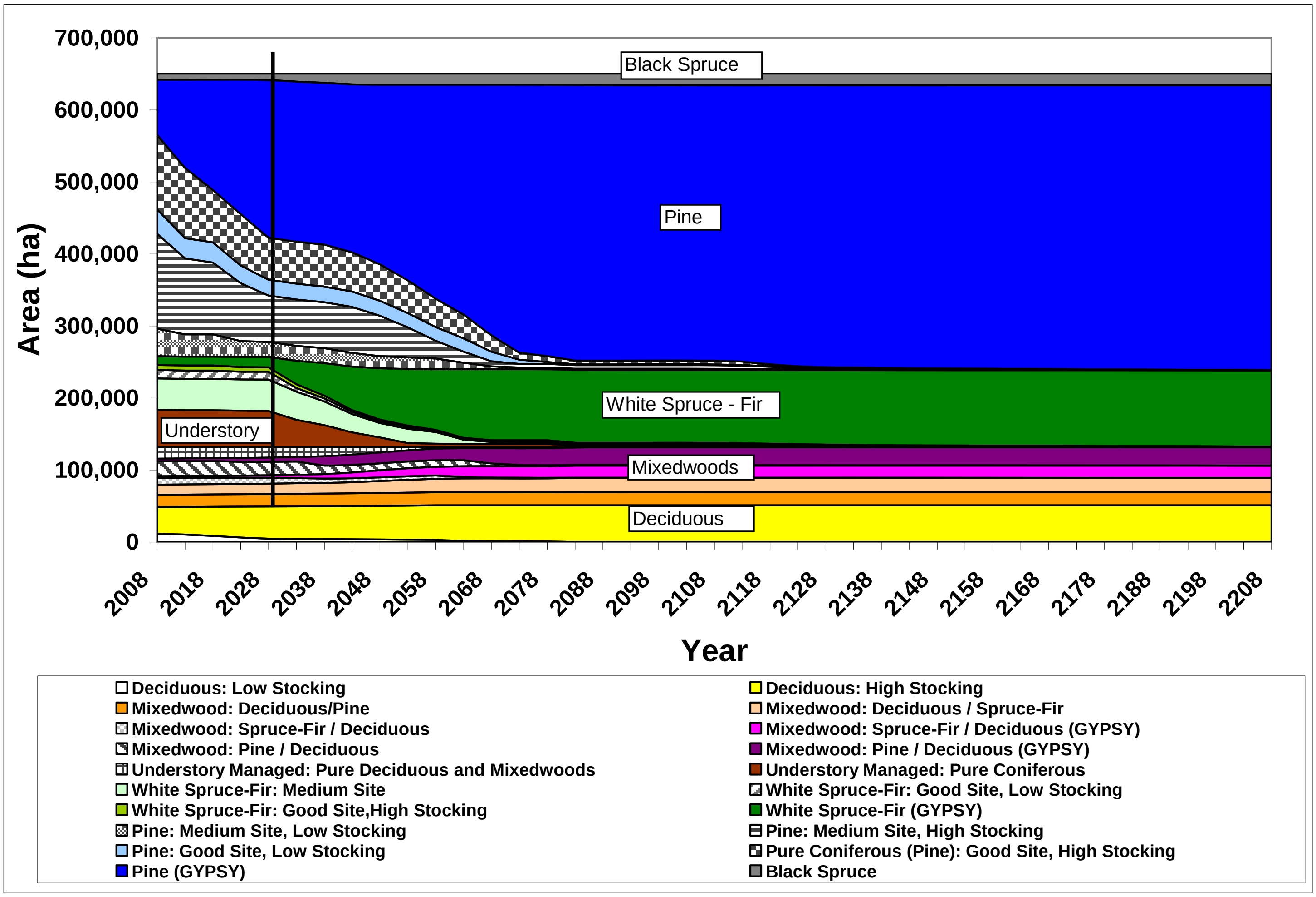


**Figure 14. PPMS yield strata transitions through time (black line represents the end of the accelerated cut period - 2028)**

## 3.4 MPB Disaster Scenario

A MPB disaster scenario was modeled as per the guidelines established by SRD:

- Massive pine mortality was assumed 10 years into the planning horizon.
- Salvage cutting was possible for 10 years (20 years into the planning horizon).
- Salvaged stands have a normal regeneration lag.

- For stands not salvaged:
  - With >=70% pine composition – the entire stand (non-pine volume included) was assumed to have died. The stand was to regenerate on a low density curve with a 15 year regeneration lag.
  - With <=60% pine composition – the pine volume only included was assumed to have died. The stand growth continues as normal (pine volume removed).
- The HWP FMA had a total of 364,627ha of rank 1 and 2 stands. Due to age class distribution and harvest deferral issues it was not possible to achieve the target to reduce the area of Rank 1 and 2 stands to 25% of that in the currently approved FMP by year 20. In the *Disaster Scenario* Rank 1 and 2 stands were aggressively harvested over the first 20 years of the disaster scenario. However, the model was allowed the flexibility to not harvest a portion of the approximately 100,000ha of rank 1 and 2 stands with a pine component <=60%. This was done to align the model better to HWP's anticipated field strategies.

The main purpose of the *Disaster Scenario* was to project the AAC downfall after a massive MPB attack. And the results were devastating, the coniferous AAC drops by well over 1,000,000m$^3$/year (compared to the even-flow AAC) to just over 400,000m$^3$/year (Table 6).

The disaster scenario is a somewhat pessimistic model as it assumes an instant infection of the entire FMA and the salvage period ends with an assumed 100% loss of all un-salvaged pine volume. Additionally, some non-pine volume was also assumed to be lost. Regardless, the MPB disaster scenario provides an understanding of the gravidity of the situation and clearly establishes that a significant drop in AAC will occur after an FMA-wide MPB epidemic.

# 4 Recommended AAC Summary

Based on the extensive analyses undertaken, HWP recommends a coniferous AAC of 1,766,576m$^3$/yr and a deciduous AAC of 249,831m$^3$/yr.

**Table 5. Recommended AAC based on the preferred pine management strategy**

| AAC (m$^3$/yr)* | |
|---|---|
| **Coniferous<br>15/11 utilization standard** | **Deciduous<br>15/10 utilization standard** |
| 1,766,576 | 249,831 |

* - No attempt was made to estimate structure retention volumes; therefore structure retention will be monitored, reported annually and charged against the AAC.

## 4.1 Spatial Harvest Sequence and Strata Description Table

HWP has produced a 10-year SHS file *[PPMS_10yearSHS.shp]* derived directly from the PPMS. This will be the file referenced during variance checks. Due to the length of the table, the *Strata Description Table* has been included as an MS Excel spreadsheet (*Strata Description.xls*) on the enclosed CD *MPB Plan Amendment – Complete Final Reports, Maps, and Strata Description Table.*

## 4.2 Comparison to the 1999 FMP

There are significant differences between the *1999 Forest Management Plan* and this *Mountain Pine Beetle Forest Management Plan Amendment*:

1. The utilization standard has changed from a pulp focus (10/8 utilization) to a sawlog standard (15/11 coniferous and 15/10 deciduous).
2. The 1999 plan did not have a MPB focus.
3. No SHS was required in 1999.

These differences make a direct comparison between the 1999 AAC and the above recommended PPMS AAC very difficult. However:

1. In 2006 an operational adjustment to the 1999 10/8 AAC was approved by SRD which changed the coniferous AAC to 1,535,000$m^3$/yr at a 15/10 utilization standard. This aligns well with the new 15/11 baseline even-flow coniferous AAC of 1,558,269$m^3$/yr (Table 6 – B2).
2. The 1999 FMP sets the 10/8 deciduous AAC to 169,449$m^3$/yr. Initially this seems to conflict with the new recommended 15/10 deciduous AAC of 249,831$m^3$/yr. However, the 1999 deciduous LRSYA was 413,587$m^3$/yr (10/8 utilization). The low 1999 deciduous AAC seems to have been caused by no even-flow constraints being imposed. A low mean deciduous AAC over the first twenty years of the planning horizon in the 1999 FMP was predominately due the prioritization of harvest in older coniferous age classes.

# 5 References


| |
|---|
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| Huang, S. 1999. Interim mortality models for white spruce and aspen grown in boreal mixed-species stands. Forest Management Division, Lands and Forest Service. Alberta Environment. Presented at the WESBOGY Annual Meeting, September 1999. |
| Weldwood of Canada. 2000. 1999 Forest Management Plan – Volume I, Management Strategy 1999 – 2008. Weldwood of Canada Limited, Hinton Forest Resources. Hinton, Alberta |
| Weldwood of Canada. 2000. 1999 Forest Management Plan – Volume II, Resource Analysis. Weldwood of Canada Limited, Hinton Forest Resources. Hinton, Alberta |
| Weldwood of Canada. 2002. Harvest Planning and Operating Ground Rules. Weldwood of Canada Limited, Hinton Forest Resources. Hinton, Alberta |

# 6 Appendix

## 6.1 PPMS Selection Process

The selection of the PPMS was done through an iterative process. First a realistic baseline even-flow coniferous and deciduous AAC was established at 1,558,269$m^3$/yr and 246,007$m^3$/yr respectively (Run B2 - Table 6). The B2 run was used as the basis for calculating the target area reduction in rank 1 and 2 stands through the 75% in 20 years guideline.

$$\text{MRank12} = 217{,}949\text{ha} \bullet 0.25$$
$$= 54{,}487\text{ha}$$

where: MRank12 = Minimum area of rank 1 and 2 stands that must remain on the landbase after 20 years of accelerated cut.

Due to age class distribution and harvest deferrals, reducing the total area of rank 1 and 2 forests to 54,487ha was not possible within 20 years. The minimum achievable area was 71,803ha. Therefore, a healthy pine model was run (H2) to project the implications of achieving as close as possible to the 71,803ha goal (75,000ha was used as the target to provide the model with some flexibility). This resulted in a radical accelerated coniferous AAC of 2,913,347$m^3$/yr and a resultant fall-down to 945,811$m^3$/yr. These AAC fluctuations were unrealistic to implement.

The next step was to control the coniferous post-accelerated AAC fall-down by inserting a minimum AAC constraint (column K - Table 6). Through this process it was decided that *Run P1* was the most operationally realistic aspatial management strategy. *Run P1* projected a 20 year accelerated AAC at 17% above the baseline run (B2) while projecting a fall-down AAC that is only 4% below baseline even-flow.

The use of a constraint to force a maximum area reduction on MPB Rank 1 and 2 stands was abandoned for two reasons:

1. The model disproportionably harvested the least productive stands to maximize the area reduction.
2. Many of the MPB rank 1 and 2 stands have significant non-pine volumes making those stands more likely to remain at merchantable status in the event of an MPB attack.

The approach adopted was to allow only rank 1 and 2 pine-dominated pure coniferous stands to be sequenced during the twenty year accelerated cut period. For the deciduous landbase, only pure deciduous stands were sequenced.

**Table 6. TSA scenario tracking sheet**

| A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | AAC $m^3$/yr – during the surge (2008 - 2027) | | AAC $m^3$/yr - last 180 years of the planning horizon (2028 - 2207) | | | |
| **Run #** | **Category** | **Locks & Pre-blocks Included** | **Compartment Plan Followed** | **Marlboro Coniferous AAC >= 300,000 m3/yr between 2013 and 2028 (periods 2 to 4)*** | **Growing Stock Does Not Decline over the last 50 years of the planning horizon** | **Force Surge Harvest (periods 1 to 4) into Pure Pine Rank 1 and 2 stands** | **Spatial Harvest Sequence Included** | **Coniferous** | **Deciduous** | **Coniferous** | **Deciduous** | **Area (ha) of rank 1 and 2 stands at the start of 2008** | **Area (ha) of rank 1 and 2 stands at the end of 2027** |
| B1 | Baseline | Yes | No | No | Yes | No | No | 1,564,303 | 246,007 | 1,564,303 | 265,509 | 364,627 | 216,743 |
| B2 | | Yes | Yes | Yes | Yes | No | No | 1,558,269 | 244,652 | 1,558,269 | 263,739 | 364,627 | 217,949 |
| D2 | Disaster | Yes | Yes | Yes | Yes | Yes | No | 2,303,572 | 379,019 | 409,678 | 193,885 | 364,627 | 145,000 |
| H2 | Healthy Pine | Yes | No | Yes | Yes | No | No | 2,913,347 | 322,041 | 945,811 | 220,899 | 364,627 | 75,000† |
| H6 | | Yes | No | Yes | Yes | No | No | 2,180,572 | 305,583 | 1,400,000 | 278,570 | 364,627 | 172,864 |
| P1 | Preferred Pine Management Strategy (Non Spatial) | Yes | Yes | Yes | Yes | Yes | No | 1,820,548 | 261,817 | 1,500,000 | 264,802 | 364,627 | 204,935 |
| P3 | Preferred Pine Management Strategy (Spatial) | Yes | Yes | Yes | Yes | Yes | Yes | **1,766,576** | 249,831 | **1,399,724‡** | 241,204‡ | 364,627 | 208,700 |

* - not a hard constraint
† - assigned as a model constraint.
‡ - mean of spatially allocated portion of the planning horizon (see Table 10 for details)

## *6.2 Long Run Sustained Yield Average*

**Table 7. LRSYA for the HWP FMA: natural to natural stand transitions were assumed (minimum harvest ages applied)**

| Yield Stratum | Landbase Type | Age of Maximum MAI* | Coniferous MAI ($m^3$/ha/yr) | Deciduous MAI ($m^3$/ha/yr) | Net Area (ha) | Coniferous LRSYA ($m^3$/yr) | Deciduous LRSYA ($m^3$/yr) |
|---|---|---|---|---|---|---|---|
| E_B2_XX | Coniferous (Pure Coniferous or Mixedwood) | 1.27 | 0.71 | 17,195 | 21,906 | 12,146 | 1.27 |
| E_B3_XX | | 1.37 | 1.45 | 14,244 | 19,574 | 20,668 | 1.37 |
| E_B4_XX | | 2.65 | 0.41 | 9,239 | 24,509 | 3,817 | 2.65 |
| E_B5_XX | | 1.90 | 0.47 | 21,057 | 39,993 | 9,982 | 1.90 |
| E_B7_GH | | 2.23 | 0.50 | 6,866 | 15,312 | 3,443 | 2.23 |
| E_B7_GL | | 1.83 | 0.87 | 11,766 | 21,519 | 10,228 | 1.83 |
| E_B7_MX | | 2.06 | 0.04 | 43,671 | 89,973 | 1,788 | 2.06 |
| E_B8_GH | | 2.37 | 0.21 | 103,589 | 245,080 | 21,831 | 2.37 |
| E_B8_GL | | 1.95 | 0.16 | 33,808 | 65,897 | 5,456 | 1.95 |
| E_B8_MH | | 1.67 | 0.02 | 131,841 | 220,457 | 2,762 | 1.67 |
| E_B8_ML | | 1.27 | 0.05 | 38,092 | 48,466 | 1,731 | 1.27 |
| E_B9_XX | | 1.11 | 0.11 | 8,074 | 8,985 | 911 | 1.11 |
| E_UN_CX | | 2.36 | 0.41 | 51,955 | 122,532 | 21,469 | 2.36 |
| E_UN_DM | | 0.91 | 2.00 | 12,846 | 11,713 | 25,643 | 0.91 |
| G_B4_XX† | | 2.39 | 0.46 | 2,315 | 5,530 | 1,055 | 2.39 |
| G_B5_XX† | | 2.98 | 0.67 | 3,424 | 10,205 | 2,288 | 2.98 |
| G_B7_XX† | | 2.52 | 0.54 | 12,336 | 31,092 | 6,677 | 2.52 |
| G_B8_XX† | | 3.23 | 0.35 | 76,615 | 247,141 | 26,566 | 3.23 |
| E_B1_XH | Pure Deciduous | 0.72 | 2.20 | 36,975 | 26,487 | 81,305 | 0.72 |
| E_B1_XL | | 0.83 | 1.52 | 11,257 | 9,363 | 17,100 | 0.83 |
| E_UN_DM | | 1.06 | 2.00 | 2,997 | 3,172 | 5,992 | 1.06 |
| **Total** | | | | | **650,163** | **1,288,908** | **282,858** |

* - A two year regeneration lag was included. A minimum harvest age of 80years for the coniferous landbase and 60 years for deciduous landbase was assumed.
† - All stands currently on a GYPSY based managed stand yield curve, were assumed to remain within the yield strata.

**Table 8. LRSYA for the HWP FMA: natural to managed stand transitions were assumed (minimum harvest ages applied)**

| Yield Stratum | Age of Maximum MAI* | Coniferous MAI ($m^3$/ha/yr) | Deciduous MAI ($m^3$/ha/yr) | Net Area (ha) | Coniferous LRSYA ($m^3$/yr) | Deciduous LRSYA ($m^3$/yr) |
|---|---|---|---|---|---|---|
| E_B1_XH | 100 | 0.72 | 2.20 | 51,116 | 36,616 | 112,399 |
| E_B2_XX | 80 | 1.27 | 0.71 | 18,343 | 23,369 | 12,957 |
| E_B3_XX | 80 | 1.37 | 1.45 | 19,652 | 27,006 | 28,515 |
| G_B4_XX | 105 | 2.39 | 0.46 | 17,070 | 40,780 | 7,779 |
| G_B5_XX | 90 | 2.98 | 0.67 | 25,313 | 75,450 | 16,915 |
| G_B7_XX | 100 | 2.52 | 0.54 | 106,693 | 268,902 | 57,749 |
| G_B8_XX | 90 | 3.23 | 0.35 | 395,961 | 1,277,278 | 137,301 |
| E_B9_XX | 105 | 1.11 | 0.11 | 16,014 | 17,823 | 1,807 |
| **Total** | | | | **650,163** | **1,767,223** | **375,421** |

* - A two year regeneration lag was included. A minimum harvest age of 80years for the coniferous landbase and 60 years for deciduous landbase was assumed.

**Table 9. LRSYA for the HWP FMA: natural to managed stand transitions were assumed (no minimum harvest age applied)**

| Yield Stratum | Age of Maximum MAI* | Coniferous MAI ($m^3$/ha/yr) | Deciduous MAI ($m^3$/ha/yr) | Net Area (ha) | Coniferous LRSYA ($m^3$/yr) | Deciduous LRSYA ($m^3$/yr) |
|---|---|---|---|---|---|---|
| E_B1_XH | 100 | 0.72 | 2.20 | 51,116 | 36,616 | 112,399 |
| E_B2_XX | 60 | 1.34 | 0.31 | 18,343 | 24,552 | 5,715 |
| E_B3_XX | 65 | 1.41 | 1.37 | 19,652 | 27,665 | 26,983 |
| G_B4_XX | 105 | 2.39 | 0.46 | 17,070 | 40,780 | 7,779 |
| G_B5_XX | 90 | 2.98 | 0.67 | 25,313 | 75,450 | 16,915 |
| G_B7_XX | 100 | 2.52 | 0.54 | 106,693 | 268,902 | 57,749 |
| G_B8_XX | 90 | 3.23 | 0.35 | 395,961 | 1,277,278 | 137,301 |
| E_B9_XX | 105 | 1.11 | 0.11 | 16,014 | 17,823 | 1,807 |
| **Total** | | | | **650,163** | **1,769,065** | **366,647** |

* - A two year regeneration lag was included. A minimum harvest age of 80years for the coniferous landbase and 60 years for deciduous landbase was assumed.
Note: This table was constructed based on data from 5yr age classes so slight differences are expected between this table and the MAI targets tables (5-2 & 5-3) in *Technical report #2: Yield Projections.*

## *6.3 Additional Tables and Graphs Related to the PFMS*

**Total Coniferous AAC**

Projected total coniferous AAC was divided into three planning stretches:

Planning Stretch 1 = Periods 1 to 4 (2008 to 2027)
- Accelerated Cut
- Allocated Spatially

Planning Stretch 2 = Periods 5 to 14 (2028 to 2077)
- Post-Accelerated Cut
- Allocated Spatially

Planning Stretch 3 = Periods 15 to 40 (2078 to 2207)
- Post-Accelerated Cut
- Allocated Aspatially

Total coniferous AAC for each planning period fell within the +/-5% even flow requirement (Table 10).

**Total Deciduous AAC**

Projected total deciduous AAC was divided into four planning stretches:

Planning Stretch 1 = Periods 1 to 4 (2008 to 2027)
- Accelerated Cut
- Allocated Spatially

Planning Stretch 2 = Periods 5 to 12 (2028 to 2067)
- Post Accelerated Cut
- Allocated Spatially

Planning Stretch 3 = Periods 13 to 14 (2068 to 2077)
- Post Accelerated Cut
- Partially Allocated Spatially
- Grouped with periods 15 to 40 to calculate the mean AAC

Planning Stretch 4 = Periods 15 to 40 (2078 to 2207)
- Post Accelerated Cut
- Allocated Aspatially

The deciduous AAC was fully allocated spatially for the first 60 years (12 periods) of the planning horizon. Periods 13 and 14 represent only a partial spatial allocation. This was due to a technical issue that required stands to be re-sequenced (ie. Pure deciduous stands with a minimum harvest age of 60 years could be sequenced twice within a 70 spatial harvest sequence). When discussed with SRD it was agreed that a 60 year deciduous spatial harvest sequence was the requirement for this plan. Additionally the mean deciduous AAC for periods 13 to 40 was

35,000m$^3$/yr higher than the mean AAC for periods 5 to 12. This indicates that the AAC fall-down projected in periods 13 and 14 was caused purely by a technical issue and does not reflect an expected occurrence (Table 10).

The projected deciduous AACs for periods 2 and 4 violate the +/-5% even flow requirement (Table 10). This was not considered to be a significant issue as the fluctuations were just outside the 5% range (+7% and -6%). Additionally the SHS will be operationally implemented on a decadal scale (all periods 1 and 2 blocks will be pooled together and so will all period 3 and 4 blocks). When this is done the deciduous SHS is well within the +/-5% even-flow rule (+1.7% for periods 1 and 2; -1.7% for periods 3 and 4).

**Table 10. PPMS summary of AAC projections for each 5 year period (starting May 1, 2008)**

| Period | Coniferous AAC (m$^3$/yr) | | | | | Deciduous AAC (m$^3$/yr) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | From Coniferous Landbase | From Deciduous Landbase | Total Planned | Planning Stretch Mean | % Diff. Planned versus Stretch Mean | From Deciduous Landbase | From Coniferous Landbase | Total Planned | Planning Stretch Mean | % Diff. Planned versus Stretch Mean |
| 1 | 1,720,282 | 91,237 | 1,811,518 | 1,766,576 | +3% | 168,705 | 73,039 | 241,744 | 249,831 | -3% |
| 2 | 1,639,815 | 97,854 | 1,737,669 | | -2% | 183,439 | 83,058 | 266,496 | | +7% |
| 3 | 1,640,406 | 128,897 | 1,769,303 | | 0% | 185,079 | 70,578 | 255,657 | | +2% |
| 4 | 1,626,850 | 120,965 | 1,747,815 | | -1% | 187,302 | 48,128 | 235,430 | | -6% |
| 5 | 1,336,481 | 47,230 | 1,383,711 | 1,399,724 | -1% | 79,675 | 158,508 | 238,183 | 241,204 | -1% |
| 6 | 1,324,177 | 44,438 | 1,368,615 | | -2% | 86,367 | 157,322 | 243,689 | | +1% |
| 7 | 1,325,671 | 43,650 | 1,369,321 | | -2% | 86,275 | 156,772 | 243,047 | | +1% |
| 8 | 1,338,708 | 36,351 | 1,375,059 | | -2% | 84,800 | 158,318 | 243,118 | | +1% |
| 9 | 1,388,677 | 32,514 | 1,421,191 | | +2% | 79,078 | 157,879 | 236,958 | | -2% |
| 10 | 1,396,343 | 33,512 | 1,429,855 | | +2% | 82,969 | 158,965 | 241,933 | | 0% |
| 11 | 1,407,288 | 36,321 | 1,443,609 | | +3% | 80,139 | 156,866 | 237,005 | | -2% |
| 12 | 1,404,627 | 38,646 | 1,443,273 | | +3% | 83,214 | 162,487 | 245,700 | | +2% |
| 13 | 1,378,085 | 17,444 | 1,395,530 | | 0% | 47,231 | 161,253 | 208,485 | 276,286 | -25% |
| 14 | 1,367,071 | 0 | 1,367,071 | | -2% | 0 | 159,019 | 159,019 | | -42% |
| 15 | 1,430,678 | 69,322 | 1,500,000 | 1,500,000 | 0% | 98,532 | 173,845 | 272,377 | | -1% |
| 16 | 1,463,930 | 36,070 | 1,500,000 | | 0% | 98,532 | 173,845 | 272,377 | | -1% |
| 17 | 1,464,257 | 35,743 | 1,500,000 | | 0% | 98,532 | 173,845 | 272,377 | | -1% |
| 18 | 1,464,376 | 35,624 | 1,500,000 | | 0% | 98,532 | 173,845 | 272,377 | | -1% |
| 19 | 1,464,686 | 35,314 | 1,500,000 | | 0% | 98,532 | 173,845 | 272,377 | | -1% |
| 20 | 1,464,765 | 35,235 | 1,500,000 | | 0% | 98,532 | 173,845 | 272,377 | | -1% |
| 21 | 1,464,084 | 35,916 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 22 | 1,460,469 | 39,531 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 23 | 1,466,318 | 33,682 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 24 | 1,466,249 | 33,751 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 25 | 1,466,221 | 33,779 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 26 | 1,466,238 | 33,762 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 27 | 1,466,190 | 33,810 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 28 | 1,466,258 | 33,742 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 29 | 1,466,447 | 33,553 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 30 | 1,466,758 | 33,242 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 31 | 1,466,253 | 33,747 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 32 | 1,466,369 | 33,632 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 33 | 1,466,428 | 33,572 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 34 | 1,466,479 | 33,521 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 35 | 1,466,512 | 33,488 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 36 | 1,466,527 | 33,473 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| 37 | 1,466,530 | 33,470 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |

| Period | Coniferous AAC ($m^3$/yr) | | | | | Deciduous AAC ($m^3$/yr) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **From Coniferous Landbase** | **From Deciduous Landbase** | **Total Planned** | **Planning Stretch Mean** | **% Diff. Planned versus Stretch Mean** | **From Deciduous Landbase** | **From Coniferous Landbase** | **Total Planned** | **Planning Stretch Mean** | **% Diff. Planned versus Stretch Mean** |
| **38** | 1,466,528 | 33,472 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| **39** | 1,466,527 | 33,473 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |
| **40** | 1,466,527 | 33,473 | 1,500,000 | | 0% | 93,605 | 193,107 | 286,713 | | +4% |

Note: **Green** shading denotes that the AAC has been spatially allocated.

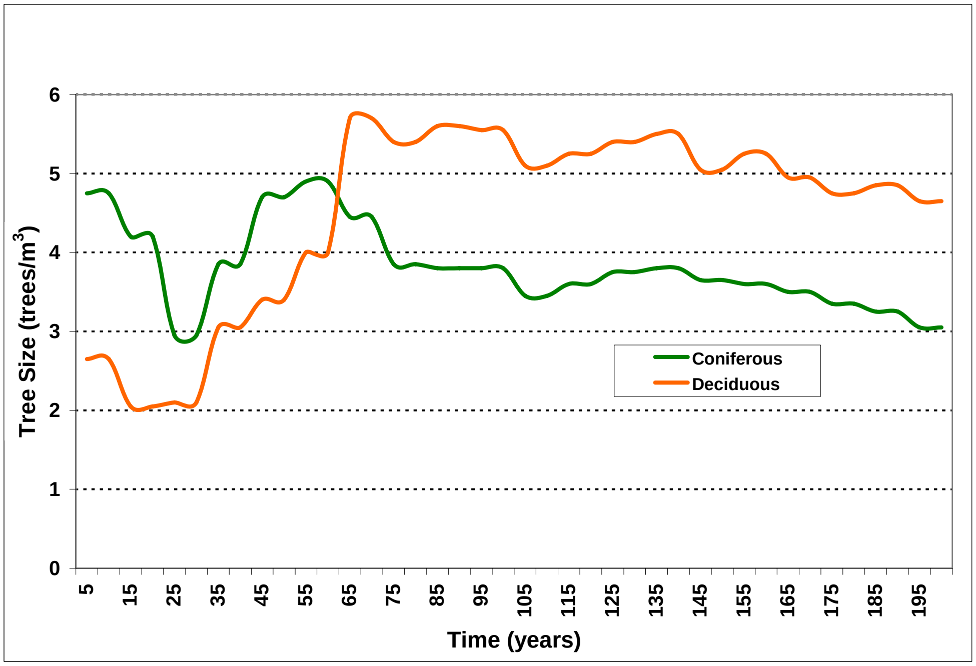



**Figure 15. PPMS mean piece size (Trees/$m^3$) – results averaged by decade**

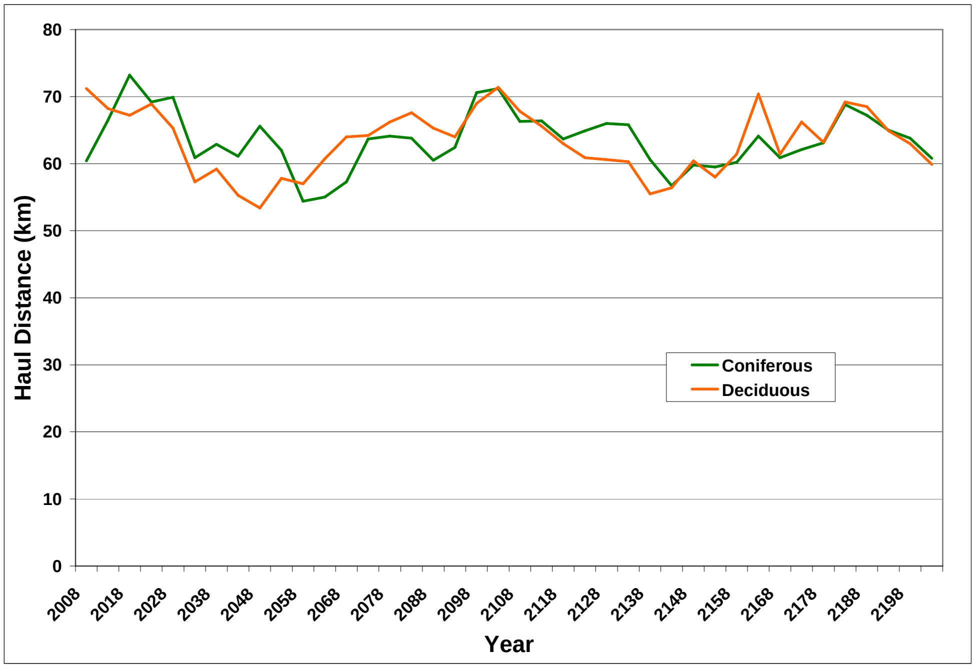



**Figure 16. PPMS mean haul distance (to Hinton mill site)**

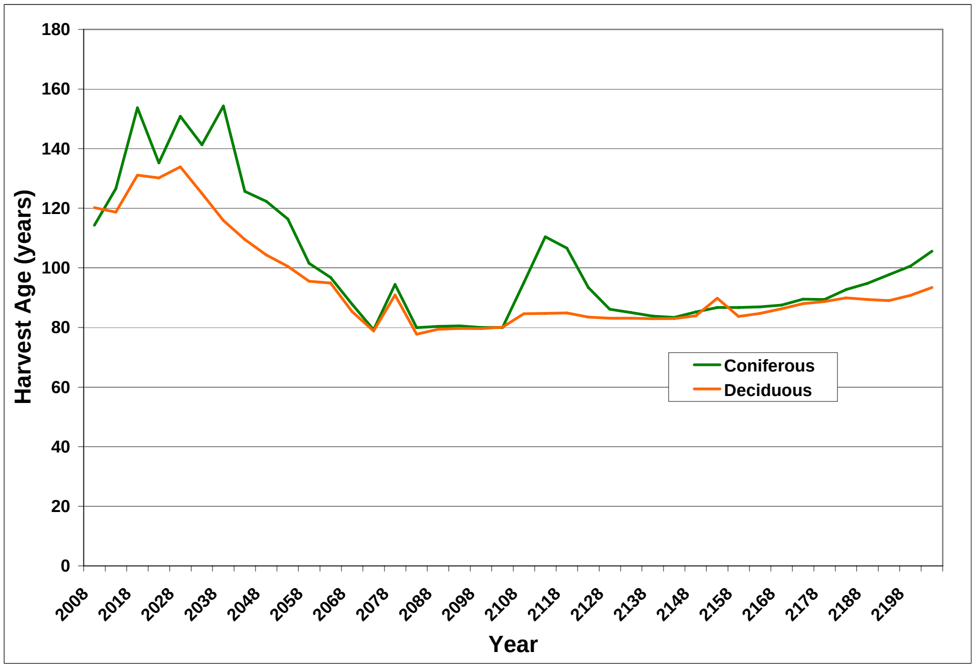



**Figure 17. PPMS mean harvest age**

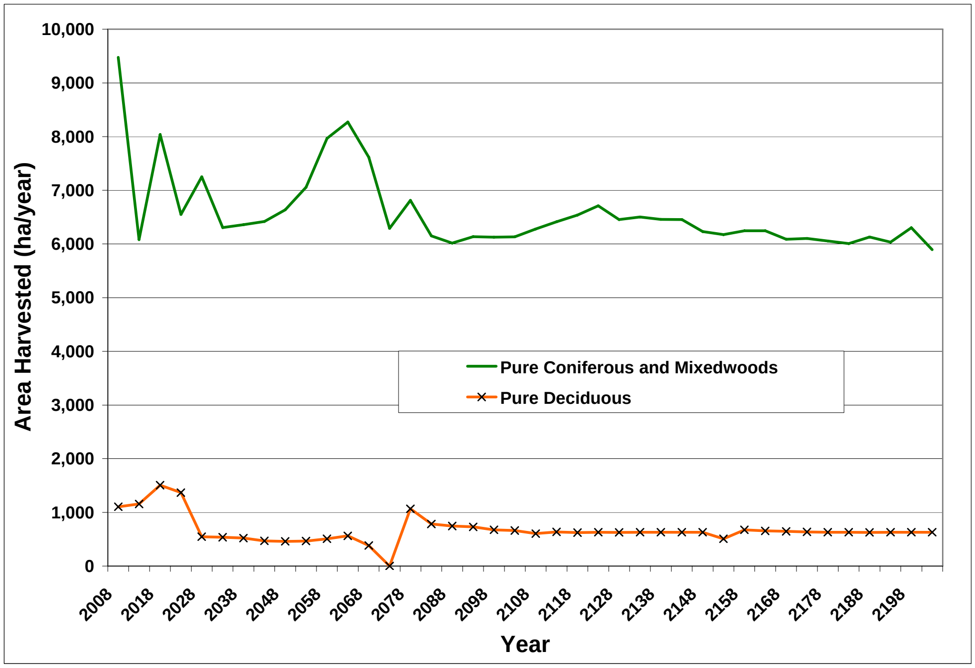



**Figure 18. PPMS mean harvest area by broad cover group**

**Table 11. PPMS total merchantable volumes harvested by compartment from 2008 to 2017**

| Compartment | Coniferous ($m^3$) | Deciduous ($m^3$) | Grand Total ($m^3$) |
|---|---|---|---|
| ATHABASCA 01 | 467,675 | 11,570 | 479,245 |
| ATHABASCA 02 | 0 | 0 | 0 |
| ATHABASCA 03 | 0 | 0 | 0 |
| ATHABASCA 04 | 0 | 0 | 0 |
| ATHABASCA 06 | 0 | 0 | 0 |
| ATHABASCA 08 | 0 | 0 | 0 |
| ATHABASCA 09 | 0 | 0 | 0 |
| ATHABASCA 10 | 0 | 0 | 0 |
| ATHABASCA 11 | 0 | 0 | 0 |
| ATHABASCA 12 | 0 | 0 | 0 |
| ATHABASCA 13 | 0 | 0 | 0 |
| ATHABASCA 14 | 0 | 0 | 0 |
| ATHABASCA 15 | 284,165 | 21,013 | 305,178 |
| ATHABASCA 16 | 59 | 4 | 63 |
| ATHABASCA 17 | 0 | 0 | 0 |
| ATHABASCA 18 | 0 | 0 | 0 |
| ATHABASCA 19 | 33,397 | 1,983 | 35,380 |
| ATHABASCA 20 | 0 | 0 | 0 |
| ATHABASCA 21 | 0 | 0 | 0 |
| ATHABASCA 22 | 153,809 | 20,367 | 174,177 |
| ATHABASCA 23 | 106 | 6 | 112 |
| ATHABASCA 24 | 521,950 | 18,444 | 540,394 |
| ATHABASCA 26 | 579,782 | 16,916 | 596,698 |
| ATHABASCA 27 | 451,222 | 35,836 | 487,058 |
| ATHABASCA 28 | 557,235 | 28,117 | 585,352 |
| ATHABASCA 29 | 187,390 | 9,771 | 197,161 |
| ATHABASCA 30 | 447,445 | 23,212 | 470,656 |
| ATHABASCA 31 | 209,489 | 9,987 | 219,476 |

| Compartment | Coniferous ($m^3$) | Deciduous ($m^3$) | Grand Total ($m^3$) |
|---|---|---|---|
| ATHABASCA 32 | 0 | 0 | 0 |
| ATHABASCA 33 | 0 | 0 | 0 |
| ATHABASCA 34 | 0 | 0 | 0 |
| ATHABASCA 35 | 366,292 | 17,829 | 384,121 |
| BERLAND 01 | 0 | 0 | 0 |
| BERLAND 02 | 0 | 0 | 0 |
| BERLAND 03 | 0 | 0 | 0 |
| BERLAND 04 | 0 | 0 | 0 |
| BERLAND 05 | 0 | 0 | 0 |
| BERLAND 06 | 71,785 | 3,250 | 75,034 |
| BERLAND 07 | 8,885 | 591 | 9,476 |
| BERLAND 08 | 0 | 0 | 0 |
| BERLAND 09 | 120,437 | 7,053 | 127,490 |
| BERLAND 10 | 66,114 | 3,416 | 69,529 |
| BERLAND 11 | 326,236 | 18,920 | 345,156 |
| BERLAND 12 | 278,061 | 17,273 | 295,333 |
| BERLAND 13 | 0 | 0 | 0 |
| BERLAND 14 | 0 | 0 | 0 |
| BERLAND 16 | 0 | 0 | 0 |
| BERLAND 18 | 29,019 | 1,402 | 30,421 |
| BERLAND 20 | 0 | 0 | 0 |
| BERLAND 21 | 0 | 0 | 0 |
| BERLAND 22 | 0 | 0 | 0 |
| BERLAND 23 | 580,593 | 18,714 | 599,307 |
| BERLAND 24 | 186 | 11 | 197 |
| BERLAND 25 | 231,382 | 9,821 | 241,204 |
| BERLAND 26 | 259,206 | 10,976 | 270,182 |
| BERLAND 27 | 109,430 | 3,231 | 112,661 |
| BERLAND 28 | 0 | 0 | 0 |
| BERLAND 29 | 521,469 | 25,337 | 546,806 |
| BERLAND 30 | 459,245 | 19,304 | 478,549 |
| BERLAND 31 | 316 | 19 | 335 |
| BERLAND 33 | 361,787 | 9,115 | 370,902 |
| BERLAND 34 | 1 | 0 | 1 |
| EMBARRAS 01 | 0 | 0 | 0 |
| EMBARRAS 02 | 0 | 0 | 0 |
| EMBARRAS 03 | 0 | 0 | 0 |
| EMBARRAS 04 | 0 | 0 | 0 |
| EMBARRAS 05 | 111 | 1 | 112 |
| EMBARRAS 06 | 273,336 | 10,360 | 283,696 |
| EMBARRAS 07 | 600,326 | 77,374 | 677,701 |
| EMBARRAS 08 | 0 | 0 | 0 |
| EMBARRAS 09 | 7,211 | 13,318 | 20,529 |
| EMBARRAS 10 | 472,419 | 15,614 | 488,033 |
| EMBARRAS 11 | 384,517 | 119,795 | 504,312 |
| EMBARRAS 12 | 645,759 | 37,645 | 683,404 |
| EMBARRAS 13 | 0 | 0 | 0 |
| EMBARRAS 14 | 61 | 1 | 62 |
| EMBARRAS 15 | 0 | 0 | 0 |
| EMBARRAS 16 | 0 | 0 | 0 |
| EMBARRAS 17 | 0 | 0 | 0 |
| EMBARRAS 18 | 0 | 0 | 0 |
| EMBARRAS 19 | 0 | 0 | 0 |
| EMBARRAS 20 | 891,771 | 20,379 | 912,150 |
| EMBARRAS 21 | 0 | 0 | 0 |
| EMBARRAS 22 | 0 | 0 | 0 |
| MCLEOD 01 | 0 | 0 | 0 |
| MCLEOD 02 | 1,338 | 8 | 1,346 |
| MCLEOD 03 | 777,354 | 19,957 | 797,310 |
| MCLEOD 04 | 748 | 39 | 787 |
| MCLEOD 05 | 414,278 | 12,445 | 426,724 |
| MCLEOD 06 | 19,060 | 1,871 | 20,931 |
| MCLEOD 07 | 291,827 | 11,206 | 303,032 |
| MCLEOD 08 | 78,496 | 1,083 | 79,579 |

| Compartment | Coniferous ($m^3$) | Deciduous ($m^3$) | Grand Total ($m^3$) |
|---|---|---|---|
| MCLEOD 09 | 1,071 | 35 | 1,106 |
| MCLEOD 10 | 0 | 0 | 0 |
| MCLEOD 11 | 0 | 0 | 0 |
| MCLEOD 12 | 389,785 | 104,612 | 494,397 |
| MCLEOD 13 | 40,341 | 87,702 | 128,043 |
| MCLEOD 14 | 0 | 0 | 0 |
| MCLEOD 15 | 633 | 187 | 820 |
| MCLEOD 16 | 42,116 | 88,819 | 130,935 |
| MCLEOD 17 | 230,925 | 13,154 | 244,079 |
| MCLEOD 18 | 7,236 | 477 | 7,713 |
| MCLEOD 19 | 0 | 0 | 0 |
| MCLEOD 20 | 281,340 | 8,600 | 289,940 |
| MCLEOD 21 | 21 | 0 | 22 |
| MCLEOD 23 | 442,448 | 28,912 | 471,359 |
| MCLEOD 24 | 178,650 | 3,780 | 182,430 |
| MCLEOD 25 | 2,206 | 2,042 | 4,247 |
| MCLEOD 27 | 215,349 | 11,549 | 226,898 |
| MCLEOD 28 | 0 | 0 | 0 |
| MARLBORO 01 | 0 | 0 | 0 |
| MARLBORO 02 | 289,712 | 16,975 | 306,687 |
| MARLBORO 03 | 0 | 0 | 0 |
| MARLBORO 04 | 1,095,297 | 53,404 | 1,148,701 |
| MARLBORO 05 | 271,562 | 11,234 | 282,795 |
| MARLBORO 06 | 0 | 0 | 0 |
| MARLBORO 07 | 241 | 78 | 319 |
| MARLBORO 08 | 41,107 | 75,466 | 116,573 |
| MARLBORO 09 | 0 | 0 | 0 |
| MARLBORO 10 | 0 | 0 | 0 |
| MARLBORO 11 | 0 | 0 | 0 |
| MARLBORO 12 | 0 | 0 | 0 |
| MARLBORO 13 | 552,635 | 408,764 | 961,399 |
| MARLBORO 14 | 0 | 0 | 0 |
| MARLBORO 15 | 0 | 0 | 0 |
| MARLBORO 16 | 311,675 | 515,155 | 826,830 |
| MARLBORO 17 | 67,024 | 86,453 | 153,477 |
| MARLBORO 18 | 161,526 | 286,624 | 448,150 |
| MARLBORO 19 | 0 | 0 | 0 |
| MARLBORO 20 | 0 | 0 | 0 |
| MARLBORO 21 | 442,061 | 25,243 | 467,304 |
| MARLBORO 22 | 138,201 | 7,354 | 145,555 |
| MARLBORO 23 | 0 | 0 | 0 |
| MARLBORO 24 | 0 | 0 | 0 |
| MARLBORO 25 | 0 | 0 | 0 |

## 6.4 PPMS TSA Models and Output Spatial Data

The final spatial harvest sequence files are:

- ***FMP2009_TSAinput_SQ***: the same as the TSA input file from *Technical Report #1 landbase classification* ***[FMP2009_TSAinput]*** except all polygons <0.0001ha in size have been removed and the entire 14 period spatial harvest sequence have been declared.
- ***PPMS_10yearSHS***: 10year SHS with individual polygon volumes and operator declared.

The final TSA Woodstock models are:

- ***PFMS_SPAT:*** Pine Final Management Strategy (Spatial) - PPMS with full spatial allocation (Woodstock re-optimization).
- ***PFMS_NOTSPAT:*** Pine Final Management Strategy (Non-spatial) - PPMS with only pre-blocks spatially allocated (run P1 - Table 6).

### 6.4.1 Data Library

| FMP2009_TSAinput<br>FMP2009_TSAinput_SQ<br>PPMS_10yearSHS | | | | | |
|---|---|---|---|---|---|
| **Field Name** | **Description** | **Type** | **Width** | **Dec** | **Valid codes and description** |
| Areaha | Total Polygon Area (ha) | Numeric | 20 | 10 | ha |
| netarea | Net Polygon Area (ha) (excluded unmanaged portions of horizontal stands) | Numeric | 20 | 10 | ha |
| Horxha | Area of unmanaged portions of horizontal stands | Numeric | 16 | 4 | ha |
| STANLOCK | Spatial Locks (deferrals used in the PPMS) | Character | 15 | | _Lock6 = 6 period lock (30 years)<br>_Lock2 = 2 period lock (10 years) |
| ACTION | TSA model action number | Numeric | 3 | 0 | 1: Clear-cut (Operational planned blocks)<br>2: Clear-cut (Compartments eligible for harvest: 2008 to 2017)<br>3: Clear-cut (Compartment eligible for harvest from 2018 on) |
| BLOCK | Block | Character | 10 | | SXXXXX = Stanley defined block number<br>PREB999 = Operational pre-blocks |
| Cut_Period | Period action is applied | Numeric | 3 | | Numeric: Designates the period of harvest 1 to 14 |
| FID_LINK | Unique Identifier | Numeric | 9 | | Sequential number |
| WS_UID | Watershed Unique Identifier | Character | 50 | | Watershed + Numeric Unique Identifier |
| AGE5YR | Stand age in 5 yr periods (2 year regeneration lag <u>not</u> included ) | Numeric | 3 | | 1 = 0 to 5 years<br>2 = 6 to 10 years<br>etc. |
| FIN5YR | Stand age in 5 yr periods (2 year regeneration lag included ) | Numeric | 3 | | 1 = 0 to 5 years<br>2 = 6 to 10 years<br>etc. |
| AGE10YR | STD_AGE in 10 yr periods (2 year regeneration lag <u>not</u> included ) | Numeric | 3 | | 1 = 0 to 10 years<br>2 = 10 to 20 years<br>etc. |
| PREBLK08 | Pre-blocks at the start date 2008 | Numeric | 16 | 4 | 1 = Block harvested during the 2008 timber year or planned for harvest from the 2008 timber year on. |
| DEL | Deletion | Character | 2 | | AN: Anth Non-vegetated<br>AO: Deleted for being an “A” overstory with no understory present<br>AV: Anth Vegetated<br>CL: Cutline / Seismic<br>DR: Disposition<br>EC: Poor Ecosite<br>EP: ESIP<br>LR: Larch composition 10%+<br>NV: Non-Forested<br>NO: No Deletion (Operable)<br>NN: Non-Vegetated<br>OB: Out of FMA<br>PP: Potentially Productive<br>SB: SB composition 80%+<br>SS: Steep Slopes<br>WB: Water Buffer<br>WT: Wet Site |
| DEL_HIER | Deletion Hierachy | Numeric | 2 | 0 | Describes the order of deletion removals:<br>1 = OB: Out of FMA<br>2 = NN: Naturally Non-Vegetated<br>3 = NF: Naturally Non-Forested<br>4 = AN: Anth Non-vegetated<br>5 = AV: Anth Vegetated<br>6 = EP: ESIP<br>7 = DR: Disposition<br>8 = WT: Wet Site<br>9 = LR: Larch composition 10%+<br>10 = EC: Poor Ecosite |

| FMP2009_TSAinput<br>FMP2009_TSAinput_SQ<br>PPMS_10yearSHS | | | | | |
|---|---|---|---|---|---|
| **Field Name** | **Description** | **Type** | **Width** | **Dec** | **Valid codes and description** |
| | | | | | 11 = AO: Deleted for being an "A" overstory with no understory present<br>12 = SB: SB composition 80%+<br>13 = PP: Potentially Productive<br>14 = SS: Steep Slopes<br>15 = WB: Water Buffer<br>16 = CL: Cutline / Seismic<br>99 = NO: No Deletion (Operable) |
| FIN_BASE10 | Story of Primary Management Base 10 Strata | Numeric | 16 | 4 | 1: Pure Deciduous<br>2: Deciduous Dominated Mixedwood (Pine is the leading conifer species)<br>3: Deciduous Dominated Mixedwood (Spruce/Fir is the leading conifer species)<br>4: Coniferous Dominated Mixedwood (White Spruce is the leading conifer species)<br>5: Coniferous Dominated Mixedwood (Pine is the leading conifer species)<br>6: Coniferous Dominated Mixedwood (Black Spruce is the leading conifer species)<br>7: Pure Coniferous (White Spruce is the leading conifer species)<br>8: Pure Coniferous (Pine is the leading conifer species)<br>9: Pure Coniferous (Black Spruce is the leading conifer species) |
| Cl_multipy | Cut line regeneration multiplier | Numeric | 16 | 4 | This will be discussed in detail in Technical Report #3 - TSA modeling and final results |
| Ws_short | Watershed Basin Unique Identifier | Character | 6 | | **Large Basin + Sub-basin number**<br><br>Brazeau River<br>BRAZ149, BRAZ150, BRAZ152, BRAZ171, BRAZ4<br>Cardinal River<br>CARD0, CARD140, CARD144, CARD145, CARD146, CARD147, CARD148<br>Edson River<br>EDSO13, EDSO41, EDSO42, EDSO43, EDSO44, EDSO45, EDSO46, EDSO47, EDSO48, EDSO49<br>Embarras River<br>EMBA100, EMBA101, EMBA103, EMBA104, EMBA105, EMBA108, EMBA109, EMBA110, EMBA111, EMBA6, EMBA98, EMBA99<br>Greg River<br>GREG172, GREG173, GREG174, GREG175, GREG176, GREG5<br>Little Berland River<br>LITT221, LITT222, LITT8<br>Lower Athabasca River<br>LOWA14, LOWA257, LOWA258, LOWA54, LOWA55, LOWA56, LOWA57, LOWA58<br>Lower Berland River<br>LOWB1, LOWB217, LOWB218, LOWB251, LOWB252, LOWB253, LOWB254, LOWB255, LOWB256<br>Lower Erith River<br>LOWE121, LOWE122, LOWE123, LOWE124, LOWE126, LOWE127, LOWE26<br>Lower McLeod River<br>LOWM106, LOWM72, LOWM73, LOWM74, LOWM75<br>Lower Wildhay River<br>LOWW212, LOWW213, LOWW214, LOWW24, LOWW262, LOWW263<br>Mid-Athabasca River<br>MIDA107, MIDA18, MIDA61, MIDA62, MIDA63, MIDA64, MIDA65, MIDA66, MIDA67, MIDA68, |

| FMP2009_TSAinput<br>FMP2009_TSAinput_SQ<br>PPMS_10yearSHS | | | | | |
|---|---|---|---|---|---|
| **Field Name** | **Description** | **Type** | **Width** | **Dec** | **Valid codes and description** |
| | | | | | MIDA69, MIDA70, MIDA71<br>Mid-Berland River<br>MIDB242, MIDB243, MIDB244, MIDB245, MIDB248, MIDB250<br>Mid-McLeod River<br>MIDM102, MIDM12, MIDM120, MIDM90, MIDM91, MIDM92, MIDM93, MIDM94, MIDM95, MIDM96, MIDM97<br>Oldman Creek<br>OLDM83, OLDM84, OLDM85, OLDM86, OLDM87, OLDM88, OLDM89, OLDM9<br>Pembina River<br>PEMB131, PEMB132, PEMB133, PEMB134, PEMB135, PEMB136, PEMB137, PEMB138, PEMB139, PEMB3<br>Pine Creek<br>PINE261, PINE50, PINE51, PINE52, PINE53<br>Pinto Creek<br>PINT202, PINT203, PINT204, PINT205, PINT206, PINT207, PINT208, PINT209, PINT210, PINT211, PINT7<br>Sundance<br>SUND22, SUND77, SUND78, SUND79, SUND80, SUND81, SUND82<br>Trout Creek<br>TROU35, TROU36, TROU37, TROU38, TROU39, TROU40<br>Upper Athabasca River<br>UPPA15, UPPA177, UPPA178, UPPA179, UPPA180, UPPA181, UPPA182, UPPA183, UPPA184, UPPA185, UPPA186, UPPA187, UPPA188, UPPA189<br>Upper Berland River<br>UPPB20, UPPB224, UPPB225, UPPB227, UPPB228, UPPB229, UPPB230, UPPB232, UPPB233, UPPB23<br>Upper Erith River<br>UPPE11, UPPE112, UPPE113, UPPE114, UPPE115, UPPE116, UPPE117, UPPE118, UPPE119, UPPE129, UPPE130<br>Upper McLeod River<br>UPPM10, UPPM154, UPPM158, UPPM159, UPPM160, UPPM161, UPPM162, UPPM163, UPPM164, UPPM165, UPPM166, UPPM167, UPPM168, UPPM169, UPPM155<br>Upper Wildhay River<br>UPPW190, UPPW191, UPPW192, UPPW193, UPPW194, UPPW195, UPPW196, UPPW198, UPPW199, UPPW2, UPPW200, UPPW201<br>Unnamed Watershed<br>WSID999<br>Willow Creek<br>WILL16, WILL59, WILL60<br>Windhill Creek<br>WIND30, WIND31, WIND32, WIND33 |
| SSICLASS | MPB Stand Susceptibility Index with Climate Factor Groupings | Character | 5 | | SSI10: SSI_CF>=0 AND SSI_CF<10<br>SSI20: SSI_CF>=10 AND SSI_CF<20<br>SSI40: SSI_CF>=20 AND SSI_CF<40<br>SSI60: SSI_CF>=40 AND SSI_CF<60<br>SSI80: SSI_CF>=60 AND SSI_CF<80 |
| OCON40 | Non-pine Coniferous Composition | Character | 1 | | Y: >=40% non-pine coniferous composition<br>N: <= 30% non-pine coniferous composition |
| Theme1 | WC_CMPT field<br>FMA working circle and compartment | Character | 6 | | In the FMA<br>The first 4 letters are:<br>ATHA: Athabasca, MARL: Marlboro, EMBR: Embarras, MCLD: McLeod, BERL: Berland<br>The last 2 numbers represent the compartment. |

# FMP2009_TSAinput
# FMP2009_TSAinput_SQ
# PPMS_10yearSHS

| Field Name | Description | Type | Width | Dec | Valid codes and description |
|---|---|---|---|---|---|
| | | | | | Outside the FMA<br>The first 2 letters are:<br>XX: outside the FMA<br><br>The last 4 letters identify the location:<br>ROBB: Robb townsite<br>COLS: Coalspur<br>LUCR: Luscar<br>MUSK: Muskiki<br>OUTS: Generic Outside FMA<br>WKLK: Wiki Lake<br>HINT: Hinton Townsite<br>OBED: Obed Mine<br>PINT: Pinto<br>SILV: Silver Summit<br>SQBK: Square Block<br>SUND: Sundance Provincial Park<br>SWIT: Switzer Provincial Park<br>WILD: Wildhay Natural Area |
| Theme2 | Special Management Wildzone | Character | 5 | | HIGHS - High Elevation Sheep and Goat SMA<br>PINTO - Pinto Creek Mountain Goat SMA<br>TRUMP - Trumpeter Swan SMA<br>WOODL - Woodland Caribou SMA<br>XXXXX – Not in a SMA |
| Theme3 | Ground Operability | Character | 4 | | SUMM – Summer Ground<br>WINT – Winter Ground |
| Theme4 | Mountain Pine Beetle Risk Ranking | Character | 2 | | M1: High<br>M2: Medium<br>M3: Low<br>M0: Minimal |
| Theme5 | Identifies stands with a stand height of 19m or greater | Character | 5 | | OVR19: Stand is at least 19m tall<br>UND19: Stand is less than 19m tall |
| Theme6 | Final Yield Strata | Character | 7 | | E= Empirical yield curves<br>G= GYPSY / ARS Curves<br>B#=Base 10 strata<br>Last to letters = Site & Crown Closure (H=C or D; L = A or B; X = All)<br><br>E_B1_XL, E_B1_XH, E_B2_XX, E_B3_XX, E_B4_XX, E_B5_XX, E_B7_MX, E_B7_GL, E_B7_GH, E_B8_ML, E_B8_MH, E_B8_GL, E_B8_GH, E_B9_XX, E_UN_DM, E_UN_CX, E_B1_XL, E_B1_XH, E_B2_XX, E_B3_XX, G_B4_XX, G_B5_XX, G_B7_XX, G_B8_XX, E_B9_XX, E_PAS_DE_PAS_C<br>NOYIELD – not a forest type |
| Theme7 | Fire versus Managed | Character | 4 | | FIRE – fire origin<br>LMAN – Low-stocked regenerating stand<br>MANA – managed stands<br>NSR – Not sufficiently re-stocked (in TSA model only)<br>DIE – Stand dead (in TSA model only)<br>NONE – non-forested |
| Theme8 | Contributing Versus Passive | Character | 4 | | CONT – Contributing<br>PASS - Passive |
| Theme9 | Stands with a cutline within its boundary | Character | 5 | | CLINE – Cutline within boundary which can be regenerated<br>NOTCL – No cutlines within polygon boundary |
| Theme10 | Regeneration curve for 2008 cutblocks and understory managed stands | Character | 7 | | E= Empirical yield curves<br>G= GYPSY / ARS Curves<br>B#=Base 10 strata<br>Last to letters = Site & Crown Closure (H=C or D; L = A or B; X = All)<br>E_B1_XH, E_B2_XX, E_B3_XX, G_B4_XX, G_B5_XX, |

# FMP2009_TSAinput
# FMP2009_TSAinput_SQ
# PPMS_10yearSHS

| Field Name | Description | Type | Width | Dec | Valid codes and description |
|---|---|---|---|---|---|
| | | | | | G_B7_XX, G_B8_XX, E_B9_XX<br>NOT2008 – not a 2008 cutblock or an understory managed stand |
| Theme11 | Landbase designation | Character | 5 | | CONIF – Stand managed for coniferous volume (Pure Coniferous and Mixedwoods)<br>DECID – Stand managed for deciduous volume (Pure Deciduous) |
| Theme12 | Pine composition | Character | 4 | | PL70 – Stand composition >= 70% pine<br>UNDR – Stand composition < 70% pine |
| Theme13 | Non-pine coniferous composition | Character | 5 | | CON40 – Stand composition >= 40% non-pine coniferous<br>LOWCN – Stand composition < 40% non-pine coniferous |
| preblock | TSA model preblock | Character | 1 | | Y = Preblock to be sequenced in the first period of the TSA model |
| lock | TSA model lock | Character | 1 | | Y = TSA model deferral |
| harvlock | User defined model lock | Character | 7 | | Lock 2 = deferred for 2 periods (10 years)<br>Lock 6 = deferred for 6 periods (30 years) |
| CONHA_SQ | Sequenced net coniferous volume/ha | Numeric | 18 | 4 | Net coniferous volume/ha includes cull deductions |
| DECHA_SQ | Sequenced net deciduous volume/ha | Numeric | 18 | 4 | Net deciduous volume/ha includes cull deductions and deciduous mortality |
| TOTCON_SQ | Total sequenced net coniferous volume | Numeric | 18 | 4 | Net total coniferous volume/ha includes cull deductions |
| TOTDEC_SQ | Total sequenced net deciduous volume/ha | Numeric | 18 | 4 | Net total deciduous volume/ha includes cull deductions and deciduous mortality |
| Operator | Assigned block operator | Character | 3 | | HWP = Hinton Wood Products |

## 6.5 Non-Timber Values: Water Yields Assessment

Water yield impacts of timber harvesting were modelled for the period between 2008 and 2027[1].
Projected water yield changes were assessed using three different sizes of watersheds:

- 27 major basins (average: 38,361 ha - maximum: 77,360 ha - minimum: 4,676 ha)
- 67 watershed groups (average: 15,419 ha - maximum: 33,315 ha - minimum: 4,676 ha)
- 222 watersheds (average: 4,653 ha - maximum: 11,977 ha - minimum: 5 ha)

The watershed groups are the most appropriate for the purposes of the FMP amendment water yield assessment. The major basins are too large and the watersheds tend to be too small for the scale of assessment completed. As the name suggests, the watershed groups were created by grouping smaller watersheds together with the intent to create units of approximately 10,000 ha in size. Groupings were limited to adjacent units that contained watercourses which flowed to a common outlet. For some watersheds along very large watercourses (e.g. Athabasca River), the groups were simply the smaller watersheds that flowed into the larger watercourse. Particular attention was focused on creating reasonable watershed groups in locations impacted during the first ten-years of the spatial harvest sequence.

### Water Yield Assessment Tool

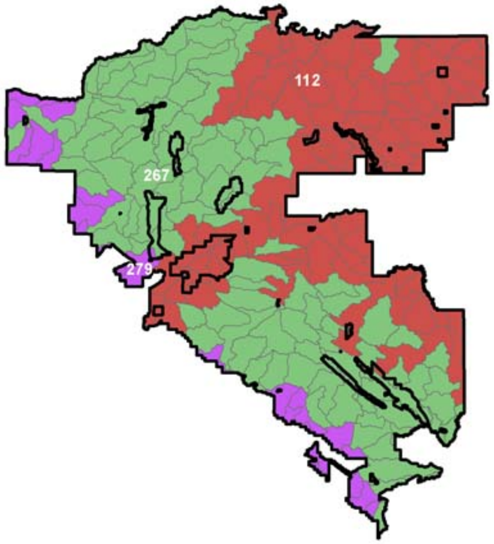
The Alberta ECA model was used to evaluate potential impacts of the spatial harvest sequence on water yield. Base precipitation and base yield estimates were obtained from a report completed for the Hinton FMA area (Strategic Planning Tools for Hydrologic Resources Phase 2 Study, Golder Associates Ltd. 1999.) Base yield estimates were provided for three hydrologic zones, which covered the extent of the FMA:

- Front Range: 279 mm
- Upper Foothills: 267 mm

[1] HWP was required to create a ten-year spatial harvest sequence for the FMP amendment. However, the water yields were assessed using a projected twenty-year sequence.

- Lower Foothills: 112 mm

Base precipitation estimates were provided for ten selected basins. These estimates were extended to all 222 watersheds in this assessment, based on the relative proximity of each watershed to the original ten (from the Golder study). See the following diagrams for an illustration of the assignments of yield and precipitation to the individual watersheds.

| Figure 19. Base Yield Estimates[2] | Figure 20. Base Precipitation Estimates |
|---|---|
|  |  |

[2] Regions where base precipitation and yield estimates were applied are identified by colour.

### 6.5.1 Major Basins

The following figure illustrates the geographic extent of the 27 major basins within the Hinton FMA.

**Figure 21: Major Basins**

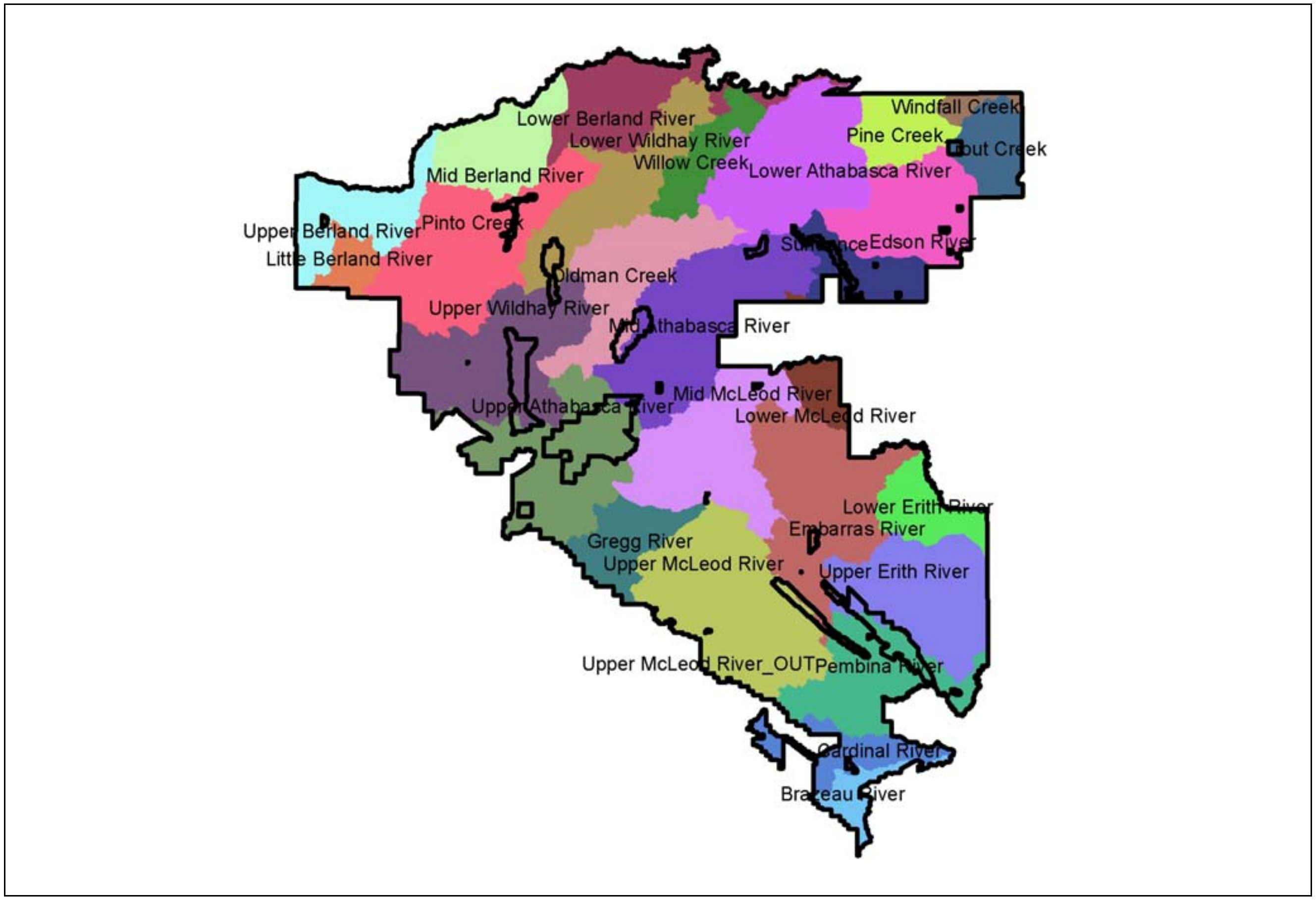


Table 12 summarizes the results of the Alberta ECA projections for the major basins. Windfall Creek shows project yield increases above 15%. This watershed is on the edge of the FMA, only 4,676 ha are within the Hinton FMA.

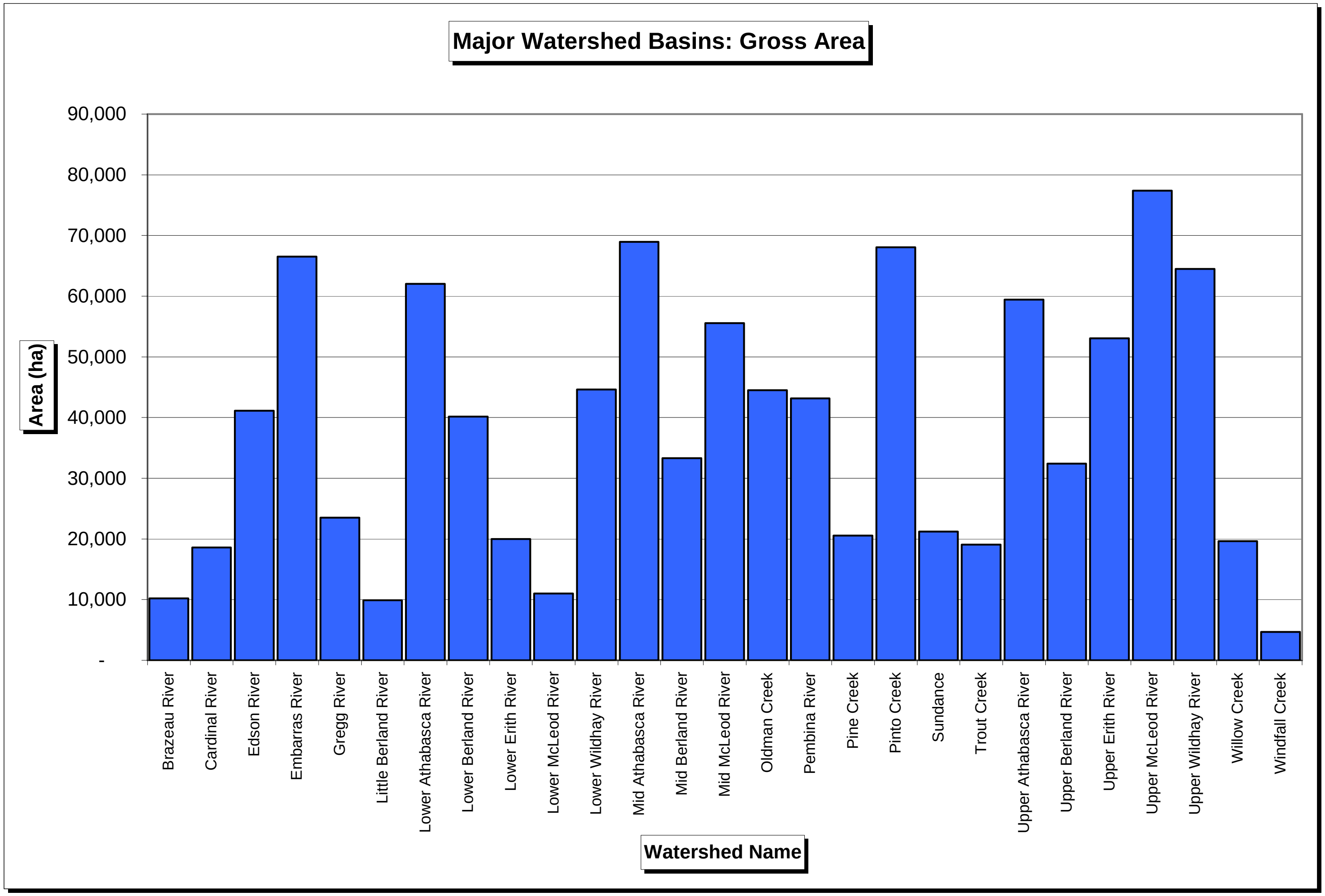
**Table 12 – Water Yield Assessment: Major Basins**

| Major Basin | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Brazeau River | 621 | 273 | 10,189 | 536 | 5% | 1.3% | 2027 |
| Cardinal River | 621 | 272 | 18,595 | 817 | 4% | 0.9% | 2027 |
| Edson River | 567 | 112 | 41,123 | 7,286 | 18% | 6.2% | 2027 |
| Embarras River | 564 | 187 | 66,507 | 11,269 | 17% | 2.5% | 2017 |
| Gregg River | 621 | 268 | 23,523 | 2,093 | 9% | 1.1% | 2022 |
| Little Berland River | 596 | 279 | 9,911 | 981 | 10% | 1.7% | 2026 |
| Lower Athabasca River | 567 | 112 | 62,047 | 10,573 | 17% | 4.5% | 2027 |
| Lower Berland River | 591 | 238 | 40,156 | 10,844 | 27% | 3.2% | 2018 |
| Lower Erith River | 468 | 112 | 19,990 | 2,144 | 11% | 4.6% | 2023 |
| Lower McLeod River | 469 | 112 | 11,016 | 463 | 4% | 1.6% | 2027 |
| Lower Wildhay River | 582 | 190 | 44,617 | 11,709 | 26% | 6.2% | 2013 |
| Mid Athabasca River | 498 | 164 | 68,937 | 8,121 | 12% | 1.9% | 2022 |
| Mid Berland River | 596 | 267 | 33,316 | 6,740 | 20% | 3.1% | 2023 |
| Mid McLeod River | 519 | 202 | 55,536 | 6,858 | 12% | 1.8% | 2016 |
| Oldman Creek | 545 | 267 | 44,499 | 4,794 | 11% | 1.2% | 2013 |
| Pembina River | 621 | 268 | 43,172 | 2,808 | 7% | 1.1% | 2023 |
| Pine Creek | 567 | 149 | 20,569 | 7,160 | 35% | 12.8% | 2018 |
| Pinto Creek | 596 | 267 | 68,045 | 15,290 | 22% | 3.3% | 2027 |
| Sundance | 567 | 112 | 21,198 | 6,068 | 29% | 7.4% | 2022 |
| Trout Creek | 567 | 112 | 19,057 | 4,588 | 24% | 8.3% | 2023 |
| Upper Athabasca River | 564 | 146 | 59,408 | 1,914 | 3% | 1.0% | 2027 |
| Upper Berland River | 596 | 273 | 32,404 | 9,722 | 30% | 6.3% | 2023 |
| Upper Erith River | 575 | 207 | 53,058 | 11,594 | 22% | 3.3% | 2027 |
| Upper McLeod River | 621 | 269 | 77,361 | 14,223 | 18% | 3.4% | 2013 |

| Major Basin | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Upper Wildhay River | 582 | 269 | 64,501 | 9,834 | 15% | 1.6% | 2013 |
| Willow Creek | 567 | 112 | 19,644 | 3,975 | 20% | 7.6% | 2017 |
| Windfall Creek | 567 | 112 | 4,676 | 1,575 | 34% | 17.0% | 2017 |

Figure 22 shows the area of each of the major basins within the Hinton FMA.

**Figure 22: Major Basins – Gross Area**



### 6.5.2 Watershed Groups

The following figure illustrates the geographic extent of the 67 watershed groups within the Hinton FMA.

**Figure 23: Watershed Groups**

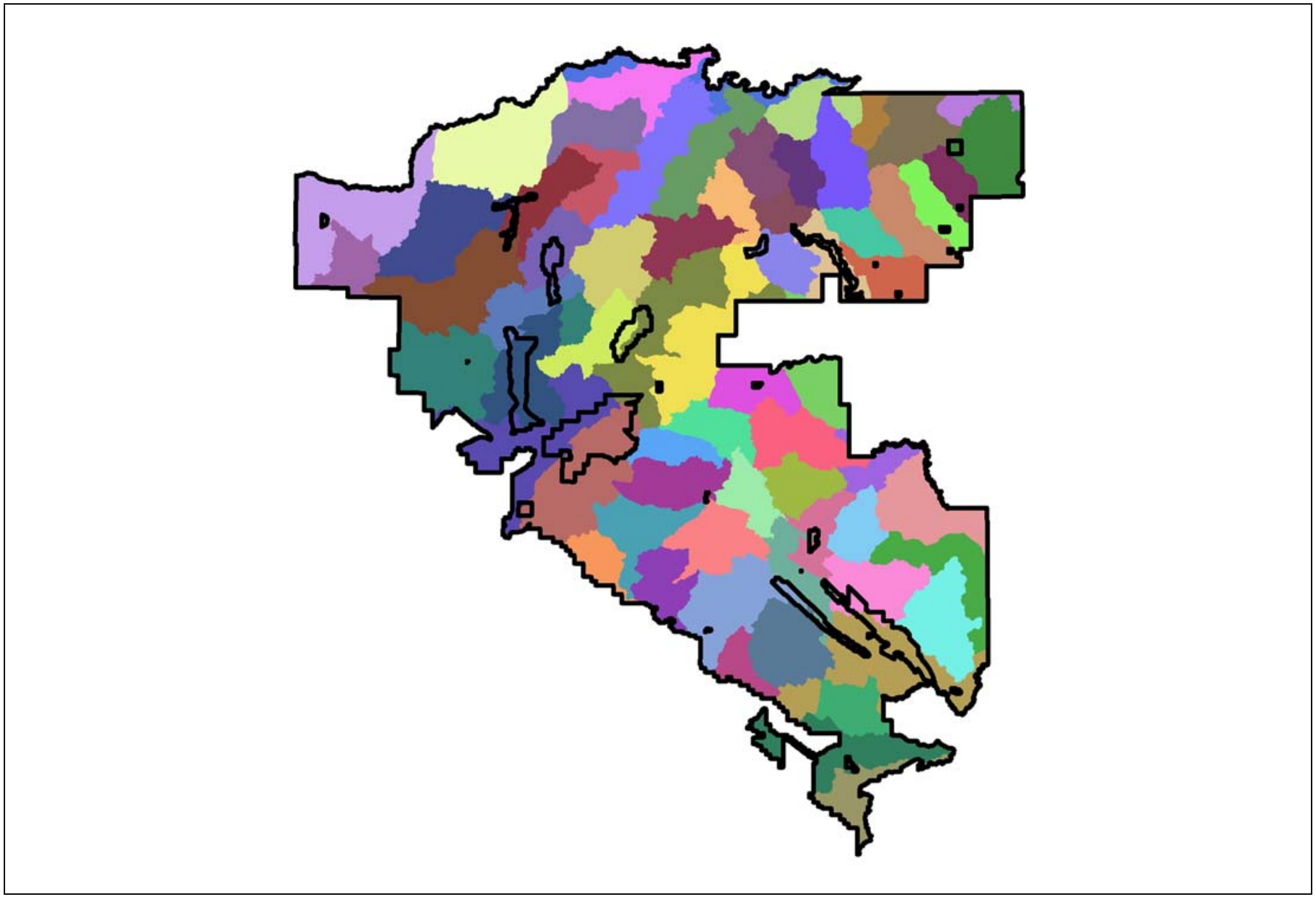


Figure 24 illustrates the distribution of the scheduled harvest for two decades against the 67 watershed groups.

**Figure 24: Watershed Groups with 20 Year Spatial Harvest Sequence**

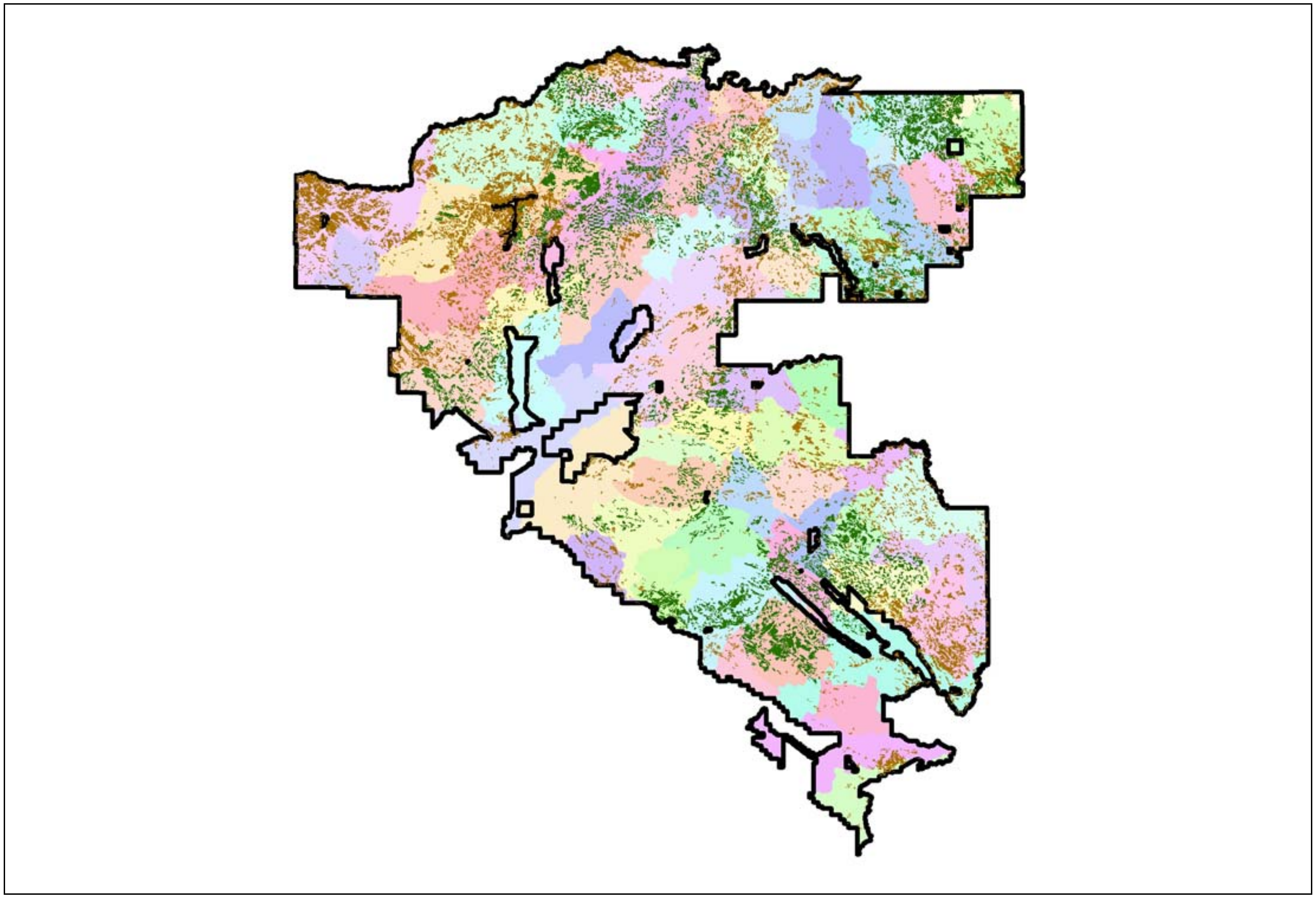


Table 13 summarizes the results of the Alberta ECA projections for the watershed groups. “Pine Creek – G2” and “Windfall Creek – G1” show projected yield increases above 15%. These watersheds are on the edge of the FMA; hence the analysis does not include the entire watershed area. Figure 7 shows the location of these two watershed groups. These areas were attacked by MPB in 2009.

**Table 13 – Water Flow Assessment: Watershed Groups**

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Brazeau River - G1 | 621 | 273 | 10,189 | 536 | 5% | 1.3% | 2027 |
| Cardinal River - G1 | 621 | 272 | 18,595 | 817 | 4% | 0.9% | 2027 |
| Edson River - G1 | 567 | 112 | 7,675 | 1,930 | 25% | 8.6% | 2018 |
| Edson River - G2 | 567 | 112 | 9,820 | 924 | 9% | 3.3% | 2027 |
| Edson River - G3 | 567 | 112 | 14,751 | 2,322 | 16% | 5.4% | 2022 |
| Edson River - G4 | 567 | 112 | 8,876 | 2,110 | 24% | 10.3% | 2027 |
| Embarras River - G1 | 468 | 112 | 17,420 | 1,831 | 11% | 4.8% | 2027 |
| Embarras River - G2 | 621 | 267 | 9,831 | 3,177 | 32% | 4.4% | 2013 |
| Embarras River - G3 | 621 | 267 | 11,326 | 2,690 | 24% | 3.8% | 2017 |
| Embarras River - G4 | 621 | 267 | 11,039 | 977 | 9% | 1.5% | 2027 |
| Embarras River - G5 | 468 | 112 | 7,238 | 807 | 11% | 4.3% | 2023 |
| Embarras River - G6 | 621 | 112 | 9,654 | 1,787 | 19% | 10.5% | 2017 |
| Gregg River - G1 | 621 | 267 | 15,280 | 1,144 | 7% | 1.3% | 2018 |
| Gregg River - G2 | 621 | 271 | 8,243 | 949 | 12% | 2.2% | 2026 |
| Little Berland River - G1 | 596 | 279 | 9,911 | 981 | 10% | 1.7% | 2026 |
| Lower Athabasca River - G1 | 567 | 112 | 11,357 | 1,623 | 14% | 6.4% | 2027 |
| Lower Athabasca River - G2 | 567 | 112 | 9,368 | 2,811 | 30% | 8.5% | 2018 |
| Lower Athabasca River - G3 | 567 | 112 | 10,973 | 3,313 | 30% | 7.8% | 2027 |
| Lower Athabasca River - G4 | 567 | 112 | 15,792 | 346 | 2% | 1.0% | 2027 |
| Lower Athabasca | 567 | 112 | 8,311 | 760 | 9% | 5.3% | 2027 |

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase Amount (%) | Maximum Water Yield Increase Year |
|---|---|---|---|---|---|---|---|
| River - G5 | | | | | | | |
| Lower Athabasca River - G6 | 567 | 112 | 6,247 | 1,719 | 28% | 9.2% | 2017 |
| Lower Berland River - G1 | 596 | 267 | 14,328 | 4,333 | 30% | 4.1% | 2018 |
| Lower Berland River - G2 | 594 | 254 | 15,313 | 3,914 | 26% | 2.6% | 2017 |
| Lower Berland River - G3 | 579 | 174 | 10,515 | 2,598 | 25% | 5.5% | 2027 |
| Lower Erith River - G1 | 468 | 112 | 19,990 | 2,144 | 11% | 4.6% | 2023 |
| Lower McLeod River - G1 | 469 | 112 | 11,016 | 463 | 4% | 1.6% | 2027 |
| Lower Wildhay River - G1 | 567 | 112 | 22,083 | 5,934 | 27% | 12.2% | 2013 |
| Lower Wildhay River - G2 | 596 | 267 | 9,754 | 2,715 | 28% | 4.7% | 2013 |
| Lower Wildhay River - G3 | 596 | 267 | 12,780 | 3,061 | 24% | 3.0% | 2013 |
| Mid Athabasca River - G1 | 567 | 112 | 10,034 | 1,791 | 18% | 5.6% | 2027 |
| Mid Athabasca River - G2 | 486 | 112 | 28,468 | 4,368 | 15% | 3.8% | 2022 |
| Mid Athabasca River - G3 | 486 | 229 | 30,435 | 1,962 | 6% | 0.8% | 2022 |
| Mid Berland River - G1 | 596 | 267 | 33,316 | 6,740 | 20% | 3.1% | 2023 |
| Mid McLeod River - G1 | 472 | 112 | 11,557 | 1,807 | 16% | 5.2% | 2017 |
| Mid McLeod River - G2 | 478 | 159 | 10,988 | 1,745 | 16% | 3.5% | 2013 |
| Mid McLeod River - | 468 | 267 | 8,148 | 322 | 4% | 0.3% | 2013 |

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase Amount (%) | Maximum Water Yield Increase Year |
|---|---|---|---|---|---|---|---|
| G3 | | | | | | | |
| Mid McLeod River - G4 | 545 | 224 | 14,934 | 1,962 | 13% | 1.9% | 2016 |
| Mid McLeod River - G5 | 621 | 267 | 9,909 | 1,022 | 10% | 1.1% | 2012 |
| Oldman Creek - G1 | 486 | 267 | 13,039 | 48 | 0% | 0.1% | 2022 |
| Oldman Creek - G2 | 572 | 267 | 17,927 | 3,254 | 18% | 2.2% | 2013 |
| Oldman Creek - G3 | 567 | 267 | 13,533 | 1,492 | 11% | 1.5% | 2013 |
| Pembina River - G1 | 621 | 266 | 10,483 | 155 | 1% | 0.4% | 2027 |
| Pembina River - G2 | 621 | 269 | 32,690 | 2,653 | 8% | 1.4% | 2023 |
| Pine Creek - G1 | 567 | 267 | 4,974 | 1,230 | 25% | 3.6% | 2018 |
| Pine Creek - G2 | 567 | 112 | 15,595 | 5,930 | 38% | 20.4% | 2018 |
| Pinto Creek - G1 | 596 | 267 | 28,496 | 4,135 | 15% | 2.5% | 2027 |
| Pinto Creek - G2 | 596 | 267 | 25,545 | 5,565 | 22% | 4.1% | 2027 |
| Pinto Creek - G3 | 596 | 267 | 14,005 | 5,590 | 40% | 4.1% | 2013 |
| Sundance - G1 | 567 | 112 | 10,715 | 4,035 | 38% | 11.0% | 2023 |
| Sundance - G2 | 567 | 112 | 10,483 | 2,034 | 19% | 6.5% | 2027 |
| Trout Creek - G1 | 567 | 112 | 19,057 | 4,588 | 24% | 8.3% | 2023 |
| Upper Athabasca River - G1 | 553 | 161 | 28,515 | 781 | 3% | 0.9% | 2027 |
| Upper Athabasca River - G2 | 573 | 133 | 30,893 | 1,132 | 4% | 1.0% | 2027 |
| Upper Berland River - G1 | 596 | 273 | 32,405 | 9,724 | 30% | 6.3% | 2023 |
| Upper Erith River - G1 | 508 | 152 | 16,226 | 2,424 | 15% | 3.4% | 2022 |
| Upper Erith River - G2 | 621 | 192 | 17,301 | 4,650 | 27% | 5.8% | 2018 |
| Upper Erith River - G3 | 591 | 267 | 19,531 | 4,521 | 23% | 3.4% | 2027 |
| Upper McLeod River - G1 | 621 | 267 | 16,021 | 1,274 | 8% | 1.3% | 2013 |
| Upper McLeod River - | 621 | 267 | 12,237 | 1,807 | 15% | 2.7% | 2013 |

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase Amount (%) | Maximum Water Yield Increase Year |
|---|---|---|---|---|---|---|---|
| G2 | | | | | | | |
| Upper McLeod River - G3 | 621 | 269 | 22,874 | 4,649 | 20% | 3.2% | 2013 |
| Upper McLeod River - G4 | 621 | 279 | 6,978 | 623 | 9% | 1.2% | 2012 |
| Upper McLeod River - G5 | 621 | 267 | 19,292 | 5,873 | 30% | 7.0% | 2013 |
| Upper Wildhay River - G1 | 596 | 267 | 11,977 | 1,978 | 17% | 2.3% | 2013 |
| Upper Wildhay River - G2 | 555 | 267 | 21,502 | 974 | 5% | 0.4% | 2027 |
| Upper Wildhay River - G3 | 596 | 271 | 31,023 | 6,882 | 22% | 2.3% | 2013 |
| Willow Creek - G1 | 567 | 112 | 19,644 | 3,975 | 20% | 7.6% | 2017 |
| Windfall Creek - G1 | 567 | 112 | 4,676 | 1,575 | 34% | 17.0% | 2017 |

**Figure 25: Watershed Groups with projected increase in water yield > 15% (Pine Creek and Windfall Creek)**

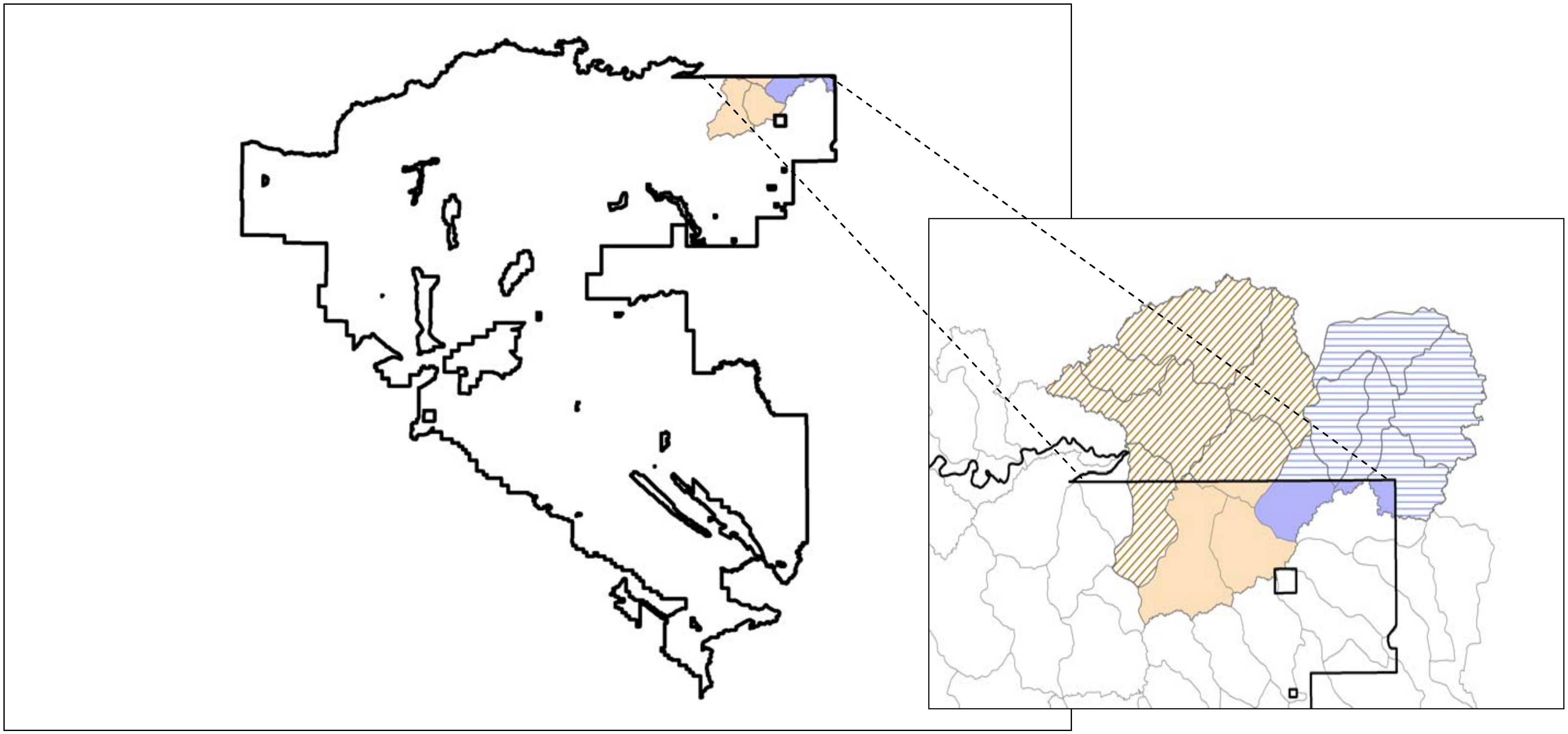
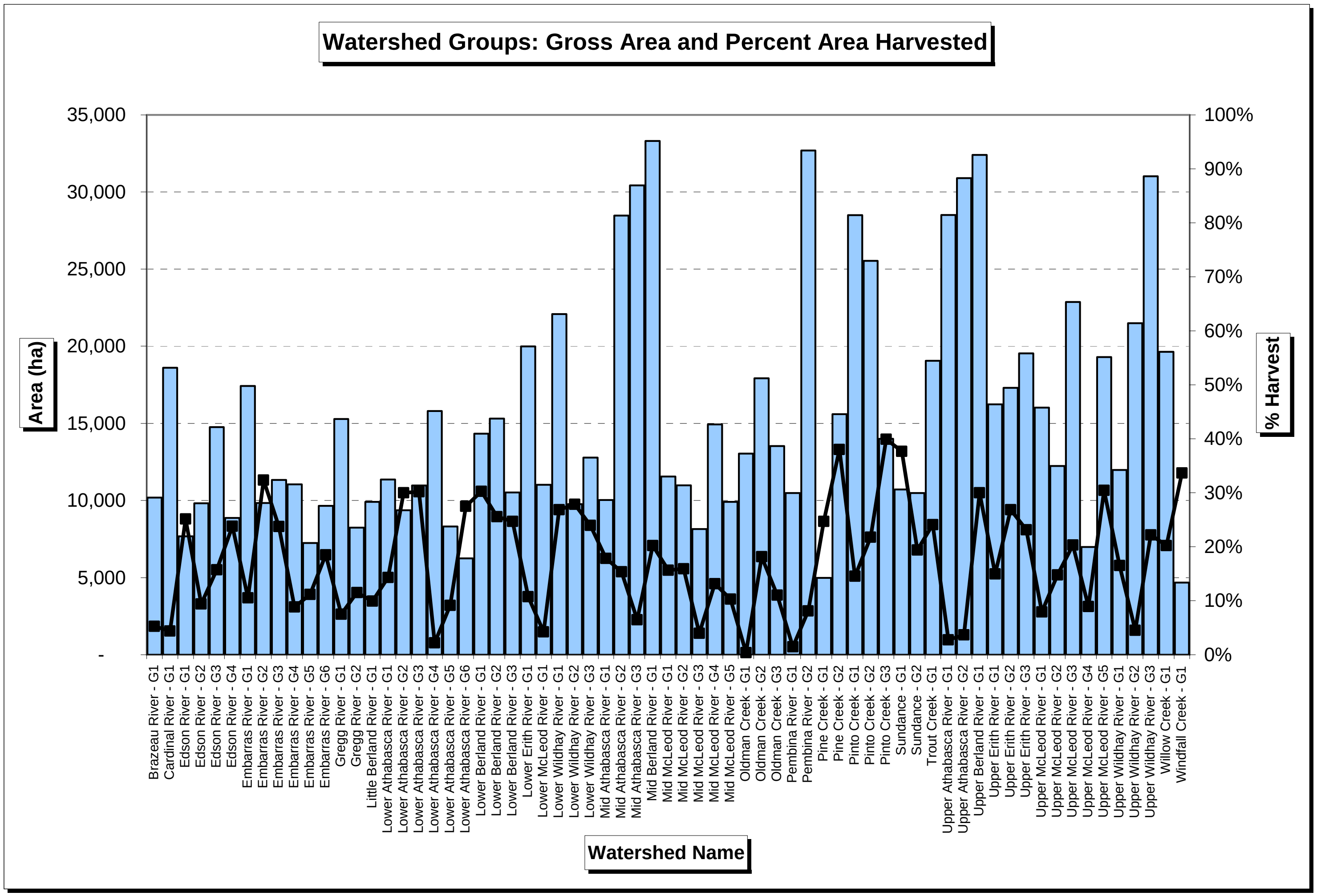


Figure 26 shows the gross area and percent of area scheduled for harvest for each watershed group.

**Figure 26: Watershed Groups – Gross Area (within FMA) & Harvest Summary**



### 6.5.3 Watersheds

The following figure illustrates the geographic extent of the 222 small watersheds within the Hinton FMA.

**Figure 27: Watersheds**

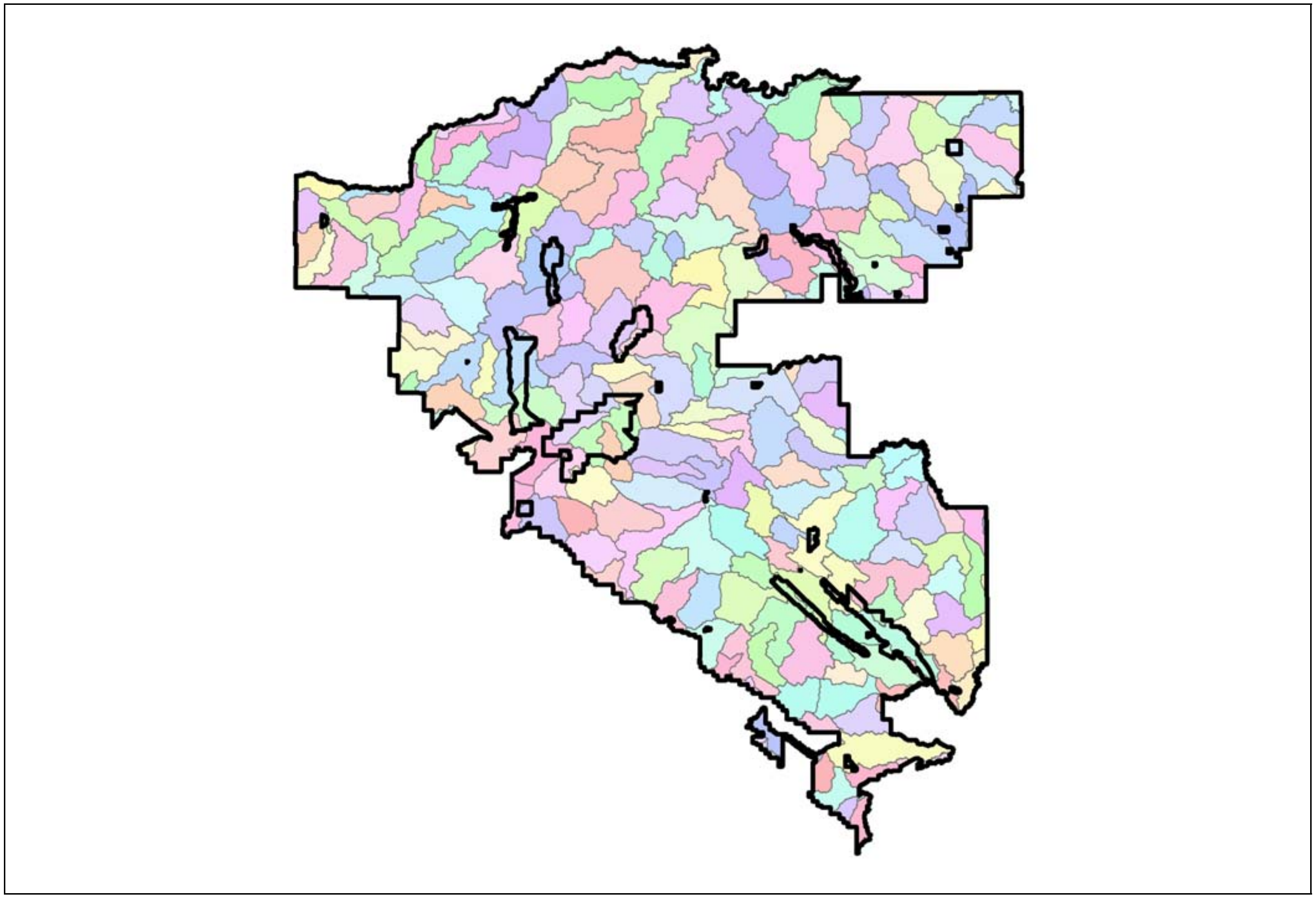


Table 14 summarizes the results of the Alberta ECA projections for the small watersheds. A total of 10 watersheds show projected yield increases above 15% (highlighted in yellow shading in the table). As previously stated, these watersheds are generally smaller than those that would typically be used in a strategic assessment. Factors such as the timing of harvest, incorporation of residual areas, etc, may mitigate the impact on water flow. The MPB has attacked several of these watersheds in 2009. Should the MPB infestation grow significantly, water yield impacts may be best mitigated through timber harvesting and prompt regeneration.

**Table 14 – Water Yield Assessment: Watersheds**

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Brazeau River-150 | 621 | 279 | 1,299 | 26 | 2% | 0.6% | 2027 |
| Brazeau River-152 | 621 | 279 | 3,559 | 32 | 1% | 0.2% | 2021 |
| Brazeau River-171 | 621 | 267 | 888 | 95 | 11% | 3.1% | 2026 |
| Brazeau River-4 | 621 | 267 | 4,286 | 382 | 9% | 2.4% | 2027 |
| Cardinal River-0 | 621 | 267 | 10,535 | 786 | 7% | 1.6% | 2027 |
| Cardinal River-140 | 621 | 279 | 1,953 | 31 | 2% | 0.4% | 2027 |
| Edson River-13 | 567 | 112 | 7,447 | 1,462 | 20% | 5.9% | 2023 |
| Edson River-41 | 567 | 112 | 1,975 | 775 | 39% | 14.0% | 2018 |
| Edson River-42 | 567 | 112 | 5,700 | 1,154 | 20% | 7.3% | 2027 |
| Edson River-43 | 567 | 112 | 5,033 | 201 | 4% | 2.1% | 2027 |
| Edson River-44 | 567 | 112 | 4,539 | 661 | 15% | 5.3% | 2023 |
| Edson River-45 | 567 | 112 | 249 | 62 | 25% | 9.8% | 2022 |
| Edson River-46 | 567 | 112 | 3,273 | 266 | 8% | 5.3% | 2027 |
| Edson River-47 | 567 | 112 | 5,603 | 1,844 | 33% | 14.7% | 2023 |
| Edson River-48 | 567 | 112 | 2,827 | 231 | 8% | 4.3% | 2011 |
| Edson River-49 | 567 | 112 | 4,478 | 629 | 14% | 9.6% | 2027 |
| Embarras River-100 | 468 | 112 | 8,237 | 607 | 7% | 2.4% | 2027 |
| Embarras River-101 | 468 | 112 | 4,893 | 806 | 16% | 8.3% | 2027 |
| Embarras River-103 | 621 | 267 | 9,831 | 3,177 | 32% | 4.4% | 2013 |
| Embarras River-104 | 621 | 267 | 2,424 | 854 | 35% | 5.9% | 2013 |
| Embarras River-105 | 621 | 267 | 6,401 | 1,464 | 23% | 4.2% | 2018 |

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Embarras River-108 | 621 | 267 | 4,626 | 484 | 10% | 1.7% | 2027 |
| Embarras River-109 | 621 | 267 | 2,501 | 373 | 15% | 2.1% | 2013 |
| Embarras River-110 | 621 | 112 | 9,654 | 1,787 | 19% | 10.5% | 2017 |
| Embarras River-111 | 468 | 112 | 3,841 | 418 | 11% | 4.8% | 2023 |
| Embarras River-6 | 468 | 112 | 3,396 | 389 | 11% | 3.8% | 2022 |
| Embarras River-98 | 621 | 267 | 6,413 | 493 | 8% | 1.3% | 2027 |
| Embarras River-99 | 468 | 112 | 4,291 | 418 | 10% | 5.3% | 2027 |
| Gregg River-172 | 621 | 267 | 6,946 | 802 | 12% | 2.2% | 2018 |
| Gregg River-173 | 621 | 267 | 5,599 | 615 | 11% | 2.1% | 2026 |
| Gregg River-174 | 621 | 279 | 44 | 11 | 25% | 7.5% | 2021 |
| Gregg River-175 | 621 | 279 | 174 | 9 | 5% | 1.7% | 2020 |
| Gregg River-176 | 621 | 279 | 2,426 | 315 | 13% | 2.6% | 2027 |
| Gregg River-5 | 621 | 267 | 8,334 | 342 | 4% | 0.6% | 2017 |
| Little Berland River-222 | 596 | 279 | 3,437 | 443 | 13% | 2.5% | 2023 |
| Little Berland River-8 | 596 | 279 | 6,441 | 537 | 8% | 1.6% | 2026 |
| Lower Athabasca River-14 | 567 | 112 | 11,357 | 1,623 | 14% | 6.4% | 2027 |
| Lower Athabasca River-257 | 567 | 112 | 9,368 | 2,811 | 30% | 8.5% | 2018 |
| Lower Athabasca River-258 | 567 | 112 | 10,973 | 3,313 | 30% | 7.8% | 2027 |
| Lower Athabasca River-54 | 567 | 112 | 7,637 | 197 | 3% | 1.6% | 2027 |
| Lower Athabasca River-55 | 567 | 112 | 2,226 | 21 | 1% | 0.8% | 2025 |
| Lower Athabasca River-56 | 567 | 112 | 5,930 | 128 | 2% | 0.9% | 2022 |
| Lower Athabasca River-57 | 567 | 112 | 8,311 | 760 | 9% | 5.3% | 2027 |
| Lower Athabasca River-58 | 567 | 112 | 6,247 | 1,719 | 28% | 9.2% | 2017 |
| Lower Berland River-1 | 596 | 267 | 4,217 | 1,691 | 40% | 5.1% | 2026 |
| Lower Berland River-217 | 567 | 112 | 1,156 | 265 | 23% | 9.3% | 2027 |
| Lower Berland River-218 | 567 | 112 | 5,142 | 642 | 12% | 4.6% | 2013 |
| Lower Berland River-251 | 596 | 267 | 6,724 | 2,172 | 32% | 4.2% | 2018 |
| Lower Berland River-252 | 596 | 267 | 7,605 | 2,160 | 28% | 4.0% | 2018 |

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Lower Berland River-253 | 596 | 267 | 6,429 | 1,932 | 30% | 3.7% | 2018 |
| Lower Berland River-254 | 596 | 267 | 5,054 | 875 | 17% | 2.3% | 2012 |
| Lower Berland River-255 | 567 | 112 | 1,240 | 395 | 32% | 22.1% | 2013 |
| Lower Berland River-256 | 596 | 267 | 2,590 | 712 | 28% | 4.7% | 2023 |
| Lower Erith River-121 | 468 | 112 | 4,301 | 625 | 15% | 6.5% | 2023 |
| Lower Erith River-122 | 468 | 112 | 6,743 | 759 | 11% | 5.0% | 2023 |
| Lower Erith River-123 | 468 | 112 | 216 | 31 | 14% | 10.0% | 2020 |
| Lower Erith River-124 | 468 | 112 | 2,832 | 238 | 8% | 4.8% | 2023 |
| Lower Erith River-126 | 468 | 112 | 2,539 | 173 | 7% | 2.9% | 2027 |
| Lower Erith River-26 | 468 | 112 | 3,358 | 318 | 9% | 3.3% | 2023 |
| Lower McLeod River-106 | 468 | 112 | 43 | 5 | 12% | 8.3% | 2021 |
| Lower McLeod River-72 | 468 | 112 | 1,109 | 42 | 4% | 2.1% | 2022 |
| Lower McLeod River-73 | 486 | 112 | 640 | 27 | 4% | 2.7% | 2026 |
| Lower McLeod River-74 | 468 | 112 | 4,277 | 237 | 6% | 2.4% | 2027 |
| Lower McLeod River-75 | 468 | 112 | 4,947 | 152 | 3% | 1.3% | 2022 |
| Lower Wildhay River-212 | 567 | 112 | 6,155 | 2,199 | 36% | 18.3% | 2014 |
| Lower Wildhay River-213 | 596 | 267 | 6,767 | 1,148 | 17% | 2.6% | 2013 |
| Lower Wildhay River-214 | 596 | 267 | 6,014 | 1,914 | 32% | 3.5% | 2014 |
| Lower Wildhay River-24 | 567 | 112 | 9,807 | 2,809 | 29% | 11.4% | 2014 |
| Lower Wildhay River-262 | 596 | 267 | 9,754 | 2,715 | 28% | 4.7% | 2013 |
| Lower Wildhay River-263 | 567 | 112 | 6,121 | 925 | 15% | 8.1% | 2013 |
| Mid Athabasca River-107 | 486 | 112 | 112 | 16 | 14% | 6.5% | 2020 |
| Mid Athabasca River-18 | 486 | 112 | 9,864 | 1,242 | 13% | 3.4% | 2027 |
| Mid Athabasca River-61 | 567 | 112 | 6,899 | 1,456 | 21% | 6.2% | 2018 |
| Mid Athabasca River-62 | 567 | 112 | 3,135 | 335 | 11% | 5.5% | 2027 |
| Mid Athabasca River-63 | 486 | 112 | 1,693 | 114 | 7% | 3.1% | 2027 |
| Mid Athabasca River-64 | 486 | 267 | 7,908 | 487 | 6% | 0.5% | 2023 |
| Mid Athabasca River-65 | 486 | 267 | 7,880 | 203 | 3% | 0.4% | 2023 |

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Mid Athabasca River-66 | 486 | 267 | 3,558 | 265 | 7% | 1.2% | 2023 |
| Mid Athabasca River-67 | 486 | 267 | 3,679 | 239 | 6% | 0.6% | 2022 |
| Mid Athabasca River-68 | 486 | 112 | 5,717 | 655 | 11% | 4.2% | 2022 |
| Mid Athabasca River-69 | 486 | 112 | 3,125 | 689 | 22% | 6.7% | 2017 |
| Mid Athabasca River-70 | 486 | 112 | 7,975 | 1,007 | 13% | 3.4% | 2022 |
| Mid Athabasca River-71 | 486 | 112 | 7,392 | 1,414 | 19% | 5.7% | 2023 |
| Mid Berland River-242 | 596 | 267 | 5,127 | 694 | 14% | 2.8% | 2023 |
| Mid Berland River-243 | 596 | 267 | 5,355 | 949 | 18% | 3.0% | 2023 |
| Mid Berland River-244 | 596 | 267 | 7,656 | 1,320 | 17% | 3.0% | 2027 |
| Mid Berland River-245 | 596 | 267 | 7,719 | 2,137 | 28% | 4.7% | 2026 |
| Mid Berland River-248 | 596 | 267 | 2,445 | 455 | 19% | 3.5% | 2023 |
| Mid Berland River-250 | 596 | 267 | 5,013 | 1,184 | 24% | 3.3% | 2018 |
| Mid McLeod River-102 | 468 | 112 | 4,738 | 608 | 13% | 4.4% | 2013 |
| Mid McLeod River-12 | 468 | 112 | 9,095 | 1,224 | 13% | 4.7% | 2015 |
| Mid McLeod River-120 | 468 | 112 | 4,151 | 626 | 15% | 6.1% | 2017 |
| Mid McLeod River-90 | 468 | 267 | 8,148 | 322 | 4% | 0.3% | 2013 |
| Mid McLeod River-91 | 621 | 267 | 7,517 | 992 | 13% | 1.5% | 2015 |
| Mid McLeod River-92 | 468 | 267 | 3,266 | 344 | 11% | 0.8% | 2012 |
| Mid McLeod River-93 | 621 | 267 | 5,484 | 646 | 12% | 1.6% | 2017 |
| Mid McLeod River-94 | 621 | 267 | 4,425 | 376 | 9% | 1.1% | 2027 |
| Mid McLeod River-95 | 486 | 267 | 3,361 | 662 | 20% | 1.8% | 2013 |
| Mid McLeod River-96 | 486 | 112 | 2,889 | 476 | 16% | 6.4% | 2014 |
| Mid McLeod River-97 | 486 | 112 | 2,462 | 583 | 24% | 8.4% | 2022 |
| Oldman Creek-83 | 567 | 267 | 1,648 | 121 | 7% | 1.3% | 2013 |
| Oldman Creek-84 | 567 | 267 | 3,314 | 133 | 4% | 0.5% | 2012 |
| Oldman Creek-85 | 567 | 267 | 8,571 | 1,238 | 14% | 1.9% | 2013 |
| Oldman Creek-87 | 486 | 267 | 7,656 | 48 | 1% | 0.1% | 2022 |
| Oldman Creek-88 | 567 | 267 | 3,709 | 1,007 | 27% | 2.5% | 2018 |

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Oldman Creek-89 | 596 | 267 | 2,919 | 820 | 28% | 4.5% | 2017 |
| Oldman Creek-9 | 567 | 267 | 11,299 | 1,427 | 13% | 2.1% | 2013 |
| Pembina River-131 | 621 | 267 | 3,056 | 356 | 12% | 2.6% | 2023 |
| Pembina River-132 | 621 | 267 | 5,162 | 254 | 5% | 0.9% | 2023 |
| Pembina River-133 | 621 | 267 | 5,880 | 645 | 11% | 1.8% | 2013 |
| Pembina River-134 | 621 | 267 | 6,662 | 615 | 9% | 2.5% | 2023 |
| Pembina River-136 | 621 | 267 | 4,811 | 20 | 0% | 0.1% | 2026 |
| Pembina River-137 | 621 | 267 | 4,638 | 546 | 12% | 2.5% | 2023 |
| Pembina River-138 | 621 | 267 | 2,621 | 158 | 6% | 1.5% | 2023 |
| Pembina River-139 | 621 | 267 | 5,620 | 135 | 2% | 0.6% | 2027 |
| Pembina River-3 | 621 | 279 | 4,672 | 81 | 2% | 0.3% | 2010 |
| Pine Creek-261 | 567 | 112 | 5 | 3 | 64% | 42.9% | 2010 |
| Pine Creek-50 | 567 | 112 | 5,689 | 2,985 | 52% | 29.5% | 2018 |
| Pine Creek-51 | 567 | 112 | 8,759 | 2,320 | 26% | 13.8% | 2017 |
| Pine Creek-52 | 567 | 267 | 4,974 | 1,230 | 25% | 3.6% | 2018 |
| Pine Creek-53 | 567 | 112 | 1,143 | 622 | 54% | 38.8% | 2016 |
| Pinto Creek-202 | 596 | 267 | 5,034 | 202 | 4% | 0.7% | 2026 |
| Pinto Creek-203 | 596 | 267 | 4,258 | 171 | 4% | 0.9% | 2023 |
| Pinto Creek-204 | 596 | 267 | 6,105 | 911 | 15% | 2.8% | 2027 |
| Pinto Creek-205 | 596 | 267 | 7,503 | 1,037 | 14% | 2.8% | 2027 |
| Pinto Creek-206 | 596 | 267 | 2,928 | 384 | 13% | 2.4% | 2027 |
| Pinto Creek-207 | 596 | 267 | 9,008 | 3,233 | 36% | 6.7% | 2027 |
| Pinto Creek-208 | 596 | 267 | 3,084 | 656 | 21% | 4.7% | 2027 |
| Pinto Creek-209 | 596 | 267 | 8,124 | 1,160 | 14% | 2.9% | 2027 |
| Pinto Creek-210 | 596 | 267 | 7,996 | 1,945 | 24% | 3.6% | 2027 |
| Pinto Creek-211 | 596 | 267 | 6,751 | 2,661 | 39% | 6.0% | 2013 |
| Pinto Creek-7 | 596 | 267 | 7,254 | 2,930 | 40% | 5.9% | 2027 |
| Sundance-22 | 567 | 112 | 5,953 | 2,146 | 36% | 11.8% | 2023 |

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Sundance-77 | 567 | 112 | 6,421 | 1,008 | 16% | 6.3% | 2027 |
| Sundance-78 | 567 | 112 | 3,759 | 827 | 22% | 7.1% | 2027 |
| Sundance-79 | 567 | 112 | 303 | 199 | 66% | 31.3% | 2012 |
| Sundance-80 | 567 | 112 | 1,414 | 779 | 55% | 15.3% | 2017 |
| Sundance-81 | 567 | 112 | 1,713 | 426 | 25% | 7.8% | 2017 |
| Sundance-82 | 567 | 112 | 1,635 | 684 | 42% | 15.1% | 2023 |
| Trout Creek-35 | 567 | 112 | 4,954 | 1,801 | 36% | 13.9% | 2023 |
| Trout Creek-36 | 567 | 112 | 1,511 | 574 | 38% | 12.6% | 2022 |
| Trout Creek-37 | 567 | 112 | 198 | 94 | 47% | 18.7% | 2018 |
| Trout Creek-38 | 567 | 112 | 6,294 | 1,797 | 29% | 10.2% | 2023 |
| Trout Creek-39 | 567 | 112 | 4,577 | 199 | 4% | 2.2% | 2027 |
| Trout Creek-40 | 567 | 112 | 1,523 | 123 | 8% | 6.2% | 2027 |
| Upper Athabasca River-15 | 486 | 112 | 6,928 | 307 | 4% | 1.5% | 2026 |
| Upper Athabasca River-177 | 621 | 279 | 172 | 11 | 6% | 1.8% | 2020 |
| Upper Athabasca River-178 | 621 | 267 | 4,008 | 435 | 11% | 2.0% | 2012 |
| Upper Athabasca River-180 | 621 | 112 | 5,591 | 222 | 4% | 2.7% | 2027 |
| Upper Athabasca River-181 | 486 | 112 | 3,990 | 149 | 4% | 2.6% | 2027 |
| Upper Athabasca River-182 | 621 | 112 | 4,983 | 8 | 0% | 0.1% | 2026 |
| Upper Athabasca River-183 | 596 | 279 | 737 | 44 | 6% | 1.5% | 2027 |
| Upper Athabasca River-184 | 596 | 279 | 605 | 70 | 12% | 1.9% | 2017 |
| Upper Athabasca River-185 | 596 | 279 | 6,964 | 640 | 9% | 1.5% | 2027 |
| Upper Athabasca River-187 | 596 | 112 | 6,491 | 11 | 0% | 0.2% | 2026 |
| Upper Athabasca River-189 | 486 | 112 | 3,460 | 17 | 1% | 0.3% | 2022 |
| Upper Berland River-20 | 596 | 267 | 6,719 | 2,201 | 33% | 5.8% | 2027 |
| Upper Berland River-224 | 596 | 279 | 3,366 | 1,777 | 53% | 12.1% | 2023 |
| Upper Berland River-225 | 596 | 267 | 3,280 | 1,048 | 32% | 6.5% | 2023 |
| Upper Berland River-227 | 596 | 279 | 3,480 | 451 | 13% | 2.3% | 2023 |
| Upper Berland River-228 | 596 | 279 | 2,819 | 1,558 | 55% | 12.8% | 2023 |

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Upper Berland River-229 | 596 | 279 | 1,536 | 435 | 28% | 6.5% | 2023 |
| Upper Berland River-230 | 596 | 279 | 3,865 | 1,273 | 33% | 7.6% | 2023 |
| Upper Berland River-232 | 596 | 267 | 2,862 | 606 | 21% | 4.7% | 2022 |
| Upper Berland River-233 | 596 | 267 | 4,477 | 374 | 8% | 1.6% | 2026 |
| Upper Erith River-11 | 621 | 112 | 8,424 | 2,298 | 27% | 13.9% | 2018 |
| Upper Erith River-112 | 621 | 267 | 5,581 | 1,327 | 24% | 4.1% | 2018 |
| Upper Erith River-113 | 621 | 267 | 3,296 | 1,024 | 31% | 5.3% | 2027 |
| Upper Erith River-114 | 621 | 267 | 5,678 | 1,872 | 33% | 5.9% | 2027 |
| Upper Erith River-115 | 468 | 112 | 5,035 | 605 | 12% | 4.8% | 2023 |
| Upper Erith River-116 | 621 | 267 | 5,233 | 1,229 | 23% | 3.3% | 2027 |
| Upper Erith River-117 | 468 | 267 | 3,790 | 509 | 13% | 1.5% | 2023 |
| Upper Erith River-118 | 621 | 267 | 4,222 | 1,043 | 25% | 3.1% | 2018 |
| Upper Erith River-119 | 468 | 112 | 4,971 | 340 | 7% | 3.7% | 2023 |
| Upper Erith River-129 | 468 | 112 | 1,999 | 435 | 22% | 11.0% | 2027 |
| Upper Erith River-130 | 621 | 267 | 4,830 | 911 | 19% | 3.3% | 2027 |
| Upper McLeod River-10 | 621 | 267 | 7,853 | 2,300 | 29% | 4.8% | 2017 |
| Upper McLeod River-154 | 621 | 279 | 4,599 | 777 | 17% | 2.1% | 2013 |
| Upper McLeod River-158 | 621 | 267 | 6,945 | 751 | 11% | 1.9% | 2013 |
| Upper McLeod River-159 | 621 | 267 | 4,679 | 510 | 11% | 1.9% | 2016 |
| Upper McLeod River-160 | 621 | 267 | 4,835 | 1,302 | 27% | 5.1% | 2013 |
| Upper McLeod River-161 | 621 | 267 | 7,402 | 505 | 7% | 1.2% | 2012 |
| Upper McLeod River-162 | 621 | 267 | 9,076 | 523 | 6% | 1.0% | 2017 |
| Upper McLeod River-163 | 621 | 279 | 1,595 | 59 | 4% | 1.1% | 2021 |
| Upper McLeod River-165 | 621 | 279 | 4,881 | 564 | 12% | 1.7% | 2012 |
| Upper McLeod River-166 | 621 | 267 | 4,334 | 1,257 | 29% | 7.3% | 2012 |
| Upper McLeod River-167 | 621 | 267 | 7,975 | 2,143 | 27% | 6.7% | 2013 |
| Upper McLeod River-168 | 621 | 267 | 6,983 | 2,473 | 35% | 7.3% | 2013 |
| Upper McLeod River-169 | 621 | 267 | 5,702 | 1,060 | 19% | 3.7% | 2013 |

| Watershed | Base Precipitation (mm) | Base Water Yield (mm) | Total Area (ha) | Total Harvest (ha) | Percent Harvest | Maximum Water Yield Increase | |
|---|---|---|---|---|---|---|---|
| | | | | | | Amount (%) | Year |
| Upper Wildhay River-190 | 486 | 267 | 7,922 | 163 | 2% | 0.3% | 2027 |
| Upper Wildhay River-191 | 596 | 267 | 4,795 | 284 | 6% | 0.7% | 2013 |
| Upper Wildhay River-192 | 596 | 267 | 8,785 | 527 | 6% | 0.7% | 2017 |
| Upper Wildhay River-193 | 596 | 267 | 4,878 | 580 | 12% | 2.3% | 2013 |
| Upper Wildhay River-195 | 596 | 279 | 4,775 | 1,043 | 22% | 3.8% | 2027 |
| Upper Wildhay River-196 | 596 | 279 | 998 | 130 | 13% | 2.5% | 2018 |
| Upper Wildhay River-198 | 596 | 267 | 5,337 | 1,257 | 24% | 4.0% | 2013 |
| Upper Wildhay River-199 | 596 | 279 | 5,640 | 1,863 | 33% | 4.9% | 2027 |
| Upper Wildhay River-2 | 596 | 267 | 11,977 | 1,978 | 17% | 2.3% | 2013 |
| Upper Wildhay River-200 | 596 | 267 | 3,122 | 712 | 23% | 3.6% | 2018 |
| Upper Wildhay River-201 | 596 | 267 | 6,269 | 1,296 | 21% | 2.5% | 2015 |
| Willow Creek-16 | 567 | 112 | 7,461 | 1,756 | 24% | 9.4% | 2017 |
| Willow Creek-59 | 567 | 112 | 5,027 | 942 | 19% | 9.3% | 2018 |
| Willow Creek-60 | 567 | 112 | 7,156 | 1,277 | 18% | 4.9% | 2015 |
| Windfall Creek-30 | 567 | 112 | 3,579 | 1,516 | 42% | 22.2% | 2017 |
| Windfall Creek-31 | 567 | 112 | 41 | 0 | 0% | 0.0% | 2015 |
| Windfall Creek-33 | 567 | 112 | 776 | 59 | 8% | 6.6% | 2027 |

## 6.6 Non-Timber Values: Grizzly Bear

Grizzly bear has not been officially designated "at risk" under the Alberta Wildlife Act. In 2002, the Endangered Species Conservation Committee recommended designation as a Threatened species and this recommendation was reaffirmed in 2010. As of April 30, 2010, the Alberta government has not made a designation status decision. DNA-based grizzly bear population studies have been underway in Alberta since 2004 and a Recovery Plan was approved in 2008.

In Alberta, six Grizzly Bear Population Units have been identified. Grizzly Bear Population Units are management units based on genetic distinctions within the Alberta grizzly bear population. These population units are generally separated by major highway corridors. The population units are further subdivided into Grizzly Bear Watershed Units (GBWU), a management unit based on major watersheds subdivided along heights of land and occasionally along watercourses, to approximate the size of an adult female grizzly bear home range (~700 km2).

Each GBWU is characterized as being either Core or Secondary grizzly bear habitat based on current landscape conditions. Core Areas are areas of high habitat value (as measured by Resource Selection Function) and generally low mortality risk currently measured through Open Route Densities. Secondary Areas are areas of good habitat, reflecting the broader range of grizzly bears. The Hinton FMA is comprised of approximately:

- Core area: 48%
- Secondary area: 37%
- Not classified grizzly bear habitat: 15%

Alberta SRD conducted the necessary grizzly bear analysis and provided much of the information contained in this section of the FMP amendment. Four key values were analyzed and the results are reported for individual Grizzly Bear Watershed Units (Figure 28).

- Resource Selection Function: Resource Selection Functions (RSF) can be used as a surrogate for grizzly bear habitat and supply. Research shows a clear relationship between high RSF values and the current presence and distribution of grizzly bears as determined by DNA population inventory work. SRD's RSF objectives are:
    - In Core GBWUs the objective is to maintain or increase the current maximum RSF values.
    - In Secondary GBWUs the objective is to increase current maximum RSF values.
- Mortality Risk: Mortality Risk is a spatial model that represents the relative probability of human-caused grizzly bear mortality. The mortality risk should be used in conjunction with the open route density information to understand how

access and habitat variables interact to impact grizzly bear survival rates. SRD's mortality risk objectives are:

  - In Core GBWUs the objective is to maintain or reduce current levels of mean mortality risk as determined through the mortality risk model.
  - In Secondary GBWUs the objective is to reduce current levels of mean mortality risk.

- Open Route Density: Open Route Densities are defined as the total length of all open routes divided by the area of each grizzly bear watershed unit. Research conducted in both Alberta and many other parts of grizzly bear range in North America, have found that the key to maintaining grizzly bear populations is to keep human caused grizzly bear mortality rates low. Regulating human use of access (specifically motorised vehicle routes) in grizzly bear range reduces the risk of human-caused mortality. Because human use of access is difficult to measure, the Recovery Plan recommends using Open Route Densities as a surrogate for the amount of human use. SRD's open route density objectives are:
  - In Core GBWUs the open route density threshold is 0.6 $km/km^2$.
  - The open route density threshold in Secondary GBWUs is 1.2 $km/km^2$.
  - In both Core and Secondary GBWUs the objective is to maintain or reduce current levels of open route density.
- Safe Harbour: Safe Harbour is a combination of habitat quality and risk. A safe harbour is an area of good habitat (high RSF values), to which bears are attracted by an abundance of resources, but also where the bear faces a low risk of human caused mortality (low Mortality Risk). SRD's safe harbour objectives are:
  - In all Core GBWUs the objective is to maintain or increase both the quantity (area) and quality (mean safe harbour value) that is currently present.
  - In Secondary GBWUs the objective is to increase current values of safe harbour quantity and quality.

The results of the resource selection function (RSF), mortality risk and safe harbour analyses are presented in Table 15 and Table 16. The open route density analysis results are presented in Table 17 and Table 18.

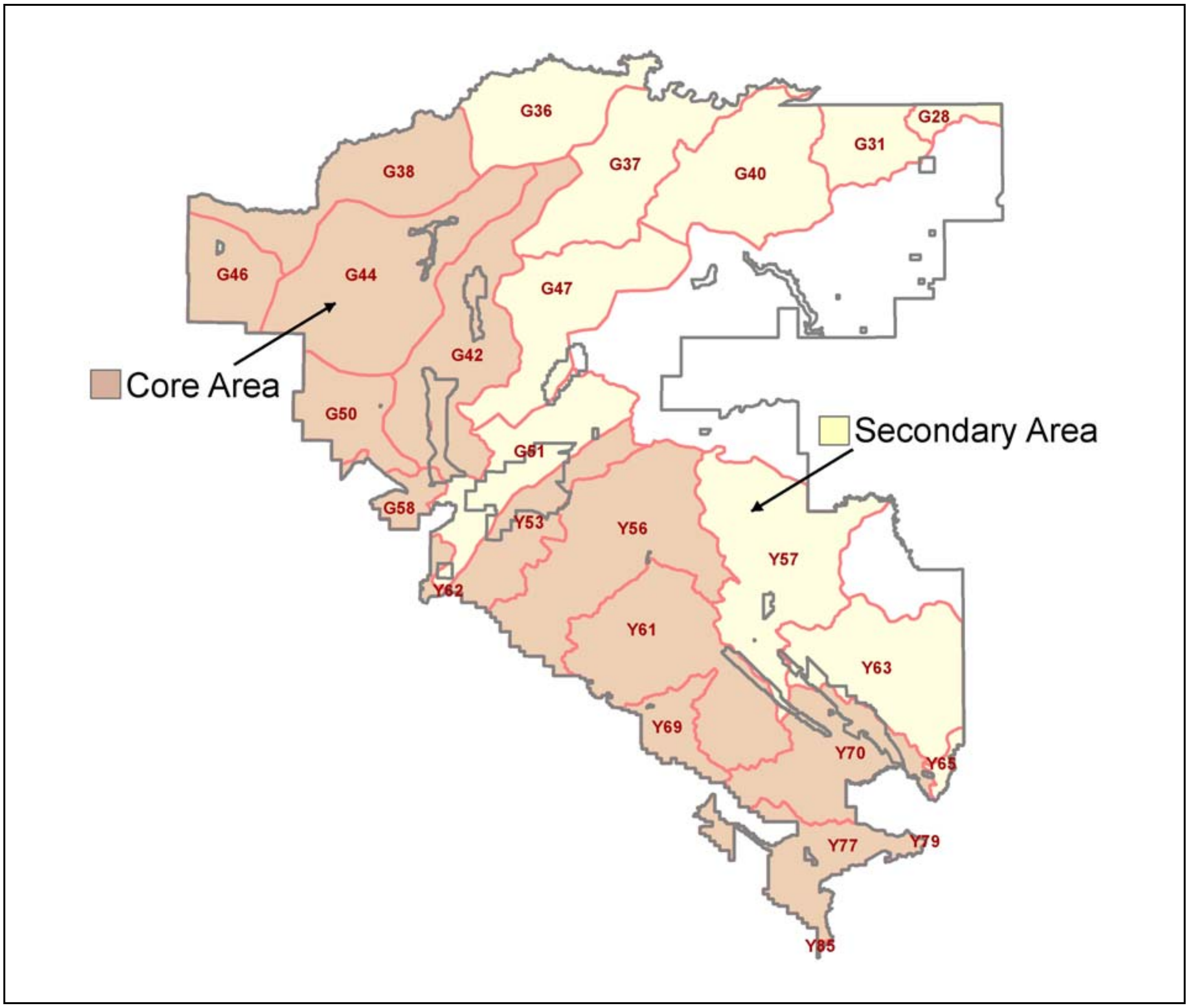



**Figure 28. Grizzly Bear Watershed Units**

**Table 15. RSF, Mortality Risk and Safe Harbour Summary – Grande Cache Population**

| Grizzly Bear Unit | Habitat | Area Km Sq | Current Mean | Future Mean | Difference +/- | % Change |
|---|---|---|---|---|---|---|
| Resource Selection Function (max) | | | | | | |
| G42 | Core | 537.3 | 7.54 | 7.88 | 0.34 | 4.5% |
| G44 | Core | 728.6 | 8.02 | 8.22 | 0.20 | 2.5% |
| G50 | Core | 232.1 | 7.98 | 8.48 | 0.50 | 6.3% |
| G58 | Core | 107.0 | 7.51 | 7.57 | 0.06 | 0.8% |
| G28 | Secondary | 58.0 | 6.46 | 7.64 | 1.18 | 18.3% |
| G31 | Secondary | 204.2 | 6.66 | 7.74 | 1.08 | 16.2% |
| G36 | Secondary | 376.7 | 7.05 | 7.32 | 0.27 | 3.8% |
| G37 | Secondary | 477.8 | 6.19 | 6.51 | 0.32 | 5.2% |
| G40 | Secondary | 539.9 | 5.46 | 5.66 | 0.20 | 3.7% |
| G47 | Secondary | 475.7 | 8.01 | 8.12 | 0.11 | 1.4% |
| G51 | Secondary | 289.6 | 5.94 | 5.96 | 0.02 | 0.3% |
| Mortality Risk | | | | | | |
| G42 | Core | 537.3 | 6.29 | 6.64 | 0.35 | 5.6% |
| G44 | Core | 728.6 | 5.76 | 5.97 | 0.21 | 3.6% |
| G50 | Core | 232.1 | 3.29 | 3.67 | 0.38 | 11.6% |
| G58 | Core | 107.0 | 4.50 | 4.52 | 0.02 | 0.4% |
| G28 | Secondary | 58.0 | 3.60 | 4.49 | 0.89 | 24.7% |
| G31 | Secondary | 204.2 | 5.91 | 6.67 | 0.76 | 12.9% |
| G36 | Secondary | 376.7 | 6.44 | 6.78 | 0.34 | 5.3% |
| G37 | Secondary | 477.8 | 6.45 | 6.51 | 0.06 | 0.9% |
| G40 | Secondary | 539.9 | 5.12 | 5.37 | 0.25 | 4.9% |
| G47 | Secondary | 475.7 | 7.54 | 7.70 | 0.16 | 2.1% |
| G51 | Secondary | 289.6 | 6.18 | 6.20 | 0.02 | 0.3% |
| Safe Harbour | | | | | | |
| G42 | Core | 537.3 | 75.45 | 78.77 | 3.33 | 4.4% |
| G44 | Core | 728.6 | 80.22 | 82.17 | 1.95 | 2.4% |
| G50 | Core | 232.1 | 79.84 | 84.76 | 4.92 | 6.2% |
| G58 | Core | 107.0 | 75.15 | 75.73 | 0.58 | 0.8% |
| G28 | Secondary | 58.0 | 64.60 | 76.43 | 11.83 | 18.3% |
| G31 | Secondary | 204.2 | 66.64 | 77.44 | 10.80 | 16.2% |
| G36 | Secondary | 376.7 | 70.53 | 73.18 | 2.65 | 3.8% |
| G37 | Secondary | 477.8 | 61.92 | 65.09 | 3.17 | 5.1% |
| G40 | Secondary | 539.9 | 54.60 | 56.63 | 2.02 | 3.7% |
| G47 | Secondary | 475.7 | 80.09 | 81.23 | 1.14 | 1.4% |
| G51 | Secondary | 289.6 | 59.45 | 59.56 | 0.11 | 0.2% |

**Table 16. RSF, Mortality Risk and Safe Harbour Summary – Yellowhead Population**

| Grizzly Bear Unit | Habitat | Area Km Sq | Current Mean | Future Mean | Difference +/- | % Change |
|---|---|---|---|---|---|---|
| Resource Selection Function (max) | | | | | | |
| Y53 | Core | 230.6 | 5.05 | 5.64 | 0.59 | 11.7% |
| Y56 | Core | 691.7 | 7.49 | 7.85 | 0.36 | 4.8% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Y61 | Core | 624.5 | 7.14 | 7.92 | 0.78 | 10.9% |
| Y69 | Core | 138.1 | 7.18 | 7.68 | 0.50 | 7.0% |
| Y70 | Core | 343.4 | 6.83 | 6.89 | 0.06 | 0.9% |
| Y57 | Secondary | 642.8 | 4.41 | 5.04 | 0.63 | 14.3% |
| Y63 | Secondary | 495.1 | 6.27 | 6.51 | 0.24 | 3.8% |
| Mortality Risk | | | | | | |
| Y53 | Core | 230.6 | 5.04 | 5.55 | 0.51 | 10.1% |
| Y56 | Core | 691.7 | 6.59 | 6.83 | 0.24 | 3.6% |
| Y61 | Core | 624.5 | 5.74 | 6.10 | 0.36 | 6.3% |
| Y69 | Core | 138.1 | 4.09 | 4.35 | 0.26 | 6.4% |
| Y70 | Core | 343.4 | 4.02 | 4.04 | 0.02 | 0.5% |
| Y57 | Secondary | 642.8 | 5.82 | 6.32 | 0.50 | 8.6% |
| Y63 | Secondary | 495.1 | 6.99 | 7.08 | 0.09 | 1.3% |
| Safe Harbour | | | | | | |
| Y53 | Core | 230.6 | 50.45 | 56.39 | 5.94 | 11.8% |
| Y56 | Core | 691.7 | 74.87 | 78.45 | 3.59 | 4.8% |
| Y61 | Core | 624.5 | 71.45 | 79.15 | 7.71 | 10.8% |
| Y69 | Core | 138.1 | 71.76 | 76.82 | 5.05 | 7.0% |
| Y70 | Core | 343.4 | 68.29 | 68.93 | 0.64 | 0.9% |
| Y57 | Secondary | 642.8 | 44.07 | 50.42 | 6.35 | 14.4% |
| Y63 | Secondary | 495.1 | 62.70 | 65.12 | 2.43 | 3.9% |

**Table 17. Open Route Density – Grande Cache Grizzly Bear Population**

| Grizzly Bear Unit | Habitat | Road Length (Km) Current | Area (Km Sq) | Road Density Km/Km Sq |
|---|---|---|---|---|
| G42 | Core | 354.6 | 537.3 | 0.66 |
| G44 | Core | 335.6 | 728.6 | 0.46 |
| G50 | Core | 131.1 | 232.1 | 0.56 |
| G58 | Core | 67.6 | 107.0 | 0.63 |
| Core Total | | 889.0 | 1605.0 | 0.55 |
| G28 | Secondary | 23.0 | 58.0 | 0.40 |
| G31 | Secondary | 140.1 | 204.2 | 0.69 |
| G36 | Secondary | 326.5 | 376.7 | 0.87 |
| G37 | Secondary | 463.9 | 477.8 | 0.97 |
| G40 | Secondary | 382.2 | 539.9 | 0.71 |
| G47 | Secondary | 340.9 | 475.7 | 0.72 |
| G51 | Secondary | 164.0 | 289.6 | 0.57 |
| Secondary Total | | 1840.6 | 2421.9 | 0.76 |

**Table 18. Open Route Density – Yellowhead Grizzly Bear Population**

| Grizzly Bear Unit | Habitat | Road Length (Km) Current | Area (Km Sq) | Road Density Km/Km Sq |
|---|---|---|---|---|
| Y53 | Core | 131.0 | 230.6 | 0.57 |
| Y56 | Core | 493.1 | 691.7 | 0.71 |
| Y61 | Core | 333.3 | 624.5 | 0.53 |
| Y69 | Core | 44.1 | 138.1 | 0.32 |

| | | | | |
|---|---|---|---|---|
| Y70 | Core | 200.8 | 343.4 | 0.58 |
| Core Total | | 1202.3 | 2028.3 | 0.59 |
| Y57 | Secondary | 350.7 | 642.8 | 0.55 |
| Y63 | Secondary | 324.2 | 495.1 | 0.65 |
| Secondary Total | | 674.9 | 1137.9 | 0.59 |

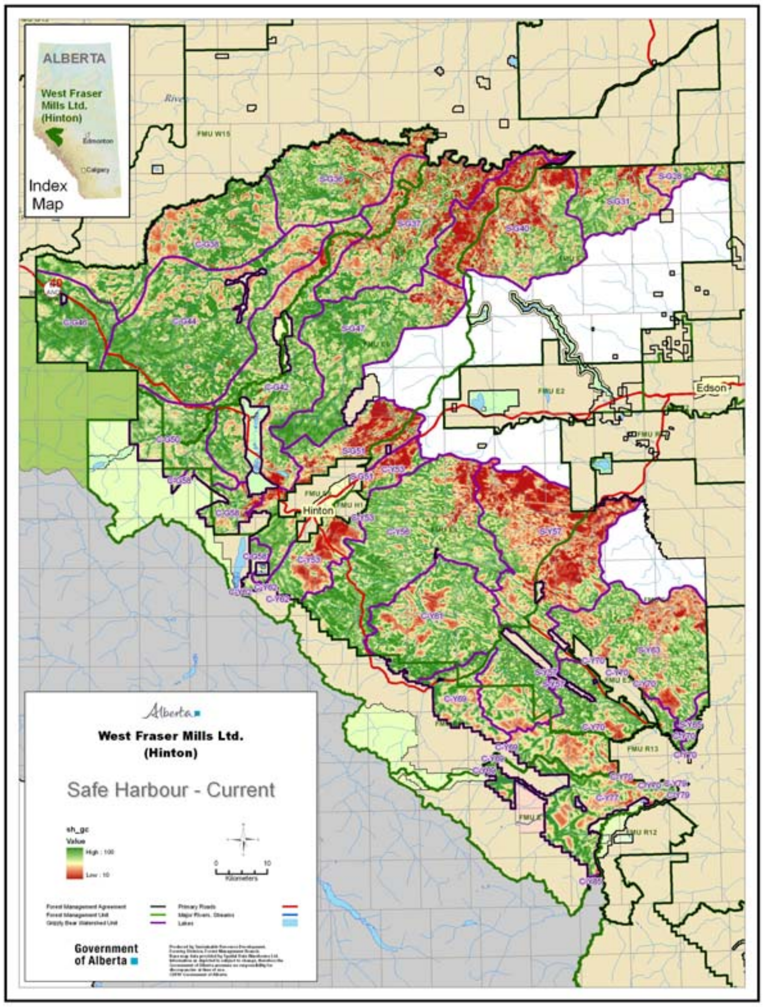
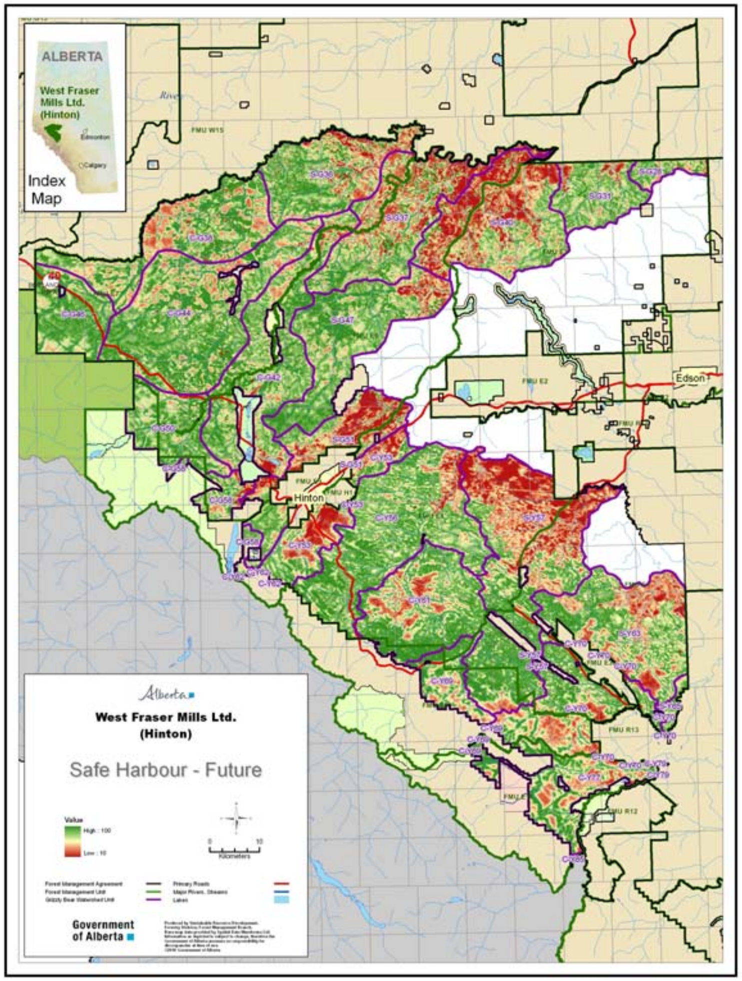



**Figure 29. Grizzly Bear Safe Harbour (current)**

Future




Change from Current

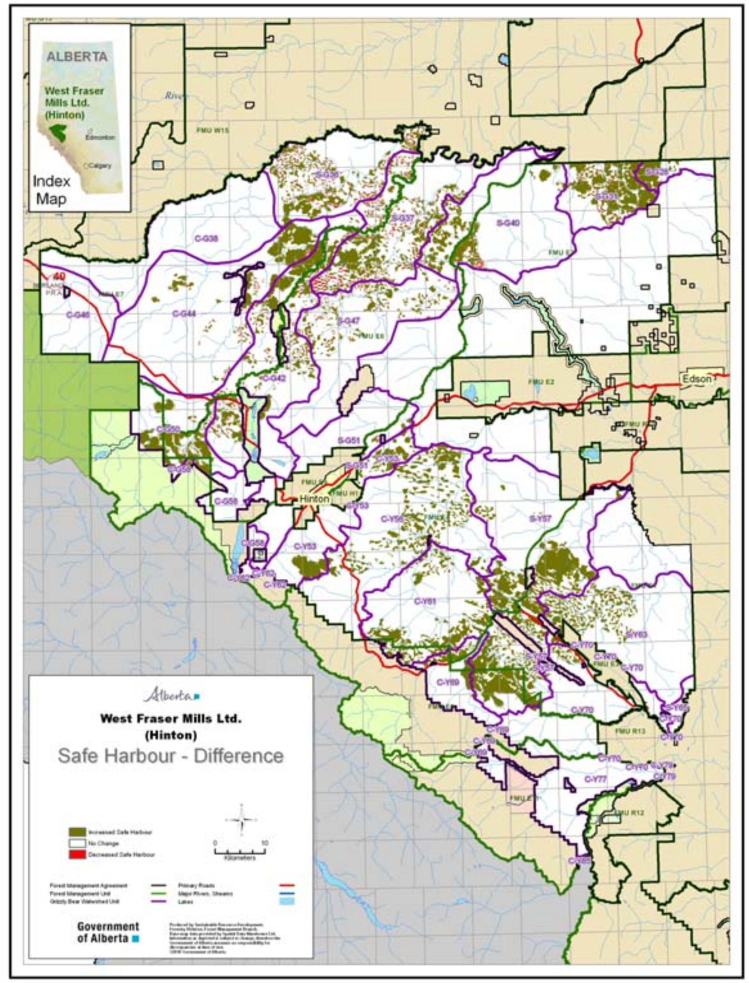



**Figure 30. Grizzly Bear Safe Harbour (future)**