

Appendix 1

1 Woodstock Setup

A wide variety of input parameters and management assumptions must be specified prior to projecting harvest schedules with Woodstock™. These are specified in order to reflect both the biological processes of the forest and the current realities of operational forest management practices. Unless otherwise mentioned in this appendix, model setup was the same as the 2005 DFMP submission.

1.1 Input shapefiles

As part of the net landbase determination process, shapefiles are created for each FMU consistent with the requirements for Woodstock. This involves classifying the landscape into themes (described below), and assigning pre-block information.

Due to changes in pre-blocks, as well as the addition of a mountain pine beetle strategy, the input shapefiles have undergone some changes since their initial creation from the net landbase determination process. The specifics are documented in the following sections.

1.2 Effective Date

November 18, 2000 was selected as the effective date and is unchanged from the DFMP. The start date is defined as the point in time that best reflects the forest attributes at the beginning of the TSA model. Therefore, every reasonable attempt was made to have all input data sets consistent with November 18, 2000.

1.3 Planning Horizon and Period Length

The planning horizon used in this analysis was 160 years or 32 periods. The period length was set as 5 years. These are unchanged from the 2005 DFMP.

1.4 Lifespan

The lifespan identifies the maximum age of a development type before it dies or is replaced by another development type. The DFMP outlines the life spans by broad cover group used in this TSA. Lifespan is unchanged from the DFMP, as follows:

1. Coniferous (C AND CD) broad cover groups [*theme4 = CON*] were assigned a lifespan of 300 years (60 periods).
2. Deciduous (D AND DC) broad cover groups [*theme4 = DEC*] were assigned a lifespan of 180 years (40 periods).
3. A regeneration lag applied to some areas [*theme8=REG*] are assigned a lifespan of 5 years (1 period).

1.5 Landscape

The landscape section defines the variables (called themes) that will be utilized during the modeling process. Theme 10 was not present in the DFMP but the remaining themes are unchanged. Refer to Appendix 4.3D of the 2005 submission for information on themes 1-9.

Theme10 – MPB Susceptibility Rating

Alberta’s Forest Management Branch has adapted the Shore/Safranyik Stand Susceptibility Index (SSI) Model for use in Alberta. AVI attribute data was processed by the SSI model (version Sept 14, 2006) resulting in a dBase file containing Stand Susceptibility Index (SSI), Climate Factor (CF) and SSICF values for each polygon. The MPB susceptibility rating used in Woodstock is a 3 letter code based on CF, SSI and SSICF. Table 1-1 summarizes the MPB susceptibility rating system for Theme10.

Table 1-1 MPB Susceptibility Rating

Climate Factor Rating (CF)	Pine Component Rating (SSI)	SSI_CF Classification (CF * SSI)
A = 1.0	A = 81-100	L = Low (0-30)
B = 0.8	B = 51-80	M = Medium (31-50)
C = 0.5	C = 31-50	H = High (51-100)
D = 0.2	D = 0-30	
E = 0.1		

Non-pine stands were assigned a value of “ZZ”.

Aggregates were used to identify the pine stand ranking (Rank 1, 2 or 3) based on the assigned compartment risk, consistent with the September 2006 (version 2.6) Interpretive Bulletin (Planning Mountain Pine Beetle Response Operations). Drayton Valley was given a “low” compartment risk. Stands were assumed to remain at their initial susceptibility rating until they were harvested or died.

Key aggregates:

mpb ; all mpb (pine) stands

AAH ABH ACM ADL BAH BBM BBH BCL BCM BDL CAM CBL CBM CCL CDL
DAL DBL DCL DDL EAL EBL ECL EDL

low1 - rank 1 stands for low compartment risk

AAH ABH BAH

low2 - rank 2 stands for low compartment risk

ACM ADL BBM BBH BCL BCM BDL CAM CBL CBM CCL DAL DBL DCL

low3 - rank 3 stands for low compartment risk

CDL DDL EAL EBL ECL EDL

low - low stands requiring harvest strategy (i.e., managed rank 1 and rank 2)

low1 low2

1.6 Areas

The area files were built using the automated Spatial Woodstock function. There were no user-defined locks or proximal analysis.

1.7 Actions

The action section applies activities and/or treatments to the forest. There are two actions used:

CCC – Harvesting of pure coniferous stands (theme7 = CX)

CCD – Harvesting of pure deciduous and mixedwood stands (theme7 = DX, CD, or, DC)

Death is a system-provided action that occurs when a stand reaches the lifespan age.

Minimum Harvest Age

Minimum harvest ages were used to define an “operability window” when a stratum meets the minimum age requirement to be eligible for harvest (i.e., becomes merchantable). Age operability limits remained unchanged from the 2005 DFM with the exception of the pine broad cover group (theme4 = PL). Minimum harvest age for the first rotation pine was reduced from 100 years (20 periods) to 80 years (16 periods) to allow the model to harvest MPB susceptible pine earlier in the planning horizon.

Harvest Design Area (HDA) Sequencing

Harvest design areas (HDAs) are used by Weyerhaeuser foresters as operational planning units. Constraining the ability of the TSA model to allocate blocks within HDAs (especially over the next 20 years) resulted in a spatial sequence that better conforms to the operational intent. Table 1-2 HDAs that are open for harvest are assigned a ZONERES yield of 1. HDAs that are closed for harvest are assigned a ZONERES yield of 0. ZONERES must be 1 for a stand to be actionable. Table 1-2 indicates when HDAs were closed for the allocation of additional harvesting.

Table 1-2 Allowable harvest periods by harvest design area

LMU	Harvest Design Area	Periods* Closed for Harvest Allocation
Baptiste	Brewster Creek	2, 4
	Buster Creek	2, 4
	Chambers Creek	2, 4
	Crimson	3, 5
	Diamond Hill	2, 4
	Grace Creek	2, 4
	Louis Lake	N/A
	No Name Creek	2, 4
	Omni	3, 5
	Prentice Creek	3, 5
	Sunchild	3, 5
Blackstone	Beaver Flats	3, 5

LMU	Harvest Design Area	Periods* Closed for Harvest Allocation
	Black Mountain	3, 5
	The Gap	3, 5
	Lookout Creek	2, 4
	North False Gap	2, 4
	R2	N/A
	South False Gap	2, 4
	Trunk Road	3, 5
	Wapiabi	N/A
Elk River	Broken Arm	3, 5
	North Dismal Creek	3, 5
	Poachers Creek	3, 5
	South Dismal Creek	2, 4
	Wolf Lake East	3, 5
	Wolf Lake West	2, 4
Marshy Bank	Chungo Lookout	3, 5
	Canyon Creek	3, 5
	Race Creek	2, 4
Medicine Lake	Gosling lake	3, 5
	Medicine Creek	2, 4
Nordegg River	Elke Summers	N/A
	East Rundell	2, 4
	South Brazeau	3, 5
	South Reservoir	2, 4
	Wawa Creek	2, 4
	West Rundell	3, 5
O'Chiese	Boundary	2, 4
	Doc's Lake	3, 5
	Grey Owl Creek	2, 4
	North Canal	2, 4
	Rapid Creek	3, 5
	South Canal	3, 5
Sand Creek	Stevens Creek	2, 4
	Brazeau Tower	2, 4
	Cathedral Grove	3, 5
	Jack Knife	N/A
	Lodgepole	2, 4
Tall Pine	Pembina	3, 5
	Big Bend	N/A
	Little One	2, 4
	North Brazeau	N/A
	Norms Throw	N/A
	Power House	N/A
	Saskatchewan	N/A

LMU	Harvest Design Area	Periods* Closed for Harvest Allocation
Willesden Green	Alder Flats	2, 4
	Dominion Lake	2, 4
	Open Creek	3, 5
	South Deer Corner	3, 5
	Strawberry Mountain	3, 5
	Wolf Creek	2, 4

* Excludes pre-blocks

1.8 Yields

Yield curves remain unchanged from the 2005 DFMP, with the exception of the addition of a ZONERES yield. ZONERES is a time-dependent yield curve that identifies which HDAs are ineligible for harvest in which periods. Any development type mask with a ZONERES value of 0 is ineligible for harvest. It is used in the Action section as an operability limit to control the timing of harvesting.

1.9 Transitions

The stand transition rules are identical to the 2005 DFMP with the exception of the MPB theme (theme 10). After either death or harvest, stands transition to a non-ranked Mountain Pine Beetle stand (*theme10 = ZZ*).

1.10 Optimize section

The optimize section is where the objective function and constraints are formulated as a linear program.

Objective Function

The primary objective of this analysis was to maximize the total volume harvested over the planning horizon. This essentially means maximizing the sum of coniferous and deciduous harvest volumes (both primary and incidental) over the next 160 years.

An additional factor (*srgpj25*) was added to the objective function to aid in MPB management. Adding conifer volume from pine cover group stands in periods 2-5 to the objective function provides Woodstock with an incentive to harvest pure pine stands during the main MPB management periods.

An additional factor (*srgpc25*) was subtracted from the objective function. This factor summed conifer harvest from rank 3 and non-ranked MPB stands in periods 2-5. Subtracting this factor from the objective function provides a disincentive to harvest non-rank 1 and rank 2 stands during the main MPB management periods.

Volume Flow Constraints

Constraints were incorporated into the model to ensure that the level of forest management is sustainable over time and to incorporate controls to ensure that any specific strategic or

operational requirements are met. Constraints to control the flow of both conifer and deciduous volumes are implemented in the model.

Due to the introduction of the MPB management strategy requirements, constraints on the conifer and deciduous flows had to be applied over distinct timeframes, as follows:

Conifer

- Period 1 – with a November 18, 2000 model reference date, the first period was constrained to have conifer harvest equal to the period 1 Stanley allocation from the 2005 DFMP submission (Appendix 4.3A)
- Period 2 – The first ~1.5 years of period 2 (from November 18, 2005 to May 1, 2007) were set at the Stanley allocated volumes from the 2005 DFMP. The harvest level for the remaining ~3.5 years was set at the surge harvest level of period 3.
- Periods 3 to 5 – strict even flow during the “surge period”.
- Periods 6 to 12 – strict even flow.
- Periods 12 to 32 – $\pm 5\%$ flow variation from the post-surge average harvest level (periods 6-32).
- The post-surge average was also constrained to a maximum 10% drop from the baseline harvest level (current DFMP average from periods 1-32 as shown in Table 4.20 of the 2005 DFMP, consistent with Section 5.6(iv)(c) of Annex 1 of the Alberta Forest Management Planning Standard).

Deciduous

- Period 1 – with a November 18, 2000 model reference date, the first period was constrained to have deciduous harvest equal to the period 1 Stanley allocation from the 2005 DFMP submission (Appendix 4.3A)
- Periods 2 to 12 – strict even flow.
- Periods 12 to 32 – $\pm 5\%$ flow variation from the period 2 to 32 average with no drop from the baseline (current DFMP average over periods 1-32) allowed.
- An OSB deciduous flow constraint requiring a minimum of 300,000 m³/yr of deciduous volume was implemented from period 2 to the end of the planning horizon.

Growing Stock Constraints

To provide some support to long term sustainability, the operable deciduous and coniferous growing stocks were not permitted to decline over the last 40 years (8 periods) of the planning horizon:

Seral Stage Constraints

Seral stage constraints were unchanged from the 2005 DFMP, with the exception of pine (*theme 4 = PL*) and Pine/Spruce (*theme 4 = PS*) cover groups which had their constraints removed for the entire planning horizon.

Mountain Pine Beetle Constraints

The Prevention (Pine) Strategy proposed by SRD aims to decrease the spread and outbreak potential of MPB by reducing the area of susceptible pine stands to 25% of that in the baseline

scenario (DFMP 2000-2015) at a point 20 years in the future. Weyerhaeuser's strategy for the Preferred Forest Management Scenario attempts to reduce the area of Rank 1 and Rank 2 stands on the net landbase by 75% from the initial (year 0) inventory by the end of the 5th period (November 17, 2025).

Constraints limiting the decline in the post-surge conifer harvest levels to 90% of those in the baseline (submitted DFMP) make it impossible to realize a 75% reduction in MPB susceptible stands. As a result, whether the target reduction is based on the DFMP inventory after 20 years or the initial inventory in the current model has no effect on the model results.

Rather than implement a 20-year MPB strategy, Weyerhaeuser has utilized a ~18.5 year surge cut on conifer, effective May 1, 2007. With a model reference date of November 18, 2000, this means the surge cut extends for the remaining ~3.5 years of period 2 through to the last year of period 5.

To further reduce the area of Rank 1 and Rank 2 stands beyond the first 25 years, the model is constrained, from period 5 onwards, to harvest all operable Rank 1 and Rank 2 stands in the period in which they are (or become) operable. This constraint is goal programmed to ensure the remaining sustainability constraints are not broken.

Area-specific constraints

Additional constraints were imposed on the model as follows:

- A minimum of 10% of the total volume harvested from periods 2-32 must come from west of the trunk road
- The area harvested in the Marshy Bank LMU must be ≤ 500 -ha in period 1
- The area harvested in the Blackstone LMU must be $\leq 1,000$ -ha in period 1
- There is to be no harvest in the Chungo Lookout area in period 1 or 2
- Conifer yield from Rose Creek in the Jack Knife HDA must be ≥ 4000 m³/yr net
- Conifer yield from the Tall Pine LMU must be $\geq 40,250$ m³/yr gross

1.11 Outputs

Outputs are largely unchanged from the previous DFMP submission. A series of MPB related outputs were added as follows:

- Mountain Pine Beetle Outputs
 - GMPB_AREA: Gross area of ranked MPB stands
 - MGMPB_AREA: Gross area of Rank 1 and Rank 2 ("managed") MPB stands
 - NMPB_AREA: Net area of ranked MPB stands
 - MNMPB_AREA: Net area of Rank 1 and Rank 2 ("managed") MPB stands
 - OMPB_AREA: Harvest operable area of MPB stands
 - MOMPB_AREA: Harvest operable area of Rank 1 and Rank 2 MPB stands
 - HMPB_AREA: Harvested area of ranked MPB stands
 - MHMPB_AREA: Harvested area of Rank 1 and Rank 2 MPB stands
 - MDMPB_AREA: Area of Rank 1 and Rank 2 MPB stands that have undergone death