MOUNTAIN PINE BEETLE UPLIFT
TIMBER SUPPLY ANALYSIS
INFORMATION PACKAGE

BOWRON-COTTONWOOD TREE FARM LICENCE
(TFL 52 BLOCKS 1 AND 2)

Version 7

Prepared for:
West Fraser Mills Ltd.
Quesnel, B.C.

Prepared by:
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West Fraser Timber Co. Ltd

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February 19, 2007

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Attention: Alan Hunter, RPF

Reference: *MPB Uplift Timber Supply Analysis Information Package TFL 52*

Dear Al,

Enclosed please find the updated *Mountain Pine Beetle Uplift Analysis Information Package* for West Fraser Mills' TFL 52. A number of edits have been made based on feedback from the Ministry of Forests and Range and Ministry of Environment, discussed at our meeting February 15, 2007. In addition references to the TFL have been updated to reflect the new licence and there is now information related to spruce harvest levels to address the spruce beetle issue.

We will proceed with the analysis, as per our discussion after the MoFR meeting. Thank you for your input during the preparation of the *Information Package*. Please call if you have any questions or comments related to the document or any other aspect of the analysis.

Yours truly,
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1.0 INTRODUCTION

The recent infestation of Mountain Pine Beetle (*Dendroctonus ponderosae*) (MPB) has reached critical levels throughout the interior of British Columbia including West Fraser Mills Ltd.'s (WFM) Bowron-Cottonwood Tree Farm Licence (TFL 52). Many of the adjacent timber supply areas (TSAs) have been granted increased allowable annual cut (AAC) levels to address salvage of dead and damaged timber or to provide harvesting that will reduce the spread of the beetle. The impact of this far-reaching outbreak of MPB could affect the forest for timber and other resource values.

Based on the urgency of the MPB outbreak an expedited timber supply analysis is being conducted on TFL 52. The objective of the analysis is to provide information to the British Columbia Chief Forester to support an *uplift* to the current AAC. The uplift, which is a temporary increase in AAC, is required to allow recovery of the dead and at-risk pine volume on the TFL prior to stand breakup and complete loss of merchantable pine volume. The analysis will summarize the volume of timber at risk to attack and how adjustments in the current AAC will allow improved recovery of dead and at-risk timber. In addition, the analysis will explain possible impacts of increasing current harvest rates on future timber supply.

This *Information Package* has been prepared on behalf of WFM as a source document prior to the completion of the uplift timber supply analysis for TFL 52. It provides a summary of the inputs and assumptions made in preparing the timber supply analysis data model. Included are inventory and land base summaries, growth and yield information and management assumptions for timber and non-timber resources as they relate to timber supply.

TFL 5, the MacKenzie-Cariboo Tree Farm Licence, was recently acquired by WFM as part of their purchase of Weldwood of Canada Ltd. (Weldwood). As of December 28, 2006 TFL 5 was officially merged with TFL 52 to form a single licence (TFL 52). The original TFL 52 is now called "Block 1" and the old TFL 5 is referred to as "Block 2". The analysis will be conducted as one management unit. However, all land base definitions and management assumptions that are unique to each area will be maintained in the analysis. The most recent timber supply analyses completed for each TFL were:

- TFL 5 Management Plan 10 (MP 10), as documented in Weldwood of Canada Ltd. Mackenzie-Cariboo Tree Farm Licence (TFL 5) Management Plan 10 Timber Supply Analysis (Timberline, October 2002); and
- TFL 52 Management Plan 3 (MP 3), as documented in West Fraser Mills Ltd. Bowron-Cottonwood Tree Farm Licence (TFL 52) Management Plan 3 Timber Supply Analysis (Timberline, July 2001).

The analysis will use "shelf life" which defines the length of time beetle-killed pine trees will remain merchantable after attack. In addition, volumes will be adjusted to reflect dead pine remaining in stands not harvested prior to shelf life expiration. This includes mixed species stands, of which many will remain un-harvested after the pine shelf life has expired.

A number of sensitivity analyses will also be conducted to test the impact of different assumptions on timber supply for the TFLs. All analysis simulations will be completed using Woodstock/Stanley developed by Remsoft. Upon acceptance by the British Columbia Ministry of Forests and Range (MoFR) Timber Supply Analyst, the assumptions and methodology provided in the *Information Package* will be used by WFM to prepare and submit a timber supply analysis to the MoFR. All analysis results will be provided to the Chief Forester of British Columbia, or his designate, for the allowable cut determination.

2.0 TIMBER SUPPLY ANALYSIS PROCESS

Traditionally, the preparation of a timber supply analysis in support of a TFL management plan follows the *Guide for Tree Farm Licence Management Plans (20-month) and Calendar Year Reports* (BC MoFR, 2001). The information package is submitted to the Timber Supply Forester at Forest Analysis and Inventory Branch 14 months prior to the expiry date of the present management plan for the license.

However, an accelerated schedule is being adopted because of the critical nature of the MPB issue. As a result this *Information Package* will be submitted outside the conventional management plan process. Upon acceptance, the *Information Package* will guide the timber supply analysis, and will be included as an appendix to the timber supply analysis report, which will be submitted in the spring of 2007.

Forest inventory and land base information have been collected in recent field projects and associated mapping updates, as well as from WFM's existing inventory database.

The *Information Package* will be provided to Qiong Su, Timber Supply Forester, MoFR Forest Analysis and Inventory Branch for review and acceptance prior to commencing with the timber supply analysis. MoFR staff at the Southern BC Regional office and Quesnel Forest District office will also contribute to the review process prior to commencement of the analysis.

In addition to the submission of the *Information Package* to the Timber Supply Forester, growth and yield information will be submitted to the following ministry staff:

- Tamara Brierly, Forest Mensurationist, MoFR Vegetation Resources Inventory Branch (natural stand yields tables and forest cover polygon volumes); and
- Mario Dilucca, Growth & Yield Application Specialist, MoFR Stand Development Modelling (managed stand yield tables).

It is important to note that the approved yield tables used in the previous management plan analyses, MP 10 for TFL 5 and MP 3 for TFL 52, will be used in the current uplift analysis. Some adjustments will be made to reflect losses associated with dead pine and subsequent stand recovery.

2.1 Missing Data

The information package is complete for the proposed analysis methods and inputs.

3.0 TIMBER SUPPLY OPTIONS

This section provides an overview of the options that will be evaluated in the timber supply analysis.

3.1 Base Case/Mountain Pine Beetle

The MPB outbreak is the primary issue facing forest managers in the Quesnel Forest District. Most of the pine stands on TFL 52 are under attack or have been attacked. The *Base Case/Mountain Pine Beetle* option reflects current management performance at January 1, 2006, the date of commencement for the preparation of Uplift Analysis. The analysis will incorporate the following:

- Vegetation resources inventory (VRI), updated for disturbance to December 31, 2005;
- BC Timber Sales (BCTS) take-back areas;
- Biogeoclimatic ecological classification (BEC) version 6;
- Terrestrial ecosystem mapping (TEM);
- Terrain resource inventory mapping (TRIM-II) with enhanced road and stream information;
- Genetic gains from tree improvement;
- Current silviculture regimes;
- Incremental silviculture on demonstrated sites;
- Current utilization standards;
- Managed stand site index estimates based on the JS Thrower & Associates reports *Potential Site Indices for Major Commercial Tree Species on TFL 52* and *Updating Potential Site Index Estimates for Commercial Tree Species on TFL 5*;
- Terrain stability mapping (TSM);
- Operability mapping based on TSM;
- Landscape units and resource development zones (RDZ) as defined by *Cariboo-Chilcotin Land Use Plan* (CCLUP);
- Recognized old growth management areas (OGMAs);
- Updated stand-level biodiversity requirements as accepted by Quesnel Forest District;
- Community watershed;
- Recreational and visually sensitive areas;
- Streams, lakes, wetlands and final fish habitat inventory;
- Updated caribou habitat areas;
- Wildlife habitat requirements for moose, mule deer and other species based on *Fish, Forest and Wildlife Management Plan for TFL 5* (Keystone Wildlife Research); and
- Conservation legacy areas within Block 1.

3.2 Sensitivity Analysis

Sensitivity analysis is used to assess the uncertainty of assumptions made in the base case. A specific variable is adjusted and the magnitude of the increase or decrease in the sensitivity variable reflects the degree of uncertainty surrounding the assumption associated with that given

variable. By developing and testing a number of sensitivity analyses, it is possible to determine which variables most affect results.

For the Uplift Analysis, sensitivity will focus on inputs and assumptions related to pine harvest and volume. Table 3.1 summarizes the sensitivity issues to be addressed in the analysis. In addition to the scenarios listed in the table, one or more composite sensitivity scenarios may be explored if warranted by the results of the individual sensitivity analyses.

Table 3.1 - Sensitivity analyses

Issue	Sensitivity Levels to be Tested
Land base	Timber harvesting land base ± 5%
Growth and yield	Shelf life estimates +/- 5 years Mortality in pine stands +/- 10%, +/- 25%, +/- 50% Minimum age of pine stands attacked by MPB Regen delay +/- 10 years in non-harvested pine Stand rehabilitation on non-harvested sites Increase genetic gains on Block 1 MSYTs to match Block 2
Resource management	Order of harvesting priorities – pine vs non-pine Remove disturbance constraint limits on each REA type
Biodiversity	Mature+old and old requirements in non-MPB stands

3.3 Alternative Harvest Flow

A number of different harvest flows will be explored, based on alternative priorities for harvesting dead and at-risk pine timber. In many analysis simulations forest cover constraints and biological capacity of the timber harvesting land base (THLB) will dictate timber availability and harvest level options.

Due to the circumstances associated with the MPB outbreak, conventional objectives related to harvest flow might not apply in all analysis scenarios. However, wherever possible harvest flow will reflect the following objectives:

- Recover the maximum volume of dead and at-risk pine volume prior to loss of merchantability;
- After the uplift period, maintain or increase the current AAC for as long as possible;
- Limit changes in harvest level to less than 10% of the level prior to the reduction; and
- Achieve stability in the long-term harvest level and growing stock profiles.

It will be important to evaluate the impact of beetle attack, and potential changes to short-term harvest levels on the TFL, on mid-term timber supply approximately 20 to 60 years into the future. This is expected to be the period when timber supply will be most affected by the MPB infestation.

4.0 FOREST ESTATE MODEL

The TFL 52 Uplift Timber Supply Analysis will use Remsoft's spatial planning system Woodstock–Stanley (www.remsoft.com). Woodstock is the aspatial component of the suite and addresses the majority of the model objectives and constraints. Woodstock performs a similar function as the MoFR's FSSIM model whereby management zones and constraints are defined, and yield curves are incorporated and applied to an aggregated area file. The primary difference between Woodstock and FSSIM is that Woodstock is capable of using either optimization or sequential simulation in developing a harvest forecast.

Stanley, the spatial component of the suite, applies the Woodstock harvest forecast to specific polygons on the land base. Stanley will aggregate individual polygons into suitable harvest units (blocks) based on specified minimum, maximum, and target block sizes. The model will also enforce green-up and adjacency requirements as it schedules the harvest spatially.

Although optimization can be modelled with Woodstock, this approach will not be included in the development of the base case harvest schedule. If considered appropriate, and time permitting, optimization may be included in a final aggregated analysis scenario. The optimization will be subject to a number of harvest constraints including the requirement to produce a long-term sustainable harvest forecast.

The model will use five-year planning periods and will be run for a minimum 250-year planning horizon. For the base case the pre-uplift AAC for each block of the TFL will be used as a starting point and will be maintained as long as necessary to recover dead and at-risk pine. If necessary, a controlled decline of a maximum of 10% per decade will be employed. As managed stands become harvestable, a long-term harvest level will be established that maintains a stable growing stock level over the long-term.

5.0 FOREST COVER INVENTORY

5.1 Base Inventory

Many of the source inventory data set have been updated since the previous management plan for each TFL. Both TFLs use VRI to describe the forest inventory, with updated for disturbance and silviculture to December 31, 2005.

Phase 2 adjustments have been made for TFL 5 but these have not been through the full review process and therefore have not been incorporated into the VRI for this analysis. Similarly net volume adjustment factors (NVAF) for TFL 52 have been developed, but are still undergoing review.

5.2 Data Sources

Many sources of data were compiled to provide input to the timber supply analysis for TFLs 5 and 52. Data was used for two general purposes:

- Netdowns – classification of the land base into non-productive, non-harvesting, and harvesting components; and
- Resultant – which is the final analysis database.

Blocking was not developed for this analysis database because the Woodstock/Stanley model is capable of assembling blocks, as required, during simulation. Data sources are documented in Tables 5.1 and 5.2

Table 5.1 – Block 1 (old TFL 52) data sources

Description	Timberline Coverage	Source	Date Created
BCTS Tract	***bcts_tract***	TFIC	28-Feb-06
Caribou Habitat	***caribou***	TFIC	28-Feb-06
Land Use Plan	***cclup***	TFIC	28-Feb-06
Creeks	***creeks***	TFIC	28-Feb-06
Fish Inventory	***cri_fish***	TFIC	28-Feb-06
PSYU/FIZ	***f_rc***	TFIC	28-Feb-06
Forest Development Plan	***fdp_blocks***	TFIC	28-Feb-06
Lake Classes	***lakeclasses***	TFIC	28-Feb-06
Landscape Units	***landunits***	TFIC	28-Feb-06
Logged - Recent	***logged_blks***	TFIC	28-Feb-06
Operability	***mp3_inop***	TFIC	28-Feb-06
Mule Deer Planning Cells	***muledeer***	TFIC	28-Feb-06
Old Growth Management Area	***ogma_cover***	TFIC	28-Feb-06
Forest Cover	***old_forest***	TFIC	28-Feb-06
Recreation Areas	***rec***	West Fraser	15-Mar-06
Roads	***roads***	West Fraser	28-Feb-06
Recreational Opportunity Spectum	***ros***	TFIC	28-Feb-06
Watersheds	***subbasins***	TFIC	28-Feb-06

Description	Timberline Coverage	Source	Date Created
Terrestrial Ecosystem Management	***tem***	TFIC	28-Feb-06
Terrain	***terrain***	TFIC	28-Feb-06
Ownership	***tfl_all***	West Fraser	15-Mar-06
Roads Buffered	***tfl_road_buf***	TFIC	28-Feb-06
Visual Quality	***vqo***	TFIC	28-Feb-06
Wildlife Tree Patch	***wtp***	TFIC	28-Feb-06
TFL boundary	***tfl52***	West Fraser	15-Mar-06
Lakes	***tfl52_lake***	West Fraser	15-Mar-06
Wetlands	***tfl52_wet***	West Fraser	15-Mar-06
Land Use Plan	***tfl52_lup***	West Fraser	15-Mar-06
VRI	***tfl52_vri***	TFIC	28-Feb-06
Old Logged Blocks	***log_old***	TFIC	28-Feb-06
Bio-ecological Classification	***tfl52_bec***	MoFR	8-Mar-06
Buffered Riparian Areas	***rip_buffers***	TFIC	12-Apr-05
Land Use Plan	***cclup_intfl***	West Fraser	8-Mar-06

Table 5.2 – Block 2 (old TFL 5)data sources

Description	Timberline Coverage	Source	Date Created
Alexander Mackenzie Heritage Trail	amht_cover	TFIC	28-Feb-06
BCTS Tract	bcts_tract	TFIC	28-Feb-06
Fish Inventories	cri_fish	TFIC	28-Feb-06
Forest Development Plan	fdp_blocks	TFIC	28-Feb-06
Old Growth Management Area	ogma_cover	TFIC	28-Feb-06
Roads	roads	TFIC	28-Feb-06
Bio-ecological Classification	tfl5_bec	MoFR	8-Mar-06
Ecology	tfl5_ecology	TFIC	28-Feb-06
TFL Boundary	tfl5_legal	TFIC	28-Feb-06
Logged - Recnet	tfl5_logged	TFIC	28-Feb-06
Riparian	tfl5_ripar	TFIC	28-Feb-06
Terrain	tfl5_terrain	TFIC	28-Feb-06
Wildlife Tree Patch	wtp	TFIC	28-Feb-06
Land Use Plan	tfl5_lup	West Fraser	15-Mar-06
Ownership	tfl5_owner	West Fraser	15-Mar-06
Visual Quality	tfl5_visual	West Fraser	15-Mar-06
Wildlife Management Units	tfl5_wmu	West Fraser	15-Mar-06
Roads Buffered	t5_rd_buf	West Fraser	15-Mar-06
Wetlands	tfl5_wet	West Fraser	15-Mar-06
Recreation Areas	tfl5_rec	West Fraser	15-Mar-06

Description	Timberline Coverage	Source	Date Created
Streams	tfl5_strm	West Fraser	15-Mar-06
Landscape Units	tfl5_lu	West Fraser	15-Mar-06
Lakes	tfl5_lake	West Fraser	15-Mar-06
Buffered Riparian Areas	rip_buffers	TFIC	12-Apr-06
VRI	tfl5_vri	TFIC	28-Feb-06
Bio-ecological Classification	bec_jun06	West Fraser	6-Jun-06
CCLUP	lup_jun06	West Fraser	6-Jun-06

6.0 LAND BASE DESCRIPTION

This section describes the TFL land bases and the methodology used to determine the way in which land contributes to the analysis. Some portions of the productive land base, while not contributing to harvest, may be available to meet other resource needs. Note that tables are provided for each TFL individually and combined where similar features are present on the land base. The order of presentation is: Block 1 (old TFL 52); Block 2 (old TFL 5); and total TFL 52.

6.1 Timber Harvesting Land Base Determination

Tables 6.1, 6.2 and 6.3 present the results of the land base classification process to identify the timber harvesting land base (THLB). Individual areas may have several classification attributes. For example, stands within riparian reserve boundaries might also be classified as non-commercial. These areas have been classified on the basis of this latter attribute, prior to the riparian classification. Therefore, in most cases the net reduction will be less than the total area in the classification. The order of the entries in each table corresponds to the sequence in which the land base classifications were applied. Volumes include only coniferous species.

Table 6.1 – Block 1 Base Case timber harvesting land base determination

Land Classification	Total Area (ha)	Reduction		Net Remainder	
		Area (ha)	Volume (m^3)	Area (ha)	Volume (1000s m^3)
Total area	**258,866**			**258,866**	**43,821.7**
Non-productive, non-forest		17,246	2.4		
Existing roads		4,054	370.3		
Productive forest				**237,566**	**43,449.0**
Non-commercial brush		54	0		
Riparian reserve zones		7,089	1,693.7		
Riparian management zones		5,984	1,357.4		
Caribou no-harvest		19,626	3,709.3		
Inoperable		3,494	786.6		
Low productivity		2,969	430.3		
Deciduous		2,274	81.4		
Non-merchantable		5,291	171.8		
Preservation VQO		87	23.8		
Wildlife tree patches (WTP)		1,526	446.7		
OGMA		17,511	4,886.1		
Total productive reductions		**65,904**	**13,587.1**		
Current THLB				**171,662**	**29,861.9**
less future roads		3,760	654.1		
Long-term THLB				**167,902**	**29,207.8**

There has been a new land base classification process associated with the VRI since the MP 3 timber supply analysis, in which case more area has been classified as productive land. Other significant changes to the netdown process include:

- Updated caribou no-harvest areas;
- Revised WTP methodology; and
- Designation and subsequent removal of OGMAs.

Road areas have been reduced compared with MP 3 because many small roads and trails were included in the MP 3 analysis. Since the completion of MP 3 many roads have been reviewed and the surveys clearly indicate that these roads and trails are back in production and supporting stands of young trees.

Table 6.2 – Block 2 Base Case timber harvesting land base determination

Land Classification	Total Area (ha)	Reduction		Net Remainder	
		Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
Total area	**34,619**			**34,619**	5,043.8
Non-productive, non-forest		1,275	0.6		
Existing roads		695	97.6		
Productive forest				**32,649**	**4,945.6**
Non-commercial brush		167	0.2		
Moose calving habitat		315	45.0		
Riparian reserve zones		317	70.3		
Riparian management zones		198	43.0		
Terrain class V		339	78.7		
Deciduous		1,023	57.1		
Wildlife tree patches (WTP)		620	169.5		
OGMA		1,956	501.3		
Total productive reductions		**4,936**	**965.0**		
Current THLB				**27,713**	**3,980.6**
less future roads		40	5.7		
Long-term THLB				**27,673**	**3974.9**

The recent VRI has reclassified some of the land within Block 2. As a result the non-productive area has increased. Similarly, there has been an increase in the classified road area for this part of the TFL. There is no longer any reduction for terrain class IV (TC IV), which was subject to a 25% reduction in the MP 10 timber supply analysis. This is the result of overlap between TC IV and other productive exclusions. The designation of old growth management areas (OGMAs) has also been introduced since MP 10.

Block 2 contains approximately 320 ha of private (Schedule A) land, of which 265 ha is productive and 199 ha are part of the THLB. These totals are slightly lower (9 hectares)

compared to the areas from MP10 for TFL 5. The private land area is being reviewed as part of the process to update the TFL Instrument. This will confirm the area of both the private and crown land areas on Block 2, and the rest of the TFL.

Table 6.3 – Total TFL 52 Base Case timber harvesting land base determination

Land Classification	Total Area (ha)	Reduction		Net Remainder	
		Area (ha)	Volume (m^3)	Area (ha)	Volume (1000s m^3)
Total area	**293,485**			**293,485**	**48,865.5**
Non-productive, non-forest		18,521	3.0		
Existing roads		4,749	468.0		
Productive forest				**270,215**	**48,394.5**
Non-commercial brush		221	0.2		
Riparian reserve zones		7,406	1,764.0		
Riparian management zones		6,182	1,400.4		
Moose & Caribou no-harvest		19,941	3,754.3		
Inoperable & terrain class V		3,833	865.2		
Low productivity		2,969	430.3		
Deciduous		3,297	138.5		
Non-merchantable		5,291	171.8		
Preservation VQO		87	23.8		
Wildlife tree patches (WTP)		2,146	616.1		
OGMA		19,467	5,387.4		
Total productive reductions		**70,839**	**14,552.0**		
Current THLB				**199,376**	**33,842.5**
less future roads		3,800	659.8		
Long-term THLB				**195,576**	**33,182.7**

6.1.1 Distribution of Area by Leading Age and Leading Species

Tables 6.4, 6.5 and 6.6 summarize the distribution of area and coniferous volume by 10-year age class for both the productive and net timber harvesting land base.

Table 6.4 – Block 1 age class distribution

Age Class	MoFR Age Class	Productive Area (ha)	Productive Volume (1000s m^3)	THLB Area (ha)	THLB Volume (1000s m^3)
NSR	0	6,295	0.0	5,930	0.0
1	1	11,195	0.0	10,876	0.0
2		23,037	1.1	22,190	1.1
3	2	19,649	21.2	18,634	20.3
4		7,861	178.2	6,700	164.4
5	3	2,592	156.1	1,717	132.6
6		3,408	248.4	1,941	185.7
7	4	3,606	467.3	2,335	371.4
8		10,303	1,863.3	6,891	1,404.1
9	5	9,123	1,617.7	5,624	1,192.8
10		16,365	3,321.2	10,586	2,379.3
11	6	11,098	2,315.8	7,131	1,668.4
12		8,160	1,873.5	5,597	1,371.6
13	7	9,326	2,435.7	6,082	1,742.6
14		8,892	2,588.2	5,969	1,854.0
15	8	6,483	1,511.8	2,944	826.7
16		10,872	2,710.2	6,479	1,812.8
17		7,462	2,262.2	5,024	1,553.8
18		9,438	2,979.3	6,186	2,014.1
19		14,709	4,801.0	10,182	3,416.1
20		9,989	3,304.3	6,980	2,345.6
21		16,706	5,293.8	9,796	3,346.2
22		2,155	735.8	1,505	531.0
23		3,162	949.5	1,409	482.0
24		2,461	809.9	1,387	482.7
25		742	244.4	478	171.9
26+	9	2,477	759.5	1,088	390.6
Total		**237,566**	**43,449**	**171,662**	**29,862**

Table 6.5 – Block 2 age class distribution

Age Class	MoFR Age Class	Productive Area (ha)	Productive Volume (1000s m^3)	THLB Area (ha)	THLB Volume (1000s m^3)
NSR	0	1,499	0.0	1,406	0.0
1	1	3,522	0.0	3,478	0.0
2		4,387	0.1	4,237	0.1
3	2	2,868	8.4	2,777	8.0
4		2,643	108.9	2,505	106.1
5	3	1,046	70.7	914	64.5
6		272	34.8	196	26.2
7	4	360	42.4	216	35.7
8		2,256	507.6	1,961	472.2
9	5	2,066	512.7	1,646	461.0
10		1,197	363.8	1,032	324.4
11	6	1,377	382.0	967	303.7
12		1,085	287.2	716	233.3
13	7	2,299	735.3	1,747	599.7
14		422	134.9	361	122.2
15	8	1,354	437.0	966	325.8
16		1,641	495.9	870	290.4
17		71	22.2	58	20.1
18		268	81.1	217	65.0
19		227	70.7	181	62.2
20		766	257.8	507	177.5
21		0	0.0	0	0.0
22		483	188.1	392	151.6
23		203	65.1	125	42.1
24		27	12.1	27	12.1
25		117	49.4	117	49.3
26+	9	193	77.3	94	27.5
Total		**32,649**	**4,945**	**27,713**	**3,981**

Table 6.6 – Total TFL 52 age class distribution

Age Class	MoFR Age Class	Productive Area (ha)	Productive Volume (1000s m^3)	THLB Area (ha)	THLB Volume (1000s m^3)
NSR	0	7,793	0.0	7,336	0.0
1	1	14,717	0.0	14,354	0.0
2		27,424	1.2	26,427	1.1
3	2	22,517	29.6	21,412	28.3
4		10,505	287.1	9,206	270.4
5	3	3,638	226.8	2,631	197.1
6		3,679	283.2	2,137	211.9
7	4	3,966	509.8	2,551	407.1
8		12,559	2,371.0	8,852	1,876.3
9	5	11,189	2,130.4	7,270	1,653.8
10		17,562	3,685.0	11,618	2,703.8
11	6	12,475	2,697.8	8,098	1,972.1
12		9,245	2,160.7	6,313	1,604.9
13	7	11,625	3,171.0	7,829	2,342.4
14		9,314	2,723.1	6,330	1,976.2
15	8	7,837	1,948.8	3,910	1,152.5
16		12,513	3,206.0	7,349	2,103.2
17		7,533	2,284.4	5,082	1,574.0
18		9,706	3,060.4	6,402	2,079.1
19		14,936	4,871.7	10,363	3,478.3
20		10,756	3,562.1	7,488	2,523.2
21		16,706	5,293.8	9,796	3,346.2
22		2,638	923.9	1,897	682.6
23		3,365	1,014.5	1,534	524.1
24		2,488	822.0	1,414	494.7
25		859	293.8	595	221.2
26+	9	2,669	836.7	1,182	418.1
Total		**270,215**	**48,395**	**199,375**	**33,843**

Figures 6.1, 6.2 and 6.3 summarize the area of each TFL block and the total land base by 10-year age class.

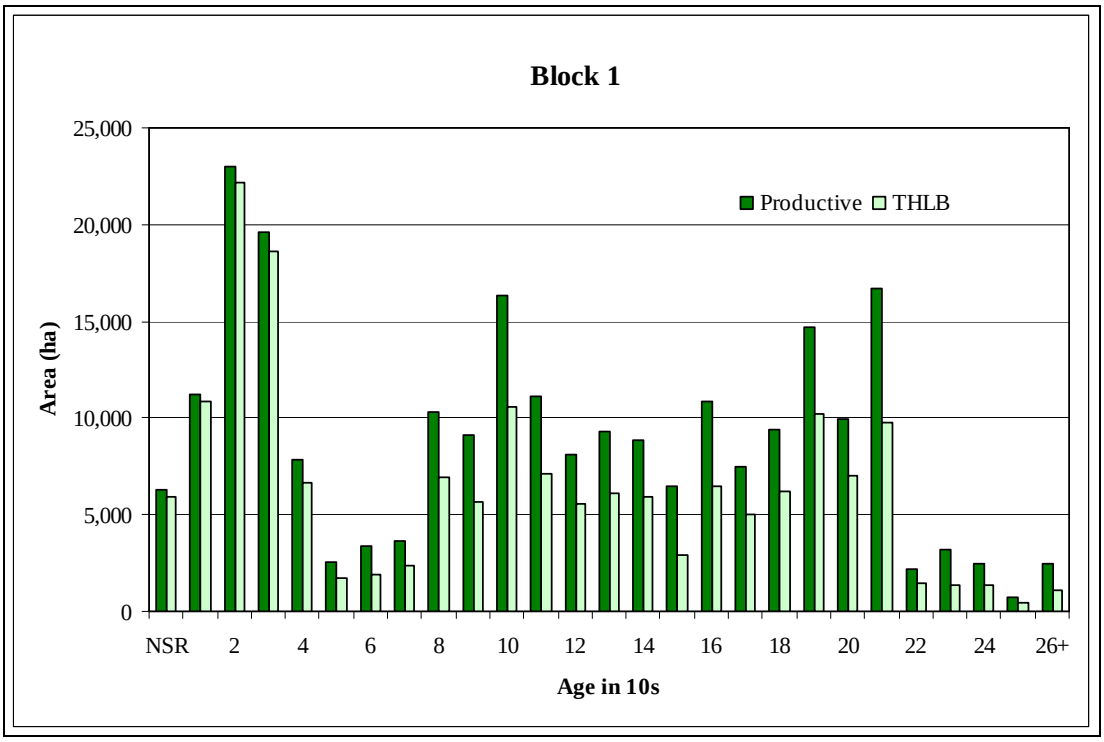

Figure 6.1 – Block 1 age class distribution

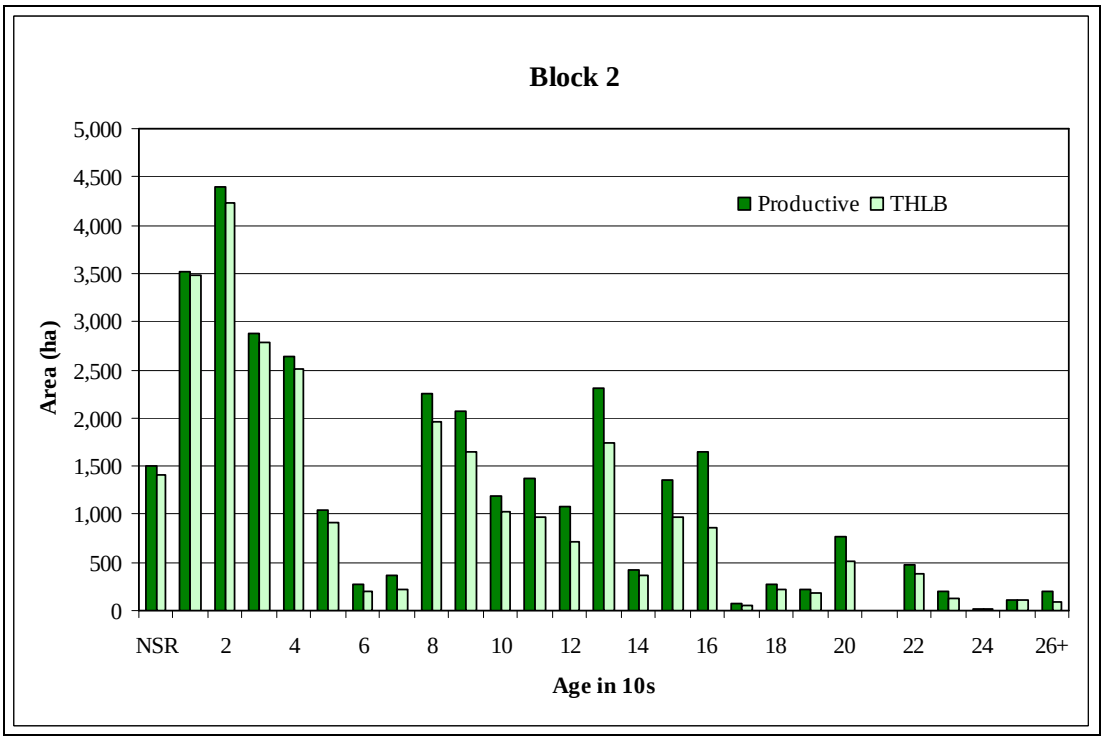

Figure 6.2 – Block 2 age class distribution

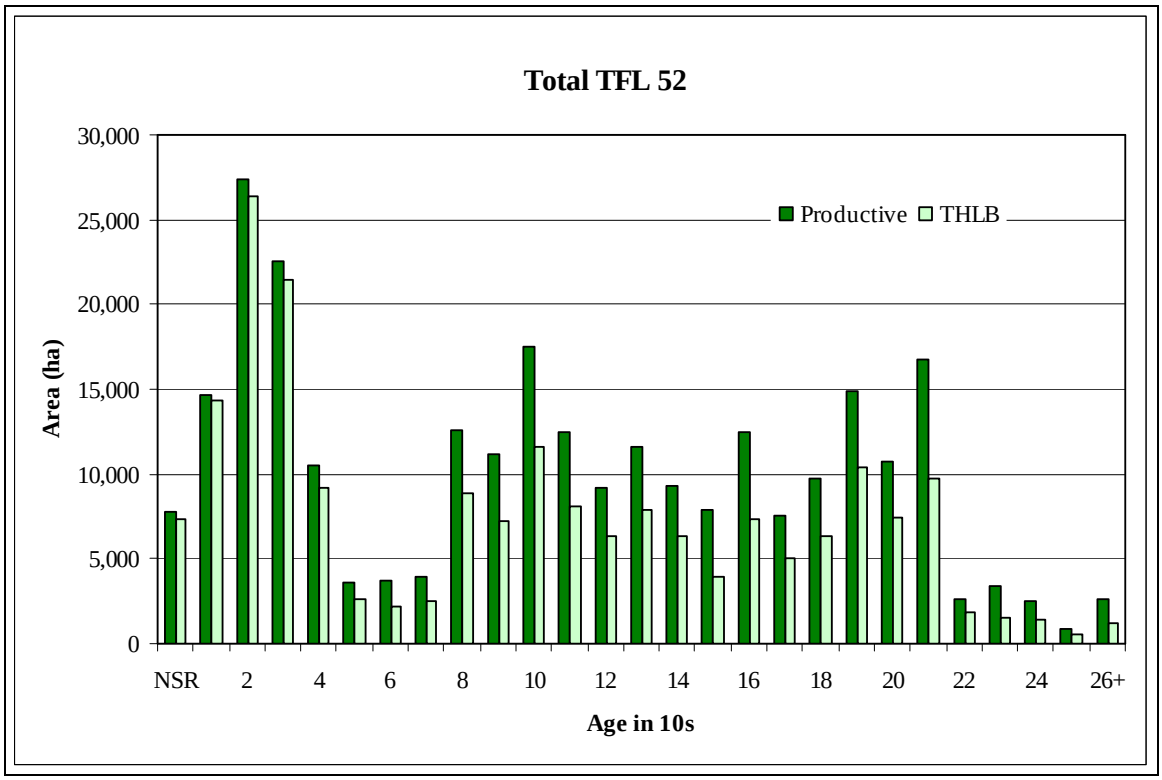

Figure 6.3 – Total TFL 52 age class distribution

Tables 6.7, 6.8 and 6.9 summarize the distribution of area by leading species for both the productive and timber harvesting land base.

Table 6.7 – Block 1 leading species distribution

Leading Species		Productive Area (ha)	Net THLB (ha)
Name	Code		
No species label	N/A	1,499	1,406
Cottonwood	Ac	250	0
Aspen	At	570	351
Balsam	Bl	476	410
Cedar	Cw	0	0
Birch	Ep	2,541	1,510
Douglas-fir	Fd	11,187	9,758
Western hemlock	Hw	0	0
Lodgepole pine	Pl	7,495	7,134
Black spruce	Sb	96	46
Interior spruce	Sx	8,535	7,098
Total		**32,649**	**27,713**

Table 6.8 – Block 2 leading species distribution

Leading Species		Productive Area (ha)	Net THLB (ha)
Name	Code		
No species label	N/A	6,295	5,930
Cottonwood	Ac	665	332
Aspen	At	5,982	3,266
Balsam	Bl	55,938	28,789
Cedar	Cw	88	86
Birch	Ep	678	254
Douglas-fir	Fd	2,256	1,774
Western hemlock	Hw	64	64
Lodgepole pine	Pl	54,450	44,843
Black spruce	Sb	939	175
Interior spruce	Sx	110,211	86,148
Total		**237,566**	**171,662**

Table 6.9 – Total TFL 52 leading species distribution

Leading Species		Productive Area (ha)	Net THLB (ha)
Name	Code		
No species label	N/A	7,793	7,336
Cottonwood	Ac	915	332
Aspen	At	6,552	3,617
Balsam	Bl	56,415	29,199
Cedar	Cw	88	86
Birch	Ep	3,219	1,764
Douglas-fir	Fd	13,443	11,532
Western hemlock	Hw	64	64
Lodgepole pine	Pl	61,945	51,977
Black spruce	Sb	1,035	221
Interior spruce	Sx	118,746	93,246
Total		**270,215**	**199,375**

6.2 Total Area

The total area of Block 1 is 258,866 hectares, and Block 2 is 34,619 hectares. This includes water, non-forest and non-productive land as well as all productive forest land. Non-TFL private land and Indian Reserves are excluded from this total area.

6.3 Non-forest and Non-productive Forest

All land classified as non-forest or non-productive forest, such as lakes, swamps, rock, alpine, *etc*., coded in the VRI as *bclcs_lvl_1 = "N"* or *"V"*, or *nprd = "3"* or *"12"*, is excluded from the THLB. This includes road rights-of-way wide enough to be identified as individual inventory polygons.

Based on the VRI, non-productive land accounts for 17,246 ha on Block 1 and 1,275 ha on Block 2 for a total of 18,521 ha for the combined land base.

6.4 Roads, Trails and Landings

Forest operations create roads, trails and landings that can reduce the productivity of growing sites, and reduce the area available for growing trees. Reductions to the THLB are made to account for the loss of existing and future productivity associated with these areas. The methodology by which roads, trails and landings constructed during future harvesting operations will be accounted for is described in Section 6.4.2.

6.4.1 Existing Roads

Block 1 road data is stored in *The Forest Manager* (TFM). Since MP 3 there have been some adjustments to road classification and associated road widths. Additional road development is still required on TFL 52 although mainline roads are in place.

Recent road construction on Block 2 has occurred to provide access to MPB attacked pine stands. These were mainline and operational roads, which make the TFL fully roaded except for some ongoing in-block roads. Road information was converted from its original format in the *GENUS* accounting system to the current status in TFM.

Table 6.10, 6.11 and 6.12 provide a summary of the length, width, and area removed for each category of road. Note that there are non-productive exclusions in the netdown process before existing roads are removed. Therefore the "Area Removed" is less than the "Total Area" of roads.

Table 6.10 – Block 1 existing unclassified road area summary

Description	Road Length (km)	Road Width (m)	Total Area (ha)	Area Removed (ha)
BC MoT highway	67.8	50.0	339	216
Main logging roads	482.5	20.0	965	614
FSR	399.3	20.0	400	255
Operational logging roads	1098.6	15.0	1,648	1,049
Block and winter roads	2,320.4	10.0	2,320	1,477
Secondary trails	1,160.3	6.0	696	443
Total	**5,528.9**		**6,368**	**4,054**

Table 6.11 – Block 2 existing unclassified road area summary

Description	Road Length (km)	Road Width (m)	Total Area (ha)	Area Removed (ha)
Main logging roads	71.1	12.8	91	87
Operational logging roads	271.2	10.6	287	273
Block	460.8	6.2	286	272
Secondary trail	14.6	6.2	9	9
Skid road	98.5	5.8	57	54
Total	**916.9**		**730**	**695**

The road width has not been included in Table 6.12 because widths are not consistent between the two blocks of the TFL.

Table 6.12 – Total TFL 52 existing unclassified road area summary

Description	Road Length (km)	Total Area (ha)	Area Removed (ha)
BC MoT highway	67.8	339	216
Main logging roads	553.6	1,056	701
FSR	399.3	400	255
Operational logging roads	1,369.8	1,935	1,322
Block and winter roads	2,781.2	2,606	1,749
Skid road	1,174.9	705	452
Secondary trails	98.5	57	54
Total	**6,445.1**	**7,098**	**4,749**

6.4.2 Future Roads

All future road development on Block 1 is expected to be for class B and C roads. A future road estimation process was completed for TFL 52 as part of MP 3, with additional review from proposed road information in TFM. This study indicated that a reduction of **3.46%** to all unlogged areas within the THLB will be required to account for future road development on the Block 1. This will result in an additional 3,760 ha of area removed.

Future road access on Block 2 will include a minor addition of block access and cutting permit roads. The main road network is in place for the TFL. Based on a review of future road access completed for MP 10 and the information from TFM for proposed roads, approximately 40 ha of future roads will be required in the future. This represents a reduction of **0.35%** to all unlogged areas of Block 2 which will be applied during the first harvest of those unlogged areas.

During analysis simulations land will be permanently removed from the THLB to reflect future road development.

6.5 Non-commercial Brush

Non-commercial brush is area identified in the VRI using the attribute *non_forst_dsc = "NCBR"*. These areas are productive land, but are not occupied by any commercial tree species. They are not included in the analysis for any forest cover requirement assessments.

Based on the current inventory 54 hectares and 167 hectares of NCBr were excluded from the THLB on Block 1 and Block 2, respectively.

6.6 Riparian Management Areas

Areas adjacent to rivers, streams and other wetlands are classified as *riparian*. These riparian areas are important as thermal cover for fish-bearing streams, habitat for wildlife, and for protection of streambeds from erosion.

New stream and lake classification was completed for Block 1 prior to MP 3. This included fish habitat classification. This classification process identified those streams that are important as fish habitat -- *S1*, *S2*, *S3*, and *S4* -- and other non-fish bearing streams -- *S5*, and *S6*. The critical fish habitat inventory has now been finalized. Wetlands, swamps and lakes were also included in the stream classification.

Similarly, stream classification for Block 2 was recently updated to include all FPC classification criteria, in addition to other criteria outlined in the Wildlife Plan.

Two buffers were assigned in the GIS database to identify areas adjacent to each stream and wetland:

- *Riparian reserve zone (RRZ)* - the area directly adjacent to the stream which is completely excluded from any harvesting activity, and
- *Riparian management zone (RMZ)* - additional area beyond the *RRZ*, which is partially removed based on FPC basal area retention guidelines.

Management guidelines recommend that a portion of the basal area within the RMZ be maintained. The level of retention ranges from 5% to 100% depending on the riparian category. This approach of reserving the land base equivalent of the basal area percentage has been used in other timber supply analyses to address RMZ requirements. For example, if the requirement is to retain 25% of the basal area, then 25% of the land within the RMZ will be placed in permanent reserve.

During operations there will be variable levels of retention within the RMZ. In some cases the RMZ may be located outside the cutblock. For the timber supply analysis the FPC recommended levels of basal area retention are assumed to reflect average conditions across the TFL.

Current accepted operations on TFL 52 place block boundaries outside S6 streams whenever possible. When S6 streams are encountered within cutblocks only the merchantable timber is removed. Based on these practices there are no reductions for S6 RMZs on TFL 52.

Reserve areas within the RMZ are adjacent to the RRZ, or the riparian feature if no RRZ is present. The remainder of the RMZ is then available for harvesting. Tables 6.13, 6.14, and 6.15 summarize the exclusions to address riparian management areas on the TFL.

Table 6.13 – Block 1 riparian exclusions

Riparian Class	Riparian Zone Width (m)	Percent Removal (%)	Total Area (ha)	Riparian Reductions	
				Area (ha)	Volume (1000s m^3)
RRZ					
Streams:					
S1 RRZ	50	100	2,079	1,166	319.7
S2 RRZ	30	100	2,882	1,606	427.4
S3 RRZ	20	100	4,615	3,199	722.1
Lakes:					
A RRZ	10	100	146	2	0.9
B RRZ	10	100	951	17	4.1
C RRZ	10	100	756	37	10.1
E RRZ	10	100	111	9	1.4
Wetlands:					
W1 RRZ	10	100	3,046	1,054	207.9
RRZ subtotal			**14,586**	**7,089**	**1693.4**
RMZ					
Streams:					
S1 RMZ	20	50	2,421	231	61.3
S2 RMZ	20	50	3,801	588	151.7
S3 RMZ	20	50	6,990	1,658	378.0
S4 RMZ	30	25	1,033	787	158.0
S5 RMZ	30	25	133	103	18.9
Lakes:					
A RMZ	200	100	396	99	41.6
B RMZ	150	90	1,425	263	59.8
C RMZ	100	80	1,423	373	99.8
E RMZ	25	50	132	13	2.2
Wetlands:					
W1 RMZ	40	25	3,946	710	164.7
W3 RMZ	30	25	6,526	1,158	221.6
RMZ subtotal			**28,226**	**5,983**	**1,357.6**
Total			**42,812**	**13,073**	**3,051.2**

Table 6.14 – Block 2 riparian exclusions

Riparian Class	Riparian Zone Width (m)	Percent Removal (%)	Total Area (ha)	Riparian Reductions	
				Area (ha)	Volume (1000s m^3)
RRZ					
Streams:					
S1 RRZ	50	100	726	140	30.0
S2 RRZ	30	100	65	62	14.0
S3 RRZ	20	100	87	70	16.6
Lakes:					
C RRZ	10	100	39	3	0.9
E RRZ	10	100	19	2	0.1
Wetlands:					
W1 RRZ	10	100	55	9	1.3
W5 RRZ	10	100	137	30	7.3
RRZ subtotal			**1,128**	**317**	**70.3**
RMZ					
Streams:					
S1 RMZ	20	50	156	14	2.2
S2 RMZ	20	50	87	21	5.1
S3 RMZ	20	50	131	37	9.3
S4 RMZ	30	25	12	8	1.9
S5 RMZ	30	25	28	27	4.2
Lakes:					
C RMZ	100	80	113	42	11.1
E RMZ	25	50	22	3	0.1
Wetlands:					
W1 RMZ	40	25	72	4	0.5
W3 RMZ	30	25	261	22	4.1
W5 RMZ	40	25	162	20	4.6
RMZ subtotal			**1,044**	**198**	**43.1**
Total			**2,172**	**514**	**113.3**

Table 6.15 – Total TFL 52 riparian exclusions

Riparian Class	Riparian Zone Width (m)	Percent Removal (%)	Total Area (ha)	Riparian Reductions	
				Area (ha)	Volume (1000s m^3)
RRZ					
Streams:					
S1 RRZ	50	100	2,805	1,306	349.7
S2 RRZ	30	100	2,947	1,668	441.4
S3 RRZ	20	100	4,702	3,269	738.7
Lakes:					
A RRZ	10	100	146	2	0.9
B RRZ	10	100	951	17	4.1
C RRZ	10	100	795	40	11.0
E RRZ	10	100	130	11	1.5
Wetlands:					
W1 RRZ	10	100	3,101	1,063	209.2
W5 RRZ	10	100	137	30	7.3
RRZ subtotal			**15,714**	**7,406**	**1,763.8**
RMZ					
Streams:					
S1 RMZ	20	50	2,577	245	63.5
S2 RMZ	20	50	3,888	609	156.8
S3 RMZ	20	50	7,121	1,695	387.3
S4 RMZ	30	25	1,045	795	159.9
S5 RMZ	30	25	161	130	23.1
Lakes:					
A RMZ	200	100	396	99	41.6
B RMZ	150	90	1,425	263	59.8
C RMZ	100	80	1,536	415	110.9
E RMZ	25	50	154	16	2.3
Wetlands:					
W1 RMZ	40	25	4,018	714	165.2
W3 RMZ	30	25	6,787	1,180	225.7
W5 RMZ	40	25	162	20	4.6
RMZ subtotal			**29,270**	**6,181**	**1,400.7**
Total			**44,984**	**13,587**	**3,164.5**

6.7 Critical Habitat

Caribou, mule deer and moose are the significant wildlife species found on TFL 52. Caribou habitat on Block 1 has a no-harvest area identified, as designated in the Regional Management Committee as part of the CCLUP. These caribou areas are not established wildlife habitat areas (WHA).

The Wildlife Plan produced for the old TFL 5 [*Fish, Forest and Wildlife Management Plan for TFL 5* (Keystone Wildlife Research, October 1995)] describes critical habitat requirements for mule deer and moose on that section of the licence. West Fraser's GIS database includes locations of these critical habitat areas, which provide the necessary forest attributes for these wildlife habitats.

Critical mule deer winter range (MDWR) is located primarily along the Fraser River in the drier, high crown closure Douglas-fir timber types of Block 2. This area represents the northern limit of mule deer habitat in the Cariboo, which corresponds to the northern limit of Douglas-fir stands. Winter range is considered limiting for mule deer in this area. Management objectives for maintaining MDWR recommend that *core habitat* areas be excluded from harvesting plans.

Only salvage of MPB or Douglas-fir beetle (*Dendroctonus pseudotsugae*) damaged timber is permitted in these Core MDWR areas. For the timber supply analysis Core MDWR will be included in the timber harvesting land base, after reductions for other categories - riparian, deciduous, etc.

However, Core MDWR will only contribute a maximum of 10 hectares of harvest annually. Over the past 49 years, salvage within the Core area has averaged approximately 10 hectares per year on the productive land base (485 ha), and only 6 hectares on the THLB (302 ha). This represents less than 0.5% of the Core MDWR area (gross productive) being disturbed each year. If salvage operations become unnecessary in future, Core MDWR areas may become land base exclusions for timber supply analysis.

Moose calving areas are found in deciduous and deciduous-coniferous timber types on the banks of the Fraser River and on small islands in the River. The fast-growing deciduous species provide ample cover and food for young animals. These areas are completely excluded from the THLB. Tables 6.16, 6.17, and 6.18 summarize the areas excluded for critical caribou and moose habitat on the TFL 52.

Table 6.16 – Block 1 critical habitat (caribou) exclusions

Leading Species	Gross Productive		Reductions for Caribou Habitat	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
NCBr/NSR	36	0.0	36	0.0
Deciduous	74	4.7	72	4.5
Balsam	15,173	2,617.7	14,983	2,580.7
Lodgepole pine	595	90.4	593	90.2
Interior spruce	4,060	1,065.7	3,941	1,033.7
Total	**19,938**	**3,778.5**	**19,625**	**3,709.0**

Table 6.17 – Block 2 critical habitat (moose) exclusions

Leading Species	Gross Productive		Reductions for Moose Habitat	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
Deciduous	201	13.5	195	13.5
Douglas-fir	29	8.3	29	8.2
Interior spruce	90	23.3	90	23.3
Total	**321**	**45.0**	**315**	**45.0**

Table 6.18 – Total TFL 52 critical habitat exclusions

Leading Species	Gross Productive		Reductions for Wildlife Habitat	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
NCBr/NSR	36	0.0	36	0.0
Deciduous	275	18.1	267	17.9
Balsam	15,173	2,617.7	14,983	2,580.7
Douglas-fir	29	8.3	29	8.2
Lodgepole pine	595	90.4	593	90.2
Interior spruce	4,150	1,089.0	4,031	1,057.0
Total	**20,259**	**3,823.5**	**19,940**	**3,754.0**

6.8 Unstable Terrain and Inoperable

An operability assessment has been completed for Block 1, updating the information used for the MP 3 analysis. Inoperable areas are defined as unsuitable for commercial harvesting due to poor access and/or unstable soils and slopes. The operability mapping exercise included an air photo review of all terrain class IV and V polygons identified in the TSM, combined with local knowledge of ground conditions, past road building and harvesting activities, and forest development plans. Table 6.19 summarizes the inoperable removals for Block 1 of TFL 52.

Table 6.19 – Block 1 inoperable exclusions

Leading Species	Gross Productive		Reductions for Inoperable	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
NCBr/NSR	23	0	23	0.0
Deciduous	166	8	140	6.3
Balsam	1,384	234	1,129	192.1
Douglas-fir	65	20	49	15.8
Lodgepole pine	1,084	259	933	221.8
Interior spruce	1,573	456	1,220	350.6
Total	**4,295**	**977**	**3,494**	**786.7**

A terrain stability mapping (TSM) exercise was completed for Block 2, when it was still under licence to Weldwood. Further review of the TSM class IV and V areas resulted in estimates of the area that should be excluded from harvesting. It was estimated that 90% of the class V areas would not be available for harvesting over the long-term. However, for the analysis all of the class V sites will be excluded from the THLB.

For the MP 10 analysis a 25% land base reduction was assigned to all class IV areas. A review of the land base indicates that other productive forest removals cover approximately 50% of the class IV sites on this area of the TFL. Therefore no additional exclusions are made for the current analysis.

Table 6.20 summarizes the land excluded to account for terrain class V on Block 2.

Table 6.20 – Block 2 terrain class V exclusions

Leading Species	Gross Productive		Reductions for Terrain Class V	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
NCBr/NSR	4	0	0	0.0
Deciduous	105	5	90	4.7
Balsam	8	2	8	2.1
Douglas-fir	241	64	209	63.4
Lodgepole pine	2	1	1	0.5
Interior spruce	61	9	31	7.9
Total	**422**	**81**	**339**	**78.6**

Table 6.21 summarizes the total removals for unstable terrain and inoperable for the combined land base.

Table 6.21 – Total TFL 52 terrain class V and inoperable exclusions

Leading Species	Gross Productive		Reductions for TC V & Inoperable	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
NCBr/NSR	27	0	23	0
Deciduous	271	13	230	11.0
Balsam	1,392	236	1,137	194.2
Douglas-fir	306	85	257	79.2
Lodgepole pine	1,086	259	934	222.3
Interior spruce	1,634	465	1,251	358.5
Total	**4,717**	**1,058**	**3,833**	**865.2**

6.9 Low Productivity Types

Sites may have low productivity either because of inherent site factors (nutrient availability, aspect, excessive moisture, etc), or because they are incompletely occupied by commercial tree species. Long development periods may enable stands classified as low productivity to achieve merchantable volumes. Sites that are currently occupied by unmerchantable stands may be productive with other species, or following silvicultural treatments.

All stands that have been harvested and returned to full stocking are not considered in the low site reductions. It is assumed that these sites were capable of producing merchantable timber in the past and should therefore produce merchantable timber in the future.

Young stands (< 30 years old) are assigned a site index (SI50) value in the new VRI. Older stands have been assigned SI50 with VDYPbatch, based on age and height attributes from the VRI. This SI50 estimate is used to evaluate the long-term timber growing potential of the site.

Natural stands with no logging history with a SI50 below 7.0 are excluded from the THLB. These sites will not produce 120m^3/ha of merchantable volume by age 150 years.

Table 6.22 summarizes the reductions for low productivity sites on Block 1. Low site reductions are not defined for Block 2 because other reductions account for poor growing areas.

Table 6.22 – Block 1 low productivity exclusions

Leading Species	Gross Productive		Reductions for Low Productivity	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
NCBr/NSR	1	0.0	1	0.0
Balsam	2,525	227.4	1,412	127.6
Lodgepole pine	46	2.2	21	2.2
Black spruce	215	5.5	85	2.7
Interior spruce	1,711	347.3	1,450	297.9
Total	**4,498**	**582.4**	**2,969**	**430.3**

6.10 Deciduous

WFM harvests a portion of the deciduous profile on Block 2 (aspen, birch, and very minor amounts of cottonwood) as part of their operations. The remainder of the deciduous inventory is considered non-merchantable under current salvage, market and milling conditions. Therefore this unmerchantable component is excluded from the THLB.

Only a minor component of deciduous is included in the harvest operations on Block 1. Deductions for leading deciduous stands on TFL 52 are:

- All naturally established cottonwood-deciduous stands (inventory type group 36) with no previous logging history that will not produce 120 m^3/ha of coniferous volume by age 150; and
- All deciduous-leading stands (inventory type groups 35 - 42) within the forest corridor, general and core MDWR management zones, regardless of logging history (TFL 5 only).

Cottonwood has limited merchantability on TFL 5 and is often found in riparian and moose habitat areas that are reserved from harvesting. Any cottonwood-leading stands remaining in the THLB have been labeled as managed stands. All other cottonwood within the THLB occurs as minor amounts (< 10% of stand composition) and is utilized in harvesting operations by WFM.

Aspen and birch-leading stands are only harvested incidentally. Harvesting is restricted in forest corridor, general and core MDWR management zones (almost completely in core MDWR) and it is unlikely that deciduous stands will be harvested in these important habitat areas. It is more effective to retain deciduous stands in wildlife zones because deciduous provides valuable habitat in these areas. Tables 6.23, 6.24 and 6.25 summarize the deciduous removals for the land base.

Note that volumes reported in these tables include both coniferous and deciduous volume content so the volume estimates will differ from those presented in Tables 6.1, 6.2 and 6.3.

Table 6.23 – Block 1 deciduous exclusions

Leading Species	Gross Productive		Reductions for Deciduous	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
Cottonwood	163	14.4	141	13.6
Aspen	1,800	243.2	1,773	242.9
Birch	362	34.6	361	34.6
Total	**2,325**	**292.2**	**2,274**	**291.1**

Table 6.24 – Block 2 deciduous exclusions

Leading Species	Gross Productive		Reductions for Deciduous	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
Cottonwood	246	51.3	67	15.0
Aspen	215	42.9	138	26.3
Birch	976	162.2	818	135.7
Total	**1,436**	**256.5**	**1,023**	**177.0**

Table 6.25 – Total TFL 52 deciduous exclusions

Leading Species	Gross Productive		Reductions for Deciduous	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
Cottonwood	409	65.7	208	28.6
Aspen	2,015	286.1	1,911	269.1
Birch	1,337	196.9	1,179	170.4
Total	**3,761**	**548.7**	**3,297**	**468.1**

6.11 Non-merchantable Forest Types

Deductions for low productivity sites and deciduous stands may not identify mature stands whose merchantability is marginal. Mature stands in which the trees are too small, of poor quality, or which contain a high proportion of decadent wood, are also non-merchantable. Significant portions of the non-merchantable stands on Block 1 are classified as balsam "intermediate utilization" (balsam IU). These areas were partially harvested during the 1960s and have low stocking levels and volume.

Similar to the deciduous reductions, non-merchantable removals are based on stands not achieving a minimum coniferous volume of 120m^3/ha by age 150. Any stands currently older than 150 years that do not have 120m^3/ha of coniferous volume are excluded as summarized in Table 6.26.

Table 6.26 – Block 1 non-merchantable exclusions

Leading Species	Gross Productive		Reductions for Non-merchantable	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
Balsam	6,236	271.5	3,280	131.6
Douglas-fir	31	0.9	31	0.9
Lodgepole pine	616	19.0	449	12.8
Interior spruce	2,205	45.4	1,532	26.5
Total	**9,088**	**336.8**	**5,291**	**171.8**

6.12 Preservation VQO

Sugarloaf Mountain is classified as being visually significant in the Block 1 landscape and recreation inventory. This area is excluded from any harvesting activity. Other visually sensitive areas will be modelled with forest cover constraints that will limit the amount of harvesting that may occur during a period of time. Table 6.27 summarizes the area and volume removed from the THLB to address this VQO preservation (VQO-P) area.

Table 6.27 – Block 1 preservation VQO exclusions

Leading Species	Gross Productive		Reductions for VQOs	
	Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
Cedar	1	0.4	1	0.4
Douglas-fir	31	11.0	31	11.0
Lodgepole pine	55	12.4	55	12.4
Total	**87**	**23.8**	**87**	**23.8**

6.13 Stand-level Biodiversity (Wildlife Tree Patches)

Reserves of mature timber (wildlife tree patches, WTPs) must be retained within or adjacent to cutblocks. These areas are intended to provide long-term habitat for various wildlife species on the TFL, and contribute to stand-level biodiversity objectives. If they are large enough some WTPs can also be classified as OGMAs.

A number of information sources were included in the assessment of WTP requirements for the analysis including:

- TFL 5 MP 10 Information Package;
- TFL 52 MP 3 Information Package;
- CCLUP Integration Report (April, 1998);
- Wildlife Tree Management at the Stand Level – Administrative Guiding Principles (January, 2006);
- CCLUP OGMA establishment process; and
- Draft Quesnel Sub-regional Management Plan WTP targets.

There is currently a 7% WTP requirement with some consideration for overlaps with OGMAs, riparian areas and other productive forest exclusions. Based on the CCLUP up to 50% of the WTP area may by available to maintain opportunities for timber harvesting.

Specific WTPs have been identified on Blocks 1 and 2 of TFL 52. They represent 0.7% and 2% of the productive forest, respectively. In addition, OGMAs account for 7.3% and 6% on Blocks 1 and 2, respectively. These amounts more than exceed the 7% targets.

Aggregate productive forest removals on Block 1 account for 28% of the productive forest area. Productive forest exclusions on Block 2 represent 15% of the productive land base

Tables 6.28, 6.29 and 6.30 summarize the areas removed to address WTPs on each Block of the TFL and the combined total.

Table 6.28 – Block 1 WTP exclusions

BEC Variant	Total Productive BEC Area (ha)	Gross Productive in WTP		Reductions for WTPs	
		Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
ESSFwc3	33,303	24	6.8	19	5.8
ESSFwcp3	398	0	0	0	0
ESSFwk1	68,336	303	83.3	204	58.7
ICHmk3	1,086	0	0	0	0
ICHwk4	442	0	0	0	0
SBSdw1	1,619	3	0.8	1	0.3
SBSmh	67		0	0	0
SBSmw	47,575	870	243.2	610	172.9
SBSwk1	84,740	998	298.3	691	209.2
Total	**237,566**	**2,199**	**632.4**	**1,526**	**446.7**

Table 6.29 – Block 2 WTP exclusions

BEC Variant	Total Productive BEC Area (ha)	Gross Productive in WTP		Reductions for WTPs	
		Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
SBSmh	6,511	86	24.1	57	17.4
SBSmh-mw	1,153	30	6.9	21	5.1
SBSmw	24,984	626	157.9	541	146.0
Total	**32,648**	**742**	**188.9**	**620**	**168.5**

Table 6.30 – Total TFL 52 WTP exclusions

BEC Variant	Total Productive BEC Area (ha)	Gross Productive in WTP		Reductions for WTPs	
		Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
ESSFwc3	33,303	24	6.8	19	5.8
ESSFwcp3	398	0	0.0	0	0.0
ESSFwk1	68,336	303	83.3	204	58.7
ICHmk3	1,086	0	0.0	0	0.0
ICHwk4	442	0	0.0	0	0.0
SBSdw1	1,619	3	0.8	1	0.3
SBSmh	6578	86	24.1	57	17.4
SBSmh-mw	1,153	30	6.9	21	5.1
SBSmw	72,559	1,496	401.1	1,151	318.9
SBSwk1	84,740	998	298.3	691	209.2
Total	**270,214**	**2,940**	**821.2**	**2,145**	**615.2**

6.14 Old Growth Management Areas

Old growth management areas have been designated on all of TFL 52 as part of the CCLUP. They are intended to be permanent reserves of unique ecosystems present on the landscape. This will help to maintain important components of natural ecological succession that might be compromised in intensively managed forest landscapes.

For the purposes of timber supply analysis OGMAs are permanently excluded from the THLB. As a result forest cover constraints typically used to model old forest objectives are no longer required. Mature plus old constraints may still be necessary in certain landscape units.

Tables 6.31, 6.32 and 6.33 summarize the land base reductions to account for OGMAs.

Table 6.31 – Block 1 OGMA exclusions

BEC Variant	Total Productive BEC Area (ha)	Gross Productive in OGMA		Reductions for OGMAs	
		Area (ha)	Volume (m3)	Area (ha)	Volume (1000s m^3)
ESSFwc3	33,303	2,109	437.8	1,459	330.3
ESSFwcp3	398	5	0.1	0	0.0
ESSFwk1	68,336	10,980	2,824.5	8,406	2,286.0
ICHmk3	1,086	0	0	0	0
ICHwk4	442	0	0	0	0
SBSdw1	1,619	338	51.6	141	30.9
SBSmh	67	67	9.3	31	6.6
SBSmw	47,575	5,772	1,604.6	4,162	1,238.2
SBSwk1	84,740	4,776	1,375.6	3,311	994.1
Total	**237,566**	**24,047**	**6,303.5**	**17,511**	**4,886.1**

Note that although ICH is present on Block 1, it represents less than 0.5% of the productive land base. Therefore this BEC variant has not been included in OGMAs for this portion of the TFL.

Table 6.32 – Block 2 OGMA exclusions

BEC Variant	Total Productive BEC Area (ha)	Gross Productive in OGMA		Reductions for OGMAs	
		Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
SBSmh	6,511	1,962	371.4	976	229.9
SBSmh-mw	1,153	104	25.0	82	19.9
SBSmw	24,984	1,284	355.3	898	251.5
Total	**32,648**	**3,350**	**751.7**	**1,956**	**501.3**

Table 6.33 – Total TFL 52 OGMA exclusions

BEC Variant	Total Productive BEC Area (ha)	Gross Productive in OGMA		Reductions for OGMAs	
		Area (ha)	Volume (1000s m^3)	Area (ha)	Volume (1000s m^3)
ESSFwc3	33,303	2,109	437.8	1,459	330.3
ESSFwcp3	398	5	0.1	0	0.0
ESSFwk1	68,336	10,980	2,824.5	8,406	2,286.0
ICHmk3	1,086	0	0.0	0	0.0
ICHwk4	442	0	0.0	0	0.0
SBSdw1	1,619	338	51.6	141	30.9
SBSmh	6578	2,029	380.8	1,007	236.5
SBSmh-mw	1,153	5,876	1,629.6	4,245	1,258.0
SBSmw	72,559	1,284	355.3	898	251.5
SBSwk1	84,740	4,776	1,375.6	3,311	994.1
Total	**270,214**	**27,397**	**7,055.2**	**19,467**	**5,387.4**

6.15 Conservation Legacy Areas

Conservation legacy areas (CLAs) are a new land base category as described in the *Quesnel Forest District Enhanced Retention Strategy for Large Scale Salvage of Mountain Pine Beetle Impacted Stands* (Quesnel Forest District Enhanced Retention Strategy Committee, 2006). This document outlines the need for additional retention of pine-leading stands during the implementation of large-scale salvage of MPB-attacked stands.

The *Strategy* suggests retaining 20% of the MPB-affected area to support stand level biodiversity requirements. Existing riparian areas, WTPs, unique habitat types, and high risk terrain stability areas may contribute to this 20% target, with WTPs contributing a maximum of 8%. OGMAs are not eligible to contribute to the 20% target.

It is important to note that the *Strategy* was developed for the Quesnel TSA, which is comprised of approximately 75% pine-leading timber types. Conversely, TFL 52 is only about 25% pine-leading. Other productive exclusions for riparian, unstable terrain, habitat, *etc*. will contribute to the maintenance of biodiversity with only minor enhancements at the stand level.

For the base case analysis no additional reductions to the productive land base will be made to account for CLAs. However, the analysis will include a forest cover requirement that requires a portion of the THLB in the Umiti and Victoria landscape units be retained to ensure that the 20% target for pine-leading productive stands is achieved.

Table 6.34 summarizes the areas in pine-leading stands by Block 1 landscape unit. Included in the summary is the area required to achieve 20% in CLAs. There are productive areas outside the THLB that meet the definition of CLAs, and these contribute to the CLA total. Note that during the analysis simulations forest cover constraints for CLAs will be applied to the THLB only.

Table 6.34 – Block 1 conservation legacy area requirements

Landscape Unit	Productive Area – All species (ha)	Productive Area – Pine Leading (ha)	THLB – Pine Leading (ha)	Productive Reductions (ha)	Productive Reductions (%)	Additional Retention Area to Achieve 20% CLA (ha)	Additional Retention Area to Achieve 20% CLA (%)
Antler	41,844	10,276	7,503	2074	20.2	-19	-0.3
Big Valley	18,242	2,961	2539	304	10.3	288	11.3
Bowron	7,452	1,074	982	81	7.5	134	13.6
Indianpoint	11,900	2,080	1962	88	4.2	328	16.7
Jack of Clubs	18,952	1,346	824	331	24.6	-62	-7.5
Lightning	14,808	4,241	3,874	186	4.4	662	17.1
Swift	25,232	2,727	2,420	221	8.1	324	13.4
Umiti	36,854	13,498	11,658	787	5.8	1,913	16.4
Victoria	43,666	20,233	16,903	1842	9.1	2,205	13.0
Willow	18,615	2,308	2,108	134	5.8	328	15.5
Total	237,565	60,744	50,773	6,049	10.0	6,100	12.0

Only Umiti and Victoria landscape units will have forest cover constraints applied during the analysis simulations. Other LUs have either sufficient productive area excluded from the THLB and/or they do not have significant pine-leading area within Block 1.

Section 10.3.2 summarizes the forest cover constraints that will be applied to address CLAs within the Umiti and Victoria landscape units.

7.0 INVENTORY AGGREGATION

In order to reduce the complexity of the forest description for the purpose of timber supply analysis, aggregation of individual forest stands is necessary. However, it is critical that this aggregation does not obscure significant differences in biological productivity or management objectives and prescriptions. It is important to note that aggregation of the land base will be consistent in all options and sensitivity analyses. This is to ensure that differences in results are a consequence of the modelled management regime, not the aggregation procedure.

The use of forest cover constraints allows management objectives for non-timber resources to be included in timber supply analysis simulations. For forest level modelling purposes, areas requiring the same management regime, that is having the same forest cover constraints, are assigned to a common land base aggregate. Within each land base aggregate, specific forest cover constraints are implemented. Aggregates defined for each block of the TFL are based on current forest management to address timber and non-timber resources.

Resource emphasis areas (REAs) are aggregates of area with similar non-timber resource concerns. These include visually sensitive areas, wildlife habitat, and general IRM areas. It is possible to assign a stand to more than one REA if overlapping resource objectives exist for that area. Maximum disturbance (based on green-up requirements), minimum mature plus old and old growth forest cover constraints will be assigned to each REA forest cover group to address specific resource needs.

Two levels of REAs will be assigned to the land base to allow modelling of forest cover constraints. These constraints will control the levels of disturbance and mature/old forest within an REA depending on the objectives specified for the non-timber resource. Maximum disturbance (based on green-up height requirements) and/or minimum mature and old growth forest cover objectives will be assigned to each REA forest cover group to address needs of the resource. Areas will be required to meet all overlapping forest cover constraints, or have the ability to meet constraints in the future, before harvesting is allowed to proceed.

With the designation of OGMAs, the forest cover constraints related to old forest will not be modelled. It is assumed that the OGMAs will accommodate the old forest objectives. Mature plus old constraints may be required in some landscape units.

To assign yield information, individual stands will be given a reference to both an existing (natural or managed stand) and regeneration (managed stand) yield table. Analysis unit definitions are based on species composition, site productivity, existing stand condition and future management regime. Existing and regeneration yield tables were developed for all stands. These base yield tables were then clustered using a statistical review based on species and site index, curve shape, culmination age and culmination volume. The result is a significant number of yield tables for the existing and future forest. Yield information used in the MP 10 and MP 3 analyses, developed by JS Thrower and Associates, will be used for the current uplift analysis.

7.1 Cariboo–Chilcotin Land Use Plan

The CCLUP requires that 30% of the Quesnel Highlands Special Resource Development Zone (QHSRDZ) be maintained in “backcountry recreation condition”. For the analysis, it is assumed that the forested and alpine areas that will be modelled as minimal or no access to harvesting will contribute to this “condition”. Table 7.1 summarizes the current state of the QHSRDZ with respect to backcountry recreation condition.

Table 7.1 – Block 1 QHSRDZ backcountry recreation status

Resource Emphasis Area	Area (ha and % of total QHSRDZ)					
	Total		Productive		THLB	
Caribou modified and no-harvest	26,533	31	23,461	27	4,314	5
VQO retention	4,109	5	3,595	4	876	1
OGMAs	4,557	5	4,375	5	0	0
Total backcountry	35,199	41	31,431	36	5,190	6
Non-backcountry	50,968	59	46,887	54	41,320	48
QHSRDZ total	**86,167**	100	**78,318**	91	**46,510**	54

The 30% backcountry target is exceeded within the productive component of the QHSRDZ areas that will have little or no harvesting over the long-term. In addition, there are non-productive areas (alpine meadow, treed swamp, *etc*.) that meet the definition of backcountry recreation. Given the current state of non-harvesting areas, it is likely that CCLUP backcountry recreation targets for the Block 2 portion of the QHSRDZ will be satisfied and additional forest cover constraints will not be required in the timber supply analysis. The most heavily used components of the backcountry area are "islands" near Wells and Barkerville with nearby access.

7.2 Resource Emphasis Areas

The resource emphasis areas defined for this analysis are listed in Tables 7.2 to 7.5. Maximum disturbance (based on green-up height or age requirements), minimum mature and old growth forest cover objectives will be assigned to each REA forest cover group according to the requirements of the particular resource. Where REA classifications overlap, areas must meet all overlapping forest cover objectives before harvesting will be permitted. Forest cover constraints that will be assigned to each REA in the analysis are listed in Table 10.1.

Table 7.2 – Block 1 VQO and IRM resource emphasis areas

Analysis ID	Resource Emphasis Area	Area (ha)		
		Total	Productive	THLB
All	VQO-R	4,667	4,129	1,155
All	VQO-PR	16,453	15,356	9,758
All	VQO-M	12,873	11,950	7,564
All	IRM	200,597	184,035	147,645

Table 7.3 – Block 1 wildlife resource emphasis areas

Analysis ID	Resource Emphasis Area	Area (ha)		
		Total	Productive	THLB
41	Antler Caribou-No	12,246	10,639	0
42	Big Valley-Caribou-No	885	706	0
43	Bowron Caribou-No	2,022	1,471	0
44	Jack of Clubs Caribou-No	2,961	2,772	0
45	Swift Caribou-No	4,666	4,346	0
	Caribou No-harvest subtotal	22,779	19,933	0
51	Antler Caribou-Mod	1,298	1,260	1,193
52	Big Valley Caribou-Mod	1,924	1,813	1,398
53	Jack of Clubs Caribou-Mod	1,883	1,838	1,600
54	Swift Caribou-Mod	2,428	2,295	1,912
55	Victoria Caribou-Mod	1,273	1,252	311
	Caribou Modified subtotal	8,805	8,457	6,415
61	Umiti MDWR	523	508	54

Table 7.4 – Block 2 VQO and IRM resource emphasis areas

Analysis ID	Resource Emphasis Area	Area (ha)		
		Total	Productive	THLB
All	VQO-PR	454	405	110
All	VQO-M	738	642	421
38	T5-IRM	25,917	24,634	22,653

Table 7.5 – Block 2 wildlife resource emphasis areas

Analysis ID	Resource Emphasis Area	Area (ha)		
		Total	Productive	THLB
1	NW Core-MD D-Habitat-Fd	469	450	203
2	NW Core-MD D-Habitat	317	279	75
3	NW Core-MD Other-Fd	38	33	1
4	NW Core-MD Other	118	109	3
11	NE/SE Core-MD D-Habitat-Fd	816	771	392
12	NE/SE Core-MD D-Habitat	311	282	51
13	NE/SE Core-MD Other-Fd	119	79	27
14	NE/SE Core-MD Other	72	68	26
	Core MD subtotal	2,261	2,070	777
5	NW MD-A D-Habitat	397	395	266

Analysis ID	Resource Emphasis Area	Area (ha)		
		Total	Productive	THLB
6	NW MD-A Other	844	800	758
15	NE/SE MD-A D-Habitat	772	764	631
16	NE/SE MD-A Other	1,609	1,482	1,335
	MD A subtotal	3,622	3,441	2,990
7	NW MD-B D-Habitat	382	333	173
8	NW MD-B Other	99	79	16
17	NE/SE MD-B D-Habitat	922	894	611
18	NE/SE MD-B Other	136	134	99
	MD B subtotal	1,539	1,440	898
9	NW Corridor	252	242	61
19	NE/SE Corridor	778	578	170
	Corridor subtotal	1,030	820	231

Overlaps between different REAs exist, therefore the total area for all REAs in Tables 7.2 to 7.5 will exceed the respective TFL areas. VQO areas will be modelled by the individual polygon identified in their respective inventories, 247 on Block 1, 17 on Block 2. All other areas are modelled as an aggregate of landscape unit and REA (wildlife, IRM) listed in the previous tables.

7.3 Ecosystem Types

OGMAs have been assigned to both blocks of the TFL and therefore mature plus old and old seral constraints will not be modelled in the analysis. Tables 7.6 and 7.7 summarize the areas of each BEC variant by landscape unit that could be used to monitor the state of old forest, or in sensitivity analysis.

Table 7.6 – Block 1 landscape unit – BEC variants

Analysis ID	Analysis LU-BEC/NDT	Area (ha)			
		Total	Productive	OGMA	THLB
11	Antler-ESSFwc3-1	13,620	12,005	133	1,884
12	Antler-ESSFwk1-1	16,208	15,332	1,762	11,711
13	Antler-SBSwk1-2	16,174	14,508	890	10,848
	Antler subtotal	46,002	41,845	2,785	24,444
14	Big Valley-ESSFwc3-1	3,281	2,979	355	1,842
15	Big Valley-ESSFwk1-1	9,745	9,405	1,293	7,660
16	Big Valley-SBSwk1-2	6,459	5,858	279	4,587
	Big Valley subtotal	19,485	18,242	1,928	14,089
17	Bowron-ESSFwc3-1	1,812	1,282	0	75
18	Bowron-ESSFwk1-1	2,481	2,323	0	1,929
19	Bowron-ICHmk3-2	1,173	1,086	0	1,002
20	Bowron-ICHwk4-1	465	442	0	388

Analysis ID	Analysis LU-BEC/NDT	Area (ha)			
		Total	Productive	OGMA	THLB
21	Bowron-SBSwk1-2	2,409	2,320	0	2,043
	Bowron subtotal	8,340	7,452	0	5,437
22	Indianpoint-ESSFwc3-1	169	169	0	24
23	Indianpoint-ESSFwk1-1	2,168	2,126	0	1,940
24	Indianpoint-SBSwk1-2	10,884	9,606	129	8,667
	Indianpoint subtotal	13,221	11,900	129	10,631
25	Jack of Clubs-ESSFwc3-1	7,011	6,677	52	3,593
26	Jack of Clubs-ESSFwk1-1	11,003	10,375	2,373	7,001
27	Jack of Clubs-SBSwk1-2	2,387	1,900	113	1,297
	Jack of Clubs subtotal	20,401	18,952	2,538	11,890
28	Lightning-ESSFwc3-1	316	303	148	148
29	Lightning-ESSFwk1-1	3,308	3,116	502	2,392
30	Lightning-SBSmw-3	2,397	2,070	219	1,599
31	Lightning-SBSwk1-2	10,112	9,320	391	7,620
	Lightning subtotal	16,132	14,808	1,259	11,758
32	Swift-ESSFwc3-1	7,528	7,143	22	2,896
33	Swift-ESSFwk1-1	11,741	11,196	1,652	8,749
34	Swift-SBSwk1-2	7,934	6,893	373	5,860
	Swift	27,203	25,232	2,047	17,505
35	Umiti-ESSFwc3-1	405	392	224	168
36	Umiti-ESSFwk1-1	3,064	2,976	520	2,379
37	Umiti-SBSdw1-3	1,855	1,619	338	924
38	Umiti-SBSmh-3	67	67	67	0
39	Umiti-SBSmw-3	28,284	26,005	2,778	20,003
40	Umiti-SBSwk1-2	6,124	5,794	542	4,980
	Umiti subtotal	39,799	36,854	4,469	28,455
41	Victoria-ESSFwc3-1	2,146	2,095	817	1,079
42	Victoria-ESSFwk1-1	6,300	6,126	1,802	4,151
43	Victoria-SBSmw-3	21,525	18,566	2,774	13,960
44	Victoria-SBSwk1-2	18,354	16,878	1,924	13,489
	Victoria subtotal	48,325	43,666	7,316	32,679
45	Willow-ESSFwc3-1	661	657	362	284
46	Willow-ESSFwk1-1	5,496	5,360	1,078	4,183
47	Willow-SBSmw-3	968	935	1	693
48	Willow-SBSwk1-2	12,833	11,663	134	9,613
	Willow subtotal	19,958	18,615	1,576	14,773
	Total	**258,866**	**237,566**	**24,047**	**171,662**

It is important to note that Bowron and Indianpoint LUs overlap with Bowron Provincial Park. Old growth targets in these two LUs are deemed to have been met, and therefore minimal OGMAs are required in these areas.

Table 7.7 – Block 2 landscape unit – BEC variants

Analysis ID	Analysis LU-BEC/NDT	Area (ha)			
		Total	Productive	OGMA	THLB
1	TFL5-SBSmh-NDT3	6,831	6,511	1,962	3,836
2	TFL5-SBSmhmw-NDT3	1,269	1,153	104	1,005
3	TFL5-SBSmw-NDT3	26,520	24,984	1,284	22,872
Total		**34,620**	**32,649**	**3,350**	**27,713**

7.4 Analysis Units

Stands are grouped into analysis units to reduce modelling complexity. In Management Plans 3 and 10 for Blocks 1 and 2 respectively, analysis units were developed on an ecologically-based system for grouping stands. This approach was selected because it integrates more closely with ecologically-based productivity estimates that have been developed for each area. In addition, many management and silviculture treatment decisions are determined based on the ecological classification of the site and/or stand being treated.

Although the licences were held by different companies at the time of the previous management plan analyses, the VRI and TEM were completed by Timberline for both areas. Similarly, the development of managed stand site index and yield tables for existing and future stands was carried out by JS Thrower and Associates. Therefore there is consistency across the TFL for the major inventory and growth and yield components of the analysis.

For the current analysis, yield tables have been aggregated into a more reasonable number. In the previous analyses, approximately 1300 analysis units were used. For the current analysis the yield tables have been aggregated based on stand and yield characteristics into a group of 238 for both blocks of the TFL.

Additional analysis units will be included in the timber supply analysis in order to model changes in stand volume resulting from MPB attack. For stands that have been attacked and no immediate harvesting (salvage) takes place, these stands will convert to an analysis unit and yield table which reflects loss of pine volume. In cases where the pine content in the original stand was high, these stands will convert to a regeneration (natural) stand type.

8.0 GROWTH AND YIELD

This section outlines the methodologies used to develop yield tables to be used in the analysis for both natural (VDYP) and managed stands (TIPSY) and which stands will be assigned to the various yield tables. Standing volume and site index assignment are also discussed in this section.

Yield tables are duplicates of those developed for the previous management plans for each block of the TFL. Modification will be included to address pine volume lost as a result of MPB attack.

As part of separate projects, JS Thrower and Associates developed the managed stand site index information and all yield tables for both TFL blocks prior to the previous management plans for each licence.

8.1 Site Index Assignments to Inventory Polygons

8.1.1 VRI Natural Site Index

The latest MoF site index curves embedded in VDYP Version 6.4a have been used to assign site index (SI50) to all existing unmanaged stands. Existing managed stands used information from the respective managed stand site index studies. These studies used the same set of MoFR site index curves as those found in VDYP for assigning SI50 to various species within productivity groups identified on Block 1. Table 8.1 lists the site index curve reference for species included in VDYP Version 6.4a.

Table 8.1 - Source of Site Index Equations

Species	Site Index Reference
Trembling aspen (At)	Goudie (1982)
Subalpine fir (Bl)	Kurucz (1982)
Paper birch (Ep)	Goudie (1982)
Interior Douglas-fir (Fdi)	Thrower & Goudie (1982)
Lodgepole pine (Pli)	Goudie (1984)
Interior spruce (Sx)	Goudie (1984), natural stands

8.1.2 Managed Stand Potential Site Index Estimates

A site index study for TFL 5 was completed prior to MP 10, which supplemented information gathered for MP 9. It provides important information for assessing site productivity for managed stands on TFL 5. BEC classification was used to aggregate stands into site series groups for each species: Douglas-fir; lodgepole pine; and interior spruce. Within these species-site series groups, site index was calculated with age and height measurements from a number of samples. As recommended in the site index study, mixed species stands use the leading species SI50 value.

A study of potential site index (PSI) was completed for TFL 52 prior to MP 3. Results of this study provided PSI for pine, spruce, Douglas-fir and balsam managed stands on TFL 52. Site index is assigned at the target species and BEC site series level. Site series classification is provided in the new TSM. PSI was used for developing yield tables for all existing and future managed stands on the TFL (all existing stands less than 26 years old and all future stands). PSI

includes appropriate adjustments for species conversions where appropriate. Species conversion occurs on sites where the leading species of the natural stand is replaced by another species in the managed regeneration (*eg*. balsam to spruce). PSI was not used to generate any forest cover polygon volumes.

8.2 Utilization Levels

The utilization levels modelled are listed in Table 8.2. They reflect current standards and performance.

Table 8.2 - Utilization levels

Leading Species	Minimum DBH (cm)	Stump height (cm)	Minimum top DIB (cm)
Block 1:			
Pine	12.5	30.0	10.0
All others	17.5	30.0	10.0
Block 2:			
Pine	12.5	20.0	10.0
All others	17.5	20.0	10.0

Note: DBH = diameter breast height, DIB = diameter inside bark

A study of operational stump heights on TFL 5 which included information from the previous five-years was completed prior to MP 10. The results indicated that average stump heights are approximately 16.0 cm. MoFR Research Branch and Resources Inventory Branch reviewed the stump height information and approved it for use in the MP 10 yield tables. Weldwood, the former licensee on TFL 5, committed to use a lower stump height operationally as part of MP 10. Yield tables have been adjusted (+2%) to account for lower stump heights.

8.3 Decay, Waste, and Breakage for Natural Unmanaged Stands

Decay is assigned to natural stand volumes automatically in VDYP, based on the PSYU location, which is interior. Waste and breakage (WB) factors associated with forest inventory zone (FIZ) H (Block 2) and I (Block 1) and the appropriate public sustained yield unit (PSYU) 305 (Block 2) and 477 (Block 1) were used to generate both natural stand yield tables and standing inventory volumes assigned to each forest cover polygon.

8.4 Operational Adjustment Factors for Managed Stands

Deductions for decay waste and breakage are inherent in VDYP forecasts based on specific factors for the assigned FIZ and special cruise. However when using BatchTIPSY (Version 2.1) operational adjustment factors (OAFs) are applied to TIPSY yields to reflect the difference between potential yields and operational conditions. The main sources of the difference are:

- Spatial arrangement of stems in the stand including regularity of spacing (clumpiness) and areas lacking trees (gaps);
- Non-commercial competition; and
- Loss of volume by pests, disease or waste and breakage.

TIPSY accounts for these adjustments using two adjustment factors. OAF1 is a magnitude adjustment across the entire age range of the curve to address bullets 1 and 2 listed above. The OAF2 reduction increases with advancing age and addresses bullet 3.

On Block 1, the following OAFs were included in the managed stand yield tables:

- OAF1 - 11%; and
- OAF2 - 5%.

On Block 1 localized values were determined for OAF1, assuming a base value of 7.5%. Additional amounts were included for non-productive areas described within the eco-polygons from TEM. Development of OAFs is documented in *Yield Table Summary Report, West Fraser Mills TFL 52 Quesnel* (JS Thrower & Associates, 2000). MoF Research Branch WFM accepted the MSYT OAF1 prior to the MP 3 analysis after reviewing the methods and rationale for OAF1 with WFM.

Conventional TIPSY OAFs were used in the development of the Block 2 managed stand yields:

- OAF1 – 15% to address unmapped stand openings; and
- OAF2 – 5% to address age-related losses.

8.5 Volume Reductions

Standing inventory volumes reported in this document are reduced for any deciduous component. Similarly, for the purposes of modelling, all yield tables are reduced by a percentage reflecting the deciduous component of the stand.

8.6 VDYP Natural Stand Yield Tables

VDYP (Version 6.4a) was used to develop natural stand yields at the analysis unit level. A yield table was first generated for each stand using the following attributes:

- Species composition;
- Crown closure (CC);
- VRI site index (base age 50) of the stand;
- Interior location (FIZ H/I) for decay; and
- FIZ H/I and PSYU 305/477 to account for waste and breakage.

These yield tables were then “clustered” (based on area weighting) to produce one yield function for each analysis unit, as described in the reports *Yield Table Summary Report, West Fraser Mills TFL 52 Quesnel* (JS Thrower & Associates, 2000) and *Yield Tables for Natural and Managed Stands: Management Plan 10 on TFL 5* (JS Thrower & Associates, 2002).

Due to the large number of analysis units, and associated yield tables produced for the management plan analyses, these yield tables were further aggregated for the Uplift Analysis. JS Thrower & Associates used the original source data for each TFL block to prepare new yield tables. The result is 50 natural stand yield tables for each block with a duplicated set for post-MPB attack stands (not harvested within the shelf life period), numbered as follows:

- 1 – 50 Block 2 existing natural stands;
- 101 – 150 Block 2 existing MPB pine natural stands (all “moist” for shelf life estimate);
- 151 – 200 Block 2 post-MPB attack natural stands (reduced volume);
- 201 – 250 and 360 Block 1 existing natural stands;

- 301 – 350 Block 1 existing MPB pine natural stands (“wet”);
- 401 – 450 Block 1 existing MPB pine natural stands (“moist”); and
- 501 – 550 Block 1 post-MPB attack natural stands (reduced volume).

Average stand characteristics and minimum harvest age attributes for the natural stand yields are provided in Appendices I and II for Blocks 1 and 2, respectively. It is important to note that the yield tables were developed for individual stands and subsequently aggregated; they were not developed using the average attributes provided in the Appendices.

8.6.1 Existing Timber Volume Check

Table 8.3 presents a comparison of the total initial timber volume calculated from the yield tables and the inventory volume for each forest cover polygon. Volumes are net of deciduous in both cases. This information will be provided in the timber supply analysis report, after the input data is complete.

Table 8.3 - Timber volume check

TFL Block	Polygon Volume	Yield Curve Volume	% Difference (polygon / yield curve)
Block 1 (TFL 52)			submitted in timber
Block 2 (TFL 5)			supply analysis report

8.7 Genetic Gains (Tree Improvement)

Seed planning units (SPUs) are the new organizational units that form the basis for breeding and seed production planning carried out by the Forest Genetics Council and the Tree Improvement Branch of the MoFR. SPUs are polygon features that geographically delineate the extent of biologically feasible seedling use for stock originating from specific seed orchards throughout the province. Each SPU identifies the area throughout which seedlings of a given species originating from orchards within a specific region of the province may be used in regeneration. Note also that each SPU lies within a prescribed elevation band.

Estimates of future genetic worth and seedling availability are provided at the SPU level. Consequently these features must be incorporated into the resultant database in order to georeference the genetic gain estimates for subsequent yield curve construction.

The individual SPUs overlap each other in various combinations such that each unique combination of SPUs identifies a specific supply of seedlings of a certain species originating from specific orchards, each with a particular genetic gain factor. Therefore it is these unique combinations of overlapping SPUs that act as the common denominator for targeting genetic gain factors in the timber supply analysis.

Since 1998 all spruce planting stock has been grown with Class A seed. Between 2005 and 2008 all planting stock should be derived from improved seed. Genetic (volume) gains from improved seed are based on information from the Vernon Seed Orchard Company.

The gains included in the yield tables for the managed stand yield tables are provided in Table 8.4.

Table 8.4 – Base case tree improvement gains

Species	Block 1 Gain (%)	Block 2 Gain (%)
Lodgepole pine	5	8
Douglas-fir	5	28
Interior spruce	8	18

A sensitivity analysis will be completed in which the tree improvement gains listed in Table 8.4 for Block 2 will be assigned to the managed stands in Block 1.

8.8 Silviculture Management Regimes

WFM has developed a set of silviculture regimes based on BEC site series. The individual regimes describe species composition, stand density, and potential treatments. A complete list of the silviculture regimes is outlined in the Yield Table Summary reports for each block of the TFL. All sites are planted, the majority to lodgepole pine, interior spruce and Douglas-fir, with minor components of balsam (Block 1 only).

8.9 Regeneration Delay

Regeneration delay is the time elapsed between harvesting and the establishment of a new stand of trees. The end of the regeneration delay is time zero for a yield table; it is the point in time when stand growth begins.

Regeneration on harvested areas is carried out within two years of harvest completion. Many areas are replanted within one year of harvest. A small percentage is replanted during the same year as harvest (*eg*. harvested in winter, planted in spring or summer of the same year).

Some MPB attacked stands will revert to new regeneration because the remaining stand will never reach a useable merchantable volume in the future. These sites may not be planted because of existing understory and/or limited resources to complete the work. A regeneration delay of 10 years will be assigned to these areas.

8.10 TIPSY Managed Stand Yield Tables

Existing and future managed stand yields were developed using MoF BatchTIPSY (Version 2.5r). TIPSY incorporates the following inputs to generate a yield table for each analysis unit:

- Species composition;
- Initial density - based on Block 1 and 2 silviculture survey results;
- Regeneration method (planting or natural);
- Treatments - all stands will be untreated (i.e. no thinning);
- Potential site index; and
- Regeneration delay, zero for all stands as this value is included in the timber supply model.

Specific inputs to TIPSY, other than species composition and site index are:

- Utilization levels;
- Genetic worth (weighted average of the seed planning units in each analysis unit);
- Genetic gains (see Section 8.7);
- Operational adjustment factors specific for each TFL;
- Initial stocking based on local silviculture regimes; and
- Regeneration type – all planted on the entire TFL.

As stated in Section 8.6, a large number of analysis units, and associated yield tables were produced for the management plan analyses, and these yield tables have been further aggregated for the Uplift Analysis. The result is 50 managed stand yield tables for each TFL block assigned to both existing and future managed stands, numbered as follows:

- 51 – 100 Block 2 managed stands; and
- 251 – 300 and 370 Block 1 managed stands.

Average stand characteristics and minimum harvest age attributes for the managed stand yields are provided in Appendices I and II for Blocks 1 and 2, respectively. It is important to note that the yield tables were developed for individual stands and subsequently aggregated; they were not developed using the average attributes provided in the Appendices.

8.11 Silviculture Systems

The majority of the harvesting in the analysis will use even-aged clearcut silviculture systems with varying levels of retention. On Block 1 the caribou "modified harvest" areas will use partial harvest methods as recommended by the CCLUP caribou strategy. These caribou areas are important for arboreal lichen production. All caribou modified harvest areas will be assigned to a single analysis unit (current AU 360, future AU 370). Table 8.5 summarizes the details of the caribou modified harvest.

Table 8.5 – Caribou modified harvest parameters

Partial Cutting Area	Planned Rotation	Years Between Entries	Stand Removal per Entry
Caribou arboreal lichen	240 years	80	33%

After harvest the regeneration age of the cut areas will be set to zero. This reflects the harvesting methods which include small openings that are planted after harvest.

8.12 Silviculture History

All stands less than 26 years of age on Block 1 or less than 56 years of age on Block 2 are assigned to managed stand yield curves based on a review of information in the history component of the forest inventory and the silviculture records for the TFL. Incremental treatments (brushing, spacing, fill-planting) have been completed on some areas. These treatments are reflected in the managed stand yield tables developed for the analysis.

WFM has initiated a fertilization program on young spruce and Douglas-fir stands, with approximately 2,945 ha treated on Block 1 and 1,199 ha treated on Block 2 over the past two years.

All harvested sites will regenerate to managed stand yields reflecting adherence to minimum stocking standards. Pine sites that are attacked by MPB and not harvested within the shelf life period will revert to a reduced natural stand yield table after expiration of the shelf life. These reduced natural stand yields will reflect loss of pine volume as described in Section 8.14.

8.12.1 Not Satisfactorily Restocked Areas

NSR regenerates to the appropriate managed stand analysis unit based on the regeneration delay prescribed for the regeneration type, typically 2 years or less for all current NSR.

The TEM and recent site index assignments provide a means for assigning managed stand site index to NSR lands accurately. The assignment to a MSYT is based on the same silviculture regimes that are used for all other stands on the TFL as outlined in the respective yield table summary reports for each TFL block. Tables 8.6 and 8.7 summarize the assignment of NSR lands to future MSYT analysis units for each block of TFL 52.

Table 8.6 – Block 1 NSR in THLB by analysis unit

Managed Stand Analysis Unit	Species-SI50		Net THLB (ha)
251	PlSx	16.5	192
252	PlSx	19.8	782
253	PlSxAt	21.6	570
254	PlSx	16.7	40
255	PlSx	19.9	335
256	PlSxAt	22.2	1,016
257	PlSxAt	22.1	171
258	SxPlBl	12.9	5
259	PlSx	19.5	148
260	PlSx	16.7	102
261	PlSxAt	21.5	142
262	PlSxAt	19.8	167
263	PlSxAt	22.3	53
264	PlSxAt	22.1	570
265	PlSx	19.2	19
266	PlSx	20.3	362
267	SxPlBl	13.3	1
268	SxPl	21.5	105
269	PlSxAt	19.8	41
270	PlSxAt	19.8	167
271	PlSx	16.8	23
272	PlSx	16.6	88
273	SxPl	18.9	4
275	PlSxAt	21.0	7
276	PlSx	20.0	84
277	SxPl	19.4	7
280	PlSx	16.2	46

Managed Stand Analysis Unit	Species-SI50		Net THLB (ha)
282	PlSx	19.8	35
283	PlSxAt	21.9	152
285	SxPl	21.7	5
286	PlSx	16.6	93
287	PlSxAt	22.4	46
288	Pl	16.5	34
289	PlSxAt	24.5	1
290	PlSx	18.5	2
292	SxPl	21.5	35
293	SxPl	16.7	16
295	PlSxAt	23.9	52
297	PlSxAt	19.9	4
298	SxPl	24.6	13
300	PlSxAt	17.7	136
370	SxBl	16.7	60
Total			**5,930**

Table 8.7 – Block 2 NSR in THLB by analysis unit

Managed Stand Analysis Unit	Species-SI50		Net THLB (ha)
51	Pl	21.5	179
52	Pl	21.2	48
53	Pl	21.3	360
54	Pl	21.3	87
55	Pl	21.2	163
56	Pl	21.9	2
57	Pl	21.4	59
58	Pl	21.3	5
59	Fd	20.9	1
60	Pl	21.4	63
61	Fd	20.7	1
62	Pl	21.9	14
63	Sx	22.9	37
64	Pl	21.8	27
67	Pl	21.2	194
68	Sx	22.4	5
69	Pl	21.8	24
70	Fd	20.7	2
74	Pl	21.9	14
79	Pl	21.2	1
80	Pl	21.2	8
82	Sx	22.2	8
85	Fd	21.7	7

Managed Stand Analysis Unit	Species-SI50		Net THLB (ha)
86	Pl	21.2	2
88	Sx	22.9	2
98	Sx	23.2	1
100	Sx	19.9	88
Total			**1,404**

8.13 Pine Shelf Life

The analysis will include a "shelf life" for pine stands attacked by MPB. This defines the time in years that pine trees will remain merchantable after attack. Shelf life estimates use moisture classification based on BEC variant. Using the moisture regimes listed in the report *Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: An Overview of the Model (BCMPBBv2) and Results of Year 2 of the Project* (CFS/MoFR, April 2005) each analysis unit was assigned to a moisture class of wet or moist. For timber supply modelling it is assumed that wet sites will have a five year shelf life and moist sites will have a 10 year shelf life. Based on current conditions, both TFLs are at full attack and the shelf life will begin at year 1 of the Base Case analysis simulation.

Table 8.8 summarizes the THLB area by moisture class for each block of the TFL based on the moisture regimes provided in the CFS/MoFR report. Only pine stands greater than 35 years of age (those assumed to be affected by MPB) are included in the table.

Recent analysis, consultation with staff at University of Northern British Columbia, and observations on the TFL are the basis for the shelf life estimates and the age for pine stands likely to be attacked by MPB.

Table 8.8 – THLB area by shelf life moisture class

Moisture Class	Block 1	Block 2	Combined
Wet	38,660	0	38,660
Moist	19,532	8,817	28,349
Total	58,192	8,817	67,009

There are no analysis units that are classified as dry based on BEC variant.

8.14 Yields for Attacked Pine

It is assumed that pine volume with remain merchantable for up to 10 years after attack. If salvage has not been completed the stands will lose a significant portion of the pre-attack pine volume. Based on field observations by WFM staff and a study completed by the JS Thrower and Associates division of Timberline (Appendix III) yields for post-attack stands will be reduced using the following formula:

$Volume_{post\text{-}attack}$	=	$Volume_{pre\text{-}attack}$ * (A * Sx volume% + B)

where:

$Volume_{post\text{-}attack}$	=	live post-attack merchantable volume
$Volume_{pre\text{-}attack}$	=	live pre-attack merchantable volume
Sx volume %	=	pre-attack Sx (non-pine) volume
A	=	parameters: 0.0062 high attack 0.0033 moderate attack
B	=	parameters: 0.3454 high attack 0.6418 moderate attack

Duplicate analysis units and companion yield tables will be included to model pine types attacked by MPB that are not salvaged during the first 10 years of the planning horizon. These yield tables will be reduced according to the formula noted above.

Other assumptions that will be included in the analysis related to volumes in pine stands after attack:

- All pine stands 36 years and older not harvested within the estimated shelf life will lose a component of the pine volume;
- Post-attack yield tables will follow the same growth pattern as the original curve with reductions for estimated pine losses; and
- Minimum harvest ages for the reduced yield tables will be based on achieving a minimum of 120 m^3/ha of post-attack volume.

9.0 PROTECTION

Damage to timber caused by fire, wind, insects, diseases and other pests contribute to loss in harvestable volumes. This volume loss is difficult to quantify, although losses to insects and disease that normally occupy stands (endemic losses) are accounted for in empirical yield table estimates. Depending on the type of damage and stand accessibility, losses due to catastrophic or epidemic events may be either salvageable or unsalvageable. These non-recoverable losses (NRLs) are not accounted for in the yield tables.

There have been minor losses related to fire and blowdown on both blocks of the TFL in the past. Currently the MPB epidemic losses will make these other losses insignificant. Typically unsalvaged loss estimates are included in the periodic harvest target and then discounted after a modelling simulation to provide the net available timber from a land base.

With the current analysis NRLs will simply be the difference between the annual harvest achieved and the total pine volume at risk to loss. Other losses will be included but are negligible. The objective will be to minimize loss of dead pine volume (the NRL) while addressing non-timber resources and mid-term harvest objectives.

Table 9.1 summarizes the NRLs for wind and wildfire and provides the total volume of pine volume at risk to loss on the TFL, stands greater than 35 years of age.

Table 9.1 - Estimated non-recoverable losses

Loss Agent	Estimated NRL (m^3/yr)		
	Block 1	**Block 2**	**Total TFL 52**
Insects[1]	7,218,310	975,850	8,194,160
Wind damage	1,200	570	1,770
Wildfire	550	150	700
Total	**7,220,060**	**976,570**	**8,196,630**

[1]: The estimate provided is the total of all affected pine on the land base, harvesting and salvage will reduce the final NRL from this maximum.

10.0 INTEGRATED RESOURCE MANAGEMENT

This section provides details on how the modelling methodology addresses non-timber resource requirements.

10.1 Forest Resource Inventories

A complete summary of the non-timber resource inventories along with approximate dates of completion and approvals are presented in Section 5.2.

10.2 Forest Cover Objectives – Rationale

The analysis will apply forest cover objectives to model wildlife habitat guidelines, hydrologic green-up, and visual quality objectives. Old forest requirements to address biodiversity objectives will not be modelled because OGMAs have now been identified on the TFL.

The use of forest cover objectives improves forest management modelling by ensuring that non-timber resources are given appropriate consideration. Cover constraints are applied at different levels of spatial resolution depending on the REA in question.

Forest cover objectives place maximum and/or minimum limits on the amount of young second growth and/or old growth found in land base aggregates (REAs). The land base aggregates defined for this analysis were previously discussed in Section 7.0. The following three types of forest cover constraints for modelling management objectives within each land base aggregate:

- Disturbance: the maximum area that can be younger than a specified age or shorter than a specified height. This is intended to model cutblock adjacency and green-up requirements.
- Mature retention: the minimum proportion of area that must be retained over a lower retention age. This is intended to model thermal cover for wildlife or plus old biodiversity requirements. Mature plus old and old growth retention forest cover objectives overlap and area that qualifies for both is counted in both.
- Old-growth retention: the minimum area that must be older than, or as old as, a specified age. This is intended to model both retention of cover and retention of old growth.

A summary of forest cover constraints that will be assigned to the REAs in the timber supply analysis is provided in Table 10.1.

Table 10.1 - Forest cover requirements – Base Case

Resource Emphasis Area	Maximum Disturbance	Minimum Mature	Minimum Old	Land Base Component[1]
Block 2 Core MDWR				
1 - NW Core-MD D-Habitat-Fd	2.0 ha/year	n/a	n/a	THLB
2 - NW Core-MD D-Habitat	1.2 ha/year	n/a	n/a	THLB
3 - NW Core-MD Other-Fd	0.5 ha/year	n/a	n/a	THLB
4 - NW Core-MD Other	0.3 ha/year	n/a	n/a	THLB
11 - NE/SE Core-MD D-Habitat-Fd	3.7 ha/year	n/a	n/a	THLB
12 - NE/SE Core-MD D-Habitat	1.2 ha/year	n/a	n/a	THLB
13 - NE/SE Core-MD Other-Fd	0.7 ha/year	n/a	n/a	THLB
14 - NE/SE Core-MD Other	0.4 ha/year	n/a	n/a	THLB
Block 2 A & B MDWR				
MD D-Habitat	33% < 40 years	33% > 60 years	11% > 120 years	PFLB
MD Other Habitat	33% < 40 years	n/a	n/a	PFLB
Block 2 Corridors	33% < 20 years	33% > 80 years	11% > 120 years	PFLB
Block 1 MDWR	15% < 3metres	50% > 140 years	25% > 250 years	THLB/PFLB
Block 1 Caribou modified	20% < 33 years	n/a	n/a	PFLB
VQO				
Retention (R)	5% < 3 metres	n/a	n/a	PFLB
Partial retention (PR)	15% < 3 metres	n/a	n/a	PFLB
Modification (M)	25% < 3 metres	n/a	n/a	PFLB
Integrated Resource Management	33% < 3 metres	n/a	n/a	THLB

[1]PFLB = productive forest land base

NTHLB = (productive) non-timber harvesting land base

THLB = timber harvesting land base

If no disturbance constraint is specified a default of 33% < 3 metres will be applied to the THLB. Descriptions of each forest cover requirement for the resource emphasis areas listed in Table 10.1 are described in the following sections.

10.2.1 Block 2 Core Mule Deer Winter Range

This area is significant for providing key wintering habitats for mule deer. It was designated as ungulate winter range when the Forest Practices Code was in effect. The area, which is located along the steep south facing slopes above the Fraser River, is dominated by Douglas-fir stands and is used for both thermal cover and forage by deer. High crown closure stands are most important for thermal habitat.

This area is reserved from harvesting except for salvage operations. Historically about 10 hectares per year have been removed from the core MDWR area to salvage beetle-damaged Douglas-fir. For the analysis, a constraint will be assigned to ensure that the harvest is limited to

10 hectares/year. Pine is not significant in this area of the Block 2, making up only about five percent of the volume. Therefore pine salvage from this area of Block 2 will not be an important issue in the analysis.

10.2.2 Block 2 General Mule Deer Winter Range (A & B)

The general MDWR zones are located above (A) and below (B) the core MDWR zone along the Fraser River. These areas provide similar habitat for deer, which includes shrub production and escape cover. A more normal age class distribution is intended for these areas compared with the core zone. Harvesting activities are permitted within these zones, with a maximum cutblock size of 10 ha within 500 metres of the core MDWR.

Constraints, provided in the *Fish, Forest and Wildlife Management Plan for TFL 5*, are designed to maintain forage production and dispersion of harvesting throughout the MDWR area. The entire productive forest within the MDWR area will be available to meet the retention requirements. Disturbance limits are based solely on the timber harvesting land base.

10.2.3 Block 2 Forest Corridors

Forest corridors are designed to provide continuous areas of forest that include a broad geographic distribution of ecosystems and species. Within the corridors are a variety of age classes, seral conditions, movement corridors and habitat types. Forest corridors are expected to address connectivity issues on Block 2. Additional disturbance limits and old forest constraints are intended to maintain this variety of age and seral conditions, as recommended in the *Fish, Forest and Wildlife Management Plan for TFL 5*.

10.2.4 Block 1 Mule Deer Winter Range

Constraints are designed to maintain forage production and dispersion of harvesting throughout the MDWR area. The entire productive forest within the MDWR area will be available to meet the retention requirements. Disturbance limits are based solely on the timber harvesting land base. These constraints are based on objectives used for the adjacent TSAs. Only 54 hectares of MDWR falls within the THLB on Block1, approximately 10% of the MDWR productive forest, so harvesting in this area is not likely to impact winter range.

10.2.5 Caribou Habitat

MoELP have defined three categories within the caribou zone:

- No harvest – completely excluded from the THLB, no harvesting permitted;
- Modified harvest – partial harvesting on an extended rotation (240 years); and
- Conventional harvest – harvesting rules similar to those in IRM areas.

The combination of these three harvesting types allows some access to timber while maintaining caribou habitat. In the eastern caribou areas, wildlife is the primary resource and all other activities must be conducted in ways that do not compromise caribou habitat. Details of the partial harvesting methods for the modified harvest are provided in Section 8.11.

The *Caribou-Chilcotin Land Use Plan Implementation Report* allows up to 10% of the "no-harvest" zone to be harvested for salvage reasons. None of this harvesting will be included in the timber supply analysis because the specific location and timber types are not known.

10.2.6 Visual Quality Objectives

Visual quality objectives are based on operational guidelines for maintaining viewscapes. A re-inventory of the recreation and landscape features and objectives for the TFL was recently completed. CCLUP guidelines and MoFR methods (Quesnel TSA TSR-II) for establishing VQO constraints have been considered in developing the constraints for Block 2. Operational standards focus on cutblock design, harvesting methods and public perception. VACs (visual absorption capability), LS (landscape sensitivity) and dispersion were considered in determining the final allowable disturbance percentages listed in Table 10.1 for VQOs on both blocks of the TFL.

Forest cover constraints for visual objectives will be assigned to individual VQO polygons. This will ensure that objectives are maintained for each specific area, and not simply across an entire landscape unit or management unit.

10.2.7 Integrated Resource Management

IRM areas include all of the residual THLB areas on the TFL that have no specific visual or wildlife concerns. Areas have been excluded from IRM REAs to address riparian, unstable terrain, *etc*. during the land base classification (netdown) process.

10.2.8 Adjacent Cutblock Green-up

Silvicultural green-up is required on all clearcut harvest areas prior to harvesting adjacent areas. A cutblock is considered "greened-up" if it is stocked with trees 3.0 metres tall, and has a minimum of 1,000 stems/ha.

10.3 Biodiversity

10.3.1 Landscape-level Biodiversity

Previous timber supply analyses for TFLs 5 and 52 included forest cover constraints to ensure old forest types were maintained at the landscape unit-BEC variant level. Since the completion of MP 3 and MP 10, OGMAs have been designated on both areas.

These areas are intended to be permanent reserves of unique ecosystems present on the landscape. This will help to maintain important components of natural ecological succession that might be compromised in intensively managed forest landscapes.

As a result forest cover constraints typically used to model old forest objectives are no longer required. However, mature plus old constraints will be assigned as needed in specific landscape units (high and intermediate biodiversity emphasis). Table 10.2 summarizes the mature plus old constraints that will be modelled in the base case. Note that all of Block 2 is entirely within the SBS BEC zone (NDT3) and is considered low emphasis. Therefore no mature plus old constraints are required for this portion of the TFL because the mature plus old and old constraints are the same.

Table 10.2 – Base case mature plus old constraints for Block 1

Analysis ID	Analysis LU-BEC/NDT	Area (ha)		Mature Plus Old (% > years)
		Productive	THLB	
11	Antler-ESSFwc3-1	12,005	1,884	36% > 120
12	Antler-ESSFwk1-1	15,332	11,711	36% > 120
13	Antler-SBSwk1-2	14,508	10,848	31% > 100
16	Big Valley-SBSwk1-2	5,858	4,587	15% > 100
19	Bowron-ICHmk3-2	1,086	1,002	15% > 100
20	Bowron-ICHwk4-1	442	388	17% > 100
21	Bowron-SBSwk1-2	2,320	2,043	15% > 100
24	Indianpoint-SBSwk1-2	9,606	8,667	15% > 100
27	Jack of Clubs-SBSwk1-2	1,900	1,297	15% > 100
31	Lightning-SBSwk1-2	9,320	7,620	15% > 100
34	Swift-SBSwk1-2	6,893	5,860	15% > 100
35	Umiti-ESSFwc3-1	392	168	36% > 120
36	Umiti-ESSFwk1-1	2,976	2,379	36% > 120
37	Umiti-SBSdw1-3	1,619	924	23% > 100
38	Umiti-SBSmh-3	67	0	23% > 100
39	Umiti-SBSmw-3	26,005	20,003	23% > 100
40	Umiti-SBSwk1-2	5,794	4,980	31% > 100
41	Victoria-ESSFwc3-1	2,095	1,079	54% > 120
42	Victoria-ESSFwk1-1	6,126	4,151	54% > 120
43	Victoria-SBSmw-3	18,566	13,960	34% > 100
44	Victoria-SBSwk1-2	16,878	13,489	46% > 100
48	Willow-SBSwk1-2	11,663	9,613	15% > 100

Modelling disturbance in the non-THLB productive (inoperable) forest is now a common practice in timber supply analysis. Now that OGMAs have been designated and therefore other non-THLB areas are not explicitly required to satisfy landscape level biodiversity objectives, disturbance in the non-THLB will not be modelled in this analysis.

10.3.2 Stand-level Biodiversity and Conservation Legacy Areas

After other land classification is complete additional reductions to the timber harvesting land base may be required to provide sufficient reserves of productive timber for wildlife at the site-specific level. These small reserves are also referred to as wildlife tree patches (WTPs).

Existing wildlife tree patches on Blocks 1 and 2 have been mapped, and are incorporated into the spatial resultant database for this analysis. These WTPs were removed from the THLB as part of the land base classification process described in Section 6.13.

As discussed in Section 6.15, conservation legacy areas are being identified in the Quesnel Forest District in the wake of the MPB outbreak. These areas are not likely to be permanent reserves; therefore a forest cover constraint will be used to simulate the retention of pine-leading stands.

Two landscape units on Block 1 will have CLAs modelled during the analysis: Umiti and Victoria, based on the size, current pine inventory, and the productive non-THLB area of these LUs. Table 10.3 summarizes the forest cover constraints that will be assigned to pine-leading LU-BEC variants in the Umiti and Victoria LUs to address future CLAs. Retention ages are based on the Biodiversity Guidebook "mature" age for each BEC-NDT.

Table 10.3 - Forest cover requirements – conservation legacy areas

LU-BEC/NDT	THLB (ha)	Minimum Retention Constraint
Umiti LU		
ESSFwc3-1	71	16.4% > 120 years
ESSFwk1-1	185	16.4% > 120 years
SBSdw1-3	411	16.4% > 100 years
SBSmw-3	9,443	16.4% > 100 years
SBSwk1-2	1,547	16.4% > 100 years
Victoria LU		
ESSFwc3-1	12	13.0% > 120 years
ESSFwk1-1	768	13.0% > 120 years
SBSmw-3	9,470	13.0% > 100 years
SBSwk1-2	6,654	13.0% > 100 years

10.4 Timber Harvesting

10.4.1 Minimum Harvest Age

Minimum harvest ages for all AUs were modelled as the age at which stand volume achieves at least 95% of its culmination mean annual increment (MAI). The 95% culmination age was determined as the youngest age at which the MAI was greater than 95% of the culmination MAI Culmination is defined as the point where volume less decay, waste and breakage is maximized to one decimal place. This is a reasonable approach to avoid excessively high culmination ages resulting from small increases in MAI, but still ensures that the productive capacity of the land base is being utilized.

A list of minimum harvest age attributes for the yield tables are provided in Appendix I (Block 1) and Appendix II (Block 2).

It should be recognized that the application of cover constraints in particular zones may delay stand entry well beyond the minimum ages listed in Appendices I and II. This will result in realized long-term harvest levels that are lower than the theoretical long run sustained yield (LRSY), which is based on harvesting all stands at culmination age.

10.4.2 Silviculture Systems

The purpose of this section is to document the silviculture management regimes that are applied on each TFL and how these regimes are reflected in the analysis.

The use of different silvicultural systems is evolving and includes clearcutting with prescriptions that include small blocks and green tree retention. Generally, lodgepole pine, Engelmann spruce, subalpine fir will be managed as even aged stands and are thus harvested by the clearcut system and reforested. Modified harvest caribou areas are managed with partial cutting as noted in Section 8.10. Minor salvage operations, typically openings of one hectare, are permitted in the Core MDWR areas of Block 2.

10.4.3 Initial Harvest Rate

The most recent AAC for TFL 5 was 300,000 m^3/year. Prior to the most recent uplift the AAC was 122,800 m^3/year. The current AAC for the original TFL 52 is 570,000 m^3/year. A portion of the TFL 52 AAC, 70,000 m^3/year, is allocated to the British Columbia Timber Sales Program.

The initial harvest rate for the Base Case analysis will be the combined pre-uplift AAC plus NRLS for disease and blowdown, 695,270 m^3/year. As noted in Section 9 the difference between the pine volume attacked by MPB and the actual harvest of attacked or dead pine will be the NRL for insects. WFM expects that 500,000 – 600,000 m^3 will be harvested from Block 2 over the next two years.

A number of initial harvest rates will be tested in the analysis to evaluate the impact on salvage of dead pine volume and how the initial harvest rate impacts the mid-term harvest level for the land base.

10.4.4 Harvest Rules

Harvest rules are used by the model to rank stands for harvest. Past analyses have used "oldest first". However, the objective of this analysis will be to maximize the recovery of pine volume in the first 10 years of simulation. To accommodate this objective, analysis units will be grouped based on the average pine content of the stands. This will allow those stands with the highest pine volume to be salvaged first, thereby maximizing recovery.

Pine composition groupings are:

- >= 50%;
- 30 – 50%; and
- <30%;

In addition all stands must have a minimum of 120 m^3/ha to be eligible for harvest. The model will not always be able to harvest all pine volume because of other influences such as forest cover constraints and non-pine volume limits. There will likely be some pine stands left unsalvaged and these will lose the pine volume if not harvested within the first 10 years of simulation, as described in Section 8.14.

During the period 2005 – 2006 (break-up to break-up) the harvest profile was:

- 86.1% beetle wood;
- 11.2% non-damaged stands (mainly for the plywood plant); and
- 2.7% blowdown.

WFM anticipates that many spruce stands will be left intact, but some areas will be harvested to address blowdown and spruce beetle concerns. It is estimated that 100,000 m^3/year of mature spruce will be harvested during the next five years to manage spruce beetle concerns on Block 1.

This will be used as comparison to the profile harvested during the initial 10 years of simulation.

10.4.5 Harvest Flow Objectives

In all phases of the analysis, the harvest flow will reflect a balance of the following objectives:

- Maintain or increase the current harvest level to maximize salvage for the first 10 years of simulation;
- Limit changes in harvest level to less than 10% of the level prior to the reduction;
- Minimize impacts on mid-term harvest levels; and
- Achieve stability in the long-term harvest level and growing stock profiles.

In addition, the analysis will evaluate the recovery times for mixed species stands after attack. Two recovery periods are of interest, 20 and 40 years. This evaluation will assist WFM in identifying which stands should be harvested in the short-term, and which stands should be left unsalvaged to maintain the best supply of timber in the short and mid-term when the impact of the MPB attack will be most severe.

Forest cover constraints and biological capacity of the THLB will dictate the long-term harvest level determined in the analysis.

10.4.6 Pine Volume

The following tables summarize the volume of pine and conifer volume by age class and pine percentage on each block of the TFL. In addition the tables highlight the priorities for harvest based on age and pine content, similar to that outlined in Section 10.4.4. In Tables 10.4 – 10.6 "pine volume" includes all measurable pine volume regardless of whether pine is the dominant species in the stand or not. Tables 10.7 – 10.9 include all measurable conifer volume.

Table 10.4 – Block 1 pine volume by age class and pine content

Pl Percent in Stand	Pine Volume by Age Class (1000s m^3)									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
< 10	0	0	7	25	35	26	22	139	1	256
11 - 20	0	2	2	26	41	30	30	159	4	294
21 - 30	0	1	8	47	83	62	64	289	0	554
31 - 40	0	10	4	61	62	67	67	206	1	479
41 - 50	0	16	4	59	68	84	114	197	0	541
51 - 60	0	14	3	60	147	86	133	265	0	708
61 - 70	0	11	2	56	128	110	198	256	0	762
71 - 80	0	12	3	149	223	185	140	231	3	946
81 - 90	0	25	4	73	219	250	345	120	0	1,036
91 - 100	0	15	4	69	400	364	776	71	0	1,699
Total	**0**	**106**	**42**	**625**	**1,407**	**1,264**	**1,890**	**1,932**	**9**	**7,275**

Priority 1		1,117	995	1,592	943	3	4,650
Priority 2		130	151	181	403	1	866
Priority 3	625	159	118	116	587	5	1,610
70% lost Pl volume	438	111	83	81	411	4	1,127

The "70% lost Pl volume" (blue-shaded area) is an estimate of pine volume that will not be harvested during salvage operations due to priorities and operational realities. This estimate is based on either low pine content in the stand and or young age of the stand. It is anticipated that these stands will not be harvested prior to expiration of the dead pine shelf life.

Table 10.5 – Block 2 pine volume by age class and pine content

Pl Percent in Stand	Pine Volume by Age Class (1000s m^3)									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
< 10	0	2	2	11	11	5	9	23	0	63
11 - 20	0	0	1	15	26	14	13	11	0	79
21 - 30	0	0	1	11	21	13	15	5	0	65
31 - 40	0	0	1	15	8	3	8	9	0	44
41 - 50	0	0	0	9	29	12	8	9	0	67
51 - 60	0	0	0	4	13	29	33	3	0	83
61 - 70	0	1	0	12	35	11	9	0	0	68
71 - 80	0	1	0	16	40	26	28	11	0	122
81 - 90	0	2	0	26	23	16	45	7	0	120
91 - 100	0	0	0	18	57	108	79	13	0	275
Total	**0**	**7**	**5**	**136**	**263**	**238**	**247**	**91**	**0**	**986**

Priority 1		168	190	194	34	0	586
Priority 2		37	15	16	18	0	86
Priority 3	137	58	32	37	39	0	303
70% lost Pl volume	96	41	22	26	27	0	212

Table 10.6 – Total TFL 52 pine volume by age class and pine content

Pl Percent in Stand	Pine Volume by Age Class (1000s m^3)									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
< 10	0	2	9	36	46	31	31	162	1	319
11 - 20	0	2	3	41	67	44	43	170	4	373
21 - 30	0	1	9	58	104	75	79	294	0	619
31 - 40	0	10	5	76	70	70	75	215	1	523
41 - 50	0	16	4	68	97	96	122	206	0	608
51 - 60	0	14	3	64	160	115	166	268	0	791
61 - 70	0	12	2	68	163	121	207	256	0	830
71 - 80	0	13	3	165	263	211	168	242	3	1,068
81 - 90	0	27	4	99	242	266	390	127	0	1,156
91 - 100	0	15	4	87	457	472	855	84	0	1,974
Total	**0**	**113**	**47**	**761**	**1,670**	**1,502**	**2,137**	**2,023**	**9**	**8,261**

Priority 1		1,285	1,185	1,786	977	3	5,236
Priority 2		167	166	197	421	1	952
Priority 3	762	217	150	153	626	5	1,913
70% lost Pl volume	533	152	105	107	438	4	1,339

Table 10.7 – Block 1 conifer volume by age class and pine content

Pl Percent in Stand	Pine Volume by Age Class (1000s m^3)									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
< 10	0	13	137	330	606	398	325	2,269	36	4,114
11 - 20	0	11	14	126	233	158	162	910	21	1,634
21 - 30	0	4	27	164	293	198	220	1,039	0	1,945
31 - 40	0	17	12	149	157	159	156	542	2	1,194
41 - 50	0	29	8	114	126	153	219	400	0	1,049
51 - 60	0	25	5	92	244	136	214	451	1	1,167
61 - 70	0	14	3	79	185	157	273	378	0	1,090
71 - 80	0	14	4	180	280	232	172	290	3	1,176
81 - 90	0	26	4	84	249	280	379	136	0	1,158
91 - 100	0	15	4	72	413	373	789	73	0	1,740
Total	**1**	**170**	**218**	**1,389**	**2,785**	**2,244**	**2,908**	**6,490**	**62**	**16,267**

Priority 1		1,371	1,178	1,827	1,328	4	5,708
Priority 2		283	312	375	942	2	1914
Priority 3	1,390	1,132	754	707	4,218	57	8,258

Table 10.8 – Block 2 conifer volume by age class and pine content

Pl Percent in Stand	Pine Volume by Age Class (1000s m^3)									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
< 10	0	30	26	151	149	75	122	405	0	958
11 - 20	0	2	5	100	152	76	77	57	0	469
21 - 30	0	1	1	42	75	50	49	16	0	236
31 - 40	0	1	3	44	21	7	22	24	0	122
41 - 50	0	0	0	24	62	25	16	15	0	142
51 - 60	0	1	1	7	21	47	55	6	0	136
61 - 70	0	1	0	20	48	17	14	0	0	100
71 - 80	0	1	0	21	49	35	37	15	0	158
81 - 90	0	2	0	27	25	20	48	8	0	128
91 - 100	0	0	0	20	61	115	83	13	0	292
Total	**0**	**38**	**36**	**455**	**662**	**467**	**524**	**559**	**0**	**2,741**

Priority 1		204	234	237	42	0	717
Priority 2		83	32	38	39	0	192
Priority 3	456	376	201	248	478	0	1,759

Table 10.9 – Total TFL 52 conifer volume by age class and pine content

Pl Percent in Stand	Pine Volume by Age Class (1000s m^3)									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
< 10	0	43	163	481	755	473	447	2,674	36	5,072
11 - 20	0	13	19	226	385	234	239	967	21	2,103
21 - 30	0	5	28	206	368	248	269	1,055	0	2,181
31 - 40	0	18	15	193	178	166	178	566	2	1,316
41 - 50	0	29	8	138	188	178	235	415	0	1,191
51 - 60	0	26	6	99	265	183	269	457	1	1,303
61 - 70	0	15	3	99	233	174	287	378	0	1,190
71 - 80	0	15	4	201	329	267	209	305	3	1,334
81 - 90	0	28	4	111	274	300	427	144	0	1,286
91 - 100	0	15	4	92	474	488	872	86	0	2,032
Total	**1**	**208**	**254**	**1,844**	**3,447**	**2,711**	**3,432**	**7,049**	**62**	**19,008**

Priority 1		1,575	1,412	2,064	1,370	4	6,425
Priority 2		366	344	413	981	2	2106
Priority 3	1,846	1,508	955	955	4,696	57	10,017

11.0 SENSITIVITY ANALYSES

This section briefly describes the sensitivity analyses that will be performed on the Base Case. The sensitivities reflect the stability of the Base Case in the face of uncertainty surrounding specific analysis assumptions. They also reflect the impact of alternative management or potential changes in forest practices. Additional sensitivity analyses may be carried out based on the results of the analysis simulations, and will be documented in the timber supply analysis report.

11.1 Land base Definition

Timber Harvesting Land Base ± 5%

Area will be shifted between the noncontributing and net land base components to simulate changes in the operable land base definition.

11.2 Growth and Yield Assumptions

Shelf Life Estimates Adjustments

Increase and reduce the time that pine stands remain merchantable after attack.

Mortality in Pine Stands ± 10% ± 25% ± 50%

Increase and decrease the Base Case level of pine mortality in attacked stands.

Regeneration Delay ± 5 Years in Non-Salvaged Pine Stands

Regeneration delay in stands not salvaged will be adjusted by five years.

Stand Rehabilitation in Non-Salvaged Pine Stands

Rehabilitate dead pine sites within prescribed delay (2 years).

Increase Genetic Gains for TFL 52 MSYTs

Increase the yield gains for TFL 52 managed stands using the gains documented for TFL 5.

11.3 Resource Emphasis Assumptions

Order of Harvest Priorities – Pine and Non-Pine

Shift harvest priority into non-pine stands, thereby reducing salvage.

Remove Disturbance Limits to Increase Salvage Opportunities

Disturbance constraints relaxed to allow increased salvage of attacked pine.

11.4 Biodiversity Assumptions

Maintain Mature Plus Old and Old Seral Requirements by LU-BEC/NDT

Include mature plus old and old forest cover requirements to address seral objectives.

12.0 REFERENCES

B.C. Ministry of Forests. 1994. *Cariboo-Chilcotin Land Use Plan.*

B.C. Ministry of Forests. 1999. Cariboo-Chilcotin Land Use Plan – Integration Report.

B.C. Ministry of Forests and Range, Quesnel Forest District. 2006. Quesnel Forest District Enhanced Retention Strategy for Large Scale Salvage of Mountain Pine Beetle Impacted Stands.

J.S. Thrower & Associates Ltd. 2000. *Updating Potential Site Index Estimates for Commercial Tree Species on TFL 5*. Contract report for Weldwood of Canada Ltd. March 31, 2000. 10 pp.

J.S. Thrower & Associates Ltd. 2000. *Potential Site Index Estimates for Major Commercial Tree Species on TFL 52*. Contract report for West Fraser Mills Ltd. March 15, 2000. 20 pp.

J.S. Thrower & Associates Ltd. 2000. *Yield Table Summary Report, West Fraser Mills TFL 52 Quesnel*. Contract report for West Fraser Mills Ltd. May 4, 2000. 35 pp.

J.S. Thrower & Associates Ltd. 2002. *Yield Tables for Natural and Managed Stands: Management Plan 10 on TFL 5*. Contract report for Weldwood of Canada Ltd. February 6, 2002. 32 pp.

J.S. Thrower & Associates Ltd. 2006. *Development of Volume Recovery Model for MPB-Attacked Stands on TFL 52*. Contract report for West Fraser Mills Ltd. May 2, 2006. 7 pp.

Timberline Forest Inventory Consultants Ltd. 2000. *Bowron-Cottonwood Tree Farm Licence (TFL 52) Management Plan 3 Timber Supply Analysis Information Package*. Contract report for West Fraser Mills Ltd. December 20, 2000. 53 pp.

Timberline Forest Inventory Consultants Ltd. 2001. *Bowron-Cottonwood Tree Farm Licence (TFL 52) Management Plan 3 Timber Supply Analysis.* Contract report for West Fraser Mills Ltd. July 12, 2001. 30 pp.

Timberline Forest Inventory Consultants Ltd. 2002. *MacKenzie-Cariboo Tree Farm Licence (TFL 5) Management Plan 10 Timber Supply Analysi Information Package*. Contract report for Weldwood of Canada Ltd. October 16, 2002. 49 pp.

Timberline Forest Inventory Consultants Ltd. 2002. *MacKenzie-Cariboo Tree Farm Licence (TFL 5) Management Plan 10 Timber Supply Analysis.* Contract report for Weldwood of Canada Ltd. October 18, 2002. 30 pp.

APPENDIX I

TFL 52 Block 1 (Old TFL 52) Yield Table
Minimum Harvest Age Attributes

TFL 52 Block 1 Existing NSYT minimum harvest attributes

Analysis Unit	Net THLB Area (ha)	Species Composition	Avg SI50	Avg CC	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
201	20,968	Sx49 Bl48 Pl3	11.5	45.0	130	21.1	29.6	185	1.42
202	4,017	Pl73 Sx19 Bl5 At3	19.3	49.3	60	20.6	19.9	251	4.31
203	3,619	Pl71 Sx18 At9 Fd2	21.7	49.7	50	20.4	19.6	229	5.03
204	1,686	Pl58 Sx27 Bl12 At3	17.5	49.2	70	19.3	19.9	219	3.23
205	9,073	Sx66 Bl24 Pl9 At1	12.3	43.9	120	21.8	29.2	190	1.60
206	6,181	Pl77 Sx15 At6 Bl2	19.3	49.4	70	21.6	21.4	183	2.81
207	5,192	Sx58 Bl19 Pl16 At7	19.4	42.3	90	26.1	30.0	221	2.67
208	2,403	Bl71 Sx29	10.8	45.5	130	18.5	28.5	153	1.17
209	5,761	Sx61 Bl29 Pl8 Fd2	16.0	44.9	100	23.6	29.4	209	2.14
210	5,264	Sx58 Bl33 Pl7 At2	15.8	43.3	100	23.5	29.3	210	2.13
211	4,420	Sx59 Bl21 Pl14 Fd6	16.1	43.5	100	23.7	29.3	206	2.15
212	3,846	Sx64 Bl20 Pl12 At4	19.1	44.9	90	25.7	29.7	237	2.74
213	3,866	Sx63 Pl18 Fd11 At8	22.7	47.8	80	27.8	29.6	246	3.34
214	3,109	Pl72 Sx13 At12 Bl3	17.3	51.2	80	21.3	22.7	152	2.21
215	3,722	Bl69 Sx26 Pl3 At2	11.5	43.8	120	18.9	28.3	156	1.30
216	3,184	Pl74 Sx17 Bl5 At4	17.1	48.5	70	19.2	20.5	155	2.30
217	2,075	Sx65 Bl32 Pl3	11.7	44.6	130	22.0	29.8	191	1.47
218	2,082	Sx72 Bl18 Pl8 At2	17.4	41.3	90	23.5	29.0	206	2.34
219	1,535	Sx68 Bl13 Pl12 At7	21.8	47.5	80	26.6	29.3	238	3.20
220	1,531	Pl71 Sx21 At5 Bl3	21.5	50.2	60	22.2	21.2	194	3.41
221	1,228	Sx55 Bl31 Pl11 At3	18.8	47.7	90	25.3	29.7	232	2.66
222	1,260	Pl71 Sx19 Bl7 At3	18.9	51.8	60	19.4	20.2	158	2.72
223	1,186	Sx57 Bl35 Pl8	12.2	40.4	120	20.7	29.2	173	1.44
225	1,075	Bl71 Sx24 Pl4 At1	11.7	41.4	120	18.6	28.2	150	1.26
227	999	Sx69 Bl20 Pl10 At1	17.4	39.5	90	23.7	29.1	208	2.36
228	18	Pl48 Sx32 Fd11 Bl9	24.5	57.3	50	23.0	21.5	337	6.88

Analysis Unit	Net THLB Area (ha)	Species Composition	Avg SI50	Avg CC	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
229	489	Sx60 Bl34 Pl6	16.1	47.3	90	22.1	28.2	194	2.16
230	866	Pl73 Sx15 Bl7 At5	13.4	48.7	100	17.7	21.2	148	1.54
232	745	Pl78 Sx14 Bl4 At4	13.6	47.6	100	18.7	22.0	153	1.61
233	561	Pl68 Sx22 At7 Fd3	24.5	50.8	50	23.1	20.9	184	3.95
234	408	Bl55 Sx39 Pl5 At1	10.9	41.8	130	19.7	29.4	165	1.27
235	546	Sx66 Bl20 Pl9 At5	21.6	40.1	80	26.4	30.1	230	3.09
237	479	Pl66 Sx16 At16 Bl2	14.5	47.7	100	19.5	23.4	136	1.62
238	393	Pl67 Sx24 Bl5 At4	21.8	45.6	60	22.7	21.5	208	3.57
239	409	Sx66 Bl17 Cw13 Pl4	15.9	51.0	100	23.3	29.6	211	2.18
240	26	Sx75 Pl16 Bl5 Ac4	26.4	35.0	80	24.2	23.3	315	4.23
241	197	Sx59 Bl39 Pl1 At1	11.7	41.6	130	20.7	29.7	177	1.36
242	289	Pl70 Sx21 At6 Bl3	21.8	48.8	60	22.5	21.5	191	3.43
243	254	Sx70 Bl21 Pl7 At2	19.2	41.7	90	25.3	30.0	237	2.69
244	293	Sx65 Pl17 At10 Bl8	25.4	51.0	70	28.0	28.5	231	3.67
245	196	Pl67 Sx24 Bl6 At3	22.0	44.3	60	22.4	21.3	193	3.32
246	273	Pl76 Sx20 Bl2 At2	19.6	45.8	60	19.7	20.7	157	2.70
247	227	At45 Sx32 Pl19 Bl4	19.7	52.0	80	25.1	28.4	91	2.10
248	229	Sx68 Bl14 Pl13 Cw5	13.9	45.2	120	22.6	30.2	212	1.77
250	3,233	Sx35 Bl29 Pl23 At13	15.4	39.0	80	21.6	25.3	140	2.13
360	6,004	Bl66 Sx34	19.0	43.4	90	25.3	30.0	78	0.87
Total	115,417								

Note that analysis units 301 – 350 and 401 – 450 are duplicates of the 201 – 250 series. They are included in the analysis to enable modelling of different shelf life assumptions for wet and moist MPB pine stands on Block 1. If the stands assigned to the 301 and 401 series are harvested prior to expiration of the shelf life they will use the yields and minimum harvest ages associated with the 201 - 250 series.

TFL 52 Block 1 Existing and future MSYT minimum harvest attributes

Analysis Unit	Existing MSYT Net THLB Area (ha)	Future MSYT Net THLB Area (ha)	Species Group	Avg SI50	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
251	192	21,159	PlSx	16.5	70	19.2	19.1	247	3.53
252	17,201	21,218	PlSx	19.8	60	21.1	19.9	303	5.04
253	13,301	16,921	PlSxAt	21.6	50	20.8	19.8	294	5.87
254	8,745	10,432	PlSx	16.7	70	19.4	19.4	254	3.63
255	370	9,443	PlSx	19.9	60	21.4	20.2	306	5.09
256	1,578	7,759	PlSxAt	22.2	50	21.2	20.3	305	6.10
257	1,972	7,163	PlSxAt	22.1	50	21.0	20.1	298	5.95
258	16	2,419	SxPlBl	12.9	110	21.5	22.7	252	2.29
259	716	6,477	PlSx	19.5	60	20.9	19.7	297	4.95
260	315	5,579	PlSx	16.7	70	19.5	19.3	253	3.62
261	584	5,005	PlSxAt	21.5	50	20.5	19.6	286	5.72
262	1,120	4,966	PlSxAt	19.8	60	21.1	19.9	302	5.03
263	294	4,160	PlSxAt	22.3	50	21.4	20.4	309	6.19
264	766	3,875	PlSxAt	22.1	50	20.9	20.1	296	5.92
265	51	3,774	PlSx	19.2	60	20.5	19.5	287	4.79
266	572	3,755	PlSx	20.3	60	21.7	20.5	309	5.15
267	1	2,076	SxPlBl	13.3	110	21.9	22.9	266	2.42
268	180	2,262	SxPl	21.5	70	25.5	24.1	393	5.61
269	337	1,872	PlSxAt	19.8	60	21.2	20.0	305	5.09
270	211	1,742	PlSxAt	19.8	60	21.3	20.2	306	5.11
271	137	1,366	PlSx	16.8	70	19.7	19.5	261	3.73
272	188	1,448	PlSx	16.6	70	19.4	19.6	252	3.59
273	4	1,190	SxPl	18.9	70	22.7	22.4	310	4.43
274	1,361	1,361	SxPl	21.6	60	23.3	22.0	325	5.41
275	7	1,082	PlSxAt	21.0	60	22.6	21.1	342	5.71
276	1,174	1,174	PlSx	20.0	60	21.5	20.2	313	5.22

Analysis Unit	Existing MSYT Net THLB Area (ha)	Future MSYT Net THLB Area (ha)	Species Group	Avg SI50	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
277	30	1,029	SxPl	19.4	70	23.2	22.7	324	4.63
278	905	924	PlSxFd	24.1	50	23.1	21.6	352	7.04
279	0	489	SxPlBl	13.1	110	21.8	22.9	262	2.38
280	46	912	PlSx	16.2	70	19.0	19.4	241	3.44
281	815	815	SxPlBl	13.2	110	21.9	23.0	264	2.40
282	35	780	PlSx	19.8	60	21.2	20.0	304	5.07
283	152	714	PlSxAt	21.9	50	21.2	20.4	305	6.10
284	0	408	PlSx	11.8	110	18.6	21.8	194	1.76
285	10	556	SxPl	21.7	70	25.5	24.1	394	5.63
286	655	655	PlSx	16.6	80	21.5	20.8	300	3.75
287	50	529	PlSxAt	22.4	50	20.9	20.1	294	5.89
288	34	427	Pl	16.5	70	19.3	19.6	252	3.59
289	60	469	PlSxAt	24.5	50	23.4	22.0	354	7.09
290	493	520	PlSx	18.5	70	22.4	21.7	300	4.28
291	0	196	SxPlBl	15.3	90	21.8	22.6	270	3.00
292	35	324	SxPl	21.5	60	23.2	22.4	325	5.41
293	16	269	SxPl	16.7	80	21.6	21.1	278	3.47
294	0	292	PlSxAt	20.5	60	21.7	20.5	308	5.14
295	104	300	PlSxAt	23.9	50	23.2	21.7	359	7.19
296	0	273	SxPl	19.6	70	23.0	22.9	322	4.59
297	31	258	PlSxAt	19.9	60	21.1	20.0	301	5.02
298	13	243	SxPl	24.6	50	23.5	22.0	355	7.11
299	221	221	PlSx	17.1	80	22.4	21.4	301	3.76
300	992	4,225	PlSxAt	17.7	60	18.5	19.1	217	3.61
370	154	6,157	SxBl	16.7	80	21.6	21.1	92	1.15
Total	56,245	171,662							

TFL 52 Block 1 Existing post-MPB attack NSYT minimum harvest attributes

Analysis Unit	Net THLB Area (ha)	Species Composition	Avg SI50	Avg CC	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
502	4,017	Sx19 Bl5 At3	19.7	49	70	22.6	21.6	154	2.20
503	3,619	Sx18 At9 Fd2	21.5	49	60	23.0	21.7	154	2.56
504	1,686	Sx27 Bl12 At3	16.8	49	80	21.0	21.1	158	1.97
505	9,073	Sx66 Bl24 At1	12.2	43	120	21.8	29.2	173	1.44
506	6,181	Sx15 At6 Bl2	19.3	49	120	27.0	27.7	153	1.27
507	5,192	Sx58 Bl19 At7	19.4	42	90	26.1	30.0	193	2.15
509	5,761	Sx61 Bl29 Fd2	15.8	44	100	23.6	29.4	192	1.92
510	5,264	Sx58 Bl33 At2	15.8	43	100	23.5	29.3	194	1.94
511	4,420	Sx59 Bl21 Fd6	15.9	43	100	23.7	29.3	182	1.82
512	3,846	Sx64 Bl20 At4	19.0	44	90	25.7	29.7	212	2.36
513	3,866	Sx63 Fd11 At8	22.7	47	80	27.8	29.6	212	2.65
514	3,109	Sx13 At12 Bl3	17.3	51	160	27.4	31.0	145	0.91
516	3,184	Sx17 Bl5 At4	17.0	48	130	25.2	27.4	149	1.15
518	2,082	Sx72 Bl18 At2	17.4	41	90	23.5	29.0	189	2.10
519	1,535	Sx68 Bl13 At7	21.8	47	80	26.6	29.3	213	2.67
520	1,531	Sx21 At5 Bl3	21.7	50	90	27.0	25.4	156	1.73
521	1,228	Sx55 Bl31 At3	18.8	47	90	25.3	29.7	209	2.32
522	1,260	Sx19 Bl7 At3	19.0	51	100	25.1	25.3	145	1.45
523	1,186	Sx57 Bl35	12.0	40	120	20.7	29.2	159	1.32
527	999	Sx69 Bl20 At1	17.4	39	90	23.7	29.1	188	2.09
528	18	Sx32 Fd11 Bl9	24.1	57	50	23.0	21.5	228	4.56
529	489	Sx60 Bl34	16.0	47	90	22.1	28.2	181	2.01
530	866	Sx15 Bl7 At5	12.8	48	170	22.0	26.1	120	0.71
532	745	Sx14 Bl4 At4	13.5	47	190	23.6	28.0	121	0.64
533	561	Sx22 At7 Fd3	24.8	50	70	27.8	24.3	146	2.09
534	408	Bl55 Sx39 At1	10.6	41	130	19.7	29.4	154	1.18

Analysis Unit	Net THLB Area (ha)	Species Composition	Avg SI50	Avg CC	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
535	546	Sx66 Bl20 At5	21.7	40	80	26.4	30.1	210	2.63
537	479	Sx16 At16 Bl2	14.1	47	200	24.6	30.2	121	0.61
538	393	Sx24 Bl5 At4	22.3	45	80	26.3	24.4	154	1.93
540	26	Sx75 Bl5 Ac4	19.0	35	80	24.2	23.3	275	3.43
542	289	Sx21 At6 Bl3	22.0	48	90	27.4	25.9	153	1.70
543	254	Sx70 Bl21 At2	19.0	41	90	25.3	30.0	219	2.43
544	293	Sx65 At10 Bl8	25.3	51	70	28.0	28.5	200	2.86
545	196	Sx24 Bl6 At3	22.0	44	80	25.9	24.2	146	1.83
546	273	Sx20 Bl2 At2	19.5	45	110	26.4	27.3	148	1.35
547	227	At45 Sx32 Bl4	19.9	52	130	30.0	36.2	123	0.95
548	229	Sx68 Bl14 Cw5	12.8	45	120	22.6	30.2	189	1.58
550	3,233	Sx35 Bl29 At13	17.4	39	100	24.5	28.3	153	1.53
Total	78,564								

APPENDIX II

TFL 52 Block 2 (Old TFL 5) Yield Table
Minimum Harvest Age Attributes

TFL 52 Block 2 Existing NSYT minimum harvest attributes

Analysis Unit	Net THLB Area (ha)	Species Composition	Avg SI50	Avg CC	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
1	3,201	Pl36 Sx33 Fd22 Ep9	21.4	35.3	60	22.3	21.1	247	4.62
2	2,806	Fd42 Sx36 Pl17 Ep5	21.2	40.1	80	26.9	24.8	316	4.34
3	2,531	Pl51 Fd25 Sx20 Ep4	24.3	37.0	50	22.3	20.4	192	4.18
4	1,935	Fd59 Sx18 Pl17 Ep6	19.7	51.4	90	26.7	30.1	221	2.67
5	1,522	Pl64 Fd19 Sx16 Ep1	19.2	46.0	70	21.5	20.8	212	3.09
6	1,471	Sx40 Fd33 Ep16 Pl11	21.8	41.8	70	25.4	25.1	268	4.72
7	1,256	Fd57 Pl21 Sx18 Ep4	23.8	51.7	80	29.9	30.2	276	3.67
8	1,148	Sx37 Fd27 Pl25 Ep11	21.3	38.4	70	25.0	24.5	302	5.01
9	1,329	Fd66 Sx17 Ep13 Pl4	19.6	50.6	90	26.4	30.5	185	2.36
10	1,735	Sx39 Fd28 Pl22 Bl11	20.5	35.3	80	25.0	28.5	218	2.96
11	542	Fd57 Sx18 Pl13 Ep12	20.6	42.6	70	23.9	21.9	242	4.12
12	608	Sx45 Pl26 Fd24 Bl5	23.7	50.0	80	28.7	30.0	297	3.90
13	580	Sx44 Fd27 Bl17 Pl12	20.9	37.9	80	25.5	29.4	213	2.89
14	561	Fd50 Pl22 Sx22 Ep6	17.3	49.9	100	25.1	29.6	212	2.33
15	579	Fd37 Sx36 Ep18 Pl9	21.3	44.6	70	24.9	24.8	224	3.99
17	479	Pl57 Fd23 Sx17 Ep3	16.6	29.9	80	20.2	20.8	192	2.50
18	456	Sx46 Bl28 Fd17 Pl9	26.3	36.9	70	28.8	29.1	227	3.53
19	394	Fd41 Sx26 Pl25 Bl8	19.6	36.2	90	26.5	30.2	210	2.56
20	248	Fd54 Sx24 Ep15 Bl7	23.2	46.9	80	29.2	30.9	209	3.11
21	172	Fd62 Sx19 Ep13 Pl6	16.6	51.5	100	24.0	29.5	157	1.85
22	249	Fd40 Sx35 Ep13 Bl12	22.9	44.2	80	28.7	30.9	228	3.32
23	185	Pl39 Sx38 Fd19 At4	21.9	40.5	50	21.1	22.3	267	5.88
24	163	Fd47 Sx29 Ep12 Pl12	17.3	46.6	100	24.9	29.8	158	1.86
25	121	Pl37 Fd26 Sx21 Ep16	17.0	27.2	70	19.4	19.4	159	2.81
26	180	Sx51 Ep21 Fd21 Bl7	22.8	35.2	60	24.6	25.0	265	5.81
27	179	Fd40 Sx38 Bl13 Pl9	19.4	43.6	90	26.3	26.5	296	3.65

Analysis Unit	Net THLB Area (ha)	Species Composition	Avg SI50	Avg CC	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
28	143	Fd67 Sx15 Ep12 Bl6	10.8	54.7	230	22.2	31.9	104	0.54
29	79	Fd39 Pl38 Sx17 Ep6	19.6	41.8	80	24.2	26.2	178	2.40
30	111	Sx39 Pl26 Fd26 Bl9	16.8	47.4	100	24.8	28.5	255	2.68
31	73	Fd38 Sx29 Ep24 Pl9	21.4	39.7	70	25.2	25.5	236	4.50
32	113	Pl34 Sx33 Fd25 Ep8	21.6	39.0	60	22.1	20.9	184	3.52
33	55	Fd54 Ep29 Sx13 Pl4	17.5	50.3	110	26.6	30.3	135	1.73
35	73	Fd56 Sx21 Pl13 Ep10	19.8	46.6	90	25.9	28.3	154	2.06
36	83	Pl58 Fd25 Sx13 Ep4	13.8	63.2	110	20.7	23.7	133	1.26
37	94	Fd38 Sx34 Pl20 Ep8	17.2	44.6	80	22.4	22.5	256	3.52
38	83	Fd32 Sx31 Pl23 Ep14	19.6	34.9	80	24.6	28.5	188	2.77
39	36	Sx44 Fd28 Bl17 Pl11	22.2	42.6	80	27.3	28.0	281	3.90
40	53	Sx32 Fd31 Ep29 At8	21.1	50.6	70	24.6	24.4	180	3.91
41	48	Pl45 Fd29 Sx17 Ep9	19.4	29.3	70	21.7	21.3	180	2.96
42	14	Fd63 Sx18 Ep14 Pl5	19.8	55.8	90	26.6	29.2	162	2.14
43	34	Fd56 Sx27 Pl14 Ep3	16.5	57.4	100	23.6	29.3	187	1.95
44	23	Ep37 Fd33 Sx20 At10	22.4	56.0	70	26.3	26.2	151	3.93
45	2	Pl67 Fd27 Ep4 At2	24.9	55.4	50	22.9	20.8	204	4.35
46	21	Sx49 Bl23 Ep14 Pl14	25.9	35.5	70	28.3	29.3	220	3.93
48	24	Sx36 Fd33 Pl18 Bl13	14.6	38.8	110	22.7	30.0	169	1.65
49	28	Sx46 Fd28 At13 Bl13	23.4	41.8	60	25.6	23.8	281	5.71
50	470	Fd40 Pl33 Sx18 Ep9	19.1	38.8	70	21.5	23.1	214	3.06
Total	26,290								

Note that analysis units 101 – 150 are duplicates of the 1 – 50 series. They are included in the analysis to enable modelling of different shelf life assumptions for moist MPB pine stands on Block 2. If the stands assigned to the 101 series are harvested prior to expiration of the shelf life they will use the yields and minimum harvest ages associated with the 1 – 50 series.

TFL 52 Block 2 Existing and future MSYT minimum harvest attributes

Analysis Unit	Existing MSYT Net THLB Area (ha)	Future MSYT Net THLB Area (ha)	Leading Species	Avg SI50	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
51	179	3,380	Pl	21.5	60	24.1	22.3	340	5.66
52	48	2,854	Pl	21.2	60	23.7	21.8	332	5.53
53	360	2,891	Pl	21.3	60	23.8	21.9	334	5.56
54	87	2,023	Pl	21.3	60	23.9	21.9	326	5.44
55	163	1,685	Pl	21.2	60	23.7	21.8	329	5.49
56	2	1,473	Pl	21.9	60	24.6	22.8	350	5.83
57	59	1,315	Pl	21.4	60	23.9	22.1	336	5.59
58	5	1,153	Pl	21.3	60	23.8	22.0	336	5.59
59	1	1,331	Fd	20.9	70	26.8	23.3	352	5.03
60	63	1,798	Pl	21.4	60	23.9	22.2	338	5.63
61	1	543	Fd	20.7	70	26.6	23.1	346	4.94
62	14	623	Pl	21.9	60	24.5	23.0	356	5.93
63	37	616	Sx	22.9	60	25.9	24.3	381	6.36
64	27	588	Pl	21.8	60	24.5	22.5	343	5.71
65	0	579	Pl	21.6	60	24.3	22.4	342	5.69
66	19	19	Pl	21.2	60	23.7	21.8	329	5.49
67	194	674	Pl	21.2	60	23.6	21.7	327	5.46
68	5	461	Sx	22.4	60	25.3	23.5	361	6.02
69	24	418	Pl	21.8	60	24.4	22.8	352	5.87
70	2	250	Fd	20.7	60	23.7	21.5	293	4.88
71	0	172	Fd	21.0	70	27.0	23.3	353	5.04
72	0	249	Sx	22.9	60	26.0	24.0	371	6.19
73	0	185	Pl	21.7	60	24.3	22.5	347	5.78
74	14	176	Pl	21.9	60	24.9	22.5	340	5.66
75	0	121	Pl	16.6	70	20.3	19.1	237	3.38
76	0	180	Sx	22.4	60	25.4	23.7	367	6.12

Analysis Unit	Existing MSYT Net THLB Area (ha)	Future MSYT Net THLB Area (ha)	Leading Species	Avg SI50	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
77	0	179	Pl	21.3	60	23.7	21.9	334	5.56
78	0	143	Pl	21.3	60	23.8	21.9	334	5.56
79	1	80	Pl	21.2	60	24.0	21.9	321	5.36
80	8	119	Pl	21.2	60	23.7	21.9	333	5.54
81	0	73	Fd	21.4	60	25.0	21.8	303	5.05
82	8	121	Sx	22.2	60	25.1	23.3	359	5.98
83	0	55	Fd	21.5	60	25.0	21.7	303	5.05
85	7	80	Fd	21.7	60	24.8	22.3	332	5.53
86	2	85	Pl	21.2	50	20.8	19.5	261	5.22
87	0	94	Pl	17.8	60	19.7	18.9	230	3.83
88	2	85	Sx	22.9	60	25.8	24.5	390	6.49
89	0	36	Sx	22.2	60	24.9	23.8	369	6.15
90	0	53	Fd	21.4	60	25.0	21.8	303	5.05
91	0	48	Fd	19.9	60	22.8	20.4	261	4.35
92	0	14	Fd	21.1	60	24.6	21.6	295	4.91
93	0	34	Fd	17.3	70	21.5	19.9	253	3.61
94	0	23	Fd	22.0	60	25.4	22.8	333	5.54
95	0	2	Sx	18.7	70	23.4	22.7	322	4.60
96	0	21	Fd	20.6	70	26.3	23.6	358	5.11
98	1	25	Sx	23.2	60	26.0	24.8	397	6.61
99	0	28	Sx	22.4	60	25.3	23.9	371	6.19
100	88	558	Sx	19.9	60	22.7	20.8	273	4.56
Total	1,423	27,714							

TFL 52 Block 2 Existing post-MPB attack NSYT minimum harvest attributes

Analysis Unit	Net THLB Area (ha)	Species Composition	Avg SI50	Avg CC	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
151	3,201	Sx33 Fd22 Ep9	21.4	51	70	24.7	23.0	221	3.16
152	2,806	Fd42 Sx36 Ep5	21.2	51	80	26.9	24.8	275	3.44
153	2,531	Fd25 Sx20 Ep4	24.3	58	60	24.9	22.1	161	2.69
154	1,935	Fd59 Sx18 Ep6	19.7	57	100	28.4	32.0	219	2.19
155	1,522	Fd19 Sx16 Ep1	19.2	63	90	24.3	23.3	162	1.80
156	1,471	Sx40 Fd33 Ep16	21.8	51	70	25.4	25.1	243	3.47
157	1,256	Fd57 Sx18 Ep4	23.8	56	90	32.2	32.4	270	3.00
158	1,148	Sx37 Fd27 Ep11	21.3	49	70	25.0	24.5	249	3.56
159	1,329	Fd66 Sx17 Ep13	19.6	52	90	26.4	30.5	170	1.89
150	1,735	Sx39 Fd28 Bl11	20.5	47	80	25.0	28.5	188	2.34
151	542	Fd57 Sx18 Ep12	20.6	50	70	23.9	21.9	216	3.09
152	608	Sx45 Fd24 Bl5	23.7	52	80	28.7	30.0	242	3.02
153	580	Sx44 Fd27 Bl17	20.9	42	80	25.5	29.4	190	2.37
154	561	Fd50 Sx22 Ep6	17.3	56	100	25.1	29.6	178	1.78
155	579	Fd37 Sx36 Ep18	21.3	48	70	24.9	24.8	205	2.94
157	479	Fd23 Sx17 Ep3	16.6	61	100	22.5	23.0	155	1.55
158	456	Sx46 Bl28 Fd17	26.3	38	70	28.8	29.1	208	2.97
159	394	Fd41 Sx26 Bl8	19.6	50	90	26.5	30.2	173	1.92
150	248	Fd54 Sx24 Ep15 Bl1	23.2	50	80	29.2	30.9	195	2.43
152	249	Fd40 Sx35 Ep13 Bl1	22.9	50	80	28.7	30.9	205	2.57
153	185	Sx38 Fd19 At4	21.9	53	50	21.1	22.3	197	3.94
154	163	Fd47 Sx29 Ep12	17.3	52	100	24.9	29.8	143	1.43
155	121	Fd26 Sx21 Ep16	17.0	58	80	21.0	20.6	144	1.79
157	179	Fd40 Sx38 Bl13	19.4	47	90	26.3	26.5	270	3.00
159	79	Fd39 Sx17 Ep6	19.6	58	90	25.5	27.7	152	1.69
150	111	Sx39 Fd26 Bl9	16.8	55	100	24.8	28.5	207	2.07
151	73	Fd38 Sx29 Ep24	21.4	52	70	25.2	25.5	215	3.07

Analysis Unit	Net THLB Area (ha)	Species Composition	Avg SI50	Avg CC	Minimum Harvest Age Attributes				
					Age	Height (m)	DBH (cm)	Volume (m^3/ha)	MAI (m^3/ha/yr)
152	113	Sx33 Fd25 Ep8	21.6	57	60	22.1	20.9	141	2.35
155	73	Fd56 Sx21 Ep10	19.8	54	100	26.9	29.7	155	1.55
156	83	Fd25 Sx13 Ep4	13.8	67	210	26.5	30.0	121	0.58
157	94	Fd38 Sx34 Ep8	17.2	55	80	22.4	22.5	217	2.72
158	83	Fd32 Sx31 Ep14	19.6	48	80	24.6	28.5	157	1.96
159	36	Sx44 Fd28 Bl17	22.2	48	80	27.3	28.0	253	3.16
151	48	Fd29 Sx17 Ep9	19.4	54	80	23.2	22.7	147	1.84
153	34	Fd56 Sx27 Ep3	16.5	57	100	23.6	29.3	164	1.64
155	2	Fd27 Ep4 At2	24.9	61	70	27.6	24.2	163	2.33
156	21	Sx49 Bl23 Ep14	25.9	34	70	28.3	29.3	197	2.81
158	24	Sx36 Fd33 Bl13	14.6	42	120	23.9	31.6	163	1.36
Total	25,151								

APPENDIX III

JS Thrower & Associates Summary of Volume for MPB-Attacked Stands on TFL 52

Memo

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CERTIFIED ISO 9001:2000

To: Earl Spielman
From: Craig Mistal
cc:
Date: May 2, 2006
Project: WFQ-031 8.13
File: WFQ-031_volume_recovery_model_2006May02
Re: Development of volume recovery model for MPB-attacked stands on TFL 52

The purpose of this memo is to provide an overview of the methods used to develop the stand volume recovery model for MPB-attacked stands on TFL 52, and to develop a preliminary system for assigning stand priorities in a forest model.

Background

Pine stands in TFL 52 are currently being attacked by the Mountain Pine Beetle (MBP). West Fraser Mills (WFM) contacted J.S. Thrower & Assoc. (JST) to develop a volume recovery model to estimate the time required for a stand to recover a target volume following MPB attack. WFM will use the volume recovery model to assign stand priorities in a forest model.

Existing stand conditions

WFM provided JST a matrix of stand conditions on TFL 52 that should be represented in the TASS simulations used to develop the model.[1] The matrix of stand conditions included a range of pre-attack stand volumes and Pl:Sx combinations at reference stand ages and site indices (Table 1).

Table 1. Matrix of stand conditions on TFL 52.

Attribute	Matrix of values
Site Index	18, 21, and 24 m
Sx % volume (pre-attack)	20,30,40,50,60,70, and 80%
Merch. volume class (pre-attack)	100, 200, 300, 400, and 500 m³/ha
Reference age	50, 70, 90, 110 years

WFM also provided the proportion of Pl stems attacked for two MPB attack severity levels (Table 2).[2]

Table 2. Simulated MPB-attack dynamics.

MPB attack severity	% stems attacked by diameter class 0-15 cm	15-30 cm	> 30 cm
High	20 %	60%	80%
Moderate	0%	30%	50%

TASS experiment

We developed a series of TASS simulations, which created the desired pre-attack stand conditions at the specified reference ages (Table 1). The simulations modelled an MPB attack (at both severity levels)

[1] E-mail from Earl Spielman, Stewardship Forester, West Fraser Mills March 2, 2006

[2] E-mail from Earl Spielman, Stewardship Forester, West Fraser Mills Feb 23, 2006

according to the parameters in Table 2 at the specified reference ages, and then grew the unattacked stems to stand age 250 years.

Volume recovery model analysis

The outputs from the TASS experiments were used to develop a volume recovery model following MPB attack. The volume recovery model estimates the amount of time a stand will need to recover to a post attack volume of 150 m³/ha or 250 m³/ha. We modelled recovery time as a function of post-attack stand volume, MPB attack age, and site index (*Equation 1*, *Table*, R^2=0.98, p<0.05). Figure 1 and Figure 2 illustrate that that there is a minimum volume that a can stand recover from for each combination of site index and MPB attack age, beyond which recovery takes far too long, or is not possible.

Table 3. Parameters for volume recovery model.

Parameter	Target recovery volume	
	150 m³/ha	250 m³/ha
a1	-6.187	-9.268
a21	-1.697	-2.158
a22	327.261	507.358
b1	-0.126	-0.203
b2	-1.186	0.795

Equation 1

$$\text{Recovery time} = b/(LN(volume\_to\_recover/a))$$

Where,

volume_to_recover[a] = Target volume (150 or 250 m³/ha) – $Volume_{post\text{-}attack}$

$Volume_{post\text{-}attack}$ = Live post-attack merch. volume[b]

a = a1*pl_si +(a21 * mpb_attack_age + a22)

b = b1 * mpb_attack_age + b2

mpb_attack_age = Stand age when MPB attacks (50, 70, 90 or 110 years)

a1, a21, a22, b1, b2 = Parameters (Table)

[a]Must be greater than minimum volume possible for recovery.
[b]Must be less than target volume (i.e. recovery time is 0 years if post-attack volume is greater than target volume).

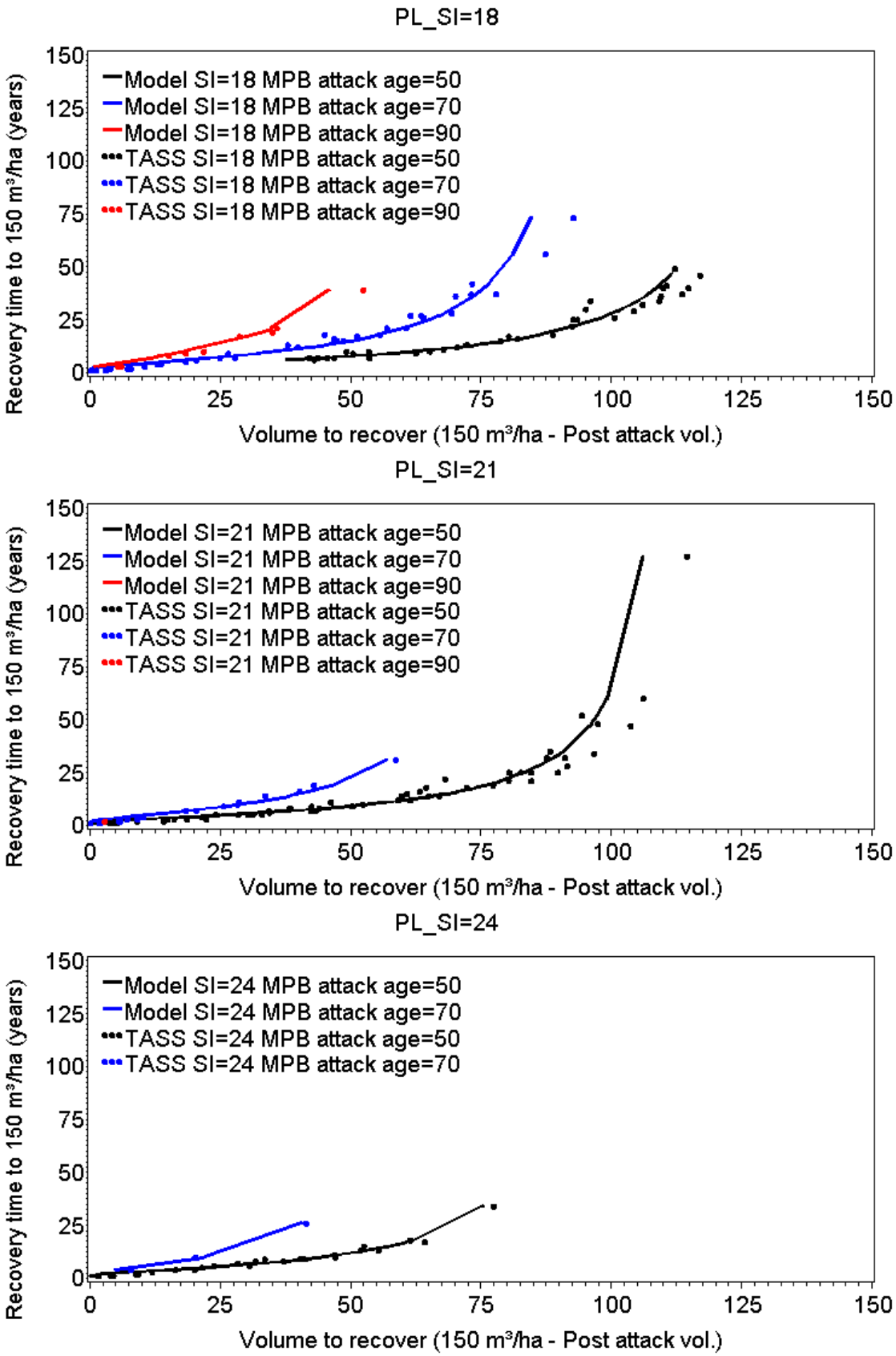


Figure 1. Recovery time to 150 m³/ha following MPB attack.

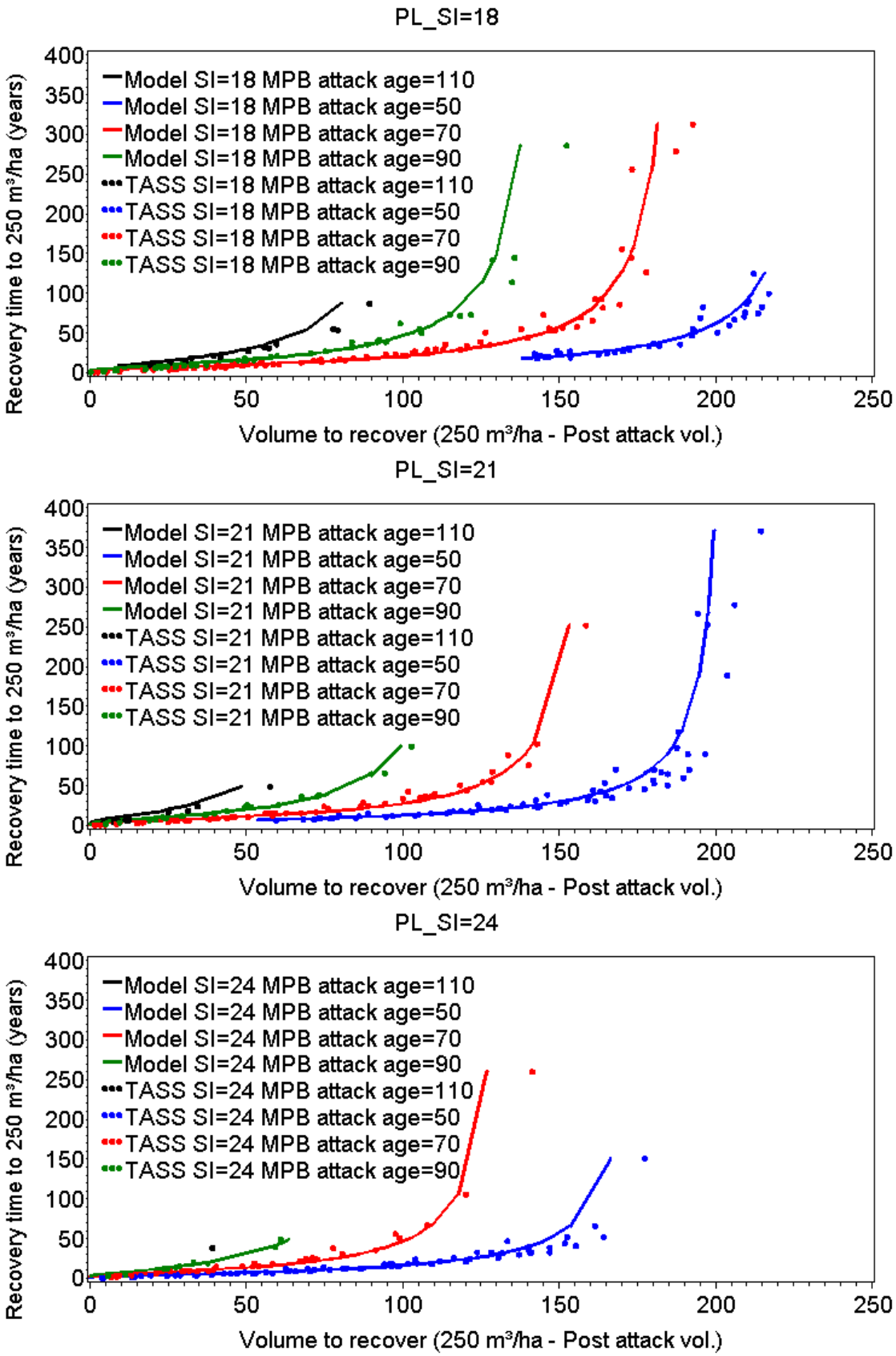


Figure 2. Recovery time to 250 m³/ha following MPB attack.

Post attack volume

We developed a function to estimate the live post-attack volume as a function of MPB attack severity, Sx percent volume (pre-attack) and pre-attack total volume (Table 4, Figure 3, Figure 4, R^2=0.95-0.99, p<0.05). Use Equation 2 to estimate the live post-attack volume if it is not known. The live post-attack volume is an input in the volume recovery model (Equation 1).

Equation 2

$$Volume_{post\text{-}attack} = Volume_{pre\text{-}attack} * (a * Sx\ volume\% + b)$$

Where,

$Volume_{post\text{-}attack}$ = Live post-attack merch. volume

$Volume_{pre\text{-}attack}$ = Live pre-attack merch. volume

Sx volume% = Pre-attack Sx % volume (20-80%)

a,b = Parameters (Table 4)

Table 4. Parameters for post-attack volume estimate.

Parameter	MPB attack severity	
	high	moderate
a	0.0062	0.0033
b	0.3454	0.6418

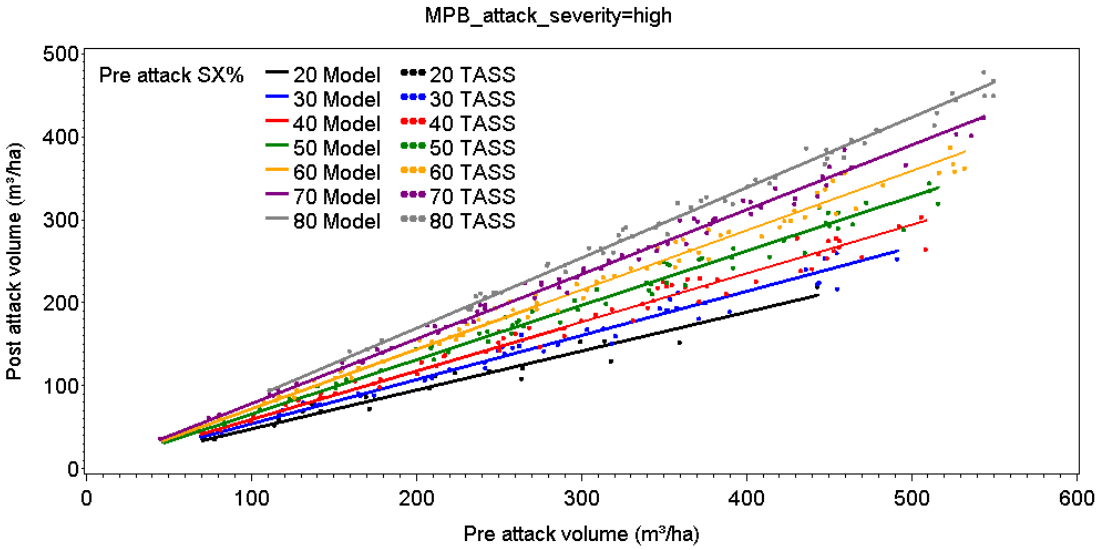


Figure 3. Live post-attack stand volume model (high attack severity).

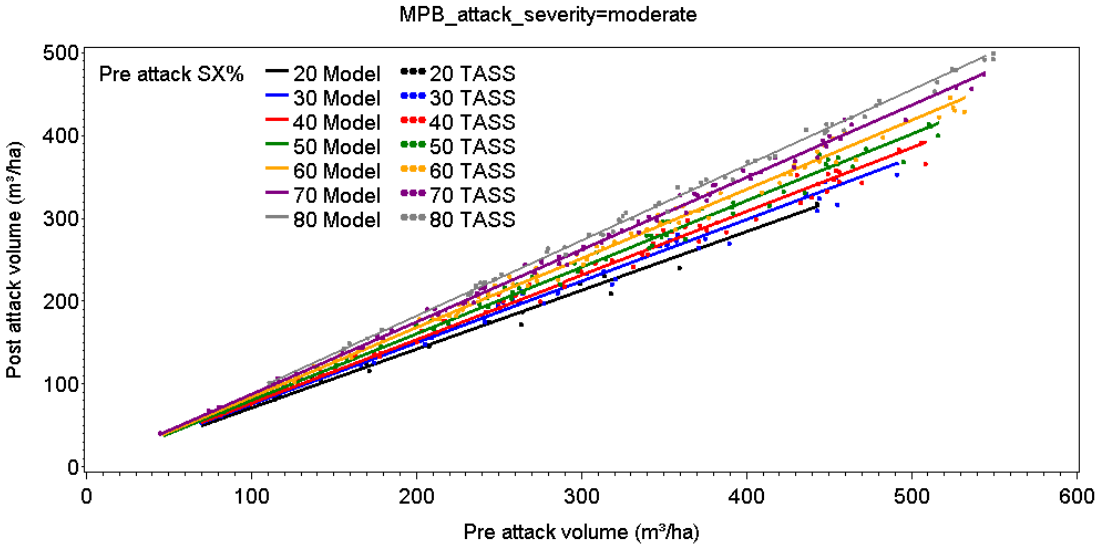


Figure 4. Live post-attack stand volume model (moderate attack severity).

Post attack Pl volume

We developed a function to estimate the post-attack percent Pl volume as a function of attack severity, site index, and pre-attack percent Pl volume (Equation 3, Table 5, $R^2_{\text{high severity}}=0.97$, $R^2_{\text{moderate severity}}=0.99$, $p<0.05$).

Equation 3

$$Pl\%_{\text{post-attack}} = (a1*pl\_si+a2\ ) *(Pl\%_{\text{pre-attack}})^{b}$$

Where,

$Pl\%_{\text{post-attack}}$ = post-attack percent Pl volume

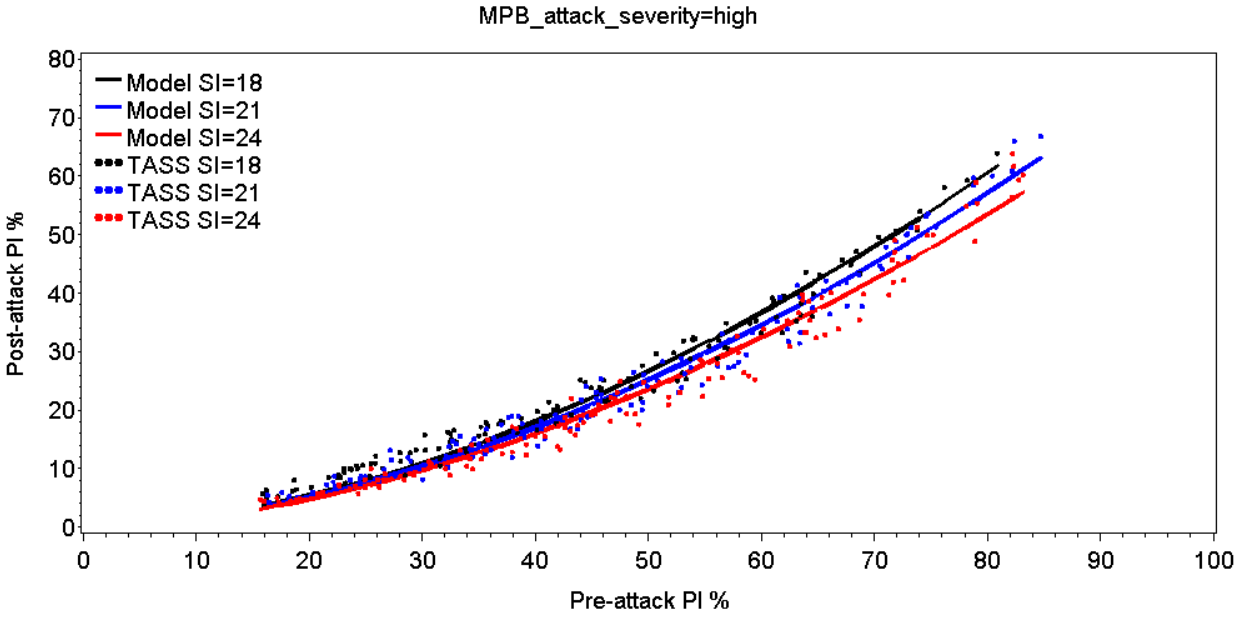
$Pl\%_{\text{pre-attack}}$ = pre-attack percent Pl volume

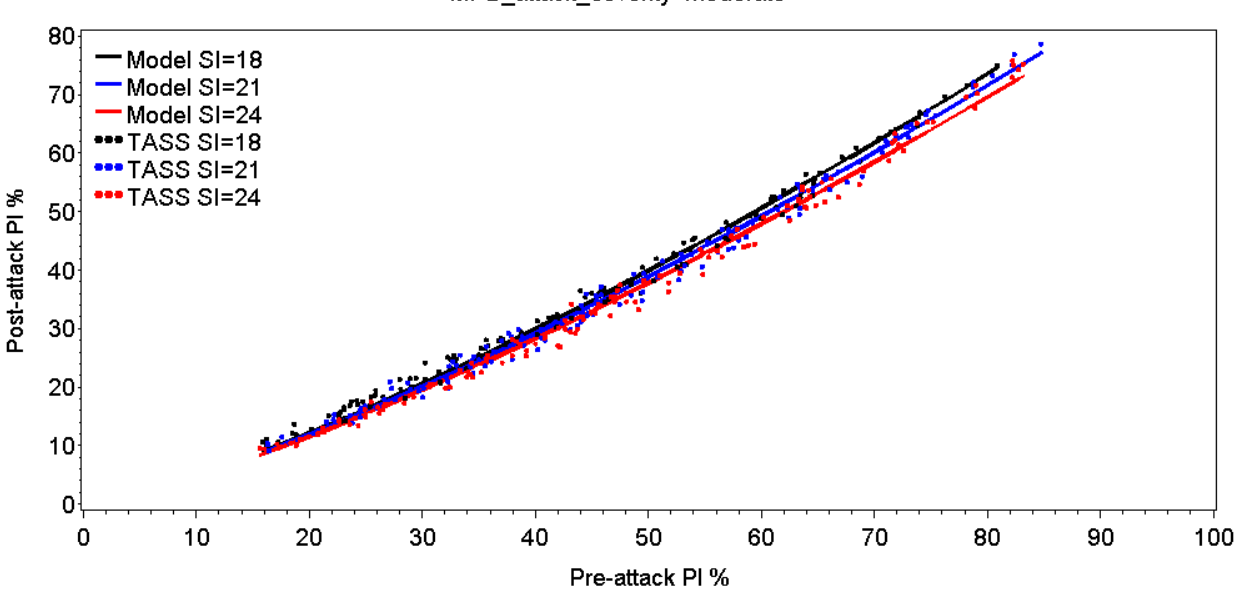
pl_si = Pl site index (m)

a1,a2,b = Parameters (Table 5)

Table 5. Parameters for post-attack percent Pl volume estimate.

Parameter	MPB attack severity	
	high	moderate
a1	-0.00056	-0.00222
a2	0.0388	0.2901
b	1.7465	1.2970





Implementation to assign priorities in forest model

1. Assign MPB attack severity and Pl:Sx % to each polygon
2. calculate post-attack stand volume (Equation 2)
3. Assign target volume (150 or 250 m³/ha), Pl site index (18, 21, or 24 m), and MBP attack age (50, 70, 90, or 110 years) to each polygon.
4. Assign priorities base on recovery time model (Table 6)
5. Calculate post-attack percent Pl volume if desired (Equation 3).

Table 6. Priority assignment in forest model.

Site index class (m)	MPB attack age (years)	$Volume_{post\text{-}attack}$ cut-offs for priority assignment	
		Priority 1 (recovery time ≤ 20 years)	Priority 2 (recovery time ≤ 40 years)
150 m³/ha Target volume			
18	50	60	40
	70	90	74
	90	116	104
	110	N/A	N/A
21	50	73	57
	70	102	89
	90	126	117
	110	N/A	N/A
24	50	85	72
	70	114	103
	90	N/A	N/A
	110	N/A	N/A
250 m³/ha Target volume			
18	50	104	66
	70	153	115
	90	189	156
	110	215	190
21	50	122	88
	70	167	134
	90	201	174
	110	224	206
24	50	139	110
	70	182	154
	90	212	191
	110	234	222

N/A: Post-attack volume in model already exceeds target volume.