

# Williams Lake TSA Type 1 Silviculture Strategy

Version 1.0

March 24, 2006

British Columbia  
Ministry of Forests and Range

Funded By:



<b>Strategies at a Glance</b>							
General Strategy	The focus of the Williams Lake TSA Silviculture Strategy over the next 5 years is to treat non lodgepole pine stands to improve midterm timber supply, mitigate habitat supply impacts brought about by the mountain pine beetle epidemic, and restore the structure and health of drybelt Fd ecosystems. Implementing the strategy will add volume to existing non PI stands, bring managed stands online sooner or with more volume, reforest areas that have no regeneration obligations, improve wildlife habitat in drybelt Fd ecosystems, minimize the loss of habitat for species and ecosystems of conservation and management concern, and ensure that invasive plants do not explode in the treated areas. It also recommends that a site index adjustment project be completed, that treatments be coordinated with a landscape level conservation or retention plan, and that an access management plan be completed. A coordinated review of investment opportunities aimed at maximizing benefits to multiple values was also recommended.						
Working Targets	<table border="1" style="width: 100%;"> <tr> <td style="width: 30%; vertical-align: top;">Timber Supply:</td> <td> <u>Short term (0-20 yrs)</u>                      AAC uplift to level required to capture MPB mortality.  <u>Mid Term (30-70 yrs)</u>                      Minimize the depth and duration of midterm trough.  <u>Long term (70<sup>+</sup> yrs)</u>                      Maintain long term harvest level at or near the productivity capacity of the land base.                 </td> </tr> <tr> <td style="vertical-align: top;">Timber Quality:</td> <td> <u>Mid – Long term</u>                      Manage for a diversity of currently valuable premium wood types (house logs, peelers, poles, MSR) to ensure that they are available over time.                 </td> </tr> <tr> <td style="vertical-align: top;">Habitat Supply:</td> <td> <u>Short Term</u>                      - Develop retention strategy to minimize impacts on watersheds, ecosystems, and species (20% of THLB) for short term retention to improve or maintain environmental values where opportunities exist.                      - Increased levels of broadleaved trees and other appropriate species on the land base.                      - 50% of impacted WTP / OGMA / RMA or other landscape-level retention areas reforested to reduced stocking levels where ecologically appropriate.                      - minimize loss of habitat for species and ecosystems of conservation and management concern.  <u>Mid Term and Long Term</u>                      - Maintain or improve the conservation status of all species (Ensure forestry practices do not make species status worse)                 </td> </tr> </table>	Timber Supply:	<u>Short term (0-20 yrs)</u> AAC uplift to level required to capture MPB mortality. <u>Mid Term (30-70 yrs)</u> Minimize the depth and duration of midterm trough. <u>Long term (70<sup>+</sup> yrs)</u> Maintain long term harvest level at or near the productivity capacity of the land base.	Timber Quality:	<u>Mid – Long term</u> Manage for a diversity of currently valuable premium wood types (house logs, peelers, poles, MSR) to ensure that they are available over time.	Habitat Supply:	<u>Short Term</u> - Develop retention strategy to minimize impacts on watersheds, ecosystems, and species (20% of THLB) for short term retention to improve or maintain environmental values where opportunities exist. - Increased levels of broadleaved trees and other appropriate species on the land base. - 50% of impacted WTP / OGMA / RMA or other landscape-level retention areas reforested to reduced stocking levels where ecologically appropriate. - minimize loss of habitat for species and ecosystems of conservation and management concern. <u>Mid Term and Long Term</u> - Maintain or improve the conservation status of all species (Ensure forestry practices do not make species status worse)
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<sup>1</sup> References are to strategies presented in this document (TS = Timber Supply, TQ = Timber Quality, HS = Habitat Supply)

## Strategies at a Glance

### Habitat Supply

1. Planting of impacted non-THLB areas with a habitat focus (HS1).
2. Spacing/thinning in drybelt Fd stands (HS2).
3. Underburning in drybelt Fd (HS3).
4. Treat invasive plants (HS6).
5. Rehabilitate roads and landings to control access.
6. Complete a retention strategy and access management plan.
7. Incorporate management of species and ecosystems of conservation and management concern into all silviculture planning.

## Strategies at a Glance

**Silviculture Program**

**Idealized funding level (\$63 million over 5 yrs)**

Proposed Area Treated (ha)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	-	-	-	-	-	-
Fertilize	11,200	10,700	10,700	10,700	10,700	54,000
Spacing/Thinning (timber)	5,100	5,000	5,000	5,000	5,000	25,100
Spacing/Thinning (habitat)	2,000	2,000	2,000	2,250	2,250	10,500
Planting (timber)	-	2,000	2,000	1,000	1,000	6,000
Planting (habitat)	-	450	450	450	650	2,000
Pruning	-	-	-	-	-	-
Rehab roads	-	30	30	30	30	120
Address Backlog NSR/Impeded	1,000	2,000	4,000	5,000	5,000	17,000
Treat for Invasives/Noxious weeds	2,000	2,000	2,000	2,000	2,000	10,000
Habitat Enhancement/Underburning	1,000	1,000	1,000	1,000	1,000	5,000
<b>Totals</b>	<b>22,300</b>	<b>25,180</b>	<b>27,180</b>	<b>27,430</b>	<b>27,630</b>	<b>129,720</b>

Proposed Budget (\$)

Activity	Year 1 (\$)	Year 2 (\$)	Year 3 (\$)	Year 4 (\$)	Year 5 (\$)	Totals (\$)
Studies/Surveys	\$ 1,024,000	\$ 100,000	\$ -	\$ -	\$ 125,000	\$ 1,249,000
Fertilize	\$ 4,480,000	\$ 4,280,000	\$ 4,280,000	\$ 4,280,000	\$ 4,280,000	\$ 21,600,000
Spacing/Thinning (timber)	\$ 3,100,000	\$ 3,000,000	\$ 3,025,000	\$ 3,000,000	\$ 3,000,000	\$ 15,125,000
Spacing/Thinning (habitat)	\$ 800,000	\$ 800,000	\$ 800,000	\$ 950,000	\$ 950,000	\$ 4,300,000
Planting (timber)	\$ -	\$ 3,000,000	\$ 1,400,000	\$ 1,050,000	\$ 1,050,000	\$ 6,500,000
Planting (habitat)	\$ -	\$ 315,000	\$ 315,000	\$ 315,000	\$ 455,000	\$ 1,400,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab roads	\$ -	\$ 171,000	\$ 171,000	\$ 171,000	\$ 171,000	\$ 684,000
Address Backlog NSR/Impeded	\$ 600,000	\$ 1,200,000	\$ 2,400,000	\$ 3,000,000	\$ 3,000,000	\$ 10,200,000
Treat for Invasives/Noxious weeds	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 1,000,000
Habitat Enhancement/Underburning	\$ 125,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 925,000
<b>Totals</b>	<b>\$ 10,329,000</b>	<b>\$ 13,266,000</b>	<b>\$ 12,791,000</b>	<b>\$ 13,166,000</b>	<b>\$ 13,431,000</b>	<b>\$ 62,983,000</b>

Estimated Timber Supply Outcomes

- 196,300 m<sup>3</sup> made available at the front end of the trough
  - Realized from late rotation fertilization.
- 1,316,300 m<sup>3</sup> made available in the middle of the trough
  - Realized from drybelt Fd spacing (thinning from below) and fertilization of young (15 – 40 year old) Fd and Sx leading stands.
- 1,300,000 m<sup>3</sup> made available in the back end of the trough
  - Realized through maintaining previously planted NSR sites (impeded stands) and reforestation MOFR responsibility lands in unsalvaged MPB areas and stands impacted by hemlock looper.

If this level of funding was continued for 20 years (\$252 million total) and similar benefits were achieved throughout, the midterm trough could be maintained at a level 125,000 m<sup>3</sup>/yr higher than currently projected. Completion of a site index adjustment project may have positive implications on the long term harvest level but it was not possible to estimate the effect without completing appropriate model simulations which is beyond the scope of a Type 1 Silviculture Strategy.

Timber Quality Outcomes

- None

Habitat Supply Outcomes

- Improved stand structure and ecosystem health on 35,000 ha of drybelt Fd stands by thinning/spacing, 5000 hectares of under burning, and 500 hectares of spacing to promote old growth structural conditions.
- Speed hydrologic recovery by regenerating 2000 ha of stands with a habitat focus, and regenerating 6000 ha of stands with a timber focus.
- Invasive plants will have been treated on 10,000 hectares
- 120 hectares of road and landing rehabilitation to protect wildlife and recreation values.
- Minimized loss of habitat for species and ecosystems of conservation and management concern during silviculture activities.

<b>Strategies at a Glance</b>							
<b>Silviculture Program</b>	<b>Constrained funding (\$39.6 million over 5 years)</b>						
	<u>Proposed Area Treated (ha)</u>						
	<b>Activity</b>	<b>Year 1 (ha)</b>	<b>Year 2 (ha)</b>	<b>Year 3 (ha)</b>	<b>Year 4 (ha)</b>	<b>Year 5 (ha)</b>	<b>Totals (ha)</b>
	Studies/Surveys	-	-	-	-	-	-
	Fertilize	11,200	8,700	9,200	5,700	5,000	39,800
	Spacing/Thinning (timber)	1,100	1,500	2,000	2,500	2,500	9,600
	Spacing/Thinning (habitat)	1,000	2,000	2,000	2,250	2,250	9,500
	Planting (timber)	-	100	100	1,100	1,100	2,400
	Planting (habitat)	-	450	450	450	650	2,000
	Pruning	-	-	-	-	-	-
Rehab roads	1,000	1,030	2,030	2,030	2,030	8,120	
Address Backlog NSR/Impeded	-	-	-	-	-	-	
Treat for Invasives/Noxious weeds	2,000	2,000	2,000	2,000	2,000	10,000	
Habitat Enhancement/Underburning	1,000	1,000	1,000	1,000	1,000	5,000	
<b>Totals</b>	<b>17,300</b>	<b>16,780</b>	<b>18,780</b>	<b>17,030</b>	<b>16,530</b>	<b>86,420</b>	
<u>Proposed Budget (\$)</u>							
<b>Activity</b>	<b>Year 1 (\$)</b>	<b>Year 2 (\$)</b>	<b>Year 3 (\$)</b>	<b>Year 4 (\$)</b>	<b>Year 5 (\$)</b>	<b>Totals (\$)</b>	
Studies/Surveys	\$ 1,024,000	\$ 100,000	\$ -	\$ -	\$ 125,000	\$ 1,249,000	
Fertilize	\$ 4,480,000	\$ 3,480,000	\$ 3,680,000	\$ 2,280,000	\$ 2,000,000	\$ 15,920,000	
Spacing/Thinning (timber)	\$ 700,000	\$ 900,000	\$ 1,225,000	\$ 1,500,000	\$ 1,500,000	\$ 5,825,000	
Spacing/Thinning (habitat)	\$ 400,000	\$ 800,000	\$ 800,000	\$ 950,000	\$ 950,000	\$ 3,900,000	
Planting (timber)	\$ -	\$ 1,250,000	\$ 250,000	\$ 1,220,000	\$ 1,220,000	\$ 3,940,000	
Planting (habitat)	\$ -	\$ 315,000	\$ 315,000	\$ 315,000	\$ 455,000	\$ 1,400,000	
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Rehab roads	\$ -	\$ 771,000	\$ 1,371,000	\$ 1,371,000	\$ 1,371,000	\$ 4,884,000	
Address Backlog NSR/Impeded	\$ 600,000	\$ -	\$ -	\$ -	\$ -	\$ 600,000	
Treat for Invasives/Noxious weeds	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 1,000,000	
Habitat Enhancement/Underburning	\$ 125,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 925,000	
<b>Totals</b>	<b>\$ 7,529,000</b>	<b>\$ 8,016,000</b>	<b>\$ 8,041,000</b>	<b>\$ 8,036,000</b>	<b>\$ 8,021,000</b>	<b>\$ 39,643,000</b>	
<u>Estimated Timber Supply Outcomes</u>							
<ul style="list-style-type: none"> <li>• 196,300 m<sup>3</sup> made available at the front end of the trough                             <ul style="list-style-type: none"> <li>- Realized from late rotation fertilization.</li> </ul> </li> <li>• 671,100 m<sup>3</sup> made available in the middle of the trough                             <ul style="list-style-type: none"> <li>- Realized from fertilization of young (15 – 40 year old) Fd and Sx leading stands and spacing drybelt Fd stands (thinning from below).</li> </ul> </li> <li>• 592,500 m<sup>3</sup> made available in the back end of the trough                             <ul style="list-style-type: none"> <li>- Realized though maintaining previously planted NSR sites (impeded stands) and reforestation MOFR responsibility lands in unsalvaged MPB areas and stands impacted by hemlock looper.</li> </ul> </li> </ul>							
<p>If this level of funding was continued for 20 years (\$158 million total) and similar benefits were achieved throughout, the midterm trough could be maintained at a level 64,000 m<sup>3</sup>/yr higher than currently projected. Completion of a site index adjustment project may have positive implications on the long term harvest level but it was not possible to estimate the effect without completing appropriate model simulations which is beyond the scope of a Type 1 Silviculture Strategy.</p>							
<u>Timber Quality Outcomes</u>							
<ul style="list-style-type: none"> <li>• None</li> </ul>							
<u>Habitat Supply Outcomes</u>							
<ul style="list-style-type: none"> <li>• Improved stand structure and ecosystem health on 18,500 ha of drybelt Fd stands by thinning/spacing, 5000 hectares of under burning, and 500 hectares of spacing to promote old growth structural conditions.</li> <li>• Speed hydrologic recovery by regeneration of 2000 ha of stands with a habitat focus, and regeneration of 2400 ha of stands with a timber focus.</li> <li>• Invasive plants will have been treated on 10,000 hectares.</li> <li>• 120 hectares of road and landing rehabilitation to protect wildlife and recreation values.</li> <li>• Minimized loss of habitat for species and ecosystems of conservation and management concern during silviculture activities.</li> </ul>							

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## 1.0 Introduction

### 1.1 About This Strategy

Type 1 Silviculture Strategies are currently being created or updated for most management units (TSAs and TFLs) in British Columbia's interior to provide a context for land base investment decisions. The strategies will help guide funding allocations between and within management units where that flexibility exists (i.e., Forests for Tomorrow and federal funds). One of the key motivating factors behind the completion of these strategies is the need to mitigate expected future impacts of the mountain pine beetle (MPB) epidemic and recent large scale fires in the interior of BC. More specifically, there is a need to improve midterm timber supply and mitigate impacts to environmental values.

A Type 1 silviculture strategy compiles existing information to identify issues related to timber supply, timber quality, and habitat supply in the TSA, and then engages stakeholders in a workshop setting to identify silviculture strategies/investments that can be used to address the issues.<sup>2</sup> The strategy is based on readily available information and the knowledge of local forestry and environmental professionals. These potential strategies will need to be quantified and/or refined in a more in-depth Type 2 analysis. The results of a Type 2 analysis will be a better guide for on-the-ground implementation.

Incremental silviculture is part of a suite of strategies, which together may influence the future quality and quantity of habitat and timber supply. This strategy document broadly analyzes the potential range of silviculture activities in order to identify priority treatments for an incremental silviculture strategy. An incremental silviculture strategy should not be confused with the allowable annual cut (AAC) determination process. AACs are based on current practices at the time of the determination. This strategy is forward looking and is about creating desired future conditions for our forests. The degree to which the strategy proves appropriate and is achieved may influence future AAC determinations.

### 1.2 Methods

This strategy was prepared through the following process:

- Prior to the district workshop, Forsite and PRYZM prepared a background document, summarizing all available information relevant to a strategy and identified opportunities to improve the future quantity and quality of timber and habitat supply. Mike Fenger and Associates provided input on habitat related issues on behalf of the Ministry of Environment.
- A district workshop was held December 13<sup>th</sup> & 14<sup>th</sup>, 2005 in Williams Lake, attended by representatives of the MoFR, MoE and forest licensees within the Williams Lake TSA. John Przeczek of PRYZM Environmental and Cam Brown of Forsite Consultants Ltd. led the session. Chris Schmid (MoE), Cris Guppy (Mike Fenger and Associates), and Mike Fenger represented MoE's interests at the workshop.

<sup>2</sup> These Type 1 silviculture strategies build upon those done in the late 1990s funded by Forest Renewal BC. See <http://www.for.gov.bc.ca/hfp/silstrat/> for links to previous strategies.

- Participants reviewed the potential opportunities identified in the draft document and provided others as they were discussed. The outcome of the session was a regime table, complete with priorities.
- Two five-year budget scenarios were developed; an idealized 'needs' budget, and a constrained 'historical' budget. The constrained budget forced participants to make choices between the identified strategies/opportunities.
- The consultants incorporated the results of the working session into this draft document and added forecasts of future harvest quantity and quality and of job outcomes.

### 1.3 Acknowledgements

We would like to thank all those who participated in the workshop; without their input this strategy would not have been possible. They are as follows:

Attendee	Affiliation
Susan Woermke	West Fraser, Williams Lake
Guy Burdikin	West Fraser, Williams Lake
Kim Peel	Tolko, Williams Lake
Ken Day	UBC, Alex Fraser Research Forest
Nola Daintith	MOFR, SI Region, Williams Lake
Grant Feldinger	MOFR, Chilcotin F.D.
Shane Schofield	MOFR, Chilcotin F.D.
Ray Leduc	MOFR, Central Cariboo F.D.
Kerri House	MOFR, Central Cariboo F.D.
Guy Newsome	MOFR, SI Region, Williams Lake
Rocky Chan	MOFR, SI Region, Kamloops
Oliver Thomae	Arbourtech Forest Management Services (MOFR, SI Interior Rep.)
Chris Schmid	MOE, Chilcotin (Beetle Specialist?)
Crispen Guppy	Mike Fenger & Associates (MOE Rep.)
Mike Fenger	Mike Fenger & Associates (MOE Rep.)

Mike Fenger and Associates provided summary information on habitat related issues prior to the workshop, participated in the workshop, and helped craft this document.

The project was managed by Ralph Winter and Nigel Fletcher of the Ministry of Forests, Forest Practices Branch and funding was provided by Forest for Tomorrow BC.

### 1.4 Limitations and Assumptions

This strategy is focused on silviculture investments not covered by legislative obligations which can be completed over the next 5 years (2006-2011). Because of risks associated with the current MPB infestation, investments in PI stands were avoided. After the MPB epidemic subsides, investment in PI stands represents a significant opportunity to address many of the TSAs timber supply issues.

Timber supply modeling was not completed in this project and all timber supply projections are from existing published sources or have been estimated based on professional judgment. Sources are indicated with each graph.

This strategy was developed to reflect TSA needs and proposed strategies were not excluded because they did not fit within existing funding sources. The intent is for the TSA to use whatever funding sources are available to address those issues important to the TSA. The strategy itself is assumed to be funding independent.

## 2.0 Basic Data

This section provides a summary of basic TSA data that describe the land base and related issues. This information is included to provide context for the resulting strategies that are presented later in the document.

### 2.1 AAC History

In 1995 the AAC was set at 3.807 million m<sup>3</sup>/year which included a 107,000 m<sup>3</sup>/year apportionment for Pulpwood Agreement (PA) 16 as well as 850,000 m<sup>3</sup>/year for the salvage of timber killed by MPB (Table 1). In 2003, the AAC was set at 3.77 million m<sup>3</sup>/year, which maintained the previous partition for PA 16, increased the harvest from the western-supply blocks to 450,000, as well as maintained the MPB uplift partition of 850,000 m<sup>3</sup>/year. Within the 3 western supply blocks, at least 100,000 m<sup>3</sup>/yr must come from low volume stands (65-100 m<sup>3</sup>/ha) and within the conventional partition, at least 70,000 m<sup>3</sup>/yr must come from low volume stands. This volume was previously accounted for in a Non Timber Harvest Land Base (THLB) partition.

Table 1. Historical and current AAC (m<sup>3</sup>/year).

AAC Type	1995	2003
Conventional	2,500,000	2,361,400
Pulpwood Agreement Partition	107,000	107,000
3 western-supply blocks	350,000	450,000
MPB Uplift	850,000	850,000
<b>Total</b>	<b>3,807,000</b>	<b>3,768,400</b>

### 2.2 Land Base Characteristics

Approximately 64% of the TSA is considered crown-forested land (Table 2), while 67% of this area is considered available for long term timber harvest (Figure 1).

Table 2. Land base area statistics.

Description	Area (ha)	Area (%)
Total TSA Area	4,904,558	100%
CFLB	3,145,826	64%
Current THLB	2,096,251	43%
Long Term THLB	2,122,001	43%

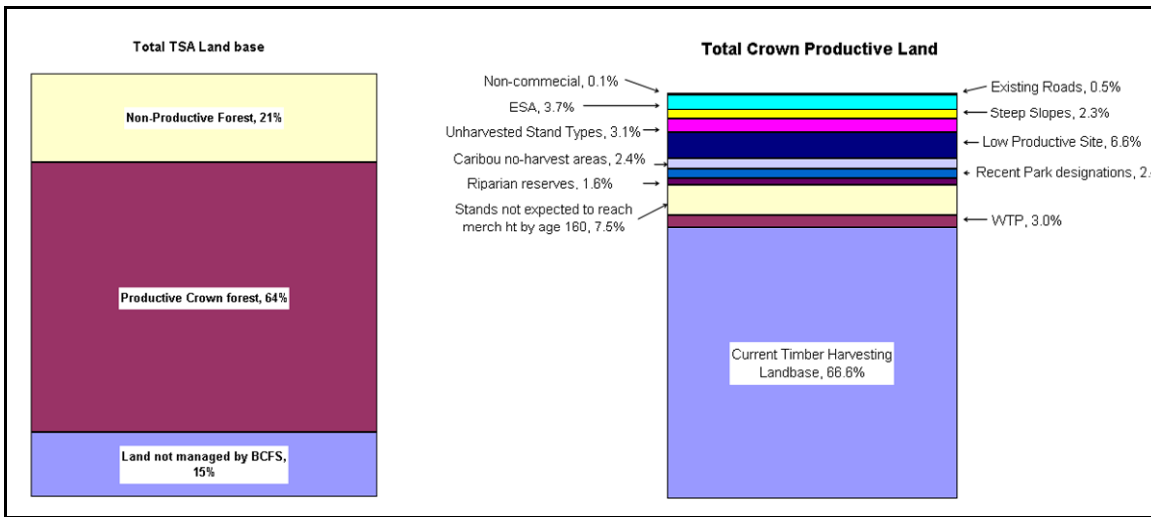


Figure 1. Total and crown forested land bases (TSR2).

### 2.2.1 Species Profile

The majority of stands on the THLB are PI leading (67%), with about 13% of the THLB having some level of impact from the 1980's MPB epidemic (Figure 2). PI dominates the western supply blocks while Fd stands tend to dominate the central portion of the TSA, and older Sx stands tend to dominate the eastern portion of the TSA. The significant component of susceptible PI-dominated forests puts the TSA at high risk for MPB infestation.

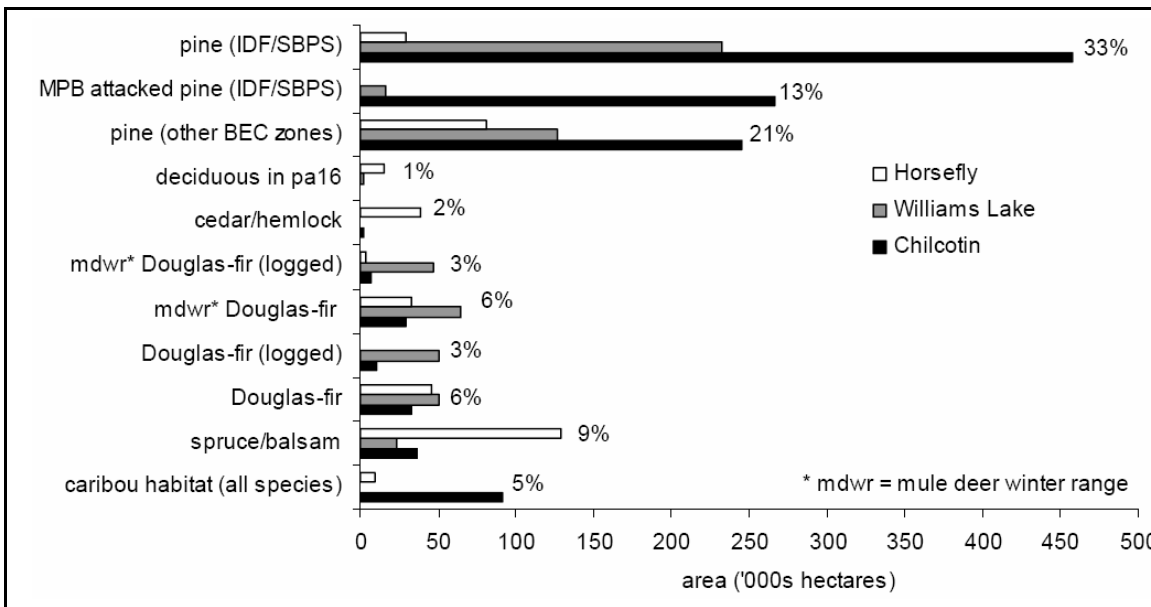


Figure 2. Tree species profile on the THLB (TSR2).

### 2.2.2 Age Class Profile

There is a significant portion of the THLB between 70 and 150 years old (Figure 3) and relatively little area older than 250 yrs (4%). Roughly 33% of the THLB is older than 140 years. This data does not adequately reflect losses to MPB from the 1980s or the current epidemic, so considerably more area should be falling within the youngest age classes.

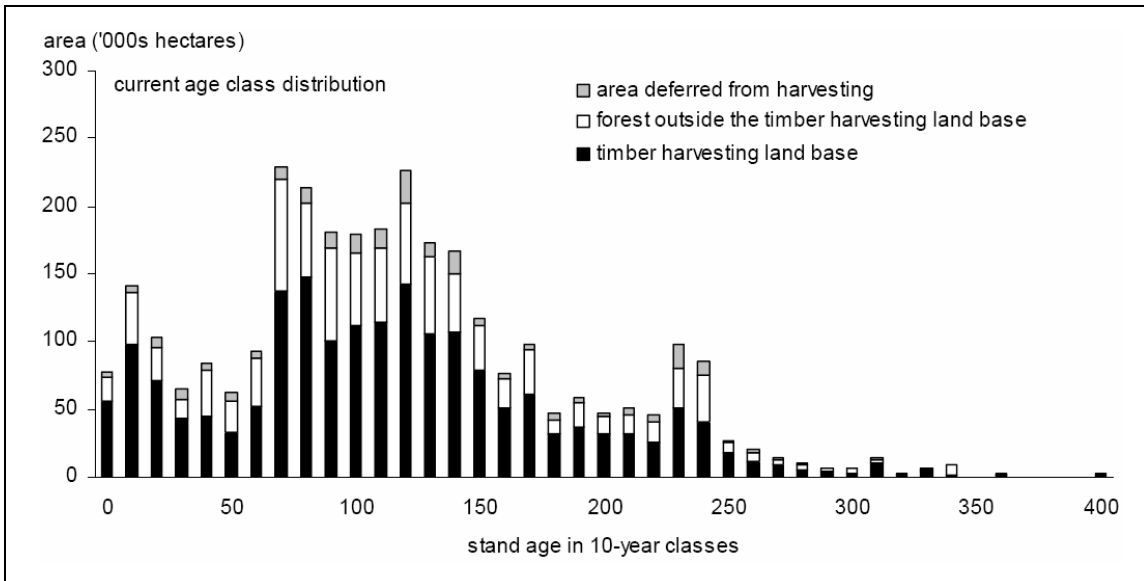


Figure 3. Age class distribution (TSR2).

### 2.2.3 Site Class Profile

The average site index in the THLB is 16.1 meters and the average site index in the CFLB is 14.0 meters (Figure 4).

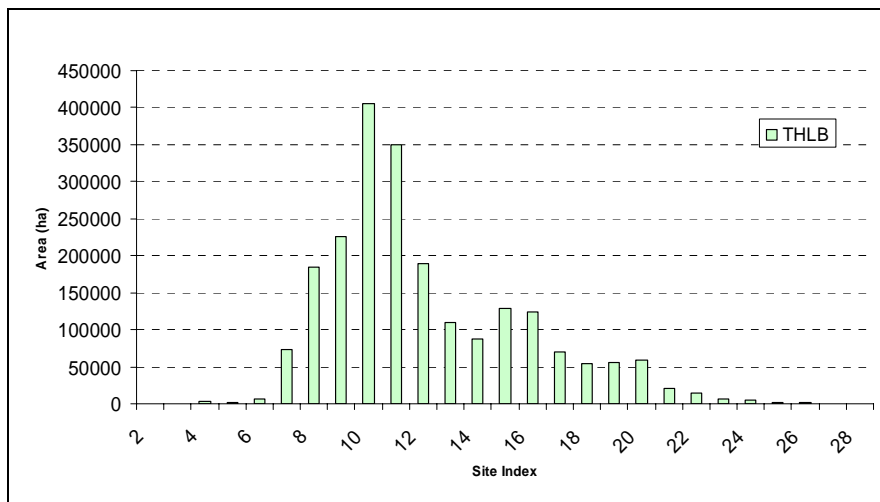


Figure 4. Site class profile (TSR2).

### 2.2.4 Biogeoclimatic Profile

The THLB in the Williams Lake TSA has a diversity of ecosystems that include SBPS (37%), IDF (24%), MS (16%), ESSF (8%), ICH (7%), and SBS (5%) variants (Figure 5). Approximately 72% of the THLB falls within drybelt ecosystems.

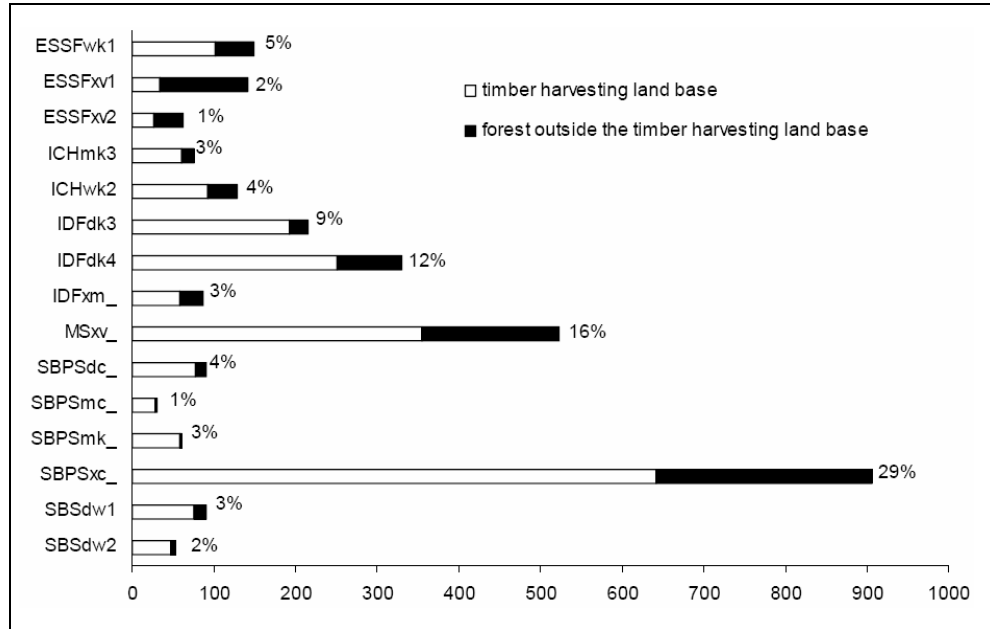


Figure 5. Biogeoclimatic profile (TSR2).

### 2.3 Incremental Silviculture History

Table 3 shows the incremental silviculture conducted on the Williams Lake TSA over the past 10 years. Relatively little area has been fertilized or pruned. Treatment area for juvenile spacing peaked in 1996 and has more or less gradually tapered off since then.

Table 3. Incremental silviculture history for the Williams Lake TSA.<sup>3</sup>

Year	Fertilize	Juvenile Spacing	Pruning
1995		1,573	
1996	4	3,186	10
1997	317	1,615	27
1998	543	1,942	28
1999		1,153	54
2000	117	1,871	
2001		1,318	
2002	43	571	
2003		70	
2004		12	
Total	1,025	13,311	120

<sup>3</sup> This information was extracted from the RESULTS database (October 2005).

## 2.4 Use of Select Seed

The 2005 seedling requests (Table 4) indicate that 97.7% of the Sx seed used is improved, 18.4% of Fdi seed is improved, and 47% of PI seed used is improved. Table 5 shows the expected gain from improved seed by seed planning unit (SPU). The improved PI and Sx seed is currently available for a significant part of the TSA but Class B+ stock and natural stand seed supplies will be required to meet seedling needs. Increased salvage harvesting (uplifts) focused on PI stands will put further pressure on seed availability in the next 10-20 years.

Table 4. Seedlings requested by species and genetic class for the Williams Lake TSA for 2005.

Species	Class A Seedlings Requested (000s)	Class B+ Seedlings Requested (000s)	Class B Seedlings Requested (000s)	Total Seedlings Requested (000s)	Percent Class A seedlings Requested (%)	Percent Improved Seed
Bl	-	-	40.0	40.0	0.0%	0.0%
Cw	-	-	9.0	9.0	0.0%	0.0%
Fdi	91.9	-	406.7	498.6	18.4%	18.4%
Pli	32.3	4,078.3	4,629.7	8,740.3	0.4%	47.0%
Sx	2,488.6	-	59.0	2,547.6	97.7%	97.7%
<b>Grand Total:</b>	<b>2,612.8</b>	<b>4,078.3</b>	<b>5,144.4</b>	<b>11,835.5</b>	<b>22%</b>	<b>56.5%</b>

Table 5. Forecasted gain in volume and availability for improved seed for the Williams Lake TSA.

SPU	Elevation (M)	SPU Seedling Need (million)	Gain From Improved Seed/Availability										Gross Area
			2005				2010			2015			
			Actual Gain	Actual Percent Class A used (%)	Projected Gain	Est. % Avail.	Projected Gain	Est. % Avail.	Est. Avail. Rating	Projected Gain	Est. % Avail.	Est. Avail. Rating	
FDC SM LOW	200-1000	1	-	-	2%	50%	8%	80%	2	8%	150%	1	16,749
FDI CT LOW	600-1200	0.9	13%	0.41%	2%	67%	20%	144%	1	20%	156%	1	303,820
FDI QL LOW	700-1200	0.5	11%	0.36%	9%	60%	12%	160%	1	16%	220%	1	267,648
PLI BV LOW	700-1200	16.4	3%	-	9%	31%	10%	73%	3	11%	115%	1	42,716
PLI PG LOW	700-1200	30	3%	0.27%	8%	12%	10%	34%	4	12%	62%	3	666,513
SX BVP LOW	500-1200	34.7	2%	0.05%	18%	54%	25%	82%	2	26%	119%	1	42,702
SX PG HIGH	1200-1550	2.6	8%	-	18%	131%	19%	188%	1	19%	188%	1	68,217
SX PG LOW	600-1200	25.2	8%	7.35%	24%	9%	28%	81%	2	28%	125%	1	322,440
SX PGN HIGH	1200-1900	8	6%	-	12%	133%	13%	175%	1	14%	184%	1	143,684
SX PGN LOW	1-1200	26.4	6%	-	7%	211%	12%	120%	1	14%	140%	1	331,853
SX PGN MID	1000-1500	4.5	6%	11.63%	7%	211%	12%	120%	1	14%	140%	1	134,381
SX TO HIGH	1300-1900	3.3	9%	-	8%	73%	12%	118%	1	17%	124%	1	1,199,837
SX TO LOW	700-1300	1.2	9%	1.10%	9%	200%	12%	250%	1	22%	150%	1	1,935,369

## 3.0 Mountain Pine Beetle Situation

Figure 6 illustrates the extent of the mountain pine beetle infestation in the Southern Interior Forest Region as mapped from overview flights in 2004 and Figure 7 shows the 2005 overview assessments themed by attack severity. The spatial extent of the attack has not changed significantly between the two years but the intensity of attack has increased within the affected areas.

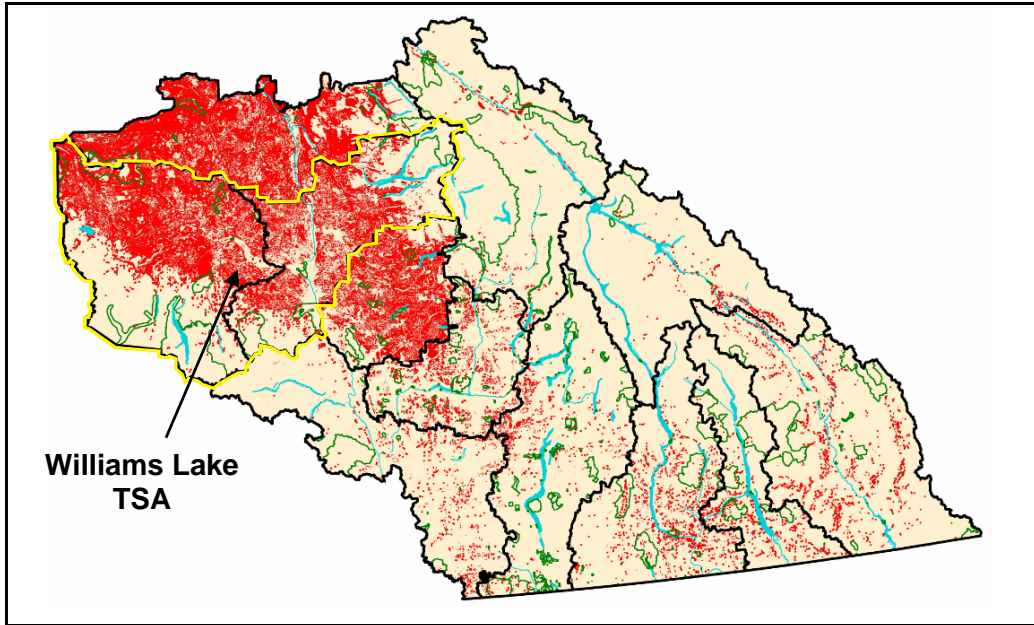


Figure 6. The extent of the mountain pine beetle infestation in the Southern Interior Region as mapped from overview flights in 2004.

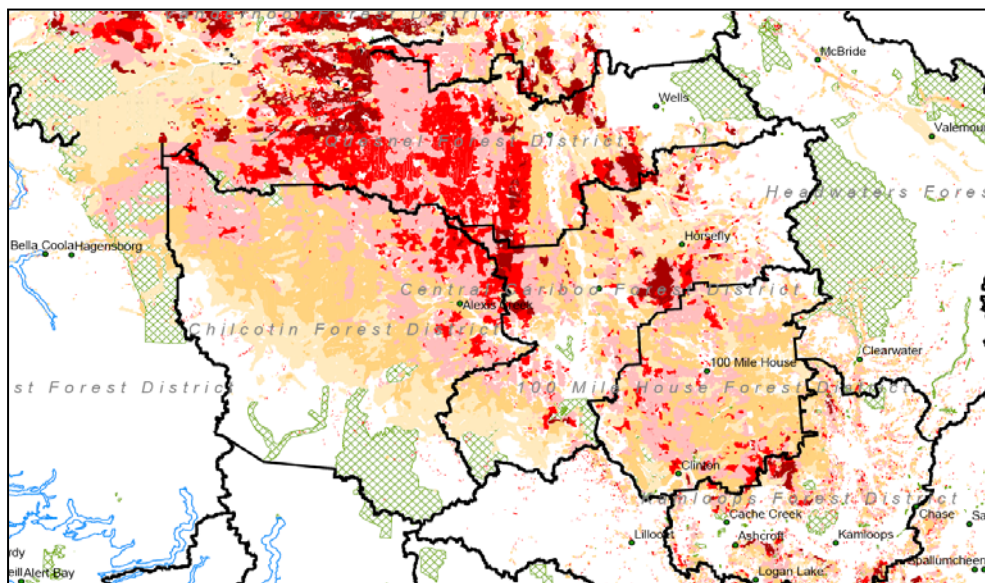


Figure 7. 2005 Overview results for MPB themed by attack severity (darker is heavier attack).

Since PI-leading stands make up approximately 67% of the current growing stock in the Williams Lake TSA, there are severe implications on timber supply. Figure 8 shows the trend predicted by Marvin Eng for yearly volume killed peaking in 2007 at 15.2 million m<sup>3</sup> for this TSA. The current rate of mortality is exceeding the harvest AAC (3.76 million m<sup>3</sup>) and even with a 15 year shelf life it is likely that there will be significant unsalvaged losses. Between 2005 and 2010, roughly 77 million m<sup>3</sup> will be killed. Assuming the AAC remains at current levels, the harvesting horsepower during this period will be 18.8 million m<sup>3</sup>, thus leaving significant volume to be captured before the shelf life expires.

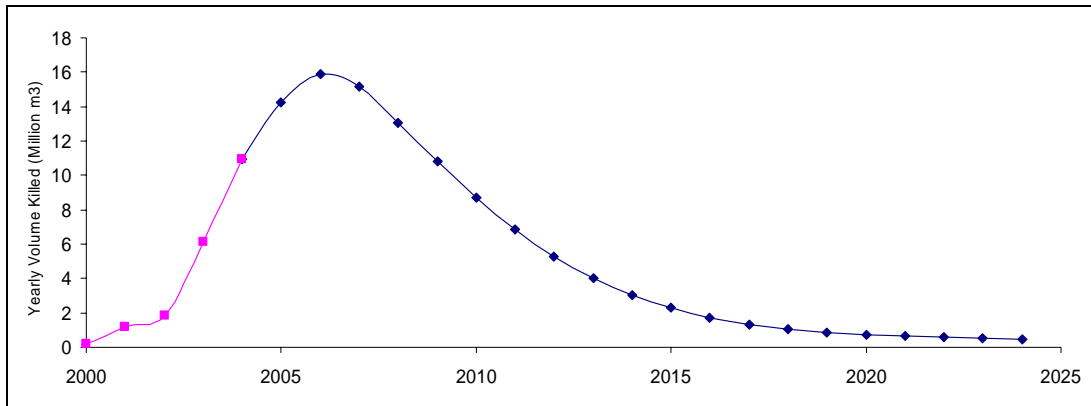


Figure 8. MPB killed volume trend (purple) and predictions of future trend (blue).

Table 6 shows projections of the cumulative pine volume killed by the MPB to 2020 (Marvin Eng 2005)<sup>4</sup> given the current AAC level (included 850,000 m<sup>3</sup>/year uplift for MPB salvage). Pine volume makes up approximately 52% of the current growing stock in the Williams Lake TSA (103 million m<sup>3</sup>). Marvin Eng’s model predicts that within the next 15 years MPB will kill approximately 90.6 million m<sup>3</sup> of pine. This does not include the potential impact to pine stands under 60 years old.

Table 6. MPB infestation projections – cumulative volume killed to 2020 (m3).

	Current AAC (m3)	Projection Year							
		2005			2010			2015	2020
		Total Effectuated Area	Equivalent area dead	Equivalent volume dead	Total Effectuated Area	Equivalent area dead	Equivalent volume dead	Equivalent volume dead	Equivalent volume dead
THLB > 60 years	3,768,400	842,422	203,186	25,514,244	946,880	561,071	66,723,741	86,545,430	90,603,920

## 4.0 Current TSA Situation

### 4.1 Timber Supply Issues

#### 4.1.1 TSR2 Base Case Harvest Forecast

Figure 9 shows the base case scenario from TSR2 (time 0=1998). This scenario indicates an initial harvest level of 3.765 million m<sup>3</sup>/yr implemented in the first 5 years (MPB uplift from 1980s epidemic). After that, the harvest level declines significantly to 2.92 million m<sup>3</sup>/year, which is maintained until decade 16. The long-term harvest level of approximately 3.25 million m<sup>3</sup>/yr is achieved 170 years into the harvest forecast. It is important to note that this forecast was conducted in 2000-2001 based on data from 1998 and does not reflect the impacts associated with the current MPB infestation. This will be discussed further below.

<sup>4</sup> Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: An Overview of the Model (BCMPB v2) and Results of Year 2 of the Project.

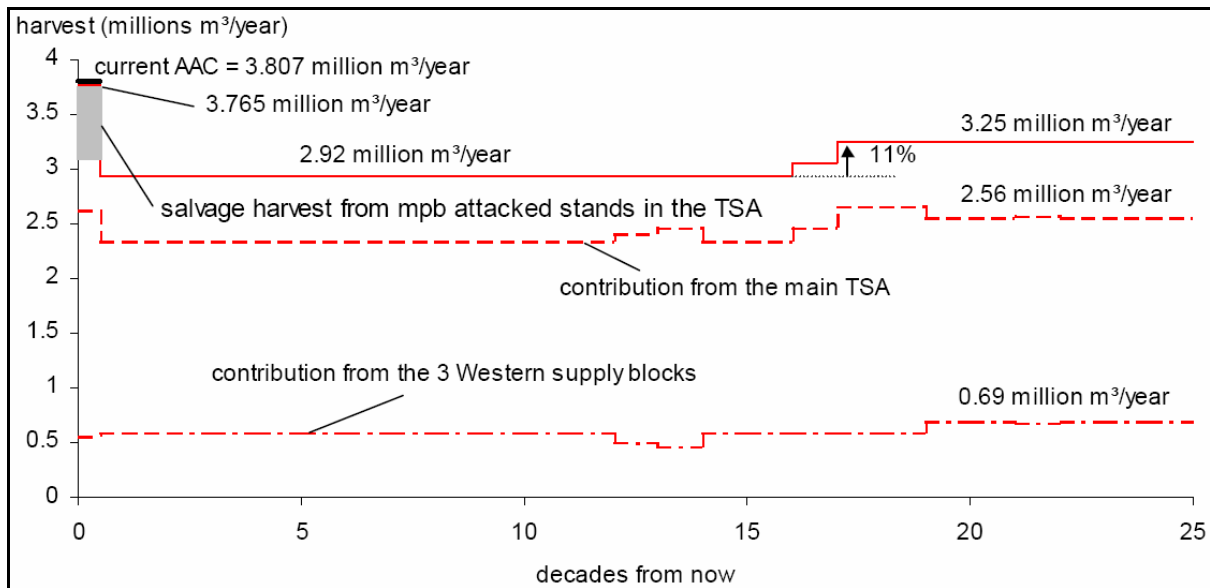


Figure 9. TSR2 Base case harvest forecast (Time 0 is 1998, includes 1980s MPB impacts).

Growing stock on the THLB is currently 210 million m<sup>3</sup>. Growing stock above minimum harvest criteria reaches its lowest levels in decades 10-12 (150 million m<sup>3</sup>). These decades likely correspond with the most constrained periods for timber supply (least available timber) and occurs because harvest is relying heavily on the managed stands that are just coming online (Figure 10).

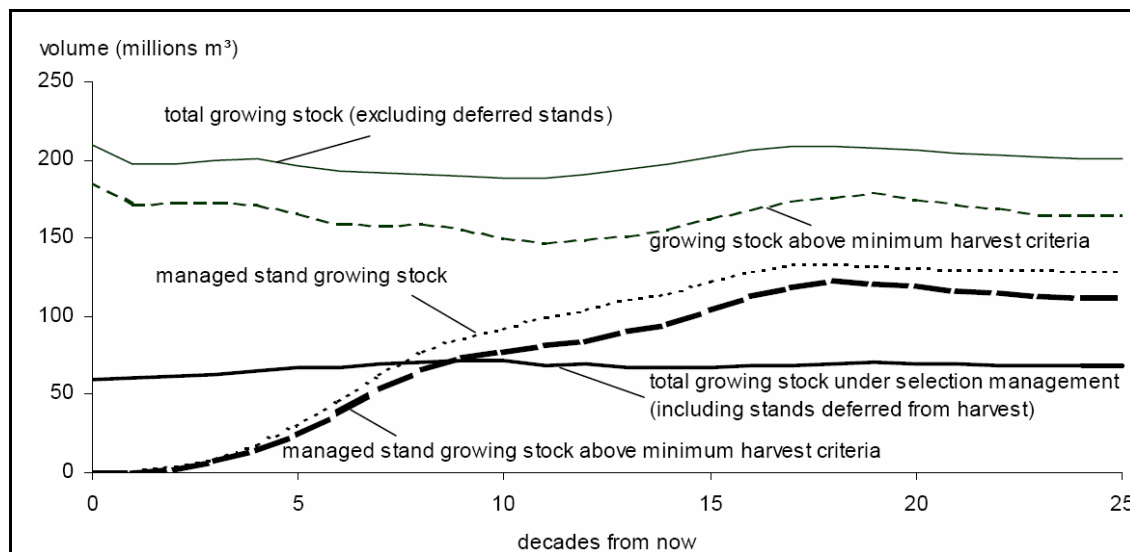


Figure 10. Total and merchantable growing stock (TSR2).

Figure 11 shows that managed stands are first harvested in period 6 and make up the vast majority of harvest by period 14. Harvest levels continue to rely somewhat on natural stands because of the use of natural regeneration in selection management areas. These stands contribute roughly 10% of the AAC over time.

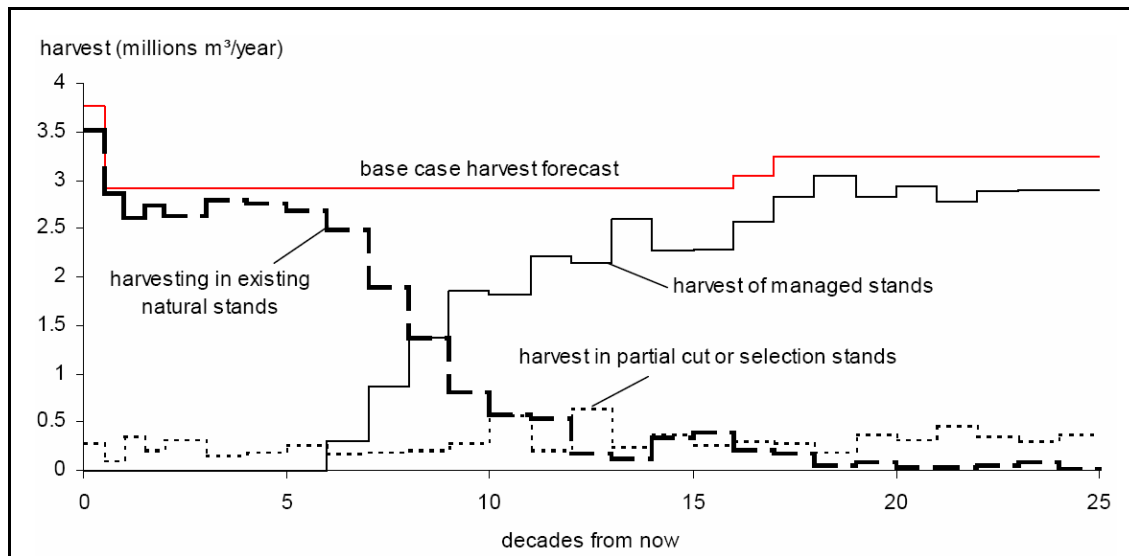


Figure 11. Harvest contribution from managed and unmanaged stands (TSR2).

A site index adjustment project could result in an improvement in the current timber supply situation for the TSA. Figure 12 shows the impact of an Old Growth Site Index (OGSI) adjustment sensitivity analysis from TSR2 (10% increase in midterm flow, and 26% increase in long term flow). This projection gives a good indication of the relative gains that can be expected from a site index adjustment but the absolute values should be seen as optimistic because of several assumptions in the TSR2 base case and the ongoing MPB impacts.

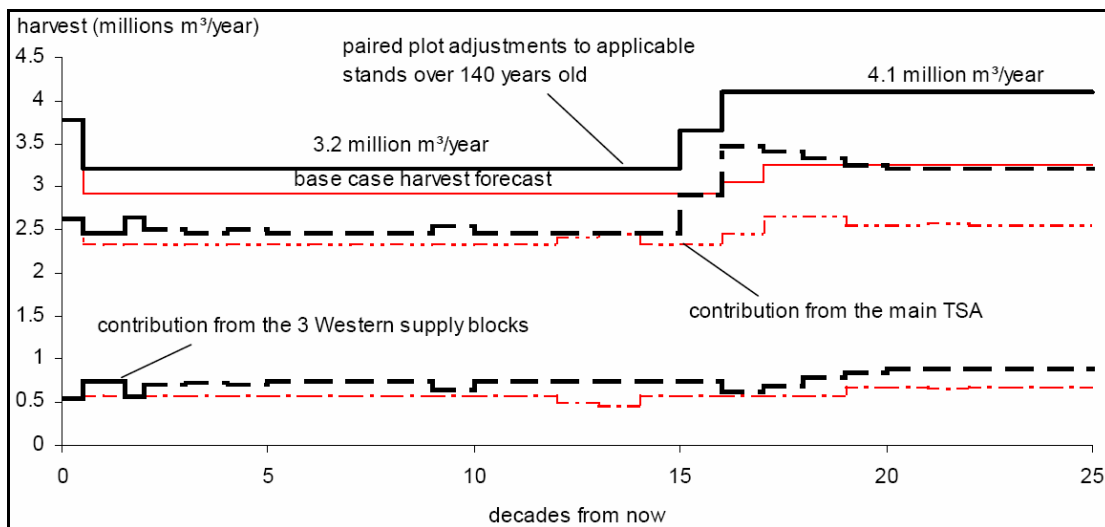


Figure 12. Harvest forecast including an OGSI site index adjustment (TSR2).

Figure 13 shows a hypothetical timber supply forecast incorporating expected impacts from the current MPB infestation using the following assumptions:

- MPB kills 90-100 million m<sup>3</sup> of PI volume in the next 10-15 years.
- MPB uplift of 850,000 m<sup>3</sup>/yearr continues for the next 20 years

- The AAC allows capture of ~90 million m<sup>3</sup> during the period of uplift (~90% of AAC directed at PI volume) and the subsequent 10 yrs and then falls sharply as salvage efforts end.
- TSR2 run showing additional volume harvested at front end had a 2.7 million m<sup>3</sup> midterm level.
- Approximately 10 million m<sup>3</sup> remains unsalvaged and additional areas of younger stands are also impacted (assumed to be a 300,000 m<sup>3</sup> hit during the midterm).
- The TSR2 run showing a site index adjustment (50%), random harvest priority, natural disturbance in the non-THLB, and a 100m<sup>3</sup>/ha merchantability cutoff likely better reflects reality and results in an additional 9% reduction in the midterm.

Midterm harvest levels could potentially be ~2.2 million m<sup>3</sup>/yr because of MPB mortality on the land base. (25% below TSR2 base case values). Harvest levels may start to climb back up to the base case levels in period 12 because natural stands have been converted to managed stands at a faster rate than in TSR2.

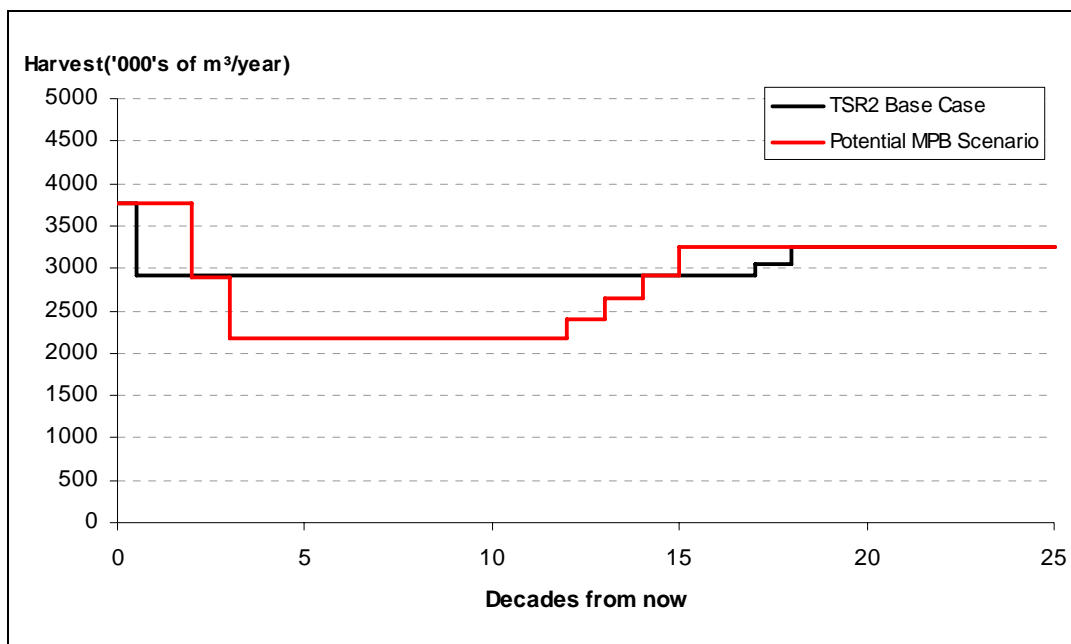


Figure 13. Hypothetical timber supply scenario reflecting potential of MPB impacts.

## 4.1.2 Timber Supply Issues To Address

### 4.1.2.1 Midterm Dip in Harvest Levels

As a result of the sudden reduction in growing stock over the next 10-20 years from the MPB infestation, harvest flow will have to drop into a midterm trough.

### 4.1.2.2 Unsalvaged MPB-killed Timber with Poor/No Regeneration

Lack of AAC and/or lack of access (other values or economics) to timber means that approximately 5,000 ha of mature timber will remain unsalvaged. As a result, this area

will likely have poor or no natural regeneration (assuming it does not burn). Additionally, approximately 25,000 ha of immature stands not currently of merchantable size could be partly or entirely killed by the mountain pine beetle (1/4 of 20-60 year-old PI). This area will also have little or no regeneration.



Figure 14. MPB mortality occurring in 25-20 years old plantation in the Cariboo.<sup>5</sup>

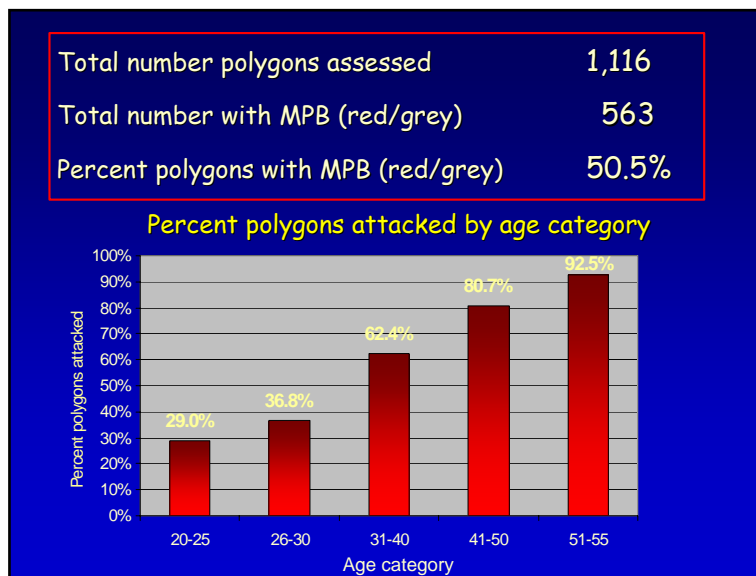


Figure 15. 2005 study examining MPB impacts in younger PI stands in the Cariboo.<sup>6</sup>

It will be key to ensure these all impacted THLB sites with no reforestation obligations are regenerated to maximum potential. If not regenerated, it will be critical to understand the extent of the impacts as they are represented in non-recoverable losses or stand volume reductions.

<sup>5</sup> Photo taken as part of Lorraine Maclauchlan's 2005 study looking at MPB impacts in young stands.

<sup>6</sup> Preliminary results from Lorraine Maclauchlan's 2005 study of MPB impacts in young stands.

#### 4.1.2.3 *Reliance on non-PI leading stands*

Harvesting 30-70 years in the future will likely require a significant reliance on non-PI leading stands.

#### 4.1.2.4 *Impacts on Age Class Distribution*

Given the magnitude of area affected by the mountain pine beetle across many age classes (as low as 30 years to 200+ years old) there will be a large shift of area into a single age class. This large area will become available for harvest at the same period in the future. As well, if this area is dominated with pine, it will also become susceptible to a major MPB epidemic.

## 4.2 Timber Quality Issues

Premium log content would likely fall over the next 80 years because the average age of harvested stands will decline as we move into the harvest of second growth managed stands. The midterm timber supply deficit caused by the MPB will expedite this trend because very young managed stands will be the primary source of harvest during this time. As a result, timber quality (associated with larger piece sizes) will decrease during the deficit period along with average piece size. However, MSR wood is also a quality product that is produced by the mills in the Williams Lake TSA and it will continue to be an important product into the future.

The primary timber quality issues to be addressed are declining piece size and reduced potential for MSR lumber with shorter rotations.

## 4.3 Habitat Supply Issues

Pressures on the environment will come through direct impacts of pine mortality due to the MPB epidemic and indirect impacts of PI and non-PI mortality due to salvage logging and efforts to minimize reductions in AAC during the “fall down” period. The loss of mature and old forest (PI and PI mixed with other species) over the next 10 years will have significant impacts on associated aquatic and terrestrial values.

Significant planning has taken place in the area through the CCLUP to minimize impacts of forest harvesting on environmental values. In some cases, due to changes caused by MPB, the plans are no longer pertinent and require re-evaluation. Specifically, environmental values managed for under the CCLUP and in the Forest and Range Practices Act are being adversely impacted, such as:

- General Biodiversity – old and mature seral objectives; mature/old forest connectivity and patch size objectives
- Parks
- Visual Quality Objectives
- Tourism/Wilderness Objectives
- Mule Deer Winter Range Objectives
- Lakeshore Management Zone Objectives
- Riparian Reserve Zones
- Wildlife Habitat Areas
- Caribou Habitat
- Wildlife Habitat Features
- Community Watersheds

- Water quality/fisheries values for all watersheds
- Species and ecosystems of conservation concern, including Species at Risk

Two natural disturbances types (NDTs) characterize the area where PI and Fd forests dominate in the Williams Lake TSA (Biodiversity Guidebook 1995).

1. NDT 3 (Ecosystems with frequent stand-initiating events)

Absence of fires has increased the mature and old PI component, which provides the MPB a higher than natural level of host trees.

2. NDT 4 (Ecosystems with frequent stand-maintaining fires).

Absence of understorey fires has resulted in a high level of in-growth, and unnaturally high density (especially in the understorey) Fd stands. There is also concern that catastrophic wildfires may occur due to the high fuel accumulations associated with dense stands, and a shift from ground fires to crown fires. Spacing in these stands could provide long term habitat and wildfire management benefits.

Forest biodiversity requirements for old and mature forest dependent species will be adversely affected by the large decline of old and mature seral forest. Table 7 lists examples of wildlife species in the Williams Lake TSA that could be negatively affected by MPB salvage logging.

Table 7. Forest dependent species especially impacted by MPB.

Species/ Ecosystems	Forest Dependency	Habitat Supply Implications
Bull Trout	Cool streams	Hydrologic recovery, green up
Salmon	Water quality/quantity	Hydrologic recovery, green up
Lewis's woodpecker	Stand structure	Mature trees, aspen, mature/old deciduous
Flammulated Owl	Mature/old forest	Old forest habitats
Great Blue heron, herodias subspecies	Mature/old forest	Mature/old stands
Sandhill Crane	Riparian condition Mature conifer forest	Hiding cover adjacent to wetland nesting habitats; low disturbance areas
Northern Goshawk	Mature/old forest	Larger mature/old forest stands
Grizzly Bear	Road sensitive	Access management, road rehabilitation
Fisher	Stand structures, CWD Landscape connectivity	Continuity of habitats across landscape through time
Pine Marten	Stand structure overstory plus CWD Landscape connectivity	Continuity of habitats across landscape through time
Wolverine	Stand structure overstory plus CWD Landscape connectivity	Continuity of habitats across landscape through time
Moose	Riparian condition Mature conifer forest	Thermal and hiding cover
Mule Deer	Old forest and understory	Old forest stand structures
White Wintergreen	Dry to moist mature/old forests	Mature/old forest understory conditions
Fd - PI / cladonia lichens	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand
PI - Sb / red-stemmed feathermoss	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand

Species/ Ecosystems	Forest Dependency	Habitat Supply Implications
PI - cladonia lichens - juniper haircap moss	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand
PI / altai fescue / foam lichens	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand
PI / black huckleberry - velvet-leaved blueberry	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand
PI / black huckleberry / reindeer lichens	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand
PI / Kruckeberg's holly fern - Indian's-dream	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand
PI / Labrador tea - velvet-leaved blueberry	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand
PI / trapper's tea / crowberry	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand
Py / bluebunch wheatgrass	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand
Py / red three-awn	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand

The significant loss of mature/old PI-dominated forest stands will influence riparian ecosystems through changes such as higher water tables, increased erosion due to increased peak flows, increased late summer drought, decreased shade, increased standing dead trees (short term), increased large woody debris (midterm), and eventually decreased large woody debris (long term). Aquatic ecosystems will be affected by warmer water, changes in flow patterns, channel morphology changes, and increased sediment concentrations. There will also be landscape level watershed effects, including increased peak flows and decreased low flows. Increased road access is a major concern because of the potential to exacerbate higher rates of run-off during the freshet and after major storms during the growing season. Roads provide access for people and livestock, both of which can negatively affect wildlife and ecosystems. Existing issues, such as culverts that block fish passage or are historically undersize, and hence, may not be able to handle higher peak flows, could be made worse with pine mortality and increased harvest levels.

There is specific concern regarding where conservation retention areas will be located, should an AAC uplift be approved. The current AAC was set in 2003 and includes 850,000 m<sup>3</sup> to harvest lodgepole PI stands damaged by a MPB infestation in the 1980s and the new beetle outbreak. The immediate preparation of a comprehensive retention plan is required to ensure that habitat and timber resources are managed effectively. This includes protection of riparian systems and maintenance of mixed wood stands. Suitable areas should be identified as part of the retention plan for specific species or species guilds, such as nesting birds and furbearers. There may be an opportunity to use Predictive Ecosystem Mapping together with the habitat requirements for the species to identify those ecosystems to be maintained as part of the retention plan.

Improving hydrologic green up in community watersheds and high value fisheries are a priority. This can benefit both timber and water quality because reforestation outside of salvaged areas will aid long term timber production, in the short-term it will speed hydrological recovery and mitigate habitat impacts. However, care must be taken that reforestation is done in a manner that does not adversely impact the community watershed in the short term.

For this TSA approximately 130 species have been identified by the Conservation Data Centre as being of conservation concern, including rare plant communities (ecosystems). For the purposes of the silviculture strategy, most will not be strongly affected by the MPB epidemic or the associated harvesting or incremental silviculture. Of those that are affected, most do not have to be considered individually, for example salmon, bull trout and rainbow trout could be considered together for any type of treatment plan, as can PI-leading rare ecosystems. Specific management strategies need to be developed for rare species and ecosystems that do not presently have approved strategies, including mechanisms to determine their presence in an area to be treated.

## 5.0 Summary of TSA Issues by Period

### 5.1 Short term

No timber supply issues exist in the short term as the current AAC will be maintained or increased to salvage MPB-impacted wood. Habitat supply issues exist in the short term because of salvage and/or mortality associated with the MPB. Pressure will be put on habitat values and watersheds by elevated harvest levels, loss of older PI stand types, and increases in the amount of active road.

### 5.2 Mid term

The mid term will see reductions in timber supply to levels below the TSR2 base case forecast. Salvage harvesting will have ended and harvest will be focused on remaining mature non-PI stands. Harvesting of these currently existing natural stands will occur in the front and middle portions of the midterm trough, while the back end will be made up of the first managed stands coming online. These stands will be very young and have small piece size, and thus will put pressure on the log quality profile.

The supply of habitat needed to maintain current fish and wildlife populations and maintain biological diversity and complexity will be at high risk because the remaining mature and old forests will be diminished in extent and fragmented in distribution. In addition, it is expected that remaining mature and older forests in the THLB will be under pressure to provide timber harvesting opportunities. At the start of the midterm, many watersheds will have high ECAs from the impacts experienced in the short term and further harvesting may create significant hydrological risks. In addition, some of the tools originally designed to help maintain biological diversity will have been severely impacted by MPB (OGMAs, WTPs, Riparian Areas, Parks, etc). Only the live tree species unharvested today will be available to bridge the midterm habitat supply gap. In addition, climate change has the potential to change ecosystem processes and species habitats in unknown and potentially dramatic ways.

### 5.3 Long term

Long term harvest levels are projected to be above TSR2 levels because of underestimated managed stands site indices but be below potential maximum productivity because of poor or no regeneration on MPB-impacted sites that have no reforestation obligations. Long term harvest levels are most sensitive to the size of the THLB, and the productive capacity of the land base. A site index adjustment project is necessary to update the inventory data to better reflect the growth potential of regenerating stands and understand the long term capacity of the land base.

Timber quality may improve over that experienced at the back end of the midterm trough but it will remain depressed relative to current levels because of short rotations and focus on volume production.

Environmental values, including habitat quality and quantity, will likely have recovered somewhat from the worst period near the front of the midterm trough, but will remain under pressure indefinitely due to an extensively roaded land base managed for growing timber on short rotations (50-100 yrs). In addition, climate change has the potential to change ecosystems and species habitats in unknown and potentially dramatic ways in the long term.

## 6.0 Opportunities to Address TSA Issues

Prior to the district workshop, background information was used to identify the following silviculture strategies as having potential to address timber and habitat issues at the TSA level. Each of these potential strategies was discussed during the workshop to clarify or refine them and/or add new strategies. Each strategy was assigned an effective opportunity area based on data and local knowledge. The impacts on Timber Supply, Timber Quality, and Habitat Supply were estimated and each strategy was given a ranking of High, Medium, or Low (summarized in Table 8).

Table 8. Summary of potential silviculture strategies to address TSA issues.

Strategy	Opportunity in Next 5 yrs (ha)	Timber Supply Effects			Quality	Habitat	Cost/ha (\$)	Rank
		Short	Mid	Long				
TS1 a-b. Late rotation fertilization (40-80yrs old non PI)	13,800	++	++		+	+/-	400	H
TS1 c-d. Late rotation fertilization (81+yrs old) non PI	35,000	+	+		+	+/-	400	H <sup>7</sup>
TS2 a-b. Young stand fertilization (non PI)	43,500		+++		+	++	400	H
TS3 a. Space and fertilize repressed PI	20,000		+	+++	+	++	1000	H <sup>8</sup>
TS4 a. Spacing (drybelt Fd)	150,000		++	+++	++	++	600	H
TS4 b. Spacing non-PI <= 20 yrs old, 5000-10000 sph	1050		+	+	+	+	600	L
TS4 c. Spacing young PI stands	40,000			+++	++	++	600	L-M
TS4 d. Spacing high value stands where CT is anticipated	100		++	+++	++	++	600	L

<sup>7</sup> High on a trial basis only.

<sup>8</sup> High for fertilization treatments in spaced stands

		Timber Supply Effects							
TS4 e. Even aged Fd or Sx stands 21-40 yrs old with densities >5,000 sph	100		++	+++	++	++	600	L	
TS5 a-b. Plant, no potential for salvage, safe areas (MPB, wildfires)	25,100			+++		++	700	H	
TS5 c. Fill-plant, old FG areas now MOFR responsibility (plantations affected by pests, diseases)	500		+	++	+	+	700	L	
TS6 a-b. Site prep. and planting (old MPB, current MPB, Hw looper killed stands)	67,500			+++		++	1700	H	
TS6 c. Site prep. and planting (fuels reduction, major travel corridors near communities)	5000		+	+++		++	1700	L	
TS7 a. Rehab backlog areas	Unknown, need surveys		+	+++	+	+/-	2100	H	
TS7 b. Maintain backlog areas (brush, space)	26,000		+	+		++	600	H	
TS8 a. Rehab non-merch problem forest types	500		+	+++	++	+	1700	L	
TQ1 a-b. Pruning non-PI stands < 20 yrs old	1800				++	++	800	L	
TQ1 c. Pruning previously pruned PI stands (1 <sup>st</sup> lift complete)	120				++	++	800	L	
TQ2 a. Manage for long rotations in existing constrained areas (UWR, Caribou, VQOs)	unknown				++	++	400	H	
TQ3 a. Manage for higher stocking levels for MSR	Subset of TS4b,c				++	++	800	H	
HS1 a-c. Planting NonTHLB sites with no reforestation obligations (habitat focus)	2000		+	+		+	700	H	
HS2 a. Spacing/thinning drybelt Fd stands (ingress/encroachment)	10,000		+	+	++	++	600	VH	
HS2 b. Spacing/thinning mid-seral to mature for old growth attributes	500		+	+	++	++	600	H	
HS3 a. Burn to improve habitat quality in drybelt Fd ecosystems	5000					++	50	H	
HS4 a. Manage for long rotations or spacing of older drybelt Fd stands (partial cut)	100					++	0 <sup>9</sup>	H	
HS5 a. Road and landing rehabilitation	1200		+	+		++	100	H	
HS6 a. Enhance habitats for specific species	??		+	+	+	++	?	H	
HS6 b. Manage invasive plants	Entire TSA						100	H	

The following sections provide additional detail on the potential strategies.

## 6.1 Potential Strategies to Improve Timber Supply

Table 9 provides detail regarding potential timber supply strategies. The information presented reflects discussions at the workshop and provides additional information for each strategy and how they were ranked.

<sup>9</sup> Treatment costs and revenues are considered equal for commercial tree species.

Table 9. Timber supply strategy details.

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TS1a-b Late rotation fertilization of near mature Fd and Sx stands (wetbelt stands 40-80 years old)	<p>These stands will be candidates for harvesting near the front end of the trough. The intent is to add volume to these stands to reduce the depth of the front end of the trough. Focus is Fd stands first as it has a greater response than Sx. Moisture limited sites (drybelt) should be avoided.</p> <p>Priority = High (one of the few opportunities to influence the front end of the trough)</p>	<p>Fd -17m<sup>3</sup>/ha per application.<sup>10</sup> Sx -11 m<sup>3</sup>/ha per application.</p> <p>Benefit realized over 10 year period.</p>	Short to Midterm
TS1c-d Late rotation fertilization of older Fd and Sx stands (wetbelt stands 81-140 years old)	<p>These stands will be candidates for harvesting near the front end of the trough. The intent is to add volume to these stands to reduce the depth of the front end of the trough. Moisture limited sites (drybelt) should be avoided.</p> <p>Priority = High as a trial. Response is less certain as data is limited on treating older stands; therefore a trial is suggested for stands at the younger end of the range.</p>	<p>No North American data but response could be similar to younger stand benefits described above.</p>	Short to Midterm
TS2 a-b. Young stand fertilization (Fd and Sx)	<p>These stands will be candidates for harvesting in the mid-back end of the trough. The intent is to add volume to these stands more quickly through several fertilizations at 10 yr intervals. This will make these stands available sooner or have more volume at time of harvest. Moisture limited sites (drybelt) should be avoided.</p> <p>Priority = High. The intent is to focus on Fd first over Sx because of better response and concerns around terminal weevil. <i>Once the risks associated with MPB are reduced, treatment of younger PI stands will become a high priority with very large potential benefits.</i></p>	<p>Fd - 17m<sup>3</sup>/ha per application. Sx - 11 m<sup>3</sup>/ha per application.</p> <p>Benefit realized over 10 year period.</p>	Back end of Midterm
TS3 a. Space/fertilize repressed PI	<p>Several recent small scale studies have shown spacing and fertilization of these stands has the potential to break them out of their stagnant condition and promote height differentiation.</p> <p>Priority = High on areas that have already been spaced, Low on other areas that require spacing and fertilization due to uncertainty of success.</p>	<p>Bring stands back into the THLB or improve their merchantable volume (~100 m<sup>3</sup>/ha).</p>	Mid to Long Term

<sup>10</sup> Rob Brockley, pers comm., August 2005. More detailed provided in Fertilization Backgrounder, Forsite et al. 2005. BC interior data on Fd and Sx data is unpublished. Published PI data for the BC interior is showing average response of 12m<sup>3</sup>/ha per application (Brockley 2001).

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TS4 a. Spacing (drybelt Fd – Managed Forest Types)	<p>Spacing in layer 3 to thin out stagnant thickets will help to realize more merchantable volume in subsequent entries. Some stands will also require treatment of layer 2 to achieve the objective. Dealing with budworm through spraying of BTK will be required in many of these stands prior to any spacing treatments. There was interest expressed in implementing a trial that looked at fertilizing these stands as well (BTK+space+fertilization).</p> <p>Priority = High – lots of potential area and both timber and non-timber benefits will be achieved (habitat, urban interface fuels reductions, etc). MOE had concerns over large scale BTK spray programs because of impacts to non target lepidoptera species.</p>	Based on Ken Day's research on thinning these stands, it was felt that 30m <sup>3</sup> /ha was a conservative potential gain.	Mid to Long Term
TS4 b. Space non-PI stands <= 20 years old, 5000 – 10000 sph	<p>Improve merchantability of remaining stems; reduce time to 1<sup>st</sup> entry (technical rotation).</p> <p>Priority = Low</p>	Maintain productivity of the THLB.	Mid to Long Term
TS4 d. Space high value stands where CT is anticipated	<p>Not many stands available where CT would pay, should try some in high productivity non-PI stands.</p> <p>Priority = Low due to limited stand availability.</p>	Opportunity to improve piece size/wood quality and provide a stand entry in the mid-term.	Mid to Long Term
TS4 e. Space even-aged Fd and Sx stands 21-40 years old, > 5000 sph	<p>Improve merchantability of remaining stems; reduce time to 1st entry (technical rotation), not many stands available.</p> <p>Priority = Low due to limited stand availability and potential for leader weevil damage.</p>	Opportunity to improve piece size/wood quality and provide a stand entry in the mid-term.	Mid to Long Term
TS5 a-b. Planting where there is no existing reforestation obligation and no potential for salvage harvesting (timber focus)	<p>Ensuring that all of the THLB is promptly regenerated will have significant timber supply and habitat supply benefits. Candidate areas are stands killed by MPB and/or other natural mechanisms and not salvaged (wildfires), or areas that are salvaged and have no reforestation obligations on them (i.e. small scale salvage). Planting under dead stems may be an option if done quickly (need to work with WCB to allow access) although there is concern over future access for other treatments (spacing, brushing, etc).</p> <p>Priority = High on area where natural regeneration is expected to be poor or slow. One of the most cost effective ways to improve timber supply and habitat supply. Habitat supply would benefit most from regeneration in highly impacted/high risk watersheds.</p>	Maintain productivity of the THLB.	Mid to Long Term
TS5 c. Fill plant areas declared FG that are MOFR responsibility but have dropped below minimum stocking	<p>Some areas have been declared FG and have since been affected by insect/disease damage to the point where they are not producing volume at levels assumed in TSR2.</p> <p>Priority = Low (limited area available)</p>	Maintain productivity of the THLB.	Mid to Long Term

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TS6 a-b. Site preparation and planting	Some old MPB (1980s), Hw Looper, and current MPB sites will require snag knockdown before they will be safe to plant, others will also require additional site preparation (piling).  Priority = High where economics are reasonable)	Maintain productivity of the THLB.	Mid to Long Term
TS6 c. Site preparation and planting (fuels reduction)	Some old MPB (1980s), Hw Looper, and current MPB sites will require snag knockdown before they will be safe to plant, others will also require additional site preparation (piling).  Priority = High (Looper and old MPB in short term, new MPB longer term).	Maintain productivity of the THLB.	Mid to Long Term
TS7a-b. Backlog rehab and maintenance	There are still a few hectares of backlog NSR that require site preparation and planting or brushing and fill planting. In addition, there are sites that require brushing treatments to protect the investments that have already been made (i.e., backlog impeded stands).  Priority = High because THLB land is not producing an appropriate crop or there is a significant potential to lose previous investments.	Increase the size and maintain the productivity of the THLB.	Mid to Long Term
TS8 a. Rehab non-merchantable problem forest types	Many of these areas are not included in the cut. However, they are often difficult to identify on the ground and make a commitment to the aggressive treatments that would be required to prepare them for planting.  Priority = Low due to high costs along with the difficulty in locating and prescribing these sites.	Increase the size of the THLB.	Mid to Long Term

## 6.2 Potential Strategies to Improve Timber Quality

Detail regarding potential timber quality strategies that were discussed in the workshop is presented in Table 10.

Table 10. Strategies to Improve timber quality

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TQ1. Pruning	Clear logs were not a priority for the TSA thus pruning was not deemed an economically suitable treatment at this time.	NA	NA
TQ2. Manage for long rotations, partial cut, and fertilize	This option does not fit with the objective of managing for a mid term trough. It may be an option where harvest is constrained by non timber objectives that force longer rotations (VQOs, MDWR, Cariboo, etc).	Larger piece sizes, diversity in log products.	Long Term
TQ3. Manage for Higher Densities on a portion of the land base	This was seen as a possible option but must be coordinated with other options that are promoting shorter rotations to fill the midterm trough.	MSR grade timber.	Long Term

## 6.3 Potential Strategies to Improve Habitat Quality

Table 11 provides detail regarding the potential habitat supply strategies discussed in the workshop.

Table 11. Strategies to Improve habitat quality

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
HS1 a-c. Planting NonTHLB sites with no reforestation obligations (habitat focus)	<p>Reforestation of non-THLB areas impacted MPB can improve habitat quality. The intention is to plant trees and/or shrubs with a habitat focus (use of broadleaves, diverse spacing, etc). Intent is to treat without removal of dead stems so there is a need to address this quickly by working with WCB to allow access. Potential candidate areas include heavily impacted watersheds, riparian reserves/management zones<sup>11</sup>, WTPs, and potentially OGMAs.</p> <p>Priority = High</p>	Improved habitat quality hydrologic recovery, improved recovery of pine dominated riparian for shade and reductions in stream temperature.	Continuous
HS2 a-b. Thinning/Spacing drybelt Fd stands	<p>An integrated strategy incorporating timber and habitat objectives is needed. Focus on cover objectives (e.g., MDWR) and/or removal of ladder fuels from a habitat perspective. Habitat specific treatments would aim to reduce ingress / encroachment in historically open stands [Grasslands Strategy].</p> <p>There is also a desire to treat select mid to mature seral stands where old growth attributes need to be accelerated (deficit LU – BEC Units).</p> <p>Priority = drybelt: Very High, Others: High</p>	Improved stand structure in drybelt Fd types. Reduce crown fire risk, a shift back towards stand structures with a range of natural variables( less stems and more understory). Reduced interface fire hazard.	Short to Midterm
HS3 a. Underburn to improve habitat quality	<p>The primary focus is to follow-up drybelt spacing treatments with underburning to promote historic ecological processes.</p> <p>Priority = High</p>	Improved stand structure in drybelt Fd types. Reduce crown fire risk, a shift back towards stand structures with a range of natural variables(less stems and more understory). Promote earlier development of old growth characteristics in selected stands. Reduced interface fire hazard.	Short to Midterm
HS4 a. Manage for long rotations or spacing of older drybelt Fd stands (partial cutting)	<p>Partial cutting, particularly where the PI component can be removed effectively, provides an opportunity to extend rotations and create stand structures that will be come less common over time (e.g., large dbh).</p> <p>Priority = High</p>	Larger diameter stems will be available for species with that habitat preference; premium logs goals will be promoted.	Mid to Long Term

<sup>11</sup> Restoration of riparian ecosystems associated with the following areas will be key: fish bearing streams, wetlands, temperature sensitive streams, and community watersheds.

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
HS5 a. Road and landing rehabilitation	Restrict access to areas by rehabilitation of dead-end spurs in blocks and landings – especially large landings. Other roads should be looked at within a coordinated access plan. Priority = High	Road density reduced, less access for predators and human disturbance.	Continuous
HS6 a. Enhance habitats for specific species	There will be opportunities to improve specific habitats (e.g., riparian) while focusing on larger scale MPB treatments. Potential sites will be identified (found) during layout of larger scale treatment areas to minimize impacts on species and ecosystems of conservation and management concern. Priority = High	Enhance the expected benefits from larger scale treatments proposed in this strategy while ensuring that other (often small) important habitats are protected or enhanced.	Continuous
HS6 b. Treat invasive weeds	There is a significant potential for invasive plants to increase with the level and wide distribution of harvesting that is required to deal with the MPB epidemic. Also, invasive plants have the potential to reduce the effectiveness of drybelt Fd enhancements treatments. Priority = High	Maintain expected benefits from other treatments proposed in this strategy, make up for lack of historic funding and maintain weed issues in the Williams Lake TSA at a relatively low level (compared to other areas).	Continuous

## 6.4 General Stewardship Strategies

Table 12 provides a list of general strategies that will assist in meeting the TSAs issues (timber supply/timber quality, habitat supply) but are not considered incremental silviculture strategies because they:

- fall under basic licensee silviculture obligations, or
- are considered outside the scope of a silviculture strategy (i.e. harvesting practices), or
- are information gathering requirements.

Table 12. General stewardship strategies

Strategy	Workshop Comments / Discussion
GS1. Minimize regeneration delay	Decrease regeneration delay and get stands online sooner. Planting instead of relying on naturals may be considered in some ecosystems in the TSA. MoE strongly supports planting to mitigate watershed level impacts on selected watersheds. However, there is concern with stocking density and tree species diversity. This applies to all stands types. Increasing diversity is considered prudent for biological diversity and timber in the long term and a hedge against climate change.
GS2. Use improved planting stock (best available) whenever possible	Get stands online sooner, improve merchantable volume. Increase diversity of planting stock.
GS3. Protect Growing Volume, Don't clearcut low % PI stands	Stands with PI as a minor species. Remove only PI or don't harvest at all. Need to keep green timber growing and available for deficit period (midterm).

Strategy	Workshop Comments / Discussion
GS4. Partial Harvest during Deficit Period	Constrained areas (VQOs, MDWR, etc) in deficit period. Help to realize volume and will supply more premium logs (older stands).
GS5. Ensure Flexibility around Minimum Harvest Ages (midterm only)	Regenerating stands where minimum harvest ages are above merchantability limits. Allowing short term flexibility to harvest younger stands could dramatically help in the midterm with smaller long term consequences.
GS6. Forest Cover Re-Inventory	There is a need to update the inventory to better reflect net stands volumes on the landbase – specifically Cw/Hw, drybelt Fd, and MPB impacted stands.
GS7. Complete a site index adjustment project	Adjusting site indexes in the inventory to reflect managed stand potentials will have the single biggest impact on timber supply of any strategy discussed in this report. Ecosystem mapping meeting accuracy requirements set out by Forest Analysis Branch is required (in progress).
GS8. Better define growth and yield predictions for complex stands (drybelt Fd)	Yields for sites under selection management may be underestimated.
GS9. Protect growing volume from forest health threats	Non-PI stands, need to keep green timber growing and available for use in the deficit period (mid-term)
GS10. Vary regenerated stand spacing/density	Ensure that managed stands provide a range of structural habitats over time.
GS11. Manage Tree Species for Diversity	Retain or establish non PI species, including broadleaves, during spacing, thinning, or planting.
GS11. Vary regenerated stand spacing	Stands to be spaced, Leave clumps, low and high densities to also encourage a diversity of products and habitats. (relates to timber supply strategies)
GS12. Complete an Access Management Plan	Watersheds with high wildlife values or extensive road systems. Need to limit access within forested land base when so much of it will be opened up all at once for salvage purposes.
GS13. Complete Retention Planning associated with salvage	TSA as a whole, need to establish BMPs for salvage of timber and spatially identify areas where salvage is a lower priority than non-timber values.

## 7.0 Working Targets

The following working targets were created using the current TSA situation as outlined in this document. The targets reflect what the TSA would like to achieve through the implementation of this silviculture strategy. It is recognized that it may not be possible to achieve all of the targets because of limited budgets or conflicts between targets, but they are presented to help frame high level objectives for the TSA.

### 7.1 Timber Supply Targets

Short Term (0-20 years)

- Capture as much of the MPB mortality in the THLB as possible.

Mid Term (30-70 years)

- Minimize the depth and duration of the midterm trough.

Long Term (70 years+)

- Maintain long term harvest level at or near the productive capacity of the land base.

## 7.2 Timber Quality Targets

### Mid – Long Term

- Manage for a diversity of currently valuable premium wood types (house logs, peelers, poles, MSR) to ensure that they are available over time.

Overall the intent is favour timber supply strategies over quality strategies where resources are limited. There is also a need to recognize the importance of MSR wood in the quality discussions in this TSA.

## 7.3 Habitat Supply Targets

### General

- Retention strategy developed
- Minimize impacts on watersheds, ecosystems and species across landscapes and within stands in both the short and long term (improve or maintain where opportunities exist)
- Increase use of broadleaved trees and other appropriate species on the land base

# 8.0 Silviculture Strategy

This section summarizes the preferred silviculture strategy developed at the Williams Lake TSA workshop. First, the high priority strategies are outlined and then two different 5-year implementation plans/budgets are presented. The idealized plan/budget reflects TSA needs over the next 5 years and was not constrained by anything other than the availability of stands for treatment, desire to complete the treatments, and logical timelines for treatments. The constrained plan/budget reflects a five year flat-line budget that is relatively consistent with historical funding levels for incremental silviculture.<sup>12</sup> This plan/budget illustrates where resources would be allocated if resources were limited.

## 8.1 High Priority Strategies

The workshop group in the Williams Lake TSA considered the following strategies to be high priority for implementation in the next five years. The treatment of PI stands was avoided because of the risk associated with MPB; spacing and fertilization treatments that can begin in approximately 10 years have the potential to add significant gains to the timber supply profile.

### Late Rotation Fertilization (40-80 year old Fd and Sx stands, non-drybelt)

Late rotation fertilization was identified as the only means of making more volume available at the front end of the midterm timber supply trough and is seen as the

<sup>12</sup> The 2002 FRBC RMP spreadsheets were used to define a historical expenditure level and then it was increased somewhat to reflect expected funding levels in the next 5 years

most cost effective method of fertilization.<sup>13</sup> Fertilization is restricted to non-drybelt sites due to moisture limitations on fertilizer uptake. Fd stands were considered more desirable to treat due to the higher volume gains compared with Sx stands. Stands older than 80 years may also represent an opportunity but it was felt that treatment of these stands should be limited to operational trials only.

#### Young Stand Fertilization (15-40 year old Fd and Sx stands, non-drybelt)

Fertilization of younger stands was identified as a good opportunity to add volume to the middle and back end of the midterm timber supply trough. Fd was considered the more desirable species to treat due to higher volume gains and the concern of leader weevil attacks in young Sx stands<sup>14</sup>. These stands will provide options for multiple treatments prior to harvest and can therefore provide a larger net impact if funding can be sustained over several decades. The risks associated with this treatment are the long timeframes over which the investment must be held and protected from loss (i.e. pests or other natural disturbances).

#### Spacing / Thinning for Timber and Habitat Values

Large areas of drybelt Fd have regenerated naturally with dense thickets under mature overstories. These ecosystems are adapted to fire which had the ability to thin the understory, reduce ladder fuels, and create more open conditions for surviving trees. With the exclusion of fire, high understory densities limit individual tree growth, increase ladder fuels, reduce habitat suitability for a range of wildlife species, and generally slow recruitment of trees into larger classes over time.

An integrated strategy that includes harvesting, treatment of budworm (BTK), thinning, and burning is required to optimize the benefits from the treatment of these drybelt stands. Realizing timber and habitat benefits will require flexibility in prescribing post spacing densities over the landscape. Layer 3 is the primary concern but a subset of stands may require that layer 2 be addressed. Also, the strategy must be part of a long-term plan for uneven-aged management that considers forest health agents (e.g., spruce budworm), ungulate winter range objectives, and long term sustainable timber flows as each layer recruits into successive layers. This strategy is a high to very high priority, as it will yield habitat and timber supply benefits. It also has the potential to integrate with wildland/urban interface fuel treatments. A desire was expressed to develop a trial that looked at fertilizing these stands as well (BTK+spacing+fertilization).

Spacing/thinning treatments to promote old growth attributes could also be implemented. These treatments should focus on Landscape Unit/BEC combinations where there is a deficit in old growth habitats with the objective of accelerating their development.

#### Planting for Timber Values

Benefits were identified for planting impacted areas of the THLB that have no reforestation obligations. Planting these sites will provide future volume and ensure timely access to the remaining mature timber in heavily impacted watersheds or landscape units. The assumption is that a portion of the impacted areas will remain

<sup>13</sup> Return on investment analysis often shows positive values for late rotation fertilization because of the shorter period over which the investment must be held before realizing the gain (~10 yrs). This short period also means less risk of losing the investment to pests or natural disturbances when compared with fertilization of younger stands.

<sup>14</sup> Studies where young Sx stands are fertilized have shown increased weevil damage but the net gains are still positive. This is likely part of the reason why mean Sx fertilization response is lower than that of mean Fd response.

unharvested due to AAC capacity and /or marginal economics and, depending upon the site; natural regeneration may be slow or unable to reforest the site. This includes PI stands impacted by MPB and areas burned by wildfires.

There are numerous logistical challenges for this strategy. First, areas have to be identified that will not (likely) be salvage harvested. Second, areas need to be prioritized to identify those that would benefit from artificial regeneration (i.e. not regenerate naturally for a long period) and would best help non-timber values. Third, work must be coordinated with WCB to ensure safe working conditions for planters and those who follow. Fourth, seedlings need to be ordered and funded.

### Planting for Habitat Values

Benefits were identified for planting heavily impacted areas of the NonTHLB where natural regeneration is not expected to occur in a reasonable amount of time (i.e. portions of selected watersheds, riparian areas, WTP, retention areas, and specific watersheds where hydrologic green up will speed recovery and reduce risk to fish). Planting these sites with conifers, broadleaves, and/or shrubs will provide improved habitat values in high risk/high values areas. There is a time limit on making decisions for these areas, as it is not considered practical if snag falling is required. A timely under-planting program, coordinated with WCB concerns in mind, will need to be pursued. Since there are short term benefits to hydrological /aquatic values and long term timber benefits to rapid reforestation these treatments require consideration of environmental risk and coordination with timber salvage operations.

### Address Backlog Issues

Both backlog NSR and impeded stands were identified as candidates for treatment. Fill planting or brushing treatments are planned to add additional volume in the mid to back end of the trough. This ongoing program includes prioritizing stands based on their potential for treatment response/success. In some instances the no treatment option is preferred to promote structural diversity at the landscape scale, and because of low return on investment.

### Under-burning in Drybelt Fd Stands

A program of underburning in drybelt Fd stands will help to promote or maintain desired stand structures and ecosystem health. Under-burning should be coordinated with spacing/thinning treatments to optimize the treatment benefits, including reduction of interface fire hazards.

### Manage for Long Rotations

Managed stands will be harvested at relatively young ages in the future and it is important to recognize that habitats associated with older stands will become less common. There is an opportunity to manage a component of the land base using partial cutting and longer rotations to ensure that stands with larger average diameter are available throughout the landscape. This may have specific applicability in constrained areas including riparian habitats, designated VQ corridors, MDWR, and caribou habitat. This strategy will provide timber quality and habitat supply benefits.

### Rehabilitation of Roads

Removing access opportunities on the land base will have long term timber and habitat benefits.

### Enhance Habitats for Specific Species

One of the most significant problems with managing unique habitats is the lack of an inventory of their location and character. It is important to recognize and delineate these rare and important habitats while MPB layout progresses; some of them may then be available for specific habitat enhancement treatments (e.g., mixed species tree and shrub plantings in riparian areas).

#### Treat Invasive Plants

The Williams Lake TSA has a developing weed problem. Aggressive treatments are required to ensure that treatment benefits are realized and that invasive plant problems are managed effectively.

#### Maintain Tree Species Diversity

Wherever ecologically feasible, there should be a focused commitment to manage for all ecologically appropriate species, including deciduous trees. Where rehabilitation treatments are being prescribed, species conversions should be avoided; this is of particular importance in ICH subzones.

#### Site Index Adjustment Project

Improving the estimates of site productivity for managed stands in the TSA will have the single largest impact on timber supply relative to all strategies presented in this document. It would be extremely helpful to have this information at the time of the next timber supply review as the implications of the MPB mortality will not be fully known until a site index adjustment is incorporated into the analysis.

#### Retention Strategy Planning

The retention strategy will provide clarity on available harvest/salvage areas, as well as identification of long-term retention areas that may benefit from under-planting. Identifying areas for planting (i.e. dead, unsalvaged areas) will be problematic until a retention strategy is in place.

#### Use of Improved Seed

Continuing to maximize use of improved seed will improve timber supply forecasts in subsequent timber supply analyses.

## 8.2 Silviculture Strategy Program (Idealized Funding Level)

This section describes an idealized (no constraints on dollars or manpower) silviculture program in terms of area treated (ha), budget requirements (\$), and job outcomes (person days). It assumes approximately \$63 million are available over the next five years.

### Proposed Area Treated (ha)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	-	-	-	-	-	-
Fertilize	11,200	10,700	10,700	10,700	10,700	54,000
Spacing/Thinning (timber)	5,100	5,000	5,000	5,000	5,000	25,100
Spacing/Thinning (habitat)	2,000	2,000	2,000	2,250	2,250	10,500
Planting (timber)	-	2,000	2,000	1,000	1,000	6,000
Planting (habitat)	-	450	450	450	650	2,000
Pruning	-	-	-	-	-	-
Rehab roads	-	30	30	30	30	120
Address Backlog NSR/Impeded	1,000	2,000	4,000	5,000	5,000	17,000
Treat for Invasives/Noxious weeds	2,000	2,000	2,000	2,000	2,000	10,000
Habitat Enhancement/Underburning	1,000	1,000	1,000	1,000	1,000	5,000
<b>Totals</b>	<b>22,300</b>	<b>25,180</b>	<b>27,180</b>	<b>27,430</b>	<b>27,630</b>	<b>129,720</b>

### Proposed Budget (\$)

Activity	Year 1 (\$)	Year 2 (\$)	Year 3 (\$)	Year 4 (\$)	Year 5 (\$)	Totals (\$)
Studies/Surveys	\$ 1,024,000	\$ 100,000	\$ -	\$ -	\$ 125,000	\$ 1,249,000
Fertilize	\$ 4,480,000	\$ 4,280,000	\$ 4,280,000	\$ 4,280,000	\$ 4,280,000	\$ 21,600,000
Spacing/Thinning (timber)	\$ 3,100,000	\$ 3,000,000	\$ 3,025,000	\$ 3,000,000	\$ 3,000,000	\$ 15,125,000
Spacing/Thinning (habitat)	\$ 800,000	\$ 800,000	\$ 800,000	\$ 950,000	\$ 950,000	\$ 4,300,000
Planting (timber)	\$ -	\$ 3,000,000	\$ 1,400,000	\$ 1,050,000	\$ 1,050,000	\$ 6,500,000
Planting (habitat)	\$ -	\$ 315,000	\$ 315,000	\$ 315,000	\$ 455,000	\$ 1,400,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab roads	\$ -	\$ 171,000	\$ 171,000	\$ 171,000	\$ 171,000	\$ 684,000
Address Backlog NSR/Impeded	\$ 600,000	\$ 1,200,000	\$ 2,400,000	\$ 3,000,000	\$ 3,000,000	\$ 10,200,000
Treat for Invasives/Noxious weeds	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 1,000,000
Habitat Enhancement/Underburning	\$ 125,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 925,000
<b>Totals</b>	<b>\$ 10,329,000</b>	<b>\$ 13,266,000</b>	<b>\$ 12,791,000</b>	<b>\$ 13,166,000</b>	<b>\$ 13,431,000</b>	<b>\$ 62,983,000</b>

### Job Outcomes

Activity	Year 1 Person Days	Year 2 Person Days	Year 3 Person Days	Year 4 Person Days	Year 5 Person Days	Totals Person Days
Studies/Surveys	3,413	333	-	-	417	4,163
Fertilize	1,120	1,070	1,070	1,070	1,070	5,400
Spacing/Thinning (timber)	17,289	16,950	16,950	16,950	16,950	85,089
Spacing/Thinning (habitat)	6,800	6,800	6,800	7,650	7,650	35,700
Planting (timber)	-	6,000	6,000	2,250	2,250	16,500
Planting (habitat)	-	900	900	900	1,300	4,000
Pruning	-	-	-	-	-	-
Rehab roads	-	30	30	30	30	120
Address Backlog NSR/Impeded	4,600	9,200	18,400	23,000	23,000	78,200
Treat for Invasives/Noxious weeds	2,000	2,000	2,000	2,000	2,000	10,000
Habitat Enhancement/Underburning	200	200	200	200	200	1,000
<b>Totals</b>	<b>35,422</b>	<b>43,483</b>	<b>52,350</b>	<b>54,050</b>	<b>54,867</b>	<b>240,172</b>

In addition to the above strategies/investments, a site index adjustment project, preparation of a retention strategy, and preparation of an access management plan were considered as very high priorities for completion. The studies/surveys listed in the tables above reflect the initial setup of specific programs (e.g. identify and prioritize fertilization candidates), the cost of a Type 2 Silviculture Strategy, and a seed needs/acquisition

strategy. Ongoing survey and layout costs associated with specific strategies are included in the strategy costs.

### 8.2.1 Expected Outcomes (Idealized Funding Level)

If approximately \$63 million was invested over a 5-year period, the following outcomes could be expected:

#### Estimated Timber Supply Outcomes

- 196,300 m<sup>3</sup> made available at the front end of the trough
  - Realized from late rotation fertilization.
- 1,316,300 m<sup>3</sup> made available in the middle of the trough
  - Realized from drybelt Fd spacing (thinning from below) and fertilization of young (15 – 40 year-old) Fd and Sx leading stands.
- 1,300,000 m<sup>3</sup> made available in the back end of the trough
  - Realized through maintaining previously planted NSR sites (impeded stands) and reforestation MOFR responsibility lands in unsalvaged MPB areas and stands impacted by hemlock looper.

#### Timber Quality Outcomes

- None

#### Habitat Supply Outcomes

- Improved stand structure and ecosystem health on 35,000 ha of drybelt Fd stands by thinning/spacing, 5000 hectares of under burning, and 500 hectares of spacing to promote old growth structural conditions.
- Speed hydrologic recovery by regenerating 2000 ha of stands with a habitat focus, and regenerating 6000 ha of stands with a timber focus.
- Invasive plants will have been treated on 10,000 hectares
- 120 hectares of road and landing rehabilitation to protect wildlife and recreation values.
- Minimized loss of habitat of species and ecosystems of conservation and management concern through silviculture activities..

### 8.2.2 Expected Outcomes for 20 Year Investment (Idealized Funding Level)

If this level of funding was continued for 20 years (\$252 million total) and similar benefits were achieved throughout, the midterm trough could be maintained at a level 125,000 m<sup>3</sup>/yr higher than currently projected in the Potential MPB Scenario (Figure 16). Both of these forecasts are highly speculative and there is no guarantee that enough suitable treatment areas could be found for the 20-year potential investment run. Completion of a site index adjustment project would further improve the mid and long term harvest levels but it was not possible to estimate the effect without completing appropriate model simulations.

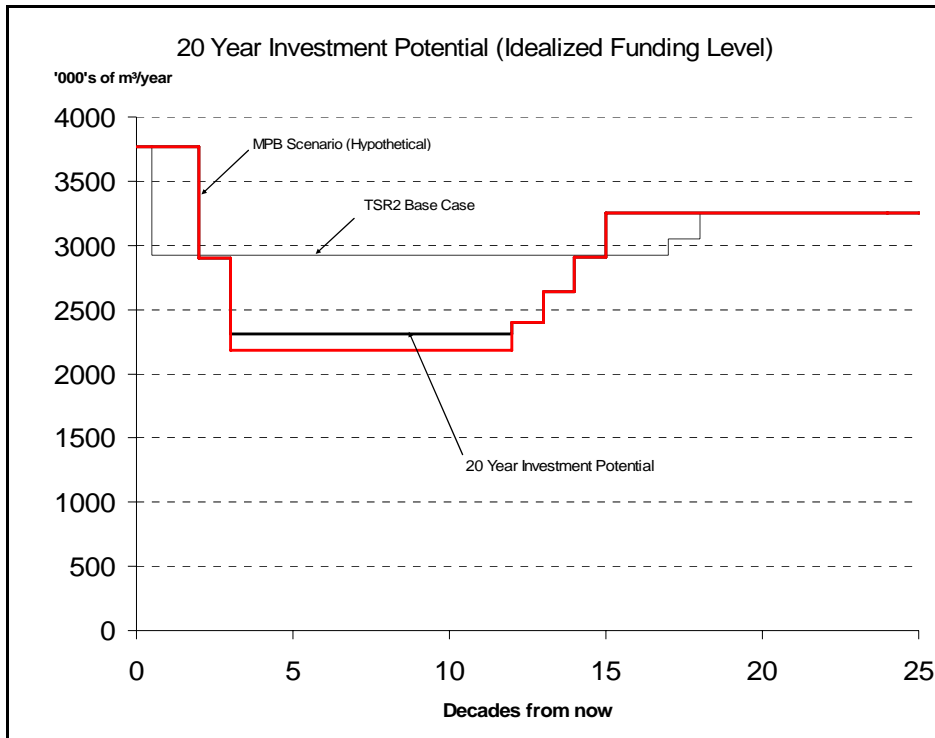


Figure 16. 20 year continuous investment (idealized funding level).

### 8.3 Silviculture Strategy Program (Historical Funding Level)

This section describes a silviculture program constrained to approximately 7.9 million dollars per year over five years, in terms of area treated (ha), budget requirements (\$), and job outcomes (person days).

#### Proposed Area Treated (ha)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	-	-	-	-	-	-
Fertilize	11,200	8,700	9,200	5,700	5,000	39,800
Spacing/Thinning (timber)	1,100	1,500	2,000	2,500	2,500	9,600
Spacing/Thinning (habitat)	1,000	2,000	2,000	2,250	2,250	9,500
Planting (timber)	-	100	100	1,100	1,100	2,400
Planting (habitat)	-	450	450	450	650	2,000
Pruning	-	-	-	-	-	-
Rehab roads	1,000	1,030	2,030	2,030	2,030	8,120
Address Backlog NSR/Impeded	-	-	-	-	-	-
Treat for Invasives/Noxious weeds	2,000	2,000	2,000	2,000	2,000	10,000
Habitat Enhancement/Underburning	1,000	1,000	1,000	1,000	1,000	5,000
<b>Totals</b>	<b>17,300</b>	<b>16,780</b>	<b>18,780</b>	<b>17,030</b>	<b>16,530</b>	<b>86,420</b>

#### Proposed Budget (\$)

Activity	Year 1 (\$)	Year 2 (\$)	Year 3 (\$)	Year 4 (\$)	Year 5 (\$)	Totals (\$)
Studies/Surveys	\$ 1,024,000	\$ 100,000	\$ -	\$ -	\$ 125,000	\$ 1,249,000
Fertilize	\$ 4,480,000	\$ 3,480,000	\$ 3,680,000	\$ 2,280,000	\$ 2,000,000	\$ 15,920,000
Spacing/Thinning (timber)	\$ 700,000	\$ 900,000	\$ 1,225,000	\$ 1,500,000	\$ 1,500,000	\$ 5,825,000
Spacing/Thinning (habitat)	\$ 400,000	\$ 800,000	\$ 800,000	\$ 950,000	\$ 950,000	\$ 3,900,000
Planting (timber)	\$ -	\$ 1,250,000	\$ 250,000	\$ 1,220,000	\$ 1,220,000	\$ 3,940,000
Planting (habitat)	\$ -	\$ 315,000	\$ 315,000	\$ 315,000	\$ 455,000	\$ 1,400,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab roads	\$ -	\$ 771,000	\$ 1,371,000	\$ 1,371,000	\$ 1,371,000	\$ 4,884,000
Address Backlog NSR/Impeded	\$ 600,000	\$ -	\$ -	\$ -	\$ -	\$ 600,000
Treat for Invasives/Noxious weeds	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 1,000,000
Habitat Enhancement/Underburning	\$ 125,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 925,000
<b>Totals</b>	<b>\$ 7,529,000</b>	<b>\$ 8,016,000</b>	<b>\$ 8,041,000</b>	<b>\$ 8,036,000</b>	<b>\$ 8,021,000</b>	<b>\$ 39,643,000</b>

#### Job Outcomes

Activity	Year 1 Person Days	Year 2 Person Days	Year 3 Person Days	Year 4 Person Days	Year 5 Person Days	Totals Person Days
Studies/Surveys	3,413	333	-	-	417	4,163
Fertilize	1,120	870	920	570	500	3,980
Spacing/Thinning (timber)	3,729	5,085	6,780	8,475	8,475	32,544
Spacing/Thinning (habitat)	3,400	6,800	6,800	7,650	7,650	32,300
Planting (timber)	-	300	300	2,550	2,550	5,700
Planting (habitat)	-	900	900	900	1,300	4,000
Pruning	-	-	-	-	-	-
Rehab roads	-	30	30	30	30	120
Address Backlog NSR/Impeded	4,600	4,600	9,200	9,200	9,200	36,800
Treat for Invasives/Noxious weeds	2,000	2,000	2,000	2,000	2,000	10,000
Habitat Enhancement/Underburning	200	200	200	200	200	1,000
<b>Totals</b>	<b>18,462</b>	<b>21,118</b>	<b>27,130</b>	<b>31,575</b>	<b>32,322</b>	<b>130,607</b>

In addition to the above strategies/investments, a site index adjustment project, preparation of a retention strategy, and completion of an access management plan were considered as very high priorities for completion. The studies/surveys listed in the tables above reflect the initial setup of specific programs (e.g., identify and prioritize fertilization candidates), the cost of a Type 2 Silviculture Strategy, and a seed needs/acquisition

strategy. Ongoing survey and layout costs associated with specific strategies are included in the strategy costs.

### 8.3.1 Expected Outcomes (Historical Funding Level)

If approximately \$39.6 million was invested over a 5-year period, the following outcomes could be expected:

#### Estimated Timber Supply Outcomes

- 196,300 m<sup>3</sup> made available at the front end of the trough
  - Realized from late rotation fertilization.
- 671,100 m<sup>3</sup> made available in the middle of the trough
  - Realized from fertilization of young (15 – 40 yr. old) Fd and Sx leading stands and spacing drybelt Fd stands (thinning from below).
- 592,500 m<sup>3</sup> made available in the back end of the trough
  - Realized though maintaining previously planted NSR sites (impeded stands) and reforestation MOFR responsibility lands in unsalvaged MPB areas and stands impacted by hemlock looper.

#### Timber Quality Outcomes

- None

#### Habitat Supply Outcomes

- Improved stand structure and ecosystem health on 18,500 ha of drybelt Fd stands by thinning/spacing, 5000 ha of under burning, and 500 ha of spacing to promote old growth structural conditions.
- Speed hydrologic recovery by regeneration of 2000 ha of stands with a habitat focus, and regeneration of 2400 ha of stands with a timber focus.
- Invasive plants will have been treated on 10,000 ha.
- 120 ha of road and landing rehabilitation to protect wildlife and recreation values.
- Minimized loss of habitat of species and ecosystems of conservation and management concern through silviculture activities.

### 8.3.2 Expected Outcomes for 20 Year Investment (Historical Funding Level)

If this level of funding was continued for 20 years (\$158 million total), and similar benefits were achieved throughout, the midterm trough could be maintained at a level 64,900 m<sup>3</sup>/yr higher than currently projected in the Potential MPB Scenario (Figure 16). Both of these forecasts are highly speculative and there is no guarantee that enough suitable treatment areas could be found for the 20-year potential investment run. Completion of a site index adjustment project would further improve the mid and long term harvest levels but it was not possible to estimate the effect without completing appropriate model simulations.

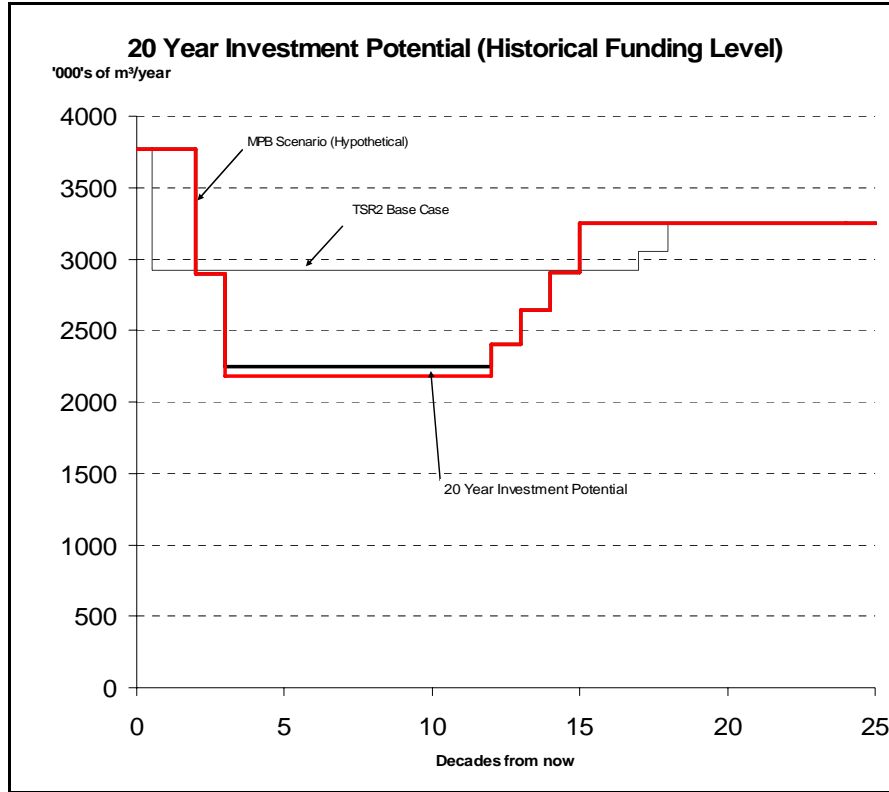


Figure 17. 20 year continuous investment (historical funding level).

## 9.0 Summary of Information and Research Needs

During the preparation of this document, the following needs for further information and/or research were identified in support of meeting TSA objectives for timber supply, timber quality, and habitat supply.

1. A site index adjustment project is required. This involves the completion of predictive ecosystem mapping (currently underway), accuracy assessment of the mapping to Forest Analysis Branch Standards, and then application of ecological correlations with site productivity (i.e. SIBEC).
2. Retention planning is required to identify areas where salvage will not occur and to provide guidance around retention at the stand level. A non-timber values risk assessment (impacted riparian areas, watersheds with high % PI, etc) is needed to support this process.
3. Improving the accuracy of growth and yield predictions for drybelt Fd stands is desirable.
4. Updating the forest inventory to better reflect existing stand volumes (partially harvested areas, MPB impacted areas, etc) is desirable.
5. There is a desire to look at changing stocking standards / free growing standards to include more broadleaves.
6. Inventory for locations of species/ecosystems of conservation concern so that management, including incremental silviculture activities, can better address these species.
7. Develop a forest health strategy that looks beyond MPB in order to protect growing volume that will be critical in the midterm trough.
8. Develop an access management plan to limit the amount of open road within the TSA.
9. Develop a seed strategy that identifies seed inventories (natural stand and orchard), seed gaps and seed mitigation strategies over the short and long term.
10. Increased production of non-traditional seed suitable for planting to increase species diversity (i.e. cottonwood, grasses for rehabilitation work).
11. Better define regeneration delays, and managed stand (TIPSY) OAFs.
12. Remeasure growth & yield plots at the end of the beetle mortality (benchmark for response going forward).
13. Check on Free Growing stands to see how well they are performing.
14. Investigate the effectiveness of BTK and follow up spacing in Fd to improve the growth performance of impacted stands.
15. Conduct additional research into the performance of repressed PI stands that have been spaced and fertilized.
16. Conduct research into the growth response of older stands (80"+ years) to fertilization.
17. Monitoring of caribou populations and habitat.
18. Watershed risk assessment / ranking relative to impending MPB impacts.
19. A Type 2/3 silviculture strategy is needed to identify areas where it is most effective to achieve habitat outcomes (e.g., identification watersheds most in need of hydrologic green-up, riparian reserves and management zones to target for under-planting, IDF stands to treat, and roads and landings to rehabilitate). The assessment is to provide insight where greatest return on investment and benefit to the environment will take place.

## 10.0 References

- Brockley, R.B. 2001a. *Fertilization of lodgepole pine in western Canada*. In C. Bamsey (ed.). Enhanced Forest Management: Fertilization and Economics Conference, March 1-2, 2001, Edmonton, AB. pp. 44-55
- Brockley, R.P. 2001b. *Foliar sampling guidelines and nutrient interpretative criteria for lodgepole pine*. B.C. Ministry of Forests, Research Branch, Victoria. Extension Note 52.
- Brockley, R.P. and D.G. Simpson. 2004. *Effects of intensive fertilization on the foliar nutrition and growth of young lodgepole pine and spruce forests in the interior of British Columbia (E.P. 886.13): establishment and progress report*. B.C. Min. For., Res. Br., Victoria, B.C. Tech. Rep. 018. <http://www.for.gov.bc.ca/hre/standman/maxprod/gryld.htm>
- Eng, M.; A. Fall; J. Hughes; Shore, T; Riel, B. and Hall, P. 2005. *Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: An Overview of the Model (BCMPB v2) and Results of Year 2 of the Project*. <http://www.for.gov.bc.ca/hre/bcmpb/>
- Farnden, C. and L. Herring. *Severely repressed lodgepole pine responds to thinning and fertilization: 19-year results*. For. Chron. 78(3) 404-414.
- Forsite et al. 2005. *Fertilization Backgrounder*, Unpublished report compiled by Pryzm Environmental, Symmetree Consulting, and Forsite as part of the Type 1 Silviculture Strategy project completed 2005/2006.
- Inland Timber Management Ltd., 2000., *Type 2 Forest Level Silviculture Analysis Report for the Williams Lake TSA.*, Williams Lake, BC.
- MoF, 2002. *Williams Lake Timber Supply Area – Rationale for Annual Allowable Cut (AAC) Determination*. Larry Peterson – Chief Forester, Victoria, BC.
- MoF, 2001. *Williams Lake Timber Supply Area Analysis Report*. Timber Supply Branch, Victoria, BC.
- Newsome, T.A. and J.L. Perry. 2003. *Stand-tending and rehabilitation treatment options for 36-year-old, height-repressed lodgepole pine*. Res. Br., B.C. Min. For., Victoria, B.C. Tech. Rep. 007. [www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr007.htm](http://www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr007.htm)
- Timberline Forest Inventory Consultants Ltd. 1998. *TISC Cariboo Region Stand treatments analysis – Williams Lake TSA Timber Supply Analysis Report*, Victoria, BC.

## Appendix A: Abbreviations

AAC	Allowable Annual Cut	LTHL	Long Term Harvest Level
Analysis	Timber Supply Analysis	LU	Landscape Unit
AU	Analysis Unit	Lw	Western Larch
BCTS	BC Timber Sales (Formerly Small Business Forest Enterprise Program)	MoFR	Ministry of Forests and Range
BEC	Biogeoclimatic Ecosystem Classification	MoE	Ministry of Environment
BEO	Biodiversity Emphasis Options	MPB	Mountain Pine Beetle
BGB	Biodiversity Guidebook	MSR	Machine Stress Rated
BI	Subalpine fir	MSY	Maximum Sustained Yield
BMP	Best Management Practices	MSYT	Managed Stand Yield Tables
CF	Chief Forester	NCC	Non-Commercial Cover
CFLB	Crown Forested Land base	NDT	Natural Disturbance Type
CT	Commercial Thinning	NP	Non Productive
CW	Western Red Cedar	PI	Lodgepole Pine
DBH	Diameter at breast height (1.3m)	PSP	Permanent Sample Plot
DEO	Designated Environment Official	PSYU	Public Sustained Yield Unit
DFO	Department of Fisheries and Oceans	Pw	White Pine
DM	District Manager	Py	Ponderosa Pine (tree species) or person years (economics)
ECA	Equivalent Clearcut Area	RM	Regional Manager
ESA	Environmentally Sensitive Area	RMZ	Riparian Management Zone
Fd	Douglas Fir	ROS	Recreation Opportunity Spectrum
FES	Forest Ecosystem Specialist	THLB	Timber Harvesting Land base
FIP/FC1	Old Forest Cover Digital Files	TIPSY	Table Interpolation Program for Stand Yields (growth and yield model)
FMER	Fire Maintained Ecosystem Restoration	TSA	Timber Supply Area
FIZ	Forest Inventory Zone	TSR	Timber Supply Review
FPC	Forest Practices Code	UREP	Use, Recreation, and Enjoyment of Public
FRBC	Forest Renewal British Columbia	VDYP	Variable Density Yield Predictor (growth and yield model)
FSSIM	Forest Service Simulation Model	VEG Ht	Visually Effective Greenup Height
GIS	Geographic Information System	VQO	Visual Quality Objective
HLPO	Higher Level Plan Order	WTP	Wildlife Tree Patch
HW	Western Hemlock		
ICH	Interior Cedar Hemlock		
IWAPS	Interior Watershed Assessment Procedure System		
LA	Alpine Larch		
LRMP	Local Resource Management Plan		