

Kamloops TSA Type 1 Silviculture Strategy

Version 2.0

March 22, 2006

British Columbia
Ministry of Forests and Range

Funded By:



Mike Fenger and Associates

Strategies at a Glance		
General Strategy	The focus of the Kamloops TSA Silviculture Strategy over the next 5 years is to treat non lodgepole pine stands to improve midterm timber supply and to mitigate habitat supply impacts brought about by the mountain pine beetle epidemic and associated harvesting. The strategy aims to add volume to existing non PI stands, bring managed stands online sooner or with more volume, reforest areas with no regeneration obligations, improve the yields and stand structure in complex drybelt Fd stands, rehabilitate roads and problem stand types, and address invasive plants. It also recommends that a site index adjustment project be completed, better inventory and growth and yield information is gathered, treatments be coordinated with a conservation or retention plan and that an inventory for species and ecosystems of conservation concern be completed prior to, or in conjunction with, planning of silviculture treatments.	
Working Targets	Timber Supply:	<u>Short term (0-20)</u> AAC uplift to the level required to capture MPB mortality <u>Midterm (30-70 years)</u> Minimize the depth and duration of trough <u>Long term (70+years)</u> Maintain long term harvest level at or near the productivity capacity of the land base.
	Timber Quality:	<u>Midterm</u> (10% premium logs – house logs/peelers/MSR) <u>Long term</u> (10% premium logs – house logs/peelers/MSR)
	Habitat Supply:	<u>Short Term</u> - Stand and landscape level retention strategy developed for short-term retention to optimally mitigate impacts to environmental values. - Reforest a proportion of impacted WTP / OGMA / RMA's/ or other strategically identified retention areas and to reduced stocking levels where ecologically appropriate. - Increased levels of broad leaf trees and other appropriate species to increase stand level diversity across the land base. - Improve habitat supply of open forest conditions within NDT 4. <u>Midterm and Long Term</u> Maintain or improve the conservation status of all species (Ensure forestry practices do not make species status worse).
Major Silvicultural Strategies	Timber Supply	1. Late Rotation Fertilization of Non-PI (Fd and Sx) (TS1) 2. Young Stand Fertilizations – focus is on Fd (TS2) 3. Spacing of clumped drybelt Fd stands (TS4) 4. Planting of THLB sites with no reforestation obligations (TS5) 5. Address backlog issues (NSR and impeded stands) (TS7a,b) 6. Rehab underperforming IU-logged balsam and Fd residual stands (TS8b)
	Timber Quality	1. Manage for larger logs (house logs/peelers) through long rotations in stands constrained by non-timber objectives (VQO's UWR, etc). 2. Manage for MSR lumber through acceptance of higher stand densities on a portion of the land base.

Strategies at a Glance

	<div>Habitat Supply</div> <div><div><div>1. Planting of impacted non-THLB areas and retention areas with a habitat focus. (HS1,2,3). Creating cattle barriers adjacent to high priority habitat (i.e. wetlands) should be considered as part of any site prep work.</div><div>2. Spacing/thinning in drybelt Fd stands (HS4a)</div><div>3. Under-planting in NDT4 (HS5)</div><div>4. Rehabilitation of spur roads and landings (HS8)</div><div>5. Treat for invasive plant species (HS6)</div><div>6. Complete inventories and planning required to maintain habitat of species and ecosystems of conservation concern.</div><div>7. Vary regenerated stand spacing.</div><div>8. Look to change stocking standards / free growing standards to include more broadleaves.</div></div></div>																																																																																																																																																																																																																		
<div>Silviculture Program</div>	<div>Idealized Funding Level (\$35.4 million over 5 years)</div> <div>Area</div> <table><tr><th>Activity</th><th>Year 1 (ha)</th><th>Year 2 (ha)</th><th>Year 3 (ha)</th><th>Year 4 (ha)</th><th>Year 5 (ha)</th><th>Totals (ha)</th></tr><tr><td>Studies/Surveys</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>Fertilize</td><td>2,500</td><td>10,200</td><td>11,500</td><td>11,200</td><td>10,550</td><td>45,950</td></tr><tr><td>Spacing/Thinning (timber)</td><td>500</td><td>1,000</td><td>1,000</td><td>1,000</td><td>1,000</td><td>4,500</td></tr><tr><td>Spacing/Thinning (habitat)</td><td>-</td><td>100</td><td>100</td><td>100</td><td>100</td><td>400</td></tr><tr><td>Planting (timber - MPB/Other)</td><td>-</td><td>-</td><td>6,650</td><td>8,150</td><td>8,100</td><td>22,900</td></tr><tr><td>Planting (timber - fires)</td><td>500</td><td>2,000</td><td>-</td><td>-</td><td>-</td><td>2,500</td></tr><tr><td>Planting (habitat)</td><td>100</td><td>-</td><td>500</td><td>950</td><td>800</td><td>2,350</td></tr><tr><td>Pruning</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>Rehab underperforming & PFT stands</td><td>-</td><td>2,100</td><td>2,100</td><td>2,100</td><td>700</td><td>7,000</td></tr><tr><td>Address Backlog NSR/Impeded</td><td>-</td><td>5,300</td><td>4,000</td><td>4,000</td><td>4,000</td><td>17,300</td></tr><tr><td>Rehab roads</td><td>100</td><td>-</td><td>-</td><td>-</td><td>-</td><td>100</td></tr><tr><td>Treat for Invasives</td><td>500</td><td>500</td><td>500</td><td>500</td><td>500</td><td>2,500</td></tr><tr><td>Under burning</td><td>100</td><td>100</td><td>100</td><td>100</td><td>100</td><td>500</td></tr><tr><td>Totals</td><td>4,300</td><td>21,300</td><td>26,450</td><td>28,100</td><td>25,850</td><td>25,850</td></tr></table> <div>Dollars</div> <table><tr><th>Activity</th><th>Year 1 (ha)</th><th>Year 2 (ha)</th><th>Year 3 (ha)</th><th>Year 4 (ha)</th><th>Year 5 (ha)</th><th>Totals (ha)</th></tr><tr><td>Studies/Surveys</td><td>\$ 1,110,000</td><td>\$ -</td><td>\$ -</td><td>\$ -</td><td>\$ -</td><td>\$ 1,110,000</td></tr><tr><td>Fertilize</td><td>\$ 1,065,000</td><td>\$ 4,080,000</td><td>\$ 4,600,000</td><td>\$ 4,480,000</td><td>\$ 4,220,000</td><td>\$18,445,000</td></tr><tr><td>Spacing/Thinning (timber)</td><td>\$ 325,000</td><td>\$ 600,000</td><td>\$ 600,000</td><td>\$ 600,000</td><td>\$ 600,000</td><td>\$ 2,725,000</td></tr><tr><td>Spacing/Thinning (habitat)</td><td>\$ -</td><td>\$ 60,000</td><td>\$ 60,000</td><td>\$ 60,000</td><td>\$ 60,000</td><td>\$ 240,000</td></tr><tr><td>Planting (timber - 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MPB/Other)	-	-	6,650	8,150	8,100	22,900	Planting (timber - fires)	500	2,000	-	-	-	2,500	Planting (habitat)	100	-	500	950	800	2,350	Pruning	-	-	-	-	-	-	Rehab underperforming & PFT stands	-	2,100	2,100	2,100	700	7,000	Address Backlog NSR/Impeded	-	5,300	4,000	4,000	4,000	17,300	Rehab roads	100	-	-	-	-	100	Treat for Invasives	500	500	500	500	500	2,500	Under burning	100	100	100	100	100	500	Totals	4,300	21,300	26,450	28,100	25,850	25,850	Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)	Studies/Surveys	\$ 1,110,000	\$ -	\$ -	\$ -	\$ -	\$ 1,110,000	Fertilize	\$ 1,065,000	\$ 4,080,000	\$ 4,600,000	\$ 4,480,000	\$ 4,220,000	\$18,445,000	Spacing/Thinning (timber)	\$ 325,000	\$ 600,000	\$ 600,000	\$ 600,000	\$ 600,000	\$ 2,725,000	Spacing/Thinning (habitat)	\$ -	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 240,000	Planting (timber - MPB/Other)	-	-	\$ 8,055,000	\$10,505,000	\$10,470,000	\$29,030,000	Planting (timber - fires)	\$ 550,000	\$ 2,160,000	-	-	-	\$ 2,710,000	Planting (habitat)	\$ 180,000	\$ -	\$ 630,000	\$ 1,175,000	\$ 920,000	\$ 2,905,000	Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Rehab underperforming & PFT stands	\$ -	\$ 3,570,000	\$ 3,570,000	\$ 3,570,000	\$ 1,190,000	\$11,900,000	Address Backlog NSR/Impeded	\$ -	\$ 3,180,000	\$ 2,400,000	\$ 2,400,000	\$ 2,400,000	\$10,380,000	Rehab roads	\$ 500,000	\$ -	\$ -	\$ -	\$ -	\$ 500,000	Treat for Invasives	\$ 250,000	\$ 250,000	\$ 250,000	\$ 250,000	\$ 250,000	\$ 1,250,000	Under burning	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 50,000	Totals	\$ 3,990,000	\$13,910,000	\$20,175,000	\$23,050,000	\$20,120,000	\$81,245,000
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Strategies at a Glance

benefits were achieved throughout, the midterm trough could be eliminated (306,000 m³/year more harvest volume). This forecast is highly speculative and there is no guarantee that enough suitable treatment areas exist.

Timber Quality Outcomes

- None

Habitat Supply Outcomes

- Enhance old forest stand structure on 4,900 ha of drybelt Fd stands (thinned/spaced), with 500 ha of this also under-planted.
- Speed hydrologic recovery by regeneration of 2,350 ha of impacted stands with a habitat focus, and regeneration of 25,400 ha of impacted stands with a timber focus. Emphasis was on under-planting. Site prep will also be used to create/maintain cattle barriers around sensitive habitats (i.e. windrowing of slash to create barrier).
- Treat invasive plants on 2,500 hectares of habitat to protect native plant and wildlife species.
- Maintain wildlife and recreational values by rehabilitating 100 hectares of road and landing.

Silviculture Program

Constrained Funding (\$13.0 million over 5 years)

Area

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	-	-	-	-	-	-
Fertilize	1,500	700	2,100	1,800	2,150	8,250
Spacing/Thinning (timber)	500	-	300	300	300	1,400
Spacing/Thinning (habitat)	-	100	100	100	100	400
Planting (timber - MPB/Other)	-	-	100	600	600	1,300
Planting (timber - fires)	500	1,900	-	-	-	2,400
Planting (habitat)	100	-	100	100	100	400
Pruning	-	-	-	-	-	-
Rehab underperforming & PFT stands	-	-	-	-	-	-
Address Backlog NSR/Impeded	-	300	2,150	1,800	1,500	5,750
Rehab roads	-	-	-	-	-	-
Treat for Invasives	-	-	-	-	-	-
Under burning	100	100	100	100	100	500
Totals	2,700	3,100	4,950	4,800	4,850	4,850

Dollars

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	\$ 940,000	\$ -	\$ -	\$ -	\$ -	\$ 940,000
Fertilize	\$ 640,000	\$ 280,000	\$ 840,000	\$ 720,000	\$ 860,000	\$ 3,340,000
Spacing/Thinning (timber)	\$ 325,000	\$ -	\$ 180,000	\$ 180,000	\$ 180,000	\$ 865,000
Spacing/Thinning (habitat)	\$ -	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 240,000
Planting (timber - MPB/Other)	\$ -	\$ -	\$ 170,000	\$ 520,000	\$ 520,000	\$ 1,210,000
Planting (timber - fires)	\$ 550,000	\$ 2,090,000	\$ -	\$ -	\$ -	\$ 2,640,000
Planting (habitat)	\$ 180,000	\$ -	\$ 70,000	\$ 70,000	\$ 70,000	\$ 390,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab underperforming & PFT stands	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Address Backlog NSR/Impeded	\$ -	\$ 180,000	\$ 1,290,000	\$ 1,080,000	\$ 900,000	\$ 3,450,000
Rehab roads	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Treat for Invasives	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Under burning	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 50,000
Totals	\$ 2,645,000	\$ 2,620,000	\$ 2,620,000	\$ 2,640,000	\$ 2,600,000	\$ 13,125,000

Estimated Timber Supply Outcomes

- 140,250 m³ made available at the front end of the trough
 - o Realized from late rotation fertilization
- 313,300 m³ made available in the middle of the trough
 - o Realized mainly from maintaining backlog impeded stands, with a small benefit from thinning drybelt Fd stands (small area treated).

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- 555,000 m³ made available in the back end of the trough
 - o Realized through planting of sites with no obligations.

If this level of funding was continued for 20 years (\$52 million total) and similar benefits were achieved throughout, the midterm trough could rise by 47,500 m³/year. This forecast is highly speculative and there is no guarantee that enough suitable treatment areas exist.

Timber Quality Outcomes

- None

Habitat Supply Outcomes

- Enhance old forest stand structure on 1800 ha of drybelt Fd stands (thinned/spaced).
- Under-planting on 500 ha of drybelt Fd and Py stands.
- Speed hydrologic recovery by regeneration of 400 ha of impacted stands with a habitat focus, and regeneration of 3,700 ha of impacted stands with a timber focus. Emphasis on under-planting. Site prep will also be used to create/maintain cattle barriers around sensitive habitats (i.e. windrowing of slash to create barrier).

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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 issues¹. 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. AAC's 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 Symmetree 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 6th & 7th, 2005 in Kamloops, attended by representatives of the MoFR, MoE and forest licensees within the Kamloops TSA. Ken Zielke of Symmetree Consulting Group Ltd and Cam Brown of Forsite Consultants Ltd. led the session. Dave Jones, working for Mike Fenger and Associates represented MoE's interests in the workshop.

¹ 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
Rocky Chan	Ministry of Forests, Southern Region
Toby Jeffreys	Gilbert Smith Forest Products
Sean Curry	Weyerhaeuser Canada Ltd.
Dave Dobi	Canadian Forest Products Ltd.
Jeff Mycock	West Fraser Mills
Brent Olsen	Kamloops District, Ministry of Forests
Jeff Leahy	Kamloops District, Ministry of Forests
Abbey Bates	Headwaters Forest District, Ministry of Forests
Dave Jones	Mike Fenger and Associates
Jeremy Hachey	Forsite Consulting
Cam Brown	Forsite Consulting
Ken Zielke	Symmetree Consulting

Mike Fenger and Associates provided summary information on habitat related issues prior to the workshop, participated in the workshop, and helped to 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 describes 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

Table 1 provides an overview of the AAC since 1996. Pulpwood Agreement 16 stands are included in the TSR2 THLB and have a partitioned cut of 112,000 m³. Actual performance in the TSA has shown a significant undercut in PA16 (Avg. harvest of 21,000 m³/year). The PA16 harvest level and land base are treated as separate from the rest of the TSA until they are harvested for the first time – when they then become part of the regular THLB. Non PA16 licensees have been cutting PA16 stands, indicating the traditional sawlog THLB may be larger than assumed.

Table 1. Historical and current AAC (m³/year).

AAC Type	1996	2003	2004 - Present
Conventional	2,393,180	2,361,900	2,361,900
Pulpwood Agreement Partition	86,000	106,000	106,000
Cedar Hemlock Partition	200,000	200,000	200,000
IFPA - Adams Lake	-	14,870	14,870
Fire Salvage	-	-	670,000
MPB Uplift	-	-	1,000,000
Total	2,679,180	2,682,770	4,352,770

In 1996 the AAC was set at 2.679 million m³/year which included a 200,000 m³/year apportionment for harvesting decadent cedar/hemlock or hemlock/cedar as well as a 86,000 m³/year apportionment for Pulpwood. In 2003, the AAC was set at 2.682million m³/year, which maintained the previous partitions as well as included an additional 14,870 m³/year for the Innovative Forestry Agreement (IFPA) in Adams Lake, and an additional 20,000 m³/year for deciduous stands outside the PA16 boundaries.

In 2003, the Kamloops MoF District Manager requested an AAC uplift to deal with the emerging MPB situation and the burned-over areas from the 2003 fire storm. The Chief Forester determined that an uplift of 1,000,000 m³/year and 670,000 m³/year was required to address MPB and the burned over areas, respectively. This uplift has been in effect since January 1, 2004

2.2 Land Base Characteristics

Approximately 53% of the TSA is considered crown-forested land (Table 2 and Figure 1), while 37.3% of this area is considered to be available for long term timber harvest.

Table 2. Land base area statistics.

Description	Area (ha)	Area (%)
Total TSA Area	2,666,375	100%
CFLB	1,409,110	53%
Current THLB	1,040,860	39%
Long Term THLB	993,426	37.3%

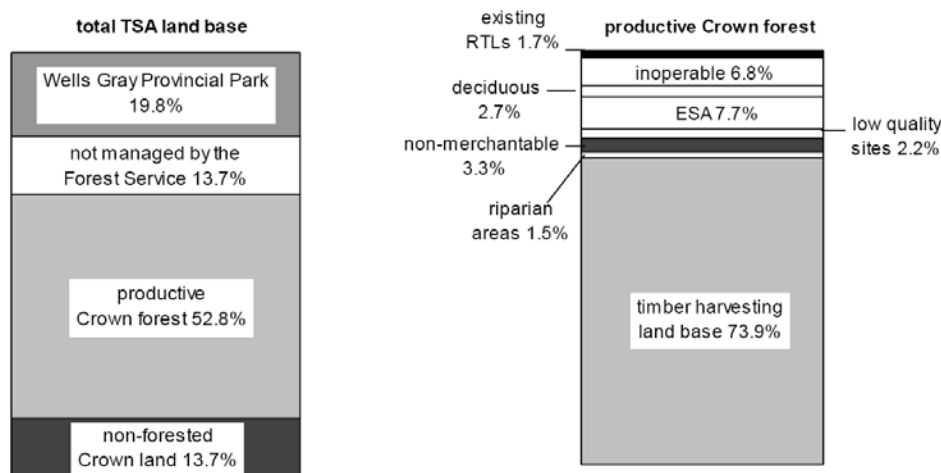


Figure 1. Total and crown forested land bases for the Kamloops TSA (TSR2).

2.2.1 Species Profile

Within the THLB, more area consists of mature PI-dominated forests, than any other type (Figure 2).

Approximately 31% of the THLB is occupied by pine leading stands. About 20% (~220,000 ha) are mature pine-leading stands (>60 years). There are another 191,000 ha of mixed forests with a component of mature pine. In total, mature lodgepole pine trees represent a significant merchantable volume - about 58.5 million m³ - which is at risk because of the current mountain pine beetle infestation. Based on 2005 overview flight mapping, approximately, over half (56%) of the PI-leading stands >60years old currently have some level of attack occurring within them.

Ponderosa pine is also affected by MPB and Py leading stands make up ~1% (3700 ha of THLB) of the pine leading stands in the THLB. The majority of this Py area is older than 60 years.

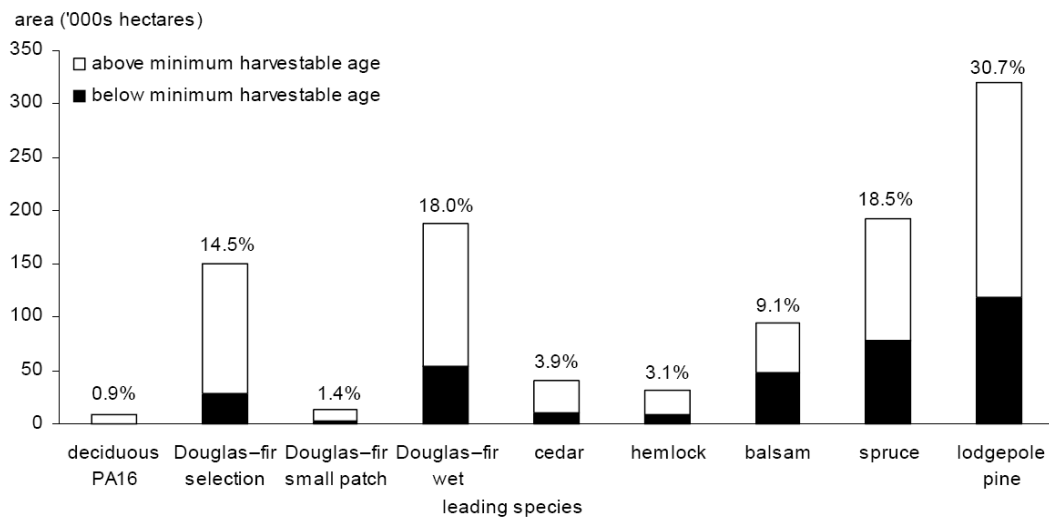


Figure 2. Tree species profile on the THLB (TSR2 – 2001).

2.2.2 Age Class Profile

Approximately 64% of the THLB is currently in older age classes (100-250 years). From a timber supply perspective, the lack of area in the 41-60 year age class is of concern (Figure 3).

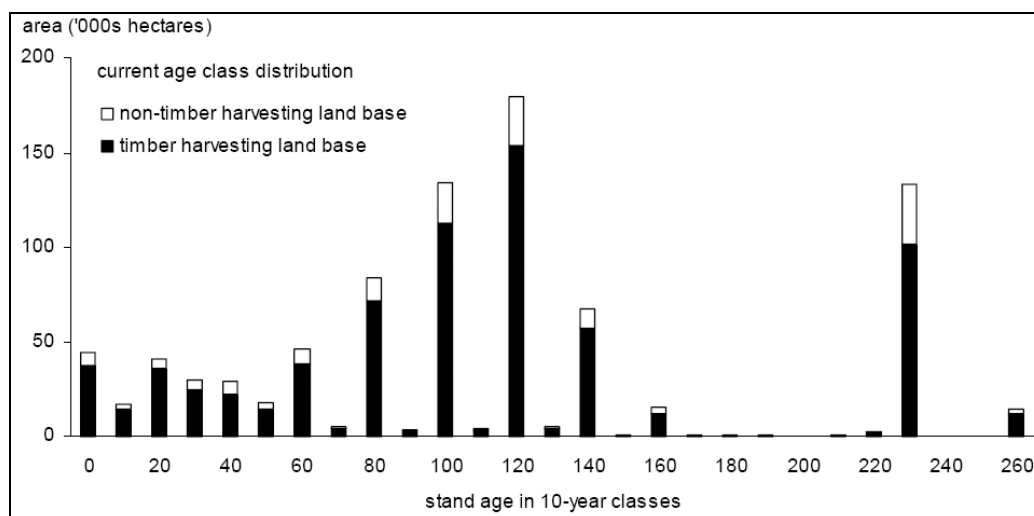


Figure 3. Age class distribution (TSR2 – 2001).

2.2.3 Site Class Profile

The weighted average site index for the THLB is 15.5m (Figure 4).

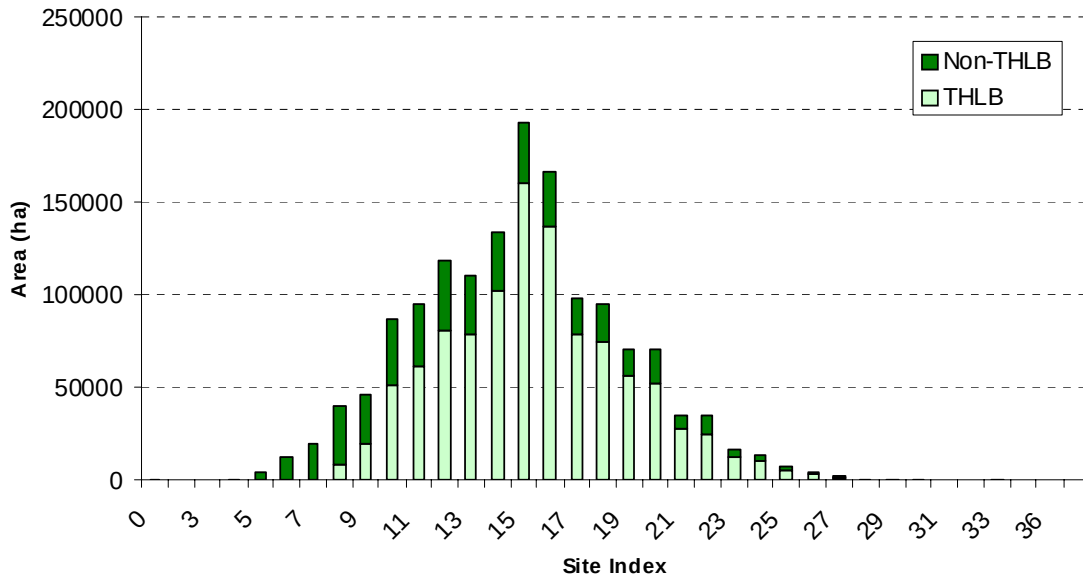


Figure 4. Site class profile (TSR2).

2.2.4 Biogeoclimatic Profile

The THLB in the Kamloops TSA has a diversity of ecosystems that typically fall within the ESSF, ICH, IDF, and MS variants (Figure 5). Approximately 44% of the THLB area falls within drybelt ecosystems.

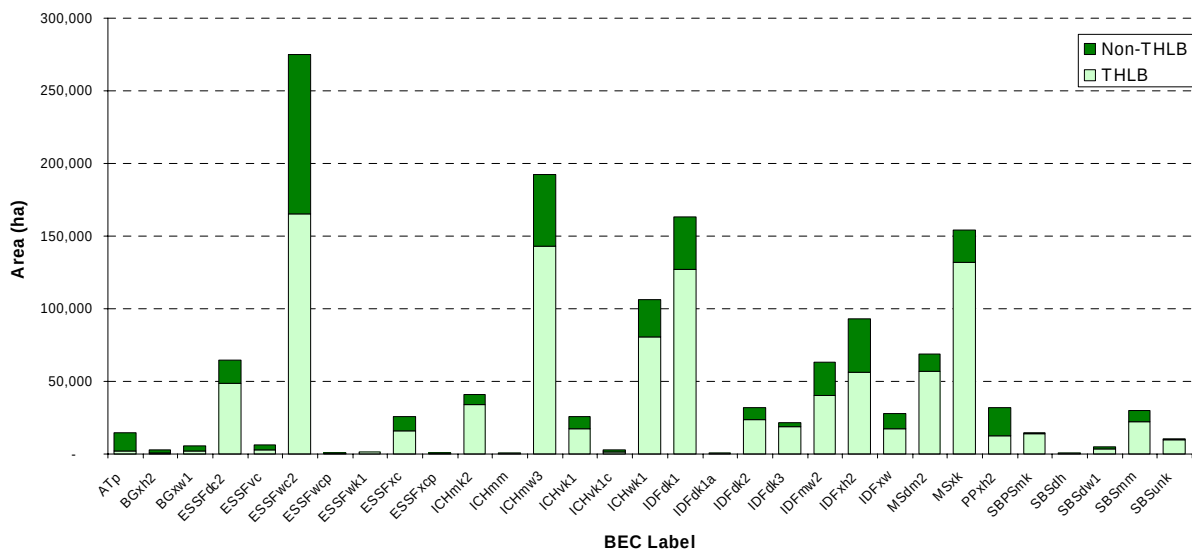


Figure 5. Biogeoclimatic profile (TSR2).

2.2.5 THLB Management Emphasis

Management of visuals is the single largest issue impacting the THLB. Approximately 39% of the THLB has visual management objectives (Figure 6).

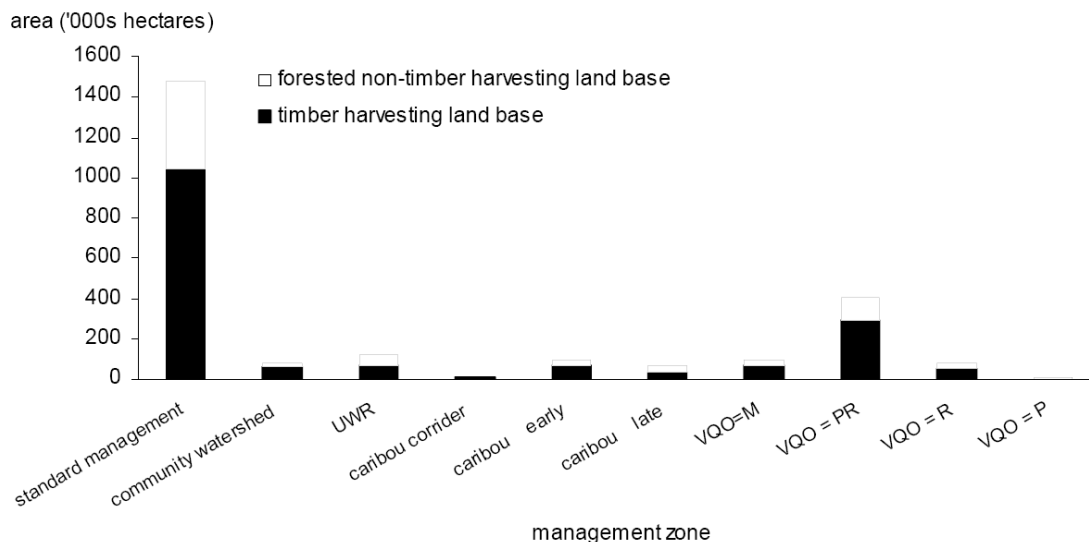


Figure 6. THLB management emphasis (TSR2).

2.3 Incremental Silviculture History

Table 3 shows the areas associated with incremental silviculture in the Kamloops TSA over the past 10 years. Relatively little area has been fertilized. Treatment area for juvenile spacing peaked in 1995 and has more or less gradually tapered off since then.

Table 3. Incremental silviculture history for the Kamloops TSA²

Year	Fertilize	Juvenile Spacing	Pruning
1995		1,173	89
1996	123	939	104
1997	49	977	126
1998	48	511	234
1999	97	140	69
2000	5	226	55
2001	66	407	
2002	41	56	26
2003		106	
2004		112	
Total	429	4,647	703

² This information was extracted from the RESULTS database (October 2005).

2.4 Use of Select Seed

Reliance on natural regeneration occurs on specific pine sites, but planting is the preferred method of regeneration for most ecosystems. TSR2 assumed all clearcut sites were planted and implemented regeneration delays of 2-3 years depending on analysis unit.

The 2005 seedling requests indicate that 95% of the Sx seed used is improved (7% gain), and 15.9% of PI seed used is improved (7% gain) with 31% at least B+ seed (source: SPAR Database). As well, 100% of Pw seed used is improved. Pw seedlings are bred for their resistance to white pine blister rust. Select seed orchards for Douglas-fir are just beginning to come online.

Table 4 shows the forecasted gain for improved seedlings from established seed orchards as well as the forecasted availability. In general, these projections show:

- o Fd seed gains of 12-29% with limited-good availability in the next 5-10 years.
- o Lw seed gains of 35% with unlimited availability within its limited geographic range in the TSA.
- o PI seed gains of 10-14% with good to limited availability in the short term and gains of 12-16% with good to unlimited availability in the long-term.
- o Sx seed gains of 9-28% (avg of ~12%) with very good–unlimited availability.

Table 4. Forecasted gain in volume and availability for improved seed for the Kamloops 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		
FDI NE HIGH	1000-1600	3.4			29%	3%	29%	29%	5	29%	59%	3	645,218	
FDI NE LOW	400-1000	2.5			24%	4%	24%	44%	4	24%	100%	2	364,996	
FDI QLN HIGH	1000-1600	3.4			29%	3%	29%	29%	5	29%	59%	3	13,232	
FDI QLN LOW	400-1200	3			13%	46%	19%	93%	2	22%	137%	1	2,980	
LW NE LOW	700-1400	3	29%	62%	33%	80%	35%	123%	1	35%	133%	1	548,594	
PLI NE LOW	700-1400	3.7	6%		9%	86%	11%	138%	1	15%	92%	2	329,782	
PLI PGN LOW	700-1400	33.7			8%	47%	10%	69%	3	12%	66%	3	3,511	
PLI TO HIGH	1400-1600	5.3			11%	21%	14%	42%	4	16%	85%	2	158,860	
PLI TO LOW	700-1400	13.6	7%	26%	9%	765%	12%	38%	4	13%	64%	3	202,185	
PLI TON HIGH	1400-2000	8.4			11%	21%	14%	42%	4	16%	85%	2	235,131	
PLI TON LOW	700-1400	17.3	6%		9%	744%	12%	88%	2	14%	72%	3	373,462	
SX NE HIGH	1500-1900	5.4			9%	133%	9%	169%	1	11%	181%	1	246,501	
SX NE LOW	1-800	1.2	8%		0%	0%	21%	92%	2	25%	117%	1	178,209	
SX NE MID	800-1500	4.5			7%	211%	12%	120%	1	14%	140%	1	351,389	
SX TO HIGH	1300-1900	3.3			8%	73%	12%	118%	1	17%	124%	1	352,632	
SX TO LOW	500-1200	9.5	9%	98%	16%	69%	17%	86%	2	21%	97%	2	341,574	
SX TON HIGH	1300-1900	8.7	7%		9%	118%	10%	153%	1	13%	165%	1	160,515	
SX TON LOW	1-1300	2.4	0%		9%	200%	14%	208%	1	23%	135%	1	299,485	
SX TON MID	1000-1500	4.5	0%		7%	211%	12%	120%	1	14%	140%	1	141,520	

Note: Gross areas are provided because THLB areas were not available. Areas can be overlapping between different species SPU's. SPU seedling needs are based on the previous five-year average and do not reflect forecasted needs. Availability rating are as follows: Unlimited (100+%) available, 2= Very Good (75-99%), 3=Good (50-75%), 4=Limited (30-50%), 5=Severely Limited (<30%).

3.0 Mountain Pine Beetle Situation

Figure 7 graphically illustrates the extent of the mountain pine beetle infestation in the southern interior as mapped from overview flights in 2004. Figure 8 shows expansion in 2005. Although not as seriously infested as some of the more northerly TSAs, it is likely that the Kamloops TSA will face a similar impacts to its pine stands. Pine volume on the

THLB currently makes up about 57 million m³ (30%) of the current growing stock in the TSA. This pine volume is heavily weighted to the southern half of the TSA.

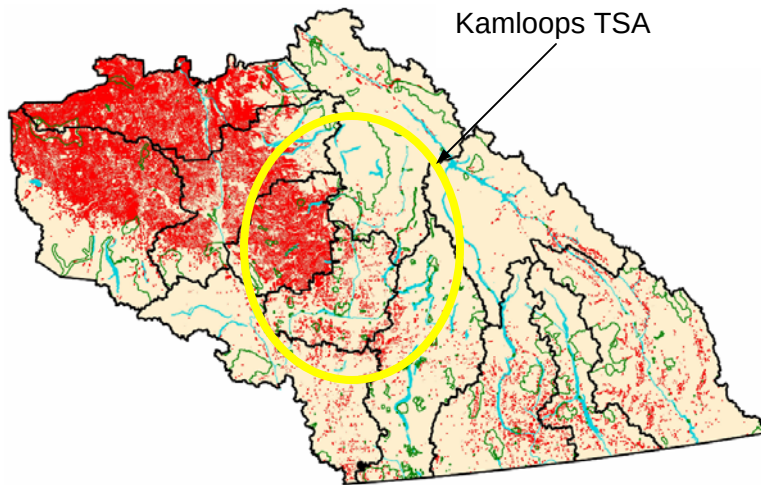


Figure 7. The extent of the mountain pine beetle infestation in the Southern Interior Region as mapped from overview flights in 2004.

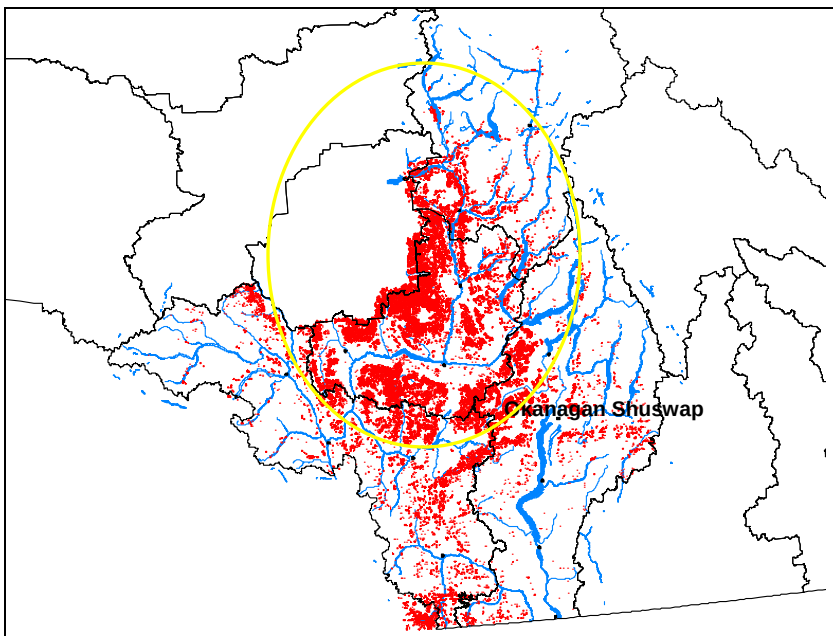


Figure 8. The extent of the mountain pine beetle infestation in the old Kamloops Region portion of the SIR as mapped from overview flights in 2005.

Figure 9 shows the trend predicted by Marvin Eng³ for yearly volume killed peaking in 2008 for this TSA at 4.83 million m³ killed/year. If maintained, the current MPB uplift

³ 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/>

should be able to capture much of this mortality given a shelf life of 1-2 years for these stands.

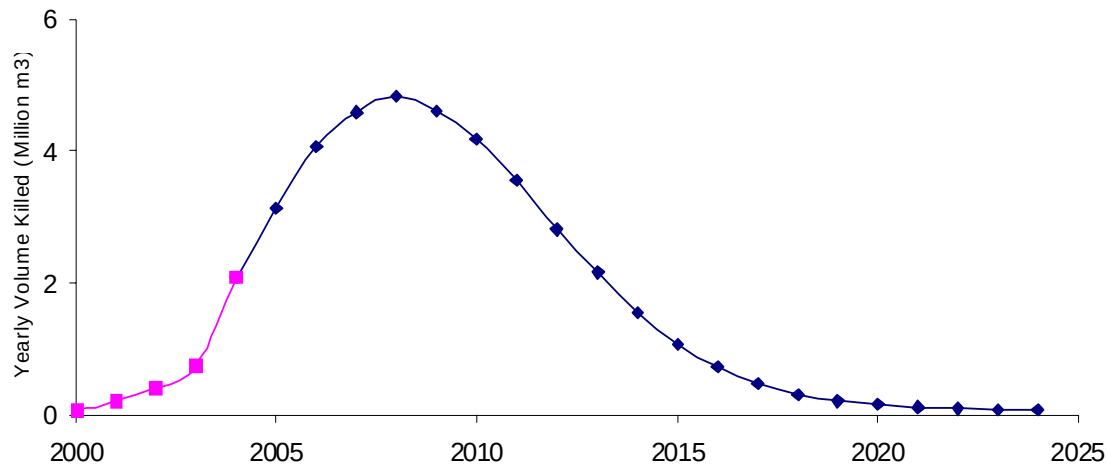


Figure 9. MPB killed volume trend (purple) and predictions of future trend (blue).

Table 5 shows projections of the cumulative pine volume killed by the MPB to 2020 (Marvin Eng 2005) given the current AAC level.

Table 5. MPB infestation projections assuming no intervention (M. Eng 2005)

	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	4,352,770	299,829	37,078	6,203,430	450,504	140,211	24,383,629	40,127,520	41,986,960

Pine volume makes up about ~31% (57 million m³) of the current growing stock in the Kamloops TSA (185 million m³), so there are significant implications on timber supply. Marvin Eng's model predicts that within the next 15 years MPB will kill approximately 42.0 million m³ of pine and salvage harvesting will remove an additional 14 million m³ of pine before it is killed. This does not include the potential impact to pine stands under 60 years old.

4.0 Current TSA Situation

4.1 Timber Supply Issues

4.1.1 Base Case Harvest Forecast

Figure 10 shows the timber supply projection used by the Chief Forester to complete his 2004 uplift determination. It is very similar to the TSR2 base case (2001) with the exception of an immediate ~3year uplift in harvest volume ($4,352,770 \text{ m}^3/\text{year}$) to capture volume impacted by the 2003 fires and current MPB mortality, and the resulting deficit in timber availability 90-120 years in the future.

This scenario assumes that 2 million of the 5.1 million m^3 killed by the 2003 firestorm will be salvaged and the rest is lost. It also assumes that a higher level of harvest will be used to capture existing MPB mortality, but no future MPB mortality was implemented. In the long term, the steady harvest level is projected to be the same as shown in the 2001 TSR2 analysis report– 2.246 million m^3/year .

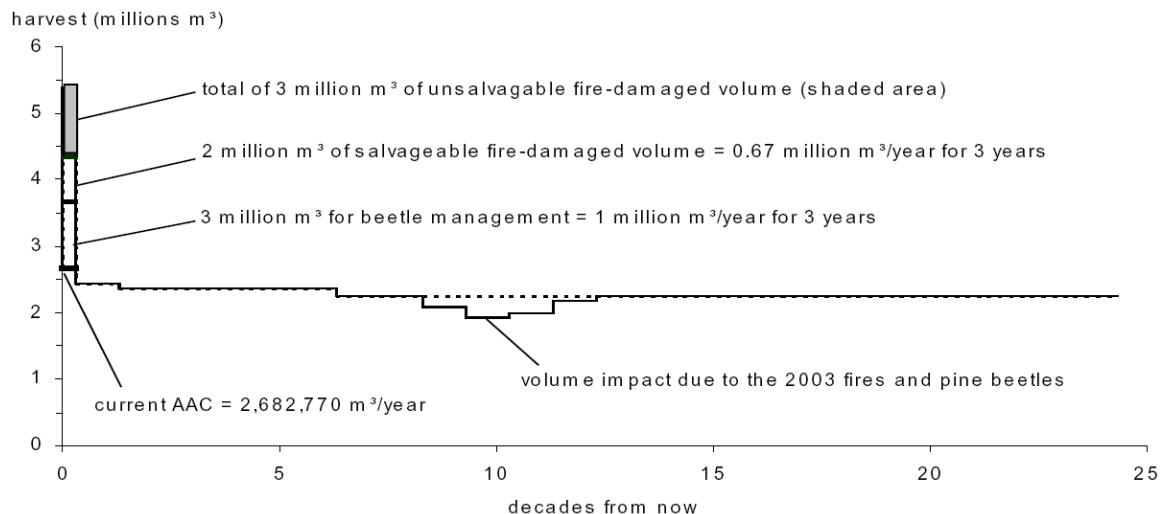


Figure 10. Harvest forecast (Jan 1, 2004 Uplift Rationale).

Growing stock is at its lowest levels in decades 10-15 (Figure 11). These decades correspond with the most constrained periods for timber supply (least available timber) and occur because harvest is near the end of the transition from natural to managed stands. The managed stands harvested in decade 10 are, on average, the youngest/lowest volume sites harvested in the planning horizon.

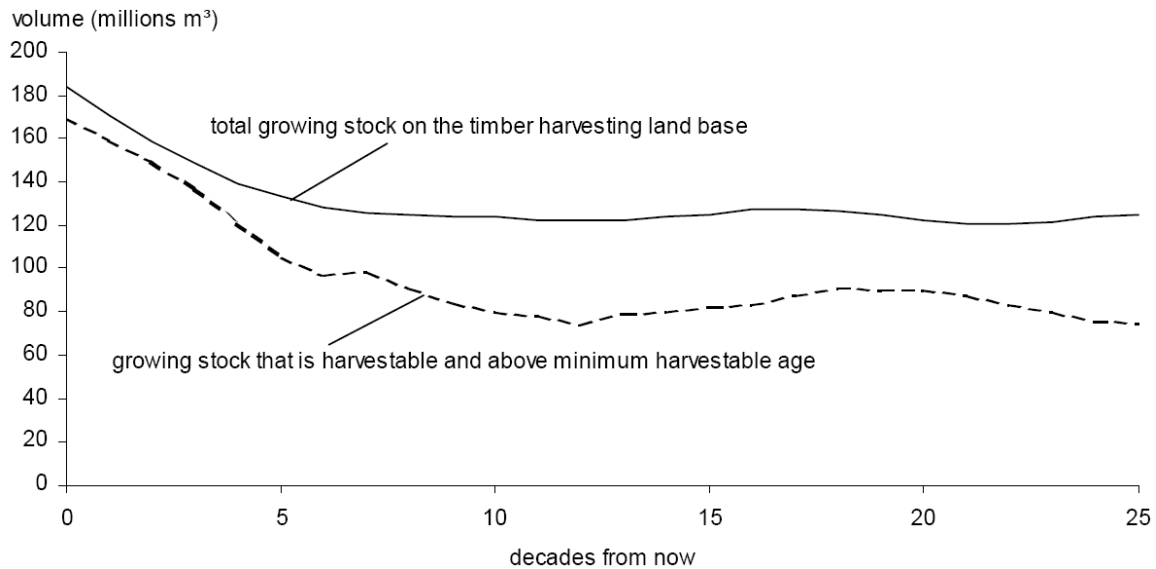


Figure 11. Total and merchantable growing stock (TSR2 Base Case).

Figure 12 shows that managed stands are first harvested in decade 5 and make up the vast majority of harvest by decade 9. During this time period, the last of the eligible natural stands and the first of the managed stands are being harvested.

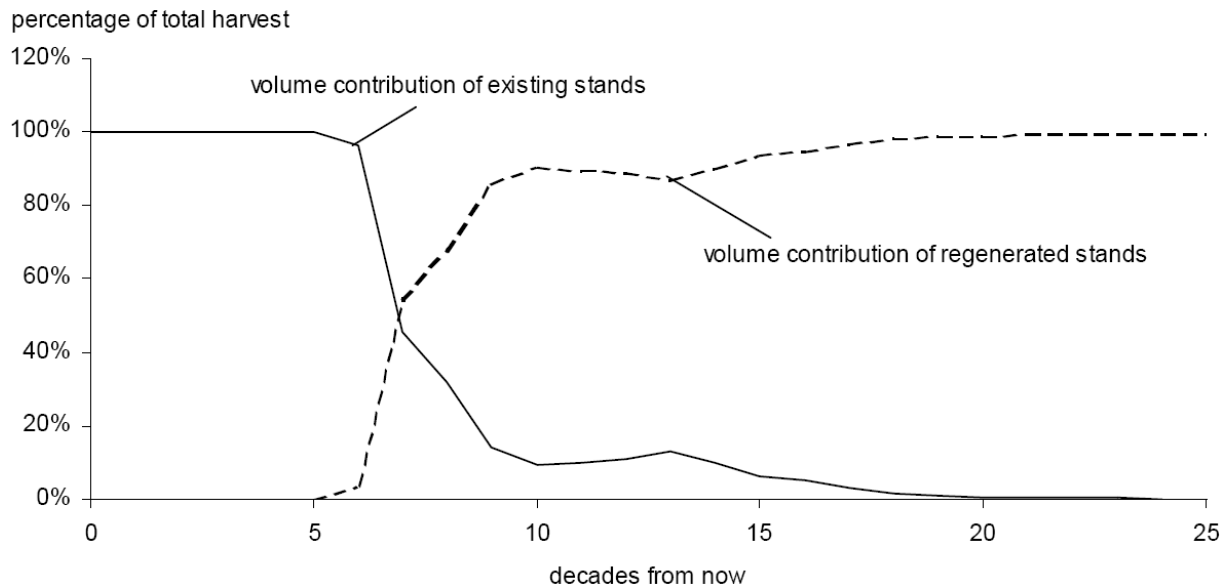


Figure 12. Harvest of natural and managed stands over time (TSR2 Base Case).

4.1.2 Timber Supply Projection Including MPB Impacts

Figure 13 shows the results of the Chief Forester's 2004 Rationale scenario discussed earlier and a hypothetical forecast that attempts to take into account expected future losses of pine volume to mountain pine beetle.

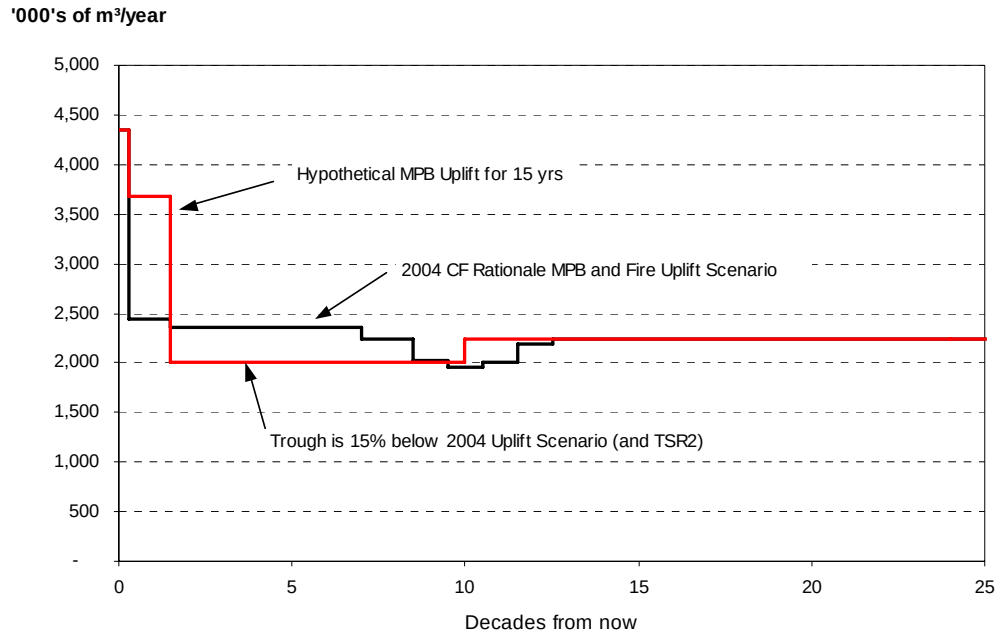


Figure 13. Possible outcome of current MPB infestation reflecting a hypothetical uplift.

This scenario may still be optimistic because there is likely to be MPB mortality in younger PI plantations not recognized in Marvin Eng's projections. However, there has been no site index adjustment for managed stands in this projection and the incorporation of this change could significantly improve timber supply following the uplift period.

Assumptions:

- 42 million m³ killed by 2020 (15 years from now) and volume will have a shelf life of 10 years. Thus, need to capture 54 million m³ in 20 years = 2.7 million m³/year. We can assume that at least 25% will not be salvaged as it is dispersed across the land base as minor species in otherwise green stands or within designated retention areas.
- The current uplift will capture 75% of the killed volume, leaving only those stands that were unsuitable for salvage.
- After the uplift period, harvest levels are expected to step down significantly to roughly 15% below pre-uplift harvest levels and remain at this level until managed stand volume come online in a significant way. In the long term, the steady harvest level is projected to be the same as shown in the 2001 TSR2 analysis report– 2.246 million m³/year.

Timber supply issues to be addressed:

1. 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 sooner than what the 2004 uplift scenario would suggest.
2. As a result of mixed species stands, dispersed mortality, and retention strategies, it is likely that a significant amount of dead PI volume will go unsalvaged. Additionally, there will likely be stands not currently of merchantable size killed by the mountain pine beetle. These areas will have no reforestation obligations and may require some intervention to get regeneration established. Where stands will not regenerating within a short timeframe, planting will greatly benefit timber supply in the mid to long term.
3. 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 area will in turn become available for harvest again at the same period in the future. As well, if this area is dominated with pine, it will once again become susceptible to a MPB epidemic

4.2 Timber Quality Issues

The current provincial target for premium sawlog production is 10% of a TSAs AAC. Premium sawlogs in this TSA are considered to be house logs, peelers, poles, or logs that will produce MSR lumber.

In general, the average age of harvested stands is declining over time as we move into the harvest of shorter rotation second growth managed stands. The midterm timber supply deficit caused by the MPB will accelerate this trend because very young managed stands will be the primary source of harvest toward the end of this period. As a result, timber quality as correlated with piece size will decrease during the deficit period.

Timber quality issues to be addressed:

1. Declining piece size and reduced potential for MSR lumber with shorter rotations.

4.3 Habitat Supply Issues

The current habitat supply issues results from the MPB infestation and the recent wildfires through both direct impacts of pine due to mountain pine beetle and indirect impacts of both pine and non pine due to salvage harvesting. Habitat supply in NDT 4 is being impacted by infill of Douglas fir and ponderosa pine forests, beetle mortality of ponderosa pine and encroachment of conifers into grasslands.

Treatment focus depends on Natural Disturbance Type (NDT): Two NDTs characterize the area where pine and fir forests dominate in the Kamloops TSA (Biodiversity Guide Book 1995).

- 1) NDT 3 (frequent stand replacing events)

Pine dominated forests evolved with relatively frequent crown fires and MBP infestations. Wildlife and fish species also evolved in this type of disturbance pattern over time. The current MPB infestation is considered unprecedented and attributed to many factors, including fire suppression and climate change. Salvage logging in highly infested areas is expected to result in larger than normal openings. To achieve resemblance of a natural disturbance requires increased stand structure in the form of tree retention, understory vegetation and coarse woody debris. In this NDT, added retention, strategically located will reduce risk to environmental values.

2) NDT 4 (frequent stand-maintaining under story fires).

Suppression of frequent understory fires, climate change, past grazing and logging practices has created extensive in-growth, and fuels in Douglas-fir and Ponderosa stands increasing the risk of catastrophic fires. Removing some of this ingrowth mechanically and through managed fire will enhance and protect both timber and environmental values in many areas. Managing other areas as open forests to promote understory productivity is very desirable from an environmental perspective.

Landscape/watershed issues placed at increased risk

- **Aquatic ecosystems, species and supply of domestic water use**

The hydrology risks in watersheds will depend upon a number of factors: ECA, soil texture and composition, slope, aspect, road density, number of stream crossings etc. Changes in hydrology will result from MPB and salvage harvesting. High ECA's in sub-basins can place environmental values at risk both in the basin and further downstream.

Hydrology risk can be reduced through speeding up hydrological green up in the most sensitive of watersheds and increased emphasis on riparian ecosystem function, and managing the amount of open roads. This is especially important to consider in the following areas:

1. All fish-bearing streams
2. Wetlands and wetland complex's
3. Community and domestic watersheds

- **Loss of mature and old pine (Lodgepole and Ponderosa):** The loss of mature and old forests (pine and pine mixed with other species) over the next 5 – 10 years will have significant impacts on aquatic and terrestrial values. The old and mature pine dominated forests which provide habitats for a variety of wildlife will be in short supply. Many of the OGMA's that are in pine dominated stands will be at risk. Some OGMA's that were designated as recruitment OGMA may benefit from thinning to bring these stands into older seral condition more quickly. Where possible replacing pure pine OGMA's with mixed stands is a preferred option to retain old and mature forests in the short and midterm. Boundary fine tuning in mixed stands is anticipated in order to maximize the amount of functioning OGMA's in NDT 3 and possibly NDT 4. There is also considerable value in maintaining patches of mature and old pine, of various sizes, throughout the landscape. Focus silvicultural practices and restoration activities to achieve mature and old attributes as quick as possible.

- **Reduced Landscape Connectivity:** Clearcut harvesting to remove infested pine in both mixed and pure pine stands, and intensive large scale fires and resulting salvage harvesting removes stand structure that connects habitats across the landscape. The loss of connectivity within and between watersheds can create problems for wildlife species that require a continuous mature forest cover to survive. Marten for example need older canopy cover to meet its life requisites. Focused retention and silviculture strategies in riparian areas, and between wetland complexes will help provide some connectivity. Identifying and mapping these areas and other known retention areas by watershed will help identify deficiencies and focus priorities for both retention and silviculture.
- **Loss of Large Older and mature sized Forest Patch:** The large cutblock strategy considers and incorporates patch size considerations, but the strategy was not designed to be implemented at the scale or for the purpose of addressing mountain pine beetle infestations. MPB has the advantage of promoting larger patch sizes in landscapes that traditionally experienced large scale disturbances. However, salvage harvesting is in many ways different from what would occur in nature, and the extent and intensity of current infestations may be exceeding historical scales of disturbance. Managing to maintain a continuous supply of the various patch sizes over space and time poses a daunting task when overlaid by MPB patterns of infestation. Nevertheless, this deserves to be considered as part of silviculture planning.
- **Wildlife trees and coarse woody debris:** Wildlife trees are managed in the TSA through provisions in the Forest and Range Practices Act. MPB infestation will enhance supplies of wildlife trees and CWD, at least in the short to medium term but, actions such as salvage, road building, and safety issues associated with roads, replanting and stand tending may result in the loss of higher value large diameter fir, larch, ponderosa pine and deciduous wildlife trees and CWD. Wildlife trees and CWD are also vulnerable to intensive fires promoted by climate change and large supplies of MPB killed pine. Strategies to retain coarse woody debris, wildlife trees and wildlife tree supply through time are a critical part of silviculture planning.
- **Increase in Roads and access:** Many species at risk or of management concern are negatively affected by roads and road densities due to disturbances by people during all seasons of the year, increases in predation, heavier sediment risks, and lack of refugia to high quality habitat. The potential for impact to many species including grizzly bear, caribou, moose, and fish is of concern. Increased emphasis on managing road impacts is warranted.
- **Cattle use:** Cattle use in sensitive habitats, like rare ecosystems (aspen copse) and riparian areas will be of a greater concern for managing habitat supply and maintaining proper functioning condition. The forage produced in logged over areas would decline with time and animals would then target the native vegetation of wetlands and other riparian areas along streams and lakes. When designing silviculture treatments, consider, retain and enhance existing

barriers to cattle access associated with key riparian areas and rare ecosystems.

- **Enhanced diversity of crop tree species used for reforestation obligations:** Deciduous trees such as aspen and cottonwood are favoured by many cavity nesting birds, and animals that den in trees. Accepting deciduous as suitable crop trees will help moderate the impacts of future MPB outbreaks and impacts on wildlife.
- **Forest infill and encroachment**
In many NDT forests, Douglas fir and ponderosa pine regeneration forms dense thickets. These thickets tend to stagnate due to competition for light and moisture. Many of these stands historically grew under open forest conditions and provided habitat for a variety of wildlife. Directing silviculture activities into these types of stands will improve habitat for wildlife and timber and reduce forest health risks.
There are some grasslands within NDT 4 where conifer encroachment is impacting forage values.

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 at its elevated level to salvage MPB impacted wood. Timber quality will remain relatively constant with historical levels, although a higher proportion of PI is expected. The bulk of the harvesting activity will occur in the southern half of the TSA because of its predominance of pine stands.

Habitat supply issues exist in the short term as a result of the AAC uplift/salvage harvesting and/or MPB mortality. 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. These pressures will occur disproportionately in the southern half of the TSA.

5.2 Midterm

The midterm (20-100 years from now) is likely to experience significant reductions in timber supply. 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 intense pressure on the log quality profile.

The supply of habitat needed to maintain current fish and wildlife populations and maintain biodiversity complexity and water supply will be at 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 will be under pressure to provide timber harvesting opportunities. . Early in the midterm some watersheds will still

be at risk as cut over areas may have not achieved hydrological green up and much of the area would still be roaded from past salvage operations and ongoing minor salvage. Unless the roads and crossing structures are addressed stream integrity could remain at considerable risk. Further harvesting and road construction in some watersheds will create significant hydrological risks. In addition, some of the tools originally designed to help maintain biodiversity will have been severely impacted by MPB (OGMA's, WTP's, Riparian Areas, Parks, etc). Even areas left unharvested and untreated will go through a period where there is little remaining CWD. Species such as pine marten will find little suitable habitat. Only the live tree species left today will be available to bridge the midterm habitat supply gap.

5.3 Long term

Long term harvest levels are projected to be above midterm levels but below the potential shown in TSR2 because of poor or no regeneration on MPB or wildfire 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 this 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 growing timber on short rotations (50-100 years). In addition, climate change has the potential to change ecosystems and species habitats in 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 silvicultural 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 impact on Timber Supply, Quality and Habitat were estimated and each strategy was given a ranking of Very High, High, Medium or Low priority (Table 6).

Table 6. Summary of potential silviculture strategies to address TSA issues.

Strategy	Opportunity in Next 5 years (ha)	Timber Supply Effects			Quality	Habitat	Cost/ha (\$)	Rank
		Short	Mid	Long				
TS1a-b. Late rotation fertilization (40-80years old) non PI	9,547	++	++		+	+/-	400	VH
TS1c-d. Late rotation fertilization (81+years old) non PI	44,406	+	+		+	+/-	400	H ⁴
TS2. Young stand fertilization (non PI)	36,524		+++		+	++	400	H
TS3. Space + Fertilize Repressed PI stands	8,000		+	++	+	++	1000	H ⁵
TS4. Spacing drybelt Fd ⁶	30,000		++	+++	++	++	600	H
TS4b. Spacing young dense Fd or Sx leading stands (non-drybelt)	1000		++	+++	++	+	600	M-L
TS4 e. Spacing high value stands where CT is anticipated	100		++	+++	++	++	600	Nil
TS5,6. Planting THLB sites with no reforestation obligations (timber focus)	25,000		+	+++		+++	1000	H
TS7b. Address Backlog NSR sites	Limited		+	+		-	1200	L
TS7b. Address Backlog Issues (impeded stands)	17,375		+	+		-	700	VH
TS8a Rehab areas mapped as problem forest types	500			++	++	-	1700	M
TS8b Under-performing IU-logged balsam and Fd.	6,500		+	++	+	++/--	23	H
TQ1a. Pruning	500				++	++	800	L
HS1,2,3. Planting NonTHLB sites with no reforestation obligations (habitat focus)	2750		+	+		++	1000	H
HS4a. Spacing/thinning in NDT4 (ingress/encroachment)	5,000		+	+	++	++	600	VH
HS4b. Midseral to mature stands to accelerate old growth attributes.	100					++	600	M
HS5. Under-plant in NDT4.	500					++	300	H
HS6. Treat for invasive species	100,000					++	100	L/H ⁷
HS8. Rehab roads and landings (habitat focus)	100		+	+		++	5000	H ⁸

The following sections provide additional detail on the potential strategies.

⁴ High on a trial basis only.

⁵ High on a trial basis only.

⁶ All spacing and planting prescriptions would incorporate habitat direction where applicable.

⁷ Mostly considered low (outside the responsibility of a silviculture strategy), except for MoE rep who considered it a high priority.

⁸ MoE expressed a high ranking for this as a means of restricting access in areas with significant roading to address salvage. A functioning access management plan is desirable, with an option to rehabilitate roads and landings to restrict all motorized traffic.

6.1 Potential Strategies to Improve Timber Supply

The following table (Table 7) provides detail regarding potential timber supply strategies. It reflects discussions within the workshop and is meant to add clarity around the strategy and how it was ranked.

Table 7. Timber supply strategies.

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TS1a-b Late rotation fertilization of near mature Fd and Sx stands (40-80years old stands where moisture is not limiting)	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. Priority = Very High (one of the few opportunities to influence the front end of the trough)	Fd -17m ³ /ha per application. ⁹ Sx -11 m ³ /ha per application. Benefit realized over 10 year period.	Short to Midterm
TS1c-d Late rotation fertilization of older Fd and Sx stands (81-140years old stands where moisture is not limiting)	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. 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.	No North American data but response could be similar to younger stand benefits described above.	Short to Midterm
TS2a-b Young stand fertilization (Fd and Sx - where moisture is not limiting)	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 year intervals. This will make these stands available sooner or have more volume at time of harvest. Moisture limited sites (drybelt) should be avoided. Priority = High. The intent is to focus on Fd first and Sx as a trial, some concerns around terminal weevil. <i>Once the risks associated with MPB are reduced, treatment of younger PI stands will become a high priority with significant potential benefits.</i>	Fd - 17m ³ /ha per application. Sx - 11 m ³ /ha per application. Benefit realized over 10 year period.	Back end of Midterm
TS3 Space and fertilize repressed PI	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 differentiate. Priority = High for a trial only.	Bring stands back into the THLB (~150m ³ /ha) or improve their merchantable volume (~100 m ³ /ha).	Mid to Long Term
TS4 Spacing (drybelt Fd)	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 into order to achieve the objective. An integrated strategy incorporating timber and habitat objectives is needed to ensure the treatments are effective for both objectives. Priority = High – It is tough to estimate the amount of area as it is scattered, but there is a sense that lots of potential area is available, with both timber and non-timber benefits achieved (habitat, urban interface fuels reductions, etc)	It was assumed that an additional entry into the stand would be possible if treatment occurs (15-30 m ³ /ha).	Mid to Long Term

⁹ 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 12m³/ha per application (Brockley 2001).

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TS4b. Spacing young dense Fd or Sx leading stands (non-drybelt)	Spacing of younger even aged stands to realize merchantable volume more quickly, particularly if combined with subsequent fertilization, perhaps several times, further reducing the time to merchantability. Priority = Low.	Benefit here is mostly the promotion of a suitable stand for a subsequent fertilization adding 11-17 m ³ /ha.	Back end of Midterm
TS4 e. Space high value stands where CT is anticipated	Stand that will be partially harvested in the future could be better setup with a spacing treatment now. Would make the partial entry more economical. Priority = Nil (seen as not applicable and non economic by group)	Opportunity to improve piece size/wood quality and provide a stand entry in the midterm.	Mid to Long Term
TS5. Planting THLB sites with no reforestation obligations (timber focus)	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 disturbances such as fire, and are not salvaged and therefore have no reforestation obligations on them. 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). Planning will be needed to identify suitable areas and approaches. Priority = High. One of the most cost effective ways to improve timber supply and habitat supply. Seems like there is a significant amount of this type of area in the large recent wildfire areas (need better data to confirm). Habitat supply would benefit most from regeneration in highly impacted/ high risk watersheds.	Maintain productivity of the THLB.	Mid to Long Term
TS7b. Address Backlog NSR	Backlog NSR sites are not an issue in the Kamloops TSA because the cost effective opportunities have been exhausted. Priority = Low.	Maintain productivity of the THLB.	Mid to Long Term
TS7b. Address Backlog Impeded Stands	There is some concern about backlog plantations that have not yet reached free growing (impeded stands). Some of these stands require treatments (i.e. brushing) to ensure earlier investments are not lost. The amount of area is uncertain although current projects are working to quantify the issue. Priority = High.	Maintain productivity of the THLB. Realize yields already projected by TSR.	Mid to Long Term
TS8a Rehab areas mapped as problem forest types	This treatment is aimed at putting more ground into timber production – mostly the old Cw / Hw stands with hemlock looper kill. Priority = Moderate. It was ranked low for most participants as they felt these sites were fairly constrained (terrain, slash loads etc). For one licensee who operates in many of these types it was a high priority – so ranked as moderate.	Increase the size of the THLB.	Mid to Long Term
TS8b Under-performing IU-logged balsam and Fd.	These stands were logged under intermediate-utilization standards, leaving a legacy of residual stands, dominated by BI with highly variable vigor and growth rates. A variety of treatments may be required, including: quality spacing /slashing, site prep, planting. Need to survey to determine the scale of the problem. TFLs have some data, but little for the TSA. Priority – High as it is felt this is significant and a decent gain can be achieved.	Maintain existing volume in non PI stands.	Short and Midterm

6.2 Potential Strategies to Improve Timber Quality

The following table provides detail regarding potential timber quality strategies discussed in the workshop.

Table 8. Strategies to improve timber quality.

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TQ1. Pruning	Investing to finish second lift pruning on previously treated stands (mostly PI) was generally seen as not worthwhile because MPB is likely to impact the stands. Priority = Low	Increase high value clear log volume.	Mid to 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

The following table provides detail regarding the potential habitat supply strategies discussed in the workshop.

Table 9. Strategies to improve habitat quality.

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
HS1,2,3. Planting NonTHLB sites with no reforestation obligations (habitat focus / only danger trees felled)	Reforestation of non-THLB areas impacted by MPB or other natural disturbances 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 parks, riparian reserves/management zones ¹⁰ , WTP's, and potentially OGMA's. Priority = High	Improved habitat quality hydrologic recovery, improved recovery of pine dominated riparian for shade and reductions in stream temperature,	Continuous
HS4a Spacing drybelt Fd – Habitat focus (encroachment/ ingress)	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 of Douglas-fir and ponderosa pine.. Priority = High	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)	Short to Midterm
HS4b. Midseral to mature stands to accelerate old growth attributes.	Candidate stands are mid seral to mature stands where old growth attributes need to be accelerated (deficit LU-BEC units/recruitment OGMA's). Priority = Moderate (High for MoE rep, but licensees felt there were few benefits for them).	To accelerate the development of old forest attributes in appropriate stand types – trees will increase diameter, branch size, bark thickness more quickly.	Midterm
HS5 Under-plant in drybelt Fd	Areas that have been spaced and/or currently open stands require under-planting to develop 'natural' stand conditions. Not a lot of stands currently	Improved stand structure in drybelt Fd types - same benefits as above.	Short to Midterm

¹⁰ 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
	available but could start areas now. Priority = High		
HS6. Treat for invasive species	A high priority from a biodiversity standpoint. It is not clear how much this will increase due to salvage of beetle-killed pine. It is anticipated to increase since invasive species come in on trails and other logging disturbances, as well as cattle concentrations that can occur as a result of logging. Some participants felt this treatment fell under a different funding mandate. Priority = Low (High for MoE)	Reduction in extent of invasive species.	Continuous.
HS8 Rehab roads and landings	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
HS9 Site prep and planting to maintain or restore natural barriers to sensitive habitats	Utilize dead PI site prep plantings to manage cattle access to sensitive habitats such as wetlands used by wintering moose.	Stands no potential for salvage but may be within THLB.	Continuous

6.4 General Stewardship Strategies

The following table 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 10. General stewardship strategies

Strategy	Workshop Comments / Discussion
1. Minimize regen delay	Decrease regeneration delay and get stands online sooner. Planting instead of relying on naturals may be considered in some ecosystems in the TSA. Provide some areas that follow more natural regeneration stocking densities so that planting does not reduce biological complexity.
2. Utilize improved planting stock (best available) whenever possible.	Get stands online sooner or with more volume.
3. Protect growing volume for use in the midterm. (Non PI species in mature stands and/or advanced regeneration)	Avoid harvest of non PI during salvage period as this directly affects the midterm trough in wood and habitat supply. Retain areas with advanced regeneration as this affect the long term habitat and wood supply. Need to keep green timber growing and available for deficit period (midterm).
4. Partial harvest during deficit period	Constrained areas (VQO's, MDWR, etc) in deficit period.
5. Ensure flexibility around Minimum Harvest Ages (midterm)	Regenerating stands where minimum harvest ages are above merchantability limits. This will allow short term flexibility to harvest younger stands which could dramatically improve the midterm timber flows, with minimal long term consequences.

Strategy	Workshop Comments / Discussion
6. Improve forest cover inventory.	Fd drybelt stands, Cw/Hw stands, residual balsam IU-logged stands. A high priority for this TSA.
7. Complete a site index adjustment project.	Adjusting site indexes in the inventory to reflect managed stand potentials will have the <u>single biggest impact on timber supply of any strategy discussed in this report</u> . A high priority for this TSA.
8. Better define growth and yield predictions for complex stands (drybelt Fd).	Yields for sites under selection management may be underestimated. A high priority for this TSA.
9. Look to change stocking standards / free growing standards to include more broadleaves.	Inclusion of broadleaves will provide habitat benefits and will diversify the future log products available to the forest industry.
10. Inventory for locations of species and ecosystems of conservation concern.	In order to manage for these species we need to understand where they are or where they are likely to be. This knowledge is required, in part, to ensure that funded incremental silviculture activities do not adversely impact these species and ecosystems.
11. Develop a forest health strategy	Need a coordinated strategic look at how to address forest health concerns beyond MPB.
12. Vary stand densities	Don't do same thing everywhere. E.g., Tom Sullivan's work – there are certain habitat benefits with lower densities – 1000 sph.
13. Complete a retention strategy to guide salvage operations	<p>Intent is to identify stand level retention objectives and landscape level areas for retention that will guide salvage operations. The planting strategies identified in Section 6.1 will require the completion of this plan in order to identify areas that will not be salvaged.</p> <p>The workshop suggested that this is a planning project that must first identify where the highest risks are, how a range of values overlap and where we get the best return for the investment. There may also be an opportunity to help future timber supply if stands with advanced regen can be retained. A Type 2 strategy may help with the development of this strategy. It is especially important in Community Watersheds and other watersheds with significant amounts of pine and recent harvesting.</p>

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 of the TSA.

7.1 Timber Supply Targets

Short Term (0-20)

- AAC uplift to a level required to capture MPB mortality.

Midterm (30-70 years)

- Minimize the depth and duration of the midterm trough.

Long Term (70years+)

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

7.2 Timber Quality Targets

Midterm

- 10% premium logs – house logs/peelers / MSR lumber.

Long Term

- 10% premium logs – house logs/peelers / MSR lumber.

Overall the intent is favour timber supply strategies over quality strategies where resources are limited.

7.3 Habitat Supply Targets

Goal/Objective is to minimize negative impacts on water resources, ecosystems and species and protect the ecological integrity of watersheds.

Short Term

- Stand and landscape level retention strategy developed for short-term retention to optimally mitigate impacts to environmental values.
- Reforest a proportion of impacted WTP / OGMA / RMA's/ or other strategically identified retention areas and to reduced stocking levels where ecologically appropriate.
- Increased levels of broad leaf trees and other appropriate species to increase stand level diversity across the land base.
- Improve habitat supply of open forest conditions within NDT 4.

Midterm and Long Term

- Maintain or improve the conservation status of all species (ensure forest practices do not make it worse).

8.0 Silviculture Strategy

This section summarizes the preferred silviculture strategy developed at the Kamloops TSA workshop. First, the high priority strategies are outlined and then two different five-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 consistent with historical funding levels for incremental silviculture¹¹. This plan/budget illustrates where resources would be allocated if resources were limited.

8.1 High Priority Strategies

The workshop group in the Kamloops TSA considered the following strategies to be high priority for implementation in the next five-years. The treatment of PI stands was avoided during this time period because of the risk associated with MPB.

¹¹ 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.

Late Rotation Fertilization (40-80 year old Fd and Sx stands where moisture not limiting)

Late rotation fertilization was identified as one of the only means of making more volume available at the front end of the midterm timber supply trough and is seen as the most cost effective method of fertilization¹². Fertilization is restricted to the wet belt other than on a trial basis due to moisture limitations in the drybelt. 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 where moisture not limiting)

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 stands¹³. 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).

Planting for Timber Values

Benefits were identified for planting impacted areas of the THLB that have no reforestation obligations (recent wildfires, MPB killed stands, etc). 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 areas will remain 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 young PI stands and plantations impacted by MPB.

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 paid for. These concerns need to be addressed as soon as possible to allow for timely implementation of this strategy. This work is well underway for the recent wildfires but consideration of future MPB impacts is important as well. Planting of small scale salvage areas was considered important but licensees were opposed to the use of special funding mechanisms (FIA / FFT / Federal funds) to complete this work.

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

¹² Return on investment analysis often shows positive values for late rotation fertilization because of the short period over which the investment must be held before realizing the gain (~10 years). This short period also means less risk of losing the investment to pests or natural disturbances when compared with fertilization of younger stands.

¹³ 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.

time (i.e. riparian areas, WTP, retention areas, and specific watersheds where hydrologic green will speed recovery and reduce risk to fish, water users and downstream infrastructure). 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 extensive danger tree falling is required, so a timely under-planting program coordinated with WCB will need to be pursued. In some cases, falling dead trees/ using dead and down material will be prescribed to create a movement barrier for cattle near sensitive ecosystems. Since there are short term benefits to hydrological /aquatic values and long term timber benefits to rapid reforestation this requires coordination of environmental risk and timber salvage.

Spacing / Thinning in Drybelt Fd stands

Large areas of IDF and PP have regenerated naturally with dense thickets under mature overstories. These ecosystems were adapted to some level of fire, which had the ability to thin the understory, reduce ladder fuels, and create more open conditions for surviving trees and associated wildlife.. With the exclusion of fire, high understory densities limit individual tree growth, increase ladder fuels, and generally slow recruitment of trees into larger classes over time. Forage productivity and species generally associated with open forest conditions have declined.

Both timber supply and habitat supply benefits were recognized with the treatment of these stands. It was determined that an integrated strategy is required in the IDF to determine different approaches to varying densities in the understory layers (layer 2 and 3). 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), wildlife and range objectives, and long term sustainable timber flows as each layer recruits into successive layers. This strategy is a high priority as it will yield habitat, range, and timber supply benefits. It also has the potential to integrate with wildland/urban interface fuel treatments.

Under-burning in Drybelt Stands

A program of under-burning in open grown NDT stands will help to promote or maintain desired stand structures. The workshop group identified it as a desirable objective but suggested it has several logistical challenges for implementation – specifically around liabilities with initiating fires.

Address Backlog Issues – Impeded Stands

Impeded stands were identified as priority candidates for treatment. Brushing treatments (possibly fill planting) are planned to add additional volume in the mid to back end of the trough. This is an ongoing program that 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.

Rehabilitation of under-performing IU-logged Balsam and Douglas-fir residual stands

These stand types were identified as a concern, although it is not clear what the scope of the problem is. Therefore assessments at the front end of the funding

period will be critical. Harvesting, quality spacing/thin-to-waste or slash-and-plant treatments may be required. It is recognized that maintaining some of these areas will provide for habitat diversity.

Manage for higher stocking densities to produce some MSR lumber

A subset of spacing strategies – basically the intent is to leave some higher density stands in place to produce wood quality suitable to MSR lumber.

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 is not an immediate priority because the current (or higher) harvest levels will likely be in place for at least the next 10 years, but 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.

Improve forest cover inventory information and determine better growth and yield information for complex drybelt stands.

Better inventory information is needed for drybelt Fd, Cw/Hw stands, and residual BI IU-logged stands. As well, better growth and yield data for drybelt fir stands is required.

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. A well designed retention strategy may also help with timber supply by retaining mixed pine stands with advanced regeneration.

Use of Improved Seed

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

Rehabilitation of Roads

Ripping and planting roads on the land base will have habitat benefits.

8.2 Silviculture Strategy Program (Idealized Funding Level)

This section describes an idealized (no constraints on \$ or manpower) silviculture program in terms of ha treated, budget requirements, and job outcomes. It assumes 81.2 million dollars 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	2,500	10,200	11,500	11,200	10,550	45,950
Spacing/Thinning (timber)	500	1,000	1,000	1,000	1,000	4,500
Spacing/Thinning (habitat)	-	100	100	100	100	400
Planting (timber - MPB/Other)	-	-	6,650	8,150	8,100	22,900
Planting (timber - fires)	500	2,000	-	-	-	2,500
Planting (habitat)	100	-	500	950	800	2,350
Pruning	-	-	-	-	-	-
Rehab underperforming & PFT stands	-	2,100	2,100	2,100	700	7,000
Address Backlog NSR/Impeded	-	5,300	4,000	4,000	4,000	17,300
Rehab roads	100	-	-	-	-	100
Treat for Invasives	500	500	500	500	500	2,500
Under burning	100	100	100	100	100	500
Totals	4,300	21,300	26,450	28,100	25,850	25,850

Proposed Budget (\$)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	\$ 1,110,000	\$ -	\$ -	\$ -	\$ -	\$ 1,110,000
Fertilize	\$ 1,065,000	\$ 4,080,000	\$ 4,600,000	\$ 4,480,000	\$ 4,220,000	\$ 18,445,000
Spacing/Thinning (timber)	\$ 325,000	\$ 600,000	\$ 600,000	\$ 600,000	\$ 600,000	\$ 2,725,000
Spacing/Thinning (habitat)	\$ -	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 240,000
Planting (timber - MPB/Other)	-	-	\$ 8,055,000	\$ 10,505,000	\$ 10,470,000	\$ 29,030,000
Planting (timber - fires)	\$ 550,000	\$ 2,160,000	-	-	-	\$ 2,710,000
Planting (habitat)	\$ 180,000	\$ -	\$ 630,000	\$ 1,175,000	\$ 920,000	\$ 2,905,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab underperforming & PFT stands	\$ -	\$ 3,570,000	\$ 3,570,000	\$ 3,570,000	\$ 1,190,000	\$ 11,900,000
Address Backlog NSR/Impeded	\$ -	\$ 3,180,000	\$ 2,400,000	\$ 2,400,000	\$ 2,400,000	\$ 10,380,000
Rehab roads	\$ 500,000	\$ -	\$ -	\$ -	\$ -	\$ 500,000
Treat for Invasives	\$ 250,000	\$ 250,000	\$ 250,000	\$ 250,000	\$ 250,000	\$ 1,250,000
Under burning	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 50,000
Totals	\$ 3,990,000	\$ 13,910,000	\$ 20,175,000	\$ 23,050,000	\$ 20,120,000	\$ 81,245,000

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	3,700	-	-	-	-	3,700
Fertilize	250	1,020	1,150	1,120	1,055	4,595
Spacing/Thinning (timber)	1,695	3,390	3,390	3,390	3,390	15,255
Spacing/Thinning (habitat)	-	340	340	340	340	1,360
Planting (timber - MPB/Other)	-	-	9,500	14,000	14,000	37,500
Planting (timber - fires)	1,000	3,800	-	-	-	4,800
Planting (habitat)	300	-	1,300	2,450	2,000	6,050
Pruning	-	-	-	-	-	-
Rehab underperforming & PFT stands	-	9,450	9,450	9,450	3,150	31,500
Address Backlog NSR/Impeded	-	5,300	4,000	4,000	4,000	17,300
Rehab roads	100	-	-	-	-	100
Treat for Invasives	500	500	500	500	500	2,500
Underburning	20	20	20	20	20	100
Totals	7,565	23,820	29,650	35,270	28,455	124,760

In addition to the above strategies/investments, a site index adjustment project and a retention strategy plan were considered as high priority for completion. The studies/surveys listed in the tables above reflect the initial setup of specific programs (e.g. identify and prioritize fertilization candidates). Ongoing survey and layout costs associated with specific strategies are included in the strategy costs.

8.2.1 Expected Outcomes (Idealized Funding Level)

If 81.2 million was invested over a five-year period, the following outcomes could be expected:

Estimated Timber Supply Outcomes

- 174,650 m³ made available at the front end of the trough
 - o Realized from late rotation fertilization.
- 1,418,300 m³ made available in the middle to back of the trough
 - o Realized mainly from maintaining backlog impeded stands and fertilizing young stands, with a small benefit from thinning drybelt Fd stands.
- 4,820,000 m³ made available in the back end of the trough
 - o Realized mainly through planting of sites with no obligations (fires and MPB), with smaller contributions from rehabilitation of underperforming IU-logged balsam and Fd residual stands, and road/landing rehabilitation.

Timber Quality Outcomes

- None

Habitat Supply Outcomes

- Improved stand structure on 4,900 ha of drybelt Fd stands (thinned/spaced), with 500 ha of this also under-planted.
- Regeneration of 2,350 ha of impacted stands with a habitat focus, and regeneration of 25,400 ha of impacted stands with a timber focus.
- Invasive plants will have been treated on 2,500 hectares.
- 100 hectares of road and landing rehabilitation will have occurred.

8.2.2 Expected Outcomes for 20year Investment (Idealized Funding Level)

If this level of funding was continued for 20 years (\$325 million total) and similar benefits were achieved throughout, the midterm trough could be maintained at a level 306,000 m³/year higher than currently projected in the Potential MPB Scenario (Figure 14). 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.

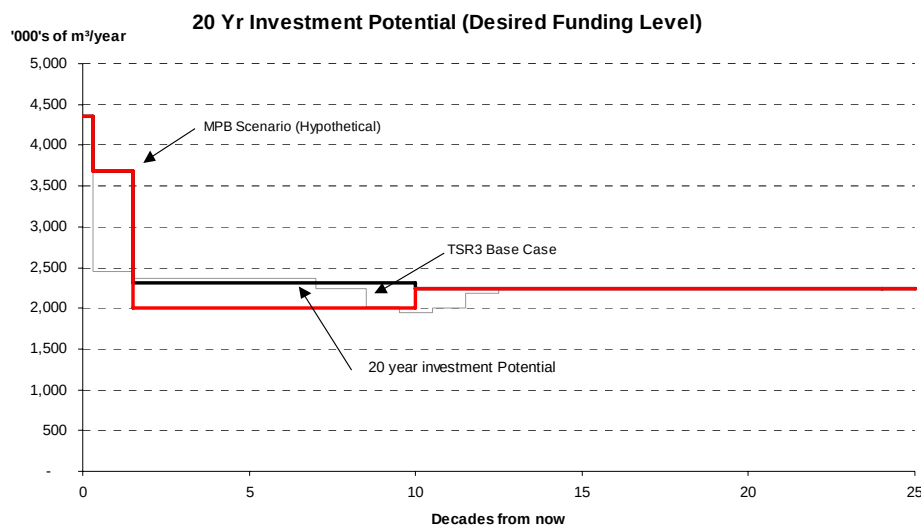


Figure 14. 20 year continuous investment (idealized funding level).

8.3 Silviculture Strategy Program (Historical Funding Level)

This section describes a silviculture program constrained to approximately 13 million dollars over five-years in terms of ha treated, budget requirements, and job outcomes.

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	1,500	700	2,100	1,800	2,150	8,250
Spacing/Thinning (timber)	500	-	300	300	300	1,400
Spacing/Thinning (habitat)	-	100	100	100	100	400
Planting (timber - MPB/Other)	-	-	100	600	600	1,300
Planting (timber - fires)	500	1,900	-	-	-	2,400
Planting (habitat)	100	-	100	100	100	400
Pruning	-	-	-	-	-	-
Rehab underperforming & PFT stands	-	-	-	-	-	-
Address Backlog NSR/Impeded	-	300	2,150	1,800	1,500	5,750
Rehab roads	-	-	-	-	-	-
Treat for Invasives	-	-	-	-	-	-
Under burning	100	100	100	100	100	500
Totals	2,700	3,100	4,950	4,800	4,850	4,850

Proposed Budget (\$)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	\$ 940,000	\$ -	\$ -	\$ -	\$ -	\$ 940,000
Fertilize	\$ 640,000	\$ 280,000	\$ 840,000	\$ 720,000	\$ 860,000	\$ 3,340,000
Spacing/Thinning (timber)	\$ 325,000	\$ -	\$ 180,000	\$ 180,000	\$ 180,000	\$ 865,000
Spacing/Thinning (habitat)	\$ -	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 240,000
Planting (timber - MPB/Other)	-	-	\$ 170,000	\$ 520,000	\$ 520,000	\$ 1,210,000
Planting (timber - fires)	\$ 550,000	\$ 2,090,000	-	-	-	\$ 2,640,000
Planting (habitat)	\$ 180,000	\$ -	\$ 70,000	\$ 70,000	\$ 70,000	\$ 390,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab underperforming & PFT stands	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Address Backlog NSR/Impeded	\$ -	\$ 180,000	\$ 1,290,000	\$ 1,080,000	\$ 900,000	\$ 3,450,000
Rehab roads	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Treat for Invasives	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Under burning	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 50,000
Totals	\$ 2,645,000	\$ 2,620,000	\$ 2,620,000	\$ 2,640,000	\$ 2,600,000	\$ 13,125,000

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	3,133	-	-	-	-	3,133
Fertilize	150	70	210	180	215	825
Spacing/Thinning (timber)	1,695	-	1,017	1,017	1,017	4,746
Spacing/Thinning (habitat)	-	340	340	340	340	1,360
Planting (timber - MPB/Other)	-	-	300	300	300	900
Planting (timber - fires)	1,000	3,800	-	-	-	4,800
Planting (habitat)	300	-	200	200	200	900
Pruning	-	-	-	-	-	-
Rehab underperforming & PFT stands	-	-	-	-	-	-
Address Backlog NSR/Impeded	-	300	2,150	1,800	1,500	5,750
Rehab roads	-	-	-	-	-	-
Treat for Invasives	-	-	-	-	-	-
Underburning	20	20	20	20	20	100
Totals	6,298	4,530	4,237	3,857	3,592	22,514

In addition to the above strategies/investments, a site index adjustment project and a retention strategy plan were considered as high priority for completion. The

studies/surveys listed in the tables above reflect the initial setup of specific programs (e.g. identify and prioritize fertilization candidates). 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 13 million was invested over a five-year period, the following outcomes could be expected:

Estimated Timber Supply Outcomes

- 140,250 m³ made available at the front end of the trough
 - o Realized from late rotation fertilization
- 313,300 m³ made available in the middle of the trough
 - o Realized mainly from maintaining backlog impeded stands, with a small benefit from thinning drybelt Fd stands.
- 555,000 m³ made available in the back end of the trough
 - o Realized through planting of sites with no obligations.

Timber Quality Outcomes

- None

Habitat Supply Outcomes

- Improved stand structure on 1800 ha of drybelt Fd stands (thinned/spaced).
- Under-planting on 500 ha of drybelt Fd and Py stands.
- Regeneration of 400 ha of impacted stands with a habitat focus, and regeneration of 3,700 ha of impacted stands with a timber focus.

8.3.2 Expected Outcomes for 20year Investment (Historical Funding Level)

If this level of funding was continued for 20 years (\$52 million total) and similar benefits were achieved throughout, the midterm trough could be maintained at a level 47,500 m³/year higher (Figure 15). 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.

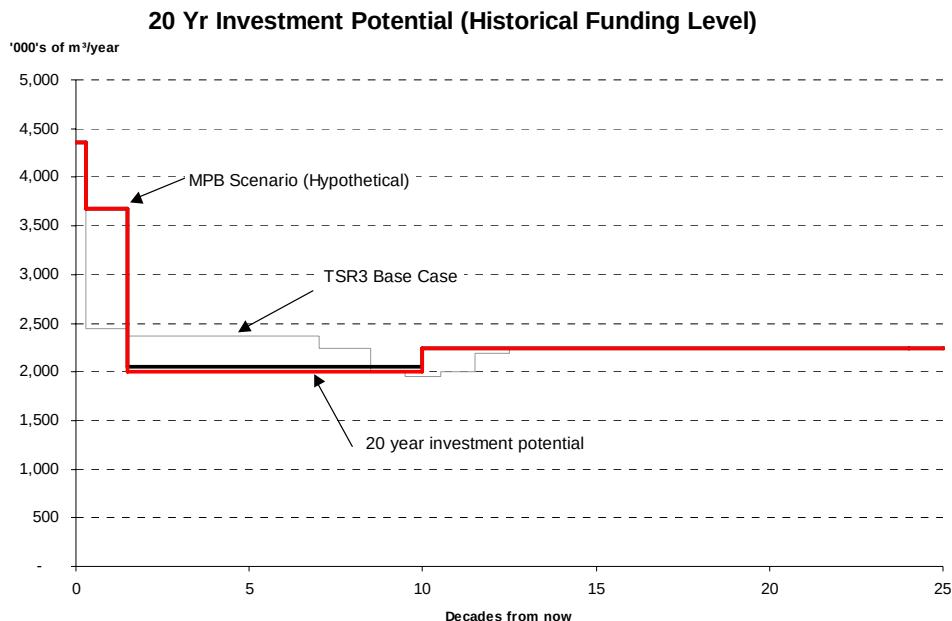


Figure 15. 20 year continuous investment (Historical funding level).

9.0 Summary of Research and Information 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 so ecological mapping at the site series level is required. This mapping must meet accuracy standards set by Forest Analysis Branch.
2. Retention planning is required to identify areas where salvage will not occur and to provide guidance around increased retention at the stand level. Needs to be coordinated with a planning project that will determine where the highest risks are, how a range of values overlap and where the best return is.
3. Improvements in the accuracy of forest cover inventory volume estimates for a range of stands types is desired (Cw/Hw, BI or Fd IU residual stands, complex drybelt stands).
4. Better defining growth and yield predictions for managed NDT4 stand types is also a priority.
5. Inventory for locations of species of conservation concern so that management, including incremental silviculture activities, can better address these species.
6. Develop an access management plan to limit the amount of open road within the TSA.
7. Develop a seed strategy that identifies seed inventories (natural stand and orchard), seed gaps and seed mitigation strategies over the short and long term.

8. A Type 2/3 Silviculture Strategy is needed to clarify the outcomes for opportunities presented here and to identify areas for treatment. All of the potential opportunities presented here require refinement in terms of areas, timing and impacts.
9. Questions exist around the potential for increased resistance to MPB with increasing tree vigor through fertilization.
10. There is a desire to monitor stands post free growing to ensure success of these stands and consistency with TIPSy projections.

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 Background*, Unpublished report compiled by Prizm Environmental, Symmetree Consulting, and Forsite as part of the Type 1 Silviculture Strategy project completed 2005/2006.
- MoF, 2004. *Kamloops Timber Supply Area – Rationale for Annual Allowable Cut (AAC) Determination (In response to a request for a temporary increase)*. Larry Peterson – Chief Forester, Victoria, BC.
- MoF, 2003. *Kamloops Timber Supply Area – Rationale for Annual Allowable Cut (AAC) Determination*. Larry Peterson – Chief Forester, Victoria, BC.
- MoF, 2001. *Kamloops Timber Supply Area Analysis Report*. Timber Supply Branch, Victoria, BC.
- MoF, 2001. *Kamloops TSA Silviculture Strategy (Type 1)*. <http://www.for.gov.bc.ca/hfp/silstrat/map/kamloops-tsa-kaml.htm>.
- 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

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
Bl	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		