Boundary Timber Supply Area

Interim Silviculture Strategy

-- Version 1.2 --

British Columbia
Ministry of Forests

Funded By

Forest Renewal BC

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Contents

1. Executive Summary

Introduction

This strategy is intended to help optimize the application of available funding for silviculture activities towards the goals of improving the future quantity and quality of both habitat and timber supply. The strategy will be considered as one of several inputs in decisions on funding allocations and treatment activities. The degree to which the overall strategy ultimately proves appropriate and is achieved will also be the degree to which the expressed targets will be achieved.

Objectives

1. Because the TSR2 analysis is not yet available it is difficult to identify with any precision both the silvicultural opportunities and their relative importance. In its stead, the workshop participants relied on their own local knowledge of issues and opportunities as well as some expectation of what TSR2 may look like. While the TSR1 forecast suggests the existing harvest level can be maintained for many decades, in contrast forest companies are having difficulty finding available wood for harvest. <u>The first objective of this strategy, therefore, is to undertake silvicultural actions that will enhance short term timber supply, both in terms of amount and availability.</u> Workshop analysis indicates there is a potential for late rotation fertilization of some stands.

2. It is not possible to predict the shape of mid term timber supply in the absence of TSR2 information. <u>A mid term objective, therefore, is to increase the quantity of the timber to be available for harvesting in this time period.</u> Programs of spacing and fertilization can accomplish this.

3. In the long term, starting about 90 years from now, workshop analysis indicates silvicultural activities can result in at least 20% higher harvest levels. The baseline to which this is applied, however, must await TSR2 analysis. In the absence of this analysis, <u>a long term objective is to maximize timber production within a context of sound multiple resource stewardship.</u> Workshop analysis indicates that silvicultural activities can contribute significantly to this objective.

4. Based on a clear log definition of being able to produce 25% clear lumber by volume, 2nd growth managed stands will have no clear logs. <u>A second long term objective is to create a long term timber supply yielding at least 1% clear logs on a total harvest volume basis.</u>

Accomplishing these objectives requires an incremental silviculture program substantially above historic levels. Some changes in basic silviculture activities also present opportunities to contribute to the objectives.

Product Objectives

The following are product objectives at the log level for the Boundary TSA.

Quality Class	Species	Characteristics
Premium Log:	Douglas-fir, spruce Pl Lw	35+ cm DBH, clear 3-5 m log.
	larch,	30+ cm DBH, straight, low taper, building log

Quality Class	Species	Characteristics
	spruce	
	western redcedar	25+ cm DBH, pole
	lodgepole pine	30+ cm DBH; large log
Sawlog:	western white pine	30+ cm DBH, tight knots, premium species.
	Douglas-fir, larch, ponderosa pine, redcedar	30+ cm DBH.
	lodgepole pine, spruce, balsam, hemlock	25+ cm DBH.

Major Silvicultural Strategies

The strategies listed below are those considered in the workshop and follow-up analysis to be appropriate towards achieving the working targets. Other strategies that were considered but found to have no opportunity are documented in the report.

Timber Quantity

Some of the following are not within the traditional scope of incremental silviculture but are included here for completeness. Some practices are pre free-growing and are not likely to be undertaken by licensees without funding assistance if free growing obligations can be achieved without them.

Number	Strategy	Priority*
	*B - denotes basic silviculture item, the cost of which would be borne by licensees. Most items are current practice.	
Surveys	Conduct approximately 5 400 ha/yr of silviculture surveys in support of all strategies.	

SHORT TERM

Objectives:

- enhance short term timber supply, both in terms of availability and physical extent.

Working Targets:

- Maintain the current harvest level for at least 20 years.

Strategies:

ST1	Late rotation fertilize 530 ha/yr to produce approximately 8 000 m3/yr of additional harvest volume by the 2nd decade.	**5**
ST2	Commercially thin stands where needed to enhance timber availability when adjacency rules might otherwise constrain the harvest.	**As needed**

MID TERM

Objectives:

- Increase the quantity of timber to be available for harvesting.

Working Targets:

- Generate a potential additional 1.5 million m3 to mid-term timber supply.

Strategies:

MT2	Reduce green-up ages by 5 years in the IRM, VQO and Watershed zones, by:	
(a)	for existing stands:	
	(i) fertilizing 1 200 ha/yr of existing Pl/Fdi stands currently 1-2 m high; and	**B-3**
	(ii) spacing 2 000 ha of pre-87 repressed Pl stands that are currently 10-20 years old at the rate of 400 ha/yr (to speed up hydrologic recovery).	**2**
(b)	for about to be regenerated stands:	
	(i) using improved seed on all planted areas (1 440 ha/yr);	**B-1**
	(iii) using larger (415) planting stock on 300 ha/yr (current practice);	**B-2**

Number	Strategy	Priority*
	*B - denotes basic silviculture item, the cost of which would be borne by licensees. Most items are current practice.	
	(viii) Continuing MT2(a)(i) - fertilization 1 200 ha/yr of Pl/Fdi;	**B-3**
	(ix) include rust resistant white pine in plantations (500 ha/yr).	**B-1**
MT3	Set up Pl and Fdi stands (target stands having good access, even terrain and M to G site) for future partial harvesting or commercial thinning, by:	
(a)	spacing 600 ha/yr; and	**3**
(b)	repeat fertilizing 600 ha/yr (subset of LT3 (b)). (Alternatively may be fertilized 10-15 yrs prior to PH/CT and 2-3 yrs after, which would have no implications for current programs.)	**5**

LONG TERM

Objectives:

- Maximize long term timber production within a context of sound multiple resource stewardship.
- Improve the quality of the timber to be harvested.

Working Targets:

- Increase long term timber supply by at least 20%.
- Generate at least 7% of total harvest volume in premium large logs (no current silviculture strategy implications).
- Generate at least 1% of total harvest volume in clear premium logs (clear logs will generally also be large logs).

Strategies:

LT1	Maintain the timber harvesting land base by:	
(a)	Planting approximately 300 ha of backlog NSR.	**1**
(b)	Maintaining approximately 900 ha of previously reforested backlog plantations.	**2**
LT3	Increase the volume of regenerated stands by 20% over those used at the base case by, in addition to those practices in MT 2:	
(b)	Repeat fertilizing 1 200 ha/yr (as per strategies MT2(a) and MT3 (b)), rising gradually over about 60 years to 6 700 ha/yr as more stands come under management, for an expected result of a 6% gain in LTHL.	**5**
LT4	Reduce losses to root rot by:	
(a)	pushover logging/stumping 400 ha/yr on slopes < 30% (basic silvicul-	**B-4**

Number	Strategy	Priority*
	*B - denotes basic silviculture item, the cost of which would be borne by licensees. Most items are current practice.	
	ture; being phased out in favour of small-diameter spacing);	
(b)	planting Lw, Pw and Py on 1 440 ha/yr (basic silviculture);	B-2
(c)	pop-up spacing 10 ha/yr; and	6
(e)	small diameter spacing 800 ha/yr (basic silviculture; being phased in as an alternative to stumping).	B-4
Q1	Space 500 ha/yr of existing (and future) stands with 5-7 000 sph down to levels in accordance with the district stand level strategy to increase average stand diameters.	3
Q2	First-lift prune 100 ha/yr and 2nd lift prune 50 ha/yr for a total pruning program of 150 ha/yr (target stands spaced to 800 sph and under repeat fertilization regime).	4

Illustration of Working Targets

Chart not available – pending TSR2 analysis results.

Silviculture Regimes & Investment Priorities

The following table indicates silviculture regimes which are suitable to attaining the above working targets and strategies.

	Regimes	Strategy	Opportunity Area (Ha/Yr)	Timber Supply Effects Short	Medium	Long	Quality	Habitat	Jobs Days/ha	Cost $/ha[1]	Workshop Rank
Survey											
1	Surveys		5,400						0.1	20	1
Backlog											
2	NSR	L1 (a)	100		+	+			0.8	550	1
3	Brushing	L1 (b)	400			+		+/-	3.5	600	2
Pre FG											
4	improved seed	M2(b)(i)	1440		+				0	80 - B	B-1
5	larger planting stock	M2(b)(ii)	300		+				0.5	153 - B	B-2
6	fertilize existing regen (accelerate greenup)[1]	M2(a-i)(b-viii)	1200	+	+				0.1	300	B-3
7	plant Pw	M2(b)(ix)	500		+	+	+		0	B	B-1
8	space repressed Pl[2]	M2(a)(ii)	400		+	+	+	+	3.5	550	2
9	push-over /stumping	L4(a)	400			+		-	1	B	B-4
10	plant alternative species(larch, Py, Pw, Ep)	L4(b)	1440			+		+	0	B	B-2
11	small diameter spacing[2]	L4(e)	800		+	+			3.5	550	B-4
12	pop-up spacing[2]	L4(c)	10		+	+			3.5	550	6
Post FG											
13	spacing stands for future PH/CT[2]	M3 (a)	600		+	+	+	+	3.5	550	3
14	spacing stands for quality[2]	Q1	500		+	+	+	+	3.5	550	3
15	Fertilize late rotation[1]	S1	530	+				+	0.1	300	5
16	Fertilize (spaced (#13), planned for PH/CT)[1]	M3 (b)	600		+	+/-		+			5
17	Prune (100 ha 1st lift, 50 ha 2nd lift)	Q2	150			-	+	+	6	965	4

Notes:

[1] Total immediate fert = 2 330 ha/yr. Fert program could ultimately expand to a max. level of about 6700 ha/yr in about 60 years (see LT 3(b)).

[2] Total spacing = 2 310 ha/yr, 800 of which is basic spacing for root rot control purposes. Total spacing will diminish over time as the spacing of existing Pl subject to repression is completed, and the basic spacing (800 ha - small diameter) ultimately reduces the area requiring later stocking control.

B - denotes basic silviculture item, the cost of which would be borne by licensees. Most items are current practice.

Incremental Silviculture Program

The following annualized program will contribute to achieving the above goals and strategies. This program is considerably above historic levels and some activities may require phasing in. Spacing and fertilization goals are totals of several strategies. Lesser program levels should be oriented to specific target stands in accordance with the ranking shown in the regime table.

Incremental Silviculture Program Table - Ha, Boundary TSA July 21-22, 1999

Year	Surveys*	Backlog: Establish	Backlog: Maintain	Backlog: Space Repressed	Space**	Prune	Fertilize	Total
1	5,400	100	400	400	1,110	150	2,330	9,890
2	5,400	100	300	400	1,110	150	2,330	9,790
3	5,400	100	200	400	1,110	150	2,330	9,690
4	5,400		200	400	1,110	150	2,330	9,590
5	5,400		100	400	1,110	150	2,330	9,490
Subtot Yr 1 - 5	27,000	300	1,200	2,000	5,550	750	11,650	48,450
6 - 10	27,000	-	150	-	5,550	750	11,650	45,100
Total Yr 1 - 10	54,000	300	1,350	2,000	11,100	1,500	23,300	93,550

* Includes prescription and layout

** Does not include 800 ha/yr of small-diameter basic spacing for root rot control purposes.

Unit cost ($/ha)	20	550	600	550	550	965	300

Program Table - $ 000s, Boundary TSA July 21-22, 1999

Year	Surveys*	Backlog: Establish	Backlog: Maintain	Backlog: Space Repressed	Space**	Prune -	Fertilize -	Total
1	108	55	240	220	611	145	699	2,077
2	108	55	180	220	611	145	699	2,017
3	108	55	120	220	611	145	699	1,957
4	108	-	120	220	611	145	699	1,902
5	108	-	60	220	611	145	699	1,842
Subtot Yr 1 - 5	540	165	720	1,100	3,053	724	3,495	9,796
6 - 10	540	-	90	-	3,053	724	3,495	7,901
Total Yr 1 - 10	1,080	165	810	1,100	6,105	1,448	6,990	17,698

* Includes prescription and layout

** Does not include 800 ha/yr of small-diameter basic spacing for root rot control purposes.

Job Creation

The following are the anticipated job outcomes associated with the preceding program, assuming the program is maintained into the future as necessary to achieve the working targets.

Program Job Outcomes, Boundary TSA July 21-22, 1999

Short term *employment associated with undertaking the silviculture activity, in person years*

Year	Surveys*	Backlog: Establish	Backlog: Maintain	Backlog: Space Repressed	Space** -	Prune -	Fertilize -	Total
1	2.7	0.4	7.0	7.0	19.4	4.5	1.2	42.2
2	2.7	0.4	5.3	7.0	19.4	4.5	1.2	40.4
3	2.7	0.4	3.5	7.0	19.4	4.5	1.2	38.7
4	2.7	-	3.5	7.0	19.4	4.5	1.2	38.3
5	2.7	-	1.8	7.0	19.4	4.5	1.2	36.5
Subtot Yr 1 - 5	13.5	1.2	21.0	35.0	97.1	22.5	5.8	196.2
6 - 10	13.5	-	2.6	-	97.1	22.5	5.8	141.6
Total Yr 1 - 10	27.0	1.2	23.6	35.0	194.3	45.0	11.7	337.7

Note: Assumes 200 days of harvesting, silviculture work, and timber processing = 1 job

** Does not include 800 ha/yr of small-diameter basic spacing for root rot control purposes.

Further Research and Information Needs

During the assessment process, the following needs for further information and research became apparent. The outcome of these have implications for an incremental silviculture strategy. Bracketed numbers refer to the strategy numbers under which the need is identified (see tables in "Workshop Review of Potential Strategies," page 29.

1. Compare the actual post-harvesting stands in older partially harvested areas with inventory labels to (a) ensure the label correctly reflects the stocking of residual stands; and (b) determine how the residual stands are performing and if there is a need for silvicultural actions. (ST2 (a))
2. Better growth and yield information is needed for commercially thinned stands. The role of commercial thinning in enhancing timber availability when harvesting would otherwise be constrained should be investigated in the Type II strategy analysis. (ST2 (b))
3. Trials are needed to determine the effects on time until green-up of fertilizing stands 1-2 m tall. Trials should also investigate the fertilizer impact on the other vegetation in the stand and whether density control is needed prior to fertilization at early ages. (MT2 (a))
4. Pw management opportunities and harvest forecast implications need further investigation. (MT2 (b) (ix))
5. Following release of TSR2 analysis report, review the TSA sensitivity to a reduction in the age requirement for older forests. If the TSA is sensitive to this, revisit potential strategy MT4. (MT4)
6. Following release of TSR2 analysis report, review the extent of excluded deciduous areas to determine their potential and suitable silviculture treatments, if any. (LT2 (a))
7. OAF 1 factor of 15% requires confirmation. Survey techniques are available. Requires statistical validity at the management unit level if to be used for AAC determination. (LT3 (a))
8. Further study of root rot management techniques and resultant OAF2 impact is needed. (LT4 - Summary)

2. Introduction

2.1 About the Interim Strategy

This strategy, and the process on which it is founded, is intended to help optimize the application of available funding for silviculture activities towards the goals of improving the future quantity and quality of both habitat and timber supply. The strategy will be considered as one of several inputs in decisions on funding allocations and treatment activities.

The limitations of time, budget and available information have tended to cause the focus in this first version of the strategy to be on the future quantity of the timber resource. It is expected that as the strategy development process evolves and as better and more information becomes available, the strategy will have more regard to the matters of future timber quality and the future quantity and quality of habitat supply.

To achieve the optimization objective, the opportunity evaluation process recorded herein is not limited by factors such as the availability of funding, funding source (e.g., public vs. private), or the ability to deliver a program. Because of this, the strategy generally illustrates the plausible high end of the potential of the timber resource. Within this context as well as a broad context of cost-effectiveness, available treatment opportunities, and operational realities -- all of which were explored in general terms in the workshop -- potential treatment activities are ranked. The end result hopefully points to the most effective and efficient means of at least partially achieving the working targets. The degree to which the overall strategy ultimately proves appropriate and is achieved will also be the degree to which the expressed targets will be achieved. This, of course, could also be affected by future unknowns, such as major changes in forest policy, land base available for timber production, or market demand.

Although this strategy focuses primarily on silviculture, it is recognized that silviculture is part of a suite of potential strategies which together may influence the future quality and quantity of habitat and timber supply.

This strategy should not be confused with the allowable annual cut (AAC)[1] determination process. AAC's are based on actual practice and current information at the time of the determination. This strategy, on the other hand, is about creating a future state of our forests. Again, the degree to which the strategy proves appropriate and is achieved may influence future, but not necessarily present, AAC determinations.

This strategy is founded on readily available information and the knowledge of forestry professionals. It is intended as an interim strategy until a more in-depth analysis-based review is completed.

[1] See "Abbreviations," page 67 for a full listing of abbreviations used.

2.2 Methodology

This strategy was prepared through the following process:

1. Prior to the district workshop, in co-operation with district office personnel, L. P. Atherton & Associates undertook preliminary research to identifying issues and opportunities relevant to improving the future quantity and quality of timber supply.
2. A district workshop was held July 21 & 22, 1999 in Grand Forks, attended by representatives of the organizations and forest companies listed below. Larry Atherton of L. P. Atherton & Associates and Doug Williams of Cortex Consultants Inc. led the session. Participants reviewed the potential opportunities along with others that arose. The outcome of the session was a regime table, complete with priorities.
3. The consultants incorporated the results of the working session into the draft document and added forecasts of future harvest quantity and quality and of job outcomes.
4. After ministry review, the consultants submitted a completed strategy document to the Ministry of Forests (MoF) in electronic format as version 1.1. (The ministry will assign higher version numbers (e.g., 1.2, 1.3, etc.) as the strategy evolves and changes are made.)

2.3 Acknowledgements

The participation of the following persons and organizations at the district workshop is gratefully acknowledged.

Organization	*Participant's Name*	*Title*
Ministry of Forests, Boundary Forest District		
	Gord Lesergent	Incremental Silviculture Forester
	Jeff Leahy	District Planning Forester
	Dan Barron	Small Business Officer
Ministry of Forests, Nelson Forest Region		
	Ivan Listar	Incremental Silviculture Forester
	Bernie Peschke	Forest Sectors Initiatives Officer
Ministry of Forests, Forest Practices Branch		
	Frank Barber	Stand Management Specialist
Pope & Talbot Ltd.		
	Randy Waterous	Forestry Planner
	Lyle LeClair	Silviculture Forester

The project was directly managed by Ivan Listar of the Ministry of Forests, Nelson Forest Region. Funding was provided by Forest Renewal BC under a contract between the Ministry of Forests, Nelson Forest Region, and Cortex Consultants, Inc.

3. Higher Level Goals and Objectives

3.1 Provincial Goals and Objectives

The document, *Incremental Silviculture Strategy For British Columbia (Interim)*, states the Ministry of Forests' provincial level strategy. The strategy's executive summary is reprinted below. The provincial strategy was considered in the development of this TSA strategy.

STRATEGY AT A GLANCE

Purpose

This strategy provides guidance to the application of available funds for incremental silviculture activities. It is not tied to a specified funding level.

Government's Goals

- Sustainable Use
- Community Stability
- A Strong Forest Sector

Key Principles

1. Because the distant future cannot be foretold, the best and only course of action in managing the timber resource is that which minimizes risk and maintains options.
2. British Columbia's forests are important locally, provincially, nationally and globally and should be managed in this context.
3. Each generation of British Columbians becomes the steward of the province's forest resources and has a moral obligation to preserve this heritage for future generations.

Working Targets

Within the context of the guiding principles:

WT 1: Minimize the anticipated interim reduction in timber supply so that provincial annual harvests of at least 65 million m^3 can be achieved during this period.

WT 2: Create a long term timber supply capable of supporting a steady long term provincial harvest level of at least 75 million m^3.

WT 3: Over the long term, maintain the production of premium quality logs at or above 10% of total harvest.

Major Silvicultural Strategies

- Increase the use of alternative silvicultural systems and commercial thinning.
- Achieve earlier green-up of harvested areas.
- Increase regenerated stand volumes 20%.
- Eliminate all pre-1982 good and medium site backlog NSR and all 1982 to 1987 backlog NSR.
- Initiate a long rotation quality management program for stands where harvesting must be delayed.

Other silvicultural and non-silvicultural strategies must also be implemented to achieve the working targets.

Strategy Implementation

Regional and management unit strategies must be developed, followed by programs and plans to implement them.

It is recognized that not every management unit has the same capability to contribute to these interim objectives. Further, it is recognized that these objectives may not be attainable at current funding levels. Their purpose is to provide general guidance to the application of available funds.

3.2 Regional Objectives

The region has not set out formal regional silviculture objectives. In the interim, the provincial objectives are accepted as being broadly applicable within the region.

3.3 Higher Level Plans

Formal higher level plans are strategic plans defined by the Forest Practices Code, however, there are currently no approved higher level plans covering the Columbia Forest District. The Kootenay Boundary Land Use Plan has been approved but the decision whether to make it a higher level plan has not been finalized. Until that time it provides guidance for management practices.

There are other plans that exist at a higher level which are strategic (policies and guidelines), or operational that provide direction to any lower level of plans, prescriptions, or forest practices. These, however, are not higher level plans as defined under the Code.

4. Basic Data

4.1 Land Area

Description	Area (ha)	Area %
Total Area of TSA	580 100	100
Total Productive Crown Forest	425 100	73
Net Timber Harv. Land Base	311 300	54

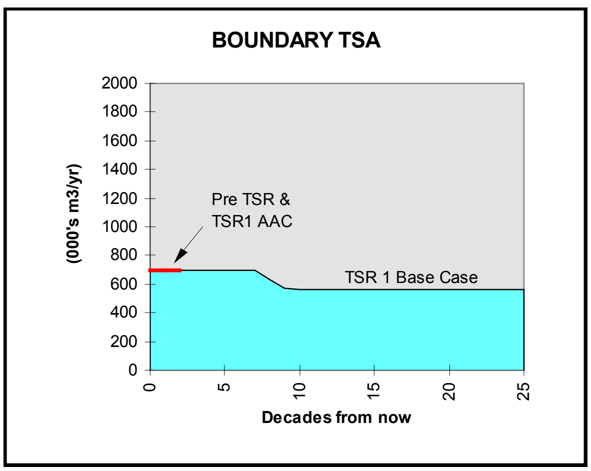
Source: TSR1 analysis report - rounded to nearest 100 ha.

4.2 AAC

AAC Type	Pre-TSR	TSR1*	Change (%)
Conventional	700 000	700 000	0.0
Deciduous	-	-	
Insect/Disease	-	-	
Marginal	-	-	
Total	700 000	700 000	0.0
Woodlot AAC			

*effective March 1/95

4.3 Harvest Forecast

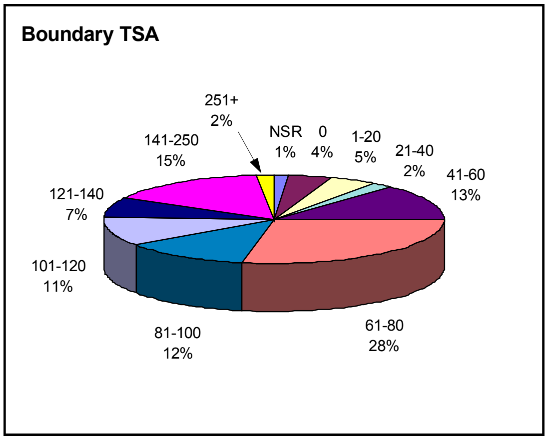


4.4 Site Class

Boundary TSA

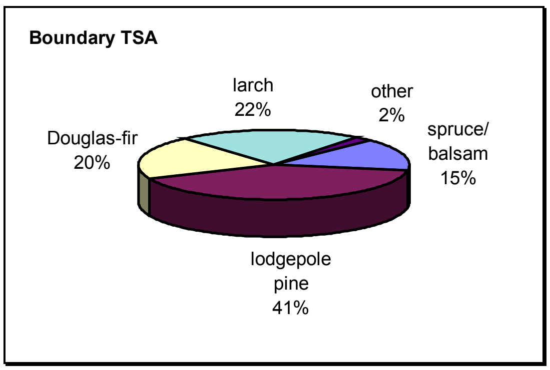
DATA NOT AVAILABLE

4.5 Age Class



Data interpreted from chart in TSR1 analysis report.

4.6 Tree Species



Source: Boundary TSA TSR 1 Discussion Paper.

5. Incremental Silviculture History

Treatment	TSR2 Status (1998)		Current Status (1999)
	Incorporated in Timber Supply Analysis	Not Incorporated in Timber Supply Analysis	Source: BFD[2]
Backlog			Approximately 300 ha are planned for treatment. An additional 900 ha require brushing to ensure free growing is achieved.
Conversion	None.		None
Commercial Thin	None.		None
Space	TIPSY used for stands regenerated over the past 10 years. TSR2 managed stand yields will be based on current experienced initial stocking levels and post-spacing target densities. Assumes incremental spacing for stocking control on stands harvested prior to 1987 and either basic or incremental spacing thereafter.		Recent spacing has been about 500 ha/yr. This is also the maximum past program level. By the end of fiscal 99/00, there will be a total of about 5 500 ha of spaced stands. There are presently 1 000 ha under approved prescription.
Prune			Recent level 70 ha/yr. Max past program of 90 ha/yr. Total accomplishment of 412 ha, 4 ha of which is 2 lift pruned. Many stands are now ready for 2nd lift.
Fertilize			Recent and max level 500 ha/yr. District is capable of higher program level. 500 ha currently under approved prescription. Total accomplishment of 760 ha: 136 ha in stands with CT potential, 90 of pruned stands and 534 ha of spaced stands. 253 ha have been fertilized twice.

[2] BFD - Boundary Forest District

6. Timber Harvesting Trends

Harvested area over the past five years (1994 to 1998, inclusive) has averaged approximately 2 800 ha/yr. Of this, about 2 200 ha/yr, or approximately 80% of the total, was managed under an even-aged silvicultural system (largely clearcutting). The other 600 ha/yr was managed under an uneven-aged silvicultural system. (Source: Boundary Forest District)

In terms of forecast future harvesting, the TSR1 analysis report (page 19) indicates approximately 2 500 ha/yr to be harvested over time, of which about 1 800 ha/yr, or 75%, will be under even-aged management.

7. Issues and Silvicultural Opportunities

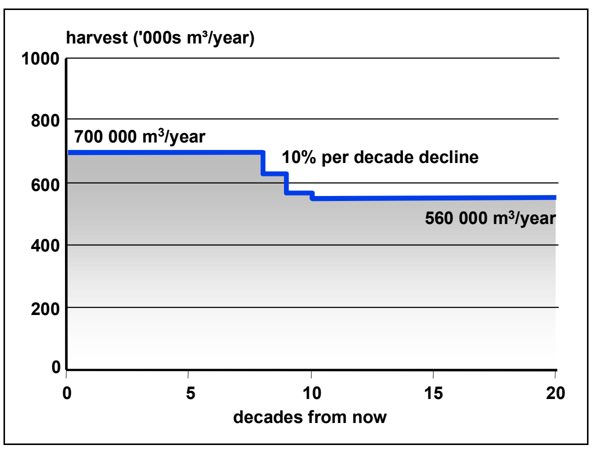
7.1 Discussion of Issues and Opportunities

TSA modelling in support of silviculture planning has not yet been undertaken. In its absence, sensitivity analyses from the TSR1 analysis report are the best available source of information as to the opportunities for incremental silviculture to increase future timber supply.

The following are selected sensitivity analsysis charts from the TSR1 analysis report. To the right of each chart is a brief discussion of the timber supply dynamics indicated by the chart, and associated silvicultural opportunities to influence these. In many cases, further modelling is required to confirm the indicated effects.

(NOTE: The following analysis was prepared in advance of to the district workshop. During the workshop, participants indicated that much of the TSR1 information would be different or would be differently analyzed in TSR2. The end result is that many of the sensitivities and the underlying timber supply dynamics that drove the TSR1 sensitivity analysis results are likely to change, sometimes substantially. Where this is the case, this is noted in italics following the discussion text.)

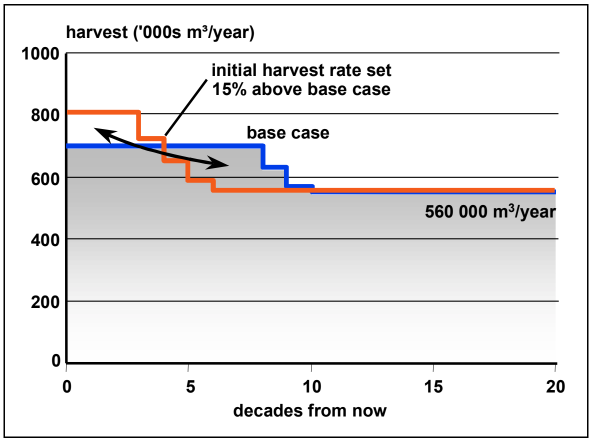
Figure 1. TSR1 Base Case Harvest Forecast



The TSR1 base case indicates the current harvest level can be maintained for 80 years. For TSR2, however, it can be expected that a smaller timber harvesting land base, tighter forest cover constraints and older forest requirements will put more pressure on the base case. Offsetting these will be higher regenerated stand volumes associated with better site productivity estimates (sensitivity test only) and shorter green-up periods.

For the purposes of this interim silviculture strategy, it is assumed the TSR2 base case forecast will remain relatively consistent with the TSR1 forecast.

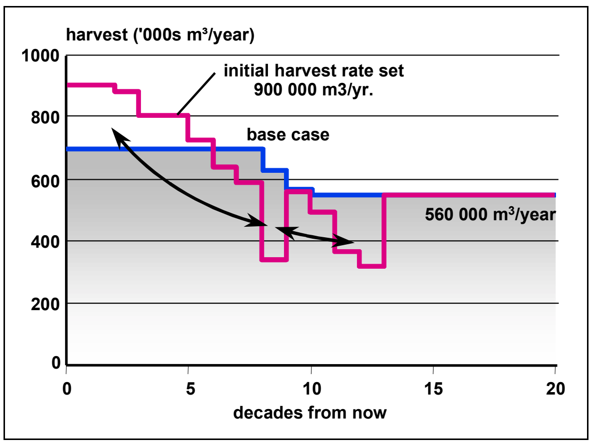
Figure 2. The Potential for Increasing the Initial Harvest Level



Harvest flow objectives require the initial harvest level to be maintained for as long as possible without causing undue disruption to future timber supply. In the Boundary TSA, timber that could otherwise be harvested early in the first 3 decades is held so as to extend the initial harvest level (current AAC) through decades 5-8. Other than harvest flow rules, there are no other constraints that prevent the initial harvest level from being raised to 800 000 m3/yr.

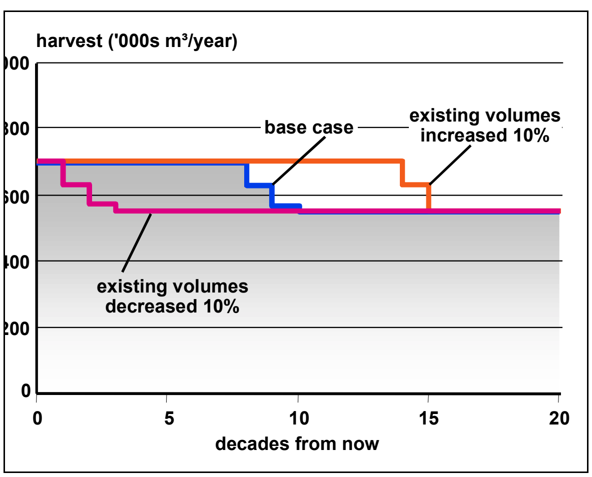
(Licensees and the small business program are currently having difficulty locating available timber, which does not support this conclusion.)

Figure 3. The Effect of Harvest Flow Objectives on the Base Case



Harvest flow objectives have a major impact on both the base case and the results of sensitivity analyses. In the base case, to avoid serious future harvest shortfalls, timber that otherwise could be available for harvesting in the first 5 decades is held until decades 8, 11 and 12. **It is the avoidance of these shortfalls, combined with harvest flow objectives, that controls the responses to many sensitivity tests.**

Figure 4. Sensitivity to Changes in Existing Stand Volumes

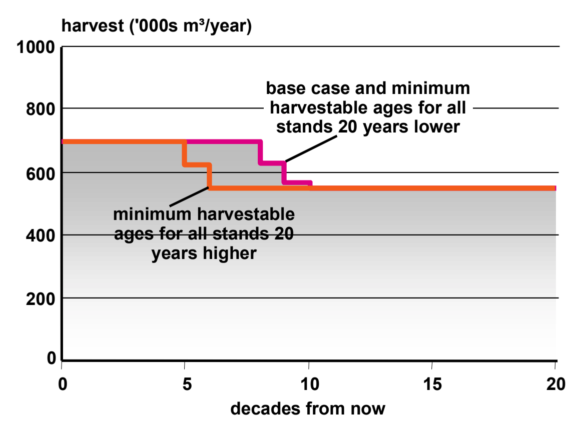


Increasing existing stand volumes 10% extends the initial harvest level another 6 decades beyond that in the base case. **This is the common response to the relaxation of constraints in most sensitivity tests and is largely dictated by harvest flow objectives.** Alternatively, as Figure 2 shows, the potential also exists to increase the initial harvest level above the current AAC.

A recent audit indicates inventory stand volume estimates to be acceptable, so the base case is not at risk from lower estimates. Nevertheless, the response to a lowering of existing volumes by 10% demonstrates the timber supply dynamics of the TSA. Lowering existing volumes causes the starting harvest level to be lowered much sooner than in the base case, not because there is a lack of timber early on, but to prevent a shortage of timber in later years (analysis report, p 26). Also, decreasing the volume/ha magnifies the impact of forest cover constraints. Lower volumes/ha require more area to be harvested to obtain the same volume. This increases the area not greened-up at a faster rate and the limits of forest cover constraints are reached sooner.

The TSA has a large fertilizable land base. Fertilization of suitable existing stands would increase their volumes and could contribute to extending or increasing the initial harvest level.

Figure 5. Sensitivity to Changes in Minimum Harvestable Ages and Implications for Timber Quality Management



TSR1 minimum harvestable ages are:

Min Age	Species	Site Class
60	Pl, Pl mix	G, M
80	Pl, Pl mix	P
	All except Pl	G, M
100	Pl – dense	G, M
120	Pl – dense	P
	All except Pl	P

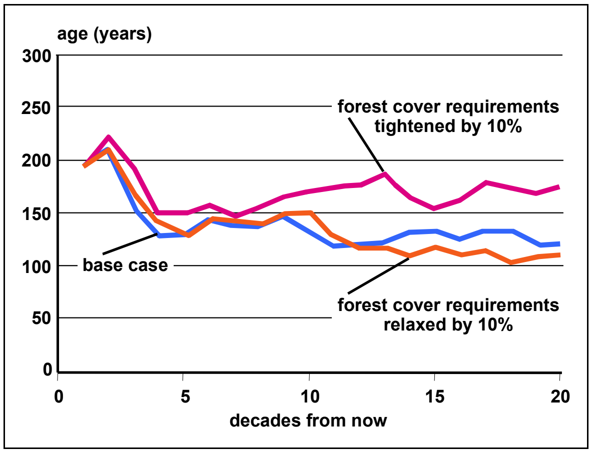
The TSR1 base case is not sensitive to a 20 year decrease in minimum harvest ages. The reason for this is discussed opposite Figure 6 below.

(Discussions in the workshop indicated that the TSA may prove sensitive to minimum harvest ages in TSR2. A significant portion of current harvests is in younger stands.)

Growing forests to older ages generally improves their quality. However, this chart indicates that doing so would substantially shorten the length of time the initial harvest level could be maintained, likely because this makes less timber available decades 8 to 11.

The objective of growing forests longer for quality may be more compatible over the very long term, where increasing harvestable ages does not appear to affect harvest levels. This would require additional analysis to confirm, however, because it is possible the model is slowly parcelling out over decades 10 –20 timber that has been saved from decades 4-9.

Figure 6. Changes in Average Harvested Age Related to a 10% Change in Forest Cover Constraints



After 40 years, the model harvests trees at an average of about 130 years of age – substantially above the minimum ages. Thus, as Figure 5 shows, lowering the minimum ages further has no effect on timber supply.

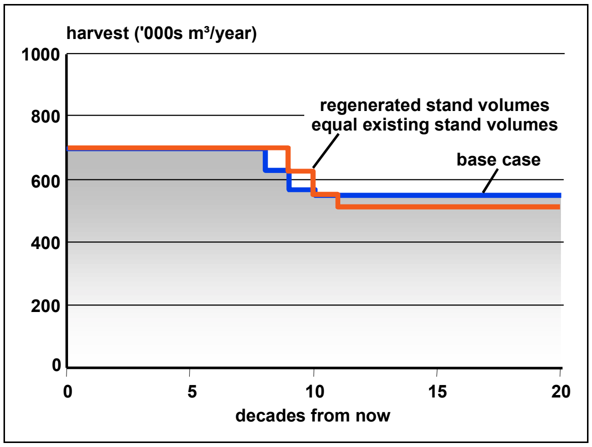
Figure 10 shows the TSA is highly sensitive to a 10% increase in forest cover constraints. As the figure to the left indicates, increased cover constraints also substantially increases the average age of stands harvested by the model (possibly the highest in the province).

The high ages are possibly linked to the low productivity of most regenerated stands (see Figure 7). The lower the average site productivity the larger the area that must be harvested annually to achieve a given harvest level. The larger the harvest area, the more sensitive the TSA becomes to green-up and adjacency constraints.

Higher ages may also be related to the 9 m green-up height in the wildlife zone (see discussion opposite Figure 9).

Increasing the productivity and harvestable volumes of regenerated stands will help alleviate the FCC's both through reduced green-up times and lowering the amount of area that must be harvested to achieve a given harvest level. Many silvicultural practices can be used to increase regenerated stand volumes.

Figure 7. Differences Between Regenerated and Managed Stand Volume Estimates

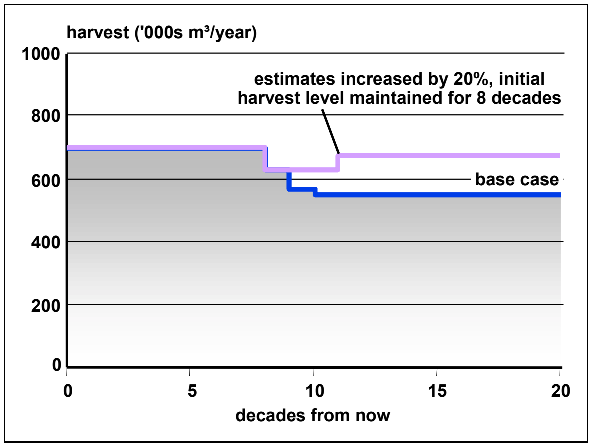


An 8% reduction in the long term harvest level (LTHL) occurs when regenerated stand volumes are made equal to existing stand volumes. This indicates the regenerated stand volumes in the base case average only 8% more than existing stand volumes. This is probably the lowest differential of all TSA's in the province. Appendix A.5 of the analysis report shows the MAI's of regenerated stands are often lower than that of the existing stands they replace.

Regenerated stand volumes may be underestimated. Volumes were reduced an additional 5% to account for root disease (Analysis Report, page 60). *(Note: discussion in the workshop indicated the 5% reduction is likely appropriate.)* The Old Growth Site Index project also indicates that volumes of certain regenerated stands are generally underestimated due to underestimates in site index.

Figure 8. Sensitivity to an Increase in Regener-

ated Stand Volumes

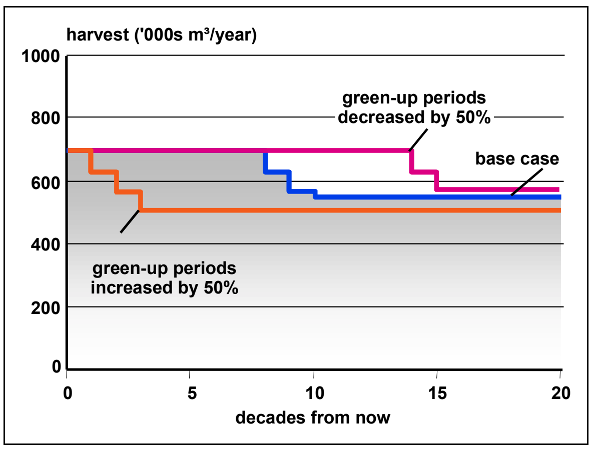


Regenerated stand volumes may be underestimated (see discussion opposite Figure 7, above).

Increasing regenerated stand volumes by 20% results in a 20% increase in the long term harvest level (LTHL) over the base case. The resulting shortfall in decades 8-11 occurs because there is a limited amount of mature timber available during this period (analysis report, p 28). This is related to the lack of stands currently aged 21 to 40 years and therefore this scenario may show sensitivity to a reduction in minimum harvestable ages.

Many silvicultural practices can be used to achieve an increase in regenerated stand volumes, including practices to reduce losses to root disease.

Figure 9. Sensitivity to Changes in Green-up Ages



TSR1 green-up heights and ages are as follows:

Zone	% THLB	Ht	Age	%allowed below age
IRM	50	3	20	33
Wildlife	20	9	34	20
Uneven Age	23	N/A		N/A

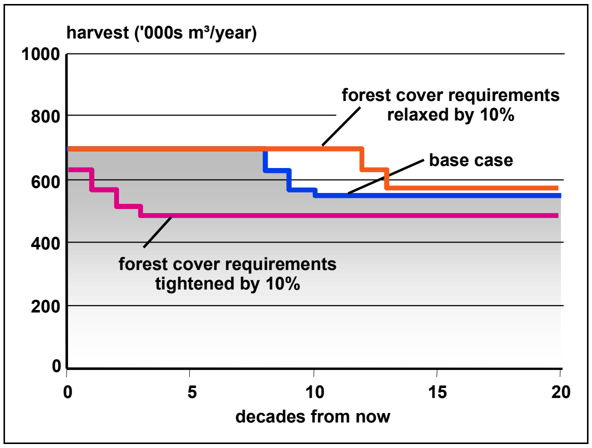
Allowing no more than 20% of the area in the wildlife zone to be below 9 m ht is particularly restricting, considering the zone also occupies 20% of the THLB.

Regional studies have indicated 3 m green-up ages used in TSR1 to be overestimated by about 5 years and 9 m ages to be reasonably accurate (Nelson region report MIT-003).

The sensitivity test to the left indicates reducing time until green-up by half (an ambitious target) results in a substantial increase in timber supply. Whenever timber supply is relieved in decades 8 to 12, timber flow objectives result in the initial harvest level being extended, rather than increasing the short term harvest level. Based on the modelled results, **directing efforts to overcoming green-up in the short term may have little direct impact on the critical periods of decades 8, 11 and 12. It may be that green-up is only critical in these latter few decades, with relieving green-up in the short term being inconsequential.** On the other hand, because licensees are having difficulty locating available timber in the short term, reality may be that green-up *is* a short term issue, regardless of the indications of timber supply modelling. *(This was confirmed in the workshop.)*

Many silvicultural practices can be used to reduce the time until green-up. There is little risk to focus-ing on green-up issues in the short term, because these same practices will also serve to increase regenerated stand volumes. Figure 8 shows this would also be of considerable long term benefit.

Figure 10. Sensitivity to Changes in Forest Cover Constraints

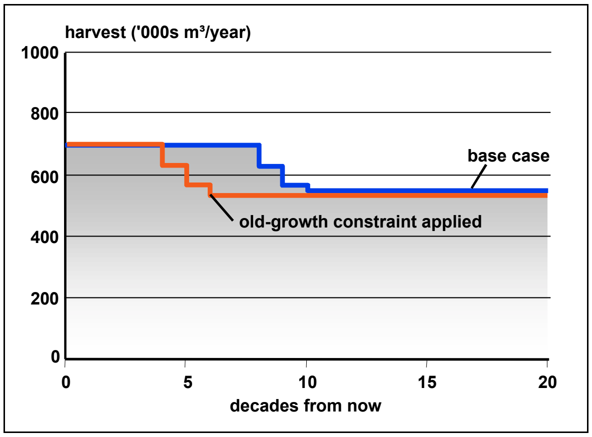


The TSA is highly sensitive to increased forest cover constraints (FCC's). Tighter FCC's than modelled in the base case may in fact already exist. Local companies and the MoF's small business program are having difficulty locating available timber for harvesting.

Boundary District staff believe forest cover constraints (FCC's) in the IRM zone are likely to be 25% of area not allowed below green-up (vs the 33% modelled in the base case). It is unclear, however, how much of the sensitivity in Figure 10 may be attributable to the IRM zone. **It may be more attributable to the wildlife zone where lowering the area allowed to be not greened-up by10% results in no more than 10% of this zone to be below 34 years of age (9 m ht.) at any one time.** The wildlife zone covers 20% of the THLB. This no doubt also contributes to the substantial increase in average harvest ages that occurs when FCC's are reduced by 10% (see Figure 6).

(Workshop: TSR2 analysis will not have a wildlife zone with a 9m restriction, so while the wildlife zone limitation noted above is likely what drove the TSR1 sensitivity analysis, this won't be the case in TSR2. Workshop participants indicated that the two most limiting on-the-ground constraints at present are the biodiversity mature plus old requirement and the maximum clearcut area limitation of the Forest Practices Code. Also it was generally agreed that adjacency constraints are likely to continue to be limiting timber supply into the future.)

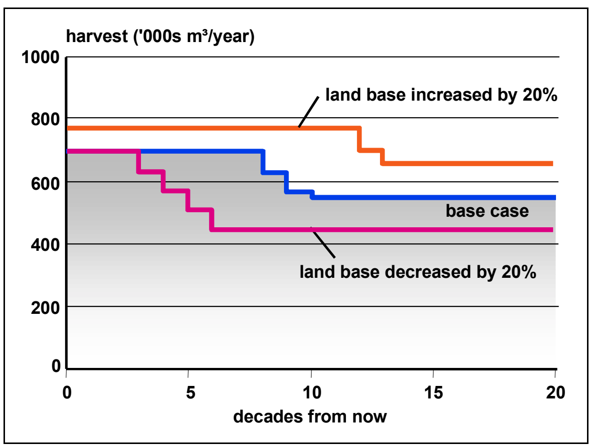
Figure 11. Sensitivity to the Application of an Older Forest Constraint



The TSR1 base case only had an old-growth constraint (10% of area must be at least 150 years old at all times) applied to the community watershed zone (4% of the THLB). Applying this constraint across all zones cuts the time the initial harvest level can be maintained in half. This harvest level drop begins at about the same time as the average harvested age falls to 130 years (see Figure 6). Given the relatively high average harvestable age, this response is somewhat unexpected. Again, this is likely a response to reduced timber availability in decades 8-11 that requires timber to be held over from earlier decades to fill in what would otherwise be a shortfall. [What do KBLUP restraint reports show?] Further analysis is required to isolate the cause of the sensitivity.

Increased older forest requirements will no doubt become part of the TSR2 base case to reflect FP Code biological diversity requirements. Silvicultural practices such as fertilization and commercial thinning may be used to accelerate stand structure so that the desired older forest attributes are achieved at an earlier age **in decades 8-11**. This could potentially free up some timber supply for harvesting in decades 4-8.

Figure 12. Sensitivity to Changes in the Size of the Timber Harvesting Land Base



Subsequent to the TSR1 analysis, the Kootenay-Boundary Land Use Plan has reduced the land base of the TSA. A sensitivity test of a 20% land base reduction shortens the time the initial harvest level can be maintained to 3 decades and correspondingly reduces the LTHL.

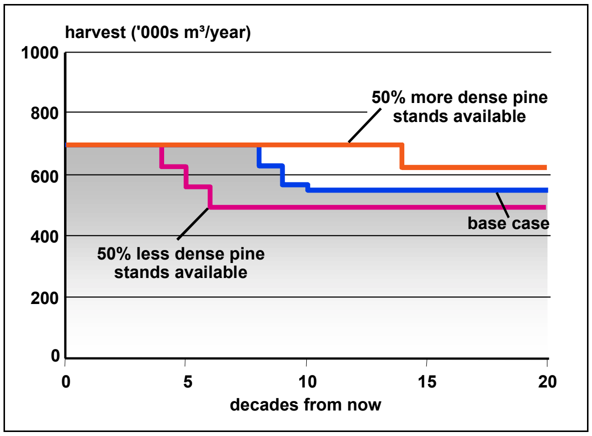
Silvicultural practices may be used to increase the size of the THLB through conversion of unutilized stands to merchantable species and to increase the productivity of low sites.

Opportunity area consists of the areas deducted from the TSR1 THLB. These include:

Type	Area	Equiv % THLB
Low site	3 600	1.2
Decid	3 400	1.1
Non Merch	14 200	4.6

There is little remaining treatable backlog NSR.

Figure 13. Sensitivity to Changes in the Merchantability of Dense Lodgepole Pine Stands



Dense Pl stands cover about 70 700 ha (23%) of the THLB. These stands were included in the TSR1 base case but assigned min harvestable ages 40 years greater than normal Pl stands. Removing half of these stands results in a substantial reduction in mid and long term harvest levels. (The sensitivity test for increasing the area available appears to be for illustration purposes because these stands don't exist.)

Are there silvicultural practices regarding dense stands that could make them more available?

7.2 Summary of Issues and Silvicultural Opportunities

At the time this interim strategy was prepared, the TSR2 analysis report for the Boundary TSA was not available. However, it can be expected that a smaller timber harvesting land base (due to KBLUP), tighter forest cover constraints and older forest requirements will put more pressure on the TSR 2 base case. Offsetting these will be higher regenerated stand volumes associated with better site productivity estimates (sensitivity test only) and shorter green-up periods. In the absence of the TSR2 analysis, for this interim strategy, it is assumed that the preceding factors will be largely offsetting and the base case will be similar in shape to that of the TSR1 forecast. The onset of the transition from the initial harvest level to the long term harvest level may occur sooner. Higher productivity among regenerated stand volumes may result in the model harvesting stands at lower ages, with a resultant sensitivity to a reduction in minimum harvestable ages occurring.

7.2.1 Future Timber Volumes (Quantity)

Short Term (1 - 20 years)

The short term period is somewhat arbitrarily defined as the next 20 years.

The TSR2 base case is likely to indicate that harvest levels can be maintained at the current AAC throughout the short term period, unless forest cover constraints are increased substantially (see Figure 10).

In the TSR1 analysis, short term harvest levels are largely governed by the need to extend existing timber supply to cover what appears to be critical shortages in decades 8 to 11. Were the short term to be isolated from future timber supply difficulties it is likely that it would not of itself be sensitive to changes in any factors. This is because the short term has a relative abundance of available timber supply from which to satisfy constraints. Reality, however, is that licensees are having difficulty finding timber that is available for harvest.

Short term timber supply therefore may benefit from:

1. Activities that will reduce the critical shortages in decades 8-11;
2. Activities that will overcome currently experienced adjacency constraints, such as partial harvesting and commercial thinning;
3. Activities that will achieve-green-up earlier (likely a 2nd decade benefit at the earliest); and
4. Activities that will increase the volume of stands to be harvested in this time period (of which there is only one – fertilization of suitable stands).

The allocation of the potential benefit from the above activities is a matter of allowable annual cut policies and determinations. Under current policy, short term harvest levels are typically not increased as long as future harvest levels are indicated to decline. Therefore, in this strategy, all of the above potential activities would serve to maintain the existing base case harvest level.

Mid Term (21 - 90 years)

The mid term period begins at the end of the short term period (i.e., 21 years from now) and continues until the transition from harvesting in existing natural stands to harvesting mainly in 2nd growth managed stands is complete. Until the TSR2 analysis is available it is not known when the end of the transition period will be. For the purposes of this strategy, it is assumed to be 90 years, the same as in TSR1.

Even more than the short term, the mid term is governed by the need to extend existing timber supply to cover what appears to be critical shortages in decades 8 to 11. Both the harvest flow objectives used in timber supply modelling and a diminishing growing stock contribute to the high degree of sensitivity of the mid term to changes in various factors.

Mid term timber supply may benefit from:

1. Activities that will reduce the critical shortages in decades 8-11, such as:
   (a) setting up stands now for commercial thinning in that period;
   (b) setting up stands now to meet older forest requirements in that period;
2. Setting up for and continuing activities that will overcome adjacency constraints that may exist in the early decades of the mid term, such as partial harvesting and commercial thinning;
3. Activities that will achieve-green-up earlier, so that green-up is not limiting on the ground; and
4. Activities that will increase the volume of stands to be harvested in this time period (of which, given the stands for harvesting in this time are predominantly existing stands, there is only one – fertilization of suitable stands).

Because it is in the later decades of the mid term period that activities that could reduce green-up restrictions in decades 8-11 would be instigated, this has no impact on a silviculture strategy oriented towards the next decade. *(Note: In the workshop, the mid term deficit in decades 8-11 could not be confirmed as it was noted there will be no wildlife zone in TSR2 and the modelling methodology for wildlife constraints will be different.)*

Long Term (91 + years)

The long term period is the time when harvesting is primarily in managed 2nd growth stands and is characterized by a steady state harvest level.

In the absence of TSR2 information, the long term is assumed to be sensitive only to changes in managed stand volumes, the size of the timber harvesting land base, and the amount of losses to root rot diseases.

7.2.2 Future Timber Quality

To date there has been little attention to the matter of future timber quality. The focus of the timber supply review on AAC determination has resulted in the planning emphasis being solely on timber volumes. Until recently, there has been little higher-level policy guidance with respect to managing for future timber quality.

Using age as a surrogate measure of timber quality, the expected decline in harvest ages towards lower harvestable ages indicates future timber quality will be generally be lower than today's. The future timber supply will be much smaller in average diameter and, without pruning, there will be little, if any, clear wood. On the positive side, other than areas affected by root rot, most harvested second growth timber will be sound wood with little or no decay.

Smaller diameter material is not necessarily all negative in terms of timber quality. There is some evidence that slower grown, smaller diameter lodgepole pine produces a better proportion of machine stress rated (MSR) lumber, which currently commands a higher price than standard grade lumber.

If a "clear" log is defined as one having at least 25% clear lumber content (based on coastal log grading rules), then 2nd growth forests will have produce few if any such logs. Pruning will be necessary if future standing inventories are to contain any clear log content.

Lower quality stands present some future market risk. In low market periods it is often only the readily accessible, higher-quality timber that is profitable to harvest. Also, a narrow portfolio of small diameter timber offers less opportunity for creating a range of value-added forest products.

Timber quality can be improved through silviculture practices such as spacing, fertilization and pruning.

8. Opportunities to Increase Timber Supply

8.1 Potential Silviculture Strategies

Prior to the district workshop, information in the previous sections was used to identify the following potential silvicultural strategies for either maintaining or increasing future timber supply at the TSA level. Each of these was discussed in detail in the district workshop, the results of which are recorded in "Workshop Review of Potential Strategies," page 29, along with additional strategies that arose during the meeting. Strategies that are ultimately adopted are noted in "Silviculture Strategies," page 58.

8.1.1 Short Term (1 - 20 yrs)

ST 1: Fertilize ____ ha/yr of existing stands scheduled for harvest in the 2nd decade to increase their volumes. (increase)[3]

ST 2: Commercial thin _____ ha/yr to overcome adjacency constraints.

ST3:

8.1.2 Mid Term (21 - 90 yrs)

MT 1: Fertilize ____ ha/yr of existing stands scheduled for harvest 20 to 90 years from now to increase their volumes (continuation of ST 1). (increase)

MT 2: Reduce green-up ages by 5 years in the IRM, VQO and Watershed zones and by 10 years in the wildlife management zone by: (maintain)

(all zones, except uneven-aged management zone)

(a) site preparing ___ additional hectares;

(b) using improved seed;

(c) using larger planting stock;

(d) fertilizing at time of planting;

(e) brushing ____ ha/yr for growth enhancement (in addition to ___ ha/yr to ensure free growing; and

(wildlife zone only)

(f) spacing ____ ha/yr of pine stands subject to repression;

[3] (Increase) means oriented to increasing harvest levels above those indicated by the TSR2 base case. (Maintain) means oriented to maintaining the harvest level indicated by the TSR 2 base case.

(g) spacing ____ ha/yr of Douglas-fir stands subject to seasonal moisture deficits; and

(h) fertilizing ____ ha/yr.

MT 3: Set up stands for future partial harvesting/ commercial thinning in the wildlife management zone (emphasis on decade 8-11 harvests):

(a) spacing ____ ha/yr of _____ to set up stocking appropriate to commercial thinning; and

(b) repeat fertilizing ____ ha/yr.

MT 4: Increase the area satisfying older forest biodiversity requirements in decades by achieving the desired stand characteristics by 130 years of age by:

(a) spacing ____ ha/yr; and

(b) repeat fertilizing ____ ha/yr.

8.1.3 Long Term (91+ yrs)

LT 1: Maintain the THLB by

(a) Planting ____ ha of backlog NSR; and

(b) Maintaining ____ ha of existing backlog plantations.

LT 2: Increase the THLB by:

(a) converting/rehabilitating ____ ha/yr of deciduous stands; (increase)

(b) converting/rehabilitating ____ ha/y of non-merchantable ____?____ stands; (increase)

(c) assessing _______ ha of low-site stands for proper classification; or

(d) improve the site productivity of low-site stands by _________ (fertilization?). (increase/maintain)

LT 3: Increase regenerated stand volumes by, in addition to those practices in MT 2:

(a) managing stocking so voids do not account for more than 10% of the area (increase); and

(b) repeat fertilize _____ ha/yr on a 15 yr return cycle (increase).

LT 4: Reduce losses to root rot by: (increase)

(a) pushover logging/stumping _____ ha/yr;

(b) planting alternate/mixed species on ______ ha/yr; or

(c) pop-up spacing on _____ ha/yr.

LT 5:

LT 6:

LT 7:

8.2 Workshop Review of Potential Strategies

8.2.1 Introduction

Potential strategies were reviewed in the workshop according to the response time frames of short, mid and long term time periods. Each response time frame is the period in which the anticipated result of a potential strategy is expected, not the period in which actions must necessarily commence.

Workshop discussions are documented in the following tables. The contents of each column are further described below.

Column Number	Note
1	Strategy numbers correspond with the numbers recorded earlier in “Potential Silviculture Strategies,” page 26. Items followed by an asterisk (*) were added during the district workshop.
2	Information is largely from the district workshop, combined with information presented earlier in this document.
3	Anticipated results are calculated using a variety of methods.

At the end of each time period is a summary of the anticipated responses for all strategies proposed for the period. Normally a potential harvest forecast is prepared under this summary. However, this is presently awaiting TSR2 analysis results on which to base a forecast.

8.2.2 Short Term (1 - 20 years)

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
ST 1	1. Fertilize all suitable stands scheduled for harvest in the 2nd decade. (increase)	1. Although the recent harvesting level has been 2 800 ha/yr, the level indicated by TSR1 analysis (2 500 ha/yr) is used here for consistency with other calculations. Relevant factors for stand suitability for late rotation fertilization are: species, site productivity, age, and crown closure. logging 2 500 ha/yr total 1 800 ha/yr even aged --- about 10% of this is suitable for late rotation fert = 180 ha/yr 700 ha/yr uneven-aged --- about 50% is suitable for late rotation fert. = <u>350</u> **total potential late rotation fertilization program 530** Fertilization in uneven-aged stands would follow partial harvesting. Target stands are Pl, Fdi M-sites. Dry-belt Fdi is not recommended. Must be commercially thinned or partially cut in advance of fertilization so there is room for tree crowns to expand and utilize the fertilizer. There is a concern about being able to accurately identify stands for fertilization that will be harvested in 10-15 years. CT'ing or partially harvesting before fertilization would make planning a final harvest in 10-15 years more certain. A single late-rotation fertilization is estimated to increase yields by 15 m3/ha. 530 ha/yr X 15 m3/ha = 8 000 m3/yr. Cost at $200/ha = $106,000/yr. The allocation of the benefit to the short term is a matter of harvest flow policies and AAC determination. If the AAC remained the same, harvesting larger volumes/ha would result in fewer ha's being harvested (8 000 m3/yr ÷ 250 m3/ha = 32 fewer ha would require harvesting). This has a positive effect on green-up.	1. Gain of 8,000 m3/yr, about 10-15 yrs after fertilization.
ST 2	2. Overcome adjacency limitations by increasing:	2.	2.
ST 2	(a) partial harvesting; and	(a) Lots of partial harvesting occurring in the IDF zone to accommodate mule deer winter range and in the ICH zone to accommodate adjacency constraints. There are concerns about the residual stands: • What do the residual stands look like? • What is the inventory label? – NSR or the original label is retained? There is a danger residual stand volumes are being overestimated in the inventory. A review of these areas is needed. Noted under "Summary of Information and Research Needs," page 65.	(a) Partial harvesting is currently taking place where necessary to manage for winter range.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
ST 2	(b) commercial thinning.	(b) Commercial thinning is differentiated from partial harvesting in that CT has no re-generation implications. There is presently no commercial thinning taking place. However, the district is planning some timber sales for harvesting post material. The recently issued Paxton value-added licence may involve some commercial thinning. Better growth and yield information is needed for CT'd stands. Noted under "Summary of Information and Research Needs," page 65. The potential for CT to contribute to timber supply was not evaluated in the workshop but was noted as having potential to enhance timber availability where adjacency rules might otherwise constrain the har-vest. The role of commercial thinning in enhancing timber availability when harvesting would otherwise be constrained should be investigated in the Type II strategy analysis.	(b) Some CT planned in the short term. Better growth & yield info req'd.
	Short Term Harvest Forecast Summary	Potential Strategy # / Effect **ST1** Late rotation fertilize 530 ha/yr — 8 000 m3/yr **ST2** Overcome adjacency constraints by increasing: (a) increase partial harvesting; and — Current practice (b) commercial thinning. — Some planned. No info on effect on harvest forecast available.	
	Conclusion	Of the potential strategies examined, only late rotation fertilization has the identified po-tential to increase harvested volumes in the short term - by 8 000 m3/yr starting in the 2nd decade. Harvest flow objectives will typically apply the "gain" to extending the current harvest level for a longer period of time rather than immediately increasing AAC. Even if not harvested under an increased AAC, increasing timber volume in the 2nd decade also improves overall timber availability. Commercial thinning has potential to enhance tim-ber availability where adjacency rules might otherwise constrain the harvest. No harvest forecast prepared. Normally TSR information is used as a basis for activity response estimates. However TSR1 information is too old and TSR2 results are not yet available.	

8.2.3 Mid Term (21 - 90 years)

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
MT 1	1. Repeat fertilize all suitable existing stands scheduled	1. This strategy overlaps with ST1, MT2 and LT3 and therefore in itself has no direct impli-cations for silviculture activities over the next 5 years. In the early part of this time period,	1. Initially 8,000 m3/yr, rising thereafter as more treat-

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
	for harvest 20 to 90 years from now.	approximately the same area will be suited to late rotation fertilization as in the short term (i.e. 530 ha/yr). At about 40 years from now, more managed stands will be of an age suitable for late rotation fertilization and the potentially treatable area will increase. This area can be determined by future strategies as the appropriate time nears. By this time, some of these stands could be under a multiple fertilization regime, in which case the late rotation fertilization under this potential strategy would be the last fertilization of the series. The first fertilization in a repeat fertilization program is covered under strategy MT2 (a) or MT2 (b)(viii). Ultimately, should virtually all fertilizable stands become managed, the program level would rise by the end of the mid term period to the level indicated in strategy LT 3 (b). Stands to be fertilized must have had density controlled. This is assumed to have occurred under the strategies MT2 (b-vi), MT3 (a), LT4 (e) and Q1.	able area comes available.
MT 2	2. Reduce green-up ages by 5 years in the IRM, VQO and Watershed zones ~~and by 10 years in the wildlife management zone~~ by:	2. Anticipate that TSR2 will show green-up to be a major issue. 35% of the THLB is currently managed under Interior Watershed Assessment Procedure (IWAP) rules for equivalent clearcut area (ECA). These rules are: ht (m) — ECA % Contribution < 3 = 100 3-5 — 75 5-7 — 50 7-9 — 25 9+ — 10 Partially harvested areas contribute to this formula on a pro-rata basis. After all areas are factored, IWAP specifies the maximum proportion of clearcut area in a drainage is 30%. The district manager may determine a lower limit where appropriate. The management emphasis zones will also change for TSR 2. The TSR2 zones will be as follows (TSR1 in brackets): Zone — %THLB — Ht — Age — Max % below IRM — 90 (50) — 3 — 15 (20) — 25 (33) Com W/S — 10 — 9 — 34 — 30 **The objective of reducing time to green-up by 5 years results in a target of achieving 3 m hts on average across the TSA by age 10.** *Note 1: Because a wildlife management zone will not be used in TSR2, this part of the initial proposed strategy was dropped.* *Note 2: The activities listed under this strategy affect not only time until green-up but also stand yields at harvest and the minimum harvestable ages of stands. Lowering minimum harvestable ages was not a factor in TSR1 (see* Figure 5*, page 18), but might be in TSR2. Increasing stand yields is a potential long-term strategy (see*	

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
		LT 3). These responses are also tracked under this potential strategy. *Note 3: The initial potential strategy (see "Potential Silviculture Strategies," page 26) was substantially revised in the workshop. This necessitated re-numbering the activities.)*	
MT 2	(a) for existing stands: (i) fertilizing existing stands currently 1-2 m in ht;* and	(a)(i) This strategy was added during the workshop. The objective is to get existing young stands over 3 m as soon as possible. The 3 m ht has the largest impact in both adjacency and IWAP calculations. This strategy would be of greatest value were further modelling to identify an adjacency problem 10-20 years from now. If even-aged harvesting over the past 10 years has been 1 800 ha/yr then maximum potential treatment area = 10 X 1 800 = 18 000 ha. Of this, about 2/3rd's is estimated to be 1-2 m ht. = 12 000 ha. If 75% of this is Pl/Fdi and 2/3rd's of that is available the net treatable area can be calculated as: 12 000 X .75 (Pl/Fdi) = 9 000 X .66 (2/3rd's available) = 6 000 treatable ha. This could be developed into a program of either **1 200 ha/yr for 5 yrs** or 2 000 ha/yr over 3 yrs. Although there is confidence that fertilization will be effective, further research is needed to determine the best cultural practices and to accurately estimate the actual reduction in time until green-up . The need for trials is noted under "Summary of Information and Research Needs," page 65. Trials should also investigate the fertilizer impact on the other vegetation in the stand and whether density control is needed prior to fertilization at early ages. Estimate that 3 m green-up could be reached 1 yr earlier. (Pl does not respond well in ht increment, more of the response in radial increment.)	(a) (i) 3 m green-up achieved 1 year earlier on about 1/3 of the area currently below 3 m ht. <u>stand level</u> Vol gain – 2% GU red'n – 1yrs min age red'n - 2 yrs <u>TSA level (2nd decade)</u> Vol gain – ? % GU red'n – 0.5yr min age red'n - ? yrs See "Summary" below.
MT 2	(ii) spacing ____ ha/yr of pine stands subject to repression	(a)(ii) Spacing Pl stands subject to repression would speed up hydrologic recovery. There are about 2 000 ha of pre-87 Pl > 10 000 sph that are 10-20 yrs old. These should be treated soon before repression sets in and the opportunity is lost. **Treating over a 5 yr period requires a program of spacing 400 ha/yr.**	(a)(ii) Maintains base case assumptions.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
MT 2	(b) for about to be regenerated stands: (i) using improved seed; (increase)	(b)(i) 80% of even-aged managed areas are planted. In 1998 about 1/6th of all planted area was improved S but the volume gain is low, between 2 and 9.4%. Future gains by 2007 are estimated to be: Species: Pl / S / Fdi / Lw / Pw % gain: 12 / 13.8 / 0 / 7 / ? No improved Fdi will be available but there is little planted in the TSA, with most of the IDF being under uneven-aged management. Opportunity area is all planted area which = (1800/2500 (75% of area) X 80% planted) = 1 440 ha/yr = 60% of THLB. Assuming gains across all species trend towards 13%, LTHL can be expected to rise (60% THLB X 13% volume gain) = 8%. Tree improvement could significantly reduce green-up (estimate by 2 yrs) & minimum harvest ages (estimate by 10 – 15 yrs) on 60% of the THLB.	(b)(i) stand level Vol gain – 13% GU red'n – 2 yrs min age red'n - 10-15 yrs TSA level Vol gain – 8% GU red'n – 1 yr min age red'n - 10 yrs See "Summary" below.
MT 2	(b)(ii) site preparing ___ additional hectares	(b)(ii) 10-20% of P&T area harvested annually is mounded, largely in the wetter sites in the ESSF & ICH zones. MoF does about 10% of areas because is generally operating on drier sites than P&T. **No additional opportunity** to increase site prep.	(b)(ii) No opportunity.
MT 2	(b)(iii) using larger planting stock	(b)(iii) Normal stock in the past has been 313's. P&T now using more 415's, especially on site-prepared ground, to reach free-growing sooner. **Anticipate this will reach a max of about 300 ha/yr.** Total opportunity area estimated at 1 800 annual even-aged harvest X 80% planted = 1 400 ha/yr. Species ratios are 40% Pl, 30% S and 30% Lw. However, workshop discussion indicates little opportunity to expand. Much of the ground has shallow soils that will not accommodate larger stock. Larger stock (in combination with site prep) is estimated to reach green-up 2 years sooner. Based on a 100 year rotation, this also equates to a 2% gain in MAI. Minimum harvestable sizes would also be achieved 2 years earlier. At the TSA level, planting larger stock on 300 ha/yr = 300/2500 = 12% of the THLB.	(b)(iii) stand level Vol gain – 2% GU red'n – 2 yrs min age red'n - 2 yrs TSA level Vol gain – 0.25% GU red'n – 0.25yr min age red'n - 0.25yrs See "Summary" below.
MT 2	(b)(iv) fertilizing at time of planting	(b)(iv) P&T is investigating adding fertilizer to container stock at the nursery. Have attempted a few trials but results are inconclusive. No opportunity.	(b)(iv) No opportunity.
MT 2	(b)(v) brushing ____ ha/yr for growth enhancement (in addition to ___ ha/yr to ensure free growing	(b)(v) Brush is not much of a problem. P&T would like to work with the brush rather than against it. A little backlog brushing is needed. – see LT1(b)	(b)(v) No opportunity.
MT 2	(b)(vi) spacing ____ ha/yr of pine stands subject to repression	(b)(vi) Not likely to be any repression levels in future regenerated stands. See MT2(a)(ii).	(b)(vi) Maintains base case assumptions.
MT 2	(b)(vii) spacing ____ ha/yr of Douglas-fir stands subject	(b)(vii) Evidence from the Shawnigan plots is that spacing in Fd stands subject to seasonal moisture deficits can increase productivity. Spacing can either increase or decrease ar-	(b)(vii) No opportunity.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
	to seasonal moisture deficits/armillaria.*	millaria infection, depending on when and how it is done. No opportunity. Most Fd stands are managed on an uneven-aged management regime and are not suited/do not require spacing.	
MT 2	(b)(viii) fertilizing ____ ha/yr.	(b)(viii) Ideally, newly regenerated stands would be on a repeat fertilization management regime where normally the first fertilization would occur after juvenile spacing. See LT 3. For the objective of earlier green-up, however, stands might have to be fertilized earlier than would be the usual time. This is effectively **a continuation of the 1 200 ha/yr fertilization program identified under MT 2(a). – 1200 ha/yr.**	(b)(viii) See MT 2(a).
MT 2	(b)(ix) planting rust-resistant white pine	(b)(ix) Blister rust resistant Pw stock is now available. About 20% of the TSA is suited to this species – mostly in the Burrell and Granby areas (ICHmw2, Msmci). Annual opportunity are estimated at 20% X 2 500 ha/yr annual harvest = **500 ha/yr**. Pw usually forms about 15-25% of a stand and **can reach 3 m ht in 5 years**. Because green-up is based on the 100 tallest trees Pw could easily form all of the counted trees. Planting Pw has very high potential to reduce green-up. Pw also has strong potential to lift the wood supply in the critical late transition period (decades 8-11). Pw planted now would be maturing right in this period, or even past maturity. Because of its value, early mortality would likely be harvestable through commercial thinning. Assuming it survives, it could lower the minimum harvest ages of stands by 15 years. Other than shifting the timing of harvests, it is uncertain how much Pw might contribute to increasing total stand volumes. For now, it is considered part of the stand and contributes to the increased volumes assumed under MT 2(b)(i), improved trees, but does not increase volumes beyond this through improved site occupancy or recovery of lost stand mortality through CT, both of which have potential to increase volumes further. Pw management opportunities and harvest forecast implications need further investigation - noted under "Summary of Information and Research Needs," page 65. MT 2(b)(i) indicated tree improvement could reduce min. harv. ages 10-15 yrs. On stands planted with improved Pw as well as other improved species, this effect will easily be 15 yrs. TSA level effects are calculated based on factoring the stand level effects by 20%, the proportion of the TSA THLB suited to Pw.	(b)(ix) stand level Vol gain – ?% GU red'n – 10 yrs min age red'n - 15 yrs TSA level Vol gain – ?% GU red'n – 3yr min age red'n - 3yrs See "Summary" below.
MT 2	(b)(x) planting birch	(b)(x) Planting birch has potential in areas prone to root rot and in watersheds for achieving early green-up. Limited suitable area.	(b)(x) Minor opportunity.

<table>
<tr><th>Number</th><th>Potential Strategy/Action</th><th>Discussion / Current Status</th><th>Conclusion / Anticipated Result</th></tr>
<tr><td>MT 2</td><td>SUMMARY</td><td>The following summarizes the estimated effects of strategy MT2. Effects at the TSA level are prorated based on the opportunity area as a percentage of the TSA's THLB. Totals are estimated using best judgement with respect to potential overlapping effects.
<table>
<tr><th>Strategy</th><th>Volume Gain (%) Stand</th><th>Volume Gain (%) TSA</th><th>Green-up age red'n(yrs) Stand</th><th>Green-up age red'n(yrs) TSA</th><th>Min Harv. Age red'n(yrs) Stand</th><th>Min Harv. Age red'n(yrs) TSA</th></tr>
<tr><td>(a)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>(i) fertilize</td><td>2</td><td>?</td><td>1</td><td>0.5</td><td>2</td><td>?</td></tr>
<tr><td>(ii) space repressed Pl</td><td></td><td></td><td colspan="2">maintains base case</td><td></td><td></td></tr>
<tr><td>(b)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>(i) improved stock</td><td>13</td><td>8</td><td>2</td><td>1</td><td>10-15</td><td>10</td></tr>
<tr><td>(ii) incr. site prep</td><td></td><td></td><td colspan="2">no opportunity</td><td></td><td></td></tr>
<tr><td>(iii) large stock</td><td>2</td><td>0.25</td><td>2</td><td>0.25</td><td>2</td><td>0.25</td></tr>
<tr><td>(iv) fert at planting</td><td></td><td></td><td colspan="2">no opportunity</td><td></td><td></td></tr>
<tr><td>(v) brush for growth</td><td></td><td></td><td colspan="2">no opportunity</td><td></td><td></td></tr>
<tr><td>(vi) space repressed Pl</td><td></td><td></td><td colspan="2">not likely req'd in future</td><td></td><td></td></tr>
<tr><td>(vii) space Fdi</td><td></td><td></td><td colspan="2">no opportunity</td><td></td><td></td></tr>
<tr><td>(viii) fert 1-2 m stands</td><td>2</td><td>?</td><td>2</td><td>?</td><td>2</td><td>?</td></tr>
<tr><td>(ix) plant resistant Pw</td><td>?</td><td>?</td><td>10</td><td>3</td><td>15</td><td>3</td></tr>
<tr><td>(x) plant Birch</td><td></td><td></td><td colspan="2">minor opportunity</td><td></td><td></td></tr>
<tr><td>(b) Total</td><td>17+</td><td>8.25+</td><td>6-10</td><td>1.25-3</td><td>10-15</td><td>10+</td></tr>
</table>
See also LT3 for additional potential strategies relevant to potential volume gains.</td><td>A 5 yr reduction in green-up ages will be achievable on some stands. At the TSA level, however, the overall effect is probably between 1 & 3 years.</td></tr>
<tr><td>MT 3</td><td>3. Set up stands for future partial harvesting/ commercial thinning ~~(emphasis on decade 8-11 harvests)~~ by:</td><td>3. TSR 1 indicated timber supply in decades 8-11 is either heavily constrained or very low due to an age class gap in stands currently aged 21-40 years, or both. It is unknown if TSR2 forecasts will show the same sensitivity, particularly with respect to adjacency constraints. It is expected that there may be a need to commercially thin to overcome adjacency constraints. In the workshop, because TSR2 results are not yet available, the emphasis on decades 8-11 was determined not an issue. Also, TSR2 will not be using a wildlife management zone, so this reference was also deleted from the potential strategy.

Target stands are Pl and Fdi with good access, even terrain, and medium to good productivity.</td><td>3.</td></tr>
<tr><td>MT 3</td><td>3.(a) spacing ____ ha/yr of _____ to set up stocking appropriate to commercial thinning; and</td><td>(a) Workshop participants estimated about 1/3 of the areas harvested under even-aged management (600 ha) could be appropriate for commercial thinning (CT). This requires a spacing program of 600 ha/yr to set up stocking.

While spacing under this strategy is preparatory for CT, it can of itself have some volume implications. Table 1, page 50, shows that while spacing Pl, SI 21 from 5 000 sph down to 1 600 sph only marginally raises MAI on a culmination MAI basis (from 4.78 to 4.84), it substantially raises MAI (by 7%, from 4.48 to 4.81) at a target DBH of 25cm. At this technical rotation age, spaced stand MAI is close to culmination MAI. Depending on how min ages are set and used in TSR2, this may or may not have an influence on the har-</td><td>(a) Spacing is preparatory for CT. Spacing can raise MAI at technical rotation ages. Requires Type II analysis to properly determine effects.</td></tr>
</table>

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
		vest forecast. For creating CT potential, generating merchantable tree sizes at the time of planned CT is the governing factor, not culmination MAI. An unspaced Pl stand having 5 000 sph will have diameters too small for early CT, inadequate vigour for later CT when diameters finally reach merch sizes, and will be too old and too dense to respond to fertilization. Furthermore, later CT is less likely to generate timber supply in the mid term period, where is it presumably needed more.	
MT 3	3. (b) repeat fertilizing ____ ha/yr.	(b) A repeat fertilization would start at 600 ha/yr – the area annually spaced. This would be a subset of LT3(b). While repeat fertilization would be ideal, a 2X fertilization regime would be the next best management regime. In a 2X regime, the first fertilization (600 ha/yr) would be 10 yrs before CT and the second (600 ha/yr) about 2-3 yrs following CT. This fertilization regime would be phased in starting 40-60 years from now at 600 ha/yr (10 – 15 yrs before the first CT), rising to 1 200 ha/yr to include a 2nd fertilization 2-3 years after the first commercial thinning takes place. Because this fertilization does not begin until 40 years from now, it does not show in the program table which covers only the next 10 year period. Each fertilizer application would add about (600 ha/yr X 15 m3/ha=) 9 000 m3/yr to harvest levels. Presumably the CT would capture the first volume lift in the mid to late part of the mid term period, while the capture of the 2nd volume lift would depend on whether the final harvest occurs in the late mid term or long term period. Based on the Pl spacing regime and data in row 4 of Table 1, page 50, (Pl, SI 21, spaced from 5000 sph to 1600 sph) volume at 25 cm technical rotation is 366 m3/ha. If pre-CT fert adds 15 m3/ha, stand volume is increased to 381 m3/ha. Row 4 indicates 20% of stand volume is in the DBH class 15 – 20 cm (actual range 12.5 – 22.5 cm). Fertilization may shift these diameters up slightly. If thinning from below removes these smaller stems, CT could potentially transfer (20% of 381 m3/ha =) 76 m3/ha X 600 ha/yr = 45 600 m3/yr from the long term into the mid term, or else make this volume available when it otherwise wouldn't be due to forest cover constraints up to IWAP limits.. This calculation is probably optimistic because it is based on more productive Pl. Typical candidate stands may be not as productive or are Fdi.	(b) This is a subset of LT3(b). Fertilization could directly add 9 000 m3/application. CT could potentially transfer 45 600 m3/yr from LT to MT, or else make this volume available when it otherwise wouldn't be due to FCCs up to IWAP limits. Requires further analysis post-TSR2. Creates flexibility in timber supply.
MT 4	4. Increase the area satisfying older forest biodiversity requirements in decades by achieving the desired stand characteristics by 130 years of age by: (a) spacing ____ ha/yr; and (b) repeat fertilizing ____ ha/yr.	4. Old seral and mature plus old biodiversity requirements are significantly affecting the current availability of timber for harvesting. However, without the TSR2 analysis results it is not possible to determine in the longer term what the effects will be. The model is expected to satisfy these requirements from outside the THLB. Because of this, a sensitivity test is planned that will not age the outside stands. Otherwise, as stands are aged, it becomes easier for the model to satisfy older forest constraints. Workshop participants felt that there was insufficient information at this time on which to review the potential strategy. This should be revisited once TSR2 results are available – noted under "Summary of Information and Research Needs," page 65.	4. Insufficient information.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
	Mid Term Harvest Forecast Summary	(see table below)	
	Conclusion	In the absence of TSR2 information, it is not possible to confidently know the need for certain potential strategies. For example, without TSR2 analysis or Type II silviculture analysis, the effect of reduced green-up ages on freeing up mid term timber supply cannot be determined. At this point, the greatest potential for increasing mid term timber supply is through fertilization and commercial thinning. Late rotation fertilization of 530 ha/yr offers the potential to increase harvests in the early part of the mid term by about 8 000 m3/yr, rising to probably twice this amount in the later mid term as more stands become suitable for fertilization. CT during the last several decades of the MT could potentially transfer 45 600 m3/yr from LT to the MT, or else make this volume available when it otherwise wouldn't be due to FCCs, up to IWAP limits. Some of the CT volume that is brought forward from the long term in this manner could be replaced in the LT by a post-CT fertilization.	

Mid Term Harvest Forecast Summary:

Potential Strategy #	Effect
MT1 Late rotation/repeat fert existing spaced.	8 000 m3/yr. Rises over time. See MT2 (a), MT2 (b)(viii), LT3 (b).
MT2 Reduce green-up ages by 5 years in the IRM, VQO and Watershed zones by:	
(a) for existing stands:	
(i) fert 1200 ha/yr of 1-2 m ht stands/5 yrs.	Hrvst forecast implications not calculated.
(ii) space 2000 ha repressed Pl	Maintains base case.
(b) many practices in regenerated stands.	MT hrvst forecast implications of reduced green-up ages not calculated. In total, all practices are estimated to increase LTHL by 8%.
MT3 Set up stands for PH/CT by:	
(a) spacing 600 ha/yr to set up for CT.	Hrvst forecast implications require Type II silv analysis after TSR2.
(b) repeat fertilizing 600-1200 ha/yr.	Subset of LT3(b). Adds 9 000 m3/application. Could add 9 000 m3 MT and 9 000 m3 long term. CT could potentially transfer 45 600 m3/yr from LT to MT, or else make this volume available when it otherwise wouldn't be due to FCCs, up to IWAP limits.
MT4 Increase area satisfying old forest req'mts	Revisit after TSR2.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
		Because some of the late rotation fertilization area would be CT'd, the total combined effect (of late rot'n fert area not CT'd plus CT volumes) during the later part of the mid term may be somewhere in the neighbourhood of 50 000 m3/yr. Alternatively, an even-flow mid term harvest target can be roughly determined on the following basis. Assuming CT would occur in the last 2 decades of the MT, this would transfer (20 yr X 45 000 m3/yr =) 900 000 m3 into the MT. Dividing this by the 70 year span of the MT gives an even-flow amount of ≅ 13 000 m3/yr. Adding 8 000 m3/yr from late rotation fertilization results in a total potential of 21 000 m3/yr across the full mid term, about 3% of current AAC. **Total additional mid-term timber supply ≅ (21 000 m3/yr X 70 yr ≅) 1.5 million m3. CT may reduce long term timber supply by a corresponding amount.**	

8.2.4 *Long Term (91+ years)*

<table>
<tr><th>Number</th><th>Potential Strategy/Action</th><th>Discussion / Current Status</th><th>Conclusion / Anticipated Result</th></tr>
<tr><td>LT 1</td><td>1. Maintain the THLB by
(a) Planting approx. 300 ha of backlog NSR; (maintain) and
(b) maintaining approx.____ ha of existing backlog plantations. (maintain)</td><td>1. (a) Most of the backlog NSR has been treated or reclassified. The 300 remaining treatable ha requires the program shown below to achieve free growing.
(b) About 900 ha of previously reforested area requires brushing to ensure free growing is achieved. The program shown below is required.
<table>
<tr><th></th><th colspan="5">Area (ha)</th></tr>
<tr><th></th><th></th><th></th><th colspan="3">Brush</th></tr>
<tr><th>Year</th><th>Site Prep</th><th>Plant</th><th>New Plnt'n</th><th>Existing</th><th>Total</th></tr>
<tr><td>1</td><td>100</td><td>100</td><td>0</td><td>400</td><td>400</td></tr>
<tr><td>2</td><td></td><td>100</td><td>0</td><td>300</td><td>300</td></tr>
<tr><td>3</td><td></td><td>100</td><td>100</td><td>100</td><td>200</td></tr>
<tr><td>4</td><td></td><td></td><td>100</td><td>100</td><td>200</td></tr>
<tr><td>5</td><td></td><td></td><td>100</td><td>0</td><td>100</td></tr>
<tr><td>6-10</td><td></td><td></td><td>150</td><td></td><td>150</td></tr>
</table></td><td>1. (a) (b) Maintain base case LTHL.</td></tr>
<tr><td>LT 2</td><td>2. Increase the THLB by:
(a) converting /rehabilitating ___ ha/yr of deciduous</td><td>2. Due to time constraints, this potential strategy was not reviewed in the workshop. Post-workshop follow-up indicates there will probably be few opportunities given biodiversity, possible future use or management of these stands.</td><td>2. Summary. Little potential identified.</td></tr>
</table>

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
	stands; (increase)	Area (ha) / %THLB / Treatable Area: (a) Decid — 3 400 — 1.2 — ______ (b) Non-merch — 14 200 — 4.6 — 6 218* (c) Low site — 3 600 — 2 — ______ *Source: district dense pine study. (a) Decid. The condition of these stands is not known. Some stands may be harvestable, some may be suitable for conifer release, some may be best allocated to meeting wildlife habitat objectives, while others may be suited to continuous deciduous management. If harvesting does occur then they can be converted to conifers or managed for hardwoods. Awaiting TSR2 results to better define the extent of excluded deciduous area (noted under "Summary of Information and Research Needs," page 65).	(a) Awaiting TSR2 results to define extent of excluded area.
LT 2	(b) converting/rehabilitating non-merchantable ______________ stands; (increase)	(b) Non-merch. These stands are mostly Pl. There are two reasons for not treating them immediately: (1) some may be suitable now for post and rail sales, or may prove merchantable in the future, and (2) if old-growth constraints are at their limits, other stands of better species and productivity would have to be immediately set aside to replace them upon rehabilitation.	(b) No opportunity.
LT 2	(c) assessing _______ ha of low-site stands for proper classification; or	(c) Awaiting TSR2 results to better define the extent of excluded low-site area.	
LT 2	(d) improve the site productivity of low-site stands by (fertilization?). (increase/maintain)	(d) Awaiting TSR2 results to better define the extent of excluded low-site area.	
LT 3	3. Increase the volume of regenerated stands by 20% over those used at the base case by, in addition to those practices in MT 2: (a) managing stocking so voids do not account for more than 10% of the area (increase); and	3. (a) TIPSY standard OAF1 factor for voids is 15%. Objective is to reduce this to 10%. Three factors indicate an OAF1 of 15% is likely high. 1. Current free growing requirements will result in < 15% in voids, however the actual amount is unknown. 2. A relatively high proportion of the total land area of the Boundary TSA (54%) is within the THLB. This implies more gentle terrain, with stand voids being less likely. 3. A relatively small proportion of the TSA is subject to under-stocking due to brush problems. Otherwise the problem is one of overstocking. Again, stand voids are less likely under this condition. There is a need for completion of surveys for voids to get a measure of the actual area in voids (noted under "Summary of Information and Research Needs," page 65). Voids can be desirable for wildlife habitat, so intensive void management may not be practicable on	3. (a) 5% gain possible. See "Summary" below.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
		all areas.	
LT 3	(b) repeat fertilize _____ ha/yr on a 15 yr return cycle (increase).	(b) On a long term steady state basis, 50% of the species (Fdi & Pl) on 50% of the site classes could be suitable for a multiple fertilization regime. About 90% of this is considered available for treatment. This equates to (.5 X .5 X .9 =) 22.5% of the THLB or 67 000 ha. On a 10 yr return cycle, **this requires a program of (67 000/10 =) 6 700 ha/yr**. Estimated cost at $200/ha = $1.3 million/yr. Probably 4 applications would be required, with the first occurring after juvenile spacing. Each application is estimated to add 15 m3/ha of growth, so 4 applications yields an additional 60 m3/ha. This is a 25% volume gain on a base stand yield of 250 m3/ha. Note 1: The program of 6 700 ha/yr would be reached over a period of about 60 years, as ultimately all suitable stands become managed. Over the next decade, the program would initially be at the level defined under strategies ST1 – 530 ha/yr MT2 (a) – 1200 ha/yr and MT3 (b) – 600 ha/yr, for a total of 2 330 ha/yr. Note 2: Stands to be fertilized must have had density controlled. This is assumed to have occurred under the strategies MT3 (a), LT4 (e) and Q1.	3. (b) A 25% volume gain on 22.5% of the THLB = a 6% volume gain overall. See "Summary" below.
LT 3	3. Summary	The following summarizes the estimated effects of strategy LT3 and combines it with those from MT2 to get a total potential. Effects at the TSA level are prorated based on the opportunity area as a percentage of the TSA's THLB. Totals are estimated using best judgement with respect to potential overlapping effects.	3. Summary 20% appears marginally achievable. Better site index estimates would likely indicate it is achievable.

Strategy	Volume Gain (%) Stand	Volume Gain (%) TSA	Green-up age red'n(yrs) Stand	Green-up age red'n(yrs) TSA	Min Harv. Age red'n(yrs) Stand	Min Harv. Age red'n(yrs) TSA
From MT2						
(b) Total	17+	8.25+	6-10	1.25-3	10-15	10+
From LT3						
reduce voids	5	5	0	0	0	0
repeat fert. (LT3)	25	6	already in MT2		10	2
total (b) + LT 3	47+	19+	6-10	1.25-3	20-25	12+

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
LT 4	4. Reduce losses to root rot by: (increase)	4. A 10% OAF2 factor will be applied across all species in TSR2. Exceptions are Lw 7% and Fd 12% (due to Lw resistance, and Fd susceptibility and predominance of partial harvesting in Fd). Estimate 1 000 ha/yr of 2500 total area harvested is seriously infested with armillaria = 40% of THLB. Infection is worst in Pl and Fdi, but occurs across entire land base. If volume loss in heavily infected stands is 20%, then loss over entire THLB is .(2 X .4 =) 8%. Given that a basic OAF2 of 5% is intended to be 2% for breakage and 3% for decay, then a 10% OAF2 equates to an 8% deduction for decay. Thus a 10% estimate appears reasonable. Any action to reduce root disease losses would therefore serve to increase timber supply above the TSR2 base case.	

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
LT 4	(a) pushover logging / stumping;	(a) P&T is currently doing 4-500 ha/yr of stumping on slopes < 30% as part of basic silviculture. This program is decreasing in favour of less costly and equally effective alternatives.	(a) Basic silviculture obligation. Being phased out.
LT 4	(b) planting alternate species;	(b) Wherever possible Lw, Pw and Py is planted on sites prone to armillaria. Some birch planting on an experimental basis.	(b) Basic silviculture obligation. Current practice on all planted areas.
LT 4	(c) pop-up spacing;	(c) This is not a desirable treatment. Small diameter spacing (see below) is felt to be equally effective at less cost.	(c) Not done.
LT 4	(d) hyphaloma inoculation*	(d) This potential strategy was added during the workshop. Currently, inoculating with hyphaloma is considered experimental but early results are encouraging.	(d) Experimental
LT 4	(e) small diameter spacing*	(e) This potential strategy was added during the workshop. Small diameter spacing is increasingly used in silviculture prescriptions as an alternative to stumping or pop-up spacing. Early results indicate it is equally effective, plus has the added benefit of stocking control. P&T anticipates this could apply to 500 ha/yr and SBFEP expects 300 ha/yr to be treated. Assuming this occurs only on even-aged management sites, from which 90% of harvest volume originates, equals 800/1800 X .9 = 40% of volume. A potential variation to small diameter spacing is to partially cut or break and push over trees that are ½ the height of crop trees.	(e) Basic silviculture obligation. Current practice on area equating to 40% of volume.
LT 4	(f) chemical spacing*	(f) This potential strategy was added during the workshop. Chemical spacing is experimental at this time.	(f) Experimental
LT 4	SUMMARY	The FP Code requires silviculture prescriptions incorporate actions to deal with armillaria when it is present in a harvested stand. Alternatives are being actively pursued, but their overall success over time is unknown. The need for further study of root rot management noted under "Summary of Information and Research Needs," page 65.	4. Summary Basic silviculture obligation. Being actively pursued. Results unknown but could be expected to ultimately result in a reduced OAF2.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
	Long Term Harvest Forecast Summary	Potential Strategy # — Effect **LT1** Backlog NSR — Maintain base case LTHL **LT2** Increase the THLB (a) convert decid — Need TSR2 info. (b) rehab non-merch Pl — No opportunity (c) assess L site classifications — Need TSR2 info. (d) fert L site stands — Need TSR2 info. **LT3** Incr. regenerated stand vol's 20% by: in addition to MT2, — MT2 indicates pot'l to incr. LTHL by 8% (a) managing voids — 5% increase in LTHL appears likely (b) repeat fertilizing 6,700 ha/yr — 6% increase in LTHL. Summary: 20% appears marginally achievable. Better site index estimates would likely indicate it is achievable. **LT4** Root rot — Basic silviculture obligation. Being actively pursued. Results unknown but could be expected to ultimately result in a reduced OAF2.	
	Conclusion	Backlog NSR treatment activities must continue to maintain the base case. A 20% LTHL gain can be expected with current tree improvement program plans plus a very large repeat fertilization program that would commence at a low level and increase gradually as more area becomes occupied by managed stands. Additional tree improvement and possible site index adjustments may increase this further.	

8.3 Potential Harvest Forecast

A potential harvest forecast is not available, pending TSR2 analysis results.

9. Opportunities to Improve Timber Quality

The effects of incremental silviculture on the future quality of the timber resource are not analyzed in the timber supply review. Information in this section is taken from the *Boundary TSA Interim Stand Level Stand Tending Strategy* (MoF, undated) or was gathered during the district workshop.

9.1 Product Objectives

The following are product objectives at the log level for the Boundary TSA.

Quality Class	Species	Characteristics
Premium Log:	Douglas-fir, spruce Pl Lw	35+ cm DBH, clear 3-5 m log.
	larch, spruce	30+ cm DBH, straight, low taper, building log
	western redcedar	25+ cm DBH, pole
	lodgepole pine	30+ cm DBH; large log
	western white pine	30+ cm DBH, tight knots, premium species.
Sawlog:	Douglas-fir, larch, ponderosa pine, redcedar	30+ cm DBH.
	lodgepole pine, spruce, balsam, hemlock	25+ cm DBH.

9.2 Potential Strategies by Response Time Frame

The following strategies have potential to increase timber quality. These were reviewed in the district workshop. The response time frame is the period in which the anticipated result is expected, not the period in which actions must necessarily commence.

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result / Premium Log Forecast
Short Term (1 - 20 yrs)	None	Short term harvests will come from existing older stands which are not treatable to improve quality.	Quality profile of existing old growth will prevail. Assume this is equal to a recent coast-wide estimate of 15%.
Mid Term (21 - 90 yrs)	Q1. space 500 ha/yr to increase average stand $DBHg_{all}$ from ___ cm to ___ cm.	Current program is 500 ha/yr. There is a need to continue this program in existing and future stands. Normal regime is 5-7000 sph spaced to 1400-1600 sph. There is an opportunity to increase the treated area, but awaiting TSR2 results re future age class distribution problems. See also: LT4(e) – spacing 800 ha/yr for root rot control; MT3(a) – spacing 600 ha/yr in preparation for PH/CT.	See large log analysis.
	Q2. 1st lift prune 100 ha/yr to 3.5 m, and 2nd lift prune 50 ha to 5.5 m.	Max historic program has been 90 ha/yr. Currently 412 ha have been 1st lift pruned and only 4 ha's have been 2-lift pruned. Goal is a 10 cm radius of clear wood. This requires a minimum DBH of 30 cm, preferably 35 cm. Target species are Pl, Fdi, Lw and Pw (future). An annual program of 100 ha/yr would equal (100/1800 ha/yr harvested =) 4% of THLB. If 3.5 m = 15% of tree vol, (.04 X .15 =) 0.6%/yr of future harvest volume will be clear logs resulting from pruning. To get 5% clear by volume would need to 1st lift prune 800 ha/yr. **Feeling is that a small program of 100 ha/yr 1st lift and 50 ha/yr 2nd lift is reasonable. 2nd lift on ½ of area would raise clear volume to about 0.8% of total. Should be tied to corresponding regimes of spacing to 800 sph and repeat fertilization.**	0.6 – 0.8% clear log content across total annual harvest volume.
Long Term (91 + yrs)	As above.	As above.	As above.

9.3 Large Premium Log Analysis

Two large log analyses are reported below, both based on an annual spacing program of 900 ha/yr. This is equal to spacing one-half the annual area harvested under an even-aged management system. Spacing regimes are based on an amalgamation of the district target post-spacing stand densities presented in Table 1 of the *Boundary TSA Interim Stand Level Stand Tending Strategy* (MoF, undated). The district post-spacing densities are based on a goal of maximizing MAI while maintaining piece size and minimizing harvest age. The purpose of the analysis in this report is to gain some insight into the future timber quality profile under two basic scenarios: first, managing stands to a target sawlog DBH; and second, managing to reduced minimum harvest ages. This analysis is to a lower resolution than that of the district stand level strategy and is not a replacement of it.

All tables were generated using TIPSY version 2.1e with standard OAF's, to a 12.5 cm utilization standard for Pl and 17.5 for all other species. (There is no published validation for this model and it is an even-aged single-species model.) Because TIPSY has no mechanism for in-growth following planting, unspaced stands having a stocking level of 5 000+ sph were assumed to be naturally regenerated. Stands with a stocking level of ≤ 3 000 sph were assumed to be planted. The difference between the # sph actually planted and the # used in the table is assumed ingrowth (e.g.; 3 000 sph planted = 1 400 sph planted + 1 600 sph ingrowth).

The table immediately below summarizes the assumed distribution of species and area spaced. The current species mix is derived from TSR1 data. The total area used in calculations includes only even-aged stands which are assumed to be 1800 of 2 500 ha of annual harvest area. The large log tables do not include an estimate for the premium log content from harvests in uneven-aged stands. Fdi/Lw stands occupy approximately 40% of the THLB and therefore 1 000 of the 2 500 ha of annual harvest, but because uneven-aged management is assumed to be largely in Fdi stands, only 300 ha of Fdi/Lw stands are shown in the tables under even-aged management. The area spaced is an allocation of the 900 ha total made by the consultant in preparation for the workshop.

Species	% of THLB	Annual Harvest Area based on % THLB	Area under un-even aged management	Area under even-aged management	Area spaced
Fdi/Lw	40	1000	700	300	100
Pl	40	1000		1000	700
S/B/Other	20	500		500	100
Total	100	2500	700	1800	900

The site indices used are weighted averages from Martin (1999) and can be considered inclusive of an OGSI site index adjustment. They do not, however, incorporate gains from stand management activities proposed under the potential strategies to improve the quantity of future timber supply.

Table 1 to Table 3 illustrate the effects of spacing on achieving a technical rotation (sawlog targets of 25 cm DBH for Pl (Table 1), 30 cm for Lw/Fdi (Table 2), and 25 cm for S/B (Table 3)). For example, rows 3 & 4 of Table 1 show that by spacing a Pl stand from 5 000 sph to 1 600 sph, a 25 cm DBH avg diameter target can be reached 15 years earlier, at 76 years vs at 91 years for the unspaced stand. At the technical rotation of 25 cm DBH, the MAI of the spaced Pl stand is 7% higher than that of the unspaced stand (rises from 4.48 to 4.81), indicating that spacing would also increase the harvest level over time at this technical rotation.

Under the assumptions employed, even with spacing, Table 1 to Table 3 show that only (2.1 + 1.5 + 2.8 =) 6.4% of annual harvested volumes in the long term will be large premium logs (32.5+ cm DBH for all species, except Fdi/Lw which is 42.5 cm+ DBH). It is unknown what the premium log content will be from uneven-aged stands, but conservatively could be estimated to raise the premium log content to at least **7%**.

Table 4 to Table 6 show the effects of managing stands to younger harvest ages (Pl – 60 & 80, other species – 100). This would be representative of the harvest profile at about the time of transition from existing stands to managed stands, about 90-100 years from now, with minimum harvest ages reduced about 15 years below culmination for Pl, about 35 years for Fdi/Lw, and 10 years for S/B. Under this scenario the large premium log content falls to (0.7+0.0+1.5 =) **2.2%**. Again, it is unknown what the premium log content will be from uneven-aged stands, but conservatively could be estimated to raise the premium log content under this scenario to at least **2.5%**. Offsetting the lower premium log content associated with harvesting at younger ages, Table 4 shows that, at younger harvest ages, spacing significantly reduces the number of smaller trees in the stand and increases those in the middle size range, while still maintaining about the same overall stand volume. For example, spacing Pl from 5 000 sph to 1 600 sph (row 3 vs row 4) reduces the # stems/ha in the 15-20 cm class by over 250 and increases the # stems/ha in the 25-30 cm DBH class from 345 to 449 sph. Total stand volume at 1 600 sph is 2 m3 greater than at 5 000 sph. Average stand DBH increases by almost 3 cm, creating a merchantable stand, whereas the unspaced stand would likely not be merchantable at the target age. Two other factors are also significant. First, the MAI of the spaced stand at the target harvest age of 60 years is virtually the same as that of the culmination MAI of the unspaced stand at 67 years. Second, the number of stems per hectare below merchantability drops substantially from 238 in the unspaced stand to 60 in the spaced stand. While this alone is not likely to be cause for conducting a spacing, it nevertheless does have implications for harvesting costs, fire hazard, aesthetics, etc.

With regard to Fdi, Table 5 TIPSY results indicate that, at a target harvest age of 100, MAI and total merch volume increases slightly as stocking levels are reduced from 10 000 down to 900. At 700 sph, MAI decreases, indicating the site is not fully occupied. Diameter distributions, however, are significantly affected by stocking. An unspaced stand with 5 000 sph at establishment has 60% of its stems below the 17.5 cm merchantability limit, compared to a stand spaced to 900 sph, which has only 19% of stems below merchantability. Again, this has implications to harvesting costs, fire hazards, plantability, aesthetics, etc. and depending on the local situation may or may not be relevant to the decision to space. More relevant to log quality and harvesting costs is the shift in of the number of stems in the smallest merchantability group (20 -25 cm) into the mid-range group (30 - 40 cm). Spacing from 3 000 sph down to 900 sph, for example, reduces the number of stems and the % total volume in the smallest merchantable size grouping by about one-third. Unspaced, virtually half of the stand's volume is in the smallest diameter grouping, while, with spacing, this falls to about one-third of total volume. At the same time, the volume in the mid-sized grouping (30 –40 cm) increases by about 30%. The foregoing responses increase with increasing pre-treatment density and decrease with increasing post-treatment density.

For spruce, Table 6 indicates spacing again significantly reduces the number of stems in the non-merch and small-merch diameter groups, but, differently from Pl and Fdi, also significantly shifts volume into the large-diameter group. The data in this table do not show a direct spacing regime from 5 000 sph to 900 sph but comparing data from two of the regimes shown indicates large log volume could increase from 16% of total volume of unspaced (5 000 sph) stands to 47% spaced (to 900 sph). The spaced stand is also likely to have more total volume.

See also the discussion under workshop topic MT3 (a) on page 36 regarding the need for spacing related to preparing stands for fertilization and/or commercial thinning.

Table 1. Large log analysis – Pl target harvest diameter of 25 cm

Lodgepole pine: Target - 25.0 cm DBHg, 12.5 cm DBH utilization

Row #	Species	%inv	SI[2]	Regime spaced	Area not space	Space frm/to:	Reference Cul Age	Reference Cul Vol	Reference Cul MAI	Target DBHg -all (0.0+)	Harv Age	Harv Ht. (m)	MAI	LRF bf/m3	Total Vol (12.5cm util)	Total Trees (0.0+)	Largest 250 Vol	Largest 250 DBHg	DBH class[1] 0 - 10 cm # trees	0 - 10 cm % tot trees	15 - 20 cm # trees	15 - 20 cm tot trees	15 - 20 cm vol	15 - 20 cm tot vol	25 - 30 cm # trees	25 - 30 cm tot trees	25 - 30 cm vol	25 - 30 cm tot vol	35+ cm # trees	35+ cm tot trees	35+ cm vol	35+ cm tot vol	5m large log[3] - % tot hrvst vol
1	Pl	21																															
2	comparison					nat10000/unspaced	91	403	4.43	25.0	101	27.2	4.19	249	423	861	227	32.9	22	3	325	38	81	19	427	50	244	58	88	10	98	23	0.0
3	comparison					nat5000/unspaced	67	320	4.78	25.0	91	26.2	4.48	245	407	907	207	32.8	15	2	364	40	82	20	446	49	243	60	82	9	82	20	0.0
4				200		nat5000/1600	69	334	4.84	25.0	76	24.1	4.81	235	366	927	176	32.3	7	1	363	39	72	20	483	52	231	63	73	8	62	17	0.5
5	comparison					nat5000/1400	71	334	4.71	25.0	70	23.1	4.70	231	329	882	165	32.3	15	2	337	38	63	19	449	51	202	61	70	8	64	19	0.0
6	comparison					nat5000/1000	77	343	4.46	25.0	56	20.1	4.15	220	232	733	129	31.3	22	3	248	34	41	18	403	55	151	65	60	8	39	17	0.0
7				300		plt2500/1400	63	303	4.89	25.0	72	23.9	4.82	227	347	906	172	32.2	7	1	355	39	69	20	460	51	208	60	84	9	70	20	0.8
8	comparison					plt2500/900	68	312	4.59	25.0	50	19.4	4.22	213	211	694	117	30.5	14	2	217	31	35	17	420	61	149	71	45	6	27	13	0.0
9					150	plt1600/unspaced	66	314	4.75	25.0	83	25.3	4.54	229	377	958	182	32.4	5	1	373	39	73	19	512	53	239	63	70	7	65	17	0.4
10	Pl	15																															
11	comparison					nat10000/unspaced	101	258	2.55	24.6[4]	250	26.9	1.52	247	381	821	220	32.6	29	4	330	40	79	21	388	47	219	57	75	9	83	22	0.0
12				100		nat5000/1400	97	245	2.53	25.0	134	23.0	2.36	231	316	855	164	32.2	15	2	330	39	61	19	433	51	194	61	75	9	61	19	0.3
13	comparison					nat5000/1000	100	234	2.34	25.0	97	20.1	2.34	220	227	718	128	31.3	22	3	244	34	41	18	394	55	148	65	58	8	38	17	0.0
14				100		plt2500/1400	93	246	2.65	25.0	147	23.9	2.26	227	333	872	171	32.1	8	1	343	39	67	20	441	51	200	60	79	9	66	20	0.3
15	comparison					plt2500/900	93	224	2.41	25.0	86	19.3	2.37	212	204	681	115	30.3	14	2	218	32	35	17	409	60	143	70	40	6	24	12	0.0
16					150	plt1600/unspaced	95	247	2.60	25.0	182	25.3	1.96	229	356	908	182	32.4	4	0	354	39	69	19	484	53	226	63	66	7	61	17	0.4
17	Subtot.	40		700	300																												2.1

[1] Actual ranges are 0 - 12.5 cm, 12.6 - 22.5 cm, 22.6 - 32.5, and 32.6 + cm

[2] From Martin, 1999. *ISIS Polygon Area by Site Index Class*

[3] 1st 5 m log assumed to be 25% of tree volume. Volume calculated is a % of total harvest volume based on proportion of annual harvested area under a particular regime, **not** a % of stand volume.

[4] Exceeds TIPSY data: max's out at DBHg =24.6 at age 250

Table 2. Large log analysis – Lw/Fdi target harvest diameter of 30 cm

Larch / Douglas-fir : Target - 30.0 cm DBHg, 17.5 cm DBH utilization

Row #	Species	%inv	SI[2]	Regime spaced	Area not space	Space frm/to:	Reference Cul Age	Reference Cul Vol	Reference Cul MAI	Target DBHg -all (0.0+)	Harv Age	Harv Ht. (m)	MAI	LRF bf/m3	Total Vol (17.5cm util)	Total Trees (0.0+)	Largest 250 Vol	Largest 250 DBHg	DBH class[1] 0 - 15 cm # trees	0 - 15 cm % tot trees	20 - 25 cm # trees	20 - 25 cm tot trees	20 - 25 cm vol	20 - 25 cm tot vol	30 - 40 cm # trees	30 - 40 cm tot trees	30 - 40 cm vol	30 - 40 cm tot vol	45+ cm # trees	45+ cm tot trees	45+ cm vol	45+ cm tot vol	5m large log[3]- % tot hrvst vol
1	Fd[4]		18																														
2	comparison					nat5000/unspaced	136	374	2.75	29.7[5]	239	37.2	2.25	270	538	742	470	44.8	212	29	211	28	69	13	209	28	232	43	108	15	238	44	0.0
3					100	nat3000/unspaced	135	376	2.78	30.0	210	35.8	2.44	261	513	718	426	43.5	180	25	213	30	69	13	236	33	262	51	89	12	183	36	0.5
4				50		nat3000/1400	135	374	2.77	30.0	177	33.7	2.62	257	464	684	374	42.0	144	21	208	30	64	14	258	38	262	56	73	11	138	30	0.2
5	comparison					nat3000/900	138	376	2.72	30.0	135	30.1	2.72	251	367	588	288	38.9	91	15	170	29	53	14	294	50	257	70	34	6	57	16	0.0
6					100	plt2000/unspaced	133	372	2.79	30.0	223	36.6	2.36	263	527	731	455	44.4	189	26	222	30	67	13	215	29	234	44	104	14	226	43	0.6
7				50		plt2000/1200	132	375	2.84	30.0	173	33.6	2.69	258	465	685	379	42.2	147	21	207	30	64	14	253	37	254	55	77	11	148	32	0.2
8	comparison					plt2000/900	132	378	2.87	30.0	139	30.8	2.86	252	397	617	309	39.5	97	16	192	31	62	16	285	46	263	66	42	7	72	18	0.0
8	comparison					plt2000/700	134	374	2.79	30.0	115	28.1	2.73	246	314	516	250	37.3	54	10	162	31	53	17	279	54	229	73	20	4	31	10	0.0
9	comparison					plt1600/unspaced	133	371	2.79	30.0	211	36.0	2.44	264	515	731	442	44.2	180	25	236	32	72	14	214	29	230	45	102	14	213	41	0.0
10	comparison					plt1200/unspaced	132	373	2.83	30.0	177	33.9	2.65	258	469	699	382	42.5	133	19	238	34	70	15	248	35	244	52	81	12	154	33	0.0
11	Subtot.	20		100	200																												1.5

[1] Actual ranges are 0 - 17.5 cm, 17.6 - 32.5 cm, 32.6 - 42.5, and 42.6 + cm

[2] From Martin, 1999. *ISIS Polygon Area by Site Index Class*

[3] 1st 5 m log assumed to be 25% of tree volume. Volume calculated is a % of total harvest volume based on proportion of annual harvested area under a particular regime, **not** a % of stand volume.

[4] TIPSY does not contain data for Larch. Fdi is the recommended substitute

[5] TIPSY data base limits reached at 29.7 cm DBH at 239 years.

Table 3. Large log analysis – S/B target harvest diameter of 25 cm

Spruce / Balsam / Other : Target - 25.0 cm DBHg, 17.5 cm DBH utilization

Row	Species	%inv	SI[2]	Regime	Area	Space frm/to:	Reference			Target					Total		Largest 250		DBH class[1]														5m large
							Cul	Cul	Cul	DBHg	Harv	Harv	MAI	LRF	Vol	Trees	Vol	DBHg	0 - 10 cm		15 - 20 cm				25 - 30 cm				35+ cm				log [3]-
#				spaced	not space		Age	Vol	MAI	-all (0.0+)	Age	Ht. (m)		bf/m3	(17.5c m util)	(0.0+)			# trees	% tot trees	# trees	tot trees	vol	tot vol	# trees	tot trees	vol	tot vol	# trees	tot trees	vol	tot vol	% tot hrvst vol
1	**Sw[4]**		**16**																														
2	comparison					nat5000/unspaced	122	388	3.18	27.5	147	29.9	3.02	256	444	779	278	36.9	21	3	235	30	57	13	350	45	197	44	173	22	200	45	0.0
3					**400**	**plt2300/unspaced**	**108**	**370**	**3.43**	**27.5**	**140**	**29.9**	**3.12**	**242**	**437**	**801**	**263**	**36.5**	**1**	**0**	**245**	**31**	**57**	**13**	**395**	**49**	**211**	**48**	**159**	**20**	**179**	**41**	**2.3**
4				**100**		**plt2300/1545[5]**	**108**	**386**	**3.57**	27.5	**128**	**28.6**	**3.39**	**241**	**434**	**833**	**251**	**36.6**	**4**	**0**	**248**	**30**	**54**	**12**	**417**	**50**	**212**	**49**	**166**	**20**	**176**	**41**	**0.6**
8	comparison					plt2000/900	108	370	3.42	27.5	92	23.3	3.21	234	295	693	188	35.1	10	1	200	29	36	12	343	49	149	51	139	20	116	39	0.0
10	comparison					plt1200/unspaced	108	375	3.47	27.5	114	26.9	3.45	241	394	833	226	36.4	6	1	246	30	49	12	409	49	190	48	173	21	162	41	0.0
11	**Subtot.**	**20**		**100**	**400**																												**2.8**

[1] Actual ranges are 0 - 12.5 cm, 12.6 - 22.5 cm, 22.6 - 32.5, and 32.6 + cm
[2] From Martin, 1999. *ISIS Polygon Area by Site Index Class*
[3] 1st 5 m log assumed to be 25% of tree volume. Volume calculated is a % of total harvest volume based on proportion of annual harvested area under a particular regime, **not** a % of stand volume.
[4] TIPSY does not contain data for Balsam. Sw is the recommended substitute
[5] TIPSY data base limits reached at spacing to 1545 (district regime is to 1600).

Table 4. Large log analysis – Pl target harvest ages 60 & 80

Lodgepole pine: Target - Harvest Age 60 for SI 21 & Age 80 for SI 15, 12.5 cm DBH utilization

Row #	Species	%inv	SI[2]	Regime spaced	Area not space	Space frm/to:	Reference Cul Age	Reference Cul Vol	Reference Cul MAI	DBHg -all (0.0+)	Target Harv Age	Harv Ht. (m)	MAI	LRF bf/m3	Total Vol (12.5cm util)	Total Trees (0.0+)	Largest 250 Vol	Largest 250 DBHg	DBH class[1] 0 - 10 cm # trees	0 - 10 cm % tot trees	15 - 20 cm # trees	15 - 20 cm tot trees	15 - 20 cm vol	15 - 20 cm tot vol	25 - 30 cm # trees	25 - 30 cm tot trees	25 - 30 cm vol	25 - 30 cm tot vol	35+ cm # trees	35+ cm tot trees	35+ cm vol	35+ cm tot vol	5m large log[3] - % tot hrvst vol
1	**Pl**		**21**																															
2	comparison					nat10000/unspaced	91	403	4.43	17.7	60	21.1	4.64	209	279	1656	119	27.0	469	28	897	54	151	54	282	17	121	43	8	0	6	2	0.0
3	comparison					nat5000/unspaced	67	320	4.78	19.4	60	21.1	4.72	211	283	1396	122	28.1	238	17	799	57	129	46	345	25	142	50	14	1	11	4	0.0
4				**200**		**nat5000/1600**	**69**	**334**	**4.84**	**22.3**	60	**21.1**	**4.76**	**217**	**285**	**1064**	**128**	**29.6**	**60**	**6**	**532**	**50**	**89**	**31**	**449**	**42**	**178**	**62**	**25**	**2**	**18**	**6**	**0.2**
5	comparison					nat5000/1400	71	334	4.71	23.3	60	21.1	4.60	219	276	950	133	30.4	45	5	429	45	72	26	433	46	172	62	44	5	31	11	0.0
6	comparison					nat5000/1000	77	343	4.46	25.9	60	21.1	4.27	225	256	722	143	32.2	16	2	221	31	39	15	400	55	159	62	85	12	59	23	0.0
7				**300**		**plt2500/1400**	**63**	**303**	**4.89**	**23.1**	60	**21.7**	**4.89**	**214**	**293**	**1002**	**138**	**30.3**	**38**	**4**	**485**	**48**	**84**	**29**	**433**	**43**	**177**	**60**	**45**	**4**	**33**	**11**	**0.5**
8	comparison					plt2500/900	68	312	4.59	27.0	60	21.7	4.53	225	272	681	153	32.8	8	1	159	23	29	11	416	61	173	64	99	15	70	26	0.0
9					**150**	**plt1600/unspaced**	**66**	**314**	**4.75**	**22.0**	**60**	**21.3**	**4.73**	**207**	**284**	**1126**	**124**	**29.1**	**39**	**3**	**627**	**56**	**100**	**35**	**436**	**39**	**165**	**58**	**24**	**2**	**18**	**6**	**0.1**
10	**Pl**		**15**																															
11	comparison					nat10000/unspaced	101	258	2.55	14.6	80	18.1	2.41	187	192	2191	78	23.9	1013	46	1044	48	146	76	134	6	46	24	0	0	0	0	0.0
12				**100**		**nat5000/1400**	**97**	**245**	**2.53**	**20.7**	**80**	**18.1**	**2.36**	**198**	**189**	**1000**	**89**	**27.4**	**101**	**10**	**560**	**56**	**81**	**43**	**329**	**33**	**103**	**54**	**10**	**1**	**5**	**3**	**0.0**
13	comparison					nat5000/1000	100	234	2.34	23.1	80	18.1	2.15	205	172	738	96	29.0	37	5	317	43	47	27	366	50	115	67	18	2	10	6	0.0
14				**100**		**plt2500/1400**	**93**	**246**	**2.65**	**20.7**	**80**	**18.5**	**2.55**	**193**	**204**	**1049**	**92**	**27.2**	**80**	8	**644**	**61**	**96**	**47**	**316**	**30**	**103**	**50**	**8**	**1**	**5**	**2**	**0.0**
15	comparison					plt2500/900	93	224	2.41	24.4	80	18.5	2.29	205	184	685	103	29.5	15	2	248	36	39	21	398	58	130	71	24	4	14	8	0.0
16					**150**	**plt1600/unspaced**	**95**	**247**	**2.60**	**20.0**	**80**	**18.3**	**2.46**	**184**	**197**	**1145**	**83**	**26.2**	**66**	**6**	**798**	**70**	**111**	**56**	**276**	**24**	**84**	**43**	**5**	**0**	**3**	**2**	**0.0**
17	**Subtot.**	**40**		**700**	**300**																													**0.7**

[1] Actual ranges are 0 - 12.5 cm, 12.6 - 22.5 cm, 22.6 - 32.5, and 32.6 + cm

[2] From Martin, 1999. *ISIS Polygon Area by Site Index Class*

[3] 1st 5 m log assumed to be 25% of tree volume. Volume calculated is a % of total harvest volume based on proportion of annual harvested area under a particular regime, **not** a % of stand volume.

[4] Exceeds TIPSY data: max's out at DBHg =24.6 at age 250

Table 5. Large log analysis – Lw/Fdi target harvest age 100

Larch / Douglas-fir : Target - Harvest Age 100, 17.5 cm DBH utilization

							Reference				Target				Total		Largest 250		DBH class[1]														5m large
Row	Species	%inv	SI[2]	Regime	Area	Space frm/to:	Cul	Cul	Cul	DBHg	Harv	Harv	MAI	LRF	Vol	Trees	Vol	DBHg	0 - 15 cm		20 - 25 cm				30 - 40 cm				45+ cm				log [3]-
#				spaced	not space		Age	Vol	MAI	-all (0.0+)	Age	Ht. (m)		bf/m3	(17.5cm util)	(0.0+)			# trees	% tot trees	# trees	tot trees	vol	tot vol	# trees	tot trees	vol	tot vol	# trees	tot trees	vol	tot vol	% tot hrvst vol
1	**Fd[4]**		**18**																														
2	comparison					nat5000/unspaced	136	374	2.75	18.6	100	25.6	2.56	223	256	1429	170	30.8	851	60	403	28	131	51	174	12	123	48	1	0	1	0	0.0
3					**100**	**nat3000/unspaced**	**135**	**376**	**2.78**	**20.3**	**100**	**25.6**	**2.59**	**217**	**259**	**1154**	**171**	**31.3**	**572**	**50**	**393**	**34**	**126**	**49**	**188**	**16**	**132**	**51**	**1**	**0**	**1**	**0**	**0.0**
4				**50**		**nat3000/1400**	**135**	**374**	**2.77**	22.8	**100**	**25.6**	**2.60**	**222**	**260**	**870**	**177**	**32.1**	**306**	**35**	**351**	**40**	**110**	**42**	**212**	**24**	**147**	**57**	**2**	**0**	**2**	**1**	**0.0**
5	comparison					nat3000/900	138	376	2.72	25.9	100	25.6	2.53	231	253	625	184	33.2	121	19	261	42	84	33	240	38	165	65	4	1	5	2	0.0
6					**100**	**plt2000/unspaced**	**133**	**372**	**2.79**	**20.5**	**100**	**26.0**	**2.64**	**217**	**264**	**1173**	**177**	**31.5**	**587**	**50**	**392**	**33**	**124**	**47**	**192**	**16**	**136**	**52**	**2**	**0**	**3**	**1**	**0.0**
7				**50**		**plt2000/1200**	**132**	**375**	**2.84**	**23.3**	**100**	**26.0**	**2.70**	**225**	**270**	**847**	**187**	**32.7**	**288**	**34**	**329**	**39**	**104**	**39**	**228**	**27**	**161**	**60**	**3**	**0**	**5**	**2**	**0.0**
8	comparison					plt2000/900	132	378	2.87	25.9	100	26.0	2.72	231	272	661	193	33.5	130	20	272	41	87	32	254	38	180	66	4	1	6	2	0.0
8	comparison					plt2000/700	134	374	2.79	28.2	100	26.0	2.62	236	262	523	203	34.6	58	11	198	38	64	24	261	50	189	72	6	1	9	3	0.0
9	comparison					plt1600/unspaced	133	371	2.79	21.4	100	26.0	2.64	221	264	1052	180	31.8	463	44	390	37	120	45	196	19	138	52	4	0	6	2	0.0
10	comparison					plt1200/unspaced	132	373	2.83	23.6	100	26.0	2.69	224	269	826	183	32.5	235	28	372	45	113	42	216	26	151	56	2	0	3	1	0.0
11	**Subtot.**	**20**		**100**	**200**																												**0.0**

[1] Actual ranges are 0 - 17.5 cm, 17.6 - 32.5 cm, 32.6 - 42.5, and 42.6 + cm

[2] From Martin, 1999. *ISIS Polygon Area by Site Index Class*

[3] 1st 5 m log assumed to be 25% of tree volume. Volume calculated is a % of total harvest volume based on proportion of annual harvested area under a particular regime, **not** a % of stand volume.

[4] TIPSY does not contain data for Larch. Fdi is the recommended substitute

Table 6. Large log analysis – S/B target harvest age 100

Spruce / Balsam / Other : Target - Harvest Age 100, 17.5 cm DBH utilization

Row #	Species	%inv	SI[2]	Regime spaced	Area not space	Space frm/to:	Reference Cul Age	Reference Cul Vol	Reference Cul MAI	DBHg -all (0.0+)	Target Harv Age	Harv Ht. (m)	MAI	LRF bf/m3	Total Vol (17.5c m util)	Total Trees (0.0+)	Largest 250 Vol	Largest 250 DBHg	DBH class[1] 0 - 10 cm # trees	0 - 10 cm % tot trees	15 - 20 cm # trees	15 - 20 cm tot trees	15 - 20 cm vol	15 - 20 cm tot vol	25 - 30 cm # trees	25 - 30 cm tot trees	25 - 30 cm vol	25 - 30 cm tot vol	35+ cm # trees	35+ cm tot trees	35+ cm vol	35+ cm tot vol	5m large log[3]- % tot hrvst vol
1	**Sw[4]**		**16**																														
2	comparison					nat5000/unspaced	122	388	3.18	20.8	100	23.5	2.92	220	292	1320	161	31.1	186	14	727	55	127	43	354	27	160	55	54	4	47	16	0.0
3					**400**	**plt2300/unspaced**	**108**	**370**	**3.43**	**22.5**	**100**	**24.7**	**3.38**	**216**	**338**	**1208**	**179**	**32.3**	**64**	**5**	**659**	**55**	**115**	**34**	**408**	**34**	**187**	**55**	**79**	**7**	**70**	**21**	**1.2**
4				**100**		**plt2300/1545[5]**	**108**	**386**	**3.57**	24.3	**100**	**24.7**	**3.53**	**224**	**353**	**1036**	**188**	**33.5**	**29**	**3**	**471**	**45**	**87**	**25**	**434**	**42**	**196**	**56**	**101**	**10**	**91**	**26**	**0.4**
8	comparison					plt2000/900	108	370	3.42	28.6	100	24.7	3.36	239	336	681	216	36.6	7	1	170	25	32	10	327	48	150	45	178	26	159	47	0.0
10	comparison					plt1200/unspaced	108	375	3.47	26.1	100	24.7	3.41	233	341	874	192	34.6	13	1	315	36	59	17	424	49	186	55	122	14	106	31	0.0
11	**Subtot.**	**20**		**100**	**400**																												**1.5**

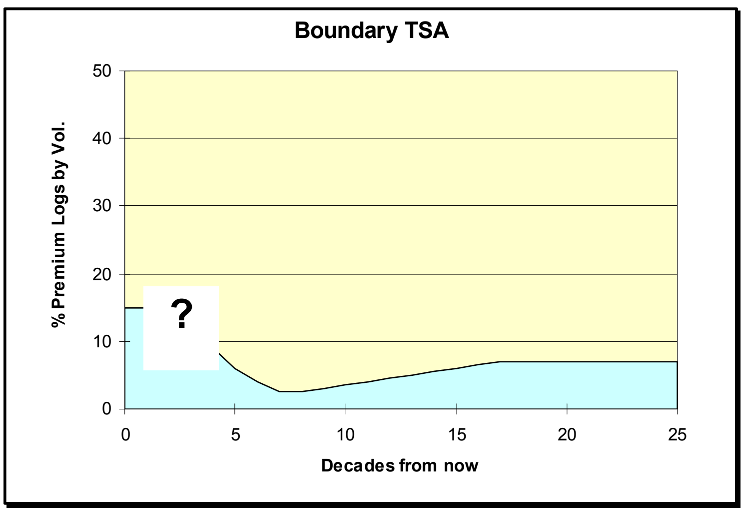
[1] Actual ranges are 0 - 12.5 cm, 12.6 - 22.5 cm, 22.6 - 32.5, and 32.6 + cm
[2] From Martin, 1999. *ISIS Polygon Area by Site Index Class*
[3] 1st 5 m log assumed to be 25% of tree volume. Volume calculated is a % of total harvest volume based on proportion of annual harvested area under a particular regime, **not** a % of stand volume.
[4] TIPSY does not contain data for Balsam. Sw is the recommended substitute
[5] TIPSY data base limits reached at spacing to 1545 (district regime is to 1600).

9.4 Timber Quality Forecast

The foregoing analysis indicates the premium log content of harvests in the mid and long term will be lower than today's levels. In the absence of more precise analysis, it is assumed that premium log content will fall to about 2.5% in the later mid term and recover to about 7% in the long term. Data for the current local percentage of harvest that is in premium logs is not available, but could readily be obtained from local sawmills. In the interim it is assumed to be about 15%, the figure used in the provincial interim strategy document (MoF, 1999).

Postponing harvest to ages that are past culmination age would increase the large dimension component of premium logs.

Figure 14. Potential Quality Forecast, Boundary TSA



This quality forecast is for large-premium logs. Best estimate is that large premium logs will likely form 2.5 - 7% of future harvest volumes.

Clear logs could form about 1% of future harvest volumes (based on 1st lift pruning 100 ha/yr & 2nd lift of 50 ha/yr). Most clear logs will also be large logs. Without pruning there will be no clear logs from the majority of the 2nd growth forests.

10. Incremental Silviculture Strategy

This section synthesizes the preceding background information, workshop discussion and subsequent analysis into a silviculture strategy for the TSA. Basic silviculture as required by the *Forest Practices Code of British Columbia Act* is assumed.

10.1 General Strategy

Because the TSR2 analysis is not yet available it is difficult to identify with any precision both the silvicultural opportunities and their relative importance. In its stead, the workshop participants relied on their own local knowledge of issues and opportunities as well as some expectation of what TSR2 may look like. While the TSR1 forecast suggests the existing harvest level can be maintained for many decades, in contrast forest companies are having difficulty finding available wood for harvest. The first objective of this strategy, therefore, is to undertake silvicultural actions that will enhance short term timber supply, both in terms of amount and availability. Workshop analysis indicates there is a potential for late rotation fertilization of some stands.

It is not possible to predict the shape of mid term timber supply in the absence of TSR2 information. A mid term objective, therefore, is to increase the quantity of the timber to be available for harvesting in this time period. Programs of spacing and fertilization can accomplish this.

In the long term, starting about 90 years from now, workshop analysis indicates silvicultural activities can result in at least 20% higher harvest levels. The baseline to which this is applied, however, must await TSR2 analysis. In the absence of this analysis, a long term objective is to maximize timber production within a context of sound multiple resource stewardship. Workshop analysis indicates that silvicultural activities can contribute significantly to this objective.

Based on a clear log definition of being able to produce 25% clear lumber by volume, 2nd growth managed stands will have no clear logs. A second long term objective is to create a long term timber supply yielding at least 1% clear logs on a total harvest volume basis.

Accomplishing these objectives requires an incremental silviculture program substantially above historic levels. Some changes in basic silviculture activities also present opportunities to contribute to the objectives.

10.2 Log Product Objectives

The following are product objectives at the log level for the Boundary TSA.

Quality Class	Species	Characteristics
Premium Log:	Douglas-fir, spruce Pl Lw	35+ cm DBH, clear 3-5 m log.
	larch, spruce	30+ cm DBH, straight, low taper, building log
	western redcedar	25+ cm DBH, pole
	lodgepole pine	30+ cm DBH; large log
	western white pine	30+ cm DBH, tight knots, premium species.
Sawlog:	Douglas-fir, larch, ponderosa pine, redcedar	30+ cm DBH.
	lodgepole pine, spruce, balsam, hemlock	25+ cm DBH.

10.3 Silviculture Strategies

The following strategies have identified potential to maintain and/or increase the quantity and quality of the timber supply of the Boundary TSA. Strategy numbers correspond with those recorded earlier.

10.3.1 Strategies to Increase the Quantity of Future Timber Supply

Some of the following are not within the traditional scope of incremental silviculture but are included here for completeness. Some practices are pre free-growing and are not likely to be undertaken by licensees without funding assistance if free growing obligations can be achieved without them.

These strategies are supported by specific silvicultural regimes listed on page 62 along with investment priorities.

Number	Strategy	Priority*
	*B - denotes basic silviculture item, the cost of which would be borne by licensees. Most items are current practice.	
Surveys	Conduct approximately 5 400 ha/yr of silviculture surveys in support of all strategies.	

SHORT TERM

Objectives:

- enhance short term timber supply, both in terms of availability and physical extent.

Working Targets:

- Maintain the current harvest level for at least 20 years.

Strategies:

ST1	Late rotation fertilize 530 ha/yr to produce approximately 8 000 m3/yr of additional harvest volume by the 2nd decade.	**5**
ST2	Commercially thin stands where needed to enhance timber availability when adjacency rules might otherwise constrain the harvest.	**As needed**

MID TERM

Objectives:

- Increase the quantity of timber to be available for harvesting.

Working Targets:

- Generate a potential additional 1.5 million m3 to mid-term timber supply.

Strategies:

MT2	Reduce green-up ages by 5 years in the IRM, VQO and Watershed zones, by:	
(a)	for existing stands:	
	(i) fertilizing 1 200 ha/yr of existing Pl/Fdi stands currently 1-2 m high; and	**B-3**
	(ii) spacing 2 000 ha of pre-87 repressed Pl stands that are currently 10-20 years old at the rate of 400 ha/yr (to speed up hydrologic recovery).	**2**
(b)	for about to be regenerated stands:	
	(i) using improved seed on all planted areas (1 440 ha/yr);	**B-1**

Number	Strategy	Priority*
	*B - denotes basic silviculture item, the cost of which would be borne by licensees. Most items are current practice.	
	(iii) using larger (415) planting stock on 300 ha/yr (current practice);	**B-2**
	(viii) Continuing MT2(a)(i) - fertilization 1 200 ha/yr of Pl/Fdi;	**B-3**
	(ix) include rust resistant white pine in plantations (500 ha/yr).	**B-1**
MT3	Set up Pl and Fdi stands (target stands having good access, even terrain and M to G site) for future partial harvesting or commercial thinning, by:	
(a)	spacing 600 ha/yr; and	**3**
(b)	repeat fertilizing 600 ha/yr (subset of LT3 (b)). (Alternatively may be fertilized 10-15 yrs prior to PH/CT and 2-3 yrs after, which would have no implications for current programs.)	**5**

LONG TERM

Objectives:

- Maximize long term timber production within a context of sound multiple resource stewardship.
- Improve the quality of the timber to be harvested.

Working Targets:

- Increase long term timber supply by at least 20%.
- Generate at least 7% of total harvest volume in premium large logs (no current silviculture strategy implications).
- Generate at least 1% of total harvest volume in clear premium logs (clear logs will generally also be large logs).

Strategies:

LT1	Maintain the timber harvesting land base by:	
(a)	Planting approximately 300 ha of backlog NSR.	**1**
(b)	Maintaining approximately 900 ha of previously reforested backlog plantations.	**2**
LT3	Increase the volume of regenerated stands by 20% over those used at the base case by, in addition to those practices in MT 2:	
(b)	Repeat fertilizing 1 200 ha/yr (as per strategies MT2(a) and MT3 (b)), rising gradually over about 60 years to 6 700 ha/yr as more stands come under management, for an expected result of a 6% gain in LTHL.	**5**

Number		Strategy	Priority*
		*B - denotes basic silviculture item, the cost of which would be borne by licensees. Most items are current practice.	
LT4		Reduce losses to root rot by:	
	(a)	pushover logging/stumping 400 ha/yr on slopes < 30% (basic silviculture; being phased out in favour of small-diameter spacing);	**B-4**
	(b)	planting Lw, Pw and Py on 1 440 ha/yr (basic silviculture);	**B-2**
	(c)	pop-up spacing 10 ha/yr; and	**6**
	(e)	small diameter spacing 800 ha/yr (basic silviculture; being phased in as an alternative to stumping).	**B-4**
Q1		Space 500 ha/yr of existing (and future) stands with 5-7 000 sph down to levels in accordance with the district stand level strategy to increase average stand diameters.	**3**
Q2		First-lift prune 100 ha/yr and 2nd lift prune 50 ha/yr for a total pruning program of 150 ha/yr (target stands spaced to 800 sph and under repeat fertilization regime).	**4**

10.3.2 Working Target Illustration

A graphical representation of the potential harvest forecast is not available, pending TSR2 analysis results.

10.3.3 Strategies to Increase the Quantity *or* Quality *of Future Habitat Supply*

The following strategy has identified potential to increase the quality or quantity of the habitat supply of the Boundary TSA.

No.	Strategy	Priority
	No specific strategies proposed at this time. See “Silviculture Regimes and Investment Priorities,” page 62 for implications of specific silvicultural activities for habitat.	

11. Silviculture Regimes and Investment Priorities

The following table indicates silviculture regimes which are suitable to attaining the above working targets and strategies.

Regimes	Strategy	Opportunity Area (Ha/Yr)	Timber Supply Effects Short	Medium	Long	Quality	Habitat	Jobs Days/ha	Cost $/ha[1]	Workshop Rank
Survey										
1 Surveys		5,400						0.1	20	1
Backlog										
2 NSR	L1 (a)	100		+	+			0.8	550	1
3 Brushing	L1 (b)	400			+		+/-	3.5	600	2
Pre FG										
4 improved seed	M2(b)(i)	1440		+				0	80 - B	B-1
5 larger planting stock	M2(b)(ii)	300		+				0.5	153 - B	B-2
6 fertilize existing regen (accelerate greenup)[1]	M2(a-i)(b-viii)	1200	+	+				0.1	300	B-3
7 plant Pw	M2(b)(ix)	500		+	+	+		0	B	B-1
8 space repressed Pl[2]	M2(a)(ii)	400		+	+	+	+	3.5	550	2
9 push-over /stumping	L4(a)	400			+		-	1	B	B-4
10 plant alternative species(larch, Py, Pw, Ep)	L4(b)	1440			+		+	0	B	B-2
11 small diameter spacing[2]	L4(e)	800		+	+			3.5	550	B-4
12 pop-up spacing[2]	L4(c)	10		+	+			3.5	550	6
Post FG										
13 spacing stands for future PH/CT[2]	M3 (a)	600		+	+	+	+	3.5	550	3
14 spacing stands for quality[2]	Q1	500		+	+	+	+	3.5	550	3
15 Fertilize late rotation[1]	S1	530	+				+	0.1	300	5
16 Fertilize (spaced (#13), planned for PH/CT)[1]	M3 (b)	600		+	+/-		+			5
17 Prune (100 ha 1st lift, 50 ha 2nd lift)	Q2	150			-	+	+	6	965	4

Notes:
[1] Total immediate fert = 2 330 ha/yr. Fert program could ultimately expand to a max. level of about 6700 ha/yr in about 60 years (see LT 3(b)).
[2] Total spacing = 2 310 ha/yr, 800 of which is basic spacing for root rot control purposes. Total spacing will diminish over time as the spacing of existing Pl subject to repression is completed, and the basic spacing (800 ha - small diameter) ultimately reduces the area requiring later stocking control.
B - denotes basic silviculture item, the cost of which would be borne by licensees. Most items are current practice.

12. Incremental Silviculture Program

The following annualized program will contribute to achieving the above goals and strategies. This program is considerably above historic levels and some activities may require phasing in. Spacing and fertilization goals are totals of several strategies. Lesser program levels should be oriented to specific target stands in accordance with the ranking shown in the regime table.

Incremental Silviculture Program Table - Ha, Boundary TSA July 21-22, 1999

		Backlog			Space**	Prune	Fertilize	
Year	Surveys*	Establish	Maintain	Space Repressed				Total
1	5,400	100	400	400	1,110	150	2,330	9,890
2	5,400	100	300	400	1,110	150	2,330	9,790
3	5,400	100	200	400	1,110	150	2,330	9,690
4	5,400		200	400	1,110	150	2,330	9,590
5	5,400		100	400	1,110	150	2,330	9,490
Subtot Yr 1 - 5	27,000	300	1,200	2,000	5,550	750	11,650	48,450
6 - 10	27,000	-	150	-	5,550	750	11,650	45,100
Total Yr 1 - 10	54,000	300	1,350	2,000	11,100	1,500	23,300	93,550

* Includes prescription and layout

** Does not include 800 ha/yr of small-diameter basic spacing for root rot control purposes.

Unit cost ($/ha)	20	550	600	550	550	965	300	

Program Table - $ 000s, Boundary TSA July 21-22, 1999

		Backlog			Space**	Prune	Fertilize	
Year	Surveys*	Establish	Maintain	Space Repressed		-	-	Total
1	108	55	240	220	611	145	699	2,077
2	108	55	180	220	611	145	699	2,017
3	108	55	120	220	611	145	699	1,957
4	108	-	120	220	611	145	699	1,902
5	108	-	60	220	611	145	699	1,842
Subtot Yr 1 - 5	540	165	720	1,100	3,053	724	3,495	9,796
6 - 10	540	-	90	-	3,053	724	3,495	7,901
Total Yr 1 - 10	1,080	165	810	1,100	6,105	1,448	6,990	17,698

* Includes prescription and layout

** Does not include 800 ha/yr of small-diameter basic spacing for root rot control purposes.

13. Job Outcomes

The following are the anticipated job outcomes associated with the preceding program, assuming the program is maintained into the future as necessary to achieve the working targets.

Program Job Outcomes, Boundary TSA July 21-22, 1999

Short term *employment associated with undertaking the silviculture activity, in person years*

		Backlog			Space**	Prune	Fertilize	
Year	Surveys*	Establish	Maintain	Space Repressed	-	-	-	Total
1	2.7	0.4	7.0	7.0	19.4	4.5	1.2	42.2
2	2.7	0.4	5.3	7.0	19.4	4.5	1.2	40.4
3	2.7	0.4	3.5	7.0	19.4	4.5	1.2	38.7
4	2.7	-	3.5	7.0	19.4	4.5	1.2	38.3
5	2.7	-	1.8	7.0	19.4	4.5	1.2	36.5
Subtot Yr 1 - 5	13.5	1.2	21.0	35.0	97.1	22.5	5.8	196.2
6 - 10	13.5	-	2.6	-	97.1	22.5	5.8	141.6
Total Yr 1 - 10	27.0	1.2	23.6	35.0	194.3	45.0	11.7	337.7

Note: Assumes 200 days of harvesting, silviculture work, and timber processing = 1 job

** Does not include 800 ha/yr of small-diameter basic spacing for root rot control purposes.

14. Summary of Information and Research Needs

During the assessment process, the following needs for further information and research became apparent. The outcome of these have implications for an incremental silviculture strategy. Bracketed numbers refer to the strategy numbers under which the need is identified (see tables in "Workshop Review of Potential Strategies," page 29.

1. Compare the actual post-harvesting stands in older partially harvested areas with inventory labels to (a) ensure the label correctly reflects the stocking of residual stands; and (b) determine how the residual stands are performing and if there is a need for silvicultural actions. (ST2 (a))
2. Better growth and yield information is needed for commercially thinned stands. The role of commercial thinning in enhancing timber availability when harvesting would otherwise be constrained should be investigated in the Type II strategy analysis. (ST2 (b))
3. Trials are needed to determine the effects on time until green-up of fertilizing stands 1-2 m tall. Trials should also investigate the fertilizer impact on the other vegetation in the stand and whether density control is needed prior to fertilization at early ages. (MT2 (a))
4. Pw management opportunities and harvest forecast implications need further investigation. (MT2 (b) (ix))
5. Following release of TSR2 analysis report, review the TSA sensitivity to a reduction in the age requirement for older forests. If the TSA is sensitive to this, revisit potential strategy MT4. (MT4)
6. Following release of TSR2 analysis report, review the extent of excluded deciduous areas to determine their potential and suitable silviculture treatments, if any. (LT2 (a))
7. OAF 1 factor of 15% requires confirmation. Survey techniques are available. Requires statistical validity at the management unit level if to be used for AAC determination. (LT3 (a))
8. Further study of root rot management techniques and resultant OAF2 impact is needed. (LT4 - Summary)

15. References

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16. Abbreviations

The following abbreviations may be used.

AAC	allowable annual cut
CF	chief forester
CT	commercial thinning
DBH	diameter at breast height
ESSF	engelmann spruce - subalpine fir (ecological zone)
FCC	forest cover constraints
FG	free growing
FRBC	Forest Renewal BC
ICH	interior cedar-hemlock (ecological zone)
IHL	initial harvest level
IRM	integrated resource management
KBLUP	Kootenay-Boundary Land Use Plan
LT	long term
LTHL	long term harvest level
LRSY	long run sustained yield
MoELP	Ministry of Environment, Lands and Parks
MoF	Ministry of Forests
MS	montane spruce (ecological zone)
MT	mid term
NCBr	non-commercial brush
NSR	not satisfactorily restocked
OAF	operational adjustment factor
OLB	operable land base
SBFEP	small business forest enterprise program
SI	site index
ST	short term
TFL	tree farm licence
THLB	timber harvesting land base
TIPSY	table interpolation program for stand yields
TSA	timber supply area
TSR	timber supply review
VDYP	variable density yield projection
VQO	visual quality objective
WT	working target

Species abbreviations: B or Ba - balsam fir; Cw - western redcedar; Fd - Douglas-fir; Fdi - interior Douglas-fir; Hw - western hemlock; Pl - lodgepole pine; S - spruce species.

Site class abbreviations: G - good; M - medium; P - poor; L - low.