

Kootenay Lake Timber Supply Area

Interim Silviculture Strategy

-- Version 1.1 --

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British Columbia
Ministry of Forests

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STRATEGY AT A GLANCE

General Strategy

Better resource information and accelerated tree improvement offer the two greatest possibilities for increasing future harvest levels in the Kootenay Lake TSA. The first may result in an increased land base, while the second will shorten green-up periods as well as increase regenerated stand volumes.

Elimination of the NSR backlog was assumed in the TSR1 base case and its accomplishment is necessary to maintain that forecast and the AAC on which it was founded.

Spacing will improve the future quality of the timber resource and should also be used to set up stands for future commercial thinning. Commercial thinning may offer opportunities to restructure the harvest queue, thereby assisting in overcoming adjacency limitations and increasing the harvest level during the critical time period 3-5 decades from now. Further analysis is required to confirm the CT potential as well as determine target stands.

Reducing losses to root rot is being addressed through silviculture prescriptions and actions required under the Forest Practices Code. Incremental silviculture activities can supplement this to bring losses to reasonable levels.

Working Targets

Quantity: Manage long term timber supply to yield harvest levels of 650 million m³/yr.

Quality: Manage regenerated stands to yield at least 10% premium logs by volume, with the majority of the remainder being of sawlog quality.

Product Objectives

<u>Quality Class</u>	<u>Species</u>	<u>Characteristics</u>
Premium Log:	Douglas-fir, lodgepole pine, larch	suitable for achieving machine stress rated (MSR) lumber grading - grown in higher density stands (slower growth rate less of an issue than density)
	Douglas-fir, spruce peelers..	clear or few tight knots.
	white pine, clear.....	17.5+ cm min diameter at breast ht (DBH), manually or naturally pruned, min 5.2 m log.
	cedar, tight knot or clear	30+ cm min DBH, naturally pruned.
	white pine, large timber.....	40+ cm min DBH, unpruned.
	lodgepole pine, large timber.	30+ cm min DBH, 15 m min length, 20 cm + top.
	spruce, large timber	45+ cm min DBH.
Sawlog:	Minimum average stand DBH of 17.5 cm and min. stand vol. of 150 m ³ /ha.	

Major Silvicultural Strategies

Quantity

(Some of the following are not within the traditional scope of incremental silviculture but are included here for completeness.)

1. Overcome forest cover constraints by reducing time to green-up through the use of large improved stock, and implementing a regime of spacing 200 ha/yr and fertilizing 60 ha/yr of spaced stands (both commencing immediately) and commercial thinning (commencing in about 30 years) in all zones, particularly in the visual quality zone.

Further analysis is required to refine the spacing/commercial thinning strategy and locate target stands.

2. (a) Rehabilitate all remaining treatable backlog NSR - 1 800 ha; and
(b) maintain 5 000 ha of existing backlog plantations.
3. Increase the timber harvesting land base by:
(b) converting /rehabilitating 5 000 ha of deciduous stands;
(d) inventorying low site stands to determine if correctly classified and to enable development of silvicultural strategies to improve the productivity of some stands.
4. Reduce losses to root rot through pop-up spacing 100 ha/yr (other solutions lie within the basic silviculture domain).
5. Increase the volume of regenerated stands 15% by:
(a) using genetically improved stock;
(e) brushing for growth enhancement
(l) 2nd lift pruning 100ha/yr of white pine to reduce blister rust losses.

Quality

1. Space 500 ha/yr to obtain large dimension timber and prepare stands for fertilization.

Incremental Silviculture Program (ha)

Year	Surveys	Backlog Planting	Backlog Brushing	Conversion	Space	Fertilize	Prune
1	18,360	360	1,000	100	800	160	100
2	18,360	360	1,000	100	800	160	100
3	18,360	360	1,000	100	800	160	100
4	18,360	360	1,000	100	800	160	100
5	18,360	360	1,000	100	800	160	100
Subtot Yr 1 - 5	91,800	1,800	5,000	500	4,000	800	500
6 - 10	91,800	-	3,750	500	4,000	800	500
Total Yr 1 - 10	183,600	1,800	8,750	1,000	8,000	1,600	1,000

* Includes prescription and layout

Introduction

About the Interim Strategy

Incremental silviculture is part of a suite of strategies which together may influence the future quality and quantity of habitat and timber supply. This strategy document broadly analyzes the full potential range of silviculture activities in order to create a context for an incremental silviculture strategy.

An incremental silviculture 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. 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.

Methodology

This strategy was prepared through the following process:

1. Prior to the district working session, L. P. Atherton & Associates prepared a preliminary draft of this document, summarizing all available information relevant to a strategy and identifying opportunities to improve the future quantity and quality of timber supply.
2. A district workshop was held November 23 & 24, 1998 in Nelson, attended by representatives of the MoF and forest licensees of the Kootenay Lake Timber Supply Area (TSA). Because the session was also a demonstration of the methodology, licensee representatives from outside the TSA also attended. Larry Atherton of L. P. Atherton & Associates and Doug Williams of Cortex Consultants Inc. led the session. Participants reviewed the potential opportunities identified in the draft document 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 of Forests' (MoF) review, the consultants submitted a completed strategy document to the MoF in electronic format as version 1.0. (The ministry will assign higher version numbers (e.g., 1.1, 1.2, etc.) as the strategy evolves and changes are made.)

Acknowledgments

The participation of representatives of the following organizations at the district working session is gratefully acknowledged.

Ministry of Forests:

- Kootenay Lake Forest District;
- Nelson Forest Region.
- Forest Practices Branch, Victoria

Forest licensees of the Kootenay Lake TSA:

- Pope & Talbot
- Crestbrook Forest Industries
- Wynndel Box
- Slocan Forest Products
- Kalesnikoff Lumber

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, Victoria (administered by Ralph Winter, Forest Practices Branch) and Cortex Consultants, Inc.

¹ See “
Abbreviations,” page 46 for a full listing of abbreviations used.

Basic Data

Land Area

Description	Area (ha)	Area %
Total Area of TSA	1 018 400	100
Total Productive Crown Forest	502 500	49
Net Timber Harv. Land Base	233 800	23

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

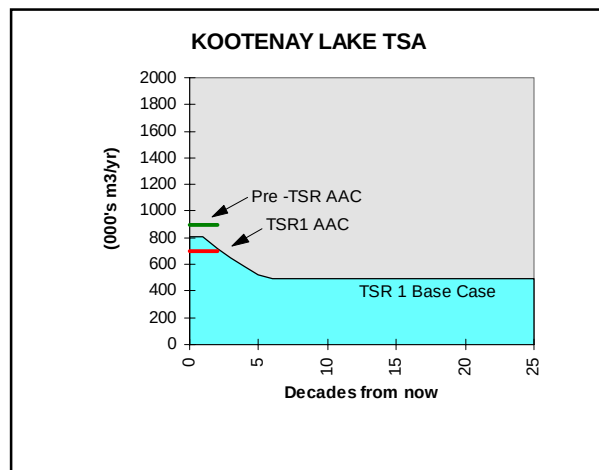
AAC

AAC Type	Pre-TSR	TSR1*	Change (%)
Conventional	900 000	700 000	-22.2
Deciduous	-	-	-
Insect/Disease	-	-	-
Marginal	-	-	-
Total	900 000	700 000	-22.2

Woodlot AAC

*effective June 1/95

Harvest Forecast



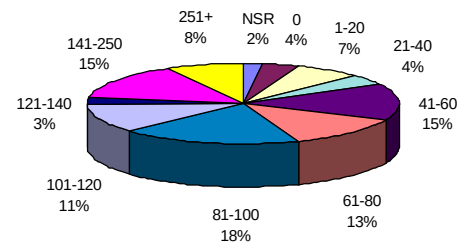
Site Class

Kootenay Lake TSA

DATA NOT AVAILABLE

Age Class

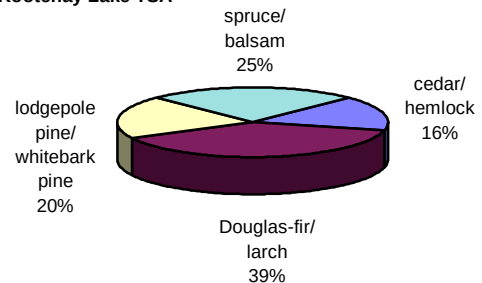
Kootenay Lake TSA



Data scaled from chart in TS analysis report.

Tree Species

Kootenay Lake TSA



Data from chart in TS analysis report.

Issues

Individual Issue Analysis

The following information is primarily from documentation produced under the first timber supply review, or TSR1. Sources are noted, with full references given on page 46. Only information which is relevant to an incremental silviculture strategy is recorded. Key statements are bolded.

Issue	Description	Discussion	Silvicultural Opportunities	
			Increase Over Base Case	Maintain Base Case
♦ Harvest Forecast	<p>The starting harvest level of 803 000 m³/yr (11% below the pre-TSR allowable annual cut (AAC) of 900 000 m³/yr) can be maintained for 2 decades. This is followed immediately by 5 successive declines of 10%/decade to a long term harvest level of 490 000 m³/yr (46% below the pre TSR AAC, 40% below the initial harvest level (IHL)) reached at the start of decade 7 (i.e., 60 years from now). (analysis, 13-14)</p> <p>The first regenerated stands become available for harvest after 10 decades, but the available area is limited. Beginning in decade 14, more second-growth stands become mature and the amount of available timber increases. (analysis, 13).</p> <p>Forest cover guidelines cause most of the timber to be harvested well beyond minimum harvest age. Overall, growing stock decreases only 29% over a 400 year horizon. (analysis, 13)</p> <p>The 3rd and 4th decades are the most difficult for timber supply. In decades 2 - 6, one or both of the green-up or old growth forest cover guidelines are at their limit in all zones. (analysis, 13) In decade 3, constraints on harvesting older forests cause harvesting to shift into younger, lower vol/ha stands. Consequently, the area harvested by the model increases sharply in this decade. After the 3rd decade, the area harvested/yr declines mainly due to the decrease in harvest levels projected for decades 4 to 8. As harvesting shifts more into regenerated stands after decade 8, avg area harvested again rises due to the lower average volumes of these stands. (analysis, 17)</p> <p>Average harvest age falls steeply over the first 3 decades, thereafter stabilizing in the 150-200 year range (analysis, 18).</p>	<p>Variable density yield projection system (VDYP) yields were used for regenerated stands. Thus regen stand volumes are underestimated by 15%-35% (presence of root rot makes estimates difficult). Min harvest ages may be considerably younger than used in the analysis but this may not matter because forest cover constraints (FCC's) limit harvest to well beyond min ages. At these older ages, volumes of managed stands may be considerably higher than unmanaged stands.</p>	<p>Decade 3 appears pivotal and may be governed by min ages. What would happen if min ages about this time were reduced? Is there anything silviculturally that could be done to assist this time period?</p>	

Issue	Description	Discussion	Silvicultural Opportunities	
			Increase Over Base Case	Maintain Base Case
♦ Age Class	<p>Theoretical long term harvest level (LTHL), after allowing for fire and other losses is about 612 000 m3/yr, 25% above the forecast LTHL. (analysis, 14)</p> <p>Only 23 % of stands are older than 140 years. 46% are between 70 and 140 years of age, the range of minimum harvestable ages. A large amount of timber is, or soon will be, available for harvest. However, after this inventory is drawn down over the next 50 years, the forest cover guidelines cause a significant amount of old growth to build up over time. (analysis, 15)</p> <p>Over the planning horizon, a significant amount of area remains over 140 years of age at all times, because the forest cover guidelines extend the age at which stands are harvested. (analysis, 15)</p>		<p>The large amount of area between 7-140 yrs of age causes problems for FCC's. Candidates for commercial thinning (CT)?</p>	
♦ Silvicultural Systems	<p>About 75% of annual area harvested is under a clearcut silvicultural system (paper, 6), with the other 25% partially harvested (rationale, 26). Analysis incorporates regen delays of 5 - 8 yrs to incorporate the effects of brush competition. Chief forester (CF) acknowledges some delays are over-estimated (rationale, 19) and considers the effect of this on green-up delays in the AAC determination (rationale, 46).</p>			
♦ Backlog NSR	<p>All backlog NSR (6 133 ha), with the exception of 820 ha which cannot be treated without the use of herbicides, will be treated by the year 2000 (net 5 313 ha) (rationale, 19-20). Analysis assumed will be restocked within 20 years (analysis, 54). (NB: preceding info is TSR1 estimate. For more recent estimates, see "Incremental Silviculture History," page 17.</p>			<p>Failure to rehabilitate would result in a lower base case forecast.</p>
♦ Land Base	<p>53 569 ha (equiv to 18% of THLB) deducted as:</p> <ul style="list-style-type: none"> low quality sites (32 471 ha - equiv to 11% of THLB); deciduous (11 547 ha - equiv to 4% of THLB); non-commercial cover (4 593 ha - equiv to 1.5% of THLB); and low volume stands (4 958 ha - equiv to 1.5% of THLB). <p>No land base sensitivity test reported in the analysis. CF reports a 10% decrease in THLB would result in a 5-10% lower IHL depending upon which harvest forecast is considered (rationale, 18).</p>	<p>Analysis in other TSA's generally show a 1% corresponding increase or decrease in LTHL for every 1% increase or decrease in THLB. Short term response to a THLB increase depends on amount of timber that can be recovered during rehab/conversion. In this TSA, could be a measurable</p>	<p>Rehabilitate/convert deciduous (often in riparian areas) and/or non-merch types?</p> <p>Fertilize low productivity stands?</p> <p>Does old growth site index (OGSI) have impact on low-site cut-off? What about use of</p>	

Issue	Description	Discussion	Silvicultural Opportunities	
			Increase Over Base Case	Maintain Base Case
♦ Forest Cover	<p><i>Wildlife zones</i> (% of THLB) allow a max of 33% of the area < 20 yrs of age and require a minimum of between 30-60% of stands must be greater than 46 yrs of age, except for the early winter zone which requires 50% to be greater than 120 years of age.</p> <p>In the visual quality objective (VQO) <i>zones</i> (27% of THLB - rationale, 25), the modification, partial retention and retention VQO's allow 25%, 16% and 5% respectively to be < 30 yrs of age and require 10% to be > 140 yrs of age.</p> <p>In the <i>Watershed zones</i> (45% of THLB) a maximum of between 25-33% may be < 31 yrs of age (except for class 6 watersheds for which a maximum of 33% may be < 20 yrs), while a minimum of 10% of the area must be > 140 yrs of age. (analysis, 45)</p>	<p>short term response as all categories except non-commercial cover (NCC) have timber on them.</p> <p>It is becoming increasingly difficult to find suitable and available timber to meet planning requirements. Both the small business forest enterprise program (SBFEP) and major licensees are expected to fall short of cut control requirements by approx. 15% at the end of the current cut control period (1996).</p>	<p>Table Interpolation Program for Stand Yields (TIPSY) yields vs VDYP?</p> <p>Role for CT?</p> <p>Harvesting timber using partial harvesting or CT methods has the effect of “relaxing” the constraint. (mid term (MT), long term (LT))</p>	
	<p><i>Sensitivity to Changes in Green-up Area and Old-Growth Area - all zones</i></p> <p>All zones: Sensitivity tests of ± 5% of area allowed to be not greened up and ± 5% of old forest requirement. (analysis, 27-29)</p> <p><u>Relax Constraint:</u> (for all zones, allow 5% more area to be not greened-up and require 5% less area to be in older forests) Very sensitive. Harvest levels increase 11% over the base case during the first 6 decades. LTHL 6% higher than base case.</p> <p><u>Increase Constraint:</u> (for all zones, allow 5% less area to be not greened-up and require 5% more area to be in older forests) Very sensitive. IHL 19% below base case, after which harvest levels are 26% lower until the LTHL is reached after 40 years. LTHL 9% below base case. The base case pushed the harvest to the limits of most constraints, so when FCC's are more restrictive a significant change results. The lower starting level was controlled by the availability of timber in the 3rd decade.</p>			<p>The short term (ST) harvest level is at serious risk should there be a substantial increase in FCC's. Accelerating growth of young existing stands to achieve earlier green-up would serve to reduce this risk. (ST)</p>

Issue	Description	Discussion	Silvicultural Opportunities	
			Increase Over Base Case	Maintain Base Case
Draft	<p><i>Sensitivity to Increasing to 4 or 5 Pass Systems - All Wildlife Zones & 3 of 4 Watershed Zones</i></p> <p>Sensitivity test of increasing constraints from allowing a max of 33% to be not greened-up (3 pass system) to allowing either 25% (4 pass) or 20% (5 pass).</p> <p><u>Increase Constraint to 4 pass:</u> IHL 5% below base case and 2nd decade 14% below. LTHL same as base case but reached 1 decade earlier.</p> <p><u>Increase Constraint to 5 pass:</u> Very sensitive. IHL 19% below base case and 23-27% below thereafter until same LTHL reached 2 decades earlier.</p> <p><i>Sensitivity to Relaxing Forest Cover Guidelines to Basic Levels</i></p> <p>Sensitivity test of relaxing all forest cover guidelines in all zones so that no more than 33% of the area can be < 20 years old (does not change wildlife zone constraint which is already at this level) and at least 10% of the area must be > 140 years old (changes wildlife zone but not others).</p> <p>Increases harvest levels 11% over the base case over the 1st 6 decades. LTHL 6% higher. This is similar to other sensitivity test results. Forest cover guidelines are relaxed to the point where they are no longer the most binding constraint. The desire for a reasonable rate of decline to the LTHL and for a harvest level that does not fall below the long term level controls the results of this analysis.</p> <p><i>Sensitivity to Changes in Green-up and Old-growth Ages</i></p> <p><i>Green-up:</i> Green-up ages are 20 yrs for all wildlife zones and watershed class 6 zones (ht equivalent is unspecified - 2m? ht) and 30 to 31 yrs for all VQO zones and watershed classes 1-5 zones (6m ht?) (analysis, 45).</p> <p>Sensitivity test of ± 5 years in both green-up and old growth ages, all zones. (analysis, 26)</p> <p><u>Relaxation of Constraint:</u> (- 5 yrs in both green-up ages and old-growth ages) IHL 11% above base case. Only 1% above base case thereafter, including LTHL.</p> <p><u>Increase Constraint:</u> (+ 5 yrs in both green-up ages and old-growth ages) Moderately sensitive - initial harvest level 2% below base case. 11% below base case thereafter until LTHL is reached, which is 4% below.</p>			
		Relaxation only affects 1 st decade, where harvests rise 11%. Unclear whether effect is a result of changes to g-up ages or old growth ages or both.		Ages used are not likely under-estimated. Not a concern.
		CF convinced g-up periods have been over-estimated by 1-2 yrs due to overestimate of regen delay but not convinced an 11% increase in IHL can be realized		

Issue	Description	Discussion	Silvicultural Opportunities	
			Increase Over Base Case	Maintain Base Case
♦ Bio-diversity	<p>Sensitivity test of ± 10 years in both green-up and old growth ages, all zones. (analysis, 27-28)</p> <p><u>Relaxation of Constraint:</u> (- 10 yrs in both green-up ages and old-growth ages) Harvest levels 11% above base case for first 6 decades (exact same result as for relaxing all forest cover area restrictions by 5%). LTHL 5% higher.</p> <p><u>Increase Constraint:</u> (+ 10 yrs in both green-up ages and old-growth ages) Very sensitive - initial harvest level 14% below base case. Between 23% & 18% below base case thereafter until LTHL is reached, which is 7% below.</p>	<p>(rationale, 46)</p> <p>When all cover ages are decreased 10 years total growing stock remains almost constant and after about 70 years remains at roughly 17% above base case growing stock levels (analysis, 27-28).</p> <p>The change in green-up ages also results in green-up area becoming more binding in decade 4. (analysis, 27) [Are harvest levels drawn down more in decades 2 & 3 to be able to get past decade 4?]</p>		
	<p><i>Removal of Old-growth Cover Constraint in Watershed and VQ zones</i></p> <p>Base case requires at least 10% of stands in these zones must be >140 yrs of age at all times. Sensitivity test of complete removal of this requirement. Older forest requirements for wildlife were not removed. Very sensitive in 1st decade - IHL is 14% above base case. After this, harvest levels are 5% higher, including the LTHL. (analysis, 30-31)</p>	<p>See “Age Class” above, “Biodiversity contribution from areas outside the THLB” below.</p>		<p>Use CT to create old-seral stand structures at earlier ages? Not likely effective by 2nd decade.</p>

Issue	Description	Discussion	Silvicultural Opportunities	
			Increase Over Base Case	Maintain Base Case
♦ Min. Harvest Ages	<p>Minimum ages determined by a committee and do not necessarily reflect biological culmination ages. (analysis, 56) They represent an approximate minimum volume of 150 m3/ha (analysis, 19). Ages are assigned by analysis unit (61 units) and range from 72-126 years. (analysis, 57)</p> <p>Sensitivity test of ± 20 years. Not sensitive to increase or decrease in the long term. (analysis, 21)</p> <p><u>Decrease:</u> (- 20 yrs) Only sensitive in the first decade, which is 9% above the base case. This is because reducing the minimum age makes more timber available in the short term when the availability of mature timber is particularly critical. Beyond this decade, forest cover constraints limit the amount of area that can be harvested. The 9% increase cannot be achieved, however, were the cutblock adjacency rules tightened to a 4 pass system.</p> <p><u>Increase:</u> (+20 yrs) Very sensitive. There is 7% less timber available in each of the 1st 5 decades. LTHL unchanged.</p>	<p>[Check modeling methodology: are ages shifted but vol's held constant; or are both shifted?]</p> <p>Base case use of VDYP presumes no stocking control [check].</p> <p>Raising the min ages reduces the initial available growing stock by 20%. The long term average age is beyond the min ages, resulting in no long term harvest level effect even when min ages are increased 20 years. (analysis, 21)</p> <p>If the forest industry is not capable of using the younger timber that must be harvested during the first few decades of this forecast and the base case, there could be a shortfall of available timber in the 3rd or 4th decade. (analysis, 21)</p>	<p>There are many references to the timber supply in the 3rd and 4th decades being limiting and dependent upon younger ages (approx 140 yrs old at that time or 110 yrs old now). These stands may be candidates for partial harvesting and fertilization. However, opportunities may be limited because of root rot and fertilization limited because of watershed limitations. (MT)</p>	<p>If younger stands in the 3rd and 4th decade do not prove merchantable at that time, the base case may not be attained. (MT)</p>
♦ Timber Volume Estimates	<p>VDYP used for both existing and regenerated stands. (analysis, 22)</p> <p><i>Existing stand volumes:</i></p> <p>Sensitivity test for $\pm 10\%$ in volume. Short term highly sensitive. Long term insensitive to either increase or decrease. (analysis, 22)</p> <p><u>Increase:</u> (+10%) IHL 13% above base case. Remains 3% above base case until decade 7 when LTHL reached. LTHL unchanged.</p>	<p>Very sensitive.</p> <p>A recently completed inventory audit indicates no statistical difference between the audit and inventory volume estimates. The mean audit volume was 5 m3/ha > the mean inventory volume.</p>	<p>There is little silviculture opportunity to raise existing stand vol's in the 1st decade.</p>	<p>Increasing vol's of existing stands would prevent substantial short and mid term reductions if volumes prove over-estimated.</p>

Issue	Description	Discussion	Silvicultural Opportunities	
			Increase Over Base Case	Maintain Base Case
♦ Site Productivity	<p><u>Decrease:</u> (-10%) Highly sensitive. IHL must be decrease by 26% from the base case; 2nd decade is 33% below the base case. The lower volume/ha causes more area to be harvested and thus the forest cover guideline limits are encountered sooner. This magnifies the timber supply problem in the 3rd and 4th decades and results in a shortfall in several of the later decades. LTHL reached in 3rd decade, 4 decades sooner than base case.</p>			However, the most recent information is that volume estimates are accurate.
	<p><i>Regenerated stand volumes:</i> VDYP yields used.</p> <p>Sensitivity tests for $\pm 10\%$ in volume. Short term insensitive to either. Unbalanced sensitivity to both in the long term. (analysis, 22-23)</p> <p><u>Increase:</u> (+10%) Short and mid term insensitive. LTHL 7% higher than base case, starting at the beginning of decade 11. Creates a mid term shortfall during decades 7-10.</p> <p><u>Decrease:</u> (-10%) LTHL 14% below base case. Lower volume/ha means more ha's must be harvested. Forest cover guidelines become more limiting than they are for the base case.</p>	<p>TIPSY yields can be expected to be in the order of 35% higher than VDYP yields at culmination ages. Root rot may reduce these yields by 10-20%, still leaving a 15-25% higher yield.</p>	<p>Possibilities to increase regen vol's: (LT)</p> <ul style="list-style-type: none"> • Improved seed. • Larger planting stock. • Reduced first operational adjustment factor (OAF). • Fertilization at planting. • Brushing for growth. • Repeat fertilization. • Commercial thin. • Management for root rot to limit losses to 5%. 	(LT)
	<p>Armillaria infects an estimated 70% of the land base.</p> <p>CF expects that even if site index of older stands is under-estimated, there would be a small impact overall because only 23% of the THLB is occupied by stands older than 140 yrs. (rationale, 10)</p>			

Illustration of Issues and Silvicultural Opportunities

TSA modelling in support of planning incremental silviculture has not yet been undertaken. In its absence, sensitivity analyses from the TSR analysis report are the best source of information as to the opportunities for incremental silviculture to maintain or increase future timber supply. These opportunities are identified in the “Issues” section, which starts on page 5. The following are selected sensitivity analysis charts from the TSR2 analysis report, to which opportunity information is added to illustrate the opportunities. Detailed analyses are required to confirm the indicated effects.

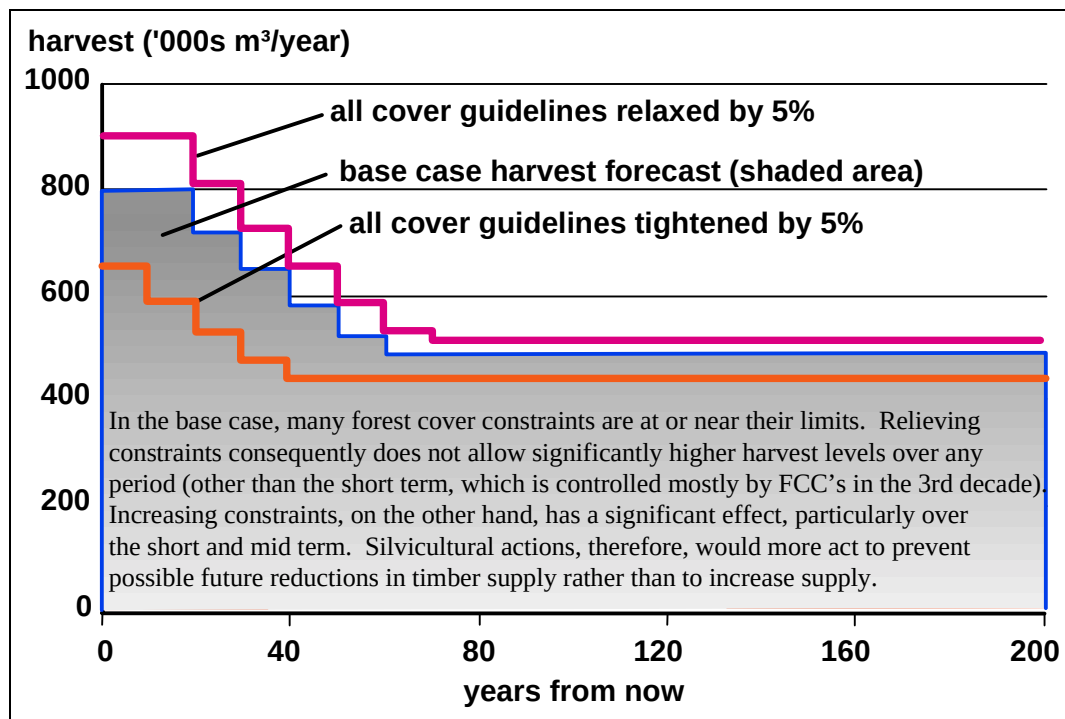


Figure 1. Changes in adjacency and older forest area requirements, Kootenay Lake TSA

Draft

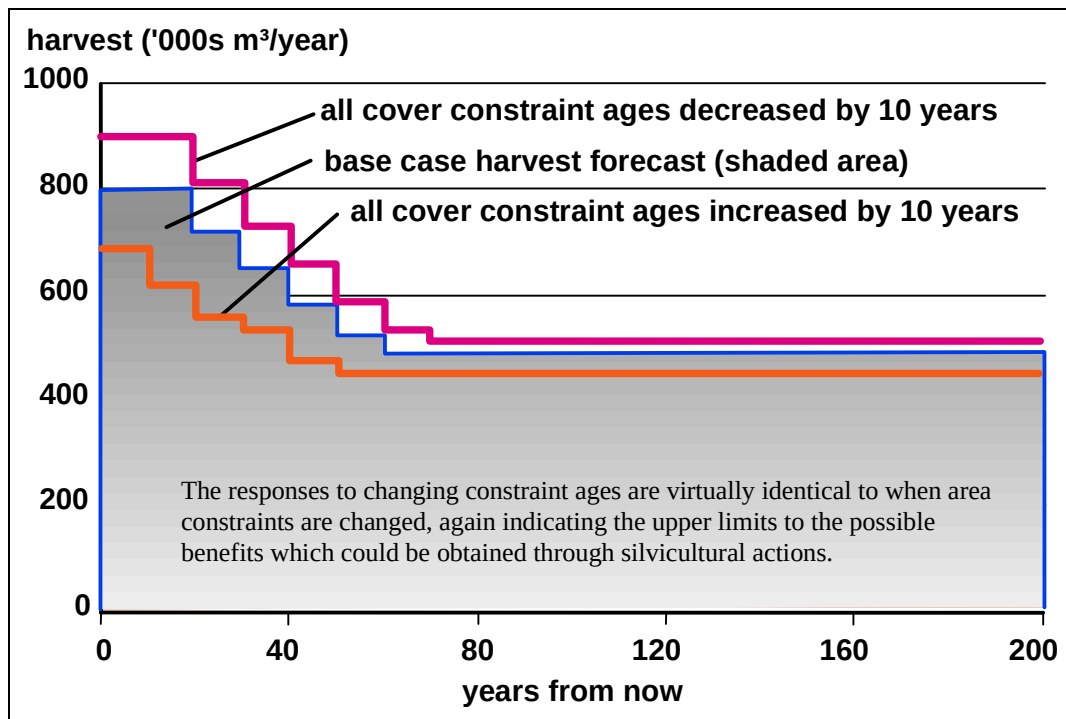


Figure 2. Changes in constraint ages, Kootenay Lake TSA

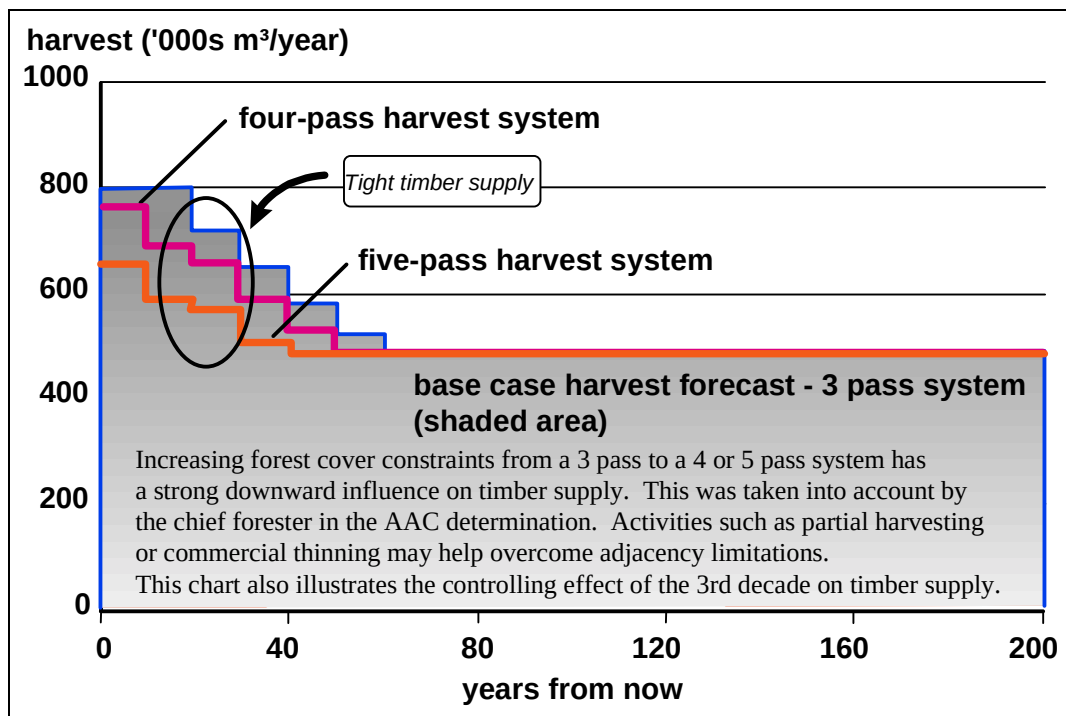


Figure 3. Effect of increasing the basic forest cover constraints over all areas, Kootenay Lake TSA

Draft

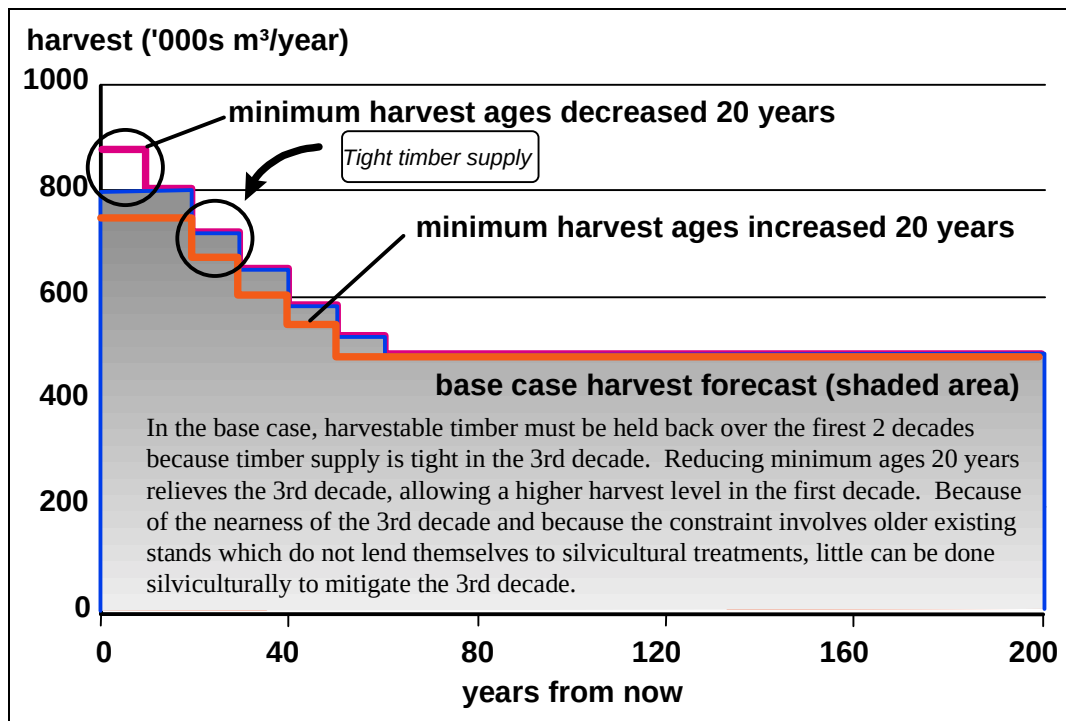


Figure 4. Changes in minimum harvest ages, Kootenay Lake TSA

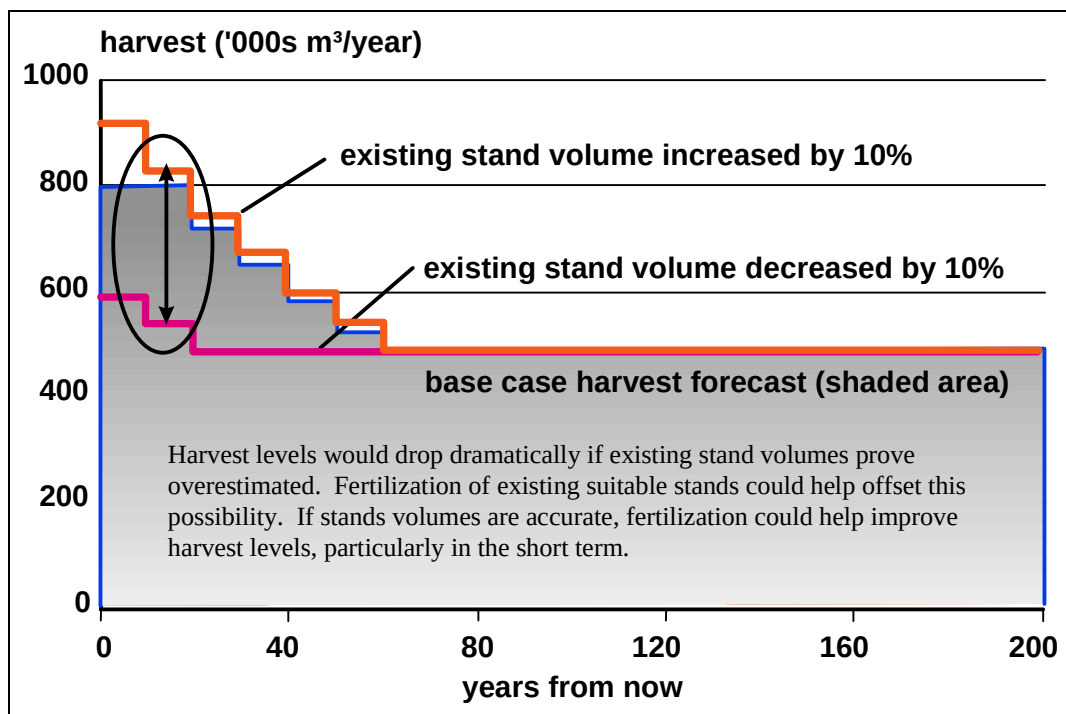


Figure 5. Changes in existing stand volumes, Kootenay Lake TSA

Draft

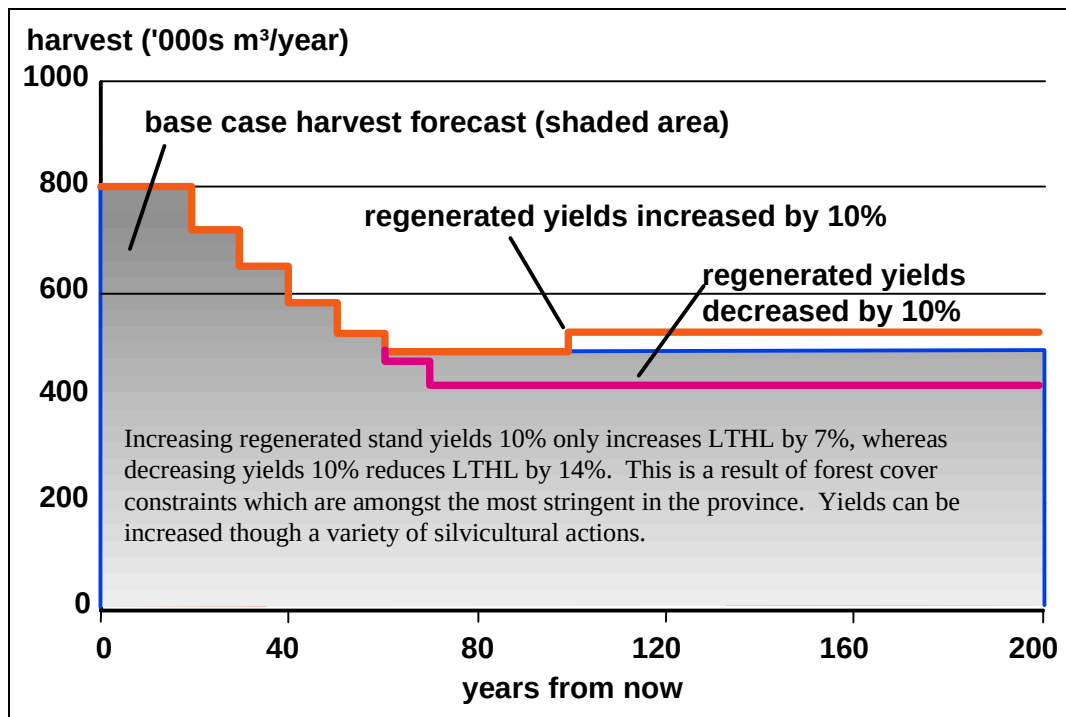


Figure 6. Changes in regenerated stand volumes, Kootenay Lake TSA

Summary of Issues by Period

General

The base case harvest forecast is a complex interaction between harvest flow constraints, forest cover constraints and the age class structure. While the base case FCC's are substantial, relaxing them causes some rise in harvest levels across all periods but does not overly increase harvest levels. Sensitivity analysis continually point to harvest flow constraints becoming more binding after FCC's are relaxed. In particular, the 3rd decade is pivotal.

Reactions to positive stimuli appear suppressed. Raising existing stand volumes 10% has a significant impact in the 1st decade, but is marginal after that. Raising regenerated stand volumes 10% raises LTHL only 7%, whereas in 90% of other TSA's the reaction is normally a 10% increase in LTHL.

The most severe impacts and consequent sensitivities are in the 1st and 2nd decade. In many cases little can be done to overcome this in this time period.

Planning incremental silviculture activities is made difficult by the fact VDYP yields were used for regenerated stands. Managed stand yields (using TIPSy) are likely to be noticeably higher, along with lower time until green-up and lower minimum harvest ages.

FCC's are amongst the most limiting of any TSA in the province. As evidence of this, the theoretical LTHL, after allowing for fire and other losses, is about 25% above the base case LTHL. In most other TSA's, the difference is in the 10-15% range. The new methodology used in TSR2, where stands outside of the THLB are considered in the determination of biodiversity and FCC's, may change the limiting factors that so governed this analysis. Conversely, the chief forester noted in the AAC rationale that harvesting on private land has not been taken into account, and that it will impact harvest levels by

increasing the amount of area harvested on the total land base, which makes it more difficult to meet overall forest cover requirements (rationale, 28).

The forest cover guidelines result in a large variability in the harvest ages and in the area harvested annually over the first 12 decades. Harvesting normally occurs in the oldest stands first, but the FCC's can cause a shift to harvesting of much younger stands. This occurs when the older timber is in management zones that are at or near the limit of the FCC's. The result is the harvesting of all available timber in all management zones including stands at or near the minimum harvest age. This effect is pronounced during the 3rd decade, when there is a sharp drop in average age of harvested stands (from 300 yrs in decade 1 to 150 yrs in decade 3) and a commensurate sharp rise in area harvested (from 1 750 ha/yr to about 2 550 ha/yr). The forest cover requirements also force postponement of a small amount of the total harvest in the highly restrictive retention VQO area until ages of 400 years or more, which may not prove realistic. (analysis, 17)

Short Term (1 - 20 years)

Short term harvest levels are reduced to be able to supply enough timber to get through decades 3 & 4 of the mid term, which are severely restricted by FCC's. Thus factors that affect the existing timber supply greatly affect the ability to maintain the initial harvest level for longer or shorter than in the base case.

Increasing minimum harvest ages by 20 years, decreasing existing stand volumes 10%, increasing all cover constraint ages (the green-up age and the minimum age of old-growth), increasing the all cover constraint area requirements by 5%, or allowing only a 5 pass harvesting system in all wildlife and 3 of the 4 watershed zones each can result in a need to lower the IHL substantially below that of the base case (the current AAC).

Decreasing minimum harvest ages 20 years allows the harvest in the first decade to rise above the base case. This is because the need to hold timber until decades 3 & 4 is lessened. These decades are limited by a combination of minimum ages and forest cover constraints, so reducing the minimum ages makes more timber available in this period, in turn lessening the requirement to hold mature timber until then.

The TSR1 base case forecasts harvest levels can be maintained at 803 000 m³/yr for 2 decades. However, the CF determined the AAC at 700 000 m³/yr after taking into account factors which lower the forecast.

Mid Term (21 - 60 years)

The mid term is characterized by a steady 10%/decade decline in harvest volumes during the transition to the LTHL which is reached at the end of the 5th decade (i.e., at 60 years). For the purposes of this strategy, 60 years is taken as the end of the mid term period.

As noted above under the general comments, the early part of the mid term appears to be the most constraining.

At no time, other than when regenerated stand volumes are increased by 10%, does a sensitivity test result in a mid term shortfall below its forecast LTHL.

The mid term is tightly constrained by both the harvest flow rules and being at or near limits imposed by some forest cover constraints. Relaxing many of the forest cover constraints or increasing existing stand volumes by 10% does not greatly increase harvest levels over this period. The responses to these sensitivity tests are noticeably less than typical responses in other TSA's. This is because the harvest flow rules soon become restricting. Increasing some constraints, on the other hand, particularly those constraints where the existing condition is near or at its limit, can have substantial immediate impacts on both the short and mid term. The effect of tightening the cover guidelines is about double the effect of relaxing them (analysis, 29). The greatest harvest level reduction occurs when existing stand volumes are decreased 10% (while an inventory audit found volumes to be accurate, a reduction in the THLB

would likely have a similar effect). The next largest impact occurs when forest cover constraints are tightened.

Decreasing minimum harvest ages has no effect on mid term harvest levels because the harvest flow rules push the harvest level benefit back into the short term. Decreasing minimum ages in decades 3 & 4 will no doubt provide needed flexibility at that time. On-the-ground restrictions are likely to be tighter than a timber supply model would infer.

Increasing regenerated stand volumes 10% extends the mid term period to 110 years, generating a mid term shortfall by raising LTHL above the base case level (but does not lower the mid term below the base case), starting in the 11th decade.

Long Term (61 + years)

The long term harvest level is insensitive to increasing the forest cover constraints to a 5 pass system in the four wildlife zones (from 3 pass system in the base case) and in all four watershed zones (from 3 and 4 pass systems in the base case). However, LTHL is significantly affected (9% below base case) by tightening all forest cover area guidelines by 5%. Unfortunately, this sensitivity analyses at the same time both decreased the area allowed below green-up and increased the area required to be in mature forest making pinpointing sensitivity difficult. Between the two sensitivity analyses, it can be concluded that the long term is sensitive to either reducing the area allowed below green-up in the VQO zones or to increasing the old-growth requirements. VQO's cover 27% of the THLB and have the most restrictive cover requirements of all zones. Increasing the requirement by 5% is a higher % increase than for the other zones (For example, the retention VQO allows only 5% of the area to be not greened up in the base case. Reducing this 5% eliminates all harvesting from this zone). This, then, is more likely to be the cause than increasing old-growth requirements. The harvest forecast is not sensitive to reduction in the area allowed below green-up in the wildlife or watershed zones.

As age classes even out, the long term becomes more affected by forest cover constraints, The "fit" is so tight that increases or decreases in regenerated stand yields show substantially disproportionate response. A 10% increase in yields results in only a 7% gain in harvest levels over the base case. This lower than normal response may be attributed to the fact that timber is often held considerably beyond its biological culmination age, resulting in lower average annual rates of growth than if harvested at or near culmination. [check]. When regenerated stand volumes are lowered 10% the lower volume/ha means more area must be harvested to obtain the same harvest level. However, with more area being harvested, forest cover guidelines become more limiting than they are for the base case.

When regenerated stand volumes are increased 10%, LTHL does not rise until 100 years from now, indicating this is when the first of the regenerated stands become available.

Future

There were a number of unknowns at the time of the TSR1 analysis, including site productivity, impact of the Forest Practices Code, the outcome of the protected areas strategy, and the volume gains associated with managed stands. Many of these unknowns will be clarified for TSR2. The TSR2 base case may have a different profile than TSR1. This needs to be taken into account when designing an incremental silviculture strategy. Adopted strategies should be robust and made in the anticipation that they will still be valid following re-analysis.

Incremental Silviculture History

Approximately 2000 ha are harvested annually.

Treatment	TSR1 Status (1993)		Current Status (1998) Source: KLFD ²
	Incorporated in Timber Supply Analysis	Not Incorporated in Timber Supply Analysis	
◆ Backlog	Objective is to rehab 5 313 ha by year 2000. Analysis assumed 6 133 ha will be restocked over the next 20 yrs.		Approx 1 800 of 3 600 ha of backlog are economical to treat. 5 500 ha of existing plantations require maintenance. Current program is to plant 300 ha/yr and brush 1 200 ha/yr.
◆ Conversion			
◆ Commercial Thin			
◆ Space			200 ha/yr.
◆ Prune			60 ha/yr.
◆ Fertilize			500 ha every 5 years.

Higher Level Goals and Objectives

This section documents higher level goals and objectives relevant to an incremental silviculture strategy for the TSA.

Provincial Goals

Fundamentally, government's goals can be characterized as:

- sustainable use;
- community stability; and
- a strong forest sector. (MoF, 1998a)

Provincial Objectives

Until provincial targets for timber quantity and quality are established, management unit strategies are to consider the following interim provincial strategic objectives (MoF, 1998a). Incremental silviculture strategies must also be in keeping with higher level plans under the Forest Practices Code.

Objective 1: Maintain current harvest levels as long as possible without creating disruptive shortfalls in future timber supply.

Objective 2: Create a long term timber supply capable of supporting a steady long term provincial harvest level similar to current levels.

Objective 3: Minimize the interim shortfall in provincial harvest anticipated before a steady long term timber supply is achieved.

² KLFD - Kootenay Lake Forest District

Objective 4: Create a long term timber supply which will enable the timber quality profile of future harvests to be the same or better than the current profile.

The Provincial goal is to bring all backlog sites to free growing status by the year 2015.

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.

Regional Objectives

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

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 Kootenay Lake 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.

Local Resource Use Plans

Local resource use plans are not higher level plans as defined by the Forest Practices Code, but are respected when preparing prescriptions. Examples of local resource use plans are:

Arrow Mountain	Powder Clute	Ainsworth
Smallwood Creek	Yahk CRMP	Queen's Bay
Kaslo River	Clearwater Creek	Pilot Peninsula
Duck Creek	Blewett	Sitkum
Summit Creek	Anchor Creek	
Twin Bays	West Arm Demonstration Forest	

Opportunities to Increase Timber Supply

Potential Silviculture Strategies

Prior to the district workshop, information in the previous sections was used to identify the following silvicultural strategies as having potential to either maintain or increase future timber supply at the TSA

level.³ Each of these was reviewed in the workshop, to the extent time allowed. The results are recorded in “Workshop Review of Potential Strategies,” page 23, along with additional strategies that arose during the meeting. Strategies that are ultimately adopted are noted in “Silviculture Strategies,” page 39.

◆ **Short Term (1 - 20 yrs)**

ST 1: Fertilize all suitable stands scheduled for harvest in the 2nd decade. (increase)⁴

ST 2: Overcome adjacency limitations by implementing partial harvesting/CT regimes in all zones, particularly the VQO zone. (increase)

◆ **Mid Term (21 - 60 yrs)**

MT 1: Continue partial harvesting/CT regimes as in ST 2. (increase?)

MT 2: Repeat fertilize all suitable existing stands scheduled for harvest 20 to 100 years from now to increase harvested volumes. (increase)

MT 3: Commercially thin stands to create old-seral attributes earlier. (increase)

◆ **Long Term (61+ yrs)**

LT 1: (a) Rehabilitate all remaining treatable backlog NSR and (b) brush ____ ha of existing backlog plantations. (maintain)⁵

LT 2: Increase the THLB by:

- a) rehabilitating NCB; (increase)
- b) converting/rehabilitating deciduous stands; (increase)
- c) converting/rehabilitating non-merchantable hemlock stands; (increase)
- d) improve the site productivity of low-site stands by (fertilization?). (increase/maintain)

LT 3: Reduce losses to root rot by _____ (increase).

LT 4: Increase the volumes of regenerated stands 20%.

Available Information Regarding Potential Treatments and Treatable Area

This section summarizes available information directly relevant to the potential treatments for the TSA.

Treatment	Comment	Treatable Area
◆ Brushing	On many sites, herbaceous brushing is critical to seedling survival, and is an important component of regenerating a site. Spot treatment around individual seedlings, is preferable to brushing entire sites. Where public concerns allow, herbicide spot treatments should be utilized, as this form of treatment has proven to be the most effective, and least expensive method of controlling competing vegetation. Deciduous brushing ensures that the growth of the conifers is not impeded and that free growing is achieved. Uninterrupted height growth is critical to achieving height and crown size objectives. In	

³ The original draft presented in the workshop contained gaps in strategy numbering. These have been eliminated in this document.

⁴ (increase) means oriented to increasing harvest levels above those indicated by the TSR2 base case.

⁵ (maintain) means oriented to maintaining the harvest level indicated by the TSR 2 base case.

Treatment	Comment	Treatable Area
<p>◆ Spacing</p>	<p>recognition of the value of deciduous species for biodiversity, some deciduous trees should be retained, either singularly or in groups. Brushing prescriptions should consider the ecological value of deciduous species, such as alder, <i>Shepherdia</i> and <i>Ceanothus</i> for nitrogen fixation, and birch and aspen for reducing the spread of <i>Armillaria</i> root disease.</p> <p>Juvenile spacing is a pre-requisite to fertilization, pruning, or commercial thinning activities.</p> <p>Spacing is used primarily to increase individual tree diameters by concentrating the growth potential of a site on fewer stems. At lower densities larger piece size is produced at the expense of total yield. Species composition can also be controlled and shifted to faster growing species if desired. Removal of competing deciduous and other conifers is also done at this stage. Height growth, which is a function of site index and not density, is not usually affected unless there is height repression impacting over dense stands (e.g. Pl stands > 40,000 sph). Merchantable volume can increase, total volume may decrease, and there is a reduction in the time needed to get a particular diameter. This has the effect of producing merchantable trees sooner, thereby decreasing the harvest age and making more wood available sooner.</p> <p>The value of treated stands will be increased as well. This could be equally important as increased volume. Stand values are increased by lower harvesting costs due to fewer pieces, better prices for larger logs and potentially increased merchantable volume.</p> <p>Studies have shown that for some management units, it may be possible to directly increase mid-term timber harvests by intensively managing those stands scheduled for harvest in that period. It is also likely to increase mid term harvests by shifting harvest volume from the long-term to the mid-term through commercial thinning opportunities that would not exist without early density control. This strategy is generally adopted in management units where age class imbalances create timber supply shortages in the mid-term. This is <u>not</u> the situation in the Kootenay Lake TSA, where a well balanced age class distribution occurs. Future timber supplies are not restricted by lack of suitable wood, but rather by very high levels of constraint to meet other resource objectives (ie. water, and visuals).</p> <p>Stand-level prescriptions must ensure that landscape level objectives are achieved. This treatment has the potential to negatively impact the visual quality and hydrologic recovery of an area, because spacing reduces crown closure. Post treatment densities should generally be maintained at or above Regional guideline targets in all watershed areas.</p> <p>Currently, juvenile spacing is considered a low priority.</p> <p>However, CF recognizes may have a role in reducing greenup ages and alleviating anticipated adjacency problems in the 3rd and 4th decades when combined with fertilization.</p>	<p>Candidate stands limited by type and location.</p>
<p>◆ Fertilization</p>	<p>Fertilization is the application of nutrients, primarily nitrogen, in order to increase the growth rate of the tree, particularly in height, diameter and crown width. Of all the treatments that have the potential to quicken green-up, fertilization and the planting of genetically improved seedlings show the most promise. Fertilizing</p>	

Draft

Treatment	Comment	Treatable Area
<p>♦ Commercial Thinning</p>	<p>suitable stands will also reduce rotation ages, increase merchantable volume of harvested stands, and increase the value of pruned stands. The following stand conditions must be present to realize the financial and volume gains anticipated:</p> <ul style="list-style-type: none"> • Fertilize only spaced stands to ensure additional growth is captured only on dominant trees that will survive until harvest • Fertilize spaced stands approximately 10-15 years prior to commercial thinning to maximize thinning yields • Fertilize commercially thinned stands 10-15 years prior to final harvest to maximize growth on the residual trees • Fertilize spaced and pruned stands to maximize the amount of clear, mature wood. <p>Fertilizing older stands may have some potential to improve merchantable yields, but there are few natural stands that have both suitable biological characteristics and a reasonable chance of being harvested on schedule to capture the effects of the fertilizing. Therefore fertilizing older stands is not a recommended strategy at this time.</p> <p>Although technical studies indicate water quality is unaffected by careful fertilizer application most watershed groups oppose the use of "chemicals" in domestic watersheds. For the present, fertilizing stands in licenced watersheds should be avoided.</p> <p>The demand for fibre from commercial thinning in the future is not possible to predict, however, the recent trends of decreasing utilization standards suggest that the demand may continue. Additionally, there is a greater and continuing demand for partial cutting to meet more of the non-timber management objectives such as visual quality, biodiversity etc. If these demands for increased partial cutting continue, and appropriate stand densities have not been planned, there will be few options to meet the demand other than at the expense of future harvests.</p> <p>The effects of this treatment are more indirect than previously discussed treatments as commercial thinning allows some merchantable volume to be realized in areas where non-greened up areas are at a maximum. Due to the similarity to partial cutting, this treatment leaves most of the remaining stand intact, thereby minimizing additions to the non-greened up area. Stands most suitable for commercial thinning are juvenile spaced stands. In the past this treatment has not been widely prescribed due to the relative abundance of large sawlogs and poor markets for small sawlogs and pulpwood. In the future as available wood supplies decrease, it is possible that the markets for this type of material will improve, making this a viable treatment.</p>	<p>Approx. 73 000 ha ages 41-80. Opportunities are limited by root rot, wildlife needs for thermal cover, and the lack of suitable stand structure in unmanaged natural stands.</p>
<p>♦ Conversion</p>	<p>THLB could be increased by over 5% were deciduous and non-merchantable areas rehabilitated.</p>	<p>11 500 ha deciduous types 3 000 ha classified non-merchantable</p>
<p>♦ Backlog NSR</p>	<p>Planned for restocking in 20 years (TSR1). No additional opportunity.</p>	

Workshop Review of Potential Strategies

Explanatory notes with respect to the following tables.

<u>Column Number</u>	<u>Note</u>
1	The response time frame is the period in which the anticipated result is expected, <u>not</u> the period in which actions must necessarily commence.
2	Strategy numbers correspond with the numbers recorded earlier in “Potential Silviculture Strategies,” page 19. Items followed by an asterisk (*) were added during the district workshop.
3	Information is largely from a meeting of ministry personnel and forest licensees held November 23 & 24, 1998 in Nelson (the “district workshop”) combined with information presented earlier in this document.
4	Anticipated results are typically calculated using the timber supply response indicated by TSR1 sensitivity analyses.
5	The TSR1 base case is adjusted to roughly account for major changes since it was produced. The harvest forecast column was not thoroughly reviewed during the district workshop. <i>Results are largely conjecture and are meant to illustrate the potential of the strategies.</i>

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result	Harv Forecast (000s m3/yr)																		
	Base Case Adjustment	<p>(a) The chief forester, in the TSR1 AAC determination, found the base case to over-estimate short term harvest levels and therefore set the AAC at 700 000 m3/yr, approx. 100 000 m3/yr below the base case IHL, and 200 000 below the pre-TSR AAC. The new AAC becomes the starting point for any future harvest level projection.</p> <p>(b) The TSR1 base case is now 5 yrs old and it used data that was probably already 5 years old. Developing an appropriate incremental silviculture strategy necessitates broadly adjusting the base case, particularly to determine if the shape of the harvest forecast has changed since then. (Different shapes often merit different strategies.) Major adjustments were estimated in the workshop as follows.</p> <table><tr><th>Factor</th><th>Short Term</th><th>Long Term</th></tr><tr><td>Protected areas</td><td>-10%</td><td>-10%</td></tr><tr><td>Change from VDYP to TIPSYP</td><td>0%</td><td>+25%</td></tr><tr><td>Old growth site index adjustment</td><td>0%</td><td>+10%</td></tr><tr><td>Watershed/fisheries</td><td><u>0%</u></td><td><u>-10%</u></td></tr><tr><td>Total</td><td>-10%</td><td>+15%</td></tr></table> <p>13% of volume and 8% of area will be removed from the TSA due to new protected areas (Lasca, White, Grizzly creeks). The workshop estimate of a related short term 10% reduction is probably low. There was not TSR1 land base sensitivity test. The best indication is a sensitivity test of a 10% reduction in existing stand volumes. This showed a dramatic 26% reduction in the base case IHL.</p> <p>There is some uncertainty whether the positive effect of TIPSYP yields has adequately accounted for root rot losses.</p> <p>Avg site index is 2m/ha/yr. This seems low given the TSA is mostly interior cedar-hemlock (ICH) zone. Anticipate a doubling for age class 8 & 9 stands, which are 22% of the THLB.</p> <p>Watersheds are 41% of THLB. On non-watershed lands, other important IRM issues exist (Kootenay-Boundary Land Use Plan (KBLUP)).</p>	Factor	Short Term	Long Term	Protected areas	-10%	-10%	Change from VDYP to TIPSYP	0%	+25%	Old growth site index adjustment	0%	+10%	Watershed/fisheries	<u>0%</u>	<u>-10%</u>	Total	-10%	+15%	<p>In total, short term harvest levels can be expected to be slightly below TSR1 while long term levels may be higher. The transition from short to long term becomes less dramatic but basically the shape of the harvest forecast can be expected to be similar to the TSR1 base case.</p>	<p>Initial harvest level</p> <p>700 AAC <u>-70</u> 10% adj 630</p> <p>Long term harvest level</p> <p>490 LTHL <u>+74</u> 15% adj 564</p>
Factor	Short Term	Long Term																				
Protected areas	-10%	-10%																				
Change from VDYP to TIPSYP	0%	+25%																				
Old growth site index adjustment	0%	+10%																				
Watershed/fisheries	<u>0%</u>	<u>-10%</u>																				
Total	-10%	+15%																				

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result	Harv Forecast (000s m3/yr)
♦ Short Term (1 - 20 yrs)	1. Fertilize all suitable stands scheduled for harvest in the 2nd decade. (increase)	1. Many stands coming up for harvest are too old for fertilization. They would have to be CT'd first to open up the canopy to provide room for it to expand in response to fertilization. However, in the Kootenay Lake TSA the oldest stands are not necessarily being harvested first, due to cover constraints. Thrifty stands that may be eligible for harvest in the 2 nd decade are very scattered and do not lend themselves to an operational fertilization program. A very small program of 100 ha/yr could be considered if there was certainty that the fertilized stands could be harvested at an appropriate time in the future to capture the effects of the fertilization.	1. 100ha/yr of fert = (100 / 2 000 ha/yr of harvest =) 5% of annual area harvested. A 5% vol gain would result in a (.05 X .05 X 100 =) 0.25% increase in 2 nd decade harvest levels. Minimal effect at the management unit level. Consider for stand level effects.	<u>Short Term Summary</u> 630 1 st dec. -60 10%/dec decline 570 2 nd dec 570 2 nd dec. 1 fert (0.25%) 0 CT & Fert & earlier grn-up 571 total
♦	2. Overcome adjacency limitations through (a) reducing green-up delay* and (b) regimes of spacing and commercial thinning in all zones, (c) particularly the VQO zone. (increase). ⁶	2. Determined to mostly have a mid term effect. See MT 1 below.	2. No short term effect. See MT 1.	

⁶ * - indicates added during the district working session.

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result	Harv Forecast (000s m3/yr)
♦ Mid Term (21 - 60 yrs)	1. Overcome adjacency limitations through: (a) reducing time to green-up;*	1. (a) Time to green-up can be substantially reduced from TSR1 levels. Age to reach ht 2m 3m 9m TSR1 22 26 48 Actual current (Reichenback) 14 16 40 w genetic improvement 11 13 25 [#] w genetic + large stock 10 12 [#] Workshop participants felt the time to reach 9m with improved stock would be considerably shorter than at present. A 25 yr estimate is derived (post workshop) as follows. At ½ m ht growth/yr, should grow from 3m to 9m in 12 yrs. Should reach 9m at 13 + 12 = 25 yrs. This is half the TSR1 estimate, and is consistent with the 2m and 3m estimates also being half. 2 nd generation improved stock is not available until 2015 (see 4a), so related green-up benefits cannot occur until then.	1. (a) TSR sensitivity analysis (fig 20) indicates a 10 yr reduction in both green-up ages and older forest requirements results in an 11% increase in harvest levels during the 1 st 6 decades (LTHL increased 5%). Effect of reduced green-up ages alone is not modeled. Timberline study (p36) indicates a 6% rise in harvest levels in decades 3-6 when green-up ages are reduced 5 yrs. See "Summary" below.	<u>Mid Term Summary</u> 564 - LTHL reached in decade 3 34 CT & Fert & earlier grn-up (6%) — 1 Fert prior to hrvt 599 Total
	(b) regimes of spacing and commercial thinning in all zones,	(b) Hawe (1996) found "...in the Kootenay Lake District, it is likely that there is significant potential for increasing the amount of partial cutting used." Timberline (1997) undertook sensitivity analysis and tree and stand simulator (TASS)-based responses to stand-alone treatments of commercial thinning and fertilization, as well as combinations of the two. They also looked at the effect of fertilization on green-up. Although the reasons for some of the responses were unclear and some of the responses do not correspond to the findings of TSR1 sensitivity analysis, Timberline generally indicates commercial thinning can yield improvements in harvest levels in 3 to 5 decades from now. CT was modeled over all decades, so no indication is provided as to when CT should optimally begin and end to achieve this benefit. An analysis by Wang and Pollack (1998) on the effects of partial cutting/CT in the Arrow TSA supports the Timberline findings. This study demonstrates increased harvest levels can be obtained from concentrating partial cutting/CT activities in constrained areas. Root rot can limit CT options. Studies using the Prognosis model have indicated the best partial harvesting strategies (Pollack and Robinson,	(b) Timberline indicates a 5% gain in decades 3 & 4 and a 2% gain in decade 5 from CT & fertilizing 300 ha/yr (p39). See "Summary" below.	

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result	Harv Forecast (000s m3/yr)
♦	(c) particularly the VQO zones. (increase).	<p>1996). Further study of root rot management techniques and options are needed. Noted under "Summary of Information and Research Needs," page 41.</p> <p>Because of past fire suppression history, programs of commercial thinning from below would also serve to maintain ecosystem processes, similar to what government agencies are trying to accomplish in the Columbia River Basin project, south of the US border.</p>	(c) No information available.	
	1. Summary	<p>(c)(Not reviewed in the workshop.) VQO zone is 27% of THLB. Typically this zone is very limiting to timber supply, due to the low area allowed below green-up as well as having a higher green-up ht (6 m vs. 3 m in general zones). TSR1 did not undertake a separate sensitivity analysis, so no info is available. Info from other TSA's would suggest focusing CT in visually sensitive areas would have the greatest benefit. Watershed zones (45% of THLB) are similarly limiting in 6m ht, but the area allowed to be not greened up is not as limiting.</p> <p>1. Summary</p> <p>Further analysis is required. The KBLUP constraint reports can be used to help pinpoint what constraints are binding timber supply and their location; i.e., in what landscape units and habitat types. Treatable timber types must be identified now and spaced (if not already spaced) and perhaps fertilized to set up for commercial thinning in 30 to 50 years. Candidate stands would probably be currently aged 10 -25 years old (unspaced) and 25-40 years old (previously spaced to densities suitable to CT), on M or G site, accessible, relatively free of root disease, and within visually sensitive or watershed areas. The extent of CT may be limited by the Equivalent Clearcut Area (ECA) rule. Assume in the interim a spacing program of 200 ha/yr to set up stands for CT (assumes the equivalent of 100 ha/yr has already been spaced). Assume 20% (see L4g) of 300 ha/yr planned for CT is suitable for fertilization, equals 60 ha/yr of fert. CT & post-CT fert would occur 30 to 50 years from now.</p>	<p>1. Summary</p> <p>Because the TSA is heavily constricted it is unlikely the benefits from both earlier green-up and the use of CT are additive. Also, CT may not be able to be implemented to the level that was modeled. ⇒ Assume no gain in the short term, and a 6% gain overall in decades 3-6.</p> <p>Further analysis is required.</p>	
♦	2. Repeat fertilize all suitable existing stands scheduled for harvest 20 to 100 years from now to increase harvested volumes.	2. Effectively, this strategy is a continuation of ST 1. See ST1.	2. Minimal effect at the management unit level (0.25% increase). Consider for stand level effects.	

Response Time Frame	Potential Strategy/Action	Discussion / Current Status			Anticipated Result	Harv Forecast (000s m3/yr)													
♦	3. Commercially thin stands to create old-seral attributes earlier. (increase)	3. Half of land base has old-growth constraints. In the analysis, age is a surrogate for biodiversity and stand structure. Silviculture treatments may be used to create suitable stand structures or create old growth recruitment areas. There is a lack of knowledge about these structures and attributes. More refined definitions are needed before strategies can be developed. Noted under “Summary of Information and Research Needs,” page 41.			3. More information required.														
♦ Long Term (61+ yrs)	1. (a)Rehabilitate all remaining treatable backlog NSR - 1 800 ha (maintain); and (b) maintain 5 000 ha of existing backlog plantations. (maintain)	1. Backlog rehab is a top priority in order to reduce the area considered not greened up. May have positive impacts over all time periods. (a) Gross backlog NSR area is now about 3 600 ha, of which 1 800 is operable. A program of 1 800 ha over the next 5 years is needed. (b) About 5 000 ha of previously restocked backlog areas require maintenance. Brushing is needed on some plantations to ensure they attain free-growing. A program of 1 000 ha/yr over the next 5 years followed by 750 ha/yr for 5 years is needed. [Requires confirmation.]			1. (a) (b) Maintain base case LTHL.	<u>Long Term Summary</u>													
						564 - LTHL reached in decade 3													
						0 rehab & maintain backlog													
						23 incr THLB (4%)													
						0 root rot													
♦	2. Increase the THLB by: (a) rehabilitating non-commercial brush (NCBr); (increase)	2. <table><tr><th>Type</th><th>Area</th><th>%THLB</th></tr><tr><td>NCBr</td><td>4 600</td><td>1.5</td></tr><tr><td>Deciduous</td><td>11 500</td><td>4.0</td></tr><tr><td>Low volume</td><td>3 000</td><td>1.5</td></tr><tr><td>Low site</td><td>32 500</td><td>11.0</td></tr></table> Bringing these areas into the THLB may impact green-up. Generally, not much volume can be obtained from these stands, but when in a non-greened up state they contribute equally as does an area that had a high-volume stand. There is also concern about the impacts on other resources, particularly	Type	Area	%THLB	NCBr	4 600	1.5	Deciduous	11 500	4.0	Low volume	3 000	1.5	Low site	32 500	11.0	2. Summary Assume, in total, THLB could be increased by 10 000 ha. or 4%. No TSR1 sensitivity analysis for land base changes. Analysis in other TSAs generally indicates a 4 % increase in land base raises LTHL by 4%. Assume LTHL impact only.	<u>56</u> rgn std vols (10%) 643 Total
Type	Area	%THLB																	
NCBr	4 600	1.5																	
Deciduous	11 500	4.0																	
Low volume	3 000	1.5																	
Low site	32 500	11.0																	

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result	Harv Forecast (000s m3/yr)
		wildlife. Work done in Cranbrook TSA indicates that for every 3 ha brought into the land base only 1 ha can be logged on due to constraints.		
		(a) NCBBr has wildlife habitat potential. Few large contiguous areas that lend themselves to treatment. More info needed.		
	(b) converting /rehabilitating deciduous stands; (increase)	(b) Decid is mostly aspen/cottonwood in lower areas. A significant portion of the cottonwood may be in riparian reserves. About 5 000 ha of aspen. Again, can have impacts on wildlife and on green-up. Rather than total rehab probably better to underplant and hack and squirt the aspen. A survey in year 1 is required to determine the overall opportunities. (Noted under "Summary of Information and Research Needs," page 41.) Possibly start with a small program of 100 ha/yr. Need a different yield curve to properly assess the contributions of such stands to future harvests. (Noted under "Summary of Information and Research Needs," page 41.)		
♦	(c) converting/rehabilitating non-merchantable hemlock stands; (increase)	(c) Not specifically discussed in the workshop.		
♦	(d) improve the site productivity of low-site stands by (fertilization?). (increase/maintain)	(d) This is the most significant area reduction. Work on problem forest types (PFT's) in the Cranbrook TSA identified 3 000 000 m3 of additional volume from low site stands which has been previously netted out. Need to do a similar inventory in Kootenay Lake at an estimated cost of \$140 000. Need to determine how many sites are actually low site and how many are mis-classified. (Noted under "Summary of Information and Research Needs," page 41.) Although some low-site stands may be mis-classified as higher site, there is generally a bias to classifying higher site as low site, so expect to see a net gain. Once the characteristics of true low site stands are determined, it may be possible to derive a silviculture strategy to bring some of them into the THLB. In the meantime, fertilization of low site is not a viable strategy.		

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result	Harv Forecast (000s m3/yr)																														
♦	3. Reduce losses to root rot through various management practices (maintain).	<p>3. TIPSy OAF2 of 5% will be used in TSR 2. Expectation is that this does not adequately reflect current losses to root rot. The need for further study of root rot management noted under “Summary of Information and Research Needs,” page 41.</p> <p>Estimate of extent of root rot:</p> <table><tr><th>Zone</th><th>%THLB</th><th>% Incidence</th><th>%stand vol loss</th><th>% mgmt unit vol loss</th></tr><tr><td>ICH</td><td>50</td><td>100</td><td>25</td><td>13.0</td></tr><tr><td>ESSF</td><td>40</td><td>10</td><td>10</td><td>0.4</td></tr><tr><td>MS</td><td>10</td><td>10</td><td>10</td><td><u>0.1</u></td></tr></table> <p>Total: ≅ 14</p> <table><tr><th><u>Alternative management options</u></th><th><u>potential/yr (ha)</u></th></tr><tr><td>• stumping</td><td>125</td></tr><tr><td>• alternate species</td><td>125</td></tr><tr><td>• include deciduous</td><td></td></tr><tr><td>• pop-up spacing</td><td>100</td></tr></table>	Zone	%THLB	% Incidence	%stand vol loss	% mgmt unit vol loss	ICH	50	100	25	13.0	ESSF	40	10	10	0.4	MS	10	10	10	<u>0.1</u>	<u>Alternative management options</u>	<u>potential/yr (ha)</u>	• stumping	125	• alternate species	125	• include deciduous		• pop-up spacing	100	3. Neutral. Actual increases in long term volume availability as a result of these practices is not known at this time. Assume will reduce losses to 5% as planned for use in TSR2 base case.	
Zone	%THLB	% Incidence	%stand vol loss	% mgmt unit vol loss																														
ICH	50	100	25	13.0																														
ESSF	40	10	10	0.4																														
MS	10	10	10	<u>0.1</u>																														
<u>Alternative management options</u>	<u>potential/yr (ha)</u>																																	
• stumping	125																																	
• alternate species	125																																	
• include deciduous																																		
• pop-up spacing	100																																	
♦	4. Increase the volume of regenerated stands 20% by: a) using improved seed; (increase)	<p>4. (a) 90% of areas are planted. About 75% of S (which is 50% of planting) is improved; not available for high elevation sites. All Pl is improved. Improved larch will be available in 3-5 yrs, with 2nd gen in about 35 years. No improved Fdi. Latest estimates of yield gains are (%):⁷</p> <table><tr><th>Species</th><th>Cur %</th><th>Future %[#]</th><th>1st gen % gain</th><th>2nd gen % gain</th></tr><tr><td>S</td><td>25</td><td>40</td><td>2-3</td><td>20 by 2015</td></tr><tr><td>Pl</td><td>20</td><td>30</td><td>2-3</td><td>20 by 2015</td></tr><tr><td>Fd/Lw</td><td>40</td><td>20</td><td></td><td></td></tr><tr><td>Cw/Hw</td><td>15</td><td>10</td><td></td><td></td></tr></table> <p>[#] Estimates were not completed in the workshop. Confirmation of trends between current and future profile required.</p> <p>Yield gains were not included in TSR 1.</p>	Species	Cur %	Future % [#]	1 st gen % gain	2 nd gen % gain	S	25	40	2-3	20 by 2015	Pl	20	30	2-3	20 by 2015	Fd/Lw	40	20			Cw/Hw	15	10			4. a) Sensitivity analysis indicates LTHL rises 7% with a 10% increase in regen stand volumes. Based on S & Pl 2 nd gen gain, LTHL can be expected to rise (70% of area X 20% gain X.7 =) 10%.						
Species	Cur %	Future % [#]	1 st gen % gain	2 nd gen % gain																														
S	25	40	2-3	20 by 2015																														
Pl	20	30	2-3	20 by 2015																														
Fd/Lw	40	20																																
Cw/Hw	15	10																																

⁷ Source: participants at district workshop.

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result	Harv Forecast (000s m3/yr)
♦	b) managing stocking so voids do not account for more than 10% of the area; (increase)	(b) (Not reviewed in workshop - insufficient time.) TIPSYS standard OAF1 factor for voids is 15%. Objective is to reduce this to 10%. Current free growing requirements will result in < 15% in voids, however the actual amount is unknown. 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 41). Voids can be desirable for wildlife habitat, so intensive void management may not be practicable on all areas. See also 4 (h) below.	b) Not reviewed.	
♦	c) using larger planting stock; (increase)	<p>(c) Pre free-growing item. Larger stock could be used but not likely in current economic conditions. Common stock types are 1+0, 415 for S, Fd & L -, except 412 used for higher elevation S; and 1+0, 410 for PL.</p> <p>Moving up to a 1+0, 512 stock costs about \$.30/tree. Doing this on all planted areas would cost (90% of area planted X 2 000 ha/yr harvested X 1200 st/ha planted X \$.30/tree =) \$648,000/yr.</p> <p>Fertilizing at the time of planting with a "tea bag" may give the same response as larger stock but would be considerably cheaper.</p> <p>Depending on size of stock, could reduce green-up ages and minimum ages by 1 or 2 yrs.</p>	c) Possibly a 1-2% gain related to green-up and 1-2% related to minimum ages.	
♦	d) fertilizing at the time of planting; (increase)	(d) Insufficient time in workshop to discuss this strategy.	d) Not reviewed.	
♦	e) brushing for growth enhancement (i.e., not only for survival); (increase)	<p>(e) Currently brushing 1200 ha/yr of backlog sites.</p> <p>MoF small business brushes about 200 ha/yr and licensees about 500 ha/yr to meet basic silviculture obligations. This equates to brushing about 350 ha/yr due to multiple treatments of the same site. Roughly 15% of sites are brushed for survival.</p> <p>Participants agreed there was an opportunity to brush more area for growth, but the effects on green-up are unknown. (The need for further information is noted under "Summary of Information and Research Needs," page 41.)</p>	e) Effects unquantified.	
♦	f) spacing stands. (maintain) and	(f) TSR1 base case used VDYP to determine regenerated stand yields. TSR2 will use TIPSYS yields. Inherent in the use of TIPSYS are assumptions about stocking levels. The plan is to identify different densities by analysis unit in 3 000 stems/ha increments based on total stems. This is important as historic levels of spacing are relatively low in this TSA.	More accurate projection of yields.	

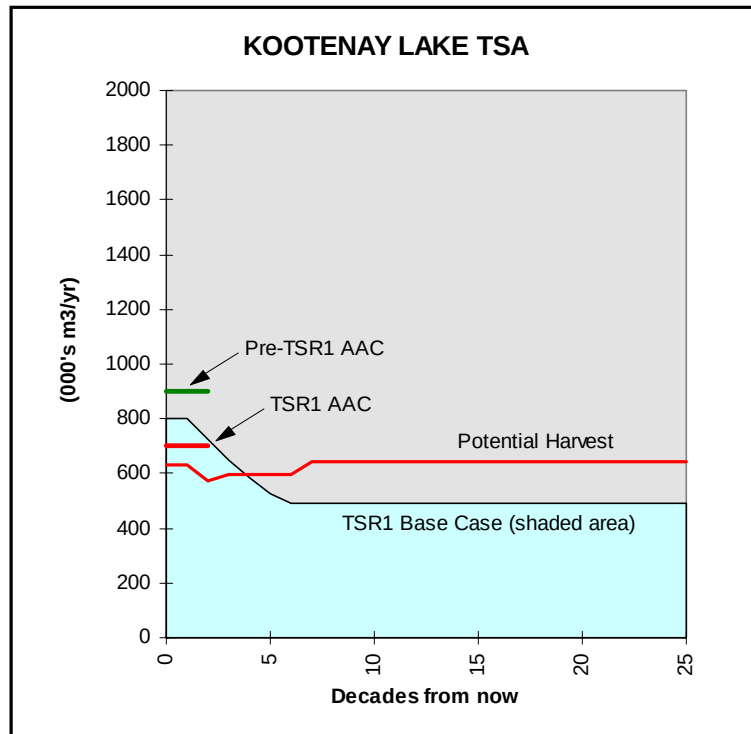
Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result	Harv Forecast (000s m3/yr)
♦	g) repeat fertilize suitable stands on a 15 yr return cycle.	(g) A rough calculation can be done as follows. 60% of species respond to fertilization, 60% of area is M site. This indicates approx. 36% of the THLB is suited to fertilization. Constraints on water quality restrict fertilization on a further 40% of the THLB, resulting in approx. (.6 X .36 =) 21% of the THLB being fertilizable. If repeat fertilization results in a 10% volume gain, this would result in (.21 X .1=) a 2% overall rise in regenerated stand volumes across the entire THLB. On a 15 yr repeat cycle, this indicates a fertilization program of 3 300 ha/yr (.21 X 233 800 / 15). This constitutes a rough estimate of the upper bound to fertilization in this TSA. [Does fertilization accelerate mortality in root rot infected stands?]	(g) TSR1 sensitivity analysis indicates that a 10% rise in regen stand vol's results in a 7% rise in LTHL. A 2% rise results in a (.02 X 0.7 =) 1.4% rise in LTHL.	
♦	h) Managing to target stocking density vs. to minimum density;*	h) Target stocking is 1 200 st/ha vs. minimum of 700 st/ha. Even at target stocking, get patches of heavier stocking which offsets patches of lower stocking. This does not give the same growth as uniform distribution. This strategy was not fully addressed in the workshop due to insufficient time. See 4(b) "voids".		
♦	i) Duff planting;*	i) Insufficient time in workshop to discuss this strategy.		
♦	j) Species selection;*	j) Insufficient time in workshop to discuss this strategy.		
♦	k) Site preparation;*	k) Insufficient time in workshop to discuss this strategy.		
♦	l) Prune white pine to reduce blister rust losses;*	l) White pine is approx. 2% of inventory. The FP code pruning obligation applies only to naturally regenerated Pw; planted Pw being bred for disease resistance. This is about 50-100 ha/yr. Post free growing could do a 2nd lift prune on about 100 ha/yr.	l) Not likely to affect harvest levels so much as maintain Pw as part of the species profile.	
♦	m) Rehab of residual stands.*	m) Insufficient time in workshop to discuss this strategy.		
♦	Summary	From the above, it would appear a 15-20% gain in regenerated stand volumes is achievable.	4. Summary Sensitivity analysis indicates a 10 yr increase in regen stand vol's will result in a 7% increase in mid term	

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result	Harv Forecast (000s m3/yr)
			harvest levels. A 15% gain = (.15 X .7) $\Rightarrow$ 10%; Increased site productivity may further compound these effects.	

Draft

Potential Harvest Forecast

Figure 7 graphs the potential harvest level that may be attained through implementation of the silvicultural strategies in the preceding tables. ***This forecast is highly speculative and requires confirmation through computer-based modeling and analysis.*** It also includes silvicultural activities that are not within the traditional scope of incremental silviculture. Modeling may indicate more precise timing, targeting and program levels associated with incremental silviculture activities than could be developed in this interim strategy.



NB: The potential harvest forecast in Figure 7 contains adjustments to the TSR1 base case to recognize recent land use planning decisions as well as new information since then. The short term recognizes the TSR1 AAC as the starting point and is adjusted downwards for protected area removals. In addition to these, the long term recognizes expected increases from managed stands as well as improved knowledge about site indices. Thus the two forecasts are not directly comparable.

Figure 7. Potential harvest forecast, Kootenay Lake TSA

Opportunities to Improve Timber Quality

The effects of incremental silviculture on the future quality of the timber resource were not analyzed in the timber supply review. Information in this section was gathered during the district workshop.

Product Objectives

For the Kootenay Lake TSR1 analysis, minimum harvestable ages were based on a minimum volume of 150 m³/ha for conventional ground skidder operations, (200 m³/ha for cable yarding on slopes >50%) and then adjusted according to a combination of local industry and MoF experience. In the district workshop, Crestbrook reported it is harvesting in 80 year-old stands with volumes of 80m³/ha in the Creston area. Slocan FP is operating in higher volume stands in the northern portion of the TSA.

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

<u>Quality Class</u>	<u>Species</u>	<u>Characteristics</u>
Premium Log:	Douglas-fir, lodgepole pine, larch	suitable for achieving machine stress rated (MSR) lumber grading - grown in higher density stands (slower growth rate less of an issue than density)
	Douglas-fir, spruce peelers	clear or few tight knots.
	white pine, clear	17.5+ cm min diameter at breast ht (DBH), manually or naturally pruned, min 5.2 m log.
	cedar, tight knot or clear	30+ cm min DBH, naturally pruned.
	white pine, large timber	40+ cm min DBH, unpruned.
	lodgepole pine, large timber	30+ cm min DBH, 15 m min length, 20 cm + top.
	spruce, large timber	45+ cm min DBH.
Sawlog:	Minimum average stand DBH of 17.5 cm and min. stand vol. of 150 m ³ /ha. While smaller sawlogs are being harvested in the TSA, the cost of harvesting decreases and product recovery increases with increasing size and volume. The sawlog target definition is therefore larger than minimum harvestable size.	

Available Information Regarding Potential Treatments and Treatable Area

Treatment	Comment/ Potential Treatment Regimes	Treatable Area
<ul style="list-style-type: none"> ◆ Spacing ◆ Commercial Thinning ◆ Pruning 	<p>Pruning has the potential to increase the value of the wood being produced, although volume increases are not expected. Pruning lower limbs increases the density of the wood and produces clear knot-free lumber which is more valuable than normal lumber. Pruning however, has the potential to alter hydrologic recovery and impact visual quality, because it removes a portion of the tree crowns, thereby reducing crown closure. Accordingly, pruning should be avoided or at least applied selectively. Snow interception and hiding cover for wildlife will also be reduced in pruned stands. Pathological pruning for control of white pine blister rust should be continued to reduce the potential for mortality in young stands.</p> <p>Due to the forest cover constraints of the various resources, considerable timber will not be harvested at it's biological rotation, but rather at older ages. These older stands will produce high value clear lumber naturally. In terms of timber supply, pruning is therefore a lower priority than juvenile spacing or fertilization in this TSA, with the exception of pathological pruning of white pine.</p>	

Potential Strategies by Response Time Frame

The following strategies have potential to increase timber quality. These were identified in the district workshop, but not thoroughly discussed due to insufficient time. The response time frame is the period in which the anticipated result is expected, not the period in which actions must 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%.	15%?
◆ Mid Term (21 - 60 yrs)	Q1. Space 500 ha/yr to obtain large dimension timber and prepare stands for fertilization and commercial thinning.	1. Avg. annual area harvested = 2 000 ha Assume spacing program of 500 ha/yr, a future species profile as recorded under strategy 4(a), average TSR1 harvest age of 160 years for Sw & Fd, and 120 yrs for Pl. Assume 250 ha/yr spacing in S, 200 in Pl and 50 in Fd (limited by root rot). Minor species (Cw,Hw) not analyzed.								1. 7-10% premium (large) log content, 4% from spaced stands and 2% from unspaced stands. Although only 25% of stands are spaced, these stands produce twice as much large log volume as the 75% of stands that are unspaced. Pl stands show a significant diameter response to spacing with no loss of merchantable volume. If another 200 ha/yr are spaced and later CT'd, the premium log content may rise to 9-10%. Note: For an interior TSA the definitions of large premium logs are on the high side. Were the definitions to be lowered, the % premium would measurably increase.	7% premium logs, some of which will also be clear.
		%’s ≥ min DBH cm (Y cm) and ≥ 1.33 X min DBH (Z cm) are from TIPSY stock table, rounded to nearest 5%. Fd large log assumed = S large log. For Fd & S: Y = 45 cm, Z = 60 cm. For Pl: Y =30 cm, Z = 40 cm									
		For trees between Y and Z cm, bottom 5m log is considered large diameter and = 20% of tree vol. For trees ≥ Z cm, first two 5 m logs are considered large diameter and = 35% of tree vol.									
		% large = {(Area/2000) X (%≥ Y cm & < Z cm) X (20% of tree vol.)} + {(Area/2000) X (%≥ Z cm) X (35% of tree vol.)}									
		Species	SI	Hrvst Age	Space frm: /to	Area	% ≥ Y <Z cm	%>Z	% large		
		Sw	17.5	160	3000/900 unspaced	250 550	30 10	0 0	1 1		
		Pl	17.5	120	4000/900 unspaced	200 400	60 35	15 0	2 1		
Fdi	20.0	160	3000/900 unspaced	50 350	45 35	5 0	1 1				
Total				1800		7					
◆ Long Term (61 + yrs)	As above.	As above.								As above.	7%

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 (7% forecast vs. current estimate of 15%). The largest factor contributing to this premium log achievement is the delay in average harvest ages brought about by the highly constrained nature of this TSA. (To illustrate, the LTHL for the Kootenay Lake TSA is 26% below the long run sustained yield (LRSY), whereas in most other TSA's it is usually in the order of 10-15% below.)

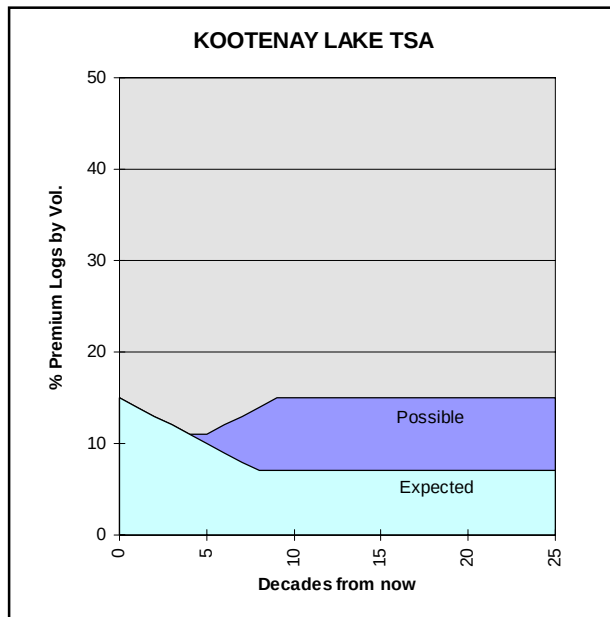


Figure 8. Potential Quality Forecast, Kootenay Lake TSA

This quality forecast is for large-dimension premium logs. Large logs are projected to be 7% of future harvests, based on spacing 500 ha/yr. If an additional 200 ha/yr are spaced for CT this may rise to the 10% range. Some large logs will also be clear logs, but no estimate for the clear component is available.

Were large log definitions relaxed to more toward the norm for interior stands and the area spaced for the purpose of setting up stands for future commercial thinning included, the future premium log component may possibly approach today's (presumed) level of 15%.

Incremental Silviculture Strategy

This section synthesizes the preceding background information and analysis into an incremental silviculture strategy for the TSA.

General Strategy

Better resource information and accelerated tree improvement offer the two greatest possibilities for increasing future harvest levels in the Kootenay Lake TSA. The first may result in an increased land base, while the second will shorten green-up periods as well as increase regenerated stand volumes.

Elimination of the NSR backlog was assumed in the TSR1 base case and its accomplishment is necessary to maintain that forecast and the AAC on which it was founded.

Spacing will improve the future quality of the timber resource and should also be used to set up stands for future commercial thinning. Commercial thinning may offer opportunities to restructure the harvest queue, thereby assisting in overcoming adjacency limitations and increasing the harvest level during the critical time period 3-5 decades from now. Further analysis is required to confirm the CT potential as well as determine target stands.

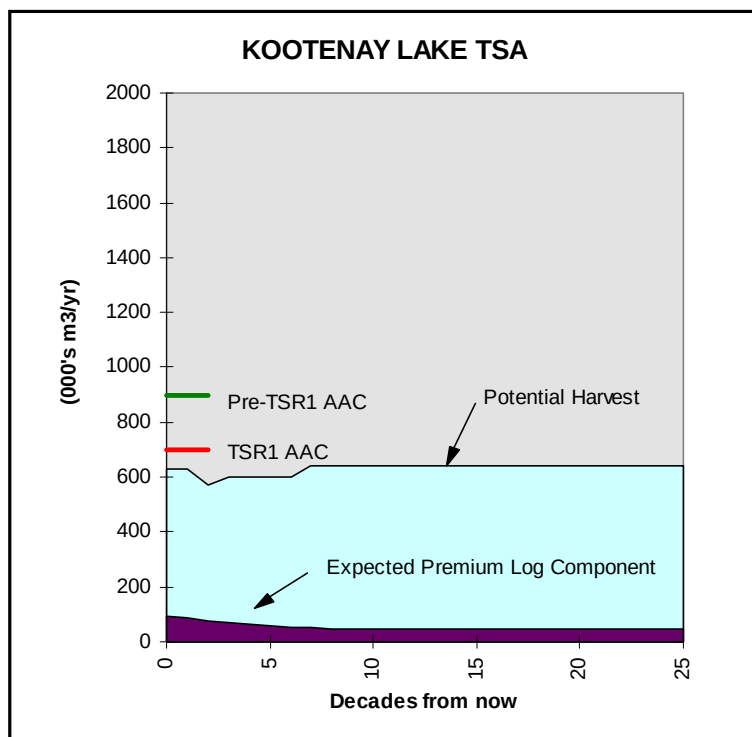
Reducing losses to root rot is being addressed through silviculture prescriptions and actions required under the Forest Practices Code. Incremental silviculture activities can supplement this to bring losses to reasonable levels.

Working Targets

The preceding analysis indicates the following working targets (WT) are attainable. Figure 9 illustrates these.

WT 1 (Quantity): Manage long term timber supply to yield harvest levels of 650 million m³/yr.

WT 2 (Quality): Manage regenerated stands to yield at least 10% premium logs by volume, with the majority of the remainder being of sawlog quality.



See notes beside Figure 7, page 34, and Figure 8, page 37.

Figure 9. Combined Potential Quantity and Quality Harvest Forecasts, Kootenay Lake TSA

Log Product Objectives

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

<u>Quality Class</u>	<u>Species</u>	<u>Characteristics</u>
Premium Log:	Douglas-fir, lodgepole pine, larch	suitable for achieving machine stress rated (MSR) lumber grading - grown in higher density stands (slower growth rate less of an issue than density)
	Douglas-fir, spruce peelers.....	clear or few tight knots.
	white pine, clear.....	17.5+ cm min diameter at breast ht (DBH), manually or naturally pruned, min 5.2 m log.
	cedar, tight knot or clear.....	30+ cm min DBH, naturally pruned.
	white pine, large timber.....	40+ cm min DBH, unpruned.
	lodgepole pine, large timber	30+ cm min DBH, 15 m min length, 20 cm + top.
	spruce, large timber	45+ cm min DBH.

Sawlog: Minimum average stand DBH of 17.5 cm and min. stand vol. of 150 m³/ha.

Silviculture Strategies

The following strategies have identified potential to maintain and/or increase the quantity and quality of the timber supply of the Kootenay Lake TSA. Strategy numbers correspond with those recorded earlier. Potential strategies found to be not applicable are omitted, resulting in gaps in strategy numbering.

◆ 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 42 along with investment priorities. The priority column below is based on regime rankings. Due to insufficient time, the regime table was not fully completed in the workshop. Consequently, some priorities were assigned post workshop. Generally, only the high priority strategies are listed in the “STRATEGY AT A GLANCE” section.

<u>No.</u>	<u>Strategy</u>	<u>Priority</u>
<u>Short Term</u>		
ST1	Fertilize 100 ha/yr of suitable stands scheduled for harvest in the 2nd decade. (increase)	low

<u>No.</u>	<u>Strategy</u>	<u>Priority</u>
-------------------	------------------------	------------------------

Mid Term

- | | | |
|------------|---|------------------------------------|
| MT1 | Overcome forest cover constraints by (a) reducing time to green-up through the use of large improved stock and (b) implementing a regime of spacing 200 ha/yr and fertilizing 60 ha/yr of spaced stands (both commencing immediately) and commercial thinning (commencing in about 30 years) in all zones, (c) particularly in the VQO zone. (increase).

<i>Further analysis is required to refine the spacing/CT strategy and locate target stands.</i> | (a) high
(b) high
(c) medium |
| MT2 | Repeat fertilize all suitable existing stands scheduled for harvest 20 to 100 years from now to increase harvested volumes. | low |
| MT3 | Commercially thin stands to create old-seral attributes earlier. (increase)
<i>Research is required to determine desired attributes and the silvicultural mechanisms to achieve them.</i> | medium |

Long Term

- | | | |
|------------|---|---|
| LT1 | (a) Rehabilitate all remaining treatable backlog NSR - 1 800 ha (maintain); and

(b) maintain 5 000 ha of existing backlog plantations. (maintain) | (a) high

(b) high |
| LT2 | Increase the THLB by:
(b) converting /rehabilitating 5 000 ha of deciduous stands; (increase)
(d) inventorying low site stands to determine if correctly classified and to enable development of silvicultural strategies to improve the productivity of some stands. | (b) high
(d) high |
| LT3 | Reduce losses to root rot through pop-up spacing 100 ha/yr (other solutions lie within the basic silviculture domain). | high |
| LT4 | Increase the volume of regenerated stands 15% by:
(a) using improved seed; (increase)
(c) using larger planting stock; (increase)
(e) brushing for growth enhancement
(l) 2 nd lift pruning 100ha/yr of white pine to reduce blister rust losses. | (a) high
(c) low
(e) medium
(l) medium |

◆ Strategies to Increase the *Quality* of Future Timber Supply

<u>No.</u>	<u>Strategy</u>	<u>Priority</u>
Q1	Space 500 ha/yr to obtain large dimension timber and prepare stands for fertilization.	Medium

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

Strategies to address habitat supply were not discussed in the district workshop due to insufficient time. Concerns expressed were:

- (a) The truncation of the early seral stage of stands if there is a move to harvest younger stands.
- (b) The conversion of species (e.g., more spruce and less cedar and hemlock, the conversion of deciduous stands to coniferous).

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 23).

1. Further study of root rot management techniques and options are needed. (MT1b, LT3)
2. Silviculture treatments may be used to create suitable stand structures or create old growth recruitment areas. There is a lack of knowledge about these structures and attributes. More refined definitions are needed before strategies can be developed. (MT3)
3. A survey of opportunities and prescriptions for the conversion of aspen stands to coniferous stands are needed. (LT2b)
4. Yield curves are needed for deciduous stands to improve their consideration in forest estate planning. (LT2b)
5. An inventory and re-classification of low site stands is needed. (LT2d)
6. 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. (LT4b)
7. More information about the opportunities and effects of brushing young stands to improve growth (vs. for survival as is current practice) is needed. (LT4e)

Silviculture Regimes and Investment Priorities

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

Draft

Table 1. Regime Table for the Kootenay Lake TSA, developed at the Silviculture Planning Workshop, November 23-24,1998.

Regimes	Strategy	Opportunity Area (Ha/Yr)	Timber Supply Effects			Quality	ES	Habitat	Forest Health	Jobs Days/ha	Direct Cost \$/ha	Rank
			Short	Medium	Long							
Survey		18360								0.1	25	2
Backlog												
1 establishment	L1a	360	+	++	+	0	+/-	+/-	0	8	2200	
2 maintenance	L1b	1000	++	+	0	0	+/-	+/-	0	2.5	600-800	1
Increase Land Base												
3 convert decid	L2b	100	+	+/-	+	0	+/-/?	+/-/?	0	2.5	600-800	
4 inventory low site ¹	L2d											4
Pre Free Growing												
5 large stock	L4c											
6 fertilize at planting	L4d											
7 brush for growth	L4e											
8 manage for target stocking	L4h											
Spacing												
9 spacing (for quality) ²	Q1	500	0	0	0	+	+	+	+	3	800	
10 spacing (space/fert/CT/fert)	M1	200	+	++	0	+	+	+	+	3	800	3
11 spacing (habitat)			0	0	0	+	+	+	+	3	800	
Fertilization												
12 fertilize maximum ³	L4g	3300										5
13 fertilize (second decade harvest)	S1,M2	100	++	++	+	+	0	0/+	0	0.1	250	
14 1st fertilize (space/fert/CT/fert)	M1	60	+	++	+	+	0	0/+	0	0.1	250	
Commercial Thinning												3
15 CT (space/fert/CT/fert) ⁴	M1	300										
16 CT(old seral)	M3	Need more info	+	0	0	+	+	+	+			
17 CT(natural stands)			++	+	0	0	+	+	+			5
Pruning												
18 Pw (2nd lift)	L4l	100	+	+	?	+	0	0	0	4	1000	
Forest Health												5
19 pop-up spacing	L3	100	0	0	0	0	0	0	+	3	600-800	
20 species conversion			0	0	0	0	-	-	+	2.5	600-800	

To Do List: (#1 rank)

- 1 Inventory and quantify opportunities for low volume stands.
- 2 Determine a program to (either/both) reduce greenup age or overcome adjacency requirements in decades 3-5.

Notes:

- 1 Not a silviculture activity. Once the characteristics of low sites are quantified, a silviculture strategy to raise productivity may be possible.
- 2 For the purposes of this strategy/analysis, this is considered separate and not overlapping with other spacing strategies.
- 3 Fertilization regimes are likely to overlap. This regime (3 300 ha/yr) is the maximum that could be applied based on repeat fertilization of suitable areas across the entire THLB.
- 4 300 ha/yr of CT per year is likely the upper bound of CT potential. Other CT regimes presented below would be more focussed subsets of this regime.

Incremental Silviculture Program

The following annualized program will contribute to achieving the above goals and strategies.

Program Table - Ha, Kootenay Lake TSA, November 1998

Year	Surveys	Backlog Planting	Backlog Brushing	Stand Conversion	Space	Fertilize	Prune
1	18,360	360	1,000	100	800	160	100
2	18,360	360	1,000	100	800	160	100
3	18,360	360	1,000	100	800	160	100
4	18,360	360	1,000	100	800	160	100
5	18,360	360	1,000	100	800	160	100
Subtot Yr 1 - 5	91,800	1,800	5,000	500	4,000	800	500
6 - 10	91,800	-	3,750	500	4,000	800	500
Total Yr 1 - 10	183,600	1,800	8,750	1,000	8,000	1,600	1,000

* Includes prescription and layout

Unit cost (\$/ha)	25	2,200	700	700	800	250	1,000
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Program Table - \$ 000s, Kootenay Lake TSA, November 1998

Year	Surveys	Backlog Planting	Backlog Brushing	Stand Conversion	Space	Fertilize	Prune	Total
1	459	792	700	70	640	40	100	2,801
2	459	792	700	70	640	40	100	2,801
3	459	792	700	70	640	40	100	2,801
4	459	792	700	70	640	40	100	2,801
5	459	792	700	70	640	40	100	2,801
Subtot Yr 1 - 5	2,295	3,960	3,500	350	3,200	200	500	14,005
6 - 10	2,295	-	2,625	350	3,200	200	500	9,170
Total Yr 1 - 10	4,590	3,960	6,125	700	6,400	400	1,000	23,175

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, Kootenay Lake TSA, November 1998

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

Year	Surveys	Backlog Planting	Backlog Brushing	Backlog Conversion	Space	Fertilize	Prune	Total
1	9	14	13	1	12	0	2	51
2	9	14	13	1	12	0	2	51
3	9	14	13	1	12	0	2	51
4	9	14	13	1	12	0	2	51
5	9	14	13	1	12	0	2	51
Subtot Yr 1 - 5	46	72	63	6	60	0	10	257
6 - 10	46	-	47	6	60	0	10	169
Total Yr 1 - 10	92	72.0	109.4	12.5	120.0	0.8	20.0	426

Note: Assumes 200 days of silviculture work = 1 job (Source: Jobs and Timber Accord)

Long term employment associated with improved quality and quantity of the timber resource¹

Decade	Harvest Increment ('000 m3)	Incremental Jobs			
		per year by decade		Total by decade	
		TSA ²	Prov ³	TSA ²	Prov ³
1		-	-	-	-
2 ⁴		-	-	-	-
3		-	-	-	-
4	13	20	30	203	295
5	72	112	163	1,123	1,634
6	109	170	247	1,700	2,474
7	153	239	347	2,387	3,473
8	153	239	347	2,387	3,473
9	153	239	347	2,387	3,473
10	153	239	347	2,387	3,473
11	153	239	347	2,387	3,473
12	153	239	347	2,387	3,473
13	153	239	347	2,387	3,473
14	153	239	347	2,387	3,473
15	153	239	347	2,387	3,473
16	153	239	347	2,387	3,473
17	153	239	347	2,387	3,473
18	153	239	347	2,387	3,473
19	153	239	347	2,387	3,473
20	153	239	347	2,387	3,473
21	153	239	347	2,387	3,473
22	153	239	347	2,387	3,473
23	153	239	347	2,387	3,473
24	153	239	347	2,387	3,473
25	153	239	347	2,387	3,473
Total				48,376	70,393

Notes:

- Assumes continuation of on the incremental silviculture program beyond the first 10 years, in accordance with the strategy.
The total harvest increment is associated with all the silvicultural practices documented in the "Opportunities" section and is only partly attributable to spacing and fertilization practices. Some of the increase may be associated with pre-free growing silviculture that was not current practice at the time of TSR1.
- Assumes 1.56 TSA level harvesting and processing jobs (PYs) per 1000 cubic metre (Source: Sinclair Tedder, BC MoF, 1998, pers.com.)
- Assumes 2.27 Provincial level harvesting and processing jobs (PYs) per 1000 cubic metre (Source: Sinclair Tedder, BC MoF, 1998, pers.com.)
- Decades 2 & 3 have negative harv increments due to adjustments to TSR1 AAC & land base reductions. These are excluded from the jobs table.

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Abbreviations

The following abbreviations are used.

AAC	allowable annual cut
CF	chief forester
CRMP	co-ordinated resource management plan
CT	commercial thinning
DBH	diameter at breast height
ECA	equivalent clearcut area
ESSF	engelmann spruce - subalpine fir (ecological zone)
FCC	forest cover constraints
FRBC	Forest Renewal BC
ICH	interior cedar-hemlock (ecological zone)
IHL	initial harvest level
KBLUP	Kootenay-Boundary Land Use Plan
KLFD	Kootenay Lake Forest District
LRSY	long run sustained yield
LT	long term
LTHL	long term harvest level
MoF	Ministry of Forests
MS	montane spruce (ecological zone)
MSR	machine stress rated
MT	mid term

NCBr	non-commercial brush
NCC	non-commercial cover
NSR	not satisfactorily restocked
OAF	operational adjustment factor
OGSI	old growth site index
PFT	problem forest type
SBFEP	small business forest enterprise program
ST	short term
TASS	tree and stand simulator
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; Fdi - interior Douglas-fir; Hw - western hemlock; Pl - lodgepole pine; Lw - western larch; S - spruce species.

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