
Lakes TSA

Silviculture Strategy (Type 1)

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Preface

The development of silviculture strategies for TSAs and TFLs is motivated by the desire to clarify the relationship between investments in silviculture and the critical forest-level issues specific to the management unit.

The Type 1 analysis is workshop-based. It draws on the expert knowledge of the participants to identify the critical issues, derive objectives with respect to those issues, specify regimes to meet those issues, and identify the regime activities that can be implemented in the next five years. After consideration of the benefits and costs of each of the activities on each of the forest-level objectives, the participants rank the silviculture activities by priority. The result is a prioritized list of silviculture activities that are explicitly linked to the critical issues of the management unit.

Type 2 analyses are model-based, but the analysis process is fundamentally identical to the Type 1 analysis. A forest-level model is used to evaluate the impacts of regimes on the forest-level objectives, to identify the silviculture activities constituting the “preferred management scenario”, and to rank those activities.

The Type 2 (model-based) analysis will result in a silviculture strategy that is considerably more appropriate and robust than the Type 1 approach, but it is more expensive and demanding of scarce modeling expertise. Hence the Type 1 (workshop-based) approach has been designed to produce an interim silviculture strategy that will serve until a Type 2 analysis can be completed. A Type 2 analysis will be undertaken in the Lakes TSA in 2001 or 2002.

Strategy Summary

Issues Addressed by the Strategy

While many issues were proposed and discussed in the workshop, the participants developed a silviculture strategy that addressed five issues: reducing losses to stem rusts, eliminating backlog brushing and NSR, increasing long-term harvest levels, maintaining log quality, and treating beetle-killed areas.

Elements of the Strategy

1. Determine appropriate treatments for mountain pine beetle killed areas, both salvageable and unsalvageable areas. These areas must be monitored once the current epidemic subsides. Maintaining stand productivity will contribute to maintaining long term timber supply. The mountain pine beetle epidemic could pose a serious threat to the current timber supply picture. Increased cut levels over the short term may be required to cope with the beetle epidemic, affecting future supply scenarios.
2. Eliminate backlog NSR areas by year 2002, by surveying and planting with large stock on all candidate stands. Subsequent to the Lakes TSA Type 1 workshop it was decided that it was possible to eliminate backlog brushing areas by year 2003.
3. Maintain production of clear, large, premium quality logs over the long term. Implement a regime of using improved seed followed by spacing and pruning and then repeated fertilization on 50 hectares a year. This strategy will help ensure that a component of premium value logs will be available on a continued basis over the long term. The



workshop group established a target of producing 20% of the total harvest as high quality logs larger than 22.5 cm diameter over the long term. Implement a regime to plant stock from improved seed and juvenile space where necessary. This strategy recognizes flexibility and opportunities for markets and manufacturing over the long term. [This target may not exploit the potential for Lakes TSA given available funding and the amount of area free of rust. Staff in the District and licensee operations should consider re-examining the 20% high-quality sawlog target in the near future.]

4. Increase the long term harvest level by increasing productivity. Implement regimes of fertilizing stands previously treated that will be available for harvest in the next 20 years. Also rehabilitate and plant problem forest type stands to lower densities, along with logging and planting under-performing stands with more than 200 m³/ha that could have a higher site index.
5. Reduce losses in volume attributed to stem rusts affecting pine. A higher percentage of spruce should be planted where acceptable. Stands that have become NSR due to rusts should be rehabilitated. In some limited cases planting to higher densities in high rust hazard areas may be an option.

Tactical Priorities

The tactical priorities set by the participants represent a balance between the participant's strategic objectives for the management unit and the silvicultural opportunities available on the TSA in the next 5 years. Table S-1 lists activities identified by the participants and the rank (priority) assigned to each activity.



Table S-1. Silviculture treatments and areas selected by the workshop participants

Activities/Treatments	Opportunity (ha/year)	Workshop Rank
Surveys		
Survey – backlog not-FG	300	2
Survey – NSR backlog	300	3
Survey – stands that have become NSR due to rust infection	250	4
Regeneration		
Plant backlog NSR	30	3
Plant higher % of spruce where suitable to reduce losses to stem rusts	4000	1
Site prep & plant rehab sites due to losses from stem rusts	250	4
Plant stock from improved seed for stands targeted for premium quality logs	50	8
Plant stock from improved seed for stands targeted for high quality logs	everywhere	9
Plant to higher densities to offset losses to stem rusts	50 – 100	10
Spacing		
Stands targeted for production of premium quality logs	50	8
Juvenile space stands targeted for production of high quality logs	??	9
Fertilization		
Stands previously treated, to be harvested in next 20 years	2000	5
Stands targeted for production of premium quality logs (repeat 15 year cycle)	50	8
Prune		
Stands targeted for production of premium quality logs (2 lifts)	50	8
Brush		
Brush backlog not free-growing	300	2
Brush backlog NSR after fill-planting	30	3
Monitoring and Evaluation		
Unsalvaged beetle kill areas for management strategy when current epidemic subsides	??	11
Areas <1 ha in size resulting from beetle for reforestation success	500	12



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1. Issues and Strategies

This section identifies the critical issues that guide silviculture planning on the TSA and strategies developed in the workshop for addressing those issues. These strategies were assessed by the workshop participants as to their appropriateness and efficacy. Some of these strategies were selected by the participants as feasible and desirable for the TSA and are listed in Table 1. This set of strategies constitutes the silviculture strategy for the Lakes TSA, as determined by the workshop participants. Strategies that were rejected by the workshop are listed in Appendix 4, together with the reasons for their rejection.

The main issues in Lakes TSA are, volume losses due to stem rusts, elimination of backlog NSR and brushing, increasing long term harvest levels, maintaining log quality and dealing with the mountain pine beetle epidemic.

1.1 Losses to stem rusts

Loss of volumes to stem rust is the highest priority issue in Lakes TSA. This is a real concern as the current inventory consists of 77% pine. The District desires to reduce losses to stem rusts and proposes to use species that are not susceptible to rust, where they are suitable.

Strategies:

1. Plant non-susceptible species
Target: pine sites that are also suitable for spruce
2. Rehabilitate infected stands
Target: stands that have become NSR due to hard pine rusts (blister rust, western gall rust)
3. Plant at higher densities
Target: pine sites that are rated to be high hazard for rust

Other potential opportunities to reduce losses to stem rusts that were discussed by the workshop participants and are worth further discussion and re-examination include:

- re-introducing broadcast burning as a site preparation tool to help reduce the current levels of rust and retard their re-establishment
- investigating the availability of rust-resistant stock for use in normal reforestation practice.

1.2 Eliminate backlog (brushing and NSR)

The Lakes Forest District has targeted to eliminate all backlog NSR by the year 2002. In addition they also plan to address all backlog brushing by 2003. It is estimated that only approximately 600 ha of backlog NSR remains on the records.

Strategies:

1. Identify and treat backlog NSR areas



Target: backlog areas that current survey results indicate status remains NSR

2. Identify and treat backlog brushing areas

Target: backlog areas that current survey results indicate are not FG

1.3 Increasing long term harvest level

Although the current TSR harvest forecast for Lakes TSA remains favourable over the long term, workshop participants agreed that it would be prudent to try and increase the harvest level. This approach is based on concerns about future downward pressures on the timber harvesting land base, and on the potential for beetle epidemics to alter the timber supply forecast drastically.

Strategies

1. Fertilization

Target: stands previously treated that will be harvested in the next 20 years

2. Rehab and plant problem forest type stands to lower densities

Target: problem forest type stands

3. Log and plant under-performing sites to thinner densities

Target: stands with less than 200 m³/ha that could have higher site indexes than indicated

With regard to increasing long term harvest levels, discussion indicated that Lakes staff need to keep abreast of the availability of improved reforestation stock. There is potential for expanding the timber harvesting land base by investigating harvesting opportunities in dog hair pine stands that may have higher site indices. Looking at ways to mitigate the impact of VQOs on harvest levels by identifying effects of variable treatments within viewscapes should also be addressed. In TSR 1, 24% of the timber harvesting land base was assigned to either the retention or partial retention visual quality zone.

1.4 Maintaining log quality over the long term

In order to ensure flexibility to meet market and manufacturing demands in the future the workshop participants felt it was important to maintain log quality over the long term. This was to be addressed by maintaining production of clear, large, premium quality logs on at least one percent of the total harvest area. The workshop group also established a target of producing 20 percent of the total harvest as high quality logs larger than 22.5 cm diameter over the long term. [This target may not fully utilize the potential for Lakes TSA given available funding and the amount of area free of rust. Staff in the District and licensee operations should consider re-examining the 20% high-quality sawlog target in the near future.]

Strategies

1. For maintaining premium quality logs utilize improved seed for planting stock, space, prune and fertilize every 15 years.

Target: Pure pine stands with low incidence of stem rust and a SI > 20 m that are accessible.



2. For maintaining high quality logs utilize improved seed for planting and implement density control as needed.

Target: stands consisting of any coniferous species with good or medium site class.

1.5 Dealing with the mountain pine beetle epidemic

The current epidemic beetle problem in the Lakes TSA brings to the forefront the question of appropriate management treatments for both salvageable and unsalvageable beetle killed areas. With more than 64% of the timber harvesting land base supporting stands older than 100 years, an epidemic having vast impacts is a real possibility.

Strategies

1. Monitor unsalvaged beetle killed areas and determine appropriate treatment

Target: unsalvaged beetle killed stands

2. Monitor cuts <1 ha for their reforestation success

Target: cut areas that are <1 ha in size and are exempt of a silviculture prescription

With the onset of the current mountain pine beetle epidemic the option of a large increase in AAC may become a reality in order to deal with the salvage of those attacked areas. The concern was raised that in the event of large scale cutting over a shortened period that the structural diversity of the cut-over stands be maintained. This could be achieved through differing silviculture regimes being implemented on a stand basis. Variability in density control, spacing, pruning and fertilization could all help to achieve the end result. The awareness of this concern will help to ensure it is addressed up-front if the situation does arise.

2. Silviculture Impacts and Priorities

The following worksheet, defining the elements of the interim strategy, was produced in the workshop in the Lakes Forest District offices.

Table 1. Showing the workshop issues, objectives, strategies, activities, targets, and impacts, Lakes TSA

Issues	Objectives	Strategies	Target	Activities	Opportunity Area (ha/yr)	Timber Supply Effects	Habitat Effects	Jobs Days/sha	Cost \$/ha	Rank
Loss of volume to stem rusts	Reduce losses to stem rusts	S_r1	pine sites where spruce is suitable	plant higher % spruce	4000 ha/yr	+	+	-		1
Backlog brushing	Eliminate backlog brushing by 2012	S_bb1	backlog not FG	survey, brush	500 ha/yr	+	+	1.04	380	2
Backlog NSR	Eliminate backlog NSR by 2002	S_nsr1	backlog NSR (total 600 ha)	survey	300 ha/yr	+	+	0.04	30	3
				plant large stock (416)	30 ha/yr	+	+	1.6	800	
				brush	30 ha/yr	+	+	1	350	4
Loss of volume to stem rusts	Reduce losses to stem rusts	S_r2	stands that have become NSR due to hard pine rusts (blister rust, western gall rust)	survey and prescription	250 ha/yr	+	+	0.04	50	
				site prep	250 ha/yr	+	+	0.25	800	
				plant	250 ha/yr	+	+	1.6	800	
Increasing long-term harvest levels	Increase productivity	S_ltv1	stands previously treated, that will be harvested in next 20 yr	fertilize	2000 ha/yr	+	+		400	5
Increasing long-term harvest levels			rehab and plant PFT stands to lower densities		50 ha/yr	+	+	1.85	1600	6
Increasing long-term harvest levels			log and plant under-performing sites to thinner densities		300 ha/yr	+	+	1.6	800	7
Log quality in long term	Maintain production of premium quality (clear, large) logs at >=1% of total harvest	S_q1	stands < 200 m3/ha that could have a higher SI than indicated	plant improved stock	50 ha/yr	+	+	1.6	30	8
Log quality in long term	Maintain production of premium quality (clear, large) logs at >=1% of total harvest	S_q1	100% pine, low incidence of rust, SI>20, accessible	space and prune	50 ha/yr	+	++	6	1200	
Log quality in long term	Maintain production of premium quality (clear, large) logs at >=1% of total harvest	S_q1		fertilize (repeat?)	50 ha/yr	+	+++		350	
Log quality in long term	Maintain production of high quality (>22.5 cm) logs at >=20% of total harvest	S_q2	all species; Good and Medium SI classes	plant improved stock	done everywhere	+	+			9
Loss of volume to stem rusts	Reduce losses to stem rusts	S_r3	pine sites identified as high hazard for rust	juvenile spacing	??	+	+	2	400	
Determining appropriate treatment for unsalvaged MPB-killed areas	Determine appropriate management strategy for unsalvaged MPB-killed areas	S_mpb1	unsalvaged beetle-killed areas	begin monitoring when current epidemic subsides	50 to 100 ha/yr	+	+	0.8	400	10
Determining appropriate treatment for salvaged MPB-killed areas	Ensure adequate reforestation in beetle-killed areas	S_mpb2	SP-exempt areas	begin monitoring when current epidemic subsides	??	+/	+/	0.05	15	11
					500 ha/yr	+/	+/	0.1	30	12



Table 2. Summary of silvicultural activities, Lakes TSA

Activities/Treatments	Target	Opportunity (ha/year)	Workshop Rank
Surveys			
Survey	backlog not-FG	300	2
Survey	NSR backlog	300	3
Survey	stands that are NSR due to rust infection	250	4
Regeneration			
Plant large stock (415)	backlog NSR	30	3
Plant higher % of spruce	spruce sites	4000	1
Rehabilitation site prep and plant	stands that are NSR due to rust infection	250	4
Plant stock from improved seed for	stands managed for premium quality logs	50	8
Plant stock from improved seed	stands targeted to produce high quality logs	everywhere	9
Plant to higher densities to offset losses to stem rusts	pine sites with high rust hazard	75	10
Spacing			
Space	stands managed for premium quality logs	50	8
Juvenile space	stands managed for high quality logs	??	9
Fertilization			
Fertilize	stands previously treated that will be harvested in next 20 years	2000	5
Repeat fertilization on 15 year cycle	stands managed for premium quality logs	50	8
Prune			
Prune (2 lifts)	stands managed for premium quality logs	50	8
Brush			
Brush	backlog not-FG	300	2
Brush after fill planting	backlog NSR	30	3
Monitoring and Evaluation			
Monitor when current epidemic subsides	unsalvaged beetle kill areas	??	11
Monitor for reforestation success	areas <1 ha in size resulting from beetle	500	12



3. Silviculture Program

3.1 Tactical Priorities

Tactical priorities for Lakes TSA were defined in the workshop by having participants ranking strategies and activities for implementation in the next five years. Priorities were assigned through discussion and consensus among the participants, and produced a clear sense of the most important activities from the participants' perspectives. In Lakes TSA, workshop participants felt that the most important tasks are those that contribute to eliminating losses to stem rusts, identifying and treating backlog areas (backlog NSR, backlog brushing), increasing long-term harvest levels, and producing premium quality (clear, large diameter) logs.

3. Program Costs and Benefits

The costs and benefits of the program developed in the workshop are summarized in Tables 3-6. Table 3 shows the assumed unit cost and employment multipliers associated with each activity. Tables 4-6 show the area treated, expenditures, and employment respectively by program year and activity. Planting higher proportions of spruce was omitted from the table because no costs are associated with it. Monitoring and evaluation for reforestation success in beetle-killed stands was omitted because it was ranked very low at the workshop (Table 1).

Table 3. Unit cost (\$/ha) and employment (person-days/ha) assumptions

	Surveys			Backlog brush	Treat backlog NSR		Treat NSR due to rust		Improved seed	Plant at higher density	Space	Fertilize	Repeat Fertilize	Prune (2 lifts)
	Backlog not-FG	Backlog NSR	NSR due to rust infection		Plant large stock	Brush	Site prep	Plant						
\$/ha average	380	30	50	380	800	350	1600	800	30	400	1200	400	350	1200
PDs/ha	1.04	0.04	0.04	1.4	1.6	1	1.85	1.6	1.6	0.8	6	0.05	0.05	6

Table 4. Area (ha) treated by activity and year

Year	Surveys			Backlog brush	Treat backlog NSR		Treat NSR due to rust		Improved seed	Plant at higher density	Space	Fertilize	Repeat Fertilize	Prune (2 lifts)	Total
	Backlog not-FG	Backlog NSR	NSR due to rust infection		Plant large stock	Brush	Site prep	Plant							
1	300	300	250	300	30	30	250	250	50	75	50	2,000	50	50	3,985
2	300	300	250	300	30	30	250	250	50	75	50	2,000	50	50	3,985
3	300	0	250	300	0	0	250	250	50	75	50	2,000	50	50	3,625
4	300	0	250	300	0	0	250	250	50	75	50	2,000	50	50	3,625
5	300	0	250	300	0	0	250	250	50	75	50	2,000	50	50	3,625
Subtotal Yr 1-5	1,500	600	1,250	1,500	60	60	1,250	1,250	250	375	250	10,000	250	250	18,845
6-10	0	0	1,250	0	0	0	1,250	1,250	250	375	250	10,000	250	250	15,125
Total Yr 1-10	1,500	600	2,500	1,500	60	60	2,500	2,500	500	750	500	20,000	500	500	33,970

Table 5. Expenditure ('000 \$) by activity and year

Year	Surveys			Backlog brush	Treat backlog NSR		Treat NSR due to rust		Improved seed	Plant at higher density	Space	Fertilize	Repeat Fertilize	Prune (2 lifts)	Total
	Backlog not-FG	Backlog NSR	NSR due to rust infection		Plant large stock	Brush	Site prep	Plant							
1	114	9	13	114	24	11	400	200	2	30	60	800	18	60	1,853
2	114	9	13	114	24	11	400	200	2	30	60	800	18	60	1,853
3	114	0	13	114	0	0	400	200	2	30	60	800	18	60	1,810
4	114	0	13	114	0	0	400	200	2	30	60	800	18	60	1,810
5	114	0	13	114	0	0	400	200	2	30	60	800	18	60	1,810
Subtotal Yr 1-5	570	18	63	570	48	21	2,000	1,000	8	150	300	4,000	88	300	9,135
6-10	0	0	63	0	0	0	2,000	1,000	8	150	300	4,000	88	300	7,908
Total Yr 1-10	570	18	125	570	48	21	4,000	2,000	15	300	600	8,000	175	600	17,042

Table 6. Short term employment benefits (person-years), by activity and year

Year	Surveys			Backlog brush	Treat backlog NSR		Treat NSR due to rust		Improved seed	Plant at higher density	Space	Fertilize	Repeat Fertilize	Prune (2 lifts)	Total
	Backlog not-FG	Backlog NSR	NSR due to rust infection		Plant large stock	Brush	Site prep	Plant							
1	2	0	0	2	0	0	2	2	0	0	2	1	0	2	13
2	2	0	0	2	0	0	2	2	0	0	2	1	0	2	13
3	2	0	0	2	0	0	2	2	0	0	2	1	0	2	12
4	2	0	0	2	0	0	2	2	0	0	2	1	0	2	12
5	2	0	0	2	0	0	2	2	0	0	2	1	0	2	12
Subtotal Yr 1-5	8	0	0	11	0	0	12	10	2	2	8	3	0	8	62
6-10	0	0	0	0	0	0	12	10	2	2	8	3	0	8	43
Total Yr 1-10	8	0	1	11	0	0	23	20	4	3	15	5	0	15	105



4. Items Requiring Investigation (“To-Do List”)

As various issues, objectives and strategies were discussed in the workshop, there were inevitably some that were clouded by lack of information. Either the lack of information itself was the issue (e.g., uncertainty about the values that should be used in the operational adjustment factors (OAFs) parameters in projecting yield tables for timber supply analysis), or the issue could not be resolved until further investigation provided some clarification (e.g., the actual heights of hectares classed as problem forest types). These items were added to a running “To Do List” throughout the workshop. At the end of the workshop participants ranked these items by urgency (Table 7).

The items on the to do list were mainly related to three general topics: timber supply analysis, pest management, and wildlife-forestry conflicts. Two items were related to improving or confirming the values used for parameters important for timber supply analysis (OAFs and site index for very dense pine stands). Two items were related to criteria used in defining the timber harvesting landbase for timber supply analysis (criteria for defining, and the actual heights of hectares classed as problem forest types).

Three items were related to pests (mountain pine beetle, pine rusts, and the use of prescribed burning to prevent incidence of rust). The remaining items were related to mitigating the impacts of VQOs on timber supply, and research on the effects of silviculture activities on small mammal habitat.

1. Reexamination of the possible use of burning as a site preparation tool must be investigated for the Lakes TSA. Burning can help reduce the incidence of stem rusts and retard their occurrence. It appears that smoke management concerns have had the largest impact on the elimination of burning to date. Re-introduction of this tool on a select basis could be a benefit to reducing stem rust losses.
2. Development of rust resistant stock could help to reduce losses to stem rusts in pine stands. Lakes District staff must keep apprised of the availability of any rust resistant stock. Inquiry into this could help to prompt more research directed in this area.
3. One possible solution to increasing the timber harvesting land-base is to look at harvesting overstocked pine stands currently classified as problem forest types. Some of these candidate stands may be overstocked with dog hair pine. These same stands may have higher site indexes than classified and may be converted to good stand production. These stands should be examined as to their real site productivity and potential for conversion.
4. Increases through genetic gain and breeding programs could help to increase long term harvest levels. Investigation into the status of these programs and plans, for species acceptable in the Lakes TSA, should take place. Any possible operational programs should be acted on and at the least it could help prompt research in this area.
5. Finding ways to mitigate impacts of VQOs on harvest levels would help free up volume for harvest. A program to identify effects of variable treatments within viewscapes in the Lakes TSA should be initiated. A review of research on accessing VQO areas for harvest carried out in other areas of the province should also be included in this task.



Table 7. Items identified in the workshop as requiring investigation, Lakes TSA

Rank	Topic
1	Explore worst case Mountain Pine Beetle (MPB) scenario by modelling using TSR2 data set and FSSIM
2	Check OAF values used in timber supply analysis (survey?)
3	Find ways to mitigate impact of VQOs on harvest level
4	Confirm criteria for defining problem forest types (PFT)
5	Confirm actual heights of hectares classed PFT
6	Investigate site index on dog-hair pine stands
7	Monitor harvest blocks <1 ha for reforestation success, after MPB epidemic subsides
8	Look into availability of rust-resistant planting stock
9	Re-examine use of burning in site preparation
10	Research (including literature review) habitat need of small mammals (marten prey) with direct relationship to silviculture activities



Appendix A. Timber Supply Dynamics

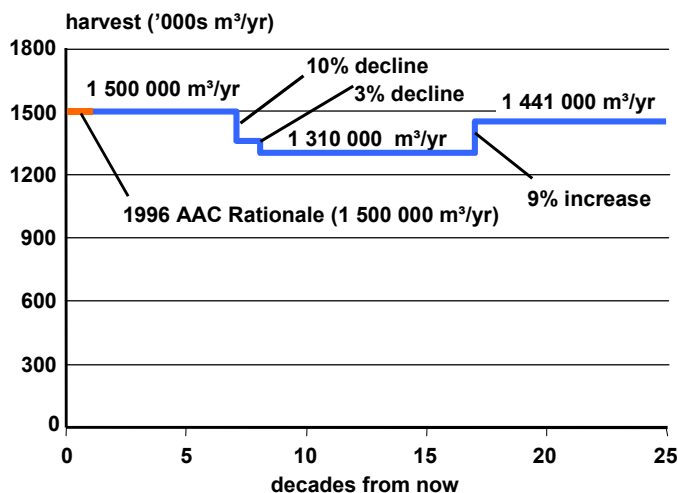
Timber supply is the rate at which timber is made available for harvesting, and it is made available through natural, administrative, and economic processes. The forest economy draws timber from the land base in response to consumer demand, and this flow of timber is limited by the rate at which the forest can physically grow trees, and by a variety of administrative constraints. The combined effect of these administrative constraints is incorporated in the Annual Allowable Cut (AAC).

The base case of the timber supply review (TSR) forecasts future timber supply subject to current administrative constraints and assuming present market conditions. The purpose of this section is to identify the “pinch points” and constraining mechanisms that shape the timber supply forecast for the unit. Observations drawn from the TSR base case and selected sensitivity analyses are used to describe the timber supply dynamics of the management unit and to suggest how silviculture treatments might enhance timber supply.

Timber Supply and the AAC

The 1995 TSR base case projected an initial harvest level of 1 500 000 m³ per year that could be maintained for the first 8 decades (Figure A-1). The harvest then declines by 10% in the eighth decade, and by another 3% in the ninth decade, to 1 310 000 m³ per year. This level is maintained until decade 18 when the harvest rises 9% to the long-term harvest level (LTHL) of 1 441 000 m³ per year.

Figure A-1. Base case harvest forecast, Lakes TSA, 1995



Rationing Mature Timber

The abundance of existing mature timber allows the current harvest level (1.5 million m³/yr) to be maintained for 8 decades, after which the harvest level must be reduced to ration the remaining mature inventory until regenerated stands reach minimum harvestable age. Harvesting can be increased to the long-term level after the transition to managed stands. The gaps in the age class distribution in the 30-50 year classes and the 90-100 year classes (Figure A-2)



is “filled in” by rationing the stock of available mature – timber which is currently age 100 years and older. Timber rationing is the main objective of constraints on the rate of change of harvest levels.

This mechanism shaping timber supply – constraints on the rate of change of the harvest level – also provides a means of capturing silvicultural benefits in the short term. Note that the efficacy of this effect is determined by the shape of the timber supply curve and hence is specific to a management unit. After 50 years there is a drawing down of the mature stock. Figure A-3 forecasts a steady decline in total and harvestable growing stock for the first 13 decades. After this time, both measures of stock rise and then stabilize once managed stands come on stream. If the forecast was extended past 400 years, the figure would illustrate a stable growing stock level, therefore maintaining the long-term harvest level in perpetuity.

Figure A-2. Current age class distribution-age class gaps identified, Lakes TSA 1995

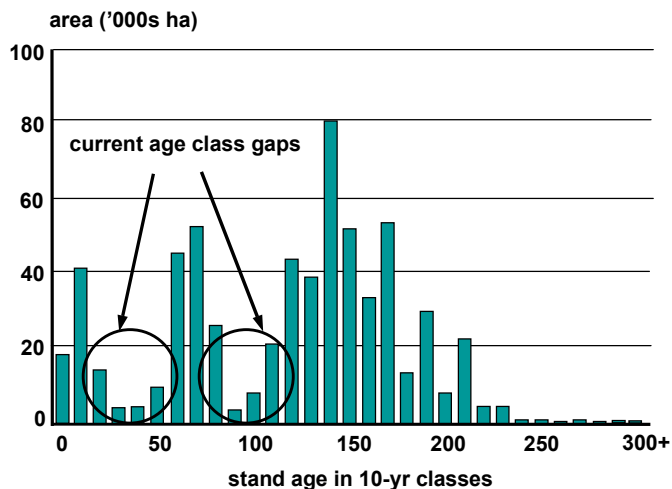
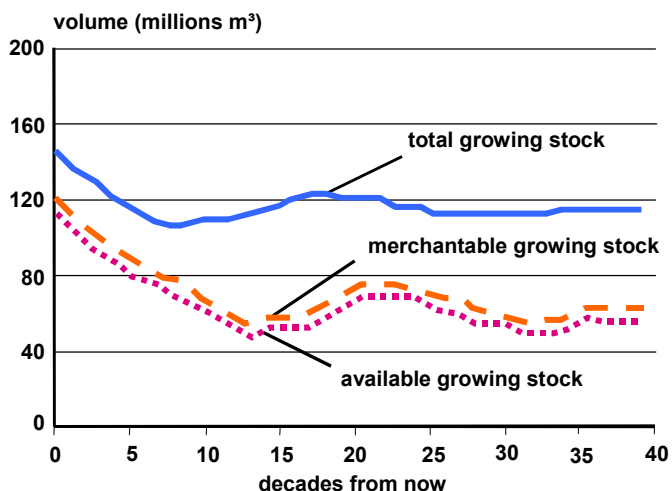


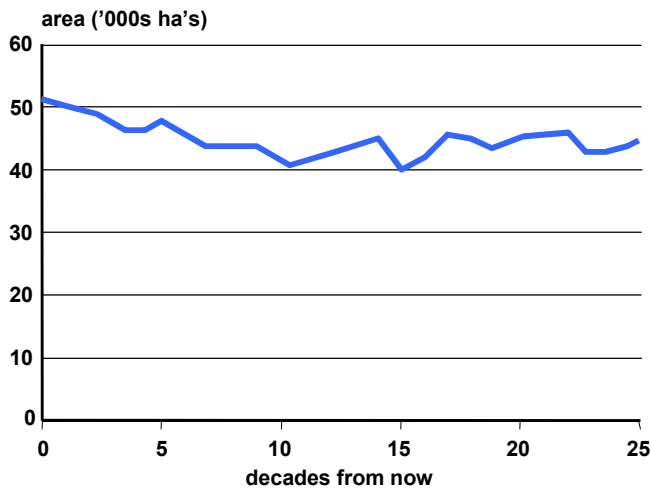
Figure A-3. Total merchantable and available growing stock, Lakes TSA, 1995





The area harvested over time decreases while the oldest stands are eliminated from the timber harvesting land base (Figure A-4). As the mature stands become depleted, timber rationing begins and the area harvested drops until the managed stands reach merchantable limits.

Figure A-4. Average area harvested over time, Lakes TSA, 1995

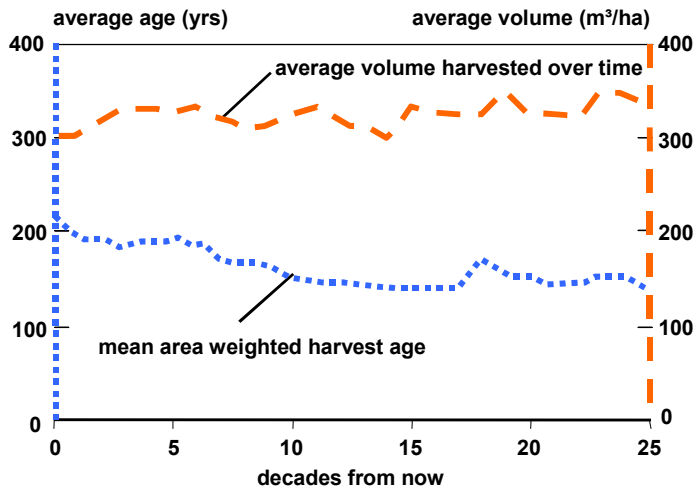


The average volume per hectare of timber harvested remains between 300 and 340 cubic metres per hectare even though the average age harvested drops steadily until a long-term level is reached in decade 12 (Figure A-5).

The reason the average volume harvested remains at a steady state is that after culmination the existing-stand volume curves are similar. This creates similar average harvest volumes for all existing stands. Secondly, managed stands may have lower minimum harvestable ages, but the volume curves are similar to those for existing stands. This creates similar average harvest volumes once mature stands are depleted.



Figure A-5. Average age and volume per hectare of harvested stands over time, Lakes TSA, 1995



Transition from Natural to Managed Stands

The transition of the harvest from old growth to predominantly second growth is plotted on Figure A-6. Note that the placement of this transition line is estimated—this information was not reported from the TSR1 analysis. The transition curve helps identify the response framework for Type 1 and Type 2 Silviculture Analyses because the end of the mid-term (beginning of the long-term) period is the point when the harvest is predominantly dependent on managed stands. We have identified 180 years as the end of the mid-term for the Lakes TSA. The short term is arbitrarily defined as the first 20 years.

Figure A-6. Transition from natural to managed stands, Lakes TSA, 1995

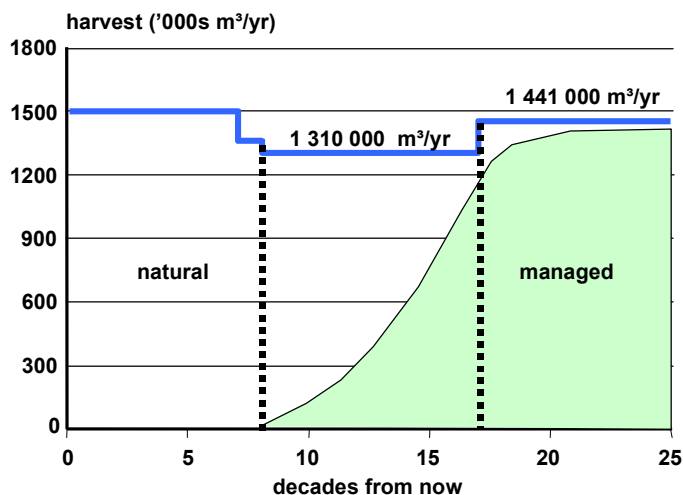
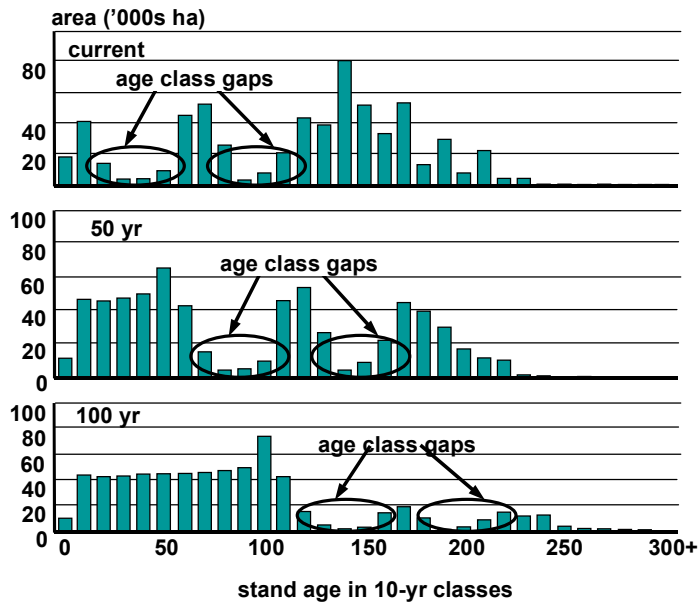


Figure A-7 displays the age class distribution on the timber harvesting land base currently, in 50 years, and in 100 years. It also shows how the age class gaps will affect the forecast even after the



transition from natural to managed stands has occurred. The shortage of mature timber 100-150 years from now is caused by the current age-class gaps. The area found in these gaps 100-150 years from now will be used to meet forest cover objectives; there will be little area remaining to contribute to the harvest. The harvest level cannot rise until decade 18 when managed stands are available for harvesting.

Figure A-7. Current and future age class distribution, Lakes TSA, 1995



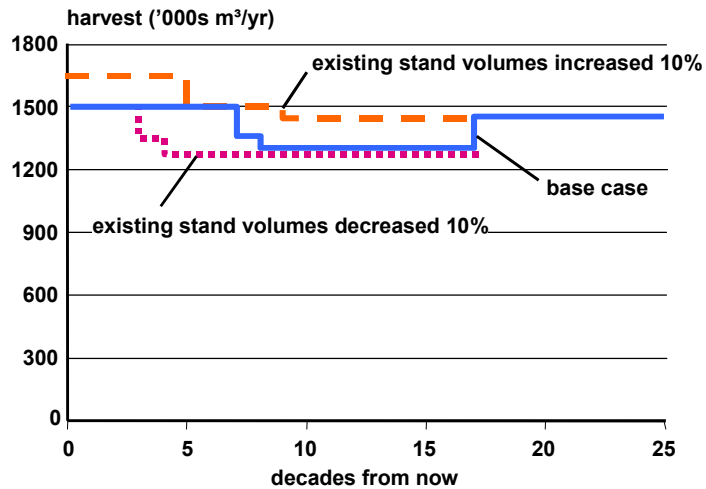
Sensitivity to Existing Stand Volumes

Increasing existing stand yields has a significant effect on the short to mid-term harvest levels (Figure A-8). Since a large proportion of stands are older than the minimum harvestable age, increasing yield estimates means that more volume will be obtained from these stands, and the initial harvest level can be increased for the first 5 decades.

Decreasing the volumes for existing stands by 10% causes a drastic decline in the harvest level, but does not change the harvest level in the first 20 years. Decreasing stand volumes could represent risk of losing inventory or overestimating utilization.



Figure A-8. Sensitivity to existing stand volumes, Lakes TSA, 1995



Sensitivity to Regenerated Stand Volumes

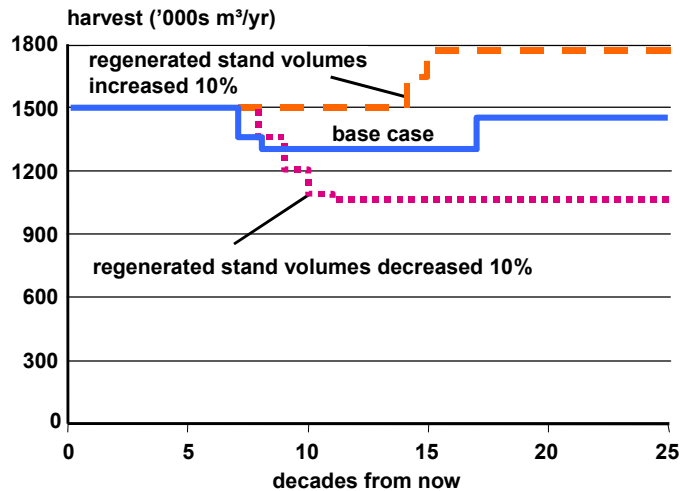
Enhancing regenerated stand volumes by 25% increases the long-term harvest level (LTHL) so that the initial harvest level can be maintained for 14 decades, when it can increase to a LTHL that is 24% higher. (Figure A-9). The effect of using genetically improved seed would be similar to that from enhancing regenerated stand volumes. Genetic gain is estimated to be 7% to 9% for pine and 2% to 12% for spruce¹. The District uses only improved seed for spruce, and the first improved pine seed will be available this year.

Decreasing regenerated volumes reduces the LTHL to approximately 24% lower than the base case LTHL. Reductions in the regenerated stand volumes could represent overestimating site productivity or increased intensity of pest infestations.

¹ Data from MoF Timber Supply Branch, Victoria.



Figure A-9. Sensitivity to regenerated stand volumes, Lakes TSA, 1995



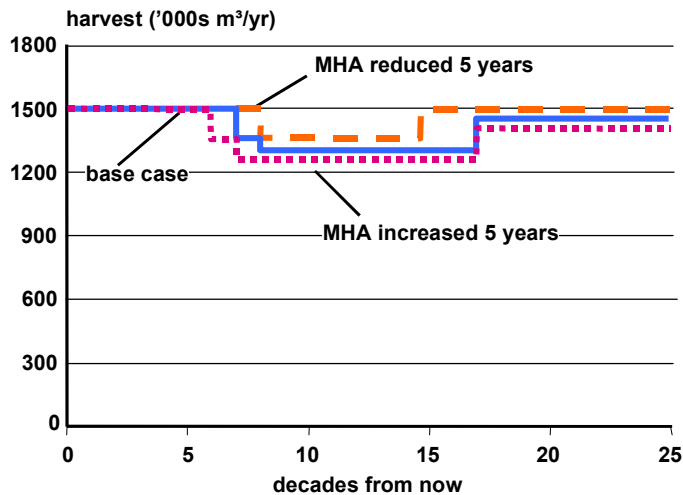
Sensitivity to Minimum Harvestable Ages

Minimum harvest ages might be reduced through silviculture. The TSR sensitivity analysis (Figure A-10) gives a sense of the nature, magnitude, and timing of timber supply effects that would result from doing so.

Reducing minimum harvest ages by ten years increases the volume of timber available between decades 11 and 14, allowing the initial harvest level to be maintained one decade longer than in the base case. It allows makes the first regenerated stands available for harvest sooner, allowing the harvest to be increased to the long-term harvest level two decades earlier than in the base case. Increasing minimum harvest ages by ten years reduces the volume of timber available in the mid-term, making it necessary to reduce the harvest level one decade earlier than in the base case. Neither increasing nor reducing minimum harvest ages affects the harvest level earlier than decade seven.



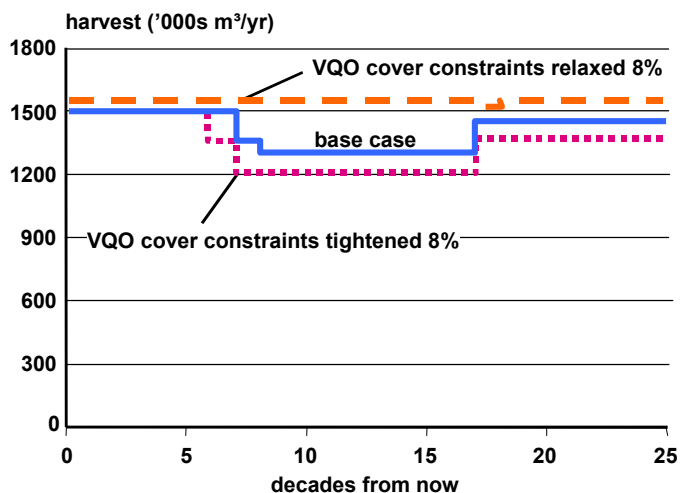
Figure A-10. Sensitivity to minimum harvestable ages, Lakes TSA, 1995



Sensitivity to Forest Cover Requirements for Visual Quality

Figure A-11 illustrates the effects of changing the amount of area required to meet VQO cover guidelines. Relaxing VQO requirements makes it possible to maintain the initial harvest level throughout the planning horizon. Tightening VQO cover requirements necessitates a marked reduction in the mid-term and long-term harvest levels.

Figure A-11. Sensitivity to forest cover objectives for visual quality, Lakes TSA, 1995



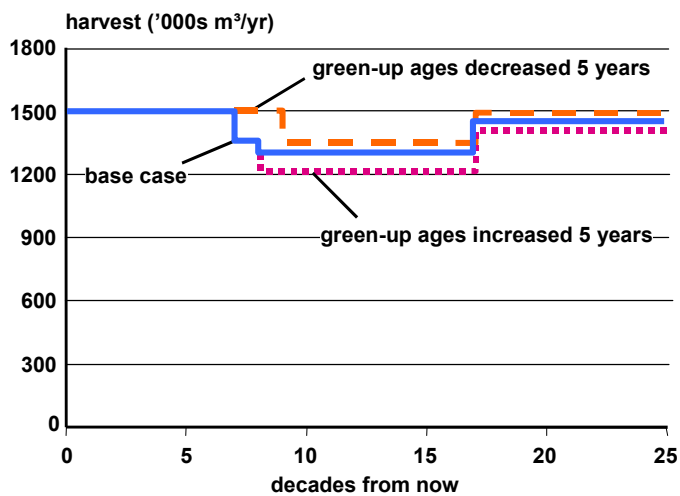
Sensitivity to Green-up Ages

Another way of affecting managed stand volumes is increasing or decreasing green-up age (Figure A-12). Silvicultural regimes can be employed to reduce the number of years to reach the desired green-up age. Pre-free growing regimes such as improved planting stock, site



preparation, brushing, and fertilization are examples of regimes that could lessen the number of years required to reach desired green-up age. Changing green-up age has no effect on the short-term harvest level, and a modest effect in the mid-term and long-term.

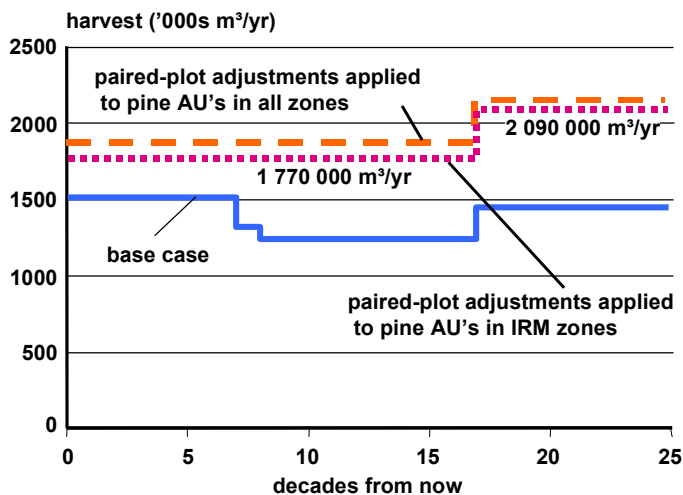
Figure A-12. Sensitivity to green-up ages, Lakes TSA, 1995



Uncertainty in Site Productivity for Managed Pine Stands

There is some uncertainty about site index values for regenerated pine stands in the Lakes TSA. Dense stocking in fire-regenerated stands is thought to suppress the height growth of these pine stands. Incorrect site index values affects projected stand volumes, minimum harvestable age, and green-up age. If the site indices for regenerated pine stands are adjusted by applying the results of paired-plot studies in the Lakes and Morice TSAs, harvest levels throughout the planning horizon can be increased significantly (Figure A-13).

Figure A-13. Sensitivity to site productivity estimates, Lakes TSA, 1995





Timber Supply Dynamics -- Summary

The main constraint on timber supply in the Lakes TSA is the scarcity of available timber in the late mid-term, due mainly to the gaps in the age class distribution of stands currently aged 30-50 years and 90-100 years. The harvest forecast is very sensitive to the estimates of site productivity for regenerated pine stands, and to the constraints on percent area disturbed representing visual quality requirements. Management interventions that affect these factors could significantly affect timber supply.



Appendix B. Executive Summary, Incremental Silviculture Strategy for BC

Purpose

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

Government's Goals

- Sustainable Use
- Community Stability
- A Strong Forest Sector

Key Principles

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

Working Targets

Within the context of the guiding principles:

- 1 Minimize the anticipated interim reduction in timber supply so that provincial annual harvests of at least 65 million m³ can be achieved.
- 2 Create a long-term timber supply capable of supporting a steady long-term provincial harvest level of at least 75 million m³.
- 3 Over the long term, maintain the production of premium quality logs at or above 10% of total harvest.

Major Silvicultural Strategies

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

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

Strategy Implementation

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



Appendix C. Rejected strategies

During the workshop the following strategies were rejected because they were considered infeasible. Many of them were moved to the To-Do list.

Determining appropriate treatment for salvaged MPB-killed areas	Ensuring adequate age or structural diversity in large areas of salvage cutting	Smpb3	Be aware of this problem if there is a large increase in AAC to deal with beetle salvage	large areas of beetle infestation & salvage	
Loss of volume to stem rusts	Reduce losses to stem rusts	Sr1	re-examine use of burning in site prep		move to To Do list
Loss of volume to stem rusts	Reduce losses to stem rusts	Sr3	look into availability of rust-resistant stock		move to To Do list
Log quality in long term					
VQOs restricting harvesting	find ways to mitigate impact of VQOs on harvest level	Svqo1	Identify effect of variable treatments within viewscapes	scenic areas	move to To Do list
Increasing long-term harvest levels	Increase genetic gain	Sltv1	check status of spp. plans and breeding programs		move to To Do list
Increasing long-term harvest levels	Expand THLB to provide opportunities in case beetle problems change timber supply forecast drastically	Sltv2	Problem forest types and overstocked pine stands--opportunities for harvesting	investigate site index on dog-hair pine stands	move to To Do list
Moose and deer winter range	Maintain forage for ungulates	Suwr1	allow for adequate forage production in pre-FG state (current levels are acceptable)	specific identified ungulate winter range areas	
Losing deciduous component of forests (LRMP concern)	avoid reducing the proportion of aspen in regenerating stands		already accounted for in recent changes to guidebooks allowing decid stems to be left		
Marten populations "crash" after brushing and spacing treatments					