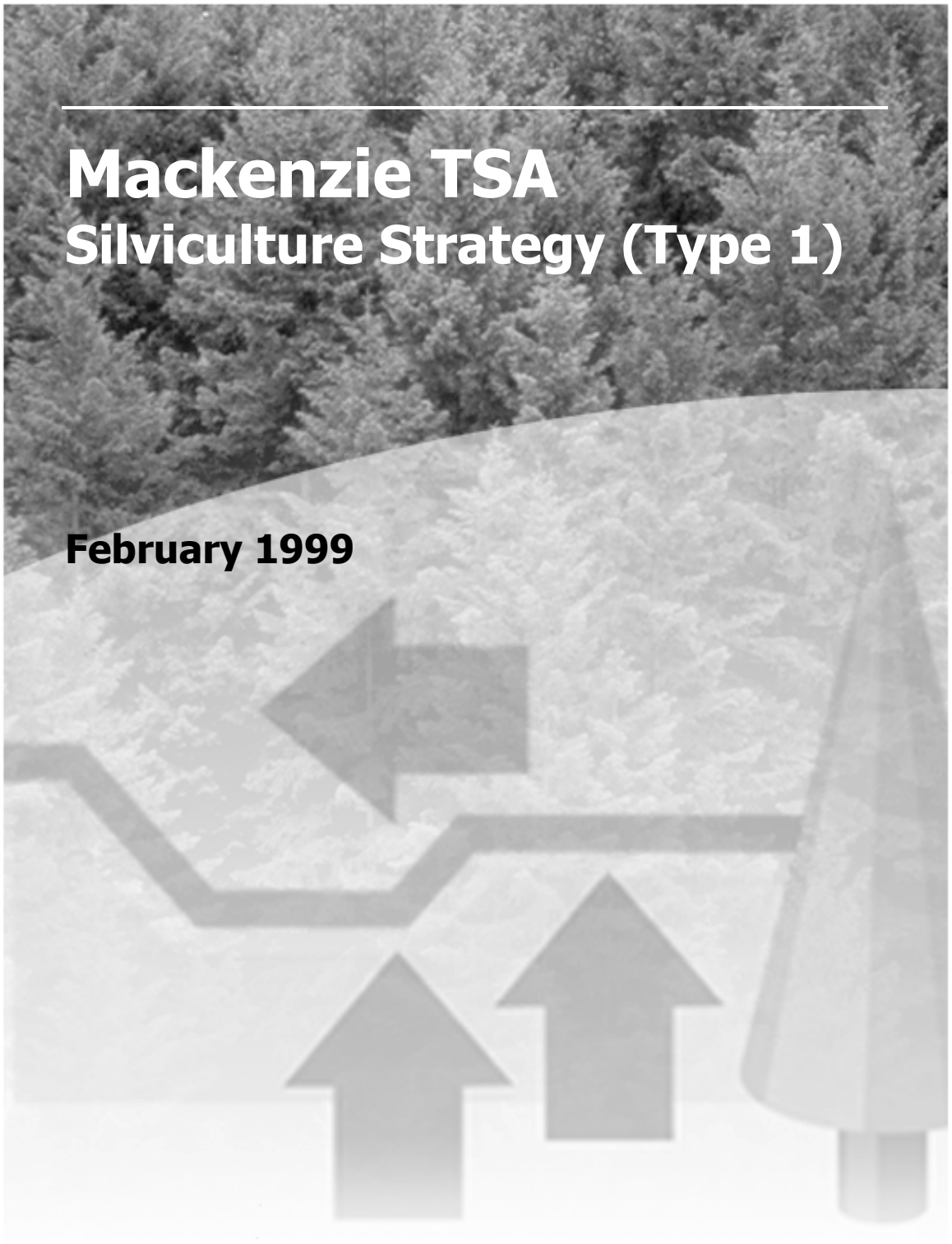
Mackenzie TSA
Silviculture Strategy (Type 1)

February 1999



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DRAFT

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The consultants also wish to thank the participants in the workshop whose contributions are the basis of this strategy.

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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, as well as regional and provincial silviculture objectives.

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.

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 four timber issues (short, medium and long-term timber supply, a timber quality - clear wood), and three habitat issues relating to the maintainance and restoration of caribou and Grizzly bear habitat.

Elements of the Strategy

1. Maintain the dimension of timber harvesting land base that is assumed by the TSR by ensuring the stocking of pre-87 backlog logging-origin stands.

   Maintaining the timber harvesting land base will contribute to maintaining long-term timber supply.

   In addition to the treatment of the logging-origin backlog, two closely related topics were listed as requiring investigation: 1) evaluate the effects of lower than optimal stocking levels of the pre-87 stands within the THLB on the harvest forecast in the upcoming Type II silviculture analysis and 2) prepare a treatment plan for those areas confirmed to be not satisfactorily restocked.

2. Implement a regime of fertilizing Pl and Sx on appropriate sites, from age 15 until harvest , at 15-year intervals to increase existing and regenerating stand yields.

3. Space pre-87 under-performing Pl to reduce green-up ages.

4. Prune Pl to stands to increase the volume of clear wood.

5. Undertake treatments on specific areas and across the timber harvesting land base to ensure that caribou habitat is maintained or enhanced and that disturbed Grizzly bear habitat is restored.

6. Undertake investigations and studies identified in the workshop as necessary for the further development of the TSA silviculture program.

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		
1	Surveys - general	15,900	nr
2	Surveys- burn	8-10,000	nr
3	Survey, Fg – pre-87	70,000	1
4	Field Sampling	130,000 (tot)	1
	Regeneration		
5	Backlog - Fill plant	550 /2 years	1
6	Backlog - Brush and weed	1350 ha /1yr	1
7	Plant improved seed	10,000	3
	Spacing		
8	Pre-87 repressed Pl	800	4
	Fertilize, Pl, Sx (25%G,M,25%P)	1000	
9	Pl late rotation, scheduled for harvest in decade 2		5
10	Pl late rotation		5
11	Pl, Sx regenerating		5
	Prune		
12	Pl, 1st lift	100	7
13	Pl, 2nd lift	100 in 8-10 yrs	7
	Habitat		
15	Recruit caribou habitat – Pine Burn	ns	2
16	Recruit caribou habitat – timber harvesting land base	ns	4
17	Enhance Grizzly habitat (space)	ns	8

nr: not ranked
ns: not specified

Table of Contents

1. Introduction

The objective of this section is to identify the critical issues that guide silviculture planning on the TSA and to identify objectives with respect to those issues.

1.1 TSA Issues Impacted by Silviculture

Issues that can be addressed through silviculture were obtained from the District (District Enquiry), the most recent Resource Management Plan, and other documents identified by the District. These issues were reviewed and expanded by the workshop.

1.1.1 Timber Supply Issues

NSR Area - The TSR base case assumed that 18 200 ha of backlog NSR would be restocked within the next 10 years. The AAC rationale notes that the district expects this to happen over 20 years.

Uncertainty with respect to status of the pre-87 logging and fire disturbed land base - There is concern that many pre-87 logging and fire disturbed stands are not stocked to the levels assumed in the TSR1 analysis. The District estimates that in excess of 32 000 ha of logging origin stands are impeded and 12 820 require confirmation of stocking and a further 69,300 require stocking and/or free growing surveys to confirm their backlog status. Of the fire-origin pre-87 land base, (275 000 ha) only 8% is confirmed NSR and the remainder is of unknown status.

Site Index - As indicated in the 1999 Mackenzie RMP, the site index of stands in the TSA may be 20% higher than existing stands. This would mean for a medium site Pl stand an increase in SI from about 16 to about 19. A Pl stand, SI 16, planted to 1600 sph culminates at age 85 and yields 248 m3 per ha at 12.5 cm utilization (standard TIPSY OAFs). At SI 19, this same stand culminates at age 72 and yields 286 m3 per ha. The MAI increases by 36%, from 2.92 (SI16) to 3.97 m3 per hectare per year (SI 19).

Biotic Growth Factors -There is some evidence that deciduous competition (32 000 ha) and lodgepole pine stem rust infections on many pre-87 managed stands are resulting in sub-optimal stocking levels and that therefore these stands will yield lower volumes than expected. Most of these stands, however, are older than 10 years and therefore their yields were projected using VDYP. VDYP yields are considerably below those of managed stands (TIPSY yields).

1.1.2 Habitat Issues

Caribou – The local LRMP caribou management strategy includes the following statement: "Encourage use of reforestation and stand tending practices that enhance terrestial lichen retention and recovery on sites that are potential forested winter habitat (for caribou)." There are two objectives: 1) to enhance the creation of suitable microsites for lichen establishment after logging on dry sites and 2) to enhance the dispersal of the preferred species into these areas. The success of these measures in providing caribou habitat at an earlier stand age might also depend on the forest canopy providing suitable cover at an earlier age but there is some indication locally that young pine stands can do that. The stand tending strategy is to retard the succession of lichen cover on the forest floor to moss cover on some of the more mesic sites, thus retaining the value of these stands as caribou habitat for a longer period prior to harvest.

The highest lichen loadings found by UNBC researcher Darwin Coxson were in sites that were logged during the winter about 20 years ago. This suggests that winter logging in prime areas would benefit caribou. In the short term the goal would be to retain lichens by winter logging and thinning or creating small opening in caribou range. Peak lichen abundance occurs about 90 – 100 years post logging. About 150 years post logging moss mats begin replacing, or overgrowing the lichens. In the long term the re-introduction of fire would benefit caribou.

Grizzly Bear – The manipulation of stocking densities on prime valley bottom grizzly bear habitat sites is desirable to try to avoid the dense spruce canopy that usually occurs in the mid-seral stage. The problem is not immediate, but is anticipated 30-40 years after logging, persisting to approx. age 100-120 in this area.

Deciduous component – There is concern that a combination of better fire suppression, prompt reforestation of recent burns with conifers, and natural succession of deciduous stands to conifer will, over time result in the elimination of deciduous dominant stands. Deciduous dominant stands often provide habitat components that are unavailable in conifer stands in this area.

Moose - The Peace-Williston Compensation Program is considering some trials of a proposed manual brushing technique that may achieve conifer release while continuing to provide moose browse for a longer period of time than the standard brushing methods. If the trials are successful these techniques could be very useful on good upland moose winter habitat.

1.2 Objectives of the Silviculture Program

1.2.1 Management Unit Objectives

The workshop did not define objectives specific to the issues listed in section 1.1 but instead adopted the facilitators more general objectives of increasing timber supply in each of the short, medium and long term (defined in section 2.4), and to increase timber quality with respect to premium and sawlog product definitions.

1.2.2 Provincial and 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. The *Incremental Silviculture Strategy For British Columbia (Interim)* states the Ministry of Forests' provincial level strategy. The strategy's executive summary is reprinted in Appendix 1. The provincial strategy was considered in the development of this TSA strategy.

2 The Timber Supply Context

Timber supply is often the dominating issue on British Columbia management units. The objective of this section is to identify aspects of the timber harvesting land base and its management that govern the supply of timber from the TSA. This information provides the basis for identifying the constraining mechanisms that shape the timber supply forecast for the unit and for specifying possible silvicultural remedies. Unless otherwise indicated, the data in section is drawn from the Mackenzie TSA Timber Supply Analysis (1994).

2.1 Synopsis of the Land Base Inventory

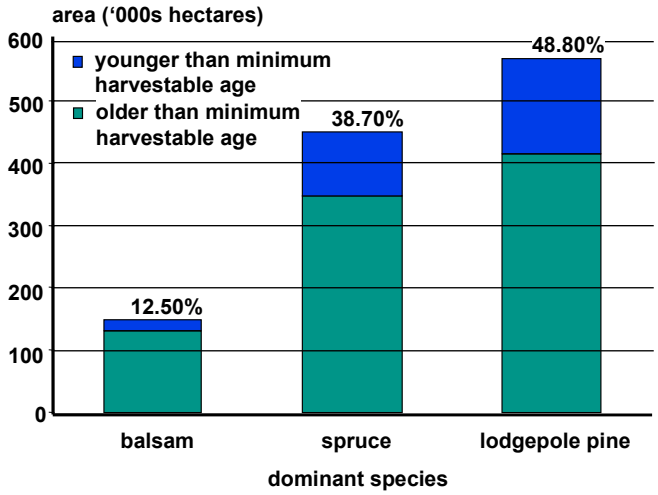
This section reviews aspects of the land base inventory that are relevant to determining a silviculture strategy.

The Mackenzie TSA covers 1 018 400 hectares, of which 233 800 (23%) is considered to be in the timber harvesting land base.

The site class classification for TSR 1 was: 55% medium, 28% poor, 1% low, and 16 % good site. A recent re-inventory has shifted the site classification used for TRS2. The current site classification is: 38% medium, 41% medium, 21% poor, and 38% good site.

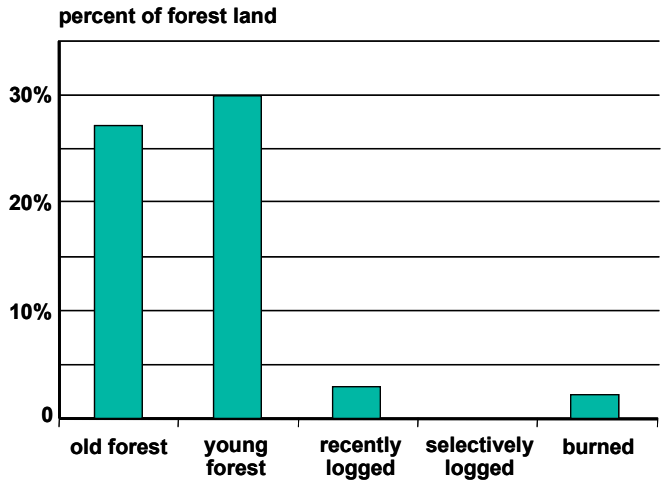
Figure 2-1 shows the proportion of area of each species that is either younger or older than the minimum harvestable age. Approximately 77% of the stands in the timber harvesting land base are at or above the minimum harvestable age.

Figure 2-1 Area by dominant species, Mackenzie TSA 1995.



The Watersheds BC database classifies forests stands by age and disturbance, and is useful for identifying habitat issues. On Figure 2-2, old forests are defined as age >140 years, young forests are age <140 years, recently logged forests are age ≤ 20 years, selectively logged forests are forests selectively logged during the last 20 years, and burned forests are forests burned during the last 20 years. The maps used to create this database were based on data from 1992-1993. Therefore any areas burned or logged in the last 6 or 7 years are not reflected by this data.

Figure 2-2. Watersheds BC forest classification of the timber harvesting land base, Mackenzie TSA 1995.



2.2 Silviculture Program

2.2.1 Silviculture History

Table 2-1 records backlog (pre-1988 openings) silviculture for the TSA, while Table 2-2 records current (post 1998 openings) silviculture. Only silvicultural activities which took place after 1985 are shown for both tables.

2.2.2 Backlog

The latest inventory estimates of pre-'87 backlog in the TSA is 395 000 ha, or 13% of the productive forest land base (34% of the current harvesting land base). Of this total, 120 000 ha consists of sites disturbed by logging activity, and 275 000 ha are of wildfire origin. Of the combined total, 376 333 ha were assumed in the TSR analysis to be contributing to the timber supply at a fully stocked, unimpeded rate.

In reality, many of these stands are marginally stocked with conifers and/or impeded by broadleaf vegetation, thereby producing coniferous timber a rate lower than may have been assumed. Current estimates (from Mackenzie District backlog database), for example, indicate that at least 32 000 ha of the logging origin pre-'87 land base requires some form of impeded stand release intervention.

Table 2-1 Backlog silviculture history 1986-98 , Mackenzie TSA.

Year	Backlog Site Preparation (ha)	Backlog Planting (ha)	Backlog Brushing (ha)	Backlog Spacing (Pre-Commercial Commercial Thin) (ha)	Backlog Pruning (ha)	Backlog Fertilization (ha)
1986	18746.7	8434.9	885.9	245		
1987	9692.9	9440.9	1712.9	766		739
1988	7539.9	10460.4	946	851		580
1989	4001.4	8636	2044.5	1135.5	21	581
1990	1111.8	4265.8	1411.9	491.1		
1991	1317.9	1972.6	2352.8	920.4		
1992	1248.8	1269.4	1602.3	344.5		
1993	347	1764.7	1888.2	14		
1994	142.9	389.6	1185.6	565.3		
1995	276.4	26	1328.6	92.3		
1996	4	307.8	2496.2	463		
1997		3.6	2762.8	844.5		
1998		35.7				
Total	**44429.7**	**46971.7**	**20653.4**	**6732.6**	**46971.7**	**1900**

Table 2-2 Current silviculture history 1988-99 , Mackenzie TSA.

Year	Site Preparation (ha)	Planting (ha)	Brushing (ha)
1988	863.2	56.4	
1989	5276.9	1562.1	
1990	5782.9	6977	
1991	6179.3	6154.8	
1992	5504.9	6247.6	
1993	7004.2	9632.2	240.2
1994	3930.3	9911	
1995	2602	10086.8	251.1
1996	610.5	8010.5	1906.1
1997	102.8	3039.6	1240.1
1998	93.8	2578	689.1
1999	21.9	474.8	
Total	**37972.7**	**64730.8**	**4326.6**

2.2.3 Spacing Regimes

The annual area spaced has fluctuated greatly over the 1990's. Recent spacing has averaged about 500 hectares per year. Maximum past program level was about 1 100 hectares per year in 1990.At the end of fiscal 98/99, there was a total of about 7 600 hectares of spaced stands (about 0.7% of THLB).

2.2.4 Tree Improvement

The tree improvement program is likely to significantly improve stand yields over time, in the order of 5% for lodgepole pine and 15% for spruce. Table 2-3 lists the most recent volume gain estimates for improved seed.

Table 2-3. Forecast gain in volume from improved seed for the Mackenzie TSA.

			% Gain – Improved Seed		
Species	**Seed Zone**	**Elevation (m)**	**98-99**	**90-00**	**2007-08**
Pli	CP Low	<1000	6	3	7
Sx	PG Low	<1200	14	15	17
Sx	PG High	<1200	17	17	16
Fdi	PG Low	<1200	19	19	19

2.3 TSR1 Management Assumptions

In addition to the inventory, or current state of the forest, assumptions about how it will be managed as essential for determining a silviculture strategy.

2.3.1 Inventory Profile

The inventory profile (species composition) of the timber harvesting land base is expected to change over time. After harvest, stands with a predominance of balsam are planned for regeneration to spruce. Under this management regime, the forest would consist about equally of lodgepole pine and spruce dominated stands. Table 2-4 records the trend in species profile resulting from the harvesting schedule of the TSR base case.

Table 2-4. Current inventory profile by area, Mackenzie TSA 1995.

	Species Profile
Species	**Area%**
Pl	49
S	39
B	12
Total	**100**

2.3.2 Management Zones and Forest Cover Requirements

The TSR management zones and their associated forest cover requirements are listed in Table 2-5. The requirements are applied by: a maximum of 33% of the area in a zone may be younger than the specified green-up age.

Table 2-5. Management zones and forest cover requirements.

Zone	Green-up age (years)	Maximum per cent area younger than green-up age	Old-age forest (years)	Minimum per cent area older than 150 years
Wildlife/watershed	16	21		
Wildlife (old-age 1)	18	33	150	25
Wildlife (old-age 2)	15	33	150	25
Integrated resource management	17	33		
Retention VQO	21	3		
Partial Retention VQO	20	11		
Modification VQO	20	27		

Source: Derived from TSR Mackenzie TSA Timber Supply Analysis 1995, p75.

2.3.3 Minimum Harvestable Age

For the Mackenzie TSR1 analysis, minimum harvestable ages were defined as the age at which 95% of the maximum average growth rate is reached. Table 2-6 lists the minimum harvestable ages for natural and managed stands by species and site class.

Table 2-6. Minimum harvestable ages by leading species and site class, Mackenzie TSA 1995

Species	Stand Origin	Min Age by Site Class (yrs)		
		G	M	P/L
B	Managed	65	90/120*	125/160*
B	Natural	60	70/80*	90/110*
S	Managed	70	95	130/170*
S	Natural	75	95	120/140
Pl	Managed	55	70	80
Pl	Natural	60	75	100

Source: Derived from TSR Mackenzie TSA Timber Supply Analysis 1995, p70. Minimum ages for stands regenerated from original whose ages were under/over 140 yrs of age – the reason for this distinction is not stated.

2.3.4 Harvesting Practices

The TSR1 analysis report indicates a first decade harvest level of about 11 000 hectares per year, rising to about 12 000 hectares per year in the second decade, after which it declines steadily to about 8 600 ha/yr in decade 9. The next peak in area harvested is in decade 16, corresponding with harvesting in primarily poor site managed stands.

It was estimated that approximately 10 059 hectares is harvested per year. This estimation was derived by adding the area for the first 50 years when the age class distribution is 50 years in the future. Virtually all area is clearcut followed by planting.

For the purposes of this strategy, a mid to long term average harvest area of 10 000 hectares per year is assumed. Of this, all is assumed to be clearcut.

2.4 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 landbase 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.

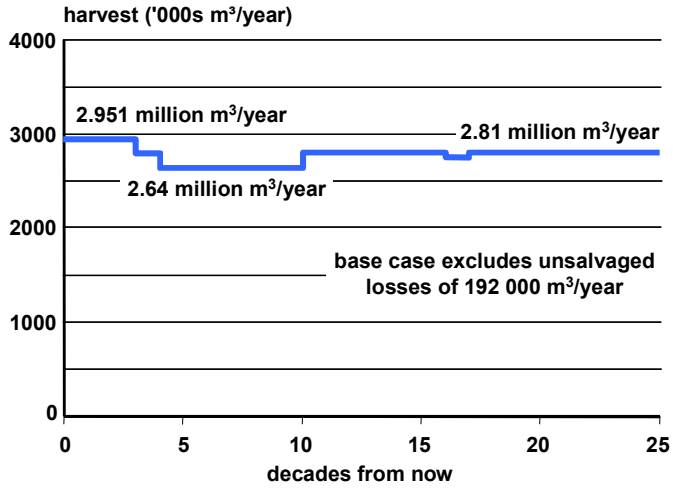
2.4.1 Timber Supply and the AAC

The 1995 TSR, upon which the current AAC determination was based, shows that the pre-TSR AAC could be maintained for 3 decades before dropping at the rate of 5.25% per decade over the next 2 decades to a trough about 10.5% below the initial harvest level (Figure 2-3). After 10 decades, beginning 100 years from now, the harvest level rises about 5% to the long-term harvest level (LTHL).

The LTHL is only 4% below the long run sustained yield (LRSY). One-half of this (2%) is attributed to below optimum scheduling of the harvest related to the objective of maintaining a constant even flow. The other half is attributed to sub-optimal scheduling resulting from forest cover constraints. This forest cover constraint effect is among the lowest in the province, which are often in the 8-10% range elsewhere. It is consistent with the very small areas in highly constrained wildlife, watershed and scenic management zones.

The mid term shortfall is not a product of a shortage, but rather occurs be-cause the higher productivity associated with 2nd growth managed stands (54% higher MAI) allows harvest levels to increase once these stands become available

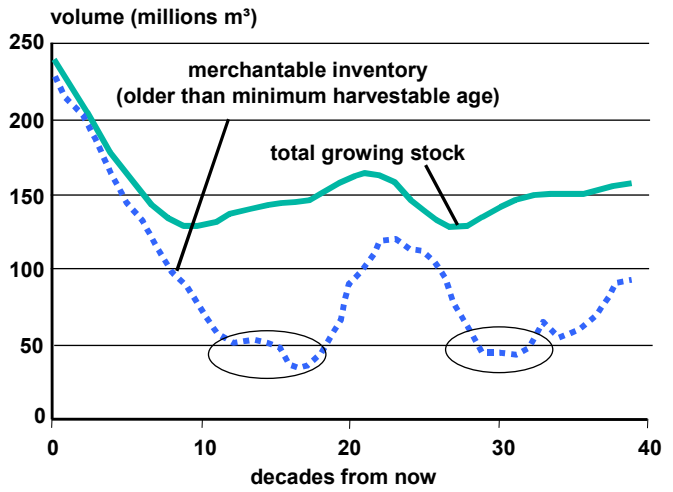
Figure 2-3. Base case harvest forecast, Mackenzie TSA, 1995.



2.4.2 Harvest Scheduling and Growing Stock Availability

The available and merchantable growing stock (Figure 2-4) decline steeply until decade 10, coincidental with end of the mid-term trough. This pattern is indicative of rationing of natural mature stands until managed stands predominate the harvest.

Figure 2-4. Total and harvestable growing stock, Mackenzie TSA, 1994

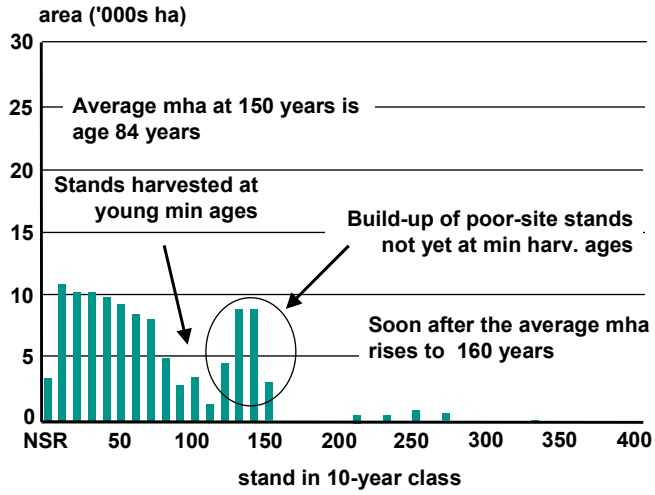


Growing stock is at a very low level during decades 11-17 and this low level repeats itself about every 150 year. This repetition reflects a 160 to 170 year cycle of growth and harvest of the less productive sites with older minimum harvest ages.

This cycle results a unique age class structure in the TSA 150 years from now (Figure 2-5). When the forecast reaches 150 years from now, there is a shortage of stands that are available for

harvesting. Higher minimum ages for poorer site stands result in a build-up of slightly older stands.

Figure 2-5. Age class composition 150 years from now.



This cursory examination of the TSR graphics indicates that the shape of the timber supply forecast is determined by the need to ration timber until the cut can be supported by managed stands and that the main constraining mechanism is the age class structure of the TSA, the distribution of sites productivity in that age class distribution, and growth rates.

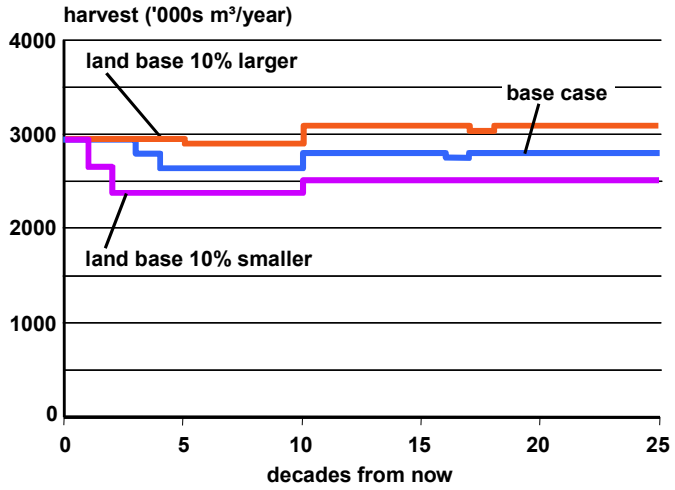
2.4.3 Changes to the Timber Harvesting Land Base

Various silvicultural activities can be interpreted as bringing land into the timber harvesting land base and so the TSR sensitivity analyses of the effect of increasing the timber harvesting land base (Figure 2-6) will provide information on the magnitude and timing of the benefits. Increasing the timber harvesting land base increases timber supply across the whole planning horizon, while land base reductions result in a disproportionately large impact in the short and early mid-term.

Increases in the timber harvesting land base may be accomplished silviculturally by treating NC Br, deciduous, low site, and non-merchantable stands. Note that Figure 2-6 indicates that if a relatively small proportion of the area that was deducted in TSR1 becomes operable and/or merchantable, then the current AAC can be maintained indefinitely.

Decreases in the timber harvesting land base may occur due to newly protected areas or, of special interest in Mackenzie TSA (see sections 1.1 and 2.2.2), due to management not meeting TSR assumptions with respect to stocking levels on pre-87 disturbed lands.

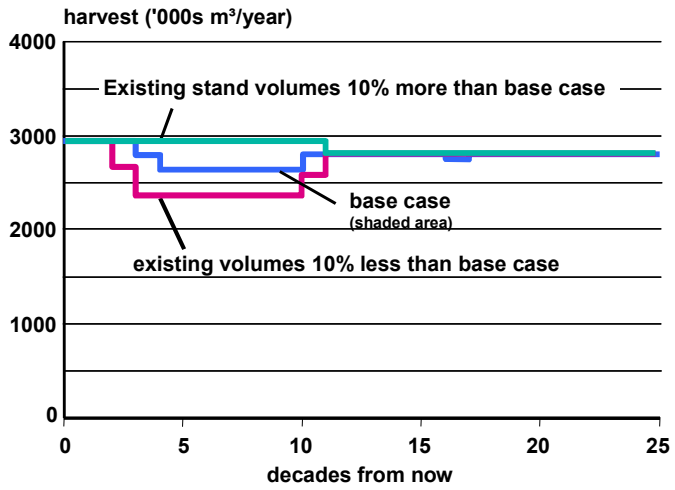
Figure 2-5. Harvest forecast with the timber harvesting land base +/- 10%, Mackenzie TSA, 1995.



2.4.4 Changing Stand Volumes

The TSR found that lowering existing stand volumes 10% causes the drop to the shortfall level to begin one decade earlier than in the base case (Figure 2-7). The shortfall is lowered further to about 19% below the current AAC.

Figure 2-7. Harvest forecast with existing stand volumes +/- 10%, Mackenzie TSA, 1995.

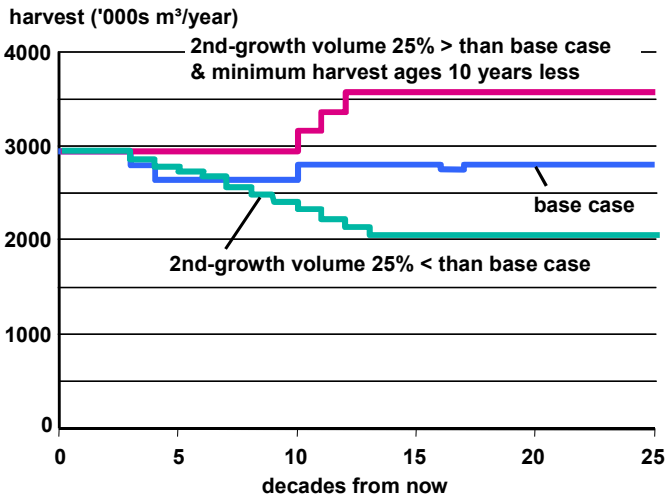


Fortunately, a recent inventory audit has indicated inventory stand volume estimates to be acceptable, so the base case is not inordinately at risk from lower estimates.

However the TSA has a large fertilizable land base. Fertilization of suitable existing stands would increase their volumes and could contribute to increasing the timber supply in the short and mid terms. Given the size of the TSA, however, a very large fertilization program would be necessary in order to significantly affect the harvest forecast.

The TSR defined managed stands include existing stands less than 10 years old and all future regenerated stands. Figure 2-8 shows the effects of increasing and decreasing managed stand volumes.

Figure 2-8. Harvest forecast with existing stand volumes +/- 25%, Mackenzie TSA, 1995.



Clearly, any silviculture treatment that enhances yields of current or future managed stands will have potential impacts in the mid- or long-term. The analysis report does not state when managed stands first become available for harvesting, but given that stands less than 10 years of age are considered managed and given a minimum harvest-able age of 55 years for good-site Pl, then its possible (although not likely) for the model to harvest the first managed stands only 45 years into the planning horizon.

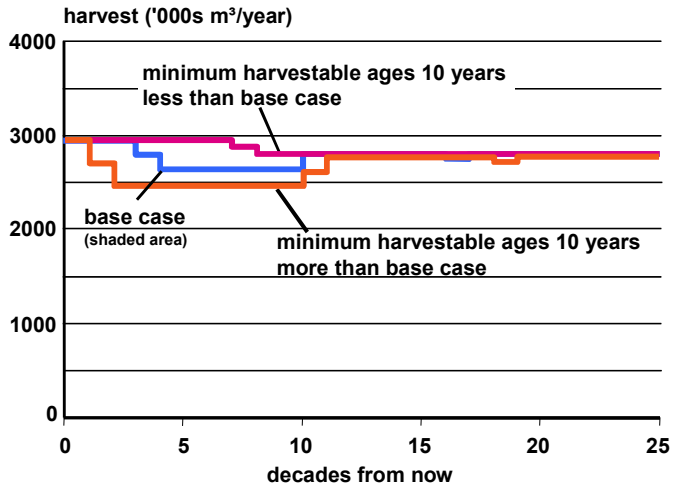
2.4.5 Minimum Harvestable Ages

Changing the minimum ages by only 10 years has a dramatic effect on the harvest forecast (Figure 2-9). Although not stated in the analysis report, this effect may be linked to the shortage of timber exceeding minimum harvest age in decades 12-17.

Lowering the min age 10 years makes timber immediately available to solve the timber supply problem. Conversely, raising the age 10 years makes the problem even worse. Depending upon the alternative, either less or more wood has to be held from the mid term to maintain the constant LTHL. What is not clear is whether the stands being held are existing or managed stands, or a combination of both. If the modelled harvest schedule is likely to occur in reality, then spacing should be focused in poor-site managed stands to reduce their minimum harvest ages. The benefits, in the form of increased harvest levels, could be realized as soon as 3 decades from now.

Growing forests to older ages generally improves their quality. However, Figure 2-9 demonstrates that delaying harvests for this purpose would lower harvest levels substantially in the short and mid-term.

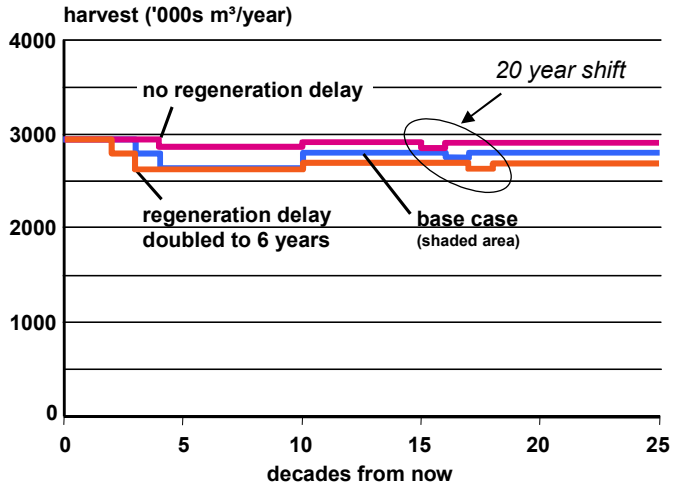
Figure 2-9. Harvest forecast with minimum harvestable ages +/- 10 years, Mackenzie TSA, 1995.



2.4.6 Regeneration Delay

The Mackenzie TSA is highly sensitive to changes in regeneration delay. Reducing the regeneration delay to 0 (a virtually impossible operational achievement) almost eliminates the mid term shortfall and significantly raises the LTHL (Figure 2-10).

Figure 2-10. Harvest forecast with increases to the regeneration delay, Mackenzie TSA, 1995.



Conversely, doubling the delay to 6 years causes harvest levels to commence the drop to the mid term shortfall one decade earlier as well as significantly lowers the LTHL. This is a rather extraordinary response to a relatively small change. The fact that increasing or decreasing the delay causes a 20 year shift in the dip in LTHL indicates that there may be some interaction here with the shortage in timber in decades 12-17.

2.4.8. Timber Supply Dynamics - Summary

The main constraint on timber supply in the Mackenzie TSA is the relative scarcity of harvestable timber in the late mid-term, as the harvest becomes more dependent on managed stands. This scarcity requires that the substantial volumes of existing mature timber from unmanaged stands be rationed until managed stands are ready for harvest. The rationing mechanism (TSR harvest flow constraints) also conveys back to the short- and early mid-term the future timber supply benefits resulting from manipulating forest-level parameters. Silvicultural practices that adjust minimum harvest ages, stand yields, and the extent of timber harvesting land base will have significant effect on timber supply.

However, the same mechanism works in reverse if timber supply is reduced at the period of scarcity : currently mature and available timber must be pulled backward in the harvest queue (rationed) to offset the reduction in available supply in the critical period. Short- and mid-term reductions due to increases in minimum harvest ages and decreases in the timber harvesting land base are disproportionately large relative to the timber supply benefits accruing to those time periods from reducing minimum harvest ages and increasing the land base.

2.4.8. Revision of the TSR Base Case

The TSR1 timber supply analysis was completed in 1995 and was almost five years out of date at the time of the workshop. In those five years new information about the TSA has been obtained, including a new base case harvest schedule developed for the LRMP. The TSR1 base case (Figure 2-3) was reconsidered by the workshop participants in light of their present knowledge of the management unit.

The participants decided, after considering potential upwards and downwards influences on the timber supply, that the base case harvest forecast did not need to be revised.

Potential upward influences include the significant potential to increase the timber harvesting land base (through increasing the operable area and harvesting of stands currently considered non-merchantable) and higher site productivity estimates. Potential downward influences are the LRMP forecast which shows a significant mid-term harvest reduction; the protected areas strategy which may reduce the TSA land base by 7%; the very low levels of forest cover constraints in TSR1 (taken into account in the LRMP forecast); and concerns that managed stand volumes were over-estimated.

3. Silviculture Strategies

Prior to the district workshop, information in the previous sections was used to identify silvicultural strategies as having potential to either maintain or increase future timber supply at the TSA level. These strategies and others introduced by participants at the workshop were analyzed by the 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 3-1. This set of strategies constitutes the silviculture strategy for the Robson Valley TSA, as determined by the workshop participants.

Strategies that were rejected by the workshop are listed in Appendix 3, together with the reasons for their rejection.

Table 3-1. Silviculture strategies, targets and activities identified in the workshop as feasible and desireable for the Mackenzie TSA.

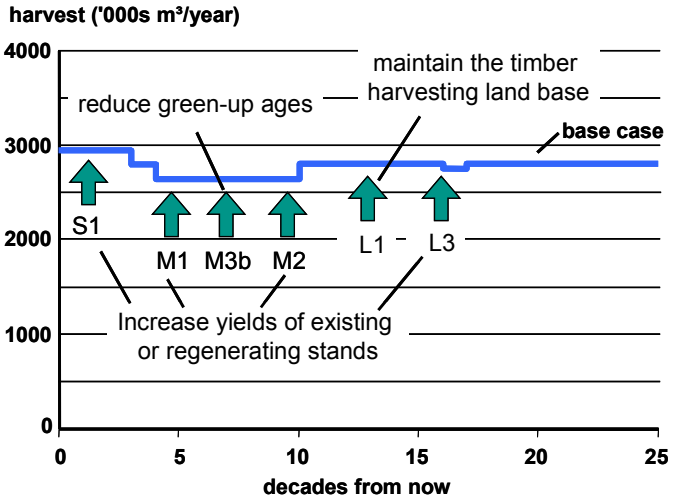
ID	Strategy	Target	Activities
S1	Increase volumes of exisiting stands	Pl (25%G,M,25%P) late rotation -harvest in dec 2	fertilize
M1	Increase volumes of exisiting stands	Pl (25%G,M,25%P) late rotation	fertilize
M2	Increase volumes of regenerating stands	Pl (25%G,M,25%P)	fertilize: 4 applications at 15, 30, 45 and 60 years
M3b	Reduce green-up ages	pre-87 repressed Pl	space
L1	Maintain timber harvesting land base	understocked pre-87 logging-origin stands	1 fill plant 2 brush and weed
L3	Increase volumes of regenerating stands	Pl, S	1 improved seed 2 fertilize: 4 applications at 15, 30, 45 and 60 years
Q1	Ensure clear timber	Pl	Prune 2 lifts
H1	Recruit/modify Pl lichen habit (caribou)	Pl burns	recruit
H2	Recruit Pl lichen caribou habitat	timber harvesting land base	survey recruit
H3	Grizzly Bear habitat	disturbed habitat	space

Note: (25%G,M,25%P) refers to the site range including the lower 25% of good sites, all medium sites, and the upper 25% of poor sites

The ID of each strategy in Table 3-1 conveys the expected time of timber supply response (S-short term, M-medium term, and L-long term, or whether the strategy is timber quality oriented (Q), designed to address forest health (FH) or habitat (H) issues.

Figure 3-1 illustrates the timber supply responses of strategies selected in Table 3-1. Strategies S1, M1, M2 and L3 increase the existing and regenerating timber yields through fertilization. L1 ensures that the timber harvesting land base is not reduced in size by fill planting and brushing and weeding the understocked pre-87 logging-origin stands. M3b reduces green-up ages by spacing underperforming Pl.

Figure 3-1. Location of timber supply effects of the selected strategies.



4. Silviculture Impacts and Priorities

The silviculture activities required to implement the strategies identified in Table 3.1 are listed below in Table 4.1, together with their impacts on the TSA objectives adopted in section 1.2. The workshop determined the opportunity area (i.e., the area available for treatment for the next 5 years), the impacts on timber supply quantity and quality, and habitat effects for each treatment. The employment effects and costs are based on district and licensee records. The rank (priority) of each treatment was determined through consideration of the impacts of each activity on each objective, and represents a consensus of the participants.

5. Silviculture Program

5.1 Tactical Priorities

The rankings of Table 4.1 represent a balance between the participant's strategic concerns and the silvicultural opportunities available on the TSA in the next 5 years.

General surveys are necessary precursors to the remainder of the program and were not ranked.

Free-growing surveys of pre-87 disturbances, field sampling <expand target> were ranked as priority 1, as were and fill-planting and brush/weeding of understocked pre-87 logging-origin stands. All of these activities implement strategy L1, the maintenance of the timber harvesting land base as represented in the TSR.

The project to recruit caribou habitat was ranked as number 2.

Ensuring that the entire timber harvesting land base was planted with improved seed was ranked 3. This activity implements strategy L3, which is to increase the yield of future stands and increase timber supply in the long term.

Spacing pre-87 repressed Pl was ranked 4. The intent of this activity is to implement strategy Mb3, to reduce green-up ages and increase mid-term timber supply.

The fertilization program was ranked 5. This program implements strategies S1, M1, M2, and L3, to increase yields of existing and regenerating stands.

Finally, spacing to enhance disturbed Grizzly bear habitat is ranked 6, and pruning to ensure a supply of clear logs (strategy Q1) is ranked 7 and last.

5.2 Program Costs and Benefits

Table 5-1 contains the area treated by activity and year. Variations in activity levels by year were supplied by the workshop and most often represent the completion of an obligation or specific opportunity (e.g., backlog) or the ramping up of treatment to a higher level of effort (e.g., fertilization).

Table 5-2 contains the expenditure by activity and year, based on the unit costs recorded in the treatment table (Table 4.1).

Table 5-3 contains the silviculture employment benefits associated with the program. These benefits were calculated using employment multipliers tabulated for the most recent TSR.

Table 4-1. Silviculture activities, the strategies they implement, their impacts on TSA objectives, and their priorities as determined by the workshop.

	Activities/Treatments	Strategy	Opportunity Area	Opportunity Area (Ha/Yr)	Timber Supply Effects Short	Medium	Long	Quality	Habitat	Jobs Days/ha	Cost $/ha[1]	Wkshp Rank
1	Surveys - general			15900						0.05	20	
2	Survey - burn			8-10,000						0.05	20	
3	Survey, FG - pre-87		14000	70,000 total						0.05	20	1
4	Field Sampling		26000	130,000 total						0.05	20	1
	Backlog - understocked pre-87 logging-origin stands											
5	fill plant	L1		550 ha over 2 yr		M	M			2.0	1000	1
6	brush and weed	L1		1350 1 yr			M			2.0	1100	1
7	Plant improved seed - 100 % of timber harvesting land base	L3		10,000		++	++	+?	+	2.0	100	3
8	Spacing - pre-87 repressed Pl	M3b		800		M			+/-	3.0	1100	4
	Fertilize - Pl, Sx (25%G,M,25%P)			1000								
9	Pl late rotation -harvest in decade 2	S1			+			+	- ?	0.1	400	5
10	Pl late rotation	M1				+		+	- ?	0.1	400	5
11	Pl, Sx regenerating	L3				+	+	+	- ?	0.1	400	5
	Fertilize, repeat 15 year cylce											
12	Pl,Sx (25%G,M,25%P)	M2, L3		1000		++	++	+/-	- ?	0.1	400	5
	Prune											
13	1st lift Pl	Q1		100				+		4.0	1500	7
14	2nd lift Pl	Q1		100 in yr 8-10				+		5.0	2000	7
15	Recruit caribou habitat	H1		8-10,000 ha total					+	???	???	2
16	Recruit caribou habitat	H2		5000 total					+	???	???	4
17	Space - Grizzly habitat	H3		2500/10 years		-?	-		+	???	???	6

Notes:

+, - indicates, respectively, a positive or negative impact on the indicated objective.

+/- indicates that the activity could have a positive or negative effect, depending on its circumstances of application

M necessary to maintain the TSR; TSR assumption

nr not ranked

Activity 1, general surveys, is estimated to be three times the annual total program level of 5100 ha

Activity 12, repeat fertilization impacts on quality depend on branchiness and product requirements

Activity 12, repeat fertilization impacts on habitat is -ve it is caribou habitat

<-- means emplyment figures must be confirmed

Table 5-1. Area (ha) treated by activity and year.

Year	Surveys* General	Other General	Backlog Fill Plant	Backlog Brush	Space	Prune 1st	Prune 2nd	Fertilize	Total
1	15,900	40,000	550	1,350	800	100		1,000	59,700
2	15,900	40,000	550	-	800	100	-	1,000	58,350
3	15,900	40,000	-	-	800	100	-	1,000	57,800
4	15,900	40,000	-	-	800	100	-	1,000	57,800
5	15,900	40,000	-	-	800	100	-	1,000	57,800
Subtot Yr 1 - 5	79,500	200,000	1,100	1,350	4,000	500	-	5,000	291,450
6 - 10	79,500	200,000	-	-	4,000	500	300	5,000	289,300
Total Yr 1 - 10	159,000	400,000	1,100	1,350	8,000	1,000	300	10,000	580,750

* Includes prescription and layout

Table 5-2. Expenditure ('000 $) by activity and year.

Year	Surveys* General	Other General	Backlog Fill Plant	Backlog Brush	Space	Prune 1st	Prune 2nd	Fertilize	Total
1	318	800	550	1,485	880	150	-	400	4,583
2	318	800	550	-	880	150	-	400	3,098
3	318	800	-	-	880	150	-	400	2,548
4	318	800	-	-	880	150	-	400	2,548
5	318	800	-	-	880	150	-	400	2,548
Subtot Yr 1 - 5	1,590	4,000	1,100	1,485	4,400	750	-	2,000	15,325
6 - 10	1,590	4,000	-	-	4,400	750	600	2,000	13,340
Total Yr 1 - 10	3,180	8,000	1,100	1,485	8,800	1,500	600	4,000	28,665

Table 5-3. Short term employment benefits (person-years) of the silviculture program, by year and activity.

Year	Surveys* General	Other General	Backlog Fill Plant	Backlog Brush	Space	Prune 1st	Prune 2nd	Fertilize	Total
1	4.0	10.0	5.5	13.5	12.0	2.0	-	0.5	47
2	4.0	10.0	5.5	-	12.0	2.0	-	0.5	34
3	4.0	10.0	-	-	12.0	2.0	-	0.5	28
4	4.0	10.0	-	-	12.0	2.0	-	0.5	28
5	4.0	10.0	-	-	12.0	2.0	-	0.5	28
Subtot Yr 1 - 5	19.9	50.0	11.0	13.5	60.0	10.0	-	2.5	167
6 - 10	19.9	50.0	-	-	60.0	10.0	7.5	2.5	150
Total Yr 1 - 10	39.8	100.0	11.0	13.5	120.0	20.0	7.5	5.0	317

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

Appendix 1
Executive Summary of *The Incremental Silviculture Strategy For British Columbia (Interim)*

STRATEGY AT A GLANCE

Purpose	This strategy provides guidance to the application of available funds for incremental silviculture activities. It is not tied to a specified funding level.
Government's Goals	• Sustainable Use • Community Stability • A Strong Forest Sector
Key Principles	1. Because the distant future cannot be foretold, the best and only course of action in managing the timber resource is that which minimizes risk and maintains options. 2. British Columbia's forests are important locally, provincially, nationally and glo bally and should be managed in this context. 3. Each generation of British Columbians becomes the steward of the province's forest resources and has a moral obligation to preserve this heritage for future generations.
Working Targets	Within the context of the guiding principles: WT 1: Minimize the anticipated interim reduction in timber supply so that provincial annual harvests of at least 65 million m^3 can be achieved during this period. WT 2: Create a long term timber supply capable of supporting a steady long term provincial harvest level of at least 75 million m^3. WT 3: Over the long term, maintain the production of premium quality logs at or above 10% of total harvest.
Major Silvicultural Strategies	• Increase the use of alternative silvicultural systems and commercial thinning. • Achieve earlier green-up of harvested areas. • Increase regenerated stand volumes 20%. • Eliminate all pre-1982 good and medium site backlog NSR and all 1982 to 1987 backlog NSR. • Initiate a long rotation quality management program for stands where harvesting must be delayed. Other silvicultural and non-silvicultural strategies must also be implemented to achieve the working targets.
Strategy Implementation	Regional and management unit strategies must be developed, followed by programs and plans to implement them.

Appendix 2
Summary of Issues Requiring Investigation

During the workshop's consideration of TSA issues, strategies and silvicultural regimes, a number of additional issues were identified that require investigation.

7. Conduct further analysis and modelling of timber supply as a pre-requisite to developing a focused and validated incremental silviculture strategy.

   The upcoming Type II silviculture analysis should investigate the significant influence of the large component of poor and low-site spruce stands on the TSR1 base case and the minimum harvest age sensitivity test results. If these effects are confirmed and are not simply a model artifact (e.g., a result of a harvest queue rule), investigate the effects of various silvicultural practices, particularly pre-commercial thinning, to reduce the minimum harvest ages of these or other stands.

   Workshop participants also expressed a desire to expand the scope of analysis to include non-FRBC fundable activities that may be relevant to a full silviculture strategy (i.e., not just an incremental silviculture strategy).

8. Evaluate the effects of lower than optimal stocking levels of the pre-87 stands within the THLB on the harvest forecast in the upcoming Type II silviculture analysis. [Supports strategy ALL 2]

9. Prepare a treatment plan for those areas confirmed to be not satisfactorily restocked. [Supports strategy ALL 2]

10. Develop a growth and yield legacy plan. [Supports strategy ALL 3]

11. Review European literature on the response of lodgepole pine to fertilization. [Supports strategy M2]

12. Develop an aspen management strategy, including an agreement amongst stakeholders on aspen objectives for the TSA (including timber/forest management and habitat/biodiversity perspectives). To develop the strategy, the following is needed.

    - mixed-wood growth and yield information for development of mixed-wood successional management regime(s) — objective maintain some aspen seral stage across the landscape;
    - a layered aspen inventory; and
    - a review/consolidation of existing information. [Supports strategy L2b]

13. Enquire into how and when higher yields might be obtained for lodgepole pine (objective 20% gain) and spruce species (objective 15% gain) in the central plateau seed zone. [Supports strategy L2b]

14. Add the OAF1 survey methodology to free-growing surveys as a start towards accumulating an OAF1 data set. [Supports strategy L3b]

15. Evaluate density management options for both species in the upcoming Type II analysis.

16. Investigate mixed-wood complex habitat management strategies.

Appendix 3
Rejected Strategies

The workshop participants rejected some strategies after identifying their silvicultural target and the activities required to implement the strategy. These rejected strategies and the reasons why they were rejected are listed in Table A3-1.

******* Table A3-1 was not available in time for this draft. *****