

TFL 6
Tree Farm License

Incremental Silviculture Strategy (Interim)

British Columbia
Ministry of Forests

Funded by
Forest Renewal BC

June, 2001

TFL 6 INCREMENTAL SILVICULTURE STRATEGY (TYPE 1)

Acknowledgements

The project was coordinated through Mr. Larry Sigurdson of the Ministry of Forests, Vancouver Forest Region. Funding was provided by Forest Renewal BC. Input from the following people is gratefully acknowledged:

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EXECUTIVE SUMMARY

General Strategy

Policies developed over the last two decades to ensure multi-resource sustainability limit the timber supply in the short to medium-term. Reductions in the amount of old forest available for harvest result in the annual allowable cut (AAC) being stepped down over the next 50 years. In the mid to long term, as more second growth becomes merchantable, the AAC slowly recovers until it reaches a long-term sustainable level higher than the current harvest rate.

The key opportunities for silviculture investments are applying treatments or strategies which minimize constraints on old stands, developing programs for harvesting stands not included in the timber harvesting landbase (THLB) and increasing the number of second growth stands which could be harvested in the 2020 to 2050 “trough”.

Past silviculture (basic and intensive) efforts have lessened the effects of the medium-term reduction in the AAC. Many of the treatment options discussed in this report have been included in the Current Management Option (CMO) of the most recent timber supply analysis (TSA). Most of the additional suggested treatments are considered “experimental” and will require further study or research before they can be implemented. As a result funding for these studies is an important priority in the near future.

In the short-term there is an opportunity to harvest some alder which would diversify the log profile recovered from the TFL. In the mid to long-term as the harvest moves to second growth, it is expected that significant components of premium logs will be produced primarily because of the longer rotations which result from harvesting based on achievement of minimum piece sizes. As a result of previous and future pruning, some premium logs with clear cuttings will be harvested starting in late mid-term.

The existing second growth inventory is dominated by Hw. There may be opportunities to diversify the species mix used in reforestation which will impact mid to long-term timber quality.

Working Targets

WT1 (Quantity): In addition to the treatments included in the CMO there are quantified opportunities to increase the short-term AAC by about 10,000 to 12,000 m³ (alder conversion) and the mid-term AAC by about 50,000 m³ (commercial thinning).

There are also several treatments which have the potential to further increase the mid to long – term AAC. However, the impacts of these treatments on timber supply have not been quantified.

WT1 (Quality): Quantified working targets have not been finalized for quality. An interim estimate is that pruning about 350 ha / year to 5 meters in height should yield, starting in the mid – term, >4% of the harvest in premium logs with some clear cuttings

Second Growth Log Product Objectives

Log product quality objectives have not yet been finalized for TFL 6. As a starting point for further discussion the following basic log specifications are suggested.

Quality Class	Species	Characteristics
Premium Log	Hw-Ba, Ss, Fd	50+ cm dbh, with or without pruned 5.5m first log
	Dr	40+ cm dbh, with or without pruned 5.5m first log
Sawlog	All conifers	40+ cm dbh
	Dr	30+ cm dbh

Silviculture Strategies

Strategies to Increase the Quantity of Future Timber Supply

Short Term:	<ol style="list-style-type: none"> 1. Reduce regeneration delay on salal sites by continuing to fertilize at the time of planting. 2. Increase the short-term AAC by harvesting alder.
Mid Term:	<ol style="list-style-type: none"> 1. Reduce the minimum harvest age and thereby increase the AAC in the 2041 to 2060 “trough” by maintaining or increasing current spacing levels and modifying residual densities and/or, if viable, starting an “Early” commercial thinning program. 2. If commercial thinning can be proved to be viable, a program starting in about 2030 could be used to increase the AAC in the 2041 to 2060 “trough.” 3. Increase the AAC in the 2041 to 2060 “trough” by looking at establishing alder plantations on ecologically-suitable currently harvested areas. 4. If non-SCHIRP fertilization response can be demonstrated, the mid-term AAC could be significantly increased by fertilization.
Long term:	<ol style="list-style-type: none"> 1. Increase long-term AAC by continuing to aggressively fertilize and monitor treatment response under SCHIRP. 2. Reduce long-term minimum harvest ages by continuing to use genetically improved seed. 3. Increase the long-term AAC with an aggressive road rehabilitation program. 4. Increase the long-term AAC by converting un-managed alder-leading stands to managed coniferous stands. 5. Increase the long-term AAC by draining wet, low productivity sites.

Strategies to Increase the Quality of Future Timber Supply

Short Term:	1. Increase product diversification by harvesting alder.
Mid Term:	<ol style="list-style-type: none"> 1. Increase mid-term clear recovery by continuing or increasing the current pruning program. 2. Improve mid-term sawlog quality by continuing or increasing current juvenile spacing levels and/or, if viable, starting an “Early” commercial thinning program. 3. If commercial thinning can be proved to be viable, a program starting in about 2030 could be used to increase the quality of the final harvest. 4. Increase product diversification and recover logs with some clear cuttings by growing alder.
Long Term:	1. Diversification / refinement of the species mixes used in reforestation can be used to diversify the mix of species harvested in the long-term.

Strategies to Increase the Quantity or Quality of Future Habitat Supply

Long Term:	1 Density management and conversion of alder-leading stands in riparian management zones to mixed to deciduous-coniferous stands will improve long-term fish and riparian habitat.
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1 INTRODUCTION

1.1 About the Interim Strategy

The terms of a service agreement between Forest Renewal BC (FRBC) and the BC Ministry of Forests (MoF) require the MoF to develop, and FRBC to fund, what is essentially an incremental silviculture strategy. This document addresses this contractual requirement for Tree Farm License (TFL) 6 which is held by Western Forest Products Limited (WFP).

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 for TFL 6.

An incremental silviculture strategy should not be confused with the AAC 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 current, AAC determinations.

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

1.2 Methodology

This strategy was prepared through the following process:

1. Initially B. A. Blackwell and Associates Ltd. and Compass Resource Management Ltd. (the consultants) prepared a preliminary draft of this report, summarizing available information relevant to a strategy and identifying opportunities to improve the future quantity and quality of timber and habitat.
2. The preliminary draft report formed the basis for a workshop that was held December 12, 2000 in Port McNeill. This workshop was led by B. A. Blackwell and Associates Ltd. and attended by WFP staff from TFL 6 and head office, Dr. John Barker (Silviculture Chair, UBC), Larry Sigurdson of the MoF Regional Office and a representative of the Port McNeill MoF district office. Participants reviewed the potential opportunities identified in the draft report along with other treatments that were suggested.
3. Following the workshop the consultants incorporated the workshop feedback into the draft report and produced and circulated a questionnaire for prioritizing the potential treatment opportunities. Responses to the questionnaire were subsequently used to develop a silviculture regime table along with the resulting forecasts of future harvest quantity and quality and of job outcomes.
4. After WFP and MoF review, a completed strategy document was submitted to the MoF.

2 BASIC DATA

(Source for this Section: Timber Supply Analysis Information Package for Management Plan 9 for TFL 6, WFP)

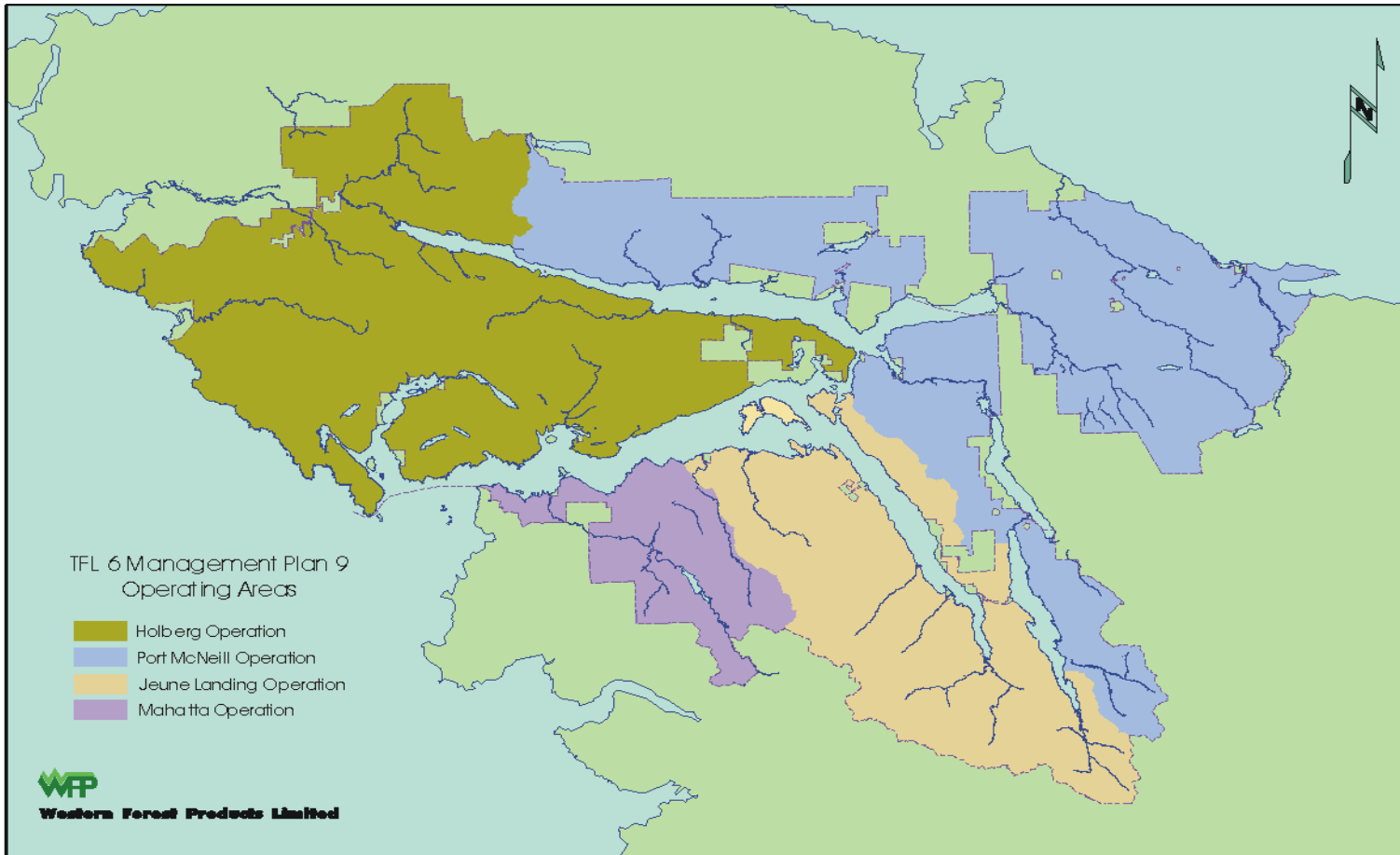


Figure 1. Overview of TFL 6

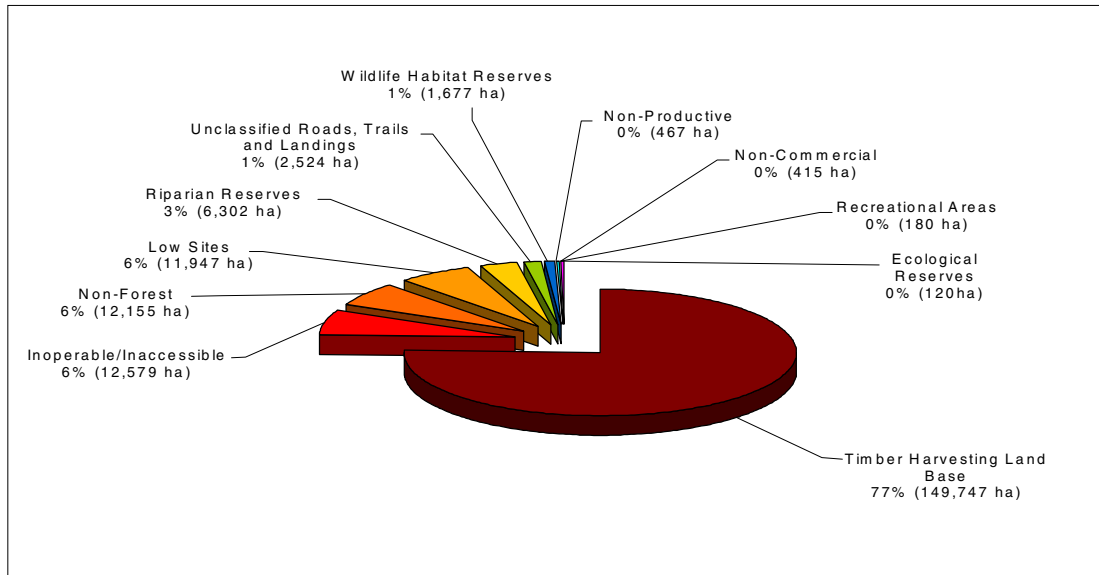


Figure 2. Breakdown of Productive Forest Land

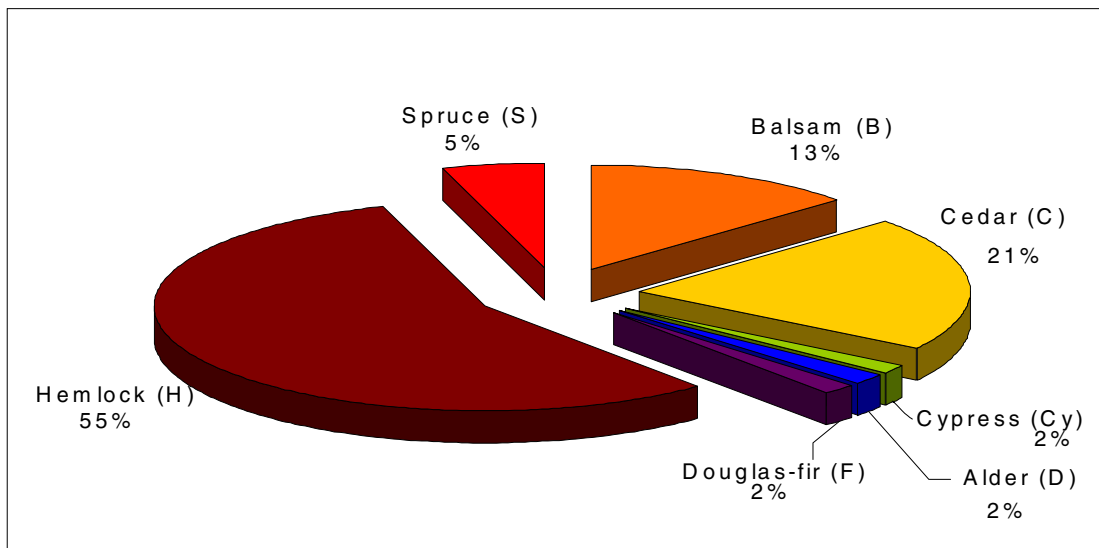


Figure 3. Distribution of Tree Species on the THLB

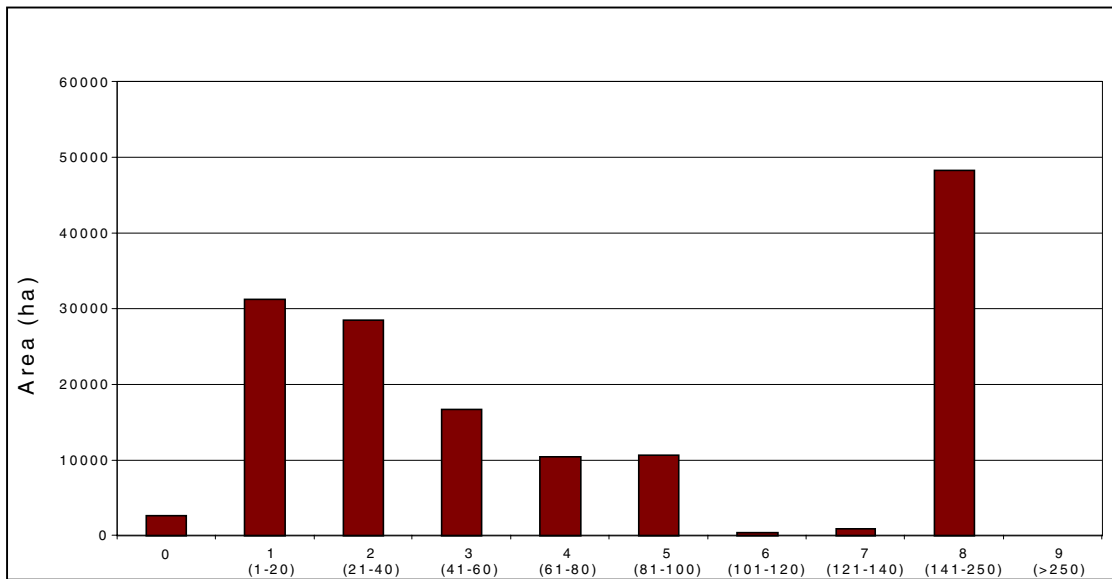


Figure 4. Age Class Distribution on the THLB

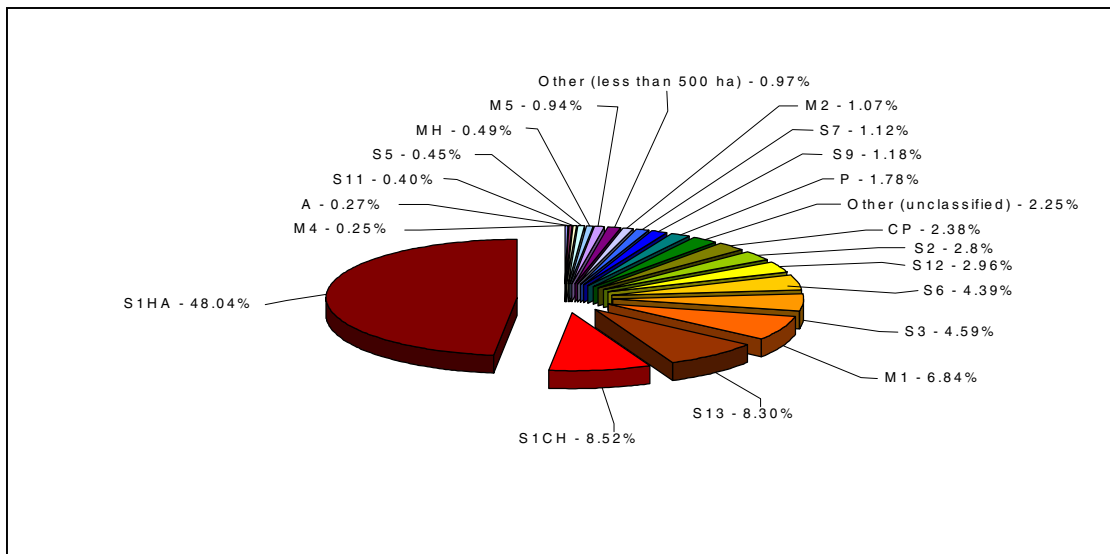


Figure 5. Lewis Ecosystem Unit Distribution on the THLB

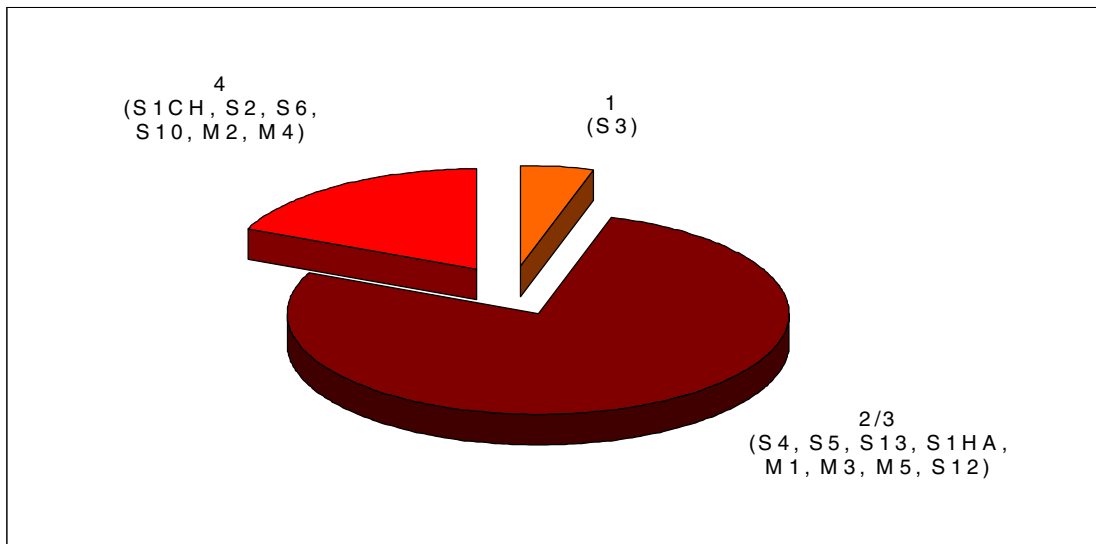


Figure 6. Distribution of Productivity Groups on the THLB

Table 1. Site Index Values by Productivity Group

Productivity Group	Lewis Ecosystem Units	Leading Species				
		H	C	B	S	F (Dec & Pl, Pw)
1	S3	33.7	27.0	30.1	35.2	37.5
2/3	S4, S5, S13, S1ha, M1, M3, M5, S12	28.0	23.8	26.2	31.0	31.4
4	S1, S2, S6, S10, M2, M4	20.1	19.2	20.7	25.0	22.6

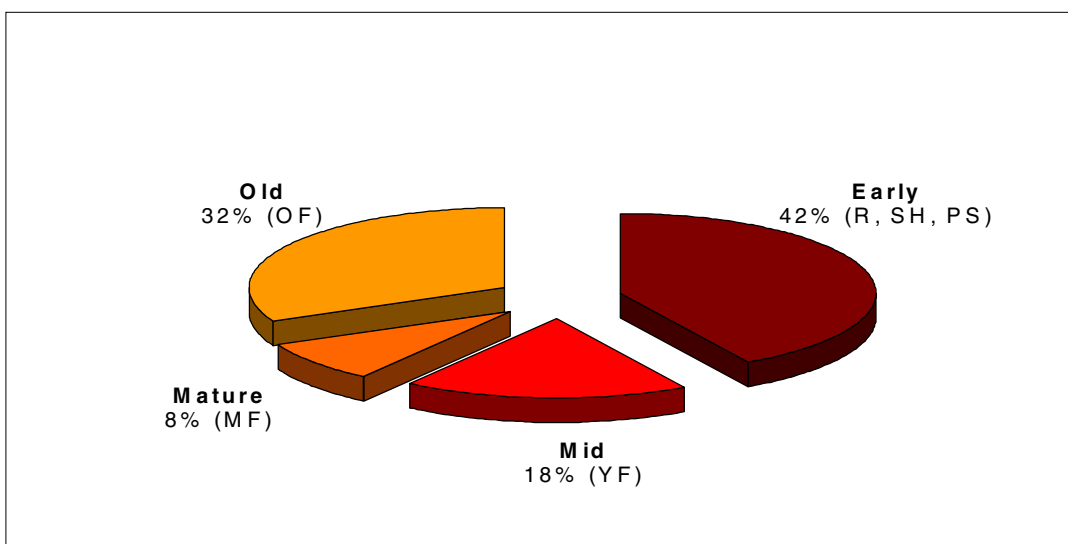


Figure 7. Seral Stage Distribution on the THLB

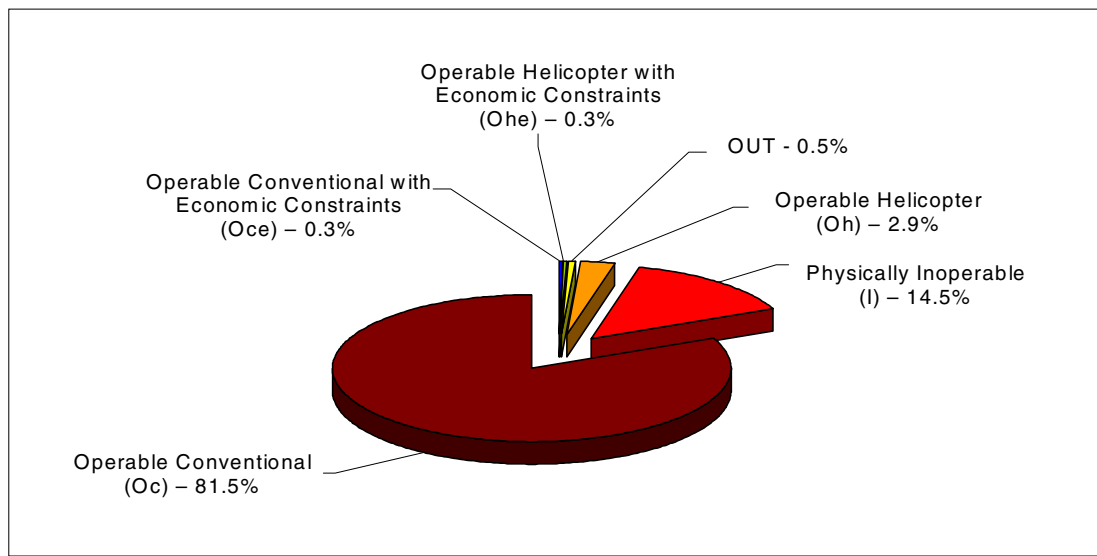


Figure 8. Operability

3 SILVICULTURE HISTORY AND STATUS

(Source for this Section: TFL 6 1999 Annual Report, WFP)

3.1 Basic Silviculture

- Since 1950 almost 73,000 ha have been logged. Over the last 5 years the average annual harvest has been about 1,440 ha.
- Since 1950 almost 38,000,000 trees have been planted on approximately 41,000 ha. Currently almost all of the harvested area is planted. The majority of planted seedlings are from genetically improved seed.
- Since 1950 site preparation (primarily prescribed burning) has occurred on 27,000 ha. Currently only a minor amount of site preparation is being done.
- Since 1950 approximately 25,000 ha have been brushed. Over the last 5 years the average annual area brushed has been about 1,100 ha. As of the end of 1999 about 2,100 ha were classified as NSR. Of this NSR virtually none was classified as backlog.

3.2 Incremental Silviculture

- Since 1965 almost 11,000 ha have been juvenile spaced. Currently about 300 to 400 ha per year are treated.
- Since 1965 about 10,000 ha have been fertilized. Most of this fertilization has occurred within the last five years and has been primarily on salal sites.
- Since 1984 almost 2,800 ha have been pruned. Most of this program has occurred within the last five years.
- Since 1981 several small commercial thinning trials have been done.

4 ISSUES AND SILVICULTURAL OPPORTUNITIES

4.1 Status of Silviculture Treatments and Other Key Issues Relative to Management Plans 8 & 9

(Sources for this Section: Management Plans 8 and 9 for TFL 6, WFP)

Issue or Treatment	MWP #8 Status (Jan, 1995) Incorporated in Timber Supply Analysis [Yes or No]	MWP #9 (Draft; Nov, 2000) Incorporated in Timber Supply Analysis [Yes or No]
Implementation of FPCA and Van. Is. LUP	No	Yes
Future estimate of PAS	Yes; 5%	Yes; 4%
Min. Harvest Size for G, M and P sites	Yes; 45, 40 and 35 cm quadratic mean dbh	Yes; 42, 37 and 35 cm quadratic mean dbh
Utilization of Non-conv. Harv areas	No; ~1300 ha suitable for heli. Not included in AAC; results in partitioned harv of ~10,200m ³ /yr	Yes; included in AAC
Utilization of Low sites	No; some low site not included in AAC; results in partitioned harv of ~26,000m ³ /yr (1/2 of pot. Contribution)	No, productivity group 5 excluded; Results exceeded MWP #8 partition expectations.
Deciduous-leading stands	Only coniferous volumes included in timber supply. AAC assumes that ~2260 ha will be harvested and converted to conifers through a rotation in conjunction with adjacent conifer harvest blocks.	Only coniferous volumes included in timber supply. AAC assumes conversion to coniferous-leading stands through natural succession increasing volumes to harvestable conifer minimums.
Growth & Yield models used for existing 2 nd Growth stands	TIPSY for Fd, VDYP for Ba and decid. WFP's local tables for Hw, Ss, Cw and Yc.	VDYP for deciduous stands >40 years old. Rest TIPSY.

Issue or Treatment Cont'd	MWP #8 Status (Jan, 1995)	MWP #9 (Draft; Nov, 2000)
	Incorporated in Timber Supply Analysis [Yes or No]	Incorporated in Timber Supply Analysis [Yes or No]
SIBEC	Yes	Yes; Revised and updated with statistical site index assignment by productivity group
Forest Inventory	Based on 1970 inventory. For AAC determination, inventory updated to 1990.	Based on 1970 inventory. For AAC determination, inventory updated to January 1, 1998. VRI in progress.
Backlog	None.	None.
Pre-FTG		
Reforestation	Yes; Regen delay 2 to 3 years on good sites and 5 years on rest of ecosites.	Yes; Planting on most sites. Regen delay of 1 to 2 years on low elevation sites and 4 years on high elevation ecosites. Fertilization at time of planting included for all salal sites.
Tree Improvement	No; 1 st generation stock being used in planting programs. No gains modeled in AAC determination.	Yes; Improved stock continuing to be used. 5 to 15% Hw gains modeled in AAC determination for current and future planting.
Post-FTG		
Space	Yes; ~770 ha/yr assumed in AAC determination	Yes; 300 ha/yr assumed in AAC determination (subject to the availability of suitable stands)
Prune	No	No
Fertilization	No.	Yes; All Cw-salal sites to be fertilized.
Commercial Thin	No. MWP 8 commits to feasibility studies.	No. Same as for MWP 8.

5 HIGHER LEVEL GOALS AND OBJECTIVES

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

5.1 Provincial Goals

Fundamentally, government's goals can be characterized as:

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

5.2 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.

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

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.

5.3 Regional Objectives

The objectives of the regional incremental silviculture strategy are to:

- Ensure a long term sustainable harvest, which approximates the current harvest value and volume levels and that produces a diversified mix of products necessary to create and maintain sustainable forest employment.
- Balance treatments that enhance growth and yield such as fertilizing, spacing and forest health activities with those that increase the value of the wood such as pruning.
- Utilize incremental silviculture treatments to contribute to sustainable management of non-timber values at the landscape level. (MoF, 1998b)

5.4 Review of the Timber Supply Analysis (MP 9)

(Source for this Section: Timber Supply Analysis Section of Management Plan 9 for TFL 6, WFP)

The following figures summarize the AAC forecast for the CMO (Figure 9) according to the current TSA and show the impacts of this forecast on annual harvested area, average harvested diameter, volume per hectare and harvested age (Figures 10 and 11). These figures show a step down in the harvest from now until about 2050 as the remaining non-constrained old-growth is harvested. From about 2020 to 2050 there is a shift in harvesting to second growth. After about 2050 the harvest is entirely from second growth and the AAC recovers slowly until about 2140. As a result of past and projected future silviculture treatments and stand diameter targets, the second growth volumes at the projected harvest ages tend to be higher than for the currently harvested old-growth and lead to a “fall up” in harvest levels.

Figure 12 shows the trend in growing stock and Figure 13 shows the age class distribution over the next 140 to 150 years.

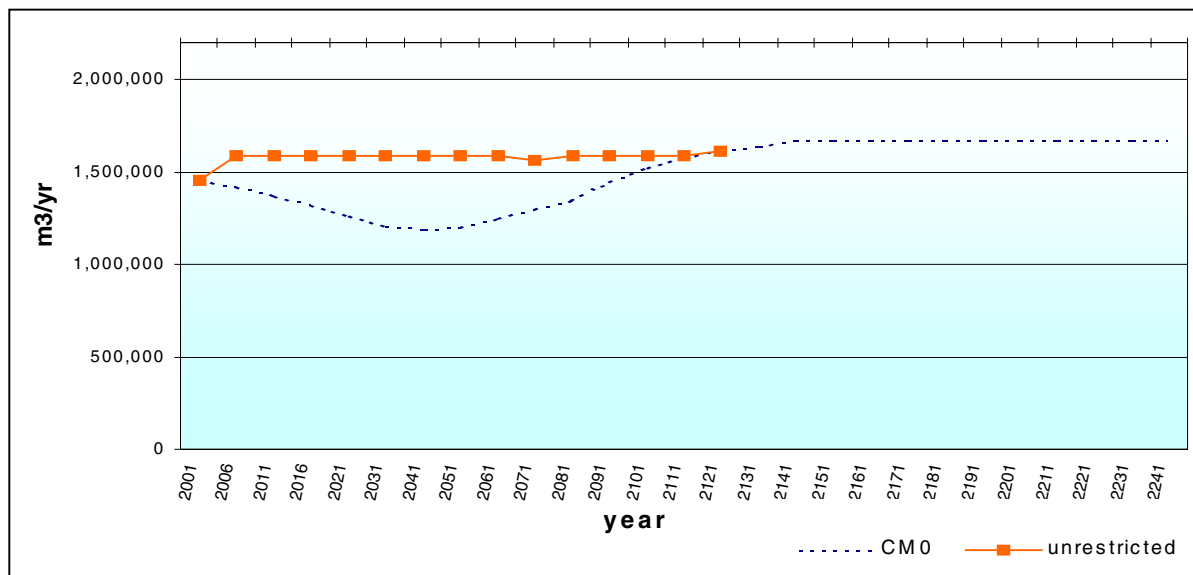


Figure 9. Current Management Option (CMO) and Unrestricted Harvest Rates

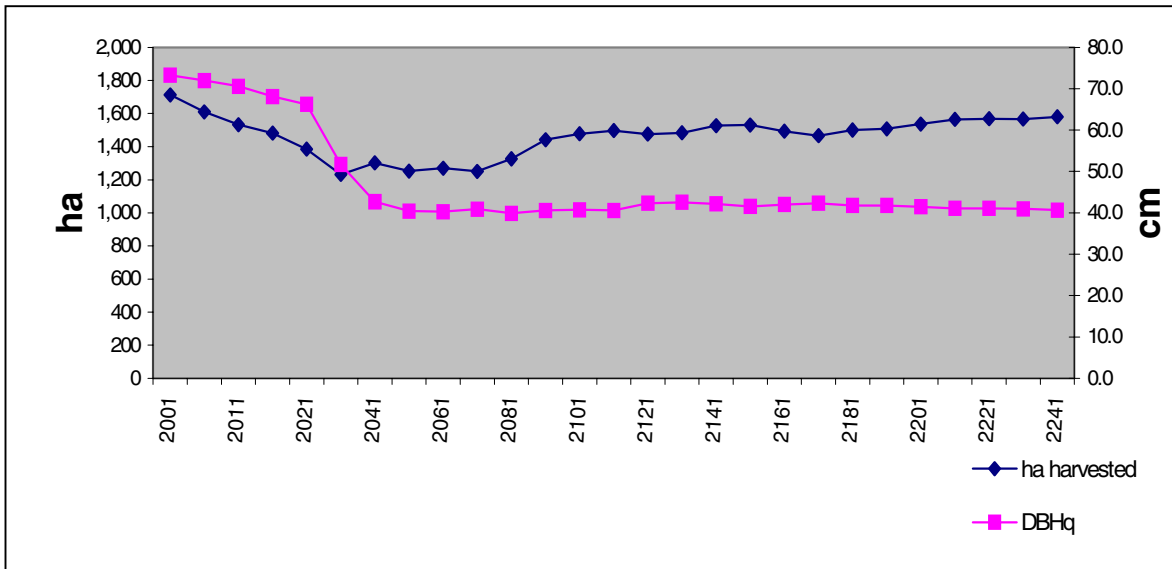


Figure 10. Annual Area Harvested and Average Diameter Harvested

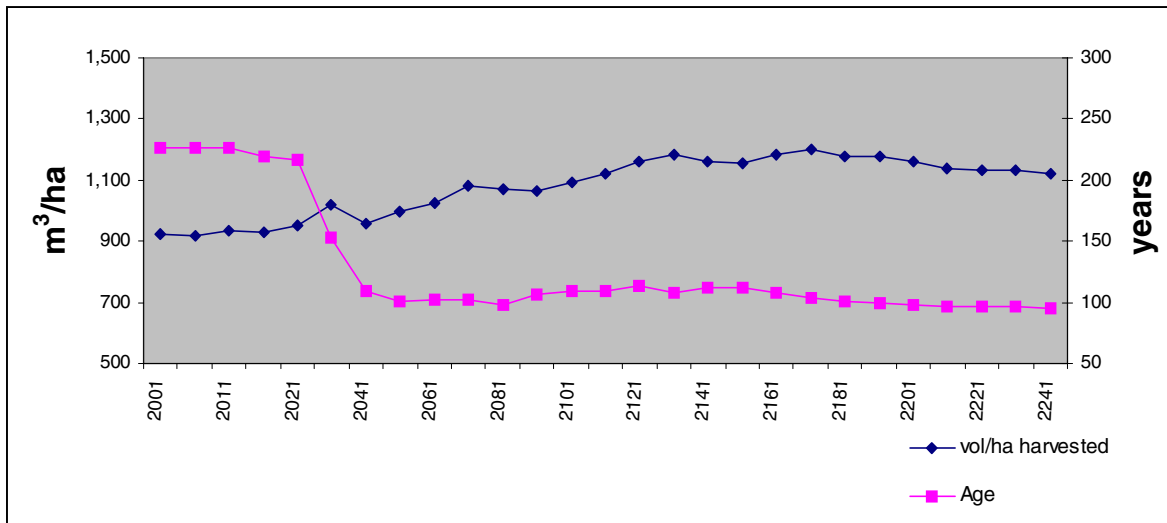


Figure 11. Annual Volume/ha and Age Harvested

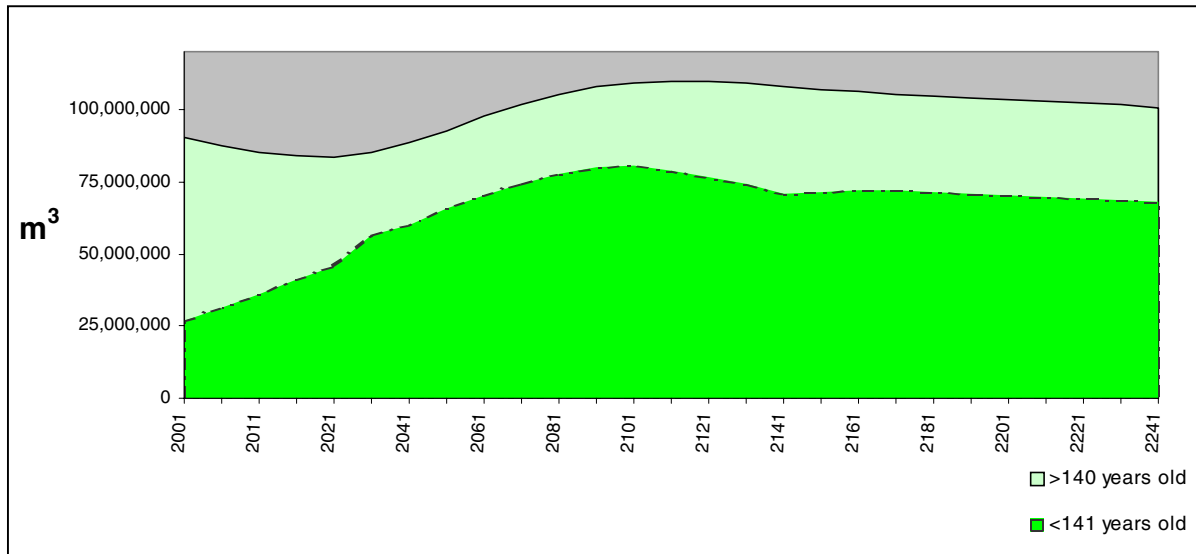


Figure 12. Growing Stock Distribution under the CMO

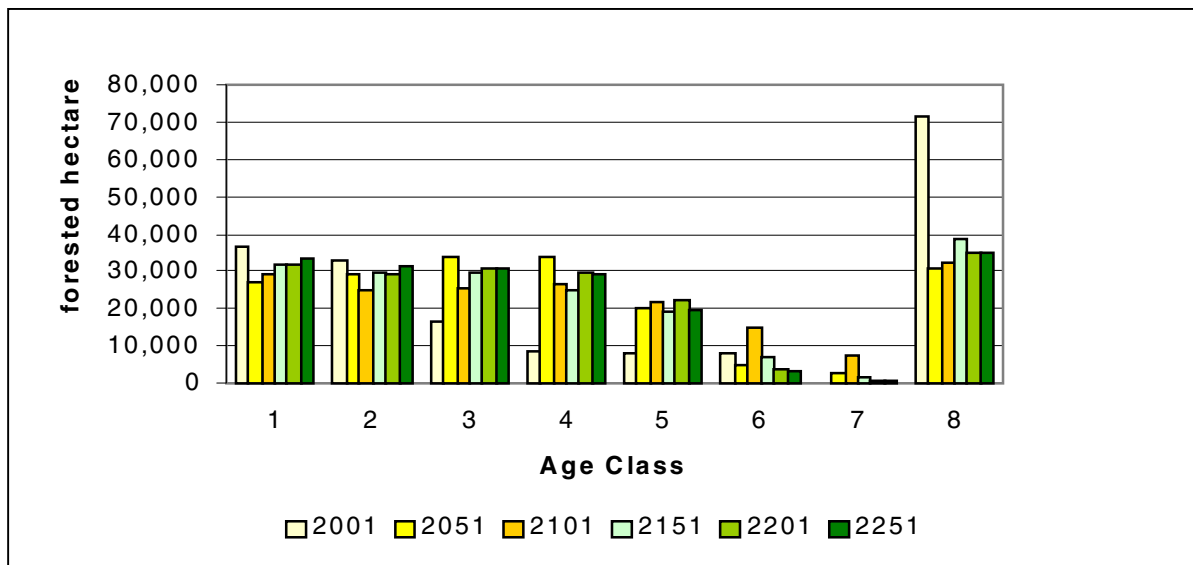


Figure 13. Age Class Distribution under the CMO from 2001 through 2251

5.5 Individual Issues and Opportunities Analysis

The following information is primarily from the Timber Supply Analysis (TSA) Section of Management Plan 9 for TFL 6. Only information that is relevant to an incremental silviculture strategy has been recorded. Key statements have been bolded. Sensitivity analysis charts from the TSA are presented to highlight the key issues.

Key Issue	Period(s) Effected	Discussion (Key issues, opportunities)
Non-Timber Resources		Policies developed over the last two decades to ensure multi-resource sustainability limit the timber supply in the short to medium-term. Reductions in the amount of old forest available for harvest result in the annual allowable cut (AAC) being stepped down over the next 50 years (see Figure 14). During this period these policies are the primary factors affecting timber supply.
<i>Green-Up</i>	Medium-term	Mid-term harvest rates are slightly sensitive to +/- 2 meter changes in green-up heights. Removal of the green-up constraint has a moderately significant positive impact on mid-term timber supply (see Figure 15). <i>Opportunities:</i> fully stock and accelerate early growth rates by prompt reforestation, fertilization at time of planting, use of genetically improved stock and early removal of brush competition. Use of partial cutting or a retention silviculture system which removes or reduces adjacency concerns.
Timber Resources		
<i>Age Class Distribution</i>	Short to medium-term	An age class gap created by the loss of old forest from the THLB is the key reason which leads to the step down in the AAC through ~2050 (corresponds to the liquidation of the remaining available old forest). From about 2020 to 2040 the harvest shifts to second growth. After 2040 the entire AAC is from second growth (see Figure 13). <i>Opportunities:</i> treatments which can make more second growth stands harvestable between 2020 and 2050. Examples of potential treatments are juvenile spacing of pole-sapling stands and regenerating some richer sites to alder that could be managed over a 30 to 50 year rotation. In addition a commercial thinning program which starts in about 2030 would be beneficial.

Key Issue Continued	Period(s) Effected	Discussion (Key issues, opportunities)
Timber Resources Cont'd		
<i>Rotation and minimum harvest ages</i>	Short to Medium-term	<p>The timber supply is very sensitive to minimum stem size at harvest in the AAC “trough” between 2010 and 2100 (see Figures 16 and 17). Harvest age is set based on achievement of target dbh. This system is based on economic operability and generally results in harvest ages which are > biological rotations. There is no provision for minimum harvest ages.</p> <p><i>Opportunities:</i> any treatments that can be done in second growth to reduce the merchantable harvest age, particularly for stands that can be used to reduce the effect of the “trough”. Examples of potential treatments are juvenile spacing and/or fertilization.</p>
<i>Species distribution and quality</i>	Medium to long term	<p>Established second growth stands are dominated by Hw. Given the current problems marketing Hw, this lack of diversification may be a problem. Second growth piece sizes will be small and uniform and will yield mostly construction grades of lumber. Some clear cuttings should come from pruned second growth stands which are harvested after about 2070.</p> <p><i>Opportunities:</i> where ecologically appropriate, diversify the species used in reforestation (ie: manage for Dr on some richer sites, manage some more non-salal types for Cw, use Fd wherever possible and establish weevil resistant Ss-Hw or Ss-Ba mixes on the more productive sites). Continue or increase the pruning program on Hw and Fd leading stands (also look at pruning other species such as Ss [in closed stands only due to epicormic branching]).</p>
<i>Deciduous-leading stands</i>	Short to medium-term	<p>There are about 2700 ha of deciduous-leading stands on the THLB. The deciduous volumes from deciduous-leading stands have not been included in the Timber Supply Analysis (TSA) for MWP #9. The TSA shows that if the deciduous volumes were included there is potential for a modest increase in the AAC.</p> <p><i>Opportunities:</i> stand conversion/harvesting of the best, non-constrained alder-leading stands.</p>

Key Issue Continued	Period(s) Effected	Discussion (Key issues, opportunities)
<i>Operability, Utilization of stands on low sites</i>	Short to medium-term	<p>Recently harvesting from stands growing on lower site classes has exceeded AAC requirements. Continuation of this performance could lead to a modest increase in AAC. Helicopter logging has been ongoing for the last few years improving operability. Mapping of operability has recently been updated.</p> <p><i>Opportunities: Continue to utilize stands on lower site classes as markets allow.</i></p>
<i>Intensive Silviculture</i>	Long-term	<p>Past silviculture (basic and intensive) efforts have and continue to soften the effects of recent harvesting restrictions. Past silviculture treatments are projected to have reduced the AAC reductions in the “trough” (~2021 to 2091 by about 8%).</p> <p>According to the TSA, future intensive silviculture treatments such as juvenile spacing, fertilization and tree improvement do not impact the timber supply until the long-term (ie: after ~2140). After this time future intensive treatments, of the magnitude assumed in the CMO, potentially account for between 5 and 20% of the projected AAC (see Figure 18).</p> <p><i>Opportunities: Continue intensive treatments at or above CMO levels.</i></p>

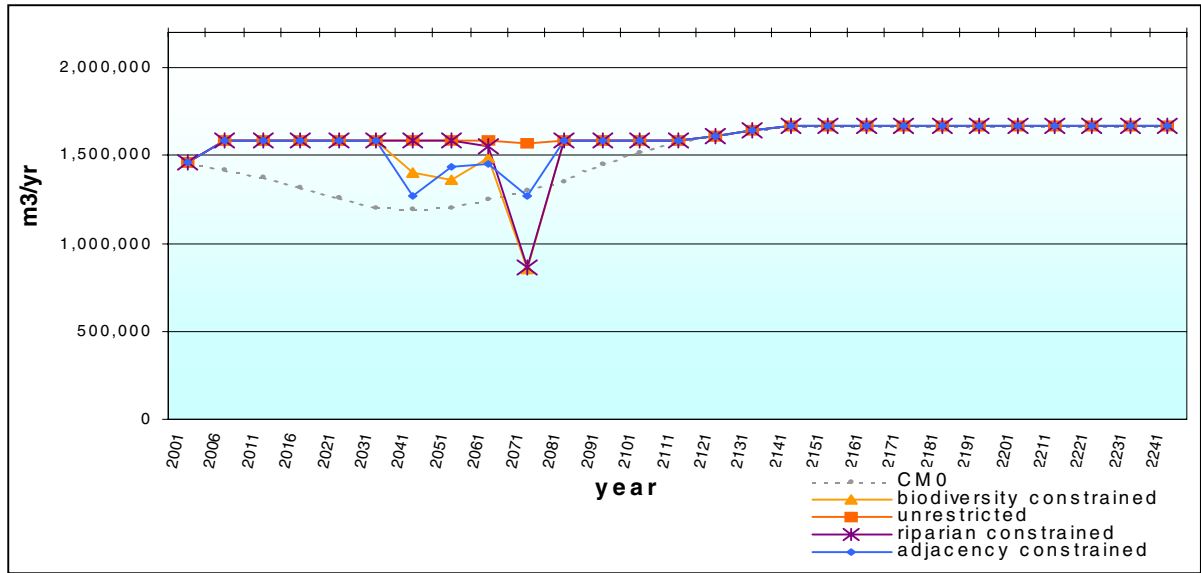


Figure 14. Impacts of Non-Timber Resource Constraints

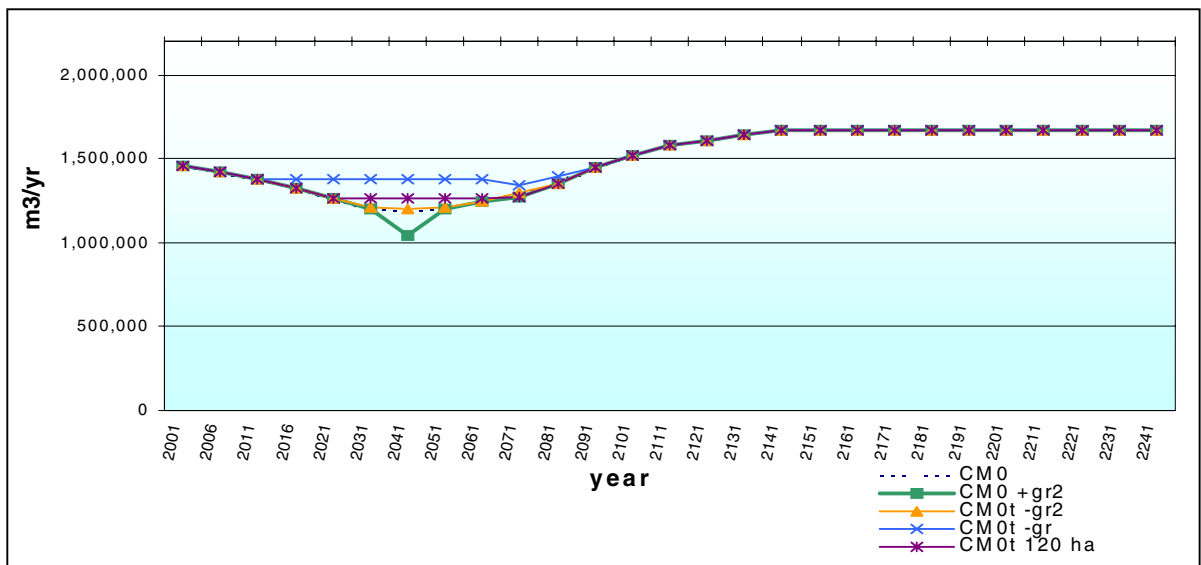


Figure 15. Green-up and Adjacency Effects

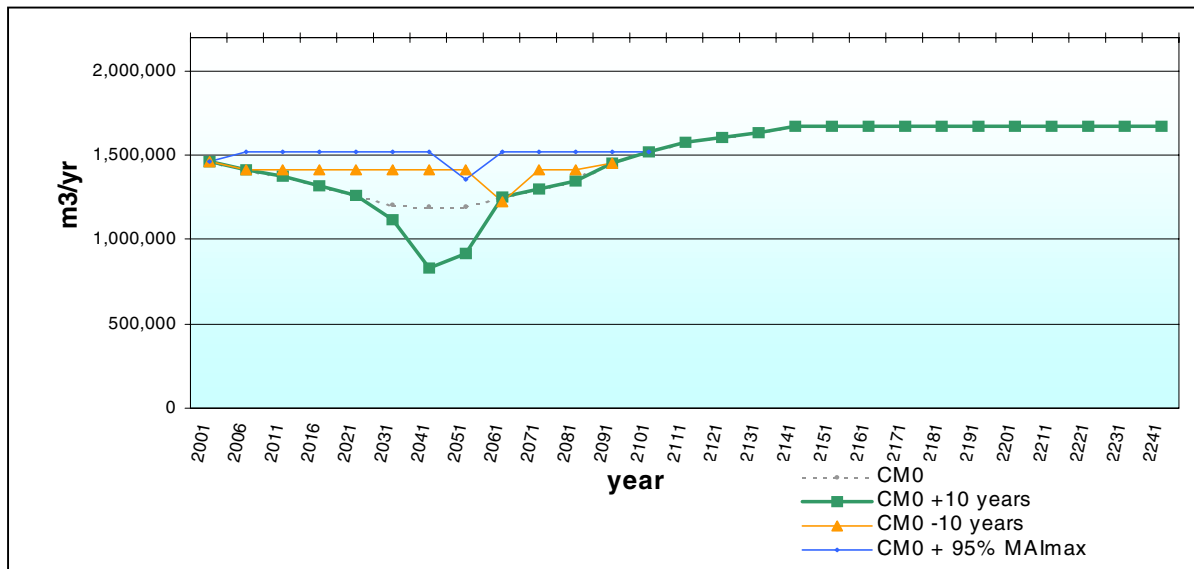


Figure 16. Impacts of Changes to Minimum Harvest Age

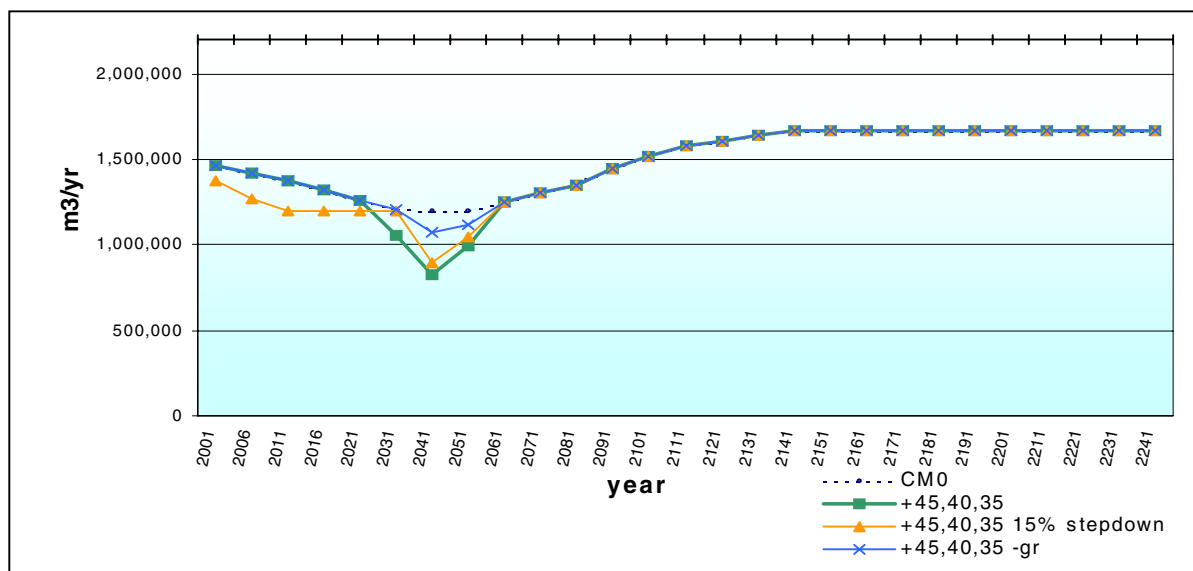


Figure 17. Impacts of Changes to Minimum Harvest Sizes

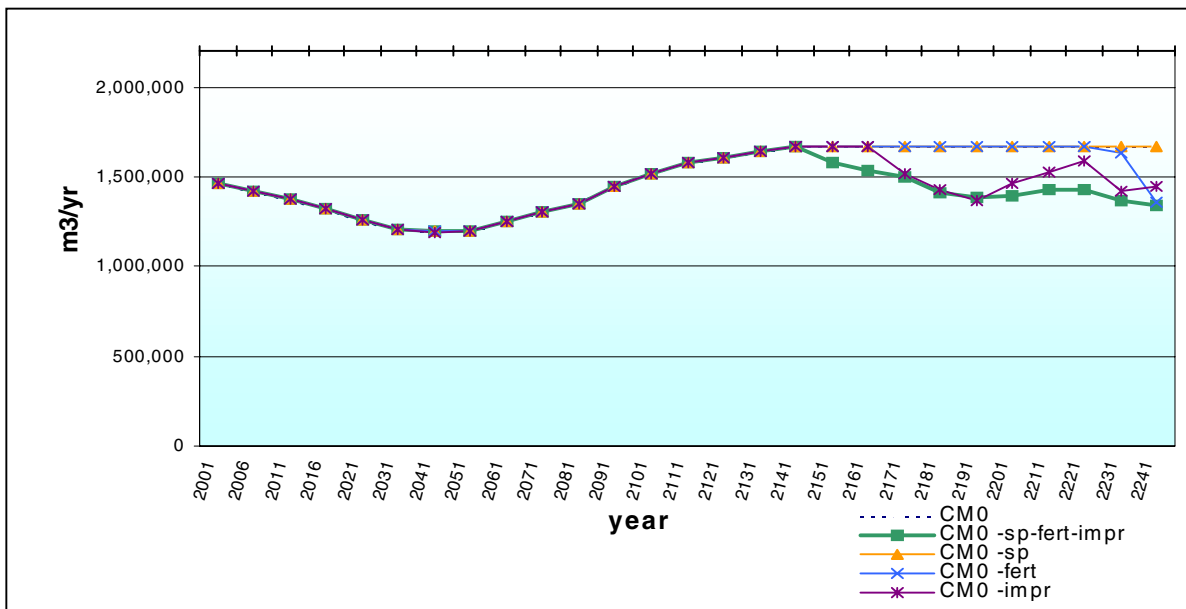


Figure 18. Impacts of not doing Selected Future Incremental Silviculture Treatments

5.6 Other Timber Supply Issues by Period

Short-Term (1 – 20 years)

- Potential inaccuracies in the old growth inventory.
- Changes to the THLB which involve mature timber (see Figure 20).
- Changes in the regulations governing forest practices that involve mature timber (Ie: max. opening size, green-up, biodiversity seral stage targets, etc.) Changes to harvesting techniques and/or markets which allow for utilization of previously uneconomic wood.

Mid-Term (21 – 100 years)

- Potential inaccuracies in the managed stand inventory and growth projections (see Figure 19).
- Changes to the THLB which involve immature timber.
- Changes in technology which effect operability and markets.
- Improved silvicultural opportunities/returns through research.

Long-Term (100 + years)

- Short and medium term changes and,
- Global warming.

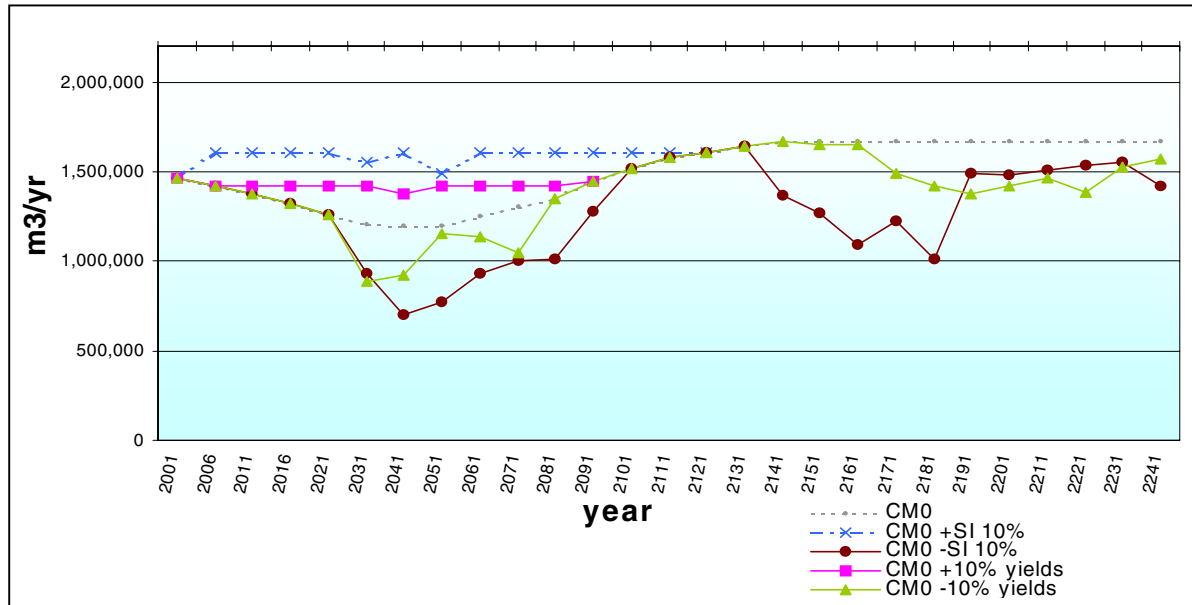


Figure 19. Impacts of Changes to Yield Curves

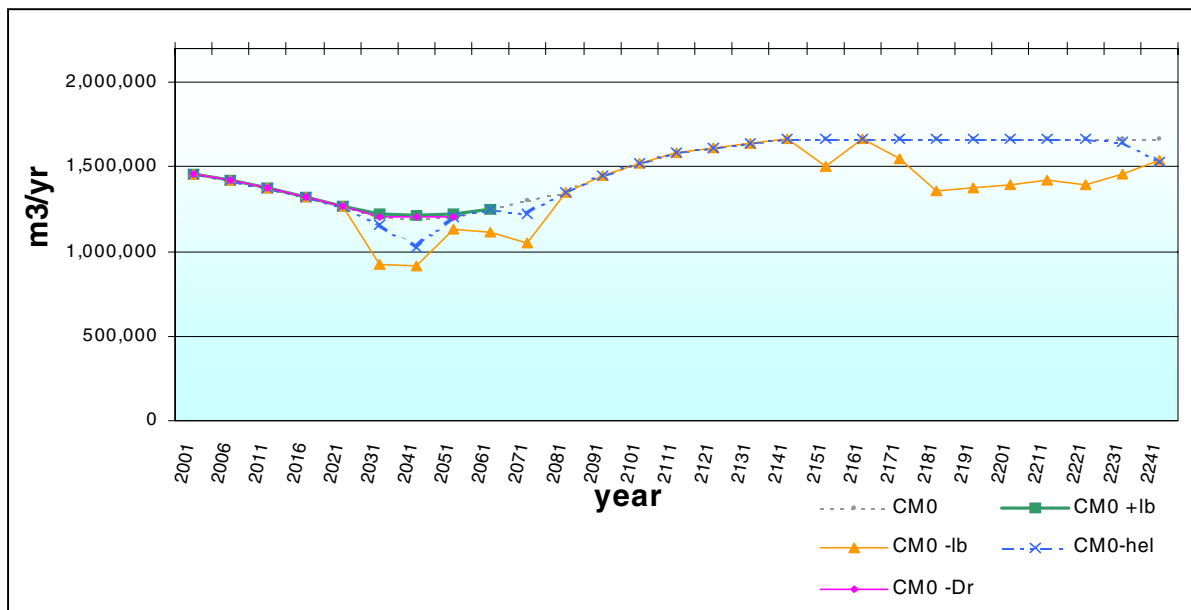


Figure 20. Impacts of Changes to the THLB due to Operability and deciduous

6 OPPORTUNITIES TO INCREASE TIMBER SUPPLY

Information from the previous sections of this report were used by the consultants to identify several potential treatment options. While it is recognized that the most appropriate way to deal with most forest-level issues is by designing a series of treatment regimes (a series of silviculture treatments), as a starting point individual treatments were reviewed.

Treatments were initially divided into two groups “Main” and “Experimental”. “Main” treatments are those that are already practiced and the treatment effects and cost/benefits are well understood. “Experimental” treatments are those which are not currently being done operationally on the TFL and which require more study and research before they can be implemented.

For each treatment option presented preliminary screening criteria were developed to indicate which stands and sites would be potentially suitable for treatment. Using these criteria the TFL database was queried to determine rough opportunity areas for each treatment.

For each treatment the assumed prescription for implementation of the treatment was listed under “Treatment Details”.

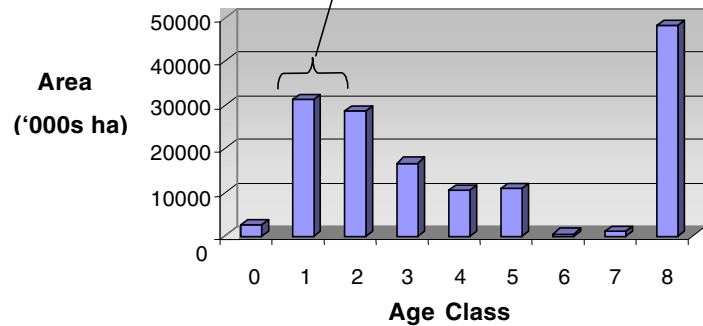
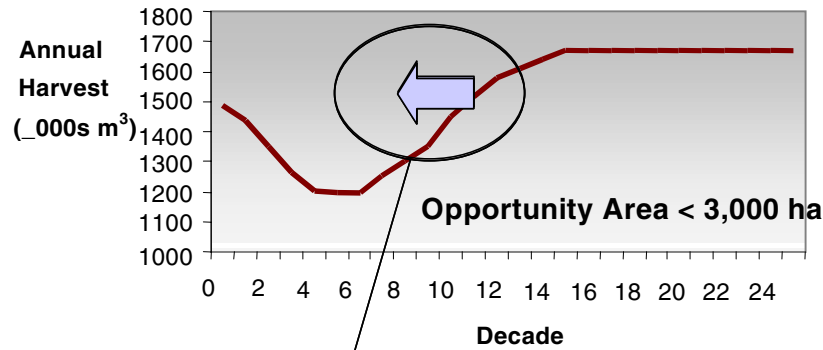
For each treatment the expected stand-level treatment effects are listed together with the term(s) in which the effects can be expected. As this timber supply is most constrained by minimum harvest age/piece size, for treatments which affect volume or minimum harvest age/piece size, the treatment effect was taken on minimum harvest age.

Each of the treatment options was discussed in detail at the workshop along with other strategies which arose during the meeting. A summary of the discussions is listed for each treatment.

6.1 Review of “Main” Potential Treatment Options

These treatments include juvenile spacing, SCHIRP fertilization, fertilization at time of planting and reforestation with genetically improved seed.

6.1.1 Juvenile Spacing



Screening Criteria

Ecosystems	S1ha, S13, S12, S3
Structural Stage	PS (10-15 yrs)
Type (Spp comp)	H-H (B,S,C)
Density	>3000sph
Slope/terrain	< 30% / no issues
Access	Road / < 50km from town

Treatment Details

Density	850 crop trees/ha
Inter-tree distances	3.7m (target), 2.0m (min)
Species and/or size preferences	Tallest tree regardless of species.

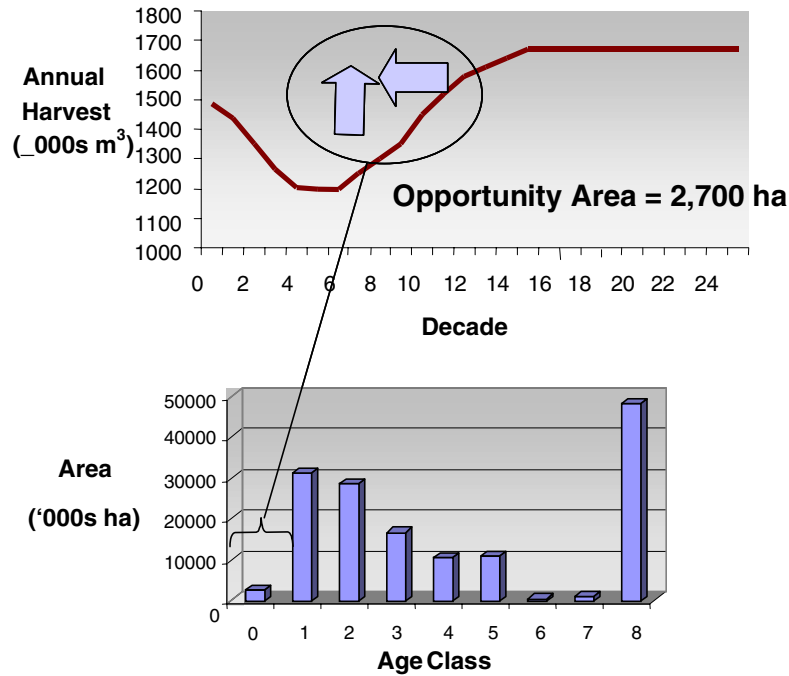
Treatment Effects

Mid-term

Timber Volume	↓
Min. harvest age	↓
Quality	↑
Biodiversity	↑ Natural succession
Jobs	5 –7 days / ha
Cost	\$ 1,500 - \$ 2,500 / ha

Notes: Juvenile spacing can reduce the merchantable age however it reduces the volume recovered. Changes to residual density will impact the diameter distribution (and therefore rotation age), timber quality and volume / ha at harvest. Therefore, the impact of varying residual density needs further evaluation. There was much discussion about whether spacing could impact the 2041 to 2060 “trough”. Using WINTIPSY and the minimum piece sizes from the TSA it appears as though spacing only the very best sites would have an impact on the “trough”. However using a spreadsheet model developed by J. Barker which was based on WFP’s local Hw growth curves, spacing was shown to reduce the harvest age about 40 years on S1ha sites. This issue will be studied further. The TFL Forest Cover database shows that up to 3,000 ha meet the Screening Criteria. WFP foresters feel that most stands that needed spacing had been spaced and that the opportunity area is <400/year. This discrepancy needs to be evaluated.

6.1.2 SCHIRP Fertilization



Screening Criteria

Ecosystems	S1ch, S10, S12ch
Structural Stage	SH-PS (5-15)
Type (Spp comp)	CH-HC-H(C)
Crown Closure	10 – 30 %

Treatment Details

1st Application	@ 4 – 8 years , Blend of 30.5-23-0 200 kg N and 75 kg of P for a total blend of 740 kg/ha
2nd Application	@ 12-15 years, 46-0-0 N only (if necessary to close crowns) 200 kg of N for a total blend of 455 kg/ha

Treatment Effects

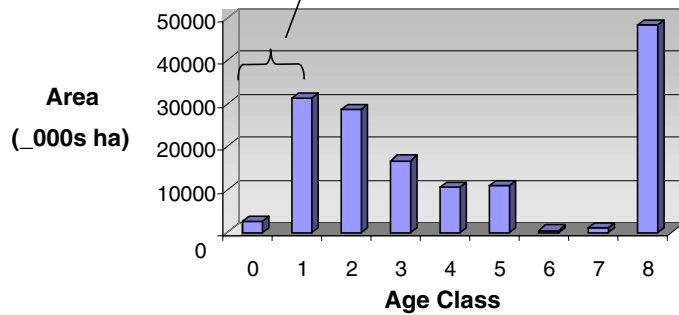
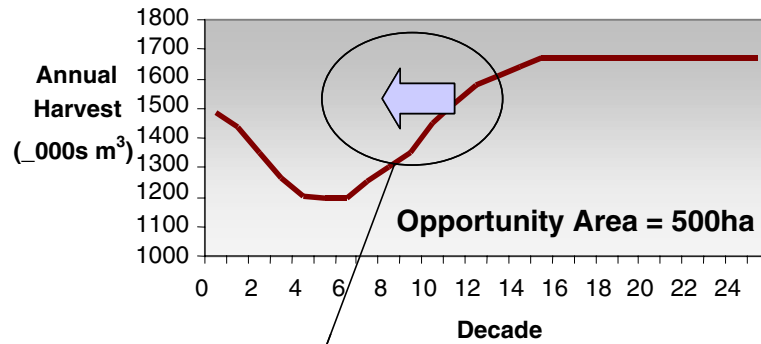
Long-term

Timber Volume	none
Min. harvest age	↓
Quality	No impact
Biodiversity	Minor (↑ productivity)
Jobs	0.2 days / ha
Cost	\$ 450-600 / ha /application

Notes:

Research on this program is ongoing but results continue to show that this fertilization program is beneficial. For this TSA fertilization is assumed to raise productivity by one group (ie: 4 to 2/3). Research has shown that the preferred age of the first application is at a stand age of 4 to 5. However, as FRBC funding is only available for FTG stands the actual stand age of the first application is about 8 years. The opportunity area is an estimate as the Forest Cover Database does not yet track previous fertilization.

6.1.3 Fertilization at Time of Planting



Screening Criteria

Ecosystems	S1ch, S10, S12ch, S3
Structural Stage	Establishment

Treatment Details

Single application per tree	

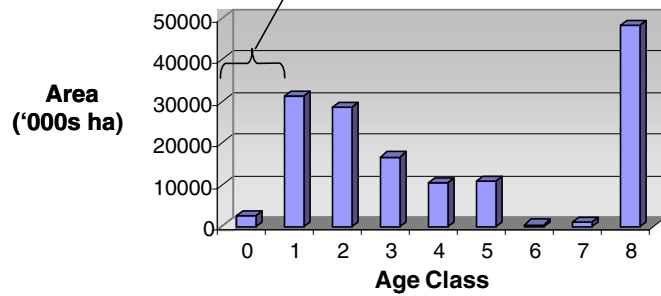
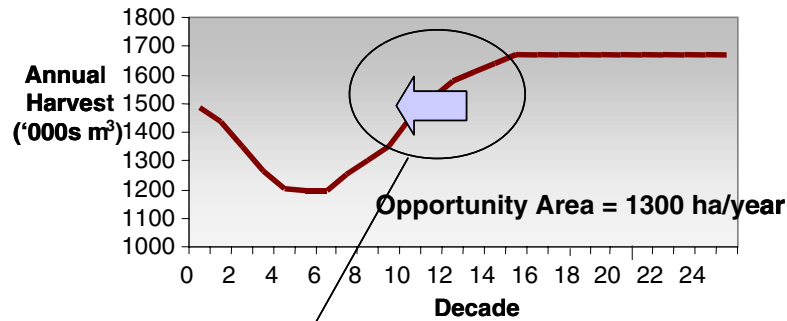
Treatment Effects Short-term

Timber Volume	None
Min. harvest age	↓ green-up time
Quality	None↑
Biodiversity	None
Jobs	0.3 / ha
Cost	\$130 - \$150 / ha

Notes:

Treatment is not eligible for FRBC funding.
 All salal sites are treated. Experimental use on potential brush sites is ongoing.
 The primary benefit of this treatment on the timber supply is through the fast achievement of green-up to reduce adjacency constraints.

6.1.4 Reforestation With Genetically Improved Stock



Screening Criteria

Ecosystems	All
Structural Stage	Establishment

Treatment Details

1st Generation for Fd, Hw, Cw, Yc	

Treatment Effects (Mid) to Long-term

Timber Volume	None
Min. harvest age	↓
Quality	minor ↑
Biodiversity	None.
Jobs	0.1 / ha
Cost	\$17 - 60 / ha

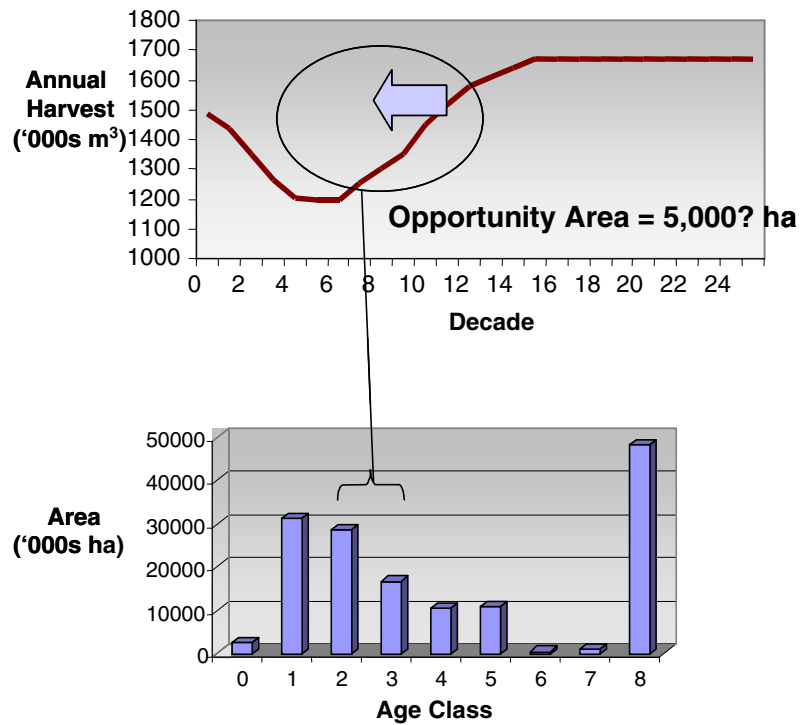
Notes:

Treatment is not eligible for FRBC funding.
 Where available, by regulation, improved seed is required to be used. Currently about 70 to 80% of planted trees are from improved seed. For first generation seed the TSA assumes a 5% gain. Second generation seed for Fd, Hw and Yc is expected to be available by the end of this decade. The TSA assumes a 15% gain for second generation seed of these species.

6.2 Review of “Experimental” Potential Treatment Options

These treatments include commercial thinning, “early” commercial thinning (ECT), establishing alder, fertilization (non-SCHIRP), road rehabilitation, harvesting/conversion of deciduous-leading stands and drainage of low productivity sites.

6.2.1 Commercial Thinning



Screening Criteria

Ecosystems	S1ha, S12, S3
Structural Stage	YF (40-50 yrs)
Type (Spp comp)	H-H(B,S,C,F), F(H,B,C)
Density	> 60 m2/ha
Live Crown of Dom:	CD: > 25%
Slope/terrain	< 20%/ easy GB harv
Access	Close to roads

Treatment Details

Target retained BA	60 – 75 %
Target removal volume	> 250 m3 / ha
Leave-tree species and/or size preferences	Tallest tree regardless of species with consideration of form, susceptibility to decay, wind resistance and habitat value.

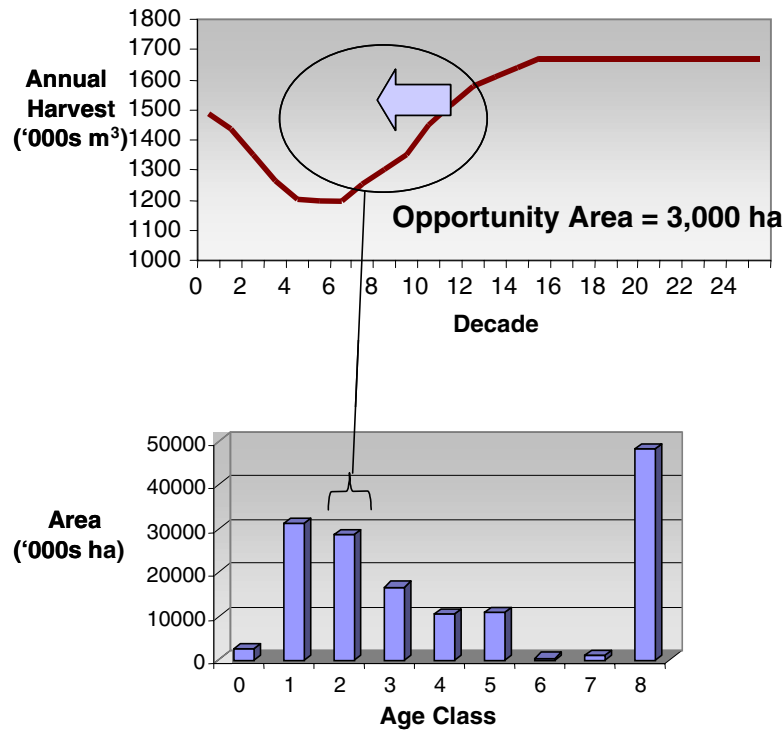
Treatment Effects

Mid-term

Timber Volume	No significant impact
Min. harvest age	↓ Initial entry earlier with final harvest at same age
Quality	↓ (thinnings) ↑ (final cut)
Biodiversity	↑ natural succession
Jobs	8 - 12 / ha
Cost	\$0 – 3,000 / ha

Notes: Treatment is not eligible for FRBC funding. Small experiments done to date in Hw second growth have not been very successful. Big concerns are losses in the residual stands due to windthrow and damage and profitability. CT is not recommended in the short-term as it would exacerbate the AAC shortfall in the 2040 to 2060 “trough”. If CT can be proved viable, it can be used to bring stands forward into the “trough”. The TSA shows that an aggressive CT program starting in ~2030 could augment the AAC through the “trough” by over 50,000m³/year. More research, trials, and operational experience are needed over the next 30 years.

6.2.2 “Early” Commercial Thinning



Screening Criteria

Ecosystems	S13, S12, S3, S1ha
Structural Stage	YF (25 -40 yrs)
Type (Spp comp)	H-H (B,S,C,Fd), Fd>50%
Density (crop trees)	1200-1800sph
Slope/terrain	< 20%/ easy GB harv
Access	adjacent to roads, near log dump

Treatment Details

Medium-term

Target retained BA	70 - 80 %
Target removal volume	N/A
Species and/or size preferences	Tallest tree regardless of species with consideration of form, susceptibility to decay, wind resistance and habitat value..

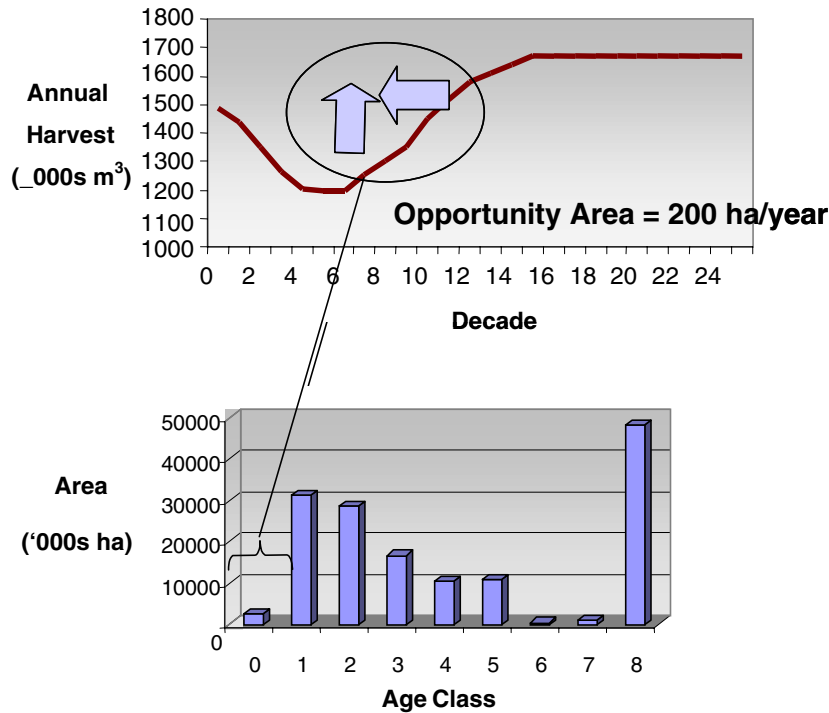
Treatment Effects

Mid-term

Timber Volume	↓
Min. harvest age	↓
Quality	↓ (thinnings) ↑ (final cut)
Biodiversity	↑ natural succession
Jobs	8 – 12 / ha
Cost	\$1,000 – 3,000 / ha

Notes: The “Early” commercial thinning (ECT) concept comes from the 1998 FRBC report, *Silviculture Investment Opportunities: A Methodology for identifying Key Decision Variables* (E. McWilliams and R. Carter). ECT is an alternative to JS. It's benefits are the improved economics of harvesting stands which have undergone density management while reducing the cost implications of the density management treatment. ECT implies that the stands must be old enough to recover some economic material but does not mean that the treatment must be profitable. Together with the increase in the value of the residual stand, the recovery of economic material should reduce the treatment cost enough to increase the NPV of the stand. Treatment would not be eligible for FRBC funding. ECT may be viable as a source of pulp to the local pulp mill as harvesting moves into second growth. Feasibility studies and trials are required to further assess.

6.2.3 Establishment of Alder



Screening Criteria

Ecosystems	S3, , (S5)
Structural Stage	establishment
Slope/terrain	< 30% / no issues
Access	Road / < 30km from town

Treatment Details

Est. Density	1500 – 1700 sph
Site Preparation	thin forest floor or mechanical disturb; chemical prep.
Space and Prune	@ 10-12 yrs to 800-1100sph
Commercial Thin	@ 15-17 to 250-400 sph

Treatment Effects

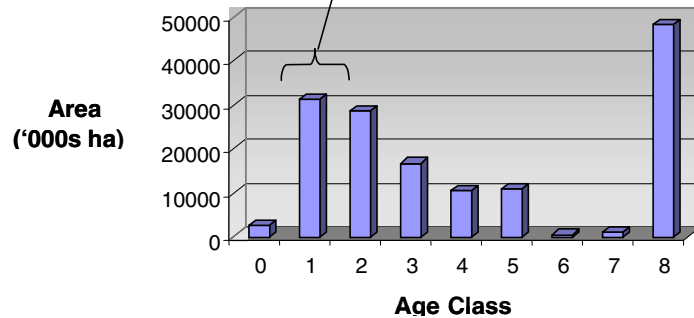
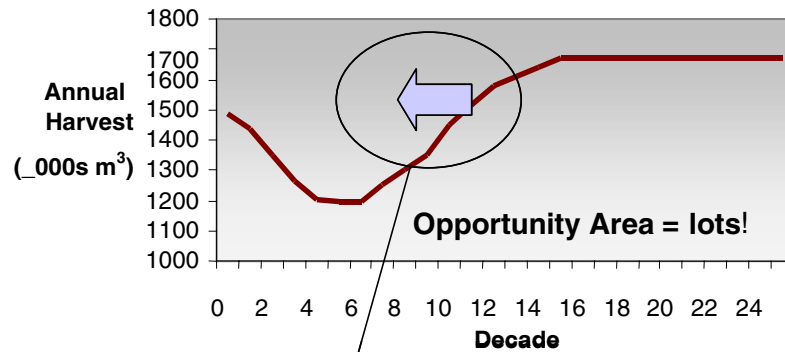
Mid-term

Timber Volume	↑ ?
Min. harvest age	↓
Quality	↑ some clear produced; product diversification
Biodiversity	↑ (habitat diversification)
Jobs	3 -5 / ha
Cost	\$1,000 – 2,000 / ha

Notes:

This treatment potentially impacts timber supply constraints in the “trough” and allows product diversification. Opportunity area is based on the percentage of the annual harvested area which come from ecosystems meeting the screening criteria. Treatment details are based on Weyerhaeuser’s regimes from the US Pacific Northwest with final rotation ages projected to be ~50 years. In order to be viable there must be local sawmill capacity (in Campbell River or on northern Vancouver Island) and preferably dry kilns and re-manufacturing facilities. Treatment would not be eligible for FRBC funding. Feasibility studies are required to further assess.

6.2.4 Fertilization on Hw, (Ba, Ss, Cw)-dominated (Non-SCHIRP)



Screening Criteria (to be developed)

Ecosystems	
Structural Stage	

Treatment Details

Blend of N + P

Treatment Effects

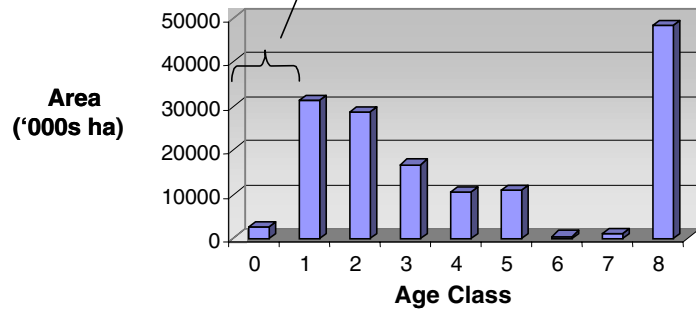
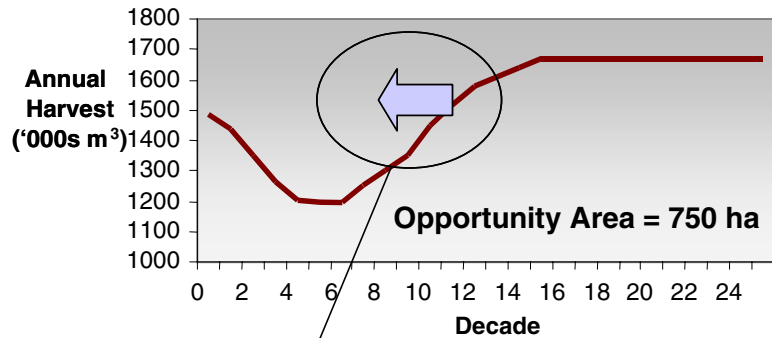
Mid-term

Timber Volume	None
Min. harvest age	↓
Quality	minor ↑
Biodiversity	Minor (↑ productivity)
Jobs	0.2 jobs / ha
Cost	\$ 450 - 600 / ha / application

Notes:

Hw is the primary species in question. To date research shows that Hw’s response to fertilization is inconsistent and not predictable. Due to this TFL’s reliance on Hw second growth for the future timber supply, WFP needs to be a leader in Hw fertilization research. Research is also required into the fertilization response of other species such as Ba, Cw and Ss.

6.2.5 Road Rehabilitation



Screening Criteria

Ecosystems	All
Structural Stage	Establishment

Treatment Details

Rehabilitation to achieve	3% PAS

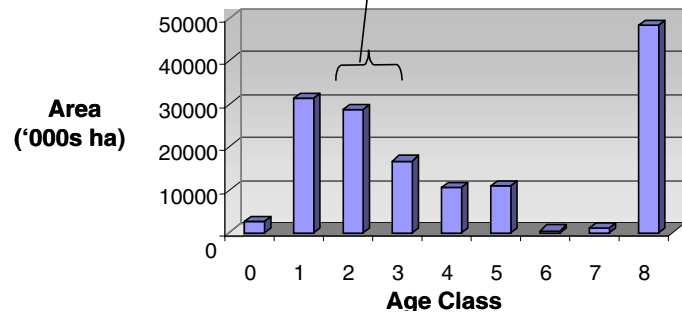
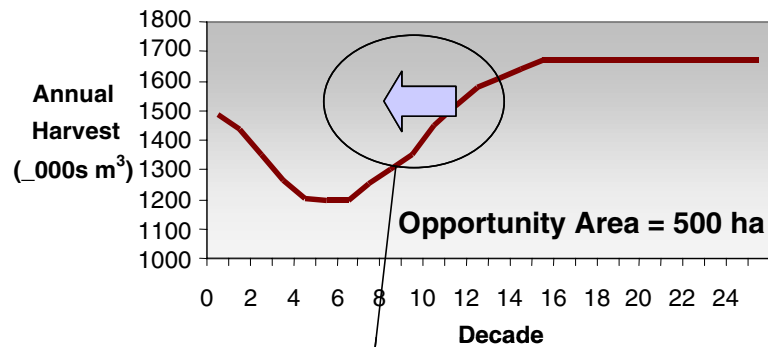
Treatment Effects Long-term

Timber Volume	↑ THLB
Min. harvest age	
Quality	none
Biodiversity	none
Jobs	2 – 3 / ha
Cost	\$1,800 – 2,300 / ha

Notes:

This option is similar to Canfor’s program of aggressive road rehabilitation of non-strategic roads in TFL 37. The opportunity area relates to the effects of rehabilitation of future roads only. Discussion was about how most current roads were well built and required as assets for future management. Also that other treatments could achieve similar timber supply effects and be more cost-effective.

6.2.6 Conversion of Dr-Leading Stands



Screening Criteria

Ecosystems	S3, S4, (S1ha)
Structural Stage	YF (30-60 years)
Type (Spp comp)	Dr-coniferous
Volume (m3/ha)	>500
Access	<30km from town

Treatment Details

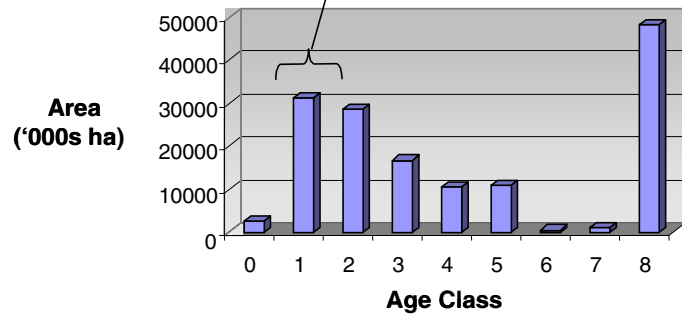
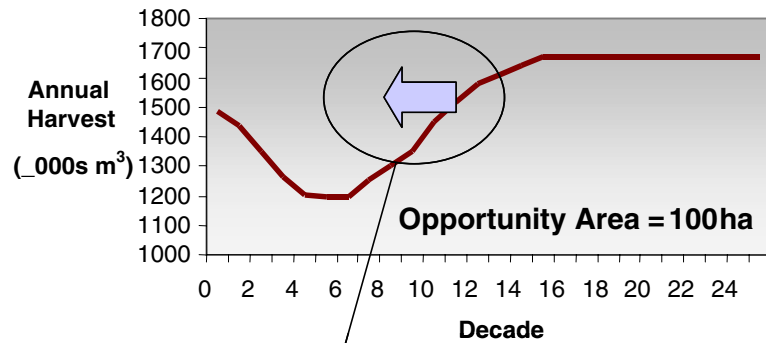
Treatment Effects Short, Long-term

Timber Volume	↑ THLB
Min. harvest age	None
Quality	↑ Dr sawlogs currently more valuable than Hw.
Biodiversity	Riparian ↑ or ↓
Jobs	8 – 12 / ha
Cost	\$200 - 1500 / ha

Notes:

The opportunity area is a conservative estimate based on stands which can be harvested at break-even or a profit and are not constrained by other resource values (primarily riparian habitat). The short-term treatment effect is based on recovering alder which is not considered part of the timber supply. The TSA estimates that a partitioned AAC of about 10,000 to 12,000 m3/year for alder could exist under the right market conditions. More accurate estimates of the opportunity area and potential alder AAC will be analyzed in the Type II report. The long-term treatment effect is bringing the harvested areas under management (for conifers or alder). The challenges to alder utilization are the same as those listed under “Establishment of Alder”. However there is more urgency to find solutions to these problems as the majority of the alder in the inventory will start to become over-mature in the next 10 to 20 years.

6.2.7 Drainage of Low Productivity Sites



Screening Criteria

Ecosystems	S7, S6, (S5)
Structural Stage	Establishment
Slope/Terrain	<30%/No issues
Access	Road/<30km from settlement or log dump

Treatment Details

Treatment Effects

Long-term

Timber Volume	None
Min. harvest age	↓
Quality	minor ↑
Biodiversity	None.
Jobs	4 –6 / ha
Cost	\$2,000 – 3,000 / ha

Notes:

A small research trial was recently established to evaluate this treatment. The opportunity area is based on treating the portion of the annual area that is logged from the ecosystems listed in the screening criteria.

6.3 Other Potential Treatment Options

These additional treatment options were raised during the workshop.

- **Update Terrain Stability and Riparian Mapping.**
These projects are not directly within the scope of an incremental silviculture strategy. However, it was noted that better mapping/inventories of these resources will allow constraints on timber supply to be minimized.
- **Verification of Wintipsy OAF1 and OAF2.**
For existing managed stands the TSA used 10% for OAF1 and 5% for OAF2. It was suggested that these OAF's need verification for TFL 6 as the long-term timber supply may be sensitive to inaccuracies.

6.4 Summary of Potential Strategies by Response Time Frame

Following is a summary of the previous treatment options organized by response time frame (Short Term (1 to 20 years) = ST, Mid Term (21 – 70 years) = MT, and Long Term (71+ years) = LT).

Response Time Frame	Potential Treatment	Current Status	Anticipated Result	Harvest Forecast (000 000s m3/yr)
ST1	Fertilization at time of planting	All salal sites and some brush sites are treated.	About a 1 year reduction in regeneration delay.	Included in CMO.
ST2	Conversion of Dr-leading stands	As opportunities arise in conjunction with other harvesting	Short-term effect is increase in AAC.	Partitioned harvest of up to an additional 12,000 m3 / yr.
MT1	Juvenile Spacing	About 300 to 400 ha / year are treated to a residual density of 850 / sph	Reduction in harvest age based on an increase in average piece size and reduction in volume harvested / ha.	Treatment of 300 ha / yr is included in the current TSA (subject to the availability of suitable stands). An increase or decrease in the annual area treated may impact the AAC in the 2041 to 2060 “trough”. The magnitude of the potential response needs to be evaluated.
MT2	Commercial Thinning	Nothing	A CT program starting in ~2030 could be used to increase the AAC in the 2041 to 2060 “trough”.	If CT can be proved to be viable, the AAC could be increased by ~50,000m3 /year through the “trough”.

Response Time Frame	Potential Treatment	Current Status	Anticipated Result	Harvest Forecast (000 000s m3/yr)
MT3	“Early Commercial Thinning	Nothing	Similar to juvenile spacing with very small short-term AAC gain.	Needs to be evaluated.
MT4	Establishment of Alder	Nothing	About 200 ha /yr could be treated. If started soon could be used to increase the AAC in the 2041 to 2060 “trough”.	Needs to be evaluated.
MT5	Fertilization (Non – SCHIRP)	Minor areas of Fdc only	For non-Fd stands, requires on-going research. If fertilization response can be demonstrated, mid to late rotation treatments could have significant effects on AAC.	Nothing.
LT1	SCHIRP Fertilization	All cedar – salal sites are being treated in the Shrub-Herb to Pole-Sapling structural stages.	Research is ongoing but current results suggest long – term increases in productivity.	Included in CMO.
LT2	Reforestation with Genetically Improved Stock	Currently about 70 to 80% of planted trees are from first generation improved seed.	For first generation seed a 5% gain is conservatively forecasted. Second generation seed is expected to be available for Fd, Hw and Yc in 10 years and a 15% gain is conservatively forecasted for this seed. Further advances are expected within 20-30 years.	Included in CMO.
LT3	Road Rehabilitation	Currently on a forest – level permanent access occupancy (PAS) is estimated to be about 4%.	Reduction in PAS to 3% based on an aggressive program of rehabilitating non-strategic roads.	Needs to be evaluated.

Response Time Frame	Potential Treatment	Current Status	Anticipated Result	Harvest Forecast (000 000s m3/yr)
LT4	Conversion of Dr-leading stands	Nothing	Long-term effect is an increase in AAC by bringing additional un-managed area under intensive management sooner than is forecast.	Needs to be evaluated.
LT5	Drainage of Low Productivity Sites	Nothing	Increase in AAC by improving site productivity.	Needs to be evaluated.

6.5 Potential Harvest Forecast

Past silviculture (basic and intensive) efforts have and continue to soften the effects of recent harvesting restrictions. Past silviculture treatments are projected to have reduced the AAC reductions in the “trough” (~2021 to 2091) by about 8%.

According to the current TSA, future intensive silviculture treatments which are included in the CMO such as juvenile spacing, fertilization and tree improvement do not impact the timber supply until the long-term (ie: after ~2140). After this time future intensive treatments, of the magnitude assumed in the CMO, potentially account for between 5 and 20% of the projected AAC.

In addition to the treatments included in the CMO there are quantified opportunities to increase the short-term AAC by about 10,000 to 12,000 m3 and the mid-term AAC by about 50,000 m3.

Finally there are several treatments which have the potential to further increase the mid to long – term AAC. However, the impacts of these treatments on timber supply have not been quantified.

7 OPPORTUNITIES TO IMPROVE TIMBER QUALITY

The effects of incremental silviculture on future timber quality were not analyzed in the current TSA. To identify one potential treatment option that primarily effects timber quality, the consultants used information from reviews of Management Plans 8 and 9. In addition the previously identified treatments which effect timber supply were all rated relative to their impacts on timber quality. Each of these treatment options was discussed at the workshop. Key points from the discussions are listed for each treatment.

7.1 Second Growth Product Objectives

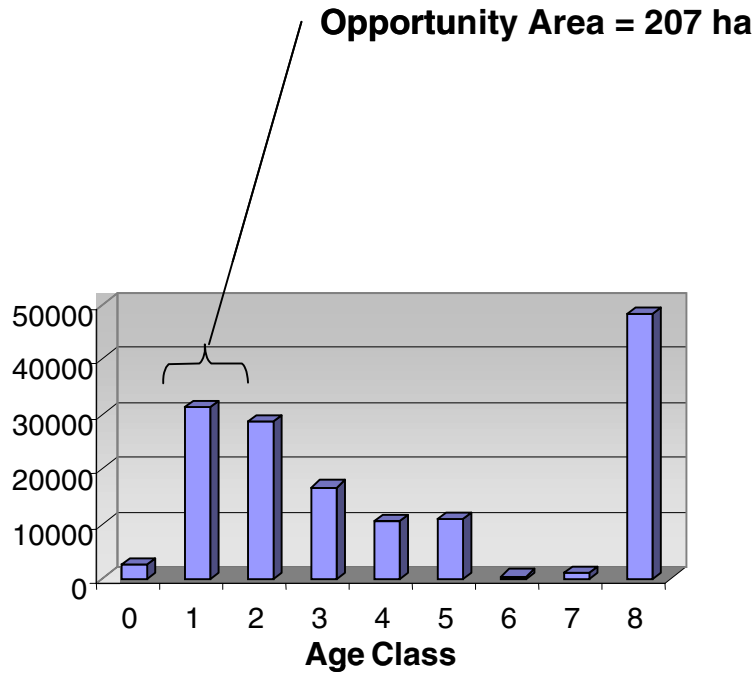
Aside from setting target piece sizes for harvest rotation ages, product objectives are not specified in Management Plans 8 or 9 and were not discussed at the workshop. Therefore as a starting point for further discussion the consultants have suggested some basic log specifications. It is expected that these will be refined in the initial stages of the Type 2 Strategic Silviculture Analysis for TFL 6.

Quality Class	Species	Characteristics
Premium Log	Hw-Ba, Ss, Fd	50+ cm dbh, with or without pruned 5.5m first log
	Dr	40+ cm dbh, with or without pruned 5.5m first log
Sawlog	All conifers	40+ cm dbh
	Dr	30+ cm dbh

7.2 Review of Potential Treatment Options

Following is the potential treatment option that primarily effects timber quality.

7.2.1 Pruning (Hw) 1st lift (3.5 m); 2nd lift (5.5)



Screening Criteria

Ecosystems	S13, S12, S3, (S1ha)
Structural Stage	PS [6-8m], [9-11m]
DBH (doms)	[,8cm], [dia @3.5m,8cm]
Type (Spp comp)	H, F, Ba
Density (crop trees)	spaced 800-850 sph
Slope/terrain	< 30% / no issues
Access	Road / < 50km from town

Treatment Details

Trees / ha	1st lift = 560 tallest trees/ha largest 2/3rds 2nd lift = 350 – 560 tallest previously-pruned trees /ha
Min % live crown length retained	Maintain 50% height for 1 st lift and 1/3 for height for 2 nd lift.

Treatment Effects

Mid-term

Timber Volume	None
Min. harvest age	None
Quality	↑ supply of clear
Biodiversity	Minor ↑ increases browse
Jobs	6 – 10 days / ha
Cost	1st lift: \$ 1,300 - \$ 2,200 / ha 2nd lift: \$ 1,700 - \$ 3,000 / ha

Notes:

Opportunity area reflects only areas that have not been pruned to the first lift.
WFP would like to experiment with pruning Ss, Cw, and Yc.

7.3 Other Potential Treatment Options

The consultants developed this treatment option after the workshop.

- **Diversification/Refinement of Species Mixes used in reforestation.**
To improve future product diversification, aside from establishment of alder, it may be beneficial to reduce the use of Hw in reforestation. Primarily this involves managing for more Ss (weevil-resistant)Hw or SsBa mixes on the nutrient medium to rich sites and planting more Cw and/or Fd on the nutrient medium non-salal types. Fd should also continue to be used on other sites where ecologically appropriate.
These are basic reforestation strategies that are not eligible for FRBC funding. These treatments are introduced to primarily address long-term timber quality. However these strategies will also effect long-term timber supply.

7.4 Summary of Potential Strategies by Response Time Frame

Following is a summary of the treatment options which effect timber quality organized by response time frame (Short Term (1 to 20 years) = ST, Mid Term (21 – 70 years) = MT, and Long Term (71+ years) = LT).

Response Time Frame	Potential Strategy / Action	Current Status	Anticipated Result
ST1	Conversion of Dr – leading stands	As noted under timber supply.	Increase in quality is through product diversification. In addition some clear lumber will be recovered.
MT1	Pruning	About 500 ha / year of spaced Hw have been pruned over the last 4 years. About 350 ha / year is planned for the next 5 years.	Increase clear recovery from the 1 st 5 m log. Pruning about 350 ha / year should yield, starting in the mid – term, >4% of the harvest in premium logs with some clear cuttings.
MT2	Juvenile Spacing / “Early” Commercial Thinning	As noted under timber supply.	Treatment selects the best trees/species as crop trees.
MT3	Commercial Thinning	As noted under timber supply.	Quality of thinnings will be low due to small size. Quality of final harvest will be improved as post-thinning growth will be on the best trees.
MT4	Establishment of Dr	As noted under timber supply.	Increase in quality is through product diversification. In addition some clear lumber will be recovered.
LT1	Diversification / Refinement of Species Mixes used in reforestation.	Ongoing	Reduction in the use of Hw in future reforestation. Primarily this involves managing for more Ss(weevil-resistant)Hw and SsBa mixes on the nutrient medium to rich sites and planting more Cw and/or Fd on the nutrient medium non-salal types.

7.5 Timber Quality Forecast

A timber quality forecast was not done as part of the TSA. In the short-term the harvest will be primarily from old growth stands which will yield some high quality clear cuttings. In the short-term there is an opportunity to harvest some alder which would provide some product diversification and some clear recovery.

In the mid to long-term as the harvest moves to second growth, it is expected that significant components of premium logs will be produced primarily because of the longer rotations which result from harvesting based on achievement of target piece sizes. Figure 10 (from the Review of the Timber Supply Analysis Section) shows that average dbh harvested after 2040 is forecast to be steady at about 40 cm.

As a result of previous and future pruning, some coniferous premium logs with clear cuttings will be harvested starting in late mid-term.

Hw dominates the existing second growth inventory. There are opportunities to diversify the species mix used in reforestation that will impact mid to long-term timber quality.

8 OPPORTUNITIES TO INCREASE/IMPROVE HABITAT SUPPLY

The effects of incremental silviculture on future timber quality were not analyzed in the TSA. Prior to the workshop the consultants did not identify treatment options designed specifically for habitat quality and/or supply. Instead the previously identified treatments which were developed to primarily effect timber supply or timber quality were all rated relative to their impacts on biodiversity. Limited discussion about habitat occurred during the workshop. Key points are noted with the treatment options in the timber supply and timber quality sections. One treatment option specifically designed for habitat was raised during the workshop.

Many of the treatments options which were identified to improve timber supply and quality can be modified to improve habitat. However, these modifications usually lead to a reduction in timber supply or timber quality effects. Specific treatment prescriptions may be designed and analyzed for identified habitat issues during the Type 2 Strategic Silviculture Analysis for TFL 6.

8.1 Other Potential Treatment Options

This treatment option was raised and discussed during the workshop.

- **Density management and conversion of Alder-leading stands in Riparian Management Zones.**

WFP is currently working in conjunction with the MOE to improve fish and riparian habitat by creating openings in mature alder and coniferous-leading stands. About 30 hectares per year are planned for treatment over the next 5 years.

These treatments are eligible for FRBC funding and are designed to improve long-term habitat. These treatments have no timber supply or quality effects.

9 INCREMENTAL SILVICULTURE STRATEGY

This section synthesizes the preceding background information into an incremental silviculture strategy for the TFL.

9.1 General Strategy

Policies developed over the last two decades to ensure multi-resource sustainability limit the timber supply in the short to medium-term. Reductions in the amount of old forest available for harvest result in the annual allowable cut (AAC) being stepped down over the next 50 years. In the mid to long term, as more second growth becomes merchantable, the AAC slowly recovers until it reaches a long-term sustainable level higher than the current harvest rate.

The key opportunities for silviculture investments are applying treatments or strategies which minimize constraints on old stands, developing programs for harvesting stands not included in the timber harvesting landbase (THLB) and increasing the number of second growth stands which could be harvested in the 2020 to 2050 “trough”.

Past silviculture (basic and intensive) efforts have lessened the effects of the medium-term reduction in the AAC. Many of the treatment options discussed in this report have been included in the Current Management Option (CMO) of the most recent timber supply analysis (TSA). Most of the additional suggested treatments are considered “experimental” and will require further study or research before they can be implemented. As a result funding for these studies is an important priority in the near future.

In the short-term there is an opportunity to harvest some alder which would diversify the log profile recovered from the TFL. In the mid to long-term as the harvest moves to second growth, it is expected that significant components of premium logs will be produced primarily because of the longer rotations which result from harvesting based on achievement of minimum piece sizes. As a result of previous and future pruning, some premium logs with clear cuttings will be harvested starting in late mid-term.

Hw dominates the existing second growth inventory. There may be opportunities to diversify the species mix used in reforestation, which will impact mid to long-term timber quality.

9.2 Working Targets

WT1 (Quantity): In addition to the treatments included in the CMO there are quantified opportunities to increase the short-term AAC by about 10,000 to 12,000 m³ (alder conversion) and the mid-term AAC by about 50,000 m³ (commercial thinning).

WT1 (Quality): Quantified working targets have not been finalized for quality. An interim estimate is that pruning about 350 ha / year to 5 meters in height should yield, starting in the mid – term, >4% of the harvest in premium logs with some clear cuttings.

9.3 Second Growth Log Product Objectives

Log product quality objectives have not yet been finalized for TFL 6. As a starting point for further discussion the following basic log specifications are suggested.

Quality Class	Species	Characteristics
Premium Log	Hw-Ba, Ss, Fd	50+ cm dbh, with or without pruned 5.5m first log
	Dr	40+ cm dbh, with or without pruned 5.5m first log
Sawlog	All conifers	40+ cm dbh
	Dr	30+ cm dbh

9.4 Silviculture Strategies

9.4.1 Strategies to Increase the Quantity of Future Timber Supply

Short Term:	<ol style="list-style-type: none"> 1. Reduce regeneration delay on salal sites by continuing to fertilize at the time of planting. 2. Increase the short-term AAC by harvesting alder.
Mid Term:	<ol style="list-style-type: none"> 1. Reduce the minimum harvest age and thereby increase the AAC in the 2041 to 2060 “trough” by maintaining or increasing current spacing levels and modifying residual densities and/or, if viable, starting an “Early” commercial thinning program. 2. If commercial thinning can be proved to be viable, a program starting in about 2030 could be used to increase the AAC in the 2041 to 2060 “trough.” 3. Increase the AAC in the 2041 to 2060 “trough” by looking at establishing alder plantations on ecologically-suitable currently harvested areas. 4. If non-SCHIRP fertilization response can be demonstrated, the mid-term AAC could be significantly increased by fertilization.
Long term:	<ol style="list-style-type: none"> 1. Increase long-term AAC by continuing to aggressively fertilize and monitor treatment response under SCHIRP. 2. Reduce long-term minimum harvest ages by continuing to use genetically improved seed. 3. Increase the long-term AAC with an aggressive road rehabilitation program. 4. Increase the long-term AAC by converting un-managed alder-leading stands to managed coniferous stands. 5. Increase the long-term AAC by draining wet, low productivity sites.

9.4.2 Strategies to Increase the Quality of Future Timber Supply

Short Term:	1. Increase product diversification by harvesting alder.
Mid Term:	<ol style="list-style-type: none"> 1. Increase mid-term clear recovery by continuing or increasing the current pruning program. 2. Improve mid-term sawlog quality by continuing or increasing current juvenile spacing levels and/or, if viable, starting an “Early” commercial thinning program. 3. If commercial thinning can be proved to be viable, a program starting in about 2030 could be used to increase the quality of the final harvest. 4. Increase product diversification and recover logs with some clear cuttings by growing alder.
Long Term:	1. Diversification / refinement of the species mixes used in reforestation can be used to diversify the mix of species harvested in the long-term.

9.4.3 Strategies to Increase the Quantity or Quality of Future Habitat Supply

Long Term:	1. Density management and conversion of alder-leading stands in riparian management zones to mixed to deciduous-coniferous stands will improve long-term fish and riparian habitat.
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10 SILVICULTURE REGIMES AND INVESTMENT PRIORITIES

10.1 Incremental Silviculture Program

The following tables illustrate the results of an evaluation process to assess the rank or priority of specific silviculture treatment options and to develop an associated five-year program that supports attainment of the stated goals and objectives. This evaluation process was completed by the consultants and a representative of WFP following the workshop. Prior to this draft report being finalized changes may be required to the treatment ranking. For a depiction and description of the evaluation framework please refer to Appendix I.

Table 2 summarizes the actual and scaled impact of each treatment on the stated objectives (scaled data was obtained via questionnaire where actual data was unavailable). The net direct costs of each treatment and the relative importance of each objective are also noted. This information forms the basis of the ranking process described below.

Table 3 summarizes the weighted sum of all silviculture treatment benefits and highlights the cost/benefit ratio and corresponding rank associated with each treatment. This information flows directly from the preceding data. In order to assess the overall impact of each treatment relative to all others, all treatment effects on each objective are rolled up into a single weighted sum for each treatment (given the relative importance of each objective). (Please refer to Appendix I). The cost of each treatment is divided by its overall benefit in order to determine the cost effectiveness of each treatment relative to all others. The rank of the cost effectiveness of each treatment determines the order that they should be pursued when budget constraints are faced

Table 2: Data Framework

Data Framework	Timber Supply	Timber Quality	Wildlife Habitat & Biodiversity	Employment		Net Direct Cost
Incremental Treatment Options	Score / ha (-100 to 100)	Score / ha (-100 to 100)	Score / ha (-100 to 100)	Total Person days / ha	Implied Score/ha (-100 to 100)	Unit Cost \$/ ha
MAIN						
Surveys				0.10		\$ 25
Juvenile Spacing	100	100	100	6.50	87	\$ 2,500
Pruning	0	75	30	7.50	100	\$ 3,000
SCHIRP Fertilization	75	0	0	0.20	3	\$ 600
Reforestation (GM stock)	65	0	0	0.10	1	\$ 60
Fertilization at Planting	10	0	0	0.30	4	\$ 200
Backlog Brushing	40	75	0	1	13	\$ 700
Planning & Prescriptions				0.10		\$ 40
EXPERIMENTAL						
Early Commercial Thinning (ECT)	10	50	100	10.00	100	\$ 3,000
Commercial Thinning	50	50	100	10.00	100	\$ 3,000
Establishing Alder	100	100	30	4.00	40	\$ 2,000
Fertilization (Non-SCHIRP)	100	0	20	0.20	2	\$ 550
Conversion of Deciduous Leading Stands	60	80	35	10.00	100	\$ 1,500
Road Rehabilitation	40	0	10	2.70	27	\$ 2,300
Drainage of Low Productivity Sites	70	0	25	4.50	45	\$ 3,000
Objective Weight Score	70	20	70	100		
Implied Weight	27%	8%	27%	38%		

Table 3: Ranking Framework

Ranking Framework	Weighted Sum of Benefits		Cost / Benefit Ratio	
			Direct Cost <i>divided by</i> Sum of Benefits	
Incremental Treatment Options	Total Weighted Score (unitless)	Rank (within Main and Experimental Separately)	\$ / Unit Score	Rank (within Main and Experimental Separately)
MAIN				
Juvenile Spacing	95	1	\$ 26	2
Pruning	52	2	\$ 57	6
SCHIRP Fertilization	21	4	\$ 28	3
Reforestation (GM stock)	18	5	\$ 3	1
Fertilization at Planting	4	6	\$ 47	5
Backlog Brushing	22	3	\$ 32	4
EXPERIMENTAL				
Early Commercial Thinning (ECT)	72	2	\$ 42	5
Commercial Thinning	83	1	\$ 36	4
Establishing Alder	58	4	\$ 34	3
Fertilization (Non-SCHIRP)	33	6	\$ 17	1
Conversion of Deciduous Leading Stands	70	3	\$ 21	2
Road Rehabilitation	24	7	\$ 96	7
Drainage of Low Productivity Sites	43	5	\$ 70	6

Table 4 summarizes the opportunity areas associated with each treatment.

Table 4: Opportunity Area

Opportunity Area	Hectares			
	Total Currently Available	Average / Year for Next Five Years	Low Estimate / Year for next 5 years	High Estimate / Year for next 5 years
INCREMENTAL TREATMENT OPTIONS				
MAIN				
Juvenile Spacing	3,000	250	150	700
Pruning	500	350	200	450
SCHIRP Fertilization	2,700	1,000	800	1,200
Reforestation (GM stock)	n/a	900	800	1,000
Fertilization at Planting	n/a	350	300	400
Backlog Brushing	1,500	300	100	600
<div style="background-color: #cccccc; width: 300px; height: 15px; display: inline-block;"></div> based primarily on SH2 tables from WFP				
EXPERIMENTAL				
Early Commercial Thinning (ECT)	3,000	600		
Commercial Thinning	5,000	1,000		
Establishing Alder	n/a	200	150	300
Fertilization (Non-SCHIRP)	25,000	5,000		
Conversion of Deciduous Leading Stands	500	100		
Road Rehabilitation	750	150		
Drainage of Low Productivity Sites	50	10		

10.2 Development of a Five-year Incremental Silviculture Plan

Table 5 depicts a 5-year tactical plan that will support achievement of the stated goals and objectives. This plan entails the use of all main treatment options over all opportunity areas specified in Table 4. This plan falls within the bounds of the FRBC funding allotment determined in the WFP 2001/2002 SH RMP.¹

¹ Exact totals will differ given that some stand tending and survey activities noted in the 2001/2002 RMP are not considered here.

Table 5: Five-year Silviculture Investment Plan

5-Year Program	Total Hectares					Unit Cost \$/ ha	Total Cost (\$'000's)				
	1	2	3	4	5		1	2	3	4	5
MAIN											
Surveys	3,150	3,150	3,150	3,150	3,150	\$ 25	\$ 79	\$ 79	\$ 79	\$ 79	\$ 79
Juvenile Spacing	250	250	250	250	250	\$ 2,500	\$ 625	\$ 625	\$ 625	\$ 625	\$ 625
Pruning	350	350	350	350	350	\$ 3,000	\$1,050	\$1,050	\$1,050	\$1,050	\$1,050
SCHIRP Fertilization	1,000	1,000	1,000	1,000	1,000	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600
Reforestation (GM stock)	900	900	900	900	900	\$ 60	\$ 54	\$ 54	\$ 54	\$ 54	\$ 54
Fertilization at Planting	350	350	350	350	350	\$ 200	\$ 70	\$ 70	\$ 70	\$ 70	\$ 70
Backlog Brushing	300	300	300	300	300	\$ 700	\$ 210	\$ 210	\$ 210	\$ 210	\$ 210
Planning & Prescriptions	3,150	3,150	3,150	3,150	3,150	\$ 40	\$ 126	\$ 126	\$ 126	\$ 126	\$ 126
Riparian Habitat Supply	30	35	35	35	35	\$ 2500	\$ 2500	\$ 2500	\$ 2500	\$ 2500	\$ 2500
EXPERIMENTAL											
Early Commercial Thinning (ECT)	Under study / consideration					\$ 3,000					
Commercial Thinning						\$ 3,000					
Establishing Alder						\$ 2,000					
Fertilization (Non-SCHIRP)						\$ 550					
Conversion of Deciduous Leading Stands						\$ 1,500					
Road Rehabilitation						\$ 2,300					
Drainage of Low Productivity Sites						\$ 3,000					
STUDIES (SCHIRP, windthrow)											
Total (\$'000's) (1)							\$3,014	\$3,014	\$3,014	\$3,014	\$3,014
Total FRBC Funded Treatments Only (\$'000's) (2)							\$2,809	\$2,809	\$2,809	\$2,809	\$2,809
Shaded treatments are not eligible for FRBC funding											
(1)	Total does not include other stand tending activities, such as Habitat Supply and Biodiversity Enhancement										
(2)	Ineligible treatment and associated survey costs are netted off this total										

10.3 Job Outcomes

Table 6 highlights the anticipated job outcomes over the course of the 5-year program specified above.

Table 6: Job Outcomes

Job Outcomes	Person Days / ha	Person Years (1)				
		Year				
Incremental Treatment Options		1	2	3	4	5
MAIN						
Surveys	0.10	2	2	2	2	2
Juvenile Spacing	6.50	9	9	9	9	9
Pruning	7.50	15	15	15	15	15
SCHIRP Fertilization	0.20	1	1	1	1	1
Reforestation (GM stock)	0.10	1	1	1	1	1
Fertilization at Planting	0.30	1	1	1	1	1
Backlog Brushing	1.00	2	2	2	2	2
Planning & Prescriptions (2)	0.10	2	2	2	2	2
EXPERIMENTAL						
Early Commercial Thinning (ECT)	10.00	Under study / consideration				
Commercial Thinning	10.00					
Establishing Alder	4.00					
Fertilization (Non-SCHIRP)	0.20					
Conversion of Deciduous Leading Stands	10.00					
Road Rehabilitation	2.70					
Drainage of Low Productivity Sites	4.50					
Total (person years)		31	31	31	31	31

(1) Assumes that 1 person year of employment equals 180 person days of work.

REFERENCES

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APPENDIX I

Depiction of the Evaluation Framework

DEPICTION OF THE EVALUATION FRAMEWORK

Obtain information on the relative performance of each treatment under each objective	Information From Questionnaire		Information From Other Sources		
	Objectives				
	Benefits				Cost
		Timber Supply	Timber Quality	Habitat / Biodiversity	Employment
Treatments	Score 0-100 /ha	Score 0-100 /ha	Score 0-100 /ha	PD / ha	\$ / ha
treatment 1	100	80	100	3	\$ 20
treatment 2	50	20	20	8	\$ 25
treatment 3	40	100	80	10	\$ 50

Weight the relative importance of each objective	Objectives	Score 0 to 100	Implied Weight of Objectives
	Timber Supply	100	53%
	Timber Quality	50	26%
	Hab / BioD	10	5%
	Employment	30	16%

Align the information in an evaluation framework ----- Obtain the Weighted Sum of Benefits for each treatment	Objectives					
	Benefits				Cost	
		Timber Supply	Timber Quality	Habitat / Biodiversity	Employment	
	Treatments	Score 0-100 /ha	Score 0-100 /ha	Score 0-100 /ha	Implied Score 0-100 / ha	\$ / ha
	treatment 1	100	80	100	30	\$ 20
treatment 2	50	20	20	80	\$ 25	
treatment 3	40	100	80	100	\$ 50	

Weight of Objective	53%	26%	5%	16%
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	Weighted Sum of Benefits			Cost
	For each treatment: Score*Weight (Benefit 1) + Score*Weight (Benefit 2) + Score*Weight (Benefit 3) + Score*Weight (Benefit 4)			
treatment 1	84			\$ 20
treatment 2	45			\$ 25
treatment 3	67			\$ 50

Obtain the Cost per Unit of Benefit (Cost-Benefit Ratio) and Rank the Treatments	Cost per Unit of Benefit (Cost/Benefit Ratio) (Cost divided by Weighted Benefit Score)		Treatment Rank
	treatment 1	\$ 0.24	1
	treatment 2	\$ 0.55	2
	treatment 3	\$ 0.74	3

Comments

Notice that the rank based on the cost / benefit ratio differs from the rank of the treatments if you based the ranking solely on the weighted sum of the benefits.

That is: The weighted benefits of Treatment 3 are greater than those for Treatment 2 and thus Treatment 3 would rank higher than Treatment 2 if ranked based on Benefits only. However, Treatment 2 ranks higher than Treatment 3 in terms of Cost/Benefit after accounting for the fact that Treatment 3 is twice as expensive as Treatment 2.

Quite possibly, all treatments could be pursued if they came within budget , but in this framework the order they should be pursued until budget constraints are met is their rank order based on the cost/benefit ratio.