

Invermere Timber Supply Area

Interim Silviculture Strategy

-- Version 1.1 --

British Columbia
Ministry of Forests

Funded By
Forest Renewal BC

September 15, 1999

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1. EXECUTIVE SUMMARY

Note: See page 68 for a list of abbreviations used.

- Introduction** This strategy is intended to help optimize the application of available funding for silviculture activities towards the goals of improving the future quantity and quality of both habitat and timber supply. The strategy will be considered as one of several inputs in decisions on funding allocations and treatment activities. The degree to which the overall strategy ultimately proves appropriate and is achieved will also be the degree to which the expressed targets will be achieved.
- Objectives** Because the TSR2 analysis is not yet available it is difficult to identify with any precision both the silvicultural opportunities and their relative importance. In its stead, the workshop participants relied on their own local knowledge of issues and opportunities as well as some indication of what TSR2 may look like based on preliminary TSR2 information as well as inferences from timber supply analysis of the EFMPP area.
1. Both the TSR1 and EFMPP base case forecasts indicate timber supply to be falling in the near future. In addition, forest companies are having difficulty finding available wood for harvest. Workshop analysis of a variety of potential silviculture strategies to increase short term (i.e., the next 20 years) timber supply could not identify any feasible strategies. Therefore, the strategy has no stated objective for the short term period.
 2. A mid term harvest shortfall below the ultimately higher long term harvest level will occur, driven largely by the age class structure of the TSA. There is a substantial shortage of stands presently aged 31 – 50 years, followed by a substantial excess of stands presently aged 1 – 30 years. A mid term objective, therefore, is to increase the quantity of the timber to be available for harvesting in this time period. The most significant opportunity is through programs of spacing and fertilization in a large proportion of those stands presently aged 1-30 years to advance their merchantability and bring them forward into the mid term harvest period. *The spacing treatments must be completed in the near future before the biological window of opportunity closes.*
 3. *In the long term, starting about 90 years from now, workshop analysis indicates silvicultural activities can result in harvest levels substantially above the TSR1 base case forecast level. Therefore, a long term objective is to maximize timber production within a context of sound multiple resource stewardship.* Workshop analysis indicates that silvicultural activities can contribute significantly to this objective.
 4. Based on a clear log definition of being able to produce 25% clear lumber by volume, 2nd growth managed stands will have no clear logs. Given the low site productivity generally across the TSA, this area is not seen as a priority for this type of investment. A second long term objective is to create a long term timber supply yielding a minor amount (0.5%) of clear logs on a total harvest volume basis.
 5. The TSA contains significant areas of prime ungulate habitat. As well, there is a need to maintain the natural biodiversity of the area. A third long term objective is to maximize ungulate habitat and foster biodiversity through harvesting and silvicultural activities.
 6. Accomplishing these objectives requires an incremental silviculture program substantially above historic levels. Some changes in basic silviculture activities also present opportunities to contribute to the objectives.

Product Objectives

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

Quality Class	Species	Characteristics	Value
Premium Log:			(\$/m3)
Peelers	All	25+ cm DBH, clear, 5 m log, min 20 cm top.	90
Building Log	Douglas-fir, larch, lodgepole pine, spruce	42.5+ cm DBH, straight, low taper, minimal twist, min 9 m log, min 27.5 cm top	130
Poles	western redcedar	27.5+ cm DBH, 9 m log, straight, min 10 cm top, no rot.	150
Large logs	All	47.5+ cm DBH, 5 m log, min 35 cm top	90
Sawlog:	Douglas-fir, larch, ponderosa pine, redcedar	27.5+ cm DBH.	70
	lodgepole pine, spruce, balsam, hemlock	22.5+ cm DBH.	70
			Balsam - 50

Major Silvicultural Strategies

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

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

No.	Strategy	Priority
Surveys	Conduct approximately 10 900 ha/yr of silviculture surveys in support of all strategies.	0

SHORT TERM

Objectives:

- None.

Working Targets:

- None.

Strategies:

No viable short term strategies.

MID TERM

Objectives:

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

Working Targets:

- Generate an additional 7.1 million m³ to mid-term timber supply.

Strategies:

- MT3** Achieve merchantable size 30 years earlier in approximately 60% of stands currently 1-30 years old and increase their volumes by 20% by:
- (b) In addition to the 16 400 ha already spaced, spacing an additional 20 000 ha at the rate of 2 850 ha/yr as follows:
- 5 000 ha of PI stands subject to severe repression at the rate of 1 650 ha/yr for 3 years; 1
 - 7 000 ha of stands having a stocking level of 4-10 000 sph at the rate of 700 ha/yr; 5
 - 5 000 ha of moderate density clumpy stands having 3-5 000 sph at the rate of 200 ha/yr; and 8
 - mixed Fdi/Lw stands having future commercial thinning potential at the rate of 300 ha/yr. 6
- (d) Repeat fertilizing 30 000 ha of spaced stands currently aged 1-30 yrs (about ½ of the total area in this age class) on a 15 year cycle at the rate of 2 000 ha/yr. (Note: the total area of fertilization will gradually rise over time to 5 000 ha/yr as more areas are harvested and regenerated to managed stands – see LT3.) 6

No.	Strategy	Priority
<u><i>LONG TERM</i></u>		
Objectives:		
<ul style="list-style-type: none"> Maximize long term timber production within a context of sound multiple resource stewardship. Improve the quality of the timber to be harvested. 		
Working Targets:		
<ul style="list-style-type: none"> Increase long term timber supply by at least 11%. Generate at least 2.5% of total harvest volume in premium large logs (no current silviculture strategy implications). Generate at least 0.5% of total harvest volume in clear premium logs (clear logs will generally also be large logs). 		
Strategies:		
LT1	Maintain the timber harvesting land base by:	
(a)	<ul style="list-style-type: none"> Fill-planting approximately 300 ha of backlog NSR at the rate of 100 ha/yr for the next 3 years, 	5
	<ul style="list-style-type: none"> Surveying 6 000 ha/yr of pre-1987 SR areas to ensure they remain fully stocked; 	3
(c)	Reforestation areas destroyed by wildfire (historic rate - 100 ha every 3 years).	5
LT3	Increase the volume of regenerated stands by 17% by:	
(b)	By 2011, expanding the use of improved seed to include PI, with the expected result of a 5% gain in LTHL.	2
(h)	Repeat fertilizing 2 000 ha/yr, rising gradually over about 60 years to 5 000 ha/yr as more stands come under management, for an expected result of a 6% gain in LTHL. (Note: The initial 2 000 ha/yr are the same stands as in MT3 (d).	6
LT4	Reduce losses to root rot by surveying 1 200 ha/yr to monitor root rot development in stands. (Note: basic silviculture practices are also employed to reduce the incidence of root rot.)	6.5
LT5	Monitor stands for mountain pine beetle attack by surveying 200 km/yr of strip lines.	4
Q2	First-lift prune 50 ha/yr.	10

*HABITAT AND BIODIVERSITY***Objectives:**

- Maximize ungulate habitat and foster biodiversity through harvesting and silvicultural activities.

No.	Strategy	Priority
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Working Targets:

- None. Further research and information required.

Strategies:

H1	Space 300 ha/yr of mixed species and clumpy stands	6
H2	Improve ungulate winter range by spacing 40 ha/yr with the objectives of removing pine trees, leaving clumpiness and creating/enlarging voids.	9
H3	Create NDT4 fingers into NDT3 areas at the rate of 50 ha/yr in order to better emulate the naturally ragged boundary between the 2 disturbance types.	7

Silviculture Regimes & Investment Priorities

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

Regimes	Strategy	Opportunity Area (Ha/Yr)	Timber Supply Effects			Quality	Habitat	Jobs Days/ha	Cost \$/ha ¹	Wkshp Rank
			Short	Medium	Long					
		Mpb survey -m							Mpb survey -\$/m	
1 Surveys - general		10570						0.05	26	1
2 Survey - root rot	L4	1200						0.05	20	
3 Survey - mpb	L5	200,000						0.00083	0.32	5
4 Survey - backlog	L1(a)	6000						0.05	26	4
5 Backlog reforestation	L1(a)	100/yr for 3 yrs			+		+/-	1.2	900	6
6 Reforest current fires	L1(c)	100 per 3 years			+		+/-	1.2	900	6
7 Improved seed	L3(b), M5	810	+	+	++	+	?			3
8 Space repressed PI	M3(b),M7,L3(f)	1650/yr for 3yrs		++		++	++	3.6	900	2
9 Space standard PI	M3(b),M7,L3f	700		+		+		2	500	
10 Space clumpy pine		200		+	-	+	-	1.5	375	9
11 Space mixed stands (0-30 yrs)	H1/M3(b)	300		+		++	+	2	500	7
12 Space for habitat	H2	40	+	-		-	+	1.5	375	10
13 fertilization repeat, PI & other, age 1-30	L3(h), M3(d)	2000 up to 5000		++	+		?	0.07	200	7
14 Pruning 1st lift	Q	50		-		+	+	3	750	11
15 NDT4 fingers into NDT3	H	50	?	-			+	2	500	8

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**Incremental
Silviculture
Program**

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

Program Table - Ha, Invermere TSA.

Year	Surveys *	Backlog Establish	Reforest Fires	Improved Seed	Space -	Prune -	Fertilize -	Total
1	19,770	100	100	810	2,890	50	2,000	24,910
2	19,770	100	-	810	2,890	50	2,000	24,810
3	19,770	100	-	810	2,890	50	2,000	24,810
4	19,770		100	810	1,240	50	2,000	23,160
5	19,770		-	810	1,240	50	2,000	23,060
Subtot Yr 1 - 5	98,850	300	200	4,050	11,150	250	10,000	120,750
6 - 10	98,850	-	200	4,050	6,200	250	10,000	119,550
Total Yr 1 - 10	197,700	300	400	8,100	17,350	500	20,000	244,350

* Includes prescription and layout

Program Table - \$ 000s, Invermere TSA.

Year	Surveys *	Backlog Establish	Reforest Fires	Improved Seed	Space -	Prune -	Fertilize -	Total
1	444	90	90	-	2,075	38	400	3,137
2	444	90	-	-	2,075	38	400	3,047
3	444	90	-	-	2,075	38	400	3,047
4	444	-	90	-	890	38	400	1,862
5	444	-	-	-	890	38	400	1,772
Subtot Yr 1 - 5	2,222	270	180	-	8,006	188	2,000	12,865
6 - 10	2,222	-	180	-	4,452	188	2,000	9,041
Total Yr 1 - 10	4,444	270	360	-	12,457	375	4,000	21,906

Job Creation

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

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

Year	Surveys *	Backlog Establish	Reforest Fires	Improved Seed	Space -	Prune -	Fertilize -	Total
1	4.3	0.6	0.6	-	41.5	0.8	0.7	48
2	4.3	0.6	-	-	41.5	0.8	0.7	48
3	4.3	0.6	-	-	41.5	0.8	0.7	48
4	4.3	-	0.6	-	17.8	0.8	0.7	24
5	4.3	-	-	-	17.8	0.8	0.7	24
Subtot Yr 1 - 5	21.7	1.8	1.2	-	160.1	3.8	3.5	192
6 - 10	21.7	-	1.2	-	89.0	3.8	3.5	119
Total Yr 1 - 10	43.4	1.8	2.4	-	249.1	7.5	7.0	311

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

Further Research and Information Needs

During the assessment process, the following needs for further information and research became apparent. The outcome of these have implications for a silviculture strategy. Bracketed numbers refer to the strategy numbers under which the need is identified (see tables in “[Workshop Review of Potential Strategies](#),” page 37.)

1. There is currently a PFT classification/identification project underway under the EFMPP. Results are inconclusive. Need to complete the review project. (LT2 (b))
2. Press for East Kootenay improved seed for Douglas-fir. (LT3 (b))
3. Fertilization trials are needed to determine the efficacy of fertilization at planting. (LT3 (d))
4. OAF1 factors require confirmation. Survey techniques are available. Requires statistical validity at the management unit level if to be used for AAC determination. (LT3 (i))
5. Evaluate the risk to the harvest forecast if naturally regenerated stands are not restocked by year 5. (LT3 (j))
6. Evaluate the potential for reducing regeneration delays from an average of 3 years to 1 year. (LT3 (k))
7. Evaluate the risk to yield estimates of planting some sites to lower densities should expected natural ingress not occur. (LT3 (k))
8. Further study of root rot management techniques and resultant OAF2 impact is needed. (LT4 - summary)
9. Gap analysis of habitat impacts of silvicultural treatments (re prep for Simfor modelling) (see page 57).

The following items are carried forward from the *Enhanced Forest Management Pilot Project Management Strategies Report* (MoF, 1998a) as being applicable to a silviculture strategy for the entire TSA.

10. Validate growth intercept or SIBEC derived site index estimates for use in management unit level analysis. (EFMPP Strategy/Principle #8)
11. Continue long term impact studies on the effects of pushover logging and selection harvesting practices on limiting losses to Armillaria root disease. (EFMPP Strategy/Principle #19)
12. Continue growth and yield studies associated with calcareous soils. (EFMPP Strategy/Principle #20)

2. Introduction

2.1 About the Interim Strategy

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

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

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

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

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

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

¹ See "Abbreviations," page 69 for a full listing of abbreviations used.

2.2 Methodology

This strategy was prepared through the following process:

1. Prior to the district workshop, in co-operation with district office personnel, L. P. Atherton & Associates undertook preliminary research to identify issues and opportunities relevant to improving the future quantity and quality of timber supply.
2. A district workshop was held August 4-6, 1999 in Invermere, attended by representatives of the organizations listed below. Larry Atherton of L. P. Atherton & Associates and Doug Williams of Cortex Consultants Inc. led the session. Participants reviewed the potential opportunities along with others that arose. The outcome of the session was a regime table, complete with priorities.
3. The consultants incorporated the results of the workshop into the draft document and added forecasts of future harvest quantity and quality and of job outcomes.
4. After ministry review, the consultants submitted a completed strategy document to the Ministry of Forests (MoF) in electronic format as version 1.1. (The ministry will assign higher version numbers (e.g., 1.2, 1.3, etc.) as the strategy evolves and changes are made.)

2.3 Acknowledgements

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

Organization	Participant's Name	Title
Ministry of Forests, Invermere Forest District		
	Cliff Beliveau	Silviculture Officer
	Dave White	Incremental Silviculture Forester
	Russ Hendry	Planning Officer
	Greg Anderson	Operations Manager
	Darrell Regimbald	Silviculture Audit Forester
	Fred Waterer	Silviculture Practices Forester
Ministry of Forests, Nelson Forest Region		
	Ivan Listar	Incremental Silviculture Forester
	Bernie Peschke	Forest Sectors Initiatives Officer
Slocan Forest Products Ltd.		
	Dave Dixon	Silviculturist
Crestbrook Forest Industries Ltd.		
	Barry Bensen	Forester – Canal Flats
	Brenda Hopkins	Forester – TFL 14
	Grant Neville	Forester – TFL 14
	Paul Frasca	Forester – TFL 14

<i>Organization</i>	<i>Participant's Name</i>	<i>Title</i>
Ministry of Environment, Lands and Parks		
	Sue Crowley	
Forest Renewal BC		
	Rick Allen	

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

3. Higher Level Goals and Objectives

3.1 Provincial Goals and Objectives

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

<u>STRATEGY AT A GLANCE</u>	
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	<ul style="list-style-type: none"> • Sustainable Use • Community Stability • A Strong Forest Sector
Key Principles	<ol style="list-style-type: none"> 1. Because the distant future cannot be foretold, the best and only course of action in managing the timber resource is that which minimizes risk and maintains options. 2. British Columbia's forests are important locally, provincially, nationally and globally and should be managed in this context. 3. Each generation of British Columbians becomes the steward of the province's forest resources and has a moral obligation to preserve this heritage for future generations.
Working Targets	<p>Within the context of the guiding principles:</p> <p>WT 1: Minimize the anticipated interim reduction in timber supply so that provincial annual harvests of at least 65 million m³ can be achieved during this period.</p> <p>WT 2: Create a long term timber supply capable of supporting a steady long term provincial harvest level of at least 75 million m³.</p> <p>WT 3: Over the long term, maintain the production of premium quality logs at or above 10% of total harvest.</p>
Major Silvicultural Strategies	<ul style="list-style-type: none"> • 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. <p>Other silvicultural and non-silvicultural strategies must also be implemented to achieve the working targets.</p>
Strategy Implementation	Regional and management unit strategies must be developed, followed by programs and plans to implement them.

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

3.2 Regional Objectives

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

3.3 Higher Level Plans

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

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

4. Basic Data

4.1 Land Area

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

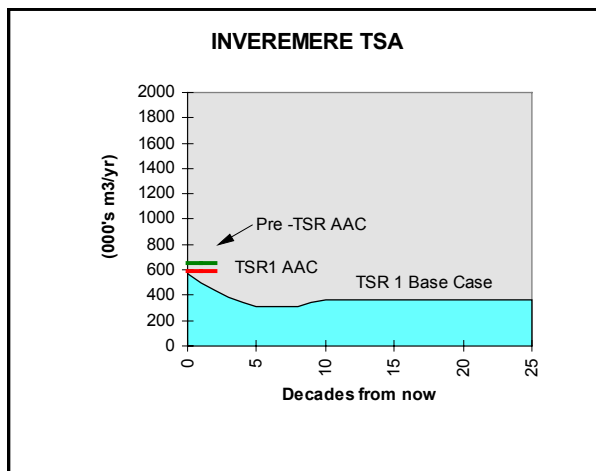
Source: TSR1 analysis report - rounded to nearest 100 ha.
The TSR1 THLB is 21% smaller than that used in the 1981 AAC determination (MoF, 1995: 20, 53)

4.2 AAC

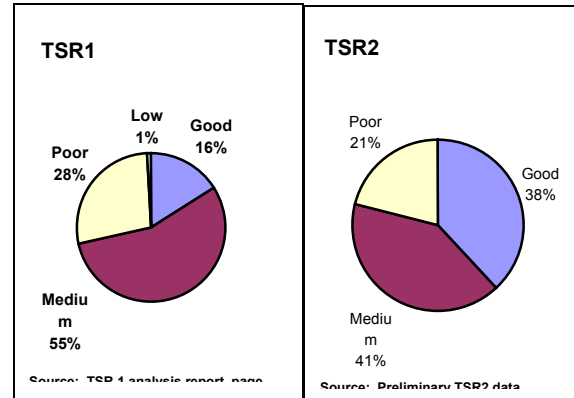
AAC Type	Pre-TSR	TSR1*	Change (%)
Conventional	657 264	591 500	-10.0
Deciduous	-	-	-
Insect/Disease	-	-	-
Marginal	-	-	-
Total	657 264	591 500	-10.0
Woodlot AAC		6 700	

*effective March 1/96

4.3 Harvest Forecast

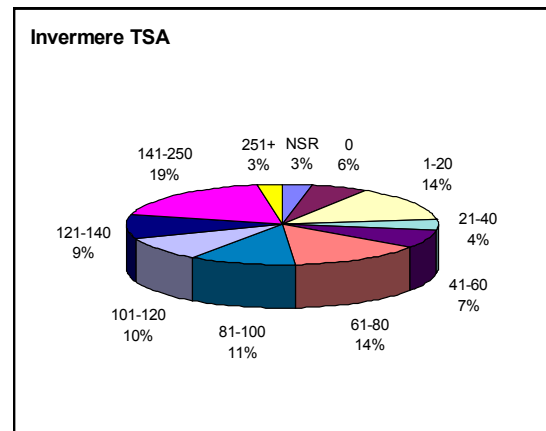


4.4 Site Class



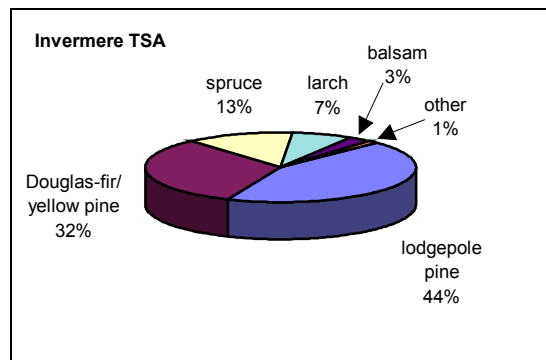
A recent re-inventory has generally shifted site productivity classifications higher

4.5 Age Class



Data interpreted from chart in TSR1 analysis report.

4.6 Tree Species



Data from chart in TSR1 analysis report.

5. Incremental Silviculture History

Treatment	TSR1 Status (1996)	Current Status (1999)
	Incorporated in Timber Supply Analysis	Source: IFD ²
Backlog	7 825 ha of backlog NSR were assumed to be re-stocked within the next 10 years. (Pedersen, 1996:18)	<p>As of June 14, 1999 there are 1 930 ha of backlog NSR in the ISIS database. Approximately 800 hectares of this will not be operationally feasible to restock due to unplantable ground (shallow soils, extensive exposed rock and/or talus, excessive debris), or a lack of economic viability (inaccessible, too small to treat, too expensive to treat, etc.).</p> <p>Of the 1100 hectares of treatable backlog NSR, approximately 400 hectares are close to required stocking levels and will be left to re-stock naturally. This area should become SR by the time of the next survey round. A further 390 hectares of NSR was planted in 1999. The licenses (FRBC funded) will not be planting in the year 2000 and there are no firm estimates when the remaining NSR will be planted.</p> <p>Few if any areas require brushing to ensure free growing is achieved. Last brushing was 66 ha in 1994. Highest past brushing program was about 300 ha in 1991.</p>
Conversion	None.	None.
Commercial Thin	None.	None at present. The upper limit of CT potential is estimated at 0 ha/yr, 1 000 ha/yr and 1 000 ha/yr for age classes 0-20, 21-50, & 50+ respectively.
Space	TIPSY used for stands re-generated over the past 20 years (Pedersen, 1996:16). TSR2 managed stand yields will be based on current experienced initial stocking levels and post-spacing target densities. Assumes incremental spacing for stocking control on stands harvested prior to 1987 and either basic or incremental spacing thereafter.	<p>Recent spacing has been about 1 200 ha/yr. Maximum past program level about 1 500 ha/yr.</p> <p>At the end of fiscal 98/99, there was a total of about 16 400 ha of spaced stands (about 6.5% of THLB).</p> <p>The upper limit of spacing potential is estimated at 1 500 ha/yr, 700 ha/yr and 1 000 ha/yr for age classes 0-20, 21-50, & 50+ respectively.</p>
Prune		<p>Recent level 0 ha/yr. Max past program of 120 ha in 1991. Total accomplishment of 580 ha, none of which is 2nd lift pruned.</p> <p>The upper limit of pruning potential is estimated at 100 ha/yr, 100 ha/yr and 100 ha/yr for age classes 0-20, 21-50, & 50+ respectively.</p>
Fertilize		<p>Recent level is 0. Max past level 1 500 ha in 1996. Total accomplishment of 2 500 ha.</p> <p>The upper limit of fertilization potential is estimated at 1 500 ha/yr, 2 000 ha/yr and 2 000 ha/yr for age classes 0-20, 21-50, & 50+ respectively.</p>

² IFD - Invermere Forest District

6. *Timber Harvesting Trends*

The TSR1 analysis report indicates a 1st decade harvest level of 1 800 ha/yr declining steadily to below 1 200 ha/yr in decade 6 (MoF, 1995:21). Harvested area fluctuates thereafter between 1 200 and 1 600 ha/yr.

District records indicate recent harvesting of about 1 700 ha/yr. Forty-six percent of this area (approx. 800 ha/yr) is partial harvested under a modified shelterwood harvesting system. The system is 'modified' in that the time until removal of the shelterwood stems is lengthened to as much as 30 years for the purposes of environmental/aesthetic constraints.

By volume, partial harvesting accounts for about 25% of annual harvesting.

For the purposes of this strategy, a mid to long term average harvest area of 1 400 ha/yr is assumed. Of this, 1 200 ha/yr is assumed to be clearcut.

7. Issues and Silvicultural Opportunities

7.1 Discussion of Issues and Opportunities

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

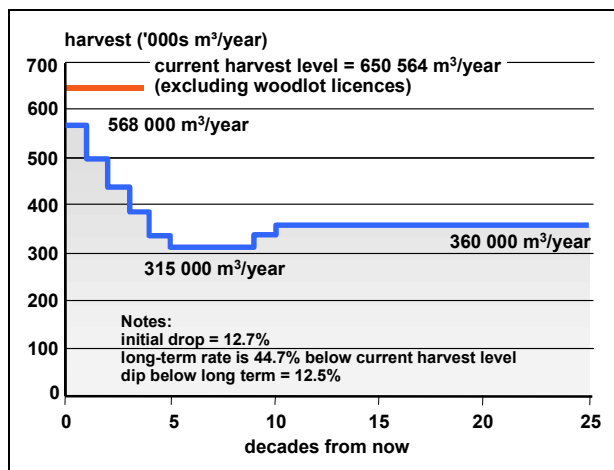
Extensive silviculture modelling and analysis has been undertaken under the Invermere Enhanced Forest Management Pilot Project (EFMPP). The project focussed on the White and Lussier River drainages of the TSA which together have about 20% of the TSA's total area (MoF, 1998a:6).

Information from the above-mentioned analyses relevant to a silviculture strategy is presented below, along with a brief coverage of the potential opportunities for silviculture to improve the future forecasts of timber volume and quality.

7.1.1 TSR1 Analysis Information

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

Figure 1. TSR1 Base Case Harvest Forecast



The TSR1 base case indicated the pre-TSR AAC could not be maintained and that a drop to less than half that level would be necessary.

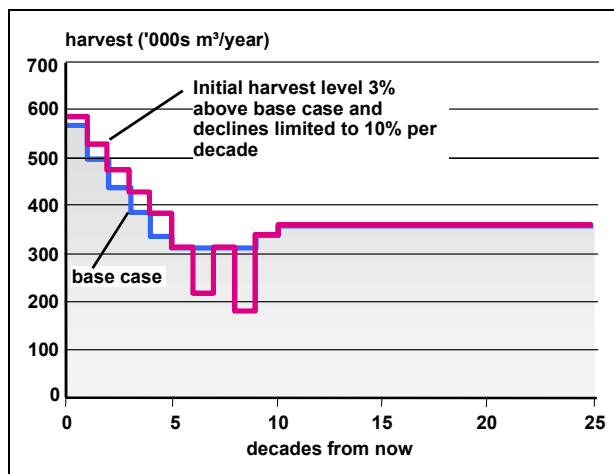
Many of the TSR1 current management practices in this TSA met or exceeded forest practices code requirements (MoF, 1995:15). Therefore, unlike most other TSA's where the TSR1 analysis did not incorporate FPC requirements, the Invermere TSA TSR2 analysis is not likely to show further reductions in the harvest forecast because of code requirements. Nevertheless, ever-tighter forest cover constraints tend to be the norm. Also, TSR1 did not account for area reductions that may result from the East Kootenay Land Use Plan and over-estimated the THLB by 4.7% due to an error (Pedersen, 1996:10).

Offsetting potentially tighter forest cover constraints will be a lower initial harvest level (because of a lower AAC), higher regenerated stand volumes associated with better site productivity estimates (sensitivity test only), a trend toward large patch cuts in pine forests to emulate stand replacing fires, lower NRL's (base case used 63 600 m³/yr but chief forester found this should have been closer to 48 800 – Pedersen, 1996:33), and shorter green-up periods. Most

TSR2 base case harvest forecasts for other TSA's are showing a higher LTHL than TSR1.

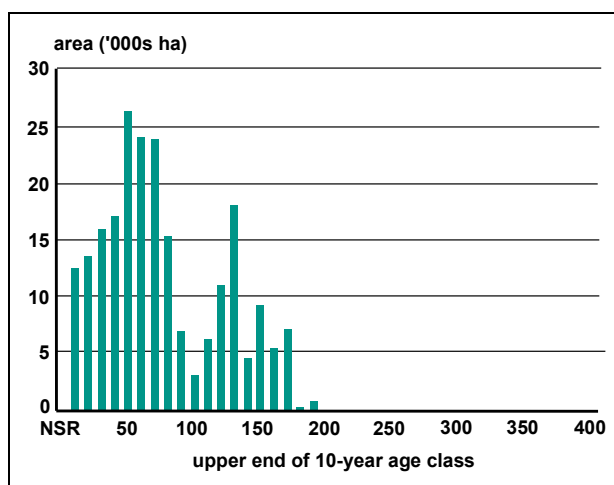
For the purposes of this interim silviculture strategy, it is assumed that the TSR2 base case forecast will likely also show declining harvest levels over the next several decades, reaching a long term harvest level (LTHL) that is higher than the TSR1 base case. While there may or may not be a mid term shortfall below the LTHL, the shortage of stands presently in age classes 3-5 will continue to be a significant factor in the forecast (see Figure 3, below).

Figure 2. The Effect of Harvest Flow Objectives on the Base Case



Harvest flow objectives have a major impact on both the base case and the results of sensitivity analyses. In the base case, timber that otherwise could be available for harvesting in the first 5 decades is held back to avoid serious harvest shortfalls in decades 7 & 9. **It is the avoidance of these shortfalls, combined with harvest flow objectives, that controls the responses to many sensitivity tests.**

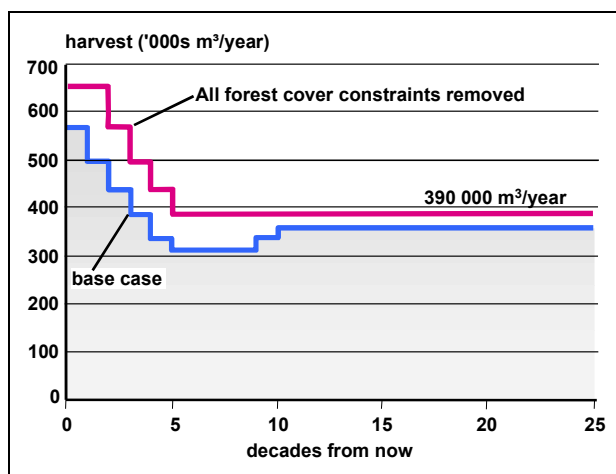
Figure 3. Age Class Structure 60 Years From Now



Sixty years from now, about the start of the lowest level in the TSR1 base case harvest forecast, there is a shortage of stands in age classes 9-11. Age class charts in the TSR1 analysis report indicate a normal forest distribution would have about 15-17 000 ha's in each 10 year age class. Age classes 9-11 each have about 1/3rd this amount.

This shortage drives the need to hold timber back from harvesting in the first 5 decades to avoid serious harvest shortfalls in decades 7 & 9 (see Figure 2 above). It is also likely the cause for the mid term dip in harvest levels before the rise to the LTHL.

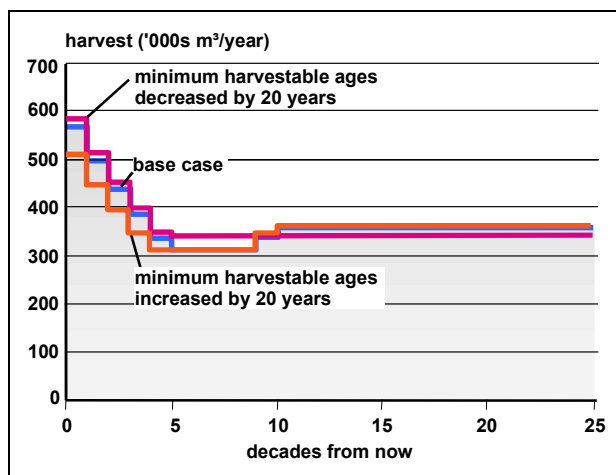
Figure 4. Sensitivity to Complete Removal of All Forest Cover Constraints



Complete removal of all forest cover constraints increases timber supply over all periods, but does not offset the need to substantially reduce harvest levels over the next 5 decades. On the other hand, this sensitivity analysis indicates an average mean annual increment of 1.66 m³/ha/yr, which appears to be a low estimate. It also indicates the LTHL is about 11% below LRSY (MoF, 1995:19).

This sensitivity test indicates the physical timber resource is simply not there to support historic and current harvest rates over the mid and long term periods. The THLB declined by 21% between this and the 1981 analysis (MoF 1995:20), primarily due to deductions for a wilderness area established in 1987, updated information on steep slopes and other areas that are not economical or feasible to harvest, and the creation of forest ecosystem networks (FEN's) (Pedersen, 1996:10).

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



TSR1 minimum harvestable ages range from a low of 70, 80 and 100 years respectively for good, medium and poor site PI; to a high of 160 years for low-site Fdi/Lw/Py. Minimum age for medium-site conifers other than PI is 110 years. (MoF, 1995:72)

Species	Min Age by Site Class			
	G	M	P	L
F/L/Py	100	110	120	160
S/B	90	110	140	
PI, Pw	70	80	100	

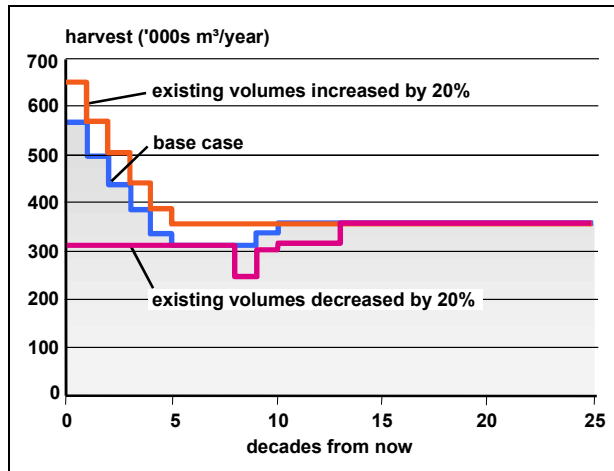
As would be expected, lowering the minimum age by 20 years eliminates the mid term shortfall. This is because the number of stands eligible for harvest between decades 5-9 increases substantially when minimum harvestable ages are lower. (For a chart of avg harvest ages over time associated with this sensitivity test, see Figure 12, page 22.) This ability to harvest younger stands enables the model to raise the mid term harvest level and eliminated the base case shortfall (MoF, 1995:33). However, consistently harvesting stands beneath their culmination MAI results in a lower long term harvest level (LTHL).

Growing forests to older ages generally improves their quality. However, this chart indicates that delaying harvests for this purpose would lower harvest levels in the first 5 decades. This is because a greater area must be reserved from harvesting to avoid worsening the mid-term shortfall.

The objective of growing forests longer for quality may be more compatible over the long term, where increasing harvestable ages does not appear to affect harvest levels. Average harvested

ages when minimum ages are 20 years greater, correspond closely with the base case (MoF, 1995:33) indicating the base case harvests on average about 20 years above minimum ages.

Figure 6. Sensitivity to Changes in Existing Stand Volumes

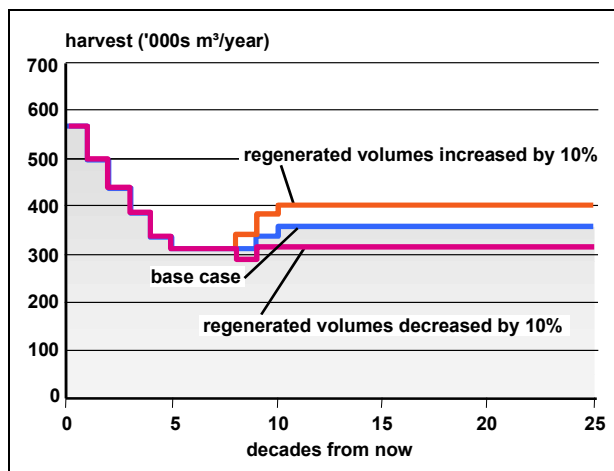


Lowering existing volumes 20% causes the starting harvest level to drop almost in half. The difficulty of finding timber in decade 9 also shows.

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

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.

Figure 7. Sensitivity to Changes in Regenerated Stand Volumes



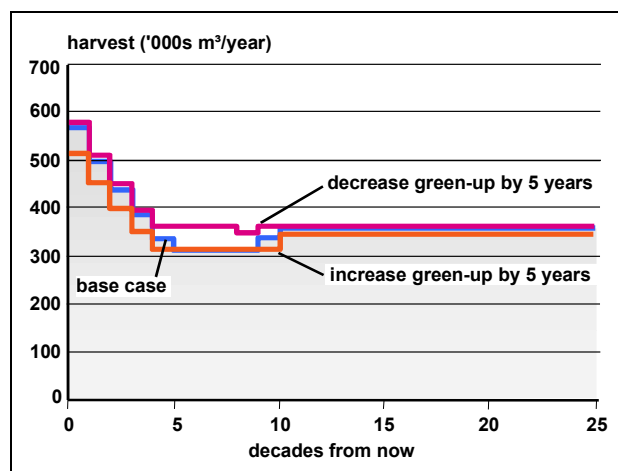
Managed stands include existing stands less than 20 years old and all future regenerated stands. The volume of these stands is determined from TIPSy, using an OAF1 of 15% and OAF2's ranging from 5% – 10.8% (MoF, 1995:77). On average, managed stands have about 20% more volume than existing stands (MoF, 1995:19). Managed stand volumes first become available for harvesting in decade 8, where about 25% of the harvest comes from these stands (MoF, 1995:21).

Changing managed stand volumes by 10% results in corresponding changes in the long term harvest level (LTHL) from the base case.

Decreasing managed stand volumes 10% also illustrates the difficulty of finding timber in decade 9.

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

Figure 8. Sensitivity to Green-up Ages



TSR1 green-up heights and ages are as follows (MoF, 1995:42, 73):

Zone	% THLB	Ht	Age	% allowed below age
IRM	49	3	15-20	40/33*
Wildlife	31	15	68	33
VQO	14	6	26	6/16/33**
Water	6			

*40% for 20 yrs then 33%.

**6% retention; 16% partial ret'n; 33% modification

Note: The chief forester found assumptions used for UWR overly constrain the base case by almost 12% in the short and mid terms. The area of UWR is 43 900 ha vs. 109 700 ha estimated in the base case.

Regional studies have indicated 3 m green-up ages used in TSR1 to be overestimated by about 5 years and 9 m ages to be reasonably accurate (Reichenback, 1996). Preliminary TSR2 green-up ages for 3 m heights range from 12 to 21 years, with the majority of ages being in the 14 to 16 year range (district data).

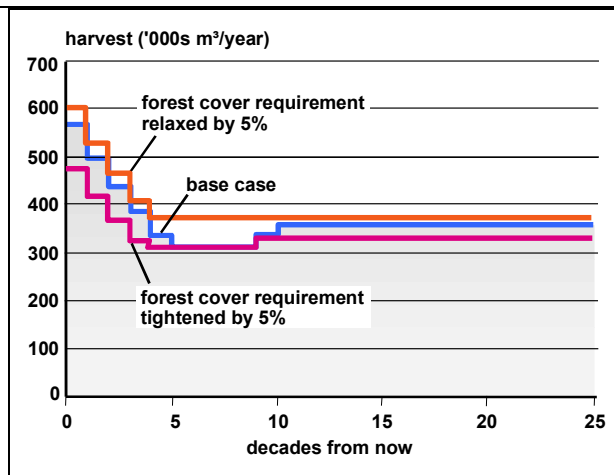
The TSR1 sensitivity test indicates reducing time until green-up by 5 years results in the elimination of the mid term shortfall. An LTHL 1% higher than the base case starts in decade 4. Most of the change is associated with shorter green-up ages in the UWR & VQO zones (MoF, 1995:39). Because these areas have such long green-up ages, even directing immediate attention on about-to-be-regenerated stands will at best have a mid-term effect. **In light of the chief forester's findings, further analysis is required to determine if and when reduced green-up ages may have an effect.**

Many silvicultural practices can be used to reduce the time until green-up. There is little risk to focusing on green-up issues in the short term, because these same practices will also serve to increase regenerated stand volumes. Figure 7 shows this would also be of considerable long term benefit.

Figure 9. Sensitivity to Changes in Forest Cover Constraints

Note: The chief forester found assumptions used for UWR overly constrain the base case by almost 12% in the short and mid terms. The area of UWR is 43 900 ha vs. 109 700 ha estimated in the base case.

The TSA is highly sensitive to increased forest cover constraints (FCC's). Slightly more than 1/2 of this sensitivity may be attributable to the UWR zone (MoF, 1995:41). A separate sensitivity test (see TSR1 Analysis Report, Figure 25, page 44) where UWR zone thermal cover requirements were tightened by 5% showed a similar but lesser response. The remainder of the response might be attributable to the retention VQO zone where

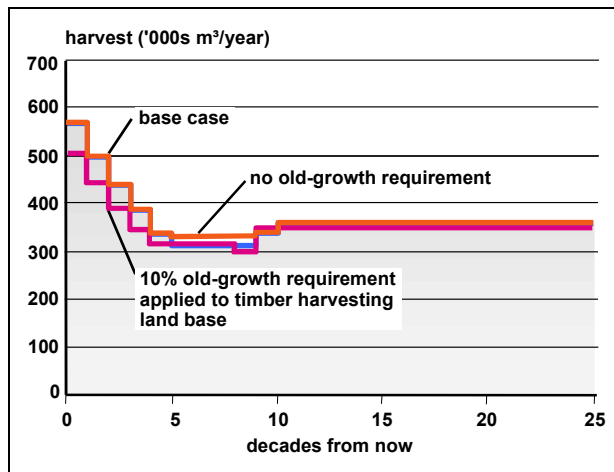


lowering the area allowed to be not greened-up by 5% results in the virtual elimination of this zone from timber harvesting.

Relaxing forest cover requirements by 5% raises harvest levels over all periods and eliminates the mid term shortfall. This increase is caused mostly by relaxing constraints in the retention VQO, partial retention VQO and UWR zones. Forest cover requirements for modification VQO and IRM zones do not constrain timber availability throughout the harvest forecast (MoF, 1995:41). Relaxing the FCC requirement in the UWR zoned by 5% does not affect harvest levels over the 1st 5 decades but eliminates the base case mid term shortfall (MoF, 1995:43).

In light of the chief forester's findings, further analysis is required to determine if and when partial harvesting or commercial thinning may be appropriate to help overcome adjacency constraints.

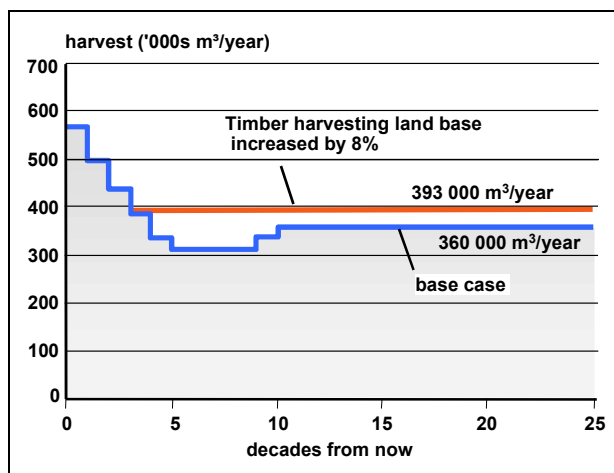
Figure 10. Sensitivity to Changes in the Older Forest Constraint



The TSR1 base case old-growth constraint generally requires 10% of area to be at least 140 years old at all times. Because this requirement can be partially satisfied from outside the THLB, the net requirement from the THLB is often < 10% (MoF, 1995:74). The base case old-growth requirement does not have a large impact on timber supply because green-up requirements cause the average age of harvested stands to be > the old-growth age (MoF, 1995: 46).

Silvicultural practices such as fertilization and commercial thinning may be used to accelerate stand structure so that the desired older forest attributes are achieved at an earlier age. However, this sensitivity test indicates there would be little benefit gained in terms of increased timber supply.

Figure 11. Sensitivity to Increasing the Size of the Timber Harvesting Land Base



A sensitivity test of an 8% land base increase does not affect the short term. Instead, harvest flow objectives direct the benefits towards the elimination of the mid term shortfall and a higher long term harvest level. Silvicultural practices may be used to increase the size of the THLB through conversion of un-utilized stands to merchantable species and to increase the productivity of low sites.

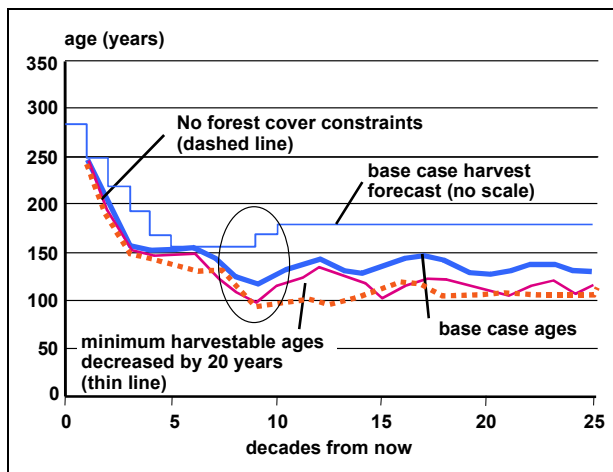
Opportunity area consists of the areas deducted from the TSR1 THLB. These include:

Type	Area	Equiv % THLB
Low site	7 900	3.4
Decid	3 500	1.5
Non Merch	15 400	6.6
FEN's	18 900	8.1

Note: In the AAC determination, the chief forester accepted that excluded forest types were over-deducted, that the THLB could be 2% larger than in the base case, and that these stands contribute up to 2% to timber supply. (Pedersen, 1996:12).

7 800 ha of backlog NSR were assumed in the base case to be restocked within the next 10 years. However, many of these sites are not feasible to treat and are currently on the margin of meeting minimum stocking requirements (Pedersen, 1996:19). Currently, there are about 300 treatable ha remaining (see "Incremental Silviculture History," page 14).

Figure 12. Sensitivity of Ages at Which Stands are Harvested to Changes in Constraints



At least two different base case constraints force the model to harvest stands at older ages. When these constraints are removed, the model harvests stands at younger ages. The two constraints are minimum harvestable ages and green-up ages. (See discussions of: green-up ages opposite Figure 8; minimum ages opposite Figure 5.) Of particular importance is the fact that the lowest harvested ages occur at the time when the first of the managed stands are coming available, about 90 years from now. (See the discussion of the means to overcome this opposite Figure 3, page 17).

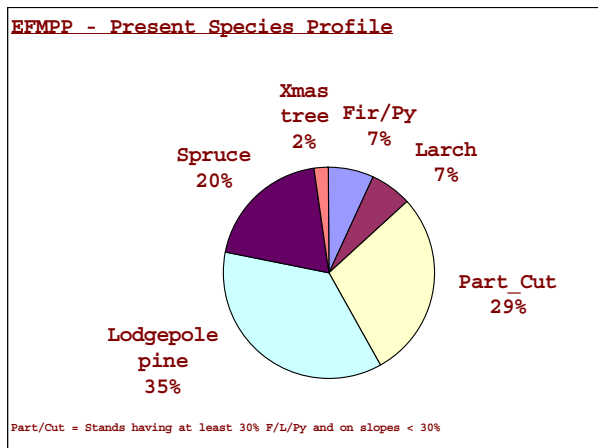
7.1.2 Invermere EFMPP Analysis Information

The White and Lussier river drainages within the Invermere TSA were the subject of a special study called the *Invermere Enhanced Forest Management Pilot Project*. Many aspects of the project area are similar to the TSA as a whole, such that some of the results of the pilot project may be extended to the TSA.

Below are selected charts from the pilot project reports. Two models, FSSIM³ and Woodstock, were used to generate these charts. While most data and forest management assumptions are the same in both models, a notable difference between them is that managed stand site indices (and consequently yields) for good and medium-site lodgepole pine and Douglas-fir/Larch were increased in Woodstock by typically about 2 metres, to reflect the expectation that the current site indices of these stands are generally underestimated.

³ FSSIM – Forest Service Simulation Model.

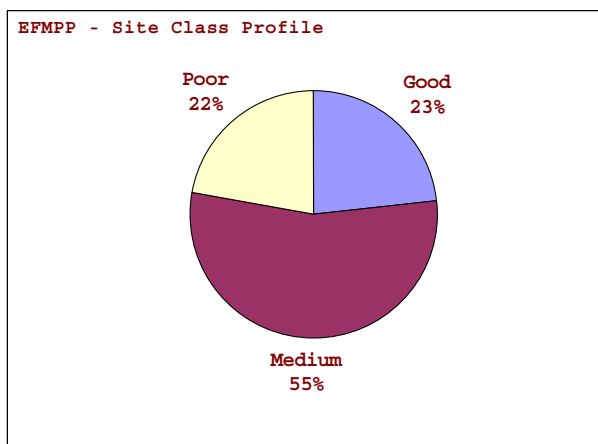
Figure 13. EFMPP – Species Profiles



To facilitate modelling, a species group “Part/Cut” was created. The criteria for this group are given in a footnote on the chart.

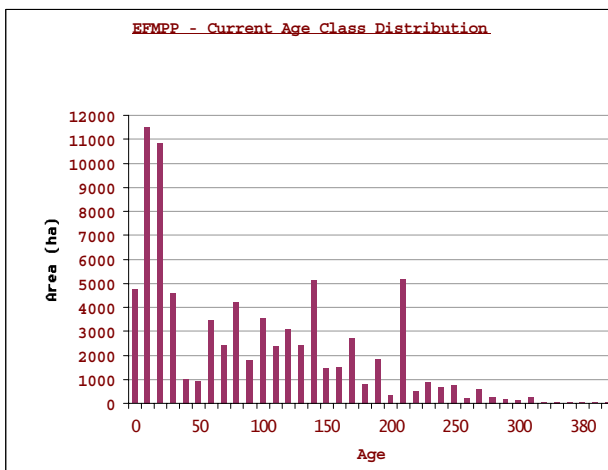
Because of the manner in which the species information was aggregated in the EFMPP area, it is not possible to directly compare its species profile with that of the entire TSA. However, the species profile is similar in many respects.

Figure 14. EFMPP – Site Class Profile



The site class profile of the EFMPP area is similar to that of the TSA as a whole (see “Site Class,” page 13).

Figure 15. EFMPP – Age Class Profile



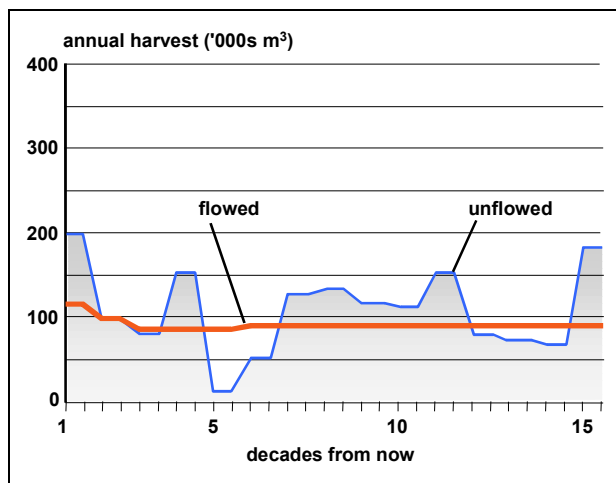
There are both similarities and differences in the age class profiles of the EFMPP area and the TSA (for the TSA age class distribution, see “Age Class,” page 13).

In the way of similarities, **both areas have a period of a relative shortage of stands**. For the EFMPP, the shortage is in stands currently aged 30 – 50 years, while for the TSA the shortage is in stands currently aged 21 – 50 years.

The age class structures are different, however, in that **the EFMPP has a much greater over-abundance of stands in certain age classes than does the TSA**. For the EFMPP, a normal forest distribution is about 4 000 ha in each 10-year age class below age 110, but stands currently in each of age classes 10 and 20 are almost 3 times this area. For the TSA, a normal forest distribution is about 16 000 ha in each 10-year age class below age 110. The greatest over-abundance in the TSA, however is not in 2

adjacent age classes as it is in the EFMP area and is only about 1.6 times its normalized area.

Figure 16. EFMP - Base Case Harvest Forecast



(FSSIM model)

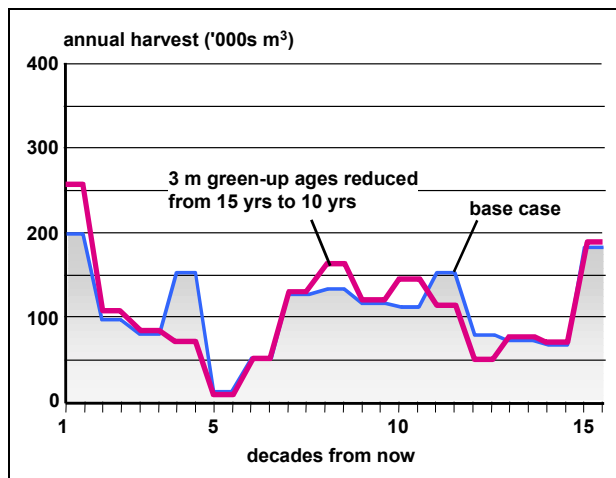
An FSSIM base case was built for the EFMP area. The process was similar to that used in the timber supply review. Data preparation and constraints are identified in a data package (MoF, 1998b – Appendix1).

The EFMP base case is plotted on both a flowed and unflowed basis. An unflowed forecast enables better pinpointing of the effects of changes to data or constraints.

The unflowed forecast results in almost no timber being harvested at about 50 years from now.

The flowed forecast is similar in shape to the TSR1 base case.

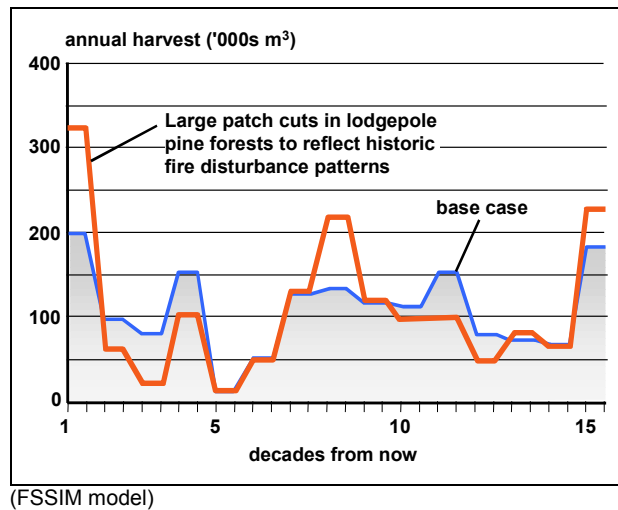
Figure 17. EFMP - Sensitivity to a 5 Year Reduction in Green-up Age



(FSSIM model)

A five year reduction in green-up ages in the EFMP area shifts the harvest between periods. This allows a higher initial harvest level, but does not contribute additional timber supply during the critically short period about 50 years from now.

Figure 18. EFMPP - Potential Effect of Large Patch Cuts in Lodgepole Pine



The fire history of the EFMPP area is one of large stand replacing fires. Large patch cuts can emulate this fire pattern and restore ecosystems.

Minimum harvestable ages are 71 years for good site and 81 years for medium and poor site PI (MoF, 1998b. Appendix1:17). This, in combination with large patch cuts, sets up a cyclical harvest. Harvest peaks occur approximately 70 years apart; in the 1st, 8th and 16th decades.

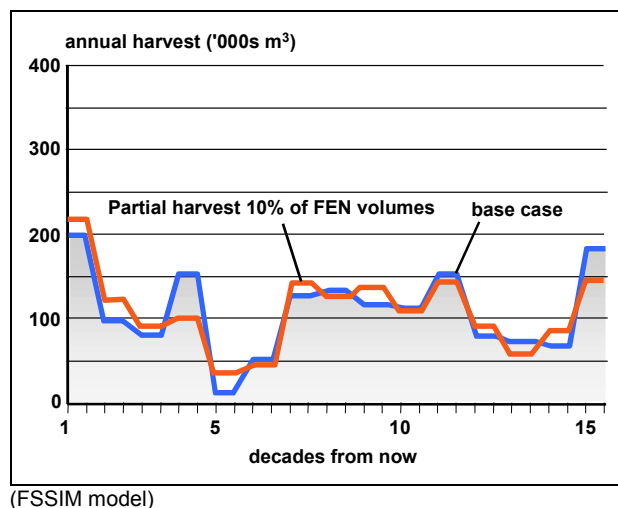
A strategy of large patch cuts in PI enables a very high initial harvest level which can contribute to the TSA's need for higher harvest levels in the short term. **The second peak is ahead of the critical TSA need for timber supply 90 years from now** (see Figure 12), indicating that implementing this strategy within (and outside?) the EFMPP could be of great advantage at the TSA level.

PI minimum harvest ages are 20 years below culmination age (MoF, 1998b. Appendix1:17).

Harvesting continuously at minimum ages will ultimately lower the total harvest. Silvicultural practices to increase regenerated stand volumes could be used to offset this.

Note: PI minimum harvest ages are the same as used in TSR1 for G & M site, but P site in TSR1 was 100 yrs vs 80 in the EFMPP.

Figure 19. EFMPP - Partial Harvesting in FEN Areas



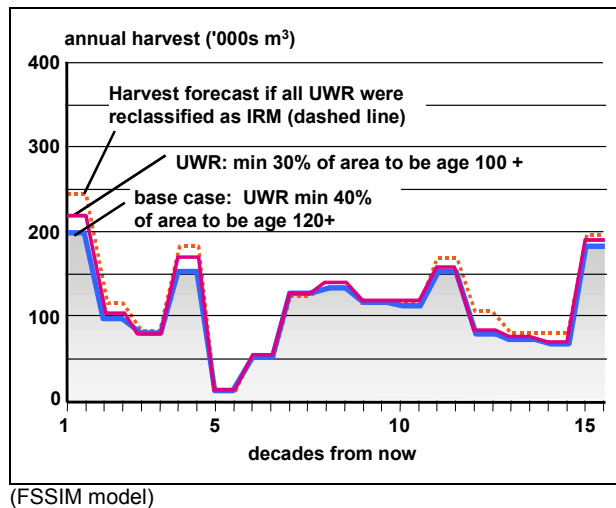
Forest ecosystem networks (FEN's) are identified through the total resource planning process. FEN's cover over 20% of the THLB and are deferred from harvest for at least 40 years, with management on a 20 pass rotation thereafter (MoF, 1998a:10-11).

EFMPP research has shown that partial harvesting can occur in these areas while still retaining old-growth attributes. Such partial harvesting is feasible on about 20% of the FEN area, making over 500 000 m³ of wood available in the short term. The chart to the left illustrates the increase in timber supply when 10% of the total volume in eligible FEN areas is removed through partial harvesting. This also makes wood available at the critical low point about 50 years from now.

Silvicultural practices can be used to prepare newly regenerated stands within FEN areas for commercial thinning which could also create old-growth attributes at younger ages.

Note: There have been recent policy changes regarding FEN's. Until the effects of this are determined, the impact of FEN's on the timber supply is uncertain and silvicultural/harvesting opportunities cannot be determined.

Figure 20. EFMPP – Sensitivity to Changes in UWR requirements

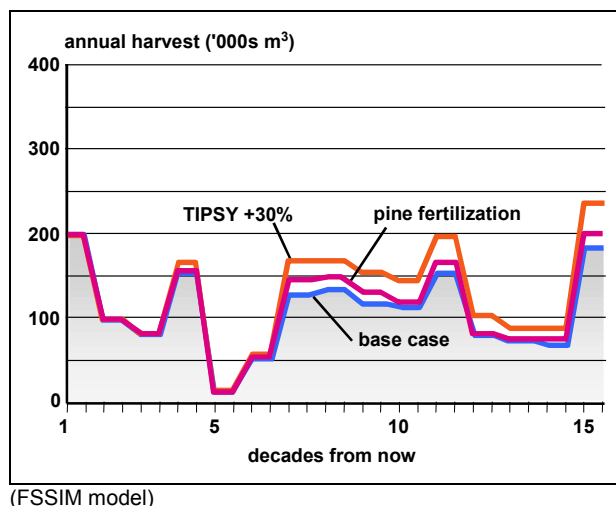


Better mapping of ungulate winter range (UWR) areas reduced this zone by about 1/3. The area no longer needed for UWR was added to the EFMPP base case IRM zone, to be managed under the less restricting cover requirements of that zone. For the now-smaller UWR zone, snow interception and thermal cover requirements were refined in consultation with MoELP staff. The stand age requirement was lowered from 120 yrs to 100 yrs. The area required to be at or above the stand age was also lowered from 40% of the zone to 30%. The thin solid line in the figure to the left shows the timber supply impacts of these changes to the UWR cover requirements. The dashed line indicates that even after these changes, **UWR forest cover constraints still significantly limit timber supply, particularly in the short term.**

In the TSR1 analysis, relaxing thermal cover requirements by 5% showed no change in the short term, but virtually eliminated the mid term harvest shortfall (MoF, 1995:43). While a relaxation may have actually freed up short term timber supply, the model allocates this benefit to increasing mid term harvests.

Silvicultural activities may be used to develop the required stand structure at even earlier ages.

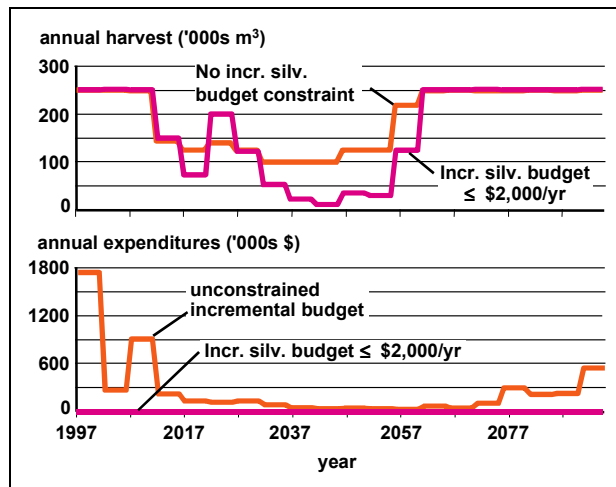
Figure 21. EFMPP – Effects of Pine Fertilization and Increased Managed Stand Volumes



A large portion of the EFMPP area is potentially suitable for fertilization. In the EFMPP analysis, the effect of fertilization of managed lodgepole pine stands on the harvest forecast was approximated by increasing the yields of these stands by 15%. Harvest levels rise above the base case starting in decade 7, which is when the first of these stands are available for harvesting. About 1 000 ha/yr in perpetuity is available for fertilization (MoF, 1998b. Appendix3:11-12).

Similarly, the potential timber supply impacts of increasing managed stand volumes through a variety of silvicultural actions was approximated by increasing their yields by 30% (shown as "TIPSY + 30%"). Again, the response begins at about decade 7. **Commercial thinning would allow capture of some of this volume increase up to 2 decades earlier (MoF, 1998a:41). Alternatively, whole stands could be harvested earlier once they have reached a minimum harvestable size and volume (i.e., at lower minimum harvest ages).**

Figure 22. EFMPP – Harvest Flows and Incremental Silviculture Budgets

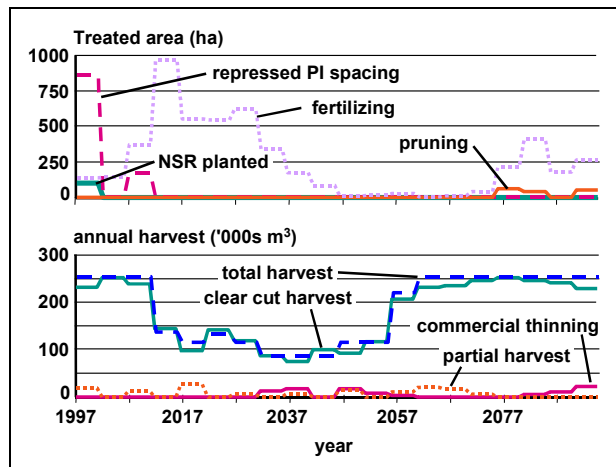


(Woodstock model)

The Woodstock model demonstrates that silvicultural treatment opportunities in the EFMPP area mostly exist early in the planning horizon. These treatments can significantly increase harvest levels 3-5 decades from now. Treatment activities are primarily spacing of repressed PI stands and fertilization (see Figure 23 below).

This is similar to the situation at the TSA level. There treatments are also required soon if the mid term shortfall is to be avoided.

Figure 23. EFMPP – Effects of Pine Fertilization and Increased Managed Stand Volumes

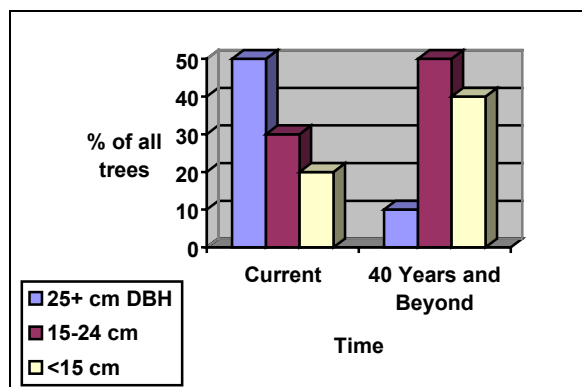


(Woodstock model)

In the top chart (opposite), the Woodstock model demonstrates that with unconstrained incremental silviculture expenditures the immediate priorities are repression spacing and planting backlog NSR. Following this is a period of fertilization. Toward the end of the planning horizon, when age classes are more balanced, pruning and fertilization are the priorities.

In the bottom chart, the Woodstock model shows under which silvicultural system wood is harvested. Most of the area is under even-aged clearcut systems. However, partial harvesting and commercial thinning play lesser but significant roles. **Because the future is unpredictable (e.g., large fires, mountain pine beetle attacks), silvicultural planning should attempt to keep partial harvesting and commercial thinning options open over a wide range of stands, rather than specifically identifying stands for such harvesting at early ages.**

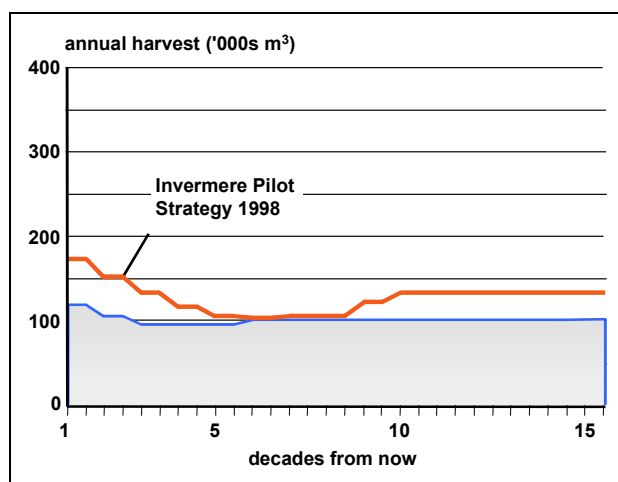
Figure 24. EFMPP – Future Timber Quality



(Woodstock model)

The chart to the left shows how the log diameter profile of the Woodstock harvest forecast changes when the silviculture budget is unconstrained (see top chart, Figure 22 for the associated harvest forecast). Over the next 40 years, the proportion of large diameter trees substantially decreases while that of small diameter trees substantially increases. From this, it may be inferred that the quality of the future forests will be substantially lower than today's.

Figure 25. EFMPP – Potential Flowed Harvest Forecast - All Strategies



(FSSIM model)

The pilot project demonstrated the potential to significantly increase the harvest levels from the EFMPP area. Including a number of non-silvicultural actions that are not shown in the preceding figures, a 44% increase in the initial harvest level is possible.

7.2 Summary of Issues and Silvicultural Opportunities

7.2.1 Limitations of Available Information

The EFMPP demonstrated that undertaking silvicultural activities, making changes in estimates, and administrative/policy changes can increase EFMPP harvest levels in the short and long terms. The scope of the strategy developed in this document, however, limits consideration to a narrower set of opportunities than those of the EFMPP, namely silvicultural opportunities.

Comparisons between the EFMPP and the TSA as a whole must be made with caution.

While some responses in the harvest forecast demonstrated by an EFMPP scenario may be intuitively considered applicable at the TSA level, there is insufficient information available to demonstrate that this will definitively be the case. To be so requires a near perfect match of:

- the forest characteristics of the two areas (such as species, site and age class profiles),
- the distribution of the THLB into analysis zones and their management requirements, and
- modelling methodologies.

This is highly unlikely.

At the time this interim strategy was prepared, the TSR2 analysis report for the Invermere TSA was not available. This strategy was therefore built on inferences largely made from TSR1 analysis information. However, because of the numerous differences the chief forester found and used in his AAC determination, **the TSR1 sensitivity analysis information is unreliable in many respects.** For this reason, the professional judgement of workshop participants played a large role in the selection of appropriate silvicultural strategies.

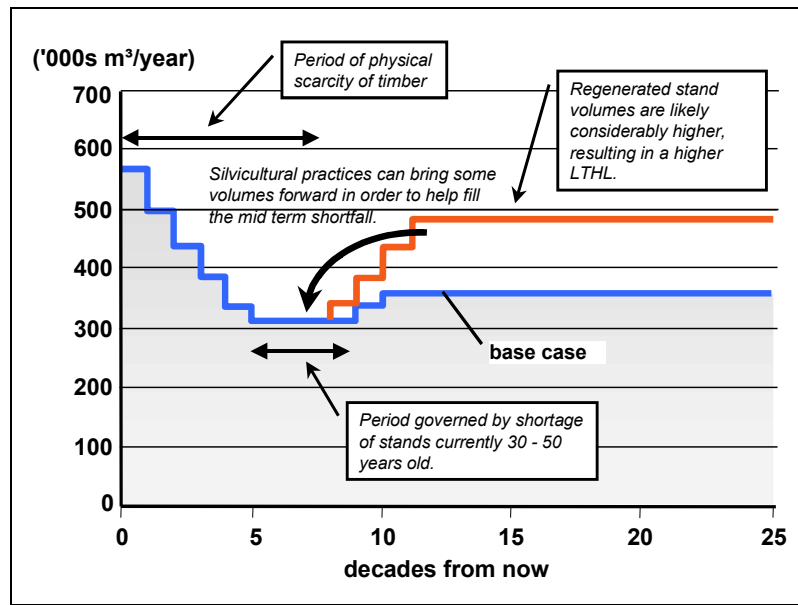
7.2.2 *The Silviculture Planning Harvest Forecast*

To ensure the appropriateness of silvicultural strategies, it is necessary to hypothesize a “most likely” harvest forecast. This silviculture planning harvest forecast is often different from the TSR base case harvest forecast because it incorporates some speculation about factors that may affect estimates of future timber supply. In the TSR process, such factors are covered by sensitivity analyses. If the sensitivity does not affect short term harvest levels, it is usually considered not relevant to an AAC determination and the base case is left unchanged. However, such factors may be highly relevant to silviculture planning which, unlike the AAC determination process, is more focused on the future than on the present.

Figure 26 below illustrates the silviculture planning harvest forecast for the Invermere TSA. This forecast was confirmed in the district workshop. For the purposes of this interim silviculture strategy, it is assumed that future timber supply forecasts will likely show declining harvest levels over the next several decades, similar to the TSR1 forecast. This reflects the physical scarcity of timber in the TSA and a transition from high historic levels of AAC to lower levels that are supportable by the current timber harvesting land base. The shortage of stands presently aged 30-50 years will continue to be a significant factor, governing the lowest point in the mid term period of the forecast. Future long term harvest levels (LTHL) are expected to be significantly above the TSR1 base case forecast, primarily due to improved estimates of site productivity and the volume gains resulting from tree improvement programs.

The significant feature of the silviculture planning harvest forecast is the higher long term harvest level. This suggests an opportunity to move some harvest volume forward in time to help fill the mid term shortfall.

Figure 26. Silviculture Planning Harvest Forecast



Factors that are likely to influence the harvest forecast, but are not certain and are subject to changes in rules are:

- old growth constraints, which may particularly impact decades 5-9; and
- green-up constraints.

While these two factors can be planned for in this strategy, confirmation of their importance to the harvest forecasts must await the TSR2 analysis results.

7.2.3 Future Timber Volumes (Quantity)

Short Term (1 - 20 years)

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

The TSR2 base case is likely to indicate that harvest levels cannot be maintained at the current AAC throughout the short term period (see Figure 26).

In the TSR1 analysis, short term harvest levels are largely governed by the need to extend existing timber supply to cover what appears to be critical shortages in decades 7 & 9. It is the avoidance of these shortfalls, combined with harvest flow objectives, that controls the responses to many sensitivity tests.

Short term timber supply therefore may benefit from:

1. activities that will reduce the critical shortages in decades 7 and 9;
2. activities that will overcome currently experienced adjacency constraints, such as large patch cuts, partial harvesting and commercial thinning, provided they do not further lower harvests in the mid term; and

3. activities that will increase the volume of stands to be harvested in this time period, such as:
 - (a) harvesting and recovering merchantable volumes from stands currently classified as non-merchantable, such as deciduous stands or decadent coniferous stands;
 - (b) late rotation fertilization of suitable stands in advance of clear-cut harvest or following partial harvesting) and
 - (c) harvest from FEN areas, in a manner that meets the objectives for which the areas were originally set aside.

The allocation of the potential benefit from the above activities is a matter of allowable annual cut policies and determinations. Under current policy, an increase in short term harvest level above the current level is highly improbable. Rather, it is likely that any benefits will be allocated:

- first, to maintaining the current harvest level for another 5-10 years, provided this does not further worsen forecast future harvest level reductions;
- second, to eliminating the mid term shortfall (below LTHL); and
- last, to extending the current harvest level beyond 10 years.

For this reason, all of the above, except item 3 are considered potential mid-term strategies.

Mid Term (21 - 90 years)

The mid term period begins at the end of the short term period (i.e., 21 years from now) and continues until the transition from harvesting in existing natural stands to harvesting mainly in 2nd growth managed stands is complete. For the purposes of this strategy, the end of the transition period is assumed to be 90 years, the same as in TSR1.

Even more than the short term, the mid term is governed by the need to extend existing timber supply to cover what appears to be critical shortages in decades 7 and 9. Both the harvest flow objectives used in timber supply modelling and a diminishing growing stock contribute to the higher degree of sensitivity of the mid term to changes in various factors.

Mid term timber supply will benefit indirectly from the movement of any additional timber supply that may be created under the short term strategies into the mid term.

Mid term timber supply may directly benefit from:

1. setting up stands for activities that will overcome adjacency constraints that may exist in the mid term, such as partial harvesting and commercial thinning;
2. activities that will achieve-green-up earlier in the UWR and VQO zones, so that green-up is not limiting on the ground;
3. setting up stands now to meet older forest requirements in that period; and
4. activities that will increase the volume of stands to be harvested in this time period, particularly in decades 7 & 9, such as:
 - (a) fertilization of suitable stands;

- (b) commercial thinning volumes from stands that otherwise will be harvested later during the long term (i.e., bring volumes forward from the long term); and
- (c) spacing and fertilizing younger existing stands and newly regenerated stands to make them merchantable sooner (i.e., effectively lower their minimum harvestable ages).

Long Term (91 + years)

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

In the absence of TSR2 information, the long term is assumed to be sensitive only to changes in managed stand volumes, the size of the timber harvesting land base, and the amount of losses to fire, insects and diseases. It is assumed that stands will be harvested at ages that are near biological rotation ages and that harvesting stands below these ages will not be occurring.

7.2.4 Future Timber Quality

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

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

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

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

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

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

8. Opportunities to Increase Timber Supply

8.1 Potential Silviculture Strategies

Prior to the district workshop, information in the previous sections was used to identify the following potential silvicultural strategies for either maintaining or increasing future timber supply at the TSA level. Each of these was discussed in detail in the district workshop, the results of which are recorded in “[Workshop Review of Potential Strategies](#),” page 37, along with additional strategies that arose during the meeting. Strategies that are ultimately adopted are noted in “Silviculture Strategies,” page 60.

8.1.1 Short Term (1 - 20 yrs)

ST 1: Harvesting and recovering merchantable volumes from (increase)⁴:

- (a) _____ ha's deciduous stands;
- (b) _____ ha's of coniferous stands currently classified as non-merchantable; and
- (c) _____ ha's of FEN's (partial harvesting?).

ST 2: Late rotation fertilize _____ ha/yr of suitable stands scheduled for harvest in the 2nd decade to increase their volumes. (increase)

ST3: Utilize large patch cuts to emulate stand replacing fires (also overcomes adjacency?) (increase)

ST4:

8.1.2 Mid Term (21 - 90 yrs)

MT 1: Late rotation fertilize _____ ha/yr of existing stands scheduled for harvest 20 to 90 years from now to increase their volumes (continuation of ST 2). (increase)

MT 2: Repeat fertilize stands presently 30 – 50 years old to increase their volumes at harvest. (increase)

MT 3: Reduce the minimum harvest ages of stands presently 0 – 20 years old by: (increase)

- (a) brushing _____ ha/yr for growth enhancement (in addition to _____ ha/yr to ensure free growing;

⁴ (Increase) means oriented to increasing harvest levels above those indicated by the TSR2 base case. (Maintain) means oriented to maintaining the harvest level indicated by the TSR 2 base case.

- (b) spacing ____ ha/yr of pine stands (priority - those subject to repression);
- (c) spacing ____ ha/yr of Douglas-fir stands (priority – those subject to seasonal moisture deficits); and
- (d) repeat fertilizing ____ ha/yr.

MT 4: Achieve green-up earlier in existing managed stands currently aged 0-20 years in the UWR (9m green-up) and VQO zones (6 m green-up) by (increase – this is a subset of MT3):

- (a) brushing ____ ha/yr for growth enhancement (in addition to ____ ha/yr to ensure free growing; and
- (b) spacing ____ ha/yr of pine stands (priority - those subject to repression);
- (c) spacing ____ ha/yr of Douglas-fir stands (priority – those subject to seasonal moisture deficits); and
- (d) repeat fertilizing ____ ha/yr.

MT 5: Reduce green-up ages of about-to-be-regenerated stands by 5 years in the VQO (base case - 26 yrs to 6 m ht) zone and by 10 years in the UWR zone (base case - 68 yrs to 15 m ht) by: (increase)

- (a) site preparing ____ additional hectares;
- (b) using improved seed;
- (c) using larger planting stock;
- (d) fertilizing at time of planting;
- (e) brushing ____ ha/yr for growth enhancement (in addition to ____ ha/yr to ensure free growing; and
- (f) spacing ____ ha/yr of pine stands (priority - those subject to repression);
- (g) spacing ____ ha/yr of Douglas-fir stands (priority – those subject to seasonal moisture deficits); and
- (h) repeat fertilizing ____ ha/yr.

MT 6: Set up stands presently 60 – 110 years old for future partial harvesting/ commercial thinning in the VQO and UWR zones (emphasis on decade 7 & 9 harvests) by:

- (a) spacing ____ ha/yr of ____ to set up stocking appropriate to commercial thinning; and
- (b) repeat fertilizing ____ ha/yr.

MT 7: Increase the area satisfying older forest biodiversity requirements in decades by achieving the desired stand characteristics by 100 years of age by:

- (a) spacing ____ ha/yr; and

- (b) repeat fertilizing ____ ha/yr.

8.1.3 Long Term (91+ yrs)

LT 1: Maintain the THLB by:

- (a) Planting ____ ha of backlog NSR; and
- (b) Maintaining ____ ha of existing backlog plantations.

LT 2: Increase the THLB by:

- (a) converting/rehabilitating ____ ha/yr of deciduous stands; (increase)
- (b) converting/rehabilitating ____ ha/y of non-merchantable ____? ____ stands; (increase)
- (c) assessing _____ ha of low-site stands for proper classification; or
- (d) improve the site productivity of low-site stands by _____ (fertilization?). (increase/maintain)
- (e) reassessing FEN area exclusions.

LT 3: Increase regenerated stand volumes by, in addition to those practices in MT 4:

- (a) managing stocking so voids do not account for more than 10% of the area (increase); and
- (b) repeat fertilize ____ ha/yr on a 15 yr return cycle (increase).

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

- (a) pushover logging/stumping ____ ha/yr;
- (b) planting alternate/mixed species on ____ ha/yr;
- (c) pop-up spacing on ____ ha/yr; or
- (d) small diameter spacing.

LT 5:

LT 6:

LT 7:

8.2 Workshop Review of Potential Strategies

8.2.1 Introduction

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

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

Column Number	Note
1	Strategy numbers correspond with the numbers recorded earlier in "Potential Silviculture Strategies," page 34. Items followed by an asterisk (*) were added during the district workshop.
2	Information is largely from the district workshop, combined with information presented earlier in this document.
3	Anticipated results are calculated using a variety of methods.

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

8.2.2 Short Term (1 - 20 years)

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
ST 1	1. Harvesting and recovering merchantable volumes from (increase)	The listed items have potential to immediately increase timber supply through the harvesting of standing timber. They also have implications, where there is no merchantable timber, for the development of silviculture rehabilitation plans and, in all cases, for expanding the timber harvesting land base. (See also: LT2)	
ST 1	(a) _____ ha's deciduous stands;	(a) About 4 000 ha's of aspen deciduous stands were deducted during the TSR2 THLB netdown process. MoELP considers these areas as valuable towards meeting biodiversity objectives and would object to them being changed to coniferous species. General consensus was to leave these sites as is.	(a) No opportunity.
ST 1	(b) _____ ha's of coniferous stands currently classified as non-merchantable;	(b) About 4 800 ha's of the following forest types were deducted during the TSR2 THLB netdown process. <ul style="list-style-type: none"> FdlWPY, 81 – 120 yrs, ht class 1 & 2, SI < 12, stocking class 0 (510/520 types) PI, 41-60 yrs, ht class 1 & 2, SI < 15.5 (310/320 – M types) PI, 61-80 yrs, ht class 1 & 2, SI < 13. <p>To avoid percentage netdowns, these PFTs are representational of a broader spectrum of non-merchantable stands. Workshop participants felt there was no merchantable volume available in any of these stands. The second stand type (M sites) may offer some stand rehabilitation opportunity - see LT2. A study by Hugh Hamilton Ltd. of problem forest types under the EFMP found there were no identifiable opportunities on a forest type map label/air photo interpretation basis. Stands must be visited in the field because stand heights of fully closed dense pine stands cannot be determined from photos.</p>	(b) No opportunity.
ST 1	(c) _____ ha's of forest ecosystem networks (FEN's) (partial harvesting?);	(c) FEN's are not a net-down item. Additionally, there have been recent policy changes regarding FEN's. Until the effects of this are determined, the impact of FEN's on the timber supply is uncertain and silvicultural/harvesting opportunities cannot be determined.	(c) No opportunity.
ST 1	(d) _____ ha's of low sites;*	(d) About 2 100 ha's of low sites were deducted during the TSR2 THLB netdown process. Review of the netdown criteria indicates these sites are so low in productivity that they are not capable of growing trees to merchantable size.	(d) No opportunity.
ST 1	(e) _____ ha's of environmentally sensitive areas (ESA's); and*	(e) About 33 100 ha's of ESA's were deducted during the TSR2 THLB netdown process. ESA's were last reviewed in 1994, with the area remaining about the same as previous. Terrain stability mapping can be used to fine tune areas classified into ESA. Otherwise, no immediate opportunity is apparent.	(e) No opportunity.
ST 1	(f) _____ ha's of steep slope areas.*	(f) About 13 100 ha's of steep slopes were deducted during the TSR2 THLB netdown process. Netdown criteria were a combination of site index and slope; e.g., all poor sites on > 60% slopes were taken out. No immediate harvesting opportunity is apparent.	(f) No opportunity.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
ST 2	2. Late rotation fertilize <u> </u> ha/yr of suitable stands scheduled for harvest in the 2 nd decade to increase their volumes. (increase)	2. There are presently no stands suitable for late rotation fertilization. Stands to be harvested over the next 20 year period are at risk of mountain pine beetle attack, are generally too old or too dense for fertilization. Lastly, there are no large contiguous areas suitable for an operational fertilization program.	2. No opportunity.
ST 3	3. Utilize large patch cuts sizes to emulate stand replacing fires (also overcomes adjacency?) (increase)	3. Large patch sizes are becoming more common practice in order to emulate stand replacing fire events. This has no associated silviculture activity potential. It is noted here more for its potential to have a positive effect in overcoming adjacency constraints. This may reduce the need to use silviculture for the same purpose.	3. Not applicable.
Short Term Harvest Forecast Summary		<u>Potential Strategy #</u> <u>Effect</u>	
		ST1 Recover merch volumes from:	
		(a) deciduous stands	No opportunity
		(b) non-merch conifer stands	No opportunity
		(c) FEN areas	No opportunity
		(d) low sites	No opportunity
		(e) ESA's	No opportunity
		(f) steep slopes	No opportunity
		ST2 Late rotation fertilization	No opportunity
		ST3 Utilize large patch cuts	Not applicable
		No opportunities identified. The short term harvest forecast can be expected to be similar to the TSR1 forecast.	

8.2.3 Mid Term (21 - 90 years)

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
MT 1	1. Late rotation fertilize _____ ha/yr of existing stands scheduled for harvest 20 to 90 years from now to increase their volumes (continuation of ST 2). (increase)	1. This strategy is a continuation of ST 2. There are no identifiable stands that would be harvested 20 to 50 years from now that are suitable for fertilization over the next 10 years.	1. No opportunity.
MT 2	2. Repeat fertilize stands presently 30 – 50 years old to increase their volumes at harvest. (increase)	2. This strategy is focused on those stands that will be harvested during the shortfall period. Few of these stands are suitable for fertilization. Their origin is spruce intermediate utilization logging in the 1940's through 1960's or burned stands. These stands have poor structure.	2. No opportunity.
MT 3	3. Reduce the minimum harvest ages of stands presently 0 – 230 years old by: (increase)	3. Upper end of strategy age range increased to 30 years to reduce the number of age groups being dealt with.	3.
MT 3	(a) brushing _____ ha/yr for growth enhancement (in addition to _____ ha/yr to ensure free growing:	(a) The TSA does not have a major brush problem.	(a) No opportunity.
MT 3	(b) spacing _____ ha/yr of pine stands (priority - those subject to repression);	<p>(b) 3 different density regimes will be used in TSR2:</p> <ul style="list-style-type: none"> Planted stands at 1 600 sph (allows a little for ingrowth); Natural stands at 4 000 sph unspaced; and Natural stands at > 5 000 sph spaced to 1 800 sph. <p>ISIS indicates a gross area of 100 000 ha currently aged 1-30 yrs across all analysis units. Of this, approx 16 400 ha's have been spaced.</p> <p>Areas identified for spacing are:</p> <ol style="list-style-type: none"> 5 000 ha of PI stands subject to severe repression 1 650 ha/yr for 3 years; 7 000 ha of spaceable stands having 4-10 000 sph 700 ha/yr steady state level; 5 000 ha of mod. density clumpy stands having 3-5 000 sph 200 ha/yr; and mixed Fdl/Lw stands having future commercial thinning potential 300 ha/yr <p>total identified spacing 2 850 ha/yr on about 20 000 ha</p>	<p>(b) TSR1 analysis report indicates about 60 000 ha aged 1-30 in the THLB (including NSR that is now stocked). Total of about 36 000 ha of this (60%) would be spaced under this strategy. Spacing 5 000 sph to 1 400 sph accelerates stand development by 30 yrs (see Table 1 rows 1 & 2, page 54). As-surning 2/3rds of the 36 000 ha (some might be CT'd, others could be limited by FCC's) are available for harvest at about age 70 with a harvest volume of 240</p>

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
MT 3	(c) spacing ____ ha/yr of Douglas-fir stands (priority – those subject to seasonal moisture deficits); and	(c) See above.	m ³ /ha, this contributes approx. 5.75 million m ³ to the mid term shortfall period, or about 115 000 m ³ /yr over 50 years.
MT 3	(d) repeat fertilizing ____ ha/yr.	(d) Currently have about 12 000 ha of managed stands suitable for fertilization. This area will increase as more stands are spaced. An initial fertilization of 2 000 ha/yr would maximize the potential of these stands. This program would gradually expand to an ultimate level of about 5 000 ha/yr (see LT 3) While fertilization can be used to reduce minimum harvestable ages even further on top of spacing related reductions, this is unlikely to be necessary. Instead, fertilization is assumed here to add volume back on to spaced stands so that they can be not only harvested earlier, but at similar volumes to those of the unspaced stands which would be harvested almost 30 years later.	(d) Each fertilization is estimated to add 15 m ³ /ha. Repeat fertilization will add about 20% to stand volumes. 2 000 ha/yr under a 15 yr return cycle equates to 30 000 ha under fertilization management, which is about ½ the area aged 1-30 yrs. 30 000 ha X 45 m ³ /ha = 1.35 million m ³ added to mid term, or about 27 000 m ³ /yr over 50 years.
MT 4	4. Achieve green-up earlier in existing managed stands currently aged 0-20 years in the UWR (9m green-up) and VQO zones (6 m green-up) by (increase – this is a subset of MT3): (a), (b), (c), and (d)	4. UWR was incorrectly mapped and modelled in TSR1 and was found to unduly influence green-up. It will be modelled differently in TSR2. Because of the large area of partial harvesting and the coming advent of large patch sizes, green-up is not currently indicated to be limiting to harvest levels. Awaiting TSR2 results before pursuing green-up strategies.	4. Awaiting TSR2 results.
MT 5	5. See LT3	5. As above, green-up is not currently seen to be limiting. Items listed under this potential strategy considered under LT3.	5. See LT3.
MT 6	6. Set up stands presently 60 – 110 years old for future partial harvesting/	6. Stands presently 60 – 110 years old will be 120 – 170 years old 60 years from now. Those that are unavailable for harvest at that time will be candidates for commercial thinning or partial harvesting. This potential strategy is about using silviculture now to pre-	6. No opportunity.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
	commercial thinning in the VQO and UWR zones (emphasis on decade 7 & 9 harvests) by: (a) spacing _____ ha/yr of _____ to set up stocking appropriate to commercial thinning; and (b) repeat fertilizing _____ ha/yr.	pare such stands for either treatment. Workshop participants felt very few stands presently 60 – 110 years old present such opportunities.	
MT 7	7. Increase the area satisfying older forest biodiversity requirements in decades by achieving the desired stand characteristics by 100 years of age by: (a) spacing _____ ha/yr; and (b) repeat fertilizing _____ ha/yr.	7. At this time, it is suspected but not certain that old growth requirements will be constraining mid term harvest levels. Spacing and fertilizing younger existing stands will aid in the recruitment of stands having older forest attributes at earlier ages. No additional opportunities were identified beyond those under MT3. Some MT3 stands may have to be reserved for older forest purposes. Presume that if these stands are not available for this purpose, harvest levels would be at risk of further reduction to accommodate older forest biodiversity needs.	7. MT3 creates options for meeting older forest criteria at earlier ages, if required.
Mid Term Harvest Forecast Summary			
	Potential Strategy #	Effect	
	MT1 Late rotation fert.	No opportunity	
	MT2 Repeat fert stands 30-50 yrs old	No opportunity	
	MT3 Reduce min ages of stands 1-30 yrs old by: (a) brushing for growth (b)(c) spacing 2 850 ha/yr (d) repeat fertilizing 2 000 ha/yr	No opportunity 115 000 m3/yr over 50 yrs* 27 000 m3/yr over 50 yrs	
	MT4 Achieve earlier green-up in UWR & VQO	Awaiting TSR2 results	
	MT5 Achieve earlier green-up – general	Awaiting TSR2 results – see LT3	
	MT6 Prep 60-110 yr old stands for PH/CT	No opportunity	
	MT7 Increase area in older forests	MT3 enables this option.	
Total potential harvest level impact		142 000 m3/yr over 50 years*	
*Includes the benefit of recent as well as planned spacing activities.			

8.2.4 Long Term (91+ years)

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result																																										
LT 1	<p>1. Maintain the THLB by</p> <p>(a) Planting approx. 300 ha of backlog NSR; (maintain) and</p> <p>(b) maintaining approx. _____ ha of existing backlog plantations. (maintain)</p> <p>(c) plant 100 ha every 3 yrs for rehabilitation of areas burned by wildfires.</p>	<p>1. (a) Most of the backlog NSR has been treated or reclassified. The 300 remaining treatable ha requires a program of fill-planting 100 ha/yr for the next 3 years (shown below) to achieve free growing.</p> <p>More NSR may be identified through surveys. The district wanted to do 6 000 ha of surveys in 1999 but didn't get the funding.</p> <p>(b) There is no/little need for backlog brushing.</p> <p>(c) Wildfire is not predictable. Based on recent fire suppression success/failure, a program of planting about 100 ha every 3 years is estimate to be required.</p> <p>Area (ha) _____</p> <table><tr><th>Year</th><th>Plant NSR</th><th>Plant Fire</th><th>New Plnt'n</th><th>Existing</th><th>Total</th></tr><tr><td>1</td><td>100</td><td></td><td></td><td></td><td>0</td></tr><tr><td>2</td><td>100</td><td></td><td></td><td></td><td>0</td></tr><tr><td>3</td><td>100</td><td>100</td><td></td><td></td><td>0</td></tr><tr><td>4</td><td></td><td></td><td></td><td></td><td>0</td></tr><tr><td>5</td><td></td><td></td><td></td><td></td><td>0</td></tr><tr><td>6-10</td><td></td><td>200</td><td></td><td></td><td>0</td></tr></table> <p>Brush _____</p>	Year	Plant NSR	Plant Fire	New Plnt'n	Existing	Total	1	100				0	2	100				0	3	100	100			0	4					0	5					0	6-10		200			0	<p>1. (a) (b) Maintain base case LTHL.</p>
Year	Plant NSR	Plant Fire	New Plnt'n	Existing	Total																																								
1	100				0																																								
2	100				0																																								
3	100	100			0																																								
4					0																																								
5					0																																								
6-10		200			0																																								
LT 2	<p>2. Increase the THLB by:</p> <p>(a) converting /rehabilitating _____ ha/yr of deciduous stands; (increase)</p>	<p>2. Following are TSR2 netdown figures. Net THLB $\approx$ 230 900 ha</p> <table><tr><th></th><th>Area (ha)</th><th>%THLB</th><th>Treatable Area</th></tr><tr><td>(a)Decid</td><td>4 000</td><td>1.7</td><td>0</td></tr><tr><td>(b)Non-merch</td><td>4 800</td><td>2.1</td><td>?</td></tr><tr><td>(c)Low site</td><td>2 100</td><td>0.9</td><td>0</td></tr></table> <p>(a) Decid. See ST1. No opportunity</p>		Area (ha)	%THLB	Treatable Area	(a)Decid	4 000	1.7	0	(b)Non-merch	4 800	2.1	?	(c)Low site	2 100	0.9	0	<p>2. (a) No opportunity.</p>																										
	Area (ha)	%THLB	Treatable Area																																										
(a)Decid	4 000	1.7	0																																										
(b)Non-merch	4 800	2.1	?																																										
(c)Low site	2 100	0.9	0																																										
LT 2	<p>(b) converting/rehabilitating non-merchantable stands;</p>	<p>(b) Non-merch. There is currently a PFT classification/identification project underway under the EFMP. Results are inconclusive. Need to complete the review project noted under</p>	<p>(b) Possible opportunity. Further info required.</p>																																										

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result																																																								
		"Summary of Information and Research Needs," page 67. See also, ST1.																																																									
LT 2	(c) assessing _____ ha of low-site stands for proper classification; or	(c) Low site is primarily trench Fdi which suffers drought. Is properly classified.	(c) No opportunity.																																																								
LT 2	(d) improve the site productivity of low-site stands by (fertilization?). (increase/maintain)	(d) Not applicable.	(d) Not applicable.																																																								
	(e) reassessing FEN area exclusions.	(e) Not applicable. See ST1.	(e) Not applicable.																																																								
LT 3	3. Increase the volume of regenerated stands by: (increase)	3. Note: items (a) to (h) were shifted in the workshop from MT5 to here.	3.																																																								
LT 3	(a) site preparing _____ additional hectares;	(a) No additional opportunity to increase site prep. Current practices must be maintained to maintain assumptions in the TSR base case.	(a) No opportunity.																																																								
LT 3	(b) using improved seed;	(b) About 40% of even-aged managed areas are planted. In 1998 about 1/6" of all planted area was improved S but the volume gain is low, between 2 – 9.4%. Future gains by 2007 are estimated to be:	(b) <u>stand level</u>																																																								
		<table><tr><th>%THLB</th><th>Species</th><th>Now</th><th>2007</th><th>2011</th><th>% gain (TSA level)</th></tr><tr><td>45</td><td>PI</td><td>-</td><td>-</td><td>6 – 18</td><td>8</td></tr><tr><td>10</td><td>S</td><td>9 – 10</td><td>25</td><td>-</td><td>2.5</td></tr><tr><td>30</td><td>Fdi</td><td>-</td><td>-</td><td>-</td><td>0</td></tr><tr><td>10</td><td>Lw</td><td>-</td><td>7</td><td>-</td><td>1</td></tr><tr><td>5</td><td>Other</td><td>-</td><td>-</td><td>0</td><td>0</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td>11.5</td></tr></table>	%THLB	Species	Now	2007	2011	% gain (TSA level)	45	PI	-	-	6 – 18	8	10	S	9 – 10	25	-	2.5	30	Fdi	-	-	-	0	10	Lw	-	7	-	1	5	Other	-	-	0	0						11.5	<table><tr><td>Vol gain –</td><td>up to 25%</td></tr><tr><td>GU red'n –</td><td>2 yrs</td></tr><tr><td>min age red'n –</td><td>10 yrs</td></tr><tr><td colspan="2"><u>TSA level</u></td></tr><tr><td>Vol gain –</td><td>5%</td></tr><tr><td>GU red'n –</td><td>1 yr</td></tr><tr><td>min age red'n –</td><td>5 yrs</td></tr></table>	Vol gain –	up to 25%	GU red'n –	2 yrs	min age red'n –	10 yrs	<u>TSA level</u>		Vol gain –	5%	GU red'n –	1 yr	min age red'n –	5 yrs
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		No improved Fdi will be available. Need for this species noted under "Summary of Information and Research Needs," page 67.	See "Summary" below.																																																								
		Opportunity area is all planted area which $\cong$ 40 % of area harvested = _____ ha/yr. LTHL can be expected to rise (40% THLB planted X 11.5% volume gain) $\cong$ 5%.																																																									
		Tree improvement could significantly reduce green-up (estimate by 2 yrs) & minimum harvest ages (estimate by 10 yrs) on 40% of the THLB. Green-up is not an issue in partial-harvesting areas.																																																									
LT 3	(c) using larger planting stock	(c) Current practice is to plant 410 stock. Larger stock is not possible due to shallow soils.	(c) No opportunity																																																								
LT 3	(d) fertilizing at time of planting	(d) Results are inconclusive. No opportunity. Need for further research noted under "Summary of Information and Research Needs," page 67.	(d) No opportunity.																																																								

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
LT 3	(e) brushing _____ ha/yr for growth enhancement (in addition to _____ ha/yr to ensure free growing	(e) Brush is not a problem.	(e) No opportunity.
LT 3	(f) spacing _____ ha/yr of pine stands (priority - those subject to repression);	(f) See MT 3(b). Spacing PI stands having 5 000 sph down to 1 400 sph can reduce time to 22.4 cm stand avg DBH by about 30 yrs. Estimated that about 24 000 out of 60 000 currently aged 1-30 yrs may be advanced to earlier harvest = 40% of these age classes. During the critical transition period and the mid term shortfall at the TSA level this equates to a .4 X 30 yrs = 12 yr min age reduction.	(f) _____ stand level Vol gain – 0% GU red'n – 0 yrs min age red'n - 30 yrs TSA level Vol gain – 0% GU red'n – 0 yr min age red'n - 12 yrs See "Summary" below.
LT 3	(g) spacing _____ ha/yr of Douglas-fir stands (priority – those subject to seasonal moisture deficits); and	(g) See (f) above.	(g) See (f) above.
LT 3	(h) repeat fertilize _____ ha/yr on a 15 yr return cycle (increase).	(h) On a long term steady state basis, 75% of the species (Fdi & PI) on 85% of the site classes (all G & M site) could be suitable for a multiple fertilization regime. About 50% of this is considered available for treatment, the primary reason for unavailability being the large area under partial harvesting. This equates to (.75 X .85 X .5 =) 30% of the THLB or $\approx 75\,000$ ha. On a 15 yr return cycle, this requires a program of (75 000/15 =) 5 000 ha/yr . Estimated cost at \$200/ha = \$1.0 million/yr. Probably 3 applications would be required, with the first occurring after juvenile spacing. Each application is estimated to add 15 m ³ /ha of growth, so 3 applications yields an additional 45 m ³ /ha. This is a 20% volume gain on a base stand yield of 250 m ³ /ha. A 20% volume gain across 30% of the THLB would increase long term harvest levels (0.2 X 0.3 =) 6%. Guestimate a 20% stand level volume gain would alternatively enable at least a 10 yr stand level reduction in min ages. If this were applicable across 30% of the THLB, would be a 3 yr min age reduction.	(h) _____ stand level Vol gain – up to 20% GU red'n – 0 yrs min age red'n - 10 yrs TSA level Vol gain – 6% GU red'n – 0 yr min age red'n - 3 yrs See "Summary" below.
LT 3	(i) managing stocking so voids do not account for more than 10% of the area (increase); and	(i) TIPSY standard OAF1 factor for voids is 15%. This was increased to 20% in TSR2 for PI/Fd leading seed tree systems to account for leaving the seed trees to meet IRM objectives. Objective of this potential strategy is to reduce OAF1 to 10%. An OAF1 of 15-20% is likely appropriate. A relatively high proportion of the total land area of the TSA (77%) is outside the THLB. This implies rough terrain, with stand voids	(i). No opportunity.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result
LT3	(j) Increase regeneration delay from 3 yrs to 7 yr.*	<p>being likely.</p> <p>There is a need for completion of surveys for voids to get a measure of the actual area in voids (noted under "Summary of Information and Research Needs," page 67). Voids can be desirable for wildlife habitat, so intensive void management may not be practicable on all areas.</p>	(i) Evaluation required. Potentially negative effect on harvest forecasts.
LT3	(k) Reduce regeneration delay from 3 yrs to 1 yr.*	<p>(j) This potential strategy was added during the workshop.</p> <p>An agreement was recently signed between the MoF and Slocan FP extending the regen delay period from 5 to 7 years for naturally restocked PI. Slocan was finding that at the 3 yr survey the sites were not stocked, would order planting stock but then find the site stocked at yr 5 when they went to plant. Extending the regen delay simply recognizes this administratively but does not change actual practices. Concern is the risk this presents to the harvest forecast if stands are not stocked by year 5. A 2 yr additional regen delay then occurs.</p> <p>The need to evaluate this risk noted under "Summary of Information and Research Needs," page 67.</p> <p>(k) This potential strategy was added during the workshop.</p> <p>TSR2 regen delay for planted stands is 3 yrs. This includes an allowance for failures. Current practice is 1 – 3 yrs. This may be difficult to improve upon operationally and is only applicable on clearcut areas. This opportunity needs further assessment - noted under "Summary of Information and Research Needs," page 67</p> <p>Sites are often planted to lower densities, with the expectation that there will be ingress. This presents some risk to yield estimates were ingress not to occur. The need to evaluate this risk noted under "Summary of Information and Research Needs," page 67.</p>	(k) Evaluation required.

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result																																																																																											
LT 3	SUMMARY	<p>The following summarizes the estimated effects of strategy LT3. Effects at the TSA level are prorated usually based on the opportunity area as a percentage of the TSA's THLB. Totals are estimated using best judgement with respect to potential overlapping effects. The volume gain and the min age reductions cannot both be captured at the same time. Benefits must be allocated to one or the other based on TSA need.</p> <table><tr><th>Strategy</th><th>Volume Gain (%) Stand</th><th>TSA</th><th>Green-up age red'n(yrs) Stand</th><th>TSA</th><th>Min Harv. Age red'n(yrs) Stand</th><th>TSA</th></tr><tr><td>(a) incr. site prep</td><td></td><td></td><td>no opportunity</td><td></td><td></td><td></td></tr><tr><td>(b) improved seed</td><td>25</td><td>5</td><td>2</td><td>1</td><td></td><td></td></tr><tr><td>(c) large stock</td><td></td><td></td><td>no opportunity</td><td></td><td></td><td>10</td></tr><tr><td>(d) fert at planting</td><td></td><td></td><td>no opportunity</td><td></td><td></td><td>5</td></tr><tr><td>(e) brush for growth</td><td></td><td></td><td>no opportunity</td><td></td><td></td><td></td></tr><tr><td>(f) (g) spacing</td><td>0</td><td>0</td><td>0</td><td>0</td><td></td><td>30</td></tr><tr><td>(h) repeat fert</td><td>20</td><td>6</td><td>0</td><td>0</td><td></td><td>10</td></tr><tr><td>(i) reduce voids</td><td></td><td></td><td>no opportunity</td><td></td><td></td><td>12</td></tr><tr><td>(j) extend regen delay</td><td></td><td></td><td>potentially negative, evaluation required</td><td></td><td></td><td></td></tr><tr><td>(k) reduce regen delay</td><td></td><td></td><td>potentially positive, evaluation required</td><td></td><td></td><td></td></tr><tr><td>(x) plant Birch</td><td></td><td></td><td>minor opportunity</td><td></td><td></td><td>3</td></tr><tr><td>(b) Total</td><td><u>45</u></td><td><u>11</u></td><td><u>2</u></td><td><u>1</u></td><td><u>50?</u></td><td><u>20?</u></td></tr></table> <p>See also LT3 for additional potential strategies.</p>	Strategy	Volume Gain (%) Stand	TSA	Green-up age red'n(yrs) Stand	TSA	Min Harv. Age red'n(yrs) Stand	TSA	(a) incr. site prep			no opportunity				(b) improved seed	25	5	2	1			(c) large stock			no opportunity			10	(d) fert at planting			no opportunity			5	(e) brush for growth			no opportunity				(f) (g) spacing	0	0	0	0		30	(h) repeat fert	20	6	0	0		10	(i) reduce voids			no opportunity			12	(j) extend regen delay			potentially negative, evaluation required				(k) reduce regen delay			potentially positive, evaluation required				(x) plant Birch			minor opportunity			3	(b) Total	<u>45</u>	<u>11</u>	<u>2</u>	<u>1</u>	<u>50?</u>	<u>20?</u>	
Strategy	Volume Gain (%) Stand	TSA	Green-up age red'n(yrs) Stand	TSA	Min Harv. Age red'n(yrs) Stand	TSA																																																																																								
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LT 4	4. Reduce losses to root rot by: (increase)	4. TSR2 OAF2 factors will be: 10.8% Fdi in P/I/Fdi mixes – G & M sites; 8.7% PI and 8.2% Fdi – P sites. These factors are calculated based on thousands of survey plots and are considered accurate. An ongoing survey program of 1 200 ha/yr is needed to monitor root rot development in stands.																																																																																												
LT 4	(a) pushover logging / stumping;	(a) About 100 ha/yr is being done. Stumping is in the root rot centres only rather than entire blocks.	(a) Basic silviculture obligation. Being phased out.																																																																																											
LT 4	(b) planting alternate species;	(b) This is the preferred method of treatment. Prescriptions call for planting away from stumps.	(b) Basic silviculture obligation. Current practice on all planted areas.																																																																																											
LT 4	(c) pop-up spacing;	(c) This is not a desirable treatment. Limited treatment opportunities.	(c) Not done.																																																																																											

Number	Potential Strategy/Action	Discussion / Current Status	Conclusion / Anticipated Result												
LT 4	(e) small diameter spacing	(e) Small diameter spacing can be used in silviculture prescriptions as an alternative to stumping or pop-up spacing. Early results indicate it is equally effective, plus has the added benefit of stocking control. A potential variation to small diameter spacing is to partially cut or break and push over trees that are ½ the height of crop trees. Current practice is normal spacing. Larger patches of root rot are excluded from spacing. Smaller infection centres are given no spacing buffer zones. Trend is towards early spacing of root rot infected stands.	(e) Not current practice.												
LT 4	(d) hyphaloma inoculation*	(d) This potential strategy was added during the workshop. Currently, inoculating with hyphaloma is considered experimental but early results are encouraging.	(d) Experimental												
LT 4	SUMMARY	The FP Code requires silviculture prescriptions address means to deal with armillaria when it is present in a harvested stand. Alternatives are being actively pursued, but their overall success over time is unknown. The need for further study of root rot management techniques noted under "Summary of Information and Research Needs," page 67.	4. Summary Basic silviculture obligation. Being actively pursued. Results unknown but could be expected to ultimately result in a reduced OAF2.												
LT 5	Monitor mountain pine beetle populations by surveying 200 km/yr.*	5. This potential strategy was added during the workshop. The TSA is a high risk area for mountain pine beetle epidemics. There is a need to continually monitor stands for beetle outbreaks. An annual program of 200km/yr of strip lines is required.	5. Maintain base case.												
Long Term Harvest Forecast Summary		<table><tr><th>Potential Strategy #</th><th>Effect</th></tr><tr><td>LT1 Backlog NSR + Fire/Pest refor.</td><td>Maintains base case</td></tr><tr><td>LT2 Increase the THLB</td><td>No immediate opportunity</td></tr><tr><td>LT3 Incr. regenerated stand vol's</td><td>Incr. LTHL by 11%</td></tr><tr><td>LT4 Root rot</td><td>Maintains base case</td></tr><tr><td>LT5 Survey mountain pine beetle</td><td>Maintains base case</td></tr></table>	Potential Strategy #	Effect	LT1 Backlog NSR + Fire/Pest refor.	Maintains base case	LT2 Increase the THLB	No immediate opportunity	LT3 Incr. regenerated stand vol's	Incr. LTHL by 11%	LT4 Root rot	Maintains base case	LT5 Survey mountain pine beetle	Maintains base case	
Potential Strategy #	Effect														
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LT4 Root rot	Maintains base case														
LT5 Survey mountain pine beetle	Maintains base case														
Total potential harvest level impact		Incr. LTHL by 11%													

8.3 Potential Harvest Forecast

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

9. Opportunities to Improve Timber Quality

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

9.1 Product Objectives

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

Quality Class	Species	Characteristics	Value
Premium Log:			(\$/m3)
Peelers	All	25+ cm DBH, clear, 5 m log, min 20 cm top.	90
Building Log	Douglas-fir, larch, lodgepole pine, spruce	42.5+ cm DBH, straight, low taper, minimal twist, min 9 m log, min 27.5 cm top	130
Poles	western redcedar	27.5+ cm DBH, 9 m log, straight, min 10 cm top, no rot.	150
Large logs	All	47.5+ cm DBH, 5 m log, min 35 cm top	90
Sawlog:	Douglas-fir, larch, ponderosa pine, redcedar	27.5+ cm DBH.	70
	lodgepole pine, spruce, balsam, hemlock	22.5+ cm DBH.	70
			Balsam - 50

9.2 Potential Strategies by Response Time Frame

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

Response Time Frame	Potential Strategy/Action	Discussion / Current Status	Anticipated Result / Premium Log Forecast
Short Term (1 - 20 yrs)	None	Short term harvests will come from existing older stands which are not treatable to improve quality.	Quality profile of existing old growth will prevail. Assume this is equal to a recent coast-wide estimate of 15%.
Mid Term (21 - 90 yrs)	Q1. space ____ ha/yr to increase average stand DBH _{gall} from ____ cm to ____ cm.	Spacing activities are discussed under potential strategies MT3 (b), MT7, LT3 (f), LT4 (c), and LT4 (e). The implications of these strategies for future timber quality are discussed in general terms in "Large Premium Log Analysis," below.	See large log analysis, below.
	Q2. 1 st lift prune ____ ha/yr to 3.5 m, and 2 nd lift prune ____ ha to 5.5 m.	Max historic program has been 120 ha/yr. Currently 560 ha have been 1 st lift pruned. No stands have been 2-lift pruned. Goal is a 10 cm radius of clear wood. This requires a minimum DBH of 30 cm, preferably 35 cm. Target species are PI, Fdi and Pw (future). An annual program of 100 ha/yr would equal (100/1200 ha/yr harvested =) 8% of THLB. If 75% of this area were suitable for pruning and if 3.5 m = 17% of tree vol, then (.08 X .75 X .17 =) ≅ 1%/yr of future harvest volume will be clear logs resulting from pruning. Pruned stands have a high risk of animal and disease damage. Workshop participants felt that because of these risks, together with the generally lower site productivity in the TSA, a reasonable pruning program would be 50 ha/yr of 1 st lift pruning.	0.5% clear log content across total annual harvest volume.
Long Term (91 + yrs)	As above.	As above.	As above.

9.3 Large Premium Log Analysis

Two large log analyses are reported below, both based on an annual spacing program of 520 ha/yr. This figure was derived based on information in Table 2 of the *Invermere Enhanced Forest Management Pilot Project Silviculture Strategic Plan* (White, 1998). The tables do not include an estimate for the premium log content from harvests in the uneven-aged management zone.

All tables were generated using TIPSYS version 2.1e with standard OAF's, to a 12.5 cm DBH utilization standard for all species. (Note: There is no published validation for this model and it is an even-aged single-species model.) Because TIPSYS has no mechanism for in-growth following planting, unspaced stands having a stocking level of 3 000+ sph were assumed to be naturally regenerated. Stands with a stocking level of < 3 000 sph were assumed to be planted. Plantations are established at 1 400 sph. No ingrowth is assumed.

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

Table 1 illustrates the effects of spacing on achieving a technical rotation (sawlog target of 27.5 cm DBH for all species except PI which is 22.5 cm). For example, rows 1 & 2 show that by spacing a PI stand from 5 000 sph to 1 400 sph, a 22.5 cm DBH avg diameter target can be reached 28 years earlier, at 72 years vs 100 years for the unspaced stand. The MAI of the spaced PI stand is virtually equivalent to that of the unspaced stand, indicating that spacing would not change the harvest level over time at this technical rotation. Under the assumptions employed, even with spacing, only 2.3% (row 22) of annual harvested volumes in the long term will be large premium logs (Note: this estimate is rounded to a 2.5% target). However, the diameter target of 42.5 cm DBH+ (45+ cm diameter class) is more demanding than in adjacent TSA's. The threshold for large premium logs in the Cranbrook and Golden TSA's is 32.5 cm + DBH. In those TSA's, albeit under different species mixes, site indexes, spacing assumptions, etc., the large log yields were 5.1% and 9.0% respectively.

Table 2 shows the effects of managing stands to younger harvest ages (PI – 65, other species – 90). This would be representative of the harvest profile at about the time of transition from existing stands to managed stands, about 80-90 years from now, with minimum harvest ages reduced about 15 years below culmination for PI and about 25-45 years for other species. Under this scenario the large premium log content falls to 0.0%. (Again, it should be noted that the criterion of 42.5 cm DBH for a large log is more demanding than that used in adjacent TSA's.) Offsetting this, Table 2 shows that, at younger harvest ages, spacing significantly reduces the number of smaller trees in the stand and increases those in the middle size range, while still maintaining about the same overall stand volume. For example, spacing PI from 5 000 sph to 1 400 sph (row 1 vs row 2) reduces the # stems/ha in the 15-20 cm class by over 400 and raises the # stems/ha in the 25-40 cm DBH class from 252 to 387 sph. Total stand volume at 1 400 sph is 11 m³ greater than at 5 000 sph. Average stand DBH increases by over 4 cm, creating a merchantable stand, whereas the unspaced stand would not likely be merchantable at age 65. Also significant, the MAI of the spaced stand at the target harvest age of 65 years is about 6% lower than that of either the spaced or the unspaced stand at culmination of about 80 years, indicating that continually harvesting at this age over several rotations would result in an equivalent reduction in long term harvest levels.

With regard to Fdi, Table 2 TIPSYS results indicate that MAI changes very little across the range of stocking levels shown in the table at age 90. Diameter distributions, however, are significantly affected by stocking. An unspaced stand with 5 000 sph at establishment has 41% of its stems in the 0-10 cm diameter grouping. Although the data are not presented in the table, likely more than 50% of total stems would not be merchantable based on a 17.5 cm DBH merchantability criterion. This has some implications to harvesting costs, fire hazards, plantability, aesthetics, etc. and depending on the local situation may or may not be relevant to the decision to space. More relevant to log quality and harvesting costs is the

shift in of the number of stems in the smallest merchantability group (15-20 cm) into the mid-range group (25-40 cm). Spacing from 5 000 sph down to 1 400 sph, for example, reduces the number of stems and the % total volume in the smallest merchantable size grouping by about one-third. Unspaced, 40% of the stand's volume is in the smallest diameter grouping, while, with spacing, this falls to below 30% of total volume. At the same time, the volume in the mid-sized grouping (25-40 cm) increases by 20%. The volume and diameter shifts are much more dramatic with spacing down to 900 sph, but total stand volume drops about 10% from that of the unspaced stand at age 90.

For spruce, Table 2 indicates spacing again significantly reduces the number of stems in the non-merch and small-merch diameter groups and also significantly shifts volume into the mid-range group (25-40 cm) (from 52% of total volume of unspaced stands to 72% spaced). The spaced stand, however, has 6 m³/ha (2%) less total volume than the unspaced stand.

Table 1. Large log analysis - Target harvest diameters

Target - 27.5 cm DBHq (22.5 for P1)																																	
Row #	Species	%hrv	SI²	Regime	Area no space	Space fmr/lo	Cul Age	Cul Vol	Cul MAI	Target DBHq -all	Harv Age	Harv Ht (m)	MAI	LRF bfr/3	Total Vol	Trees	Largest 250 Vol	DBHq	DBH class¹										5m large log ² % tot hrvt				
																			0 - 10 cm % tot trees	15- 20 cm % tot trees	20- 30 cm % tot vol	25- 40 cm % tot vol	45+ cm % tot trees	45+ cm % tot vol									
1	P1		45	18			79	286	3.62	22.5	100	23.8	3.48	229	348	1070	165	30.6	47	4	559	52	106	30	463	43	240	69	1	0	1	0	N/A
2					280	na6000/1400	81	286	3.54	22.5	72	20.2	3.49	214	251	965	121	29.7	61	6	458	47	74	29	446	46	178	71	0	0	0	0	0.0
3	comparison					na5000/1200	83	284	3.42	22.5	65	19	3.19	209	207	866	106	29.2	57	7	404	47	62	30	404	47	145	70	0	0	0	0	N/A
4	comparison					na5000/900	89	289	3.25	22.5	54	16.7	2.59	194	140	687	80	27.7	29	4	326	47	45	32	331	48	94	67	0	0	0	0	N/A
5					190	na6000/unspaced	80	284	3.55	22.5	88	22.5	3.52	221	310	1053	146	30.4	61	6	519	49	92	30	472	45	218	70	0	0	0	0	0.0
6	comparison					na3000/1200	87	288	3.31	22.5	65	19	3.06	206	199	850	103	29.0	60	7	394	46	60	30	394	46	138	69	0	0	0	0	N/A
7					160	pit1400/unspaced	78	271	3.48	22.5	72	20.4	3.46	207	249	1001	115	29.0	31	3	527	53	84	34	443	44	165	66	0	0	0	0	0.0
8	Subtot.				280	360																											
9	FdL		40	18		na6000/unspaced	126	376	2.98	27.5	197	35	2.61	264	514	843	405	42.4	103	12	327	39	56	11	337	40	304	59	75	9	154	30	N/A
10					190	na6000/1400	129	376	2.92	27.5	147	31.2	2.88	255	424	769	313	39.3	57	7	292	38	49	12	379	49	301	71	41	5	74	17	0.6
11	comparison					na6000/900	134	376	2.81	27.5	112	27.3	2.75	246	308	619	226	36.7	39	6	175	28	31	10	392	63	257	83	14	2	21	7	N/A
12					190	na6000/unspaced	128	380	2.97	27.5	171	33.3	2.78	252	475	816	355	40.7	75	9	319	39	53	11	368	45	320	67	53	6	101	21	0.7
13	comparison					na3000/1200	132	376	2.85	27.5	131	29.6	2.85	244	373	708	272	37.7	48	7	240	34	39	10	393	56	291	78	25	4	41	11	N/A
14					180	pit1400/unspaced	128	380	2.97	27.5	153	32.1	2.89	251	443	795	331	40.1	38	5	335	42	53	12	376	47	304	69	46	6	84	19	0.6
15	Subtot.				190	370																											
16	Sw/Bt⁴		15	16		na6000/unspaced	114	389	3.41	27.5	147	29.9	3.09	256	465	779	278	36.9	21	3	225	29	57	13	503	65	361	79	20	3	36	8	N/A
17					50	na6000/1400	115	399	3.47	27.5	119	26.6	3.45	246	411	821	238	36.6	12	1	261	32	51	12	530	65	331	81	19	2	28	7	0.1
18						na63000/unspaced	115	389	3.38	27.5	136	28.7	3.25	247	442	809	262	36.9	14	2	250	31	57	13	522	65	347	79	22	3	38	9	0.1
19					110	pit1400/unspaced	108	393	3.64	27.5	124	28.2	3.48	242	432	856	243	36.7	5	1	259	30	54	13	574	67	349	81	17	2	29	7	0.1
20	Subtot.				50	160																											
21																																	
22	Total				520	880																											
¹ Actual ranges are 0 - 12.5 cm, 12.6 - 22.5 cm, 22.6 - 42.5, and 42.6 + cm																																	
² From Martin, 1999. ISIS Polygon Area by Site Index Class																																	
³ 1st 5 m log assumed to be 25% of tree volume. Volume calculated is a % of total harvest volume based on proportion of annual harvested area under a particular regime, not a % of stand volume.																																	
⁴ Modeled as all planted Sw due to TPSV limitations.																																	
2.2																																	

Table 2. Large log analysis - Target harvest ages

Target - Harvest at age 90 (Pl - 65)																																	
Row #	Species	%inv	St ²	Regime	Area no spaced	Space limit:	Cul Age	Cul Vol	Cul MAI	Target DBH ¹	Harv Age	Harv Ht. (m)	MAI	LRF bfm3	Total Vol	Trees	Largest 250 Vol	DBH ²	DBH class ¹						5m large log ³								
																			0 - 10 cm	15 - 20 cm	25 - 40 cm	45+ cm	% tot	% tot									
																			# trees	% tot	# trees	% tot	# trees	% tot	# trees	% tot							
1	Pl	45	18			na5000/unspaced	79	286	3.62	17.2	65	19	3.45	195	224	1648	93	26.0	464	28	925	56	133	59	252	15	91	41	0	0	0	N/A	
2				280		na5000/1400	81	286	3.54	21.5	65	19	3.33	206	216	992	102	28.4	85	9	520	52	78	36	387	39	138	64	0	0	0	0.0	
3	comparison					na5000/1200	83	284	3.42	22.6	65	19	3.19	209	207	865	106	29.2	57	7	404	47	62	30	404	47	145	70	0	0	0	N/A	
4	comparison					na5000/900	89	289	3.25	24.8	65	19	2.99	215	194	675	112	30.4	18	3	229	34	37	19	423	63	157	81	0	0	0	N/A	
5				190		na5000/unspaced	80	284	3.55	18.9	65	19	3.35	195	218	1323	95	27.0	255	19	759	57	111	51	307	23	108	50	0	0	0	0.0	
6	comparison					na13000/1200	87	288	3.31	22.5	65	19	3.06	206	199	850	103	29.0	60	7	394	46	60	30	394	46	138	69	0	0	0	N/A	
7				160		pl11400/unspaced	78	271	3.48	21.6	65	19.2	3.33	198	217	1011	98	27.8	38	4	595	59	89	41	379	37	129	59	0	0	0	0.0	
8	Subtot			280	350																												
9	F4/L	40	18			na5000/unspaced	126	376	2.98	17.2	90	23.9	2.77	212	250	1546	137	28.5	641	41	597	39	100	40	308	20	150	60	0	0	0	N/A	
10				190		na5000/1400	129	376	2.92	21.2	90	23.9	2.68	220	241	926	145	29.8	164	18	406	44	68	28	355	38	173	72	0	0	0	0.0	
11						na5000/900	134	376	2.81	24.4	90	23.9	2.51	228	226	641	154	31.2	54	8	217	34	39	17	370	58	187	83	0	0	0	N/A	
12	comparison			190		na5000/unspaced	128	380	2.97	18.9	90	23.9	2.74	206	247	1224	139	29.0	362	30	532	43	89	36	331	27	158	64	0	0	0	0.0	
13	comparison					na13000/1200	132	376	2.85	22.4	90	23.9	2.57	215	232	792	146	30.3	107	14	321	41	55	24	365	46	177	76	0	0	0	N/A	
14				180		pl11400/unspaced	128	380	2.97	21.2	90	24.5	2.78	213	250	958	149	30.0	138	14	472	49	77	31	346	36	171	68	1	0	1	0.0	
15	Subtot			190	370																												
16	Sw/Bt ⁴	15	16			na5000/unspaced	114	389	3.41	18.7	90	21.6	3.14	207	283	1548	128	29.0	351	23	868	55	134	47	339	22	148	52	1	0	1	0	N/A
17				50		na5000/1400	115	399	3.47	22.9	90	21.6	3.08	221	277	988	145	31.6	77	8	461	47	74	27	447	45	200	72	2	0	2	1	0.0
18				50		na5000/unspaced	115	389	3.38	20.3	90	21.6	3.05	209	274	1278	132	29.9	215	17	686	54	110	40	377	29	164	60	1	0	1	0	0.0
19				110		pl11400/unspaced	108	393	3.64	23.6	90	23	3.46	220	311	1014	157	32.2	39	4	484	48	82	26	486	48	224	72	3	0	4	1	0.0
20	Subtot			50	160																												
21																																	
22	Total			520	880																											0.0	

¹ Actual ranges are 0 - 12.5 cm, 12.6 - 22.5 cm, 22.6 - 42.5, and 42.6 + cm

² From Martin, 1999. /SIS Polygon Area by Site Index Class

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

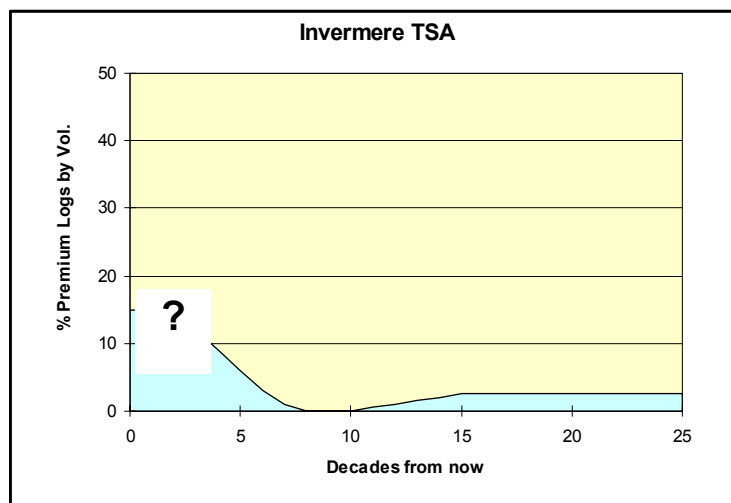
⁴ Modeled as all planted Sw due to TIPSy limitations.

9.4 Timber Quality Forecast

The foregoing analysis indicates the premium log content of harvests in the mid and long term will be significantly lower than today's levels. In the absence of more precise analysis, it is assumed that premium log content will fall to about 0% in the later mid term and recover to about 2.5% in the long term. Contributions from partially harvested areas may increase these estimates slightly. Data for the current local percentage of harvest that is in premium logs is not available, but could readily be obtained from local sawmills. In the interim it is assumed to be about 15%, the figure used in the provincial interim strategy document (MoF, 1999).

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

Figure 27. Potential Quality Forecast, Invermere TSA



This quality forecast is for large-dimension premium logs. Large logs could form about 2.5% of future harvests (based on spacing 520 ha/yr) and clear logs 0.5% (based on pruning 50 ha/yr). Some large logs will also be clear logs.

10. Habitat Supply Opportunities

The effects of silviculture on the future quantity or quality of wildlife habitat are not analyzed in the timber supply review. Information in this section was gathered during the district workshop.

10.1 Habitat Objectives

See “General” in the table below.

10.2 Potential Strategies

The following strategies have potential to increase habitat supply. These were formulated in the district workshop.

Potential Strategy/Action	Discussion / Current Status	Anticipated Result / Habitat Supply Forecast
General	There is insufficient resource information to establish specific goals for habitat supply. A gap analysis is needed to determine where information is weak or entirely lacking. Invermere FD is planning to conduct a habitat analysis using the SIMFOR model at UBC. Need to generate a guild structure for this. Studies are needed on the effects of silviculture treatments on wildlife species. The need for further study of silviculture/wildlife management interactions noted under “Summary of Information and Research Needs,” page 67.	
H1. Space mixed species and clumpy stands	Spacing mixed species and clumpy stands offers the best opportunity to maximize both timber and habitat benefits. Estimate there are sufficient candidate stands to support a program of 300 ha/yr.	
H2. Space for habitat	Ungulate winter range in the trench can be improved by spacing, specifically by removing pine, leaving clumpiness, and creating/enlarging voids. Estimate there are sufficient candidate stands to support a program of 40 ha/yr.	
H3. Space to create NDT 4 fingers into NDT 3 areas.	Spacing to create fingers would better emulate the naturally ragged boundary between the 2 disturbance types. This spacing could occur in conjunction with operational spacing for timber objectives. Estimate there are sufficient candidate stands to support a program of 50 ha/yr.	

10.3 Habitat Issues Related to Silvicultural Practices

The following concerns were raised in the workshop regarding silvicultural practices for timber management purposes:

1. Extensive, large-scale incremental silviculture activities could be an issue for habitat management.
2. A monitoring feedback loop on the impacts of large-scale treatments is needed (e.g., fertilization on flora composition, etc.).
3. Future stand-level habitat issues will be the amount of coarse woody debris left on sites and the need for habitat trees for cavity nesters.

11. Incremental Silviculture Strategy

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

11.1 General Strategy / Objectives

Because the TSR2 analysis is not yet available it is difficult to identify with any precision both the silvicultural opportunities and their relative importance. In its stead, the workshop participants relied on their own local knowledge of issues and opportunities as well as some indication of what TSR2 may look like based on preliminary TSR2 information as well as inferences from timber supply analysis of the EFMPP area.

Both the TSR1 and EFMPP base case forecasts indicate timber supply to be falling in the near future. In addition, forest companies are having difficulty finding available wood for harvest. Workshop analysis of a variety of potential silviculture strategies to increase short term (i.e., the next 20 years) timber supply could not identify any feasible strategies. Therefore, the strategy has no stated objective for the short term period.

A mid term harvest shortfall below the ultimately higher long term harvest level will occur, driven largely by the age class structure of the TSA. There is a substantial shortage of stands presently aged 31 – 50 years, followed by a substantial excess of stands presently aged 1 – 30 years. A mid term objective, therefore, is to increase the quantity of the timber to be available for harvesting in this time period. The most significant opportunity is through programs of spacing and fertilization in a large proportion of those stands presently aged 1-30 years to advance their merchantability and bring them forward into the mid term harvest period. *The spacing treatments must be completed in the near future before the biological window of opportunity closes.*

In the long term, starting about 90 years from now, workshop analysis indicates silvicultural activities can result in harvest levels substantially above the TSR1 base case forecast level. Therefore, a long term objective is to maximize timber production within a context of sound multiple resource stewardship. Workshop analysis indicates that silvicultural activities can contribute significantly to this objective.

Based on a clear log definition of being able to produce 25% clear lumber by volume, 2nd growth managed stands will have no clear logs. Given the low site productivity generally across the TSA, this area is not seen as a priority for this type of investment. A second long term objective is to create a long term timber supply yielding a minor amount (0.5%) of clear logs on a total harvest volume basis.

The TSA contains significant areas of prime ungulate habitat. As well, there is a need to maintain the natural biodiversity of the area. A third long term objective is to maximize ungulate habitat and foster biodiversity through harvesting and silvicultural activities.

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

11.2 Log Product Objectives

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

Quality Class	Species	Characteristics	Value
Premium Log:			(\$/m3)
Peelers	All	25+ cm DBH, clear, 5 m log, min 20 cm top.	90
Building Log	Douglas-fir, larch, lodgepole pine, spruce	42.5+ cm DBH, straight, low taper, minimal twist, min 9 m log, min 27.5 cm top	130
Poles	western redcedar	27.5+ cm DBH, 9 m log, straight, min 10 cm top, no rot.	150
Large logs	All	47.5+ cm DBH, 5 m log, min 35 cm top	90
Sawlog:	Douglas-fir, larch, ponderosa pine, redcedar	27.5+ cm DBH.	70
	lodgepole pine, spruce, balsam, hemlock	22.5+ cm DBH.	70
			Balsam - 50

11.3 Silviculture Strategies

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

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

These strategies are supported by specific silvicultural regimes listed on page 64 along with investment priorities.

No.	Strategy	Priority
Surveys	Conduct approximately 10 900 ha/yr of silviculture surveys in support of all strategies.	0

SHORT TERM

Objectives:

- None.

Working Targets:

- None.

Strategies:

No viable short term strategies.

MID TERM

Objectives:

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

Working Targets:

- Generate an additional 7.1 million m³ to mid-term timber supply.

Strategies:

- MT3** Achieve merchantable size 30 years earlier in approximately 60% of stands currently 1-30 years old and increase their volumes by 20% by:
- (b) In addition to the 16 400 ha already spaced, spacing an additional 20 000 ha at the rate of 2 850 ha/yr as follows:
- 5 000 ha of PI stands subject to severe repression at the rate of 1 650 ha/yr for 3 years; 1
 - 7 000 ha of stands having a stocking level of 4-10 000 sph at the rate of 700 ha/yr; 5
 - 5 000 ha of moderate density clumpy stands having 3-5 000 sph at the rate of 200 ha/yr; and 8
 - mixed Fdi/Lw stands having future commercial thinning potential at the rate of 300 ha/yr. 6
- (d) Repeat fertilizing 30 000 ha of spaced stands currently aged 1-30 yrs (about ½ of the total area in this age class) on a 15 year cycle at the rate of 2 000 ha/yr. (Note: the total area of fertilization will gradually rise over time to 5 000 ha/yr as more areas are harvested and regenerated to managed stands – see LT3.) 6

No.	Strategy	Priority
<u>LONG TERM</u>		
Objectives:		
<ul style="list-style-type: none"> Maximize long term timber production within a context of sound multiple resource stewardship. Improve the quality of the timber to be harvested. 		
Working Targets:		
<ul style="list-style-type: none"> Increase long term timber supply by at least 11%. Generate at least 2.5% of total harvest volume in premium large logs (no current silviculture strategy implications). Generate at least 0.5% of total harvest volume in clear premium logs (clear logs will generally also be large logs). 		
Strategies:		
LT1	Maintain the timber harvesting land base by:	
(a)	<ul style="list-style-type: none"> Fill-planting approximately 300 ha of backlog NSR at the rate of 100 ha/yr for the next 3 years, 	5
	<ul style="list-style-type: none"> Surveying 6 000 ha/yr of pre-1987 SR areas to ensure they remain fully stocked; 	3
(c)	Reforestation areas destroyed by wildfire (historic rate - 100 ha every 3 years).	5
LT3	Increase the volume of regenerated stands by 17% by:	
(b)	By 2011, expanding the use of improved seed to include PI, with the expected result of a 5% gain in LTHL.	2
(h)	Repeat fertilizing 2 000 ha/yr, rising gradually over about 60 years to 5 000 ha/yr as more stands come under management, for an expected result of a 6% gain in LTHL. (Note: The initial 2 000 ha/yr are the same stands as in MT3 (d).	6
LT4	Reduce losses to root rot by surveying 1 200 ha/yr to monitor root rot development in stands. (Note: basic silviculture practices are also employed to reduce the incidence of root rot.)	6.5
LT5	Monitor stands for mountain pine beetle attack by surveying 200 km/yr of strip lines.	4
Q2	First-lift prune 50 ha/yr.	10

HABITAT AND BIODIVERSITY**Objectives:**

- Maximize ungulate habitat and foster biodiversity through harvesting and silvicultural activities.

No.	Strategy	Priority
Working Targets:		
<ul style="list-style-type: none"> None. Further research and information required. 		
Strategies:		
H1	Space 300 ha/yr of mixed species and clumpy stands	6
H2	Improve ungulate winter range by spacing 40 ha/yr with the objectives of removing pine trees, leaving clumpiness and creating/enlarging voids.	9
H3	Create NDT4 fingers into NDT3 areas at the rate of 50 ha/yr in order to better emulate the naturally ragged boundary between the 2 disturbance types.	7

11.3.1 Working Target Illustration

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

12. Silviculture Regimes and Investment Priorities

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

Regimes	Strategy	Opportunity Area (Ha/Yr)	Timber Supply Effects			Quality	Habitat	Jobs Days/ha	Cost \$/ha ¹	Wkshp Rank
			Short	Medium	Long					
1 Surveys - general	L4 L5 L1(a)	10570						0.05	26	1
2 Survey - root rot		1200						0.05	20	
3 Survey - mpb		200,000						0.00083	0.32	5
4 Survey - backlog		6000						0.05	26	4
5 Backlog reforestation	L1(a) L1(c)	100/yr for 3 yrs			+		+/-	1.2	900	6
6 Reforest current fires		100 per 3 years			+			1.2	900	6
7 Improved seed	L3(b), M5	810	+	+	++	+	?			3
8 Space repressed PI	M3(b), M7, L3(f) M3(b), M7, L3f	1650/yr for 3yrs		++		++	++	3.6	900	2
9 Space standard PI		700		+		+		2	500	
10 Space clumpy pine		200		+	-	+	-	1.5	375	9
11 Space mixed stands (0-30 yrs)		300	+	+		++	+	2	500	7
12 Space for habitat	H2	40		-		-	+	1.5	375	10
13 fertilization repeat, PI & other, age 1-30	L3(h), M3(d)	2000 up to 5000		++	+		?	0.07	200	7
14 Pruning 1st lift	Q	50		-		+	+	3	750	11
15 NDT4 fingers into NDT3	H	50	?	-			+	2	500	8

13. Incremental Silviculture Program

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

Program Table - Ha, Invermere TSA.

Year	Surveys*	Backlog Establish	Reforest Fires	Improved Seed	Space -	Prune -	Fertilize -	Total
1	19,770	100	100	810	2,890	50	2,000	24,910
2	19,770	100	-	810	2,890	50	2,000	24,810
3	19,770	100	-	810	2,890	50	2,000	24,810
4	19,770		100	810	1,240	50	2,000	23,160
5	19,770		-	810	1,240	50	2,000	23,060
Subtot Yr 1 - 5	98,850	300	200	4,050	11,150	250	10,000	120,750
6 - 10	98,850	-	200	4,050	6,200	250	10,000	119,550
Total Yr 1 - 10	197,700	300	400	8,100	17,350	500	20,000	244,350

* Includes prescription and layout

Program Table - \$ 000s, Invermere TSA.

Year	Surveys*	Backlog Establish	Reforest Fires	Improved Seed	Space -	Prune -	Fertilize -	Total
1	444	90	90	-	2,075	38	400	3,137
2	444	90	-	-	2,075	38	400	3,047
3	444	90	-	-	2,075	38	400	3,047
4	444	-	90	-	890	38	400	1,862
5	444	-	-	-	890	38	400	1,772
Subtot Yr 1 - 5	2,222	270	180	-	8,006	188	2,000	12,865
6 - 10	2,222	-	180	-	4,452	188	2,000	9,041
Total Yr 1 - 10	4,444	270	360	-	12,457	375	4,000	21,906

14. Job Outcomes

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

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

Year	Surveys [*]	Backlog Establish	Reforest Fires	Improved Seed	Space -	Prune -	Fertilize -	Total
1	4.3	0.6	0.6	-	41.5	0.8	0.7	48
2	4.3	0.6	-	-	41.5	0.8	0.7	48
3	4.3	0.6	-	-	41.5	0.8	0.7	48
4	4.3	-	0.6	-	17.8	0.8	0.7	24
5	4.3	-	-	-	17.8	0.8	0.7	24
Subtot Yr 1 - 5	21.7	1.8	1.2	-	160.1	3.8	3.5	192
6 - 10	21.7	-	1.2	-	89.0	3.8	3.5	119
Total Yr 1 - 10	43.4	1.8	2.4	-	249.1	7.5	7.0	311

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

15. Summary of Information and Research Needs

During the assessment process, the following needs for further information and research became apparent. The outcome of these have implications for a silviculture strategy. Bracketed numbers refer to the strategy numbers under which the need is identified (see tables in “[Workshop Review of Potential Strategies](#),” page 37.)

4. There is currently a PFT classification/identification project underway under the EFMPP. Results are inconclusive. Need to complete the review project. (LT2 (b))
5. Press for East Kootenay improved seed for Douglas-fir. (LT3 (b))
6. Fertilization trials are needed to determine the efficacy of fertilization at planting. (LT3 (d))
7. OAF1 factors require confirmation. Survey techniques are available. Requires statistical validity at the management unit level if to be used for AAC determination. (LT3 (i))
8. Evaluate the risk to the harvest forecast if naturally regenerated stands are not restocked by year 5. (LT3 (j))
9. Evaluate the potential for reducing regeneration delays from an average of 3 years to 1 year. (LT3 (k))
10. Evaluate the risk to yield estimates of planting some sites to lower densities should expected natural ingress not occur. (LT3 (k))
11. Further study of root rot management techniques and resultant OAF2 impact is needed. (LT4 - summary)
12. Gap analysis of habitat impacts of silvicultural treatments (re prep for Simfor modelling) (see page 57).

The following items are carried forward from the *Enhanced Forest Management Pilot Project Management Strategies Report* (MoF, 1998a) as being applicable to a silviculture strategy for the entire TSA.

13. Validate growth intercept or SIBEC derived site index estimates for use in management unit level analysis. (EFMPP Strategy/Principle #8)
14. Continue long term impact studies on the effects of pushover logging and selection harvesting practices on limiting losses to Armillaria root disease. (EFMPP Strategy/Principle #19)
15. Continue growth and yield studies associated with calcareous soils. (EFMPP Strategy/Principle #20)

16. References

- B.C. Ministry of Forests. 1995. *Invermere TSA Timber Supply Analysis*. Timber Supply Branch, Victoria, British Columbia. 84p.
- _____. 1998a. *Enhanced Forest Management Pilot Project Management Strategies Report*. Invermere Forest District, Invermere, British Columbia. 76p + Attachments.
- _____. 1998b. *Appendices - Enhanced Forest Management Pilot Project Management Strategies Report*. Invermere Forest District, Invermere, British Columbia. 163p + Attachments.
- _____. 1999. *Incremental Silviculture Strategy For British Columbia (Interim)*. Forest Practices Branch, Victoria, British Columbia. 23p.
- Hawe, Angela. 1996. *Review of Past Partial-Cutting Activities in the Nelson Forest Region (1988 - Present)*. Technical Report MIT-001, prepared for the B.C. Ministry of Forests, Nelson Forest Region, Nelson, B.C. 67p.
- Martin, Patrick. 1999. *ISIS Polygon Area by Site Index Class*. B.C. Ministry of Forests, Forest Practices Branch, Victoria, B.C.
- Pedersen, Larry. 1996. *Invermere Timber Supply Area Rationale for Allowable Annual Cut (AAC) Determination*. Victoria, British Columbia. 41p + Attachments.
- Reichenback, Gerald. 1996. *Effect of Silviculture Practices on Greenup Delay in the Nelson Forest Region*. Technical Report MIT-003, prepared for the B.C. Ministry of Forests, Nelson Forest Region, Nelson, B.C. 39p.
- Timberline Forest Inventory Consultants Ltd. 1997. *Forest Level Benefits to Commercial Thinning and Fertilization*. Prepared for the B.C. Ministry of Forests, Forest Practices Branch, Victoria, British Columbia. 64p.
- Wang, Eric and John Pollack. 1998. *The Effects of Partial Cutting On the Wood Supply of the Arrow, Cranbrook and Golden TSAs*. MoF internal technical report prepared for the Kootenay-Boundary Forest Resource Task Force. Ministry of Forests, Nelson, BC. 37p.
- White, Dave. 1998. *Invermere Enhanced Forest Management Pilot Project Silviculture Strategic Plan*. Ministry of Forests, Invermere, British Columbia. 44pp + Appendices.

17. Abbreviations

The following abbreviations may be used.

AAC	allowable annual cut	NDT	natural disturbance type
CF	chief forester	NSR	not satisfactorily restocked
CT	commercial thinning	OAF	operational adjustment factor
DBH	diameter at breast height	OLB	operable land base
EFMPP	enhanced forest management pilot project	SBFEP	small business forest enterprise program
ESA	environmentally sensitive area	SI	site index
ESSF	engelmann spruce - subalpine fir (ecological zone)	SR	satisfactorily restocked
FCC	forest cover constraints	ST	short term
FG	free growing	TFL	tree farm licence
FRBC	Forest Renewal BC	THLB	timber harvesting land base
ICH	interior cedar-hemlock (ecological zone)	TIPSY	table interpolation program for stand yields
IHL	initial harvest level	TSA	timber supply area
IRM	integrated resource management	TSR	timber supply review
KBLUP	Kootenay-Boundary Land Use Plan	VDYP	variable density yield projection
LT	long term	VQO	visual quality objective
LTHL	long term harvest level	WT	working target
LRSY	long run sustained yield		
MoELP	Ministry of Environment, Lands and Parks		Species abbreviations: B or Ba - balsam fir; Cw - western redcedar; Fd - Douglas-fir; Fdi - interior Douglas-fir; Hw - western hemlock; Pl - lodgepole pine; S - spruce species.
MoF	Ministry of Forests		Site class abbreviations: G - good; M - medium; P - poor; L - low.
MS	montane spruce (ecological zone)		
MT	mid term		
NCBr	non-commercial brush		