Prince George TSA

Silviculture Strategy (Type 1) – Update

March 2003

Acknowledgements

This is an update to the March 2000 Type I Silviculture Strategy produced by Cortex Consultants Inc. and Craig Farnden. This update was required to incorporate changes relative to the TSR II (September 2001) and the revised AAC Determination (June 2002), the impact of Mountain Pine Beetle (MPB) epidemic on future timber supply being underestimated in TSR II and the change of funding source from Forest Renewal BC (FRBC) to new delivery system, the Forest Investment Account (FIA). This update was developed through the use of interviews, a questionnaire and a workshop to help identify and prioritize Prince George TSA wide silviculture projects and strategies.

The workshop was conducted at the J.D. Little Center in Prince George, on February 4, 2003. The workshop and the update of the original Type 1 report were prepared and presented by Barry Mills, Rob Schuetz and Bruce Bradley of Industrial Forestry Service Ltd. The Forest Investment Account provided funding through a contract between Canadian Forest Products Ltd Prince George and Industrial Forestry Service Ltd.

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Preface

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

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

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

In the absence of a silviculture strategy for a management unit, the Ministry of Forests' provincial level strategy *Incremental Silviculture Strategy For British Columbia (Interim)* has provided interim guidance. A summary of this document is included as appendix 2 to this report.

The role of SFMPs is to provide rationale for Forest Investment Account Funding decisions. The ability to justify expenditures and in the case of silviculture investment, demonstrate a positive return on investment and to maximize this return. Type 2 Incremental Silviculture strategies generally provide direction for silviculture planning by examining the forest level impacts of various silviculture regimes. By expanding the scope of silviculture strategies to include forest level economic analysis, SFMP investment rationale objectives can be achieved while developing a silviculture strategy that maximizes the financial return from the landbase. However, this is only likely to occur if Licencees have a defined forest management areas on which to invest. In the meantime, selection of projects through prioritization of TSA level issues and strategies is the next best option.

Strategy Summary

The original issues, which were proposed and discussed in the December 1999 workshop, were reviewed to determine relevance on maintaining or enhancing the future timber supply of the Prince George TSA. This was done in consideration of updated information from TSR II (September 2001) and the revised AAC Determination (June 2002), the impact of Mountain Pine Beetle (MPB) epidemic and the temporary 3 million cubic meter uplift in harvest to control/salvage the epidemic infestation.

The participants reviewed the 5 original sustainable harvest issues facing the Prince George TSA, as well as the potential silvicultural strategies and knowledge gaps suitable for addressing them. The Participants were asked to frame the issues, strategies and activities outlined in the original type I strategy, into Quantity, Quality and Habitat categories and add to and revise those issues, strategies and activities with regards to the updated TSR II information presented.

The three Categories, five issues with related strategies considered key are:

A. Quantity

1. Potential mid-term timber supply gaps. Strategies that move existing stands ahead in the harvest queue and/or increase volume yields of existing Stands
2. Reduced productivity of backlog NSR and impeded stands in the timber supply landbase is a concern. Strategies that maintain the productivity of the Timber Harvest landbase (THLB) need to be undertaken.
3. Lodgepole pine pest losses in managed and unmanaged stands. Strategies, which reduce stocking loss impact of pest on managed stands, recover volume losses due to pests on unmanaged stands. Pest distribution and decision support.
4. Repression-related productivity losses of existing pine stands in the and out of the Timber Harvest landbase (THLB). Strategies which, reduce/reverse/eliminate repression in existing stands.

B. Quality

1. Ensure no net change in quality relative to each Licencee's current timber harvest profile. Generally this means to licencee standards of merchantable limits. Since quality can only be defined in terms of each Licencees product, they have no incentive to invest in quality enhancing activities in the Prince George TSA without Defined Forest Area Management (DFAM) being established.

C. Habitat

1. No wildlife habitat areas (WHAs) have been established in the Prince George TSA. No habitat concerns were brought to the workshop. The workshop participants felt that silviculture activities and habitat goals are not mutually exclusive. Current silviculture activities may be effective in maintaining habitat or making alternative habitats available and current reserves covers much of the habitat requirements, e.g. Caribou High Zone equals No Harvest.

ELEMENTS OF THE STRATEGY

Issue 1: Potential Gaps in Mid-term Timber Supply

Originally in the March 2000 Type I silviculture strategy there was no mid-term fiber supply shortfall forecast for the Prince George TSA. TSR II (September 2001) has a reduction in THLB by 6.4% and some new modeling assumptions over TSR I (January 1995).

The June 2002 AAC rationale for the Prince George TSA indicates that the March 2002 public discussion paper uses a revised base case that indicates a mid-term fiber supply shortfall forecast for the Prince George TSA.

There are localized shortfalls and the Mountain Pine Beetle Epidemic are forcing large scale spatial shifts in industrial operations. Treatments to address these issues are intended to either move stands up in the harvest queue, to increase volumes in stands that are likely to be harvested in the mid-term period or to capture the MPB epidemic infestation mortality prior to it becoming part of the Prince George TSAs unsalvaged loss.

Survey old Intermediate Utilization (IU) harvest units

Many areas harvested either to intermediate utilization standards (circa 1963-1970) and those harvested earlier under a variety of partial cutting regimes have uncertain stocking and rates of growth. These areas should be surveyed and if appropriate, reclassified. There are approximately 25,000 ha of old harvesting units remaining in this category.

Reclassify and harvest old Intermediate Utilization (IU) harvest units

Once the above IU areas, have been surveyed, appropriate portions of the area should be reclassified and harvested. Benefits of this strategy include increases to the THLB, increases in MAI through accelerated conversion to more productive stands, and increased harvest flexibility in the mid-term. There are approximately 16,000 ha in area, which can be dealt with through re-classification and harvest.

Pre-commercial thin to set up mid-term commercial thin and fertilization treatments

TSR II assumes that there are 44,618 ha of unmanaged pine age 15 to 20 years old on good, medium and poor sites in the Prince George TSA. The target stands for this strategy are pine stands on medium and good sites that are currently 15-20 years of age and it is estimated that in total 24,000 ha are available for treatment.

Commercial thinning and fertilization treatments in the mid-term may increase harvesting flexibility by making more volume available for harvest by reducing the age of operability of the stand and capturing stand mortality.

Fertilize thrifty juvenile stands on 10-year cycle

Target stands include spruce and pine stands age 20 to 40 years old on medium and good sites. Total potential treatment area of spruce and pine stands in the Prince George TSA is 50,046 ha.

Fertilizing 20-40 years old stands on a repeat cycle of 10 years will make these stands available for harvest sooner. The opportunity for implementing this treatment regime is estimated to be 3000 ha over the next 10 years.

Late rotation fertilization - Fertilize thrifty pole-sized stands on 10-year cycle

Target stands include spruce and pine stands age 40 to 60 years old on medium and good sites. Total potential treatment area of spruce and pine stands in the Prince George TSA is 28,358 ha.

Fertilizing 40-60 years old stands on a repeat cycle of 10 years will make these stands available for harvest sooner. The opportunity for implementing this treatment regime is estimated to be 3000 ha over the next 10 years.

Survey previously brushed and juvenile spaced blocks (old FRBC) for Green-up

Concern was expressed that the time taken to achieve green-up in practice is less than the results obtained from the models used to project green-up. Both the percentage limitation and age at which green-up is assumed to occur are sources of uncertainty and this would effect timber supply and harvest levels in the long term. Effect of a reduced green-up age by 10 years is estimated to effect the long term AAC by 150,000 m^3/yr relative to the TSR II base case.

Alternative Silviculture Systems in Special Management Zones

Special management zones are often partially or entirely excluded from the THLB where more specific and detailed information about a particular forest resource is not available or according to their receptive categories.

There are the following Environmentally Sensitive Areas (ESA) are excluded from the THLB of the TSA is 446,920 ha in total area.

In Resource Management Zones (RMZ) in Prince George and Fort St. James there is no commercial timber harvesting in areas classified as 'caribou high' until proven management strategies are developed in the 'caribou medium' habitat. Total 'caribou high' area Prince George TSA = 113,871 ha.

This suggests a total area of opportunity in the Prince George TSA of 560,791 ha. If alternative systems could capture 25% of that area (140,198 ha x 300 m^3/ha) a potential volume of 42,059,325 m3 would potentially be available for harvest.

ISSUE 2: ADDRESSING BACKLOG STANDS

Backlog Surveys

TSR II indicates that there is a total area of 129,000 ha of area, which is NSR in the Prince George TSA. 73,000 ha of this area is assumed to be currently restocked and SR in the TSR II analysis but have the potential to become backlog impeded stands. The remaining 56,000 ha are assumed to be NSR and requiring surveys to determine stocking status and treatment requirements. A survey program will facilitate reclassification of existing backlog NSR, and support the planning of the needed silviculture improvement treatments on managed stands and the conversion of unmanaged stands to managed.

Backlog Reforestation

There are approximately 56,000 ha of stands available for treatment opportunity in the Prince George TSA. TSR II indicates that there are currently about 30,000 ha of coniferous NSR area that requires site preparation/planting/brushing sequence to be regenerated to managed stands over the next 20 yrs in the Prince George TSA.

TSR II also indicates that there are currently about 26,000 ha of coniferous NSR area that is restocked, potentially SR, requires reclassification and scheduled to be regenerated to natural stands over the next 10

yrs within the Prince George TSA.

The previous Type I Silviculture Strategy suggested a program to initiate a site preparation/planting/brushing sequence of 18,000 ha over the next ten years. This rate is faster than that currently assumed treatment of 15,000 ha over the next 10 years in TSR II on managed stands only. Conversion of additional unmanaged stands to managed stands would increase harvesting flexibility in the late mid-term and early long term.

Treat Backlog Impeded

TSR II assumes that there are approximately 73,000 ha of old NSR area that is currently restocked and SR now in the Prince George TSA. The previous Type I Silviculture Strategy assumed that 46,000 ha of this 73,000 ha would potentially become backlog impeded and require brushing and spacing (pre-commercial thinning) treatments. These treatments will ensure that currently established stands are meeting the expectations already assumed in TSR II.

Enhance Structure of Aspen Stands

The AAC Rationale for the Prince George TSA identified approximately 192,000 ha of aspen-leading stands and 28,800 ha birch leading stands. These stands are not included in the TSR II base case analyses. However, a possible conflict with this strategy is the "new" deciduous licence profile for the Prince George TSA. A deciduous partition was established for the Prince George TSA. The deciduous stands must have a $SI_{50} \geq 17.7$. The required areas for partition of the THLB for aspen-leading stands in the Prince George TSA was estimated to be 61,700 ha and THLB for birch-leading stands was estimated at 13,800 ha.

This leaves approximately130,300 ha of aspen-leading stands to survey and potentially convert to coniferous leading stands through treatment. Backlog stands that have regenerated to aspen and have been accepted as aspen stands at least for the current rotation can be enhanced for volume production either by under-planting with spruce or by planting spruce in canopy voids. A program of 1500 ha over 10 years is thought to be possible.

Enhance Intermediate Utilization (IU) Sites

IU sites that are otherwise satisfactorily restocked, but still have stocking gaps, may be enhanced through fill planting. There are approximately 25,000 ha of old IU harvesting units remaining to be surveyed in this category. A treatment program of 1500 ha was thought to be possible.

ISSUE 3: FOREST HEALTH

Strategies to protect forest health are intended to maintain conditions favorable for maximizing timber production.

Implementation of Alternative Forest Health Control Methods

The mountain pine beetle infestation in the Prince George TSA is now the largest in British Columbia's history and has increased in the past several years as a result of favourable weather conditions and an abundance of mature lodgepole pine. Implementation of new beetle detection and/or control methods and the rehabilitation of denuded sites is required.

Survey Mountain Pine Beetle killed Pine stands

Natural regeneration of mountain pine beetle killed pine stands was felt to be a growing uncertainty as the Mountain Pine Beetle epidemic expands in the Prince George TSA. Although, the exact magnitude of this problem is unknown, there will potentially be 533,333 to 816,666 ha of unsalvaged area in this category in the near future. These areas require surveys to determine status and treatment requirements.

Rehabilitation of Dead or Dying Mountain Pine Beetle Pine stands

Rehabilitation of some portion of the above surveyed area is a certainty as stands extend beyond "shelf life" and fall into the category of unsalvaged losses. The estimated opportunity for treatment may be as much as 533,333 to 816,666 ha. Burning large areas of unsalvaged losses as a rehabilitation method to bring stands back on line with managed stands predicted in TSR II and reduce potential for a high impact wildfire. Natural seed fall and regeneration of lodgepole pine combined with planting.

Reduce Risk of Hard Pine Stem Rust Losses

Forest health issues, which effect the volume production of regenerated stands. Regenerated stands heavily infected with Western Gall rust and/or Cronartium rusts can be treated to reduce impacts of branch infections. A treatment program of up to 1500 ha is thought possible.

ISSUE 4: LODGEPOLE PINE REPRESSION

Repression-related productivity losses of existing pine stands currently included in the THLB in TSR II and excluded from the THLB in TSR II.

Survey

Potentially 20,000 ha of 30-40 year-old fire origin pine stands currently out of the THLB of the Prince George TSA with a decision to be made as to either leave it to grow, treat it, or to initiate rehabilitation treatments.

Reclassifying

Of the 20,000 ha of 30-40 year-old fire origin pine stands currently out of the THLB of the Prince George TSA and surveyed approximately 12000 ha will be reclassified, scheduled for an early harvest as pulpwood or left to grow.

Rehabilitating and Planting (Stand Replacement)

Of the 20,000 ha of 30-40 year-old fire origin pine stands currently out of the THLB of the Prince George TSA and surveyed approximately 5000 ha will be rehabilitated and returned to the THLB by improvement of the stand through replacement.

Thinning

Of the 20,000 ha of 30-40 year-old fire origin pine stands currently out of the THLB of the Prince George TSA and surveyed approximately 3000 ha will be thinned. All areas will be returned to the THLB by improvement of stand through treatment.

In the March 2000 Silviculture Strategy a thinning program of 2000 ha moderately repressed 40-70 year-old pine stands currently in the THLB was proposed to increase midterm harvest flexibility.

Fertilizing

In the March 2000 Silviculture Strategy a fertilizing program of 2000 ha moderately repressed previously PCT 40-70 year-old pine stands currently in the THLB was proposed to increase midterm harvest flexibility.

Of the 20,000 ha of 30-40 year-old fire origin pine stands currently out of the THLB of the Prince George TSA approximately 3000 ha of previously PCT stands will be fertilized. All areas will be returned to the THLB by improvement of stand through treatment.

ISSUE 5: TIMBER QUALITY

Strategies to address timber quality were given minimal consideration by the workshop. It was recognized that density management treatments in other strategies listed above would have impacts on timber quality, particularly on piece size and fibre quality. Since Volume Licencees may have different product objectives with no defined forest management areas in which to grow their product, only some very general quality objectives could be defined (e.g. sawlog). The March 2000 Silviculture Strategy workshop targeted only one strategy and the February 2003 workshop added another for maintaining or increasing wood quality. These two generic quality strategies are as follows:

Prune to produce clear lumber

Trees pruned to produce clear lumber have the potential then to yield higher stumpage values than non-pruned trees. One expected benefit from a conservative pruning program is future product diversification. In the March 2000 Silviculture Strategy a program of 1700 ha was suggested by the workshop.

Stand Conversion through species planting S>Pl>Fd>Hw>Cw>Bl

Inadvertent species preferences are reducing some species while increasing others. Due to the potential forest health implications a deliberate, rather than default strategy is required.

Table S-1 summarizes the proceeding issues identified by the participants and the rank (priority) assigned to each activity.

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

Issues	Activities/Treatments	Opportunity Area (ha)	Workshop Rank
	Silviculture Options to Increase Quantity		
Mid-term gap in timber supply			
Old	Surveys of old IU Logging areas	**25,000**	**3**
Old	Reclassification and Harvesting of old IU logging areas	**16,000**	**4**
Old	Juvenile Spacing (15-20 yr old Pl stands for future Commercial Thin)	**44,600**	**7**
Old	Fertilizing thrifty juvenile stands (Both Pl & Sx stands 20-40 yrs old)	**50,000**	**17**
Old	Late Rotation Fertilization of thrifty pole-size stands (Sx & Pl stands 40-60 yrs old)	**28,300**	**14**
New	Survey previously Brushed and Juvenile Spaced blocks (Old FRBC)	**5,000**	**6**
New	Alternative Silviculture Systems in Special Management Zone	**560,000**	**15**
Productivity of Backlog Stands in the THLB			
Backlog NSR			
Old	Survey and reclassifying	**56,000**	**1**
Old	Site preparation, planting, brushing	**56,000**	**5**
Backlog Impeded Stands			
Old	Brushing, Juvenile Spacing	**73,000**	**2**
Old	Fill/Under planting in Backlog deciduous stands (as pen)	**130,300**	**8**
Old	Site Preparation, Fill planting (Marginally stocked blocks)	**25,000**	**12**
Forest Health - pest losses in managed and unmanaged stands.			
New	Implementation of Alternative Forest Health Control Method	**TSA**	**16**
Old	Pruning (Hard Pine Stem Rusts)	**44,600**	**24**
Old	Monitoring of managed stands	**TSA**	**10**
New	Survey Mountain Pine Beetle killed Pine stands	**817,000**	**18**
New	Rehabilitation of Dead or Dying Mountain Pine Beetle Pine stands	**817,000**	**20**
Lodgepole Pine Repression - existing pine stands in and out of the THLB.			
Old	Survey	**20,000**	**11**
Old	Reclassifying	**12,000**	**9**
Old	Rehabilitating and Planting (Stand Replacement)	**5,000**	**23**
Old	Thinning	**5,000**	**13**
Old	Fertilizing	**5,000**	**19**
Timber Quality			
Old	Pruning	**1,700**	**22**
New	Stand Conversion through species planting S>Pl>Fd>Hw>Cw>Bl	**TSA**	**21**
Habitat			
N/A			

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1. Introduction

The Silviculture Strategy (Type 1) workshop draws on the expert knowledge of the participants to:

1. Identify the key issues that should guide silvicultural planning on the Prince George TSA,
2. Derive objectives with respect to those issues, showing total opportunity/impact timber supply and identify Licencee priority and unit cost ($/ha) of treatment.
3. Specify regimes to meet those issues, and
4. Identify knowledge gaps needed to initiate or refine identified regimes.

The key idea is that this line of logic from issues to silvicultural activities can be retraced when evaluating funding levels, ensuring that activities are funded that address critical Prince George TSA issues.

The first step in developing this line of logic is to identify the key issues that should guide silvicultural planning on the Prince George TSA. Next, the participants' objectives with respect to these issues are clearly stated. Strategies for meeting these objectives are identified, together with the silvicultural target (stand types) to which these strategies are to be applied. A plan of action, most often a silvicultural regime, is then developed to implement each strategy. This sequence constitutes the "strategic analysis" part of the workshop and the resulting compilation of issues, objectives, strategies and regimes is the silviculture strategy.

After developing the strategy, the workshop identifies the total area of opportunities to implement the regimes. The impacts of these silvicultural activities on selected objectives are estimated by the workshop participants, and in a final step, the activities are ranked as to their importance with respect to the Prince George TSA issues.

This report documents the results of the February 4, 2003 workshop to revise the March 2000 strategy developed for the Prince George TSA. Following this introduction, section 1 summarizes the generic options and section 2 presents the TSA level issues and strategies and section 3 outlines Knowledge gaps that need to be addressed in some case prior to silviculture actions occurring and section 4 sets the priorities for silviculture strategies in the TSA. Issues that influence silviculture planning on the Prince George TSA were obtained from a questionnaire sent to the individual Licencee in the Prince George TSA, the most recent Resource Management Plan, and other documents identified by the Prince George TSA as being important.

Appendix 1 contains an examination of the timber supply situation on the Prince George TSA, also prepared prior to the workshop, as some aspect of timber supply is often a guiding issue for silviculture planning. The treatment of timber supply in this report is updated to current TSR II timber supply analysis and AAC Determination for the Prince George TSA.

Appendix 2 contains A summary of the Ministry of Forests' provincial level strategy *Incremental Silviculture Strategy For British Columbia (Interim)*.

2. Analysis of Issues and Silviculture Strategy Options

This section identifies the critical issues that guide silviculture planning in the Prince George TSA and the strategies developed in the workshop for addressing them. The generic categories into which all silviculture activities can be fit are as follows for Quantity, Quality and Habitat:

A. Options to Increase Quantity:

i) ***Find more growing space (make the THLB larger or 100% productive)***

- Backlog surveys & treatments to reduce NSR
- Rehabilitate "problem forest types" or NP
- Convert NCBr to forest
- Convert under-utilized species types to preferred species types (re-allocation only)
- Utilize species that are currently considered "non-merchantable"
- Aforestation

ii) ***Increase growth on existing productive area.***

- Reduce regeneration delays
- Reduce forest health factors affecting growth (e.g. mistletoe, root rots, defoliators)
- Increase the land productivity (fertilization, irrigate, drain, some site prep methods)
- Shorten rotations (use culmination of MAI)
- Thin to increase stand diameter and merchantable volume (re-allocation only)
- Brushing to re direct site resources into the crop species.
- Use faster growing species and / or genetic gain
- Complementary species mixes (provided both species are utilized)

iii) ***Increase yield from existing productive area***

- Thin / commercial thin to capture mortality throughout the life of the stand
- Harvest to closer utilization standards.
- Reduce or salvage "non-recoverable losses" affecting yield (e.g. MPB, Fire, etc.)
- Alternative Silviculture Systems to extract small volumes from special management zones

iv) ***Non-silviculture options that can increase AAC***

- Confirm site indices for potential higher yields & addition of excluded "poor" types
- Reduce deductions from the THLB (reserves, old growth, operable ground, etc.)
- OAF surveys to confirm better plantation stocking
- Change Models (managed vs. natural etc.)
- Change management assumptions (e.g. VQO's, NDU's, operability constraints, etc.)
- Adjust Decay, Waste & Breakage factors

B. Options to Increase Quality

i) ***End product dependant: Desired quality attributes must be defined before silviculture is applied***

- Species selection
- Pruning or thin & prune (increase clear wood & reduce proportion of juvenile wood)
- Increase rotation length (increase clear wood & reduce proportion of juvenile wood)
- Increase stand density
- Decrease stand density
- Reduce forest health factors affecting tree quality (e.g. Atropellis canker)
- Late fertilize (to add mature wood)
- Increase live branching (tight knots for decorative products)
- Increase fiber length & cellulose content
- Mixedwood management to encourage self-pruning of conifers

TSA LEVEL QUALITY can generally be defined as **no net change in the diversity of stand quality we have now** while maintaining our current Quantity Goals (i.e. AAC)

C. Options to Increase Habitat (Species Dependant**)**

- Other than increasing non-forest cover, habitat options are generally compatible with the desired quantity and quality strategies when applied on a site-specific basis.
- Landscape level planning will direct selection of silviculture strategies that allow us to combine *Quality* & *Quantity* objectives with *Habitat* objectives.
- Some forest and stand level units can have habitat objectives only (critical areas).
- All stand conditions are habitat of some type.
- A diversity of silviculture actions will produce a diversity of habitat.

The participants analyzed issues that could be:

1. Addressed with silvicultural actions
2. Not an issue or
3. Not addressable with silviculture actions, or
4. Requiring investigation prior to undertaking of silviculture actions.

By identifying objectives with respect to each issue, strategies for meeting the objectives, the target stand types, and a list of activities to implement each strategy could be analyzed and developed.

These elements are tabulated in Table 2-1 for the issues analyzed by the workshop, and are examined in more detail in sections 2.1 –2.5.

2.1 ISSUE: POTENTIAL GAPS IN MID-TERM TIMBER SUPPLY

Originally in the March 2000 Type I silviculture strategy there was no mid-term fiber supply shortfall forecast for the Prince George TSA. TSR II (September 2001) has a reduction in THLB by 6.4% and some new modeling assumptions over TSR I. A sensitivity analysis done for TSR II showed that 80% of the TSA harvest could be re-directed into mature pine stands for the next 20 years with no detrimental effects on the base case harvest flow for 170 years.

The June 2002 AAC rationale for the Prince George TSA indicates that the March 2002 public discussion paper uses a revised base case that indicates a mid-term fiber supply shortfall forecast for the Prince George TSA. The revised harvest flow can be maintained for 35 years before declining to a LTHL in 65 years.

January 2003 discussion with regional timber supply analysts, the mountain pine beetle sensitivity analyses may underestimate the actual impact the mountain pine beetle epidemic may have on midterm harvest flows. In the TSR II sensitivity analysis the mountain pine beetle scenario was run with 100% mortality of mature standing pine inventory in the Vanderhoof Forest District only. The percent mortality was not considered in the Prince George or Fort St. James Forest districts. Estimates on shelf life of standing dead pine were considered to be 5 years, after which the pine was considered unsalvaged loss. The other consideration was regeneration delay being extended to 10 years after death. It is also anticipated that only 20-30% of the anticipated mortality will be salvaged prior to expiration of the currently accepted shelf life of lodgepole pine.

These localized shortfalls and the Mountain Pine Beetle Epidemic are forcing large-scale spatial shifts in industrial operations. Treatments to address these issues are intended to either move stands up in the harvest queue, to increase volumes in stands that are likely to be harvested in the mid-term period or to capture the Mountain Pine Beetle epidemic infestation mortality prior to it becoming part of the Prince George TSAs unsalvaged loss.

Strategy: Survey old Intermediate Utilization (IU) harvest units

Many areas harvested either to intermediate utilization standards (circa 1963-1970) and those harvested earlier under a variety of partial cutting regimes have uncertain stocking and rates of growth. These areas should be surveyed to determine current status. There are approximately 25,000 ha of old harvesting units remaining in this category.

Strategy: Reclassify and harvest or rehabilitation old Intermediate Utilization (IU) harvest units

These IU areas, which have been surveyed and are appropriate for reclassification should be reclassified and harvested or rehabilitation. Benefits of this strategy include:

1. increases to the THLB (where stands are either misclassified as having a low site index or have insufficient stocking to produce minimally harvestable volume),
2. increases in MAI through accelerated conversion to more productive stands, and
3. increased harvest flexibility in the mid-term.

Some areas are growing well, but are not adequately recognized in the inventory, and will be available for harvest in the mid-term. Others, which are growing poorly, still have sufficient volume for harvest either now or in the mid-term; harvesting these stands provides greater flexibility in harvesting the rationed old growth. Some stands are now so poorly stocked (insufficient trees of an ecologically suitable species) that a total rehab treatment will both increase the productivity of the stand and produce a

harvestable crop sooner – these stands should be scheduled for prompt treatment.

There are approximately 25,000 ha of old harvesting units remaining in this category. There are approximately 16,000 ha in area, which can be dealt with through re-classification and harvest or rehabilitation.

Strategy: Pre-commercial thin to set up mid-term commercial thin treatments

TSR II assumes that there are 44,618 ha of unmanaged pine age 15 to 20 years old on good, medium and poor sites in the Prince George TSA. Broken down by district:

Prince George Forest District – 18,104 ha of Good, medium and poor sites.

Vanderhoof Forest District – 16,226 ha of Good, medium and poor sites.

Fort St. James Forest District – 10,288 ha of Good, medium and poor sites.

. The assumptions are that good sites comprise 20%, medium sites comprise 50% and poor sites comprise 30% of the total area in this age range. 31,232 ha of good and medium sites of which 75% of these areas potentially could both require treatment and meet the criteria used to determine acceptability for treatment. The target stands for this strategy are pine stands on medium and good sites that are currently 15-20 years of age and it is estimated that in total 24,000 ha are available for treatment.

In many stands, a pre-commercial thin treatment now can create optimum conditions for future commercial thinning and fertilization treatments. Commercial thinning and fertilization treatments in the mid-term may be a good way to increase harvesting flexibility by making more volume available for harvest by reducing the age of operability of the stand and capturing stand mortality. This is subject to the known biological limitations of the stand density management theory. Caution, and careful analysis is advised in the implementation of this tactic. The March 2000 workshop estimated 24,000 ha could be PCTed over the next 10 years to set up commercially thinning in the mid-term. Each commercially thinned hectare could yield approximately 100 m^3/ha of thinning volume or 240,000 m^3.

Strategy: Fertilize thrifty juvenile stands on 10-year cycle

TSR II assumes that there are approximately the following areas of unmanaged spruce and pine age 20 to 40 years old in the Prince George TSA by district:

Prince George Forest District – 42,602 ha of Sx ($SI_{50} \geq 12$) and 35,223 ha Pl on Good, medium and poor sites.

Vanderhoof Forest District – 1,884 ha of Sx with ($SI_{50} \geq 12$) and 25,062 ha Pl on Good, medium and poor sites.

Fort St. James Forest District – 7,674 ha of Sx with ($SI_{50} \geq 12$) and 8,190 ha Pl on Good, medium and poor sites.

Target stands include spruce and pine stands age 20 to 40 years old on medium and good sites.

TSR II assumes that there are approximately 52,160 ha of unmanaged spruce stands on good and medium sites ($SI_{50} \geq 12$) age 20 to 40 years old in the Prince George TSA. Assuming 50% of the area meets the criteria for treatment, 26,080 ha are estimated to potentially require treatment.

TSR II assumes that there are approximately 68,475 ha of unmanaged pine stands on good, medium and poor sites age 20 to 40 years old in the Prince George TSA. Using the same assumptions as above for pine, 47,933 ha are on good and medium sites and 23,966 ha are estimated to potentially require treatment.

Total potential treatment area of spruce and pine stands in the Prince George TSA is 50,046 ha.

Fertilizing these stands on a repeat cycle of 10 years will make these stands available for harvest sooner. Assuming a conservative volume gain of 10 m3/ha for each treatment, an average MAI of 4 m3/ha/yr, and four fertilizer treatments, stands will be ready for harvest with the same volumes 10 years earlier than

without treatment. A program which initiates this treatment regime on 3000 ha over the next 10 years would make these stands available for harvest one decade sooner than without treatments.

Strategy: Late rotation fertilization - Fertilize thrifty pole-sized stands on 10-year cycle

TSR II assumes that there are approximately the following areas of unmanaged spruce and pine age 40 to 60 years old in the Prince George TSA by district:

Prince George Forest District – 9,492 ha of Sx ($SI_{50} \geq 12$) and 10,452 ha Pl on Good, medium and poor sites.

Vanderhoof Forest District – 1,768 ha of Sx with ($SI_{50} \geq 12$) and 23,666 ha Pl on Good, medium and poor sites.

Fort St. James Forest District – 4,301 ha of Sx with ($SI_{50} \geq 12$) and 24,676 ha Pl on Good, medium and poor sites.

TSR II assumes that there are approximately 15,561 ha of unmanaged spruce stands on good and medium sites ($SI_{50} \geq 12$) age 40 to 60 years old in the Prince George TSA. Assuming 50% of the area meets the criteria for treatment, 7,780 ha are estimated to potentially require treatment.

TSR II assumes that there are approximately 58,794 ha of unmanaged pine stands on good, medium and poor sites age 40 to 60 years old in the Prince George TSA. Using the same assumptions as above for spruce, 41,155 ha are on good and medium sites and 20,578 ha are estimated to potentially require treatment.

Total potential treatment area of spruce and pine stands age 40 to 60 years old in the Prince George TSA is 28,358 ha.

Fertilizing stands currently 40-60 years old on a repeat cycle of 10 years will provide additional volume when these stands are harvested in the mid-term. This will provide increased flexibility in harvest scheduling of the rationed old growth. Assuming a conservative gain of 10 m^3/ha for each treatment and four treatments, each hectare treated will provide an extra 40 m^3. A program that initiates this treatment regime on 3000 ha over the next 10 years is expected to result in an extra 120,000 m^3 of available volume during the mid-term.

Strategy: Survey previously brushed and juvenile spaced blocks (old FRBC) for Green-up

Concern was expressed that the time taken to achieve green-up in practice is less than the results obtained from the models used to project green-up. Both the percentage limitation and age at which green-up is assumed to occur are sources of uncertainty and this would effect timber supply and harvest levels in the long term. Effect of a reduced green-up age by 10 years is estimated to effect the long term AAC by 150,000 m^3/yr relative to the TSR II base case.

Strategy: Alternative Silviculture Systems in Special Management Zones

Special management zones are often partially or entirely excluded from the THLB where more specific and detailed information about a particular forest resource is not available or according to their receptive categories.

Environmentally sensitive areas (ESA) are areas with sensitivity to disturbance, difficulty regenerating new crop trees and/or significant values for fisheries, recreation, water or wildlife. There are the following Environmentally Sensitive Areas (ESA) are excluded from the THLB of the Prince George TSA = 446,920 ha in total area. 202,694 ha in Prince George, 40,289 ha in Vanderhoof and 203,936 ha in Fort St. James.

In Resource Management Zones (RMZ) in Prince George and Fort St. James there is no commercial timber harvesting in areas classified as ‘caribou high’ until proven management strategies are developed in the

'caribou medium' habitat. Total 'caribou high' area Prince George TSA = 113,871 ha. 94,467 ha in Prince George and 19,403 ha in Fort St. James.

This suggests a total area of opportunity in special management zones in the Prince George TSA of 560,791 ha. If alternative systems could capture 25% of that area (140,198 ha x 300 m^3/ha) a potential volume of 42,059,325 m3 would potentially be available for harvest.

2.2 ADDRESSING BACKLOG STANDS

Treatment of backlog stands is viewed as a mandatory program, and assumptions for completion have already been included in TSR II. For the most part there will be no timber supply gains per se; the benefits will be in maintaining the conditions that are already assumed. The assumptions are that 30,000 ha of current NSR stands will be converted to a SR managed stand status over the next 20 years. To a small degree, however, there may be some timber supply benefits in accelerating the backlog program over the TSR II assumptions. More area treated will result in earlier availability for harvest. There may also be small gains through improvement of stocking conditions beyond those assumed. The general assumption in TSR II is that an unmanaged stand will produce approximately 200m3/ha at rotation, while a managed stand will produce approximately 300m3/ha rotation, an increase in volume of 100 m3/ha at rotation.

Strategy: Backlog Surveys

TSR II indicates that there is a total area of 129,000 ha of area, which is NSR in the Prince George TSA. 73,000 ha of this area is assumed to be currently restocked and SR in the TSR II analysis but has the potential to become backlog impeded stands. The remaining 56,000 ha are assumed to be NSR and requiring surveys to determine stocking status and treatment requirements. A survey program will facilitate reclassification of existing backlog NSR, and support the planning of the needed silviculture improvement treatments on managed stands and the conversion of unmanaged stands to managed.

Strategy: Backlog Reforestation

There are approximately 56,000 ha of stands available for treatment opportunity in the Prince George TSA. TSR II indicates that there are currently about 30,000 ha of coniferous NSR area that requires site preparation/planting/brushing sequence to be regenerated to managed stands over the next 20 yrs in the Prince George TSA.

TSR II also indicates that there are currently about 26,000 ha of coniferous NSR area that is restocked, potentially SR, requires reclassification and scheduled to be regenerated to natural stands over the next 10 yrs within the Prince George TSA.

The previous Type I Silviculture Strategy suggested a program to initiate a site preparation/planting/brushing sequence of 18000 ha over the next ten years. This rate is faster than that currently assumed treatment of 15000 ha over the next 10 years in TSR II on managed stands only.

Conversion of additional unmanaged stands to managed stands would increase harvesting flexibility in the late mid-term and early long term.

Strategy: Treat Backlog Impeded

TSR II assumes that there are approximately 73,000 ha of old NSR area that is currently restocked and SR now in the Prince George TSA. The previous Type I Silviculture Strategy assumed that 46,000 ha of this 73,000 ha would potentially become backlog impeded and require brushing and spacing (pre-commercial thinning) treatments. These treatments will ensure that currently established stands are meeting the expectations already assumed in TSR II.

Strategy: Enhancement of Aspen Stands

The AAC Rationale for the Prince George TSA identified approximately 192,000 ha of aspen-leading stands and 28,800 ha birch leading stands. These stands are not included in the TSR II base case analyses. A possible conflict with this strategy is the "new" deciduous licence profile for the Prince George TSA. A deciduous partition was established for the Prince George TSA. The deciduous stands must have a SI_{50} ≥17.7. The required areas for partition of the THLB for aspen-leading stands in the Prince George TSA was estimated to be 61,700 ha and THLB for birch-leading stands was estimated at 13,800 ha.

Approximately130,300 ha of aspen-leading stands to potentially be survey and convert to coniferous leading stands through treatment. Backlog stands that have regenerated to aspen and have been accepted as aspen stands at least for the current rotation can be enhanced for volume production either by under-planting with spruce or by planting spruce in canopy voids. A program of 1500 ha over 10 years is thought to be possible.

Strategy: Enhancement of IU Sites

IU sites that are otherwise satisfactorily restocked, but still have stocking gaps, may be enhanced through fill planting. This would potentially lead to improved volume growth as currently many of these sites have reduced volume projections due to poor stocking. There are approximately 25,000 ha of old IU harvesting units remaining to be surveyed in this category. In the March 2000 Silviculture Strategy a program of 1500 ha is thought to be possible.

2.3 ISSUE: FOREST HEALTH

Strategies to protect forest health are intended to maintain conditions favorable for maximizing timber production. Avoiding pest problems will help maintain productivity levels already assumed in TSR II, thus no gains per se are expected.

Strategy: Implementation of Alternative Forest Health Control Method

The mountain pine beetle infestation in the Prince George TSA is now the largest in British Columbia's history and has increased in the past several years as a result of favourable weather conditions and an abundance of mature lodgepole pine. This infestation is a forest health emergency that is unprecedented and demands extraordinary measures. R&S Rogers Consulting of Nanoose Bay was hired by the Ministry of Forests to work with the forest industry and other stakeholders to develop strategic recommendations to manage the issues resulting from the ongoing Mountain Pine Beetle infestation. Implementation of new beetle detection and/or control methods and the rehabilitation of denuded sites is required.

Strategy: Survey Mountain Pine Beetle killed Pine stands

Natural regeneration of mountain pine beetle killed pine stands was felt to be a growing uncertainty as the beetle epidemic expands into the Prince George TSA. Timber at risk from Mountain Pine Beetle epidemic is estimated to be between 200 – 350 million m^3 in the Prince George TSA. Recovery through salvage is estimated at 20-30 % of the volume at risk. Unsalvaged Mountain Pine Beetle losses are estimated at160-245 million m^3. Although the exact magnitude of this problem is unknown, assuming the average pine stand is 300 m^3/ha it is estimated that there will be between 533,333 to 816,666 ha of area in this category in the near future. These areas will require surveys to determine status and treatment requirements.

Strategy: Rehabilitation of Dead or Dying Mountain Pine Beetle Pine stands

Rehabilitation of some portion of the above surveyed area is a certainty as stands extend beyond "shelf life" and fall into the category of unsalvaged losses. If the estimated opportunity for treatment is 100 % than

there may be 533,333 to 816,666 ha of opportunity. Burning large areas of unsalvaged losses as a rehabilitation method to bring stands back on line with managed stand profile predicted in TSR II and reduce potential for a high impact wildfire. Natural seed fall and regeneration of lodgepole pine combined with planting.

Strategy: Reduce Risk of Hard Pine Stem Rust Losses

Forest health issues, which effect the volume production of regenerated stands. Regenerated stands heavily infected with Western Gall rust can be treated to reduce impacts of branch infections that will eventually be engulfed in the bole of the tree. Pruning-removal of lethal infected branches will reduce/minimize stand production losses. Regenerated stands infested with Cronartium rusts, lower branches are the most susceptible infection sites and infection rates rapidly decline following crown closure, when lower branches are killed due to suppression and light available to alternative host species is reduced. Treatments may prevent rust infected areas classified as SR from becoming classified as NSR. This may be a cost effect alternative to stand rehabilitation and re-establishment. A treatment program of up to 1500 ha is thought possible, primarily within the Ft. St. James and Vanderhoof Forest Districts. There are approximately 59,000 ha of current NSR pine stands and 26,500 ha of age 15-20 year old pine stands on good, medium and poor sites in the Vanderhoof and Fort St. James Forest Districts.

Strategy: Forest Health Hazard Mapping

A project to enhance current efforts in mapping forest health hazards is needed to improve both silvicultural planning specifically and forest management planning generally. This is a risk management function needed to help both direct and protect forest investments.

2.4 ISSUE: LODGEPOLE PINE REPRESSION

Density related repression of lodgepole pine reduces volume production by dramatically slowing stand development. Stands with light and moderate levels of repression are still included in the THLB, but projected volume production is well below site potential. E.g. a reduction in apparent SI_{50} from 20 to 15 will result in roughly a 50% loss in MAI. Stands with high levels of repression may be excluded from the THLB and classified a problem forest types due to a low apparent site index, even though potential SI_{50} may be18 or more. These stands are not expected to produce merchantable timber if left untreated. Treatment options for such stands are currently not well defined. These stands ability to respond to silviculture treatments has generally been considered low or nil.

Strategy: Survey

A survey program 20,000 ha of 30-40 year-old fire origin pine stands currently out of the THLB of the Prince George TSA could be implemented as follows:

1. 5000 ha in the Prince George District can be surveyed, with a decision to be made as to either leave it to grow or to initiate rehabilitation treatments.
2. 15000 ha in the Vanderhoof District can be surveyed, with a decision to be made as to either leave it to grow, treat it, or to initiate rehabilitation treatments.

Strategy: Reclassifying

Of the 20,000 ha of 30-40 year-old fire origin pine stands currently out of the THLB of the Prince George TSA and surveyed approximately:

1. 3000 ha in the Prince George District will be reclassified and returned to the THLB and scheduled for an early harvest as pulpwood stands over a time horizon of 10 to 50 years. Volume harvested as pulpwood from these stands (80-120 m3/ha) would increase harvest flexibility in midterm.
2. 9000 ha in the Vanderhoof District will be reclassified and left to grow.

Strategy: Rehabilitating and Planting (Stand Replacement)

Of the 20,000 ha of 30-40 year-old fire origin pine stands currently out of the THLB of the Prince George TSA and surveyed approximately:

1. 3000 ha in the Vanderhoof District and
2. 2000 ha in the Prince George District

will be rehabilitated and returned to the THLB by improvement of the stand through replacement. The benefits of this treatment would be an immediate increase in the THLB through rehabilitation treatments

Strategy: Thinning

The full potential for this treatment is not yet known on moderately repressed 40-70 yr-old pine stands currently in the THLB. Conservative estimates for thinning are that stands will be available for harvest two decades earlier than with no treatment. Studies are currently being carried out on a limited basis in the Fort St. James District.

In the March 2000 Silviculture Strategy a thinning program of 2000 ha moderately repressed 40-70 year-old pine stands currently in the THLB was proposed to increase midterm harvest flexibility. A thinning program would provide 2000 ha for harvest in the mid-term that would not otherwise be available.

Of the 20,000 ha of 30-40 year-old fire origin pine stands currently out of the THLB of the Prince George TSA and surveyed approximately 3000 ha in the Vanderhoof District will be thinned. All areas will be returned to the THLB by improvement of stand through treatment.

Strategy: Fertilizing

A trial in the Cariboo Forest Region on 36 year old fire originated height repressed lodgepole pine applied both stand tending (spacing and fertilization alone and in combination) and rehabilitation treatments to the stand to determine how these stands should be managed. A combination of both treatments produced the best results. Initial results suggested that if current growth rates continued, the stand might become merchantable in 50 years.

A study was recommended by workshop participants to investigate the effects on fertilizing or applying multiple fertilizer treatments to these stands. If the stands show a standard fertilizer response, there is the potential for an extra 10-15 m^3/ha for each fertilizer application. If in addition to the standard response there is an effect of helping the stand to overcome density related repression as has been observed in some younger stands, the benefits could be much greater. Potentially, MAI for the remainder of the rotation in these stands might be doubled.

Recent reports indicated that lodgepole pine responds favorably to 'conventional' fertilization (e.g. fertilization once or twice during the rotation), these results indicate that more intensive fertilization strategies to increase forest productivity may be better suited to spruce than lodgepole pine plantations.

In the March 2000 Silviculture Strategy a fertilizing program of 2000 ha moderately repressed previously PCT 40-70 year-old pine stands currently in the THLB was proposed to increase midterm harvest flexibility.

Of the 20,000 ha of 30-40 year-old fire origin pine stands currently out of the THLB of the Prince George TSA approximately 3000 ha of previously PCT in the Vanderhoof District will be fertilized. All areas will be returned to the THLB by improvement of stand through treatment.

2.5 ISSUE: TIMBER QUALITY

Strategies to address timber quality were given minimal consideration by the workshop. The Licencees all hold volume based tenures, which reduces the likelihood of incremental silviculture treatments as return on investment to the individual Licencee is not guaranteed. The consensus from the participants was no net change to current harvest profile was desired for the foreseeable future.

It was recognized that density management treatments in other strategies listed above would have impacts on timber quality, particularly on piece size and fibre quality. A range of post-PCT densities was recognized as desirable to ensure at least a small component of future harvests in large or premium saw logs. It was also recognized that low densities, particularly in lodgepole pine, can lead to low fibre quality by maintaining a high proportion of juvenile stemwood. *There is an optimal combination of stocking density and harvest age that will produce the highest value combination of volume and quality for each interaction of species and site*[1]. The specific prescription will depend on the desired end product. These, however, are issues requiring no specific program of treatments. The March 2000 Silviculture Strategy workshop targeted only one strategy and the February 2003 workshop added another for maintaining or increasing wood quality. These two generic quality strategies are as follows:

[1] A Discussion of Wood Quality Attributes and their Practical Implications by L.A. Jozsa and G.R. Middleton. December 1994 Forintek Canada Corp. Special Publication No. SP-34 ISSN No. 0824-2119

Strategy: Prune to produce clear lumber

Clear lumber is commonly valued 3-4 times greater than similar wood containing knots. Trees pruned to produce clear lumber have the potential then to yield higher stumpage values than non-pruned trees (although regimes to prune trees in interior BC stands are typically financially non-viable or highly risky). Expected benefits from a conservative pruning program include short-term employment and future product diversification. A program of 1700 ha was suggested by the workshop.

Strategy: Stand Conversion through species planting S>Pl>Fd>Hw>Cw>Bl

Inadvertent species preferences are reducing some species while increasing others. Due to the potential forest health implications a deliberate, rather than default strategy is required.

2.6 ISSUES RAISED IN THE WORKSHOP

Stocking Effects on Harvest Flexibility

The issue of stocking targets for both current and backlog reforestation was raised. It was suggested that higher stocking levels than are typically being currently applied would increase harvest volumes and decrease culmination ages. For example, test runs with TIPSY suggest that for a lodgepole pine stand with an SI_{50}=20, increasing free growing targets from 1200 sph to 1800 sph would result in an 0.4 m³/ha/yr (8%) increase in CMAI, and decrease culmination age by 8 years. Benefits would include increased harvest flexibility and a higher LTHL.

Current Pre-commercial and Commercial Thinning

A demand for current pre-commercial and commercial thinning opportunities was recognized, primarily for the purposes of employment. Commercial thinning was acknowledged as a niche treatment in 50-60 year-old pine stands, with minimal opportunities for application. Potential impacts on mid term harvest flexibility need to be explored.

Optimize timber production on current harvest units

An intensive regime of treatments was suggested to accelerate volume production on current harvest units, with the objective of increasing harvest flexibility in the mid term. A regime was suggested that included planting improved seed, fertilizing on a 5-year cycle throughout the rotation, commercial thinning at age 40 and harvesting at age 60. It was suggested that such a regime could both provide volume in the mid-term that would otherwise be unavailable, and increase MAI by 2 m³/ha/yr.

Current Commercial Thinning with Fertilization

A program of commercial thinning combined with fertilizer treatments in the thinned stands was suggested to improve harvest flexibility in the mid-term. Volumes removed from stands in the short term would improve options for rationing old growth, and volumes removed from the thinned stands could at least partially replaced with fertilizer treatments. Target stands for current CT treatments would be 60-80 year-old pine stands on medium and good sites with 800-1200 trees/ha. Final harvest would occur 20-40 years in the future.

Table 2-1. ISSUES AND SILVICULTURAL STRATEGIES SUMMARY TABLE

Issue Name	Issue Description	Objective	Strategy	Target	Activities	Area (ha)
Mid-term gap in fibre supply	Localized shortfalls are forcing large scale spatial shifts in industrial operations	Make more volume available in mid-term by either moving stands up in harvest queue, or increasing volume yields	Survey	old Intermediate Utilization (IU) harvest units	Survey	**25,000**
			Reclassify and Harvest		Reclassify and Harvest	**16,000**
			Pre-commercial thin to set up for commercial thinning	15-20 yr old Pl on medium and good sites	Pre-commercial thin	**44,600**
			Fertilize thrifty juvenile stands	20-40 yr old Sx, Pl in a PGFD, on medium and good sites	Fertilize on 10-yr cycle	**50,000**
		Increase volume yields		40-60 yr old Sx and Pl stands in PGFD on medium and good sites		**28,300**
		Make more volume available in mid-term by either moving stands up in harvest queue	Determine actual green-up timeframes	Previously Brushed and spaced blocks	Survey	**5,000**
		Make more volume available in mid-term by increasing the THLB	Use of alternative silviculture systems	Special management zones in the TSA were currently no harvest is allowed.	Implement alternative Silviculture systems	**560,000**
Backlog	Treatment of backlog is mandatory and already assumed in TSR II--a "must do" for the TSA.	Eliminate all existing backlog NSR	Backlog surveys and Reclassification	Areas labeled backlog NSR?	Survey and reclassify	**56,000**
			Backlog reforestation	Areas surveyed and classed backlog NSR	Site preparation, planting, brushing	**81,000**
		Ensure all existing backlog impeded stands reach FG	Treat backlog impeded	Backlog impeded areas	Brush, space	**73,000**
		Make more volume available in mid-term by either moving stands up in harvest queue	Treat deciduous stands	Aspen deciduous stands with SI_{50} < 17.7	Fill and under-plant with conifers	**130,300**
Forest Health	Losses to hard pine rust	Reduce risk of Cronartium rusts	Reduce impacts of branch infections	pre-87 SR pine in FSJFD and VFD	Prune infected branches	**44,600**
			Map risk due to forest health hazards	Managed stands	Pest and disease monitoring	**TSA**
	Losses to Mountain Pine beetle	Reduce impact of MPB epidemic on midterm harvest flows	Implement alternative Forest health Control Methods	Attacked MPB stands and unattacked pine stand	Pest and disease control	**TSA**
			Survey MPB killed pine stands	Attacked and unsalvaged MPB pine stands	Survey	**817,000**
			Rehabilitation of dead or dying MPB pine stands	Attacked and unsalvaged MPB pine stands	Rehabilitation	**817,000**
Repressed Pine	Density-related repression may reduce stand productivity so that stands are netted out of the THLB	Increase THLB by treating repressed Pli stands to make them operable	Survey, and either reclassify, rehabilitate, or thin and fertilize	30 - 40 yr old fire origin pine (currently out THLB) and moderately repressed 40-70 yr pine stands (currently in THLB)	Survey	**20,000**
					Reclassify, bring into THLB, early harvest or let grow	**12,000**
					Rehabilitate and plant	**5,000**
					Thinning	**5,000**
					Fertilize	**5,000**
Timber Quality	Clear lumber is about 3 or 4 times greater than similar wood containing knots	Diversify log products from TSA by producing small amounts of clear lumber		Pine	Pruning	**1,700**
	Stand conversions	Diversification of tree species	Plant desired species mix for end product	Newly harvested stands	Plant	**TSA**

3.0 KNOWLEDGE GAPS

The participants identified knowledge gaps that require investigation. Each topic was assigned a rank reflecting the consensus priority. These knowledge gaps require answers prior to proceeding with suggested strategies to remedy with some of the Prince George TSA issues. The workshop ranked the following knowledge gaps as highest priority:

1. Evaluation of "Shelf-Life" of dead and dying Mountain Pine Beetle stands.
2. Inventory of old fires in the Prince George TSA.
3. Production of Timber and Vegetation Inventories.
4. Determination of stocking standards for different resource emphasis.

Issues that were identified by the participants as requiring investigation prior to silvicultural action are listed in detail in Table 3-1.

Table 3-1. KNOWLEDGE GAP OR ISSUES REQUIRING INVESTIGATION (THE "TO-DO" LIST AS RELATED TO QUANTITY, QUALITY AND HABITAT)

		Origin	Timber Supply Effects					Impact Level		Licencee
Issues	Activities/Treatments		Short	Medium	Long	Quality	Habitat	TSA	Local	Rank
			0-20	21-120	121+					
	Find more growing space (make THLB larger or 100% productive)									
New	Growth & Yield - Inventory old fires -rehab of problem forest type.	(PAS)	+	+	+	Y	Y			2
Old	Operational trials -Repressed 40-70 year old fire origin Pine, thinning and fertilization trial -rehab of problem forest type.			+		Y				9
New	Use of alternative methods to survey and reclassify backlog. (Use of Aerial Surveys and Satellite images)	(CFP) (SFP)		+	+		Y			5
Old	Improved data tracking and inventory updates and Data Warehousing		+	+	+					7
New	Growth & Yield - Better Timber and Vegetation Inventories – Updated information through PEM/VRI	(TAN)	+	+	+		Y			3
New	RESULTS Project - Spatial referencing of inventory Data									21
New	Analysis of road access concerns (Incremental Silviculture treatments and salvage of beetle killed Pli stands, relative to site productivity)									15
	Increase growth on existing productive area									
Old	Operational trials - Fertilization trials in white spruce stands. Increase the Land Productivity		+	+		Y				36
New	Operational trials - Disc trenching trials. Increase the Land Productivity.	(FLSM)			+					41
New	Operational trials - Drainage Enhancement by ditching trails. Increase the Land Productivity	(FLSM)			+					38
New	Modeling - Develop model to help priorize fertilization of stands to enhance growth. Increase the Land Productivity	(CFP) (SFP)		+	+	Y				27
New	Forest Health - Funding pine seed sources that are resistant to rust. Literature review. Reduce Forest Health Factors affecting growth.	(CFP)		+	+	Y				10
New	Forest Health - Develop hazard rating system for rusts to be used to classify landscape. Reduce Forest Health Factors affecting growth.	(SFP)		+	+	Y				29
New	Forest Health - Pest survey of budworm outbreak to determine impact on AAC. Reduce Forest Health Factors affecting growth.	(CFP)		+						28
New	Growth & Yield - Operational trials for Juvenile Spacing & Rust control. Re-allocation of stand diameter and merchantable volume.	(SFP)		+	+	Y				30
New	Vegetation management - Snow mold trial.	(PAS)			+					33
New	Vegetation management - Stock type trial	(PAS)		+	+		Y			16
New	Growth & Yield - Reforestation Strategies for MPB areas. Regeneration studies and surveys.	(BCTS)		+	+	Y	Y			20
New	Growth & Yield - Development of model to help guide silviculture investments	(SFP)	+	+	+	Y	Y			6
New	Operational Trials - Mixed-wood-Thinning Overstory Birch and underplanting Douglas-fir - JPRF. Complementary species mix.			+	+	Y	Y			42
Old	Growth & Yield - Growth and yield of managed stands for pure and mixed stands (Recalibrate MGM)			+	+	Y	Y			39
Old	Growth & Yield/Operational trials - Monitor Commercial Thinning regimes with and without intensive fertilization.		+	+	+	Y	Y			31
Old	Growth & Yield - ESSF establishment and growth				+		Y			22
New	Growth & Yield - Ingress models-Natural Regeneration Prediction System for Pli	(FLSM) (SFP)			+					19
New	Forest Health - NIVMA remeasurement funding and conversion to G & Y or PSP plots, habitat monitoring and vegetation management	(CFP) (PAS)			+		Y			12
New	Growth & Yield - Determination of stocking standards for different resource emphasis - Impact on AAC	(CFP)			+		Y			4
New	Growth & Yield - Operational land base trials reviewing long-term impacts on AAC improperly planted trees grow and	(CFP)			+	Y				24
New	Growth & Yield - Maximum Density limit adjustments, effects on self pruning and timber quality.	(SFP)		+	+	Y				25
New	Growth & Yield/operational trials - Site disturbance levels-impact on growth									17
New	Forest Health - Determine Link between MPB and Root rots.									44

Table 3-1. KNOWLEDGE GAP OR ISSUES REQUIRING INVESTIGATION (THE "TO-DO" LIST AS RELATED TO QUANTITY, QUALITY AND HABITAT) - CONTINUED

		Origin	Timber Supply Effects					Impact Level		Licencee
Issues	Activities/Treatments		Short	Medium	Long	Quality	Habitat	TSA	Local	Rank
			0-20	21-120	121+					
	Increase yield from existing productive area									
New	Growth & Yield -Evaluation of "Shelf Life" of dead/dying stands – Reduce non-recoverable losses/capture mortality	(LL) (CLL)	+	+		Y	Y			**1**
New	Forest Health - Development of Alternative Forest Health Control Methods and Strategies	(LL)	+							**8**
New	Forest Health - Forest health Overview Assessment	(FLSM)	+							**14**
New	Forest Health - Develop a risk rating system for DMP and the determine the necessity to eradicate residual pine post harvest	(FLSM)	+							**40**
New	Growth & Yield - Development of Models/analysis tools to look at the impacts rate and extent of spread of current MPB infestations	(BCTS)	+							**37**
	Non-silviculture options that increase AAC (merchantable volume)									
Old	Growth & Yield - OAF Study for Plantations.		+	+	+					**13**
Old	Growth & Yield - Improved SI estimates for disturbed sites – Young stands. Leads to SI validation.		+	+	+					**23**
Old	Growth & Yield - OGSI paired plots; local paired plots required – Old stands. Leads to SI validation.		+	+	+					**35**
Old	Growth & Yield - Studies to collect better SIBEC data. Mature stands. Leads to SI validation.		+	+	+					**18**
Old	Growth & Yield - Inventory audit/VRI - check Heights. Leads to SI validation.		+	+	+					**11**
New	Growth & Yield -Green-up survey for VFD - IFPA requirement based on R.M. Approval letter of IFPA uplift. Validation for TIPSY.	(FLSM)	+							**43**
New	Forest Health - Studies into social implications of MPB epidemic. Leads to potential changes in management assumptions.	(FLSM)	+							**32**
New	Forest Ecology - Remapping of the BEC zones in the western portion of PGFD and VFD	(CFP)	+							**34**
New	Forest Ecology - Revision of PG BEC Guidebook	(FLSM)	+							**26**

4. Priorities for Silviculture Strategies

The silviculture strategies identified in Table 2.1 are summarized below in Table 4.1, together with their impacts on selected TSA objectives. The total opportunity area (i.e., the area available for treatment in the future), the impacts on timber supply quantity and quality, and habitat effects for each treatment was determined. The unit costs are based on district and licensee records. The rank (priority) of each treatment was determined through consideration of the impacts of each activity on each objective, and represents a consensus of the participants. In general the highest ranked activities are:

1. Surveying and reclassifying backlog NSR,
2. Brushing and spacing impeded backlog SR. Treating backlog is necessary to maintain the timber harvesting land base as represented in the TSR II, and impacts long term timber supply.
3. The next priority identified by the participants was surveying old intermediate utilization sites.
4. The fourth-ranked strategy was reclassifying and harvesting of old intermediate utilization sites.

Table 4-1. SILVICULTURE STRATEGIES PRIORITIES AND POTENTIAL IMPACTS ON TSA LEVEL OBJECTIVES

	Opportunity	Potential	Quantity			Quality			Habitat			Cost	Licencee
Issues	Activities/Treatments	Area	Impact on Timber Supply in			Decrease	Maintain	Improve	Decrease	Maintain	Improve	$/ha	Rank
		(Total)	Short	Medium	Long								
	Silviculture Options to Increase Timber Quantity	**TSA Level**	**0-20**	**21-120**	**121+**								
Mid-term gap in fibre supply													
Old	Surveys of old IU Logging areas	25,000										32	**3**
Old	Reclassification and Harvesting of old IU logging areas	16,000	+	+			Y		Y				**4**
Old	Juvenile Spacing (15-20 yr old Pl stands for future Commercial Thin)	44,600		+				Y		Y		562	**7**
Old	Fertilizing thrifty juvenile stands (Both Pl & Sx stands 20 -40 yrs old)	50,000		+	+		Y	Y		Y		443	**17**
New	Late Rotation Fertilization - Fertilizing thrifty pole-size Sx & Pl stands	28,300	+					Y		Y		443	**14**
New	Survey previously Brushed and Juvenile Spaced blocks (Old FRBC)	5,000		+			Y			Y			**6**
New	Alternative Silviculture Systems in Special Management Zone	560,000	+				Y	Y		Y	Y		**15**
Backlog NSR													
Old	Survey and reclassifying	56,000		+	+		Y		Y	Y		32	**1**
Old	Site preparation, planting, brushing	56,000		+	+		Y		Y	Y		2027	**5**
Backlog Impeded Stands													
Old	Brushing, Juvenile Spacing	73,000		+			Y	Y	Y	Y		1200	**2**
Old	Fill/Under planting in Backlog deciduous stands (aspen)	130,300		+	+		Y	Y	Y	Y		1450	**8**
Old	Site Preparation, Fill planting (Marginally stocked blocks)	25,000		+	+		Y	Y	Y	Y		1450	**12**
Forest Health – Pest losses in managed and unmanaged stands													
New	Implementation of Alternative Forest Health Control Method	TSA	+				Y			Y			**16**
Old	Pruning (Hard Pine Rust)	44,600		+				Y		Y			**24**
Old	Monitoring of managed stands	TSA		+	+		Y			Y			**10**
New	Survey Pli stands	817,000			+		Y			Y			**18**
New	Prescribed Burn of dead or dying Pli stands	817,000			+		Y				Y		**20**
Lodgepole Pine Repression – existing pine stands in and out of the THLB													
Old	Survey	20,000		+	+		Y			Y		25	**11**
Old	Reclassifying	12,000		+			Y			Y			**9**
Old	Rehabilitating and Planting (Stand Replacement)	5,000		+	+		Y			Y	Y	1400	**23**
Old	Thinning	5,000		+				Y	Y	Y		500	**13**
Old	Fertilizing	5,000	+	+				Y		Y		562	**19**
	Timber Quality												
Old	Pruning	1,700		+	+			Y		Y		1188	**22**
New	Stand Conversion through species planting S>Pl>Fd>Hw>Cw>Bl	TSA			+		Y	Y		Y			**21**

Appendix 1

Timber Supply Context of Silviculture in Prince George TSA

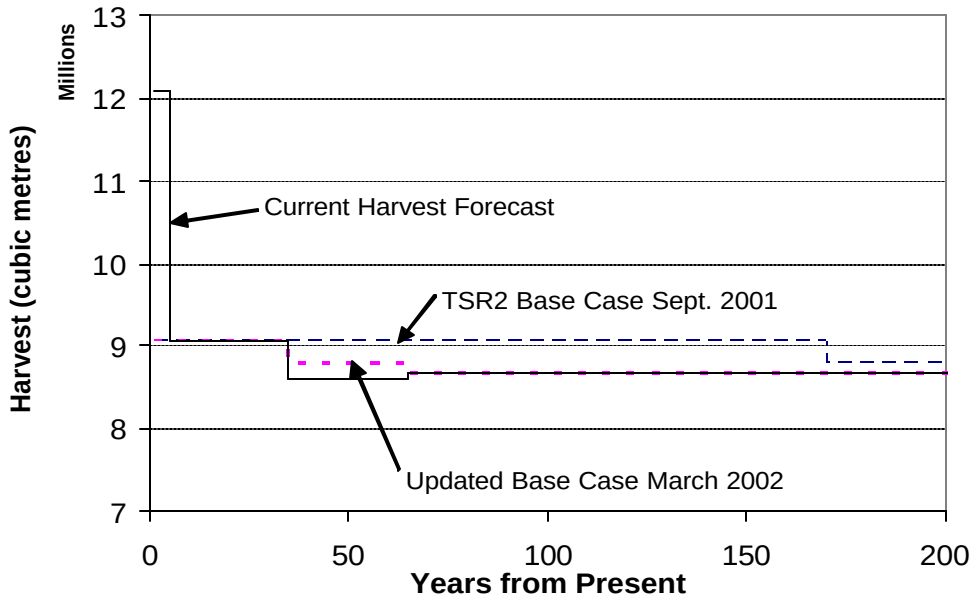
The objective of this section is to provide a very broad overview of the evolving timber supply forecast for the Prince George TSA.

Historically, the harvest flow for the Prince George TSA has been depicted by a "flat-line" sustainable harvest level that has been supported by a robust overabundance of mature merchantable timber. Unfortunately, the mountain pine beetle epidemic is quickly making dramatic inroads into the merchantable timber growing stock. Each passing year leads to a historically unparalleled drop in the merchantable growing stock of the Prince George TSA. The consequence of these drops is a shift the sustainable harvest flow on an almost yearly basis. The current Base Case harvest forecast for the Prince George TSA made several general assumptions regarding the shelf life and merchantability of beetle attacked lodgepole pine; as well as the future extent of the epidemic. Some of these assumptions are rapidly proving themselves to have been optimistic; specifically with regard to the extent of the spread of the epidemic. Figure A2-1 describes three harvest forecasts for the Prince George TSA that were modeled during the term of TSR2.

The AAC for the Prince George TSA has been slightly greater than 9 million cubic metres per year for the past decade. TSR2 substantiated this harvest level, however modeling the MPB epidemic predicts that the harvest level to fall in 35 years. In three and half decades, a drop of 5 percent or 473,000 cubic metres per year is predicted primarily as result of the loss in merchantable pine growing stock. The severity of the fall being bounded somewhat by the amount of salvage and control measures taken by licensees at an operational level.

An immediate uplift of the allowable annual cut to 12 million cubic metres (with the uplift directed towards salvage and control measures) was one mechanism used to alleviate some of the mid-term AAC fall-down.

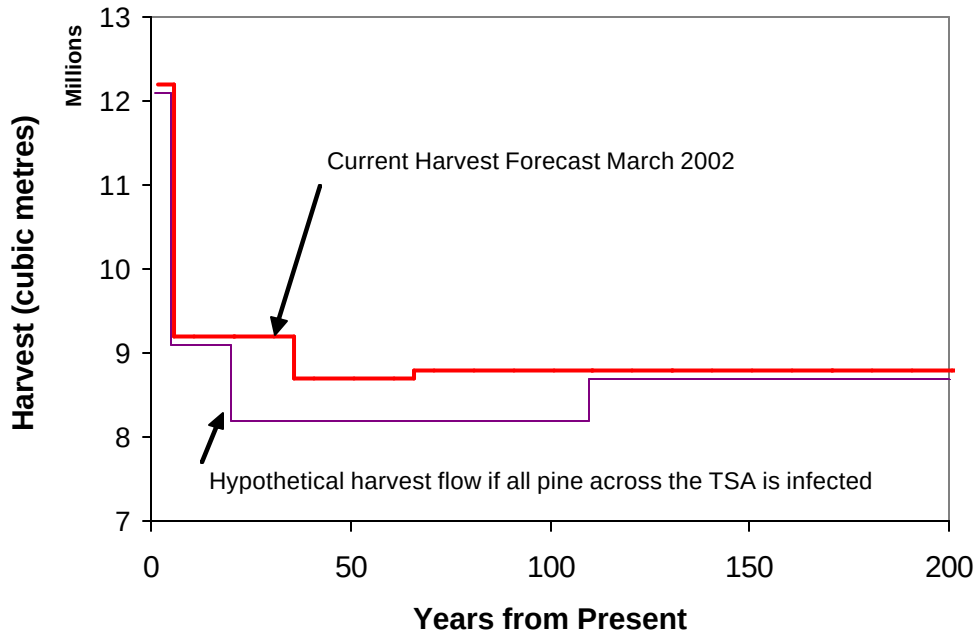
Figure A1- 1 Base harvest forecasts Prince George TSA



The future validity of the current harvest flow has been questioned. Assumptions surrounding the shelf life of beetle killed pine and geographic extent of the epidemic is evolving, however firm answers are not readily available. Discussions between timber supply analysts have suggested that the current mid-term harvest level fall-down will likely be considerably more severe than what has been modeled as part of the timber supply review. Figure A1- 2 depicts a possible hypothetical harvest flow as a result of the epidemic spreading throughout the mature pine in the entire Prince George TSA. A decline in the AAC for the Prince George TSA to ±8,000,000 cubic metres per year is predicted within 25 years.

Figure A1 – 2 illustrates that operational and silvicultural actions taken towards and within the Prince George TSA can now more than ever have dramatic consequences with respect to the mid-term harvest flow.

Figure A1- 2 Hypothetical harvest flow



Appendix 2

Executive Summary, *Incremental Silviculture Strategy for BC*

STRATEGY AT A GLANCE

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