

TFL 46

TYPE 1

Silviculture Strategy

TFL Forest Ltd. (TimberWest)

Funded By

Forest Renewal BC

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Background

Historically, through the Forest Renewal British Columbia (FRBC) program and previous funding programs including the Federal-Provincial Forest Resource Development Agreement (FRDA), the Employment and Benefits Assistance Program (EBAP), and Section 88 projects, the governments of Canada and British Columbia have invested millions of dollars into incremental silviculture projects on crown forest land. Although a variety of documents and research was available with respect to the planning and rationalization of silviculture investments, a need was identified for a provincial strategy to guide the investments of public funds on crown lands. In response to this need, the Ministry of Forests (MoF) developed the *Incremental Silviculture Strategy for British Columbia* in 1997. The strategy was field tested and released in 1999. The purpose of the Provincial strategy is to provide broad general direction to the incremental silviculture program and a context for the development of management unit (i.e. Tree Farm Licence (TFL), Timber Supply Area (TSA) etc.) level strategies, stand level analysis, and FRBC required Resource Management Plans (RMP).

This document is a management unit level strategy for TFL 46 and is referred to as a TYPE I Silviculture Strategy. The purpose of this strategy is to identify issues and opportunities for silviculture investments and produce TFL specific harvest level, timber quality and habitat objectives. This information can be utilized as inputs into the more in depth TYPE 2 silviculture strategy which employs a variety of forest modeling techniques to further develop strategies and identify funding.

As outlined in the Provincial Strategy, **'incremental silviculture is defined as any silviculture activity which is in addition to mandatory silviculture required by law. Under this definition, incremental silviculture extends beyond the traditional activities of spacing, pruning, and fertilization. It also includes pre-free growing silviculture activities that are in excess of legal requirements, commercial thinning and backlog reforestation.'** For the purposes of this strategy, the full range of silviculture activities are assessed, both incremental and those required by law. It is also noted that funding for enhanced basic silviculture activities on pre free growing stands is not available at this time.

Methodology

A summary of key TFL issues with respect to timber supply, timber quality, habitat management and employment was prepared using the information provided in the proposed Management Plan (MP) No.4, the Forest Development Plan (FDP), and in discussion with various TFL staff. In addition, a list of potential silviculture strategies to address the identified issues was prepared. This information was presented at a workshop on February 4, 2002 with representatives of TFL 46, MoF and Ministry of Water, Lands and Air Protection (MWLAP) staff in attendance. The objective of the workshop was to review the management issues and draft strategies with the ultimate goal of developing a program of plausible silviculture investments. Following the workshop, the information was consolidated to provide the foundation of this draft document. In addition, forecasts of future harvest quantity, quality and employment projections were integrated into the document.

Acknowledgements

The participation of representatives of the following organizations at the workshop is gratefully acknowledged:

Ministry of Forests

Larry Sigurdson, Vancouver Forest Region
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Ministry of Water, Lands, and Air Protection

Glen Johnson, Water Resource Specialist
Mary Jo Hamey, District Habitat Protection Officer

TimberWest

Tom Jones, Honeymoon Bay Operations
Steve Lorimer, Nanaimo Regional Office
Ken Kaps, Nanaimo Regional Office

Strategy Summary

The purpose of this silviculture strategy is to review the various management issues that shape the timber and habitat supply for TFL 46 and identify potential opportunities for the application of silviculture practices to improve the quantity and quality of these resources over time. Program objectives were developed in light of government and company direction and are intended to provide a general framework for future silviculture projects. Review of the proposed Management Plan No. 4 and other TFL documents provided the base information from which a variety of potential silviculture strategies were identified and developed. Input into these strategies was received from the operational and regional staff of the Licensee, TFL Forest Ltd. (TimberWest), and participants of the workshop which included Ministry of Forests and the Ministry of Water, Lands and Air Protection personnel. The strategies were prioritized at the workshop and working targets developed in light of these priorities. Strategies with a high rating include effective basic reforestation, programs to accelerate regenerating tree height growth to reduce operational constraints, the implementation of fertilization to boost stand yields and working towards the resolution of land base issues that are constraining the amount of available timber or limiting options for habitat. In terms of habitat, ungulate management and the elimination and/or control of introduced species rated high on the priority list. Summaries of projected hectares for treatment, the estimated cost of treatment and employment benefits are also included in the strategy.

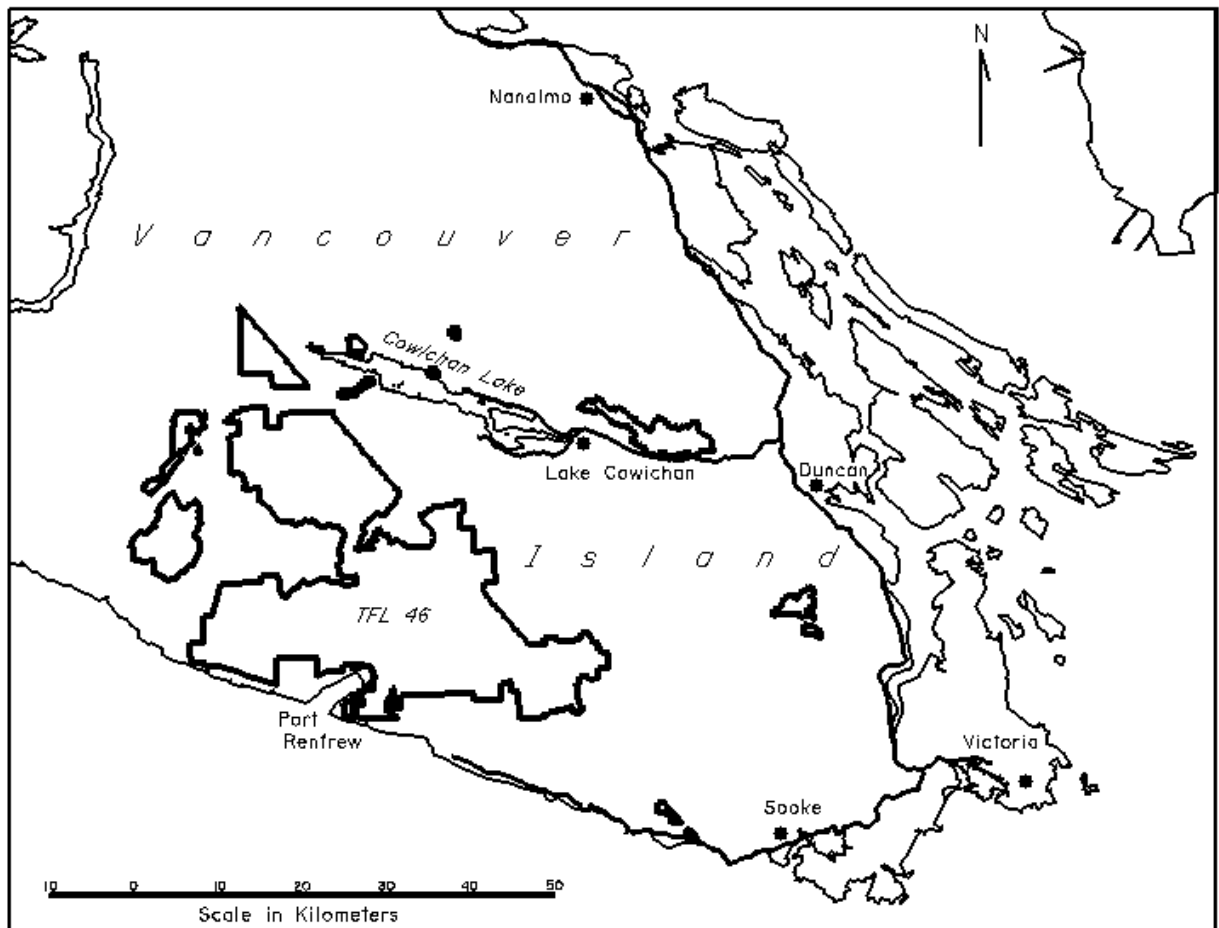
Note: The completion of programs that fall under the definition of incremental silviculture as outlined in the 'Background' section of this document is based on the premise that external funding will be provided.

1. Introduction

Tree Farm Licence (TFL) No. 46 consists of seven individual units located mainly on the western coast of Vancouver Island between Muir Creek in the south, and Nitinat River and Cowichan Lake in the west and north. Smaller portions of the TFL are located on the southeast part of the Island. Although the majority of the TFL is crown land, there is a component of private forest land owned by the Licensee. An overview map of TFL 46 is presented in Figure 1.

The combination of topography, soils and climate have resulted in a diverse land base with a multitude of timber and non timber resource values. Situated in close proximity to Victoria and other smaller communities, the area has a rich history of early logging activity and continues to play a major role in providing employment to local residents. There is great potential to manage identified forest values to provide the greatest possible benefit in terms of wood supply, habitat values and employment. Some of these values may not be realized to their full extent today, as the growth and development of forests is a long term investment. The intent of this silviculture strategy is to provide a framework for current and future silviculture programs to positively influence the yield and benefits of the forests in TFL 46.

Figure 1. Map of TFL 46 relative to southern Vancouver Island



1.1 TFL Issues Impacted by Silviculture

There are a multitude of issues associated with any forest land base. The combination of historic harvest activities, legislation, government and company policies, and the nature and characteristics of the land base itself, make each management unit unique. The following section briefly describes some of the issues associated with TFL 46 that can be addressed through silviculture practices or strategies. The issues are broadly categorized into the following areas: Timber supply - which is a function of quality and quantity, Habitat, Employment and First Nations.

1.1.1 Timber Supply Issues

The land base within TFL 46 has a long history of industrial forestry activity dating back almost 100 years. Up until the last decade, the harvest has been almost entirely in old growth. The historic harvest activity has formed a relatively balanced age class distribution of second growth stands. The harvest of old growth is anticipated to taper off in the next few decades at which point, the harvest will be almost exclusively second growth. This provides a whole host of opportunities and challenges with respect to harvesting technology, employment levels, and economic feasibility.

Over the years the TFL land base has gradually been reduced through the creation of Parks, losses associated with ownership changes and private land deletions. Reduction of the land base continues with the formation of the Walbran and Hitchie Creek Parks, the San Juan Estuary and San Juan Ridge Ecological Reserves, the 5% take back area resulting from the latest ownership change and additional volume associated with the recent disposal of the undercut from the 1993-1997 cut control period. The challenge to silviculturalists is to optimize the productivity of the remaining land base to minimize the impact of these changes.

The land use planning process has also had an effect on the operability of TFL 46. Under the Vancouver Island Land Use Plan Higher Level Plan Order, the Walbran area within TFL 46 was declared a special management zone (SMZ). Harvesting activities are constrained by a variety of objectives included in the Vancouver Island Land Use Plan and the Vancouver Island Summary Land Use Plan.

The retention of old growth is an issue that is anticipated to be resolved through the Landscape Unit Planning Process. In the interim, significant areas of old growth on TFL 46 are either unavailable or constrained for harvest. These areas include portions of the timber harvesting land base (THLB) required to meet old seral stage targets and wildlife tree patch (WTP) requirements, areas temporarily removed to retain options for marbled murrelet habitat, areas removed and/or constrained for ungulate winter ranges (UWRs), goshawk management, and red-listed plant communities. There may be an opportunity to explore the feasibility of utilizing silvicultural methods to create or enhance stand characteristics in non contributing areas to free up old growth in the THLB.

In addition, to downward pressures on the land base, the harvest of available timber in the THLB is heavily constrained by regulation and policy designed to address concerns regarding the protection of a variety of non timber resource values. These include rate of cut issues and minimum tree height requirements associated with watershed management, visual quality management objectives and adjacency. Strategic silviculture planning initiatives can play a significant role in reducing the impact of constraints on timber supply.

1.1.2 Habitat Issues

Ungulate management is an issue on TFL 46. Grandparented ungulate winter ranges (UWR) are designated in old growth and second growth stands. Some of the second growth UWR may lack the desirable attributes of critical over wintering habitat. In addition, a concern at the Forest Development Plan (FDP) stage is the perpetual availability of forage in close proximity to the UWRs. The development of a comprehensive ungulate winter range management plan would provide a framework for future incremental investment in forage enhancement and over wintering habitat creation.

Goshawks have been found nesting in various areas within the TFL. A proposed goshawk wildlife habitat area is located along the Gordon River. In the interim, harvesting restrictions and specific reforestation guidelines apply to the area.

TFL 46 is within close proximity to the Pacific ocean and as such is considered to have suitable marbled murrelet (MaMu) habitat. Several areas within the THLB are temporarily deferred from harvest to provide large patches of undisturbed MaMu habitat. These deferrals are anticipated to be addressed through the landscape unit planning process.

In addition to the wildlife concerns, there are several red listed plant communities found within the THLB of the TFL 46. Currently, in absence of government management guidelines with respect to these ecosystems, harvesting is limited in these areas.

There is ongoing work in the area of watershed and riparian area restoration. When determining the state of a watershed using the watershed assessment procedure, indicators, which include the reforestation status of previously logged areas, the condition of riparian areas in terms of bed load and streamside vegetation and the area of exposed material from road building (sediment sources) are considered.

The majority of these issues can or have the potential to be addressed by the strategic implementation of silviculture activities.

1.1.3 Employment Issues

The TFL supports a large number of employees comprised of staff, IWA hourly workers, and contractors. With the shift to second growth harvesting, reductions in land base, and recent economic conditions, employment levels are experiencing significant downward pressures. The implementation of an effective silviculture program can contribute to short term employment of employees and contractors and will provide long term stability to the surrounding communities through sustained harvest opportunities.

1.1.4 First Nations Issues

First Nations bands with an interest in TFL 46 include the Pacheedaht Band, the Ditidaht Band, and several bands associated with the Hul'qumi'num and Te'mexw Treaty Associations. The bands have a variety of interests in the land base including concerns around cultural heritage resources. Silvicultural practices can potentially impact the future capability of an area to provide First Nations values such as food gathering opportunities or forest experiences predicated on specific stand attributes.

1.2 Objectives of the Silviculture Program

The following section provides a review of existing government and Licensee management objectives with respect to silviculture that provide guidance for the development of specific silviculture program objectives for the silviculture strategy for TFL 46.

1.2.1 BC Provincial Government Incremental Silviculture Goals and Principles¹

Provincial Government

The 'Incremental Silviculture Strategy for BC (Interim)', MoF April 15, 1999 is intended to provide the context for the development of management unit strategies. The Provincial strategy is based on 3 key goals for forest management:

- ◆ Sustainable Resource Use
- ◆ Community Stability
- ◆ A strong forest sector

In support of these goals the following Provincial Government Key Principles were developed:

- ◆ 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.
- ◆ British Columbia's forests are important locally, provincially, nationally, and globally and should be managed in this context.
- ◆ 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.

Within the context of the guiding principles, the following Provincial Working Targets were developed:

- ◆ 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.
- ◆ Create a long term timber supply capable of supporting a steady long term provincial harvest level of at least 75 million m³.
- ◆ Over the long term, maintain the production of premium quality logs at or above 10% of total harvest.

¹ BC Ministry of Forests, April 15, 1999 - Incremental Silviculture Strategy For British Columbia

Regional Government

Although specific incremental silviculture objectives have not been developed for the Vancouver Forest Region at this time, the following broad based objectives² will be considered in the interim:

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

1.2.2 TimberWest's Excellence in Forestry Best Practices Guide

The overall objective of the 'Best Practices Guide' is to provide key considerations to all TimberWest operations in the application of silviculture programs. The objectives and statements around incremental silviculture include the following:

- ◆ Incremental Silviculture - delivers returns greater than investment
- ◆ A forecast return on investment that exceeds the cost of capital and competes favorably with other investment options
- ◆ Optimize money spent on any investment

Objectives around basic forestry that will influence the incremental program include:

- ◆ An objective of 30-40cm J Grade sawlogs at first entry age with good form and minimum pulp content
- ◆ Capturing the full productive potential of each site in high value trees at least cost

Cited benefits from silviculture programs to the company and stakeholders include

- ◆ sustained employment and income to employees and community businesses
- ◆ a renewable resource
- ◆ protection of other values like clean water, clean air, and recreation opportunities

² BC Ministry of Forests 1998 - Vancouver Region Incremental Silviculture Objectives. Handout. Vancouver Forest Region, Nanaimo, BC.

- ◆ improved site productivity and occupancy, and future product opportunities

1.2.3 TFL 46 Management Plan No. 4 Objectives

The following information is derived from the proposed Management Plan (MP) No.4 for TFL 46. The Management Plan does not include specific objectives around timber supply quantity and quality, however the following broad objectives are cited:

- ◆ Harvest 100% of the AAC
- ◆ To help sustain harvest levels during the transition from old growth to second growth harvesting by adopting first entry rotation ages

Employment objectives include:

- ◆ To maintain a financially viable and world-competitive forest products company that will contribute to the economic stability of the communities where it operates
- ◆ To constantly innovate in ways that add value, increase production performance, improve product quality and provide an acceptable return on investment
- ◆ To utilize the expertise of company employees
- ◆ To balance the available fibre supply with market demands and economics

Following is the silviculture objective included in the Management Plan:

- ◆ To fund and implement basic silviculture in a manner that will ensure all areas requiring reforestation reach 'free growing' status within the acceptable standards as specified in the approved SP

Following is the research objective included in the Management Plan:

- ◆ To carry out operational silviculture trials as needed

There are no specific objectives for incremental silviculture in the management plan however, the following excerpts provide guidance for the development of objectives:

- ◆ The emphasis of TW's silviculture program is to maximize volume on stems 20 to 50 cm in diameter of good form (e.g. straight boles with minimal taper and small branches)
- ◆ Incremental silviculture is applied to free growing stands to increase the yields of merchantable volume and/or wood quality, to reduce the time to future harvest, to increase wildlife capability or in the case of spacing, to increase employment in high unemployment areas. On crown lands, incremental silviculture will continue provided external funding is available.

1.2.4 TFL 46 Silviculture Strategy Objectives³

In light of the Provincial Government objectives, information contained in the MP No.4, the Excellence in Forestry Best Practices Guide and in consultation with participants at the workshop, the following objectives were developed for the silviculture strategy for TFL 46.

The application of these objectives is intended to be within the context of the TFL 46 Management Plan.

Timber Quantity Objectives

- ◆ To manage the timber supply to yield harvest levels at or above the current annual allowable cut by
 - ◆ enhancing short and long term harvest levels
 - ◆ reducing the impact of spatial and temporal constraints on timber supply
- ◆ To continue to manage backlog pre 1987 forest lands subject to external funding
- ◆ Increase the THLB by working to restore degraded areas

Timber Quality Objectives

- ◆ To engage in silviculture activities that will aid in the production of stems 20-50 cm in diameter, minimum J Grade sawlogs at first entry age with a minimum of pulp content and a component of premium quality sawlogs
 - Sawlog** - Top diameter > or = 10 cm and <38 cm
 - Premium log** - Top diameter of 38 cm or more
- ◆ To capture the full productive potential of each site by regeneration with high value tree species ecologically suited for the site
- ◆ To manage forest health issues such that timber loss and/or damage is reduced

Habitat Objectives

³ The delivery of activities incremental to the basic silviculture program is based on the premise that funding is provided by external sources

- ◆ To apply incremental silviculture strategies to address issues around
 - ◆ wildlife habitat
 - ◆ stand and forest level biodiversity
 - ◆ watersheds and riparian area management

Employment Objectives

- ◆ To contribute to the economic stability of employees and neighboring communities by the utilization of effective silviculture strategies that enhance the availability of timber for harvest

First Nations

- ◆ To consider the cultural needs and concerns of First Nations when prescribing and delivering silviculture programs

Financial Objectives

- ◆ To maximize the return on silviculture investments giving consideration to other objectives

2.0 Resource Dynamics

This section further defines the timber supply issues and identifies constraints that shape the timber supply forecast for the TFL. The information for the following section is summarized directly from the proposed Management Plan No.4 for TFL 46.

2.1 Synopsis of the Land Based Inventory

Basic Data - TFL46

Following are of graphs and charts that describe land based inventory on the TFL.

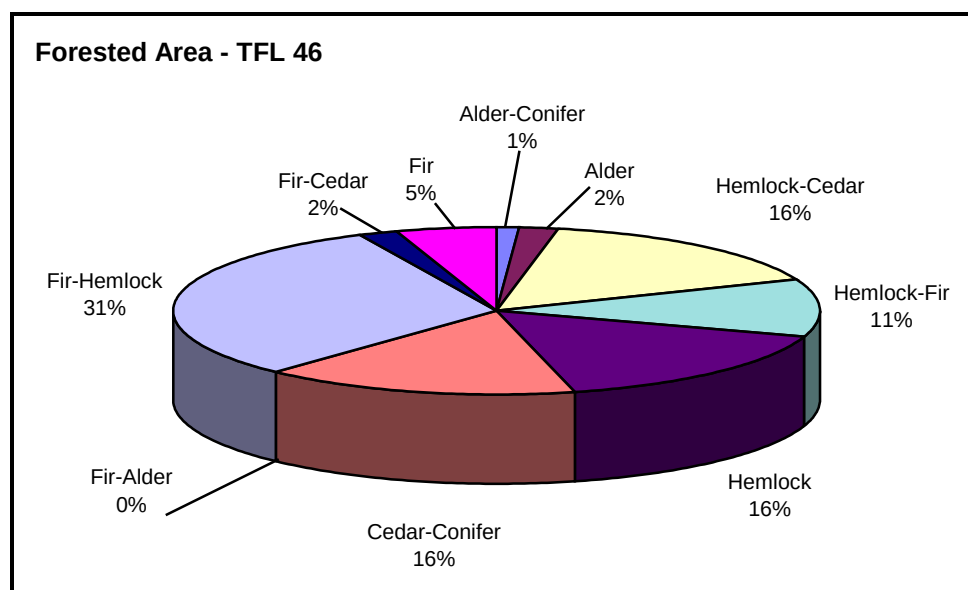
TFL 46 Land Area*

Table 1- TFL 46 Land Area Breakdown

Description	Area (ha)	Area (%)
Total Area of TFL 46	90,870	100
Remove: <u>Ha</u>		
Parks 7,324		
Non forest 2,933		
Non Productive Forest <u>68</u>		
10,325		
Total Productive Forest	80,545	89%
Remove: <u>Ha</u>		
Current roads 2,530		
Inoperable areas 2,874		
Low sites 247		
Rec Inventory/Wildlife reserves (UWR etc.) 2,172		
ESA -soils,regen,fish,snow 5,965		
Riparian 1,677		
WTPs <u>1,302</u>		
16,768		
Timber Harvesting Land Base	63,777	70%

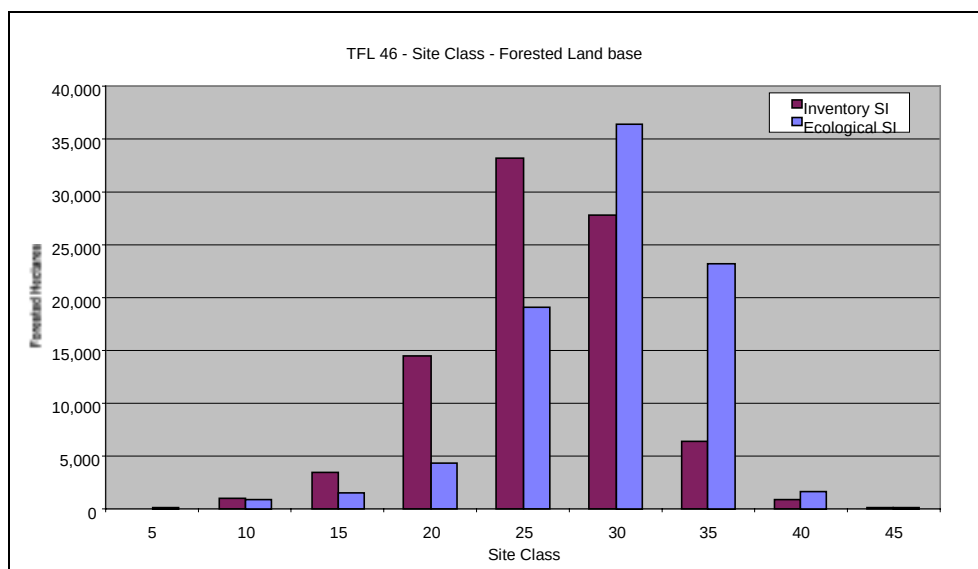
Tree Species Distribution

Chart1 - TFL 46 Forested Area Breakdown



Site Class Distribution

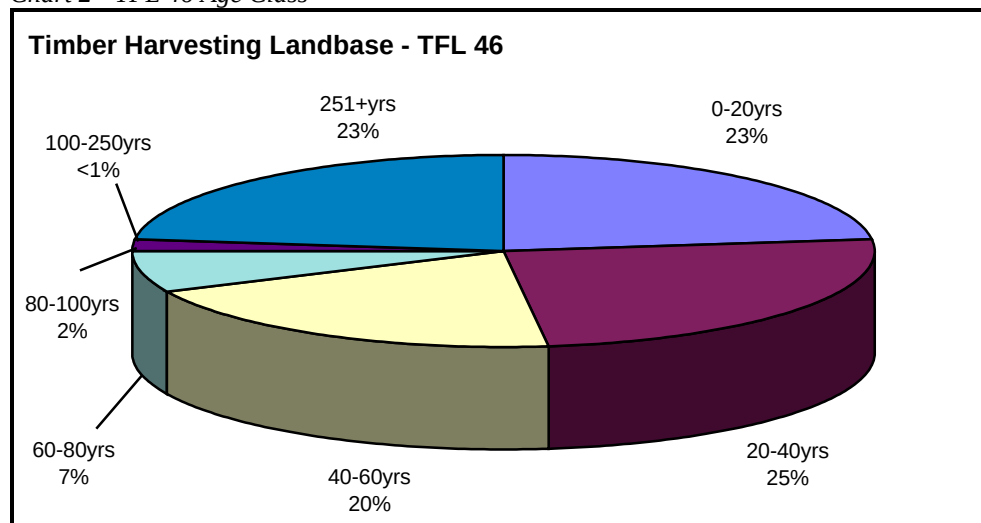
Graph 1 - TFL 46 Site Class



The inventory site index is determined using forest inventory information based on variable density yield plot (VDYP) information. The ecological site indexes are indexes determined by the biogeoclimatic classification of the site. The ecological site indexes are used on TFL 46 as they have been determined to more accurately reflect the productivity of second growth stands.

Age Class Distribution

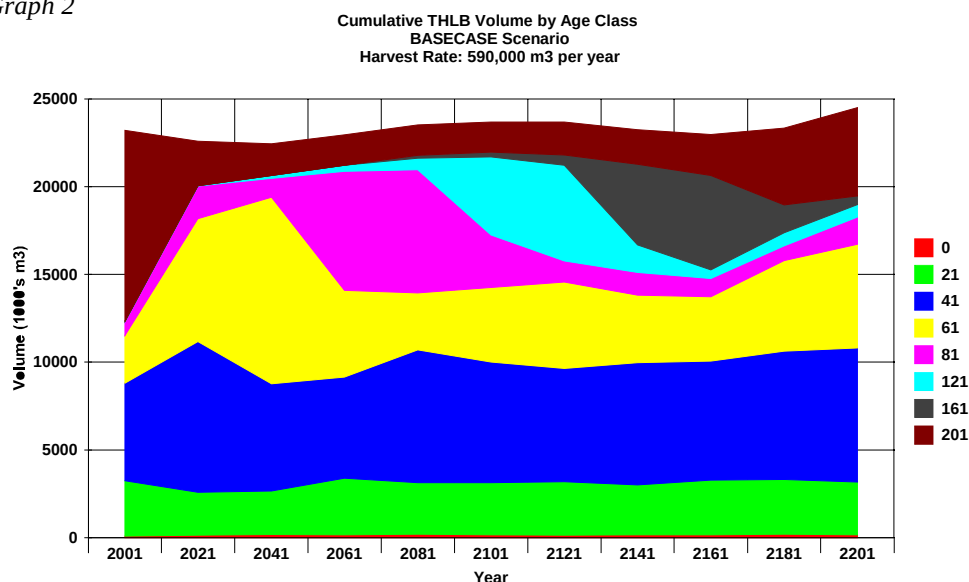
Chart 2 - TFL 46 Age Class



The majority (77%) of the THLB is under 100 years of age with approximately 23% remaining in old growth 250+ years. Historic harvest activity has created a relatively balanced age class distribution. The harvest of old growth will taper off in the first few decades of the planning horizon and be replaced with upcoming second growth stands. The remaining old growth will be primarily those areas retained for biodiversity requirements. In the later years of the planning

horizon the availability of old growth increases as second growth stands in constrained areas reach 250+ yrs and replace old growth set aside in the THLB to satisfy seral stage targets. The graph below illustrates the cumulative THLB volume by age class for the base case scenario.

Graph 2



Annual Allowable Cut (AAC) History

Table 2 -TFL 46 Historical AACs

Year	AAC m ³ /y
1992	558, 860
1997	535,000
1998	514,804
1999	462,544

The decrease in harvest level during the time frame 1992 through to 1999 is largely a result of land deletions from the TFL.

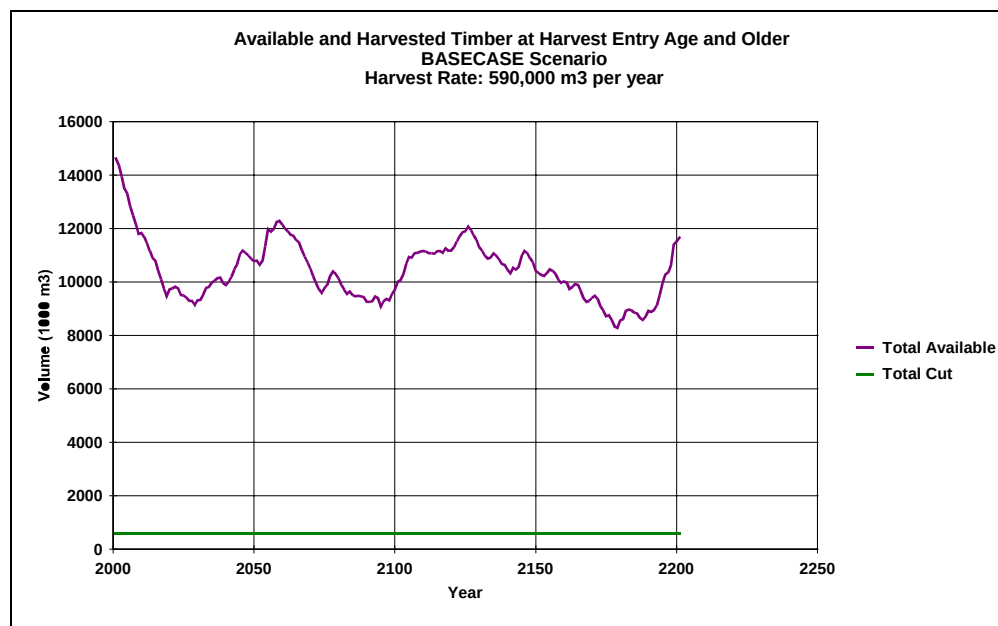
Proposed Cut Levels

TW is proposing a harvest level of 586,500m³/year for MP No. 4 which covers the period December 1, 2001 to November 30, 2006. The AAC was derived from analysis of available timber resource in the base case timber supply and the effects of a variety of management constraints presented in the sensitivity analyses. The issues which provide a framework for determination of the AAC are discussed in the following section 'Timber Supply Dynamics'. However, in general terms the increase in AAC from historic levels is associated with revised estimates of ecologically-based site index for timber stands established in 1955 and later, a relaxation of visual landscape

requirements associated with the government's visual buy-back initiative that is reflected in the new inventories.

Base Case Available and Harvested Timber

Graph 3 - TFL 46 Available and Harvested Timber at Harvest Entry Age and Older - Base Case



The results of the base case simulation indicates an even flow harvest level of 590,000m³/year, as depicted by the straight green line in the lower section of the figure. The transition from old growth to second growth will largely occur the first few decades of the modeling horizon. The total available timber⁴, shown in purple, fluctuates but remains within a range that provides operational flexibility. The large gap between the total available timber and the even flow harvest level is a result of a variety of harvesting constraints imposed by either government or company policy. These constraints will be further explored in the following section on timber supply dynamics.

2.2 Timber Supply Dynamics

The timber supply analysis examines the base case timber supply and selected sensitivity analyses to create a picture of the timber supply dynamics of the TFL over time. The following section provides a breakdown of the timber supply analysis and will be used to provide insight as to how the strategic application of silviculture treatments can be used to enhance timber supply.

⁴ Total Available Timber - The total merchantable timber in the THLB greater than first entry (i.e. Average 30cm diameter and 300m³/ha).

2.2.1 Breakdown of Timber Supply

The availability of the timber resource for harvesting is influenced by a multitude of management constraints. They can be broadly classified into 1) factors that influence the area of timber harvesting land base (THLB), usually referred to as permanent deferrals or netdowns and 2) factors that constrain the availability of timber within the timber harvesting land base or forest cover constraints.

Factors influencing the area of THLB

◆ Area Deletions

There is a long history of area deletions on TFL 46. Over time the removal of land base for the creation of Parks, ownership changes etc. has steadily decreased the area of THLB. Currently, there is a temporary deferral of approximately 1600 ha of the Hill 60 operating area to allow for resolution of First Nations issues in the area and the imminent removal of lands associated with the 5% government 'take back' for latest ownership change. The base case timber supply analysis includes these areas, however, a sensitivity analysis indicates a 32,000m³ impact for Hill 60 and a 21,000m³ impact for the ownership change. The removal of area from the TFL cannot be influenced by silviculture, however, the need to perform effective, strategic programs on the remaining lands is critical to minimize the impacts of these changes.

◆ Wood Quality

3121ha are classified as inoperable or low site are deducted from the THLB. This includes coniferous stands with <250m³/ha @ culmination, J-grade or poorer deciduous forest types with a site index 15 or less.

2,530 ha of roads are deducted from the THLB. This is based on a road width of 14m applied to all active and deactivated roads, trails and landings.

The government recommended reduction of 8.86% to the yield of Fd leading stands in root rot susceptible Biogeoclimatic (BEC) subzones. 15% of Fd leading stands are in susceptible areas.

There is potential opportunity to improve and/or restore low productivity areas and those areas currently outside the THLB. In addition, the forest health assumptions currently used in the analysis are not based on survey information specific to the TFL. Verification of these assumptions may produce a positive benefit to timber supply by increasing the yields from the THLB.

◆ Deciduous

The base case timber supply analysis removed all deciduous leading stands from the THLB. Including the deciduous component into a sensitivity analysis results in a 29,000m³/yr increase in the sustainable timber supply, providing the areas are restocked with Fir-cedar stands. Based on an assumption that a component of these areas will return to deciduous leading stand types, TimberWest is proposing an increase of 24,708 m³/yr to sustainable harvest levels.

◆ Timber Volumes

The base case timber supply utilizes average volume lines derived from cruise data and previous analyses for stands 200+ years and older. Variable density yield plot projections (VDYP i.e. forest inventory site indexes) are applied to stands 40 to 200 yrs old. Table Interpolation for Stand Yields (TIPSY), adjusted to account for the JS Thrower and Associates report⁵, is used for stands 40 yrs or younger. Finally, genetic gains are applied to Fd (8% increase) and Cw (5% increase) on stands planted from 1999 on.

A sensitivity analysis tests the impact of the using the site index estimates in JS Thrower report on harvest levels. The application of unadjusted yield curves to the model showed an impact of 82,000m³/yr, or 14% reduction in the sustainable harvest level. The available timber continues to decline over the planning horizon and further impact can be anticipated as slower height growth will affect forest cover constraints (i.e. adjacency, green-up, VEG).

A second sensitivity analyses adjusts all growth and yield estimates by +/-10%. A 10% increase in yield estimates, raises the sustainable harvest level by 47,000m³/yr. A 10% decrease in yield estimates reduces the sustainable harvest level by 43,000m³/yr. The impact is not proportional due to the non-linear nature of yield curves.

The timber supply analysis results indicate the model has high sensitivity to volume estimates. A silviculture practise that produces even a small change in the volume estimate, can have a substantial impact on long run timber supplies.

◆ **Minimum Harvest Age**

For the base case, the minimum entry age for harvesting second growth stands is set at either VDYP culmination age or the 'first entry' age, when the stand reaches an average diameter at breast height (DBH) of 30cm and a volume of 300m³/ha. Using these parameters, stands on less productive sites tend to have minimum entry ages equal to culmination age, stands on more productive sites will have entry ages less than culmination age. Timber stands with less than 250m³/ha at culmination are not considered merchantable.

A sensitivity analyses models the impact of not applying 'first entry' ages. The assumption is that VDYP culmination ages are applied to all second growth stands. The result is an increase in the sustainable harvest level of 10,000m³/yr. The average difference in culmination ages and first entry is two years. The difference in harvest level is attributable to the additional volume grown on the higher site stands during the two year period.

Factors Constraining the Availability of the THLB

⁵ The JS Thrower and Associates report, 'Second Growth Site Index Estimates for Douglas-fir, Western Hemlock, Pacific Silver fir, and Western red cedar on TFL 46' dated July 17, 2000, indicates the immature site indices on TFL 46 are underestimated. The report includes updated second-growth site index (SGSI) estimates based on the biogeoclimatic classification (BEC) of the site. The updated information was incorporated into the TIPSY yield curves for the base case scenario.

◆ Forest Cover

Green-Up/Adjacency - General TFL

The size of a given clearcut or harvested opening is subject to a maximum threshold value. If the maximum size is attained, areas adjacent to the opening cannot be harvested until the trees within the opening are 'greened-up'. For a tree to be considered greened-up, it must attain a height of 3m or more. In order to simulate green-up/adjacency requirements, the base case assumes a 'four pass' rule. This means the area stocked with stands less than 3m in height is not permitted to exceed 25% of the total forested area. This constraint applies to all areas with the exception of mapped visual landscape polygons.

Following are the approximate age to green-up by species type summarized from the information package for MWP no.4 :

Table 3 - TFL 46 Age to Green-up (>3m)

Species	Site Class	Stand Age (yrs)	Stand Height (m)
Fd , FdCw, FdHw, HwCw	15	14	>3.0
	25	10-11	
	35	5-6	
Cw-Conifer mix	15	14	>3.0
	25	9	
	35	4	
Hw & HwFd	15	13	>3.0
	25	9	
	35	5	
Dr, Dr-Conifer mix	25	12	>3.0
	35	8	
	45	4-5	
FdDr	25	11	>3.0
	35	6	
	45	4	

Variation to the green-up height criteria is modeled in a sensitivity analysis. The threshold average height at which a plantation is considered 'greened-up' was increased from 3m to 4m. The model did not show an impact on timber supply.

Visual Landscape Areas

Approximately 15,886 ha or 25% of TFL 46 is within visual quality zones. The maximum percent of stand alteration (i.e. denudation) permitted within a given visual quality zone is determined by the recommended visual quality class (RVQC) assigned to the area. The recovery of an area following stand alteration is governed by the slope of the terrain and the corresponding height of regenerating trees. The assumption is that once a regenerating stand meets a threshold height, the area has achieved visual effective green-up (VEG) and further harvesting may occur. The table below outlines the criteria used to determine VEG by RVQC for the base case.

Table 4 - TFL 46 VEG Height by slope and RVQC

RVQC	VAC ⁶	Total Area	Ave Slope (%)	Maximum Denudation Percent	VEG Height (m)
P-Preservation	L	22	50	1	7.0
R-Retention	L	456	61	5	8.5
R	M	614	38	5	6.5
PR -Partial Retention		205	13	15	4.0
PR		2,374	54	15	7.5
PR		6,132	46	15	7.0
M-Modification		170	28	25	5.5
M		1,050	57	25	8.0
M		4,863	46	25	7.0
Total		15,886			

A sensitivity analysis varies the visual landscape constraint by increasing and decreasing the tree heights. An increase in threshold tree heights did not impact the sustainable harvest level, however a decrease in tree heights increased harvest levels by 12,000m³ or 2%. The results are not proportional as the yield curves indicate faster growth rates for trees between 3 and 4m than trees between 2 and 3m.

Watershed Assessment Areas

Coastal watershed assessments have been completed for the Hatton Creek and Gordon River drainages. The recommendations in these assessments are to constrain harvest levels such that the maximum area-weighted equivalent clearcut area (ECA) within the watershed does not exceed 33% of the total area. The impact of this constraint is modeled in a sensitivity analysis and was calculated using the following assumptions:

Table 5 - TFL 46 Canopy height and Corresponding Recovery Rate

Coastal Watershed ECA Recovery Curve	
Average Height of the Main Canopy (m)	% Recovery
0-<3	0
3-<5	25%
5-<7	50%
7-<9	75%
9+	90%

Community Watersheds

There are technically two watersheds within TFL 46, the Shawnigan and Malachan Creek. The Malachan Watershed overlaps approximately 1.8ha of the TFL and consequently has negligible impact on the timber supply analysis. The Shawnigan watershed is under a forest cover constraint to ensure harvesting does not exceed 5% of the total forested area over a period of five years. The recovery heights for harvested areas are consistent with the Coastal Watershed Recovery Curve heights listed above in Table 5.

⁶ VAC - Visual Absorption Capability

Forest Cover Considerations

TFL 46 is a heavily constrained land base. A relaxation in one constraint is often masked by others. In addition, the model is designed to show long term harvest levels and as such is less sensitive to short term constraints. The base case graph, indicates a significant difference in total available timber and the sustainable harvest level. This difference is largely attributable to the combined impacts of the forest cover constraints. Intuitively, it can be surmised that the relaxation of these constraints through increased growth of stands adjacent to constrained timber would be beneficial to timber supply and provide increased operational flexibility.

◆ Landscape Level Biodiversity

Landscape level biodiversity in TFL 46 is presently provided for through the management of a grandparented forest ecosystem network (FENs). The FEN is comprised of components of non-contributing, constrained and THLB areas for the purposes of conserving elements of biodiversity. Government direction is to replace FENs with old growth management areas (OGMAs) by 2003. The area set aside as OGMAs in each landscape unit will meet the seral stage targets defined by government for each biogeoclimatic variant in the TFL.

Base Case Timber Supply Biodiversity Assumptions

Only the retention of old growth stands to meet seral stage targets is modeled in the base case timber supply scenario. The impact of retaining the FENs is modeled in subsequent sensitivity analysis. The targets for old growth retention range from 9-19% of the total forested area in each respective landscape unit. Harvesting is constrained within each landscape unit to ensure the minimum area of old growth is set aside. Past logging history and a significant proportion of the land base dominated by stands less than 50 years of age indicate some targets will not be achieved until the later portion of the planning horizon.

Sensitivity Analyses

Several sensitivity analyses were run to understand the impact of the various potential biodiversity constraints on future harvest levels. Following are the results:

- ◆ **No biodiversity constraints** (i.e. no old seral stage constraints, FENs available for harvest). The result, a 22,000m³/yr or 4% increase in the sustainable harvest level.
- ◆ **FENs only** (FENs deferred from harvest, no old seral stage constraints). The result, a 15,000m³/yr or 3% decrease in the sustainable harvest level.
- ◆ **Old seral stage constraints and FENs** (Old seral stage constraints applied and Fens deferred from harvest). The result, a 37,000m³/yr or 7% decrease in the sustainable harvest level.
- ◆ **Mature and old seral stage constraints**
The result, a 140,000m³/yr or 24% decrease in sustainable harvest levels. These constraints are modeled as one combined target. This allows the model to select between mature and old at various stages of the planning horizon. If these constraints were modeled independent of each other, a larger impact would be realized.

◆ Backlog NSR

Current records indicate 0 ha of backlog NSR.

◆ **Silviculture Systems**

A large portion of the THLB is managed under the clear cut with reserves harvesting system. TW plans to harvest one-third of the volume using dispersed variable retention (VR). A sensitivity analyses indicates the application of the VR regime results in a reduction to the sustainable harvest level of $1,000\text{m}^3/\text{year}$.

◆ **Regeneration**

The base case assumes a regeneration delay of 2 years.

◆ **Special Management Zones**

The Walbran Periphery and San Juan Special Management Zones (SMZs) are within TFL 46. The combined THLB of these area is approximately 1,321 ha. Using the provincial government assumption that the management of SMZs will have an average impact on timber supply of 10%, the impact to timber supply was calculated at $1030\text{m}^3/\text{yr}$, or less than 1% of the base case sustainable harvest.

◆ **Harvest Priority**

The base case assumes the oldest stands are harvested first. A sensitivity analyses tests the impact of setting harvest priority according to species composition. The sustainable harvest remains unchanged however, a greater proportion of second growth timber is harvested earlier in the planning horizon than in the base case scenario. Also, the harvest of old growth is extended out for approximately 70 years at which point the harvest is almost exclusively second growth.

2.2.2 Stand-Level Tradeoffs of Quality, Quantity and Harvest Timing

There are potential stand-level tradeoffs involved with the establishment of product objectives. TimberWest is managing for 20-50cm in diameter, minimum J Grade sawlogs at first entry age with a minimum of pulp content and a component of premium quality sawlogs. Using the Stand Density Management Diagram for Coastal Douglas Fir, (planted stands) produced by Craig Farnden, May 31, 1996⁷ (See *Graph 4*, pg 20) the following can be interpreted:

Sawlog Production Trade-off

- ◆ TimberWest considers a stand available for harvest at first entry age when average stem diameter is 30cm and average stand volume/ha is 300m^3 . Assuming stand establishment to be 1200 stems/ha (i.e. a combination of planted and natural) and a planned harvest entry when stems reach a diameter of 30cm, the stand density management model

⁷ Data Source: TASS generated managed stand yield tables contained in the computer program WINTIPSY version 1.3 (B.C. Ministry of Forests, Forest Productivity and Decision Support Section)

indicates a final harvest stand density of approximately 1000 stems/ha. A harvest entry at this point, is marginally within the lower limit of the zone of imminent competition mortality. Beyond the 30cm diameter class, the stand density begins to decline quickly as trees succumb to competition.

The product goal of a 30cm sawlog, permits an early harvest entry which maximizes financial returns and minimizes stand losses due to competition mortality.

Premium Sawlog Production Trade-off

- ◆ Premium sawlogs are associated with straight boles, minimal knots and tight grain. The largest trees in a given stand are not necessarily the highest quality, however for the purposes of assessing the stand level trade-offs, it will be assumed that larger piece size equates to enhanced quality. Assuming an establishment density of 1200 stems/ha and a target diameter of 38-50cm, the stand density management model indicates a projected stand density of approximately 480 - 700 stems/ha at harvest. The trade-off involved with growing a stand to the high end of the product range is the forfeit of volume to competition mortality and the opportunity cost of delaying harvest against the benefit of larger piece size. Under this regime, stands selected for longer rotation, given favorable markets, would provide candidate areas for commercial thinning entries to capture stand mortality.

In light of the tradeoffs discussed above, TimberWest has opted to focus on the production of high quality, smaller piece sizes. A component of larger piece sizes will be provided in the harvest profile from areas where harvesting must be delayed due to an overlying constraint or areas where extensive harvesting is undesirable (See Section 3.2, strategy 3.2.2.2 for further details).

2.3 Habitat Supply Dynamics

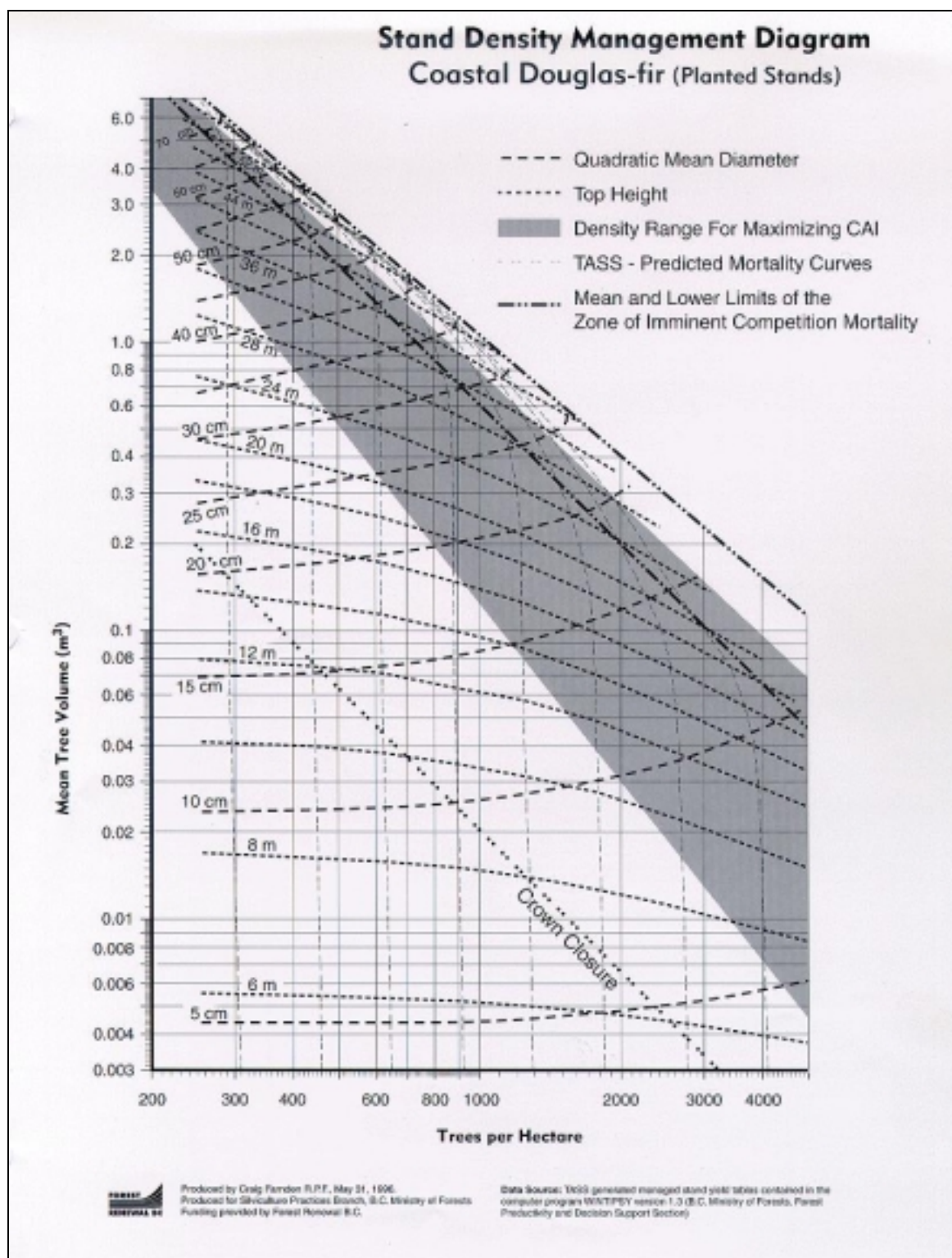
Habitat Issues on TFL 46

◆ Ungulate Winter Ranges (UWR)

Known areas with significant wildlife issues are mapped in the TFL inventories. These areas may be fully or partially netted out of the THLB depending on the specific site characteristics. The objective of the UWRs is to provide critical over wintering habitat for ungulates. Some of the areas selected for this purpose are in high capability second growth, however, the current stand structure may not be ideal. There is an opportunity to prescribe commercial thinning entries to improve habitat values while providing harvest volume. Future opportunities may exist to use silviculture applications to enhance high capability second growth areas in non contributing areas to replace those UWR that have resulted in removals from the THLB.

In addition to the grandparented UWRs, the availability of suitable forage, in close proximity to the winter ranges is an issue at the Forest Development Plan stage as the timing of harvest has in some instances been constrained to ensure the availability of future forage opportunities. There is an opportunity to use silvicultural practices to create and sustain forage opportunities instead of utilizing rotational harvesting methods that constrain operational flexibility (See Section 3.2 for further details).

Graph 4 - Stand Density Management Diagram for Planted Coastal Douglas fir



◆ Goshawks

Currently, a potential Goshawk wildlife habitat area is proposed in the Gordon River drainage. An interim agreement includes restrictions around harvest opening sizes, density, timing, proximity of operations to nesting sites and guidelines for reforestation stocking limits. The impact of Goshawk management is currently not modeled in the timber supply analyses. Ongoing research indicates Goshawks nest in 2nd growth areas as well as old growth. As more information becomes available, a potential silviculture strategy could be developed to manage the habitat requirements of the Goshawk in non contributing areas or potentially on a temporal, landscape level basis so long term impacts to timber supply are minimized.

◆ **Marbled Murrelets**

The management of old growth marbled murrelet habitat is also an issue on TFL 46. Several areas within the THLB of TFL 46 are temporarily deferred from harvesting to provide management options for long term marbled murrelet habitat. It is anticipated that landscape unit planning, will permanently identify areas for long term retention in OGMA's. The permanent designation of some or all of these areas will further decrease the THLB.

◆ **Red listed Plant Communities**

TFL 46 has a number of red listed⁸ plant communities present. Although there are no specific guidelines associated with the management of red listed species, historically the ability of the operation to harvest in these ecosystems has been constrained. The constraints on these areas may be relaxed pending the outcome of landscape unit planning providing a suitable, representative area of these ecosystems is contained within OGMA's. In the event, the red listed plant communities are not represented adequately and continue to constrain timber availability, there may be an opportunity to recreate old seral stage attributes in suitable second growth stands.

◆ **Riparian Values**

The condition of previously harvested riparian areas is evaluated in the course of conducting watershed assessments and has an influence on future harvest levels in a given drainage. TFL 46 has a long history of industrial forestry activities and as such there are several drainage systems that have been impacted by past harvesting. Several riparian restoration programs have been implemented on the TFL over the last few years and this is expected to continue. The implementation of silviculture programs designed to restore structural attributes and values associated with natural riparian ecosystems provide a positive contribution to watershed restoration efforts and ultimately influence future harvest levels.

2.4 Incremental Silviculture History on TFL 46

⁸ Red Listed Species - Threatened or endangered species identified by the Ministry of Environment, Lands and Parks (Now referred to as the Ministry of Water, Lands and Air Protection).

Following are tables summarizing historical planting, juvenile spacing, and fertilization activities as presented in the MWP No. 4 proposal. Additional information, including data on pruning has been added to bring the records up to date.

History of Planting (Basic and Incremental)⁹

Table 6 - TFL 46 Planting History

Year	Hectares	No. of Trees "000"	Year	Hectares	No. of Trees "000"
1955	368	358	1979	931	656
1956	300	250	1980	918	711
1957	492	470	1981	1,246	868
1958	655	685	1982	906	724
1959	579	530	1983	613	462
1960	518	343	1984	911	677
1961	1,029	712	1985	965	628
1962	1,268	916	1986	344	323
1963	1,003	762	1987	955	575
1964	1,134	954	1988	721	525
1965	1,499	1,238	1989	1,519	904
1966	1,727	1,364	1990	229	132
1967	1,731	1,185	1991	1,232	586
1968	1,294	980	1992	225	117
1969	1,175	909	1993	1,351	690
1970	1,279	1,143	1994	632	363
1971	1,144	1,010	1995	1,080	729
1972	881	758	1996	1,019	747
1973	1,216	1,071	1997	768	735
1974	1,289	915	1998	365	353
1975	879	629	1999	288	263
1976	1,225	893	2000	380	364
1977	1,189	873	2001	500	508
1978	1,210	723			
			TOTAL	40,747	30,213

History of Juvenile Spacing and Fertilization

Table 7 - TFL 46 Juvenile Spacing and Fertilization History

⁹ The planting numbers were adjusted to reflect current TFL boundaries

Year	Ha Juvenile Spacing Completed	Ha. Fertilization Completed	Year	Ha Juvenile Spacing Completed	Ha. Fertilization Completed
1968	83	0	1986	628	0
1969	180	0	1987	855	0
1970	183	0	1988	542	0
1971	192	0	1989	66	0
1972	210	0	1990	109	0
1973	588	0	1991	30	0
1984	597	0	1992	260	0
1975	512	233	1993	640	0
1976	1,914	255	1994	440	0
1977	2,703	404	1995	0	0
1978	2,587	764	1996	15.6	211.0
1979	1,827	986	1997	51.0	103.7
1980	1,870	2,021	1998	7.5	18.1
1981	2,038	2,362	1999	108.6	27.1
1982	910	3,885	2000	21.6	339
1983	1,315	0	2001	70.0	410.5
1984	200	0			
1985	569	0			
			TOTAL	22,322.3	12,019.4

History of Pruning

Table 8 - TFL 46 Pruning History

Year	Ha Pruned
2000	15.4

3.0 SILVICULTURE STRATEGIES

The following section outlines potential silviculture opportunities as indicated through the examination of timber supply analysis, and in consultation with agencies and TimberWest Staff. The opportunity hectares are derived using local knowledge, and available information. In several cases, the estimates are purely conjecture as the planning phase necessary to define treatment hectares is either in progress or yet to be completed eg. Landscape unit planning, ungulate winter range planning, roadside strategies etc.

3.1 Timber Quantity Strategies

Strategies	Rationale	Target Strata	Silviculture Activities	Expected Gain	Opp.* in next 5 years (ha/yr)	Opp. In next 10 years (ha/yr)
*Opportunity						
3.1.1 Short Term¹⁰						
♦ 3.1.1.1 Use alternative silviculture systems and commercial thinning, where watershed/adjacency/visual constraints limit short term harvests	♦ This strategy will increase harvesting opportunities in otherwise constrained areas	♦ Merchantable stands constrained by forest cover constraints (i.e. greenup, VEG etc.)	♦ Utilization of silviculture systems that retain sufficient cover to meet requirements	♦ Reduce impact of spatial & temporal constraints ♦ Employment ♦ Financial gain (Opportunity cost of leaving 1m ³ 5yrs = \$5.41/m ³ -assume 8% ret., stump. \$15/m ³) ♦ Enhance wildlife habitat	High Opp. IF ¹¹ 40ha/yr	High Opp. IF 40ha/yr

¹⁰ Short Term - The next 20 years

¹¹ IF - Industry Funded

Timber Quantity Con't

Strategies	Rationale	Target Strata	Silviculture Activities	Expected Gain	Opp.* in next 5 years (ha/yr)	Opp. In next 10 years (ha/yr)
					*Opportunity	
<ul style="list-style-type: none"> ◆ 3.1.1.2 Accelerate regenerating tree height growth in areas adjacent to timber constrained by visual quality, water shed recovery, and green-up minimum threshold values 	<ul style="list-style-type: none"> ◆ TFL46 is a heavily constrained land base. The timber supply model is not sensitive to short term constraints. However, intuitively and in reviewing the 20 yr plan, these constraints affect short term availability of timber. There is an opportunity to strategically apply silviculture techniques to reduce the impact of the height related constraints and in effect also reduce rotation ages. 	<ul style="list-style-type: none"> ◆ New plantations, immature plantations adjacent to constrained timber 	<ul style="list-style-type: none"> ◆ Prompt planting ◆ Enhanced basic silviculture¹² - large stock, genetically improved stock, fert. At planting ◆ Intensive veg. Management ◆ Multiple stand entries for fert. ◆ Areas of deciduous to help green-up 	<ul style="list-style-type: none"> ◆ Enhance long term harvest levels ◆ Reduce impact of spatial & temporal constraints ◆ Employment opportunities ◆ Financial -Gain associated with earlier stand availability 	Basic silv. -IF High Opp. EF ¹³ for: <u>Post 1987</u> 500 ha enhanced basic <u>Pre 1987</u> 100 ha early rotation fert. 20 ha - intensive veg management for 3 years	Basic silv. IF High Opp. Given EF for: <u>Post 1987</u> 500 ha <u>Pre 1987</u> 100 ha
<ul style="list-style-type: none"> ◆ 3.1.1.3 Late rotation fertilization - Stands scheduled for harvest 7-12 years from now 	<ul style="list-style-type: none"> ◆ Accelerate volume growth prior to harvest 	<ul style="list-style-type: none"> ◆ Fd leading 2nd growth stands ◆ Appropriate stand characteristics ◆ SI 25-35 (Blackwell report) 	<ul style="list-style-type: none"> ◆ Aerial broadcast fertilization 	<ul style="list-style-type: none"> ◆ Enhance short term harvest levels (Assume 10% increase in volume) ◆ Enhance wildlife habitat ◆ Financial Gain ◆ Enhance timber quality objectives 	High Opp given EF 280 ha	High Opp given EF 280 ha

¹² The Government does not fund enhanced basic activities at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests.

¹³ EF - External Funding -i.e. FRBC

Timber Quantity Con't

Strategies	Rationale	Target Strata	Silviculture Activities	Expected Gain	Opp.* in next 5 years (ha/yr)	Opp. In next 10 years (ha/yr)
*Opportunity						
3.1.2 Long Term¹⁴						
♦ 3.1.2.1 An effective basic reforestation program Post 1987 areas	♦ A high quality, effective basic reforestation program is critical to capture the full productive potential of the land base and maximize long term outputs. This will minimize regen delay times, reduce brushing costs, encourage rapid height growth and reduce growing times to first entry age	♦ All harvested areas logged after 1987 that are not free growing	♦ Immediate planting ♦ Robust healthy stock, genetically improved stock ♦ Capture root growth window to encourage survival ♦ Prioritize full utilization of favorable microsite planting over spacing distribution ♦ Monitoring ♦ Timely veg. Mgt.	♦ Enhance long term harvest levels ♦ Reduce the impact of spatial & temporal constraints on timber supply ♦ Enhance timber quality obj. ♦ Financial - reduced veg. Mgt costs	Ongoing -IF	IF
♦ 3.1.2.2 An effective basic reforestation program Pre 1987 areas	♦ 0 NSR at this time ♦ Same rationale as post 1987 lands	♦ All harvested areas logged prior to 1987 that are not free growing	♦ Monitoring surveys ♦ Vegetation Management ♦ Surveys in support of incremental strategies	♦ Enhance long term harvest levels ♦ Enhance timber quality objectives ♦ Reduce impact of spatial & temporal constraints ♦ Employment	Ongoing - EF 350 total ha FG svy 60 total ha Veg mgt 100 ha/yr surveys for incremental strategies	

¹⁴ Long Term - When timber supplies are forecast to reach the steady long term harvest level. For TFL 46, this immediately follows the short term period.

Timber Quantity Con't

Strategies	Rationale	Target Strata	Silviculture Activities	Expected Gain	Opp.* in next 5 years (ha/yr)	Opp. In next 10 years (ha/yr)
					*Opportunity	
<ul style="list-style-type: none"> ◆ 3.1.2.3 Continue to use available genetically improved stock and expand to additional species where possible 	<ul style="list-style-type: none"> ◆ Genetically improved Cw and Fd shown significant increase in volume production which corresponds to faster height growth and shortened rotations 	<ul style="list-style-type: none"> ◆ Sites where Fd and Cw are the highest value species 	<ul style="list-style-type: none"> ◆ Plant genetically improved Fd and Cw on appropriate microsites 	<ul style="list-style-type: none"> ◆ Enhance long term harvest levels (Cw-5%gain. Fd-8%gain. A 1% inc. in vol. est.=4700m³) ◆ Reduce impact of spatial & temporal constraints ◆ Financial Gain 	High Opp Planting-IF	High Opp Planting-IF
<ul style="list-style-type: none"> ◆ 3.1.2.4 Assess productivity of previously deactivated areas and rehabilitate degraded areas currently outside the THLB 	<ul style="list-style-type: none"> ◆ Restoration of degraded areas currently netted out of the timber supply analysis provides an opportunity to increase the THLB. In addition, areas previously deactivated and revegetated need to be assessed and added back into the THLB where appropriate to do so. 	<ul style="list-style-type: none"> ◆ Deactivated roads ◆ Road edges (<14m) ◆ Gravel Pits ◆ Other as determined 	<ul style="list-style-type: none"> ◆ Assess deactivated roads for productivity ◆ Institute reveg. /planting program ◆ Plant, fertilize, seed ◆ Intensive roadside stocking/veg management program to reduce degraded area 	<ul style="list-style-type: none"> ◆ Increase the area of THLB by 759 ha (1.2%) ◆ Enhance long term harvest levels ◆ Employment ◆ Financial - undetermined 	High Opp. Given EF (Assume 30% recovery of 2530 ha of roads) 50 ha/yr	High Opp. Given EF 100 ha/yr

Timber Quantity Con't

Strategies	Rationale	Target Strata	Silviculture Activities	Expected Gain	Opp.* in next 5 years (ha/yr)	Opp. In next 10 years (ha/yr)
					*Opportunity	
<ul style="list-style-type: none"> ◆ 3.1.2.5 Manage areas suited to high yield, shorter rotation hardwood management where hardwoods have high productivity 	<ul style="list-style-type: none"> ◆ Opportunity exists to manage hardwoods where they are productive and cost effective species. 	<ul style="list-style-type: none"> ◆ Stands where conifer establishmnt would be limited to high microsites at < 150stems/ha ◆ Root rot areas ◆ areas with seasonally high water tables ◆ Wet draws & gullies 	<ul style="list-style-type: none"> ◆ Regenerate deciduous species ◆ Intensively manage Deciduous Sp. utilizing spacing, pruning or herbicides where positive returns can be realized 	<ul style="list-style-type: none"> ◆ Enhance long term harvest levels ◆ Enhancement of habitat values ◆ Potential financial gain 	Moderate Opp. -IF 30 ha	Moderate Opp. -IF 120 ha
<ul style="list-style-type: none"> ◆ 3.1.2.6 Intensively Manage Selected Stands to add Value 	<ul style="list-style-type: none"> ◆ An opportunity exists to employ multiple entries to produce forest products earlier and on a continual basis. Opportunities include the intensive management of roadside stratus. 	<ul style="list-style-type: none"> ◆ Roadside stratus with easy access ◆ SI 30+, Suitable immature & 2nd growth stands & newly harvested areas 	<ul style="list-style-type: none"> ◆ Enhanced Basic Silviculture¹⁵-High density (1200st/ha) initial reforestation ◆ Multiple harvest entries ◆ Multiple fertilizings-aerial or manual 	<ul style="list-style-type: none"> ◆ Reduce impact of spatial & temporal constraints ◆ Enhance harvest levels (Assume from fert. a 10% gain in 2nd growth - 1 entry, 25% gain in new plantations- 2 entries) ◆ Enhance habitat values ◆ Employment ◆ Financial Gain - realize profits earlier 	High Opp. Basic Silv - IF Given EF: 10 ha incremental density planting 20 ha 2 nd growth stand management	High Opp. Basic Silv - IF Given EF: 50 ha incremental density planting 20 ha 2 nd growth stand management

¹⁵ The Government does not fund enhanced basic activities at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests.

3.2 Timber Quality Strategies

Strategies	Rationale	Target Strata	Silviculture Activities	Expected Gain	Opp.* in next 5 years (ha/yr)	Opp in next 10 years (ha/yr)
*Opportunity						
3.2.1 Short Term						
♦ None identified						
3.2.2 Long Term						
♦ 3.2.2.1 To target the highest value mix of species when implementing silviculture treatments	♦ To select the highest value mix of species as an effective method of increasing the quality of the stand - increased growth and yield performance and maintaining future options	♦ All Plantations ♦ Stands subject to stocking control or fertilizing treatments	♦ Strategic planting of ecologically suited species ♦ Retention of desirable species when delivering silv. Programs ♦ Fertilization of desirable species	♦ Enhance long term harvest levels ♦ Reduce impact of spatial & temporal constraints ♦ Potential financial gain	High Opp. Basic Silv -IF Strategy to be implemented in conjunction with silv. Treatments	High Opp. Basic Silv -IF Strategy to be implemented in conjunction with silv. Treatments
♦ 3.2.2.2 Strategically implement longer rotation for stands where harvesting must be delayed or extensive harvesting is undesirable	♦ Ensures a component of the land base produces larger piece sizes with the potential of contributing premium quality logs	A component of ♦ Riparian Management Zones ♦ Visual quality zones ♦ Stand level reserves ♦ Temp. deferred areas ♦ Gullies	♦ May consider Stocking control to differentiate species, fertilization	♦ Enhance timber quality objectives ♦ Enhancement of habitat values ♦ Employment	Mod. Opp given EF 10 ha Comm. Thin and fert. if positive returns	Mod. Opp given EF 10 ha Comm. Thin and fert. if positive returns

Timber Quality Con't

Strategies	Rationale	Target Strata	Silviculture Activities	Expected Gain	Opp.* in next 5 years (ha/yr)	Opp in next 10 years (ha/yr)
*Opportunity						
<ul style="list-style-type: none"> ◆ 3.2.2.3 Strategically prune trees to create knot free wood 	<ul style="list-style-type: none"> ◆ An opportunity exists to strategically prune trees in conjunction with roadside brushing traditionally done to address visibility and safety concerns along roadsides. This would provide high quality trees immediately adjacent to the road for easy harvest 	<ul style="list-style-type: none"> ◆ Second growth stands - roadsides and road corners ◆ Target trees within 10-15m of the road edge ◆ 5-6m lift ◆ Managed stands from 3.1.2.6 	<ul style="list-style-type: none"> ◆ Hydraulic pruning from trucks along the roadsides ◆ Stocking control (Commercial Thin) ◆ Fertilization 	<ul style="list-style-type: none"> ◆ Financial - lower pruning costs, lower harvest costs ◆ Enhance timber quality objectives ◆ Employment 	High Opp. Given EF: 20 ha	High Opp. Given EF: 30 ha
<ul style="list-style-type: none"> ◆ 3.2.2.4 To intensify forest health management to reduce loss and damage to timber by insects and disease 	<ul style="list-style-type: none"> ◆ An opportunity exists to reduce the netdown to timber supply for forest health which would increase the amount of available timber. TFL 46 has areas with root rot, spruce weevil balsam woolly adelgid, and white pine blister rust. 	<ul style="list-style-type: none"> ◆ Infected Stands ◆ New plantations with a history of disease ◆ Young Pre 1987 plantations with areas of infection large enough to make treatment worthwhile 	<ul style="list-style-type: none"> ◆ Stand level disease surveys to identify areas for projects ◆ Plant resistant stock or alternative species ◆ Sanitize or harvest infected area and plant with appropriate tree species. 	<ul style="list-style-type: none"> ◆ Increase stand yields proportional to % decrease in diseased vol. ◆ Enhance long term harvest levels ◆ Increase operational flexibility ◆ Employment ◆ Financial - undetermined 	Basic Silv., surveys/treatments -IF Mod. Opp given EF: 300 ha of TFL surveys 0-5 ha of treatment of areas post FG	Basic Silv., surveys/treatments -IF Mod. Opp given EF: 300 ha of TFL surveys 0-5 ha of treatment of areas post FG

3.3 Habitat Strategies

Strategies	Rationale	Target Strata	Silviculture Activities	Expected Gain	Opp.* in next 5 years (ha/yr)	Opp in next 10 years (ha/yr)
3.3.1 Short Term						
♦ 3.3.1.1 To employ silv methods to create over wintering habitat for deer	♦ Some of the 2 nd growth UWRs do not have optimal habitat for over wintering deer. This work would create old growth attributes to improve the habitat values	♦ 2 nd growth UWR with habitat values	♦ Stocking Control , Pruning ♦ Pruning of understory veg ♦ Establishment of forage species (i.e seeding)	♦ Enhance wildlife habitat ♦ Enhance short term harvest levels ♦ Provide employment	High Opp. Given EF: Estimate 25 ha Habitat Creation	Uncertain at this time
♦ 3.3.1.2 To employ silv methods to create forage opportunities for deer	♦ When the UWRs are confirmed, each will have a FMZ. A certain level of forage is to be provided within the zone. Several UWR are surrounded by 2 nd growth stands with little forage value	♦ 2 nd growth stands within FMZ where forage is limiting	♦ Stocking Control, Pruning ♦ Pruning of understory veg ♦ Establishment of understory veg	♦ Enhance wildlife habitat ♦ Reduce timing constraints on harvest ♦ Enhance short term harvest levels ♦ Provide employment	High Opp Given EF: Estimate 15 ha Forage Creation	Uncertain at this time
♦ 3.3.1.3 Restoration and Enhancement of Riparian Reserves	♦ Selective harvest of second growth riparian reserve zones can be used to enhance riparian values while contributing volume to short term harvest levels.	♦ Accessible second growth riparian reserve zones which can benefit from stocking control	♦ Commercial Thinning ♦ Fertilization ♦ Planting of beneficial species ♦ Vegetation Mgmt	♦ Enhance wildlife/fisheries habitat ♦ Provide employment ♦ Enhance short term harvest levels	High Opp. IF 15 ha	High Opp. IF 25 ha

Habitat Con't

Strategies	Rationale	Target Strata	Silviculture Activities	Expected Gain	Opp.* in next 5 years (ha/yr)	Opp. In next 10 years (ha/yr)
*Opportunity						
<ul style="list-style-type: none"> 3.3.1.4 Restoration of watersheds and riparian areas <p>(The tree planting portion of this strategy contributes to the long term response time frame)</p>	<ul style="list-style-type: none"> The restoration of these areas will positively influence water quality, moderate peak flows, improve habitat values and impact on future watershed assessment determinations which ultimately affect harvest levels. 	<ul style="list-style-type: none"> Slides Road ditches and cutslopes Streamsides and sandbars Riparian management areas 	<ul style="list-style-type: none"> RMAs- Stocking control, planting of preferred species willow/ cottonwood planting of sandbars and streamsides slide restoration grass seeding 	<ul style="list-style-type: none"> Enhance wildlife/fisheries habitat Provide employment Reduce the impact of spatial and temporal constraints Enhance short term harvest levels Stabilize bedloads 	<p>High Opp.</p> <p>FPC grass seeding -IF</p> <p>Given EF</p> <p>20 ha</p>	<p>High Opp.</p> <p>FPC grass seeding -IF</p> <p>Given EF</p> <p>20 ha</p>
<ul style="list-style-type: none"> 3.3.1.5 Develop a program to control the spread of invasive exotic plants 	<ul style="list-style-type: none"> Some species of invasive exotic plants compete with indigenous vegetation and ultimately degrade habitat values 	<ul style="list-style-type: none"> Areas of Gorse, Scotch broom, Blackberry and Japanese knotweed 	<ul style="list-style-type: none"> Manual brushing and/or chemical treatment Grass Seeding 	<ul style="list-style-type: none"> Enhance wildlife habitat Provide employment Enhance long term harv. levels 	<p>Mod Opp</p> <p>Given EF:</p> <p>20 ha</p>	<p>Mod Opp</p> <p>Given EF:</p> <p>20 ha</p>
3.3.2 Long Term						
<ul style="list-style-type: none"> 3.3.2.1 Creation of old growth characteristics in suitable second growth to meet seral stage targets 	<ul style="list-style-type: none"> This is a strategy to create old growth attributes in 2nd growth stands to meet old growth seral targets where there is insufficient old growth or to work towards moving OGMA's in the THLB into non contributing 2nd growth stands that in the long run may have higher values eg move to lower elevation 2nd growth. 	<ul style="list-style-type: none"> 2nd growth stands in non contributing areas with high habitat values or potential for high habitat values 	<ul style="list-style-type: none"> Commercial Thinning Fertilization Promotion of suitable understory vegetation 	<ul style="list-style-type: none"> Enhance long term harvest levels Address some issues around forest level biodiversity Provide Employment Financial - free up constrained timber 	<p>High Opp</p> <p>Given EF:</p> <p>Estimate 45 ha Old growth creation projects</p>	<p>High Opp</p> <p>Given EF:</p> <p>100 ha Old growth creation projects</p>

3.4 Other Projects and Further Planning Initiatives

The initiatives listed below will form the basis of future silviculture activities.

Planning Initiatives	Rationale	Activity	Expected Gain
<ul style="list-style-type: none"> ◆ 3.4.1 Increase Knowledge regarding volume response on high sites (SI 35+) to fertilization 	<ul style="list-style-type: none"> ◆ Potential opportunities to provide additional volume growth on high sites. Testing has revealed potential benefits up to SI 37 on some sites. Further work is needed to determine treatment regimes. 	<ul style="list-style-type: none"> ◆ Establishment of field trials and foliar analysis ◆ Measurement Surveys 	<ul style="list-style-type: none"> ◆ High potential gains as there is a large component of high site lands on the TFL.
<ul style="list-style-type: none"> ◆ 3.4.2 Increase the knowledge regarding volume response to manual fertilization of individual stems within a stand 	<ul style="list-style-type: none"> ◆ Potential opportunity to provide additional volume growth on individual trees within stands where Fd is not the leading species or where small scale thinning has occurred. 	<ul style="list-style-type: none"> ◆ Establishment of field trials and foliar analysis ◆ Measurement Surveys 	<ul style="list-style-type: none"> ◆ High potential gains as there is a large component of Fd in non Fd leading stands.
<ul style="list-style-type: none"> ◆ 3.4.3 Research the feasibility of strip spacing dense Hw stands 	<ul style="list-style-type: none"> ◆ Possible lower cost treatment than traditional stocking control. This method is anticipated to have less post treatment blowdown issues yet still provide benefits of spacing -improved growth on residuals resulting in faster height growth and all associated benefits. 	<ul style="list-style-type: none"> ◆ Establish trial area in dense Hw stand, less than 15 yrs old, >SI 27, Cut strips or swaths through the stand to improve growing conditions for residual trees. 	<ul style="list-style-type: none"> ◆ Reduce impact of spatial & temporal constraints ◆ Enhance timber supply ◆ Habitat enhancement (easier travel through treatment areas, dense stands adjacent to opening for cover etc.) ◆ Reduced spacing costs
<ul style="list-style-type: none"> ◆ 3.4.4 To develop an updated Comprehensive Ungulate Habitat Management Plan 	<ul style="list-style-type: none"> ◆ A comprehensive plan would be beneficial to provide a framework for future investment in forage enhancement and over wintering habitat creation. 	<ul style="list-style-type: none"> ◆ Consolidation of existing information into a comprehensive plan which includes clear program objectives and strategies for future forage production. 	<ul style="list-style-type: none"> ◆ Relaxation of harvest constraints. Currently the timing of harvest activities within the vicinity of identified UWR is constrained due to government agency concerns around forage management. ◆ Ensure adequate forage levels are maintained adjacent to UWRs.
<ul style="list-style-type: none"> ◆ 3.4.5 To develop a landscape unit planning strategy 	<ul style="list-style-type: none"> ◆ Large areas of the TFL land base are tied up in the landscape unit planning process including areas for marbled murrelet, old growth, goshawk, UWRs, red listed plant communities and the forest ecosystem network. There is an opportunity to develop a comprehensive plan to address identified habitat concerns while minimizing the impact on timber supply. 	<ul style="list-style-type: none"> ◆ Develop a comprehensive strategy that identifies suitable retention areas to address wildlife and habitat concerns while minimizing the impact on the THLB. The strategy would include identification of suitable 2nd growth areas for old growth creation projects. 	<ul style="list-style-type: none"> ◆ Reduce the area of THLB currently constrained under the uncertainty of landscape unit planning. ◆ An effective plan will minimize the impact on timber supply by potentially relocating interest areas currently in the THLB into non contributing areas. ◆ Increased efficiency to operational planning

Other Project and Future Planning Initiatives Con't

Planning Initiatives	Rationale	Activity	Expected Gain
♦ 3.4.6 To work with First Nations, to identify their cultural needs and concerns with respect to silviculture	♦ Further understanding of First Nations traditional use of vegetation can provide opportunities to consider First Nations values in future silviculture programs.	♦ Meet with First Nations to discuss issues and concerns that are impacted by silviculture. Where appropriate, incorporate strategies to address First Nations concerns.	♦ Building a positive relationship - Consideration given to the cultural needs and concerns of First Nations

4.0 Silviculture Priorities

The following table, indicates the relative ranking of the silviculture strategies developed at the workshop. A '+' mark is used to indicate a positive contribution under 'Silviculture Program Objective'. Financial is not included as a category under the silviculture objectives as all programs are subject financial analysis prior to commencement. In addition, the financial benefits of some of these strategies is yet to be determined.

Important Consideration: These rankings were determined by participants at the workshop and are provided as general guidance only. The rankings and/or relative importance of these projects is subject to change given new information or changes in government or company direction.

Ranking Category	Silviculture Strategy	Silviculture Program Objective			
		Timber Quantity ¹⁶	Timber Quality	Habitat ¹⁷	Employment
High	♦ 3.1.2.1 An effective basic reforestation program - Post 1987 areas	+	+		+
	♦ 3.1.2.2 An effective basic reforestation program - Pre 1987 areas	+	+		+
	♦ 3.1.2.3 Continue to use available genetically improved stock and expand to additional species where possible	+	+		+
	♦ 3.2.2.1 To target the highest value species when implementing silviculture treatments	+	+		
	♦ 3.1.1.2 Accelerate regenerating tree height growth in areas adjacent to timber constrained by visual quality, watershed recovery, and green-up minimum threshold values	+	+	+	+
	♦ 3.4.4 To develop an updated comprehensive ungulate winter range habitat management plan	+		+	
	♦ 3.3.1.2 To employ silviculture methods to create forage opportunities for deer	+		+	+
	♦ 3.1.1.3 Late rotation fertilization - stands scheduled for harvest in 7-12 years	+	+	+	+
	♦ 3.4.1 Increase knowledge regarding volume response on high sites (>SI37) to fertilization	+	+	+	+
	♦ 3.4.2 Increase knowledge regarding volume response to manual fertilization of individual stems within a stand	+	+		+
	♦ 3.4.5 To develop a landscape unit planning strategy	+			
	♦ 3.3.1.4 Restoration of watersheds and riparian areas	+		+	+
	♦ 3.1.2.6 Intensively manage selected stands to add value	+	+	+	+
Ranking	Silviculture	Silviculture Program Objective			

¹⁶ Strategies that increase volume, are also considered beneficial to timber quality as there is an increase in piece size.

¹⁷ Strategies that utilize aerial fertilization are assumed to increase production of understory vegetation which is considered beneficial to wildlife.

Category	Strategy				
		Timber Quantity ¹⁸	Timber Quality	Habitat ¹⁹	Employment
	♦ 3.3.1.5 Develop a program to control the spread of invasive exotic plants	+		+	+
Medium	♦ 3.1.1.1 Increase the use of alternative silviculture systems and commercial thinning, where watershed/adjacency/visual constraints limit short term harvest	+	+	+	+
	♦ 3.3.1.1 To employ silviculture methods to create over wintering habitat for deer	+		+	+
	♦ 3.3.2.1 Creation of old growth characteristics in suitable second growth to meet seral stage targets	+		+	+
	♦ 3.3.1.3 Restoration and Enhancement of Riparian Reserves	+		+	+
	♦ 3.1.2.4 Assess productivity of previously deactivated areas and rehabilitate degraded areas currently outside the THLB	+	+	+	+
	♦ 3.2.2.2 Strategically implement longer rotations for stands where harvesting must be delayed or extensive harvesting is undesirable		+	+	
Low	♦ 3.4.6 To work with First Nations, to identify their cultural needs and concerns with respect to silviculture				
	♦ 3.1.2.5 Manage areas suited to higher yield, shorter rotation hardwood management where hardwoods have high productivity	+	+	+	+
	♦ 3.2.2.4 To intensify forest health management to reduce loss and damage to timber by insects and disease	+			+
	♦ 3.2.2.3 Strategically prune trees to create knot free wood		+		+
	♦ 3.4.3 Research the feasibility of strip spacing dense Hw stands	+	+	+	+

¹⁸ Strategies that increase volume, are also considered beneficial to timber quality as there is an increase in piece size.

¹⁹ Strategies that utilize aerial fertilization are assumed to increase production of understory vegetation which is considered beneficial to wildlife.

5.0 Silviculture Program

5.1 Working Targets

The following targets are intended as general guidelines. As stated earlier, incremental activities that are either post free growing or in some instances pre free growing (i.e. those activities that are not necessary to meet free growing), will not be undertaken by the Licensee without external funding assistance.

Timber Quantity

- ◆ Continued implementation of an effective basic reforestation program on pre and post 1987 land base. Following are specific targets:
 - ◆ Minimize regen delay times 2 years or less
 - ◆ Settings 2 years following logging completion 98% SR
 - ◆ Utilize strategies to minimize vegetation²⁰ management <30ha/yr
 - ◆ Use of 100% genetically improved Fd and Cw stock when available
- ◆ Strategically manage regenerating areas adjacent to constrained timber to meet or exceed the timelines modeled in the timber supply analysis as defined in *TABLE 3*, pg 15.
(This will inherently provide a benefit in visual quality zones and sensitive watersheds as well)
- ◆ Fertilize at least 75% of suitable second growth stands projected for harvest in 7-12 years.
- ◆ Complete planning projects on non-timber resource values that are currently constraining the THLB. These include the landscape unit planning process and the ungulate winter range habitat management plan and associated forage maintenance strategies.
- ◆ Survey 100% of previously deactivated roads for productivity and stocking. Adjust future timber supply assumptions as necessary.
- ◆ Develop a model for intensive management of roadside stands to add volume and value.
- ◆ Develop a hardwood management strategy to identify suitable sites and outline regeneration and management regimes.

Timber Quality

- ◆ Implement effective silviculture programs and stand retention strategies within harvested areas to promote the development of at least 10% premium sawlogs.
- ◆ Operational prescriptions will target the retention of high value species in all silviculture programs.

²⁰ Vegetation in this case excludes deciduous competition such as alder and maple

- ◆ Forest health of the TFL to be assessed and the timber supply assumptions adjusted accordingly.

Habitat

- ◆ Continued restoration of disturbed areas deemed detrimental to downstream fisheries values.
- ◆ The elimination of Gorse from the TFL and implementation of programs to control the spread of other invasive exotic species such as scotch broom, blackberry and Japanese knotweed.
- ◆ Develop prescriptions and implement stand improvement programs in all confirmed second growth ungulate winter ranges to improve habitat values.
- ◆ Develop prescriptions and implement suitable silviculture strategies to provide at minimum, the threshold hectares of forage as identified in the ungulate winter range habitat plan.²¹

Other

- ◆ As needed, conduct research projects in support of the program objects and working targets above.

²¹ The ungulate winter range habitat management plan is yet to be fully developed and is included under timber quantity as a project.

5.2 Incremental Program Costs and Benefits

5.21 Estimated Area treated by Activity and Year

Strategy	Year	Estimated Program Hectares									Total Ha	
		Surveys	Seed	Bank Stabilization	Planting	Large Stock Planting ²²	Early Rotation Fert. ²³	Late Rotation Fert.	Vegetation Management	Prune		
TIMBER QUANTITY												
3.1.1.2 Accelerate regenerating tree height growth in areas adjacent to constrained timber	1					500	500	100 ²⁴		20 ²⁵		1120
	2					500	500	100		20		1120
	3					500	500	100		20		1120
	4					500	500	100				1100
	5					500	500	100				1100
3.1.1.3 Late rotation fertilization	1								280			280
	2								280			280
	3								280			280
	4								280			280
	5								280			280
3.1.2.2 An effective basic reforestation program -Pre 1987 land base	1	450								60		450
	2	100										160
	3	100										100
	4	160 ²⁶								20		180
	5	100										100
3.1.2.4 Assess productivity of previously deactivated areas and rehabilitate degraded areas currently outside the THLB	1	250	20			50	50			20		390
	2	250	20			50	50			20		390
	3	250	20			50	50			20		390
	4		20			50	50			20		140
	5		20			50	50			20		140

²²Enhanced basic silviculture. Shaded areas: The incremental cost of large stock is not funded by the Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

²³ Enhanced basic silviculture. Shaded areas: The cost of pre free growing fertilization is not funded by the Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

²⁴ Hectares for pre 1987 areas

²⁵ Areas where brush is inhibiting the achievement of green-up on pre 1987 lands

²⁶ An additional 60ha to re-survey any problem areas identified in year 1

Strategy	Year	Estimated Program Hectares										Total Ha
		Surveys	Seed	Bank Stabilization	Planting	Large Stock Planting ²⁷	Early Rotation Fert. ²⁸	Late Rotation Fert.	Vegetation Management	Stocking Control	Prune	
TIMBER QUANTITY CON'T												
3.1.2.5 Manage areas suited to higher , shorter rotation hardwood management	1	30 ²⁹										30
	2	30								10		40
	3	30								10		40
	4	30								10		40
	5	30								10		40
3.1.2.6 Intensively manage selected stands to add value	1	30				10 ³⁰	10	20				70
	2	30				10	10	20				70
	3	30				10	10	20				70
	4	30				10	10	20				70
	5	30				10	10	20				70
TOTAL		1960	100			2800	3300	1500	240	40		9940

²⁷ Enhanced basic silviculture. Shaded areas: The incremental cost of large stock is not funded by the Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

²⁸ Enhanced basic silviculture. Shaded areas: The cost of pre free growing fertilization is not funded by the Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

²⁹ Pre harvest surveys to find suitable areas for hardwood management.

³⁰ For this strategy, this column indicates ha with incremental cost of planting at increased densities (i.e. 1200stems/ha rather than FPC 900 stems/ha). This is not funded by Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

Strategy	Year	Estimated Program Hectares										Total Ha
		Surveys	Seed	Bank Stabilization	Planting	Large Stock Planting ³¹	Early Rotation Fert. ³²	Late Rotation Fert.	Vegetation Management	Stocking Control	Prune	
TIMBER QUALITY												
3.2.2.2 Strategically implement longer rotations for stands where harvesting must be delayed or extensive harvesting is undesirable	1	40						10				50
	2	40						10				50
	3	40						10				50
	4	40						10				50
	5	40						10				50
3.2.2.3 Strategically prune trees to create knot free wood	1										10	10
	2										10	10
	3										20	20
	4										30	30
	5										30	30
3.2.2.4 To intensify forest health management to reduce loss and damage to timber by insects & disease (Pre 1987 lands)	1	300				5		5				310
	2	300				5		5				310
	3	300				5		5				310
	4	300				5		5				310
	5	300				5		5				310
TOTAL		1700				25		75			100	1900

³¹ Enhanced basic silviculture. Shaded areas: The incremental cost of large stock is not funded by the Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

³² Enhanced basic silviculture. Shaded areas: The cost of pre free growing fertilization is not funded by the Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

Strategy	Year	Estimated Program Hectares										Total Ha
		Surveys	Seed	Bank Stabilization	Planting	Large Stock Planting ³³	Early Rotation Fert. ³⁴	Late Rotation Fert.	Vegetation Management	Stocking Control	Prune	
HABITAT												
3.3.1.1 To employ silviculture methods to create over wintering habitat for deer	1	25	10									60
	2	25	10									60
	3	25	10									60
	4	25	10									60
	5	25	10									60
3.3.1.2 To employ silviculture methods to create forage opportunities for deer	1	15								10	10	40
	2	15								10	10	40
	3	15								10	10	40
	4	15								10	10	40
	5	15								10	10	40
3.3.1.3 Restoration and enhancement of riparian reserves	1	15				5	15		5			55
	2	15				5	15		5			55
	3	15				5	15		5			55
	4	15				5	15		5			55
	5	15				5	15		5			55
3.3.1.4 Restoration of watersheds and riparian area	1	20	20	2		5	5					52
	2	20	20	2		5	5					52
	3	20	20	2		5	5					52
	4	20	20	2		5	5					52
	5	20	20	2		5	5					52
3.3.1.5 Develop a program to control the spread of invasive exotic plants	1	40	20						20			80
	2	40	20						20			80
	3	40	20						20			80
	4	40	20						20			80
	5	40	20						20			80

³³Enhanced basic silviculture. Shaded areas: The incremental cost of large stock is not funded by the Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

³⁴ Enhanced basic silviculture. Shaded areas: The cost of pre free growing fertilization is not funded by the Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

Strategy	Year	Estimated Program Hectares										Total Ha
		Surveys	Seed	Bank Stabilization	Planting	Large Stock Planting ³⁵	Early Rotation Fert. ³⁶	Late Rotation Fert.	Vegetation Management	Stocking Control	Prune	
3.3.2.1 Creation of old growth characteristics in suitable second growth to meet seral stage targets	1	50										50
	2	50				2	25					102
	3	50				2	25					102
	4	50				2	25					102
	5	50				2	25					102
TOTAL		825	250	10		58	200		125	50	50	1568

The items list below are research projects and planning initiatives. The projects that involve dollars for surveys or experimental treatments are included here. It is anticipated that some of these projects will result in future silviculture activities.

Strategy	Year	Estimated Program Hectares										Total Ha
		Surveys	Seed	Bank Stabilization	Planting	Large Stock Planting	Early Rotation Fert	Late Rotation Fert.	Vegetation Management	Stocking Control	Prune	
PLANNING INITIATIVES												
3.4.1, 3.4.2 Increase knowledge regarding vol. response on high sites (SI35+) and to manual fert.	1	30						20				50
	2											
	3											
	4											
	5											
3.4.3 Research the feasibility of strip spacing dense Hw stands	1	30								20		50
	2											
	3											
	4											
	5											
TOTAL		60						20		20		100

³⁵Enhanced basic silviculture. Shaded areas: The incremental cost of large stock is not funded by the Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

³⁶³⁶ Enhanced basic silviculture. Shaded areas: The cost of pre free growing fertilization is not funded by the Government at this time. Future funding is contingent on consensus between TimberWest and Ministry of Forests

5.2.2 Expenditure by Activity and Year for All Activities

Activity	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Surveys	Ha						
	a) Surveys:	1325	915	915	725	665	4545
	\$/ha	28.00	28.00	28.00	28.00	28.00	28.00
	Total \$	37,100	25,620	25,620	20,300	18,620	127,260
Bank Stabilization	Ha	2	2	2	2	2	10
	\$/ha	2,000	2,000	2,000	2,000	2,000	2,000
	Total \$	4,000	4,000	4,000	4,000	4,000	20,000
Standard Planting	Ha	0	0	0	0	0	0
	\$/ha	800	800	800	800	800	800
	Total \$	0	0	0	0	0	0
Large Stock Planting (615)	Ha						
	a) Planting:	65	67	67	67	67	333
	b) Incremental planting of large stock ³⁷ :	500	500	500	500	500	2500
	c) Higher density ³⁸ plt:	10	10	10	10	10	50
	\$/ha a)	1061	1061	1061	1061	1061	1061
	b)	261	261	261	261	261	261
	c)	582	582	582	582	582	582
	Total \$ a)	68,965	71,087	71,087	71,087	71,087	353,313
	b)	130,500	130,500	130,500	130,500	130,500	652,500
	c)	5,820	5,820	5,820	5,820	5,820	29,100
Early rotation	Ha a) 900st/ha	670	695	695	695	695	3450
	b) 1200st/ha	10	10	10	10	10	50
	\$/ha³⁹ a)	189	189	189	189	189	189
Fertilization	b)	252	252	252	252	252	252
	Total \$ a)	126,630	131,355	131,355	131,355	131,355	652,050
	b)	2,520	2,520	2,520	2,520	2,520	12,600
Late rotation Fertilization	Ha	335	315	315	315	315	1595
	\$/ha⁴⁰	400	400	400	400	400	400
	Total \$	134,000	126,000	126,000	126,000	126,000	638,000
Vegetation Management	Ha	125	65	65	65	45	365
	\$/ha	700	700	700	700	700	700
	Total \$	87,500	45,500	45,500	45,500	31,500	255,500

³⁷ The cost shown here is to cover the incremental cost of planting stock larger than required to meet free growing. Based on \$.04 more per seedling to purchase and \$.25 more to plant at a density of 900 stems/ha= \$261.00. (Note this is not currently funded by Government. Future funding for this strategy is contingent on consensus between TimberWest and Ministry of Forests.)

³⁸ The cost shown here is to cover the incremental cost of planting 300 more trees/ha of large stock. Based on a planting cost of \$.47, a tree cost of \$.60 at 300 additional stems=\$321.00 Plus the incremental cost of large stock on the original 900 stems/ha of \$261.00/ha gives a total incremental cost of \$582.00/ha (Note this is not currently funded by Government. Future funding for this strategy is contingent on consensus between TimberWest and Ministry of Forests.)

³⁹ The cost shown is based on \$.14/teabag and \$.07 to apply when planting = \$0.21/tree. Based on 900stems/ha - \$189.00/ha. The 10 hectares scheduled for planting at 1200.00 are shown at \$252.00/ha

⁴⁰ The cost shown here is based on aerial application at a rate of \$400.00/ha

Activity	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Stocking Control	Ha	30	20	20	20	20	110
	\$/ha	1200	1200	1200	1200	1200	1200
	Total \$	36,000	24,000	24,000	24,000	24,000	132,000
Pruning	Ha	20	20	30	40	40	150
	\$/ha	2000	2000	2000	2000	2000	2000
	Total \$	40,000	40,000	60,000	80,000	80,000	300,000
Seeding	Ha	70	70	70	70	70	350
	\$/ha	750	750	750	750	750	750
	Total \$	52,500	52,500	52,500	52,500	52,500	262,500

5.2.2.1 Expenditure by Activity and Year for Enhanced Basic Silviculture

Activities

(Enhanced activities refer to those activities on post 1987 plantations currently not fundable by Government. Future Funding is contingent on consensus between TimberWest and Ministry of Forests)

Activity	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Large Stock Planting ⁴¹	a)Ha larger stock	500	500	500	500	500	2500
	\$/ha	261.00	261.00	261.00	261.00	261.00	261.00
	Total \$	130,500	130,500	130,500	130,500	130,500	652,500
	b)Ha larger stock & higher density ⁴²	10	10	10	10	10	50
	\$/ha	582.00	582.00	582.00	582.00	582.00	582.00
	Total \$	5,820	5,820	5,820	5,820	5,820	29,100
Early Rotation Fertilization ⁴³	a)Ha 900st/ha	500	500	500	500	500	2500
	\$/ha	189.00	189.00	189.00	189.00	189.00	189.00
	Total \$	94,500	94,500	94,500	94,500	94,500	472,500
	b)Ha 1200st/ha	10	10	10	10	10	50
	\$/ha	252.00	252.00	252.00	252.00	252.00	252.00
	Total \$	2,520	2,520	2,520	2,520	2,520	12,600

⁴¹ See table 5.2.2 for explanation the incremental cost of larger stock.

⁴² See table 5.2.2 for explanation the incremental cost of high density planting above 900st/ha.

⁴³ See table 5.2.2 for explanation the incremental cost of early rotation fertilization.

5.2.2.2 Expenditure by Activity and Year for Basic Silviculture Activities on Pre 1987 Plantations

Activity	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Surveys	Ha	450	100	100	160	100	910
	\$/ha	28.00	28.00	28.00	28.00	28.00	28.00
	Total \$	12,600	2,800	2,800	4,480	2,800	25,480
Large Stock Planting	Ha	5	5	5	5	5	25
	\$/ha	1061	1061	1061	1061	1061	1061
	Total \$	5,305	5,305	5,305	5,305	5,305	26,525
Early rotation Fertilization	Ha	100	100	100	100	100	500
	\$/ha	189	189	189	189	189	189
	Total \$	18,900	18,900	18,900	18,900	18,900	94,500
Vegetation Management	Ha	60			20		80
	\$/ha	700			700		700
	Total \$	42,000			14,000		56,000

5.2.2.3 Expenditure by Activity and Year for Incremental Silviculture Activities (Activities in excess of legal requirements)

Activity	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Surveys	Ha	710	650	650	400	400	2,810
	\$/ha	28.00	28.00	28.00	28.00	28.00	28.00
	Total \$	19,880	18,200	18,200	11,200	11,200	78,680
Large Stock Planting ⁴⁴	Ha	50	50	50	50	50	250
	\$/ha	1061	1061	1061	1061	1061	1061
	Total \$	53,050	53,050	53,050	53,050	53,050	265,250
Seed	Ha	20	20	20	20	20	100
	\$/ha	750	750	750	750	750	750
	Total \$	15,000	15,000	15,000	15,000	15,000	75,000
Vegetation Management	Ha	40	40	40	20	20	160
	\$/ha	700	700	700	700	700	700
	Total \$	28,000	28,000	28,000	14,000	14,000	112,000
Early Rotation Fertilization ⁴⁵	Ha	50	50	50	50	50	250
	\$/ha	189	189	189	189	189	189
	Total \$	9,450	9,450	9,450	9,450	9,450	47,250
Late Rotation Fertilization	Ha	335	315	315	315	315	1,590
	\$/ha	400	400	400	400	400	400
	Total \$	134,000	126,000	126,000	126,000	126,000	638,000
Prune	Ha	10	10	20	30	30	100
	\$/ha	2,000	2,000	2,000	2,000	2,000	2,000
	Total \$	20,000	20,000	40,000	60,000	60,000	200,000
Stocking Control	Ha	20	10	10	10	10	60
	\$/ha	1,200	1,200	1,200	1,200	1,200	1,200
	Total \$	24,000	12,000	12,000	12,000	12,000	72,000

⁴⁴ See table 5.2.2 for explanation of the cost of planting large stock.

⁴⁵ See table 5.2.2 for explanation of the cost of early rotation fertilization.

5.2.2.4 Expenditure by Activity and Year for Habitat Activities

Activity	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Surveys	Ha	165	165	165	165	165	825
	\$/ha	28.00	28.00	28.00	28.00	28.00	28.00
	Total \$	4620	4620	4620	4620	4620	23,100
Large Stock Planting	Ha	10	12	12	12	12	60
	\$/ha	1061	1061	1061	1061	1061	1061
	Total \$	10,610	12,732	12,732	12,732	12,732	61,538
Seed	Ha	50	50	50	50	50	250
	\$/ha	750	750	750	750	750	750
	Total \$	37,500	37,500	37,500	37,500	37,500	187,500
Vegetation Management	Ha	25	25	25	25	25	125
	\$/ha	700	700	700	700	700	700
	Total \$	17,500	17,500	17,500	17,500	17,500	87,500
Early Rotation Fertilization	Ha	20	45	45	45	45	200
	\$/ha	189	189	189	189	189	189
	Total \$	3,780	8,505	8,505	8,505	8,505	37,800
Stocking Control	Ha	10	10	10	10	10	50
	\$/ha	1200	1200	1200	1200	1200	1200
	Total \$	12,000	12,000	12,000	12,000	12,000	60,000
Pruning	Ha	10	10	10	10	10	50
	\$/ha	2000	2000	2000	2000	2000	2000
	Total \$	20,000	20,000	20,000	20,000	20,000	100,000
Bank Stabilization	Ha	2	2	2	2	2	10
	\$/ha	2000	2000	2000	2000	2000	750
	Total \$	4,000	4,000	4,000	4,000	4,000	20,000

5.2.3 Employment Benefits by Activity and Year for all Activities

Activity	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Surveys	Ha	1325	915	915	725	665	4545
	Ha/manday	20	20	20	20	20	20
	Tot. mandays	66.3	45.8	45.8	36.3	33.3	227.5
Bank Stabilization	Ha	2	2	2	2	2	10
	Ha/manday	0.17	0.17	0.17	0.17	0.17	0.17
	Tot. mandays	11.8	11.8	11.8	11.8	11.8	58.8
Standard Planting	Ha	0	0	0	0	0	0
	Ha/manday						0
	Tot. mandays						0
Large Stock Planting	Ha	575	577	577	577	577	2883
	Ha/manday	1	1	1	1	1	1
	Tot. mandays	575	577	577	577	577	2883
Early Rotation Fertilization	Ha	680	705	705	705	705	3500
	Ha/manday	1	1	1	1	1	1
	Tot. mandays	680	705	705	705	705	3500
Late rotation Fertilization	Ha	335	315	315	315	315	1595
	Ha/manday	40	40	40	40	40	40
	Tot. mandays	8.4	7.9	7.9	7.9	7.9	40
Vegetation Management	Ha	125	65	65	65	45	365
	Ha/manday	0.5	0.5	0.5	0.5	0.5	0.5
	Tot. mandays	250	130	130	130	90	730
Stocking Control	Ha	30	20	20	20	20	110
	Ha/manday	0.4	0.4	0.4	0.4	0.4	0.4
	Tot. mandays	75	50	50	50	50	275
Pruning	Ha	20	20	30	40	40	150
	Ha/manday	0.2	0.2	0.2	0.2	0.2	0.2
	Tot. mandays	100	100	150	200	200	750
Seeding	Ha	70	70	70	70	70	350
	Ha/manday	0.5	0.5	0.5	0.5	0.5	0.5
	Tot. mandays	140	140	140	140	140	700

6.0 REFERENCES

L.P. Atherton and Associates, prepared for Ministry of Forests, Incremental Silviculture Strategy for British Columbia, Working Paper 3: Government's Goals, Proposed Guiding Principals

B.C. Ministry of Forests, April 15, 1999 Incremental Silviculture Strategy for British Columbia (Interim), Version 1.0

B.C. Ministry of Forests, September 18, 1998 Arrowsmith Timber Supply Area, Incremental Silviculture Strategy (interim), Version 1.0

B.C. Ministry of Forests, August 31, 1998 Strathcona Timber Supply Area, Incremental Silviculture Strategy (interim), Version 1.0

B.C. Ministry of Forests, August 31, 1998 Mid Coast Timber Supply Area, Incremental Silviculture Strategy (interim), Version 1.0

B.C. Ministry of Forests, August 31, 1998 Sunshine Coast Timber Supply Area, Incremental Silviculture Strategy (interim), Version 1.0

EBA Engineering Consultants, March 28, 2001, for TimberWest, Tree Farm Licence No. 47 Type 1 Silviculture Strategy

B.C. Ministry of Forests, 1998, Vancouver Region Incremental Silviculture Objectives, Handout

TFL Forest Ltd., September 2001, Tree Farm Licence No. 46 Proposed Management Plan No.4, December 1, 2001-November 30, 2006

TFL Forest Ltd., September 28, 2001, Timber Supply Analysis Information Package for Tree Farm Licence No. 46, Management Plan No.4, Draft 3 with MoF Revisions

TFL Forest Ltd., October 23, 2001, Timber Supply Analysis, Appendix 5 to Management Plan No.4, of TFL 46.

TimberWest, May 16, 2001, Excellence in Forestry Best Practices Guide