

Tree Farm Licence No. 47

Type 1 Silviculture Strategy

March 28, 2001



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Executive Summary

The objective of this Strategy is to identify, analyze, prioritize and schedule incremental silvicultural activities that will have a positive influence on the future quality and quantity of habitat and timber supply within Tree Farm Licence No. 47 (TFL 47). TFL 47 is under the management of TFL Forest Ltd. (TimberWest). David Elstone of EBA Engineering Consultants Ltd. (EBA), led a workshop session on October 27, 2000, to present and discuss various silviculture regimes and treatments with representatives from the Ministry of Forests (MoF), the Ministry of Environment, Lands and Parks (MELP) and TimberWest. Strategies were presented and discussed within the context of Tree Farm Licence No. 47, Draft Management Plan No. 3, for January 1, 2001 – December 31, 2005, and its associated Appendices and Information Reports.

The workshop session resulted in an understanding of which silviculture treatments TimberWest would likely pursue through Forest Renewal BC (FRBC) funding. Proposed silviculture treatments were ranked in order of interest by TimberWest. EBA incorporated the results of the workshop session into a draft document and added forecasts of future effects to harvest quality and quantity, funding requirements and employment yields.

Silvicultural activities discussed in the Strategy will only proceed with funding from FRBC or other similar programs.

TFL 47 consists of three management units (MU) on Vancouver Island, the mainland and the Queen Charlotte Islands: Johnstone Straits, Bonanza Lake and Moresby Island. The Type 1 Silviculture Strategy includes only the Johnstone Straits and Bonanza Lake management units. For the purpose of the Strategy, the Johnstone Straits and Bonanza Lake portions of TFL 47 will henceforth be collectively referred to as TFL 47.

TFL 47 is in two Ministry of Forests forest districts: Campbell River and Port McNeill.

Access to the forests of the Johnstone Strait MU is by air or water. The Bonanza Lake MU is easily accessible from Highway 19 from its western and northern boundaries.

The timber supply analysis for the Johnstone Strait MU shows the base case scenario equal to the long-term sustainable harvest. A 'fall down' is not expected for the Johnstone Strait MU due to a long history of timber harvesting which has resulted in the progressive re-distribution of stand age classes.

The Bonanza Lake MU has a forecasted timber supply 'fall-down'; however, it is expected that the fall-down will not be significant due to a step down progression in harvest levels to the long term sustainable harvest level.

As discussed at the workshop session, the Johnstone Straits MU has no significant habitat supply issues to be addressed as there are no 'critical' wildlife species to be managed. There are no ungulate winter ranges within the Johnstone Strait MU. Reserves and buffers for streams and the ocean supply much of the important habitat for wildlife species within the Johnstone Strait area.

Habitat supply issues were discussed in limited scope at the workshop for the Bonanza Lake MU. Current efforts for habitat supply are deemed status quo for the short term.

Objectives of the Silviculture Program are paraphrased from TimberWest's Tree Farm Licence No. 47, Draft Management Plan No. 3. Management of timber supply and timber quality will be accomplished through the following objectives:

- To promote forest growth by practicing high quality basic silviculture and by implementing an incremental silviculture program (where funded by external sources).
- To manage age class imbalances by harvesting some second growth stands before they reach culmination of mean annual increment (MAI) provided that the stands are economically viable.
- To maximize the production of high quality sawlogs. TimberWest follows the concept that differentiating future products through strategic investment in conversion facilities is far more prudent than attempting to differentiate the forest resource today for unknown markets of the future. Efforts in stand management are to maximize volume growth to achieve stems 20 to 50 cm in diameter with straight boles, minimal taper and small branches.
- TimberWest has no explicit employment objectives within its Management Plan.
- TimberWest's financial objective is for incremental silviculture activities to provide a positive, acceptable return on investment.

TimberWest's FRBC Silviculture Program's Working Targets are:

- Working Target 1 (Overall) - Most projects to yield a positive return on investment.
- Working Target 2 (Quantity) - Increase yields in the short, medium and long term in direct proportion to area fertilized.
- Working Target 3 (Quantity) - Develop stand structure that allows greater harvest flexibility in the medium and long term.
- Working Target 4 (Quantity) - Increase timber supply by widening the forest product market profile through management of crop species with no previous stand management.

- Working Target 5 (Quality) - Increase proportion of dominant Fd, Cw and Yc in merchantable second growth stands to 10% of volume in medium and long term.
- Working Target 6 (Quality) - Manage for wood quality attributes including small knot sizes and low bole taper.
- Working Target 7 (Habitat) - Promote the survival of white pine in reforested stands of the Johnstone Strait MU by preventing the spread of white pine blister rust, through pruning of lower branches.
- Working Target 8 (Habitat) - Assess pre-1994 logged riparian areas in terms of damaged riparian function and what role silviculture can play in the recovery of the riparian forest ecosystem.

TimberWest ranks late rotation fertilization as its highest priority for FRBC investment. All other FRBC eligible incremental silviculture activities have a medium to low priority.

Hectares (ha) Treated By Activity and Year for Tree Farm Licence No. 47.

<i>Program</i>	<i>Management Unit</i>	<i>Year</i>	<i>Aerial Fertilization*</i>	<i>Manual Fertilization*</i>	<i>Spacing</i>	<i>Pruning</i>	<i>Total</i>
Incremental	Johnstone Strait	Subtotal 1-10	6,000	500	400	150	7,050
Incremental	Bonanza Lake	Subtotal 1-10	0	750	500	0	1,250
Incremental	Johnstone Strait + Bonanza Lake	Total 1-10	6,000	1,250	900	150	8,300
Habitat Supply	Johnstone Strait	Subtotal 1-10	-	65	65	3.5	133.5
Habitat Supply	Bonanza Lake	Subtotal 1-10	-	65	65	-	130
Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	-	130	130	3.5	263.5
Incremental + Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	6,000	1,380	1,030	153.5	8,563.5

*Both aerial and manual fertilization treatments include a combination of early and late rotation stands.

Expenditure (\$) By Activity and Year for Tree Farm Licence No. 47.

<i>Program</i>	<i>Management Unit</i>	<i>Year</i>	<i>Aerial Fertilization*</i>	<i>Manual Fertilization*</i>	<i>Spacing</i>	<i>Pruning</i>	<i>Total</i>
Incremental	Johnstone Strait	Subtotal 1-10	2,100,000	262,500	560,000	210,000	3,132,500
Incremental	Bonanza Lake	Subtotal 1-10	0	375,000	700,000	0	1,075,000
Incremental	Johnstone Strait + Bonanza Lake	Total 1-10	2,100,000	637,500	1,260,000	210,000	4,207,500
Habitat Supply	Johnstone Strait	Subtotal 1-10	-	34,125	117,000	4,900	156,025
Habitat Supply	Bonanza Lake	Subtotal 1-10	-	34,125	117,000	-	151,125
Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	-	68,250	234,000	4,900	307,150
Incremental + Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	2,100,000	705,750	1,494,000	214,900	4,514,650

*Both aerial and manual fertilization treatments include a combination of early and late rotation stands.

Employment (Person Years¹) By Activity and Year for Tree Farm Licence No. 47.

<i>Program</i>	<i>Management Unit</i>	<i>Year</i>	<i>Aerial Fertilization*</i>	<i>Manual Fertilization*</i>	<i>Spacing</i>	<i>Pruning</i>	<i>Total</i>
Incremental	Johnstone Strait	Subtotal 1-10	1.30	2.80	6.66	6.60	17.36
Incremental	Bonanza Lake	Subtotal 1-10	0.00	4.17	5.60	0.00	9.77
Incremental	Johnstone Strait + Bonanza Lake	Total 1-10	1.30	6.97	12.26	6.60	27.13
Habitat Supply	Johnstone Strait	Subtotal 1-10	-	0.53	1.43	0.07	2.03
Habitat Supply	Bonanza Lake	Subtotal 1-10	-	0.53	1.43	-	1.96
Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	-	1.06	2.86	0.07	3.99
Incremental + Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	1.30	8.03	15.12	6.67	31.12

*Both aerial and manual fertilization treatments include a combination of early and late rotation stands.

¹ Note: Assumes 180 days of silviculture work = 1 job (Source: Strathcona TSA, Incremental Silviculture Strategy (Interim) using the Source: Jobs and Timber Accord)

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Acknowledgements

The terms of a service agreement between Forest Renewal British Columbia (FRBC) and the British Columbia Ministry of Forests (MoF) require the MoF to develop, and FRBC to fund, an incremental silviculture strategy. As Tree Farm Licence No. 47 is under the management of TFL Forest Ltd., (TimberWest), the MoF subcontracted development of the silviculture strategy to TimberWest, who in turn subcontracted the work to EBA Engineering Consultants Ltd. (EBA). EBA as agent for TimberWest are responsible for the implementation of TimberWest's FRBC Multi-Year Agreement, including incremental silviculture activities.

A workshop session was held on October 27, 2000, in Campbell River to discuss and gather consensus on various strategies. The participation of representatives of the following organizations is gratefully acknowledged:

Ministry of Forests

John Ingram, Campbell River Forest District
Sheldon Martell, Port McNeill Forest District
Larry Sigurdson, Vancouver Forest Region

Ministry of Environment, Lands and Parks

Dave Donald, Vancouver Forest Region

TimberWest

Rick Monchak, Middlepoint Operations
Colin Buss, Middlepoint Operations
Gordon Glover, Kokish River Operations

Preface – Type 1 Silviculture Strategy for TFL 47.

The Type 1 Silviculture Strategy is a strategic silviculture planning initiative for Crown forest land in British Columbia. The MoF as forest stewards and FRBC as a funding agency are the agencies driving this initiative. The ultimate goal is to improve the future quantity and quality of both timber and habitat supply

This document is a forest level planning exercise that analyzes the affects of backlog and incremental silviculture investments on the achievement of :

- management objectives (timber volume and value, habitat supply);
- management unit conditions (age class distribution, site productivity, species); and,
- operational constraints/objectives (green-up, adjacency rules, visual quality).

in Tree Farm Licence No. 47 (TFL 47).

These analyses will determine the potential types and amounts of FRBC silviculture investments that could be made to assist in the achievement of desired management objectives.

The Type 1 analysis uses existing Timber Supply Review (TSR) summary information to identify issues and opportunities for silviculture investments, producing interim management unit specific harvest level, timber quality and habitat objectives. Type 1 analyses provide targets and strategies and silvicultural regimes which can be utilized as inputs in the more in depth Type 2 and 3 analyses.

A Type 2 analysis is an in-depth forest level analysis to identify silviculture strategies and funding needs.

A Type 3 analysis looks at developing habitat supply and other non-timber modeling approaches for future incorporation into Type 2 analyses.

The scope of this document is only to perform a Type 1 analysis.

This planning initiative is aimed at documenting objectives and desired future forest conditions, and identifying silviculture management that can be used to improve or achieve certain desired target conditions. This initiative has a direct linkage into Resource Management Plans (RMPs) and management unit specific performance indicators, which are required by FRBC. A RMP is an annual plan that FRBC requires of Recipients (TimberWest) to monitor FRBC performance and pinpoint FRBC investment.

Strategy Summary

The objective of this Strategy is to identify, analyze, prioritize and schedule incremental silvicultural activities that will have a positive influence on the future quality and quantity of habitat and timber supply within TFL 47. David Elstone of EBA Engineering Consultants Ltd. (EBA), led a workshop session on October 27, 2000, to present and discuss various silviculture regimes and treatments with representatives from the MoF, Ministry of Environment, Lands and Parks (MELP) and TimberWest. Strategies were presented and discussed within the context of Tree Farm Licence No. 47, Draft Management Plan No. 3, for January 1, 2001 – December 31, 2005, and its associated Appendices and Information Reports.

The workshop session resulted in an understanding of which silviculture treatments TimberWest would likely pursue through FRBC funding. Proposed silviculture treatments were ranked in order of interest by TimberWest. EBA incorporated the results of the workshop session into a draft document and added forecasts of future effects to harvest quality and quantity, funding requirements and employment yields.

Silviculture activities discussed in this Strategy will only proceed with funding from FRBC or a similar program.

1. Introduction

Tree Farm Licence No. 47 (TFL 47) consists of three management units (MU) on Vancouver Island, the mainland and the Queen Charlotte Islands: Johnstone Straits, Bonanza Lake and Moresby Island. TFL 47 was divided into management units in order to recognize the unbalanced distribution of the immature age classes and the geographic location of the old growth and mature second growth timber. This Type 1 Silviculture Strategy includes only the Johnstone Straits and Bonanza Lake management units as the Moresby Island management unit is the subject of an asset purchase agreement, which is awaiting ministerial approval.

For the purpose of this Strategy, the Johnstone Straits and Bonanza Lake portions of TFL 47 will henceforth be collectively referred to as TFL 47.

TFL 47 is in two Ministry of Forests forest districts: Campbell River and Port McNeill. TFL 47 is under the management of TFL Forest Ltd. (TimberWest).

Johnstone Strait Management Unit

The Johnstone Strait Management Unit extends from Quadra Island near Campbell River to Hanson Island near Port McNeill. It includes islands in the Johnstone Strait and portion of the adjacent mainland. This management unit is characterized by coastline with mountainous, but not especially rugged or steep terrain. The majority of the MU lies within the Coastal Western Hemlock biogeoclimatic zone with small portions in the Mountain Hemlock zone.

Access to the forests of the Johnstone Strait Management Unit is primarily by air or water.

Bonanza Lake Management Unit

The Bonanza Lake Management Unit is located on northern Vancouver Island south of Port McNeill. The MU is contained within a valley formed by glacial processes and is classified within the Coastal Western Hemlock and the Mountain Hemlock biogeoclimatic zone.

The Bonanza Lake Management Unit is easily accessible from Highway 19 from its western and northern boundaries.

1.1 TFL 47 Issues Impacted by Silviculture

1.1.1 Timber supply issues

Timber Supply 'Fall-down'

The timber supply analysis for the Johnstone Strait MU shows the base case scenario equal to the long-term sustainable harvest. A 'fall down' is not expected for the Johnstone Strait MU due to a long history of timber harvesting which has resulted in the progressive re-distribution of stand age classes.

The Bonanza Lake MU has a forecasted timber supply 'fall-down'; however, it is expected that the fall-down will not be significant due to a step down progression in harvest levels to the long term sustainable harvest level.

Age Class Distribution

There is no age class distribution gap for the Johnstone Strait MU.

There is a forecasted short fall in the 80+ age class in the mid term for the Bonanza Lake MU.

Harvesting in Old Growth Stands

Only 10 % of the Johnstone Strait MU harvestable landbase is old growth forest, while another 45 % of the harvestable landbase is between the ages of 70 and 250 years. Timber harvesting operations are currently concentrated to stand ages less than 80 years old.

In the Bonanza Lake MU, the majority of the harvesting takes place in old growth forests. Harvesting has begun in second growth stands.

Land Use Planning

The Johnstone Strait MU landbase is encompassed by the Central Coast Land and Coastal Resource Management Planning process which is still ongoing and the Vancouver Island Land Use Plan which has been declared a higher level plan effective Dec 1, 2000.

The Vancouver Island Land Use Planning process has designated the Bonanza Lake MU as an 'Enhanced Forestry' zone. This will have a neutral to positive effect on timber supply if government approves this designation along with appropriate regulations to reduce old seral stage forest cover and biodiversity constraints.¹

¹ Source: Appendix IV, to Tree Farm Licence No. 47 Management Plan # 3, Timber Supply Analysis.

Both land use plans have proposed landscape management units and associated biodiversity emphasis options (BEO). It is anticipated that once BEOs are official, harvesting in old growth forests and mature second growth forests will be constrained to meet old seral stage targets.

Visual Management and Green-Up Requirements

Over 47% of the landbase in the Johnstone Strait MU has a requirement for visual management. Interpretation of the timber supply analysis shows that growing the stand faster to achieve visual management objectives (Visually Effective Green-Up Height) does not affect harvest levels.

There are no significant visual management constraints to harvest levels in the Bonanza Lake MU.

1.1.2 Habitat issues

As discussed at the workshop session, the Johnstone Straits MU has no significant habitat supply issues to be addressed as there are no ‘critical’ wildlife species to be managed.

There are no ungulate winter ranges within the Johnstone Strait MU.

Reserves and buffers for streams and the ocean supply much of the important habitat for wildlife species within the Johnstone Strait area.

Habitat supply issues were discussed in limited scope at the workshop for the Bonanza Lake MU. Current efforts for habitat supply are deemed status quo for the short term.

An issue discussed at the workshop was the past harvesting of riparian areas. Riparian stand tending treatments may help to accelerate recovery of lost riparian functions in riparian areas logged prior to the requirement for riparian reserves. Within both MUs there are limited opportunities for riparian stand management. TimberWest is interested in riparian stand management on a trial basis.

1.2 Objectives of the Silviculture Program

1.2.1 Management Unit Objectives

The following management unit objectives apply to both the Johnstone Straits MU and the Bonanza Lake MU and are paraphrased from TimberWest's Tree Farm Licence No. 47, Draft Management Plan No. 3

Timber Supply Objectives

Timber supply objectives are presented in the Draft Management Plan in the form of a Second Growth Management Strategy. This Second Growth Management Strategy states TimberWest's goal is to focus "on production of high quality saw logs and pulp logs. The intent is to maximize volume and/or reduce rotation age by producing an economically viable product as early as possible."²

Consequently with regards to this timber supply goal, TimberWest's objectives are:

1. To promote forest growth

- i) By practicing high quality basic silviculture
Rational: Prompt regeneration effectively helps keep rotation length to a minimum and reduces the need for vegetation management.
- ii) By implementing an incremental silviculture program (where funded by external sources)
 - Utilize genetically improved seed, when available
Rational: TimberWest uses improved seed from its own seed orchard, when available, in order to maximize yield.
 - Consider late rotation fertilization of Douglas-fir leading stands
Rational: Fertilization of Douglas-fir leading sites about 10 years before the final harvest provides the greatest return on the investment. TimberWest will consider late rotation fertilization where the Crown provides funding for public lands within TFL 47.

2. Manage age class imbalances by harvesting some second growth stands before they reach culmination of mean annual increment (MAI) provided that stands are economically viable.

Rational: Due to past harvesting patterns there are large areas of second growth reaching culmination of MAI. Current harvesting restrictions will delay harvesting much of this area well past culmination of MAI, effectively lengthening the rotation. To offset this, TimberWest enters some second growth stands prior to culmination of MAI (at 'First Entry Age'), provided that

² Source: Tree Farm Licence No. 47, Draft Management Plan No.3, January 1, 2001 – December 31, 2005, TFL Forest Ltd., July 2000. (pg20)

stands are economically viable. First entry age allows for increased harvest flexibility under a variety of constraints

Timber Quality Objectives

Maximize the production of high quality sawlogs.

Rational: TimberWest does not expect future markets to show significant differential pricing associated with larger diameters and/or rapidly grown clear logs. TimberWest's research indicates that juvenile spacing treatments will not significantly impact the broad matrix of log sizes at harvest age as a result of considerable variation associated with species, site and harvest ages; therefore, TimberWest focuses on maximizing stand volume rather than product differentiation.

Differentiating future products through strategic investments in conversion facilities is far more prudent than attempting to differentiate the forest resource today for unknown markets of the future.

Efforts in stand management are to maximize volume growth to achieve stems 20 to 50 cm in diameter with straight boles, minimal taper and small branches.

Employment Objectives

Tree Farm Licence No. 47, Draft Management Plan No. 3 provides no explicit employment objectives.

Financial Objectives

Tree Farm Licence No. 47, Draft Management Plan No. 3 states an objective for incremental silviculture activities is to provide positive, acceptable return on investment.

1.2.2 Provincial and Regional Objectives

The provincial government has the following fundamental goals:

- sustainable resource use;
- community stability; and,
- a strong forest sector.

The provincial government has the following provincial objectives³:

³ Guidance towards Participation in the Forest Renewal BC Planning Process and the Development of Resource Management Plans, B.C. Ministry of Forests, 1998a.

- Maintain current harvest levels as long as possible without creating disruptive shortfalls in future timber supply;
- Create a long term timber supply capable of supporting a steady long term provincial harvest level similar to current levels;
- Minimize the interim shortfall in provincial harvest anticipated before a steady long term timber supply is achieved; and,
- Create a long term timber supply which will enable the timber quality profile of future harvests to be the same or better than the current profile.

The provincial government has the following regional objectives:

- Ensure a long term sustainable harvest which approximates the current harvest value and volume levels and 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; and,
- Utilize incremental silviculture treatments to contribute to sustainable management of non-timber values at the landscape level.

2. Resource Dynamics

The objective of this section is to further define timber supply issues and identify constraining mechanisms that shape the timber supply forecast for each Management Unit.

2.1 Synopsis of the Land-based Inventory

Table 1 shows an area breakdown for TFL 47 by total landbase and the total long-term harvestable timber base. Table 2 shows TFL 47's current AAC. Figures 1a and 1b are graphs of the historical harvest rates for both Management Units. Figures 2 to 7 show the site class, species and age class distributions for each Management Unit. Figures 8 and 9 show the base case harvest forecasts based on the timber supply analysis for TFL 47, Draft Management Plan No. 3 for each Management Unit.

Table 1. Area Breakdown for Tree Farm Licence No. 47.*

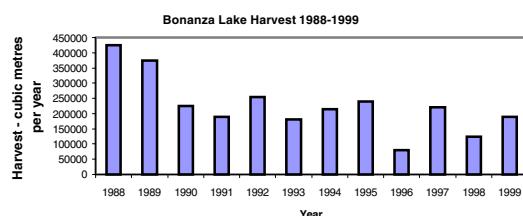
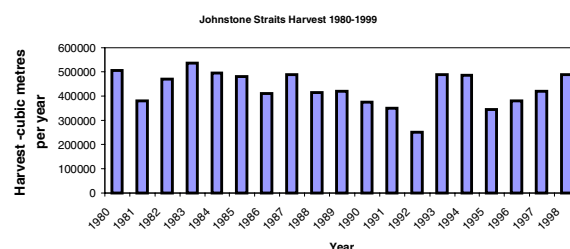
<i>Management Unit</i>	<i>Total Landbase (ha)</i>	<i>Total Long-term Harvestable Timber Base (ha)</i>
Johnstone Straits	101,847	71,313
Bonanza Lake	38,020	21,831
Total Area	139,867	93,144

*Source: Tree Farm Licence No. 47, Draft Management Plan No.3, January 1, 2001 – December 31, 2005, TFL Forest Ltd., July 2000

Table 2. Derivation of Proposed AAC for Tree Farm Licence No. 47.*

<i>Description</i>	<i>Johnstone Strait</i>	<i>Bonanza Lake</i>	<i>Total</i>
Base Case – 1998-2003	559,350	188,100	747,450
Less Reduction in yield for Variable Retention	(10,500)	(3,500)	(14,000)
Subtotal	548,850	184,600	733,450
Less Reduction for Change in Ownership (5% Transfer)	(20,524)	(4,630)	(25,154)
Proposed AAC	528,326	179,970	708,296

*Source: Appendix IV, Timber Supply Analysis, Tree Farm Licence No. 47, Draft Management Plan No.3, January 1, 2001 – December 31, 2005, TFL Forest Ltd., July 2000.



Figures 1a and 1b. Historical Harvest Levels – Tree Farm Licence No. 47.

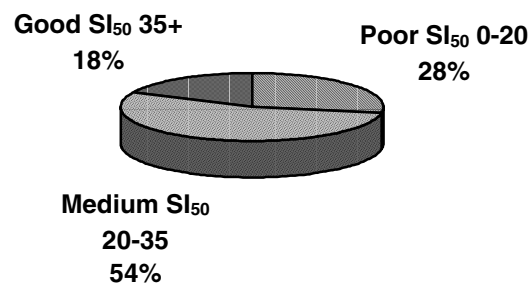


Figure 2. Site Class Distribution for the Johnstone Strait Management Unit.

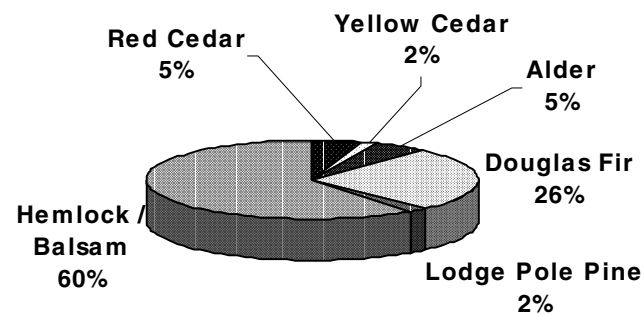


Figure 3. Species Distribution for the Johnstone Strait Management Unit.

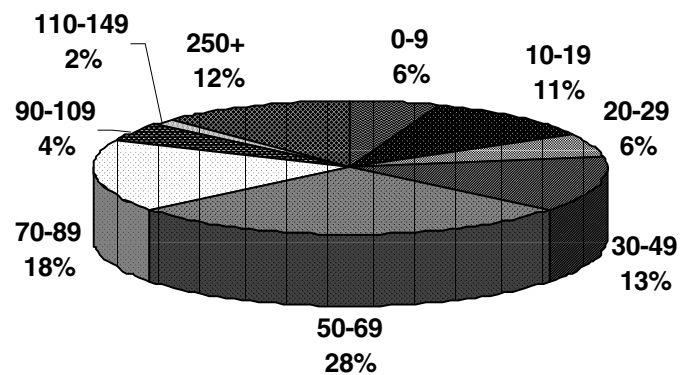


Figure 4. Age Class Distribution for the Johnstone Strait Management Unit.

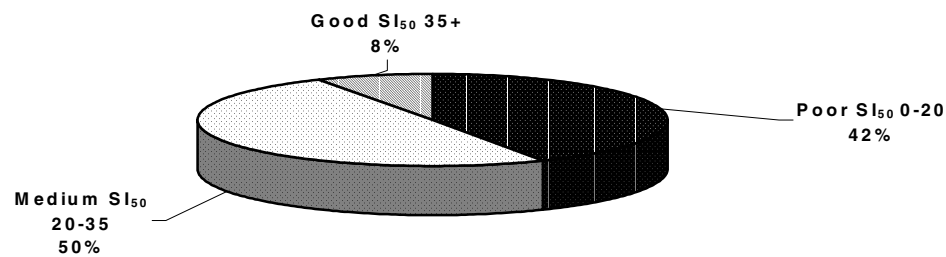


Figure 5. Site Class Distribution for the Bonanza Lake Management Unit.

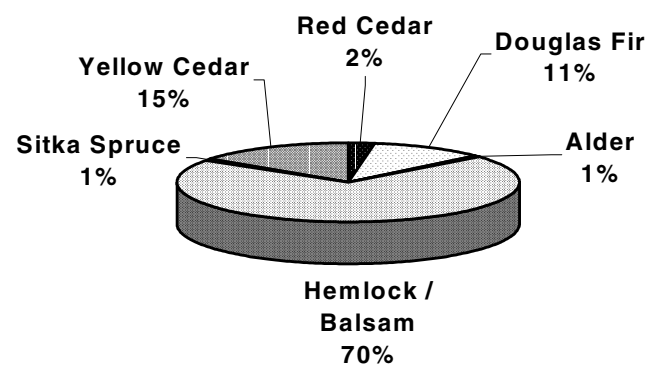


Figure 6. Species Distribution for the Bonanza Lake Management Unit.

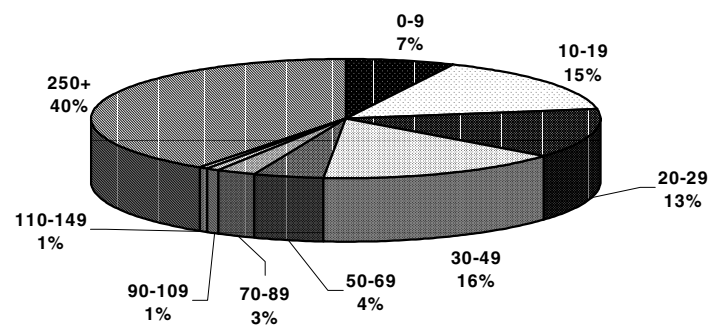


Figure 7. Age Class Distribution for the Bonanza Lake Management Unit.

Figure 8. The Base Case Harvest Forecast for the Johnstone Strait Management Unit*.

Figure 8 is not available in digital format. Figure 8 is a graph of cubic metres per year over time in years. The graph indicates that a simulated harvest rate of 565, 000 m³ per year can be maintained over the 250+ years of the timber supply analysis.

Figure 9. The Base Case Harvest Forecast for the Bonanza Lake Management Unit*.

Figure 9 is not available in digital format. Figure 9 is a graph of cubic metres per year over time in years. The graph indicates a harvest rate of 188, 100 m³ per year is maintained for the first 20 years of the simulation period. Over the next 120 years, the harvest rate gradually decreases to 146, 400 m³ per year before rising to the long-term sustainable harvest rate of 163, 350 m³ per year.

*Source: Appendix IV, Timber Supply Analysis, Tree Farm Licence No. 47, Draft Management Plan No.3, January 1, 2001 – December 31, 2005, TFL Forest Ltd., July 2000.

2.2 Timber Supply Dynamics

2.2.1 Tree Farm Licence No. 47 Timber Supply Analysis ‘Deconstructed’

A deconstruction of the timber supply analysis for both Management Units was presented at the workshop. A list of harvest level sensitivities, a description of constraining mechanisms and suggestions as to how silviculture activities might enhance timber supply are provided in Tables 3 and 4 for each Management Unit.

Table 3. Timber Supply Analysis Harvest Level Sensitivities for the Johnstone Strait Management Unit.

<i>Sensitivity/Constraint</i>	<i>Scenario</i>	<i>Implication on Harvest Level</i>	<i>Time Frame</i>	<i>Modeled Impact on Harvest Level (m³/yr)</i>	<i>Silviculture Treatments to Resolve Timber Supply Issues*</i>
Harvest Age Criteria	• Harvest age at first entry age = culmination of MAI.	Base Case** unsustainable	Medium	See graph	n/a
	• Harvest age at first entry age = culmination of MAI.	Increase	Long	+ 19 800	n/a
	• Harvest age at first entry age = stand has quad. dbh of 30 cm and/or 300 m ³ /ha.	Maintain sustainable harvest level	Constant	0	Treatments to maximize volume will provide increased harvest flexibility.
	• Harvest age at first entry age = reduced by 10 years.	Maintain sustainable harvest level	Constant	0	Treatments to maximize volume will provide increased harvest flexibility.
Estimates of Timber Yield	• Accuracy of volume estimate for stands established after 1973.	Increase or decrease	Medium to Long	+/-10% change	n/a
Visual Resources	• Without visual constraints.	Increase	n/a	+ 34 650	n/a
	• Increase height to Visual Effective Green-Up (VEG) by 1 m.	Decrease	Medium	- 20 000	n/a
	• Decrease height to VEG by 1 m.	None	None	0	Reducing height by 1 m could be interpreted to have the same result as reducing the time to reach VEG height or accelerating tree growth through silviculture treatments. No impact forecasted, therefore no treatments required.
Green-Up Adjacency	• Increase green-up height by 1 m.	None	None	0	n/a
	• Decrease green-up height by 1 m.	None	None	0	Reducing height by 1 m could be interpreted to have the same result as reducing the time to reach green-up height or accelerating tree growth through silviculture treatments. No impact forecasted, therefore no treatments required.

Table 3. Continued.

<i>Sensitivity/Constraint</i>	<i>Scenario</i>	<i>Implication on Harvest Level</i>	<i>Time Frame</i>	<i>Modeled Impact on Harvest Level (m³/yr)</i>	<i>Silviculture Treatments to Resolve Timber Supply Issues*</i>
Biodiversity – Seral Stage Targets	• Without any seral stage target.	Increase	Medium to Long	+ 15 000	n/a
	• Implementation of mature and old growth seral stage targets.	Decrease	Medium to Long	- 45 000 Medium - 20 000 Long	Silviculture treatments done to accelerate old growth characteristics in immature stands do not guarantee substitution for constrained merchantable stands. Constrained areas, whether or not they are young or old growth forests, still impact timber supply.
Quadra Island Special Management Zone	• Special Management Zone - long-term effects.	Decrease	Long	- 5500	Maximize volume growth to offset potential losses.
Regeneration System	• Implementation of variable retention (VR).	Decrease	Short	- 10 500	Increase acquisition of knowledge in growth and yield for variable retention stands should assist in the long term to reduce the shift in the forest management paradigm.

*It is assumed that if no timber supply issues require resolution by silviculture investment, all silviculture treatments undertaken serve to enhance timber supply beyond the base case harvest level.

**Base Case Harvest Level = 559 350 m³

Table 4. Timber Supply Analysis Harvest Level Sensitivities for the Bonanza Lake Management Unit.

<i>Sensitivity/Constraint</i>	<i>Scenario</i>	<i>Implication on Harvest Level</i>	<i>Time Frame</i>	<i>Modeled Impact on Harvest Level (m³)</i>	<i>Silviculture Treatments to Resolve Timber Supply Issues*</i>
Harvest Age Criteria	• Harvest age at first entry age = culmination of MAI.	Base Case** unsustainable	Short to Medium	- 25 000	n/a
	• Harvest age at first entry age = culmination of MAI.	Maintain sustainable harvest level	Long	0	n/a
	• Harvest age at first entry age = financial rotation	Follows Base Case Scenario	Constant	0	Treatments to maximize volume will provide increased harvest flexibility.
	• Harvest age at first entry age = reduced by 10 years.	Increase Decrease	Medium Long	See graph - 9 900	Treatments to maximize volume will provide increased harvest flexibility and assist in regaining loss volume in the long term.
Estimates of Timber Yield	• Accuracy of volume estimate for stands established after 1973.	Increase or decrease	Medium to Long	+/-10% change	n/a
Visual Resources	• Increase height to Visual Effective Green-Up (VEG) by 1 m.	None	None	0	n/a
	• Decrease height to VEG by 1 m.	None	None	0	Reducing height by 1 m could be interpreted to have the same result as reducing the time to reach VEG height or accelerating tree growth through silviculture treatments. No impact forecasted, therefore no treatments required.
Green-Up Adjacency	• Increase green-up height by 1 m.	None	None	0	n/a
	• Decrease green-up height by 1 m.	None	None	0	Reducing height by 1 m could be interpreted to have the same result as reducing the time to reach green-up height or accelerating tree growth through silviculture treatments. No impact forecasted, therefore no treatments required.

Table 4. Continued.

<i>Sensitivity/Constraint</i>	<i>Scenario</i>	<i>Implication on Harvest Level</i>	<i>Time Frame</i>	<i>Modeled Impact on Harvest Level (m³)</i>	<i>Silviculture Treatments to Resolve Timber Supply Issues*</i>
Biodiversity – Seral Stage Targets	• Without any seral stage target.	None	None	0	n/a
	• Implementation of old growth seral stage targets.	Decrease	Medium to Long	-20 000	Silviculture treatments done to accelerate old growth characteristics in immature stands do not guarantee substitution for constrained merchantable stands. Constrained areas, whether or not they are young or old growth forests, still impact timber supply.
TEM Derived Site Indices	• Preliminary indications are that the potential site indices for Bonanza Lake may be underestimated by 10%.	Increase	Medium to Long	+ 9 900	n/a
Regeneration System	• Implementation of variable retention (VR).	Decrease	Short to Long	- 3 500	Increase acquisition of knowledge in growth and yield for variable retention stands should assist in the long term to reduce the shift in the forest management paradigm.

**It is assumed that if no timber supply issues require resolution by silviculture investment, that all silviculture treatments undertaken serve to enhance timber supply beyond the base case harvest level.

**Proposed ACC = 20 year Planned Harvest Level of 188 100 m³. The harvest level for Bonanza Lake MU will experience a mild 'fall down'.

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

Production of high value sawlogs without the intervention of stand management implies stand self thinning and self pruning, which are a function of high stand densities and time. Prompt reforestation to desired stocking with the best seed source available also contributes to the production of high value sawlogs. In general, the longer time to rotation, the greater probability in having a greater proportion of stems in larger diameter classes. Juvenile spacing increases rotation length (assuming rotation is at culmination of MAI).

Stand development over time is a function of site productivity and stocking. Growing stands for quality and quantity while minimizing rotation length can be done by managing initial stocking and enhancing site growth. Enhancing growth and value can be done through several silviculture investments. Table 5 lists silviculture investments that can influence growth and value.

Table 5 A comparison of stand-level tradeoffs to achieve product objectives

<i>Product Objective(s)</i>	<i>Silviculture Investments</i>	<i>Harvest Timing</i>	<i>Quality</i>	<i>Quantity</i>
High quality sawlogs (premium logs) the following details define high quality sawlogs 20 –50 cm dbh -straight boles, minimal tape, and small branches	Quality oriented silviculture practices			
	• Practice high quality basic silviculture* (i.e. Reforestation for desired site occupancy)	+	+	+
	• Tree Improvement	+	+	+
	• Promotion of value crop species (pilot)	n/a	+	n/a
“+” positive relationship between silviculture practice, harvest timing, quality and quantity.	Quantity oriented silviculture practices			
	• Practice high quality basic silviculture*	+	+	+
	• Tree Improvement	+	+	+
“n/a” zero or neutral relationship between silviculture practice, harvest timing, quality and quantity.	• Fertilization	+	+	+

*High quality basic silviculture is funded through non-FRBC sources.

2.3 Habitat Supply Dynamics

Habitat in Reserves

The Johnstone Strait MU encompasses the islands of Johnstone Straits and portions of the adjacent British Columbia mainland. This settings offers an immense interface between terrestrial and marine ecosystems and associated wildlife species. Timber buffers for coastlines and riparian reserves account for a large percentage of the Johnstone Strait MU’s critical habitat areas⁴. The equivalent

⁴ Observation stated by TimberWest staff.

harvest volume net-downs for areas within these timber buffers have already been accounted for in the most recent timber supply analysis.

A large percentage of the Johnstone Strait MU consists of second growth forest. Wildlife species dependent on second growth forests should experience no shortcomings in second growth forest habitat.

The Bonanza Lake MU has official ungulate winter range areas set asides. The equivalent harvest volume net-downs for these areas have already been accounted for in the most recent timber supply analysis.

Old Growth Habitat

The small proportion (10% of the harvestable landbase) of old growth forests within the Johnstone Strait MU may offer habitat to old growth forest dependent species. The majority of harvesting in the Johnstone MU is concentrated to second growth stands.

The Bonanza Lake MU currently is logging in mainly old growth forests. Harvesting has begun in second growth stands.

The designation of BEO zones will exclude some old growth forests from being harvested to ensure that the forested landbase contains a specified percentage of old-seral stages per biogeoclimatic variant. In fulfilling this requirement, habitat for old growth dependent species will be preserved.

Riparian Areas

Pre-Forest Practices Code harvesting of riparian areas was identified as a potential issue in both MUs. Logged riparian areas may have had their ecosystem function changed. This Strategy would be able to identify silviculture techniques to recover riparian function by enhancing the development of old growth characteristics (such as large woody debris). Riparian stand management treatments would be subject to an initial trial and evaluation period.

2.4 Incremental Silviculture History

A record of silviculture activities in TFL 47 has been maintained. Figures 10 to 13 show the levels and trends in silviculture activities. Note the correlation of silviculture activity to public funding initiatives – i.e. the early 1980's Employment Benefits Assistance Program (EBAP), the late 1980's to early 1990's Forest Resource Development Agreement (FRDA) I and II programs and the FRBC program starting in 1995.

Appendix I provides the silviculture history for TFL 47 in table format.

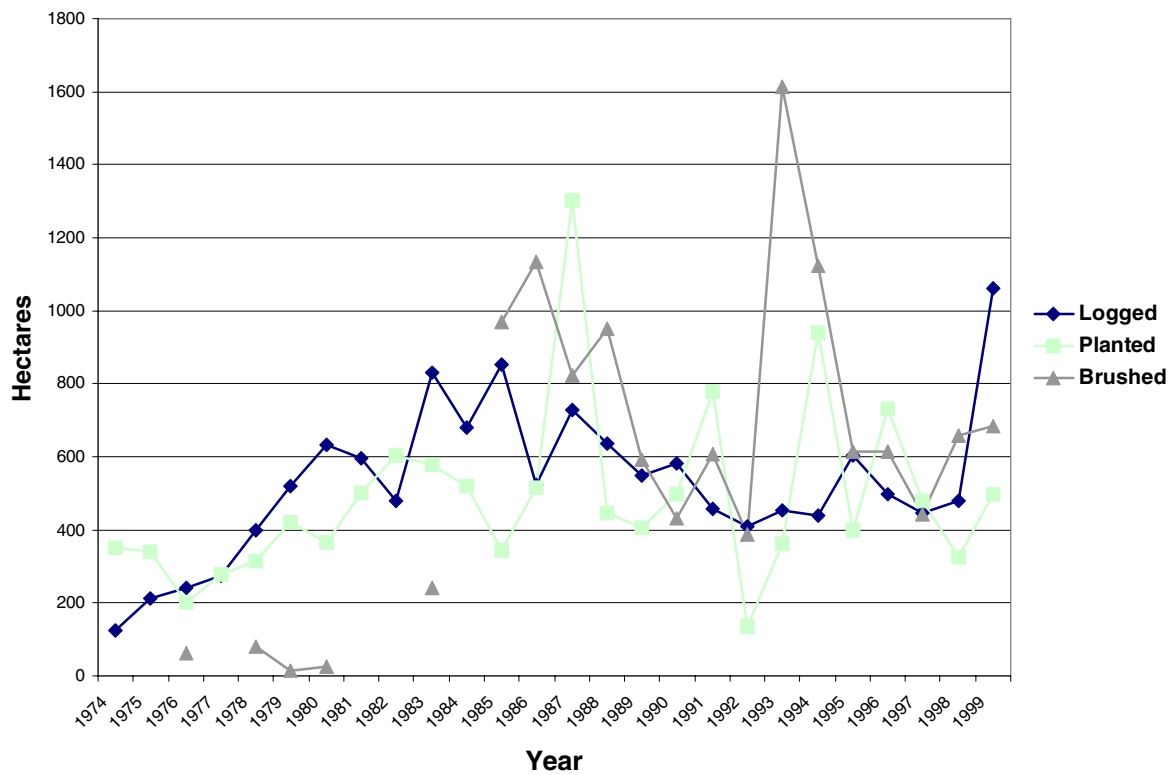


Figure 10. Hectares logged, planted and brushed in the Johnstone Strait Management Unit.

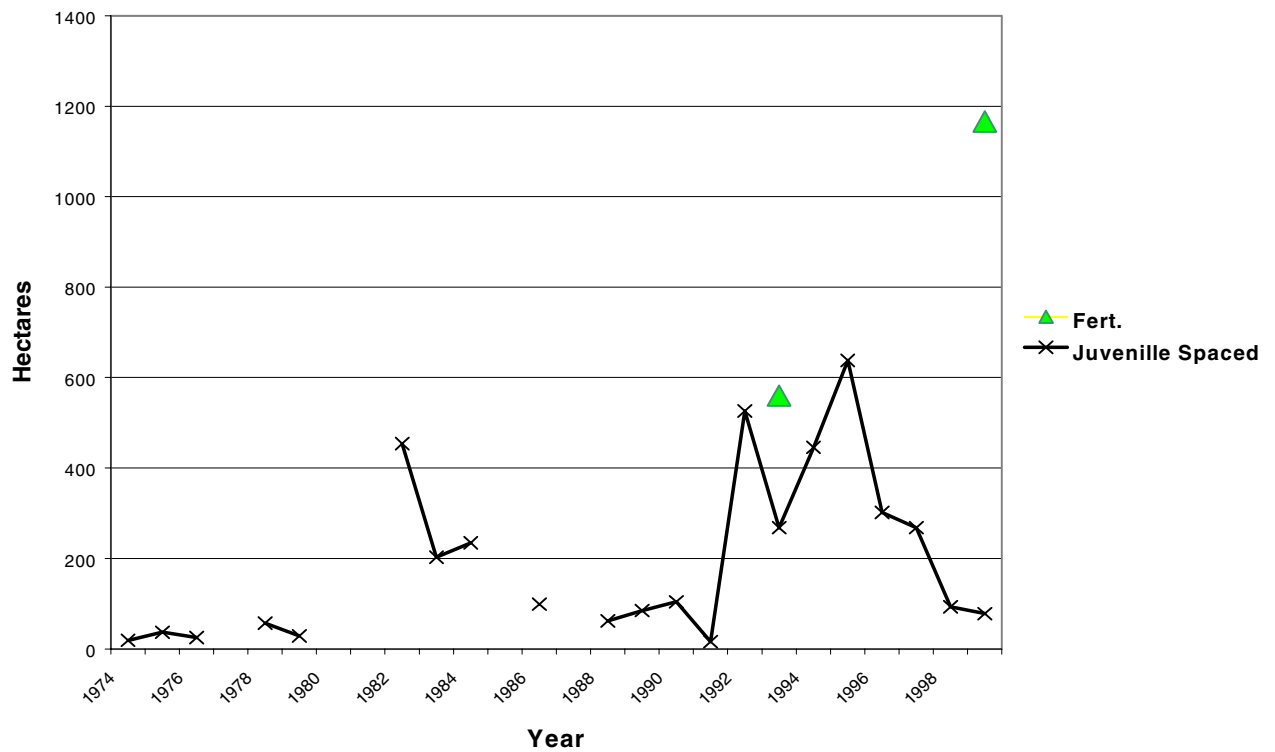


Figure 11. Hectares fertilized and juvenile spaced in the Johnstone Strait Management Unit.

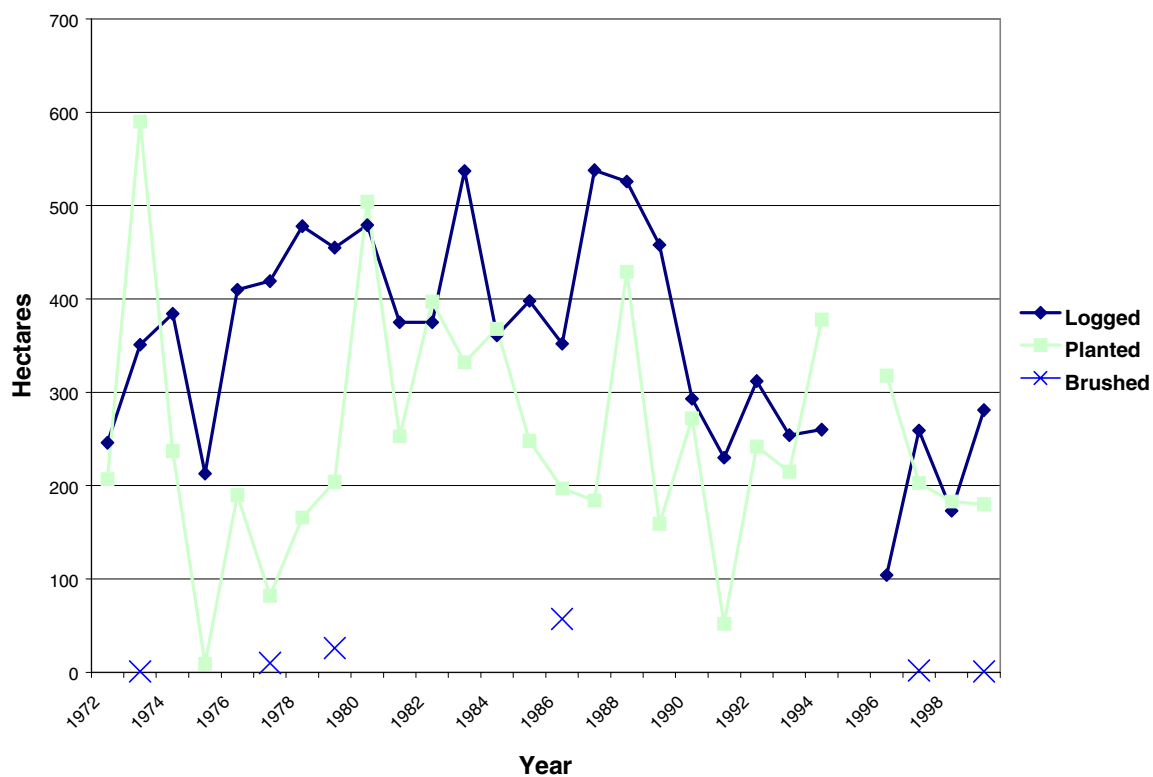


Figure 12. Hectares logged, planted and brushed in the Bonanza Lake Management Unit.

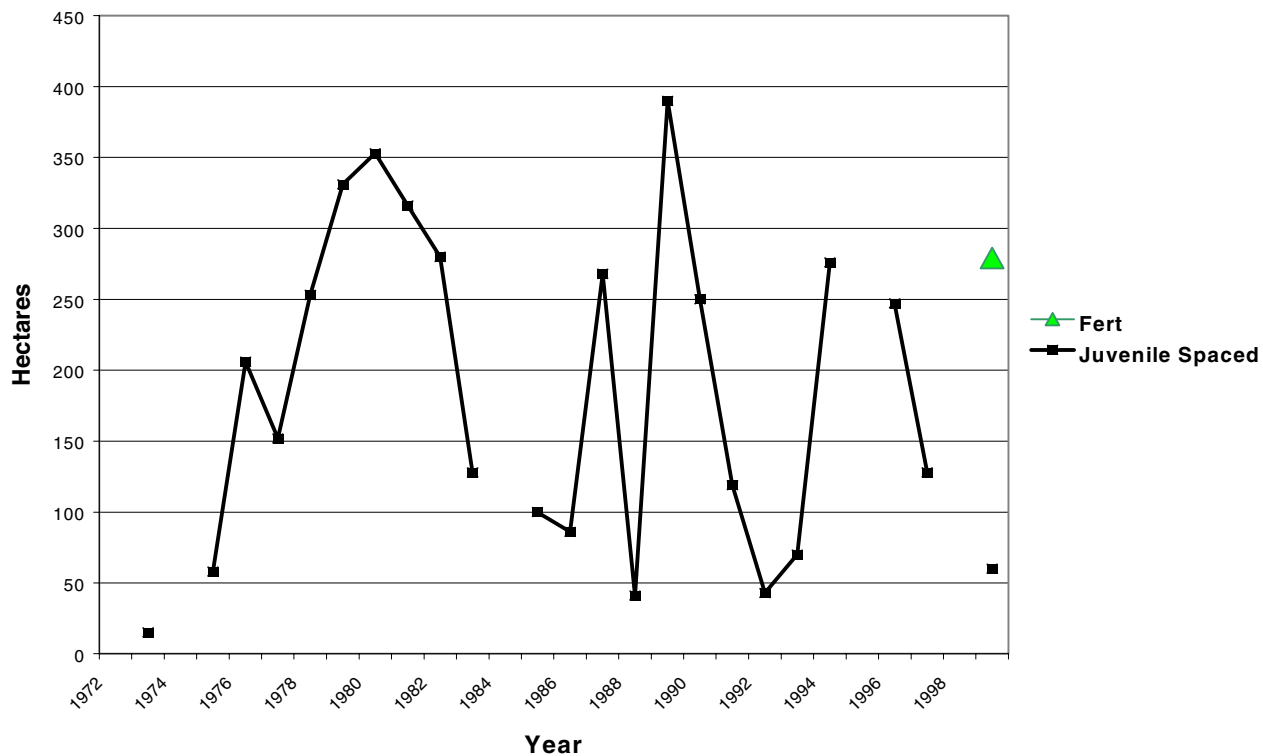


Figure 13. Hectares fertilized and juvenile spaced in the Bonanza Lake Management Unit.

3. Silviculture Strategies

3.1 Timber Quantity Strategies

A Timber Quantity Strategy is provided in Table 6. Included in the Timber Quantity Strategy are strategies or regimes not eligible for FRBC funding – basic silviculture including the use of genetically improved stock. It is important to mention these activities, as they are the main strategies for which TimberWest directly funds for the attainment of management objectives as presented in the Draft Management Plan.

Strategies presented in Table 6 are intended to increase the mid- to long-term supply of timber volume. Additional volume produced due to the implementation of the strategies is in excess of the long-term sustainable harvest.

Table 6. Timber Quantity Strategies for Tree Farm Licence No. 47.

<i>Response Framework</i>	<i>Strategy/Regime</i>	<i>Rationale⁵</i>	<i>Target Strata</i>	<i>Silvicultural Activity</i>	<i>Expected Gain</i>	<i>Opportunity in the next 5 years (ha/year)</i>	<i>Opportunity in the next 10 years (ha/year)</i>
ST1 <u>JS, BL</u>	Improve site index estimation.	Higher long-term sustained yield.	Existing second growth stands.	TFL 47 Site Index Adjustment Project.	i) Adjustments anticipated to be completed in 2001. ii) Results to be incorporated into the timber supply analysis.	-	-
ST2 <u>JS, BL</u>	Late rotation fertilization of Douglas-fir leading stands.	Accelerate volume growth.	Fd stands, age class 3-5, min. 300` dom/codominant stems per hectare (sph).	a) Aerial broadcast fertilization. b) Manual fertilization. To be done on a trial basis.	i) Estimate 15 m ³ /ha/10 years (increase in merchantable volume over a ten year period). ii) Based on treatment opportunities in the next 5 years: <u>JS</u> a) 7500 m ³ b) 3750 m ³ <u>BL</u> a) 0 m ³ b) 0 m ³ iii) Gains have yet to be incorporated into the timber supply analysis.	<u>JS</u> a) 100 ⁶ b) 50 ⁷ (trial) <u>BL</u> a) 0 ⁶ b) 0 ⁶	<u>JS</u> a) 100 ⁶ b) 50 ⁷ <u>BL</u> a) 0 ⁶ b) 0-50 ⁶
MT1 <u>JS, BL</u>	Practice high quality basic silviculture.	Minimize rotation length. Maximize volume growth. Minimize brush control.	All areas to be reforested.	a) Rapid and adequate reforestation b) Aggressive vegetation management.	i) Increased long-term sustainable harvest levels have yet to be measured. ii) Gains have yet to be incorporated into the timber supply analysis.	Non-FRBC eligible.	
MT2 <u>JS, BL</u>	Utilize genetically improved seed.	Minimize rotation length. Maximize volume growth. Maximize green-up. Minimize brush control.	Use seed when available for areas to be reforested.	Continue provincial research program and plant improved stock.	i) Increased long-term sustainable harvest levels have yet to be measured. ii) Gains have been incorporated into the timber supply analysis.	Funding of research is FRBC eligible. Planting of improved stock is non-FRBC eligible.	

⁵An increase in stand volume will work to offset future reductions in harvest levels. Moreover, larger piece sizes due to increased volume reduces the time to reach first entry age, which in turns increases opportunities in harvest flexibility.

⁶ This value of hectares to treat per year is based on experience in searching for suitable stands available for late rotation fertilization.

⁷ The potential opportunities for manual Fd fertilization depends on public support from the community on Quadra Island where a significant amount of candidate stands exist.

Table 6. Continued.

<i>Response Framework</i>	<i>Strategy/Regime</i>	<i>Rationale⁸</i>	<i>Target Strata</i>	<i>Silvicultural Activity</i>	<i>Expected Gain</i>	<i>Opportunity in the next 5 years (ha/year)</i>	<i>Opportunity in the next 10 years (ha/year)</i>
MT3 <u>JS, BL</u>	Multiple-stand entries to fertilize crop trees at regular intervals through to rotation.	Minimize rotation length Maximize volume growth.	<u>JS</u> Fd stands and in limited cases Cw and Yc, age classes 1-4, starting at a minimum stand age of 15 years, min. 300 dom/codominant sph Crop trees with expressed dominance. <u>BL</u> Cw and Yc stands and in limited cases Fd stands, age classes 1-4, min. 300 dom/codominant sph. Crop trees with expressed dominance.	<u>JS</u> a) Aerial broadcast fertilization. <u>BL</u> b) Manual fertilization. Prior to fertilization, target crop trees may require reduction of inter- tree competition. To be done on a trial basis.	i) Estimate 15 m ³ /ha/10 yrs (increase in merchantable volume over a ten year period). ii) Based on opportunities in the next 5 years: a) 37500 m ³ b) 3750 m ³ iii) Gains have yet to be incorporated into the timber supply analysis.	<u>JS</u> a) 500 ⁹ <u>BL</u> b) 50 (trial) ⁹	<u>JS</u> a) 500 ⁹ <u>BL</u> b) 50 ⁹
MT4 <u>JS</u>	Manage deciduous stands. To be done on a trial basis as opportunities arise.	Increased harvest profile and thereby contributing to greater harvest levels.	Pure high density red alder stands, age classes 1 and 2.	Intensive management regime of juvenile spacing and pruning.	Management of timber stands previously viewed to have no significant market value. Exact gains unknown.	0-5	25
LT1 <u>JS, BL</u>	Increase knowledge of growth and yield for variable retention stands.	Offset decreases to harvest level due to shift in forest management paradigm.	All variable retention stands.	Research.	Further research and analysis required.	-	-

⁸ It is assumed any increase in volume will contribute to offset anticipated reductions in harvest levels and to create more opportunities for harvest flexibility by increasing piece size.⁹ This value of hectares to treat per year is based on experience in searching for suitable treatment areas.

3.1.1 Additional Rationale for Proposed Strategies

Aerial Fertilization

Suitable late rotation stands, with sufficient size to make an aerial fertilization treatment feasible are becoming less available in the next 5 to 10 years. It is anticipated that in the long-term, the quantity of aerial fertilization treatment area will increase as younger managed stands reach the age for late rotation treatment. In the mid-term, the small amount of late rotation stands that could be fertilized will be either aerial treated if project size is feasible or stands may be considered for manual fertilization.

Aerial fertilization treatments may include a range of stands with varying site productiveness. It is anticipated that low and high productive sites may be treated along with medium productive sites during treatment of large contiguous areas that contain a mosaic of microsites.

Manual Fertilization

Manual fertilization is a treatment activity agreed upon by all attending organizations of the workshop. This treatment was agreed to be carried out on a pilot basis with the provision that operational trials be conducted to investigate treatment feasibility in terms of treatment efficacy and cost per hectare. Appendix II provides a list of operational trials recommended by this document.

Manual treatments may be used for late rotation and in multiple-stand entry fertilization regimes.

Red Alder Management

Red alder management was presented as an optional regime at the workshop by TimberWest. The potential of this management regime has yet to be fully realized. As red alder increasingly becomes part of coastal BC's log market profile, it is anticipated that more areas will be managed for a red alder crop.

Treatment areas and type of treatment stands would need to be investigated. It is assumed that red alder management requires intensive management by spacing and perhaps pruning. The product objective of red alder management would be to produce sawlogs.

Suitable candidate stands are limited in quantity. Red alder management will be subject to a trial and evaluation period.

3.2 Timber Quality Strategies

The management goal is to produce high quality sawlogs and to direct logs to manufacturing plants best able to maximize the value of the species, quality and size available.

A Timber Quality Strategy is provided in Table 7. Included in the Timber Quality Strategy are strategies or regimes not eligible for FRBC funding – basic silviculture and using improved stock. It is important to mention these activities, as they are the main strategies for which TimberWest directly funds for the production of high quality sawlogs as presented in the Draft Management Plan.

Table 7. Timber Quality Strategies for Tree Farm Licence No. 47.

<i>Response Framework</i>	<i>Strategy/Regime</i>	<i>Rationale</i>	<i>Target Strata</i>	<i>Silvicultural Activity</i>	<i>Expected Gain</i>	<i>Opportunity in the next 5 years (ha/year)</i>	<i>Opportunity in the next 10 years (ha/year)</i>
QST1 <u>JS, BL</u>	Late rotation fertilization of Douglas-fir leading stands.	Short time period to return on investment.	Fd stands, age class 3-5, min. 300 dominant/codominant stems per hectare (sph).	a) Aerial broadcast fertilization. b) Manual fertilization. To be done on a trial basis.	i) Realized return on investment.	<u>JS</u> a) 100 ¹⁰ b) 50 ¹¹ (trial) <u>BL</u> a) 0 ¹² b) 0 ¹²	<u>JS</u> a) 100 ¹⁰ b) 50 ¹¹ <u>BL</u> a) 0 ¹² b) 0-50 ¹²
QMT1 <u>JS, BL</u>	Practice high quality basic silviculture.	To achieve quality product objectives of high value sawlogs.	All areas to be reforested.	a) Rapid reforestation. b) Ensure adequate stocking. c) Aggressive vegetation management.	Log pieces 20 to 50 cm in diameter having straight boles, minimal taper and small branches.	Non-FRBC eligible.	
QMT2 <u>JS, BL</u>	Utilize genetically improved seed.	Promotion of characteristics desirable in wood quality – wood density, knot size etc...	Use seed when available for areas to be reforested.	Continue research.	High value sawlogs.	Funding of research is FRBC eligible. Planting of improved stock is non-FRBC eligible.	
QMT3 <u>JS, BL</u>	Promotion of valuable crop tree species through to rotation. To be done on a trial basis.	i) Forest product diversification. ii) Preservation of basic silviculture investment (i.e. To ensure the stocking of potentially valuable crop species at free growing, will be present in the stand at rotation).	<u>JS</u> Fd stands, age class 1. <u>BL</u> Cw and Yc stands, age class 1.	a) Species manipulation – clearing away non-target trees within a specified radius of target crop tree. b) Manual fertilization. To be done on a trial basis.	i) Effectiveness unknown. ii) Intent is to produce a stand at rotation with valuable crop tree species that otherwise may have been out-competed for growing space by other less desirable or overly abundant conifer species such as western hemlock.	<u>JS</u> a) 25 ¹³ b) 0 <u>BL</u> a) 50(trial) b) 50(trial)	<u>JS</u> a) 25 b) 0 <u>BL</u> a) 50 b) 50

¹⁰ This value of hectares to treat per year is based on experience in searching for suitable stands available for late rotation fertilization.¹¹ The potential opportunities for manual Fd fertilization depends on public support from the community on Quadra Island where a significant amount of candidate stands exist.¹² Very few if any late rotation Fd stands that meet the 'Target Strata' criteria exist within the Bonanza Lake Management Unit.¹³ This value of hectares to treat per year is based on experience in searching for suitable treatment areas.

Table 7. Continued.

<i>Response Framework</i>	<i>Strategy/Regime</i>	<i>Rationale</i>	<i>Target Strata</i>	<i>Silvicultural Activity</i>	<i>Expected Gain</i>	<i>Opportunity in the next 5 years (ha/year)</i>	<i>Opportunity in the next 10 years (ha/year)</i>
QMT4 <u>JS</u> , <u>BL</u>	Non-Density Management.	Promotion of desirable wood quality characteristics.	All reforested conifer stands.	Stand densities are not to be reduced below 900 sph for <u>JS</u> and 1000 sph for <u>BL</u> as a result of any silviculture treatment designed for management of timber quantity and/or quality.	i) Small knot sizes. ii) Smaller diameter juvenile or crown wood core. iii) Tight growth rings.	-	-
QMT5 <u>JS</u>	Manage deciduous stands. To be done on a trial basis.	New access to markets previous not developed.	Pure high density red alder stands, age classes 1 and 2.	Intensive management regime of juvenile spacing and pruning.	Diversified market potential.	0-5	25
QLT0	No long term timber quality strategies have been identified at this time.						

3.2.1 Additional Rationale for Proposed Strategies

Promotion of valuable crop trees species through to rotation

Species manipulation is a treatment activity agreed upon by all attending organizations of the workshop. This treatment was agreed to be carried out on a pilot basis with the provision that operational trials be conducted to investigate treatment feasibility in terms of treatment efficacy and cost per hectare. Appendix II provides a list of operational trials recommended by this document.

Species manipulation involves the clearing away of non-target species around the target species to provide growing space to the target species. Treatment is concentrated on target species rather than on all species in the entire stand (juvenile spacing). Concentrating treatment to the target species may result in a lower cost per hectare than if all species within the hectare were treated.

Manual fertilization (Cw and Yc) is recommended to be done at the same time as the species manipulation treatment. Concurrent treatments should result in cost savings for implementing two treatments at once.

A rationale of this strategy is to provide for forest product diversity. This objective is not presented in the Draft Management Plan. TimberWest believes the best way to manage value per hectare is at the manufacturing facility as opposed to in the forest. For this reason, strategies with the explicit intent to manage stand density have not been developed (i.e. juvenile spacing).

It is not practical or possible to predict future markets. Today's markets show that western redcedar, yellow cedar (cypress) and Douglas-fir are the most valued species. In general, western redcedar, yellow cedar and Douglas-fir are species are less in abundance than western hemlock and amabilis fir in coastal BC second and third growth stands. From a stand management perspective it would be diligent to manage for a species known to have a history of high market value, especially when it is known that this species will be less in abundance in the future. Species manipulation is a term that may be applied to the concept of promoting valuable crop trees species through to rotation.

Another rationale for species manipulation is provided by TimberWest foresters. It has been observed by the foresters that potential valuable crop species (such as Douglas-fir in the Johnstone Strait MU and western redcedar in the Bonanza Lake MU) are being out competed by western hemlock. With time, these valuable species may regain their position in the stand due to growth strategies or through ecological succession. Unfortunately, timeframes are relatively short given that harvesting occurs when the stand reaches a merchantable size and not when the stand yields a desired species composition.

In lieu of a species manipulation treatment, juvenile spacing to high target densities with criteria for crop tree selection (Fd, Cw and Yc) may take place.

The issues with the following strategies/regimes have already been discussed in section 3.1, Timber Quantity Strategies: *Aerial Fertilization – Late Rotation Stands, Manual Fertilization and Red Alder Management*.

3.3 Habitat Supply Strategies

A Habitat Supply Strategy is provided in Table 8. The strategies proposed represent ideas that were discussed at the workshop. The strategies proposed by no means represents a complete list. Additional input is anticipated over time.

Table 8. Habitat Supply Strategies for Tree Farm Licence No. 47.

<i>Response Framework</i>	<i>Strategy/Regime</i>	<i>Rationale¹⁴</i>	<i>Target Strata</i>	<i>Silvicultural Activity</i>	<i>Expected Gain</i>	<i>Opportunity in the next 5 years (ha/year)</i>	<i>Opportunity in the next 10 years (ha/year)</i>
HLT1 <u>JS</u>	White pine management.	To reduce risk of infection by white pine blister rust.	Juvenile stands of white pine.	Pruning of lower branches.	i) Preservation of a coniferous species known to be low in abundance. ii) Promotion of stand-level biodiversity.	0.5	0.2
HLT2 <u>JS, BL</u>	Riparian stand tending. To be done on a trial basis.	Recovery of damage or lost riparian function due to logging riparian areas.	Pre-Forest Practices Code logged riparian areas.	Assessments to be done to determine exact treatments – type of treatments spacing and/or fertilization as well as scarring (creating pathways for decay to enter trees).	Enhancing the development of old growth characteristics in second growth riparian areas: i) Recruitment of large woody debris. ii) Promotion desirable riparian coniferous species i.e. western redcedar. iii) Variable stand structure. iv) etc.....	10	3

¹⁴ An increase in stand volume will work to offset future reductions in harvest levels. Moreover, larger piece sizes due to increased volume reduces the time to reach first entry age, which in turns increases opportunities in harvest flexibility.

4. Silvicultural Priorities

Table 9 is a treatment table that ranks silviculture activities versus forest level objectives developed at the workshop.

Table 9. Treatment Activity Priorities for Tree Farm Licence No. 47.

<i>Regime</i>	<i>Rank (#) Priority (L, M, H)</i>		<i>Strategy</i>	<i>Opportunity Area (ha/year)</i>	<i>Timber Supply Effects</i>			<i>Quality</i>	<i>Habitat¹⁵</i>			<i>Direct¹⁶ Silvic. Jobs (Days/ha)</i>	<i>Direct¹⁷ Cost (\$/ha)</i>
	<i>JS</i>	<i>BL</i>			<i>Short</i>	<i>Medium</i>	<i>Long</i>		<i>OG</i>	<i>Riparian</i>	<i>Wildlife</i>		
1. High quality basic silviculture Rapid and adequate reforestation Vegetation management	1	1	MT1, QMT1	All harvested stands (Non-FRBC eligible)	0	+	+	+	+	+	+	N/a	N/a
2 Tree Improvement	2	2	MT2, QMT2	All harvested stands (Non-FRBC eligible)	0	+	+	+	+	+	+	N/a	N/a
Fertilization													
3. Late rotation Fd stand fertilization	3	3											
Aerial fertilization – <u>JS</u>	H	H	ST2, QST1	100	+	+	+	+	+	0(+) ¹⁸	+	0.04	350
Aerial fertilization – <u>BL</u>			ST2, QST1	0	+	+	+	+	+	0(+) ¹⁸	+	0.04	300
Manual fertilization – <u>JS</u>			ST2, QST1	50	+	+	+	+	+	0(+) ¹⁸	+	1.00	525
Manual fertilization – <u>BL</u>			ST2, QST1	0	+	+	+	+	+	0(+) ¹⁸	+	1.00	500
4. Multiple-stand entry fertilization	4	4											
Aerial fertilization – <u>JS</u> (Fd, Cw, Yc)	M	M	MT3	500	0	+	+	0	+	0(+) ¹⁸	+	0.04	350
Manual fertilization – <u>BL</u> (Cw, Yc) ¹⁹			MT3	50	0	+	+	0	+	0(+) ¹⁸	+	1.00	500
Stand tending													
5. Promotion of valuable crop species	5	5											
Spacing – <u>JS</u> (Fd)	L	L	QMT3	25	0	0	0	+	+	+	+	3.00	1400
Spacing – <u>BL</u> (Cw, Yc)			QMT3	50	0	0	0	+	+	+	+	2.00	1400
Manual fertilization – <u>JS</u> (Fd)			QMT3	0	0	0	0	+	+	+	+	0.00	0
Manual fertilization – <u>BL</u> (Cw, Yc)			QMT3	50	0	0	0	+	+	+	+	1.0	500
6. Stand density control of red alder	6	N/a											
Spacing – <u>JS</u> (Dr)	L		MT4, QMT5	0-5	0	+	+	+	0	0	0	3.00	1400
Pruning – <u>JS</u>			MT4, QMT5	0-5	0	+	+	+	0	0	0	8.00	1400

¹⁵ It is generally accepted that any treatment on the landscape that promotes diversity in landscape attributes will promote biodiversity.¹⁶ Estimates for productivity and costs for many of the treatments listed are based on limited or no previous experience within TFL 47. Future analyses will require this information which should be collected from operational trials.¹⁷ Costs for the same treatment within the same management unit may differ depending on if the activity is coupled with one or more other type of activities.¹⁸ It is expected that treatments will not take place within riparian reserve zones (unless intentionally prescribed for non-timber management objective), but may occur within the riparian management zones as defined by the Forest Practices Code.¹⁹ The first stand entry for manual fertilization in stands of BL may be done concurrently with a spacing treatment under an overall treatment regime for promoting valuable crop species.

Table 9. Continued.

Regime	Rank (#) Priority (L, M, H)		Strategy	Opportunity Area (ha/year)	Timber Supply Effects			Quality	Habitat ²⁰			Direct ²¹ Silvic. Jobs (Days/ha)	Direct ^{2,22} Cost (\$/ha)
	JS	BL			Short	Medium	Long		OG	Riparian	Wildlife		
7. White pine management	8	N/a											
Pruning – JS	L		HLT1	0.5	0	0	0	0	+	0	0	4.00	1400
8. Riparian stand tending	9	7											
Spacing – JS	L	L	HLT2	10	0	0	0	0	+	+	+	4.00	1800
Spacing – BL			HLT2	10	0	0	0	0	+	+	+	4.00	1800
Manual fertilization – JS			HLT2	10	0	0	0	0	+	+	+	1.50	525
Manual fertilization – BL			HLT2	10	0	0	0	0	+	+	+	1.50	525

²⁰ It is generally accepted that any treatment on the landscape that promotes diversity in landscape attributes will promote biodiversity.

²¹ Estimates for productivity and costs for many of the treatments listed are based on limited or no previous experience within TFL 47. Future analyses will require this information which should be collected from operational trials.

²² Costs for the same treatment within the same management unit may differ depending on if the activity is coupled with one or more other type of activities.

5. Silviculture Program

5.1 Working Targets

Working Target 1 (Overall)

Most projects to yield a positive return on investment.

Working Target 2 (Quantity)

Increase yields in the short, medium and long term in direct proportion to area fertilized.

Working Target 3 (Quantity)

Develop stand structure that allows greater harvest flexibility in the medium and long term.

Working Target 4 (Quantity)

Increase timber supply by widening the forest product market profile through management of crop species with no previous stand management.

Working Target 5 (Quality)

Increase proportion of dominant Fd, Cw and Yc in merchantable second growth stands to 10% of volume in medium and long term.

Working Target 6 (Quality)

Manage for wood quality attributes including small knot sizes and low bole taper.

Working Target 7 (Habitat)

Promote the survival of white pine in reforested stands of the Johnstone Strait MU by preventing the spread of white pine blister rust, through pruning of lower branches.

Working Target 8 (Habitat)

Assess pre-1994 logged riparian areas in terms of damaged riparian function and what role silviculture can play in the recovery of the riparian forest ecosystem.

5.2 Program Costs and Benefits

Table 10 is a schedule for area treated by silviculture activity and year.

Table 11 is a schedule for expenditure by activity and year.

Table 12 is a summary of employment benefits by activity and year.

The Long-term timber supply effects from implementing this strategy are expected to be positive.

Table 10. Hectares (ha) Treated By Activity and Year for Tree Farm Licence No. 47.

<i>Program</i>	<i>Management Unit</i>	<i>Year</i>	<i>Aerial Fertilization</i>	<i>Manual Fertilization</i>	<i>Spacing</i>	<i>Pruning</i>	<i>Total</i>
Incremental	Johnstone Strait	1	600	50	30	5	685
		2	600	50	30	5	685
		3	600	50	30	5	685
		4	600	50	30	5	685
		5	600	50	30	5	685
Incremental	Johnstone Strait	Sub-total 1-5	3,000	250	150	25	3,425
Incremental	Johnstone Strait	6-10	3,000	250	250	125	3,625
Incremental	Johnstone Strait	Subtotal 1-10	6,000	500	400	150	7,050
Incremental	Bonanza Lake	1	0	50	50	0	100
		2	0	50	50	0	100
		3	0	50	50	0	100
		4	0	50	50	0	100
		5	0	50	50	0	100
Incremental	Bonanza Lake	Sub-total 1-5	0	250	250	0	500
Incremental	Bonanza Lake	6-10	0	500	250	0	750
Incremental	Bonanza Lake	Subtotal 1-10	0	750	500	0	1,250
Incremental	Johnstone Strait + Bonanza Lake	Total 1-10	6,000	1,250	900	150	8,300
Habitat Supply	Johnstone Strait	1	-	10	10	0.5	20.5
		2	-	10	10	0.5	20.5
		3	-	10	10	0.5	20.5
		4	-	10	10	0.5	20.5
		5	-	10	10	0.5	20.5
Habitat Supply	Johnstone Strait	Sub-total 1-5	-	50	50	2.5	102.5
Habitat Supply	Johnstone Strait	6-10	-	15	15	1.0	31
Habitat Supply	Johnstone Strait	Subtotal 1-10	-	65	65	3.5	133.5
Habitat Supply	Bonanza Lake	1	-	10	10	-	20
		2	-	10	10	-	20
		3	-	10	10	-	20
		4	-	10	10	-	20
		5	-	10	10	-	20
Habitat Supply	Bonanza Lake	Sub-total 1-5	-	50	50	-	100
Habitat Supply	Bonanza Lake	6-10	-	15	15	-	30
Habitat Supply	Bonanza Lake	Subtotal 1-10	-	65	65	-	130
Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10		130	130	3.5	263.5
Incremental + Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	6,000	1,380	1,030	153.5	8,563.5

Table 11. Expenditure (\$) By Activity and Year for Tree Farm Licence No. 47.

<i>Program</i>	<i>Management Unit</i>	<i>Year</i>	<i>Aerial Fertilization</i>	<i>Manual Fertilization</i>	<i>Spacing</i>	<i>Pruning</i>	<i>Total</i>
Incremental	Johnstone Strait	1	210,000	26,250	42,000	7,000	285,250
		2	210,000	26,250	42,000	7,000	285,250
		3	210,000	26,250	42,000	7,000	285,250
		4	210,000	26,250	42,000	7,000	285,250
		5	210,000	26,250	42,000	7,000	285,250
Incremental	Johnstone Strait	Sub-total 1-5	1,050,000	131,250	210,000	35,000	1,426,250
Incremental	Johnstone Strait	6-10	1,050,000	131,250	350,000	175,000	1,706,250
Incremental	Johnstone Strait	Subtotal 1-10	2,100,000	262,500	560,000	210,000	3,132,500
Incremental	Bonanza Lake	1	0	25,000	70,000	0	95,000
		2	0	25,000	70,000	0	95,000
		3	0	25,000	70,000	0	95,000
		4	0	25,000	70,000	0	95,000
		5	0	25,000	70,000	0	95,000
Incremental	Bonanza Lake	Sub-total 1-5	0	125,000	350,000	0	475,000
Incremental	Bonanza Lake	6-10	0	250,000	350,000	0	600,000
Incremental	Bonanza Lake	Subtotal 1-10	0	375,000	700,000	0	1,075,000
Incremental	Johnstone Strait + Bonanza Lake	Total 1-10	2,100,000	637,500	1,260,000	210,000	4,207,500
Habitat Supply	Johnstone Strait	1	-	5,250	18,000	700	23,950
		2	-	5,250	18,000	700	23,950
		3	-	5,250	18,000	700	23,950
		4	-	5,250	18,000	700	23,950
		5	-	5,250	18,000	700	23,950
Habitat Supply	Johnstone Strait	Sub-total 1-5	-	26,250	90,000	3,500	119,750
Habitat Supply	Johnstone Strait	6-10	-	7,875	27,000	1,400	36,275
Habitat Supply	Johnstone Strait	Subtotal 1-10	-	34,125	117,000	4,900	156,025
Habitat Supply	Bonanza Lake	1	-	5,250	18,000	-	23,250
		2	-	5,250	18,000	-	23,250
		3	-	5,250	18,000	-	23,250
		4	-	5,250	18,000	-	23,250
		5	-	5,250	18,000	-	23,250
Habitat Supply	Bonanza Lake	Sub-total 1-5	-	26,250	90,000	-	116,250
Habitat Supply	Bonanza Lake	6-10	-	7,875	27,000	-	34,875
Habitat Supply	Bonanza Lake	Subtotal 1-10	-	34,125	117,000	-	151,125
Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	-	68,250	234,000	4,900	307,150
Incremental + Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	2,100,000	705,750	1,494,000	214,900	4,514,650

Table 12. Employment (Person Years²³) By Activity and Year for Tree Farm Licence No. 47.

<i>Program</i>	<i>Management Unit</i>	<i>Year</i>	<i>Aerial Fertilization</i>	<i>Manual Fertilization</i>	<i>Spacing</i>	<i>Pruning</i>	<i>Total</i>
Incremental	Johnstone Strait	1	0.13	0.28	0.50	0.22	1.13
		2	0.13	0.28	0.50	0.22	1.13
		3	0.13	0.28	0.50	0.22	1.13
		4	0.13	0.28	0.50	0.22	1.13
		5	0.13	0.28	0.50	0.22	1.13
Incremental	Johnstone Strait	Sub-total 1-5	0.65	1.40	2.50	1.10	5.65
Incremental	Johnstone Strait	6-10	0.65	1.40	4.16	5.50	11.71
Incremental	Johnstone Strait	Subtotal 1-10	1.30	2.80	6.66	6.60	17.36
Incremental	Bonanza Lake	1	0.00	0.28	0.56	0.00	0.84
		2	0.00	0.28	0.56	0.00	0.84
		3	0.00	0.28	0.56	0.00	0.84
		4	0.00	0.28	0.56	0.00	0.84
		5	0.00	0.28	0.56	0.00	0.84
Incremental	Bonanza Lake	Sub-total 1-5	0.00	1.39	2.80	0.00	4.20
Incremental	Bonanza Lake	6-10	0.00	2.78	2.80	0.00	5.58
Incremental	Bonanza Lake	Subtotal 1-10	0.00	4.17	5.60	0.00	9.77
Incremental	Johnstone Strait + Bonanza Lake	Total 1-10	1.30	6.97	12.26	6.60	27.13
Habitat Supply	Johnstone Strait	1	-	0.08	0.22	0.01	0.31
		2	-	0.08	0.22	0.01	0.31
		3	-	0.08	0.22	0.01	0.31
		4	-	0.08	0.22	0.01	0.31
		5	-	0.08	0.22	0.01	0.31
Habitat Supply	Johnstone Strait	Sub-total 1-5	-	0.40	1.10	0.05	1.55
Habitat Supply	Johnstone Strait	6-10	-	0.13	0.33	0.02	0.48
Habitat Supply	Johnstone Strait	Subtotal 1-10	-	0.53	1.43	0.07	2.03
Habitat Supply	Bonanza Lake	1	-	0.08	0.22	-	0.30
		2	-	0.08	0.22	-	0.30
		3	-	0.08	0.22	-	0.30
		4	-	0.08	0.22	-	0.30
		5	-	0.08	0.22	-	0.30
Habitat Supply	Bonanza Lake	Sub-total 1-5	-	0.40	1.10	-	1.50
Habitat Supply	Bonanza Lake	6-10	-	0.13	0.33	-	0.46
Habitat Supply	Bonanza Lake	Subtotal 1-10	-	0.53	1.43	-	1.96
Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	-	1.06	2.86	0.07	3.99
Incremental + Habitat Supply	Johnstone Strait + Bonanza Lake	Total 1-10	1.30	8.03	15.12	6.67	31.12

²³ Note: Assumes 180 days of silviculture work = 1 job (Source: Strathcona TSA, Incremental Silviculture Strategy (Interim) using the Source: Jobs and Timber Accord)

6. References

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

B.C. Ministry of Forests, October 15, 1999. *Attachment 1, Sample Report Layout – Sample TSA Silviculture Strategy (Type 1)*

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

TFL Forest Ltd., August 21, 2000. *Tree Farm Licence No. 47, Draft Management Plan No. 3, Part A, Johnstone Strait and Bonanza Lake Management Units, January 1, 2001 – December 31, 2005*

TFL Forest Ltd., February, 2000. *Appendix IV to Tree Farm Licence No. 47 Management Plan #3, Timber Supply Analysis.*

Appendices

Appendix I

SILVICULTURE HISTORY

TFL 47 Block 17 - Beaver Cove

Year	Logged	Planted	Fert	Juvenile Spaced	Pruned	Fires	Site Preparation	Brushed
1972	246	207						
1973	351	590		15			11	1
1974	384	237						
1975	213	9		58				
1976	410	190		206				
1977	419	82		152				10
1978	478	166		253				
1979	455	204		331				26
1980	479	504		353				
1981	375	253		316				
1982	375	397		280				
1983	537	332		128			297	
1984	361	368					209	
1985	398	248		100			6	
1986	352	197		86				57
1987	538	184		268				
1988	526	429		41			57	
1989	458	159		390		7		
1990	293	272		250				
1991	230	52		119				
1992	312	242		43				
1993	254	215		70				
1994	260	378		276	6			
1995								
1996	104	318		247	10	11		
1997	259	203		128	5			2
1998	173	183				24	2	
1999	281	180	279	60			7	1
Total	9521	6799	279	4170	21	42	589	97
Average	340	243	10	149	1	2	21	3

SILVICULTURE HISTORY

TFL 47 Blocks 1 - 12 - Johnstone Straits

Year	Logged	Planted	Fert.	Juvenile Spaced	Pruned	Fires	Site Preparation	Brushed
1974	123	352		19				
1975	213	342		37				
1976	242	200		25			74	64
1977	276	278						
1978	397	313		57				81
1979	519	421		29				15
1980	632	365					344	27
1981	598	502					167	
1982	481	604		454			126	
1983	830	578		203				243
1984	679	518		235			527	
1985	851	344						971
1986	522	516		99				1133
1987	727	1302			13	2		823
1988	635	448		62		3		953
1989	549	407		85				594
1990	580	499		104		3		433
1991	459	779		16				609
1992	408	134		526				387
1993	454	362	560	268				1614
1994	439	940		446				1123
1995	603	398		638				614
1996	498	732		302				616
1997	447	481		268				443
1998	478	325		93			5	657
1999	1062	498	1166	78		1	2	684
Total	13702	12638	1726	4044	13	9	1245	12084
Average	527	486	66	156	1	0	48	465

Appendix II

Summary of Proposed Operational Trials

<i>Proposed Operational Trial</i>	<i>Objective</i>	<i>Estimated Cost</i>	<i>Timing</i>
Species Manipulation	Worker Productivity	\$4,500	2001/02
Manual Fertilization			
Late Rotation Year 1	Worker Productivity and Efficacy	\$3,500	2001/02
Late Rotation Year 2	2 nd data collection for Efficacy	\$4,000	2002/03
Multi-stand entries Year 1	Worker Productivity and Efficacy	\$4,500	2001/02
Multi-stand entries Year 2	2 nd data collection for Efficacy	\$3,500	2002/03