TIMBER SUPPLY BRANCH

TIMBER SUPPLY REVIEW

Strathcona Timber Supply Area Analysis Report

February 1999

BRITISH COLUMBIA

Ministry of Forests

Strathcona
Timber Supply Area
Analysis Report

B.C. Ministry of Forests
595 Pandora Avenue
Victoria, B.C.
V8W 9C3

February 1999

Canadian Cataloguing in Publication Data

Main entry under title:
Strathcona timber supply area analysis report

Includes bibliographical references: p.
ISBN 0-7726-3780-6

1. Timber – British Columbia – Vancouver Island.
2. Forests and forestry – British Columbia – Vancouver Island – Mensuration. 3. Forest management – British Columbia – Vancouver Island.
4. Vancouver Forest Region (B.C.). I. British Columbia. Ministry of Forests.

SD438.B7S77 1999 333.75'11'097112 C99-960055-9

© 1999 Province of British Columbia
Ministry of Forests

Preface

This report contains a timber supply analysis and a social-economic analysis and is part of the provincial Timber Supply Review carried out by the British Columbia Forest Service. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) and tree farm licences (TFLs) throughout British Columbia. A review of each TSA and TFL is completed at least once every five years.

To determine allowable timber harvesting levels according to legislated requirements, the Chief Forester must have an up-to-date assessment of the timber supply, based on the best available information and reflecting current management direction. **The report that follows provides this assessment but should not be construed as a recommendation on permissible harvest levels.**

This report focuses on a single forest management scenario — current management practices. Current management practices are defined by the specifications in management plans for the timber supply area including guidelines for the protection of forest resources, the Forest Practices Code (FPC) and official land-use decisions made by Cabinet.

Assessing the implications of only current practices rather than looking at a number of different management schemes expedites the analysis process, allowing analysis of all TSAs in the province every five years. An important part of these analyses is an assessment of how results might be affected by uncertainties — a process called sensitivity analysis. Together, the sensitivity analyses and the assessment of the effects of current forest management on the timber supply form a solid basis for discussions among stakeholders about alternative timber harvesting levels.

In addition to having an up-to-date assessment of timber supply when setting the allowable annual cut (AAC) the Chief Forester considers short- and long-term implications of alternative harvest levels, capabilities and requirements of existing and proposed processing facilities, and the social and economic objectives of the Crown. The socio-economic analysis provides the Chief Forester with some of the information necessary for these considerations.

The socio-economic analysis considers forestry activity associated with the harvesting and processing of timber harvested from the TSA within the context of regional timber supply and production capacity.

This report is the third of five documents that will be released for each TSA as part of the Timber Supply Review. (The first two documents are the information report and the data package). This document provides detailed technical information on the results of the timber supply and socio-economic analyses. A separate document called the public discussion paper will summarize the technical information to provide a focus for public discussions of possible timber harvest levels. The fifth will outline the Chief Forester's harvest level decision and the reasoning behind it.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Strathcona Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over both the short (next 20 years) and long (next 250 years) terms. It also examines the potential changes in timber supply stemming from uncertainties about forest growth and management actions. It is important to note that the various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. **As such, the forecasts should be used for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Strathcona TSA covers about 705 071 hectares of area in the central portion of Vancouver Island and southwest portion of the mainland area of British Columbia. Within this area, 353 144 hectares are classified as productive forest managed by the B.C. Forest Service. Only about one-half of this area, or about 177 797 hectares, are considered available for timber production and harvesting under current management practices. The three factors which most reduce the availability of the productive forest for timber supply are: inoperability, soil stability and low site productivity, which make up 28.5%, 10% and 3.9% of the productive forest area respectively. Within the area available for timber harvesting, most forests are dominated by western hemlock, although there are also large areas dominated by Douglas-fir on the eastern side of Vancouver Island.

The criteria used to define the base case harvest forecast included managing the rate of decline in harvests from the current level, avoiding large and abrupt harvest shortfalls, timing the rise to a long-term harvest level commensurate with the productivity of the timber harvesting land base, and maintaining the decline in the short- and medium-term at a rate that is comparable with the rise to the long-term harvest level, in an effort to balance current reductions with future harvest level increases. These criteria are attempts to avoid both excessive changes from decade-to-decade, and significant timber shortages in the future, either of which might limit future options.

The base case harvest forecast begins 12% below the current AAC, at 1.25 million cubic metres per year. The harvest level declines at 12% per decade for two decades to a mid-term harvest level of 970 000 cubic metres per year before rising to a long-term harvest level of 1.07 million cubic metres per year in decade 11, just over 100 years from now. The rise to the long-term harvest level coincides with attaining enough volume in high productivity managed stands to support harvesting until poor productivity managed stands become available for harvest.

The base case harvest forecast was chosen to provide a first decade harvest that is stable in the face of uncertainty and that enables a short transition to the lowest projected harvest level, while still maintaining a rise to the long-term harvest level equal to or below the decline rates used in the short term. The base case first decade harvest level was shown to be stable with respect to all uncertainties examined, with the exception of further restricting the maximum allowable disturbance in visual quality. Sensitivity analysis showed timber supply to rely significantly on the freedom of harvest activity in the visual quality partial retention areas of the Strathcona TSA, and relative independence from the timing of when stands become harvestable.

First decade timber supply was reduced to below base case levels by reductions in the timber harvesting land base, and by restriction of disturbance in visual quality areas to the bottom of the acceptable range. While analysis showed it would be possible to increase short-term harvests above base case levels, any reductions in the area of the timber harvesting land base, increases in green-up ages, reductions in maximum allowable disturbance, or application of early-seral biodiversity guidelines would threaten the ability to achieve such an increase.

Mid-term timber supply is quite sensitive to uncertainty and depends on the first decade harvest level. Over the range of uncertainties tested, mid- term supply declined to between 0.852 million and 1.07 million cubic metres per year, given first decade harvest level of 1.25 million cubic metres per year. Increasing short-term supply above the base case would reduce mid- term timber supply, possibly for many decades, relative to base case levels.

Executive Summary

The socio-economic analysis for the Strathcona TSA indicates that the current AAC of 1.42 million cubic metres can support a provincial total of approximately 1,859 person-years of direct employment. Residents of the Strathcona TSA account for approximately 40% of this direct employment. Strathcona TSA direct forestry sector activity supports a further 2,325 person-years of indirect and induced employment across the province.

The base case harvest forecast for the first decade is 1.25 million cubic metres per year — 12% less than the current AAC — and would support a provincial total of 1,636 person-years of direct employment and a further 2,046 person-years of indirect and induced employment.

As shown in the timber supply analysis, by the second decade the harvest level is projected to decline to 1.1 million cubic metres per year which would reduce provincial employment to 1,439 person-years of direct employment and 1,801 person-years of indirect and induced employment. By the third decade, the harvest level is projected to decline to 970 thousand cubic metres per year and would further reduce provincial employment based on timber supply from this area to 1,270 person-years of direct employment and 1,588 person-years of indirect and induced employment.

The current AAC provides the provincial government with, on average, revenues of $66.4 million per year. Under the base case harvest forecast, the initial reduction in the harvest level could reduce annual revenues by $8.1 million. In the second decade, annual revenues could decline by a further $6.9 million, and in the third decade by a further $6.1 million.

In conclusion, this analysis indicates that — based on current inventory, growth and yield information, and current forest management practices — the current rate of harvest in the Strathcona TSA cannot be maintained without causing larger timber supply shortfalls in the future. Several factors related to the current forest inventory and management regime could affect timber supply; however, there is no evidence available prior to completion of the analysis to suggest that the data and assumptions used in the analysis should be changed.

Table of Contents

PREFACE ..... **III**

EXECUTIVE SUMMARY ..... **IV**

INTRODUCTION **1**

1 DESCRIPTION OF THE STRATHCONA TIMBER SUPPLY AREA **4**

1.1 The environment 4

1.2 First Nations 7

2 INFORMATION PREPARATION FOR THE TIMBER SUPPLY ANALYSIS **8**

2.1 Land base inventory 8

2.2 Timber growth and yield 16

2.3 Management practices 16

3 TIMBER SUPPLY ANALYSIS METHODS **21**

4 RESULTS **22**

4.1 Base case harvest forecast 22

4.2 Harvest transition from existing natural stands to managed stands 25

4.3 Area, average volume, and average age harvested 26

4.4 Age class composition over time 27

4.5 Contribution from the Kyuquot supply block 30

5 TIMBER SUPPLY SENSITIVITY ANALYSES **31**

5.1 Alternative harvest flows over time 32

5.2 Sensitivity to changes in minimum harvestable ages 34

5.3 Uncertainty in the size of the timber harvesting land base 36

5.4 Uncertainty in timber volume estimates for existing unmanaged stands 37

5.5 Uncertainty in timber volume estimates for regenerated (managed) stands 39

5.6 Uncertainty in green-up ages 40

5.7 Uncertainty in harvest scheduling rules 41

5.8 Uncertainty in site productivity estimates for older stands 43

5.9 Uncertainty in the application of guidelines for visual quality 45

5.10 Uncertainty in the approximation of cutblock adjacency objectives 46

5.11 Uncertainty in the application of both visual quality and cutblock adjacency objectives 49

5.12 Uncertainty in levels of harvesting in alder stands and helicopter-logging areas 50

5.13 Uncertainty in application of biodiversity guidelines 51

6 SUMMARY AND CONCLUSIONS OF THE TIMBER SUPPLY ANALYSIS **53**

Table of Contents

7 SOCIO-ECONOMIC ANALYSIS 55

7.1 CURRENT SOCIO-ECONOMIC SETTING 55

7.1.1 Population and demographic trends 55

7.1.2 Economic profile 57

7.2 STRATHCONA TSA FOREST INDUSTRY 59

7.2.1 Current allowable annual cut 59

7.2.2 Strathcona TSA harvest history 60

7.2.3 Strathcona TSA major licensees and processing facilities 61

7.2.4 Forest sector employment and employment coefficients 68

7.2.5 Strathcona TSA forestry employment income 70

7.2.6 Provincial government revenues 70

7.3 SOCIO-ECONOMIC IMPLICATIONS OF THE BASE CASE HARVEST FORECAST 71

7.3.1 Short- and long-term implications of alternative harvest levels 72

7.3.2 Community level impacts 75

7.3.3 Nature, production capabilities, and timber requirements of processing facilities 76

7.3.4 Regional timber supply implications 77

7.4 SUMMARY 78

8 REFERENCES 79

9 GLOSSARY 80

APPENDIX A DESCRIPTION OF DATA INPUTS AND ASSUMPTIONS FOR THE TIMBER SUPPLY ANALYSIS 87

INTRODUCTION 88

A.1 INVENTORY INFORMATION 89

A.2 ZONE AND ANALYSIS UNIT DEFINITION 90

A.3 DEFINITION OF THE TIMBER HARVESTING LAND BASE 92

A.4 FOREST MANAGEMENT ASSUMPTIONS 96

A.5 VOLUME ESTIMATES FOR EXISTING STANDS 101

A.6 VOLUME ESTIMATES FOR REGENERATED STANDS 105

APPENDIX B SOCIO-ECONOMIC ANALYSIS BACKGROUND INFORMATION 109

B.1 LIMITATIONS OF ECONOMIC ANALYSIS 110

B.2 ECONOMIC IMPACT ANALYSIS METHODOLOGY 111

Table of Contents

Tables

1. Vulnerable, endangered, threatened and regionally significant species....6
2. Determining the timber harvesting land base for the Strathcona TSA....11
3. Summary information from the timber supply sensitivity analyses....54
4. Population statistics — Campbell River Forest District and selected communities, 1991-2001....56
5. Employment multipliers by sector, Campbell River Forest District, 1996....59
6. Strathcona TSA allowable annual cut, by licence type, 1997....59
7. Strathcona TSA volumes billed, by licence type, 1993-1997....60
8. Doman-Western harvest and provincial employment statistics....61
9. Interfor harvest and provincial employment statistics....62
10. Canfor harvest and provincial employment statistics....63
11. MacMillan Bloedel harvest and provincial employment statistics....64
12. TimberWest Forest Ltd. harvest and provincial employment statistics....65
13. Hecate harvest and provincial employment statistics....66
14. Other licensee harvest and provincial employment statistics....67
15. Strathcona TSA employment and employment coefficients, average 1995-1997....69
16. Average annual direct and indirect/induced incomes and total employment income, 1995-1997....70
17. Average annual provincial government revenues, 1995-1997....71
18. Strathcona TSA socio-economic impacts: base case harvest forecast, 1999.....74

A-1. Groupings created to model forest cover requirements and facilitate modelling of second-growth harvest....90
A-2. Area in species/productivity groups to facilitate volume projection....91
A-3. Minimum site index used to identify sites with low timber growing potential....92
A-4. Description of soil stability categories and reduction factors....93
A-5. Description of areas with high recreation values....93
A-6. Description of areas with high wildlife values....94
A-7. Problem forest types criteria....94
A-8. Minimum harvestable age criteria — stands less than 140 years, and managed stands....96
A-9. Commercial thinning regime....97
A-10. Regeneration assumptions by analysis unit....98
A-11. Not satisfactorily restocked (NSR) areas....99
A-12. Unsalvaged losses....100
A-13. Timber volume tables for existing natural stands (cubic metres/hectare)....102
A-14. Timber volume tables for managed stands (cubic metres/hectare)....106

B-1. Total employment multipliers for the Strathcona TSA, 1999.....113
B-2. Strathcona TSA provincial government revenue estimates....114

Table of Contents

Figures

1. Map of the Strathcona timber supply area. 5
2. Area by dominant species and relative age — Strathcona TSA timber harvesting land base, 1999. 12
3. Area by dominant species and timber productivity — Strathcona TSA timber harvesting land base, 1999. 13
4. Area by age classification — Strathcona TSA timber harvesting land base, 1999. 14
5. Current age class composition — Strathcona TSA productive forest land base, 1999. 15
6. Area by management emphasis — Strathcona TSA timber harvesting land base, 1999. 19
7. Area by biogeoclimatic classification — Strathcona TSA timber harvesting land base, 1999. 20
8. Base case harvest forecast for the Strathcona TSA, 1999. 22
9. Changes in timber growing stock over time — Strathcona TSA base case, 1999. 24
10. Harvest transition from existing natural stands to managed stands for the Strathcona TSA base case, 1999. 25
11. Annual area harvested and average volume per hectare harvested over time — Strathcona TSA base case, 1999. 26
12. Annual area weighted harvest age over time — Strathcona TSA base case, 1999. 27
13. Changes in age composition on the productive forest land base over time — Strathcona TSA base case, 1999. 28
14. Contribution from the Kyuquot supply block over time — Strathcona TSA, 1999. 30
15. Harvest forecast using an alternative short-term harvest flow — Strathcona TSA, 1999. 32
16. Harvest forecast if harvest request is set to the long-term harvest level — Strathcona TSA, 1999. 33
17. Harvest forecasts if minimum harvestable age is derived using growth rate rather than volume per hectare — Strathcona TSA, 1999. 34
18. Harvest forecasts if minimum harvestable ages are increased by 20 years — Strathcona TSA, 1999. 35
19. Harvest forecast if minimum harvestable ages are lowered 10 years — Strathcona TSA, 1999. 36
20. Harvest forecasts if changes to the timber harvesting land base occur — Strathcona TSA, 1999. 37
21. Harvest forecasts if existing natural stand yields are changed by 10% — Strathcona TSA, 1999. 38
22. Harvest forecasts if managed stand yields are changed by 10%- Strathcona TSA, 1999. 39
23. Harvest forecasts if green-up ages are changed by 5 years — Strathcona TSA, 1999. 40
24. Harvest forecasts if alternative harvest priority rules are used — Strathcona TSA, 1999. 42
25. Harvest forecast if future site productivity for the remaining old-growth stands is increased to the potential site index suggested by recent research — Strathcona TSA, 1999. 44
26. Harvest forecasts if the forest cover requirement for maximum allowable disturbance in visual quality areas is modified — Strathcona TSA, 1999. 45
27. Harvest forecast if the forest cover requirement for cutblock adjacency is reduced to a maximum allowable disturbance of 16% — Strathcona TSA, 1999. 47
28. Timber supply from the Kyuquot supply block if the forest cover approximation for cutblock adjacency is applied to two age ranges — Strathcona TSA, 1999. 48
29. Harvest forecast if the maximum allowable disturbance for all forest cover requirements are reduced by five percentage points — Strathcona TSA, 1999. 49
30. Harvest forecasts if specific harvest requests are made for helicopter-logging areas or alder stands — Strathcona TSA, 1999. 50
31. Harvest forecasts if various seral-stage requirements based on the Vancouver Regional Landscape Unit Planning Strategy and the Forest Practices Code Biodiversity Guidebook are applied — Strathcona TSA, 1999. 52
32. Experienced labour force by sector, Campbell River Forest District, 1996. 57

Introduction

Timber supply is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time.

Assessing the timber supply involves considering physical, biological, social and economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

All of these factors are linked: the financial profitability of harvest operations depends upon the terrain, as well as the physical characteristics of the trees to be harvested. Determining the physical characteristics of trees in the future requires knowledge of their growth. Decisions about whether a stand is available for harvest often depend on how its harvest could affect the growth and development of another part of the forest resource, such as wildlife or a recreation area.

These factors are also subject to both uncertainty and different points of view. Financial profitability may change as world timber markets change. Unforeseen losses due to fire or pest infestations will alter the amount and value of timber. The appropriate balance of timber and non-timber values in a forest is an ongoing subject of debate, and is complicated by changes in social objectives over time.

Thus, before an estimate of timber supply is interpreted, the set of physical, biological and socio-economic conditions on which it is based, and which define current forest management — as well as the uncertainties affecting these conditions — must first be understood.

Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit (a geographic area). For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by the Chief Forester of British Columbia in determining an allowable annual cut (AAC)* — the permissible harvest level for the area.

Timber supply projections made for TSAs look far into the future — 250 years or more. However, because of the uncertainty surrounding the information and because forest management objectives change through time, these projections should not be viewed as static prescriptions that remain in place for that length of time. They remain relevant only as long as the information upon which they are based remains relevant. Thus, it is important that re-analysis occurs regularly, using new information and knowledge to update the timber supply picture. Indeed, the *Forest Act* requires that the timber supply for management units throughout British Columbia be reviewed at least every 5 years. This allows close monitoring of the timber supply and of the implications for the AAC stemming from changes in management practices and objectives.

**Throughout this document, an asterisk after a word or phrase indicates that it is defined in a box at the foot of the page, as well as in the glossary.*

Timber supply area (TSA)
An integrated resource management unit established in accordance with Section 7 *of the* Forest Act.

Allowable annual cut (AAC)
The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

Introduction

Timber supply analysis involves three main steps. The first is collecting and preparing information and data. The B.C Forest Service forest inventory* plays a major role in this. The second step is using these data along with a timber supply computer model or models to make projections or estimates of possible harvest levels over time. These projections are made using different sets of assumed values or conditions for the factors discussed above. The third step is interpreting and reporting results.

The following sections outline the timber supply analysis for the Strathcona TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Analysis methodology and results are presented in Sections 3 and 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used. This is followed by a summary and conclusions.

Appendix A contains further details about the data and assumptions used in this analysis and outlines any changes made to the data package released in December of 1997.

As part of the timber supply review, information is gathered on the short- and long-term implications of alternative harvest levels, and the capabilities and requirements of existing and proposed processing facilities. The socio-economic analysis provides information for the Chief Forester and the local community to better understand the potential magnitude of impacts associated with any possible harvest level changes.

The socio-economic analysis considers the current and projected levels of forestry activity associated with timber harvested in the Strathcona TSA within the context of regional timber supplies and production capacity.

Forest inventory
Assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of additional forest values such as recreation and visual quality.

Introduction

The socio-economic analysis includes an estimate of the employment and income impacts associated with timber supply analysis projections by three main sectors: harvesting and other woodlands related activities, processing, and silviculture. Employment is measured in terms of person-years. A person-year is defined as a full-time job and part-time positions are converted to person-years. Employment income is calculated using average industry income estimates.

Data on direct employment, harvest levels, and fibre flows was obtained by surveying licensees and mill operators. The information was used to estimate harvesting, processing and silviculture direct employment averages associated with the harvest, and the proportion of workers living in the area. The estimates of local and provincial harvesting, processing, and silviculture direct employment were then used to determine ratios of employment per 1000 cubic metres of timber harvested.

Indirect and induced* employment figures were calculated using the Strathcona TSA and provincial employment multipliers* developed by the Ministry of Finance and Corporate Relations. Indirect impacts result from direct businesses purchasing goods and services; induced impacts result from direct employees purchasing goods and services. Employment coefficients per 1000 cubic metres were also determined for the indirect and induced impacts.

To estimate the level of employment that could be supported by alternative harvest rates, projected timber supply levels were multiplied by the calculated employment coefficients. It should be noted that employment coefficients are based on current productivity, harvest practices and management assumptions* and will not likely reflect industry conditions decades into the future. As such, the employment estimates can only be viewed as general indicators.

Indirect and induced jobs
Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employees spending their incomes on goods and services; for example, at retail outlets.

Multiplier
An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

Management assumptions
Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

1 Description of the Strathcona Timber Supply Area

The Strathcona TSA covers a total area of about 705 071 hectares on central Vancouver Island and adjacent areas on the mainland. A significant portion of this is marine area and non-productive forest. The total productive forest area is approximately 353 144 hectares, of which about half (177 797 hectares) is considered available for timber harvesting.

The Strathcona TSA is part of the larger Campbell River Forest District (see map, page 5). The forest district is comprised of the Strathcona TSA and portions of Tree Farm Licences (TFLs) 19, 25, 39, 45, and 47. Communities within the western portion of the forest district are Gold River, Tahsis, Zeballos, and Kyuquot. Communities in the eastern portion include Campbell River, Courtenay, Comox, Sayward, and Cumberland. There are other smaller communities located in the district, mainly along Highway 19.

The TSA extends from the west coast of Vancouver Island (Nootka Sound to Brooks Peninsula) to the east coast (from Fanny Bay to Sayward), and includes islands in the Johnstone Strait, the northern Gulf Islands, and a large area lying between Knight and Bute Inlets on the mainland. It is comprised of three timber supply blocks (subunits of the timber supply area): the Kyuquot to the west and the Sayward to the east of Strathcona Park, and the Loughborough on the mainland.

The current allowable annual cut for the Strathcona TSA is 1 420 000 cubic metres as determined by the chief forester in January 1996. The 1996 determination was a reduction of approximately 16% from the previous level of 1 693 745 cubic metres.

A significant number of large provincial parks, including Strathcona Park, Tahsish-Kwois and Brooks-Nasparti, are located partially or wholly within the timber supply area. New protected areas include Bligh Island, Catala Island, Main Lakes Chain, White Ridge and several special feature areas.

1.1 The environment

The Strathcona TSA is largely a mosaic of wet, mountainous terrain dissected by streams and rivers, many of which create estuaries as they enter the ocean. The six ecosections occurring in the area are Western Island Mountains, Northern Island Mountains, Leeward Island Mountains, Strait of Georgia, Outer Fjordland, and Northern Pacific Ranges.

Most of the forested land occurs within the Coastal Western Hemlock (CWH) biogeoclimatic zone, the most productive forest ecosystem in Canada. This zone covers low to mid-elevations, and is characterized by high rainfall, cool summers and mild winters. Western hemlock is the most common tree species in the CWH zone, but Douglas-fir, western redcedar, Sitka spruce, yellow-cedar, amabilis fir, mountain hemlock, shore pine, big-leaf maple and red alder also occur, depending on local conditions and the history of stand disturbance.

The other forested ecosystem within the Strathcona TSA is the Mountain Hemlock (MH) biogeoclimatic zone. This is the coastal subalpine zone, occurring above the CWH zone (between about 900 and 1800 metres in elevation). The zone is characterized by short, cool summers and long, cool, wet winters, with heavy snow for several months. Mountain hemlock, amabilis fir and yellow-cedar are the most common tree species. Other frequently occurring tree species are western hemlock, western redcedar, Douglas-fir and western white pine. Except at lower elevations, forests are not continuous in the MH zone. With increasing elevation, the forest thins out into parkland, with clumps of trees interspersed with alpine tundra.

The Alpine Tundra zone occurs at high elevations above the MH zone. This zone by definition is treeless, due to the cold, windy and snowy conditions, with a short, cool growing season.

1 Description of the Strathcona Timber Supply Area

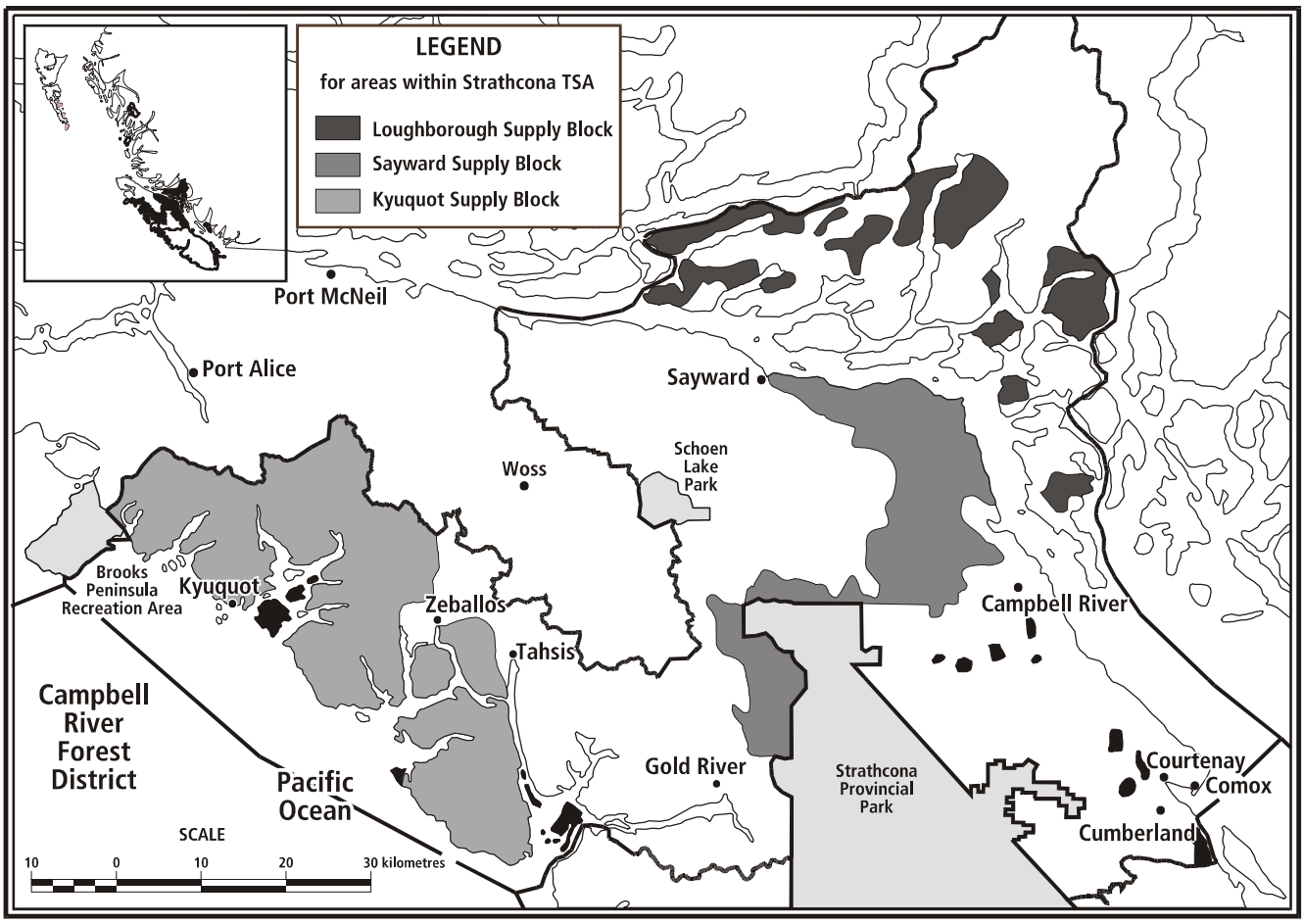

Figure 1. Map of the Strathcona timber supply area.

1 Description of the Strathcona Timber Supply Area

Due to the variation in topography and climate, the Strathcona TSA contains a rich and diverse array of wildlife. Of particular importance are the old-growth forests of the CWH zone and the protected, nutrient-rich estuaries.

More than 300 species of migratory and resident birds, 45 species of mammals and 13 species of amphibians and reptiles occur in the timber supply area. Native mammals include black-tailed deer, Roosevelt elk, black and grizzly bear, mountain goat, wolf, beaver, pine marten, wolverine and weasel. Native and migratory birds in the forests of the area include species of management concern such as marbled murrelets, Queen Charlotte Island goshawks (coastal sub-species of northern goshawks), great blue herons and pileated woodpeckers. Adjacent marine habitats and estuaries support populations of species such as Peale's peregrine falcons, bald eagles, trumpeter swans, harlequin ducks and over-wintering birds.

The many rivers and streams of the Strathcona TSA are used for spawning and rearing by five species of salmon. These watercourses also support significant numbers of resident and ocean-run trout, including cutthroat and rainbow trout, as well as dolly varden (char). Steelhead is a particularly famed game fish, largely because of its relative rarity. Vancouver Island has over 200 rivers containing steelhead, each run genetically unique, but the overall numbers of fish are small.

The majority of species that occur or potentially may be found in the Strathcona TSA, and that are considered at risk or regionally significant, are presented in Table 1.

Table 1. Vulnerable, endangered, threatened and regionally significant species[1]

Endangered/threatened (red-listed)	Vulnerable (blue-listed)		Regionally significant (yellow-listed)
northern goshawk (*laingi)*	great blue heron	grizzly bear	brant
marbled murrelet	American bittern	Roosevelt elk	turkey vulture
common murre	green heron	Townsend's big-eared bat	rhinoceros auklet
sea otter	tufted puffin	wolverine (*luscus*)	bald eagle
northern sea lion	Vancouver Island	fisher	harlequin duck
wolverine	pygmy owl	Vancouver Island ermine	Baird's pelagic cormorant
Vancouver Island marmot (*Vancouver-ensis*)	white-tailed ptarmigan (*saxatilis*)	orca (3 eco-types)	
Keen's long-eared myotis	surf scoter	tailed frog (coastal)	
Vancouver Island water shrew	western screech-owl (*saturatus*)		
	pine grosbeak (*carlottae*)		
	Cassin's auklet		

(1) B.C. Conservation Data Centre, November 1998.

1 Description of the Strathcona Timber Supply Area

In the Strathcona TSA, species that are of particular management concern are those that rely on the characteristics of old-growth forests. As these forests are converted to younger stands, habitat loss and fragmentation may occur.

Current forest management practices follow the standards and legislation set out by the Forest Practices Code. Consequently the protection of wildlife and the environment will primarily be managed through the Code. In addition, the application of the *Coastal Fish/Forestry Guidelines* address specific fisheries concerns. Some inventory work and development of management guidelines is still outstanding in order to fully mitigate impacts to fish and wildlife as anticipated by the Code.

1.2 First Nations

Fourteen First Nations, ten of which are located in the TSA, have territorial interests in the Strathcona TSA. Five treaties, representing eleven First Nations, are currently being negotiated. Four of the five have reached the Agreement-in–Principle stage.

Issues of concern that have been identified by various First Nations include access to tenure, continued access to sizable yellow and redcedar trees for cultural purposes, the establishment of sustainable harvest levels by territory, and protection of an economically viable forestry base that will be accessible in the post-treaty environment.

First Nations' involvement in the forest sector currently includes silviculture crews (approximately eight), forest licences (two), salvage licences and shake mills, watershed restoration, cultural heritage resource assessments, and recreation. The First Nations in the western portion of the Strathcona TSA have developed a particularly strong dependence on the forest sector. Much of the First Nations' forestry employment is linked with Forest Renewal BC funds provided in multi-year funding agreements to forest companies based on their allowable annual cut.

For more information on the Strathcona TSA communities and First Nations, see Section 7.1.1, "Population and demographic trends."

2 Information Preparation for the Timber Supply Analysis

A wide variety of information is required for timber supply analysis. This information falls into three general categories: land base inventory; timber growth and yield; and management practices.

2.1 Land base inventory

Land base information used in this analysis came in the form of a computer file compiled in 1998 by the Vancouver Forest Region, B.C. Forest Service. This file contains a considerable amount of information on the forest land in the Strathcona TSA and surrounding forest within the landscape units managed by the Campbell River Forest District including general geographic location, area, nature of forest cover (such as presence or absence of trees, species, number of trees, age, and timber volume), and other notable characteristics such as terrain stability and physical accessibility (operability). Stand characteristics such as tree height, stocking* and age have been projected to January 1998. Except for a few mapsheets shared with adjacent forest districts, the inventory file has been updated to account for timber harvesting up to mid-1996.

The inventory file represents the land base for the entire TSA and adjacent parklands. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur. Examples are land set aside for parks, areas needed to protect wildlife habitat, and areas in power lines, highways, or town sites. A description of these areas specific to the Strathcona TSA is provided below. These types of areas do not contribute to the timber supply of the Strathcona TSA but may assist in achieving biodiversity objectives. Before assessing timber supply these non-contributing areas are identified and separated from the land base which represents the timber harvesting land base*. When deriving this data file, care is taken to make only a single separation for areas with more than one characteristic that would make it unavailable for harvesting (for example, where a park area is also suitable for wildlife habitat).

Identifying areas that do not contribute to timber supply does not mean they are removed from the Strathcona TSA. The B.C. Forest Service still manages the entire area of the TSA (except for designated areas under the jurisdiction of other agencies) as a land unit that contributes a mix of timber and non-timber values. The timber supply is managed within this integrated resource context, and the analysis described herein is consistent with this philosophy.

This section describes the types of areas that do not contribute to the timber harvesting land base. Use of the term timber harvesting land base in this report does not mean the area is open to unrestricted logging. Rather, it implies that forests in the area contain timber of sufficient economic value — and sites of adequate environmental resilience — to accommodate timber harvesting with due care for other resources.

Stocking
The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.

Timber harvesting land base
Crown forest land within the timber supply area that is currently considered feasible and economical for timber harvesting.

2 Information Preparation for the Timber Supply Analysis

For the Strathcona TSA, the following types of areas do not contribute to the timber harvesting land base:

- non-Crown / non-Forest Service area — areas not managed directly by the B.C. Forest Service. Included in this category are parks and ecological reserves declared since the last AAC determination.
- non-productive areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies).
- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- inoperable areas* — areas classified as unavailable for harvest for terrain-related or economic reasons.
- low timber productivity areas — areas occupied by forest with low timber-growing potential.
- problem forest types — areas covered by timber stands that are physically operable and have adequate productivity, but are not currently utilized or have marginal merchantability. In the Strathcona TSA, these types are predominantly cottonwood and pine stands.
- sensitive terrain areas* — areas with moderate to high potential for landslide initiation following timber harvesting or road construction.
- recreation areas — areas of recreational significance, such as campgrounds, trails and lookout sites.
- wildlife areas — areas with high to moderate wildlife habitat suitability.
- karst features* — areas of high karst potential not otherwise managed through recreational significance.
- existing roads, trails and landings — areas of forest land that no longer support timber production due to access development.
- streamside buffers — areas unavailable for timber harvesting to protect riparian* and stream ecosystems.
- future roads, trails, and landings — future losses of productive forest land to access development. These areas are initially included in the timber harvesting land base, and are subsequently removed as part of the first harvest.
- wildlife tree patches — areas left within and along the sides of cutblocks for the maintenance of stand structure. Valuable for the conservation or enhancement of wildlife.

Inoperable areas
Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.

Sensitive terrain areas
Areas with moderate to high potential for landslide initiation. If timber harvesting or road construction occurs and where specific combinations of forest practices are required to ensure adequate site.
Karst features
Areas identified that have a high potential for sub-surface caves.
Riparian area
Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.

A more detailed description of these categories, including specific criteria for identification is located in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Table 2 summarizes the areas in each category and shows the total area of the timber harvesting land base. The column "Productive forest area by classification" provides the total productive forest area managed by the B.C. Forest Service within the given category. For example, while there is a total of 125 152 hectares of land classified with unstable soils, due to previous reductions and the use of partial reductions, only 35 306 hectares is considered unavailable for harvesting because of soil stability at the point in the classification that soil stability is considered. This difference indicates a high degree of overlap among categories.

The current timber harvesting land base in the Strathcona TSA represents about 25% of the total TSA area and about 50% of the productive forest. The three categories which most reduce the availability of the productive forest for timber supply are: inoperability (25.8%), soil stability (10%) and low site productivity (3.9%). A number of other categories, such as recreation, wildlife and riparian each account for about 2% of the productive forest area. The percentages provided are dependent on the order in which each class is considered. For instance, soil stability concerns would likely constitute a larger proportion of the reduction if it was considered prior to inoperability.

2 Information Preparation for the Timber Supply Analysis

Table 2. Determining the timber harvesting land base for the Strathcona TSA

Classification	Productive forest area by classification	Area (hectares)	Per cent of total TSA area	Per cent of Crown forest land
Total area on inventory file[a]		852 666		
Total TSA area		705 071	**100.0**	
Land not managed by the B.C. Forest Service or marine water bodies		289 191		
Non-productive forest		62 736		
Total productive forest managed by the B.C. Forest Service (Crown forest)		**353 144**	**50.1**	**100.0**
Reductions to the Crown forest available for timber supply				
Non-commercial brush	171	171	0.0	0.0
Inoperable areas	90 997	90 997	12.9	25.8
Pine forest types	2 976	885	0.1	0.3
Deciduous forest types that are not used	297	253	0.0	0.1
Sites exhibiting low productivity	55 993	13 794	2.0	3.9
Areas with soil stability concerns	125 152	35 306	5.0	10.0
High recreation value	22 731	6 910	1.0	2.0
High wildlife value	16 995	7 448	1.1	2.1
Riparian reserves		8 370	1.2	2.4
Karst features	14 624	690	0.1	0.2
Existing unclassified roads		6 895	1.0	2.0
Wildlife tree patches		3 629	0.5	1.0
Total reductions[b]		**175 348**	**24.9**	**49.7**
Current timber harvesting land base (includes 16 239 hectares of not satisfactorily restocked (NSR) land and 4 210 hectares of timber licences)[c]		**177 797**	**25.2**	**50.3**
Future reductions				
Future roads trails and landings		2 479	0.4	0.7
Future timber harvesting land base		**175 318**	**24.9**	**49.6**

(a) Total area on the inventory file includes park land which is not within the Strathcona TSA but is within landscape units that will be managed by the Campbell River Forest District.
(b) Reductions were performed in the order listed in the table.
(c) NSR includes all NSR on the inventory file, see Appendix A for further information.

2 Information Preparation for the Timber Supply Analysis

Figure 2 shows the current composition of the timber harvesting land base by dominant tree species. Western hemlock or balsam-leading stands and Douglas-fir stands dominate most of the timber harvesting land base at 59% and 25% respectively. The remainder of the timber harvesting land base is covered by cedar-leading, spruce-leading and alder-leading stands. After harvest, coniferous stands are generally expected to be regenerated to the same leading species as is currently dominant in the stand. About 75% of currently alder-leading stands are expected to be converted to Douglas-fir stands after harvesting, with the remainder being regenerated back to alder.

Figure 2 also shows the split for each species between stands that are younger than the minimum harvestable age and those that are older (see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" for details on the minimum harvestable age for each species). In total, about 44% of stands in the timber harvesting land base are at or above the minimum harvestable age.

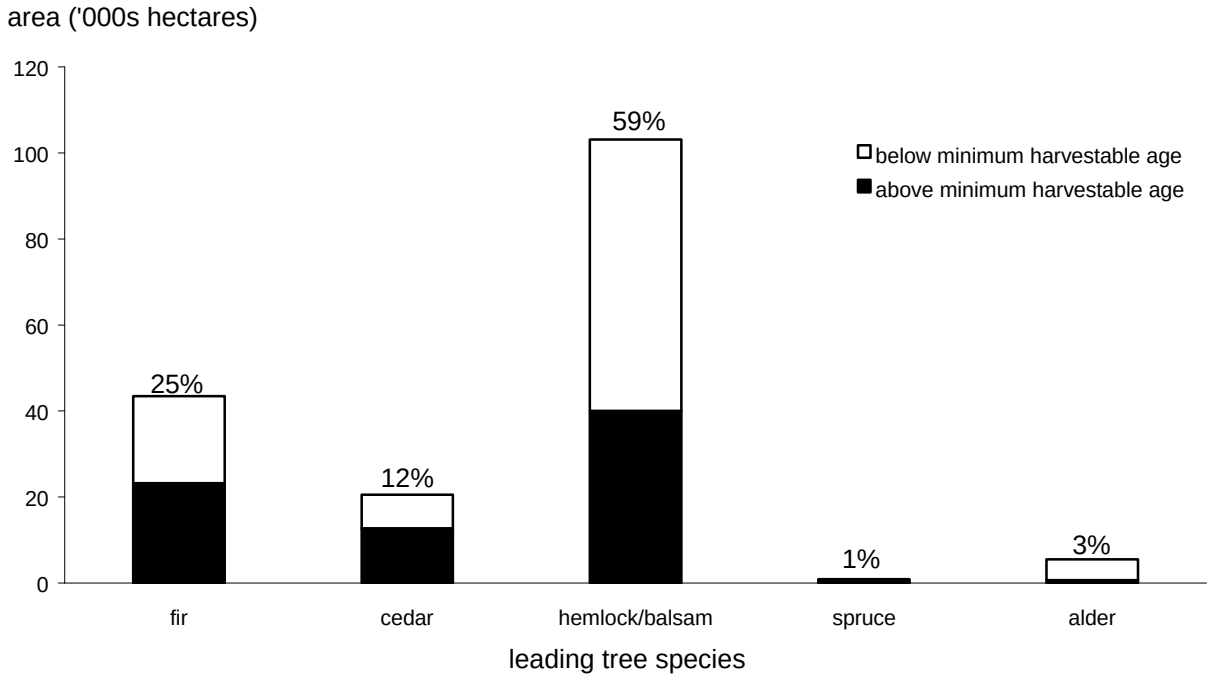

Figure 2. Area by dominant species and relative age — Strathcona TSA timber harvesting land base, 1999.

2 Information Preparation for the Timber Supply Analysis

Figure 3 provides an overview of the distribution of site productivity within the timber harvesting land base. Both hemlock- and balsam-leading (HB) stands and Douglas-fir (Fir) stands have been separated into three productivity classes based on site index, while cedar-leading (CHB) stands have been split into only two productivity classes and alder- and spruce-leading stands have been grouped into one site productivity class each. The site class groupings were based on the amount of timber harvesting land base in each species group as will as the range of site indexes found in each group. All site index values in Figure 3 are in metre heights at 50 years of age.

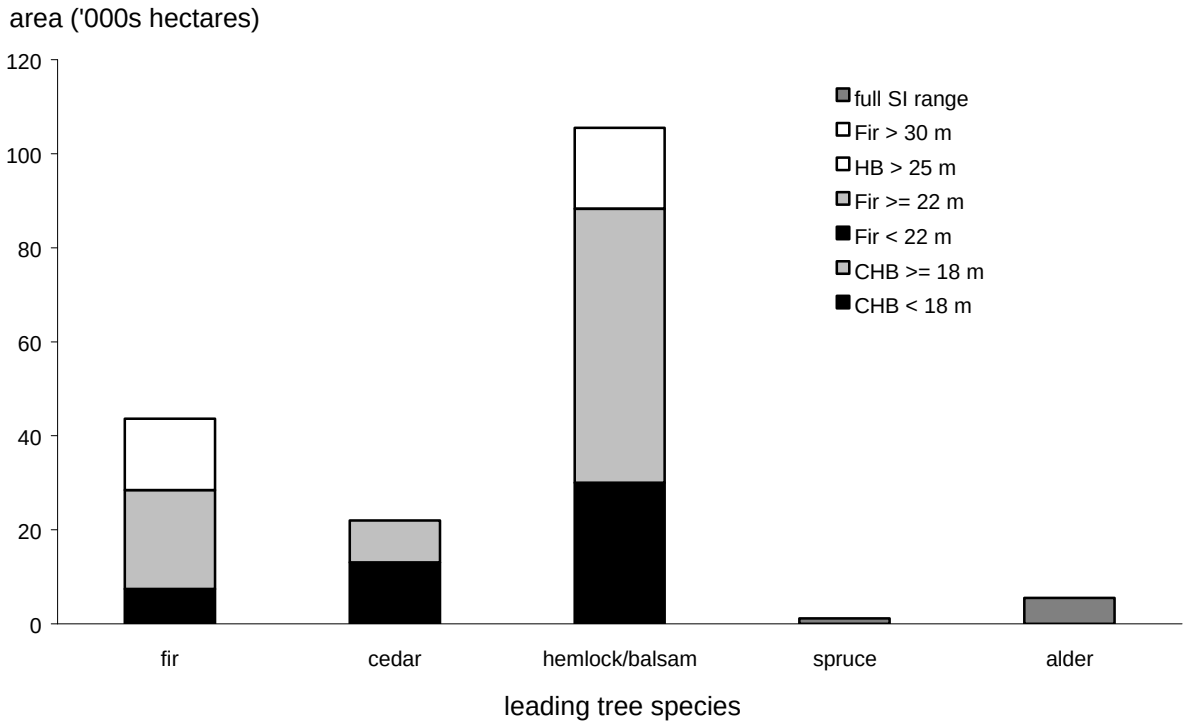

Figure 3. Area by dominant species and timber productivity — Strathcona TSA timber harvesting land base, 1999.

2 Information Preparation for the Timber Supply Analysis

A further breakdown aside from site productivity was used in classifying the forest types of the Strathcona TSA. Figure 4 shows the age breakdown used to refine analysis units. About 23% of the timber harvesting land base consists of stands above the age of 140 years. One reason to separate out stands older than 140 years is that recent research indicates that productivity estimates from these old stands under-estimates actual productivity. The issue will be reviewed in Section 5, "Timber Supply Sensitivity Analyses." About 37% of stands are younger than 140 years but are considered unmanaged. About 41% of the timber harvesting land base is currently considered to be managed. In this context, a managed stand is one in which species composition and stand density are monitored and controlled to maximize productivity.

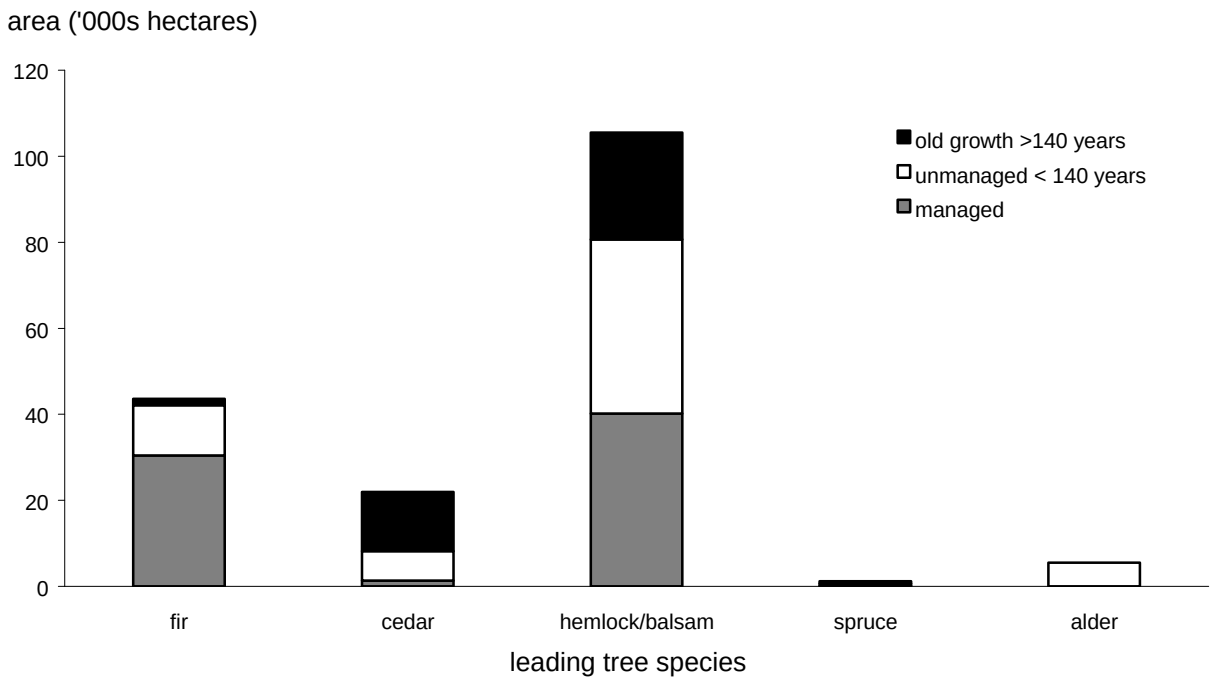

Figure 4. Area by age classification — Strathcona TSA timber harvesting land base, 1999.

2 Information Preparation for the Timber Supply Analysis

Figure 5 shows the current age composition of forested stands in the Strathcona TSA. About 60% of the forest outside of the timber harvesting land base and about 17% of stands included in the timber harvesting land base are currently older than 250 years. Stands less than 60 years of age make up about 66% of the timber harvesting land base compared to only 21% in the non-contributing forest. A large proportion of the area under 60 years in the timber harvesting land base is expected to be available for harvest over the next 20 to 30 years.

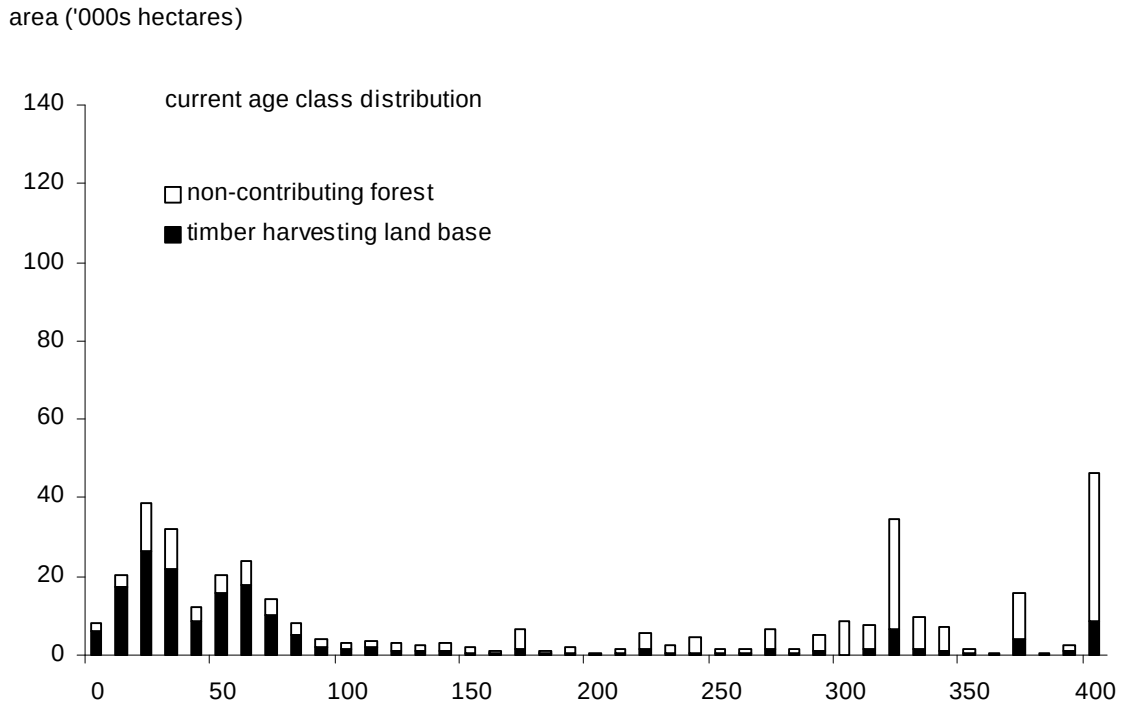

Figure 5. Current age class composition — Strathcona TSA productive forest land base, 1999.

The ages of forested stands excluded from the timber harvesting land base affect timber supply. In the case of the Strathcona TSA, a significant portion of the total forested land base (50%) is covered by these stands which, although they do not contribute timber volume in the harvest forecast, do provide stand conditions such as old-forest attributes that help to achieve forest management objectives. Thus, the contribution of area outside the timber harvesting land base to meeting non-timber management objectives can affect how much harvesting can be conducted and the pattern of harvesting within the Strathcona TSA. A large proportion of the requirements for old-forest attributes within each landscape unit in the Strathcona TSA are met by forested areas that are not part of the timber harvesting land base.

2 Information Preparation for the Timber Supply Analysis

2.2 Timber growth and yield

Timber growth and yield refers to the prediction of the growth and development of forest stands over time. Forest stands have many characteristics that change over time (for example, number of trees per unit area, tree diameter, tree height, species composition). Since timber supply analysis concentrates on timber volumes available over time, the most relevant measure for this analysis is volume per unit of area (in British Columbia, cubic metres per hectare). An estimate of timber volume in a stand assumes a specific utilization level, or set of dimensions, that establish the minimum tree and log sizes that must be removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters both near the base and the top of a tree.

Two growth and yield models were used to estimate* and develop timber volumes for the Strathcona TSA analysis. The variable density yield prediction (VDYP) model developed by the B.C. Forest Service, Resources Inventory Branch, was used for estimating timber volumes for all existing natural stands and managed deciduous stands.

The table interpolation program for stand yields (TIPSY), developed by the B.C. Forest Service, Research Branch was used to estimate timber volumes for existing and future managed coniferous stands. All cedar stands less than 10 years of age, hemlock, balsam and spruce stands less than 20 years of age, and Douglas-fir stands less than 60 years of age and all stands that will be harvested in the future with the exception of alder stands, are assumed to grow according to managed stand volume estimates from TIPSY.

Volume estimate (yield projections)
Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.

Free-growing
An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.

Volume estimation and prediction is subject to a fair amount of uncertainty due to uncertainty in inventories which form the basis for estimating site productivity, and to limited experience with second growth in British Columbia. Sensitivity analyses described in Section 5, "Timber Supply Sensitivity Analyses," address the possibility that actual timber volumes may be different from the estimates used in this analysis.

Based on the timber volume estimates, the current timber inventory on the timber harvesting land base is about 51 million cubic metres. About 45 million cubic metres, or 88%, of the total inventory, is currently in stands greater than 350 cubic metres per hectare, the criterion used to define the minimum harvestable age. This is a departure from the criteria listed in the data package which stated that the minimum age would be set at the point where 95% of the maximum average growth occurred (see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" for a review of the minimum harvestable age for each species).

2.3 Management practices

Timber supply depends directly on how the forest is managed for both timber and non-timber values. Therefore, levels of management activity must be defined for the timber supply analysis process. The focus of the timber supply review is to assess timber supply based on current management practices as implemented in plans for the area. Staff in the Campbell River Forest District provided descriptions for the following management practices:

- Silviculture practices — reforestation activities required to establish free-growing* stands of acceptable tree species.

- Forest health and unsalvaged losses* — average annual unsalvaged losses to natural forces such as insects, fire, wind, and disease are estimated to be 43 150 cubic metres per year for the entire 250 year analysis horizon, and have been subtracted from all harvest forecasts shown in this report.
- Utilization levels — minimum sizes of trees, and logs to be removed during harvesting.
- Cutblock adjacency* and green-up* — in the Strathcona TSA, approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up (3 metres in height), before adjacent stands may be harvested. To approximate the implications of cutblock adjacency for this analysis, the general integrated resources management portions of each landscape unit will have a limit of 25% of the area in the timber harvesting land base below green-up condition at any time. The purpose of the cutblock adjacency guidelines is to prevent timber harvesting from becoming overly concentrated in an area at any time.
- Maintenance of deer winter range — deer winter range requirements are met by ensuring that 50% of the timber harvesting land base in the deer winter range in each of the Sayward and Salmon landscape units is always maintained in stands that are above five metres in height. In addition, an approximation for cutblock adjacency guidelines is used (i.e., no more than 25% of the timber harvesting land base can be less than three metres in height). High value wildlife areas are considered unavailable for harvest.
- Management of scenic values — maintaining important scenic values requires that visible evidence of harvesting in the productive forest be kept within limits in some areas of the Strathcona TSA. The proportion of each visual quality class within individual landscape units that may be less than five metres in height, which is the visually effective green-up (VEG) requirement, varies depending upon the visual quality class. Two visual quality classes have been modelled: retention with a maximum allowable disturbance of 5% and partial retention with a maximum allowable disturbance of 15%.
- Minimum harvestable ages — the time it takes for stands to grow to a merchantable condition. Minimum harvestable ages for this analysis were estimated to be the age at which stands reach a minimum volume of 350 cubic metres per hectare. Actual harvest age may be greater but not less than the minimum, and will depend on ages of other available stands, forest cover objectives* and overall timber harvest targets.

Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.
Cutblock adjacency
The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.

Green-up
The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Forest cover objectives
Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see Cutblock adjacency guidelines and Green–up).

- Landscape-level biodiversity* — to reflect the maintenance of old forest across the Strathcona TSA, requirements are placed on the proportion of area in each draft landscape unit* and biogeoclimatic variant* (BEC) that must be covered by stands with old-forest characteristics (defined as 250 years old). The amount of forest required in the old-forest category depends on the natural disturbance regime associated with a given BEC variant.

More detailed descriptions of these management practices and the assumptions used to assess their impacts on timber supply are included in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis."

Landscape level biodiversity
The Forest Practices Code Biodiversity Guidebook *provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.*
Biogeoclimatic zones
A large geographic area with broadly homogeneous climate and similar dominant tree species.

Landscape unit
A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.

2 Information Preparation for the Timber Supply Analysis

Figure 6 shows a TSA-level overview of the proportion of the timber harvesting land base associated with wildlife, visual resource and cutblock adjacency management emphases. On about 66% of the timber harvesting land base, only cutblock adjacency, guidelines apply, while on the remaining 34% emphasis is split between visual resource and wildlife management. Some stands meet the criteria for both visual and wildlife management and are therefore included in both resource emphases for modelling purposes to reflect the integrated nature of planning within individual landscape units.

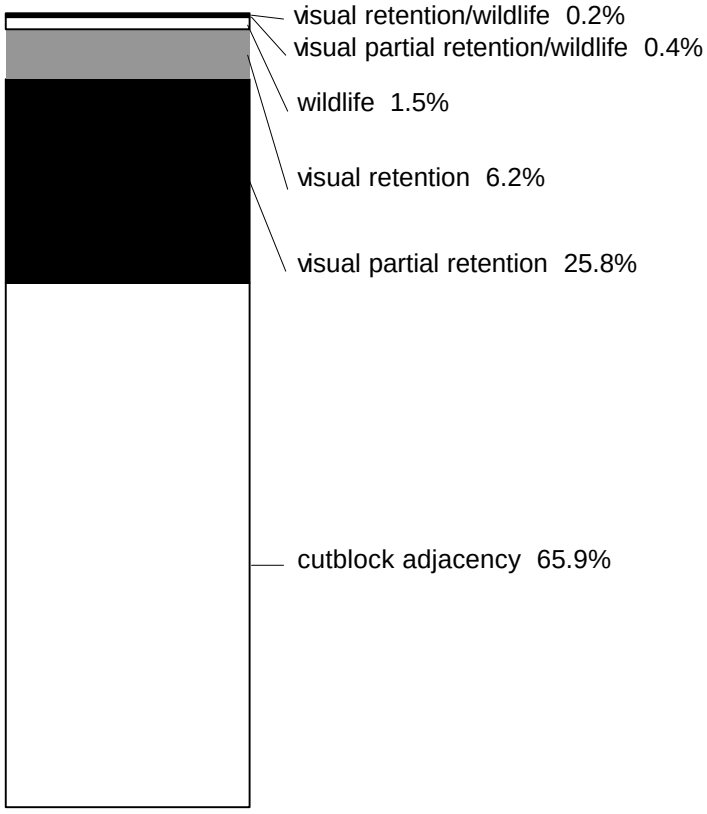

Figure 6. Area by management emphasis — Strathcona TSA timber harvesting land base, 1999.

2 Information Preparation for the Timber Supply Analysis

The productive forest is also categorized by biogeoclimatic (BEC) classification. Figure 7 shows a TSA-level overview of the proportion of each BEC variant in the timber harvesting land base. Each BEC variant is listed with the percentage of the timber harvesting land base in the respective variant, and also the percentage of the productive forest within a variant which is available for harvest. While the proportion listed in the classification table (Table 2) indicates that on average 50% of the productive forest is available for timber harvesting, the percentage varies by BEC classification. The percentage of the productive forest available for harvest within a variant ranges from as little as 12% in the MH mm1 to about 74% in the CWH xm1.

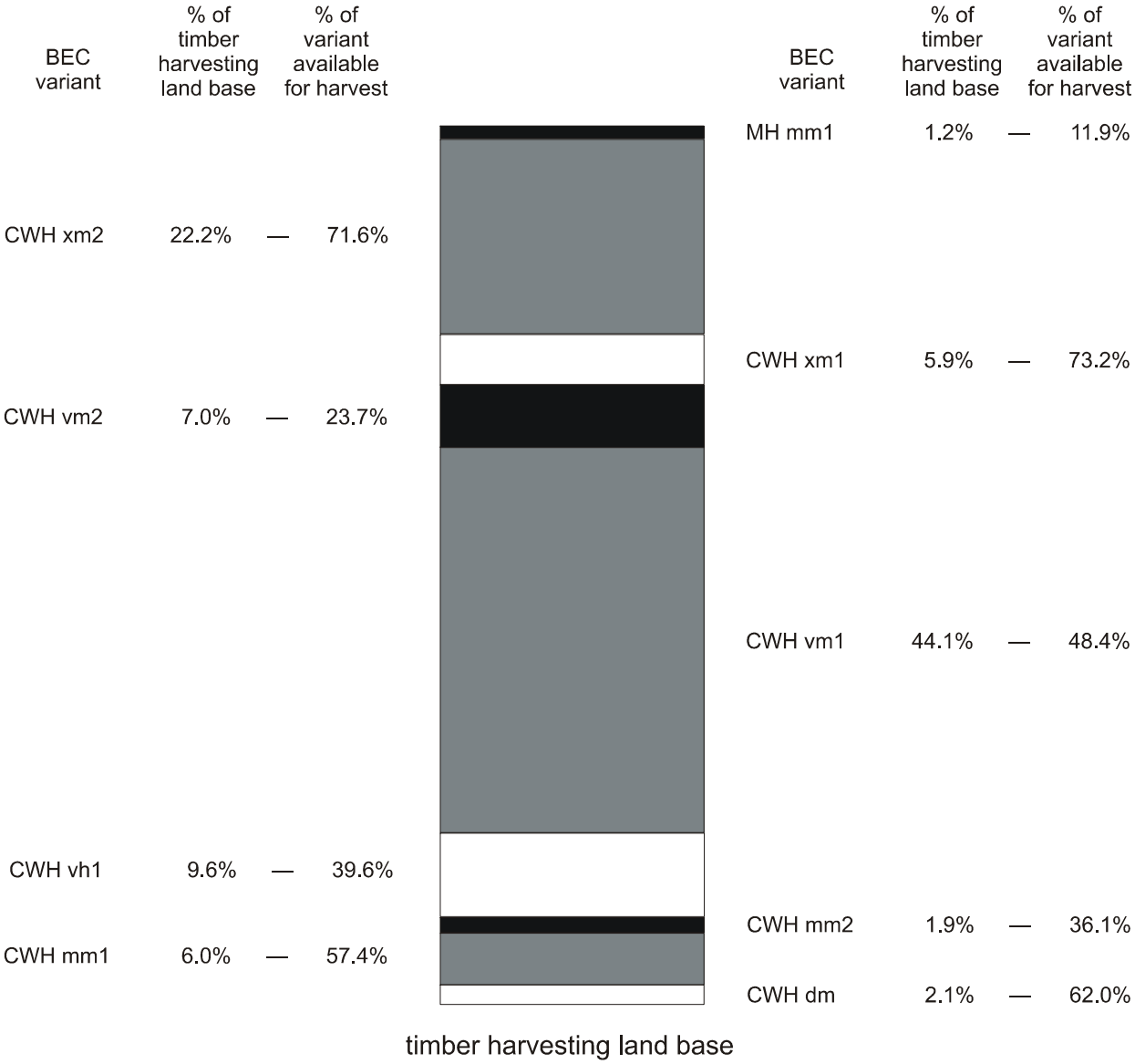

Figure 7. Area by biogeoclimatic classification — Strathcona TSA timber harvesting land base, 1999.

3 Timber Supply Analysis Methods

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in the Strathcona TSA, in light of current forest management practices. A timber supply computer simulation model developed by the B.C. Forest Service was used to aid in the assessment. A timber supply model, as distinct from a growth and yield model, assists the timber supply analyst in determining how a whole forest (collection of stands) could be managed to obtain a harvest forecast (supply of timber over time). The simulation model uses information about the productive forest land base, timber harvesting land base, timber volumes, and the management regime to represent how trees grow and are harvested over a long period of time. Generally, only the results for the first 250 years are shown graphically in this report because the harvest level remains constant after that time.

Similar to other models, the B.C. Forest Service model assumes that trees grow according to provided yield projections and are harvested according to either a volume target or a specified objective set by the analyst, such as harvest volume maximization. The Forest Service model also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of cutblock adjacency and green-up prescriptions. For example, guidelines might specify that no more than some maximum percentage of the forest can be younger than a specified green-up age, or that some minimum percentage of the forest must be in older age classes to provide wildlife habitat. The B.C. Forest Service simulation model facilitates examination of the effects of such guidelines on timber supply.

This type of analysis is used to determine the timber supply implications of a particular timber harvesting regime. The results of the analysis are especially important in determining allowable cuts that will not restrict options of future resource managers, and that will assist local B.C. Forest Service staff to administer their programs according to relevant guidelines and principles. However, the results of the analysis are not meant to be taken as recommendations of any particular AAC.

The main results of the analysis are forecasts of potential timber harvests and timber inventory changes (ages and volumes) over time. Although this information gives field staff only very limited guidance in the design of operational activities such as harvesting block location and silviculture planning, it does help ensure that the timber harvest level supports rather than hinders sustainable forest management in the field.

4 Results

This section presents results of the timber supply analysis for the Strathcona TSA. The base case harvest forecast uses the most recent assessments of current forest management, the land available for timber harvesting, and timber yields as described in Section 2, "Information Preparation for the Timber Supply Analysis." Because forest management is inherently a long-term venture, uncertainty surrounds much of the information important in determining timber supply. This uncertainty will be discussed in Section 5, "Timber Supply Sensitivity Analyses." However, it is important to keep in mind that the base case provides only a part of the timber supply picture for the Strathcona TSA, and should not be viewed in isolation of the sensitivity analyses.

4.1 Base case harvest forecast

Figure 8 shows the base case harvest forecast* for the Strathcona TSA. The initial harvest level is 1.25 million cubic metres per year, a 12% reduction from the current harvest level of 1.42 million cubic metres per year. After 12% declines in the next two decades, the medium-term harvest level of 970 000 cubic metres is maintained for 80 years until the long-term harvest level is achieved in the eleventh decade. The harvest level then rises 10% to 1.07 million cubic metres.

Unsalvaged losses to natural forces such as insects, fire, and disease are estimated to be 43 150 cubic metres per year for the entire 250-year horizon, and have been subtracted from all harvest forecasts shown in this report.

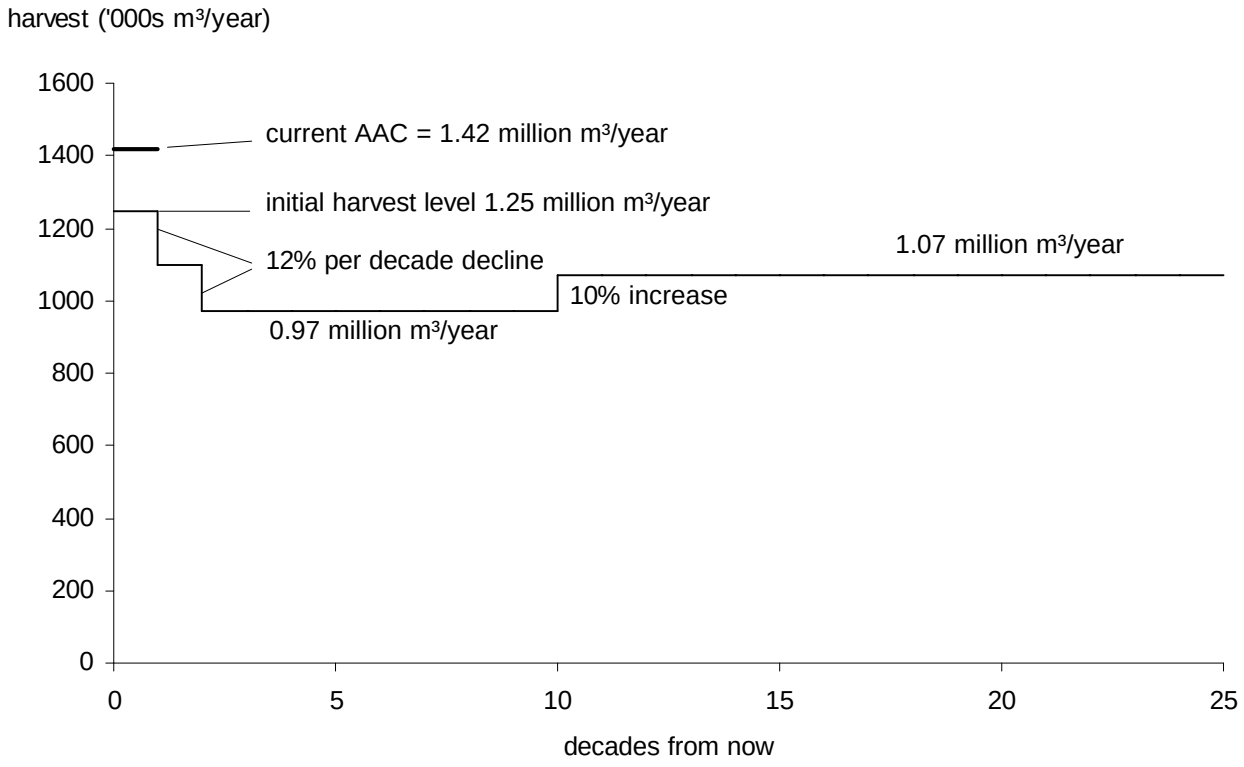

Figure 8. Base case harvest forecast for the Strathcona TSA, 1999.

4 Results

The most important factors contributing to the projected decline in the harvest forecast over the short term are:

- Significant reductions in the productive forest available for timber supply due to the creation or expansion of several parks and the completion of terrain stability mapping.
- The significant changes in forest management brought about with the implementation of Forest Practices Code.
- The harvest flow policy used in this analysis attempts to equalize the rate of decline in both the short- and medium-term with the rise to the long-term harvest level. A slower rate of decline or an increase in the first decade harvest level would result in a lower medium-term harvest level and an increase in the rise to the long-term harvest level.

The rate of decline in the harvest forecast in the base case is moderated by the following changes that have occurred since the last timber supply review for the Strathcona TSA:

- the addition of alder stands to the timber harvesting land base;
- changes in visual quality objectives;
- younger minimum harvestable ages for higher productivity stands based on a minimum volume per hectare of 350 cubic metres;
- in general, stands that do not contribute to timber supply provide a significant portion of the old forest requirements by biogeoclimatic variant in the short term, and anticipated growth of non-contributing forest eventually results in all old-forest requirements being met by forest outside the timber harvesting land base.

Figure 9 shows the changes occurring in the standing timber inventory in various categories of stands in the timber harvesting land base. The total inventory is currently estimated at about 51 million cubic metres, of which about 45 million cubic metres is above the minimum harvestable age criterion. Managed stands initially provide about 15% of the total inventory, and 74% of the volume in managed stands is currently above the minimum harvestable age criterion. Harvestable inventory, or the volume above minimum harvestable age, remains above 76% of the total inventory for the first 100 years, and even climbs as high as 83% in decade 15.

These results demonstrate that at no time is the base case harvest forecast limited by available volume. Rather, the base case harvest levels have been derived to ensure that a cycle of harvesting stands continually at their respective minimum harvestable ages is not initiated. The latter case would lead to a significantly reduced long-term harvest level as more productive stands would be harvested significantly earlier than their maximum average growth rate.

4 Results

The base case harvest forecast for the Strathcona TSA is dependent more on harvest flow choices than on available harvestable volume. Sufficient flexibility is provided in the definition of minimum harvestable age to enable a wide range of possible harvest forecasts. The base case harvest forecast shown in Figure 8 was chosen to represent short-term harvest that is insensitive to uncertainties and enables a short transition to the lowest projected harvest level while still maintaining a rise to the long-term harvest level equal to or less than the decline rates in the short term. As will be seen in Section 5.1, "Alternative harvest flows over time," an equally feasible base case forecast would be to start at the current AAC, followed by 12% declines for the next three decades and one 8% decline to a medium-term harvest level below the base case. The subsequent rise to the long-term harvest would be 19% compared to 10% in the base case. A first decade harvest level at the current AAC would be far more sensitive to uncertainties and risks than the base case. To facilitate review of this alternate projection, maximum short-term harvests will generally be provided if the maximum is determined strictly by restricting access to otherwise forest cover requirements (i.e., all requirements are available timber supply), as will per cent increases to the long-term harvest level.

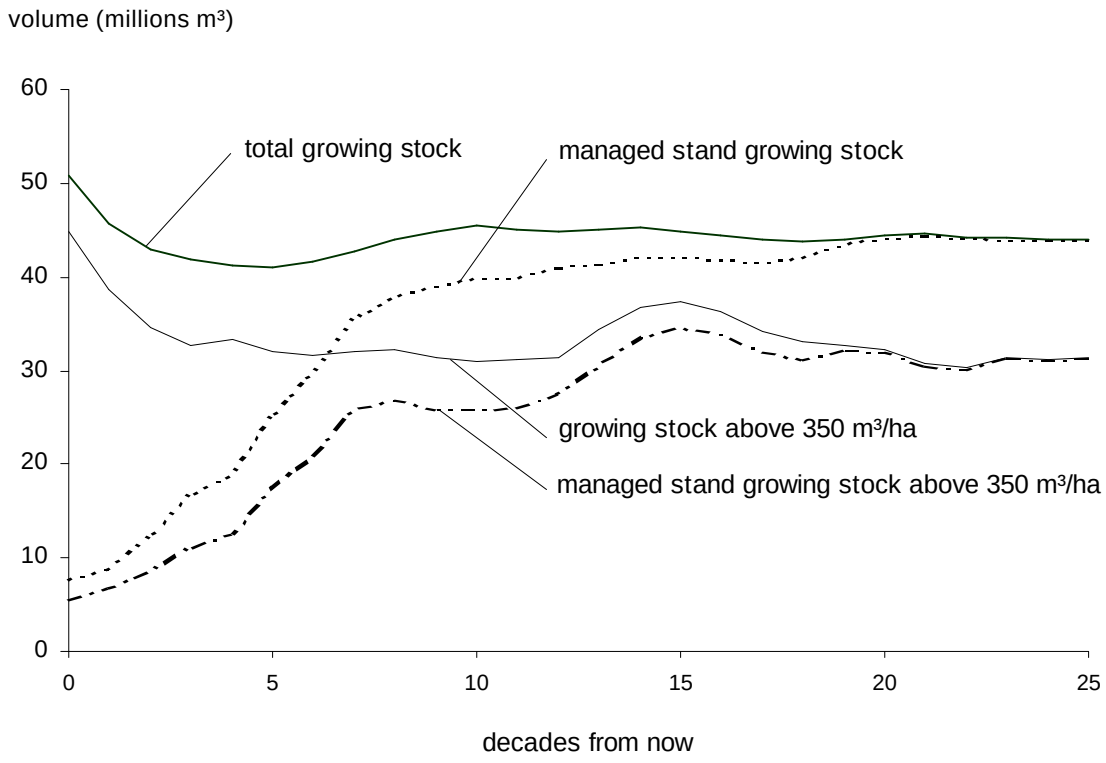

Figure 9. Changes in timber growing stock over time — Strathcona TSA base case, 1999.

4.2 Harvest transition from existing natural stands to managed stands

Figure 10 shows that within 40 years, harvesting of managed stands is anticipated to make up about 50% of the harvest. By decade 9, this has increased to about 94%. However, a rise to the long-term harvest level cannot occur until after a large proportion of total growing stock has been converted to managed stands and volume on productive sites is well beyond the minimum harvestable age. Between decades 7 through 11, the managed stand volume above minimum harvestable age (i.e., above 350 m^3/ha), shown by the dark dashed line in Figure 9, is flat and is generally attributable to stands with higher site productivity. The supply of this volume must be sparingly allocated until poorer productivity sites enter a harvestable condition between decades 13 through 16. If more of the supply of higher productivity sites is used earlier than decade 11, attempting to rise to the long-term harvest level in decade 11 creates a trend of harvesting more productive stands closer to minimum harvestable age, thereby reducing the harvest level that can be achieved over the long term.

Stands currently above 140 years of age are expected to provide well over 80% of the harvest over the next 20, years declining quickly thereafter. Small amounts of older forest are harvested even 100 years from now as a result of stands outside the timber harvesting land base aging to the point that they contribute to the biodiversity criteria associated with old forest.

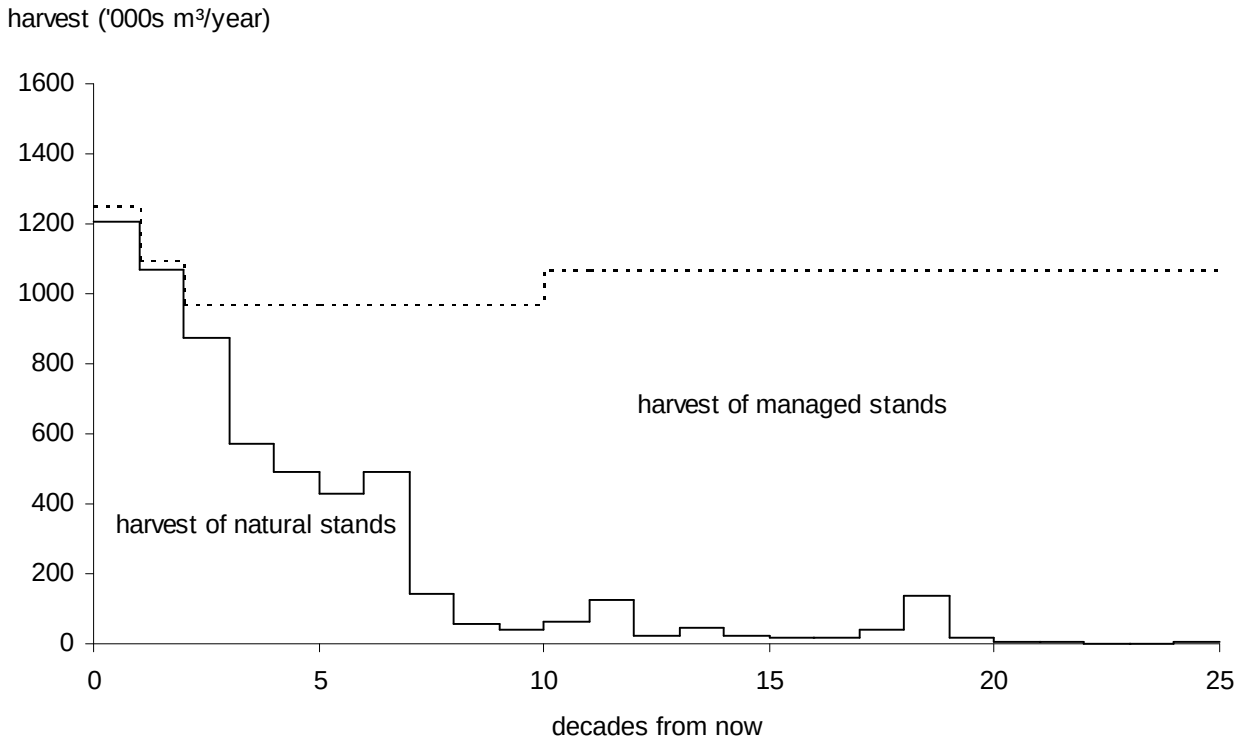

Figure 10. Harvest transition from existing natural stands to managed stands for the Strathcona TSA base case, 1999.

4.3 Area, average volume, and average age harvested

Figure 11 shows both the annual area harvested and the average volume per hectare harvested in the base case within three resource emphasis groups. The wildlife group has been omitted due to its small size. Generally, area harvested begins just over 2000 hectares per year and declines as the harvest rate declines for the first three decades. The area harvested then rises as harvesting begins to occur on lower volume stands and also as a result of as harvesting increases from the mid-term to the long-term harvest level. The average volume per hectare trends show that generally the partial retention and cutblock adjacency areas produce similar averages while in the retention visual quality area the forest cover requirement tends to increase harvest age which in turn increases volume per hectare harvested. The first decade average volume per hectare for the retention visual quality area is 225 cubic metres per hectare because a large area portion of harvest volume is derived through commercial thinning in this area.

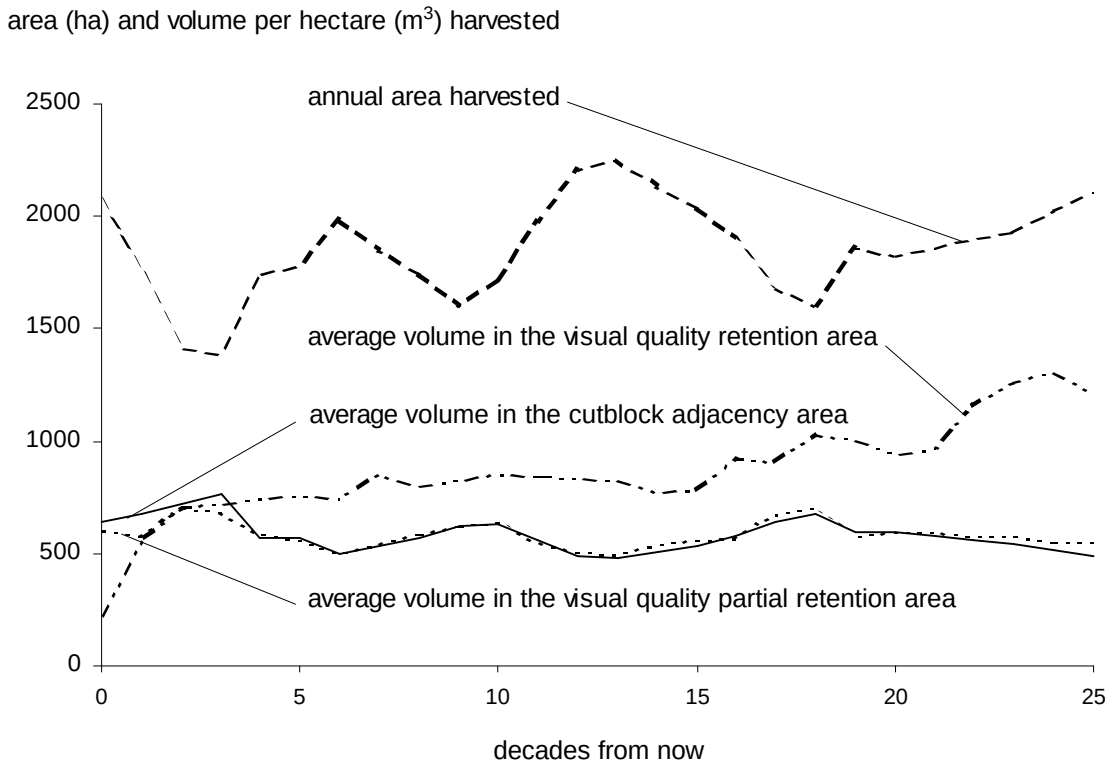

Figure 11. Annual area harvested and average volume per hectare harvested over time — Strathcona TSA base case, 1999.

4 Results

The average area-weighted harvest age in the base case is shown in Figure 12. Within 30 years, the average harvest age stabilizes at about 90 years, although actual harvest age will vary widely among stands of varying productivity and resource emphasis. For instance the average harvest age in retention visual quality areas is just below 200 years of age.

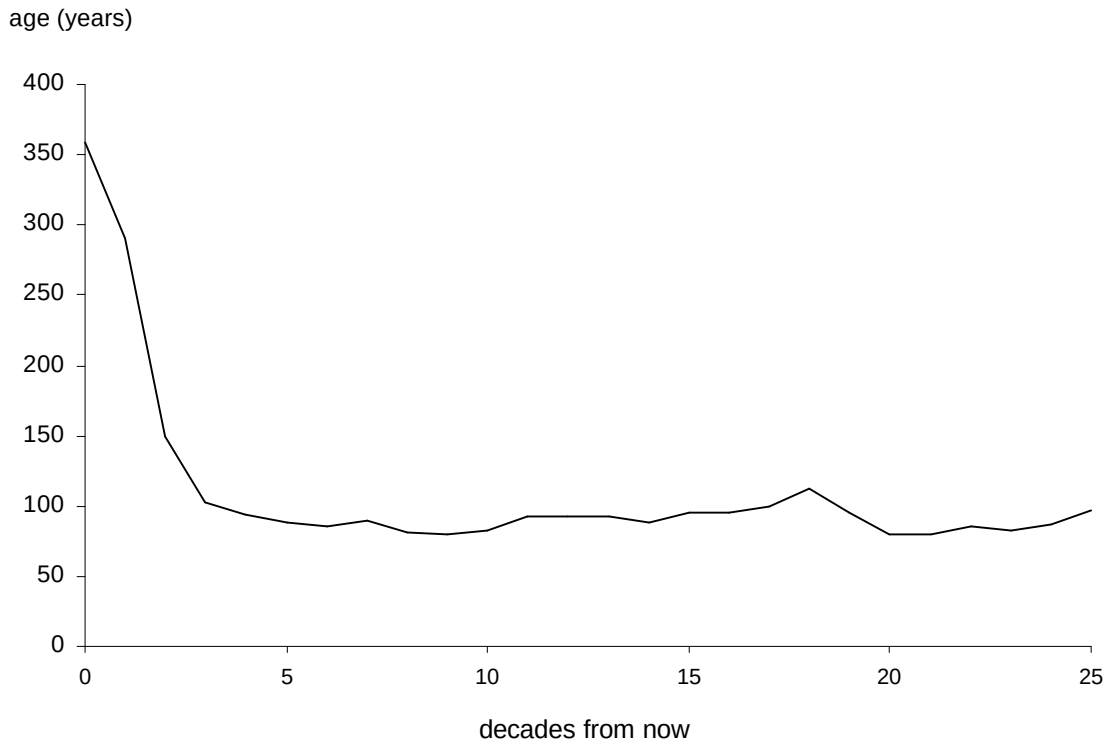

Figure 12. Annual area weighted harvest age over time — Strathcona TSA base case, 1999.

4.4 Age class composition over time

The charts in Figure 13 show how the age composition of the productive forest within the Strathcona TSA would change over the next 150 years under the base case harvest forecast. The current age class distribution shows a relatively high proportion of young stands on the timber harvesting land base (shown by the dark solid bars), due to the historical harvest levels in the Sayward timber supply block of the Strathcona TSA. Age classes are not evenly distributed within the TSA. Large contiguous areas of very old forest and very young forest are found in the Kyuquot supply block and contiguous areas of second-growth forest are found in the other two supply blocks. Over the first 100 years as harvesting moves progressively into the large areas of second growth, the age class distributions on the timber harvesting land base are projected to become similar, with relatively even areas in stands up to about 100 years old. In the long term, the portion of the timber harvesting land base that is over 100 years old is predominantly on poor-growing sites with minimum harvestable ages above 100 years or areas with restrictive forest cover requirements (i.e., areas being maintained for biodiversity purposes, and retention visual quality areas).

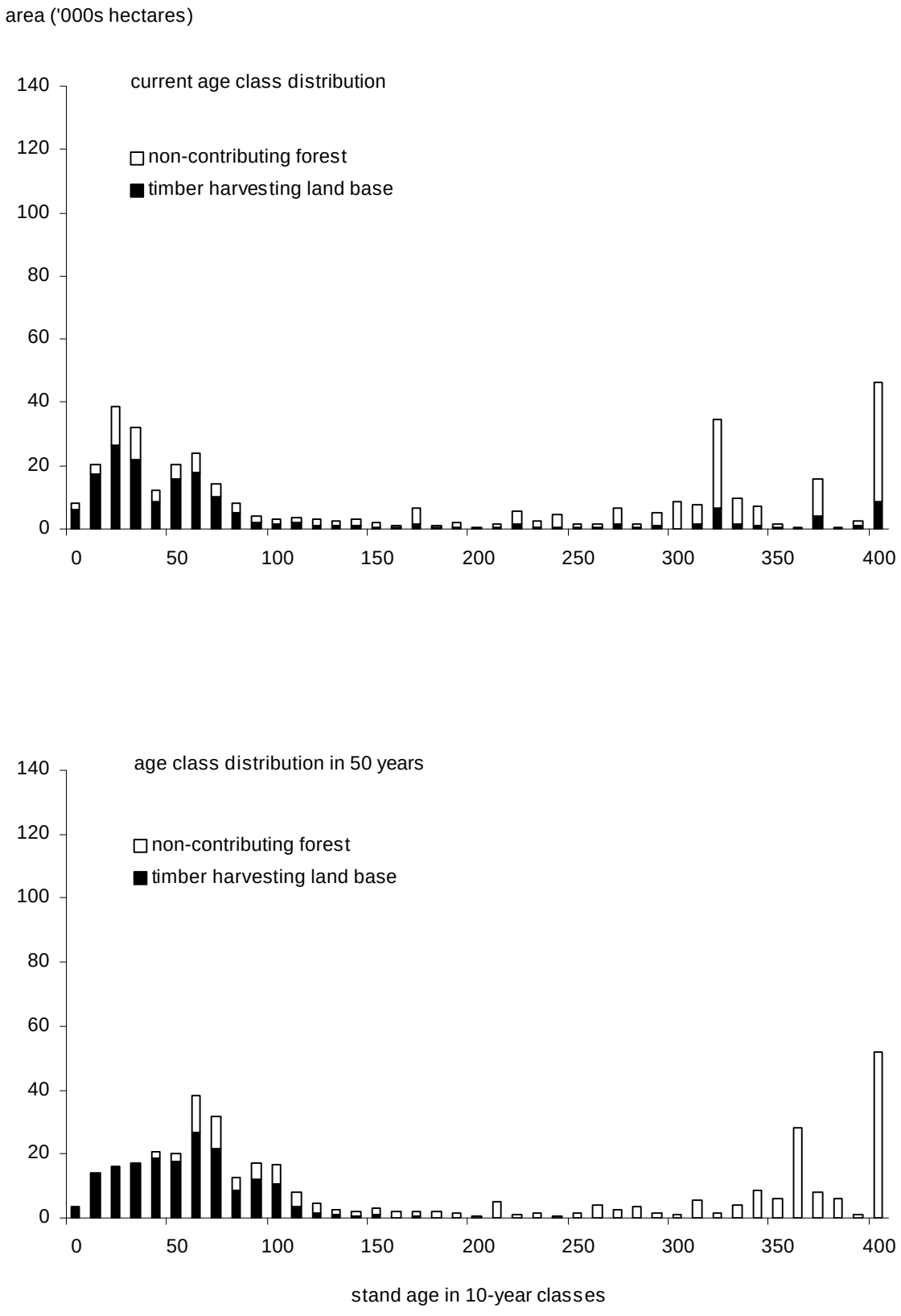

Figure 13. Changes in age composition on the productive forest land base over time — Strathcona TSA base case, 1999 *(continued)*

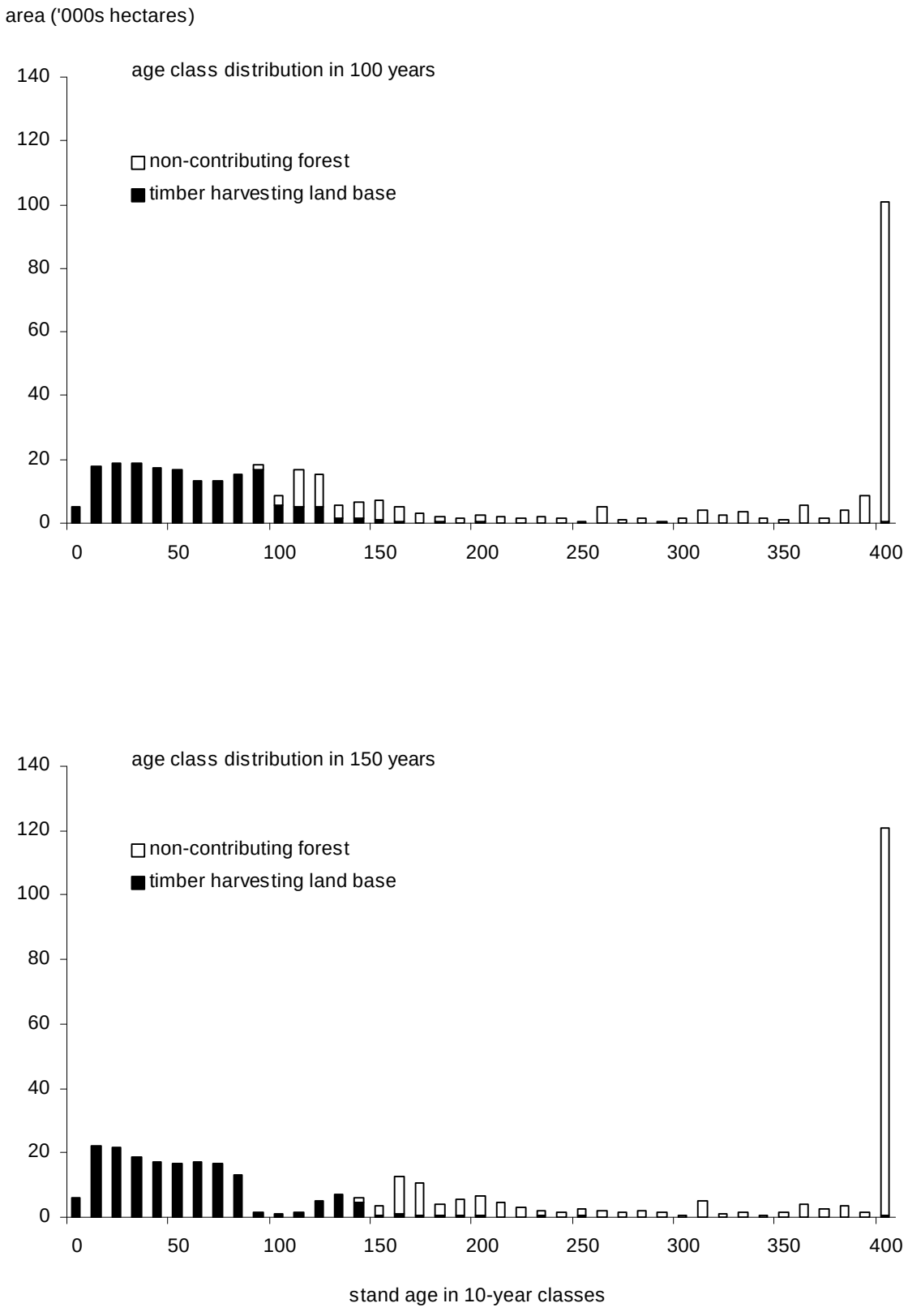

Figure 13. Changes in age composition on the productive forest land base over time — Strathcona TSA base case, 1999 *(concluded)*

4 Results

Overall, about 40% of the total productive forest in the Strathcona TSA is currently in stands above 250 years of age while only about 17% of the timber harvesting land base is above 250 years. Over the next 100 years, the portion of the productive forest area covered by stands with ages above 250 is projected to decline slightly to about 38% as some of the older forest in the timber harvesting land base is harvested while forest outside the timber harvesting land base ages (assuming that non-contributing forest areas are not lost to natural events such as large fires or windthrow).

4.5 Contribution from the Kyuquot supply block

Figure 14 shows the base case forecast for the Strathcona TSA and two different harvest forecasts for the Kyuquot supply block. The solid line represents the harvesting resulting from the schedule implied in the base case in which stands oldest relative to their minimum harvestable ages are harvested first. The long-dashed line represents a harvest where the supply from the Kyuquot supply block is reduced to 700 000 cubic metres per year for the next 10 years followed by a maximum of 600 000 cubic metres per year thereafter. Either harvest contribution from the Kyuquot supply block produces the base case harvest forecast, with the caveat that a review of all harvesting statistics indicates that forcing a specific harvest flow from the Kyuquot supply block will reduce flexibility and could have negative harvest implications for TSA-level harvests in the future. With a specific harvest flow, existing mature forest in the Kyuquot supply block would need to be allocated for harvest in recognition of when second-growth managed forest in that area would become available for harvest, in order to maintain harvests above some minimum level. A harvest flow with more consistent levels from the Kyuquot area over the next few decades actually reduces mid-term timber supply for the whole TSA by delaying the time at which areas begin to grow as managed stands, which are predicted to produce timber at a relatively high rate.

Some of the social issues arising from harvest level changes in the Kyuquot supply block will be discussed in the social and economic assessment included in this report (Section 7, "Socio-Economic Analysis"), and in the public discussion paper.

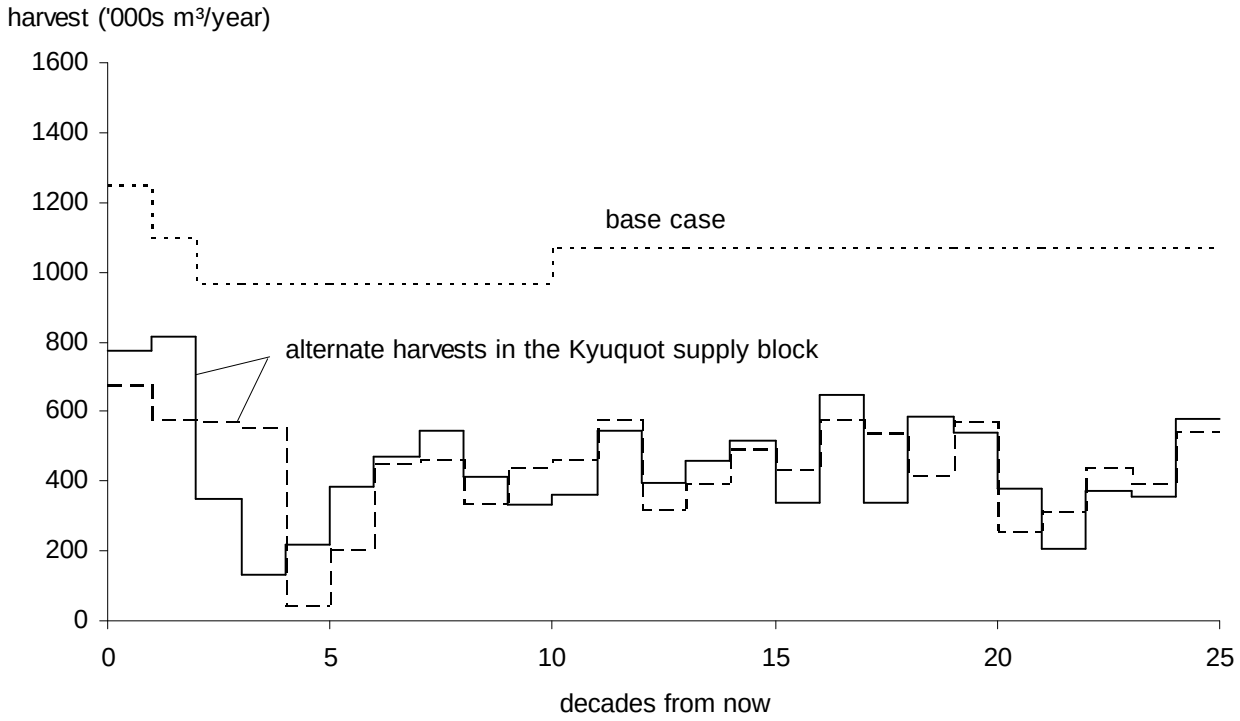

Figure 14. Contribution from the Kyuquot supply block over time — Strathcona TSA, 1999.

5 Timber Supply Sensitivity Analyses

The best available information on forest inventories and management practices is used to analyze the timber supply implications of continuing with current management. However, forest management is a complicated and ever-changing endeavor that must account for diverse and changing human values, the dynamics of complex ecosystems, and fluctuating and uncertain economic factors. As well, forests grow quite slowly in terms of human time spans, which means that decisions we make today have not only short-term but also long-term effects. In such a context, we cannot be certain that all data accurately reflect the current state of all values in the forest, how the forest will change, or how our management activities will affect the forest.

One important way to deal with this uncertainty is to revise plans and analyses frequently to ensure they incorporate up-to-date information and knowledge. Frequent planning and decision-making can help minimize any negative effects that may occur if decisions are based on inaccurate information. Frequent revision can also ensure that opportunities that become apparent from new information are not missed.

Another important way of dealing with uncertainty is to assess how values of interest, for example, timber supply, could change if the information used in the analysis is not accurate. Sensitivity analysis is one way of evaluating how uncertainty could affect analysis results, and ultimately decision-making. Sensitivity analysis can highlight that fairly small uncertainties about some variables could have large effects on timber supply projections, or conversely that fairly large inaccuracies in others could have negligible effects. Also, sensitivity analysis could show that some variables affect timber supply more in the short term than in the long term, while others have the opposite effect. Sensitivity analysis can highlight priorities for collecting information for future analyses, and show which variables, and associated uncertainties, have the most significance for decisions. It can clarify whether current best estimates provide safe bases for decisions, or whether high uncertainty about important variables means more conservative decisions may be wiser.

In this section, results of several sensitivity analyses are discussed. The results from Section 4, "Results" are based on current forest management assumptions and are referred to as the base case.

5 Timber Supply Sensitivity Analyses

5.1 Alternative harvest flows over time

The base case harvest forecast shown in Figure 8 was defined using criteria discussed in Section 4.1, "Base case harvest forecast," including managing the transition from the current harvest level to the long-term harvest level, managing the rate of decline in harvests from the current level, avoiding large and abrupt harvest shortfalls and managing the rise to a long-term harvest level commensurate with the productivity of the timber harvesting land base. These criteria are attempts to avoid both excessive changes from decade-to-decade, and significant timber shortages in the future either of which might limit future options. However, there are many possible harvest flows, with different decline rates, starting harvest levels, and potential trade-offs between short- and long-term harvests.

Figure 15 shows the alternate harvest forecast discussed at the end of Section 4.1. It is possible, as shown by the solid line, to maintain the current AAC for one decade, followed by three declines of 12% per decade, then a further decline of 8% to a mid-term level below the base case. This forecast would then rise 19% to the same long-term harvest level as the base case. However, the first decade harvest is more sensitive to uncertainties, particularly if mid-term harvest levels are not permitted to decline any further. As noted earlier, some comments will be made for each sensitivity analysis regarding the implications of maintaining the current AAC given the uncertainty being examined.

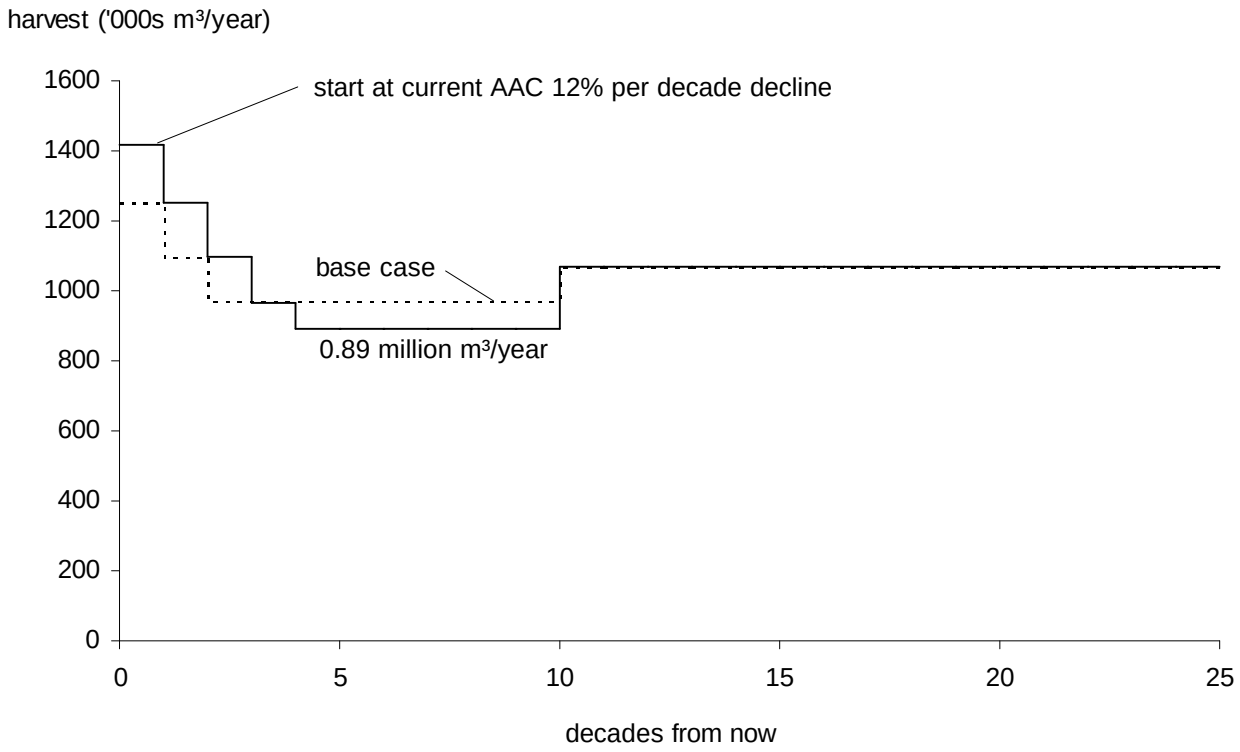

Figure 15. Harvest forecast using an alternative short-term harvest flow — Strathcona TSA, 1999.

5 Timber Supply Sensitivity Analyses

Figure 16 shows the implications of reducing the harvest level immediately to the base case long-term level, a 25% reduction from the current AAC. The harvest forecast (solid line in Figure 16) shows major disruptions in decades 11 and 12, and over the long term. The existing forest inventory and projected growth over the next few decades are not sufficient to sustain harvests at the base case long-term level without resulting in significantly reduced long-term supply. To avoid these disruptions while maintaining a constant timber supply over the first 100 years, and achieving the base case long-term level, the harvest level would have to be reduced immediately to just above one million cubic metres per year, 29% below the current AAC (dashed line in Figure 16). This level is only slightly above the mid-term level projected in the base case. This latter forecast demonstrates that significantly reducing short-term harvests can actually reduce mid-term supply by reducing the rate at which areas are brought under silvicultural management regimes that are projected to increase timber productivity.

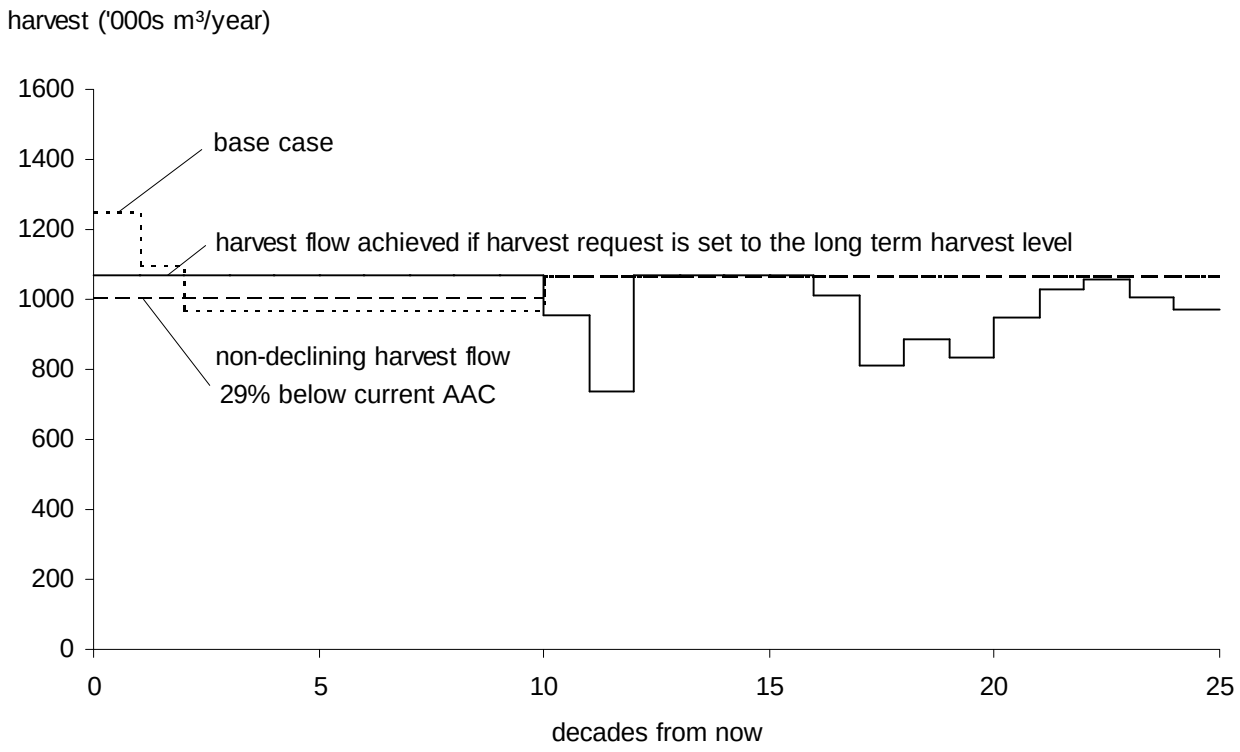

Figure 16. Harvest forecast if harvest request is set to the long-term harvest level — Strathcona TSA, 1999.

5.2 Sensitivity to changes in minimum harvestable ages

For the base case, minimum harvestable ages were set at the age when stand volume is predicted to reach 350 cubic metres per hectare. Appendix A "Description of Data Input and Assumptions for the Timber Supply Analysis" contains a comparison of minimum harvestable ages that would result if different derivation criteria, such as achievement of maximum average growth, were used.

Figure 17 shows the timber supply implication of changing the minimum harvestable age derivation criteria. The solid line reflects the timber supply if minimum harvestable ages are set at the age of highest average growth (culmination age). In the base case, many managed stands are available for harvest in decade 7. However if minimum harvestable ages are set at culmination age, many of these stands would be unavailable, hence the large shortfall between decades 7 and 10. The long dashed line represents the implications if minimum harvestable ages are set at the age at which 95% of the culmination mean annual increment has been achieved. The small degree of flexibility provided by this change largely eliminates the mid-term shortages forecast if minimum harvestable age were set at the culmination age. However, the long-term harvest level is 5% lower than with harvestable ages set at culmination age.

The base case long-term harvest level is shown to be below both of the forecasts where productivity was the basis for deriving minimum harvestable age. In the base case, some less productive stands that have reached culmination age have not achieved the minimum volume criterion set for the base case minimum harvestable ages. Conversely, more productive sites achieve the minimum volume criterion much earlier than culmination age. The volume-based minimum harvestable ages used in the base case, in concert with the relative-oldest first harvest schedule rule, result in harvesting stands further from their age of maximum average growth, thus reducing the long-term harvest level relative to that achieved when harvestable ages are set at or near culmination age.

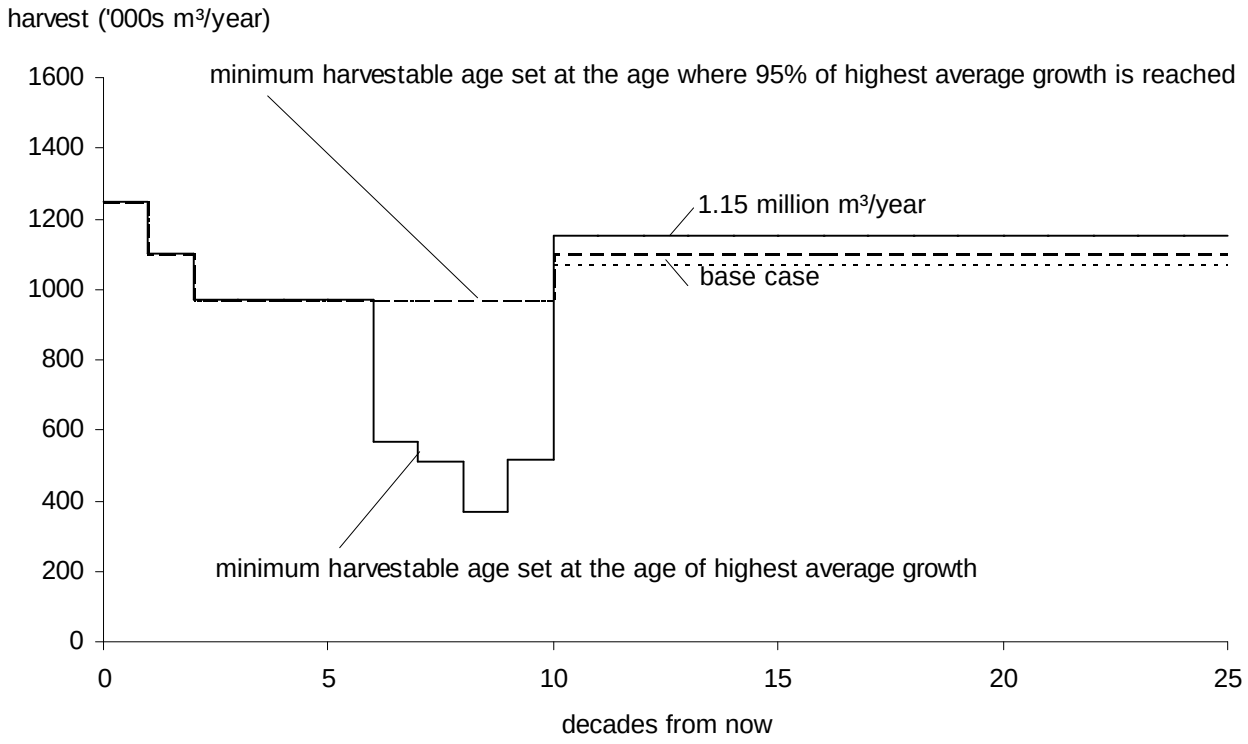

Figure 17. Harvest forecasts if minimum harvestable age is derived using growth rate rather than volume per hectare — Strathcona TSA, 1999.

5 Timber Supply Sensitivity Analyses

In describing the dynamics of the base case, it was stated that the base case harvest forecast is insensitive in the short term to available changes in volume. Figure 18 shows analysis results that illustrate this. Minimum harvestable ages were increased by 20 years thereby reducing the available timber volume. The resulting harvest forecast is shown by the long dashed line. In this sensitivity analysis, the only timber supply implication is a delay of roughly three decades the rise to a higher long-term harvest level of 1.1 million cubic metres per year. The higher long-term harvest level is a direct result of harvesting stands much closer to culmination age than occurs in the base case. This sensitivity analysis also shows that if the long-term harvest level is not attempted until decade 15, then a higher long-term harvest level can be achieved.

The solid line shows the implications of attempting to start at the current AAC. A significant disruption is experienced in decade 6 when the harvest level is reduced by 20% due to a lack of available harvestable timber. By reducing harvest levels significantly below the long-term harvest level from decade 7 through 10, the growing stock recovers to the point that the same long-term harvest level of 1.1 million cubic metres per year can be sustained from decade 11 to the end of the planning horizon.

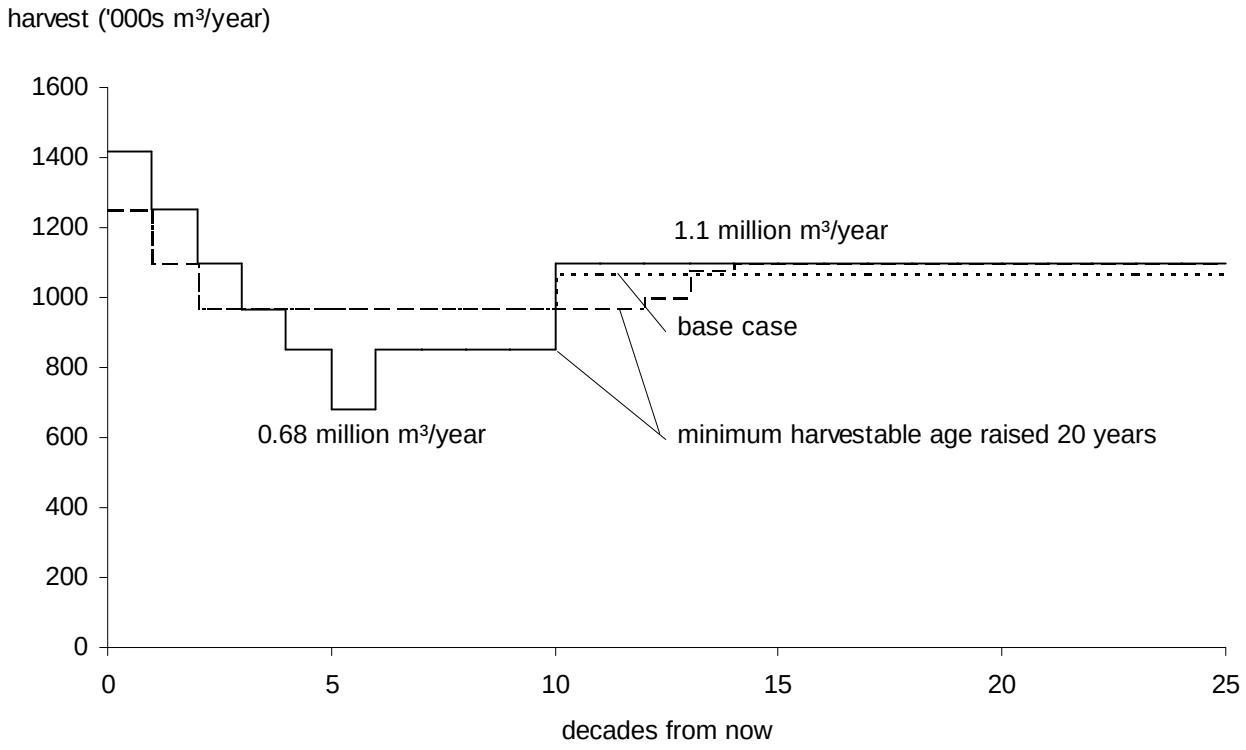

Figure 18. Harvest forecasts if minimum harvestable ages are increased by 20 years — Strathcona TSA, 1999.

Figure 19 displays the effects of reducing minimum harvestable ages by 10 years. While reduced harvestable ages increase the volume of available timber, any attempt to use this increased flexibility in the short-term would involve reduced supply in the mid —and long terms. Attempting to take advantage of this increased flexibility by maintaining the current AAC and declining at the rate of 10% per decade to a level just 50 000 cubic metres below the base case mid- term harvest level would lead to an overall reduction in mid- or long-term harvests as shown by the solid line in Figure 19. The reduction in long-term supply occurs because the higher harvest levels in the short- to mid-term initiate the systematic harvest of younger stands until most of the harvesting occurs at minimum harvestable ages. As noted earlier, the minimum harvestable ages on more productive sites are below the ages at which maximum average growth occurs.

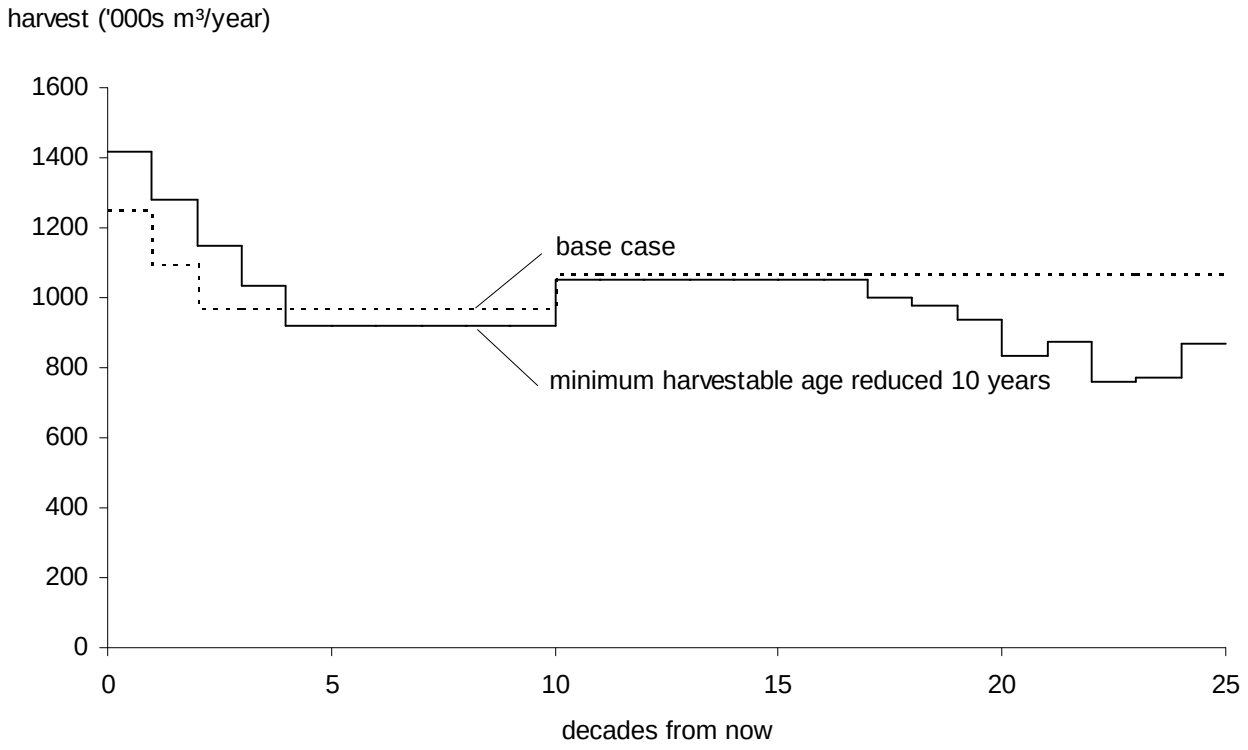

Figure 19. Harvest forecast if minimum harvestable ages are lowered 10 years — Strathcona TSA, 1999.

5.3 Uncertainty in the size of the timber harvesting land base

Uncertainty in the estimated size of the timber harvesting land base is due to factors such as fluctuations in timber prices, changes in harvesting and milling technology, land-use decisions and new inventory information. For example, recent terrain stability mapping has shown where timber is now likely to be unharvestable due to the high likelihood of landslides and erosion. Conversely, emerging markets may make a species like pine, or low volume stands attractive for harvesting.

The solid line in Figure 20 shows the implications of a reduction of 10% in the timber harvesting land base. For this sensitivity analysis, an additional 10% of the timber harvesting land base in each landscape unit is excluded from harvesting, however, this excluded area can contribute to achieving forest cover objectives. The starting harvest level is roughly 6% below the base case initial harvest level. The rise to the long-term harvest level is 12%. To increase short-term harvests, it would be necessary to significantly decrease mid-term harvests with a subsequent increase in the rise to the long-term harvest level.

5 Timber Supply Sensitivity Analyses

If the timber harvesting land base were to increase in size, one possible forecast is illustrated by the long-dashed line in Figure 20. The long-term harvest level is about 8% higher than the base case, given that the stands outside the timber harvesting land base in the base case that are included in this sensitivity analysis tend to be moderate to poorer productivity classes, with a slightly higher representation of stands in the visual quality resource emphases areas than in the cutblock adjacency areas. The larger timber harvesting land base would enable the maintenance of the current AAC, with a mid-term harvest level of 1.04 million cubic metres per year, about 70 000 cubic metres per year higher than in the base case.

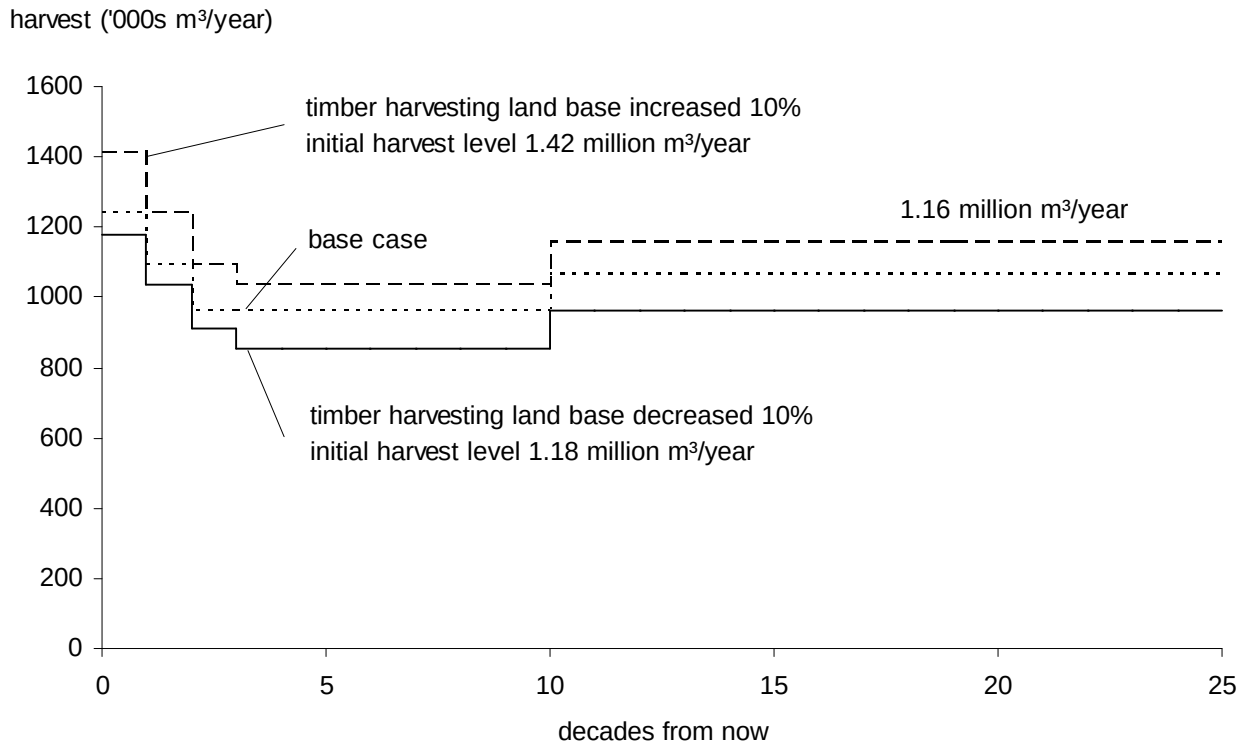

Figure 20. Harvest forecasts if changes to the timber harvesting land base occur — Strathcona TSA, 1999.

5.4 Uncertainty in timber volume estimates for existing unmanaged stands

Estimates of standing timber volumes in existing forest stands are subject to some uncertainty because they are based on extrapolation of measurements from some stands to all stands in an area, and on inventory classifications which contain some uncertainty. The standing volumes are more accurate when averaged over large areas, but may not reflect actual volumes in a specific stand. Uncertainty may also stem from estimates of the volume lost to decay in standing trees and to waste and breakage during timber harvesting, as well as estimates of utilization practiced during harvesting. Inventory audit information for the Strathcona TSA should be available prior to the AAC determination, which will assist in evaluating the overall accuracy of the inventory.

5 Timber Supply Sensitivity Analyses

Figure 21 illustrates the sensitivity of timber supply to changes in estimates for existing stand yields. If existing natural stand volumes are overestimated by 10%, a further 9% decline relative to the base case would be experienced 30 years from now, as shown by the long dashed line. Alternatively, the current AAC could be achieved in the first decade but would be followed by a minimum of about five declines of 12% per decade in order to stabilize harvest flow.

If existing natural stand volumes are underestimated by 10%, the second decade decline in the base case could be reduced from 12% to 5%, with a rise to the long-term harvest level of only 3% in decade 11. Alternatively, the current AAC could be maintained but declines over the next 30 years would bring the medium-term harvest level to one million cubic metres, about 40 000 cubic metres less than the harvest forecast shown by the solid line in Figure 21.

Long-term timber supply is not affected by changes to volume estimates for existing natural stands.

In conclusion, short- and mid-term timber supply is relatively insensitive to uncertainty in estimates of volumes in existing natural stands. In part this is because existing natural stands do not make up the entire existing inventory; existing managed stands also contribute to the growing stock. The effects of volumes in existing natural stands are also dampened by objectives for a controlled harvest flow with gradual changes, and by the effects of timber growth in managed stands on timber supply over the mid- and long terms.

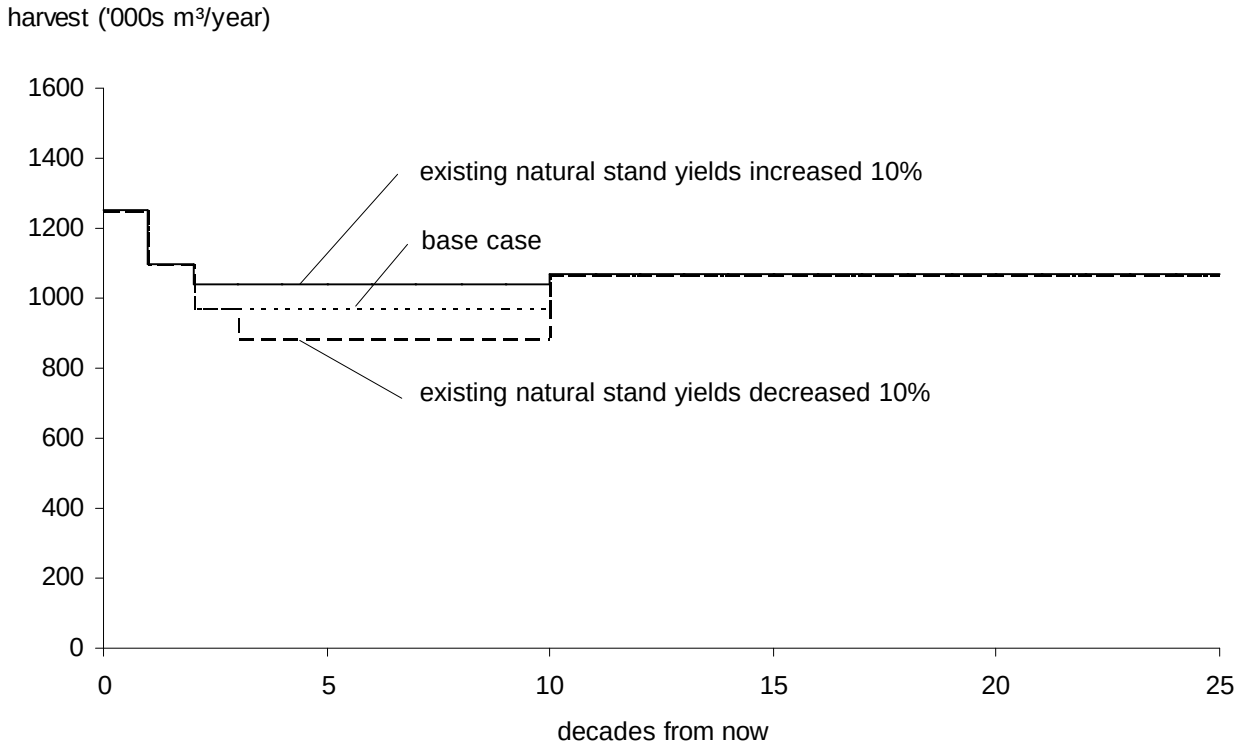

Figure 21. Harvest forecasts if existing natural stand yields are changed by 10% — Strathcona TSA, 1999.

5.5 Uncertainty in timber volume estimates for regenerated (managed) stands

Uncertainty in volume estimates for managed stands exists for all of the same reasons listed for existing unmanaged stands (uncertainties in the forest inventory and the growth and yield models), but also because of the limited experience and data that is available for regenerated managed stands in B.C. There is also uncertainty around how the productivity of sites occupied by older stands may change after the old forest is harvested and regenerated as a managed stand. This issue is examined in Section 5.8, "Uncertainty in the site productivity estimates in older stands." The following sensitivity analysis examines the effect of changing only the estimated timber volumes for managed stands.

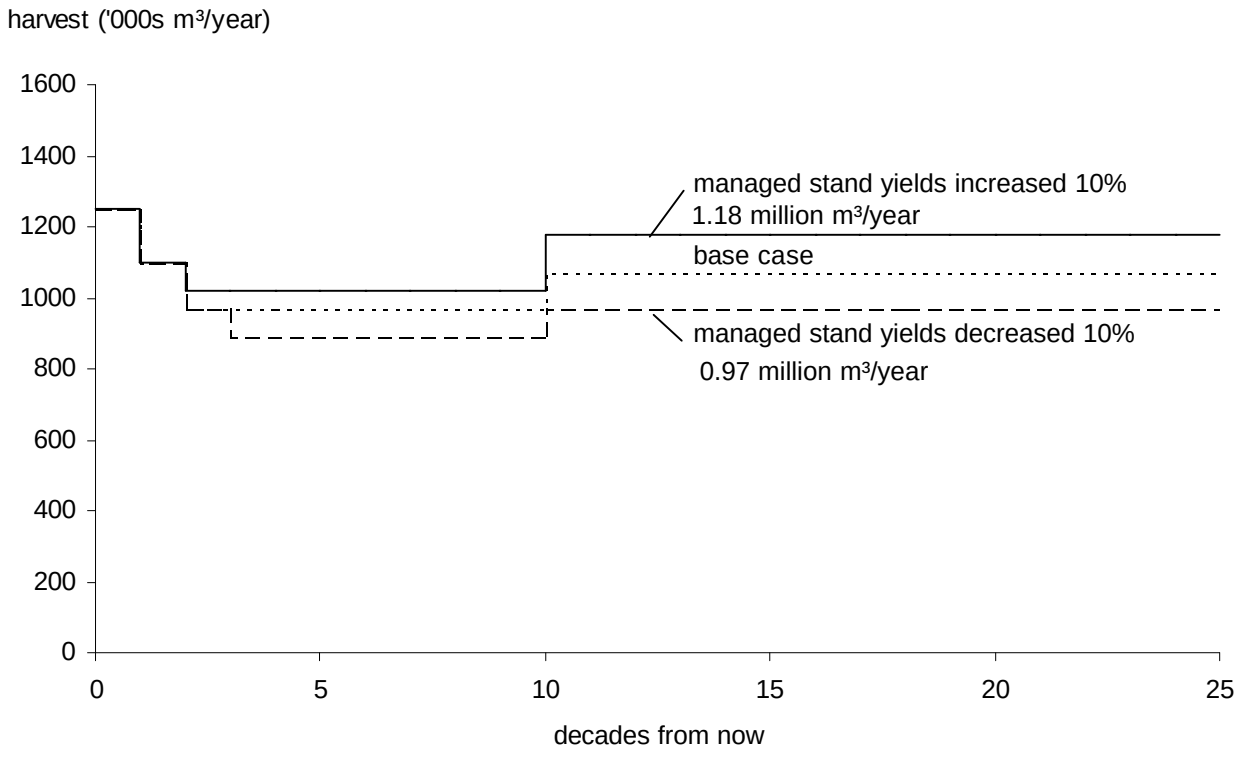

Figure 22. Harvest forecasts if managed stand yields are changed by 10%- Strathcona TSA, 1999.

The effect on timber supply of a 10% reduction in managed stand yields can be seen in the long dashed line in Figure 22. No change from the base case harvest forecast is experienced until decade 4 when the harvest forecast declines by about 8%. The new long-term harvest level is 9% below the base case. If the current AAC had been chosen in the short term, five decadal declines of roughly 12% each would be required, followed by a 26% increase to the long-term harvest level of 970 000 cubic metres per year shown in Figure 22.

With a 10% increase in managed stand yields, timber supply in the medium term could be increased above the base case harvest forecast and the long-term harvest level would increase by 10%. Medium-term harvests would be roughly 5% higher than the base case, as managed stands compose about 50% of the harvest volume. Alternatively, the current AAC could be achieved in the first decade, but timber supply declines to a level of 960 000 cubic metres per year would still be necessary so that the same long-term harvest level could be achieved in decade 11 onwards.

5.6 Uncertainty in green-up ages

Forest cover requirements for visual quality, cutblock adjacency and ungulate winter range include estimates of when stands will reach green-up conditions, expressed as the desired height of a stand. For visual areas this is termed visually effective green-up (VEG). Green-up age, the age at which a stand exhibits the desired condition, is determined using a growth and yield model. The green-up period includes both the green-up age and the regeneration delay*, or time taken to establish a stand after harvesting. Uncertainty exists because the specified green-up condition (i.e., tree height) may either exceed or fall short of actual requirements, the period of stand establishment may vary, and uncertainties about growth and yield may mean that stands will reach the desired condition sooner or later than estimated.

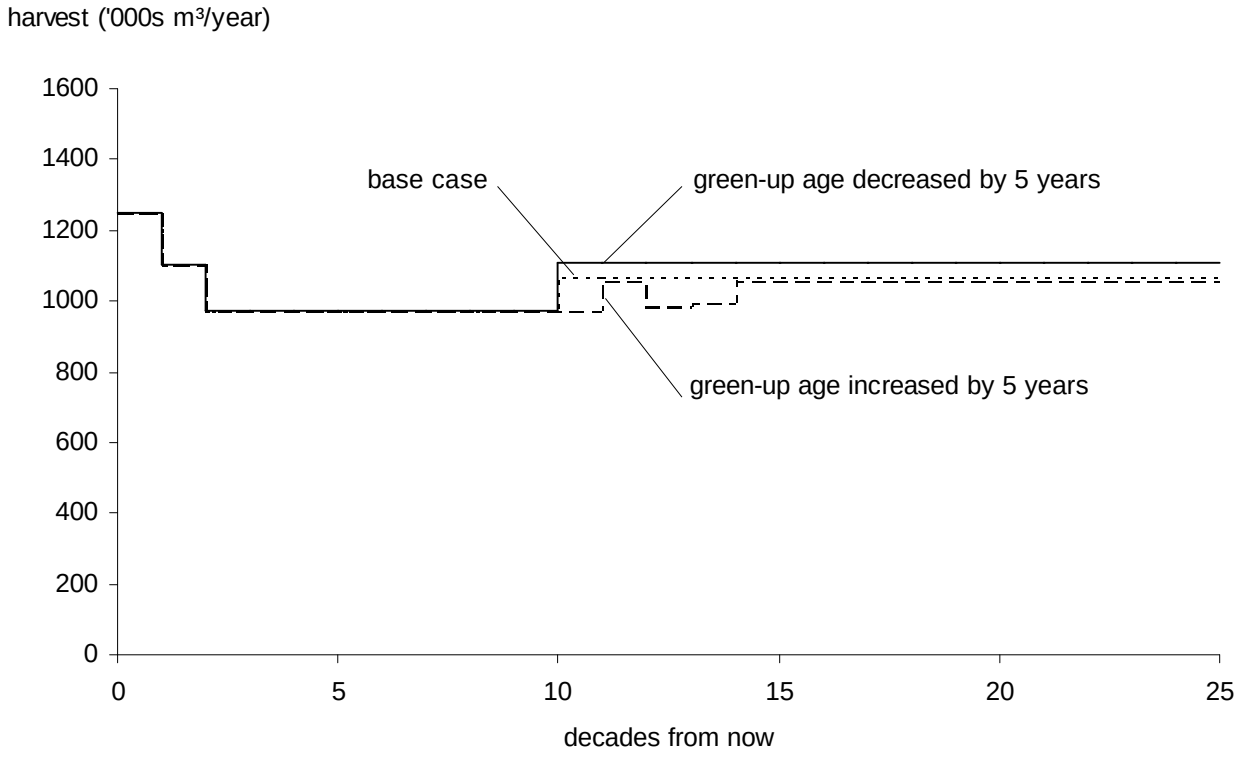

Figure 23. Harvest forecasts if green-up ages are changed by 5 years — Strathcona TSA, 1999.

Regeneration delay
The period of time between harvesting and the date by which an area is occupied by a specified minimum number of acceptable well-spaced trees.

The base case harvest forecast is insensitive to a five-year increase in green-up ages as can be seen by the long dashed line in Figure 23 except that average harvest age in the visual quality management emphasis areas is increased marginally, such that there is a slight reduction in the long-term harvest level of about 10 000 cubic metres per year. The most significant harvest scheduling impact would be a reduction in first decade harvest in the Kyuquot supply block from about 60% in the base case to about 30% in this sensitivity analysis. Over the last 10 years, much of the harvesting activity in the Strathcona TSA has been in the Kyuquot supply block and an increase in the length of time required for a stand to reach the desired green-up height reduces the amount of forest that can be harvested from that area without violating forest cover requirements. The short-term timber supply reduction in this supply block is compensated for by opportunities in the Sayward supply block. The highest possible first decade harvest in this sensitivity analysis is about 1.39 million cubic metres per year, 30 000 cubic metres less than the current AAC, followed by a maximum second-decade harvest of about 1.17 million cubic metres per year, a decline of 16% from 1.39 million cubic metres per year.

With a decrease in green-up ages of 5 years, the long-term harvest level would be increased by about 37 000 cubic metres per year as shown by the solid line in Figure 23. If the current AAC were maintained, a decline to a medium-term harvest level of 890 000 cubic metres, would be necessary, while the long-term level would increase to the same level as shown in Figure 23. Reducing green-up restrictions does not increase supply over the short -and mid-terms. Only the forest cover requirements in the retention visual quality class produce any significant changes to timber availability which affects the long-term harvest level.

5.7 Uncertainty in harvest scheduling rules

Many rules can be used to place stands eligible for harvest (i.e., those above the minimum harvestable age) into a harvest queue or list. In the base case harvest forecast and most sensitivity analyses, highest priority was given to stands that are oldest relative to their minimum harvestable age. Another possible rule could be absolute oldest first, under which poor productivity stands with high minimum harvestable ages are chosen for harvest before more productive stands with lower minimum harvestable ages.

The first rule assessed in this sensitivity analysis is a random harvest rule, where stands above the minimum harvestable age are chosen at random. It was decided that harvesting completely at random given the very wide range of possible harvest ages was not realistic operationally so one caveat was introduced. Stands were placed into two lists. The first list contained stands that are within 10 years of their respective culmination ages*, while the second list included any stand not meeting this criterion. The second list included stands both that are significantly younger than the age of maximum average growth, but also stands that are significantly older. Stands were then chosen randomly for harvest, first from the culmination age list and if there was still a deficiency in harvest volume, from the second list. This ensures that stands are harvested at a variety of harvest ages but recognizes the likelihood that some stands will be considered for harvest before younger stands.

Culmination age
The age at which a timber stand reaches its highest average growth rate, or mean annual increment (MAI). MAI is calculated as stand volume divided by stand age. Culmination age is the optimal biological rotation age to maximize volume production from a growing site.

5 Timber Supply Sensitivity Analyses

The solid line in Figure 24 shows the implications to timber supply if stands are harvested in a more random order than the systematic method used in the base case. Use of partially random priorities results in lower timber supply over the mid- and long terms. Supply is lower because giving higher priority to stands close to their age of maximum productivity means that other stands, for example, those retained until older ages to achieve visual quality objectives, are placed lower in the harvest queue, and retained for even longer while their average timber productivity declines. The overall result is lower timber production over the long term. If this harvest forecast is followed, the average harvested volume drops to about 400 cubic metre per hectare by decade 4, compared to 600 cubic metres per hectare in the base case. At that time the average harvested age of stands would be 20 years younger than in the base case.

Another possible harvest rule is to set a high priority on second-growth stands, before harvesting existing unmanaged forest. The long-dashed line in Figure 24 shows the implications of this strategy. Essentially all second-growth stands are targeted for harvest at their minimum harvestable age, which results in foregone volume growth in the mid -and long term. Most statistics associated with this forecast are similar to those for the random rule discussed previously.

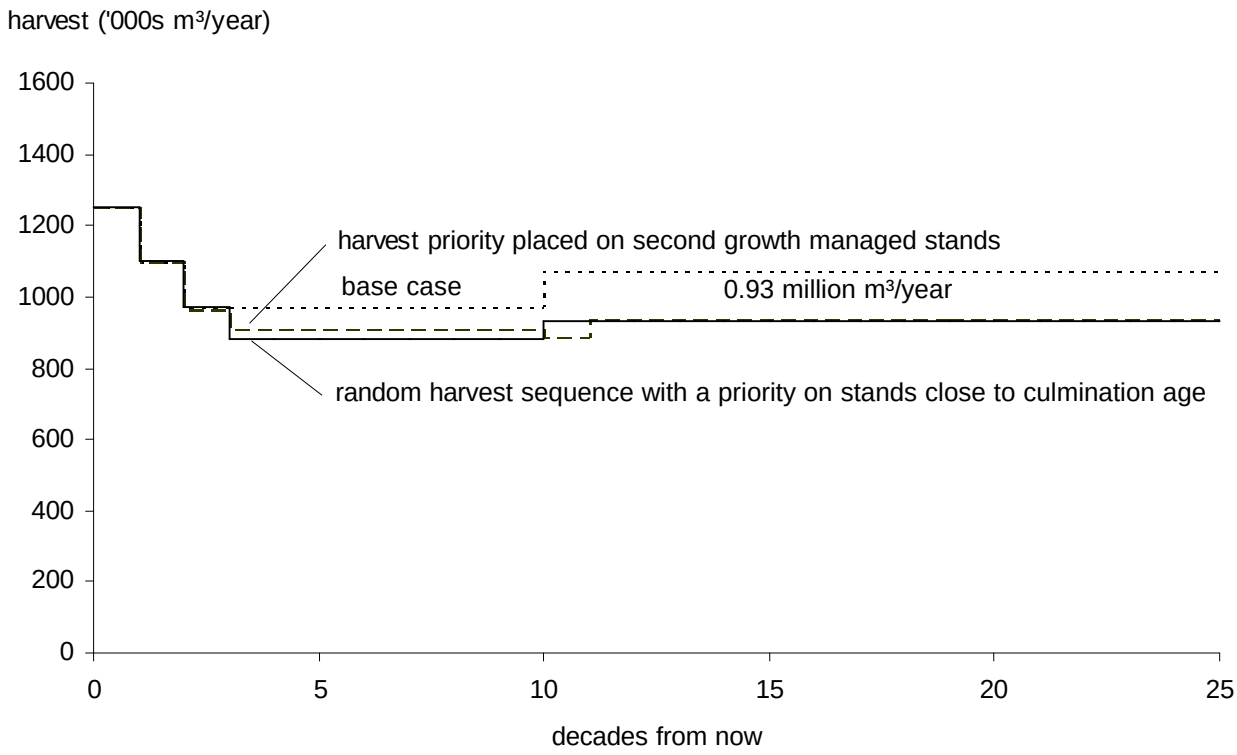

Figure 24. Harvest forecasts if alternative harvest priority rules are used — Strathcona TSA, 1999.

5.8 Uncertainty in site productivity estimates for older stands

Estimating the future productivity of the existing mature forest is difficult in that it is not possible to know with certainty how the productivity of a regenerated stand will compare to the productivity of the existing stand it replaces. The productivity of a site largely determines how quickly trees will grow. It therefore affects the timber volumes in a regenerated stand, the time to reach green-up and the age at which those stands will reach merchantable size. The most accurate assessments of site productivity come from stands between 30 and 150 years of age. At ages less than 30 years, a temporary increase or decrease in growth due to factors such as a post-harvest flush of nutrients or an unusual drought year can affect the overall productivity estimated for the stand. However techniques such as the growth intercept method developed by the Ministry of Forests, Research Branch are improving early site index* estimation for these stands. At older stand ages, future site productivity estimates may be incorrect due to deficient tree height estimates as a result of the death of dominant trees or top damage, or due to inaccurate estimates of stand ages. In the Strathcona TSA, almost a quarter of the timber harvesting land base has site productivity estimates based on old-growth stands. The results of recent research suggest that the future productivity of these sites may be significantly underestimated. This research focuses on comparing the measured productivity of existing young regenerated stands using the growth intercept method for site index estimation, with site productivity estimates based on characteristics of old-growth stands growing on adjacent, ecologically identical sites. The measured productivity of the regenerated stands is generally higher than the estimated future productivity of the old-growth stands. The site productivity adjustments suggested by this recent research are based on the maximum potential site productivity, and the adjustments used in this analysis can be found in Working Paper 36. (*Nigh, Gordon. 1998. Site index adjustments for old-growth stands base on veteran trees. Research Branch, B.C. Ministry of Forests, Victoria, B.C. Work Paper 36/1998*).

To test the sensitivity of the harvest forecast to this issue, the estimated site indices for all old-growth stands in the current forest inventory were increased to the maximum potential productivity using the application guidelines provided in *Working Paper 36*. Timber supply analysis inputs affected by changes in estimated future forest productivity (managed stand volume estimates, green-up ages and minimum harvestable ages) were recalculated based on the increased site productivity. The overall increase in site indices on the mature stands (greater than 140 years) is about 8.5 metres, shifting the average site index on these stands from 17 to 25.5 metres. Similarly, the average site index for all stands above 30 years of age changes from 23 to 26.3 metres. Changing old-growth site index after harvest results in reductions to minimum harvestable age ranging from no change for more productive sites to 60 years on less productive sites, and reductions in green-up age ranging from 0 to 7 years on more and less productive sites, respectively.

Site index
A measure of site productivity. Site indices in British Columbia are based on heights of free-growing dominant trees of a given species at a reference age of 50 years above breast height. Site index curves have been developed for British Columbia's major commercial tree species.

5 Timber Supply Sensitivity Analyses

Figure 25 shows the timber supply implications of adjusting the site index on the old-growth stands in the Strathcona TSA after harvesting. The solid line shows that harvests in the mid-term can be 100 000 cubic metres per year higher than the base case harvest forecast and the long-term harvest level could be about 14% higher, and be achieved a decade earlier than in the base case harvest forecast. If the current AAC were to be maintained, a decline to a mid-term harvest of about one million cubic metres would be necessary. Generally, the average harvested volumes are slightly higher than in the base case but the average harvest age is about 10 years lower than the base case.

Finally, while the results of this analysis show that mid- and long-term timber supply are significantly sensitive to uncertainty in site productivity estimates, the study on which the adjustments are based itself notes the "lower reliability" of the data and results (Nigh, 1998, page 16). Therefore, the harvest forecast shown in Figure 25 should be viewed as an indication of the general timber supply trends associated with site index adjustments rather than an accurate and precise projection of expected timber supply.

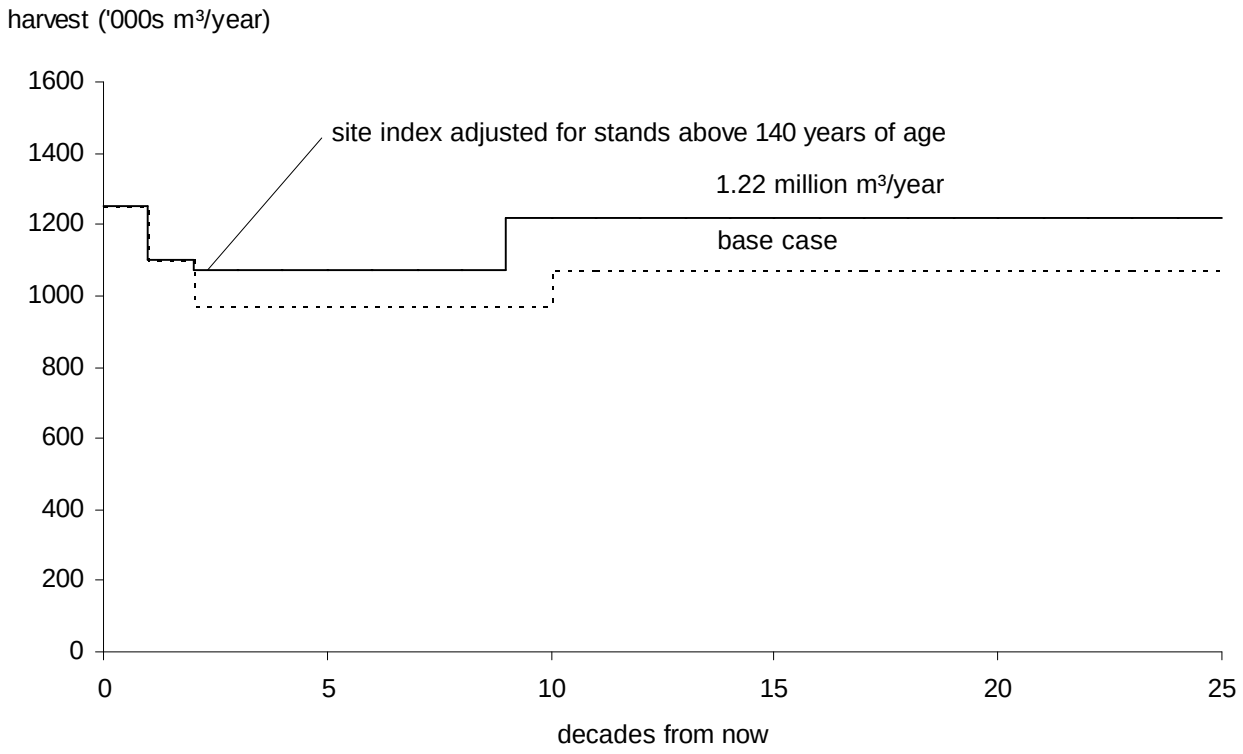

Figure 25. Harvest forecast if future site productivity for the remaining old-growth stands is increased to the potential site index suggested by recent research — Strathcona TSA, 1999.

5.9 Uncertainty in the application of guidelines for visual quality

Two separate approaches were used to examine the sensitivity of timber supply to uncertainty about maximum allowable disturbance guidelines for visual quality. First, timber supply forecasts were generated when applying both the mid-point and the lower end of the maximum allowable disturbance range for each visual quality class. The management assumption applied in the base case is that the upper end of the acceptable range of disturbance would be applied (see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis"). Secondly, rather than applying the base case assumptions to the productive forest land base within each landscape unit, they were applied to the timber harvesting land base within each landscape unit. These two approaches provide a bound to the timber supply contribution of visual quality areas.

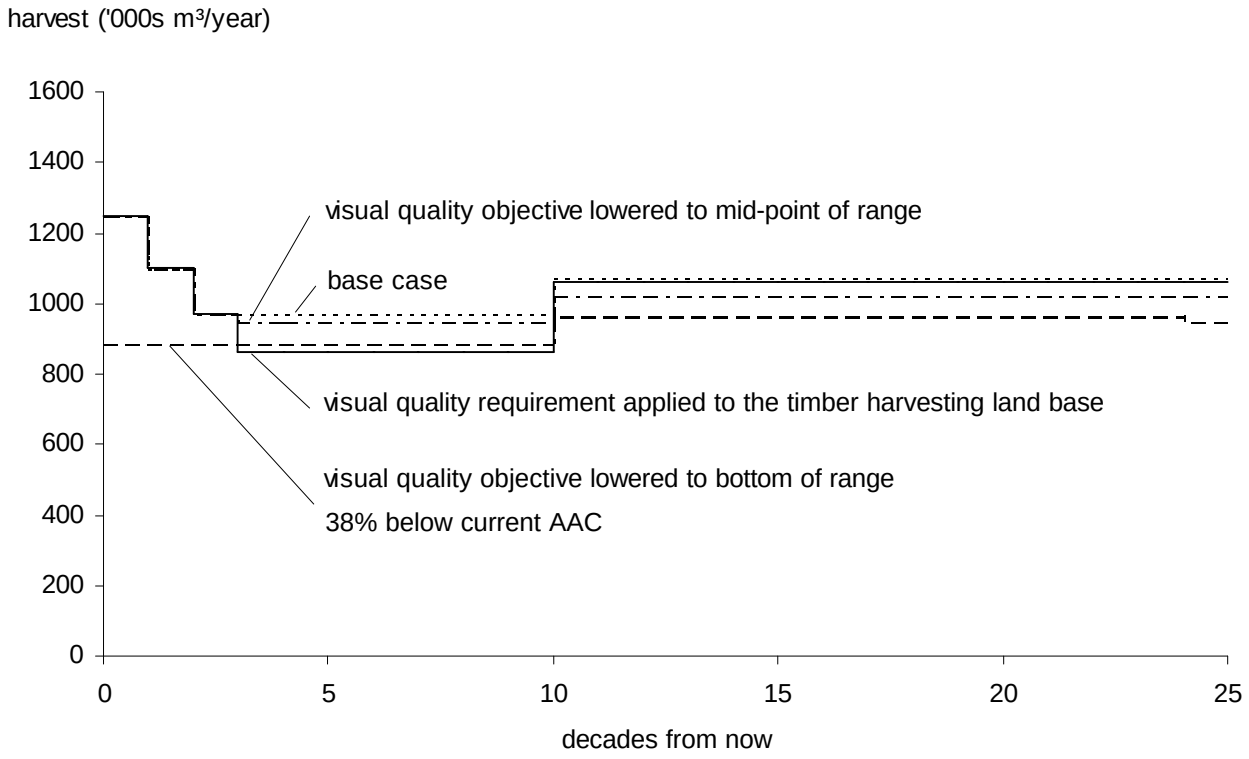

Figure 26. Harvest forecasts if the forest cover requirement for maximum allowable disturbance in visual quality areas is modified — Strathcona TSA, 1999.

At the mid-point of the acceptable range of maximum disturbance (i.e., 3% for retention, 10% for partial retention), an additional 3% decline in the fourth decade, as shown by the double dashed line in Figure 26, is required given the reduced flexibility in harvesting primarily from the partial retention visual quality class, and the increase in harvested ages in the retention visual quality class. In addition, the long-term harvest level is reduced by about 5% from the base case harvest forecast. However, contribution from the partial retention visual quality class remains proportional to its area, indicating that while the change in the forest cover requirement reduces fluctuation between time periods, it does not extend harvested ages in this class beyond those reflected in the base case.

If the bottom of the maximum disturbance range is used (i.e., 1% for retention, 6% for partial retention), significant implications to timber supply occur. The first decade harvest would be about 38% below the current AAC as shown by the long-dashed line in Figure 26. Timber supply is reduced in the retention visual quality class such that contribution to long-term timber supply averages about 1% while it comprises over 6% of the timber harvesting land base. The partial retention visual quality class provides harvest volume proportional to its contribution to the timber harvesting land base and average harvest volume in the cutblock adjacency areas is less than 400 cubic metres per hectare, well below the base case average of 500 cubic metres over the long term for the cutblock adjacency group. Therefore, while some increase in the long-term level relative to that shown by the long-dashed line in Figure 26 would be possible, it would come at the cost of even lower short- and mid-term timber supply.

Application of the forest cover requirement for visual quality to the timber harvesting land base rather than the productive forest area causes some mid-term timber supply reductions. The solid line in Figure 26 reveals that while there are mid-term implications, there is very little long-term impact. A shift away from harvesting in the visual quality resource emphasis areas forces increased reliance on the cutblock adjacency areas to meet the short-term harvest level. Once the timber has been allocated in the short term, it is no longer available in the medium term. The change in the area over which the visual quality requirements are evaluated reduces the flexibility to shift any harvesting to visual management areas. However, the forest cover requirement for the partial retention visual quality group does not reduce long-term timber availability. The roughly 1% reduction in long-term timber supply is due to a small reduction in availability in the retention visual quality areas. A reduction in the first decade harvest would be necessary to maintain mid-term supply closer to the long term level; the rise to the long-term harvest level shown here is about 22%.

5.10 Uncertainty in the approximation of cutblock adjacency objectives

To ensure that harvesting-related disturbance does not become overly concentrated in an area, the Forest Practices Code requires that trees in a harvested area must reach a specified height (green-up height) before adjacent areas are harvested. To model this requirement, it was assumed that a maximum of 25% of the timber harvesting land base within each landscape unit, outside of ungulate winter range and visual quality areas, may be covered by stands that have not met the green-up condition (i.e., minimum height of three metres).

Figure 27 shows that the maximum allowable disturbance can be reduced to 16% in the cutblock adjacency area in each landscape unit, while having very little impact on the short-term harvest level for the base case in the Strathcona TSA. Cutblock adjacency areas contribute on average about 50% to the first decade harvest (compared to 70% in the base case), while partial retention visual quality areas contribute just over 40% (compared to 26% in the base case). Decreasing the allowable disturbance reduces timber availability significantly in the Kyuquot supply block, to an average of roughly 430 000 cubic metres per year for the first decade. The highest possible first decade harvest level in this sensitivity analysis is about 1.28 million cubic metres per year, just 29 000 cubic metres greater than the first decade harvest level shown.

5 Timber Supply Sensitivity Analyses

The use of forest cover requirements to represent cutblock adjacency is most appropriate in areas of homogenous forest cover (e.g., watersheds with contiguous old growth) or where harvestable timber is well dispersed within an area. This representation appears to reflect much of the forest cover within the Strathcona TSA. To test the sensitivity of timber supply to a change in the forest cover requirement used to represent cutblock adjacency, the timber harvesting land base in the cutblock adjacency area within each landscape unit was divided into two categories. The first category consisted of stands above the age of 80 as well as stands currently less than 15 years old, that is roughly less than green-up. The composition of this category represents the fact that most of the timber harvesting in the last 15 years has occurred in stands above 80 years of age. The second category is made up of stands above 15 years but below 80 years, reflecting that the harvest pattern in the past tended to be large contiguous cutblocks, larger than the common cutblock size currently harvested. The same forest cover requirement was applied to both categories within the cutblock adjacency portion of a landscape unit.

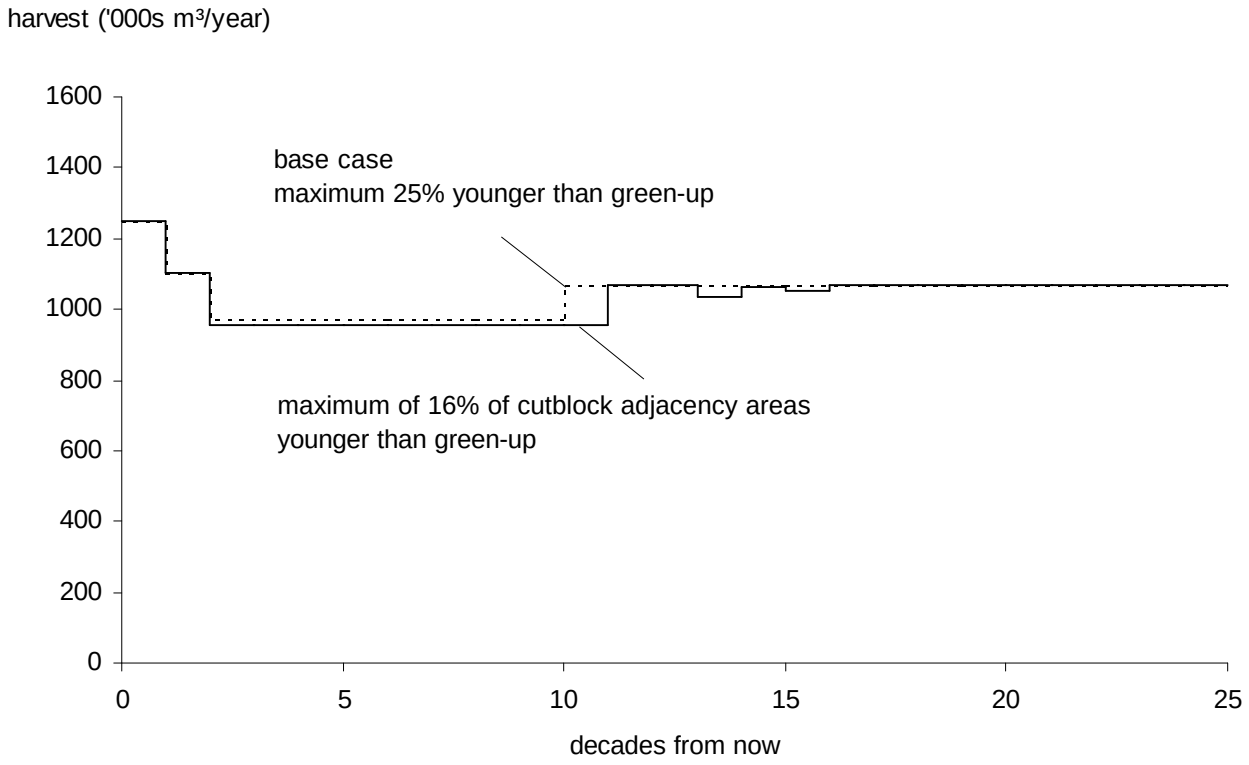

Figure 27. Harvest forecast if the forest cover requirement for cutblock adjacency is reduced to a maximum allowable disturbance of 16% — Strathcona TSA, 1999.

5 Timber Supply Sensitivity Analyses

Figure 28 shows the implications of applying the forest cover requirement separately to the two age groups within each landscape unit. While the Strathcona TSA harvest forecast remains the same as the base case, significant changes to the harvest schedule occur. The solid line represents base case Kyuquot contribution, while the dashed line represents its contribution in this sensitivity analysis. There is a significant decline in the contribution of the Kyuquot supply block over the first 20 years, indicating the high sensitivity of short and mid-term timber supply within that area to constraints on the spatial distribution of harvesting activity. In addition, harvesting of forest above 140 years of age is reduced to between 50% and 70% of the total harvest for the TSA over the next 30 years, rather than up to 90% in the first 20 years as in the base case harvest forecast. This result suggests that spatial constraints on harvesting could affect the types of stands that are available for harvest over the next few decades.

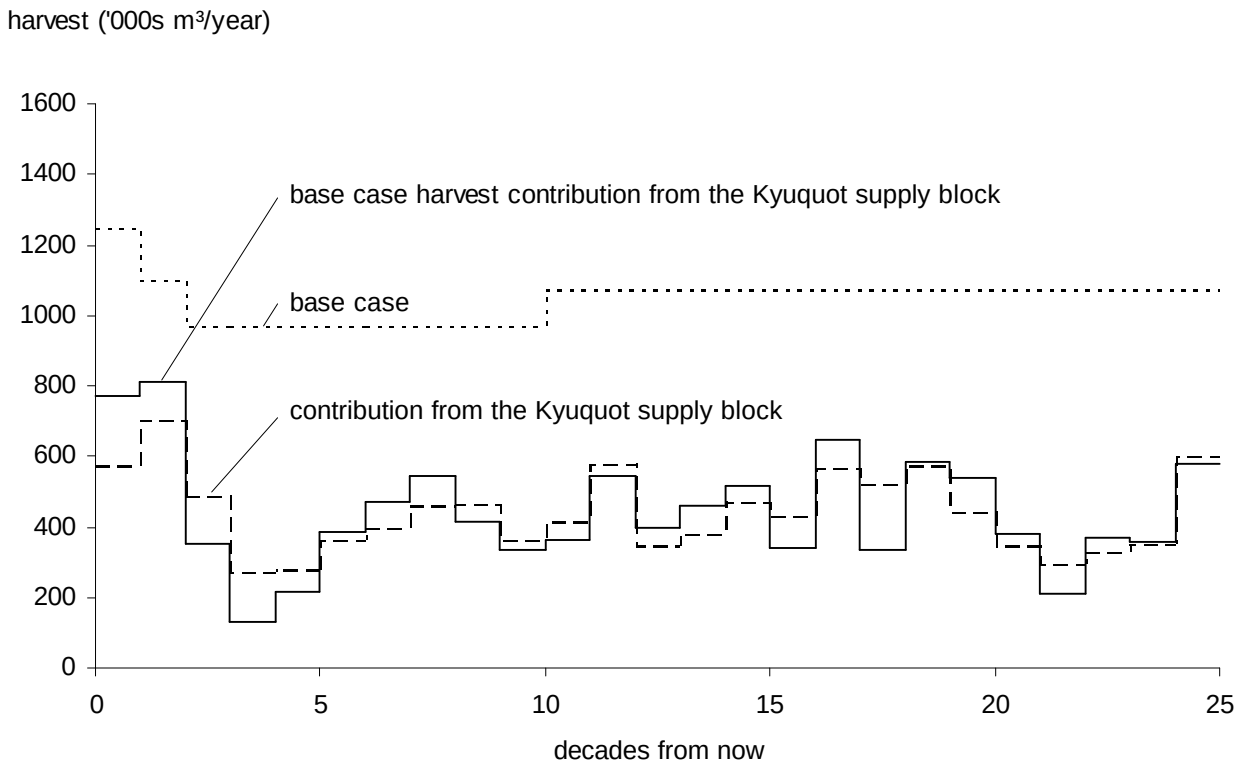

Figure 28. Timber supply from the Kyuquot supply block if the forest cover approximation for cutblock adjacency is applied to two age ranges — Strathcona TSA, 1999.

5.11 Uncertainty in the application of both visual quality and cutblock adjacency objectives

To understand the sensitivity of the base case harvest forecast to simultaneous changes in all maximum allowable disturbance limits, the maximum allowable disturbances for visual quality, ungulate winter range and cutblock adjacency were reduced by five percentage points, making all of these requirements more restrictive. This change removes the retention visual quality class from harvest eligibility completely. While the discussion in the previous section suggested that the maximum allowable disturbance in cutblock adjacency areas could be reduced to 16% with little implication to short-term harvests (solid line in Figure 27), any reduction in the allowable disturbance in visual quality, wildlife and cutblock adjacency areas simultaneously results in the timber supply shown by the solid line in Figure 29. The highest possible first decade harvest in this sensitivity analysis is just under 1.3 million cubic metres, about 4% above the starting harvest level shown.

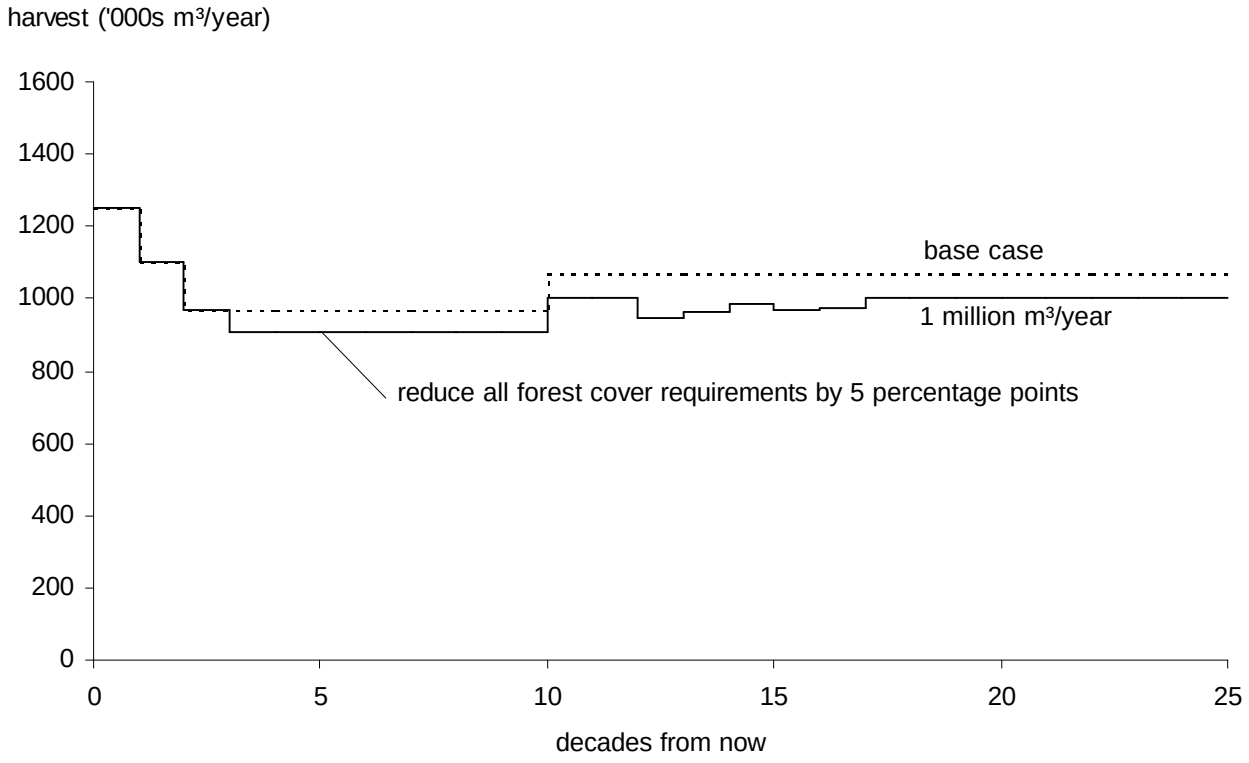

Figure 29. Harvest forecast if the maximum allowable disturbance for all forest cover requirements are reduced by five percentage points — Strathcona TSA, 1999.

5 Timber Supply Sensitivity Analyses

5.12 Uncertainty in levels of harvesting in alder stands and helicopter-logging areas

The levels of performance in, helicopter-logging areas and alder stands are uncertain. There is current performance in both categories but harvest opportunities tend to be more economically sensitive than in other categories within the timber harvesting land base. Attempts were made to find the harvest levels for both categories below which the base case timber supply would be affected within the 250 year horizon.

Figure 30 shows that the harvest of alder stands would have to be set at a maximum of 10 000 cubic metres per year, or the helicopter-logging harvest rate set at a maximum of 50 000 cubic metres per year before timber supply implications occur within the analysis horizon. Setting these relatively low harvest rates, reduces the flexibility of scheduling areas for harvest. The harvest disruptions shown in the long term are a result of harvests in the other portions of the land base which do not have explicit targets, which begin a cycle of harvesting stands closer to their minimum harvestable age. The disruptions shown in Figure 30 could be avoided by small reductions either in the long-term level, which would reduce that level below the productive capacity indicated in the base case, or in the short or mid-term. Overall, timber supply is not highly sensitive to application of harvest level limitations on alder stands or helicopter-logging areas.

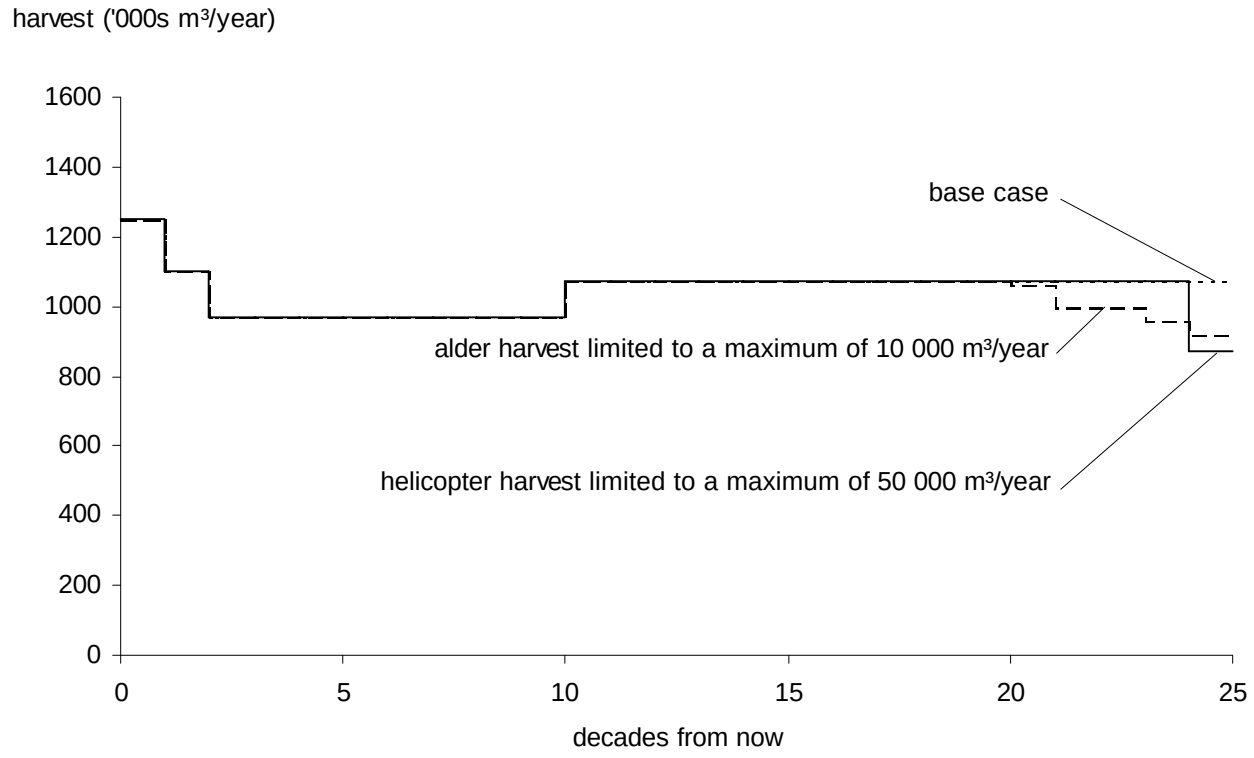

Figure 30. Harvest forecasts if specific harvest requests are made for helicopter-logging areas or alder stands — Strathcona TSA, 1999.

5 Timber Supply Sensitivity Analyses

5.13 Uncertainty in application of biodiversity guidelines

The Ministry of Forests and the Ministry of Environment, Lands and Parks have agreed on some aspects regarding operational application of the *Forest Practices Code Biodiversity Guidebook*. Two of the most important assumptions for timber supply analysis, with respect to the application of landscape-level biodiversity guidelines are:

1) The late-seral (old growth) requirements are the most important to achieving landscape-level biodiversity objectives and will be applied operationally in all landscape units.

2) Mature plus old seral requirements and early-seral requirements are less critical for achieving landscape-level biodiversity objectives, often have partial overlap with other forest management prescriptions (i.e., visual quality objectives or cutblock adjacency guidelines), have the potential to cause significant timber supply impacts and therefore will not be applied operationally unless it can be shown in a timber supply analysis that the application of these seral-stage requirements will not have an impact on the timber supply forecast

In the base case, weighted average old-seral requirements were applied to each landscape unit, since final biodiversity emphasis options have not been designated. The average requirements were based on an assumption that low, medium and high emphases will apply to 45%, 45% and 10% respectively of the forested area in the TSA.

Four sensitivity analyses are discussed in this section. They examine the timber supply effects of different applications of the biodiversity seral guidelines based on the draft biodiversity emphasis options for each landscape unit. The four analyses include application of: old-seral guidelines only, both old-seral and mature plus old-seral guidelines; early, mature plus old and old-seral guidelines; and finally all three guidelines with a phase-in of old-seral guidelines in landscape units with a low draft biodiversity emphasis option. No attempt has been made to smooth the harvest flow in these forecasts, for instance, by reducing starting harvest levels or increasing the rate of decline. The purpose of these model runs was simply to show whether or not the harvest forecast is affected and, if so, the magnitude and timing of the impact.

5 Timber Supply Sensitivity Analyses

Figure 31 shows the incremental impact from the various seral guidelines as indicated in the *Forest Practices Code Biodiversity Guidebook*. For most of the Strathcona TSA, non-contributing forest is expected to provide most, if not all, of the requirement for old- or mature-forest by the end of the analysis horizon. The impacts shown are a result of stands that were assumed to be harvestable in the base case becoming ineligible during the transition in harvesting from existing natural stands to managed forest because they are required to achieve biodiversity requirements. Further, managed stands must be harvested earlier than in the base case, in many cases at the minimum harvestable age, in an attempt to maintain the base case harvest levels over the mid-term. Applying the early-seral requirement does limit the highest possible first decade harvest to just under 1.38 million cubic metres per year, followed by a 16% decline in the second decade. This is about 150 000 cubic metres higher than the starting level shown in Figure 31. Overall, however, timber supply is relatively insensitive to different applications of biodiversity requirements in the short- and mid-terms, with some effects appearing in the long term.

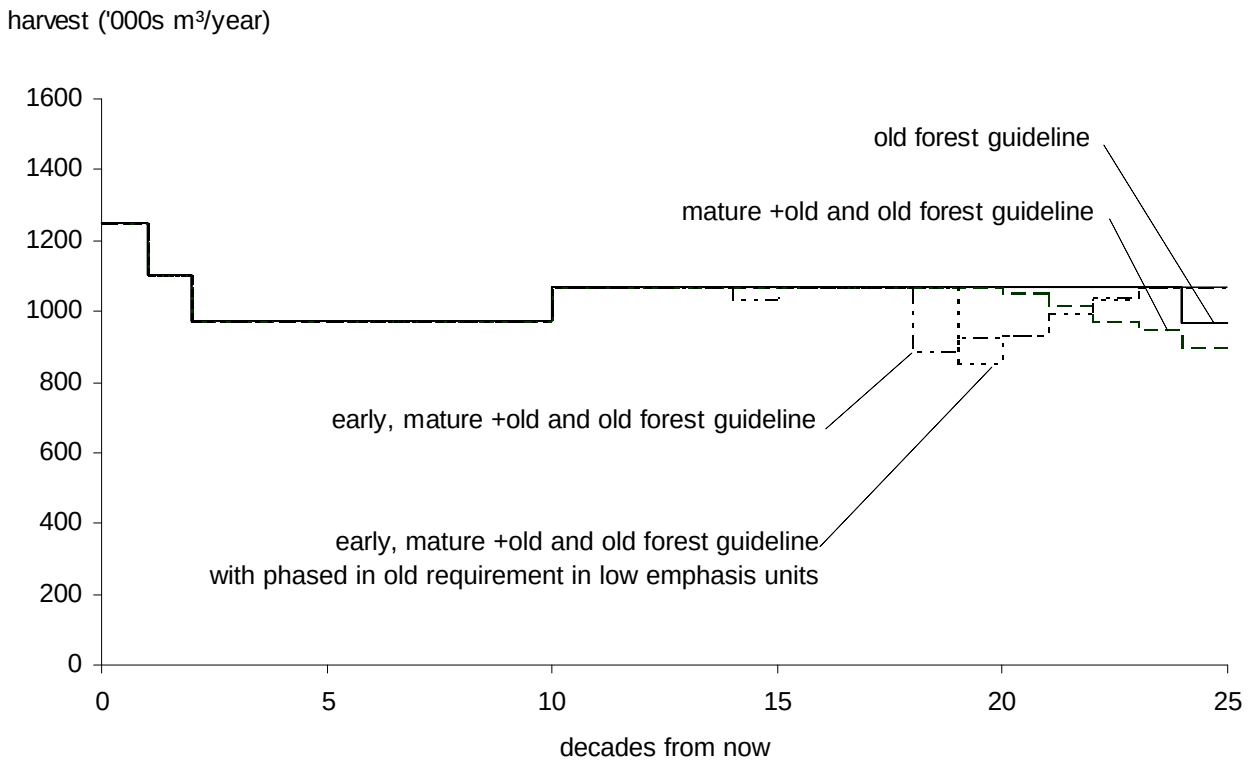

Figure 31. Harvest forecasts if various seral-stage requirements based on the Vancouver Regional Landscape Unit Planning Strategy and the Forest Practices Code Biodiversity Guidebook are applied — Strathcona TSA, 1999.

6 Summary and Conclusions of the Timber Supply Analysis

The criteria used to define the base case harvest forecast included managing the rate of decline in harvests from the current level, avoiding large and abrupt harvest shortfalls, timing the rise to a long-term harvest level commensurate with the productivity of the timber harvesting land base, and maintaining the rate of decline in both the short- and medium-term. Using these criteria, the base case harvest forecast was developed. An initial harvest level of 1.25 million cubic metres per year (12% below the current AAC) is maintained for one decade, followed by two further 12% per decade declines and a 10% rise to the long-term harvest level of 1.07 million cubic metres per year in decade 11.

In the base case harvest forecast, stands currently above 140 years of age are projected to provide well over 80% of the harvest in the next 20 years, declining in contribution quickly thereafter. Small amounts of existing natural forest are forecast to be harvested even 100 years from now when stands outside the timber harvesting land base age to the point that they are able to contribute to the biodiversity criteria associated with old forest. Within 40 years, harvesting of managed stands is anticipated to make up about 50% of the harvest in the Strathcona TSA. By decade 9, this has increased to about 94%. However, a rise to the long-term harvest level cannot occur until after a large proportion of managed stands are beyond minimum harvestable age. The harvest rate between decades 7 and 11 determines the future long-term harvest level for the Strathcona TSA. While there is a surplus of managed stand volume above minimum harvestable age in stands with high site productivity during that time, there is a limited supply of this volume. It must be allocated for harvest generally until poorer productivity sites enter a harvestable condition in decades 13 through 16. If the limited supply is tapped earlier than decade 11, attempting to rise to the long-term harvest level in decade 11 creates a trend of harvesting more productive stands closer to minimum harvestable age, reducing the harvest level that can be achieved over the long term.

To facilitate a summary of the sensitivity analyses, Table 3, "Summary information from the timber supply sensitivity analyses" was prepared to describe first-decade harvest levels, mid-term harvest levels and the percentage rise to the long-term harvest level.

The base case first decade harvest level of 1.25 million cubic metres per year is shown to be stable with respect to most of the uncertainties examined. The only exceptions are a reduction in the timber harvesting land base of 10% when the starting harvest level would need to decline to about 1.18 million cubic metres per year, and a reduction in the maximum allowable disturbance to the bottom of the acceptable range for visual quality areas when the starting harvest level would need to decline to about 0.89 million cubic metres per year.

If a first decade harvest level above that shown in the base case were chosen, the likelihood of timber supply instability would increase with the magnitude of the harvest level increase above the base case. Short-term timber supply was particularly sensitive to uncertainty in the following: an increase of 5 years in green-up age, a reduction in the maximum allowable disturbance to 16% in the cutblock adjacency portion of each landscape unit, a reduction in all maximum allowable disturbances by five percentage points, and application of early seral requirements for biodiversity.

All sensitivity analyses indicated that declines to a mid-term harvest level of at least 1.07 million cubic metres per year are likely for the Strathcona TSA, and possibly as low as 0.852 million cubic metres per year based on the base case first decade harvest level of 1.25 million cubic metres per year and the level of uncertainty in different inventory and management factors. Increasing short-term timber supply above the base case lowers mid-term harvest levels by more than 60 000 cubic metres for a minimum of 60 years than otherwise would be experienced by starting at the base case level.

Based on the results of the timber supply analysis, timber supply in the Strathcona TSA appears to be defined primarily by harvest flow choices and is not highly sensitive to changes in available harvestable volume or changes in allowable disturbance. The base case first decade harvest level was shown to be achievable based on review of the uncertainties examined. Harvest levels above the base case are possible, however higher harvests in the short term introduce an increased risk of timber supply instability in the mid-term.

6 Summary and Conclusions of the Timber Supply Analysis

Table 3. Summary information from the timber supply sensitivity analyses

Section of report	Sensitivity analysis	First decade harvest level (millions of m^3/year)	Minimum mid-term harvest level (millions of m^3/year)	Percentage rise to the long-term harvest level
4.1	Base case harvest forecast	1.25	0.970	10
5.1	Alternative harvest flows	Current AAC[a]	0.890	19
		1.005	1.005	6
5.2	20 year increase in minimum harvestable age	Base case[b]	0.970	13
		Current AAC	0.682	29
5.2	10 year decrease in minimum harvestable age	Current AAC	0.920	14
5.3	10% reduction in the timber harvesting land base	1.179	0.852	12
5.3	10% increase in the timber harvesting land base	Current AAC	1.040	11
5.4	Reduce existing stand yields by 10%	Base case	0.885	20
5.4	Increase existing stand yields by 10%	Base case	1.040	3
		Current AAC	1.000	7
5.5	Reduce regenerated stand yields by 10%	Base case	0.890	9
		Current AAC	0.760	26
5.5	Increase regenerated stand yields by 10%	Base case	1.020	15
		Current AAC	0.960	22
5.6	Green-up ages increased 5 years	Base case	0.970	9
		1.392	0.890	19
5.6	Green-up ages decreased 5 years	Base case	0.970	14
5.7	Random harvest scheduling	Base case	0.880	5
		Current AAC	0.800	15
5.8	Adjustment of site index for stands above 140 years	Base case	1.070	13
		Current AAC	1.000	21
5.9	Maximum allowable disturbance in visual quality areas reduced to the middle of the acceptable range	Base case	0.945	8
		Current AAC	0.850	19
5.9	Maximum allowable disturbance in visual quality areas reduced to the bottom of the acceptable range	0.887	0.887	9
5.9	Maximum allowable disturbance in visual quality areas applied to the timber harvesting land base	Base case	0.860	22
5.10	Maximum allowable disturbance reduced to 16% in the cutblock adjacency portion of each landscape unit (LU)	Base case	0.957	11
		1.279	0.890	19
5.11	All maximum allowable disturbances reduced by five percentage points	Base case	0.910	9
		1.299		
5.13	Application of the early-seral, mature+old and old-seral requirements	Base case	—	—
		1.375		

(a) Current AAC is 1.42 million cubic metres per year.

(b) Initial harvest level in the base case is 1.25 million cubic metres per year.

7 Socio-Economic Analysis

The impact of timber supply adjustments on local communities and the provincial economy is an important consideration in the timber supply review. The socio-economic analysis compares the level of forestry activity currently supported by timber harvested from the Strathcona TSA to the level of activity that the TSA could support as the timber supply moves towards its long-term harvest level.

The socio-economic analysis examines the harvest levels as projected in the base case harvest forecast. The base case is intended to reflect our best understanding of current forest management practices; consequently, the socio-economic analysis does not evaluate alternative management scenarios.

The socio-economic analysis consists of the following:

1) a profile of the current socio-economic setting;
2) a description of the Strathcona TSA forest industry; and
3) an analysis of the socio-economic implications of the base case harvest forecast.

7.1 Current socio-economic setting

7.1.1 Population and demographic trends

The socio-economic analysis focuses on the Strathcona TSA; however, the TSA is part of the larger Campbell River Forest District (*see map, page 5*). The forest district boundary encompasses the Strathcona TSA and also portions of Tree Farm Licences 19, 25, 39, 45, and 47. Since there are communities located throughout the Campbell River Forest District, Section 7.1 profiles the forest district, instead of the Strathcona TSA; Section 7.3, "Socio-economic implications of the base case harvest forecast" describes the socio-economic impacts that result from changes to the Strathcona TSA timber supply, and how those changes will affect communities within the larger forest district and province.

Communities within the forest district are located either in the more populous east coast of Vancouver Island, or in the less populous western portion of the Campbell River Forest District. Communities in the west include Gold River, Tahsis, Zeballos, and Kyuquot. Communities in the east include Campbell River, Courtenay, Comox, Sayward, and Cumberland. Other smaller communities are located in the district, mainly along Highway 19. North of the forest district boundary are the communities of Woss and Port McNeill. From 1991 to 1996, the population of the Campbell River Forest District increased by approximately 18% to 93,620 *(see Table 4).*

7 Socio-Economic Analysis

Table 4. Population statistics — Campbell River Forest District and selected communities, 1991-2001

	1991	1996	2001 (projected)	% change 1991-1996	% change 1996-2001
Western communities					
Gold River	2,166	2,041	-	–5.8	-
Tahsis	1,053	940	-	–10.7	-
Zeballos	220	232	-	5.5	-
Other electoral area G[a]	533	546	-	2.4	-
Eastern communities					
Campbell River	25,259	28,851	-	14.2	-
Courtenay	11,698	17,335	-	48.2	-
Comox	9,477	11,069	-	16.8	-
Cumberland	2,220	2,548	-	14.8	-
Sayward	406	440	-	8.4	-
Campbell River Forest District	79,318	93,620	110,470	18.0	18.0
Port McNeill[b]	2,641	2,925	-	10.8	-
Other electoral area D[c]	428	510	-	19.2	-
British Columbia	3,282,910	3,724,500	4,249,075	13.5	14.1

(a) Other electoral area G includes Kyuquot, Esperanza, Ceepeecee, and other rural areas.

(b) Port McNeill is located north of the Campbell River Forest District.

(c) Other electoral area D is partially in the Campbell River Forest District and includes Woss and other rural areas which are just north of the forest district.

Source: Census of Canada 1991, 1996. Data and growth rates from BC Stats Population Section.

Population changes varied widely in the forest district communities between 1991 and 1996, with the eastern communities experiencing the highest growth rates. Courtenay had the third highest population growth rate in the province with a 48.2% increase. Other communities in the east that experienced population growth include Sayward which grew by 8.2%, Campbell River which grew by 14.2%, Cumberland which grew by 14.8%, and Comox which grew by 16.8%. In the more forestry-dependent western portion of the forest district, Gold River and Tahsis experienced population declines of 5.8% and 10.7%, respectively. The largest population increases across the forest district occurred in the 45-55 age category which grew by 42%, and the 70+ age group which grew by 25% from 1991 to 1996.

The population of the Campbell River Forest District is expected to grow by a further 18%[1] by 2001. Much of this growth will likely concentrate around the Courtenay/Comox area where retirement and recreation communities are growing rapidly.

(1) B.C. Stats, Population Section.

7 Socio-Economic Analysis

There are a number of First Nations communities located within the Strathcona TSA. In the eastern portion of the forest district they are: the Campbell River Band (population 560), Cape Mudge First Nation (population 804), Comox First Nation (population 266), Kwiakah First Nation (population 18), and the Homalco First Nation (population 389). In the western portion of the forest district they are: the Ehattesaht First Nation (population 212), Ka:'yu:'k't'h'/Che:k:tles7et'h' First Nation (population 445), Mowachaht/Muchalaht First Nation (population 480), and the Nuchatlaht First Nation (population 130). First Nations members live on reserve lands within the forest district or in communities across Vancouver Island. Within the forest district they are involved with, or are developing their participation in a variety of activities including commercial and sport fisheries, forestry including Forest Renewal activity and traditional uses, and tourism. Employment is seasonal in many areas and high unemployment rates are not uncommon.

7.1.2 Economic profile

From 1991 to 1996, the total experienced labour force of the Campbell River Forest District increased by 19% to 48,110. By comparison, the provincial experienced labour force increased by 14% over the same period. In 1996, the unemployment rate was 11.1% compared to 11.4% in 1991.

As Figure 32 illustrates, the largest employment sectors in the Campbell River Forest District are the public sector and wholesale and retail trade, accounting for 21% and 17%, respectively.

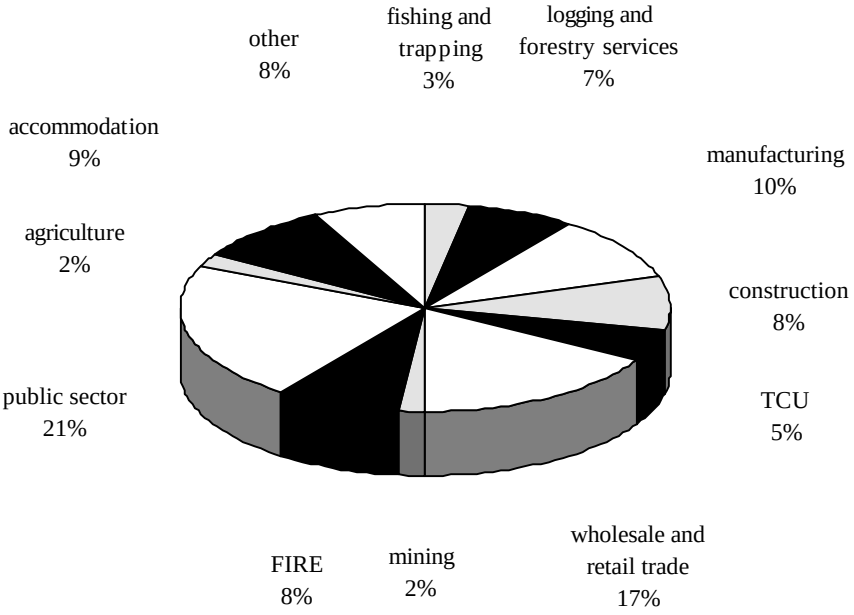

Figure 32. Experienced labour force by sector, Campbell River Forest District, 1996.

Source: 1996 Census of Canada.

Note: TCU is transportation, communications and utilities. FIRE is finance, insurance, real estate and other business services. Other includes personal services not elsewhere allocated.

7 Socio-Economic Analysis

Forestry, comprised of the logging and forestry services sector and approximately 60% of the manufacturing sector, is the largest industrial sector, accounting for approximately 13% of the forest district's labour force. Between 1991 and 1996, employment in the logging and forestry services sector increased marginally to 3,320 from 3,295; however, its share of the total experienced labour force declined to 7% from 8%, as growth in service sectors outpaced the forestry sector. The number of people employed in the manufacturing sector, which is dominated by forest products manufacturing, declined to 4,630 from 4,728 and its share of the total experienced labour force also declined to 10% from 12%. These employment figures do not reflect the closure of Campbell River Mills Ltd. or the announced closure of the Bowater pulp mill in Gold River. These processing facilities employed a total of over 500 people.

From 1991 to 1996, the fishing and trapping sector, which is dominated by commercial and sport fishing, and aquaculture increased slightly; however, its share of the labour force decreased to 2.7% from 3.1%. In the Courtenay to Campbell River area, including Quadra Island there are eight salmon farms and 18 shellfish farms operating. In 1997, these salmon farms produced 2076 tonnes of chinook and Atlantic salmon for a total value of close to $7.8 million. This value is down almost one-half from 1996 as a result of lower prices. Shellfish farms produced approximately 364 tonnes for a total value of $398 thousand in 1997; the shellfish tonnage and value figures were up by 34% and 90%, respectively, from 1996.

The strongest sectors in terms of employment growth are finance, insurance, real estate, and other business services (FIRE), which increased by 56% from 1991 to 1996; construction, which grew by 28%; and other personal services sectors, which grew by 21%. The combined employment of the FIRE, construction, and other personal services sectors accounted for 24% of the total experienced labour force in 1996, versus 20% in 1991.

It is unlikely that employment increases in FIRE, construction, and personal services sectors reflect a higher level of revenues, investment or spending in the traditional sectors of forestry, mining and fishing. A more probable reason would be the influx of retirees, an increase in recreational services, and the people and business opportunities that followed. Given the sources of growth, the eastern portion of the forest district was the main recipient of this expansion.

The traditional industrial sectors, however, remain important for the economic diversity and strength of the communities within the forest district. Statistics Canada labour force data comparing average weekly earnings in different sectors of the economy indicate that the forestry sector is one of the highest paying sectors and, therefore, a major contributor to local and provincial economies. Mining is the only sector that has consistently paid higher average wages than forestry. In 1997, the average weekly earnings in the forestry sector were approximately $903, compared to $1,050 for the mining sector. In comparison, average weekly earnings were approximately $709 for the construction industry; $791 for other goods producing industries; $266 for the accommodation, food and beverage service industries; and $785 for public administration.

The employment percentages above also do not reflect the dependence of one sector on the spending of another. For example, since the FIRE and TCU sectors of Figure 32 provide services to the forestry and public sectors, a portion of their business depends on spending by companies and employees of the forestry and public sectors. Sectors with higher incomes and spending levels tend to purchase more supplies and services and, therefore, support more business activity.

Employment multipliers***** illustrate this spending effect: a larger multiplier indicates that the business activity that supports each direct job will subsequently support more business activity at supply and service companies. For example, estimates by the Ministry of Finance and Corporate Relations indicate that every 100 full-time direct forestry jobs in the Campbell River Forest District supports another 53 to 73 indirect and induced jobs, depending on the forestry activity (harvesting or processing). In comparison, every 100 full-time direct jobs in the tourism sector supports an estimated additional 16 indirect and induced jobs. These differences are a result of larger revenue earnings and spending patterns by both forestry sector businesses and their employees. Table 5 compares employment multipliers for sectors of the forest district's economy.

Table 5. Employment multipliers by sector, Campbell River Forest District, 1996

Sector	Employment multiplier
Forestry, including manufacturing	1.53 – 1.73
Mining and mineral processing	1.60
Agriculture and food	1.26
Tourism	1.16
Public sector	1.31
Construction	1.58

Source: The Revised Forest District Tables, Ministry of Finance and Corporate Relations, 1996.

7.2 Strathcona TSA forest industry

7.2.1 Current allowable annual cut

The current allowable annual cut (AAC) for the Strathcona TSA, effective as of January 1996, is 1 420 000 cubic metres, including a partition of 16 000 cubic metres for deciduous timber.

Previously, the AAC was set in 1986 at 1 645 030 cubic metres. In 1989 the AAC was increased to 1 661 030 cubic metres to include 16 000 cubic metres for deciduous stands. In 1992, land was withdrawn from TFL 47 and added to the Strathcona TSA which increased the AAC to 1 693 745 cubic metres. In April 1993, the AAC was temporarily reduced by 188 000 cubic metres due to three designated areas specified under part 15 of the *Forest Act*.

Table 6. Strathcona TSA allowable annual cut, by licence type, 1997

	Volume (cubic metres)	Per cent (%)
Forest licences — replaceable	1 033 038	73.0
Timber sale licence (TSL) > 10 000 m³	12 219	0.9
TSL < = 10 000 m³	6 919	0.4
Small business forest enterprise program (SBFEP)	216 173	15.0
Forest Service reserve	27 549	2.0
Woodlot licences	13 788	1.0
Forest licences, non-replaceable	94 314	6.6
Forest licenses, deciduous non-replaceable	16 000	1.1
Total	1 420 000	100.0

Source: Ministry of Forests, 1997.

7 Socio-Economic Analysis

The Strathcona TSA is divided into three timber supply blocks: Loughborough (mainland portion), Sayward (eastern Vancouver Island portion), and Kyuquot (western Vancouver Island portion). Approximately 65% to 70% of the timber harvested in the Strathcona TSA comes from the Kyuquot timber supply block; however, this focus will shift as the supply of old-growth timber available for harvest in the Kyuquot supply block declines, and harvesting activity shifts to the Sayward supply block where significant second-growth timber is available for harvest.

7.2.2 Strathcona TSA harvest history

Table 7 summarizes the volume of timber harvested in the Strathcona TSA from 1993-1997. The actual volume of timber harvested is an important indicator of forestry activity in the TSA. While the AAC is the maximum allowable annual harvest level, the actual volume of timber harvested in a particular year determines the level of economic activity. Differences in annual harvest levels are the result of provisions for cut control[2] variations that allow licensees to vary their harvests based on operating and market conditions. If actual annual harvest levels are consistently less than the AAC, then forestry activity is below its full potential.[3] This difference between the AAC and the actual annual harvest level could mitigate some of the potential short-term impacts of changes in the AAC.

In 1997, the Strathcona TSA harvest level was approximately 987 060 cubic metres of timber, and from 1993 to 1997 the annual average harvest was 1 295 950 cubic metres. The most recently completed cut control period was 1992-1996 when all but two of the major licensees harvested their full allocation. The two licensees were unable to meet their cut control commitments as a result of chart area concerns and land use planning issues. It is expected that the current apportioned volumes will now be fully harvested.

Table 7. Strathcona TSA volumes billed, by licence type, 1993-1997

Tenure	(Cubic metres)					
	1993	1994	1995	1996	1997	Average 1993-1997
Forest licences	1 329 967	1 025 744	1 140 217	994 909	826 881	1 063 544
Small business forest enterprise program (SBFEP)	259 883	264 966	256 475	104 705	153 311	207 868
Timber sale licence (TSL)	6 999	42 452	5 846	11 070	597	13 393
Woodlots	15 324	8 219	8 641	11 531	6 038	9 951
Other[a]	346	378	4 386	629	233	1 194
Total	1 612 519	1 341 759	1 415 565	1 122 844	987 060	1 295 950
Allowable annual cut (AAC)	1 505 745	1 505 745	1 505 745	1 420 000	1 420 000	

(a) Other consists of cutting permits such as rights of way, road permits, and other small temporary permits.
Source: Ministry of Forests.

(2) Cut control allows licensees to vary the volume between annual harvest and AAC by +/- 50 % per year, and by +/- 10 % over a 5-year cut-control period.
(3) Full potential as referred to here is based on the allocated volumes of the AAC, and is not necessarily the same as full economic potential which is based on the international market for wood products.

7.2.3 Strathcona TSA major licensees and processing facilities

Doman-Western Inc.

Doman-Western has a replaceable forest licence (purchased from Pacific Forest Products Ltd. in late 1997) to harvest 378 035 cubic metres per year, with current harvesting activities located in Nootka Sound and Kyuquot Sound areas of the Strathcona TSA. The combined operations of Doman-Western and Doman Industries have several tenures in the province totalling approximately 4.5 million cubic metres. In 1997, Doman-Western harvested 352 847 cubic metres from the Strathcona TSA. Table 8 outlines this licence's recent harvest activity and 1995-1997 average employment levels, in person-years* of employment.

Table 8. Doman-Western harvest and provincial employment statistics

AAC	378 035 cubic metres
1997 harvest	352 847 cubic metres
1995-1997 average harvest	333 540 cubic metres
Employment[a] (1995-1997 person-years)	
Harvesting and administration	143
Transport, road building and maintenance	—
Basic silviculture	10
Processing	260
Total	413

(a) The employment figures relate to the 1995-1997 average volume harvested of 333 540 cubic metres (including waste and reject) from the Strathcona TSA land base only and processed in B.C.

Doman-Western and Doman Industries operate nine lumber mills, seven of which are located on Vancouver Island. One lumber mill is located in the Campbell River Forest District at Tahsis. In 1997, the Tahsis lumber mill used approximately 340 thousand cubic metres of timber in the production of 71 million board feet of lumber and employed over 200 people. The 1997 production numbers for the Tahsis sawmill were down from previous years. Doman also operates a pulp mill on Vancouver Island, a second pulp mill near Squamish, and a value-added mill on Vancouver Island. In 1997, the sawmills processed approximately 3.5 million cubic metres of timber and the pulp mills processed approximately one million bone dry units of wood chips. The sawmills produce housing components and other specialty products, which are is destined for Japan (86% in 1997[4]), the United States, Canada, and Europe.

From 1995 to 1997, 80% of Doman-Western's Strathcona TSA harvest was processed at the Tahsis and Ladysmith lumber mills. The remaining 20% was processed at the Bowater pulp mill in Gold River, and a minor portion went to other Vancouver Island mills. This log flow is based on the management of this licence by Pacific Forest Products, and may change as Doman-Western makes adjustments to meet its overall timber supply priorities.

Person-year(s)
One person working the equivalent of one full year, defined as at least 180 days of work. If someone works full-time for 90 days, he or she accounts for 0.5 person years.

(4) Doman Industries, Annual Report, 1997.

International Forest Products Ltd.

International Forest Products Ltd. (Interfor) has a replaceable forest licence to harvest 271 740 cubic metres per year in the Strathcona TSA. Interfor has numerous other tenures throughout the province totalling 3.5 million cubic metres. In 1997, Interfor harvested 246 292 cubic metres from the Strathcona TSA. Table 9 outlines Interfor's recent harvest activity in the Strathcona TSA and 1995-1997 average employment levels.

Table 9. Interfor harvest and provincial employment statistics

AAC	271 740 cubic metres
1997 harvest	246 292 cubic metres
1995-1997 average harvest	258 145 cubic metres
Employment[a] (1995-1997 person-years)	
Harvesting and administration	123
Transport, road building and maintenance	50
Basic silviculture	15
Processing	200
Total	388

(a) The employment figures relate to the 1995-1997 average volume of 258 145 cubic metres harvested from the Strathcona TSA land base only and processed in B.C.

Interfor operates eight lumber mills in the province; however, at this time the Squamish and Flavelle cedar mills are not operating. In 1997, Interfor lumber mills processed approximately 2.8 million cubic metres of timber. Interfor also operates a value-added plant in Surrey with a dry kiln, resawing, sorting and planing equipment. Approximately 45%-50% of Interfor's production is shipped to countries in the Pacific Rim, 25%-30% is shipped to the United States, approximately 18% remains in Canada, and the remainder is shipped to Europe.[5]

Approximately 85% of the timber harvested under this licence is shipped to the Vancouver Lower Mainland, mainly for lumber production. The remaining 15% stays on Vancouver Island for the production of pulp.

Canadian Forest Products Ltd.

Canadian Forest Products Ltd. (Canfor) has a replaceable forest licence to harvest 119 981 cubic metres per year, with current harvesting activities located in the Kyuquot Sound area of the Strathcona TSA. Canfor has numerous other tenures throughout the province totalling 4.8 million cubic metres. In 1997, Canfor harvested 75 042 cubic metres from the Strathcona TSA. Table 10 outlines Canfor's recent harvest activity in the Strathcona TSA and 1995-1997 average employment levels.

(5) Interfor Annual Report, 1997.

Table 10. Canfor harvest and provincial employment statistics

AAC	119 981 cubic metres
1997 harvest	75 042 cubic metres
1995-1997 average harvest	114 545 cubic metres
Employment[a] (1995-1997 person-years)	
Harvesting and administration	78
Transport, road building and maintenance	12
Basic silviculture	1
Processing	89
Total	180

(a) The employment figures relate to the 1995-1997 average volume of 114 545 cubic metres harvested from the Strathcona TSA land base only and processed in B.C.

Canfor operates eight sawmills, three pulp mills, four remanufacturing plants, and a panel and fibre operation in the province. However, none of these operations are located on Vancouver Island. In 1997, Canfor lumber mills processed approximately 5.2 million cubic metres of timber and its pulp operations processed close to two million bone dry units of wood chips. The majority of Canfor's products are sold in the United States (46% in 1997), Canada (22%), and Asia (19%).[6]

Approximately 95% of the timber harvested under this forest licence is either sold or traded for chips for the Howe Sound pulp mill, or goes directly into the production of pulp at Howe Sound. The remainder is sold within Campbell River or the Vancouver Lower Mainland.

MacMillan Bloedel Ltd.

MacMillan Bloedel Ltd. has a replaceable forest licence to harvest 102 802 cubic metres per year, with current harvesting activities located in the Kyuquot Sound and Sayward areas of the Strathcona TSA. MacMillan Bloedel has numerous other tenures throughout the province totalling 5.9 million cubic metres. MacMillan Bloedel also has significant private land holdings on Vancouver Island. In 1997, MacMillan Bloedel harvested 64 134 cubic metres from the Strathcona TSA. Table 11 outlines MacMillan Bloedel's recent harvest activity in the Strathcona TSA and 1995-1997 average employment levels.

(6) Canfor Corporation, Annual Report, 1997.

Table 11. MacMillan Bloedel harvest and provincial employment statistics

AAC	102 802 cubic metres
1997 harvest	64 134 cubic metres
1995-1997 average harvest	80 283 cubic metres
Employment[a] (1995-1997 person-years)	
Harvesting and administration	44
Transport, road building and maintenance	—
Basic silviculture	2
Processing	63
Total	109

(a) The employment figures relate to the 1995-1997 average volume harvested of 98 611 cubic metres (including waste and reject) from the Strathcona TSA land base only and processed in B.C.

MacMillan Bloedel operates six sawmills in B.C., four of which are located on Vancouver Island in the South Island Forest District. In late 1997, MacMillan Bloedel permanently closed its Powell River sawmill and restructured its Alberni Pacific and Island Phoenix mills, reducing production to one shift per day from three shifts. MacMillan Bloedel also operated pulp and paper mills in Port Alberni and Powell River. In 1998, MacMillan Bloedel's paper division was sold and a new company, Pacifica Papers Inc. was formed. In 1997, MacMillan Bloedel lumber mills processed close to 2.6 million cubic metres of timber (based on use prior to the restructuring at the Alberni Pacific and Island Phoenix mills). Its pulp and paper mills processed approximately 885 000 bone dry units of wood chips. In 1997, 37% of MacMillan Bloedel's lumber products were shipped to Japan, 30% to the United States, and 17% remained within Canada.

From 1995-1997, approximately 37% of the timber harvested under this licence remained on Vancouver Island for processing, with the remainder shipped to the Vancouver Lower Mainland and Powell River. Approximately 10% of the harvest was processed in the Strathcona TSA.

TimberWest Forest Ltd.

TimberWest Forest Ltd. (TimberWest) has two replaceable forest licences to harvest a combined total of 71 284 cubic metres per year, with current harvesting activities located in the Kyuquot and Loughborough supply blocks of the Strathcona TSA. TimberWest has several tenures in the province totalling over 1.44 million cubic metres, plus a significant amount of private land holdings on Vancouver Island. In 1997, TimberWest harvested 23 261 cubic metres from the Strathcona TSA. Table 12 outlines TimberWest's recent harvest activity in the Strathcona TSA and 1995-1997 average employment levels.

Table 12. TimberWest Forest Ltd. harvest and provincial employment statistics

AAC	71 284 cubic metres
1997 harvest	23 261 cubic metres
1995-1997 average harvest	84 671 cubic metres
Employment[a] (1995-1997 person-years)	
Harvesting and administration	32
Transport, road building and maintenance	10
Basic silviculture	1
Processing	66
Total	109

(a) Employment estimates reflect the 1995-1997 average volumes of 84 671 cubic metres harvested from the Strathcona TSA land base only and processed in B.C.

TimberWest operates two lumber mills on Vancouver Island: one located in the Campbell River Forest District just north of Campbell River, and the other in the South Island Forest District at Youbou. In 1997, the Campbell River mill processed over 300 000 cubic metres of timber in the production of 57 million board feet of lumber and employed over 180 people. TimberWest has fibre supply agreements to provide pulp logs and chips to the Fletcher Challenge pulp mill north of Campbell River. In 1997, TimberWest lumber mills processed approximately 685 000 cubic metres of timber; however, production was affected by the downturn in lumber markets and labour strike action. Approximately 66% of its production in 1997 was shipped to Japan (a reduction from 75% in 1996) with the remainder shipped within Canada, to Australia and Europe. Minor volumes are shipped to the United States.

Approximately 20% of the timber harvested under this licence is processed at the Campbell River lumber mill and another 15% is processed into pulp on Vancouver Island. The majority of the Strathcona TSA harvest is shipped to Vancouver Lower Mainland sawmills and the Vancouver log market.

Hecate Logging Ltd.

Hecate Logging Ltd. (Hecate) is a joint venture between the Ehattesaht First Nations and Coulson Logging Co. and has a replaceable forest licence to harvest 65 547 cubic metres per year, with current harvesting activities located in the Nootka Sound area of the Strathcona TSA. In 1997, Hecate harvested 57 537 cubic metres from the Strathcona TSA. Table 13 outlines Hecate's recent harvest activity in the Strathcona TSA and 1995-1997 average employment levels.

7 Socio-Economic Analysis

Table 13. Hecate harvest and provincial employment statistics

AAC	65 547 cubic metres
1997 harvest	57 537 cubic metres
1995-1997 average harvest	74 815 cubic metres
Employment[a] (1995-1997 person-years)	
Harvesting and administration	20
Transport, road building and maintenance	1
Basic silviculture	1
Processing	58
Total	80

(a) Employment estimates reflect the 1995-1997 average volume of 74 815 cubic metres harvested from the Strathcona TSA land base only and processed in B.C. Employment reported in person-years.

Approximately 50% of Hecate's harvest is shipped to Coulson Manufacturing Ltd. in Port Alberni. The remainder is processed into lumber and pulp at other Vancouver Island facilities.

Other licensees

There are five minor timber sale licences in the Strathcona TSA totalling 6919 cubic metres, and one major timber sale licence for 12 219 cubic metres. In 1997, only 597 cubic metres were harvested under both minor and major timber sale licences; however, the average harvest from 1995-1997 was 5838 cubic metres per year. These timber sale licences operate under periodic cut control requirements, which are more flexible and have no annual harvesting minimum, but licensees must harvest within 10% of their timber allocation by the end of two five-year cut control periods.

The Strathcona TSA also has three non-replaceable forest licences totalling 68 000 cubic metres per year. The companies holding non-replaceable forest licences in the Strathcona TSA are Nootka First Nations Forest Products Ltd. with an apportionment of 20 000 cubic metres, Nootka Sound Economic Development Corp. with an apportionment of 40 000 cubic metres, and Coast Mountain Hardwoods Ltd. with an apportionment of 8000 cubic metres of deciduous species. Coast Mountain operates in the eastern portion of the Strathcona TSA while the other two operate in the western portion. There is also an unallocated non-replaceable forest licence volume of 34 314 cubic metres previously held by Doman Industries. In 1997, harvests under non-replaceable forest licences totalled 15 390 cubic metres, and from 1995 to 1997 the annual average harvest totalled 59 378 cubic metres.

The Small Business Forest Enterprise Program (SBFEP) has an apportionment of 216 173 cubic metres per year. This volume is split among numerous small and large SBFEP apportionments. The majority of the SBFEP harvesting occurs in the eastern portion of the Strathcona TSA. The number of small business companies operating varies each year, subsequently the volume of timber harvested varies also. In 1997, 155 311 cubic metres was harvested under the SBFEP and from 1995 to 1997 the average annual SBFEP harvest was 171 497 cubic metres.

Table 14 provides a combined harvest and employment summary for timber sale licences, non-replaceable forest licences and the SBFEP.

Table 14. Other licensee harvest and provincial employment statistics

AAC	337 625 cubic metres
1997 harvest	171 298 cubic metres
1995-1997 average harvest	236 713 cubic metres
Employment[a] (1995-1997 person-years)	
Harvesting and administration	97
Transport, road building and maintenance	-
Basic silviculture	7
Processing	180
Total	284

(a) Employment estimates reflect the 1995-1997 average volume of 236 713 cubic metres harvested from the Strathcona TSA land base only and processed in B.C.

Other processing facilities

In addition to the Doman-Western and TimberWest lumber mills discussed above, sixteen other primary processing facilities operate within the Campbell River Forest District. The largest facility is the Fletcher Challenge pulp and paper mill north of Campbell River, which employs over 1,200 people and has an estimated annual capacity of 875 metric tonnes of pulp and approximately 560 metric tonnes of paper. The next largest facility was the Bowater pulp mill in Gold River, which closed permanently on February 16, 1999. While in operation the mill employed from 450 to 500 people and had an estimated annual production capacity of approximately 260 metric tonnes of pulp.

Other facilities include the Primex Forest Products lumber mill in Courtenay, which employs approximately 200 people and has an annual capacity of 70-80 million board feet of lumber. There are five other smaller sawmills located in the Campbell River and Courtenay areas, which together employ approximately 62 people and have an annual capacity of 21.6 million board feet of lumber. In addition, one chip mill, one pole and post mill, and five shake/shingle mills operate in the forest district and employ approximately 100 people.

In an average year, processing facilities in the Campbell River Forest District (excluding the recently closed Campbell River Mills Ltd. operation) have the capacity to process 2.1 million cubic metres of timber and over 2.0 million bone dry units of chips; from 1995-1997 these processors used an average of 1.52 million cubic metres of timber per year and approximately 1.3 million bone dry units of chips.

On average, approximately 58% of the Strathcona TSA harvest remains on Vancouver Island for processing, of which one-half is processed in the Strathcona TSA. The TSA supplies approximately 15%-20% of local solid wood mill requirements, and approximately 5%-10% (including logs and residual chips) of local pulp mill requirements. Timber harvested from the Strathcona TSA also supplies mills in other Vancouver Island forest districts and the Vancouver Lower Mainland. The remaining 42% of the timber harvested from the Strathcona TSA is shipped to the Vancouver Lower Mainland for processing. Approximately 74% of the total Strathcona TSA harvest is processed into lumber products, 21% goes directly into the production of chips and pulp, and the remainder is processed into a variety of products such as shakes, shingles, poles and posts.

7.2.4 Forest sector employment and employment coefficients

The preceding harvesting and employment information is used to develop employment coefficients*****, which are used to project future employment levels in the forestry sector. For this purpose, the forestry sector has been divided into three sub-sectors:

- harvesting and other woodlands-related employment including falling, log salvage, log scaling, harvest planning and administration;
- silviculture employment such as planting, surveying, and other basic and intensive silviculture activities, such as spacing, fertilizing and pruning; and,
- primary timber processing employment at lumber mills, veneer and plywood mills, shake and shingle mills, chip mills, log home mills, and pulp and paper mills.

Harvesting and silviculture employment

The harvesting sub-sector of the forest industry includes both company and contract loggers and is the most closely tied to the AAC; consequently, harvest level changes will affect this sub-sector first. The active logging season in the Strathcona TSA lasts nine to eleven months per year and the majority of the harvesting workforce resides within the Campbell River Forest District. Based on information from major licensees, in the eastern communities approximately 30% of the harvesting workforce resides in the Campbell River area, 21% reside in the Courtenay/Comox area. In the western portion of the forest district over 3% resides in each of the Zeballos, Gold River and Tahsis areas, and nearly 1% of the total direct workforce resides in the Kyuquot area. While the overall percentages in the western communities are low, the number of workers would represent a large portion of each community's workforce. The remaining workforce resides outside the Strathcona TSA in the Port McNeill, Woss, and Nanaimo areas.

The silviculture sub-sector is less tied to the current level of harvest, since silviculture activities occur at least three to six years after harvesting. Basic silviculture consists of surveys, site preparation, planting, brushing, cone collecting and some spacing. Enhanced, or intensive silviculture includes spacing, fertilizing, and pruning. In the Strathcona TSA, licensees are responsible for basic silviculture on areas harvested under major licences. The remaining basic and all enhanced silviculture on Crown land is the responsibility of the provincial government and is completed by silviculture contractors.

The 1995 *Strathcona TSA Socio-Economic Analysis* prepared for the previous timber supply review concluded that harvesting and silviculture operations associated with the previous AAC of 1 694 000 cubic metres supported approximately 765 person-years of direct harvesting and silviculture employment across the province. This timber supply review indicates that harvesting and silviculture operations associated with the average 1995-1997 harvest of 1.175 million cubic metres supported approximately 617 person-years of direct harvesting and silviculture employment across the province.

Primary timber processing employment

Processing facilities in the TSA rely on the Strathcona TSA and other TSAs, TFLs, woodlots, and private lands on Vancouver Island, and the mainland for their timber supply. Timber from the Strathcona TSA also supports processors outside the TSA. The 1995 *Strathcona TSA Socio-Economic Analysis* estimated that the previous AAC of 1 694 000 cubic metres supported approximately 1,415 person-years of direct processing employment across the province. The survey undertaken for this timber supply review indicates that the 1995-1997 average harvest of 1 175 000 cubic metres supported approximately 922 person-years of direct processing employment.

Employment coefficient
The number of person-years of employment supported by each 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that each 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

7 Socio-Economic Analysis

Forest Service employment

The Strathcona TSA is administered by the Campbell River Forest District office located in Campbell River. Currently, 84 people work in the forest district office. Forest Service activities are related more to administration and enforcement of government policy than directly to the volume of timber harvested. Consequently, jobs in the Forest Service are not included in the analysis of forestry sector impacts. Planning jobs related to SBFEP sales and harvests are more closely tied to the AAC; however, the forest district employs only a small number in this category.

Employment coefficients

Table 15 summarizes the employment supported by the 1995-1997 average harvest in the Strathcona TSA and the corresponding employment coefficients. Coefficients have been calculated at a TSA and provincial level to highlight the importance of the forestry sector within the Strathcona TSA and to identify the contribution that the Strathcona TSA's forestry sector makes to the provincial economy. The two levels are defined as follows:

1) TSA employment and employment coefficients, which comprise residents of the Strathcona TSA who are employed in the forestry sector within the Strathcona TSA and who rely on the Strathcona TSA timber supply; and

2) Provincial employment and employment coefficients, which comprise all forestry sector employment in the province that relies on the Strathcona timber supply, including both residents of the Strathcona TSA and those who live elsewhere.

Employment is divided into direct, indirect and induced components; the sum of the components is the total impact. The coefficients are expressed as the number of full-time jobs, or person-years, per 1000 cubic metres of timber harvested. Indirect and induced employment figures were derived using employment multipliers developed by the Ministry of Finance and Corporate Relations.

More detailed information regarding employment coefficients is presented in Appendix B, "Socio-Economic Analysis Background Information."

Table 15. Strathcona TSA employment and employment coefficients[7], average 1995-1997

Forest industry activity	TSA employment (person-years)	TSA coefficients (person-years/'000s m³)	Provincial employment (person-years)	Provincial coefficients (person-years/'000s m³)
Harvesting	314	0.27	538	0.46
Silviculture	32	0.03	79	0.07
Processing	257	0.22	922	0.78
Total direct	603	0.51	1,539	1.31
Indirect + induced	479	0.41	1,924	1.64
Total employment	1,082	0.92	3,463	2.95

Note: Employment estimates are reported in person-years based on average 1995-1997 employment levels and the average 1995-1997 Strathcona TSA harvest of 1 175 156 cubic metres. Wood products transport, and road building and maintenance are included in indirect estimates (see Appendix B, "Socio-Economic Analysis Background Information"). Estimates may not add due to rounding.

(7) Other employment coefficients may be found in other documents for the same or similar areas. A difference in ratios can occur for several reasons, such as using different sources of employment data and rounding of estimates, dividing employment by a different harvest level, using a different definition of a full time position, and changing the definition of forestry sub-sectors. However, the magnitude of impacts associated with a timber supply change should illustrate similar effects.

7.2.5 Strathcona TSA forestry employment income

In 1997, the average annual income for forest sector employees related to the Strathcona TSA was approximately $49,065, based on average provincial income levels for logging and forestry services, solid wood manufacturing, and pulp and paper manufacturing.[8] Table 16 outlines the average annual wages and salaries, total income levels, and total income per thousand cubic metres of timber harvested. The average annual income for indirect and induced employees was $34,070 per year. The total direct income associated with the forest sector in the Strathcona TSA averaged $75.5 million per year and total income for indirect and induced employment averaged $65.5 million per year (incomes are reported in 1997 dollar value). The combined total employment income averaged $141 million per year.

Table 16. Average annual direct and indirect/induced incomes and total employment income, 1995-1997

	Average annual income (1997 dollar value)	Total annual income ($ millions)	Total income ($ per '000s m^3)
Direct	49,065	75.5	64,224
Indirect / induced	34,070	65.5	55,790
Total income		141.0	120,014

Figures may not be exact due to rounding.

7.2.6 Provincial government revenues

The provincial government receives various taxes and other revenues from the forest industry. The forest industry pays stumpage, royalties and rents to the provincial government for the rights to harvest and use timber, and other industry operating taxes such as corporate income, property, and sales taxes. The provincial and federal governments also receive revenues from forest industry employees through income taxes.

From 1995-1997, forest industry activity in the Strathcona TSA led to an annual average of approximately $32.7 million in stumpage and rent payments to the provincial government (see Table 17). Other government revenues from forest industry taxes accounted for $10.2 million and the total employment supported by the Strathcona TSA harvest generated provincial and federal income taxes worth $36.2 million, of which approximately one-third of the income tax, or $12.1 million, went to the provincial government.

(8) Income information from Statistics Canada, Survey of Employment Payrolls and Hours.

Table 17. Average annual provincial government revenues, 1995-1997

	Average annual revenue 1995-1997 ($1997 millions)	Revenue ($ per '000s m^3)
Stumpage, rents and royalties	32.7	27,790
Industry taxes	10.2	8,664
Provincial income tax	12.1	10,261
Total government revenues	55.0	46,715

Figures may not be exact due to rounding.

7.3 Socio-economic implications of the base case harvest forecast

The socio-economic analysis focuses on harvest level changes in the short to mid-term and considers:

- the implications of alternative harvest levels for both the Strathcona TSA and the province;
- possible impacts on communities within the Strathcona TSA;
- timber requirements of processing facilities within the Strathcona TSA; and,
- regional timber supply implications.

The socio-economic analysis considers the average levels of forestry related activities that the base case harvest forecast could support. Impacts associated with future harvest levels are calculated using employment, income and revenue coefficients (per 1000 cubic metres). This method assumes that the current role of the forest industry in the provincial economy continues and that labour productivity will not change. This means for example, employment levels in the future can be predicted based on today's relationship between employment and the volume of timber harvested and processed. The analysis also assumes that the proportions of harvesting, silviculture and timber processing employment will remain constant and that the types and proportions of wood products manufactured will remain the same.

While this method is reasonably accurate for short-term forecasts (within the next 3 to 5 years), employment coefficients 20 years from now may be very different due to changes in market conditions, timber processing technologies, etc. The analysis provides an indication of the magnitude of impacts to employment, employment income and provincial government revenues, within a constantly changing socio-economic environment.

7.3.1 Short- and long-term implications of alternative harvest levels

Strathcona TSA employment and income impacts

Strathcona TSA employment and income includes workers who are supported by the TSA harvest and who reside within the TSA. Workers who come to the TSA to work but who reside outside the TSA are included in the provincial impact section, as is employment supported by Strathcona TSA timber processed at mills outside the TSA. Table 18 indicates the employment and income the current AAC can support when fully harvested and processed, and the levels that would be supported in the short to mid-term by the harvest volumes suggested in the base case forecast.

The current AAC of 1 420 000 cubic metres can support approximately 728 person-years of direct employment and a further 579 person-years of indirect and induced employment within the Strathcona TSA. This does not reflect the closure of the Bowater pulp mill in Gold River which relied on the TSA for approximately 10%-15% of its fibre requirements. The closure of the pulp mill is a significant issue for the community of Gold River and the Campbell River Forest District. If the timber previously used in Gold River is redirected to mills outside the Strathcona TSA, TSA employment would decline by more than is indicated in this analysis. Although the timber will remain available to other processors and could help to maintain or create a similar number of jobs elsewhere, the town of Gold River is still affected by the socio-economic impacts of the mill closure, regardless of the potential shift of employment.

The base case harvest forecast's initial harvest level of 1.25 million cubic metres per year could support an average of 641 person-years of direct employment and up to 510 person-years of indirect and induced employment in the Strathcona TSA. This is a reduction from current levels of 87 person-years of direct employment and between 59 to 70 person-years of indirect and induced employment.[9] Total annual income supported by the Strathcona timber supply would decline from current levels by between $5.6 and $6.7 million (1997 dollar value).

In the second decade, the projected harvest level of 1.1 million cubic metres per year would support approximately 564 person-years of direct employment and up to 449 person-years of indirect and induced employment in the Strathcona TSA. This is a reduction from current levels of 164 person-years of direct employment and between 110 to 131 person-years of indirect and induced employment. Total annual income supported by the Strathcona TSA timber supply would decline from current levels by between $10.5 and $12.5 million (1997 dollar value).

In the third decade, the harvest level is projected to reach its mid-term harvest level of 970 000 cubic metres per year where it would remain for eight decades. This timber supply level would support approximately 497 person-years of direct employment and up to 396 person-years of indirect and induced employment in the Strathcona TSA, assuming operating conditions are similar to those of today. This is a total reduction from current levels of 231 person-years of direct employment and between 154 to 183 person-years of indirect and induced employment. Total annual income supported by the Strathcona TSA timber supply would decline from current levels by between $14.8 and $17.6 million (1997 dollar value).

(9) The employment range for indirect and induced employment accounts for employment insurance and other social assistance payments that provide short-term income to displaced workers, subsequently lessening the number of induced job losses. The actual impact would fall within the range.

Provincial employment and income impacts

Provincial employment and income impacts include all the activity supported by the Strathcona TSA harvest, regardless of processing location and place of residence. Employment is supported by the Strathcona TSA harvest across Vancouver Island in harvesting, processing, and silviculture related activities and also on the B.C. Lower Mainland, mainly in processing. The current AAC can support approximately 1,859 person-years of direct employment and up to 2,325 person-years of indirect and induced employment in the province.

Reducing the harvest level in the first decade to 1.25 million cubic metres from 1.42 million cubic metres would reduce provincial employment to 1,636 person-years of direct employment and up to 2,046 person-years of indirect and induced employment. This is a reduction of 223 person-years of direct employment and between 237 and 279 person-years of indirect and induced employment. Total annual income supported by the Strathcona TSA would decline from current levels by between $17.4 and $20.4 million (1997 dollar value).

In the second decade, the harvest level of 1.1 million cubic metres per year would support 1,439 person-years of direct employment and up to 1,801 person-years of indirect and induced employment in the province. This is a reduction from current levels of 420 direct person-years of employment, and between 445 and 524 person-years of indirect and induced employment. Total annual income supported by the Strathcona TSA would decline from current levels by between $32.6 and $38.4 million (1997 dollar value).

The mid-term harvest level of 970 000 cubic metres per year would support 1,270 person-years of direct employment and up to 1,588 person-years of indirect and induced employment in the province. This is a total reduction from current levels of 589 direct person-years of employment, and between 626 and 737 person-years of indirect and induced employment. Total annual income supported by the Strathcona TSA would decline from current levels by between $45.9 and $54.0 million (1997 dollar value).

Vancouver Island is highly dependent on a number of sources for its timber supply. Section 7.3.3, "Nature, production capabilities, and timber requirements of processing facilities" and Section 7.3.4, "Regional timber supply implications" discuss the implications of these timber supply reductions in more detail for the processing sector and within the context of regional changes in timber supply.

7 Socio-Economic Analysis

Table 18. Strathcona TSA socio-economic impacts: base case harvest forecast, 1999.

	Current[a] AAC	Base case harvest forecast		
		Decades 1	Decade 2	Decade 3+
Timber supply (cubic metres)	1 420 000	1 250 000	1 100 000	970 000
Harvest level (1995-1997 average)	1 175 156	N/A	N/A	N/A
Difference from current AAC	(244 844)	(170 000)	(320 000)	(450 000)
Strathcona timber supply area				
Employment		**(person-years)**		
Direct	728	641	564	497
Indirect/induced	579	510	449	396
Total	1,307	1,150	1,012	893
Range[b] of employment gain (loss)		(146-157)	(274-295)	(385-414)
Employment income		**($1997 million/year)**		
Direct	35.7	31.4	27.7	24.4
Indirect/induced	19.7	17.4	15.3	13.5
Total	55.4	48.8	43.0	37.9
Range of income gain (loss)		(5.6-6.7)	(10.5-12.5)	(14.8-17.6)
Province[c]				
Employment		**(person-years)**		
Direct	1,859	1,636	1,439	1,270
Indirect/induced	2,325	2,046	1,801	1,588
Total	4,184	3,682	3,240	2,858
Range of employment gain (loss)		(460-502)	(865-944)	(1,215-1,326)
Employment income		**($1997 million/year)**		
Direct	91.2	80.3	70.6	62.3
Indirect/induced	79.2	69.7	61.3	54.1
Total	170.4	150.0	132.0	116.4
Range of income gain (loss)		(17.4-20.4)	(32.6-38.4)	(45.9-54.0)
Provincial government revenues		**($1997 million/year)**		
Stumpage and related payments	39.5	34.7	30.6	27.0
Forest industry taxes	12.3	10.8	9.5	8.4
Employee income taxes	14.6	12.8	11.3	9.9
Total	66.4	58.3	51.4	45.3
Gain (reduction) in revenues		(8.1)	(15.0)	(21.1)

(a) Estimates for current employment differ from those in Table 15. Employment figures in Table 18 are based on the current AAC of 1 420 000 cubic metres, while the figures in Table 15 are based on the 1995-1997 annual average harvest volume of 1 175 156 cubic metres. Due to rounding, some totals may not be exact.

(b) The ranges for employment and income changes take into consideration employment insurance and other social assistance programs that provide temporary short-term income to unemployed or displaced workers. The range's upper limit assumes that all those who are unemployed or displaced will leave the TSA to seek opportunities elsewhere and will no longer spend their income locally, thus imparting a higher impact on the local economy than if they had not left. The range's lower limit assumes that employment insurance and other social assistance payments to unemployed or displaced workers will temporarily encourage them not to leave the community, thus reducing the induced impacts of a lower harvest level. The actual impacts of changes in harvest levels on employment and incomes will likely fall within the specified ranges. More details are provided in Appendix B, "Socio-Economic Analysis Background Information."

(c) TSA employment and income estimates are included in the provincial employment and income estimates.

Government revenue impacts

Provincial government revenues from the forest industry include stumpage, royalties and rent payments, other taxes such as logging, corporate income, sales, property and electricity taxes, and income taxes from direct, indirect and induced employees. Under the existing tax and stumpage regimes, the current AAC of 1.42 million cubic metres provides on average approximately $66.4 million annually to the provincial government (1997 dollar value).

Assuming tax, stumpage, royalty and rent rates are similar to the average rates from 1995-1997, the initial reduction in the timber supply would reduce annual government revenues from the Strathcona TSA by $8.1 million. In the second and third decades, annual government revenues would decline by $6.9 million and $6.1 million, respectively. In total, reducing the timber supply to the mid-term level of 970 000 cubic metres per year would reduce average annual government revenues by $21.1 million.

7.3.2 Community level impacts

The impacts of changes in the timber supply may affect the socio-economic environment of a community. These changes have a greater effect on an economy dependent on a single industry than on one more diversified. A reduction in employment and income may affect various socio-economic conditions in communities; for example, population growth rates, the size of the labour force, economic development opportunities, and federally, provincially, and locally funded services.

The Campbell River Forest District is above average in terms of economic diversification[10]. However, the western communities are far more dependent on resource extraction and processing than the eastern communities located along Highway 19. The manufacturing base of the forest district is highly dependent on the forest industry with primary timber processing accounting for approximately 68% of total manufacturing employment. In the western communities with mills, the dependence can climb to 80%-95% of the total manufacturing employment base.

The employment and income changes that could occur as a result of a declining timber supply place the more timber dependent communities in the western portion of the Strathcona TSA at greater risk of experiencing additional socio-economic impacts. While the closure of the Gold River pulp mill is the result of a number of factors, declining timber supplies will continue to affect production capabilities throughout the region. Communities with a smaller population base and labour force declining or, slower population growth rates, are at higher risk of experiencing socio-economic impacts. In addition, the potential redistribution of harvesting activity out of the Kyuquot timber supply block will further impact remote smaller communities, such as Kyuquot, where there is a higher-than-average dependence on the small business program and access to transportation routes is limited.

(10) See Horne, G, and C. Powell. 1995, *British Columbia Local Area Economic Dependencies and Impact Ratios*. Ministry of Finance and Corporate Relations.

The eastern portion of the forest district along the Campbell River and Courtenay/Comox corridor is the most diversified part of the forest district. This area's labour force increases are concentrated in the service sectors and have occurred regardless of the relative decline in the forestry sector. While changes to the forestry sector will have implications for the eastern portion of the forest district, the area's overall growth should help offset some of these changes.

Individuals from the communities of the Strathcona TSA who lose their jobs are not only subject to economic concerns, but also physical and emotional difficulty while in transition to another job or profession. Physical and emotional effects on individual workers vary depending on age, education, future job opportunities, and various existing physical and emotional characteristics. Lee[11] notes that unemployment has been associated with a number of physical and emotional, or stress related symptoms. However, the loss of one's job is only one of many factors associated with illness, although job loss often precipitates physical and/or mental breakdown. A 1996 discussion paper by the Canadian Public Health Association[12] found that the literature examining the health impact of unemployment indicates a strong relationship between unemployment and ill health. This highlights the importance of a quick transition to new opportunities for displaced workers. How pressures related to job loss and uncertainty will affect residents of the Strathcona TSA is impossible to predict, yet these possible emotional and physical reactions should be anticipated.

7.3.3 Nature, production capabilities, and timber requirements of processing facilities

Approximately 58% of the timber harvested from the Strathcona TSA remains on Vancouver Island for processing, with over one-half of that portion processed in the Strathcona TSA. The remainder is shipped to the Vancouver Lower Mainland. Based on this flow of timber, solid-wood mills operating within the Strathcona TSA rely on timber from the TSA for an average of approximately 15%-20% of their requirements and pulp mills rely on timber and chips from the TSA for an average of approximately 5%-10% of their total requirements. These percentages are weighted to the larger mills and many of the smaller mills may depend on the Strathcona TSA for a far greater percentage of their timber supply.

A reduction of up to 450 000 cubic metres in the annual harvest over the next three decades will affect the mills which rely on the Strathcona TSA timber supply. This volume is sufficient to supply one or two medium to large sawmills. Each mill has its own operating characteristics and depending on the availability of supply substitutes, some mills may reach an operating threshold level* where there are no options other than to reduce the number of shifts or shutdown the mill completely.

(11) Lee, Robert, 1993. "Effects of Federal Timber Sales Reductions on Workers, Families, Communities, and Social Services," in *Building Toward a Balances Solution: Position Papers on Northwest Forestry Issues*, compiled by the Northwest Forestry Research Council.

(12) Canadian Public Health Assoc. 1996. *1996 Discussion Paper on the health impact of unemployment.*

Threshold level
A mill's timber supply level which, when dropped below, will cause a mill to reduce the number of shifts or to stop production.

7.3.4 Regional timber supply implications

The future timber supply of other sources of timber from around the Strathcona TSA and the Vancouver Forest Region is also an important issue for mill operators. The Vancouver Forest Region is highly inter-related with timber flowing across district boundaries and the Strait of Georgia. In terms of mill production levels, the Campbell River Forest District's primary mills have generally produced below manufacturing capacity from 1995-1997. This situation is due not only to market conditions and labour related shutdowns, but also the capacity of the region's mills to process more than the available timber supply.

These two conditions — 1) that mills rely on outside sources of timber, and 2) the over-capacity of production facilities—indicate that future declines in the regional timber supply, not just the Strathcona TSA, is an important consideration in an already limited timber supply situation.

The previous timber supply review for the Strathcona TSA, the adjacent Kingcome TSA, the Arrowsmith TSA, and Tree Farm Licences 19, 25, and 39 reduced the total AAC of these areas by 7%, or 676,515 cubic metres.[13] The base case timber supply forecasts from the previous timber supply review indicate that in approximately 25 years, the timber supply in these areas could decline by a further 14%, or an additional 1.2 million cubic metres, assuming a continuation of current management practices and land-use priorities. Given that a medium to large lumber mill can process between 300 000 to 600 000 cubic metres of timber per year, a timber supply of 1.2 million cubic metres (assuming an average sawlog component of 80%) could support at least two to three large lumber mills.

The forestry sector would continue to restructure operations given a reduction of this magnitude. It is impossible to predict, however, which mills, product types, and communities would be most affected, or if new "value-added" operations will offset some of these changes. It is also important to note that these potential changes are over two decades away and would probably occur gradually as industry adjusts to anticipated harvest levels. Regardless, changes to the forest industry will likely be substantial.

(13) The AAC for Tree Farm Licence 19 did not change and for Tree Farm Licence 39 increased by 1.8%. Over the next 20-25 years, however, both units are projected to decline based on the previous timber supply review results.

7.4 Summary

Population growth of communities within the Campbell River Forest District varied greatly between the eastern and western portions of the Strathcona TSA. From 1991-1996, Courtenay experienced the third highest population growth rate in the province (48.2%), while population declines occurred in the predominantly forestry-dependent communities of Tahsis and Gold River (–10.7% and –5.8%, respectively).

From 1991 to 1996, the total experienced labour force in the forest district increased by 19% — led mainly by growth in the service sector. Although the forestry sector experienced declines, the service sector, which depends in part on the forestry sector, has experienced high employment growth rates.

Forestry is the largest industrial sector of the Campbell River Forest District's economy and continues to be a significant contributor to the regional economy. In 1996, logging and forestry services accounted for 7% of the total labour force, and primary processing accounted for approximately 68% of the total manufacturing base. From 1991-1996, direct forestry employment in the forest district declined by approximately 5.4%; recent mill closures will have further affected the forest sector.

The base case harvest forecast for the Strathcona TSA indicates that harvest levels could decline over the next several decades. In the first decade, the timber supply could decline to 1.25 million cubic metres per year from the current level of 1.42 million cubic metres per year, reducing provincial employment by 223 person-years of direct and between 237 and 279 person-years of indirect and induced employment. Total annual income supported by the Strathcona TSA would decline from current levels by between $17.4 and $20.4 million (1997 dollar value).

In the second decade, reducing the timber supply to 1.1 million cubic metres per year would reduce provincial employment from current levels by 420 direct person-years and between 445 and 524 person-years of indirect and induced employment. Total annual income supported by the Strathcona TSA would decline from current levels by between $32.6 and $38.4 million (1997 dollar value).

In the third decade, reducing the timber supply to 970 000 cubic metres per year would reduce provincial employment from current levels by 589 direct person-years and between 626 and 737 person-years of indirect and induced employment. Total annual income supported by the Strathcona TSA would decline from current levels by between $45.9 and $54.0 million (1997 dollar value).

The initial reduction in the timber supply would reduce annual government revenues from the Strathcona TSA by $8.1 million. In the second and third decades, annual government revenues would decline by a further $6.9 million and $6.1 million, respectively. In total, reducing the timber supply to the mid-term harvest level of 970 000 cubic metres per year would reduce annual government revenues by $21 million.

8 References

B.C. Ministry of Forests, Timber Supply Branch. 1996. Forest management issues identified through the AAC determination process. Victoria, B.C.

B.C. Ministry of Forests, Timber Supply Branch. 1997. Strathcona TSA — Timber Supply Review Data Package. Victoria, B.C.

Canadian Public Health Association 1996. 1996 Discussion paper on the health impact of unemployment. Canadian Public Health Association: Ottawa.

Canfor Corporation Annual Statutory Report. 1997.

Doman Industries Ltd. 1997 Annual Review.

Horne, G., C. Powell. 1996. The revised forest district tables, Ministry of Finance and Corporate Relations.

Horne, Garry, R. Riley, L. Ransom, S. Kosempel. 1996. A provincial impact estimation procedure for the British Columbia forest sector. Ministry of Finance and Corporate Relations.

International Forest Products Ltd. Statutory Report for the period ended December 31, 1997.

Lee, Robert. 1993. Effects of federal timber sales reductions on workers, families, communities, and social services, building toward a balances solution: position papers on northwest forestry issues, compiled by the Northwest Forestry Research Council.

MacMillan Bloedel Ltd. 1997 Annual Report.

Nigh, Gordon. 1998. Site index adjustments for old-growth stands base on veteran trees. Research Branch, B.C. Ministry of Forests, Victoria, B.C. Work Paper 36/1998.

Price Waterhouse. 1997. The Forest Industry in British Columbia.

Timber West Timber Trust. 1997 Annual Report.

9 Glossary

Allowable annual cut (AAC) — The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

Analysis unit — The basic building blocks around which inventory data and other information are assembled for use in forest planning models. A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location, done to simplify analysis and generation of timber yield tables.

Available volumes — The portion of total inventory volumes that is available for harvesting after all management constraints on timber harvesting have been considered, including definition of the timber harvesting land base, age of tree merchantability, deferrals, and any other priorities or constraints on timber harvesting.

Base case forecast — The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.

Basic income and employment — Indicators used to describe the size of a basic sector.

Basic sector — Sectors of the economy, such as forestry, tourism and mining, that create flows of income into the region and are assumed to be drivers of the local economy. Non-basic sectors, such as retail outlets, are supported by basic sectors.

Biodiversity (biological diversity) — The diversity of plants, animals and other living organisms in all their forms and levels of organization, and includes the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.

Biogeoclimatic zones — A large geographic area with broadly homogeneous climate and similar dominant tree species.

Buffer strip — A strip of land (often including undisturbed vegetation) where disturbance is not allowed or is closely monitored to preserve or enhance non-timber values along or adjacent to trails, water bodies and recreation sites.

Clearcut harvesting — A harvesting method whereby all trees that meet utilization standards are harvested. The harvested site is then regenerated to acceptable standards by appropriate means including planting and natural seeding.

Coarse woody debris — Logs and stumps that provide habitat for plants, animals and insects, and a source of nutrients for soil development.

Commercial thinning — A silviculture treatment that 'thins' out an overstocked stand by removing trees that are large enough to be sold as products such as poles or fence posts (see also, Juvenile spacing). It is carried out to improve the health and growth rate of the remaining crop trees.

9 Glossary

Culmination age — The age at which a timber stand reaches its highest average growth rate, or mean annual increment (MAI). MAI is calculated as stand volume divided by stand age. Culmination age is the optimal biological rotation age to maximize volume production from a growing site.

Cutblock — A specific area, with defined boundaries, authorized for harvest.

Cutblock adjacency — The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.

Diameter limit harvesting — A silvicultural system used to maintain established understory trees. All trees larger than a specified diameter are removed, with care being taken to not damage the residual stand. Horses are often used to harvest trees under this system.

Employment coefficient — The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

Environmentally sensitive areas — Areas with significant non-timber values, fragile or unstable soils, or impediments to establishing a new tree crop, or areas where timber harvesting may cause avalanches.

Forest cover objectives — Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see Cutblock adjacency guidelines and Green–up).

Forest cover requirements — Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see Cutblock adjacency guidelines and Green–up).

Forest inventory — Assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of additional forest values such as recreation and visual quality.

9 Glossary

Forest planning model — An analytical (usually computer-based) model that successively harvests and grows collections of forest stands over a period of several decades according to specific data and management assumptions. Forest planning models are of two basic forms: forest estate simulation models, which address "what-if" questions by determining the effects a specified policy or management alternative; and optimization harvest scheduling models, which seek out the policy or management alternative that best attains a specified management objective (e.g., maximum volume harvested over time) subject to specified management constraints. This analysis employs a computer simulation model developed by the B.C. Forest Service.

Forest Practices Code — Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values

Forest type representation — Retaining a representative sample of all naturally occurring forest types.

Forest type — The classification or label given to a forest stand, usually based on its tree species composition. Pure spruce stands and spruce-balsam mixed stands are two examples.

Free-growing — An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.

Green-up — The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.

Growing stock — The volume estimate for all standing timber, at a particular time.

Harvest forecast — The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.

Hydrologic green-up (height) — The height a stand must reach for it to provide the same timing and quantity of water yields as old-growth.

Indirect and induced jobs — Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.

Inoperable areas — Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.

9 Glossary

Integrated resource guidelines — Guidelines requiring that forest management activities (such as harvesting, road building and silviculture treatments) be conducted in a special way to protect or enhance timber and non-timber forest resource values.

Integrated resource management — The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

Juvenile spacing — A silvicultural treatment to reduce the number of trees in young stands, often carried out before the stems removed are large enough to be used or sold as a forest product. Prevents stagnation and improves growing conditions for the remaining crop trees so that at final harvest the end-product quality and value is increased (see Commercial thinning).

Karst features — Karst features include fluted rock surfaces, vertical shafts, sinkholes, sinking streams, springs, complex sub-surface drainage systems and caves. Karst is a distinctive topography that develops as a result of the dissolving action of water on carbonate bedrock (usually limestone, dolomite or marble).

Landscape level biodiversity — The *Forest Practices Code Biodiversity Guidebook* provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.

Landscape unit — A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.

Long-line skylines — A system that allows harvesting over long distances, as well as suspension of logs above the ground. Such systems decrease the amount of road needed to access an area, and minimize soil disturbance. The operability classification distinguishes between areas operable by conventional skyline (yarding distance up to 750 metres) and non-conventional skyline (longer than 750 metres).

Long-term harvest level — A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

Management assumptions — Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

Mean annual increment (MAI) — Stand volume divided by stand age. The age at which average stand growth, or MAI, assumes its maximum is called the culmination age. Harvesting all stands at this age results in a maximum average harvest over the long term.

9 Glossary

Model	An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.
Modification VQO	Visible alterations may dominate the landscape, but should blend with natural features. Up to 25% of the visible area can be altered by harvesting activity (see Visual quality objective).
Multiplier	An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.
Natural disturbance type	An area that is characterized by a natural disturbance regime, such as wildfires, which affects the natural distribution of seral stages. For example areas with less stand-initiating disturbance have more older forests, and generally a greater abundance of species.
Non-merchantable forest types	Stands that are accessible and otherwise available for harvesting but are assumed to be non-merchantable due to stand characteristics such as small piece size, incidence of decay, species composition and low stocking.
Not satisfactorily restocked (NSR)	An area not covered by a sufficient number of well spaced tree stems of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since 1987 are classified as current NSR.
Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Partial retention VQO	Alterations may be visible but not conspicuous. Up to 15% of the area can be visibly altered by harvesting activity (see Visual quality objective).
Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. If someone works full-time for 90 days, he or she accounts for 0.5 person years.
Preservation VQO	Alterations are generally not visible. Up to 1% of the visible landscape can be visibly changed by harvesting activity. (see Visual quality objective).
Protected Area	A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).
Pruning	The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.
Pulpwood agreements	An agreement applying to a fixed geographic area that allows harvesting of timber below sawlog standards if mill residues suitable for the facility under the agreement are not available.

9 Glossary

Regeneration delay	The period of time between harvesting and the date by which an area is occupied by a specified minimum number of acceptable well-spaced trees.
Rehabilitation	Removing all non-commercial cover, preparing the site and stocking it with acceptable commercially valuable species.
Retention VQO	Alterations are not easy to see. Up to 5% of the visible landscape can be altered by harvesting activity (see Visual quality objective).
Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Riparian habitat	The stream bank and flood plain area adjacent to streams or water bodies.
Seed-tree system	Removal of most of the mature, merchantable trees in one harvest, except for a small number of trees to provide seed to facilitate establishment of a new stand.
Selection management	A silvicultural system used to maintain or create areas containing a wide range of tree ages or sizes. The time interval between harvests in such areas is fairly short (usually less than 30 years), and during these harvests either single scattered trees or small groups of trees are removed from across the entire area.
Sensitive terrain areas	Areas with moderate to high potential for landslide initiation. If timber harvesting or road construction occurs and where specific combinations of forest practices are required to ensure adequate site.
Sensitivity analysis	Examines how uncertainty in data and management assumptions affect timber supply.
Seral stages	Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.
Shelterwood system	Involves leaving a significant proportion of the mature, merchantable trees standing after an initial harvest to provide seed and shelter to assist in establishing a new stand. Usually the shelter trees are harvested after the new stand is well established.
Silvicultural treatments	Activities that ensure the regeneration of young forests on harvested areas, enhance tree growth or improve wood quality in selected stands. Activities include: site rehabilitation and preparation, planting, spacing, fertilization and pruning.
Site index	A measure of site productivity. Site indices in British Columbia are based on heights of free-growing dominant trees of a given species at a reference age of 50 years above breast height. Site index curves have been developed for British Columbia's major commercial tree species.

9 Glossary

Stand-level biodiversity	A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.
Stocking	The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
Threshold level	A mill's timber supply level which, when dropped below, will cause a mill to reduce the number of shifts or to stop production.
Timber harvesting land base	Crown forest land within the timber supply area that is currently considered feasible and economical for timber harvesting.
Timber supply area (TSA)	An integrated resource management unit established in accordance with Section 7 of the *Forest Act*.
Timber supply	The amount of timber that is forecast to be available over a specified time period, under a particular management regime.
Tree farm licence (TFL)	Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.
Unsalvaged losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.
Visual quality objective (VQO)	Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Visual sensitivity	A measure of the level of concern for the scenic quality of a landscape. Visual sensitivity ratings take into account the physical character of the landscape, as well as viewer related factors such as the number of viewers and the angle, position, and distance from which the landscape is viewed.
Volume estimate (yield projections)	Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.
Watershed	An area drained by a stream or river. A large watershed may contain several smaller watersheds.
Wildlife tree	A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

Appendix A

Description of Data Inputs and Assumptions for the Timber Supply Analysis

Introduction

The Strathcona Timber Supply Area Timber Supply Review data package, on which the data inputs and assumptions for the Strathcona TSA timber supply analysis are based, was released in December of 1997. Where information was incomplete (e.g., lacking timber harvesting land base summaries) or has changed due to information received during the public review of the data package, it is recorded in the following tables. The data package is therefore a companion to this appendix, and should be consulted for detailed information on data and assumptions used in the timber supply analysis. The information used in the analysis represents current forest management in the area. Current management is defined as the set of land-use decisions and forest and stand management practices currently implemented and enforced. Future forest management objectives that may be intended, but are not currently implemented and enforced are not included in this appendix. The purpose of the Timber Supply Review is to provide information on the effects of current management on both short- and long-term timber supply in each timber supply area in the province. Any changes in forest management objectives and practices, and any improvements to the data will be included in subsequent timber supply analyses.

A.1 Inventory Information

The inventory information used in this analysis combines the Ministry of Forests forest cover inventory for the Strathcona TSA (updated to 1997) with non-standard overlays added to provide information on:

- visual quality objectives;
- karst features;
- operability;
- terrain stability;
- draft landscape-unit boundaries;
- resource management zones from the *Vancouver Island Land Use Plan*;
- biogeoclimatic variants.

Forest cover information has been updated to reflect harvest depletion up to 1996. See Section 3.1 "Background Information" in the data package for more information.

A.2 Zone and Analysis Unit Definition

A.2.1 Management zones and tracking of multiple objectives (grouping)

For the purpose of modelling current forest management, several resource emphasis groupings were defined for this analysis based on common forest management objectives.

1. Landscape unit/biogeoclimatic variants (landscape-level biodiversity);
2. Deer winter range by landscape unit;
3. Visual quality objectives by landscape unit; and,
4. Cutblock adjacency by landscape unit.

Land considered unavailable for timber harvesting was included in the timber supply model and contributed to the attainment of both green-up forest cover objectives in visual quality areas and old-forest cover objectives in each LU and BEC variant combination. Forest cover requirements in the deer winter range and cutblock adjacency areas were applied to the timber harvesting land base only.

Table A-1. shows the inventory variables used to define the various model groupings used in this analysis. The forest cover requirements that were applied to areas subject to each management objective in Table A-1. are described in Section 6.4.1 "Objectives which require forest cover requirements" of the data package.

Table A-1. Groupings created to model forest cover requirements and facilitate modelling of second-growth harvest

Objectives	Inventory definition
Cutblock adjacency only	No VQO =R or PR, no wildlife code assigned, modelled by landscape unit.
VQC[a] = Retention	VQO code = R, requirements modelled by landscape unit.
VQC = Partial retention	VQO code = PR, requirements modelled by landscape unit.
Deer winter range/draft landscape units (LU)	Areas within the Salmon and Sayward landscape units currently identified on the inventory file by CC (cover constraint) in the EW_MGMT field. (see section A.3.7 "Areas with high wildlife value")
Landscape unit/biogeoclimatic variant	Each LU/variant combination is assigned a unique identifier to facilitate modelling of landscape level biodiversity guidelines.

(a) Visual quality class

A.2 Zone and Analysis Unit Definition

A.2.2 Analysis unit characteristics

To facilitate modelling of stand growth and silvicultural treatments, individual forest stands were grouped according to dominant tree species (inventory type group), age range and timber growing capability (site index).

Table A-2. shows the variables used to define each analysis unit and the amount of area in the timber harvesting land base. A separate timber volume table was generated for each analysis unit (see Table A-13. for existing natural stands and Table A-14. for existing and future managed stands). The analysis units are not management zone specific; that is, an analysis unit can be in one or more management zones described in Section A.2.1, " Management zones and tracking of multiple objectives (grouping)." The site index ranges used to separate stands of each leading tree species into good, medium and poor site analysis units were based on the area of the timber harvesting land base that the species covers, and the overall range of site indexes found for that species in the Strathcona TSA. Fir-leading stands up to 60 years of age, cedar-leading stands up to 10 years of age and other coniferous-leading stands up to 20 years of age are currently considered managed.

Table A-2. Area in species/productivity groups to facilitate volume projection

	Species group	Inventory type groups	Site index range (metres)	Area by category (ha)		
				Age ≥ 140	Age < 140	Managed
1	Fir, good site	1-8	> 30	40.0	6 197.6	8 910.9
2	Fir, medium site	1-8	≥ 22 through 30	643.6	3 777.0	16 602.4
3	Fir, poor site	1-8	13.6 to < 22	847.8	1 706.0	4 897.3
4	Cedar, good site	9-11	> = 18	2 555.7	5 156.4	1 142.1
5	Cedar, medium site	9-11	12.4 to < 18	11 234.4	1 664.4	202.8
6	Hemlock/balsam, good site	12-20	> 25	537.6	13 020.9	3 704.0
7	Hemlock/balsam, medium site	12-20	≤ 18 through 25	9 247.7	21 112.1	27 879.0
8	Hemlock/balsam, poor site	12-20	~11.3 to < 18	15 055.2	6 343.5	8 642.7
9	Spruce	21-26	All sites	534.4	475.9	180.1
10	Alder	37-38	All sites		5 515	

A.3 Definition of the Timber Harvesting Land Base

A.3.1 Land not managed by the B.C. Forest Service

The ownership (OWNER and OWNR_CH) codes on the inventory file were used to determine which areas are not managed by the B.C. Forest Service for timber supply. This category may include areas such as parks, ecological reserves, private land and various special use permit areas. Forest in ownerships 62 C (forest management unit), 69 C (forest reserves) and 70 N (timber licences) contributes to timber harvesting within the Strathcona TSA. Areas with any other ownership codes are excluded from the timber harvesting land base.

A.3.2 Non-productive forest and non-forest land

Non-forest and non-productive forest (TYPID_PR = 6) and non-typed (TYPID_PR = 8) areas do not contribute to timber harvesting. These categories include areas covered by such things as sparse alpine forest, ice, swamps, water, and rock. In some cases, there is a species label and site index associated with non-productive forest.

A.3.3 Non-commercial (brush) forest cover

Non-commercial brush types (TYPID_PR = 5), were not included in the timber harvesting land base.

A.3.4 Sites with low timber growing potential

Sites may have low productivity either because of inherent site factors (nutrient availability, exposure, excessive moisture, etc.), or because they are not fully occupied by commercial tree species. Typically, these stands are intermixed with other stands within the forested land base. As these stands are not considered to be harvestable, they need to be identified and removed from consideration for the timber harvesting land base. The criteria used to define low timber growing potential was the ability for a site to produce 19.5-metre tall trees by 120 years of age. NSR area was not evaluated for low site criteria as NSR is generally created from logging activity which indicates the site has harvesting potential. Sites with site index lower than those listed in Table A-3. were excluded from the timber harvesting land base.

Table A-3. Minimum site index used to identify sites with low timber growing potential

Species	Site Index to achieve minimum criteria (m @ 50yrs)
Fir	13.6
Cedar	12.4
Hemlock	11.3
Balsam	11.5
Spruce	9.7
Alder	14.0

A.3 Definition of the Timber Harvesting Land Base

A.3.5 Soil stability areas (ESAs)

Table A-4. shows the updated criteria used to account for unstable terrain where harvesting is not expected to occur. Reductions were revised upon recommendations provided by June Ryder, P.Geo. NSR area was not reduced.

Table A-4. Description of soil stability categories and reduction factors

Stability category	Description	Location	Reduction per cent (%)
S1	Highly unstable	Entire TSA	95
S2	Moderately unstable	Kyuquot supply block	40
S2	Moderately unstable	Sayward and Loughborough supply blocks	50

A.3.6 Areas with high recreation value

Recreation areas such as campgrounds, trails and lookout sites are identified in the inventory file through the recreation feature significance and recreation management code variables. Recreation management codes are more current and are used instead of ESA designations for the purpose of excluding areas with high recreation value. Areas with a recreation management class code of '0' are those areas such as established campsites that have very high, identified recreation values. NSR area was not reduced.

Table A-5. Description of areas with high recreation values

Recreation management class code	Recreation value description	Reduction per cent (%)
0	Managed exclusively for recreation	100
1	Special management required	50
VQO=P	Visual quality preservation	100
L5	Karst feature where not already reduced for special management (management class 1)	8

A.3 Definition of the Timber Harvesting Land Base

A.3.7 Areas with high wildlife value

Wildlife inventory information has been captured using two different variables added to the inventory file: EW and EW_MGMT. EW represents the value rating applied to a given polygon while EW_MGMT identifies the management regime for EW polygons with a rating of two. A label of 50% in this category is given to stands that should receive an area reduction of 50% while a CC represents stands to which a forest cover requirement will apply as per Section 2.3, "Management practices" of the timber supply analysis (see also section 6.4.1 "Objectives that require forest cover requirements" in the data package). Most of the area with an EWZ rating is found in the Sayward supply block.

Table A-6. Description of areas with high wildlife values

EW rating	EW_MGMT	Timber harvesting land base (ha)	Productive forest (ha)t	Reduction per cent (%)
1	-	0	9 995	100
2	-	1 194	2 784	0
2	CC	2 242	7 000	0
2	50%	3 695	4 544	50
Total		7 131	24 323	

A.3.8 Problem forest types

Problem forest types (PFT) are stands which are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability. These types are wholly excluded from the timber harvesting land base.

Table A-7. Problem forest types criteria

Species	Inventory type groups	Reduction per cent (%)
Pine	27-32	100
Deciduous other than Alder	35, 36, 39, 42	100

A.3.9 Riparian reserve zones

A total forested land base of 137 365 hectares on thirteen mapsheets was reviewed for riparian considerations.

A total of 4470 hectares of riparian area reductions was found to occur on these mapsheets. The forested areas which were unlikely to possess significant riparian considerations, namely inoperable areas and BEC variants, CWH vm2 and MH mm1 were subtracted from the total forested land base. Dividing the entire 4470 hectares of riparian areas by the remaining 96 985 hectares of forested land base assumed to contain riparian reductions produces a TSA reduction percentage of 4.6%. This reduction was applied to all polygons except those in inoperable areas or the two BEC variants mentioned.

A.3 Definition of the Timber Harvesting Land Base

A.3.10 Timber licence reversions

Timber licences are old-tenure arrangements that give a licensee exclusive rights to harvest merchantable timber within the licence area and do not contribute to the TSA allowable annual cut. Once these areas have been harvested, regenerated and attain free-growing status, the timber licence area reverts to B.C. Forest Service jurisdiction. Accordingly, these areas contribute to the Strathcona TSA timber supply in the medium to long term.

There are currently about 18 416 hectares of timber licences in the timber harvesting land base. Approximately 13 360 hectares of the timber licences are less than 100 years of age and are assumed to have been harvested but for which application has not yet been made to adjust ownership status. About 80% of these stands are currently less than 20 years of age. The projected ages and species labels from the inventory file were used to assign these stands to analysis units. The remaining 5056 hectares, are assumed to comprise timber licence areas that have never been harvested. They are assigned to regenerated analysis units consistent with the existing forest cover (see Section A.4.3 "Basic silviculture and regeneration assumptions"), and are assumed to be harvested, and revert to Crown jurisdiction at a rate of 170 hectares per year.

A.3.11 Wildlife tree patches requirements

Table 20a of the *Biodiversity Guidebook*, which is used when biodiversity emphasis has been assigned to a landscape unit, was used for deriving the wildlife tree patch target because a surrogate for biodiversity emphasis has been assumed for old-seral retention. Given that approximately 60% of the Crown forest area in this TSA is available for harvest and 50% of the area has already been harvested without regard for wildlife tree patch requirements, a wildlife tree patch target of 8% of each cutblock has been assumed. This figure was reduced by 75% following assumptions used in the *Forest Practices Code Timber Supply Analysis*, February 1996, that 75% of the wildlife tree patch requirements will be met by riparian reserves and management zones, unmerchantable stands or forest growing on inoperable slopes and unstable soils. For this timber supply analysis, it was assumed that 2% of the area otherwise available for harvest will be unavailable for harvest over the long term to account for stand-level biodiversity requirements specified in the *Biodiversity Guidebook*.

An area reduction is used to model wildlife tree patch requirements because the wildlife tree patches in the Strathcona TSA, in conjunction with other riparian reserves and area removals, are generally larger than two hectares in size and are left to maintain stand structure within an area over time. As the wildlife tree patches are larger than two hectares in size this area will contribute to meeting old-seral stage forest requirements at the landscape level. It is assumed that these wildlife tree patches will not be available for harvest at a later date, nor will they be available to harvest during subsequent harvests of the surrounding area.

A.4 Forest Management Assumptions

A.4.1 Minimum harvestable age by analysis unit

Minimum harvestable ages are, as the term implies, the minimum age at which harvesting is expected to be feasible. The Campbell River Forest District staff revisited the minimum harvestable age criteria during the public review of the data package. Given the low volume per hectare obtained on poorer quality sites when using the culmination of average annual growth criteria, it was decided that using the volume achieved at 95% of culmination on sites of average productivity (350 cubic metres per hectare) was more suitable. The implications of this are shown in Table A-8. where more productive sites become harvestable early than culmination age and less productive sites take longer to reach the minimum harvestable age. While harvesting may occur in stands at the minimum requirements in order to meet forest level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large inter-decadal changes in harvest levels), most stands will be not be harvested until past the minimum timber production ages because management of other resource values take precedence (e.g., requirements for the retention of older forest). Table A-8. does not include figures for stands over 140 years of age as these are beyond the minimum volume criteria used in this analysis. The age ranges in the table correspond to the criteria used to define whether a stand is managed (less than the age listed) or natural (older than the stated age, but younger than 140 years).

Table A-8. Minimum harvestable age criteria — stands less than 140 years, and managed stands

Leading species	SI range (m @ 50 yrs)	Age range (yrs)	Volume at culmination age (m^3/ha)	Culmination age (yrs)	Age where 95% of culmination MAI has occurred (yrs)	Age to reach 350 m^3/ha minimum (yrs)
Fir	SI > 30	> 60	617	70	50	45
Fir	22 <= SI <= 30	> 60	426	70	60	60
Fir	13.6 <= SI < 22	> 60	278	90	70	120
Cedar	SI >= 18	> 10	470	80	70	65
Cedar	12.4 <= SI < 18	> 10	281	110	85	140
Hemlock/balsam	SI > 25	> 20	572	70	50	45
Hemlock/balsam	18 <= SI <= 25	> 20	439	80	65	67
Hemlock/balsam	11.3 <= SI < 18	> 20	282	90	85	115
Spruce	All sites	> 20	444	70	60	60
Alder	All sites	All ages	227	40	35	75
Fir	SI > 30	< 60	736	70	55	45
Fir	22 <= SI <= 30	< 60	715	100	75	55
Fir	13.6 <= SI < 22	< 60	429	130	95	100
Cedar	SI >= 18	< 10	703	120	95	70
Cedar	12.4 <= SI < 18	< 10	478	170	130	125
Hemlock/balsam	SI > 25	< 20	1080	90	65	42
Hemlock/balsam	18 <= SI <= 25	< 20	808	120	95	65
Hemlock/balsam	11.3 < SI < 18	< 20	479	150	105	110
Spruce	All sites	< 20	966	110	80	55

A.4 Forest Management Assumptions

A.4.2 Commercial thinning opportunities

Significant amounts of commercial thinning are occurring within 'medium' site Douglas-fir stands in the Sayward supply block. While commercial thinning is not considered to be a true 'silvicultural system', the application of this technique may have implications both for short- and medium-term timber supplies. The current plans to harvest 45 000 cubic metres per year for the next 10 years and an anticipated 30 000 cubic metres per year for the following 10 years were modelled in this timber supply analysis.

About 813 hectares of commercial thinning has taken place within the Strathcona TSA. This area was mapped and the analysis unit yields for the associated stands were reduced by 165 cubic metres per hectare, which reflects the average volume removals in existing stands that have been commercially thinned. Forest district staff indicate that future thinning will remove about 130 cubic metres per hectare. This was modelled by removing 130 cubic metres per hectare from Table Number 22 shown in Table A-14.

Table A-9. Commercial thinning regime

Silvicultural system	Eligible analysis units or locations	Volume removed	Entry age	Number of entries before final felling	Time before final felling
Commercial thinning	Douglas-fir — medium site	130 m³/ha	41-60 years	One	Minimum 20 years
Final entry	Mixed analysis units	AU volume less 165 m³/ha	80	N/A	N/A

A.4.3 Basic silviculture and regeneration assumptions

Basic silviculture consists of any activities required to establish free-growing stands of commercially-valued tree species after harvesting an area. Basic silviculture is a legislated requirement under the *Forest Act*, and is assumed to occur in the Strathcona TSA. Table A-10. outlines the regeneration regime for each analysis unit, and specifies the expected regeneration delay following harvesting. The regeneration delay has been modified from the assumptions outlined in the data package because the BEC variants which tend to take longer to regenerate, and thus may raise average regeneration delay, were found to represent very little of the timber harvesting land base.

A.4 Forest Management Assumptions

Table A-10. Regeneration assumptions by analysis unit

Composition	Regen delay (yrs)	OAFs[a] (%)		Method		Species		Density (stems/ha)	
		1	2	Type	%	Code	%	Initial	Thin
Douglas-fir G	2	15	5	Plant	100	Fd	100	900	750
Douglas-fir M	2	15	5	Plant	100	Fd H	50 50	1200	750
Douglas-fir P	2	15	5	Plant	100	Fd H	50 50	1200	750
Cedar G	3	15	5	Plant	100	Cw Ba	30 70	1200	750
Cedar M	3	15	5	Plant Natural	100 Ingress	Cw Hw	50 50	1200	850
H/B G	3	15	5	Plant Natural	100 Ingress	Ba Hw	50 50	1200	850
H/B M	3	15	5	Plant Natural	100 Ingress	Ba Hw	50 50	1200	850
H/B P	3	15	5	Plant Natural	100 Ingress	Cw/Yc Hw	50 50	1200	850
SS	3	15	5	Plant	100	Ss Cw/Yc	30 70	800	
Alder	2	15	5	Plant	100	Alder Fd-G	25 75	1200 900	600 750

(a) Operational adjustment factors (OAFs) are used to adjust timber yield estimates to account for operational factors. OAF1 is a constant percentage reduction to account for small unproductive areas within stands. OAF2 accounts for losses that increase with stand age, for example decay due to disease. In this case OAF2 increases from 0 at stand establishment and passes through 5% at 100 years of age.

A.4 Forest Management Assumptions

A.4.4 Not satisfactorily restocked (NSR) areas

Land classified in the Strathcona TSA inventory file as type identity 4 or 9 is included in the current timber harvesting land base. These type identities indicate not satisfactorily restocked land base. Table A-11. identifies the total area of NSR on the inventory file currently existing in the timber harvesting land base, and the estimated rate at which the NSR area will be restocked. The Campbell River Forest District staff reviewed the NSR area by landscape unit and three resource emphasis groups (cutblock adjacency, retention and partial retention visual quality classes). Based on district knowledge of current NSR in each LU by resource emphasis group, a ratio was then applied to each polygon to approximate the proportion of NSR on the inventory file which is actually satisfactorily restocked (SR) versus NSR.

NSR was not removed from the productive forest eligible for consideration as timber harvesting land base during land base classification, even if the area has characteristics which would otherwise have resulted in exclusion, as it was assumed that land which has been recently harvested will be eligible for harvest again. The forest cover information was used in assigning NSR to analysis units. Forest district staff reviewed the species breakdown in Table A-11. and the age distribution of young stands in the inventory file and found that the species assignment was reflective of recent harvesting and silvicultural activity in the species groups.

Table A-11. Not satisfactorily restocked (NSR) areas

	Analysis unit	Area (hectares)	Hectares of NSR	
			Currently SR (2 years old)	Currently NSR (stocked in 3 years)
21	Fir, good site	4.9	1.2	3.7
22	Fir, medium site	54.8	19.7	35.1
23	Fir, poor site	35.4	34.4	1
24	Cedar, good site	79.5	37.6	41.9
25	Cedar, medium site	38.5	6.3	32.2
26	Hemlock/balsam, good site	1301.8	455.8	846.1
27	Hemlock/balsam, medium site	9197.2	2979.4	6217.8
28	Hemlock/balsam, poor site	5484.9	1857.2	3627.8
29	Spruce, good site	7.1	1.3	5.8
10	Alder	34.6	6.3	28.4
Total		16 238.7	5 399	10 839.7

A.4 Forest Management Assumptions

A.4.5 Unsalvaged losses

Table A-12. shows the estimated average annual unsalvaged volume loss to catastrophic events such as insect epidemics, fires, wind damage or other agents over the long term on the timber harvesting land base. The unsalvaged loss column only reflects those areas in which the volume will not be recovered or salvaged.

Table A-12. Unsalvaged losses

Cause of loss	Total loss (m^3/year)	Annual unsalvaged loss (m^3/year)
Fire	2 500	1 750
Windthrow	60 000	30 000
Disease	11 400	11 400
Total	73 900	43 150

The windthrow and fire estimates are based on district blowdown ledgers, district experience with salvage and district fire occurrence records.

Ongoing monitoring of insect infestations within the Strathcona TSA reveals that losses are relatively minor (i.e., within-stand) and should be accounted for in existing yield models. Key insect species that are monitored in this district are western black-headed budworm, western hemlock looper, balsam woolly adelgid, and conifer sawflies.

Laminated root rot (*phellinus*) occurs in the drier regions of the district, primarily in younger Douglas-fir forests, in the Sayward forest, Quadra Island, and minor pockets in the Gold River area. Current estimates of annual unsalvaged losses total 11 400 cubic metres.

A.5 Volume Estimates for Existing Stands

The variable density yield projection (VDYP) model, version 6.4a developed and supported by the B.C. Ministry of Forests, Resources Inventory Branch, was used to estimate timber volumes for existing natural stands. In developing the timber volume projections, utilization levels shown in section 6.1.1 "Utilization levels" of the data package were employed. Also, the volume tables do not include any deciduous or pine volumes found in mixed-species stands (see section 6.1.2 "Volume exclusions for mixed species stands" in the data package). See Tables A-2 and A-8 in this appendix for more information on the analysis units to which the tables apply.

Table A-13. shows the volume estimates by analysis unit for existing natural stands.

A.5 Volume Estimates for Existing Stands

Table A-13. Timber volume tables for existing natural stands (cubic metres/hectare)

Table #	1	2	3	4	5	6	7
Description	**Fir > 30**	**Fir > = 22**	**Fir < 22**	**Cedar > = 18**	**Cedar < 18**	**H/B > 25**	**H/B > = 18**
Age group	**> 140**	**> 140**	**> 140**	**> 140**	**> 140**	**> 140**	**> 140**
10	0	0	0	0	0	0	0
20	0	0	0	0	0	5	0
30	136	28	1	7	0	134	18
40	290	140	46	76	16	270	115
50	421	235	116	149	63	386	206
60	532	316	178	218	114	485	286
70	629	385	231	280	160	570	356
80	713	446	277	338	204	643	418
90	784	498	317	386	240	705	472
100	847	544	353	428	272	757	519
110	903	585	385	464	300	803	561
120	950	621	414	492	322	842	596
130	990	650	436	526	347	882	633
140	1 024	674	454	558	370	919	666
150	1 051	693	468	585	391	951	695
160	1 071	706	478	609	408	980	722
170	1 085	714	484	629	422	1 006	745
180	1 093	718	487	650	438	1 030	768
190	1 108	726	493	670	453	1 053	789
200	1 123	735	500	690	467	1 074	808
210	1 137	743	506	708	481	1 093	827
220	1 151	751	511	731	497	1 110	843
230	1 164	759	517	753	513	1 126	859
240	1 177	766	522	774	529	1 141	874
250	1 189	773	527	794	544	1 155	888
260	1 189	774	528	798	546	1 164	896
270	1 190	775	529	800	549	1 171	903
280	1 190	776	529	803	551	1 178	910
290	1 190	776	530	805	553	1 184	916
300	1 190	777	531	807	555	1 189	922
310	1 190	777	531	809	557	1 194	927
320	1 190	778	532	811	558	1 198	931
330	1 189	778	532	812	560	1 202	935
340	1 189	779	532	813	561	1 205	939
350	1 188	779	533	814	562	1 208	942

continued

A.5 Volume Estimates for Existing Stands

Table A-13. Timber volume tables for existing natural stands (cubic metres/hectare) (continued)

Table #	8	9	10	11	12	13	14
Description	**H/B < 18**	**Spruce**	**Alder**	**Fir > 30**	**Fir > = 22**	**Fir < 22**	**Cedar > = 18**
Age group	**> 140**	**> 140**	**All**	**61-140**	**61-140**	**61-140**	**11-140**
10	0	0	4	0	0	0	0
20	0	33	65	3	0	0	0
30	0	115	154	146	52	0	54
40	22	216	227	293	170	37	149
50	78	312	282	418	269	97	240
60	137	396	323	524	353	153	325
70	191	468	343	617	424	200	400
80	240	530	362	698	487	241	470
90	282	582	377	768	541	277	527
100	320	627	391	831	588	309	576
110	354	665	404	886	631	337	619
120	384	697	414	936	669	362	652
130	414	731	424	975	699	383	693
140	441	761	433	1 008	724	399	731
150	466	788	441	1 034	743	412	763
160	488	812	447	1 053	756	421	791
170	508	834	452	1 065	764	426	815
180	528	854	457	1 072	767	428	840
190	546	873	462	1 085	776	434	864
200	563	890	466	1 098	784	439	886
210	580	906	471	1 111	793	444	908
220	595	920	475	1 124	801	449	935
230	609	934	480	1 137	809	454	961
240	623	946	484	1 148	816	459	986
250	636	958	487	1 160	823	463	1 010
260	643	969	489	1 161	824	464	1 013
270	650	979	490	1 161	825	465	1 016
280	656	988	491	1 161	825	466	1 018
290	662	997	492	1 162	826	467	1 020
300	668	1 005	493	1 162	827	468	1 022
310	673	1 013	494	1 162	827	469	1 023
320	677	1 020	495	1 162	828	470	1 025
330	681	1 027	496	1 162	828	471	1 026
340	685	1 034	496	1 162	828	471	1 027
350	689	1 040	497	1 162	828	472	1 027

continued

A.5 Volume Estimates for Existing Stands

Table A-13. Timber volume tables for existing natural stands (cubic metres/hectare)(concluded)

Table #	15	16	17	18	19
Description	**Cedar < 18**	**H/B > 25**	**H/B > = 18**	**H/B < 18**	**Spruce**
Age group	**11-140**	**21-140**	**21-140**	**21-140**	**21-140**
10	0	0	0	0	0
20	0	12	0	0	19
30	0	147	35	0	83
40	14	280	135	20	187
50	57	393	227	76	283
60	104	490	307	135	368
70	148	572	377	187	442
80	188	644	439	235	508
90	222	704	491	276	564
100	253	755	537	312	614
110	281	799	577	345	657
120	304	837	612	373	696
130	328	875	647	401	730
140	350	909	678	427	761
150	369	938	706	449	787
160	385	964	731	470	809
170	399	985	752	487	827
180	414	1 005	771	504	842
190	428	1 024	790	520	858
200	441	1 042	808	535	873
210	454	1 058	824	549	888
220	469	1 073	840	563	901
230	484	1 087	854	575	913
240	498	1 100	867	587	925
250	512	1 112	879	598	936
260	514	1 117	885	604	945
270	517	1 122	890	609	953
280	519	1 125	895	615	960
290	521	1 129	899	619	968
300	523	1 131	903	623	975
310	524	1 134	906	627	981
320	526	1 135	909	631	987
330	527	1 137	911	634	994
340	529	1 137	913	637	999
350	530	1 138	915	640	1 005

A.6 Volume Estimates for Regenerated Stands

WinTIPSY (Windows™ version of the Table Interpolation Program for Stand Yields) version 2.1, supported by the B.C. Ministry of Forests', Research Branch, was used to estimate growth and yield for existing and future managed stands. The area-weighted site index for each analysis unit was used, along with regeneration assumptions from Section A.4.3 Table A-10. in this appendix, as inputs to TIPSY. Table A-2. documents the area assumed to be managed in the analysis.

Operational adjustment factors (OAFs) used in managed stand yield table generation are shown in Table A-10. The volume tables incorporate the utilization levels shown in section 6.1.1 "Utilization levels" of the data package.

Table A-14. displays the volume tables for managed stands. Volumes are assumed to remain constant after 300 years of age. No volume table for alder-leading stands is included in Table A-14. The portion of alder stands that is regenerated to alder (see Table A-10.) is assumed to grow according to the existing natural stand table #10 in Table A-13. The rest of the current alder stands in the timber harvesting land base are planned for regeneration to good-site fir, for which yields are projected by table #21 in Table A-14.

A.6 Volume Estimates for Regenerated Stands

Table A-14. Timber volume tables for managed stands (cubic metres/hectare)

Table #	21	22	23	24	240
Description	**Fir > 30**	**Fir > = 22**	**Fir < 22**	**Cedar > = 18**	**Cedar > = 18**
Age group	**Managed all ages**	**Managed all ages**	**Managed all ages**	**Managed > 140**	**Managed < 140**
10	1	1	1	0	1
20	43	13	4	4	15
30	176	74	22	34	90
40	336	175	55	100	209
50	503	275	106	185	340
60	647	385	158	277	483
70	778	490	207	360	615
80	889	581	254	446	742
90	989	670	297	529	864
100	1 086	751	345	604	971
110	1 172	821	389	676	1 067
120	1 250	883	428	738	1 161
130	1 321	943	463	794	1 249
140	1 384	998	497	853	1 328
150	1 437	1 049	531	905	1 393
160	1 485	1 096	561	952	1 452
170	1 523	1 137	587	992	1 508
180	1 556	1 171	612	1 031	1 563
190	1 587	1 203	635	1 066	1 611
200		1 233	656	1 099	1 654
210		1 263	674	1 130	1 689
220		1 290	691	1 163	1 725
230		1 316	706	1 194	1 759
240		1 338	720	1 223	1 790
250		1 356	733	1 247	1 820
260		1 372	746	1 268	1 848
270		1 388	758	1 287	1 875
280		1 403	769	1 306	1 900
290		1 417	780	1 323	1 924
300					

continued

A.6 Volume Estimates for Regenerated Stands

Table A-14. Timber volume tables for regenerated stands (cubic metres/hectare) (concluded)

Table #	25	26	27	28	29
Description	**Cedar < 18**	**H/B > 25**	**H/B > = 18**	**H/B < 18**	**Spruce**
Age group	**Managed all ages**	**Managed all ages**	**Managed all ages**	**Managed all ages**	**Managed all ages**
10	0	2	1	0	0
20	1	37	8	2	9
30	8	172	43	11	63
40	24	336	129	34	178
50	52	520	222	72	316
60	89	696	317	122	442
70	130	867	417	173	578
80	173	1 010	514	223	701
90	217	1 150	599	273	800
100	258	1 284	690	319	909
110	295	1 402	772	359	1 011
120	333	1 496	848	399	1 095
130	371	1 588	913	438	1 172
140	407	1 677	970	474	1 242
150	440	1 750	1 026	507	1 305
160	470	1 814	1 081	538	1 360
170	500	1 874	1 133	567	1 408
180	528	1 933	1 181	594	1 453
190	553	1 987	1 226	619	1 496
200	577	2 034	1 268	642	1 534
210	599	2 073	1 307	663	1 571
220	621	2 109	1 335	685	1 611
230	640	2 142	1 362	704	1 644
240	659	2 173	1 386	721	1 674
250	677	2 202	1 410	738	1 701
260	692	2 230	1 432	753	1 726
270	706	2 255	1 453	766	1 747
280	720	2 280	1 473	778	1 768
290	734		1 492	791	1 787
300					
310					
320					
330					
340					
350					

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The report identifies employment and income impacts, changes in government revenues, and community impacts at various harvest levels and times in the future. This type of analysis requires several assumptions of which the reader should be aware. Some of these assumptions are outlined below:

- Employment multipliers — the multipliers used in the analysis of indirect and induced impacts are based on analytical assumptions and estimated using data collected at a certain time, thus they reflect industry and employment conditions at that time. Consequently, they may not accurately reflect future industry conditions. While generally good indicators when based on fairly recent information, older multipliers can be dated and potentially unreflective of the industry under examination. In any impact analysis, the information should be considered as order of magnitude indicators.
- Employment coefficients — employment impacts associated with future harvest levels are calculated using employment coefficients (person-years per 1000 cubic metres). This approach assumes that the industry structure will be the same in future as it is today. While reasonably accurate in the short term, the employment coefficients may change in future, as a result of changing market conditions or production technologies, for example.
- Timing of impacts — employment impacts are shown to occur simultaneously with a change in the harvest level. While fairly accurate for the harvesting sub-sector, this may not be the case for the processing and silviculture sub-sectors of the forest industry. Additionally, indirect and induced impacts will likely occur over a longer period of time, as business and consumer spending levels adjust.
- Processing thresholds — processing job impacts are unlikely to occur in direct proportion to harvest changes, i.e., a 10% harvest reduction may not lead to a 10% processing employment reduction. Impacts are more likely to occur in a step-wise manner related to processing thresholds. A processing threshold is the level of a mill's timber supply where, when reached, will cause a mill to either lay-off a shift or shut down the mill, temporarily or permanently. Accurately predicting a mill's threshold level is not possible. As a result, the analysis may overestimate processing impacts if mills continue to operate the same number of shifts, but perhaps at lower production levels, or alternatively could underestimate impacts if a mill were to eliminate a shift. Over the medium- to long-term the impact figures should be reasonably accurate, however.
- Government expenditures — provincial government expenditures are more related to population levels than to industry activity. As such, expenditures on education, health care and other government services are assumed to remain unchanged despite harvest changes and any subsequent change in government revenues. However, public expenditures would likely change if community population levels change sufficiently. This would amplify the community impacts of forestry job losses or gains.
- Proportional harvest reductions — harvest reductions are assumed to be spread evenly among all licensees and all forms of tenure.

B.2 Economic Impact Analysis Methodology

Data sources

Data for the socio-economic analysis were obtained from several sources. Harvest volume and stumpage data are from the Ministry of Forests. Timber flow and employment data are from responses to questionnaires that were sent to licensees, operators and processing facilities in the Strathcona TSA. Other general economic data are from BC STATS, the Ministry of Finance and Corporate Relations, Statistics Canada and local communities.

Person-year of employment

The unit of measurement for employment is a person-year. A person-year of employment is defined as a full-time job, which lasts at least 180 days per year. Part-time jobs were converted to equivalent full-time person-years of employment.

To estimate employment and income impacts associated with changes in TSA timber harvest levels, the forestry sector was divided into three sub-sectors:

1) harvesting;
2) silviculture; and
3) timber processing.

The procedure for estimating employment and income impacts involves several steps. The first step was to assess current activity in each of the three sub-sectors. This was followed by an estimate of indirect and induced employment and employment income impacts, using data from Ministry of Finance and Corporate Relations and Statistics Canada. Next, employment coefficients were calculated and then applied to the base case harvest forecast. Other indicators of the forestry sector's contribution to the provincial economy, such as government revenues and industry taxes were also calculated, using Ministry of Forests stumpage estimates and other data sources.

Employment — harvesting

Direct employment in harvesting consists of all woodlands related jobs including harvesting, log salvage, planning and administration functions. While log transport and hauling, road building and maintenance work are important activities in the forest industry, the employment multipliers used in this analysis define these activities as indirect rather than direct, as a result log transport and hauling, road building and maintenance employment are not included in the direct impact estimates; including these as direct would result in double-counting and an overestimation of employment impacts.

Data on employment, place of residence and timber flows were obtained through a survey of licensees and operators in the TSA. The information was then used to estimate employment averages associated with harvest changes and the proportion of resident versus non-residents who work in the TSA.

Two estimates of direct employment in harvesting were calculated:

1) TSA direct employment in harvesting — consists of employees who are engaged in harvesting and related activities within the TSA and who reside in communities within the TSA; and
2) Provincial direct employment in harvesting — consists of employees who are engaged in harvesting, as above, plus those workers who reside outside the TSA, but who come to the TSA to work in harvesting and harvesting related activities.

The estimates of TSA and provincial direct employment in harvesting were used to calculate employment coefficients on a per 1000 cubic metres basis. These employment coefficients were then used to estimate harvesting employment associated with the different harvest levels in the base case forecast.

B.2 Economic Impact Analysis Methodology

Employment — silviculture

Silviculture employment consists of all basic and intensive reforestation activities, including surveys, site preparation, planting, fertilizing, pruning and spacing. Silviculture employment data were collected from the Ministry of Forests and licensees whose tenures require post-harvest silviculture work. Most silviculture work is seasonal and silviculture employees usually only work part-time during the year. Because of this, silviculture jobs were converted into equivalent full-time person-years of employment. Respondents were also asked to provide estimates of the percentage of their silviculture employees who resided within the Strathcona TSA and outside the Strathcona TSA.

As with the harvesting sub-sector, two estimates of direct employment in silviculture were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for silviculture employment in the same manner as the employment coefficients for harvest employment.

Employment — timber processing

Information about employment, production and sources of timber was gathered from TSA mills. Information was also gathered as to whether timber harvested from the TSA was processed within the TSA or outside the TSA. This information indicates the degree of dependence the mills have on timber harvested within the TSA. To estimate the share of processing employment supported by TSA timber, mill employment was prorated by the relative contribution of timber from the TSA to a mill's total timber requirement. For example, if 80 % of a plant's timber requirement was supplied by the harvest from the TSA, then 80 % of the employment in the plant would be attributable to the TSA harvest.

Employment figures were also adjusted to reflect the residences of workers; i.e., those who lived within the TSA and those who lived outside the TSA. Employment in timber processing which is supported by chip by-products from milling operations was also estimated in a similar fashion.

As with the harvesting sub-sector, two estimates of direct employment in timber processing were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for timber processing employment in the same manner as the employment coefficients for harvest employment.

Indirect and induced employment estimates

Indirect employment in the forestry sector are those who work to provide goods and services to firms directly engaged in the basic forestry sector; for example, those who provide log transport services. Induced employment are those who work to provide the goods and services purchased by employees who are directly and indirectly engaged in the industry; for example, those who work in retail outlets. Indirect and induced employment figures were calculated using TSA and provincial employment multipliers developed by the Ministry of Finance and Corporate Relations.

Two sets of employment multipliers were used for this report: migration multipliers and no-migration multipliers. The migration multipliers assume that a displaced worker will leave the region, reducing total income in the region by his/her full wage. The no-migration multipliers assume that a displaced worker remains in the area, at least in the short term, and unemployment and other social safety net payments temporarily offset some of the income loss. Using the no-migration multipliers diminishes the degree of induced impacts associated with a change in direct employment.

B.2 Economic Impact Analysis Methodology

The TSA and provincial employment multipliers used in the Strathcona TSA analysis are shown in Table B-1.

Table B-1. Total employment multipliers for the Strathcona TSA, 1999.

Forest sub-sector	TSA migration multiplier	TSA no-migration multiplier	Provincial coastal migration multiplier	Provincial coastal no-migration multiplier
Harvesting	1.73	1.46	2.02	1.72
Solid wood processing	1.53	1.30	2.31	1.94
Pulp	1.81	1.51	2.54	2.13

Employment estimates of alternative timber supply levels

To estimate employment generated by alternative timber supplies, the forecasted harvest level is multiplied by the calculated employment coefficients. It should be noted that employment coefficients are based on current industry productivity, harvest practices and forest management assumptions and will not likely reflect industry operating conditions far into the future. Therefore, the employment estimates should be viewed as indicators of orders of magnitude of change rather than as precise estimates of changes in employment levels.

Employment income estimates

Employment income was calculated using average income estimates for workers in the forest industry. Income data is from *Statistics Canada Survey of Employment Payrolls and Hours*. In 1997, the average pre-tax annual income (less benefits) for sub-sectors of the forestry sector were approximately: $47,850 for logging and forestry services; $46,250 for solid wood manufacturing; and $54,990 for the pulp and paper sector. The weighted average annual income for direct forestry workers was $49,065. Indirect and induced employees averaged an annual income of $34,070 in 1997. This figure is based on a selection of business and personal service sectors, accommodation, food and beverage sector, and the construction sector average annual wages. Income taxes were calculated based on marginal tax rates of 23 to 28% with one-third of the total income tax accruing to the province.

B.2 Economic Impact Analysis Methodology

Provincial government revenues

Except for stumpage, royalty and rents, which are specific to the TSA, provincial government revenue impacts were estimated by using industry averages. Revenues per 1000 cubic metres of harvest, expressed as dollars per 1000 cubic metres, were calculated and applied to the harvest levels in the base case forecast in a manner similar to how employment impacts were estimated. See Table B-2.

Table B-2. Strathcona TSA provincial government revenue estimates

	Average revenue 1995-1997 ($1997 millions)	Revenue ($ per '000s m^3)
Stumpage, rents and royalties	32.7	27,790
Industry taxes	10.2	8,664
Provincial income tax	12.1	10,261
Total government revenues	55.0	46,715

Source: Ministry of Forests. Price Waterhouse.