Queen Charlotte Timber Supply Area Analysis Report

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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 accurately and rationally, 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 will expedite 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 industry 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. 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 regarding possible timber harvest levels and will provide a focus for public discussion. 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 B.C. Forest Service has examined the availability of timber in the Queen Charlotte Timber Supply Area (TSA). The analysis makes an estimate of the available timber supply in both the short and long term, assuming the continuation of current forest management practices. It also examines the potential changes in timber supply stemming from uncertainties about the land base available for timber harvesting, the forest inventory, forest growth and yield, and management actions. It is important to note that the many forecasts included in the report are intended only to show the timber supply implications of current management practices and uncertainty and are not allowable annual cut (AAC) recommendations. An allowable annual cut is determined by the chief forester after consideration of many factors, including but not limited to the results of this analysis.

The Queen Charlotte TSA covers a total of about 460 000 hectares. It is situated on Graham and Moresby Islands within the Queen Charlotte Islands, or Haida Gwaii. Of the total TSA area, only about 82 300 hectares is considered to contribute to the "timber harvesting land base" — the area available and suitable for timber harvesting. The area is dominated by stands of old-growth western hemlock, western redcedar and Sitka spruce.

The results of timber supply analysis indicate that, based on the current forest inventory, current management practices and the availability of the entire timber harvesting land base within the Queen Charlotte TSA — including the Duu Guusd area and Tlell River watershed — the AAC determined by the chief forester in May 1996, of 475 000 cubic metres, can be maintained for as long as five decades. The chief forester recently reduced the AAC for the Queen Charlotte TSA to 361 000 cubic metres corresponding to Cabinet designation of 148 000 hectares of the TSA under Part 13 of the *Forest Act*. The 1996 AAC will be called the pre-Part 13 AAC. After five decades the harvest level will need to decline to a sustainable long-term level of 323 000 cubic metres per year by the beginning of the ninth decade. This total timber harvesting land base (THLB) forecast represents an increase in the projection of available short-term and long-term timber supply compared to the results of the 1996 timber supply review analysis. The increase is attributed to a 7% increase in the estimated size of the economically operable timber harvesting land base and an increase of approximately 9% in the estimated yields from natural stands. Increases in yield estimates are the result of adjustments derived from an inventory audit and a timber decay and waste study.

The total THLB harvest forecast is highly dependent on contributions from the entire timber harvesting land base. However, there is uncertainty regarding the contribution from several areas within the TSA. The Tlell River watershed is subject to a short-term abeyance in harvesting to allow development of a local plan. This plan will be in place prior to April 2001. The Duu Guusd area has been deferred from harvesting after the passing of an Order-in-Council (OIC) identifying the Duu Guusd as a designated area. The OIC is in effect until December 31, 2000. The combined contribution of the Duu Guusd area and Tlell River watershed to the initial harvest level is 29% and 31% to the steady long-term sustainable harvest level.

Implementation of the *Forest Practices Code* (FPC), which was not fully accounted for in the last timber supply review, resulted in area being excluded from the timber harvesting land base to protect riparian areas, wildlife tree patches, sensitive soils and cultural heritage values. However, these exclusions have been more than offset by the addition of areas excluded in the last timber supply review due to inoperability or objectives to preserve visual quality. Approximately 77% of the forested area within the Queen Charlotte TSA is not considered part of the timber harvesting land base. Therefore, biodiversity guidelines that specify a minimum amount of older forest to be retained in the TSA are met without significant limitations on timber availability from the timber harvesting land base. The analysis indicated that the full range of seral stage requirements (early, mature-plus-old, and old) from the *Biodiversity Guidebook* can be applied without significant effect on the timber supply forecast.

Executive Summary

The timber supply analysis uses timber volume estimates that incorporate adjustment ratios derived from the inventory audit of the Queen Charlotte TSA. If these adjustments are not applied, a harvest level of 475 000 cubic metres can be maintained for only one decade before stepping down to the steady long-term level.

Sensitivity analysis indicates that as long as timber harvesting will be allowed in areas currently deferred from harvesting, and if existing mature stand yield estimates are accurate to within 10%, short-term timber supply in the Queen Charlotte TSA is not significantly affected by uncertainties in data and management assumptions. Changes in data and management assumptions do however increase or decrease the amount of time over which a harvest level of 475 000 cubic metres can be maintained. In addition, some uncertainties affect medium- and long-term timber supply, in particular assumptions that define economic operability, including the operability of low-volume cedar stands and minimum harvestable ages. Also, sensitivity analysis based on results of recent site productivity research in managed forests suggests that long-term timber supply, could be substantially higher than in the total THLB forecast.

The socio-economic analysis for the Queen Charlotte TSA indicates that the current, post-Part 13 AAC of 361 000 cubic metres, if fully harvested, can support a provincial total of about 450 person-years of direct employment. Residents of the Queen Charlotte TSA account for about 24% of this direct employment. Total provincial direct employment associated with the Queen Charlotte TSA forestry sector supports a further 560 person-years of indirect and induced employment across the province. At the pre-Part 13 AAC of 475 000 cubic metres, and assuming the timber supply is fully harvested, the TSA could support about 590 person-years of direct employment across the province.

From 1997 to 1999, the average annual harvest rate was 272 000 cubic metres per year and supported about 340 person-years of direct employment across the province.

If the harvest were to drop immediately to the long-term harvest level of 323 000 cubic metres per year suggested in the total THLB forecast, the Queen Charlotte TSA could support about 400 person-years of direct employment across the province and a further 500 person-years of indirect and induced employment. If the harvest level were reduced to 255 000 cubic metres per year, it would support about 320 person-years of direct employment across the province.

Provincial government revenues associated with the current, post-Part 13 AAC of 361 000 cubic metres would average about $15.0 million per year, if the timber supply were fully harvested. Increasing the timber supply to 475 000 cubic metres per year would generate government revenues of $19.7 million per year.

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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 harvesting. 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 viability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

All of these factors are linked: the financial viability 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 patterns. 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 viability 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 and assumptions 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. 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
The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
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, in which the B.C. Forest Service forest inventory* plays a major role. The second step is using this 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.

Sections 1 through 7 outline the timber supply analysis for the Queen Charlotte TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2 and critical issues are discussed in Section 3. Analysis methodology and results are presented in Sections 4 and 5. Section 6 examines the sensitivity of the results to uncertainties in the data and assumptions used. A summary and conclusions of the timber supply analysis are provided in Section 7. Appendix A, "Descriptions of Data Inputs and Assumptions for the Timber Supply Analysis" contains further details about the data and assumptions used in this analysis.

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, presented in section 8, provides information for the chief forester and the local community to better understand the potential magnitude of impacts associated with any proposed harvest level changes.

The socio-economic analysis considers the current and projected levels of forestry activity associated with the Queen Charlotte TSA within the context of regional timber supplies and production capacity. It does this by examining the profile of the region and the local forest industry; and by undertaking a socio-economic analysis using the harvest forecasts as projected in the total THLB forecast.

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*. 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.

Forest inventory
An 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 other forest values such as recreation and visual quality.
Person-year(s)
One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.

Introduction

Indirect and induced* employment figures were calculated using the Queen Charlotte 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 necessarily reflect industry conditions decades into the future. As such, the employment estimates can only be viewed as order of magnitude indicators

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.
Employment 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.

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.
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 Queen Charlotte Timber Supply Area

The Queen Charlotte Timber Supply Area (TSA) lies entirely within the Queen Charlotte Islands, or Haida Gwaii, a group of more than 150 islands located approximately 90 kilometres off British Columbia's north coast. The TSA is part of a larger administrative unit known as the Queen Charlotte Islands Forest District, which is part of the Vancouver Forest Region. The Queen Charlotte TSA is administered from the forest district office in Queen Charlotte City. See map in Figure 1.

The total area of the Queen Charlotte Islands-Haida Gwaii is about one million hectares. The Queen Charlotte TSA covers approximately 45% of the Islands (460 000 hectares), parks and park reserves cover 22% (229 000 hectares), and tree farm licence (TFL)* areas cover 32% (324 000 hectares). Most of the Queen Charlotte TSA is located on Graham Island, the more northerly of the two major islands of the Queen Charlotte group. A relatively small portion of the TSA is situated along the northwest coast of Moresby Island.

The rugged, steep terrain of the Queen Charlotte Ranges dominates the west coast of Graham Island, producing a rain shadow effect; annual precipitation on the west coast averages more than 4,000 mm while on the east coast it averages about 1,300 mm. The relatively flat and poorly drained Queen Charlotte lowlands dominate the east side of the island, while the Skidegate Plateau dominates the centre of the island. Where soil drainage* and nutrient conditions are favourable, forests in the Queen Charlotte TSA can achieve some of the fastest growth rates on the B.C. coast. Approximately 77% of the TSA is considered productive forest area (about 354 000 hectares) and 18% of the TSA (about 82 300 hectares) is currently available for timber harvesting.

The dominant (by volume) tree species in this TSA are western and mountain hemlock (46%), western redcedar (37%) and Sitka spruce (17%). The majority of the existing forest is mature and old (79%) and almost two-thirds of this mature and old forest occupies poorer growing sites.

On May 1, 1996, the chief forester reduced the allowable annual cut (AAC) for the Queen Charlotte TSA from 514 335 cubic metres to 475 000 cubic metres, of which 75 000 cubic metres were specific to low-volume cedar stands. On December 16, 1999, the chief forester temporarily reduced the AAC to 361 000 cubic metres, following the provincial government's decision to declare the Duu Guusd a designated area under Part 13 of the *Forest Act*. This AAC reduction will remain in effect until the Duu Guusd ceases to be a designated area. The Order-in-Council designating the Duu Guusd is currently in effect until December 31, 2000.

Tree farm licence (TFL)
Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.
Drainage
The surface and sub-surface water derived within a clearly defined catchment area, usually bounded by ridges or other similar topographic features, encompassing part, most, or all of a watershed. The term is sometimes used to describe an operating area or location.

1 Description of the Queen Charlotte Timber Supply Area

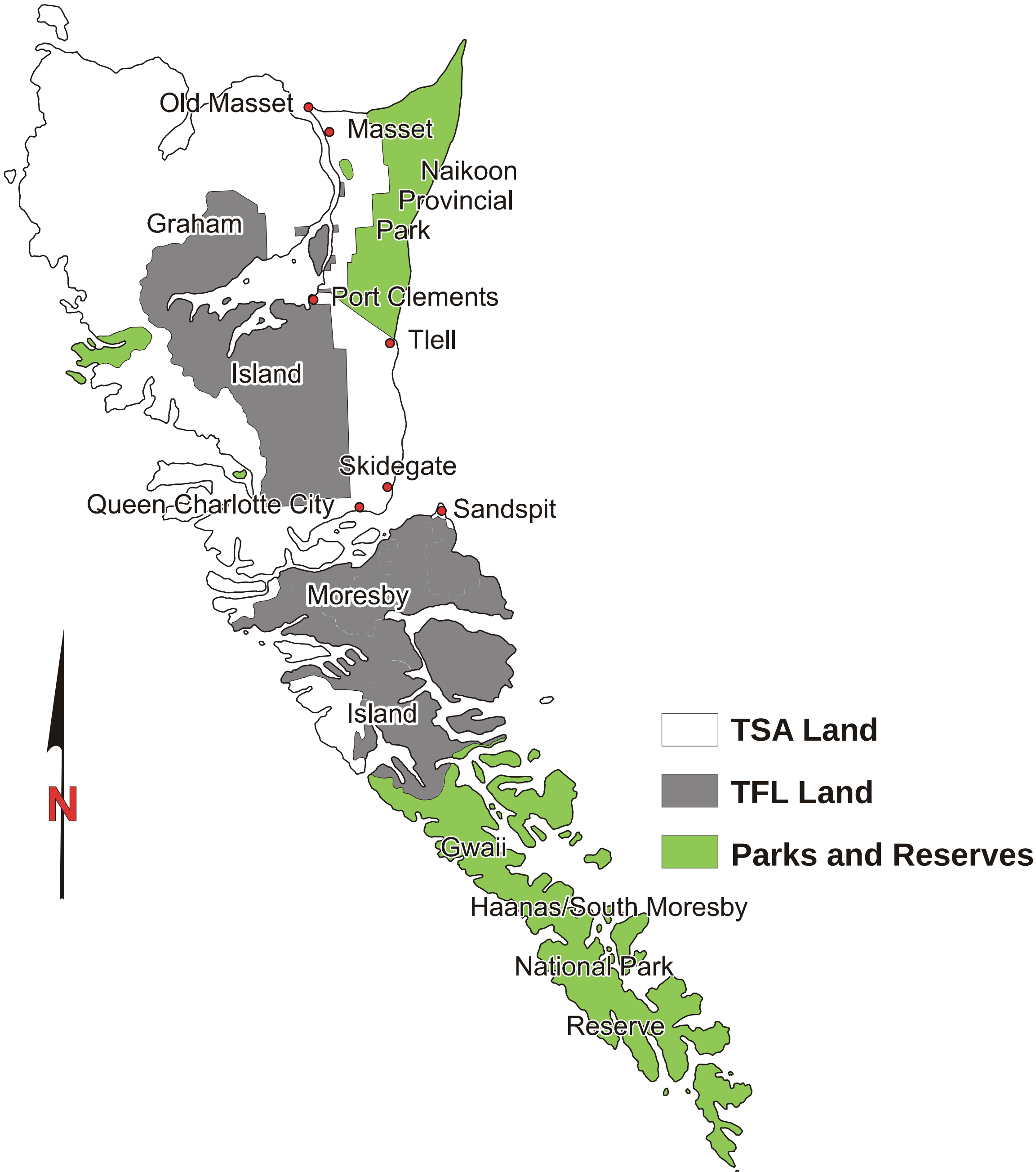

Figure 1. Map showing the Queen Charlotte Timber Supply Area in the Vancouver Forest Region.

1 Description of the Queen Charlotte Timber Supply Area

Communities on the Queen Charlotte Islands include Queen Charlotte City, Sandspit, Skidegate, Tlell, Port Clements, Masset and Old Masset. The Islands attract visitors from all parts of the world as a place to explore the west coast rain forest and associated marine environments. South Moresby National Park Reserve on Moresby Island and Naikoon Class A Provincial Park provide visitors with large tracts of pristine wilderness in a world class setting. Recreational opportunities in the Queen Charlotte TSA include kayaking, beachcombing, hiking alpine ridges and exploring old-growth forests.

1.1 The environment

The Queen Charlotte TSA contains three biogeoclimatic zones*. The dominant zone is the Coastal Western Hemlock (CWH) zone, which covers about 97% of the TSA. This zone is a mosaic of low productivity forests in lowland areas, and highly productive forests on floodplains and on moderate to steep slopes. Forests in this zone are dominated by western hemlock, western redcedar, Sitka spruce and yellow-cedar (cypress). Shore pine, western yew and mountain hemlock are also present. Deciduous* species are rare, mainly consisting of red alder along rivers and in some previously harvested areas.

Two subzones of the CWH zone occur on the Queen Charlotte Islands. The very-wet, hypermaritime (CWHvh) subzone occurs on the windward side of the Queen Charlotte Ranges, and a wet, hypermaritime (CWHwh) subzone occupies the rolling plateau and lowlands east of the Ranges. The most productive forest communities in the CWH zone are found on recently deposited alluvial materials adjacent to streams and rivers and are typically dominated by large Sitka spruce. Vigorous hemlock-spruce stands occur at lower elevations on well-drained slopes while similar stands with a yellow-cedar component occur at higher elevations. Less vigorous spruce stands occur on sandy soils behind marine beaches and on rocky headlands exposed to sea spray. Low productivity forest communities occur widely in the CWH zone on the poorly drained, flat terrain of the eastern portion of the Skidegate Plateau and the Queen Charlotte Lowlands. Western redcedar and western hemlock often dominate these areas.

Biogeoclimatic zones
A large geographic area with broadly homogeneous climate and similar dominant tree species.
Deciduous
Deciduous trees commonly have broad-leaves and usually shed their leaves annually.

The second major biogeoclimatic zone is the Mountain Hemlock (MH) zone, which makes up about 3% of the TSA. The MH zone generally occurs at high elevations, between 500 and 900 metres on the windward side of the Queen Charlotte Ranges and on the Skidegate plateau. Mountain hemlock dominates the MH zone although yellow-cedar is also present and western hemlock, western redcedar and Sitka spruce occur as minor species.

The Alpine Tundra (AT) zone makes up less than one per cent of the TSA. This zone is found above 800 metres and is characterized by heaths, meadows and steep rocklands.

The Queen Charlotte Islands are home to many wildlife species that are distinct from continental forms, including species of deer mouse, dusky shrew and short-tailed weasel and subspecies of black bear and pine marten (both larger than their mainland cousins). In addition, numerous introduced species such as black-tailed deer, raccoons, squirrels, beaver and three species of rats are thriving on the Islands, to the detriment of native plants and animals.

The Islands lie along an important flyway for migratory birds and are one of the more important seabird nesting areas in the north Pacific Ocean. Streams support significant spawning runs of salmon, steelhead and cutthroat trout.

A number of species are considered to be at risk either because of conflicting human activities or because of alterations to their habitats. The majority of species that are considered at risk and that are endemic to the islands are either red listed or blue listed in British Columbia. These species are shown in Table 1.

Table 1. Vulnerable, endangered and threatened species

Endangered or threatened (red-listed)	Vulnerable (blue-listed)
northern (Queen Charlotte) goshawk	ancient murrelet
marbled murrelet	Cassin's auklet
horned puffin	sandhill crane
pelagic cormorant	northern saw-whet owl (*brooksi*)
common murre	great blue heron
thick-billed murre	short-eared owl
Keen's long-eared myotis	Queen Charlotte Steller's jay
northern sea lion	Peregrine falcon (*pealei*)
Haida ermine (weasel)	tufted puffin
giant black stickleback	short-billed dowitcher
	surf scoter
	hairy woodpecker (*picoideus*)
	pine grosbeak (*carlottae*)
	killer whale

Source: B.C. Conservation Data Centre, April 26, 1999.

One mammal and five bird species endemic to the Islands are designated identified wildlife under the *Forest Practices Code* and require special management of critical habitats in order to maintain or restore populations or distributions. These species are Keen's long-eared myotis, northern (Queen Charlotte) goshawk, sandhill crane, marbled murrelet, ancient murrelet and Cassin's auklet. Of these, only the habitats of the Queen Charlotte goshawk and the marbled murrelet occur on the operable land base and require special consideration in this timber supply review. The draft Identified Wildlife Management Strategy (IWMS) indicates the kind of measures which could eventually be adapted for goshawk nesting areas. The impact of the measures outlined in the draft IWMS are examined through a sensitivity analysis discussed later in this report. The draft IWMS also recommends that the *Biodiversity Guidebook* old-seral stage retention requirements be adopted to protect marbled murrelet habitat. These requirements are incorporated into the timber supply analysis.

The Keen's long-eared myotis has one of the smallest geographic ranges of any bat species, and is red-listed in B.C. due to its limited distribution, apparent rarity and the lack of knowledge about its basic biology. The only known maternity colony is located on Hot-Springs Island in Gwaii Hanaas. Tree cavities, loose bark, rock crevices and small caves are likely important as day and maternity roosts.

The Queen Charlotte goshawk is a subspecies of the northern goshawk and is red-listed because its population is sparse, restricted to coastal forests and heavily reliant on mature to old growth. The Queen Charlotte goshawk's home range includes nest sites, nest areas, a post-fledging area and a foraging area. The nest area, which may contain several nest sites, is usually about 12 hectares and is characterized by large, old trees with a dense canopy. The post-fledging area is usually about 240 hectares, including the active nest area and a number of alternate nest areas. It is characterized by an abundance of habitat attributes critical for goshawk prey (snags, coarse woody debris*, forest openings) and areas with dense canopy that provide protection to fledglings. The foraging area may cover up to 2400 hectares, including the post-fledgling area, and may contain a diversity of landforms and forest cover types.

The sandhill crane is a blue-listed species because of the lack of information on breeding populations, as well as habitat loss and degradation in other parts of the province. The crane roosts and feeds in open wetlands such as estuaries, dry upland areas and bogs, swamps, marshes and fens. It nests in secluded freshwater wetlands.

The marbled murrelet, a small seabird found along the coast from California to Alaska, is red-listed because it is believed to have suffered loss of nesting habitat in old-growth forests and mortality caused by drift netting and oil spills. The reproductive rate of the marbled murrelet is very low and nest predation by jays, ravens, crows and raccoons is high. Habitat protection for the marbled murrelet will be handled through old-growth retention objectives in landscape unit* planning.

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

The ancient murrelet, also a small seabird, is blue-listed primarily due to threats from introduced predators, such as rats and raccoons, and mortality caused by oil spills and gill nets. The ancient murrelet feeds primarily on plankton in areas of ocean upwelling and comes to land only to breed. It nests in burrows up to 500 metres inland on forested islands where the major tree species are Sitka spruce, western hemlock and western redcedar.

The Cassin's auklet is another small seabird that is blue-listed due to threats from introduced predators and to mortality caused by oil spills and gill nets. Cassin's auklet feeds in offshore waters along most of the outer coast and comes to land only to breed from late spring through summer. The auklet is a burrow-nester, occupying sites with grassy or low shrub cover. Most colonies in the Queen Charlotte's are on the perimeter of islands forested with Sitka spruce, western redcedar and western hemlock.

Current forest management practices follow the legislation and guidelines set out by the *Forest Practices Code*. Consequently, the protection of wildlife and the environment will be managed through the *Code*, including the *Identified Wildlife Management Strategy*.

The province recognizes the need to resolve complex issues related to land and resource management on the Queen Charlotte Islands. These issues are normally resolved through strategic land use planning, interim measures negotiations or treaty. Once decisions have been made, the Chief Forester will consider them in future timber supply reviews."

1.2 First Nations[1]

The Queen Charlotte Islands-Haida Gwaii has been home to the Haida people for as long as oral history and archaeology have recorded occupation of the islands. Up to 14,000 people have lived in over 126 known village sites at one time. Today, most Haida are members of one of two Haida Bands; between 2,200 and 2,300 people are registered as Old Masset Band members and about 1,500 are registered as Skidegate Band numbers according to the 1996 census information. Two out of three Haida live away from the Islands.

Haida people belong to matrilineal clans that belong in turn to either the Raven or the Eagle moiety*. In 1998, hereditary clan chiefs, the Councils of Skidegate and Old Masset, and representatives of the urban councils of Haida in Vancouver and Prince Rupert formalised an agreement referred to as the *Haida Accord*. The accord provided a framework for the Council of the Haida Nation, the Band Councils, and hereditary chiefs to work together in relation to the provincial and federal governments on matters dealing with land and resources. To guide the Council, a House of Assembly was formed and is open to all people with Haida ancestry.

In December 1993, a statement of intent was filed to pursue treaty negotiations with the provincial and federal governments. The Council of the Haida Nation has not moved beyond stage 2 of the treaty process with the intent of having more favourable conditions for negotiation. From their viewpoint, favourable conditions may result from a number of pending initiatives. First, a higher court may be asked to make a decision on whether the Haida hold aboriginal title to its traditional territories. Second, a higher court ruling may be pending on how Haida title (or claims) could affect area-based tenures issued by the province. Third, the House of Assembly may demonstrate that the political will exists to pursue Haida interests through the treaty process.

The forest and other resources of the land and marine environments have been and continue to be used by the Haida people. Food, shelter, medicines, and an extensive artisan culture have been derived from over 200 species of plants. Some physical evidence of this usage, principally in the form of culturally modified trees (CMTs), has been lost to commercial logging and large wildfires. Much of the Haida cultural expression depends on yellow and red cedar. The demand for all age classes of these trees appears to be increasing, being driven by the current renaissance of Haida art, particularly for monumental trees suitable for canoes, poles and longhouses.

Moiety
One of two complementary tribal subdivisions. The Haida consist of two moieties – the Raven and the Eagle.

[1] This passage was taken from *Queen Charlotte Islands – Haida Gwaii Background Report* – Draft, July 1999, Prince Rupert Interagency Management Committee.

Interest in the economic opportunities of forestry has also increased, in part as a result of declining opportunities in fishing. Fourteen areas of forestland have been declared as protected by the Council of the Haida Nation or by the Haida House of Assembly. Resolution of issues arising from these declarations has yet to be successfully negotiated. On October 6, 1999, the B.C. government passed an Order-in-Council identifying the area known as Duu Guusd as a designated area until April 1, 2000. The designation was invoked for several reasons including the Haida interest in the area, support of island communities for the deferral and because part of the area falls within the Protected Areas Strategy study area. On December 16, 1999, the chief forester temporarily reduced the AAC by 24% for the Queen Charlotte TSA. The order-in-council has been extended until December 31, 2000. The AAC reduction will remain in place until the Duu Guusd ceases to be a designated area.

Although negotiations have been underway between the Ministry of Forests, the Council of Haida Nations and Indian and Northern Affairs Canada to address forest management issues in the Duu Guusd and other areas, they are currently in abeyance due to ongoing litigation.

2 Information Preparation for the Timber Supply Analysis

Information required for timber supply analysis can be divided 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 was assembled into a computer file by the Vancouver Forest Region, B.C. Forest Service in 1999. This file contains information on the forest land in the Queen Charlotte TSA including: location, area, type of forest cover (such as presence or absence of trees, species, number of trees, age, and timber volume), and other notable characteristics such as environmental sensitivity and physical accessibility and harvest system suitability. Stand characteristics such as average tree height, tree age and stocking* were projected to 1999 and the forest cover information was updated to account for timber harvesting up to 1997.

The inventory file represents the land base for the entire TSA. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur (e.g., land set aside for parks, land needed to protect wildlife habitat and right-of-ways for highways). These areas do not contribute to the timber supply of the TSA and were separated from the timber harvesting land base (THLB)*. Care was taken to avoid double counting when an area was unavailable for harvesting for more than one reason (e.g., where a park area is also suitable for wildlife habitat).

Areas that do not contribute to timber supply are not removed from the Queen Charlotte TSA. The B.C. Forest Service still manages the entire area of the TSA (except for certain areas under the jurisdiction of other agencies) as a land unit that contributes a mix of forest values.

For the Queen Charlotte TSA, the following types of land do not currently contribute to the timber harvesting land base:

- land not administered by the British Columbia Forest Service for timber supply (e.g., federal land, private land, parks);
- non-forest areas — areas not occupied by productive forest cover (e.g., rock/ice, swamp, alpine areas and water bodies);
- land not capable of supporting commercial forest cover — areas occupied by brush or non-commercial tree species;
- land inaccessible or inoperable due to difficult terrain (e.g., areas too steep to safely fall timber);
- areas with low timber productivity — areas incapable of producing timber of sufficient quantity and value to allow for economically viable harvest;
- environmentally sensitive areas* — areas with sensitive soil that may be damaged by harvesting activities and areas with high avalanche hazard;
- areas with outstanding recreational, educational, scientific or heritage value that are more appropriately managed exclusively for recreational values (e.g., campgrounds, trails and lookout sites);

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.

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.

- areas reserved from harvesting to protect important cultural heritage features (e.g., areas where culturally modified trees occur);
- wildlife tree reserves and streamside reserves and buffers required to protect fisheries and water quality;
- areas occupied by permanent roads, trails and landings.

Areas that have been deferred from harvesting because they are contentious or are under study, such as the Haida declared areas, study areas identified under the *Protected Areas Strategy* and the Tlell River watershed* are not normally removed from the timber harvesting land base. However, a number of alternative land base forecasts were generated to examine the effect of excluding or deferring logging in different combinations of these areas.

A more detailed description of the criteria used to determine the timber harvesting land base is provided in Appendix A, "Descriptions of Data Inputs and Assumptions for the Timber Supply Analysis." Table 2 summarizes the area excluded in each of the above categories when defining the timber harvesting land base.

Watershed
An area drained by a stream or river. A large watershed may contain several smaller watersheds.

Table 2. Timber harvesting land base for the Queen Charlotte Timber Supply Area

Land base classification	Land base reductions (hectares)[a]	Land base area (hectares)	Per cent (%) of the total TSA land area	Per cent (%) of BCFS managed forest area
Total area on inventory file[b]		**1 386 981**		
Total area in Queen Charlotte TSA		**979 456**		
Marine and fresh water	519 365			
Land area in Queen Charlotte TSA		**460 091**	**100.0**	
Federal lands and reserves	6 589		1.4	
Lands not managed by B.C. Forest Service	9 212		2.0	
Non-forest	78 632		17.1	
Non-productive forest	11 305		2.5	
Total productive forest managed by the B.C. Forest Service		**354 353**	**77.0**	**100.0**
Ecological reserve areas	1 621		0.4	0.5
Unmerchantable forest types*	8 346		1.8	2.4
Inaccessible and inoperable areas*	54 999		12.0	15.5
Uneconomic and low site stands	165 331		35.9	46.7
Environmentally sensitive areas	8 333		1.8	2.4
Areas with high recreation values	2 412		0.5	0.7
Areas with unstable soils	13 574		3.0	3.8
Riparian management areas	9 774		2.1	2.8
Areas with cultural/heritage values	5 757		1.3	1.6
Wildlife tree reserve areas	593		0.1	0.2
Unmapped roads	1 240		0.3	0.3
Total current reductions	**271 980**	**– 271 980**	**– 59.1**	**– 76.8**
Current timber harvesting land base[c]		**82 373**	**17.9**	**23.2**
Future reductions				
Future roads	4 842	– 4 842	–1.1	– 1.4
Long-term timber harvesting land base		77 531	16.9	21.9

(a) Reductions were applied in the order presented.
(b) Total area on file contains a large area not within the TSA, such as provincial parks, tree farm licences and private lands. None of these areas contribute to the TSA timber supply but the 55 858 hectares of parkland outside the TSA in landscape units that overlap the TSA do contribute to biodiversity requirements in the analysis.
(c) Current timber harvesting land base includes 3,752 hectares of Not Satisfactorily Restocked (NSR) land and 2,069 hectares of Timber License lands. Timber Licence areas are initially excluded from the timber harvesting land base and added after the licence areas are projected to be harvested and regenerated.

2 Information Preparation for the Timber Supply Analysis

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 consideration for other resources.

Figure 2 illustrates the proportion of the Queen Charlotte TSA within various classes of forested and non-forested land. Approximately 17% of the Queen Charlotte TSA is non-forest (primarily alpine areas, rock and swamp), 3% is non-productive forest and 3% is productive forest not managed by the B.C. Forest Service (parks, reserves and private lands). Areas that are productive forest but are not available for timber harvesting (due to access, unstable terrain or requirements for other values) make up 59% of the TSA. The total timber harvesting land base makes up 18% of the TSA.

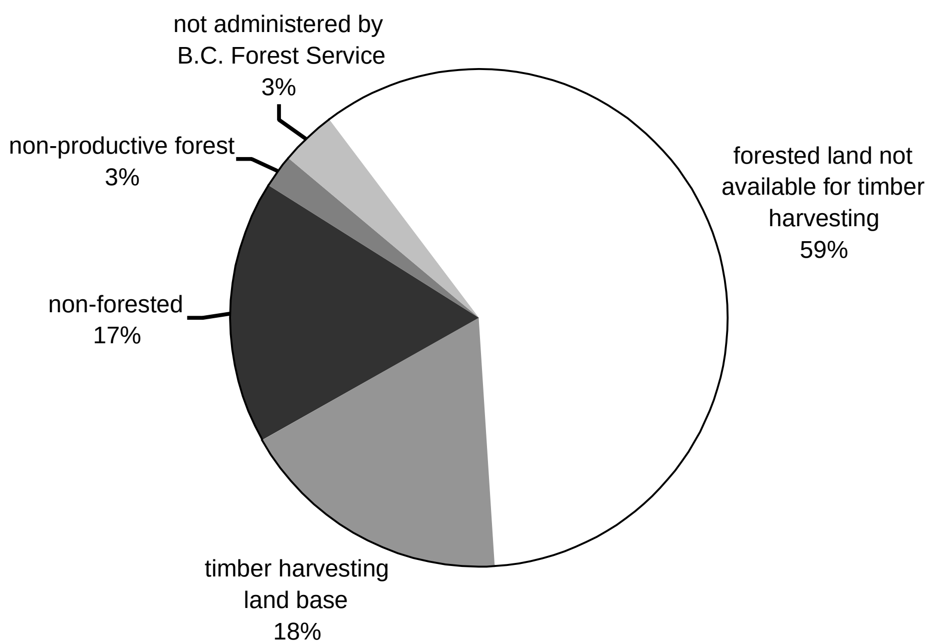

Figure 2. Timber harvesting land base as proportion of the entire Queen Charlotte TSA — Queen Charlotte TSA, 2000.

Figure 3 is a chart of the productive forest area within the Queen Charlotte TSA subdivided into timber harvesting land base and three other classes of non-contributing forest. Inoperable, inaccessible and non-merchantable areas make up about 65% of the productive forest. Environmentally sensitive areas, including recreation reserves and potentially unstable terrain make up 7% of the productive forest area. In-block reserves, including riparian management areas, cultural/heritage reserves and wildlife tree patches together with unmapped roads make up 5% of the productive forest. The remaining timber harvesting land base constitutes 23% of the productive forest within the Queen Charlotte TSA.

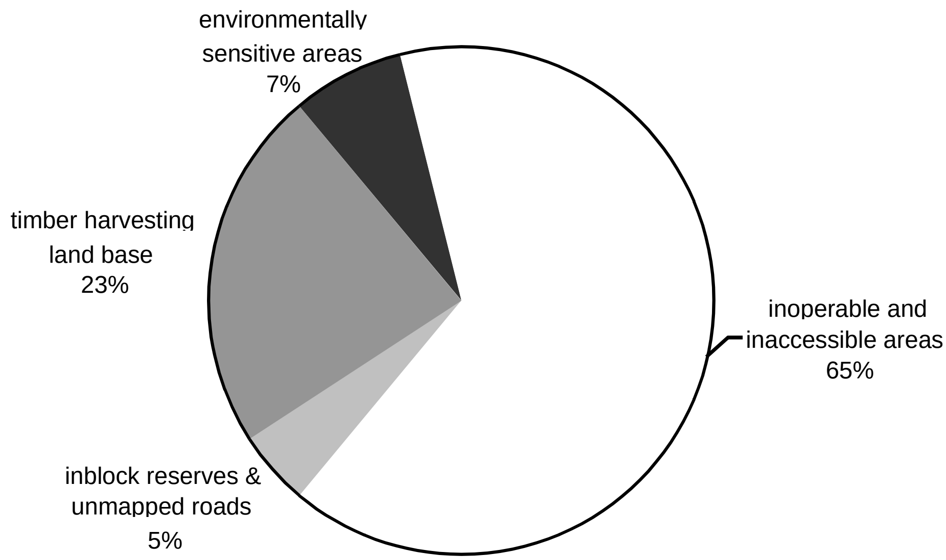

Figure 3. Timber harvesting land base as a proportion of the productive forest area — Queen Charlotte TSA, 2000.

The distribution of timber harvesting land base among stands grouped by leading tree species and stand age is shown in Figure 4. Hemlock stands predominate, covering approximately 46% of the timber harvesting land base; cedar-leading stands cover 37% of the timber harvesting land base and Sitka spruce-leading stands cover the remaining 17%.

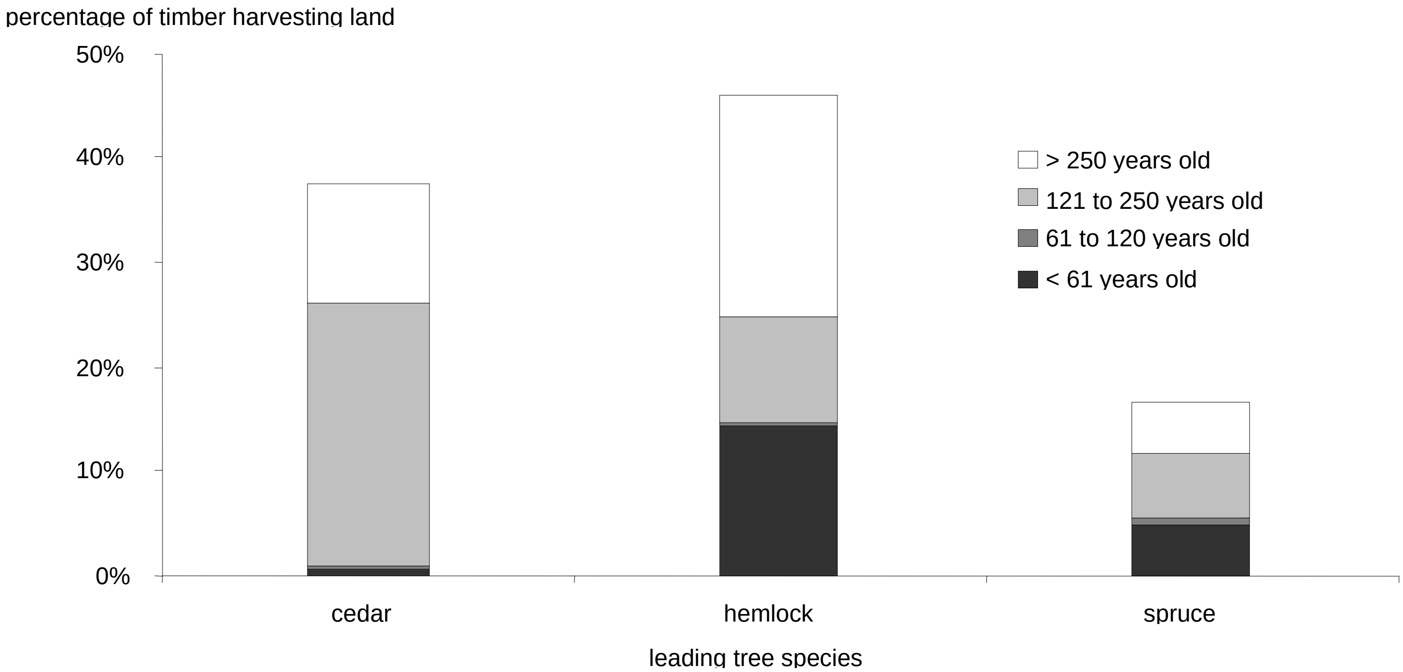

Figure 4. Percentage of the timber harvesting land base under each species broken down by age class — Queen Charlotte TSA, 2000.

The majority of stands are over 120 years of age, with 38% greater than 250 years old and 41% between 121 and 250 years old. The large cohort of cedar stands in the 121 to 250 year-old group is due, in part, to a forest fire that swept through a large portion of central and eastern Graham Island in the 1860's. Only 2% of the timber harvesting land base is between 61 and 120 years old and 19% is 60 years of age or younger. The latter group is comprised primarily of stands that originated from previous timber harvesting within the Queen Charlotte TSA.

Figure 5 shows the distribution of the timber harvesting land base among the three stand productivity classes defined for this analysis. Stands were assigned to each class based on leading species and site index*. The site index thresholds separating each class are provided in Appendix A, "Descriptions of Data Inputs and Assumptions for the Timber Supply Analysis." (These thresholds were chosen to divide the stands in each species group into classes of approximately uniform areas, and are not the same as those used to delineate historic site classes in the forest inventory program).

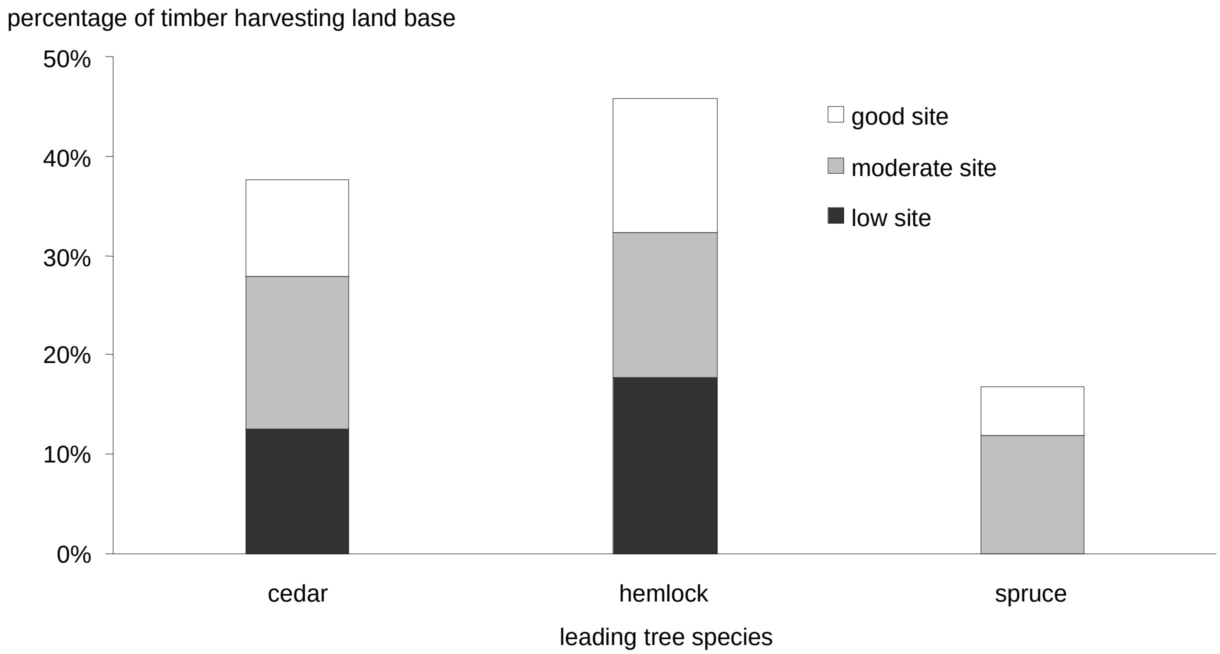

Figure 5. Percentage of the timber harvesting land base under each species broken down by productivity group — Queen Charlotte TSA, 2000.

A significant portion of the timber harvesting land base is occupied by western redcedar and western hemlock-leading stands on poor and low productivity sites. These forests occur widely over the poorly drained lowland areas of the Skidegate Plateau and Queen Charlotte lowlands. Stands on good sites occur in areas of recently deposited alluvial soils along rivers and on freely-drained slopes. The best sites are generally dominated by Sitka spruce or western hemlock.

Recent studies by the Ministry of Forests indicate that site index is underestimated for old-growth stands in the Queen Charlotte Islands Forest District, and elsewhere in the Province (Nigh 1998, Nussbaum 1998). Underestimated site index may skew the distribution of stands among the site classes shown here and may result in underestimated yield projections for second-growth stands. This issue is examined in Section 6.16, "Sensitivity to changes in productivity estimates for future stands."

Site index
A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.

The current age distribution of productive forest inside and outside the timber harvesting land base is illustrated in Figure 6. Ninety per cent of the productive forest within the TSA is over 120 years of age, and approximately two-thirds is over 250 years of age.

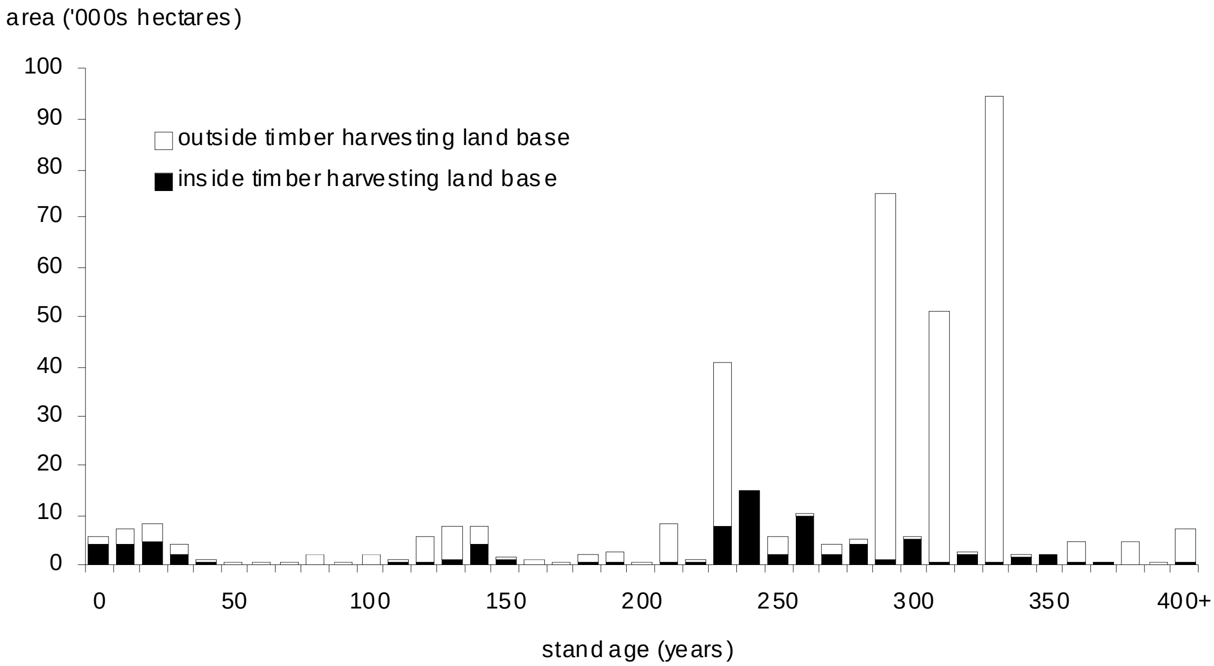

Figure 6. Age class distribution of productive forest inside the total timber harvesting land base and outside the timber harvesting land base — Queen Charlotte TSA, 2000.

Most of the forest outside the timber harvesting land base is old. Although not directly contributing to timber supply, these areas can effect the timber supply forecast by providing for non-timber values such as wildlife habitat, biodiversity* and wilderness recreation, and by reducing the extent to which these values must be achieved on the timber harvesting land base.

The large variation in area in non-contributing forest age classes between 290 and 330 years results because the interpretation of stand age is less precise in very old forests. The distribution of area between these age groups is probably more uniform than shown. The effects of the forest fire that occurred on Graham Island in the 1860s, and of logging over the last 60 years are evident in the current age distribution.

The timber harvesting land base comprises two biogeoclimatic (BEC) zones, three BEC sub-zones and five BEC variants. The distribution of timber harvesting land base among these is shown in Figure 7. A more detailed description of ecosystems found in the Queen Charlotte TSA is provided in Section 1, "Description of the Queen Charlotte Timber Supply Area."

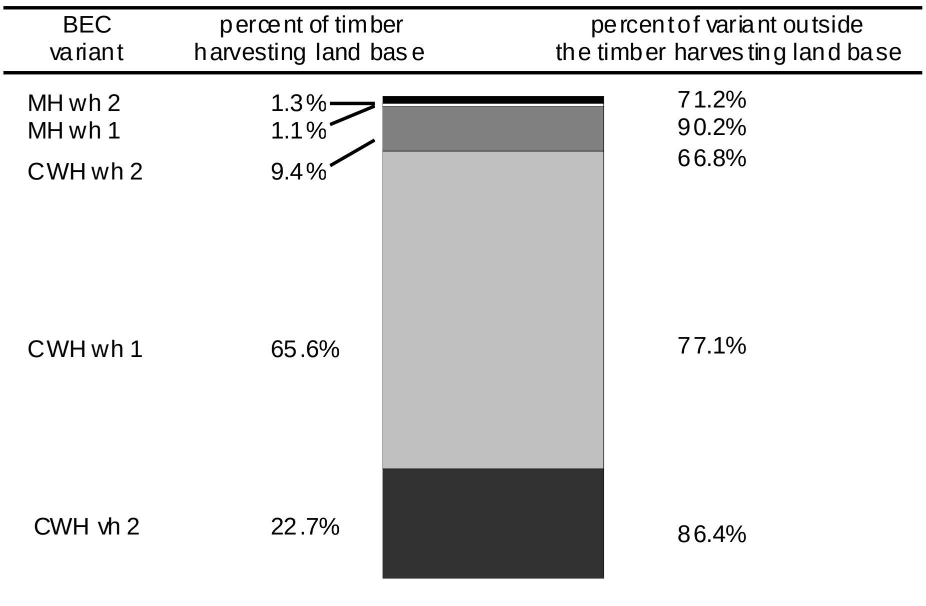

Figure 7. Distribution of timber harvesting land base among biogeoclimatic classes — Queen Charlotte TSA, 2000.

Over 97% of the timber harvesting land base is within the Coastal Western Hemlock (CWH) zone, of which 75% is within wet hypermaritime variants (i.e., influenced substantially by maritime conditions — CWH wh1, CWH wh2) and about 23% is within the very-wet hypermaritime (CWH vh1) variant. Figure 7 also lists the percentage of the total productive forest land within each variant that is outside the timber harvesting land base. These figures provide an indication of the significant amount of forest available outside the timber harvesting land base that can assist in meeting forest cover requirements.

2.2 Timber growth and yield

Growth and yield refers to the prediction of future growth and development of forest stands, and estimates of timber volumes that may be harvested. Forest stands have many characteristics that change over time such as: number of trees per hectare, tree diameter, tree height, and species composition. Since timber supply analysis concentrates on timber supply volumes available over time, the most relevant measure is volume per hectare. Timber volume estimates are made assuming a specific utilization level which establish the minimum tree and log sizes that must be utilized from a site. The dimensions assumed in this analysis are presented in Section 2.3, "Management practices."

Two growth and yield models were used to estimate timber volumes for the Queen Charlotte TSA analysis. The variable density yield prediction (VDYP) model developed by the B.C. Ministry of Forests, Resources Inventory Branch, was used for estimating timber volumes for all existing 'naturally established' stands. The table interpolation program for stand yields (TIPSY) developed by the B.C. Ministry of Forests, Research Branch, was used to estimate timber volumes for managed stands.

Initially, managed stands include a percentage of stands less than 40 years old. The percentage varies with age as specified in Appendix A "Descriptions of Data Inputs and Assumptions for the Timber Supply Analysis." All others stands are assumed to be naturally established and are replaced by managed stands if harvested.

In 1998, two forest inventory projects were completed which contributed to the revision of estimates of current and future timber volume for the Queen Charlotte TSA inventory. The first was the *QCI Volume and Decay Study*[2] and the second was the *Inventory Audit for the Queen Charlotte TSA*[3]. The *QCI Volume and Decay Study* provided new stand volume, decay and waste estimates for the Queen Charlotte Islands using a newly developed, unbiased decay sampling methodology. These estimates were designed to replace the old Forest Inventory Zone (FIZ) based estimates. Results of the study included unbiased adjustment ratios for correcting stand volume, decay and waste estimates for the TSA.

[2] Flewelling J.W. 1998 Volume and Decay Monitoring Analysis: the QCI Methodology (review draft). A report prepared for the B.C. Ministry of Forests, Resources Inventory Branch.

[3] Jahraus, K. and A.Y. Omule, 1999 Queen Charlotte Islands TSA Timber Supply Analysis Adjustment proposed FIP File Adjustment Process. A report prepared for the B.C. Ministry of Forests, Resources Inventory Branch,

2 Information Preparation for the Timber Supply Analysis

The forest inventory audit was conducted to test the accuracy of the TSA volume estimates and, if necessary, to derive adjustment ratios to correct stand volumes. Sixty-seven mature stands (older than 60 years) were sampled among five stand types: cedar-young (less than 200 years old), cedar-old, hemlock-on-good-sites, hemlock-on-poor-sites and spruce. The audit results indicated that stand ages and heights were over stated in the forest inventory by 14% and 6%, respectively. However, stand volumes were underestimated in the inventory compared to audit sample volumes compiled using the unbiased adjustment ratios for taper (tree shape) and volume loss developed from the QCI volume and decay study. After application of all adjustments (height, age, volume and tree taper), the average stand volume (net decay, waste and breakage without veteran trees) was 9.3% higher than the average calculated from the inventory. The differences vary for the five species groups:

- cedar-young—adjusted volume 53% greater than the inventory volume
- cedar-old—adjusted volume 20% greater than the inventory volume
- hemlock-poor—adjusted volume 9% greater than the inventory volume
- hemlock-good—adjusted volume 8% greater than the inventory volume
- spruce—adjusted volume 18% *less* than the inventory volume

These adjustment ratios were applied to the age, height and volume attributes for mature stands in the current inventory file and used to develop timber yield projections for natural stands. As well as being used in establishing volume estimates for existing stands, the unbiased adjustment ratios for tree taper, generated in the volume and decay study, were also used in developing the timber yield projections for managed stands.

2.3 Management practices

The forest management practices applied to lands inside and outside the timber harvesting land base have a direct effect on the timber supply forecast. The focus of the timber supply analysis is to project timber supply assuming that current forest management practices, as implemented in plans for the area, will continue into the future. The current forest management practices that have been accounted for in the timber supply analysis are as follows: Silvicultural practices — the clearcut-with-reserves silvicultural system is the primary silvicultural system applied in the TSA. The analysis assumes that harvested areas are reforested with acceptable tree species within 3 to 5 years of harvesting and Juvenile spacing* occurs on 90% of stands on good sites and 25% of the stands on poor sites. No intensive treatments, such as pruning* or fertilization, are assumed.

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).
Pruning
The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.

Cutblock adjacency* — outside of scenic areas, cutblocks* are generally approved for harvesting only after trees established on adjacent cutblocks achieve a minimum top height of three metres. The length of time it takes a stand to attain a top height of three metres is referred to as the green-up* period. In this analysis, the green-up period is estimated individually for each landscape unit since the average productivity of forest can vary widely among landscape units. An assumption made in the analysis is that harvesting can occur over a maximum of 25% of the harvestable area of each landscape unit in each green-up period to avoid excessive concentration of harvesting activities and to meet management objectives for forest resources such as terrain stability. An exception to this assumption is a requirement that no more than 20% of forest within the Haida declared areas of interest can be below green-up height when these areas are included in the timber supply forecast. This adjustment is not applied to increase the adjacency constraint but rather to approximate the slower rate of development that is likely within the Haida declared areas.

- Utilization level — utilization levels define the maximum stump height, minimum top diameter inside bark (DIB) and minimum diameter at breast height (DBH) by species for merchantable trees. The levels used in this analysis are consistent with provincial standards: 17.5 centimetre minimum DBH, 30 centimetre maximum stump height and 10 centimetre minimum top DIB.

Unsalvaged volume loss — unsalvaged losses* of timber to natural agents (fire, wind, insect and disease infestations) in the Queen Charlotte TSA are estimated to total 7100 cubic metres per year. This amount is modelled as an average level volume lost to natural causes each year and is subtracted from all harvest forecasts* noted in this report.

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

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.
Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.
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.

Minimum harvestable age — the time required for stands to grow to a harvestable size. Harvesting may occur in stands at the minimum age in order to meet forest level objectives such as maintaining harvest levels for a short period. However, many stands will not be harvested until past the minimum age due to management objectives for other resources such as scenic quality or watershed values. In this analysis, minimum harvestable age for stands is set to the greater of: a) the estimated age at which the stand is predicted to reach a required volume; and b) the age at which the stand's mean annual increment (MAI)* achieves a value of 95% of the maximum (culmination). The ages determined using these criteria are provided in Appendix A, "Descriptions of Data Inputs and Assumptions for the Timber Supply Analysis."

- Community watersheds — in order to protect water quality within established community watersheds, no more than 5% of each community watershed will be allowed to be harvested within a five-year period. This criterion is consistent with the guidelines provided in the *Forest Practices Code Community Watershed Guidebook*. Approximately 1930 hectares or 2% of the timber harvesting land base falls within three established community watersheds.

Biodiversity — forest practices used to maintain biodiversity in areas where forest development is occurring include the retention of wildlife trees within and adjacent to cutblocks, and the maintenance of a satisfactory proportion of old-growth forest in each biogeoclimatic variant* within each landscape unit. The requirements for wildlife trees and wildlife tree patch retention are specified in *the Forest Practices Code Biodiversity Guidebook* and the *Landscape Unit Planning Guide*. These requirements are calculated for each landscape unit based upon the proportion of the total productive forest that is available for harvesting, and the percentage of forest that has been harvested prior to implementation of wildlife tree retention requirements. The requirements for old-growth retention specify a minimum percentage of the forest within each landscape unit/biogeoclimatic variant combination that must be retained as old forest. This percentage depends on the biodiversity emphasis assigned to the landscape unit. Areas with a low biodiversity emphasis require less old forest, and more time is allowed before the guidelines must be met compared to areas with higher biodiversity emphasis. Given that specific biodiversity emphases have not yet been designated for each individual landscape unit in the Queen Charlotte TSA, the total THLB forecast and alternative land base forecasts shown in Section 5, "Results," assume an average level of management for biodiversity in all landscape units. The average area-weighted guideline that is applied to all landscape units is calculated based on the assumption that the timber harvesting land base will eventually be divided into about 45% lower biodiversity emphasis, 45% intermediate biodiversity emphasis and 10% higher biodiversity emphasis. Other analysis assumptions related to biodiversity management are examined through sensitivity analysis.

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.
Biogeoclimatic (BEC) variant
A subdivision of a biogeoclimatic zone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.

Scenic values — areas for which scenic values are to be maintained when carrying out forest development have been identified by the manager of the Queen Charlotte Islands Forest District. These were identified after careful consideration of the level of recreational use; terrain and forest cover characteristics in each area. Management to maintain scenic values in these areas is modelled by limiting the proportion of young forests that has not achieved visually effective green-up (VEG). VEG is assumed to be achieved when the regenerated stands grows to a top-height of 6 metres. Figure 8 shows the distribution of the timber harvesting land base among the three visual quality objectives*.

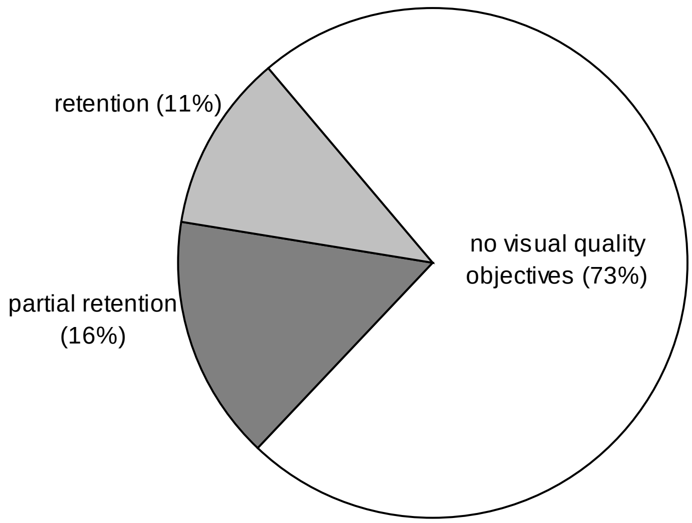

Figure 8. Proportion of the timber harvesting land base subject to visual quality objectives — Queen Charlotte TSA, 2000.

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.

3 Critical Issues

Land use decisions and forest management practices that constitute current management are not always defined with absolute certainty. Several critical issues related to the availability of forest for timber harvesting within the Queen Charlotte TSA may have a significant impact on the TSA timber supply. The three largest issues are described are below.

3.1 Haida declared areas

Since the early 1980's fourteen areas within Haida Gwaii have been declared by the Council of Haida Nations (CHN) as being significant for spiritual, cultural and environmental values. Since being declared by the Haida, these areas have been subject to land-use uncertainty. Collectively, they represent approximately 34% of the timber harvesting land base within the Queen Charlotte TSA. The largest, known as the Duu Guusd area, alone represents approximately 26% of the timber harvesting land base. Table 3 lists all fourteen Haida declared areas and shows how much of each falls within the productive forest area and timber harvesting land base within the TSA.

Table 3. Productive forest area and timber harvesting land base within the Queen Charlotte TSA and within the Haida declared areas.

#	Haida declared area	Productive forest area within the TSA (hectares)	Timber harvesting land base within the TSA (hectares)
1	Duu Guusd	119 002	20 958
2	Tllall	8 368	3 237
3	Jiinanga	2	—
4	Kun Xalaas	50	27
5	Gwaii Gawgaay	3 000	904
6	Yaagun Siwaay (Yakoun Lake and River)	516	3
7	Nang Xaldangaas	5 072	2 248
8	Kamdis	534	192
9	Qaysun (Kitogoro-Niisii)	1 187	83
10	Qanuu Gandll	82	12
11	Qanuu	258	—
12	Qaysun (Kaisun)	—	—
13	Tsuuguus Gandll	—	—
14	Gwaii Hanaas	—	—
	Total area	138 072	27 665

Although timber supply contributions of the deferred areas were not specifically analyzed in the previous timber supply review (TSR), the chief forester did address the issue in his AAC rationale of May 1996. He noted that the lack of harvesting in the declared areas created an inconsistency between the total timber harvesting land base and the reduced land base on which harvest was expected to occur. He also noted that "if the deferrals continue, at some point, the achievement of integrated resource management* objectives may preclude the achievement of higher rates of harvesting in the remaining areas." In response to these concerns and other land use issues, a number of community led initiatives have been formed, including the Islands Community Stability Initiative (ICSI). Also, the Ministry of Forests, the Council of Haida Nation and Indian and Northern Affairs Canada have held negotiations around forest management in the declared areas.

Given the uncertainty about if and how timber harvesting may be conducted in the Haida declared areas, this timber supply analysis assesses the supply under a number of alternative land base scenarios. These include a scenario with deferred areas not excluded from the timber harvesting land base, and a scenario in which harvesting is excluded within all of the Haida declared areas.

3.2 Duu Guusd

A large area along the north-west coast of Graham Island has been identified for consideration under the Protected Areas Strategy. Also along this coast is the Duu Guusd, one of the several Haida declared areas. With support for the deferral of harvesting on this area by island communities, an order-in-council was issued by Cabinet that designated the Duu Guusd area under Part 13 of the *Forest Act* on October 5, 1999. This designation allowed timber harvesting and road building to be halted while forest management issues were resolved for the area. The designation also enabled the chief forester to reduce the AAC for the Queen Charlotte TSA, which he did on December 16, 1999, decreasing the AAC by 24% to 361 000 cubic metres from 475 000 cubic metres. The chief forester’s AAC reduction expires when the Duu Guusd Designated Area ceases to be a designated area. The designation was initially to end on April 1, 2000, but was extended by nine months to end December 31, 2000.

Given the uncertainty about if and how timber harvesting may be conducted in the Duu Guusd area, this timber supply analysis assesses the supply under a scenario in which the area contributes to timber harvesting, and a scenario to assess the relative contribution of timber supply from the Duu Guusd area.

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

3.3 Tlell River watershed

The Tlell River watershed covers approximately 34 400 hectares of central and eastern Graham Island. This area includes 19 300 hectares of productive forest of which 6985 hectares are within the timber harvesting land base defined for this analysis (8.5% of the timber harvesting land base). The total volume of mature timber within the area is approximately 2.3 million cubic metres.

The management of forest resources within the Tlell River watershed has been the subject of much discussion among Islands residents. Currently, a Local Resource Use Plan (LRUP) is being developed for the area. LRUP participants examine the extent, location and distribution of all resource values and uses within a defined area, and make recommendations on how resource use could take place through a zoning scheme and area-specific management objectives and strategies. Recommendations from the Tlell River Watershed LRUP may call for a significant departure from current practices on the TSA.

The Islands Community Stability Initiative (ICSI) was formed in November 1995 by elected representatives from communities and rural electoral area. ICSI has received conditional approval to manage lands within the Tlell River watershed as one of the province's seven Community Forest Pilot Agreements (CFPA) awarded by the Minister of Forests. The Ministry of Forests and ICSI are negotiating the terms of this new tenure. However, the exact land base and rate of timber harvesting for the licences have yet to be determined. Once the community forest licence is granted, the land will be removed from the Queen Charlotte TSA.

Very little harvesting has occurred on TSA lands within the watershed. However, restrictions on harvesting in the Duu Guusd area and other parts of the TSA have increased pressure for harvesting within the Tlell portion of the TSA. The Small Business Forest Enterprise Program (SBFEP) has proposed nine blocks within the TSA portion of the Tlell watershed for harvesting over the next five years subject to the outcome of the LRUP process.

Given the uncertainty about how timber harvesting may be conducted in the Tlell River watershed and given the potential for a community forest licence in the area, this analysis includes an assessment of the timber supply if harvesting is excluded within Tlell River watershed. The results are presented along with the other alternative land base scenarios listed previously.

4 Timber Supply Analysis Methods

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in the Queen Charlotte 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 (FSSIM version 3.0). 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 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 is generally constant after that time.

Similar to other models, the B.C. Forest Service model assumes that stands of trees grow according to provided yield projections and are harvested according to rules set by the analyst, such as harvest volume targets, harvest scheduling priority and minimum harvestable ages. The Forest Service model also allows the application of forest cover requirements that specify the desired age composition of the forest. These requirements can be used to examine the effects of green-up prescriptions and old forest retention objectives. For example, guidelines might specify that no more than a particular maximum percentage of the forest can be younger than a specified green-up age, or that a certain 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 requirements on timber supply.

This type of analysis is used to determine the timber supply implications of various forest management practices. The results of the analysis are especially important in indicating allowable cuts that will not restrict options of future resource managers, and that will allow 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 provides for sustainable forest management.

5 Results

This section presents results of the timber supply analysis for the Queen Charlotte TSA. The forecasts presented in this section use the most recent assessments of current forest management applied to several alternative land-base scenarios. Given the current uncertainty about total TSA land base that will be available for timber harvesting now and in the future, several alternative land base forecasts are presented. All are based on an identical set of assumptions about forest management and timber yields as described in Section 2, "Information Preparation for the Timber Supply Analysis."

Section 6, "Timber Supply Sensitivity Analyses" builds on the results of this section by providing timber supply forecasts that test the sensitivity of a selected forecast to various changes in forest resource information or management. These "sensitivity runs" are useful in pointing out which aspects of forest management have the greatest effect on the timber supply forecast and should be most carefully considered in forest management decisions.

For this analysis, “pre-Part 13 AAC” refers to the level of 475 000 cubic metres in place prior to the AAC reduction made subsequent to the Part 13 designation of the Duu Guusd area.

> ***Partition***
> *A portion of the AAC that is attributable to certain types of timber and/or terrain.*

5.1 Total timber harvesting land base forecast

For the total THLB forecast, the timber harvesting land base was defined by excluding all areas on which timber harvesting is not likely to occur as outlined in Section 2 "Information Preparation for the Timber Supply Analysis" and Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" of this report. The total THLB includes areas where harvesting is not currently occurring, such as the Duu Guusd area, the Tlell River watershed, and areas of interest such as Haida declared areas, and areas under consideration in the Protected Areas Strategy that would be considered harvestable according to the criteria described in Section 2 and Appendix A. While the harvestable portions of these areas are included in the total THLB forecast, the timber supply impacts of excluding them are examined in alternative land base forecasts described in Section 5.2.

The total THLB forecast incorporates growth and yield predictions that reflect age, height and volume adjustments derived from the 1998 inventory audit of the Queen Charlotte TSA and the *QCI Volume and Decay Study*. The timber harvesting land base includes low-site cedar stands, which contribute 75 000 cubic metres to the pre-Part 13 AAC of 475 000 cubic metres. Since these stands represent the economic margin for timber harvesting in the TSA, their total contribution to the forecasted harvest in each decade is limited to 10% of the harvest for the entire TSA. This prevents the harvest forecast being heavily reliant on high proportions of partition* timber in one or more periods.

5 Results

Figure 9 shows the timber supply forecast for the entire Queen Charlotte TSA under the data package assumptions. The initial harvest level is equal to the current AAC of 475 000 cubic metres per year. This level is maintained for five decades before declining 10% at the end of each of the fifth, sixth, and seventh decades and 6% at the end of the eighth decade to a steady long-term harvest level* of 323 000 cubic metres per year at the beginning of the ninth decade.

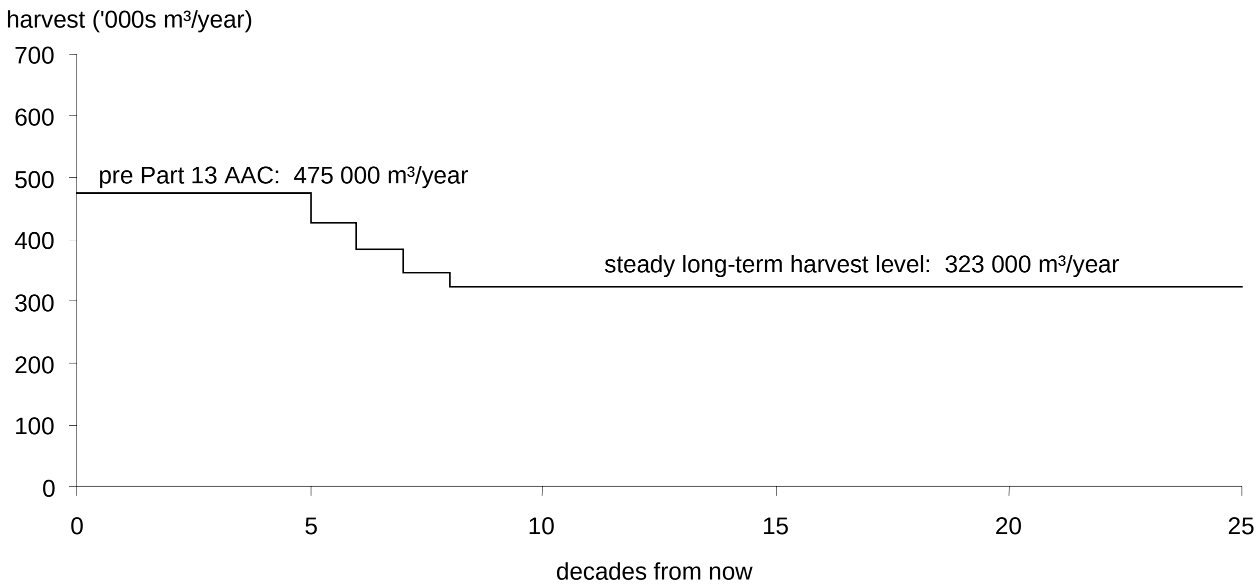

Figure 9. Total timber harvesting land base harvest forecast assuming data package assumptions and the deferred areas are not excluded from the timber harvesting land base—Queen Charlotte TSA, 2000.

The total THLB forecast indicates a much more stable short- and medium term supply than the analysis conducted in 1994. The 1994 analysis showed timber supply declining after the first decade, while in the total THLB forecast the pre-Part 13 AAC is maintained for 50 years. In addition, the long-term level in the total THLB forecast is 21% higher than in the 1994 analysis[4]. These increases have occurred despite additional constraints introduced to meet more stringent management requirements for fisheries, biodiversity and cultural heritage values. There are two reasons for the increase in supply:

- the timber harvesting land base is 7% larger than in 1994[5], a result of the new operability mapping.
- existing timber yields estimates are 9.3%[6] higher, a result of an in-depth growth and yield study and Forest Inventory Audit (Section 2.2).

> ***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.*

4 Assuming the long-term harvest level reported in the 1994 Analysis Report is adjusted upward by 7.5% to include the additional low-volume cedar stands factored in to the AAC in the 1996 determination.

5 Assumes the effective timber harvesting land base in the 1996 AAC determination was 77 045 hectares which includes an additional allowance of 13 000 hectares to support harvesting in low-volume cedar.

6 This figure is the combined increase for all audit strata. Actual adjustments varied by stratum.

5 Results

Figure 10 shows the contribution of existing natural stands and managed stands to the overall harvest volume projected in the total THLB forecast. Over the first eleven decades, the timber supply comes almost entirely from natural stands because few managed second-growth stands have achieved minimum harvestable age. By the twelfth decade, the majority of timber is harvested from managed stands and by the sixteenth decade, almost all of the harvest is from managed stands. The steady long-term harvest level reflects the rate of harvesting that can be sustained on the TSA with current management practices.

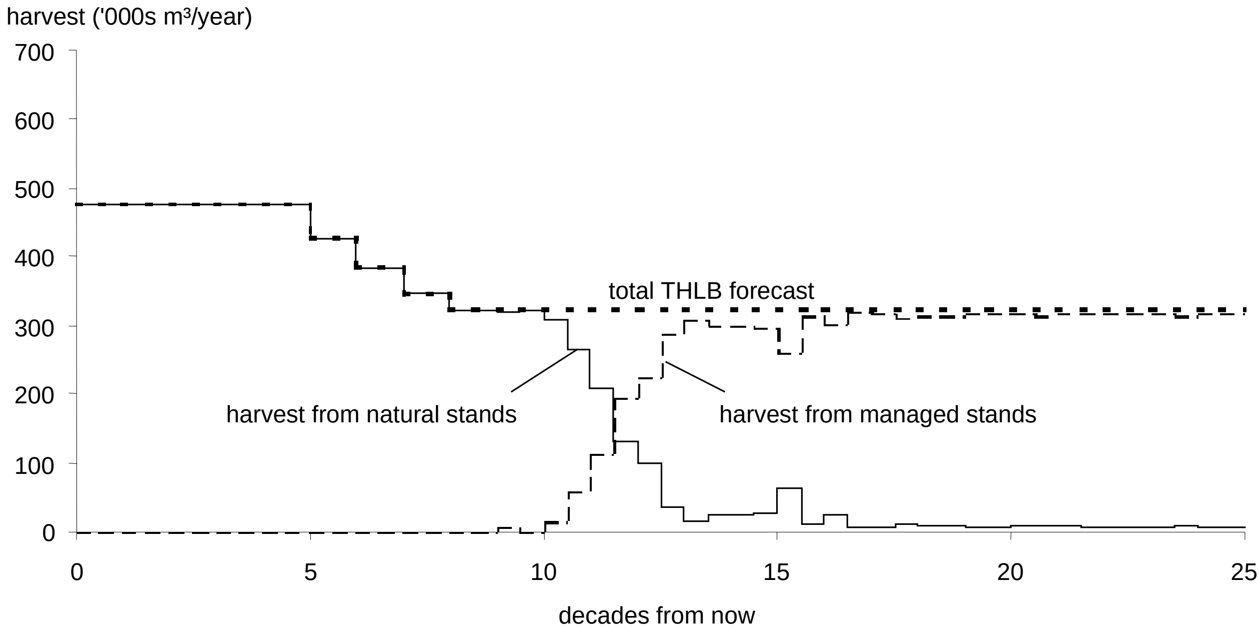

Figure 10. Harvest transition form existing natural stands to managed stands in the total THLB forecast — Queen Charlotte TSA, 2000.

Figure 10 shows that a small portion of the timber supply comes from natural stand growing stock* into the twenty-fifth decade. This is from a small portion of natural growing stock that persist in the THLB because of visual quality and biodiversity forest cover constraints.

Both the pre-Part 13 AAC and the current AAC specified that approximately 16% of the total AAC be attributable to low-volume cedar stands (mature cedar with less than 350 cubic metres per hectare). In this analysis partition stands are allowed to contribute no more than 10% of the annual harvest. This cap was applied to ensure that the harvest in any one period was not predominately low-volume cedar. The contribution of low-volume cedar partition stands to the overall harvest is illustrated in Figure 11.

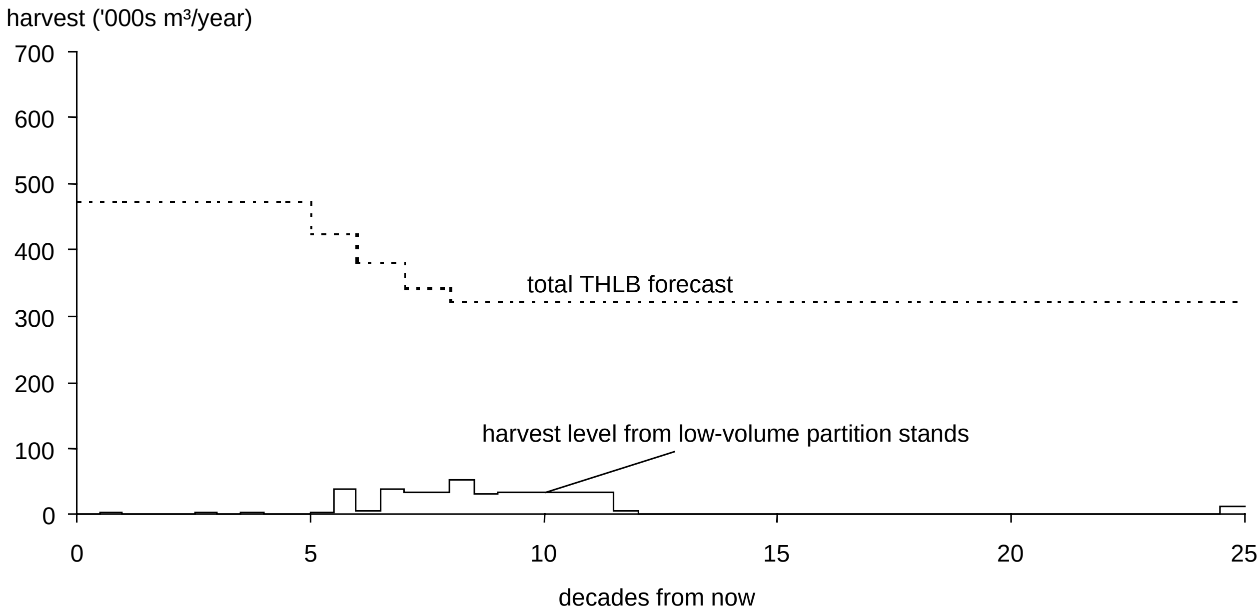

Figure 11. Harvest from low-volume cedar partition stands (maximum contribution of 10% of the harvest in each period in the total THLB forecast) — Queen Charlotte TSA, 2000.

Natural low-volume cedar stands primarily contribute to the timber flow in the total THLB forecast between the sixth and the twelfth decades. This is because the timber supply model was run using a relative oldest first rule to select stands for harvesting. Since the low-volume cedar stands have very high minimum harvestable ages they generally have a lower harvest priority than similarly aged forests on better sites.

It is important to note that a significant portion of cedar on poor-growing sites in the timber harvesting land base does not fall within the low-volume cedar partition. This is because many low-site cedar stands are very old (often several hundred years) and have accumulated volumes of more than 350 cubic metres per hectare.

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

5 Results

Figure 12 charts the mean annual harvest area for each period of the total THLB forecast. Since only the flow of harvested timber volume was regulated for the analysis, and stands have a range of volumes, the area harvested varies between periods. The annual area harvested is highest in the period between the third and sixth decades. At that time, the harvest contains a high proportion of poor-site, lower volume natural stands that, under the relative oldest first rule, are scheduled after better-site stands. Annual area harvested is lowest in the twelfth and thirteenth decades. This is the point at which the harvest transfers to second growth stands. Since more productive sites reach their minimum harvestable ages first, they make up a large portion of the harvest in this period and the volume target is achieved from a smaller area.

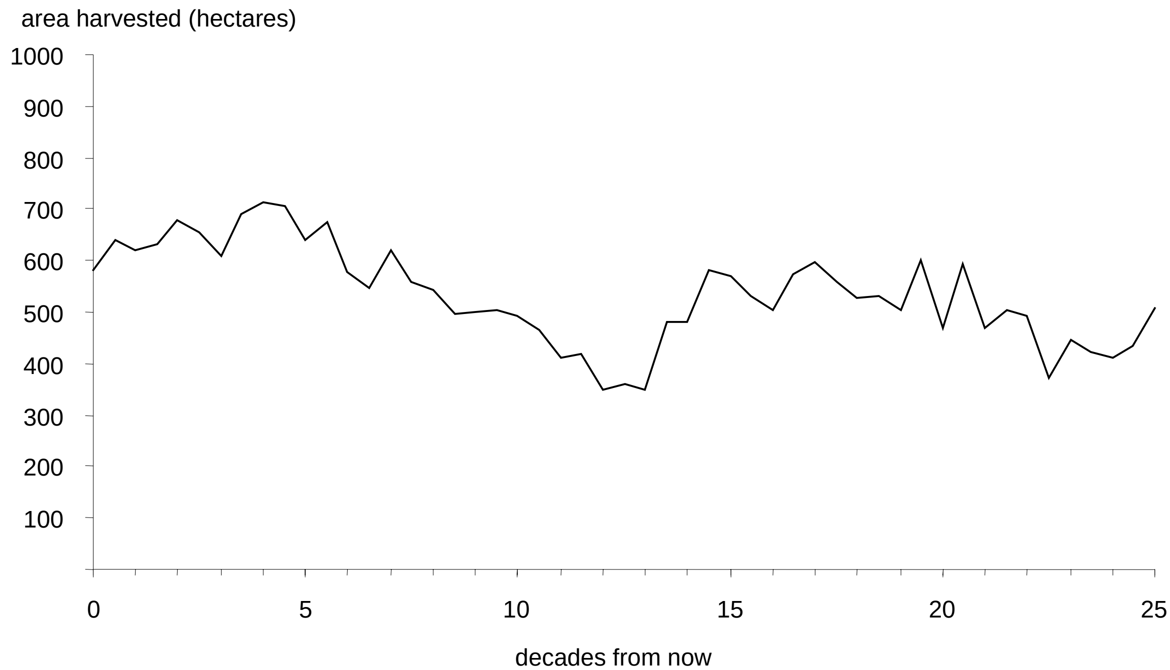

Figure 12. Mean annual harvest area in the total THLB forecast — Queen Charlotte TSA, 2000.

5 Results

The growing stock on the timber harvesting land base, as projected in the total THLB forecast, is shown in Figure 13. The total growing stock (dark solid line) is from stands of all ages, while the merchantable growing stock (light solid line) is only from stands old enough to harvest. Over the next thirty decades the total growing stock is projected to decline from the current level of about 41 million cubic metres to a steady, long-term level of about 21 million cubic metres. The total growing stock (and the average age of forest stands within the THLB) declines as existing stands, which have relatively high timber volumes due their advanced age, are harvested and replaced by younger stands with lower timber volumes.

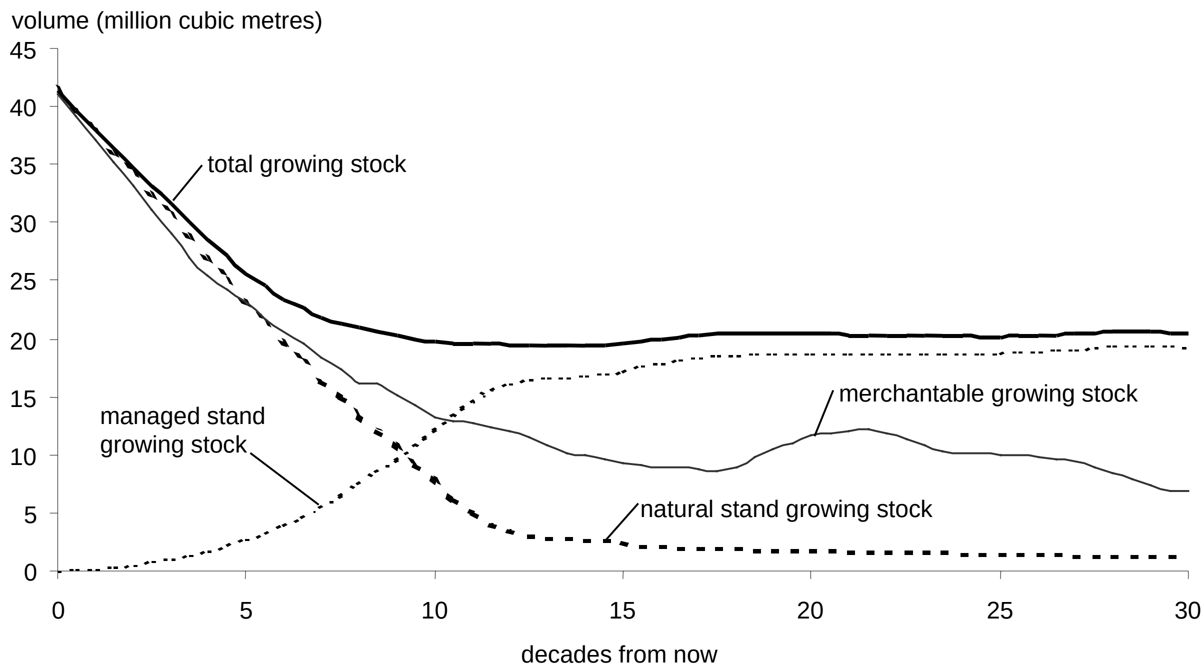

Figure 13. Changes in timber growing stock over time following the total THLB forecast — Queen Charlotte TSA, 2000.

As shown in Figure 13, almost all of the total growing stock (41 million cubic metres) is currently merchantable. This is because the great majority of stands in the Queen Charlotte TSA are either very young, with little or no volume, or very old (above minimum harvestable age). A 'bump' occurs in the line projecting merchantable growing stock between the eighteenth and twenty-third decades. This is caused by large cohorts of regenerated hemlock and cedar stands that reach merchantable age in that period.

The average area-weighted harvest age in the total THLB forecast is shown in Figure 14. Initially, the average age of harvested stands is about 350 years. The average age declines steadily as the harvest shifts from primarily natural stands to managed stands. By the fifteenth decade, the average harvest age stabilizes at about 125 years. The range of ages harvested in each period (not shown in Figure 14) is considerable given the wide range of forest productivity within the land base.

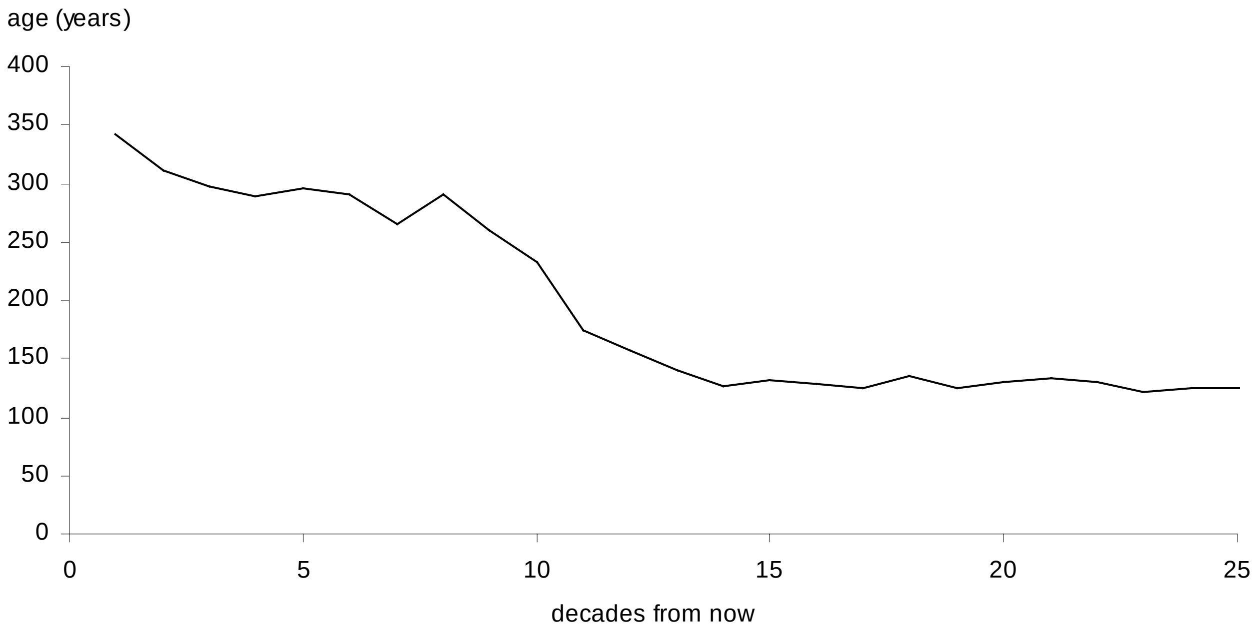

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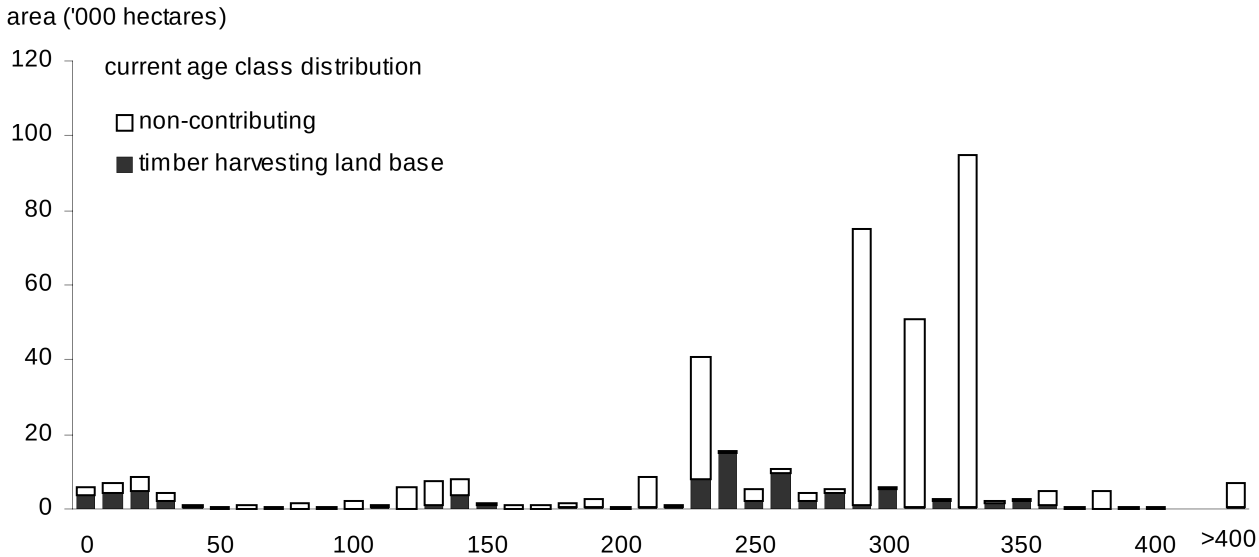
Figure 14. Annual area weighted harvest age over time following the total THLB forecast — Queen Charlotte TSA, 2000.

Figure 15 includes four charts depicting the age class distribution of productive forests within the Queen Charlotte TSA from the total THLB forecast at four times: currently; in 50 years; in 100 years; and 150 years from now.

The present distribution includes a high proportion of old (over 240 years) forest in both the timber harvesting land base and the non-contributing land base. The projected distributions at 50, 100 and 150 years from now show how the current age-class distribution within the timber harvesting land base moves to an even distribution among younger classes. Since the timber supply analysis does not assume disturbance within the non-contributing forest, the age class distribution of this component simply shifts to the right from the current condition between graph intervals.



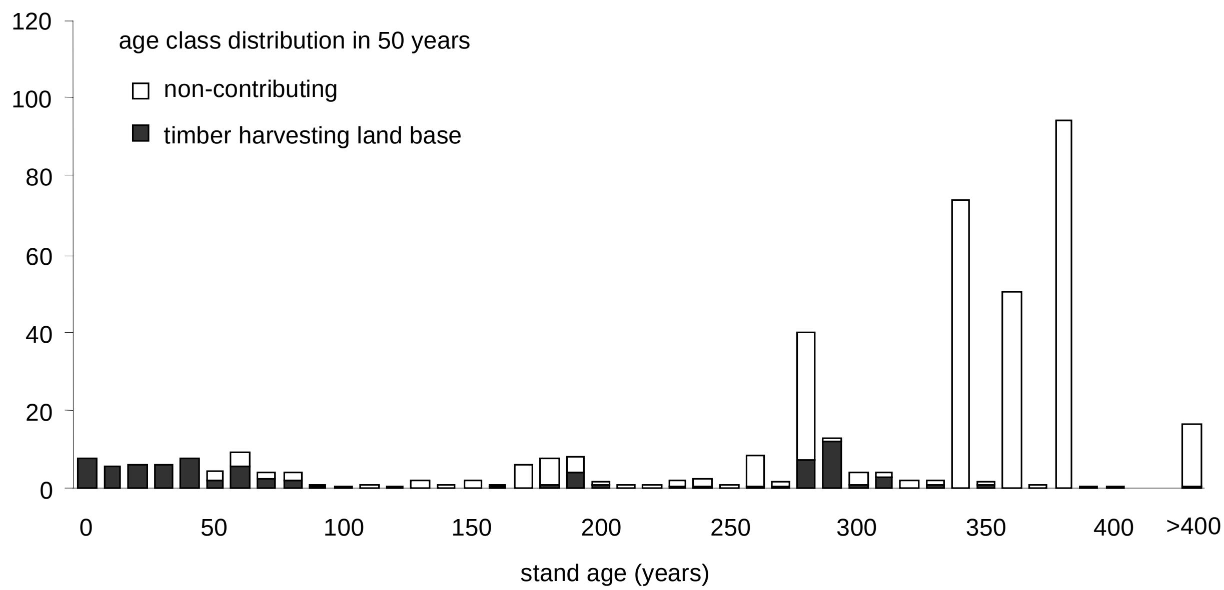


Figure 15. Changes in age composition on the productive forest land base over time following the total THLB forecast — Queen Charlotte TSA, 2000.

continued

5 Results

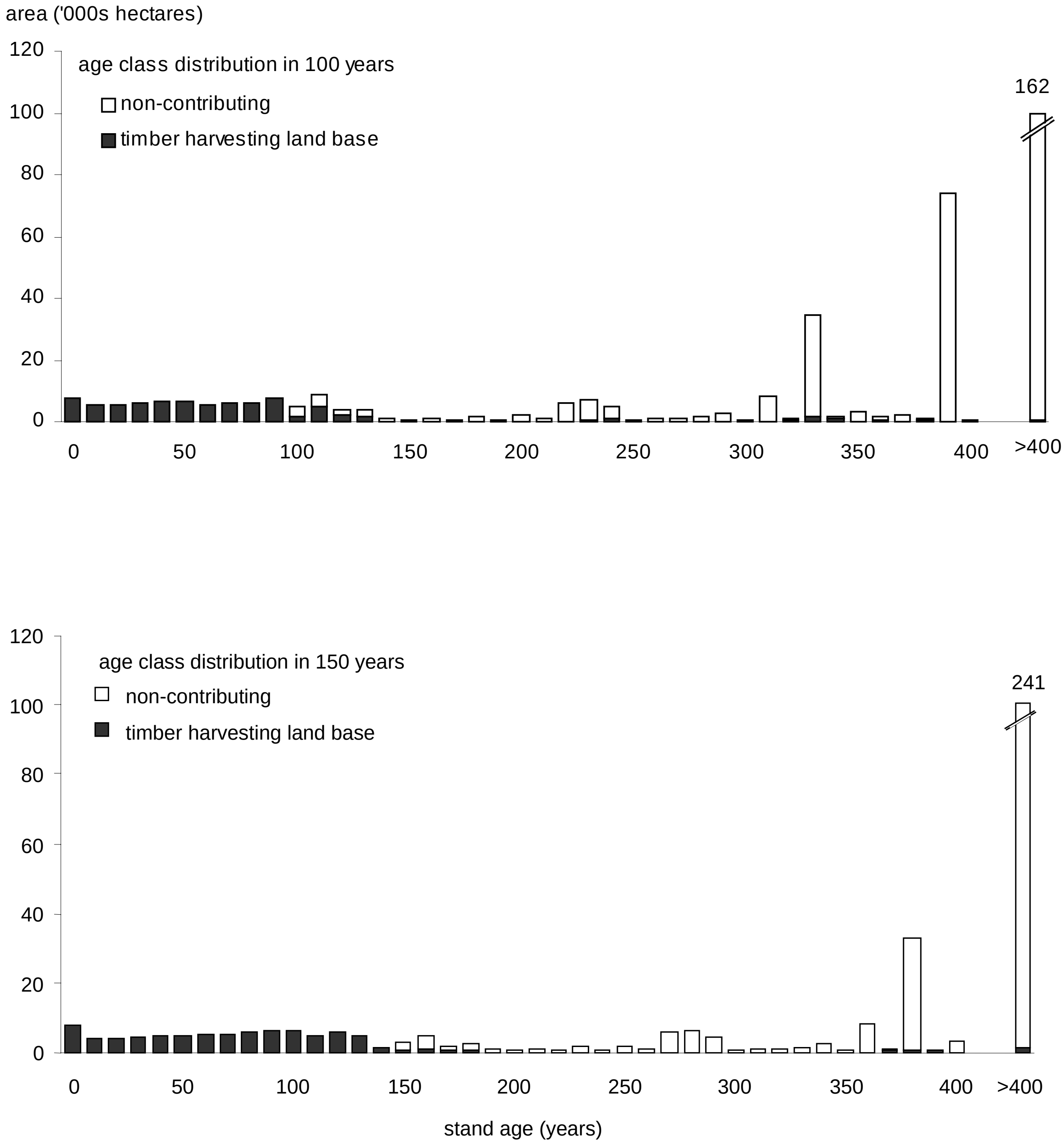


Figure 15. Changes in age composition on the productive forest land base over time following the total THLB forecast — Queen Charlotte TSA, 2000.

5 Results

5.2 Timber supply impacts of excluding Haida declared areas, study areas and the Tlell River watershed

The total THLB forecast assumes that all of the Queen Charlotte TSA timber harvesting land base is potentially available for timber harvesting. Areas that have been deferred from harvesting because they are contentious or under study, including the Haida declared areas and the Tlell River watershed, were included. The following sections discuss how the contentious areas contribute to timber supply.

5.2.1 Forecast assuming no timber harvesting in the Haida declared areas

Figure 16 shows the contribution of the forest within the Haida declared areas to the total THLB forecast.

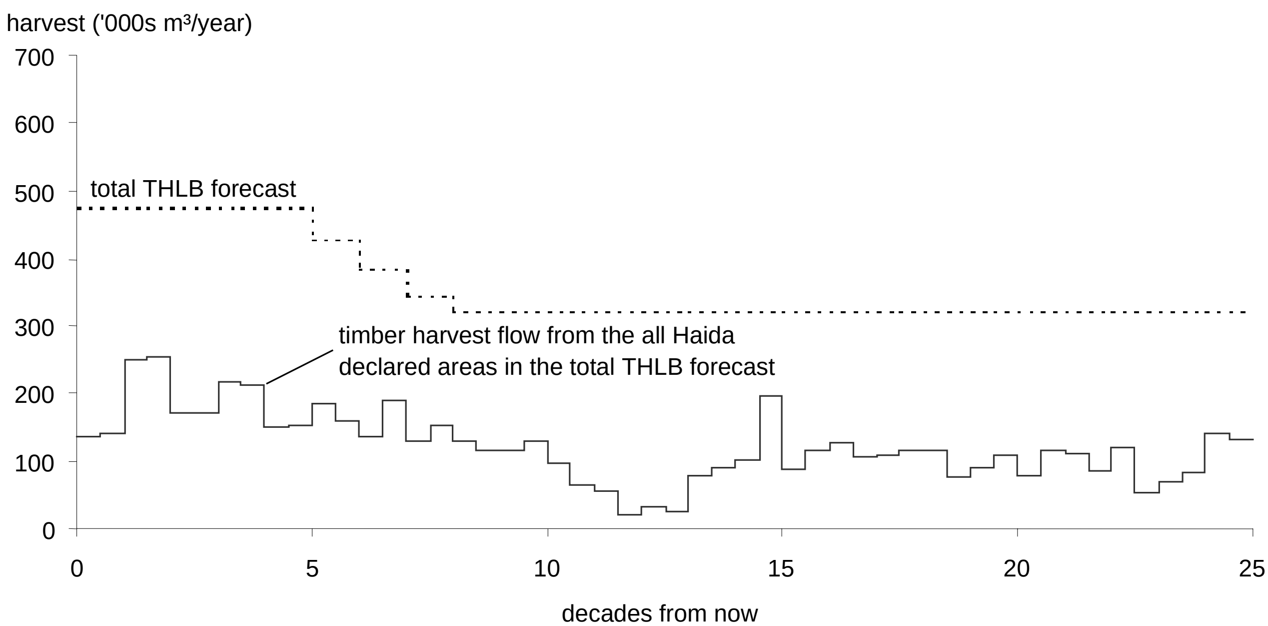


Figure 16. Contribution of Haida declared areas to the TSA timber supply in the total THLB forecast — Queen Charlotte TSA, 2000.

Figure 17 illustrates the contribution of timber supply from a) the Duu Guusd area only, and b) all Haida declared areas, including the Duu Guusd. The Duu Guusd area contribution to the initial harvest level is 96 000 cubic metres per year, or 20% of the pre-Part 13 AAC, and 88 000 cubic metres per year or 21% to the steady long-term harvest level. All Haida declared areas within the TSA, contribute 135 000 cubic metres or 28% to the initial harvest level, and 109 000 cubic metres or 34% to the steady long-term harvest level.

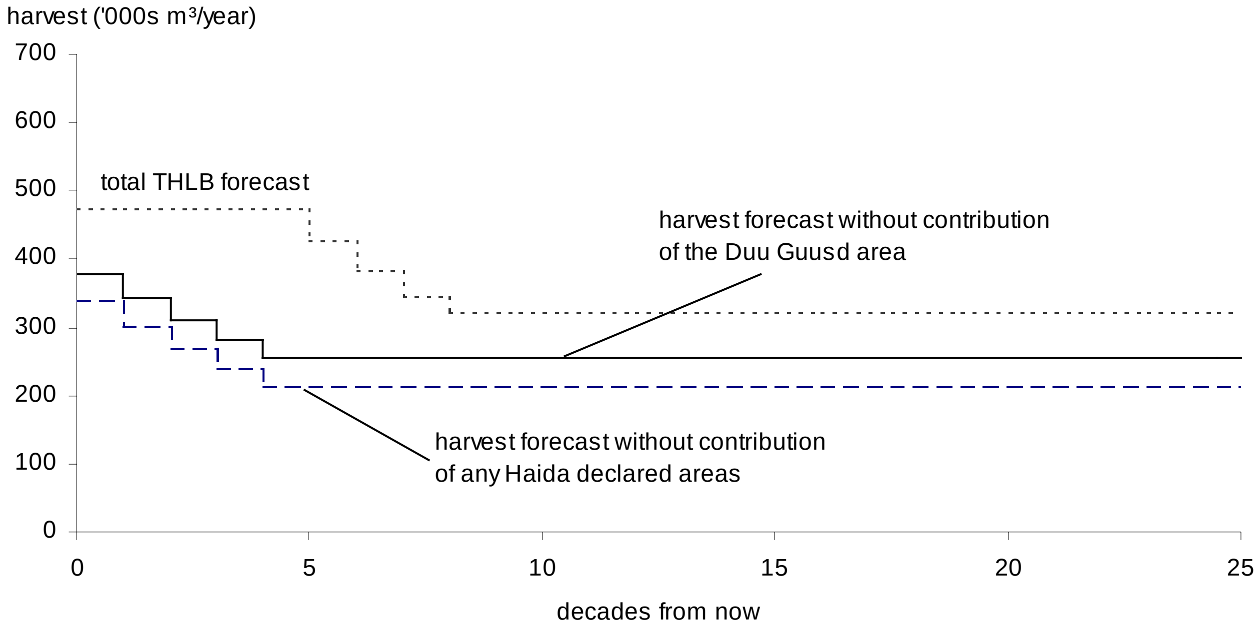


Figure 17. Timber supply forecasts if the Duu Guusd area only, and if all Haida areas are excluded from timber harvesting — Queen Charlotte TSA, 2000.

A timber supply forecast was also generated that assumed logging will be deferred in the Haida declared areas only for the first decade. Although the results indicated that the timber flow in the total THLB forecast could be maintained with a one decade deferral of the Haida areas, the TSA timber supply would depend heavily upon timber from the Haida areas in the second and third decades of the forecast.

5.2.2 Forecast assuming no timber harvesting in the Tlell River watershed

Harvesting in the Tlell River watershed has been deferred to allow for negotiations between government and community groups on how forest in the area should be managed. The area may also become part of a Community Forest Licence. The contribution of the Tlell River watershed (as defined by the *Tlell Local Resource Use Plan* boundary) to the TSA timber supply in the total THLB forecast is illustrated in Figure 18.

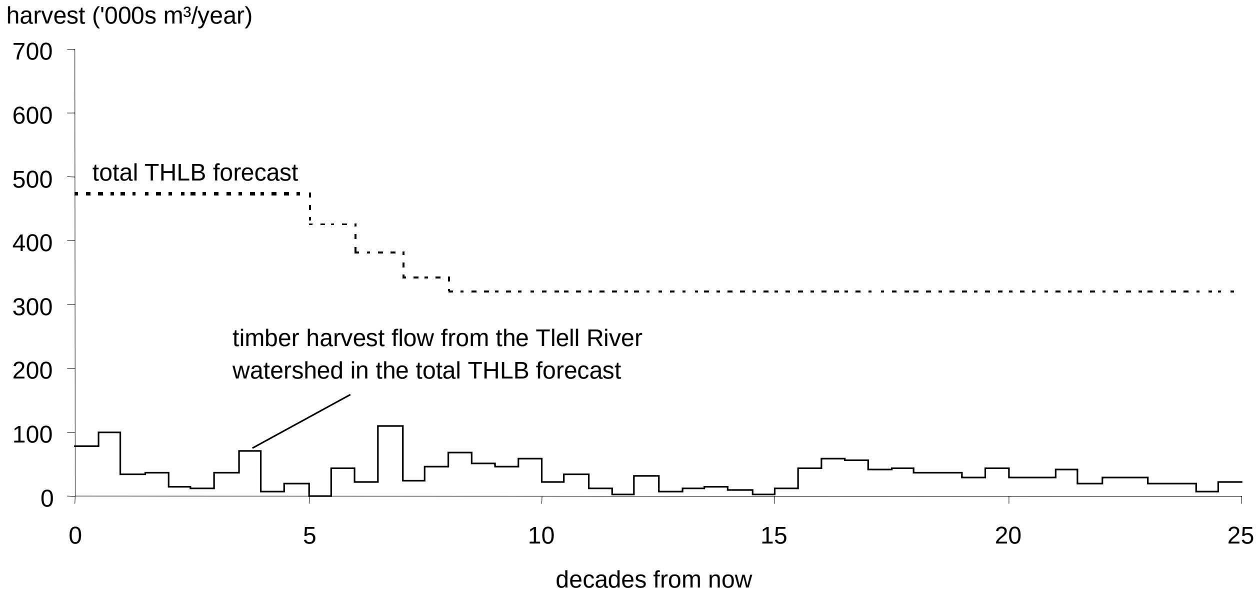


Figure 18. Contribution of Tlell watershed to the TSA timber supply in the total THLB forecast — Queen Charlotte TSA, 2000.

Figure 19 illustrates the timber supply projection for the TSA if no harvesting were to occur within the Tlell River Watershed. The results show that if harvesting is indefinitely deferred in this area, the initial harvest level can only be maintained until the third decade. The steady long-term harvest level would decline to 296 000 cubic metres per year, 8% below the total THLB forecast.

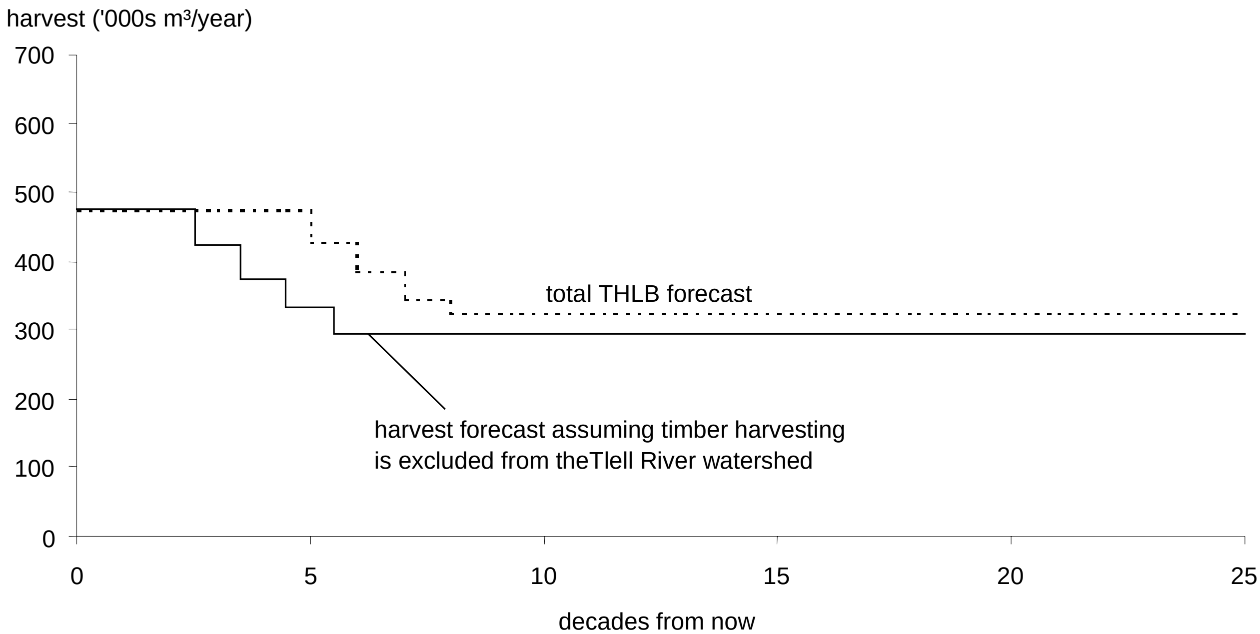


Figure 19. Timber supply forecast if Tlell watershed is excluded from the timber harvesting land base — Queen Charlotte TSA, 2000.

5.2.3 Forecast assuming no timber harvesting in the Duu Guusd area and the Tlell River watershed

Figure 20 illustrates the timber supply contribution from both the Duu Guusd area and the Tlell River watershed. The initial harvest level contribution is 139 000 cubic metres per year, or 29% of the harvest. The steady long-term sustainable harvest level contribution is 102 000 cubic metres per year, or 31% of the harvest.

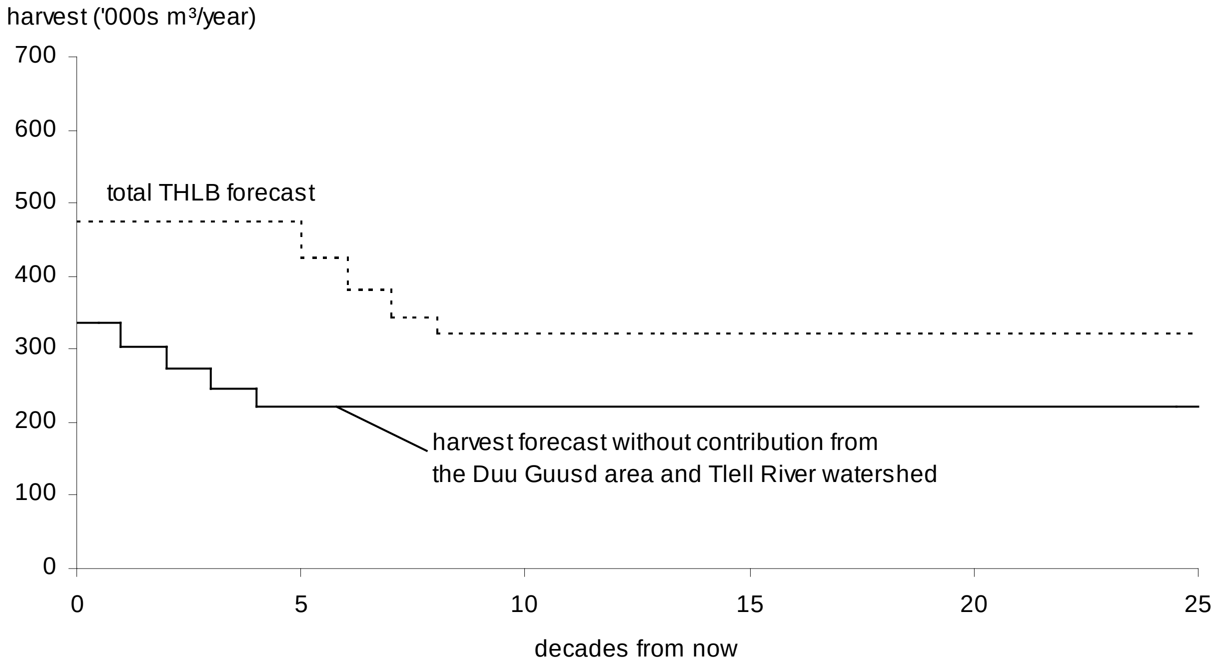


Figure 20. Timber supply forecast if the Duu Guusd area and the Tlell watershed are excluded from the timber harvesting land base— Queen Charlotte TSA, 2000.

6 Timber Supply Sensitivity Analyses

Sensitivity analysis* is the exercise of examining how changes in the data or assumptions about management practices may affect the outcome of an analysis. The main purpose of sensitivity analysis is to highlight which variables most affect results. It is an important aid to understanding the timber supply and decision-making, since many variables used in timber supply analysis are estimated or derived statistically. The best available information on forest inventories; forest growth and yield; and management practices was used in this analysis. However, even small inaccuracies in some variables could have a large effect on results. Conversely, large inaccuracies in other variables may be of little or no consequence to timber supply. Sensitivity analysis can highlight priorities for collecting information for future analyses. As well it can clarify for decision makers whether current best estimates are a safe basis for decisions, or whether high uncertainty around important variables may indicate more cautious decisions.

The total THLB forecast presented in Section 5.1, "Forecast assuming deferred areas are not excluded from the timber harvesting land base (total THLB)," which does not exclude harvesting in either the Haida declared areas or the Tlell River watershed, is used as a basis for comparison in the sensitivity analyses. None of the alternative land base forecasts, in which contentious areas are excluded from the timber harvesting land base, were chosen as the base since there has been no decision by government as to whether or not harvesting will continue in these areas. The relative sensitivity of the total THLB forecast to assumptions should be indicative of the sensitivity of the alternative land base forecasts.

Several critical assumptions outlined in Section 2, "Information Preparation for the Timber Supply Analysis" are tested, usually by varying levels above and below those in listed in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." The resulting forecasts are then compared to the total THLB forecast.

6.1 Sensitivity to alternative harvest flow

The total THLB forecast, shown in Figure 9, was defined using criteria discussed in Section 5.1, “Total timber harvesting land base forecast.” These criteria include managing the rate of decline in harvest from the current level (defined by the pre-Part 13 AAC) to the maximum sustainable long-term level while avoiding large and abrupt harvest shortfalls. The initial harvest was set to the pre-Part 13 AAC with the knowledge that the harvest would decline from the short term to long term as the average age of harvested stands decreases. The rate of decline was limited so as not to allow more than a 10% drop each decade. Long-term harvest levels were considered sustainable if the total merchantable growing stock achieved a constant level over two or more rotations.

Sensitivity analysis
A process that examines how uncertainty in data and management assumptions affect timber supply.

Many other harvest flow patterns are possible, with different decline rates, starting harvest levels, and potential trade-offs between short- and long-term harvests. Figure 21 illustrates two examples of alternative flows. One example shows the effect of increasing the initial harvest level above the pre-Part 13 AAC. Here, the initial harvest level is 6% higher than the pre-Part 13 AAC. This higher rate of harvest requires that the forecast be reduced earlier, in the second decade as opposed to the fifth decade, compared to the total THLB forecast. The second example illustrates the harvest flow under a non-declining timber flow policy. That rate is identical to the steady long-term harvest level of the total THLB forecast, which is the maximum rate of harvest that can be sustained over the 250-plus year projection. In this case the conversion from natural stands to managed stands progresses at a much slower rate than in the total THLB forecast.

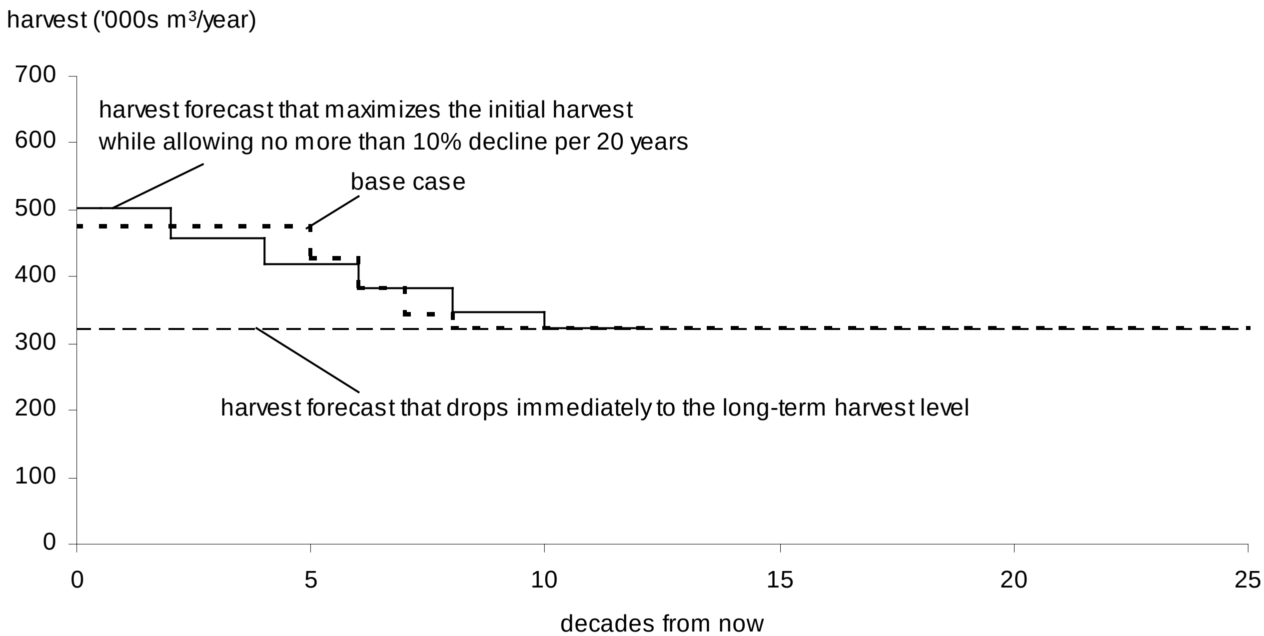


Figure 21. Alternative harvest flows to the total THLB forecast — Queen Charlotte TSA, 2000.

6.2 Sensitivity to alternative operability assumptions

The timber harvesting land base in the total THLB forecast was 7% higher than the timber harvesting land base estimated in the 1996 timber supply review (TSR). This change resulted largely from new operability mapping developed from two new sets of maps that classify the land base according to access difficulty and harvest system suitability. These maps were used with economic thresholds (specifying a minimum volume per hectare) derived from timber appraisal data, to predict whether stands were economically operable or inoperable. Although this approach to operability is thought to be an improvement over the subjective classifications used previously, a degree of uncertainty exists regarding these economic thresholds. In addition to uncertainty in forest product market demand and prices, there is uncertainty in operability data due to the limited logging history in areas of difficult access. For these reasons, two additional forecasts were prepared, one assuming more restrictive thresholds and one assuming less restrictive thresholds.

A description of the thresholds used in the total THLB forecast and sensitivity forecasts is provided in Appendix A, "Descriptions of Data Inputs and Assumptions for the Timber Supply Analysis." The more restrictive thresholds increased the minimum volume per hectare requirements for stands with moderate and difficult access. This resulted in fewer stands being considered operable in these areas. The effect was a reduction in the timber harvesting land base of 7.3% compared to the total THLB forecast. The less restrictive thresholds had the opposite affect, allowing more stands in areas classified as moderately difficult or difficult to access. The effect is an increase in the timber harvesting land base by 5.5% relative to the total THLB forecast.

6 Timber Supply Sensitivity Analyses

Figure 22 illustrates the timber supply under the two alternative operability assumptions relative to the total THLB forecast. When less restrictive operability thresholds are assumed, the initial harvest level can be maintained for an additional five years and the steady long-term level is about 6.5% higher. When more restrictive operability thresholds are assumed, the initial harvest level can only be maintained for three decades and the steady long-term level is 7% lower.

These results indicate that the medium- and long-term harvest levels in the total THLB forecast are sensitive to changes in the economic operability thresholds. This sensitivity is understandable given that the stands added to or deleted from the land base tend to be on higher producing sites and affect both the existing mature inventory available for harvesting, as well as the land base available for long-term timber production.

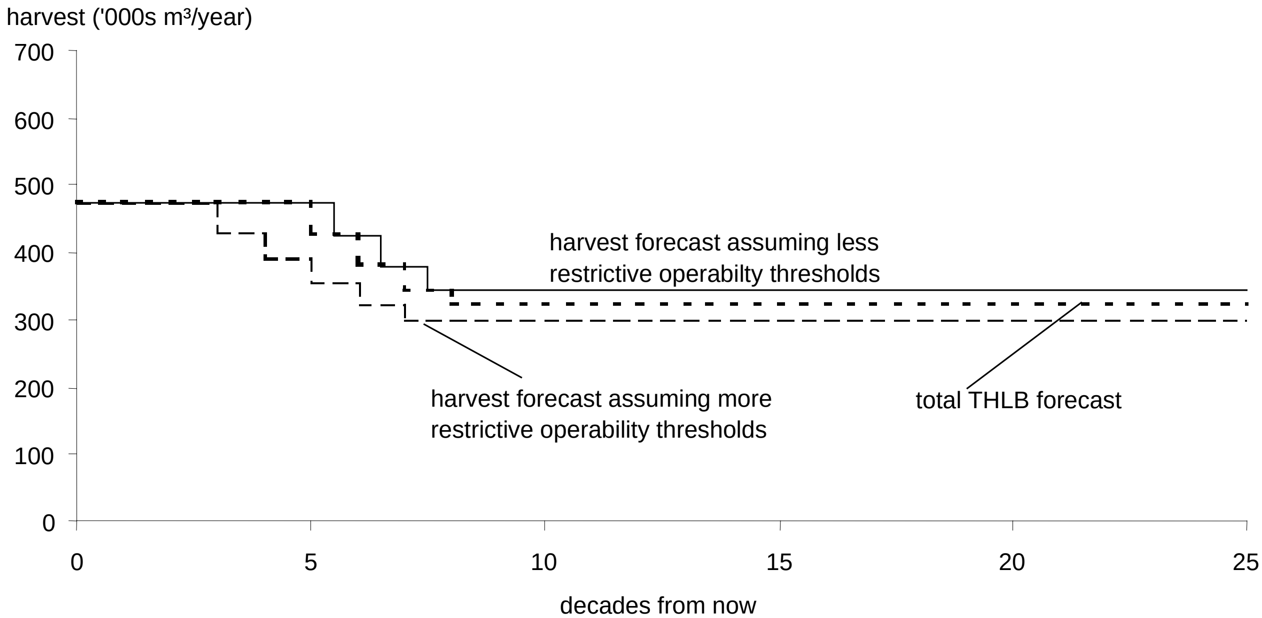


Figure 22. Timber supply forecast under two alternative sets of operability thresholds — Queen Charlotte TSA, 2000.

6.3 Sensitivity to changes in timber volume estimates for natural stands

Timber volume estimates for existing natural stands are subject to uncertainty due to the statistical process used to derive growth and yield estimates for stands (from stand age, height and crown closure). In the Queen Charlotte TSA, there is additional uncertainty related to the statistical derivation of timber volume adjustments from the inventory audit data.

Figure 23 illustrates the impact of varying the natural stand volume estimates up and down by 10% and 20%. If volumes are increased by 10%, the resulting increase in the natural stand growing stock allows the pre-Part 13 AAC to be maintained for eight and a half decades before stepping down to the steady long-term level. Similarly, if natural stand volume estimates are increased by 20%, the initial harvest level can be maintained until the tenth decade. When the natural stand yields are decreased by 10%, the smaller natural stand growing stock allows a harvest at the pre-Part 13 AAC for only two decades before stepping down towards the steady long-term level. If the natural stand yields are decreased by 20%, growing stock is sufficient to allow an initial harvest of only 290 000 cubic metres per year, a level below the steady long-term harvest level. In all cases, the long-term harvest level is not affected by changes in the natural stand volume estimates, because the long-term supply is determined by managed stand volume estimates.

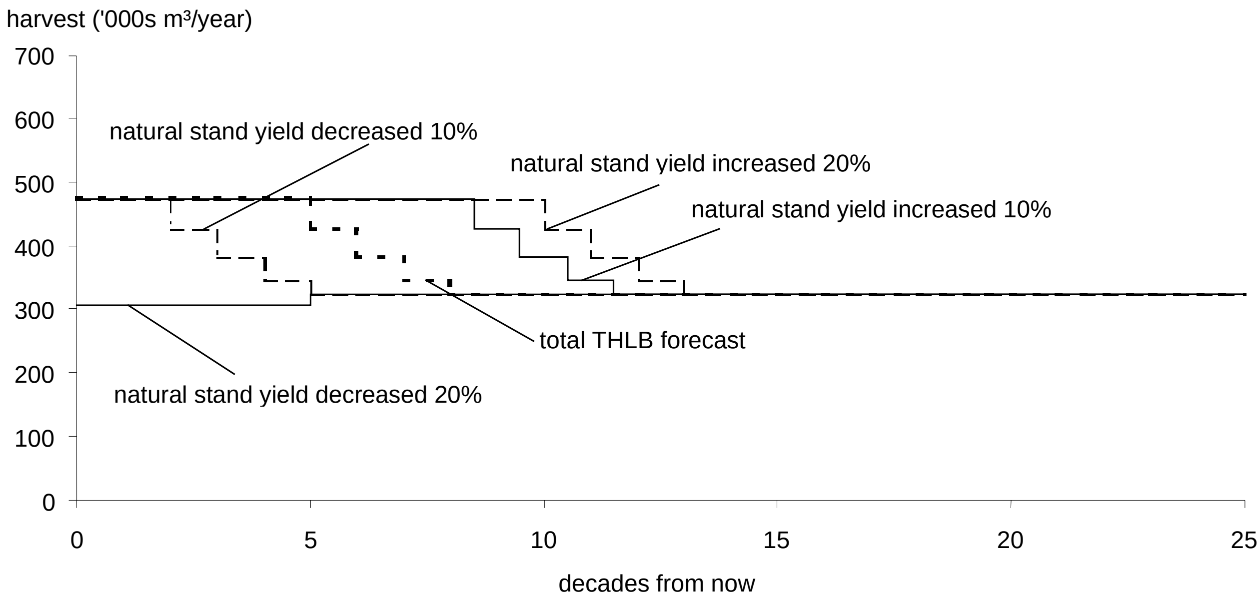


Figure 23. Harvest forecast if estimated volume of timber in natural stands is increased and decreased by 10% and by 20% — Queen Charlotte TSA, 2000.

6.4 Impact of the forest inventory audit adjustments

The two forest inventory projects (the volume and decay study and the inventory audit) used to revise estimates of current timber volume were discussed in Section 2.2 “Timber growth and yield.”

The volume and decay study was used to derive new adjustment ratios that corrected biases in the tree taper and decay equations. Overall, these new ratios tended to increase whole-stem volume estimates and decrease estimates of losses due to decay and waste. Confidence in these ratios is fairly high given they were derived from a rigorous, unbiased, sampling protocol. The new adjustment ratios were used in compiling the inventory audit results.

Sampling for the inventory audit, which tested the accuracy of the forest inventory volume, was somewhat less rigorous than for the volume and decay study. Sixty-seven sample clusters in five stand types — cedar-young (less than 200 years old), cedar-old, hemlock-on-good-sites, hemlock-on-poor-sites and spruce—were located across the operable portion of the Queen Charlotte TSA in stands 60 years and older. The overall sampling error for volume estimates was 9.8%[7], well within the acceptable limits applied in provincial inventory studies. However, the sampling error varied by species group from 17 to 27%, suggesting that although the overall results provide reasonable confidence regarding the standing inventory at the TSA level, there is more uncertainty about species-specific adjustments. A concern about the sampling was that the operable land base from which the samples were drawn was somewhat smaller than that defined in the analysis. However, the distribution of stands by species, age and height, is similar between the sample population and analysis operable land base.

The bias identified in the audit can be divided into two sources: the attribute error and the model error. The attribute error is associated with biases in age and height estimates, which alone would tend to overstate volumes. The model error is associated with biases with the VDYP model and tends to significantly underestimate stand volumes (when adjustment ratios for form and loss factors are applied) in the TSA. The total model error offsets the attribute errors. The audit results indicated that stand ages and heights were over stated in the forest inventory by 14% and 6%, respectively. However, stand volumes were underestimated in the inventory compared to audit sample volumes compiled using the unbiased adjustment ratios for taper and loss developed from the QCI volume and decay study. After application of all adjustments (height, age, volume and tree taper), the average stand volume (net decay, waste and breakage without veteran trees) was 9.3% higher than the average calculated from the inventory. The differences vary for the five species groups:

- cedar-young—adjusted volume 53% greater than the inventory volume
- cedar-old—adjusted volume 20% greater than the inventory volume
- hemlock-poor—adjusted volume 9% greater than the inventory volume
- hemlock-good—adjusted volume 8% greater than the inventory volume
- spruce—adjusted volume 18% *less* than the inventory volume.

These adjustment ratios were applied to the age, height and volume attributes for mature stands in the current inventory file and used to develop timber yield projections for natural stands.

[7] The sampling error corresponding to the ± 95% confidence interval expressed as a percentage of the mean volume per hectare. Sampling objectives of the audit was to ensure at least a 15% sampling error for timber volume per hectare overall.

Although the audit-based adjustments reflect the best available information on timber volumes, a harvest forecast was generated for which no adjustments were applied simply to show the impact of the adjustments. Figure 24 compares this forecast with the total THLB forecast. In the unadjusted forecast, the pre-Part 13 AAC could be maintained only for one decade before begin stepping down to the steady long-term level. The largest effects were in the short-term because the volume adjustment, which corrected for bias in the decay, waste and breakage functions, were only applied to natural stand volume estimates. The slight difference in the long-term levels is due to the positive adjustments that corrected for bias in the taper functions, which were applied when estimating managed stand yields, as well existing stands yields. The taper adjustments were applied in the total THLB forecast but not in the unadjusted inventory forecast.

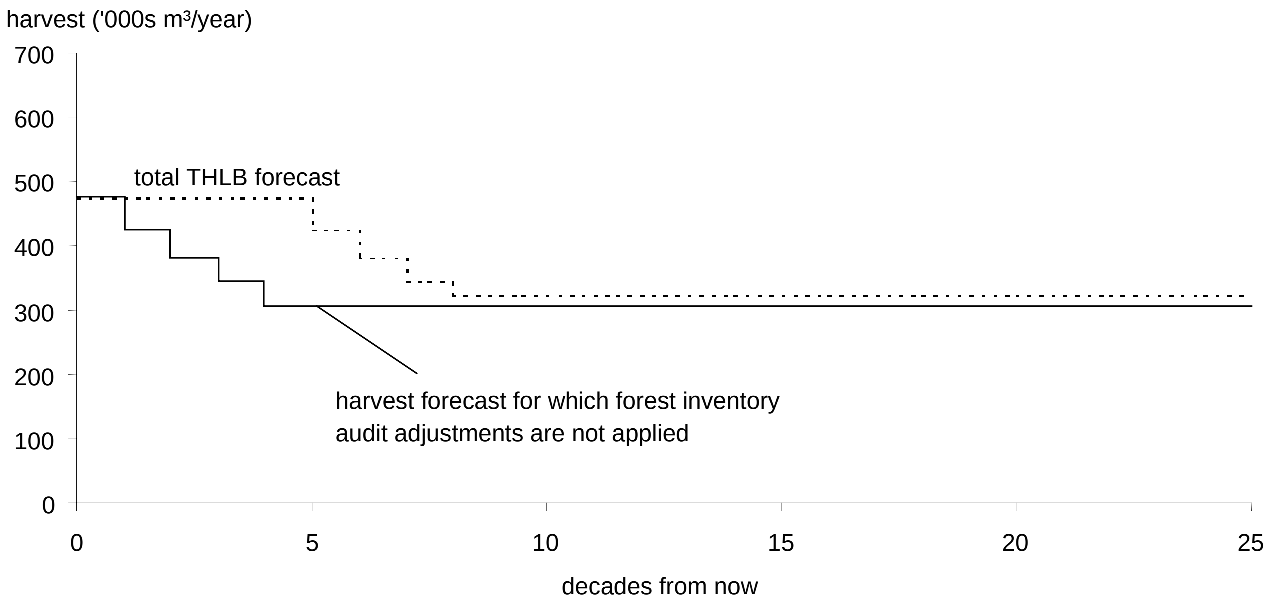


Figure 24. Harvest forecast if inventory audit adjustment ratios are not applied to the forest inventory — Queen Charlotte TSA, 2000.

6.5 Sensitivity to changes in managed stand yields

A number of factors add to uncertainty about managed stand volume estimates. As with natural stands, managed stand volumes may be influenced by biases in the forest inventory information and in growth and yield projections. In addition, there is uncertainty regarding the level of stand tending and the ultimate affects these efforts might have on future stand yields. Since the managed stand yield curves for the Queen Charlotte TSA were adjusted using ratios to adjust for bias in tree taper equations, uncertainty arises in the statistical process used to derive the taper adjustment factors.

Uncertainty also exists in assumptions about natural losses due to insects and diseases in managed stands. These losses were assumed to increase with stand age, trending from zero at the time of establishment to 5% at the reference age of 100 years, and higher in older stands. This assumption may under estimate losses due to defoliation by the blackheaded budworm and hemlock sawfly. An epidemic of these insects has persisted for four years on the Queen Charlotte Islands. Although unsalvaged volume losses due to mortality have been factored into the analysis, the long-term growth losses are not well quantified. A recent rough estimate, based on radial increment loss, indicates the additional volume loss may be up to 1.75% in budworm-damaged areas.

The managed stand yields used in the analysis may not reflect gains that will result from the use of improved tree seed. Currently, improved seed for cedar, hemlock and Sitka spruce is used in the TSA. Although the future yield gains achieved through the use of improved seed has not been calculated, trends indicate the gains to be between 2% and 8% at rotation age (estimated at 80 years for this purpose).

6 Timber Supply Sensitivity Analyses

Sensitivity analysis was conducted to test the timber supply impact of changes in estimates of timber volume from managed stands. The results are illustrated in Figure 25. If managed stand volume estimates are increased by 10%, then the steady long-term harvest level increases proportionately (about 10%.) If the managed stand volume estimates are increased by 20%, then the medium-term harvest level goes up by about 10% and the steady long-term increases by roughly 20%. The full increase in harvest levels does not occur until the fifteenth decade when the harvest is almost entirely second-growth forest. If managed stand volumes are decreased by 10 or 20%, the steady long-term harvest level must decline proportionately by 10 or 20%.

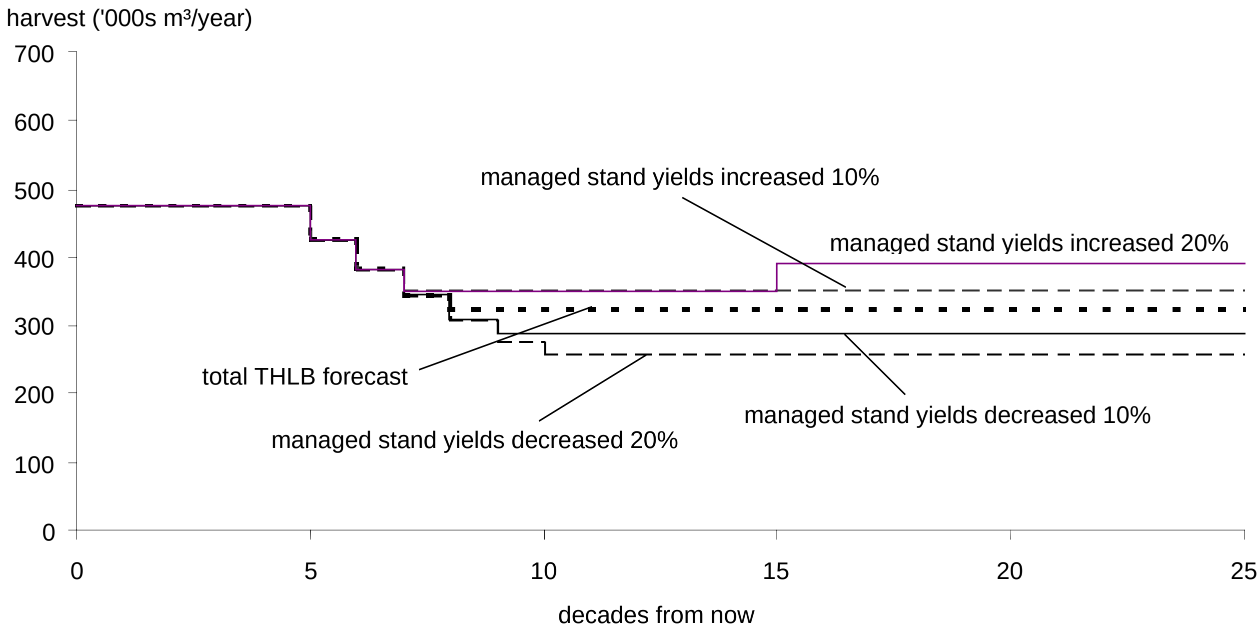


Figure 25. Harvest forecast if estimated volume of timber in managed stands is increased and decreased by 10% and by 20% — Queen Charlotte TSA, 2000.

6.6 Sensitivity to changes in minimum harvestable ages

Minimum harvestable age refers to the time required for stands to grow to a harvestable size, and defines the lower limit for harvesting. In the total THLB forecast, the minimum harvestable age for stands in each analysis unit* was set to the greater of: a) the estimated age at which an average stands in the unit is predicted to achieve a merchantable volume of 400 cubic metres per hectare; and b) the age at which an average stand in the unit achieves a mean annual increment (MAI) that is 95% of the maximum. The actual ages determined using these criteria are provided in Appendix A, "Descriptions of Data Inputs and Assumptions for the Timber Supply Analysis", and range from a high of over 200 years for low-site cedar to a low of 60 years for good-site spruce.

There is uncertainty regarding the criteria used to determine minimum harvestable ages. Future economic conditions and changing forest product objectives may affect the age at which stands can be profitably harvested. For instance, future harvesting may target sawlogs larger than those achieved at the minimum harvestable ages defined for the total THLB forecast. Alternatively, advances in milling technology may make the harvest of smaller logs on shorter rotations more economical.

Figure 26 illustrates the impact of increasing and decreasing the minimum harvestable ages for all analysis units by 10%. Figure 27 illustrates the impact of adjusting the minimum harvestable ages up and down by 20%. Per cent adjustments were applied, instead of fixed age adjustments, because of the high variation in minimum harvestable ages among analysis units. For example, a fixed adjustment of 20 years would affect good-site spruce stands much more than low-site cedar stands.

Analysis unit
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.

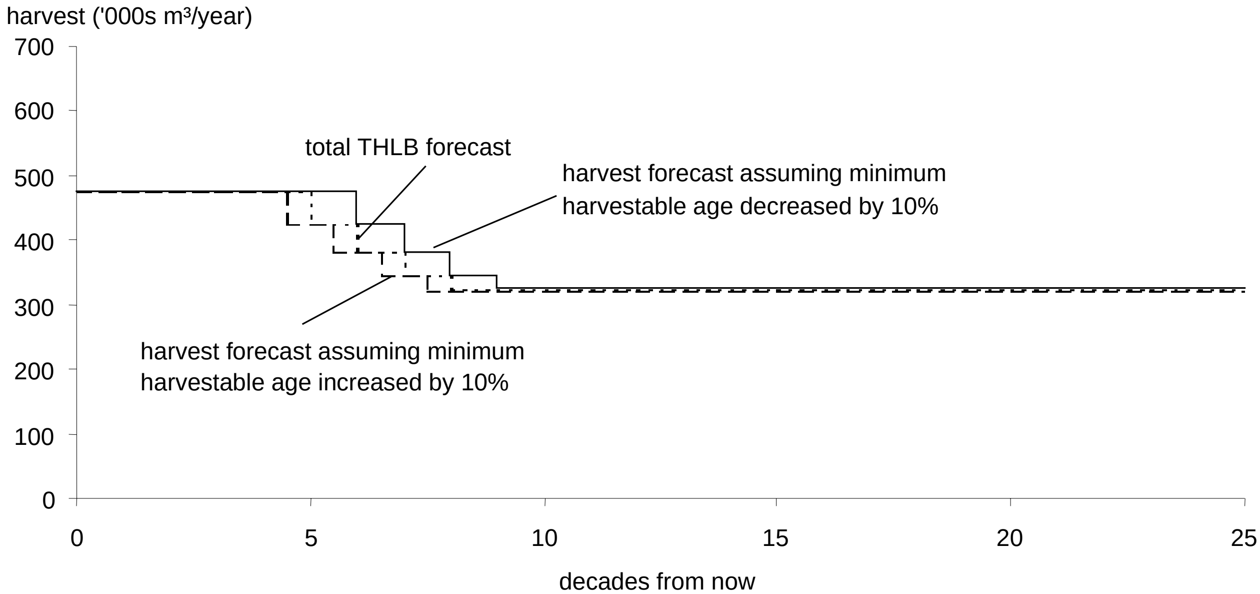


Figure 26. Harvest forecast if all minimum harvestable ages are increased and decreased by 10% — Queen Charlotte TSA, 2000.

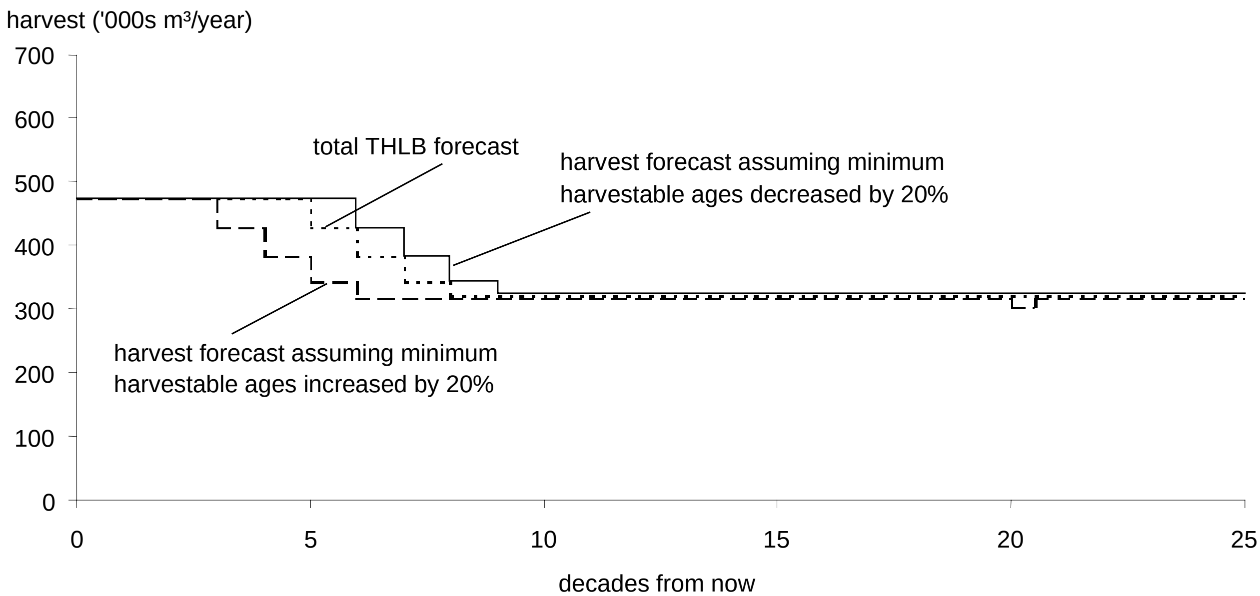


Figure 27. Harvest forecast if all minimum harvestable ages are increased and decreased by 20% — Queen Charlotte TSA, 2000.

When minimum harvestable ages are decreased by 10%, the initial harvest level can be maintained one decade longer than in the total THLB forecast. When minimum harvestable ages are increased by 10%, the initial harvest level must decline five years earlier.

When minimum harvestable ages are decreased by 20%, the harvest flow is the same as with the 10% decrease, indicating that at some point between the 10% and 20% reduction, minimum harvestable ages place further limits on timber supply. Increasing minimum harvestable ages by 20% requires that the initial harvest level decline two decades earlier than in the total THLB forecast.

In all examples, adjustment to the minimum harvestable ages affect the projected timber supply in the medium-term, generally between the third and ninth decades. Over the short term, the timber supply comes almost entirely from old natural stands that are well above the minimum harvestable age. In the medium term the source of timber supply shifts from predominantly natural stands to managed stands. When the minimum harvestable ages are increased, it takes longer for second-growth stands to become harvestable. Therefore, the level of harvest in the medium term must be reduced to conserve growing stock until the second-growth stands reach harvestable age. Decreasing the minimum harvestable ages shortens the length of time it takes second-growth stands to become harvestable. Therefore, the rate of harvest in the medium term can be increased since there is a larger amount of harvestable growing stock.

The long-term harvest level is generally insensitive to changes in the minimum harvestable ages by 10% to 20%. This is because in the long-term stands are generally harvested above the minimum harvestable age.

6.7 Sensitivity to changes in the timber harvesting land base

The area estimated to be available for timber harvesting in the Queen Charlotte TSA is based on assumptions regarding management objectives for forest values such as timber, wildlife habitat, biodiversity*, traditional uses and wilderness recreation; availability of contentious areas for timber harvesting; and assumptions about the economic feasibility of timber harvesting in different areas.

Sources of uncertainty include bias or error in the estimates of areas to be removed from the timber harvesting land base for the following reasons:

- forest lands that are environmentally sensitive and/or significantly valuable for resources other than timber;
- forest land on sensitive or unstable terrain, incremental to environmentally sensitive areas;
- forest lands reserved in riparian management areas
- forest lands with high recreation values;
- forest lands with low-timber growing potential;
- forest lands removed from timber production for roads, trails and landings;
- forest lands within areas reserved to protect cultural heritage values, including culturally modified trees (CMT).

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. Seral stages Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.

Appendix A, "Descriptions of Data Inputs and Assumptions for the Timber Supply Analysis", describes each of the above land base assumptions and the methods used to derive them. The land base reduction for forest within riparian management areas applied in the total THLB forecast is 9.8%. This assumed no difference in composition of the forest inside and outside of the riparian areas*. However, the productivity of riparian forests is normally better on average than forests outside of riparian zones. Recent analysis in the Eden landscape unit indicates the reduction for riparian management zones in that landscape unit is 4.4% higher when the difference in forest productivity is considered than the 9.8% applied in the total THLB forecast.

The sensitivity of the total THLB forecast to changes in the timber harvesting land base was evaluated by arbitrarily increasing and decreasing the area of all stands by 5% and by 10%. Figure 28 illustrates the impact of these adjustments relative to the total THLB forecast. The results show that the harvest forecast varies more or less in direct proportion to the amount the land base is increased or decreased.

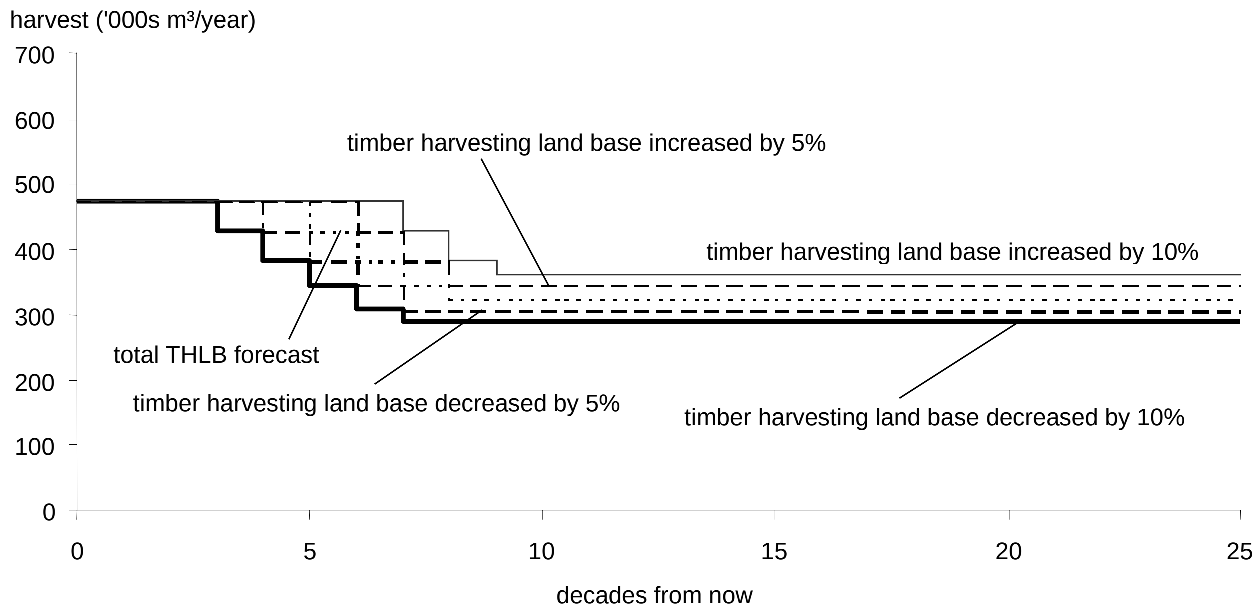


Figure 28. Harvest forecast if the area of timber harvesting land increased or decreased by 5% and by 10% — Queen Charlotte TSA, 2000

> ***Riparian area***
> *Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.*

6.8 Sensitivity to excluding PAS study areas from the timber harvesting land base

Under the Protected Areas Strategy (PAS,) eleven study areas have been identified in the Queen Charlotte TSA. Collectively, these areas comprise approximately 4700 hectares of the total timber harvesting land base. The Northwest Graham Island study area, located wholly within the Duu Guusd area, is the largest, covering about 4100 hectares (87%) of the timber harvesting land base in the study areas. Figure 29 shows the harvest forecast if all PAS study areas are excluded from the timber harvesting land base.

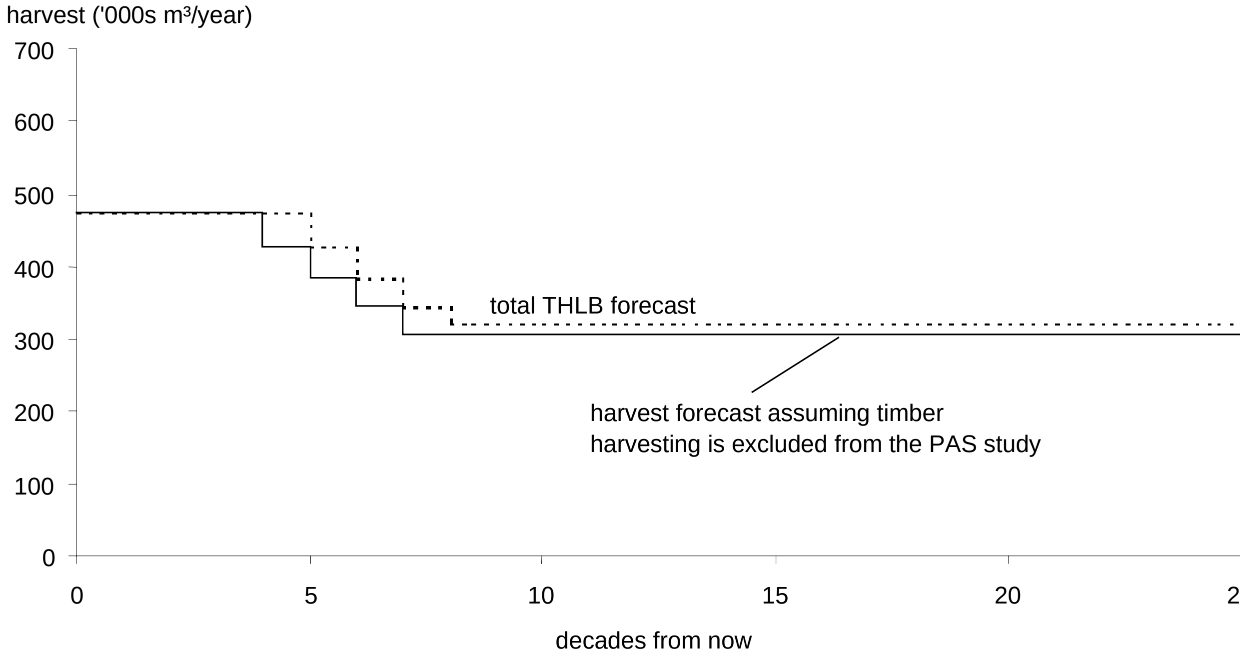


Figure 29. Timber supply forecast when all protected area strategy study areas are excluded from the timber harvesting land base — Queen Charlotte TSA, 2000.

If the study areas do not contribute to the timber supply, the initial harvest level can only be maintained until the fourth decade and the steady longterm harvest level would decline to 307 000 cubic metres per year; 5% below the total THLB forecast.

6.9 Sensitivity to the exclusion of the low-volume cedar partition from the timber harvesting land base

The chief forester, in his 1996 AAC determination for the Queen Charlotte TSA, specified that 75 000 cubic metres per year of the full pre-Part 13 AAC (475 000 cubic metres per year) was attributable to low-volume cedar stands. Low-volume cedar stands were defined by the district manager on July 11, 1997, as stands that are cedar-leading (based on gross volume) and have a net merchantable volume of less than or equal to 350 cubic metres per hectare. These stands make up approximately 5% of the current total timber harvesting land base. A significantly larger portion of other low-site cedar stands also occurs in the timber harvesting land base, but does not contribute to the partition. These stands, by nature of their advanced age, have standing volumes in excess of 350 cubic metres per hectare. Figure 11 illustrates the contribution of low-volume cedar stands that fall within the district manager's definition to the total THLB forecast.

The generally poor quality and low volume of timber available in the partition stands leads to uncertainty about the number of these stands that should be included in the timber harvesting land base. Many partition stands may not be profitable to harvest if log market values for cedar fall significantly below current levels. Also the amount of harvesting that has occurred in the low-volume cedar partition has been lower than expected.

The effects of excluding partition stands from the timber harvesting land base were tested in a sensitivity analysis. Figure 30 illustrates the harvest forecast generated when these stands are excluded from the timber harvesting land base. The pre-Part 13 AAC can be maintained only until mid-way through the second decade and then steps down to a steady long-term level approximately equal to that of the total THLB forecast. This medium-term effect is the result of the smaller initial growing stock available relative to the total THLB forecast. The long-term effect is minimal since the minimum harvestable age for managed low-volume cedar stands is over 200 years, and at that age the overall long-term production is low.

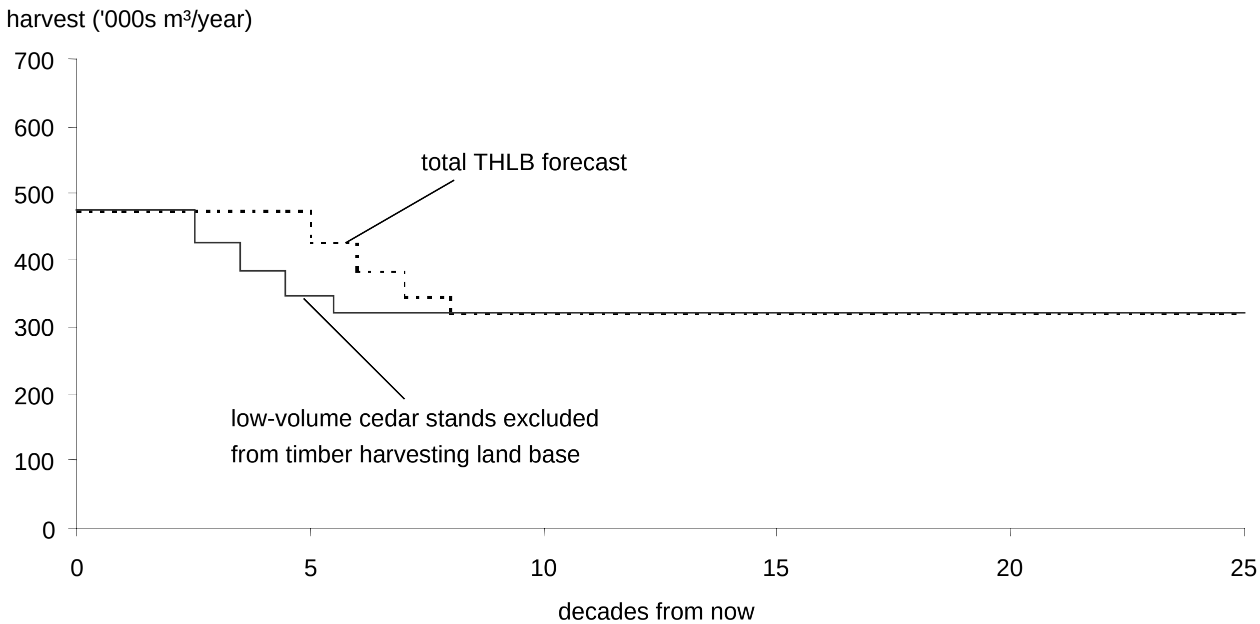


Figure 30. Harvest forecast if the timber harvesting land base does not include low-volume cedar stands — Queen Charlotte TSA, 2000.

6.10 Sensitivity to changes in approximations used to model cutblock adjacency guidelines

As explained in Section 2.3, "Management practices," the rate of harvest within the Queen Charlotte TSA is regulated by guidelines that limit the concentration of timber harvesting in any given area. These guidelines limit the size of harvest blocks and specify the conditions that must be achieved before stands adjacent to cutblocks can be harvested. To approximate these guidelines, an assumption of the analysis is that no more than 25% (20% in Haida declared areas[8]) of the harvestable area in each landscape management unit can be harvested within each 'green-up' period. The green-up period is the length of time it takes an average stand to achieve a top-height of three metres. The value of 25% is based on an estimate that it would require four entries to harvest all of the timber harvesting land base within a landscape while achieving the adjacency guidelines.

8 In the Haida declared areas a maximum of 20% of the THLB within each landscape unit is allowed to be harvested in each green-up period. This incremental constraint is not applied for additional adjacency constraint but to approximate the likely slower rate of development within the Haida declared areas.

The extent to which the 25% maximum limit represents the actual constraint on harvesting from the adjacency guidelines is uncertain. To test the sensitivity of the harvest forecast to changes in this assumption, two additional forecasts were generated. One forecast assumed a maximum of 20% of the THLB forest in each landscape unit could be harvested in each green-up period. The other assumed a maximum of 15% could be harvested in each green-up period. Figure 31 illustrates the harvest levels forecast under these assumptions relative to the total THLB forecast.

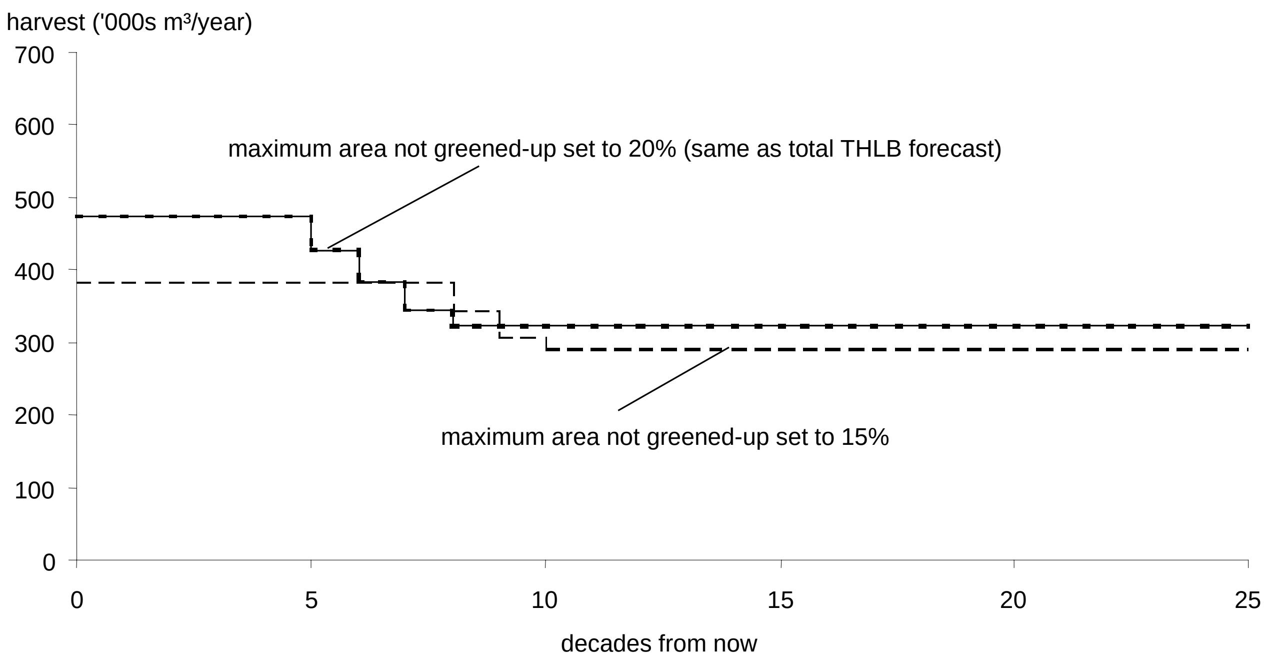


Figure 31. Harvest forecasts if the maximum percentage of the timber harvesting land base allowed in stands less than three metres tall (to model cutblock adjacency guidelines) is decreased by 5% and 10% — Queen Charlotte TSA, 2000.

The harvest forecast based on a 20% green-up rule was identical to the total THLB forecast, while the harvest forecast based on a 15% green-up rule showed a significantly reduced harvest flow. Under the 15% green-up rule, the pre-Part 13 AAC could not be achieved and the short-term harvest level would need to fall immediately by 20% to 383 000 cubic metres per year. In the long term, the harvest level would be about 9% below the total THLB forecast long-term level. Given the low ratio of operable to inoperable forests and the non-contiguous distribution of THLB within the Queen Charlotte TSA, it is likely that the 15% green-up rule overstates the actual constraint due to cutblock adjacency in the TSA.

6 Timber Supply Sensitivity Analyses

Sensitivity analysis was also conducted to test the sensitivity of the timber supply to changes in green-up height. Two forecasts were generated; one that assumed a green-up height of two metres, and one that assumed green-up height of four metres. In both cases, the harvest forecast was the same as the total THLB forecast, indicating that the timber supply is not sensitive to a one metre change in green-up height.

In the total THLB forecast, the number of landscape units that can be accessed simultaneously is not limited. Therefore, if the adjacency requirements are limiting in one or more landscape units, the timber supply model can draw on timber from any number of other available landscape units. This assumption may depart from operational reality because road construction and maintenance costs usually limit the number of active operating areas in a given period. Since these operational factors were not modelled, their potential effects on timber harvesting are not reflected in the analysis results. Presently, licensees are harvesting near the projected short-term level while achieving adjacency guidelines which suggests that operational constraints associated with the cutblock adjacency guidelines are, generally, not limiting in the TSA. However harvesting at the short-term level indicated in the total THLB forecast on a land base that excludes large tracts of the TSA, such as the Haida declared areas and the Tlell River watershed, will likely soon lead to harvest operations becoming limited by cutblock adjacency constraints.

6.11 Sensitivity to changes in visible disturbance allowances in scenic areas

In addition to cutblock adjacency guidelines, the rate of harvest is further constrained by visual quality guidelines in areas for which scenic values are to be maintained when carrying out forest development. These areas were identified by the District Manager after careful consideration of the level of recreational use; terrain and forest cover characteristics of each area. Visual quality guidelines limit the proportion of young forests that have not achieved visually effective green-up (VEG). VEG is assumed to be achieved when the regenerated stands grow to a top-height of 6 metres.

Visual quality guidelines are modelled in the analysis by limiting the percentage of harvested area that has not achieved VEG within the scenic areas of individual landscape units. The maximum allowable disturbance not greened-up (maximum alteration) is assigned to the upper end of the range of disturbance allowed for each recommended visual quality class (RVQC). The ranges are from 1.1% to 5% for areas in the 'retention' RVQC and 5.1% to 15% for the 'partial retention' RVQC. Managing to the upper end of the ranges reflects current practice within the Queen Charlotte TSA where visual landscape design is actively applied to reduce the visual impact of harvesting.

The maximum alterations assumed in the total THLB forecast are 5% for areas in the 'retention' RVQC and 15% for areas in the 'partial retention' RVQC. Figure 32 illustrates the impact of reducing the maximum alteration to the mid-points of the recommended ranges. These are 3% for areas in the 'retention' RVQC and 10% for areas in the 'partial retention' RVQC. Applying the alterations equal to the mid-point of the of the recommended ranges does not affect the harvest forecast in either the short-term or medium-term. There is a slight effect in the long-term where the harvest rate was 3% lower than in total THLB forecast.

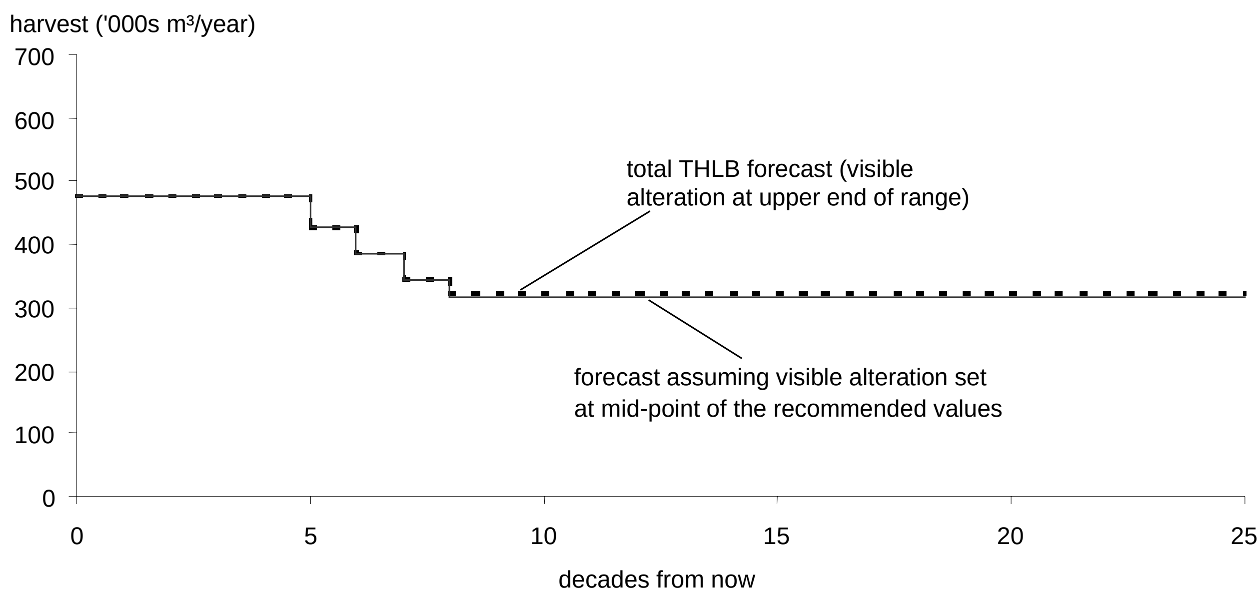


Figure 32. Harvest forecast if the percentage of visible alteration allowed in each visually sensitive area is set at mid-point of the recommended values — Queen Charlotte TSA, 2000.

6.12 Sensitivity to changes in biodiversity guidelines

The Ministry of Forests and the Ministry of Environment, Lands and Parks have agreed on how the *Forest Practices Code Biodiversity Guidebook* and *Landscape Unit Planning Guide* will be applied operationally. Priority has been given to achieving objectives for the retention of old-growth (late seral) forest and wildlife trees in all landscape units. Mid-seral and early-seral requirements are believed to be less critical to achieving landscape-level biodiversity, often overlap with other forest management prescriptions (i.e., wildlife habitat prescriptions, recreation values), and have the potential to cause significant timber supply impacts. As a result, mid-seral and early-seral requirements will not be applied operationally unless it can be shown in a timber supply analysis that the application of these seral stage targets will not have an impact on the timber supply forecast.

The *Forest Practices Code* guidelines for maintaining biodiversity specify a minimum percentage of the forest within each landscape unit/biogeoclimatic variant combination that must be retained in old forest. The percentage that must be retained depends on the biodiversity emphasis assigned to the landscape unit. In areas with a lower biodiversity emphasis less old forest is required and more time is allowed before the guideline must be met than in areas with higher biodiversity emphasis. Given that specific biodiversity emphases for each individual landscape unit in the Queen Charlotte TSA are still draft, the total THLB forecast and alternative land base forecasts shown in Section 5, "Results" assume an "average" level of management for biodiversity in all landscape units. The average area-weighted guideline applied to all landscape units is calculated on the assumption that the timber harvesting land base will eventually be divided into approximately 45% lower biodiversity emphasis, 45% intermediate biodiversity emphasis and 10% higher biodiversity emphasis.

Sensitivity analysis was done to compare the total THLB forecast to a harvest forecast that assumed the biodiversity emphasis assignments applied in the *Regional Landscape Unit Planning Strategy* prepared for the Queen Charlotte Forest District. The forecast results were the same. This result was expected given the large proportion of old forest outside of the timber harvesting land base. There is enough old forest outside the timber harvesting land base to meet even a high biodiversity emphasis in most landscape units. In the total THLB forecast, only the late-seral (old growth) forest cover requirements* were applied. Sensitivity analysis was done to compare these results to those of a forecast in which the early-seral, mature-plus-old and late-seral forest cover requirements recommended by the *Biodiversity Guidebook* were applied. The early-seral requirements limit the amount of forest in the early-seral stage within each biogeoclimatic variant to a maximum of 28%. The mature-plus-old requirements aim to ensure that a minimum of 30% of the forest in each biogeoclimatic variant is in mature seral* stage[9] or older. Even with these additional requirements, the total THLB forecast can be maintained without disruption. The early-seral and mature-plus-old forest cover requirements had no additional impact on timber supply because they can be met in forest outside the timber harvesting land base in all landscape units. In the case of the early-seral requirement, the large area of older forest outside the timber harvesting land base ensures that the maximum limit on early-seral area is never exceeded. In the Queen Charlotte TSA about 77% of the productive forest is outside the timber harvesting land base.

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).

Seral stages
Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.

[9] Ages that define seral stages vary by biogeoclimatic unit.

6.13 Sensitivity to general measures for managing Queen Charlotte goshawk nesting areas

The Ministry of Environment, Lands and Parks (MELP) has designated the Northern Goshawk (*Accipiter gentilis laingi*) as a red-listed species on the Queen Charlotte Islands (i.e., indigenous species that is threatened or endangered). Special management practices to protect identified wildlife species may be established by the deputy minister of MELP and the chief forester. These may involve the establishment of defined wildlife habitat areas (WHA), and through general wildlife measures (GWM). Although no such practices have yet been established in the TSA, current practice in the forest district is to avoid timber harvesting in or around goshawk nesting areas.

Currently there is one known goshawk nest site within the TSA. The *Identified Wildlife Management Strategy* (IWMS) indicates the kind of measures that could eventually be adapted for goshawk nesting areas. These call for a three-tiered wildlife habitat areas at each breeding site. The WHAs include a 12-hectares nest area, a 240-hectare post-fledgling area, and a 2400-hectare foraging area. The GWMs call for no harvesting in nest areas, and the maintenance of a minimum of 20% old-seral forest, a minimum of 40% mature-seral forest and a maximum of 20% in young-seral forest in each of the foraging and post-fledgling areas.

A timber supply forecast was created which assumed the above measures around the one known goshawk nest site within the Queen Charlotte TSA[10]. This had no impact in the projected timber flow relative to the total THLB forecast. The reason for no impact is that most of the old- and mature-seral requirements are met within the non-contributing forest, which occurs on more than one-half of the 2400 hectares around the nest site.

6.14 Sensitivity to changes in the level of stand management

In the Queen Charlotte TSA, regeneration densities are typically very high, often above 10,000 stems per hectare. Current management practices in the TSA include pre-commercial thinning on sites with good or moderate productivity. Pre-commercial thinning has advantages over natural spacing that occurs naturally during the life of a stand because it provides the opportunity to select healthier trees and trees on preferred micro-sites as crop trees. Although thinning immediately reduces the number of trees and standing volume per hectare, the remaining crop trees generally enjoy an extended period of free growth. Where utilization standards are high (minimum diameter at or above 17.5 centimetres) trees in thinned stands reach merchantable size sooner than in unthinned stands. The managed stand yield curves assumed in the total THLB forecast assumed that 90% of stands on good and moderate site will be thinned.

[10] At the time of the data preparation the post fledgling and foraging areas had not been delineated, therefore for this analysis they were considered to be circular areas of 240 and 2400 hectares in size concentric with the nest site.

6 Timber Supply Sensitivity Analyses

Uncertainty regarding the level of pre-commercial thinning that will be applied in the future is mostly due to the uncertainty of future funding for such activity. Also, changes in the estimates of the costs and benefits of pre-commercial thinning may indicate fewer stands should be treated than assumed in the total THLB forecast. To test the sensitivity of the total THLB forecast to the level of pre-commercial thinning a forecast was generated using managed stand yield tables that assumed no pre-commercial thinning.

Figure 33 illustrates the results of the no-thinning forecast relative to the total THLB forecast. The steady long-term harvest level is 5% lower than that of the total THLB forecast. This is due to the lower projected volume of unthinned stands at minimum harvestable age. The minimum harvestable ages estimated using the unthinned yield tables were slightly lower than those used in the total THLB forecast but the difference was not enough to affect the medium-term harvest levels.

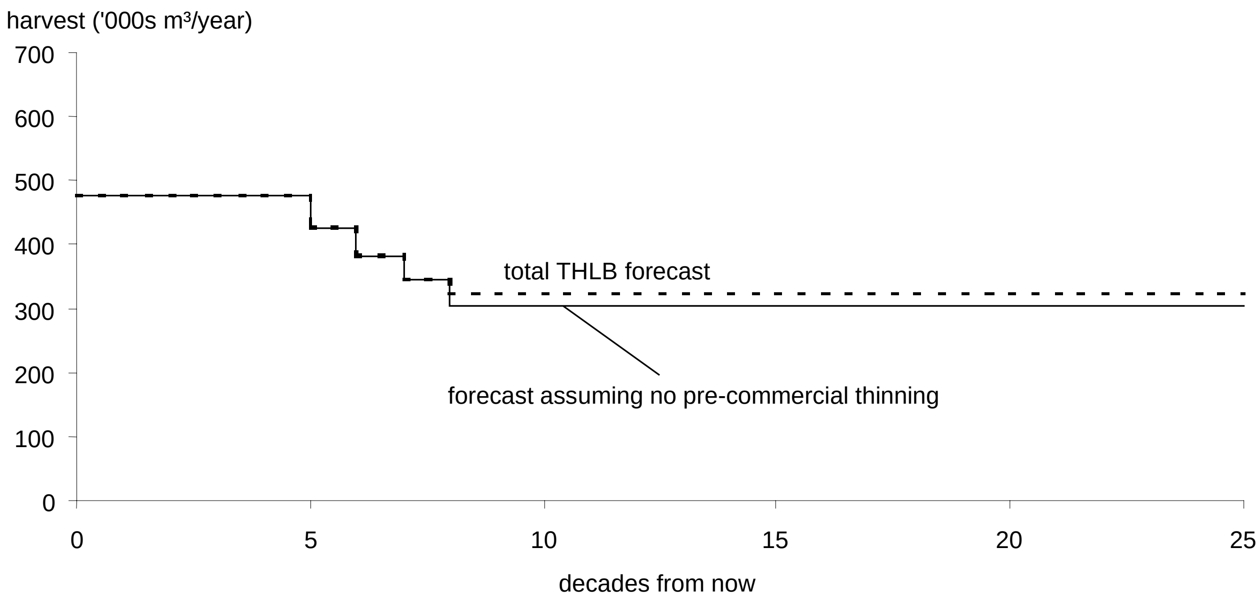


Figure 33. Harvest forecast if no pre-commercial thinning is conducted in managed stands — Queen Charlotte TSA, 2000.

6.15 Sensitivity to changes in the level of conversion of cedar stands

Current management defined for the total THLB forecast assumes that a portion of the area occupied by cedar on good and moderate sites will convert to spruce and hemlock after harvesting, and a portion of the area occupied by spruce on poor/moderate sites will convert to hemlock after being harvested. The conversion of cedar sites is largely due to the influence of heavy deer browse on regenerating cedar. The conversion of spruce to hemlock is the consequence of high levels of natural hemlock regeneration in these areas. The long-term consequence of stand conversion is the reduction in the percentage of cedar-leading and spruce-leading stands in the timber harvesting land base. Initially, the percentage of timber harvesting land base in hemlock-, spruce- and cedar-leading stands is 42%, 42% and 16% respectively. By the twentieth decade of the forecast the percentage of timber harvesting land base in hemlock-, spruce- and cedar-leading stands is 59%, 28 % and 13%, respectively. No attempt was made to project changes in the relative proportion of these species for the 77% of the forest that occurs outside of the timber harvesting land base.

Sensitivity analysis was done to determine how the harvest forecast changes if no species conversion occurred. Figure 34 illustrates the harvest forecast assuming no species conversion. The results show that if no species conversion is assumed, the steady long-term harvest level must fall by 8% relative to the total THLB forecast. The decline in the steady long-term harvest level occurs because the estimated merchantable volumes for managed cedar stands on good and moderate sites are slightly lower than those for hemlock.

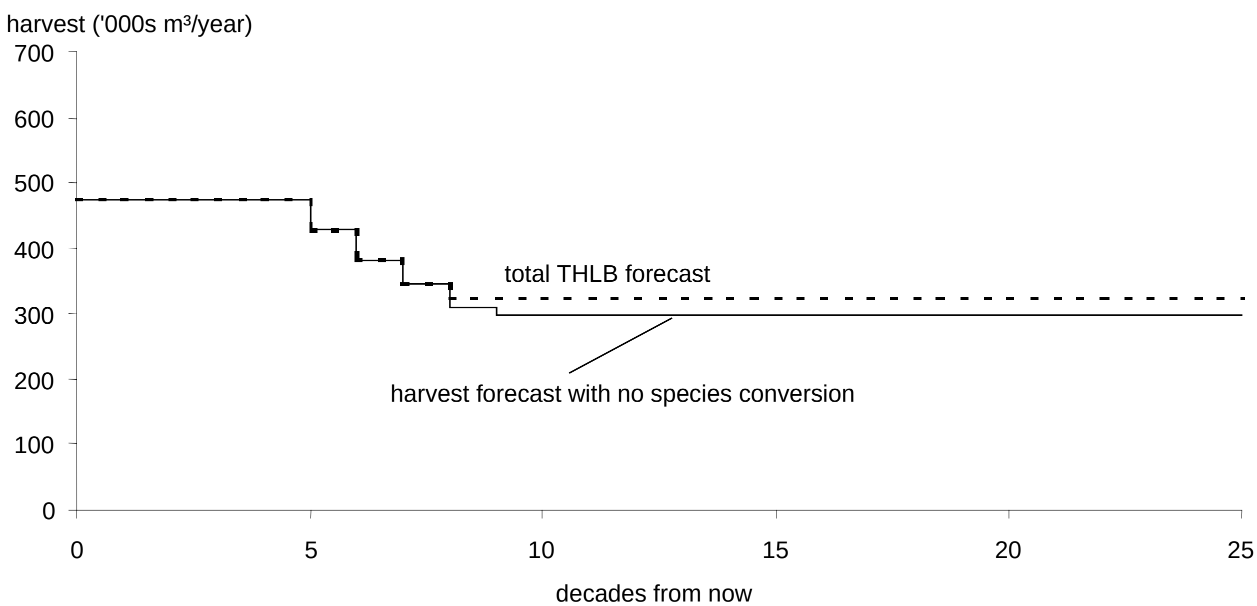


Figure 34. Harvest forecast if no species conversion of cedar and spruce occurs following harvesting of natural stands — Queen Charlotte TSA, 2000.

6.16 Sensitivity to changes in productivity estimates for future stands

The productivity of a site largely dictates how quickly a tree will grow, and therefore affects timber volumes, the time it takes to meet green-up requirements, and the age at which stands reach merchantable size and are available for harvest. The potential productivity of land for growing forests is estimated using site indices. Site index (SI) is the average height that the 100 largest diameter, suitable trees per hectare of a given species are expected to achieve at a specified reference age (50 years at breast height). In the total THLB forecast, the future productivity of a managed stand is predicted from the site index estimate for the natural stand it replaces.

However, it is difficult to know how the productivity of managed stands actually compares to the productivity of the natural stands they replace partly because it is difficult to estimate the true site index in natural old-growth stands. The most accurate estimates of site productivity come from stands between about 30 and 150 years old. At ages of less than 30 years, tree growth often varies widely from short-lived influences (e.g., post-harvest flush of nutrients or periodic drought). At older ages, site index estimates may be incorrect because measured tree heights do not represent the true potential of a stand due to top-breakage or die-back, and because it is often difficult to accurately determine the age of old trees. To address these concerns the Ministry of Forests undertook an *Old Growth Site Index* (OGSI) project. The goal of the OGSI project was to re-examine and improve, if necessary, site index estimates for old-growth stands. Although two OGSI studies have been completed[11] neither included data from the Queen Charlotte Islands. To address this data gap, the Vancouver Forest Region conducted the *Queen Charlotte Islands Stump-Site Index Study*[12]. This study used old cruise information with tree stump measurements in reforested areas in the forest district to derive factors that correct for bias in the old-growth site index estimates.

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11 Nigh, G. D. 1998. Site index adjustment for old-growth stands based on veteran trees. Research. Branch. B.C. Ministry of Forests Working Paper 36/1998.
Nussbaum A. F. 1998. Site Index Adjustments for Old-Growth Stands Based on Paired Plots. Research Branch. B.C. Ministry of Forests Working Paper 37/1998.

12 Hardy, K.J., 2000. *Draft Queen Charlotte Islands Stump-Site Index Study*. Vancouver Forest Region, B.C. Ministry of Forests. –Draft manuscript-

Stump-site index adjustments were developed for a) hemlock stands regenerated on sites previously occupied by old-growth hemlock, spruce and cedar, and b) spruce stands regenerated on sites previously occupied by old-growth hemlock, spruce and cedar. No adjustments were developed for sites regenerated to cedar. The data used to develop the adjustments were collected from sites on Graham, Moresby and Louise Islands within Tree Farm Licence 39, Block 6.

Sensitivity analysis was conducted in which site index estimates from stands over 140 years old in the Queen Charlotte TSA inventory were adjusted according to the stump study. Figure 35 illustrates the magnitude of the site index adjustments applied to the TSA forest inventory relative to those developed in the OGSI veteran study (Nigh 1998). Several caveats should be considered when evaluating the information in Figure 35:

- the adjustments suggested by this research reflect the potential site productivity that might be achieved under optimal conditions. Realistically, growth conditions are seldom optimal because of competition from other trees and brush. Therefore, some stands may not achieve the maximum potential productivity suggested by the research.
- there is uncertainty about how well the sample data, which were collected in stands within TFL 39, represent conditions and productivity in the Queen Charlotte TSA.
- there is some probability that the cruise data used in the stump study represent trees that would not have met site index tree criteria (e.g. were not the largest trees in the stand). Because of this possibility, the site indexes for the old-growth stands may have been underestimated. If the old-growth site indexes were underestimated, the difference between the site indexes for old-growth and regenerated stands would be overestimated. The degree of potential overestimation of the difference is unknown.
- for spruce-to-hemlock, cedar-to-hemlock, and cedar-to-spruce, the nature of the relationship between estimated old-growth site index and regenerated stand site index is not clear. Regenerated stand site indexes were consistently higher than those for old growth, however, the data showed no clear trend line to allow derivation of a regression equation.
- in some cases, site index adjustments were applied to stands outside the range of site indexes that were sampled.

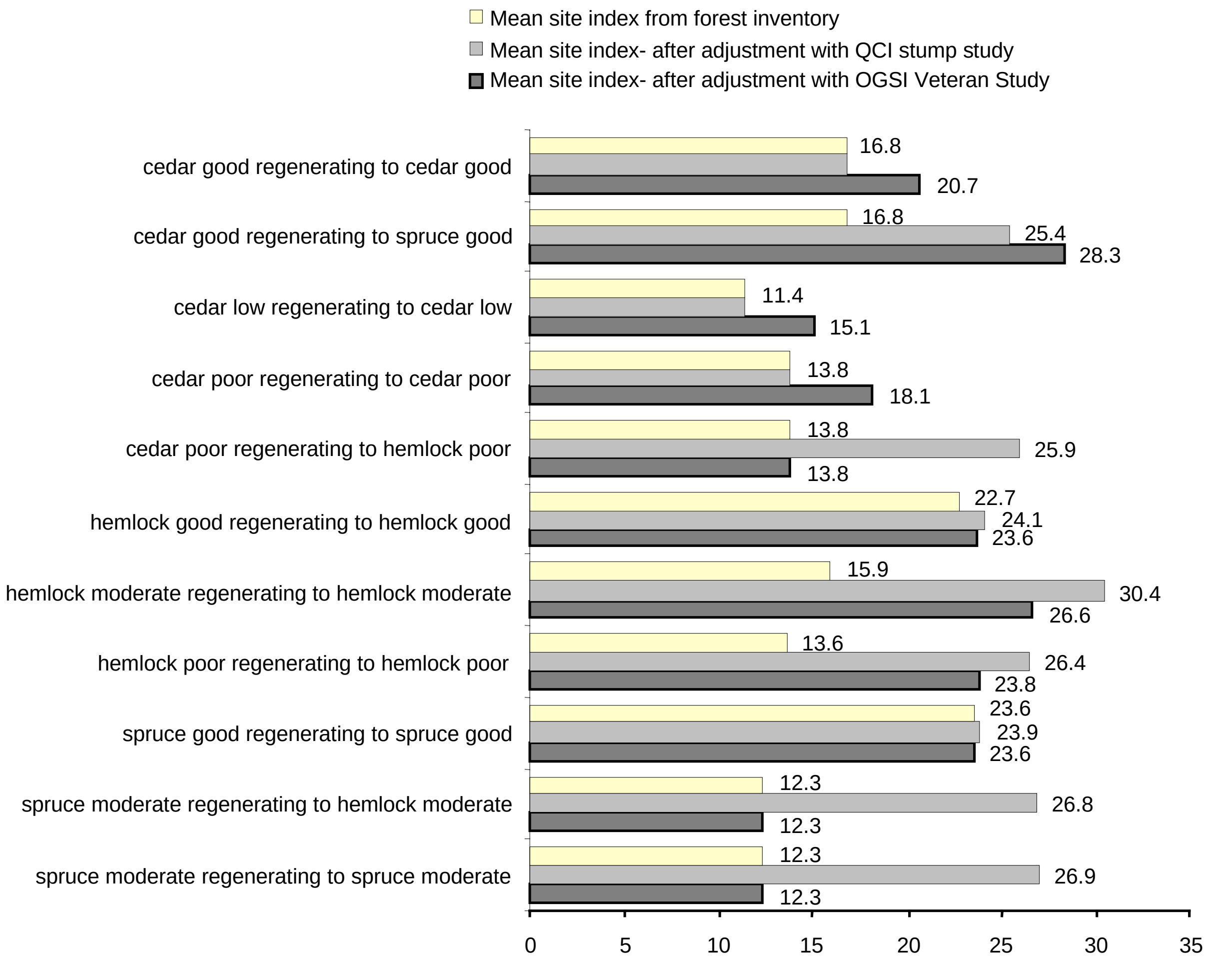

Figure 35. Comparison of mean site index estimates from the forest inventory data to mean site index estimates following adjustment using equations from the Queen Charlotte Islands Stump-Site Index Study and the Old growth Site Index Project Veteran Tree Study — Queen Charlotte TSA, 2000.

A harvest forecast was generated using managed stand yield curves and minimum harvestable ages that reflect adjustments from the stump-site index study. Figure 36 compares the harvest forecast that used the adjusted site indices to the total THLB forecast. By applying the site index adjustments, managed stand volume estimates are increased significantly and the minimum harvestable ages significantly reduced. These changes allow for a dramatic 80% increase in the steady long-term harvest level relative to the total THLB forecast.

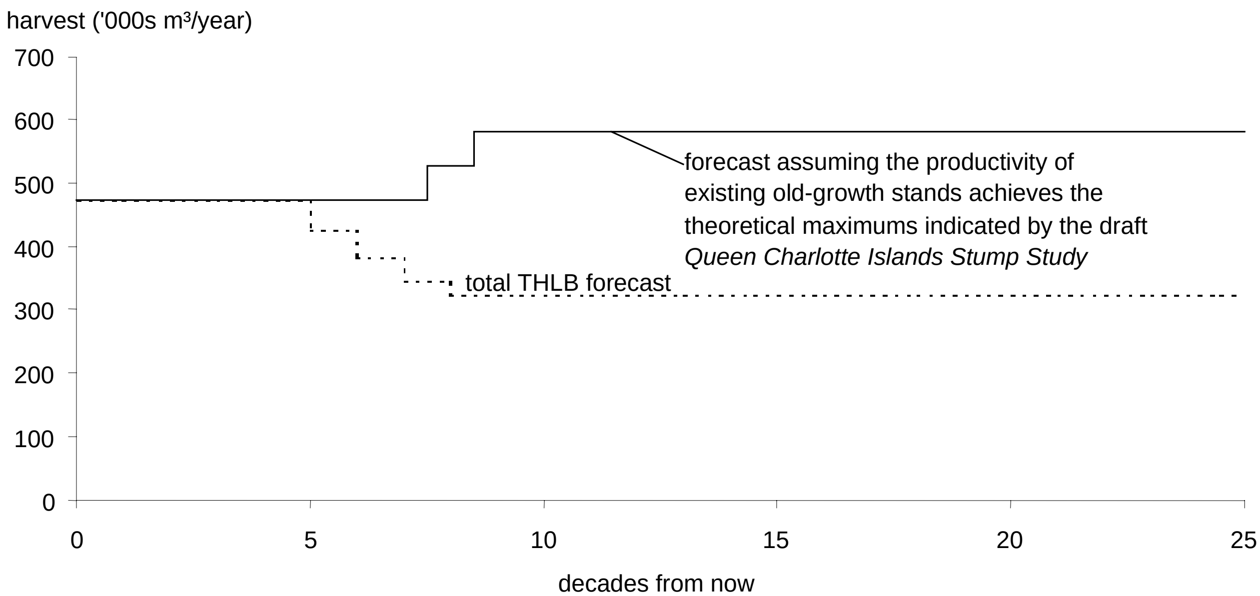

Figure 36. Harvest forecast if the productivity of the future forest is increased by the amount suggested by recent and ongoing research — Queen Charlotte TSA, 2000.

The effect on harvest flow illustrated here must be viewed cautiously for the reasons discussed above, as it provides an upper limit on the likely impacts of improved site productivity information. It is unclear how well actual second-growth stands are growing relative to the theoretical maximums. To illustrate this issue the forest inventory on the timber harvesting land base was divided by analysis units and three age groupings: 0-to-39 years, 40-to-139 years and 140 years and older. After applying the site index adjustments, the site indices for the oldest group in all spruce and hemlock analysis units were higher than the younger groups. Given that past harvesting in the Queen Charlotte TSA has generally occurred in what were considered higher productivity stands; these results are counter to what is expected. There are also uncertainties about the applicability of data collected in TFL 39 to the TSA; about the potential overestimation of the difference between the old-growth and regenerated stand site index stemming from use of cruise data; and about the relationship between site indexes for some of the species conversions.

Analysis results indicate that uncertainty about site productivity can significantly influence timber supply in the long term. While research around the province and in the Queen Charlotte Islands indicates that actual site productivity is underestimated by data from old-growth stands, the degree of underestimation is not certain, and requires more research.

7 Summary and Conclusion of the Timber Supply Analysis

The results of this analysis indicate that the pre-Part 13 AAC of 475 000 cubic metres can be maintained for as long as five decades, assuming availability of the entire timber harvesting land base within the Queen Charlotte TSA, and based on the current forest inventory, and continuation of current management practices. This forecast represents an increase in the available short- and medium-term timber supply compared to the results of the 1994 analysis. The increase is attributed to a 7% increase in the estimated size of the economically operable timber harvesting land base, and an increase of approximately 10% in the estimated yields from natural stands based on adjustments derived in the inventory audit.

Maintaining the pre-Part 13 level of harvest depends upon a supply of timber from the Duu Guusd area identified by the Council of Haida Nations and from the Tlell River watershed. The Duu Guusd area contributes 20% of the initial harvest volume and 21% of the steady long-term harvest. The Tlell River watershed is not critical to the initial harvest level, but does contribute 8% of the steady long-term harvest level.

The total THLB forecast used timber volume estimates that were adjusted according to the results of a forest inventory audit of the Queen Charlotte TSA. Audit volumes were compiled using new unbiased ratios to correct for error in taper, decay and waste estimates. These new ratios tended to increase whole stem volumes and decrease allowances for decay. The conclusion of the audit was that the inventory volumes were underestimated by approximately 10% overall. When these adjustments were not applied in the analysis, the pre-Part 13 AAC could be maintained for one decade before having to step down to the steady long-term level. However, the long-term harvest level was not significantly impacted since the adjustments apply primarily to the natural stands.

Analysis results suggests that implementation of the *Forest Practices Code* (FPC), which was not fully accounted for in the last timber supply review, does not significantly affect the Queen Charlotte TSA harvest forecast. More area was excluded from the timber harvesting land base than in the last timber supply review to account for FPC requirements such as reserves for riparian areas, wildlife tree patches, sensitive soils and cultural heritage values. However, this increase has been more than offset by addition of area to the timber harvesting land base since the last timber supply review based on new operability information. Nevertheless, a large proportion — about 77% — of the productive forest area is not part of the timber harvesting land base. Therefore, biodiversity guidelines that specify a maximum proportion of early-seral forest and a minimum amount of older forest are easily met without significant limitations on timber availability from the timber harvesting land base. The full range of seral-stage requirements (early, mature-plus-old, and old) from the *Biodiversity Guidebook* can be applied without significant effect on the timber supply forecast.

The results of preliminary work to quantify and adjust for bias in old-growth site index estimates were applied in a sensitivity analysis. The results indicate that the productivity of managed stands may be higher than the estimates obtained from the old-growth stands that preceded them. If so, the reduction in timber supply shown in the total THLB forecast after five decades may not occur or may not be as great. Further work is needed to quantify the bias associated with old-growth site index in the Queen Charlotte TSA, and the degree to which full site potential may actually be achieved.

Sensitivity analysis indicated that provided timber harvesting is allowed in areas currently deferred from harvesting, and natural stand yield estimates are accurate to within 10%, short-term timber supply in the Queen Charlotte TSA is not significantly affected by uncertainties in data and management assumption. However, changes in data and management assumptions increased or decreased the amount of time over which the pre-Part 13 AAC can be maintained.

Some uncertainties could affect medium- and long-term timber supply, particularly those related to assumptions used to define economic operability including the operability of low-volume cedar stands, managed stand yield estimates and minimum harvestable age.

8 Socio-Economic Analysis

The impacts of timber supply adjustments on local communities and the provincial economy are important considerations in the Timber Supply Review. The socio-economic analysis compares the level of forestry activity currently supported by timber harvested from the Queen Charlotte 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 harvest levels as projected in the total THLB harvest forecast and is not intended to examine alternative management scenarios.

The socio-economic analysis consists of the following:

- a profile of the current socio-economic setting;
- a description of the Queen Charlotte TSA forest industry; and,
- an analysis of the socio-economic implications of the total THLB harvest forecast.

8.1 Current socio-economic setting

8.1.1 Current population and demographic trends

The Queen Charlotte TSA is part of the larger Queen Charlotte Islands Forest District, which also includes portions of Tree Farm Licences (TFLs) 25, 39 and 47. Communities within the Queen Charlotte Islands include Masset, Old Masset, Port Clements, Tlell, Skidegate, Queen Charlotte City and Sandspit. In 1999, the estimated population of the Queen Charlotte Islands was 5,799 people, reflecting a decline since 1996 of less than 1%[13] (see Table 4). The decline in population, which occurred mainly in Masset and Sandspit, reflects the downsizing of Canadian Forces Station (CFS) Masset and employment opportunities in Sandspit.

From 1999 to 2005, the population of the Queen Charlotte Islands is expected to increase by 2.6% to 5,947.[14]

13 BC STATS, Population Section. Ministry of Finance and Corporate Relations.

14 BC STATS, Population Section. Ministry of Finance and Corporate Relations.

Table.4. Queen Charlotte Islands Forest District and selected community population statistics, 1991–2005

	1991	1996	1999	2005	% change 1996–1999	% change 1996–2005
Masset	1,476	1,293	1,211	N/A	– 6.3	—
Old Masset	632	692	N/A	N/A	—	—
Port Clements	483	558	573	N/A	2.7	—
Tlell and East Coast	282	369	N/A	N/A	—	—
Skidegate	469	695	N/A	N/A	—	—
Queen Charlotte City	1,079	1,222	N/A	N/A	—	—
Sandspit	734	568	N/A	N/A	—	—
Queen Charlotte Islands	5,475	5,841	5,799	5,947	– 0.7	2.6
British Columbia	3,282,910	3,882,043	4,023,100	4,372,900	3.6	8.7

Source: Census 1991, 1996. BC STATS Population Section. N/A: data unavailable.

8.1.2 Economic profile

From 1991 to 1996, the total experienced labour force in the Queen Charlotte Islands increased by 11.3% to 3,200 from 2,875.[15] In comparison, the provincial experienced labour force increased by 14% over the same period. Based on the minor reduction in the population of the Queen Charlotte Islands since 1999, the labour force may also have declined marginally.

The solid growth in the labour force from 1991 to 1996 is not indicative of the longer term trends on the Queen Charlotte Islands. From 1986 to 1991, the labour force declined by 7.1%. From 1986 to 1996, the labour force grew by 3.4%. In comparison, from 1986 to 1996, the total provincial labour force grew by 32%.

The sectors showing the greatest volatility in employment are fishing, forestry and manufacturing. They show a similar pattern of decline from 1986 to 1991, followed by an increase from 1991 to 1996. Regardless of the increase, however, fishing, forestry and manufacturing declined by 17%, 2.4% and 26%, respectively, over the 10-year period. Not surprisingly, employment in some service sectors also decreased, given the reliance of these services on the three sectors. From 1986 to 1996, finance, insurance and real estate employment declined by 20%, transportation, communication and utilities employment declined by 11.5%, and government-related employment declined by 15%.

15 Census of Canada, 1991, 1996.

The increases in the labour force from 1986 to 1996 occurred in other service-related sectors such as accommodation, wholesale and retail trade, and construction, which increased by 21%, 50%, and 8%, respectively. Business services on the Queen Charlotte Islands grew an impressive 400%, although that increase only represents an increase of 60 jobs and 2% of the total labour force.

The decline in some of the service sectors likely reflects the decline in the three traditional sectors of fishing, forestry and manufacturing, although the increase in these sectors from 1991 to 1996 likely had a positive effect. The growing tourism sector has also had a positive effect for the Islands' economy. The service sector employs a similar total number of people as the resource sectors; however, many of the service sector jobs provide services to the traditional resource sectors, as well as tourism. The resource sectors support as much as 50% of the supply and service sector related employment and continue to play a central role in the local economy.

Figure 37 shows the Queen Charlotte Islands experienced labour force by industry sector. The percentage figures are based on employment that includes total, direct, indirect and induced full-time employment positions, thus supply and service industry employment is allocated to individual basic sectors.* These figures are from the 1996 Census, which provides the most comprehensive and recent data available. Given the fairly stable labour force, these figures are at least as accurate as any non-Census regional estimates.

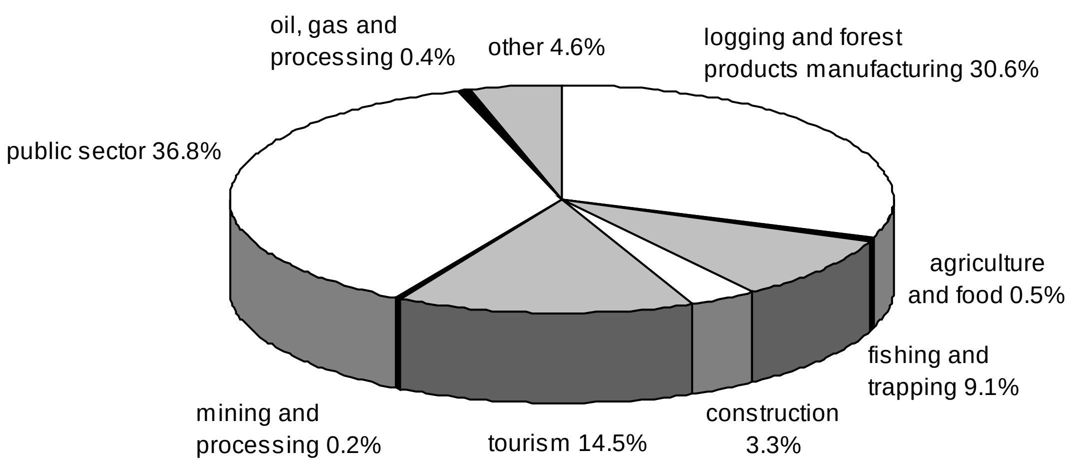

Figure 37. Queen Charlotte Islands Forest District, total employment by sector, 1996.

Source: Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables.
Based on 1996 Census of Canada data.
"Other" includes employment not elsewhere allocated and employment related to spending pension, employment insurance and other transfer payments.

In 1996, the public sector supported about 37% of the total (direct, indirect and induced) experienced labour force. Public sector activity, which includes education, health and local, provincial and federal government expenditures, accounted for the second largest share (33%) of income flowing into the region.[16] The share of public sector employment and income on the Queen Charlotte Islands was well above the provincial averages of 28% and 23%, respectively, for forest districts across the province. The downsizing of CFS Masset in the mid-1990s would have lowered those levels, and the government sector may no longer be the largest direct employer on the Islands and may be more in line with provincial averages.

The forestry sector on the Queen Charlotte Islands includes logging, forestry services and wood products processing. It is supported by timber harvested not only from the Queen Charlotte TSA, but also from Tree Farm Licences 25, 39 and 47, and private and federal lands. In 1996, the forestry sector was the second largest employment sector on the Queen Charlotte Islands providing work for about 31% of the total resident labour force, or about 650 to 675 direct jobs and a further 300 indirect and induced full-time jobs. As a result of the changes at CFS Masset, the forest sector may be the largest employer on the Islands. The forestry sector on the Islands also supports a large non-resident logging, forestry services and manufacturing workforce. The forestry sector is the largest single source of income flowing into the Islands, accounting for about 35% of total income. From 1997 to 1999, the average volume of timber harvested from the forest district was slightly below 1.3 million cubic metres per year.

Besides timber, the forestry sector also includes resources such as mushrooms, salal, berries and other products for both commercial and personal use. The Queen Charlotte Islands is a well-established and important source of chanterelle mushrooms. The mushrooms, which are shipped mainly to European markets, can attract numerous buyers and hundreds of resident and non-resident pickers. Many other products may help diversify the local economy; however, local acceptance of the commercialization of any product is mixed.[17]

[16] Ministry of Finance and Corporate Relations. 1999. *The 1996 forest district tables.*

[17] For a discussion of many of the issues and potential opportunities for non-timber forest products on the Queen Charlotte Islands see Tedder, Mitchell, and Farran. 2000. *Seeing the forest beneath the trees: The social and economic potential of non-timber forest products and services on the Queen Charlotte Islands/Haida Gwaii.* South Moresby Forest Replacement Account. Victoria, B.C.

In 1996, the fishing sector supported about 9% of the total experienced labour force. The fishing sector has had some of the most volatile shifts in labour, continually rising and falling with the availability of and market for fish products. However, employment levels have ranged from 25 to 55 jobs and the sector's share of the labour force has remained about the same since 1981.[18] Note that these data reflect place of residence; the fishing activity may not necessarily occur around the Queen Charlotte Islands. The fishing industry also includes fish processing. Masset had been the site of fish processing, although none of the plants are currently in operation, but the plants can employ a total of from 10 to 70 people when in production.

The travel sector in Figure 37 includes both holiday and business travel, and consists of accommodation, resort, restaurant, retail, tour, charter and guiding, and other service-related businesses. In 1996, the tourism sector supported almost 15% of the total labour force, or about 450 jobs. The tourism sector also supports seasonal non-resident employment. The main tourist activities on the Queen Charlotte Islands are sport fishing, hunting, adventure tourism, cultural and art appreciation, and general touring. Gwaii Haanas National Park Reserve offers the most remote and challenging travel on the Islands and draws people from around the world. In 1998, 2,005 visitors and guides used the park. This level is 12% above the number of visits in 1997, but 6% below the number in 1996.[19]

The indirect and induced employment included in Figure 37 reflects the income spent by companies and employees and the number of jobs that depend on those expenditures. Employment multipliers illustrate this spending effect: a larger multiplier indicates that each job in a particular sector will support more business activity at supply and service companies, due to higher company revenues, supply requirements and wages. For example, estimates by the Ministry of Finance and Corporate Relations indicate that every 100 full-time direct forestry jobs in the Queen Charlotte TSA support an additional 33 to 49 indirect and induced jobs, depending on the forestry activity (harvesting or processing). In comparison, every 100 full-time direct jobs in the tourism and business travel sector support an estimated 15 indirect and induced jobs, and every 100 jobs in the public sector support an additional 25 indirect and induced jobs. The differences are due to larger spending patterns by forestry sector businesses and their employees, both of which tend to have higher incomes. The multipliers indicate how a change to a particular sector could affect the broader economy. Table 5 compares employment multipliers for sectors of the Queen Charlotte Islands' economy.

[18] Census labour force data indicate that the direct fishing, trapping and fish processing sector accounted for 4.4% of the labour force in 1981, 5.6% in 1986, 4.2% in 1991, and 4.5% in 1996.

[19] Parks Canada, Queen Charlotte City, B.C.

Table 5. Employment multipliers, by sector Queen Charlotte Islands Forest District, 1996

Basic sector	Employment multiplier
Forestry – logging and manufacturing	1.33-1.49
Agriculture and food	1.13
Tourism	1.15
Public sector	1.25
Construction	1.34

Source: Ministry of Finance and Corporate Relations. 1999. *The 1996 forest district tables.*

8.2 Queen Charlotte TSA forest industry

8.2.1 Current allowable annual cut

The current allowable annual cut (AAC) for the Queen Charlotte TSA is 361 000 cubic metres, which reflects a temporary reduction under Part 13 of the *Forest Act* from 475 000 cubic metres. The pre-Part 13 AAC of 475 000 cubic metres was set in 1996. The AAC is divided into a conventional volume of 304 000 cubic metres and a partitioned volume to harvest 57 000 cubic metres of low-volume cedar. Table 6 gives a breakdown of the AAC by licence type.

Table 6. Queen Charlotte TSA allowable annual cut, by licence type

	AAC conventional (m^3)	AAC partition (m^3)	Total AAC (m^3)	% of total AAC
Forest licences, replaceable	208 506	39 094	247 600	68.6
Timber sale licence < 10 000 m^3	7 336	1 376	8 712	2.4
Small Business Forest Enterprise Program (SBFEP)	76 684	14 379	91 063	25.2
Forest Service Reserve	6 000	1 125	7 125	2.0
Woodlot licences	5 474	1 026	6 500	1.8
Total	304 000	57 000	361 000	100.0

Source: Ministry of Forests.

8.2.2 Queen Charlotte TSA harvest history

Table 7 summarizes the volume of timber harvested from the Queen Charlotte TSA from 1993 to 1999. 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 due to cut control[20] provisions that allow licensees to vary their harvests based on operating and market conditions. The last complete cut control period was from 1993 to 1997; the current cut control period is from 1998 to 2002. If actual annual harvest levels are consistently less than the AAC, then forestry activity is below its full potential.[21]

In 1999, about 339 000 cubic metres was harvested from the Queen Charlotte TSA (see Table 7). During the previous cut control period from 1993 to 1997, the average harvest was 357 902 cubic metres. The undercut for the period was about 700 000 cubic metres, or an average 140 000 cubic metres per year. The undercuts in the previous and current cut control periods have occurred for several reasons, including the downturn in the Asian market, and limited access to U.S. markets. The current AAC of 361 000 cubic metres is more reflective of the harvesting activity that has occurred on the Queen Charlotte Islands for the last several years.

In addition to timber harvested from the Queen Charlotte TSA, timber is harvested from TFLs 39, 47 and 25, and a lesser amount from timber licences, private and federal lands. From 1995 to 1999, timber harvests from these areas averaged 985 000 cubic metres per year. About 96% of this volume was harvested from the Forest District's tree farm and timber licences. Tree farm licences account for about 77% of the total harvest from the Queen Charlotte Islands Forest District.

[20] Cut control allows licensees to vary the volume between annual harvest and AAC by +/- 50% per year, and by
+/- 10% over a five-year period.

[21] Full potential 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 local operating conditions and the international market for wood products.

Table 7. Queen Charlotte TSA volumes billed, by licence type, 1993 to 1999

	(cubic metres)						
Tenure	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Forest licences	327 561	263 568	166 864	315 442	164 141	227 303	296 729
Small Business Forest Enterprise Program (SBFEP)	125 022	75 773	41 153	71 725	53 663	26 786	41 265
Timber Sale Licence (TSL)	105 858	26 573	0	37 239	5	0	0
Other[a]	901	2 897	6 069	656	4 398	480	1 010
Total	559 342	368 812	214 086	425 062	222 207	254 569	339 004
AAC[b]	514 335	514 335	514 335	475 000	475 000	475 000	475 000

Average harvest 1993–1997: 357 902 cubic metres.

Average harvest 1998–1999: 296 786 cubic metres.

(a) "Other" consists of cutting permits such as rights-of-way, road permits, and other small temporary permits.
(b) The AAC was reduced in May, 1996, and in December, 1999.
Source: Ministry of Forests.

8.2.3 Queen Charlotte TSA major licensees and processing facilities

The following section describes the Queen Charlotte TSA's major licensees, other smaller licences and processing facilities.

Husby Forest Products

Husby Forest Products Ltd. (Husby) is the parent company of four companies operating on the Queen Charlotte Islands: Husby Forest Products Ltd., Sitkana Timber Ltd., Naden Harbour Timber Ltd. and Dawson Harbour Logging Co. Ltd. The Husby companies have three replaceable forest licences and one timber sale licence to harvest a total of 238 503 cubic metres per year of conventional and low-volume cedar. Prior to the Part 13 reduction, the Husby companies had a total AAC of 316 367 cubic metres. From 1997 to 1999, these companies harvested an average total volume of 211 905 cubic metres. Husby Forest Products has asserted that the shortfall between the harvest and AAC is due to deferral of logging in the Duu Guusd.

8 Socio-Economic Analysis

Table 8 shows Husby's recent harvest activity and 1996-1998 average person-years of employment associated with its Queen Charlotte TSA operations.

Table 8. Husby volumes billed and provincial employment statistics

AAC[a]	238 503 cubic metres
1999 harvest	271 708 cubic metres
1997-1999 average volumes billed	211 905 cubic metres
Employment[b] (1996-1998 average person-years)	
Logging, log transport and forestry services	102
Processing	168
Total	270

(a) In December 1999, the AAC was reduced to 238 503 cubic metres from 316 367 cubic metres.
(b) The average employment figures relate to data collected from 1996 to 1998 and the average volume of 227 627 cubic metres harvested from the Queen Charlotte TSA and processed within British Columbia.

Husby is a market logger, as such does not process the timber it harvests. In general, over 95% of the timber harvested on the Queen Charlotte Islands is processed at mills in the Lower Mainland and Vancouver Island. The rest flows to mills in the Kalum Forest District. Identifying the types of products into which the timber is milled is not possible, as most of the timber flows through the Vancouver log market. As a result, average timber flows for the district are used: 67% of the timber is assumed to be processed into lumber, 28% into pulp and the remaining 5% into shake and shingles.[22]

[22] Simon Reid Collins and Pierce Lefebvre Consulting. 1996. *Analysis of woodflow in the Vancouver Forest Region*. Unpublished report. B.C. Ministry of Forests, Victoria, B.C.

8 Socio-Economic Analysis

J.S. Jones Ltd.

J.S. Jones Ltd. (J.S. Jones) operates under TimberWest Forest Products' replaceable forest licence in the Queen Charlotte TSA with the rights to harvest 15 931 cubic metres of timber. Prior to the Part 13 reduction, TimberWest had an AAC of 21 312 cubic metres. From 1997 to 1999, an average of 17 463 cubic metres was harvested under this licence, although no timber was harvested in 1998. Table 9 outlines J.S. Jones recent harvest activity and 1996-1998 average employment levels associated with its Queen Charlotte TSA operations. J.S. Jones also operates on the Queen Charlotte Islands portion of TFL 47.

Table 9. J.S. Jones volumes billed and provincial employment statistics

AAC[a]	15 931 cubic metres
1999 harvest	25 021 cubic metres
1997-1999 average volumes billed	17 463 cubic metres
Employment[b] (1996-1998 average person-years)	
Logging, log transport and forestry services	8
Processing	15
Total	23

(a) In December 1999, the AAC was reduced to 15 931 cubic metres from 21 312 cubic metres.
(b) The average employment figures relate to data collected for 1996-1998 and the average volume of 20 415 cubic metres harvested from the Queen Charlotte TSA only and processed within British Columbia, adjusted for licence downtime.

J.S. Jones operates two lumber mills, J.S. Jones Timber in Boston Bar and Stag Timber in Surrey, and one shake and shingle mill, Teal Cedar Products in Surrey. In 1999, these mills consumed about 705 000 cubic metres of timber and employed about 600 individuals. Most of the timber processed at these mills comes from the Fraser TSA. At this time, about 90% of the timber harvested from the Queen Charlotte Islands is marketed to mills through the Vancouver log market. The rest, in the form of pulp logs, is shipped to Prince Rupert.

Other licensees

The Small Business Forest Enterprise Program (SBFEP) and timber sale licences account for the rest of the timber harvested annually from the Queen Charlotte TSA. The total volume apportioned to the SBFEP is 76 684 cubic metres of conventional timber and 14 379 cubic metres of low volume cedar for a total AAC of 91 063 cubic metres. Prior to the Part 13 reduction, the AAC apportioned to the SBFEP was 121 818 cubic metres. SBFEP sales in fiscal 1998-99 and 1999-2000 ranged from 100 000 cubic metres to 140 000 cubic metres. Some of these sales included backlog volumes. Sales figures and volumes billed are not equivalent as sales generally provide multiple years to harvest. In 1999, 41 265 cubic metres was harvested and billed under the SBFEP. From 1997 to 1999, an annual average of about 40 570 cubic metres was harvested under the Queen Charlotte TSA SBFEP. Most of this volume was shipped to mills in the southwest of the province, although a minor portion was processed locally.

Queen Charlotte Islands processors

Abfam Enterprises Ltd. (Abfam) does not hold a major licence on the Queen Charlotte Islands; however, it is the largest of the few processors on the Islands. The sawmill, located at Port Clements, can process up to 50 000 to 75 000 cubic metres of timber per year in the production of up to 12 million board feet of lumber. However, the mill has been operating below capacity. From 1997 to 1999, the mill produced an average of 2.5 million board feet per year from 12 000 to 20 000 cubic metres of timber per year. The mill employs between 20 and 25 people, but not year-round.

Most of the timber processed at the mill is obtained through its SBFEP licences, with the rest coming from other tenure holders and private sources on the Islands. Abfam currently harvests timber through the SBFEP. From 1997 to 1999, Abfam harvested an average of about 11 290 cubic metres per year. This timber is mainly harvested from TFLs and less than 1% comes from the Queen Charlotte TSA. Abfam is concerned about the inability to secure a stable and sufficient supply of timber for its operation. These concerns mirror those generally expressed on the Islands that most of the timber is processed off-island with too few benefits accruing to locals.

Similar to Abfam, Queen Charlotte Islands Sawmills Ltd. does not hold a major licence to harvest timber, but is one of the larger processing facilities on the Queen Charlotte Islands. Queen Charlotte Islands Sawmills, located south of Masset, employs from seven to 10 people in the production of log homes and lumber products. Queen Charlotte Islands Sawmills Ltd., through Queen Charlotte Islands Forest Products, currently harvests timber through the SBFEP, and from 1997 to 1999 harvested an average of about 20 800 cubic metres per year. This timber is harvested from areas within TFLs.

Several smaller processors operate on the Queen Charlotte Islands, including PC Wood Preservers Ltd., Ken Foote Contracting Ltd., Silva Services Ltd., Port Clements Wood Preservers Ltd. and Delkatla Wood Products Ltd. Combined, these operations processed about 19 000 cubic metres in 1999. The mills employ a total of anywhere from 20 to 50 people for various lengths of time depending on the availability of wood and markets.

8.2.4 Forestry 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, log transport, harvest planning and administration;
- silviculture employment such as planting, surveying and other basic and intensive silviculture activities, such as spacing, fertilization 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 first sub-sector that would be affected by a change in the AAC. The predominant silvicultural system used in the Queen Charlotte TSA is clearcutting using ground-based, cable, and helicopter yarding systems. The active logging season runs from January through December, but varies by company and weather conditions. Local residents account for an average of about 30% of the harvesting workforce, but this ranges significantly among companies. Most of those harvesting SBFEP timber reside on the Queen Charlotte Islands.

The silviculture sub-sector is perhaps the least tied to the current level of harvest, given that silviculture activities are ongoing for as much as 10-15 years following harvesting. Basic silviculture consists of pre- and post-harvest surveys, site preparation, planting, brushing, cone collecting and some spacing. Enhanced, or intensive silviculture includes spacing, fertilization, and pruning. In the Queen Charlotte TSA, major licensees are responsible for basic silviculture on areas harvested under major licences. The provincial government is responsible for the remaining basic and all enhanced silviculture on Crown land, which is completed by silviculture contractors.

Employment data compiled for this Timber Supply Review indicate that from 1997 to 1999, the average TSA harvest of about 272 000 cubic metres per year supported about 140 person-years annually of direct harvesting and silviculture employment across the province. About 48% of this workforce resides on the Queen Charlotte Islands. According to the previous socio-economic assessment for the Queen Charlotte Timber Supply Review, the average 1993-1995 harvest of 380 750 supported about 170 person-years of direct harvesting and silviculture employment across the province.

Processing employment

The Queen Charlotte Islands has a small processing sector that from 1997 to 1999 processed an average of about 40 000 cubic metres per year. Products range from dimension lumber, shake and shingles, to specialty products such as log homes. The timber processed at local mills comes not only from the TSA but also TFLs and private sources. The remaining timber is shipped to the North Coast, Lower Mainland and Vancouver Island for processing. Much of the timber is shipped via the Vancouver log market to various producers.

Employment data compiled for this Timber Supply Review indicate that, from 1997 to 1999, the TSA harvest of about 272 000 cubic metres per year supported approximately 200 person-years (three-year average) of direct processing employment across the province. About 8% of this processing employment is associated with operations on the Queen Charlotte Islands. According to the previous socio-economic assessment for the Queen Charlotte Timber Supply Review, the average 1993-1995 harvest of 380 750 cubic metres per year supported about 300 person-years of direct processing employment across the province.

Forest Service employment

The Queen Charlotte TSA is administered by the Queen Charlotte Islands Forest District office in Queen Charlotte City. Currently, there are 46.5 full time jobs in the forest district office. Forest Service staff are involved in administration, enforcement of government policy, SBFEP-related planning for the Queen Charlotte TSA, TFLs and timber licences that lie within the Queen Charlotte Islands Forest District.

Queen Charlotte TSA employment coefficients

Table 10 summarizes the employment supported by the 1997–1999 average harvest in the Queen Charlotte TSA and the corresponding employment coefficients[23]. These coefficients have been calculated for the TSA and province to highlight the level of forestry activity within the Queen Charlotte TSA and to identify the contribution that the Queen Charlotte TSA's forestry sector makes to the provincial economy. The two employment levels are defined as follows:

- TSA employment and employment coefficients, which comprise residents of the Queen Charlotte TSA who are employed in the forestry sector within the Queen Charlotte TSA and who rely on the Queen Charlotte TSA timber supply; and,
- Provincial employment and employment coefficients, which comprise all forestry sector employment in the province that relies on the Queen Charlotte TSA timber supply, including both residents of the Queen Charlotte TSA and those who live elsewhere.

[23] 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 size of impacts associated with a timber supply change should illustrate similar effects.

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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. Table 10 reflects the average harvest and employment from 1997 to 1999. The harvest rate is lower than the longer-term (e.g., 1993-1999) harvest level and cut control averages as indicated in Table 7. Table 10 is not intended to show the average harvest as it relates to cut control, but to present TSA dependent employment and corresponding coefficients used to estimate employment levels in Section 8.3, and that can be used by readers to determine employment levels at alternative harvest levels. Since available employment figures relate to the last few years, the 1997-1999 average harvest is the more appropriate reference point.

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

Table 10. Queen Charlotte TSA employment and employment coefficients, average 1997-1999

Forest industry activity	TSA employment (person-years)	TSA coefficients (person-years / '000s m³)	Provincial employment (person-years)	Provincial coefficients (person-years / '000s m³)
Harvesting	54	0.20	112	0.41
Silviculture	13	0.05	27	0.10
Processing	15	0.05	201	0.74
Total direct	82	0.30	340	1.25
Indirect + induced	38	0.14	420	1.55
Total employment	120	0.44	760	2.80

Note: Employment estimates are reported in person-years based on average 1997-1999 employment levels and the average 1997-1999 Queen Charlotte TSA harvest of 272 000 cubic metres per year.

8.2.5 Queen Charlotte TSA employment income

From 1997 to 1999, the average income for forestry sector employees associated with the Queen Charlotte TSA was about $48,300, based on average provincial income levels for logging and forestry services, solid wood manufacturing and pulp and paper manufacturing (see Appendix B, "Socio-Economic Analysis Background Information"). Even though no pulp mills are located on the Queen Charlotte Islands, pulp mills are included as the timber shipped off the Islands is processed into lumber, which creates residual chips for the pulp mill and panel industry, and subsequently supports some of the employment and income at these mills. Average income for indirect and induced sector employees was $30,300. The total direct income associated with the forestry sector in the Queen Charlotte TSA averaged $16.4 million per year and total income for indirect and induced employment averaged $12.7 million per year (incomes are reported in 1998 dollar values). Combined, total employment income in the Queen Charlotte TSA averaged $29.1 million per year. Table 11 shows income levels, average wages and salaries, and total income per 1000 cubic metres.

Table 11. Average direct and indirect and induced incomes and total employment income, 1997-1999

	Average wage (1998 dollar value)	Total income ($ millions)	Total income ($/'000 m^3)
Direct	48,300	16.4	60,375
Indirect + induced	30,300	12.7	46,835
Total income		29.1	107,205

Source: Statistics Canada. Annual estimates of employment, earnings and hours. Catalogue # 10-009XKB. Statistics Canada. Labour Force Survey, Average weekly wage rate.

8.2.6 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 timber and its use, and other industry operating taxes such as corporate income, property, and sales taxes. The provincial and federal governments also receive revenues from forestry employees directly through income taxes.

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From 1997 to 1999, forest industry activity in the Queen Charlotte TSA led to an average of about $6.4 million in annual stumpage, royalty and rent payments to the provincial government. Other government revenues from forest industry taxes accounted for $2.7 million per year. Total employment supported by the Queen Charlotte TSA harvest generated total annual provincial and federal income taxes worth $7.5 million. About one-third of the total income tax, or $2.5 million per year goes to the provincial government. Table 12 shows average annual provincial government revenues for 1997–1999.

Table 12. Average annual provincial government revenues, 1997-1999

	Average annual revenue 1997-1999 ($1998 millions)	Average revenue ($/'000 m^3)
Stumpage, rents and royalties	6.4	23,132
Industry taxes	2.7	9,037
Provincial income tax	2.5	9,370
Total provincial government revenues	11.6	41,539

Sources: Ministry of Forests, Revenue Branch; PricewaterhouseCoopers; Revenue Canada.

8.3 Socio-economic implications of the harvest forecasts

The socio-economic analysis focuses on harvest level changes in the short- to medium-term of 10-30 years from now and considers:

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

The socio-economic analysis considers average levels of forest industry-related activity that the total THLB harvest forecast could support. It also examines the effects of removing the Duu Guusd from the timber harvesting land base. 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 and labour productivity will not change. 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 five years), employment coefficients 20 years from now may differ greatly due to changes in market conditions, timber processing technologies, etc. The analysis indicates the magnitude of impacts to employment, employment income and provincial government revenues, within a constantly changing socio-economic environment.

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

Employment and income impacts in the Queen Charlotte TSA

Queen Charlotte TSA employment and income impacts focus on those 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 are those supported by Queen Charlotte TSA timber processed at mills outside the forest district. Table 13 indicates the employment and income that the current AAC, set by the chief forester after the Part 13 designation, could support if fully harvested and processed.

The current AAC of 361 000 cubic metres, if fully harvested, can support about 108 person-years of direct employment and a further 50 person-years of indirect and induced employment within the Queen Charlotte TSA. This level of employment would result in about $6.7 million in annual total employment income. The pre-Part 13 AAC of 475 000 cubic metres could support about 140 person-years of direct employment within the TSA. Data from major licensees indicate that labour is quite responsive to fluctuating harvest levels. As such, fully harvesting either the current or the pre-Part 13 AAC would likely increase harvesting employment.

From 1997 to 1999, the average harvest level was 272 000 cubic metres per year which is well below the current AAC of 361 000 cubic metres, or the pre-Part 13 AAC of 475 000 cubic metres. Therefore, reducing the timber supply to the long-term harvest level of 323 000 cubic metres would not have the same impact that would be expected if the full AAC were being harvested. The actual number of people who may be affected will depend on several factors, such as company expectations and threshold levels*. For example, effects on numbers of jobs depends on whether the companies have already downsized their labour force or shortened the work year to harvest the lower volume, or if they are maintaining employment levels in an effort to retain experienced employees. Given that the harvest rate has been below the AAC for six of the last seven years, companies have likely adjusted their workforce in some way. Nonetheless, if timber supply were permanently reduced from the pre-Part 13 level, those workers currently laid-off and waiting for work to resume would lose the opportunity to be rehired to harvest timber on the Queen Charlotte Islands, unless retirement or other conditions create open positions.

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Provincial employment and income impacts

Provincial employment and income impacts include all the activity supported by the Queen Charlotte TSA harvest, regardless of processing location and place of residence.

The current, post-Part 13 AAC of 361 000 cubic metres can support about 450 person-years of direct employment and a further 560 person-years of indirect and induced employment across the province. This level of employment results in $39 million in annual total provincial employment income.

If the timber supply returned to 475 000 cubic metres per year and the supply, on average, was fully harvested, 590 person-years of direct employment could be supported across the province. The long-term harvest level of 323 000 cubic metres would support about 400 person-years of direct employment across the province.

Table 13 also provides estimates for a reduced long-term harvest level of 255 000 cubic metres per year. Moving immediately to the long-term harvest level of 255 000 cubic metres per year would reduce the current timber supply by about 106 000 cubic metres. A timber supply of 255 000 cubic metres could support about 320 person-years of direct employment across the province.

Any reduction to the AAC may result in lost opportunities to increase the work year for those working part-time, or to provide jobs for those laid-off or seeking new employment.

Table 13. Queen Charlotte TSA socio-economic impacts: base case harvest forecast

	At current (post-Part 13) AAC[a]	Total THLB harvest forecast decades 1-5	Total THLB long-term harvest level	Reduced Long-term harvest level
Timber supply ('000s m³)	361 000	475 000	323 000	255 000
Harvest level (1997-1999 average)	—	—		
Difference from current AAC		114 000	(38 000)	(106 000)
Queen Charlotte TSA				
Employment		**(person-years)**		
Direct	108	142	97	76
Indirect + induced	50	66	45	36
Total	158	208	142	112
Range[b] of employment gain (loss)		46–50	(15–16)	(42–46)
Employment income		**($1998 millions per year)**		
Direct	5.2	6.8	4.6	3.6
Indirect + induced	1.5	2.0	1.3	1.1
Total	6.7	8.8	5.9	4.7
Range of income gain (loss)		1.9–2.1	(0.7–0.8)	(1.8–2.0)
Province[c]				
Employment		**(person-years)**		
Direct	451	594	404	319
Indirect + induced	558	734	499	394
Total	1,009	1,328	903	713
Range of employment gain (loss)		275-319	(91-106)	(255-296)
Employment income		**($1998 millions per year)**		
Direct	21.8	28.7	19.5	15.4
Indirect + induced	16.9	22.3	15.1	11.9
Total	38.7	51.0	34.6	27.3
Range of income gain (loss)		10.5-12.3	(3.5-4.1)	(9.8-11.4)
Provincial government revenues		**($1998 millions per year)**		
Stumpage and related payments	8.3	11.0	7.5	5.9
Forest industry taxes	3.3	4.3	2.9	2.3
Employee income taxes	3.4	4.4	3.0	2.4
Total	15.0	19.7	13.4	10.6
Gain (reduction) in revenues		4.7	(1.6)	(4.4)

a) Estimates for current employment differ from those in Table 10. Current employment figures in Table 13 are based on the current AAC of 361 000 cubic metres; figures in Table 10 are based on the 1997–1999 annual average harvest of 272 000 cubic metres.

b) Gains or losses are based on the difference between the current average harvest. The ranges for employment and income changes consider employment insurance and other social assistance programs that give 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 in Appendix B, "Socio-Economic Analysis Background Information."

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

Provincial 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 361 000 cubic metres, if fully harvested, would provide on average about $15 million annually to the provincial government.

Increasing the harvest to the total THLB timber supply of 475 000 cubic metres would increase the amount of annual revenue to about $19.7 million. Moving immediately to the long-term harvest level would result in a slight decrease to $13.4 million from potential current AAC revenues.

Based on the average 1997-1999 harvest rate of 272 000 cubic metres per year, a reduction from the current AAC would not likely result in changes to recent government revenues. However, by moving immediately to the long-term harvest level of 255 000 cubic metres, government would receive about $1 million less (10.6 *versus* 11.6) than it received on average from 1997 to 1999.

8.3.2 Community-level impacts

The impacts related to changes in the timber supply can affect the socio-economic environment of a community. A reduction in employment and income could affect various socio-economic conditions in communities: for example, population growth rates, the size of the labour force, economic development opportunities and government-funded services. These changes would have a greater effect on an economy dependent on a single industry than on one which is more diversified and experiencing growth in other sectors.

The Queen Charlotte Islands depend on the forest industry for 35% of the income flowing within the region and on the public sector for somewhere between 25% to 33% of their income. Reductions in forestry activity could lead to reductions in other sectors, such as the public sector, if population levels are affected. The volume of timber harvested from the Queen Charlotte TSA has been below the AAC for several years and any reduction to a new AAC may not appreciably affect the labour force. Other opportunities such as tourism will likely continue to grow, although limiting factors include the number of visitors allowed into Gwaii Haanas, the level of facilities throughout the Islands and the more remote location and associated costs. These remote features may be the attraction for many visitors, and any large-scale development may harm the Islands' remote appeal and way of life.

The communities on the Queen Charlotte Islands would eventually adapt to any changes that may occur as a result of timber supply reductions, but changes to the current community makeup and its individuals must not be overlooked. Communities in areas such as the Queen Charlotte Islands will have more difficulty replacing or developing employment opportunities than more accessible regions of the province.

Census labour force data offer some broad insights into how future changes in the forestry sector may affect local communities in the Queen Charlotte Islands. Statistics from 1981 to 1996 indicate that the number of logging and forestry service workers residing on the Islands as a percentage of the total experienced labour force has changed marginally from about 21% in 1981 to 19% in 1996, despite a change in the average harvest of about 27%.[24] These numbers indicate that forest companies have adjusted their workforce by reducing their off-Island workforce at a greater rate. If companies were to continue to adjust their workforce in this manner, the actual effects on local TSA communities would be less than indicated in Table 13. However, this assumption is highly uncertain, and communities should be aware of the upper limit impacts outlined in Table 13.

A more specific illustration of the potential impacts comes from Census population data for Moresby Island. The economic structure and subsequent population of the community of Sandspit, and of Moresby Island in general, have changed substantially. Changes to the forestry sector and the closure of the mine at Tasu steadily reduced the population of Moresby Island, and the communities of Sandspit and Sewell Inlet. From 1976 to 1981, the population of Moresby Island increased from 1,221 to 1,278; but by 1986 it declined to 865, by 1991 it declined to 764, and by 1996 it declined to 618.[25] Sandspit's share of Moresby Island's population went from about 50% to over 90%, but the community's overall numbers also declined. Some minor development or employment opportunities have appeared on Moresby Island as a result of the creation of Gwaii Haanas and associated mitigation efforts; however, there have been no population increases in communities nearest the park. Population declines also put pressure on the community's ability to maintain and provide new services.

[24] The average harvest in 1980–1981 was 2.1 million cubic metres and increased through the mid-1980s before declining to 1.5 million cubic metres by 1996.

[25] Census of Canada, 1976, 1981, 1986, 1991, 1996.

Most of the new development has occurred on Graham Island and some residents argue that large-scale tourism development was not the intention in any case. Sandspit's population could arguably be at a more long-term sustainable level, although this favourable view does not consider the hundreds of people who had to leave the Islands and the uncertainly and dislocation that resulted. It is not the intent of this report to speculate on sustainable population levels for individual communities, but to provide information for the chief forester and communities to be aware of the potential impacts of changing timber supplies.

The preceding discussion illustrates the difficulty that many communities in British Columbia could face as timber supplies decrease: some communities may benefit from alternative opportunities while others will not. It also shows the difficulty in accurately predicting how regions, and communities in particular, may respond to structural changes in their economies. Any promise of increased development similar to that witnessed in the U.S. Pacific Northwest must be viewed cautiously. Because numerous differences exist between many regions of British Columbia and the Pacific Northwest, transferring those experiences to British Columbia is unlikely for many areas.[26]

Individuals from the communities of the Queen Charlotte TSA who lose their jobs face economic, physical and emotional difficulties while in transition to another job or profession. Physical and emotional effects on workers depend on age, education, future job opportunities and various existing physical and emotional characteristics. Unemployment has been associated with many physical and emotional, or stress-related symptoms.[27] However, job loss is only one of many factors associated with illness, although job loss often causes physical and/or mental breakdown. A 1996 discussion paper by the Canadian Public Health Association[28] found that the literature examining the health impact of unemployment indicates a strong relationship between unemployment and ill health. How pressures related to job loss and uncertainty might affect residents of the Queen Charlotte TSA and province is impossible to predict, yet these possible emotional and physical reactions, whether short term or longer term, should not be disregarded.

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[26] For a clear discussion of development options for forest resources on the Queen Charlotte Islands see Stennes, B. and B. Wilson. 2000. *The Queen Charlotte Islands: A discussion of forest sector development.* Working paper 2000.01. South Moresby Forest Replacement Account. Canadian Forest Service, Pacific Forestry Centre, Victoria, B.C.

[27] Lee, R. 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.

[28] Canadian Public Health Association. 1996. *1996 Discussion paper on the health impact of unemployment.*

8.3.3 Nature, production capabilities and timber requirements of processing facilities

The current milling structure on the Queen Charlotte Islands consists of several small to medium producers of lumber products, log homes, and shake and shingle products. There are many other small-scale secondary producers, generally involving the craftsmanship of one person. From 1997 to 1999, the total volume processed by local processors was about 40 000 cubic metres per year. However, the processing capacity is much higher and an estimated 100 000 to 125 000 cubic metres could be processed if mills operated at full capacity. In this case full capacity depends not simply on the timber supply, but also on the logistics and costs of more remote operations, among other economic and market considerations.

The current average annual volume of 40 000 cubic metres being processed on the Queen Charlotte Islands represents about 3% of the total harvest from all Island sources. Conversely, up to 97% of the timber leaves the Queen Charlotte Islands for processing elsewhere in British Columbia.

8.3.4 Regional timber supply issues

The regional timber supply is an important consideration when examining potential future impacts associated with timber supply changes. The Queen Charlotte Islands supplies timber to mills in the southwest portion of the province. From 1997 to 1999, solid wood mills in the Vancouver Forest Region processed an average of 17.4 million cubic metres of timber per year. The timber processed at these mills comes from numerous coastal operations, including Vancouver Island, the Lower Mainland, the Central Coast, Queen Charlotte Islands and the North Coast. Timber from all sources on the Queen Charlotte Islands accounts for about 7% of the region's consumption.

Recent timber supply forecasts indicate that over the next 25 years the average annual harvest in the Vancouver Forest Region could decline by up to 20%, or 4 million cubic metres.[29] Given a change of this size, the current processing structure of southwestern British Columbia could not be maintained. The Queen Charlotte Islands could provide some stability to the region if the timber supply were maintained as suggested in the total THLB harvest forecast. However, the current TSA timber supply of 361 000 cubic metres per year accounts for only 2% of the timber processed within the Vancouver Forest Region.

[29] This reduction is based on moving from the current Vancouver Forest Region timber supply of about 20 million cubic metres per year to 16 million cubic metres.

8.4 Summary

The forest industry in the Queen Charlotte TSA is an important source of employment and income for local residents. The TSA also supplies timber to mills in the southwestern portion of the province. Other sectors important to the local economy include the public sector and the tourism sector.

The current AAC of 361 000 cubic metres, if fully harvested and processed, can support about 450 person-years of direct forestry employment and a further 560 person-years of indirect and induced employment across the province. About 24% of the direct employment accrues to residents of the Queen Charlotte Islands. The employment income associated with this direct, indirect and induced employment would be about $38.7 million per year.

If the timber supply were to return to the pre-Part 13 level of 475 000 cubic metres per year, the Queen Charlotte TSA could support up to 590 person-years of direct employment across the province.

The average harvest from 1997 to 1999 was 272 000 cubic metres per year. Harvesting below the AAC has been common in the last six years due in part to fluctuating markets.

Based on the average 1997–1999 harvest, the provincial government currently collects about $11.6 million per year in stumpage and related payments, other industry taxes and provincial income taxes. If the forestry sector were to increase its activity to fully harvest the current timber supply of 361 000 cubic metres per year, government revenues would average about $15 million per year. If the timber supply were at the pre-Part 13 AAC of 475 000 cubic metres, government revenues would increase to about $19.7 million per year.

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10 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	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 (BEC) variant	A subdivision of a biogeoclimatic zone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.
Biogeoclimatic zones	A large geographic area with broadly homogeneous climate and similar dominant tree species.
Buffer strip	A strip of land 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.
Clearcutting with reserves	A variation of the clearcut silvicultural system in which trees are retained, either uniformly or in small groups, for purposes other than regeneration.
Climax forest	A forest community that represents the final stage of natural forest succession).
Coarse woody debris	Logs and stumps that provide habitat for plants, animals and insects, and a source of nutrients for soil development.

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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.
Coniferous	Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.
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.
Cultural heritage resource	An object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community or an aboriginal people.
Culturally modified tree	A tree or a remnant of a tree with evidence of traditional aboriginal forest use.
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.
Cutblock	A specific area, with defined boundaries, authorized for harvest.
Deciduous	Deciduous trees commonly have broad-leaves and usually shed their leaves annually.
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. Horse skidding is often used to harvest trees under this system.
Drainage	The surface and sub-surface water derived within a clearly defined catchment area, usually bounded by ridges or other similar topographic features, encompassing part, most, or all of a watershed. The term is sometimes used to describe an operating area or location.
Early seral	Stands are defined as early seral if they are younger than: 40 years in the Spruce-Willow-Birch (SWB) biogeoclimatic zone; 40 years for coniferous stands; and, 20 years for deciduous stands in the Boreal White and Black Spruce (BWBS) biogeoclimatic zone.

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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.
Employment 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.
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	An 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 other forest values such as recreation and visual quality.
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.

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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.
Helicopter operability	Stands with greater than 500 cubic metres per hectare within a reasonable flight distance (about 2-km) from a land or water drop.
Higher level plans	Higher level plans establish the broader, strategic context for operational plans, providing objectives that determine the mix of forest resources to be managed in a given area
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.
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.

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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).
Land and Resource Management Plan (LRMP)	A strategic, multi-agency, integrated resource plan at the subregional level. It is based on the principles of enhanced public involvement, consideration of all resource values, consensus-based decision making, and resource sustainability.
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.
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.
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.
Mature seral	Stands are defined as mature seral if they are older than: 120 years in the Spruce-Willow-Birch (SWB) biogeoclimatic zone; 100 years for coniferous stands; and, 80 years for deciduous stands in the Boreal White and Black Spruce (BWBS) biogeoclimatic zone.

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Maximum modification VQO	Alterations are dominant and out of scale, but appear natural in the background. Up to 33% of the area can be visibly altered by harvesting activity (see Visual quality objective).
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.
Mixed-wood	Forests that have a mix of coniferous and deciduous trees
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).
Moiety	One of two complementary tribal subdivisions. The Haida consist of two moieties – the Raven and the Eagle.
Natural disturbance type (NDT)	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) areas	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.
Old seral	Old seral forest contains structural features and other characteristics of old-growth forests, including: large trees for the species and site; variation in tree sizes and spacing; accumulations of large dead standing and fallen trees; multiple canopy layers; canopy gaps and understory patchiness. The age and structure of old growth varies significantly by forest type and from one biogeoclimatic zone to another.
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.

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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).
Partition	A portion of the AAC that is attributable to certain types of timber and/or terrain.
Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days 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.
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.
Scenic area	Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
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.

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Sensitive terrain areas	Areas with moderate to high potential for landslide initiation during timber harvesting or road construction, which therefore require special forest practices to ensure adequate site protection.
Sensitivity analysis	A process that 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. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.
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 for harvesting 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.

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Uneconomic areas	Areas defined as unavailable for harvest for economic or terrain-related reasons. Characteristics used in defining uneconomic areas include distance from processing facilities, existing roads, difficulty of road access, and availability of suitable timber. Areas considered uneconomic can change over time as a function of changing harvesting technology and economics.
Ungulate	Hoofed-herbivore, such as deer
Unsalvaged losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.
Variable Density Yield Projection model	BC Forest Service computer program that generates natural stand yields.
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 estimates (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 following tables and commentary outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Queen Charlotte TSA timber supply analysis. This information 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 inventories used in this analysis to define the timber harvesting land base and current management practices for the Queen Charlotte TSA are listed in Table A-1.

Table A-1. Inventory information

Data	Source	Vintage	Update	Scale
Forest cover	Ministry of Forests (MoF)	1992/1967	1997	1:20 000
Harvest system / access	MoF	1998	—	1:20 000
Biogeoclimatic subzones	MoF	1994/1995	—	1:20 000
Draft landscape units	MoF and Ministry of Environment, Lands and Parks (MELP)	1997	1997	1:70 000
Known scenic areas	MoF	1997	—	1:20 000
Culturally modified trees (CMT)	MoF/MELP	1998	N/A	1:20 000
Community watersheds	MELP	1995	1998	1:20 000
Recreation / landscape inventory	MoF	1991/1995	N/A	1:20 000
ESA mapping	MoF	1978	1983 (soils)	1:20 000

Data source and comments:

Forest cover inventory update

In 1997, the forest inventory for the Queen Charlotte TSA was updated to account for changes due to harvesting and other disturbances. To accomplish this, the Ministry of Forests had digital orthophotographs for the area prepared from aerial photos flown in 1997. Orthophotographs are composites of aerial photos that have been corrected to eliminate distortions due to terrain, camera lens and other reasons. These orthophotographs were used to delineate areas that have been logged in the TSA since the time of the last update. Information from silvicultural records was used to compile attributes for harvested areas. Stand polygon boundaries and attributes in areas adjacent to new openings were altered if warranted. The inventory files were checked for major discrepancies, and stand attributes were projected using FCAPS to May 1998. The updated map files were then posted to the provincial *Object Distribution Management System* (ODM).

A.1 Inventory Information

Forest inventory audit

In a 1992 forest inventory audit, a sample of forest stands within the TSA was examined to compare volumes derived from field measurements to volumes estimated from the inventory data. Although the results indicated that volume estimates for the total forested area within the TSA were statistically acceptable, Queen Charlotte Islands Forest District staff expressed concern that the sample size (17 stands) was too small. The forest district staff was also concerned that significant biases may have existed in the application of provincial taper and decay functions for some species when applied to the TSA.

In 1998, further sampling was conducted to test the accuracy of the inventory volume estimates. The new data would also serve to derive Forest Inventory Zone-based adjustment ratios to correct stand volume estimates, if warranted. Sixty-seven sample clusters in five stand types — cedar-young (less than 200 years old), cedar-old, hemlock-on-good-sites, hemlock-on-poor-sites and spruce—were located across the operable portion of the Queen Charlotte TSA in stands 60 years and older. Audit volumes were compiled using the revised taper and decay equations developed in the *Queen Charlotte Islands Volume and Decay Study* and compared to the inventory volumes within each stratum.

The bias identified in the audit can be divided into two sources: the attribute error and the model error. The attribute error is associated with biases in age and height estimates, which alone tended to overstate volumes. The model error is associated with biases with the VDYP model and tended to significantly underestimate stand volumes (when adjustment ratios for form and loss factors are applied) in the TSA. The total model error offsets the attribute errors. The audit results indicated that stand ages and heights were over stated in the forest inventory by 14% and 6%, respectively. However, stand volumes were underestimated in the inventory compared to audit sample volumes compiled using the unbiased adjustment ratios for taper and loss developed from the QCI volume and decay study.

Factors for age and height were applied first, then stand volumes were recompiled using VDYP and the resulting volumes were adjusted using the volume adjustment ratios. The volume adjustment ratios reflect stand volumes without veteran trees, with taper and loss factor adjustments, and net decay, waste and breakage.

After application of all adjustments (height, age, volume and tree taper), the average stand volume (net decay, waste and breakage without veteran trees) was 9.3% higher than the average calculated from the inventory.[30] The differences vary for the five species groups:

- cedar-young—adjusted volume 53% greater than the inventory volume
- cedar-old—adjusted volume 20% greater than the inventory volume
- hemlock-poor—adjusted volume 9% greater than the inventory volume
- hemlock-good—adjusted volume 8% greater than the inventory volume
- spruce—adjusted volume 18% *less* than the inventory volume.

[30] Results and procedures for the 1998 audit were prepared by Resources Inventory Branch, Ministry of Forests.

A.1 Inventory Information

Site index

To address concerns that site index (SI) is underestimated for old-growth stands in the current forest inventory, the Ministry of Forests has undertaken an *Old Growth Site Index* (OGSI) project. The goal of the OGSI project is to re-examine and improve, if necessary, site index estimates for old-growth stands. Although two OGSI studies have been completed, which compare the SI estimates between old-growth and second-growth stands[31] neither included data from the Queen Charlotte Islands Forest District. The Vancouver Forest Region conducted a study of old-growth site index using data from tree stumps in reforested areas in Block 6 of Tree Farm Licence (TFL) 39 which is located within the Queen Charlotte Islands Forest District. Since the *Queen Charlotte Islands Stump-Site Index Study* results are preliminary, and since there is uncertainty how well the samples collected in TFL 39 represent the forest in the Queen Charlotte TSA the adjustments, were not applied in the total THLB forecast. However, the potential timber supply impact of these adjustments was examined through sensitivity analysis.

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[31] Nigh, G. D. 1998. Site index adjustment for old-growth stands based on veteran trees. Research Branch B.C. Ministry of Forests Working Paper 36/1998

Nussbaum A. F. 1998. Site Index Adjustments for Old-Growth Stands Based on Paired Plots. Research Branch. B.C. Ministry of Forests Working Paper 37/1998.

A.2 Management Zone and Analysis Unit Definition

A.2.1 Management zones, groups and multiple objectives

Management zones were used in this analysis to differentiate areas within the Queen Charlotte TSA that have different management emphasis or objectives. Zones were grouped to enable timber harvesting constraints to be applied to different combinations of zones or other stand variables. Groups may be thought of as layers of different objectives, which must be tracked over time. An outline of the objectives tracked in the TSA analysis is provided in Table A-2.

Further information on the forest cover requirements to be applied to these areas can be found in Section A.4.4 "Integrated resource management."

Table A-2. Objectives to be tracked

Objectives	Inventory definition
Level 1 grouping	
All areas	Cutblock adjacency only
RVQC = Retention	RVQC code = R
RVQC = Partial retention	RVQC code = PR
Level 2 grouping	
Landscape units/ BEC variant	Draft landscape units and biogeoclimatic subzone variants
Level 3 grouping	
Community watersheds	Community watershed areas
Level 4 grouping	
Haida declared areas	Groups defined for each of Haida declared area of interest within the TSA
Level 5 grouping	
PAS area	Groups defined for each of goal 1 and goal 2 area defined in the *Protected Areas Strategy*
Level 6 grouping	
Tlell local resource use plan area	TSA area covered by the *Tlell Watershed Local Resource Use Plan* area
Level 7 grouping	
Goshawk nest site	Known Queen Charlotte Goshawk nest sites as defined in the draft *Identified Wildlife Management Strategy* (for critical issue analysis)
Level 8 grouping	
AAC partition	Area within the low-volume cedar partition

A.2 Management Zone and Analysis Unit Definition

A.2.2 Analysis units

An analysis unit represents a combination of stands dominated by specific tree species or a silvicultural regime with a specific timber growing capability — as indicated by the inventory type group and sites index in the forest inventory file.

Each analysis unit was assigned its own timber volume projections (yield tables) for existing and future stands. In this analysis, cedar (*Thuja plicata + Chamaecyparis nootkatensis*), sitka spruce (*Picea sitchensis*) and hemlock (*Tsuga heterophylla + Tsuga mertensiana*) stands were grouped into analysis units on the basis of leading species and site index class. The criteria for dividing stands into these are shown in Tables A-3a. and A-3b.

Table A-3a. Definition of analysis units for stands other than spruce age class 7 to 9

Analysis unit	Class	Species	Inventory type groups	Site index range[a]
Cedar — good / medium	1 – 9	Cw / Cy	9 – 11	SI ≥ 15
Cedar — poor	1 – 9	Cw / Cy	9 – 11	15 > SI ≥ 12.5
Cedar — low	1 – 9	Cw / Cy	9 – 11	SI < 12.5
Hemlock — good	1 – 9	H	12 – 20	SI ≥ 18
Hemlock — medium	1 – 9	H	12 – 20	18 > SI ≥ 15
Hemlock — poor	1 – 9	H	12 – 20	SI < 15
Spruce — good	1 – 6	S	21 – 26	SI ≥ 16[b]
Spruce — medium / poor	1 – 6	S	21 – 26	SI < 16[b]

(a) Site index reference age is 50 years at breast height.
(b) SI threshold applied to immature stands and derived from audit adjusted height and age attributes

Table A-3b. Definition of analysis units for spruce age class 7 to 9

No	Analysis unit	Age class	Species	Inventory type groups	Stand type[a]
7	Spruce — good	7 – 9	S	21 – 26	751, 861, 961, 962, 971
8	Spruce — medium / poor	7 – 9	S	21 – 26	741, 841, 851, 852, 951, 952, 731, 831, 941

(a) Based on Ministry of Forests forest cover inventory classification. For example, a stand type 751 comprises age class 7, height class 5, and stocking class 1.

A.2 Management Zone and Analysis Unit Definition

Data source and comments:

Site index was used to classify cedar, hemlock and immature (less than 141 years) spruce stands into productivity groups as indicated in Table A-3a. These ranges were set to divide the operable area of each inventory type group into relatively equal sized units. Pine, alder and other species are excluded from the timber harvesting land base. The site index ranges used in Tables A-3a. and A-3b. to classify the relative capability of each analysis unit may be revised once the timber harvesting land base has been finalized.

Current site index curves may not accurately predict site index for old-growth forests. For spruce, the application of site index curves is particularly problematic; therefore, forest inventory age-height-stocking descriptions were used to group spruce leading stands into productivity classes as indicated in Table A-3b.

A.3 Timber Harvesting Land Base Definition

A.3.1 Identification of the timber harvesting land base

The timber harvesting land base for the Queen Charlotte TSA was determined by excluding various categories of land that do not contribute to the timber supply in the TSA. This section outlines the steps used to identify the timber harvesting land base within the TSA.

Land may be unavailable for timber harvesting for three principle reasons:

- it is not administered by the British Columbia Forest Service for timber supply (e.g., tree farm licences, private land, parks);
- it is not suitable for timber production (e.g., non-forest, non-productive forest); and
- it is required for other forest values (e.g., recreation areas, riparian management areas).

Land may also be added to the timber harvesting land base:

- by management activities which improve productivity or operability (e.g., the stocking of land currently classified as non-commercial brush);
- by the addition of productive forest land to the TSA (e.g., timber licence reversions).

The classification of "unavailable for timber harvesting" applies only to land where no harvesting is anticipated to occur. Any area in which some timber harvesting will occur remains in the timber harvesting land base, even if the area is subject to stringent constraints.

Once all lands that do not contribute to the timber harvesting land base were identified, lands classified as not satisfactorily restocked areas that have been reforested were added back into the land base. The resulting productive forest land base is the "current timber harvesting land base" for the Queen Charlotte TSA.

A.3.2 Details on land base deductions

A.3.2.1 Land not administered by the British Columbia Forest Service for timber supply

Ownership codes included in the forest inventory file were used to identify whether or not land contributes to the timber supply for the TSA. Ownership codes 62C and 69C denote Crown land in a forest management unit and miscellaneous reserves respectively. Timber license areas — ownership code 70N — only contribute to the timber supply after they have been harvested and restocked.

Areas with other ownership codes were removed from the timber harvesting land base. These include woodlot licence areas, since the AACs for woodlot licences are determined independently of the timber supply review.

A.3.2.2 Land classified as non-forest

Lands labeled as inventory type identity 6 (non-forest alpine forest, lakes, rocks, etc.) and inventory type identity 8 (untyped) were excluded from the land base considered for timber supply.

A.3.2.3 Non-commercial cover

Lands labeled with inventory type identity 5 are areas occupied by non-commercial brush species. These areas were considered unlikely to support timber production and were excluded for the timber harvesting land base.

A.3.2.4 Environmentally sensitive areas

Some forest lands are environmentally sensitive and/or significantly valuable for resources other than timber. These areas were identified and delineated in inventory projects conducted in 1978 and 1983 and are called environmentally sensitive areas (ESAs). The ESA system uses the following classification: sensitive soils (Es) forest regeneration problems (Ep), snow avalanche (Ea), recreation values (Er), watershed values (Eh) and wildlife risk (Ew). Two ESA categories are recognized for each class: highly sensitive and moderately sensitive.

The factors applied to ESA sites in Queen Charlotte TSA are listed in Table A-4. These were established by the Ministry of Forests (MoF) staff in collaboration with the District Forest Ecosystem Specialist from the Ministry of Environment Lands and Parks (MELP).

Table A-4. Description of environmentally sensitive areas

ESA category	ESA description	Reduction percentage (%)
Es1, Es2[a]	Soils — high	100
Ea1, Ea2	Avalanche	100

(a) Netdown for terrain stability was applied in addition to those for Es1 and Es2 (see next section).

Data source and comments:

All areas classified as having significantly fragile or unstable soils (Es) and at risk of avalanche (Ea) were removed from the timber harvesting land base. In addition to the netdown of Es areas, the timber harvesting land base was further reduced due to sensitive terrain as described in the next section.

The timber harvesting land base was not reduced for ESA designations for recreation values (Er) since the recreation feature significance and recreation management class variables provided in the recreation inventory are more current (see section a.3.2.6). No reductions were applied for ESA designations for wildlife (Ew) since the reliability of this information is low. A general level of habitat protection was modelled following the provisions for landscape biodiversity and reductions to the timber harvesting land base were applied for riparian areas and wildlife habitat patches. No reductions were applied for ESA designations for watershed values (Eh) since the forest cover constraints set out in the *Community Watershed Guidebook* were modelled for these areas.

Although the current inventory identifies areas sensitive due to regeneration problems (Ep), theses areas do not correlate well with regeneration or silviculture difficulties experienced in the field. Therefore, no reductions were applied to Ep designated polygons in the timber harvesting land base.

A.3.2.5 Incremental areas sensitive to terrain stability

Although ESA mapping classifies areas with significantly fragile or unstable soils, terrain stability mapping (TSM) is considered to more accurately predict sensitive or unstable terrain. While ESA mapping has been completed for the entire TSA, TSM has been completed for only sixteen mapsheets (or portions thereof). Nevertheless, TSM covers both the Skidegate Plateau and West Coast Queen Charlottes over both Graham and Moresby Islands, and is considered to form a representative sample of terrain conditions present.

A comparison of ESA and TSM for these mapsheets was made to evaluate whether ESA mapping adequately captures the amount of sensitive terrain. The results indicated that within the productive forest area, there was 3.1 times more area in TSM classes IV and V (areas where timber harvesting will result in a high to moderate likelihood of landslides) than in the ESA classes S1 and S2.

A separate review was conducted to estimate how much of the area in TSM classes IV and V is operable. This involved an examination of 35 cutblocks with TSM coverage developed by both the Small Business Forest Enterprise Program and Husby Forest Products Ltd. The results indicated that about 79% of TSM class IV and 97% of TSM class V in harvested areas were excluded from timber harvesting. By adjusting the total area of TSM classes IV and V with these percentages and then comparing their sum to the total area of ESA class Es1 and Es2 polygons in the 16 mapsheets, the ratio of TSM / ESA area was 2.55.

Therefore, the land base available for timber harvesting after 100% of the ESA class Es1 and Es2 areas have been removed (see previous section on ESA), should be further reduced by an area equal to 1.55 times the total area of ESA classes Es1 and Es2. This reduction was applied to the TSA on an individual mapsheet basis.

A.3.2.6 Areas with high recreation values

Recreation areas such as campgrounds, trails and lookout sites are identified in the inventory file through the recreation feature significance and recreation management class variables. These variables were deemed to be more current and were used instead of ESA designations to identify areas with high recreation value. Areas with a recreation features significance code of 'A' or 'B' and a recreation management class code of '0' are areas with outstanding recreational, educational, scientific or heritage value that are more appropriately managed exclusively for recreational values. Areas with a recreation feature code of 'A' or 'B' and a recreation management class code of '1' are areas requiring special management consideration to protect or maintain their recreational values. The amounts that the timber harvesting land base was reduced for areas with high recreation value are listed in Table A-5.

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

Recreation value description	Recreation feature significance code	Recreation management class code	Reduction percentage (%)
Areas to be managed exclusively for recreational values	A or B	0	100
Areas requiring special management to protect recreational values	A or B	1	50

Data source and comments:

Some areas with a recreation management class code of '1' are known scenic areas with assigned recommended visual quality class (RVQC). Since these areas were dealt with in the analysis by applying forest cover requirements no per cent area reduction was applied to them. Reductions were only applied to areas with recreation management class code of '1' not covered by RVQCs.

A.3.2.7 Areas considered inoperable

Forest operability classification generally reflects the presence or absence of physical barriers or limitations to harvesting, logging methods, and the merchantability of stands.

In 1998/99, the Vancouver Forest Region, in consultation with Queen Charlotte Islands Forest District staff, conducted a project to classify forest accessibility for the TSA. This involved classifying and mapping the physical limitations to forest accessibility using two parameters: forest access and harvest system. The forest access parameter was assigned to woodsheds (areas serviced by a common wood gathering point e.g., dry-land sort, water sort, loading area) as easy, moderate, difficult or unlikely based on haul distance and terrain conditions. Accessibility mapping also considered restrictions on development due to fisheries and cultural features which precluded wood gathering point locations, *Forest Practices Code* constraints, plus fixed cost limitations (viability) of developing individual woodsheds. The harvest system parameter classified forest areas within woodsheds as being suited to ground based, cable based or aerial harvesting systems or as "improbable" where terrain conditions were prohibitive for falling and/or yarding. Aerial photos, forest cover maps, TRIM base maps and available terrain stability maps were used to interpret access and harvest system.

A.3 Timber Harvesting Land Base Definition

Economic criteria were used to identify the portion of the physically operable land base that is economically inoperable. These criteria were defined by the amount and type of timber required, on a per hectare basis, in order for harvesting in an area to be considered economically feasible. The species and minimum volume requirements varied by harvest system class and access class. Stands that did not have sufficient volume of timber of acceptable species were considered uneconomic and thus inoperable. The economic limits are outlined in Table A-6.

Table A-6. Economic operability constraints

		Stand type (cubic metres per hectare)		
Access difficulty	**Harvest system**	**Cedar (Cw, Cy)**	**Spruce (Ss)**	**Hemlock (Hw)**
Easy	Conventional	NMV > 300	NMV > 400	NMV > 400
	Aerial	NMV > 450	NMV > 500	NMV > 500
Moderate	Conventional	NMV > 390	NMV > 520	NMV > 520
	Aerial	NMV > 590	NMV > 650	NMV > 650
Difficult	Conventional	NMV > 510	NMV > 680	NMV > 680
	Aerial	NMV > 770	NMV > 850	NMV > 850

Note: NMV = net merchantable volume. Volume thresholds as reported were applied to inventory volumes adjusted for attribute error only.

For stands less than 150 years old, the constraints in TableA-6. were applied as minimum site indices at which stands are projected to achieve the threshold volumes at age 150.

The threshold volumes for easy access areas in Table A-6. were derived from a review of cruise compilation summaries for cutting permits issued from 1993 to 1997. For the cedar-conventional class, the minimum threshold was set to 300 cubic metres per hectare to allow the contribution of low site cedar (the partition) to be tracked in the analysis. The thresholds for moderate access and difficult access areas were computed by multiplying the easy access values by factors of 1.3 and 1.7, respectively, to reflect the incremental costs for operating in these areas. Since no cutting permits have been issued in moderate and difficult areas over the last two years, these factors were based on cost estimates derived using the *Coast Appraisal Manual*. Given uncertainty about these factors sensitivity analysis was conducted that examined the effects of more restrictive thresholds 1.5 (moderate access) and 2.0 (difficult access) and of less restrictive thresholds 1.2 (moderate access) and 1.5 (difficult access).

A.3.2.8 Unmerchantable forest types

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

Table A-7. Unmerchantable forest types criteria

Species	Inventory type groups	Reduction per cent (%)
Hardwoods[32]	35 – 42	100
Pine	27 – 34	100

Problem forest types are defined as species currently not utilized in the Queen Charlotte TSA.

A.3.2.9 Roads, trails and landings

Estimates of the loss in productive forest land due to existing and future roads, trails and landings (RTL) were made separately. Existing-RTL estimates were applied as reductions to the current productive forest available for timber harvesting. Future-RTL estimates were assumed to apply after stands are harvested for the first time only.

Table A-8. Estimates for existing and future roads, trails and landings

Location	Age class	Reduction per cent (%)
Existing roads, trails and landings	1 – 4	7.2
Future roads, trails and landings	5 – 9	6.5

Data source and comments:

The area of existing roads, trails and landings (RTLs) was estimated using information provided in a 1993 MoF study on site degradation due to permanent access in the Vancouver Forest Region. This report summarized the total area of main roads, skid roads, landings, gravel pits and quarries within 282 cutblocks in the region. Results were averaged separately for high-lead, grapple, skidder and helicopter harvest systems. The overall allowance for existing RTLs in the Queen Charlotte TSA was estimated as the average of RTL area for all harvest systems estimated in the 1993 study weighted by the area logged under each system.

The allowances for future RTLs in conventionally harvested blocks was determined from a forest district review of areas harvested between June 1995 and December 1997 (comprising the TSA and TFL 39). Forty-two cutblocks within the TSA were reviewed. Most of these were located on mid to upper slopes and did not adequately represent harvesting on lower slopes. Therefore, a random sample of 16 cutblocks from TFL 39 Block 6 was used to augment the TSA sample.

[32] While interest in Red Alder (*Alnus rubra*) as a commercial species is increasing, the total area present in the Queen Charlotte TSA is considered too small to warrant a separate analysis unit for this timber supply review.

A.3 Timber Harvesting Land Base Definition

The per cent RTL area for aerial (helicopter) cutblocks not harvested in association with conventional blocks was 2.8%.[33] No RTL loss was assumed for aerial blocks harvested in association with conventional blocks. The overall allowance for future RTLs was estimated by averaging the observed area of RTLs for conventional and aerial logging systems weighted by the area logged under each system over the sampled period.

A.3.2.10 Reduction to protect cultural heritage resources

A total of 396 cutblocks harvested in the Queen Charlotte Islands Forest District between June 1995 and June 1998 were reviewed for reductions due to the presence of cultural heritage resources, specifically culturally modified trees (CMT). Cutblocks deferred from harvest by the licensees due to high concentrations of CMTs were also included in this review. The results showed that the average per cent cutblock area reserved from harvest exclusively due to CMT's was 6.4% (weighted average based on gross cutblock area for all licensees).

Data source and comments:

A listing of cutblock for all licensees within the Forest District was obtained from the Ministry of Forest's Timber Information Access (TIA) database from which a subset of cutblocks harvested between June 1995 and June 1998 was extracted. This list was augmented with 'new' cutblocks missing from the TIA but approved for harvest in the forest district, plus cutblocks which have been 'deferred' by the licensees during this period due to expected high concentrations of CMT's.

Cutblocks that received CMT surveys[34] by the Council of Haida Nation (CHN) were identified. Where CMT's were identified, the reserved area was quantified by one of the following methods:

- using the reserved area calculated by the licensee in the silviculture prescription (SP), and shown on SP map;
- if the reserved area was not quantified by the licensee, the area reserved for CMT's (identified on the SP map) was hand drawn to approximate the potential cutblock size without CMT constraints, and measured by dot grid;
- the original engineered cutblock before a CMT survey was compared with the same cutblock following a CMT survey, with the area excluded from harvest identified as the reserved portion.

The per cent cutblock reduction was computed as the reserved area divided by the gross cutblock area. A number of cutblocks originally proposed during the review period were deferred from harvest by the licensee due to expected high concentrations of CMT's. It was assumed the reduction for deferred cutblocks was equal to the mean percent reduction of harvested cutblocks with the highest 20% of CMT concentrations.[35].

A CMT netdown of 5.5 % was reported in the data package released prior to this analysis. However, a review of the data following the release of the data package revealed two cutblocks originally proposed for harvest during this review period but deferred due to CMTs were not considered in the original analysis. Also, two harvest blocks included in the original analysis were outside the review period window (i.e., 1999) and therefore deleted in the subsequent analysis. There was also a change in the method used to calculate the CMT netdown in blocks planned under alternative silvicultural systems.

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33 Based on a review conducted for TSR 1.

34 No distinction is made between reconnaissance, walk through, and full cutblock surveys.

35 The highest 20% was used to ensure an adequate number of observations, plus minimize the influence smaller cutblocks would have on the average reduction ratio.

A.3.2.11 Riparian management area

In the timber supply analyses, the area of all stands in the timber harvesting land base, (after netdowns for non-forest, non-productive and unstable terrain have been applied), were reduced by 9.8% to account for riparian management areas (RMA), including both riparian reserve zones (RRZ) and riparian management zones (RMZ).

The per cent netdown associated with RRZ and RMZ areas was derived from a review of 58 cutblocks harvested from June 1995 to December 1997 (located within the TSA and TFL 39). Forty-two cutblocks within the TSA were reviewed. The majority of these was located on mid to upper slopes and did not adequately represent harvesting on lower slopes, which are often associated with fisheries' issues. Therefore, a random sample of 16 cutblocks from TFL 39 Block 6 was used to augment the TSA sample. Results of the review were stratified by biogeoclimatic subzone/variant, and the overall summaries were weighted by the area of each subzone/variant in the timber harvesting land base. The area of RMZ in each block was adjusted according to the per cent retention in the RMZ specified in the silviculture prescriptions. RMA measurements were taken after low productivity sites and unstable terrain were excluded, to ensure no double counting of area. The average area of cutblock reserved for RMA's was 9.8%.

A.3.2.12 Protected areas strategy

The Queen Charlotte TSA includes thirteen Cabinet-approved study areas identified under the *Protected Areas Strategy* (PAS) (Table A-9.). British Columbia is committed to developing and expanding a protected areas system that will protect 12% of the province by the year 2000. The PAS will be used by land-use planning processes to recommend land allocations to Cabinet.

While all PAS goal 1 (representation) and goal 2 (special features) study areas were included in the timber harvesting land base, a sensitivity analysis evaluated the impact of removing all PAS study areas from the timber harvesting land base.

Table A-9. Summary of PAS goal 1 and goal 2 study areas in the Queen Charlotte TSA

Location	PAS goal #	Location	PAS goal #
NW Graham Island	1	Boulton Lake	2
Yakoun Lake	1	Tlell River – Pontoons	2
Gudal Bay / Marble Island	1	Tlell River – Survey Creek	2
Sturgess Bay / Maast Island	2	Tana Bay	2
Naden Harbour / Davidson River	2	Kitgoro Inlet	2
Eden Lake – South End	2	Kootenay Inlet	2
Kumdis Slough / Yakoun Bay	2		

A.3.2.13 Timber licence reversions

Timber licences (TL) are old tenure agreements that give a licensee exclusive rights to harvest merchantable timber within the licence area and do not contribute to the AAC for the TSA. Once these areas have been harvested, regenerated and have attained free-growing status, the TL area reverts to British Columbia Forest Service jurisdiction. In the analysis, these areas contributed to the TSA timber supply only after being harvested and regenerated.

The total area of timber harvesting land base classified as Timber Licences in the Queen Charlotte TSA is approximately 2069 hectares of which about 650 hectares is under 80 years old and deemed to have already reverted to TSA. In the analysis the remaining 1420 hectares of Timber Licences are assumed to revert at a rate of 85 hectares per year.

A.4 Forest Management Assumptions

A.4.1 Harvesting

A.4.1.1 Utilization levels

The utilization levels define the maximum stump height, minimum top diameter inside bark (dib) and minimum diameter at breast height (dbh) by species. These are used in the analysis to calculate merchantable volume.

Table A-10. Utilization levels

	Utilization		
Analysis unit	**Minimum dbh (cm)**	**Maximum stump height (cm)**	**Minimum top dib (cm)**
All analysis units	17.5	30	10

Data source and comments:

Table A-10. reflects current regional standards, licence requirements and current management.

A.4.1.2 Volume exclusions for mixed species stands

Deciduous species in a predominantly coniferous stand are not normally harvested. Therefore, the unharvested portions do not contribute to the estimated stand volume in the timber supply analyses.

Table A-11. Volume exclusions for mixed species types

Species	Volume exclusion (%)
Deciduous	100

A.4.1.3 Minimum harvestable age derivation

The minimum harvestable age is the time required for stands to grow to a harvestable size, and defines the lower limit for harvesting. Minimum harvestable ages are simply minimum criteria. Harvesting may occur in stands at the minimum age in order to meet forest level objectives (e.g., maintaining harvest levels for a short period of time, or avoiding large inter-decade changes in harvest levels). However, many stands will not be harvested until past the minimum age due to management objectives for other resource values (e.g., requirements for the retention of older forest).

The minimum harvestable age for stands in each analysis unit was set to the greater of: a) the estimated age at which the stand is predicted to reach a required volume; and b) the age at which the stand's mean annual increment (MAI) achieves a value of 95% of the maximum (culmination) MAI. Table A-12 lists the ages corresponding to the two criteria.

A.4 Forest Management Assumptions

Table A-12. Minimum stand volumes and minimum mean dbh for determining minimum harvestable age

Analysis unit	Average age (yrs) at which 400 m³/ha is achieved	Average age (yrs) at which 95% of culmination MAI is achieved
Cedar low — natural	210	100
Cedar poor — natural	130	90
Cedar good — natural	90	80
Hemlock poor — natural	140	80
Hemlock medium — natural	105	85
Hemlock good — natural	65	60
Spruce poor — natural	125	90
Spruce good — natural	60	60
Cedar low — managed	240	140
Cedar poor — managed	140	110
Cedar good — managed	100	100
Hemlock poor — managed	140	130
Hemlock medium — managed	105	110
Hemlock good — managed	65	85
Spruce poor — managed	110	130
Spruce good — managed	55	80

Data source and comments:

Minimum harvestable ages for existing stands were based on inventory adjusted natural stand yield estimates, and those for managed stands on managed stands yield estimates. Natural stand yields were adjusted for bias in age, height and volume (taper and loss) estimates. Managed stand yields were adjusted for age, height and tree taper.

As a result of the significant volume adjustment for cedar, the minimum harvestable ages for natural cedar are lower than those for managed cedar. While this result is counter-intuitive (the expectation would normally be that managed stands would achieve merchantability more quickly than natural stands), the uncertainty does not affect timber supply significantly. First, very few cedar stands are younger than 140 years, therefore most are subject to the lower natural stand minimum harvestable ages, which are based in part on volumes that were adjusted according to the inventory audit. Second, analysis results showed that changes to managed stand minimum harvestable ages had little effect on long term timber supply (see section 6.6 of the main report).

A.4.1.4 Harvest scheduling priorities

Over the first ten-year period of the analysis horizon, harvesting priority was assigned to landscape units where harvesting is currently being conducted. These are: Eden Lake, Rennell, Honna, Tasu, Otun, Gudal, Naikoon, Beresford, and Tlell.

A.4.2 Unsalvaged losses

Table A-13. shows the estimated average annual unsalvaged volume loss to catastrophic events such as insect epidemics, fires, wind or other agents in the timber harvesting land base. The unsalvaged loss column reflects only losses of volume that will not be recovered or salvaged.

Table A-13. Unsalvaged losses

Cause of loss	Annual unsalvaged loss (m^3/year)
Fire	0
Insect and disease	3 300
Wind damage	3 800
Total	7 100

Data source and comments:

The volumes in the above table were derived by the MoF from a 1993 study of unsalvaged losses in the Queen Charlotte TSA. The assumptions, data and results of this study were reviewed by the Regional Forest Entomologist and Regional Forest Pathologist who judged them to be reasonable for the current timber supply analysis.

Forest fire records from 1981 to 1991 were reviewed, and no losses due to fire were found in this period. Current policy within the Queen Charlotte Islands Forest District is to utilize fire damaged timber, when it is possible to do so, and to measure the waste left after salvage operations. Due to the lack of fires during the analysis period, no loss to fire is assumed in the analysis.

Forest insect and disease conditions were reviewed for the period 1982 to 1992. Damage during this period was primarily due to defoliating insects, although dwarf mistletoe also caused minor growth losses. The majority of tree mortality caused by defoliating insects, was due to coincidental attacks by the western blackheaded budworm and the hemlock sawfly which occurred between 1985 and 1987. Assuming a thirteen-year frequency and a 50% salvage rate, the total unsalvaged loss due to these two pests was estimated at 3300 cubic metres per year. Subsequent to this review, a recent outbreak of western blackheaded budworm occurred between 1996 and 1998, however, its impact has not been assessed or applied.

Although wind is a major forest disturbance factor in the Queen Charlotte TSA, salvage operations recover a significant portion of wind damaged timber on the timber harvesting land base. A review of harvest-related wind damage between 1975 and 1985 resulted in an estimated unsalvaged loss of 3550 cubic metres per year. A review of non-harvest related damage from 1990 to 1993 resulted in an estimate of unsalvaged losses of 250 cubic metres per year. In total, unsalvaged losses due to wind amount to 3800 cubic metres per year.

A.4 Forest Management Assumptions

A.4.3 Silviculture

A.4.3.1 Silviculture and regeneration activities in managed stands

The silviculture program was modelled using the information shown in Table A-14, which reflects the mix of treatments currently practiced on the Queen Charlotte TSA. Growth of recent plantations and future stands was projected with managed stand yield tables (MSYT) produced using the B.C. Forest Service table interpolation program for stand yields (TIPSY) growth and yield model.

Table A-14. Regeneration assumptions by analysis unit

#	Analysis unit (AU)	Regen delay (years)	OAF %		Method type	New AU		Density		
			1	2		#	%	Initial	Space	%
1	Cedar — low	5	15	5	Plant	3	100	2000	N/A	0
2	Cedar — poor	5	15	5	Plant	2	50	3000	1600	25
		5	15	5	Plant	4	50	7000	1600	50
3	Cedar — good / medium	3	15	5	Plant	8	75	15000	1600	90
		3	15	5	Plant	1	25	15000	1600	90
4	Hemlock — poor	5	15	5	Natural/plant	4	100	30000	1600	90
5	Hemlock — medium	3	15	5	Natural/plant	5	100	20000	1600	90
6	Hemlock — good	3	15	5	Natural/plant	6	100	20000	1600	90
7	Spruce — medium / poor	3	15	5	Natural/plant	7	70	15000	1600	90
		3	15	5	Natural/plant	5	30	15000	1600	90
8	Spruce — good	3	15	5	Plant	8	100	3000	700	25

Data source and comments:

Table A-14. was compiled by the District Silviculturalist based on a review of past and current practices within the Queen Charlotte TSA. In the past, spacing projects focused on hemlock (medium and poor) and spruce (medium) sites. Fewer spruce (good) or spruce/cedar/hemlock (good) sites were treated since these were harvested, restocked and had matured past optimum spacing-age by the time stand tending became standard practice in the Queen Charlotte Islands Forest District. Future harvesting will likely be concentrated in hemlock/spruce (medium) sites and hemlock/cedar (poor to medium) sites, and therefore future stand tending activities will concentrate in these types. The data package indicated a post spacing density of 700 stems per hectare (sph) would be assumed for all analysis units. However, yield projections from TIPSY indicate that minimum harvest ages and stand yields were significantly lower in stands thinned to 700 sph compared to stands thinned to 1600 sph in analysis units 1 to 7 when a utilization level of 17.5 cm is assumed. This large net-volume effect of thinning to 700 sph was not intended with the data package assumption. Therefore, the post-spacing densities were adjusted to more closely reflect actual field response. The densities provided in Table A-14. were used in the analysis.

A.4 Forest Management Assumptions

While current practice has been to juvenile-space the majority of stands harvested in the Queen Charlotte TSA, the sensitivity analyses includes a scenario that assumes no spacing.

Operational adjustment factors (OAF) are used to adjust the potential yields generated from TIPSY to reflect actual yields achieved under operational conditions. OAF 1 reduces the potential yields by a constant percentage to reflect small stocking gaps within stands incapable of growing trees. OAF 2 reduces potential yields to reflect losses due to pests, disease and decay. OAF 2 increases with age, and for this analysis, passes through 5% at age 100.

A.4.3.2 Immature plantation history

This section identifies areas of existing immature forest where stand density (stems per hectare) has been controlled and therefore should be assigned to a MSYT. All NSR and future harvested stands were projected using MSYTs. Table A-15 lists the percentage of managed immature forest in the Queen Charlotte TSA.

Table A-15. Immature plantation history

	Area managed (%)			
Analysis units	**Age 1 – 10**	**Age 11 – 20**	**Age 21 – 30**	**Age 31 – 40**
All units	60	70	60	30

Data source and comments:

The proportion of immature stands that are considered "managed" is based on a review of silvicultural records for areas logged between 1957 and 1997. For each decade in Table A-15., the total area of spacing was divided by the total area logged and rounded to the nearest 10% to derive the estimates provided.

A.4.3.3 Not satisfactorily restocked areas

Not satisfactorily restocked (NSR) areas are lands which have been logged but not yet fully regenerated, or where stocking is uncertain. Table A-16 summarizes the restocking schedule of NSR lands in the Queen Charlotte TSA.

Table A-16. Not satisfactorily restocked (NSR) areas

Analysis unit	Total NSR area in the inventory (hectares)
All units	3 752

Data source and comments:

In the Queen Charlotte TSA, forest regenerates quickly following harvesting, therefore, there is very little backlog NSR apart from areas stocked with undesirable species. Furthermore, the *Forest Practices Code* requires that all harvested areas be satisfactorily restocked. The area of NSR in Table A-16 generally consists of recently harvested forest. In the analysis, all of the current NSR is assumed to be restocked within 5 years.

A.4 Forest Management Assumptions

A.4.4 Integrated resource management

As noted in Section A.2.1, the Queen Charlotte TSA is divided into management zones that define areas of distinct management emphasis. Since the computer simulation model used for the timber supply analysis can track multiple objectives for an area, management zones can overlap. For example, a landscape unit that is managed for biodiversity may be partly covered by a visually sensitive area. The objectives for each area may specify requirements to retain different forest characteristics across the landscape, such as a minimum percentage of old-growth forests or a maximum percentage of forest area below green-up height.

A.4.4.1 Integrated resource management and visual values

In order to limit the impact of harvesting on visual, wildlife, hydrological and other values in the Queen Charlotte TSA, the forest cover requirements outlined in Table A-17a were applied to areas that fall into each "Level 1" grouping.[36]

Table A-17a. Forest cover requirements for integrated resource management and visual values

Grouping	Green-up height (metres)	Maximum allowable area not greened-up (% area)
IRM base area	3	25% (of harvestable land base)
RVQC = Retention	6	5% (of total forested area)
RVQC = Partial retention	6	15% (of total forested area)

Data source and comments:

Green-up height for the integrated resource management (IRM) base area represents the top-height (average height of the 100 largest trees per hectare) for the regenerating forest which is required to meet general integrated resource management objectives associated with hydrology, wildlife, recreation, or other similar concerns. The green-up height for RVQC areas is the visually effective green-up (VEG). VEG is achieved when previously harvested openings no longer appear disturbed to potential viewers. A 1994 Ministry of Forests study[37] on public perceptions of VEG indicated that stands with an average height of six metres had a 70% probability of achieving VEG. Also, a green-up height of six metres is consistent with results obtained from the application of the *Procedures for Factoring Visual Resources into Timber Supply Analyses*[38] which were applied to two mapsheets in the Queen Charlotte TSA.

The maximum allowable disturbance not greened-up was determined according to the Ministry of Forests *Procedure for Factoring Visual Resources into Timber Supply Analyses*. Accordingly, values at the high end of the range recommended for each class were adapted since landscape design is actively practiced in the Queen Charlotte TSA to mitigate the visual impact of timber harvesting.

[36] Grouping levels identified in Table A-2 “Objectives to be tracked”.

[37] Ministry of Forests 1994. A First Look at Visually Effective Green-up in British Columbia — A Public Perception Study. Recreation Branch Technical Report.

[38] Ministry of Forests 1998. Procedures for Factoring Visual Resources into Timber Supply Analyses. REC-029, page 9, Table 6.

A.4.4.2 Water quality

In order to protect water quality the forest cover requirements outlined in Table A-17b were applied to the forested area in community watersheds.

Table A-17b. Forest cover requirements — community watersheds

Area applied	Green-up height (metres)	Maximum allowable area below green-up (% area)
Community watersheds	5	5

Data source and comments:

Community watershed guidelines are taken from the *Forest Practices Code Community Watershed Guidebook*. The maximum allowable disturbance percentages reflect current practice in the Queen Charlotte TSA.

A.4.4.3 Landscape-level biodiversity

To ensure that older forests are maintained reasonably evenly within the TSA, the forest cover requirements outlined in Table A-17c were applied to each draft landscape units/biogeoclimatic variant group. These requirements were derived from the *Forest Practices Code Landscape Unit Planning Guide* (*LUPG*).

Table A-17c. Forest cover requirements — biogeoclimatic units and natural disturbance types (NDTs) within the Queen Charlotte TSA (based on gross productive forest)

Biogeoclimatic unit	NDT	Minimum old growth retention area by decade (%)			Minimum age (years)
		1 to 7	8 to 14	15 to 21	
CWH	1	9.7	11.6	13.6	250
MH	1	14.2	17.0	19.9	250

Data source and comments:

Interim biodiversity emphasis options (BEOs) have been assigned to each landscape unit through the *Regional Landscape Unit Planning Strategy*. However, these BEOs have not yet been legally established. Therefore, a single old-seral stage requirement was developed based on the anticipated distribution of 10% high-, 45% intermediate- and 45% low-emphasis for the total THLB forecast. The values shown in Table A-17c reflect the weighted *LUPG* values. These values are based on initially achieving one-third of the *LUPG* old-seral stage requirement in the lower-emphasis portions. As seen in the table, this is built up over time to ensure that the full retention of old-seral forest will be met by the end of three 70-year rotations, or 210 years from now.[39]

The timber supply impacts of implementing the interim BEO assignment for each landscape unit were examined in a sensitivity analysis. The old-growth retention requirements for each individual landscape unit were determined from Table A2.3 of the *LUPG* applying a one-third drawdown for the lower-emphasis areas.

A.4.4.4 Goshawk nest sites

The Ministry of Environment, Lands and Parks (MELP) has designated the Northern Goshawk (*Accipiter gentilis laingi*) as a red-listed species on the Queen Charlotte Islands (i.e., indigenous species that is threatened or endangered). Management practices to protect nest sites beyond those generally provided by the *Forest Practices Code* have not yet been established. Special practices for wildlife may only be established by the Deputy Minister of the Ministry of Environment, Lands and Parks and the Chief Forester as general wildlife measures, or through the objectives of a higher level plan. Nevertheless, current practice in the Queen Charlotte Forest District is to avoid timber harvesting in or around goshawk nesting areas.

The *Identified Wildlife Management Strategy* (*IWMS*) indicates the kind of measures which could eventually be adopted for goshawk nesting areas. The impacts of the measures outlined in the *IWMS* are examined through a sensitivity analysis. The analysis does not include special constraints for nesting areas.

The Marbled Murrelet (*Brachyramphus marmoratus*) is another red-listed bird species on the Queen Charlotte Islands. These small sea birds nest in large old-growth trees, normally up to 30 kilometres inland from the ocean. The *IWMS* recommends that the *Biodiversity Guidebook* old-seral stage retention requirements be adopted to protect marbled murrelet habitat. These requirements are incorporated into the analysis as outlined in Section A.4.4.3 “Landscape-level biodiversity.”

[39] Modelling assumptions are based on the letter “Incorporating Biodiversity and Landscape Units in the Timber Supply Review” by G. Townsend, Director Timber Supply Branch, December 1, 1997.

A.4.4.5 Wildlife trees (WT) and wildlife tree patches (WTP)

The *LUPG* describes two methods for providing the maintenance of stand structure over time: wildlife trees (WTs) and wildlife tree patches (WTPs). WT and WTP retention requirements are calculated for each landscape unit using Table A3.1 of the *LUPG,* based on the proportion of each landscape unit that is harvestable, and the percentage of the harvestable area that has already been harvested. Table A3.1 was used for deriving the wildlife tree patch targets because a surrogate for biodiversity emphasis has been assumed for old-seral retention.

WTP and WT requirements were calculated for each BEC subzone and landscape unit combination within the Queen Charlotte TSA. The area-weighted mean retention requirement for the TSA is provided in Table A-18.

Table A-18. Mean area-weighted reduction to reflect area retention in cutblocks for wildlife tree patches in each biogeoclimatic subzone and landscape unit combinations

Management zone	Analysis unit	Persistence	Mean WTP retention requirement in the timber harvesting land base (%)	Mean WTP retention requirement in the timber harvesting land base (%) incremental to other exclusions
All	All	Long term	2.8	0.7

Given that approximately 20% of the Crown forest area in this TSA is available for harvest and 20% of the area has already been harvested without regard for wildlife tree patch requirements, average wildlife tree patch target of 2.8% of each cutblock was 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.

An area reduction was used to model wildlife tree patch requirements because the wildlife tree patches, 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 they can contribute to meeting old-seral stage forest requirements at the landscape level. It was assumed that these wildlife tree patches will not be available for harvest at a later date.

A.5 Volume Estimates for Natural and Managed Stands

For existing natural stands, where density management has not been practiced, the variable density yield prediction (VDYP) model, version 6.4a, developed and supported by the B.C. Ministry of Forests, Resources Inventory Branch, was used to generate timber yield tables. WinTIPSY (Windows TM version of the Table Interpolation Program for Stand Yields) version 1.4, supported by B.C. Ministry of Forests, Research Branch, was used to estimate growth and yield for existing and future managed stands. Tables A-19 and A-20 show the yield estimates for natural and managed stands.

A.5 Volume Estimates for Natural and Managed Stands

Table A-19. Natural stand volume-over-age estimates

Age	Table 1 Cedar low	Table 2 Cedar poor	Table 3 Cedar good	Table 4 Hemlock poor	Table 5 Hemlock medium	Table 6 Hemlock good	Table 7 Spruce poor	Table 8 Spruce good
10	—	—	—	—	—	0.2	—	0.3
20	—	0.2	0.8	1.4	2.9	9.6	1.5	28.8
30	0.3	1.4	7.3	5.4	12.2	80.3	16.2	102.3
40	1.1	12.3	63.8	22.6	61.9	192.0	41.0	213.1
50	16.4	64.7	147.5	78.4	135.8	286.2	82.2	309.7
60	54.7	126.5	226.5	132.2	199.5	367.5	134.4	394.0
70	99.2	182.7	298.9	180.2	256.3	437.4	186.5	465.6
80	140.8	235.0	366.9	223.5	307.4	498.4	234.8	527.7
90	175.8	278.2	422.7	261.0	351.4	551.7	278.4	581.6
100	206.3	316.0	471.6	294.3	390.5	598.5	318.0	628.3
110	233.2	349.3	515.0	324.1	425.4	639.7	354.1	669.0
120	253.6	374.7	548.8	349.6	455.2	675.9	386.4	704.2
130	277.9	406.2	591.4	376.7	486.7	711.4	418.7	738.4
140	300.0	434.7	629.2	401.9	515.9	743.9	448.8	769.4
150	319.3	459.4	661.9	424.9	542.6	773.3	476.6	797.3
160	335.6	480.5	689.7	445.8	566.8	800.0	502.2	822.5
170	349.2	498.1	712.9	464.7	588.7	824.4	525.8	845.3
180	363.5	516.4	736.6	483.2	610.0	846.8	548.3	866.3
190	377.0	533.5	758.5	500.8	630.1	867.3	569.5	885.7
200	390.0	550.1	780.2	517.4	649.0	886.3	589.5	903.6
210	402.3	566.0	801.0	533.2	666.9	903.7	608.3	920.1
220	416.6	584.8	826.4	548.1	683.8	919.9	626.1	935.5
230	430.9	603.5	851.2	562.3	699.7	934.8	642.9	950.0
240	444.7	621.6	875.3	575.8	714.8	948.5	658.8	963.4
250	458.0	639.0	898.7	588.6	729.1	961.2	674.0	976.0
260	461.6	644.0	905.8	596.3	737.9	972.0	686.1	987.1
270	465.0	648.7	912.4	603.4	746.2	982.0	697.6	997.5
280	468.2	653.0	918.8	610.1	753.9	991.2	708.5	1 007.4
290	471.2	657.1	924.8	616.4	761.2	999.7	718.9	1 016.8
300	474.0	661.0	930.5	622.3	767.9	1 007.5	728.8	1 025.6
310	476.6	664.7	935.9	627.8	774.2	1 014.7	738.2	1 034.0
320	479.0	668.1	941.0	633.1	780.1	1 021.2	747.2	1 042.0
330	481.4	671.3	945.9	638.0	785.7	1 027.2	755.8	1 049.7
340	483.5	674.4	950.6	642.6	790.8	1 032.7	764.0	1 057.0
350	485.5	677.2	955.0	646.9	795.6	1 037.7	771.9	1 064.0

A.5 Volume Estimates for Natural and Managed Stands

Table A-20. Managed stand volume-over-age estimates

Age	Table 101 Cedar low	Table 102 Cedar poor	Table 103 Cedar good	Table 104 Hemlock poor	Table 105 Hemlock medium	Table 106 Hemlock good	Table 107 Spruce poor	Table 108 Spruce good
10	—	—	—	—	—	—	—	—
20	—	—	—	—	—	—	—	—
30	—	—	—	—	—	12.9	—	27.6
40	—	—	3.0	1.9	5.8	130.3	—	173.9
50	1.2	2.9	64.4	7.6	60.7	250.5	8.7	347.8
60	3.5	44.4	149.5	60.7	133.8	360.9	67.0	494.9
70	21.9	94.3	232.7	115.7	204.8	475.5	138.6	646.0
80	58.8	154.0	309.6	171.1	269.5	571.6	223.1	777.3
90	91.2	210.0	364.8	220.3	329.0	667.8	298.9	893.0
100	129.2	265.7	411.4	265.5	385.3	756.9	363.3	1 000.9
110	162.7	315.9	464.6	307.6	442.6	837.2	422.1	1 102.6
120	193.8	352.5	513.4	346.5	494.7	897.4	475.4	1 190.4
130	223.8	381.3	557.9	384.4	538.5	951.9	533.2	1 263.6
140	251.5	407.0	599.1	422.2	579.3	1 007.2	587.6	1 326.2
150	275.8	432.1	635.2	457.0	619.1	1 058.6	635.5	1 376.9
160	298.8	458.9	666.0	488.6	658.8	1 105.4	680.1	1 422.3
170	319.6	483.2	690.4	515.2	695.5	1 148.3	721.5	1 453.7
180	333.4	505.9	711.8	540.5	728.2	1 188.2	757.4	1 480.5
190	345.0	525.6	731.9	564.1	758.7	1 215.7	790.1	1 505.2
200	355.4	544.0	750.0	586.5	787.3	1 240.2	820.6	1 524.8
210	364.6	560.2	771.1	608.9	812.7	1 263.7	848.9	1 539.5
220	376.1	580.6	799.8	629.4	837.2	1 287.2	877.0	1 553.0
230	386.5	599.1	827.4	649.8	854.4	1 311.5	902.0	1 564.5
240	396.9	617.6	852.9	668.2	869.8	1 333.9	925.9	1 575.8
250	407.3	634.9	877.2	685.5	884.1	1 355.3	947.6	1 586.0
260	417.7	650.7	899.4	700.8	898.3	1 375.7	967.2	1 590.0
270	428.1	666.0	914.4	714.1	911.7	1 390.2	985.7	1 594.3
280	438.4	676.1	929.3	727.2	923.9	1 401.7	1 003.1	1 598.3
290	447.7	685.4	943.1	739.5	935.1	1 412.3	1 018.4	1 602.3
300	456.9	694.3	955.9	750.8	945.4	1 422.8	1 033.6	1 605.3

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The socio-economic analysis identifies employment and income impacts, changes in government revenues and community impacts at various harvest levels and times in the future. Some of the assumptions used in the analysis are as follows:

- **Employment multipliers** — these multipliers are used to estimate indirect and induced employment impacts of a change in direct industry activity. Employment multipliers are calculated based on analytical assumptions and data collected at a specific time. Consequently, the multipliers reflect industry and employment conditions at that time and may not accurately reflect future industry conditions. While generally good indicators when based on fairly recent information, older multipliers can be dated and may not reflect industry conditions at the time of analysis. In any impact analysis, the information should be considered as indicators of magnitude.
- **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, 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. Also, indirect and induced impacts will likely occur over a longer period, as business and consumer spending levels adjust to changes in harvest levels.
- **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 stepwise 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 impossible. 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 proportionately 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 Queen Charlotte 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 the Queen Charlotte TSA timber harvest levels, the forestry sector was divided into three sub-sectors:

- harvesting;
- silviculture; and,
- timber processing.

Estimating employment and income impacts involves several steps. First, the current activity in each of the three sub-sectors was assessed. Then, indirect and induced employment and employment income impacts were estimated, using data from the Ministry of Finance and Corporate Relations, and Statistics Canada. Next, employment coefficients were calculated and 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.

B.2 Economic Impact Analysis Methodology

Employment — harvesting

Direct employment in harvesting consists of all woodlands-related jobs including harvesting, log transport, log salvage, planning and administration functions. The employment multipliers used in this analysis define road building and maintenance work as indirect rather than direct employment. Including this employment in direct estimates would result in double counting.

Data on employment, place of residence and timber flows were obtained through a survey of licensees and operators in the Queen Charlotte 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:

- 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,
- 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 per 1000 cubic metres. These employment coefficients were then used to estimate harvesting employment associated with the different harvest levels in the base case forecast.

Employment — silviculture

Silviculture employment consists of all basic and intensive reforestation activities, including surveys, site preparation, planting, fertilization, 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 estimate the percentage of their silviculture employees who resided within the TSA and outside the 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.

B.2 Economic Impact Analysis Methodology

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: 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 similarly.

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 employees in the forestry sector are those who supply goods and services to firms directly engaged in the basic forestry sector; for example, those who provide road maintenance services. Induced employment are those who supply 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 displaced workers will leave the region, reducing total income in the region by their 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 induced impacts associated with a change in direct employment.

B.2 Economic Impact Analysis Methodology

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

Table B-1. Total employment multipliers

Forest sub-sector	TSA migration multiplier	TSA no-migration multiplier	Provincial coastal migration multiplier	Provincial coastal no-migration multiplier
Harvesting	1.49	1.35	2.02	1.72
Solid wood processing	1.33	1.26	2.31	1.94
Pulp	N/A	N/A	2.54	2.13

N/A — not applicable.
Sources: Horne, G., R. Riley, L. Ransom, and S. Kosempel. 1996. A provincial impact estimation procedure for the British Columbia forest sector.
Ministry of Finance and Corporate Relations. 1999. *The 1996 forest district tables*.

Employment estimates of alternative timber supply levels

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

Estimates of employment income

Employment income was calculated using average income estimates for workers in the forest industry. Income data are from Statistics Canada annual estimates of employment, earnings and hours. From 1997 to 1999, the average pre-tax annual income (less benefits) for sub-sectors of the forestry sector associated with the Queen Charlotte TSA was about $46,800 for logging and forestry services; $46,200 for solid wood manufacturing; and $55,900 for the pulp and paper sector. The weighted average annual income for direct forestry workers was $48,300. The average annual income for indirect and induced employees averaged about $30,300. This figure is based on data for all service producing industries from the Statistics Canada Labour Force Survey, B.C. Industrial Comparison, average weekly wage rates. Income taxes were calculated based on marginal tax rates of 23-28% 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. Table B-2 summarizes provincial government revenue estimates.

Table B-2. Estimates of provincial government revenue, Queen Charlotte TSA

Source of revenue	Average revenue 1997–1999 ($1998 millions)	Revenue ($/'000s m^3)
Stumpage, rents and royalties[a]	6.4	23,132
Industry taxes[b]	2.7	9,037
Provincial income tax[c]	2.5	9,370
Total government revenues	11.6	41,539

a) Ministry of Forests.
b) PricewaterhouseCoopers.
c) Based on marginal tax rates from Revenue Canada.