Kispiox Timber Supply Area Analysis Report

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Preface

This report contains a timber supply analysis and a socio-economic analysis and is part of the provincial Timber Supply Review (TSR) 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.

To determine allowable timber harvesting levels, 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 considered 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) of B.C. Act* and official land-use decisions made by Cabinet.

Focussing the assessment on the implications of current practices rather than looking at a number of different management regimes expedites the analysis process. 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 provide a 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.

This report is the third of five documents that will be released for each TSA as part of the timber supply review. (The first two documents are the information report and the data package). A fourth document called the public discussion paper will summarize the technical information and will provide a focus for public discussions of possible timber harvest levels. The fifth will outline the chief forester's harvest level decision and the reasoning behind it.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Kispiox Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over the short- (next 20 years), medium- (21 to 100 years from the present) and long- (beyond 100 years from the present) terms. It also examines the potential changes in timber supply resulting from uncertainties about forest growth and management actions. **It is important to note that the various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. As such, the forecasts should be used for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Kispiox Timber Supply Area (TSA) covers approximately 1.22 million hectares in the northwest interior of British Columbia. It is bordered on the east and south by the Bulkley TSA, on the north by the portion of the Prince George TSA that is in the Fort St. James Forest District, and on the west by the Nass, Cranberry and Kalum TSAs and Tree Farm Licence (TFL) 1. Within this area, approximately 697 000 hectares (57%) are productive forest managed by the Ministry of Forests. Of this productive forest, approximately 263 000 hectares (38%) are considered available for timber production and harvesting under current management practices. These practices follow the standards and legislation set out by the *Forest Practice Code* as well as objectives approved under the Babine Local Resource Use Plan (LRUP) and the Kispiox Land and Resource Management Plan (LRMP). In the area available for timber harvesting, the greater part (approximately 201 000 hectares or 77%) of the forest is dominated by hemlock and balsam species.

The allowable annual cut (AAC) for the Kispiox TSA was last set in 1996 at 1 092 611 cubic metres per year. Several woodlot licences have been created or expanded since then. To account for this, the initial harvest level assumed in the analysis was 1 086 327 cubic metres per year.

Since the 1996 timber supply analysis, six new protected areas have been created and changes have occurred in forest management practices. These changes have reduced the size of the current timber harvesting land base by 17%. In addition, there are new estimates for unsalvaged losses due to insects and disease.

The results of this timber supply analysis suggest that the current harvest level in the Kispiox TSA cannot be maintained. The base case harvest forecast has an initial harvest level of 903 000 cubic metres per year, which excludes woodlot licences issued since the last AAC determination. The initial harvest level declines 10% per decade to reach a stable long-term harvest level of 430 000 cubic metres per year 90 years from now. The base case harvest forecast reflects current knowledge and information on forest inventory, growth and management. Uncertainty exists about several factors important in defining timber supply. A series of sensitivity analyses showed that these uncertainties affect timber supply to varying degrees.

One alternative to the base case harvest forecast shows that it may be possible to increase the initial harvest level to 967 000 cubic metres per year by accepting a harvest flow that declines 12% per decade instead of 10% per decade.

An important factor in determining the initial harvest level is the current age class distribution. There is a critical gap in the amount of timber harvesting land base covered in stands 31 to 70 years old. This requires the harvest of existing unmanaged stands to be spread out over approximately 100 years until sufficient young managed stands are available to support harvesting. Short- and medium-term timber supply are therefore sensitive to changes that affect the amount of timber available from existing unmanaged stands.

For the short and medium terms, the largest effects on projected harvests are associated with uncertainties in minimum harvestable ages (MHAs), size of the timber harvesting land base, timber volume estimates for existing unmanaged stands, timber volume estimates for regenerated managed stands, allowable disturbance levels for visual quality objectives (VQOs), green-up ages, forest cover requirements for adjacency, management for pine mushroom habitat, reduced coniferous regeneration in backlog stands, and estimates of unsalvaged losses.

For the long term, the largest effects are associated with uncertainties in the size of the timber harvesting land base, timber volume estimates for existing unmanaged stands, timber volume estimates for regenerated managed stands, allowable disturbance levels for VQOs, site productivity estimates for old stands, and estimates of unsalvaged losses.

In conclusion, the base case forecast suggests that the current AAC should be reduced to 903 000 cubic metres per year. Extensive sensitivity analysis examined the effect on the base case harvest forecast of changes in the information used in this analysis. There is no evidence to suggest that the data used in this analysis is inaccurate. However, several factors could act to further reduce the initial harvest level. These factors include lower timber volume estimates for existing unmanaged stands, management for pine mushroom habitat, coniferous regeneration in backlog stands, and pine needle blight. Two factors could act to partly offset these downward pressures on the initial harvest level, including a larger timber harvesting land base and lower unsalvaged losses for insects and disease.

The socio-economic analysis for the Kispiox TSA indicates that the base case forecast of 903 000 cubic metres could support a total of approximately 755 person-years of direct forestry employment. Direct forestry activity in the TSA would support a further 909 person-years of indirect and induced employment across the province. The base case forecast, if fully harvested, could provide the provincial government with average revenues of about $21.9 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. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

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

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

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

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

Timber supply projections made for TSAs look far into the future — 250 years or more. However, because of the uncertainty surrounding the information and because forest management objectives change through time, these projections should not be viewed as static prescriptions that remain in place for that length of time. They remain relevant only as long as the information upon which they are based remains relevant. Thus, it is important that re-analysis occurs regularly, using new information and knowledge to update the timber supply picture. 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. The B.C. Forest Service forest inventory* plays a major role in this. 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.

The following sections outline the timber supply analysis for the Kispiox TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Section 3 outlines the timber supply analysis methodology. Timber supply analysis results, are presented in Section 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used, and is followed by a summary and conclusions in Section 6. Section 7 shows results of a socio-economic analysis for the Kispiox TSA. Appendixes A and B contain further details about the data and assumptions used in the 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 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 Kispiox 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 assessing employment and income implications of the timber harvesting levels projected in the base case.

The analysis includes estimates of the employment and income impacts associated with timber supply analysis projections by three main sectors: harvesting and 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 were 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.
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.

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 were calculated using the Kispiox TSA and provincial employment multipliers* developed by the Ministry of Finance. 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 these indirect and induced impacts.

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

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 Kispiox Timber Supply Area

The Kispiox Timber Supply Area (TSA) covers approximately 1.22 million hectares in the northwest interior of British Columbia. This TSA is bordered to the north by the Nass and Prince George TSAs, to the west by the Kalum and Cranberry TSAs, and to the south and east by the Bulkley TSA. The Kispiox TSA (along with the Cranberry TSA) is administered by the Kispiox Forest District office in Hazelton.

According to the 1996 census, the population of the Kispiox TSA was about 6,292, a 5% increase from 1991. Since then, early estimates for 2001 project that the population has declined back to about 5,995 people. According to band registries for 1995, about 2,800 band members were living on reserves in the Kispiox TSA. The District of New Hazelton (2001 population about 750) is the principal commercial, administrative and retail centre for the area. Other smaller communities include Hazelton, South Hazelton, Kitwanga, Cedarvale, Kispiox, Gitsegukla, Gitwangak and Gitanyow.

The topography of the Kispiox TSA is mountainous with broad river valleys between the mountain ranges. The TSA is situated around the confluence of the Skeena and Bulkley rivers, with the Babine and Kispiox rivers also being major features. To the south, the TSA is bounded by the Rocher Deboule and Seven Sisters ranges, and by the Sicintine watershed* and Kispiox River headwaters to the north. To the west are the Hazelton Mountains and to the east is the North Babine mountain range. The overall climate in the TSA is transitional between coast and interior, with cool summers and cool winters.

The forests of the Kispiox TSA are diverse and many tree species are commercially harvested and processed into a variety of wood products. Within the land base currently considered available for timber harvesting, forests are dominated by hemlock and subalpine fir. Spruce (Engelmann, white and hybrid), lodgepole pine, western redcedar, amabilis fir and cottonwood are also commonly found.

The current allowable annual cut (AAC) in the Kispiox TSA is 1 092 611 cubic metres. This level was set by the chief forester in December 1996, and represented no change from the previous AAC.

About 57% of the TSA land base is considered productive forest land managed by the B.C. Forest Service (approximately 697 000 hectares). Currently about 38% of this forested land base is considered available for harvesting (22% of the total TSA land base).

Significant changes that influence forest management have occurred since the last Timber Supply Review was completed. These changes include:

- implementation of the *Forest Practices Code (FPC)**;
- creation of a deciduous* management strategy;
- completion of terrain stability mapping in areas with unstable soils, and a review of other types of environmentally sensitive areas (ESAs)*;
- a review of the amount of timber reserved from harvesting in cutblocks* with reserves;
- research into the extent and distribution of the pine mushroom, and development of management strategies and objectives (in process);

Watershed
An area drained by a stream or river. A large watershed may contain several smaller watersheds.
Forest Practices Code
Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Deciduous
Deciduous trees shed their leaves annually and commonly have broad-leaves.

Environmentally sensitive areas
Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.
Cutblock
A specific area, with defined boundaries, authorized for harvest.

- delineation of riparian management areas (RMAs), using geographic information systems (GIS); and
- development of draft landscape units (LUs)* and assignment of biodiversity* emphasis.

Current management practices from the 1994 Babine River Local Resource Use Plan (LRUP) are considered in this timber supply analysis, as is the Kispiox Land and Resource Management Plan (LRMP)*, approved by government in April, 1996. This approval marked the culmination of a seven-year planning process that provided an opportunity for the public, interest groups and local government to make recommendations to the provincial government about future management of public forest lands in the Kispiox TSA. In 1996, key objectives from the LRMP were legally designated in a higher level plan (HLP)*.

The plan included the development of special management zones to maintain significant values in community watersheds and in four specific areas (Atna/Shelagyote, East Kispiox/Kuldo, Rocher Deboule and Babine River Valley). As well, recommendations were made for four new protected areas* that have now been designated as provincial parks (Swan Lake Wilderness Area, Babine River Wilderness Area, Kitwanga Mountain and the Bulkley Junction on the Skeena River). A fifth area, Catherine Creek, has been designated as an ecological reserve.

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

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.
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.
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).

1 Description of the Kispiox Timber Supply Area

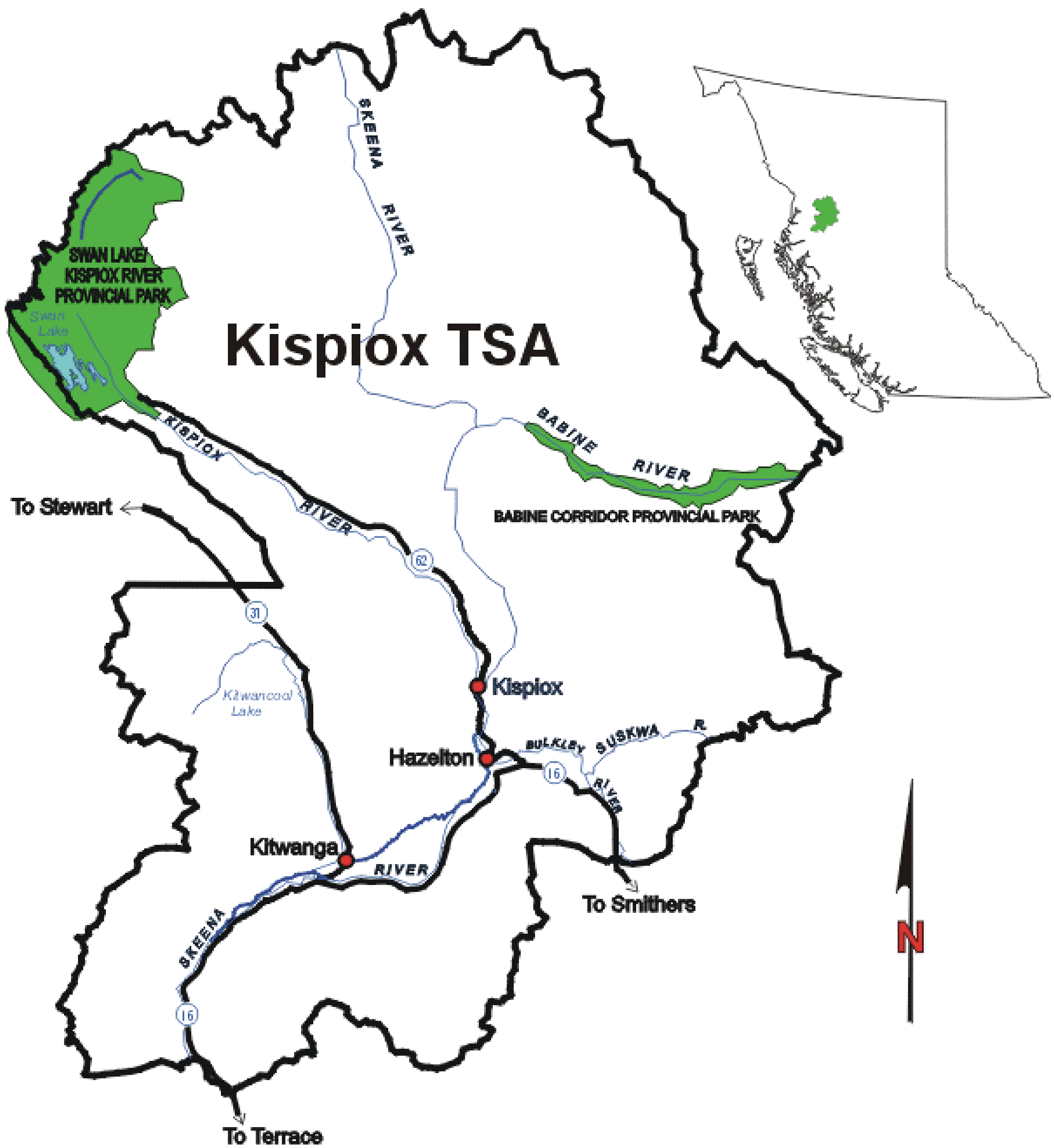

Figure 1. Map of the Kispiox Timber Supply Area, Prince Rupert Forest Region.

1 Description of the Kispiox Timber Supply Area

As part of the higher level plan as well, the Upper Kispiox Valley and the Seven Sisters area were deferred from harvesting to allow for local planning processes. In June 1999, about 42 800 hectares in the Upper Kispiox Valley were designated as provincial park and 7600 hectares as a special management zone. In 2000, about 27 000 hectares in the Seven Sisters mountains were designated as a provincial park, 11 900 hectares were designated as a protected area and 7200 hectares as a general resource development zone.

The forests of the Kispiox TSA provide a broad range of forest land resources, including forest products (timber and non-timber, such as pine mushrooms), outdoor recreation and tourism amenities, minerals and a variety of fish and wildlife habitats. The scenic mountain landscapes and numerous rivers and lakes provide a variety of opportunities for outdoor recreation, including climbing and mountaineering, hiking, mountain biking, wildlife viewing, rafting, canoeing, cross-country skiing, snowmobiling, dog-sledding and trapping. Hunting and fishing have been popular for many years in this area and these activities have important cultural significance for First Nations.

1.1 The environment

The six biogeoclimatic zones* that occur in the Kispiox TSA reflect the diversity of climate and vegetation in the area, and its transitional location between coastal and interior ecosystems. The varied ecological features and unique nature of the area contribute to the high biodiversity values found in this TSA.

The Interior Cedar-Hemlock (ICH) zone occurs in the low- to mid-elevations in valley bottoms throughout most of the TSA. This zone has an interior, continental climate with cool wet winters and warm moist summers, and has the highest diversity of tree species of any zone in the province. Mature forests are dominated by western hemlock, subalpine fir, western redcedar, amabilis fir and a spruce hybrid known as Roche spruce. Other species found include lodgepole pine, Engelmann spruce, white spruce, trembling aspen, black cottonwood and birch.

The Sub-Boreal Spruce (SBS) zone is found in the valley bottom of the Babine River in the eastern part of the TSA. This zone is characterized by seasonal extremes of temperature, with severe, snowy winters and relatively warm, moist and short summers. Frequent, large-scale fires occur in the SBS zone (the average fire return interval is 100 years). Hybrid spruce, subalpine fir, lodgepole pine and trembling aspen are the most common tree species.

The Engelmann Spruce-Subalpine Fir (ESSF) zone is the uppermost forested zone in most of the Kispiox TSA, occurring above the ICH and SBS zones. The ESSF zone has a continental climate, with cool, moist and short growing seasons, and long, cold winters. The ESSF zone is comprised of continuous forest at its lower elevations and parkland at its higher elevations. Subalpine fir is the dominant tree species throughout the zone; hybrid spruce and lodgepole pine are common in drier parts of the zone that have been influenced by fire.

The Coastal Western Hemlock (CWH) zone has a limited occurrence at low- to mid-elevations in the western part of the TSA. The climate is predominantly coastal but is significantly influenced by continental weather patterns. As a result, the CWH zone is not as subject to winter cold spells and summer droughts as are the more interior zones. The dominant tree species are western hemlock, amabilis fir, mountain hemlock, lodgepole pine, trembling aspen and subalpine fir.

The Mountain Hemlock (MH) zone occurs above the CWH zone in the western portion of the TSA. The MH zone's subalpine climate is characterized by short, cool summers and long, cool and wet winters. The deep winter snowpack is slow to disappear and a short growing season results. Mountain hemlock and amabilis fir are the dominant tree species.

The Alpine Tundra (AT) zone occurs at high elevations above the ESSF and MH zones. The climate is cold, windy and snowy with a short, cool growing season. Frost can occur at any time during the year. By definition this zone is treeless, although trees in stunted form are common at lower elevations. Vegetation is dominated by shrubs, herbs, mosses and lichens. Much of the alpine landscape lacks vegetation and is the domain of rock, ice and snow.

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

1 Description of the Kispiox Timber Supply Area

The forests of the Kispiox TSA are home to an abundance of wildlife species including grizzly bear, moose, mule deer and mountain goat, as well as songbirds, raptors, owls, and many other smaller mammal species. Black bears are common and widespread, and a population of the Kermode colour variant of black bears extends into the western half of the TSA. Many wildlife species are dependent on the mature and old forest ecosystems within the TSA. The Skeena River (and its tributaries) is a highly productive system for many fish species, providing important spawning habitat and migration routes for chinook, coho, sockeye and pink salmon. Other rivers and lakes in the TSA provide habitat for steelhead, bull trout, Dolly Varden and lake trout.

Under the *Forest Practices Code*, a process exists for identifying species at risk and designating wildlife habitat areas (WHAs) with specific management practices. The wildlife species that have been identified in Volume 1 of the provincial *Identified Wildlife Management Strategy* in the five ecosections of the Kispiox Forest District are presented in Table 1.

Table 1. Species at risk under the Forest Practices Code (February 1999)

Common names of identified wildlife	Ecosection				
	Nass Basin	Nass Ranges	Babine Upland	Northern Skeena Mtns.	Southern Skeena Mtns.
Bull trout	x	x	x	x	x
Tailed frog	x	x			
Trumpeter swan	x	x	x	x	x
Northern goshawk *atricapillus*	x	x	x	x	x
Fisher	x	x	x	x	x
Grizzly bear	x	x	x	x	x
Mountain goat		x		x	x

Source: Managing Identified Wildlife, Volume 1, February 1999.

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*. In addition, locally-developed plans such as the Kispiox land and resource management plan (LRMP), provide further management direction for public forest lands in the Kispiox TSA, as well as for wildlife species not included in the above list.

1.2 First Nations

The Gitxsan, Wet'suwet'en, Gitanyow, Nisga'a, Nat'oo'ten and Tsimshian First Nations have traditional lands within the Kispiox TSA. The Gitxsan Nation has five villages (Gitanmaax, Glen Vowell, Kispiox, Gitsegukla and Gitwangak) and the Wet'suwet'en and the Gitanyow have one village each (Hagwilget and Gitanyow, respectively).

The Nisga'a Treaty, finalized in April 2000, includes the Nass Wildlife Area which covers part of the Kispiox TSA. The Gitanyow are currently engaged in accelerated treaty negotiations toward an agreement-in-principle with the province and Canada. The Wet'suwet'en are at the agreement-in-principle stage of the treaty process and, together with the province and Canada, are focused on implementation of a pre-treaty agreement on lands and resources, primarily regarding forestry economic development. The Gitxsan are involved in treaty negotiations working toward an agreement-in-principle with the province and Canada.

All of the First Nations are interested in increasing their involvement in the forestry sector and in acquiring forest tenure. They have also expressed concerns about timber harvesting in areas with high cultural and economic values. An archaeological overview assessment, which identified sites of potential archaeological significance, has been completed. Other inventory studies to assess botanical forest products and cultural heritage resources* (i.e., traditional use studies and archaeological impact assessments) are ongoing. Once these studies are completed, they will be considered in future timber supply reviews.

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.

2 Information Preparation for the Timber Supply Analysis

Timber supply analysis requires three general categories of information: land base inventory; timber growth and yield; and management practices. These three categories are discussed below. Also, in preparation for the analysis, a number of changes since the 1996 Kispiox TSA timber supply analysis were noted, and are described in Section 2.4, "Changes since the 1996 Kispiox TSA timber supply analysis."

2.1 Land base inventory

Land base information used in this analysis came in the form of a computer file compiled by the B.C. Forest Service in 2000. This file contains information on the forest land in the Kispiox TSA including the geographic location, area, nature of the forest cover (such as presence or absence of trees; species, number and age of trees; and timber volume), environmental sensitivity, and physical accessibility (operability*). Stand characteristics such as tree height, stocking* and age have been projected to 1999. Also, the file has been 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 on areas where timber harvesting is not expected to occur. Examples are lands set aside for parks, areas needed to protect wildlife habitat, power line right-of-ways, highways, or town sites. A general description of these areas specific to the Kispiox TSA is provided below.

Before assessing timber supply, the TSA is classified and specific areas (e.g., stands of trees) are assigned either to the timber harvesting land base*, or to the non-contributing land base. There is no double counting of area; for example, the area of a forest stand that falls within a park, and also has sensitive soils, is assigned only once to the non-contributing land base.

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

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

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.
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 where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.

2 Information Preparation for the Timber Supply Analysis

For the Kispiox TSA, the following types of areas were excluded from the timber harvesting land base:

- area not managed by the B.C. Forest Service — this includes private land, parks, and woodlot licences*.
- new protected areas — the location of new protected areas was mapped and overlaid on the inventory file. These include Swan Lake/Kispiox River, Kitwanga Mountain, Babine River Corridor, Bulkley Junction and Seven Sisters parks, and Catherine Creek Ecological Reserve.
- non-productive areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies).
- non-commercial (NC) cover areas — areas occupied by non-commercial tree or brush species.
- environmentally sensitive areas (ESAs) — areas with avalanche problems and areas with sensitive soils that may be damaged by harvesting activities, were completely or partially excluded.
- inoperable areas* — areas classified as unavailable for harvest for terrain-related or economic reasons.
- sites with low timber productivity — areas occupied by forest with low timber-growing potential.
- problem forest types (PFTs) — stands which are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability. In the Kispiox TSA, these types include deciduous stands (except cottonwood) and stands with low stocking.
- cultural heritage features — areas adjacent to the Telegraph Trail were removed from the timber harvesting land base.

Woodlot licence
An agreement entered into under the Forest Act. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.

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.

- riparian areas* — areas unavailable for timber harvesting to protect riparian habitat* and stream ecosystems.
- specific geographic areas — riparian ecosystems, forest ecosystem networks (FENs)* and high value grizzly bear habitat identified by the Babine Local Resource Use Plan; and the cedar stand and reserve zone within the Mill Creek Sensitive Area.
- existing roads, trails and landings (RTLs) — areas occupied by permanent roads and landings.
- Other unforested areas — includes wildlife tree patches (WTPs) and portions of stands that remain unharvested for a variety of operational reasons.

A more detailed description of these categories, including specific criteria for identification is located in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Table 2 summarizes the areas in each category and shows the total area of the timber harvesting land base. Figure 2 displays the same information graphically. In Table 2, the column "Productive forest area by classification" provides the total productive forest area managed by the B.C. Forest Service within each category.

Because there is a high degree of overlap among land classification categories, the order in which the reductions are made influence the amount of area attributed to each reduction category. For example, while there is a total of 63 470 hectares of land classified as having low productivity, only 9487 hectares were excluded specifically due to low productivity. The difference arises because one area can be in more than one classification (e.g., inoperable and low productivity), and the actual area deducted depends on the point at which the reduction occurs in the sequence. Further, partial reductions are sometimes employed to represent situations where parts of areas are excluded from timber harvesting to protect a particular value.

The current timber harvesting land base in the Kispiox TSA represents about 22% of the total TSA area and about 38% of the Crown productive forest. The inoperable category reduces the availability of the productive forest for timber supply by 43.8%. The next three major categories are: non-merchantable deciduous stands (4.9%), WTPs and other reserves (4.6%), and ESAs (4.1%). The remaining reduction categories represent 4.9% of the productive forest. The percentages provided depend on the order in which each category is considered.

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.

Forest Ecosystem Network (FEN)
An area that serves to maintain or restore the natural connectivity within an area.

Table 2. Determination of the timber harvesting land base for the Kispiox TSA, 2002

Classification	Productive forest area by classification	Area (hectares)	Per cent (%) of total TSA area	Per cent (%) of Crown forest land
Total TSA area		1 224 075	100.0	
Not managed by the B.C. Forest Service		149 352	12.2	
Non-forest		377 666	30.8	
Total productive forest managed by the Forest Service[a] (Crown forest)		697 057	56.9	100.0
Reductions to Crown forest:				
Non-commercial cover (brush)	897	897	0.1	0.1
Environmentally sensitive areas (ESAs)	30 058	28 916	2.4	4.1
Inoperable areas	306 345	305 231	24.9	43.8
Sites with low productivity	63 470	9 487	0.8	1.3
Low stocking	8 498	831	0.1	0.1
Deciduous	44 307	34 368	2.8	4.9
Telegraph Trail	1 168	973	0.1	0.1
Riparian areas	88 474	11 304	0.9	1.6
Babine Treatment Unit (TU) 1 — riparian	4 404	1 683	0.1	0.2
Babine TU 2 — forest ecosystem network	2 967	904	0.1	0.1
Babine TU 4 — grizzly buffer	3 348	2 248	0.2	0.3
Mill Creek Sensitive Area	70	63	0	0
Existing roads, trails and landings		4 925	0.4	0.7
Wildlife tree patches and other reserves		32 180	2.6	4.6
Total current reductions		434 011	35.5	62.3
Current timber harvesting land base (includes 6594 hectares not satisfactorily restocked (NSR)* land)		263 046	21.5	37.7
Future reductions				
Future roads		9 412	0.7	1.3
Long-term timber harvesting land base		253 634	20.7	36.4

(a) The total productive forest area that contributes to landscape-level biodiversity, which includes parks and protected areas, is 746 408 hectares.

Note: Numbers may not sum exactly due to rounding.

Not satisfactorily restocked (NSR) areas
An area not covered by a sufficient number of well-spaced trees of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.

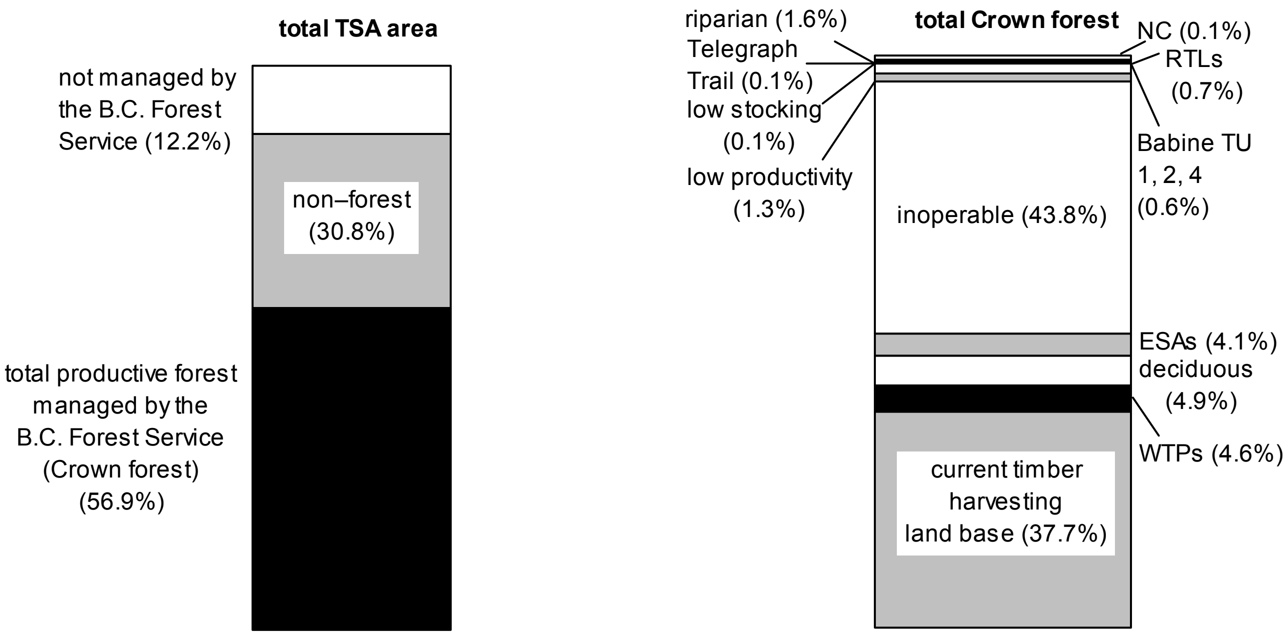

Figure 2. Composition of the total and Crown forested land bases — Kispiox TSA, 2002.

Figure 3 shows the current composition of the timber harvesting land base by tree species group (see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis," for a description of these groups). The timber harvesting land base is dominated by hemlock-leading stands (44%) and balsam-leading stands (33%). Spruce-leading and pine-leading stands account for most of the rest of the timber harvesting land base (13% and 9% respectively). Cottonwood-leading stands with a coniferous* component account for 1% of the timber harvesting land base. A small area of cedar-leading stands was combined with the hemlock-leading stands to facilitate the analysis. Cedar also occurs as a component of other stands. After harvest, most stands will be planted with spruce and pine, plus some natural infill of hemlock or balsam is assumed to occur.

Figure 3 also shows the proportion of area of each species group that is either younger or older than the minimum harvestable age (MHA) (see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" for details on the minimum harvestable age for each species). In total, about 66% of the area in the timber harvesting land base is at or above the MHA. There is considerable variation around this proportion for each of the species groupings: 74% of balsam stands, 39% of cottonwood stands with a coniferous component, 78% of hemlock stands, 24% of pine stands, and 37% of spruce stands are currently older than the MHA. The pine and spruce stands have a relatively low component above MHA because they have largely been recently established.

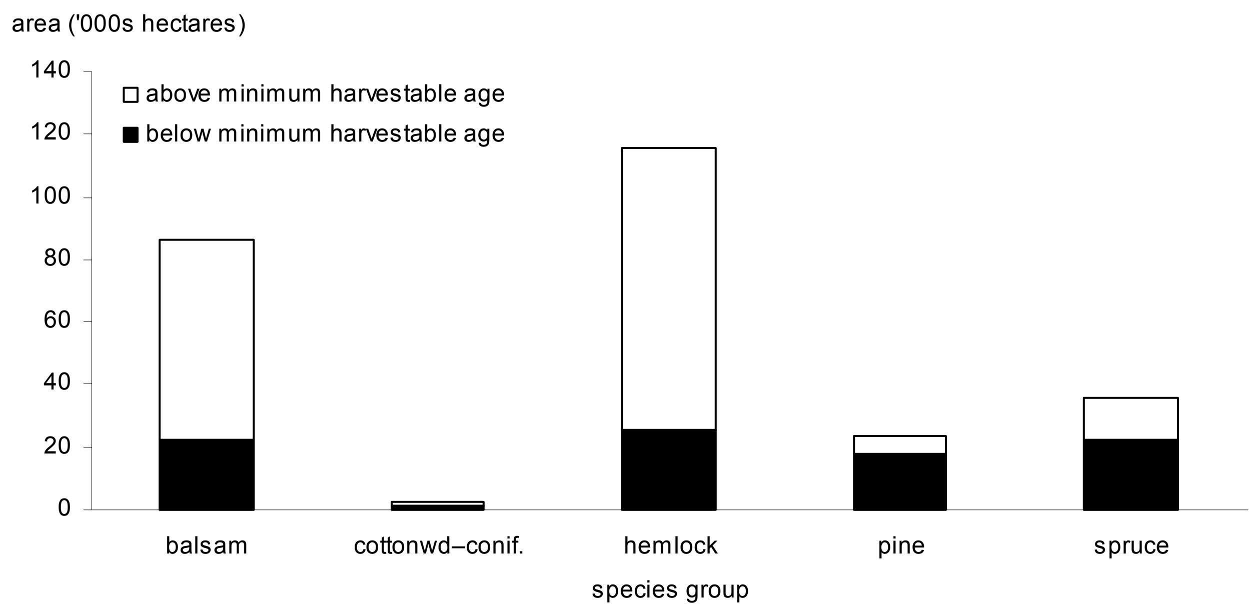

Figure 3. Area by tree species group relative to minimum harvestable age — Kispiox TSA timber harvesting land base, 2002.

Coniferous
Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.

Figure 4 shows the distribution of stands by productivity class and species group within the timber harvesting land base. Stands were classified into good, medium or poor productivity classes based on site index (SI)* (see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" for details on the site index groupings for each species). Only 2% of the timber harvesting land base is in the good productivity class. Most of the forested area is in the poor productivity class: 86% of balsam stands, 81% of cottonwood-coniferous, 69% of hemlock, and 60% of spruce. The exception is the pine species group which has 70% of its area in the medium productivity class. Sites of low productivity are excluded from the timber harvesting land base.

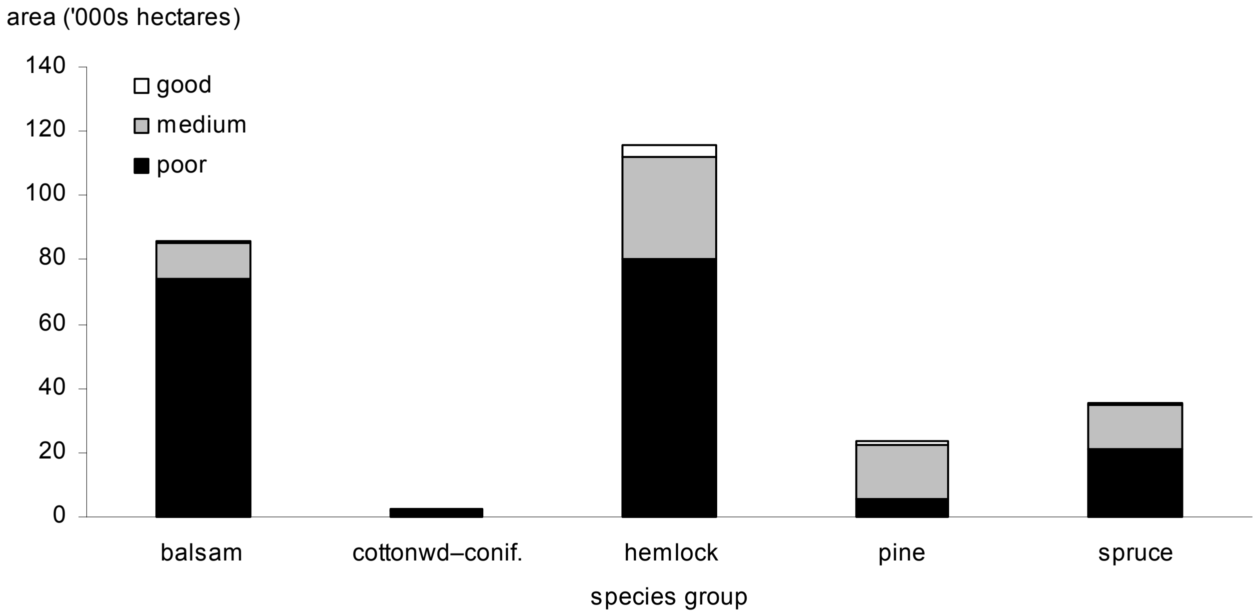

Figure 4. Area by tree species group and timber productivity — Kispiox TSA timber harvesting land base, 2002.

> ***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.*

Figure 5 shows the area of the timber harvesting land base by species group and the age groups relevant for defining timber yield projections. Stands that are less than 21 years old are considered managed and their yields are projected on managed stand yield curves. Recent research indicates that site index estimates for old coniferous stands (> 140 years old) are underestimated. In a sensitivity analysis* discussed in Section 5, site index estimates for this group of old stands are adjusted after they are harvested. Figure 5 shows that 47% of balsam stands, 46% of hemlock stands, and 5% of spruce stands are older than 140 years of age and will be affected by a site index adjustment. Very few pine stands are older than 140 years of age. Altogether these old stands account for approximately 37% of the timber harvesting land base.

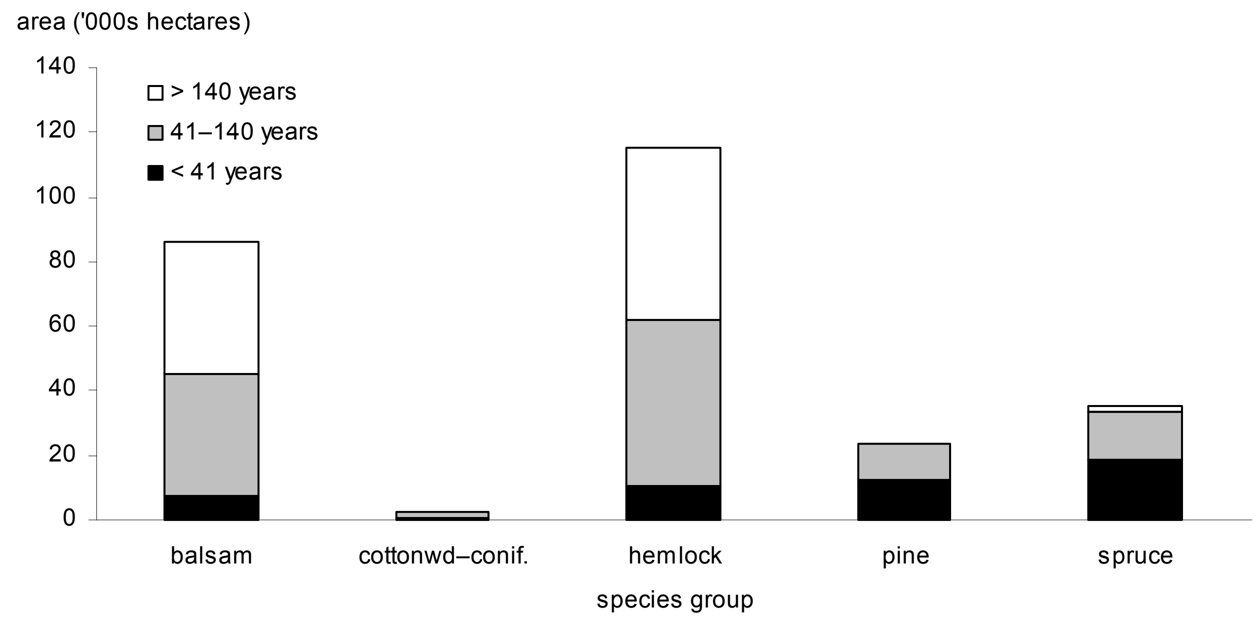

Figure 5. Area by tree species group and age group — Kispiox TSA timber harvesting land base, 2002.

> ***Sensitivity analysis***
> *A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.*

Figure 6 shows the current age class distribution of forested stands in the Kispiox TSA. The timber harvesting land base accounts for 35% of the total forested land base of 746 408 hectares (which includes some land not managed by the B.C. Forest Service). Within the timber harvesting land base, 37% of the stands are older than 250 years and 66% are older than 140 years. About 15% of stands are 20 years or younger, 11% are between 21 and 100 years old, and 8% are between 101 and 120 years old.

The age class distribution of forested stands excluded from the timber harvesting land base also affects timber supply. In the Kispiox TSA, 65% of the total forested land base is covered by excluded stands. Although they do not contribute directly to the timber supply, they can affect how much harvesting can be conducted and the pattern of the harvesting within the TSA by providing old forest and biodiversity attributes. Approximately 43% of the stands outside the timber harvesting land base are older than 250 years of age and 76% are older than 140 years of age. About 3% of stands are 20 years old or younger, 13% are between 21 and 100 years old, and 8% are between 101 and 120 years old. The forested area outside the timber harvesting land base has a higher proportion in old stands than the area within the timber harvesting land base.

The current age class distribution shows a significant gap in stands between ages 31 and 70 years of age. This gap was also identified in the 1996 analysis. To maintain a steady flow of timber, the existing natural stands must be allocated for harvest over time until younger stands become old enough to be harvested.

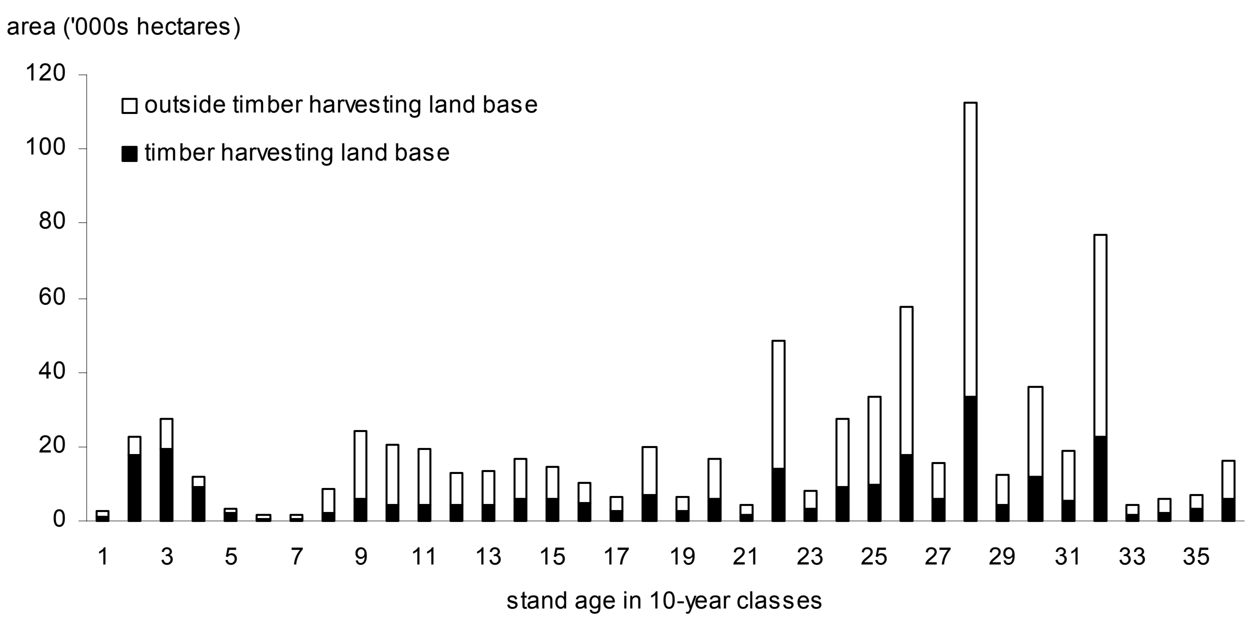

Figure 6. Current age class distribution — Kispiox TSA productive forest land base, 2002.

2.2 Timber growth and yield

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

Two growth and yield models were used to estimate timber volumes for the Kispiox TSA analysis. The variable density yield prediction (VDYP) model* supported by the Ministry of Sustainable Resource Management, Terrestrial Information Branch, was used for estimating timber volumes for all existing natural stands and all coniferous stands that will be harvested in the future by partial harvesting. The table interpolation program for stand yields (TIPSY)*, developed by the B.C. Forest Service, Research Branch was used to estimate timber volumes for both existing and future managed stands. All existing coniferous stands less than 21 years old and coniferous stands that will be harvested in the future by clearcutting or patch cutting were assumed to grow according to managed stand volume estimates* from TIPSY.

Uncertainty in volume estimation and prediction may result from uncertainty in the inventories that form the inputs for growth and yield models, from variability around the average estimates provided by growth and yield models, from limited experience with second-growth in British Columbia, and from the long-time frame over which trees grow. Sensitivity analyses described in Section 5, "Timber Supply Sensitivity Analyses," address the possibility that actual timber volumes may be different from estimates used in this analysis.

Based on timber volume estimates, the current timber inventory or growing stock* on the timber harvesting land base is approximately 75 million cubic metres. Most of this growing stock (about 65 million cubic metres, or 87% of the total) is currently merchantable; that is, in stands older than minimum harvestable age.

Variable Density Yield Prediction model
An empirical yield prediction system supported by the B.C. Forest Service, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed composition.
Table Interpolation Program for Stand Yields
A B.C. Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.

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

2.3 Management practices

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

- Silviculture practices — reforestation activities required to establish free-growing* stands of acceptable tree species. Approximately 22% of coniferous areas in the Kispiox TSA are harvested using a partial harvesting system. Other areas are harvested using a clearcut system. All areas are restocked by planting.
- Forest health and unsalvaged losses* — timber losses to fire, windthrow, insects and diseases are expected to be 203 365 cubic metres per year for the first decade. This is expected to fall to 78 690 cubic metres per year in the long term as the harvesting of mature balsam stands reduces the amount of balsam and hence the losses to balsam bark beetle.
- Utilization levels — minimum sizes of trees, and logs to be removed during harvesting.
- Minimum harvestable ages — the time it takes for stands to grow to a merchantable condition. In most cases, minimum harvestable ages were defined as the age at which a stand reaches a minimum volume of 200 cubic metres per hectare. Exceptions for partially cut stands and cottonwood-coniferous stands are described in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Actual harvest ages may be greater but not less than the minimum, and will depend on ages of other available stands, forest cover objectives* and overall timber harvest targets.
- Cutblock adjacency* and green-up* — in the Kispiox TSA, approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up (three metres in height) before adjacent stands may be harvested. The purpose of the cutblock adjacency guidelines is to prevent timber harvesting from becoming overly concentrated in an area at any time. To approximate the effect of cutblock adjacency, a maximum of 33% of the integrated resource management (IRM)* portion of the timber harvesting land base was allowed to be below green-up condition at any time within each landscape unit.

Free-growing
An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.
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*** *and* ***Green–up****).*

Cutblock adjacency
The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.
Green-up
The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Integrated resource management (IRM)
The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

- Maintenance of scenic values — maintaining important scenic values requires that visible evidence of harvesting must be kept within limits in some areas of the Kispiox TSA. The maximum proportion of each scenic area* that may be less than the visually effective green-up (VEG) height varies depending on the forest characteristics and the visual quality class (VQC) for each area, but generally ranges between 1% and 25%. The VEG height was 6 metres for all visual quality classes.
- Community watersheds — to protect water quality, each of eight community watersheds is required to have no more than 21% of the total forested area below a height of six metres. One additional community watershed has no area in the timber harvesting land base.
- Water quality — the Kispiox land and resource management plan (LRMP) requires that no more than 15% of the stands in the total forested area of each landscape unit be below a height of six metres.
- Landscape-level biodiversity* — to maintain biological diversity, each draft landscape unit and biogeoclimatic ecosystem classification (BEC) variant is required to have at all times a minimum amount of forested area as stands with old forest characteristics. The amount of old forest required depends on the natural disturbance type (NDT)* associated with each BEC variant.
- Seral stage* targets — in addition to the *Landscape Unit Planning Guide (LUPG)*, the Babine River Local Resource Use Plan (LRUP) specifies additional seral stage targets by biogeoclimatic ecosystem classification (BEC) zone for sub-drainages in the plan area. The Kispiox LRMP specifies that a minimum of 12% of the stands on the Crown forested land in each landscape unit be older than 200 years.
- Deer habitat — the Kispiox LRMP specifies old-seral* retention targets for deer wintering habitat.

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

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.
Landscape-level biodiversity
The Landscape Unit Planning Guide 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.

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 subject to less frequent stand-initiating disturbances usually have more older forests.
Seral stages
Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.
Old seral
Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.

Figure 7 shows the distribution of the timber harvesting land base by management emphasis. The integrated resource management (IRM) zone accounts for 64% of the timber harvesting land base and the Babine Local Resource Use Plan area accounts for 16%. Areas with visual quality objectives (VQOs)* account for 19% of the timber harvesting land base. Deer winter range and community watersheds together account for less than 1% of the timber harvesting land base.

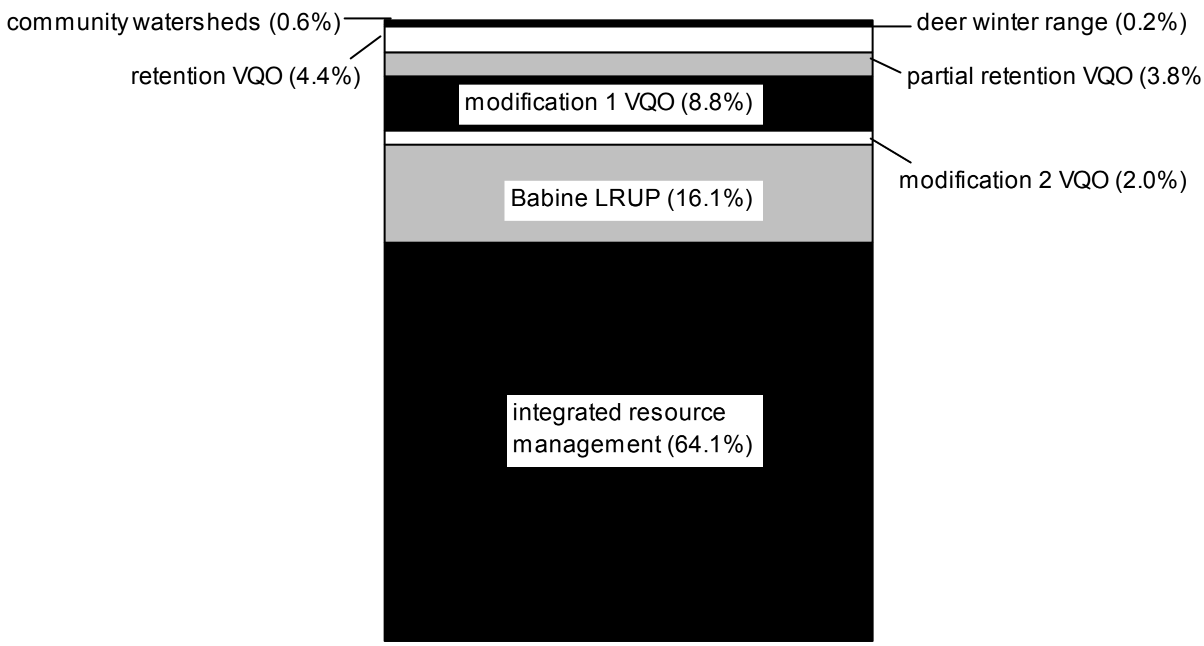

Figure 7. Area by management emphasis — Kispiox TSA timber harvesting land base, 2002.

> ***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.*

Table 3 shows the distribution (area and proportion) of the Crown productive forest and timber harvesting land base by biogeoclimatic ecosystem classification (BEC) variant. The ICH variants account for 68% of the timber harvesting land base. The ESSF variants, which represent high elevation sites, account for 18% of the timber harvesting land base. Small portions of the timber harvesting land base occur in the CWHws2 (6%) and SBSmc2 (8%) variants.

The last column in Table 3 shows what proportion of each BEC variant is in the timber harvesting land base. Several variants have approximately one-half of their area in the timber harvesting land base — ESSFmc, ICHmc1, ICHmc2 and SBSmc2. Other variants have less than one-third of their area in the timber harvesting land base. This indicates that it may not be necessary to reserve portions of the timber harvesting land base to meet landscape-level biodiversity requirements, such as old forest retention, because such requirements may largely be met outside of the timber harvesting land base.

Table 3. Area of productive forest by biogeoclimatic ecosystem variant and timber harvesting land base — Kispiox TSA, 2002

BEC variant	Productive forest (hectares)	Per cent (%) of productive forest	Timber harvesting land base (hectares)	Per cent (%) of timber harvesting land base	Per cent (%) of BEC variant in timber harvesting land base
ATp	9 632	1.3	0	0	0
CWHws2	57 221	7.7	15 308	5.8	26.8
ESSFmc	30 511	4.1	15 560	5.9	51.0
ESSFwv	221 606	29.7	32 343	12.3	14.6
ICHmc1	183 231	24.5	86 054	32.7	47.0
ICHmc2	178 877	24.0	93 653	35.6	52.4
MHmm2	22 381	3.0	38	0	0.2
SBSmc2	42 948	5.8	20 091	7.6	46.8
Total	746 408	100	263 046	100	

2.4 Changes since the 1996 Kispiox TSA timber supply analysis

A number of changes have occurred to the land base, timber growth and yield, and forest management assumptions since the last timber supply analysis in 1996.

2.4.1 Land base changes

Changes to the land base assumptions were:

- Protected areas — six new protected areas were established as a result of the Kispiox LRMP and excluded from the timber harvesting land base: Babine River Park, Bulkley Junction Park, Kitwanga Mountain Park, Seven Sisters Park, Swan Lake/Kispiox River Park, and Catherine Creek ecological reserve. These new protected areas cover 106 744 hectares, of which 14 287 hectares would have been within the timber harvesting land base.
- Woodlot licences — woodlot licences do not form part of the timber harvesting land base and have their AACs determined independently of the timber supply review process. A number of woodlot licences have been created or expanded since the 1996 analysis, so they have been excluded from the timber harvesting land base.
- Environmentally sensitive areas (ESA) — removals for sensitive soils in the current analysis were done using terrain stability mapping instead of ESA mapping for soils. ESA mapping for regeneration problems was used in the 1996 analysis but was not used in the current analysis. This mapping was found to be inaccurate because many of these areas had been logged and successfully regenerated or overlapped with riparian areas.
- Sites with low timber growing potential — the current analysis uses minimum site index for each leading species based on achieving a minimum coniferous volume of 200 cubic metres per hectare by age 200 years. These minimum site index values are slightly higher than those used in the 1996 analysis.
- Problem forest types (PFT) — the exclusions used in the current analysis are identical to those used in the 1996 analysis, except that there was no exclusion of cottonwood stands greater than 40 years old and exclusion of mature stands below height class 3.
- Roads, trails and landings (RTL) — the reductions for existing as well as future roads, trails and landings were each 9.2% in the 1996 analysis. In the current analysis, this was changed to approximately 7.2% for existing and 4.4% for future roads, trails and landings based on buffering roads in a geographic information system (GIS) and the results of soil conservation surveys.
- Riparian areas — the current analysis identified area to be excluded based on buffering streams in a GIS. This resulted in a larger reduction than in the 1996 analysis.
- Unharvested retention in stands — the current analysis accounted for WTPs (stand-level biodiversity*) and portions of stands that are retained due to unmapped riparian, inoperable, unproductive and unmerchantable areas within stands. The 1996 analysis did not account for these reductions.

The changes that primarily acted to reduce the relative size of the timber harvesting land base are those for protected areas, woodlot licences, sites with low timber growing potential, riparian areas, and unharvested retention within stands for stand-level biodiversity and other reasons. The change for environmentally sensitive areas, problem forest types, and roads, trails and landings acted to increase the relative size of the timber harvesting land base.

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.

Table 4 compares the timber harvesting land bases for the 1996 and current analyses. The net impact was a reduction in the size of the current timber harvesting land base of about 17%. The smaller reduction for ESAs in the current analysis is almost entirely offset by the increased exclusions for operability. New protected areas account for 14 287 hectares of the timber harvesting land base and exclusions from the productive forest for unharvested retention within stands account for 32 180 hectares. The long-term timber harvesting land base is 14% smaller than in the 1996 analysis.

Table 4. Comparison of the size of the timber harvesting land base for the Kispiox TSA

Timber harvesting land base	1996 analysis	2002 analysis	Change 1996 to 2001	
			hectares	per cent (%)
Current	317 939	263 046	– 54 893	– 17.3
Long term	294 113	253 634	– 40 479	– 13.8

2.4.2 Timber growth and yield changes

Changes to timber growth and yield assumptions were:

- Regeneration assumptions — the 1996 analysis assumed a 2-year regeneration delay*, except for good site hemlock stands, for which the analysis assumed a 5-year regeneration delay. The current analysis assumes no regeneration delay for most species to recognize that most sites are promptly reforested. A 5-year regeneration delay is assumed for hemlock stands and medium- and poor-site balsam stands.

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

2.4.3 Forest management changes

Changes to the forest management assumptions were:

- Green-up ages — new information on green-up ages has reduced the green-up period used in forest cover constraints for adjacency, visual quality, community watersheds and landscape level water quality.
- Minimum harvestable ages — in the 1996 analysis, minimum harvestable ages were set at the age at which a stand reaches 95% of the maximum average growth rate (culmination of mean annual increment (CMAI)*). In this analysis, most minimum harvestable ages were set at the age at which a stand reaches a minimum volume of 200 cubic metres per hectare. For stands harvested by clearcutting, this change reduced minimum harvestable ages by up to about 30 years.
- Partial harvesting — the current analysis contains new partial harvesting regimes that apply to 22% of the area covered with coniferous stands of the timber harvesting land base.
- Scenic areas — after the 1996 analysis, some scenic areas with a partial retention visual quality class (VQC) were assigned a higher maximum allowable disturbance as part of a visual impact mitigation strategy, and re-labelled as a modification VQC. Modification VQCs were not modelled in the 1996 analysis, but cover 11% of the timber harvesting land base in the current analysis. Areas with retention and partial retention VQCs covered 12% of the timber harvesting land base in the 1996 analysis, compared to 8% in this analysis.
- Community watersheds — the current analysis applied new forest cover requirements to protect water quality in community watersheds.
- Landscape level water quality — the current analysis applied new forest cover requirements to protect general water quality.
- Old forest — the current analysis applied forest cover requirements to meet the Kispiox LRMP objective of maintaining at least 12% of the stands on the Crown forested area at or above 200 years of age.
- Landscape-level biodiversity — the current analysis applied new requirements of the *Forest Practices Code* for landscape-level biodiversity that relate to retention of old forest.

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

Management requirements for scenic areas and cutblock adjacency were applied by landscape unit in this analysis to prevent localized concentration of harvesting, and to better approximate the intent of the management requirements. This is generally more restrictive than applying them over the entire TSA, as was done in the 1996 analysis.

Changes in forest management assumptions do not affect the size of the timber harvesting land base. Instead, they act by either relaxing or tightening management constraints in the timber supply model. The changes that acted to relax management constraints were those for green-up ages and minimum harvestable ages. The lower green-up ages reduced the impact of requirements for adjacency, VQOs and water quality. The significantly lower minimum harvestable ages produced greater flexibility to harvest some younger, but still merchantable, stands in periods when older, higher volume stands might be in short supply.

The addition of requirements for community watersheds, landscape unit water quality and landscape-level biodiversity acted to constrain timber supply by placing restrictions on the distribution of age classes, which decreases flexibility to harvest timber. However, there is considerable overlap with the old forest requirements that were applied in the 1996 analysis. Indeed, the integrated resource management zone has decreased in proportion only slightly from 66% to 64% of the timber harvesting land base. In the 1996 analysis, management requirements were prioritized so that there were no overlapping requirements; this timber supply analysis was able to model overlapping requirements because of advances in the modelling system.

2.4.4 Summary of changes

In summary, the current timber harvesting land base has decreased by 17%, there were minor changes in the timber growth and yield assumptions, and the definition of current practices have changed considerably since the 1996 analysis. Given the extent of these changes, direct comparisons between this and the previous analysis should not be made. Each analysis needs to be evaluated in the context of the management regime and related data inputs and assumptions that applied at the time (see Appendix A of the respective reports). As noted in the introductory section, there is uncertainty surrounding information used in analyses and forest management objectives change over time, which is why the *Forest Act* requires the chief forester to periodically review the timber supply and AAC for each TSA.

Any changes to the land base or management assumptions that may occur or become effective after the completion of this timber supply analysis will be presented to the chief forester for consideration during the AAC determination if possible.

3 Timber Supply Analysis Methods

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in the Kispiox TSA under current forest management practices. A timber supply computer simulation model developed by the B.C. Forest Service (FSSIM version 4.1) was used for the analysis. A timber supply model, as distinct from a growth and yield model, assists the timber supply analyst in determining how an entire 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 forests grow and are harvested over hundreds of years. Generally, only the results for the first 250 years are shown graphically in this report because the projected harvest remains constant after that time.

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

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

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

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.

4 Results

This section provides the results of timber supply analysis for the Kispiox TSA. The base case harvest forecast* uses the most recent assessments of current forest management, the land available for timber harvesting and timber yields as described in Section 2, "Information Preparation for the Timber Supply Analysis." The impacts of uncertainty in the inputs to the analysis will be discussed in Section 5, "Timber Supply Sensitivity Analyses." It is important to keep in mind that the base case provides only part of the timber supply picture for the Kispiox TSA, and should not be viewed in isolation of the sensitivity analyses.

4.1 Base case harvest forecast

The base case harvest forecast for the Kispiox TSA represents current management as described in various sections of Appendix A of this report. The base case harvest forecast was developed by first determining an initial estimate of the maximum sustainable long-term harvest level*. This harvest level should produce a growing stock that is stable in the long term, so that harvesting can continue at that level in perpetuity. Falling long-term growing stock indicates that timber is being harvested above the productive capability of the land. Once an initial long-term harvest level has been determined, the next step is to maintain the current harvest level as long as possible, with reductions of no more than 10% per decade to provide an orderly transition to the long-term harvest level. After this step, there may be an opportunity to raise the long-term harvest level because raising the initial harvest level above the long-term harvest level produces managed stands with high yields earlier than under an even-flow harvest.

Figure 8 shows the base case harvest forecast for the Kispiox TSA. The harvest level in the first decade is 903 000 cubic metres per year, which is 17% below the current AAC. It then falls 10% per decade until reaching the long-term harvest level of 430 000 cubic metres per year in decade 8.

Unsalvaged losses due to natural forces such as insects, fire and disease have been subtracted from all harvest forecasts shown in this report. Unsalvaged losses were estimated to be 203 365 cubic metres per year for the first decade. This included an estimated unsalvaged loss due to balsam bark beetle of 138 525 cubic metres per year. The losses due to balsam bark beetle were assumed to decline in equal steps of 10% per decade as harvesting reduced the area of old balsam stands. A total unsalvaged loss of 78 690 cubic metres per year was assumed by decade 10, of which 13 850 cubic metres per year was due to balsam bark beetle. This level of unsalvaged losses was assumed to remain constant for the remainder of the 250-year horizon.

Base case harvest 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.

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.

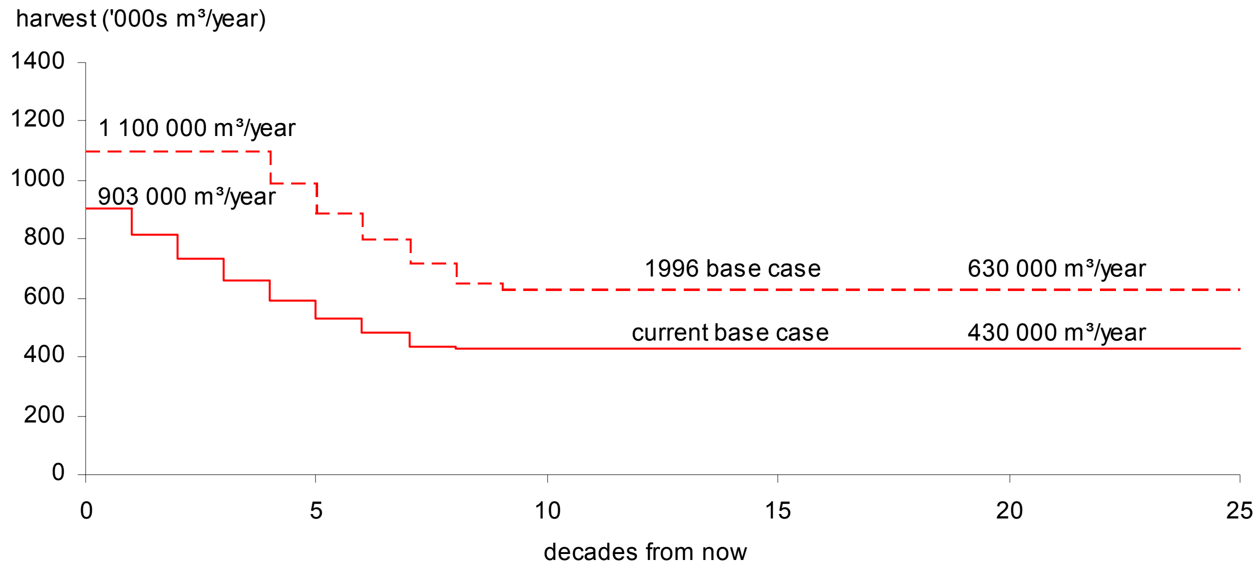

Figure 8. Current and 1996 base case harvest forecasts — Kispiox TSA, 2002.

Two main factors contributed to the differences between the initial harvest levels in this base case and the 1996 base case. First, the current timber harvesting land base is 17% smaller than in 1996. Second, the estimate of unsalvaged losses is higher than in 1996 because of the inclusion of loss estimates for balsam bark beetle and Tomentosus root disease in spruce. The losses from these agents are approximately 197 430 cubic metres per year in the first decade and 72 760 cubic metres per year in the long term. These additional losses amount to approximately 18% of the initial harvest level and 12% of the long-term harvest level of the 1996 base case. The effect of these two factors (reduced land base and higher unsalvaged losses) almost completely accounts for the difference between this analysis and the 1996 analysis.

4.2 Base case harvest characteristics

Figure 9 shows the volume contribution to the base case harvest forecast from managed stands. The transition to managed stands begins in decade 7 and is almost complete by decade 14. Natural stands continue to contribute small amounts after decade 17 because stands regenerated after partial harvesting are not considered "managed" in this context.

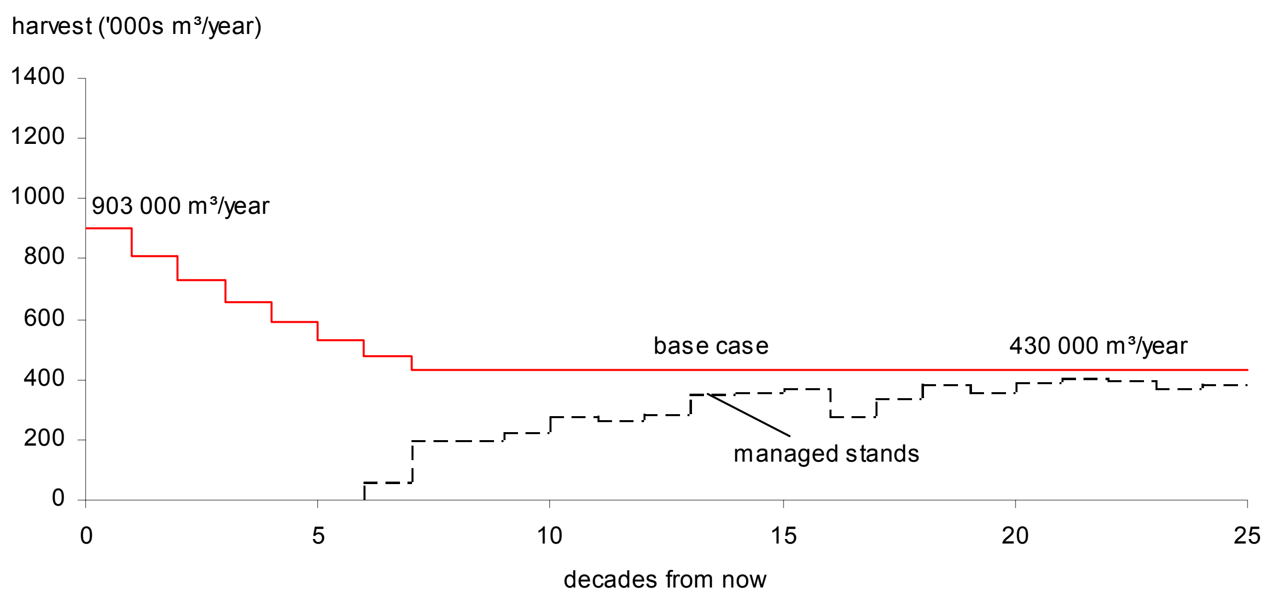

Figure 9. Harvest contribution from managed stands — Kispiox TSA, 2002.

Figure 10 shows the volume contribution to the base case harvest forecast from areas under different management emphasis. The contribution from the integrated resource management (IRM) zone (including the Babine LRUP area) follows the same pattern as the total harvest forecast. It contributes between 77 and 92% of the harvest volume. The contribution from VQO zones fluctuates from 6 to 22%. The contribution from community watersheds and deer habitat is less than 1% because of the small size of these zones.

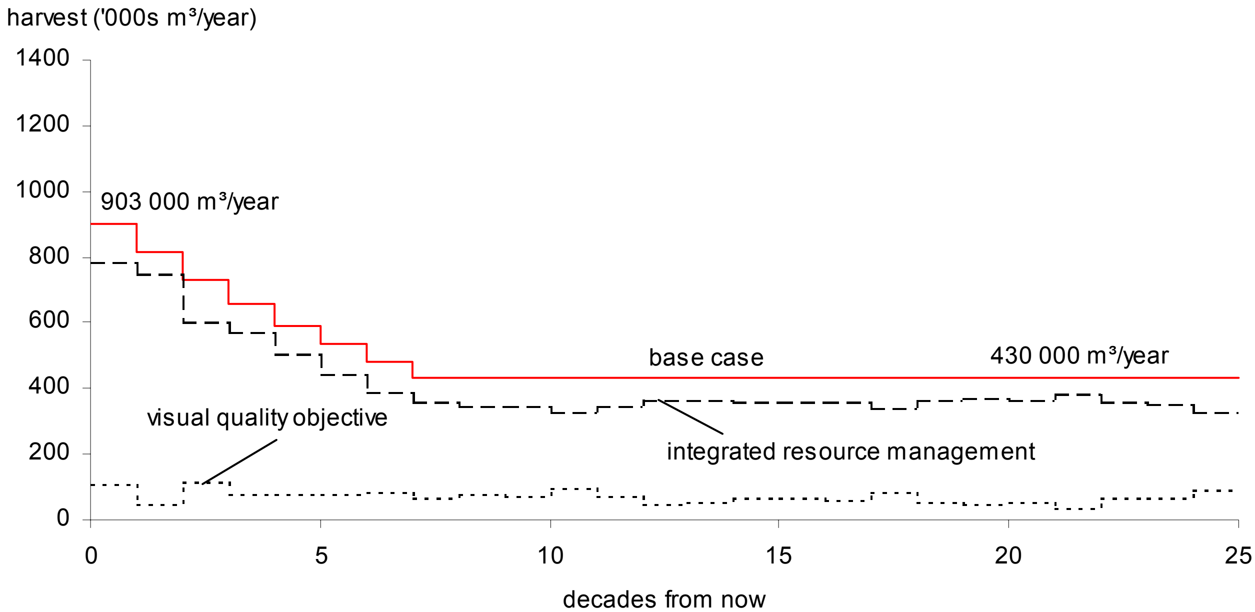

Figure 10. Harvest contribution by management emphasis — Kispiox TSA, 2002.

4 Results

Figure 11 shows the volume contribution to the base case harvest forecast from areas harvested under different silvicultural systems. Clearcut harvesting* contributed 78 to 100% of the total harvest. Partial cutting was expected to contribute 22% of the harvest, so the timber supply model was requested to carry out partial cutting on 22% of the coniferous timber harvesting land base. However, the higher minimum harvestable ages and lower harvest volume for each entry combined to reduce the volume contribution of partial cutting to an average of 9% (ranging from 0 to 20%) of the total harvest volume. Small patch cutting was expected to contribute 4% of the total harvest. However, the volume contribution from patch cutting averaged 2% (ranging from 0 to 10%) of the total harvest, likely as a result of the varying volume of timber harvested by partial cutting in combination with the many forest cover requirements.

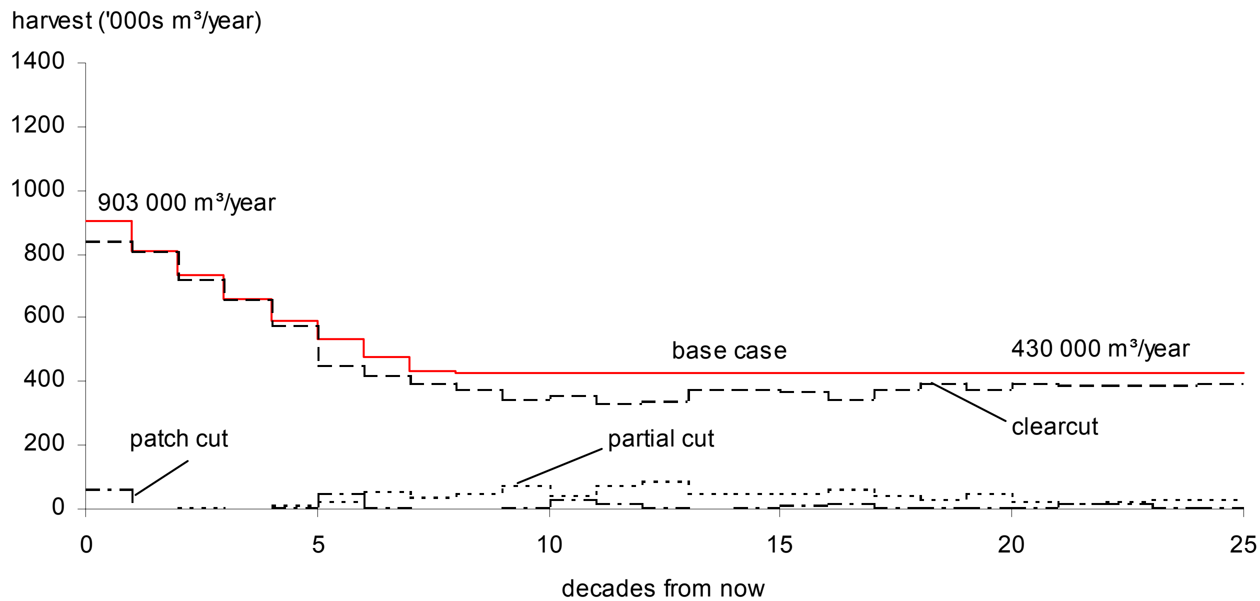

Figure 11. Harvest contribution by silvicultural system — Kispiox TSA, 2002.

Clearcut harvesting
A harvesting method in which all trees are removed from an area of land in a single harvest. The harvested site is then regenerated to acceptable standards by appropriate means including planting and natural seeding. Note that retention of some live trees and snags for purposes of biodiversity now occurs on most clearcuts.

4 Results

Figure 12 shows the average annual area harvested and the average volume per hectare harvested. The average annual yield in the first decade is approximately 470 cubic metres per hectare. It falls to a low of approximately 180 cubic metres per hectare in decade 16 before rising again to approximately 290 cubic metres per hectare in decade 24. This pattern is consistent with a transition from harvesting old existing stands to harvesting younger managed stands, followed by a period where managed stands have the opportunity to grow older before being harvested.

The initial annual area harvested is approximately 2660 hectares, but ranges from a high of 2810 hectares in decade 16 to a low of 1755 hectares in decade 24. The annual area harvested in the first eleven decades declines as the harvest level declines. The long-term harvest level is reached in decade 11, after which the annual area harvested also begins to rise. This is because the average annual yield is still falling while the annual harvest volume remains constant, so more area must be harvested to achieve the same harvest volume. In decade 17 the average annual area harvested begins to fall again because the managed stands are growing older before being harvested, thereby providing a higher yield.

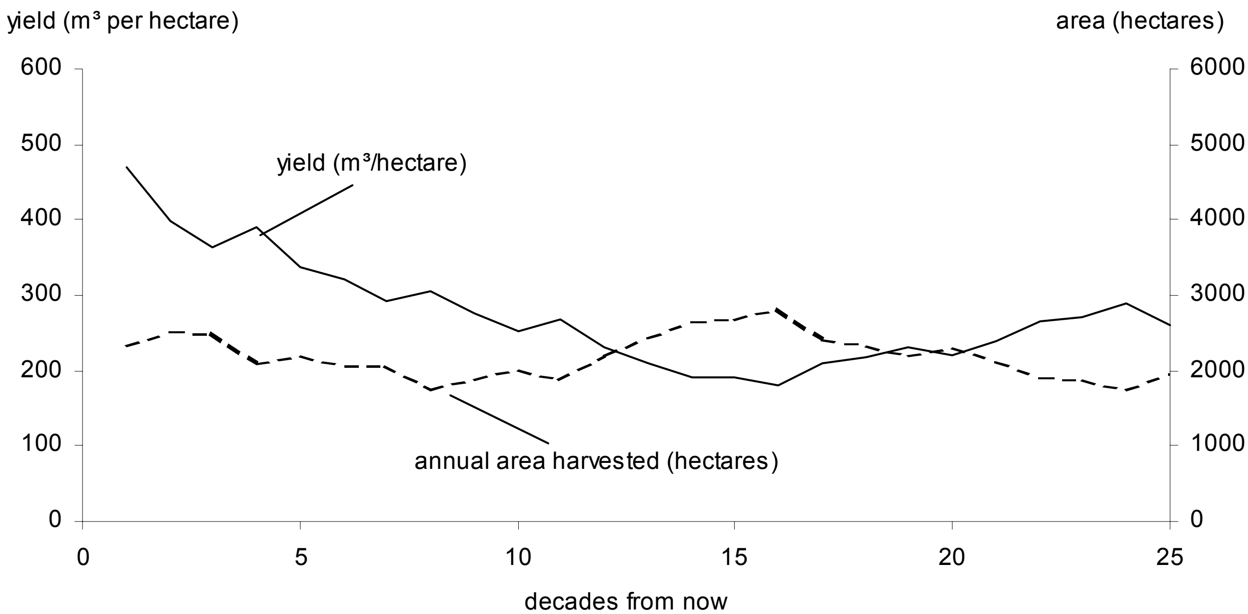

Figure 12. Average volume yield and average annual area harvested — Kispiox TSA, 2002.

4 Results

Figure 13 shows the average age (weighted by area) of the stands harvested over time. The average harvest age generally declines as a result of the transition from harvesting old existing stands to harvesting younger managed stands.

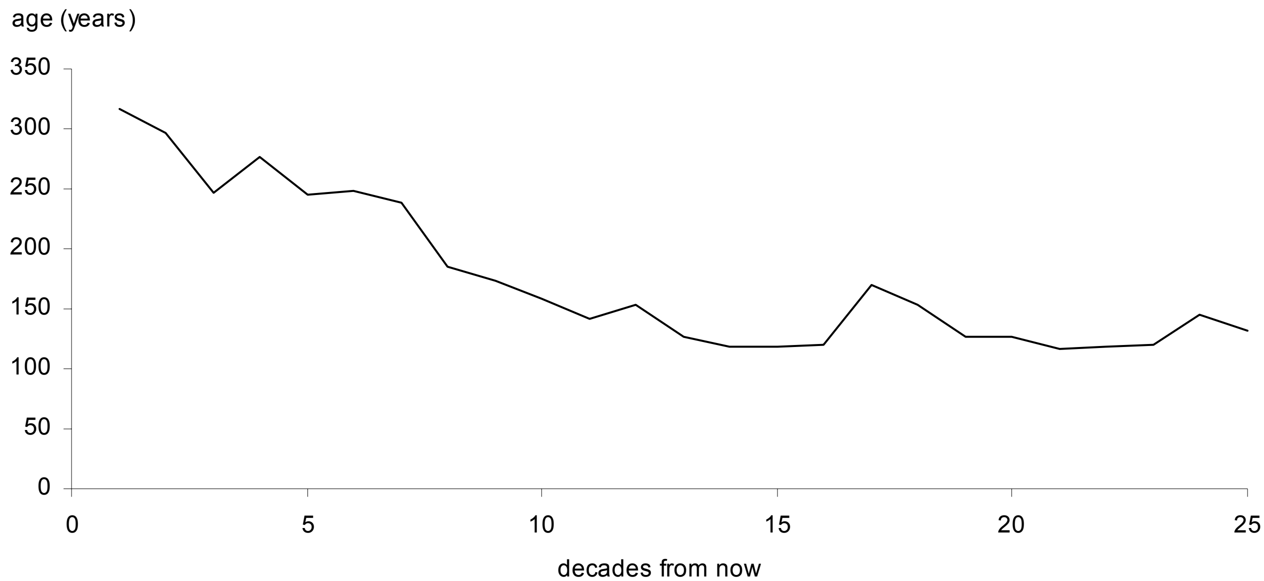

Figure 13. Average area-weighted harvest age — Kispiox TSA, 2002.

4.3 Base case forest characteristics

Figure 14 shows growing stock levels for the timber harvesting land base. The total growing stock declines during the transition from harvesting in old existing stands to harvesting in younger managed stands. The total growing stock for managed stands grows steadily from decades 2 to 20. The merchantable growing stock levels follow the same trends. Figure 14 appears to show growing stock declining at the end of the 250-year horizon, but 400-year forecasts indicate that growing stock is stable with minor cyclic fluctuations.

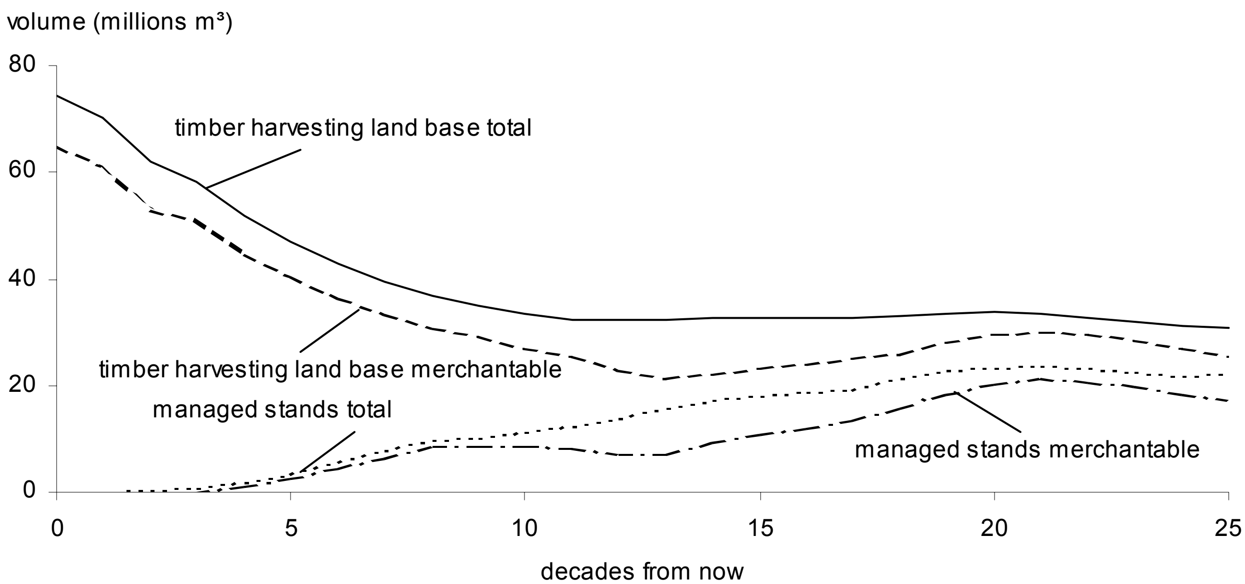

Figure 14. Timber growing stock forecasts — Kispiox TSA, 2002.

4 Results

The charts in Figure 15 show how the distribution of age classes of the productive forest is projected to change under the base case harvest forecast. The current age class distribution has a significant gap of stands in the 31 to 70 year old age classes. This gap was also identified in the 1996 analysis. It is a limiting factor in determining the initial harvest level. When the harvest level is declining to the long-term harvest level, the existing natural stands must be allocated for harvest over time until currently younger stands become old enough to be harvested, in order to avoid timber supply shortfalls in decades 12 to 15. This also explains why the average annual yield and average harvest age increase after decade 15; after this time there are sufficient harvestable managed stands to allow some of them to grow to older ages before being harvested.

By year 150, the age class distribution for the stands on the timber harvesting land base is forecast to be relatively even in stands under 100 years of age. By year 250, very little area in the timber harvesting land base remains above age 200. The area that remains in these old age classes is required to meet habitat and landscape-level biodiversity requirements.

The charts in Figure 15 also reflect the assumption in the timber supply model that natural disturbance occurs at an even rate in the forest outside of the timber harvesting land base. This produces an even distribution of age classes, although by year 250 there remains some area that is 400 years and older. This occurs because to reflect natural disturbance patterns some of the forest outside the timber harvesting land base was assumed to undergo disturbance on a 347 year rotation; as a result, some area remains undisturbed at the end of 250 years of the harvest forecast.

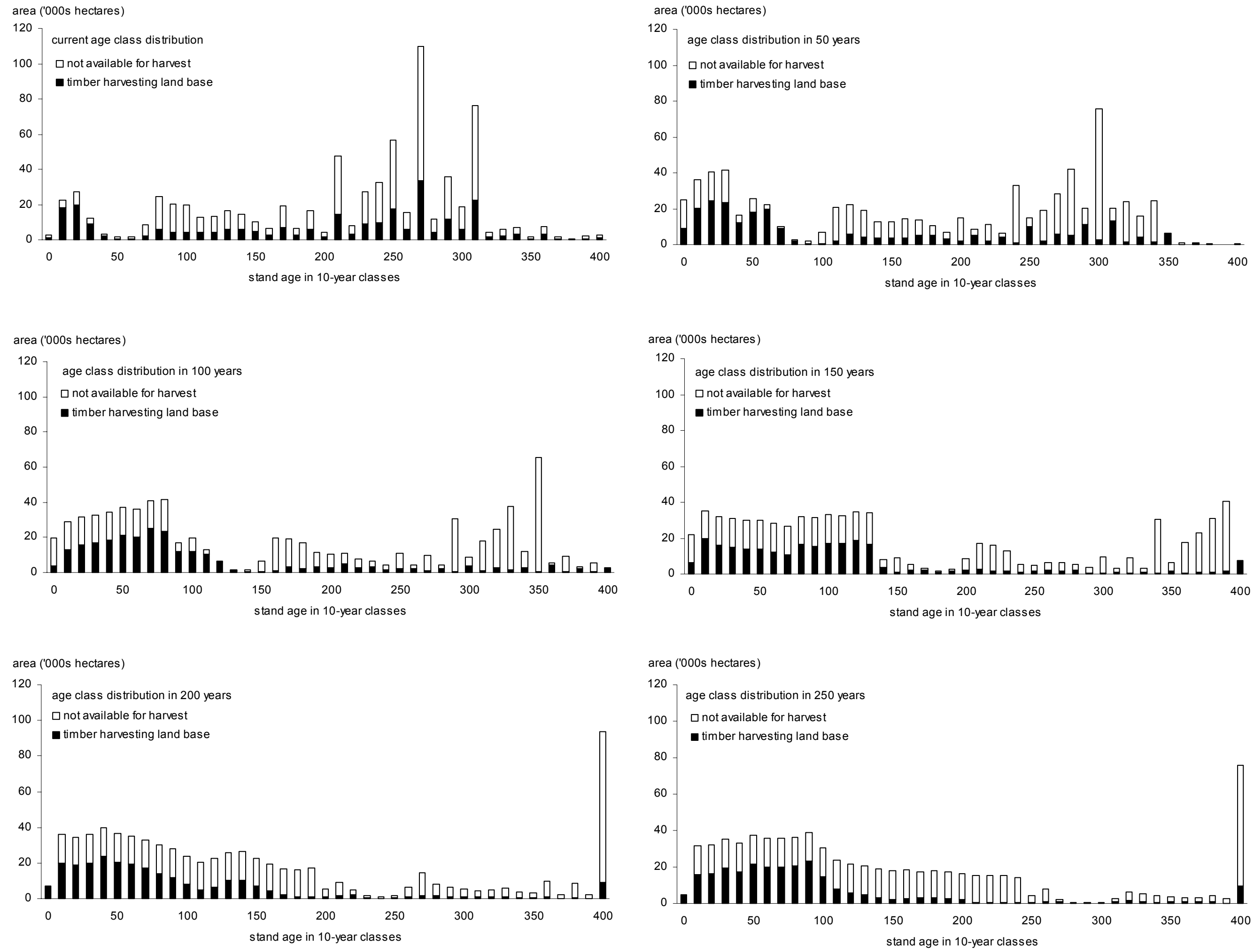

Figure 15. Age class distribution for the productive forest at 50 year intervals — Kispiox TSA, 2002.

5 Timber Supply Sensitivity Analyses

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

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

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

In this section, results of a number of sensitivity analyses are discussed. Sensitivity analyses are intended primarily to test the relative change (i.e., high *versus* low sensitivity) in the harvest forecast resulting from changes in forest management assumptions and data used in the base case. Short-term refers to the first 20 years of the harvest forecast, medium-term is 21 to 100 years from now, and long-term is after 100 years from now.

5 Timber Supply Sensitivity Analyses

5.1 Alternative harvest flows over time

The base case harvest forecast shown in Figure 8 was defined using criteria discussed in Section 4.1, "Base case harvest forecast," including managing the rate of decline in harvests from the current level, avoiding large and abrupt harvest shortfalls, and maintaining a fairly constant growing stock over the long term. The last of these criteria is linked to maintaining the productivity of forest land, and is therefore an indicator of sustainability. The other criteria are used to avoid both excessive changes from decade-to-decade, and significant timber shortages in the future, either of which might limit future options. However, there are many possible harvest flows, with different decline rates, starting harvest levels, and potential trade-offs between short-and long-term harvests.

Figure 16 shows three alternatives to the base case harvest forecast. The first alternative uses the same assumptions as the base case harvest forecast except that the harvest level declines from the initial harvest level to the long-term harvest level at a rate of 12% per decade instead of 10% per decade. This alternative shows that the initial harvest level of the base case can be increased by approximately 7% to 967 000 cubic metres per year while reaching the same long-term harvest level one decade earlier (decade 8).

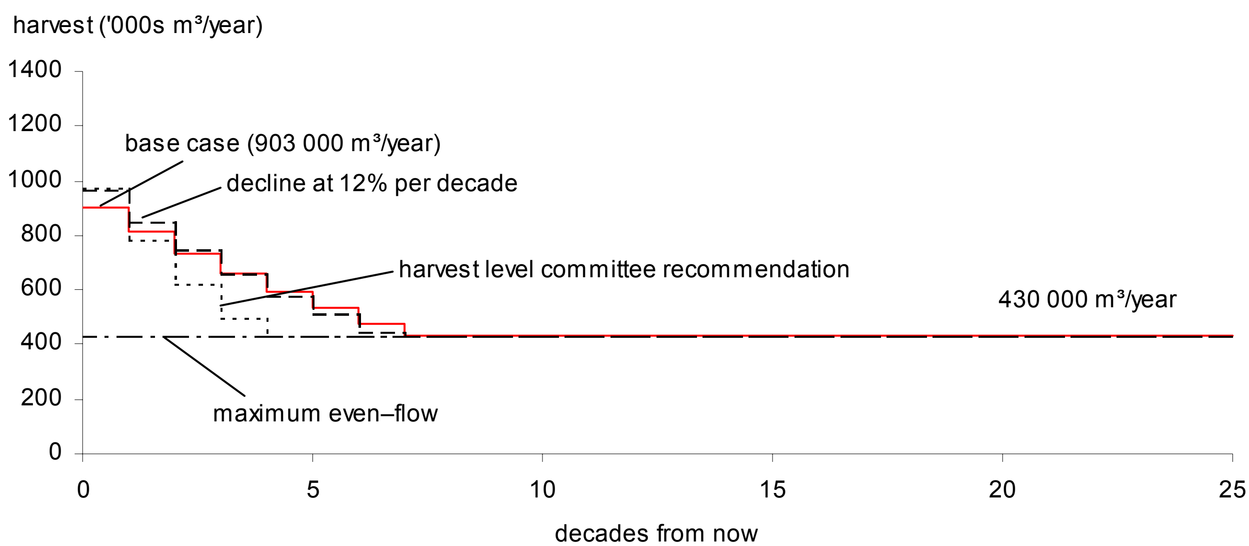

Figure 16. Alternative harvest flows — Kispiox TSA, 2002.

The second alternative implements the 1993 recommendation of the Kispiox TSA Harvest Level Committee, which was to immediately reduce the harvest level by 2% per year until the long-term harvest level is reached. The recommended rate of decline was modelled by decade instead of annually. A 2% decline per year is approximately equal to a 20% decline per decade. The result of this alternative harvest forecast shows that the desired flow can be attained but there is no benefit to the long-term harvest level. The initial harvest level is approximately 8% higher than that of the base case at 977 585 cubic metres per year. The long-term harvest level is the same as that of the base case, but is reached four decades earlier (in decade 5).

The third alternative shows the maximum even-flow attainable. The result of this alternative is a constant harvest level of 430 000 cubic metres per year, which is the same as the long-term harvest level of the base case.

5.2 Uncertainty in minimum harvestable ages

For most stands in the base case, minimum harvestable ages were set at the age at which stands reach minimum volumes of 200 cubic metres per hectare. Exceptions for partially cut stands and cottonwood-coniferous stands are described in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Some of the resulting minimum harvestable ages are up to approximately 30 years lower than the ages in the 1996 analysis for stands harvested by clearcutting, although many minimum harvestable ages were higher for managed stands on poor sites.

Figure 17 shows the sensitivity of the harvest forecast to changes in minimum harvestable ages. Increasing the minimum harvestable volume criterion from 200 to 250 cubic metres per hectare for stands harvested with the clearcut silvicultural system reduces the initial harvest level of the base case by approximately 7.5% to 835 000 cubic metres per year. Similarly increasing the minimum harvestable volume criterion from 200 to 300 cubic metres per hectare for clearcut stands, but only on good and medium sites, reduces the initial harvest level of the base case by approximately 5% to 860 000 cubic metres per year. The latter change has less impact than the first change because the first change applies to all stands whereas the latter change is applied only to stands on good and medium sites, which account for only 30% of the timber harvesting land base.

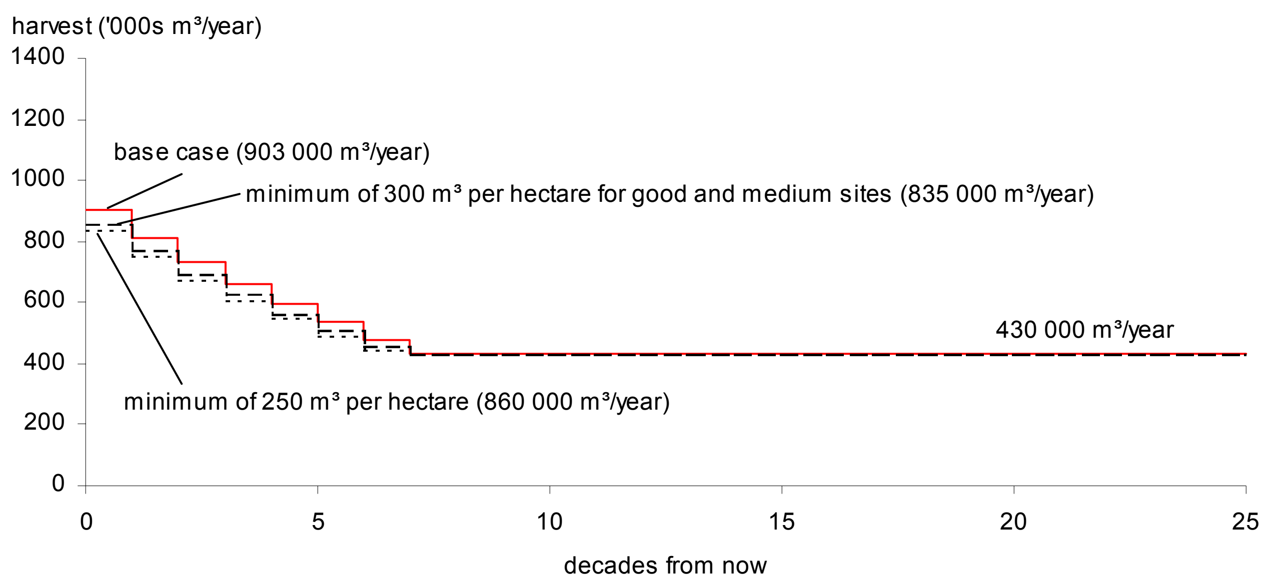

Figure 17. Harvest forecasts resulting from different criteria for minimum harvestable ages — Kispiox TSA, 2002.

Increasing minimum harvestable ages at these levels does not affect the long-term harvest level because they are generally not limiting in the long term. The main impact is on the short- and medium-term harvest levels which must be reduced to avoid shortfalls in decades 13 and 14. These shortfalls are caused by a lack of harvestable timber that is available to overcome the gap in the age class distribution.

5.3 Uncertainty in land base available for timber harvesting

Figure 18 shows the sensitivity of the harvest forecast to changes in the size of the timber harvesting land base. This sensitivity analysis adjusted the assumed unsalvaged losses in proportion to the change in size of the timber harvesting land base. If the timber harvesting land base increases by 10% then the initial harvest level of the base case increases by approximately 10% to 992 000 cubic metres per year and the long-term harvest level increases by approximately 9% to 470 000 cubic metres per year. If the timber harvesting land base decreases by 10% then the initial harvest level of the base case decreases by approximately 10% to 813 000 cubic metres per year and the long-term harvest level decreases by approximately 9% to 391 000 cubic metres per year. This indicates that changes in the timber harvesting land base produce a proportional change in the entire harvest forecast.

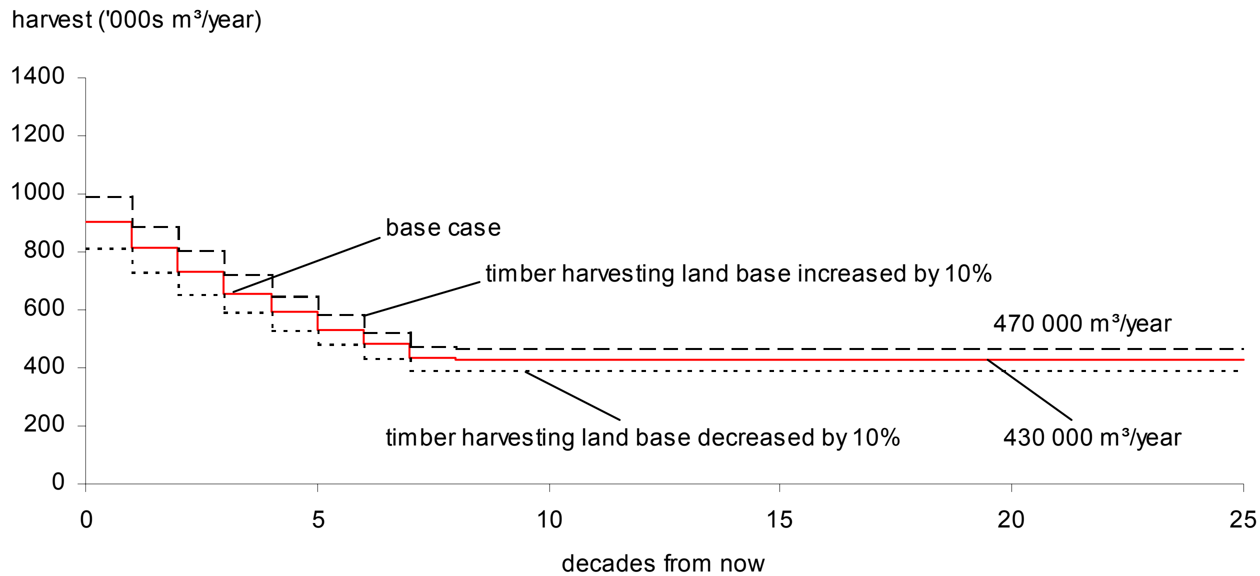

Figure 18. Timber harvesting land base sensitivity analysis — Kispiox TSA, 2002.

Two factors have been identified that might affect the size of the timber harvesting land base. The first factor is the accounting for the exclusion of areas with unharvested volume. See Section A.4.12, "Wildlife trees and other reserves" in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" for a complete description of this reduction. If this exclusion was reduced to account only for the small patches of wildlife trees* (< 2 hectares) then the exclusion would be only 3.8% and the timber harvesting land base would increase by 20 961 hectares or 8.0%. If the exclusion for wildlife tree patches was based strictly on the recommendations in the *Landscape Unit Planning Guide (LUPG)* for the Kispiox TSA (1.5%, assuming that one-half of the requirement is located in the timber harvesting land base), then the timber harvesting land base would increase by 27 751 hectares or 10.5%.

Wildlife tree
A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

The second factor that might affect the size of the timber harvesting land base is the amount of area excluded for riparian habitat. The uncertainty in this factor has two components. The first component is the assumptions for high-bench floodplains. In the base case, low- and mid-bench floodplains were excluded from the timber harvesting land base as riparian reserve zones (RRZ). High-bench floodplains were considered to be part of the riparian management zone (RMZ) and 25% of their area was excluded from the timber harvesting land base. If high-bench floodplains were also considered as riparian reserve zones, then the timber harvesting land base would decrease by 296 hectares or 0.1%.

The second component of uncertainty around the accounting for riparian areas is the amount of area excluded in the riparian management zones for stream classes S1 to S4. In the base case, it was assumed that 25% of these riparian management zones were not harvested as per current levels of retention. If only 15% of these riparian management zones were retained, then the timber harvesting land base would increase by 1877 hectares or 0.7%.

If the changes in the two riparian components are combined (high-bench floodplain as riparian reserve zone and 15% retention in riparian management zone for S1 to S4 streams), the net effect on the timber harvesting land base would be an increase of 1581 hectares or 0.6%.

The possible effect of uncertainty in two factors (areas with unharvested volumes, riparian areas) on the timber harvesting land base fall within the range of uncertainty tested. The impact for both of these factors should be proportional to the impacts for the range of uncertainty tested, as shown in Figure 18.

5.4 Uncertainty in timber volume estimates for existing unmanaged stands

Timber volume estimates for existing natural stands are subject to uncertainty due to factors such as inaccuracies in the forest inventory information used to estimate timber volumes (estimated tree heights and stand ages) and the statistical process used to develop equations for predicting forest growth and yield. Volume estimates are more accurate when averaged over large areas, but may not reflect actual volumes in specific stands. Uncertainty may also arise from estimates of the volume lost to decay in standing trees and to waste and breakage during timber harvesting, as well as from estimates of utilization practiced during harvesting.

5 Timber Supply Sensitivity Analyses

The preliminary results of an inventory audit conducted in 1996 for the Kispiox TSA concluded that volumes in operable stands were 13% lower than estimated by the inventory. Figure 19 shows two possible harvest forecasts evaluating the timber supply impact of this uncertainty in timber volume estimates for existing unmanaged stands. This sensitivity analysis only addresses the change in timber yield and does not address any change in minimum harvestable age that might accompany those yield changes.

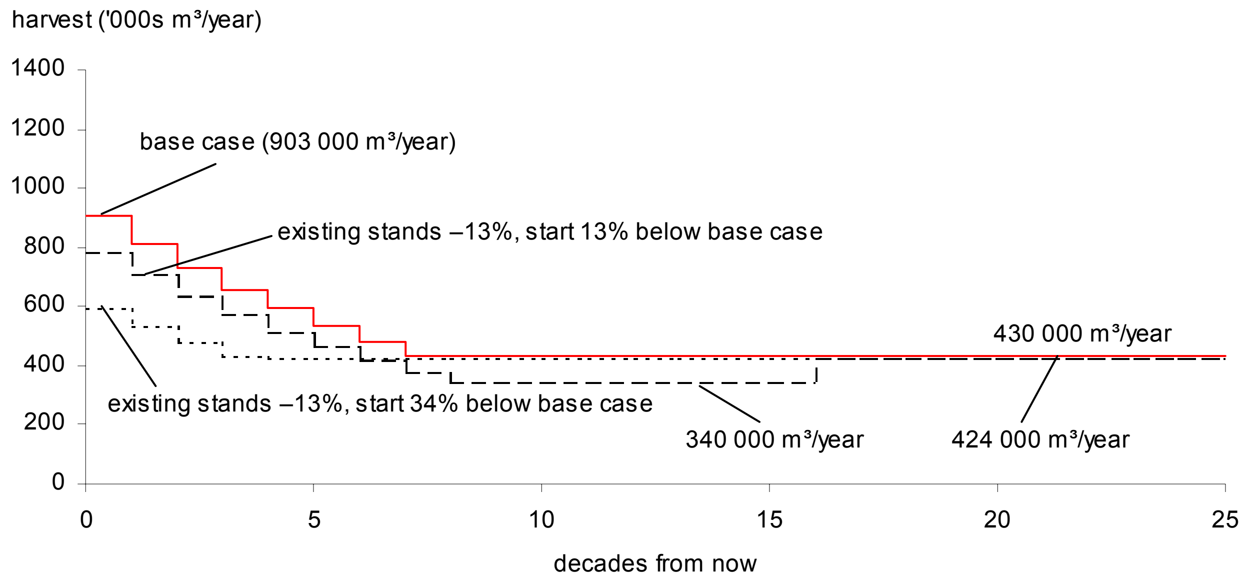

Figure 19. Sensitivity analysis of existing stand yields — Kispiox TSA, 2002.

One harvest forecast shows that if existing timber volumes are 13% lower than in the base case, the initial harvest level is reduced by approximately 34% to 592 000 cubic metres per year. This large reduction is required to avoid large shortfalls in decades 15 to 18. The long-term harvest level is also reduced by approximately 1.4% to 424 000 cubic metres per year because the stand yields of partially harvested stands is also reduced by 13%. An alternate harvest flow is possible where the initial harvest level is reduced by only 13% to 786 000 cubic metres per year. However, this requires the harvest level to fall to 340 000 cubic metres per year between decades 9 to 16, which is 20% below the level of the first alternative. The harvest level rises in decade 17 to the same long-term harvest level as the first alternative.

5.5 Uncertainty in timber volume estimates for managed stands

Uncertainty in volume estimates for managed stands exists for the same reasons listed for estimated existing stand yields (inaccuracies in the forest inventory and the growth and yield models), but also because of the limited experience and data that is available for regenerated managed stands in B.C. There is also uncertainty around the site productivity assigned to older unmanaged stands relative to the site productivity expressed by the stands after they regenerate. This issue is examined in Section 5.6, "Uncertainty in site productivity estimates for old stands."

Figure 20 shows the effect on the base case harvest forecast if managed stand yields have been over- or underestimated by 15%. It only addresses the change in timber yield and does not address any change in minimum harvestable age that might accompany those yield changes.

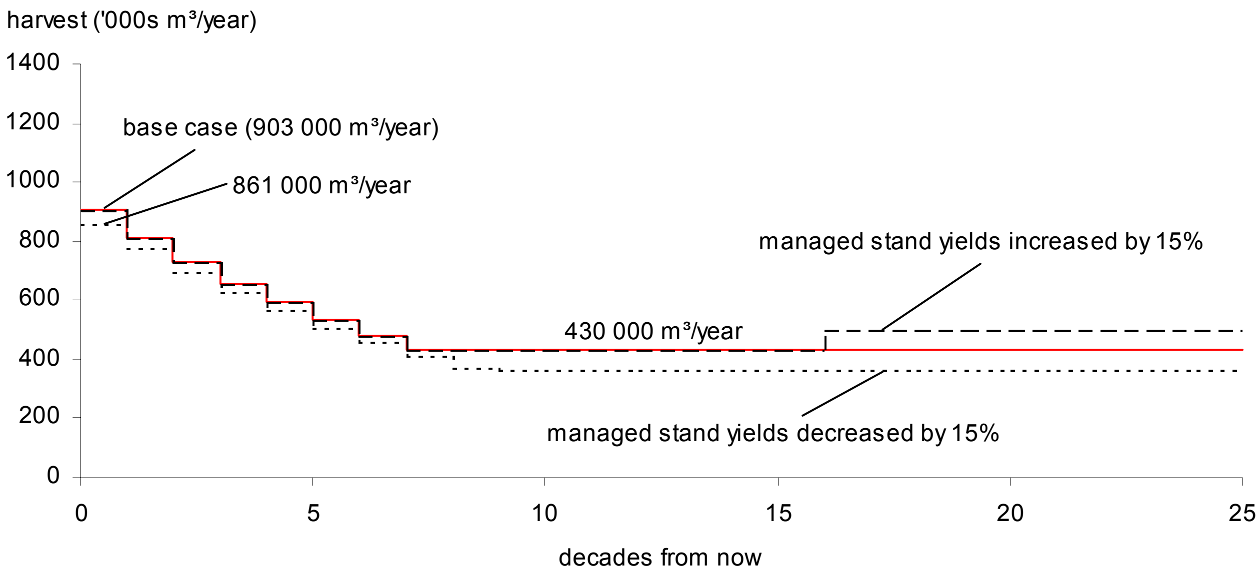

Figure 20. Sensitivity analysis of managed stand yields — Kispiox TSA, 2002.

If timber volumes in managed stands are 15% higher than in the base case, then the long-term harvest level increases in decade 17 by approximately 16% to 500 000 cubic metres per year. It cannot increase earlier because the shortage of stands currently between 41 and 70 years of age limits harvesting in decades 15 and 16. If timber volumes in managed stands are 15% lower than in the base case, then the long-term harvest level falls by 15% to 366 000 cubic metres per year. The initial harvest level also falls by approximately 5% to 861 000 cubic metres per year. This is required to avoid shortfalls in decades 15 and 16 caused by reduced timber volume in harvestable managed stands during the transition from harvesting in old growth to harvesting in managed stands.

5.6 Uncertainty in site productivity estimates for old stands

The productivity of a site largely determines how quickly trees will grow. It therefore affects the timber volumes in regenerated stands, the time to reach green-up and the age at which those stands will reach merchantable size. The most accurate estimates of site productivity come from stands between 30 and 150 years old. At ages less than about 30 years a temporary increase or decrease in growth due to factors such as a post-harvest flush of nutrients or an unusual drought year can affect the overall productivity estimated for the stand.

Old growth site index (OGSI)

Site productivity estimates derived for older stands may be incorrect because tree heights do not represent actual productivity — for example due to top breakage — and it is very difficult to determine ages of old trees accurately. The results of recent province-wide research suggest that the estimated productivity of sites currently occupied by old-growth stands may be significantly underestimated. Two Old-Growth Site Index (OGSI) studies applicable to timber supply forecasting are:

- *Site index adjustments for old-growth stands based on paired plots* (Nussbaum 1998). Data were obtained from paired plots installed in old-growth stands and adjacent logged and regenerated stands of the same productivity. Site index was estimated for both and comparisons were made. Results are available for Douglas-fir, lodgepole pine, and interior spruce.
- *Site index adjustments for old-growth stands based on veteran trees* (Nigh 1998). The objective of the study was to develop site index adjustments for species not covered by the paired-plot project. The data for this study came from temporary and permanent plots with a veteran and main stand component. The site indices for the two components were estimated and an adjustment equation for each species was derived using linear regression analysis. The results of the study are considered less reliable than those from the paired-plot study.

5 Timber Supply Sensitivity Analyses

Table 5 shows the site productivity estimates for old stands (older than 140 years) before and after old-growth site index adjustments. Site indices for stands originating from spruce and pine were adjusted using the paired-plot study and stands originating from hemlock and balsam were adjusted using the veteran tree study.

Table 5. Site productivity estimates for old stands — Kispiox TSA, 2002

Existing species group	Productivity class	Regenerated leading species	Current site index	Adjusted site index	Adjustment type
Hemlock/ cedar	Good	Spruce	21.3	21.6	Veteran tree
Hemlock/ cedar	Medium	Hemlock	15.6	19.9	Veteran tree
Hemlock/ cedar	Poor	Hemlock	10.7	17.2	Veteran tree
Balsam	Medium	Spruce	17.0	20.8	Veteran tree
Balsam	Poor	Spruce	10.4	19.5	Veteran tree
Spruce	Medium	Spruce	19.0	21.2	Paired plot
Spruce	Poor	Hemlock	11.9	17.9	Paired plot
Pine	Medium	Pine	16.9	20.4	Paired plot
Pine	Poor	Pine	12.9	19.5	Paired plot

Figure 21 shows the result of sensitivity analysis when site index is adjusted for old stands. When the paired-plot adjustments are applied to old stands originating from spruce and pine, the long-term harvest level increases by approximately 23% to 530 000 cubic metres per year, beginning in decade 11. When site index adjustments are made for all old stands, including adjustments from both paired-plot and veteran-tree studies, the long-term harvest level increases in decade 17 by approximately 57% to 675 000 cubic metres per year. In addition, the harvest level for decades 5 to 16 increases to 607 000 cubic metres per year.

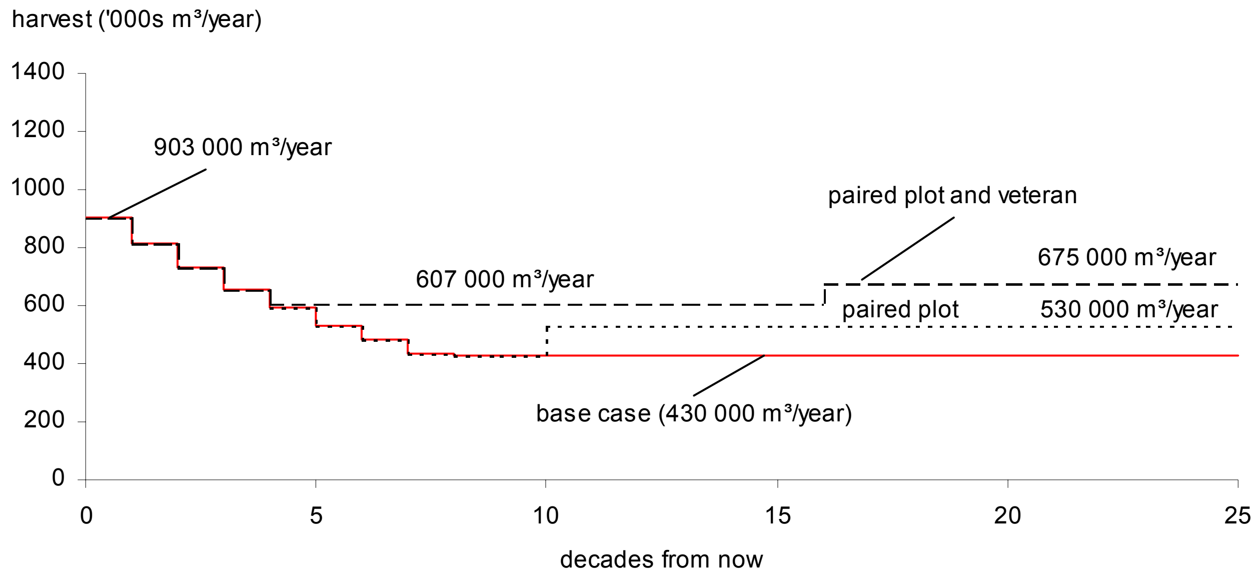

Figure 21. Sensitivity analysis of site productivity in old stands — Kispiox TSA, 2002.

5.7 Uncertainty in forest cover requirements for visual quality management

Approximately 19% of the timber harvesting land base is subject to visual quality management, of which 4.4% has a retention VQO*, 3.8% has a partial retention VQO*, 8.8% has a modification 1 VQO, and 2.0% has a modification 2 VQO. The base case applied a forest cover requirement to each VQO category within each landscape unit. A range of allowable visible disturbance is recommended for each VQO category (B.C. Ministry of Forests 1998). This range is subdivided according to the visual absorption capability class (which accounts for the ability of a harvested area to be visually absorbed within a visible landscape). The allowable visible disturbance used in the base case is an area-weighted average based on the distribution of visual absorption capability for that VQO category.

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****).*

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).

5 Timber Supply Sensitivity Analyses

Figure 22 shows the sensitivity of timber supply to using the top and the bottom of the range of allowable disturbance for each VQO category, instead of weighting by the area in each visual absorption capability class. If the top of the range of allowable visible disturbance is used for each VQO category, then the initial harvest level of the base case increases by approximately 7% to 967 000 cubic metres per year and the long-term harvest level increases by almost 2% to 437 000 cubic metres per year. If the bottom of the range is used, then the initial harvest level of the base case is reduced by approximately 14% to 775 000 cubic metres per year and the long-term harvest level is reduced by approximately 7% to 400 000 cubic metres per year. These results indicate that the short-term harvest level is more sensitive to changes in VQO disturbance limits than the long-term harvest level.

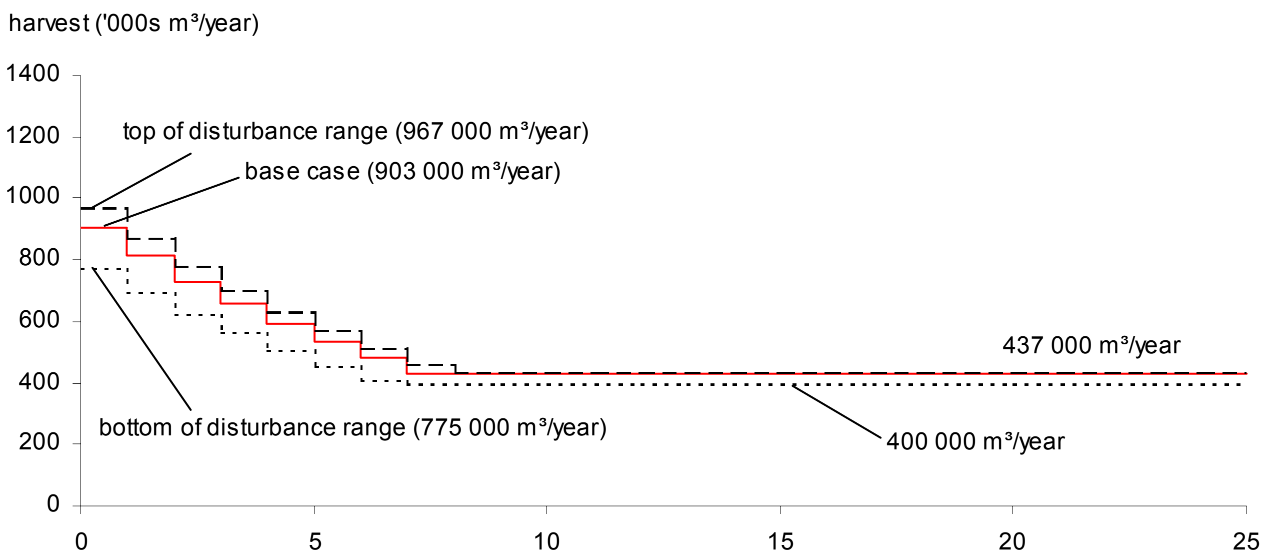

Figure 22. Sensitivity analysis of forest cover requirements for VQOs — Kispiox TSA, 2002.

5.8 Uncertainty in length of green-up period

Green-up period includes regeneration delay and the time required to grow to green-up height. Green-up height is converted to green-up age for use in the timber supply model. The base case contained forest cover requirements with green-up ages for VQOs, community watersheds, landscape unit water quality, and for cutblock adjacency. The green-up ages were calculated as an area-weighted average of the green-up ages for managed stand analysis units (AU)* within each resource management emphasis. The green-up ages used in the base case are lower than those used in the 1996 analysis by 2 to 14 years, based on new information from a study of actual green-up ages (B.C. Ministry of Forests, 2000).

Figure 23 shows the sensitivity of the harvest forecast to a change in green-up ages. If green-up ages are increased by 5 years, then the initial harvest level is reduced by 26% to 670 000 cubic metres per year, to avoid severe shortfalls in decade 3. This is largely due to adjacency requirements as described in Section 5.9, "Uncertainty in forest cover requirements for adjacency." There is no impact on the long-term harvest level, which is determined by the stability of long-term growing stock and is not limited by green-up ages.

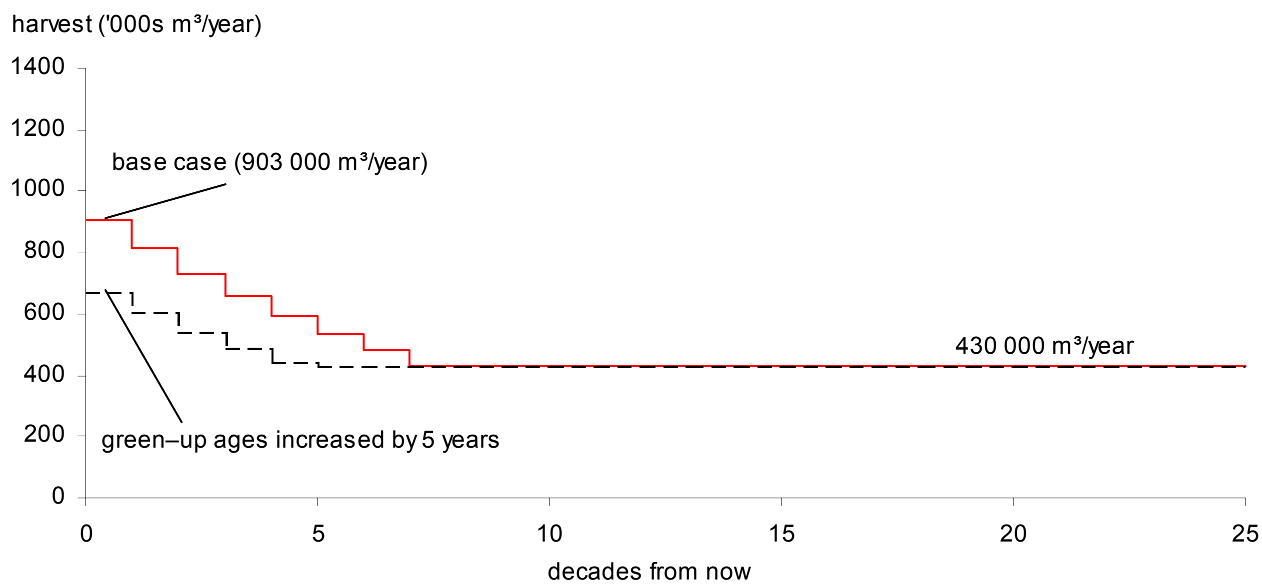

Figure 23. Sensitivity analysis of green-up periods — Kispiox TSA, 2002.

> ***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.*

5.9 Uncertainty in forest cover requirements for adjacency

The base case harvest forecast included a requirement that no more than 33% of the stands on the timber harvesting land base within a landscape unit could be less than 3 metres in height for stands harvested under the clearcut silvicultural system. The 33% limit approximates a 3-pass harvest system. This is assumed to prevent stands from being harvested until adjacent harvested stands have reached the minimum green-up height.

The base case harvest forecast remains unchanged if the maximum allowable disturbance level of 33% is reduced to 29%. Below this level, shortfalls occur in decades 2 and 3. This result is also true for levels of 25% and 20% which represent a 4-pass and 5-pass harvest system respectively. No other disruptions occur at these levels, which indicates that adjacency appears to be critical only in the short term.

5.10 Uncertainty in age of old forest characteristics

The base case included requirements for old-growth retention for landscape-level biodiversity and for land and resource management plan (LRMP) old-growth retention. There is uncertainty about the age at which stands achieve old-growth characteristics. For landscape-level biodiversity, the recommended ages at which stands achieve these characteristics are 141 and 251 years, depending on natural disturbance type. Under the LRMP old-growth requirements, the recommended age is 201 years.

If the old-growth age increases or decreases by 20 years, there is no change to the base case harvest forecast.

5.11 Uncertainty in application of seral-stage requirements for landscape-level biodiversity

Management for landscape-level biodiversity was modelled in this analysis through the use of forest cover requirements applied to the Crown forested area of each biogeoclimatic (BEC) variant* within each landscape unit. The old-growth targets were those recommended by the *Landscape Unit Planning Guide*. The targets were a weighted average of the targets for low-, medium- and high-biodiversity emphasis option (BEO), with the assumption that 45% of the area was in the low BEO, 45% was in the medium BEO, and 10% was in the high BEO. Under the low BEO, it was further assumed that the full old-growth target would be achieved over three rotations. See Appendix A, Section A.4.11, "Forest cover requirements," for further details.

Biogeoclimatic (BEC) variant
A subdivision of a biogeoclimatic subzone. 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.

5 Timber Supply Sensitivity Analyses

Figure 24 shows the sensitivity of the harvest forecast to changes in forest cover requirements for landscape-level biodiversity. Four sensitivity analyses were conducted, and in each of them the draft BEO for each landscape unit instead of the weighted average BEO was applied.

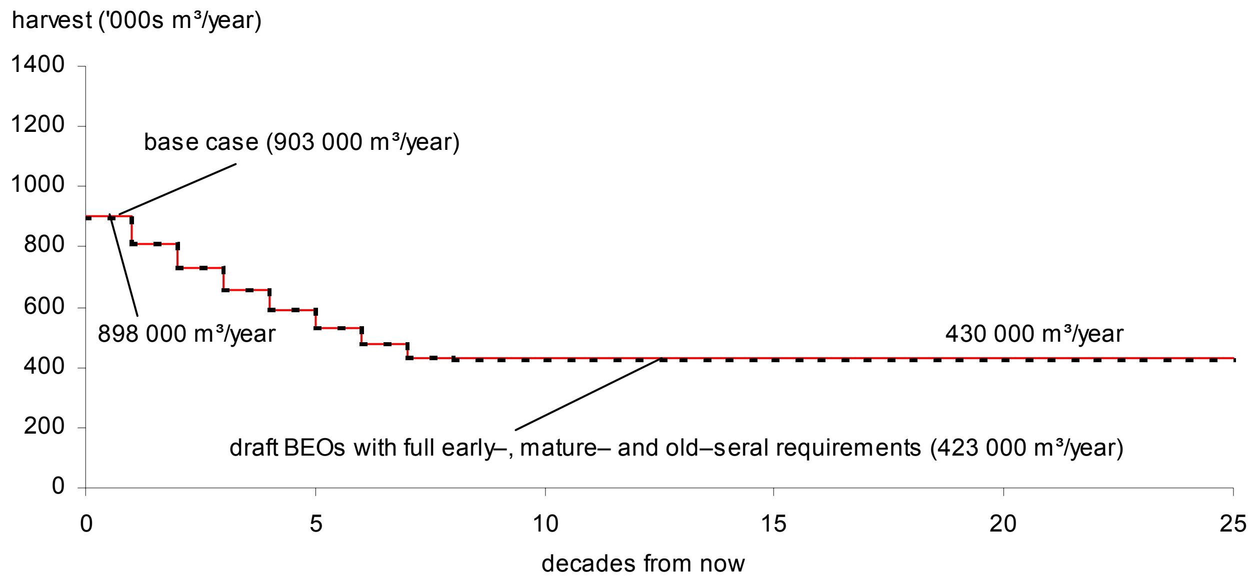

Figure 24. Sensitivity analysis of requirements for landscape-level biodiversity — Kispiox TSA, 2002.

1. Use draft BEO assigned to each landscape unit instead of average BEO and apply old-seral targets only, achieving them over three rotations.

   This has no impact on the base case harvest forecast or growing stock.

2. Use draft BEOs and apply full old-seral target for lower BEO immediately, instead of phasing it in over three rotations.

   The initial harvest level is reduced by less than 1% to 898 000 cubic metres per year and the long-term harvest level is reduced by less than 1% to 427 000 cubic metres per year.

3. Use draft BEOs and apply mature- and full-old-seral targets.

   The initial harvest level is reduced by less than 1% to 898 000 cubic metres per year and the long-term harvest level is reduced by approximately 1.6% to 423 000 cubic metres per year.

4. Use draft BEOs and apply early-, mature- and full-old-seral targets.

   The impact is the same as the previous sensitivity analysis.

5.12 Uncertainty in harvest deferrals

The base case included an accounting for harvest deferrals for three areas. Harvesting is deferred in the Big Slide chart area for 70 years, in accordance with the Babine Local Resource Use Plan. Harvesting is also deferred because of lack of access in two areas:

- 10 years in a large portion of the Atna landscape unit and a portion of the Atna/Shelagyote special management zone;
- 5 years in unallocated chart areas.

There is no change in the base case harvest forecast if there were no harvest deferrals. The deferrals for areas that lack access in the Atna area and unallocated chart areas are too short to have any impact. The deferral for the Big Slide chart area is longer, but other factors limit timber supply during the first 15 decades.

5.13 Uncertainty in management for botanical forest products

Pine mushrooms are an important botanical forest product harvested in the Kispiox TSA. One of the objectives in the Kispiox LRMP is to maintain mushroom resources and provide opportunities for sustainable harvesting of mushrooms. The timber supply implications of applying management strategies for pine mushrooms were tested through sensitivity analyses. A report by Recknell (2001) estimated the amount of potential pine mushroom habitat within the timber harvesting land base of the Kispiox TSA and provided recommendations for long-term management.

The report provided two area estimates of pine mushroom habitat which occur in the CWH and ICH biogeoclimatic zones in the TSA. One estimate covers 16 809 hectares of timber harvesting land base whereas the other covers 12 775 hectares. The management prescription requires that 33% of the habitat be excluded from harvesting, 33% fully contributes to timber supply and the remainder partially contributes (200-year rotation, 50% volume removal).

Figure 25 shows the sensitivity of the harvest forecast to the management scenarios for pine mushrooms. The 200-year rotation was interpreted as a first entry at 100 years with a 50% volume removal, followed by a second entry 100 years later to remove the remaining stand volume. Using the smaller habitat estimate, the initial harvest level is reduced by approximately 4% to 865 000 cubic metres per year and the long-term harvest level is reduced by approximately 2% to 421 000 cubic metres per year. Using the larger habitat estimate, the initial harvest level is reduced by approximately 4% to 863 000 cubic metres per year and the long-term harvest level is reduced by approximately 3% to 417 000 cubic metres per year. Most of these reductions are attributable to the reduction in the size of the timber harvesting land base by reserving one-third of the mushroom habitat from harvesting.

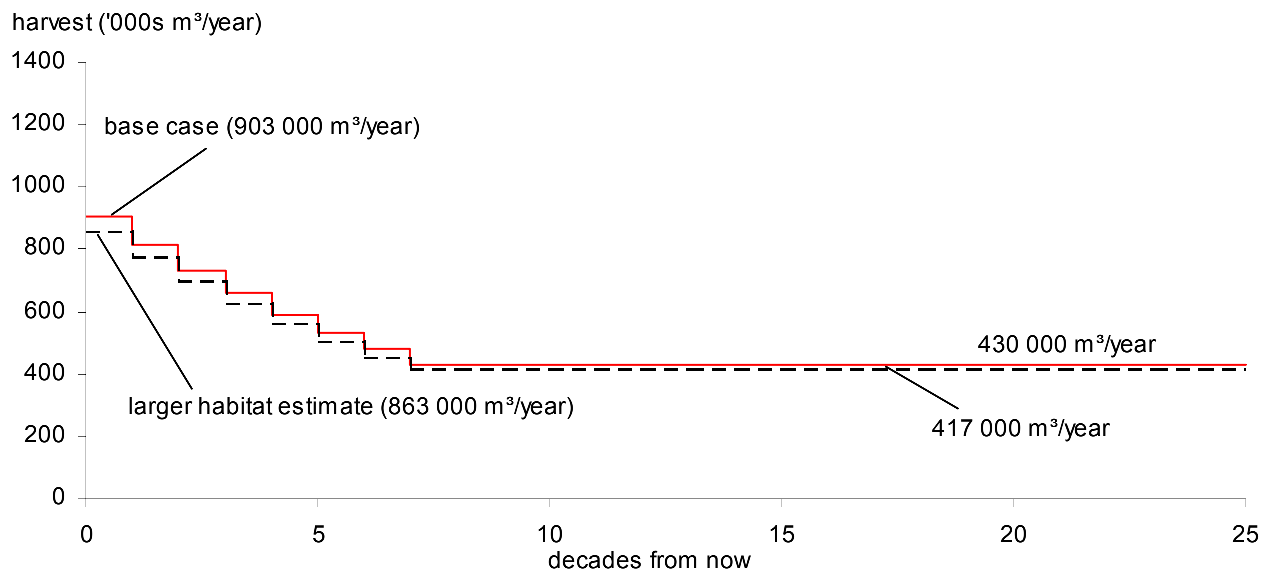

Figure 25. Sensitivity analysis of managing for pine mushroom — Kispiox TSA, 2002.

5.14 Uncertainty in estimate of unsalvaged losses

Figure 26 shows the sensitivity of the base case to changed assumptions about unsalvaged losses. The estimate of unsalvaged losses for the base case was 203 365 cubic metres per year for the first decade. This included an estimated unsalvaged loss due to balsam bark beetle of 138 525 cubic metres per year. The losses due to balsam bark beetle were assumed to decline in equal steps of 10% per decade as harvesting reduced the area of old-balsam stands. These assumptions produced a total unsalvaged loss of 78 690 cubic metres per year in decade 10, of which 13 850 cubic metres per year was due to balsam bark beetle and 52 000 cubic metres per year due to Tomentosus root disease in spruce stands. This level of unsalvaged losses was assumed to remain constant for the balance of the 250-year horizon.

The preliminary results of an inventory audit conducted in 1996 for the Kispiox TSA concluded that volumes in operable stands were 13% lower than estimated by the inventory. There is a possibility that at least part of this underestimate is due to losses from the balsam bark beetle. If a 13% reduction in timber volume estimates for existing unmanaged stands is applied in conjunction with just the long-term unsalvaged losses (78 690 cubic metres per year), the initial harvest level would be reduced by approximately 18% to 736 000 cubic metres per year. This large reduction is required to avoid large timber supply shortfalls in decades 15 to 18 caused by the gap in the age class distribution.

If the 13% reduction in timber volume estimates for existing unmanaged stands is applied together with an unsalvaged loss of 12 840 cubic metres per year (for wildfire and windthrow), the initial harvest level is reduced by approximately 11% to 807 000 cubic metres per year. The long-term harvest level would increase by approximately 16% to 499 000 cubic metres per year because the long-term unsalvaged losses are decreased.

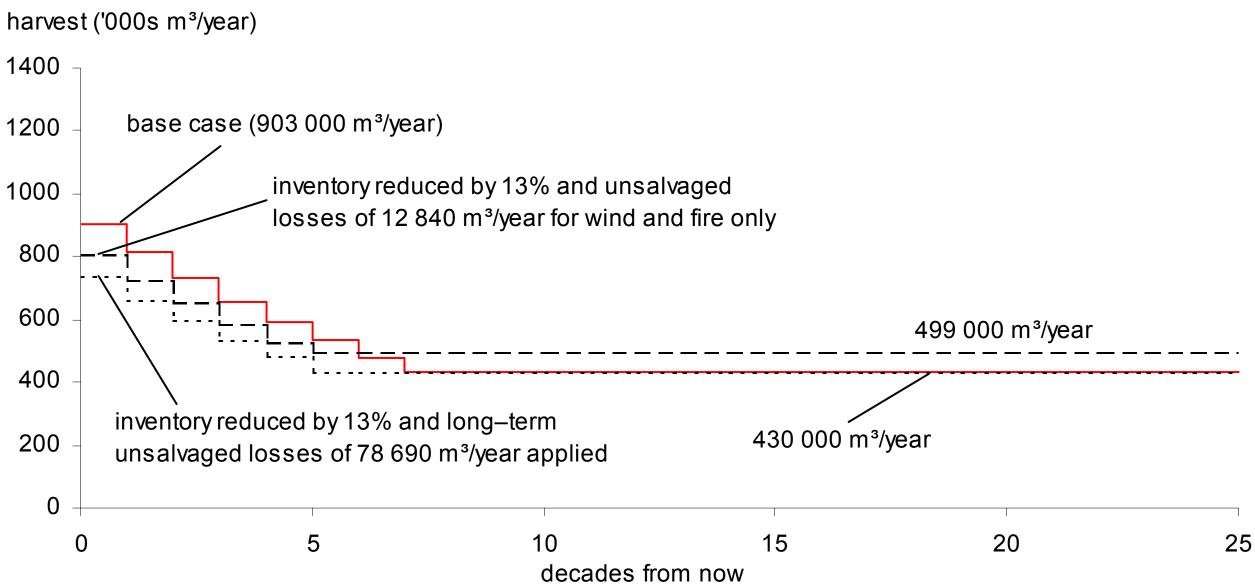

Figure 26. Sensitivity analysis of unsalvaged losses — Kispiox TSA, 2002.

5.15 Uncertainty in regeneration of backlog stands

Low levels of brushing in recent years have created a risk that backlog coniferous stands currently classified as satisfactorily restocked could be overcome with deciduous competition. This applies to coniferous stands between 21 and 40 years old with a logging history, which amounts to approximately 9660 hectares or 3.6% of the timber harvesting land base. The consequence would be reduced stocking of coniferous trees, which could reduce timber volumes in these stands by up to 40%.

Figure 27 shows the impact of this risk on the base case harvest forecast. The initial harvest level is reduced by approximately 5% to 859 000 cubic metres per year. There is no impact on the long-term harvest level.

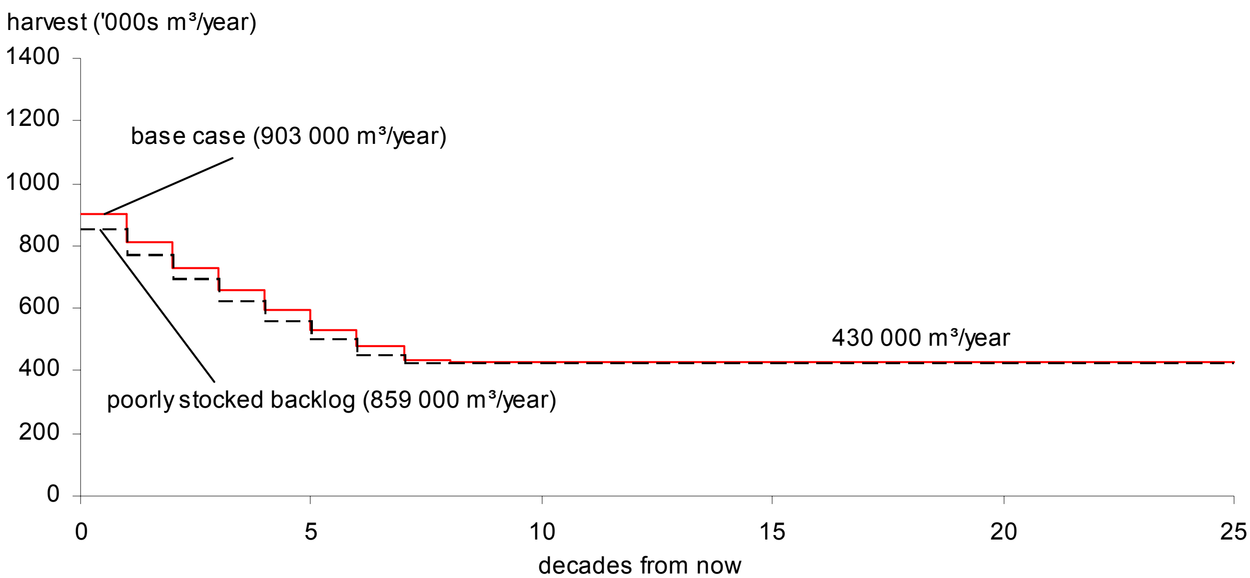

Figure 27. Sensitivity analysis of poor stocking in backlog stands — Kispiox TSA, 2002.

An alternate outcome is that these backlog areas will never be harvestable because they have insufficient coniferous volume. In this case these areas would be excluded from the timber harvesting land base. Given the results of the sensitivity analysis in Section 5.3, "Uncertainty in land base available for timber harvesting," reducing the size of the timber harvesting land base to account for the area of backlog stands would produce a proportionate reduction in the entire base case harvest forecast of approximately 3.6%. The initial harvest level of the base case would be reduced to approximately 870 000 cubic metres per year and the long-term harvest level would be reduced to approximately 415 000 cubic metres per year.

5.16 Uncertainty due to needle blight in pine stands

For the last five years, pine stands have been affected by dothistroma needle blight. This disease causes pine trees to lose all of their needles, thereby killing the trees. Spread of the disease has been facilitated by a series of wet summers. There is a risk that these stands will die completely and be replaced by naturally regenerated, younger stands. Pine stands account for approximately 35 530 hectares or 9% of the timber harvesting land base.

Figure 28 shows the impact on the base case harvest forecast if one-quarter of the existing pine stands die and are replaced by natural stands of hemlock that are 20 years younger. This assumption was used to model the pattern of succession that might occur in these stands. The initial harvest level is reduced by approximately 1.4% to 890 000 cubic metres per year. There is no impact on the long-term harvest level.

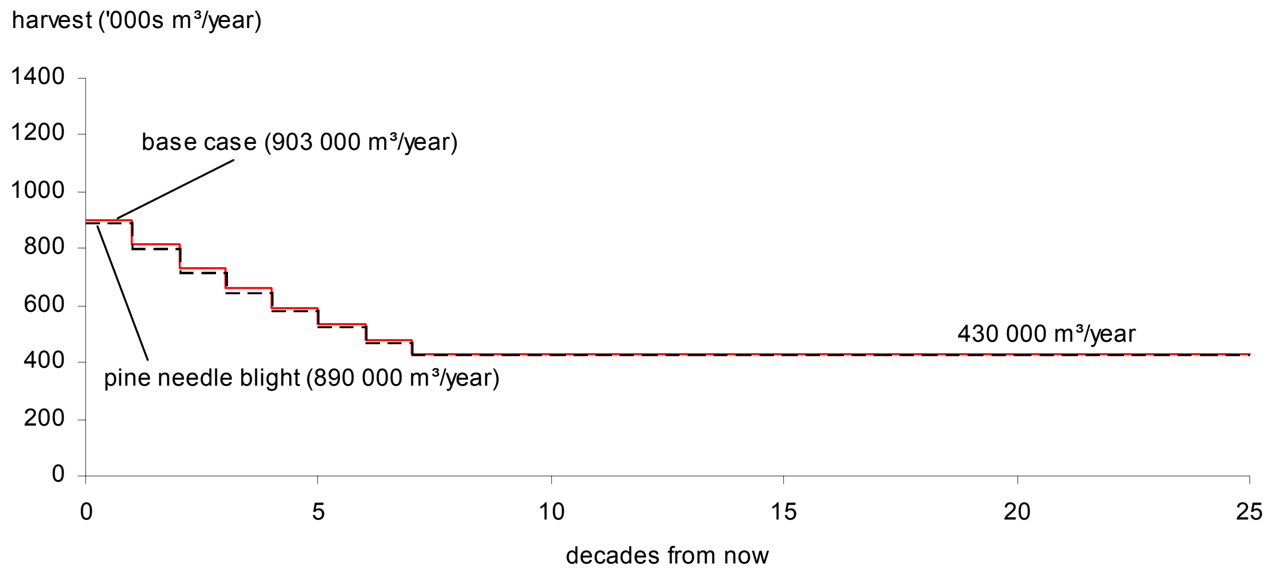

Figure 28. Sensitivity analysis of success of pine plantations — Kispiox TSA, 2002.

If the needle blight affects the pine stands to such an extent that there is no alternate seed source for coniferous species, then an alternate outcome is that the affected pine stands will regenerate to largely deciduous species. In this case the areas would be considered unharvestable and would be excluded from the timber harvesting land base. Given the results of the sensitivity analysis in Section 5.3, "Uncertainty in land base available for timber harvesting," reducing the size of the timber harvesting land base to account for the area of affected pine stands would produce a proportionate reduction in the entire base case harvest forecast of approximately 2.3% (one-quarter of 9%). The initial harvest level of the base case would be reduced to approximately 882 000 cubic metres per year and the long-term harvest level would be reduced to approximately 420 000 cubic metres per year.

5.17 Combined uncertainties

The previous sections presented sensitivity analyses testing the uncertainty associated with individual issues. This section presents sensitivity analyses evaluating the uncertainty associated with combinations of issues. These help to ascertain the total uncertainty associated with the assumptions in the base case harvest forecast. Figure 29 shows the results of the following combined sensitivity analyses.

1. A sensitivity analysis testing the impacts of two factors that tend to increase timber supply:
    - Site productivity adjustments from paired-plot and veteran tree studies.
    - Smaller land base exclusions for stands with unharvested volume (equal only to the amount recommended by the *Landscape Unit Planning Guide (LUPG)*). This represents a 10.5% increase in the size of the timber harvesting land base.

    This combination of adjusted assumptions increases the initial harvest level of the base case by approximately 10% to 993 000 cubic metres per year and increases the long-term harvest level by approximately 72% to 742 000 cubic metres per year beginning in decade 17. In addition, the harvest level for decades 5 to 16 increases to 670 000 cubic metres per year. These results are approximately 10% higher than when applying only the site productivity adjustments.
2. A sensitivity analysis testing the impacts of three factors that tend to reduce timber supply:
    - An accounting for management of pine mushroom habitat.
    - Reduced coniferous volume in backlog stands.
    - Needle blight in pine stands (conversion to younger hemlock stands).

    This combination of adjusted assumptions reduces the initial harvest level by approximately 10% to 810 000 cubic metres per year and reduces the long-term harvest level by approximately 3% to 417 000 cubic metres per year.
3. A sensitivity analysis that included the assumptions from the second combined sensitivity analysis above, but also factors that tend to reduce short-term timber supply but increase long-term timber supply:
    - Timber volume estimates for existing unmanaged stands are reduced by 13%.
    - No unsalvaged losses resulting from insects or diseases. These are assumed to be accounted for by volume reduction in existing unmanaged stands.

This third combination of adjusted assumptions reduces the initial harvest level by approximately 14% to 775 000 cubic metres per year and increases the long-term harvest level by approximately 12% to 482 000 cubic metres per year.

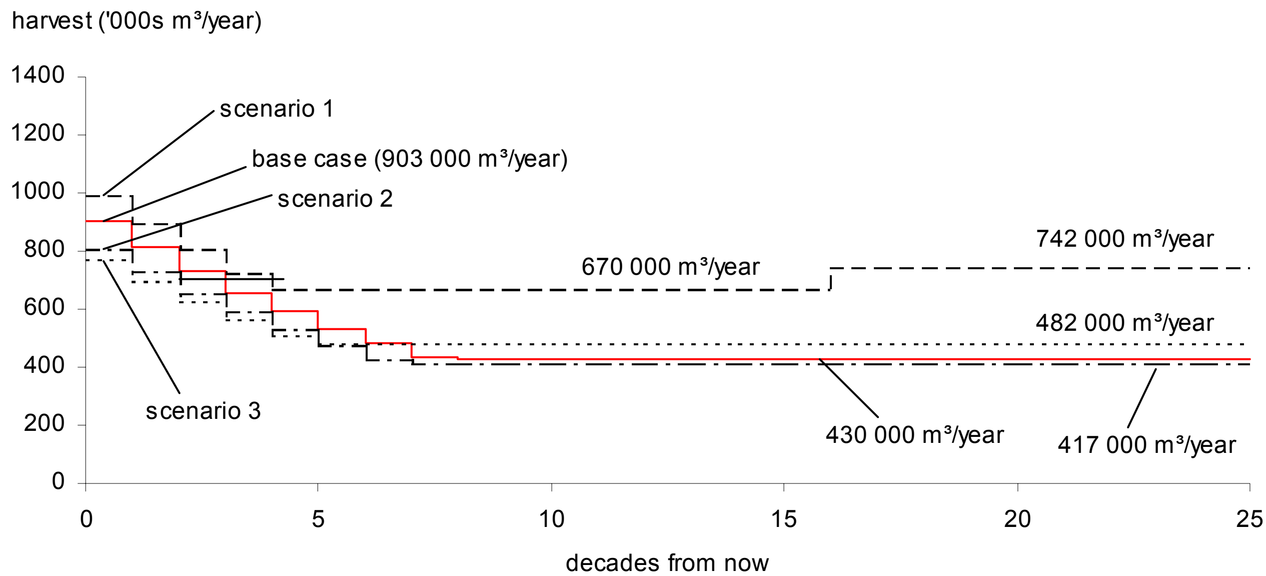

Figure 29. Sensitivity analysis of combined uncertainties — Kispiox TSA, 2002.

5 Timber Supply Sensitivity Analyses

Table 6. Summary of sensitivity analyses — Kispiox TSA, 2002

Report section	Harvest forecast description	Harvest level per cent relative to the base case: Short term (1-20 years)	Medium term (21-100 years)	Long term (> 100 years)
5.1	Alternative harvest flow — decline 12% per decade	106	99	100
	Alternative harvest flow — decline 20% per decade	103	86	100
	Alternative harvest flow — even-flow	50	97	100
5.2	Minimum harvestable ages based on 250 m^3/hectare	92	95	100
	Minimum harvestable ages based on 300 m^3/hectare for good and medium sites	95	97	100
5.3	Timber harvesting land base increased by 10%	110	110	109
	Timber harvesting land base decreased by 10%	90	90	91
5.4	Existing stand volumes reduced 13%	66	81	99
	Existing stand volumes reduced 13% — alternate harvest flow	87	86	99
5.5	Managed stand volumes increased 15%	100	100	110
	Managed stand volumes reduced 15%	95	93	85
5.6	Productivity of old stands — paired-plot site index adjustments	100	100	123
	Productivity of old stands — paired-plot and veteran tree site index adjustments	100	117	151
5.7	VQOs use top of allowable disturbance range	107	106	102
	VQOs use bottom of allowable disturbance range	86	88	93
5.8	Green-up ages increased 5 years	74	84	100
5.9	Adjacency — reduce allowable disturbance from 33% to 29%	100	100	100
5.10	Age of old forest characteristics increased 20 years	100	100	100
	Age of old forest characteristics reduced 20 years	100	100	100
5.11	Seral-stage requirements — draft BEOs and old requirements phased-in	100	100	100
	Seral-stage requirements — draft BEOs and full old requirements	99	99	99
	Seral-stage requirements — draft BEOs and full mature and old requirements	99	99	98
	Seral-stage requirements — draft BEOs and full early, mature and old requirements	99	99	98
5.12	No harvest deferrals	100	100	100
5.13	Pine mushrooms — larger habitat area	96	96	97
	Pine mushrooms — smaller habitat area	96	96	98
5.14	Long-term unsalvaged losses with existing stand volumes reduced 13%	82	88	100
	No unsalvaged losses from insects and disease with existing stand volumes reduced 13%	89	100	116
5.15	Poor stocking of backlog stands	95	97	100
5.16	Needle blight in pine	99	99	100
5.17	Combined uncertainty 1	110	129	166
	Combined uncertainty 2	90	92	97
	Combined uncertainty 3	86	96	112

6 Summary and Conclusions of the Timber Supply Analysis

Several land use and forest management initiatives have been implemented since the last timber supply analysis was conducted for the Kispiox TSA in 1996. The current timber harvesting land base is approximately 17% smaller than in the 1996 analysis, largely because of assumptions about removals from the Crown productive forested land base and new protected areas. New estimates for unsalvaged losses had a major impact in reducing timber supply. All of these changes acted to decrease timber supply.

The results of this timber supply analysis suggest that the current harvest level in the Kispiox TSA cannot be maintained. The base case harvest forecast has an initial harvest level of 903 000 cubic metres per year, which declines 10% per decade to reach a stable long-term harvest level of 430 000 cubic metres per year 90 years from now. The base case harvest forecast reflects current knowledge and information on forest inventory, growth and management. Uncertainty exists about several factors important in defining timber supply. A series of sensitivity analyses showed that these uncertainties affect timber supply to varying degrees. Table 6 provides a summary of the results of these sensitivity analyses.

One alternative to the base case harvest forecast shows that it may be possible to increase the initial harvest level to 967 000 cubic metres per year by accepting a harvest flow that declines 12% per decade instead of 10% per decade.

An important factor in determining the initial harvest level is the current age class distribution. There is a critical shortage of stands currently 31 to 70 years old. This requires the harvest of existing unmanaged stands to be spread out over approximately 100 years until sufficient young managed stands are available to be harvested. The uncertainties with the largest potential negative effects on the harvest forecast are minimum harvestable ages, size of the timber harvesting land base, timber volume estimates for existing unmanaged stands, timber volume estimates for regenerated managed stands, allowable disturbance levels for visual quality objectives (VQOs), green-up ages, forest cover requirements for adjacency, management for pine mushroom habitat, and reduced coniferous regeneration in backlog stands. All of these factors reduce the availability of existing unmanaged stands for harvest in the first 100 years.

The analysis results show increased minimum harvestable ages based on a minimum harvestable volume of 250 cubic metres per hectare instead of 200 cubic metres per hectare would reduce the initial harvest level by approximately 7.5% to 835 000 cubic metres per year. Reducing the size of the timber harvesting land base by 10% reduces the initial harvest level by approximately 10% to 813 000 cubic metres per year. The preliminary results of an inventory audit showed that timber volumes may be 13% lower than indicated by the forest cover inventory. If timber volume estimates in existing unmanaged stands are reduced by 13%, the initial harvest level is reduced by approximately 34% to 592 000 cubic metres per year. This impact can be mitigated by allowing the mid-term harvest level to fall below the long-term harvest level in decades 9 to 16. If timber volume estimates in regenerated managed stands are reduced by 15%, the initial harvest level is reduced by approximately 5% to 861 000 cubic metres per year.

Setting allowable disturbance levels for VQOs at the bottom of the recommended disturbance ranges reduces the initial harvest level by approximately 14% to 775 000 cubic metres per year. Increasing green-up ages by 5 years reduces the initial harvest level by approximately 26% to 670 000 cubic metres per year. Reducing the area allowed to be below green-up height for adjacency to reflect a 4-pass harvesting system causes shortfalls in decades 2 and 3 only, but does not affect harvesting in any other decade. Managing for pine mushroom habitat reduces the initial harvest level by up to 4% to 863 000 cubic metres per year. Reduced coniferous regeneration in backlog stands reduces the initial harvest level by approximately 5% to 859 000 cubic metres per year.

6 Summary and Conclusions of the Timber Supply Analysis

The uncertainties with the largest potential positive effects on the harvest forecast are the size of the timber harvesting land base, allowable disturbance levels for VQOs, and unsalvaged losses. Increasing the size of the timber harvesting land base by 10% increases the initial harvest level of the base case by approximately 10% to 992 000 cubic metres per year. Setting allowable disturbance levels for VQOs at the top of the recommended disturbance ranges increases the long-term harvest level by approximately 7% to 967 000 cubic metres per year. Lower estimates of unsalvaged losses for insects and disease have the potential to increase the initial harvest level. However, they are more likely to partly offset the effect of reduced timber volumes in existing unmanaged stands, rather than producing an actual increase in the initial harvest level.

Within the ranges of uncertainty tested, all other factors were shown to have little to no effect (3% or less) on the base case harvest forecast.

In conclusion, the base case suggests that a harvest level of 903 000 cubic metres per year can be maintained for 10 years. Extensive sensitivity analysis examined the effect on the base case harvest forecast of changes in the information used in this analysis. For much of this information, there is no evidence to suggest that it is inaccurate. However, several factors could act to further reduce the initial harvest level. These factors include lower timber volume estimates for existing unmanaged stands, management for pine mushroom habitat, poor coniferous regeneration in backlog stands, and pine needle blight. Two factors could act to partly offset these downward pressures on the initial harvest level, including a larger timber harvesting land base from better management practices for stand-level biodiversity, and lower unsalvaged losses for insects and disease.

7 Socio-Economic Analysis

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

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

The socio-economic analysis includes:

- a profile of the current socio-economic setting;
- a description of the Kispiox TSA forest industry; and
- an analysis of the socio-economic implications of the base case harvest forecast.

7.1 Current socio-economic setting

7.1.1 Overview

The socio-economic analysis focuses on the timber supply from the Kispiox TSA, located in west central British Columbia. The area includes the communities of the Village of (Old) Hazelton, District of New Hazelton, South Hazelton, Kispiox, Glen Vowell, Two Mile, Gitsegukla, Kitwanga, Gitanyow, Gitwangak and Cedarvale. The TSA is administered from the Kispiox Forest District office in Hazelton, and has a total area of about 1.2 million hectares.

Named after the hazel bushes which cover the Kispiox and Skeena river terraces, the Hazeltons are situated amidst a majestic landscape dominated by the 8,000 foot walls of the rugged Roche Deboule Range. Easily accessible along the Yellowhead Highway 16, the Hazeltons are a tourism stop for travellers between Prince George and Prince Rupert.

7.1.2 Population and demographic trends

According to the 1996 Census, the population of the Kispiox TSA increased by approximately 5% between 1991 and 1996 from 5,965 to 6,292. Early estimates from the 2001 Census indicate the population has declined since then. The District of New Hazelton (2001 population 750) is the principal commercial, administrative and retail centre for the area. By 2005, the population of the Kispiox timber supply area is expected to reach about 6,200.

Aboriginal band registries for July 1995 list about 2,800 band members living on reserves in the Kispiox planning area. The number of band members living off-reserve in the area is difficult to determine.

7 Socio-Economic Analysis

Table 7. Population trends in the Kispiox TSA (1991-2005)

Community	1991	1996	2001	2005 (estimated)	% change per year 1996-2005
New Hazelton (District Municipality)	786	822	750		
Hazelton (Village)	339	347	345		
Other	4,840	5,069			
Kispiox TSA	5,965	6,292	5,995	6,200	– 0.2

Source: Census of Canada 1991, 1996, 2001; BC Stats.

7.1.3 Economic profile

The economy of the Kispiox timber supply area is not well diversified. Figure 30 illustrates total employment by industry sector for the area. Forestry is the most important sector of the area's economy but commercial fishing, tourism, ranching, mining and the public sector are also important sources of employment.

The trade and services sectors have gained in relative importance in recent years as traffic volumes on Highway 16 have risen. Cattle ranching is the main form of agricultural enterprise. However, existing forest cover is generally wide-spread over potential range land, which leads to high development costs. A number of smaller silver, lead and zinc properties have operated in the past on an intermittent basis when metal prices are favourable. Tourism has become an important part of the local economy. The feature attraction is the 'Ksan Indian Village' — a re-creation of an authentic aboriginal community. Surveys undertaken for the nearby Cassiar Iskut-Stikine LRMP area indicate that the recent strong growth in the tourism sector offers a good short- to medium-term potential for the creation of up to 300 additional jobs in guide-outfitting and other wilderness tourism.[1] Finally, the Kispiox River hatchery, located at the confluence of the Skeena and Kispiox rivers, produces chinook and coho stock and employs a number of local band members.

Forestry employment in the timber supply area is supported by harvesting and silviculture activity and the processing of wood products. Facilities range from single owner-operators to the Kitwanga Lumber Company's planer mill at Kitwanga, which employed just under 50 people in 2000.

Figure 30 illustrates the shares of total employment by industry sector which existed in the Kispiox Forest District in 1996 (the latest year for which this type of data is available).

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(1) *Cassiar Iskut-Stikine LRMP Consensus Recommendations Package*, Holman and Terry, August 2000. The job estimate is based on a survey of existing tourism operators and takes into account the growth potential of the operators, as well as the estimated carrying capacity of the areas in which they operate.

7 Socio-Economic Analysis

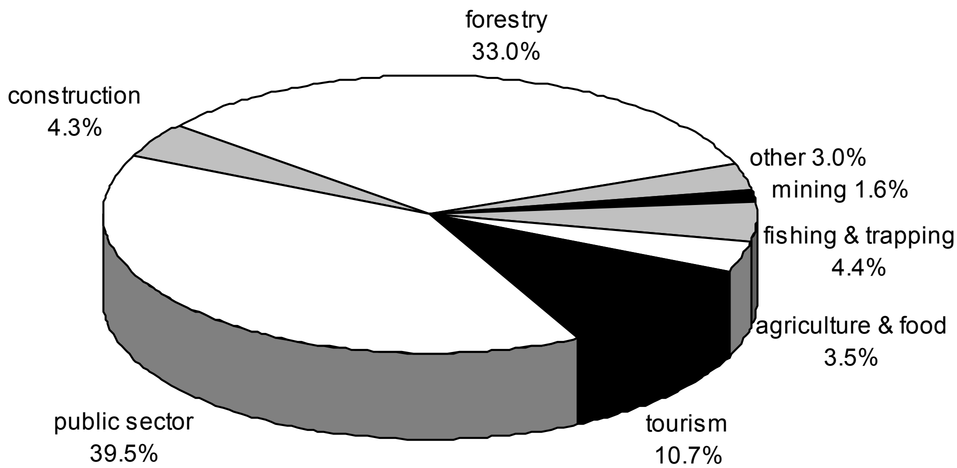

Figure 30. Major employment by sector for the Kispiox TSA, 1996.

Notes: 'Forestry' consists of harvesting related activity and manufacturing. 'Other' consists of finance, insurance, real estate and other business services. 'Public sector' consists of local and provincial government, health and education.

Source: The 1996 Forest District Tables (April 1999), Ministry of Finance and Corporate Relations.

During 1996, the forest sector supported numerous jobs in the region through logging companies and employees purchasing goods and services from local businesses. Aside from direct impacts, this spending is an indicator of the basic role forestry has in the economy. Each 100 direct forestry jobs in the Kispiox TSA were estimated to support a further 20 to 45 indirect and induced jobs*[2], depending on the type activity (logging or wood products manufacturing). In comparison, each 100 agricultural sector jobs supported approximately 12 additional positions, while the tourism and public sector supported 10 to 15 additional positions per 100. The forest industry in the Kispiox TSA declined significantly in 2001 with the closure of the area's largest sawmill — the Skeena Cellulose Inc. mill in Carnaby.

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.

(2) The 1996 Forest District Tables, April 1999, Ministry of Finance and Corporate Relations.

Table 8. Kispiox TSA allowable annual cut apportionment, by licence type

Licence types	AAC (cubic metres per year)	Per cent of total (%)
Forest licences	818 500	75.0
Timber Sale licences (TSL)	17 034	1.6
Small Business Forest Enterprise Program (SBFEP)	242 466	22.0
Forest Service Reserve	11 000	1.0
Woodlot licence	3 611	0.4
Total	1 092 611	100.0

Source: Ministry of Forests – 2002.

7.2 Kispiox TSA harvest history

The actual annual harvest level is an important indicator of forestry activity in the timber supply area. While the AAC is the maximum allowable annual harvest level, the actual volume of timber harvested in a particular year indicates the economic activity supported by the timber supply area. If actual annual harvest levels are consistently less than the AAC, then the economic activity is below its full potential. This gap between actual and allowable harvest activity will influence the potential short-term impacts of changes to the AAC.

The annual harvest activity in the Kispiox TSA rose about 10% per year over 1997 – 2000. Harvest volumes are permitted to vary from licenced volumes (under the licence cut-control provisions) enabling the licensee to respond to market conditions and other factors. As well, the harvest of diseased, dead or damaged trees is attributed to the Forest Service Reserve portion of the AAC, or in some cases may not be included in the AAC.

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The AAC in the TSA makes up about 15% of the total harvest in the Prince Rupert Forest Region (7.8 million cubic metres) which in turn accounts for about 10% of the total provincial Crown harvest (69 million cubic metres [2000/01]). Table 9 summarizes the actual volume of timber harvested in the TSA from 1997 to 2000. In 2001, the TSA harvest volume decreased substantially to 390 000 cubic metres.

Table 9. Kispiox TSA volumes billed, by licence type, 1997-2000

Licence type	(cubic metres per year) 1997	1998	1999	2000	1997-2000 average
Forest licences	578 578	555 677	675 115	716 700	631 518
Timber Sale Licences (TSL)	3 584	0	16 468	9 762	7 454
Small Business Forest Enterprise Program (SBFEP)	178 740	269 818	281 065	250 797	245 105
Other[a]	12 591	4 438	17 659	51 485	21 543
Total	773 493	829 933	990 307	1 028 744	905 619

Source: Ministry of Forests

(a) Other consists of cutting permits such as rights-of-way, road permits, woodlot licences and other smaller permits.

7.2.1 Kispiox TSA major licensees

Skeena Cellulose Inc.

Skeena Cellulose Inc. (Skeena) had a replaceable forest licence to harvest 576 815 cubic metres per year in the Kispiox TSA. Table 10 outlines Skeena's recent harvest activity in the Kispiox TSA and its 1997 to 2000 average employment levels for TSA operations.

The sale of Skeena to NWBC Timber and Pulp Ltd. was ongoing at the time of this publication. The terms of agreement included Skeena's replaceable forest licence to harvest 576 815 cubic metres per year in the Kispiox TSA and two processing facilities in the TSA: the Carnaby sawmill and chipping complex with an annual capacity of approximately 750 000 cubic metres and the Hazelton whole log chipper which has an annual capacity of about 300 000 cubic metres. These plants employed approximately 160 people in the year 2000. In February 2001, the Carnaby operation shut down indefinitely with over 100 people receiving layoff notices.

Table 10. Skeena Cellulose Inc. harvest and direct employment statistics

Allowable annual cut (AAC)	576 815 cubic metres
2000 harvest	563 550 cubic metres
1997 – 2000 average harvest	443 429 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	110
Processing	142

Note: The employment figures relate to the volumes harvested from the Kispiox TSA land base only.

Kispiox Forest Products Ltd.

Kispiox Forest Products Ltd. (Kispiox FP) has two forest licences in the TSA allowing the harvest of a total of 94 559 cubic metres per year. Kispiox FP has an established sawmill and planer operation located in South Hazelton and employs up to 120 people annually in its forestry, harvesting and manufacturing operations.

Table 11 outlines Kispiox FP's recent harvest activity and 1997 to 2000 average employment levels associated with its TSA operations. The mill was shut-down in 1999 and 2000, but reopened in early 2001 and provides employment for approximately 50 people.

Table 11. Kispiox Forest Products harvest and direct employment statistics

Allowable annual cut (AAC)	94 559 cubic metres
2000 harvest	2 288 cubic metres
1997 – 2000 average harvest	39 244 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	13
Processing	47

Note: The employment figures relate to the volumes harvested from the Kispiox TSA land base only.

Kitwanga Lumber Co. Ltd.

Kitwanga Lumber Co. Ltd. (Kitwanga) has three forest licences in the TSA allowing the harvest of up to 92 180 cubic metres per year. Table 12 outlines Kitwanga's recent harvest activity and 1997 to 2000 average employment levels associated with its Kispiox TSA operations. The company's mill/planer, in Kitwanga, British Columbia, produces dimension-cut lumber and wood chips by-product.

Table 12. Kitwanga harvest and direct employment statistics

Allowable annual cut (AAC)	92 180 cubic metres
2000 harvest	82 993 cubic metres
1997 – 2000 average harvest	105 665 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	34
Processing	42

Note: The employment figures relate to the volumes harvested from the Kispiox TSA land base only.

Bell Pole Co.

Bell Pole Co. (Bell Pole) has one forest licence in the TSA that allows for the harvest of 55 414 cubic metres per year. Bell Pole is a family owned company, producing electric utility poles for markets throughout North America.

Beginning in Minnesota in 1909 and expanding to British Columbia in 1925, the company harvests western redcedar, lodgepole pine and, in the United States, red pine, to produce its products, and markets the remaining logs to others in return for pole quality logs. Bell Pole has forest operations in seven TSAs throughout the province, which are administered through offices at Terrace and Salmon Arm.

Table 13 outlines Bell Pole's recent harvest activity and 1997 to 2000 average employment levels associated with its Kispiox TSA operations.

Table 13. Bell Pole harvest and direct employment statistics

Allowable annual cut (AAC)	55 414 cubic metres
2000 harvest	70 466 cubic metres
1997 – 2000 average harvest	48 843 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	15
Processing	20

Note: The employment figures relate to the volumes harvested from the Kispiox TSA land base only.

Other licensees

Other licensees in the Kispiox TSA are the Small Business Forest Enterprise Program (SBFEP) with a total AAC apportionment of 242 466 cubic metres; Canema Timber Ltd. with a replaceable timber sale licence of 11 381 cubic metres, and Anspayaxw Tenure Corp with a non-replaceable forest licence of 53 406 cubic metres. However, there has been no recent harvesting on either the Anspayaxw or Canema tenures.

From 1997 – 2000, SBFEP harvests averaged 245 105 cubic metres annually, which normally would support about 165 direct harvesting, silviculture and processing person-years.

7.2.2 Forest sector employment summary

In this section, the preceding harvesting and employment information is considered in the development of employment coefficients used to project future employment levels. For this purpose, the forest sector has been divided into the following three sub-sectors:

- harvesting and other woodlands-related employment such as log salvage and log scaling, and planning;
- silviculture activity including all planting and other basic and intensive operations; and
- primary timber processing employment.

Harvesting and silviculture employment

The harvesting sub-sector of the forest industry includes both company and contract loggers and is the most closely tied to the AAC; consequently, harvest level changes will affect this sub-sector first, and in close to the same proportions.The silviculture sub-sector is less linked to the current level of harvest, since silviculture activities occur at least three to six years after harvesting. Silviculture activity is divided into basic and enhanced work. Basic silviculture consists of surveys, site preparation, planting, brushing, cone collecting and some spacing. Enhanced or intensive silviculture includes spacing, fertilizing, and pruning*. In the Kispiox TSA, as in the rest of the province, licensees are responsible for basic silviculture on areas harvested under forest licences. The provincial government is responsible for the remaining basic and all enhanced silviculture on Crown land, which is normally completed by silvicultural contractors.

Forest Service employment

The Kispiox TSA is administered from the Kispiox Forest District Office in Hazelton. Currently about 32 people work in the Kispiox office. Although these jobs are not included in the assessment of forestry sector impacts, they are included in the public sector. The Hazelton office is scheduled to close by March 31, 2003.

Kispiox TSA forestry employment and employment coefficient summary

Table 14 summarizes employment supported by the 1997 – 2000 average harvest in the Kispiox TSA, and the corresponding employment coefficients. The employment and coefficients are separated into two groups:

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

Calculations have been made for both groups to identify the importance of the forest sector within the Kispiox TSA and to highlight the contribution that the Kispiox TSA's forest sector makes to the provincial economy.

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

7 Socio-Economic Analysis

The average annual harvest from the timber supply area, from 1997 – 2000, was 905 619 cubic metres, or about 17% lower than the AAC of 1 092 611 cubic metres per year. If the full AAC was harvested, it would potentially support about 15% more employment.

Table 14. Kispiox TSA employment and employment coefficients

Activity	TSA person-years	TSA coefficients	Provincial person-years	Provincial coefficients
Harvesting	195	0.21	216	0.24
Silviculture	81	0.09	90	0.10
Processing	222	0.25	451	0.50
Total direct	497	0.55	757	0.84
Indirect + induced	146	0.16	912	1.01
Total employment	643	0.71	1669	1.85

Note: Employment estimates are person-years based on average 1997-2000 employment levels and the average 1997-2000 harvest of 905 600 cubic metres. Person-years do not indicate individual jobs. Wood products transport, and road building and maintenance are included in indirect estimates. For further discussion please see the economic assessment methodology appendix.

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

7.2.3 Kispiox TSA employment income

From 1998 – 2000 the average annual income for direct forest sector employees was approximately $50,500 (depending on the type of forestry activity); and $31,500 for indirect and induced employment (in year 2000 dollars). Based on these averages, current harvesting, silviculture, and processing of timber from the Kispiox TSA generates an estimated $38.1 million in direct wages and salaries and $28.7 million in indirect and induced wages and salaries, annually throughout the province (see Table 15).

Table 15. Average annual direct and indirect/induced incomes and total employment income, 1997 –

	Average annual income (year 2000 dollar value)	Total annual income ($ millions)	Total income ($ per '000s m³)
Direct	50,500	38.1	42,075
Indirect / induced	31,500	28.7	31,700
Total income		66.8	73,775

Source: Statistics Canada, Survey of Employment Payrolls and Hours.

7.2.4 Provincial government revenues

Provincial government revenues from the forestry industry include stumpage, royalties and rent payments, other taxes such as logging, corporate capital, sales, property and electricity taxes, and income taxes from direct, indirect and induced employees.

From 1997 – 2000, average stumpage and rent payments for Crown timber in the Kispiox TSA were about $9.4 million per year. Forest and corporate taxes and revenues generated $6.9 million, while employment supported by the Kispiox timber harvest accounted for $5.7 million in provincial income taxes (see Table 16).

In the year 2001, average stumpage and rent payments fell to about $1.5 million, forest and corporate taxes and revenues to $2.9 million, and income taxes generated by forestry employment to about $2.3 million.

Table 16. Average annual provincial government revenues, 1997 – 2000

	Average annual revenue 1997 – 2000 (year 2000 dollar value)	Revenue ($ per '000s m³)
Stumpage, rents and royalties	9 425	10 400
Industry taxes	6 875	7 600
Provincial income tax	5 700	6 300
Total government revenues	22 000	24 300

7.3 Socio-economic implications of the base case harvest forecast

The base case harvest forecast suggests that a harvest level of 903 000 cubic metres per year (17% below the current AAC), could continue to decline by 10% per decade for eight decades until reaching the long-term harvest level of 430 000 cubic metres per year. The socio-economic analysis focuses on the short- to medium-term, and considers:

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

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The socio-economic analysis considers the average levels of forestry activity that the base case harvest forecast could support, assuming that employment changes by the same percentage as the harvest level, and that the proportion of harvesting, processing, and silviculture employment remains the same. Since the analysis also assumes that the types and proportions of products manufactured remain constant, it does not attempt to predict how timber flows, technology or product lines may change in response. The analysis provides an indication of the magnitude of impacts to expect within a constantly changing socio-economic environment.

Employment and income impacts are divided into direct, indirect and induced components; the sum of all the components is the total impact. Direct impacts reflect harvesting, silviculture, and processing activity. Indirect impacts are the result of direct businesses purchasing goods and services, and induced impacts are the result of direct and indirect employees spending their incomes on consumer goods and services.

Table 17 estimates the range of impacts the base case harvest forecast may have on employment and income. Ranges are utilized to reflect the uncertainties associated with workforce mobility given the availability of employment insurance and social assistance payments and their dampening effects in the shorter term. The lower end of the range reflects the diminished short-term impacts which result because employment insurance and social assistance provide income support to workers who would otherwise consider moving from the TSA. The upper end of the range represents long-term impacts when unemployed workers finally do leave the area, and local spending patterns are more fundamentally affected. In reality, a combination of these two scenarios — some workers staying and accessing social assistance payments, and some moving away from the area — is more likely to occur.

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

Kispiox TSA employment and income impacts

For accounting purposes, TSA employment and income includes only that of 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, and jobs supported by Kispiox TSA timber processed at mills outside the TSA, are included in the provincial impact section. Table 17 indicates the employment and income that could be supported within the Kispiox TSA by the base case harvest forecast. If fully harvested and processed, the initial base case harvest level of 903 000 cubic metres could support approximately 496 person-years of direct employment and another 146 indirect and induced person-years of employment within the timber supply area. Approximately $20.3 million (2000 dollar value) total after-tax annual income would be supported by the Kispiox timber supply.

Provincial employment and income impacts

Provincial employment and income impacts include all forest sector employment supported by the timber harvested from the Kispiox TSA, regardless of the location of the impacts. If the initial base case harvest level of 903 000 cubic metres is fully harvested and processed, the Kispiox TSA could support about 755 person-years of direct forestry employment and a further 909 person-years of indirect and induced employment across the province and contribute $49 million ($2000) in total after-tax annual income.

Provincial government revenue impacts

Based on current tax and stumpage rates, the base case harvest level of 903 000 cubic metres per year has the potential to provide $21.9 million annually to the provincial government (2000 dollar value), $4.5 million less than full utilization of the current AAC would have provided (assuming current taxation and stumpage rates do not change).

Table 17. Socio-economic impacts of the base case harvest forecast — Kispiox TSA

		Base case harvest forecast		
	Current	**Years 0+**	**Years 30+**	**Years 81+**
Timber supply ('000s m³)				
AAC	1 092	903	658	430
Harvest level (average 1997-2000)	906			
Cumulative change		– 183	– 428	– 656
Kispiox TSA				
Employment		(person-years)		
Direct	497	496	362	236
Indirect / induced	146	146	106	69
Total	644	642	468	306
Cumulative change in total person-years		(29) – 25	(193) – (154)	(349) – (323)
Net employment income		($ 2000 million)		
Direct	16.9	16.8	12.3	8.0
Indirect / induced	3.5	3.5	2.6	1.7
Total	20.4	20.3	14.8	9.7
Cumulative change in total income		(0.7) – 0.6	(6.0) – (5.0)	(11.0) – (10.3)
Province (includes Kispiox TSA)				
Employment		(person-years)		
Direct	757	755	550	359
Indirect / induced	912	909	663	433
Total	1,669	1,664	1,213	792
Cumulative change in total person-years		(154) – 144	(560) – (342)	(943) – (801)
Net employment income		($ 2000 million)		
Direct	27.4	27.3	19.9	13.0
Indirect / induced	22.1	22.0	16.1	10.5
Total	49.5	49.3	36.0	23.5
Cumulative change in total income		(3.8) – 3.5	(16.0) – (10.7)	(27.6) – (24.1)
Provincial government revenues		($ 2000 million)		
Provincial income tax	5.7	5.7	4.1	2.7
Stumpage and rent	9.4	9.4	6.8	4.5
Other B.C. revenues	6.9	6.8	5.0	3.3
Total B.C. revenues	22.0	21.9	16.0	10.4
Cumulative change in total revenue		(0.4) – 0.3	(6.2) – (5.7)	(11.6) – (11.3)

Note:

(1) Provincial employment includes both Kispiox TSA employment and employment supported outside the TSA by Kispiox TSA harvested timber.

(2) Estimates for employment income differ from those in Table 15. Income figures in Table 17 are net of taxes while those of Table 15 are gross income.

(3) The ranges for employment and income changes take into consideration employment insurance and other social assistance programs. The range's upper limit is based on the assumption that all those who are unemployed will leave the TSA. The lower limit is based on the assumption that employment insurance and other social assistance payments will reduce the induced impacts of a lower harvest level.

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The ranges for employment and income changes take into consideration employment insurance and other social assistance programs. The range's lower limit is based on the assumption of full and immediate labour force mobility. The higher limit is based on the assumption that in the short-term employment insurance and other social assistance payments will reduce the induced impacts of a lower harvest level.

7.3.2 Community level impacts

In 1996, the Kispiox timber harvest provided 30% of basic employment in the TSA. Given that, changes to the timber supply might be expected to have a fairly significant impact on the overall economic trends of the region. However, considering that the average 1997 – 2000 harvest level was almost 20% below the AAC, and that the 2001 harvest level was only 390 000 cubic metres, the impacts of the initial step down to 903 000 cubic metres will be not be significant.

7.3.3 Regional timber supply implications

The future of the regional timber supply is important to primary processing facilities in individual timber supply areas. In the Prince Rupert Forest Region, the previous timber supply review led to a 6.8% reduction in the coniferous component of the AAC, or about 600 000 cubic metres. In two to three decades, the annual timber supply from the Prince Rupert Forest Region may fall by another 5%, assuming that current forest management remains the same.

Mill level impacts will not occur solely as a result of changes in the volume of timber harvested from the TSAs in which they are located; they will also result from harvest changes that occur across the region. It is not possible to predict which mills and regions will be most affected, or if new "value added" operations will offset or exacerbate some of these changes.

7.4 Summary

The forestry sector is an important source of employment and income for the Kispiox TSA. Between 1997 and 2000, 30% of the TSA's employment base resulted from the Kispiox harvest. The potential impact of the base case forecast could be minimal as the first decade of the forecast shows a harvest level which is approximately at the same level as the 1997 – 2000 average harvest. The long-term projected level (430 000 cubic metres per year) is higher than the actual 2001 harvest level.

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9 Glossary

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

Analysis unit
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.

Base case harvest 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.

Biodiversity (biological diversity)
The diversity of plants, animals and other living organisms in all their forms and levels of organization, including 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 subzone. 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.

Clearcut harvesting
A harvesting method in which all trees are removed from an area of land in a single harvest. The harvested site is then regenerated to acceptable standards by appropriate means including planting and natural seeding. Note that retention of some live trees and snags for purposes of biodiversity now occurs on most clearcuts.

Coniferous
Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.

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.

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

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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.

Deciduous
Deciduous trees shed their leaves annually and commonly have broad-leaves.

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, impediments to establishing a new tree crop, or high risk of 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 and Green–up**).

Forest Ecosystem Network (FEN)
An area that serves to maintain or restore the natural connectivity within an area.

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

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Landscape-level biodiversity

The *Landscape Unit Planning Guide* provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.

Landscape unit

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

Long-term harvest level

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

Management assumptions

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

Mean annual increment (MAI)

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

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.

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 subject to less frequent stand-initiating disturbances usually have more older forests.

Not satisfactorily restocked (NSR) areas

An area not covered by a sufficient number of well-spaced trees of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.

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Old seral	Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.
Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Partial retention VQO	Alterations may be visible but not conspicuous. Up to 15% of the area can be visibly altered by harvesting activity (see **Visual quality objective**).
Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.
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.
Regeneration delay	The period of time between harvesting and the date at which an area is occupied by a specified minimum number of acceptable well-spaced trees.
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.
Sensitivity analysis	A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.
Seral stages	Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.

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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.
Table Interpolation Program for Stand Yields	A B.C. Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.
Timber harvesting land base	Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.
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*.
Unsalvaged losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.
Variable Density Yield Prediction model	An empirical yield prediction system supported by the B.C. Forest Service, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed composition.

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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.

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.

Woodlot licence
An agreement entered into under the *Forest Act*. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.

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 Kispiox 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.

More detail on the derivation of many of the land base exclusions and modelling approaches is available in the October 2000 *Kispiox Timber Supply Area Timber Supply Review Data Package*. This appendix includes any change to the assumptions contained in the data package that were made as a result of its public review or any developments in current management that occurred after the data package was published. Any changes are noted in the appropriate section of this appendix.

A.1 Inventory Information

Table A-1. Inventory information

Data	Source	Vintage	Update	Datum
Forest cover	Ministry of Forests (MoF)	1992	1997	NAD83
Landscape units and biodiversity emphasis assignment	MoF/Ministry of Environment, Lands and Parks (MELP)	1998/1999		NAD83
Riparian reserve and management areas	MoF	1999		NAD83
Visual landscape inventory	MoF	1999		NAD83
Telegraph Trail	MoF	1995	1999	NAD83
Mill Creek sensitive area	MoF	1998		NAD83
Babine wetland buffers	MoF	1998		NAD83
Babine treatment units	Babine LRUP	1993		NAD27
Babine sub-drainages	Babine LRUP	1993	1999	NAD83
Resource management zones from LRMP	Kispiox LRMP	1996		NAD27
Community watersheds	MoF	1996		NAD27
Chart areas	MoF	Unknown	1999	NAD27
New parks	MELP	1998/1999		NAD83
Seven Sisters protected area	MoF	1999		NAD83
Harvest priority areas	MoF	1999		NAD83
Mule deer winter range (MDWR)	MoF	1999		NAD83
Terrain stability mapping	MoF	1999		NAD83

Data source and comments:

Landscape unit boundaries and their respective biodiversity emphasis assignments have not been established by the district manager. The draft information was used to perform sensitivity analysis related to landscape-level biodiversity.

Riparian reserve zones and management zones were generated with a geographic information system (GIS) analysis using terrain resource information management (TRIM) and slope data.

A visual landscape inventory was finalized for the entire TSA in 1999. This inventory identifies the visual condition, characteristics and sensitivity to alteration of many areas.

The Telegraph Trail has high archaeological values.

A.1 Inventory Information

As approved by the district manager in 1998, the Mill Creek Sensitive Area Plan describes special management constraints to be applied in the Mill Creek sensitive area.

The Babine Local Resource Use Plan (LRUP) identifies six treatment units (Riparian Ecosystems, Forest Ecosystem Networks, Linkage Areas, High Grizzly Bear Habitat, Moderate Grizzly Bear Habitat, and the Integrated Resource Management Zones) and a special management zone. These all have specific management objectives. The Babine LRUP also specifies special management objectives in a number of sub-drainages: Shedin, Shenismike, Shelagyote North, Shelagyote South, and Gail. Management strategies for important grizzly bear habitat are also identified in the Babine LRUP.

The Kispiox Land and Resource Management Plan (LRMP), approved by Cabinet in 1996, identifies specific management objectives for three resource management zones: special management zones, community watersheds and integrated resource management zone.

In the Big Slide Chart Area, located within the Babine LRUP area, specific management constraints are applied.

Four new parks have been established since the last timber supply review: Swan Lake/Kispiox River Park, Babine River Park, Kitwanga Mountain Park, and Bulkley Junction Park. A fifth area, Catherine Creek, was designated as an ecological reserve. As these parks and the ecological reserve are not identified in the forest cover inventory; the information from the non-standard overlay was used to determine the portion of land not administered by the B.C. Forest Service for timber supply.

The Seven Sisters area has been deferred from logging since 1987. A land-use consensus decision was reached in 1997 and approved by Cabinet in March of 1999. Under this consensus, 42 208 hectares are to be protected from logging and mining developments. The area was officially designated as a park in 2001.

The mule deer winter range mapping was used to define the area subject to forest cover requirements from the LRMP.

A harvest priority map was used to identify which areas will not be available for harvest for the next decade due to access constraints.

Terrain stability mapping, completed in 1999, was used to determine the location and size of reductions to the land base to account for unstable terrain.

A.2 Zone and Analysis Unit Definitions

A.2.1 Management zones (grouping) and objectives

For the purpose of modelling current forest management, several resource emphasis groupings were defined for this analysis based on the forest management objectives shown in Table A-2.

Table A-2. Objectives to be tracked

Objectives	Inventory definition
Landscape-level biodiversity by landscape unit and BEC variant	Non-standard mapped layer — see Table A-1.
Visual quality objectives by landscape unit and visual quality class as modified by visual sensitivity class	Non-standard mapped layer — see Table A-1.
Babine LRUP treatment units and sub-drainages	Non-standard mapped layer — see Table A-1.
Community watershed	Non-standard mapped layer — see Table A-1.
Deer winter range	Non-standard mapped layer — see Table A-1.
LRMP integrated resource management objectives by landscape unit — old growth	Non-standard mapped layer — see Table A-1.
LRMP integrated resource management objectives by landscape unit — equivalent clearcut area (ECA)	Non-standard mapped layer — see Table A-1.
LRMP integrated resource management objectives by landscape unit — adjacency/green-up	Non-standard mapped layer — see Table A-1.
Mill Creek Sensitive Area (SA) objectives	Non-standard mapped layer — see Table A-1.

A.2.2 Analysis unit characteristics

An analysis unit is composed of forest stands that have similar tree species composition, timber growing capability and treatment regimes. Each analysis unit is assigned its own timber volume projections (yield tables) for existing and future stands. Yield tables for existing natural stands will be derived using the variable density yield prediction (VDYP) model. Yield tables for recent plantations and future stands will be derived using the table interpolation program for stand yields (TIPSY).

The following table defines the analysis units used for existing stands.

A.2 Zone and Analysis Unit Definitions

Table A-3. Definition of analysis units for existing natural stands

		Criteria		
	Analysis unit	Inventory type groups (ITG)	Site index range (m @ 50 years)	Age class
1.	Hemlock/cedar — good	9-17	≥ 20.0	≤ 7
2.	Hemlock/cedar — medium	9-17	H: 14.0 – 19.9 C: 15.0 – 19.9	≤ 7
3.	Hemlock/cedar — poor	9-17	H: < 14.0 C: < 15.0	≤ 7
4.	Balsam — good	18-20	≥ 21.0	≤ 7
5.	Balsam — medium	18-20	15.0 – 20.9	≤ 7
6.	Balsam — poor	18-20	< 15.0	≤ 7
7.	Spruce — good	21-26	≥ 27.0	≤ 7
8.	Spruce — medium	21-26	16.0 – 26.9	≤ 7
9.	Spruce — poor	21-26	< 16.0	≤ 7
10.	Pine — good	28-31	≥ 22.0	≤ 7
11.	Pine — medium	28-31	15.0 – 21.9	≤ 7
12.	Pine — poor	28-31	< 15.0	≤ 7
13.	Cottonwood/coniferous — good	35	≥ 37.0	All
14.	Cottonwood/coniferous — medium	35	28.0 – 36.9	All
15.	Cottonwood/coniferous — poor	35	< 28.0	All
51.	Old hemlock/cedar — good	12-17	≥ 20.0	8 & 9
52.	Old hemlock/cedar — medium	12-17	H: 14.0 – 19.9 C: 15.0 – 19.9	8 & 9
53.	Old hemlock/cedar — poor	12-17	H: < 14.0 C: < 15.0	8 & 9
54.	Old balsam — good	18-20	≥ 21.0	8 & 9
55.	Old balsam — medium	18-20	15.0 – 20.9	8 & 9
56.	Old balsam — poor	18-20	< 15.0	8 & 9
57.	Old spruce — good	21-26	≥ 27.0	8 & 9
58.	Old spruce — medium	21-26	16.0 – 26.9	8 & 9
59.	Old spruce — poor	21-26	< 16.0	8 & 9
60.	Old pine — good	28-31	≥ 22.0	8 & 9
61.	Old pine — medium	28-31	15.0 – 21.9	8 & 9
62.	Old pine — poor	28-31	< 15.0	8 & 9

A.2 Zone and Analysis Unit Definitions

Data source and comments:

Separate analysis units were created for the old-growth component (age class 8 and 9, i.e., 141 years and older) of each coniferous analysis unit. This facilitated the critical issue analysis of old-growth site index adjustments following harvest.

The original data package specified separate analysis units for cedar-leading stands. These stands occupied a small area and were subsequently combined with the hemlock-leading stands. However, the original site index criteria for cedar stands was retained when defining analysis units.

A.3 Definition of the Timber Harvesting Land Base

This section outlines the steps used to identify the timber harvesting land base (the productive forest expected to support timber harvesting) within the Kispiox TSA. Land may be unavailable for timber harvesting for three principal reasons:

- it is not administered by the Forest Service for timber supply (e.g., private land, parks, etc.);
- it is not suitable for timber production; or
- it is required for other forest values.

The classification of 'unavailable for timber harvesting' applies only to land where no harvesting is anticipated. Any area in which some timber harvesting is expected to occur remains in the timber harvesting land base, even if the area is subject to management constraints. Such constraints were represented in the timber supply analysis.

After all areas that do not contribute to the timber harvesting land base are identified, the resulting land base is defined as the "current timber harvesting land base" for the Kispiox TSA.

A.3.1 Land not administered by the British Columbia Forest Service for timber supply

Ownership codes were used to identify whether the land was considered to contribute to timber supply. Generally, only ownership codes 62C and 69C contribute to the TSA timber supply. These codes indicate Crown land in a forest management unit and miscellaneous reserves (including recreation sites), respectively. All areas with other ownership codes were removed from the land base considered available for timber supply. New parks and ecological reserves that were created since the last timber supply review, and which did not have their ownership updated in the forest cover inventory, were removed. These include Swan Lake/Kispiox River, Seven Sisters, Kitwanga Mountain, Babine River Corridor, and Bulkley Junction parks and Catherine Creek Ecological Reserve.

Seven Sisters Park has been officially designated since the data package was published, but was excluded as noted above.

A.3.2 Land classified as non-forest

Areas with projected type identity 6 are non-forest or non-productive forest, and areas with projected type identity 8 have no typing available. These categories include alpine areas, lakes, swamps, rivers, rock, and ice, which do not contribute to timber supply.

A.3.3 Non-commercial cover

Areas with projected type identity 5 are occupied by non-commercial brush species. These areas are considered to be unlikely sites for timber production and were excluded from the area considered available for timber harvesting.

A.3.4 Environmentally sensitive areas

Some forest lands are environmentally sensitive and/or significantly valuable for other resources. These areas are identified and delineated during a forest inventory as environmentally sensitive areas (ESAs). The ESA system uses the following categories: soil (Es), forest regeneration problems (Ep), snow avalanche (Ea), recreation (Er), wildlife (Ew), water (Eh) and fisheries (fisheries symbols). With the exception of avalanche and fisheries, two ESA categories are recognized: high and moderately sensitive.

A.3 Definition of the Timber Harvesting Land Base

Environmental sensitivity may reduce or preclude harvesting on identified sites, which can be accounted for through per cent area reductions or specific evaluation of individual ESA polygons for harvesting opportunity.

Table A-4. identifies the proportion of ESAs in various categories that are unavailable for harvesting.

Table A-4. Land base exclusions for environmentally sensitive areas

ESA category	ESA description	Reduction per cent (%)
Ea	Areas having severe snow chute and avalanche problems.	100
Classes V and U from terrain stability mapping	Area with a high likelihood of landslide initiation following timber harvesting or road construction.	100
Classes IV and P from terrain stability mapping	Area with a moderate likelihood of landslide initiation following timber harvesting or road construction.	95

Data source and comments:

The current ESAs were mapped in the early 1970's and were seldom used in forest resources management planning as other mapping data provided more valuable information. There was also some uncertainty about the reliability of the ESA classification, particularly for the soil and regeneration categories. This recognition led the chief forester to direct district staff to "re-examine environmentally sensitive areas and their corresponding incorporation in or exclusion from the timber harvesting land base" in his 1996 *Rationale for Allowable Annual Cut (AAC) Determination in the Kispiox Timber Supply Area (TSA).*

The results of this re-examination for the soil and regeneration categories are described in detail in the data package. In summary:

- Terrain stability mapping was used to replace ESA mapping for sensitive soils. Potentially unstable sites (class IV) had a 95% removal unless the area had already been logged (activity=L). Sites with a high likelihood of landslide (class V) were completely removed.
- Mapping of ESAs for areas with regeneration problems (Ep) was found to be inaccurate because many of these areas were logged and regenerated or overlapped with riparian areas. No reductions were made for this factor.
- ESAs for wildlife (Ew) were replaced by specific habitat mapping, such as critical deer winter range or grizzly bear habitat. Parts of these areas were removed from the timber harvesting land base (Table A-10., "Exclusion of specific, geographically defined areas") and parts of them were assigned specific forest cover requirements.

A.3 Definition of the Timber Harvesting Land Base

A.3.5 Inoperable areas

Operability codes are generally based on the presence or absence of physical barriers or limitations to harvesting, appropriate logging methods (e.g., cable), and the merchantability of stands. Table A-5. lists the operability classes that were removed from the timber harvesting land base.

Table A-5. Description of inoperable areas

Inventory description	Code	Reduction per cent (%)
Operability	I or N	100

Data source and comments:

The operability lines were established in 1988. Areas with slopes greater than 70%, rock outcrops, steep gullies, avalanche tracks, and isolated small stands of timber were all considered as economically or physically inoperable. Areas with average volumes below 150 – 200 cubic metres per hectare, and areas where road building would be too difficult or too costly were also considered to be inoperable. These criteria still represent current management practices although a minor adjustment of the operability lines was done in 1999 to account for physical accessibility constraints in a small portion of the TSA.

Helicopter logging was not considered when the current operability lines were established. However, some areas currently classified as inoperable have potential for helicopter logging, and have been identified as such on some recent Forest Development Plan submissions. Cutting permit applications for these proposed areas have not yet been submitted, and as the potential harvest is linked to high market value, it is unknown when logging may occur.

A.3.6 Sites with low timber growing potential

Sites may have low productivity either because of inherent site factors (nutrient availability, exposure, excessive moisture, etc.), or because they are not fully occupied by commercial tree species. Typically, these stands are intermixed with other stands within the forested land base. As these stands were not considered to be harvestable, they were identified and removed from the timber harvesting land base.

Table A-6. Description of sites with low timber growing potential

Zone/ group	Inventory type group	Characteristics			
		Age (years)	Volume (m^3/hectare)	Site index	Reduction per cent (%)
All	9-11 Cedar	> 200	< 200	< 10.0	100
All	12-17 Hemlock	> 200	< 200	< 7.8	100
All	18-20 Fir	> 200	< 200	< 9.0	100
All	21-26 Spruce	> 200	< 200	< 7.2	100
All	28-31 Pine	> 200	< 200	< 9.5	100
All	35 Cottonwood/coniferous	> 200	< 200	< 19.0	100

Data source and comments:

A review of current forest management practices revealed that stands that do not achieve a minimum coniferous volume of 200 cubic metres per hectare are not suitable for harvest. Variable density yield prediction (VDYP) was used to determine the minimum site index at which each species group would produce 200 cubic metres per hectare at age 200. All stands below the minimum site index were removed from the timber harvesting land base, except for NSR areas (where the site index information is uncertain), young managed stands, and those old stands that currently have more than 200 cubic metres per hectare of coniferous volume.

A.3.7 Problem forest types

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

Table A-7. Problem forest types criteria

Description	Inventory type group	Characteristics	
		Stocking class	Reduction per cent (%)
Low/dense stocking pine	28-31	2, 3, 4	100
Low stocking other species	9-21, 23-26, 35	2	100
Deciduous stands other than cottonwood/coniferous stands	36-45	—	100

Data source and comments:

A review of current management practices revealed that all coniferous stands with fewer than 76 stems per hectare with a diameter at breast height (dbh) of at least 27 cm are not harvested. A further subdivision of this category (stocking class 3 and 4) applies to lodgepole pine-leading stands to characterize stagnant (stocking class 3) stands or stands with low density and few large stems (stocking class 4).

Except for cottonwood/coniferous stands (inventory type group 35), deciduous stands do not contain sufficient coniferous volume to be merchantable.

Not satisfactorily restocked (NSR) areas were not excluded based on these problem forest type criteria because of uncertain species composition information.

A.3.8 Wildlife habitat reductions

Managing Identified Wildlife: Procedures and Measures describes management prescriptions including core "no harvesting" areas around nesting sites or other valuable habitats for endangered species. However, no wildlife habitat areas have been identified in the Kispiox TSA under the Identified Wildlife Management Strategy at this time.

Treatment units 1, 2 and 4 of the Babine local resource use plan (LRUP) have wildlife management objectives in addition to biodiversity and riparian objectives. These exclusions are all accounted for in Table A-10. (Section A.3.11, "Exclusion of specific, geographically defined areas").

Objectives for deer winter range are discussed in Section A.4.11, "Forest cover requirements."

A.3.9 Cultural heritage resource reductions

Table A-8. lists the areas with cultural heritage values that were removed from the area considered available for timber harvesting.

Table A-8. Cultural heritage resources

Location	Excluded area (hectares)	Reason for exclusion
Telegraph Trail	100 metres on each side of the trail	Current management practices exclude harvesting along the trail.

Data source and comments:

The Telegraph Trail Management Plan, approved by the district manager in 1995, specifies that a buffer of 100 metres must be left on each side of the trail. The Telegraph Trail is also in the process of being established under the *Heritage Act of B.C.*

The Old Kuldo Interpretive Trail accesses an ancient village site along the Skeena River. Because this area is being protected through other land base exclusions (riparian), no further exclusions were applied.

There are several known sites with cultural heritage value in the Kispiox timber supply area. As cultural heritage inventory studies, archaeological impact assessments, and traditional-use survey results become available, they will be considered in the timber supply review process.

A.3.10 Riparian reserve and management zones

Table A-9. lists the area reductions that were applied to account for riparian reserve zones and riparian management zones along streams and around lakes and wetlands. These areas include:

- areas identified by a stream classification and mapping project for riparian reserve zones or riparian management zones under the *Forest Practices Code*;
- riparian no-harvest areas from the Babine LRUP;
- floodplain areas.

A.3 Definition of the Timber Harvesting Land Base

Table A-9. Riparian reserve zones

Riparian class	TRIM definition	Gradient	Riparian reserve zones (RRZ) (metres)	RRZ per cent (%) reduction	Riparian management zones (RMZ) (metres)	RMZ per cent (%) reduction
Low bench	Floodplains of Kitwanga, Gitsegukla, Kispiox, Suskwa, Sicintine, Shelagyote, Cranberry rivers	All	All	100	0	0
Mid bench	Floodplains of Kitwanga, Gitsegukla, Kispiox, Suskwa, Sicintine, Shelagyote, Cranberry rivers	All	All	100	0	0
High bench	Floodplains of Kitwanga, Gitsegukla, Kispiox, Suskwa, Sicintine, Shelagyote, Cranberry rivers	All	0	0	All	25
S1	Skeena, Kispiox, Babine, Sicintine, Gitsegukla, Kitwanga and Suskwa rivers	All	50	100	20	25
S2/S3	River/stream left bank and right bank	All	25	100	20	25
S3/S4	River/stream — definite	< 20%	10	100	25	25
S4	River/stream — indefinite and intermittent	< 20%	0	0	30	25
S6	River/stream — definite, indefinite, and intermittent	> 20%	0	0	20	5
L1	> 5 hectares	N/A	10	100	0	0
L3	< 5 hectares	N/A	0	0	30	25
W1	> 5 hectares	N/A	10	100	40	15
W3	< 5 hectares	N/A	0	0	30	15
W5	Wetland complex	N/A	10	100	40	15

Data source and comments:

A geographic information system (GIS) analysis was completed for the Kispiox TSA in 1999 using TRIM and slope data to determine the extent of riparian area in the TSA. Fish inventory information was incorporated into the analysis, where available. The resulting map layer consists of stream buffers that identify riparian reserve zones (RRZ) and riparian management zones (RMZ). The assumptions used to create the coverage are presented in the above table and are consistent with the *Forest Practices Code*. A separate floodplain mapping project identified high-, mid- and low-bench areas. Discussions between the Kispiox Forest District staff and the forest ecosystem specialist of the former Ministry of Environment, Lands and Parks (MELP) led to agreement (and district operating procedure) that harvesting was feasible in high bench areas, so they are treated as a RMZ, whereas mid and low benches are treated as a RRZ.

Current management practice (reflected through a district operating procedure) involves 25% retention within all riparian management zones from S1 to S4. Only 5% retention is required on S6 streams.

The GIS analysis was not able to differentiate between S5 and S6 streams. Streams having > 20% gradient and > 3 metres wide (S5) are unusual in this district and have been combined with the S6 streams for the analysis. The GIS data do not identify the wetland class for wetland RMZs, so all wetland RMZs have a common reduction factor of 15%, which reflects an average percentage retention for W1, W3 and W5 wetlands.

A.3.11 Exclusion of specific, geographically defined areas

Table A-10. describes additional areas excluded from the timber harvesting land base to account for area exclusions not discussed in previous sections.

Table A-10. Exclusion of specific, geographically defined areas

Inventory source	Area description	Excluded area (hectares)	Reason for exclusion
Babine LRUP	TU[a] 1: Riparian Ecosystems	All	No harvest
Babine LRUP	TU 2: Forest Ecosystem Networks	All	No harvest
Babine LRUP	TU 4: High Value Grizzly Bear Habitat	100 metres buffer around all wetlands	No harvest
Non-standard mapping	Mill Creek Sensitive Area — Cedar stand and reserve zone	All	No harvest

(a) TU = treatment unit.

Data source and comments:

Treatment Unit 1 (Riparian Ecosystem, upland buffers/movement corridors) and Treatment Unit 2 (Forest Ecosystem Networks) are no harvest zones according to the Babine LRUP and current management practices.

To provide screening for grizzly bears in Treatment Unit 4 (High Value Grizzly Bear Habitat) of the Babine LRUP, the plan requires that a 100-metre buffer be retained around all high value wetlands in and around cutblocks, and that roads be constructed no closer than 150 metres to high value wetland habitat. For the analysis, a 100-metre buffer around all wetlands in TU 4 was assumed, since timber harvesting can occur between roads and wetlands as long as a 100-metre buffer is retained.

The Mill Creek Sensitive Area Plan*,* approved by the district manager in 1998, reserves from harvest a rare cedar stand and adjacent reserve zone.

A.3 Definition of the Timber Harvesting Land Base

A.3.12 Roads, trails and landings

Separate estimates are made to reflect the loss in productive forest land due to existing and future roads, trails and landings (RTL). Existing RTL estimates were applied as reductions to the current productive forest considered available for harvesting. Future RTL reductions were applied after stands are harvested for the first time in the timber supply model.

Table A-11. Estimates for existing and future roads, trails, and landings

Existing RTLs	Road length (km)	Road width (m)	Road area (ha)	Reduction area for age classes 1 and 2 (ha)	Reduction area for age classes 3+ (ha)
Logging road	1 734.6	15.5	2 688	1 586	1 102
Trail	724.1	14.0	1 014	814	200
Secondary road	27.6	30.0	83	37	46
Highway	1.8	40.0	7	2	5
Landings			1 133	1 133	0
Total			4 925	3 572	1 353
Future RTLs					4.4%

Data source and comments:

Road lengths were obtained by overlaying the entire road network with the timber harvesting land base and calculating the length of roads intersecting the timber harvesting land base. As shown in the above table, road types are differentiated by a code (FCODE) in the forest cover inventory file. A visual review of the road coding reveals that the trails usually represent in-block roads or old brushed-in roads. Logging roads and generic roads can either represent a main road or an in-block road.

Road width estimates were obtained from various district staff familiar with permanent access measurements throughout the district. Staff indicated that main road widths vary from 15.5 metres to 18.5 metres, while in-blocks road widths (cut-to-fill) vary from 12.5 metres to 15.5 metres. To reflect the fact that individual road coding applies to more than one road type, an average width of 14 metres was used for trails and 15.5 metres for logging roads and generic roads. Average widths of highways and secondary roads were estimated at 40 metres and 30 metres, respectively. There were no reductions to account for recreation trails.

Reduction areas for regenerating stands (age class 1 and 2) and older stands (age classes 3+) were calculated with the help of a GIS system. A buffer was applied to each road type (logging road, trail, secondary, and highway), and the buffer was overlaid onto the preliminary timber harvesting land base. The area of overlap between the two groups of age classes and the buffered road was then calculated.

The area occupied by landings was obtained from silviculture records and Soil Conservation Surveys conducted in 1995, 1997, and 1998. These surveys show that the average area occupied by landings was 1.4% of the gross cutblock area surveyed. According to the silviculture databases, the total gross cutblock area for the TSA is 80 952.5 hectares. Assuming the same percentage of landings in the unsurveyed cutblocks, the area occupied by landings amounts to 1133.3 hectares.

The reductions for existing RTL were not applied in unallocated chart areas, community watersheds and special management zones, because there are no roads in those areas.

The Soil Conservation Surveys also showed that 4.4% of the gross cutblock area is occupied by RTLs. This percentage will be applied to all stands in age classes 3-9 as they are harvested for the first time in the timber supply model to estimate future productivity losses.

Reductions for existing RTL were revised after the data package was published, based on buffering roads in a geographic information system, as described above.

A.4 Current Forest Management Assumptions

A.4.1 Woodlots

The current AAC for the Kispiox TSA, as determined in 1996, is 1 092 611 cubic metres per year. Since the 1996 AAC determination, 6284 cubic metres per year have been allocated to new or expanded woodlot licences. Therefore, the current harvest level (which excludes allocated woodlot licences) for this analysis is considered to be 1 086 327 cubic metres per year. The original data package showed an incorrect amount of 6406 cubic metres as the additional AAC allocated to woodlot licences since 1996.

A.4.2 Utilization levels

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

Table A-12. Utilization levels

	Utilization		
Analysis unit	**Minimum dbh (cm)**	**Maximum stump height (cm)**	**Minimum top dib (cm)**
All pine	12.5	30	10
All other species	17.5	30	10

A.4.3 Volume exclusions for mixed species stands

The purpose of this section is to identify any species in mixed species stands that are unmerchantable. The unharvested portion of a stand does not contribute to the estimated stand volume. Table A-13. shows the species, excluded from affected stands.

Table A-13. Volume exclusions for mixed species types

Inventory type group	Species	Volume exclusion (%)
All	All deciduous except cottonwood	100
All	Cottonwood	50

Data source and comments:

Cottonwood is the only deciduous species that is commercially harvested along with coniferous species. Since much of the volume is left standing for biodiversity objectives or felled to waste, it is estimated that only 50% of the cottonwood volume in mixed-wood stands is utilized. This proportion is based on a comparison of cruised and scale volumes for cottonwood in a sample of mixed-wood stands.

A.4.4 Minimum harvestable age derivation

The minimum harvestable age is the age at which a stand is considered to be harvestable. While harvesting may occur in stands at the minimum ages to meet forest level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large changes in harvest levels), most stands will not be harvested until past the minimum ages because of management objectives for other resource values (e.g., requirements for the retention of older forest). Table A-14. shows the minimum harvestable ages used in the analysis.

Table A-14. Minimum harvestable ages

		Natural stands				Managed stands
	Analysis unit	Clearcut and patch cut	Partial cut (3 entry)	Babine TU3 non-clearcut (4 entry)	Mill Creek non-clearcut (2 entry)	Clearcut and patch cut
1.	Hemlock/cedar — good	64	196	300	90	52
2.	Hemlock/cedar — medium	77	203	300	107	72
3.	Hemlock/cedar — poor	111	298	300	153	123
4.	Balsam — good	64	140	246	88	45
5.	Balsam — medium	89	240	300	135	68
6.	Balsam — poor	149	300	300	229	123
7.	Spruce — good	63	224	300	89	63
8.	Spruce — medium	87	300	300	136	87
9.	Spruce — poor	131	300	300	221	131
10.	Pine — good	69	300	300	110	40
11.	Pine — medium	86	300	300	144	58
12.	Pine — poor	124	300	300	300	108
13.	Cottonwood/conif. — good	150				150
14.	Cottonwood/conif. — medium	150				150
15.	Cottonwood/conif. — poor	150				150
51.	Old hemlock/cedar — good	55				52
52.	Old hemlock/cedar — medium	75				78
53.	Old hemlock/cedar — poor	114				132
54.	Old balsam — good	64				42
55.	Old balsam — medium	86				72
56.	Old balsam — poor	153				128
57.	Old spruce – good	66				37
58.	Old spruce — medium	84				60
59.	Old spruce — poor	138				111
60.	Old pine — good	76				39
61.	Old pine — medium	78				64
62.	Old pine — poor	117				98

A.4 Current Forest Management Assumptions

Data source and comments:

Deciduous analysis units are ineligible for partial cutting regimes. "Old" analysis units (age classes 8 and 9) are not identified in areas where partial cutting regimes occur. Regeneration in these analysis units would experience substantial shading and would not be eligible for a site index adjustment for old stands.

A review of Silviculture Prescription and Cutting Permit applications for the 1994-1999 period reveals that only stands having a volume of 200 cubic metres per hectare and more are harvested. This is the minimum criteria for clearcut and patch cut stands. The only exceptions are cottonwood analysis units for which the ages are set at 150 years.

Partial cutting regimes require a minimum harvest volume of 150 cubic metres per hectare at the first harvest entry. This was multiplied by the number of entries (2 to 4) for the particular regime to determine the minimum volume required to make an analysis unit eligible for harvesting, i.e., 300 cubic metres per hectare for Mill Creek, 450 for 3-entry partial harvesting, and 600 for Babine Treatment Unit 3. Where these criteria could not be met, the minimum harvestable age was set at 300 years. Minimum harvestable ages under subsequent entries for partial cutting regimes are determined by the time between entries specified in Table A-16., "Silvicultural systems."

A.4.5 Harvest scheduling priorities

Table A-15. shows the priorities applicable to certain management zones or analysis units to reflect insect infestations, salvage operations or similar forest management activity.

Table A-15. Priorities for scheduling the harvest

Description	Management zone or location	Analysis unit	Period (years)	Scheduling priority
Remote area with no infrastructure (portions of Atna LU and Atna/ Shelagyote SMZ)	Harvest priority coverage = 'No'	All	10	No harvest
Unallocated areas	Licensee = 'unallocated'	All	5	No harvest
Big Slide Chart	Chart name = 'Big Slide'	All	70	No harvest

Data source and comments:

A large portion of the Atna landscape unit (LU) and a portion of the Atna/Shelagyote special management zone (SMZ) have not yet been accessed and it is estimated that it will take a minimum of ten years before any road system can be developed in the area. This area should therefore not be considered available for harvest in the timber supply model until year 11.

Unallocated areas have never been harvested, have no Forest Development Plan in progress or approved, and have not yet undergone a Timber Allocation Plan. These areas will not be harvested in the next five years, as they are currently physically inaccessible. All other areas in the TSA are accessed or expected to be within five years, except for the Atna deferral area as described above.

Logging activities in the Big Slide Chart area, located within the Babine LRUP zone, were completed in 1999. As per the LRUP direction and current management practices, this area will not be available for harvest for the next 70 years.

A.4 Current Forest Management Assumptions

A.4.6 Silvicultural systems

Table A-16. lists the silvicultural systems currently employed in the Kispiox TSA and the respective silvicultural regime.

Table A-16. Silvicultural systems

Silvicultural system	Eligible analysis units or locations	Per cent (%) retention	# of entries	Time between entries (years)
Clearcut and clearcut with reserves	78% of area in coniferous analysis units and 100% of deciduous analysis units	0 (see data source and comments)	1	N/A
Even age patch cuts (> 1 hectare)	4% of area in coniferous analysis units	50	2	30
Uneven age partial cutting	18% of area in coniferous analysis units	67	3	30
Non-clearcut system	Babine LRUP TU 3	75	4	25
Non-clearcut system	Mill Creek management zone	50	2	50

Data source and comments:

For 1987 to 1999, FTAS records indicate that 94% of the area harvested was harvested using clearcut or clearcut with reserve systems. The remaining area was harvested by non-clearcut systems. However there is a significant difference for 1996 to 1998. If only those three years are used, the percentage of clearcut and clearcut with reserves drops to 78%. This trend of increasing partial cutting continues in the current (approved) Forest Development Plans. The percentages for 1996 to 1998 are used as they reflect the *Forest Practices Code* and best represent current management.

Tree patches and reserves left with clearcut systems overlap with riparian reserve and management zones and wildlife tree patches.

The Babine LRUP states that only single tree selection will be allowed in treatment unit 3 (Linkage Area). This has been interpreted as non-clearcut systems.

The Mill Creek sensitive area management zone objectives and strategies state that a non-clearcut system with 50% basal area removal is permitted.

Areas within coniferous analysis units outside of Babine LRUP treatment unit 3, and Mill Creek management zone were randomly assigned to analysis units for clearcut, small patch, and uneven-aged partial cutting to meet the target percentages shown in Table A-17.

Small patch cutting is modelled as a variation of an adjacency/green-up requirement, using a forest cover constraint that allows a maximum of 33% of the area to be less than 50 years old (the time between entries). This is applied to the timber harvesting land base within areas subject to patch cutting in each landscape unit. Refer to Section A.6, "Volume estimates for partially cut stands" for a discussion of how partial cutting is modelled.

A.4 Current Forest Management Assumptions

A.4.7 Unsalvaged losses

Table A-17. shows the estimate of average annual unsalvaged volume lost to insect and disease epidemics, fires, wind damage or other agents on the timber harvesting land base. The unsalvaged loss column reflects only areas where the volume is not expected to be recovered or salvaged.

Table A-17. Unsalvaged losses

Cause of loss	Affected volume (m^3/year)	Annual unsalvaged loss (m^3/year)	
		1st decade	10th + decade
Wildfire	254 224	12 105	12 105
Balsam bark beetle	228 012	138 525	13 850
Tomentosus root disease	52 000	52 000	52 000
Windthrow	15 674	735	735
Total	549 910	203 365	78 690

Data source and comments:

Wildfire and windthrow unsalvaged losses

Data was obtained from the inventory file for fires from 1978 to 1988, and from the Northwest Fire Centre for the period 1989 to 1998. The total activity period for this analysis covers the years 1978 to 1998 (21 years). The inventory file contains records of wildfire and salvage activity beginning in 1958. Wildfire/salvage activity for 1958 to 1977 was not used in data compilation due to the extraordinarily high fire activity during 1958 to 1961 period and the absence of reliable data covering the period 1962 to1977 (i.e., large number of fires and area burned and no records available respectively). Data selection was limited to the timber harvesting land base of the Kispiox TSA.

Data was extracted from the inventory, and the total activity period covers 1971 to 1991 (21 years). No records related to windthrow are available in the inventory for periods prior to 1971 or after 1991. Data selection was limited to the timber harvesting land base of the Kispiox TSA. Cutblock-edge blowdown was not quantified, as no reliable data sources exist.

To estimate the volume losses, the total area burned or blown down was calculated. For the same areas, the size of the area salvaged was calculated. The difference represents the unsalvaged area. Volume losses were estimated by using the average volume per hectare for all merchantable stands in the TSA from the *Kispiox TSA Inventory Audit* (387 cubic metres per hectare).

Balsam bark beetle losses

A study by the Regional Entomologist estimated balsam volumes lost due to balsam bark beetle for balsam-leading stands 101 years and older in the ESSF and ICH BEC zones. The losses were estimated as 7.82 cubic metres per hectare per year for ESSF in forest inventory zone (FIZ) I, 4.22 cubic metres per hectare per year for ESSF in FIZ J and 2.87 cubic metres per hectare per year for ICH. These factors were multiplied by the corresponding areas within the timber harvesting land base to estimate the total loss. The Regional Entomologist reviewed this estimate and determined that only the losses for the ESSF should be used. Salvaged volumes were estimated from harvest billing summaries. Losses were assumed to be approximately proportional to the volume of mature balsam stands, so the losses should decline over time as the natural balsam stands are harvested. The loss for balsam bark beetle was modelled as declining in each subsequent decade in equal steps of 10% of the initial estimate. The long-term loss beginning in decade 10 is estimated to be 10% of the initial estimate.

Tomentosus root disease losses

A study by the Regional Pathologist estimated spruce volumes lost due to Tomentosus root disease for spruce-leading stands 81 years and older in the ICH BEC zone. The losses were estimated as 4.29 cubic metres per hectare per year, which was multiplied by the corresponding area within the timber harvesting land base to estimate the total loss. Spruce is not currently targeted for salvage so the estimate of total loss was not reduced. Even if salvage were to occur, total loss may be underestimated because it does not account for spruce losses outside of spruce-leading stands. Therefore, any salvage was assumed to be offset by additional losses.

A.4.8 Regeneration assumptions in managed stands

Recent plantations and future stands were grown on managed stand yield tables (MSYTs) produced using the Forest Service TIPSY growth and yield model. The table below contains the inputs required to produce MSYTs for the analysis. A MSYT may be built from a number of tables if more than one regeneration method is used within an analysis unit. When this is the case, tables are produced for the different regeneration methods (each method and species combination) and are then aggregated into one table.

The specifications contained in Table A-18. apply only to stands managed under the clearcut and even-aged patch cut silvicultural systems. The even-aged patch cut system creates sufficiently large openings that there is no shading of regeneration. Analysis units managed under the uneven-aged partial cut and non-clearcut systems result in shading of regeneration. For those analysis units, the original VDYP yield tables adjusted for the partial harvesting regime were used.

For partial cutting systems, Table A-16., "Silvicultural systems" lists the levels of retention and return intervals used in the analysis.

A.4 Current Forest Management Assumptions

Table A-18. Regeneration assumptions by analysis unit

Existing analysis unit[a]	Regen. analysis unit	Site index (m @ 50 years)	Description	Regen. delay (years)	OAFs[b] % 1	OAFs[b] % 2	Method Type	Method %	Species Code	Species %	Density (sph) Initial	Density (sph) Thin[c]
1, 101 51, 151	101 151	21.4 21.5	Hemlock/ Cedar good site	5	15	5	Plant	100	Hw Pl Sw	30 30 40	3000	30% to 1600
2, 102 52, 152	102 152	16.6 15.6	Hemlock/ Cedar medium site	5	15	5	Plant	100	Hw Pl Sw	40 20 40	3000	30% to 1600
3, 103 53, 153	103 153	12.1 10.7	Hemlock/ Cedar poor site	5	15	5	Plant	100	Hw Pl Sw	40 20 40	3000	30% to 1600
4, 104 54, 154	104 154	22.7 23.1	Balsam good site	0	15	5	Plant	100	Hw Sw	40 60	3000	30% to 1600
5, 105 55, 155	105 155	17.0 16.4	Balsam medium site	5	15	5	Plant	100	Bl Hw Pl Sw	15 15 10 60	3000	30% to 1600
6, 106 56, 156	106 156	12.9 10.5	Balsam poor site	5	15	5	Plant	100	Bl Sw	20 80	3000	30% to 1600
7, 107 57, 157	107 157	28.9 29.2	Spruce good site	0	15	5	Plant	100	Pl Sw	30 70	3000	30% to 1600
8, 108 58, 158	108 158	19.6 18.9	Spruce medium site	0	15	5	Plant	100	Hw Pl Sw	20 40 40	3000	30% to 1600
9, 109 59, 159	109 159	13.7 11.9	Spruce poor site	0	15	5	Plant	100	Cw Hw Sw	10 70 20	3000	30% to 1600
10, 110 60, 160	110 160	22.9 23.5	Pine good site	0	15	5	Plant	100	Pl Sw	70 30	3000	30% to 1600
11, 111 61, 161	111 161	17.8 16.9	Pine medium site	0	15	5	Plant	100	Pl Sw	70 30	3000	30% to 1600
12, 112 62, 162	112 162	12.0 12.9	Pine poor site	0	15	5	Plant	100	Bl Pl Sw	10 60 30	3000	30% to 1600
13, 113	113	21.4	Cottonwood–coniferous good site	0	15	5	Plant	100	Hw Sw	80 20	3000	30% to 1600
14, 114	114	19.6	Cottonwood–coniferous medium site	0	15	5	Plant	100	Cw Hw Sw	15 15 70	3000	30% to 1600
15, 115	115	12.0	Cottonwood–coniferous poor site	0	15	5	Plant	100	Pl	100	3000	30% to 1600

(a) See Table A-3. and discussion under "Data source and comments" for a description of the meaning of analysis unit numbers.
(b) Operational adjustment factors (OAFs) are used to adjust timber yield estimates to account for operational factors. OAF1 is a constant percentage reduction to account for small unproductive areas within stands, uneven stem distribution and endemic losses that do not increase with age. OAF2 accounts for losses that increase with stand age, for example, decay due to disease. In this case OAF2 increases from 0 at stand establishment and passes through 5% at 100 years of age.
(c) 30% of the area is thinned to a density of 1600 stems per hectare.

A.4 Current Forest Management Assumptions

Data source and comments:

The area-weighted mean site index for each existing natural stand analysis unit (i.e., 1-65) was used to generate timber yield tables for the corresponding regenerated analysis unit (i.e., 101-165). For coniferous analysis units, the site index applied to the original leading species in the analysis unit. For deciduous analysis units, the site index shown for the analysis unit that corresponds with the regenerated leading species (e.g., Hw for analysis unit 16) was used. All site indices were converted to appropriate site indices for the other species being planted in each regenerated analysis unit.

All the harvested area in the Kispiox TSA is planted with conifers. However, the records of crop development indicate that a proportion of area still develops into stands with different composition than anticipated. This evolution can be attributed to a combination of natural regeneration and release of advanced natural regeneration. This is most obvious in two cases. Harvested hemlock timber types, although typically planted with spruce and pine, develop at 5-20 years into leading-hemlock stands. The other case is balsam in the ESSF zones. Balsam has not been planted historically, however, these stands have frequently returned to leading balsam. Regeneration delay was increased in these situations to account for natural ingress. Natural ingress of all species is common in the ICH zone.

There are occasions, specific to backlog blocks, where the deciduous component is considered acceptable. This is evident where previous timber types were deciduous leading. However, deciduous ingress will not be modelled explicitly. Deciduous ingress, if any, cannot exceed 10% in managed stands, so it is assumed that it does not compete with the coniferous species at the densities shown in Table A-19. It is further assumed that the deciduous volume of managed stands will not be harvested in the future, so it is not included in the regeneration specifications.

Regeneration delay for most stand types is met by planting one-year-old stock one season after harvest. Analysis of planting between 1996 and 1999 for all licensees throughout the Kispiox Forest District show that the average time between harvesting and planting is 1.02 years (ICH is 1.0, CWH is 1.04, and ESSF is 0.94).

Blocks are currently being planted in a "mixed bag" method. An analysis of all blocks planted in the Kispiox Forest District between 1996 and 1999 showed that in the ESSF zone, an average of 1.7 species were planted per block. Although, this translates to 43% of the blocks being planted with a single species, this represents only 25% of the area. In the ICH zone, on the other hand, an average of 2.8 species are planted on each block. Only 13% of the blocks (19% of the area) are planted with a single species.

The species listed in the "species code" in Table A-18. refer to the leading species of the regenerated stands. This was derived through an Integrated Silviculture Information System (ISIS) and Major License Silvicultural Information System (MLSIS) analysis of all regenerated blocks within the Kispiox TSA, in which the data set was first sorted by previous timber type and site class, and then within each of these categories by silviculture label-leading species. It was then possible to calculate the amount of area regenerated to each species and then convert that value to per cent of land regenerated to each species.

The density of 3000 stems per hectare accounts for planting densities of 1200 to 1600 plus ingress. Planting densities for the past 3 years, in both the Kispiox and neighbouring Cranberry TSAs combined indicate that first-plant blocks are being planted to 1338 stems per hectare in the ICH and 1579 stems per hectare in the ESSF. Within the district programs, spacing is considered when countable conifers have exceeded 3000 stems per hectare and often is performed in conjunction with brushing treatments to improve economic efficiencies. Spacing reduces stand density to a target of 1600 stems. It is expected that licensees will only space when density exceeds the maximum density of 10,000 stems per hectares allowed in the standards. As the Small Business Forest Enterprise Program (SBFEP) currently represents 22% of the Kispiox TSA harvest volume, thinning should occur on 30% of the regenerated stands to account for SBFEP and periodic licensee spacing.

A.4 Current Forest Management Assumptions

A 2002 analysis of SPAR (Seedling, Planning and Registry) seed sowing requests shows that between 1998 and 2002 Class A seed represents 12% of all trees planted (use of Class A seed has increased from 3% in 1998 to 32% in 2002). Use of Class A seed is restricted to pine. Due to endemic and epidemic pest problems associated with pine, it is not appropriate to model increased volumes attributed to seed progeny and therefore not applied in the base case.

The original data package contained regeneration assumptions for cedar analysis units. They do not appear in Table A-18. above because the cedar analysis units were combined with hemlock analysis units (see Section A2.2, "Analysis unit characteristics").

A.4.9 Immature plantation history

This section identifies areas of existing immature forest where the density (stems per hectare) has been controlled and was assigned to a managed stand yield table (MSYT).

Table A-19. Immature plantation history

Analysis unit	Area managed (%)				
	Age 1 – 10	Age 11 – 20	Age 21 – 30	Age 31 – 40	Age 40+
All	100	100	0	0	0

Data source and comments:

For the purposes of this timber supply review, stands older than 20 years were considered unmanaged. Under the current FRBC funding structure and levels, only 1000 hectares per year of backlog land (harvested pre-1987) has been brushed and/or spaced over the last 2 years. Indications are that this level will not be increased for the 2000 field season and beyond. This could result in backlog conifer stands currently classified as satisfactorily restocked being overcome with deciduous competition.

A.4.10 Not satisfactorily restocked (NSR) areas

Some land classified in the Kispiox TSA forest cover inventory as type identity 4 or 9 was included in the current timber harvesting land base. These type identities indicate not satisfactorily restocked land base. This section identifies the total area of NSR currently existing in the timber harvesting land base, and the estimated rate at which the NSR area was restocked in the analysis.

A.4 Current Forest Management Assumptions

Table A-20. Not satisfactorily restocked (NSR) areas

Analysis unit	Inventory NSR (hectares)	ISIS NSR (hectares)	Area of NSR (hectares) (years from now)			
			Restocked	1 – 5	5 – 10	11 – 30
Backlog NSR outside timber harvesting land base						
N/A	3 150	1 706	1 444	285	285	1 136
Backlog NSR inside timber harvesting land base						
2	408	321	87	160	161	
5	265	209	56	105	104	
8	451	355	96	177	178	
Subtotal	**1 124**	**885**	**239**	**442**	**443**	
Current NSR inside timber harvesting land base						
102	1 506	1 186	320	1 186		
105	3 462	2 726	736	2 726		
111	781	615	166	615		
Subtotal	**5 749**	**4 527**	**1 222**	**4 527**		
Total	**10 023**	**7 118**	**2 905**	**5 254**	**728**	**1 136**

Data source and comments:

Backlog NSR consists of 884.9 hectares on blocks harvested prior to October 1987. Planting backlog NSR is currently subject to funding pressures. The last two years (1998-99) have seen increased expenses and effort particularly for the development of Backlog Silviculture Prescriptions and layout. Treatment priorities are in flux as a result of insecure backlog funding levels. Budgets and staffing levels have been limiting to treatment capacity, as illustrated by the following backlog planting figures:

Planting year	Backlog area planted (hectares)
1996	80.1
1997	219.0
1998	138.0
1999	58.7
2000	0.0 (planned)

Current NSR applies to blocks logged between October 1987 and September 9, 1999. The inventory label for leading species was used to assign analysis units. According to ISIS, there are 4527 hectares of current NSR.

Information on SBFEP NSR was derived in one of two ways. Planted blocks classified as NSR were sorted by inventory label species and site index. Blocks that had been harvested and not yet planted were sorted by preferred species as prescribed in the SP. Site index was assigned based on pre-harvest estimates.

It was not possible to attain inventory labels for current NSR for licensees other than SBFEP. As a result, analysis units were sorted on the basis of the primary preferred species as prescribed in the SP.

All NSR area is managed under a clearcut silvicultural system.

The total Inventory NSR area in Table A-20. includes only areas within the timber harvesting land base or areas outside of the timber harvesting land base that contribute to landscape-level biodiversity (i.e., Crown ownerships 61, 62, 69). Analysis units were determined from ISIS species and site index information described above, and were amalgamated where individual analysis unit areas were small. Analysis units were assigned to the inventory NSR inside the timber harvesting land base in the same proportion as they exist for the corresponding ISIS NSR. Backlog NSR outside the timber harvesting land base was all assigned to a single analysis unit because timber yields do not need to be tracked outside of the timber harvesting land base.

NSR areas in the inventory data set were randomly assigned to analysis units and age classes according to the information presented in Table A-20.

The original data package assigned some NSR area to cedar analysis units. They do not appear in Table A-20. above because the cedar analysis units were combined with hemlock analysis units (see Section A2.2, "Analysis unit characteristics").

A.4.11 Forest cover requirements

Forest cover requirements may be examined at a number of different levels, including landscape units, wildlife areas, and visual quality areas. With the requirement to retain different forest characteristics across the landscape, it is important to identify how non-contributing forest (productive forest which does not contribute to the timber harvesting land base) may be considered in the forest cover requirements (i.e., maximum allowable disturbance or minimum area retention).

The following tables describe the forest cover requirements to be applied. The green-up ages shown are lower than those shown in the data package based on new information from the Forest Service study, *Age to green-up height: using regeneration survey data, 2000.*

A.4 Current Forest Management Assumptions

Table A-21a. Forest cover requirements

Zone or group or resource emphasis	Maximum allowable disturbance (% area)	Green-up height (metres) or age (years)	Minimum retained area (%)	Minimum age for retention (years)	Land base to which constraints apply
IRM — cutblock adjacency	33	3 metres / see Table A-21c. for age			Timber harvesting land base
Retention VQO	See Table A-21c.	6 metres			Crown forested
Partial retention VQO	See Table A-21c.	6 metres			Crown forested
Community watersheds					Crown forested
Dale Creek	20.7	6 metres / 20 years			
Juniper Creek	8.7	6 metres / 21 years			
Kits Creek	20.0	6 metres / 19 years			
Quirmas Creek	21.0	6 metres / 20 years			
Sikedakh Creek	19.9	6 metres / 21 years			
Station Creek	6.0	6 metres / 19 years			
Ten Link Creek	20.4	6 metres / 20 years			
Two Mile Creek	19.5	6 metres / 20 years			
Babine LRUP — SBS					Crown forested
Gail Sub-drainage	50	20 years	30	80	
Shenismike	50	20 years	30	80	
Shelagyote North	50	20 years	30	80	
Shelagyote South	50	20 years	30	80	
Shedin	50	20 years	30	80	
Babine LRUP — ESSF					Crown forested
Gail Sub-drainage	30	20 years	50	80	
Shenismike	30	20 years	50	80	
Shelagyote North	30	20 years	50	80	
Shelagyote South	30	20 years	50	80	
Shedin	30	20 years	50	80	
Babine SMZ			30	140	Crown forested
Deer winter range			6	150	Crown forested
Landscape units — old growth (Kispiox LRMP)			12	200	Crown forested
Landscape units — water quality	15	6 metres See Table A-21d. for age			Total forested

Data source and comments:

Strategies in the Kispiox LRMP which are current management practice were modelled. Strategies are tools to meet the higher level plan (HLP) objectives from the LRMP. Strategies that were modelled are: deer winter range at the confluence of the Suskwa and Natlan creeks, old-growth retention at the landscape level, equivalent clearcut area at the landscape level, and visual quality objectives.

A.4 Current Forest Management Assumptions

Although the Babine LRUP is not a higher level plan, objectives and strategies provide forest management direction. Strategies which are current management practice were modelled. These include: seral stage requirements by Babine LRUP sub-drainage; visual screening and habitat buffers around high value grizzly bear habitat; and no harvest zones in certain Babine LRUP treatment units.

Landscape units used in the analysis were used as a modelling tool. The landscape units are preliminary.

The requirement for cutblock adjacency was applied to stands managed under the clearcut and small patch cut silvicultural systems within the integrated resource management (IRM) zone of each landscape unit. The IRM zone is defined as the area in the timber harvesting land base outside of VQOs and community watersheds. The deer winter range area was considered part of the IRM zone for applying cutblock adjacency requirements. Green-up height was converted to a unique green-up age for each landscape unit (Table A-21c.). The Kispiox LRMP and the *Forest Practices Code* specify these requirements. Where silvicultural systems involving over 40% retention are used, the area was not subject to green-up requirements.

Visual quality objectives (VQO) green-up requirements were identified through field analysis of existing cutblocks within the TSA. Green-up height was converted to a unique green-up age for each combination of landscape unit and VQO (Table A-21c.). Modification 1 and 2 were developed by the district as part of the visual impact mitigation strategy. The VQOs were assigned as shown in Table A-21b.

Table A-21b. Assignment of VQOs

Final visual sensitivity class	Recommended VQO	Per cent (%) alteration by VAC[a] (planimetric)		
		Low	Medium	High
1	Retention	1.1	3.0	5.0
2	Retention	1.1	3.0	5.0
3	Partial retention	5.1	10.0	15.0
3	Modification 1	5.1	11.5	18.0
4	Modification 2	15.1	20.0	25.0
5	Modification 2	15.1	20.0	25.0

(a) VAC = visual absorption capability.

The maximum allowable disturbance and green-up age for each combination of landscape unit and VQO was calculated by area weighting the per cent alteration shown in Table A-21b. The results of these calculations are shown in Table A-21c. The green-up ages shown are lower than those shown in the data package based on new information from the Forest Service study, *Age to green-up height: using regeneration survey data, 2000.*

A.4 Current Forest Management Assumptions

Table A-21c. Integrated resource management (IRM) green-up ages and maximum allowable disturbance and green-up ages in visual quality objectives (VQO)

Landscape unit	IRM green-up ages (years to 3 metres)	VQO maximum allowable disturbance (%) and green-up age (years)			
		Retention	Partial retention	Modification 1	Modification 2
Atna	14		5.1% / 28 years	10.7% / 28 years	
Babine	14				
Babine River	14	1.4% / 20 years	7.4% / 24 years	7.7% / 22 years	20.0% / 21 years
Cranberry River	13	3.0% / 19 years	10.0% / 18 years	12.8% / 20 years	20.0% / 20 years
Deep Canoe	12		10.0% / 25 years		
Gail	14		9.9% / 25 years	10.8% / 27 years	
Hanawald	14		9.3% / 27 years	7.2% / 28 years	
Hazelton	12	1.7% / 20 years	9.5% / 20 years	11.6% / 21 years	24.6% / 20 years
Juniper	12		8.4% / 20 years	8.4% / 20 years	
Kispiox	12		10.1% / 21 years	13.9% / 20 years	20.6% / 22 years
Gitsegukla	12		10.0% / 19 years	12.1% / 21 years	25.0% / 18 years
Kitwancool	12		5.1% / 28 years	10.2% / 19 years	20.0% / 18 years
Kitwanga	12	1.1% / 19 years		11.2% / 19 years	
Kuldo	13		10.0% / 20 years	11.5% / 19 years	
Larkworthy	12	1.3% / 21 years	7.8% / 21 years	11.1% / 20 years	
McCully	13	3.0% / 20 years	10.0% / 19 years	11.5% / 22 years	20.0% / 19 years
Moonlit	12	2.3% / 19 years	9.4% / 18 years	11.3% / 19 years	
Natlan	13			11.5% / 24 years	25.0% / 21 years
Seven Sisters	12	3.0% / 19 years	6.0% / 19 years	11.4% / 18 years	
Shedin	13	2.0% / 24 years	7.6% / 24 years	6.3% / 20 years	
Shegunia	13	3.0% / 21 years			
Sheladamus	13	1.1% / 23 years	5.1% / 23 years		
Shelagyote	14	1.1% / 28 years	5.1% / 25 years	10.6% / 29 years	
Sicintine	13	1.1% / 20 years	5.1% / 20 years		
Skeena Crossing	12	3.0% / 19 years	11.8% / 19 years	11.7% / 20 years	22.2% / 19 years
Skeena West	11		5.1% / 19 years	10.8% / 17 years	
Suskwa	13	1.1% / 21 years	5.5% / 23 years	11.5% / 20 years	25.0% / 24 years
Sweetin	13	2.3% / 23 years	10.0% / 23 years		20.0% / 20 years
Tenas	12	1.9% / 20 years	9.0% / 23 years	9.7% / 21 years	20.0% / 20 years
Upper Cranberry	12			9.3% / 20 years	
Upper Kispiox	13	2.3% / 23 years		8.2% / 20 years	

A.4 Current Forest Management Assumptions

The maximum allowable disturbance value was applied to the entire forested land base, so no adjustment to the per cent requirements was required to account for the total forest to harvestable forest (green operable) ratio. No adjustment is required for dispersion of operable and non-operable forest because visual absorption capability (VAC) accounts for dispersion.

The requirements for community watersheds and landscape unit water quality assume an equivalent clearcut area (ECA) of 30% and 22% respectively. The Kispiox LRMP specifies the landscape unit water quality requirement. The maximum allowable disturbance listed in Table A-21a. in both cases was based on interpretation of the percentage recovery by height guidelines presented in the *Watershed Assessment Procedures Guidebook (1999),* Appendix A, and a calculation developed by Timber Supply Branch. The equation accounts for the gradual recovery of harvested areas, and approximates the forest cover requirement applicable to a 6-metre stand height that would achieve the desired ECA. The original data package indicated a maximum allowable disturbance of 21% for community watersheds, which was to be applied to the total area. Since only forested area was modelled, the requirement was adjusted to reflect the ratio of forested-to-total area in each community watershed.

The green-up ages for landscape unit water quality are shown in Table A-21d. The green-up ages shown are lower than those shown in the data package based on new information from the Forest Service study, *Age to green-up height: using regeneration survey data, 2000.*

Table A-21d. Green-up ages for landscape unit water quality

Landscape unit	Green-up age (years)
Skeena West	17
Juniper	18
Hazelton, Kitwanga, Kitwancool, Seven Sisters	19
Cranberry River, Kispiox, Moonlit, Skeena Crossing, Tenas, Upper Cranberry	20
Deep Canoe, Gitsegukla, Larkworthy, Sweetin, Upper Kispiox	21
McCully, Suskwa	22
Kuldo, Natlan, Shegunia	23
Shedin, Sheladamus	24
Babine, Babine River, Gail, Hanawald, Sicintine	25
Atna, Shelagyote	27

The Babine LRUP specifies seral stage retention targets, by biogeoclimatic zone, within each sub-drainage within the LRUP area. The Babine LRUP specifies seral stage and rotation length requirements for the special management zone.

The Kispiox LRMP states that 15% of high value deer winter range be managed on a rotation of 150 years. Of that 15%, at least 40% must be older than 150 years at all times. Therefore, a minimum of 6% of high value deer winter range must be older than 150 years at any time.

The Kispiox LRMP states that a minimum of 12% of the forested area within a landscape unit must be older than 200 years at any time.

A.4 Current Forest Management Assumptions

Old-seral requirements for landscape-level biodiversity are shown in Table A-21e. In areas where non-clearcut systems are used, only areas with greater than 70% retention contributed to the old-seral requirement, as described in the *Biodiversity Guidebook*. These requirements were applied by landscape unit and BEC variant.

Table A-21e. Old-seral requirements by biogeoclimatic variant

Biogeoclimatic variant	Natural disturbance type	Old-seral requirement (%) starting in year			Age (years)	Land base to which constraints apply
		1	**71**	**141**		
ESSF wv MH mm2	1	14.2	17.1	19.9	> 250	Crown forested area
CWH ws2 ESSF mc ICH mc1 ICH mc2	2	6.7	8.1	9.4	> 250	Crown forested area
SBS mc2	3	8.2	9.9	11.5	> 140	Crown forested area

The percentages in Table A-21e. are calculated as follows:

Year 1: low % *0.333*0.45 + medium % * 0.45 + high % *0.10

Year 71: low % *0.667*0.45 + medium % * 0.45 + high % *0.10

Year 141: low % * 0.45 + medium % * 0.45 + high % *0.10

where low %, medium % and high % are the old-seral requirements for low-, medium- and high-BEOs contained in the *Forest Practices Code Landscape Unit Planning Guide (LUPG)*.

Although current policy is not to apply the mature plus old-seral requirement, a critical issue analysis examined its impact on timber supply. An average mature plus old-seral requirement was applied by biogeoclimatic variant within each landscape unit. This was calculated in the same manner as the old-seral requirement, except that the entire requirement was applied beginning immediately (i.e., the retention percentages shown in Table A-21e. for year 141 when the full old-seral requirement applies). The mature plus old requirements are shown in Table A-21f.

Table A-21f. Mature plus old-seral requirements by biogeoclimatic variant

Biogeoclimatic variant	Natural disturbance type	Mature+old-seral requirement (%) (starting in year 1)	Age (years)	Land base to which constraints apply
ESSF wv MH mm2	1	30.2	> 120	Crown forested area
CWH ws2 ESSF mc ICH mc1 ICH mc2	2	28.1 23.1 25.3 25.3	> 80 > 120 > 100 > 100	Crown forested area
SBS mc2	3	18.7	> 100	Crown forested area

A.4 Current Forest Management Assumptions

When modelling old-seral requirements, it was assumed that some level of natural disturbance occurs in stands outside of the timber harvesting land base. This assumption was required to prevent those stands from aging forever in the timber supply model, with the result that almost all of the old-seral requirements would be met outside of the timber harvesting land base in the long term. The amount of disturbance was calculated separately for each BEC variant, using the specifications in *the Forest Practices Code Biodiversity Guidebook* that define the age of old forest and the proportion required to be old. These specifications were used to determine a rotation age that would produce the required amount of old-seral forest. The annual disturbance rate was calculated for each variant using the rotation age and the amount of productive forest outside the timber harvesting land base. The results of the calculations are shown in Table A-22. The timber supply model applied the calculated disturbance rates and the disturbed areas were set to age 0 years after being disturbed.

Table A-22. Annual area disturbed in the productive forest outside of the timber harvesting land base

Biogeoclimatic variant	Natural disturbance type	Rotation age (years)	Disturbance area (hectares per year)
ESSF wv	1	347	545
MH mm2			64
CWH ws2	2	287	146
ESSF mc			52
ICH mc1			339
ICH mc2			297
SBS mc2	3	160	137

A.4 Current Forest Management Assumptions

For a critical issue analysis, the old and mature plus old-seral requirements recommended in the *LUPG* for the draft BEOs outlined in Table A-23., was applied instead of an average BEO for each landscape unit.

Table A-23. Draft landscape units and biodiversity emphasis assignment

Biodiversity emphasis assignment (1999)	Landscape units		
Low	Atna Deep Canoe Gail Hanawald Juniper Kispiox	Kitwancool Kitwanga Kuldo Larkworthy Moonlit Natlan	Seven Sisters Shedin Skeena West Upper Cranberry Upper Kispiox
Intermediate	Babine Cranberry River Hazelton McCully	Shegunia Sheladamus Sicintine Skeena Crossing	Suskwa Sweetin Tenas
High	Babine River	Gitsegukla	Shelagyote

A.4.12 Wildlife trees and other reserves

According to recommendations in the *LUPG*, trees are left standing in cutblocks to maintain structural attributes for wildlife habitat and stand-level biodiversity. However, Kispiox Forest District staff have found that some unmapped marginally- or non-productive forest areas and other reserves (e.g., small riparian areas) are being retained in addition to areas left specifically as wildlife tree patches. During the surveys for wildlife trees (WT), it was not possible to distinguish areas left specifically to meet stand-level biodiversity objectives from other areas.

Table A-24. summarizes the portion of stand area that is currently being retained in wildlife tree and marginally productive forest patches. This retention was represented in the analysis by land base reductions in order to account for the contributions of the patches to both stand- and landscape-level biodiversity.

Table A-24. Reductions to reflect volume retention for wildlife trees and other reserves

Management zone	Analysis unit	Persistence	Per cent (%) recommended in landscape unit planning guide	Residual volume or area estimate on the timber harvesting land base (%)
All	All	Long term	3	10.9

Data source and comments:

Wildlife tree patch (WTP) retention requirements for the Kispiox Forest District are outlined in a biodiversity district operating procedure (DOP). This DOP is consistent with the *Draft Provincial Wildlife Tree Policy and Management Recommendations, December 1999* prepared by the Forest Practices Branch (MoF) and the Habitat Branch (MELP). Current management practices reflect the DOP.

A.4 Current Forest Management Assumptions

Within the TSA, forest patches are reserved from harvest for a number of reasons. These include, but are not limited to, maintenance of riparian habitat around small unmapped waterbodies, removal of non-productive and inoperable areas, and management for other non-timber resources.

A review of all blocks logged between 1992 and 1997 with in-block retention (148 blocks), showed that on average, 7.1% was retained as unharvested patches. A subsequent review was conducted to calculate the percentage of unharvested patches retained on 179 blocks harvested between January 1, 1997 and August 1, 2000. This second review shows that unharvested patches occupy about 11% of the net forested area of the blocks. Patches contributing only to stand-level biodiversity (less than two hectares) account for 3.8% of the net forested area, while patches contributing to both stand- and landscape-level biodiversity (greater than two hectares) account for 7.1% of the total. For the purpose of this timber supply review, the results from the second unharvested patch analysis were modelled. Estimates of patch retention over the next five years, as identified in forest development plans, show that the per cent retention indicated in the second study will be maintained or increased.

The following areas were not included in the calculation of unharvested patches: aggregate harvest units larger than 150 hectares, partial cut areas with a mature residual component, areas reserved for future entry, and areas already accounted for in timber supply deductions (e.g., Telegraph Trail, and riparian areas identified on TRIM maps). Where non-productive or non-forested areas were not quantifiable in the area summary, maps, or the silviculture prescription, it was assumed that the entire reserve was forested. Where non-forested or non-productive areas were apparent within a reserve, but had been separated in the area summary, these areas were measured and deducted from the forested area. Thus, the net forested area used in unharvested patch calculations does not include non-commercial, non-productive, and inoperable areas, riparian reserves and management zones, cultural heritage features, or roads.

Table A3.1 of the *LUPG* recommends an average 3% WTP retention for the Kispiox TSA. Current management practice is 7.9% higher than recommended in the guidebook for the following reasons.

Areas are identified during silviculture prescription development that are unavailable for timber harvesting. These may be small riparian areas, low productivity sites, or wet soils that are situated within a forest stand that is otherwise classified as available for timber harvesting using forest cover inventory attributes.

For timber supply review, the per cent retention would normally be reduced to account for overlap with areas outside of the timber harvesting land base (e.g., riparian areas, low timber productivity). A review of unharvested patches identified in silviculture prescriptions compared with the forest inventory shows that these riparian areas, low productivity sites and wet soils are not identified on the forest inventory and are not accounted for by any other netdowns. The difference in scales used for silviculture prescription development (1:5,000) and the forest inventory (1:20,000) is the cause of this discrepancy.

A large percentage of the unharvested patches (7.1%) meet landscape-level biodiversity objectives outlined in the LRMP (see Table A-21a., "Forest cover requirements").

In the timber supply model, the 7.1% portion of the retained patches that contributed to landscape-level biodiversity also contributed to the old-growth forest cover requirements from the Kispiox LRMP (Table A-21a.), as well as the old-seral forest cover requirements (Table A-21e).

A.5 Volume Estimates for Existing Stands

The variable density yield projection (VDYP) model, version 6.5 developed and supported by the Ministry of Sustainable Resource Management, Terrestrial Information Branch, was used to estimate timber volumes for existing natural stands that are harvested under clearcut and patch cut regimes (see Table A-16., "Silvicultural systems"). Table A-25. shows the volume estimates by analysis unit for existing natural stands.

A.5 Volume Estimates for Existing Stands

Table A-25. Timber volume tables for existing natural stands (cubic metres per hectare)

Table no.	1	2	3	4	5	6	7	8
Species group	Hemlock/ cedar	Hemlock/ cedar	Hemlock/ cedar	Balsam	Balsam	Balsam	Spruce	Spruce
Site productivity	Good	Medium	Poor	Good	Medium	Poor	Good	Medium
Age	1-140	1-140	1-140	1-140	1-140	1-140	1-140	1-140
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	7	0	0	12	5	0	0	0
40	67	16	0	62	33	3	58	10
50	130	68	5	124	70	14	126	53
60	184	123	27	179	107	33	184	101
70	230	171	61	229	144	59	232	143
80	269	214	98	271	174	81	271	179
90	301	251	133	309	202	102	303	209
100	327	282	166	343	226	121	329	234
110	350	309	196	374	249	138	351	256
120	368	332	224	401	270	154	368	274
130	388	356	250	428	291	171	384	291
140	403	375	273	451	311	187	397	305
150	416	392	294	472	329	202	409	317
160	426	407	312	491	346	216	418	327
170	434	419	328	507	361	230	425	335
180	441	430	342	521	376	243	432	341
190	447	438	354	534	390	255	437	347
200	452	448	367	548	403	267	441	352
210	457	456	378	560	416	279	445	357
220	461	464	390	572	428	290	449	362
230	465	472	400	583	439	301	452	366
240	469	478	410	594	450	311	455	370
250	473	484	420	604	461	322	457	373
260	475	488	427	606	463	323	459	375
270	476	491	434	609	464	325	460	377
280	478	494	440	611	466	326	461	378
290	479	497	446	613	467	327	462	380
300	481	500	451	615	468	329	462	381
310	482	503	456	617	469	330	463	382
320	483	505	460	619	470	331	463	383
330	484	507	464	620	472	332	464	383
340	485	509	468	622	472	333	464	384
350	486	511	472	623	473	334	464	384

(continued)

A.5 Volume Estimates for Existing Stands

Table A-25. Timber volume tables for existing natural stands (cubic metres per hectare)

Table	9	10	11	12	13	14	15
Species group	**Spruce**	**Pine**	**Pine**	**Pine**	**Cottonwood/ coniferous**	**Cottonwd/ conif.**	**Cottonwd/ conif.**
Site productivity	**Poor**	**Good**	**Medium**	**Poor**	**Good**	**Medium**	**Poor**
Age	**1-140**	**1-140**	**1-140**	**1-140**	**1-140**	**1-140**	**1-140**
10	0	0	0	0	0	0	0
20	0	0	0	0	5	2	0
30	0	41	11	1	35	40	13
40	0	92	53	8	58	70	45
50	3	135	93	37	75	93	72
60	22	172	128	67	88	111	94
70	50	204	159	93	98	125	112
80	80	232	186	118	106	136	127
90	108	257	210	139	112	144	138
100	134	279	231	159	116	151	148
110	158	299	251	177	119	156	155
120	179	317	269	194	122	159	161
130	199	334	285	210	124	163	168
140	216	345	297	221	127	167	173
150	232	354	306	231	129	170	178
160	245	359	312	238	130	171	180
170	256	362	317	243	131	172	182
180	266	363	319	247	132	173	184
190	275	362	319	248	132	174	185
200	284	363	321	252	133	175	187
210	292	365	324	255	134	176	188
220	299	367	326	258	134	177	190
230	306	369	329	261	135	177	191
240	312	372	331	264	135	178	192
250	318	374	334	267	135	178	193
260	322	375	336	269	135	178	193
270	325	377	338	271	135	178	193
280	328	379	339	273	135	178	193
290	331	380	341	275	135	178	193
300	334	382	342	276	135	178	193
310	336	383	344	278	135	178	193
320	338	385	345	279	135	178	193
330	340	386	346	281	135	178	193
340	342	387	347	282	135	178	193
350	344	388	348	283	135	178	193

(continued)

A.5 Volume Estimates for Existing Stands

Table A-25. Timber volume tables for existing natural stands (cubic metres per hectare)

Table	51	52	53	54	55	56	57	58
Species group	**Hemlock/ cedar**	**Hemlock/ cedar**	**Hemlock/ cedar**	**Balsam**	**Balsam**	**Balsam**	**Spruce**	**Spruce**
Site productivity	**Good**	**Medium**	**Poor**	**Good**	**Medium**	**Poor**	**Good**	**Medium**
Age	**141 +**	**141 +**	**141 +**	**141 +**	**141 +**	**141 +**	**141 +**	**141 +**
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	4	0	0	26	4	0	0	0
40	84	11	0	78	28	1	57	11
50	164	63	3	132	67	11	120	54
60	232	123	20	182	108	28	173	105
70	290	176	51	229	149	53	215	149
80	339	223	87	269	182	75	250	186
90	378	263	124	305	212	95	277	217
100	411	297	158	338	239	114	300	243
110	438	326	188	368	264	132	318	265
120	461	351	216	395	286	148	333	283
130	486	378	243	424	310	164	346	301
140	507	400	267	451	331	180	358	316
150	525	419	289	476	351	195	368	329
160	540	436	309	499	369	210	376	339
170	553	451	326	522	386	223	383	348
180	564	464	341	542	402	237	388	355
190	573	474	354	562	416	249	393	362
200	581	486	368	581	431	261	397	368
210	589	496	380	599	445	273	401	374
220	596	506	393	616	458	284	404	379
230	602	515	404	632	470	295	407	383
240	608	523	415	648	482	306	409	387
250	613	530	425	662	493	316	411	391
260	616	534	433	664	496	318	411	393
270	619	538	441	665	498	320	412	395
280	621	542	448	666	500	321	412	397
290	623	545	454	667	502	323	413	398
300	625	548	459	668	503	324	413	399
310	627	551	465	668	505	325	413	400
320	629	554	469	669	506	326	412	401
330	630	556	474	670	508	328	412	402
340	631	559	478	671	509	329	412	402
350	632	561	481	671	510	330	411	403

(continued)

A.5 Volume Estimates for Existing Stands

Table A-25. Timber volume tables for existing natural stands (cubic metres per hectare) (concluded)

Table	59	60	61	62
Species group	Spruce	Pine	Pine	Pine
Site productivity	Poor	Good	Medium	Poor
Age	141 +	141 +	141 +	141 +
10	0	0	0	0
20	0	0	0	0
30	0	32	8	1
40	0	83	53	10
50	3	124	100	38
60	18	157	140	69
70	42	185	175	98
80	69	208	206	124
90	96	229	233	147
100	122	247	257	168
110	145	263	279	188
120	166	278	299	206
130	185	292	318	223
140	203	302	332	236
150	219	310	343	246
160	233	314	351	254
170	245	317	357	260
180	257	318	361	264
190	267	317	362	266
200	276	319	365	270
210	285	320	369	274
220	293	322	372	277
230	301	323	376	281
240	308	325	379	284
250	314	326	382	287
260	319	328	384	289
270	322	329	387	292
280	326	330	389	294
290	329	331	391	295
300	332	332	393	297
310	334	334	394	299
320	337	334	396	300
330	339	335	397	301
340	341	336	398	302
350	342	337	400	303

A.6 Volume Estimates for Partially Cut Stands

Yield tables for existing stands were used for analysis units with partial cutting regimes, with the modifications described in this section. Refer to Table A-16., "Silvicultural systems," for details of the partial cutting regimes.

Partial cutting yield tables represent the harvestable volume available after all previous entries. For example, in a 3-entry partial cutting regime, the first yield table is the existing stand yield table, the yield table for the second entry is two-thirds of the existing stand yield table, and the yield table for the third (final) entry is one-third of the existing stand yield table. The final entry yield table is used for all subsequent entries, and reflects the volume that is available from the oldest cohort in the stand. The Mill Creek cutting regime is a 2-entry regime, so it has two yield tables in addition to the existing stand yield table for each analysis unit. The Babine Treatment Unit 3 cutting regime has four entries, so it has four additional yield tables for each analysis unit.

Because the actual age of harvest for the first entry is not known in advance, the timber supply model retains the stand age when doing partial harvesting for all entries except the final entry. Harvest volumes are calculated as the difference between the yield tables at each entry.

Stands with less than 70% retention are not allowed to contribute to old forest requirements. Since a stand's age is retained when it is partially harvested (except for the final entry), the yield table ages for partial cutting regimes were offset after each entry to reduce the apparent age of stands, so they would not be considered as old forest.

The actual yield tables for partial cutting are not presented here. Instead, Table A-26. shows the parameters used to define the yield tables.

Table A-26. Parameters for partial cutting yield tables

Partial cutting regime	Analysis unit	Entry #	Yield table description
Mill Creek	All	1	Existing yield table.
		2	Volumes one-half of existing volumes, existing ages reduced by 150 years.
		3 +	Volumes one-half of existing volumes, existing ages unchanged.
General partial cut	All	1	Existing yield table.
		2	Volumes two-thirds of existing volumes, existing ages reduced by 150 years.
		3	Volumes one-third of existing volumes, existing ages reduced by 180 years.
		4 +	Volumes one-third of existing volumes, existing ages unchanged.
Babine treatment unit 3	All	1	Existing yield table.
		2	Volumes three-quarters of existing volumes, existing ages reduced by 150 years.
		3	Volumes one-half of existing volumes, existing ages reduced by 170 years.
		4	Volumes one-quarter of existing volumes, existing ages reduced by 200 years.
		5 +	Volumes one-quarter of existing volumes, existing ages unchanged.

A.6 Volume Estimates for Partially Cut Stands

Partial cutting retains the stand age after each entry, except for the final and subsequent entries, which reset the stand age. In the latter cases, the stand age is reset to the age of the oldest cohort that has been created by the earlier entries. After the final entry, the yield table has no age offset from the existing stand yield table. In this case the timber supply model uses the yield table volume directly as the harvest volume, instead of calculating the difference between yield tables. For example, in a 3-entry partial cutting regime, the final and all subsequent entries will harvest one-third of the volume of the original, existing stand yield table.

Partial cutting specifies the time between entries instead using of a minimum harvestable age (except for the final entry). These times are specified in Table A-16., "Silvicultural systems." The final entry used a minimum harvestable age that was calculated by multiplying the number of entries by the time between entries. For example, in a 3-entry partial cutting regime, the minimum harvestable age is 3 times 30 equals 90 years. This approach for the final entry assumes that cohorts are created at each previous entry and that only the oldest cohort is harvested.

Table A-27. shows the parameters used to further modify the yield tables and define the regeneration paths.

Table A-27. Parameters for partial cutting regeneration paths

Partial cutting regime	Entry #	Regeneration age (years)	Offset to regeneration age (years)	Time between harvests (years)	Minimum harvestable age (years)
Mill Creek	1	Keep	– 150	50	Existing
	2	50	0	0	0
	3 +	50	0	0	100
General partial cut	1	Keep	– 150	30	Existing
	2	Keep	– 30	30	0
	3	60	0	0	0
	4 +	60	0	0	90
Babine treatment unit 3	1	Keep	– 150	25	Existing
	2	Keep	– 20	25	0
	3	Keep	– 30	25	0
	4	75	0	0	0
	5 +	75	0	0	100

A.7 Volume Estimates for Regenerated Stands

WinTIPSY (Windows™ version of the Table Interpolation Program for Stand Yields) version 3.0, supported by the B.C. Ministry of Forests, Research Branch, was used to estimate growth and yield for existing and future managed stands. Inputs to TIPSY, including site index adjustments, are documented in Section A.4.8, "Regeneration assumptions in managed stands" and Table A-18. Section A.4.9, "Immature plantation history" and Table A-19. document which stands are assumed to be managed in the analysis. Table A-28. displays the volume tables for managed stands.

A.7 Volume Estimates for Regenerated Stands

Table A-28. Timber volume tables for managed stands (cubic metres per hectare)

Table No.	1	2	3	4	5	6	7	8
Species group	Hemlock/ cedar	Hemlock/ cedar	Hemlock/ cedar	Balsam	Balsam	Balsam	Spruce	Spruce
Site productivity	Good	Medium	Poor	Good	Medium	Poor	Good	Medium
Age	1-140	1-140	1-140	1-140	1-140	1-140	1-140	1-140
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	8	0
30	12	0	0	22	0	0	99	5
40	85	9	0	136	13	0	247	53
50	186	54	1	268	65	0	380	133
60	274	120	4	389	140	1	452	214
70	358	189	25	477	211	13	452	285
80	424	248	54	549	276	40	452	347
90	472	306	89	609	337	74	452	395
100	519	354	127	658	383	117	452	433
110	554	397	158	685	415	154	452	464
120	584	430	190	716	441	190	452	492
130	584	458	220	745	465	223	452	515
140	584	485	248	772	485	257	452	531
150	584	509	271	798	502	288	452	545
160	584	530	292	798	515	312	452	555
170	584	551	309	798	525	332	452	564
180	584	566	324	798	528	349	452	564
190	584	580	339	798	533	365	452	564
200	584	592	350	798	538	377	452	564
210	584	602	362	798	541	386	452	564
220	584	609	373	798	543	393	452	564
230	584	618	384	798	543	402	452	564
240	584	622	393	798	543	407	452	564
250	584	626	400	798	543	412	452	564
260	584	632	404	798	543	418	452	564
270	584	636	409	798	543	421	452	564
280	584	641	417	798	543	424	452	564
290	584	644	420	798	543	427	452	564
300	584	648	424	798	543	428	452	564
310	584	648	424	798	543	428	452	564
320	584	648	424	798	543	428	452	564
330	584	648	424	798	543	428	452	564
340	584	648	424	798	543	428	452	564
350	584	648	424	798	543	428	452	564

(continued)

A.7 Volume Estimates for Regenerated Stands

Table A-28. Timber volume tables for managed stands (cubic metres per hectare)

Table	9	10	11	12	13	14	15
Species group	Spruce	Pine	Pine	Pine	Cottonwood/ coniferous	Cottonwd/ conif.	Cottonwd/ conif.
Site productivity	Poor	Good	Medium	Poor	Good	Medium	Poor
Age	1-140	1-140	1-140	1-140	1-140	1-140	1-140
10	0	0	0	0	0	0	0
20	0	10	0	0	0	0	0
30	0	92	20	0	4	1	0
40	1	200	76	5	78	27	8
50	5	292	148	19	190	106	31
60	45	353	212	44	298	201	62
70	93	404	262	80	400	284	97
80	146	435	306	115	490	360	128
90	197	456	339	149	566	419	155
100	245	474	362	178	641	459	177
110	290	474	380	205	706	497	195
120	328	474	393	227	765	529	211
130	365	474	405	246	810	553	224
140	396	474	414	264	848	575	233
150	427	474	422	280	884	592	245
160	453	474	427	293	922	606	253
170	477	474	433	303	956	615	258
180	500	474	437	313	987	624	264
190	518	474	438	320	1 017	635	271
200	539	474	439	325	1 044	644	276
210	555	474	437	331	1 068	650	280
220	572	474	437	336	1 068	658	284
230	590	474	438	338	1 068	664	288
240	604	474	437	340	1 068	670	288
250	616	474	434	342	1 068	675	287
260	627	474	433	342	1 068	679	287
270	638	474	435	345	1 068	679	287
280	646	474	435	344	1 068	679	286
290	657	474	434	345	1 068	679	285
300	667	474	434	345	1 068	679	286
310	667	474	434	345	1 068	679	286
320	667	474	434	345	1 068	679	286
330	667	474	434	345	1 068	679	286
340	667	474	434	345	1 068	679	286
350	667	474	434	345	1 068	679	286

(continued)

A.7 Volume Estimates for Regenerated Stands

Table A-28. Timber volume tables for managed stands (cubic metres per hectare)

Table	51	52	53	54	55	56	57	58
Species group	**Hemlock/ cedar**	**Hemlock/ cedar**	**Hemlock/ cedar**	**Balsam**	**Balsam**	**Balsam**	**Spruce**	**Spruce**
Site productivity	**Good**	**Medium**	**Poor**	**Good**	**Medium**	**Poor**	**Good**	**Medium**
Age	**141 +**	**141 +**	**141 +**	**141 +**	**141 +**	**141 +**	**141 +**	**141 +**
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	8	0
30	12	0	0	41	0	0	100	4
40	83	3	0	179	8	0	250	44
50	184	34	0	319	50	0	383	120
60	273	90	3	442	118	1	453	199
70	356	153	15	526	189	10	453	267
80	421	210	41	603	250	31	453	329
90	470	262	71	656	311	62	453	379
100	515	312	105	693	359	102	453	419
110	551	355	139	729	395	140	453	448
120	582	389	166	765	423	173	453	477
130	582	419	195	796	445	205	453	499
140	582	444	223	796	466	238	453	517
150	582	466	247	796	484	270	453	533
160	582	486	269	796	498	295	453	542
170	582	505	287	796	508	317	453	552
180	582	522	302	796	517	337	453	558
190	582	538	316	796	524	351	453	565
200	582	550	328	796	528	364	453	565
210	582	561	339	796	529	376	453	565
220	582	571	349	796	532	385	453	565
230	582	580	358	796	534	393	453	565
240	582	584	366	796	534	397	453	565
250	582	590	376	796	534	403	453	565
260	582	595	382	796	534	408	453	565
270	582	599	389	796	534	414	453	565
280	582	604	393	796	534	417	453	565
290	582	606	397	796	534	420	453	565
300	582	609	402	796	534	423	453	565
310	582	609	402	796	534	423	453	565
320	582	609	402	796	534	423	453	565
330	582	609	402	796	534	423	453	565
340	582	609	402	796	534	423	453	565
350	582	609	402	796	534	423	453	565

(continued)

A.7 Volume Estimates for Regenerated Stands

Table A-28. Timber volume tables for managed stands (cubic metres per hectare) (concluded)

Table	59	60	61	62
Species group	**Spruce**	**Pine**	**Pine**	**Pine**
Site productivity	**Poor**	**Good**	**Medium**	**Poor**
Age	**141 +**	**141 +**	**141 +**	**141 +**
10	0	0	0	0
20	0	12	0	0
30	0	103	12	1
40	0	213	56	8
50	2	304	122	28
60	10	369	181	63
70	43	415	233	103
80	78	446	275	142
90	120	468	310	176
100	159	468	338	207
110	196	468	356	233
120	230	468	370	255
130	264	468	380	276
140	293	468	392	292
150	319	468	400	306
160	343	468	407	319
170	365	468	412	328
180	385	468	416	337
190	404	468	420	342
200	422	468	420	345
210	437	468	420	349
220	450	468	422	352
230	461	468	425	354
240	475	468	424	357
250	486	468	424	358
260	495	468	421	362
270	506	468	419	361
280	515	468	415	364
290	523	468	411	365
300	531	468	409	365
310	531	468	409	365
320	531	468	409	365
330	531	468	409	365
340	531	468	409	365
350	531	468	409	365

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The socio-economic analysis portion of this report identifies employment and income impacts, changes in government revenues, and community impacts as a result of changes in the TSA's harvest levels over time. Some of the assumptions used in this report are as follows:

- **Employment multiplier** — employment multipliers are used to estimate indirect and induced employment impacts of a change in direct industry activity. The calculation of employment multipliers is based on analytical assumptions and data collected at a specific time period. The multipliers reflect industry and employment conditions at that time and may not accurately reflect industry and employment conditions in the future.
- **Employment coefficient** — employment coefficients are ratios of person-years of employment per 1000 cubic metres of timber harvested. These ratios are used to estimate employment levels associated with alternative harvest rates. This method of analysis assumes that the industry structure will be the same in the future as it is today. While reasonably accurate in the short term, employment coefficients may change in the future due to changes in market conditions, product mix or production technologies.
- **Timing of impacts** — employment impacts are shown to occur simultaneously with a change in the harvest level. While this assumption is reasonably accurate for the harvesting sub-sector, employment estimates for the silviculture and timber processing sub-sectors may not be as coincidental. As well, indirect and induced impacts tend to occur over a longer period, as levels of business and consumer spending adjust to changes in harvest levels.
- **Operating thresholds of mills** — it is unlikely that impacts on timber processing employment due to changes in harvest levels will be in direct proportion to the harvest changes (i.e., a 10% change in harvest may not lead to a 10% change in timber processing employment). Impacts on timber processing employment are more likely to occur step-wise related to operating thresholds of mills. For example, if a mill's timber supply is reduced, its operating threshold is reached when the decrease in timber supply causes it to lay-off a shift of workers or to close the mill, either temporarily or permanently. Conversely, if the timber supply to the mill is increased, a processing threshold is reached when the mill has to decide whether to add another shift of workers or new capacity to process the increase in timber supply. In both cases, the per cent change in employment in the mill would probably differ from the per cent change in the timber processed. Because mills have many different operating configurations, accurately predicting an individual mill's operating threshold is impossible. As a result, impact figures pertaining to employment in timber processing are best interpreted as size of change rather than as precise changes in employment levels.
- **Government expenditures** — provincial government expenditures are more related to government policy and population levels than to industry activity. As such, expenditures on education, health care and other government services are assumed to remain unchanged despite changes to the harvest level and subsequent changes in government revenues from the forestry sector. However, provincial government expenditures would likely change if a community's population significantly changes. This would amplify the community impacts of losses or gains in forestry sector jobs.
- **Proportional harvest reductions** — harvest reductions are assumed to be proportionately distributed among all licensees and all forms of tenure within the TSA.

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 TSA. Other general economic data are from BC STATS, the Ministry of Finance, Statistics Canada and local communities. Estimates of taxes paid by the forest industry are from PriceWaterhouseCoopers.

Person-year of employment

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

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

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

Employment and income impacts were estimated in several steps. The first step was to assess current activity in each of the three sub-sectors. Then, indirect and induced employment and employment income impacts were estimated, using data from Ministry of Finance (1996) and Statistics Canada. Next, employment coefficients were calculated and then applied to the base case harvest forecast. Other indicators of the forestry sector's contribution to the provincial economy, such as government revenues and industry taxes were also calculated, using Ministry of Forests stumpage estimates and other data sources.

Employment — harvesting

Direct employment in harvesting consists of all woodlands-related jobs including harvesting, log salvage, planning and administration functions and log transportation. The employment multipliers used in this analysis define activities such as road building or maintenance work as indirect employment rather than direct employment because the forestry sector and other basic sectors purchase these services.

Data on employment, place of residence and timber flows were obtained from responses to questionnaires that were sent to licensees and operators in the TSA. The information was then used to estimate employment averages associated with harvest changes and the proportion of residents *versus* non-residents who work in the TSA.

Two estimates of direct employment in harvesting were calculated:

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

The estimates of TSA and provincial direct employment in harvesting were used to calculate employment coefficients 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.

B.2 Economic Impact Analysis Methodology

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, information on silviculture employment was 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.

Employment — timber processing

Information about employment, production and sources of timber was gathered from 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 pro-rated 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 supply is from the harvest of the TSA, then 80% of the employment in the plant would be attributable to the TSA harvest. Employment figures were also adjusted to reflect the residences of workers (i.e., those who lived within the TSA and those who lived outside the TSA). Employment in timber processing that is supported by chip by-products from milling operations was also similarly estimated.

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

Indirect and induced employment estimates

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

Two sets of employment multipliers were calculated for this report: a migration multiplier and a no-migration multiplier. 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 displaced workers remain in the area, at least in the short term, and unemployment and other social safety net payments temporarily offset some of the income loss. Using the no-migration multipliers diminishes the degree of induced impacts associated with a change in direct employment.

B.2 Economic Impact Analysis Methodology

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

Table B-1. Employment multipliers — Kispiox TSA

Forestry sub-sector	Kispiox TSA migration multiplier	Kispiox TSA no-migration multiplier	Provincial (interior) migration multiplier	Provincial (interior) no-migration multiplier
Harvesting	1.29	1.20	2.14	1.80
Solid wood processing	1.66	1.51	2.29	1.93

Sources: Ministry of Finance. 1999. The 1996 Forest District Tables.
Ministry of Finance. 1996. A provincial impact estimation procedure for the British Columbia forestry sector.

Estimates of employment income

Employment income was calculated using average income estimates for workers in the forest industry. Based on Statistics Canada data, the weighted average annual pre-tax income (less benefits) for forestry sector workers during the period 1998 to 2000 (in year 2000 dollars) was:

$48,100 for those working in logging and forestry services, and

$45,800 for those working in solid wood manufacturing.

Those in indirect and induced occupations earned approximately $31,400. Income taxes were calculated based on marginal tax rates of 23 – 28% with one-third of the total income tax paid accruing to the province.

Employment estimates of alternate 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 future years. Therefore, the employment estimates should be viewed as indicators of size of change rather than as precise estimates of changes in employment levels.

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.).

Table B-2. Estimates of provincial government revenues — Kispiox TSA

	Average annual revenue 1997-2000 ($ thousands)	Revenue ($ per '000s m^3)
Stumpage and related payments[a]	9,425	10,400
Forest industry taxes[b]	6,875	7,600
Employee income tax[c]	5,700	6,300
Total	22,000	24,300

(a) Source: Ministry of Forests, Revenue Branch.

(b) Based on estimates by PriceWaterhouseCoopers. Includes taxes for logging, corporate income, corporate capital, sales, property and electricity.

(c) Estimated from Revenue Canada income tax rates and includes only the provincial share of income taxes paid.