

North Coast TSA Timber Supply Analysis

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Preface

This analysis is part of the provincial Timber Supply Review being carried out by the British Columbia Forest Service. The review is examining the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) throughout British Columbia. In many areas of the province, timber supply analyses performed in the early 1980s have not been updated to reflect new inventory information or changes in management practices.

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

Unlike past analyses, which normally assessed the implications of several forest management scenarios, this report focuses on a single scenario — current

management practices. This approach will expedite the analysis process, allowing analysis of all TSAs in the province to be completed by the end of 1994. An important part of these analyses, however, 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 timber supply will form a solid basis for discussions among stakeholders about alternative timber harvesting levels.

This report is one of four documents that will be released for each timber supply area as part of the Timber Supply Review. Two of these documents provide detailed technical information on results of timber supply and socio-economic analyses. One report summarizes this information to provide a focus for public discussions of possible timber harvest levels. The fourth outlines the Chief Forester's decision and the reasoning behind it.

Executive Summary

As part of the provincial Timber Supply Review, the B.C. Forest Service has examined the availability of timber in the North Coast Timber Supply Area (TSA). This analysis assesses how current forest management practices affect the supply of wood available for harvesting over the next 200 years. It also examines the potential variation in timber supply stemming from uncertainties about forest growth and management actions. It is important to note that the various harvest forecasts included in this report indicate only the timber supply implications of current practices and the associated uncertainty of these implications. **The forecasts are to be used for discussion purposes only; they are not intended to imply any particular allowable annual cut (AAC) recommendations.**

The North Coast TSA covers a total of 1.95 million hectares, of which only about 114 000 hectares are currently considered available for timber harvesting under existing management practices. The area is dominated by hemlock and hemlock/amabilis fir stands.

The current AAC for the North Coast TSA is 600 000 cubic metres per year.

Visual quality and biodiversity objectives were not incorporated in the last analysis for the North Coast TSA. Since then, however, visual quality corridors have been established, the Khutzeymateen Valley has been given protected status for grizzly bear habitat, and proposed guidelines for ensuring biodiversity have been developed. The Inside Passage, Highway 16, and Work Channel visual

quality corridors represent 8% of the area currently available for harvest. The Khutzeymateen Valley has been completely excluded from the harvestable land base. Interim harvesting guidelines meet some of the new biodiversity objectives. Other biodiversity guidelines which have not yet been implemented fully, may have impacts on the harvest forecast. This is addressed through sensitivity analysis.

Under current management assumptions, the analysis indicates that the current harvest level of 600 000 cubic metres per year can be maintained for another 6 decades, followed by a 10% decline per decade for 7 decades to a long-term harvest level of 301 000 cubic metres.

Many of the data and assumptions used in the analysis are subject to varying degrees of uncertainty. The harvest forecast is most sensitive to changes in harvest flow requirements.

Over the first 40 years, the harvest forecast is moderately affected if existing stand yields have been overestimated and is slightly affected if the timber harvesting land base has been overestimated. The long-term harvest forecast is moderately affected by uncertainties of regenerated stand volumes and the timber harvesting land base. It is possible that the harvest level may have to begin declining before decade 7. Overall, however, all forecasts presented indicate that the current harvest level can be maintained for at least a decade more without significantly reducing the future options of resource managers.

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Introduction

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

Assessing timber supply involves considering physical, biological and socio-economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study, in addition to 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 on 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. Deciding whether a stand is available for harvest often depends on how its harvest could affect another aspect of the forest, such as wildlife habitats or a recreation area.

These factors are also subject to 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 — a debate that 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 the uncertainties affecting those 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)*.

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

Timber Supply Area (TSA)

An integrated resource management unit established in accordance with Section 6 of the Forest Act.

Allowable annual cut (AAC)

The permissible harvest level from a specified area of land. The Chief Forester sets AACs for Timber Supply Areas (TSAs) and Tree Farm Licences (TFLs) in accordance with Section 7 of the Forest Act.

Introduction

Timber supply projections made for TSAs look far into the future — 200 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 schedules that remain in place for that length of time. They remain relevant only as long as the information on which they are based remains relevant. Thus, it is important that re-analysis occur regularly, using new information and knowledge to update the timber supply picture. Indeed, the *Forest Act* now requires that the timber supply for management units throughout British Columbia be reviewed at least every 5 years. This allows close monitoring of the timber supply and assessment of the implications for the AAC resulting from changes in management practices and objectives.

Timber supply analysis involves three main steps. The first is the collection and preparation of information and data. The B.C. Forest Service forest inventory* plays a major role in this. The second step is using this information with a timber supply

computer model or models to make a projection or estimation of possible harvest levels over time (called harvest forecasts*). These projections are made using different sets of assumed values or conditions for the factors discussed above. The third step in timber supply analysis is the interpretation and reporting of results.

The following sections outline the timber supply analysis for the North Coast TSA. Following a brief description of the TSA in Section 1, data preparation and formulation of the assumptions are discussed in Section 2. The analysis methodology and results are then presented in Sections 3 and 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used. The report summary and conclusions are presented in Section 6.

Appendix A contains further details about the data and assumptions used in this analysis; Appendix B contains a summary of land base changes in the North Coast TSA since 1981.

Forest inventory

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

Harvest forecasts

The forecast 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 assumptions. 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.

1 Description of the North Coast Timber Supply Area

The North Coast TSA (Figure 1) includes the coastal portion of the Prince Rupert Forest Region, and stretches from Meyers Passage (Klemtu) in the south to Stewart in the north. It covers approximately 1.95 million hectares and contains the City of Prince Rupert, the District of Port Edward, the Village of Port Simpson and many small coastal communities. The TSA is administered from the North Coast Forest District Office located in Prince Rupert.

Industry in the North Coast TSA is mainly resource based, with forestry, mining and fishing dominating. The forest industry provides a substantial source of revenue and employment for

the communities in the area. Tourism and recreation industries are also important economic factors, complemented by beautiful scenery, unique outdoor opportunities and diverse wildlife habitats.

The forests are a mixture of hemlock (43%), cedar (39%), lodgepole pine (10%), amabilis fir (6%), sitka spruce (2%) and various deciduous species (less than 1%). The history of harvesting is short which, when combined with the limited incidence of fire, insect and disease attack, has resulted in a forest composed mainly of old stands (95% of the stands are older than 140 years) containing a diversity of species and ages.

Figure 1. The Prince Rupert Forest Region showing the North Coast Timber Supply Area.

2 Information Preparation

Many pieces of information are required for timber supply analysis. Each piece falls into one of three categories: land base inventory, timber growth and yield, or management practices.

2.1 Land base inventory

Land base inventory information used in this analysis comes in the form of a computer file prepared by the B.C. Forest Service Inventory Branch in 1993. This file contains a considerable amount of data about the thousands of pieces of forest land that make up a TSA, including the geographic location, area and nature of forest cover (such as presence or absence of trees, number of trees, species, age and timber volume).

Initially, this file is a representation of the land base for the entire TSA. It includes data for areas on which timber harvesting operations are not expected to take place, and which therefore do not contribute to the timber supply of the area. Examples are land that has been set aside for a park, or the areas occupied by power lines, highways or town sites (such non-contributing areas specific to the North Coast TSA are described below). Before this land base file is used to make timber supply projections, data for these non-contributing areas must be removed to ensure that the file represents the timber harvesting land base*.

The reduced data file is derived through a computer process that identifies information for non-contributing areas and removes it from the file. When these reductions are made, care is taken to ensure that only a single reduction is made where categories overlap (for example, where a park area also has unstable soils).

It is important to remember that removal of data for areas not contributing to the timber supply does

not imply withdrawal of areas from the TSA. The B.C. Forest Service still manages the entire area of the TSA (except for certain designated lands) as a forest unit that contributes a mix of timber and non-timber values. The timber supply is managed within that integrated resource context, and the timber supply analysis in this report 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* does not mean that an area is open to unrestricted harvesting activities. Rather, it implies that forests in the area contain timber of sufficient economic value—and sites with adequate environmental resilience to—accommodate timber harvesting with due care for other resources.

Areas on which timber harvesting is not expected to occur, given current forest management in the North Coast TSA, are as follows:

- non-Crown areas — areas not managed directly by the B.C. Forest Service.
- non-forest areas — areas not occupied by productive forest cover (for example, rock, swamp and alpine areas).
- special wildlife areas — such as the Khutzeymateen Valley for the protection of Grizzly bear habitat (Figure A-1.)
- environmentally sensitive areas* — a proportion of the areas considered to be sensitive were deducted from the timber harvesting land base.

Timber harvesting land base

The portion of the total land area of a management unit considered to contribute to, and be available for, long-term timber supply. The harvesting land base is calculated by reducing the total land base according to specified management assumptions.

Environmentally sensitive areas

An area with significant non-timber values or fragile or unstable soils, or in which there are impediments to establishing a new tree crop or where timber harvesting may cause avalanches.

2 Information Preparation

- inoperable areas — areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include steepness of slope, elevation, the presence of gullies or exposed rock, and the market price of wood products.
- streamside buffers — areas of fish habitat for sport and commercial use.
- non-merchantable forest types — stands of non-merchantable coniferous species, low quality timber or low volume.
- sites with low timber growing potential (low site classification*).
- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- forest roads, skid trails and landings — currently 1011 hectares exist within the North Coast TSA. As harvesting occurs, the B.C. Forest Service timber supply model deducts future losses related to access.
- not satisfactorily restocked* (NSR) areas — these areas are initially removed but are considered available for timber production and are added back into the timber harvesting land base.
- timber licence areas — land currently in these tenure arrangements does not contribute to the timber harvesting land base of the TSA until either the current timber stands are harvested or the expiry date is reached. At that point, these areas are added into the timber harvesting land base.

Site classification

An expression of site productivity. Site classifications are based on tree height as a function of stand age and are usually expressed in groupings such as good, medium, poor or low.

Not satisfactorily restocked

An area not covered by a sufficient number of tree stems of desirable species. Stocking standards are set by the Forest Service, Silviculture Branch. If the expected regeneration delay (the period of time between harvesting and the date by which an area is occupied by a specified minimum number of acceptable well-spaced trees) has not elapsed, the land is defined as current NSR. If the expected delay has elapsed, the land is classified a backlog NSR.

2 Information Preparation

Table 1 summarizes the areas represented by these categories. A more detailed description of the categories and the rationale for the removals and

additions are provided in Appendix A, "Description of Data Inputs and Assumptions."

Table 1. Timber harvesting land base for the North Coast TSA.

Classification	Area (hectares)	Per cent of total TSA	Per cent of productive Crown land
Total TSA area	1 947 531	100.0	
Timber licence areas	425	0.0	
Non-Crown	54 333	2.8	
Crown land	1 892 773	97.2	
Non-productive Crown land	1 187 928	61.0	
Productive Crown land	704 845	36.2	100.0
Current reductions to productive Crown land			
Khutzymateen Valley	15 906		
Environmentally sensitive area	139 190		
Inoperable	418 234		
Streamside buffers (riparian)	6 508		
Non-merchantable forest types	5 627		
Low site	4 249		
Non-commercial cover	67		
Roads, skid trails, landings	1 011		
Not satisfactorily restocked (NSR) ^a	4 491		
Total current reduction	595 283	30.6	84.5
Current additions to productive Crown land			
NSR reclassified to stocked	1 397		
Backlog NSR	1 879		
Current NSR	1 215		
Timber licence area currently reverted, harvested and stocked	154		
Total current addition	4 645	0.2	0.7
Total current timber harvesting land base	114 207	5.9	16.2
Future reductions to timber harvesting land base			
Future roads reduction	8 378		
Total future reduction	8 378	0.4	1.2
Future additions to timber harvesting land base			
Timber licence area reverted in 10 years	101		
Timber licence area reverted in 20 years	170		
Total future addition	271	0.0	0.0
Long-term timber harvesting land base	106 100	5.4	15.1

^a All NSR land is initially subtracted. The portion of NSR area considered available for timber production, as recorded in silviculture history records, is then added to the harvesting land base. NSR can be created by natural forces - particularly fire - as well as timber harvesting, and some is not operable for harvesting.

2 Information Preparation

Figure 2 summarizes the land base categories for the North Coast TSA. The figure shows that most of the TSA is Crown land, of which less than 10% is

available for timber harvesting. Overall, the timber harvesting land base accounts for less than 6% of the total TSA (see Table 1).

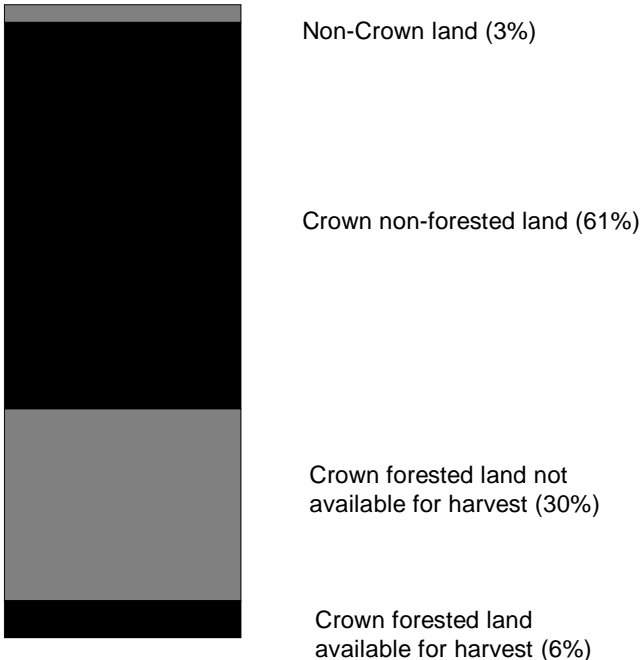


Figure 2. Land base classification for the North Coast TSA.

2 Information Preparation

Figure 3 shows the area by species and maturity for the timber harvesting land base. Overall, 83% of the timber harvesting land base is made up of stands that are of harvestable age (see Appendix A, "Description of Data Inputs and Assumptions," Table

A-10. for minimum harvest ages). Seventy-seven per cent of the timber harvesting land base is composed of hemlock and hemlock/amabilis fir stands. The remainder are cedar and cedar/hemlock (15%), spruce (8%) and cottonwood (less than 1%).

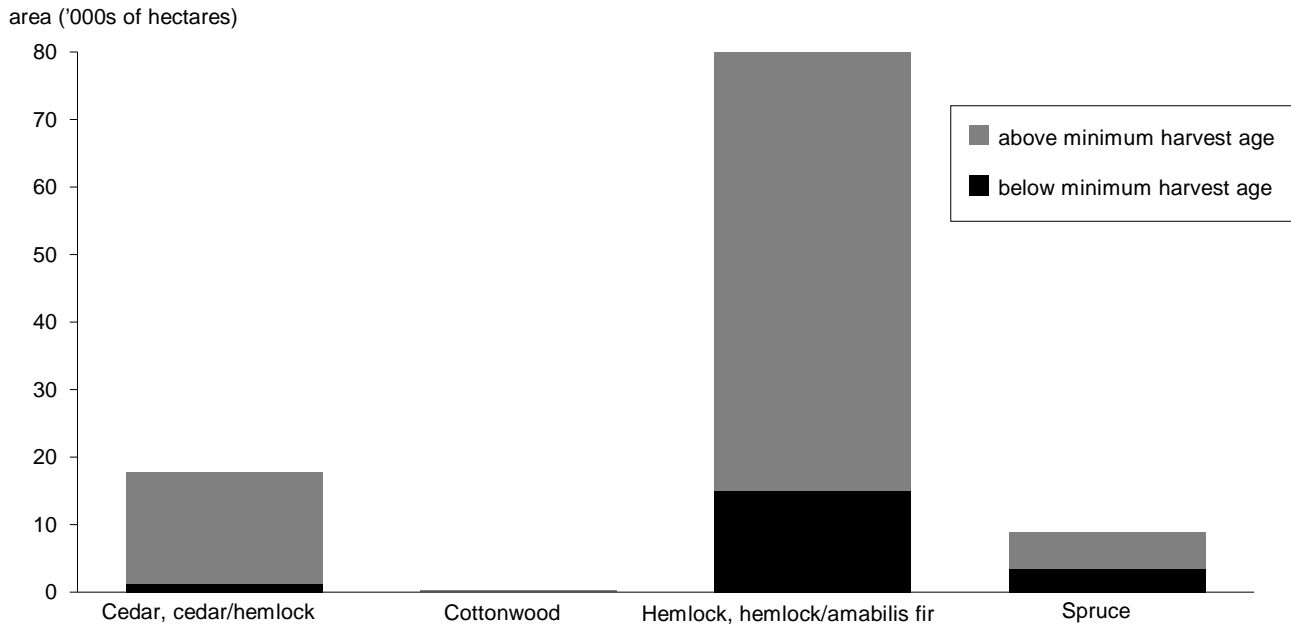


Figure 3. Area of the current timber harvesting land base, by dominant tree species and maturity.

2 Information Preparation

Figure 4 shows the age class distribution by tree species for the timber harvesting land base. Most of the existing stands are older than 280 years; few are younger than 50 years. The latter are indicative of the short harvesting history within the North Coast TSA.

Very few stands are between 50 and 280 years old because of the limited occurrence of fire, insect and disease attack. The stands older than 280 years are typical of old coastal forests which are comprised of trees of various species and ages.

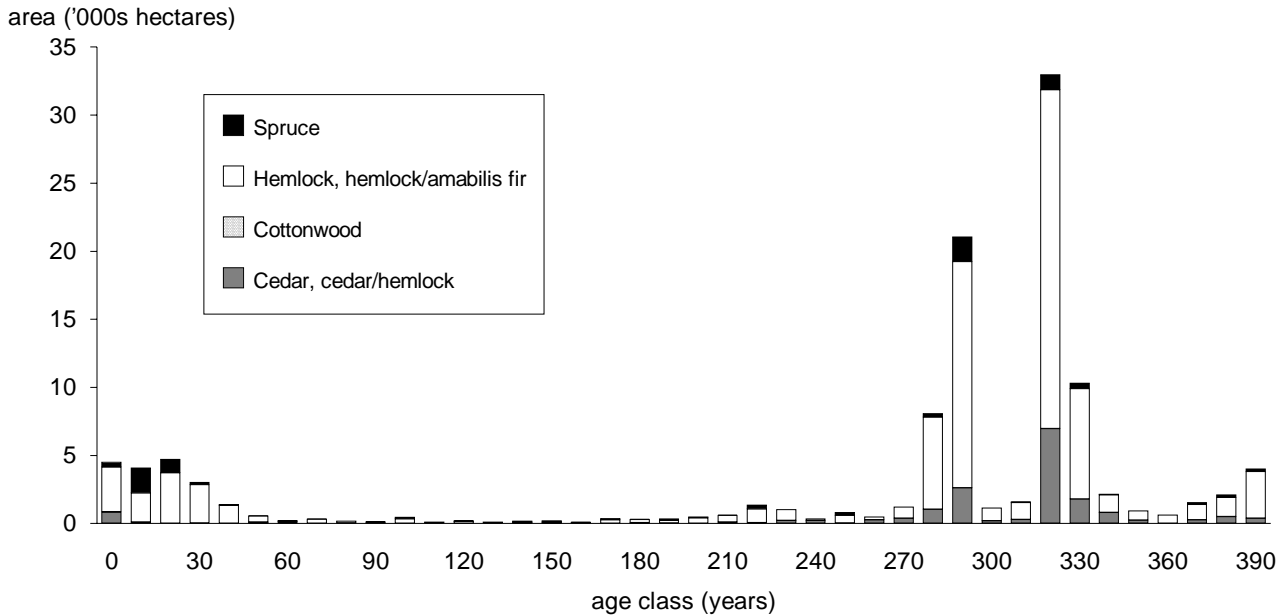


Figure 4. Age class distribution of the current timber harvesting land base, by dominant tree species.

2 Information Preparation

2.2 Timber growth and yield

Timber growth and yield refers to the prediction of the growth and development of individual forest stands over time. The most common measure of the amount of standing timber is volume per unit area (in British Columbia, cubic metres per hectare). This measure assumes a utilization level or set of dimensions that establishes a minimum size limit for trees and logs that must be harvested and removed from a site. Utilization levels specify a maximum stump height and minimum diameters at the tree base and top.

Timber volumes for the North Coast TSA analysis are based on the Variable Density Yield Prediction (VDYP) model developed for the B.C. Forest Service Inventory Branch. This model provides estimates of volume for existing and regenerated (future) stands according to their age. Sensitivity analysis addresses the possibility that actual stand volumes may be different from those predicted.

2.3 Management practices

Timber supply is directly connected to forest management activity. The focus of the Timber Supply Review is to describe the timber supply based on current management practices, as implemented in plans for the area. Staff in the North Coast Forest District and in the Prince Rupert Forest Region described the various management assumptions* as follows:

- Basic silviculture — those reforestation activities required to establish free-growing* stands of acceptable species after harvesting.

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 cutting ages, utilization levels and standards, integrated resource guidelines, and silviculture and pest management programs.

Free growing

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

- Forest health and unsalvaged losses — these are the expected timber losses due to fire, pest (insect, disease and animals) and wind damage. For the North Coast TSA, unsalvaged losses of approximately 2000 cubic metres per year are currently assumed to be solely fire caused. These losses are deducted from gross harvest volumes to produce the net volumes shown in Sections 4, "Results", and 5, "Timber Supply Sensitivity Analysis."
- Forest cover requirements* — these are applied to the Retention* and Partial Retention* Visual Quality management areas within the TSA (Figure A-1.) to meet Visual Quality Objectives*. The forest cover requirements specify the maximum percentage of area allowed to be in a disturbed condition at any one time. A stand is considered to be disturbed until its regeneration reaches some desired condition — usually a specific height — that would allow adjacent timber to be harvested. The length of time required to reach the desired condition is referred to as the green-up period. The remainder of the timber harvesting land base is harvested under a one-pass system, under which there are no restrictions on when areas adjacent to a disturbed area can be harvested.

Forest cover requirements

Desired distributions of areas by age or size class groupings. These requirements can be used to reflect desired conditions for wildlife, biodiversity, watershed protection, visual quality and old-growth objectives. General adjacency and green-up guidelines are also specified using forest cover requirements.

Retention visual quality

Alterations are not easy to see in this VQO class.

Partial retention visual quality

Alterations may be visible but not conspicuous.

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.

2 Information Preparation

- Utilization levels — tree and log size limits that must be removed from the site.
- Minimum harvest ages — these are defined by the time it takes for stands to grow to harvestable size. The minimum harvest age determines the lower limit for harvesting. Actual harvest age depends on many factors, including the ages of other adjacent stands, limits on overall harvest level, and forest cover requirements.
- Restocking of backlog and current NSR — all backlog and current NSR is scheduled to be restocked within 10 years.

A more detailed discussion of all the management assumptions is contained in Appendix A, "Description of Data Inputs and Assumptions."

In addition to the current management practices, biodiversity* guidelines for the Prince Rupert Forest Region have been proposed. Interim timber harvesting guidelines which satisfy some of the biodiversity objectives are being followed, while the implementation of additional biodiversity requirements are being reviewed. The potential impacts on the harvest forecast from additional biodiversity requirements are examined through sensitivity analysis (Section 5, "Timber Supply Sensitivity Analysis").

2.4 Forest management areas

In the North Coast TSA, all areas with particular wildlife, environmental or visual quality importance are identified. Forest management activities are adjusted within these areas to maintain the identified values. In many cases no timber harvesting activities are permitted and the area is excluded from the timber harvesting land base. In recognition of the various forest management activities and objectives, the timber harvesting land base of the TSA has been separated into three forest management areas:

- 1) Integrated Resource management area;
- 2) Retention Visual Quality management area; and
- 3) Partial Retention Visual Quality management area.

All three management areas are subject to the North Coast Timber Harvesting Guidelines. The Integrated Resource management area which represents 92% of the timber harvesting land base, does not have any Visual Quality Objectives, thus a one-pass harvest is permitted. The Visual Quality management areas represent 8% of the timber harvesting land base and allow no more than 13% of the harvestable area in the Retention and 34% in the Partial Retention areas to be less than 5 metres tall (younger than 20 years old).

Biodiversity (biological diversity)

Diversity of life in all its forms and levels of organization, including genes, species, ecosystems and the evolutionary and functional processes that link them.

3 Analysis Methods

The purpose of this analysis was to examine both the short- and long-term timber harvesting opportunities in the North Coast TSA, in light of current forest management practices. A timber supply computer simulation model developed by the B.C. Forest Service was used to aid in the assessment. A timber supply model, as distinguished from a growth and yield model, assists the timber supply analyst in determining how a whole forest, or collection of stands, could be managed to obtain a harvest forecast or supply of timber over time. The model is also used to determine the available supply of timber over time for a given set of management practices. The simulation model uses information about the timber harvesting land base, timber volumes and the management regime to represent how trees grow and are harvested over a period of 0 to 400 years. However, because the harvest forecast remains constant from 200 to 400 years from present, only the results for the first 200 years are usually presented graphically in this report.

Similar to other models, the B.C. Forest Service model assumes that trees grow according to pre-determined yield projections and are harvested according to either a volume target or a specified objective set by the analyst, such as harvest volume maximization. However, the Forest Service model differs from other models in that it allows the use of forest cover guidelines that specify the desired age composition of the forest. These cover guidelines can be used to examine the effects of harvest block spatial

distribution rules and green-up prescriptions. For example, guidelines might specify that no more than some maximum per cent of the area can be younger than a specified green-up period, or that some minimum per cent of the area must be in older age classes to provide wildlife habitat. The B.C. Forest Service simulation model incorporates such guidelines and allows for the examination of their effects on timber supply.

This type of analysis is used to determine the timber supply implications of a particular timber harvesting regime. The results of the analysis are especially important in determining harvest schedules that will not significantly restrict future options of resource managers, and that will allow local B.C. Forest Service staff to administer their programs according to relevant guidelines and principles. **However, the results of the analysis should not be viewed as implying any particular AAC recommendation.**

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

4 Results

This section presents the results of the timber supply analysis based on the timber harvesting land base and the current management practices already described for the North Coast TSA.

4.1 Base Harvest forecast

The harvest forecast based on current management assumptions for the North Coast TSA, the base case harvest forecast, is shown in Figure 5. The purpose of the base case analysis is to indicate the potential maximum harvest levels that can be attained over time. These maximum levels are determined by the characteristics of the timber harvesting land base, yield estimates and current management practices already described. Harvest levels are also affected by the restrictions applied to the harvest flow pattern, such as the desire for a reasonable rate of decline to the long-term timber harvesting level. In the base case harvest levels are initially maintained at the current AAC as long as possible without causing future timber supply shortages. The long-term harvesting rate is established at a maximum that can be maintained indefinitely. This forecast will be used as a comparison for all other harvest forecasts in this report. Expected timber losses (2000 cubic metres per year) to fire, pest and wind have been subtracted from all harvest forecasts shown in this report.

In the base case, the current harvest level of 600 000 cubic metres per year is maintained for 6 decades. After the sixth decade the harvest level declines at 10% per decade until a long-term harvest level of 301 000 cubic metres is reached in decade 13. The harvest from that period on can be maintained indefinitely.

The long-term harvest level is set to maintain total growing stock* at a constant level over the long term. A constant growing stock results when the annual periodic volume grown is equal to the annual periodic volume harvested and that which is lost. Figure 6 shows that the total growing stock is constant in the base case from approximately decade 13 onward, corresponding to when the long-term harvest level is reached. A declining growing stock, as seen over the first 10 decades, means that the timber inventory is being depleted. If harvests over the long term exceed the productive capability of the land, the amount of growing stock would continue to decline, resulting in a future timber shortage.

Growing stock

The volume estimate for all standing timber, of all ages, at a particular time.

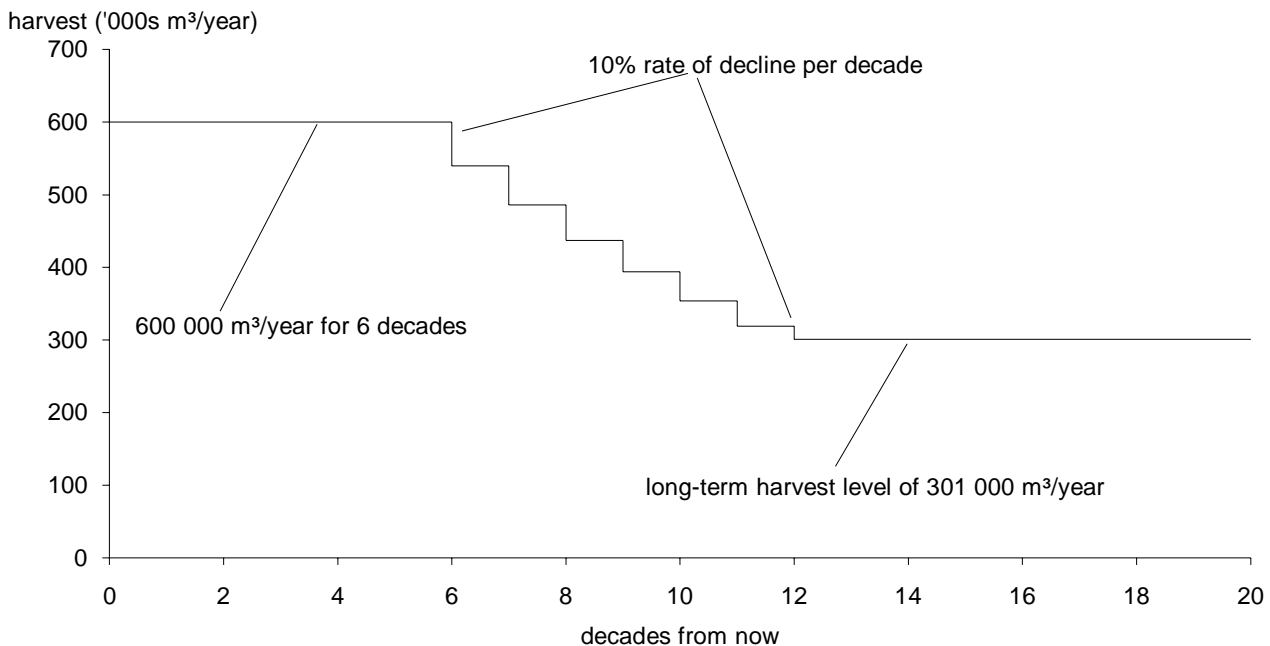


Figure 5. The base case harvest forecast for the North Coast TSA.

4 Results

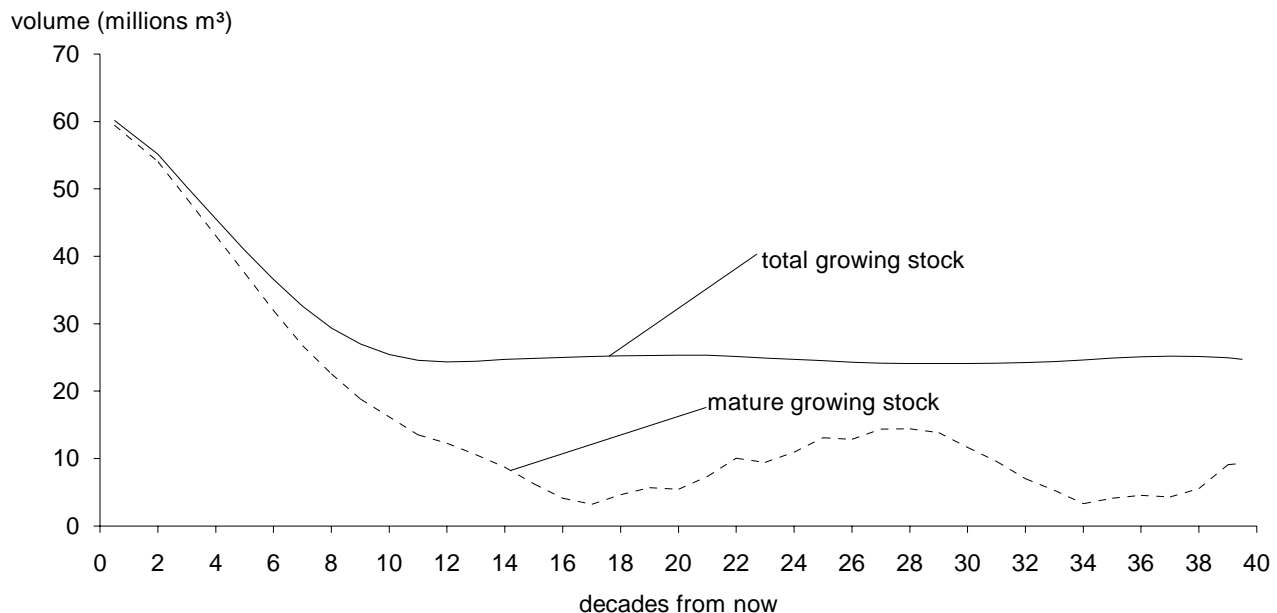


Figure 6. Projected growing stock over time for the North Coast TSA.

Harvests in the North Coast TSA can be maintained above the long-term level for several decades because of the existing timber inventory. Much of the area has yet to be harvested, therefore an abundance of high volume older aged stands are available. The timing and the rate of decline to the long-term level is driven mainly by when lower volume regenerated stands reach a harvestable age and by the amount of growing stock available for harvest. Section 5, "Timber Supply Sensitivity Analysis," provides more information on how yield estimates and minimum harvest ages of regenerated stands may affect the harvest forecast.

Note that the harvest forecast shown here, as well as those in Section 5, provides an upper limit on

timber supply given the land base and current management practices. **This forecast is for discussion purposes only and is not meant to suggest a particular AAC.**

4.2 Long-term harvest level

It is important that the long-term harvest level of 301 000 cubic metres per year not be interpreted as being the same as the theoretical maximum sustainable harvest level based on mean annual increment*. The theoretical level, about 327 000 cubic metres per year, is not achievable for several reasons.

Mean annual increment (MAI)

Stand volume divided by stand age. The stand age at which the MAI assumes its maximum value is called the culmination age. Harvesting all stands at this age results in a maximum average harvest over the long term.

4 Results

First, losses from fire and other causes must be deducted from the theoretical maximum. This reduces the maximum to about 325 000 cubic metres per year. Second, stands are almost always harvested at ages other than those that maximize stand volume production. Such deviations in harvest age occur because of the combined effects of the specified minimum harvest ages, the forest cover guidelines and the required harvest forecast pattern over time. Any deviation from harvesting at culmination age, whether older or younger, results in a long-term harvest level that is lower than the theoretical maximum sustainable harvest level.

4.3 Age class distribution over time

Figure 7 shows the changes that occur in the age class distribution of the timber harvesting land base over the 200-year planning horizon. Currently, 83% of the timber harvesting land base is above minimum harvest age. The current age class distribution in Figure 7 also shows about 4500 hectares of backlog and current NSR area (age class 0). Over the 200-year planning horizon, the area of older stands is reduced and the area of each age class becomes more balanced.

The 200-year projection in Figure 7 shows a relatively even-age class distribution. This combined with the constant total growing stock (Figure 6) indicates a stable forest that can maintain the long-term harvest level indefinitely.

4 Results

area ('000s of hectares)

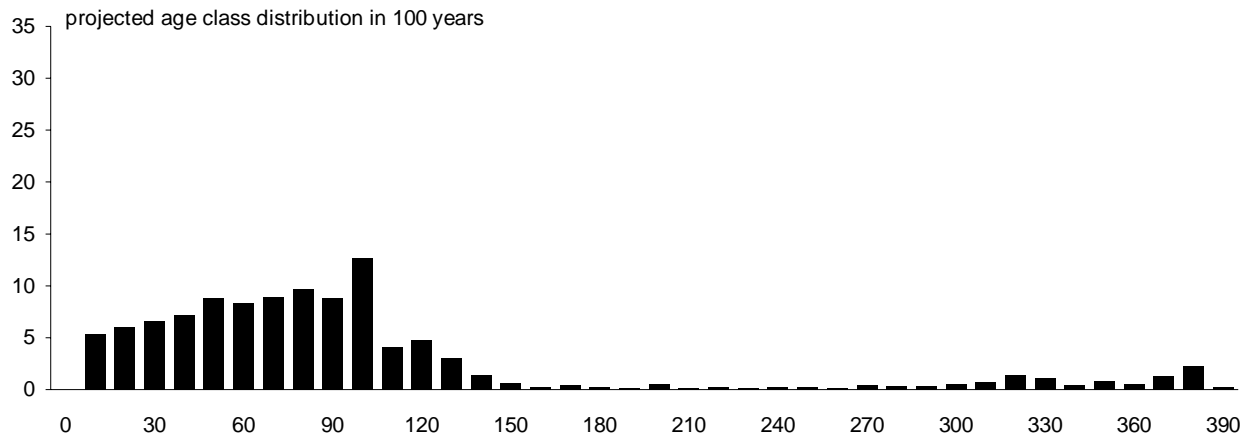
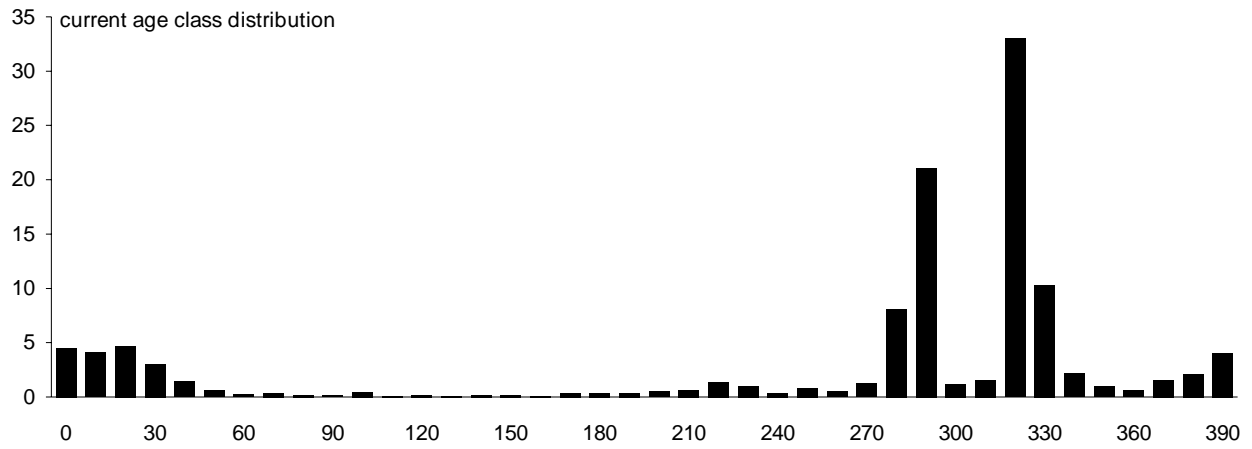


Figure 7. Projected age class distributions of the timber harvesting land base for the North Coast TSA.

4 Results

4.4 Average area harvested, harvest age, and volume per hectare

The average area harvested, shown in Figure 8, continues at the initial level of about 950 hectares per year for 6 decades, then declines steadily to a low of 500 hectares per year in decade 12. The decline is due to decreasing volumes being harvested in decades 6 through 12 (Figure 5). During decades 1 through 12, high volume old stands are being harvested.

The area harvested in decade 13 increases, even though the total volume harvested decreases. This is the result of the transition to harvesting regenerated stands that are younger and have lower volumes (as shown in Figures 9 and 10). Figure 9 shows that the average age of stands harvested drops from over 300 years to 150 years in decade 13. Figure 10 shows a corresponding decrease in average volume harvested, from 650 to 500 cubic metres per hectare. After this transition, an average of 660 hectares per year is harvested, yielding an average of 460 cubic metres per hectare.

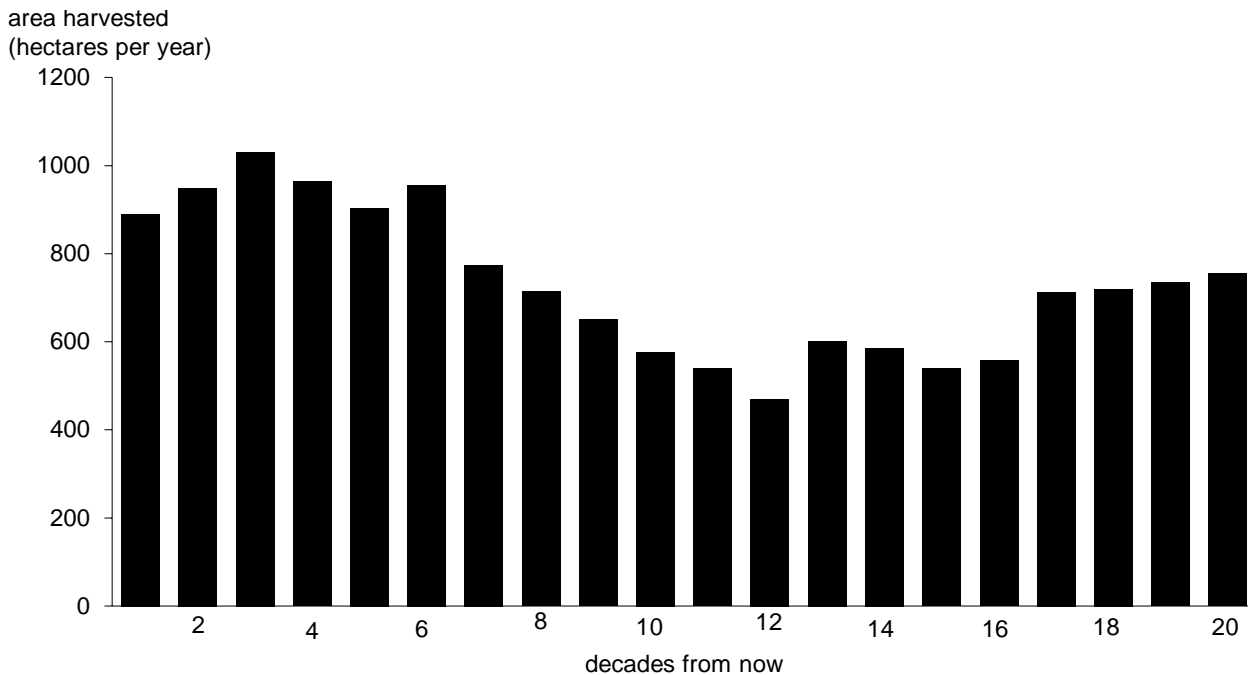


Figure 8. Projected area harvested in the base case.

4 Results

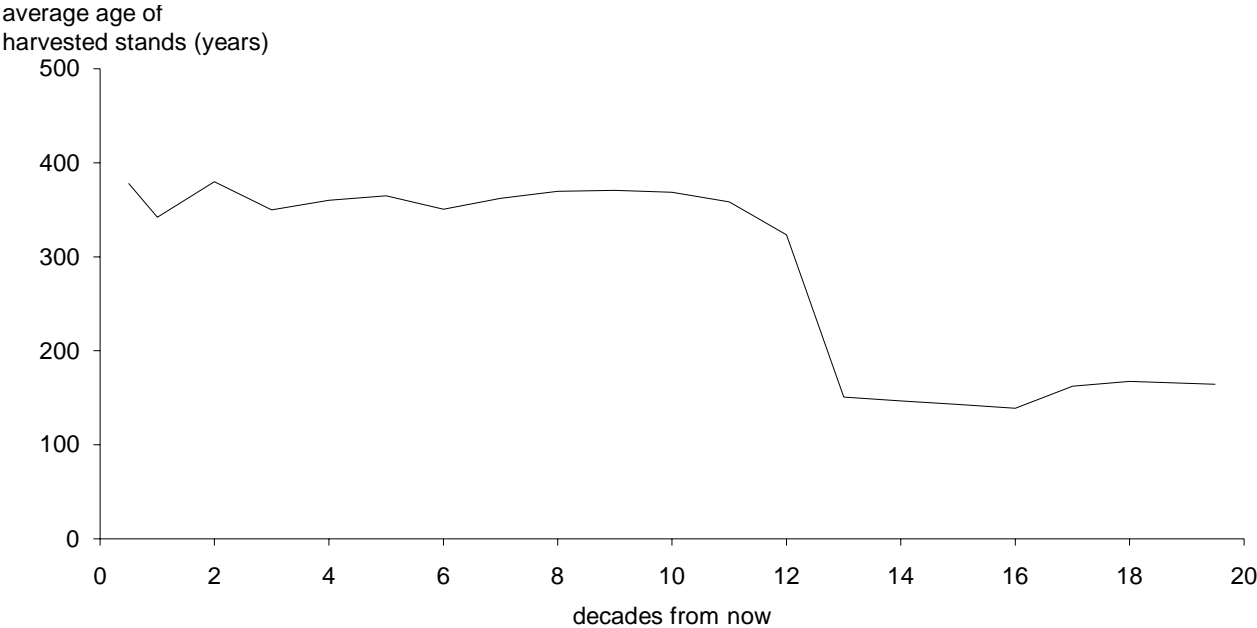


Figure 9. Projected average age of harvested stands.

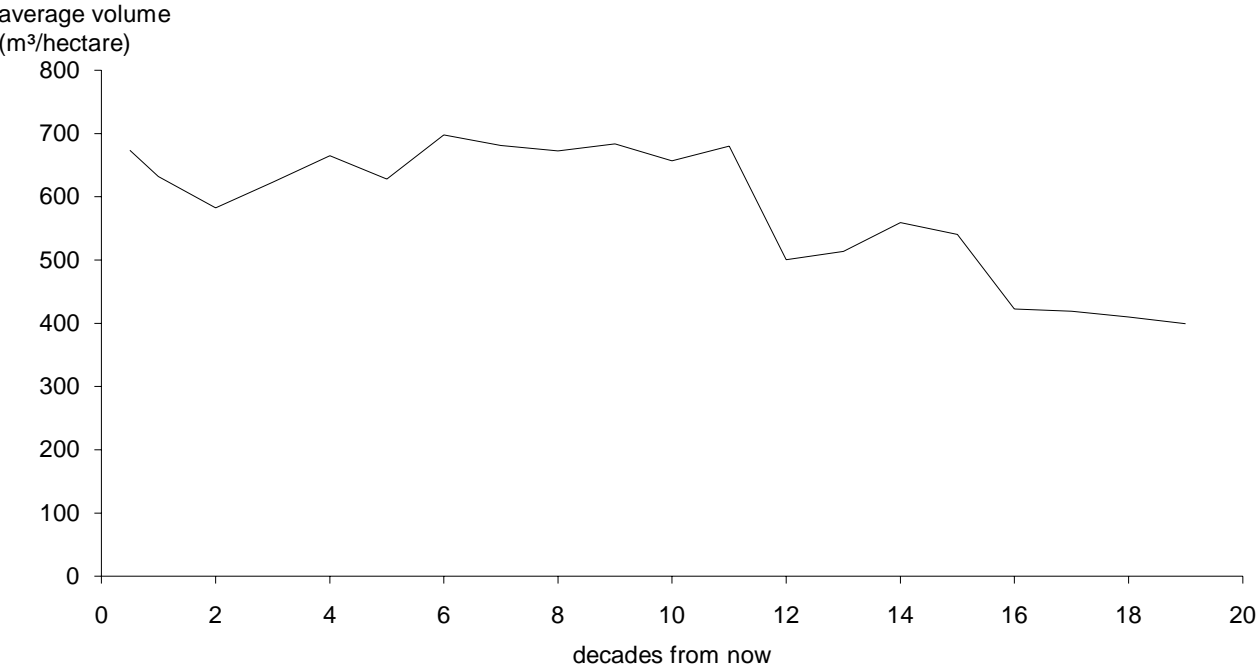


Figure 10. Projected average volume per hectare harvested in the base case.

5 Timber Supply Sensitivity Analysis

Sensitivity analysis is the exercise of examining how uncertainty in data and assumptions affect the outcome of the analysis. The main purpose of timber supply sensitivity analysis is to highlight how this uncertainty could affect results. Sensitivity analysis is an important aid to decision-making, since uncertainty surrounds estimates of many variables used in timber supply analysis.

The best available information on forest inventories and management practices is used to analyse the implications for timber supply of current management. It is possible, nevertheless, that small inaccuracies in estimating some variables could have large effects on results, or that fairly large inaccuracies for other variables could have negligible effects. Sensitivity analysis can highlight priorities for collecting information for future analyses. As well, it can clarify for decision-makers whether current best estimates are reasonable for decisions, or whether high uncertainty around important variables necessitates more conservative decisions.

In this section, results of several sensitivity analyses are outlined. The results are compared to the base case.

5.1 Harvest forecast alternatives

Although many other harvest forecasts are possible, five alternatives are examined here (shown in Figures 11, 12 and 13) and compared to the base case harvest forecast.

To review, the base case harvest forecast starts at 600 000 cubic metres per year for 6 decades, then declines by 10% per decade until the long-term harvest level of 301 000 cubic metres per year is reached in decade 13 (Figure 5).

Figure 11 shows the first alternative harvest forecast in which the rate of decline is limited to 9% per decade. If all other assumptions remain constant, a significant short fall occurs in decades 16 and 17. The reason for the short fall is that existing growing stock is depleted before sufficient volumes from regenerated stands are available to harvest. This illustrates that the minimum rate of decline is 10% per decade. Any lower rate of decline will result in future harvest short falls.

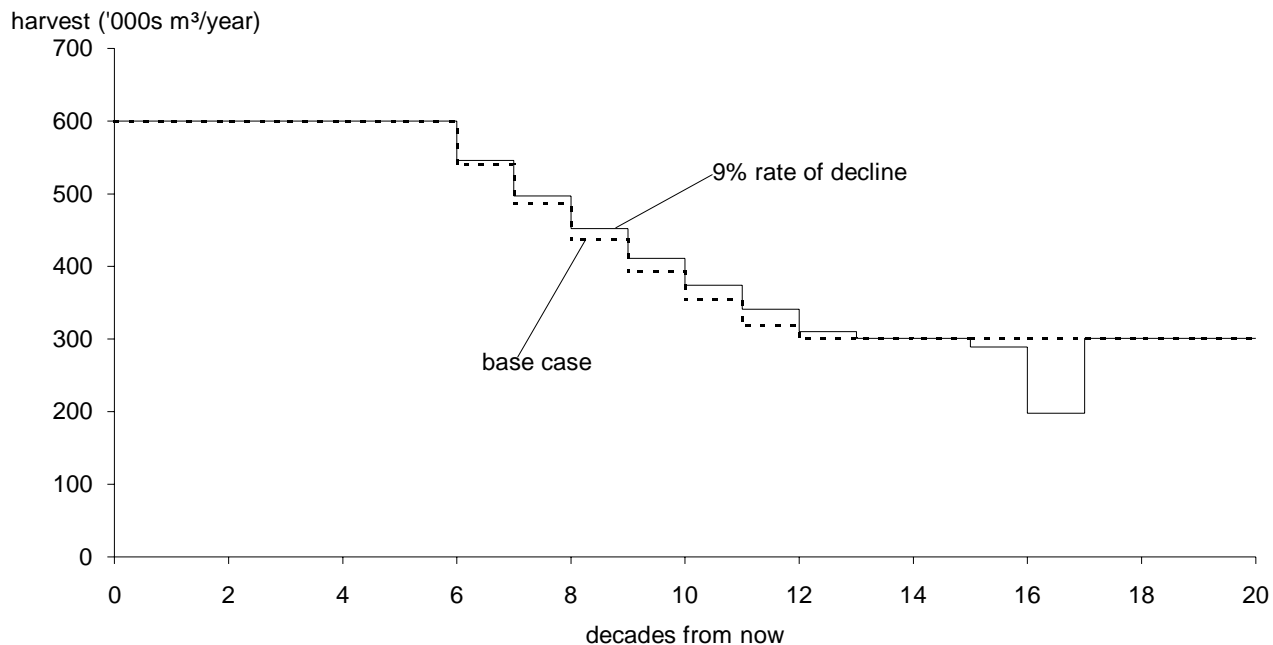


Figure 11. Projected harvest forecast with 9% rate of decline.

5 Timber Supply Sensitivity Analysis

In the second alternative, the initial harvest is elevated (shown in Figure 12) to the highest level possible, while maintaining a reasonable rate of decline to the long-term harvest level. The result is a harvest level that starts at 854 000 cubic metres per year for only 1 decade, then declines by 10% per decade until the long-term harvest level of 301 000 cubic metres per year is reached in decade 11. The long-term harvest level is 65% below the starting harvest level.

The elevated forecast indicates that an initial harvest level anywhere between 600 000 and 855 000 cubic metres per year can be obtained without significantly restricting future options of resource managers. The amount of flexibility indicated may be overstated, considering proposed biodiversity guidelines have not yet been fully incorporated into the North Coast Forest District forest management activities. As the harvest level increases above the base case, the total growing stock is used up earlier (Figure 14), thus quickly reducing any flexibility to incorporate changes without undesirable future effects. The elevated harvest also

means more area is harvested each year in the short term. This additional area of harvest may significantly hinder the application of biodiversity guidelines.

The total volume harvested over the 200-year horizon is 4% greater in the elevated harvest forecast alternative than in the base case. The elevated harvest also reduces the risk of losing stands to fire, pest and decay by accelerating the harvest of the older, more susceptible stands. As well, it means that a constant total growing stock and an even-age class distribution are obtained earlier than in the base case. This indicates the establishment of a stable forest from which the long-term harvest level can be sustained indefinitely.

The third alternative, the extended harvest (Figure 12), shows the current harvest level maintained as long as possible, then declining immediately to the long-term harvest level. The result is that the current harvest level can be maintained for 8 decades, before declining by 50% to the long-term harvest level of 301 000 cubic metres per year in decade 9.

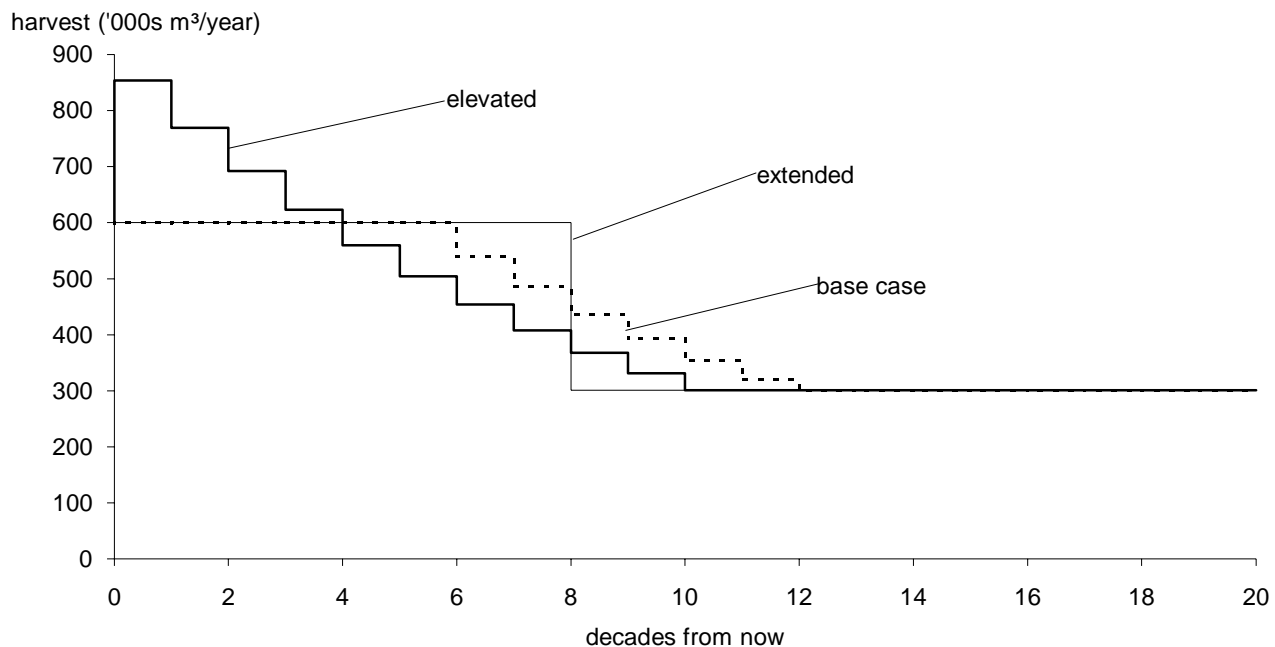


Figure 12. Elevated and extended harvest forecast alternatives.

5 Timber Supply Sensitivity Analysis

The extended harvest forecast alternative is very similar to the base case forecast. The total volume harvested over 200 years is only 1% lower, and the total growing stock over time (Figure 14) is essentially the same as for the base case. The opportunity to accommodate future changes in forest management during decades 1 through 6 is also the same. The ability to accommodate land management changes in the extended harvest forecast is less during decades 7 through 12, because of the increased area harvested in decades 7 and 8. As with the base case, old stands in the extended harvest forecast are maintained for a long time, therefore the risk to fire, pest and decay is greater than in the elevated harvest forecast.

The fourth harvest forecast alternative, the gradual decline, is the result of decreasing the current harvest level to the long-term harvest level at as slow a rate as possible (Figure 13). The result is a harvest level that starts at 570 000 cubic metres per year (5% lower than the current harvest level), then declines by 5% per decade until the long-term harvest level of 301 000 cubic metres per year is reached in decade 14. Any rate of decline slower than 5% will result in

future harvest short falls. The long-term harvest level is 47% below the starting harvest level. The total growing stock (Figure 14) declines slower than in the base case, and is still declining 200 years from now.

The resource managers ability to accomodate changes without restricting future options is better in the gradual decline harvest forecast alternative than in the base case. Also under this alternative: the total volume harvested over the 200-year horizon is 10% lower; the risk of losing stands to fire, pest and decay is greater; and the length of time until the growing stock and the age class distribution indicate a stable forest is much longer.

The fifth alternative, the long-term harvest level alternative (Figure 13) shows an immediate 50% decline to the long-term harvest level of 301 000 cubic metres per year. The total volume harvested over the 200-year planning horizon is 29% lower than in the base case. The total growing stock over time declines much slower (Figure 14), and still indicates a declining total growing stock at the end of the 200-year horizon.

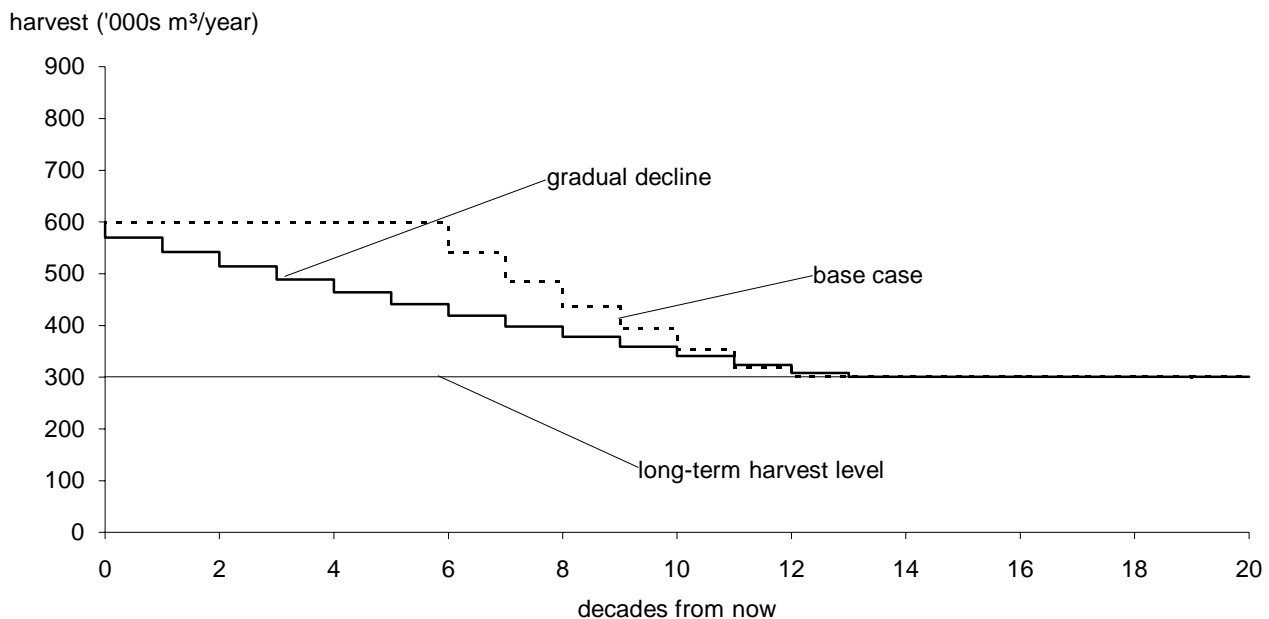


Figure 13. 5% decline and long-term harvest level harvest forecast alternatives.

5 Timber Supply Sensitivity Analysis

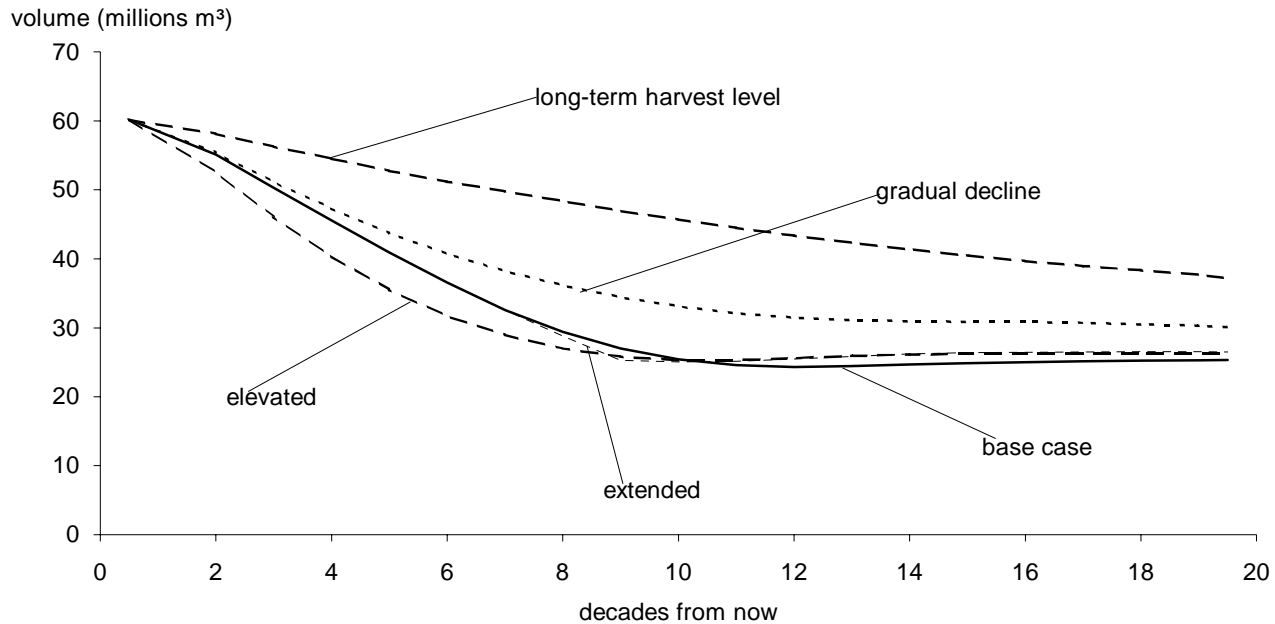


Figure 14. Projected growing stock over time for the alternative harvest forecasts.

Of the alternatives presented, the long-term harvest level alternative has the greatest ability to accommodate future change. It also contains the highest risk of losses resulting from fire, pest and decay and takes the longest time to produce a forest with an even age class distribution and a constant total growing stock. Conversely, the elevated harvest alternative is limited the most in its ability to accommodate future changes. However, it also contains the lowest risk to losses resulting from fire, pest and decay and takes the least time to obtain a stable forest.

5.2 Sensitivity to minimum harvest ages

Minimum harvest ages are based on the time it takes for a stand to reach minimum volume and diameter requirements. Table A-9. in Appendix A, "Description of Data Inputs and Assumptions," lists the minimum harvest ages specified for the base case.

These minimum harvest ages range from 40 years for cottonwood to 160 years for poor site cedar, cedar/hemlock, and hemlock, hemlock/amabilis fir stands. Since very few young stands have been harvested in the North Coast TSA, there is uncertainty around the ages at which future stands will actually be harvested. The effect of 20% changes in minimum harvest ages is discussed here.

An increase of 20% in minimum harvest ages (Figure 15) means that more time is required before a previously harvested stand becomes available for a second harvest, and that the long-term harvest level is lower than in the base case. As a result, existing growing stock must be maintained longer to allow sufficient volume from regenerated stands to become available for harvest. The current harvest level of 600 000 cubic metres is maintained for 4 decades, followed by a 10% per decade decline to a long-term harvest level of 278 000 cubic metres per year (8% lower than in the base case).

5 Timber Supply Sensitivity Analysis

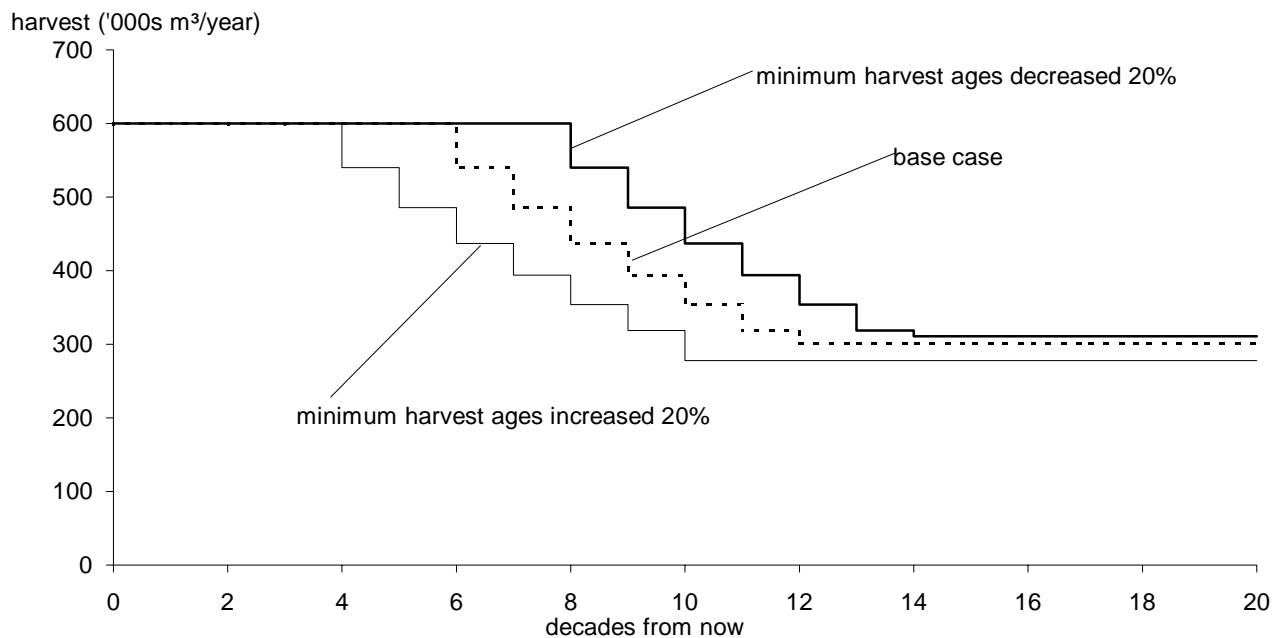


Figure 15. Projected harvest forecasts with changes in minimum harvest ages.

Reducing minimum harvest ages by 20% means that less time is required before previously harvested stands become available for a second harvest, and that the long-term harvest level is higher than in the base case (Figure 15). The current harvest level of 600 000 cubic metres can be maintained for 8 decades, before declining by 10% per decade to a long-term harvest level of 311 000 cubic metres per year.

5.3 Sensitivity to uncertainty of existing stand volumes

The variable density yield prediction system (VDYP), a growth and yield model, is used to estimate existing stand volumes. The impacts of 10 and 20% changes in existing yields were evaluated in this analysis.

Although it is recognized that change in volumes could result in changes in minimum harvest ages, only volumes are changed here.

The base case harvest forecast is driven mainly by the growing stock available for harvest and the time at which regenerated stands reach a harvestable age. Assuming existing stand yields are greater than in the base case means there is more growing stock available before the transition to harvesting regenerated stands occurs. For this reason, 10 and 20% increases in existing stand yields allow the current harvest level to be maintained for 8 and 10 decades (Figures 16 and 17), compared to 6 decades in the base case. Because regenerated stand yields are unchanged, the long-term harvest level is unchanged.

5 Timber Supply Sensitivity Analysis

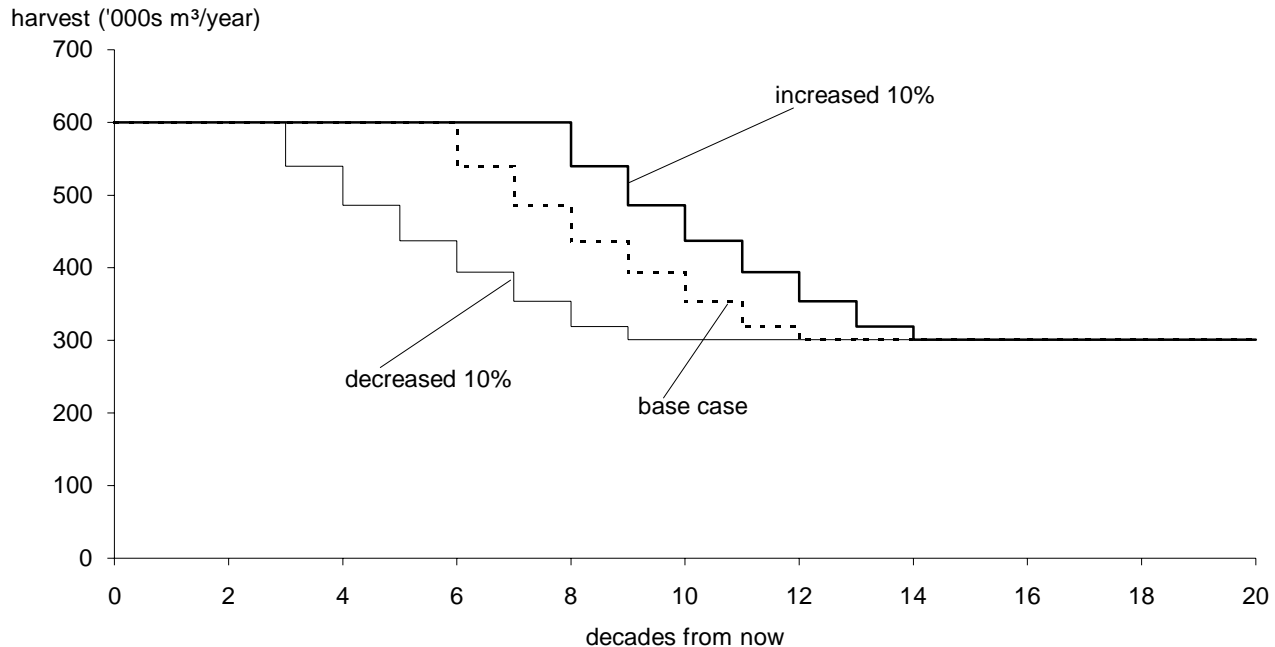


Figure 16. Projected harvest forecasts with 10% changes to estimated existing stand yields.

Likewise, assuming existing stand volumes are lower than those in the base case implies less growing stock is available for harvest before the transition to harvesting regenerated stands occurs. If the harvest flow were not changed, existing stands would be depleted before sufficient volumes were obtainable from regenerated stands, and a harvest short fall would occur. To avoid such short falls, harvest levels must begin declining towards the long-term harvest level earlier than in the base case. Therefore, 10 and 20% decreases in existing stand yields result in lower

harvest forecasts than in the base case. As shown in Figure 16, the current harvest level can be maintained for 3 decades, followed by a 10% decline until the long-term harvest level is reached, if existing yields are reduced 10%. If existing yields are to be 20% lower, then the starting harvest level must be reduced by 2000 cubic metres to 598 000 cubic metres per year, followed by a 10% per decade decline until the long-term harvest level is reached (Figure 17). Again, the long-term harvest level is unchanged.

5 Timber Supply Sensitivity Analysis

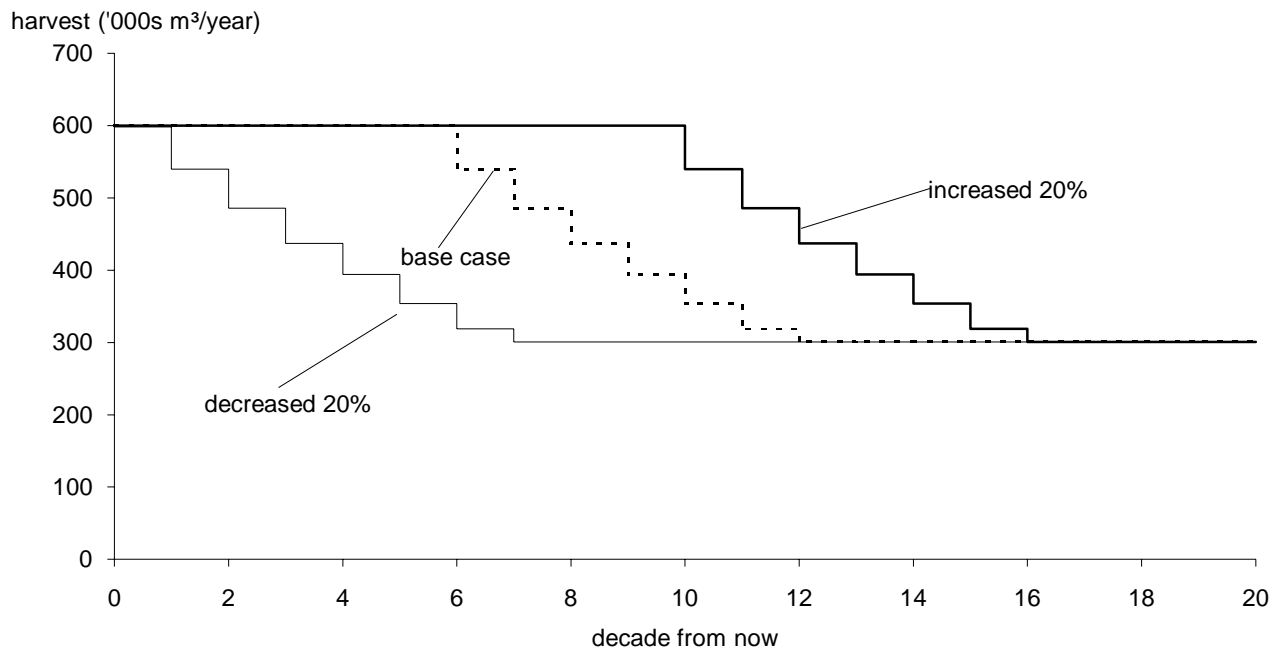


Figure 17. Projected harvest forecasts with 20% changes to estimated existing stand yields.

5.4 Sensitivity to uncertainty of regenerated stand volumes

Volume estimates from VDYP are also used for regenerated stands. Managed stand yield tables were not available for the North Coast TSA at the time of this analysis. Uncertainty regarding the volume estimates used for regenerated stands exists given the limited harvesting history within the TSA. The impact of 10 and 20% changes in regenerated yields is evaluated below. Minimum harvest ages remain the same as in the base case.

Increases of 10 and 20% in regenerated stand yields result in corresponding increases of 10% and 19% in the long-term harvest level (Figures 18 and 19). It is interesting to note that these yield increases result in the current harvest level being maintained

for 5 decades rather than 6 in the base case. This is the result of the higher long-term harvest levels and a harvest forecast policy that does not allow the harvest level to decline below the long-term level. The higher long-term harvest level means that growing stock from existing stands must be maintained longer, allowing sufficient volume from regenerated stands to become available for harvest.

The current harvest level can be maintained for 6 decades if a temporary decline to the base case long-term level is acceptable. This temporary decline allows sufficient volume from regenerated stands to become available to maintain the new long-term harvest level. Alternatively, it is possible that decreases in the minimum harvest ages would offset the necessity for the earlier decline.

5 Timber Supply Sensitivity Analysis

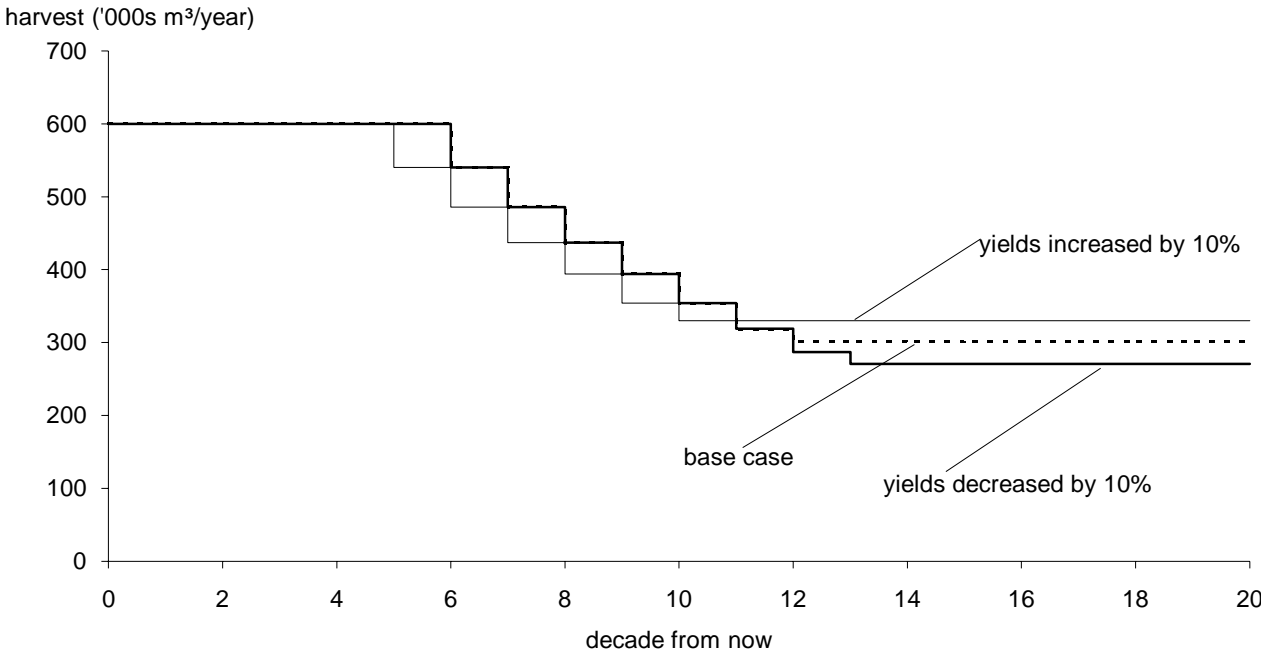


Figure 18. Projected harvest forecasts with 10% changes to estimated regenerated stand yields.

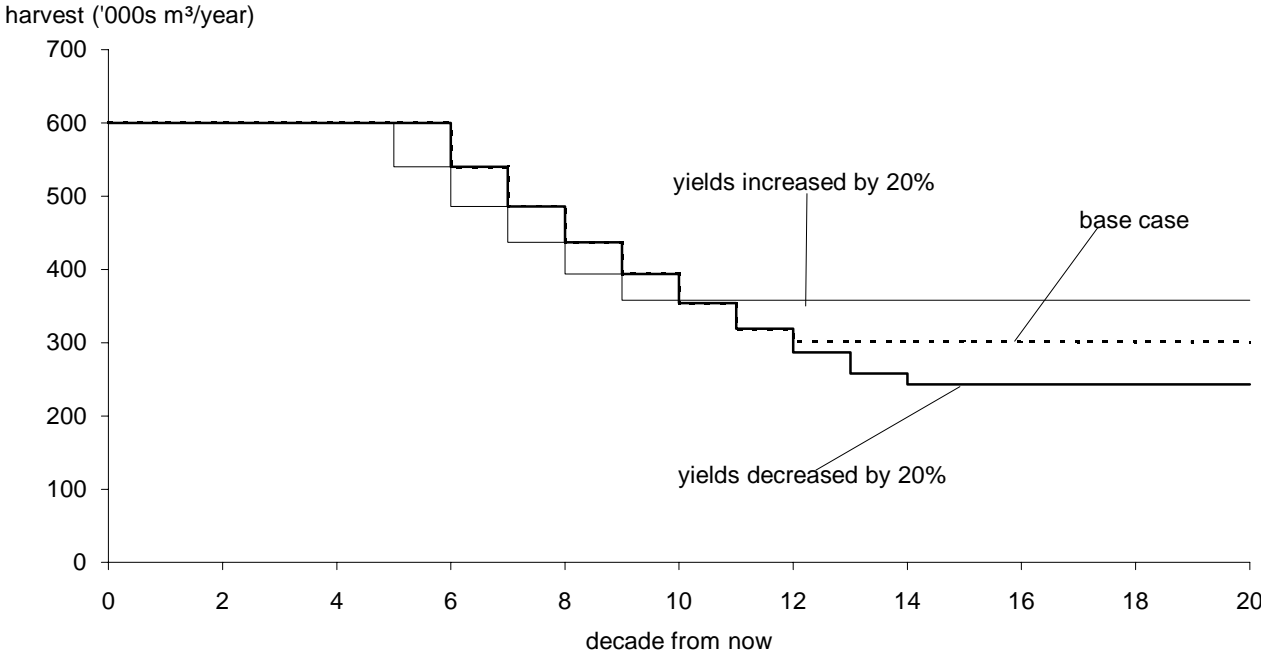


Figure 19. Projected harvest forecasts with 20% changes to estimated regenerated stand yields.

5 Timber Supply Sensitivity Analysis

Decreases of 10 and 20% in regenerated stand yields result in decreases in the long-term harvest level of 10 and 19%, respectively (Figures 18 and 19). The reduced long-term harvest levels mean greater declines from the current harvest level. It therefore takes longer, 8 and 9 decades respectively, to decline to the long-term harvest level compared to the base case. Decreases in regenerated stand yields have no effect on the short-term harvest level.

5.5 Sensitivity to uncertainty of existing and regenerated stand volumes

The sensitivities in Sections 5.3, "Sensitivity to uncertainty of existing stand volumes," and 5.4, "Sensitivity to uncertainty of regenerated stand volumes," were performed on existing and

regenerated stand volumes independent of each other. In this section, the sensitivity of 10 and 20% changes to both existing and regenerated stand volumes is evaluated; minimum harvest ages were kept as in the base case. Figures 20 and 21 show the harvest forecasts with the 10 and 20% changes to all yields.

Increases of 10 and 20% to all yields allow the current harvest level to be maintained for 7 and 10 decades respectively, compared to 6 decades for the base case. The long-term harvest level also increases by 10 and 19%, compared to the base case.

Decreases of 10 and 20% to all yields allow the current harvest level to be maintained for 5 and 2 decades respectively. The long-term harvest level also decreases by 10 and 19%, compared to the base case.

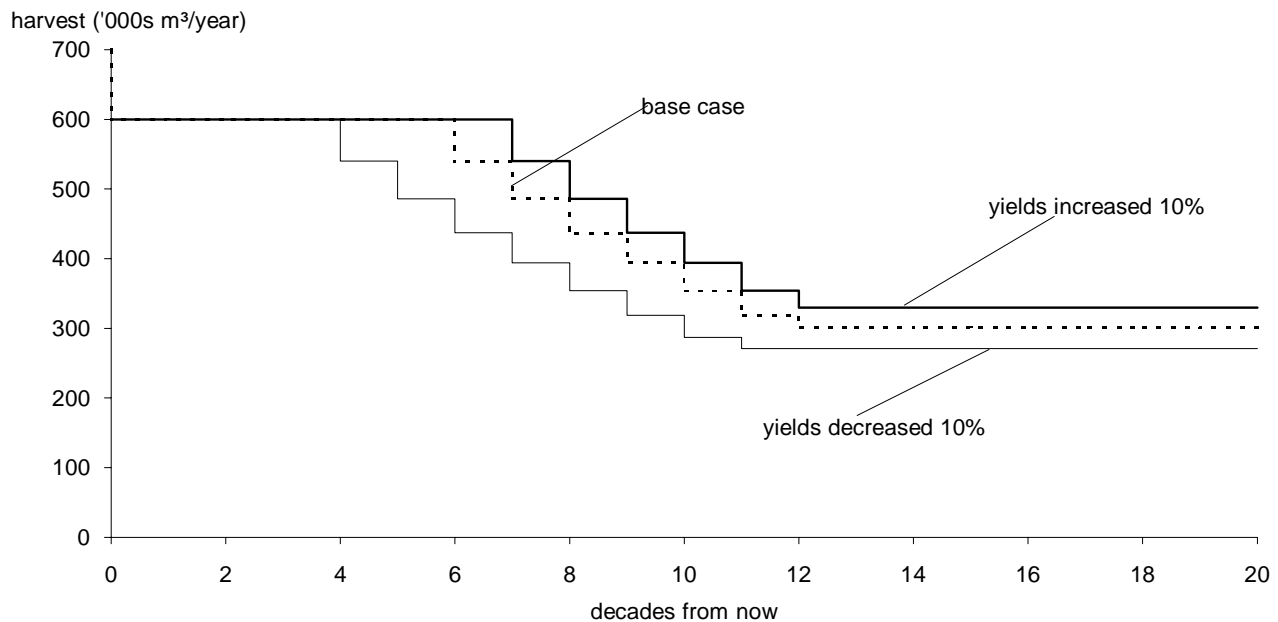


Figure 20. Projected harvest forecasts with 10% changes to estimated existing and regenerated stand yields.

5 Timber Supply Sensitivity Analysis

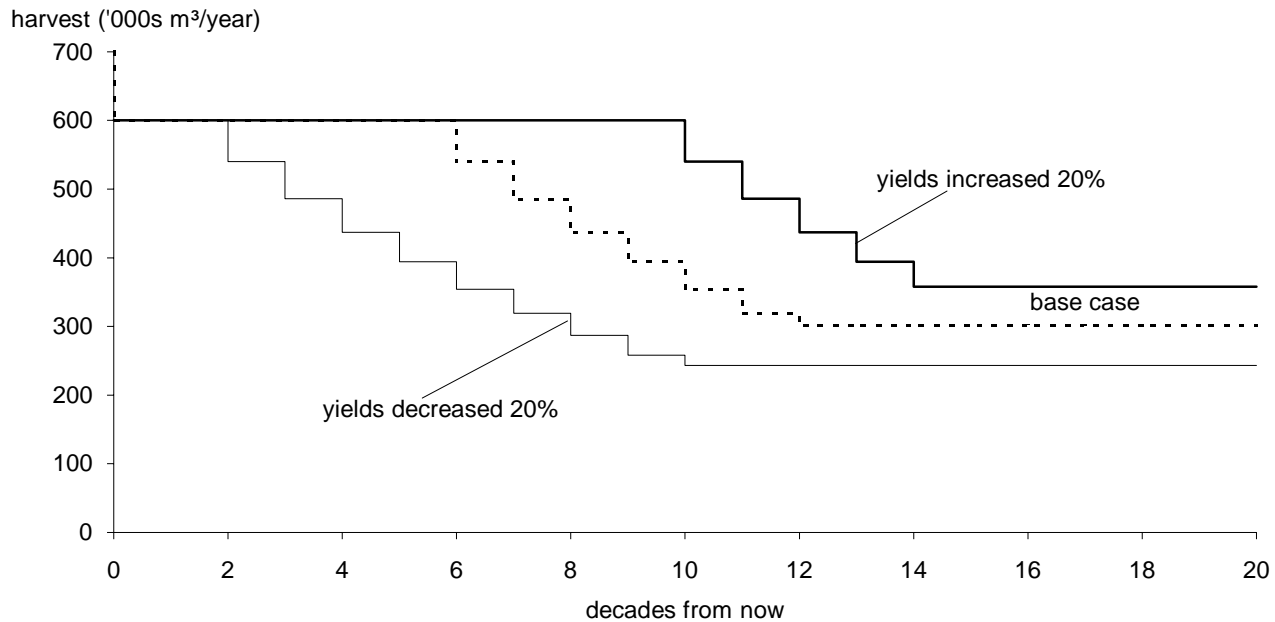


Figure 21. Projected harvest forecasts with 20% changes to estimated existing and regenerated stand yields.

5.6 Sensitivity to uncertainty of visual quality cover requirements

Forest cover requirements specify desired distributions of areas by age class groupings. The B.C. Forest Service timber supply model is able to control harvests so as to limit the area that may be younger than a specified age and to ensure a minimum area that must be older than another age. Forest cover requirements apply only to the Retention and Partial Retention management areas in the North Coast TSA (refer to Section 2.4, "Forest management areas."). Thirteen per cent of the Retention and 34% of the Partial Retention management area may be in a disturbed condition below green-up age at any point in time. The visual green-up requirements are met when trees are at least 5 metres tall (20 years of age). Section A.4, "Visual quality objectives," in Appendix A describes in detail the forest cover requirements specified for the base case. The effect of removing all visual quality cover requirements, reducing the maximum area permitted to be below green-up age by one-third and varying

the age at which green-up requirements are met by 10 years are discussed below.

Removing all visual quality cover requirements in both the Retention and Partial Retention management areas has no significant effect, thus the harvest forecast is the same as the base case. An increase in the long-term harvest level should occur, but the change is too small to be evident. The forest cover requirements do affect the area harvested in the Retention Visual Quality management area in most periods, but very little merchantable timber is actually restricted from harvest. Forest cover guidelines in the Partial Retention Visual Quality management area do not restrict the base case harvest forecast.

The maximum area allowed to be younger than green-up age was reduced by a third to 8% in the Retention Visual Quality Area and 24% in the Partial Retention Visual Quality Area. This reduces the rate at which existing stands may be harvested thus the decline to the long-term level begins one decade sooner than in the base case (Figure 22). A decrease in the long-term harvest level should occur but the change is too small to be evident.

5 Timber Supply Sensitivity Analysis

Decreasing the visual quality green-up period by 10 years has no effect on the harvest forecast, but an increase of 10 years reduces the number of decades that the current harvest level can be maintained to 5 (Figure 23). This is similar to the effect noted when the maximum area permitted to be below green-up

period is reduced by one-third in the Retention and Partial Retention Visual Quality management areas. There is no change in the long-term harvest level, though a decrease too small to be evident should occur.

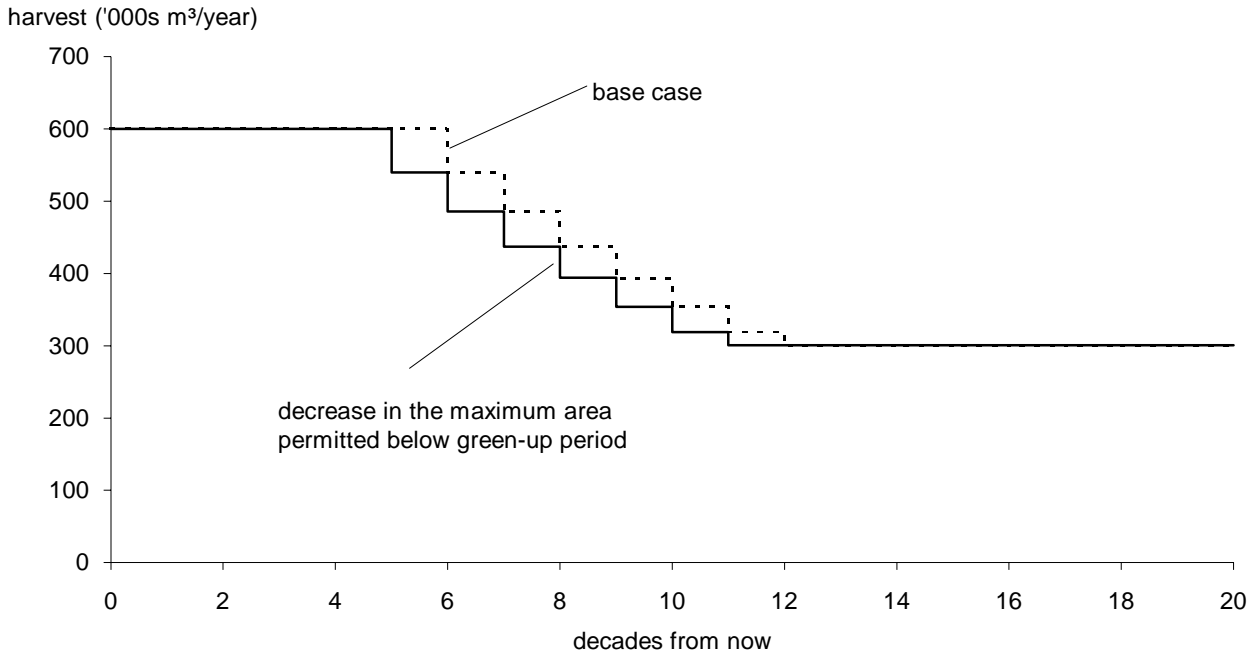


Figure 22. Projected harvest forecasts with a decrease in the maximum area permitted below green-up period.

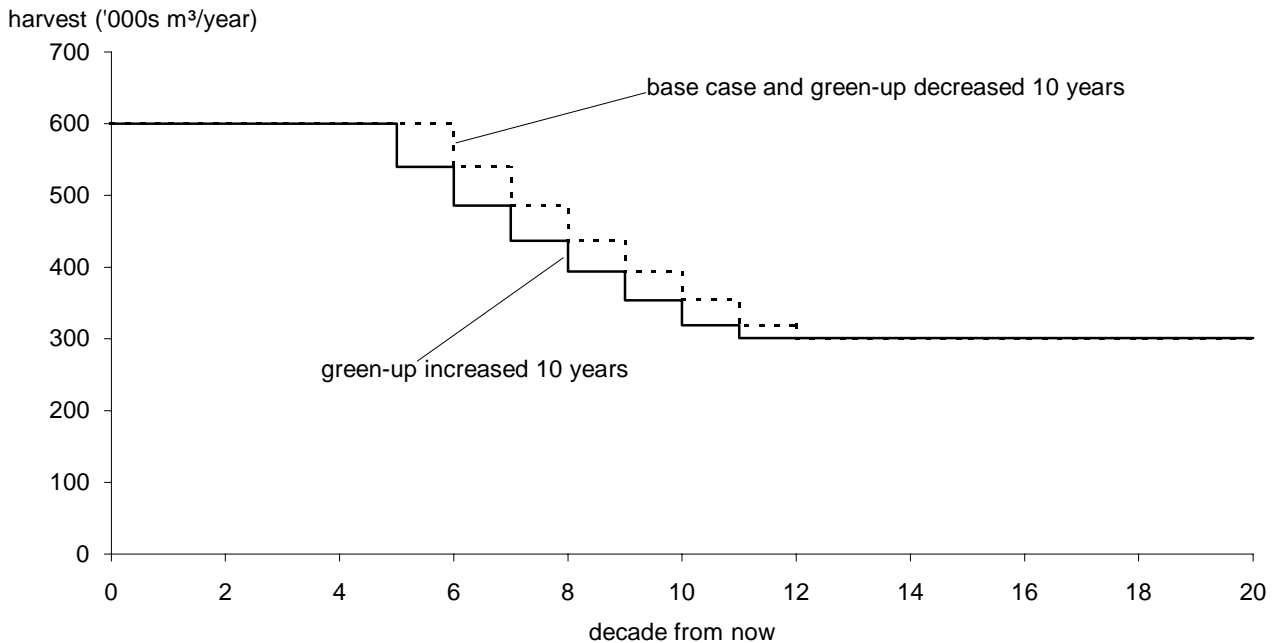


Figure 23. Projected harvest forecasts with changes to green-up period requirements.

5 Timber Supply Sensitivity Analysis

5.7 Sensitivity to uncertainty of additional forest cover requirements

Potentially, additional forest cover requirements may be required to meet future requirements for such things as increased hydrological integrity, visual quality or biodiversity. Because these requirements are beyond those currently practiced, they are not incorporated in the base case. Nevertheless, sensitivity analysis of the impact of additional forest cover requirements is evaluated here.

These additional forest cover requirements are applied to all of the timber harvesting land base, in a similar manner as the visual quality forest cover is applied to the Visual Quality management areas. For this sensitivity analysis, the potential requirements are applied on each analysis unit independently within the Integrated Resource management area. In

the Visual Quality management areas, the most binding of the visual quality or the potential forest cover requirements are used. Imposing a maximum area of 50, 33 and 25% which may be younger than the 20-year green-up period is evaluated.

In the base case, all area outside the Visual Quality management area has no forest cover requirements, thus allowing up to 100% of the area to be less than the green-up period (harvested) at any point in time. This is equivalent to a one-pass harvest system as noted in Figure 25. The 50, 33 and 25% maximum areas were selected because they describe two-, three- and four-pass harvesting systems, respectively. For example, a forest cover requirement limiting the maximum stand area that may be younger than 20 years to 25% means it will take at least four harvest entries to harvest all of the timber harvesting land base (four-pass harvesting).

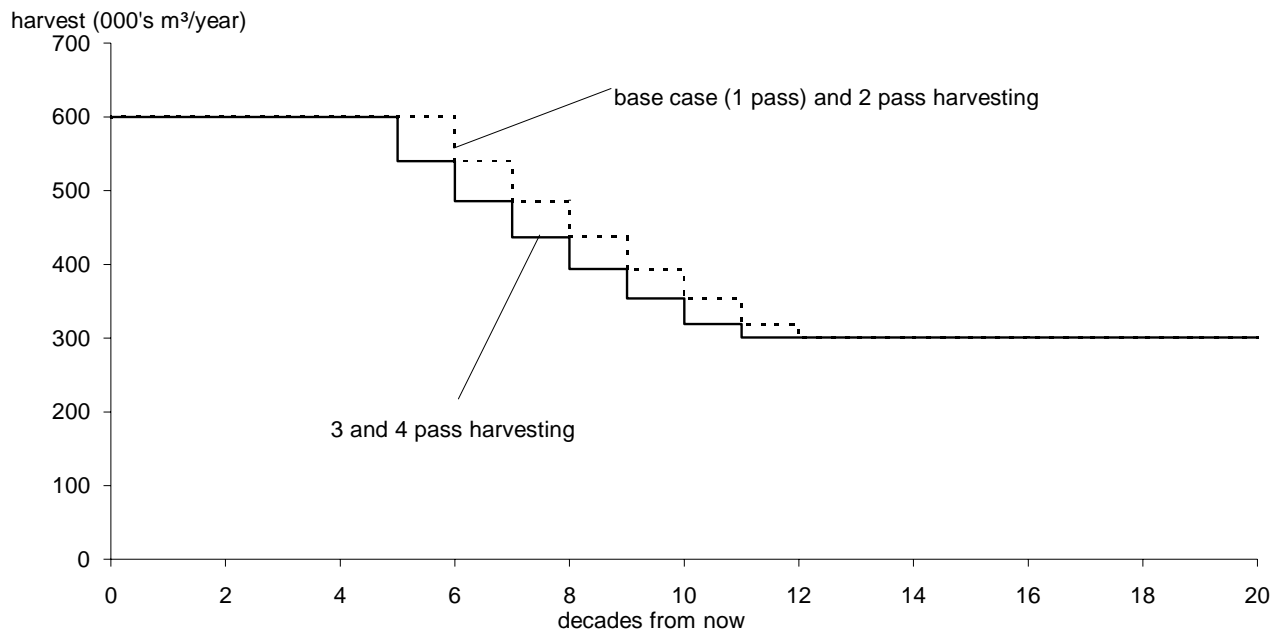


Figure 24. Projected harvest forecasts with incorporation of additional forest cover requirements.

5 Timber Supply Sensitivity Analysis

Restricting the maximum area that may be younger than the 20-year green-up period to 50% (two-pass harvesting) has no impact on the harvest forecast.

As shown in Figure 24, restricting the maximum area to 33 and 25% (three- and four-pass) reduces the number of decades the current harvest level can be maintained to 5. The long-term harvest level is unchanged.

This sensitivity analysis indicates that the harvest forecast is relatively insensitive to additional forest cover requirements. The impact of the potential forest cover requirements may be understated, for they would also likely cause a reduction in the area available to harvest. Areas currently considered marginally economical to harvest could become uneconomical because of multiple harvest pass requirements.

5.8 Sensitivity to uncertainty of future road losses

For this analysis the term *roads* refers to all roads, trails, landings, fireguards and related disturbance not accounted for in the inventory file. The inventory file accounts for major roads such as highways and major logging roads.

To date very little road construction has been required, because most of the past harvesting has occurred along the coast and has been accessed from the water. In the future, a large portion of the harvesting will occur inland and will require extensive road construction. Because of the limited history of road construction, uncertainty exists as to how much area will be lost to future roads. In the base case it was assumed that 8.3% of all areas without roads would eventually be lost from the timber harvesting land base. Sensitivity analysis of the impact of an increase or decrease of 2% in area lost to future roads is evaluated below.

Figure 25 shows that increasing or decreasing the area lost to roads has no effect on the short-term harvest forecast, though there is a very small effect on the long-term harvest level. Areas are deducted over a 140-year period from stands presently 21 years of age or older to account for road construction. The timber now growing on areas that will become future roads is harvested once, then converted to road status. If 2% more area is lost to roads, the long-term harvest level decreases by almost 2% but if 2% less area is lost, the long-term harvest level increases by 1%.

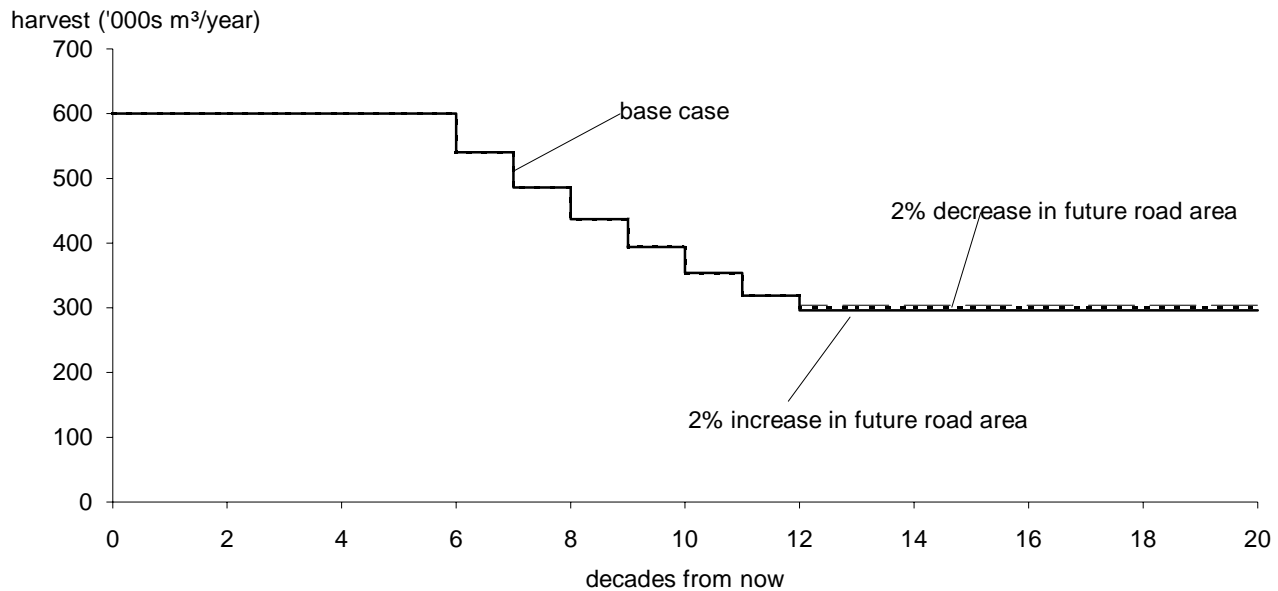


Figure 25. Projected harvest forecasts with 2% increase and decrease to future road area.

5 Timber Supply Sensitivity Analysis

5.9 Sensitivity to uncertainty of timber harvesting land base

The area considered as the timber harvesting land base is the factor subject to the most uncertainty in this analysis and is very likely to change. Numerous factors could result in either an increase or decrease in the amount of land available for harvest. The potential more restrictive integrated resource management requirements, new parks, new reserves and land claim areas may significantly reduce the land base available for harvest. Economic conditions may also have a significant effect. For example, if the price of wood products increases, operators could afford to harvest in areas where harvesting is costly

and wood is of lower quality. However, if the price of wood products decreases, or if the cost of harvesting wood increases, the area available for harvest would decrease. The impact of increases or decreases in the area available to harvest by 15% is evaluated here.

A 15% increase in area available for harvest would allow the current harvest level to be maintained for 9 decades and the long-term harvest would increase to 350 000 cubic metres per year. A 15% decrease in area available for harvest would still allow the current harvest level to be maintained for 3 decades and the long-term harvest would decrease to 249 000 cubic metres per year. Figure 26 shows the harvest forecast if the harvestable land base increases or decreases by 15% relative to the base case.

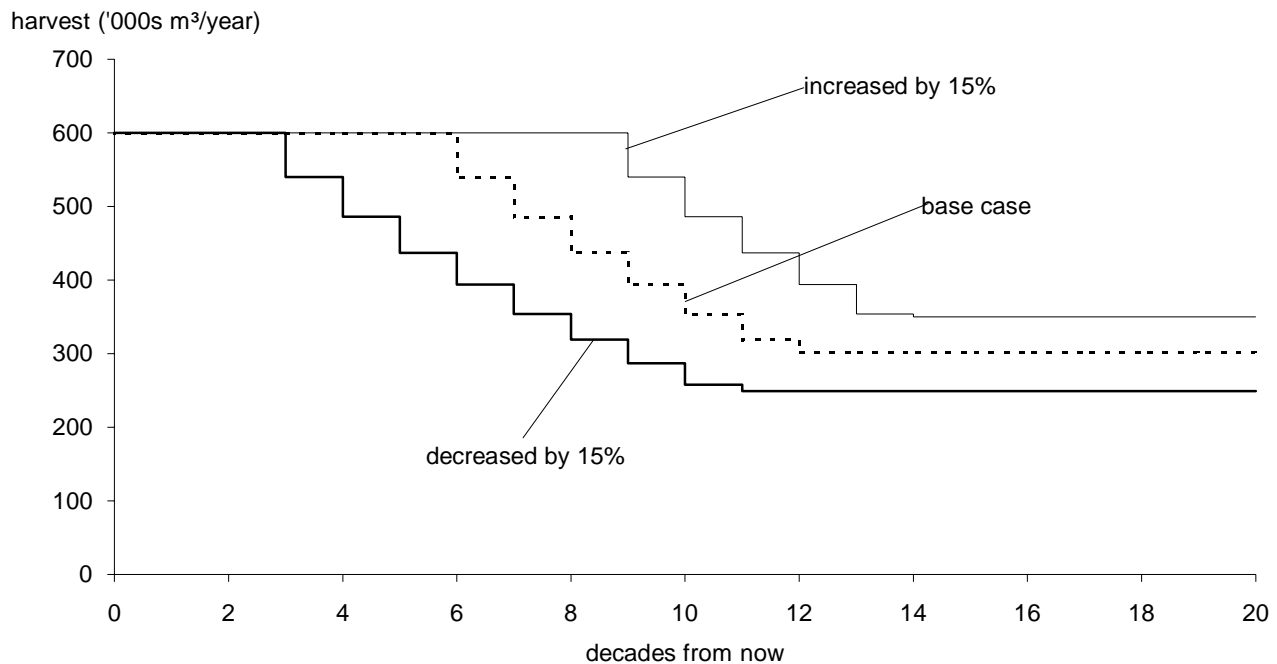


Figure 26. Projected harvest forecasts with 15% changes to the timber harvesting land base.

5 Timber Supply Sensitivity Analysis

5.10 Sensitivity to uncertainty in all assumptions

All of the preceding sensitivity analyses have examined the effect on the harvest forecast of changing one assumption at a time. The following sensitivity analysis examines the cumulative effect of changing several assumptions that increase or decrease the harvest forecast concurrently. The light solid line in Figure 27 shows the effect of changing several assumptions concurrently that increase the timber supply. The specific changes from the base case are as follows:

- minimum harvest ages are reduced by 20%;
- existing stand yields are increased by 10%;
- regenerated stand yields are increased by 10%;

- green-up periods are reduced by 10 years;
- in the Retention Visual Quality management areas, the maximum area allowed to be less than green-up period is increased to 18%;
- in the Partial Retention Visual Quality management areas, the maximum area allowed to be less than green-up period is increased to 44%;
- area lost to future roads is reduced by 2%;
- the timber harvesting land base is increased by 15%.

In this situation, the current harvest level could be maintained for 15 decades and the long-term harvest level would be 394 000 cubic metres per year (31% greater than the base case).

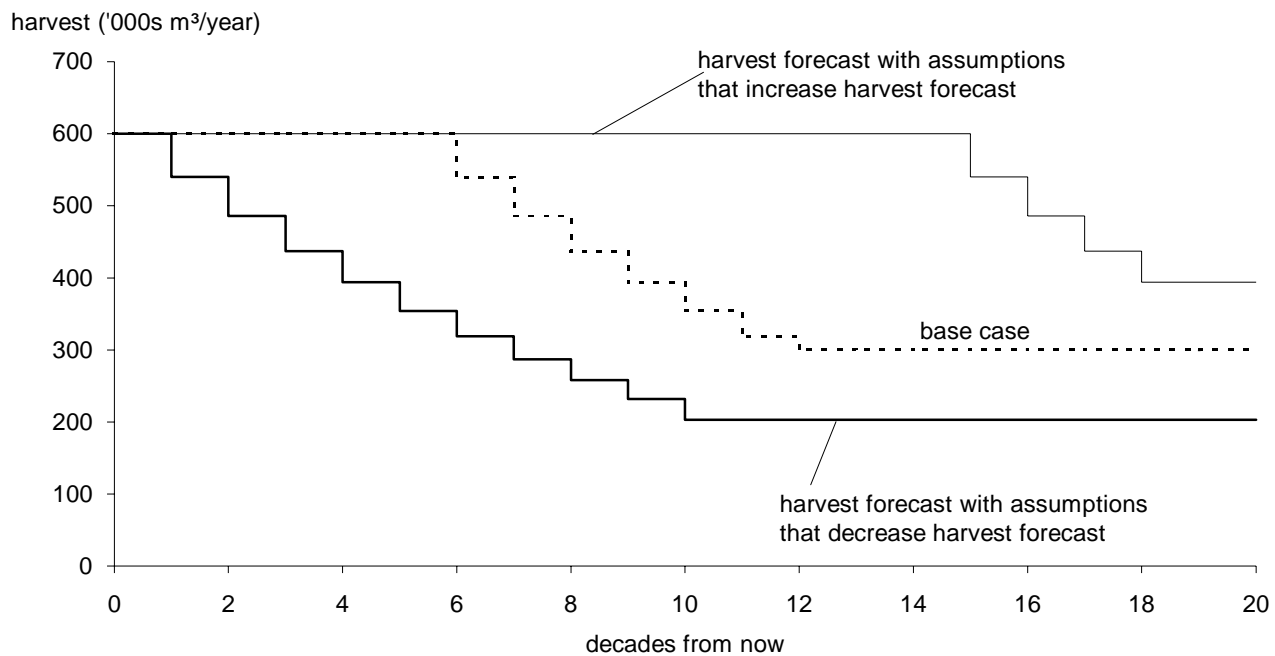


Figure 27. Projected harvest forecasts with combined assumptions that either increase or decrease the harvest forecast.

5 Timber Supply Sensitivity Analysis

The solid dark line in Figure 27 shows the effect of changing several assumptions concurrently that decrease the harvest forecast.

- minimum harvest ages are increased by 20%;
- existing stand yields are decreased by 10%;
- regenerated stand yields are decreased by 10%;
- green-up periods are increased by 10 years;
- in the Retention Visual Quality management areas, the maximum area allowed to be less than green-up period is decreased to 8%;
- in the Partial Retention Visual Quality management areas, the maximum area allowed to be less than green-up period is decreased to 24%;
- in the Integrated Resource management area, the maximum area allowed to be less than green-up period is set at 50% (two-pass harvest system);

- area lost to future roads is increased by 2%;
- the timber harvesting land base is decreased 15%.

It is possible that assumptions which independently have no effect, when combined do have a significant effect on the harvest forecast. For example, previous sensitivity analysis indicated that the two-pass harvest does not constrain the harvest forecast, compared to the base case, when analyzed independently. Thus assumptions which had little or no effect were included in this sensitivity.

Under this constraining harvest forecast situation, the current harvest level can still be maintained for 1 decade, although the long-term harvest level would be 203 000 cubic metres per year (33% less than the base case).

6 Summary and Conclusions

Using current management assumptions, the analysis for the North Coast TSA indicates that an initial annual harvest of 600 000 cubic metres can be maintained for 6 decades. Harvests would then begin to decline at a rate of 10% per decade until the long-term harvest level of 301 000 cubic metres per year is reached in decade 13.

This analysis employs the best estimates for all variables used to describe forest management in the North Coast TSA. However, many of the estimates contain some degree of uncertainty. Thus, sensitivity analysis around these uncertainties is evaluated on the base case harvest forecast. Any change in the harvest forecast, such as allowing the starting harvest level to be higher than the current level, could change the evaluations of the sensitivity analysis. If the initial harvest level was allowed to rise above the current level a moderate uplift may have occurred instead of the 2 decade extension of the current harvest level.

The sensitivity analysis shows the short-term harvest forecast is moderately affected if volume estimates for existing stands have been overestimated and is slightly affected if the timber harvesting land base has been overestimated. The range of uncertainties of other factors had no effect on the short-term harvest forecast. The combining of several

assumptions concurrently that decrease the harvest forecast, indicates that the current harvest level of 600 000 cubic metres could be maintained for at least one more decade without hampering the possibility of maintaining biodiversity or achieving a reasonable rate of decline to the long-term harvest level.

The following assessment considers the impact of uncertainty on the level of harvest that can be maintained indefinitely. The long-term harvest forecast is moderately affected by uncertainties of regenerated stand volumes and of the size of the timber harvesting land base. It is slightly affected by uncertainties of minimum harvest ages and of area lost to future roads. All other factors evaluated have very little or no effect on the long-term harvest forecast. Moderate effects on the long-term harvest forecast are indicated when several assumptions which increase the harvest forecast are combined.

Sensitivity analysis indicates that the current harvest level can be maintained one more decade while still accommodating a substantial amount of change, such as forest cover requirements. Any changes in forest management, the timber harvesting land base, data and estimates that occur over the next few years will be incorporated in the next analysis which will occur within 5 years.

7 References

B.C. Ministry of Environment, Lands and Parks. May 1992. Khutzeymateen Study Report. Victoria, B.C.

B.C. Ministry of Forests, Prince Rupert Forest Region. March 1993. Biodiversity and Forest Management in the Prince Rupert Forest Region (Draft). A Discussion Paper. Smithers, B.C.

B.C. Ministry of Forests, Prince Rupert Forest Region. August 1992. Interim timber harvesting guidelines for the coastal portion of the Prince Rupert Forest Region (Draft). Smithers, B.C.

B.C. Ministry of Forests, Prince Rupert Forest Region. January 1981. North Coast Timber Supply Area Report. Smithers, B.C.

B.C. Ministry of Forests, Recreation Branch and Integrated Resources Branch. 1993. Procedures for Factoring Recreation Input into Timber Supply Analysis. Victoria, B.C.

B.C. Ministry of Forests, Research Branch. 1992. User's Guide for TIPSU: A Table Interpolation Program for Stand Yields - Version 2.0 Beta. Victoria, B.C.

8 Glossary

Allowable annual cut (AAC)	The permissible harvest level from a specified area of land. The Chief Forester sets AACs for Timber Supply Areas (TSAs) and Tree Farm Licences (TFLs) in accordance with <i>Section 7</i> of the <i>Forest Act</i> .
Biodiversity (biological diversity)	Diversity of life in all its forms and levels of organization, including genes, species, ecosystems and the evolutionary and functional processes that link them.
Environmentally sensitive areas	An area with significant non-timber values or fragile or unstable soils, or in which there are impediments to establishing a new tree crop or where timber harvesting may cause avalanches.
Forest cover requirements	Desired distributions of areas by age or size class groupings. These requirements can be used to reflect desired conditions for wildlife, biodiversity, watershed protection, visual quality and old-growth objectives. General adjacency and green-up guidelines are also specified using forest cover requirements.
Forest inventory	Assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of some non-timber values such as recreation and visual quality.
Free growing	An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Growing stock	The volume estimate for all standing timber, of all ages, at a particular time.
Harvest forecasts	The forecast 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 assumptions. 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.
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 cutting ages, utilization levels and standards, integrated resource guidelines, and silviculture and pest management programs.

8 Glossary

Mean annual increment (MAI)	Stand volume divided by stand age. The stand age at which the MAI assumes its maximum value is called the culmination age. Harvesting all stands at this age results in a maximum average harvest over the long term.
Not satisfactorily restocked (NSR)	An area not covered by a sufficient number of tree stems of desirable species. Stocking standards are set by the Forest Service, Silviculture Branch. If the expected regeneration delay (the period of time between harvesting and the date by which an area is occupied by a specified minimum number of acceptable well-spaced trees) has not elapsed, the land is defined as current NSR. If the expected delay has elapsed, the land is classified as backlog NSR.
Partial retention visual quality	Alterations may be visible but not conspicuous (see Visual quality objective).
Retention visual quality	Alterations are not easy to see in this VQO class (see Visual quality objective).
Site classification	An expression of site productivity. Site classifications are based on tree height as a function of stand age and are usually expressed in groupings such as good, medium, poor or low. Site classifications are currently being replaced by site indices.
Timber harvesting land base	The portion of the total land area of a management unit considered to contribute to, and be available for, long-term timber supply. The harvesting land base is calculated by reducing the total land base according to specified management assumptions.
Timber Supply Area (TSA)	An integrated resource management unit established in accordance with <i>Section 6</i> of the <i>Forest Act</i> .
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 (see Retention and Partial Retention Visual Quality definitions).

APPENDIX A
Description of Data Inputs and Assumptions

Introduction

The following sections outline the methods and inputs used to derive the timber harvesting land base and to construct the timber supply model data set for the timber supply review of the North Coast TSA. For the purpose of the review, this information represents current forest management in the area. "*Current forest management*" is defined as the set of land use decisions and forest and stand management practices that are currently implemented and enforced. Future forest management objectives that may be intended, but are not currently implemented and enforced, are not included here. Changes in forest management, when and if they occur, will be included in subsequent timber supply analyses after the Timber Supply Review has been completed.

A.1 Management Area, Zone, and Analysis Unit Definitions

A.1.1 Definition of management areas and zones

The timber harvesting land base is grouped into zones based on differences in forest management. These zones are used in the Forest Service Simulation Model (FSSIM) to facilitate modelling of the different forest management emphasis that exists in each zone. The zones used in the timber supply analysis for the North Coast TSA are listed below:

- Zone 1 - All cedar and cedar/hemlock types on good/medium growing sites not included in other zones
- Zone 2 - All cedar and cedar/hemlock types on poor growing sites not included in other zones
- Zone 3 - All hemlock and hemlock/amabilis fir types on good growing sites not included in other zones
- Zone 4 - All hemlock and hemlock/amabilis fir types 140 years of age or younger on medium growing sites not included in other zones
- Zone 5 - All hemlock and hemlock/amabilis fir types older than 140 years of age on medium growing sites not included in other zones
- Zone 6 - All hemlock and hemlock/amabilis fir types 140 years of age or younger on poor growing sites not included in other zones
- Zone 7 - All hemlock and hemlock/amabilis fir types older than 140 years of age on poor growing sites not included in other zones
- Zone 8 - All spruce types on good growing sites not included in other zones
- Zone 9 - All spruce types older than 140 years of age on medium growing sites not included in other zones
- Zone 10 - All spruce types younger than 140 years of age on medium growing sites not included in other zones
- Zone 11 - All spruce types on poor growing sites not included in other zones
- Zone 12 - Areas identified as being considered under current land claim negotiations with the Nisga'a Tribal Council
- Zone 13 - Visually sensitive areas where alterations are not to be easily seen.
- Zone 14 - Visually sensitive areas where alterations may be visible but not conspicuous.

For further discussion, these zones have been grouped into three management areas as follows:

- Zones 1 to 12 are referred to as the Integrated Resource management area;
- Zone 13 is referred to as the Retention Visual Quality management area; and
- Zone 14 is referred to as the Partial Retention Visual Quality management area.

The visual Quality management areas are shown in Figure A-1.

A.1 Management Area, Zone, and Analysis Unit Definitions

Figure A-1. Map of the North Coast TSA.

A.1 Management Area, Zone, and Analysis Unit Definitions

A.1.2 Analysis unit characteristics

Within each zone, areas identified in the forest inventory as having similar forest cover and growing site quality are grouped together in the timber supply analysis for the purposes of modelling forest growth and yield and silvicultural treatments. Each of these grouping is referred to as an analysis unit. Table A-1. defines the analysis units used in the timber supply analysis for the North Coast TSA.

Table A-1. Analysis unit definition.

Analysis unit	Cover type	Type group ^a	Site class ^b	Age ^c
1	Cedar Cedar/hemlock	9 - 11	G/M	0+
2	Cedar Cedar/hemlock	9 - 11	P	0+
3	Hemlock, hemlock/amabilis fir	12 - 20	G	0+
4	Hemlock, hemlock/amabilis fir	12 - 20	M	0 - 140
5	Hemlock, hemlock/amabilis fir	12 - 20	M	141+
6	Hemlock, hemlock/amabilis fir	12 - 20	P	0 - 140
7	Hemlock, hemlock/amabilis fir	12 - 20	P	141+
8	Spruce	21 - 26	G	0+
9	Spruce	21 - 26	M	0 - 140
10	Spruce	21 - 26	M	141+
11	Spruce	21 - 26	P	0+
12	Cottonwood	35 - 36	G/M	0+

^a Type group is the field and coding used in the Forest Inventory Planning (FIP) file to identify the forest cover type.

^b Site class G (good), M (medium) and P (poor) are as found on the FIP file and on the forest cover maps. When present, the FIP file site class variable, Special Site, is used. Otherwise the FIP file site class variable, New Site, is used. These site classes do not necessarily correlate with the site indexes produced by the updated VDYP. The site classifications are used in this analysis because current management decisions are based on these indicators.

^c Significant differences have been noted in the yield projections for some stands currently identified as immature (0-140 years) versus mature (141+ years). Differences in yields have been attributed to the misclassification of actual site indices of mature stands. Thus, age class 0-7 (immature) and 8-9 (mature) are used to divide analysis units which displayed significant differences in yields and contained significant areas of immature and mature stands.

A.2 Utilization Levels

The utilization level defines the maximum allowable stump height and minimum diameter by species and is used in the VDYP aggregation to calculate merchantable volume (Section A.8). The North Coast TSA timber supply analysis assumes a 30 cm stump height, a 10 cm diameter top for all species, and a minimum diameter at breast height of 17.5 cm for coastal species and 12.5 cm for interior species.

A.3 Definition Of The Timber Harvesting Land Base

The timber harvesting land base is determined by deducting from the total TSA area all areas currently considered to be unavailable for timber harvesting. Additions such as NSR areas and timber licence reversions are then made to the timber harvesting land base.

A.3.1 Non-Crown and non-forest areas

All areas not designated as being ownership code 62C (Crown forest management unit available for long-term integrated management) are excluded from the timber harvesting land base. In addition, 23 hectares of projected type identity 8 (no type identity) are deducted under this category. Table A-2. summarizes area by ownership code for the North Coast TSA. In total, 54 333 hectares, or 2.8%, of the total North Coast TSA area is in the non-Crown category.

Non-forested and non-productive areas, designated as projected type identity 6 on the inventory file, are also excluded from the timber harvesting land base. These areas account for the removal of 1 187 928 hectares, or 61%, of the total North Coast TSA.

Table A-2. Summary of total area by ownership for the North Coast TSA.

Ownership	Ownership code	Total area (hectares)
Crown grant	40	16 118
Federal reserve	50	3 010
Indian reserve	52	22 734
Use, recreation and enjoyment of public	61	8 840
Forest management unit (Crown land)	62	1 892 773
Provincial park - special or reserve	67	103
Government reserve	69	3 528
Timber licence reversion area	70	425
Total North Coast TSA		1 947 531

A.3 Definition Of The Timber Harvesting Land Base

A.3.2 Khutzeymateen Valley

The Khutzeymateen Valley, 45 kilometres northeast of Prince Rupert, is currently subject to a designation process that will protect Grizzly bear habitat. The Khutzeymateen steering and management committees concluded that timber harvesting in the Khutzeymateen would result in unacceptable impacts on Grizzly bears, and therefore no timber harvest activity is permitted within this area.

For this analysis the Khutzeymateen Valley is removed from the timber harvesting land base as follows:

- 50% of Region 64, Compartment 67^a;
- 50% of Region 64, Compartment 68^a;
- 100% of Region 64, Compartment 69; and
- 100% of Region 64, Compartment 70.

^a It is assumed that the area within the Khutzeymateen Valley is representative of the area within the identified compartment.

A.3.3 Environmentally sensitive areas (ESAs)

Some forest areas are categorized as being environmentally sensitive (ESA). Table A-3. summarizes the per cent area reductions that are applied by ESA category for the North Coast TSA analysis.

Table A-3. Per cent area reduction for environmentally sensitive areas.

ESA code	ESA description	Per cent area reduction
ES1	High soil sensitivity	100
EP1	High regeneration problems	100
EA1	High avalanche problems	100
EH1	High water quality concerns	100
EH2	Moderate water quality concerns	100
EP2	Moderate regeneration problems	50
ES2	Moderate soil sensitivity	25
EW1g	High mountain goat habitat	25

Areas with sensitive wildlife habitat (except for mountain goat) were not considered in the ESA data table. It is assumed that the area necessary to satisfy the requirements for this habitat is met with the 35 metre streamside buffers (Section A.3.5, "Streamside buffers").

Areas identified with the ESA classification as being important for recreation were not considered in the ESA data table. Instead, recreational values have been incorporated with the visual quality objectives and are assumed to be met within the Visual Quality management areas (Section A.4, "Visual Quality Objectives").

A.3.4 Inoperable areas

All areas defined as inoperable are excluded from the timber harvesting land base.

A study that determined operable areas within the North Coast TSA was completed in October 1991. Land was identified that is operable via conventional harvest methods (cable systems), operable via non-conventional harvest methods (helicopter systems), and inoperable. The study reviewed all but seven mapsheets within the North Coast TSA.

Inoperable areas on the seven mapsheets that were not included in the operability study are identified as projected type identity equals 2 (mature forest) and new projected height class less than 4 (stand height shorter than 28.5 metres).

A.3 Definition Of The Timber Harvesting Land Base

A.3.5 Streamside buffers

Class I and II streams have high habitat value for sport and commercial fish habitat. Thirty-five metres on each side of Class I and II streams, as identified on 1:50 000 scale Department of Fisheries and Oceans salmon stream inventory maps, were designated as a non-harvest buffer and excluded from the timber harvesting land base in this analysis. These buffers exceed buffer widths required according to the Coastal Fisheries/Forestry Guidelines. The excess is to account for Class III and IV streams, which were not buffered in the analysis, and to provide for biodiversity, old-growth, wildlife habitat and wildlife corridor requirements. Table A-4. below lists the area reductions for streamside buffers.

A.3 Definition Of The Timber Harvesting Land Base

Table A-4. Area reductions for Class I and II streamside buffers by mapsheet.

Mapsheet	Location	Area reduction (hectares)
103A095	Kiln Creek	51.1
103A096	Unnamed Creek	13.3
103G070	Unnamed Creek	11.2
103G080	Unnamed Creek	93.8
103G089	Alpha Creek	81.2
103G090	Pa-aat River	107.8
103G098	Unnamed Creek	2.1
103G099	Oona River	100.8
103G100	Kroman Creek	72.8
103H006	Surf Inlet	11.2
103H014	Gil Island	81.2
103H015	Cornwall Inlet	5.6
103H016 ^a	Cornwall Inlet	0.0
103H017	Princess Royal Island	46.2
103H024	Gil Island	21
103H025	Whalen Lake	19.6
103H026	McKay Reach	119
103H032	Leavitt Lagoon	9.8
103H033	Tsimitack Lake	7
103H034	Grenville Channel	12.6
103H035	Gribbell Island	100.8
103H036	Goat River	119
103H037	Triumph Creek	172.2
103H043	Belowe Lake	32.2
103H044	Douglas Channel	35
103H045	Verney Passage	32.2
103H046	Ursula Channel	77
103H047	Paril River	124.6
103H048	Gardner Canal	5.6
103H051	Unnamed Creek	1.4
103H052	Satter Lake Creek	1.4
103H053	Verney Falls	1.4
103H054	Kiskosh Inlet	25.9
103H055	Fishtrap Bay	23.8
103H056	Verney Passage	8.4
103H061	Hevenor Inlet	8.4
103H062	Exposed Inlet	32.2
103H064	Quall River	159.6
103H065	Hawksbury Island	26.6
103H071	Kxngeal Inlet	25.2
103H072	East Inlet	33.6
103H073	Ecstall River	54.6
103H074	Quaal River	106.4
103H075	Douglas Channel	60.2

^a No area is deducted for Class I and II streams because no operable area is remaining on these mapsheets.

A.3 Definition of the Timber Harvesting Land Base

Table A-4. (Continued)

Mapsheet	Location	Area reduction (hectares)
103H081	Kumealon Inlet	215.6
103H082	Ecstall River	191.8
103H083	Ecstall River	203
103H091	Brown Lake	105
103H092	Ecstall River	133
103H093	Big Falls Creek	114.8
103I001	Hayward Creek	130.9
103I002	Scotia River	109.9
103I003	Scotia River	9.8
103I012	Ayton Creek	148.4
103I013	Khtada River	73.5
103I021	Lachmach River	58.8
103I023	Alder Creek	44.1
103I024	Alder Creek	25.2
103I031	Lachmach River	13.3
103I051	Toon River	60.2
103I061	Khutzeymateen Inlet	96.6
103I071	Kwinamass River	140
103I091	Kincolith River	32.9
103J009	Spiller River	35
103J010	Standard Creek	40.6
103J019	Unnamed Creek	3.5
103J030	Diana Creek	38.5
103J040	Marion Creek	54.6
103J049	Georgetown Creek	58.1
103J050	Unnamed Creek	8.4
103J059	Ensheshese River	25.2
103J060	Ensheshese River	72.8
103J069	Unnamed Creek	8.4
103J070	Unnamed Creek	61.6
103J079	Unnamed Creek	49
103J080	Kwinamass River	249.9
103J088	Unnamed Creek	3.5
103J089	Unnamed Creek	93.1
103J090	Chambers Creek	41.3
103J099	Unnamed Creek	23.1
103O009 ^a	Unnamed Creek	0
103O010	Dogfish River	18.2
103O050	Donaue Creek	35.7
103O070	Walk Creek	16.1
103O080	Georgie River	28.7
103O090	Marmot River	9.1

^a No area is deducted for Class I and II streams because no operable area is remaining on these mapsheets.

A.3 Definition of the Timber Harvesting Land Base

Table A-4. (Continued)

Mapsheet	Location	Area reduction (hectares)
103P001	Iknovk River	209.3
103P002	Keazoah Creek	164.5
103P003	Diskangieq River	96.88
103P012	Kincolith River	88.2
103P021	Salmon Creek	86.8
103P022	Stagoo Creek	172.2
103P023	Stagoo Creek	8.4
103P032	Kelskiist Creek	133.7
103P043	Kitsault River	93.8
103P053	Dak River	113.4
103P063	Kitsault River	89.6
104A001	Bear River	127.4
104A002	Bitter Creek	79.8
104A011	Amerian Creek	28
Total		6508.18

A.3 Definition of the timber harvesting land base

A.3.6 Unmerchantable forest and non-commercial cover types

Some forest stands are not currently utilized because either they cannot be harvested economically or they contain mostly non-commercial tree species. Examples include older stands that contain low net timber volumes or poor quality trees and stands dominated by deciduous species. Table A-5. lists the unmerchantable forest types for the North Coast TSA. All unmerchantable forest types are 100% excluded from the timber harvesting land base. In addition, all non-commercial areas, designated as projected type identity 5, are excluded.

Table A-5. Definition of unmerchantable and non-commercial forest types.

Species group	Inventory type group	Stocking class	Site class ^a	Crown closure (%)	Height (metres)	Age (years)
All	All		Low			
All	All			0 - 35		81+
All	All				0 - 19.4	81+
All	All					
Cedar	9 - 11	2				
Hemlock	12 - 17	2				
Amabilis	18 - 20	2				
Pine	27 - 32					
Spruce	21 - 26	2				
Cottonwood ^b	35 and 36					
Other Deciduous	37 - 42					

a Site class is based on the new site class except when modified by special site class.

b Good and medium site cottonwood types, stocking classes 0 and 1, are not excluded from the operable land within the Highway 16 corridor.

A.3.7 Existing and future roads

A.3.7.1 Existing roads

Past timber harvesting operations have resulted in a reduction of productive forest land. However, many of the existing roads, trails, landings, fireguards and related disturbances are not accounted for in the inventory file. To account for this loss, a 1011-hectare reduction is applied to areas currently available for timber production with stands younger than 21 years of age (the areas assumed to have a timber harvesting history). This reduction is based on measurements that 535 kilometres of forest road presently exists, with an average of 1.89 hectares of disturbed area per kilometer.

A.3.7.2 Future roads

There will also be losses in productive area as future harvesting occurs. All existing stands currently older than 20 years of age will be subject to these losses. The area that will eventually be lost is not initially excluded from the land base. Instead, 8.3% of all forest stands older than 20 years of age are aggregated into the Future Roads Zone which is harvested, in the B.C. Forest Service timber supply model, over a 140-year period. After initial harvest, these areas are set aside in non-productive status.

A.3 Definition of the Timber Harvesting Land Base

A.3.8 Not satisfactorily restocked areas

All areas on the inventory file assigned a projected type identity of 4, 7 or 9 are initially excluded from the land base. Silviculture history records indicate there are 3094 hectares of backlog and current NSR. The backlog and current NSR area is scheduled to be restocked within 10 years, and is added back into the timber harvesting land base with a 4-year regeneration delay. The FIP file identified an additional 1397 hectares of NSR area which is not identified in the silviculture records. Because the silviculture NSR records are considered to be more accurate than the inventory file, this 1397 hectares is assumed to be presently restocked and is added back into the timber harvesting land base with no regeneration delay.

A.3.9 Timber licence reversion areas

A total of 424.9 hectares of timber harvesting land was scheduled to revert to Crown administration within 25 years. Table A-6. summarizes the reductions that have been made to the timber harvesting land base to account for timber licence areas. Only 270.9 hectares are deducted because 154.0 hectares have already reverted to Crown administration. Table A-7. summarizes the additions that have been made to the timber harvesting land base to account for the reverting timber licences.

Table A-6. *Reductions to the timber harvesting land base to account for timber licence areas.*

Zone	Analysis unit	Area reduction (hectares)
2	2	32.4
5	5	135.7
7	7	102.8
Total area reduction		270.9

Table A-7. *Additions to the timber harvesting land base for timber licence reversions.*

Zone	Analysis unit	Year area is added to the land base	Area added (hectares)
5	5	2002	45.9
7	7	2002	55.0
2	2	2012	32.4
5	5	2012	89.8
7	7	2012	47.8
Total area added			270.9

A.4 Visual Quality Objectives

Aesthetic objectives are established for the Work Channel, Highway 16 (Skeena River) and Inside Passage corridor areas. Of the timber harvesting land base, 4985 hectares (4.4%) is Retention Visual Quality management area and 4481 hectares (3.9%) is Partial Retention Visual Quality management area. Figure A-1. indicates where the Visual Quality management areas are located within the North Coast TSA.

Visual landscape management considers the total green portion of the visual landscape, whether operable or not, and applies a maximum per cent disturbed figure to this area. Timber supply analysis uses the operable area for modelling and applies a maximum per cent disturbed figure to the area. To make the two consistent, the ratio of total green to operable area, and the distribution of the operable area over the landscape, must be considered (as outlined in the *Procedures for Factoring Recreation Input into Timber Supply Analysis*, B.C. Ministry of Forests, 1993).

The North Coast Forest District staff consider an area disturbed when the trees are shorter than 5 metres. Trees in the North Coast TSA usually obtain 5 metres by 20 years of age, thus a green-up period of 20 years is used in the timber supply model.

The visual absorption capacity of the visually sensitive areas is considered high; therefore 5 and 15% of the total green portion of the Retention and Partial Retention visual landscape may be disturbed at any time. Using the total green to operable adjustment, it was determined that at most 13% of the harvestable area in the Retention Visual Quality management area and 34% of the harvestable area in the Partial Retention Visual Quality management area may be younger than 20 years at any time. No cover requirements for visual quality are applied to the Integrated Resource management area.

A.5 Unsalvaged Losses

Unsalvaged losses are timber volumes destroyed or damaged by natural causes such as fire and disease epidemics. Estimated annual losses are deducted from the gross timber supply to determine the projected net volumes that will be harvested over time. The total annual loss for the North Coast TSA is estimated to be 1675 cubic metres per year. For precision, 2000 cubic metres per year is subtracted from harvest volumes modelled to derive all harvest forecasts in this report.

The unsalvaged losses accounted for in the North Coast TSA are solely due to fire. Additional losses from other causes such as various diseases, spruce aphid, tent caterpillar, porcupine and blowdown are experienced. These additional losses have not been accounted for since they are endemic, occur in species not considered economical, occur outside of the timber harvest land base, or sufficient data has not been collected to quantify their impact.

A.6 Minimum Harvest Ages for Each Analysis Unit

To be considered for harvesting, stands must meet minimum volume and diameter criteria. Minimum harvest ages for all species except cottonwood are determined as the age at which volumes of 400 cubic metres per hectare and diameters at breast height (dbh) of 40 cm can be achieved. The batch VDYP tables are used to determine the age at which the minimum volume is obtained. The Ministry of Forests Table Interpolation Program for Stand Yields (TIPSY) is used to determine the age at which the minimum dbh is obtained. District experience is then used to modify the minimum harvest ages to more closely reflect the minimum age these stands are harvested. Table A-8. indicates the minimum harvest age based on the minimum volume and dbh harvest criteria and the associated volume and dbh obtained at those ages. Table A-9. indicates the minimum harvest ages used in the timber supply model, as determined by the North Coast Forest District staff.

A.6 Minimum Harvest Ages for Each Analysis Unit

Table A-8. Minimum harvest ages based on minimum volume and dbh harvest requirements.

Zone	Analysis unit	Yield table	Minimum harvest age based on minimum harvest criteria	Volume at minimum harvest age	dbh at minimum harvest age	Limiting factor V=volume D=dbh
1	1	1	91	400	44	V
2	2	2	184	400	44	V
3	3	3	90	444	40	D
4	4	4	155	440	40	D
5	5	5	105	474	40	D
6	6	6	150	418	40	D
7	7	7	180	457	40	D
8	8	8	78	400	47	V
9	9	9	69	400	45	V
10	10	10	174	400	41	V
11	11	11	107	400	46	V
12	2	12	180	400	44	V
12	3	13	90	477	40	D
12	4 & 5	14	115	466	40	D
12	6 & 7	15	180	457	40	D
12	8	16	88	400	40	D & V
12	9 & 10	17	117	400	44	V
12	11	18	110	400	42	V
13	1	19	105	400	45	V
13	2	12	180	400	44	V
13	3	13	90	477	40	D
13	4 & 5	14	115	466	40	D
13	6 & 7	15	180	457	40	D
13	8	16	88	400	40	D & V
13	9 & 10	17	117	400	44	V
13	11	18	110	400	42	V
13	12	20	N/A ^a	N/A	N/A	N/A
14	1	19	105	400	45	V
14	2	12	180	400	44	V
14	3	13	90	477	40	D
14	4 & 5	14	115	466	40	D
14	6 & 7	15	180	457	40	D
14	8	16	88	400	40	D & V
14	9 & 10	17	117	400	44	V
14	11	18	110	400	42	V
14	12	20	N/A	N/A	N/A	N/A

a No minimum volume or dbh harvest requirements are established for cottonwood.

A.6 Minimum Harvest Ages for Each Analysis Unit

Table A-9. Minimum harvest ages used in the timber supply model and associated volume and dbh obtained.

Zone	Analysis unit	Yield table	Minimum harvest age based on minimum harvest criteria	Volume at minimum harvest age	dbh at minimum harvest age
1	1	1	90	400	44
2	2	2	160	367	42
3	3	3	90	445	40
4	4	4	105	324	41
5	5	5	105	474	40
6	6	6	150	418	40
7	7	7	160	421	39
8	8	8	80	416	47
9	9	9	80	471	50
10	10	10	110	172	25
11	11	11	110	413	46
12	2	12	160	373	42
12	3	13	90	477	40
12	4 & 5	14	105	435	38
12	6 & 7	15	150	401	38
12	8	16	80	359	39
12	9 & 10	17	90	292	36
12	11	18	110	403	42
13	1	19	90	350	42
13	2	12	160	373	42
13	3	13	90	477	40
13	4 & 5	14	105	435	38
13	6&7	15	150	401	38
13	8	16	80	359	39
13	9 & 10	17	90	292	36
13	11	18	110	403	42
13	12	20	40	123	N/A
14	1	19	90	350	42
14	2	12	160	373	42
14	3	13	90	477	40
14	4 & 5	14	105	435	38
14	6 & 7	15	150	401	38
14	8	16	80	359	39
14	9 & 10	17	90	292	36
14	11	18	110	403	42
14	12	20	40	123	N/A

A.7 Basic Silviculture and Regeneration Assumptions

The silviculture program includes the mix of treatments required to achieve success in basic forest management. This level of activity is assumed to be continued indefinitely into the future with the required funding.

Eighty per cent of the area harvested by the licensees and 90% of the area harvested under the Small Business Forest Enterprise Program is planted; the remainder regenerates naturally. The regeneration delay usually ranges from 2 to 6 years in the North Coast TSA and plantation failure is rare. A 4-year regeneration delay is used in the timber supply model for all species and it is assumed that all analysis units regenerate back to the same analysis unit.

A.8 Yield Estimates for Existing and Regenerated Stands

A batch version of the Variable Density Yield Projection system (VDYP, version 4.2b), developed by the Inventory Branch of the B.C. Forest Service, is used to estimate volume yields for both existing and regenerated stands. The batch VDYP model provides a complete yield table for every forest stand in the timber harvesting land base, according to the species composition, height, age, stocking and geographic location of the stand. These tables are then aggregated into the analysis unit tables, by averaging the individual tables, weighted by the area of each stand that makes up the analysis unit. Managed stand yield tables for regenerated stands were not available for the North Coast TSA at the time of this analysis.

Initially 41 stand yield tables were produced — one for each management area and analysis unit combination, with some additional tables for mature and immature analysis unit splits. Due to the similarity of the yield tables, the similarity of the minimum harvest ages and the significance of the areas associated with the tables, many of the tables are combined resulting in 20 tables as summarized in Table A-10. and Table A-11.

A.8 Yield Estimates for Existing and Regenerated Stands

Table A-10. Management area, zone, analysis unit and yield table associations

Zone	Analysis unit	Table	Timber harvest land base (hectares)	Per cent of net area
Integrated Resource management area				
1	1	1	942	0.8
2	2	2	13 628	11.9
3	3	3	1 087	1.0
4	4	4	6 573	5.8
5	5	5	9 645	8.4
6	6	6	2 285	2.0
7	7	7	35 492	31.1
8	8	8	2 178	1.9
9	9	9	1 800	1.6
10	10	10	1 508	1.3
11	11	11	506	0.4
12	2	12	711	0.6
12	3	13	190	0.2
12	4 & 5	14	6 632	5.8
12	6 & 7	15	19 371	17.0
12	8	16	1 353	1.2
12	9 & 10	17	817	0.7
12	11	18	19	0.0
			104 741	91.7
Retention Visual Quality management area				
13	1	19	131	0.1
13	2	12	1 088	1.0
13	3	13	22	0.0
13	4 & 5	14	1 144	1.0
13	6 & 7	15	2 206	1.9
13	8	16	120	0.1
13	9 & 10	17	188	0.2
13	11	18	69	0.1
13	12	20	16	0.0
			4 985	4.4
Partial Retention Visual Quality management area				
14	1	19	199	0.2
14	2	12	1 036	0.9
14	3	13	24	0.0
14	4 & 5	14	1 129	1.0
14	6 & 7	15	1 625	1.4
14	8	16	130	0.1
14	9 & 10	17	130	0.1
14	11	18	27	0.0
14	12	20	180	0.2
			4 481	3.9
Total net area			114 207	100.0

A.8 Yield Estimates for Existing and Regenerated Stands

Table A-11. Volume estimates for existing and regenerated stands.

Age	Table 1 volume m ³	Table 2 volume m ³	Table 3 volume m ³	Table 4 volume m ³	Table 5 volume m ³	Table 6 volume m ³	Table 7 volume m ³
10	0	0	0	0	0	0	0
20	1	0	9	1	2	1	0
30	21	1	77	24	16	12	2
40	91	13	148	61	96	36	13
50	166	52	226	117	178	93	57
60	235	98	294	167	250	146	108
70	297	141	352	211	312	192	156
80	354	181	403	249	368	233	200
90	400	214	443	283	415	268	237
100	438	243	481	312	456	299	271
110	472	269	512	337	493	326	301
120	496	288	539	359	524	349	327
130	529	311	568	384	556	374	353
140	560	332	594	408	586	397	378
150	587	351	618	430	613	418	400
160	610	367	640	450	638	437	421
170	630	380	659	468	660	454	439
180	652	395	678	485	681	471	457
190	672	409	694	501	700	486	474
200	691	422	709	515	718	500	490
210	709	434	724	529	735	513	505
220	731	449	736	541	750	525	519
230	752	463	748	553	765	537	532
240	773	477	759	564	778	547	545
250	793	491	769	575	791	557	556
260	797	494	777	583	800	565	564
270	801	497	784	591	808	572	572
280	804	500	791	599	816	579	578
290	808	502	796	606	823	585	585
300	811	505	802	612	830	590	591
310	814	507	806	618	836	596	596
320	817	509	811	624	841	600	601
330	819	511	815	629	846	605	606
340	821	513	818	634	851	609	611
350	823	514	821	639	855	613	615

A.8 Yield Estimates for Existing and Regenerated Stands

Table A-11. (Continued)

Age	Table 8 volume m ³	Table 9 volume m ³	Table 10 volume m ³	Table 11 volume m ³	Table 12 volume m ³	Table 13 volume m ³	Table 14 volume m ³
10	0	0	0	0	0	0	0
20	18	32	0	7	0	3	1
30	70	101	2	35	1	60	14
40	145	185	8	79	14	144	81
50	218	265	18	126	54	231	158
60	290	342	33	184	100	306	225
70	357	411	51	239	144	372	284
80	416	471	73	289	184	428	335
90	469	522	102	334	218	477	379
100	516	567	136	376	247	519	418
110	557	605	172	413	273	555	452
120	593	638	208	448	292	587	481
130	629	672	246	483	316	619	511
140	663	702	283	516	338	649	539
150	693	730	319	547	356	675	565
160	721	755	354	575	373	700	588
170	746	777	389	602	386	722	609
180	770	798	422	628	401	742	628
190	792	818	455	652	415	760	646
200	812	836	487	674	428	777	663
210	832	853	518	696	441	793	678
220	850	869	549	716	456	807	692
230	867	884	578	735	470	820	705
240	882	898	607	753	485	832	717
250	897	911	636	771	498	843	728
260	910	922	661	786	502	853	738
270	923	933	685	801	504	862	746
280	935	943	709	815	507	870	754
290	946	952	732	828	510	877	761
300	956	961	755	841	512	884	767
310	966	970	776	853	514	890	773
320	976	978	797	865	516	896	779
330	985	986	818	876	518	901	784
340	993	994	838	887	520	906	789
350	1002	1001	857	897	522	910	793

A.8 Yield Estimates for Existing and Regenerated Stands

Table A-11. (Continued)

Age	Table 15 volume m ³	Table 16 volume m ³	Table 17 volume m ³	Table 18 volume m ³	Table 19 volume m ³	Table 20 volume m ³
10	0	0	0	0	0	0
20	0	15	9	3	1	9
30	2	55	31	20	9	82
40	14	113	70	52	72	123
50	59	177	113	91	139	156
60	111	240	157	150	202	180
70	159	302	201	209	257	197
80	202	359	248	263	309	209
90	240	411	292	313	350	218
100	273	460	335	360	385	225
110	303	504	375	403	415	230
120	329	544	413	442	438	233
130	355	583	449	483	468	236
140	379	619	484	521	495	238
150	401	653	517	556	520	239
160	422	684	548	590	541	239
170	440	713	578	621	559	239
180	458	740	606	650	577	239
190	474	766	632	677	595	240
200	489	790	658	703	612	240
210	504	812	682	728	628	240
220	517	833	705	751	648	240
230	530	853	727	773	666	240
240	541	872	748	794	685	240
250	553	890	769	814	702	240
260	561	907	787	831	707	240
270	568	923	805	848	711	240
280	576	938	821	865	715	240
290	582	952	838	880	719	240
300	589	965	853	895	723	240
310	594	978	868	909	726	240
320	600	990	882	922	729	240
330	605	1002	896	935	732	240
340	610	1013	909	947	735	240
350	614	1023	922	959	737	240

APPENDIX B

Land Base changes Since the
1981 North Coast Timber Supply Area Report,
Prince Rupert Forest Region

Table B-1. Summary of land base changes since 1981.

Classification	Areas for 1994 Timber Supply Review (hectares)	Areas for 1981 analysis (hectares)	Land base change (hectares)
Total land base	1 947 531	1 767 200	+180 331 ^a
Productive Crown land	704 845	676 400	+ 28 445
Reductions to productive Crown land	595 283	570 200	+ 25 083
Non satisfactorily restocked (NSR) area	4 491	17 000 ^b	- 12 509 ^c
Timber licence reversions	154	0	+ 154
Total current timber harvesting land base less NSR	109 716	106 200	+ 3 516
Total current timber harvesting land base ^d	114 207	106 200	+ 8 007

a Since the 1981 analysis, area from the Mid Coast and Kalum timber supply areas have become the responsibility of the North Coast TSA.

b In 1981, NSR and non-commercial areas were deducted at the same time, thus the 17 000 hectares represents both NSR and non-commercial areas.

c This is not a good indication of land base change, because the 1994 figure is for NSR areas only, while the 1981 figure is for NSR and non-commercial areas.

d NSR area is included with the total current timber harvesting land base in 1994, but it was not included in 1981.

