



TIMBER SUPPLY BRANCH

Quesnel TIMBER SUPPLY AREA

Analysis Report and Information for Urgent Allowable Annual Cut (AAC) Increase

February 2001

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



Ministry of Forests

National Library of Canada Cataloguing in Publication Data

Main entry under title:

Quesnel timber supply area : analysis report and information for urgent allowable annual cut (AAC) increase

Includes bibliographical references: p.

ISBN 0-7726-4478-0

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

SD438.Q47 2000

333.75'11'0971175

C2001-960041-0

© 2001 Province of British Columbia
Ministry of Forests

Executive Summary

Overview of the process

The British Columbia Forest Service's chief forester has been requested to consider an increase in the allowable annual cut (AAC) for the Quesnel timber supply area (TSA). This request is urgent due to the current epidemic mountain pine beetle (MPB) infestation in the area.

In accordance with the *Forest Act*, Section 8 — and under normal circumstances — the chief forester reviews and determines a new AAC for each of the 37 TSAs and 34 tree farm licences (TFLs) in the province at least once every five years. The chief forester's determination is an independent, professional judgment based on the best available information. By law, the chief forester is independent of the political process, and is not directed by the minister of forests when determining AACs.

The B.C. Forest Service (BCFS) has been preparing for a timber supply review and had planned to release a new allowable annual cut for the Quesnel TSA before the end of 2001. However, the infestation has created an urgent need to address the associated forest management concerns immediately.

The objectives of this analysis report are to provide British Columbians with information regarding the recent timber supply analysis and the request to temporarily increase the Quesnel AAC, and to provide an opportunity for public review. The timelines for completion of the timber supply review have been modified to permit a 21-day public review period following the release of this report, instead of the normal 60-day public review period.

As part of the provincial Timber Supply Review and in consideration of the urgent beetle epidemic, the BCFS has now completed a review of the timber supply in the Quesnel TSA. This analysis report assesses how current forest management practices affect the supply of wood available for harvesting over both the short- (next 20 years) and long- (next 250 years) term.

It also examines the potential changes in timber supply stemming from the mountain pine beetle epidemic and uncertainties about forest growth and management actions. Due to the increase in the mountain pine beetle population, in conjunction with its proximity to a large area of its preferred host—mature lodgepole pine—the epidemic now poses a significant risk to the standing timber inventory in the Quesnel TSA.

Current forest management practices follow the standards and legislation set out by the *Forest Practices Code* and the *Cariboo-Chilcotin Land Use Plan*. The analysis contained in this report has reviewed these current practices as well as the potential timber supply impact of the epidemic in the Quesnel TSA.

To the extent possible, harvesting of the current AAC is focussed on infested stands of timber. However, if harvesting levels are not increased, much of the attacked timber will soon be unsuitable for lumber manufacturing.

The chief forester has agreed to review the AAC as soon as possible and therefore a new AAC determination will be released early this spring. The AAC decision will be documented in a rationale and publicly released.

Executive Summary

The details of the request for an AAC increase are:

Proposed term of increase: from April, 2001 until the next five-year AAC determination is due, or sooner if required.

Requested increase: as much as 1 000 000 cubic metres per year for the control of the mountain pine beetle and salvage of beetle attacked stands.

In June 1999, the BCFS released a data package and information report for public review and comment. The submissions already received regarding these documents will be provided to the chief forester prior to his AAC determination.

This analysis report provides information that the chief forester will consider in making his decision regarding this request. Before determining if an increase in the Quesnel AAC is necessary, the chief forester will review all relevant and available reports, as well as public input.

The public is invited to provide written comments regarding any information contained in this document for the chief forester to consider when reaching his decision.

Public comments will be accepted until 4:30 p.m. on March 8, 2001. A response form at the end of this document will assist you in providing your comments. See page 27 for more details.

Overview of the analysis

The Quesnel TSA covers a total of about 1.6 million hectares. The area considered available for timber harvesting—the timber harvesting land base—under current management practices is approximately one million hectares. The total volume of standing timber on the timber harvesting land base is currently about 235 million cubic metres, of which 167.4 million cubic metres is mature volume.

The current mountain pine beetle infestation started in the 1990s and has now attacked about 24 400 hectares of lodgepole pine stands scattered throughout the Quesnel TSA.

The results of this timber supply analysis for the Quesnel TSA suggest that current AAC of 2 340 000 cubic metres per year—the base case forecast—could be maintained for 19 decades without creating abrupt future timber shortages.

However, if the mountain pine beetle epidemic continues, during its peak the volume losses could be as much as 10 million cubic metres in one year with significant impacts to the timber supply. The timber supply implications of the epidemic are viewed as a critical issue in this analysis report.

The analysis results reflect current knowledge and information on forest inventory, growth, and management. However, it is important to recognize that uncertainty exists about several factors important in defining the base case forecast. A series of sensitivity analyses show that these uncertainties can affect timber supply to varying degrees. These sensitivity analyses show that, within the ranges examined, uncertainties do not generally impact the short-term timber supply (next 20 years) as projected in the Quesnel TSA base case forecast. However, the uncertainty with the largest potential impact on projected harvests over the short and medium term is the rate of spread and duration of the current MPB epidemic.

As part of the timber supply review, data was gathered about the social and economic information associated with the timber supply in the Quesnel TSA. The socio-economic assessment for the Quesnel TSA indicates that the current AAC of 2 340 000 cubic metres per year can support a provincial total of approximately 1,678 person-years of direct employment. Residents of the Quesnel TSA account for about 90% of this direct employment. Direct forest sector activity in the TSA supports a further 2,246 person-years of indirect and induced employment across the province. The current AAC provides the provincial government with average annual revenues of \$106.4 million.

As shown in the analysis, the harvest level could be increased to 3 340 000 cubic metres per year. This volume would support an estimated total of 2,395 person-years of direct employment in the forestry sector, and a total of 3,207 person-years of indirect and induced employment in province. The higher harvest level could provide the provincial government with average annual revenues of \$151.9 million.

Table of Contents

Executive Summary	iii
Overview of the process	iii
Overview of the analysis	iv
Introduction.....	1
1 Critical Issue — MPB.....	3
1.1 The mountain pine beetle epidemic.....	3
1.2 Proposed strategies for managing the epidemic.....	7
2 Timber Supply Results	8
2.1 Base case harvest forecast	8
2.2 Mountain pine beetle forecasts.....	9
3 Timber Supply Sensitivity Analyses.....	13
3.1 Uncertainty in the estimated area of the timber harvesting land base.....	14
3.2 Uncertainty in the estimate of mature stand volume	15
4 Social and Economic Information	16
5 Summary and Conclusion of the Timber Supply Analysis	17
Appendix	19
1 Information Preparation for the Timber Supply Analysis	20
1.1 Land base inventory.....	20
1.2 Timber growth and yield	23
1.3 Current management practices	23
1.4 Timber supply analysis methods	24
References	25
Your Input is Needed	26

Introduction

As part of the provincial Timber Supply Review, the B.C. Forest Service has now completed a review of the timber supply in the Quesnel TSA. This analysis report assesses how current forest management practices affect the supply of wood available for harvesting over both the short- (next 20 years) and long- (next 250 years) term. It also examines the potential changes in timber supply stemming from the recent epidemic mountain pine beetle infestation and uncertainties about forest growth and management actions.

The Quesnel TSA is located in the northern part of the Cariboo Forest Region, encompassing the Blackwater, Nazko, and Itcha-Ilgachuz areas west of Quesnel, and the Barkerville, Cariboo River and Quesnel Lake areas to the east. The TSA covers about 1.6 million hectares, of which approximately 81% is productive Crown forest, and about 63% is available for timber harvesting.

The area covered by Quesnel Forest District encompasses the Quesnel TSA, woodlot licence areas, as well as Tree Farm Licences 5 and 52. The information provided in this report is specific to the TSA unless otherwise indicated.

The mountain pine beetle (MPB) infestation currently covers a vast area in central B.C., including the Quesnel TSA. At present it threatens to infest most of the mature and near-mature lodgepole pine stands in the TSA, which cover about 321 000 hectares of the timber harvesting land base and comprise the majority of the merchantable and harvestable timber supply. At the current average rate of spread, and from experience gained from the Chilcotin MPB outbreak during the 1970s to 1980s, projections indicate that the epidemic could infest all

the mature and near-mature pine within 7 to 9 years. If the right conditions exist—continual availability of susceptible lodgepole pine and mild winters—at its peak the MPB could affect 80 000 hectares, or about 10 million cubic metres in one year.

The Quesnel TSA is included in the area covered by the *Cariboo Chilcotin Land-Use Plan* (CCLUP) and forest development is required to be consistent with aspects of the plan that have *Higher Level Plan* (HLP) direction as provided under the *Forest Practices Code*. Any accelerated harvesting to control the spread of mountain pine beetle will be done within the context of the HLP. This objective will be addressed as much as possible by shifting harvesting to infested MPB stands as a priority so that the remaining stands can continue to contribute to achieving the HLP targets (see section 1.2, "Proposed strategies for managing the epidemic"). If it becomes apparent that the beetle control measures represent a risk to achieving the HLP targets, then the BCFS will develop a transition strategy to ensure these risks are minimized. The Cariboo Mid-Coast Interagency Management Committee and the Cariboo Chilcotin Regional Resource Board are mandated by government to monitor the implementation of the CCLUP. The BCFS will keep these groups informed of the beetle control measures and will request their advice or direction where required to manage any risk to achievement of the CCLUP.

Effective January 1, 1996, the chief forester set the current AAC for the Quesnel TSA at 2 340 000 cubic metres. Of this total AAC, a partition was established for 300 000 cubic metres for problem forest types and 40 000 cubic metres for deciduous stands.

Introduction

Under provincial policy, the rate of timber harvesting should not exceed the maximum limits — with minor variations permitted — established for each licence, and the sum of these should not exceed the AAC set for the TSA. To the extent possible, the current AAC for the Quesnel TSA is completely dedicated to the removal of existing attacked timber as a first priority. There is insufficient AAC available to ensure that the attacked timber from the recent natural infestation can be recovered.

Timber supply* is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time. For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by British Columbia's chief forester in determining an allowable annual cut (AAC)* — the permissible harvest level for the area.

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

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

Timber supply

The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.

Timber supply area (TSA)

An integrated resource management unit established in accordance with Section 7 of the Forest Act.

Allowable annual cut (AAC)

The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

1 Critical Issue — Mountain Pine Beetle

1.1 The mountain pine beetle epidemic

The mountain pine beetle (MPB), *Dendroctonus ponderosae* Hopkins (Coleoptera: Scolytidae), is the most damaging insect that attacks lodgepole pine in western Canada.¹ The insect is a bark beetle, which is a small, cylindrical insect that attacks and kills mature trees by boring through the bark and mining the phloem — the layer between the bark and wood of a tree.

In the Cariboo Forest Region, about 73% of the region's MPB infestation is located in the Quesnel TSA. In 1991, the area affected by the MPB in the Quesnel TSA was estimated to be only 33 hectares. By 2000, this area increased to over 24 400 hectares. As shown in Figure 1, a substantial area in the Quesnel TSA is now covered by the MPB infestation. The increase is attributed to abundant host material, and a series of mild winters conducive to high overwinter survival of the MPB larvae.

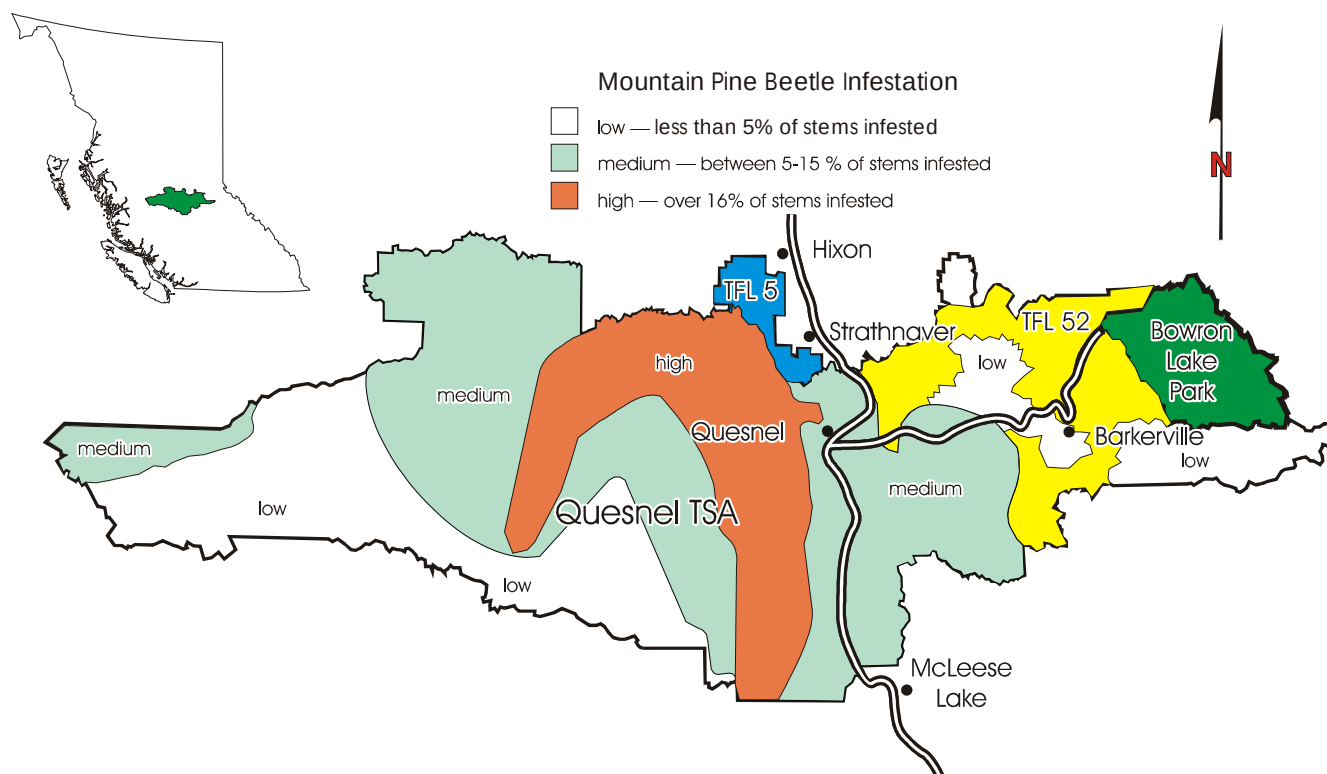


Figure 1. Map of the Quesnel TSA showing general location of the mountain pine beetle infestation, 2001.

(1) There are other beetles in the area, such as Douglas-fir bark beetle (*Dendroctonus pseudotsugae*) and western balsam beetle (*Dryocoetes confusus*), however at present the mountain pine beetle is considered the most damaging.

1 Critical Issue — Mountain Pine Beetle

Outbreaks of mountain pine beetle often last about 8 to 10 years and usually end when cold winter conditions kill the insect during its larval stage. The last outbreak in the Cariboo Forest Region took place during the late 1970's to mid-1980's. It covered approximately 400 000 hectares in the Cariboo Forest Region, predominantly in the Chilcotin Forest District, and timber from this infestation is still being salvaged.

In the Quesnel TSA, the recent MPB infestation centres are widely distributed in the central and western portions, affecting many of the mature lodgepole pine stands to some degree. Eastern areas are less affected by the MPB, partly because pine stands are less prevalent, and possibly due a cooler and wetter climate. Nonetheless, most of the mature (over 80 years) lodgepole pine stands in the TSA are now threatened by the MPB. About 60% of the timber harvesting land base is comprised of lodgepole pine forests between the ages of 80 to 140 years.

Given the dependence of the communities in the Quesnel TSA on the forest industry, and the preponderance of lodgepole pine, the current MPB epidemic represents a serious threat to the medium- and long-term economic viability of Quesnel and area.

Susceptible stands are largely comprised of even-aged lodgepole pine greater than 80 years of age. During infestations, the MPB initially selects the largest trees in an area, but as the outbreak intensifies, the beetle can attack the remaining stems,

thereby severely depleting the entire lodgepole pine component.

The increase in the number and area of 'red attack' (tree crowns are red and indicate dead lodgepole pine trees due to MPB) indicated by the detailed aerial survey in 2000, caused concern that current management strategies for the beetle infestation were not adequately controlling its spread. In 2000, field assessments were conducted to evaluate the level of 'green attack' (tree crowns are green but trees have just been attacked) in select areas in the Quesnel TSA. The level of green attack varied among areas, but on average, the rate of green attack to red attack approached 10:1, an extremely high ratio. While many of the visited stands had very high ratios of green-attack to red-attack trees, other locations showed the MPB had moved into stands of predominately small-diameter trees (typically considered to be low-risk areas). This type of beetle population behaviour and spread indicates intense pressure from this beetle infestation.

Based on surveys undertaken in 2000, it is conservatively estimated that the MPB has killed about 2 million cubic metres of timber in the Quesnel TSA, with an additional 5 million cubic metres attacked and expected to die (based on an average of 250 cubic metres per hectare). However, given the potential area covered by susceptible lodgepole pine stands and the current rate of MPB expansion, this number could increase to 10 million cubic metres per year at its peak in the next 7 to 9 years.

1 Critical Issue — Mountain Pine Beetle

Table 1 shows expansion rates by area — as estimated from detailed aerial overview flights of red attack — of the mountain pine beetle in the Quesnel TSA. The average expansion was derived by determining annual expansion rates over the past seven years. The MPB population has been growing significantly since 1994 in the Quesnel TSA. Following the summers of 1997 and 1998, the population increased dramatically. Factors contributing to this epidemic include:

- a mature and aging lodgepole pine forest;
- natural cycling of the insect population;
- availability of large areas of suitable host (lodgepole pine);
- favourable climatic conditions conducive to MPB survival and development (three mild winters enhanced by a very hot, dry summer in 1998).

Table 1 Annual rate of area expansion of mountain pine beetle, Quesnel TSA, 1994–2000

Year	Estimated infested area of mountain pine beetle (hectares)	Average annual expansion rate of mountain pine beetle area (%)
1994	2 690	79%
1995	3 883	44%
1996	4 920	26%
1997	5 644	15%
1998	9 323	65%
1999	21 368	129%
2000	24 383	14%
		average 44.4%

The most recent beetle flight resulted in an increase in affected area from 1999 to 2000, of at least 3015 hectares, affecting about 683 200 cubic metres. The average annual expansion of the MPB affected area over the TSA for the period 1994 to 2000 is about 44% annually. At the current level of attack (about 24 400 hectares), an additional

10 825 hectares of MPB attack are predicted for the year 2001. However, the future expansion rate is very uncertain as it depends on factors such as the level of harvesting for control, effectiveness of the MPB control, and most importantly changing weather patterns.

1 Critical Issue — Mountain Pine Beetle

As mentioned earlier, the data collected from the detailed aerial overview surveys in the 2000, indicate that MPB affects an area in excess of 24 400 hectares within the Quesnel TSA, excluding parks. This overview survey captured information about the 2000 beetle infestation and therefore these estimates are now already out of date. It is important to note that these populations have since expanded as a result of the 2000 beetle flight. Initial ground reconnaissance work appears to indicate that substantial expansion has resulted from the 1999 flight and that some populations have dispersed to new stands of susceptible pine. By the end of 2001, its likely that about 39 000 hectares will be infested.

It is estimated that approximately 90% of the affected area falls within the timber harvesting land base. If the current rate of expansion continues, the area attacked by MPB could increase to encompass all susceptible lodgepole pine stands within 7 to 9 years.

In spite of the BCFS implementing one of the most intensive single-tree treatment programs in the province (with the goal of reducing the spread of MPB), the problem and its impact on all forest resource values continues to increase. The epidemic especially places the future timber supply for the Quesnel TSA in jeopardy since such a large component of the TSA is comprised of susceptible lodgepole pine.

1 Critical Issue — Mountain Pine Beetle

1.2 Proposed strategies for managing the epidemic

The B.C. Forest Service and the local forest industry have been actively trying to control and manage the mountain pine beetle (MPB) infestation in the Quesnel TSA. In 2000, an Emergency Task Force² was formed and in the fall they released their report *State of Emergency Declared*.

Since 1998, the management strategy has been to direct harvesting to MPB infested stands as a priority so that the remaining stands can continue to contribute to achieving the HLP targets of the CCLUP. Currently, the licensees in the TSA are dedicating 85% of their harvest to the recovery of timber from these stands.

In addition, provisions under the *Forest Act* allow harvesting to be redirected from other management units. The infestation in the Quesnel TSA was recognized as severe enough to warrant this type of redirection. Since 1999, 300 000 cubic metres per year from Tree Farm Licence 52 has been redirected to the Quesnel TSA. As well, in 2000, the regional manager redirected about 340 000 cubic metres from the Williams Lake TSA to the Quesnel TSA. Most of this volume now has been harvested.

Also, the district has been trying to control the MPB spread by a single-tree disposal program for areas where conventional harvesting is not feasible.

Despite the above-noted measures the epidemic continues to increase. As a major component (about 1 965 500 cubic metres per year) of the current AAC

is focused in the infested stands, there is a serious imbalance between the volume of timber attacked (about 5.0 million cubic metres) and the current permitted harvest level.

The MPB epidemic in the Chilcotin during the 1980's resulted in the continual harvesting of beetle-killed trees as merchantable sawlogs for over 10 years, and as pulp (chip) fibre for over 15 years after the trees were attacked. However, the current infestation in the Quesnel TSA is very different; once the trees have been attacked they are not expected to be merchantable for very long. The Quesnel TSA has a wetter climate and decay is expected to occur faster than in the drier Chilcotin.

Another important difference compared to the Chilcotin epidemic is that due to the experience gained there, harvesting is now directed to stands while the beetles are still present, rather than waiting until the trees are dead. This active control has been shown to reduce the rate of spread. In the Quesnel TSA, this proactive approach is possible because there is a reasonably good road network already in place in most of the affected forest area. Another important difference is that the current MPB epidemic is very scattered with no specific attack front.

Section, 2.2 "Mountain pine beetle forecasts" provides details regarding potential harvest levels to control the infestation in the Quesnel TSA.

(2) Represents member companies of the Cariboo Lumber Manufacturers' Association and the Northern Forest Products Association.

2 Timber Supply Results

This section presents results of the timber supply analysis for the Quesnel TSA. The base case harvest forecast uses the most recent assessments of current forest management, the land available for timber harvesting, and timber yields as described in "Information Preparation for the Timber Supply Analysis." As this report is an abbreviated version of a timber supply analysis report normally completed for the Timber Supply Review, there is more detailed information available upon request from the Timber Supply Branch.

Because forest management is inherently a long-term venture, uncertainty surrounds much of the information important in determining timber supply. This uncertainty will be discussed in Section 3, "Timber Supply Sensitivity Analyses." The base case provides only a part of the timber supply picture for the Quesnel TSA, and should not be viewed in isolation of the sensitivity analysis.

2.1 Base case harvest forecast

For the Quesnel TSA, a base case harvest forecast was selected to represent the potential timber supply,

given the current management regime. This forecast does not include implications of the MPB epidemic, which is covered below in Section 2.2, under "Mountain pine beetle forecasts."

The current AAC for the Quesnel TSA is 2 340 000 cubic metres per year. This AAC includes 300 000 cubic metres for problem forest types and 40 000 cubic metres per year for deciduous stands.

Figure 2 shows a base case harvest level of 2 340 000 cubic metres per year, which could be maintained for 19 decades. Thereafter, the long-term harvest level is maintained at 2 000 000 cubic metres per year.

In the base case, the current harvest level partitioned for problem forest types can be maintained for 9 decades. After this time, most of the problem forest types have been harvested once, and regenerated stands are assumed to be managed and contribute to the conventional timber supply. The harvest level of 40 000 cubic metres partitioned for deciduous stands can generally be maintained over the planning horizon.

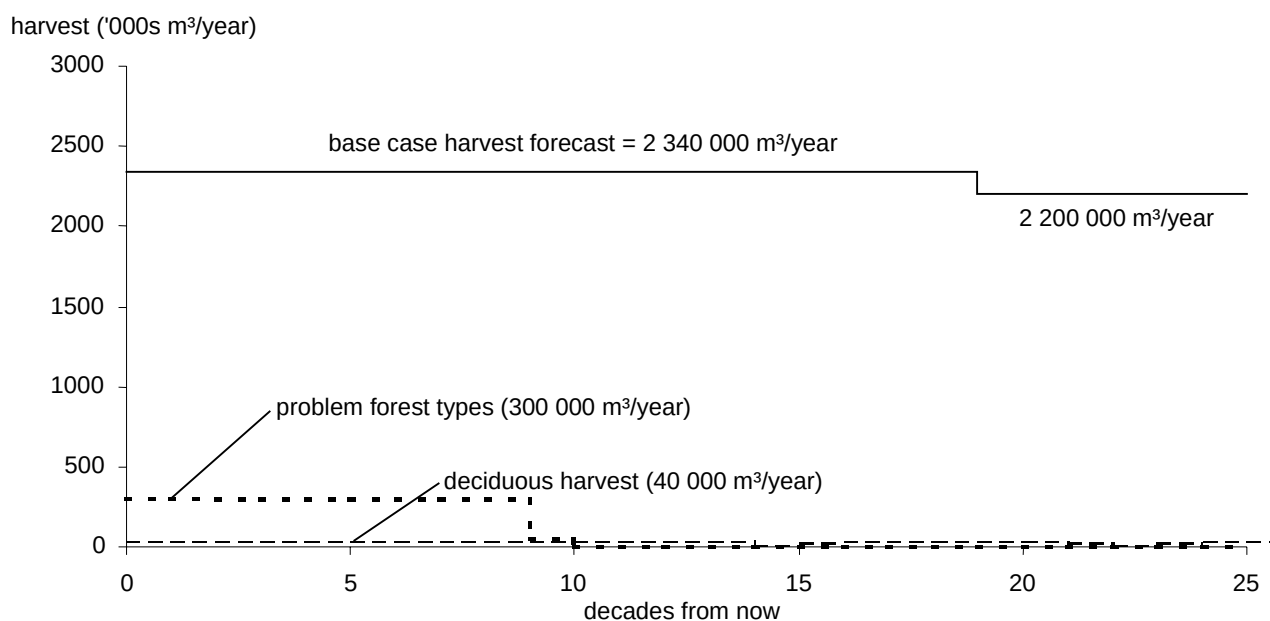


Figure 2. Base case harvest forecast, Quesnel TSA, 2001.

2 Timber Supply Results

2.2 Mountain pine beetle forecasts

Due to the current mountain pine beetle epidemic, the potential area and volume impacted now and over the next 10 years was analyzed by examining a number of possible outcomes.

The mountain pine beetle epidemic in the Quesnel TSA is critical. At the current average annual rate of spread of 44%, the MPB could infest all the susceptible lodgepole pine stands within 7 years. If control harvesting and treatments are fully implemented, it is likely that the rate of spread might be reduced to 35%, delaying the infestation of all susceptible stands for one or two years. Figure 3 shows how much the estimated area affected by the mountain pine beetle will continue to increase each year (in addition to the 24 400 hectares at the

beginning of 2001). Based on current projections, the MPB could expand and during its peak could affect up to 80 000 hectares per year. The total affected volume of wood at this level is estimated to be about 20 million cubic metres, of which about half is expected to be killed.

The following figure is a graphical interpretation showing the projected annual area affected by the mountain pine beetle based on expansion rates of 35 and 44%. If significant changes are made immediately to address beetle populations, including the continued management approach of redirecting existing harvesting operations and an AAC increase, the BCFS believe the situation may be brought to a more manageable level within the next five years.

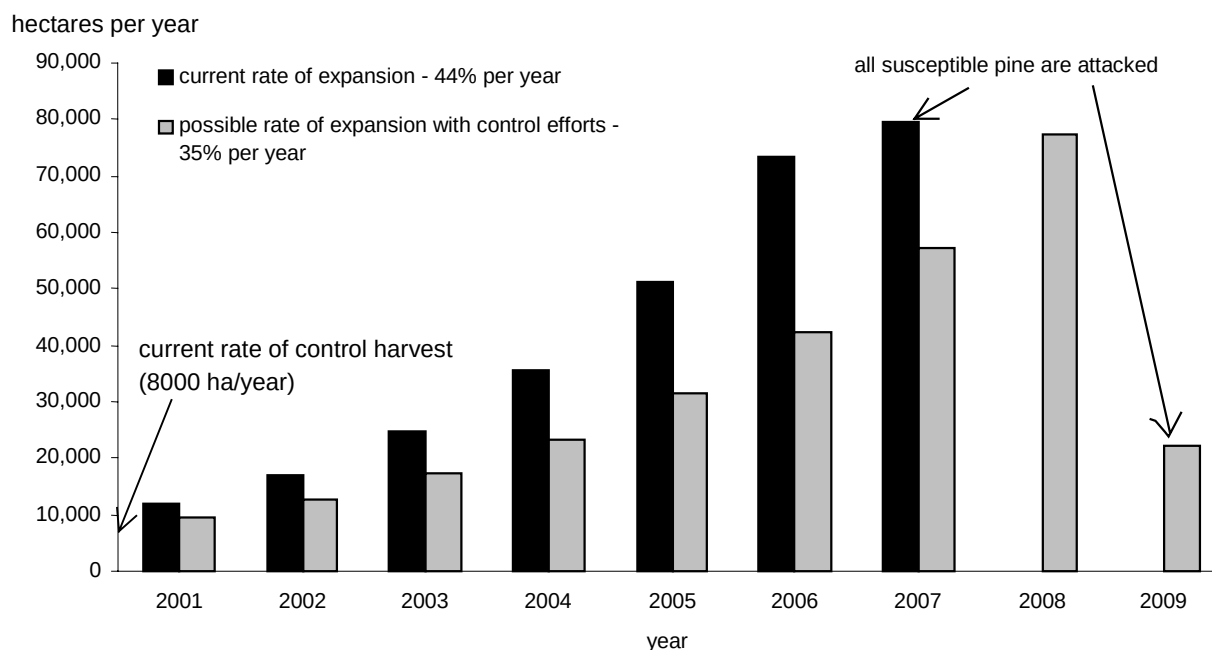


Figure 3. Forecast of area per year infested by mountain pine beetle — Quesnel TSA, 2001.

2 Timber Supply Results

Figure 4 shows the total area — both within and outside of the timber harvesting land base — of forest stands for the base case forecast. A significant amount of the timber harvesting land base is covered by stands greater than 80 years old. As shown in Figure 5, the majority of these stands are pine. Due to this situation, the forests within the

Quesnel TSA reflect some of the most MPB susceptible conditions within the province. Therefore, forest management activities must be planned in coordination with the current, and predicted future status of the mountain pine beetle population.

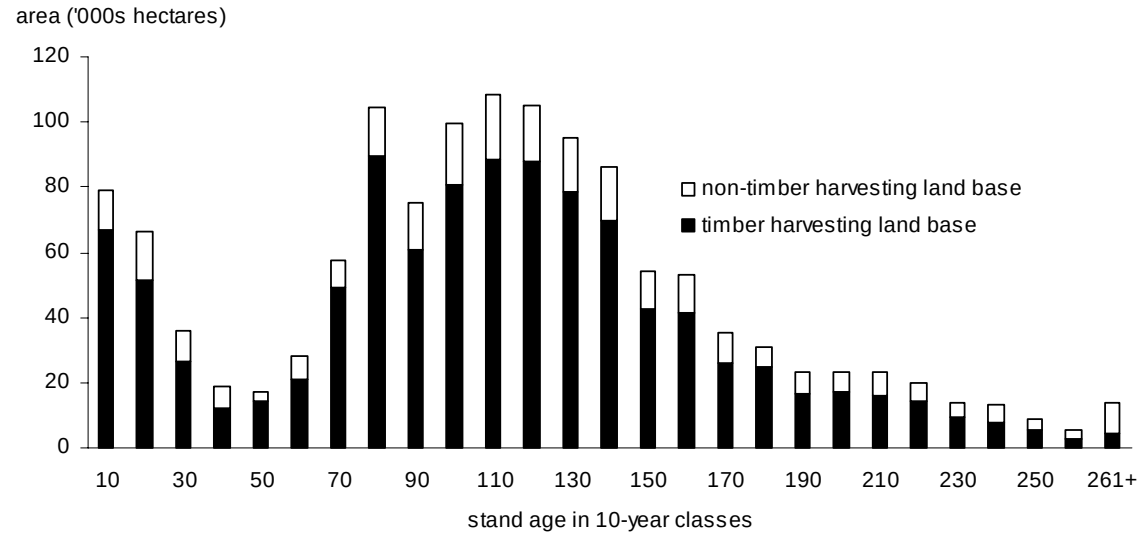


Figure 4. Current age class distribution — Quesnel TSA base case, 2001.

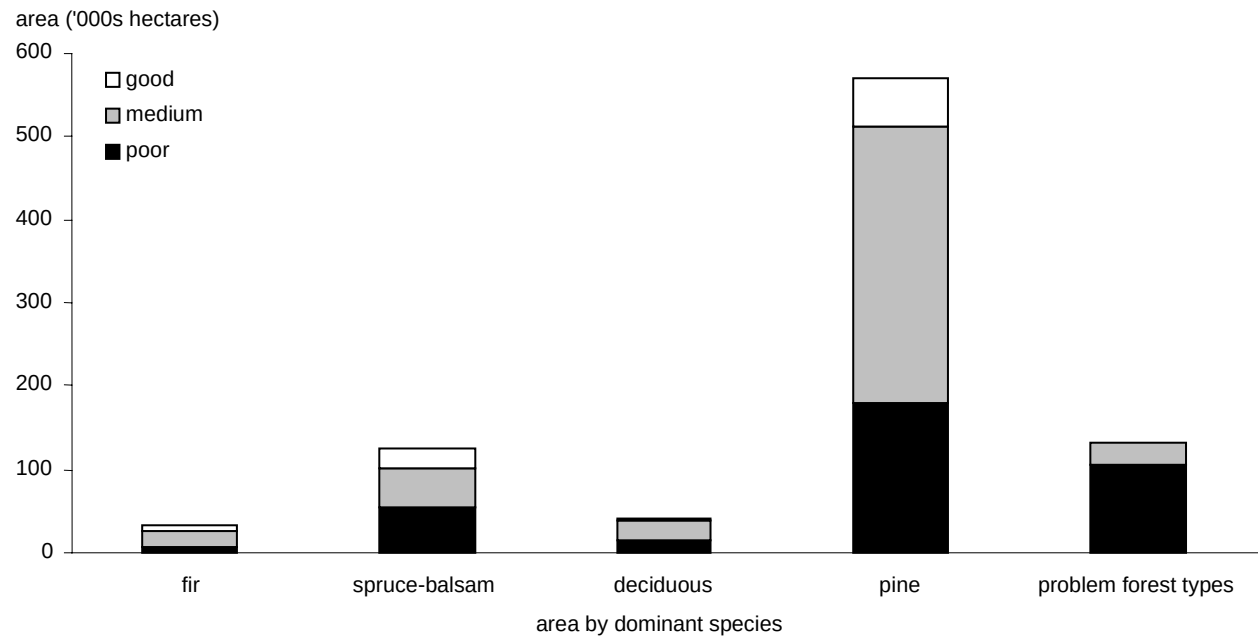


Figure 5. Timber harvesting land base by species and site productivity — Quesnel TSA base case, 2001.

2 Timber Supply Results

Three alternative forecasts examine the timber supply implications of the mountain pine beetle outbreak:

- the worst case scenario – the MPB infestation continues to spread at its current rate of 44%, infesting all susceptible pine stands within 7 years,
- a moderate scenario – the MPB infestation continues to spread at a reduced rate of 35%, infesting all susceptible pine stands within 9 years, and
- the best case scenario – favourable (cold) weather conditions contain the MPB infestation within one year at an estimated 39 000 hectares.

These forecasts assume all the same forest cover requirements are applied (i.e., landscape-level biodiversity, wildlife habitat, VQOs and adjacency requirements) as in the base case. In practice, if the

MPB epidemic continues these requirements may be affected.

Figure 6 shows the worst case scenario, which represents a 44% rate of MPB spread that infests all the susceptible lodgepole pine stands within 7 years. It also assumes that once stands are attacked, they will only be harvestable (at full volume per hectare) for five years. In reality, this is unlikely to occur since it assumes no conditions will occur to limit the spread from its maximum rate due to many factors, mainly the weather. A cold winter in 2001/2002 could significantly reduce the rate of MPB spread. Therefore, this forecast indicates the upper limit of the maximum timber supply impacts. The initial harvest level is 3.34 million cubic metres per year, which is 1.0 million cubic metres per year higher than the current AAC. After 10 years, the harvest level declines to 2 340 000 cubic metres and then reaches the medium-term harvest level of 2 070 000 cubic metres per year for 14 decades.

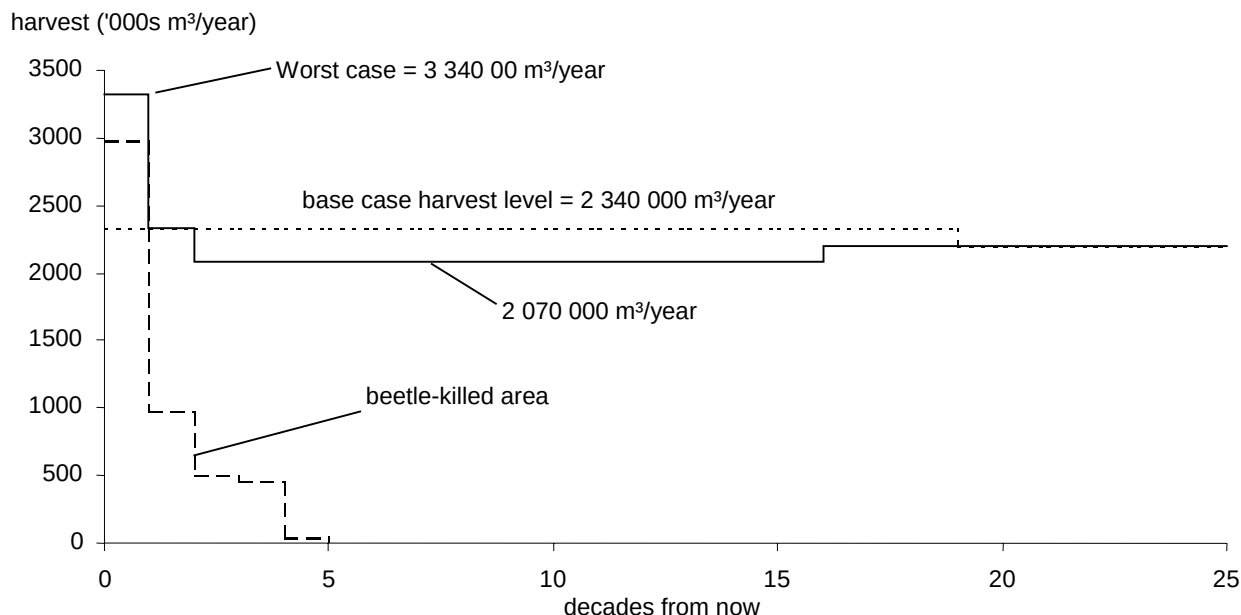


Figure 6. Alternative forecast for worst case due to mountain pine beetle, Quesnel TSA, 2001.

2 Timber Supply Results

Figure 7 shows the best and moderate case scenario's. The best scenario represents favourable (cold) weather conditions that contain the MPB infestation within its current size, and the moderate scenario represents a 35% rate of MPB spread that infests all the susceptible lodgepole pine stands within 9 years. Under the best case scenario, the

1.0 million cubic metre increase would only be required for 10 years and then the harvest forecasts as similar to the base case forecast. The moderate scenario shows a 1.0 million cubic metre increase for one decade and then it declines to a slightly higher medium-term harvest level of 2 120 000 cubic metres per year for 14 decades.

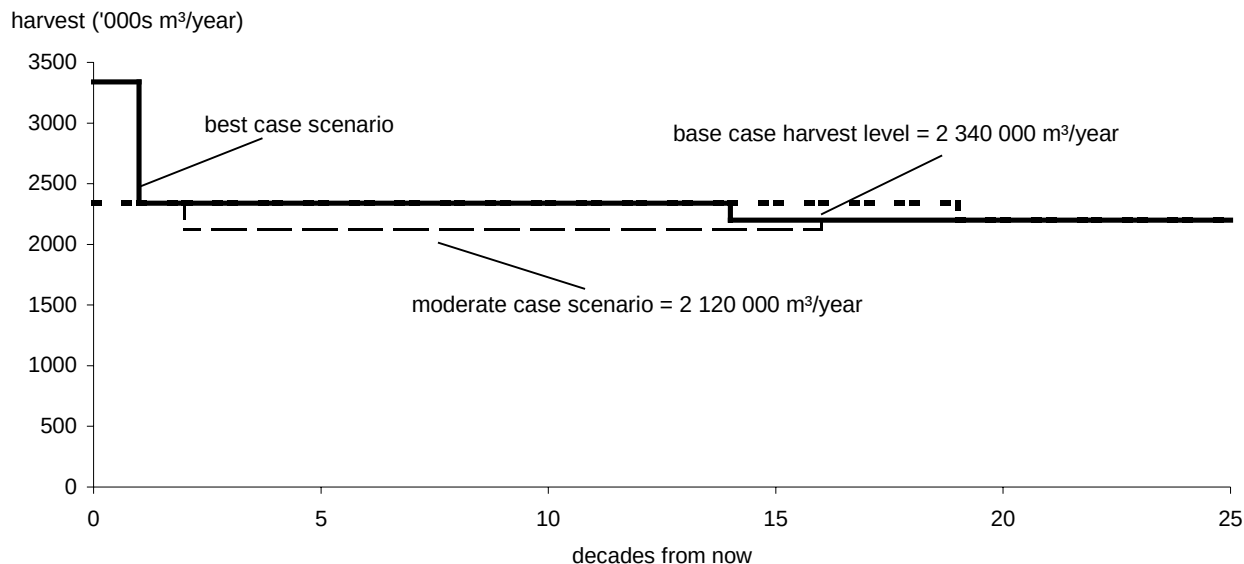


Figure 7. Alternative forecast for best and moderate case due to mountain pine beetle, Quesnel TSA, 2001.

3 Timber Supply Sensitivity Analyses

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

One important way to reduce the risk of this uncertainty is to undertake analyses frequently to ensure they incorporate up-to-date information and knowledge. Frequent reviews can also ensure that opportunities that become apparent from new information are not missed.

Another important way of dealing with uncertainty is to assess how timber supply is impacted if the information and variables used in the analysis are not accurate. Sensitivity analysis is one way of evaluating how uncertainty could affect analysis results, and ultimately decision-making.

Sensitivity analysis can highlight that fairly small uncertainties about some variables could have large effects on timber supply projections, or conversely that fairly large inaccuracies in others could have negligible effects. Also, sensitivity analysis could show that some variables affect timber supply more in the short term than in the long term, while others have the opposite effect.

In this section, results of two sensitivity analyses are discussed. Sensitivity analyses are intended primarily to test the relative change (i.e., high *versus* low sensitivity) in the harvest forecast resulting from changes in forest management assumptions and data used in the base case harvest forecast.

In general, the base case forecast for the Quesnel TSA reflects a timber supply that is stable enough to offset uncertainties about current assumptions regarding forest inventory and forest practices in the short-term

For this analysis, short-term timber supply refers to the first 20 years, medium term refers to 21 to 100 years from now and the long-term timber supply is more than 100 years from now. The short- and medium-term timber supply is defined mostly by existing stand yields and the long-term timber supply is defined by the productivity of managed stands.

3 Timber Supply Sensitivity Analyses

3.1 Uncertainty in the estimated area of the timber harvesting land base

Uncertainty in the estimated size of the timber harvesting land base is due to factors such as fluctuations in timber prices, changes in harvesting and milling technology, and land-use decisions.

Currently it is not possible to assess whether the timber harvesting land base has been over- or

underestimated. A sensitivity analysis was performed to evaluate the outcome of decreasing the timber harvesting land base by 10% and shifting the area to the non-timber harvesting land base.

Figure 8 shows if the timber harvesting land base is 10% smaller there is still sufficient area in older existing stands to support the higher harvest level for two decades. In the medium-term, the harvest level is slightly lower at 1 846 000 cubic metres per year.

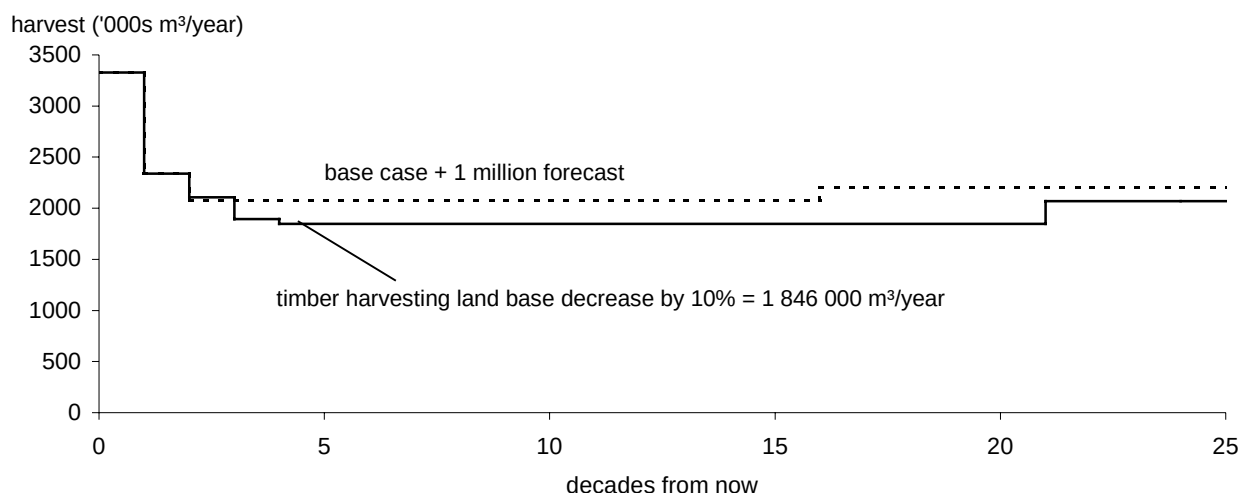


Figure 8. Uncertainty about the size of the timber harvesting land base — Quesnel TSA, 2001.

3 Timber Supply Sensitivity Analyses

3.2 Uncertainty in the estimate of mature stand volume

Timber volume estimates for existing unmanaged stands are subject to uncertainties in the forest inventory used to estimate timber volumes (i.e., estimated tree heights and stand ages), and the statistical process used to develop the equations for predicting forest growth and yield. Timber volumes are normally accurate when averaged over large areas, but may not reflect actual volumes within individual stands. Uncertainty may also arise in the estimates of the volume lost both to decay in older trees, and to waste and breakage during harvest, and of the utilization levels practiced during harvesting.

During the last several years, Resources Inventory Branch has performed audits of the standing volume of trees within TSAs and TFLs*

across the province. These audits provide an indication of how confident we can be that the estimates of volume are close to the actual volumes in the management unit. For the Quesnel TSA, initial indications from the inventory audit were that standing volumes were being overestimated by approximately 11%. Although these findings indicate a trend, the audit was not conclusive and did not provide sufficient evidence to warrant an adjustment of existing stand volumes. A sensitivity analysis (see Figure 9), which examined the risk to timber supply if existing stand volumes are 10% lower shows that the higher harvest forecast can be maintained for three decades, and then it declines to a medium-term harvest level of 1 876 000 cubic metres per year.

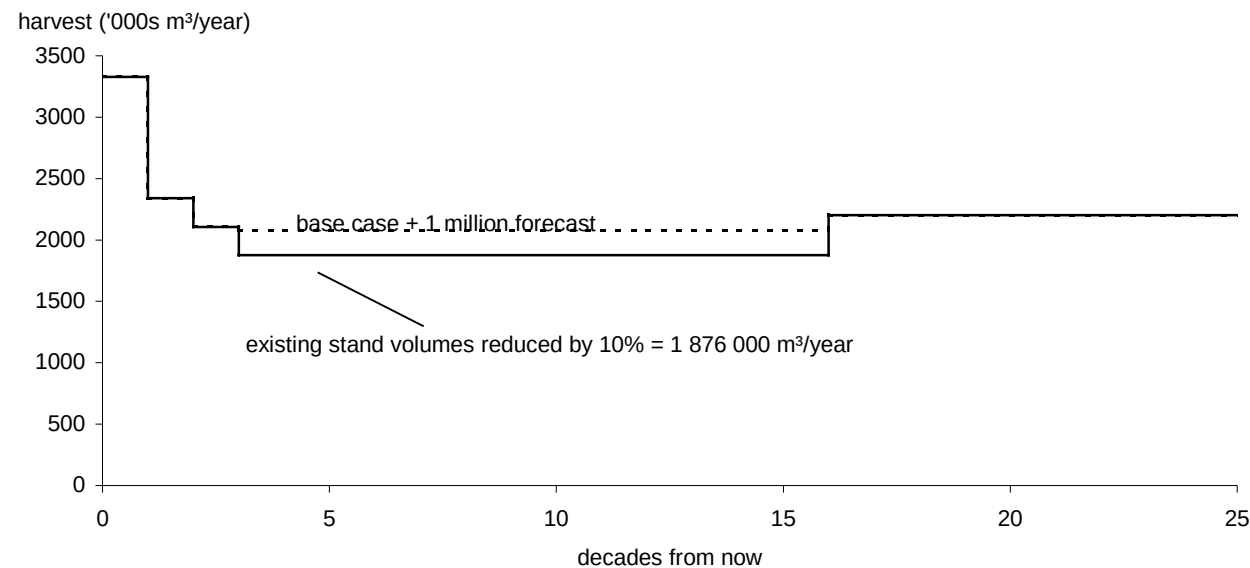


Figure 9. Uncertainty about the estimate of mature stand volume — Quesnel TSA, 2001.

Tree farm licence (TFL)

Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.

4 Social and Economic Information

The major population centre in the timber supply area is the City of Quesnel. Other communities include Wells and Barkerville in the east, and Nazko in the west. The Kluskus Band, the Lhtako-Dene First Nation (Red Bluff Band), Alexandria Band, and the Nazko Band have asserted their traditional territory within the timber supply area. Ten other First Nations communities located outside the timber supply area have asserted their traditional interest within the timber supply area.

According to the 1996 Census, the population of the timber supply area is about 26,000. The City of Quesnel and adjacent communities of Red Bluff, Barlow Creek and Bouchie Lake form the largest populated area with about 8,500 people.

The economy of the Quesnel TSA is not well diversified. Forestry accounts for about 45% of the timber supply area's total employment, making it one of the most forest-dependent areas in the province. Other major sectors in the area are the public sector and tourism.

Forestry employment is supported by harvesting, silviculture activity, and the processing of wood at the major sawmills. These include six major sawmills, two panel mills, two pulp mills and a number of small independent sawmills. In addition, several value-added manufacturing plants are operated, either by the major mills as joint ventures with First Nations companies, or as independent companies.

The forestry sector supports other jobs in the region through companies and employees purchasing goods and services from local businesses. This

spending is another indicator of the role of forestry in the economy. For every 100 direct forestry jobs in the Quesnel timber supply area, another 22 to 84 indirect and induced jobs are supported, depending on the type of forest activity (logging or manufacturing) and the associated level of income. In comparison, every 100 jobs in the public sector or tourism industry supports another 6 to 25 positions.

The socio-economic analysis for the Quesnel TSA indicates that the current AAC of 2 340 000 cubic metres per year can support a provincial total of approximately 1,678 person-years of direct employment. Residents of the Quesnel TSA account for about 90% of this direct employment. Direct forest sector activity in the TSA supports a further 2,246 person-years of indirect and induced employment across the province. The current AAC provides the provincial government with average annual revenues of \$106.4 million.

As shown in the analysis, the base case harvest forecast is the same as the current AAC. Therefore, under this forecast the number of direct, indirect and induced employment in the province would remain unchanged. However, if the current AAC is increased by one million cubic metres per year to 3 340 000 cubic metres per year, this would support an estimated total of 2,395 person-years of direct employment in the forestry sector, and a total of 3,207 person-years of indirect and induced employment in province. If the harvest level is increased, it would provide the provincial government with average annual revenues of \$151.9 million.

5 Summary and Conclusion of the Timber Supply Analysis

The results of this timber supply analysis suggest that the current AAC of 2 340 000 cubic metres per year for the Quesnel TSA could be increased by as much as 1 000 000 cubic metres per year for the next 10 years.

Current assessments of the catastrophic losses due to the mountain pine beetle have shown that the present harvest levels need to be increased to control the spread of the mountain pine beetle, and to recover beetle-attacked lodgepole pine trees. District staff are proposing a management strategy that includes both higher harvesting levels and a continued

requirement that existing harvesting activities be focused on the attacked timber.

The increase in mountain pine beetle populations in conjunction with the presence of a large amount of mature lodgepole pine host material imposes a significant risk on the standing timber inventory of the Quesnel TSA.

The mountain pine beetle epidemic is considered a catastrophic event that requires an urgent timber supply review. The timber supply assessments indicate that current harvest levels are insufficient to enable the proposed management strategy for the MPB epidemic.

Appendix

1 Information Preparation for the Timber Supply Analysis

Much information is required for timber supply analysis. This information can be divided into three general categories: land base inventory; timber growth and yield; and management practices.

1.1 Land base inventory

The various sources of land base information used in this analysis were compiled into one computer file in 1999 by the Ministry of Forests, Quesnel Forest District. This file contains information on the forest land in the Quesnel TSA including general geographic location, area, nature of forest cover (such as number and type of trees, age, and timber volume), and other characteristics such as environmental sensitivity and physical accessibility (operability*). Stand attributes such as tree height, stocking* and age have been projected to 1998. The inventory file has been updated to account for timber harvesting up to 1998.

The inventory file represents the land base for the entire TSA. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur. Examples are land set aside for parks, areas needed to protect wildlife habitat, areas in utility and transportation corridors, and residential and industrial development.

A description of these areas specific to the Quesnel TSA is provided below. These types of areas do not contribute to the timber harvesting land base* of the TSA. Before assessing timber supply, these non-contributing areas are identified and separated from the timber harvesting land base. When deriving this data file, care is taken to make only a single reduction for areas which overlap (for example, where an inoperable area is also wildlife habitat).

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

- not managed by the BCFS — these are non-Crown areas and parks removed from the TSA. The forested portions of parks and reserves (e.g., ecological reserves) contribute towards biodiversity* values.
- non-forest areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies).

Operability

Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.

Stocking

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

Timber harvesting land base

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

Biodiversity (biological diversity)

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

1 Information Preparation for the Timber Supply Analysis

- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- woodlot licence areas — areas classified as issued woodlots are not part of the TSA.
- environmentally sensitive areas* — portions of the areas considered environmentally sensitive and/or significantly valuable for other resources.
- roads, trails and landings — areas of forest land that have been removed from timber production due to access development and harvesting to date.
- sites with low timber productivity — areas occupied by forest with low timber-growing potential.
- non-merchantable and low volume stands — stands which are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability.
- riparian areas* — areas entirely or partially reserved from harvesting to provide protection for riparian and stream ecosystems.
- wildlife tree* patch areas — areas reserved within and along the edges of cutblocks* for the maintenance of stand-level biodiversity* (stand structure), primarily for conservation or enhancement of wildlife.

Environmentally sensitive areas

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

Riparian areas

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

Wildlife tree

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

Cutblock

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

Stand-level biodiversity

A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.

1 Information Preparation for the Timber Supply Analysis

Table 2 summarizes the areas in each category, and shows the area of the timber harvesting land base. The current timber harvesting land base in the Quesnel TSA represents about 63% of the total TSA area and about 78% of the forest area managed by the BCFS.

Table 2. Determination of the timber harvesting land base, Quesnel TSA — 2001

Classification	Reductions to Crown forest by classification (hectares)	Area (hectares)	Per cent (%) of total TSA area	Per cent (%) of Crown forest land
Total TSA area		1 603 111	100.0	
Non-forest		180 989	11.4	
Land not managed by the BCFS		75 932	4.7	
Woodlots (20 456 hectares) and parks (23 957 hectares)		44 413	2.8	
Total Crown productive forest managed by BCFS		1 025 810	81.4	100.0
Reductions to Crown productive forest:				
Non-commercial forest	505	505	< 0.1	< 0.1
Caribou no-harvest zone	71 063	71 026	4.4	5.5
Class-A lakes	2 226	2 206	0.1	0.2
Non-merchantable species	67 787	64 094	4.2	4.9
Environmentally sensitive areas	15 163	8 919	0.9	0.7
Sites with low productivity	16 708	16 667	1.0	1.3
Riparian reserves	30 041	26 602	1.9	2.0
Riparian management zone	17 458	15 787	1.1	1.2
Residual non-merchantable stands	7 876	2 406	0.5	0.2
Current roads, trails and landings	42 252	30 454	2.6	2.3
Wildlife tree patch area	46 296	37 315	2.9	2.9
Additional low-productivity deciduous stands	18 374	14 908	1.1	1.1
Total current reductions	335 749	290 889	20.9	22.3
Current timber harvesting land base		1 010 888	63.1	77.7
Future road reductions		– 14 651	0.9	1.1
Long-term timber harvesting land base		999 327	62.1	76.5

1 Information Preparation for the Timber Supply Analysis

1.2 Timber growth and yield

Two growth and yield models were used to estimate timber volumes for the Quesnel TSA analysis. The variable density yield prediction (VDYP version 6.5a) model developed by the BCFS, Resources Inventory Branch, was used for estimating volumes in unmanaged coniferous* stands and all deciduous stands. The table interpolation program for stand yields (batch TIPSy version 2.1 alpha5), developed by the BCFS, Research Branch was used to estimate yields for coniferous managed stands. Managed stands were defined as all existing planted stands less than 40 years old, and all future planted stands.

Based on timber volume estimates*, the current timber inventory on the timber harvesting land base is approximately 167.4 million cubic metres.

1.3 Current management practices

Timber supply depends directly on how the forest is managed for both timber and non-timber values. Therefore, levels of management activity must be defined for the timber supply analysis process. The *Forest Practices Code of British Columbia Act*, associated regulations, and the *Cariboo-Chilcotin Land Use Plan* guide forest management practices in the Quesnel TSA. Staff in the Quesnel Forest District provided descriptions for the following current management practices **for the purposes of the base case forecast**:

- Silviculture practices — reforestation activities required to establish free-growing* stands of acceptable tree species. Most areas in the Quesnel TSA are harvested using a clearcut harvesting* system and restocked by planting.
- Utilization levels — standard levels specify minimum sizes of trees, and logs to be removed during harvesting.
- Cutblock adjacency* and green-up* — in the Quesnel TSA, approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up (three metres in height in the multiple-use areas), before adjacent stands may be harvested. The purpose of the cutblock adjacency guidelines is to prevent timber harvesting from becoming overly concentrated in an area at any time. These guidelines were modelled by limiting the areas that do not meet green-up conditions to a maximum of 35% in the multiple-use areas within each landscape unit.

Coniferous

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

Volume estimates (yield projections)

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

Free-growing

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

Clearcut harvesting

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

Cutblock adjacency

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

Green-up

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

1 Information Preparation for the Timber Supply Analysis

- Caribou River management area was modelled by ensuring that a maximum of 15% of the forested area is permitted to be less than three metres tall. The purpose of this modelling guideline is to reflect habitat management for moose.
- Northern and Mountain caribou areas were modelled by reflecting partial harvesting. In these areas, harvesting was limited by a maximum volume removal and by requiring 70 to 80 years between harvesting entries.
- Mule deer winter range — guidelines were reflected in the model by selection harvesting with 50 – 80% volume retention with harvesting entries every 30 to 50 years, depending on crown closure.
- Maintenance of scenic values — maintaining important scenic values requires that visible evidence of harvesting be kept within limits in some areas of the Quesnel TSA. These guidelines were modelled by limiting harvesting to a maximum of between 5-15% can be less than five-metres tall.
- Minimum harvestable ages (MHA) — the time it takes for stands to grow to a merchantable condition. The criteria used to define minimum harvestable ages were that all stands should have a volume of at least 150 cubic metres per hectare. Actual harvest age may be greater but not less than the minimum, and will depend on ages of other available stands, forest cover objectives* and overall timber harvest targets.
- Landscape-level biodiversity* — the modelling assumptions are consistent with CCLUP–Biodiversity Conservation Strategy.

The data package for the Quesnel Timber Supply Area (TSA) was released in June 1999. As a result of public input, changes were made to the data package. The revised data package, which includes detailed descriptions of the management practices and the assumptions used to incorporate them into the analysis is available from the Timber Supply Branch, upon request.

1.4 Timber supply analysis methods

A computer simulation model (FSSIM version 3.0) developed by the BCFS was used to assess timber supply in the Quesnel TSA. The simulation model uses information about the timber harvesting land base, timber volumes, and the management regime to represent how trees grow and are harvested over a long period of time. Generally, only the results for the first 250 years are shown graphically in this report because the harvest level remains constant after that time.

This type of analysis is used to determine the timber supply implications of a particular forest management regime. The results of the analysis are especially important in determining harvest levels that will not restrict options of future resource managers, and that will assist local BCFS staff to administer their programs according to relevant guidelines and principles. In addition, due to the recent epidemic mountain pine beetle infestation, the results of the Quesnel timber supply analysis include an examination of alternative harvest flows.

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

Forest cover objectives

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

Landscape-level biodiversity

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

References

- British Columbia Ministry of Forests, Forest Practices Branch. 1998. Procedures for factoring visual resources in timber supply analyses. Victoria, B.C. REC-029.
- British Columbia Ministry of Forests, Timber Supply Branch. 1994. Quesnel TSA Timber Supply Analysis. 81 pp.
- British Columbia Ministry of Forests, Timber Supply Branch. 1995. Quesnel TSA Allowable Annual Cut (AAC) determination. 37 pp.
- British Columbia Ministry of Forests, Timber Supply Branch. 1999. Quesnel TSA Timber Supply Review Data Package. 34 pp.
- Cariboo Lumber Manufacturer's Association and the Northern Forest Products Association. 2000. State of Emergency Declared. 25 pp.
- Forest Practices Code of British Columbia Act. 2000.
- Forest Practices Code of British Columbia Act. 1995. Bark Beetle Management Guidebook.
- Horne, G., R. Riley, L. Ransom, and S. Kosempel. 1996. A provincial impact estimation procedure for the British Columbia forest sector. B.C. Ministry of Finance and Corporate Relations, Victoria, B.C. 40 pp.
- Nigh, Gordon. 1998. Site index adjustments for old-growth stands based on veteran trees. Research Branch. B.C. Ministry of Forests, Victoria, B.C. Working paper 36.
- Nussbaum, Albert. 1998. Site index adjustments for old-growth stands based on paired plots. Research Branch. B.C. Ministry of Forests, Victoria, B.C. Working paper 37.
- Price Waterhouse. 1998. The forest industry in British Columbia. 35 pp.
- Province of British Columbia. 1995. Cariboo-Chilcotin Land Use Plan, Final Report.
- Rankin, Leo and Caputa, Peter. 2000. Aerial Survey and Forest Health Report: 2000. Ministry of Forests. Cariboo Forest Region. 27 pp.

Your Input is Needed

The allowable annual cut is an important determination requiring well-informed and thoughtful public input. Please review the information contained in this document and provide any additional information you feel is important and relevant to this decision. Forest Service staff in the Quesnel office are available to discuss questions or concerns that would help you prepare your input.

You may identify yourself on your response if you wish. If you do, you are reminded that responses will be subject to the *Freedom of Information and Protection of Privacy Act* and may be made public. If the responses are requested, personal identifiers will be removed before the responses are released.

Please mail your comments to the chief forester at the address below. Your comments will be accepted until 4:30 p.m. on March 8, 2001.

A summary of public comments will be available along with the chief forester's allowable annual cut determination when it is announced.

For more information regarding this document, contact:

Gerry Grant, District Manager
B.C. Forest Service
Quesnel Forest District
322 Johnston Ave
Quesnel, B.C. V2J 3M5
Phone: (250) 992-4400
or fax (250) 992-4403

Information Report Response Form

[illegible]

B. The draft data and management assumptions

Please use the space below to provide your comments regarding the draft data and management assumptions contained in this report or other information that you believe should be considered in the determining the AAC for the Quesnel timber supply area.

Name (optional): _____

Address (optional): _____

Mail or fax this form to:

Gerry Grant, District Manager
B.C. Forest Service
Quesnel Forest District
322 Johnston Ave
Quesnel, B.C. V2J 3M5
Phone: (250) 992-4400
fax (250) 992-4403