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**Southern Interior Growth and Yield Co-operative**

**Growth and Yield Issues  
Related to TSR  
(Cariboo Forest Region)**

Prepared for the SIGY Co-op by

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## Preface

This report by Cortex Consultants is intended to serve as the initial foundation for the ongoing development and maintenance of a living document. This document will eventually provide a centralized overview of the status of growth and yield with respect to timber supply for each of the management units in the southern interior. In preparing this document, Cortex was charged with reviewing and compiling information from published timber supply rationales, supplemented with information gleaned from interviews with key players. SIGY will use this report as the basis for continued development over the next several months. As SIGY's Manager, I will pick up where Cortex left off. I will bring the overview up-to-date by identifying recent growth and yield work completed (or underway) since the last determination in each management unit. This work will help me gain greater familiarity with local issues and contribute to the strategic plans of SIGY's member organizations.

The Southern Interior Growth and Yield (SIGY) Co-operative was established under the BC Co op Act in 1999. SIGY currently has 21 members, 20 forest licensees plus the combined resource ministries of the Crown. A true public-private partnership, SIGY's mission is to facilitate and help coordinate the advancement of growth and yield information in support of timber supply in the context of sustainable forest management. SIGY undertakes strategic planning, facilitation, education and communication in support of its mission.

SIGY members support a more integrated, strategic approach to identification and prioritization of growth and yield needs and investments among licensees and ministries. SIGY has been charged with supporting existing strategic initiatives and facilitating the establishment of others where needed. One of SIGY's important contributions in this area is developing and maintaining a summary overview of the growth and yield status of each management unit as it relates to timber supply. This overview is intended to support, not replace, the strategic plans of individual management units. The overview is also meant to serve as a communication tool providing members with a consolidated summary of growth and yield status in the various management units and a better understanding of growth and yield in the context of timber supply.

Member comments, requests for copies, and continued contributions to the information contained in this report should be directed to me. This report will be maintained as a living document accessible to all members.

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## **1.0 Introduction**

### **Timber Supply Review**

In British Columbia, the Provincial Chief Forester determines an Allowable Annual Cut (AAC) for each Timber Supply Area (TSA) and Tree Farm Licence (TFL) every 5 years. The Timber Supply Review (TSR) is the process used by the Ministry of Forests since 1992 to prepare the information on which those determinations are based. Section 8 of the *Forest Act* defines the mandate of the TSR and the many types and sources of information that the Chief Forester is required to consider when determining AACs. A key source of information is the quantification of timber supply through timber supply analysis.

The main objective of the timber supply analysis in TSR is to quantify the short- and long-term timber supply resulting from current forest management and forest practices. The TSR also identifies where improved information is required for future determinations of AAC.

The process used for timber supply analysis is very similar on TSAs and TFLs, the fundamental differences being who carries out the timber supply analysis, and the context in which it is done. For TSAs the timber supply analysis is carried out by the Ministry of Forests, in a process established solely for the purpose of determining AAC. In the case of TFLs the analysis is carried out by the licensee (or a contractor retained by the licensee), as part of the process of preparing the draft Management Plan for the TFL. The approval of the Management Plan by the Chief Forester is also the determination of the AAC.

### **Southern Interior Growth and Yield Cooperative**

The Southern Interior Growth and Yield (SIGY) Co-operative was formed by licensees and the Ministry of Forests to undertake research and extension activities that support maintaining or increasing the AAC in management units of the southern interior portion of the province, which includes the Cariboo, Kamloops, and Nelson Forest Regions. One of SIGY's important contributions in this area is developing and maintaining a summary overview of the growth and yield status of each management unit as it relates to timber supply.

### **Purpose of this Report**

SIGY commissioned the preparation of this report to guide its own business planning. This overview is intended to support, not replace, the strategic plans of individual management units. It is also meant to serve as a communication tool providing SIGY members with a consolidated summary of growth and yield status in the various management units and a better understanding of growth and yield in the context of timber supply.

This report identifies, for each management unit of the southern interior, the types of growth and yield studies that would provide AAC benefits. The report describes the different types of growth and yield information used in TSR timber supply analyses, issues related to their preparation and use, and the relative impact each could have on the AAC in each management unit. Part 2 of this report provides an overview to timber supply and the factors that determine it. Part 3 provides a summary of growth and yield factors and information related to the TSR for each management unit in the Cariboo, Kamloops, and Nelson Forest Regions of the province. Appendix 1 lists all of the management units of the Southern Interior. Appendix 2 contains a glossary of terms related to growth and yield and TSR.

### 3.0 Growth and Yield Issues in Each Management Unit

This section presents the main findings of this study – the most important growth and yield issues for each management unit. The findings are based on reports from a variety of sources, and from interviews of knowledgeable people around the province.

For each of the Forest Regions of the southern interior (Cariboo, Kamloops, and Nelson), a “report card” is presented for each management unit in the Region, summarizing the important growth and yield issues for the unit.

The criteria used to determine the relative importance of each growth and yield issue or factor in each management unit were:

1. Is there evidence of an issue related to a growth and yield factor? For instance, is there evidence that site index is incorrectly estimated?
2. Is the timber supply forecast *directly* sensitive in the short-term to the growth and yield issue (does sensitivity analysis show a direct relationship between the growth and yield issue and short-term timber supply)?
3. Is the timber supply forecast *indirectly* sensitive in the short-term to the growth and yield issue (e.g., is the growth and yield factor an important parameter for other applications that affect the timber supply forecast, or does the factor affect another parameter, such as green-up age, to which timber supply is sensitive)?
4. Is the growth and yield factor important for use in development of dynamic models of nontimber values, especially habitat?

Note that this study is focused on timber supply sensitivity. Growth and yield projects may be important for many different reasons, but the scope of this study is restricted to importance with respect to effects on timber supply forecasts.

### 3.2 Cariboo Forest Region

Cariboo Forest Region includes three TSAs and two TFLs. The Lignum IFPA straddles 100 Mile House and Williams Lake TSAs.

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• 100 Mile House TSA (includes Lignum IFPA)	• TFL 5 (Weldwood)
• Quesnel TSA	• TFL 52 (West Fraser Mills)
• Williams Lake TSA (includes Lignum IFPA)	

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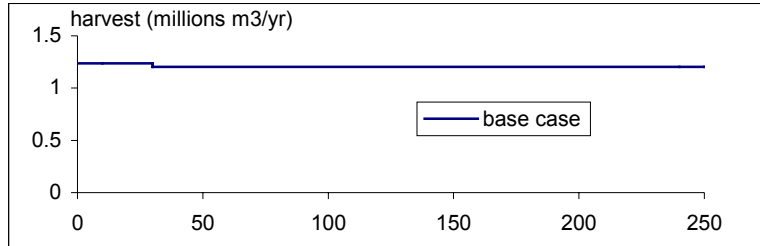


## 100 Mile House TSA (includes Lignum IFPA)

Forest District/Region: 100 Mile House District, Cariboo Region

**Documents reviewed:** Timber Supply Analysis Report (2001), AAC Rationale (2002), Cariboo Forest Region Site Productivity Problem Analysis & Opportunity Assessment (Thrower 2000)

**Base case forecast:**



<b>Land Base Description</b>	AAC = 1 334 000 m <sup>3</sup> /yr
<b>Total TSA Area (ha)</b>	1 220 426 ha
<b>Total productive forest area (ha)</b>	938 421
<b>Current THLB area (ha)</b>	718 429
<b>% Operable</b>	76.6%
<b>Ecological representation</b>	
<b>Species composition</b>	THLB is 55% pine
<b>Age-class distribution</b>	
<b>Other comments</b>	
<b>Site Productivity</b>	applied to non-PA 16 hectares older than 140 yr and under even-aged mgmt, which amounted to 44 800 ha
<b>Species</b>	all
<b>Method</b>	Results from provincial OGSi paired-plot and veteran tree studies were applied. No local data was available, so it was not included in the base case.
<b>Findings</b> (change in average SI value)	There are strong indications that SI is significantly underestimated, which would mean that green-up age and minimum harvest age are too high.
<b>Sensitivity</b>	Short-term harvest is not sensitive to change in SI, green-up age, or MHA.

<b>Inventory Audit Results</b>	Lac La Hache PSYU was inventoried in 1972, updated in 1991, and projected to 1993.  Big Bar PSYU was inventoried in 1975, updated in 1992, and projected to 1993.
<b>Audit date:</b>	2001
<b>Findings</b>	For the whole TSA, the difference between inventory and audit volume estimates was not significant, though almost. For the operable portion (THLB), the difference was statistically significant. Inventory volumes in Big Bar and IDF BEC Zone were shown to be overestimated by 19% and 25% respectively.
<b>Sensitivity</b>	Reducing yields for unmanaged stands in the Big Bar PSYU by 19% resulted in the initial harvest level being maintained for only one decade. From decades 2 to 10 the harvest level is 10% below the base case, and after decade 10, 1.6% below the base case.  Reducing yield for unmanaged stands in the IDF BEC zone by 25% resulted in the initial harvest level being maintained for only one decade. From decades 3 to 10, the harvest level is 15.7% below the base case, and after decade 10, 2.3% below the base case.  In summary, more work is needed to determine whether the volumes from existing stands are accurate across the THLB. If existing volumes are over-estimated to the extent tested in the sensitivity analysis, mid-term harvest levels may be almost 16% lower than shown in the base case forecast.
<b>Utilization Standards</b>	
	12.5 cm dbh minimum for pine-leading stands was used in the analysis, while in practice 10 cm dbh is used. Chief Forester felt that the difference is negligible.
<b>Minimum Harvestable Age</b>	40-120 yr
<b>Method for determining</b>	younger of age at which 65 m <sup>3</sup> /ha is reached, or 80 yr for pine-leading stands and 120 yr for all other stands
<b>Sensitivity</b>	using culmination age as MHA had no short-term effect, and a very small long-term effect on harvest forecast
<b>Green-up age/ requirement</b>	14 yr and 20 yr, depending on LU / max 35%
<b>Method for determining</b>	3 m height
<b>Sensitivity</b>	no short-term sensitivity to either green-up age or area; small long-term sensitivity to reducing maximum area or increasing green-up age
<b>Visual Quality</b>	
<b>Method for determining</b>	
<b>Sensitivity</b>	
<b>Old-growth Age/ Requirement</b>	
<b>Method for determining</b>	
<b>Sensitivity</b>	
<b>Regeneration Delay</b>	3 – 5 years in base case
<b>Method for determining</b>	
<b>Sensitivity</b>	no short-term sensitivity; small long-term sensitivity
<b>Managed Stand Yield Tables</b>	
<b>Yield model used</b>	TIPSY
<b>Issues?</b>	
<b>Sensitivity</b>	No short-term sensitivity

<b>OAFs</b>				
	<b>OAF1</b>	15%		
	<b>OAF2</b>	5%		
<b>Sensitivity</b>				
<b>Selection Silviculture</b>	About 14% of the harvest over the next decade will be through selection system harvesting:			
<b>Silvicultural emphasis</b>	dry-belt Fdi	MDWR low CC%	MDWR high CC%	caribou modified harvest
<b>First-entry cutting intensity (%)</b>	50%	50%	20%	33%
<b>Return interval (yr)</b>	30 yr	30 yr	50 yr	80 yr
<b>Future entries cutting intensity (%)</b>	100% of growth	100% of growth	66% of growth	33% of growth

**Comments:**

This is a robust forecast, with initial harvest level maintained for the first three decades, followed by 2.8% reduction to the LTHL. The only significant issue is the estimates of existing inventory volume – yields for existing stands. However, site index is also very important. Although not critical in this TSA for TSR, good estimates of site productivity are essential for making sound silvicultural investment decisions, strategic silvicultural planning, and habitat modeling. Improvements in site index are needed throughout Cariboo Forest Region, so there is good potential for efficient investment in site index adjustment studies.

**Assessment**

The only significant issue with respect to short-term timber supply is the yield tables for existing stands. The Chief Forester felt (AAC Rationale 2001) that volumes for existing stands could be overestimated, so that short- to mid-term timber supply could be overestimated by up to 11%. Also, the inventory audit suggested that the existing inventory overestimates ages. The Chief Forester urges the Ministry to undertake a vegetation resource inventory (VRI) for this TSA.

However, site index is also very important. Although not critical in this TSA for TSR, good estimates of site productivity are essential for making sound silvicultural investment decisions, strategic silvicultural planning, and habitat modeling. Improvements in site index are needed throughout Cariboo Forest Region, so there is good potential for efficient investment in site index adjustment studies.



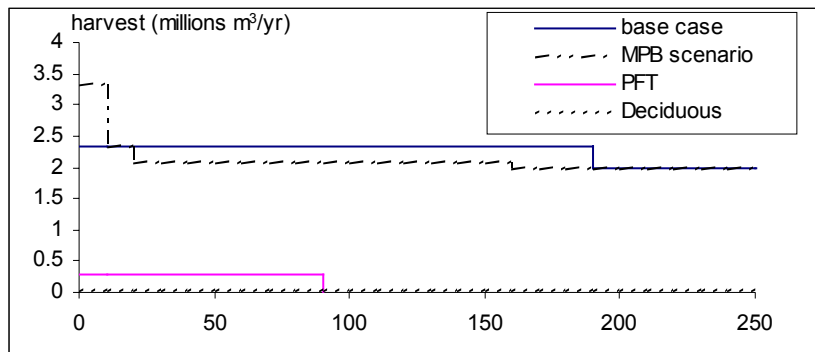
## Quesnel TSA

Forest District/Region: Quesnel Forest District, Cariboo Forest Region

**Documents reviewed:** AAC Rationale (Feb 2001, July 2001); Quesnel TSA Analysis Report and Information for Urgent Allowable Annual Cut (AAC) Increase (2001); Cariboo Forest Region Site Productivity Problem Analysis & Opportunity Assessment (Thrower 2000); Stand Treatments Analysis Timber Supply Analysis Report (Timberline 1998); Letter to District Manager from Quesnel TSA Association (09 Aug 1999).

**Other documents of interest:** Quesnel Forest District VRI Ground Sampling Preliminary Report (December 1997); Problem Forest Type (PFT) Inventory (March 1998); Predictive Ecosystem Mapping Pilot Project for the Cariboo Forest Region (July 2001); Inventory audit for Quesnel (June 1999).

### Base case forecast:



### Land base description

<b>Current AAC (m³/yr)</b>	3 248 000 m³/yr
<b>Total TSA Area (ha)</b>	1 603 111 ha
<b>Total productive forest area (ha)</b>	1 301 777 ha
<b>Current THLB area (ha)</b>	1 010 888 ha
<b>% Operable</b>	77.7%
<b>Ecological representation</b>	SBPS, SBS, MS, ESSF, IDF, ICH (in order of representation)
<b>Species composition</b>	85% pine, 10% spruce, Douglas-fir 3% (AAC Rationale)
<b>Age-class distribution</b>	70% of THLB is older than 80 yr
<b>Other comments</b>	Chief Forester (AAC Rationale 2001) felt that the site index used to identify "low productivity" areas was low enough that it is more likely to have included too much area than excluded too much.

### Site Productivity

<b>Species</b>	n/a
<b>Method</b>	SIBEC
<b>Findings</b> (change in average SI value)	Site indices were not adjusted in the base case, but provincial (not local) SIBEC adjustments were tested in sensitivity analysis. New site index values were assigned to stands younger than 41 yr, and to stands older than 140 yr.  The average site index of stands assigned a new site index value increased by 2.7 m, and the average site index for the whole TSA increased by 1 m.
<b>Sensitivity</b>	It is likely that there is "...an unquantified but substantial underestimation in

projected mid-term and long-term timber supply"			
<b>Inventory Audit Results</b>			
<b>Audit date:</b>	1999		
<b>Findings</b>	The inventory over-estimates mature volume by about 15%. VDYP over-estimates inventory volumes by about 11%.		
<b>Sensitivity</b>	If existing inventory volumes are reduced by 10% then the mid-term harvest level must be reduced by about 120 000 m <sup>3</sup> /yr (about 5%).		
<b>Utilization Standards</b>			
	standard		
	Min dbh (cm)	Max stump height (m)	Min top dib (cm)
pine	12.5	30	10
others	17.5	30	10
<b>Minimum Harvestable Age</b>			
<b>Method for determining</b>	Age at which 150 m <sup>3</sup> /ha is achieved		
<b>Sensitivity</b>			
<b>Green-up Age/ Requirement</b>			
<b>Method for determining</b>			
<b>Sensitivity</b>			
<b>Visual Quality</b>			
<b>Method for determining</b>			
<b>Sensitivity</b>			
<b>Old-growth Age/ Requirement</b>			
<b>Method for determining</b>			
<b>Sensitivity</b>			
<b>Regeneration delay</b>			
<b>Method for determining</b>			
<b>Sensitivity</b>			
<b>Managed Stand Yield Tables</b>			
<b>Yield model used</b>	TIPSY		
<b>Issues?</b>	Regeneration of residual unsalvaged stands after beetle attack		
<b>Sensitivity</b>			
<b>OAFs</b>			
<b>OAF1</b>	15%		
<b>OAF2</b>	5%		
<b>Sensitivity</b>			
<b>Incremental Silviculture</b>			
<b>Treatments used in the MU</b>			
<b>How represented in TS analysis?</b>			

Comments:

It is likely that site index is underestimated in the Quesnel TSA, and that the standing inventory is overestimated. Neither of these issues currently appears to strongly affect the short-term

timber supply forecast, and their individual importance may be diminished because they offset each other to some extent.

Dealing with mountain pine beetle adds significant uncertainty to the otherwise robust timber supply situation in this TSA. Choosing strategies to deal with mountain pine beetle is dominating other considerations. Adjacency requirements are currently being waived to facilitate managing beetle in the short-term. The accelerated levels of harvesting may more significantly affect late mid-term and long-term timber supply than short-term timber supply.

### Assessment

Addressing the problems with site productivity estimates is important in the Quesnel TSA, as it is in all management units of the Cariboo Forest Region. Mountain pine beetle-related harvesting activity and its effect on the timber supply forecast should be frequently assessed. Interaction between expanded harvesting operations and non-timber management objectives may affect timber supply indirectly if the outbreak persists and accelerated harvesting is continued. Nevertheless, timber supply in the Quesnel TSA appears to be very robust in the short-term despite the accelerated levels of harvesting.

There is some concern that current estimates of decay, waster and breakage are too high.

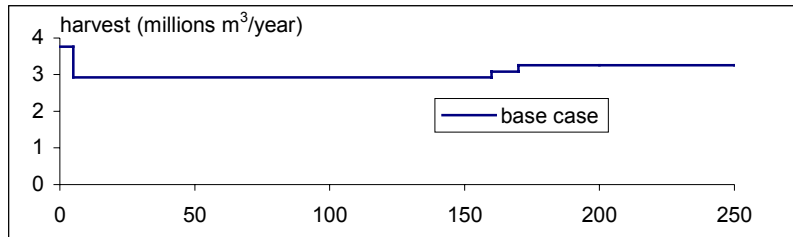


## Williams Lake TSA (includes Lignum IFPA)

Forest District/Region: Williams Lake Forest District, Cariboo Region

**Documents reviewed:** AAC Rationale (2001); TSR Timber Supply Analysis Report (2001); Type 2 Silviculture Analysis Report (Inland Timber Management Ltd. 2000); Cariboo Forest Region Site Productivity Problem Analysis & Opportunity Assessment (Thrower 2000)

**Base case forecast:** This analysis differs from most in having a very high initial harvest level for only 5 years to represent current beetle salvage operations, followed by a significant reduction to the mid-term harvest level.



### Land Base Description

<b>Current AAC (m<sup>3</sup>/yr)</b>	3 807 000 m <sup>3</sup> /yr
<b>Total TSA Area (ha)</b>	4 904 558 ha
<b>Total productive forest area (ha)</b>	3 145 826 ha
<b>Current THLB area (ha)</b>	2 096 251 ha
<b>% Operable</b>	42.7%
<b>Ecological representation</b>	This is a large and diverse unit. The main BEC zones are ESSF, ICH, IDF, MS, SBPS, and SBS. Two thirds of the productive forest is in SBPSxc (29%), MSxv (16%), IDFdk4 (12%) and IDFdk3 (9%).
<b>Species composition</b>	THLB composition: 67% pine-leading stands; most of the pine stands are in Chilcotin Forest District, while most of the Douglas-fir stands are in the Williams Lake F.D. , and most of the spruce stands are in the Horsefly F.D.
<b>Age-class distribution</b>	Very few stands are older than 250 yr. About 78% of the volume on the THLB in stands older than minimum harvestable age.  13% of the THLB is considered to be existing managed forest (younger than 34 yr in the main TSA, younger than 20 yr in the western supply blocks)
<b>Other comments</b>	Mountain pine beetle (MPB) is a very significant issue.  The current THLB is about 430 000 ha larger (26%) than used in TSR 1, mostly due to the use of merchantability limits to define operability rather than broad descriptive classes (e.g., PFT).

### Defining merchantability

<b>Method of determining</b>	In general, stands had to be able to yield a minimum sawlog volume of 65 m <sup>3</sup> /ha
<b>Sensitivity</b>	When the volume threshold was changed to 100 m <sup>3</sup> /ha, the size of the THLB was reduced by 9%, which reduced mid- and long-term timber supply by 6%.

**Site Productivity**

<b>Species</b>	Pine and spruce (species managed with even-aged systems)
<b>Method</b>	OGSI paired-plot results were applied to stands older than 140 yr.
<b>Findings</b> (change in average SI value)	Applying OGSI paired plot adjustments to stands older than 140 yr (pine and spruce) increased average site index of those stands by 6.5 m, and of the entire THLB by 2 m.
<b>Sensitivity</b>	Applying OGSI adjustments to pine and spruce stands older than 140 yr increased mid-term timber supply by 10%, and long-term timber supply by 26%.  Also applying the OGSI veteran study adjustments to other species older than 140 yr increased long-term harvest level by an additional 100 000 m <sup>3</sup> /yr.

**Inventory Audit Results**

<b>Audit date:</b>	1998; subsequent reanalysis by Steve Smith for Resources Inventory Branch.
<b>Findings</b>	Inventory may overestimate existing volumes. There was a 12% difference between average ground-measured volume and the average inventory volume estimate adjusted for mountain pine beetle disturbance history information, for all timber types in the Williams Lake TSA.
<b>Base case adjustment</b>	Draft volume adjustment factors were applied to stands 60 yr and older in the base case.
<b>Sensitivity</b>	When existing natural stand yields were increased/decreased by 10%, mid-term timber supply increased/decreased by 8% and 7% respectively.  Applying a corrected volume adjustment factor to existing natural pine stands not in the IDF or SBPS BEC zones increased mid-term timber supply by 2%.

**Utilization Standards**

	Min dbh (cm)	Max stump height (m)	Min top dib (cm)
pine	12.5	30	10
all other species	17.5	30	10
PA 16 types	12.5	30	10

**Minimum Harvestable Age**

<b>Method for determining</b>	age at which specified minimum height or volume are achieved		
	Analysis Unit	Minimum volume (m <sup>3</sup> /ha)	Minimum height (m)
	pine stands	65	Williams L, Horsefly - 15 Chilcotin - 13
	MPB-attacked pine with < 65 m <sup>3</sup> /ha	40	13
	all other conifers	65	17
	deciduous (PA 16)	65	17

**Sensitivity** The results of this sensitivity analysis are difficult to interpret. The sensitivity analysis did not clearly quantify the significance of MHA on short-term harvest.

**Green-up Age/ Requirement**

<b>Method for determining</b>	normal approaches
<b>Sensitivity</b>	small mid-term sensitivity, no long-term sensitivity

**Visual Quality**

<b>Method for determining</b>	
<b>Sensitivity</b>	

<b>Old-growth Age/ Requirement</b>				
<b>Method for determining</b>				
<b>Sensitivity</b>				
<b>Regeneration Delay</b>	2 yr, 4 yr for natural and planted stands respectively			
<b>Method for determining</b>				
<b>Sensitivity</b>				
<b>Managed Stand Yield Tables</b>				
<b>Yield model used</b>	TIPSY			
<b>Issues?</b>	Existing managed stands were assumed to be those with age of 34 yr or less in main TSA, and 20 yr or less in western supply blocks.			
<b>Sensitivity</b>	Proportional increase or decrease in LTHL.			
<b>OAFs</b>				
<b>OAF1</b>	12%			
<b>OAF2</b>	5%			
<b>Sensitivity</b>				
<b>Selection Silviculture</b>	<b>About 19% of the THLB is managed under selection system, and selection or partial harvesting contributes 300 000 to 400 000 m<sup>3</sup>/year.</b>			
<b>Silvicultural emphasis</b>	Normal selection	MDWR selection and VQO-R	Terrestrial lichen sites	Arboreal lichen sites
<b>First-entry cutting intensity (%)</b>	50	20	50	33
<b>Return interval (yr)</b>	30	50	70	80
<b>Future entries cutting intensity (%)</b>	same	same	same	same
<b>Incremental Silviculture</b>				
<b>Treatments used in the MU</b>				
<b>How represented in TS analysis?</b>				

Comments:

Important issues in this unit are:

1. MPB—given the potential volatility of the beetle outbreak, modeling development of stands affected by beetle attack, and beetle-attacked stands harvested with some partial-cutting system is very important.
2. Site productivity estimates—significant potential to increase late short-term, and mid-term yields; preponderance of pine has large potential for current site index estimates to be low.
3. Selection management—significant, especially for management of Douglas-fir and in Williams Lake Forest District; requires investment in modeling yields (and estimating site productivity) for selection silviculture systems, and representing yields in timber supply analysis.

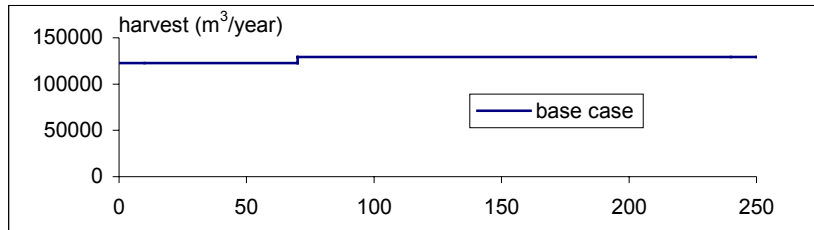


## TFL 5 (Weldwood)

Forest District/Region: Quesnel Forest District, Cariboo Forest Region

Documents reviewed: AAC Rationale (1997), Type 1 Silviculture Analysis Report (2000)

### Base case forecast:



### Land base description

<b>Current AAC (m³/yr)</b>	122 800 m³/yr (incl. SBFEP at 5454 m³/yr, and deciduous harvest of 1500 m³/yr)
<b>Total TFL Area (ha)</b>	34 447 ha
<b>Total productive forest area (ha)</b>	32 907 ha
<b>Current THLB area (ha)</b>	30 100 ha
<b>% Operable</b>	91%
<b>Ecological representation</b>	SBSmw (82% THLB), SBSmh (18% THLB)
<b>Species composition</b>	40% Douglas-fir, 26% spruce, 25% pine, and 9% other species
<b>Age-class distribution</b>	One third of the area is in stands younger than 45 years, mainly regenerated after harvesting. Twenty-two % of the area is older than 140 yr. Shortage of area between 30 and 60 years old.
<b>Timber Supply Forecast</b>	The forecast is robust, with initial harvest level maintained until the seventh decade, when it increases by 5% to the LTHL.
<b>Other comments</b>	70% of the TFL is in the Lower Blackwater Special Resource Development Zone of the CCLUP. It has high value for wildlife, and mule deer winter range in particular.  Current management is a "clearcut with reserves" harvesting system.

### Site Productivity

<b>Species</b>	
<b>Method</b>	Site indexes were assigned on the basis of BEC system site series mapping, productivity groups, and leading species, from data collected by the licensee.
<b>Findings</b> (change in average SI value)	
<b>Sensitivity</b>	Adjustments were incorporated in the base case.
<b>Eco-mapping status</b>	
<b>Recent Strategy and Projects</b>	

<b>Inventory Audit Results</b>	The most recent inventory was completed in 1985, updated in 1995
<b>Audit date</b>	1995
<b>Findings</b>	Volume estimates were reasonable.
<b>Base case adjustment</b>	
<b>Sensitivity</b>	

<b>Utilization Standards</b>			
	Min dbh (cm)	Max stump height (m)	Min top dib (cm)
pine	12.5	30	10
others	17.5	30	10
DWB factors	Standard DWB procedures and factors were used.		
<b>Minimum Harvestable Age</b>			
	60 to 120 yr		
<b>Method for determining</b>	age of MAI culmination		
<b>Sensitivity</b>	Establishing MHA as the age at which minimum volume of 180 m <sup>3</sup> /ha is reached, results in a lower average MHA. In sensitivity analysis this increased short-term harvest level by about 5%, and reduced LTHL by 7%. Increasing MHA reduced short term harvest level by 10%, with no change in the LTHL.		
<b>Green-up Age/ Requirement</b>			
	3 m/ max 33% in IRM, max 25% in other zones		
<b>Method for determining</b>	based on Quesnel District development plan evaluation criteria, Wildlife Plan, MDWR requirements		
<b>Sensitivity</b>	not sensitive		
<b>Visual Quality</b>			
<b>Method for determining</b>			
<b>Sensitivity</b>			
<b>Old-growth Age/ Requirement</b>			
<b>Method for determining</b>			
<b>Sensitivity</b>			
<b>Regeneration Delay</b>			
	2 yr		
<b>Method for determining</b>	current operational experience		
<b>Sensitivity</b>	no short-term sensitivity		
<b>Managed Stand Yield Tables</b>			
	Current management is a "clearcut with reserves" harvesting system.		
<b>Yield model used</b>	TIPSY		
<b>Issues?</b>	none		
<b>Sensitivity</b>			
<b>OAFs</b>			
	<b>OAF1</b>	15%	
	<b>OAF2</b>	5%	
<b>Sensitivity</b>			
<b>Incremental Silviculture</b>			
<b>Treatments used in the MU</b>	For the last 10 years, the licensee has been trying to improve long-term productivity of managed stands by using conifer release, juvenile spacing, planting, brushing and weeding and vegetation management.		
<b>How represented in TS analysis?</b>	Base case included genetic gain (4.3% increase) in yield tables for post-1987 stands. Tested "Enhanced Silviculture Option", which included:		
	<ul style="list-style-type: none"> <li>• converting 546 ha of deciduous that were previously outside the THLB (regenerate to coniferous after harvesting)</li> <li>• - fertilizing and juvenile spacing all Fdi and Pli</li> </ul>		
<b>Sensitivity</b>	8% increase in mid-term and long-term timber supply		

**Comments:**

Timber supply is robust. It may be possible to increase the short-term harvest level by re-defining minimum harvestable age based on a minimum volume/ha criterion instead of culmination age.

**Assessment**

There is little short-term timber supply pressure on this management unit, and it would seem no urgent growth and yield issues.

The main areas of concern should be improving the OAFs used to produce managed-stand yield tables, and refining the estimates of site productivity already based on site series mapping. Both of these are very important for any planning and analysis of silvicultural investments.



## TFL 52 (West Fraser Mills)

Forest District/Region Quesnel Forest District, Cariboo Forest Region

The information in this summary is based on MP #3, and was provided by Earl Spielman, West Fraser Mills. No base case forecast was available at the time.

**Documents reviewed:** Management Plan #3 (2000); AAC Rationale (December 1996); no silviculture strategies available

**Other reports of interest:** Cariboo Forest Region Site Productivity Problem Analysis & Opportunity Assessment (Thrower 2000); Quesnel Forest District VRI Ground Sampling Preliminary Report (December 1997); Problem Forest Type (PFT) Inventory (March 1998); Predictive Ecosystem Mapping Pilot Project for the Cariboo Forest Region (July 2001)

**Base case forecast:**

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<b>Land Base Description</b>	
<b>Current AAC (m<sup>3</sup>/yr)</b>	549 000 m <sup>3</sup> /yr, Base case recommendation- 596 900 m <sup>3</sup> /yr
<b>Total TFL Area (ha)</b>	258 866 ha
<b>Total productive forest area (ha)</b>	235 023 ha
<b>Current THLB area (ha)</b>	188 177 ha
<b>% Operable</b>	80%
<b>Ecological representation</b>	Mainly SBS, ESSF, with very small area of ICH
<b>Species composition</b>	Mainly spruce (50%), and pine (40%), with balsam, fir, and aspen making up the remainder.
<b>Age-class distribution</b>	42% of TFL is older than 120 yr; 26% is younger than 41 yr
<b>Other comments</b>	

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<b>Defining Merchantability</b>	2695 ha of "low productivity sites" were excluded from the THLB
<b>Method of determining</b>	Stands currently than 30 yrs and older that will have less than 120 m <sup>3</sup> /ha at age 150 yr.
<b>Sensitivity</b>	No sensitivity analysis.

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<b>Site Productivity</b>	See Thrower (2000)
<b>Species</b>	New site index estimates for pine, spruce; conversions for balsam, Douglas-fir.
<b>Method</b>	Balsam and Douglas-fir estimates were developed from MoF site index conversion equations using the new site index estimates for pine and spruce.
<b>Findings</b> (change in average SI value)	Average SI increased from approximately 15.1 m to 18.8 m (all species) on the TFL's productive forest area.
<b>Sensitivity</b>	Reduce managed stand yields by 10%- results in a decline of 1% and 10% in the initial and long-term harvest levels.  Reduce managed stand yields by 40%- results in a decline of 3% and 40% in the initial and long-term harvest levels.  Increases to managed stand site indices and yields have helped minimize the impacts of the Cariboo Chilcotin Land Use Plan (CCLUP) forest cover constraints on TFL 52's timber supply.
<b>Eco-mapping status</b>	Predictive Ecosystem Mapping Pilot Project for the Cariboo Forest Region (July 2001).  TEM used to determine OAF1's used in TIPSYS.

**Recent Strategy and Projects**

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<b>Inventory Audit Results</b>	The existing inventory is based on surveys done in 1967-69 for about 2/3 of the unit, with a more recent reinventory conducted in 1988 for about 1/3 of the TFL.  Inventory updates for growth and depletion were done up to 1994.  Vegetation Resource Inventory completed in 2000.
<b>Audit date:</b>	1995
<b>Findings</b>	The MoF audit plots were recompiled based on the TFL's new VRI inventory.  There were no significant differences (i.e. attribute bias) between the VDYP estimates using either the MOF audit – ground sample data or the new VRI inventory attributes data.  A significant model bias of 10% was found between the VDYP estimate and the cruise compilation estimate using the MOF audit – ground sample data.
<b>Base case adjustment</b>	
<b>Sensitivity</b>	

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<b>Utilization Standards</b>			
	Min dbh (cm)	Max stump height (cm)	Min top dib (cm)
pine	12.5	30	10
other species	17.5	30	10

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<b>Minimum Harvestable Age</b>	
<b>Method for determining</b>	Age of MAI culmination, taken to be the youngest age when MAI increases by less than 0.05 m <sup>3</sup> /ha/yr
<b>Sensitivity</b>	

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<b>Green-Up Age/ Requirement</b>	
<b>Method for determining</b>	A 3.0 metre green-up period derived from the future managed stand height growth curves.
<b>Sensitivity</b>	Green-up requirements adjusted by 1.0 metre (to 2.0 and 4.0 m) in VQO and general Integrated Resource Management (IRM) REAs resulted in only a 1.0% difference in the harvest during the planning horizon.

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<b>Visual Quality</b>	
<b>Method for determining</b>	A 3.0 metre green-up period derived from the future managed stand height growth curves.

**Sensitivity** Reducing the maximum disturbance rate by as much as 10% lowered the short-term harvest by 6.0% and long-term harvest by 3.0%.  
 Increasing the maximum disturbance rate by as much as 10% increased the short term harvest by 2.0% and had almost no impact on the long-term harvest.

**Old-Growth Age/ Requirement**

**Method for determining** Allowing a minimum area within a REA that must be older than a specified age of 250 years.

**Sensitivity** Old age was reduced from 250 years to 200 years in the Natural Disturbance Types (NDT) 1 and 2, which increased the initial short-term harvest by 7.0%.  
 Intermediate and high biodiversity constraints were assigned to Landscape Units (LU) with the highest non-timber constraints (Special Resource Emphasis Zone (SRDZ)) while, Enhanced Resource Development Zones (ERDZ) were assigned low biodiversity constraints. Shifting the draft biodiversity emphasis to SRDZ LUs increased the initial harvest by 6.0% over the base case.

**Regeneration Delay** 2 yr

**Method for determining** Operational experience.

**Sensitivity** Sensitivity analysis involved increasing regeneration delay to 4 yr and decreasing it to 0 yr. The short-term harvest is not affected by changing regeneration delay. Lowering regeneration delay to 0 yr increases LTHL by 4.0% while, raising the regeneration delay to 4 yr decreases the LTHL by 4.0%.

**Managed Stand Yield Tables**

**Yield model used** TIPS Y

- Issues?**
- 1) Establish monitoring program to validate managed stand yields.
  - 2) Need to do additional site index sampling on high elevation sites (ESSFwk & wc3) to further refine site index elevation model.
  - 3) The genetic gains from planting Vernon Seed Orchard Company (VSOC) A-seed were incorporated in the MP #3 MSYTs. These estimates were based on preliminary MOF estimates: Fd 5.0%, PI 5.0%, and Sx 8.0%. New genetic worth information obtained from MoF Research Branch (TICtalk 2001) and Seed Planning and Registry System (SPAR) will be used in the development of MSYTs for MP #4: Fd 19.0%, PI 8.0% and Sx 18.0%.
  - 4) Silviculture type 2 analysis to evaluate impacts of high density plantations on TFL 52's short and long term harvest levels (i.e., optimization modelling using Woodstock).

**Sensitivity** Reducing managed stand yields by 10% resulted in a decline of 1% and 10% in the initial and long-term harvest levels.  
 Reducing managed stand yields by 40% resulted in a decline of 3% and 40% in the initial and long-term harvest levels.

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**OAFs**

<b>OAF1</b>	Based on TEM:	
	Subzone Variant	Average OAF1
	ESSFwc3	16.4%
	ESSFwcp	100.0%
	ESSFwk1	9.7%
	ICHmk3	8.5%
	ICHwk4	7.5%
	SBSdw1	12.5%
	SBSmh	8.6%
	SBSmw	10.0%
	SBSwk1	10.7%

**OAF2** 5%

**Sensitivity** A sensitivity analysis was done by reducing managed stand yields by 10%, which resulted in a decline of 1% and 10% in the initial and long-term harvest levels.

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**Selection Silviculture**

**Silvicultural emphasis** Visually constrained areas will be harvested with smaller clearcuts. Harvesting in the Caribou Zone is generally clearcut with reserves. A pilot study in the Mt Tom – Caribou Zone will use some group selection to evaluate the impact of alternative harvesting practices on high elevation Caribou areas.

**First-entry cutting intensity (%)**

**Return interval (yr)**

**Future entries cutting intensity (%)**

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**Incremental Silviculture**

**Treatments used in the MU** High density plantations, spacing, A-seed planting, site preparation (mechanical, broadcast burning), and herbicide treatments.

**How represented in TS analysis?** Only high planting densities, spacing and A-seed were represented in the analysis.

- 1) Planting spruce A-seed on suitable variants/site series has been 100% operational since 1998. The only exception is the ESSFwc3 subzone/variant. Similarly, planting of A-seed Fd and PI on all suitable variants/site series will be 100% operational by 2005. The genetic gains from planting Vernon Seed Orchard Company (VSOC) A-seed were incorporated in the MP #3 MSYTs. These estimates were based on preliminary MOF estimates: Fd 5.0%, PI 5.0%, and Sx 8.0%. New genetic worth information obtained from MoF Research Branch (TICtalk 2001) and Seed Planning and Registry System (SPAR) will be used in the development of managed yield tables for MP #4: Fd 19.0%, PI 8.0% and Sx 18.0%.
- 2) High density plantations were included in the development of MSYTs.
- 3) BEC variants/site series requiring spacing were identified by operational staff and this information was incorporated into the MSYTs (i.e. Approximately 10% for each BEC variant/site series.)

**Rehabilitation of residual balsam** Approximately 11 232 ha of residual balsam (*A. lasiocarpa*) left after harvesting between the 1950s and 1970s. Surveys show approximately 30% of this area is in need of silviculture treatment—mainly salvage harvesting or site rehabilitation.

**timber supply impact** A significant portion of this balsam IU (5,318 ha) has been excluded from the THLB as non-merchantable and balsam IU stands.

Including this area in the THLB increases the initial harvest by 2.0% while, the long-term harvest is almost the same as the base case. VDYP natural stand

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yield tables developed by J.S. Thrower and associates Ltd are applied to all balsam IU not excluded from the THLB for the base case. These yield curves are also assigned to the balsam IU area added for the sensitivity analysis.

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**Comments:**

At the last TSR the timber supply forecast appeared to be very resilient, even in the face of land use planning requirements that might result from the CCLUP. There does not appear to be timber supply pressure on this management unit, unless it comes from mountain pine beetle, which could change the outlook dramatically.

**Assessment**

Growth and yield priorities for TFL 52 are to:

- continue work improving estimates of site index, particularly in high elevation sites of the ESSFwk and wc3,
- survey or otherwise confirm condition of the area of 1950's - 1970's vintage residual balsam IU that has been netted out of the THLB.



## Appendix 1 Management units of the Southern Interior

<b>Cariboo Forest Region</b>	<b>Kamloops Forest Region</b>	<b>Nelson Forest Region</b>
100 Mile House TSA (Lignum IFPA)	Kamloops TSA (Adams Lake IFPA)	Arrow TSA (Arrow IFPA)
Quesnel TSA	Lillooet TSA	Boundary TSA
Williams Lake TSA (Lignum IFPA)	Merritt TSA (Merritt IFPA)	Cranbrook TSA
TFL 5 (Weldwood)	Okanagan TSA (Okanagan IFPA)	Golden TSA
TFL 52 (West Fraser)	TFL 15 (Weyerhaeuser)	Invermere TSA
	TFL 18 (Slocan)	Kootenay
	TFL 33 (Federated Co-ops)	Revelstoke TSA
	TFL 35 (Weyerhaeuser)	TFL 8 (Pope & Talbot)
	TFL 49 (Riverside)	TFL 3 (Slocan)
		TFL 14 (Tembec)
		TFL 23 (Pope and Talbot)
		TFL 55 (Louisiana-Pacific)
		TFL 56 (Revelstoke Community Forest)

## Appendix 2 Glossary

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<b>Allometry</b>	The growth of part of an organism relative to the entire organism; the measurement and study of such growth.
<b>Allowable annual cut (AAC)</b>	The rate of timber harvesting permitted each year 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 8 of the Forest Act.
<b>Analysis unit</b>	A grouping of forest types for use in timber supply analysis. Usually based on some combination of species composition, site productivity, silvicultural regime, and or geographic location.
<b>BEC method (of estimating site index)</b>	See SIBEC method.
<b>Direct methods (of estimating site index)</b>	Any of the site index estimation methods that require tree measurements.
<b>Destructive sampling</b>	Sampling that requires falling and sectioning trees.
<b>FSSIM</b>	The Forest Service Simulator, a timber supply analysis model developed by the MOF Timber Supply Branch for use in TSR.
<b>Growth intercept method (of estimating site index)</b>	A direct method of estimating site index from the height and age of carefully selected site trees. The growth intercept (GI) method uses 5-year height growth above DBH. Site index is then obtained from a look-up table. This method is best used on stands that have between 3 and 30 years growth above breast height. (See also BEC method and site index curve method.)
<b>Growth and yield model</b>	A model that predicts growth over time and the resulting yields at various points in time.
<b>Harvest schedule</b>	A schedule of hectares to be harvested by time period (e.g., decade), specifying treatment type, area, and amount of harvesting and regeneration treatments to be implemented throughout the planning horizon.
<b>Height-age models</b>	Models that estimate height as a function of site index and age (and are commonly used to estimate site index from height and age).
<b>Indirect methods (of estimating site index)</b>	Any of the site index estimation methods that do not require direct tree measurements. Mainly SIBEC and SIA.
<b>Managed-stand yield table</b>	A yield table representing the yields from managed stands, for use in timber supply analysis.
<b>Meta-model</b>	A model derived from the output of another model.
<b>MGM</b>	Mixedwood Growth Model— An individual-tree, distance independent model for boreal mixedwoods being developed by the University of Alberta. Northern licensees and the ministries have assisted development work in BC.
<b>Natural-stand yield table</b>	A yield table representing the yields from naturally established (usually existing) stands, for use in timber supply analysis.
<b>Operational Adjustment Factors (OAF) for TASS/TIPSY</b>	For timber supply analysis, adjustments are required to reduce TIPSY (TASS) yields to reflect expectations under normal, sub-optimal field conditions. Unadjusted TASS (TIPSY) yields are intentionally set to reflect operational “potential” under ideal field conditions, i.e., with complete stocking and minimal growth losses from insects, diseases, brush competition, etc. Refer to TIPSY’s HELP files.
<b>OASIS</b>	OASIS is the operational adjustment to site index study piloted on the Bulkley TSA. A non-spatial technique for applying SIBEC estimates, it does not require PEM or TEM.
<b>OGSI</b>	Old-Growth Site Index (OGSI) refers to data collection procedures for paired plots, and relocation and remeasurement of logged temporary sample plots. The OGSI procedure is used to adjust the site index value assigned to post-harvest regenerated stands based on estimates from the preceding old-growth stand. OGSI adjustments are derived from pairs of site index plots established in old-growth stands and adjacent second-growth stands of the same inherent productivity, hence the name “paired plot”.
<b>Paired Plot</b>	OGSI adjustments are derived from pairs of site index plots established in old-growth stands and adjacent second-growth stands of the same inherent productivity.
<b>PEM</b>	Predictive Ecosystem Mapping – one of two mapping methods used in BC to provide

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	spatial linkage of SIBEC/SIA to the inventory in timber supply analysis. Also see TEM.
<b>PrognosisBC</b>	The BC version of the Forest Vegetation Simulator (FVS). It is an individual-tree, distance independent model intended for application in multi-spp and/or uneven-age conditions, including partial cutting, in the southern interior.
<b>Sensitivity analysis</b>	A modeling technique used to explore a problem by testing the sensitivity of the solution to changes in inputs. In timber supply analysis it involves changing the value of a model parameter (e.g., minimum harvestable age), and then measuring the effect of that change on the harvest forecast.
<b>SIA</b>	A three-phase procedure for obtaining site index estimates, involving preliminary estimates, field-sample based "actual" estimates, and statistical adjustment of the preliminary estimates.
<b>SIBEC</b>	Site index-biogeoclimatic ecosystem classification. SIBEC is a method to predict site index using site series of the biogeoclimatic ecosystem classification. This method is intended for use in very young stands, very old stands, and stands not suitable for other methods. (See also growth intercept method and site index curve method.)
<b>Site index</b>	A measure of forest site productivity expressed as the average height of <i>top height</i> trees of a given species at age 50 years (breast height age).
<b>Site index curve method (of estimating site index)</b>	A site index prediction method that uses the height and age of carefully selected sample trees measured on-site. Site index is then obtained from a look-up table. This method is best used on stands that have between 30 and 140 years growth above breast height. (See also BEC method and growth intercept method.)
<b>Site tree</b>	A tree measured for height and age for use in estimating site index from site index curves.
<b>SORTIE</b>	SORTIE is a light-driven ecological gap model, focused on predicting natural regeneration under various levels of ground and canopy disturbance. Work is underway to develop a version for the northern ICH.
<b>Species conversion table</b>	A table used to predict the site index for one species from the site index measured on a different species on the same site.
<b>SPS</b>	Stand Projection System--an individual-tree, distance independent model in the private domain. Different versions are currently supported by three consulting companies in BC and the USA.
<b>Stand yield model</b>	A model predicting only yield at various points in time. In contrast to a growth and yield model, it lacks actual growth components.
<b>Stem analysis data</b>	The data from destructively sampling trees.
<b>TASS</b>	Tree and Stand Simulator-- an individual-tree, distance-dependent model used mainly to produce yield tables for single-species, even-aged managed stands. See TIPSYP.
<b>TEM</b>	Terrestrial Ecosystem Mapping-- one of two mapping methods used in BC to provide spatial linkage of SIBEC/SIA to the inventory in timber supply analysis. Also see PEM.
<b>Timber supply</b>	The rate at which timber is made available for harvesting over time, measured in m <sup>3</sup> /year
<b>Timber supply analysis</b>	A process of exploring the effects of different management scenarios on timber supply.
<b>TIPSYP</b>	Table Interpolation Program for Stand Yields-- historically, the main source of managed stand yield tables for TSR. TIPSYP merely provides convenient access to yield tables produced by TASS.
<b>Tree list</b>	A representative sample list of individual tree measurements describing a particular stand or stand conditions. Tree lists are required input data for models such as PrognosisBC, MGM and SPS.
<b>VAC</b>	Volume over age curve--the simplest form of yield model.
<b>VDYP</b>	Variable Density Yield Prediction model-- a yield model developed for the BC forest inventory. It predicts stand volume from air-photo interpreted inventory attributes. It continues to be the primary source of natural stand yield tables in TSR.
<b>Volume and decay factors</b>	Individual tree volume and decay predictions used to compile plot volume estimates.
<b>Yield curve</b>	A figure showing volume yield per hectare as a function of stand age.
<b>Yield table</b>	A table showing the volume yield per hectare as a function of stand age.

