Arrowsmith Timber Supply Area
Timber Supply Review

Data Package

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1. Introduction

The data package contains inputs that describe current performance for the timber supply area. For the timber supply review, "current performance" is defined by:

- the current forest management regime — the productive forest land available for timber harvesting, the silviculture treatments, the harvesting systems, the integrated resource management guidelines used in the area, and the regional manager's direction relating to the implementation of the draft Landscape Unit Objectives and the draft Vancouver Island Summary Land Use Plan;
- the standards used to approve or reject forest development (5-year development) plans;
- fully implemented land-use plans;
- land-use decisions approved by Cabinet;
- approved higher level plans under the Forest Practices Code Act of British Columbia; and,
- other approved British Columbia Forest Service (BCFS) and joint agency forest management practices and policy.

This idea of current performance should be kept in mind at all times when reviewing the data package as purpose of the timber supply review program is to model "what is" not "what if". Changes in forest management objectives and data, when and if they occur, will be captured in future timber supply analyses.

Each section of this data package is organized in the following way:

1) A short explanation of the data needed to properly fill out the data table;
2) Data table;
3) Area for comments and the source of the data.

Tables with shading indicate the columns which will be filled in by the timber supply analyst upon receiving the FIP file.

2. Current Forest Management Considerations and Issues

2.1 Base case management assumptions

These assumptions reflect current performance with respect to the status of forest land, forest management practices and knowledge of timber growth and yield. The harvest forecast developed from these assumptions is termed the base case harvest forecast and is used as a baseline term of reference for uncertainty with respect to any of the assumptions. Uncertainty around the assumptions used in the base case will be assessed through analyses listed in Section 8, "Sensitivity Analyses."

2.2 Statement of major forest management considerations and issues

The major forest management issues and considerations for the Arrowsmith TSA are listed in the table below. Where issues are defined within legislation, regulations or standards, a timber supply assessment will be made. Issues and factors that are difficult to quantify or assess using a timber supply model may be either analysed separately or noted as upward or downward pressure on the timber supply.

Table 1. Major forest management considerations

Consideration/issue	Description
Protected areas	New parks which have received an Order-in-Council (OIC) designation are excluded from the timber harvesting land base.
Draft *Vancouver Island Summary Land Use Plan*	Approval of the draft *Vancouver Island Summary Land Use Plan* (the Plan) will set in motion changes in forest management on Vancouver Island. The Plan sets out special management zones (SMZ) and objectives, general management zones (GMZ) and objectives, and enhanced management zones (EMZ) and objectives. SMZs are areas of primary non-timber values. EMZs are areas of primary timber values and GMZs are areas of both timber and non-timber values. It is assumed that the enhanced management objectives in the EMZ areas will result in timber supply benefits which — at a minimum, and across the entire TSA — will offset the additional timber supply impacts associated with management in SMZ areas. Since the plan is draft, it is not reflected in the base case. Instead, a sensitivity analysis will be performed to examine the timber supply implications of the Plan. When the Plan is approved it will be incorporated into future timber supply reviews.
Landscape-level biodiversity	Draft landscape units (LU) and draft biodiversity emphasis options (BEOs) have been assigned, but not yet established under the *Forest Practices Code of British Columbia Act (*the *Code Act).* For the base case, retention of the old-seral stage (> 250 years) will reflect the BEOs for the higher and intermediate draft BEO landscape units and for the lower draft BEO landscape units one-third of the old-growth target will be modelled over the first rotation and built back to the full target by age 210 years as per the August 25th 1997, Deputies' letter. The ratio of higher, intermediate and lower BEO ratings for the timber harvesting land base of the TSA is approximately 0.3%, 60.9%, and 38.8% respectively. A sensitivity analysis will be performed to examine the timber supply implications using a weighted average of 10%, 45%, and 45%.
Forest Practices Code of British Columbia Act	Requirements of the *Code Act* will be modelled in the base case. These include constraints for riparian areas and wildlife tree patches.

(continued)

Table 1. Major forest management considerations (continued)

Consideration/issue	Description
Clayoquot Sound	The Clayoquot Sound portion of the Arrowsmith TSA is subject to forest management practices as per the *Scientific Panel Report* and therefore modelled separately from the remainder of the Arrowsmith TSA. The method used in the base case for the Clayoquot Sound portion does not model the results of fully implementing the Panel's recommendations (which is not possible at this time), but does provide a close approximation.
East/west distribution of harvest (not including Clayoquot)	There are differences in stand composition and stand profile, distribution of harvest, and forest management practices between the east and west portions of the TSA. Reporting will be generated to highlight activities expected from the east/west division using the timber supply block (TSB) boundaries. The west division is made up of the Barkley TSB, and the east division is made up of the Cowichan and Nanaimo TSBs.
Deciduous harvest	On May 24, 1996, a 15-year non-replaceable Forest License was awarded to Coast Mountain Hardwoods Inc. specifying an allowable annual cut (AAC) of 6300 m^3/year for the harvest of red alder stands. As per the specifications outlined in "G" of the Forest License Agreement, the AAC may be increased from 6300 m^3/year to a volume not exceeding 7000 m^3/year. Therefore, red alder-leading deciduous stands will be included in the base case. A sensitivity analysis will be performed to examine the timber supply impacts of changing the target level and managing for alder over the long term, including planting 20 hectares annually.
Wildlife	All environmentally sensitive wildlife areas identified in the last timber supply review (TSR1) for the Arrowsmith TSA are also identified for the base case for this analysis along with a few additional areas identified since TSR1. With regards to ungulate winter range (UWR) this includes both grandparented UWR (October 15, 1998) and non-grandparented UWR (which are subject to a pending Memorandum of Understanding (MOU) between the Forest District Manager and designated Environment Official). There are currently no wildlife habitat areas (WHAs) identified in the Arrowsmith TSA. A downward pressure of up to a 1% impact on the mature timber harvesting land base may be applied in a sensitivity analysis to accommodate species in the *Identified Wildlife Management Strategy* (IWMS).
Scenery	Established visual quality objectives (VQOs) and recommended visual quality classes (RVQCs) will be modelled to reflect forest practices within the Arrowsmith TSA. As part of the visual buy-back exercise, the TSA has been divided into three zones. Zone 1 areas are highly focal visual areas. The mid-range of per cent alteration for a VQO or RVQC within this zone will be used in the analysis. Zone 2 areas are moderately focal visual areas. The upper limit of the per cent alteration for a VQO or RVQC within this zone will be used. Zone 3 areas (integrated resource management (IRM) areas) are low focal importance and are not covered by VQOs or RVQCs.

(continued)

2. Current Forest Management Considerations and Issues

Table 1. Major forest management considerations (concluded)

Consideration/issue	Description
Fragmentation of land base	The historic development of southern Vancouver Island has resulted in a complex and fragmented distribution of land ownership's and forest management units within the Arrowsmith TSA. Fragmentation on the east coast has increased the edge interface with urban and rural development resulting in demands for retention green space, recreation use and protection of non-timber values. Fragmented areas are identified and modelled in a sensitivity analysis to reflect potential management pressures and constraints.
Cultural heritage values	Cultural heritage resources are features, sites or locations that are of historical, cultural or archaeological significance to British Columbia, a community or an aboriginal people. *The Heritage Conservation Act* and the *Code Act* requires that these resources be managed and conserved. The timber supply impacts relating to the presence of cultural heritage resources, including culturally modified trees (CMT), have been estimated and addressed in the Arrowsmith TSA base case.
Forest inventory audit	An audit was recently conducted to evaluate the accuracy of standing inventory volume estimates in the Arrowsmith TSA inventory. The audit results have not been officially released. Once released, this information will be incorporated into the analysis.
Old-growth site index (OGSI)	Sensitivity analysis will be performed using the approved regional old-growth site index adjustments.
Root rot	Managed stand yield curves for Fd leading and Fd mixed species stands within the eastern portion of the Arrowsmith TSA have been adjusted for losses due to root rot.
Commercial thinning — east division	Within the east division of the Arrowsmith TSA, approximately 127 hectares a year of Fd good and medium sites are commercially thinned. This will be modelled in the base case for the first two decades. A sensitivity analysis will be conducted to examine different targets for commercial thinning over the short-, medium- and long-term.

3. Inventories

3.1 Background information

Table 2 lists the inventories that will be used to define the timber harvesting land base, and to model forest management activities.

Table 2. Inventory information

Data	Source	Vintage	Update	Scale
Forest cover	Ministry of Forests (MoF)	1988-1992	1999	1:20,000
Ungulate winter ranges[a]	Ministry of Environment, Lands and Parks (MELP)	1998	1999	1:20,000
Biogeoclimatic classification[a]	MELP	1994		1:20,000
ESAs mapping	MoF	1993		
Operability mapping	MoF	1988 1994		1:20,000
Recreation inventory	MoF	1993		1:20,000
Landscape inventory	MoF	1991-1997		1:20,000
VQO and RVQC management zones overlay[a]	MoF	1998		1:20,000
VQO and VQC overlay[a]	MoF	1998		1:20,000
Community watersheds[a]	MELP	1996	1999	1:20,000
Clayoquot Sound land-use decision boundary[a]	Provincial Government	1993		1:20,000
Clayoquot Sound watersheds and sub-basins[a]	MoF	1997		1:20,000
Escalante River watershed sub-basins[a]	Interfor	1999		1:20,000
Draft landscape unit boundaries[a]	MoF and MELP	1997	1999	1:20,000
Resource management zones (VILUP)[a]	Land Use Coordination Office (LUCO)	1997		1:20,000

(a) Non-standard data.

3. Inventories

Data source and comments:

Forest cover — map bases for all mapsheets, except those within the Clayoquot Sound Land Use Decision, were shifted to the NAD83 datum in 1998. At the same time TRIM line features were incorporated into the FC1 file. The last forest cover update was completed in 1999 and includes all changes to forest cover due to harvesting and other disturbance to September 1998.

Draft landscape unit boundaries — this is a non-standard overlay produced by Ministry of Forests that identifies the draft landscape boundaries and biodiversity emphasis options as proposed by Ministry of Forests and Ministry of Environment, Lands and Parks. The draft landscape unit boundaries and biodiversity emphasis options were subject to public review as part of the *Vancouver Island Land Use Plan* and have been incorporated into the *Regional Landscape Unit Planning Strategy*. The boundaries were reviewed in 1999 as part of the Chief Forester's direction for the *Regional Landscape Unit Planning Strategy Review*. Two minor adjustments were made: the Rosewall and Qualicum draft landscape units were amalgamated and the boundary between the Caycuse and Cowichan draft landscape units was amended to reflect the tree farm licence (TFL 44 and 46) boundaries.

Ungulate winter ranges — this is a non-standard overlay produced by Ministry of Environment, Lands and Parks that identifies both grandparented and TSR1 non-grandparented ungulate winter ranges (UWR). This overlay, together with the forest cover inventory, provides the area and amount (as a percentage of area) to be removed from the timber harvesting land base.

Community watersheds — this is a non-standard overlay produced by Ministry of Environment, Lands and Parks that identifies all designated community watersheds within the Arrowsmith TSA.

VQO and RVQC Overlay and VQO and RVQC management zones — this is set of two non-standard overlays produced by Ministry of Forests. The first overlay is the visual quality objectives and recommended visual quality classes taken from the landscape inventory. The second overlay contains the visual quality management zones produced for the visual quality buyback exercise.

Resource management zones — the *Vancouver Island Summary Land Use Plan* identifies three land-use zone types — Special Management Zones, General Management Zones and Enhanced Forestry Zones. The Special Management, General Management and Enhanced Forestry Zones are identified on a non-standard overlay produced by the Land Use Coordination Office. Protected areas have been identified on the ownership level of the forest cover inventory.

Clayoquot Sound Land Use decision boundary — 1993 Cabinet decision. Defines the area known as Clayoquot Sound.

Escalante River watershed sub-basins — This 1:20,000 non-standard map was produced as part of the 1999 *Coastal Watershed Assessment* by International Forest Products for the Escalante River and shows the watershed's three sub-basins — the North, South, and Residual sub-basins.

Clayoquot Sound watershed map — prepared by Alan Chapman, MoF Vancouver Region, 1997. The watersheds and sub-basins shown on this map are derived from topographic information presented on 1:20,000 TRIM maps. They correspond to the watershed area criteria contained in recommendation R3.1 of the *Scientific Panel for Sustainable Forest Practices in Clayoquot Sound* (Report 5).

4. Division of the Area into Management Zones

4.1 Management zones and tracking of multiple objectives (grouping)

Management zones differentiate areas with distinct management emphasis and homogenous forest cover. For example, a zone may be based on a harvesting system, silviculture system, visual quality objective or wildlife consideration. In previous timber supply analyses, management zones were mutually exclusive with respect to the application of forest cover requirements. If wildlife habitat overlapped with visual quality areas, a choice had to be made as to which forest cover requirement would be applied. Functionality has been added to the computer simulation model to track overlapping objectives on the forested land base. The forest cover data set can now be grouped by different variables. In addition, the non-contributing forest (land considered unavailable for timber harvesting) will be included for consideration in attaining some forest cover objectives. Grouping enables constraints to apply to different combinations of variables or zones as well as enhancing reporting structures. Groups may be thought of as layers of different objectives which must be tracked over time. Whether to put an objective into a group or a mutually exclusive management zone will be decided after data assessment with the timber supply analyst.

For example, all management zones within a landscape unit may be grouped to track seral stage distribution in that landscape unit. This is an important feature as management activities within the management zones may lead to the creation of older forest characteristics. Not considering the combined effects of the management activities in the landscape unit could lead to an over-estimate of the amount of older forest that needs to be maintained to meet landscape unit objectives. Further information on the forest cover requirements to be applied to these areas can be found in Section 6.4, "Integrated resource management forest cover requirements."

4. Division of the Area into Management Zones

Table 3. Objectives to be tracked

Group	Objectives	Comments
1	Clayoquot portion versus remainder of Arrowsmith TSA	Separate analysis for Clayoquot Sound portion of the Arrowsmith TSA versus the remainder of the Arrowsmith TSA.
2	Timber harvesting land base by draft landscape unit or sub-basin	Reporting purposes. Crown forested, operable area where timber harvesting may occur. Provides an assessment of the timber harvesting land base.
3	All forested land by draft landscape unit or sub-basin	Reporting purposes. Provides an assessment of the total forest by draft landscape unit or sub-basin.
4	Scenery (excluding Clayoquot Sound portion of the Arrowsmith TSA)	Application of VQOs and RVQCs by draft landscape unit that fall within zone 1 and zone 2 areas. Zone 1 areas are managed at the midpoint of the per cent alteration for a given VQO or RVQC. Zone 2 areas are managed at the upper point of the per cent alteration for a given VQO or RVQC. VQOs & RVQCs include: retention, partial retention and modification.
5	Integrated resource management areas (IRM) (excluding Clayoquot Sound portion of the Arrowsmith TSA)	Application of adjacency criteria by draft landscape unit. Crown, forested, operable area where harvesting operations are not otherwise constrained by visual resources or wildlife habitat.
6	Distribution of harvest (excluding Clayoquot Sound portion of the Arrowsmith TSA)	Distribution of harvest between eastern and western divisions. The west division is made up of the Barkley TSB, and the east division is made up of the Cowichan and Nanaimo supply blocks.
7	Fragmentation of land base (excluding Clayoquot Sound portion of the Arrowsmith TSA)	Application of criteria for areas of crown forest within the east and west division of the Arrowsmith TSA that are fragmented.
8	Deciduous component of the harvest (excluding Clayoquot Sound portion of the Arrowsmith TSA)	Reporting purposes. Provides an assessment of the harvest level for deciduous stands leading in red alder.
9	Vancouver Island Summary Land Use Plan	Application of resource management objectives and strategies for areas of crown forest that fall within the three zone types — special management zone, enhanced management zone, and general management zone.

(continued)

4. Division of the Area into Management Zones

Table 3. Objectives to be tracked (concluded)

Group	Objectives	Comments
10	Community watersheds	Application of rate of harvest for community watersheds — no more than five per cent disturbance in five years.
11	Coastal watershed assessments	Application of the rate of harvest in terms of equivalent clearcut area (ECA) for those watersheds that have had a coastal watershed assessment. Hydrological recovery is modelled as per Table A2.2 of the *Coastal Watershed Assessment Procedure Guidebook* (CWAP), Second Edition April 1999.
12	Unconventional harvest	Reporting purposes. Provides an assessment of the harvest level attributable to unconventional harvesting methods such as long-line and helicopter systems.

Data source and comments:

See Sections 2.1 and 3.1 for background information and map sources of the objectives to be tracked.

4.2 Analysis units

An analysis unit represents a combination of stands dominated by specific tree species or silvicultural regime with a specific timber growing capability — as indicated by the inventory type group and site index in the forest inventory file. Each analysis unit is assigned its own timber volume projections (yield tables) for existing and future stands.

Yield tables for existing natural stands are derived using the variable density yield projection (VDYP) growth and yield model. Yield tables for recent plantations and future stands are derived using the table interpolation program for stand yields (TIPSY).

4. Division of the Area into Management Zones

Table 4. Definition of analysis units

Analysis unit	Criteria		
	Inventory type groups	Site index range[a]	Site class
Fir[b]	1–8		Good
Fir[b]	1–8		Medium
Fir	1–8		Poor
Cedar	9–11		Good/medium
Cedar	9–11		Poor
Hemlock/balsam	12–20		Good/medium
Hemlock/balsam	12–20		Poor
Spruce	21–26		Good/medium
Spruce	21–26		Poor
Red alder (red alder leading stands that are = 50% deciduous by gross stand volume)	37–38, greater than 50% alder on volume basis		All sites
Other Red alder (red alder leading stands that are < 50% deciduous by gross stand volume)	37–38, less than 50% alder on volume basis		All sites
Other stands (coniferous and deciduous)	27–36, 39–42		All sites

(a) Site index range reference age is 50 years.

(b) Portions of these analysis units are commercially thinned.

Data source and comments:

Once the timber harvesting land base has been defined, appropriate site index ranges will be defined to separate some species groups by site productivity.

5. Timber Harvesting Land Base Definition

5.1 Identification of the timber harvesting land base

This section outlines the steps used to identify the timber harvesting land base (the productive forest expected to support timber harvesting) for the Arrowsmith TSA.

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

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

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

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

The classification of "unavailable for timber harvesting" will apply only to land where no harvesting is anticipated to occur. Any area in which some timber harvesting will occur will remain in the timber harvesting land base, even though the area may be subject to stringent conditions.

After all areas that do not contribute to the timber harvesting land base have been identified, any additional lands are added to the land base (e.g., regenerated NSR lands). The resulting productive forest land base is defined as the "current timber harvesting land base" for the TSA

5.2 Details on land base classification

5.2.1 Land not administered by the BCFS for timber supply

Ownership codes are generally used to identify whether the land can be considered to contribute to timber supply. Ownership codes 62C, 61C and 69C indicate crown land in a forest management unit, crown land in UREPs and miscellaneous reserves, respectively. These are generally the only ownership codes which are considered to contribute to timber supply. Ownership code 70N, timber license land in a TSA, is considered under Section 5.2.6. Areas with other ownership codes will be removed from the land base considered for timber supply. This includes woodlot license areas since their AACs are determined independently from the timber supply review process.

5.2.2 Land classified as non-forest

Type identity 6 areas, such as alpine, lakes, rocks etc., and type identity 8 areas (untyped) are removed from the land base considered for timber supply.

5.2.3 Non-commercial cover

Type identity 5 represents those areas which were inventoried to have non-commercial brush species growing on them. These areas are considered to be unlikely sites for timber production.

5.2.4 Environmentally sensitive areas

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

In the context of timber supply analysis, ESAs may result in a reduction in the harvesting opportunity on these sites. Two strategies for accounting for this are: per cent area reductions, and the specific evaluation of individual ESA polygons for harvesting opportunity.

As noted previously it is important to ensure that only areas in which harvesting is expected to take place are allowed to contribute to the timber harvesting land base. Thus it is important to separate the areas in which some limited harvesting will take place and those areas which are unavailable. The table below indicates the proportions of areas in the various ESA categories that are unavailable for timber harvesting.

Table 5. Description of environmentally sensitive areas

ESA category	ESA code	ESA descriptor	Reduction per cent (%)
Soil sensitivity Cowichan Timber Supply Block (TSB). Environmentally sensitive areas for soils are on the FIP file planning cell level.	S001 S002	Es1 Es2	90 20
Soil sensitivity Nanaimo TSB.	Es1 Es2		90 20
Soil sensitivity Barkley TSB.	S001 S002		90 20
Ungulate winter ranges Ew1, Ew2 and Ewz, and wildlife other than ungulate winter ranges.		Ew1 Ew2 Ewz	100 50 Range from 20-70
Regeneration	Ep1 Ep2		90 50
High avalanche hazard	Ea1 and Ea2		100

Data source and comments:

Soil sensitivity was assigned codes on two levels on the FIP file: the planning cell polygons (Cowichan TSB, Barkley TSB, and several mapsheets in the Nanaimo TSB) and forest cover polygons (Nanaimo TSB and several polygons in the Barkley TSB).

Environmentally sensitive areas for wildlife (Ew) are mapped on the Ew coverage with specific reduction factors assigned to each polygon. The Ew1 polygons have a netdown of 100% and the Ew2 polygons have a netdown of 50%. There are also grandparented ungulate winter ranges (UWR) and UWRs that will be reviewed as part of a pending MOU between the Ministry of Forests and the Ministry of Environment, Lands, and Parks. In general, the UWRs are classified as Ew1 with a 100% netdown or Ew2 with a 50% netdown. There are also some that are Ewz (zones) which have netdowns ranging from 20% to 70%.

Avalanche ESAs were listed as Ea1 and Ea2, and are subject to a 100% reduction.

Regeneration ESAs were assessed and assigned reduction factors of 90% for Ep1 and 50% for Ep2.

5.2.5 Areas with high recreation values

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

Table 6. Description of areas with high recreation values

Feature significance	Management class	Reduction per cent (%)
A or B	0	100
A or B	1	50
C	1	10[a]

(a) Reduction percentage applied only to those C1 polygons that do not have a VQO or RVQC.

Areas with a recreation feature code of 'C' and a recreation management class code of '1' in known scenic areas with assigned VQOs or RVQCs will be dealt with in this analysis by applying forest cover requirements (see Table 22a.,"Forest cover requirements for cutblock adjacency and visual values"), no per cent area reduction will be applied to them. Reductions will only be applied to 'C1' areas not covered by a VQO or RVQC. Assessment of the C1 areas also included consideration of the intersection of C1 areas with recreation fishing corridors.

5.2.6 Areas considered inoperable

Operability and inoperability codes are generally used to describe the presence or absence of physical barriers or limitations to harvesting, appropriate logging methods (e.g., cable), and the merchantability of stands.

Areas defined as inoperable are identified in the inventory file under the "OPERABLE" label by "I" (inoperable) and "X" (uneconomic) field codes. The operable areas are identified in the inventory file under the "OPERABLE" label by "G" (operable ground based), "U" (operable long line) and "H" (operable helicopter or water based) field codes. Areas that are identified by an activity code "L" (logged) in the activity layer will remain in the inventory regardless of inoperable or uneconomic operability coding.

Table 7. Description of inoperable areas

Inventory description	Code	Reduction per cent (%)
Operable — ground based	G	0
Operable — long line	U	0
Operable — helicopter/water based	H	0
Marginal	X	0
Inoperable	I	100

Data source and comments:

There is no operability netdown for the area covering the former Duncan Forest District. Other land reductions, such as low site, ESAs, etc. are considered sufficient to account for operability in that area.

Operability for the Nanaimo TSB is based on 1988 operability mapping.

Operability mapping for the west coast of the former Port Alberni Forest District was completed in January 1994. In TSR1 the marginal category was called uneconomic and the stands that fell within this category were not included in the timber harvesting land base. Currently, some of these stands are being harvested. No reductions will be made for marginal stands using operability criteria.

5.2.7 Sites with low timber growing potential

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

Table 8. Description of sites with low timber growing potential

Species	Inventory type group	Volume (m^3/hectare)	Reduction per cent (%)
Red alder (Dr)	37–38 with greater than or equal to 50% deciduous by gross stand volume	< 200 m³/hectare or greater than 70 years of age	100
Conifers, other red alder and other stands	1–34 37–38 — with less than 50% deciduous by gross stand volume	West division < 400 m³/hectare East division < 300 m³/hectare and Any stand projected to never achieve a height of 19.5 metres or greater and never to achieve above volumes per hectare by 150 years.	100

Data source and comments:

TSR1 criteria. Reflects current management of merchantable forest types.

5.2.8 Unmerchantable forest types

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

Table 9. Unmerchantable forest types criteria

Species	Inventory type groups	Reduction per cent (%)
Deciduous other than red alder	35, 36, 39–42	100

5.2.9 Roads, trails and landings

Separate estimates are made to reflect the loss in productive forest land due to existing and future roads, trails and landings (RTL). Existing RTL estimates are applied as reductions to the current productive forest considered available for harvesting, and future RTL reductions are applied after stands are harvested for the first time in the simulation model. Estimates can be applied as the amount or percentages of area to be removed from specified age classes and zones. Estimates account only for the area that will be permanently removed from the timber harvesting land base.

5. Timber Harvesting Land Base Definition

Table 10. Estimates for existing and future roads, trails, and landings

Location	Age class (years)	Road length (metres)	Road width (metres)	Reduction area (hectares or per cent)
Existing RTLs				
Logging roads east division	≤ 80		15	
Logging roads west division	≤ 80		20	
Trails	≤ 80		5	
Future RTLs				
All commercial thinning analysis units. East division.	30–60			3.6%
All other analysis units within conventional operable areas. East division.	> 80			4%
All analysis units within conventional operable areas. West division.	> 80			6.1%

Data source and comments:

Existing roads, trails and landings data was collected using INVSPECS and adjusted for rebuilding. Road widths were based on district staff knowledge and experience. The figure for commercial thinning shown above represents additional road requirements for commercial thinning.

Approximately 230 km of existing roads were deactivated in the Arrowsmith TSA from 1996-1999. Of the total area deactivated, approximately 40% is planted with trees species. More time is needed to evaluate the success of reforesting deactivated roads before these areas are returned back to productive forest. In the next 5 years, South Island Forest District (SIFD) staff estimate that only an additional 25 km of road will be deactivated within the Arrowsmith TSA (occurring mostly within the west division) given FRBC funding pressures.

Future roads, trails and landings were estimated using Integrated Silviculture Information System (ISIS) reports for areas logged on or after December 16, 1995, and actual site degradation survey information for commercially thinned areas. Unconventional harvesting areas, as shown on the operability mapping (i.e., long-line, helicopter and water-based systems), will have no reductions for roads, trails and landings.

5.2.10 Wildlife habitat reductions

In the *Managing Identified Wildlife Procedures and Measures, Vol.1*, management prescriptions include core "no harvesting" areas around nesting sites or other valuable habitats for rare and endangered species. Where these have been specifically identified geographically, they should be addressed for consideration in the determination of the timber harvesting land base. Where only occurrences in broad geographic space are known, these should be discussed with the timber supply analyst in order to determine if sensitivity analysis can be performed around habitat needs based on the best estimate available. With only occurrence information, a higher degree of uncertainty exists in whether the timber harvesting land base is actually impacted by the respective habitat requirements.

5. Timber Harvesting Land Base Definition

The *Identified Wildlife Management Strategy (IWMS) Guidebook* which addresses specific habitat requirements of old growth dependent wildlife was released on February 19, 1999. Queen Charolette northern goshawk (*Accipiter gentilis laingi*) and Marbled Murrelet *(Brachyramphus marmoratus)* are among the 36 species currently listed as identified wildlife. Both are red-listed species (i.e., indigenous species that are threatened or endangered).

At present there is one Queen Charlotte goshawk nesting site known within the Arrowsmith TSA, but it is presently vacant. The Ministry of Environment, Lands and Parks (MELP) has not identified this particular site as a high priority site for wildlife habitat area (WHA) status. To date, no WHAs have been established for this or any other identified wildlife species in the Arrowsmith TSA.

Marbled murrelets will be managed according to the *IWMS* which states that WHAs for marbled murrelets must be composed of some or all of the old-seral retention requirements recommended in the *Biodiversity Guidebook,* September 1995. These requirements will be incorporated into the base case as outlined in Table 22c – *Forest cover requirements for landscape unit biodiversity in the base case.*

Data source and comments:

Information with respect to *IWMS* and interim measures is from the *Managing Identified Wildlife Procedures and Measures, Vol.1*, a letter from Larry Pedersen, Chief Forester, Ministry of Forests and Cassie Doyle, Deputy Minister, Ministry of Environment, Lands and Parks dated February 15, 1999, Chief Forester policy as attached to the February 15, 1999 letter, and a letter from Ken Collingwood, Regional Manager, Vancouver Forest Region, Earl Warnock, Regional Director, Vancouver Island Regional Headquarters, Jim McCracken, Regional Director Lower Mainland Regional Headquarters, Herb Largin, A/Regional Director Cariboo Regional Headquarters, and Jim Yardley, Regional Director Skeena Regional Headquarters dated December 23, 1998.

5.2.11 Wildlife tree retention

The *Landscape Unit Planning Guide* recommends retention of wildlife tree patches (WTPs) for providing stand structure over time. The *Biodiversity Guidebook* also indicates that wildlife tree patches (group reserves) larger than two hectares in size within a cutblock boundary can contribute to old-seral stage forest requirements at the landscape level.

Wildlife tree patch retention targets were developed by the Ministry of Forests and the Ministry of Environment, Lands and Parks staff using Tables 20a and 20b of the *Biodiversity Guidebook* (equivalent to Tables A3.1. and A3.2 in the *Landscape Unit Planning Guide)* and released by the District Manager on December 8, 1997, as a *District Policy* (DSI-01). This policy specifies for each draft landscape unit two wildlife tree patch retention targets — one for when landscape units are in place (20a) and one for when they are not (20b). The district targets using Table 20a have been used in this analysis because forest cover requirements for landscape unit biodiversity are modelled in the base case. Since these district targets were set, the Rosewall and Qualicum draft landscape units have been combined into one draft landscape unit. Until landscape planning is undertaken, the higher draft landscape unit retention targets will be used in the district and will be reflected in this analysis. A tracking system is currently being developed to document the actual wildlife tree patch retention being met.

5. Timber Harvesting Land Base Definition

The wildlife tree patch retention targets have been reduced by 75% as per the assumption used in the *Forest Practices Code Timber Supply Analysis*, February 1996, that 75% of the wildlife tree patch requirements will be met by riparian reserves and other areas outside of the timber harvesting land base. The percentage of the timber harvesting land base required for wildlife tree patches ranges between 0.25 to 4% by landscape unit using this approach for the remaining 25% of the WTP requirements. This assumption will be verified for the Arrowsmith TSA in preparation for TSRIII.

In addition to the wildlife tree patch requirements as per the *South Island Forest District Wildlife Tree Patch Retention Policy* (DSI-01, December 8, 1997), the area known as the Nanaimo Lowland Ecoregion requires 10 stems per hectare be retained following harvest. (*Updated Silvicultural Strategy within the Nanaimo Lowlands*, September 29, 1997). While some of these trees may provide wildlife habitat, others may serve other objectives including scenic and silvicultural objectives.

Table 11. Reductions to reflect area retention in cutblocks for wildlife tree patches

Landscape unit	Biogeoclimatic ecosystem classification (BEC) subzone	Wildlife tree patch retention targets (%)	Residual area estimate on the timber harvesting land base (%)
Cameron	CWH	11	2.75
	MH	6	1.50
Chemainus	CDF	9	2.25
	CWH	13	3.25
	MH	7	1.75
China	CWH	11	2.75
	MH	6	1.50
Cowichan	CDF	10	2.50
	CWH	12	3.00
	MH	14	3.50
Effingham	CWH	3	0.75
	MH	1	0.25
Englishman	CDF	9	2.25
	CWH	7	1.75
Escalante	CWH	10	2.50
	MH	7	1.75
French Creek	CDF	9	2.25
	CWH	12	3.00
Gordon	CWH	10	2.50
	MH	3	0.75
Henderson	CWH	6	1.50
	|MH	0	0
Koksilah	CDF	9	2.25
	CWH	13	3.25

(continued)

Table 11. Reductions to reflect area retention in cutblocks for wildlife tree patches (concluded)

Landscape unit	Biogeoclimatic ecosystem classification (BEC) subzone	Wildlife tree patch retention targets (%)	Residual area estimate on the timber harvesting land base (%)
Little Qualicum	CDF	11	2.75
	CWH	8	2.00
	MH	10	2.50
Loss	CWH	10	2.50
	MH	5	1.25
Maggie	CWH	10	2.50
Millstone	CDF	13	3.25
	CWH	11	2.75
Nahmint	CWH	4	1.00
	MH	0	0
Nanaimo	CDF	9	2.25
	CWH	12	3.00
	MH	0	0
Nanoose	CDF	9	2.25
	CWH	10	2.50
Qualicum/Rosewall	CDF	12	3.00
	CWH	11	2.75
San Juan	CWH	10	2.50
	MH	4	1.00
Sarita	CWH	10	2.50
Shawnigan	CDF	9	2.25
	CWH	8	2.00
Sooke	CWH	9	2.25
Somass	CWH	14	3.50
	MH	13	3.25
Sproat	CWH	9	2.25
	MH	0	0
Toquart	CWH	4	1.00
	MH	0	0
Tugwell	CWH	14	3.50
	MH	1	0.25

Data source and comments:

A volume reduction will be used to model wildlife tree patch requirements. It is uncertain whether wildlife tree patches (WTPs) are on average larger than two hectares within the Arrowsmith TSA. Two hectares is the minimum size requirement for WTPs to contribute to old-seral stage requirements at the landscape level. A tracking system is currently being put in place to determine the area and/or volume loss attributable to wildlife trees and wildlife tree patches. In addition to the volume reduction for WTPs, a volume reduction will be made for the 10 dominant and/or co-dominant trees per hectare retained within the Nanaimo Lowland Ecoregion. In making these reductions, volume-over-age curves for both existing and future stands will be reduced.

5.2.12 Cultural heritage resource reductions

Cultural heritage values include traplines, and sites of archaeological or traditional use.

Most of the recorded cultural heritage sites are on the west coast of Vancouver Island and are located in close proximity to the coastline.

In the Arrowsmith TSA over the past 5 years, 39 openings have been subject to archaeological impact assessment (AIAs) (approximately 455 hectares). Of this area a total of approximately 33 hectares has been reserved or deferred (harvest not likely) resulting in a netdown of 7%.

Cultural heritage site distribution between the east and west divisions may differ due to comparatively less old growth remaining in the east division.

An area of potential cultural heritage resource features will be defined by the following criteria:

- age greater than 80 years;
- species composition minimum 20% Cw or Cy; and,
- less than 200 metres from the ocean.

Within this area, a netdown of 7% will be applied.

The above criteria reflect the current management within the Arrowsmith TSA and are based on the following sources: *Archaeological Impact Assessment* reports for the Arrowsmith TSA (August 1993 to December 1998), criteria developed for TFL 44, and results from a three-year archaeological inventory in Clayoquot Sound (part of the Arrowsmith TSA falls within Clayoquot Sound).

The results of the Clayoquot archaeological inventory concluded that:

- 83% of villages reported were within 100 metres of saltwater shoreline;
- 94% of middens reported were within 100 metres of saltwater shoreline; and,
- 76% of the known CMT sites (bark-stripped and logged CMTs) occur within 200 meters of saltwater and 66% are within 100 metres of the shoreline.

5.2.13 Riparian reserve zones

Table 12 indicates the land base reductions to be applied to represent reservation from harvest of areas immediately adjacent to streams, lakes and wetlands. The information to be used in the analysis to capture the effect on timber supply from the riparian management zone is dealt with in Section 5.3.4.

Table 12. Description riparian reserve zones

Location	Reduction per cent (%)
Timber harvesting land base	4.8

Data source and comments:

To account for riparian reserve zones (RRZ), the timber harvesting land base will be reduced by 4.8%. This figure is based on a study of 92 coastal cutblocks completed in 1994 by Wild Stone Resources. The per cent area excluded from the timber harvesting land base is calculated by multiplying the specified reserve width for each stream class (from the *Riparian Management Area Guidebook*) by the lengths of stream of each class found on the cutblocks sampled, then dividing by the total area of cutblocks sampled. All stream and water features will be buffered using geographic information system (GIS). The per cent of the timber harvesting land base within these buffers will be compared with the above 4.8% reduction for riparian reserve zones.

5.2.14 Riparian management zones (RMZ)

The appropriate method to account for the timber supply implications of riparian management practices within riparian management zones (RMZs) depends upon the management practices applied in these zones (e.g., harvest pattern) and the availability of inventory information (e.g., *FPC* riparian management area stream classification).

The estimated reduction factor based on average stream density figures for the coast when using partial or selection harvesting systems in riparian management zone is 4.2% (source: *Riparian Management Area Guidebook*). Volume reductions are typically used to account for the timber volume that will be left unharvested in RMZs. In the Arrowsmith TSA current practice within the RMZs is characterized as a per cent area retention rather than per cent volume retention.

5.2.15 Exclusion of specific, geographically defined areas

The purpose of this section is to specify the location and total area to be excluded from the timber harvesting land base to account for any area exclusions that are a part of current forest management (e.g.; the number of hectares excluded to account for a designated (by Order-in-Council) wilderness area not already accounted for on the inventory file). Another example would be areas of timber which are not accessible and thus not available for timber harvesting, (e.g. obstructed by park or by other reserves).

While areas recognized in legislation or by Order-in-Council as not contributing to the timber harvesting land base may be excluded, areas which have been deferred from harvesting because they are contentious or are under study (e.g., planning deferrals, potential parks) are not considered unavailable for timber harvesting for the purposes of the timber supply review.

Table 13. Exclusion of specific, geographically defined areas

Identifying inventory variables				
Location	**Mapsheet**	**Polygons**	**Excluded area (hectares)**	**Reason for exclusion**
Growth and yield plots T7-C24D-15	092B092	92	0.4	Active growth and yield plots
Growth and yield plots T7-C13B-016	092F036	233	0.4	Active growth and yield plots
Growth and yield plots G7-C16A-017 G7-C16A-013 G7-C16A-014	092F038	404	0.4	Active growth and yield plots
Growth and yield plots R7-C12A-G04	092F047	648	0.4	Active growth and yield plots
Bamfield community forest license pilot	092C038	All land classified as 62-C	100	Area has been offered as a community forest pilot license
Woodlot – 1903	092F003 092F004	2 and 3 452, 147, 141, 136, 132, 131, 127 17, 125, 5, 11, 461, 13, 474, 15, 471 461	100	In the process of being awarded
Camper Creek TL T0057	092C058	All land classified as 62-C and 70-N	100	Crown land (Timber License T0057) will be transferred from the Arrowsmith TSA to TFL 46 as part of the land exchange for the Nitnat Park lands once the entire TL is reverted.

Data source and comments:

The growth and yield plots have been established for long-term research and should be maintained for the first rotation. The actual plot size is generally 0.04 hectares. For the purpose of TSR a buffer has been added increasing the plot size to 0.4 hectares.

SIFD staff anticipate establishment of Woodlot 1903 within the current year, therefore, the approximate area will be excluded from the land base.

Weyerhaeuser Company Ltd.'s timber license at Camper Creek would normally revert to the Crown following establishment of a free-growing stand. However, this land was part a land trade with TFL Forest Limited for the Nitnat Park land area and will revert to them (TFL 46) once a free-growing stand is established. Therefore, this land is not included in the Arrowsmith TSA.

An area of vacant Crown land (418 hectares) adjacent to the communities of Bamfield and Ana'cla has been offered as a community forest pilot license to the Bamfield/Huu-ay-aht Community Forest Society. The AAC will be determined in a similar manner to woodlots, independent of the Timber Supply Review for the Arrowsmith TSA.

5.2.16 Timber License reversions

Timber Licenses are old tenure arrangements that give a licensee exclusive rights to harvest merchantable timber within the license area and do not contribute to the TSA allowable annual cut. Once these areas have been harvested, regenerated and attain free-growing status, the timber license area reverts to BCFS jurisdiction. Accordingly, these areas are included in the timber harvesting land base after the first harvest and contribute to the TSA harvests in medium- to long-term timber supply.

Timber License areas need to be accounted for from the time the stands have been harvested, and/or from the time the stands will be harvested. Time of harvest is used as the reference point so that impact of these harvests on forest cover requirements is given full consideration in the timber supply analysis. In some cases stands that have been harvested and legally reverted have not had the necessary ownership change on the inventory file (e.g., change from 70-N to 62-C). These reversions are included in the following table.

Table 14. Timber License reversion schedule

Location (e.g., mapsheet)	Area of TL's harvested (hectares) (year of harvest)
TLs inside Clayoquot Sound	Analysis of Clayoquot Sound only considers short-term harvest level. No plans to harvest within TLs for the next 5 years.
TLs outside Clayoquot Sound	Years 1-5 — 135 hectares The following 5 year periods until all TLs reverted — 360 hectares

Note: Stands coded as 70-N and less than age 50 years are assumed to be reverted.

Data source and comments:

Currently there are 13 timber licenses within the Arrowsmith TSA; 7 are located entirely in the Clayoquot Sound portion, one is partially within Clayoquot Sound and partially within the remainder of the TSA, and 5 are located entirely outside Clayoquot Sound.

5. Timber Harvesting Land Base Definition

The timber supply review for the Clayoquot Sound portion is separate from the rest of the Arrowsmith TSA. The area occupied by timber licenses within the Clayoquot portion will contribute to old growth and rate of cut, but will not contribute to the short-term allowable harvest level. Currently, there are no approved Forest Development Plans (FDP) for areas within timber licenses in Clayoquot Sound.

The harvest rate for the timber licenses outside of Clayoquot Sound is based on: a review of harvest proposals for the next five years; and district estimates for 5-year periods until all timber licenses are reverted.

6. Current Forest Management Assumptions

6.1 Harvesting

6.1.1 Utilization levels

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

Table 15. Utilization levels

Analysis unit	Utilization		
	Minimum dbh (cm)	**Maximum stump height (cm)**	**Minimum top diameter inside bark (dib) (cm)**
All coniferous leading analysis units > 120 years	17.5	30	15
All coniferous leading analysis units = 120 years	12.5	30	10
Alder > 45 years	17.5	30	15
Alder ≤ 45 years	12.5	30	10

Data source and comments:

The table above reflects current regional utilization standards, license requirements and current performance.

6.1.2 Minimum harvestable age derivation

Analysis units are developed to achieve management objectives through groupings of stands with similar species associations, levels of productivity and growth characteristics. Minimum harvestable ages can be defined by a product goal or by harvest ages that achieve "optimal" stand level management. These are simply minimum criteria. While harvesting may occur in stands when the minimum requirements are achieved in order to meet forest level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large inter-decadal changes in harvest levels), some stands may be not be harvested until well past "optimal" timber production ages when management of other resource values takes precedence (e.g., requirements for the retention of older forest).

The minimum harvestable age for stands in each analysis unit will be set to the greater of: (a) the estimated age for the stand to reach a required stand volume; (b) the age at which the stand achieves a specified minimum mean diameter at breast height (dbh); and, (c) the age at which the stand achieves 90% of maximum mean annual increment (MAI). In the case of the red alder analysis unit, this age must be less than 71 years.

Table 16. Minimum harvestable age criteria

Analysis unit species	Site index	Minimum criteria			MAI (m^3/hectare/year)
		Age (years)	Diameter (cm)	Volume (m^3/hectare)	
East Division all species except alder analysis unit	All	N/A	25	300	90% of maximum MAI
West Division all species except alder analysis unit	All	N/A	30	400	90% of maximum MAI
Red alder analysis unit	All	≤ 70 years of age	N/A	200	90% of maximum MAI

Data source and comments:

Minimum harvestable ages criteria was based on review of current licensee operation in the South Island Forest District, economic operability, and discussions with SIFD staff.

6.1.3 Harvest scheduling priorities

For various reasons, it may be important to set priorities or minimum harvest levels on certain management zones or analysis units to reflect insect infestations, salvage operations or similar forest management activity. Table 17 lists harvest priorities for the Arrowsmith TSA.

Table 17. Priorities for scheduling the harvest

Description	Management zone or location	Analysis unit	Period	Maximum volume/year to be harvest (m^3/year)	Priority
Commercial thinning, (with some clearcut patches for root disease removal)	East Division	Fd good and medium sites	2	23 700	1
Deciduous harvest	East and West Division[a]	37– 38 and at least 50% deciduous by gross stand volume	Up to 2011		2

(a) The Clayoquot Sound portion of the Arrowsmith TSA is not included in this management zone, and is modelled separately from the remainder of the Arrowsmith TSA.

6. Current Forest Management Assumptions

Data source and comments:

The east division of the Arrowsmith TSA has higher levels of retention because of forest management issues such as visual quality, recreation, urban interface, limited old growth, and root disease in Fd stands. Commercial thinning is employed in the Fd medium and good sites where these issues arise.

Coast Mountain Hardwoods Inc. holds Forest License A49541. The license is for 15 years beginning May 24, 1996. Presently the license has an allowable annual cut of 6300 cubic metres per year for deciduous stands leading in red alder from areas of Crown land within the Arrowsmith TSA. As per the specifications outlined in "G" of the Forest License, the AAC may be increased from 6300 cubic metres to a volume not exceeding 7000 cubic metres. A harvesting priority is set for red alder leading deciduous stands to ensure that harvesting is projected to occur in these stands for the term of the Forest License which ends May 24, 2011.

The Vancouver Forest Region red alder management strategy is a 5-year trial to manage red alder in the region through limited planting. The Forest District's commitment to this strategy is to plant approximately 20 hectares/year for the next five years back to red alder. The strategy is meant to provide a transition period to gain experience in the management of red alder through the evaluation of responses to treatment on various sites, and to allow more time to evaluate the current supply of red alder as well as the economic viability of harvesting and managing red alder when implementing the treatment regimes necessary to attain maximum productivity for red alder. A sensitivity analysis will be conducted to examine the long-term timber supply implications of alder management.

6.1.4 Silvicultural systems

Table 18 lists the silvicultural systems employed in the Arrowsmith TSA.

Table 18. Silvicultural systems

	Silvicultural system	Eligible analysis units or locations	Volume removed	Entry age	# of entries before final felling	Time before final felling
1.	Even-aged silvicultural systems	All analysis units.	See note.	Minimum harvestable age or older.	N/A	Minimum harvestable age or older
2.	Commercial thinning	Fd good and medium site analysis units East Division only.	Minimum volume removed 130 m^3/hectare. Maximum volume removed 38% of the stand volume. Minimum diameter 25 cm.	Age when volume removed criteria is met.	1	Minimum 20 years
	Final entry	Fd good and medium site analysis units East Division only.		At least 20 years after initial harvest.	N/A	N/A

Note: Prior to modelling the base case, an assessment will be undertaken to determine the proportion of variable retention harvesting and the levels of retention occurring within the timber harvesting land base.

Data source and comments:

The Arrowsmith TSA principally uses even-aged silvicultural systems including clearcutting, clearcutting with reserves, patch cutting, shelterwood, and seed tree. In addition, within the east division of the Arrowsmith TSA — Nanaimo and Cowichan timber supply blocks (TSB) — significant amounts of commercial thinning are taking place in Douglas-fir stands on good and medium sites.

To date, approximately 638 hectares have been commercial thinned. These areas were mapped, and analysis unit yields for the associated stands were reduced by 38% of the original volume. While commercial thinning is not considered to be a true silvicultural system, the application of this technique may have implications both for short- and medium-term timber supply. The current plan to harvest 23 700 cubic metres per year for the next 20 years will be modelled in this timber supply analysis.

History records — last 4 years of commercial thinning, and BCFS staff personal communication.

6.2 Unsalvaged losses

The purpose of this section is to provide an estimate of average annual unsalvaged volume loss to insect and disease epidemics, fires, wind damage or other agents over the long term on the timber harvesting land base. In the past these values have been applied to the entire land base proportionately. While this may be the only available information it should be noted that in the timber supply analysis this information can be location specific and/or species specific. The unsalvaged loss column reflects those areas in which the volume will not be recovered or salvaged.

Table 19. Unsalvaged losses

Cause of loss	Total loss (m^3/year)	Annual unsalvaged loss (m^3/year)
Fire	1000	1000
Wind	2500	1000
Pests	0	0
Total	3500	2000

Data source and comments:

Fire incidence in the South Island Forest District is limited due to the wetter coastal climate combined with a highly effective and successful initial attack. Since 1993 approximately l0 hectares a year is lost to fire, of which one-third of the area results in actual loss of volume. Most fires are small, usually less than 0.5 hectares in size and inaccessible, making salvage difficult and often uneconomical.

Windthrow occurs along fringes of harvested areas throughout the TSA, however, there is an aggressive salvage program with a goal of recovering 18 000 cubic metres in 1998/1999. Since the small-scale program began on October 15, 1998, approximately 1500 cubic metres/year of windthrow has been salvaged. It is estimated that approximately 1000 cubic metres/year of blowdown wood is not salvaged.

6. Current Forest Management Assumptions

Pests including insects and problem vertebrates are not at epidemic levels. There have been no major outbreaks of pests in the past 5 years and none are anticipated over the short term.

Root rot is the most prevalent disease in the South Island Forest District and in particular laminated root rot (*Phellinus weirii*) which occurs in pure or leading Douglas-fir stands (inventory types 1-8) mainly within the east division of the Arrowsmith TSA. Losses due to root rot are factored into the operational adjustment factor (OAF 2) used to adjust managed stand yield tables.

Data Sources and Comments:

Stefan Zeglen, Forest Pathologist Vancouver Forest Region, Jeff Beale, District Manager, Robson Valley Forest District, Albert Nussbaum, Growth and Yield Applications Specialist, BCFS, and Pat Hayes, South Island Fire Zone Manager, Coastal Fire Centre, and District Staff.

Pest Register Duncan Forest District, March 1992, Sterling Wood Group, March 1992. *Vancouver Forest Region Laminated Root Disease Incidence and Hazard Assessment Overview Level*, Phero Tech Inc., March 1992. *Laminated Root Rot: Ecological Relationships and Stand Productivity Impacts in Coastal Douglas-fir Ecosystems of British Columbia.* MSc. May 1992 Jeff Beale. *Arrowsmith TSR1 Analysis and Determination Binder,* 1996. Ministry of Forests: *Protection Branch Fire Reporting System Historic Fire Information Report.*

6. Current Forest Management Assumptions

6.3 Silviculture

6.3.1 Regeneration activities in managed stands

Recent plantations and future stands will be grown on managed stand yield tables (MSYTs) produced using the Forest Service TIPSY growth and yield model. The table below contains the inputs required to produce MSYTs for this analysis. A MSYT may be built from a number of tables if more than one regeneration method is used within an analysis unit. When this is the case, tables are produced for the different regeneration methods (each method and species combination) and then aggregated into one table. Mixed species MSYTs will require a site index conversion equation to account for changes in site index when changing species on the same site. If reliable conversion equations cannot be found stands will assume to be regenerated to the same leading species currently occupying the site.

Table 20. Regeneration assumptions by analysis unit

				OAFs		Method		Species (%)					Density (SPH)	
Analysis unit	**Site quality**	**Site index**	**Regen delay**	**1**	**2**	**Type**	**%**	**Fd**	**Cw**	**Pw**	**Ba Bg**	**Hw**	**Initial**	**Final**
Fd[a]	Good		2	15	See note[c]	Plant	100	75	10	5	10		1200	700
Fd[a]	Medium		2	15	See note[c]	Plant	100	70	10	10	10		1200	700
Fd[a]	Poor		3	15	See note[c]	Plant	100	70	10	10		10	1200	700
Cw	Good/ medium		2	15	5	Plant	100		58		12	30	1000	900
Cw	Poor		3	15	5	Plant Natural	85 15		70 100			30	1000	N/A
H/B/Sp	Good/ medium		2	15	5	Plant	100		20		10	70	1000	800
H/B/Sp	Poor		3	15	5	Plant Natural	85 15		20 15		15	80 70	1000	N/A
[b]Dr (the 20 ha/yr being planted to red alder)	All		3	15	5	Plant	100	Dr–100%					1600	900 sph at 12 years
Other stands and other Dr	All		3	15	5	Plant	100	75	10		15		1400	N/A

(a) Those Douglas-fir stands < 80 years of age located in the west division of the Arrowsmith TSA within BEC variant CWHvh1, CWHvm1, or CHWvm2 are assumed to be off-site and will be regenerated as per the H/B/Sp analysis units after the first harvest.

(b) In implementing the Vancouver Forest Region red alder strategy, in 1999 and in the next four years, 20 hectares a year of red alder will be planted in the Arrowsmith TSA. For analysis purposes, 20 hectares of the red alder analysis unit will be reforested back to red alder.

(c) Douglas-fir leading stands between 0-10 years within the east division will have an OAF 2 of 10. Douglas-fir leading stands between 11-50 years within the east division will have an OAF 2 factor (yet to be calculated) using the methodology and factors established in TSR1 and the timber harvesting land base as defined for this analysis.

6. Current Forest Management Assumptions

Data source and comments:

Forest district staff and Integrated Silvicultural Information System (ISIS) reports for last 5 years of silviculture.

Losses due to root rot in Douglas-fir-leading stands are accounted for in the operational adjustment factor (OAF2). For Douglas-fir leading stands between 11 to 50 years of age within the east division, an OAF 2 factor will be calculated using the methodology and factors applied in TSR1 (Jeff Beale's, MScF Thesis and Indices/Hazard Ratings for SIFD) and the timber harvesting land base defined in this analysis.

Douglas-fir leading stands younger than 11 years of age within the east division will have an OAF 2 of 10%. This reduced OAF 2 factor reflects a reduction in the severity of root rot as a result of current management practices aimed at aggressively treating root rot areas after harvesting by stumping and planting non-susceptible species.

It is recommended that prior to TSR III, work be done to determine the severity of root rot, the associated volume losses, and any volume gains that can be attributed to current practices that are aimed at mitigating root rot within the Arrowsmith TSA.

6.3.2 Immature plantation history

The purpose of this section is to identify areas of existing immature forest where the density (stems per hectare) was controlled and therefore should be assigned to a managed stand yield curve (TIPSY).

Table 21. Immature plantation history

Analysis unit	Area managed (%)				
	Age 1-10	Age 11-20	Age 21-30	Age 31-40	Age 41-50
All analysis units except Red alder	100	100	100	100	100

Data source and comments:

Forest district silviculture staff and inventory/silviculture records.

6.3.3 Not satisfactorily restocked (NSR) areas

Land classified in the Arrowsmith TSA FIP file as type identity 4 or 9 is included in the current timber harvesting land base. These type identities indicate not satisfactorily restocked land base. The purpose of this section is to identify the total area of NSR currently existing in the timber harvesting land base, and the estimated rate at which the NSR area will be restocked. If the figures provided in this table (usually from regional/district silviculture records and 5 year plans) differ from the NSR area showing on the inventory file, the figures in this table will be prorated to match the inventory file NSR total area.

6. Current Forest Management Assumptions

According to ISIS and Major Licensee Silviculture Information System (MLSIS) records, there is 438 hectares of current NSR and 180 hectares of backlog NSR. The current NSR is scheduled to be restocked within the regen delay period specified in Table 20 according to its respective analysis unit. The backlog NSR (180 hectares) is uneconomic to treat and will be assumed to restock with a 30-year regen delay.

Data source and comments:

ISIS and MLSIS records.

6.3.4 Tree improvement

Prior to the timber supply analysis, information on the proportion of planting stock that is Class A (selected) will be compiled to allow for the assessment of the potential timber supply implications through sensitivity analysis.

6.4 Integrated resource management forest cover requirements

As noted in Section 4.1, "Management zones and tracking of multiple objectives (grouping)" the discussion on multiple objectives, forest cover requirements may be examined at a number of different levels. These may be considered as layers in GIS terminology. One possible layer may be landscape units, another may be wildlife areas, while another may be resource emphasis. With the requirement to retain different forest characteristics across the landscape, it is important to identify how non-contributing forest (productive forest which does not contribute to the timber harvesting land base) may be considered in the forest cover requirements (i.e., maximum allowable disturbance or minimum area retention).

6. Current Forest Management Assumptions

Table 22a. Forest cover requirements for cutblock adjacency and visual values

Zone or group	Green-up height (metres)	Maximum allowable area not greened-up (%)	Area to apply constraint
Zone 1 VQO or RVQC = Retention (07)	5	3	Crown forested area
Zone 1 VQO or RVQC = Partial retention (08)	5	10	Crown forested area
Zone 1 VQO or RVQC = Modification (09)	5	20	Crown forested area
Zone 2 VQO or RVQC = Retention (07)	5	5	Crown forested area
Zone 2 VQO or RVQC = Partial retention (08)	5	15	Crown forested area
Zone 2 VQO or RVQC = Modification (09)	5	25	Crown forested area
Zone 3 IRM areas	3	25	Timber harvesting land base

Data source and comments:

BCFS recreation inventory, and two non-standard overlays produced by BCFS. The first overlay shows the visual quality objectives (established and recommended), and the other shows the visual quality management zones produced as part of the visual quality buy-back exercise.

VQO and RVQC constraints restrict the amount of harvesting within visual landscapes. Forest cover requirements for visual quality objectives have been determined using the documents *Procedures for Factoring Visual Resources into Timber Supply Analysis* (March 1998) and *Visual Mitigation Strategy Arrowsmith TSA* (November 1998). The strategy is in response to the Chief Forester's directive to achieve a 2% provincial buyback in timber supply through changes in visual management and divides the TSA into three types of zones — highly focal visual areas are zone 1, moderate focal visual areas are zone 2 and areas of low focal importance not covered by a VQO or RVQC are zone 3.

Zone 1 and zone 2 areas are managed to a green-up height of 5 metres as specified in the strategy. Zone 1 areas are managed to the mid range of the VQO or RVQC for % denudation and zone 2 areas are managed to the upper range of the VQO or RVQC for denudation. See Table 3 of the *Procedures for Factoring Visual Resources into Timber Supply Analysis* (March 1998) for the per cent denudation range. Those areas in zone 3, described above as IRM areas, are managed as per the *Forest Practices Code of BC Act* and receive a minimum green-up height of 3 metres and a 25% denudation.

Table 22b. Forest cover requirements for community watersheds and the Gordon River watershed

Zone or group	Maximum allowable area not greened-up (% or hectares)	Hydrological recovery height (metres)	Area to apply constraint
Community watersheds	5% per 5 years	—	Crown forested area
Gordon River watershed	24%	Hydrological recovery is modelled as per Table A2.2 of the *Coastal Watershed Assessment Procedure Guidebook (CWAP)*	Crown forested area
Escalante River watershed	≤165 hectares harvested in the south sub-basin within the next 8 years	—	Timber harvesting land base

Data source and comments:

Community watersheds — Several community watersheds have been identified within the Arrowsmith TSA. Only one, Little Qualicum, has been through a *Coastal Watershed Assessment Process* (CWAP) and due to its size and the small proportion of Crown land within the watershed, the recommendations were specific to cutblocks identified in the *Forest Development Plan* and not the entire watershed. Therefore, the base case will model for all community watersheds the community watershed guideline taken from the *Community Watershed Guidebook* of maintaining an area cut level in the small sub-basins that does not exceed 5% cent in five years.

Gordon River coastal watershed assessment — The lowest recommended equivalent clearcut area (ECA) caps for each sub-basin comprised of crown land within the Gordon River landscape unit were weighted by area to arrive at one average ECA. The recommended sub-basin ECAs were taken from data provided by the Ministry of Environment, Lands and Parks, and TFL Forests Ltd. The weighted average ECA of 24% will be applied to the Crown land portion outside of TFLs for the first ten year period. If model limitations regarding modelling ECAs can be overcome, the Gordon River ECA will be modelled throughout the rotation.

Escalante River coastal watershed assessment — As per the recommendations of the Watershed Advisory Committee (meeting minutes amended October 6, 1999), no more than 165 hectares will be harvested in the south sub-basin of the Escalante River watershed within the next 8 years.

All stand heights shown in Tables 22a and 22b refer to top height (inventory definition).

6. Current Forest Management Assumptions

Table 22c. Forest cover requirements for landscape unit biodiversity in the base case

Biogeoclimatic zone and variant	Natural disturbance type (NDT)	% minimum old-seral stage retention by landscape unit			Minimum age of old growth (years)
		Biodiversity emphasis options			
		High	Intermediate	Low	
CWH vh1, vh2, vm1, vm2,	1	19	13	1st rotation=4 2nd rotation=9 3rd rotation=13	> 250
MH mm1, mm2	1	28	19	1st rotation=6 2nd rotation=13 3rd rotation=19	> 250
CWH mm1, mm2, xm1, xm2	2	13	9	1st rotation=3 2nd rotation=6 3rd rotation=9	> 250
CDF mm	2	13	9	1st rotation=3 2nd rotation=6 3rd rotation=9	> 250

Data source and comments:

Biodiversity emphasis options (BEOs) have been assigned to each draft landscape unit within the Arrowsmith TSA through the *Regional Landscape Unit Planning Strategy*. While draft landscape units and seral target objectives have not yet been legally established, the old-seral stage targets for landscape units with higher or intermediate BEOs are currently being applied as per the *Landscape Unit Planning Guide* in the South Island Forest District. With regards to the low BEO, only one-third of the old-seral stage target is being met in the short term (0-70 years) as per provincial direction, two-thirds target in the medium-term (70-140 years) and the full target by the end of the third 70-year rotation, or 210 years from now.

The biodiversity old-seral stage targets come from stands greater than 250 years first in constrained/ non-contributing land base, followed by areas within the timber harvesting land base. When the target is not met the percentage target is obtained by reserving areas from the next older stands younger than 250 years.

The timber supply implications of applying a weighted-average approach as outlined in the December 1, 1997, memo, *Incorporating Biodiversity and Landscape Units in the Timber Supply Review* and attachment *Timber Supply Review Base Case Modelling Assumptions for Biodiversity and Landscape Units* will be modelled as a sensitivity analysis. The weighted average is 45% lower-, 45% intermediate-, and 10% higher-biodiversity emphasis option, with one-third of the old-seral stage target for lower BEOs being met in the first rotation, and phased to a full target over three rotations.

7. Data Management Assumptions for the Clayoquot Sound Area Based on the Scientific Panel Report

After many years of public participation and consultation regarding land and resource use in Clayoquot Sound, the provincial government in 1993 announced the Clayoquot Sound Land Use Decision (CSLUD). The decision zoned the Sound into three land use categories –protected areas, special management areas, and general integrated management areas. On October 1993, the provincial government announced the formation of the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound. The Panel was tasked with the objective of defining "sustainable", "world class", forest practices for the area. On May 30, 1995, the Panel submitted to government a three-volume report containing more than 120 recommendations on forest practices and First Nations issues. On July 6, 1995, government announced acceptance of the Panel's report and its intention to fully implement the Panel's recommendations.

Since 1995 government in consultation with the Clayoquot Sound Central Region Board, First Nations, licensees and others have been working on the implementation of the recommendations. In the area of planning, four out of 15 watershed unit plans are almost complete. Watershed unit planning delineates reserve areas and harvestable areas. As per the Panel's recommendations, once watershed plans are complete for the Sound, harvest levels will be based on these plans.

Until such a time, the full implications for timber supply are uncertain and difficult or impossible to predict by conventional modelling. The Clayoquot portion of the Arrowsmith timber supply review will use the same approach applied in the last timber supply analyses for the Clayoquot portion of the Arrowsmith TSA, TFL 44, and TFL 54. Namely, the conventional timber supply analysis will be replaced by an area-calculation predicated on assumptions interpreted from recommendations by the Panel. Specifically, the recommendations that will be modelled in the base case are:

- at least 40% of the forest in a watershed-level planning unit (i.e., all reserves plus forest retained in harvestable areas) must be in age classes 8 and 9 (i.e., 141 years or older); and,
- a 1% watershed-based rate of cut.

Old-growth forests (older than 140 years) are to cover 40% of the total forested area of each watershed at all times. In some cases, this constraint will be met completely from outside the timber harvesting land base, in other cases it will require a contribution from the timber harvesting land base. Where insufficient old growth exists within a given watershed, a complementary area of the oldest available forest in the watershed will be reserved. One per cent of the remaining timer harvesting land base area will then be calculated.

Similar to past analyses, a one per cent watershed-based rate of cut will be applied to the timber harvesting land base for each watershed. Watersheds within CSLUD were identified and classified by BCFS hydrologist in 1997. In deriving the timber harvesting land base for use in this calculation, the same land-base deduction procedures will be applied as in the remainder of the Arrowsmith TSA. Further deductions may also be applied to meet 40% old growth requirement as described above.

To account for the influence of the last ten years of harvesting, it will be assumed that the area less than ten years old will be evenly distributed in ten one-year age classes. Ten per cent of the area in the watershed with forest cover less than ten years old will then be subtracted from the one per cent area calculation. This latter step accounts to some extent for anticipated delays in harvesting in watersheds which first require, in accordance with recommendation R3.1, completion of a "watershed sensitivity analysis and stream channel audit", or in which "significant hydrological disturbance, substantial or chronic increase in sediment yield, or significant deterioration in aquatic habitat" are identified.

8. Sensitivity Analysis

Sensitivity analysis can provide a measure of the timber supply impact if uncertainty in management assumptions and/or data integrity exists. The magnitude of the increase or decrease in a particular variable should reflect the degree of uncertainty surrounding the assumption. For instance, minimum harvestable age may be developed based on some minimum stand attributes, which currently appear to dictate the earliest time stands are eligible for harvest. Sensitivity analysis may indicate that a small reduction in these attributes may alleviate anticipated harvest level reductions in the future. It is important that Forest District staff outline any information that could bound the level of uncertainty. By developing and testing a number of sensitivity analyses, it is possible to determine which variables most affect results.

8. Sensitivity Analyses

Table 23. Sensitivity issues

Issue to be tested	Sensitivity levels
Minimum harvestable age	+/–10%
Existing stand yields	+/–10%
Regenerated stand yields	+/–10%
Site index estimate for older stands	OGSI
Land base changes	+/– 10%
Visual quality objectives	High/low range % denudation
Harvest flow	alternatives to base case
Green-up age	+or –5 years
Adjacency and green-up guidelines	+or– 5% cut over area
Wildlife tree patches	Area reduction assuming WTPs are > 2 hectares in size and therefore contribute to old-seral stage target.
Biodiversity requirements	Apply full old-seral stage target to all draft landscape units immediately. Apply full old-seral stage target to those draft landscape units with low BEO potential marbled murrelet habitat. Apply early-seral stage, mature + old seral stage requirements.
Harvest priority	No priority
Fragmented areas	Apply increased cover constraints to areas identified as fragmented.
Commercial thinning on Fd good and medium sites, east division	Model at different target levels, over short-, medium- and long-term.
Red alder	Model at different target levels, over short-, medium- and long-term with 20 hectares/year planted to Dr.
Silviculture systems	Varying levels of retention
Biodiversity emphasis options	Apply 10-45-45
VILUPS — RMZ	Apply EMZ, SMZ and GMZ objectives