Arrowsmith Timber Supply Area
TSR3 Data Package

Prepared for:
Arrowsmith TSA Licensee Group

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List of Acronyms

AAC	Allowable Annual Cut
BCTS	British Columbia Timber Sales
BEC	Biogeoclimatic Ecosystem Classification
BEO	Biodiversity Emphasis Option
CASH6	Critical Analysis by Simulation of Harvesting
CWAP	Coastal Watershed Assessment Procedure
ESA	Environmentally Sensitive Area
FPC	Forest Practices Code
FPPR	Forest Planning and Practices Regulation
FSP	Forest Stewardship Plan
GIS	Geographic Information System
ILMB	Integrated Land Management Bureau (Ministry of Agriculture and Lands)

List of Acronyms

IP	Information Package
IRM	Integrated Resource Management
IRM	Integrated Resource Management
LU	Landscape Unit
MHA	Minimum Harvestable Age
MoFR	Ministry of Forests and Range
NDT	Natural Disturbance Type
NSR	Not Satisfactory Restocked
OAF	Operational Adjustment Factor
OGMA	Old Growth management Area
PSYU	Public Sustained Yield Unit
QMD	Quadratic Mean Diameter
RFI	Recreation Features Inventory
RMZ	Riparian Management Zone
RRZ	Riparian Reserve Zone
RVQC	Recommended Visual Quality Class
SI	Site Index
SIFD	South Island Forest District
SRMZ	Special Resource Management Zone
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation Program for Stand Yields
TL	Timber License
TNRG	Timberline Natural Resource Group
TSA	Timber Supply Area (or Timber Supply Analysis)
TSR	Timber Supply Review
UREP	Use, Recreation and Enjoyment of the Public Reserve
UWR	Ungulate Winter Range
VDYP	Variable Density Yield Prediction
VILUP	Vancouver Island Land Use Plan
VISLUP	Vancouver Island Summary Land Use Plan
VLI	Visual Landscape Inventory
VQO	Visual Quality Objective
VRI	Vegetative Resources Inventory
WHA	Wildlife Habitat Area
WTR	Wildlife Tree Retention

1.0 INTRODUCTION

The Chief Forester is required to make an allowable annual cut (AAC) determination for each Timber Supply Area (TSA) in the province once every five years. The last determination for the Arrowsmith TSA came into force in September 2002. The timber supply review (TSR) process includes opportunities for public and First Nations review. This Data Package is the first document produced in support of the current TSR process (referred to as TSR 3). The information provided here will be used to define and model several timber supply scenarios. These results will be presented in a Timber Supply Analysis report. Finally, the Chief Forester will consider the Timber Supply Analysis report and other sources of information in order to make a new AAC determination. This determination will be published in a report entitled '*Arrowsmith Timber Supply Area – Rationale for AAC Determination*'.

This Data Package has been prepared on behalf of the Arrowsmith Timber Supply Area (TSA) Defined Forest Area Management (DFAM) licensee group. Defined Forest Area Management (DFAM), developed by the provincial Ministry of Forests and Range (MoFR), is a policy framework to identify the obligations and opportunities for collaborative forest management within the province's TSA's. Under DFAM, forest companies and BC Timber Sales (BCTS) will assume collective responsibility for timber supply analysis within each TSA. The DFAM group for the Arrowsmith includes the companies holding Forest Licenses in the TSA, and BC Timber Sales (BCTS).

This document provides a summary of the inputs and assumptions made in preparing the timber supply analysis data model. Included are inventory and land base summaries, growth and yield information and management assumptions for timber and non-timber resources as they relate to timber supply.

The Data Package allows the reader to consider the inputs and assumptions to be used in the timber supply analysis. This includes:

- The documentation of inventory data and sources;
- Classification of the land base according to each hectare's contribution to management (harvest, resource management for wildlife, *etc*.);
- Land productivity estimates and prediction of stand growth and timber yield;
- Silviculture and harvesting regimes;
- Action taken to model multi-resource requirements; and
- Timber supply scenarios and sensitivity analyses to be evaluated.

Upon acceptance by the MoFR Timber Supply Analyst, the assumptions and methodology provided in the Data Package will be used by the DFAM group to prepare and submit a timber supply analysis to the MoFR.

This document will evolve and be finalized when published as an appendix to the Timber Supply Analysis Report. For further information about the data package and timber supply analysis for the Arrowsmith TSA, please contact Jerry Miehm:

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1.1 Purpose of the Data Package

The purpose of the timber supply analysis data package is to:

- Provide a detailed account of the management unit-specific land base, growth and yield, and management assumptions related to timber supply. The Chief Forester must consider how the management assumptions will be modelled in the timber supply analysis and be applied under the forest act when determining the AAC;
- Provide a means for communicating data inputs and analysis methodology among licensees, MoFR, MoE, and other users;
- Provide MoFR staff with the opportunity to review the data and information that will be used in the timber supply analysis before it is initiated;
- Ensure that all relevant information accounted for in the analysis is to a standard acceptable to MoFR staff; and
- Provide the evidentiary basis for the information used in the analysis.

The Data Package provides information on:

- Forest and other resource inventories and adjustments;
- Definition of the land base suitable for timber harvesting;
- Classification of the land base into management zones, and growth and yield classes (analysis units);
- Development and provision of timber growth and yield information;
- Forest protection and salvage;
- Resource management emphasis; and
- Timber supply analysis methods, including model choice and management scenarios.

1.2 Process, Roles and Responsibilities

The MoFR plays a key role in reviewing and accepting the both the Data Package and the subsequent timber supply analysis. They have provided technical support, facilitated resolution of issues, and validated technical information. Table 1 shows the general roles and responsibilities associated with the timber supply analysis leading to an AAC determination.

Table 1 – Roles and Responsibilities

DFAM group obligations	**Government obligations**
Collect and prepare a data package based on the best available information	Set standards for the data package Review and accept the data package
Complete an analysis for the Arrowsmith TSA	Set standards for the analysis Review and accept the analysis
Provide information to the public and First Nations	Consult with First Nations Determine the AAC for the Arrowsmith TSA

2.0 INVENTORY AND MODEL FILES

This Data Package documents the inventory and forest management issues that will be incorporated into the analysis, as well as the sources of information used to model the timber supply. The best available data has been used.

For the Arrowsmith TSA, data for three distinct areas was required:

- The Pre-Take Back TSA – much as it existed at TSR 2;
- A TFL 44 Take Back area around Maggie Lake; and
- TFL 46 Take Back areas at Port Renfrew, Nitnat Lake and the Cowichan Valley.

These datasets are quite different in structure and content: no attempt has been made to consolidate them into a single spatial dataset for analysis purposes. Separate coverages have been maintained, and three individual resultant coverages have been created. Figure 1 shows the TFL take back areas in relation to the original TSA boundaries.

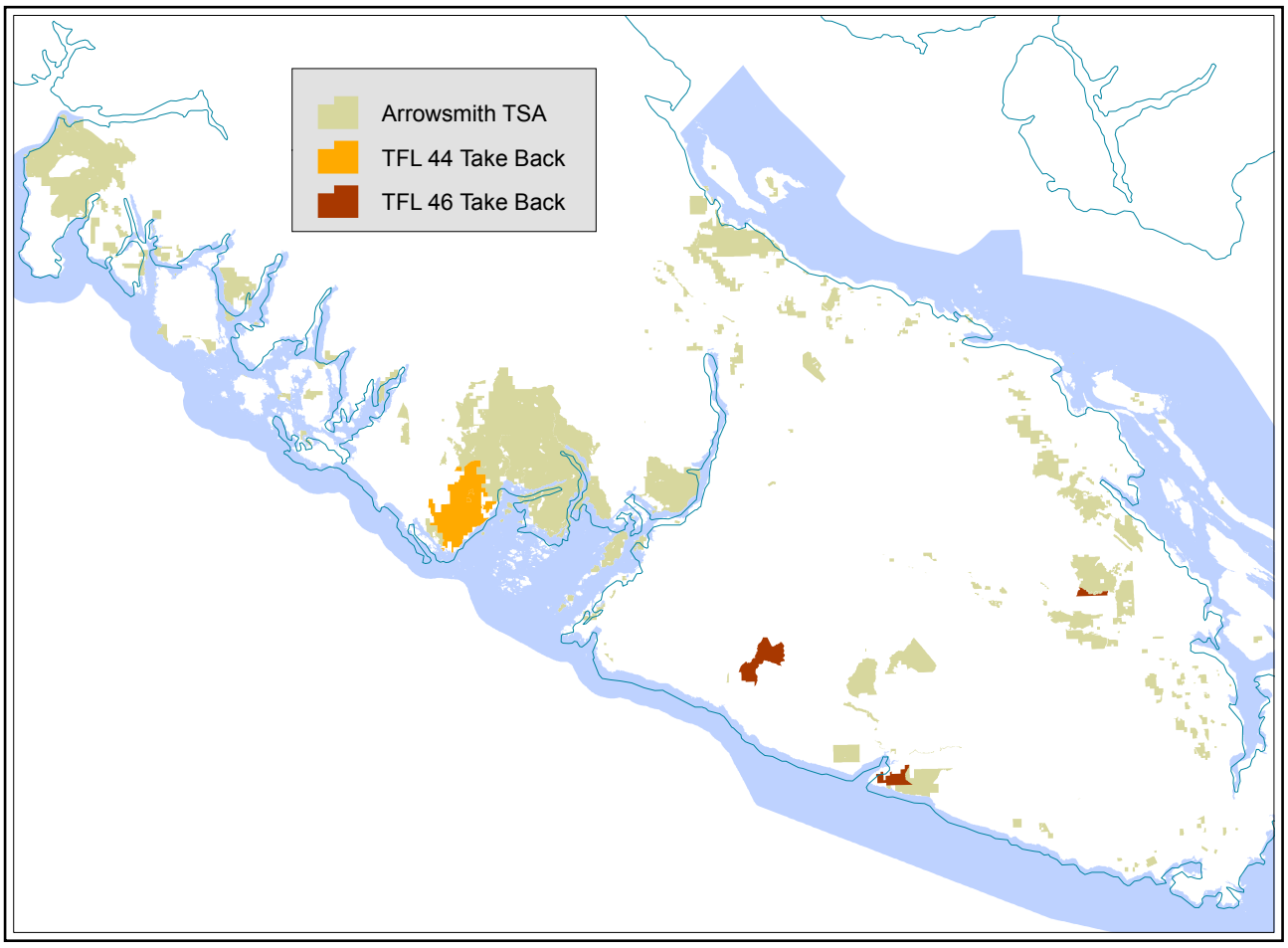

Figure 1 – Arrowsmith TSA and TFL Take Back Areas

2.1 Data Sources

Most of the data were provided from the Ministry of Forests and Range (MoFR) or from the Integrated Land Management Bureau (ILMB) of the Ministry of Agriculture. The list of inventory information is shown in Table 2. Some of the data sources are also discussed in more detail in the sections below.

Table 2 – Spatial Data Sets

Data	Source	Vintage (Update)
Forest Cover (Rollover to VRI Format)	MoFR	1992 (2005)
Ungulate Winter Range	MoFR (SIFD)	2006
Ownership	(see below)	(2006)
Landscape Unit Boundaries	ILMB	2005
Watershed Boundaries	MoFR (SIFD)	2005
Community Watersheds	MoE (LRDW)	2005
Biogeoclimatic Classification	MoE	1994
Environmentally Sensitive Areas	TSR 2 Resultant	1993 (2001)
Recreation Inventory	MoF	1993
Economic Operability	Timberline	2005
Old Growth Management Areas	ILMB	2006
Forest Development Plans	Licensees	2005
Visual Landscape Inventory	MoFR (SIFD)	1997 (2007)
Landscape Unit Boundaries	ILMB	1999
Wildlife Habitat Areas	MoFR (LRDW)	2007
VILUP Resource Management Zones	ILMB	1997
Clayoquot Sound Watershed Plans	ILMB	2006
Roads	SIFD, Licensees	2005
Landslides	MoFR (SIFD)	2006

Separate datasets were provided for each of the TFL take back areas. In both cases the data had been delivered to MoFR by the original tenure holder at the time of the take back. The TFL 44 data was supplied by South Island Forest District (SIFD) staff and the TFL 46 data set was provided by the MoFR Coast Region. The data received is listed in Table 3.

Table 3 – Spatial Data for TFL Take Back Areas

TFL 44 Spatial Data	**TFL 46 Spatial Data**
Biogeoclimatic Subzones	Contours
Contours	Creeks
Community Watersheds	Forest Cover
Drainage	Forest Ecosystem Network (FEN)
Drainage Buffers	Landscape Unit Boundaries
Economic Operability	Logged Blocks
Forest Ecosystem Network	Marbled Murrelet Habitat
Forest Cover	Mineral Claims
Operability	Recreation Features Inventory
Resource Management Zones	Roads
Roads	Settings
Terrain Classification	Terrain Classification
Visual Landscape Inventory	Terrestrial Ecosystem Classification
Watersheds	Ungulate Winter Range
	Visual Landscape Inventory
	Water

2.2 Forest Cover Inventory

The current forest cover for the Arrowsmith TSA has been retrofitted to VRI format. This inventory has been updated for logging, and timber volumes have been projected, to the end of 2005. Average site index and species composition have been assumed for approximately 1000 hectares of the TSA that have no forest cover information. The age of these stands has been set to zero.

3.0 LAND BASE

3.1 Timber Harvesting Land Base Definition

The data package includes a description of issues, information sources, assumptions, and criteria used to estimate the land base available for timber harvesting, including any relevant data processing or adjustments.

Table 4 presents the results of the land base classification process to identify the timber harvesting land base (THLB). Individual areas may have several classification attributes. For example, stands within riparian reserve boundaries might also be classified as non-commercial. These areas would have been classified on the basis of this latter attribute, prior to the riparian classification. Therefore, in most cases the net reduction will be less than the total area in the classification. The order of the entries in Table 4 corresponds to the sequence in which the land base classifications were applied.

3.1.1 Changes Since TSR 2

The TSR 2 Determination (September 1, 2002) resulted in an AAC of 373,300 cubic metres per year. Since then, it has changed for the following reasons:

- the transfer of land from TFL 46 (Port Renfrew, Nitnat Lake and Hill 60) to the TSA on April 1, 2004 – the AAC increased by 20,196 m3/year to 393,496 m3/year.
- a Part 13 Order for the Hill 60 Designated Area on April 1, 2004 – the AAC decreased by 1700 m3/year to 391,796 m3/year
- the transfer of land from TFL 46 (Maggie Lake) to the TSA on April 22, 2004 – the AAC increased by 27,000 m3/year to 418,796 m3/year.

This analysis used several updated inventories, leading to further minor changes in the THLB. A summary comparison of the TSR 2 and TSR 3 land bases is presented in Table 5. The TSR 3 information is broken down into three categories – the pre-take back TSA area and each of the take back components for TFL 44 and TFL 46. Tables throughout the remainder of this document will present total areas only and will not separately list the TFL take back areas.

Table 4 – Timber Harvesting Land Base Determination

	Area	Percent of Total Area	Percent of Productive Area	Report Section
Total Area	**155,478**	**100%**		
Not Administered By MoFR For Timber Supply	10,968	7.1%		3.2.1
Classified As Non-Forest	16,524	10.6%		3.2.2
Roads And Trails	3,895	2.5%		3.2.3
Productive Crown Forest Land	**124,090**	**79.8%**	**100%**	
Environmentally Sensitive Areas	19,412	12.5%	15.6%	3.2.4
Economically Inoperable Areas	11,810	7.6%	9.5%	3.2.5
Low Stocking	7,083	4.6%	5.7%	3.2.6
Non-Commercial Forest Types	145	0.1%	0.1%	3.2.7
Landslides	99	0.1%	0.1%	3.2.8
Wildlife Habitat	4,026	2.6%	3.2%	3.2.9
Riparian Reserve And Management Zones	6,882	4.4%	5.5%	3.2.10
Cultural Heritage Resources	304	0.2%	0.2%	3.2.11
Old Growth Management Areas	102	0.1%	0.1%	3.2.12
Low Growing Potential	1,217	0.8%	1.0%	3.2.13
Recreation Resources	2,254	1.4%	1.8%	3.2.14
Experimental Plots	180	0.1%	0.1%	3.2.15
Total Reductions to Productive Forest	**53,514**	**34.4%**	**43.1%**	
Timber Harvesting Land Base	**70,576**	**45.4%**	**56.9%**	
Timber Licenses Reversions	-			3.2.16
Allowance For Future Roads	1,949	1.3%		3.2.17
Long Term Timber Harvesting Land Base	**68,627**	**44.1%**		

Table 5 – Comparison of TSR 2 and TSR 3 Land Base

	TSR 2	TSR 3			
		TSA	TFL 44 Take Back	TFL 46 Take Back	Total
Total Area	1,574,719	141,342	9,588	4,548	155,478
Not Managed by MoFR	1,376,733	10,968			10,968
Non Productive	85,936	19,032	816	572	20,419
Productive Forest Land	112,050	111,341	8,772	3,977	124,090
Productive Reductions	51,953	50,154	1,789	1,570	53,514
THLB	60,097	61,187	6,982	2,407	70,576

3.2 Exclusions from the Timber Harvesting Land Base

This section describes the process by which the entire TSA landbase is examined, and areas that are unavailable for long-term forest management are so-designated. This 'netdown' process identifies the THLB, but also categorizes land that, though unavailable for harvesting, may contribute to other resource objectives.

3.2.1 Not Administered by MoFR for Timber Supply

A typical netdown process begins with the outer boundary of the TSA and, as the first step in the netdown, removes any area that is not under the control of the MoFR. Private Land, National Parks, Indian Reserves, and Woodlot Licenses are examples of the types of ownership that might be removed from the THLB at this stage. Some, but not all, of this area might also be unavailable to meet other resource objectives. However, the netdown for the Arrowsmith TSA has not been typical in this respect. An up-to-date ownership coverage was not available for this project. Instead, updates were made to an ownership coverage that was extracted from the TSR 2 resultant database. Updates to this information were available from Landscape Unit Planning work and from a chart mapping projects on the eastern portion of the Island. The take back areas from TFL 44 and TFL 46 are well documented and have been added. As a consequence of the way that this new ownership coverage was built, it was expected that it would only include land that was under the administrative control of the MoFR.

Maps of the resulting ownership data were carefully reviewed by licensee and SIFD staff. As a result of that review, 10,968 hectares were identified as being outside of the control of the MoFR. These areas included private land, a TFL block, Woodlot Licenses and areas of unknown ownership. Table 6 shows this area removal.

Table 6 – Land Not Administered by the MoFR for Timber Supply Purposes

Land classification	Code	Reduction (%)	Area removed (ha)
Private Land, TFL, WL, etc	n/a	100%	10,968

Although some proposed Woodlot License areas are known, they have not been removed from the THLB because they have not yet been awarded. Crown land on the Southern Gulf Islands excluded for TSR2 has been retained in the THLB for this analysis.

3.2.2 Classified as Non-Forest

Non-forest land includes areas in the forest cover that are either non-vegetated (such as lakes, rocks, shrubs that occupy less than 5% of the land, etc.), or are unreported. Non-forest land also includes vegetated areas where less than 10% of the area is occupied by trees. With the exception of areas classified as bare ground or little tree cover but recently logged, all these non-forest areas are considered non-contributing to timber supply and are excluded from the Arrowsmith TSA THLB. These exclusions are shown in Table 7.

Table 7 – Exclusion of Land Classified as Non-Forest

Land Classification	Code	Reduction (%)	Area removed (ha)
Non-Vegetated or Unclassified	N or U	100	6,624
Vegetated Non-treed	VN	100	1,980
Non Productive	NP	100	7,920
		Total Area Removed	16,524

3.2.3 Roads and Trails

Existing roads for the Arrowsmith TSA are described as line features in the consolidated road coverage used for the Arrowsmith TSA Economic Operability Study. These roads have been buffered using a 10 metre total buffer width to create polygon features. These polygons are applied as reduction to the current productive forest. Reductions to the THLB due to existing roads and trails are shown in Table 8.

Table 8 – Exclusion of Existing Roads

Description	Road Length (km)	Road Width (m)	Total Area (ha)	Area Removed (ha)
Existing Roads	3382	20	4,285	3,895

Future roads, trails and landings reductions are applied after stands are harvested for the first time in the simulation model. These are discussed in Section 3.2.17.

3.2.4 Environmentally Sensitive Areas

Some productive land is classified as environmentally sensitive and/or significantly valuable for other resources. For timber supply analysis purposes, Environmentally Sensitive Areas (ESA's) are identified and delineated through forest cover polygons and are considered for reductions to the THLB. Three categories of ESA's are taken into account in the context of the Arrowsmith TSR3: sensitive soils, sites with suspected regeneration problems, and avalanche areas. Two ESA classes are recognized within each category: highly sensitive (1) and moderately sensitive (2). Reductions to the THLB due to these ESA's are shown in Table 9.

Table 9 – Reductions for Environmentally Sensitive Areas

ESA category	Code	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Soils	Es1	90%	23,228	18,099	14,595
Soils	Es2	20%	26,863	23,180	4,442
Regeneration	Ep1	90%	9	9	9
Regeneration	Ep2	50%	-	-	-
Avalanche	Ea1	100%	698	440	338
Avalanche	Ea2	100%	105	71	28
				Total Area Removed	19,412

3.2.5 Economically Inoperable Areas

The Chief Forester recommended in the *Arrowsmith TSA, Rationale for AAC Determination (2002)* that operability be revisited prior to TSR3. The *Arrowsmith TSA Economic Operability Assessment* was completed in March 2006. This model is based on timber values and delivered wood costs for stands of timber. A stand was deemed inoperable if the net value (timber value minus costs) of a stand was less than a -$10 profit margin. This model was based on 2006 delivered wood costs, 10 year median log selling price tables, and representative log grade distributions.

This study was updated in early 2007 to incorporate improved site index estimates that became available from the *Site Index Adjustment of the Arrowsmith Timber Supply Area* (2007). This had an impact on the projected volumes for second growth stands, which in turn affect the stand value. In conjunction with the SI update, the values for second growth timber were adjusted using industrial end use sort (EUS) information. The resulting reductions to the THLB due to economic inoperability are shown in Table 10.

Table 10 – Reductions for Economically Inoperable Areas

Description	Codes	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Inoperable	<-$10	100	20,120	15,391	11,810

3.2.6 Low Stocking

Stands older than 250 years with a volume per hectare of less than 300 m3/ha are not harvested under current logging practices, and are thus removed from the THLB. Table 11 shows this reduction.

Table 11 – Reductions for Low Stocking

Description	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Low Stocking	100	16,949	9,552	7,083

3.2.7 Non-Commercial Forest Types

These are the stands that are physically operable and exceed the criteria for defining sites with low timber growing potential, but are not currently being utilized or are marginally merchantable. Cottonwood and maple stands fall into this category. Table 12 shows the area from each of these types that were excluded from the THLB.

Table 12 – Reductions for Non-Commercial Forest Types

Leading Species	Inventory Type Group	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Cottonwood / Coniferous	35	100	21	21	17
Cottonwood / Deciduous	36	100	11	10	9
Maple	39	100	257	251	118
				Total Area Removed	145

3.2.8 Landslides

Landslides have been mapped for the Clayoquot portion of the TSA and are removed from the THLB as shown in Table 13.

Table 13 – Reductions for Landslides

Description	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Landslide	100	232	193	99

Colluvium sites are characterized by rock and soil accumulated at the lower reaches of slopes. These sites may be difficult to reforest if they are harvested, and may not achieve harvestable volumes in cases where they are currently forested. Approximately 250 hectares of such sites are thought to exist, but they are not mapped. These will be factored into the timber supply analysis through yield curve reductions.

3.2.9 Wildlife Habitat

Marbled Murrelet and deer are the main species for which habitat areas are managed within the TSA. Since TSR2 many ungulate winter range and wildlife habitat areas have been identified. Harvesting is prohibited in these areas, so they are netted out of the THLB. Reductions for wildlife habitat are summarized in Table 14.

Table 14 – Reductions for Wildlife Habitat

Description	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Ungulate Winter Range	100	3,962	3,733	2,690
Marbled Murrelet	100	2,855	2,569	1,316
Douglas-fir/Garry Oak	100	20	20	20
Data Sensitive	100	145	-	-
			Total Area Removed	4,026

3.2.10 Riparian Reserve and Management Zones

Riparian areas occur next to streams, lakes and wetlands. In TSR 2, riparian reserve zones were dealt with aspatially – a 4.8% reduction was applied. No data is available to suggest that a change in the level of this netdown is required. However, it has been 'spatialized'. A buffer width of 15 metres (each side) was applied to all mapped steams in the non-Clayoquot portion of the TSA. The productive area that falls within this buffer represents 5.0% of the productive landbase of the TSA. This netdown represents the areas that fall (operationally) within reserve zones, as well as the impact of management zones with which limited harvesting is permitted.

For the Clayoquot Sound portion of the TSA, watershed reserve networks from the completed (and draft) watershed plans were consulted for riparian areas. These plans delineate reserve networks that are designed to protect all non-timber resource values, including riparian areas. No harvesting is allowed in these areas and they have been netted out of the THLB.

The TFL 44 dataset had riparian buffers included. These had been built according to the Forest Practices Code (FPC) guidebook. Three types of buffers were included, depending on the level of harvest permitted; 100% netdown, 50% netdown, and 25% netdown.

The TFL 46 dataset did not include a riparian buffer coverage. However, the single and double line water features were classified according to FPC guidelines. Buffers for Riperian Reserve Zones (RRZ's) and Riperian Management Zones (RMZ's) were built and added to the resultant. RRZ's were completely removed from the THLB; RMZ's had a 25% netdown applied.

Table 15 summarizes the resulting riparian reserved and management area reductions to the THLB consolidated from all four datasets (TSA, Clayoquot, TFL 44 and TFL 46).

Table 15 – Reductions for Riparian Areas

Description	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Riparian Reserve Zones	100	6,436	5,134	3,303
Riparian Management Zones	50	284	262	117
Riparian Management Zones	25	1,118	1,054	216
			Total Area Removed	3,636

3.2.11 Cultural Heritage Resources

Cultural heritage resources will be accounted for in two ways:

- Any mapped culturally or archaeological sensitive areas have been netted out of the THLB
- An aspatial net-down of 7% has been applied to all stands more than 80 years of age, within 200 meters of a shoreline, that have a cedar/cypress component of more than 20%.

This same approach was used in TSR 2.

Table 16 – Reductions for Cultural Heritage Resources

Description	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Known Archeological Sites	100	214	178	128
Coastal Cedar Resources	7	3,872	3,667	176
			Total Area Removed	304

3.2.12 Old Growth Management Areas

An Old Growth Management Area (OGMA) is defined in the BCFPC Operational Planning Regulation as an area established under a higher level plan which contains or is managed to replace structural old growth attributes. OGMA's have been identified for three landscape units in the Arrowsmith TSA. For the base case these areas are assumed to satisfy all seral biodiversity requirements and are unavailable for timber supply. Reductions for OGMA's are summarized in Table 17.

Table 17 – Reductions for Old Growth Management Areas

OGMA (Landscape Unit)	Reduction (%)	Total area (ha)	Productive area (ha)	Net area removed (ha)
Gordon	100	616	579	44
San Juan	100	256	249	57
Walbran	100	1	1	1
			Total Area Removed	102

The net area removed is small due to OGMA's overlapping to a large degree with WHA's which were netted out of the land base above (Section 3.2.9).

OGMA's have been defined for other landscape units as well, but these are in draft only and will not be netted out of the THLB for the base case. The effect of reserving draft OGMA's – and removing old seral constraints – will be examined during sensitivity analyses.

3.2.13 Low Growing Potential

These are stands that are not likely to achieve a harvestable volume over a reasonable time horizon. These sites may fall into this category in two ways: they are inherently unproductive due to soil moisture and nutrient regimes (*i.e.* low site index); or the sites might not be fully occupied with commercial tree species. At this stage, the following stand types are netted out of the THLB:

- Coniferous stands with less than 300 m3/ha at 150 years; and
- Red alder stands less than 200m3/ha or older than 70 years.

This reduction is applied after stands with low stocking or non-commercial species have been netted out of the land base. In order to apply this reduction, stand volume at 150 years of age was forecast using Variable Density Yield Predictor (VDPY). The area that was netted out due to low growing potential is shown in Table 18 broken down by leading species.

Table 18 – Reduction for Sites with Low Growing Potential

Leading Species	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Cottonwood	100	26	23	-
Balsam	100	47	47	20
Red Cedar	100	1,045	1,004	697
Yellow Cedar	100	120	116	85
Alder	100	5	-	-
Douglas-fir	100	438	414	308
Western Hemlock	100	162	138	83
Maple	100	2	-	-
Lodgepole Pine	100	40	33	23
White Pine	100	3	-	-
Unknown	100	48	-	-
			Total Area Removed	1217

3.2.14 Recreation Resources

Recreation data from several different sources including:

- Mapped recreational trails and sites;
- Use, Recreation and Enjoyment of the Public Reserves (UREP);
- Miscellaneous recreation reserves; and
- The Recreation Feature Inventory (RFI).

Recreation sites and UREP were removed from the THLB. Recreation trails were received as line features; they were buffered by 25 metres (each side) and also removed from the THLB. Three different netdowns were based on the RFI:

- a 100% netdown if the Feature Significance was either ‘A’ or ‘B’ and the Management Class was ‘0’
- a 50% netdown if the Feature Significance was either ‘A’ or ‘B’ and the Management Class was ‘1’
- a 10% netdown if the Feature Significance was ‘C’ and the Management Class was ‘1’ and the feature was in a visually sensitive area (a VQO of Preservation, Retention or Partial Retention).

The area that was removed from the THLB for each of the preceding categories is summarized in Table 19.

Table 19 – Reduction for Recreation Values

Description	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Recreation Sites	100	241	164	140
Recreation Trails	100	79	66	39
Miscellaneous Recreation Reserves	100	886	733	302
Recreation Reserves	100	1,037	616	357
Recreation Features Inventory – 100% Netdown	100	1,448	455	77
Recreation Features Inventory – 50% Netdown	50	3,378	2,436	765
Recreation Features Inventory – 10% Netdown	10	11,437	9,336	574
			Total Area Removed	2254

3.2.15 Experimental Plots

All Permanent Sample Plots (PSP) and Experimental Plots (EP) were removed from the THLB, as shown in Table 20.

Table 20 – Reductions for Experimental Plots

Description	Reduction (%)	Total Area (ha)	Productive Area (ha)	Net Area Removed (ha)
Experimental Plots	100	256	228	180

3.2.16 Timber Licenses Reversions

No allowance has been made for reverting Timber Licenses (TL). Where unreverted TL's occur in the existing data, their stand volumes and ages will be set to zero at the start of the base case and sensitivity model runs.

3.2.17 Allowance for Future Roads

An allowance for future roads has been calculated based on the total chance road network that was compiled for the *Economic Operability Assessment* (2006). The current road inventory for the Arrowsmith TSA is 2325 kilometers. When buffered, these roads remove 3,247 hectares (or 2.1%) from the productive forest landbase. In order to complete the road network to provide access to the entire

physically accessible landbase, an additional 1033 kilometers of road is required. An allowance for future roads has been estimated using the netdown ratio devised from the current roads and buffers.

4.0 MANAGEMENT ZONES AND ANALYSIS UNITS

Management Zones delineate areas that are subject to unique forest cover objectives that will have an impact on the way that timber is scheduled for harvest during the simulation model runs. Since the constraints that will be applied to the Clayoquot and non-Clayoquot portions of the TSA are quite different, they are described in separate sections.

4.1 Management Zones for TSA Outside of Clayoquot Sound

Five types of Management Zones have been defined for the areas of the TSA that fall outside of Clayoquot sound. These zones are implemented to manage for:

- Landscape Level Biodiversity;
- Visual Quality Objectives;
- Integrated Resource Management;
- Community Watersheds; and
- Fisheries-Sensitive and CWAP Watersheds.

4.1.1 Landscape Level Biodiversity

Landscape-level biodiversity is managed by ensuring that a quota of old growth forest stands is maintained across the landscape. To ensure that the retained old growth is spatially distributed and represents the full range of natural ecological conditions, these quotas are established by landscape unit and biogeoclimatic subzone and variant. The distribution of TSA land by LU and BCG zone is shown in Table 21.

Table 21 – Landscape Unit / BCG Summary

Landscape Unit	BGC Zone	Total Area (ha)	Productive Area (ha)	Net Area (ha)
Barkley Sound Islands	CWHvh1	1,634	1,546	1,211
	CWHvm1	688	656	580
Burman	CWHvh1	3	3	1
	CWHvm2	9	6	1
	MHmm1	1	0	0
Cameron	CMAunp	195	2	2
	MHmm1	16	1	1
Caycuse	CWHvm2	5	-	-

Landscape Unit	BGC Zone	Total Area (ha)	Productive Area (ha)	Net Area (ha)
Chemainus	CDFmm	98	76	66
	CWHmm2	565	526	325
	CWHxm	383	351	318
	CWHxm1	5,914	4,201	2,661
	CWHxm2	2,840	2,613	1,513
	MHmm1	15	-	-
China	CWHxm2	123	108	92
Clayoquot SMZ	CMAunp	132	3	-
	CWHvh1	4,728	3,954	1,890
	CWHvm1	15,174	12,615	4,960
	CWHvm2	3,640	2,354	559
	MHmm1	988	102	34
Corrigan	CWHmm2	38	-	-
	CWHvm1	38	37	37
	CWHvm2	28	26	26
	MHmm1	14	3	3
Cowichan	CDFmm	602	439	364
	CWHmm2	22	22	15
	CWHxm1	3,891	2,862	1,977
	CWHxm2	1,328	1,018	546
	MHmm1	5	-	-
Denman/Hornby	CDFmm	451	324	313
Effingham	CMAunp	83	-	-
	CWHmm1	203	1	0
	CWHvh1	2,347	2,241	1,681
	CWHvm1	11,352	9,554	4,856
	CWHvm2	3,661	2,027	570

Landscape Unit	BGC Zone	Total Area (ha)	Productive Area (ha)	Net Area (ha)
	MHmm1	848	24	6
Englishman	CDFmm	346	340	144
	CMAunp	305	3	3
	MHmm1	540	45	44
Escalante	CWHvh1	2,392	2,225	1,300
	CWHvm1	7,377	6,922	4,201
	CWHvm2	2,958	2,708	973
	MHmm1	4	4	0
French Creek	CDFmm	172	149	104
	CWHxm1	66	2	2
	CWHxm2	103	1	1
Gordon	CWHmm1	1,492	1,417	697
	CWHmm2	414	393	98
	CWHvh1	5	-	-
	CWHvm1	2,513	1,935	924
	CWHvm2	802	723	245
	CWHxm2	66	61	47
	MHmm1	202	189	30
Henderson	CWHmm1	6	-	-
	CWHvm1	7,194	6,419	4,344
	CWHvm2	1,996	1,772	1,057
	MHmm1	46	20	1
Kennedy Flats	CWHvh1	93	82	72
	CWHvm1	191	183	169
	CWHvm2	48	45	33
Koksilah	CDFmm	173	55	19
	CWHmm2	38	37	19

Landscape Unit	BGC Zone	Total Area (ha)	Productive Area (ha)	Net Area (ha)
	CWHxm1	571	522	392
	CWHxm2	603	575	454
Little Qualicum	CDFmm	959	821	652
	CMAunp	55	-	-
	CWHmm2	296	260	160
	CWHxm1	377	135	114
	CWHxm2	346	296	220
	MHmm1	17	-	-
Loss	CWHvh1	575	373	284
	CWHvm1	4,339	2,800	1,618
	CWHvm2	49	36	2
Maggie	CWHvh1	3,216	2,741	1,884
	CWHvm1	7,281	6,658	5,273
	CWHvm2	238	221	167
Metchosin	CDFmm	15	10	1
	CWHxm1	113	80	0
	CWHxm2	50	40	0
Millstone	CDFmm	13	-	-
	CWHmm2	118	65	51
	CWHxm1	236	30	27
	CWHxm2	330	1	1
Nahmint	CMAunp	9	-	-
	CWHvm1	280	277	73
	CWHvm2	148	125	65
	MHmm1	21	1	-
Nanaimo	CDFmm	113	108	93
	CWHmm2	187	178	152

Landscape Unit	BGC Zone	Total Area (ha)	Productive Area (ha)	Net Area (ha)
	CWHxm1	3,883	3,610	1,211
	CWHxm2	765	727	569
Nanoose	CDFmm	164	71	50
	CWHxm1	116	114	100
Nitinat	CWHvm1	2,558	2,112	1,579
	CWHvm2	429	410	172
	MHmm1	22	13	2
Rosewall	CDFmm	1,640	1,283	1,085
	CWHmm2	727	640	291
	CWHxm1	4,498	3,965	3,015
	CWHxm2	3,416	3,203	2,066
	MHmm1	71	64	42
San Juan	CWHmm1	20	12	2
	CWHmm2	186	174	73
	CWHvh1	55	-	-
	CWHvm1	607	367	99
	CWHvm2	417	342	30
	MHmm1	257	252	46
Sarita	CWHvh1	946	850	671
	CWHvm1	113	93	34
Shawnigan	CDFmm	226	201	67
	CWHxm1	1,411	928	554
	CWHxm2	8	-	-
Somass	CWHxm1	323	217	136
	CWHxm2	1,753	967	783
Sooke	CWHxm1	236	0	0
	CWHxm2	724	491	240

Landscape Unit	BGC Zone	Total Area (ha)	Productive Area (ha)	Net Area (ha)
Southern Gulf Islands	CDFmm	637	249	212
	CWHxm1	160	66	63
	CWHxm2	52	52	52
Sproat Lake	CWHxm1	61	2	2
Toquart	CMAunp	63	1	0
	CWHvh1	1,421	1,138	812
	CWHvm1	8,960	7,749	3,929
	CWHvm2	3,609	2,220	555
	MHmm1	941	98	18
Trent	CWHxm1	31	-	-
Tugwell	CWHmm1	2	-	-
	CWHvm1	196	179	96
	CWHxm2	121	93	9
Victoria/Saanich	CDFmm	4	0	-
Walbran	CWHvm1	1,436	1,323	1,082
	CWHvm2	5	5	3
	MHmm1	3	2	0

4.1.2 Visual Quality Objectives

Visual quality is maintained by limiting the rate of harvest in areas that are identified as visually sensitive in the Visual Landscape Inventory. Each polygon has a forest cover constraint applied to it, depending on its Visual Quality Objective (VQO) – one of 'Retention', 'Partial Retention' or 'Modification'. Table 22 summarizes the amount of area in each of these categories.

Table 22 – Visual Quality Zone Summary

Visual Area and Objective	Green-up Height (m)	Maximum Disturbance (%)	Total Area (ha)	Productive Area (ha)	Net Area (ha)
Zone 1 Retention	5	3	8,957	7,200	4,244
Zone 2 Retention	5	5			
Zone 1 Partial Retention	5	10	17,547	15,011	8,769
Zone 2 Partial Retention	5	15			

Visual Area and Objective	Green-up Height (m)	Maximum Disturbance (%)	Total Area (ha)	Productive Area (ha)	Net Area (ha)
Zone 1 Modification	5	20	22,633	19,644	11,344
Zone 2 Modification	5	25			

Zone 1 and Zone 2 are broad visual sensitivity areas. This coverage was not available when this table was compiled. The Analysis Report will show the breakdown of these areas into the two zones.

4.1.3 Integrated Resource Management

Areas that are not visually sensitive are subject to an Integrated Resource Management (IRM) constraint. This prevents the model from concentrating harvesting within a small geographic area. This constraint will be applied spatially to landscape units. The level of the constraint will be dictated by the VILUP Resource Management Zone categories. Table 23 shows the distribution of the TSA area by these zones.

Table 23 – Integrated Resource Management Zone Summary

VILUP Category	Green-up Height (m)	Maximum Disturbance (%)	Total Area (ha)	Productive Area (ha)	Net Area (ha)
General or Special	3	25	87,346	68,799	38,204
Enhanced Forestry	1.3	25	18,996	13,435	8,016

4.1.4 Community Watersheds

Both the *Forest Planning and Practices Regulation* (FPPR) and the licensee Forest Stewardship plan will place limits on harvesting in identified Community Watersheds. A summary of TSA areas that fall within a Community Watershed is presented in Table 24

Table 24 – Community Watershed Area Summary

Community Watershed	Total Area (ha)	Productive Area (ha)	Net Area (ha)
920.003	1	1	-
920.004	877	773	532
920.026	1,174	378	184
920.027	195	18	4
920.032	1,100	999	571
920.039	2,153	1,407	1,062

Community Watershed	Total Area (ha)	Productive Area (ha)	Net Area (ha)
920.045	233	159	75
920.061	1,397	978	565
920.065	17	13	11
920.07	1	1	0
930.01	216	179	25
930.011	115	87	48
930.016	76	56	51
930.021	61	2	2
930.023	60	-	-
930.037	194	165	0
930.042	427	58	51
MEA.006	195	0	0

4.1.5 Fisheries Sensitive and CWAP Watersheds

The Forest Planning and Practices Regulation (FPPR) identifies six watersheds in the TSA that are particularly sensitive for their fish habitat values, and are thus subject to additional harvesting restrictions. The licensee Forest Stewardship Plan (FSP) also makes specific commitments to the management of these watersheds. The TSA area in each of these watersheds is shown in Table 25.

Table 25 – Fisheries-Sensitive Watersheds

Sensitive Watershed	Total Area (ha)	Productive Area (ha)	Net Area (ha)
Effingham	18,494	13,847	7,112
Escalante	12,731	11,859	6,474
Gordon	5,494	4,717	2,041
Nahmint	459	403	139
San Juan	1,542	1,146	249
Toquart	14,993	11,205	5,314

In addition to FPPR and FSP guidelines, two of these watersheds (Gordon and Escalante) must also be managed in accordance with previously completed CWAP's.

4.2 Management Zones for Clayoquot Sound

Forest management in Clayoquot Sound is conducted in accordance with the findings of The Scientific Panel for Sustainable Forest Practices in Clayoquot Sound. The Panel identified fifteen watershed planning units; The Arrowsmith TSA intersects ten of these.

Separate watershed plans have been prepared for each of the fifteen major drainages in the Sound. The purpose of these plans is to map and designate the areas set aside as reserves to protect a range of forest values as defined in the Scientific Panel recommendations. They also map and designate the harvestable area – land that falls outside of reserves and on which sustainable forest harvesting can take place.

Under this planning process, reserves are selected to meet the following resource objectives:

- Protect hydroriparian resources;
- Protect sensitive soils and unstable terrain;
- Protect red- and blue-listed plant and animal species;
- Protect forest-interior conditions in late successional forest areas;
- Represent all ecosystems;
- Ensure linkages among watershed-level planning areas; and
- Protect culturally significant areas

These reserves replace reserves for wildlife habitat, ESA's, OGMA's and FPC riparian buffers. The remaining area is available for harvesting, subject to constraints for watershed rate-of-cut constraints, old seral requirements and visual quality objectives.

4.2.1 Watershed Rate of Cut

Each stand in the Clayoquot Sound portion of the TSA falls into a primary basin (i.e. watershed). It might also fall within one or more of three levels of subbasins. Rate-of-cut constraints will be applied at each of these levels. The amount of TSA area within each of these basins and subbasins is shown in Table 26

Table 26 – Clayoquot Sound Basins and Subbasins

Basin	Subbasin1	Subbasin2	Subbasin3	Total Area (ha)	Productive Area (ha)	Net Area (ha)
4	None	None	None	8,797	6,271	2,354
4	1	None	None	522	500	250
4	3	None	None	277	258	137
4	9	None	None	21	18	16
4	10	None	None	376	329	112

Basin	Subbasin1	Subbasin2	Subbasin3	Total Area (ha)	Productive Area (ha)	Net Area (ha)
4	11	None	None	862	523	160
4	12	None	None	5,202	3,301	1,007
4	12	1	None	457	255	121
4	12	2	None	599	252	42
4	12	3	1	250	142	42
4	12	3	None	324	209	44
4	12	4	None	1,280	733	188
4	12	6	None	239	99	33
11	None	None	None	16	16	13
24	None	None	None	23	14	14
39	None	None	None	79	79	78
42	None	None	None	78	67	43
67	None	None	None	67	27	16
68	None	None	None	298	286	210
69	None	None	None	1,181	1,119	730
69	1	None	None	527	497	338
70	None	None	None	258	253	141
87	None	None	None	282	280	183
95	None	None	None	117	39	10
96	None	None	None	116	50	30
99	None	None	None	197	56	30
99	1	None	None	157	46	30
102	None	None	None	2,349	2,033	538
102	2	None	None	86	69	13
102	3	None	None	593	498	118
102	4	None	None	384	348	94
102	5	None	None	718	569	147

Basin	Subbasin1	Subbasin2	Subbasin3	Total Area (ha)	Productive Area (ha)	Net Area (ha)
103	None	None	None	74	62	34
104	None	None	None	45	37	19
106	None	None	None	221	139	35
109	None	None	None	26	23	15
110	None	None	None	397	306	151
110	1	None	None	128	105	58
111	None	None	None	78	67	23
112	None	None	None	248	224	54
112	1	None	None	55	52	14
112	2	None	None	54	51	14
112	3	None	None	59	41	20
114	None	None	None	81	61	43
115	None	None	None	152	143	60
116	None	None	None	2,727	2,256	643
116	1	None	None	126	124	22
116	2	None	None	486	149	55
116	2	3	None	190	32	18
116	3	None	None	1,128	1,095	235
116	4	None	None	240	180	63
117	None	None	None	394	354	164
118	None	None	None	126	124	51
119	None	None	None	27	26	11
120	None	None	None	320	295	95
128	None	None	None	326	302	133
129	None	None	None	117	112	38
200	None	None	None	633	609	159
201	None	None	None	148	140	133

Basin	Subbasin1	Subbasin2	Subbasin3	Total Area (ha)	Productive Area (ha)	Net Area (ha)
204	None	None	None	260	217	145
206	None	None	None	200	107	65
207	None	None	None	259	234	113
209	None	None	None	489	389	211
210	None	None	None	549	539	219
211	None	None	None	357	352	73
214	None	None	None	672	286	94
215	None	None	None	261	210	90
999	None	None	None	226	184	52

4.2.2 Old Seral Objectives

In addition to a rate-of-cut constraint applied at the basin and subbasin level, an old growth target must be maintained in each primary watershed. The area of the TSA in each of these watersheds is shown in Table 27.

Table 27 – Clayoquot Sound Watersheds

Clayoquot Sound Watershed	Total Area (ha)	Productive Area (ha)	Net Area (ha)
Beach	214	107	65
Bedingfield	3,019	2,784	1,587
Clayoquot River	10	1	0
Cypre	329	296	127
Flores Island	834	811	204
Fortune Channel	634	611	159
Hesquiat	5,296	4,510	1,580
Kennedy Lake	3,819	3,158	1,400
Meares Island	857	547	407
Sydney/Pretty Girl	4,131	2,723	797
Tofino/Tranquil	16	16	14
Upper Kennedy	5,209	3,301	1,007

4.2.3 Visual Quality Objectives

The inventory of scenic resources that was completed for Clayoquot Sound differs from the visual inventories that have been completed for the rest of the province. The categories used to classify visually sensitive areas are unique to the Clayoquot. A breakdown of the area in each of these categories, and the corresponding provincial category, are shown in Table 28.

Table 28 – Clayoquot Sound Visual Landscape Summary

Clayoquot Sound Visual Class	Provincial Class	Total Area (ha)	Productive Area (ha)	Net Area (ha)
Small Scale Alteration	Partial Retention	1,099	970	460
Minimal Alteration	Partial Retention	2,795	2,035	831
Natural Appearing	Retention	2,624	2,250	719

4.3 Analysis Unit Definitions

To reduce the complexity and volume of information used and generated in timber supply models, individual stands may be aggregated into fewer, larger and more or less homogeneous units called "analysis units". Analysis units are usually comprised of combinations of stands with similar tree species, timber growing capability (site index) and occasionally silvicultural management regimes.

Yield tables representing the growth of trees on each polygon within the analysis unit are combined to represent average growth of stands on the unit. Yield tables for current and future stands are developed using this approach. Analysis units are formed in order to track growth characteristics of similar stands.

Three criteria have been used to define analysis units for the Arrowsmith TSA: geographic location (east versus west), leading species and site index range. The amount of timber harvesting land base in each of the resulting Analysis Units is shown in Table 29.

Table 29 – Analysis Unit Summary

Analysis Unit #	THLB Area	Zone	Leading Species	Site Index Range	Site Class
1	183	East	Cedar	>22	Good/Medium
2	138	East	Cedar	<=22	Poor
3	5,067	East	Fir	>=32	Good
4	5,896	East	Fir	27-31	Medium
5	5,521	East	Fir	<=26	Poor
6	452	East	Hemlock/Balsam	>22	Good/Medium
7	609	East	Hemlock/Balsam	<=21	Poor
8	759	East	Other	All	All Sites
9	7,786	West	Cedar	>=18	Good
10	8,930	West	Cedar	13-17	Medium
11	6,753	West	Cedar	<=12	Poor
12	1,650	West	Fir	>=28	Good
13	2,625	West	Fir	25-27	Medium
14	1,937	West	Fir	<=24	Poor
15	5,454	West	Hemlock/Balsam	>=23	Good
16	7,010	West	Hemlock/Balsam	17-22	Medium
17	6,228	West	Hemlock/Balsam	<=16	Poor
18	1,381	West	Other	All	All Sites
19	164	Both	Spruce	>=22	Good/Medium
20	147	Both	Spruce	<=21	Poor
21	1,885	Both	Alder	All	All Sites

5.0 FOREST ESTATE MODEL

5.1 Model Description

Timberline's simulation model CASH6 (*Critical Analysis by Simulation of Harvesting*) will be used to develop harvest schedules integrating all resource management considerations. The model uses a geographic approach to landbase and inventory in order to adhere as closely as possible to the intent of forest cover requirements. Maximum disturbance and minimum thermal and old growth retention forest cover requirements, as well as biodiversity seral stage requirements can be explicitly implemented if required.

A variable degree of spatial resolution is available depending on inventory formulation and resource emphasis area definitions. Forest stands in refuges such as environmentally sensitive and inoperable areas that do not contribute to the periodic harvest can be included to better model forest structure.

In their current implementation, forest cover objectives require a control area over which to operate. The control area for a constraint set should correspond to a realistic element in the landscape. For example, the requirements associated with visual quality objectives are designed to operate on the scene visible from discrete sets of viewpoints. The objective is to identify the "natural" constituency for forest cover constraints. CASH6 contains a hierarchical landbase organisation to assist in implementing control areas. Numerous levels of land aggregation are used to define both geographically separate areas and areas of similar management regime. Forest cover constraints can be applied at up to 5 overlapping levels.

6.0 GROWTH AND YIELD

This section describes the issues, information sources, assumptions, methods, and any relevant processing or adjustments related to growth and yield estimates for existing and future stands. Yield tables for natural stands were developed with the MoFR program Variable Density Yield Predictor (VDYP). Managed stands used the MoFR Table Interpolation Program for Stand Yields (TIPSY) growth and yield model.

Copies of these yield tables can be found in Appendix I.

6.1 Site Index

Site Index (SI) is a measure of productivity used during yield analysis. Site index is an estimate of potential height growth on a site over a fixed period of time, normally 50 years. The productivity of a site largely determines how quickly trees grow and when rotation age and minimum harvest age (MHA), are reached.

The inventory site index from the forest cover database is used to develop yield tables for all existing stands.

Adjusted site index has been used to build yield curves for future managed stands. The derivation of these site indices is describe in the report *Site Index Adjustment of the Arrowsmith Timber Supply Area*.

6.2 Utilization Levels

The utilization level defines the maximum height of stumps that may be left on harvested areas and the minimum top diameter (inside bark) and minimum diameter (dbh) of stems that must be removed from harvested areas. These factors are needed to calculate merchantable stand volume for use in the analysis. The levels used in the analysis reflect the current operational practice.

Table 30 – Timber Utilization Levels

Leading species	Utilization		
	Minimum dbh (cm)	**Maximum stump height (cm)**	**Minimum top dib (cm)**
Natural Conifer >120 years of age	17.5	30	15.0
Natural Conifer <120 years of age	12.0	30	10
Managed Conifer	12.0	30	10
Alder >45 years of age	17.5	30	15

6.3 Decay, Waste and Breakage for Natural Unmanaged Stands

The decay, waste and breakage (DWB) factors that are applied to unmanaged stand yield tables to obtain net volume per hectare. These factors are assigned to natural stand volumes automatically in VDYP based on the Public Sustained Yield Unit (PSYU) location. Licensee experience suggests that cedar volumes are being underestimated because decay, waste and breakage factors are too high. However, no data available to support this assumption, so the default PSYU factors will be used in this analysis.

6.4 Operational Adjustment Factors

Operational adjustment factors (OAF's) are applied in order to adjust managed stand yields generated by TIPSY to reflect such factors as gaps in stands and decay. The default factors most commonly used are an OAF1 of 15 percent and an OAF2 of 5 percent. OAF1 is a constant percentage reduction to account for openings in stands, distribution of stems, endemic pests and diseases, and other risks to potential yield. OAF2 is an increasing percentage reduction that can be applied to account for decay, waste and breakage. In TSR2 an OAF1 of 15% and an OAF2 of 5% were used for existing and future managed stands with leading species other than Douglas-fir.

Existing and future managed Douglas fir stands suffer volume losses due to root disease. Laminated and armillaria root diseases are prevalent in the TSA. The resulting stand volume losses are accounted for in managed stands through revised OAF2 values which are based on work conducted by the Regional Pathologist. OAF2 has been increased from 5% to 12.5% for Douglas-fir stand less than 50 years old, and to 10% for future Douglas-fir stands. These are the factors that were used for TSR2, and MoFR advises that they are still reasonable. They will be used for this analysis.

7.0 SILVICULTURE

7.1 Silviculture Management Regimes

Silvicultural practices in the TSA need to be considered as a prelude to developing yield curves. Clearcutting is the silvicultural system most commonly employed in the Arrowsmith TSA outside of Clayoquot Sound. Trees are retained when necessary to meet riparian or wildlife habitat objectives. Variable retention silviculture and commercial thinning have been applied in the TSA in the past, but are no longer current practice and will not be considered during this analysis.

Clearcutting with reserves is prevalent for the portion of the TSA in Clayoquot Sound. Retention levels are typically higher than for the remainder of the TSA. Current levels of retention are not high enough that yield models other than TIPSY need to be considered.

Reductions to account for wildlife tree and other retention will be applied when the forest estate model is run, rather than directly on the yield curves. All yield curves have been built assuming even-aged management of all stands. Any retention that is left is assumed to be permanently lost to harvesting.

Riparian reserve zones have been spatially netted out of the THLB, and no retention modelling will be required for these areas.

7.2 Regeneration Delay

Licensees have indicated that regeneration delays ranged from one to four years, with most cutblocks being replanted within one year of harvest. BCTS is the exception: due to the nature of the licenses they administer, regeneration seldom occurs within the first year and may be delayed by up to four years. For modelling purposes, a two year regeneration lag will be incorporated into all yield curves.

7.3 Current and Backlog Not Satisfactorily Restocked (NSR) Areas

NSR areas originally contained operable timber, were harvested, and have not yet regenerated to commercial species. Current NSR is part of the working forest and is expected to be regenerated on schedule. No backlog NSR exists in the Arrowsmith TSA.

7.4 Species Conversion

Any stand that is 55 years of age or younger in 2006 is deemed to be a managed stand and will have yields predicted using TIPSY. The current average species composition will be used for modelling. The silviculture regimes used for managed stands are shown in Table 31.

Table 31 – Silviculture Regimes for Managed Stands

AU	Zone	Leading Species	Site Class	Regen Delay (Years)	OAF1	OAF2	Method	Initial Density
1	East	Cedar	Good/Medium	2	15	5	Plant	1000
2	East	Cedar	Poor	2	15	5	Plant	1000
3	East	Fir	Good	2	15	10	Plant	1200
4	East	Fir	Medium	2	15	10	Plant	1200
5	East	Fir	Poor	2	15	10	Plant	1200
6	East	Hemlock/Balsam	Good/Medium	2	15	5	Plant	1000
7	East	Hemlock/Balsam	Poor	2	15	5	Plant	1000
8	East	Other	All Sites	2	15	5	Plant	1400
9	West	Cedar	Good	2	15	5	Plant	1000
10	West	Cedar	Medium	2	15	5	Plant	1000
11	West	Cedar	Poor	2	15	5	Plant	1000
12	West	Fir	Good	2	15	5	Plant	1000
13	West	Fir	Medium	2	15	5	Plant	1000
14	West	Fir	Poor	2	15	5	Plant	1000
15	West	Hemlock/Balsam	Good	2	15	5	Plant	1000
16	West	Hemlock/Balsam	Medium	2	15	5	Plant	1000
17	West	Hemlock/Balsam	Poor	2	15	5	Plant	1000
18	West	Other	All Sites	2	15	5	Plant	1400
19	Both	Spruce	Good/Medium	2	15	5	Plant	1000
20	Both	Spruce	Poor	2	15	5	Plant	1000
21	Both	Alder	All Sites	2	15	5	Plant	1600

7.5 Genetic Gain

Improvements in growth due to the use of genetically improved seed will be modeled during yield curve construction. Genetic gain is attributed to Class ‘A’ seed. Table 32 summarises the relative percent of Class A seed use by species and year.

Table 32 – Percent Class A Seed Use by Year

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Cedar	94%	79%	93%	82%	72%	87%	91%	70%	58%	71%	85%	100%
Fir	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	95%

The actual genetic gain associated with Class 'A' seed needs to be confirmed with MoFR Tree Improvement Branch. For the future managed stand yield curves shown in Appendix I, genetic gains of 2.7%, 1.9% and 1.3% for fir, hemlock and cedar respectively have been used. These values were used for TSR 2.

7.6 Fertilized Areas

No allowance will be made in the yield curves to account for past or future fertilization.

7.7 Forest Health

The main forest health issues in the Arrowsmith TSA are laminated and armillaria root diseases. Yield curve volume reductions for existing and future managed stands (described in Section 6.4) have been applied to account for these losses.

8.0 UNSALVAGED LOSSES

Non-Recoverable losses of 2000 m^3 annually were assumed during TSR2. The same assumption will be used for this analysis.

9.0 RESOURCE MANAGEMENT EMPHASIS

9.1 TSA Outside of Clayoquot Sound

9.1.1 Landscape Level Biodiversity

Biodiversity planning is modelled through the explicit delineation of OGMA's for all landscape units (LU's) without approved Landscape Unit Plans, and by tracking seral status for the other LU's. Old growth (> age 250 for natural disturbance type (NDT) 1, 2, and 4; > age 140 for NDT 3) seral stage requirements are established within each LU at the BEC variant level. All of the productive forest within each LU/BEC contributes to the old growth seral stage requirement. The forest cover requirements are based on low, intermediate, and high emphasis.

For the TSR2 analysis, landscape level biodiversity was maintained by applying cover constraints based on VISLUP and the Biodiversity Guidebook. The multi-licensee Forest Stewardship Plan (FSP) lists old growth targets by landscape unit for LU's on the West Coast. These targets will replace the Biodiversity Guidebook targets (shown in Table 33) for this analysis.

Table 33 – Landscape Unit Old Seral Forest Cover Constraints

Landscape Unit	BEO	Biodiversity Guidebook (%)	Starting Year for requirement		
			1	70	140
NDT 1	L	13	4.3	8.6	13
	I	13	13	13	13
	H	19	19	19	19
NDT 2	L	9	3	6	9
	I	9	9	9	9
	H	13	13	13	13
NDT 3	L	5	5	10	14
	I	14	14	14	14
	H	21	21	21	21
NDT 4	L	13	4.3	8.6	13
	I	13	13	13	13
	H	19	19	19	19

9.1.2 Stand-level Biodiversity

After other land classification is complete additional reductions to the timber harvesting land-base are needed to provide sufficient reserves of productive timber for wildlife at the site-specific level. These small reserves are referred to as wildlife tree patches (WTP). The stand level biodiversity requirement will account for both wildlife trees (WT) and wildlife tree patches (WTP) by reducing the average

volume per hectare that is harvested, to account for trees which must be left within cut-blocks. The FPPR mandates retention to a target of 7%. The licensee FSP mandates a 7% target, but notes that no wildlife tree retention is required within 250 meters of productive non-contributing land-base. Since riparian areas are spatially identified in the resultant, they will be available to contribute to stand level biodiversity.

9.1.3 Visual Quality Objectives

Visual quality will be maintained by limiting the rate of cut for each visually sensitive polygon according to Table 34

Table 34 – Visual Quality Forest Cover Constraints

Visual Area and Objective	Green-up Height (m)	Maximum Disturbance (%)
Zone 1 Retention	5	3
Zone 2 Retention	5	5
Zone 1 Partial Retention	5	10
Zone 2 Partial Retention	5	15
Zone 1 Modification	5	20
Zone 2 Modification	5	25

9.1.4 Integrated Resource Management

IRM constraints will limit the rate of cut in areas that are not considered to be visually sensitive. The level of the constraint will depend upon the VILUP RMZ, but the constraints will be applied spatially at the landscape unit level. These constraints are shown in Table 35.

Table 35 – Integrated Resource Management Forest Cover Constraints

VILUP Category	Green-up Height (m)	Maximum Disturbance (%)
General or Special	3	25
Enhanced Forestry	1.3	25

9.1.5 Community Watersheds

Community watersheds will have a 5%/5 year rate-of-cut constraint applied to them.

9.1.6 Fisheries Sensitive and CWAP Watersheds

The licensee commits to managing fisheries-sensitive watersheds within a 20% equivalent clearcut area (ECA) limit. In order to model this, full hydrological recovery will be assumed when a stand reaches nine metres in height. For each watershed, the average age to achieve that height will be calculated using regenerated stand yield curves. From this, percent hydrological per year will be calculated and used to implement a forest cover constraint at 20% ECA.

The TSR 2 Analysis applied a 24%/9 metre forest cover constraint to the Gordon River Watershed, and limited harvesting in the Escalante Watershed to 21 hectares annually. The same constraints will be used for this analysis as well – in addition to the ECA constraint above.

9.1.7 Wildlife Habitat

Wildlife habitat is managed through a system of reserves and netdowns. No forest cover constraints are required.

9.2 Clayoquot Sound

Timber harvesting in Clayoquot Sound is governed largely by the requirements of Watershed plans. These plans have been designed to balance competing objectives and protect non-timber resource through the designation of a reserve network and the implementation of guidelines for harvesting on the remainder of the land base.

9.2.1 Watershed Rate of Harvest

With respect to watershed-rate-of-cut, the Scientific Panel made the following recommendations:

- Limit the area cut in any watershed larger than 500 ha in total area to no more than 5% of the watershed area within a five-year period;
- In primary watersheds of 200-500 ha in total area, limit the area cut to no more than 10% of the watershed area within a 10-year period; (This prescription provides flexibility for harvesting within small watersheds.)
- In any watershed larger than 500 ha in total area, and primary watersheds of 200-500 ha in total area in which harvest has exceeded 20% of the watershed area in the most recent 10 years, allow no further harvest until the watershed conforms with the specified rate-of-cut;
- In any watershed specified in the previous recommendations and in which the recent harvest is greater than 5% in the last five years, but less than 20% in the last 10 years, allow no further cutting until a watershed sensitivity analysis and stream channel audit have been completed. If these assessments indicate significant hydrological disturbance, substantial or chronic increase in sediment yield, or significant deterioration in aquatic habitat, cease harvesting until undesirable conditions are relieved. Otherwise, harvest may continue at a rate which will bring the drainage unit within the recommended rate-of-cut limits within five years;
- In any watershed larger than 500 ha in total area (and primary watersheds of 200 - 500 ha in total area) in which harvest has occurred, require a watershed sensitivity analysis and stream channel audit once every five years. Where such assessments identify hydrological disturbance, substantial increase in sediment yield, or significant deterioration in aquatic

habitat, cease harvesting until these conditions are relieved. If such conditions are recognized at any other time, sensitivity analysis and/or stream channel audit shall be undertaken immediately; and

- In watersheds where the harvestable area is less than 30% of the total area, allow resource managers to use professional judgment to vary these standards without changing the intent to regulate rate of harvest to minimize hydrological change.

For Clayoquot Sound, watershed will be managed according to the Scientific Panel recommendations. In identified watersheds, either a 5% per 5 year or a 10% per 10 year constraint will be applied. The productive forest land-base of the watershed will be used in applying this constraint. Where watersheds overlap parks, the limits will be adjusted in recognition of the fact that parks will not be harvested.

9.2.2 Landscape Level Biodiversity

Landscape level biodiversity will be modelled by requiring a 40% old seral target at the watershed level. This limit will be reduced if part of the requirement can be met by old growth stands in adjacent parks or protected areas.

9.2.3 Stand Level Biodiversity

Areas in Clayoquot Sound are typically harvested with higher levels for retention than the remainder of the TSA. The approach to modelling this will, however, be similar to the WTP constraint being applied to areas outside of the Sound. The forest estate model will leave a fixed percentage of the volume (7% for non-Clayoquot WTP's) to meet biodiversity requirements. The retention requirement for the Clayoquot will be higher, and will be determined based on a review of guidelines along with MoFR and licensee input. Separate yield curves will not be needed to account for this retention; the forest estate model will calculate the prorated available volume based on the underlying clearcut yield curves.

9.2.4 Visual Quality Objectives

The inventory of scenic resources that was completed for Clayoquot Sound differs from the visual inventories that have been completed for the rest of the province in two significant ways:

- the categories used to classify visually sensitive area are unique to the Clayoquot; and
- while the assigned levels of acceptable landscape alteration provide qualitative guidance to operational planners, they do not provide the quantitative rules needed for strategic planning.

It was necessary to deal with these issues so that scenic resources will be appropriately considered in the timber supply modeling. The Clayoquot Sound visual classes were first translated into the established provincial classes as follows:

- Natural Appearing translated to Retention;
- Minimal Alteration translated to Partial Retention; and
- Small Scale Alteration translated to Partial Retention.

These translations were based on a comparison of Table 4.1 in the Bedingfield Watershed plan and Table 1 of the Visual Impact Assessment Guidebook.

Once these classes were translated, it was possible to deal with the second issue by determining a system of quantitative rules to be used in the modeling process. These rules have two components. First, a threshold alteration limit for the individual visual landscape polygon was decided on by consulting Table 4 of the Visual Impact Assessment Guidebook. An average residual stand height of 30 metres was assumed for the entire area. Although, the table specifies the maximum amount of volume that can be removed for a given visual class, this will be equated to a maximum proportion of area for the analysis. The following thresholds were determined:

- Natural appearing: 20%
- Minimal alteration: 30%
- Small scale alteration: 40%

Secondly, a visually effective greenup height for each visual classification was established through discussions with Interfor and MoF, a review of the approach taken by others and consultation of Berris' Draft Recommendations. The following visually effective greenup heights were decided on:

- Natural appearing: 8 metres
- Minimal alteration: 7 metres
- Small scale alteration: 6 metres

These two components will be applied together in the timber supply analysis. Within each visual polygon, height growth will be tracked on a stand by stand basis. The height and equivalent area of the youngest stand cohort will be used to compile the area of each visual polygon that is within the cover constraint. These constraints are summarized in Table 36.

Table 36 – Visual Quality Forest Cover Constraints

Clayoquot Sound Visual Class	Provincial Class	Green-up Height (m)	Maximum Disturbance (%)
Small Scale Alteration	Partial Retention	6	40
Minimal Alteration	Partial Retention	7	30
Natural Appearing	Retention	8	20

9.2.5 Wildlife Habitat

Wildlife habitat is managed through the watershed reserve network defined in the Watershed Plans. No additional forest cover constraints are required.

10.0 TIMBER HARVESTING

10.1 Minimum Harvest Age

The minimum harvestable age is the criterion that forest stands within an analysis unit must meet to be eligible for harvest. In most cases, economic factors will dictate the threshold beyond which stands are available for harvest. For the purpose of timber supply modelling, these characteristics are often expressed in terms of volume per hectare and/or average diameter. Culmination age, the age at which mean annual increment (MAI) reaches a maximum, or some proportion thereof can also be used as the threshold for minimum harvestable age. In timber supply modelling the age at which the minimum threshold is attained is called the "minimum harvestable age" (MHA). These are minimum criteria – not rotation ages or the actual ages at which the stands will be harvested. Some stands may be harvested at the minimum thresholds to meet forest-level objectives; however, other stands may not be harvested until well past the age for "optimal" timber production due to management objectives for other resource values

MHA is established for each analysis unit. An AU is first harvestable when it meets all three of the following criteria:

- Minimum volume per hectare of 300 m3/hectare;
- Minimum QMD of 25 centimeters; and
- Within 90% of maximum MAI.

The MHA that results when these criteria are applied to each analysis unit are shown in Table 37.

Table 37 – Minimum Harvest Age by Analysis Unit

AU #	Analysis Unit	Existing Natural Stands	Existing Managed Stands	Future Managed Stands
1	E-C-G/M	60	60	60
2	E-C-P	90	90	70
3	E-F-G	50	50	50
4	E-F-M	60	50	50
5	E-F-P	80	80	50
6	E-H-G/M	50	70	60
7	E-H-P	70	80	60
8	E-O-All	120	60	70
9	W-C-G	80	70	60
10	W-C-M	120	90	60

AU #	Analysis Unit	Existing Natural Stands	Existing Managed Stands	Future Managed Stands
11	W-C-P	230	230	70
12	W-F-G	50	50	50
13	W-F-M	60	60	50
14	W-F-P	90	80	60
15	W-H-G	50	60	60
16	W-H-M	70	80	60
17	W-H-P	140	110	70
18	W-O-All	160	90	90
19	S-G/M	50	70	70
20	S-P	90	80	80
21	D-All	60	70	70

10.2 Initial Harvest Rate

For the base case, the initial harvest rate will be set at 420,496 m3/year. This is the harvest rate established after the last timber supply review, plus the administrative adjustments that were made for the TFL 44 and TFL 46 take back areas (see Section 3.1.1). The 1700 m3/year Part 13 reduction for the Hill 60 Designated Area will not be deducted from the initial harvest level. This matter will be dealt with by the Chief Forester at the time of the determination.

10.3 Harvest Rules

Harvest rules are used by the simulation model to rank stands for harvest. A common approach is to harvest oldest first. With this rule, older stands are queued for harvest ahead of younger stands. Harvest rules interact with forest cover constraints to determine the actual order of harvesting within the model. If a higher ranked stand is in a constrained zone and cannot be harvested then the model will choose the next highest ranked stand that can be harvested.

'Relative oldest first' harvests those stands that are farthest past their rotation age (culmination MAI), and would be a better rule to use for the Arrowsmith TSA, which has a significant component of second growth timber on a range of sites.

11.0 TIMBER SUPPLY FORECASTS/OPTIONS/SENSITIVITIES

11.1 Base Case

The base case forecast results from assumptions about the best estimate of current management performance at the time that this analysis is being completed. It is based on current performance and so provides a reference timber supply forecast against which timber supply implications of different management assumptions may be measured. The base case is used as the baseline used to assess risk associated with any of the assumptions in the sensitivity analysis. The objective of the base case will be to:

- Maintain or increase the current harvest for as long as possible;
- Limit changes in harvest level to less than 10% of the level prior to the reduction; and
- Achieve stability in the long-term harvest level and growing stock profiles.

11.2 Sensitivity Analysis

Sensitivity analysis provides a measure of the upper and lower bounds of the base case harvest forecast and reflects the uncertainty in the data and the management assumptions made in the base case. A specific variable is adjusted and the magnitude of change in the outcome reflects the degree of uncertainty surrounding the assumption associated with that given variable. By developing and testing a number of sensitivity analyses, it is possible to determine which variables most affect results. The sensitivity analysis that will be performed around the base case are summarized in Table 38.

Table 38 – Proposed Sensitivity Analyses

Issue	Sensitivity analysis	Sensitivity level to be tested
Landbase Revisions	Adjust the Timber Harvesting Land Base	+/- 10%
Economic	Change operability assumptions (Base Case: -$10)	+/- $10
	Reduce available Hemlock/Balsam	-50%
	Increase Minimum Harvest Age	+ age equivalent to 400 m3/ha
	Decrease Minimum Harvest Age	- age equivalent to 250 m3/ha
Growth and Yield	Adjust existing yields	+/- 10%
	Adjust future yields	+/- 10%
	Adjust future yields	Unadjusted SI
Management Considerations	Adjust greenup height	+/- 1 metre
	Adjust disturbance constraints	+/- 5%
	Adjust retention constraints	+/- 10%

11.3 Alternative Harvest Flows

A number of different harvest flows will be explored, based on tradeoffs between short and mid-term harvest levels. In particular, the impacts of setting quota for second growth timber, or other mechanisms to balance harvesting between the east coast and west coast of Vancouver Island will be examined.

12.0 REFERENCES

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Appendix I

Natural and Managed Stand Yield Tables

Existing Natural Stand Yield Tables (Net Volume per Hectare)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Age	E-C-G/M	E-C-P	E-F-G	E-F-M	E-F-P	E-H-G/M	E-H-P	E-O-All	W-C-G	W-C-M	W-C-P	W-F-G	W-F-M	W-F-P	W-H-G	W-H-M	W-H-P	W-O-All	S-G/M	S-P	D-All
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	1	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	44	0	51
30	58	3	151	77	4	113	2	0	5	0	0	165	39	0	141	5	0	0	151	15	140
40	152	65	301	201	85	250	80	13	74	10	0	319	162	30	282	98	0	0	265	39	229
50	239	131	432	308	163	369	168	60	147	56	4	452	266	105	403	185	19	3	365	93	294
60	321	192	544	400	229	473	247	103	216	105	26	565	354	169	507	263	63	23	453	159	344
70	392	246	643	478	287	559	315	143	278	150	58	662	427	223	596	331	105	58	531	217	366
80	459	297	730	547	338	634	376	179	337	193	87	748	492	271	674	392	143	95	598	270	386
90	512	338	804	606	381	695	426	213	382	227	113	825	549	312	739	444	177	131	652	316	404
100	559	374	870	658	420	747	470	244	421	257	136	894	600	350	795	490	207	164	699	357	419
110	600	406	928	704	454	791	508	273	454	282	157	956	646	384	844	530	235	197	738	394	433
120	631	431	978	745	484	828	540	300	478	301	173	1011	688	414	885	564	259	227	771	426	445
130	669	460	1020	778	509	868	574	325	511	325	191	1054	719	437	927	600	283	256	807	459	455
140	704	487	1055	806	529	903	604	343	542	347	207	1090	744	456	966	632	305	279	840	491	464
150	735	509	1084	827	544	934	631	356	569	366	220	1119	763	471	999	662	324	298	870	519	471
160	760	528	1104	841	554	960	655	363	592	383	232	1140	777	481	1029	689	342	312	896	546	476
170	781	543	1118	850	560	981	675	367	612	397	242	1155	784	486	1056	713	358	323	920	570	479
180	802	559	1125	853	562	1000	693	367	633	412	252	1162	786	488	1080	735	374	331	942	593	481
190	823	575	1139	862	568	1020	711	366	654	426	262	1177	793	493	1103	757	389	336	963	614	485
200	844	590	1154	872	575	1038	728	368	673	440	271	1192	800	499	1123	777	403	343	983	634	489

Existing Managed Stand Yield Tables (Net Volume per Hectare)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Age	E-C-G/M	E-C-P	E-F-G	E-F-M	E-F-P	E-H-G/M	E-H-P	E-O-All	W-C-G	W-C-M	W-C-P	W-F-G	W-F-M	W-F-P	W-H-G	W-H-M	W-H-P	W-O-All	S-G/M	S-P	D-All
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	25	1	65	25	1	15	1	5	8	0	0	62	19	1	21	3	0	0	11	2	0
30	148	14	227	126	42	112	26	66	92	6	0	226	109	33	138	49	3	24	99	39	7
40	295	56	395	234	103	236	84	165	208	39	3	407	218	89	278	140	23	85	220	125	73
50	439	114	545	337	165	367	153	256	336	94	11	576	324	153	429	234	61	149	344	215	190
60	578	174	678	436	218	498	218	336	454	150	28	733	432	211	568	330	108	204	473	306	299
70	687	234	782	512	264	619	281	406	572	203	46	862	523	263	709	428	152	255	591	398	400
80	799	290	864	581	308	734	344	462	682	259	69	970	605	314	830	514	196	292	707	483	478
90	889	338	932	639	349	832	405	499	770	312	93	1066	681	365	927	598	236	324	809	560	538
100	969	381	932	686	383	913	459	535	856	357	114	1066	746	411	1023	677	276	351	891	640	588
110	1038	425	932	724	412	991	507	568	942	396	134	1066	802	451	1110	748	313	373	968	711	628
120	1038	467	932	724	438	1063	555	595	1013	433	153	1066	850	487	1110	809	352	390	1043	774	655
130	1038	505	932	724	457	1130	599	617	1077	471	171	1066	850	522	1110	858	388	405	1110	827	677
140	1038	540	932	724	474	1130	639	617	1135	507	188	1066	850	553	1110	904	420	417	1173	871	697
150	1038	571	932	724	489	1130	674	617	1184	540	202	1066	850	580	1110	952	448	427	1228	912	713
160	1038	599	932	724	501	1130	707	617	1227	568	216	1066	850	605	1110	995	473	435	1268	956	728
170	1038	621	932	724	509	1130	734	617	1227	594	230	1066	850	627	1110	1035	497	442	1304	995	728
180	1038	640	932	724	516	1130	757	617	1227	618	244	1066	850	647	1110	1070	520	449	1338	1032	728
190	1038	657	932	724	521	1130	779	617	1227	640	256	1066	850	663	1110	1103	543	454	1372	1065	728
200	1038	673	932	724	526	1130	798	617	1227	657	268	1066	850	679	1110	1103	565	453	1403	1095	728

Future Managed Stand Yield Tables (Net Volume per Hectare)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Age	E-C-G/M	E-C-P	E-F-G	E-F-M	E-F-P	E-H-G/M	E-H-P	E-O-All	W-C-G	W-C-M	W-C-P	W-F-G	W-F-M	W-F-P	W-H-G	W-H-M	W-H-P	W-O-All	S-G/M	S-P	D-All
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	20	5	40	39	32	17	21	2	25	18	4	61	70	36	30	30	7	0	12	2	0
30	126	69	179	172	153	120	131	42	152	129	65	222	244	170	170	171	85	24	106	35	10
40	261	170	323	309	276	247	260	120	309	276	168	399	440	318	329	331	199	84	229	119	89
50	390	277	472	454	407	385	401	204	461	417	281	565	621	478	497	499	316	148	358	207	215
60	519	373	592	570	518	518	532	272	618	566	383	720	788	615	655	658	437	203	490	296	331
70	628	471	701	677	613	643	657	335	752	700	486	847	922	745	801	804	547	254	612	385	432
80	724	564	787	764	695	760	768	391	878	810	586	954	1039	853	921	924	656	291	730	468	508
90	816	645	857	764	761	857	859	438	997	929	677	1048	1140	943	1032	1037	754	323	833	544	570
100	890	711	857	764	761	940	942	476	1098	1027	750	1048	1140	943	1135	1139	838	350	915	621	621
110	957	777	857	764	761	1022	1019	503	1193	1115	817	1048	1140	943	1135	1139	908	371	996	691	654
120	1015	841	857	764	761	1096	1089	528	1269	1194	890	1048	1140	943	1135	1139	977	389	1071	754	680
130	1015	895	857	764	761	1096	1089	551	1269	1259	955	1048	1140	943	1135	1139	1040	404	1140	809	703
140	1015	942	857	764	761	1096	1089	572	1269	1259	1008	1048	1140	943	1135	1139	1098	416	1204	852	723
150	1015	984	857	764	761	1096	1089	591	1269	1259	1056	1048	1140	943	1135	1139	1152	425	1253	892	740
160	1015	1022	857	764	761	1096	1089	608	1269	1259	1099	1048	1140	943	1135	1139	1199	434	1294	932	740
170	1015	1054	857	764	761	1096	1089	608	1269	1259	1136	1048	1140	943	1135	1139	1233	441	1331	971	740
180	1015	1083	857	764	761	1096	1089	608	1269	1259	1169	1048	1140	943	1135	1139	1264	447	1368	1007	740
190	1015	1083	857	764	761	1096	1089	608	1269	1259	1198	1048	1140	943	1135	1139	1294	453	1402	1040	740
200	1015	1083	857	764	761	1096	1089	608	1269	1259	1225	1048	1140	943	1135	1139	1322	453	1434	1070	740