

Arrowsmith Timber Supply Area Timber Supply Review

**Updated Data Package
following completion of the
Timber supply analysis**

November 2016



Ministry of
Forests, Lands and
Natural Resource Operations

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1. Overview of the Arrowsmith TSA timber supply review

Under Section 8 of the *Forest Act* the chief forester must review the timber supply for each timber supply area (TSA) at least once every 10 years. Under the same section the chief forester may extend the current allowable annual cut (AAC) up to 15 years if the current timber supply is stable and any new developments would unlikely change the AAC. For more information about the AAC process please visit the following internet site:

https://www.for.gov.bc.ca/hts/pubs/tsr/Timber%20Supply%20Review%20Backgrounder_Nov_2013.pdf

The completed data package contains those inputs that represent current performance for the TSA. For the purpose of the timber supply review (TSR), “current performance” can be defined by:

- the current forest management regime — the productive forest land available for timber harvesting, the silviculture treatments, the harvesting systems and the integrated resource management practices used in the area;
- fully implemented land-use plans;
- land-use decisions approved by Cabinet;
- orders issued through the *Government Actions Regulation (GAR)* of the *Forest and Range Practices Act (FRPA)*;
- the order establishing provincial non-spatial old growth objectives and landscape units pursuant to the *Forest Practices Code of British Columbia Act*; and,
- approved higher level plans under the *Forest Practices Code of British Columbia Act*.

The primary 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 includes:

- A short explanation of the data required;
- A data table or lists of modelling assumptions;
- A description of data sources and other comments.

The information in this data package represents the best available knowledge at the time of publication, but is subject to change. A First Nations consultation and public review period has been established to allow submission of comments and concerns about the data package to the Ministry of Forests, Lands and Natural Resource Operations (FLNR). The information and assumptions in the data package that have been revised to incorporate First Nations and public input will be used to determine the timber harvesting land base (THLB) - the productive Crown forest land in the TSA available for timber harvesting. Until the THLB is determined, it is not possible to finalize the values shown in some of the tables in this document. In addition, should any major changes in management practices occur during the next few months, the timber supply analysis will attempt to capture them.

2. Introduction

2.1 Overview of the Arrowsmith Timber Supply Area

The Arrowsmith TSA is located on the southern half of Vancouver Island, south of the Strathcona TSA (Campbell River) and bordering on Tree Farm Licences (TFLs) 44, 46, 54, 57, and 61. In contrast to other TSAs in British Columbia, this TSA is made up of many disconnected parcels of land ranging in size from a few hectares to a few thousand hectares. These parcels are interspersed with private land, including TFLs, with urban and sub-urban areas, rural agricultural lands, and with parks and reserves. The Arrowsmith TSA is administered by FLNR, South Island Natural Resource District (the district (SINRD)). Although the TSA encompasses 1 574 719 hectares, the actual productive forest land managed by FLNR is only 122 445 hectares.

In 1993, the provincial government's Clayoquot Sound Land Use Decision established management practices for a 265 000-hectare area on the west coast of Vancouver Island. Of this area, 7347 hectares contribute to the Arrowsmith TSA timber harvesting land base (THLB) – the area of productive forest available for timber production.

Spanning Vancouver Island from the west to east coast, the terrain of the TSA varies from lowland valleys, with nutrient rich, moist sites to mountainous areas, with poorer, drier sites. Most of the productive forest land lies within the Coastal Western Hemlock (CWH) biogeoclimatic zone, where cool, wet summers and mild winters support stands with a significant proportion of western hemlock. The Coastal Douglas-fir (CDF) zone occurs on the eastern side of the southern portion of the TSA, which is comparatively drier with gentler topography than the western portions of the TSA. Here warm, dry summers and cool, wet winters result in stands dominated by Douglas-fir. At higher elevations, the Mountain Hemlock (MH) zone occurs and at the highest elevations, isolated occurrences of Coastal Mountain-heather Alpine (CMA) zone.

The forests of the TSA are diverse, and slightly more than half of the forests on the land base contributing to timber supply are considered to have medium or good site productivity. Major tree species include: Douglas-fir, western redcedar, western hemlock and true firs, while other species such as cypress, spruce, red alder, and maple also occur. The forests of the TSA have a relatively long history of harvesting, and as a result there are rapidly maturing second-growth forests on the lower elevation sites that are accessible and highly productive. Almost half of the stands on the THLB are between 21 and 100 years of age.

In 2014, the population of the SINRD was 638,000 people, of which about 58% reside within the Capital Regional District, including the City of Victoria. Other major population centres include Duncan, Ladysmith, Nanaimo, North Cowichan, Parksville, Qualicum Beach and Port Alberni; smaller communities include Tofino, Ucluelet, Lake Cowichan, Nanoose, Chemainus, Union Bay and Fanny Bay.

2.2 First Nations

Thirty-seven First Nations have asserted and/or established Aboriginal Interests within the traditional territories within the SINRD that overlap the Arrowsmith TSA, including: the Ahousaht Band, Cowichan Tribes, Ditidaht First Nation, Esquimalt First Nation, Halalt First Nation, Hesquiaht First Nation, Homalco First Nation, Huu-ay-aht First Nation, Ka:'yu:k'tkh_Che:k:tles7et'h' First Nations, Komoks First Nation, Lake Cowichan First Nation, Lyackson First Nation, Malahat Nation, Mowachaht/Muchalat First Nations, Pacheedaht First Nation, Pauquachin First Nation, Penelakut Tribe, Qualicum First Nation, Scia'new First Nations, Sliammon First Nation, Snaw-naw-as First Nation, Snuneymuxw First Nation, Songhees First Nation, Stz'uminus First Nation, Toquaht Band, Tla-o-qui-aht First Nation, Tseshaht First Nation, Tsartlip First Nation, Tsawout First Nation, T'Sou-ke First Nation, Tseycum First Nation, Tsawwassen First Nation, Uchucklesaht First Nation, Ucluelet First Nation, We Wai Kai Nation, and Wei Wai Kum First Nation.

2.2.1 Treaties and treaty negotiations

There are several First Nations within the Arrowsmith TSA that are in treaty negotiations and there are two signed modern-day treaties, the Tsawwassen First Nation Treaty and the Maa-nulth Treaty. In addition there are nine Douglas Treaty Nations.

On April 3, 2009, the Tsawwassen First Nation Treaty came into effect. It is the first urban treaty in British Columbia and the first treaty negotiated under the British Columbia Treaty Commission (BCTC) process. The treaty brings certainty with respect to all of Tsawwassen First Nation's Aboriginal rights throughout the Tsawwassen First Nation claimed traditional territory, which covers approximately 279 600 hectares including the waters of the southern Strait of Georgia.

On April 1, 2011, the Maa-nulth Treaty came into effect. The Maa-nulth Treaty includes five First Nations, the Huu-ay-aht First Nation, Ka:'yu:k'tkh_Che:k:tles7et'h' First Nations, Toquaht Band, Uchucklesaht Tribe and Ucluelet First Nation. The terms of the Maa-nulth Final Agreement provide self-government, 24 550 hectares of land, and various monetary components. It also defines each Maa-nulth First Nation's rights to resources such as wildlife, fish, timber, and sub-surface minerals.

The K'omoks First Nation is in Stage 5 negotiations. The Agreement-in-Principle was signed on March 24, 2012. The Te'mexw Treaty Association recently signed their Agreement-in-Principle, moving them forward to Stage 5 in the treaty process.

Many of the nations are currently in Stage 4 negotiations: Ditidaht First Nation, Homalco First Nation, Hul'qumi'nun Treaty Group, Hupacasath First Nation, Laich-Kwil-Tach Nations Treaty Society, Nuu-chah-nulth Tribal Council, Pacheedaht First Nation, Stz'uminus First Nation, and the Tla-o-qui-aht First Nation.

The Esquimalt First Nation, Scia'new First Nations, Pauquachin First Nation, Snuneymuxw First Nation, Songhees First Nation, Tsartlip First Nation, Tsawout First Nation, Tseycum First Nation, and T'Sou-ke First Nation are Douglas Treaty Nations, signed in 1852. The Douglas Treaty granted the nations the rights to hunt over the unoccupied lands, and to carry on their fisheries as formerly.

2.2.2 Agreements and tenures

Since 2010, approximately 21 First Nations with asserted traditional territories within the Arrowsmith TSA have signed Forest Consultation and Revenue Sharing Agreements (FCRSA). This agreement provides First Nation communities with economic benefits returning directly to their community based on harvest activities in their traditional territory.

On May 22, 2014, the Maa-nulth Nations and the Province signed a Reasonable Opportunity Agreement with the objective of defining the collaborative process to evaluate the impact of authorized uses or dispositions of Crown land on each Maa-nulth First Nation's reasonable opportunity to harvest fish and aquatic plants, wildlife, and migratory birds in the Maa-nulth Harvest Areas.

As well, several First Nations have obtained area or volume-based forest tenures within the Arrowsmith TSA increasing their participation in the forest sector.

2.2.3 Archaeological assessments

Archaeological overview assessments (AOAs) have been completed for the TSA. AOAs are the basis for determining areas and sites that may require further assessment in the form of an archaeological impact assessment (AIA). AIAs are carried out as part of operational planning. The modelling assumptions for known archaeological and other First Nations' cultural heritage resources are discussed in more detail in the section on the THLB definition.

2.2.4 Monumental Cedar

First Nations have successfully accessed monumental cedar through active operations by forest licensees. Because of this success, there is small observed demand for First Nations access to monumental cedar outside of the active forest licensee operations, and therefore there is no specific constraint applied in this analysis.

3. Current Forest Management Considerations and Issues

3.1 Base case management assumptions

For a timber supply review, a number of forecasts are prepared that are an outcome of the best available data and assumptions intended to reflect current management practices. These assumptions reflect current performance with respect to the status of forest land, forest management practices and knowledge of timber growth and yield. From these forecasts, the chief forester selects one to use as a reference for the purposes of assessing the uncertainty associated with the information and assumptions used in the analysis. This forecast is referred to as the “base case”. To investigate the uncertainty around the information and assumptions used in the base case, further analysis is conducted by adjusting the assumptions. These adjusted assumptions are listed in Section 8, “Sensitivity Analyses to be Performed”.

3.2 Statement of major forest management considerations and issues

The major forest management issues and considerations 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 analyzed separately or noted as upward or downward pressure on the timber supply.

Table 1. Major forest management considerations in the Arrowsmith TSA

Consideration/issue	Description
Land base designations	Private land and established area-based forest tenures including tree farm licences, woodlots, community forests, and First Nation’s woodland licences (FNWL) will be excluded from the timber supply analysis. Provincial protected areas and regional parks will be considered no-harvest areas but will contribute to non-timber objectives tracked in the analysis.
Treaty settlement lands	Maa-nulth Treaty Settlement Lands that came into effect on April 1 st , 2011 will be excluded from the timber supply analysis.
Vancouver Island Land Use Plan	The 2000 <i>Vancouver Island Land Use Plan</i> (VILUP) increased the amount of protected area on Vancouver Island from 6 to 13%. Protected areas do not contribute to the projected timber supply. The <i>VILUP Higher Level Plan Order</i> established resource management zones (RMZs) and objectives for timber and other resource values on all Crown land within the Arrowsmith TSA outside of the Clayoquot Sound Decision Area and the Gulf Islands. RMZ types are special (SMZ) and enhanced (EFZ). The timber supply analysis will apply forest cover objectives consistent with the order.
Clayoquot Sound Land Use Decision Area (Clayoquot Sound)	The Clayoquot Sound portion of the Arrowsmith TSA is subject to forest management practices as per the <i>Scientific Panel Report</i> and the Clayoquot Sound Watershed Plans and therefore modelled separately from the remainder of the Arrowsmith TSA. The modelling assumptions used in the base case for the Clayoquot Sound portion of the TSA do not precisely match the results of fully implementing the Panel’s recommendations, but do provide a close approximation.
Coastal Douglas-fir land use order (LUO)	On July 30, 2010, an Order establishing land use objectives for the Coastal Douglas-fir (CDF) moist maritime biogeoclimatic subzone came into effect. The LUO identifies 1600 hectares for protection, mostly in Arrowsmith TSA.

(continued)

Table 1. Major forest management considerations (continued)

Consideration/issue	Description
Landscape-level biodiversity	For area of the TSA that falls outside of Clayoquot Sound, landscape-level biodiversity is managed by ensuring that a recommended amount of old growth forest stands is maintained across the landscape.
Stand level-biodiversity	Stand-level biodiversity is managed in part by retaining mature trees or mature tree patches within cutblocks to provide structural diversity and wildlife habitat.
Wildlife habitat	Marbled murrelet, deer and elk are the main species for which habitat areas are managed within the TSA. Since 2002, ungulate winter range (UWR) and wildlife habitat areas (WHAs) with associated general wildlife measures (GWMs) have been established. In addition to these species, WHAs and associated GWMs have been established to protect habitat of rare and/or endangered plant and animal species. These include WHAs for Douglas-fir/Garry oak onion grass and red-legged frogs. The GWM of all established WHAs will be modelled in the base case analysis. There are areas of interest defined for northern goshawk within the TSA. These areas will be addressed using sensitivity analysis.
Karst	Protection of karst areas, as provided by an order approved under Section 5(1) of GAR December 11, 2009, is achieved by retaining forest cover over karst features at the time of harvest. It is assumed that existing forest cover constraints are adequate to manage the protection of karst features.
Recreation features	Recreation sites, trail and interpretive forest sites designated under 5(1)(f) of GAR will be considered in analysis.
Community watershed	The timber supply analysis will assume a rate-of-harvest in these watersheds that is consistent with the recommendations in the <i>Community Watershed Guidebook</i> —which for most of these watersheds will be 5% disturbance every five years. Both the <i>Forest Planning and Practices Regulation</i> (FPPR) and the licensee Forest Stewardship Plan will place limits on harvesting in identified community watersheds.
Visual resource management	Management for visual quality is important in the Arrowsmith TSA given the large amount of coastline and the increasing recreational and tourism use of the area. Scenic areas and visual quality objectives (VQOs) were established for the SINRD (not including the Clayoquot Sound Scientific Panel Planning Area) in 2005 through a Section 7 (2) of the GAR order. Through a GAR Order Amendment in 2011 additions and amendments were made to the VQO map, and the amended map presented scenic class objectives (SCO) for Clayoquot Sound. The timber supply analysis will apply forest cover objectives that are consistent with the established VQOs and the SCOs presented on the latest VQO map.
Riparian management	The Arrowsmith TSA, like other coastal management units, contains an enormous network of freshwater streams, lakes and rivers, providing valuable habitat for resident and anadromous fish species. A predictive geographic classification model has been used to assign stream classifications which have prescribed management regimes. Reserve buffers required by the FPPR for each of the management regimes will be applied in the analysis to exclude riparian area from timber harvesting.

(continued)

Table 1. Major forest management considerations (concluded)

Consideration/issue	Description
Archeological sites and traditional use	Archaeological Overview Assessments (AOA) and Archaeological Impact Assessments (AIA) are used to identify potential archaeological sites which include cultural and historic use sites. Once they have been field verified, archaeological sites, including buffer strips, are protected and recorded in the remote access to archaeological data (RAAD). For the analysis, the buffered sites identified in the RAAD are excluded from the THLB.
Cutblock size and adjacency	A forest cover constraint will be incorporated into the base case forecast to account for cutblock adjacency limitations.
Site productivity	The site index assigned to old-growth stands has been shown to underestimate the productivity of regenerated stands. To address this, the timber supply analysis will use site productivity estimates derived from the provincial site productivity layer to project growth rates of existing and future managed stands.
Economic and physical operability	An economic operability assessment using an empirical approach was completed in April 14, 2014. This assessment will form part of the land base classification in the timber supply review.
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 January 28, 2015, a 15-year Non-Replaceable Forest Licence (NRFL) was awarded to Bruce Stewart Mills specifying an allowable annual cut (AAC) of 6300 cubic metres per year for the harvest of red-alder stands.
Fragmentation of land base	The historic development of southern Vancouver Island has resulted in a complex and fragmented distribution of land ownership 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. Community interface zones have been identified for the timber supply review. Rate-of-harvest constraints will be applied to these areas.
Root diseases	Managed stand yield curves for Douglas-fir leading stands within the eastern portion of the Arrowsmith TSA have been adjusted for losses due to root diseases (e.g., <i>Phellinus sulphurascens</i> and <i>Armillaria ostoyae</i>). These stands are predominately found in the CDF and CWH xm1 and 2 subzones.

4. Inventories

4.1 Background information

Table 2 is a list of the inventories that will be used to determine the timber harvesting land base and the associated management themes to be used in defining forest management activities. As the Vegetation Resources Inventory (VRI) maps (i.e., forest cover) contain only vegetation data, information on other resources and values such as economic operability mapping, environmentally sensitive areas (ESA), visual quality objectives, wildlife habitat area, established landscape unit boundaries, old-growth management areas (OGMAs), community watershed designations, etc., will be merged with the VRI file to produce a set of resultant data files for use in the timber supply analysis.

Table 2. Inventory information

Dataset layer	Source ¹	Factor
WHSE_ADMIN_BOUNDARIES.FADM_TSA	BCGW	TSA administration (outer boundary)
WHSE_ADMIN_BOUNDARIES.FADM_TSA (TSA_NUMBER = '38' AND TSB_NUMBER is not null)	BCGW	Timber Supply Area (inner boundary)
WHSE_FOREST_VEGETATION.F_OWN (SINRD local version)	FAIB/ SINRD	Land ownership and schedule codes
WHSE_FOREST_VEGETATION.VEG_COMP_LYR_R1_POLY	BCGW	Vegetation cover
Inventory Disturbance Update (consolidated cutblocks and change detention)	FAIB	Accounting for recent harvests
WHSE_ARCHAEOLOGY.RAAD_AOA_PROVINCIAL	BCGW	Archaeological sites
WHSE_WILDLIFE_MANAGEMENT.WCP_WILDLIFE_HABITAT_AREA_POLY	BCGW	Wildlife habitat areas
WHSE_WILDLIFE_MANAGEMENT.WCP_UNGULATE_WINTER_RANGE_SP	BCGW	Ungulate winter range
WHSE_LAND_USE_PLANNING.RMP_OGMA_LEGAL_CURRENT_SVW	BCGW	OGMAs (legal)
WHSE_LAND_USE_PLANNING.RMP_OGMA_NON_LEGAL_CURRENT_SVW	BCGW	OGMAs (transitional)
Consolidated Draft OGMAs	SINRD	OGMAs (draft from licensees)
WHSE_LAND_USE_PLANNING.RMP_PLAN_NON_LEGAL_POLY_SVW	BCGW	Non-legal objectives: VILUP - agriculture, settlement, General; Clayoquot - SMZ, Reserve, Enhanced)
CDF_LUO-signed_selections_all_final	RWC	Coastal Douglas-fir: CDF LUO July 30, 2010
RIPARIAN RESERVE ZONE and Management Zone BUFFERS	SINRD	Riparian management areas
WHSE_FOREST_VEGETATION.RESPROJ_RSRCH_INSTN_GVT_SVW	BCGW	Research installations
WHSE_FOREST_VEGETATION.GRY_PSP_STATUS_ACTIVE	BCGW	Permanent/temporary sample plots
WHSE_FOREST_TENURE.FTEN_RECREATION_POLY_SVW	BCGW	Recreation sites
WHSE_FOREST_TENURE.FTEN_RECREATION_LINES_SVW	BCGW	Recreation trails
WHSE_FOREST_VEGETATION.REC_FEATURES_INVENTORY	BCGW	Recreation features
Economic Operability Assessment (2014) – Forest Ecosystem Solutions Ltd.	SINRD	Economic operability
ESA	RWC	Environmentally sensitive areas
WHSE_BASEMAPPING.DRA_DIGITAL_ROAD_ATLAS_LINE_SP	BCGW	Roads
WHSE_FOREST_TENURE.FTEN_TIMBER_LICENCE_POLY_SVW	BCGW	Timber licence reversions

¹See data source and comments following this table for meaning of abbreviations.

(continued)

Table 2. Inventory information (concluded)

Dataset layer	Source ¹	Factor
WHSE_LAND_USE_PLANNING.RMP_LANDSCAPE_UNIT_SVW	BCGW	Landscape units
WHSE_FOREST_VEGETATION.BEC_BIOGEOCLIMATIC_POLY	BCGW	Biogeoclimatic polygons
WHSE_FOREST_VEGETATION.REC_VIMS_VLI_SVW (SINRD local version)	SINRD	Visual landscape inventory
WHSE_LAND_USE_PLANNING.RMP_STRGC_LAND_RSRCE_PLAN_SVW STRGC_LAND_RSRCE_PLAN_NAME <> 'Clayoquot Sound Land Use Plan'	BCGW	Land use/Watershed plan boundaries
WHSE_LAND_USE_PLANNING.RMP_STRGC_LAND_RSRCE_PLAN_SVW STRGC_LAND_RSRCE_PLAN_NAME = 'Clayoquot Sound Land Use Plan'	BCGW	Clayoquot Sound Study Area Boundary
WHSE_LAND_USE_PLANNING.RMP_PLAN_LEGAL_POLY_SVW	BCGW	Resource management zones (VILUP RMZs: Special vs. Enhanced)
WHSE_WATER_MANAGEMENT.WLS_COMMUNITY_WS_PUB_SVW	BCGW	Community watersheds
WHSE_WILDLIFE_MANAGEMENT.WCP_FISH_SENSITIVE_WS_POLY	BCGW	Fisheries sensitive watersheds
Community Interface Zone (BCTS_ECA)	SINRD	Community interface zones
CLAY_WS	RWC	Clayoquot Sound basins/subbasins boundaries
RATE_OF_CUT	RWC	Clayoquot Sound basins/subbasins rate of cut
Projected_Layer	SINRD	Sensitivity tests – encumbered areas (currently avoided or log around area within THLB likely to be excluded in future)
EN_Line	SINRD	Sensitivity tests – wood flow between zones
Proposed Goshawk WHA	SINRD	Sensitivity tests – proposed WHA
Woodshed_Boundaries	SINRD	Harvest priority and timing rules
Rosander VRI	SINRD	VRI information for TFL46 take-back block
HARV_METHOD2	SINRD	Harvest method – ground vs helicopter
MFR_FIRST_NATIONS_AGREEMENT_BOUNDARIES	MARR	Reporting
FIRST_NATIONS_CAD_BOUNDARIES	MARR	Reporting
REG_LEGAL_AND_ADMIN_BOUNDARIES.QSOI_BC_REGIONS	BCGW	Reporting

¹See data source and comments following this table for meaning of abbreviations.

Data source and comments:

Most of spatial data required for the analysis is standard corporate data, and it will be extracted from the BC Geographic Warehouse (BCGW), formerly the Land and Resource Data Warehouse (LRDW). Non-standard spatial data will also be used and it will be obtained from several sources: the Forest Analysis and Inventory Branch's (FAIB) spatial data for distribution library, the district's DSI TSR data library, the West Coast Region (WRC) Resource Initiatives data library and the Ministry of Aboriginal Relations and Reconciliation (MARR) data library. Spatial data will be converted to ESRI's Arc GIS feature classes format (i.e., a GIS layer) in preparation for the timber supply analysis. The listing of GIS layers in Table 2 generally follows the order layers are first mentioned in Section 6, "Timber Harvesting Land Base Definition" of this data package.

TSA Administrative Boundary

Several changes in administration within the TSA are not reflected in the BCGW data. They include the following:

- the transfer of land from TFL 46 (Port Renfrew, Nitinat Lake and Hill 60) to the TSA on April 1, 2004.
- the transfer of land from TFL 44 (Maggie Lake) to the TSA on April 22, 2004.

Parts of these additions to the TSA may contribute to the timber supply. The localized version of the FC_OWN layer will be used in the timber supply analysis to correct errors in WHSE_ADMIN_BOUNDARIES.FADM_TSA

Generalized Forest Cover Ownership

The WHSE_FOREST_VEGETATION.F_OWN dataset prepared by FAIB in December 2012 is the source of forest cover ownership used in the analysis. It provides a generalized description of the primary ownership of forest lands for use in strategic decision making such as timber supply analysis. An updated version of this dataset pertaining to the Arrowsmith TSA was prepared for the timber supply review in June 2015. This version is available from SINRD as part of the collection of local datasets prepared for timber supply review four (TSR4). A description of ownership codes can be found here: http://www.for.gov.bc.ca/hts/vridata/standards/ownership/Land_Ownership_Schedule_Codes.pdf.

An additional 'G' schedule code is found in the local dataset indicating the land is located on a Gulf Island.

Vegetation Resources Inventory (VRI)

The Arrowsmith TSA was re-inventoried in 1988 – 1989. More recently, the Toquart River watershed (1992) and the Clayoquot Sound Study Area (2004-2009) portion of the Arrowsmith TSA was re-inventoried.

As part of the VRI program, the forest cover inventory for the TSA has been transferred into the VRI data structure to facilitate data management. A phase 1 VRI inventory for the Arrowsmith TSA is underway and is planned for completion in 2017.

TFL forest cover information for the land transferred to the TSA in 2004 from TFLs 44 and 46 will be incorporated into the inventory dataset assembled for the analysis. The reference year for the TFL forest cover information is 1997 (i.e., to calculate stand age in 2015 = age in 1997 + 18). For the Rosander block of the TFL 46 takeback block more recent VRI information from Teal Cedar Products Limited was incorporated into the dataset.

The inventory information used in the timber supply analysis (VEG_COMP_LYR_R1_POLY) will be updated to 2015 for disturbance, and forest cover attributes will be projected to January 1, 2014. The Consolidated_Cutblocks_2015 and harvest_change_detection datasets available from FAIB (FAIB_DATA_FOR_DISTRIBUTION) will be used to update the inventory.

Environmentally Sensitive Areas (ESAs)

ESA data (1993 vintage) will be obtained from local sources (\\spatialfiles2.bcgov\WORK\FOR\RCO\RCO\Local_Data\land_use_planning\esa). This data is the same as it was in the previous two timber supply reviews.

Visual Landscape Inventory (VLI)

The visual landscape inventory for the SINRD underwent some changes in 2011. In December 2011 additional VQOs were established, and amendments were made to previously established VQOs.

Scenic class objectives (SCOs) assessed for Clayoquot Sound. SCOs will apply to the Clayoquot Sound area instead of VQOs from the provincial VLI.

VLI data currently available (September 2014) in the BCGW do not include the SCOs for Clayoquot Sound. For the timber supply review a dataset supplied by the district which contains the SCOs for Clayoquot Sound and the updated VQOs for the area outside of Clayoquot Sound will be used instead.

Consolidated Draft OGMAs

This is licensee supplied data (May 2015) prepared for the timber supply review. These draft OGMAs meet the intent of the Provincial Non-Spatial Old Growth Objectives Order Section 8 Notices.

Riparian Reserve Zone and Management Zone Buffers

These datasets were prepared by Simon Norris under a contract issued by the district. The methodology used is suited for TSA level resource analysis.

Economic Operability Assessment, 2014

This dataset was prepared by Forest Ecosystems Solutions under a contract issued by the district. The original dataset will be generalized (removal of unnecessary lines and polygons) before incorporation into the analysis resultant file.

Forest Ecosystems Solutions also prepared an harvest method dataset from the economic operability assessment to be incorporated into the analysis resultant file.

Projected Inaccessible

This layer is a collection of areas within the TSA that are currently not accessible and may never contribute to the TSA's AAC in the future but at the current time are assumed to be part of the THLB.

5. Division of the Area into Management Zones

5.1 Management zones and tracking of multiple objectives

The concept of management zones is used to differentiate areas with distinct management emphasis. For example, a zone may be based on a harvesting system, silviculture system, visual quality objectives or wildlife consideration.

In the timber supply analysis, a secondary level, a group, is used. A group may be thought of as layers of different objectives that must be tracked or managed over time.

Further information on the forest cover requirements to be applied to these areas can be found in Section 7.5, “Objectives with forest cover requirements”.

Table 3. Zones or objectives to be tracked

Zone or objective	Comments
Land Use Plan Division — Vancouver Island Land Use Plan (VILUP) versus Clayoquot Sound Land Use Decision Area (Clayoquot Sound)	The management of natural resources in the Arrowsmith TSA is directed by VILUP and Clayoquot Sound Watershed Plans. Objectives will be applied and tracked by LUP area in the timber supply analysis. Currently the TSA's AAC is apportioned by LUP area.
Vancouver Island Land Use Plan (VILUP) — Special Management Zones (SMZs)	SMZs are designed to maintain mature and old forest conditions to zone specific targets. Variable retention harvesting systems are used in these zones. For green-up, a three-metre green-up constraint is applied. SMZs within the TSA area are: Barkley Sound, Alberni Canal, San Juan Ridge, Upper Qualicum and Nahmint.
VILUP — Enhanced Forestry Zones (EFZs)	EFZs have an objective of enhanced timber production. For green-up in EFZs a 1.5-metre green-up constraint is applied. EFZs within the VILUP area are: Effingham, Maggie, Corrigan, Sarita and Loss-Jordon.
VILUP — General Management Zones (GMZs)	<i>Forest and Range Practices Act (FRPA)</i> and other legislation apply to the general management zones. These areas are outside SMZs and EFZs.
Clayoquot Sound Watershed Plans — Clayoquot Sound	Watershed plans have been prepared for each of the fifteen major drainages in the Sound, twelve of which intersect the TSA. The plans identify on maps harvestable areas and areas set aside as reserves to protect a range of forest values.
Watershed Rate of Cut — Clayoquot Sound Watersheds	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 sub basins. Rate of cut constraints will be applied at each of these levels. Watersheds that intersect with the TSA are: Beach, Bedingfield, Clayoquot River, Cypre, Flores Island, Fortune Channel, Hesquiat, Kennedy Lake, Meares Island, Sydney/Pretty Girl, Tofino/Tranquil, and Upper Kennedy.

(continued)

Table 3. Zones or objectives to be tracked (concluded)

Zone or objective	Comments
Landscape-level biodiversity — outside of Clayoquot Sound	The Arrowsmith TSA outside of Clayoquot Sound has been subdivided into 39 landscape units. OGMAs will be used in the base case where they have been identified and mapped. Where they have not been, the recommended seral stage distribution for the biogeoclimatic unit will be modelled.
Landscape-level biodiversity — Clayoquot Sound	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 and protected areas.
Scenery (Visuals)	Visual quality objectives include preservation, retention, partial retention and modification for the TSA outside of Clayoquot Sound. For Clayoquot Sound scenic class objectives include small scale alteration, minimal alteration and natural appearing.
Community watersheds	Community watersheds have been identified where modified harvesting practices apply.
Fisheries sensitive and CWAP watersheds	The FPPR identifies six watersheds in the TSA that are particularly sensitive for their fish habitat values, and are thus subject to additional harvesting restrictions. Sensitive watersheds are: Effingham, Escalante, Gordon, Nahmint, San Juan and Toquart.
Integrated resource management	Limits on the rate of cut in non-visual areas will depend upon the type of planning area. Types of area include special management, enhanced forestry and general management.
Community interface areas	Community interface areas are identified areas near urban area where modified harvesting practices apply.
Reserve network – Clayoquot Sound	Objectives for wildlife, riparian management, ecosystem representation, old growth management, culturally significant areas and other forest values will be met through the reserve network.
Distribution of harvest (excluding Clayoquot Sound portion of the TSA)	Distribution of harvest between eastern and western divisions. The west division is made up of the Barkley timber supply block (TSB), and the east division is made up of the Cowichan and Nanaimo TSBs.
Gulf Islands	Little or no harvesting occurs on many of the Gulf Islands often due to pressure to manage these islands for non-timber values.
Deciduous component of the harvest	Provides an assessment of the harvest level for deciduous stands leading in red alder.

Data source and comments:

Sources of information include both non-standard local map information in addition to provincial level GIS data stored in the corporate data warehouse. Origins of the data include higher-level plans, local resource management plans and ministerial orders.

5.2 Analysis units

An analysis unit is a grouping of similar forest area with the intent of simplifying the analysis and its interpretation.

In this analysis, the analysis unit is a four digit number representing forest stands with similar tree species, timber growing capability, forest management approaches, and location. As noted in Table 4, the first digit reflects the most abundant tree species; the second digit reflects the site productivity of the stand, the third digit reflects whether the stand is an existing unmanaged natural stand or a managed stand and the fourth digit reflects what part of the TSA the stand is in. For example analysis unit 3112 represents a hemlock/balsam stand having a growth rating of good, unmanaged, and located in the west part of the TSA.

Table 4. Analysis unit identifiers

Leading species	Growth rating	Status	Zone
1 – Cedar/cypress	1 – good	1 – existing, not managed	1 – east
2 – Douglas-fir	2 – medium	2 – existing, old plantation	2 – west
3 – Hemlock/balsam	3 – poor	3 – existing, contemporary plantation	3 – Clayoquot
4 – Spruce		4 – future, managed	
5 – Red alder ¹			
6 – Pine/other ² (minor)			

¹ Stand must be at least 50% hardwood, otherwise it is assigned to leading species group 6.

² Other includes deciduous stands with a logging history (incidental) or alder-leading stands having a high composition of conifer species (greater than 50%).

Data source and comments:

Silvicultural practices, regeneration assumptions and management objectives may vary among analysis units within the model. While growth, harvest and the meeting of management objectives is tracked within the model at the stand level, the analysis results will be reported by analysis unit.

Yield tables for existing natural conifer stands are derived using the Variable Density Yield Prediction (VDYPv7) yield model. Natural conifer stands are stands that, as of 2015, are 65 years of age and older. They are considered not managed (status = 1).

Yield tables for existing natural red alder stands are derived using the Variable Density Yield Prediction (VDYPv7) yield model. Natural red alder stands are stands as of 2015 that are 30 years of age and older. They are considered not managed (status = 1).

Yield tables for existing managed stands and future managed stands are derived using the Table Interpolation Program for Stand Yields (TIPSYv4.3). Managed stands are stands that, as of 2015, are 64 years of age and younger, if conifer, and 29 years of age and younger if deciduous. For analysis purposes, stands established between 1950 and 1985 are considered old plantations (status 2). Stands established 1986 onwards are considered contemporary plantations (status 3).

Stands originating from area harvested after 2015 are future managed stands (status = 4).

Inventory site index estimates are assumed to be the best for status 1 and 2 stands (i.e., natural stands and old plantations). Provincial site productivity layer estimates of site index are assumed to be the best for status 3 and 4 stands (i.e., contemporary plantations and future stands).

Assumptions for regeneration of these stands are described in Section 7.4.2, “Regeneration activities in managed stands”. Table 5 provides the definition for growth rating.

Table 5. Definition of growth rating for each leading species group

Leading species	Rating	SI range when based on current inventory value	SI range when based on provincial site productivity layer value
Cedar, Cypress	1 – good	≥ 16.5	≥ 22.0
	2 – medium	≥ 11.5 and < 16.5	≥ 15.0 and < 22.0
	3 – poor	< 11.5	< 15.0
Douglas-fir	1 – good	≥ 31.0	≥ 33.0
	2 – medium	≥ 24.0 and < 31.0	≥ 30.5 and < 33.0
	3 – poor	< 24.0	< 30.5
Hemlock, Balsam	1 – good	≥ 23.0	≥ 27.5
	2 – medium	≥ 13.0 and < 23	≥ 24.0 and < 27.5
	3 – poor	< 13.0	< 24.0
Spruce	1 – good	≥ 21.5	≥ 29.5
	2 – medium	< 21.5	< 29.5
Red Alder	2 – average	N/A	N/A
Pine, Maple, Cottonwood, Poplar	2 – average	N/A	N/A

Data source and comments:

A good rating means a stand falls within the top quartile of its leading species group when ranked by site index (roughly); medium means it falls within the 2nd or 3rd quartile; poor means it falls within the bottom quartile.

6. Timber Harvesting Land Base Definition

6.1 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 purpose of the *Forest Act* Section 8 allowable annual cut determination of the timber supply area. Land may be unavailable for timber harvesting for four principal reasons:

- it is not administered by FLNR for timber supply purposes (e.g., private land, parks, etc.);
- it is administered under a different tenure (e.g., TFL, timber licence, community forest agreement);
- it is not suitable for timber production purposes;
- it is unavailable for timber harvesting due to a non-timber objective.

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 licence reversions).

The following categories are examples of land base that do not contribute to the timber harvesting land base. This list is not exhaustive or mandatory thus land categories may be added or removed as needed:

1. Land not administered by FLNR for the purpose of timber supply;
2. Non-forest types;
3. Specific archaeological sites including culturally modified trees;
4. Specific wildlife habitat areas considered unavailable for timber harvesting;
5. Specific old-growth management areas including those for Coastal Douglas-fir;
6. Riparian reserve area considerations; these may include riparian management zone considerations if warranted (see Section 6.2.3.7);
7. Specific permanent sample plots and research installations;
8. Recreation sites and trails and recreation features;
9. Specific, geographically defined areas such as the Gulf Islands;
10. Economically inoperable forest;
11. Environmentally sensitive areas;
12. Sites with low stocking;
13. Non-commercial forest types;
14. Sites with low timber growing potential;
15. Roads, trails and landings;
16. Stand-level biodiversity.

The above categories will be excluded from the timber harvesting land base where no harvesting is anticipated to occur. Forest cover requirements may be applied to some of these areas in cases where forest management objectives may permit limited harvesting.

After all areas that do not contribute to the timber harvesting land base have been identified, any additional lands that may be added at a later date to the timber harvesting land base are specified. The resulting productive forest land base is defined as the "current timber harvesting land base" for the TSA.

6.2 Details on land base classification

For the purposes of this land base classification “TSA” means the area contained within the Cowichan, Nanaimo and Barkley SB timber supply blocks (TSBs)—the core portion of Arrowsmith TSA administrative area. Area outside the core but within the broader administrative boundary of Arrowsmith TSA is not considered in this land base classification.

6.2.1 Land excluded from Crown forest management land base

The Crown forest management land base (CFMLB) is the forested area within the TSA administered by FLNR for long-term timber supply or for other resource objectives such as water quality, wildlife and recreation. It excludes private and municipal lands; federal, Indian and military reserves; land in national or provincial park or equivalent reserve; and land in area based tenures, such as tree farm licences (TFLs), community forest agreements (CFAs), woodlot licences (WLs) and First Nations woodland licences (FNWLs). Non-forest area is also excluded from the CFMLB.

FAIB ownership (F_OWN) codes and forest vegetation cover (VEG_COMP_LYR_R1_POLY) attributes will be used to identify whether or not land contributes to the timber supply for the TSA.

In preparation for the timber supply review the corporate 2014 F_OWN layer available from FAIB was reviewed, corrected and updated by district staff (see “Data source and comments” at end of this section).

Table 6 shows the potential contribution of each F_OWN ownership code to the CFMLB and the THLB.

Table 6. Ownership contributions

Ownership code	Crown forest management land base	Timber harvesting land base
40 Private Crown Grant	No	No
41 Treaty Land, Status Transfer Land	No	No
50 Federal Reserve	No	No
51 National Park	No	No
52 Indian Reserve	No	No
53 Military Reserve	No	No
60 Crown Ecological Reserve	Yes	No
61 Crown Use, Recreation and Enjoyment of the Public (UREP) Reserves	Yes	Schedule C: Yes Schedule N: No
62 Crown Forest Management Unit (TSA) or Crown Timber Agreement Lands	Yes	Yes
63 Crown Provincial Park Class A	No	No
65 Crown Provincial Park Class C, park board	No	No

(continued)

Table 6. Ownership contributions (concluded)

Ownership code	Crown forest management land base	Timber harvesting land base
67 Crown Provincial Park equivalent or reserve, regional parks, etc.	No	No
68 Crown BMTA (Biodiversity, Mining and Tourism Area)	Yes	No
69 Crown Miscellaneous Reserves	Yes	Schedule C: Yes Schedule N: No
70 Crown Active Timber Licence in a TSA or TFL	Yes	Yes
72 Crown and Private Schedule “A” and “B” Lands in a TFL	No	No
74 Crown and Private timber alienated in watershed	Yes	No
75 Crown Christmas tree permit	Yes	No
77 Crown and Private Woodlot Licence	No	No
78 First Nation Woodland Licence	No	No
79 Community Forest	No	No
99 Crown Misc. lease (e.g., fairground, R and G Club site, recreation cottage site)	No	No

Data source and comments:

FAIB’s provincial F_OWN (2012) dataset was found to have a number of errors and omissions. These errors and omissions were corrected for Arrowsmith TSA by district staff, and a corrected version of F_OWN for Arrowsmith TSA was created for the TSR. This local version of F_OWN is available in the set of layers prepared for the TSR dataset.

6.2.1.1 Ocean or large waterbody

The TSA covers the southern portion of Vancouver Island and it includes off shore islands. The boundary of the TSA is drawn around these islands and encompasses a considerable amount of ocean. The F_OWN and VEG_COMP_LYR_R1_POLY datasets will be used to distinguish ocean from land (see Table 7).

Table 7. Criteria for defining ocean or large waterbody

Dataset	Own code	Comment
F_OWN	null or '' (no data)	Exclude area not covered by F_OWN
VEG_COMP_LYR_R1_POLY	bclcs_lv_2 = 'W'	Exclude area covered by VEG classified as water

6.2.1.2 Private and municipal land, Indian and military reserves and Maa-nulth Treaty Land (non-Crown)

The CFMLB in the Arrowsmith TSA is dispersed amongst a considerable amount of area described here as “Non-Crown”. Non-Crown includes area classified as “Private – Crown Grant”, “Treaty Land”, “Indian Reserve”, and “Military Reserve” in the F_OWN dataset. The CFMLB is fragmented as a consequence especially on the east side of the TSA. Table 8 shows the criteria to be used to define Non-Crown land.

Table 8. Ownership codes defining non-Crown land

Dataset	Own code	Comment
F_OWN	40	Exclude private - Crown grant; large share of TSA land
	41	Exclude Maa-nulth Treaty Lands (April 1, 2011)
	50	Federal reserve
	52	Exclude Indian reserve
	53	Exclude military reserve

6.2.1.3 Area-based tenures

Allowable annual cuts (AACs) are determined individually for tree farm licences, woodlots, community forest agreements and First Nation woodland licences; these lands are excluded from the timber supply review for the TSA. Except for some small fragments TFL land is found outside the TSA.

Table 9. Ownership codes defining area based tenures

Dataset	Own code	Comment
F_OWN	72	Exclude TFL fragments within TSA boundary
	77	Exclude woodlots
	78	Exclude First Nations Woodland Licences
	79	Exclude community forest

6.2.1.4 Parks and protected areas

National, provincial and regional park area and protected area within the TSA is not considered part of the CFMLB. Forest cover objectives in the timber supply analysis, however, will take into account any contribution forested area within parks and protected areas have in meeting biodiversity and wildlife values.

Table 10. Ownership codes for defining parks and protected areas

Dataset	Own code	Comment
F_OWN	51	Exclude national park from CFMLB
	63	Exclude Crown provincial park class A from CFMLB
	65	Exclude Crown provincial park class C from CFMLB
	67	Exclude Crown provincial park equivalent or reserve, regional parks, recreation areas, provincial heritages site and wildlife management reserves (single use) from CFMLB

Data source and comments:

Forest inventory coverage for parks is not reliable and is incomplete.

6.2.1.5 Non-forest

Non-forest areas such as alpine, lakes, rocks, salt water etc. are removed from the land base considered for timber supply. Non-forest areas can be identified descriptively using the BC land classification system attributes within the VRI. However, for the analysis, any areas not classified as forest management land base (FMLB) within the VRI will be excluded as non-forest. FMLB takes into account site index and harvest history to ensure that recently harvested areas are not erroneously classified as non-forest.

6.2.2 Miscellaneous Crown lands not contributing to AAC

Table 11 describes lands where forest would not contribute to the AAC. Generally, these lands are not large areas.

Table 11. Ownership codes defining miscellaneous Crown lands not contributing to AAC

Dataset	Own Schedule	Comment
F_OWN	60-N	Exclude Crown ecological reserve from THLB
	68-N	Exclude BMTA (Biodiversity, Mining and Tourism Area)
	69-N	Exclude Crown miscellaneous reserves < 100 ha with or without OIC from THLB
	74-N	Exclude Crown and private timber alienated in watershed from THLB
	75-N	Exclude Crown Christmas tree permit from THLB
	99-N	Exclude Crown Misc. lease from THLB

6.2.3 No-harvest areas

6.2.3.1 Archaeological sites

Archaeological sites, including culturally modified trees (CMT) that pre-date 1846, are protected under the *Heritage Conservation Act*. Archaeological overview assessments have been completed for the TSA, providing baseline information on archaeological resource potential, to guide field-level archaeological impact assessments (AIA). Where AIAs identify archaeological sites, they are catalogued in the RAAD.

The protection of archaeological sites will be accounted for in the analysis by delineating Remote Access to Archaeological Data (RAAD) archaeological sites as buffered polygons and points and excluding these from the THLB. A 50-metre buffer will be applied to each known site in order to capture the area needed to protect known sites.

6.2.3.2 Wildlife habitat areas

The Identified Wildlife Management Strategy (IWMS), which was announced in the spring of 1999, outlines a process to identify and establish wildlife habitat areas (WHAs) and associated general wildlife measures to protect rare and/or endangered species. Thirty-nine WHAs covering a gross area of nearly 5595 hectares have been established within the TSA. Table 12 lists the WHAs by species.

Table 12. Summary of established WHAs within the Arrowsmith TSA

Species	Number of WHAs	Conditional harvest zone (ha)	No harvest zone (ha)	Total area (ha)
Data sensitive	1	1 882	253	2 135
Douglas-fir/Garry oak-onion grass	1	0	22	22
Marbled Murrelet	31	0	3 385	3 385
Red-legged frog	5	0	48	48
Scouler's corydalis	1	1	4	5
Total	39	1 883	3 712	5 595

Since a few of the WHAs overlap with other WHAs or UWRs, it will be assumed that the most restrictive measures will apply in the overlap areas.

The boundaries of established WHAs have been mapped by Ecosystems Branch of the Ministry of Environment.

6.2.3.3 Ungulate winter range

In 2003, GAR Order U-1-017 established winter ranges for mule deer and Roosevelt elk in the Arrowsmith TSA. The Order was amended in 2010 because of boundary changes to winter range units 14, 15 and 16. This order includes a set of GWM that prohibit or constrain primary forest activities within in each UWR unit. Supporting information supplied with the orders provides background information and support to the legal order. The GWM will be modelled in the timber supply analysis by applying appropriate THLB exclusion factors. Land transferred from TFL 46 to the TSA on April 11, 2004 included a small amount of winter range and this winter range is covered by GAR Order U-1-002.

Table 13. Established ungulate winter ranges

Species	Order	Order date	Approximate area (ha)
Mule Deer	U-1-017	2003-12-11	1 367
Mule Deer	U-1-017	2010-02-25	205
Roosevelt Elk	U-1-017	2003-12-11	2 580
Mule Deer	U-1-002	2003-10-30	38

6.2.3.4 Landscape-level biodiversity outside Clayoquot Sound — old-growth management areas

Landscape biodiversity management is done in two ways: through the establishment of spatial old-growth management areas (OGMA) and through non-spatial forest cover requirements. Modelling of forest cover requirements is described in Section 7.5.5 and 7.5.6.

OGMAs are defined in the *Forest Practices Code of British Columbia Act Operational Planning Regulation* as areas established under a higher level plan that contain or are managed to replace structural old growth attributes. Spatial OGMAs have been identified for the landscape units (LUs) listed in Table 14. Not all the OGMAs listed have been established. The non-legal and draft OGMAs, however, are considered current management and will be treated like established OGMAs in the timber supply analysis.

Non-spatial forest cover requirements are modelled for the 15 landscape units intersecting the TSA not listed in Table 14. Modelling is done in accordance with the *Order Establishing Provincial Non-Spatial Old Growth Objectives*.

Landscape-level biodiversity for the Clayoquot Sound portion of the TSA is dealt with separately. Older forest requirements for this zone are described in following sections.

Table 14. Old-growth management areas by landscape unit — Arrowsmith TSA

LU Prov ID	LU name	BEO	OGMA within TSA (ha)	OGMA type
479	Gordon	Intermediate	616	Legal
953	Nitinat	Intermediate	375	Legal
1102	San Juan	Intermediate	282	Legal
1394	Walbran	Intermediate	50	Legal
209	Chemainus	Intermediate	672	Non-legal
267	Cowichan	Low	200	Non-legal
363	Effingham	Intermediate	2053	Non-legal
374	Englishman	Intermediate	19	Non-legal
431	French Creek	Low	13	Non-legal
700	Koksilah	Low	79	Non-legal
752	Little Qualicum	Intermediate	192	Non-legal
815	Maggie	Low	545	Non-legal
869	Millstone	Low	12	Non-legal
915	Nanaimo	Intermediate	335	Non-legal
917	Nanoose	Low	48	Non-legal
1089	Rosewall	Intermediate	893	Non-legal
1122	Shawnigan	Low	139	Non-legal
1293	Toquart	Intermediate	1903	Non-legal
544	Henderson	Low	1158	Draft
1106	Sarita	Low	1316	Draft
681	Klanawa	Intermediate	254	Draft
61	Barkley Sound Islands	Low	420	Draft
762	Loss	Low	351	Draft
1182	Somass	Low	119	Draft

6.2.3.5 Clayoquot Sound — areas set aside as reserves

Forest management in Clayoquot Sound is conducted in accordance with the findings of the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound. Consistent with the Scientific Panel recommendations areas have been mapped and designated as areas set aside as reserves to protect a range of forest management values. These areas will be excluded from the THLB.

Reserves are selected to meeting the following resource values:

- 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 OGMAs, wildlife habitat, ESAs and FPC riparian buffers. The remaining area is available for variable retention harvesting, subject to constraints for watershed rate-of-cut constraints, old-seral requirements and visual quality objectives.

6.2.3.6 Coastal Douglas-fir

On July 30, 2010, the Ministerial Order to protect the Coastal Douglas-fir maritime (CDFmm) Biogeoclimatic subzone came into effect establishing land-use objectives for the Coastal Douglas-fir moist maritime (CDFmm) Biogeoclimatic Subzone. The 1600 hectares identified in the order will be excluded from the THLB.

6.2.3.7 Riparian management

The effects of riparian management on the TSA timber supply were modelled by creating nested variable width buffers around streams. Buffer polygons were created for riparian reserve zones (RRZ) and riparian management zones (RMZ). Buffer widths were based on stream riparian classifications (S1-S6) approximated by examining stream order (from the BC Freshwater Atlas) on potential fish habitat (from the Fish Passage Technical Working Group’s Potential Fish Habitat Model). Within the model, potential fish habitat is defined as linear stream that is either downstream of a field fish observation (WHSE_FISH.FISS_FISH_OBSRVN_PNT_SP) or not upstream of a barrier to fish passage (slope, falls, dam, etc. from various sources).

For single-line streams, classifications and RRZ buffers are from the *FPPR* and are as follows:

Table 15. Riparian reserve zone buffer for stream classifications

Potential fish habitat	Stream order	Stream classification	RRZ buffer (m)	RMZ buffer (m)
Yes	4	S1b	50	20
Yes	3	S2	30	20
Yes	2	S3	20	20
Yes	1	S4	0	30
No	2	S5	0	30
No	1	S6	0	20

All double-line streams were classified as S1a and a 100m RMZ buffer was generated (S1a streams do not have an RRZ area). Within the RRZ buffer a 100% netdown of forest cover will be applied. Within the RMZ buffer, the *FPPR* retention requirements will be applied as an amount of forested area retained at the time of harvest as described in Table 16.

Table 16. Area retained in riparian management zones buffers

Riparian class	Basal area to be retained within riparian management zone (%)	Forest area retained (%)
S1-A or S1-B stream	>20	20
S2 stream	>20	20
S3 stream	>20	20
S4 stream	>10	10
S5 stream	>10	10
S6 stream	Not applicable	0

Data source and comments:

Lakes and wetlands have not yet been addressed in this riparian layer. Future improvement to this layer would include the buffering of wetlands and lakes. In this TSR, these features will be taken into account in estimates of area retained for stand-level biodiversity.

6.2.3.8 Permanent sample plots and research installations

Each active permanent sample plot will receive a 100-metre buffer and the total area (3.14 hectares) will be unavailable for harvesting for 100 years. The total area of each active research installation including any prescribed buffer will be unavailable for harvesting for 100 years.

6.2.3.9 Recreation features

Recreation features are features on the land base that are important for public and commercial recreation activities. These features, such as wildlife viewing areas, camp sites and sheltered moorage areas, can result in the exclusion of harvest activities.

Legally established recreation sites, trails and interpretive forests have very high recreation values. In the timber supply analysis, small recreation sites and trails identified in the forest tenure recreation map layers in the BCGW will be excluded from the THLB. Crown Use, Recreation and Enjoyment of the Public (UREP) Reserves less than 100 hectares in size identified in the F_OWN map layer as 61-N will also be excluded from the THLB.

The recreation feature inventory will also be used to exclude areas from harvest activities. Table 17 summarizes these reductions and the reductions for the other recreation values.

Table 17. Reductions for recreation values

Description	Reduction (%)	Dataset
Recreation sites	100% for sites <= 100 ha; 50% of sites > 100 ha	FTEN_RECREATION_POLY_SVW
Recreation trails	25 metre buffer on each side of trail removed	FTEN_RECREATION_LINES_SVW
Miscellaneous UREP reserve < 100 ha in size	100% ownership = '61-N'	F_OWN_LOCAL
Recreation feature with very high significance and high sensitivity	100%	REC_FEATURES_INVENTORY
Recreation feature with very high significance and moderate sensitivity; or feature with high significance and high sensitivity	50%	REC_FEATURES_INVENTORY
Recreation feature with high significance and moderate sensitivity; or feature with moderate significance and high sensitivity	10%	REC_FEATURES_INVENTORY

6.2.4 Areas uneconomic or not available to harvest and regenerate

These areas, and all following classification factors, will remain in the CFMLB and will contribute to forest management objectives.

6.2.4.1 Gulf Islands

Currently little or no harvesting occurs on many of the Gulf Islands often due to pressure to manage these islands for non-timber values (e.g., conservation of Coastal Douglas-fir (CDFmm) biogeoclimatic zone). On Saltspring and Gabriola Islands no timber harvesting has occurred for at least 20 years. In the July 2009 AAC determination the chief forester assumed these areas do not contribute to timber and accounted for this in his determination. For this analysis it will be assumed that Crown forest land on the Gulf Islands is not available for timber harvesting.

Data source and comments:

A 'G' schedule code in the F_OWN layer indicates land on a Gulf Island.

6.2.4.2 Economically inoperable areas

An economic operability assessment for Arrowsmith TSA using an empirical approach was completed by Forest Ecosystems Solutions Ltd. in April 2014. The assessment determines areas of the land base where the value of merchantable timber is greater than the cost to access and harvest it. Two meetings with several current licensees were conducted to review the minimum economic volumes (February 27, 2014) and preliminary economic classifications (March 11, 2014) and feedback from licensees was used to set the final minimum volumes and to refine the economic classification.

Table 18. Description of economically inoperable areas

Access type	Economic	Reduction (%)
All	Y - operable	0
	P - partially operable	1 – Economic_partial_pct
	N - not operable	100
	Not mapped (no data)	100

Data source and comments:

The economic operability map also identifies these access types: ‘exist road’, ‘heli’, ‘NA’ and ‘prop road’. Access type mapping will be used in determining minimum volume thresholds and reductions for future roads.

6.2.4.3 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 (ESAs) are identified and delineated through forest cover polygons and are considered for reductions to the THLB. Two categories of ESAs are taken into account: sensitive soils and sites with suspected regeneration problems. Reductions to the THLB due to these ESAs are shown in Table 19.

Table 19. Description of environmentally sensitive areas

ESA category	Logging history	Code	Reduction percent (%)
Soils	N	Es1	100%
Regeneration	N	Ep1	100%

Data source and comments:

ESAs were identified by transferring and overlaying the sensitive area attributes from the previous forest cover inventory since these attributes are not incorporated in VRI. This is currently the best available means of identifying ESA for sensitive soils, avalanche hazard, and tree regeneration reasons in the Arrowsmith TSA.

6.2.4.4 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.

6.2.4.5 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 20 shows stand types that will be excluded from the THLB.

Table 20. Description of non-commercial forest types

Leading species	Species code	Logging history	Reduction percent (%)
Poplar	AC	N	100
Black Cottonwood	ACT	N	100
Bigleaf Maple	MB	N	100
Willow	W	N	100

Data source and comments:

Stands occurring in these forest types having a harvest history are assigned to the pine/other leading analysis unit and are included in the THLB.

6.2.4.6 Sites with low timber growing potential

Existing natural stands (≥ 65 years) that are not likely to achieve a harvestable volume over a reasonable time horizon are excluded from the THLB. 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 (VDPY7).

6.2.5 Additional retention and excluded area within timber harvesting land base (THLB)**6.2.5.1 Roads, trails and landings**

Existing roads, trails and landings will be accounted in the analysis in one of two ways. Large roads, such as a highway having a wide right-of-way, are categorized in the forest cover inventory as non-forest land polygons, and will be removed from the land base considered available for timber supply (see Section 6.2.1.5). Smaller roads, as well as trails and landings, are considered unproductive area within a forest cover polygon and will be removed from the land base considered available for timber supply. These features do not get classified in the 1:20 000 scale forest cover inventory because of their linear shape and small size.

Buffers will be applied to either side of all roads and the buffered area removed from the THLB. Widths of buffers vary depending on the category of road and its location (Table 21). The buffered road area is the assumed average loss of growing space due to roads, trails and landings.

Table 21. Reductions for existing roads and trails

Zone	Road category	Buffer width (metres)	Buffer polygon width (metres)
East	Mainline	6.5 each side	13
	Branch	4 each side	8
	Spur	3.5 each side	7
West (including Clayoquot)	Mainline	6.5 each side	13
	Branch	5 each side	10
	Spur	4 each side	8

Future roads are projected to be about 5% of logged areas based on current performance. Therefore all stands above 100 years of age that are not currently roaded will have a 5% reduction applied at the time of harvest.

Data source and comments:

Buffer widths provided by SINRD engineering staff.

The economic operability assessment mapping identifies where future access roads may be built. These areas are assumed to be not currently roaded.

6.2.5.2 Stand-level biodiversity

Stand-level biodiversity planning is a requirement under the *FRPA* and is done in accordance with Section 66 of the *FPPR*. Objectives for stand structure through wildlife tree retention (WTR) are described in the *Landscape Unit Planning Guide* (1999). Further to this, higher level plan objectives for stand structure through retaining trees in harvested areas are described in *VILUP* and *Clayoquot Sound Watershed Plans*. Stand structure objectives and retention targets, if necessary, are considered and described in forest stewardship plans.

The practice of leaving trees for wildlife and for assisting in conservation of stand-level biodiversity is modelled in the timber supply analysis by reducing the land base available for harvesting to account for trees that must be left standing in harvested areas (net area). Targets take into account areas within riparian buffers, and that no wildlife tree retention is required within 250 metres of non-contributing land base. A minimum of 7% of the total area must be covered by wildlife tree retention areas across cutblocks, 3.5% within cutblocks (i.e., the percentage the THLB is reduced). For landscape units covered by the Renfrew Sustainable Resource Management Plan 50 percent of the WTP requirement prescribed in Table A must be achieved from within cutblocks.

Data source and comments:

There is uncertainty about the amount of area lost to retained overstory. This uncertainty is addressed through sensitivity analysis.

6.2.6 Timber licence reversions

Timber Licences (TLs) are a form of historic tenure that gave the licensee exclusive right to harvest merchantable timber as defined in the *Forest Act*, within the licence area. Once the merchantable timber in the area of the TL has been harvested, the timber licence area reverts to the underlying management unit. Accordingly, timber licences within the TSA are included in the THLB after the first harvest where they contribute to the mid- and long-term timber supply.

Table 22 describes how the unregulated TLs within the TSA will be treated in the timber supply analysis. TLs with closed files will be included in the THLB; those with open files are assumed to revert back to the TSA in 10 years.

Table 22. Timber licences

Status of file	TL forest file Id	Comment
Active but closed	T0057, T0174, T0277, T0553, T0775, T0811, T0825, T0828, T0843	Include in TSA's THLB now because reversion is imminent.
Active but open	T0295, T0738, T0831, T0834, T0837, T0840, T0846, T0910	Not part of the TSA's timber supply until after 2025.

Data source and comments:

TLs not listed in Table 22 are excluded for the TSA's timber supply.

7. Current Forest Management Assumptions

7.1 Harvesting

7.1.1 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.

Table 23. 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
Natural conifer between 64 and 120 years of age	12.5	30	10
Managed conifer	12.5	30	10
Alder >45 years of age	17.5	30	15

7.1.2 Minimum harvestable age and volume

Minimum harvestable ages (MHAs) are, as the term implies, the minimum age at which harvesting is expected to be feasible. While harvesting may occur in stands at the minimum requirements in order to meet forest level objectives, most stands will not be harvested until well past the minimum ages because other resource values take precedence (e.g., requirements for the retention of older timber).

The minimum harvestable age for stands in each analysis unit will be defined as age at which the stand is predicted to reach a volume of 350 cubic metres per hectare, provided there is road access. Where stands need to be heli-harvested, the minimum harvestable age will be defined as the age at which the stand is predicted to reach a volume of 450 cubic metres per hectare.

Data source and comments:

The increased minimum volume will be applied to areas mapped as 'heli' or 'heli water' in the HARV_METHOD2 dataset derived from the April 2014 Economic Operability Assessment.

In addition to minimum MHAs defined by a volume threshold, minimum harvestable age for each analysis unit will be calculated as the age at which analysis unit's mean annual increment (MAI) on average achieves a value of 90% of the MAI maximum (culmination). These MHAs will be used in sensitivity tests.

7.1.3 Harvest scheduling and target priorities

In the timber supply analysis base case available stands that are above minimum volume threshold will be queued for harvesting based on age (oldest first). For the first twenty of the harvest projection, a priority is placed on harvesting 13 700 cubic metres per year from the Clayoquot Sound Decision Area, 6300 cubic metres a year from red alder leading stands and 100 000 cubic metres per year from the east side of the TSA. After these priorities are addressed, the west side of the TSA is targeted for the balance of the annual harvest.

The SINRD has divided the TSA into woodsheds. A woodshed is a subunit of the TSA serviced by a common road system and timber gathering points. The timber supply analysis will include harvest priority rules and/or harvest timing rules to account for short-term road development and operation mobilization issues in selected woodsheds. These issues occur where necessary road infrastructure is lacking and/or there is insufficient merchantable volume within a woodshed to justify development in the immediate term.

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 targets for second-growth timber, or other mechanisms to balance harvesting between the east coast and west coast on Vancouver Island will be examined.

Data source and comments:

Final woodshed boundaries, harvest priority rules and harvest timing rules will be generated by the SINRD in consultation with major licensees and BC Timber Sales.

7.2 Silviculture management regimes

Silviculture practices in the TSA need to be considered as a prelude to developing yield curves. Silvicultural systems that include variable levels of retention are commonly employed throughout the Arrowsmith TSA. Retention is the heaviest in SMZs and Clayoquot Sound, and lightest in EFZs.

Retention harvesting will be modelled in the analysis. Two retention averages have been calculated, one for Clayoquot Sound and one for the remainder of the TSA. Volume reductions based on these averages will be applied when the forest estate model is run, rather than directly on the yield curves. Volume adjustments for retention within harvested areas are described in Section 7.3.3.

Retention to protect riparian values and for wildlife trees and wildlife tree patches requirements is treated separately and is incremental to the volume adjustment described in Section 7.3.3. This retention is spatially netted out of the THLB, so no retention modelling will be required for these areas (see Sections 6.2.3.7 and 6.2.5.2).

7.3 Volume losses

7.3.1 Unsalvaged losses

Unsalvaged losses provide an estimate of the average annual volume of timber that will be damaged or killed on the forested land base and not salvaged or accounted for by other factors. These losses result from atypical events related to a number of factors that cause tree mortality, including insects, disease, blowdown, snowpress, wildfires, etc. The values shown in the unsalvaged loss column of the tables below represent estimated annual volume that will not be recovered or salvaged.

Table 24. Annual unsalvaged losses

Cause of loss	Annual loss within the THLB	Salvage rate	Annual unsalvaged loss within the THLB
	(m ³ /year)	%	(m ³ /year)
Wind	N/A	N/A	N/A
Fire	1 067	0%	1 067
Root Diseases	5 545	25%	4 159
Douglas-fir Bark Beetle	7 691	50%	3 845
Spruce Beetle	2	0%	2
Western Balsam Bark Beetle	32	0%	32
Total	13 270		8 038

Data source and comments:**Fire**

Data from Wildfire Management Branch indicate that on average over the last 20 years 34 hectares was burned by wildfire each year in the South Island Natural Resource District. Most of the burned stands are located outside of the TSA's THLB (94%) and little of the fire-killed volume is recovered. The percentage within the THLB (6.44% x 34 hectares) was multiplied by the average volume per hectare on the THLB (487 m³/hectares) to estimate annual unsalvaged volume loss in the THLB (1067 m³).

Root diseases

The areas damaged annually by all root diseases were estimated in forest health overview assessments conducted between 2010 and 2014. Volume losses in damaged stands within the THLB were estimated from the 2014 projection of the forest cover inventory. Yield curve reductions for existing and future managed stands (described in Section 7.3.2) have also been applied to account for the endemic root disease losses.

Douglas-fir, Spruce Beetle and Western Balsam Bark Beetle

The annual areas damaged by Douglas-fir, Western Balsam Bark Beetle and Spruce Beetle were estimated in forest health overview assessments conducted between 2010 and 2014. Volume losses in damaged stands within the THLB were estimated from the 2014 projection of the forest cover inventory.

7.3.2 Operational adjustment factors

The objective of this section is to describe what operational adjustment factors (OAF) are, why they are needed, and how to determine OAF for planning purposes. OAF are required because they relate to the type of volume yields the Tree and Stand Simulator (TASS¹) model generates for use in TIPSYS.

¹ The Tree and Stand Simulator (TASS) is a three-dimensional growth simulator that generates growth and yield information for even-aged stands of pure coniferous species of commercial importance in coastal and interior forests of British Columbia. TASS generates the volume growth curves for use by TIPSYS in managed stands.

TIPSY is a model that interpolates a range of yield tables from the single tree growth model TASS. The interpolation methodology enables quick generation of yield tables applicable to many single species managed stand types in British Columbia. The TASS yield tables used as the base to TIPSY are potential yields that reflect a limited set of inputs of initial density, site index, species, and stem distribution. Potential yields do not reflect an operational environment and in order to reflect an operational environment, OAFs are applied.

Two types of OAF are available in TIPSY to account for elements that reduce potential yields. The two OAF values are referred to as OAF 1 and OAF 2. OAF 1 affects the magnitude of the yield curve and is constant across all ages, whereas the impact of OAF 2 accelerates with age. Changing both OAF values affects the magnitude and shape of the yield curve.

OAF 1 represents uneven stocking or gaps and was historically handled by a 15% reduction, or a factor of 0.85. OAF 2 represents the impact of decay, waste and breakage in second-growth stands and has generally been handled by a 5% reduction or a reduction factor of 0.95. Insect and disease problems are not part of the 5% reduction; additional adjustments to OAF 2 may be made to accommodate these issues.

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 managed stands through revised OAF 2 values which are based on work conducted by the Regional Pathologist. OAF 2 has been increased from 5% to 12.5% for Douglas-fir stands less than 65 years old in 2015, and to 10% for future Douglas-fir stands located in the east zone of the TSA. These stands are predominately in the CDF and CWH xm 1 and 2 biogeoclimatic ecosystem classification (BEC) subzones. These are the factors that were used for TSR3, and the Regional Forest Health Specialist advises that they are still reasonable. They will be used for this analysis.

7.3.3 Volume adjustments for retention within harvested areas

The VILUP sets retention targets for different resource management zones, with the Clayoquot Sound Land Use Decision Area having its own target of 40%. Almost 60% of the harvest in the VILUP portion of Arrowsmith TSA includes variable levels of retention with the rest consisting of clearcut with reserves and clearcut. It is estimated, based on information found in RESULTS, information provided by licence holders, and from stand-level data collected by the Forest and Range Evaluation Program (FREP) program, that on average in the more constrained areas such as VQO retention areas and special management zones (SMZs), 18% is retained at a stand level for an extended period of time.

Drawing from papers in the scientific literature relevant to conditions in Arrowsmith TSA, FLNR research staff suggest that stand-growth reduction (shading effect) from 18% retention, as a general average, be assumed to be proportional and a value of -18% be used to adjust volumes in the regeneration cohort (contemporary plantations and future stands). This general average for the VILUP portion of Arrowsmith TSA accounts for differences in dispersion effects (i.e., aggregated *versus* dispersed), variation in species responses and a conservative approach.

A volume adjustment of -18% will be applied in VILUP SMZs to plantations that are currently less than 15 years old and to future regenerated stands. As well, a volume adjustment of -18% will be applied in VILUP retention VQO areas to plantations that are currently less than 16 years old and to future regenerated stands.

Forty percent of a stand's volume will be retained in all stands harvested in Clayoquot Sound, as per the Scientific Panel recommendations, to account for trees left unharvested in variable retention blocks.

As mention in Section 7.2, volume adjustments will be applied when the forest estate model is ran, rather than directly on the yield curves. The volume adjustment accounts for loss of growth in the regeneration cohort but does not account for loss of the retained overstory over and above that accounted for in land base reductions made for riparian reserves, wildlife trees and wildlife tree patches.

7.4 Silviculture

7.4.1 Immature plantation history

This section identifies areas of existing immature forest where the establishment density (i.e., stems per hectare) is controlled and therefore should be assigned to a managed stand yield table (MSYT). All NSR, conifer stands in 2015 less than 65 years of age, deciduous stands in 2015 less than 30 years in age and stands harvested in the future will be managed under MSYTs.

Practices have evolved considerably over the last 65 years. To capture some of the differences, existing managed stands are classified as either old plantations or contemporary plantations under the basic premise that older managed stands will not likely perform as well as newer stands based on the relative quality of seedlings used to establish stands over this long history. Seedling quality and growth performance in the field are assumed to be dependent on nursery production practices of the day.

Two main factors appear to have had influence in determining general periods of seedling performance: the replacement of bare-root with containerized stock and the improvement seen in bare-root stock before it was phased out. The transition to containerized stock began in the mid-1970s and completed by the early 1990s – a bit earlier, say by 1990 on the coast. A major shift to containerized stock for coastal planting occurred during the mid-1980s. However, bare-root stock was significantly improved during the same time period, before it was finally abandoned.

Allowing for a slight lag between use of new techniques in the nursery and deployment of stock in the field, a transition date of 1985 – 1986 on the south coast was chosen, with old stock being assumed to be used up to and including 1985 and new stock largely being deployed from 1986 onwards. In the analysis these will be referred to respectively as old and contemporary plantations.

7.4.2 Regeneration activities in managed stands

Information on the initial stand conditions (i.e., regeneration) are required to generate yield tables for managed stands. Managed stands have been put into three categories: old plantations, contemporary plantations and future stands (see Section 7.4.1 for rationale). They will be grown on managed stand yield tables (MSYTs) produced using the FLNR table interpolation program for stand yields (TIPSY v4.3) model.

Tables 25, 26 and 27 include the criteria used to define each managed stand analysis unit yield table. For existing managed stands (Tables 25 and 26) the species composition assumption for TIPSY is based on VRI summaries for stands that fall within the analysis unit. For future managed stands (Table 27), species composition is based on RESULTS summaries for recent openings (i.e., last 12 years) that fall within the analysis unit.

Genetic gain through tree improvement is incorporated into yield estimates for contemporary and future plantations. Details on incorporating genetic gain into the MSYTs are found in Section 7.4.5.

Table 25. Regeneration assumptions for old plantations

Zone	Leading species	Site rating	Species composition	Regen delay (years)	OAF 1	OAF 2	Method	Density initial (sph)
East	Cedar	G	Cw54Hw28Fd10Dr8	2	15	5	Plant	1000
East	Cedar	M	Cw48Hw28Ba16Fd8	2	15	5	Plant	1000
East	Cedar	P	Cw48Hw28Ba16Fd8	2	15	5	Plant	1200
East	Douglas-fir	G	Fd80Hw14Cw6	2	15	12.5	Plant	1200
East	Douglas-fir	M	Fd76Hw16Cw8	2	15	12.5	Plant	1200
East	Douglas-fir	P	Fd75Hw11PI7Cw7	2	15	12.5	Plant	1000
East	Hemlock/Balsam	G	Ba39Hw29Fd17YC8Cw7	2	15	5	Plant	1000
East	Hemlock/Balsam	M	Hw48Ba25Fd15Cw12	2	15	5	Plant	1000
East	Hemlock/Balsam	P	Ba44Hw34Fd10Cw8YC4	2	15	5	Plant	1400
East	Spruce	G	Ss44Hw38Cw18	2	15	5	Plant	1000
East	Red Alder	M	Dr71Fd16Hw8PI5	2	15	5	Plant	1000
East	Pine/Other	M	PI70Fd20Dr10	2	15	5	Plant	1000
West	Cedar	G	Cw64Hw28Fd8	2	15	5	Plant	1000
West	Cedar	M	Cw68Hw26Dr6	2	15	5	Plant	1000
West	Cedar	P	Cw64Hw29Dr7	2	15	5	Plant	1200
West	Fir	G	Fd64Hw20Cw16	2	15	5	Plant	1200
West	Fir	M	Fd62Hw22Cw16	2	15	5	Plant	1200
West	Fir	P	Fd61Hw14Cw19Dr6	2	15	5	Plant	1000
West	Hemlock/Balsam	G	Hw62Ba16Cw16Fd6	2	15	5	Plant	1000
West	Hemlock/Balsam	M	Hw65Cw18Ba11Fd6	2	15	5	Plant	1000
West	Hemlock/Balsam	P	Hw58Cw36Ba6	2	15	5	Plant	1400
West	Spruce	G	Ss40Hw40Ba20	2	15	5	Plant	1000
West	Spruce	M	Ss58Hw23Cw19	2	15	5	Plant	1000
West	Red Alder	M	Dr77Hw15Cw8	2	15	5	Plant	1000
West	Pine/Other	M	Dr48Pw25Cw18Hw9	2	15	5	Plant	1000
Clayoquot	Cedar	G	Cw60Hw30Fd5Dr5	2	15	5	Plant	1000
Clayoquot	Cedar	M	Cw60Hw40	2	15	5	Plant	1000
Clayoquot	Cedar	P	Cw60Hw40	2	15	5	Plant	1200
Clayoquot	Douglas-fir	G	Fd90Hw10	2	15	5	Plant	1200
Clayoquot	Douglas-fir	M	Fd64Hw22Cw14	2	15	5	Plant	1200
Clayoquot	Douglas-fir	P	Fd55Hw21Cw17Dr7	2	15	5	Plant	1000
Clayoquot	Hemlock/Balsam	G	Hw58Cw17Ba11Fd6Dr8	2	15	5	Plant	1000
Clayoquot	Hemlock/Balsam	M	Hw55Cw17Fd10Ba5Dr13	2	15	5	Plant	1000
Clayoquot	Hemlock/Balsam	P	Hw55Cw17Fd10Ba5Dr13	2	15	5	Plant	1400
Clayoquot	Spruce	G	Ss58Hw23Cw10Fd4Dr5	2	15	5	Plant	1000
Clayoquot	Spruce	M	Ss67Hw15Cw13Dr5	2	15	5	Plant	1000
Clayoquot	Pine/Other	M	PI70Cw18Dr12	2	15	5	Plant	1000

Data source and comments:

Existing stands established between 1950 and 1985 are considered old plantations. Site index for each analysis unit will be calculated after the determination of the THLB, and it will represent the area weighted average of inventory site index estimates for stands on the THLB that fall within the analysis unit. The inventory site index is believed to better represent the performance of nursery stock planted during this period. Average species of each analysis unit is based on forest cover inventory label information.

Table 26. Regeneration assumptions for contemporary plantations

Zone	Leading species	Site rating	Species composition	Regen delay (years)	OAF 1	OAF 2	Method	Density initial (sph)
East	Cedar	G	Cw60Fd18Hw7Ba5Dr10	2	15	5	Plant	1000
East	Cedar	M	Cw64Fd14Hw7Ba7Dr8	2	15	5	Plant	1000
East	Douglas-fir	G	Fd80Cw10Hw5Ba5	2	15	12.5	Plant	1200
East	Douglas-fir	M	Fd80Cw10Hw5Ba5	2	15	12.5	Plant	1200
East	Douglas-fir	P	Fd70Cw10PI10Hw5Ba5	2	15	12.5	Plant	1000
East	Hemlock/Balsam	G	BA35Hw23Fd22Cw8Dr12	2	15	5	Plant	1000
East	Hemlock/Balsam	M	Hw62Fd28Cw10	2	15	5	Plant	1000
East	Hemlock/Balsam	P	Hw37Ba30Fd20Cw13	2	15	5	Plant	1400
East	Red Alder	M	Dr76Fd14Cw10	2	15	5	Plant	1000
East	Pine/Other	M	PI50Cw12Fd12Hw8Dr18	2	15	5	Plant	1000
West	Cedar	G	Cw67Hw24Ba9	2	15	5	Plant	1000
West	Cedar	M	Cw70Hw23Ba7	2	15	5	Plant	1000
West	Cedar	P	Cw75Hw17Yc8	2	15	5	Plant	1200
West	Fir	G	Fd76Cw14Hw10	2	15	5	Plant	1200
West	Fir	M	Fd65Hw15Cw13Ba7	2	15	5	Plant	1200
West	Fir	P	Fd75Hw15Cw10	2	15	5	Plant	1000
West	Hemlock/Balsam	G	Hw52Ba27Cw21	2	15	5	Plant	1000
West	Hemlock/Balsam	M	Hw56Ba22Cw22	2	15	5	Plant	1000
West	Hemlock/Balsam	P	Hw50Ba28Cw22	2	15	5	Plant	1400
West	Spruce	G	Ss47Hw30Cw23	2	15	5	Plant	1000
West	Spruce	M	Ss40Hw30Cw30	2	15	5	Plant	1000
West	Red Alder	M	Dr100	2	15	5	Plant	1000
West	Pine/Other	M	Fd40PI35Cw25	2	15	5	Plant	1000
Clayoquot	Cedar	G	Cw58Hw30Ba12	2	15	5	Plant	1000
Clayoquot	Cedar	M	Cw78Hw22	2	15	5	Plant	1000
Clayoquot	Cedar	P	Cw78Hw22	2	15	5	Plant	1200
Clayoquot	Douglas-fir	G	Fd55Hw25Cw20	2	15	5	Plant	1200
Clayoquot	Hemlock/Balsam	G	Hw66Cw18Ba16	2	15	5	Plant	1000
Clayoquot	Hemlock/Balsam	M	Hw60Ba25Cw15	2	15	5	Plant	1000
Clayoquot	Hemlock/Balsam	P	Hw53Ba18Cw24Yc5	2	15	5	Plant	1400
Clayoquot	Spruce	M	Ss40Dr30Hw20Cw10	2	15	5	Plant	1000
Clayoquot	Red Alder	M	Dr85Hw10Cw5	2	15	5	Plant	1000
Clayoquot	Pine/Other	M	PI55Cw22Hw10Ss5Dr8	2	15	5	Plant	1000

Data source and comments:

Existing managed stands established in 1986 and onwards are considered contemporary plantations. Site index for each analysis unit will be calculated after the determination of the THLB, and it will represent the area weighted average of BC site productivity layer site index estimates for stands on the THLB that fall within the analysis unit. The BC site productivity layer site index is believed to better represent the current performance of nursery stock planted during this period. Average species composition for each analysis unit is based on forest inventory label information.

Table 27. Regeneration assumptions for future managed stands

Zone	Leading species	Site rating	Species composition	Regen delay (years)	OAF 1	OAF 2	Method	Density initial sph
East	Cedar	G	Cw60Fd20Hw10Pw3.5Ss3.5Ba3	2	15	5	Plant	1000
East	Cedar	M	Cw60Fd20Hw10Pw3.5Ss3.5Ba3	2	15	5	Plant	1000
East	Cedar	P	Cw70Hw20Ba10	2	15	5	Plant	1000
East	Douglas-fir	G	Fd80Hw10Cw8Pw1Ss1	2	15	10	Plant	1000
East	Douglas-fir	M	Fdc80Hw15Cw3Pw2	2	15	10	Plant	1000
East	Douglas-fir	P	Fdc75Hw20Cw3Pw1P11	2	15	10	Plant	1000
East	Hemlock/Balsam	G	Hw75Cw15Fdc5Ba5	2	15	5	Plant	1000
East	Hemlock/Balsam	M	Hw75Cw15Fdc5Ba5	2	15	5	Plant	1000
East	Hemlock/Balsam	P	Hw60Cw25Ba10Fdc5	2	15	5	Plant	1000
East	Spruce	G	Hw60Cw30Fdc5Ss5	2	15	5	Plant	1000
East	Red Alder	M	Dr75Cw10Hw10Fdc4Ss1	2	15	5	Plant	1600
East	Pine/Other	M	Fdc50PI40Hw5Cw5	2	15	5	Plant	1000
West	Cedar	G	Cw60Hw30Ba5Cy4Ss1	2	15	5	Plant	1000
West	Cedar	M	Cw65Hw25B5Cy4Ss1	2	15	5	Plant	1000
West	Cedar	P	Cw70Hw20Ba5Cy5	2	15	5	Plant	1000
West	Douglas-fir	G	Fd65Hw25Cw10	2	15	5	Plant	1000
West	Douglas-fir	M	Fdc60Hw25Cw15	2	15	5	Plant	1000
West	Douglas-fir	P	Fdc55Hw25Cw20	2	15	5	Plant	1000
West	Hemlock/Balsam	G	Hw65Cw18Ba15Fdc2	2	15	5	Plant	1000
West	Hemlock/Balsam	M	Hw70Cw18Ba10Cy2	2	15	5	Plant	1000
West	Hemlock/Balsam	P	Hw70Cw20Ba10	2	15	5	Plant	1000
West	Spruce	G	Hw70cw20Ba8Ss2	2	15	5	Plant	1000
West	Spruce	M	Hw70cw20Ba8Ss2	2	15	5	Plant	1000
West	Red Alder	M	Dr70Hw20Cw10	2	15	5	Plant	1000
West	Pine/Other	M	Cw50Hw30Cy15PI5	2	15	5	Plant	1000
Clayoquot	Cedar	G	Cw60Hw30Cy5Ss5	2	15	5	Plant	1000
Clayoquot	Cedar	M	Cw50Hw30Cy15Ss5	2	15	5	Plant	1000
Clayoquot	Cedar	P	Cy30Cw30Hw25Ss5	2	15	5	Plant	1000
Clayoquot	Douglas-fir	G	Fdc50Hw30Cw20	2	15	5	Plant	1000
Clayoquot	Douglas-fir	M	Fdc40Hw30Cw30	2	15	5	Plant	1000
Clayoquot	Douglas-fir	P	Fdc40Hw30Cw30	2	15	5	Plant	1000
Clayoquot	Hemlock/Balsam	G	Hw50Cw30Cy10Ba8Ss2	2	15	5	Plant	1000
Clayoquot	Hemlock/Balsam	M	Hw50Cw30Cy10Ba8Ss2	2	15	5	Plant	1000
Clayoquot	Hemlock/Balsam	P	Hw55Cy20Ba15Cw10	2	15	5	Plant	1000
Clayoquot	Spruce	G	Hw70Cw28Ss2	2	15	5	Plant	1000
Clayoquot	Spruce	M	Hw70Cw28Ss2	2	15	5	Plant	1000
Clayoquot	Red Alder	M	Hw70Cw28Ss2	2	15	5	Plant	1600
Clayoquot	Pine/Other	M	Cw50PI40Cy5Hw5	2	15	5	Plant	1000

Data source and comments:

Stands established after 2015 are considered future plantations. Site index for each analysis unit will be calculated after the determination of the THLB, and it will represent the area-weighted average of BC site productivity layer site index estimates for stands on the THLB that fall within the analysis unit. The BC site productivity layer site index is believed to better represent the potential performance of nursery stock planted. Average species composition for each analysis unit is based on recent RESULTS information (last 12 years).

7.4.3 Not satisfactorily restocked (NSR) areas

All NSR is considered current and is assumed to regenerate within specified regeneration delay periods as per Tables 25, 26 and 27.

All NSR and previously logged areas within conventional or helicopter accessible portions of the operable land base is included in the timber harvesting land base. The base case will exclude any previously harvested cutblocks that operability modelling criteria identified as inoperable (approximately 1017 hectares).

Up to date harvest history over rides a “not forested” designation in the forest cover inventory (i.e., FMLB = ‘N’). These areas (1897 hectares) having no economic classification are assumed to be operable and are included in the timber harvesting land base.

7.4.4 Fertilized areas

Between 2007 and 2013 approximately 6800 hectares were fertilized. For this timber supply review the following assumptions are being modelled. The treatment response will be applied to the Douglas-fir component of selected stands. Fertilization information from RESULTS will be used to determine which stands receive an increase in stand volume due to this treatment.

Treatment response was estimated using TIPSY with inputs for example stands. The average gain in volume at rotation estimated per application is 30 cubic metres per hectare.

The treatment response applies only to stands that have already been fertilized and it is assumed that the full treatment response will be achieved before the stands are harvested. The potential for future fertilization is uncertain and therefore will not be modelled.

7.4.5 Genetic gain through tree improvement

Where available, select seed (class A seed from orchards) is used for regeneration because of its superior volume production. Genetic gains will be applied to contemporary and future plantations, as defined in Tables 26 and Table 27, using the genetic worth by species provided by Tree Improvement Branch staff (Table 28).

Table 28. Genetic worth by species

Species	Contemporary plantations			Future plantations	
	Applicability	Availability of select seed	Genetic worth	Availability of select seed	Genetic worth
Douglas-fir	50%	99%	7.9%	100%	11%
Western redcedar	35%	89%	6.3%	95%	10%
Western hemlock	8%	99%	6.7%	100%	14%
Sitka spruce	0%	90%	0%	100%	0%
Amabilis fir	0%	2%	0%	0%	0%
Yellow-cedar	0%	30%	21%	48%	21%

Data source and comments:

In 2015, the genetic worth associated with select seed based on information provided by FLNR Tree Improvement Branch is the following: Douglas-fir 11%, western redcedar 10%, western hemlock 14% and yellow-cedar 21%.

Below is a summary provided by Tree Improvement Branch of the percent use of select seed in plantations of the Arrowsmith TSA over the last 11 years.

Species	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Douglas-fir	100	95	97	96	NA	100	100	100	100	100	100
Western redcedar	76	86	74	77	90	100	91	96	97	96	90
Western hemlock	100	100	100	97	100	N/A	100	100	100	100	100
Sitka spruce	N/A	N/A	N/A	100	50	N/A	N/A	100	N/A	100	100
Amabilis fir	18	0	N/A	0	N/A	0	0	0	0	0	0
Yellow-cedar	0	0	0	0	100	0	0	0	100	53	86

For the analysis the following is assumed:

- In older plantations (1985 and earlier) genetic gain due to the use of select seed is negligible and does not get factored into the yield curves.
- In contemporary plantations (1986 and later) genetic gain is factored in as follows:
 - Douglas-fir: 5% genetic worth starting in 1995, incrementing each year in even steps to 11% in 2015, area weighted by the amount of area planted each year (i.e., some area allowed to naturally regenerate). Not applicable to the area planted between 1986 and 1994 (i.e., 50% of the Douglas-fir contemporary plantations).
 - Cedar: 5% genetic worth starting in 2005, incrementing each year in even steps to 10%, area weighted by the amount of ‘cedar plantations’ planted each year. Not applied to the area planted between 1986 and 2004.
 - Hemlock: 5% genetic worth starting in 2007, incrementing each year in even steps to 14%, area weighted by the amount of ‘hemlock plantation’ planted each year. Not applied to area planted between 1986 and 2006.
- The average of the last five years of select seed use reflects the availability of select seed going forward for future plantations.
- Genetic worth in contemporary plantations gets factored into yield curves using applicability x availability of select seed x genetic worth figures from Table 28 (e.g., genetic worth for Douglas-fir in existing plantations = 7.9 x 0.50 x 0.99 = 3.9%).
- Genetic worth in future managed plantations get factored into yield cures using availability of select seed x genetic worth figures from Table 28 (e.g., genetic worth for redcedar in future plantations = 10% x 0.95 = 9.5%).

7.5 Objectives with forest cover requirements

As noted in Section 5.1, the discussion on multiple objectives and 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 habitats, while another may be associated with a different resource emphasis. With the requirement to retain different forest characteristics across the landscape, it will be important in the analysis to identify how non-contributing forest (productive forest which does not contribute to the THLB) may be considered in the forest cover requirements (i.e., maximum allowable disturbance or minimum area retention).

7.5.1 Objectives for visual resources

The recommended visual quality classes for the SINRD outside the Clayoquot Sound Scientific Panel planning area were continued as established visual quality objectives (VQOs) under GAR Section 7 (2) in December 2005. In December 2011 additional VQOs were established, and amendments were made to previously established VQOs.

For areas in the TSA outside the Clayoquot Sound Scientific Panel planning area the timber supply analysis will apply forest cover objectives that are consistent with the established VQO. The maximum percent denudation was applied to each visual polygon based on its assigned VQOs and assessed Visual Absorption Capability (VAC) as outlined in Table 29.

Table 29. Forest cover requirements for visual quality objectives — TSA outside of Clayoquot Sound

Visual quality objective	Visual absorption capability	Maximum allowable disturbance (%)	Green-up height or age	Area of application
Preservation	M to H	0.5	5 m	Forested area in a visual polygon
Retention	L	3	5 m	Forested area in a visual polygon
Retention	M to H	5	5 m	Forested area in a visual polygon
Partial retention	L	10	5 m	Forested area in a visual polygon
Partial retention	M to H	15	5 m	Forested area in a visual polygon
Modification	L	20	5 m	Forested area in a visual polygon
Modification	M to H	25	5 m	Forested area in a visual polygon
Maximum modification	L to M	32.5	5 m	Forested area in a visual polygon

The inventory of scenic resources that was completed for Clayoquot Sound differs from visual inventories that have been completed for the rest of the province. Instead of VQOs, scenic class objectives (SCOs) are assessed in the inventory which is unique to Clayoquot. For the purpose of the timber supply analysis SCOs have been translated into provincial VQO classes. It is assumed no clearcutting silvicultural systems will be used, 40% variable retention systems only. In the Clayoquot Sound Scientific Panel planning area the maximum percent denudation was applied to each SCO polygon based on its translated VQO as outlined in Table 30.

Table 30. Forest cover requirements for scenic class objectives — TSA inside Clayoquot Sound

Clayoquot Sound scenic class objective	Provincial visual quality objective	Visual absorption capability	Maximum allowable disturbance (%)	Green-up height (metres)	Area of application
Small scale alteration	Partial retention	L	10	5 m	Forested area in a visual polygon
Minimal alteration	Retention	L	3	5 m	Forested area in a visual polygon
Natural appearing	Preservation	L	0.5	5 m	Forested area in a visual polygon
Small scale alteration	Partial retention	M to H	15	5 m	Forested area in a visual polygon
Minimal alteration	Retention	M to H	5	5 m	Forested area in a visual polygon
Natural appearing	Preservation	M to H	0.5	5 m	Forested area in a visual polygon

Data source and comments:

A VQO is a resource management objective established for an area that reflects the desired level of visual quality based on the physical characteristics and social concern for the area. Several classes have been defined in Arrowsmith TSA:

- Modification (M): consisting of an altered forest landscape in which the alteration, when assessed from a significant public viewpoint, (i) is very easy to see, and (ii) is (a) large in scale and natural in its appearance, or (b) small to medium in scale but with some angular characteristics;
- Partial retention (PR): consisting of an altered forest landscape in which the alteration, when assessed from a significant public viewpoint, is (i) easy to see, (ii) small to medium in scale, and (iii) natural and not rectilinear or geometric in shape;
- Retention (R): consisting of an altered forest landscape in which the alteration, when assessed from a significant public viewpoint, is (i) difficult to see, (ii) small in scale, and (iii) natural in appearance.

VAC is a component of the visual landscape inventory that rates the relative capacity of a landscape to absorb visual alterations and still maintain its visual integrity.

A SCO is a resource management objective for Clayoquot Sound for an area that reflects the desired level of alteration based on the physical characteristics and social concern for the area. Several classes have been defined in Clayoquot Sound:

- Small-scale alteration (equivalent VQO = PR): Alteration must remain subordinate in the landscape. Visible areas inside and outside scenic corridors where landscape has a relatively high ability to absorb change, is in a highly to excessively altered condition, and has low biophysical rating, viewing condition and viewer ratings.
- Minimal alteration (equivalent VQO = R): Alteration may be apparent but not clearly evident. Visible areas inside and outside scenic corridors where landscape has moderate ability to absorb change, is in a pristine or retained condition, and has moderate biophysical rating, viewing condition and viewer ratings.
- Natural-appearing (equivalent VQO = P): Alteration not discernible to casual observer. Visible areas inside and outside scenic corridors where landscape has limited ability to absorb change, is in pristine or retained condition, and has high biophysical rating, viewing condition and viewer ratings.

7.5.2 Objectives for adjacent cutblock green-up

Cutblock adjacency constraints limit the amount of harvesting in each landscape unit such that aspatially no more than 25% of the stands in the THLB are less than a green-up age. In the timber supply analysis cutblock green-up will be assumed to occur when stands achieve three metres in height in areas designated as general or special and 1.3 metres in areas designated as enhanced forestry. Spatial block adjacency or patch size constraints will not be applied in the base case forecast.

Table 31. Forest cover requirements for cutblock adjacency objectives

VILUP category	Maximum allowable disturbance (%)	Green-up height	Area of application
General or special	25	3 m	THLB within each LU outside of visual area
Enhanced forestry	25	1.3 m	THLB within each LU outside of visual area

7.5.3 Objectives for community watersheds

There are 40 designated community watershed areas that intersect with the Arrowsmith TSA without a completed Coastal Watershed Assessment Procedure (CWAP). Most of them occur on private land but six have more than 100 hectares of Crown productive forest overlapping with the THLB. To reflect current forest management practices in these areas, forest cover constraints will be applied which will limit the rate of harvesting within each watershed to 1% of the Crown productive forest area each year. This constraint was developed based on guidance in the *Community Watershed Guidebook* that indicates that in the absence of a completed CWAP harvesting activity should be limited to 5% of the productive forest area over a five-year period.

7.5.4 Fisheries sensitive and CWAP watersheds

The licensees commit to managing fisheries-sensitive and CWAP watersheds within a 20% equivalent clearcut area (ECA). In order to model this harvesting activity will be limited to 5% of the CFMLB over a five-year period. ECA monitoring shows this rate-of-cut would keep ECAs to within the set limits given the expected rate of hydrological recovery.

7.5.5 Community interface areas

Community interface areas (i.e., identified contentious area near urban area) are currently being managed similarly to designated community watersheds. Harvesting activity will be limited to 5% of the CFMLB over a five-year period.

7.5.6 Objectives for landscape-level biodiversity for TSA outside of Clayoquot Sound

Management for biodiversity is a requirement under the *FRPA*. To protect biodiversity at the landscape level, old forest is retained in every landscape unit (LU) and natural disturbance type. The order establishing provincial non-spatial old growth objectives that came into effect June 30, 2004 identifies the amount of old forest that will be maintained across a landscape unit where old-growth targets or old-growth management areas have not yet been established.

In 24 of the 39 LUs within the Arrowsmith TSA and outside of the Clayoquot Sound Special Management Zone old-forest retention amounts are achieved through spatial OGMAs which are assumed to be no-harvest areas in the analysis. In the remaining 15 LUs without OGMAs where old-seral requirements apply old-forest retention will be accounted for by applying the forest cover requirements as indicated in Table 32. These requirements are taken from the *order establishing provincial non-spatial old growth objectives* and are consistent with VILUP. Old growth (age >250 for natural disturbance type (NDT) 1, 2 and 4; > age 140 for NDT 3) are established within each LU at the BEC variant level. All the CFMLB forest within each LU/BEC variant contributes to the old-growth seral stage requirement. The forest cover requirements are based on low, intermediate, and high emphasis.

Table 32. Landscape unit old-seral forest cover requirements

Natural disturbance type (NDT)	Biodiversity emphasis option	Old growth requirement (%)
NDT 1	Low & Intermediate	13
	High	19
NDT 2	Low & Intermediate	9
	High	13
NDT 3	Low & Intermediate	14
	High	21
NDT 4	Low & Intermediate	13
	High	19

7.5.7 Objectives for landscape-level biodiversity for TSA inside Clayoquot Sound

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

7.5.8 Objectives for mature forest in VILUP SMZs (higher level plan order)

The target for mature seral forest will be one quarter of the CFMLB of each special management zone listed in Table 33.

Table 33. VILUP SMZ mature seral forest cover requirements

Special management zone (SMZ)	Biogeoclimatic unit	Mature seral stage	Mature seral forest requirement (%)
Barkley Sound (14), Alberni Canal (18), Upper Qualicum (20), San Juan Ridge (22), Nahmint (13)	CWH, CDF	>80 years	25
	MH	>120 years	25

7.5.9 Objectives for watershed rate of harvest in Clayoquot Sound

For Clayoquot Sound, watersheds will be managed according to the Scientific Panel recommendations. In identified watersheds, either a 5% per five 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 no harvesting will occur in parks.

Data source and comments:

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

- Limit the area cut in any watershed larger than 500 hectares in total area to no more than 5% of the watershed area within a five-year period;
- In primary watersheds of 200-500 hectares 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 watersheds larger than 500 hectares in total area or are primary watersheds of 200-500 hectares in total area if the 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 hectares in total area (and primary watersheds of 200-500 hectares 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.

8. Sensitivity Analyses to be Performed

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. Sensitivity analysis may indicate that a change in these attributes may alleviate or exacerbate anticipated projected timber supply. By developing and testing a number of sensitivity analyses, it is possible to determine which variables most affect results. Table 34 presents the standard sensitivity analyses that are generally performed in all analyses. Additional sensitivities may be included after the base case has been completed and new uncertainties are identified.

Table 34. Sensitivity issues

Issue	Sensitivity analysis	Sensitivity level to be tested
Land base revisions	Consider projected land use/tenure changes	Per projected layer
	Remove draft goshawk areas	
Economic	Adjust minimum volume threshold	+/- 20%
	Apply minimum harvestable age	Set at CMAI
	Consider some age class 8 and 9 hemlock/balsam stands uneconomic	50%, 100%
Growth and yield	Adjust yields of existing natural stands (VDYP)	+/- 10%
	Adjust yields of contemporary plantations (TIPSY)	Use inventory SI
	Adjust yields of all managed stands	Use natural stand yields
	Adjust future yields for effects of shading	+/- 10 percentage points
Management considerations	Adjust disturbance constraints	+/- 5%
	Adjust retention forest cover constraints	+/- 10%
	Increase in-block stand retention (from 3.5%)	7%, 15%, 20%

Data source and comments:

The dataset includes First Nations asserted traditional territories so that additional sensitivities around First Nations concerns can be performed once the base case has been completed.