Snaw-Naw-As First Nation Woodland Licence N3I

MANAGEMENT PLAN #1

Version 1.4

October 8, 2021

Project 1496-1

Prepared for:

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Submission Page

Licence: FNWL N3I

Licensee: Snaw-Naw-As First Nation

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Forsite Consultant Ltd.'s (Forsite) team included Darcie Fodor, RPF, Lauren Fernie, RPF, and Cosmin Man, RPF, who completed the Management Plan, with support from Patrick Bryant, RPF with the Timber Supply Analysis.

The Ministry of Forests, Lands, Natural Resource Operations and Rural Development provided planning information and support throughout the process.

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Document Revision History

Version	Date	Description
0.1	January 27, 2021	Draft distributed to client for review.
1.0	May 17, 2021	Complete document submitted to client.
1.1	June 29, 2021	Adjust FNWL # to N3I, change FNWL owner to Snaw-Naw-As Forest Services Ltd. Add date of proposed FNWL#.
1.2	September 07, 2021	Adjust FNWL # to N3I, add botanical forest products section 3.3, and add more details for information sharing in Public Consultation section 4.
1.3	September 13, 2021	Addressed minor spelling errors and wording for clarity.
1.4	October 08, 2021	Revised section 3, now titled “Forest Management” to describe timber and non-timber objectives and strategies. Minor revisions to section 4. Added Snuneymuxw First Nations as stakeholder for all parcels except Lasqueti Island.

Acronyms

AAC	Annual Allowable Cut
BC	British Columbia
BEC	Biogeoclimatic Ecosystem Classification
FMLB	Forest Management Land Base
FNWL	First Nation Woodland Licence
FPPR	Forest Planning and Practices Regulation
LRSY	Long-Run Sustained Yield
NEDC	Nanoose Economic Development Corporation
THLB	Timber Harvesting Land Base
VQO	Visual Quality Objective

1 Introduction

The Snaw-Naw-As First Nation are descendants of Snaw'Naw'As in Nanoose Bay, BC. The community, often known as Nanoose First Nation, along with 18 other tribes in the Salish Sea, are Coast Salish people, and are one of the most northern tribes on the east side of Vancouver Island. Through responsible governance, leadership and equality, our strong and growing Nation empowers each other, our government, and our people to have strong social well-being, an enriched cultural identity, and the freedom of self-determination. Since time immemorial and onto our future generations, we carry forward our ancestral knowledge in the pursuit of higher education, sustainable economic opportunities, and individual and collective prosperity.

1.1 PURPOSE

The Snaw-Naw-As First Nation recently received a forest tenure opportunity agreement and an invitation letter to apply for the First Nation Woodland Licence (FNWL) on February 02, 2021 (invitation letter included in Appendix 1 and overview map included in Figure 1). The proposed licence number N3I was assigned for Snaw-Naw-As FNWL on September 15, 2020. All FNWLs require an approved Management Plan before carrying out forestry activities, including harvesting and road construction within the licence area. Submission of this Management Plan fulfills the requirements set by the invitation letter included in Appendix 1.

This Management Plan describes the management strategies for all timber and non-timber resources within the FNWL aligned with the *Forest Act*, the *Forest and Range Practices Act*, and all other applicable legislation, as well as direction from the Regional Executive Director and Higher Level Plans. The Management Plan guides the development of operational plans including silviculture prescriptions and the Forest Stewardship Plan (FSP). This is the first Management Plan for the soon-to-be-awarded FNWL. Successive Management Plans will be updated to include any changing perceptions of managed values, socio-economic climates, and legislation.

The Timber Supply Analysis report, an integral component of the Management Plan, is included in Appendix 2. Nine scenarios were explored, out of which, scenario 008_LASQoff is considered for this Management Plan. Scenario 008_LASQoff estimated an annual allowable cut (AAC) of 6,406 m^3/year by assuming that the entire area available to meet the AAC within the FNWL is located on Vancouver Island and currently proposed visual quality objectives (VQO) are maintained. At a later stage, as harvest opportunities emerge on Lasqueti Island, the management Plan will be updated accordingly. An amendment is likely to be available past year 2026.

1.2 LOCATION AND DESCRIPTION

This FNWL, held by Snaw-Naw-As Forest Services Ltd., covers approximately 2,053 hectares composed of nine (9) parcels spread across central Vancouver Island and Lasqueti Island within the Arrowsmith Timber Supply Area (Figure 1). The parcels are located around Parksville and Qualicum Beach, BC, from Cameron Lake in the west (Mount Wesley parcel) to Nanoose Bay in the east (DL33, Arbutus Grove and Bonnell Creek parcels) and on southeastern tip of Lasqueti Island. The FNWL is mainly accessed by Highway 4 to the west and Highway 19 near Parksville and Nanoose Bay. The Lasqueti Island is accessed via the Lasqueti Ferry servicing from French Creek Harbour on Vancouver Island to False Bay on Lasqueti Island.

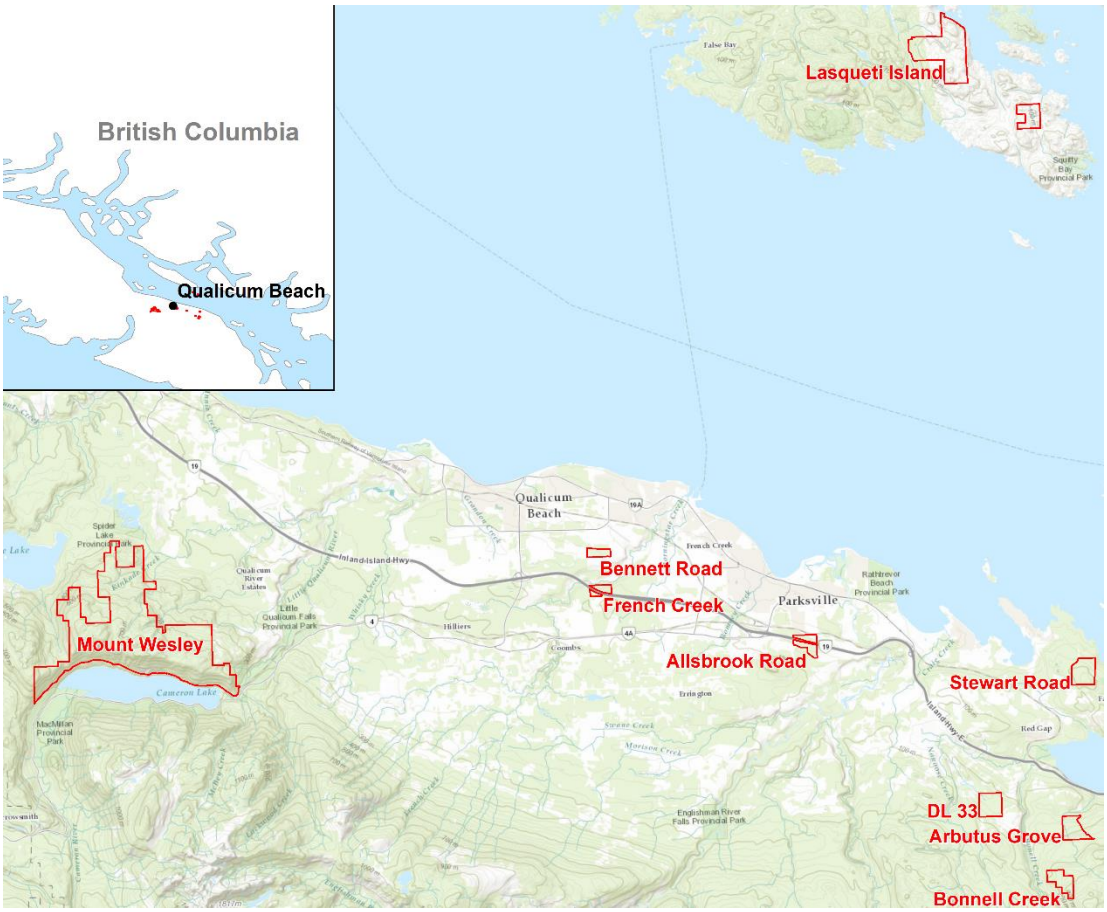

Figure 1 Location of FNWL

The forest managed land base (FMLB) of approximately 2,033 hectares is dominated by coastal Douglas-fir and western hemlock leading stands within the Coastal Western Hemlock and Coastal Douglas-fir biogeoclimatic (BEC) zones. The long-term timber harvesting land base (THLB) was estimated to be 1,086 hectares with a theoretical long run sustained yield (LRSY) (i.e., each future stand is harvested at the age of maximum mean annual increment) of ~10,000 m^3/year. Stewart Road and DL33 parcels are not available for harvest but included in the FNWL to ensure future cultural use and long term management by Snaw-Naw-As. Run [008] from Appendix 2, where the long-term THLB was reduced to 909 ha by locking Lasqueti Island from harvesting, was considered the preferred run. Here, the THLB was determined to be 925 ha supporting a LRSY of 8,391 m^3/year (Table 1). The harvest rate that meets sustainability and all timber- and non-timber objectives was determined to be 6,406 m^3/year.

Table 1 Area and Harvest Rate Summary

Gross Area (ha)	FMLB (ha)	THLB (ha)	LRSY (m^3/year)	Mean Annual Increment (m^3/ha/year)	Sustainable Harvest Rate (m^3/year)
2,053	2,033	925	8,391	9.07	6,406

1.3 TENURE ADMINISTRATION

The proposed FNWL N3I was assigned to Snaw-Naw-As Forest Services Ltd. on September 15, 2020. The initial AAC is proposed to be set at 6,406 m^3/year.

Snaw-Naw-As Forest Services Ltd. is a subsidiary company of Nanoose Economic Development Corporation (NEDC) which is solely owned by Snaw-Naw-As First Nation. The NEDC has a Board of Directors appointed by Snaw-Naw-As First Nation and operates at an arms-length from the Chief and Council. The office for Snaw-Naw-As Forest Services Ltd. is located at 209 Mallard Way, Lantzville BC, V0R 2H0. All work is contracted out to consultants and contractors and overseen by NEDC.

1.4 GENERAL MANAGEMENT PHILOSOPHY

The mission of NEDC is to build a sustainable future and contribute to self-determination of a healthy, vital, and strong Nation, creating a legacy for future generations by focusing on projects that lead to financial self-sufficiency through Snowhyulth (community inclusion), transparency, accountability and organizational effectiveness. The NEDC acts in the interest of all Snaw-Naw-As band members, both current and future, to create a better quality of life for Snaw-Naw-As people through economic development. The Snaw-Naw-As Forestry Services LP oversees the commercial forestry licenses including the FNWL.

The FNWL will be managed to ensure sustainability to support environmental health, protection of Snaw-Naw-As cultural values, and economic benefit. The Snaw-Naw-As community has pride in knowing that they have stewardship of lands within the traditional territory. Commercial forestry will focus on sustainable logging practices that protect old growth, fish bearing waterways, and all other naturally occurring species in the territory.

The NEDC operates through 7 guiding principles as outlined in their Strategic Plan:

1) Working for the community and giving back,
2) Working together as a community,
3) Respect and trust,
4) Communication,
5) Responsible decision making,
6) Commitment and discipline to contribute “What You Can Where You Are”, and
7) Innovation and learning.

2 Provincial FNWL Program Objectives

The objectives set out for the provincial FNWL program are well aligned with NEDC’s Strategic Plan which strives to guide behaviours, decision-making, and communication processes and form the basis of a Code of Ethics. The objectives for the provincial FNWL program are provided below with a discussion on how each will be addressed.

2.1 OPPORTUNITIES FOR A RANGE OF COMMUNITY OBJECTIVES

With a long-term focus in mind, the NEDC strives to invest in positive social and environmental projects that enrich and enhance Snaw-Naw-As way of life. The NEDC will inspire, support and encourage youth and community entrepreneurs to experience their full potential through support, training, and employment opportunities. The first two guiding principles of the NEDC strategic plan adhere to these commitments.

2.2 DIVERSIFY THE USE OF THE FNWL AREA

Snaw-Naw-As has seen a high level of diversification in recent years. Some examples include:

- Snaw-Naw-As Market is a 6 pump gas station and convenience store with a Tim Hortons lease located on Highway 19, just north of Nanaimo, BC.
- Snaw-Naw-As Aquaculture Ventures Incorporated is the aquaculture division of the NEDC. With four intertidal shellfish tenures in Nanoose Bay, BC, these sites represent over 45 hectares of tenure area where clams are farmed for sale to domestic markets. Through all farming practices, Snaw-Naw-As strives to create high quality shellfish products raised in a way that the ancestors and future generations would be proud of.
- Snaw-Naw-As Campground, located on Vancouver Islands East Coast, is a blend of Vancouver Islands' wild beauty and easily accessible attractions for campers at any level of experience to enjoy. From hiking and sightseeing to island adventures and fine dining, the campground is a gateway to a west coast adventure.
- Snaw-Naw-As Forest Services Ltd. oversees the commercial forestry licenses of the Nation and of this FNWL.
- Highway 4 Industrial Development is a 6.4 hectare I-3 (gravel) zone located near Highway 4 adjacent to the Coombs junction off Highway 19. Options for property development are currently being explored.

2.3 SOCIAL AND ECONOMIC BENEFITS

The four pillars of sustainable economic development defined in the NEDC Strategic Plan are: people, planet, process, and profit. While these strategic pillars are tailored to the Nation, through paying annual rent and stumpage, Snaw-Naw-As will provide socio-economic benefits to all BC residents. Additionally, the commercial forest activities will generate jobs and tax revenues which are also shared with the rest of BC residents.

2.4 SOUND PRINCIPLES OF ENVIRONMENTAL STEWARDSHIP

The NEDC four strategic pillars of sustainability are at the forefront of all Snaw-Naw-As activities. Sound principles of environmental stewardship were integrated into the Timber Supply Analysis (Appendix 2). For example, 54% of the FMLB was set aside to protect valuable Douglas-fir stands, wildlife species, riparian areas, and to maintain landscape- and local-level biodiversity objectives. In addition, the harvest schedule on the remaining 46% of the FMLB was developed such that disturbances were capped in community watersheds to maintain hydrological capacity intact, and to ensure existing and proposed VQOs were met. Finally, the harvest rate proposed as the AAC was designed to not exceed the long-term forest growth in order to maintain sustainable environmental and economic benefits for generations to come.

2.5 COMMUNITY INVOLVEMENT AND PARTICIPATION

The Snaw-Naw-As First Nation has been heavily involved through the aforementioned projects which has given the Nation a relatively high level of diversification. The NEDC will continue to maintain this high level of community involvement and participation in all future activities.

2.6 RELATIONSHIPS BETWEEN COMMUNITIES AND PERSONS

The NEDC, through its subsidiary Snaw-Naw-As Forest Services Ltd., will focus on and promote communication and strengthen relationships between Indigenous and non-Indigenous communities and persons. Learning from the experience of previous projects that ensured a relatively high level of diversification, the NEDC will continue similar successful strategies to foster positive relations with other First Nations and persons involved in forestry activities on issues such as recreation, visuals and biodiversity. For example, Snaw-Naw-As has recently signed a memorandum of understanding with the District of Lantzville to work collaboratively and cooperatively to achieve mutual goals.

2.7 INNOVATION

The NEDC strategic pillar "profit" was designed with innovation and learning in mind. The NEDC encourages and supports goal setting and believes there is a new opportunity to make positive changes at every step. With a positive attitude in mind, proud Snaw-Naw-As people learn from their mistakes and are successful at maintaining their culture and traditions to be passed down through generations. The inclusion of this FNWL in the already diversified portfolio of economic opportunities will provide new avenues for learning and innovation for Snaw-Naw-As First Nation. The management of the FNWL will seek opportunities to reduce carbon footprint by increasing fibre utilization and decreasing waste, including using residual fibre for bioenergy production.

2.8 SAFETY

In all projects and activities of the NEDC, safety of workers is paramount. This behaviour will continue with the highest strictness for the foreseeable future. Snaw-Naw-As Forest Services Ltd. will advocate forest worker safety.

3 Forest Management

The Timber Supply Analysis report (Appendix 2) includes a detailed description of all data sources, land base definition, growth and yield, timber and non-timber values, silvicultural practices, forest health factors, and analysis results which provide the rationale and support for the proposed AAC.

3.1 RESOURCE INVENTORIES

The Timber Supply Analysis was conducted using the latest vegetation resource inventory (VRI) and other available provincial government inventories and datasets, such as wildlife habitats and visual landscape inventory. A full list of inventories and supporting information is provided in Appendix 2.

3.2 ALLOWABLE ANNUAL CUT

The proposed AAC for this FNWL is **6,406 m^3/year**. This AAC meets all applicable legislation and aligns with NEDC's Strategic Plan guiding principles and sustainability pillars.

The AAC was developed based on anticipated management and forest conditions while achieving all established objectives for timber and non-timber resource values including stand- and landscape-level biodiversity, adjacent cutblock green-up, soil disturbance limits, visual quality, community watersheds, riparian areas and fish habitat, wildlife and wildlife habitat, as well as cultural heritage resources. There were no range tenures or legally established recreational resources within the FNWL.

In addition, harvest openings and young seral objectives were achieved for a more realistic representation of operational challenges related to the size distribution of harvest openings (<=40 ha) and green-up adjacency (i.e., 100 m between adjacent young seral patches 20 years and younger). Finally, the timber harvesting land base of existing natural stands following the first future harvest event was reduced by 3.97% to account for future road right-of-ways.

3.3 BOTANICAL FOREST PRODUCTS

There is currently no inventory of botanical forest products within the FNWL. To date, First Nations within this FNWL expressed interest in harvesting botanical forest products for personal and commercial use, in particular

boughs for making Christmas wreaths. The non-THLB areas, including entire parcels such as Stewart Road, DL33, and Lasqueti Island as well as retained areas to limit harvest in community watersheds, visually sensitive polygons, and to ensure landscape-level biodiversity objectives are prime candidates for providing boughs. The Snaw-Naw-As Forest Services Ltd. will continue to adopt best management practices with respect to botanical forest products:

- Assess botanical forest products within the FNWL and develop an inventory to improve understanding of quantity, quality and location of botanical forest products to support sustainable development.
- Develop ecologically and economically sustainable botanical forest products that will enhance the long-term viability of the FNWL.

3.4 HARVESTING PRACTICES

Harvesting priorities and practices will be planned to ensure compliance with all applicable legal practice requirements as well as other stewardship and socio-economic objectives, such as forest health considerations and log-profiles.

3.1 SILVICULTURAL PRACTICES

Silviculture practices will be managed consistently with the current methods and standards accepted by the Provincial Government, which will be detailed in the FSP. The focus of silvicultural practices will be the prompt establishment and tending of forested stands with ecologically suitable species. The intent of silvicultural efforts will be to ensure sustainable timber productivity while balancing and integrating other resource objectives.

In addition, the NEDC will seek to address some of the challenges imposed by the recently human-induced global warming. Subject to seed availability, the NEDC will seek to match seed sources to future planting sites guided by the predicted future climate and the BC tree species selection tool.

3.1 ACCESS STRUCTURE

Existing roads and landings were removed from the forested land base as detailed in Appendix 2 (~14 ha or 0.7% of the total FNWL area). Existing right-of-ways were estimated according to the road classification while an additional up to 3.97% of the THLB was estimated to be converted to future right-of-ways. Depending on the spatial schedule of harvest events, a lower % of THLB would be converted to right-of-ways. For example, run [008] from Appendix 2, which was used to guide the AAC, converted ~14 ha of THLB (0.8%) to future right-of-ways by the end of the 300-year planning horizon.

3.2 CULTURAL HERITAGE RESOURCES

The *Forest Act* defines a cultural heritage resource as "an object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to British Columbia, a community or an aboriginal people". This may include culturally modified trees, medicinal plants, or traditional use sites. In addition to the aforementioned definition, Cultural Heritage Resources (CHR) refer solely to those resources that are the focus of traditional use by First Nations people that are of continuing importance to that people, and not regulated under the *Heritage Conservation Act*. This includes, but it is not limited to bear dens, trails, berry patches, lithic sites and any other feature(s) identified through processes outlined below.

When encountered in the field, a full assessment of the CHRs will be completed by a Qualified Registered Professional, keeping in mind the relative importance and abundance of the CHRs. A Qualified Registered

Professional in this instance is an individual who has the education and demonstrated experience in the archeological field in British Columbia and abides by the principles of the *Heritage Conservation Act*. The Snaw-Naw-As Forest Services Ltd. commits to adhere to the recommendations of the CHR assessment with regards to primary forest activities, and will share this information with the First Nations listed in Table 2.

The timber supply analysis did not incorporate any specific assumptions regarding cultural heritage resources. The relatively small and constrained THLB by community watersheds and proposed visual quality objectives provides sufficient buffer to address cultural heritage resources at operational level.

Finally, parcels deferred from harvesting (Stewart Road, DL33, and Lasqueti Island) will be used to complement the CHRs encountered in the field via cutblock engineering.

3.3 FOREST HEALTH FACTORS

Forest health concerns, including the presence of insects and disease, will be monitored and considered in management practices in order to protect and enhance forest productivity as well as other resource values. The timber supply analysis estimated that ~157 m^3/year would be damaged and not salvaged (this value was prorated from the 2016 Arrowsmith Timber Supply Review).

3.4 SOILS

Healthy and productive soils are integral to growing future forests and forestry practices. Road building must be carried out in a manner which limits soil disturbances and soil degradation as well as erosion, landslides, and sediment delivery to water systems. In order to minimize disturbances from primary forest activities, soil disturbance and permanent access structures (roads on the block, landings, gravel pits, etc.) are regulated in *Forest Planning and Practices Regulation* (FPPR). The Snaw-Naw-As Forest Services Ltd. commits to adhere to the FPPR disturbance and permanent access structure limits:

- ≤5% soil disturbance on sites with sensitive soils;
- ≤10% soil disturbance on sites with non-sensitive soils;
- ≤25% of are covered by a roadside work area; and
- Permanent access structures will be ≤7%.

3.5 WILDLIFE

Two categories of wildlife are established under the *Forest and Range Practices Act* by the Minister responsible for the *Wildlife Act* (the Minister of Environment and Climate Change) – Species at Risk and Regionally Important Wildlife. These categories have been established because the wildlife or wildlife habitat attribute recognized under them require special management attention to address impacts of forest and range activities on Crown land. In British Columbia, both categories – Species at Risk and Regionally Important Wildlife – are referred to as Identified Wildlife. The Regionally Important Wildlife category includes species that are considered important to a region of British Columbia, rely on habitats that are not otherwise legally protected, and may be adversely impacted by forest or range practices.

Wildlife Habitat Areas (WHAs) are areas that have been deemed necessary to meet the habitat requirements of an Identified Wildlife element, such as nesting habitat or growing conditions. WHAs designate critical habitats in which human activities are managed to limit their impact on the Identified Wildlife element. The purpose is to conserve those habitats considered most limiting to a given wildlife species. Within this FNWL, there is currently

one legally approved WHA (1-037 for Douglas-fir/Garry oak-oniongrass) which was deferred from harvesting. No proposed WHAs are overlapping with this FNWL.

Ungulate Winter Range (UWR) is defined as an area(s) that contains habitat necessary to meet the winter habitat requirements of an ungulate species such as deer or mountain goat. UWRs are based on current scientific and management information, local knowledge, and other expertise from the region as to what is critical habitat for winter survival. Social and economic values also play a role in developing UWR units and objectives which are legally established via Government Actions Regulations orders. These orders include restrictions on harvesting within UWRs, restrictions on some forest harvesting in areas near UWRs, requirements to maintain forest cover in specific areas, and road building restrictions. Within this FNWL, there is currently one legally approved UWR (u-1-017 for Black-tailed Deer) which was deferred from harvesting. No proposed UWRs are overlapping with this FNWL.

In September 2020, the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development proposed a draft Order for the recovery of Marbled Murrelet by establishing minimum suitable habitat objectives. It was estimated that ~6.6 ha THLB (0.6%) overlap with this FNWL. The timber supply analysis did not explicitly excluded this area from THLB because of its relative small size and relatively wide spread (i.e., sliver polygons). Operationally, the 6.6 ha will be deferred from harvesting.

3.6 RECREATION RESOURCES

The general location of the FNWL is primed for a variety of recreation opportunities. The timber supply analysis used publicly available data (recreation sites, recreation trails, and recreation resource inventory) to identify areas with potentially high recreation values. To date, there are no known recreation sites or recreation trails overlapping with this FNWL. The recreation resource inventory indicated that within the FNWL there are recreation features with high significance and moderate sensitivity or with moderate significance and high sensitivity – these will be managed with a 10% additional retention. Should recreation sites or trails be established within this FNWL, the Snaw-Naw-As Forest Services Ltd. commits to adjust management practices accordingly – protect or relocate/restore them following harvesting events.

3.7 VISUAL QUALITY OBJECTIVES

The purpose of visual quality objectives (VQOs) are to ensure that the scenic qualities of a forested hillside continue to meet the expectations of the public and the tourism industry while providing opportunities for harvesting to the forest industry. These scenic areas are typically steep forested hillsides which are important to the tourism industry and public social values. Management of the area does not exclude timber harvesting but requires harvesting practices to be carried out in a manner whereby the designated objective for the area continues to be met.

The timber supply analysis modelled two sets of VQOs: currently established and proposed. Run [008] from Appendix 2, which was used to guide the AAC, committed to meet the more restrictive proposed VQOs. For example, Partial Retention VQO and medium visual absorption capacity is the dominant proposed VQO (543 ha overlaps with THLB) which restricts alteration in perspective view to 4.3% (i.e., area under Visually Effective Green-up height to be capped at 4.3% in each VQO polygon). Consequently, the harvest events will be scheduled subject to meeting the cap in each VQO polygon.

3.8 BIOLOGIGAL DIVERSITY

Maintenance of biological diversity of forests and a viable forest industry is dependent upon sustainable use of forests and forest resources. FNWLs were developed to recognize First Nations' asserted land and resource interests, including the protection of traditional-use practices and the harvest and management of non-timber forest products. Through this license, First Nations have the opportunity to play a role in forest stewardship and sustainable forest and land use practices. In general, biodiversity has been managed at the landscape- and stand-level.

The landscape-level biodiversity is based on natural range of variation with guidance and recommendations detailed in the British Columbia Biodiversity guidebook. In essence, minimum percentages of mature and old seral forest need to be maintained at the landscape-level to ensure biodiversity and vitality of the forested landscape. The reporting units where the seral objectives are set are typically composed of a unique combination of administrative zones (i.e., landscape units), stand-replacing disturbance frequency (i.e., natural disturbance types), and ecological inventories (i.e., Biogeoclimatic Ecosystem Classification). Despite the relatively small area of the FNWL, these landscape-level biodiversity objectives were implemented in run [008] from Appendix 2 in line with BC Biodiversity Guidebook. In addition, parcels deferred from harvesting (Stewart Road, DL33, and Lasqueti Island) will contribute to a higher percentage of mature and old seral forest within the FNWL.

The intent of stand-level retention is to provide for ecological characteristics, including structure, tree species, nesting cavities, and food sources, that are important for wildlife habitat at a smaller scale. Natural disturbances such as fire or insects create a mosaic of intact older forest and younger seral forests; this variability on the landscape provides key habitat and habitat connectivity for many species of wildlife. The stand-level biodiversity will be addressed operationally via the 3.5% committed wildlife tree retention areas in each cutblock.

3.9 WATER AND FISH HABITAT

The Snaw-Naw-As Forest Services Ltd. goals for riparian areas are to prevent or minimize any adverse impacts of primary forest activities on water quality and fish habitat. Tree retention around streams will be carried out in consideration of ecological suitability and natural disturbance factors. Riparian areas are given high priority for retention of wildlife trees, for the maintenance of biodiversity, habitat and stream integrity. The amount of timber and vegetation retained in any given riparian area will also be determined through a consideration of factors such as stream channel degradation potential, safety hazards, percent of merchantable versus non-merchantable stems, and habitat function.

Community watersheds play an important part in protecting water quality for communities and private water users that rely on surface water sources. A community watershed is defined under *Forest Range and Practices Act* as all or part of the drainage area that is upslope of the lowest point from which water is diverted for human consumption by a licensed waterworks. Community watersheds must also be designated under the Government Actions Regulation. Community watersheds require special management to conserve the quality, quantity, and timing of water flow and prevent cumulative hydrological effects having a material adverse effect on water. Three community watersheds overlap with this FNWL: Little Qualicum, Englishman, and French. In each community watershed and in each year, the disturbance rate measured by the area of stands under 5 m height will be capped to 1%.

4 Public Consultation

The public consultation goal is to ensure that interested parties, stakeholders and the Snaw-Naw-As First Nation have adequate opportunities for input into strategic and operational plans. To achieve this, NEDC will maintain the existing review and consultation process for FSPs, management plans, and subsequent operational plans.

During road and/or block development planning stage and prior to any harvest, Snaw-Naw-As Forest Services Ltd. will share draft plans and request input from the local Natural Resource District office as well as from affected First Nations, stakeholders, other tenure holders (e.g. trappers, guide outfitters), the community, and any other interested parties (e.g., community resource groups) (Table 2). All applicable information will be shared via standard Ministry referral process, including referral letters mailed or submitted to online referral portals with details specific to that activity and accompanied with maps and shapefiles (or other data formats as requested).

Table 2 List of First Nations and Stakeholders

Parcel/Area	Entity
All	Regional District of Nanaimo, Parksville, Qualicum Beach, and Islands Trust local governments
Allsbrook Road	K'omox, Nanwakolas, Qualicum, Snaw-Naw-As, and Snuneymuxw First Nations
Arbutus Grove	Snaw-Naw-As and Snuneymuxw First Nations
Bennett Road	K'omox, Nanwakolas, Qualicum, Snuneymuxw, and Snaw-Naw-As First Nations
Bonnell Creek	Snaw-Naw-As and Snuneymuxw First Nations
DL 33	Snaw-Naw-As and Snuneymuxw First Nations
French Creek	K'omox, Nanwakolas, Qualicum, Snuneymuxw, and Snaw-Naw-As First Nations
Lasqueti Island	Qualicum First Nation and Tla'amin Nation
Mount Wesley	Hupacasath, K'omox, Nanwakolas, Qualicum, Snaw-Naw-As, Snuneymuxw,Tseshaht, We Wai Kai, and Wei Wai Kum First Nations
Stewart Road	Snaw-Naw-As and Snuneymuxw First Nations

Within the Snaw-Naw-As, the NEDC will respect and encourage dialogue between community members, Chief and Council, and the band office on the overall operations. Through inclusive, frequent, and meaningful information sharing updates, members will be informed of the operations and current direction of the NEDC. Annual meetings are held with the Snaw-Naw-As community, and regular updates are posted to the NEDC website (https://www.nedmlp.com/). In addition, NEDC completes an annual survey in the community. The NEDC values constructive criticism and will work to encourage regular input from all people of Snaw-Naw-As, trusting that the community knows what is best for their future.

Appendix 1 FNWL Invitation Letter

File: 14020-30/Snaw-naw-as
Reference: 260329

February 2, 2021

VIA EMAIL: branches6@shaw.ca

Chief Gordon Edwards
Snaw-naw-as First Nation
209 Mallard Way
Lantzville, British Columbia
V0R 2H0

Dear Chief Edwards:

I am pleased to provide you with the attached Forest Tenure Opportunity Agreement (FTOA) between the Snaw-naw-as First Nation (SFN) and the Province of British Columbia. The FTOA enables SFN to apply under Section 43.54 of the *Forest Act* for a First Nations woodland licence that includes an area of approximately 927 hectares in the Arrowsmith Timber Supply Area.

I invite you to apply for the licence opportunity to the Regional Executive Director for the West Coast Natural Resource Region. The application must include the following:

1. The surrender of Forest Licence A85925 as outlined in Section 4.1 of the FTOA.
2. The name and description of the legal entity that is intended to hold the licence, including, in the case of a company holding the licence, information confirming that SFN holds sufficient voting shares to:
    a. Elect more than 50 percent of the directors of the entity, or
    b. Control the operations and direction of the entity.
3. A map of the licence operating area.
4. A proposed management plan for the licence with a proposed allowable annual cut.

An approved management plan and an allowable annual cut determination by the Regional Executive Director is required prior to the issuance of the licence. The application for the licence must be submitted to:

Regional Executive Director
West Coast Natural Resource Region
103-2100 Labieux Road
Nanaimo, British Columbia
V9T 6E9

Ministry of Forests, Lands, Natural Resource Operations and Rural Development
Office of the Minister
Mailing Address: PO BOX 9049 Stn Prov Govt Victoria, BC V8W 9E2
Tel: 250 387-6240
Fax: 250 387-1040
Website: www.gov.bc.ca/for

The applicant and/or holder of the licence will be required to comply with British Columbia law and other administrative requirements, including a licence deposit and annual rent payments in accordance with the *Forest Act*.

If you have any questions regarding the FTOA, licence application requirements, or the obligations of a holder of a licence under British Columbia law, please contact Colleen Broekhuizen, Timber Tenures Specialist, Coast Area, by email at colleen.broekhuizen@gov.bc.ca or by phone at 250-739-8227.

Sincerely,

Katrine Conroy
Minister

Attachment: Forest Tenure Opportunity Agreement

pc: Sharon Hadway, Regional Executive Director, West Coast Natural Resource Region
Rhonda Morris, District Manager, South Island Natural Resource District
Colleen Broekhuizen, Timber Tenures Specialist, Coast Area
Cindy Stern, Interim CEO/Director, Nanoose Economic Development Corporation
Via Email: Cindy Stern@telus.net
Craig Edwards, Operations Manager, Nanoose Economic Development Corporation
Via Email: craig@nanoose-edc.com

Appendix 2 Timber Supply Analysis Report

Snaw-Naw-As First Nation Woodland Licence N3I

TIMBER SUPPLY ANALYSIS

Version 0.4

June 29, 2021

Project 1496-1

Prepared for:

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FORSITE
Forest Management Specialists

Executive Summary

The Snaw-Naw-As First Nation recently received a forest tenure opportunity agreement with an assigned First Nation Woodland Licence (FNWL) #N3I, which requires a timber supply analysis. This document describes the information that is material to the analysis including the model used, data inputs, management assumptions, and scenario results.

The FNWL covers approximately 2,053 ha, spread across central Vancouver Island and on and Lasqueti Island within the Arrowsmith Timber Supply Area. The Forest Management Land Base (FMLB) that contributes towards timber and non-timber objectives was estimated to 2,033 ha after excluding 19 ha of non-forested land. The long-term timber harvesting land base (THLB) was estimated to 1,086 ha (53.4% of the FMLB) after excluding reserves, physically inoperable areas, low volume stands, future retention, and future roads right-of-way.

This analysis developed a base case scenario to reflect the expected management and forest conditions. It also demonstrated that the resulting harvest level maintained all established non-timber objectives (stand- and landscape-level biodiversity, adjacent cutblock green-up, visual quality, and community watersheds), as well as, additional operational objectives for harvest openings and young seral patches.

The results indicated that the base case scenario could maintain and even-flow harvest level of 8,700 m^3/year. Seven sensitivity analyses indicated the following:

- Proposed VQOs could reduce the base case harvest level by 12.6%,
- Given the relatively small-size AOI, landscape-level biodiversity objectives and non-legal OGMAs could be ignored in future analyses,
- Physical operability assumptions need to be refined, as their exclusion from the analysis resulted in the most promising THLB and harvest level gains,
- Possible relocation of the CDFmm reserves could increase the THLB and harvest level by ~8.5%, and
- Locking Lasqueti Island from harvesting, while meeting the proposed VQOs, could be a promising alternative that concentrates all operations on Vancouver Island, while being able to maintain a harvest level of 6,400 m^3/year.

The harvest rate resulting from the base case scenario is appropriate for setting the allowable annual cut at 8,700 m^3/year over the first management plan period. Locking Lasqueti Island from harvesting would require a reduction of the allowable annual cut to 6,400 m^3/year.

Scenario	THLB		Harvest Level	
	ha	% difference	m^3/year	% difference
001_Base	**1,103**		**8,713**	
002_VQOPon	1,104	0.0%	7,614	-12.6%
003_OGMAon	1,062	-3.8%	8,438	-3.2%
004_BIODoff	1,103	0.0%	8,820	1.2%
005_OPERoff	1,330	20.3%	9,931	14.0%
006_SLP60off	1,332	20.5%	10,431	19.7%
007_CDFmmoff	1,199	8.6%	9,445	8.4%
008_LASQoff	909	-17.4%	6,406	-26.5%

Acknowledgements

The authors thank Zoltan Schafer, RPF, Forestry Manager, for his important contributions in preparing and reviewing the project approach and assumptions.

Forsite's team included Cosmin Man, RPF, who completed the analysis, with support from Patrick Bryant, RPF.

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Document Revision History

Version	Date	Description
0.1	October 12, 2020	Initial assumptions distributed to client for review. Not all sections completed.
0.2	November 02, 2020	All sections completed. Distributed to the client for final review.
0.3	May 17, 2021	Client revisions incorporated.
0.4	June 29, 2021	Minor adjustments to replace FTOA with actual FNWL #

Acronyms

AOI	Area of Interest
AU	Analysis Unit
BC	British Columbia
BEC	Biogeoclimatic Ecosystem Classification
CC	Clearcut Silvicultural System
CWS	Community Watershed
DBH	Diameter at Breast Height
FMLB	Forest Management Land Base
FN	First Nation
FNWL	First Nation Woodland Licence
FPPR	Forest Planning and Practices Regulation
GAR	Government Action Regulation
GIS	Geographical Information System
LU	Landscape Unit
MHA	Minimum Harvest Age
NDT	Natural Disturbance Type
NHLB	Non-Harvestable Land Base
OAF	Operational Adjustment Factor
OGMA	Old Growth Management Area
SI	Site Index
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation Program for Stand Yields
TRIM	Terrain Resource Information Management
TSA	Timber Supply Area
TSR	Timber Supply Review
UWR	Ungulate Winter Range
VAC	Visual Absorption Capacity
VDYP	Variable Density Yield Projection
VEG	Visually Effective Green-Up
VLI	Visual Landscape Inventory
VQO	Visual Quality Objective
VRI	Vegetation Resource Inventory
WHA	Wildlife Habitat Area

1 Introduction

The Snaw-Naw-As First Nation recently received a forest tenure opportunity agreement, followed by a First Nation Woodland Licence (FNWL) #N3I, which requires a timber supply analysis. This document describes the information that is material to the analysis including the model used, data inputs, management assumptions, and scenario results.

1.1 AREA OF ANALYSIS

The FNWL #N3I (referred herein as area of interest or AOI) covers approximately 2,053 ha, spread across central Vancouver Island and on and Lasqueti Island within the Arrowsmith Timber Supply Area (TSA) (Figure 1). The largest communities in these areas include Qualicum Beach and Parksville.

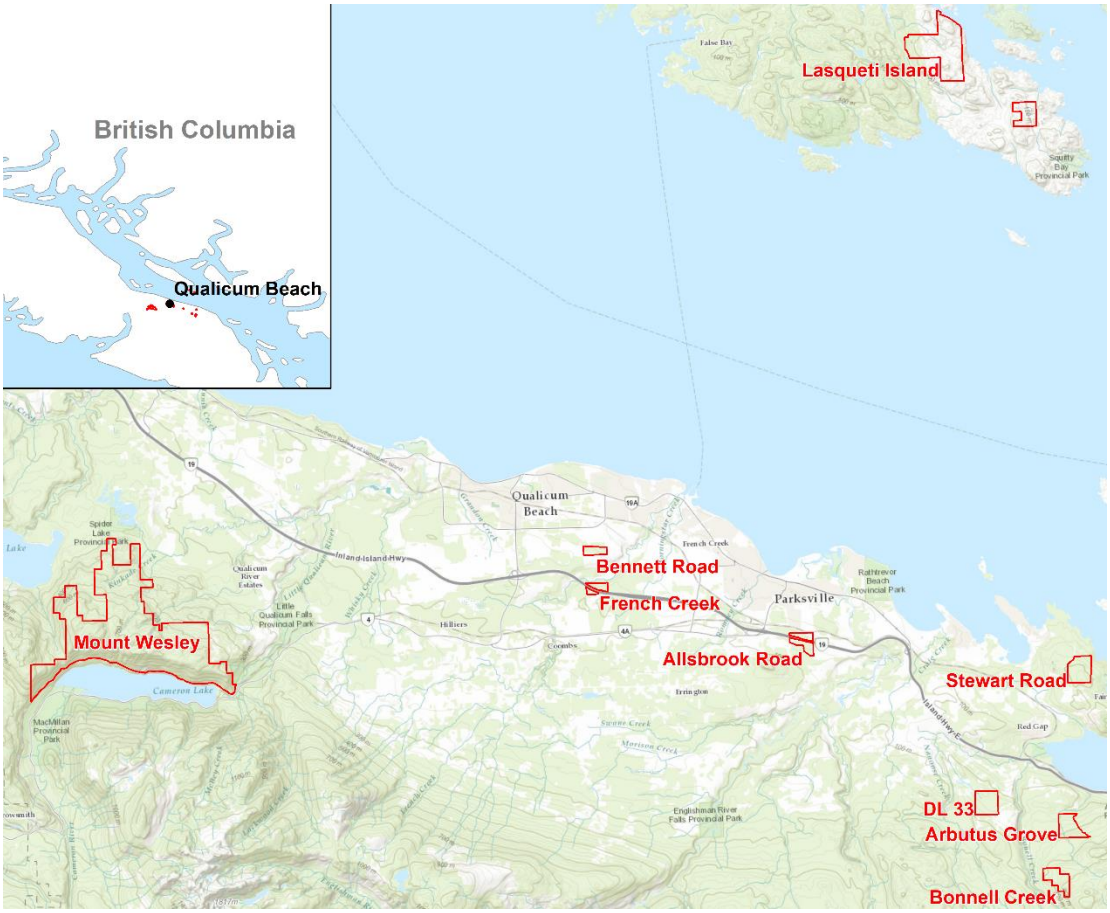

Figure 1 Location of FNWL #N3I

2 Land Base

2.1 DATA SOURCES

Various datasets covering administrative, inventory, and management guidance information were included in the analysis (Table 1). These spatial datasets were processed to develop the GIS resultant file used to build the forest

estate model for conducting the timber supply analysis and reporting results.

Table 1 Data Sources Used in the Timber Supply Analysis

Data	Source	Feature Name	Effective
Area of Interest	FTOA draft	AOI	2020
Ownership	DataBC	F_OWN	2020
Water (FWA Lakes, Wetlands, Rivers, Streams)	DataBC	FWA_LAKES_POLY,FWA_RIVERS_POLY, FWA_WETLANDS_POLY,FWA_STREAM_NETWORKS_SP	2020
Riparian buffers	Forsite	Riparian	2020
Digital Road Atlas	DataBC	TRANSPORT_LINE	2020
Landscape Units	DataBC	RMP_LANDSCAPE_UNIT_SVW	2020
Wildlife Habitat Area	DataBC	WCP_WILDLIFE_HABITAT_AREA_POLY	2020
Wildlife Habitat Area (Proposed)	DataBC	WCP_WHA_PROPOSED_SP_polygon	2020
Ungulate Winter Range (UWR)	DataBC	UWR	2020
Community Watersheds (CWS)	DataBC	WLS_COMMUNITY_WS_PUB_SVW	2020
Visual Landscape Inventory (VLI)	DataBC	REC_VISUAL_LANDSCAPE_INVENTORY	2020
Proposed Visual Landscape Inventory	District	VLI_proposed (MtWesley + Lasqueti)	2020
Biogeoclimatic Ecosystem Classification v11	DataBC	BECv11	2018
Operability (Arrowsmith TSA)	Gov FTP	Arrowsmith_EO_res11	2014
Slope DEM (TRIM)	Forsite	Slope	2020
Old Growth Management Area (OGMA)	DataBC	RMP_OGMA_NON_LEGAL_CURRENT	2020
Vegetation Resources Inventory (VRI)	DataBC	VEG_COMP_LYR_R1_POLY	2019
Site productivity point layer	DataBC	sprod	2014
Consolidated cutblocks	DataBC	BC_CONSOLIDATED_CUT_BLOCKS	2020
VDYP input tables	DataBC	VEG_COMP_VDYP_LAYER_POLY	2020
Karst	DataBC	RKPM_KARST_POTENTIAL_AREA_SP	2020
Resource Management Plans (legal)	DataBC	RMP_PLAN_LEGAL_POLY_SVW	2020
Strategic Land Resource Plan	DataBC	RMP_STRGC_LAND_RSRCE_PLAN_SVW	2020
Recreation feature inventory	DataBC	REC_FEATURES_INVENTORY	2020

2.2 FOREST INVENTORY UPDATES

The latest vegetation resource inventory (VRI) (projected to January 01, 2019) was accessed from DataBC and updated for recent harvest disturbances to January 01, 2021 using BC Consolidated cutblocks since 2010. A visual check was also performed using the most recent satellite imagery.

2.3 LAND BASE CLASSIFICATION

The AOI covers a total area of 2,053 ha, of which approximately 19 ha (1.0%) is non-forested land (Table 2, Figure 2). The Forest Management Land Base (FMLB) of approximately 2,033 ha is the area of productive forested land that can contribute towards meeting non-timber and other management objectives (e.g., biodiversity). For modelling purposes, a subset of the FMLB is identified as the timber harvesting land base (THLB), which is currently 1,169 ha or 57.5% of the FMLB. The difference between FMLB and THLB is considered non-harvestable land base (NHLB). After considering aspatial and future netdowns, the long-term THLB is 1,086 ha or 53.4% of the FMLB.

Table 2 Land Base Definition Summary

Factor		Total Area (ha)	Effective Area (ha)	% of Total Area	% of FMLB
Total Area		**2,053**		**100.0%**	
less:					
	VRI Not-Treed	4	4	0.2%	
	VRI Wetlands	2	0	0.0%	
	Roads Right-a-Way	14	13	0.7%	
	non-VRI Water	3	2	0.1%	
Forest Management Land Base (FMLB)			**2,033**	**99.0%**	**100.0%**
less:		*within FMLB*			
	Inoperable	415	415	20.2%	20.4%
	Steep Terrain (>60%)	406	308	15.0%	15.1%
	Non Merchantable	6	6	0.3%	0.3%
	WHA	20	20	1.0%	1.0%
	UWR	79	7	0.4%	0.4%
	CDFmm	110	104	5.1%	5.1%
	Riparian Reserve	2	2	0.1%	0.1%
	Low Volume (<300 m³/ha)	132	2	0.1%	0.1%
Timber Harvesting Land Base (THLB)			**1,169**	**56.9%**	**57.5%**
less:					
	In-block Retention (3.5%)		41	2.0%	2.0%
	Future Roads (3.97%)		42	2.1%	2.1%
Long Term THLB			**1,086**	**52.9%**	**53.4%**

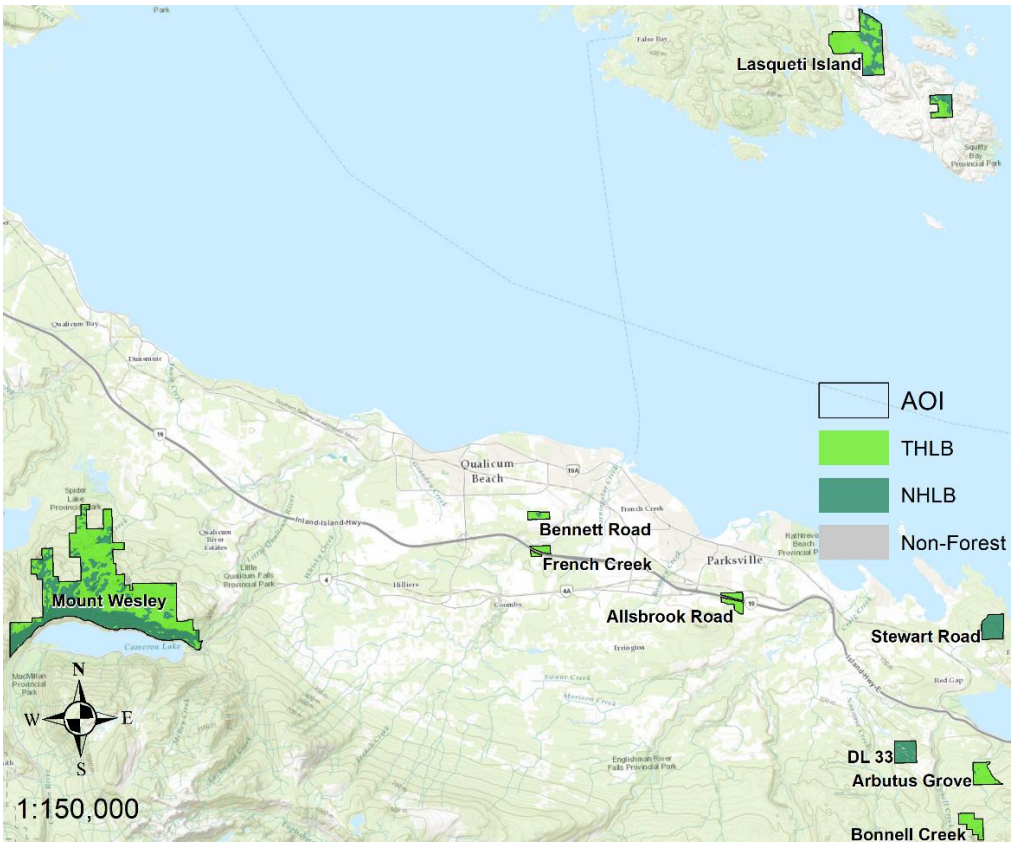

Figure 2 Land Base Definition Map

2.3.1 OWNERSHIP

The FNWL N3I issued to the Snaw-Naw-As First Nation excluded all potential ownership issues. However, a summary of the latest FOWN dataset overlapping the AOI is provided (Table 3).

Table 3 Ownership Summary

Own Code	Schedule	Description	NHLB (ha)	THLB (ha)
61	C	Crown - UREP (Use, Recreation and Enjoyment of the Public Reserve)	401	164
62	C	Crown - Forest Management Unit	111	267
69	C	Crown - Community Watershed	159	569
69	U	Crown - Misc. Reserves	130	35
91	U	Unknown Ownership/Exceptions	63	134
Total			**864**	**1,169**

2.3.2 NON-FOREST

The non-forested land base includes areas that are covered by water bodies, non-vegetated, wetlands, and existing roads and landings, or simply not typed (undefined) in the VRI (Table 4).

Table 4 Non-Forest Areas

<table>
<tr><th>Non Forest Class</th><th>Criteria</th></tr>
<tr><td>Not Typed</td><td>BCLCS Level 1 = U (or NULL) (no logging history)</td></tr>
<tr><td>Non Vegetated Land</td><td>BCLCS Level 1 = N (no logging history)</td></tr>
<tr><td>Vegetated Not Treed</td><td>No logging history and:
BCLCS Level 1 = V and BCLCS Level 2 = N and BCLCS Level 3<> U
BCLCS Level 1 = V and BCLCS Level 2 = N and BCLCS Level 3 = U and SPECIES_CD_1 is null
BCLCS Level 1 = V and BCLCS Level 2 = N and (BCLCS Level 3 = U or SPECIES_CD_1 is null)</td></tr>
<tr><td>Alpine</td><td>BCLCS Level 3 = A (no logging history)</td></tr>
<tr><td>Treed Wetlands</td><td>BCLCS Level 3 = W (no logging history)</td></tr>
<tr><td>Road Buffers</td><td>RTL_ID >0, roads not properly captured by VRI<table><tr><th>Surface Code</th><th>Buffer (m each side)</th></tr><tr><td>Highway Route</td><td>20</td></tr><tr><td>P (Paved)</td><td>7.5</td></tr><tr><td>L (Loose)</td><td>5</td></tr><tr><td>R (Rough)</td><td>3.5</td></tr><tr><td>S (Seasonal)</td><td>3.5</td></tr><tr><td>U (Unknown)</td><td>3.5</td></tr><tr><td>Other</td><td>0</td></tr></table></td></tr>
<tr><td>Water Bodies</td><td>Lakes, wetlands, and rivers not properly captured by VRI</td></tr>
</table>

2.3.3 INOPERABLE

Inoperable areas were identified using the 2014 Arrowsmith TSA Economic Operability Assessment, which also covered the Lasqueti Island. Areas considered inoperable (Economic = 'N') were 100% removed from the THLB unless they showed evidence of previous logging (Inoperable in Table 2).

2.3.4 STEEP TERRAIN

In the absence of terrain or environmentally sensitive area mapping datasets, areas with slopes >60% were 100% removed from the THLB (Steep Terrain (>60%) in Table 2). Physical harvest limitations were not incorporated in the Arrowsmith TSR, so a slope threshold adopted from the nearby 2018 TFL 54 management plan 5 was used.

2.3.5 NON-MERCHANTABLE

Non-merchantable stands that do not produce commercially viable timber were identified using the VRI species composition. In this analysis, deciduous leading stands - except red alder - were 100% excluded from the THLB unless they showed evidence of previous logging (Non Merchantable in Table 2).

2.3.6 OLD GROWTH MANAGEMENT AREAS

Old growth management areas (OGMA) are temporary reserves designated to meet landscape-level biodiversity requirements. There were no legal OGMAS overlapping with the AOI. Approximately 110 ha of non-legal OGMAs overlapped with AOI, yet these areas were not excluded from the THLB. Instead, the landscape-level biodiversity objectives were modeled (section 4.1).

2.3.7 WILDLIFE HABITAT AREAS

The approved wildlife habitat areas (WHA) established through GAR orders within the AOI were designated for Douglas-fir/Garry oak-oniongrass (tag 1-037) and 100% excluded from the THLB (WHA in Table 2). There were no proposed WHAs overlapping the AOI.

2.3.8 UNGULATE WINTER RANGE

The Mule Deer UWR# u-1-017 that overlapped with AOI was 100% excluded from the THLB (UWR in Table 2).

2.3.9 COASTAL DOUGLAS-FIR

The areas of the Coastal Douglas-fir moist maritime (CDFmm) land use objective order, established to protect rare or endangered plant communities, that overlapped with AOI were 100% excluded from the THLB (CDFmm in Table 2).

2.3.10 RECREATION FEATURES

Within the AOI there were no recreation features inventory with very high significance that required complete protection. A 10% retention was modelled for the recreation features inventory with high significance and moderate sensitivity or with moderate significance and high sensitivity that overlapped the AOI.

2.3.11 RIPARIAN RESERVES

Riparian buffer areas were created using the buffer widths adopted from the 2016 Arrowsmith TSR, as shown in Table 5. In the case of the stream classification, a second criterion was included (i.e., stream magnitude) to differentiate between fish and non-fish bearing streams.

Table 5 Riparian Buffer Widths

Class	Description	Buffer (m)
L1	Lake >5 ha	10
L2	Lake 1-5 ha in CDF or CWHxm, CWHdm, CWHds	15
L3	Lake 1-5 ha and L2	15
L4	Lake 0.25-1 ha in area	15
W1	Wetland >5 ha	30
W2	Wetland 1-5 ha in CDF or CWHxm, CWHdm, CWHds	20
W3	Wetland 1-5 ha not W2	15
W4	Wetland 0.25-1 ha in CDF or CWHxm, CWHdm, CWHds	15
W5	Two adjacent wetlands separated by <60 m and both <5 ha, or separated by <80 m if one is <5 ha and the other is >5 ha, or separated by 100 m or less if both are >5 ha.	30
S1a	River polygon; fish bearing	100
S1b	Stream order = 4; fish bearing	54
S2	Stream order = 3; fish bearing	34
S3	Stream order = 2 and magnitude >2; fish bearing	24
S4	Stream order = 1 and magnitude >2; fish bearing	6
S5	Stream order = 2 and magnitude <=2; non-fish bearing	3
S6	Stream order = 1 and magnitude <=2; non-fish bearing	0

The buffer width for linear features was applied equally on each side.

2.3.12 LOW VOLUME STANDS

Existing natural stands that never met the minimum harvest volume of 300 m^3/ha were 100% excluded from the THLB (Low Volume in Table 2). These stands were identified during the process for developing stand yields (i.e., maximum volume <300 m^3/ha less dead volume).

2.3.13 WILDLIFE TREE RETENTION

Under section 9.1 of the Forest Planning and Practices Regulation (FPPR), a minimum of 7% in-block retention has to be maintained across the cutblocks (3.5% within each cutblock) to meet stand-level biodiversity objectives. In this analysis, a 3.5% in-block retention was applied for each polygon that was clearcut.

2.3.14 FUTURE ROADS, TRAILS, AND LANDINGS

The percentage reductions to account for future roads trails and landings was determined to be 3.97% .This was the estimated ratio between the area of existing roads overlapping with the THLB and the area of developed THLB (i.e., within 300 m of existing road network). This percentage reduction was applied to all future stands regenerated from existing natural stands that had no logging history.

3 Growth and Yield

3.1 ANALYSIS UNITS

Stands were grouped into analysis units (AU) to reduce the complexity and volume of information in the model and for assigning potential treatments and transitions to yield curves following stand-replacing events. Stands 70 years and older in 2020, or 30 years and older for Red Alder leading stands, were considered naturally regenerated and no additional grouping was applied (i.e., the VRI feature ID was used to identify these stands). Stands younger

than 70 years were grouped into two management eras (35-69 years and <35 years relative to year 2020) and classified by leading species and managed site index (from provincial site productivity point layer). A third management era was implemented for future managed stands regenerated from year 2021 onwards.

Following a stand-replacing event/harvest, the existing natural stands (i.e., VRI feature ID) and existing managed stands 35-69 years were transitioned to their corresponding future managed stands classified by leading species and managed site index. In cases where no AU could be assigned because of missing or incomplete stratification criteria, the dominant AU within each corresponding BEC variant was assigned.

3.2 MINIMUM HARVEST AGES

Minimum harvest ages (MHA) were derived from yield estimates for each VRI feature ID and AU using the following criteria:

- Stand must be at least 60 years of age,
- Stand must achieve a minimum volume of 300 m^3/ha, and
- Mean annual increment must be within 90% of the maximum mean annual increment.

3.3 GROWTH AND YIELD MODELS

Yield curves developed for the forest estate model were prepared using the following stand projection models:

- Existing natural stands (70 years (30 years red alder leading) or older): Variable Density Yield Prediction (VDYP) console (v. 7.32d, Build 305). The provincial VDYP input polygon and layer datasets were used as inputs. A VDYP yield curve was generated for each VRI polygon, then volume of all live layers were summed while the dead volume component was ignored.
- Existing and future managed stands: Table Interpolation Program for Stand Yields (TIPSY) (v. 4.4, Ministry Standard Database, March 2018). A TIPSY yield was developed for each managed AU given regeneration assumptions inputs sourced from 2016 Arrowsmith TSR, and reproduced in Table 6.

Table 6 Regeneration Assumptions for Managed Stands

AU	Era	Species	SI range (m)	BEC	Regen Method	Density (sph)	Species Composition	SI (m)	Delay (yrs)	THLB (ha)
11	<35 yrs	Fd	>=33	CDF	P	1,200	Fd80 Cw10 Hw5 Ba5	33.29	2	5
12	<35 yrs	Fd	30.5<=si<33	CDF	P	1,200	Fd80 Cw10 Hw5 Ba5	31.90	2	53
13	<35 yrs	Fd	<30.5	CDF	P	1,000	Fd70 Cw10 Pl10 Hw5 Ba5	29.21	2	42
22	<35 yrs	HW, B	24<=si<27.5	CWH	P	1,000	Hw62 Fd28 Cw10	24.63	2	4
23	<35 yrs	HW, B	<24	CWH	P	1,400	Hw37 Ba30 Fd20 Cw13	23.12	2	15
32	<35 yrs	MB	any	CWH	P	1,000	Pl50 Cw12 Fd12 Hw8 Dr18	26.30	2	0
102	35-69 yrs	Cw,Yc	15<=si<22	CWH	P	1,000	Cw48 Hw28 Ba16 Fd8	19.92	2	7
111	35-69 yrs	Fd	>=33	CDF	P	1,200	Fd80 Hw14 Cw6	33.20	2	14
112	35-69 yrs	Fd	30.5<=si<33	CDF	P	1,200	Fd76 Hw16 Cw8	31.35	2	186
113	35-69 yrs	Fd	<30.5	CDF	P	1,000	Fd75 Hw11 Pl7 Cw7	29.68	2	140
122	35-69 yrs	HW, B	24<=si<27.5	CWH	P	1,000	Hw48 Ba25 Fd15 Cw12	25.10	2	4
123	35-69 yrs	HW, B	<24	CWH	P	1,400	Ba44 Hw34 Fd10 Cw8 Yc4	22.75	2	67
201	future*	Cw,Yc	>=22	CWH	P	1,000	Cw60 Fd20 Hw10 Ss7 Ba3	26.53	2	7
202	future	Cw,Yc	15<=si<22	CWH	P	1,000	Cw60 Fd20 Hw10 Ss7 Ba3	19.92	2	0
211	future	Fd	>=33	CDF	P	1,000	Fd80 Hw10 Cw8 Pw1 Ss1	33.21	2	10
212	future	Fd	30.5<=si<33	CDF	P	1,000	Fd80 Hw15 Cw3 Pw2	31.56	2	165
213	future	Fd	<30.5	CDF	P	1,000	Fd75 Hw20 Cw3 Pw1 Pl1	28.55	2	322
222	future	HW, B	24<=si<27.5	CWH	P	1,000	Hw75 Cw15 Fd5 Ba5	24.84	2	0
223	future	HW, B	<24	CWH	P	1,000	Hw60 Cw25 Ba10 Fd5	22.83	2	127
231	future	DR	any	CWH	P	1,600	Dr75 Cw10 Hw10 Fd4 Ss1	27.90	2	1
Total										**1,169**

**area of future stands was populated with area of existing natural stands (>=70 yrs) that will transition to a future state following a harvest event.*

3.4 UTILIZATION LEVELS

Net volumes for the yield curves were calculated with a minimum top diameter inside bark of 10 cm and a maximum stump height of 30 cm. A 17.5 cm minimum diameter at breast height (DBH) limit was applied for existing stands >120 years and naturally regenerated red alder leading stands, while a 12.5 cm minimum DBH limit was applied for existing natural stands <=120 years, existing managed, and future managed stands.

3.5 OPERATIONAL ADJUSTMENT FACTORS

Managed stand yield projections produce potential yields that do not reflect typical forest conditions, so operational adjustment factors (OAF) were applied. There are two OAFs: OAF 1 affects the magnitude of the yield curve and is constant across all ages, whereas the impact of OAF 2 accelerates with age. The OAF 1 represents uneven stocking or gaps and OAF 2 represents the impact of decay, waste and breakage in second-growth stands. This analysis applied OAF1 = 0.85 and OAF2 = 0.95 except Douglas-fir leading stands where OAF2 = 0.875 for existing managed stands and OAF2=0.9 for future managed stands to account for additional endemic losses caused by root disease.

3.6 GENETIC GAINS

Genetic gains (% volume at rotation) were applied to the managed stands accordingly:

- Douglas-fir – 3.9% in managed stands <35 years, 11.0% in future managed stands.
- Western redcedar – 2.0% in managed stands <35 years, 9.5% in future managed stands.
- Western hemlock – 0.5% in managed stands <35 years, 14% in future managed stands.

- Yellow-cedar – 10.0% in future managed stands.

3.7 SILVICULTURAL SYSTEMS

Clearcut with reserves was the modelled silvicultural system. Aspatial reserves of 10% were calculated in areas overlapping with the recreation features inventory records with high significance and moderate sensitivity or with moderate significance and high sensitivity, and 3.5% was applied to the rest of the THLB.

4 Objectives for Non-Timber Values

4.1 BIODIVERSITY

Stand-level biodiversity objectives were addressed by implementing in-block retention with each harvested stand (3.5% - section 2.3.13; to 10% - section 2.3.10).

The landscape-level biodiversity objectives were addressed by maintaining minimum old-seral forest requirements for each landscape unit (LU), BEC zone, natural disturbance type (NDT), and biodiversity emphasis option (BEO) (Table 7).

Table 7 Landscape-level Biodiversity Objectives

LU	BEC	NDT	BEO	Old Seral (years)	Minimum requirement (%)
Any	Any	1	Low or Intermediate	>250	13
			High		19
		2	Low or Intermediate		9
			High		13
		3	Low or Intermediate	>140	14
			High		21
		4	Low or Intermediate	>250	13
			High		19

4.2 ADJACENT CUTBLOCK GREEN-UP

Cutblock adjacency constraints were set to limit the amount of harvesting in each landscape unit to maximum 25% of the THLB stands that are less than a green-up age of 3 m. Except for Lasqueti Island, the entire AOI falls within the general management zone of the Vancouver Island Land Use Plan, which requires a 3 m green-up age. For consistency reasons, the cutblock adjacency constraint was also applied to Lasqueti Island.

4.3 VISUAL QUALITY

Visual quality objectives (VQO) were modelled for each VLI polygon using Plan-to-Perspective (P2P) ratios, Visually Effective Green-up (VEG) heights determined for 5% slope class increments, and maximum percentage alterations for a given visual absorption capacity (VAC). The specific parameters are detailed in Table 8 and Table 9. Within each VLI polygon, the area of FMLB younger than the age at VEG height needed to be lower than the area calculated as the maximum percentage alteration.

Table 8 P2P Ratios and VEG Heights by Slope Class

Category	Modified Visual Unit Slope Classes for P2P Ratios and VEG Heights														
Slope %	<5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	≥70
P2P Ratio	4.68	4.23	3.77	3.41	3.04	2.75	2.45	2.22	1.98	1.79	1.6	1.45	1.29	1.17	1.04
VEG Height (m)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	6.5	7.0	7.5	8.0	8.5	8.5	8.5

Table 9 VQO by Percent Alterations

VQO	VAC	Max % Alteration in Perspective View	Current (ha)		Proposed (ha)	
			FMLB	THLB	FMLB	THLB
Preservation	Low	0	0	0	0	0
	Medium	0	0	0	0	0
	High	0	0	0	0	0
	None	0	0	0	0	0
Retention	Low	0	0	0	242	41
	Medium	0.75	28	13	285	74
	High	1.5	0	0	0	0
	None	0.75	0	0	0	0
Partial Retention	Low	1.6	16	0	0	0
	Medium	4.3	8	8	749	543
	High	7	0	0	0	0
	None	4.3	100	99	0	0
Modification	Low	7.1	0	0	0	0
	Medium	12.55	0	0	0	0
	High	18	0	0	0	0
	None	12.55	0	0	0	0
Maximum Modification	Low	18.1	0	0	0	0
	Medium	24.05	0	0	0	0
	High	30	0	0	0	0
	None	24.05	0	0	0	0
Total			**152**	**119**	**1,276**	**658**

**source: Bulletin – Modelling Visuals in TSR III, 2003. url: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/visual-resource-mgmt/vrm_modeling_visuals_bulletin.pdf?bcgovtm=CSMLS*

Within the AOI, a total of 5 established and 14 proposed VLI polygons were considered. For each of the VLI polygon, the following were determined:

- Area-weighted average slope.
- VEG height, assigned based on relations shown in Table 8 and using the area-weighted average slope.
- Age when VEG height was reached based on the yield curve of each AU (existing and future).
- The maximum percent alteration calculated for each slope class as the P2P ratio (Table 8) x maximum % alteration in perspective view (Table 9). For example, the lowest maximum percentage alteration (except where is already 0) is for slope class ≥70%, VQO class R (retention) and medium VAC: 1.04 x 0.75 = 0.78%. The highest: 4.68*30=140.2%. In cases where the maximum percentage alteration exceeds 100%, there was no target set in the forest estate model.

4.4 WATERSHED MANAGEMENT

Three community watersheds overlapped with the AOI: Little Qualicum, Englishman, and French. Without a

completed Coastal Watershed Assessment, the disturbance was controlled by imposing a maximum 1% of the area in each year and in each watershed to be less than 5 m tall (as suggested by the Community Watershed Guidebook for timber supply analyses).

4.5 MARBLED MURRELET CONSERVATION REGION

In September 2020, the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development proposed a draft Order for the recovery of Marbled Murrelet by establishing minimum suitable habitat objectives. The proposed areas of the draft Order overlap with:

- 3.13 ha FMLB (0.95 ha THLB; 30% of FMLB habitat) within Lasqueti Island (part of Texada/Lasqueti LU, and Powell LU Aggregate) – 80% of this habitat should be protected, and
- 21.5 ha FMLB (5.6 ha THLB; 26% of FMLB habitat) within Mount Wesley (part of Rosewall, Little Qualicum, and Cameron LUs) – 100% of this habitat should be protected.

Given the relatively small THLB (5.6 + 0.95 = 6.6 ha or 0.6% of the long-term THLB) there were no modelling assumptions included in this analysis.

5 Modelling Assumptions

5.1 FOREST ESTATE MODEL

The PATCHWORKS™ modelling software was used for forecasting and analysis (Spatial Planning Systems Inc. of Deep River, Ontario, www.spatial.ca).

PATCHWORKS™ is a spatial forest estate model that can incorporate real world operational considerations into a strategic planning framework. It utilizes a goal seeking approach and an optimization heuristic to schedule activities across time and space in order to find a solution that best balances the targets and/or goals defined by the user. Targets can be applied to any aspect of the problem formulation. For example, the solution can be influenced by issues such as mature/ old forest retention levels, young seral disturbance levels, patch size distributions, conifer harvest volume, growing stock levels, snag densities, Coarse Woody Debris levels, Equivalent Clearcut Areas, specific mill volumes by species, road building/ hauling costs, delivered wood costs, net present values, etc. The PATCHWORKS™ model continually generates alternative solutions until the user decides a stable solution has been found. Solutions with attributes that fall outside of specified ranges (targets) are penalized and the goal-seeking algorithm works to minimize these penalties, resulting in a solution that reflects the user objectives and priorities. PATCHWORKS' flexible interactive approach is unique in several respects:

- PATCHWORKS' interface allows for highly interactive analysis of trade-offs between competing sustainability goals.
- PATCHWORKS software integrates operational-scale decision-making within a strategic-analysis environment: realistic spatial harvest allocations can be optimized over long-term planning horizons. PATCHWORKS can simultaneously evaluate forest operations and log transportation problems using a multiple-product to multiple-destination formulation. The model can identify in precise detail how wood flows to mills over a complex set of road construction and transportation alternatives.
- Allocation decisions can be made considering one or many objectives simultaneously and objectives can be weighted for importance relative to each other (softer vs. harder constraints).

- Allocation decisions can include choices between stand treatment types (clearcut vs. partial cut, fertilization, rehabilitation, etc.).
- Unlimited capacity to represent a problem – only solution times limit model size.
- Fully customizable reporting on economic, social and environmental conditions over time.
- Reports are built web-ready to share analysis results easily – even comparisons of multiple indicators across multiple scenarios.

5.2 GENERAL MODELLING ASSUMPTIONS

General modelling assumptions were incorporated into the model to improve its efficiency or to produce results that are spatially more realistic (Table 10).

Table 10 General Modelling Assumptions

Element	Assumption
Minimum Polygon Size	Minimum size of the polygon within the resultant was set depending on the data source: 10 m² for road/riparian buffers 100 m² for larger area features (e.g., VRI, VLI etc.) 1,000 m² for very large administrative boundaries (e.g., LU etc.)
Blocking	The THLB polygons were split into 0.5 ha hexagons. Polygons were not pre-aggregated into blocks in order to allow maximum patching and harvest flexibility.
Planning Horizon	A 300-year planning horizon was applied and reported in 10-year increments. Year zero of the planning horizon was 2020 and harvest events started in year 2021.
Solution Development	The following approach was applied: • Activate the harvest objectives (i.e., ~twice the long-term sustained yield) and allow the model to develop a harvest schedule for approximately 1 million iterations. • Activate all non-timber objectives and run the harvest schedule for another million iterations. • Activate patch objectives (relatively low weights). Allow another million iterations. • Activate the controls of the harvest flow profile (i.e., non-declining harvest, and non-declining THLB merchantable growing stock in the last 100 years of the 300-year planning horizon). • Increase the weights for undesired harvest openings (e.g., small-size clearcuts) and allow the model to converge towards a solution. Call the solution feasible when the change in objective function between 500,000 consecutive iterations was less than 0.00000001% (1e-8). The solving time for one scenario was under 10 hrs.

5.3 HARVEST OPENING AND YOUNG SERAL PATCH SIZE OBJECTIVES

Harvest opening objectives were implemented to mimic the operational reality where very small and large size classes are to be avoided (Table 11). In addition, a minimum distance of 100 m was maintained between two adjacent young seral (20 years and younger) patches by setting a second set of patch objectives.

Table 11 Young Seral Patch Definition

Definition	Size Class	Target	Weight	Roundness Weight
Harvest area in each planning period and within 20 m to merge riparian and road right-of-ways.	< 2 ha	Max 0%	High	
	2-40 ha			Low
	>=40 ha	Max 0%	High	
FMLB area <=20 yrs; within 100 m to control adjacent patches distance.	< 40 ha			Low
	>=40 ha	Max 0%	High	

5.4 NON-RECOVERABLE LOSSES ON TIMBER HARVESTING LAND BASE

Non-recoverable losses (NRL) provide an estimate of the average annual volume of timber that will be damaged or killed on the FMLB and not salvaged or accounted for by other factors. In this analysis, the NRL was prorated from 2016 Arrowsmith TSR relative to the THLB ratio as 8,038 m^3/year NRL in Arrowsmith x 1,169 ha (AOI THLB) / 59,721 (Arrowsmith THLB) = 157 m^3/year.

5.5 NATURAL DISTURBANCE ON NON-TIMBER HARVESTING LAND BASE

Most non-timber objectives are related to the maintenance of desired forest conditions such as a specified age structure or proportion of old forest and are applied to the entire FMLB. Accordingly, the natural disturbances outside of the THLB and the role they have in altering forest conditions over time should be accounted for, rather than allowing this forest to age continually and contribute inappropriately to forest cover requirements. However, given the relatively small-size of this AOI in this analysis, the NHLB was not disturbed during the planning horizon.

6 Current Forest Conditions

The FMLB within the AOI overlaps with CWH (77%) and CDF (23%) BEC zones (Figure 3). Within CWH, the largest subzone/variant is CWHxm2 (931 ha FMLB), while CDF includes only one subzone/variant (CDFmm).

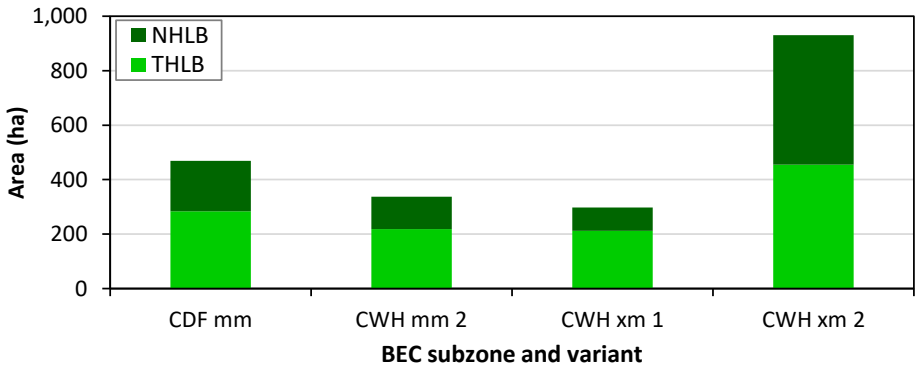

Figure 3 FMLB Distribution by BEC

The AOI overlaps with 7 different LUs; the largest extents include Little Qualicum (58.9%), Texada (18.0%), Nanoose (9.4%), and Rosewall (7.4%) (Figure 4). Relatively small areas overlap with French Creek, Englishman and Cameron LUs. Overall, THLB dominates in each LU indicating a relatively high potential to distribute harvest uniformly in each LU subject to other non-timber objectives.

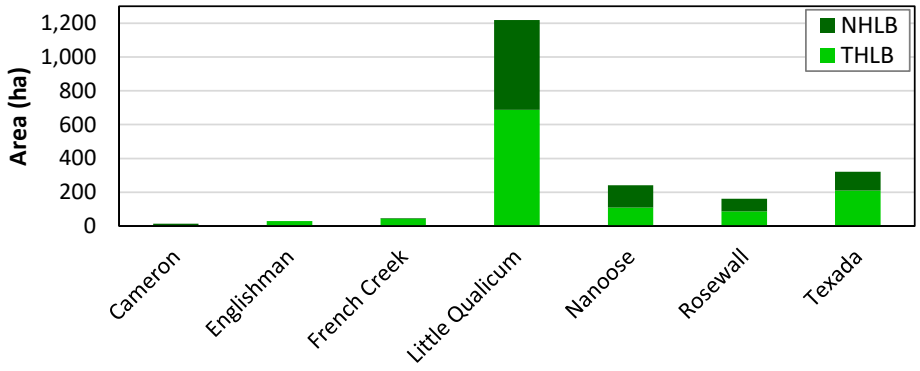

Figure 4 FMLB Distribution by Landscape Unit

The area by age class distribution (Figure 5) indicates that approximately 62% of the FMLB is older than 60 years (38% in 61-80 years age class), and approximately 38% of the FMLB is 60 years and younger, suggesting relatively more disturbances have occurred since year 1940s.

Figure 5 FMLB Distribution by Age Classes

The THLB is dominated by coastal Douglas-fir (80%) and western hemlock (18%) leading stands with relatively small components of western redcedar (1%) and red alder (<1%) leading stands (Figure 6). Approximately 46% of the THLB is in managed state (i.e., stands with previous logging history or younger than 70 years).

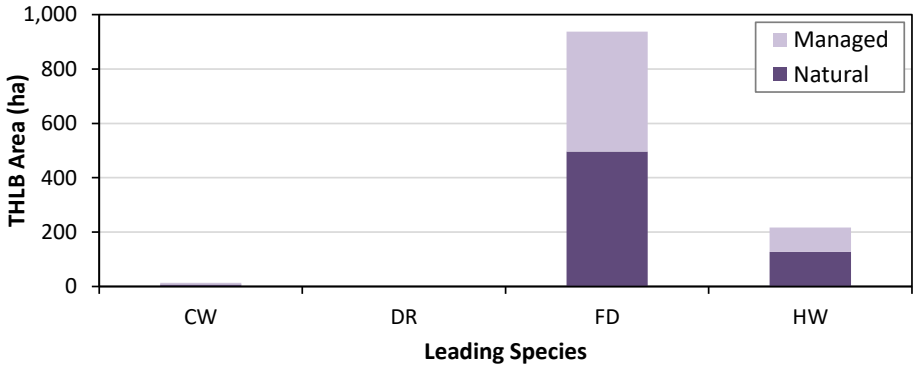

Figure 6 THLB Distribution by Leading Species

The current forest inventory from VRI indicates that most of the THLB stands (77%) have site indices over 22 m (i.e., site index (SI) expressed as top height in metres at age 50) (Figure 7). The area-weighted inventory SI for the THLB was estimated to 25.3 m. The managed SI estimates using the provincial managed SI layer for the leading species from the current VRI indicates higher growth rates for current and future managed stands (i.e., the area-weighted average was estimated to 28.6m). Approximately 99% of the THLB stands will transpose to managed site indices over 22 m.

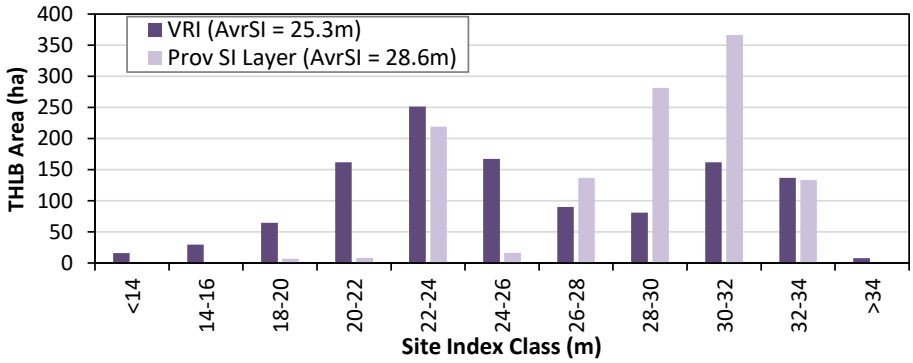

Figure 7 THLB Distribution by Site Index Classes

Non-timber objectives include the community watersheds (CWS) (63% of the FMLB, 63% of the THLB) and approved VQOs that overlap with 7% of the FMLB (Figure 8). The proposed VQOs (VQO_p) were expected to have a significant, negative impact on the harvest rate as they overlap with 63% of the FMLB and 56% of the THLB.

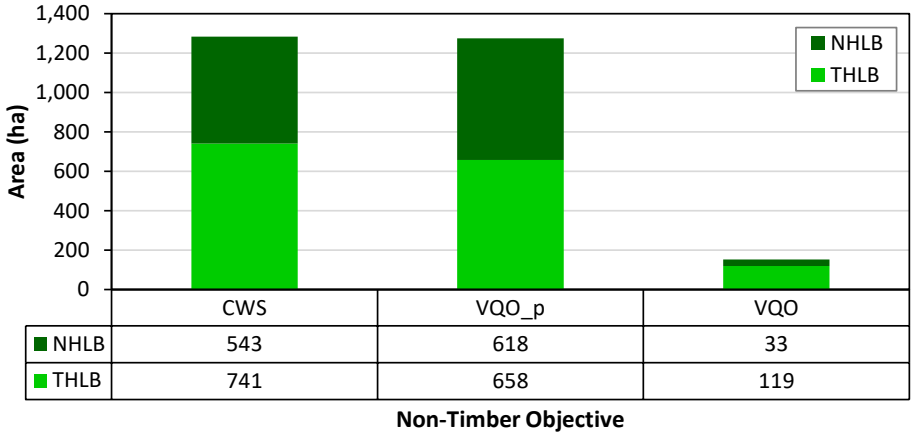

Figure 8 FMLB Distribution by Key Non-Timber Objectives

7 Scenarios

A brief summary of the modelling scenarios examined is provided in Table 12.

Table 12 Scenarios Description

Scenario ID	Name	Description
[001]	Base case	All objectives were set to meet the typical timber supply review requirements set by FRPA and other legal obligations.
[002]	Proposed VQOs	Proposed VQOs are activated and the current VQO replaced where overlaps exist.
[003]	OGMA on	Excluded non-legal OGMAs from the THLB. Landscape-level biodiversity objectives remained activated.
[004]	Biodiversity	Turned off landscape-level biodiversity objectives because of the relatively small-size AOI.
[005]	Operability	Turned off the 2014 Arrowsmith Economic Operability Assessment.
[006]	Slope	Areas with slope >60% were not excluded from the THLB.
[007]	Douglas-fir CDFmm	The CDFmm was not excluded from the THLB. Here it was assumed that these reserves would be re-located outside of the AOI.
[008]	Lasqueti Island	Locked Lasqueti Island from harvesting. Turned on proposed VQO objectives. The goal was to understand the maximum harvest level subject to locking Lasqueti Island from harvesting while meeting the proposed VQOs.

8 Results

The following subsections describe results for the Base Case scenario, which reflects expected management practices applied over the AOI according to the land base classification, growth and yield, non-timber objectives, and modelling assumptions described above. Various reports were prepared to describe timber values over time. While the PATCHWORKS™ model was configured to produce many detailed reports, the results below include key indicators for establishing a sustainable harvest level.

8.1 TIMBER VALUES

The base case scenario supports an even-flow harvest level of ~8,700 m³/year (NRLs accounted for) for the entire 300-year planning horizon (Figure 9). The maximum harvest level (grey line) had a fluctuating flow for which the best fit was an even-flow harvest level as implemented for the base case scenario. The base case harvest level was relatively smooth because the 0.5 ha maximum polygon size allowed the forest estate model to have relatively high flexibility in forming cutblocks ≥ 2 ha in size, while meeting all non-timber objectives. A higher maximum polygon size would have reduced the flexibility and would have likely produced a fluctuating harvest level over the planning horizon. Finally, the theoretical long run sustainable yield (LRSY), estimated at the age of maximum mean annual increment for each future managed stand, was ~ 10,000 m³/year (14.8% higher than the base case). The difference between LRSY and base case reflected the relative long-term negative impact of non-timber objectives on harvest level.

The initial THLB standing volume of ~437,000 m^3 declined steadily to a low of ~352,000 m^3 (80.5% of the initial volume) by the end of the planning horizon. The THLB standing volume from stands older than MHA (i.e., merchantable standing volume) increased from the initial value of ~281,000 to 345,000 m^3 and then decreased to a low of ~185,000 m^3 by year 60 of the planning horizon before stabilizing to a non-declining value above 222,000 m^3 in the last 100 years of the planning horizon. Recall, the non-declining standing volume objective in the last 100 years of the planning horizon was applied to the THLB merchantable standing volume.

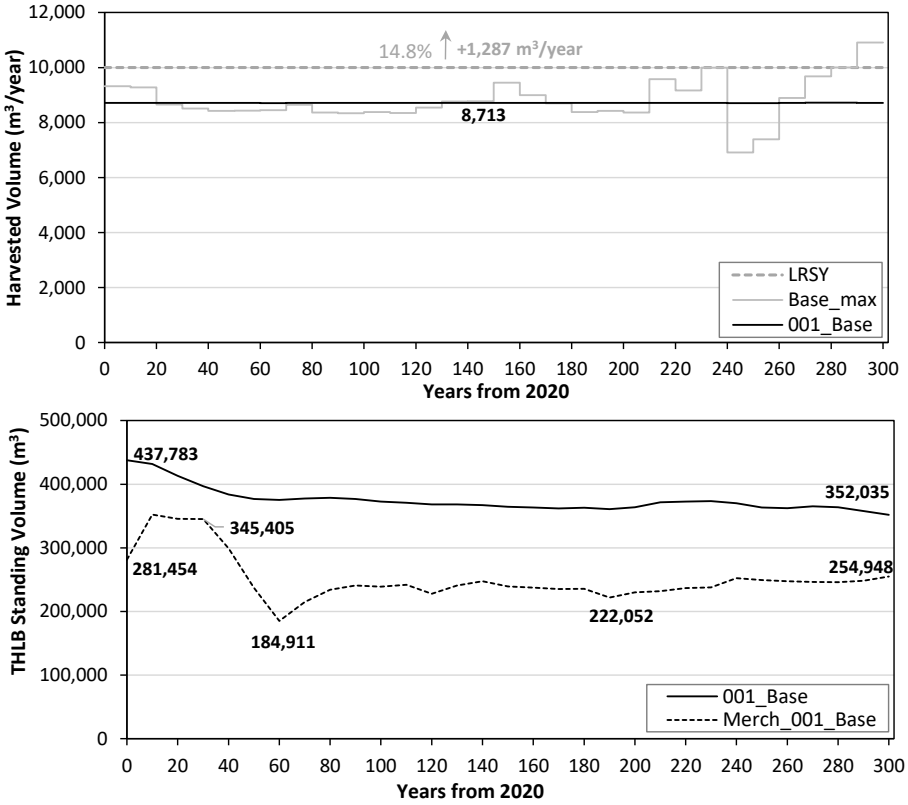

Figure 9 Base Case Harvest Level and Standing Volume

The forest estate model started to harvest existing managed (EM) stands early in the 300-year planning horizon, while the conversion of existing stands to future managed stands (FM) occurred, for the most part, over the first 60 years of the planning horizon (Figure 10). Recall, EM stands were <70 years while 38% of the FMLB in year 0 was between 61-80 years. Thus, the model was able to target EM stands sooner in the planning horizon while recruiting some existing natural (EN) stands, most likely of lower volume and SI, to meet various non-timber objectives. Some of the recruited EN stands were converted to FM stands later in the planning horizon as, the now existing FM stands, were growing at a higher rate and able to meet various non-timber objectives sooner. In addition, the continuous aging of stands in the NHLB freed-up some of the locked old seral THLB. Consequently, more area could be disturbed on shorter harvest cycle allowing the conversion of slower growing EN stands to more productive FM stands. Some of the EN stands were never harvested because they were permanently recruited to fill the deficit of old seral area needed to meet the landscape-level biodiversity objectives.

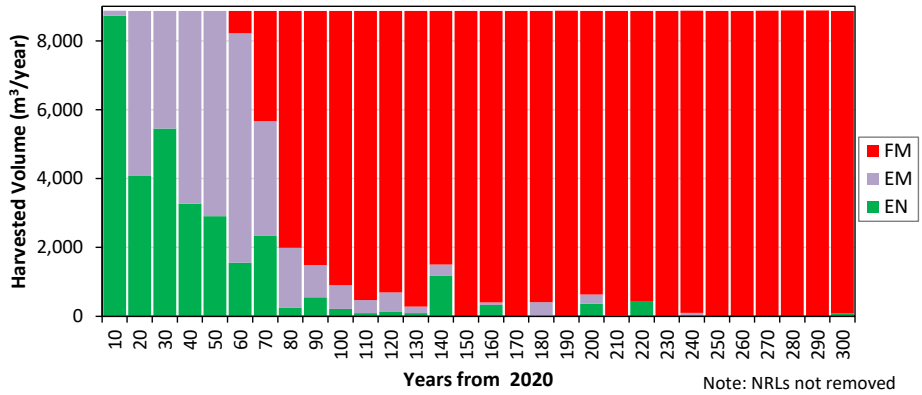

Figure 10 Base Case Harvested Volume by Management State

The harvested volume was sourced mostly from stands aged 60-120 years with standing volumes of over 500 m³/ha (Figure 11). It was observed that the older EN stands contributing to the harvested volume had lower standing volumes at harvest, between 300-500 m³/ha.

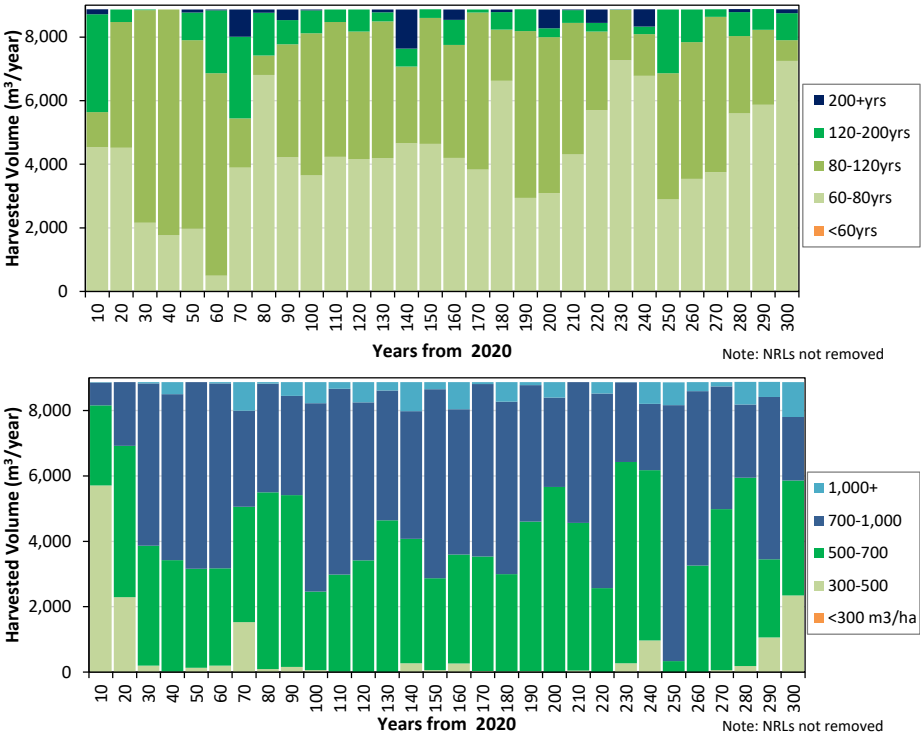

Figure 11 Base Case Harvested Volume by Age Class (top) and Volume per Hectare Class (bottom)

The average harvest volume increased from the initial value of 443 m³/ha to a high of 739 m³/ha by year 50 of the 300-planning horizon before stabilizing to ~700 m³/ha for the remaining of the planning horizon (Figure 12). Meanwhile, the harvested area followed an inverse trend to the average volume at harvest, and decreased by year 50 from an initial value of 20 ha/year to 12 ha/year before stabilizing to ~13 ha/year for the remaining of the planning horizon. The average age at harvest declined from an initial value of 109 years to a low of 79 years by year 20 of the planning horizon and it took 2 more cycles of increasing and decreasing before stabilizing at ~83 years for the last 150 years of the planning horizon. These increase/decrease cycles were in line with a higher harvested volume sourced from relatively older stands in decades 7 and 14 of the planning horizon.

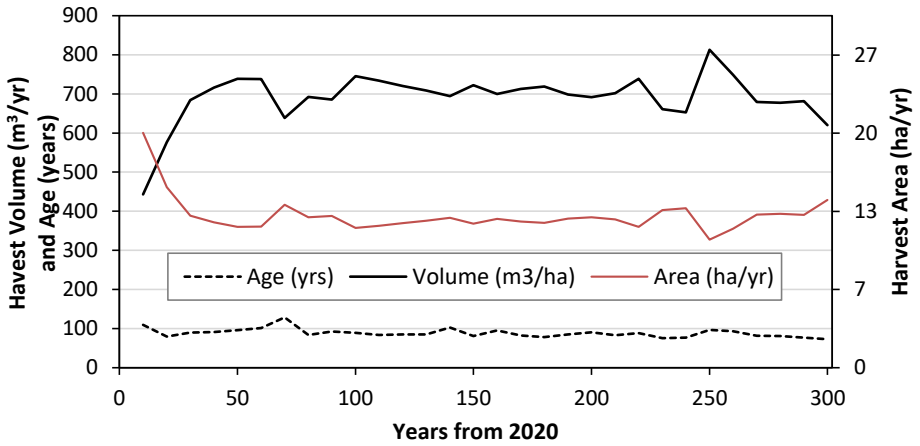

Figure 12 Base Case Harvest Area and Average Age and Volume at Harvest

The species profile of the harvested volume was dominated by Douglas-fir (FD) and western hemlock (HW) (Figure 13). Western red cedar (CW), amabilis fir (BA) and red alder (DR) had a minor contribution to the species profile. Other species (OT) included incidental lodgepole pine, cypress, arbutus, and maple leaf.

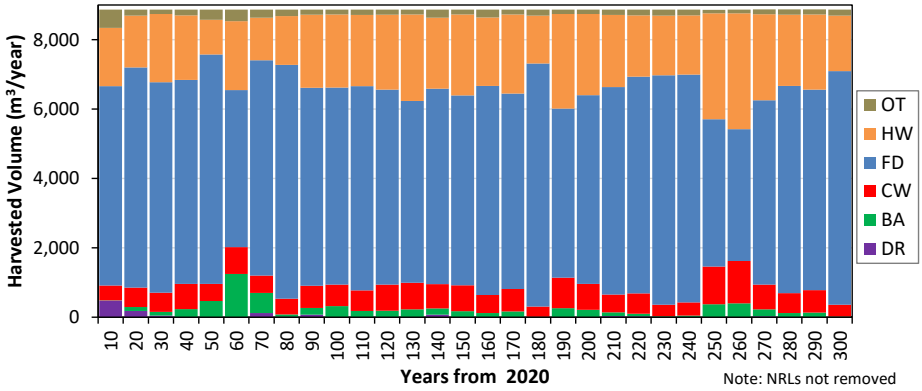

Figure 13 Base Case Harvested Volume by Individual Species

The forest estate model successfully achieved the harvest opening and young seral patch size objectives (Figure 14). The harvest openings were set-up to ensure that cutblocks were larger than 2 ha and did not exceed 40 ha in size, while young seral patches were set-up to ensure that at least 100 m existed between adjacent up to 40 ha areas that were 20 years and younger.

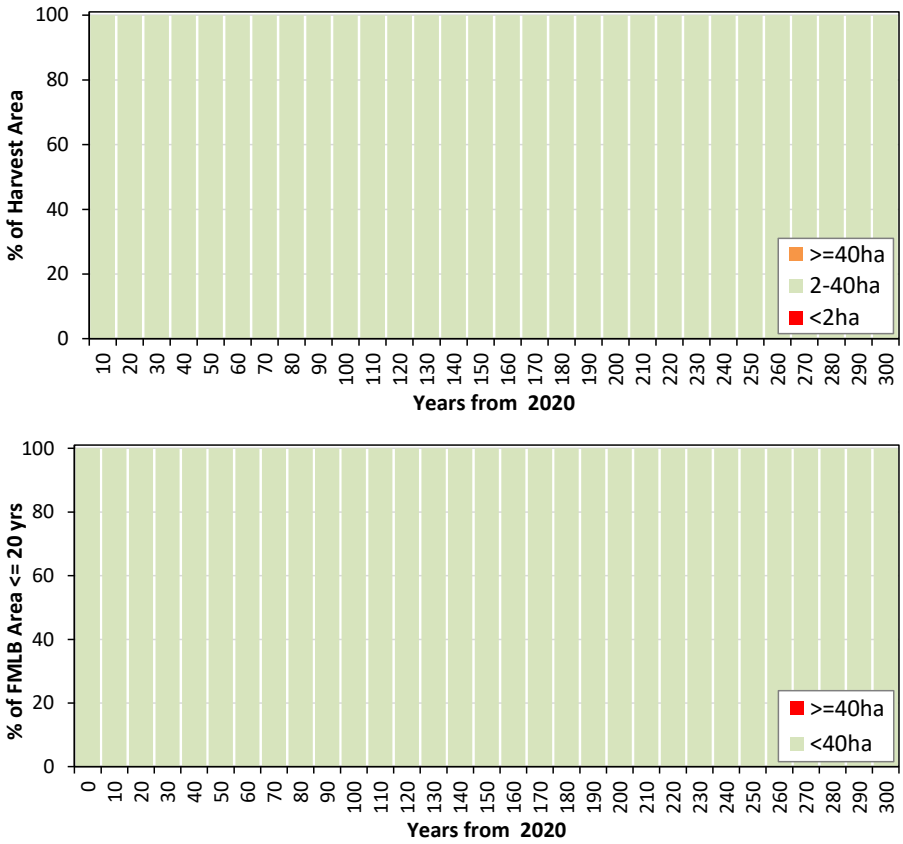

Figure 14 Base Case Harvest Openings (top) and Young Seral Patch Size (bottom) Distribution

The THLB area by age class distribution converged by year 100 of the 300-year planning horizon (i.e., approximately one harvest cycle) to a relatively regulated forest estate where approximately equal area was distributed in each age class, subject to the MHA and THLB recruitment to supplement NHLB in meeting non-timber objectives (Figure 15). In contrast, because the NHLB was not disturbed, the entire NHLB area was older than 250 years by the end of the planning horizon.

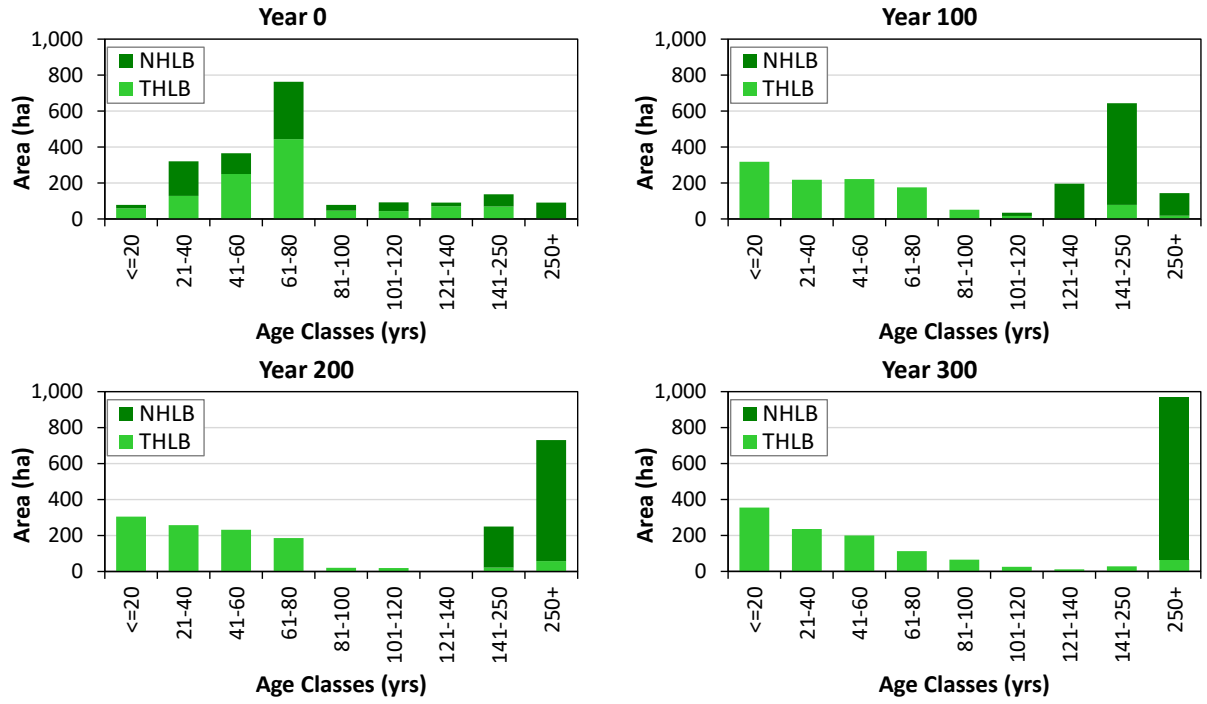

Figure 15 Area by Age Class Distribution at Year 0, 100, 200, 300

8.2 NON-TIMBER VALUES

Landscape-level biodiversity objectives were set-up to maintain a minimum % of old seral within the FMLB for each LU, BEO, NDT, and BEC variant combination. Given the initial age class distribution where 6.8% of the FMLB was >140 years and 4.5% was >250 years, the landscape-level biodiversity objectives at year 0 of the 300-year planning horizon were under the target by 111 ha in 10 out of 12 reporting units (Figure 16). Here, the overall minimum old seral area was presented as "within" target in light green colour, the surplus of old seral area as "over" target in light blue colour, while the overall deficit as "under" target in red colour. By year 180 of the planning horizon, the deficit was reduced to 1 ha (and 4 units in deficit) and by year 220, all landscape-level biodiversity objectives were fully met. By the end of the planning horizon, there were ~ 791 ha over the target because of the ever aging stands in the NHLB. Therefore, the landscape-level biodiversity objectives had a relatively small impact on the harvest level.

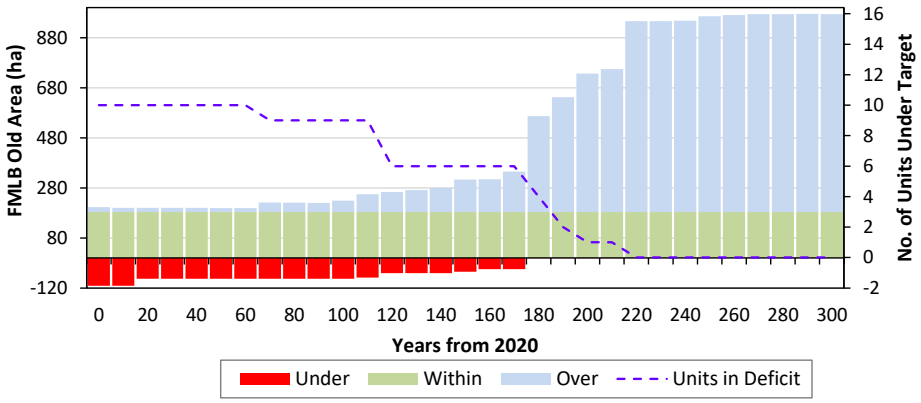

Figure 16 Base Case Landscape-level Biodiversity Objectives Status across all Reporting Units

The adjacent cutblock green-up objectives were set-up to cap to 25% the THLB area under 3 m height in each LU. The initial age class distribution indicated 5.4% THLB <= 20 years which translated into 16 ha (1 reporting unit) being over the 25% cap in year 0 of the 300-year planning horizon (Figure 17). Here, the overall maximum area with a height lower than 3 m was shown as a combination of area "within" the target in a light green colour and area "under" target in a light blue colour, while the area "over" the target was shown in a red colour. However, the forested estate model successfully met these objectives for the entire planning horizon, except in the 21st decade where one reporting unit had <0.001 ha being over the 25% cap. Such relatively small shortages in meeting the objectives are normal in heuristic-based forest estate models that avoid local optimum areas within the solution space. Given the relatively large light blue area (i.e., area under the target), we concluded that the adjacent cutblock green-up objectives had little to no negative impact on the harvest level.

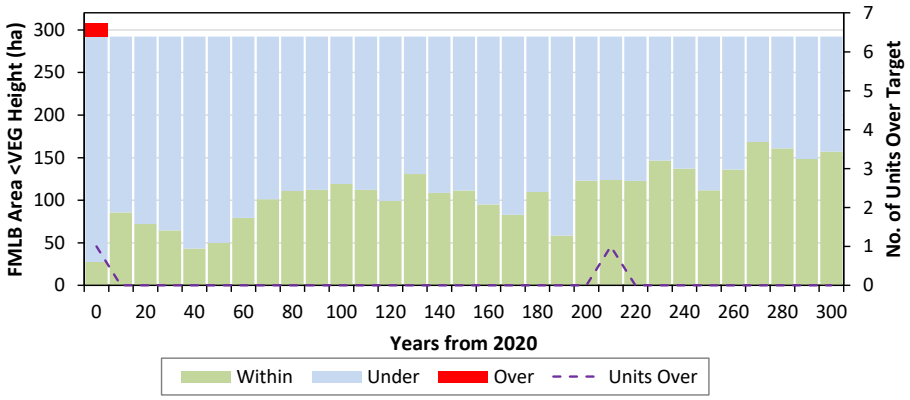

Figure 17 Base Case Adjacent Cutblock Green-up Objectives Status across all Reporting Units

VQOs were set-up to cap the FMLB area under the required VEG height (subject to slope and VAC) in each visually sensitive polygon. Initially, 26 ha (2 reporting units) were over the VQO cap in year 0 of the 300-year planning horizon (Figure 18). However, the model successfully met these objectives for the rest of the planning horizon, except year 200 when one reporting unit ha <0.001 ha was over the VQO cap. Given the relatively small light blue area (i.e., area under the target), we concluded that the VQOs had a moderate, negative impact on the harvest level. Recall, the THLB area that overlaps with the VQO polygons was approximately 10%. Therefore, the overall VQO negative impact on the harvest level was modest.

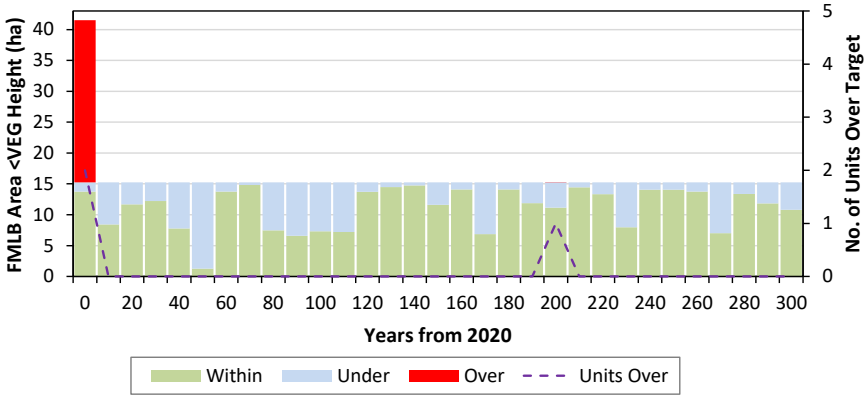

Figure 18 Base Case VQO Status across all Reporting Units

Watershed management objectives were set-up within community watersheds to cap the FMLB area under 5 m height to 1% in each year of the 300-year planning horizon. Given the strategic nature of the analysis, these

objectives were set to maximum 10% in each 10-year planning period assuming that within each planning period some annual maximum 1% objectives would not be met (more likely in the beginning of the planning period). However, if the strategic plan was to be implemented operationally, the strategic forecasted harvest area within the planning period would be re-planned in more or less equal annual parts such that the Watershed management objectives would be met. From year 0 of the planning horizon, all FMLB area within the community watersheds was above 5 m in height and the forest estate model successfully maintained the 10% cap per decade in each of the 3 community watersheds for the entire 300-year planning horizon (Figure 19). Insignificant exceptions occurred in one community watershed at various times during the planning horizon because of the heuristic nature of the forest estate model used in this analysis, and explained above. However, given the higher frequency of these exceptions, the relatively small light blue area, and that 63% of the THLB overlapped with the community watersheds, we concluded that the community watersheds objectives had the highest negative impact on the harvest level.

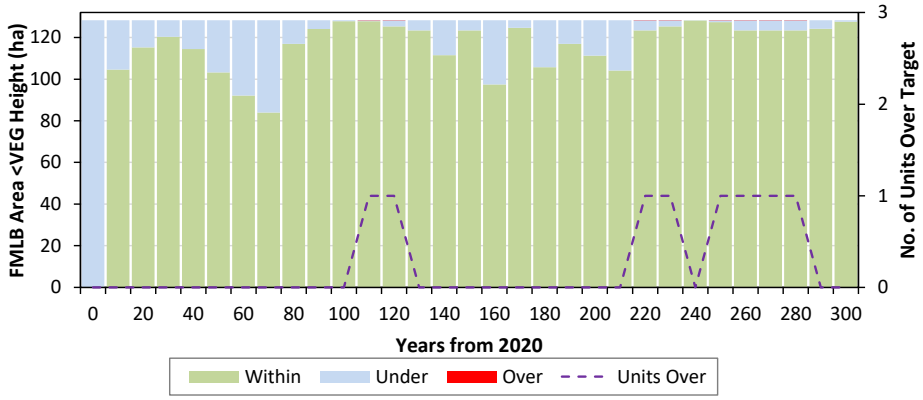

Figure 19 Base Case Community Watersheds Status across all Reporting Units

8.3 SENSITIVITY ANALYSES

Results for the 7 sensitivity analyses scenarios, each derived as even-flow harvests, are included in Table 13. Incorporating the proposed VQOs (run [002]) had a 12.6% negative impact on the harvest level, which was reduced to ~7,600 m³/year. Incorporating non-legal OGMAs THLB (run [003]) reduced the THLB to 1,062 ha (3.8%), which led to a reduction in the harvest level by 3.2%, to ~8,400 m³/year. Turning off the landscape-level biodiversity objectives (run [004]) increased the harvest level by 1.2% - this value aligned with the above conclusion that landscape-level biodiversity had a minor impact on the harvest level. Accordingly, given the relatively small-size AOI, the base case analysis could have been simplified by excluding landscape-level biodiversity objectives from the analysis altogether.

Table 13 Sensitivity Analyses Results

Scenario	THLB*		Harvest Level	
	ha	% difference	m³/year	% difference
001_Base	**1,103**		**8,713**	
002_VQOPon	1,104	0.0%	7,614	-12.6%
003_OGMAon	1,062	-3.8%	8,438	-3.2%
004_BIODoff	1,103	0.0%	8,820	1.2%
005_OPERoff	1,330	20.3%	9,931	14.0%
006_SLP60off	1,332	20.5%	10,431	19.7%
007_CDFmmoff	1,199	8.6%	9,445	8.4%
008_LASQoff	909	-17.4%	6,406	-26.5%

**excludes THLB retention (3.5%) and future roads deduction by the end of the 300-year planning horizon.*

Turning off the physical operability factors by ignoring the 2014 Arrowsmith economic operability assumptions (run [005]) and allowing harvest to occur on slopes >60% (run [006]), had greatest most positive impacts on harvest level. While the THLB gains were relatively similar (~1,330 ha, 20% higher than the base case), allowing the harvest to occur on slopes >60% increased the harvest level to a higher value of 10,400 m³/year (19.7% higher than the base case) compared to dropping the 2014 Arrowsmith economic operability assumptions (9,900 m³/year or 14.0% higher than the base case).

Potentially relocating the CDFmm protected areas (run [007]) could increase the THLB to 1,199 ha (8.6% higher than the base case), which would increase the harvest level to 9,400 m³/year (8.4% higher than the base case).

Finally, locking Lasqueti Island from harvesting (run [008]) assumed that the entire harvest would be located on Vancouver Island, which reduced the THLB to 909 ha (17.4% lower than the base case). Then, by incorporating the proposed VQOs, the negative impact on the harvest level became misaligned with the THLB difference and the harvest rate was further reduced to 6,400 m³/year (26.5% lower than the base case). Assuming that the proposed VQOs would be dismissed, the harvest level would be aligned to the THLB reduction % (i.e., 7,196 m³/year estimated as 0.826 x 8,713 m³/year – the base case harvest level)

9 Discussion and Recommendations

Assumptions developed for the Base Case scenario reflected the anticipated management and forest conditions. This analysis demonstrated that the harvest level presented for the base case scenario achieved all established objectives for stand- and landscape-level biodiversity, adjacent cutblock green-up, visual quality, and community watersheds. In addition, harvest openings and young seral objectives were achieved for a more realistic representation of operational challenges. Community watershed objectives were the most constraining to the harvest level. The initial area by age class distribution, where a relatively small portion of the FMLB was old seral, caused the landscape-level biodiversity to be fully achieved only between years 180 and 300-year of the planning horizon.

The 7 sensitivity analyses reported here indicated the following:

- Proposed VQOs could reduce the base case harvest level by 12.6%,
- Given the relatively small-size AOI, landscape-level biodiversity objectives and non-legal OGMAs had little impact on harvest levels,
- Physical operability assumptions need to be refined, as their exclusion from the analysis resulted in the most promising THLB and harvest level gains,

- Possible relocation of the CDFmm reserves could increase the THLB and harvest level by ~8.5%, and
- Locking Lasqueti Island from harvesting, while meeting the proposed VQOs, could be a promising alternative that concentrates all operations on Vancouver Island, while being able to maintain a harvest level of 6,400 m^3/year.

Based on results from this analysis, the harvest rate resulting from the base case scenario is appropriate for setting the allowable annual cut at 8,700 m^3/year over the first management plan period. Locking Lasqueti Island from harvesting would require a reduction of the allowable annual cut to 6,400 m^3/year.