Aleza Lake Research Forest

MANAGEMENT PLAN #3

2018 to 2028

Submitted for Review (July 2018)

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Special Use Permit (SUP) 23615
Term of Plan: 2018 to 2028

Aleza Lake Research Forest Society

Submitted July 2018

To: Prince George Resource District, MFLNRORD

By: The Aleza Lake Research Forest Society

Prepared by: (including signed and sealed)

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Date

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Mr. John Huybers, District Manager
BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development,
Prince George Resource District

Date

Dedication

"If I see a little further, it is because I stand on the shoulders of giants" (Isaac Newton)

This management plan is dedicated to three individuals whose forward thinking, advocacy, persistence, and leadership in forest stewardship, teaching, and research, have been instrumental in realizing the vision of the Aleza Lake Research Forest as a dedicated landbase for all these purposes, and as a university research forest:

Dr. Percy Barr (1897–1960),
BC Dept. of Forests and Lands,
Univ. of California (Berkeley)

Mr. John Revel RPF (1935-2015),
Silviculturist, BC Forest Service
1960-1993

Mr. Harry Coates,
Forest Research section,
BC Forest Service 1957-93

Acknowledgments

In the preparation of this Management Plan, we would like to gratefully acknowledge the contributions and support of the following individuals and organizations:

The Board of Directors of the Aleza Lake Research Forest Society, including Mr. Peter Forsythe RPF (president), Dr. Paul Sanborn, Dr. Pam Wright, and Dr. Scott Green (UNBC), Mr. Norm Bilodeau (MFLNRORD), and past ALRF director Dr. Wayne Martin.

Mr. Doug Perdue RPF, Dunkley Lumber Ltd,
Forest industry advisor

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Drs. Roy Rea, Hugues Massicotte, and Art Fredeen of UNBC, for their perspectives on forest habitat management, below-ground forest ecology, and forest carbon management respectively, and ALRF forest conservation generally.

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Photo Credits: Mike Nash, Curtis Fenton, Hugues Massicotte, Mark Thompson, Paul Sanborn, Roy Rea, Colin Chisholm, Mike Jull, Melanie Karjala, Judy Carlson, UNBC Communications

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PREAMBLE:

The key purpose of the Aleza Lake Research Forest (ALRF) is to provide field-based experiential education and research opportunities related to the understanding, management, and stewardship of northern and sub-boreal forest, riparian, and wetland ecosystems. As a university research forest, we strive towards these goals by applying scientific enquiry, local experience, and ecological knowledge to the practice of forest land stewardship. We recognize the ecological, social and cultural, legal, and economic bases of sustainable forest management, and the traditional territories and cultural perspectives of indigenous peoples within this and surrounding landscapes.

Many have strived to define the concept of "sustainable forest management" (SFM) in recent decades. Global and Canadian SFM definitions are recognized in this management plan. The United Nations Forum on Forests, and the international Food and Agriculture Organization (FAO), define SFM as:

"The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems."

And the Canadian Council of Forest Ministers (2008) defines SFM as:

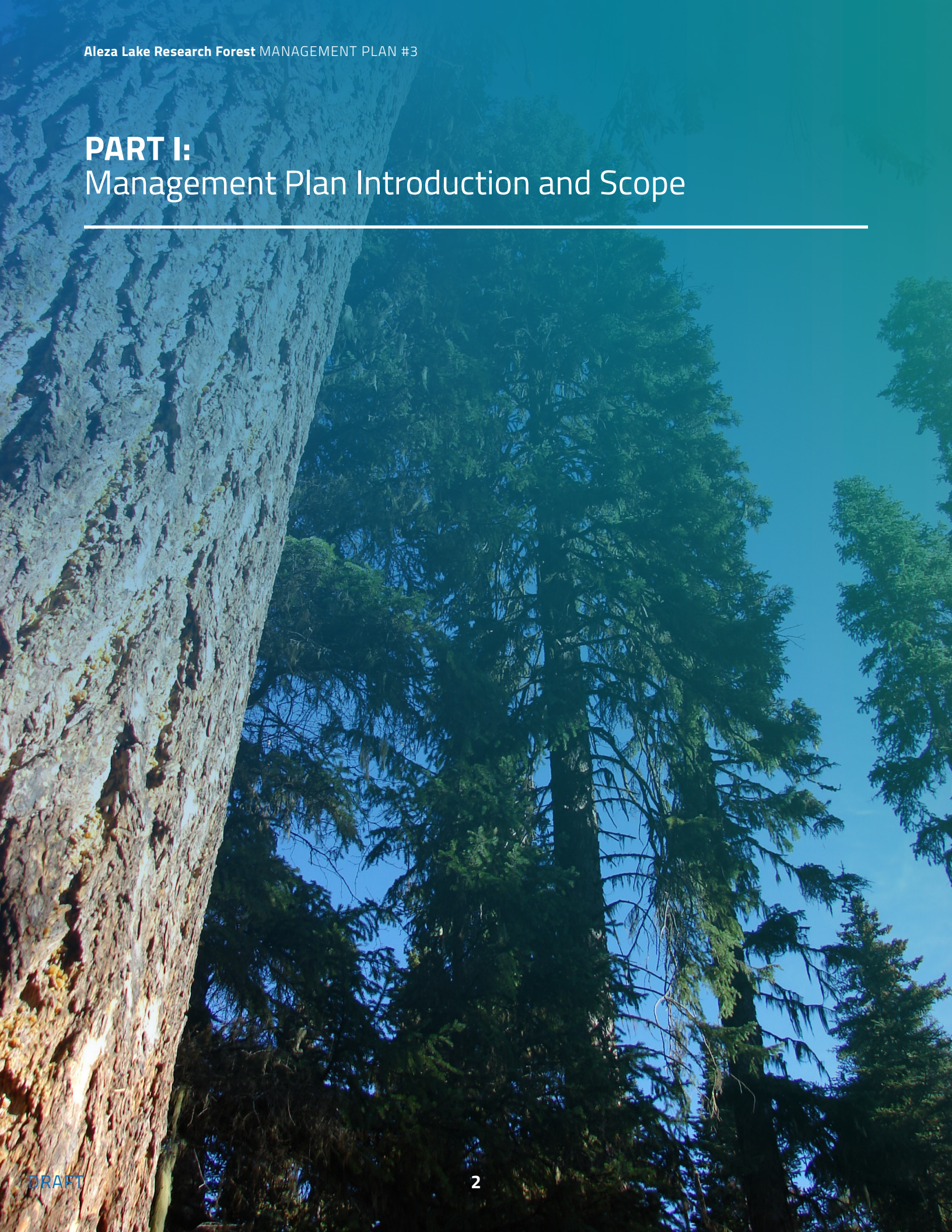
"Management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social, and cultural opportunities for present and future generations."

Opportunities for teaching, learning, innovation, and scientific enquiry relating to forest ecosystems and landscapes, including the testing and challenging of existing ideas, are core to the ALRF's mission. Principles of academic and scientific freedom of enquiry, creativity, and openness to new ideas are vital means for pursuing this ALRF mission and vision.

The following ALRF management plan seeks, to the greatest degree possible, to achieve and balance the goals of sustainable forest land management with the ALRF's core mandate of facilitating high-quality opportunities for forest-based teaching, education, and research, for the benefit of communities, the region, and the Province. The idea of such balance is of course, aspirational and evolving, with ongoing scientific research, increasing knowledge of the landbase and its ecosystems, and better understanding of the needs of people and our society.

At the ALRF, we regard a continual learning process as fundamental to the thoughtful and careful long-term stewardship of forests and ecosystems, and a driving philosophy in this management plan.

PART I:
Management Plan Introduction and Scope



1. INTRODUCTION

1.1 Purpose and Scope

The purpose of this Management Plan is to provide direction and guidance for the stewardship and management of the Aleza Lake Research Forest (ALRF), for the term of this plan.

The Aleza Lake Research Forest Society respectfully acknowledges that this area resides within the traditional territory of the Lheidli T'enneh First Nation.

The Plan has been prepared with consideration to the historical and ecological character of the Aleza Lake Research Forest landscape, legal requirements, the long-term goals and intent of the Aleza Lake Research Forest Society as tenure-holder, and the allied interests of the University of Northern British Columbia (UNBC), local communities, and the Province, in its present and future management.

Upon approval by the Province of British Columbia, this Management Plan #3 for the Aleza Lake Research Forest succeeds and replaces prior ALRF management plans.

1.2 General description and location

The Aleza Lake Research Forest is a diverse 9,000-hectare landscape of rolling hills and plateaus, moist sub-boreal upland forests, wetlands, streams and ravines, ponds and lakes, and river floodplains, located 60 kilometres east of the city of Prince George, in east-central British Columbia (Figure 1). The Research Forest is located at the approximate latitude of 54° 07' North, and longitude of 122° 04', and lies between 600 and 850 metres above sea level (a.s.l.).

Geographically, the ALRF is located in the Upper Fraser River basin, near the eastern edge of the Central Interior (McGregor) Plateau, adjacent to the western foothills of the Rocky Mountains, and the northern limit of the Columbia (Cariboo) Mountains. The nearest public highway access to the ALRF is the Upper Fraser Road to the north, and the nearest local communities are Shelley, Ferndale, Willow River, Giscome, Aleza Lake, Upper Fraser, Sinclair Mills, and Longworth.

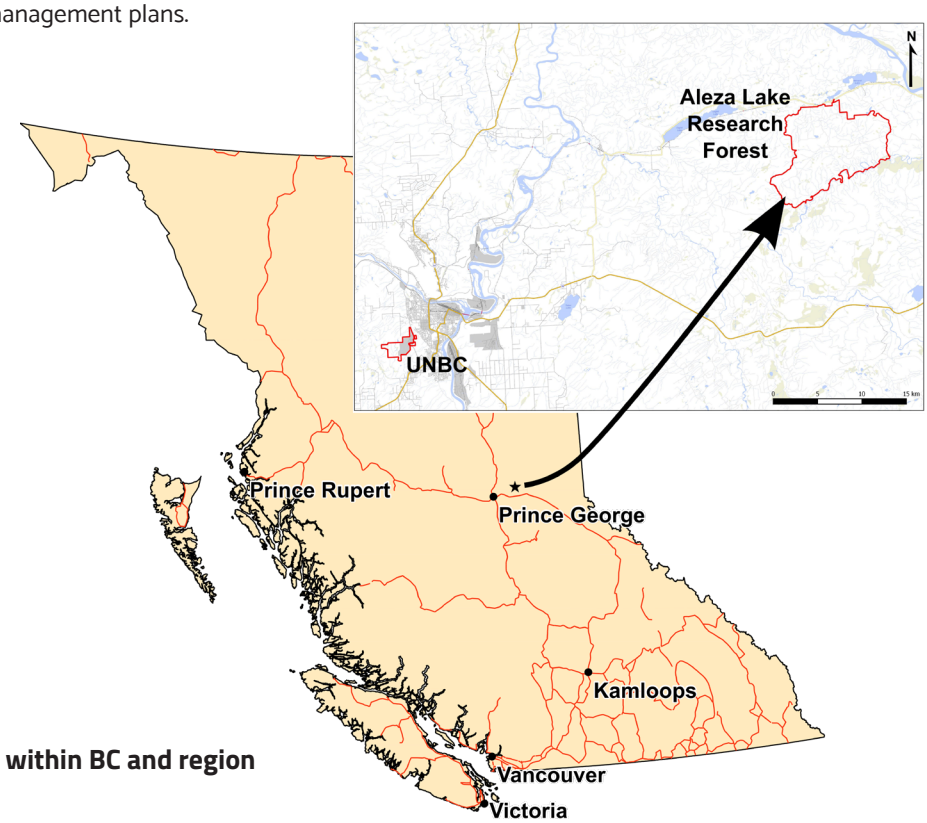


Figure 1:
General location of the ALRF within BC and region

Dr. Percy Barr travelling the railway line near Aleza Lake, BC, circa 1925
(Photo courtesy of BC Archives)

1.3 Tenure area history

The Aleza Lake Research Forest is BC's oldest research and teaching forest, dating back nearly a century to its establishment in 1924 as the Aleza Lake Forest Experiment Station by the BC Department of Forests and Lands (also later known as the BC Forest Service or "BCFS"). This area was selected by Dr. Percy Barr, director of the provincial Forest Research Division, because the area was considered typical of the productive commercially-important spruce forest types of BC's central and northern Interior (Barr, 1928, Schmidt, 1993).

Barr (1928) articulated the original management goals for the Aleza Lake Forest Experiment Station, and these were refined by subsequent management and working plans for this forest (including DeGrace, 1950, and Decie, 1957). These goals provided the framework for Aleza Forest management and innovations for many decades, and provided the foundation for more recent management (Jull, 1992, Jull and Karjala, 2005, and this current plan).

The Aleza Lake Forest Experiment Station operated as a provincial forestry field research and training centre for nearly 40 years, pioneering field forestry and technical training, ecological and soils classification, early Interior spruce reforestation techniques, silvicultural systems, and forest growth monitoring. The Province eventually closed the station in 1963-64 as the BC Interior pulp and sawmilling industry and forest research needs expanded to other regions of Interior BC. However, the forest management and forest research expertise and capacity fostered at the Aleza Forest spread throughout British Columbia and beyond.

After the closure of the Aleza Lake station in 1964, the BC Chief Forester of the time, F.S. McKinnon, directed that the Aleza Forest Reserve landbase remain set aside for a future "forest experiment station" and that the Province undertake a review of the reserve status within 10 years (BC Ministry of Forest Correspondence, 1964). Within the BC Forest Service, a standing committee on the Aleza Reserve remained active until 1975 (Revel, 2008).

In the mid-1970's and early 1980's however, external events redirected the provincial government's attention to other major forestry issues, including the 1976-1984 Bowron Valley spruce beetle outbreak and timber salvage program, a major

BC Forest Service re-organization between 1980-82, and the economic impacts of the 1981-84 North American recession.

The Aleza Forest's original purposes and significance seemed forgotten during these two decades, replaced by forest-policy priorities of the day. In the early 1980's, provincial Small Business Forest Enterprise Program (now BC Timber Sales) timber sale licenses were issued within the Aleza Forest landbase. In 1984, the Aleza Forest Reserve itself was officially dissolved, and incorporated into the larger Purden Forest Public Sustained Yield Unit (PSYU) or planning unit within the Prince George Timber Supply Area (TSA). In the mid- 1980's, about two-thirds of the old Aleza Forest Reserve was absorbed into a volume-based Forest License managed by Northwood Pulp and Timber Ltd, and the timber rights on the remaining one-third of the area were allocated to the Small Business Program.

However, some never forgot the original vision for the Aleza Forest and its forest research legacy, and its potential value for future generations. Long-time forest researchers John Revel RPF and Harry Coates tirelessly advocated for the the Aleza Forest, and the protection and stewardship of this area for forest education and research. John and Harry ultimately succeeded in building broad base of support across government, industry, and the new University of Northern British Columbia (UNBC). And in 1990, a provincially-led multi-agency "Aleza Lake Steering Committee" was formed, to help manage the ALRF area for its unique values. In 1992, a new management plan for the Aleza Lake Research Forest (Management and Working Plan #1, Jull, 1992) was approved by the BC Ministry of Forests. About 6 years later, in 1997-98, the volume-based forest tenure holders within the ALRF landbase agreed to government re-allocation of their timber harvest rights to other areas of the Prince George TSA, thereby freeing up the landbase for future research-forest tenure considerations.

In 1999, the Chief Forester of British Columbia accepted a joint proposal by UNBC and the University of BC (UBC) Faculty of Forestry, for the management of the ALRF as a university research forest. The original 8,957-hectare ALRF tenure area was awarded by the Province in May, 2001 to the not-for-profit Aleza Lake Research Forest Society, which included the two universities, the Province, and partners. In 2012, after 11 years with the ALRF Society, UBC elected to step down from its formal partnership role in the Society, but UNBC and the Province of BC remain as Society members. The ALRF Society continues to manage this research forest tenure to the present day.

In January 2015, the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development approved minor modifications to the tenure boundaries of the ALRF, adjusting them to more closely follow natural geographic and landscape features. These new boundaries replaced original ALRF boundaries which followed Land District lot survey boundaries aligned along cardinal directions. Equally importantly, these ALRF boundary changes finalized the Research Forest landbase into a single cohesive and geographically-defined landscape unit with the Bowron River on its southern boundary. The ALRF area following these changes is now 9,002 hectares.

(TOP) Aerial view of the Aleza Lake Forest Experiment Station, circa 1958
(ABOVE) Harry Coates (left) and John Revel (right) accept awards of recognition from BC Forest Service Research Branch Director Ted Baker (centre) on July 9, 1992 at the re-opening of the ALRF

A UNBC forestry class traverses a recently-cleared area now rich with thimbleberry

1.4 ALRF Permit / License Holder

The Aleza Lake Research Forest Society (or ALRFS) is a provincially-registered not-for-profit Society established in 2000 (Society # S-42412) whose membership (effective 2012) includes the University of Northern British Columbia (3 directors), the Province of British Columbia (1 director), and a member of the forest community (1 director).

The stated purposes of the Society under its Constitution are:

- **a)** "to undertake stewardship of the Aleza Lake Research Forest (the "Forest"),
- **b)** to manage and operate the Forest to promote and support education and research with respect to sustainable forest management, ecosystem management, silviculture, and forest ecology by:
  - **i.** creating educational and research opportunities for forest and natural resource professionals, resource managers, technologists, and the public,
  - **ii.** sharing and disseminating information and knowledge gained through the research conducted at the Forest, and
  - **iii.** assisting in the fulfilment of the educational and research needs of the University of Northern British Columbia

Local grade 8 students enjoy an educational class outing at the Aleza Lake Research Forest

c) to hold property in the form of: Crown tenures of the research forest lands, capital improvements on those lands, and capital assets, as are necessary to manage and operate the Forest and the educational and research activities which will take place therein,

d) to allow access and input into the management and operation of the Forest by the University of Northern British Columbia,

e) to provide a long-term, financially self-sufficient research facility, funded primarily by harvesting timber in a manner consistent with the stewardship, research and educational goals of the Society,

f) to maintain the natural levels of biodiversity throughout the Forest by way of retaining all natural ecosystem components, processes, structural attributes and micro-processes,

g) to foster innovation in ecologically-sound management strategies and practices, and in research, extension and demonstration strategies and projects,

h) to provide opportunities for demonstration, testing, and refinement of a range of silvicultural systems and partial-cutting techniques, (and)

i) to do all such things as are incidental or conducive to the attainment of the purposes herein expressed."

2. MANAGEMENT PLAN REQUIREMENTS

2.1 Term of the Plan

The initial term of Aleza Lake Research Forest Management Plan #3 is 10 years, from 2018 to 2028.

The effective date of commencement of this plan and its end date (including any amendments or extensions to the plan term) are determined by the District Manager, Prince George District, BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD) or a successor organization.

2.2 Content Requirements

Special Use Permit (SUP) 23615 was issued to the Aleza Lake Research Forest Society by the Province of BC (BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development) for the specified term of the SUP. Section 3.01 of the SUP specifies the content of the ALRF management plan, as follows:

"The Permittee must submit for the approval of the district manager, once every five years, or more often if the district manager considers that special circumstances require, a management plan that contains the following:

(a) Management objectives regarding

general research and education strategies and approaches within the Permit area,

management and utilization of the timber resources in the Permit area, including harvesting methods and utilization specifications suitable to the types of timber and terrain in the Permit area,

management and conservation of non-timber values in the Permit area, including visual quality, biological diversity, soils, water, recreation resources, cultural heritage resources, range land, and wildlife and fish habitats,

integration of harvesting activities in the Permit area with licensed use, traditional aboriginal use,, or other uses of the area for purposes other than timber production,

forest fire prevention and suppression, forest health, silviculture, and road and access management strategies,

(b) Map(s) of the Permit area which include known or available information regarding: harvesting and natural disturbances, resource inventories, reserves, research activities or project sites, man-made facilities or utilities, and any other requirement identified by the district manager,

(c) Measures to be taken by the Permittee to identify, consult with and incorporate the input received from persons using the Permit area for purposes other than timber production including licensed resource users and aboriginal people claiming an aboriginal interest in or to the area,

(d) A timber supply analysis that analyzes the short and long term availability of timber for harvesting in the Permit area, including the impact of management practices on the availability of timber,

(e) An operational timber supply projection for the Permit area that, in support of the timber supply analysis, indicates the availability of timber by identifying:

the net operable landbase, harvested areas, existing and proposed road access within the net operable land base, and areas subject to special management constraints, and

categorizing areas within the net operable landbase by the type and quality of timber, and the harvesting method suitable to the terrain,

(f) Evidence of preparation by a professional forester,

(g) Approval by the Board of Directors of the Aleza Lake Research Forest Society,

(h) Inventories of the forest, recreation, fisheries, wildlife, range, and cultural heritage resources in the Permit area,

(i) Consistency with the conditions of the Permit,

(j) Any other information on the development, management, and use of the Permit area that the district manager requires, and

(k) Commitment by the Permittee to implement the approved management plan."

2.3 Relationship to Previous Management Plans

Prior management plans for the Aleza Lake Research Forest under SUP 23615 include:

- Management and Working Plan #1, 1992-2005, and,
- Management Plan #2, 2005 until replaced.

The intent of this Management Plan #3 (MP#3) is to maintain general consistency with the management direction and principles of earlier management plans, and also incorporate new information, experience, and understandings gained since the last plan was prepared. This new plan and its strategies also consider and reflect updated direction from government, community perspectives, and new scientific knowledge regarding forest land and resource stewardship and practices.

2.4 Relationship to Operational Planning and Site Plans

Special Use Permit (SUP) 23615 for the Aleza Lake Research Forest is subject to the legislative framework described in the permit. This framework includes but is not limited to the *Forest Act, Forest Practices Code of British Columbia Act* (including the *Strategic Planning Regulation*), the *Forest and Range Practices Act* (FRPA), and the regulations and standards under those Acts, as amended from time to time.

This Management Plan describes the terms and conditions of ALRF management, as approved by the District Manager. Forest Stewardship Plans (FSP's) are not required on the ALRF, due to this form of higher-level planning, and due to the specific legal provisions of Research Forest tenure (SUP and Occupant License to Cut).

On the ALRF, operational forest plans and site plans (for example, for site- and stand-level implementation of new roads, harvest areas, and stand treatments) must still be developed. As per the SUP, such plans must be *"consistent with the intent and direction established in the Management Plan, contain information similar to that required in operational plans developed under the Forest and Range Practices Act, and be developed under the guidance and signature of a professional forester."*

3. ALRF FOREST MANAGEMENT VISION AND GOALS

Vision

The management vision for the Aleza Lake Research Forest is that of an innovative, dynamic, and financially self-sustaining university research forest that fosters (in equal order of priority):

- Forest education and research related to the conservation and management of northern sub-boreal forest ecosystems, including both scientific enquiry and experience-based knowledge.
- Sustainable forest management. And,
- Learning, skills acquisition, and enhanced awareness of responsible land and ecosystem stewardship for current and future generations.

UNBC forestry students stop for a photo at the big firs on the South Knolls Trail at the ALRF

Management Goals

The 8 management goals of the ALRF, in keeping with this vision, encompass forest education and research, and forest stewardship and management. These goals are:

Aerial view of the Aleza Field Education Centre, established 2015

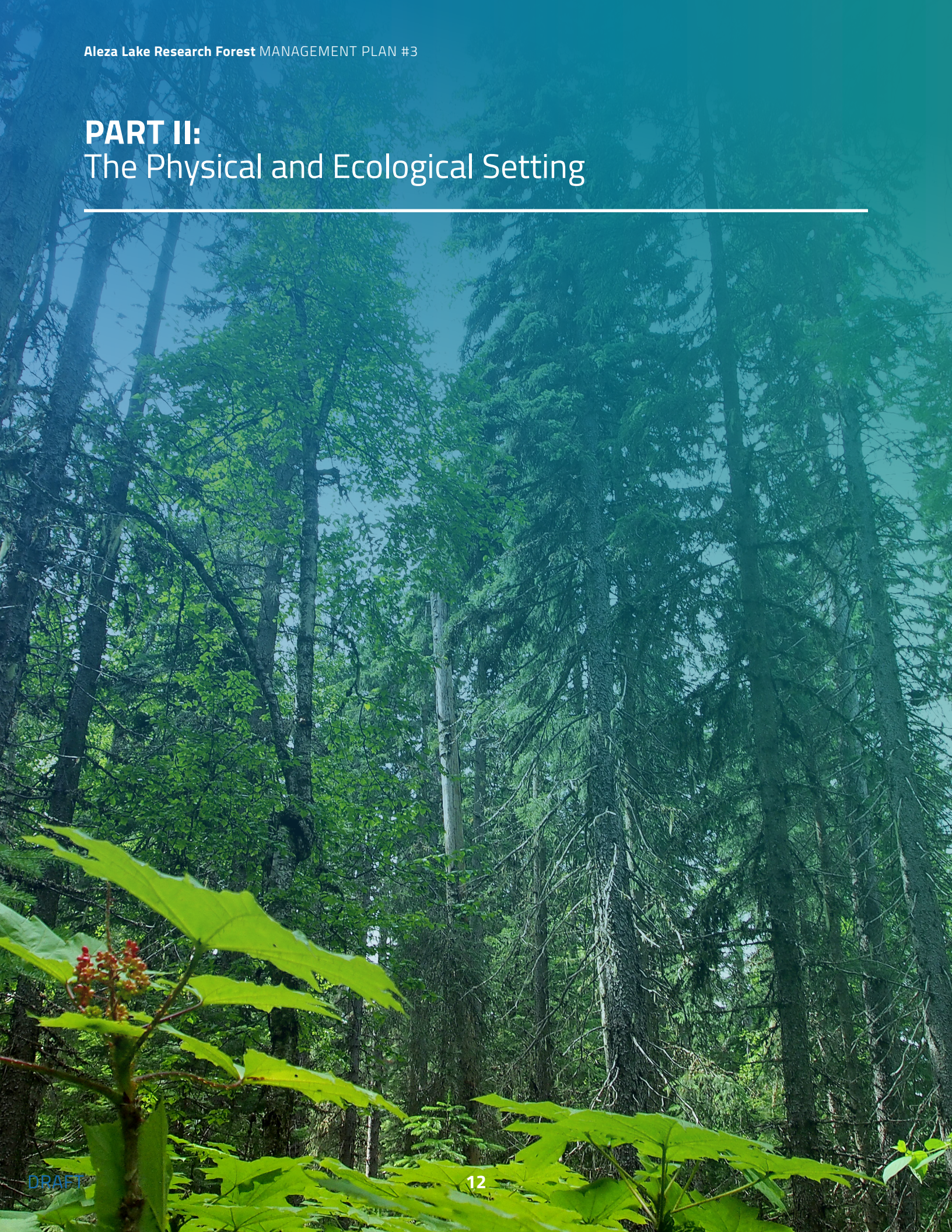
I. Forest education and research

1. To promote and support forest and environmental research, education, and demonstration on the ALRF, at UNBC, within the region, provincially, and where applicable, nationally and globally.
2. To assist in fulfilling the educational and research needs of UNBC and its allied educational and research institutions.
3. To provide diverse outdoor experiential learning opportunities for young and mature students across many different disciplines and perspectives, ranging from basic and applied sciences to the ecological, social, cultural, and economic dimensions of forest management.
4. To foster professional and practitioner innovation in forest and environmental management strategies and practices, through extension, demonstration, and practical field training.

II. Forest stewardship and management

5. To maintain forest landscape biodiversity at a range of spatial scales, a full range of early to late seral (young to old) forest conditions, and habitat connectivity within the ALRF area.
6. To protect and conserve unmanaged natural forest areas and habitats within identified areas, across a wide range of ecosystem types and conditions in the ALRF, for many values, including future research and education.
7. To grow and manage forests, and harvest timber products on a sustainable basis within the identified timber-management land base, using combinations of silvicultural systems, harvest methods, reforestation objectives, stand-structure retention patterns, and access strategies, that are compatible with, and conducive to, other management goals. And,
8. To maintain adequate flow of revenues from ALRF activities and operations that will provide resources for supporting all of the above goals on an ongoing basis.

PART II:
The Physical and Ecological Setting



4. ALRF PHYSICAL GEOGRAPHY & ECOLOGY

4.1 Climate

The Aleza Lake Research Forest is located in the Willow River Wet Cool Sub-boreal Spruce (SBSwk1) biogeoclimatic zone (DeLong, 2003). The SBSwk1 is characterized by cold, snowy winters, moist cool summers, and moderately heavy snowpack accumulations in the winter months. The continental nature of the climate is also influenced by relatively mild and moist Pacific air masses. Some ALRF ecosystems show floristic similarities and ecological characteristics transitional to the nearby Interior Cedar-Hemlock biogeoclimatic zone (i.e. – the Wet Trench Very Wet Cool ICHvk2 subzone).

The ALRF lies on the eastern edge of the Central Interior plateau, within 20km of the McGregor Range and the western slopes of the Rocky Mountains. It is likewise just 10km north of the northern Cariboo (or Columbia) Mountains. Due to its windward proximity to these mountain ranges, the ALRF receives substantially higher levels of both rainfall and snowfall compared to more central areas of the plateau. For example, the ALRF receives about 45 to 50% greater rain and snow than Prince George BC, on average.

A comparison of historical climatic normals for the ALRF and Prince George weather stations are provided in Table 1. These data, of course, describe averages of past climatic conditions to date for these two locations. Additionally, a report by Foord (2016) provides information and data on broader regional climatic patterns and trends for the Omineca and other BC northern forest regions, as well as climatic projections for these regions under the influence of anthropogenic climate change.

Table 1: Comparison of Historical Climate Normals: Prince George and Aleza Lake BC

Parameter	PG(A)*	ALRF AES**	ALRF A1 ***
Precipitation (Rainfall and Snowfall)			
Mean Annual Precipitation (mm)	615.	895.	**Data Not Available**
Mean Annual Rainfall (mm)	415.	556.	
Mean Annual Snowfall (cm)	234.	343.	
Maximum 1-Day Precipitation (mm)	38.9	57.2	
Maximum 1-Day Rainfall (mm)	38.9	55.9	
Maximum 1-Day Snowfall (cm)	30.8	49.3	

Parameter	PG(A)*	ALRF AES**	ALRF A1 ***
Temperature Regime			
Mean Annual Temperature (C°)	3.7	3.1	4.0
Extreme Coldest Temperature (C°)	- 50.0	- 46.7	- 40.9
Extreme Hottest Temperature (C°)	36.0	36.0	34.1
Mean Annual Days with Minimum Temp. > 0 degrees C (at screen height 1.5 m)	179.	156.	167.
Mean Growing Degree Days > 5 C	1284.	1173.	1232.

* Prince George "A" Station, AES, 1970 to 2000 ** Aleza Lake AES, 1952 to 1980 *** Aleza Lake A1 Climate Station, 1993-2016

4.2 Geology, landforms, and soils

4.2.1 Physiography

The ALRF is situated on the McGregor Plateau of the Fraser Basin in the Interior Plateau physiographic region, within the Nechako Plain portion of the Interior Plateau (Holland, 1976). The Interior Plateau is generally typified by undulating to moderately rolling and hilly terrain.

4.2.2 Bedrock Geology

Bedrock geology within the ALRF consists predominantly of rock strata from the Wolverine Metamorphic Complex and Wolverine Range Plutonic Suite (Struik 1989, Struik and Fuller 1988). These generally igneous rocks are granodioritic plutons, rhyolites, and granites. Smaller amounts of pillow basalts, breccia, phyllite, and minor micritic limestone may potentially outcrop in parts of the study area (Struik et al. 1990).

Recent geological mapping from GeoScience BC (2009) indicates that two main intrusive igneous bedrock types occur in the vicinity of the ALRF. These are granodiorites of Cretaceous to Tertiary origin, and quartz monzodiorites of early Tertiary origin. These bedrock types are often overlain by deep Quaternary deposits of glacio-lacustrine (post-glacial lake-bottom) sediments, glaciofluvial sands, and some areas of till and glacial drift.

4.2.3 Holocene (post-glacial) history and resultant landforms

The predominant landforms in the ALRF area are glaciolacustrine or fluvial in origin, dating from the post-glacial melt period, approximately 9,000 to 10,000 years before present. Regional studies of surficial geology indicate that the relatively low-lying Upper Fraser basin including the present-day ALRF was occupied by a large glacial lake basin (or a series of lake basins) during the late glacial period (Tipper 1971a). Higher bedrock outcrops on the ALRF were islands in this large lake. Prevailing evidence suggests that lake levels remained stationary for periods of time, creating beaches and shoals composed

Forest vegetation growing over fractured bedrock and colluvial veneer soils near the West Bear Road, ALRF

of rounded sands, gravel and stone deposits in some areas of the ALRF. These include old lakeshore deposits found in the central, southern, and eastern portions of the ALRF at elevations between 685 to 710 metres ASL (Oikos, 1994).

When the post-glacial lake(s) drained (often in abrupt drainage events as glacial ice dams shifted or gave way), rapidly-outflowing lake waters incised and eroded the lake-bottom sediments of the draining glacial lake, establishing drainage patterns in the newly-exposed land surface. Numerous ravines have been cut by natural erosional processes over millenia into the soft glaciolacustrine sediments. The elevation and location of underlying bedrock formations between the elevations of 680 to 750 metres a.s.l ultimately controlled the depth of erosional processes, and determined the location of a major watershed divide on the ALRF between the Hansard Creek watershed to the north, and the Bowron River watershed to the south.

During the post-glacial period and up to the present, the Bowron River cut down into glaciofluvial deposits along the southern boundary of the ALRF, and also formed new fluvial deposits. The Bowron River also contributes new sediments

deposited from its upper watershed, and has created a broad and very active floodplain with highly mobile stream channels and a complex micro-topography produced by ongoing lateral cutting and overbank deposition. The variable Bowron floodplain landscape is composed of floodplain deposits formed at different heights above the river, influenced and modified by ongoing alluvial processes. These create many sand and gravel bars at various successional stages, and extensive wetlands in old oxbows, back-channels, and inter-levee depressions, and provide rich and varied wildlife and aquatic habitats.

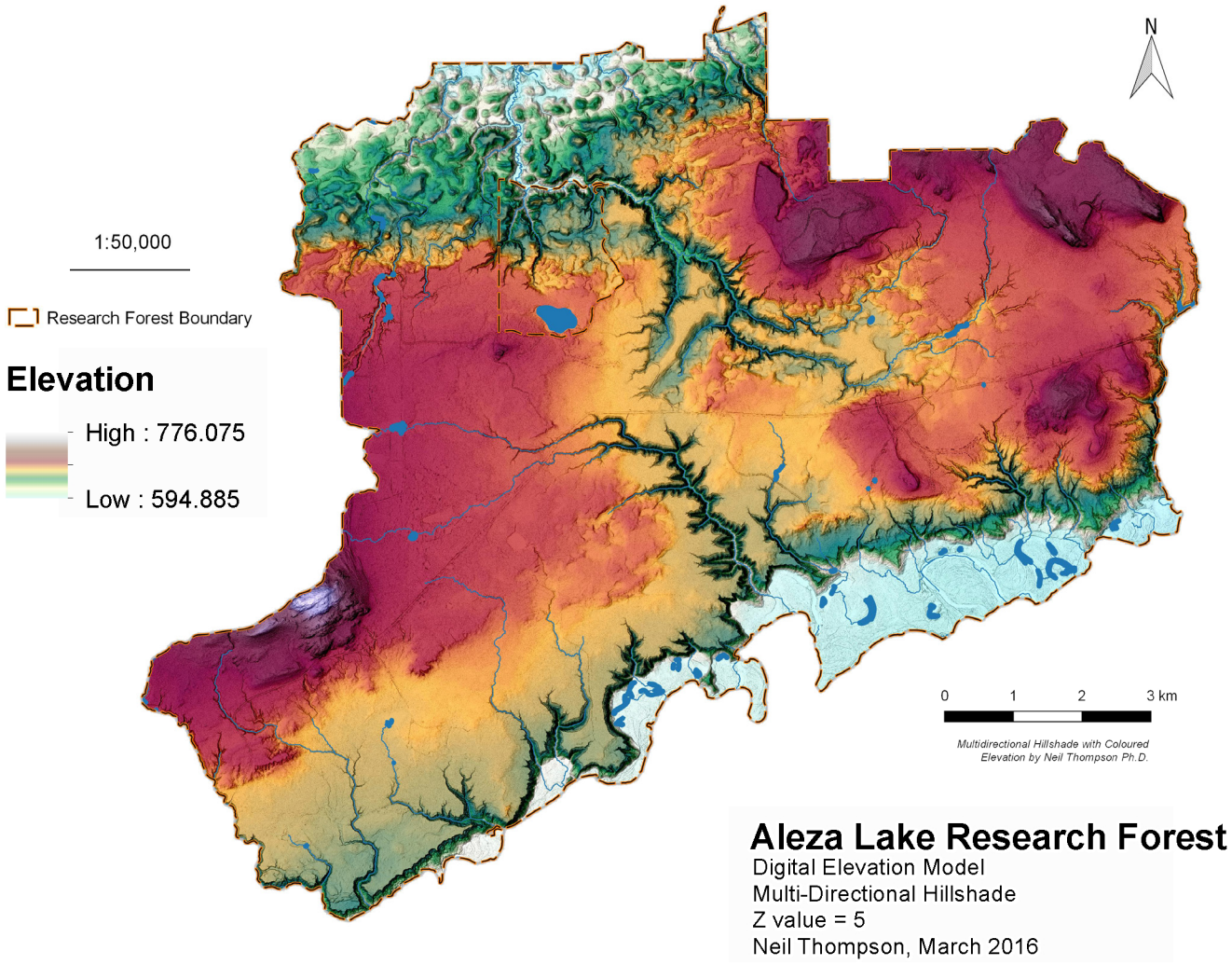


Figure 2: Digital elevation model for the Aleza Lake Research Forest

Digital elevation model for the Aleza Lake Research Forest and environs, highlighting elevational zones and landforms based on 2015 LiDAR imagery (courtesy of Dr. Neil Thompson, UNBC). Elevations are noted in metres above sea level (a.s.l.).

4.2.4 Landslide and mass-movement processes

The process of gradual natural erosion into the deep, fine-textured glaciolacustrine (lake-bottom) sediments accumulated in the post-glacial period in the upper Fraser Basin, and incising of deep, dendritic ravine systems, continues to this day. Despite thick forest cover within many drainage systems, mass movements including rotational failures and localized slipping / slumping of sediments do periodically occur in gullied ALRF areas with fine-textured sediments, steep ravine side-walls, and heavy seasonal run-off.

The proximity of such sensitive features and geomorphic processes, frequently near or to adjacent to high riparian, aquatic, and fisheries values in associated streams, makes the careful management of ravines and other area sensitive slopes a high priority for management activities within the ALRF landbase.

4.2.5 Soils and soil types

Across the rolling upland and plateau portions of the ALRF, finer-textured silt, clay, and sandy soils predominate, with some organic soils interpersed. Silty-clay lacustrine soils are most common; these soil types are mainly luvisols, including Podzolic Gray luvisols in relatively well drained areas, and Gleyed Orthic Gray luvisols in more poorly-drained, level areas with higher clay content (Dawson 1989). On sandy soils, brunisols, and occasionally, podzols, are typical soil types and can provide some of the most productive sites in the ALRF. Moderate 10 to 100 cm layers or "caps" of loamy sands occurring over fine-textured glaciolacustrine deposits are more common than deeper sand deposits. Organic soils are not uncommon in the ALRF, and form in level to depressional landscape positions with impeded drainage.

On the bedrock outcrops in the study area, soils are generally derived from bedrock weathering, fracturing, and colluvial processes, and tend to be thinner, with high coarse fragment content.

In valley bottoms and ravines with active streams, soils are generally water-deposited (fluvial) sands and silts of recent origin. On such sites and on the floodplain of the Bowron River, younger regosolic soils predominate. Organic soils and gleysols are common in wetland areas of the floodplain with high water tables.

4.3 Forests and related vegetation

The ALRF includes rolling hills, gentle plateau, river floodplain, bedrock outcrops, and a range of terrain and forest types. These include forests of upland sub-boreal hybrid white spruce *(P. glauca x engelmannii)* and subalpine fir *(Abies lasiocarpa)*, deciduous and mixedwood forests, black spruce, and forested and non-forested wetland and semi-wetland plant communities. Other conifers occurring sporadically include Douglas-fir *(Pseudotsuga menziesii)*, western hemlock *(Tsuga heterophylla)*, and lodgepole pine *(Pinus contorta var. latifolia)*. Common deciduous tree species include paper birch *(Betula papyrifera)*, trembling aspen *(Populus tremuloides)*, and black cottonwood *(Populus trichocarpa)*.

On upland sites, mature and old-growth stands in the ALRF are typically dominated by mature mixed stands of hybrid white spruce and subalpine fir, with paper birch occurring as a minor component. At the ALRF, scattered mature and immature individuals and groups of Douglas-fir also occur on drier upland sites, ridges, and interestingly, commonly on some raised sites close to wetland margins.

Mature spruce-subalpine fir stands at the ALRF are generally two-aged to multi-aged. Within the ALRF, the lifespan of the

A large hybrid white spruce (*Picea glauca* X *engelmannii*) dominates the upper canopy of an older ALRF stand

spruce is commonly 150 to 200 years of age, while the more numerous but shorter-lived subalpine fir (also sometimes referred to as 'balsam') is generally 100 to 160 years at maturity. Douglas-fir veterans scattered through the forest reach three to four centuries in age, ALRF staff have documented Douglas-fir that are 375 to 400 years of age.

On sites within the Bowron River floodplain in the south of the research forest, seasonal floods and associated erosional and depositional processes tend to drive the natural disturbance and distribution of floodplain landscapes. The Bowron floodplain is a complex mosaic of alluvial sites, stands, and habitats, including old river channels, alluvial wetlands, raised terraces, and gravel and sand-bars at many different ages and stages of succession. Black cottonwood is a large iconic and common seral tree species on the alluvial floodplains of the Bowron River. Areas of later-successional spruce on raised floodplain sites tend to be extensively interlaced with deciduous, mixedwood, shrub, and wetland communities. These are rich and diverse wildlife and plant habitats.

The climate of the ALRF and surrounding McGregor Plateau is generally substantially cooler and wetter than the drier Central Interior plateau to the west. In BC's drier western Interior plateau, large stand-replacing fires and even-aged lodgepole pine forests predominate. However, in the valleys and plateau of east-central BC typical of the ALRF, fire tends to be comparatively rare. Natural disturbances in these wetbelt forests are influenced far more by gap and small-patch disturbance dynamics, with bark beetles, tree falls, and stem rots being the main drivers of spruce-balsam stand development Lewis and Lindgren, 1999, Lewis and Lindgren, 2002, Newbery et al, 2007). Such spruce-balsam stand dynamics result in variable stand structure with a wide range of tree sizes. After gap or overstory mortality, the younger co-dominant and smaller tree layers of spruce and subalpine fir (or secondary structure) respond positively to overstory mortality and gaps through growth release (Zhanga et al, 1999).

Despite the moist to wet climate of the ALRF, there is evidence of rare but significant historical wildfires on the ALRF and in the surrounding area, with an estimated average fire return interval of perhaps 300 years or more at the stand level. The presence of old fire-seral lodgepole pine snags, scattered mature live pines in some stands, and the occasional occurrence

Large Douglas fir on a dry hilltop site at the ALRF

The lower Bowron River along the ALRF's southern boundary

of charcoal in the upper soil horizons of these sites provide evidence of past natural forest fires within the ALRF landbase. Lightning strikes and small fires are sometimes observed on the ALRF during summer convective storms. For example, a recent small lightning-caused wildfire occurred in the east-central ALRF in May 2010. In addition, a number of lightening-scarred trees have been observed over the years on other ALRF locations as well.

A variety of seral stages from early seral to old-growth forests are represented within the ALRF landscape. Younger seral stages on upland sites tend to dominantly influenced by historical forest harvesting and silvicultural practices. Younger natural fire-origin stands occur, but have been historically relatively rare within the ALRF.

In burned areas or clearcut areas, trembling aspen, cottonwood, and paper birch establish as vigorous natural regeneration, and form a minor component of the resultant seral stands. These tree species are occasionally present as scattered individual trees in older upland stands > 140 years of age. Similarly, lodgepole pine does naturally occur on sporadic upland sites within the ALRF. Pine has been historically planted on a number of harvested upland sites at the ALRF.

Naturally-occurring black spruce *(Picea mariana)* and lodgepole pine are generally confined to areas of restricted drainage and peaty soils where heavy clay soils, depressional locations, and perched water tables and organic deposits restrict the establishment of other tree species. However, black spruce does grow to sizes similar to hybrid white spruce in upland areas on well-drained soils near wetland margins.

Western hemlock *(Tsuga heterophylla)* in most ALRF forest types usually occurs as scattered individuals throughout upland coniferous types, although usually as smaller saplings, poles, and low co-dominant trees. On some elevated sites in the ALRF, it does form leading stands of mature hemlock mixed with minor other tree species.

Western redcedar *(Thuja plicata)* naturally occurs rarely in several very localized areas on the Aleza Lake Research Forest, primarily in the south half of the research forest closer to the ICHvk2 subzone. Plantings of cedar at the ALRF have experienced fair to moderate success on the right sites at the ALRF to date.

(LEFT) Skunk cabbage (*Lysichiton americanus*) (CENTER) Amanita mushroom (*Amanita muscaria*) (TOP RIGHT) Lady fern *(Athyrium filix-femina)* fronds (BOTTOM RIGHT) Devil's Club (*Oplopanax horridus*) on an ALRF seepage site

Introduced (planted) BC tree species within the ALRF (often in research trials or operational planting trials) include tamarack *(Larix laricina)*, planted on sites within the ALRF similar to those where black spruce occurs, western white pine *(Pinus monticola),* and western larch *(Larix occidentalis).*

The occurrence and distribution of understory plants vary with ecological conditions and seral stage on the ALRF. A preliminary plant species list for the ALRF adapted from Oikos (1995) and related sources is provided in Appendix B1. Recent research by Botting and Fredeen (2005) and Campbell and Fredeen (2005) has also produced a preliminary list of epiphytic plants (lichens, liverworts and bryophytes) that occur on the ALRF. The ecology of two species of a sundew (*Drosera* spp.), a notable bog-dwelling insectivorous plant endemic to the ALRF has been described by Jones et al (2015).

Provincial sources also provide lists of plant species at risk in the Prince George area (BC Conservation Data Centre (CDC), 2013 in Appendix B4). This list comprises species whose range may overlap with the ALRF but whose presence in the Research Forest is not confirmed.

4.4 Hydrology and watercourses

The ALRF is located in the upper Fraser River watershed. Natural drainage patterns on the ALRF are divided by a height-of-land running roughly east-west across the middle of the Forest. In 2017, a LiDAR-derived digital elevation model was used to systematically map the watershed drainage basins within in the ALRF tenure area, based on landscape morphology and terrain (Appendix A1).

As seen in Appendix A1, the northern half of the ALRF drains in a generally northeasterly direction, into the watershed of Aleza and Hansard Lake and tributaries, while the southern drainage basins in the Research Forest flow southward into the Bowron River. Most small creeks and sub-basins within the ALRF (other than Hansard and Slaney Creeks) lack legally-gazetted names.

Hansard Creek (also known locally as Camp Creek) flows into Aleza Lake north of the Research Forest. Hansard Creek is the largest single watershed and year-round stream within the Research Forest. With the exception of Slaney Creek, most streams and drainages in the north half of the ALRF are tributary to the main stem of Hansard Creek. Two sizable lakes and numerous small swamps and wetlands feed Hansard Creek, including the 12 hectare Loup Lake (DWB Consulting Services Ltd, 2006a) in Ecological Reserve #84, and a similar-sized large lake (locally known as Tricks Lake) in the upper Hansard watershed on the northeastern perimeter of the Research Forest. The main stem of Hansard Creek has a well-developed floodplain, especially in its lower reaches, and has substantial fish populations especially rainbow trout (DWB Consulting Services Ltd, 2006b). Juvenile chinook salmon have been captured and observed in Hansard Creek reaches within the central ALRF (Environmental Dynamics, 2002, DWB Consulting Services Ltd, 2006), indicating this stream is also used by chinook as rearing habitat.

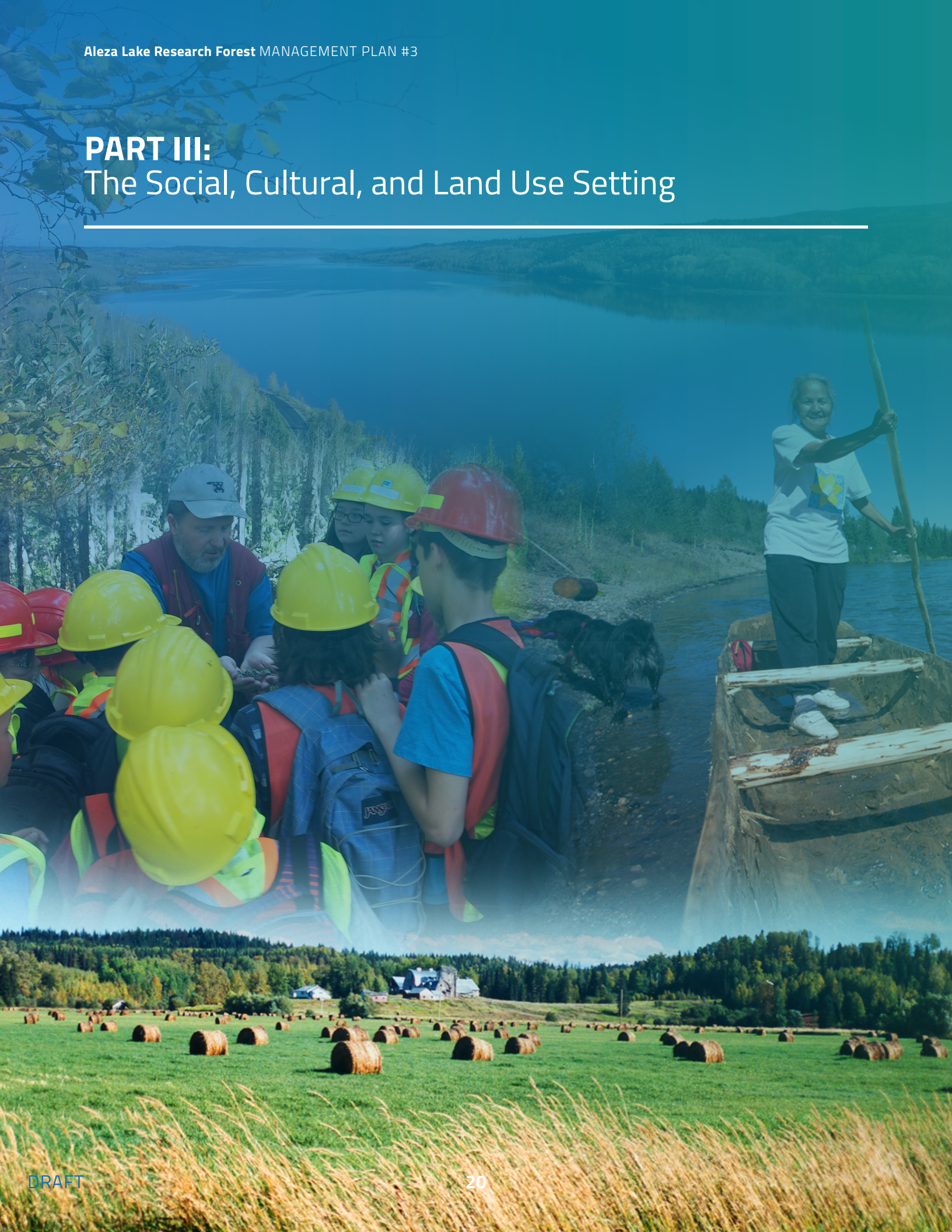
Bowron River and floodplain black cottonwood stand within the ALRF

Slaney Creek is a small perennial stream flowing through the north central part of the Research Forest and directly into Aleza Lake near the old Ranger Station site. Flow in this creek is modest due to the relatively small watershed area, but provides cooler stream temperatures due to inputs from underground springs (Kanester, 2016). Slaney Creek provides habitat for a documented small resident population of rainbow trout (Environmental Dynamics, 2002).

The southern boundary of the ALRF encompasses approximately 10 to 12 linear kilometres of the Bowron River and associated floodplain. A Water Survey of Canada gauging station along the Bowron River in the southwestern portion of the Research Forest has a continuous year-round record of river flows since 1977.

Numerous streams traverse ravines in the southern half of the ALRF, and are tributary to the Bowron River. Many are important fish habitat, especially in their lower reaches closer to the Bowron floodplain. These streams are fed by the numerous bogs, swamps, wetlands, and some springs found throughout this drainage area. Other than beaver ponds, no significant perennial lakes are found within these southern ALRF sub-basins. Numerous other smaller, primarily ephemeral drainages also dissect the area. Of these, two of the most substantial are “Boundary Creek” (local ALRF name), which forms the southeastern boundary of the Research Forest, and “Central Ravine Creek” (local name), which drains the plateau in the west-central portion of the Research Forest. Boundary Creek in particular is known to have significant fish populations (DWB Consulting Services Ltd, 2006).

PART III:
The Social, Cultural, and Land Use Setting



5. LHEIDLI T'ENNEH NATION

The ALRF area is located within the traditional aboriginal (indigenous) territory of the Lheidli T'enneh Nation. The Lheidli T'enneh are affiliated with the Carrier aboriginal peoples of the north central Interior of what is now British Columbia. The Carrier refer to themselves as Dakelh ("those who travel by boat" or "on-water traveler"), and as Dene or Dune ("people").

The word Lheidli means "where the rivers flow together", and T'enneh means "the people".

Lheidli T'enneh communities, both near Prince George, BC, include Khast'an Lhughel - North and South Shelley IR #2 – on the Fraser River, and Lhezbaonichek – Clesbaoneecheck IR #3 – on the Nechako River. Additional reserve lands include Ts'unk'ut – Lheidli T'enneh Cemetery IR #1A, and Dzulhyazchun Tsalakoh – Salaquo IR #4.

The Lheidli T'enneh territory is unceded. No treaty currently exists between Lheidli T'enneh, British Columbia, and Canadian governments.

The draft Lheidli T'enneh Land Use Plan (2017) provides some information on the traditional territory and land use of this people. It is excerpted in part, here:

"The Lheidli T'enneh Traditional Territory extends eastward to the Rocky Mountains, westward to Cluculz Lake, northward to Summit Lake and southward to Hixon. Prior to first contact, and through the fur trade era to the turn of the 20th century, the Lheidli T'enneh were composed of distinct villages and family groups who lived at seasonal camps associated with various activities on the Nechako and Fraser Rivers and throughout their traditional territories. These groups shared a distinct dialect and ties of marriage and kinship, they united for seasonal tasks particularly related to the usually abundant annual salmon runs.

Land and resource knowledge was critical to the traditional Lheidli T'enneh way of life which incorporated use of the entire territory in a 'seasonal round' of activities. These movements varied from year to year but involved returning to key sites in the summer for salmon and fish, the mountains for hunting in the fall, and fishing on the lakes in spring. Varying resource locations or campsites were used depending on shifts in caribou movements, cycles in rabbit populations, or changes in water levels..."

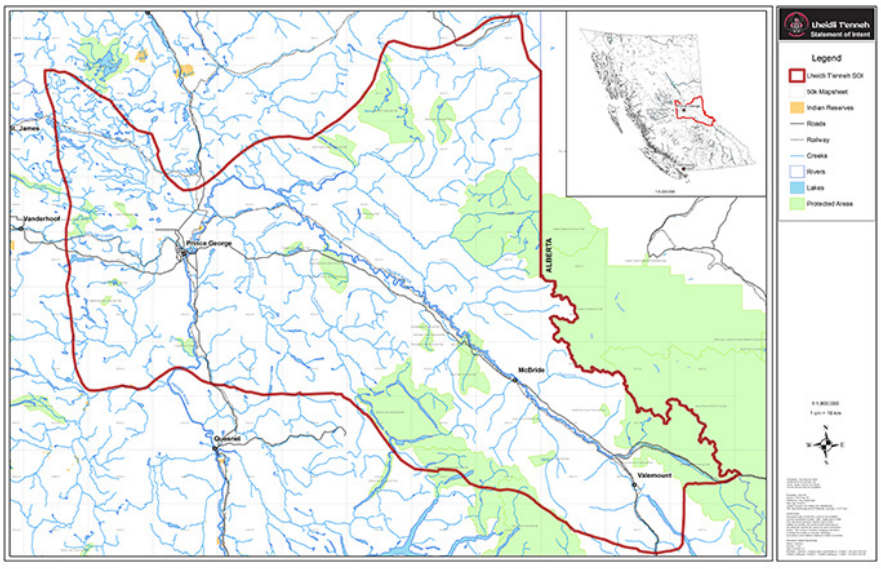
Lheidli T'enneh Chief Dominic Frederick, elders, and councillors and UNBC representatives celebrate the new UNBC campus sign in the Dakelh language in September 2016 (Photo: UNBC Communications)

Lheidli T'enneh Elder and UNBC Instructor Edie Frederick testing out the first cottonwood dugout canoe to be launched from Lheidli T'enneh territory in more than 60 years. (Photo: UNBC Communications)

The upper Fraser River area, including the lower Bowron River, was historically, and is currently used by the Lheidli T'enneh for access to fisheries and travel routes, especially in tributary rivers. The valley between the Willow and Fraser Rivers traversed by the current Upper Fraser Road and the Canadian National (CN) Railway is an ancient river channel now occupied in part by Eaglet, Aleza, and Hansard Lakes. This is a well-known part of the traditional territory of the local Indigenous people who have utilized it for hunting and gathering activities (Sedgewick, 2008).

The BC Register of Geographic Names (accessed Feb, 4th, 2017) indicates that the Dakelh name for the water body known as "Aleza" Lake is *Tatsibun*, meaning "waves lake" in English (Yinka Déné Language Institute, accessed Jan. 2018 http://www.ydli.org/dakinfo/DakelhPlacenames.html). The Register reports that Aleza Lake (referring to both the lake, and the village and original post office established around 1913) was named after an old aboriginal woman who lived in the area. Other historical accounts indicate that that this local woman liked to fish in this area. (As a point of historical reference, the railway, then named the Grand Trunk Pacific and now CN Rail, was not completed through this area until 1913 (Sedgewick, 2010)).

Figure 3: Lheidli T'enneh traditional territory



Traditional use studies by the Lheidli T'enneh within their territory are commencing or in progress at time of writing of this plan, and future disclosure of any such knowledge, if it occurs, will be at their discretion.

An archaeological overview assessment (AOA) report on the ALRF area was commissioned by the Aleza Lake Research Forest Society in 2008, and undertaking by Normand Canuel (Norcan Consulting Ltd, 2008). The AOA report indicated a potential historical aboriginal trail route

through the lower Bowron River corridor linking the Upper Fraser River with the Willow River watershed. The AOA indicated that no archaeological sites are currently known on the ALRF, though the Norcan predictive model suggested there are sites with High archaeological potential along the Bowron River and around the lake in the southern portion of in Ecological Reserve #84 (known locally in old ALRF records and maps as Loup Lake).

No detailed archaeological surveys are known to have been undertaken on the ALRF area.

The ALRF Society recognizes that it has limited and incomplete knowledge of Lheidli T'enneh traditional and current use in the area in, and adjacent to, what is now known as the Aleza Lake Research Forest.

The Aleza Lake Research Forest Society will communicate and work with the Lheidli T'enneh community to better understand and protect their community's values, interests, and important sites and resources in this area, and work towards collaborative endeavors of mutual interest.

6. LOCAL LAND USE AND ADJACENT VALUES

6.1 Local Communities

Electoral Area F of the Fraser-Fort George Regional District (Willow River-Upper Fraser) has a total resident population of 1,246 people, according to the 2016 census. Local unincorporated rural communities in the ALRF area include Shelley, Ferndale, Willow River, Giscome, Newlands, Aleza Lake, Upper Fraser, Sinclair Mills, and Longworth.

According to the 2016 census, the largest city in the region is Prince George, BC with 74,003 residents. The Regional District as a whole has a population of about 94,419 residents in the same period.

Between the 2011 and 2016 censuses, population growth in all of the above areas has averaged about 3%.

6.2 Provincial highway access

The Aleza Lake Research Forest is accessed via the paved Upper Fraser Road, which is part of the provincial highway system, with links to the west to Highway 16 East. Various tributary and secondary forest and resource roads (both status and non-status roads) provide local access to lands adjacent to the Upper Fraser Road.

A community-history tour group visits the village of Willow River and the well-known General Store (2009)

6.3 Public use of Crown land

The Aleza Lake Research Forest is "Crown" land (i.e. - publicly-held land managed by the Province of BC), and is therefore the public has a legal right enter into, and travel on the research forest. The public can also collect and use a variety of non-timber forest products on the ALRF, subject to the rights of other licensed users, and permits and regulatory requirements defined by the Crown (Province of BC). Usually, public uses are seasonal, depending on the foods and materials being gathered.

Licensed Crown tenures are discussed in the next section of this management plan.

Aside from such licensed uses, common public uses of the ALRF forest lands other than forest education and research include:

1. Forest recreation, such as hiking on ALRF trails, winter snowmobiling on ALRF roads, and nature appreciation.
2. Bear hunting (in Spring) and grouse and moose, elk, and deer hunting (in Fall) subject to BC Hunting Regulations and hunting licenses.
3. Berry- and mushroom-picking in late summer and Fall, including blueberry and huckleberry picking. (Commercial picking would require a license).
4. Cutting of dead and dry firewood for local home heating use (as per the *BC Forest Act* and regulations).

Other than the Bowron River, which has limited accessibility, sport fishing tends to be uncommon within the ALRF, However, ALRF streams do provide important fish habitat (including spawning and rearing habitat) for adjacent lakes and rivers outside the area.

6.4 Wildland Urban Interface (WUI)

The influence or threat of wildland fire risks to local communities and settlements (and vice versa) has been of increasing concern in recent years (Filmon, 2003, Morrow et al, 2013). Correspondingly, measures to define, assess, and manage the interface areas and ecosystems between these two land uses have gained increasing attention.

The Union of BC Municipalities' (UBCM) Strategic Wildfire Threat Assessment Program (2018) defines Wildland Urban Interface (WUI) as any area where combustible wildland fuels (vegetation) are found adjacent to homes, farm structures, other outbuildings or infrastructure. This may occur in the interface where development and fuels meet at a well-defined boundary or the "intermix", where development and fuels intermingle and have no clearly defined boundary.

In B.C. the WUI is generally defined by UBCM as the area within 2 kilometers of a community with a minimum density of 6 structures per square kilometer. Fire hazard, fuel mitigation planning and FireSmart activities will be focused primarily within the WUI, consistent with fire behaviour principles.

At the time of preparation and submission of this plan for provincial approval:

- WU interface definition and practices are not currently defined by legislation or regulation, and are in the non-legal realm of 'best management practices'. And,
- No WUI threat assessment or strategy has been prepared by the Regional District of Fraser-Fort George, or local government in the areas within or adjacent to the Aleza Lake Research Forest, or adjacent communities like the village of Aleza Lake BC, and buildings.

Further sections of this Management Plan will consider and address specific aspects of wildfire preparedness, woody fuel management, and fire hazard abatement, both in general as they relate to forest practices on the ALRF tenured landbase, and with consideration to potential interface areas and nearby structures.

7. LICENSED CROWN TENURES AND LAND USE DESIGNATIONS

The following section summarizes license crown tenures and land use designations other than those held by the Aleza Lake Research Forest Society. The latter are reviewed in Section 8.

7.1 Licensed Trappers

Three licensed trapline areas (Licenses # 707T004, 707T006, and 707T007) are found within the ALRF (as per Figure 4). The trapline license holders have the rights authorized by the Province to trap specified fur-bearing mammals under the the BC Trapping Regulation. The legal license holders for some trapline licenses may sub-let or delegate trapping activities on these tenure areas to other individuals from time to time.

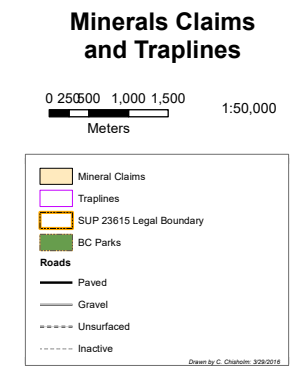
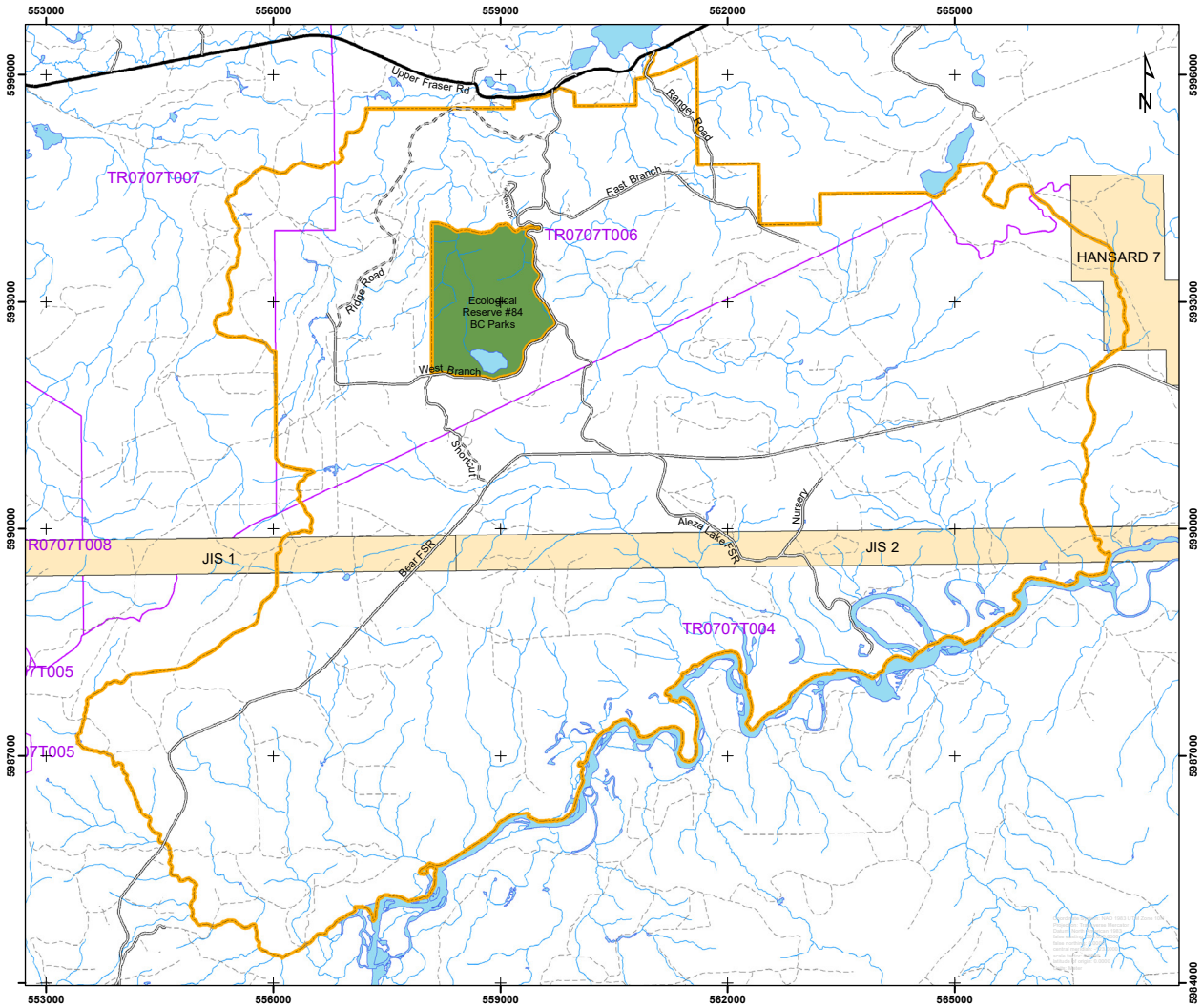


Figure 4: Trapline License Boundaries and Mineral Claims

Provincial mineral claims and trapline licenses in and around the ALRF tenure area as of 2017



Local guide-outfitter Scott Pichette takes UNBC students on an boat trip down the Bowron River within the ALRF, as part of an annual UNBC Natural Resource Management field course

7.2 Licensed Guide-Outfitter

The license area of a licensed guide-outfitter (License # 707G001, certificate 700617) encompasses the Aleza Lake Research Forest area, and includes the much larger surrounding Wildlife Management Sub-unit 7-24. The guide-outfitter currently operates a Commercial Hunting Camp (via License of Occupation) on the Bowron River within the ALRF tenure area.

7.3 Ecological Reserve #84

Ecological Reserve #84 (ER 84, the Aleza Lake Ecological Reserve) is a 269 hectare area designated under the *Ecological Reserves Act*, and is managed by BC Parks. This ecological reserve was established by the Province in 1978.

ER 84 is surrounded by, but is not part of the Special Use Permit 23615 for the ALRF (Figure 5).

As described by Ecological Reserve 84 Purpose Statement (BC Parks, 2003), ER 84 protects forest ecosystems representative of a wet cool region of the Sub-boreal Spruce biogeoclimatic zone. ER 84 contributes to Protected Areas representation of the McGregor Plateau Ecosection, and is dominantly forested. It also contains a 12 hectare lake (locally known as Loup Lake) near the southern boundary, bogs and wet meadows.

BC Parks may issue Park Use Permits to the Aleza Lake Research Forest Society for educational and research activities within ER84 by the Society and associated researchers, consistent with the terms and conditions of the permit, as amended and replaced from time to time.

7.4 Mining Claims

As of February 2017, mining claims or leases within the ALRF include claim numbers 529665, 537516, and 53517 (Figure 4), issued to Graymont Western Canada, a lime production company. At time of writing of this plan, none of these claims are active.

7.5 Rock and Gravel Pits

The ALRF Society is permitted to extract rock and gravel from two pits at designated locations on the ALRF area, via an approved amendment to Special Use Permit 23615 issued by the Province, which specifies the conditions of the land use in this area, and aggregate use from this area. Material from these pits is only used on ALRF forest roads.

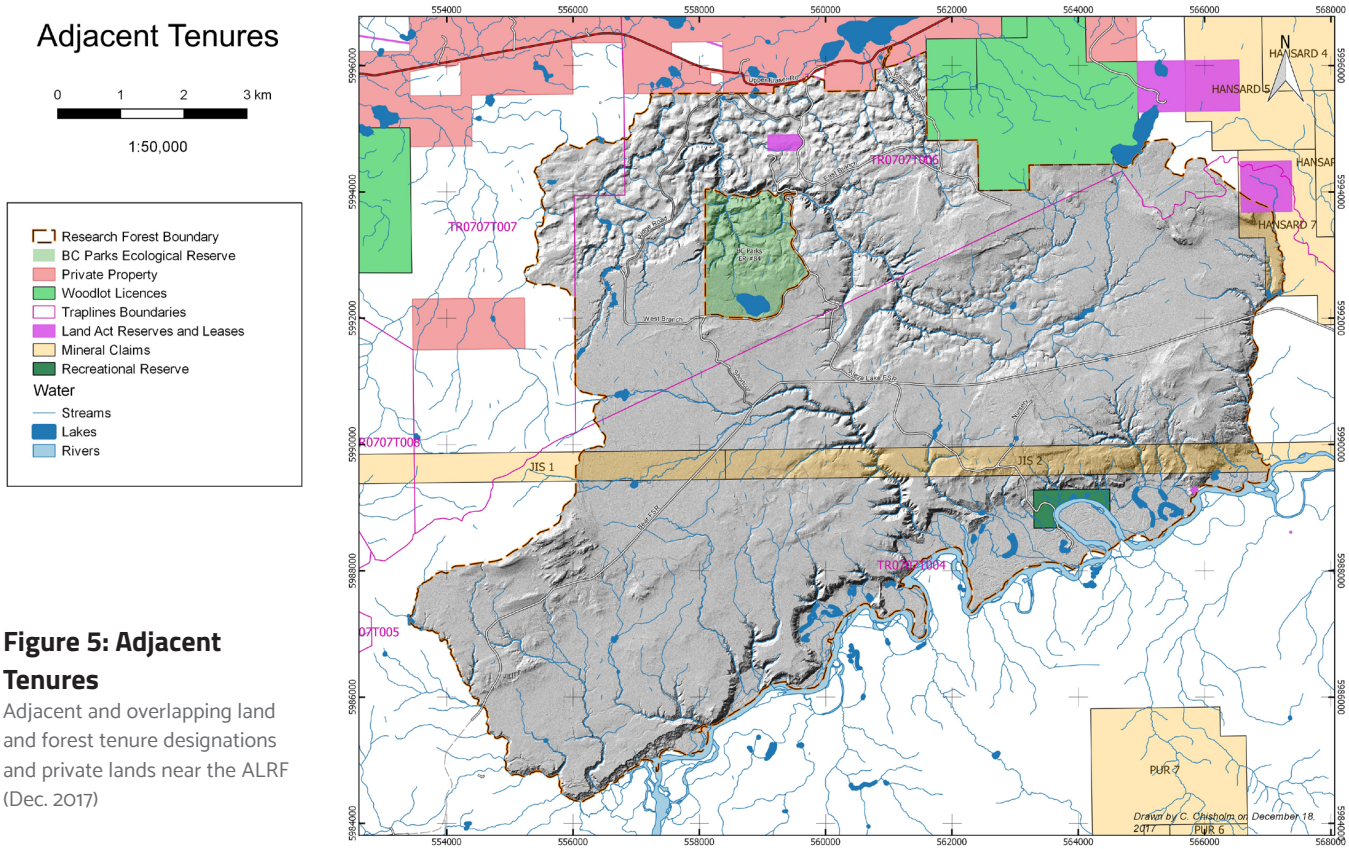


Figure 5: Adjacent Tenures
Adjacent and overlapping land and forest tenure designations and private lands near the ALRF (Dec. 2017)

7.6 Adjacent Forest Tenures

Lands and forest tenures adjacent to the Research Forest include private and Crown land lots along the northern boundary, and Woodlot License #269 adjacent to the northeastern boundary. Along this northern boundary, some private land has been cleared for agricultural use, mainly hay (dairy) production. Most other private land parcels along this boundary have been logged over the last 30 years. As of 2018, the south, west, and eastern forest lands outside of, but adjoining the Aleza Lake Research Forest are Crown Land are currently allocated to Canadian Forest Products Ltd. and BC Timber Sales Ltd. timber operating areas.

7.7 Forestry research sites identified by government

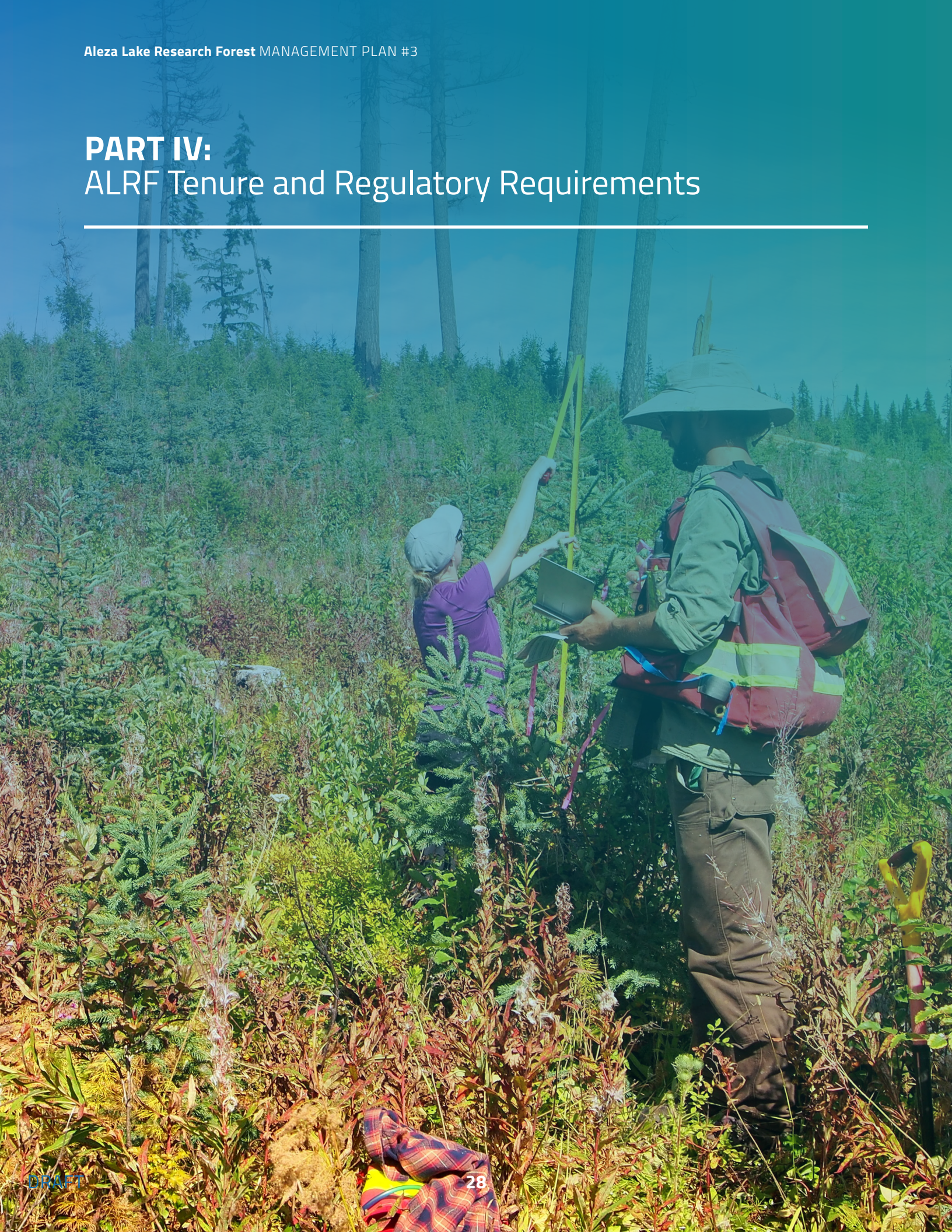
Several map reserves to protect Provincial research sites were designated on this area prior to the establishment of the Aleza Lake Research Forest under SUP 23615 in 2001. The location of the map reserves and geographical coordinates are recorded and managed within ALRF and provincial government databases. The ALRF will consider and manage such sites in a manner consistent with other research sites within the ALRF landbase.

7.8 Other potential land-use designations considered

Based on current information, the Aleza Lake Research Forest includes no known Provincial land-use designations or licenses for the following resource values:

- Range tenures.
- Natural range barriers.
- Ungulate winter range designated by the BC Ministry of Environment.
- Wildlife Habitat Areas approved by the BC Ministry of Environment.
- Temperature-sensitive watersheds.
- Community watersheds.
- Water licenses or intakes. and/or
- Recreational Areas.

PART IV:
ALRF Tenure and Regulatory Requirements



8. TENURE AND REGULATORY FRAMEWORK

8.1 ALRF regulatory overview

This section describes the legislative and regulatory framework of forest management tenure for the Aleza Lake Research Forest.

The legal basis for ALRF land and forest management is provided by 3 tenure instruments (permits and licenses) issued by the Province of British Columbia. These provide legal access to the ALRF land area and designated provincial forest roads for management activities, these tenures are the legal framework within which all ALRF forest land management activities must occur.

The nature and scope of these three ALRF tenure instruments are:

- Special Use Permit (SUP) 23615, which also enables this Management Plan.
- Occupant License to Cut L45514. And,
- Road Use Permit(s) for designated sections of provincial forest roads within the ALRF.

Current legislation and enabling regulations specific to the administration and management of these ALRF tenures include, but are not limited to:

a) The *Forest Practices Code of BC Act* and regulations, applying to administration and management of the Special Use Permit. As per SUP 23615, the ALRF tenure-holder is required to prepare a Management Plan with specified content requirements, and submit this Plan to the Province for approval.

b) The provincial *Forest Act*, applying to administration and management of the Occupant License to Cut as a minor tenure under the Act.

c) The *Forest and Range Practices Act* (FRPA) for administration and regulation of the Occupant License to Cut as a "minor tenure" under FRPA and the related *Forest Planning and Practices Regulation* (FPPR)*.

d) Other provincial legislation applicable to this Management Plan include but are not restricted to: the *Ecological Reserves Act*, the *Mining Act*, the *Wildlife Act*, the *Environmental Management Act*, the *Agricultural Land Commission Act*, and the *Wildfire Act*. Federal legislation includes the *Federal Fisheries Act,* and the *Migratory Birds Convention Act*.

The Province may, at its discretion, amend or replace legislation and regulations, or related permits and licenses, pertaining to the above.

** For greater clarity, it is noted that the FPPR applies to the ALRF tenure to the extent specifically provided for (and/or not excluded by) this regulation and as authorized under this Management Plan. Further, consistent with Special Use Permit 23615 and the administration of "minor tenures" under FRPA, the ALRF tenure holder is not required to prepare Forest Stewardship Plans.*

8.2 Special Use Permit

Special Use Permit (SUP 23615) issued by MFLNRORD describes the land area of the Aleza Lake Research Forest and the terms and conditions of the permit, and requires that the Research Forest be managed under the terms and conditions of a Management Plan approved by the District Manager.

The SUP authorizes the ALRFS to occupy and manage this area of Crown Land as per its terms and conditions, including:

a) Authorizing use of this area of Crown Land for research and educational purposes.
b) Mandating that the permittee (the ALRFS) prepare and submit a Management Plan for the Aleza Lake Research Forest, and specifying required content for the Plan.
c) Providing the general terms under which forest management and related research and education activities on the ALRF will be conducted. And
d) Allowing the building and operation of the Aleza Field Education Centre at a designated location within the permit area (as per SUP Addendum approved July, 2014).

8.3 License to Cut

Occupant License to Cut L45514 issued by the MFLNRORD, Prince George District, provides legal cutting authority for timber harvesting on behalf of the Aleza Lake Research Forest Society within the ALRF, within the scope of the Special Use Permit and the approved ALRF Management Plan, and an approved Allowable Annual Cut (or AAC).

8.4 Permits Related to Roads

A Road Use Permit (currently RUP-01-113-OT) issued by MFLNRORD, Prince George District authorizes the use and maintenance of several road sections designated in the Road Use Permit, by the Aleza Lake Research Forest Society. Specific terms and conditions are specified in this RUP, which are subject to amendment and replacement by the Province, from time to time, including via Road Permits (RP's).

Road sections currently permitted to the Aleza Lake Research Forest Society (via the RUP) as of 2017-18 include:

- The centrally-located Aleza Lake Forest Service Road (FSR 4311.01) which runs approximately north-south from Upper Fraser Road at Km 0 (junction with provincial highway) to its terminus at the Bowron River Oxbow (+/- Km 11), and,
- Several forest roads directly tributary to above FSR, as designated in the RUP, including designated sections of the East Branch, West Branch, and Beaver - Bear Roads within the ALRF.

Several permanent forest roads within the ALRF have their management and use authorized and delegated by the Province to the ALRF Society through Road Use Permits (West Branch Road, ALRF)

Please refer to ALRF road permit documents as updated from time to time for specific current descriptions of permitted road sections.

On the ALRF, in addition to roads permitted to the ALRF by the Province under Road Use Permits or Road Permits, the ALRF Society may construct other forest roads and access trails under the authority of Special Use Permit 23615. For roads constructed under SUP authority, the ALRF will report their location to the Province via updates to the provincial forest inventory.

Black bears are quite common in the ALRF and Upper Fraser region, often frequenting young forest and herbaceous areas to feed

8.5 Higher-level Direction and Guidance for ALRF Planning

8.5.1 Guidance on Landscape-level Biodiversity (Old Forest) Objectives

Higher-level guidance on landscape-level "old forest" management for the Aleza Lake Research Forest is provided by a memorandum issued by the Province (BC Integrated Land Management Bureau, 2009) entitled *"Guidance regarding the relationship between Landscape Level Biodiversity (old forest) Land Use Objectives and Research Forests in the Prince George Timber Supply Area"*.

ALRF landscape- and stand-level strategies for old-forest conservation and management under this Management Plan will be consistent with the above Guidance document, as detailed in the Landscape-level Strategies of this plan.

8.5.2 Direction from the Visual Quality Objectives Order

The *Order for the Establishment of Visual Quality Objectives* (VQO's) *for the Prince George Forest District*, established by the District Manager under the *Government Actions Regulation* (Dec. 7th, 2005) provides legal direction from the Province for management of Scenic Areas established under the regulation. ALRF forest operations will be consistent with the direction of the above VQO Order, as amended from time to time.

8.5.3 The Prince George Land and Resource Management Plan (LRMP)

The Prince George Land and Resource Management Plan (LRMP) is a non-statutory but significant guidance document for land use planning in the Prince George Natural Resource District. Its original stated term was 10 years from 1999 to 2009. As of the time of writing of this ALRF Management Plan, the LRMP not been renewed, cancelled, or replaced by government.

The LRMP can be regarded as useful information and guidance for general resource planning in the District because: (a) the LRMP was produced through a Provincial consensus-based public planning process, (b) it outlines management objectives applicable to the entire LRMP area, and (c) it provides broad objectives and strategies for designated resource management zones within the LRMP area.

Under the LRMP, the stated management intent for the Aleza Lake Research Forest is:

"to provide a secure land base on which to conduct long term scientific research studies in silviculture and forest ecology, including the associated education and demonstration activities." The LRMP further indicated that the: management of the ALRF *"...will recognize the need to manage for non-timber forest resources while doing specific studies that differ from currently accepted methods and standards."*

The LRMP notes the high fish and wildlife habitat values present in the lower Bowron River valley both within and adjacent to the ALRF. The LRMP also specifically highlighted the Bowron valley section *"below the 2,200 foot (670 metre) elevation contour from Box Canyon..."* (upstream of the ALRF) *"... to its confluence with the Fraser River"* (downstream of the ALRF), and notes that *"back channels of both the Bowron and Willow Rivers provide important rearing areas for salmon, and wet forest complexes provide good habitat for moose and fur bearers."*

The ALRF Management Plan will continue to be consistent with the above intent and resource values indicated in the Prince George LRMP, while also providing more specific and updated direction to ALRF resource management over and above the general direction provided in the LRMP.

The moist forests typical of the ALRF are good habitat for moose. As illustrated here, moose in this area prefer area close to both good browse (often in logged areas) and mature forest for thermal and hiding cover

8.5.4 Guidance from the Willow River-Upper Fraser Community Plan

This ALRF Management Plan considers, is consistent with, and complementary to, the Regional District of Fraser-Fort George's Willow River-Upper Fraser Community Plan (1996), subject to any superseding statutory or other direction provided to the ALRF tenure-holder by the Province.

8.5.5 Agricultural Land Reserve

Much of the Aleza Lake Research Forest is within the Agriculture Land Reserve (ALR, see Map Appendix A2). This management plan will be consistent with the *Agricultural Land Commission Act* and associated regulation(s). Timber production, harvesting, silviculture and forest protection are permitted uses of the ALR under Section 2(f) of the *Agricultural Land Use, Subdivision and Procedure Regulation*. Permanent buildings and structures proposed or built within the ALRF are and will be authorized within, and consistent with these regulations, including consultation and review by the Fraser-Fort George Regional District, via established processes and regulations as amended from time to time.

8.5.6 Range and Forage

No provincially-issued Grazing Licenses or Permits are known to exist within the ALRF landbase. No natural range barriers are known to exist within the ALRF. Therefore, no results and strategies for range management on the ALRF are known or are proposed under this plan.

PART V:
Available Resource Inventories and Information

9. RESOURCE INVENTORIES

9.1 Forest Inventories

The Aleza Lake Research Forest primarily relies upon the VRI (Forest Vegetation Inventory) datasets maintained by the Province of BC for baseline description and inventory of forest and stand composition. This freely available geospatial polygon-based data set is distributed by the Province of British Columbia through DataBC and associated websites. Various formats of the data can be acquired. Generally, for the research forest, data is downloaded and incorporated into the ALRF's geographic information system. Key attributes from the VRI include forest stand estimates (by inventory polygon) of tree species composition, age, height, basal area, volume, stems per hectare, ecology, and site productivity all of which are useful for forecasting future ALRF timber supply and the long-term sustainable management of the forest lands.

Attributes from this dataset are from a variety of sources. Provincial inventory attributes for mature stands without recorded harvest history are generally based on photo interpretation sources and ground truthing completed by the province. Data for second growth stands generally comes from forest cover data provided by the provincial reforestation database.

However, additional forest land base data, inventories, and descriptive information used for forest planning initiatives such as the the most recent timber supply analysis (2018), also include and consider other sources of land and forest information including aerial orthophotography, remote sensing and LiDAR-derived datasets, administrative boundaries (legal permit boundaries), land leases and authorizations, ecological reserves, spatial visual quality objectives, old-growth management areas, prior land use plans, research installation spatial information, roads and road permits, utility rights of way, waterbodies and wetland delineations, stand harvest history, and *Land Act* tenures.

9.1.1 Forest and Silvicultural History

Beyond the recording of forest cover, British Columbia's Reporting Silviculture Updates and Land Status Tracking System (or RESULTS) database is a data repository for recording specified harvest, reforestation, and stand management activities including but not limited to:

a) Milestone Declarations: previously-harvested areas that have been regenerated to a well-stocked condition defined by regeneration and free growing provisions, and expected to grow to maturity without additional management intervention. These milestone declarations are linked to the legal obligation for reforestation incurred by the ALRF Society as tenure holder, following timber harvesting.

b) Silviculture activities: all management activities relevant to reforestation obligations are recorded in RESULTS (e.g. harvest systems, site preparation, planting, and brushing projects).

c) Updated Forest Cover information required for each activity is reported with both silviculture and inventory labels. Silviculture labels describe the forest stand attributes as they relate to the tenure holder's legal, contractual, and technical requirements with the Province for establishment of well-spaced and free-growing trees. Inventory labels provide a description of all trees the forest stand.

9.1.2 ALRF Managed Forest Inventories

Under this plan, the ALRF Society as tenure holder commits to submitting data on its forest management activities to the RESULTS database as per standards set by the Province. This commitment ensures transparency between the ALRF and the Province, and ensures that both the ALRF and the Province have access to the best available data for managing for the future, that is, that such data is incorporated in the RESULTS database and migrated to the provincial VRI datasets.

In addition to the provincially managed datasets in the public domain, the ALRF also maintains its own internal data layers of forest management and forest cover. Such local knowledge provides improved detail and interpretation to forest cover data and associated operational planning and can be used to update the ALRF forest inventories database.

9.1.3 ALRF Enhanced Inventories

In May of 2015, the ALRF acquired Light Detection and Ranging (LiDAR) laser-mapped remote sensing data for the full tenured area of the research forest. This data is currently being used or in the process of being adapted for many aspects of ALRF forest lands management. This data is being used to enhance knowledge and stewardship of the ALRF, through improved detail on various forest and land features. Table 2 provides a list of data products that are being used or developed by the ALRF – at time of plan preparation - to improve forest inventories and management decisions.

Table 2: Enhanced ALRF Forest Inventories from LiDAR, as of December 2017

Product	Description	Status
Digital Terrain Model $1m^2$ resolution	This $1m^2$ terrain model replaces the $25m^2$ model available from government and has been highly effective for Site Planning including road location planning and initial stratification of ecologies	In use
Enhanced Streams Inventory	Hydrology modelling was conducted using the digital terrain model and derivatives to accurately locate streams, non-classified drainages, and seeps.	In use
Stand Height Model	Provide the mean relative heights of stands.	In use
Enhanced Forest Stand Inventory	Using LiDAR to enhance forest timber metrics is well documented in literature (e.g. Basal Area). The ALRF is committed to enhancing its forest inventory from LiDAR	Pending
Predictive Ecosystem Mapping	The ALRF is a pilot site for a Provincial study examining the use of LiDAR data to provide predictive ecosystem mapping, especially on plateau landscapes.	Pending
Site Productivity	Height data from LiDAR in combination with known stand histories can be effectively used to provide growth intercept site indices	Partial Implementation
Habitat Index Modeling	Academic literature suggests that habitat modelling based on LiDAR metrics has potential. This area will be evaluated for potential development	For evaluation

9.1.4 Forest Carbon Dynamics and Inventories

Overview of Past ALRF Forest Carbon Studies and Information Sources

With heightened international and regional concerns of anthropogenic climate change (IPCC, 2000, Foord, 2016 respectively) and its links to global carbon cycles, the inventory and assessment of carbon (C) stocks (or 'pools'), release, and sequestration in forest ecosystems has become of increasing global scientific, environmental, and forest management importance.

A large body of scientific field research on forest carbon dynamics and stocks in sub-boreal forests at the Aleza Lake Research Forest has developed over the last two decades. This body of work greatly informs the current scientific understandings and management perspectives on this issue at the ALRF and in the central BC Interior, and as well, forms a strong foundation for further scientific studies and carbon-management analyses.

The following summary provides a broad overview of this scientific work. The reader is referred to the original publications for additional detail.

Early scientific work by UNBC researchers at the ALRF examined forest carbon dioxide fluxes both below-ground and above-ground. Evans et al (1998) examined winter soil temperatures, carbon dioxide release, and organic matter decomposition under winter snowpacks at the ALRF under the influence three different harvest treatments including clearcut, shelterwood, and uncut (control) stand treatments. A later study (Pypker and Fredeen, 2002, Fredeen et al, 2006) examined regenerating spruce stands after harvesting of mature stands and planting of new even-aged stands, and investigated whether young spruce plantations (< 10 years of age) were a net source or sink for atmospheric carbon dioxide.

In a latitudinal study across a range of BC coastal and Interior ecosystems including sites at the ALRF, Prescott et al (2000, 2005) examined the effect of clearcutting and the role of site and climatic factors on rates of organic litter decomposition in the forest floor.

In the mid 2000's, a team of UNBC researchers led by Dr. Art Fredeen undertook extensive large-scale forest-level examinations of carbon pools and stocks on upland sites at the ALRF, including comparisons of above- and below-ground coniferous carbon stocks between old-growth and young second-growth forests on two soil types at the ALRF (Fredeen et al, 2005), and between ecological site series at the ALRF (Bois et al, 2009). A key enduring feature of this work was the establishment of a network about 140 carbon-monitoring permanent sample plots throughout the ALRF, randomly located across a wide variety of forest types, age classes, and site series. This carbon plot network also provides a strong basis for future systematic re-assessments of forest carbon at a landscape and forest-level at the ALRF.

A parallel UNBC study on the ALRF landbase during this time used satellite-based (Landsat TM and ETM) remote sensing to detect and model above ground carbon stocks at the ALRF for the period from 1992-2003 (Janzen et al, 2010).

Two studies at the ALRF have examined the role of smaller plants, including mosses and bryophytes in carbon and nutrient cycling in northern forests (Campbell and Fredeen, 2007, Botting et al, 2006b).

A pilot study at the ALRF by Sanborn and Jull (2008) examined the timing of peatland initiation, and therefore carbon storage, in 4 sphagnum bogs located in closed depressions underlain by glacial lake sediments. Maximum peat thickness in the ALRF bogs examined ranged from 0.7 to 5.5 metres, with an age of peat initiation (by C14 aging techniques) ranging from 2,400 to 9,100 years before present.

An experimental paired field study on both ALRF sub-boreal and BC temperate coastal ecosystems examined the effect of site preparation and fertilization of wet forest sites on soil bacterial and fungal abundance, and on soil carbon dioxide fluxes (Levy-Booth et al, 2016).

And finally, west of the ALRF in northwest BC, in the Smithers area, a study by Kranabetter (2009) examined forest carbon storage across a range of site productivity gradients in late-seral sub-boreal forest, providing a useful cross-comparison to studies within the ALRF landbase.

A roadside pile of logging slash being burned at the ALRF to reduce fine woody fuels and post-harvest fire hazard

Key ALRF Carbon Research Findings and Implications for Management

A complete summary and discussion of forest carbon studies at the ALRF is beyond the scope of this management plan, but certain key learnings from this research warrant specific mention here, due to their significant implications for management of forest carbon at the ALRF. i.e.

1. Carbon stocks and sequestration in the wet sub-boreal forests typical of the ALRF is substantial, and is intermediate between Pacific Northwest temperate coastal forests and drier, colder boreal forests.
2. Above-ground carbon stocks in unharvested old-growth forests at the ALRF substantially exceed those in both clearcut (young even-aged) and partial cut stand types, both in terms of mature trees and woody debris. Based on current data, partial cut stands at the ALRF have carbon stock levels intermediate between old-growth and recently-clearcut stands.
3. Old-growth stands on the most productive (subhygric) ALRF sites had the highest total ecosystem C stocks of all ALRF forest types, having approx. 18% more C stock than low-productivity mesic (drier) and hydric (wetter) sites. This mirrors the findings of Kranabetter (2009) in western sub-boreal forests in the Smithers BC area.
4. Clearcut-harvested sites and resulting young even-aged plantations remain a net source of carbon dioxide for at least 6 years after harvest (due to decomposition carbon fluxes exceeding sequestration), but became net carbon sinks again (i.e. – with positive net carbon sequestration) around 8-10 years post-establishment.
5. Below-ground carbon stocks on ALRF site types are relatively resilient to management, and do not appear to be significantly affected by harvest practices, based on results to date.
6. Further research work is needed on carbon stocks, sequestration, and fluxes in second-growth stands at older ages and later stages of stand development on upland sites, and on the dynamics and carbon stocks of peat bogs that are also widespread in this region.

A UNBC student inspects rainbow trout captured from Hansard Creek

9.2 Streams Inventory

For previous ALRF management plans, stream information on the ALRF land base was necessarily based on the Province's 'Freshwater Atlas' which is accessible through DataBC and associated web interfaces. From this original dataset, the ALRF streams inventory and habitat information has been progressively improved since 2001, by detailed stream surveys and habitat assessments, and more recently since 2015, by LiDAR remote sensing technologies

In 2007, DWB Consulting Services Ltd (DWB) under contract to the ALRF Society, prepared a stream class predictor model to augment a Timber Supply Review Analysis that was being conducted in the Aleza Lake Research Forest (ALRF). The main objective of that project was to develop a model to predict the expected stream classification for all watercourses within the ALRF. The design of the model was based on the use of data obtained from maps, previous stream classification reports, and aerial photographs of the area.

In 2017, using digital hydrology modelling methods and the ALRF's LiDAR dataset acquired in 2015, the location of streams, non-classified drainages, and smaller seeps were re-assessed and remapped using LiDAR digital elevation modelling at a higher level of precision and detail than has been previously possible with Provincial terrain (TRIM) data and traditional survey methods. **Three separated data layers were generated through this process including:**

a) Fish-bearing streams – previously identified as fish-bearing through surveys or through modelling (DWB, 2007) were incorporated into this layer. These were previously known streams with their locations more accurately mapped.

b) Non-classified drainages and larger streams.

c) Soil moisture flows or seepage routes not expected to have any associated channels with them but which provide a strong indication of the direction that water drains across the land.

9.3 Wildlife Inventory

While some provincial sources of overview information on wildlife occurrence are available, the ALRF's information on wildlife occurrence within its tenure area have augmented substantially by local knowledge and observation (forestry staff, local residents, UNBC researchers, information from licensed stakeholders, and other forest users, ALRF wildlife inventory surveys, trail camera pictures and data from the BC Ministry of Environment). Wildlife surveys at the ALRF started in 2003 and have been conducted on an intermittent or periodic basis over the years. Although somewhat limited in extent, the preliminary wildlife inventory data collected provide a broad picture of species presence and habitats in the Research Forest. Tables 3 and 4 below lists known vertebrate animal species within the ALRF.

Table 3: Known Mammal Species occurring within the Aleza Lake Research Forest

Type	Common Name	Latin Name
Mammals	Moose	*Alces alces*
	Mule deer	*Odocoileus hemionus*
	Black bear	*Ursus americanus*
	Grizzly bear	*Ursus arctos*
	American pine marten	*Martes americana*
	Snowshoe hare	*Lepus americanus*
	Fisher	*Martes pennanti*
	Wolverine	*Gulo gulo*
	Ermine	*Mustela erminea*
	Red-backed vole	*Clethrionomys gapperi*
	Mice	*None – multiple species*
	Grey wolf	*Canis lupus*
	Coyote	*Canis latrans*
	Red squirrel	*Tamiasciurus hudsonicus*
	Red fox	*Vulpes vulpes*
	Elk	*Cervus canadensis*
	White-tailed deer	*Odocoileus virginianus*
	Lynx	*Lynx canadensis*
	Beaver	*Castor canadensis*
	Porcupine	*Erethizon dorsatum*
	River otter	*Lutra canadensis*
	Mink	*Mustela vison*
	Weasels	*Mustela* spp.
	Groundhog	*Marmota monax*
	Chipmunk	*Tamias* spp.
	Bats	*Multiple species – more inventory needed*

Table 4: Known Birds, Reptiles, Amphibians, and Fish Species occurring within the Aleza Lake Research Forest

	Common Name	Latin Name
Birds	Three-toed woodpecker	*Picoides tridactylus*
	Hairy woodpecker	*Picoides villosus*
	Pileated woodpecker	*Dryocopus pileatus*
	Boreal owl	*Aegolius funereus*
	Great grey owl	*Strix nebulosa*
	Great horned owl	*Bubo virginianus*
	Northern goshawk	*Accipiter gentiles*
	Red-tailed hawk	*Buteo jamaicensis*
	Bald eagle	*Haliaeetus leucocephalus*
	Osprey	*Pandion haliaetus*
	Warblers	*Multiple species – more inventory needed*
	Flycatchers	*Multiple species – more inventory needed*
Reptiles & Amphibians	Western boreal toad	*Bofus borealis*
	Wood frog	*Rana sylvatica*
	Columbia spotted frog	*Rana luteiventris*
	Long-toes salamander	*Ambystoma macrodactylum*
	Garter snake	*Thamnophis sirtalis*
Fish	Rainbow trout	*Oncorhynchus mykiss*
	Bull trout	*Salvelinus confluentus*
	White sturgeon	*Acipenser transmontanus*
	Brassy minnow	*Hybognathus hawkinsoni*
	Chinook salmon	*Oncorhynchus tshawytscha*
	Sockeye salmon	*Oncorhynchus nerka*
	Dolly varden	*Salvelinus malma*
	Sucker fish	*Catostomus sp.*
	Northern pikeminnow	*Ptychocheilus oregonensis*

9.3.1 Mammals

There are numerous known mammal species within the ALRF as noted in Table 3. The following information and observations of mammal occurrence in the ALRF focus on several more well-known or prominent species.

Black bears are common in the ALRF, and grizzly bears, though more dispersed in range, also make seasonal use of the area. Results of ALRF bear den surveys reveal excavated black bear dens along major drainages in upland areas and cottonwood tree dens in the Bowron Floodplain (Hodder and Rea, 2005). At the ALRF, black bears have been observed to find refuge and denning in cavities high up in cottonwood trees in floodplain and upland sites especially in Fall months, coinciding with the arrival of Grizzly bears into the floodplain. Large Douglas-fir trees or 'veterans' also appear to be important habitat features for black bears, as claw marks are regularly observed on large stems (approximately > 50 cm). Spring bear hunt activity occurs on the Research Forest by the guide-outfitter within the Bowron Floodplain and by the general public typically in the upland areas. Local observations and sightings suggest that grizzly bears pass through the Research Forest most frequently in Spring and Fall, and occasionally grizzlies will frequent ALRF areas throughout the summer season where favourable habitat conditions and cover permits.

Wolf tracks are found extensively on the ALRF along the Bowron River, on many roads, and on wildlife trails.

River otter tracks have been observed along the Bowron River in the summer and in the lower reaches of Hansard Creek in the winter indicating healthy fish populations in these systems.

Wolverines (including a female and two cubs were observed on the Bear Road in summer 2012 by ALRF staff), and in other instances, wolverine tracks were found in the West Bear Management Unit.

Small mammal prey species widely documented at the ALRF during winter tracking surveys include snowshoe hare, red squirrel, mice, and voles. Squirrel middens are abundant in mature, old, and in partially cut stands older than 40 years.

A porcupine escapes up a spruce tree in the northwest ALRF

Biophysical ratings and mapping of ungulate carrying -capacity is available for the ALRF. Biophysical ratings are based on photo-interpretation of landforms, surficial materials, and climate, with a limited amount of ground information to supplement the former (Personal communication, Dave King (retired), formerly with the Ministry of Environment, Prince George, BC). These ratings do not take into account factors such as access, forest cover disturbance, or economics. The ALRF has a low capacity for smaller ungulate species. For mule deer, this Low rating indicates a carrying capacity of fewer than 3 animals/km^2 /year due to high winter snowpacks. This is consistent with the lack of mule deer sightings in the ALRF thus far. For moose, carrying capacity is rated as High (5-8 animals/km^2 /yr) on the alluvial floodplains of the Bowron River, Moderate (3-5 animals/km^2 /yr) on the slopes adjacent to the floodplain as well as the rolling hills and creeks of the northern part of the forest, and Low on the rest of the forest area. The ALRF area, as with most of the surrounding plateau, is heavily used for moose-hunting from early September through early November each year.

9.3.2 Birds

A list of observed bird species for the mid-elevational SBSwk1 plateau forests around the ALRF and adjacent forest types (adapted from Lance and Phinney (2001) is summarized in Appendix B2. Lance and Phinney's bird research sites were partially on the ALRF landbase as well as in directly adjacent SBSwk1 forest types to the west, so are therefore fairly representative of typical SBSwk1 forest types in and around the ALRF.

Cavity-nesting birds including the three-toed woodpecker (*Piciodes tridactylus*), hairy woodpecker (*Picoides villosus*) and pileated woodpecker (*Dryocopus pileatus*), and secondary nesters including passerine birds such as warblers and flycatchers have all been recorded at the ALRF. Larger birds including boreal owls, great grey owls, and great horned owls, and raptors, such as northern goshawks and red-tailed hawks have also been confirmed at the ALRF.

Bald eagles (*Haliaeetus leucocephalus*) and ospreys (*Pandion haliaetus carolinensis*) nest in and near riparian areas and adjacent ridges near the Bowron River. While there is currently limited information on waterfowl species on the ALRF, species have been observed in Ecological Reserve #84 on Loup Lake including the Common Goldeneye (*Bucephala clangula*), and mergansers (*Mergus* spp.). Loons (*Gavia artica*) have been sighted on other lakes within the ALRF.

9.3.3 Amphibians and Reptiles

Several species of frogs and toads common to the sub-boreal spruce zone occur and appear to be abundant within the ALRF. Numerous tadpoles and juvenile frogs can be observed between June and August in upland and floodplain habitats on the ALRF, though overall density and population dynamics need more study. One species of toad, the Western Boreal Toad (*Bufo boreas*), and two species of frog, the Columbia spotted frog (*Rana luteiventris*) and the wood frog (*Rana sylvatica*) are known to exist in the area. One species of salamander, the long-toed salamander (*Ambystoma macrodactylum*), is relatively abundant in areas with rotten downed wood.

9.3.4 Fish

On the ALRF, most low-gradient perennial streams with sufficient summer flows and lower water temperatures contain trout and in some cases, some other fish species. Aleza and Hansard Lakes north of the Research Forest contain rainbow trout (*Oncorhynchus mykiss*), sturgeon (*Acipenser transmontanus*), northern pikeminnow (*Ptychocheilus oregonensis*), and suckers (*Catostomus* spp.). Stream sampling within the ALRF between 2002 and 2017 indicates that most major stream systems (and in some cases, stream-connected beaver ponds) within the ALRF have resident populations of fish. Fish habitat in these streams ranges from good in the larger stream reaches and moderate to marginal in smaller streams. Slaney and Hansard Creeks have rainbow trout populations, while Firebreak Creek has Rainbow Trout and Brassy Minnow (*Hybognathus hankinsoni*) populations. Chinook juveniles have periodically been recorded in lower to middle reaches of Hansard Creek, as identified by qualified aquatic biologists undertaking stream sampling.

The Bowron River has resident populations of Rainbow Trout, Dolly Varden (*Salvelinus malma*), and Bull Trout (*Salvelinus confluentus*), as well as Rocky Mountain whitefish (*Prosopium williamson*). The Bowron River has important runs of chinook (*Oncorhynchus tshawytscha*) and sockeye salmon (*Oncorhynchus nerka*) which travel through the ALRF into the upper reaches of the river. The lower Bowron River is also known to have white sturgeon, especially in river reaches close to its confluence with the Fraser River (Mackenzie, 2000).

Loup Lake within Ecological Reserve 84 is not known to have resident fish populations, but is abundant habitat for amphibian and aquatic insect species (DWB Consulting Ltd, 2006, 2017)

9.4 Bowron River Hydrometric Station

The federal Water Survey of Canada (WSC) maintains an active hydrometric station on the Bowron River just south of the ALRF boundary. The hydrometric station has been monitoring continuous water flow and level of the Bowron for 41 years (ECCC, 2017), and near "real-time" data is available from the Water Survey of Canada website.

9.5 Threatened and Endangered Species

Provincially- and federally-identified species of special concern in the ALRF and surrounding region are identified from provincial and national initiatives such as the Conservation Data Centre (CDC), the British Columbia Identified Wildlife Management Strategy (BC IWMS), the *Species at Risk Act* (SARA), and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). and those identified as locally important (via the previous Prince George Land and Resource Management Plan or LRMP). Table 5 and Appendices B3 through B5 present a list of plant and animal species and ecological communities deemed to be at risk in the Prince George District as identified by the Province of BC.

This list comprises species whose range may overlap with the ALRF but whose presence in the Research Forest is known in some cases (Table 5), but not known or confirmed in others. Code definitions are provided in Appendix B6.

Table 5: List of known Red and Blue listed plant and animal species at the ALRF.

Scientific Name	Common Name	Status			
		Provincial	BC Status*	COSEWIC	Global
Acipenser transmontanus	White Sturgeon (Upper Fraser River population)	S1 (2010)	Red	E (2012)	G4T1 (2001)
Asio flammeus	Short- eared Owl	S3B,S2N (2015)	Blue	SC (2008)	G5 (2014)
Contopus cooperi	Olive-sided flycatcher	S3S4B (2015)	Blue	T (2007)	G4 (2008)
Gulo gulo luscus	Wolverine	S3 (2010)	Blue	SC (2014)	G4T4 (1996)
Pekania pennanti	Fisher	S3 (2015)	Blue		G5 (2005)
Salvelinus confluentus	Bull Trout	S3S4 (2011)	Blue	SC (2012)	G4 (2011)
Ursus arctos	Grizzly Bear	S3? (2015)	Blue	SC (2002)	G4 (2000)
Usnea glabrescens	Spotted beard	S3 (2010)	Blue		G5 (2015)

*Red = Extirpated, Endangered, or Threatened, Blue = Special Concern

9.6 Threatened and Endangered Ecological Communities

The B.C. Conservation Data Centre (CDC) and the NatureServe network use the term "Ecological Community" to capture the full range of ecosystems in B.C. at a variety of levels. The term "ecological" is a direct reference to the integration of non-biological features such as soil, landform, climate and disturbance factors. The term "community" reflects the interactions of living organisms (plants animals, fungi, bacteria, etc.), and the relationships that exist between the living and non-living components of the "ecological system" (CDC).

Currently, the most common ecological communities that are known in B.C. are based on the Vegetation Classification component of the Ministry of Forests and Range Biogeoclimatic Ecosystem Classification, which focuses on the terrestrial plant associations of B.C.'s native plants. Additional ecological communities are documented from inventory projects, theses, and other reports. Although not currently available from the CDC, the CDC notes that their future work will incorporate levels of aquatic and marine ecological communities as well as various other levels of ecosystems (CDC).

A site series as per these definitions is a location on the ground that has the potential to produce a particular plant association. It can be identified even when there is no vegetation present. However, in order to identify the CDC ecological community, the characteristic vegetation and physiognomic structure must be present. In the BEC system, each plant association can potentially occur on one or more site series, but each site series has the potential to produce only one mature plant association (CDC).

There are several ecological communities and site series that are Red and Blue listed within the BEC ecological zone and variant SBSwk1 that encompasses the ALRF. See Appendix B5 for more details.

9.7 Inventory of Noxious Weeds and Invasive Plants

9.7.1 Definitions

In British Columbia, a "noxious weed" means a plant species designated by provincial regulation under the *Weed Control Act* to be a noxious weed or pest species, and includes the seeds of the noxious weed. Therefore, the Province has legal authority to direct the control of these species. Under the *Weed Control Regulation*, noxious weeds may be designated at a provincial level, or regionally within BC (by specified Regional District).

An invasive species is defined as an organism (plant, animal, fungus, or bacterium) that is not native and has negative effects on our economy, our environment, or our health. Invasive species may spread rapidly to new areas and may out-compete native species as there are no predators or diseases to keep them under control (Invasive Species Council of BC, 2014).

Invasive plant species may be designated by the Province as noxious weeds under the regulation. However, not all invasive plants are "noxious weeds" unless designated by regulation.

(TOP) False Solomon's Seal (*Maianthemum racemosum*) is common to many most to rich ALRF forest sites, and is an important berry source for wildlife in the Fall (ABOVE) Thicket of Marsh Plume Thistle (*Cirsium palustre*) on a wet site at the ALRF

9.7.2 Inventory and Presence of Noxious / Invasive Plants at the ALRF

The most current and detailed information and report on the inventory and presence of invasive plant species for this area is provided by an area-wide inventory of "invasive" plants at the Aleza Lake Research Forest (Northwest Invasive Plant Council, 2010).

Two invasive plant species at the ALRF are also designated as noxious weeds under BC regulation, including:

- Canada Thistle (*Cirsium arvense*) – a provincially designated noxious weed
- Marsh Plume Thistle (*Cirsium palustre*) – a regionally designated noxious weed.

Three additional invasive plant species that are known to occur within the ALRF are not currently designated as noxious weeds under BC regulation. These are:

- Oxeye Daisy (*Leucanthemum vulgare*)
- Orange Hawkweed (*Hieracium* spp.)
- Scotch Thistle (*Onopordum acanthium*)

PART VI:
Landscape-Level Forest Management

10. LANDSCAPE-LEVEL ZONING OF THE ALEZA LAKE RESEARCH FOREST

10.1 Guiding Principles

The landscape-level management of the Aleza Lake Research Forest considers, and strives to balance four key management goals:

1. Maintaining and enhancing opportunities for forest research, education, and training across a range of disciplines and study areas.
2. Achieving forest conservation and ecosystem management goals for habitat and biodiversity, and old and unmanaged forests.
3. Providing sustainable timber management and harvesting on an identified landbase, for facilitating forest education and research opportunities, and for generating economic resources that sustain ALRF land management, infrastructure, and supporting professional capacity. And
4. Providing for, and promoting ecological resilience and diversity of ALRF ecosystems and landscapes (both managed and unmanaged), bearing in mind the influence of natural disturbances including biotic factors (pests and pathogens), abiotic factors (wind, fire, and drought), and climatic variability.

ALRF forest planning also considers strategies that enable these goals, both spatially across the landscape, and over time. The spatial designation of different land-use zones on the ALRF landscape is key to the forest management process. Such zoning allows diverse management goals to be achieved across the landscape as a whole, not necessarily on every hectare.

ALRF forest zoning for different land uses is spatially defined based on the inherent suitability of different areas of land and forest for particular uses or values. This suitability is based on a combination of factors including ecological characteristics, forest and stand structure, forest health and condition, management histories, soils, terrain, access, and research and education potential. Appropriate physical scale and connectivity of adjacent areas is also important for both extractive and non-extractive forest uses.

Identification of ALRF land suitability, land-use "zones", and their geographic boundaries considered all of the following considerations:

Considerations for all land use zones:

a) Terrain, landforms, and soils, including obvious geographic landmarks and boundaries.
b) The history and pattern of natural disturbances, past and current human land uses including forest harvesting, silviculture, and other management on the ALRF, and areas of cultural or aesthetic significance,
c) Forest land capability, productivity, and the current geographic distribution of different forest types and stand structures,
d) Physical geography and constraints to accessibility, including major ravines, unstable or steep terrain, streams and riparian zones, extensive wetlands, and swampy organic soils.

Considerations for potential old-growth reserves and natural areas:

a) Old-forest and natural-area ecological conservation goals at the forest level, including the spatial distribution of existing ecologically-significant or representative mature natural forests, other natural areas (forested or non-forested, old or young), rare ecosystems, and landscape connectivity,
b) The location and distribution of known sensitive areas, ecologically high-value habitats, high value areas, habitats, and/or vegetation conditions, unstable slopes, and/or rare or usual geological features.

Considerations for potential sustainable timber management areas:

a) The location of productive and accessible commercial forest lands within the ALRF that are not significantly constrained by other land use objectives and zoning.
b) Reasonable ground-based access opportunities, especially with consideration to location of the permanent road network.
c) The location of productive stands with existing silvicultural / financial investments. And,
d) Factors promoting the economically-efficient spatial arrangement of the ALRF commercial forest land base and road network.

Historical and current Management Plan zone terminology and application

Landscape-level management and zoning on the ALRF, as for all landbases, evolves over time as greater knowledge and experience of the land is gained.

Zoning terminology from the two previous ALRF Management Plans have been adapted or adjusted for Management Plan #3. Specifically:

- *"Research Natural Areas"* and *"Old-growth management areas"* (or OGMA's) are functionally similar, and for brevity, will be referred to as OGMA's in this plan.
- As per MP#2, *"Forest Management Units"* continue to refer to specific contiguous geographic areas or zones with a timber-management emphasis.

Management Units designated in Management Plan #2 are adjusted in this Management Plan #3, to simplify resource planning, reduce the number of management units from five to three, and thereby streamline implementation and monitoring activities. Specifically, these adjustments include:

- Merging of the Slaney Unit into the Northern Uplands Unit.
- Merging of the Bowron Slopes Unit into the East and West Bear Units. And,
- Merging the Central Plateau Unit into the Northern Uplands and East Bear Units.

Western Hemlock growing on granitic and colluvial bedrock outcrops on the west side of the ALRF

10.2 Management of Old Forest and associated Natural Areas

10.2.1 OGMA / Natural Area Purpose Statements

Old-growth Management Areas and Natural Areas (collectively referred to in this Plan as OGMA's) are designated areas of predominantly old forest and associated distinctive natural areas which are representative of the range of forest ecosystems on the ALRF landbase, and incorporate unique and/or locally-significant or representative forest types, ecosystems, or landforms.

The overall management purposes and intent for OGMA retention within the ALRF are:

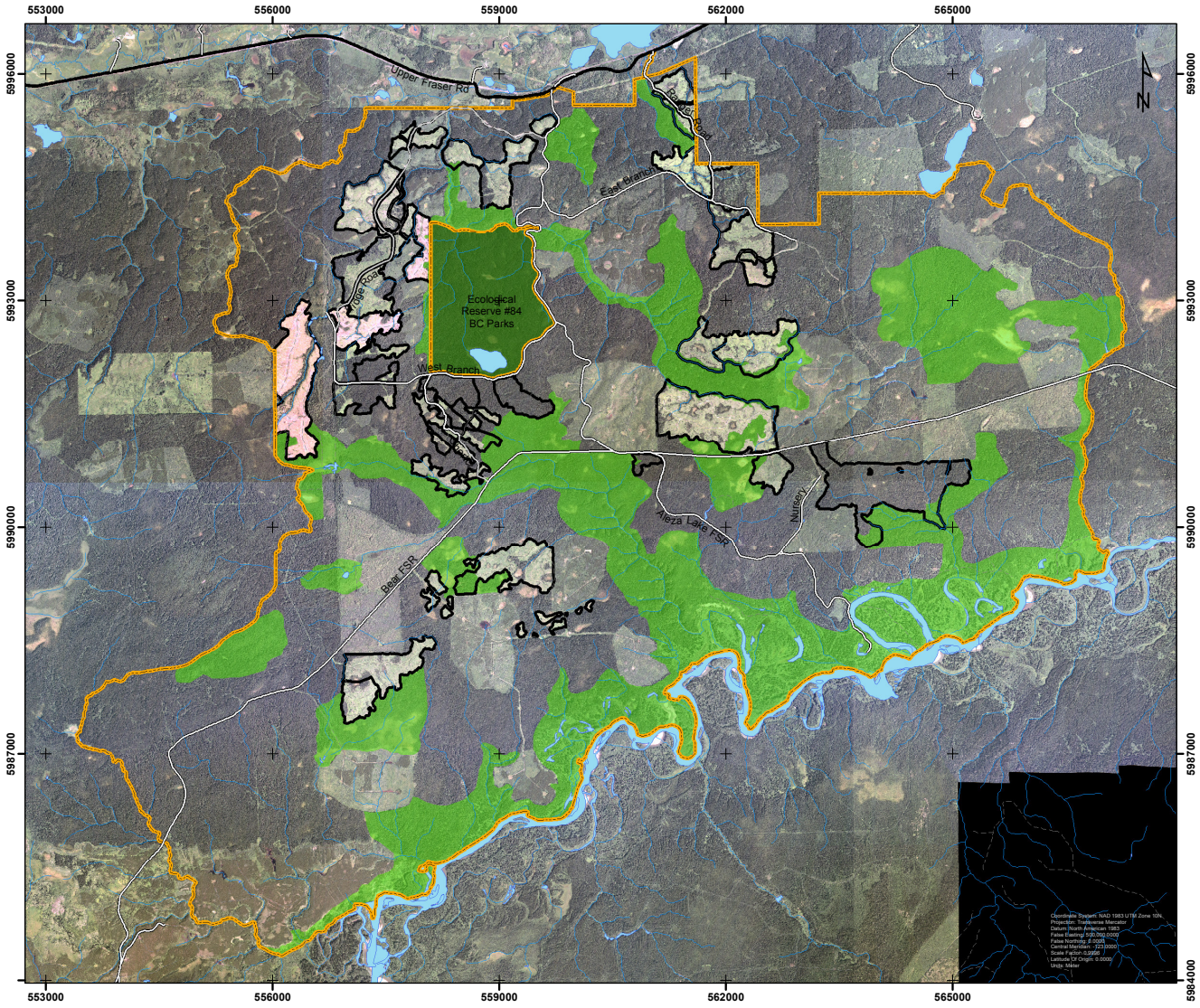
a) To protect representative upland and floodplain old-forest ecosystem structures and natural processes, without significant influence from harvesting, silvicultural management, or related anthropogenic interventions,

b) To maintain old-growth, late seral forest and natural-area habitat characteristics, including landscape-level habitat connectivity. And,

c) To maintain the ecological integrity and connectivity of natural ecosystems by avoiding the creation of new roads within designated OGMA areas and/or minimizing and mitigating the ecological impact of existing access structures within OGMA's.

Figure 6: Map of Research Forest

Map of the ALRF tenure area, indicated tenure boundaries, Ecological Reserve 84, and Old-growth Management Areas (OGMA's) designated under this management plan



10.2.2 Consistency with Old Forest Objectives set by Government

"Old Forest" and natural-area management for the Aleza Lake Research Forest is guided by direction from the Province of British Columbia (BC Integrated Land Management Bureau (ILMB), 2009) regarding *"Landscape Level Biodiversity Land Use Objectives and Research Forests in the Prince George Timber Supply Area"*.

Consistent with and building upon this provincial direction, ALRF Old-Forest management under this plan (ALRF Management Plan #3) incorporates the following plan-specific definitions, goals, and strategies to guide interpretation and implementation:

"Old Forest" Definitions for the ALRF

1. For coniferous-leading forest types, Old Forest is defined as forest types that are equal or greater than 140 years of age, according to the provincial forest inventory.
2. For deciduous-leading forest types (including, for example, black cottonwood on alluvial sites), Old Forest is defined as forest types that are equal or greater than 100 years of age, according to the provincial forest inventory.
3. "Old-growth Management Areas" (or "OGMA's") are designated areas within the ALRF landscape that are set aside and reserved as Old Forest and associated Natural Areas, and are excluded from the ALRF timber harvesting landbase.
4. ALRF Old-growth Management and Natural Areas will contain a target of at least 75% Old Forest by area. Up to 25% of OGMA areas may include younger forest age classes, non-forest ecosystems (such as wetlands), and forest-shrub complexes, to improve habitat connectivity, allow for future Old Forest recruitment, and incorporate natural ecosystem diversity and variability.

Implementation Strategies

1. The ALRF will manage Old Forest and associated Natural Areas through a combination of two interlocking strategies: (a) a primary strategy providing for specific identification of spatially-defined Old Growth Management Areas (OGMA's) excluded from the timber harvesting landbase, and (b) a supporting "aspatial" management strategy providing for complementary Old Forest retention by retention targets within the timber harvesting landbase. And,
2. The ALRF will continue the practice of incorporating Ecological Reserve #84 in ALRF OGMA / Natural Area network planning and Old Forest percentage calculations. (Ecological Reserve #84 is under the jurisdiction of BC Parks and is completely surrounded by, but excluded from the ALRF Special Use Permit area.).

Old Forest / OGMA Goals

28% is the minimum percentage of the CFLB (Crown Forest Land Base) of the ALRF tenure area (combined with the adjacent Ecological Reserve #84) that will be retained as Old Forest in OGMA's.

35% is the ALRF's target minimum percentage of the CFLB (Crown Forest Land Base) of the entire tenure area under this Management Plan, (combined with the adjacent Ecological Reserve #84) that will be retained as Old Forest, across the entire ALRF landbase.

OGMA areas for the Aleza Lake Research Forest under this plan are indicated in Figure 7. These OGMA areas (including ER 84) total at least 2,600 hectares in area, or 28% of the landbase.

Consideration of natural disturbances in OGMA planning

Catastrophic natural disturbances (such as wildfire or large, stand-level blowdown events) may periodically impact Old Forest / OGMA areas over time. Such circumstances, when they occur, will be assessed by ALRF, and may require re-evaluation of minimum and target Old Forest percentages by the Province and the tenure-holder. Where necessary or as directed by the Province, OGMA recovery or recruitment alternative strategies under this Management Plan will be prepared by the ALRF and submitted to MFLNRORD for consideration.

Endemic natural disturbances that create smaller-scale gaps or individual tree death within the broader mature forest matrix (such as bark beetles or localized wind, snow, or ice damage) are considered to be part of the normal natural disturbance regime of old SBSwk1 forests in this region, and are not considered catastrophic disturbances under this Plan.

"No Net Loss" OGMA Strategy

In the course of ALRF forest planning and implementation, preliminary OGMA boundaries identified in earlier stages of strategic planning may occasionally be modified to a minor extent as greater knowledge of the ALRF landbase and ecosystems are gained. In these cases, the "No Net Loss" strategy will be applied.

The no-net-loss OGMA strategy means that minor adjustments to defined OGMA boundaries are allowed under this Management Plan for adjacent forest harvesting or road building activities only where all of the following conditions are met, i.e.:

- **i.** Existing OGMA areas proposed for removal (i.e. for harvesting and roads) can only be replaced by bringing into OGMA's ecologically-similar Old Forest areas contiguous to existing OGMA's, in a similar geographic area,
- **ii.** Proposed OGMA adjustments (if any) must maintain or enhance OGMA connectivity and total area (hectares), and reduce, not increase, habitat fragmentation.
- **iii.** New roads or access structures cannot bisect existing or proposed OGMA areas.
- **iv.** The resultant adjusted OGMA boundaries must be similar in intent and configuration to those approved under this Plan. And,
- **v.** The revised OGMA boundaries are updated and recorded in the provincial forest inventory and databases.

10.2.3 Additional old-forest areas not included in OGMA's

Other areas of forest which meet Old Forest definitions under this Plan, but which are outside OGMA's (i.e. – they meet definitions of Old Forest but are within the timber harvesting landbase), may also contribute to the minimum and target Old Forest percentage areas under this plan.

10.3 Forest management units and general management intent

The concept of the forest management unit used in this plan is similar to planning cells (as used in the Prince George District) or working circles or forest compartments (as used in other jurisdictions). Each of the 3 ALRF forest management units in this Plan is a geographically well-defined operational area with clear physical boundaries, existing road access or capability for establishment or re-establishment of functional road access, and similar management objectives.

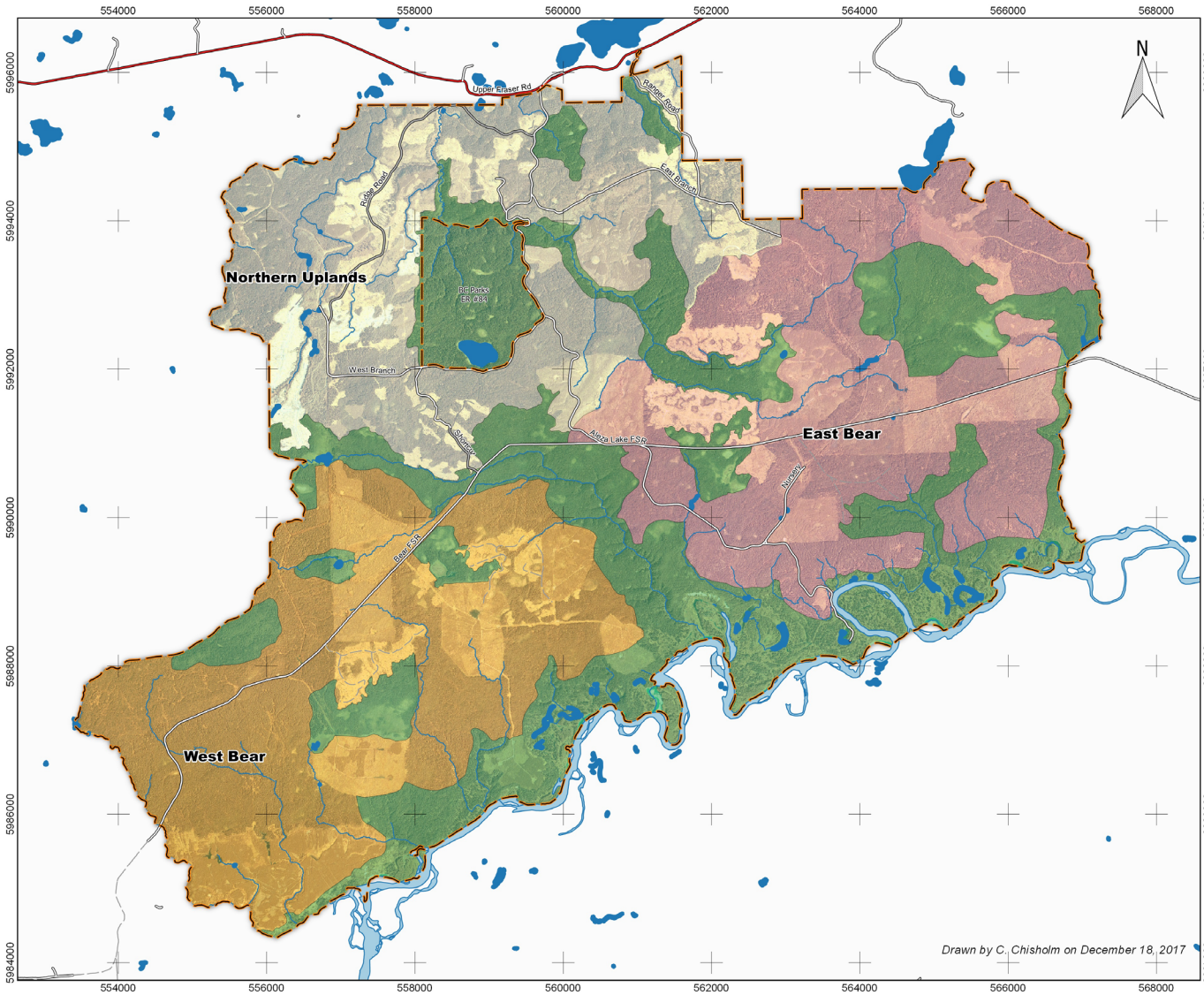


Figure 7: Map of ALRF forest management units

Map of the ALRF tenure area, indicating tenure boundaries and 3 forest management planning units. Old-growth Management Areas (OGMA's) are adjacent to, but separate from the forest planning unit areas

The three management units described in this Plan are generally similar in size, ranging from 2,000 to 2,200 hectares in area (Table 6). Each is a logical geographic unit of operational and strategic planning.

Table 6: Summary of ALRF Forest Management Compartments (gross THLB excluding OGMA's)

Forest Management Unit	Gross Area (hectares; not including OGMA areas)
Northern Uplands	2,084
East Bear	2.130
West Bear	2,218

The general resource management emphasis across all three ALRF management units (exclusive of any adjacent or embedded OGMA's) is timber growth and production and integrated resource management at intensive and extensive scales. Related broad stand management strategies include:

a) Enhancement of stand productivity, value, health, and resilience.
b) A range of rotation ages for managed stands, dependent on tree species, site productivity, site-specific stand management goals, and timber product objectives.
c) Silvicultural systems appropriate to the stand and site, and where applicable, research and demonstration objectives, and
d) Biodiversity and ecosystem management approaches and targets consistent with the general management intent and timber management focus of these compartments.

10.3.1 East Bear and West Bear Units

The East Bear and West Bear Units include a similar range of terrain, soils, and landscape types, but are geographically separated by a very large ravine system (included in the the Central Ravine OGMA), which bisects the south-central ALRF in a north to south direction.

The East and West Bear Units are areas of gently- to moderately-rolling lowland and plateau forests, with some moderately steep slopes and escarpments (steep-slope breaks) leading down to the Bowron River floodplain. The Bear Road bisects the two compartments in a southwesterly to northeasterly direction.

10.3.2 Northern Uplands Unit

The Northern Uplands Unit has the longest history of active forest management and research of all the ALRF management units, and includes the oldest and longest-established research trials and permanent sample plots in the ALRF and the region. This 2,084 hectare area also surrounds, but does not includethe 269 hectare Ecological Reserve #84 managed by BC Parks.

Forest harvesting on the Northern Uplands Unit dates back to 1919. A wide variety of partial-cut timber harvesting methods and silvicultural systems have been used in this area, including single-tree selection, uniform and group shelterwoods, clearcuts, patch cuts, alternate strip-cuts, and diameter-limit methods. The Northern Uplands area is well accessed by roads, including the Aleza

View east down the Bowron River during spring run-off, southern ALRF, May 2007

Forest Road, East and West Branch Roads, Ranger Road, and the newer Ridge Road.

The Aleza Field Education Centre is centrally located in the Northern Uplands compartment and is accessed from Km 2 on the Aleza FSR. Several interpretive trails traverse this area, including the North Ridge, South Knolls, and East Loop trail. All three trails are used extensively for field education as well as community recreation.

The Northern Uplands are characterized by rolling hills and terraces that are dissected in several areas by steep-sided draws, undulating terrain,and rounded hills. Several creeks including Hansard (Camp), Firebreak, and Slaney Creek and their tributaries flow in a northerly to northwesterly direction through the area. The Hansard Creek watershed occupies most of this management unit.

10.4 ALRF Strategic Road Access Plan and Objectives

10.4.1 Introduction, Context, and Rationale

As a 90 km^2 tenure area with a forest management history dating back nearly a century to the early 1920's, the Aleza Lake Research Forest has a complex legacy of many past and current road and access routes and accompanying administrative designations, including status and non-status roads.

Some roads and routes date back to provincial works between 1924 and 1964 through the old Aleza Lake Forest Experiment Station area and Aleza Lake Ranger Station eras. Other road networks within the ALRF tenure established between 1945 and 2000 were constructed by past forest industry licensees under road and cutting permits both within and adjacent to the current ALRF area. Finally, in the era from 2001 to the present, a number of tributary forest road sections within the ALRF were constructed for timber management and extraction by the Aleza Lake Research Forest Society, the current tenure holder.

Designated sections of Forest Service Roads (FSR's) within the ALRF have been managed, maintained, and upgraded by the ALRF under Road Use Permit with the Province, since 2001. The administrative classification of certain FSR sections within the ALRF may be changed by the Province in future at their discretion, subject to application by the ALRF Society as road tenure holder. New sections of road have been built by the ALRF Society under authority of Road Permits or Special Use Permit 23165.

As noted previously in this plan, in 2015, the Province (MFLNRORD Prince George District) approved boundary changes to the ALRF tenure area which adjusted and consolidated ALRF tenure boundaries to better reflect major landscape and topographic features and barriers, replacing old boundaries which tended to follow old administrative and survey boundaries primarily on cardinal directions. The new ALRF boundary maintained the general size (in hectares) of the ALRF while providing much more logical and coherent geographic boundaries for future ALRF landscape-level and ecosystem-based forest land management.

This management plan provides a vital and long-overdue opportunity for consideration and definition of long-term strategic road access management planning and objectives for the ALRF landbase, and for long-term coordination and rationalization of the ALRF road network for its various uses.

East Branch Road, ALRF, Fall 2010

In preparation of this section, the ALRF Society has also referenced and considered the recent information and recommendations of the BC Forest Practices Board Report (FPB SR 49, 2015) on access management and resource roads in British Columbia.

10.4.2 ALRF Road Access Management Objectives

1. The long-term vision or goal for the ALRF road network is for a coordinated and re-aligned ALRF road network that provides:
   - **a)** Safe and effective primary access to all Forest Management Units in the ALRF, for research and education, timber management, fire access, and ancillary public use of Crown land.
   - **b)** A singular access-management entrance / exit of the ALRF road network north from the ALRF tenure area to the provincial highway system at the junction of the Aleza Lake FSR (FSR 4311.01) and the Upper Fraser Road. And,
   - **c)** Limitations to, or phase-out of secondary vehicular access from outside the ALRF through west and east boundaries on the Beaver-Bear Road via specified access control points. (The ALRF will continue to manage applicable road tenures within the ALRF Special Use Permit area).
2. This ALRF management plan:
   - **a)** Identifies the core network of primary (permanent) forest roads required for short- and long-term ALRF tenure function and access, and long-term approach to road network management and use.
   - **b)** Clearly distinguishes between permanent access roads, wilderness roads, temporary roads, and fire access routes.
   - **c)** Identifies priority (or preferred) road sections and/or points for road deactivation, based on strategic access management objectives.
3. Under this management plan, the ALRF Society as tenure holder commits to the following road and access management processes:
   - **a)** First Nations and stakeholder consultation on strategic access management issues including major changes to permanent road access, and,
   - **b)** ALRF road inventory and reconnaissance-level field assessment and documentation of condition and status for historical and currently-inactive status and non-status road sections within the ALRF tenure area.

10.4.3 Road Use Classes

A. ALRF Primary Road Network

The ALRF primary road network includes designated permanent road sections designated for long-term industrial and non-industrial use, with a permanent road prism, permanent drainage structures and/or bridges. Figure 8 indicates the location of this permanent road network, as well as the general intended locations of access control structures. Most of these road sections currently have all-weather running surfaces. The long-term goal (subject to future funding and resources) is to upgrade all primary road sections to this standard.

The ALRF primary road network, with recommended access control points, will be spatially defined under this plan.

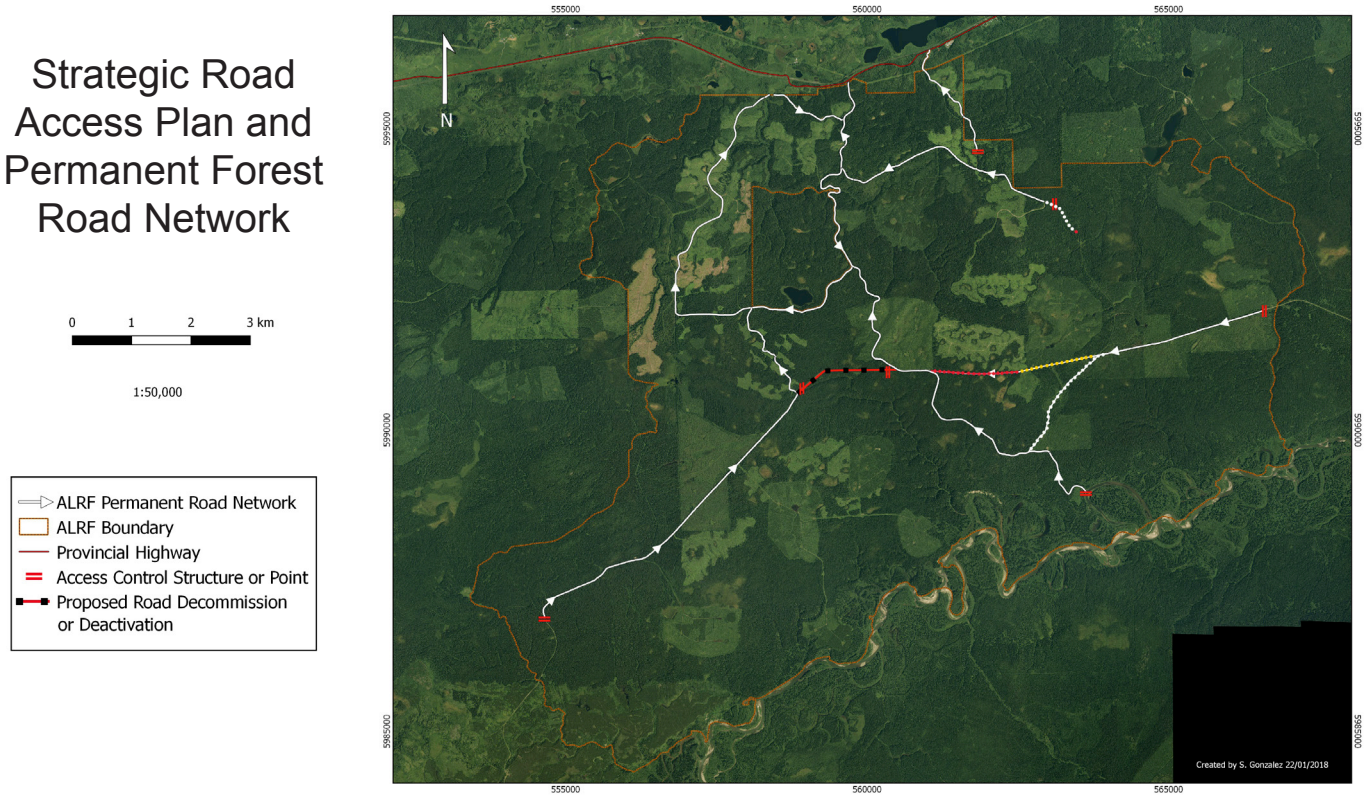


Figure 8: Strategic Road Access Plan and Permanent Forest Road Network
ALRF strategic road access plan and primary permanent road network

B. Wilderness Roads

Minor permanent tributary roads within the ALRF primary road network will be managed as "wilderness roads" with regular inspections of the road prism and drainage structures by the ALRF. Typically, these roads are secondary spur roads < 2 km in length which are an existing road infrastructure asset, and do not require deactivation.

The ALRF may at their discretion manage or limit vehicular access to individual ALRF wilderness roads, via access control structures, based on safety or other considerations.

Wilderness roads within the ALRF will be assessed, designated, and managed on a case-by-case basis, and notice signs posted on applicable wilderness road sections.

C. Temporary Forest Roads

Typically, temporary forest roads are those one-season-use to two-year-use roads required for timber access and reforestation , and deactivated and rehabilitated after use with sediment-control and revegetation measures implemented, and natural drainage patterns restored. Location of, and management of temporary forest roads will be defined in ALRF operational plans.

D. Fire Access Routes

Under this management plan, ALRF Fire Access Routes (FAR's) are a spatial GIS inventory of historical road access routes and functional road prisms on the ALRF Crown Forest landbase. These routes are capable of reasonably rapid reactivation with appropriate equipment – either as access routes or fire-guards or both – by Provincial wildfire authorities in the event of a wildfire within or near the ALRF tenure area. The ALRF will maintain this spatial FAR inventory (in the form of shape files and access descriptions) for the purposes of ALRF Fire Preparedness Planning.

For greater clarity, FAR's do not include:

- **i.** Active or wilderness roads managed under ALRF road tenures.
- **ii.** Temporary access roads for ALRF timber harvesting or forest operations, unless reactivated as such under ALRF-approved Site Plans. Or
- **iii.** Road sections that have been permanently deactivated for environmental reasons.

Further to the above, FAR's are not maintained or managed by the ALRF Society in any way, other than periodic field observation of site conditions, and maintenance of a spatial GIS inventory. A preliminary map of the FAR network is provided in Appendix A3 of this plan.

10.5 Wildfire Preparedness Planning

Even though the ALRF is located in an area considered a moist cool, ecological zone, sustained periods of high to extreme fire hazard can potentially occur in any given year in this area, especially in summer months. Large fires (such as the 1992 Eagle Fire on the southwest perimeter of the ALRF) may be relatively rare, but extensive stand-destroying events. Such conditions may be exacerbated in future with changes in regional climates and increased extreme events. Even within the ALRF under any climatic conditions, variations in site conditions and fuel types will influence local fire hazard conditions.

Therefore, consistent with BC's *Wildfire Act* and regulations (as amended from time to time), the ALRF will prepare or update a Wildfire Preparedness Plan (WPP) by no later than April 30th of each year.

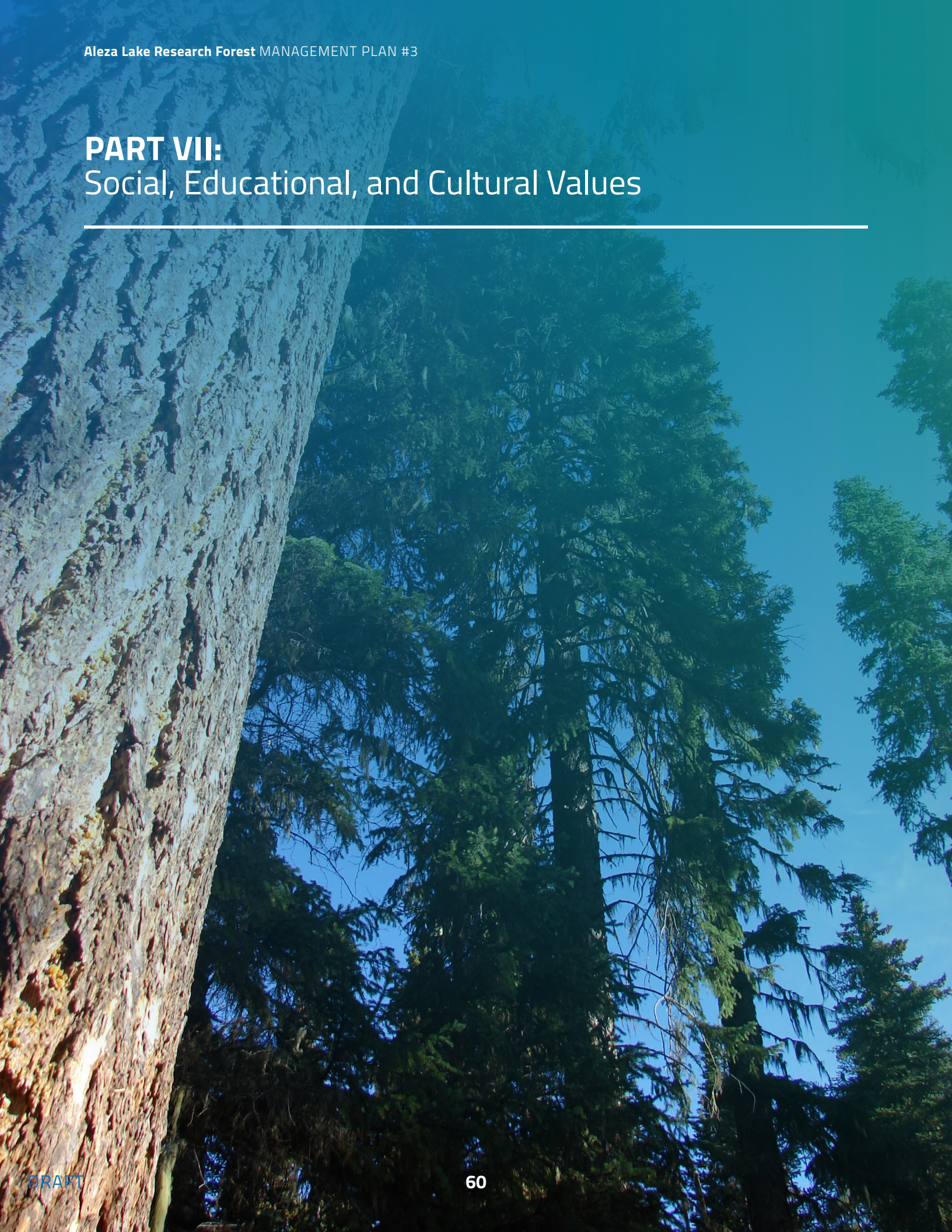
The ALRF WPP will include the following information:

1. A map and spatial inventory of ALRF active roads (including evacuation routes) and fire access routes.
2. ALRF buildings and infrastructure (e.g. Aleza Field Education Centre) and related forest-fuel treatment areas.
3. Wildland-Urban Interface (WUI) considerations for local communities, where applicable.
4. GPS Location of major forest research trials.
5. Map and spatial inventory of suitable water sources (for aerial, ground pump crew, or truck access) for fire-fighting and related purposes.
6. Mapped landscape-level natural firebreaks based on terrain features, forested and open wetland complexes, humid forest types, lakes, points, and waterbodies.
7. Other information, as applicable or as required by the Province.

The ALRF will update the WPP annually or periodically (maximum of every 3 years) during the term of this management plan, or more frequently as substantial new information becomes available.

The WPP will be provided on the ALRF website and to Provincial wildfire authorities on an as-needed basis.

PART VII:
Social, Educational, and Cultural Values



11. SOCIAL, EDUCATIONAL, AND CULTURAL VALUES AND GOALS

11.1 Cultural Heritage Resources and Histories of Land and People

Cultural heritage resources, as defined by BC legislation and regulation, address cultural resources as they pertain to aboriginal people.

The Aleza Lake Research Forest will manage and protect known cultural and heritage resources in a manner consistent will the *Heritage Conservation Act*, the *Forest and Range Practices Act*, and the *Forest Planning and Practices Regulation*.

ALRF objectives for cultural and heritage resources are to conserve, and as necessary, protect identified cultural heritage resources or features on the ALRF landbase that are the focus of traditional use by an aboriginal (indigenous) people, and that are of continuing importance to that people.

In addition, the ALRF supports more broadly the documentation and conservation of the history of local communities and their surrounding forest, both on the ALRF landbase or in its environs including the nearby Upper Fraser Valley. Of particular interest to the ALRF will be the "Big Bend of the Fraser" geographic area from the communities of Shelley and Willow River in the west to the Hansard Bridge and Upper Fraser in the east, and southward to the Bowron River. Such support will be in collaboration with regional agencies such as the UNBC Archives.

11.2 Research and Education Objectives

Research and education is the central objective of the Aleza Lake Research Forest, and this is directly referenced four times within the provincial permit (SUP 23615) for this area:

a) The Aleza Lake Research Forest is an area of Crown Land permitted for land management oriented to "educational and research purposes" (Section 1.01).

b) The management plan must contain "general research and educational strategies and approaches within the permit area" (Schedule A, Sect. 3.01(a)).

c) "Undergraduate and graduate student training will be facilitated by activities on the Research Forest." (Schedule B, Sect. 1.04). And,

d) "(T)he Research Forest will be managed to facilitate research and teaching in a wide range of topics of interest to natural resource management." (Schedule B, (Sect. 1.05)

Key strategies for facilitation of forest research opportunities at the Aleza Lake Research Forest include provision of:

- Supporting ALRF staff resources, and services for the protection, management, and coordination of field research installations and activities on the landbase. And
- ALRF infrastructure to deliver forest and environmental education opportunities at the Aleza Lake Research Forest including several educational trail networks, the Aleza Field Education Centre, and the all-season forest road network.

(ABOVE) ALRF summer student staff gain work experience in a wide range of natural resource management issues

(BELOW) ALRF roads and interpretive trails provide excellent access for local recreation, educational groups, and community events

Strategies to manage ALRF educational and research resources are detailed below.

Educational Trails

Strategies for management of educational trails at the ALRF are detailed in this management plan under the Forest Recreation section.

Field Research Installations

The management strategies for research sites at the ALRF are:

1. To maintain a current inventory of all known active and inactive research sites on the ALRF.
2. To manage forest operations within or around active research sites for the duration of the project by:
   - **a)** Minimizing or preventing impacts of logging activity or other forest operations on active research sites through comprehensive research site inventories.
   - **b)** Coordinating forest operations with researchers in specific areas to implement or maintain a desired set of experimental treatments, and research or monitoring objectives.
   - **c)** Providing direct or indirect support of research infrastructure (e.g., site maintenance, road access).
3. To avoid or minimize uncontrolled and undesirable disruption of long-term field research, for the duration of active research, by:
   - **a)** Consulting with researchers on planned or pending forest operations activities within or around research sites.
   - **b)** Minimizing external forest operations activities that would increase windthrow, fire, and pest risk in or near the site. And
   - **c)** Avoiding changes to site drainage and soil characteristics near research sites (e.g. during road construction or harvesting).

UNBC researchers Dr. Bill McGill and Mike Rutherford, and ALRF Manager Mike Jull review a research site for application of wood ash

UNBC research assistant assesses biodiversity in an old-growth stand

The nature and types of field research sites on the ALRF are extremely diverse, ranging from long-term, continuous monitoring at certain research sites, to use of ALRF sites for temporary sampling or data gathering. Appropriate management strategies will be flexible and site-specific to reflect this range of objectives and research requirements. Appropriate management strategies will be determined by ongoing communication with principle researchers to determine research objectives and circumstances that will successfully integrate ALRF forest operations with each research site.

Table 7 provides examples of suggested ALRF management strategies around or adjacent to forest research projects at the ALRF.

Table 7: Examples of types of field research installations, and potential management strategies

Type of installation	Duration	Open or Closed Forest Conditions required?	Early or Late Seral Forest Conditions required?	Segregate from, or incorporate with surrounding forest management?	Recommended Buffering
ALRF climate station	Permanent	Open field conditions	Early	Segregate	100 m
Long-term permanent GY plots (old-growth)	Permanent	Closed forest	Late seral	Segregate	60-80 m
Forest carbon monitoring plots	Temporary or periodic	Wide range of conditions	Wide range of conditions	Incorporate	None
Fertilization study	At least 20 years	Closed forest	Early-mid seral	Segregate	Min. 30 m
Vegetation diversity sample plot	Temporary	Wide range of conditions	Wide range of conditions	Incorporate	None
Shelterwood trial	10-25 years	Range of treatment conditions	Range of treatment conditions	Segregate for duration of trial	Min. 30 m

(ABOVE) The Aleza Field Education Centre, completed in Fall, 2015 (TOP RIGHT) Construction of the Field Centre commenced in Summer 2014 and was completed in 2015 (RIGHT) Field Centre facilities provide opportunities for field-oriented courses, workshops, and retreats

Aleza Field Education Centre:

The Aleza Field Education Centre is a 1,200 square-foot (or 112 square metre) teaching and interpretive centre of log-and-timber construction, located at the UNBC Aleza Lake Research Forest . The Field Centre building is permitted by the Province under an Addendum to SUP 23615. The Aleza Field Education Centre building and associated structures are owned and managed by the Aleza Lake Research Forest Society.

The Field Centre, officially opened in May 2016, is designed to host field courses, meetings, retreats, training, and community events. The Field Centre is an outdoor-oriented learning centre, social gathering place, and logistical and organizational hub for events at the Aleza Lake Research Forest. The Centre may provide some overnight accommodations for approved users, when needed.

The area of the ALRF immediately surrounding the Aleza Field Education Centre (about 150 hectares of land, approximately bounded by Hansard Creek to the south and west, the Aleza FSR to the east, and Ridge Road to the north) has very high value for field education and demonstration, due to its physical proximity and adjacency to the Field Centre and surrounding trail network.

11.3 Forest Recreation

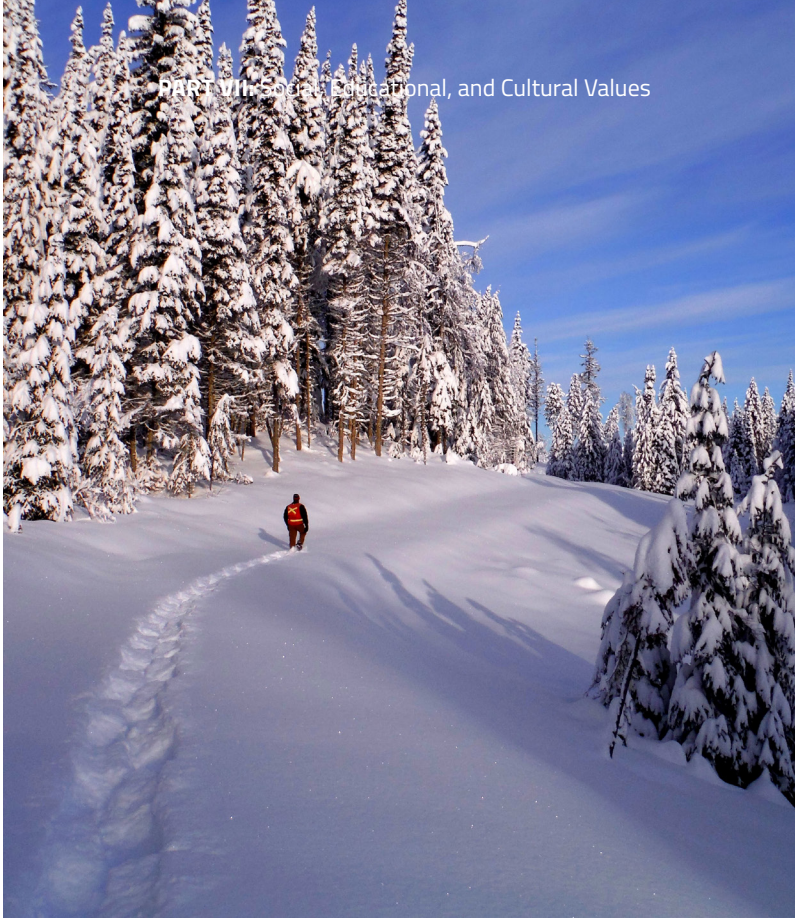
Objectives set by Government

At time of preparation of this plan, no Interpretive Forest Site, Recreation Site or Recreation Trail, or related Objectives have been established by the Province within the ALRF landbase. One Recreation Reserve is legally designated by the Province near the Bowron River within the ALRF. The ALRF will comply with any Recreation Objectives that may be established by the Province in the future.

ALRF Educational Trails

The Aleza Lake Research Forest Society maintains, establishes, and periodically modifies a network of educational walking trails on the Research Forest on an ongoing basis, as part of regular forest education activities consistent with this plan. Many of these trails are marked with signs and trail markers, and, due to their location on Crown Land, are accessible for use by the public for non-motorized recreational purposes. Educational trails on the ALRF are managed by the Society but can be used by the public only at their own risk.

The ALRF Society as permit-holder may modify or vary the location and/or design of these educational trails from time to time at their discretion, to meet educational goals, address anticipated user safety issues, or to minimize environmental impact. The Society maintains a digital / GIS record of current trail locations, and will provide such information to the Province as needed and upon request.



A winter day at the forest

11.4 Scenic Areas and Visual Resource Management

Forest operations under this management plan will be consistent with the 2005 *Order Establishing Scenic Areas for the Prince George Forest District*, including recommended Visual Quality Objectives (VQO's), Visual Quality Class and Visual Sensitivity Class, as may be amended from time to time. A portion of the ALRF along its northern boundary is within the *Giscome Highway Scenic Area* identified within this order.

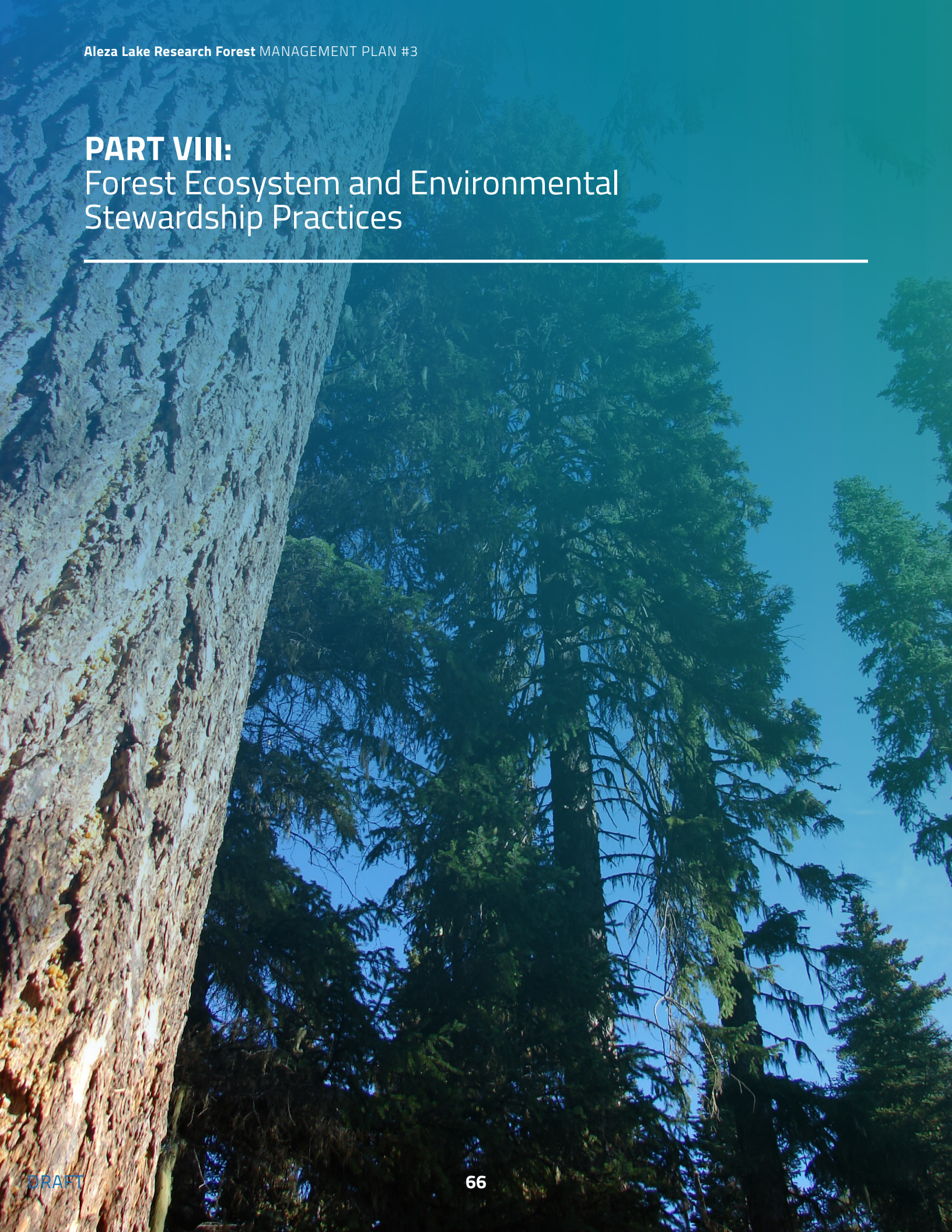
Additionally, the Prince George LRMP (1999) provides direction related to land use and visual quality, advising plan users to "avoid square or rectangular cutblocks and linear boundaries to minimize visual impacts on dominant views and within scenic areas."

The planning of primary forest activities on the portions of the ALRF within the Giscome Highway Scenic Area will include visual impact assessments (VIA's). For purposes of VIA's under this plan, primary forest activities include timber harvesting, new road construction, and related operations. A VIA is an evaluation carried out to consider whether, and demonstrate that planned timber harvesting or road operations will be consistent with the established visual quality objective for a scenic area (i.e. – consistent with the recommended visual quality class or established Visual Quality Objectives set by government). The VIA will consider the visual effects of the planned operation on the landscape from a range of relevant viewpoints during the planning process.

Primary forest activities within this Scenic Area will incorporate strategies that consider and mitigate visual impacts from major viewpoints along the Giscome Highway Scenic Area (Upper Fraser Road) and Aleza Field Education Centre building viewpoints, by incorporating into cutblock and/or road design one or more of the following approaches:

- irregular boundaries or edge treatments to avoid strong or abrupt high-visible rectilinear boundaries within the viewscape.
- creation of boundaries that follow natural landscape features or contours. And/or
- canopy or structural retention via dispersed patch cutting, partial cutting, or variable retention treatments, where ecologically and silviculturally appropriate and technically feasible.

PART VIII:
Forest Ecosystem and Environmental Stewardship Practices



12. FOREST ECOSYSTEM AND ENVIRONMENTAL STEWARDSHIP PRACTICES

12.1 Soil Conservation Objectives

The ALRF objective for soils generally, is to conserve the inherent productivity and hydrologic function of soils within the Research Forest that are influenced by forest management practices.

Soils on the ALRF are predominantly fine-textured, with frequent silt and clay loam soils. Clay-rich B horizons can also create perched water tables and wet soil conditions in lower-lying locations, and limit the depth of rooting zones. The nature of these soil factors, both individually and in combination, make many ALRF soil types very sensitive to compaction and degradation due to mechanical disturbance and surface traffic. ALRF soils and site productivity will be conserved by limiting forest operations to certain conditions and seasons of activity to avoid soil damage.

ALRF practices for soil conservation (including soil disturbance limits, permanent access structure limits, maintenance of natural surface drainage patterns, slope stability, re-vegetation of temporary roads and disturbed sites, and/or soil amendments including fertilization) will be consistent with the *Forest and Range Practices Act* and the *Forest Planning and Practices Regulation*, and other provincial and federal legislation, as amended from time to time.

Specific soil conservation targets will be provided in stand-level Site Plans. Periodically at the ALRF, forest research, demonstration, or teaching purposes may propose to apply soil treatments or impacts that will vary from the above standard requirements. In such cases, the area of such treatment variances will be planned and spatially mapped in advance, be included in a professionally-prepared prior Site Plan, and appropriate agencies informed and consulted, to ensure compliance with legal standards.

A student group heads out to a field site with their instructors at the ALRF

12.2 Biological Diversity Objectives

Management of biological diversity (or "biodiversity") objectives for both natural and managed ecosystems at the ALRF will incorporate the following inter-locking objectives and strategies at the landscape and stand / site levels:

- **a)** Landscape-level zoning, spatial reserves, and enhancement of spatial connectivity of Old Growth Management Areas and natural areas.
- **b)** Landscape-level objectives for tree species composition in managed forests within the Timber Harvesting Landbase (THLB), including but not limited to, deciduous / mixedwood management.
- **c)** Landscape-level objectives for harvest patch-size distribution (including silvicultural systems) in managed forests within the Timber Harvesting Landbase (THLB).
- **d)** Post-harvest structural retention of Wildlife Tree Retention Areas (WTRA's), individual live and dead trees (dispersed leave-tree retention), high-value wildlife trees, and coarse woody debris (CWD) within the THLB.
- **e)** Recognition and appropriate management practices for of a range of types of aquatic habitats, riparian areas, and wetlands, as discussed further in this management plan.
- **f)** Recognition, protection, and management of areas of special management concern or significance within the landbase based on special geographic or ecological features, high value habitats, or high-value wildlife trees or tree groups.
- **g)** Ecosystem restoration where appropriate, within degraded habitats. And,
- **h)** Ecosystem representation within all of the above.

Measurable, verifiable target (results) and strategies for each of these goals are provided in the following sections of this Management Plan.

12.3 Wildlife Habitat

Identified Wildlife Strategies

Within the ALRF, there are (at the time of plan preparation) no known provincially- or provincially-designated Wildlife Habitat Areas, Wildlife Strategies, or Ungulate Winter Range, as defined in the *Government Actions Regulation*, or the *Forest Planning and Practices Regulation*.

As needed, new information on Identified Wildlife Strategies (or similar objectives identified by government) will be recognized and incorporated into this management plan via addenda to the plan.

(TOP) Post-harvest retention of mature Douglas fir leave trees and riparian reserves within an ALRF harvest cutblock (ABOVE) Snail, likely a Forest Disc snail (*Discus whitneyii*) observed on a log in old-growth forest, ALRF, summer 2016

Wildlife Trees and WT Retention Areas

Within the ALRF land-use zones designated for sustainable timber management, stand-level biodiversity will be maintained by post-harvest retention of the following features within the Site Plan area:

1. Representative areas with late-seral or multi-layered stand characteristics and/or identified high-value wildlife trees and varied structural stages and wildlife tree types, tree species, and size-class cohorts. And,
2. Younger or early-seral stand types with high existing wildlife use, biologically-important geographic features for wildlife (such as watering holes, major game trails, or mineral licks), and/or high potential to recruit rare or unusual stand characteristics or wildlife features as these stands age or develop.

Designation of WTRA's during forest operations will be guided by conservation and protection of the following features:

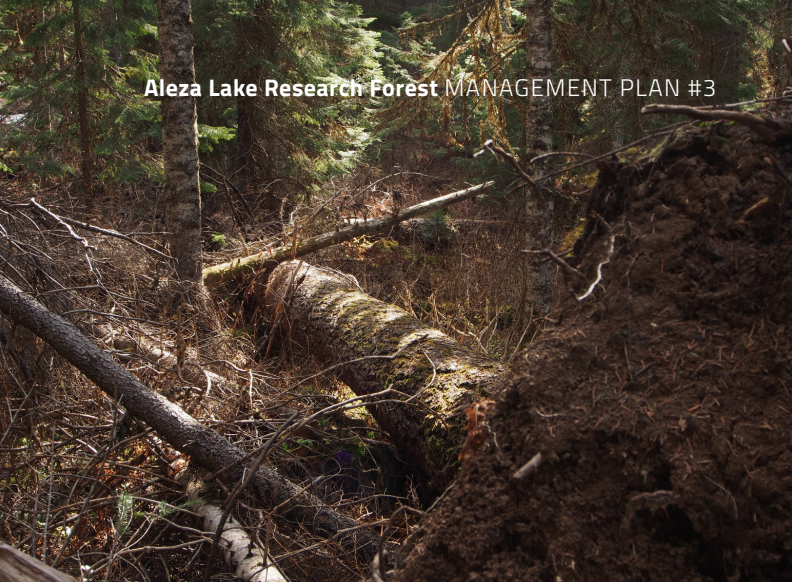
- **i.** High-value wildlife trees and wildlife-tree concentrations.
- **ii.** Wildlife water sources.
- **iii.** Raptor ("stick") nests.
- **iv.** Areas of high ungulate use or bedding sites.
- **v.** Areas with frequent or repeated wildlife sightings.
- **vi.** River floodplains and/or wetland complexes.
- **vii.** Areas with multiple or overlapping high-value biodiversity / wildlife features.

WRTA management within the ALRF will be consistent with the following conditions, and meet the following targets:

- **a)** WTRA's will be designated in professionally-prepared Site Plans and their spatial locations recorded within the provincial RESULTS database.
- **b)** On average across the ALRF, WTRA areas will be at least 12% of the total area of the total harvest area of all cutblocks.
- **c)** For individual cutblocks greater than 10 hectares in area, the total amount of WTRA's that relate to the cutblock will be at least 3.5% of the cutblock harvest area.
- **d)** A WTRA may relate to more than one harvest area if all of the harvest areas that relate to the WTRA are: (i) encompassed within a single Site Plan, and (ii) the Site Plan also provides a logical, ecologically-based, and defensible professional rationale for the WTRA location(s) relative to harvest areas.
- **e)** Timber will not be harvested from a WTRA, except where specified in detail in a Site Plan, for the purposes of ensuring worker safety, and/or reducing of windthrow potential along identified WTRA boundaries. In general, WTRA's should be laid out to minimize and avoid disturbances to WRTA boundaries.
- **f)** Requirements for dispersed leave-tree and wildlife-tree retention within harvest cutblocks will be specified in applicable Site Plans. (See also Best Practices below).

At the ALRF, WT retention Best Practices will generally apply to all harvest areas under the Site Plan excluding road rights of way and roadside processing areas. Preferred retention trees and characteristics will include the following, where safe to do so:

- Whole (unstubbed) trees, unless stubbing is specified in the Site Plan.
- Live Douglas-fir > 25 cm dbh, and especially large Douglas-fir > 40 cm dbh.
- Western hemlock.
- Deciduous tree species. And,
- Other tree species may be retained as appropriate on a site specific basis.



(TOP LEFT) Abundant downed logs and coarse woody debris are a defining feature of old-growth forest habitats in the ALRF area (TOP RIGHT) Downed logs following logging and prescribed burning on the "West Burn" (West Branch Road) at the ALRF, 1948 (ABOVE) Long-toed Salamander inhabiting rotten wood in a downed log at the ALRF

Coarse Wood Debris Retention & Management

Coarse woody debris (CWD) are non-merchantable, non-utilized logs greater than 7.5 cm at the largest end left on a harvested area (or "cutblock").

CWD, as it lays in place on the forest floor and decays over time, plays important ecological roles as wildlife habitat and plant and fungal substrates and micro-habitats, and in natural nutrient and organic matter cycles including carbon sequestration. In general, the larger the CWD log size, the longer it will take to decay and provide more sustained ecological benefits and habitat attributes to the site.

CWD management on the ALRF will emphasize leaving a wide range of piece (log) sizes on harvested sites (excluding road construction), and a key management focus will be on post-harvest retention of CWD pieces greater than 30 cm (in butt diameter at the largest end of the log) being well dispersed on harvested units. Stevenson (2009) reported on ALRF operational performance in CWD retention on various cutblocks, providing the basis for updated goals for CWD management.

Timber harvesting and post-harvest fuel management treatments on the Research Forest area will retain average amounts of logs on a cutblocks harvested over a 5-year or greater period (i.e. net harvested area) that meet the following criteria:

> At least 50 cubic metres per hectare or more of logs of Decay Class 1 and 2, greater than 7.5 cm at the largest end, of which at least 30% of this volume are at least 5 m in length and 30 cm in diameter at one end.

Specific harvest strategies for promoting CWD retention will include:

- **i.** Leaving sufficient amounts of larger non-merchantable or low-quality stems on-block or ideally "at the stump" (away from log processing and slash piling / fuel management areas).
- **ii.** Confining machine piling of logging debris and/or prescribed burning for fuel management to treatment of heavy roadside accumulations and occasional fine slash, and avoiding piling or burning of dispersed CWD. And,
- **iii.** Limiting or constraining biomass / bioenergy / pulp utilization on harvested sites at the ALRF so that biomass utilization does not reduce CWD retention below the above limits.

Flooded backwaters and oxbows along the Bowron River floodplain are important and productive aquatic and riparian habitats

12.4 Watersheds and Aquatic Habitats

Objectives, results, and strategies for watersheds and aquatic habitats (WSAH) for the ALRF are linked and interdependent with those for Riparian Areas under this plan. However, this WSAH section encompasses additional issues for aquatic and wetland ecosystem values over and above those for Riparian Areas alone.

Major watershed sub-basins within the ALRF are mapped and illustrated in Appendix A1.

The Aleza Lake Research Forest will manage and protect watersheds and water quality in a manner consistent with this Management Plan, the *Water Sustainability Act and Regulation*, the *Forest and Range Practices Act*, and the *Forest Planning and Practices Regulation*, as amended from time to time.

No community watersheds, licensed water users, or licensed water intakes are located within the Aleza Lake Research Forest at the time of preparation of this plan.

General ALRF land use objectives for watersheds, water quality and aquatic habitats (consistent with the Prince George LRMP, 1999) are:

1. To protect the quality and quantity of ground and surface water. (and)
2. To conserve the natural range of stream flow and watershed patterns and processes to safeguard fisheries, other wildlife, recreational values, and ecosystem functioning.

Specific results and strategies for ALRF water quality and aquatic habitats are:

- **a)** To protect and manage riparian areas (inclusive of waterbodies and watercourses) as per the Riparian Area results and strategies identified in this management plan.
- **b)** To develop / document best management practices (BMP's) to manage roads and drainage structures consistent with above legislation and regulations.
- **c)** To improve spatial inventory and mapping of fish-bearing vs non-fish-bearing streams on the ALRF during the term of this plan to reflect new information, including LiDAR digital elevation terrain models.
- **d)** To undertake watershed assessments on all ALRF watershed sub-basins (Appendix A1) as per WAP protocols (BC Min. of Forests, 1999).
- **e)** To manage fish-stream crossings consistent with the Fish-stream Crossing Guidebook (MFLNRORD, 2012, or as updated from time to time), and Pike et al (2010).
- **f)** Annual or bi-annually (every 2 years), to monitor and assess stream crossings and road culverts based on identified risk (e.g. - inspection of higher-risk structures at least annually, and more frequently on a routine basis and during freshet events). And,
- **g)** To develop and implement Amphibian-Habitat Best Management Practices for forest operations and road and drainage structure maintenance during the term of this plan.

Hansard ("Camp") Creek above the Aleza Forest Road crossing

12.4.1 Riparian Areas

Definitions and Key Concepts

Riparian areas are those areas that surround water bodies and watercourses in a watershed, including lakes, ponds, streams, or wetlands. These areas are generally composed of moist to saturated soils (sub-hygric to hydric) and associated plant communities and ecologies, and incorporate many interactions between the water, soil, microorganisms, plants and animals. Riparian zones are important transition areas that connect aquatic ecosystems with the land, and support a wide diversity of terrestrial, semi-aquatic, and aquatic plant and animal life. Additionally. riparian areas link the ecosystems through which water flows, providing pathways for wildlife, dispersal of plants, food sources, and nutrient transfer.

On the ALRF, as elsewhere, riparian areas support critical natural functions important to management of biodiversity, fish and fish habitat, and aquatic ecosystems including contributions of vegetation and leaf litter, shade and wind protection, habitat for insects and amphibians, inputs of large woody debris, streambank stability, and moderating temperature and moisture conditions.

ALRF Management Intent for Riparian Areas

The ALRF recognizes the statutory requirements set by the Province for management of riparian areas, and also considers potential additional best management practices. The ALRF in this plan will also use additional riparian-feature definitions and strategies appropriate to the specific climate, terrain, soils, and ecology of the ALRF landbase.

Statutory Framework

ALRF forest practice requirements related to riparian areas (including areas related to streams, wetlands and lakes) will be consistent with the riparian stewardship requirements provided by the *Forest and Range Practices Act* and the *Forest Planning and Practices Regulation*, as amended from time to time. Additionally, ALRF riparian management standards will exceed FRPA and FPPR standards in circumstances specified under this management plan.

This plan provides additional clarification of riparian definitions and terms of reference, for more locally-specific interpretation and application of riparian management at the ALRF.

Proposed ALRF variances from provincial statutory requirements – and additional supporting definitions and interpretations provided in this plan will be based upon:

- Expert opinion and consensus in available literature (for riparian-feature definitions),
- The specific ecology, geomorphology, hydrology, and character of ALRF riparian systems and individual watersheds.
- ALRF management experience and local knowledge in riparian area management. And,
- The best available science and management recommendations from regional riparian, watershed, and stream management research.

Sampling of fish populations in Hansard Creek, ALRF

Supporting Definitions for Interpretation of ALRF Riparian Features

12.4.2 Linear Riparian / Aquatic Features – Rivers and Streams

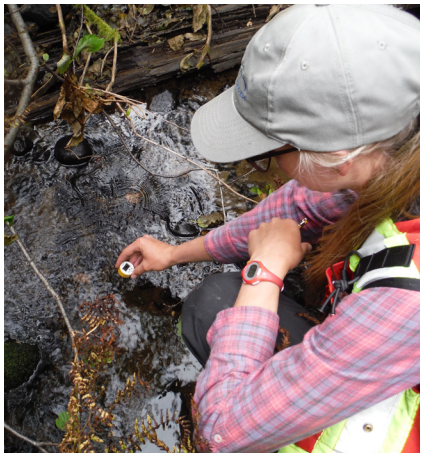
Streams

A stream is commonly defined and understood as *"a body of running water (as a river or brook) flowing on the earth"* (Merriam-Webster Dictionary, 2017).

Under the Forest and Range Practices Regulation (2016) the legal definition of a "stream" is *"a watercourse, including a watercourse that is obscured by overhanging or bridging vegetation or soil mats, that contains water on a perennial or seasonal basis, is scoured by water or contains observable deposits of mineral alluvium, and that (a) has a continuous channel bed that is 100 m or more in length, or (b) flows directly into (i) a fish stream or a fish-bearing lake or wetland, or (ii) a licensed waterworks."*

The FPPR traditionally defines 6 different classes of streams based on stream width, fish presence, and other criteria. Small watercourses that do not meet the statutory definition of a stream are referred to in this plan as *"non-classifiable drainages"* (abbreviated as "NCD's").

NCD's (including associated headwater seepage areas, springs, and watercourses with organic, non-alluvial beds) are contiguous to downstream classifiable streams, and are important hydrological features that will be recognized and managed appropriately in the course of ALRF forestry activities.



Floodplains

The Forest Planning and Practices Regulation (2016) defines an *"active flood plain" as "the level area with alluvial soils, adjacent to streams, that is flooded by stream water on a periodic basis and is at the same elevation as areas showing evidence of... flood channels free of terrestrial vegetation,... rafted debris or fluvial sediments, recently deposited on the surface of the forest floor or suspended on trees or vegetation, or... recent scarring of trees by material moved by flood waters."*

Under this plan, the ALRF will consider floodplains active at any part of the year to be part of the riparian management area of any classifiable stream.

Non- Linear Riparian Areas – Water bodies to wetlands

Lakes, Ponds, and Wetlands

A lake is commonly defined and understood as *"a considerable inland body of standing water"* (Merriam-Webster Dictionary, 2017) or *"a large area of water surrounded by land and not connected to the sea except by rivers or streams"* (Cambridge Dictionary, 2008). A pond is a *"body of water usually smaller than a lake"* (Merriam-Webster).

The Forest Planning and Practices Regulation (FPPR, 2016) does not otherwise define lakes or ponds, but does define different classes of "lakes" based on their size (in hectares) and their location within specific biogeoclimatic zones. However, the FPPR has no management criteria for lakes or ponds < 1 hectare in the Sub-boreal Spruce biogeoclimatic zone.

Therefore, the ALRF uses the following approaches and definitions in lake and wetland management:

The BC Lake Survey Toolkit (as per the Resource Information Standards Committee, 2004) defines a lake as *"an open waterbody*

Extensive pond and wetland complexes are a frequent feature of ALRF plateau landscapes

with a depth greater than 2 metres and with less than 25% of its surface area covered with wetland vegetation". This survey document further states that *"by default, an open waterbody less than 2 metres deep is a wetland"*.

The FPPR defines a "wetland" as *"a swamp, marsh, bog, or other similar area that supports natural vegetation, that is distinct from adjacent upland areas"*.

In the provincial guide to the wetlands of British Columbia, McKenzie and Moran (2004) define wetlands in more detail, as *"areas where soils are water-saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principal determinants of vegetation and soil development. Wetlands will have a relative abundance of hydrophytes in the vegetation community and/or soils featuring "hydric" characters."*

The BC Ministry of Environment's (BC MoE) Guidelines for Amphibian and Reptile Conservation (2014) and related recent operational guidelines (e.g. Wind and Beese 2008) emphasize the ecological importance of small shallow seasonal / ephemeral ponds and shallow-water wetlands for effective amphibian breeding and rearing habitat, and the vital function of such small ponds and wetlands in separating amphibians and their juveniles from fish predation. From an amphibian and reptile habitat perspective, MoE guidelines therefore emphasize the natural hydrological regime of lakes, ponds, and wetlands areas, not just the vegetation and soils of the area.

Based on such guidance, the ALRF will follow the following best practices and guiding principles for maintaining the hydrological features needed by amphibians and reptiles:

- Consider and conserve the natural hydrological regime of sensitive areas for amphibian habitat, including shallow-water wetlands.
- Avoid undue impacts, or draining, or dredging of natural wetlands during forest operations.
- Ensure that management (site) plans and operational practices (including road maintenance) consider and conserve the hydrology of wetlands and other watercourses.

(TOP) ALRF amphibians dependent on shallow water wetlands include the Western Toad (ABOVE) Long-toed Salamander

Significant ALRF Wetland Types

Wetlands may be non-forested, lightly wooded, or forested. As noted by McKenzie and Moran, *"wetlands include a broad range of ecosystem types, from those permanently flooded by shallow water and dominated by aquatic organisms to forested sites with merely wet soils"*.

This ALRF management plan recognizes and will manage all wetland types, including forested wetlands.

At the ALRF, Sundews (*Drosera* spp.) are found only in raised nutrient-poor peat bogs

Transitional Riparian Ecosystems

Riparian areas encompass a very wide range of features, ecological conditions and vegetation types from fully aquatic, semi aquatic, semi terrestrial, and terrestrial ecosystems. On gently rolling and near-level plateau terrain in the ALRF landscape, ecological changes can be gradual, and there are many transitional ecosystems. Areas near or adjacent to wetlands, streams, and lakes and ponds have such transitional or ecotonal features, and these can vary seasonally.

Two transitional riparian ecosystems that are quite common on the ALRF, and that have high management significance on the ALRF, include (a) shallow-water wetlands, and (a) forested swamps.

Shallow-water Wetlands

"Shallow-water Wetlands" as defined by the Canadian wetland classification system are: *"open waters that cover at least 75 percent of a total wetland area in summer and have a midsummer depth of less than 2 metres. They are commonly referred to as ponds, pools, shallow lakes, oxbows, reaches, channels, or impoundments, and are usually edged by water-eroded shorelines or by the landward margin of mudflats, floating vegetation mats, or shrubs. Not infrequently, this type of wetland is found within other wetland types"* (National Wetlands Working Group, 1997).

On the ALRF, these frequently include beaver ponds back-flooding lowlying areas , and seasonal marshes and fens which temporarily inundate during spring and fall seasons. Shallow-water wetlands occur in some low-lying depressional areas in the northern upland and plateau of the ALRF, but also are particularly abundant on the Bowron River floodplain in the southern portion of the ALRF. Due to the influence of more mineral-which groundwater and surface hydrology, they tend to be richer plant communities and wildlife habitat than the raised peat bogs which are the more common wetland type on the ALRF.

Forested Swamps (Spruce-Horsetail SBSwk1-09 Site Series)

The Spruce – Common horsetail – Leafy moss Swamp Site Association is a forested wetland common in the SBSwk1 subzone as the 09 site series (McKenzie and Moran, 2004). As this type often occurs on lower and toe slopes and margins of other wetland types, where there is significant flow of mineral-rich groundwater, they are technically recognized (as above) as a class of wetlands known as "forested swamps".

Though inherently variable, these can be moderate productivity sites for commercial tree growth, with spruce and subalpine fir rooting on elevated mounds. The shrub layer may be well developed or sparse, with twinberry *(Lonicera involucrata)* most prominent. Common horsetail *(Equisetum arvense)* is abundant but many other upland and wetland species are common. The diverse moss layer includes leafy mosses *(Mnium* spp.) and ribbed bog-moss *(Aulacomnium palustre)* usually in depressions, and feathermosses including *Pleurozium schreberi* on raised mounds. Soils most often have a thin, dark, well-humified, woody peat veneer over fine-textured mineral soils, but occasionally deeper peat deposits are encountered.

On the ALRF, due to their often well-developed forest cover, taller trees, and productivity, forested swamps in the SBSwk1-09 site association (and similar SBSwk-10 Devils Club-Lady Fern sites) have had a frequent history of timber harvesting activities due to their substantial timber values. These sites have been included in many individual past and current ALRF cutblocks, and form part of the ALRF timber harvesting landbase. These can often also be challenging sites for reforestation due to cold wet soils (DeLong 2003), and longer reforestation periods than would be expected than on warmer or more well-drained upland sites.

On the ALRF, forested swamps may be harvested, regenerated, and managed for sustainable timber production on a site-specific basis, within the ALRF timber harvesting land base.

Results and Strategies for Riparian Areas in the ALRF

ALRF forest practices in and adjacent to riparian areas will be consistent with (i.e. – meet or exceed) the *Forest and Range Practices Act* and the *Forest Planning and Practices Regulation* (FPPR) as amended from time to time, *except for the following circumstances, where a higher minimum standard of riparian management will apply:*

A. Riparian Reserve Zones on S4 Streams (small fish-bearing streams)

Under this management plan, the minimum riparian reserve zone (RRZ) on all S4 streams within the ALRF will be 20 metres on each side of the stream.

B. Headwater "NCD" Non-channelized Water Flows, Seepage Areas, and Springs

Headwater non-channelized surface water drainages, water-seepage areas, or springs are important hydrological features affecting headwater stream water quality, quantity, and timing. Because headwater flows, seeps, and springs in many cases may be non-channelized and/or also sub-surface water flows, they may not be classifiable streams, and may be determined to be a Non-classifiable Drainages (NCD) according to provincial stream classification criteria under the FPPR. Nevertheless these areas need management attention and appropriate measures during forest operations to manage and protect hydrological functions (Nordin and Bradford, 2017).

In ALRF operational planning, Non-classified Drainages (NCD) that include significant seepage areas and/or springs, will be spatially mapped on all ALRF operational plans, and it is recommended that a minimum Machine-Free Zone (MFZ) of 5 to 8 metres from the outside edge of the feature will be applied.

In addition, during the term of this Management Plan, the ALRF will develop Best Management Practices for the recognition and management of site characteristics and ecosystems related to these hydroriparian areas including non-channelized surface flows, seepage areas, and springs on the ALRF.

C. Riparian Management Areas for Shallow-water Ponds

Under this management plan, the recommended Riparian Management Zone (RMZ) for shallow-water ponds > 0.25 hectares in area within the ALRF is 20 metres from the terrestrial (upland) edge of the waterbody and/or wetland feature.

D. Management of Forested Swamps (Ws07 or SBSwk1-09 sites)

Under this plan, commercial timber harvesting and sustainable timber management is acceptable practice in SBSwk1-09-leading "forested wetland" site series based on a qualified professional pre-harvest assessment and Site Plan, if the sites have a high likelihood for reforestation to required standards, and are managed to windfirm harvest boundaries.

Portions of SBSwk109 forested wetlands not suitable for sustainable forest management must be excluded from harvest areas, and may, if suitable, be integrated into adjacent Wildlife Tree Retention areas.

E. Management of Riparian Areas associated with Ravines

On the ALRF, ravines are natural landscape features that have been deeply incised over time by water, into fine-textured lacustrine parent materials. In the ALRF's wet climate, ravines frequently have periodic, ephemeral, or perennial streamflows and seepage. Forest practices associated with ravines must maintain the integrity of stream-side riparian management areas, slope stability, and minimize related sediment sources.

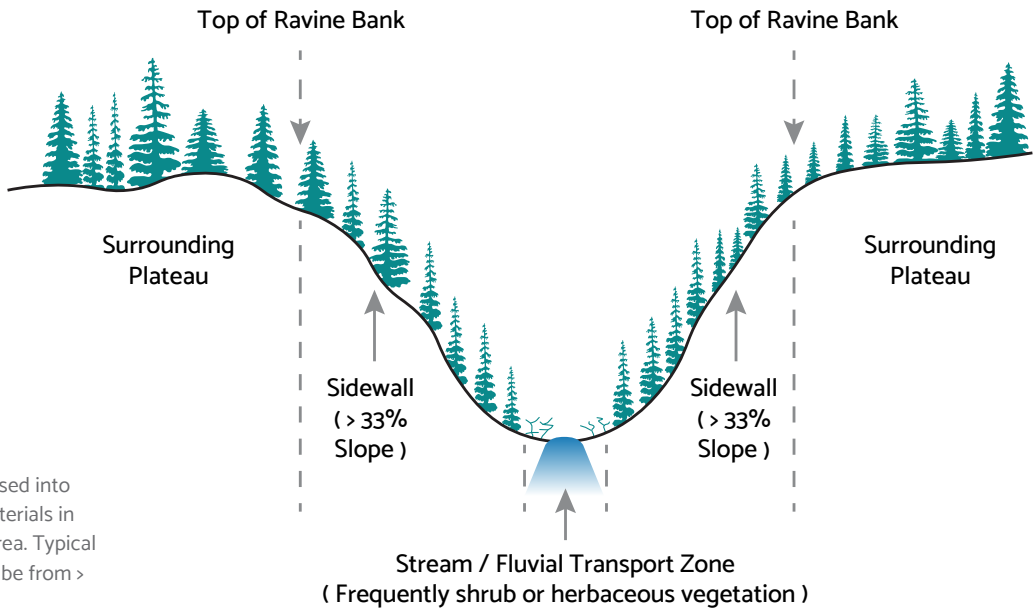
For the purposes of this Management Plan and associated operational planning, the terms "ravine" and "top of the ravine bank" are defined as follows (adapted from the *Provincial Riparian Areas Regulation*, 2004):

- A "ravine" is defined as a *narrow steep-sided valley that is commonly eroded by running water and has sidewall or headwall grade greater than 3:1 or 33%*. And,
- The "top of the ravine bank" means the first significant break in a ravine slope where the slope break occurs such that the grade beyond the break (away from the ravine) is less than 3:1 or 33% slope for greater than 15 metres horizontal distance from the slope break.

For ALRF operational planning in areas associated with classifiable streams in ravines, the following minimum riparian management standards will apply:

- The top of the ravine bank will be determined and verified by field reconnaissance, and clearly indicated on planning maps.
- Forest practices within the ravine, and adjacent to, and along the ravine bank will ensure appropriate measures to address: (a) slope stability and sediment production potential, (b) tree windthrow risk, (c) the stream classification, and (d) stream, fish and aquatic habitat, and water quality protection and management considerations.
- Where observed site conditions warrant and/or as per professional practice requirements, a qualified Terrain Stability Assessment (APEG-ABCFP Joint Guidelines, 2008) may need to be undertaken on or around ravines where forest operations are planned. Geotechnical recommendations resulting from such assessments may supersede this section and the minimum provisions of this Management Plan.

Figure 9: Cross-section of a typical ravine and location of top of the ravine bank



Cross-section of typical ravine incised into fine textured lacustrine parent materials in the Aleza Lake Research Forest Area. Typical headwall and sidewall slopes may be from > 30% to 70% gradients

12.5 Invasive Plants: Management Strategies and Best Practices

Management strategies for invasive plants within the ALRF will include periodic monitoring of invasive species, assessment of infestations, and management of noxious weeds to reduce and mitigate the spread of specified species.

Invasive plant management strategies at the ALRF will focus on linear road corridors which provide key dispersal routes for the seeding-in and spread of invasive plants that prefer early seral open conditions.

Based on current information at the time of preparation of this management plan:

Three thistle species (Canada thistle (*C. arvense*), Marsh Plume thistle (*C. palustre*), and Scotch thistle (*O. acanathium*) will be the primary focus of species-specific invasive-plant management and best practices. Canada and Marsh Plume thistles are listed provincially-regulated noxious weeds under the *Weed Control Act* in the Fraser Fort George Regional District. Scotch thistle is a similar invasive species though not currently listed as noxious for this area.

Oxeye Daisy (*L. vulgare*) and Orange Hawkweed (*Hieracium* spp.) are not listed as noxious weeds for this regional district, and will be considered under more general management provisions for limiting seedbeds and the spread of invasive plants.

Thistle management

Thistles, such as the Canada, Marsh Plume and Scotch found at the ALRF, prefer disturbed soils or bare ground and the seeds are dispersed primarily by wind (Invasive Species Council of BC, 2014). All prefer early-seral successional conditions and high light availability, and are gradually out-competed and shaded out by other species at later stages of vegetation and stand development. Canada thistle is perennial, and can reproduce by vegetative spreading into larger colonies, while Marsh Plume and Scotch thistle are biennial species that are primarily wind-dispersed by seed. Marsh Plume thistle prefers moist sites of high water availability and higher water tables (NWIPC, 2014), while Canada and Scotch thistle tend to prefer well-drained soils.

At the ALRF, allocation of available resources for active treatment and reduction of thistle infestations (by mechanical cutting of stems, seedheads, and uprooting and disposal of rosettes) will be prioritized to the following areas directly along and adjacent to (within 10 metres of):

1. Permanent walking and interpretive trails (to reduce dispersal of seeds attaching to trail users).
2. In the vicinity of buildings and visitor facilities.
3. Permanent all-weather road corridors. And
4. Recently-disturbed construction sites or rehabilitation within 100 m of permanent road corridors.

Managing linear road corridor to limit spread of invasive plants

Along permanent road corridors at the ALRF (Aleza FSR, East Branch Road, West Branch Road, Bear Road, Ridge Road), road maintenance activities (e.g. grading, ditching, culvert maintenance and replacement, and disposal of surplus soil) periodically reduce native vegetation cover and expose mineral soil seedbeds that may encourage seeding-in and establishment of invasive plants.

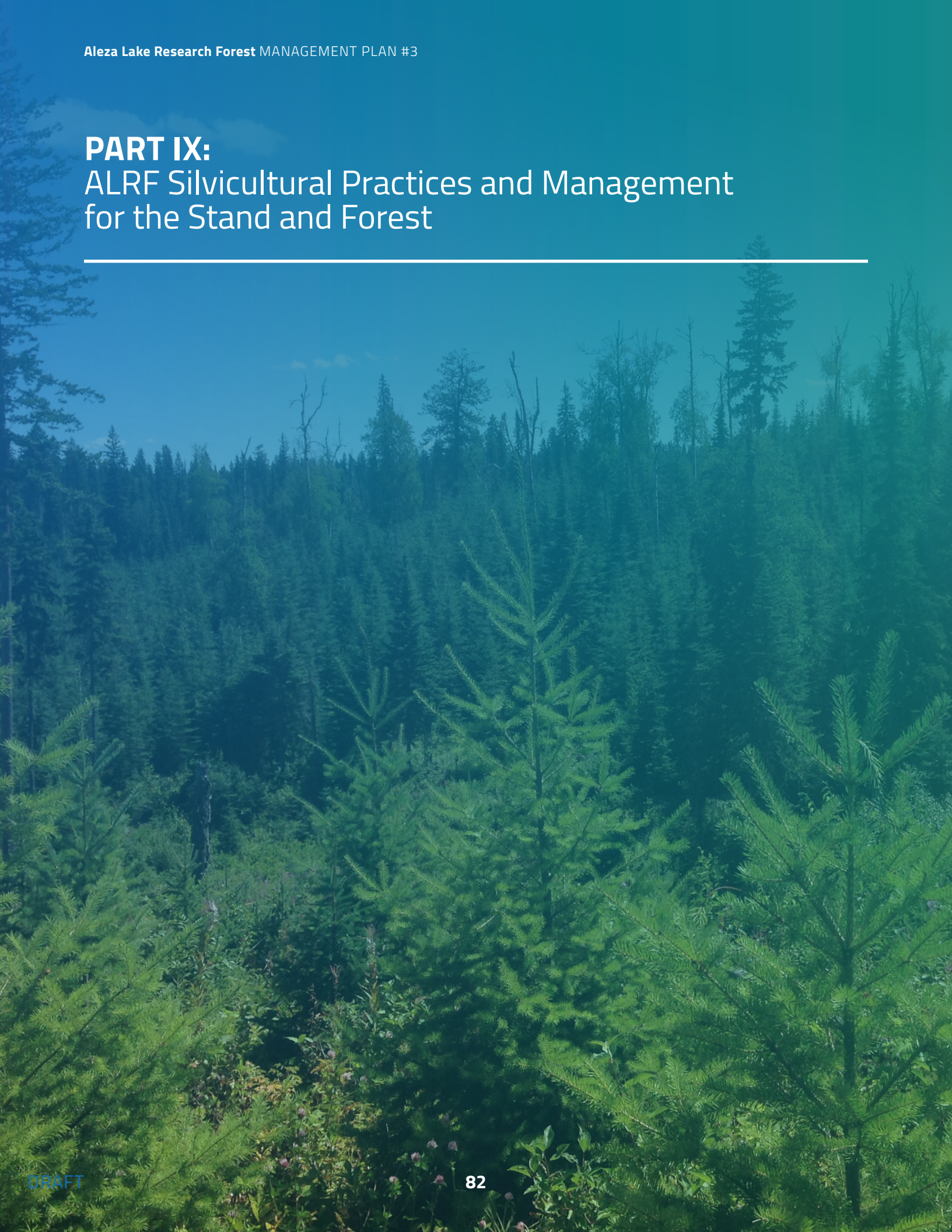
In addition to the thistle monitoring and active management measures described above, the primary strategies for mitigating the spread of invasive along permanent road corridors will be:

1. Prompt revegation of exposed mineral soils - within the road right-of-way and outside the road running surface - with agricultural or horticultural seed mixes free of weed species, or where feasible, adjacent seed sources for native plants. And,
2. Practices that encourage the retention of the root mats of existing established non-invasive plants, especially lower-growing species, without impairment of road drainage and function.

Updating and revision of invasive-plant strategies

ALRF strategies for management of noxious/invasive plants will be updated periodically and as required based on new information.

PART IX:
ALRF Silvicultural Practices and Management for the Stand and Forest



13. SILVICULTURAL PRACTICES AND MANAGEMENT FOR THE STAND AND FOREST

"The competent practice of silviculture, whether it be crude or elaborate, demands as much knowledge of such fields as ecology, plant physiology, entomology, and soil science as a forester can acquire. It is through silviculture that the growing store of knowledge about trees and forests is applied.

Skillful practice itself is a continuing informal kind of research in which understanding is sought, new ideas are applied, and old ideas are tested for validity. The observant forester, who is wise to seek to explain what is observed, will find answers to many silvicultural questions in the woods by examining the results of accidents of nature and earlier treatments of the forest."

Excerpted from: *The Practice of Silviculture: Applied Forest Ecology* (Chapter 1)
David M. Smith, Bruce C. Larson, M. Kelty, and PM Ashton (1997)

Mature ALRF spruce-subalpine fir stand, originally logged in 1927

13.1 Key ALRF Silvicultural Goals

ALRF silvicultural practices from stand establishment through to maturity will consider the overall management intent and objectives for the Aleza Lake Research Forest landbase, including forest education and demonstration, and facilitation of scientific enquiry and research across a wide range of ecosystems and forest practices.

The 6 key goals of ALRF silvicultural planning and practice are to:

1. Grow, manage, and utilize diverse, productive, resilient, high-quality forests on a sustainable basis within the identified ALRF timber-management land base, in a manner compatible with other forest land management goals and statutory requirements, and mindful of present and future climatic variability.
2. Foster diverse teaching and learning opportunities, innovation, and research opportunities relating to silvicultural strategies and practices.
3. Manage and maintain timber values amongst a diverse array of non-timber forest values on the ALRF landscape.
4. Use and demonstrate on the landbase, a wide range of tree species, silvicultural systems, harvest patterns and systems, reforestation methods, and stand-structure retention strategies.
5. Undertake scientific studies and well-monitored operational practices that differ from currently accepted methods and standards, for the purposes of teaching and demonstration, advancing scientific understanding, and testing the outcomes of contrasting management techniques. And,
6. Provide revenues from sustainable forest harvest operations to provide sufficient financial resources for supporting ALRF management goals on a long-term basis.

13.2 Chief Forester's Standards for Seed Use

Seed use for reforestation by tree-planting on the ALRF will be consistent with the Chief Forester's Standards for Seed Use, (or "CF standards") as amended and updated from time to time.

For greater clarity, the CF standards apply to planted trees, and do not apply to tree seedlings that naturally establish or regenerate on ALRF sites from locally-occurring seed sources, sprouts, or suckers.

As per the intent of these standards, the ALRF Society as tenure holder will ensure that at least 95% of the trees planted on the tenure area over a specified time period are consistent with the transfer limits for registered seedlots and vegetative material under the standards.

The ALRF will vary from the CF standard regarding the time period over which compliance with this provision is measured. For the ALRF, compliance with transfer limits will be measured based on all trees planted over 36 months (3 years) prior to the end of the most recently-completed calendar year (for the ALRF, Dec. 31st of a given year). The rationale for this variance is due to to potentially high year-to-year variability in harvest activity and reforestation scheduling at the ALRF.

Douglas-fir is an increasing component of ALRF regeneration on drier sites

As allowed for in the CF standards, the ALRF Society as tenure holder may vary from the standards and transfer limits (as above) for up to a cumulative total 5% of trees planted over the above time period. The ALRF's reasons for varying from the CF transfer limits will include:

- **a)** Establishment of controlled research and experimental trials.
- **b)** Tree species "facilitated migration" trials.
- **c)** Operational reforestation trials of specific seedlots and/or tree species mixes not compliant with Chief Forester standards. And/or,
- **d)** Arboretum or special plantation establishment for teaching and demonstration purposes.

ALRF strategies for mitigating silvicultural risk in such applications will include one or more of the following: (a) keeping trials within a relatively limited proportion of the ALRF net area to be reforested in a given time period, (b) potentially establishing 'higher-risk' seed sources as fill-plantings or minor admixtures among local natural regeneration and approved planted seedlots, and/or (c) rigorous documentation, monitoring and GPS / GIS mapping and recording of the locations of of test plantings and trials.

An ALRF summer student brush-saws cottonwood saplings to reduce brush competition in a 7-year-old western larch trial (East Branch Road area, ALRF)

13.3 Climate Change Adaptation

Because British Columbia's current and future climate will tend to change and vary over time due to natural factors and anthropogenic forcing (IPCC 2013, Foord, 2016), ALRF reforestation and silvicultural strategies must consider the productivity and forest health implications of both current climatic conditions and historical variability, and potential future climatic potential conditions. This presents an ongoing challenge for silviculturists in setting reforestation and silvicultural strategies that consider forest resilience in a range of potential future climatic possibilities for the ALRF area.

Provincially, considerations for climate change adaptation for reforestation and stand establishment are incorporated into the Chief Forester's standards for tree use, and the standards are periodically updated by MFLNRORD (or applicable agencies) to reflect new understandings and scientific knowledge. This includes a Climate Based Seed Transfer strategy developed by the Ministry (O'Neill et al, 2017).

Provincial strategies and action plans for climate change adaptation in the forest sector are evolving, and will likely continue to do so over the term of this ALRF management plan. ALRF management will continuously consider such provincial guidance and evolving scientific and local knowledge, while also providing management flexibility to periodically test ALRF climate-adaptation strategies suited to local conditions.

Based on local and regional silvicultural experience, the ALRF will incorporate the following reforestation and stand management strategies in locally-based climate change adaptation (CCA) on the ALRF landbase under this management plan, as detailed in Table 8.

Table 8: Current climate change adaptation strategies for ALRF reforestation and silvicultural practices.

Strategy #	Management issue	Concerns	Applicable ecosystems / site series	Adaptive Strategies
1	Management of droughty sites	Summer drought stress on subalpine fir (and to less extent spruce) on SBSwk1 mesic and drier sites	SBSwk1-01, 02, 03, 04	• Replace or reduce Spruce-subalpine fir stand composition as these sites are harvested or otherwise treated silviculturally. • Enhance Douglas-fir and lodgepole pine as preferred species, • Spruce as acceptable or preferred on 01 sites, • Subalpine fir not preferred or acceptable on these sites
2	Douglas-fir (Fd) range expansion and retention	Maintain and enhance regeneration opportunities for Douglas-fir (Fd), and retain fire-resistant large stems for ecological resilience and local Fd seed sources within the ALRF.	SBSwk1-01, 04, 05, 07	• Post-harvest retention of > 75% of Douglas-fir stems > 25 cm dbh especially on these site series. • Promote natural regeneration of Fd through retention of adjacent seed sources. • Promote planting of Fd on frost-shedding mesic and drier sites.
3	Red-band needle blights (*Dothistroma septosporum*) on pines on humid sites	Elevated risks of Dothistroma needle blights on pines in humid rich subhygric and hygric sites, and along watercourses given high sensitivity of needle blight risks to warmer, wetter climatic trends (McCulloch and Woods, 2009)	SBSwk1-06, 08, 09, 10	• Emphasize hybrid white spruce (Sx) as preferred species on these site series, with subalpine fir and deciduous tree species as acceptable species for admixtures. • Downgrade lodgepole pine to Acceptable species only on these sites. • Minimize or eliminate future planting of pine on these site series except on degraded sites (roads and landings). Proportion of regenerated pine outside rehabilitation sites will be ≤ 20% in high hazard areas (as per McCulloch & Woods, 2009). • Upgrade black spruce (Sb) to acceptable species on 09 and 10 site series, especially on sites prone to growing-season frosts.
4	Mixed stands and stand - and landscape level diversity	Ensure enhanced / adequate diversity of tree species across the landscape for climate-change adaptation and resilience.	All	• Strategies per this Mgmt Plan: • Landscape-level tree species composition objectives. • Deciduous strategies

13.4 Forest Health Strategies

At the ALRF, forest health management at the landscape- and stand-level will consider natural forest ecosystem dynamics and function, climate change impacts, and the developing health and condition of individual stands and trees on the managed forest landbase.

Prescription and application of forest health strategies will provide opportunities for a wide diversity of operational and experimental approaches, rather than a narrowly-defined set of methods focused on optimizing timber management alone. Forest health strategies will consider and balance:

1. Education and research opportunities for the rigorous testing, comparison, and demonstration of different forest health management methods and approaches.
2. Existing mortality or declines in tree vigor, and relative risk or consequences of loss of adjacent trees or stands, recognizing that not all tree mortality has negative ecological consequences.
3. Potential beneficial as well as detrimental aspects of forest health agents for forest habitat, stand structure, and ecosystem function (e.g., creation of canopy gaps, wildlife trees, and coarse woody debris).
4. Potential for economic salvage of existing or incipient mortality in a cost-effective manner that minimizes impacts to, or conserves other forest resources.

General ALRF strategies for monitoring and management of forest health issues in natural and managed stands are outlined in Table 9.

ALRF forest health management practices will be consistent with the *Forest and Range Practices Act* and the *Forest Planning and Practices Regulation*, as amended from time to time. If the ALRF uses trap trees or pheromones to concentrate insect populations, the ALRF will ensure that the insect brood is destroyed before the insects emerge.

Spruce-beetle Kill of mature spruce trees at the ALRF, summer 2017

Table 9: ALRF management strategies with respect to different forest health and damage agents

Damage Agent	Strategy
Bark Beetles	• Prompt detection • Prompt salvage of infested stems where risk of loss or further infestation would have an unacceptably adverse effect on other forest resources • Retention of non-susceptible crop trees and vigorous pole-sized trees ≤ 40 cm dbh where operationally practical • Thorough ground reconnaissance • Thorough cleanup • Deployment of traps and trap trees as necessary • Adherence to district transportation restrictions
Tomentosus Root Rot	• Identification of disease centres • Encouraging mixed species stands
Spruce Terminal Weevil (*Pissodes strobi*)	• Plant "weevil resistant" rated seedlots for spruce. • Consider establishing spruce in mixed stands or under partial canopy on high hazard sites. • Consider modified strategies for juvenile spacing/brushing of spruce stands to reduce but not eliminate deciduous overstory. • Considerate moderate over-topping or admixtures of conifers with deciduous species for first two decades of rotation.
Stem Rust (*Endocronartium* spp.) [lodgepole pine]	• Plant Pli at high densities ≥ 2,000 sph • Remove infected pine stems during spacing or intermediate cuts. • Avoid pure stands of pine.
Growing Season Frost	• Identify frost-prone sites before and after harvest, for identification of suitable planting species. • Consider deciduous nurse crops (including willow) for frost prone sites. • Pine establishment is to be limited or avoided in low-lying, humid locations (such as near wetlands or creek draws) where Dothistroma / needle blight risk is a moderate to high risk after the age of free-growing, and/or through to rotation age. • Plant frost sensitive species such as Douglas-fir on upland sites and avoid frost-shedding or exposed positions
Rodents	• Regenerate sites promptly • Avoid peak population cycles for stand tending • Regenerate mixed species
Wind Damage	• Consider direction of dominant damaging winds (especially southerly to westerly winds) in design of cutblock and reserve boundaries and partial-cut silvicultural systems. • Maintain existing stable stand edges and stand structures and incorporate into operational management strategies and harvest / retention planning. • Conduct windthrow hazard and risk ratings for operational plans and silvicultural prescriptions • Target conservative harvest removals and opening sizes in partial cuts to minimize damage risk. • Use detailed pre-harvested ecological and soils mapping to avoid implementing partial cuts on areas of poor rooting and / or high wind exposure
Dothistroma Red band needle blight [lodgepole pine] (*Dothistroma septosporum*)	• Plant less susceptible (non-pine) tree species in areas of cold air ponding and high humidity, including sub-hygric or hygric / hydric sites, and areas along watercourses. • Regeneration with a non-pine-leading tree species mix. The proportion of regenerated pine should not exceed 20% in high hazard areas (McCulloch & Woods, 2009).

25-year old lodgepole pine and spruce plantations in the southwest of the ALRF

13.5 Forest-level Tree Species Composition Targets

This management plan sets ecologically-based forest-level tree species targets for biodiversity of second-growth (regenerating) managed forests within the ALRF. These species targets follow the preliminary framework established in MFLNRORD Technical Report #82 (Mah and Astridge, 2014). These MFLNRORD species benchmarks for the SBSwk1 in the Prince George area have been adapted and modified in this plan to reflect the tenure-area-specific climatic, soil, and ecological conditions found within the ALRF, based on local knowledge and management experience (as per Table 10 below).

Table 10: Forest-level Tree Species Composition Targets

*For the ALRF for (a) overall all-tree-species composition in managed stands, and (b) preferred and acceptable "crop-tree" species composition in managed stands. Benchmark values for the SBSwk1 subzone as a whole in the Prince George District (Mah and Astridge, 2014) are provided for reference *.*

Tree Species	Species Code	SBSwk1 Benchmarks* (MFLNRORD Tech Rep 82)	ALRF Target % Range of All Tree Species[a] (in managed regenerating stands)
		% and range	% and range
Hybrid white spruce	Sx	40 – 60%	50 – 60%
Subalpine fir	Bl	10 – 20%	15 – 20%
Aspen / Cottonwood	At/Ac	10 – 15%	10 - 12%
Lodgepole pine	Pl	10 – 20%	8 - 10%
Douglas-fir	Fd	5 – 10%	5 – 7%
Paper birch	Ep	5 – 6%	5 - 8%
Black spruce	Sb	No target	1 – 2%
Western larch	Lw	No target	0 to 1%
Western hemlock	Hw	0 – 5%	1 – 2%
Western redcedar	Cw	0 – 5%	0 to 1%

The forest-level species target (or "benchmark") represents the desired proportion of tree species for managed stands at the landcape level that would maintain or increase tree species diversity in ecosystems, and promote resilient landscapes. The intended use of the benchmark or target is to provide higher-level management direction for forest-level species composition from an ecological perspective within a specific ecological landscape (in this case, the ALRF), for the next 10 to 20 years, with a review about every 5 years against actual tree species proportions for managed stands.

Comparison of actual forest-level tree species composition against the target or desired species composition will allow potential imbalances to be identified, and corrective management measures (if needed) to be implemented. Desired species compositions will be compared against actual species proportions for managed stands in Age Class 1 (< 20 years) at time of regeneration delay / surveys, at time of free growing achievement, and post-free growing (20 years +).

13.6 Regeneration Methods to Achieve ALRF Reforestation Objectives

The ALRF landbase contains 10 native tree species, of which 9 have widespread distribution, within specific site and seral-stage adaptations, and 1 (western redcedar) has localized natural occurrences. Hybrid white spruce and subalpine fir are the dominant naturally-occurring conifers, with Douglas-fir, lodgepole pine, black spruce, and western hemlock also occurring, in order of decreasing abundance. Typical of sub-boreal forest types, paper birch, black cottonwood, and trembling aspen are the three broad-leaved (or "hardwood" species) that naturally occur at the ALRF, often in seral situations. Paper birch is also a recurring minor element of some mature and old-growth stands.

Three other tree species native to British Columbia, but not the ALRF, that have been planted in ALRF research and demonstration trials in the past decade include western larch, tamarack, and western white pine. Western larch and western white pine are native to moister areas of the southern BC Interior, while tamarack does naturally occur in both boreal and sub-boreal BC ecosystems.

Although planting (artificial regeneration) is standard practice after logging at the ALRF, natural regeneration and "seeding in" from surrounding stands adds significantly to the diversity of the regenerating stand

Planting methods

Hybrid white spruce, lodgepole pine, Douglas-fir, and to a lesser extent. subalpine fir, have been the traditionally-preferred merchantable tree species for sawlog-oriented harvesting in ALRF forests. Over the last 3 decades, planting has tended to be been the dominant ALRF regeneration strategy for reforestation. Correspondingly, hybrid white spruce (86%), lodgepole pine (7%), and Douglas-fir (5%) have been the most-planted tree species at the ALRF over the last 14 years (2003-2016), with their proportions being generally reflective of the relative ecological suitability of planting sites for these three species. The remaining 2% of ALRF plantings have been made up of black spruce, western larch, western white pine, and tamarack.

However, understanding of the composition of regenerating stands on previously-havested sites must consider not just planting trends, but also:

a) the contributions of natural and advance regeneration influencing the composition of the regenerating sites. And,

b) the mix of regeneration strategies (including planted, natural, and advance regeneration) that may be prescribed or occur to meet tree species composition goals.

Several different native ALRF species may be regenerated by two or more regeneration strategies. Table 11 provides a summary of recommended ALRF regeneration strategies by tree species for timber-oriented stand management and silvicultural systems.

Natural regeneration methods

In addition to artificial regeneration (planting) methods, all 10 native tree species can naturally regenerate from local seed sources (or in the case of aspen, vegetatively from root suckers as well) on appropriate seedbeds in harvested and disturbed ALRF sites. The preferred regeneration strategy for subalpine fir at the ALRF has historically been, and will continue to be natural and advance regeneration, not planting, due to abundant seed sources and advance regeneration in surrounding stands. Aspen, cottonwood, and birch typically provide considerable natural regeneration establishment on harvested ALRF areas, especially areas with naturally or mechanically disturbed microsites, with more abundant mineral soil exposure.

Advance regeneration methods

Advance regeneration (including seedlings, saplings, or poles) of subalpine fir and spruce that develop or are present in the understory prior to harvest disturbance) can be an important source of regeneration stocking in second-growth stands at the ALRF where suitable harvest practices have been used. This is especially true in partial-cut stands where understory seedlings or saplings have been protected during harvest extraction of individual merchantable trees. For Douglas-fir and black spruce, advance regeneration protection is rare, with much more limited application.

Cumulative regeneration outcomes (all methods)

Although historical plantings of spruce, pine, and Douglas-fir have made up 98% of total trees planted on the ALRF to date, landscape level species composition goals aim for these tree species to make up about 73% of the resultant total stems-per-hectare within the managed forest at a landscape scale. Recommended regeneration strategies for the tree species making up the remaining approx. 27% difference in the tree-species composition for the ALRF will be met by incorporating natural regeneration strategies (for subalpine fir, paper birch, black cottonwood, trembling aspen, black spruce, and western hemlock) and advance regeneration strategies (for subalpine fir and spruce) into ALRF forest practices.

ALRF reforestation practices on the managed forest landbase as a whole will frequently include blended strategies for regeneration of harvested areas, using planted, natural, and advance regeneration (in descending order of priority for implementation), to meet both stand-level reforestation requirements, and landscape-level tree-species composition goals. Regeneration prescriptions and strategies will vary on a site-to-site basis, and individual site plans may also consider site-specific regeneration opportunities in addition to (or complementing) planting, that can contribute significantly to landscape level goals.

For example, mature Douglas-fir leave-tree retention may provide Douglas-fir seed sources for natural regeneration. Likewise, mature or second-growth stands with well-developed thrifty subalpine fir and/or spruce regeneration can provide opportunities for modified harvest procedures for advance regeneration retention, with planting needed only in larger harvest openings or unstocked pockets.

Table 11: Recommended ALRF regeneration strategies by tree species for timber-oriented stand management and silvicultural systems

(Note that tree-species suitability and acceptability will vary by BEC site series and site-specific objectives)

	Occurrence / abundance on ALRF landscape	Current timber management significance	Anticipated future timber management significance	Planted Regeneration	Natural Regeneration	Advance Regeneration and Poles *	Ecologically Suitable for Clearcuts and Patch Cuts > 1 ha?	Ecologically Suitable for Selection, Shelterwood systems, & Openings < 1 ha?
Hybrid white spruce	Yes (H)	High	High	✔	✔	✔	Yes	Yes
Subalpine fir	Yes (H)	High	High		✔	✔	Yes	Yes
Douglas-fir	Yes (M)	Moderate	High	✔	✔	✔	Yes	In openings > 0.25 ha**
Lodgepole pine	Yes (M)	Moderate	Moderate	✔	✔		Yes	No
Aspen / Cottonwood	Yes (M)	Low	Moderate		✔		Yes	No
Black spruce	Yes (M)	Low	Moderate	✔	✔	✔	Yes	Yes
Paper birch	Yes (M)	Low	Moderate		✔		Yes	In openings > 0.25 ha**
Western hemlock	Yes (M)	Low	Low		✔		Yes	Yes
Western redcedar	Yes (L)	Nil	Unknown	✔***	✔		No***	Yes***
Western larch	Planting trials	Nil	Low	✔***			Yes***	No
Tamarack (*Larix laricina*)	Planting trials	Nil	Unknown	✔***			Yes***	No

* Subject to stem damage acceptability criteria.

** Partial shade tolerance. Warmer brighter locations in openings and frost-shedding sites preferred for better performance.

*** Generally, currently in localized ALRF research trials only, due to current seed transfer limitations for the SBSwk1 subzone.

H = Species is frequently to highly abundant on many to most ALRF sites.

M = Species is of medium abundance on suitable sites.

L = Species is of low to scattered occurrence across ALRF sites.

Aerial view south of the West Branch Road at the ALRF, illustrating a variety of silvicultural systems, including clearcut (upper photo), uniform shelterwood (centre of photo), and group / strip selection (lower photo)

13.7 Silvicultural systems

Consistent with the educational and research mandate of the Aleza Lake Research Forest, ALRF silvicultural management will provide opportunities for:

1. A wide spectrum of examples of silvicultural systems and post-harvest levels of structural retention at the ALRF, for provide teaching and demonstration, to meet a range of ALRF land-use objectives, and to provide comparisons and information for research and educational purposes. And,
2. Incorporation of innovative and unconventional stand management techniques into routine year-to-year forest land management at the ALRF.

Single-tree selection-cut stand at ALRF in 2018, 23 years after a partial-cut stand entry to remove spruce-beetle-attacked trees.

Silvicultural systems that have been historically used at the ALRF generally include clearcut and patch cut systems, group (or strip) selection, irregular single-tree selection, uniform (and irregular) shelterwoods.

General considerations for, and definitions of ALRF silvicultural systems for the purposes of this management plan are summarized in Table 12 and 13.

The ALRF guidance matrix for reporting retention openings and partial-cut silvicultural systems into the RESULTS provincial silviculture reporting system is summarized in Appendix C.

Site-specific considerations for applying different silvicultural systems

In general, ALRF silvicultural systems prescribed for a given stand, site, and management situation will be the best or most feasible combination of harvest and silvicultural treatments to meet all of the following basic goals:

1. Consistency with the goals and objectives of the management unit or land-use zoning.
2. Site-specific research, demonstration, and/or educational goals.
3. Consistency with the ecology and silvics of the desired tree species and stand structure, including regeneration ecology.
4. Efficient use of growing space, timber growing stock, and site productivity, in the context of specific land use goals.
5. Minimizing damage from biotic and abiotic damage agents, including wind, insects, pathogens, and logging damage / stem decays and defect.
6. Logging equipment, treatment feasibility, and economics, both in current and future cutting cycles. And
7. Efficient spatial arrangement and organization of forest operations.

Various site and stand factors, and land-use objectives must be evaluated when considering the options for, and final choice of silvicultural systems for a particular area. Table 12 provides a summary of different site and stand factors common to the ALRF landbase that may influence the choice of partial-cut vs clearcut systems:

Table 12: Factors influencing choice of silvicultural systems and/or harvest patterns at the ALRF.

This table is designed as a general reference guide for management, and is not a comprehensive decision key.

Type of factor	Favorable for partial-cut silvicultural systems	Consider clearcut or similar even-aged systems
Stand structure and tree vigor	• Greater proportion of vigorous and healthy ("thrifty") trees vs poorer quality or declining trees. And/or • Well-developed thrifty advance regeneration layer. Or • Well-developed cohort of target leave trees	• Unfavorable stand structures or tree pathology, or advanced stand age, with much higher proportion of low-vigor, declining, or poor-quality trees (such as at stand "breakup"). And/or • Heavy damage or mortality to the majority of stems (or basal area) in the stand.
Natural disturbance characteristics	Stand - or habitat management objectives that include smaller-gap regeneration, retention of mature stand characteristics, or creation of multi-layered or - aged stand structures (e.g. - gap / patch dynamics).	Stand or habitat management objectives that include emulation of larger-scale natural disturbance characteristics (e.g. large patch sizes) and extensive even-aged stand management (e.g. - fire).
Soil drainage and texture	Moderately- to well-drained soils with (for example) > 40 cm rooting depth and lower windthrow hazard.	Relatively poorly-drained soils (e.g. heavy clay soils) with < 30 cm rooting depth and moderate to high windthrow hazard.
Past stand wind damage history or clear future wind damage potential	Stands or soils with apparently relatively little evidence of historic stand-damaging wind events.	Sites with widespread shallow tree rooting, extensive butt- or root-rots, and high wind-snap or windthrow potential (e.g. - pit-and-mound micro-topography).
Regeneration (if applicable)	Desired tree species for regeneration are ecologically suited to shaded /overstory conditions.	Desired tree species for regeneration are ecologically suited to open conditions.
Terrain and potential timber access routes	Terrain and good access routes and/or treatment-unit boundaries that facilitate efficient removal and adjacent decking of trees to be harvested, while minimizing logging damage or future wind damage to the residual stand.	Terrain and potential access routes and/or treatment unit boundaries that: • are severely constrained to difficult physical boundaries, • prevent efficient removal of trees to be harvested. And/or • Incur high risk of harvesting or wind damage to residual stand.
Ecological stratification and treatment unit size	Site has clearly-defined and consistent ecological strata (including soil types and site series), to form effective operational unit.	Highly variable ecological strata (including soil types and site series), and poor site continuity and area for effective operational standards units.
Relative ease of access for teaching and demonstration	Sites of favorable existing or future road access, or visibility, and which provide above-average opportunities and access for education and demonstration.	More remote sites limited by access and/or terrain, which few opportunities and access for effective education and demonstration.

Table 13: Guiding definitions for ALRF silvicultural systems

These definitions are provided to clearly categorize ALRF silvicultural systems based on current or potential practices at the Research Forest, and are not intended for prescriptive purposes.

Stand Structural Objective	Spatial arrangement of harvest and regeneration within stand	Spatial and temporal pattern of Leave-tree or Patch Retention	Applicable Silvicultural System
Even-aged	Clear-felled large openings, > 3 ha.	Low or no long-term retention of unharvested areas. Dominantly open conditions.	Clearcut (may include deciduous-coniferous "mixedwoods"), or, Clearcut with reserves (low retention)
	Uniform removal of most or all mature overstory, with retention of advance regeneration of adequate stocking, quantity, and suitability as crop trees.	Retention of adequate stocking and quality of advance regeneration for timber crop trees.	Natural shelterwood
Even-aged with reserves	Clear-felled large openings, generally > 3 ha.	Less than 50% of cutblock is within 60 metres (i.e. - approx 2 tree heights) from either a harvest boundary or edge of a long-term retention patch.	Clearcut with reserves
		Greater than 50% of cutblock is within 60 metres (i.e., approx 2 tree heights) from either a harvest boundary or edge of a long-term retention patch.	Variable Retention
Generally Even-aged to Two-aged	Clear-felling of small openings generally > 0.5 ha but < 3 ha. A maximum of 40% of the stand will be harvested over the whole stand prior to 3 m green-up of these harvested openings.	No point within the harvested area is > 60 metres (i.e. - approx 2 tree heights) from either a harvest boundary or edge of a long-term retention patch (or WTP).	Patch cut
	Clear-felled small or large groups with retention of seed trees (e.g. Douglas-fir or paper birch) with adequate seedbed for natural regeneration.	Dispersed mature live seed trees for crop tree regeneration objectives (plus reserves).	Seed tree
Two-aged	Dispersed partial harvest that retains > 40% of pre-harvest basal area, and creates adequate seedbed, to promote natural regeneration, under well distributed healthy mature overstory.	One or more stand entries for harvest of mature overstory within +/- 25 years of initial stand entry.	Uniform shelterwood (Seed Cut) Uniform shelterwood (Regeneration Cut)
		Long-term retention of mature overstory for > 25 years after initial stand entry, up to one rotation (80 years) or more.	Irregular shelterwood
		One or more stand entries for harvest of mature overstory within +/- 25 years of initial stand entry.	Group shelterwood
Unevenaged (Multi-aged)	Small groups, generally < 0.5 ha. (up to 1 ha.), removing < 40% of stand by area per +/- 25-40 yr cutting cycle.	Selection systems can be applied with or without reserves.	Group selection Strip selection
	Dispersed, uniform harvest and regeneration pattern, removing < 40% of stand basal area per +/- 25-40 yr cutting cycle.	Selection systems can be applied with or without reserves.	Single-tree selection

Heavier establishment of aspen, birch, and black cottonwood resulting from heavier soil disturbance in early 1980's logging at the ALRF. Conifer release treatments between 2008 and 2012 reduced deciduous competition in this area

13.8 Strategies for Management of Competing Vegetation

The ALRF has legal obligations under its tenure to adequately reforest areas within the ALRF that are denuded by forest harvesting, and these legal obligations include reforestation to required standards that incorporate criteria such preferred and acceptable tree species, required densities, and health criteria to be attained.

The ALRF will promote reforestation management strategies that are proactive and preventative in terms of anticipating vegetation management issues. To improve the likelihood of successful reforestation outcomes, the ALRF will ensure that harvested areas are planted within 18 months after harvesting, and are planted or otherwise regenerated with healthy, robust, and vigorous

stock of trees ecologically adapted to the planting site to Chief Forester standards. Standards and practices for regenerating stands at the ALRF will incorporate and accept biodiversity elements like deciduous tree species, and post-harvest mature leave trees. The ALRF will monitor and survey the progress of its regenerating stands in a timely manner.

Despite best efforts and practices, from time to time, the ALRF will need to address excessive "competing" non-crop-tree vegetation within areas to be reforested, including native brush species that unduly negatively affect the survival and growth of crop trees, and substantially constrain the likelihood of a sufficient density of crop trees in the area achieving a free growing stand.

For the purpose and context of this management plan, "vegetation management" refers to the cutting, girdling, removal, or other treatment (such as by registered permitted chemical herbicides) of specific competing vegetation species in the vicinity of crop trees within an area to be reforested. To be effective, this treatment must be in a manner sufficient to reduce competing vegetation, enhance crop tree survival and growth, and achieve reforestation objectives in a timely way.

The guiding principles of ALRF vegetation management are to choose and implement appropriate vegetation control strategies that:

1. Are biologically effective at targeting and reducing specific non-crop vegetation competition to crop trees, while minimizing the impact of vegetation management in plantations to non-target vegetation, high value browse species for wildlife, or other forest resource values,
2. In general, include monitoring and assessment of identified areas (strata) of impeded trees first for at least one year, then, prescribe vegetation management treatments only if need as demonstrated by monitoring. And,
3. Minimize the use of chemical herbicides (including but not limited to glyphosate) to the following general situations and conditions: (a) specifically targeted localized areas of high-risk vegetation complexes that also clearly demonstrate impeded seedling growth within an area being reforested, as above, (b) research purposes, and/or (c) demonstration trials.

Overall ALRF silvicultural treatment history and performance over the 15-year period from 2003 to 2017 indicate that herbicides (i.e. - glyphosate) have been used for control of competing vegetation on an average of 6 % of the net area to be reforested (or NAR). The rate over the last 10 years (2008-2017) has been 3.0 to 3.5% of NAR. All applications to date have been backpack herbicide applications. Average size of herbicide application area has historically averaged 5 to 6 hectares, and range from 1 to 10 hectares.

Specified results and strategies for vegetation management at the ALRF are summarized in Table 14.

Table 14: ALRF vegetation management strategies for different complexes of competing vegetation commonly occurring in the SBSwk1 subzone.

Competing vegetation	Treatment strategy	Conditions / qualifications
Willow (*Salix* spp.) Alder (*Alnus* spp.)	Manual cutting (brush saw)	Willow sprouting from cut stumps is highly desirable for moose browse.
Trembling aspen (*Populus tremloides*) Black cottonwood (*Populus trichocarpa*)	• Manual cutting * (brush or chainsaw) • Girdling (stems > 15 cm dbh)*	* Only where removal is consistent with Site Plan, stocking standards, and ALRF landscape-level tree species objectives. Limit tree removal to stems directly impeding crop trees.
Paper birch (*Betula papyrifera*)	Avoid treatment if not directly impeding achievement of required minimum stocking standards. Manually brush if necessary.	High value moose browse species and potential significance for birch bark uses.
Thimbleberry (*Rubus parviflorus*) and/or Raspberry (*Rubus idaeus*) and/or Twinberry (*Lonicera involucrata*)	Foliar-spraying backpack herbicide* (glyphosphate or other approved herbicide) within identified high-competition / impeded plantations.	Applications must be consistent with the provincial *Integrated Pest Management Act* as amended from time to time, and other statutory requirements.

13.9 Rotation Length

Rotation lengths for even-aged stands and species will vary from stand to stand depending on tree species or mixes, site productivity (site index), stand management objectives, desired forest product objectives, and stand density managements regime.

However, for general guidance and timber-supply project purpose, median, minimum, and maximum rotation lengths for different tree species are indicated in this plan in Table 15 below:

Table 15: General rotation lengths for different tree species at the ALRF

Leading species	Rotation Length (minimum harvest age*)	Rotation Length (median range)	Rotation Length (late)
	Years	Years	Years
Hybrid white spruce	60	70 to 90	120
Subalpine fir	60	70 to 90	100
Lodgepole pine	40	50 to 70	80
Douglas-fir	80	80 to 100	120
Deciduous species (birch, aspen, cottonwood)	40	50 to 70	80

* Commercial thinning and intermediate (partial) cuts excepted

13.10 Reforestation Standards

Preamble

Stocking standards define the legal requirements and obligation of the tenure holder for reforestation following the harvest of a forest stand. These standards are a required element of this ALRF Management Plan.

For reforestation in British Columbia under the *Forest and Range Practices Act* and its regulations, "stocking standards" are the tree stocking requirements that apply when (a) establishing a free growing stand in general (after clearcut harvesting or similar methods), or (b) meeting the requirements for tree retention and regeneration after partial harvest methods including commercial thinning, partial cut silvicultural systems, intermediate cuts, and partial harvesting for special forest products.

As per the Act and its regulations, stocking standards mandate the achievement one or both of the following requirements on harvested areas, depending on the silvicultural system used:

1. Regeneration requirements for each defined ecological site type, including identified ecologically suitable tree species, stand density (target number and minimum number per hectare), minimum inter-tree distance, free growing height, and height to brush (competition) ratio. And/or,
2. For partial-cut and retention systems, requirements for retention of remaining (or "residual") post-harvest overstory trees left for future crop trees and structural biodiversity / wildlife habitat. Specified requirements include a description of residual live leave-tree density (either stems-per-hectare or basal area), identified ecologically suitable species for leave trees, and descriptive physical criteria (i.e. – the "characteristics, quantity and distribution of retained trees of a species") for appropriate leave trees.

Stocking standards also describe the specific situations and circumstances under which a standard will be applied.

The Forest Planning and Practices Regulation (as amended from time to time) provides the legal basis for the Province to consider and/or approve stocking standards based on the following criteria:

a) Factors relating to stocking specifications, as defined by the Province.
b) Whether the proposed stocking standards will result in harvest areas being successfully regenerated with ecologically suitable species adapted to site conditions, forest health factors, and current and future climates on the area.
c) Whether the free growing criteria are suitable to reliably demonstrate that trees of a given species adapted to the site, are growing well and can reasonably be expected to continue to do so in the future. And,
d) Whether regenerated stands will be reforested to a suitable density or basal area that will maintain or enhance an economically valuable supply of commercial timber from the area in future, and in a manner consistent with the timber supply analysis and forest management assumptions that apply to the area covered by the plan.

Linkage of ALRF Reforestation Standards and Reporting of Provincial Silviculture Obligations

Under Special Use Permit 23615, the ALRF Society as tenure holder reports on its land management activities, including reforestation, to the District Manager in a manner acceptable to the Province. The form of this reporting is not specifically defined in the Permit.

To facilitate consistent reporting and tracking of forest harvesting and related ALRF reforestation obligations, and related updates to the Provincial forest inventory, the ALRF as tenure holder commits to ensuring the timely electronic submission

Commercial thinning of 30- to 45-year-old second-growth spruce stands at the ALRF will increase in potential in coming years, due to regional mid-term timber supply constraints

of reforestation obligations in the Provincial silvicultural database (currently known as RESULTS or the *"Reporting Silviculture Updates and Land Status Tracking System"*) as amended from time to time. This system is also linked to tracking of forest harvest areas in the provincial Forest Tenures Administration System (or FTAS).

It is recognized in this Plan that provincial silviculture reporting specifications require consistency in data submission requirements to maintain the integrity and quality of provincial silviculture data. It is also recognized that both stocking standards and related provincial reporting requirements may evolve over time, based on changing forest management goals and legal requirements of the Province.

This Plan presents ALRF stocking standards that have foundations in regional knowledge from past Ministry guidance documents, are guided by provincial and standards and legal requirements, and also incorporate by new scientific information and local professional experience and knowledge of ALRF ecosystems, including adaptation to climate change.

Finally, this ALRF Management Plan presents these ALRF standards in well-established stocking-standard formats and terminology intended to aid in the clear integration of ALRF standards into provincial silviculture survey protocols, and silvicultural reporting systems such as the Province's RESULTS database.

13.10.1 Stocking Standards For clearcut and patch cut silvicultural systems

ALRF even-aged stocking standards (Table 16) are applicable to clearcut or patch cut harvest openings. These are defined in this Plan as openings that are > 1 hectare in size and greater than 3 mature tree heights wide, and have less than or equal to 6 square metres per hectare of retained leave-tree basal area of live trees.

For the purposes of silviculture surveys and provincial silviculture reporting in RESULTS, please refer to Appendix C for greater detail on criteria distinguishing such clearcut and light-retention openings and silvicultural management regimes from Retention Openings and partial-cut silvicultural systems,

Table 16: ALRF Even-aged Regeneration Standards for Tree Species Selection, Stocking, and Free Growing Status.

BGC Classification (SBSwk1)		Regeneration Tree Species				Stocking (i) Well spaced / ha.					Max Regen Delay (years)	Free Growing Assessment	Free Growing Assessment
Site Series	Site Series Name	PRIMARY	Preferred (P)	Acceptable Conifers (Acon)	Acceptable Broadleaf Species (Adec)	Target	MIN P+A	MIN P	MAX Adec Broad-leave Stems	MINI Inter-tree Dist. (m)		Earliest	Latest (years)
1	Sxw - Oak Fern	Fd_{32} Pl Sx	Fd_{32} Pl Sx	$Bl_{29,32}$	At_a Ep_a	1400	700	600	300	1.6	4	9	15
2	Pl - Huckleberry – Cladina	Fd Pl	Fd Pl	Sx		1000	500	400	0	1.6	7	12	15
3	Pl - Huckleberry - Velvet leaved Blueberry	Fd Pl	Fd Pl	Sx_{28}	At_b	1000	700	600	200	1.6	7	12	15
4	SxwFd - Knight Plume	Fd Pl	Fd Pl	Sx_{28}	At_b	1000	700	600	200	1.6	7	12	15
5	Sxw - Huckleberry - Highbush Cranberry	Fd Sx	Fd Sx Pl	Pl	At_a Ep_a	1200	700	600	300	1.6	7	9	15
6	Sx - Pink Spirea - Oak Fern	Sx_{32}	Sx_{32}	Sb, Pl, $Bl_{29,32}$	At_a Ep_a	1000	700	600	300	1.0	4	9	15
7	Sxw - Twinberry - Oak Fern	Sx_{32}	Sx_{32} (Pl)	$Fd_{9,32}$ $Bl_{29,32}$ Pl	Act_b At_a Ep_a	1400	700	600	300	1.6	4	9	15
8	Sxw - Devil's Club	Sx	Sx	Pl Bl_{29} $Fd_{3,9,53}$	Act_b At_a Ep_a	1400	700	600	300	1.6	4	9	15
9	Sxw -Horsetail	$Sx_{1,32}$ Pl_1	$Sx_{1,32}$ Pl_1	Sb, $Bl_{29,32}$	At_b Ep_a	1000	500	400	200	1.0	4	9	15
10	Sxw - Devil's Club - Lady Fern	$Sx_{1,32}$	$Sx_{1,32}$	Sb $Bl_{29,32}$	Act_a, At_a, Ep_a	1000	500	400	200	1.0	4	9	15
11*	SbSxw - Scrub birch – Sedge	Pl_1 Sb $Sx_{1,32}$	Pl_1 Sb $Sx_{1,32}$	Bl		400	200	200	0	1.0	4	12	15
12	SbPl – Feathermoss	Pl	Pl, Sb	Sx_{32}		1200	700	600	0	1.6	7	12	15

Conifer Tree Species Codes for Table 16

Act – Black Cottonwood	Fd – Douglas-fir
At – Trembling Aspen	Hw – Western hemlock
Bl – Subalpine fir	Pl – Lodgepole pine
Cw – Western redcedar	Sx – Hybrid white spruce or interior spruce
Ep – Paper birch	
Sb – Black spruce	

Cautionary and Restrictive Codes for Table 16

1	elevated microsites are preferred	29	risk of heavy browsing by moose
3	restricted to sandy or coarse-textured soils	32	limited by growing-season frosts
9	restricted to crest, southerly, or westerly slopes	53	minor component
12	suitable on cold air drainage sites	a	productive, reliable, and feasible regeneration option
23	restricted to trial use	b	limited in productivity, reliability and/or feasibility
28	limited by moisture deficit		

13.10.2 Acceptability and Management of Deciduous (Broadleaf) Tree Species

Deciduous or "broadleaf" tree species are explicitly incorporated into ALRF stocking standards to specified limits on identified BEC site types (as per Table 16 of this Plan), in a manner consistent with prior provincial Chief Forester direction (Sheldan and Snetsinger, 2008) and other provincial science-based guidance and recommendations (Harper and Roach, 2014).

Mixed coniferous-deciduous 25-year old stand resulting from spruce planting and natural regeneration of deciduous trees (ALRF, 2011)

While recognizing that current ALRF timber management objectives and market opportunities for stand management are still – at time of plan preparation – dominantly oriented towards coniferous species, broad-leaf tree species are important to incorporate into ALRF stocking standards as a recognized secondary component of managed stands, for the following reasons:

1. Maintenance and enhancement of broadleaf tree species (including paper birch, trembling aspen, and black cottonwood) on the ALRF landscape are important landscape-level and stand-level goals in this Plan.
2. Broadleaf tree species may contribute to the diversity, productivity, and value of future timber species in the ALRF and the region.
3. Broadleaf trees in ALRF ecosystems are naturally abundant, especially on disturbed sites, and are ecologically important in a variety of soil and successional processes including nutrient cycling, and for the maintenance of species diversity and structural / habitat biodiversity in managed stands.
4. Maintaining broadleaf tree species in managed stands is one stand-level strategy contributing to reducing catastrophic fire risk in the ALRF landscape. And
5. The diversity of tree species in managed stands, especially including broadleaf trees as well as conifers, may provide additional ecological resilience in the face of future climate change and forest health factors.

Management Intent and Constraints for Broadleaf Trees within Stocking Standards

As per the even-aged stocking standards in Table 16, broadleaf tree species are considered "Acceptable" as crop trees to specified densities on several ecological site types within the ALRF, and are considered to be especially productive on moist, well-drained rich sites. At this time, no broadleaf species are listed as Preferred species for regeneration, due to limitations in commercial market acceptability.

Where broadleaf trees of suitable species are acceptable on a given ALRF site type, the density of Acceptable" broad-leaf trees is currently limited to 200 or 300 sph depending on the site type. **In general, the intent of these current stocking standards is that broadleaf trees at the ALRF are limited to:**

a) Acceptable trees only (not Preferred).
b) For silviculture reporting, to be acceptable only in the absence of preferred or acceptable conifer species,
c) No greater than 25% of all Preferred + Acceptable trees in aggregate, on average, across a Standards Unit.

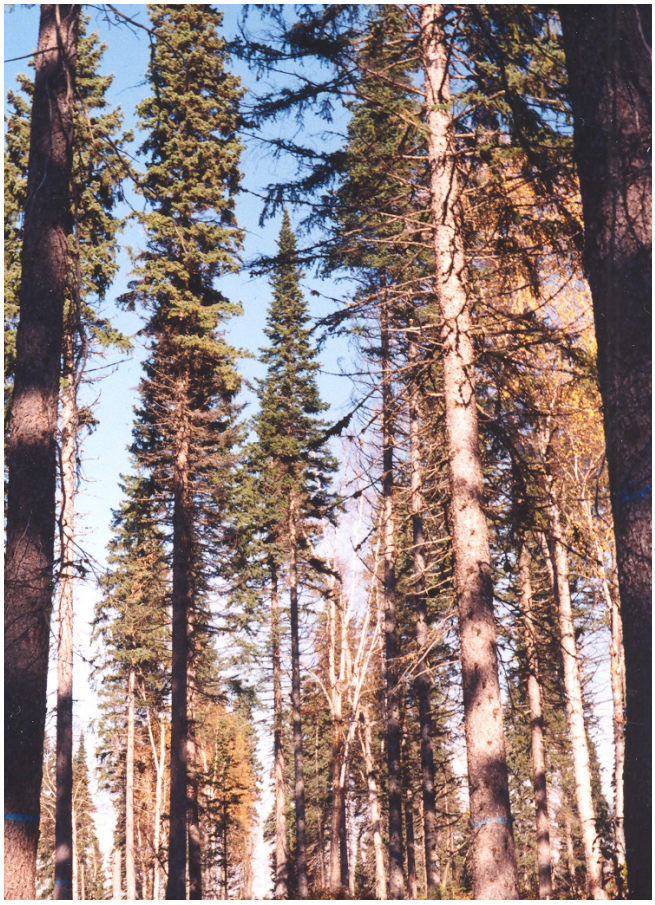
Silviculture Surveys and Assessment of Interactions between Coniferous and Broadleaf Crop Trees

For silvicultural surveys, and the Free Growing milestone declaration in particular, the Quadrant Method (as per Appendix 9 of the Establishment to Free Growing Guidebook, Prince George Forest Region, Ver. 2.3, 2000, and revised 2007) will be used to determine whether a coniferous crop tree in the immediate vicinity of competing vegetation or broadleaf trees, is potentially Free Growing. Note that any individual broadleaf tree designated as an acceptable well-spaced tree cannot also be a a competing tree.

Management of Broadleaf Tree Density within Mixed Conifer-Broadleaf Stands

Treatments for control of broadleaf tree density (such as motor-manual cutting or girdling) within managed stands over and above broadleaf densities permitted in the ALRF stocking standards will be limited to:

- For general forest operations: Removal of only a suitable amount or distribution of broadleaf trees in a stand, sufficient to attain Free Growing status for a Silvicultural Opening or Standards Unit, while maintaining as many broadleaf trees in the stand as within these requirements, for other objectives.
- Exemption for research and demonstration trials: Broadleaf retention and/or removal as required to meet relevant research and educational objectives.



Uniform shelterwood silvicultural system, 3 years after initial stand entry. Location: East Branch Road, ALRF

13.10.3 Stocking Standards for Partial-Cut and Retention Silvicultural Systems

Overview

The following standards have adapted and integrated elements from the Partial Cutting Stocking Standards for the Quesnel Forest District (MFLNRORD, 2007), the Rocky Mountain Forest District (MFLNRORD, 2010), and the provincial Silviculture Surveys Procedures Manual (MFLNRORD Resources Practices Branch, 2016). In addition, the stocking standards for partial-cut and retention silvicultural systems presented here incorporate past ALRF management experience with a harvesting and regeneration within a range of clearcut and partial-cut systems, and local knowledge of ALRF stand types, silvicultural histories, and soils.

Key ALRF management principles guiding these silvicultural systems and related standards are:

1. To achieve stand stocking levels and growth rates that will promote optimal timber production and quality.
2. To manage for stand-level biodiversity. And,
3. To create and maintain appropriate stand structures for site-specific management objectives.

Of special note for the ALRF are subalpine fir ("balsam") management strategies within ALRF partial cut or retention systems. The will take into account opportunities for subalpine fir regeneration in mixed-species stands, the high wildlife value for subalpine fir as a browse species for large ungulates including moose, timber objectives, and the generally shorter pathological rotation and sensitivity to stem damage of this species relative to spruce.

Application of ALRF Partial Cut Stocking Standards Preface

Silvicultural survey and field assessments will follow general standards and protocols as defined in the provincial Silvicultural Survey Procedures Manual. For ALRF managed stands with complex or variable stand structures, the choice of Complex Vertical Structure Survey Methodologies (detailed in the manual) to be used on any given stand and site will be specified in this management plan or in a site-specific Site Plan.

However, it is recognized that the ALRF's research and education mandate, history of a range of silvicultural systems and long-term monitoring thereof, and prevalence of different silvicultural approaches on this landbase means that the ALRF as tenure-holder will also pioneer or pilot innovative approaches to stocking standards. Therefore, ALRF stocking standards can and will evolve and improve during the term of this plan.

As such, the following stocking standards are to be considered as default standards only, unless otherwise specified in professionally-prepared Site Plans. Site-specific variances from the default standards are permitted as a matter of due course, as per professionally-prepared Site Plans with accompanying written rationales for such variances.

For greater detail on ALRF silviculture survey procedures:

- **a)** Retained leave trees are assumed to contribute to retention basal area when live, not dead.
- **b)** Dead trees are assumed to have no competitive or inhibitory effect on tree regeneration.
- **c)** Basal area is defined as the cumulative cross sectional area, represented in m^2, of the live trees, that are greater than or equal to 12.5 centimeters in diameter, measured at breast height. Basal area must be collected by species where the silviculture plan or prescription specifies basal area by species and by diameter class.
- **d)** Mappable clumps of retained leave trees > 0.25 ha and averaging > 20 m^2/ha of live trees within larger openings will be stratified out and treated separately from the surrounding more open stratum. Qualified silviculture surveyors and forest professionals may map out (stratify) retained-tree clumps of > 6 and < 20 m^2/ha at their discretion.
- **e)** To be acceptable as a crop tree for future timber production, leave trees must be consistent with attributes described in Table 4 of the Tree Wounding and Decay Guidebook (Ministry of Forests, 1997).

A. Stands with Light (< 6 m^2) Dispersed Basal Area Retention

Even-aged stocking standards (Table 16) and standard even-aged silvicultural survey methodologies (as per the Silviculture Surveys Procedures Manual) will apply to stands or mappable harvest openings > 0.25 hectares with an average basal area retention of dispersed leave trees that is less than 6 m^2/ha. For greater clarity, this standard will apply to clearcuts, patch cuts, and group selection systems where harvest openings are larger than 0.25 ha.

B. Moderate-Retention Partial Cut Stands (> 6 and < 20 m^2/ha Dispersed Basal Area Retention)

Even-aged stocking standards (Table 16) and Layered Survey methodologies (as per the Silviculture Surveys Procedures Manual) will apply to stands with an average basal area retention of dispersed leave trees that is between 6 and 20 m^2/ha.

Stocking decisions and appropriate standards for these types of partial-cuts will assume management objectives focused towards the production of sawlog timber, except in areas identified in ALRF Site Plans and strategic plans recognizing the management of non-timber values.

The timing of silvicultural survey and stocking assessments in residual stands that include prescribed retention of advance regeneration, pole-size trees, and larger trees, must be no earlier than 4 years following the harvest stand entry, in order to take into account:

1. Tree release and rates of growth.
2. Potential for mechanical damage to trees during harvest, post-release 'shock' or 'sunscald of regeneration, and/or wind or snow/ice damage or post-harvest sunscald). And
3. Planted and natural supplemental regeneration strategies establishment, and growth rates.

C. Higher-Retention Partial-cut Stands with > 20m² Dispersed Basal Area Retention

Partial Cuts in Even-aged to Two-aged Stands:
Survey methodologies for Intermediate Cuts and Commercial Thinning (as per the Silviculture Surveys Procedures Manual) will apply to even-aged to two-aged stands with an average basal area retention of dispersed leave trees that is 20 m²/ha or greater.

Partial Cuts for Unevenaged Management (single-tree selection systems):
For managed uneven-aged stands managed under single-tree selection with average basal area retention of dispersed leave trees that is 20 m²/ha or greater, silviculture survey procedures will be specified and included in professionally-prepared Site Plans with accompanying written rationales. For greater clarity, provincial standards will not apply to ALRF stands managed under single-tree selection, due to the lack of suitable provincial stocking standards for unevenaged management of spruce-subalpine fir forest types.

The timing of silvicultural survey and stocking assessments in such residual stands at the ALRF, which include retention of advance regeneration, pole-size trees, and larger trees must be no earlier than 4 years following the harvest stand entry, in order to take into account:

1) Potential for mechanical damage or stress to trees during or after harvest, and/or
2) Wind damage.

As per standard stratification requirements, contiguous mappable areas of areas of less than this basal area retention that are greater than 0.25 hectare will be identified, surveyed, and managed as a separate stratum or to even-aged stocking standards.

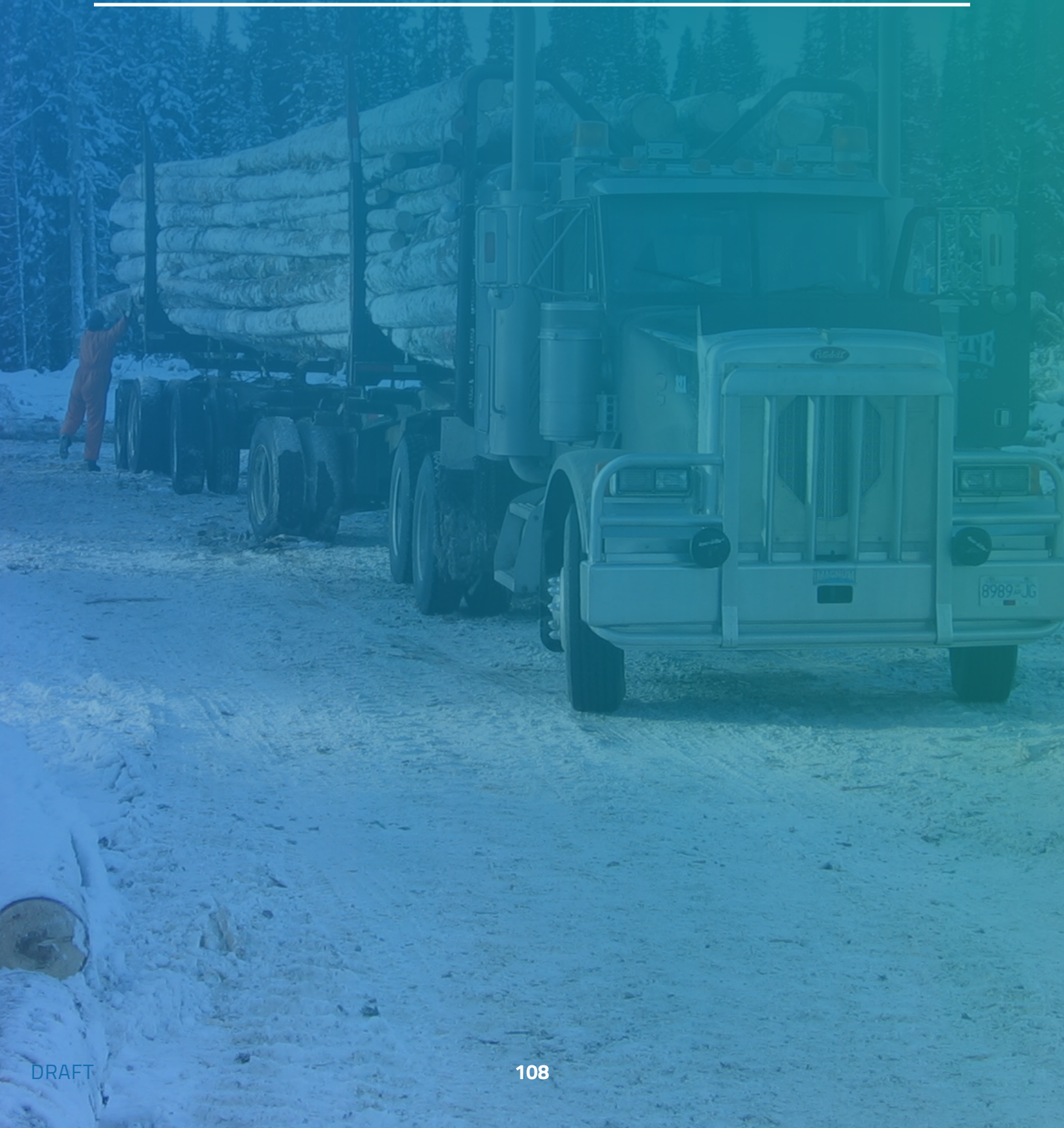
General Site Planning Provisions:
While stands with an average basal area retention of greater than 20m²/ha are managed as a class of stands distinct from Low and Moderate Retention stand types, the 20m²/ha basal area classification limit is not considered a preferred or optimum level for ALRF stands.

Rather, the qualified professional determination of an appropriate basal area retention level for a given stand and site (including potentially, prescribed variation in the spatial distribution of leave trees and canopy gaps for regeneration) will depend on site-specific factors and constraints, timber management objectives, measures to minimize windthrow (including consideration of soil and stand factors), forest health objectives, and the anticipated future silvicultural regime for the stand.

Site Plans for higher-retention partial-cut harvests will include, but are not limited to the following stand information:

1. Pre-harvest and prescribed post-harvest basal area (m²/ha.).
2. Target post-harvest stand structure (stems per hectare per diameter class).
3. Target post-harvest species composition (by basal area).
4. Prescribed stocking of suitable regeneration (by stems per hectare). And,
5. The anticipated cutting cycle or stand re-entry period.

PART X:
Timber Harvesting Planning and Operations



14. TIMBER HARVESTING PLANNING & OPERATIONS

14.1 Balancing priorities for stand harvesting

Timber will be harvested in a manner consistent with the objectives and mandate of the ALRF, and objectives set by government in ALRF permit and license documents, including this approved Management Plan.

Extensive mortality and stand damage events due to factors such as weather events and forest health agents (e.g. wind or ice/snow damage) and forest health agents (e.g – bark beetles and stem rots) will affect timber harvesting priorities and scheduling. **Two strategies are employed to rationalize timber harvesting and forest development in context of the allowable annual cut:**

Many areas at the ALRF logged between 1920 and the late 1950's now have productive second-growth stands, and form a significant component of current timber supply at the ALRF

- To actively address current losses of timber or timber values as they occur, by salvaging damaged or dead timber with merchantable value, and
- To direct timber harvesting towards those stand types most susceptible to catastrophic or substantial losses, thereby partially anticipating and pre-empting future losses.

In general, harvesting efforts will be directed in the following descending order of harvest priority:

1. Timber infested by insects,
2. Salvage of deteriorating, dead, and dying merchantable timber,
3. Silvicultural rehabilitation of productive sites occupied by stands of steadily declining quality and vigour,
4. Timber significantly affected by disease, including but not limited to stem rots and root rots,
5. Timber at risk of infestation by insects,
6. Timber of gradually declining vigour, and,
7. Healthy, vigorous timber.

Deciduous species may be harvested when appropriate markets are available.

Exceptions to the standard harvesting priority will be made by the ALRF on a case by case basis, where necessary to facilitate specific research and demonstration projects, or other operational requirements.

14.2 Cutblock size and harvesting adjacent to another cutblock

14.2.1 General Provisions

As per its current tenure provisions, the Aleza Lake Research Forest Society undertakes its timber harvesting operations under Occupant License to Cut L45514. Therefore, the ALRF is defined as a "minor tenure" holder under Forest Act and FRPA definitions.

Notwithstanding the ALRF's status of a minor tenure, considerations relating to maximum cutblock size and harvesting adjacent to another cutblock, have been considered in this management plan relative to their impact on other forest resources, and for landscape planning purposes.

Under this Management Plan, cutblock size and adjacency for timber harvesting operations is guided by the following statements:

1. Manage within the target patch size distributions specified in this plan.
2. The design of larger cutblocks within the ALRF (especially those approaching or greater than 60 hectares of continuous non-greened-up area) will be consistent with the structural characteristics and temporal and spatial distribution of openings similar to the range of natural disturbances that tend to occur within SBSwk1 forest types comparable to, and within the vicinity of the ALRF.
3. ALRF Small Gap and Large Gap harvest openings as per the target patch size distribution (and corresponding silvicultural systems) are intended to provide targets for emulation of smaller-scale and gap disturbances within the ALRF landscape.
4. "Green up" for the purposes of this management plan is defined as a previously reforested stand which is stocked in accordance with applicable stocking standards, and in which at least 75% of the net area to be reforested of the existing cutblock is stocked such that the average height of the tallest 200 sph of the trees on the area (or "top height") is a minimum of 3 metres.

Grapple Skidder at the ALRF, Winter 2007/08

Aerial view of the central ALRF, looking west (circa 2011)

14.2.2 Forest-level targets for harvest patch size distribution

The frequency and spatial distribution of harvest patch sizes resulting from both harvest operations and natural disturbances is an important benchmark for forest-level management at the ALRF, with cross-linkages to biodiversity, silvicultural planning, and silvicultural systems, and total-chance harvest panning.

The ALRF sets the following landscape-level targets for harvest patch-size distribution (Table 17), these will guide the application and proportions and extent of clearcut and partial-cut silvicultural systems on the ALRF landscape.

Table 17: ALRF landscape-level acceptable targets and range of harvest patch-size distribution *as a percentage of the net harvested area (excluding non-harvestable and non-productive areas) over each previous 5 or 10 year period.*

Patch Size Type	Applicable opening sizes (non-greened-up)	Target percentage (% of net harvest area)	Acceptable range (% of net harvest area)
Small Gap	Single-tree to ≤ 0.5 ha.	5%	3 – 7%
Medium Gap	> 0.5 ha, ≤ 4 ha	10%	7 – 13%
Clearcut (Class I)	> 4 ha. to 60 ha.	45% *	30 – 55% *
Large Clearcut (Class II)	> 60 ha.	40% *	30 – 50% *
			* Cumulative total of % Class I and II clearcuts cannot exceed 90%

Winter harvesting to protect forest soils is standard practice on the ALRF's fine-textured soils and wet climate

14.3 Timber utilization standards

Minimum timber utilization standards are defined as per Occupant License to Cut 45514 for the Aleza Lake Research Forest, and this Management Plan. Timber utilization and related waste and residue surveys and assessments will also specifically consider and incorporate post-harvest Coarse Woody Debris and Wildlife Tree retention objectives specified by this Management Plan, or any operational plans consistent with this Management Plan.

14.4 Anticipated harvest methods

The harvest method or technology on any given site (including season and conditions of harvest) will be consistent with the approved professional Site Plan, and reflect efficient and/or effective methods of harvesting suitable to meet the site conditions, harvest season, management objectives, prescribed timber utilization levels, and relevant ecological considerations for the Site Plan.

Most historical logging has tended to be winter logging on frozen soils or snowpack conditions, and includes log- or tree-length ground skidding, yarding, or hoe-chucking.

On most ALRF harvest areas, timber will be harvested using ground-based equipment configurations appropriate to the local terrain, soils, logging season and site sensitivity. These typically may include, but not be limited to:

1. Tracked or Rubber-tired skidding,
2. Mechanical and/or hand-felling,
3. Low ground pressure machines, and
4. Combinations of the above.

Very rarely, aerial or cable yarding may be used, particularly in specific circumstances where terrain or road access limits or prevents the use of conventional ground-based yarding systems. These circumstances include:

- Steep or severely gullied terrain. Or,
- Areas where slope instability or other barriers limit suitable ground access.

Variances to harvest methods will be made for specific research purposes or specific prescriptions.

14.5 Woody Fuel Reduction, Wildfire / Hazard Mitigation, and Smoke Management

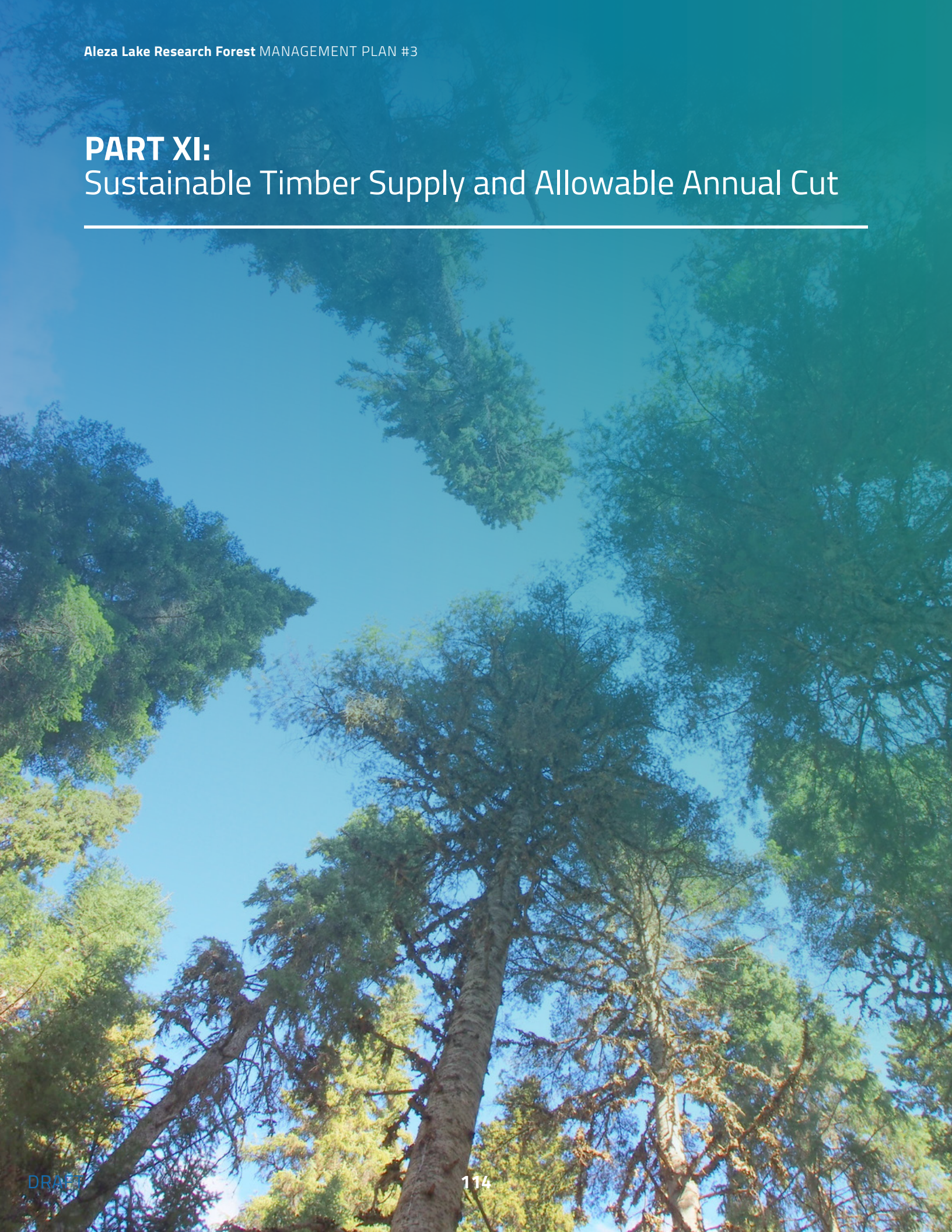
Measures for woody fuel reduction and fire hazard abatement will be consistent with the *Wildfire Act* and the *Forest Planning and Practices Regulation*, as amended from time to time.

The ALRF will ensure that post-harvest / post-treatment fire hazard assessments and timely fire-hazard abatement measures (where necessary) are undertaken on harvest (i.e. – roadside log processing areas) or treatment areas (such as thinning) with heavy or continuous accumulations of coniferous fine fuels. Fire hazard abatement strategies will consider and be consistent with measures for conservation of wildlife habitat, including CWD retention objectives at the stand- and landscape level, and soil nutrient conservation.

Activities undertaken by the ALRF permit holder under this Management Plan will comply with the *BC Environmental Management Act*, and the *Open Burning Smoke Control Regulation*, as amended from time to time.

ALRF shelterwood cut, 2014

PART XI:
Sustainable Timber Supply and Allowable Annual Cut



15. TIMBER SUPPLY MANAGEMENT

Maturing second-growth stand at the ALRF

15.1 AAC History

From 2001 (ALRF establishment) to 2010, the Allowable Annual Cut (AAC) approved by the Province was 16,000 m^3 (cubic metres) of timber per year. For the period of 2011 to 2017, the AAC was 19,000 m^3 per year.

15.2 Timber Supply Determination

The AAC for the Aleza Lake Research Forest is determined by the District Manager.

Timber supply reviews and analyses will be undertaken the permittee (the ALRF Society) to required standards, and submitted by to the District Manager, at regular intervals and/or as directed by the Province.

15.3 Cut Control and Cut Control Period

The ALRF Society as permittee will regularly monitor timber volumes harvested under the ALRF timbermark via the provincial Harvest Billing System (or equivalent mechanisms), to ensure due diligence and legal compliance with the authorized AAC over a specified 5-year period, or other cut-control period as directed by the Province.

As a guiding principle, any surplus or deficit in AAC harvest incurred in a current cut control period will be carried forward to the following cut control period. The Province may provide additional direction or guidance in this respect.

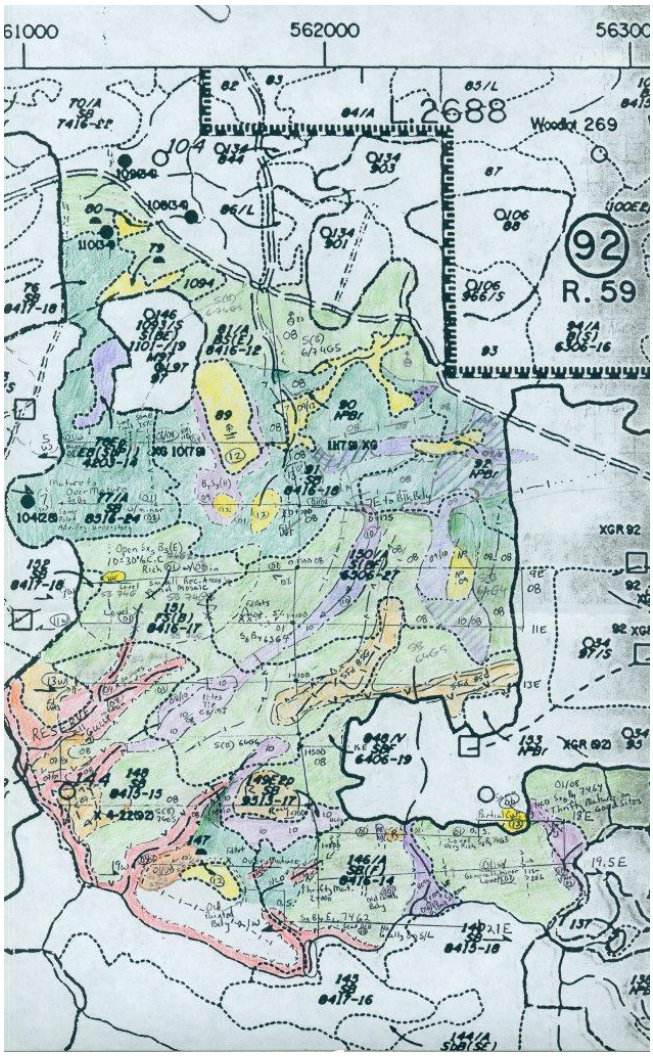
15.4 Timber Supply Analyses

Appendix D of this Management Plan includes a Timber Supply Analysis for the Aleza Lake Research Forest for the term of this plan and into the future. This analysis report considers, analyzes, and addresses the following requirements and concerns of the Province for this plan (as per SUP 23615):

1. *"the short and long term availability of timber for harvesting in the Permit area, including the impact of management practices on the availability of timber…",*

2. *"the availability of timber (based on) the net operable landbase, harvested areas, existing and proposed road access within the net operable land base, and areas subject to special management constraints…"*, and

3. *"(the) categorization of areas within the net operable landbase by the type and quality of timber, and the harvesting method(s)suitable to the terrain."*



For timber management, both field-based operational planning and mapping (example field map as shown) and computer-aided analysis of forest inventory data help to separate out areas suitable for timber harvesting and management from more sensitive areas designated for other forest values

Timber Supply Modeling / forecasting was done using the University of British Columbia's freely available ATLAS - FPS model (Forest Planning Studio, http://sfmtutorials.forestry.ubc.ca/fps-atlas/) with the intent that this model may also be used for UNBC forest planning instruction.

Initial data analysis, modeling, and training of ALRF professional forestry staff was provided by Mark Perdue RPF of Forsite Consultants Ltd. Following model training and orientation, ALRF staff used additional local ALRF data and detailed knowledge and understanding of the area to run additional iterations and scenarios of the model, as a basis for preparation of the final timber supply analysis report.

15.5 Overview of Gross Landbase and Net Timber Harvesting Landbase

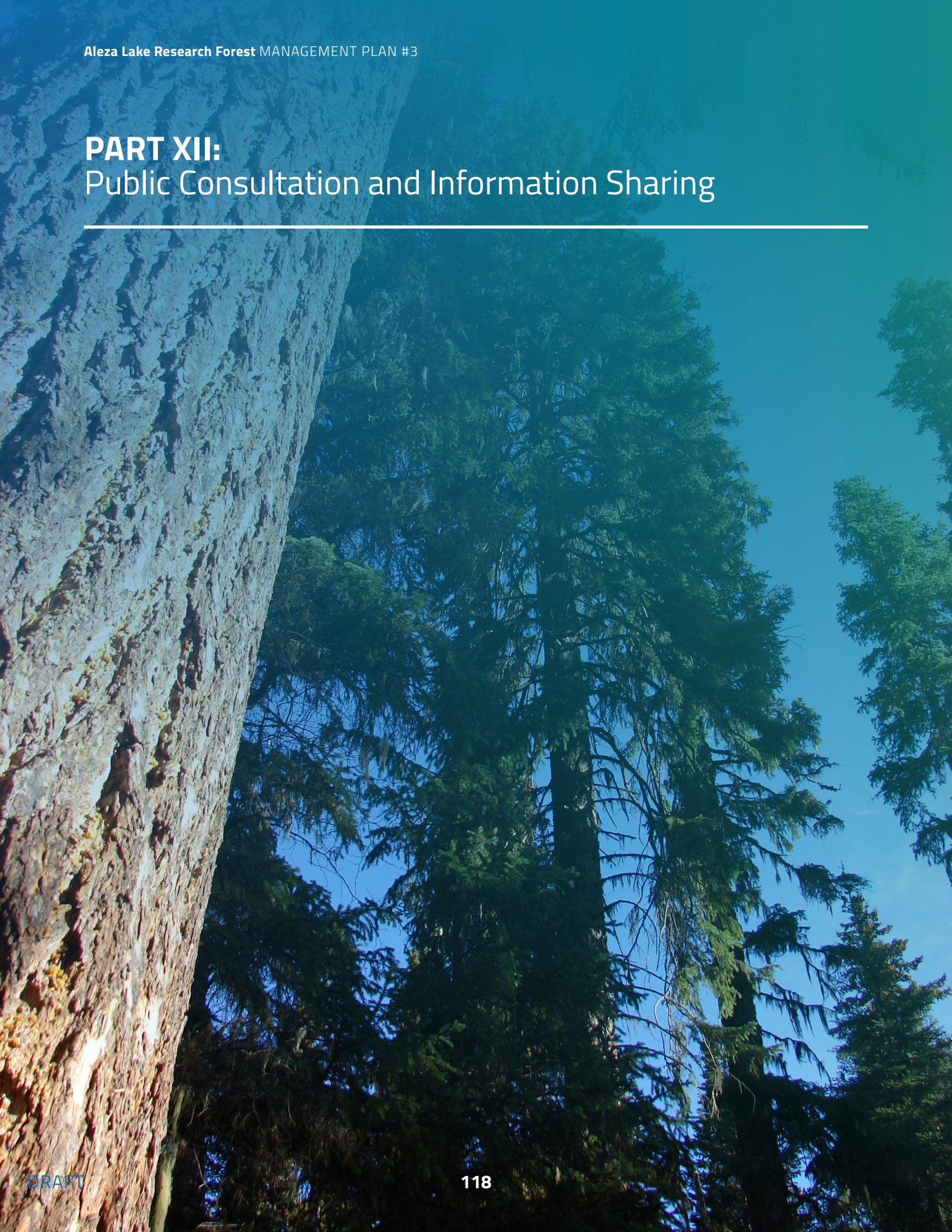
A timber-supply "net-down" table for the ALRF landbase, summarized in the Appendix D timber supply analysis, provides an overview of the gross and net landbase for the ALRF, and the proportion of the landbase available (allocated under this plan) for sustainable timber management and related harvesting.

From a gross Crown landbase of 9,002 hectares (excluding Ecological Reserve 84 under the jurisdiction of BC Parks), and after the deduction of excluded lands, non-contributing lands allocated for other purposes (including Old-growth Management Areas), and other proportionate reductions for other non-timber values, the current Total Harvestable Landbase is 5,799 hectares, or 64.4% of the gross ALRF landbase.

Estimated future reductions for road access and Wildlife Tree Retention Areas within the Total Harvestable Landbase further adjusts the long-term timber harvesting landbase (i.e.-that area allocated for growing trees for sustainable timber management) downward to a final total of 5,032 hectares or 55.9% of the total ALRF landbase.

Figure 10: Selected portion of the provincial Vegetation Resources Inventory (VRI) forest cover polygons,
overlaid on ALRF aerial ortho-photo coverage. VRI data support, and provide one of the foundations of the ALRF timber supply analyses, and are complemented and cross-referenced to other ALRF landbase data in this analysis.

PART XII:
Public Consultation and Information Sharing



16.1 Management Plan Consultation

This Management Plan, upon approval by the Province, will be the primary strategic planning document and statement of government objectives for the ALRF landbase, until its amendment or replacement by a newer plan.

As required by the Province, this Management Plan is subject to a minimum 60-day public advertising and consultation period, during which time the public may review and provide comment on the proposed plan to the ALRF. During this period, the ALRF Society will make available the plan for public review, solicit public input, and confer with licensed stakeholders.

The Province will also refer this Management Plan to local First Nations for consultation, typically based on a minimum 60-day referral period.

The ALRF will respond to written public comments submitted within the consultation period. and provide such information (comments and responses) to the Province as well.

16.2 Information sharing regarding harvesting and road construction

The ALRF as tenure holder will be guided by the following Best Practices for information sharing and public awareness of its operational planning relating to major timber harvesting and road construction. **The ALRF will:**

1. Prioritize workplace safety, the rights of First Nations and licensed tenure-holders, and the best interests of ALRF land and resource stewardship in its best practices for information sharing.
2. Make information available on the proposed location of forest harvesting activities including main access routes, and proposed cutblocks, for the information of licensed stakeholders and interested members of the public. Site Plans, where applicable, will also be made available upon request.
3. Provide map information on the proposed location of forestry activities in suitable geographic detail and scale for stakeholders and the public, including general information on the anticipated scheduling of cutblocks and road construction.
4. Strive to provide relevant information to the public and stakeholders well in advance of planned operations, and in plain language that avoids unnecessary jargon or highly technical or legal language.

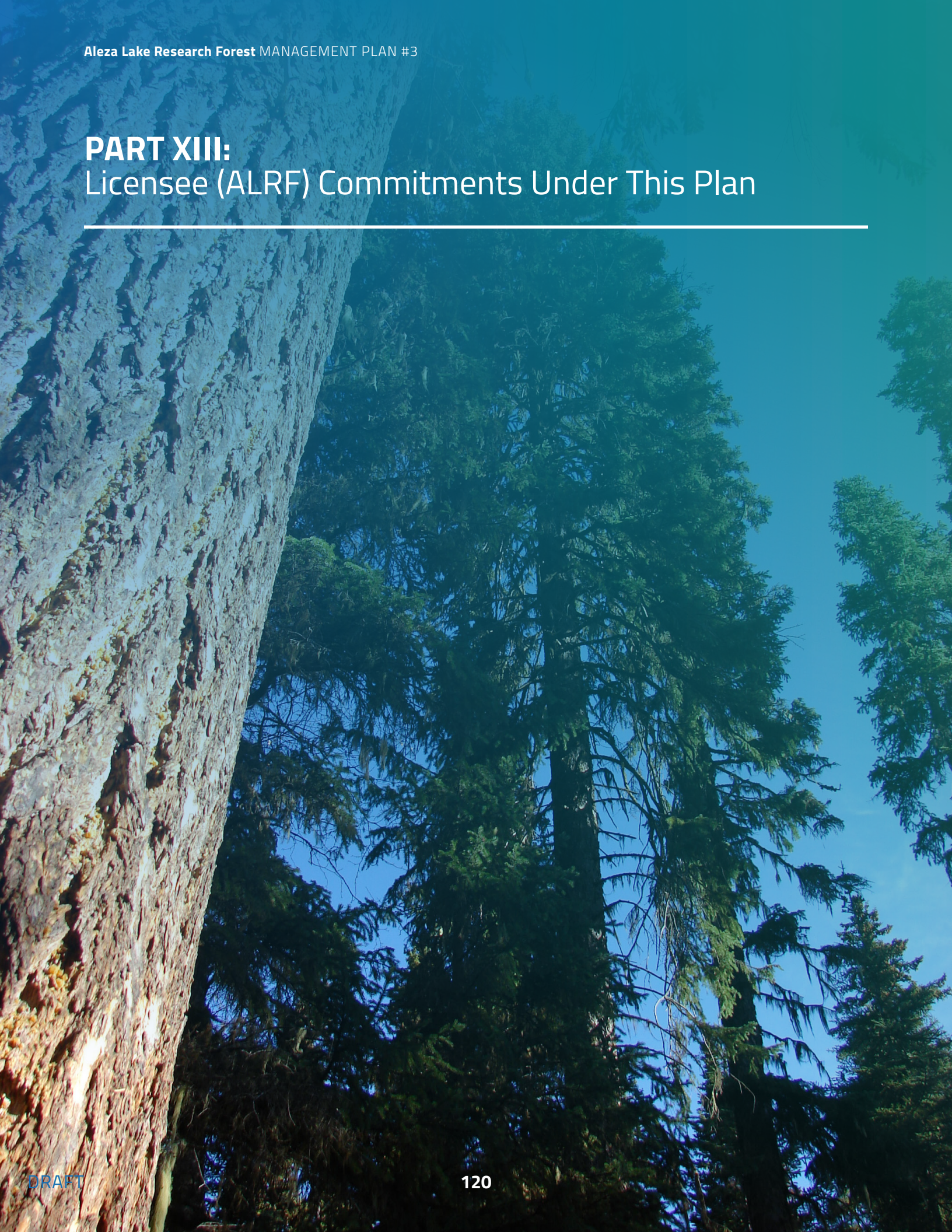
The ALRF under Special Use Permit 23615 does not prepare Forest Stewardship Plans (FSP's) and therefore is not subject to the legal requirements relating to FSP preparation and advertising.

16.3 ALRF Community Outreach

The ALRF will provide information to the public on its activities, general forestry activities, road maintenance plans, trails, and other facilities, via various media, potentially including, but not restricted or limited to:

- **a)** ALRF website posts, updates, and features.
- **b)** Newsletters – digital (generally) and hard copy (for rural and remote communities).
- **c)** Community posters in public locations (e.g. community halls, general stores) for rural residents.
- **d)** Community "Open Houses" (for example, Open House events at the Aleza Field Education Centre).
- **e)** Social media, as appropriate.

PART XIII:
Licensee (ALRF) Commitments Under This Plan



17. SUMMARY OF ALRF COMMITMENTS UNDER THIS PLAN

This section is a consolidated summary of the commitments made by the ALRF Society under this plan, for reporting and/or completion during the term of this plan.

For additional detail, please refer to the relevant section of the management plan. If there is a variance between this summary and the relevant plan sections, then the more detailed plan section shall prevail.

Table 18: Summary of ALRF commitments under this Management Plan

Issue Category	Nature and specifics of the commitment
Resource Inventory	Prepare an **enhanced spatial inventory of fish-bearing vs non-fish-bearing streams** on the ALRF, using LiDAR digital elevation models (DEM) and current fish habitat assessments and fish presence / absence data. Undertake a **road inventory and field assessment** of condition and status for **historical and currently-inactive status and non-status road sections** within the ALRF tenure area **Maintain and enhance the current inventory and database of all known active and inactive research sites on the ALRF**, and to manage forest operations in the vicinity of the research sites, in a manner appropriate to the nature of the research. **Conduct regular monitoring and assessment of stream crossings and drainage structures** on all permanent ALRF roads based on identified risk, and more frequently as needed during freshet events.
Forest Practices for Non-timber Values	Continue to develop and maintain opportunities for a **wide range of forest-based teaching and research opportunities at** the ALRF including approx. 7 km of permanent **interpretive trails**. Monitor and maintain the **integrity of Old-Growth Management Areas (OGMA's)** and Natural Areas as specified in this plan. Undertake **watershed assessments** on identified ALRF sub-basins (Appendix A1). Develop **amphibian-habitat best management practices (BMP's)** for forest operations and road and drainage maintenance.
Timber management	**Monitor and manage forest health infestations** within the ALRF timber-harvesting landbase on a timely basis, especially as they relate to spruce bark beetle infestations. Ensure **timely fire hazard assessments and abatement** in conjunction with forest operations. Submit **new timber supply analysis for the ALRF** (in conjunction with this management plan).
Referrals, Public Consultation and Information Sharing	• **Consultation** regarding the of proposed Management Plan to Lheidli T'enneh First Nation through the Province of BC. • Public and licensed stakeholder **consultation** for Management Plan. • Regular and timely **information sharing** with First Nations, stakeholders, and the public on **proposed location of timber harvest areas and related major road access development.**

PART XIIV:
Management Plan Administration

18. PLANNING AND NOTIFICATIONS TO GOVERNMENT

18.1 Notification of commencement of operations

Notification to government upon commencement of forest harvesting, and related road construction will be consistent with the ALRF's statutory responsibilities under the *Forest and Range Practices Act*, the *Forest Act*, the *Wildfire Act*, or the *Environmental Management Act*.

18.2 Annual reporting of reforestation obligations and performance

As detailed in Section 13 of this plan, the ALRF as tenure holder will ensure consistent reporting and tracking of forest harvesting and related ALRF reforestation obligations, and related updates to the Provincial forest inventory. This will include the timely electronic submission of reforestation obligations in the Provincial silvicultural database (currently known as RESULTS or the "Reporting Silviculture Updates and Land Status Tracking System") and the provincial Forest Tenures Administration System (or FTAS).

18.3 Other direction by government

An authorized agent of the Province may direct the ALRF to undertake additional measures regarding planning and/or reporting of forest practices and outcomes.

19. BEST AVAILABLE INFORMATION

The ALRF will rely upon the judgment of qualified, experienced forest professionals (or where appropriate, allied qualified professionals) to determine the best available information to be used in the preparation of operational plans or strategic plans (including this Management Plan). Qualified professionals employed by the ALRF Society on their behalf may exercise their experience and judgment to evaluate forest management situations where limited or partial information is available on a topic, and determine the best course of action to prudently manage and balance forest resource values in the face of uncertainty or inadequate information.

When experimenting or testing innovative, non-conventional, and new forest practices for which information on treatment methods, outcomes, or success is relatively limited, unreliable, or non-existent, qualified professionals employed or contracted by the ALRF will consider the following:

- **a)** The most reliable available published information, to the degree that it exists,
- **b)** Similar or comparable information or experience from other biogeoclimatic zones or other regions,
- **c)** Expert opinion,
- **d)** Timely and diligent field monitoring of treatment results, and
- **e)** The exercise of professional due diligence and appropriate cautionary measures in limiting the areal extent and application of such practices on the ALRF until such time as the treatment results can be assessed in greater detail and with more certainty

20. MANAGEMENT PLAN AMENDMENTS, EXTENSIONS, AND REPLACEMENT

In general, major amendments to the management plan should be considered only when substantial changes to the strategic direction or statutory authority of the plan are deemed necessary, due to major disruptions in external circumstances, or extensive natural disturbances within the ALRF area.

Minor amendments of the plan may be necessary from time to time during the term of the plan, for routine plan administration and updating.

20.1 Mandatory amendments

The District Manager, at their discretion, may direct the Aleza Lake Research Forest Society to prepare an amendment to this plan, and specify any required supporting information.

20.2 Discretionary amendments

The Aleza Lake Research Forest Society may submit to the District Manager for consideration and/or approval, a request for an amendment to this plan. The request will include the rationale for the requested amendment, and any supporting information required by the District Manager.

20.3 Extension of the term of the plan

The Aleza Lake Research Forest Society may submit to the District Manager for consideration and/or approval, a request for an extension to the term of this plan. The request will include the rationale for the requested term extension, and any supporting information required by the District Manager.

20.4 Expiry and Replacement of the Plan

The term of the management plan commences on the effective date specified by the District Manager. Should the effective data not be specified in the notice of approval of the plan, the default effective date shall be the date of the District Manager's letter of approval of the plan.

The plan commences on the effective date, and remains in force until:

- Ten (10) years from the effective date,
- The term is otherwise extended by the District Manager,
- Approval of a replacement plan by the District Manager, or
- Termination of the management plan by the District Manager or Province.

Within one year of the pending expiry of the plan, or at any time following the expiry of the plan term, the ALRFS may submit, for approval by the District Manager, a replacement management plan.

21. REFERENCES & LITERATURE CITED

Alexander, J. L. (1927). Silvicultural Investigation in British Columbia. The Forestry Chronicle. http://pubs.cif-ifc.org/doi/pdf/10.5558/tfc3009-2

Arlidge, J. W. C. (1967). The Durability of Scarified Seedbeds for Spruce Regeneration. British Columbia Forest Service. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.443.5616&rep=rep1&type=pdf

Barnes, G. H. (1937). The Development of Uneven Aged Stands of Engelmann Spruce, and Probable Development of Residual Stands After Logging. The Forestry Chronicle. Retrieved from http://pubs.cif-ifc.org/doi/pdf/10.5558/tfc13417-3

Barr, P.M. 1924. Report of preliminary investigations. Northern Interior Forest Experiment Station. Dept. of Lands, Forest Branch, Victoria, BC. Unpublished.

Barr, P.M. 1928. The Aleza Lake Forest Experiment Station: its development and purpose. Unpublished mimeo. Research Division, British Columbia Forest Service, Victoria, BC. . http://pubs.cif-ifc.org/doi/pdf/10.5558/tfc4003-3

B.C. Conservation Data Centre (BCCDC). 2013. BC Species and Ecosystems Explorer. B.C. Ministry of Environment, Victoria B.C. Available: http://a100.gov.bc.ca/pub/eswp/ (Nov. 29, 2017)

B.C. Conservation Data Centre (BCCDC). http://www.env.gov.bc.ca/cdc/. Web. (Dec. 7, 2017)

BC Forest Service. 2010. Rocky Mountain Forest District Partial Cutting Stocking Standards. Version 2.0, April 1st, 2010. Published on-line at: https://www.for.gov.bc.ca/ftp/drm/external/!publish/web/silviculture/V2RMFDpartcutstds.pdf

BC Forest Service. 2007. Quesnel Forest District Partial Cutting Stocking Standards. July 26th, 2007. 5 pp.

BC Integrated Land Management Bureau. 2009. Memorandum: Guidance regarding the relationship between landscape-level biodiversity (old forest) land use objectives and Research Forests in the Prince George Timber Supply Area. Memo from the Regional Director, ILMB. Oct 8th, 2009. Published on-line at: https://www.for.gov.bc.ca/hfd/pubs/docs/sil/sil391.pdf

BC Ministry of Environment. 2014. Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia http://www.env.gov.bc.ca/wld/documents/bmp/HerptileBMP_complete.pdf

Ministry of Forests, Lands, Natural Resource Operations and Rural Development, B.C. Ministry of Environment, and Fisheries and Oceans Canada. 2012. Fish-stream crossing guidebook. Revised edition. Forest Practices and Investment. Branch. Victoria, B.C. https://www.for.gov.bc.ca/hfp/fish/fish-stream%20crossing%20print.pdf

BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. 2016. Best management practices for amphibian and reptile salvages in British Columbia. Version 1.0. June 2, 2016

BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development – Resource Practices Branch. 2016. Silviculture Surveys Procedures Manual. April 1st, 2016. 309 pp. Avail at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/silviculture/silviculture-surveys/silviculture_survey_procedures_manual_2016.pdf

BC Ministry of Forests. 2005. VQO's and scenic objectives Order establishing Scenic Areas in the Prince George Forest District pursuant to Section 7 (1) of the Government Actions Regulation of the Forest and Range Practices Act, Dec 6th, 2005. Published on-line at: https://www.for.gov.bc.ca/tasb/slrp/srmp/north/prince_george/order_scenic_area.pdf

BC Ministry of Forests. 1999a. Watershed assessment procedure guidebook. 2nd Edition. Version 2.1. Forest Practices Branch, Victoria, BC. 40 pp.

BC Ministry of Forests. 1997. Tree wounding and decay guidebook. Avail. At : https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/managed-stand-pests/tree_wounding_and_decay_guidebook.pdf

BC Parks, 2003. Aleza Lake Ecological Reserve: Purpose Statement. British Columbia Ministry of Water, Lands, and Air Protection. Environmental Stewardship Division. BC Parks.Available at: http://wlapwww.gov.bc.ca/bcparks/planning/mgmtplns/aleza/aleza_ps.pdf

BC Treaty Commission, 2003. Lheidli T'enneh Treaty Negotiations Summary of Agreement in Principle. Available at: http://www.bctreaty.net/nations_2/agreements/Lheidli%20T%27enneh%20AIP%20Summary%20May%202003.pdf

Bois, C. H., Janzen, D. T., Sanborn, P. T., & Fredeen, A. L. (2009). Contrasting total carbon stocks between ecological site series in a subboreal spruce research forest in central British Columbia. Canadian Journal of Forest Research, 39(5), 897–907. https://doi.org/10.1139/X09-018

Botting, R. S., Campbell, J., & Fredeen, A. L. (2008). Contrasting Arboreal and Terrestrial Macrolichen and Bryophyte Communities in Old-Growth Sub-Boreal Spruce Forests of Central British Columbia. The Bryologist, 111(4), 607–619. https://doi.org/10.1639/0007-2745-111.4.607

Botting, R. S., & Fredeen, A. L. (2006a). Contrasting terrestrial lichen, liverwort, and moss diversity between old-growth and young second-growth forest on two soil textures in central British Columbia. Canadian Journal of Botany, 84(1), 120–132. https://doi.org/10.1139/b05-146

Botting, R. S., & Fredeen, A. L. (2006b). Net ecosystem CO2 exchange for moss and lichen dominated forest floors of old-growth sub-boreal spruce forests in central British Columbia, Canada. Forest Ecology and Management, 235(1), 240–251. https://doi.org/10.1016/j.foreco.2006.08.332

Campbell, J., Fredeen, A. L., & Prescott, C. E. (2010). Decomposition and nutrient release from four epiphytic lichen litters in sub-boreal spruce forests. Canadian Journal of Forest Research, 40(7), 1473–1484. https://doi.org/10.1139/X10-071

Canuel, N. 2010. An archaeological overview assessment of the Aleza Lake Research Forest. Prepared for the Aleza Lake Research Forest Society, 3333 University Way, Prince George, BC. Prepared by: Norcan Consulting Ltd. 1486 2nd Avenue, Prince George BC Canada, Feb. 2010.

Coates, H., & Jull, M. (1993). Seventy years of northern forestry: the Aleza Lake Research Forest (pp. 60–64). Presented at the Proceedings of the Experimental Forests Workshop, Forestry Canada and the BC Ministry of Forests. Retrieved from https://www.for.gov.bc.ca/hfd/pubs/Docs/Frr/Frr202.htm

Cottrell, C. B., & Ross, D. A. (1964). Spruce Beetle Report Prince George Forest District 1963. Information Report. Forest Entomology Laboratory, Vernon, BC, Canada, Dept. of Forestry, Forest Entomology and Pathology Branch. http://www.cfs.nrcan.gc.ca/pubwarehouse/pdfs/23950.pdf

Cottrell, C. B., Holms, J. C., & Ross, D. A. (1966). Status of the Spruce Beetle Prince George Forest District 1965 (Department of Forestry No. BC-X-3). Vernon, BC. Retrieved from http://www.cfs.nrcan.gc.ca/pubwarehouse/pdfs/26457.pdf

Cottrell, C. B., & Wood, C. S. (1971). Annual District Report Forest Insect and Disease Survey British Columbia, 1970 Part III, Prince George Forest District (No. BC-X-51). Department of Fisheries and Forestry. Retrieved from http://www.cfs.nrcan.gc.ca/pubwarehouse/pdfs/27187.pdf

Cozens, R. D. (1985). Insect and disease risk factors in established interior spruce plantations. Master of Forestry Thesis, Faculty of Forestry, University of British Columbia. https://doi.org/10.14288/1.0075430

Dawson, A.B. 1989. Soils of the Prince George - McLeod Lake Area. Report #23. British Columbia Soil Survey. Ministry of Environment Tech. Report #29. BC Ministry of Environment and Ministry of Agriculture and Fisheries, Victoria, BC.

Decie, T. 1957. Working Plan for the Forest Experiment Station Aleza Lake: For the period April 1st, 1957 to March 31st, 1967. BC Forest Service. Prince George, BC.

DeGrace, L. 1949. A preliminary working plan for the Aleza Lake Experimental Forest. BC Forest Service. Prince George Forest District. Unpublished.

DeLong, C. 2003. A field guide for site identification and interpretation for the southeast portion of the Prince George Forest Region. Research Branch, B.C. Ministry of Forests, Victoria, BC Land Management Handbook No. 51.

DeLong, S. C., Daniels, L. D., Heemskerk, B., & Storaunet, K. O. (2005). Temporal development of decaying log habitats in wet spruce–fir stands in east-central British Columbia. Canadian Journal of Forest Research, 35(12), 2841–2850. https://doi.org/10.1139/x05-215

DeLong, S. C., Sutherland, G. D., Daniels, L. D., Heemskerk, B. H., & Storaunet, K. O. (2008). Temporal dynamics of snags and development of snag habitats in wet spruce–fir stands in east-central British Columbia. Forest Ecology and Management, 255(10), 3613–3620. https://doi.org/10.1016/j.foreco.2008.02.043

Dobbs, R. C. (1972). Regeneration of White and Engelmann Spruce. Canadian Forestry Service. Retrieved from http://www.cfs.nrcan.gc.ca/pubwarehouse/pdfs/26495.pdf

DWB Forestry Services Ltd. 2006a. Loup Lake Survey (Watershed Code 100-644400-64300), Aleza Lake Ecological Reserve. Contract Report prepared for the Aleza Lake Research Forest Society, 3333 University Way, Prince George, BC, Canada

DWB Forestry Services Ltd. 2006b. Habitat assessment of Hansard and Firebreak Creek and Hansard crossing culvert inspection. Contract Report prepared for the Aleza Lake Research Forest Society, 3333 University Way, Prince George, BC, Canada

DWB Consulting Ltd. 2017. Stream Assessment Report, Aleza Lake Research Forest: Loup Lake. Contract Report prepared for the Aleza Lake Research Forest Society, 3333 University Way, Prince George, BC, Canada

Environment and Climate Change Canada (ECCC). 2017. Real-time Hydrometric Data (including Bowron River gauging station): https://wateroffice.ec.gc.ca/mainmenu/real_time_data_index_e.html) accessed on Dec. 8, 2017.

Environmental Dynamics, 2002. Environmental Management Plan: Basic Report for stream reach classification and stream crossing assessments conducted at 4sites within the Aleza Lake Research Forest (Firebreak Creek – 4.1 km Aleza North FSR,Unnamed Creek – 8.3 km Aleza FSR, Slaney Creek at 3.9 km – Aleza East FSR, and Camp Creek – 2.5 km Aleza FSR). Contract Report prepared July 2002. for the Aleza Lake Research Forest Society, 3333 University Way, Prince George, BC, Canada

Evans, R.E., Lousier, J.D., Massicotte, H.B., Coxson, D., 1998. Winter carbon dioxide evolution and soil temperatures in sub-boreal spruce forests in central British Columbia. In: Conference Proceedings, Ecology and Management of Northern Forest Soils, University of Northern British Columbia,Prince George, BC, pp. 203–222.

Farnden, C. 1998. Recommendations for future harvesting and research on the 1946-1963 single tree selection sales at the Aleza Lake Research Forest. Unpublished report submitted to BC Ministry of Forests, Prince George Forest Region and the Aleza Lake Steering Committee. Available from: The Aleza Lake Research Forest Society, 3333 University Way, Prince George, BC, Canada.

Farnden, C. (2000). Simulated conversion of unmanaged interior spruce-subalpine fir stands to a regulated uneven-aged structure. The Forestry Chronicle, 76(3), 465–474. https://doi.org/10.5558/tfc76465-3

Filmon, G. 2004. Firestorm 2003 Provincial Review. Report to the Province of British Columbia by the Firestorm 2003 Provincial Review Team. February 15th, 2004. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/wildfire-management/governance/bcws_firestormreport_2003.pdf

Foord, V. 2016. Climate patterns, trends, and projections for the Omineca, Skeena, and Northeast Natural Resource Regions, British Columbia. Prov. B.C., Victoria, B.C. Tech. Rep. 097. https://www.for.gov.bc.ca/hfd/pubs/docs/Tr/TR097.pdf

Fredeen, A. L., Bois, C. H., Janzen, D. T., & Sanborn, P. T. (2005). Comparison of coniferous forest carbon stocks between old-growth and young second-growth forests on two soil types in central British Columbia, Canada. Canadian Journal of Forest Research, 35(6), 1411–1421. https://doi.org/10.1139/x05-074

Fredeen, A. L. (2006). How is forest management influencing carbon storage in sub-boreal forests? Research Extension Note #1. Natural Resources and Environmental Studies Institute, University of Northern British Columbia. December 2006. https://www.unbc.ca/sites/default/files/assets/nres_graduate_program/pubs/nresi_ren_01_fredeen.pdf

Fredeen, A. L., Waughtal, J. D., & Pypker, T. G. (2007). When do replanted sub-boreal clearcuts become net sinks for CO2? Forest Ecology and Management, 239(1), 210–216. https://doi.org/10.1016/j.foreco.2006.12.011

Geoscience BC (2009): QUEST Project - Geology, Geoscience BC, Map 2009-4-1, scale 1:500 000.
Available at: http://cdn.geosciencebc.com/project_data/QUESTdata/GBCReport2009-4/map_2009_4_1_geo.pdf

Gerwing, T. G., Johnson, C. J., & Alström-Rapaport, C. (2013). Factors influencing forage selection by the North American beaver (Castor canadensis). Mammalian Biology - Zeitschrift Für Säugetierkunde, 78(2), 79–86. https://doi.org/10.1016/j.mambio.2012.07.157

Gray, S. (1989). The Government's Timber Business: Forest Policy and Administration in BC, 1912-1928. BC Studies: The British Columbian Quarterly, (81), 24–49. http://ojs.library.ubc.ca/index.php/bcstudies/article/viewFile/1315/1358

Griffith, B. G. (1928). Ecological studies in balsam and spruce forests in the northern interior of British Columbia. University of British Columbia. https://doi.org/10.14288/1.0100214

Griffith, B. G. (1931). The Natural Regeneration of Spruce in Central British Columbia. The Forestry Chronicle. http://pubs.cif-ifc.org/doi/pdf/10.5558/tfc7204-4

Harper, G. and J. Roach. 2014. The role of broadleaf trees: impacts of managing boreal and sub-boreal mixedwood forests in British Columbia. Victoria, B.C. Exten. Note 110. www.for.gov.bc.ca/hfd/pubs/Docs/En/En110.htm

Holland, S. S. 1976. Landforms of British Columbia. A Physiographic Outline. Bulletin 48, British Columbia Department of Mines and Petroleum Resources. Victoria, BC. 138 pp.

Hodder, D. P., & Rea, R. V. (2005). Bear den selection and considerations for forest management in the interior of British Columbia. Retrieved from http://aleza.unbc.ca/wp-content/documents/technicalreports/ALRF-Seed-Grant-Report-Hodder.pdf

Hortie, H. J., Green, A. J., & Lord, T. M. (1970). Soils of the Upper Part of the Fraser Valley in the Rocky Mountain Trench of BC (British Columbia Soil Survey No. 10). Retrieved from http://192.197.71.59/cansis/publications/surveys/bc/bc10/bc10_report.pdf

Intergovernmental Panel on Climate Change (IPCC). 2000. Land use, land-use change, and forestry. A special report of the Intergovernmental panel on climate change. WMO/UNEP. Available at: http://wwe.ipcc.ch/

Invasive Species Council of BC (2014) Invasive plants. Accessed Nov. 29, 2017. http://bcinvasives.ca/invasive-species/identify/invasive-plants

Janzen, D. T., Bois, C. H., Sanborn, P. T., Wheate, R. D., & Fredeen, A. L. (2010). Spatial and temporal modelling of aboveground carbon stocks using Landsat TM and ETM+ for a subboreal forest. Canadian Journal of Remote Sensing, 36(4), 374–390. https://doi.org/10.5589/m10-069

Jones, J. M. C., Massicotte, H. B., & Fredeen, A. L. (2015). Calcium and pH co-restrict abundance of Drosera rotundifolia (Droseraceae) in a Sphagnum bog in central British Columbia. Botany, 94(2), 139–146. https://doi.org/10.1139/cjb-2015-0136

Jull, M.& Karjala, M. (2005). Aleza Lake Research Forest: Management Plan #2. Prince George, BC. Aleza Lake Research Forest Society, 3333 University Way, Prince George, BC. http://alrf.unbc.ca/wp-content/documents/managementplans/ALRF_MP2_DM_approved_2005.pdf

Jull, M. 1992. Aleza Lake Research Forest Management Plan #1. Unpublished document prepared for the Aleza Lake Research Forest Steering Committee, BC Ministry of Forests, Prince George Forest Region.

Jull, M., Froese, R., & Fletcher, S. (1997). Shelterwood Partial Cutting in Interior White Spruce: Two-year Results of a Case Study at Aleza Lake, BC (Forest Research Note No. PG-02). Forest Service British Columbia. https://pdfs.semanticscholar.org/4107/739d543ef831eaa6f8a6f7b07266a65828e2.pdf

Kranabetter, J.M., 2009. Site carbon storage along productivity gradients of a late-eral southern boreal forest. Can. J. For. Res. 39: 1053-1060.

Lance, A. and M. Phinney. 2001. Bird responses to partial retention timber harvesting in central interior of British Columbia. For. Ecol. Mgmt. 142: 267-280.

Lewis, K.J., and B.S. Lindgren. 2002. Relationship between spruce beetle and tomentosus root disease: two natural disturbance agents of spruce. Can. J. For. Res. 32: 31-37.

Lewis, K.J., and B.S. Lindgren. 1999. Influence of decay fungi on species composition and size class structure in mature Picea glauca X engelmannii and Abies lasiocarpa in sub-boreal forests of central British Columbia. For. Ecol. Mgmt. 123(2-3): 135-143.

Lheidli T'enneh Lands Authority. 2017. Lheidli T'enneh Land Use Plan (Draft). 34 pp. http://www.lheidli.ca/Lands/index.php accessed Jan. 8th, 2018

MacKenzie, W.H. and J.R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Res. Br., B.C. Min. For., Victoria, B.C. Land Manage. Handb. No. 52. http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh52.htm

MacKinnon, A., J. Pojar and R. Coupe, eds. 1992. Plants of Northern British Columbia. Lone Pine Publishing, Edmonton, Alberta.

McCulloch, L.M. and A. Woods. 2009. British Columbia's Northern Interior Forests Dothistroma Stand Establishment Decision Aid. J. Ecosystems & Mgmt 10(1), 4 pp. Available at: http://jem-online.org/index.php/jem/article/view/406

McKenzie. S. 2000. Fraser River White Sturgeon Monitoring Program: Comprehensive report (1995-1999). RL&L Environmental Services Ltd. Prepared for BC Fisheries, BC Ministry of Environment. December 2000. 108 pp. Available at: http://wlapwww.gov.bc.ca/wld/documents/fisheriesrpts/rll_white_sturgeon/rll_summary_1995_1999.pdf

Merriam-Webster On-line Dictionary. 2017. https://www.merriam-webster.com/ accessed December 2017

Morrow, B., K. Johnston, J. Davies, 2013. Wildland Urban Interface Wildfire Threat Assessments in B.C. Report to Ministry of Forests, Lands and Natural Resource Operations, Wildfire Management Branch, January 24, 2013. 85 pp. Available At: http://fness.bc.ca/wp-content/uploads/2017/07/WTA-Guide-2012-Update.pdf

Nelson, T.C. 1997. Bowron River white sturgeon inventory, 1995-96. Contract report prepared for BC Ministry of Environment, Lands, and Parks, Fish and Wildlife Branch, Omineca-Peace Region, Prince George, by LGL Limited Environmental Research Associates, Sidney, BC. January 1997. 18 pp plus appendices.

Newberry, J. E., Lewis, K. J., & Walters, M. B. (2004). Estimating time since death of Picea glauca x P. engelmannii and Abies lasiocarpa in wet cool sub-boreal spruce forest in east-central British Columbia. Canadian Journal of Forest Research, 34(4), 931–938. https://doi.org/10.1139/x03-260

Newbery, J. E. (Ted), Lewis, K. J., & Walters, M. B. (2007). Inonotus tomentosus and the dynamics of unmanaged and partial-cut wet sub-boreal spruce–fir forests. Canadian Journal of Forest Research, 37(12), 2663–2676. https://doi.org/10.1139/X07-117

Northwest Invasive Plant Council, 2010. Aleza Lake Research Forest invasive plant inventory 2009. Report prepared for the Aleza Lake Research Forest Society. March 23rd, 2010. 6 pp plus appendices and map.

Oikos Ecological Services Ltd. 1995. Forest Ecosystem/Terrain Mapping Aleza Lake Research Forest Prince George Forest Region 1993-1995. Contract report for the Forest Sciences Section, Prince George Forest Region, BC Ministry of Forests, Prince George, BC.

O'Neill, G., T. Wang, N. Ukrainetz, L. Charleson, L. McAuley, A. Yanchuk, and S. Zedel. 2017. A proposed climate-based seed transfer system for British Columbia. Prov. B.C., Victoria, B.C. Tech.Rep. 099. www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr099.htm

Parker, A. K., & Johnson, A. L. S. (1960). Decay associated with logging injury to spruce and balsam in the Prince George region of British Columbia. The Forestry Chronicle, 36(1), 30–45. https://doi.org/10.5558/tfc36030-1

Perry, D.A., R.A. Meurisse, B. Thomas, R. Miller, J. Means, C.R. Perry and R.F. Powers (eds.). 1989. Maintaining the long-term productivity of Pacific Northwest forest ecosystems. Timber Press, Portland, OR. 256 pp.

Pike, R.G., T.E. Redding, R.D. Moore, R.D. Winker and K.D. Bladon (editors). 2010. Compendium of forest hydrology and geomorphology in British Columbia. B.C. Min. For. Range, For. Sci. Prog., Victoria, B.C. and FORREX Forum for Research and Extension in Natural Resources, Kamloops, B.C. Land Manag. Handb. 66.. https://www.for.gov.bc.ca/hfd/pubs/docs/lmh/Lmh66.htm

Powers, R.F. and K. Van Cleve. 1991. Long-term ecological research in temperate and boreal forest ecosystems. Agron. J. 83:11-24.

Prescott, C. E., Blevins, L. L., & Staley, C. L. (2000). Effects of clear-cutting on decomposition rates of litter and forest floor in forests of British Columbia. Canadian Journal of Forest Research, 30(11), 1751–1757. https://doi.org/10.1139/x00-102

Prescott, C. E., Blevins, L. L., & Staley, C. (2005). Litter decomposition in British Columbia forests: Controlling factors and influences of forestry activities. Journal of Ecosystems and Management, 5(2). Retrieved from http://www.jem-online.org/forrex/index.php/jem/article/view/298

Province of British Columbia. 1995. Biodiversity guidebook. Forest Practices Code of British Columbia. BC Ministry of Environment, Lands and Parks, and BC Ministry of Forests, Government of British Columbia. Victoria, BC.

Province of British Columbia. 1997. Recommended Prince George Land and Resource Management Plan. Prince George LRMP Working Table, Prince George, BC. https://www.for.gov.bc.ca/tasb/slrp/plan71.html accessed Jan. 8th, 2018

Pypker, T. G., & Fredeen, A. L. (2002a). Ecosystem CO2 flux over two growing seasons for a sub-Boreal clearcut 5 and 6 years after harvest. Agricultural and Forest Meteorology, 114(1), 15–30. https://doi.org/10.1016/S0168-1923(02)00139-9

Pypker, T. G., & Fredeen, A. L. (2002b). The growing season carbon balance of a sub-boreal clearcut 5 years after harvesting using two independent approaches to measure ecosystem CO2 flux. Canadian Journal of Forest Research, 32(5), 852–862. https://doi.org/10.1139/x01-187

Pypker, T. G., & Fredeen, A. L. (2003). Below ground CO2 efflux from cut blocks of varying ages in sub-boreal British Columbia. Forest Ecology and Management, 172(2), 249–259. https://doi.org/10.1016/S0378-1127(01)00799-X

Rea, R. V. (2011). Impacts of moose (Alces alces) browsing on paper birch (Betula papyrifera) morphology and potential timber quality. Silva Fennica 45(2): 227–236, Retrieved January 3, 2018, from http://www.metla.fi/silvafennica/abs/sa45/sa452227.htm

Rea, R. V. (2014a). A Preliminary Assessment of Moose (Alces alces) Winter Diets in the Aleza Lake Research Forest in North-Central British Columbia. Wildlife Afield, 11(1), 50–53.

Rea, R. V., Hjeljord, O., & Hårkönen, S. (2014b). Differential selection of North American and Scandinavian conifer browse by northwestern moose (Alces alces andersoni) in winter. Acta Theriologica, 59(2), 353–360. https://doi.org/10.1007/s13364-013-0170-9

Sanborn, P., & Jull, T. (2008). The Timing of Peatland Initiation in East-Central British Columbia: A First Look. Research Extension Note No. 2. Natural Resources Environmental Studies Institute. University of Northern British Columbia, Prince George BC. Retrieved from http://processes.soilweb.ca/wp-content/uploads/sites/10/2015/06/NRESI-REN-02-Sanborn.pdf

Schmidt, R.L. 1992. The Aleza Lake Experiment Station (1920 s' and 1930's) B.C. Min. For. Miscellaneous Report. Co-published by the B.C. Ministry of Forests, Research Branch and the Forest History Association of British Columbia. Retrieved from https://www.for.gov.bc.ca/hfd/pubs/docs/bro/bro02.htm

Sedgewick, J.K. (2008). Giscome Chronicle: The rise and demise of a sawmill community in central British Columbia, 1912 – 1976. ISBN 978-0-921087-39-7, CNC Press, College of New Caledonia Library, 3330 – 22nd Ave., Prince George, B.C. Canada. http://valleymuseum.ca/1museum/Library/2008-SEDGWICK-GISCOME13450.PDF

Sedgwick, J.K. (2010). The East Line Section of the Grand Trunk Pacific Railway in Central British Columbia. British Columbia History, Vancouver, 43(1), 13–17. https://search.proquest.com/docview/734462061?pq-origsite=gscholar

Sheldan, T. and J. Snetsinger. 2008. Memorandum: Incorporation of mixedwood and broadleaves into Forest Stewardship Plan stocking standards, SP amendments and TSR regeneration assumptions. B.C. Min. For. and Range, Victoria, B.C. www.for.gov.bc.ca/hfp/silviculture/111624%20signed%20CF%20broadleaf%20Memo.pdf

Smith, R. B., & Craig, H. M. (1968). Decay in advanced Alpine Fir Regeneration in the Prince George District of British Columbia. The Forestry Chronicle, 44(3), 37–44. https://doi.org/10.5558/tfc44037-3

Smith, D.M, Larson, B.C., Kelty, M.J, Ashton, M.S. 1997. The Practice of Silviculture: Applied Forest Ecology, 9th Edition. 506 pp.

Spilsbury, R.H. 1954. Some notes for guidance in the drafting of a comprehensive working plan for the Aleza Lake Experiment Station. Research Division, BC Forest Service, Victoria, BC. Unpublished Mimeo. 6 pp.

Statistics Canada. 2016. 2016 Census, Census Profile for Regional District of Fraser Fort George, British Columbia, Canada

Stevenson, S.K. 2009. Coarse woody debris in harvested and unharvested areas at the Aleza Lake Research Forest: Volume and attributes. Silvifauna Research, Prince George, BC. Contract Report for the Aleza Lake Research Forest Society. Nov., 2009. 16 pp.

Struik, L.C. and E.A. Fuller. 1988. Preliminary report on the geology of the McLeod Lake area, British Columbia. In: Current Research, Part E, Geological Survey of Canada, Paper 88IE, p. 39-42.

Struik, L.C. 1989. Regional geology of the McLeod Lake map area, British Columbia. In: Current Research, Part E, Geological Survey of Canada, Paper 89-1E, p. 109-114.

Struik, L.C., E. A. Fuller and T.E. Lynch. 1990. Geology of Prince George (east half) Map Area 93G/E, Open File. Scale 1:250,000. Geological Survey of Canada.

Tipper, H.W. 1971. Glacial geomorphology and Pleistocene history of central British Columbia. Geological Survey of Canada, Bulletin 196. 89 pp.

Wellwood, R. W. (1956). Review of British Columbia: Annual Report of the Forest Service for the Year ended 31st December, 1954. Empire Forestry Review, 35(1), 105–107. http://www.jstor.org/stable/42602709?seq=1#page_scan_tab_contents

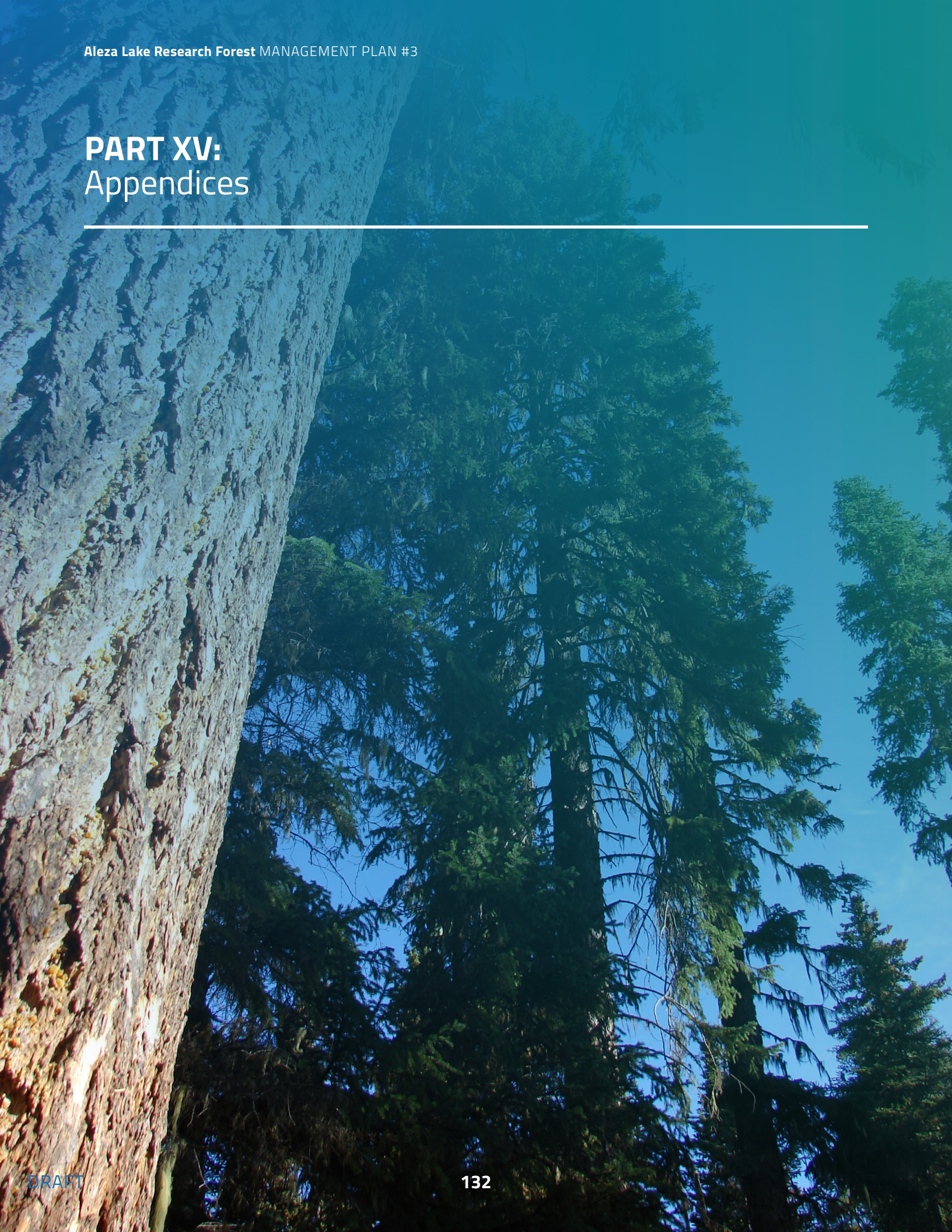
Wind, Elke & Beese, William. (2008). Little known and little understood: Development of a small wetland assessment field card to identify potential breeding habitat for amphibians. BC Journal of Ecosystems and Management. 9. 47-49.

Winder, R. S. (2017). Catalog of Provenance Trials Applicable to Climate Change Adaptation Research (No. BC-X-441). Natural Resources Canada. Zhanga, Q., Alfaro, R.I., and R.J. Hedba. 1999. Dendroecological studies of tree growth, climate, and spruce beetle outbreaks in Central British Columbia, Canada. For. Ecol. Mgmt. 121(3):215-225.

Zhanga, Q., Alfaro, R.I., and R.J. Hedba. 1999. Dendroecological studies of tree growth, climate, and spruce beetle outbreaks in Central British Columbia, Canada. For. Ecol. Mgmt. 121(3):215-225.

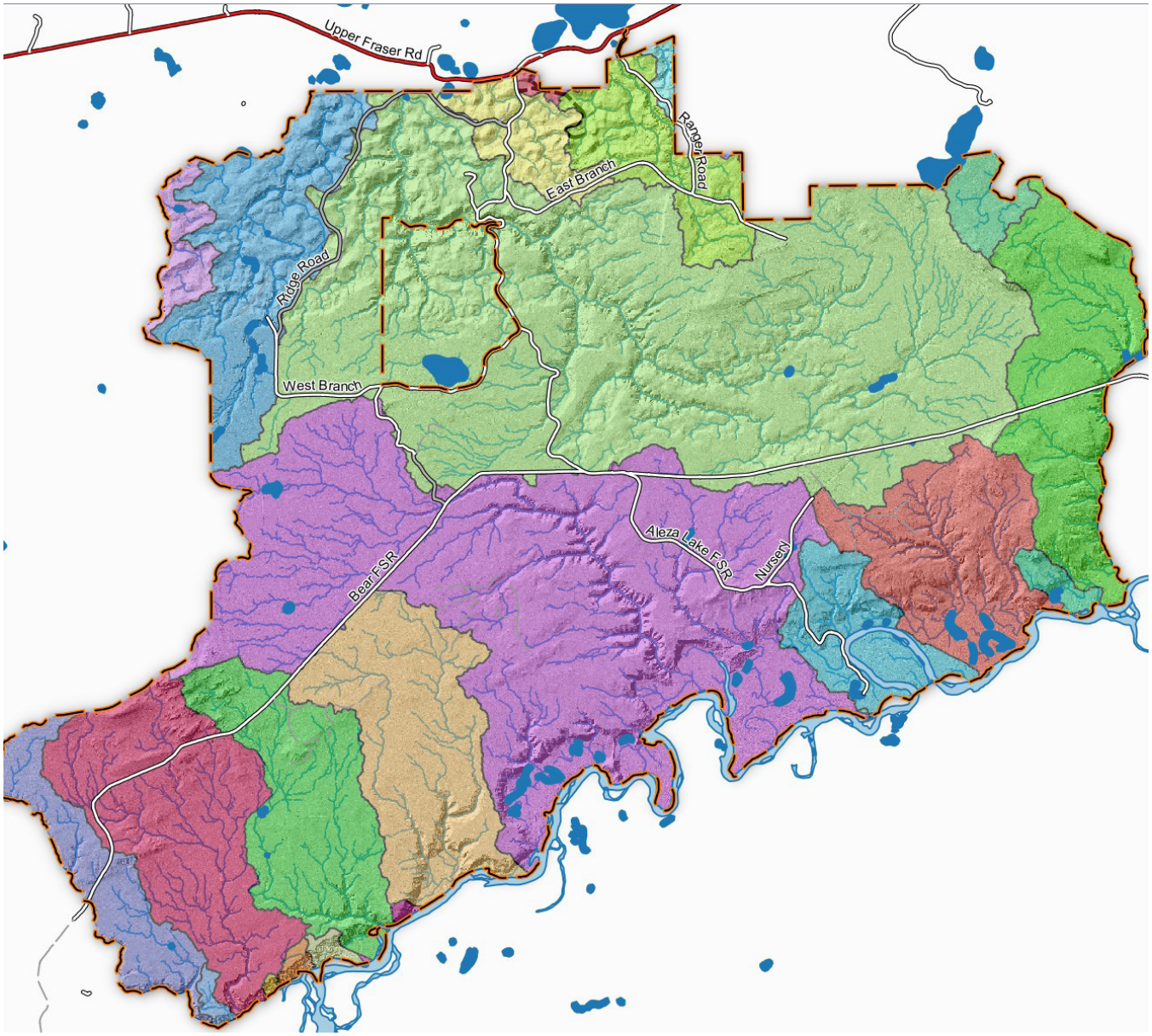
Zeglen, S. 1997. Tree wounding and partial-cut harvesting : a literature review for British Columbia. BC Ministry of Forests, Pest Management Report 14: 40 pp. https://www.for.gov.bc.ca/hfd/pubs/docs/sil/sil391.pdf

PART XV:
Appendices

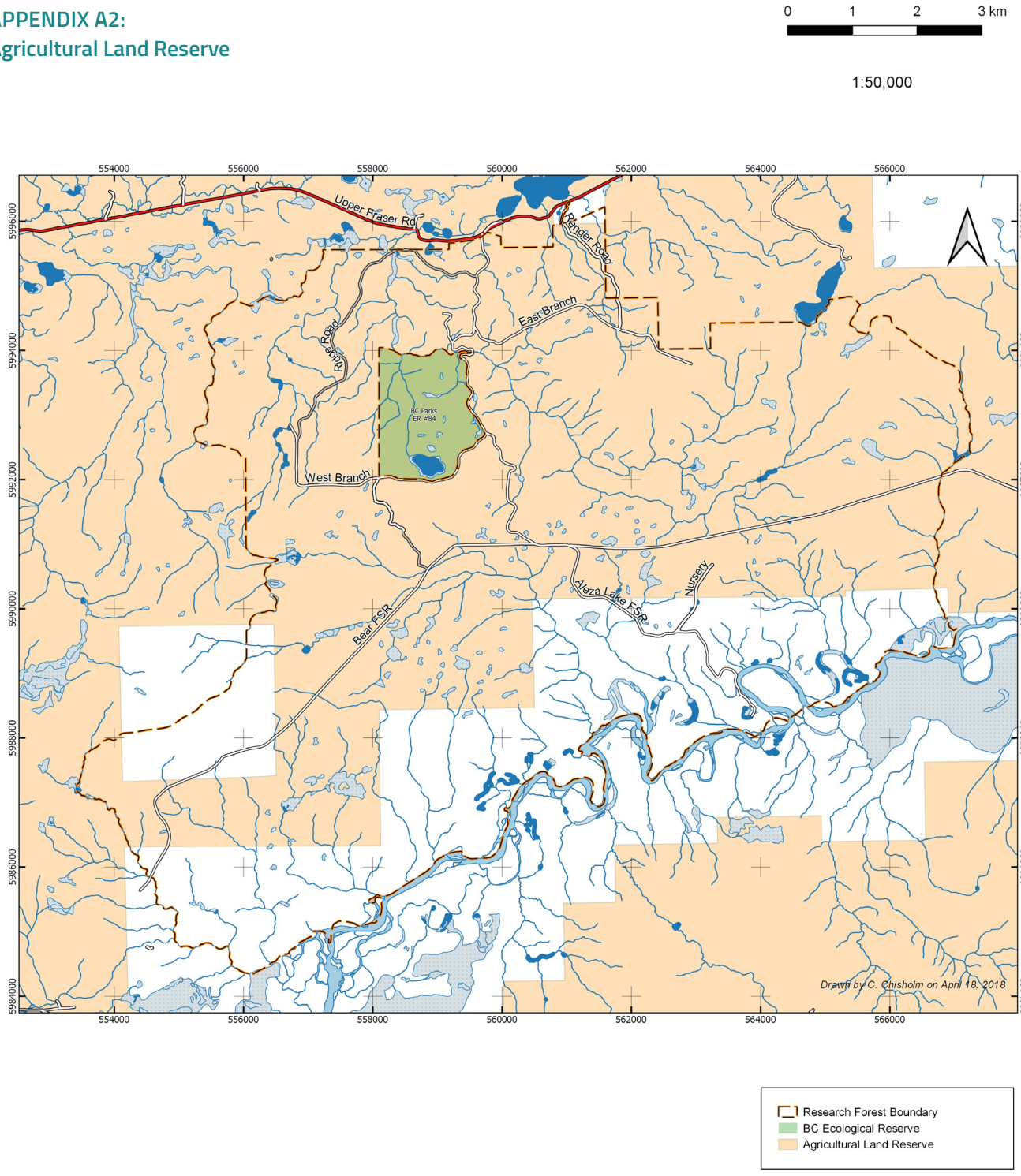


APPENDIX SERIES A: MAP SUPPLEMENTS

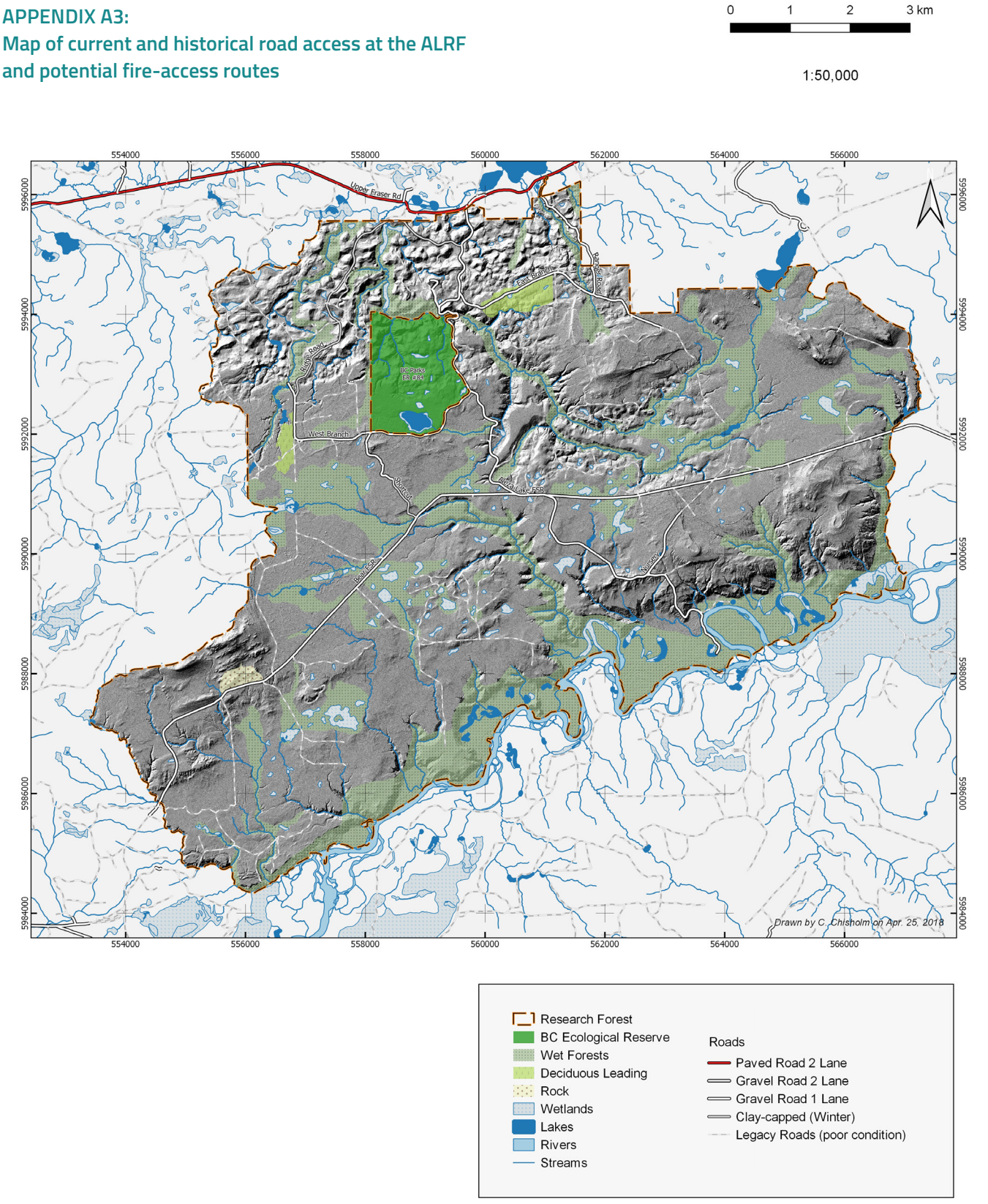
APPENDIX A1:
Major watershed basins within the Aleza Lake Research Forest



APPENDIX A2:
Agricultural Land Reserve



APPENDIX A3:
Map of current and historical road access at the ALRF and potential fire-access routes



APPENDIX SERIES B: SPECIES LISTS

APPENDIX B1:
ALRF Common Plant Species List

Group	Common Name	Latin name
Tree	Hybrid spruce	*Picea engelmannii x glauca*
	Sub-alpine fir	*Abies lasiocarpa*
	Douglas fir	*Pseudotsuga menziesii*
	Lodgepole pine	*Pinus contorta*
	Western hemlock	*Tsuga heterophylla*
	Paper birch	*Betula papyrifera*
	Black cottonwood	*Populus trichocarpa*
	Trembling aspen	*Populus tremuloides*
Shrub	Alder	*Alnus viridis*
	Common snowberry	*Symphoricarpos albus*
	Devil's club	*Oplopanax horridus*
	Birch leaved spirea	*Spiraea betulifolia*
	Pink spirea	*Spiraea douglasii*
	Highbush cranberry	*Viburnum edule*
	Black twinberry	*Lonicera involucrata*
	Velvet leaved blueberry	*Vaccinium myrtilloides*
	Oval leaf blueberry	*Vaccinium ovalifolium*
	Black huckleberry	*Vaccinium membranaceum*
	Saskatoon berry	*Amelanchier alnifolia*
	Red raspberry	*Rubus idaeus*
	Western mountain ash	*Sorbus scopulina*
	Sitka mountain ash	*Sorbus sitchensis*
	Prickly rose	*Rosa acicularis*
	Red osier dogwood	*Cornus stolonifera*
	Tall Oregon grape	*Mahonia aquifolium*
	Beaked hazelnut	*Corylus cornuta*
	Thimbleberry	*Rubus parviflorus*
	Black gooseberry	*Ribes lacustre*
	Red elderberry	*Sambucus racemosa*
	Douglas maple	*Acer glabrum*
	Willow	*Salix spp.*
Fern	Lady fern	*Athyrium filix-femina*
	Spiny wood fern	*Dryopteris expansa*
	Oak fern	*Gymnocarpium dryopteris*
Clubmoss	Various species	*Lycopodium spp.*

Table B1 - Continued...

Group	Common Name	Latin name
Herb	Bunchberry	*Cornus canadensis*
	Queens cup	*Clintonia uniflora*
	Wild sarsaparilla	*Aralia nudicaulis*
	Common mitrewort	*Mitella nuda*
	Three leaved foamflower	*Tiarella trifoliata*
	One leaf foamflower	*Tiarella unifoliata*
	Trailing raspberry	*Rubus pubescens*
	Indian hellebore	*Veratrum viride*
	Five-leaved bramble	*Rubus pedatus*
	Rosy twistedstalk	*Streptopus roseus*
	Prince's pine	*Chimaphila umbellata*
	Twinflower	*Linnaea borealis*
	Hawkweed	*Hieracium spp.*
	Oxeye daisy	*Chrysanthemum leucanthemum*
	Yarrow	*Achillea millefolium*
	Palmate coltsfoot	*Petasites palmatus*
	Hooker's fairybells	*Disporum hookeri*
	False Solomon's seal	*Smilacina racemosa*
	Lily-of-the-valley	*Maianthemum canadense*
	Goat's beard	*Aruncus dioicus*
	Strawberry	*Fragaria spp.*
	Red clover	*Trifolium pratense*
	Wintergreen	*Pyrola spp.*
	Red paintbrush	*Castilleja miniata*
	Bedstraw	*Galium spp.*
	Horsetail	*Equisetum spp.*
Bryophytes	Electrified cat's tail	*Rhytidiadelphus triquetrus*
	Red stemmed feather moss	*Pleurozium schreberi*
	Knights plume	*Ptilium crista-castrensis*
	Step moss	*Hylocomium splendens*
	Common leafy moss	*Plagiomnium medium*
	Large leafy moss	*Rhizomnium glabrescens*
	Common green sphagnum	*Sphagnum girgensohnii*
	Shiny liverwort	*Pellia neesiana*
Lichens	Lungwort	*Lobaria pulmonaria*
	Freckled lichen	*Peltigera aphthosa*
	Toad pelt	*Peltigera scabrosa*
	Pixie cup lichen	*Cladonia spp.*
	Reindeer lichen	*Cladina spp.*

APPENDIX B2:
Observed upland bird species for the mid-elevational SBSwk1 plateau forests around the ALRF and adjacent forest types.

Adapted from Lance and Phinney (2001)

Common Name	Latin Name	Observed Habitat
Sharp-shinned hawk	*Accipiter striatus*	Mature forest
Northern saw-whet owl	*Aegolius acadicus*	Mature forest
Cedar waxwing	*Bombycilla cedrorum*	Retention patches and edges of early seral habitat
Ruffed grouse	*Bonasa umbellus*	Mature forest and edges of early seral habitat
Great horned owl	*Bubo virginianus*	Mature forest
Red-tailed hawk	*Buteo jamaicensis*	Retention patches and edges of early seral habitat
Pine siskin	*Carduelis pinus*	Mature forest and edges of early seral habitat
Purple finch	*Carpodacus purpureus*	Mature forest and edges of early seral habitat
Swainson's thrush	*Catharus ustulatus*	Mature forest and edges of early seral habitat
Brown creeper	*Certhia americana*	Mature forest
Northern harrier	*Circus cyaneus*	Early seral habitat and tree edges
Evening grosbeak	*Coccothraustes vespertinus*	Retention patches and edges of early seral habitat
Northern flicker	*Colaptes auratus*	Retention patches and edges of early seral habitat
Olive-sided flycatcher	*Contopus borealis*	Retention patches and edges of early seral habitat
Western wood-pewee	*Contopus sordidulus*	Retention patches and edges of early seral habitat
Common raven	*Corvus corax*	Retention patches and edges of early seral habitat
Yellow-rumped warbler	*Dendroica coronata*	Mature forest and edges of early seral habitat
Magnolia warble	*Dendroica magnolia*	Mature forest and edges of early seral habitat
Pileated woodpecker	*Dryocopus pileatus*	Mature forest and edges of early seral habitat
Alder flycatcher	*Empidonax alnorum*	Retention patches and edges of early seral habitat
Hammond's flycatcher	*Empidonax hammondii*	Mature forest and edges of early seral habitat
Least flycatcher	*Empidonax minimus*	Retention patches and edges of early seral habitat
Dusky flycatcher	*Empidonax oberholseri*	Retention patches and edges of early seral habitat
Spruce grouse	*Falcipennis canadensis*	Mature forest and edges of early seral habitat
Merlin	*Falco columbarius*	Retention patches and edges of early seral habitat
American kestrel	*Falco sparverius*	Early seral habitat and tree edges
Common snipe	*Gallinago gallingo*	Early seral habitat and tree edges
Varied thrush	*Ixoreus naevius*	Mature forest and edges of early seral habitat
Dark-eyed junco	*Junco hyemalis*	Mature forest and edges of early seral habitat
Red crossbill	*Loxia curvirostra*	Mature forest and edges of early seral habitat
White-winged crossbill	*Loxia leucoptera*	Retention patches and edges of early seral habitat
Lincoln's sparrow	*Melospiza lincolnii*	Early seral habitat and tree edges

Table B2 - Continued...

Common Name	Latin Name	Observed Habitat
Song sparrow	*Melospiza melodia*	Early seral habitat and tree edges
MacGillivray's warbler	*Oporornis tolmiei*	Mature forest and edges of early seral habitat
Savannah sparrow	*Passerculus sandwichensis*	Early seral habitat and tree edges
Gray jay	*Perisoreus canadensis*	Mature forest and edges of early seral habitat
Black-blacked woodpecker	*Picoides arcticus*	Mature forest and edges of early seral habitat
Three-toed woodpecker	*Picoides tridactylus*	Mature forest and edges of early seral habitat
Hairy woodpecker	*Picoides villosus*	Retention patches and edges of early seral habitat
Pine grosbeak	*Pinicola enucleator*	Retention patches and edges of early seral habitat
Western tanager	*Piranga ludoviciana*	Mature forest and edges of early seral habitat
Black-capped chickadee	*Poecile atricapillus*	Retention patches and edges of early seral habitat
Boreal chickadee	*Poecile hudsonicus*	Mature forest
Ruby-crowned kinglet	*Regulus calendula*	Mature forest and edges of early seral habitat
Golden-crowned kinglet	*Regulus satrapa*	Mature forest and edges of early seral habitat
Northern waterthrush	*Seiurus novaboracensis*	Retention patches and edges of early seral habitat
Rufous hummingbird	*Selasphorus rufus*	Early seral habitat and tree edges
American redstart	*Setophaga ruticilla*	Mature forest and edges of early seral habitat
Mountain bluebird	*Sialia currucoides*	Retention patches and edges of early seral habitat
Red-breasted nuthatch	*Sitta canadensis*	Mature forest and edges of early seral habitat
Red-breasted sapsucker	*Sphyrapicus ruber*	Mature forest and edges of early seral habitat
Clay-colored sparrow	*Spizella pallida*	Retention patches and edges of early seral habitat
Chipping sparrow	*Spizella passerina*	Mature forest and edges of early seral habitat
Calliope hummingbird	*Stellula calliope*	Retention patches and edges of early seral habitat
Great gray owl	*Strix nebulosa*	Retention patches and edges of early seral habitat
Tree swallow	*Tachycineta bicolor*	Retention patches and edges of early seral habitat
Greater yellowlegs	*Tringa melanoleuca*	Early seral habitat and tree edges
Winter wren	*Troglodytes troglodytes*	Mature forest and edges of early seral habitat
American robin	*Turdus migratorius*	Mature forest and edges of early seral habitat
Orange-crowned warbler	*Vermivora celata*	Retention patches and edges of early seral habitat
Cassin's vireo	*Vireo cassinii*	Mature forest and edges of early seral habitat
Warbling vireo	*Vireo gilvus*	Mature forest and edges of early seral habitat
Wilson's warbler	*Wilsonia pusilla*	Mature forest and edges of early seral habitat
White-throated sparrow	*Zonotrichia albicollis*	Mature forest and edges of early seral habitat

APPENDIX B3:
Threatened and Endangered Species within the Omineca Region: Animal Species

Scientific Name	Common Name	Status				ALRF Presence Known/Unknown
		Provincial	BC Status*	COSEWIC	Global	
Acipenser transmontanus	White Sturgeon (Upper Fraser River population)	S1 (2010)	Red	E (2012)	G4T1 (2001)	Known
Valvata tricarinata	Threeridge Valvata	S1S2 (2015)	Red		G5 (2015)	Unknown
Acroloxus coloradensis	Rocky Mountain Capshell	S3S4 (2015)	Blue	NAR (2001)	G3G4 (2014)	Unknown
Ardea herodias herodias	Great Blue Heron	S3? (2017)	Blue		G5T5 (2000)	Unknown
Asio flammeus	Short- eared Owl	S3B,S2N (2015)	Blue	SC (2008)	G5 (2014)	Known
Botaurus lentiginosus	American Bittern	S3B (2015)	Blue		G5 (2016)	Unknown
Buteo platypterus	Broad-winged Hawk	S3?B (2015)	Blue		G5 (2014)	Unknown
Cicindela hirticollis	Hairy-necked Tiger Beetle	S2S4 (2017)	Blue		G5 (2008)	Unknown
Contopus cooperi	Olive-sided flycatcher	S3S4B (2015)	Blue	T (2007)	G4 (2008)	Known
Cypseloides niger	Black Swift	S2S3B (2015)	Blue	E (2015)	G4 (2015)	Unknown
Euphagus carolinus	Rusty Blackbird	S3S4B (2015)	Blue	SC (2017)	G4 (2014)	Unknown
Galba obrussa	Golden Fossaria	S2S3 (2015)	Blue		G5 (2015)	Unknown
Galba parva	Pygmy Fossaria	S3S5 (2015)	Blue		G5 (2015)	Unknown
Gulo gulo luscus	Wolverine	S3 (2010)	Blue	SC (2014)	G4T4 (1996)	Known
Hirundo rustica	Barn swallow	S3S4B (2015)	Blue	T (2011)	G5 (2014)	Unknown
Myotis septentrionalis	Northern Myotis	S3S4 (2015)	Blue	E (2013)	G1G2 (2015)	Unknown
Numenius americanus	Long-billed Curlew	S3B (2015)	Blue	SC (2011)	G5 (2014)	Unknown
Oeneis jutta chermocki	Jutta Arctic	S3 (2013)	Blue		G5T4Q (1999)	Unknown
Oreamnos americanus	Mountain Goat	S3 (2015)	Blue		G5 (1996)	Unknown
Pekania pennanti	Fisher	S3 (2015)	Blue		G5 (2005)	Known
Physella propinqua	Rocky Mountain Physa	S3S4 (2015)	Blue		G5Q (2015)	Unknown
Planorbula campestris	Meadow Rams-horn	S3S4 (2015)	Blue		G4G5 (2015)	Unknown
Podiceps nigricollis	Eared Grebe	S3B (2015)	Blue		G5 (1996)	Unknown
Rangifer tarandus	Caribou (northern mountain population)	S2S3 (2017)	Blue	E/SC (2014)	G5T4T5 (2013)	Unknown
Salvelinus confluentus	Bull Trout	S3S4 (2011)	Blue	SC (2012)	G4 (2011)	Unknown
Somatochlora forcipata	Forcipate Emerald	S3? (2015)	Blue		G5 (2015)	Unknown
Sphaerium striatinum	Striated Fingernail clam	S3S4 (2015)	Blue		G5 (2015)	Unknown
Tympanuchus phasianellus columbianus	Sharp-tailed Grouse	S2S3 (2005)	Blue		G4T3 (2016)	Known
Ursus arctos	Grizzly Bear	S3? (2015)	Blue	SC (2002)	G4 (2000)	Known

*Red = Extirpated, Endangered, or Threatened, Blue = Special Concern

APPENDIX B4:
Threatened and Endangered Species within the Omineca Region: Plant Species

Scientific Name	Common Name	Status				ALRF Presence Known/Unknown
		Provincial	BC Status*	COSEWIC	Global	
Acorus americanus	American sweet-flag	S2 (2015)	Red		G5 (2015)	Unknown
Myrinia pulvinata		S1S2 (2015)	Red		G4G5 (1991)	Unknown
Nymphaea tetragona	Pygmy waterlily	S1S2 (2015)	Red		G5 (1995)	Unknown
Taraxia breviflora	Short-flowered evening-primrose	S1 (2000)	Red		G5 (1988)	Unknown
Draba fladnizensis	Austrian draba	S3 (2015)	Blue		G4 (1988)	Unknown
Malaxis brachypoda	White adder's-mouth orchid	S2S3 (2015)	Blue		G4G5Q (2015)	Unknown
Meesia longiseta		S3 (2015)	Blue		G5 (2012)	Unknown
Nephroma isidiosum	Pebbled paw lichen	S3 (2010)	Blue		G3G5 (2006)	Unknown
Oxytropis campestris var. davisii	Davis' locoweed	S3 (2001)	Blue		G5T3 (2015)	Unknown
Pinus albicaulis	Whitebark pine	S2S3 (2013)	Blue	E(2010)	G3G4 (2011)	Unknown
Pyrola elliptica	Shinleaf wintergreen	S3 (2015)	Blue		G5 (2015)	Unknown
Rhodobryum roseum		S2S3 (2015)	Blue		G5 (1991)	Unknown
Sphagnum wulfianum		S2S3 (2015)	Blue		G5 (2015)	Unknown
Usnea glabrescens	Spotted beard	S3 (2010)	Blue		G5 (2015)	Known

*Red = Extirpated, Endangered, or Threatened, Blue = Special Concern

(BCCDC, 2013)

APPENDIX B5:
Threatened and Endangered Ecological Communities within the SBSwk1 Biogeoclimatic Subzone

Scientific Name	Common Name	Biogeoclimatic Unit	Provincial	BC Status*	Global
Picea engelmannii x glauca/ Spiraea douglasii/ Gymnocarpium dryopteris	Hybrid white spruce/ hardhack/ oak fern	SBSwk1/06	S2 (2015)	Red	GNR
Populus spp. - *Picea* spp./ *Cornus stolonifera*	Cottonwood - spruces/ red- osier dogwood	SBSwk1/Fm02 Flood – Middle bench	S2? (2010)	Red	GNR
Alnus incana/ Cornus stolonifera/ Athyrium filix-femina	Mountain alder/ red-osier dogwood/ lady fern	SBSwk1/Fl02 Flood – Low bench	S2 (2004)	Blue	G3G4
Betula nana/ Carex aquatilis	Scrub birch/ water sedge	SBSwk1/Wf02 Wetland - Fen	S3 (2010)	Blue	G4
Carex lasiocarpa/ Drepanocladus aduncus	Slender sedge/ common hook-moss	SBSwk1/Wf05 Wetland - Fen	S3 (2010)	Blue	G3
Carex limosa – Menyanthes trifoliate/ Drepanocladus spp.	Shore sedge – buckbean/ hook-mosses	SBSwk1/Wf08 Wetland - Fen	S3 (210)	Blue	G3
Equisetum fluviatile – Carex utriculata	Swamp horsetail – beaked sedge	SBSwk1/Wm02 Wetland - Marsh	S3 (2010)	Blue	G4
Picea mariana/ Lysichiton americanus/ Sphagnum spp.	Black spruce/ skunk cabbage/ peat-mosses	SbSwk1/Ws09 Wetland - Swamp	S2S3 (2004)	Blue	GNR
Picea mariana/ Menyanthes trifoliate/ Sphagnum spp.	Black spruce/ buckbean/ peat-mosses	SBSwk1/Wb11 Wetland - Bog	S3 (2008)	Blue	GNR
Pinus contorta/ Vaccinium membranaceum/ Cladina spp.	Lodgepole pine/ black huckleberry/ reindeer lichens	SBSwk1/02	S3 (2015)	Blue	G3
Pinus contorta/ Vaccinium membranaceum - Vaccinium myrtilloides	Lodgepole pine/ black huckleberry – velvet-leaved blueberry	SBSwk1/03	S3 (2015)	Blue	GNR
Pseudotsuga menziesii – Picea engelmannii x glauca/ Ptilium crista-castrensis	Douglas-fir – hybrid white spruce/ knights plume	SBSwk1/04	S3 (2015)	Blue	G3
Salix sitchensis/ Carex sitchensis	Sitka willow/ Sitka sedge	SBSwk1/Ws06 Wetland - Swamp	S3 (2004)	Blue	G3
Trichophorum cespitosum/ Campylium stellatum	Tufted club rush/ golden star moss	SBSwk1/Wf11 Wetland - Fen	S2S3 (2004)	Blue	G2G3

(BCCDC, 2013)

APPENDIX B6:
Code definitions for threatened and endangered species

Global Rank

Rank	Definition
GX	Presumed Extinct (species) – Not located despite intensive searches and virtually no likelihood of rediscovery. Eliminated (ecological communities)–Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species
G1	Critically Imperiled – At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2	Imperiled – At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3	Vulnerable – At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4	Apparently Secure – Uncommon but not rare, some cause for long-term concern due to declines or other factors.
G5	Secure – Common, widespread and abundant.
GNR	Unranked–Global rank not yet assessed.
T#	Infraspecific Taxon (trinomial) – The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank. Rules for assigning T-ranks follow the same principles outlined above for global conservation status ranks. For example, the global rank of a critically imperiled subspecies of an otherwise widespread and common species would be G5T1. A T-rank cannot imply the subspecies or variety is more abundant than the species as a whole-for example, a G1T2 cannot occur. A vertebrate animal population, such as those listed as distinct population segments under the U.S. Endangered Species Act, may be considered an infraspecific taxon and assigned a T-rank, in such cases a Q is used after the T-rank to denote the taxon's informal taxonomic status.

(BCCDC)

Table B6 - Continued...

Provincial Rank

CDC Conservation Status Ranks (S = Provincial, N = National, G = Global)

Status		Definition
X	Presumed Extirpated or Extinct	Not located despite intensive searches and no expectation that it will be rediscovered.
H	Historical	Not located in the last 50 years, but some expectation that it may be rediscovered.
1	Critically Imperiled	Because of extreme rarity or some factor(s) making it especially susceptible to extirpation or extinction. Typically 5 or fewer existing occurrences3 or very few remaining individuals, e.g., fewer than 1000 Spotted Owl.
2	Imperiled	Because of rarity or some factor(s) making it very susceptible to extirpation or extinction. Typically 6 to 20 existing occurrences or few remaining individuals, e.g., 1000 to 3000 White Sturgeon.
3	Vulnerable	Because rare and local, found only in a restricted range (even if abundant at some locations), or because of some other factor(s) making it susceptible to extirpation or extinction. Typically 21 to 100 existing occurrences, e.g., Gopher Snake.
4	Apparently Secure	Because uncommon but not rare, and usually widespread in the province. Possible cause for long-term concern. Typically more than 100 existing occurrences, e.g., Olive-sided Flycatcher.
5	Secure	Because common to very common, typically widespread and abundant, and not susceptible to extirpation or extinction under present conditions, e.g., Red-osier Dogwood.
?	Unranked	Rank not yet assessed.
U	Unrankable	Due to current lack of available information.

(BCCDC)

Rank Modifiers	
E	Exotic – a species introduced by man to the province
?	Inexact or uncertain due to limited information, qualifies the immediately preceding rank character
Q	Taxonomic status is not clear or is in question
T	Designates a rank associated with a subspecies or variety.
B	Designates a rank associated with breeding occurrences of mobile animals
N	Designates a rank associated with non-breeding occurrences of mobile animals

Table B6 - Continued...

COSEWIC Status Categories

Status	Definition
Extinct (X)	A wildlife species that no longer exists
Extirpated (XT)	A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species that is likely to become an endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern (SC)	A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Data Deficient (DD)	A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction
Not At Risk (NAR)	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

(BCCDC)

APPENDIX B7:
Listed Invasive Plants in the Omineca Region of BC (2017) and Presence (or lack thereof) within the ALRF, based on current information

Scientific Name	Common Name	ALRF Presence Known/Unknown
Gypsophila paniculata	Baby's breath	Unknown
Centaurea cyanus	Bachelors button (cornflower)	Unknown
Echium vulgare	Blueweed	Unknown
Arctium minus	Burdock	Unknown
Buddleja davidii	Butterfly bush	Unknown
Cirsium arvense	Canada Thistle	Known
Tanacetum vulgare	Common tansy	Unknown
Linaria genistifolia ssp. dalmatica	Dalmatian toadflax	Unknown
Daphne laureola	Daphne	Unknown
Knautia arvensis	Field scabious	Unknown
A. petiolata	Garlic mustard	Unknown
Impatiens glandulifera	Himalayan balsam	Unknown
Cynoglossum officinale	Hound's tongue	Unknown
Polygonum spp.	Knotweeds	Unknown
Cirsium palustre	Marsh plume thistle	Known
Centaurea montana	Mountain bluet	Unknown
Hieracium spp.	Orange hawkweed	Known
Leucanthemum vulgare	Oxeye daisy	Known
Lythrum salicaria	Purple loosestrife	Unknown
Matricaria maritima	Scentless chamomile	Unknown
Onopordum acanthium	Scotch thistle	Known
Centaurea biebersteinii	Spotted knapweed	Unknown
Centaurea diffusa	Diffuse knapweed	Unknown
Euphorbia esula	Leafy spurge	Unknown
E. myrsinities	Myrtle spurge	Unknown
E. cyparissias	Cypress spurge	Unknown
Hypericum perforatum	St. John's wort	Unknown
Carum carvi	Wild caraway	Unknown
Iris pseudacorus	Yellow flag iris	Unknown
Linaria vulgaris	Yellow toadflax	Unknown

Invasive Species Council of BC (2014) Invasive plants. Accessed Nov. 29, 2017. http://bcinvasives.ca/invasive-species/identify/invasive-plants

APPENDIX C: SILVICULTURE

APPENDIX C:
ALRF guidance matrix for reporting Retention Openings and Partial-cut Silvicultural Systems into RESULTS

(modified and adapted from BC MFLNRORD Silviculture Surveys Procedures Manual, 2016)

Silviculture Survey Manual Guidance					Treed Retention Submission into RESULTS Guidance	
Conifer-leading Management Regime	**Variant**	**Planned and/or Resultant Stand Structure**	**Residual-tree Basal area retention OR opening size(s)**	**Recommended Silviculture Survey Methodology (MFLNRORD 2016)**	**Long-term Leave-tree Retention (Reserves)**	**Shorter-term Retention – part of a Silvicultural System**
Single Entry – Even-aged	Clearcut with dispersed mature reserve trees	Retained mature leave trees, minor regen retention	< 6 m^3/ha	Clearcut survey method	Dispersed	Unharvested stems
	Overstory removal with regeneration retention	Substantial pre-harvest regeneration retention	< 6 m^3/ha	Layered survey	Dispersed	Unharvested stems
Multiple Entry – Multi-aged	Large-group (or Strip) Selection	Complex horizontal gap structure (harvest openings ± 3 to 6 mature tree heights wide) & group retention	Harvest openings ≥ 1 ha but ≤ 4 ha in forested matrix	Clearcut survey method		Group selection
	Small-group Selection	Complex horizontal gap structure (harvest openings ± 1 to 3 mature tree heights wide) & group retention	Small group - or patch-cuts >0.1 ha to < 1.0 ha in forested matrix	Small scale Openings survey method		Group selection
	SB Irregular Selection	Complex vertical and horizontal spruce-Abies stand structure with small harvest gaps << 1 tree height wide.	6 to ± 20 m^3/ha of post-harvest basal area.	Multi-storey survey method		Single tree selection
Intermediate Cuts (No regeneration objectives req'd)	Commercial Thin OR Shelterwood preliminary cuts (prep. & seed cuts)	Generally even-aged dispersed mature tree canopy, few to no gaps	≥ 20 m^3/ha	Commercial thin survey method		No Regen Objectives
	Stand Improvement Cut (including for timber, forest health, habitat and ecosystem goals)	Even-aged (to two-aged) dispersed older immature to mature tree canopy, minor gaps	≥ 20 m^3/ha	Commercial thin survey method		No Regen Objectives

APPENDIX D: ALRF TIMBER SUPPLY ANALYSIS FOR 2018 - 2028

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