2025 C5 Forest Management Plan

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Executive Summary

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West Fraser Timber Co. Ltd. (West Fraser) is a leading forestry company in the province of Alberta and throughout North America. The Cochrane division of West Fraser operates a modern dimensional sawmill and produces wood chips for pulp, paper products, and other wood-based products. As part of its operation, West Fraser holds a Forest Management Agreement (FMA) for the C5 Forest Management Unit (FMU), granted by the Government of Alberta (GoA).

As an FMA holder, West Fraser is required to develop a long-term strategic plan known as the Forest Management Plan (FMP). This plan outlines where, when, and how trees on Alberta crown land will be harvested, ensuring that the resource is managed sustainably. The 2025 FMP was developed in compliance with the 2021 Forest Management Agreement (FMA), the Alberta Forest Management Planning Standard (version 4.1), and the vision set forth in the South Saskatchewan Regional Plan, which encompasses the Defined Forest Area (DFA).

This FMP specifically applies to the C5 Forest Management Unit. The Terms of Reference (2022), public involvement program, First Nation consultation activities, timber supply analysis, and monitoring programs are all included in the FMP.

The area is predominantly covered by the Subalpine natural sub-region, followed by the Montane, and then Alpine sub-regions, with elevations ranging from 1,286 meters to approximately 2,997 meters. The DFA covers approximately 350,348 hectares, with the Crowsnest Forest Products FMA accounting for about 54% of the total area (190,665 ha). Of the FMA area, approximately 55% (106,097 ha) is classified as contributing landbase (or active landbase) for the purpose of determining the Annual Allowable Cut (AAC). Coniferous forests dominate the landscape, with some deciduous and mixedwood forests scattered throughout.

The FMP is driven by detailed technical analysis, grounded in an updated vegetation inventory (Alberta Vegetation Inventory 2.1) completed in 2022, along with updated timber yield information also completed in 2022.

The term of this plan is expected to run from May 1, 2025, to May 1, 2035. The AAC will become effective once approved by the Executive Director, Alberta Forestry and Parks. The timber operating year is defined as May 1 to April 30.

The development of the FMP was led by a combined team of West Fraser staff, Forestry and Parks professionals, and other subject matter experts as needed. Other timber disposition holders, including quota holders and CTPP programs, were engaged throughout the process. Additionally, West Fraser maintained a Public Advisory Committee (PAC) to review key components and consultation milestones during the FMP's development.

At West Fraser, we are committed to sustainable forest management and believe that healthy forests are critical to our future. We take pride in our dedication to quality, and our people are the foundation of our success. These core values, which are central to West Fraser, have been incorporated into this Forest Management Plan. We are confident that this plan will promote excellent forest ecosystem conservation while supporting sustainable employment and contributing to economic growth for future generations.

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Chapter 1 – Corporate Overview and Forest Management Approach

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1 Introduction

West Fraser Mills Ltd. (West Fraser) is a leading wood products company with over 60 facilities across Canada, the United States, the United Kingdom, and Europe. Drawing from responsibly sourced and sustainably managed forest resources, the company manufactures lumber, engineered wood products (such as oriented strand board (OSB), laminated veneer lumber (LVL), medium-density fiberboard (MDF), plywood, and particleboard), pulp, newsprint, wood chips, other residuals, and renewable energy. In November 2023, West Fraser acquired Spray Lake Sawmills and its subsidiary, Crowsnest Forest Products Ltd. (CFP), as part of its strategic efforts to expand its presence in Alberta. The division is also responsible for Forest Management Agreement (FMA0100038) bestowed by the Government of Alberta (GoA).

As the holder of FMA2100047, CFP is required to develop, at 10-year intervals, long-term strategic plans, called Forest Management Plans (FMPs). Based on 200-year planning horizons, FMPs set the direction for forest management activities for the next decade and determine harvesting schedules, locations and allocations, as well as performance expectations.

The 2025 FMP is CFP's comprehensive long-range plan for its FMA area. Pertaining to an area of 350,348 ha in southwestern Alberta, it was developed over three years with the involvement of the GoA, other tenure holders, forest experts, Indigenous communities, the public, and a broad range of stakeholders.

In keeping with corporate commitments to continuous improvement, this FMP builds on the work of the previous plans while also incorporating the latest developments in science and government policy. It describes the sustainable forest management strategies and activities that, when deployed, will provide a flow of renewable forest products to CFP and other mills, to preserve jobs and stimulate economic activity within the region, while maintaining and enhancing ecological integrity across the FMP area.

Upon approval by the GoA, all forest products companies operating on the FMA will be obliged to adhere to the FMP. This introductory chapter outlines the structure of the FMP, describes the Company's history and present-day operations, and ends with a discussion of the Company's adaptive approach to managing the forests in its stewardship.

1.1 Structure of the 2025 FMP

Crowsnest Forest Products Ltd.'s 2025 FMP is structured to meet the requirements of the Alberta Forest Management Planning Standard (Version 4.1 – April 2006). The plan, comprised of eight chapters and eight annexes that are summarized below, describes development processes and methodologies, as well as the inputs used to arrive at the preferred forest management scenario (PFMS). It also includes information that will guide the plan's implementation. Supporting digital media with appropriate datasets and files also form part of the final submission to government.

1.1.1 Document Outline

1.1.1.1 FMP Executive Summary

The executive summary provides a plain-language overview of the FMP.

1.1.1.2 Chapter 1: Corporate Overview and Forest Management Approach

Chapter 1 presents history and background on Crowsnest Forest Products Ltd., as well as a description of its manufacturing and forestry operations. It also discusses CFP's management goals and approach. Linkages between the Company's forest management approach and the 2025 FMP can be found in Chapters 5 and 6.

1.1.1.3 Chapter 2: FMP Development

FMP development history and procedures are summarized in Chapter 2. This section provides an overview of plan inputs and the decision-making processes, including the composition and role of the Plan Development Team (PDT), consultation and communication plans for the public, stakeholders and Indigenous communities, responses to issues identified by stakeholders, and timelines and milestones.

1.1.1.4 Chapter 3: Forest Landscape Assessment

Chapter 3 provides a detailed description of the current condition of the FMP area. It outlines the status of administrative, physical, environmental, anthropogenic and climatic conditions, in many cases using the same metrics developed for describing the Alberta land-use regions.

1.1.1.5 Chapter 4: Summary of Previous DFMP

Chapter 4 reflects CFP's commitment to sustainable forest management, summarizing its success in fulfilling the commitments outlined in the 2006 FMP and the lessons drawn from the implementation.

1.1.1.6 Chapter 5: VOITS – Values, Objectives, Indicators and Targets

The Values, Objectives, Indicators and Targets (VOITs) that guided the development of the 2025 FMP are documented in Chapter 5. VOITs, which are developed with input from the public, stakeholders and Indigenous communities, are an essential component of the FMP, linking values to forest management objectives and identifying related indicators and targets for use in performance measurement.

1.1.1.7 Chapter 6: PFMS – Preferred Forest Management Scenario

One of the primary products of the FMP development process is the Preferred Forest Management Scenario (PFMS). The PFMS is the outcome of all planning decisions and the sum of all proposed forest management actions. It describes when and where forest management activities can be carried out across the FMA and predicts the impacts of those activities on the values identified for the FMP area.

1.1.1.8 Chapter 7: Plan Implementation and Monitoring

Chapter 7 consolidates in one location the information necessary to execute the 2025 FMP and serves as an important reference chapter for those charged with its implementation. It includes both specific direction as well as strategies meant to guide lower-level planning processes for achieving FMP objectives. Chapter 7 also includes the monitoring and reporting commitments for the FMP.

1.1.1.9 Chapter 8: Research

While research commitments for the 2025 FMP implementation period are described in Chapter 7, Chapter 8 summarizes CFP's recent research initiatives.

1.1.1.10 Glossary

A list of terms and acronyms used throughout the FMP are included here.

1.1.1.11 Annex I: FMA – Forest Management Agreement

A copy of Forest Management Agreement #FMA2100047 for Crowsnest Forest Products Ltd. The FMA is included in this annex. The Agreement duration is from May 1, 2021 to April 30, 2041.

1.1.1.12 Annex II: Communication and Consultation Plans

Plans approved by GoA to guide consultation with the broader public are included in Annex II.

1.1.1.13 Annex III: Stewardship Report (2010-2015)

Ongoing reporting is a requirement of the FMA. The C5 Forest Management Plan Stewardship Report (2010-2015) by the GoA summarizing activity on the FMA for the period 2010 to 2015 is included here.

1.1.1.14 Annex IV: Yield Curve Development

Yield curve development for the timber resources across the FMA area is summarized in this Annex. Timber resource sampling programs and the processes used to develop projections of timber volumes are described.

1.1.1.15 Annex V: Landbase Development

The net landbase is a detailed spatial digital representation of the Defined Forested Area (DFA), as of May 1, 2023. This product is a key component of the modeling undertaken to develop the PFMS and the related Annual Allowable Cut (AAC), Spatial Harvest Sequence (SHS) and Non-Timber Assessments (NTA).

1.1.1.16 Annex VI: TSA – Timber Supply Analysis

Analysis undertaken to support the development of the FMP is summarized in this annex. This includes sensitivity analysis completed to support the determination of the assumptions used in the PFMS.

1.1.1.17 Annex VII: Spatial Harvest Sequence

Large scale maps of the spatial harvest sequence (SHS) are included in this annex for the first ten years (2025-2035) and second ten years (2035-2045) of the FMP, as well as quota holder sign-off documents.

1.1.1.18 Annex VIII: Growth and Yield Plan

The growth and yield plan describes the monitoring and measurements that will be undertaken to verify current growth assumptions and to refine future timber growth assumptions.

1.2 Defined Forest Area

The Defined Forest Area (DFA) is the physical extent to which the 2025 FMP applies. Forests are complex and variable, composed of a mixture of terrestrial and wetland ecosystems. Only a portion of the DFA is designated for forest management through the forest management agreement. Overall, about 45% of the DFA is designated as parks and protected areas. Of the area available for harvest, approximately 9% has been sequenced for harvesting over the next ten years. The following are examples of areas not eligible for harvesting:

- Administrative restrictions:
  - Dispositions (DIDs), Crown Land Reservations, GoA Research Sample Plots, parks and protected areas, anthropogenic features, historical resources, and areas with no AVI interpretation;
- Landscape restrictions:
  - Hydrology buffers, anthropogenic vegetated and non-vegetated lands, aquatic and flooded areas, lakes and rivers, naturally non-forested or non-vegetated land, and burned areas;
- Operational restrictions:
  - High moisture areas, low timber productivity rating (TPR) stands, low density stands, inoperable slopes, low density Douglas-fir stands with a deciduous understorey, operational deletions, seismic Lines, isolated stands, and subjective deletions.

Table 1-1 summarizes the areas within the passive landbase that are not eligible for forest harvesting activities, broken down into the categories mentioned above, as well as the total DFA that is available for harvest.

Table 1-1. Classified Landbase summary.

Landbase Category		Area (ha)
	Non-Contributing Landbase	
	Administrative Restrictions	
PPA	Parks and Protected Areas	157,612.1
ESLUZ	Eastern Slopes Land Use Zone 1	3,102.1
HRV	Historic Resource Values	1,215.7
DIDS-FOR	Forest DIDs Dispositions	266.3
DIDS-NONFOR	Non-Forested DIDs Dispositions	2,939.1
CLR	Crown Land Reservations	414.6
GOA_PSP	GOA Permanent Sample Plots	116.9
ANTH_NON	Non-Vegetated Anthropogenic Features	526.1
ANTH_VEG	Vegetated Anthropogenic Features	173.5
AVI	Areas with no AVI Interpretation	700.3
Administrative Total		**167,066.7**
	Landscape Restrictions	
LAKES_RIVERS	Lakes and Rivers	661.9
FLOOD	Flood Prone Areas	6.4
HYDROBUF	Hydrology Buffers	10,701.2
NNV	Natural Non-Vegetated Areas	2,627.4
NNF	Natural Non-Forested Areas	11,924.8
BURN	Burned Areas	12.8
OTHER_DIST	Areas Affected by Other Natural Disturbances	30.0
NFCC	Non-Forested Cutblocks (Outstanding ARIS Reconciliation)	0.0
Landscape Restrictions Total		**25,964.6**
	Operational Restrictions	
SLOPE	Areas with Slopes >45%	32,584.1
MOISTURE	High Soil Moisture	216.8
TPR	Low Timber Productivity Rating	4,785.2
DENSITY	Low Stand Density	9,025.0
LT	Larch/Tamarack	265.9
FD	Douglas-Fir	225.5
PA_PF	Whitebark/Limber Pine	1,302.1
WHITEBARK PINE PLUS	Whitebark Pine Plus protection	17.4
OPERATIONAL	Operational Deletions	1,742.4
ISO	Isolated Stands	23.6
PAR	Perimeter to Area Deletions	985.4
SEISMIC	Seismic Lines	46.0
Operational Restrictions Total		**51,219.4**
Non-Contributing Landbase Total		**244,250.7**
	Contributing Landbase	
C	Coniferous	91,217.2
CD	Coniferous Leading Mixedwood	1,507.1
DC	Deciduous Leading Mixedwood	1,258.8
D	Deciduous	12,114.4
Contributing Landbase Total		**106,097.4**
Grand Total		**350,348.1**

2 Corporate Overview

2.1 Mission Statement

For more than 65 years, West Fraser has been guided by the fundamental principles instilled by its founders, which have steered its growth trajectory and defined its operational framework. Integrity, modesty, collaboration, thriftiness, innovation, competitiveness, and regard for colleagues constitute the cornerstone of West Fraser's organizational culture, shaping its daily business. This enduring ethos has set West Fraser apart from its rivals since its establishment at Two Mile Planing Mills and continues to be indispensable to its prospective achievements. The company's goals include:

- Achieving excellence in performance and personnel
- Establishing leadership within the industry
- Providing stimulation and fulfillment
- Upholding responsibility to local communities
- Ensuring profitability and expansion

2.2 History

2.2.1 West Fraser Mills Ltd.

West Fraser was established in 1955 through the collaborative efforts of three brothers – Sam, Bill, and Pete Ketcham – who combined their resources to acquire a modest planing mill in Quesnel, B.C. With nearly seven decades of operation, the journey has been marked by resilience and growth.

At the heart of our success lies a robust and unwavering business model centered on efficiency and meticulous cost management. We consistently reinvest in our operations, providing our dedicated workforce with the tools and support needed to thrive in a fiercely competitive environment.

West Fraser's legacy is a testament to the collective spirit of individuals who transcended the aspirations of its founding trio. Today, we remain guided by the enduring principles and objectives that have withstood the test of time:

- Rigorous cost control across all facets of our operations
- Investment in state-of-the-art, efficient mills
- Commitment to environmental stewardship and leadership
- Active engagement of employees in shaping our future
- Unwavering pursuit of excellence in all endeavors

2.2.2 Crowsnest Forest Products Ltd.

On November 17, 2024, Spray Lake Sawmills and its subsidiary company Crowsnest Forest Products Ltd. became part of the West Fraser family. The sawmill in Cochrane has been re-branded as West Fraser Cochrane, but the Forest Management Agreement with the province of Alberta continues to be under the Crowsnest Forest Products legal name.

2.3 Manufacturing Operations

West Fraser has since grown from the original 12-person crew at Two Mile Flat to be the largest lumber producer in North America with more than 60 facilities in Canada, the United States, the United Kingdom, and Europe. The enduring prosperity of our company is rooted in our steadfast commitment to disciplined operational practices and a prudent approach to cost management.

2.3.1 Products

In recent years, West Fraser has expanded beyond its original stronghold in British Columbia, evolving into one of the premier lumber and oriented strand board (OSB) manufacturers globally. The Company is actively forging new avenues for expansion both within our established operational territories and in regions with a stable or growing timber supplies. With the acquisition of Spray Lake Sawmills in November 2023, we continue to be a growing part of Alberta's forest products industry.

West Fraser has two major products: lumber and oriented strand board. The Company's lumber is made from spruce, pine, and fir (SPF) and southern yellow pine (SYP). West Fraser also manufactures engineered wood products including plywood, medium density fiber (MDF), particle board and laminated veneer lumber (LVL). We also produce treated wood such as pulp & paper (NBSK and BCTMP), newsprint, furniture, wood chips, energy and other residuals.

At our Cochrane site, operations include a sawmill, planning mill, two treating plants, an agricultural fence post operation and a residual product (mulch/sawdust) recovery and storage facility. A commitment to innovation and 100% utilization of our fibre has ensured that CFP has thrived in a very competitive market for over 77 years.

<u>SPF Lumber:</u> Untreated lumber produced in Cochrane is sold through our Canadian distribution network to mainly western Canadian retail and remanufacturing customers. SPF lumber is made exclusively from Alberta harvested timber and is known world-wide for its quality. CFP is unique in our ability to manufacture sizes as small as 1×4 up to timbers as large as 8×8. The most common dimensions produced by the mill are 2×4 and 2×6 in lengths of 6' to 16', including stud trims. We also produce wider widths as well as 4×4 and rough timbers which are used internally by our pressure treatment operations.

<u>Oriented Strand Board (OSB)</u>: OSB is a type of engineered wood product commonly used in construction and furniture manufacturing. It is made by compressing and bonding together quality strands of wood in specific orientations. It is available in various grades, ranging from smooth, sanded surfaces suitable for finishing to textured surfaces for structural applications. Our OSB is known for its strength, stiffness, and dimensional stability.

<u>Pressure Treated Lumber</u>: The West Fraser Cochrane facility produce a full range of consumer products for outdoor home construction currently marked under the HiLINE premium brand, utilizing Micro Pro Sienna to pressure treat the lumber.

Our Cochrane team is proud to be the leader on new technology and treatments as well as environmental standards. The Cochrane facility was the first treatment plant in Canada to meet Wood Preservation Canada's TRD requirements for environmental excellence.

Agriculture Fence Posts: As part of our 100% utilization standard for everything that is brought into the Cochrane facility, we also operate a fence post peeling operation. Wood that is too small for lumber is not left on the forest floor but is instead manufactured into fence posts that farmers and ranchers in Alberta depend on. We are pleased to produce what is known as the highest quality post available in the prairie market. Our peeled posts are stronger and will outlast the newer dowelled (uniformly turned posts) which have recently become available in Canada.

Residuals: We are committed to 100% utilization of wood fibre. This commitment makes both environmental and economic sense. Top Spray is our by-products division and thanks to innovative products like our bark mulch, we have been able to turn what was once considered waste into a useful product that is environmentally friendly.

All lumber is third party inspected by the Alberta Forest Products Association (AFPA) to ensure that all products conform to the National Lumber Grades Authorities latest grading rules for Canadian Lumber. The AFPA inspections are also checked by Canadian Lumber Standards (CLS) and the American Lumber Standards (ALS) accreditation boards.

2.4 Forest Management Operations

2.4.1 Crowsnest Forest Products Ltd.

We are committed to sustainable forest management; a long-term goal to maintain natural ecosystems, communities and native species in balance with social and economic needs. As identified in the FMP, we monitor, measure and report performance to demonstrate our commitment.

A description of the landscape is provided in *Chapter 3 – Forest Landscape Assessment*. The assessment outlines key biological, economic and social values including baseline information for which FMP objectives are measured. The baseline information was also used to evaluate various forest management scenarios including the selection of the preferred forest management strategy.

Baseline information includes data such as forest age class distribution, seral stage distribution, and indicator wildlife habitat.

As the FMP is implemented, measurable ecological and operational benchmarks will be reported on as outlined in *Chapter 5 – Values, Objectives, indicators, and Targets (VOITs)*.

2.4.2 Other Forestry Operators

In addition to Crowsnest Forest Products Ltd., the following companies also have been granted rights to harvest timber in the FMA under GoA-allocated timber dispositions.

2.4.2.1 793128 Alberta Ltd.

793128 Alberta Ltd. holds a Coniferous Timber Quota (CTQC050002) for 2,604 m^3 in FMU C5, effective February 16, 2017.

2.4.2.2 770538 Alberta Ltd.

770538 Alberta Ltd. holds a CTQ (CTQC050005) for 6,912 m^3 in FMU C5, effective February 16, 2017.

2.4.2.3 Community Timber Permit Program (CTPP)

There are up to 9,799 m^3 of conifer logs available annually from C5 FMA to maintain the Community Timber Permit Program, effective February 16, 2017. If some or all of the annual volumes provided under this program are not used after two forest management operating years, then the unused volume will accrue to CFP. Permit holders are responsible for their harvesting activities and forest renewal activities if the responsibility is not transferred to the Forest Resource Improvement Association of Alberta (FRIAA).

2.5 Certifications

CFP's forest management standards are independently verified by auditors ensuring adherence to key criteria. CFP is certified to the Sustainable Forestry Initiative® (SFI®) standards for sustainable forest management, which are recognized by the international umbrella organization Program for the Endorsement of Forest Certification (PEFC).

3 Forest Management Approach

3.1 Philosophy

Historically, the FMA's forest ecology was driven by large landscape level wildfires. This disturbance cycle is what historically renewed the forests and kept a check on forests pests like Mountain Pine Beetle. Forest management strives to protect the forest environment from wildfire that threatens our air and water quality. Our forest management strategies focus on the health and resiliency of the forest and its ability to support biodiversity, watershed health, recreation and a vibrant forest industry.

For over six decades, CFP has been manufacturing building products while creating green jobs that support families and build our communities. The forest industry is one of the most important sectors of the Alberta economy, contributing over $13.6 billion annually, employing 31,573 Albertans, and generating over $988 million in provincial and municipal taxes in 2022 (AFPA, 2022).

3.2 Forest Management Strategies

Over the next twenty years, CFP will strive to satisfy the fibre needs of its manufacturing operations through effective utilization and enhanced management of the productive forest landbase. Sustainable forest management practices, in recognition of the Canadian Council of Forest Ministers (CCFM) and the Canadian Standards Association (CSA) have been developed by the GoA. The GoA policies that follow the CSA framework specify a set of Values, Objectives, Indicators and Targets (VOITs), which establish forest management targets for the following criteria:

1. Conservation of biological diversity.
2. Maintenance and enhancement of forest ecosystem condition and productivity.
3. Conservation of soil and water resources.
4. Forest ecosystem contribution to global ecological cycles.
5. Multiple benefits to society including a sustainable timber supply and reduction of wildfire threat.
6. Accepting society's responsibility for sustainable development, which includes compliance with government regulations and implementation of consultation with indigenous communities, the public and other stakeholders.

3.2.1 Leaders in Forest Certification

CFP's commitment to sustainable forestry is third party certified under the Sustainable Forestry Initiative® (SFI®) Forest Management Standard, which is endorsed by the Programme for the Endorsement of Forest Certification (PEFC).

The SFI program is a member of the International Union for Conservation of Nature (IUCN). The IUCN is the world's oldest and largest global environmental organization with almost 1,300 government and NGO members and more than 16,000 volunteer experts in 161 countries.

PEFC, with more than 300 million hectares of certified forests, is the world's largest non-profit, non-governmental organization dedicated to promoting Sustainable Forest Management. SFI makes up close to 40% of PEFC globally. SFI certified wood products are recognized by the Green Building Council's Leadership in Energy and Environmental Design program (LEED).

3.2.2 West Fraser Biodiversity Policy

As a leading renewable wood products company, we endeavor to safeguard and contribute positively to biodiversity through leadership in stewardship, collaboration, and sustainable management practices. We believe biodiversity considerations should be incorporated into our business strategy and decision making processes. We acknowledge our dependency on nature and the health of forest ecosystems. We are committed to identifying biodiversity risks and opportunities, operating responsibly to preserve natural capital, and demonstrating leadership through collaboration and action. We aim to uphold, share, and reinforce our biodiversity and nature-related goals to:

- Regenerate the working forests that we manage.
- Identify and act on opportunities to positively contribute to the maintenance and enhancement of biodiversity.
- Establish West Fraser as a global leader in biodiversity stewardship and sustainable forest management practices.
- Minimize our impacts from operations on habitats and waterbodies, and the species that rely on them.
- Abide by this policy in alignment with our commitments to sustainable forest management and responsible fiber sourcing, as outlined in our Sustainable Forest and Wood Procurement Policy.

Where West Fraser manages forest landscapes and, in doing so, interfaces with ecosystems and biodiversity directly, we will:

- Embody principles of adaptive management to enhance forest management and promote a holistic approach to achieve landscape resiliency.
- Contribute to the conservation of nature indirectly with in-kind and financial contributions to conservation organizations and agencies.
- Contribute to biodiversity conservation through innovations in operational practices.
- Consider the needs of species at risk in forest landscape planning and contribute to recovery and conservation of species.
- Support the development and sharing of innovative tools, techniques, strategies, and scientific knowledge to enhance sustainable forest management and biodiversity.
- Endeavor to provide opportunities for Indigenous knowledge and perspectives from Indigenous Peoples to be incorporated in our forest management plans and practices.
- Evaluate the potential to measure and report on key biodiversity indicators of forest management using sound, peer-reviewed, scientific methods.
- Employ science-informed solutions that mitigate risks to nature.

- Maintain programs to address human-wildlife interactions to minimize conflict and promote coexistence.
- Maintain certification to the Sustainable Forestry Initiative (SFI®) Forest Management Standard that promotes sustainable forestry practices based on principles, objectives, and performance measures.

At the organizational level, we:

- Have become early adopters of the Taskforce on Nature-related Financial Disclosures to align ourselves with global best practices and expectations and to further integrate nature and biodiversity-related risks into our business strategy.
- Will advance our readiness to meet market and customer needs related to existing and emerging nature-related requirements. To enable the meeting of these goals and commitments, West Fraser has established and will maintain a Biodiversity Centre of Excellence (BCOE). West Fraser's leaders, and each of our employees, agree to support and apply this policy.

4 Forest Management Issues & Values

Under the Forest Management Agreement, the Minister grants the Company the right to "establish, grow, harvest, and removing coniferous timber as provided for in the approved forest management plan." However, the agreement also requires the incorporation of other resource values and uses within the FMA area. Achieving a balance of values is accomplished by review and adoption of specifications from the South Saskatchewan Regional Plan, and its associated sub-plans such as the Livingstone-Porcupine Hills Land Footprint Management Plan & the Livingstone-Porcupine Hills Recreational Management Plan, and through input received from the public during the forest management planning process.

The following is the list of issues and values captured from Indigenous communities, the public, and stakeholders:

- Recognition and respect of Indigenous Treaty rights and traditional uses.
- Biodiversity/ecological integrity – Concerns over the effects of long-term timber harvesting on biological diversity and ecosystems.
- Protecting native grasslands.
- Climate change – CFP will receive direction from the GoA to meet any emerging management strategies.
- Watershed protection – Reduce forest fuels to minimize wildfire impacts to drinking water supplies, minimize increases in water yield, and minimize impacts to water quality.
- Aesthetic values – Concern over the impact of harvesting activity in areas of high visual sensitivity. Areas with potentially high visual sensitivity have been inventoried with the 2025 FMP and will be addressed at the preliminary harvest design stage of AOP development.
- Environmental protection – Concerns over the impacts of CFP operations on the environment, including soil productivity.
- Forest protection – Minimize forest losses from fire and Mountain Pine Beetle.
- Motorized recreational values – The issue of impacts and access management and protection of trails.
- Non-motorized recreational values – The issue of impacts to trails and access management.
- Threatened species and wildlife habitat supply – Concerns over the effects of long-term timber harvesting on wildlife habitat.
- Fisheries – The effects of timber harvesting and road construction/reclamation on fish habitat.
- Community and private property protection – Reduce forest fuels to minimize wildfire impacts to private property and communities.
- Meaningful public consultation – The process of meaningfully engaging the public in the management of crown resources.
- Access management – Development of new access and the management/use of existing access in terms of wildlife security and watershed protection.
- Historical resources – Concern over the potential loss of historical resource sites.
- Unique areas – Concern over the potential loss of unique sites.

- Integration – The potential for the integration of non-commercial uses and other industrial activity with timber harvest planning and operations including but not limited to: oil and gas, grazing, and outfitting and trapping activities.
- Land base and tenure – Recognition of other dispositions, tenure holders, and the protection of the forested land base.
- Reforestation – Concern over the regeneration success in harvested areas.
- Sustainable timber supply – Issues and obligations in establishing and sustaining our level of timber harvesting based on ecological, economic, and social needs.
- Community timber program – Commitment to and sequencing of the fixed volume allocations.
- Public safety – Potential for interaction with the public and SLS operations.
- Research – Investment in and application of research.
- Noxious weeds – Minimize the spread of noxious and invasive plant species.
- Adaptive management – The ability to change management strategies and practices in light of new research and monitoring results.

4.1 South Saskatchewan Regional Plan

The South Saskatchewan Regional Plan (SSRP) sets the stage for robust growth, vibrant communities, and a healthy environment within the region over the next 50 years. Specifically, the plan specifies that in the Green Area, public land is managed for timber production, wildfire protection, watershed, resource development, wildlife and fisheries, tourism recreation and other uses. Alignment between this FMP and the SSRP was a driving force when reassessing the Values Objectives Indicators and Targets for the management plan (see *Chapter 5 – Values, Objectives, Indicators, and Targets* for more detail). Alignment is demonstrated as follows:

- Management for wildfire protection:
    - The spatial harvest sequence has been developed to reduce the wildfire risk indicator (WRI) classes (risk reduction, continuous Improvement and intolerable) by 30% over the next 20 years, within the CFP FMA community zone. (VOIT #28). See *Chapter 7 – Plan Implementation and Monitoring* Section 6.1 for further details.
- Management for watershed:
    - The inclusion of snow sensitive areas has been identified within the classified landbase, and the subsequent equivalent clearcut area (ECA) calculation, the overall target for ECA is to be within an acceptable threshold (≤30%) (VOIT #25).
    - The FMP ties to the Alberta timber harvest planning and operating ground rules (OGRs) and supports the objective of retain ecological values and functions associated with riparian zones (VOIT #9).
        - Evaluating incidence of soil erosion and slumping (VOIT #24).
        - Compliance with relevant OGRs sections pertaining to aquatic and riparian protection (VOIT #26).
- Management for wildlife and fisheries:

- Activities identified in the plan have been reviewed against the objective of maintaining habitat for identified high value species (i.e. economically valuable, socially valuable, species at risk, species of management concern) (VOIT #14).
  - This included the addition of Clark's nutcracker modeling, which was identified as a high value indicator species during the FMP planning process.
  - This includes the addition of a specific VOIT for Westslope cutthroat trout and bull trout (VOIT # 14-2).
- Management for biodiversity & forest ecosystem resilience:
  - Retaining the full range of cover types and seral stage supports landscape level biodiversity (VOIT #1).
  - Assessing patch size (VOIT #2) and old interior forest by cover class (VOIT #3) can maintain biodiversity and avoiding landscape fragmentation.
- Integration of tourism recreation and other uses:
  - 157,611 ha of the C5 FMU is formally protected (generally a provincial or wildland park).
  - This supports the SSRP's strategic direction of providing outdoor recreation and nature-based tourism opportunities and preserving and promoting the region's unique cultural and natural heritage.
- Integration with the Livingstone-Porcupine Hills Land Footprint Management Plan (2018):
  - Forestry specific targets have been developed for open motorized access, restricted motorized access and near stream access on erodible soils (VOIT #5-1, #5-2 & #5-3). The targets are below the required density limits.
- Integration with existing integrated resource plans:
  - 70,637 ha of the C5 FMU is designated as Prime Protection Zone 1, with the majority of that area being formally protected (or soon to be). Prime Protection areas within the C5 FMA have also been removed from the contributing landbase (3,106 ha) and are classified as non-contributing for timber production.
- Supporting resource development:
  - The SSRP emphasizes maintaining and diversifying the forest industry while fostering sustainable communities. The FMP supports these objectives by identifying a sustainable timber supply, ensuring economic viability, and providing local employment.
- The SSRP identifies the objective of encouraging Aboriginal Peoples' participation in land-use planning:
  - Throughout the FMP development process, CFP engaged with First Nations using information packages, continuous project updates, and follow-up. The events of this process are described in *Chapter 2 – FMP Development*. Engagement will be a central theme that will carry through during plan implementation.

Monitoring, evaluation, and reporting are central themes of the SSRP and are embedded in this plan's adaptive forest management approach. These aspects are reflected in the VOIT tables, stewardship reporting commitments, and the 10-year FMP renewal cycle requirements.

The South Saskatchewan Regional Biodiversity Management Framework and the Spatial Human Footprint Plan, identified in the SSRP, have not yet been developed for the C5 FMU area.

5 References

Alberta Forest Products Association (AFPA). 2022. Economic Impact Report, June 2022. 29pp.

Sustainable Forestry Initiative. 2015. SFI 2015 – 2019 Forest Management Standard. Washington, DC. 13pp.

FORCORP - Project Number: P877

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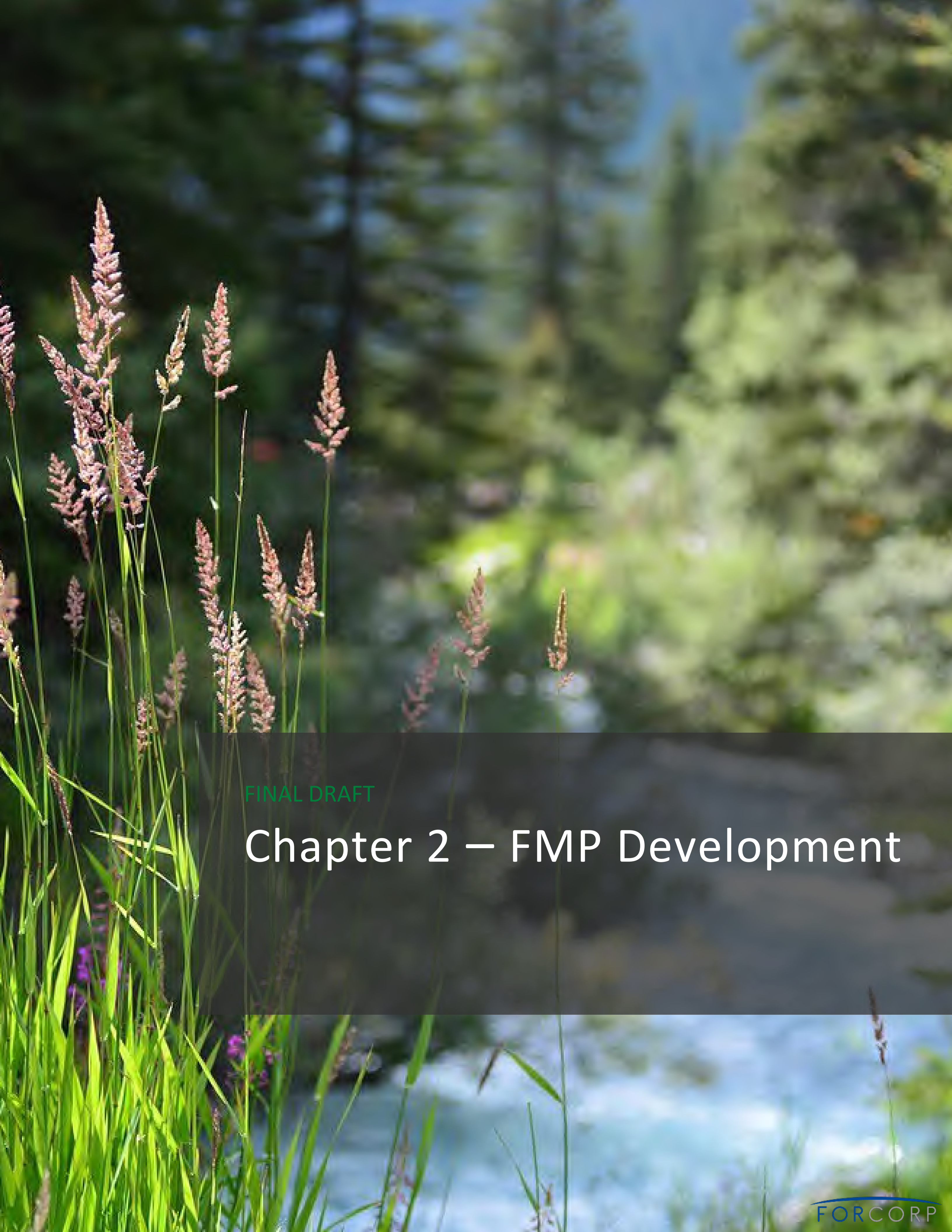

FINAL DRAFT

Chapter 2 – FMP Development

FORCORP

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	**2**	**FMP Development**
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	II	Communication Plan
	Annex	III	Stewardship Report (2010-2015)
	Annex	IV	Yield Curve Development
	Annex	V	Net Landbase Development
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	Annex	VIII	Growth and Yield Plan

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1 Overview

The Crowsnest Forest Products Ltd. (CFP) 2025 Forest Management Plan (FMP) was developed over an approximately three-year period, beginning in May 2022 and ending with the submission of the plan to the Government of Alberta (GoA) on November 1, 2025.

Building on previous FMP development processes, CFP involved a wide range of stakeholders and specialists, to build a plan that meets the requirements of the Alberta Forest Management Planning Standard (Version 4.1 – April 2006) and the Sustainable Forest Initiative (SFI) standard for sustainable forest management, to which the company is certified.

The outcome is a comprehensive plan that will direct the company's long-term strategic forest management activities for the next 10 years, or until replaced by a new FMP. This chapter outlines the process for developing the 2025 FMP.

The chapter is not intended to provide a detailed account of all the tasks involved in the plan's development but, rather, a general description, with more detailed information provided in subsequent chapters, annexes, and appendices.

2 Plan Development Process

The development of the FMP was guided by processes outlined in the Terms of Reference (ToR). CFP assembled a Plan Development Team (PDT), consisting of representatives from the GoA and CFP, quota holders, and technical consultants, to lead and manage the project. Regular PDT meetings served as the main venue for discussing status, resolving issues and providing direction (see Section 5.2).

A Technical Team (TT) consisting of CFP staff and technical experts was formed to support the PDT by addressing more complex and often highly detailed issues that required specialized professional input. TT outcomes were shared with the PDT for discussion and decision as well as to ensure that the plan was advancing from a common knowledge base.

In addition to the PDT and TT processes, public communications and Indigenous communities consultation processes were implemented to seek input. Findings from this outreach were provided to the PDT to ensure that their views were understood and considered in plan development. More details on these processes can be found in Section 6 and Section 7.

2.1 Project Management

A key element of the GoA's process for managing timber resources is to require Forest Management Agreement (FMA) holders to develop FMPs, usually at 10-year intervals. Though forest companies are obligated to develop multi-level, comprehensive plans that define sustainable forest management activities on the landbase, the GoA is ultimately responsible for setting management parameters and deciding what is acceptable in terms of the nature and extent of resource development within crown forests.

Within this framework, CFP formally began the FMP development process by establishing a ToR to define roles and responsibilities and guide project management. Anticipating that decision-making would not always be unanimous or straight forward, a clear and effective process was established for achieving agreement. The company also engaged Treaty 7 Indigenous communities, the public, and interest groups affected by forest management activities in the FMP area.

Indigenous consultation adhered to provincial guidelines while public consultation was guided by an FMP public participation program. The public participation program required the formation of a Public Advisory Committee (PAC) along with a schedule of public outreach activities. The PAC included representatives of the local watershed planning and advisory council, landowners, motorized recreation, non-motorized recreation, hunting and fishing conservation, environment, ranching, recreational trail tenure holders, trapping, and local governments.

A TT was created to provide expert advice on technical issues. The Edmonton-based, independent consultancy firm Forcorp Solutions Inc. (Forcorp) was engaged to facilitate this process, provide technical support and analysis, and assist in the development of plan components.

Alberta requires a Alberta government PDT be used throughout the planning process. The PDT included a broad representation of subject matter experts from Alberta Forestry and Parks and Alberta Environment and Protected Areas.

As outlined in the ToR, the PDT adopted an open and transparent decision-making process that involved progressive review of plan components, culminating with consensus agreement. As issues were identified, the PDT and TT discussed resolution approaches, undertook the necessary analysis, and reviewed options before unanimously accepting the preferred path forward. As they were finalized, critical plan components were submitted to the GoA, for Agreement-in-Principle (A-I-P). Though it did not constitute final approval, A-I-P provided assurance that the GoA was supportive of basic concepts and direction.

The outcome of these efforts is a scientifically sound, long-term strategic plan that upholds the principles of sustainable forest management and reflects the views and expertise of a wide range of professionals.

2.2 Information Management

FMP development is a long and complex process involving numerous parties. To ensure the project progresses in a timely manner, it is essential that mechanisms be established for the efficient management of issues and decisions.

As its information management tool, CFP utilized eTracker, an online web-based project management system hosted by Forcorp. eTracker was used to effectively manage each step of the FMP process-related activities, including the following:

- Assign project tasks to team members and monitor their progress;
- Post issues and decisions for review and tracking throughout the project process;
- Tag items such as tasks and issues, to allow for filtering and reporting capabilities;
- Enable team members to comment on tasks and issues, and allow for discussions, including progress reports, to be captured; and
- Enable CFP to monitor the overall progress of the project.

New requirements and products were also incorporated into the development of the FMP; for example, the Clark's nutcracker and forest encroachment models. As with most products being utilized for the first time, several iterations were required before achieving an acceptable result. The early establishment of a transparent and cooperative plan development process assisted with reaching consensus resolutions.

Also utilized in this FMP were GoA models and tools to incorporate non-timber assessments (NTA). These models and tools predict habitat impacts for selected species, including grizzly bears, barred owl, American pine marten, and selected songbird species.

3 FMP Components

As described in this section, the process of building an FMP in Alberta involves a number of steps, including development of guidance documents such as the FMP ToR, identification of forest values, collection and analysis of data, and forecasting future timber availability to determine annual timber allocations. The following is a description of the measures taken to ensure the FMP is accurate and thorough and complies with prevailing legislation and standards.

3.1 Terms of Reference (ToR)

The purpose of the ToR for CFP's 2025 FMP was to guide the FMP development process. The ToR adheres to the requirements of the Alberta Forest Management Planning Standard Version 4.1, April 2006 to ensure compliance with government expectations and also accounts for CFP's own policies and procedures. As well as establishing a structure for the FMP development process and identifying deliverables, it sets forth the schedule for plan development, review, and approval, and specifies the range of considerations and issues to be addressed during the process.

The ToR final draft was submitted to the GoA on May 30, 2022 and approval was received on August 29, 2022.

3.2 Completion and Approval of the New Alberta Vegetation Inventory (AVI)

CFP completed a new Alberta Vegetation Inventory (AVI) dataset for the 2025 FMP, replacing the former AVI. The AVI dataset included the following additional fields: crown closure, nutrient regime, mapcode/ecosite, and canopy pattern.

This dataset was based on colour imagery collected in 2022. Light Detection and Ranging (LiDAR) data, which was collected by GoA, was also used as part of the interpretation of the AVI dataset. Creation of the AVI dataset included photo interpretation, as well as a program for field calibration and validation. Audits were conducted by CFP and the GoA to ascertain quality.

The AVI was approved by the GoA on September 19, 2022.

3.3 Volume Sampling Plan

The CFP Natural Stand Volume Sampling Plan and Managed Stand Volume Sampling Plan were developed in cooperation with the GoA and included the following objectives:

- Collect sufficient unbiased data for the creation of robust defensible natural stand yield curves and operational timber volume estimates that can be approved for use in the C5 FMP;
- Guide the installation of sufficient new Temporary Sample Plot (TSP) installations to produce yield curves;
- Develop a set of yield curves acceptable for use in the 2025 FMP for strata with sufficient area; and
- Minimize the amount of required future monitoring and reporting.

CFP obtained approval on sampling design, plot configuration, and field sampling protocols on June 7, 2022.

3.4 Development of FMP Consultation Plans

3.4.1 Public Communications

The public participation program outlined the activities and schedule used to engage with the public and external stakeholders throughout the FMP development process. Some of the tools used to encourage input included: website postings, website news and events, emails, newspaper advertisements, social media and open houses. Public participation process efforts and results are summarized in Table 6-3. A copy of the public participation program is available in *Annex II – Communication Plan.*

3.4.2 Indigenous Consultation

Adhering to Alberta's requirements for consultation with Indigenous communities is required for approval of forest management plans. The plan was designed to satisfy GoA's *Policy on Consultation with Indigenous Communities on Land and Natural Resources Management* and accompanying guidelines, to ensure Indigenous communities consultation met regulatory requirements.

The objective was to engage the Indigenous communities at three principal milestones in plan development as follows:

1) VOITs development;

2) The preliminary spatial harvest sequence (SHS); and

3) The draft FMP.

3.5 Forest Landscape Assessment

The Forest Landscape Assessment is a description of the existing administrative boundaries, physical conditions (e.g., landscape pattern, structure, disturbance and succession), and land use in the CFP Defined Forest Area (DFA).

The information, which was derived from data used to create the Regional Forest Landscape Assessment Report for the GoA (current to December 2023) and CFP's AVI data, was assembled to promote a better understanding of the landscape's attributes and implications for resource development. The assessment was submitted to the GoA on March 15, 2023.

3.6 Values, Objectives, Indicators, and Targets (VOITs)

The GoA has developed a set of goals, known as Values, Objectives, Indicators and Targets (VOITs), to guide companies in achieving sustainable forest management on the landbase. In addition to government established VOITs, forest companies can, with government approval, create new VOITs based on internal objectives or in response to interested party input.

CFP's approach to VOIT development involved consulting with Indigenous communities, the PAC, and other interested parties on the GoA VOITs provided on March 21, 2023. This version of the VOITs incorporated additional content related to alignment with the Livingstone-Porcupine Hills Land Footprint Management Plan (LPH-LFMP) and the South Saskatchewan Sub-Regional Plan (SSRP). A target date of September 1, 2023 was set for A-I-P on VOITs for the 2025 FMP. The PDT then undertook extensive review and made wording edits to the GoA VOITs.

On June 1, 2023, the PDT accepted wording for the following VOITs: #1, #2, #3, #4-1, #4-2 , #5-1, #6, #7, #8, #9, #11, #12, #13, #15, #16, #17, #18, #19, #21, and #22. Wording for a new forest encroachment VOIT was provided to CFP by the GoA on June 28, 2023. Following additional discussion and input from subject matter experts, the complete table of all VOITs was provided to the GoA and A-I-P for wording was requested on August 30, 2023. On October 25, 2023, CFP received a response from the GoA stating that A-I-P for all VOITs could not be provided as there were still VOITs that required wording changes and further discussion. Wording for VOIT #28 was provided by the GoA on February 13, 2024. Further discussions and review, incorporating feedback from the GoA and subject matter experts, took place over a span of approximately seven months in order to finalize the full set of VOITs for the 2025 FMP.

CFP made their final submission on June 7, 2024 and the GoA granted A-I-P for the full set of VOITs on July 24, 2024, pending CFP's acceptance of proposed changes to VOITs #16, #22, and #28. The final complete set of VOITs, with all of the targets populated, is included in the FMP submission (*Chapter 5 – Values, Objectives, Indicators, and Targets*) and will be further reviewed by the GoA as part of the approval process.

3.7 Net Landbase

The net landbase (landbase or NLB) classifies the CFP FMP area into lands that are either eligible (i.e., the active or contributing landbase) or ineligible (i.e., the passive or non-contributing landbase) for timber harvesting. Stands in the landbase are classified according to the strata categories that will be used to track growth-and-yield forecasts for the duration of the FMP period.

The first phases of landbase development included reconciliation of the cutblock and Alberta Regeneration Information System (ARIS) data with the new AVI prior to GoA AVI approval. ARIS reconciliation was a new requirement for this FMP and considerable effort was expended in attempting to identify challenges and potential solutions.

Development of the landbase commenced in March of 2022. On September 27, 2023, representatives from CFP and Forcorp presented the classified landbase and the associated documentation walkthrough to the GoA, a requirement of the landbase submission process, and the NLB and documentation was submitted to the GoA on October 3, 2023. On December 15, 2023 the GoA granted A-I-P.

Annex V – Net Landbase Development provides detailed documentation of the datasets used to generate the landbase and describes how the datasets were processed to prepare them for the netdown process. It also describes the business rules applied to the amalgamated landbase, to classify and stratify it for the purposes of FMP development.

3.8 Yield Curves

Timber volume yield curves predict the merchantable timber volumes available for harvest as the stand ages. CFP developed new timber-volume yield curves for its FMP area, which were applied to the Timber Supply Analysis (TSA) component of the 2025 FMP. Stratification was based on CFP's six base-yield strata (the yield strata are a modification of the Alberta base 10 yield strata).

The six strata were assigned through the net landbase development process using either AVI attributes for natural stands or a combination of silviculture declaration, treatment information, and Reforestation Standard of Alberta (RSA) performance survey data for managed stands. The yield curves were derived from information collected in temporary sample plots (TSP) and RSA performance survey programs across the DFA area.

Gross merchantable tree-length volumes were compiled to the following utilization standard: a 11cm top diameter inside bark with a 15cm outside bark stump diameter. Stump height is measured at 30 cm, and the minimum merchantable tree length for coniferous species groups is 4.88m. For deciduous species groups, the following is the utilization standard: a 10cm top diameter inside bark, with a 15cm stump diameter outside bark. Stump height is measured at 30cm, and the minimum merchantable tree length for deciduous species groups is 4.88m. Cull was accounted for in the TSA process.

CFP identified three categories for yield curves:

- Natural stands (NAT): Includes all fire-origin stands. Yield curves were based on TSP data projected using an empirical regression approach. Strata assignment was based on AVI attributes.
- Pre-1996 managed stands (Pre96): Represents the population of managed stands harvested before May 1, 1995. Yield curves were derived from TSP data projected using GYPSY for the pure pine and white Spruce (Pl and Sw) strata. Strata assignment was based on the AVI attributes.
- Post-1995 managed stands (RSA): Represents the population of managed stands that were harvested after May 1, 1995. Yield curves were derived from RSA performance survey data projected using GYPSY. Strata were assigned using RSA sampling units and AVI reconciled with ARIS.

The growth and yield analysis was submitted for A-I-P on October 3, 2023 and A-I-P for the yield curves was granted by the GoA on December 14, 2023.

Annex IV – Yield Curve Development provides detailed documentation on the development of the yield curves, including the input datasets and models used, the yield curve categories, and the actual yield curves themselves.

3.9 SHS Access Planning

Existing and proposed roads that will be used to access all required areas have been incorporated into the corridor plan, which can be found in *Chapter 7 – Implementation and Monitoring*. This was completed in an effort to ensure the SHS is realistic and accessible given local topography. CFP has provided a map highlighting proposed and existing road access corridors as part of the plan.

CFP is pursuing a DLO disposition on a 9km portion of the Lost Creek Road with the intent of maintaining long-term access along this route to access the SHS. CFP intends to access the remainder of the SHS using existing routes.

3.10 Preferred Forest Management Scenario

The Preferred Forest Management Scenario (PFMS) describes the strategic direction and outcome of forest management activities over 200 years, with a focus on the first twenty years. A spatial modeling (forecasting) process with feedback loop was used to provide information to CFP, the quota holders, and the GoA, to assess the implications of management activities over the long-term.

This process included a Timber Supply Analysis (TSA) that determined harvest levels and a spatial allocation of harvestable stands by operator. Once approved by the GoA, these harvest levels will become the Annual Allowable Cuts (AACs) for the 10-year FMP period (i.e., the timber years 2025-26 to 2034-35).

The preliminary PFMS was developed over an 8-month period, beginning in December 2023, and included the trade-offs between timber and non-timber values, operational unit access as well as input received from the consultation process.

The preliminary PFMS (Milestone 2 Information Package) was posted to the company website open house on February 26, 2025 in order to share the PFMS with Indigenous communities and interested parties.

3.11 Spatial Harvest Sequence

The Spatial Harvest Sequence (SHS) was developed as part of the PFMS and identifies the forest stands planned for harvest during the first two 10-year periods of the 2025 FMP (2025-26 to 2034-35 and 2035-36 to 2044-45 timber years).

All operators in the FMP area must use the SHS polygons to create their Forest Harvest Plans (FHPs), which are maps and associated reports describing the harvest plan layouts. These FHPs are then included as part of a series of components that make up the Annual Operating Plan (AOP), which authorizes harvest activities for each operator upon GoA approval.

CFP developed an initial SHS in March 2024, which CFP and the quota holders refined over the following months. The review process included both field verification and modifications to the modeling assumptions to better align with management objectives. Once complete, the SHS was posted on the company website and its availability was promoted through emails, social media, and the company website.

3.12 Silviculture

Lodgepole pine, white spruce, and Douglas-fir cones are sourced from local forests, suited to harvest site growing conditions. Cones are dried, the seed is stratified and grown in Alberta and Saskatchewan tree nurseries. Presently, no chemicals, herbicides or pesticides are used in CFP's silviculture program.

During the harvest process, tree tops are retained on site for nutrient cycling. Scarification (mechanical raking) creates favorable seed beds for natural regeneration and ideal planting spots for planted seedlings. The seedling microsites provide added moisture and shade as well as wind and frost protection. Native herbaceous plants, hardwoods, and shrubs also benefit from scarification, increasing harvest area biodiversity.

Scarification also has added benefits in breaking down fuel continuity, which enhances fire prevention and control efforts. Every June, when soil temperatures and soil moisture are favorable, trees are planted by hand in microsites, to promote reforestation success.

Reforestation assessments conducted by CFP for the purpose of fulfilling the obligations of the *Forests Act*, Timber Management Regulation, shall be completed in accordance with the procedures described in the Reforestation Standard of Alberta (RSA}. These RSA standards require two surveys; establishment and performance.

Establishment surveys are legislated requirements detailed in the Timber Management Regulation. The surveys must be completed by the eighth year after harvest. Reforested areas must achieve both a specified stocking level and a minimum level of growth performance.

Performance surveys are also legislated requirements detailed in the Timber Management Regulation.

The surveys must be completed by the fourteenth year after harvest. A detailed summary of CFP's silvicultural practices and their associated prescriptions is included in *Chapter 7 – Plan Implementation and Monitoring*.

3.13 Growth and Yield Program

The Growth and Yield Program identifies data collection commitments for the following:

1) Growth Model Development: Data are required for improvements to growth models, which are used primarily for development of yield estimates in support of forest management planning and for evaluating performance survey results under the Reforestation Standard of Alberta.
2) Yield Estimation: Development of yield estimates for FMPs includes use of data for growth model initiation, calibration or localization of yield estimates, and validation of estimated yields. New data must be collected during each planning cycle to support new inventories and to ensure yield estimates remain current.
3) Growth and Yield Monitoring: Monitoring is required to evaluate whether yield assumptions underlying the AAC are being achieved. In cases where growth trajectories are not well supported by long-term data (e.g., managed stands), monitoring of growth is required to confirm accuracy of projections.

3.14 Non-Timber Assessments

Assessments of non-timber values, including values related to wildlife habitat, were conducted in the development of the PFMS using fine and coarse-filter approaches. This analysis was undertaken using models that were developed by the GoA, to support the FMP process. The models included indicators and targets for the following wildlife species:

- Grizzly bear;
- American marten;
- Clark's nutcracker;
- Barred owl; and
- Songbirds (i.e., brown creeper, varied thrush, and ovenbird).

In addition, equivalent clearcut area was modelled using GoA watersheds.

Supporting the GoA's NTA tools, coarse filter approaches consisting of seral-stage and patch-size targets were applied in the TSA, resulting in adjustments to the SHS.

Fine and coarse-filter approaches and strategies for implementation are discussed in detail in *Chapter 6 – Preferred Forest Management Scenario* and *Chapter 7 – Plan Implementation and Monitoring.*

4 Milestones

At the start of the FMP development process, the PDT assisted with identification of key milestones and completion dates, to track progress and ensure the project remained on schedule. Table 4-1 compares the milestone target dates in the ToR against the actual date the milestone was completed.

Table 4-1. FMP Milestones and completion dates.

FMP Component	Anticipated Completion (ToR)	Actual Completion
Terms of reference approval	30-May-2022	29-Aug-2022
Public participation program plan approval	15-Sep-2022	31-Aug-2022
AVI plan A-I-P	13-Nov-2020	20-Nov-2020
Volume sampling plan	07-Jun-2022	07-Jun-2022
Yield curve development plan	07-Jun-2022	31-Jan-2023
VOITs A-I-P	15-Mar-2023	24-Jul-2024
AVI approval	15-Jun-2022	19-Sep-2022
ARIS reconciliation embedded operator sign-off	31-Jul-2024	14-Nov-2024
Classified landbase/ARIS reconciliation A-I-P submission	31-Dec-2023	15-Dec-2023
Yield projections/reforestation strategy table A-I-P submission	31-Dec-2023	14-Dec-2023
SHS/PFMS finalization with PDT (Draft)	31-May-2024	TBD
Review of Draft FMP initiation	01-Oct-2024	TBD
Draft FMP consultation concluded	31-Mar-2024	TBD
Growth and Yield Program	31-Mar-2025	TBD
Quota holder’s signoff on FMP	N/A	TBD
Submission of FMP document for approval	01-May-2025	TBD
Updated operating ground rules completed	15-Apr-2026	TBD
Submission of stewardship report	01-Nov-2030	TBD

5 Plan Development Team (PDT)

Forest management activities can impact a wide range of stakeholders, while management decisions can have broad ecological, economic and social implications. For these reasons, FMP development is typically led by a diverse, multi-stakeholder group.

CFP and Alberta Forestry and Parks (AFP) formed a PDT that consisted of representatives from CFP, AFP, Alberta Environment and Protected Areas (EPA), other forest companies operating on the FMP area, as well as forestry consultants with expertise in strategic planning. The PDT was the primary mechanism for stakeholder and regulator integration and served as a vehicle to address impacts of forest management planning on a range of values across the FMP area.

CFP held their first PDT meeting on November 10, 2022.

The objectives of the PDT were to:

- Define the direction and scope of the FMP;
- Guide the FMP process;
- Advise members on the suitability of different forest management practices in meeting company and government expectations, policies and legislation;
- Identify and resolve issues;
- Coordinate the actions and involvement of others;
- Coordinate the gathering, interpretation, and flow of information (both technical and non-technical) among team members; and
- Coordinate the progressive development and review of plan components and the A-I-P recommendations.

5.1 Plan Development Team Members

In assembling a PDT for the 2025 FMP, CFP sought a comprehensive group of practitioners, in keeping with its multi-disciplinary approach to planning. PDT membership expanded, over the course of the FMP development period, to ensure the appropriate expertise was available to address specific or emerging issues. The complete list of members is provided in Table 5-1 below.

Table 5-1. List of project development team members.

Name	Affiliation	Role/Responsibility
Matt Denney	Crowsnest Forest Products Ltd.	Chair / Planning Forester
Jason Mogilefsky	Crowsnest Forest Products Ltd.	Forestry Manager
Liana Luard	Government of Alberta	Planning Forester, GoA Lead
Kirk Hawthorn	Government of Alberta	Area Forester, Forest Area Lead
Greg Greidanus	Government of Alberta	Senior Resource Analyst, GoA Advisor - NLB/TSA
Rosanise Odell	Government of Alberta	Provincial Biometrician, GoA Advisor - Growth and Yield
Brett Boukall	Government of Alberta	Wildlife Biologist, GoA Advisor - Wildlife
Andreas Luek	Government of Alberta	Provincial Fisheries Biologist, GoA Advisor - Fisheries
John Stadt	Government of Alberta	Provincial Ecologist , GoA Advisor - Ecology
Andrew Shandro	Government of Alberta	Provincial Silviculturist, GoA Advisor - Silviculture

Name	Affiliation	Role/Responsibility
Michael Wagner	Government of Alberta	Provincial Hydrologist, GoA Advisor - Hydrology
Ryan Good	Government of Alberta	Wildfire Management Specialist, GoA Advisor - Wildfire
Bob Christian	FORCORP Solutions Inc.	Partner and Senior Analyst
Logan Purdy	FORCORP Solutions Inc.	Resource Analyst, TSA and G&Y Analyst
Dan Jensen	FORCORP Solutions Inc.	Resource Analyst, Landbase Analyst

5.2 Plan Development Team Meeting Schedule

PDT meetings were held on a regular basis, approximately once every one or two months depending on time of year. Table 5-2 lists the PDT meetings that were held and their location.

Table 5-2. List of project development team members.

PDT meeting	Date	Time	Location
PDT Meeting # 1	10-Nov-2022	9:00 AM –12:00 PM	Cochrane - CFP Training Room/Remote
PDT Meeting # 2	26-Jan-2023	9:00 AM –12:00 PM	Cochrane - CFP Training Room/Remote
PDT Meeting # 3	Cancelled		
PDT Meeting # 4	11-Apr-2023	10:00 AM – 11:00PM	Remote (VOITs-specific)
PDT Meeting # 5	1-Jun-2023	9:00 AM – 4.00 PM	Forcorp Boardroom/Remote
PDT Meeting # 6	23-Nov-2023	9:30 AM – 2:30 PM	Cochrane – CFP Training Room/Remote
PDT Meeting # 7	27-Jul-2023	9:00 AM – 12:00 PM	Cochrane – CFP Training Room/Remote
PDT Meeting # 8	28-Sep-2023	9:00 AM – 12:00 PM	Cochrane – CFP Training Room/Remote
PDT Meeting # 9	25-Jan-2024	9:00 AM – 12:30 PM	Cochrane – CFP Training Room/Remote
PDT Meeting # 10	28- Mar-2024	9:00 AM – 12:30 PM	Cochrane – CFP Training Room/Remote
PDT Meeting #11	30-May-2024	9:00 AM – 12:00 PM	Cochrane – CFP Training Room/Remote
PDT Meeting #12	25-Jul-2024	9:00 AM – 12:00 PM	Cochrane – CFP Training Room/Remote
PDT Meeting #13	06-Dec-2024	9:00 AM – 12:00 PM	Cochrane – CFP Training Room/Remote
PDT Meeting #14	30-Jan-2025	9:00 AM – 12:00 PM	Cochrane – CFP Training Room/Remote

5.3 FMP Issues and Decisions

One of the main functions of the PDT was to identify and resolve issues. As issues arose, issue documents were created, which provided a summary of the issue and recommended solutions. Issue documents were presented and reviewed at PDT meetings, with decisions arrived at by consensus. In some instances, CFP sought clarity and direction, either from the GoA or quota holders, to aid in the decision-making process.

6 Public Participation Program

In keeping with its commitment to seek the input of interested parties and develop an FMP reflective of regional priorities, CFP implemented a government-approved public participation program. The objective was to provide multiple opportunities for the general public, including local community residents, non-governmental and special interest groups, and other industrial users, to become involved in plan development and attain a greater understanding of issues related to sustainable forest management.

6.1 Public Advisory Committee (PAC)

PAC members were selected from the committee members that participated on the government led 2015 FMP PAC and wanted to volunteer on the 2025 FMP. New members also came forward from advertisements and word of mouth that CFP was looking to reconvene a PAC for the 2025 FMP. Members were engaged in the FMP development process, beginning in fall of 2022, when they were provided with a detailed overview of the GoA standardized VOITs. PAC members also agreed to review and provide comments for three key components of the FMP: the VOITs, the PFMS, and the draft FMP.

A summary of FMP PAC meetings content is provided below in Table 6-1. See Appendix II for the PAC meeting notes.

Table 6-1. Summary of public advisory committee engagement sessions.

Meeting Number	Agenda Items	Meeting Dates
1	Introduction to forest management Role of the PAC – what's missing from VOITs? Want to hear how to avoid conflict? PAC Approved Terms of Reference Review-Public Consultation Program Draft Milestone 1 Information Package Planning Overview Draft VOITs is anything missing? Open discussion, questions and answers	September 2022

Meeting Number	Agenda Items	Meeting Dates
2	Role of the PAC – what's missing from VOITs? Want to hear how to avoid conflict? Review-Public Consultation Program VOITs identifying potential issues and opportunities Questions and answers Presentation-FMP Watershed Management- Alberta Forestry	January 2023
3	VOIT identification-potential issues and opportunities FMP Update Open discussion, questions and answers	May 2023
4	FMP update VOITs Forest encroachment Invasive plants Recreation Open discussion, questions and answers	November 2023
5	FMP Update VOITs Open discussion, questions and answers	May 2024
6	Review SHS maps Review VOITs Review Visual Quality Map FMP update Open discussion, questions and answers	December 2024
7	Final FMP Document	Pending

6.2 Public Engagement

CFP engaged with the public through newspaper and social media ads, email notifications, open houses website news and events, and information packages available on CFP's website. Multiple in-person and online opportunities were provided over a 3-year period.

Newspapers, the corporate website, emails, and Facebook were used to advertise public consultation opportunities including available information packages and open houses.

Public consultation activities were tracked in CFP's Public and Stakeholder Communication Database.

FMP information package links were also emailed to interested parties to obtain input including for:

- The draft FMP (May 2025);
- The FMP Milestone 2 Information Package (February 2024); and
- The FMP Milestone 1 Information Package (Fall 2022).

Other website resources included:

- An FMP feedback/comments page;
- An email subscribe function to be emailed with FMP updates, news, and events;
- The Public Participation Program document;
- News events and consultation opportunities;
- Informational videos covering forest management planning, FMA planning, the FMA planning hierarchy, and an FMA overview;
- Public Advisory Committee terms of reference, current members and meeting minutes;
- The Forest Management Agreement document;
- The Detailed Forest Management Plan document;
- The five-year Stewardship Report document;
- The Operating Ground Rules document;
- Informational videos explaining water quality BMPs and how roads are reclaimed;
- Informational videos explaining nutrient management and stump-side processing; and
- Informational videos explaining reforestation practices.

Table 6-2 summarizes the key public engagement opportunities provided and Table 6-3 summarizes the input captured and CFP responses.

Table 6-2. Public general engagement summary

Engagement	Date	Description
PAC Member Search	24-Mar-2022	Ran the following Ad for 2 weeks in the Crowsnest Herald, Pincher Creek-Shootin the Breeze and the Claresholm papers: Forest Management Plan Volunteers Needed Crowsnest Forest Products is looking for volunteers interested in joining our Public Advisory Committee. There are current vacancies for: Environmental/ naturalist organization representatives, non-motorized recreational trail user group representatives. The volunteer multi-stakeholder committee meets about twice a year. The committee's primary role

Engagement	Date	Description
		over the next 2.5 years will be to provide forest management plan input and advice concerning public communications. Interested volunteers, please send a brief statement of interest and bio to: woodlands@spraylakesawmills.com
Milestone 1 Advertisement	26-Sep-2022	Ran the following Ad for 2 weeks in the Crowsnest Herald, Pincher Creek-Shootin the Breeze and the Claresholm papers: Crowsnest Forest Products, a subsidiary of Spray Lake Sawmills is in the process of renewing its C5 Forest Management Unit 2026-2036 Forest Management Plan. The area is located south of Kananaskis Country and north of Waterton Lakes National Park. This sustainable forestry plan is renewed every 10 years and public participation is integral to the planning process. To learn more, please subscribe to our news, events and consultation information posted on our website: https://spraylakesawmills.com/woodlands/news-bulletins/
Milestone 1 Information Package	26-Sep-2022	Posted milestone 1 information package on website and emailed link to interested parties.
Open House Advertisement	04-Oct-2022	Crowsnest Forest Products, a subsidiary of Spray Lake Sawmills is in the process of renewing the C5 Forest Management Plan. The area is located south of Kananaskis Country and north of Waterton Lakes National Park. We will be hosting an open house on October 26 from 3 pm to 7 pm at the Kanata Blairmore to share the plan's draft Values, Objectives, Indicators and Targets. To learn more and provide input please subscribe to our news and events information posted on our website: SprayLakeSawmills.com/woodlands/ forest-management-planning/
Milestone 1 Open House Website Post	04-Oct-2022	We will be hosting an open house on October 26 from 3 pm to 7 pm at the Kanata Blairmore to share the plan's draft Values, Objectives, Indicators and Targets. To learn more and provide input please subscribe to our news and events information posted on our website: SprayLakeSawmills.com/woodlands/ forest-management-planning/
Open House Ad Posted on Facebook	06-Oct-2022	10-26-22 Open House ad posted on Facebook
Open House Newspaper Ad	19-Oct-2022	Ran the following Ad for 2 weeks in the Crowsnest Herald, Pincher Creek-Shootin the Breeze and the Claresholm papers: Crowsnest Forest Products, a subsidiary of Spray Lake Sawmills is in the process of renewing the C5 Forest Management Plan. The area is located south of Kananaskis Country and north of Waterton Lakes National Park. We will be hosting an open house on October 26 from 3 pm to 7 pm at the Kanata Blairmore to share the plan's draft Values, Objectives, Indicators and Targets. To learn more and provide input please subscribe to our news and events information posted on our website: SprayLakeSawmills.com/woodlands/ forest-management-planning/

Engagement	Date	Description
Milestone 1 Open House	26-Oct-2022	14 folks in attendance of which 6 were residents of Todd Creek. Asked for VOIT input. Offered to keep people informed and to thoughtfully consider feedback. Sent emails confirming email subscriptions
FMP Update	21-Apr-2023	Sent FMP VOIT updates to all of the interested party categories in our C5 Public Consultation contact list
Meeting with Rick Niwa, MD Ranchlands	14-Dec-2023	Discussed ideas for the new CFP invasive plant program
FMP Update	20-Mar-2024	Sent FMP VOIT updates to all of the interested party categories in our C5 Public Consultation contact list
Meeting with Jodie Krakowski Whitebark Pine Ecosystem Foundation of Canada	04-Jun-2024	Discussed 5 needle pine conservation strategies
FMP Update	21-Jun-2024	Sent FMP VOIT updates to all of the interested party categories in our C5 Public Consultation contact list
Meeting with Alberta Chapter of The Wildlife Society	24-Sep-2024	Discussed the FMP consultation timelines water quality and cumulative impacts.
Attended Crowsnest Nordic Ski Club Board Meeting	07-Oct-2024	Discussed the Alberta fire threat analysis of 'intolerable' for the Alison Chinook Ski Area and that FireSmart funding is likely available to address hazard abatement opportunities. Taking action could help with the current wildfire threat vulnerability.
Meeting with Diane Sawley and Jim Lynch	20-Dec-2024	Discussed FMP VOITS, encroachment, invasive plants, site preparation and an additional VOIT was added.
Milestone 2 Information Package	26-Feb-2025	Posted milestone 2 information package on website and emailed link to interested parties.
CPAWS Meeting	06-Mar-2025	Focusing on cumulative effects on this landscape and we can't really make an assessment of that without having the shape files of the cutting blocks. Unless we have the harvest spatial data to review impacts of SHS on critical habitat the consultation isn't meaningful as we cant provide the critical fish habitat feedback that we are focusing on. In other words to provide informed feedback we need some data. CFP is looking into how to share the data.
Held meeting with CPAWS	24-Apr-2025	CPAWS is looking to review the spatial data for the SHS to assess the cumulative impacts taking into account the current impacts and look how the AAC was calculated in the context of the critical habitat. West Fraser is working on a data share agreement and want to make sure the data is used for one on one consultation not something else.
Milestone 2 Advertisement	30-Apr-2025	For the week of April 30, 2025 and May 7, 2025 ran the looking for input ad for the SHS ad with linkages to VOITs, 20 year SHS and VQ map in the Crowsnest Herald, Pincher Creek-Shootin the Breeze and the Claresholm papers.

Table 6-3. Summarized public input and summarized CFP response.

Identified Concern	Scale of Concern				Value addressed within FMP (Yes, No, N/A)	If yes, where	Provided Response
	SSRP	FMP	Op.	Oth.			
Forest encroachment is a big problem, there is a loss of grazing land as a result.	✓	✓	✓		Yes	Chapter 5 VOIT 29.3 Chapter 7	Added VOIT
Invasive plants is a big issue that needs addressed in the FMP	✓	✓	✓		Yes	Chapter 5 VOIT 22 Chapter 7	Added VOIT
Need to protect native grasslands	✓	✓	✓		Yes	Chapter 5 VOIT 29.4	Added VOIT
Need to protect the Allison Chinook Trail system and other FMA designated trail networks	✓	✓	✓		Yes	Chapter 5 VOIT 29 VOIT 29.2	SHS avoided trail system

Why isn't wolverine habitat being modelled					Yes	N/A	Fine Filter species identified in the VOITs and NTAs were based on species having clear responses to forestry and hence could be modeled into the forestry planning context, as well as act as Umbrella species, whereby the habitat identified for those species, acts to benefit a host of other species (for example Marten & Grizzly Bear). Wolverine as a species appears to be influenced by large-scale disturbance processes (e.g., fire), as well as climatic conditions that influence snow cover. Hence, in a forestry context wolverine, is best managed through the coarse filter objectives, that inform both patch sizes, shape and age of the forest. Further, a clear response to forestry has not yet been established with wolverine, but Wolverine is thought to benefit from the management of other species (e.g. grizzly bear, marten). Wolverine is a data-deficient species in Alberta, and while it is not indicated as a specific VOIT indicator species, it is thought to be managed through both the coarse filter VOITs that manage the landscape level nature of the forest (VOITs 1-13), as well as both fine filter indicator species (VOIT 14), as well as the existing operating ground rules. Alberta is continuing to evaluate wolverine population dynamics and habitat associations in Alberta, and as new information is uncovered, we will look to inform necessary processes to benefit the wolverine populations in Alberta.

Need to protect Todd Creek from timber harvesting	✓	✓	✓		Yes	Chapter 5 VOIT 29-2	
VOIT 1.1.1.1 age class distribution as written this lacks definition of old, mature, young forests for different forest types/ecosystems, which makes assessment of compliance and variance effectively impossible. Consider specifically including targets for ancient forests that are a unique category in addition to "old" forests, where ancient forests are >250 years, e.g., whitebark and limber pine and some higher-elevation Engelmann spruce – subalpine fir forests. These age classes – especially in whitebark and limber pine, are currently rare relative to their historic representation (especially pre-1980s MPB outbreak). Benchmarks can be found in ecosystems in protected areas, BC East Kootenays, and Waterton Lakes National Park.	✓	✓	✓		Yes	Chapter 5 VOIT 1	The age classes are not yet defined in the draft version. This VOIT when finalized will have age class categories defined for specific age groupings such as young, immature, mature and very old forest.

VOIT 1.1.1.2 patch size pattern over the 200-year planning horizon approximating patterns created by natural disturbances, as written this lacks measurable thresholds for different ecosystem types. This data is available, there have been many studies looking at disturbance regimes in the C5 region, e.g., Land use, climate change and ecological responses in the Upper North Saskatchewan and Red Deer River Basins: A scientific assessment; Spatial and temporal variations of fire regimes in the Canadian Rocky Mountains and Foothills of southern Alberta; and a host of studies related to the fRI Landscapes in Motion project, as well as A century of landscape change in the southern Rocky Mountains and Foothills of Alberta: Using historical photography to quantify ecological change. Whitebark Pine Ecosystem Foundation of Canada |2 Suggest +/- 15% distribution tolerance (as appropriate based on range of variation and desired ecosystem condition), but also need to consider climate change impacts on future distribution of patch sizes: fire, pests, drought, pathogens, ecosystem distribution. This FMP must plan for a realistic future, not the past as those conditions are going to be outside	✓	✓	✓		Yes	Chapter 5 VOIT 1	Patch size objectives will be set such that the distribution of harvest area sizes result in increasing patch size over a 200-year planning horizon within the Montane and Subalpine natural sub-regions. For example, please view the 2021 B12 FMP, Chapter 5 pages 95-101. Chapter 5: Values, Objectives, Indicators and Targets (secureserver.net). SLS/CFP has conducted a pre-industrial forest Condition report that indicates historically, much larger patches were present that are not currently socially, environmentally or economically desirable. This report can be viewed on our website using the link: Pre-Industrial Condition – Spray Lake Sawmills

the future range of variability in much of the CFLB per climate models							

VOIT 1.1.1.3 road access/density, access management. Within the C5 FMA there are many non-designated trails that are old exploration and logging roads/skid trails that are used for motorized recreation, and that are causing significant detrimental and cumulative impacts to water quality and habitat of fish, including endangered and threatened fish species. What specific actions regarding access are planned to mitigate these impacts in C5 FMA? These also should be noted in VOITs related to water quality, fish and fish habitat. How will CFP work together with user groups to identify and deal with these access and habitat issues? Within the FMA there are various gates restricting access to public lands. Some of these gates are controlled by SLS/CFP, others by other sectors. What access management measures will be in place for the public and user groups who need to access areas behind these gates? Why are these gates in place on public land, and what are the criteria needed to gate off access to an area? Which gates will be removed? Will new gates be set up? Often contact numbers on posted signs at gates do not receive any response and this	✓	✓	✓		Yes	Chapter 5 VOIT 4-1 VOIT 4-2 VOIT 5-1	This VOIT will establish a target density for temporary forestry roads. For example, with the 2021 B12 FMP, the target was set at less than 0.038 km/km2. Existing non-designated trails and cumulative effects analysis are the responsibility of the province of Alberta. CFP is active in cooperating with various groups in a number of areas to monitor and reclaim sites within the FMA. As per the Timber Harvest Planning and Operating Ground Rules (OGR), Annual Operating Plan (AOP) forestry roads are to be closed to restrict highway vehicle access. Access management in general, is used to protect sensitive sites, critical habitat, threatened species and the watershed. Please reference section 11.5 of the OGR's for more information TABLE OF CONTENTS (secureserver.net). Currently CFP has approximately 7 active locked gates and at the end of the timber year there will be approximately 9. All of the AOP roads are for temporary access and are required to be fully reclaimed within 3 years. If there is a reason someone needs to pass through a gate, CFP is authorized to provide a key.

hinders us from accessing work and research sites. Similarly, it is a challenge to pick up and drop off keys during regular office hours when working in some more distant/remote areas. Consider a key sign in/out and/or deposit procedure for seasonal access if the gates cannot be left open or removed altogether.							

VOIT 1.1.1.4 uncommon plant communities What is the threshold or criteria for designating a plant community as uncommon? The target as currently written does not commit to identify (if not already mapped, and new locations are identified in the field), report (to ACIMS), maintain, enhance, sustain, promote, or prevent degradation or damage to these communities as a result of forestry operations or associated access. The target should reflect commitment to sustainably managing and protecting the VOIT. If any impacts are caused through forestry-related actions, what mitigation measures are proposed and what would be the measure of success? Many of these communities have no tested effective restoration methods and impacts may be such that they cannot be effectively restored to their prior function in a time frame within the FMP, so the best practice approach is to follow the Mitigation Hierarchy. Avoidance needs to be the priority approach. Only if all possible options have been exhausted – and documented per due diligence - then would the next step in the Hierarchy be considered, minimizing impacts. If that is not achievable, all measures taken	✓	✓	✓		Yes	Chapter 5 VOIT 6	The objective is to protect all known occurrences of uncommon plant communities in the DFA or province using available datasets within a Geographic Information System (GIS) analysis. The datasets include the updated 2018 Alberta Vegetation Inventory (AVI) ecosite phases, and the Alberta Conservation Information Management System (ACIMS) plant community classification and tracking list. The areas are then flagged to be reviewed and protected if operations may be in the vicinity of the plant communities. CFP is interested in learning about the WPEFC whitebark and limber pine dataset to see how it may be incorporated into the analysis. For the 2021 B12 FMP the following measures were identified to protect whitebark pine- a similar strategy will likely be incorporated into the C5 FMP: Strategic Mitigation: • 4,055 ha out of a total 4,785 ha of known Whitebark pine and Limber pine stands were removed from the active (managed) landbase; • Reduce wildfire risk on the DFA (16% of the high, very high and extreme risk stands over 20 years, see Section 6.1); and • Explore opportunities to reduce interspecies competition. Operational Mitigation (for the remaining 730 ha within the active landbase): • Establish spatially identified protective retention areas on the ground, as most Whitebark pine and Limber pine tend to grow along ridge tops and rock outcrops; • Identify spatial area within the FHP;

must be documented, then the next step is mitigate in situ, then mitigate ex situ, then compensate, then offset. Best practices and protocols for identification/mapping, mitigation, remediation, monitoring, and adaptive management strategies where necessary, should be established for rare plant communities to effectively achieve this VOIT. Is CFP planning to develop a new AVI inventory, and/or use the DEP? The existing AVI is very dated and does not accurately depict uncommon plant communities, including uncommon forest types, and a fully updated inventory should be a prerequisite for accurate determination of AAC and related management objectives in this region. For whitebark and limber pine ecosystems and occurrences, WPEFC would be pleased to provide new spatial data to improve location records and planning.							• Protect and retain mature and healthy individuals and small groups as encountered during harvest operations; • Follow the Alberta Whitebark Pine Recovery Plan (AESRD, 2014); and • Follow the Spray Lake Sawmills Timber Harvest Planning and Operating Ground Rules.

VOIT 1.1.2.1 CWD retention CWD is not created equal. Target should specify retention and/or creation values for diverse piece sizes by diameter class and minimum length based on representative undisturbed sites by ecosystem type – large debris is essential for amphibian habitat, some lichen species, and to support long-term structural diversity, some mosses, creating microhabitats for arthropods, etc. Also explicitly consider trade-offs between CWD for biodiversity and structure, fire hazard/FPPR requirements, and how CWD benchmarks and ecosystem services will be maintained given these factors.	✓	✓	✓		Yes	Chapter 5 VOIT 11	Agreed, CFP retains approximately 100% of the pre-harvest and post-harvest CWD on site.

VOIT 1.2.1.1 habitat for high value species – whitebark and limber pine Whitebark and limber pine are not mentioned as targets. We would like to see a specific VOIT dedicated to these species and ecosystems. These are endangered in Alberta under the Wildlife Act. Whitebark pine is endangered federally under Schedule 1 of the Species At Risk Act (SARA). Limber pine was assessed as endangered status by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and listing under SARA is pending. Please see the SLS 2021 FMP https://hm06e1.a2cdn1.secureserver.net/wp-content/uploads/2021/05/Ch5_VOITs.pdf, this plan should have similar measures for those species, e.g.,: 1. Obtain new imagery and develop a new, accurate, up-to-date forest inventory for the C5 FMA. The current inventory is extremely out of date and has many inaccuracies regarding species distribution, closure classes, age classes, disturbance. 2. WPEFC would be pleased to provide the most current spatial data identifying including presence and absence of whitebark pine for the C5 FMA to support due diligence and use of the best available data to support resource	✓	✓	✓		Yes	Chapter 5 VOIT 14e	Sounds very similar to the approach used for the B12 2021 FMP and the likely approach for the C5 FMP. Whitebark and limber pine will be addressed under VOIT 1.2.1.1 Maintain habitat for identified high value species (i.e., economically valuable, socially valuable, species at risk, species of management concern). The approach used for the 2021 B12 FMP involved the identification of known whitebark and Limber pine areas and depending on the amount of trees present were removed from the active landbase. The areas that are left in are then flagged to be reviewed and protected if operations may be in the vicinity. CFP is interested in learning about the WPEFC whitebark and limber pine dataset to see how the information may be incorporated into the analysis. For the 2021 B12 FMP the following measures were identified to protect whitebark pine- a similar strategy will likely be incorporated into the C5 FMP: Strategic Mitigation: • 4,055 ha out of a total 4,785 ha of known Whitebark pine and Limber pine stands (about 85%) were removed from the active (managed) landbase; • Reduce wildfire risk on the DFA (16% of the high, very high and extreme risk stands over 20 years, see Section 6.1); and • Explore opportunities to reduce interspecies competition. Operational Mitigation (for the remaining 730 ha within the active landbase): • Establish spatially identified protective retention areas on the ground, as most Whitebark pine and Limber pine tend to grow along ridge tops and rock outcrops;

management on public land. 3. Net out stands with over 20% whitebark pine, limber pine, or a combination, from the CFLB as these are xeric to subxeric stands with sensitive soils, low quality timber, poor regeneration success, and low MAI. These timber types are typically unmerchantable anyways and whitebark and limber pine are not merchantable species due to their poor form, branchy/wolfy crowns, and spiral grain. These endangered species should not be harvested only to leave them on the forest floor – it is the ecological equivalent to killing adult individuals of other endangered keystone species. Mature trees take up to a century to replace due to their extremely slow growth and maturation – they provide the essential seed source for regeneration. 4. In submesic mixed stands with whitebark pine, mark to retain all stems 5. Identify and retain >95% of habitat and live stems and regeneration. Whitebark and limber pine seedlings and saplings in the C5 FMA are also individuals of an endangered keystone species. They are exposed to some of the highest pathogen loads in the province, and those that have survived to this point may exhibit some increased resistance relative							• Identify spatial area within the FHP; • Protect and retain mature and healthy individuals and small groups as encountered during harvest operations; • Follow the Alberta Whitebark Pine Recovery Plan (AESRD, 2014); and • Follow the Spray Lake Sawmills Timber Harvest Planning and Operating Ground Rules.

to the baseline wild susceptible population. Increasing the frequency of rust resistance genetics on the landscape is a key recovery strategy and the future generation of trees holds the key to this action. 6. Identify and retain 100% of (tagged, georeferenced) plus trees and confirmed rust resistant trees. They are extremely rare and irreplaceable. 7. Retain 100% retention of all research sites and restoration sites (which have dispositions and/or reservations). These represent significant investments of partners and cannot be replaced. 8. Conduct operations to achieve results consistent with current (2022) approved recovery plans in Alberta. https://open.alberta.ca/dataset/240bbf02-af02-4232-a395-91968ce13ce6/resource/e250ec24-4ca3-4d12-8b26-3539ec91f8cf/download/aep-alberta-species-at-risk-recovery-plan-44-whitebark-pine-limber-pine.pdf							

Landscape connectivity and population size thresholds (also see VOIT 1.3.1.1) are essential to sustain these species and ecosystems through obligate bird-mediated seed dispersal and regeneration, so evaluate this VOIT at both stand and landscape levels.	✓	✓	✓		Yes		

VOIT 1.3.1.1 genetic in situ conservation Note there are species-specific seed zones and transfer rules established for whitebark and limber pine under FGRMS 10.14. Contact us or GOA Forest Health and Adaptation Section for details. These broad seed zones reflect the high diversity, extensive dispersal, and broad adaptation of these species. Retention and restoration planning for these species in situ should reflect these considerations. Per recovery plan measures, strive to collect cones from currently identified plus trees, or – with appropriate training – collect seed from new plus trees and plant seedlings from those putatively or tested rust-resistant trees in suitable habitat in C5 FMA per best practices (see WPEFC website or for BMPs or available training). If new plus trees are identified, report location (GPS), tag, and related info to GOA to include in provincial recovery efforts. Seedlings grown from trees susceptible to blister rust are a costly and ineffective measure as they are unlikely to survive the 80 to 100 years needed to reproduce themselves and provide their unique keystone ecological values. While retention of populations of whitebark and limber pine in	✓	✓	✓		Yes	Chapter 5 VOIT 14e	Thanks for sharing this information.

protected areas should be a given, as ideally they are excluded from the CFLB, WPEFC proposes that these unmerchantable species within blocks and layout areas, including roads, be retained to contribute to this measure in all cutblocks, pullouts, quarries, landings, road sections and associated ditches, culverts, etc. Avoid damaging or removing whitebark and limber pine as they have no merchantable value but extremely high value for biodiversity and ecological function. Further, their extremely slow growth means each mature individual takes a century or longer to replace. Mature living whitebark and limber pine trees, especially healthy ones, are uncommon in the C5 FMA and may contain rare genetic disease resistance. These trees are irreplaceable and form the foundation of recovery for these endangered species by increasing disease resistant genetics across the landscape. We urge CFP to take all means possible to identify (e.g., tag or flag), GPS, and protect these trees, and report their locations to GOA to contribute to provincial recovery. MPB protection can be obtained from the Calgary Area forest health officer. Saplings and seedlings are							

also individuals of these endangered species and carry key genetic diversity to sustain populations into the future. Just as it would not be acceptable to harm or kill immature endangered swift foxes, ferruginous hawks, or burrowing owls as a result of land management activities, immature endangered trees warrant the same approach.							

VOIT 1.3.1.2 genetic ex situ conservation Consider making one or more field sites of 0.5 to 2 ha with suitable characteristics available for long-term whitebark and/or limber pine ex situ gene conservation installations. WPEFC would be pleased to work with CFP to establish a list of sites with desirable characteristics. These sites could be selected in unmerchantable sites or cutblocks pending reforestation. Depending on the objective some sites may not yield merchantable volumes of commercial species during the next several decades (e.g., clone bank), while others (e.g., thinning restoration trial) may do so. Seed collections from rust-resistant trees can be stored in the provincial seed centre archive for gene conservation, or until registration and deployment per FGRMS for operational deployment. However, until these are acceptable under RSA, they cannot be tracked in ARIS and must be tracked spatially separately – WPEFC would be pleased to work with CFP to document restoration data and locations.	✓	✓	✓		Yes	Chapter 5 VOIT 14e	Thanks for sharing this information.

VOIT 1.4.1.1 transboundary values Per 1.2.1.1, the approach to whitebark and limber pine restoration was developed by, and being implemented by, jurisdictional partners across the Crown Managers Partnership in southeast BC, southwest AB, and northwest Montana.	✓	✓	✓		Yes		Thanks for sharing this information
VOIT 5.2.1.1 fire risk Confusing and not measurable as currently described.	✓	✓	✓		Yes	Chapter 5 VOIT 28	The objective of this VOIT is to assist GoA in reducing wildfire threat potential by reducing fire behavior, fire occurrence, threats to values at risk and enhancing fire suppression capability. As an example, in the 2021 B12 FMP, the specific targets established were to: a) Reduce the area (ha) in the high, very high and extreme "Summer" Fire Behavior Potential rating within the parts of FireSmart Community Zones that overlap the DFA. Targets are 17% in Bow Corridor Kananaskis Morley MD31, 25% in Bragg Creek MD 31, 22% in Coal Camp, 6% in Red Deer River, 11% in Rocky Corridor and 1% in Eden Valley IR. b) Reduce the area (ha) in the high, very high and extreme "Summer" Fire Behavior Potential rating across the DFA by 16% over 20 years. The dataset for this modelling work is from the Fire Behaviour Potential and Fuel Grid Assessment, known as Annex 3 generated by Alberta's Fire Management Branch.

VOIT 5.2.3.1 – LRSY Climate change impacts need to be considered as future timber yields will certainly be impacted downwards over the rotation and likely even over the duration of the FMP. E.g., Potential change in lodgepole pine site index and distribution under climatic change in Alberta; A niche-constrained productivity model for white spruce in Alberta: predicting suitable forestry regions under climate change; Future of Alberta's Forests: Impacts of Climate and Landscape Change On Forest Resources and dozens of others, including some which explicitly model species and population productivity. Has CFP (with SLS) considered participating in a provincial tree improvement program? This may generate significant gains in yield, depending on degree of deployment and whether C5 could be considered an extension of any current Stream 2 CPP regions. Otherwise it would be a more long-term effort; however, there may be the opportunity to procure improved seed from BC adjacent breeding zones as well as from adjacent US seed zones, and CFP/SLS can apply for ACE if intending to deploy improved seed. Further, as a more long-term	✓	✓	✓		Yes	Chapter 5 VOIT 30	CFP has completed a Climate Change Assessment and is in the process of establishing a tree improvement program that addresses climate-based see transfer and assisted migration. The prevailing science from the assessment indicates three principal threats to Southern Alberta Forests including: • High severity wildfire • Mountain Pine Beetle Outbreaks • Severe weather events The good news is for southern Alberta at mid elevations, the Alberta climate model suggests tree growth may improve due to increased growing degree days and moisture. The provincial forest inventory data suggests tree growth in Alberta is improving, this may be a result of climate change, improved forest practices and or a combination of the two.

opportunity in collaboration with GOA tree improvement specialists, consider developing opportunities and yield curves for managing Douglas-fir and ponderosa pine, which numerous models and papers show as climate change winners for the region as growing season droughts will persist and increase. Species diversity provides a significant hedge against climate change and forest health risks.							

VOIT 6.1.1.1 Indigenous consultation Consulting with directly affected communities may not be sufficient regarding Treaty obligations given contemporary interpretations. Consulting and/or information sharing with all Treaty member communities may be warranted. The scope of the consultation reflects the entire FMA, not limited to specific modifications such as blocks or roads. Recent court decisions such as Yahey v British Columbia (2021, Treaty 8), Fort McKay First Nation v. Prosper Petroleum Ltd (2020, Treaty 8), and Ermineskin Cree Nation v Canada (2021, Treaty 6), to list but a few, maintain and affirm the Constitutional, Treaty, and unextinguished rights and title regarding resource management, cumulative effects on the land, and resource benefit sharing agreements. In the spirit of reconciliation, we support consultation and information sharing with Indigenous Nations in an open and meaningful way, in a spirit of collaboration, consistent with UNDRIP which Canada has endorsed, to seek common ground and respect for traditional use and cultural practices on the land we are all working and living in.	✓	✓	✓		Yes	Chapter 5 VOIT 31	Thanks for sharing this information. CFP is actively consulting with First Nations Communities following the guidelines and direction of the province of Alberta.

VOIT 6.2.1.1 public consultation Consider exceeding rather than meeting the expectations of the 20-year-old standard, the Planning Standard CSA Z809-02, is based on to promote better relations with communities in the region. The current CSA SFM standard is CAN/CSA Z809:2016 which is similar but does have some enhancements around consultation.	✓	✓	✓		Yes	Chapter 5 VOIT 32	The C5 FMP Public Participation Program details how CFP is consulting with the public while developing the FMP. Its available on our website.

Consistency with higher-level plans ALSA supersedes all lower-level plans, and all subsidiary planning within that region, including Forest Management Plans, must be consistent with ALSA. The South Saskatchewan Regional Plan, established legally under ALSA, has provisions to complete establishment and legally implement several component frameworks and pending land use designations. WPEFC seeks clarity on how CFP anticipates ensuring their FMP will be consistent with, or will be made consistent with these, should approval occur during the 20-year duration of the FMP. What plans does CFP have to amend and align the FMP with these measures? Will the AAC or SHS be affected, and if so, would it mean increased harvest and road development in other areas, and where would those be? In particular, we are enquiring about: the Biodiversity Management Framework and the proposed protected areas in the Livingstone & Porcupine Hills PLUZ. What measures to ensure consistency with these approved plans and pending land use designations are being taken, in terms of forest management and access planning (including deactivation and working with recreational	✓	✓	✓		Yes	Chapter 5 VOIT 14e	There are priorities set out in SSRP and the Livingstone-Porcupine Hills Land Footprint Management Plan (LPH-LFMP) with watershed management and headwaters protection along with managing wildfire risk to communities being identified as the highest priority. 12 Biodiversity, forest ecosystem resiliency and timber supply have been identified as secondary. All identified values are important; however, water and wildfire have been identified as the highest priority. FMP development focuses on how activities (i.e., establishing, growing and harvesting timber) of forest tenure holders will be managed in order to reduce the negative impacts on other resource users and resource values. The FMP must clearly demonstrate how it has considered all values in alignment with the vision, outcomes, strategic direction, objectives and priorities of the SSRP, LPH-LFMP and the AFMPS.

stakeholders to work on future access management), AAC determination, and watershed protection?							
VOIT (#29). Attached is the map for the CNSC trails at Allison-Chinook PRA/PLUZ. This is an official map that was designed by AEP and AB Parks (before the ministry changes) and are considered official trails and should be protected from harvesting	✓	✓	✓		Yes	Chapter 5 VOIT 29	Theres no planned SHS overlapping the trail network.

What about - Leaving brush piles behind to aid martin along with many other mammals for denning and shelter- they are like hotels? - Recognizing beaver habitat as they are a keystone species and there are few in this region. in particular needed food for their survival. They often have to travel 50 meters or more for food on land away from the water and are critical to wetlands, and over a 200 year period I think there is an argument to made that the overall healthier habitat they create will produce more yield for you in the long term vs the short term loss do them feeding, most of which is within your riparian buffer anyways. And beavers don't need the big trees, tiny 1 inch polars are great. - Leaving travel corridors for smaller and more reclusive animals to travel between cuts. a 1-2 meter wide swath of whatever is you leased favorable vegetation connecting to sides of a cut. this would allow animals like martin to make a run for it and not be as vulnerable to owls and other predators. small gaps for equipment would be a non-issue.	✓	✓	✓		Yes	Chapter 5 VOITs 1-25	With respect to the FMP wildlife habitat models, CFP is required to follow standardized Alberta nontimber assessment (NTA) models as outlined in the VOITS. The Planning Development Team provincial biologist provided the following information: Fine Filter species identified in the VOITs and NTAs were based on species having clear responses to forestry and hence could be modeled into the forestry planning context, as well as act as Umbrella species, whereby the habitat identified for those species, acts to benefit a host of other species (for example Marten & Grizzly Bear). Wolverine as a species appears to be influenced by large-scale disturbance processes (e.g., fire), as well as climatic conditions that influence snow cover. Hence, in a forestry context wolverine, is best managed through the coarse filter objectives, that inform both patch sizes, shape and age of the forest. Further, a clear response to forestry has not yet been established with wolverine, but Wolverine is thought to benefit from the management of other species (e.g. grizzly bear, marten). Wolverine is a data-deficient species in Alberta, and while it is not indicated as a specific VOIT indicator species, it is thought to be managed through both the coarse filter VOITs that manage the landscape level nature of the forest (VOITs 1-13), as well as both fine filter indicator species (VOIT 14), as well as the existing operating ground rules.

- Adding wolverines to the animals list as a specific concern. there is a lot of data on this and I am looking to speak with Robert Anderson at the ACA on this to help refine that into some basic and tangible points- we worked extensively on wolverines together. - Brush piles and travel corridors are both things trappers can utilize as well, so it actually would not only be beneficial to wildlife, but the other stakeholders as well. The travel corridors need to be discussed with ranchers as well, there could be an issue there I'm not recognizing.							Alberta is continuing to evaluate wolverine population dynamics and habitat associations in Alberta, and as new information is uncovered, we will look to inform necessary processes to benefit the wolverine populations in Alberta.
Recommend Pausing FMP Process					No		Alberta is requiring CFP to complete the FMP as per the FMA agreement.

Include a VOIT that specifically addresses Westslope Cutthroat Trout and Bull Trout habitat. This should include: o Provisions for buffering of all streams and rivers identified as potential critical habitat by the federal recovery strategies for these species (minimum of 30m, recommended 100m). o Detailed monitoring and reporting plan for all streams and rivers identified as critical habitat by the federal recovery strategies.	✓	✓	✓		Yes	Chapter 5 VOIT 14-2	A cold water fish VOIT has been added to the FMP. Fish habitat assessment are completed by CFP as part of the operational planning process. Historically, it's been CFP's responsibility to protect fish habitat and mitigate potential impacts to fish habitat and GoA's responsibility for monitoring fish populations.

Buffering of all wetlands (identified using ABMI wetland inventory) by at least 50m. o Use of low-impact forest harvest techniques in areas adjacent to wetland buffers. o Monitoring of wetland function after harvesting has occurred to determine effectiveness of mitigation techniques. Include a VOIT that specifically addresses the maintenance of functioning wetlands. This should include:	✓	✓	✓		Yes	Chapter 5 VOITs 9, 12 ,14-2	CFP will be subject to the new wetland provisions outlined in the 2024 Provincial Timber Harvest Planning and Operating Ground Rules. CFP will be subject to the new wetland provisions outlined in the 2024 Provincial Timber Harvest Planning and Operating Ground Rules. https://open.alberta.ca/dataset/0df77414-cdb6-4e34-8972-2e422bbeaafc/resource/66326942-a29c-43fc-80d9-af29c73c5804/download/fp-timber-harvest-planning-and-ogr-2024.pdf Wetlands may be added to VOIT 9. Chapter 7 of the draft FMP will identify strategies for wetlands. The FMP focuses on the location of productive upland forested areas and the associated potential impacts from harvesting. These areas form the basis of the active landbase. A map indicating the location of hydro buffers, moist areas, and other forest management deletions will be located in Chapter 6 of the draft FMP. At the operational level, wet areas, not identified with the FMP/AVI are identified and protected on the ground. These areas are referred to as operational deletions.

Strengthen VOIT #25 Water Quantity (CSA SFM Element 3.2 Water Quantity and Quality) to use more precautionary thresholds, given the stated importance of watershed management in the region: o Apply a maximum threshold of 15% Equivalent Clearcut Area (ECA) for all forest management planning watersheds at all planning time points.	✓	✓	✓		Yes	Chapter 5 VOIT 25	The watershed assessment analysis is anticipated to be available for public comment in 4 weeks. ECA analysis used in Alberta is precautionary. Although projections will be made 200 years into the future, the modelling work is repeated, with updated data, every 10 years. The spatial harvest sequence will be planned to minimize impacts to watersheds. The presumption is that a watershed with greater than 30% ECA could exceed a 15% increase in water yield. This tool has been effective in protecting Alberta sub-basins from flooding risk potentially caused by forest harvesting.
Adjust VOIT #3 Area of Old Interior Forest (CSA SFM Element 1.1 Ecosystem Diversity) to include differentiation of managed and unmanaged landbase. Apply additional targets for the area of old interior forest by cover class on both the managed and unmanaged landbase.	✓	✓	✓		Yes	Chapter 5 VOIT 3	CFP will thoughtfully consider additional old interior forest by cover class targets for both the gross and net land bases.
For VOIT #10 Local/Stand Scale Biodiversity (CSA SFM Element 1.1 Ecosystem Diversity), ensure that the minimum structure retention level within harvested areas is 10%. In addition, commit to exploring non-clearcut systems that would have lower impacts on landscape values.	✓	✓	✓		Yes	Chapter 5 VOIT 10	CFP is thoughtfully considering use of partial cut harvesting on some sites; However, given the dominant natural disturbance regime is stand replacement fires, CFP is not considering 10% retention in pine and spruce stands.

For VOIT #4 Maintain Biodiversity by Minimizing Access (CSA SFM Element 1.1 Ecosystem Diversity) adjust VOIT to refer to all roads (not only open all-weather forestry roads) and include a target of <0.2 km/km2 total road density for bull trout and westslope cutthroat trout watersheds.	✓	✓	✓		Yes	Chapter 5 VOIT 4	Road density VOITS will be in alignment with the Livingstone Porcupine Hills Linear Footprint Management Plan.
Strengthen the consultation process for VOIT #32 Meaningful Public Participation is Achieved (CSA SFM Element 6.2 Public Participation and Information in Decision-Making) to ensure that meaningful public participation in management and operational planning is achieved, including:	✓	✓	✓		Yes	Chapter 5 VOIT 32	The public consultation program follows the standards outlined by Alberta and is publicly available on our website at: https://spraylakesawmills.com/woodlands/public-involvementprocess/. CFP maintains a rigorous and meaningful public consultation program and the government of Alberta is the decision maker concerning forest management plans and resulting operational plan approvals in the province. The public consultation process including the outcomes are provided to the public in the FMP document and CFP documents input and responds directly to public inquiries and concerns.

4-1 to 5-3 (access): •We support the changes to these indicators to directly tie them to the LFMP but cannot comment on thresholds until draft values are provided. •We would like to see the thresholds tied to known biological thresholds even outside of the LFMP zones. These should then be tied to areas/watersheds with specific species. See the attached threshold summaries PDF from the LFMP planning for background literature.	✓	✓	✓		Yes	Chapter 5 VOITs 4-1, 5-3	We will look at setting the targets in a similar manor as we are doing inside the LPH-LFMZ.
10 (retention): •We re-iterate feedback from our previous letter (August 28, 2023) that 10% retention should be a minimum for biodiversity and ecosystem function and that partial harvest systems with higher retention levels should be explored. See https://www.emendproject.ca/biodiversity.	✓	✓	✓		Yes	Chapter 5 VOIT 10	We have noted 10% and are still working on the retention levels with GoA.
14 (wildlife populations): •We support addition of whitebark/limber pine targets. •Question: Why were Canada Warbler and Black-Throated Warbler removed from VOIT?	✓	✓	✓		Yes	Chapter 5 VOIT 14	Provincial biologists have indicated these species are not prevalent in C5 and thus not an appropriate indicator species.

25 (water quantity): •We re-iterate feedback from our previous letter (August 28, 2023) that ECA of <15% should be the target given the importance of the region for water supply and biodiversity. •Question: how will snow sensitive zones be identified?	✓	✓	✓		Yes	Chapter 5 VOIT 25	The province has identified these areas, along with the micro watersheds used for the watershed assessments.
26 (riparian habitats): Question: I assume this is a wording change for clarity, rather than a change in meaning?	✓	✓	✓		Yes	Chapter 5 VOIT 25	Correct.
28 (wildfire): Question: Can you point us to details of how the new WRI approach is being used and how that differs from previous rating approach?	✓	✓	✓		Yes	Chapter 5 VOIT 28	The WRI is more of a cumulative risk (including consequence and likelihood) in combination with fuel type/environmental conditions. Whereas the previous approach focused more on fire intensity by stand types during dry conditions. The new information is specific to the wildfire risk during the summer months.
29-2 (other uses): Question: what form will this consultation take, how will 'high scenic values' be determined?	✓	✓	✓		Yes	Chapter 5 VOIT 9-2	High scenic areas are located within 0 to .8 kms of a viewing area such as a road or campground etc. We are developing a visual quality (VQ) map and VQ document that explains the process. We will be sharing the VQ strategy and map on our website and at an open house to be held in the Fall 2024.

cold water fish VOIT(s), we re-iterate our previous feedback that this is urgently needed and should specifically address Westslope Cutthroat Trout and Bull Trout habitat and include (a) Provisions for buffering of all streams and rivers identified as potential critical habitat by the federal recovery strategies for these species (minimum of 30m, recommended 100m) and (b) detailed monitoring and reporting plan for all streams and rivers identified as critical habitat by the federal recovery strategies.	✓	✓	✓		Yes	Chapter 5 VOIT 14-2	A cold water fish VOIT has been incorporated into the FMP

Should 29 and 29-2 VOITS address the concerns of the CNSC ski trails? My understanding is that West Fraser will not cut in the Allison Chinook Ski Area in order to leave our trails intact and provide scenic forest coverage for our skiers to enjoy.	✓	✓	✓		Yes		There isn't any planned spatial harvest within or immediately adjacent to the trails network- in the 2025 FMP. However, its important to note, that the Chinook trails area has been identified by Alberta Wildfire as having "intolerable" risk to wildfire so there's significant risk in losing the area to wildfire. That being said, if the trail users want to try and get ahead of that risk, there are programs such as Alberta FireSmart (selective harvesting) that can help with managing that risk and making it easier for wildland fire fighters to protect the trail networks forests while maintaining the networks aesthetic integrity. Please share this information with the trails community and let us know if there's interest in a mitigative partial harvest approach that would be in collaboration with the trails community-this is an opportunity to provide some longer term protection for the Chinook recreational area from a wildfire mitigation standpoint. Please see the map excerpted from Alberta's Annex 3 Report.
There is mounting evidence that the cumulative effects of increasingly intensive land use in the Southern East Slopes are having deleterious impacts on hydrologic response, fish and wildlife habitat and populations, aesthetics, and recreation. Land-use planning for the region must explicitly consider these cumulative effects if we are to find a sustainable path forward.	✓	✓	✓		Yes	Chapter 5 VOITS (All)	In terms of forest management, the environmental impacts have been addressed as indicated in the FMP VOITs.

while linear footprint was analyzed in the LFMP, the cumulative impacts of all disturbances on the landscapes were to be assessed and thresholds developed through the Spatial Human Footprint analysis, which was promised within one year of the release of the LFMP. Unfortunately, this work, which would have included forest harvest areas being “assessed for their contribution to Spatial Human Footprint and managed to meet the target”, has not been completed/published.							
the ACTWS have completed a cumulative effects and conservation priorities report for the Southern East Slopes1, which is directly applicable to the FMP area. This work provides a detailed analysis of cumulative effects and could be used to build cumulative effects analysis and science-based thresholds directly into the FMP.	✓	✓	✓		Yes	Chapter 5 VOITs (All)	In terms of forest management, the environmental impacts have been addressed as indicated in the FMP VOITs.

Thanks for sharing the milestone 2 draft results. AWA would like to submit feedback on the shared document; in order to do so, could you please send our way the Spatial Harvest Sequence including the Annual Allowable Cut, please?	✓	✓	✓		Yes	Chapter 5 VOIT 32	Thank you for your patience as we continue reviewing a West Fraser data sharing agreement/process. West Fraser needs to ensure a consistent approach to sharing data that aligns with our commitments and responsibilities to all the communities and stakeholders we work with. In the meantime, we'd like to let you know that the draft FMP, which includes the requested AAC, is scheduled to be available for comment within six weeks and there will be three months to review the draft. We'll notify you as soon as the draft FMP is available and when we have firm direction on a potential West Fraser data sharing agreement/process. Please don't hesitate to reach out if you have any questions.

I have concerns with seemingly too much happening in a relatively short time period in a couple of areas. I am certainly concerned about the viewscape and the effect on recreation in these areas and wonder about excessive runoff into streams in these areas in the case of heavy rainfall and/or more rapid snowmelt. One area is the whole Hidden Creek drainage and its impact on the Great Divide Trail. It would almost seem that you would want this section of trail closed during the time of harvest. The other is McGillivray Creek and NW of Coleman. See attached screen prints. I am certainly not an expert in water management and ecology but the maps look like this amount of harvest in these areas would affect this. Maybe you have data from your colleagues that can help me understand this better. Understanding the Visual Quality Map is going to take a bit of time.	✓	✓	✓		Yes	Chapter 5 VOIT 10 VOIT 25 VOIT 29-2	The below information highlights some of the approaches used in the FMP process to address the concerns indicated in your email. We are anticipating the draft FMP to be available next month which will provide more detail. We will be consulting on the draft FMP for 3 months and will be sending a link to the draft accordingly. Visual Quality- A visual quality inventory has been completed. The SHS will not include more than 12% of the identified high scenic values in the first two decades. Areas rated as high will have mitigation to minimize the visual impact. Recreation- Designated trails are to be protected including the Great Divide Trail as indicated in the Timber Harvest Planning and Operating Ground Rules. Operations near trails will be conducted to ensure safety for trail users and protection of trails. Watershed- Equivalent clear-cut area modelling (ECA) has been used to constrain harvesting in sub watersheds. ECA is a coarse filter indicator describing how forest harvesting may impact a watershed. Alberta Agriculture and Forestry's (AAF) watershed assessment process utilizes AAF delineated watersheds restricted to 10,000 hectares within the ECA model. AAF's watershed assessment is an extremely precautionary and very coarse, watershed disturbance footprint analysis rather than a reliable tool to predict water yield. The presumption is that a watershed with greater than 30% ECA could exceed a 15% increase in water yield and could increase risk.

							The ECA process uses rules of thumb based on forest hydrology research completed within forested, snow dominated watersheds. ECA's of less than 30% are assumed to not increase average annual water yield by more than 15% within the watershed unit for which the analysis is completed and are not considered a risk. Thanks,
It is concerning that the draft SHS leads to old and very old forest levels dropping below the predicted natural range of variability (NRV) on the managed landbase. It is important that the details of this analysis are made available to the public for comment. The information package lacks the necessary information (e.g. how far below NRV, and for how long?) to make informed comment on this outcome.	✓	✓	✓		Yes	Chapter 5 VOIT 1-3	

For VOIT #10 Local/Stand Scale Biodiversity (CSA SFM Element 1.1 Ecosystem Diversity), ensure that the minimum structure retention level within harvested areas is 10%. In addition, commit to exploring non-clearcut systems that would have lower impacts on landscape values. If proceeding with a target less than 10%, provide justification for this target in the context of protecting biodiversity and ecosystem function.	✓	✓	✓		Yes	Chapter 5 VOIT 10	
For bull trout and westslope cutthroat trout there are additional requirements for watercourse crossings under the Species at Risk Act (SARA) to avoid destruction of critical habitat. However, this VOIT makes no mention of SARA, the recovery strategies for these species, or DFO's requirements in this regard. This VOIT cannot be effective if SARA requirements are not included.	✓	✓	✓		Yes	Chapter 5 VOIT 14-2	
For VOIT #1 Cover Types / Seral Stages, provide details of seral stage and NRV analysis so that informed comment can be provided.	✓	✓	✓		Yes	Chapter 5 VOIT 1	

For VOIT 13 include clear commitments to following regulations (e.g. SARA permitting process) under the Species at Risk Act.	✓	✓	✓		Yes	Chapter 5 VOIT 14	
Adjust VOIT #3 Area of Old Interior Forest (CSA SFM Element 1.1 Ecosystem Diversity) to include differentiation of managed and unmanaged landbase. Provide justification for current interior old forest targets.	✓	✓	✓		Yes	Chapter 5 VOIT 1-3	
Strengthen VOIT #25 Water Quantity (CSA SFM Element 3.2 Water Quantity and Quality) to use more precautionary thresholds, given the stated importance of watershed management in the region: Apply a maximum threshold of 15% Equivalent Clearcut Area (ECA) for all forest management planning watersheds at all planning time points. Commit to exploring additional indicators that could be utilized in conjunction with ECA for more effective watershed management.	✓	✓	✓		Yes	Chapter 5 VOIT 25	

Include a VOIT that specifically addresses the maintenance of functioning wetlands. This should include: Buffering of all wetlands (identified using ABMI wetland inventory) by at least 50m. Use of low-impact forest harvest techniques in areas adjacent to wetland buffers. Monitoring of wetland function after harvesting has occurred to determine effectiveness of mitigation techniques.	✓	✓	✓		Yes	Chapter 5 VOIT 9 VOIT 12 VOIT 13 VOIT 25	Avoidance of wetlands and mitigation of impacts are core considerations in forest planning and operations. OGRs and applicable directives provide the standards to protect wetlands.
Recreational tour operator concerned with avoiding taking clients into active logging and hauling sites.	✓	✓	✓		Yes	Chapter 5 VOIT 29	Will work with tour operator with notifications in specific areas of interest.

Hoping our concerns and recent research will be taken in consideration within the forest management plan. Theres opportunity for an advanced set of criteria for maintaining biodiversity which includes hydrological response and water quality. We want to be involved on the development of the FMP. What role could the ACTWS take on that would be helpful in this regard. The draft of the spatial sequence would be good to run through the C5 cumulative effects as a first cut. Either we could run it, or we could provide it to you to run.	✓	✓	✓		Yes	Chapter 5 VOITs (All)	We would like to work together and understand the concerns. We should have more regular dialogue going forward.? We will review draft FMP and look at critical inclusions that may be useful. We will have the draft SHS available for review than the FMP. In the interim, If you could provide the key fundamentals of things you would like to know more about we can address those. West Fraser is curious about how the cumulative effects model works.
We are unclear on how to meaningfully comment on the spatial harvest sequence (SHS) without key details such as the area harvested and volume. These factors are essential for assessing the sequence effectively. Could you clarify what type of input is expected on the SHS? Additionally, we would like to again propose running it through the ACTWS cumulative effects model. This would provide a clear and effective mechanism for ACTWS to offer meaningful feedback.	✓	✓	✓		Yes	Chapter 5 VOIT 32	We will be providing the draft FMP in the next few months, and it will contain the details surrounding the timber supply modeling. At this point, we are looking for input on the items identified in the information package and happy to set up a meeting to capture any input and answer questions.

VOIT 1 Cover Types / Seral Stages: Provide details of seral stage and NRV analysis so that informed comment can be provided.	✓	✓	✓		Yes	Chapter 5 VOIT 1	
Adjust VOIT 3 Area of Old Interior Forest (CSA SFM Element 1.1 Ecosystem Diversity): Include differentiation of managed and unmanaged landbase. Provide justification for current interior old forest targets.	✓	✓	✓		Yes	Chapter 5 VOIT 3	

For VOIT 14-2 Native Trout Recovery: Provide clarity on terms “trout watersheds” and “strategic mitigations.” Include a robust monitoring program for native trout populations and/or associated indicators that includes before and after harvest assessments. Commit to reporting the results of this program publicly and to adjusting thresholds in response to this monitoring program as supported by data. Include a commitment to developing thresholds for road density and watercourse crossings based on existing scientific literature and before and after harvest monitoring. Provide details of the Habitat Conservation Strategy and other items to allow for informed feedback on these items.	✓	✓	✓		Yes	Chapter 5 VOIT 14-2	

Include a VOIT that specifically addresses the maintenance of functioning wetlands. This should include: Buffering of all wetlands (identified using ABMI wetland inventory) by at least 50m. Use of low-impact forest harvest techniques in areas adjacent to wetland buffers. Monitoring of wetland function after harvesting has occurred to determine effectiveness of mitigation techniques.	✓	✓	✓		Yes	Chapter 5 VOIT 9 VOIT 12 VOIT 13 VOIT 25	Avoidance of wetlands and mitigation of impacts are core considerations in forest planning and operations. OGRs and applicable directives provide the standards to protect wetlands.
Strengthen VOIT #25 Water Quantity (CSA SFM Element 3.2 Water Quantity and Quality): Use more precautionary thresholds, given the stated importance of watershed management in the region. Apply a maximum threshold of 15% Equivalent Clearcut Area (ECA) for all forest management planning watersheds at all planning time points. Commit to exploring additional indicators that could be utilized in conjunction with ECA for more effective watershed management	✓	✓	✓		Yes	Chapter 5 VOIT 25	

Apply a maximum threshold of 15% Equivalent Clearcut Area (ECA) for all forest management planning watersheds at all planning time points.							
For VOIT 10 Local/Stand Scale Biodiversity (CSA SFM Element 1.1 Ecosystem Diversity): Ensure that the minimum structure retention level within harvested areas is 10%. In addition, commit to exploring non-clearcut systems that would have lower impacts on landscape values. If proceeding with a target less than 10%, provide justification for this target in the context of protecting biodiversity and ecosystem function.	✓	✓	✓		Yes	Chapter 5 VOIT 10	
For VOIT 13 Interior Old Forest: Include clear commitments to following regulations (e.g. SARA permitting process) under the Species at Risk Act.	✓	✓	✓		Yes	Chapter 5 VOIT 13	

7 Indigenous Consultation

To guide its Indigenous consultation, CFP was directed by AFP and the Aboriginal Consultation Office (ACO) to follow provincial guidelines for Level 3 Consultation.

Level 3 projects require:

- Information packages for the VOITs, Spatial Harvest Sequence and visual quality maps, and the draft FMP document;
- 1st follow-up after 10 days of notification sent to Nations;
- 2nd follow-up after 15 days of notification sent to Nations;
- Bimonthly reports with the Record of Consultation log and Community Concern and Response Table;
- Record of consultation log notification sent to Nations;
- Record of consultation log review (10 GoA working days); and
- ACO adequacy assessment (20 GoA working days).

The ACO identified seven Treaty 7 Nations that CFP needed to consult with on the 2025 FMP: The Tsuut'ina Nation, Stoney Nakoda (Bearspaw) Band, Stoney Nakoda (Wesley) Band, the Stoney Nakoda (Chiniki) Band, Piikani Nation, Siksika Nation, and Blood Tribe. There are no First Nation communities with reserve land positioned within the FMA area but communities are situated around the FMA area.

7.1 Project Notification and VOIT Consultation

In November 2022, CFP began FMP consultations with First Nation communities by mailing an FMP notification and information package, consisting of a project information letter and an FMA map.

7.2 SHS and FMP Consultation Milestones

In November of 2022, the Treaty 7 Nations were emailed the Milestone 1 FMP Information Package and in May of 2025 the draft FMP document was emailed for review.

7.3 Consultation Milestones

Appendix I – Indigenous Consultation (November 2022 to October 2025) details CFP's efforts to consult with Indigenous communities throughout the FMP development process. Table 7-1 summarizes input received from Indigenous communities and how the input was addressed throughout the FMP process.

Table 7-1. Indigenous Communities consultation summary

Description of Input	First Nation Community	How the Input was Addressed
Must sign off on and approve the C5 FMP prior to approval by AFRED.	Blood/Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs and define site specific areas and potential plans for avoidance, minimization, or mitigation.

Description of Input	First Nation Community	How the Input was Addressed
A. Eastern Slopes is a key harvesting and land use area that has been used for travel, trade, harvesting and ceremonial purposes. B. The C5 FMP impacts more than hunting, fishing and trapping rights for food and includes: (a) harvesting of fish and wildlife in the area; (b) harvesting and gathering of plants and timber for cultural, spiritual, and ceremonial purposes (in particular rare plant communities of importance to Kainai culture and governance protocols); (c) use and enjoyment of their traditional territory for Kainai way of life; (d) available habitat for key species; and (e) water quality; (f) wildlife and wildlife habitat; and (g) fish and fish habitat. C. The influx of industrial development, cut-blocks, roads, industrial and other human traffic that comes along with the harvesting of timber creates a significant barrier to the use of the area for the practice of Kainai's Treaty rights.	Blood /Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs; define site specific areas and potential plans for avoidance, minimization, or mitigation; develop water quality VOITs and develop medicinal plants and plants of significance to First Nation VOITs (under the biological diversity criterion).
A. Kainai's source water for our reserve lands is located in the Eastern Slopes at the headwaters of the Oldman River. Any impact to this water source will have a direct impact to Kainai's membership and the use and access to water on Kainai's reserve lands – a core Treaty right. B. Kainai is concerned about the potential impact of industrial activity on this river system, primarily with regard to impacts to water quality and fish habitat. C. Water in the Oldman River system must be of sufficient quality for human and animal consumption. This is necessary for Kainai members who uses the water for domestic purposes on reserve and land users who camp in the area and have relied on the surface water of this area for drinking water for generations. It also applies to the wildlife species that rely on the water. The health of this wildlife is integral to the continued practice of Kainai's Treaty rights. D. We recommend that the VOIT Table include reference to water quality (as opposed to including water quantity alone). The reserve's Source waters are located in the eastern slopes at the headwaters of the Oldman Watershed.	Blood /Siksika	Have discussions to develop additional water quality VOITs particular to Treaty rights and traditional uses. Water quality and fish habitat is protected as indicated in the draft FMP VOITs and the linked Timber Harvest Planning and Operating Ground Rules.
A. Decline in key habitats – such as forested areas – for hunting. These declines were attributed to an increase in industrial traffic, recreational traffic, and associated noise.	Blood /Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs; to define site specific areas and potential plans for avoidance, minimization, or

Description of Input	First Nation Community	How the Input was Addressed
B. We recommend that the VOIT Table include reference to: effects to wildlife and species of significance to First Nations (under the biological diversity criterion).		mitigation and to develop effects to wildlife and species of significance VOITs to First Nations (under the biological diversity criterion).
A. Can no longer engage in exercise of Treaty rights due to cumulative impacts of other land uses like forestry, tourism, expansion of municipalities, conservation areas and mining. B. Can no longer be able to practice Treaty rights in core traditional territory. C. GoA's continued dismissal of Treaty rights concerns and the subsequent approval of projects impairing Treaty rights to the point they can no longer be practiced. D. About 80% of the regional study area is estimated to be inaccessible for traditional use. E. Primary concern is the contribution of timber harvesting and related activities to the cumulative degradation of the lands and resources within traditional territory. F. Siksika is undertaking a comprehensive and integrated study of the impacts of development on their traditional territory with a view to a comprehensive understanding of the areas that remain for traditional land use. We expect this study will be complete in late 2023 and will help inform consultation on the C5 FMP.	Blood /Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs. Have discussions to define site specific areas and potential plans for avoidance, minimization, or mitigation. Cumulative effects management is under the jurisdiction of Alberta, through the administration of the Land Stewardship Act which governs regional and sub regional planning- not within the control of CFP.
A. To avoid challenges from First Nations and reduce the risk of infringing the duty to consult and Aboriginal and Treaty rights, should target: (a) aligning with the honour of the Crown and recent case law on the duty to consult; (b) meeting all Treaty obligations; (c) developing formal and informal partnerships and relationships with First Nations; and (d) addressing and accommodating concerns raised by First Nations. B. SLS should enter into an engagement process with Siksika and Kainai as Blackfoot Treaty (Treaty 7) rights holders, to develop a joint work plan and consultation schedule relevant to the review and implementation of the GDP (2021-2025) as per the vague requirements set out in the 2006-2026 C5 FMP, and the slightly more specific requirements of the SFI Forest Management Standard.	Blood /Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs and to define site specific areas and potential plans for avoidance, minimization, or mitigation. SLS/CFP is legally required to engage Treaty 7 First Nations on behalf of Alberta and has been and will continue to engage both nations with the Provincial process
A. To ensure that Kainai's perspective on the VOIT Table is properly incorporated, we request that CFP provide an additional opportunity for Kainai to review and comment on	Blood /Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs be

Description of Input	First Nation Community	How the Input was Addressed
the draft Table before it is submitted to AFRED in January 2023. B. To help support the development of the VOIT Table, we recommend CFP take into account the information provided under the consultation process for the 2021 General Development Plan.		incorporated into the proposed VOITs submitted to Alberta. Have discussions to develop protection of Treaty rights and traditional use Volts including from information provided under the consultation process for the 2021 General Development Plan.
A. Kainai cannot provide a detailed accounting of any site-specific impacts to Treaty rights without a thorough site visit. Given the expansiveness of the C5 Forest Management Unit, we recommend that CFP work with Siksika to schedule a series of site visits during the three-year consultation period to better understand the sites of significance in the area, including key harvesting grounds, areas of avoidance for plant gathering sites, buffer zones for watercourses, and any further areas of cultural importance. These visits will provide CFP with the information required to understand Siksika's Treaty rights in the area and provide the necessary information for Alberta to assess the impacts of the C5 FMP on Kainai's Treaty rights. B. This work cannot be undertaken without proper funding and we seek to enter into a binding consultation funding agreement with CFP that provides adequate funding for Kainai to engage effectively with CFP and the provincial government, and to gather the necessary information to inform CFP and Alberta on the impacts of the C5 FMP on Kainai's Treaty rights.	Blood /Siksika	Blood and CFP to schedule two site visits over the next 24 months to better understand the sites of significance in the area, including key harvesting grounds, areas of avoidance for plant gathering sites, buffer zones for watercourses, and any further areas of cultural importance. CFP would like to have discussions to assist with funding support for site visits and VOIT development.
SLS should adequately explain how the planned forest management activities will not negatively impact the following established Aboriginal and Treaty rights of Siksika and Kainai: Hunting and fishing rights, including healthy populations of fish and game in preferred hunting areas; Plant harvesting rights, including plants for food, cultural and ceremonial uses in preferred harvesting areas; Access to resources required to sustain rights practices including adequacy of – and access to – known and preferred habitation sites on the land and adequate, safe and well-known routes of access and transportation; Right to healthy cultural and spiritual relationships with the land; and Right to continuity and protection of culturally important sites and heritage.	Blood /Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs and to define site specific areas and potential plans for avoidance, minimization, or mitigation. In terms of protection and maintenance of biodiversity at multiple scales, including fish, wildlife and plants, the VOITs and have been approved by professional biologists and forest ecologists and meet the criteria of sustainable forest management as per the Canadian Council of Forest Ministers and internationally by the Sustainable Forestry Initiative program.
SLS should demonstrate a higher level of effort to determine the cultural significance, needs and concerns of wildlife, plants, landscapes and water bodies and fish beyond the inadequate community profiles presented in the C5 FMP. This is also a	Blood /Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs and to define site specific areas and potential

Description of Input	First Nation Community	How the Input was Addressed
requirement of Objective 8 of the SFI (2015-2019) Forest Management Standard to which SLS is certified (last audit 2021).		plans for avoidance, minimization, or mitigation. The Alberta Forest Management Planning Standard requires SLS/CFP to consult with communities as to potential gaps in the Values, Objectives, Indicators and Targets to be addressed in the FMP. SLS/CFP is available to address concerns by adding traditional use and Treaty right FMP VOITS. SLS/CFP is also available to assist with funding to accomplish this work.
SLS should enter into an engagement process with Siksika and Kainai as Blackfoot Treaty (Treaty 7) rights holders, to develop a joint work plan and consultation schedule relevant to the review and implementation of the GDP (2021-2025) as per the vague requirements set out in the 2006-2026 C5 FMP, and the slightly more specific requirements of the SFI Forest Management Standard.	Blood /Siksika	SLS/CFP is legally required to engage Treaty 7 First Nations on behalf of Alberta and has been and will continue to engage both nations with the Provincial process.
The C5 FMP and associated forest management activities should account for other land uses (e.g., coal proposals, road development, other resource development) by taking a cumulative effects approach to impacts on the land. This would allow SLS the ability to more adequately assess and articulate the impacts of forest management activities on the rights of Siksika and Kainai.	Blood /Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs and to define site specific areas and potential plans for avoidance, minimization, or mitigation. Cumulative effects management is under the jurisdiction of Alberta through the administration of the Land Stewardship Act which governs regional and sub regional planning.
SLS and the GoA should ensure that the new C5 FMP (currently in development) include the appropriate baseline information needed to accurately assess impacts to rights holders. This should include complete and verified Nation profiles, identification of rights and interests of all Indigenous communities with traditional territories affected by the administrative boundaries of the C5 FMU, as well as agreed-upon mitigation measures to address any infringement of rights as a result of forest management activities.	Blood /Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs and to define site specific areas and potential plans for avoidance, minimization, or mitigation. The Alberta Forest Management Planning Standard requires SLS/CFP to consult with communities as to potential gaps in the Values, Objectives, Indicators and Targets to be addressed in the FMP. SLS/CFP is available to address concerns by adding traditional use and Treaty right FMP VOITS.

Description of Input	First Nation Community	How the Input was Addressed
		SLS/CFP is also available to assist with funding to accomplish this work.
Site visits to the C5 plan and consultation is a requirement in this process.	Blood /Siksika	SLS has agreed to site visits.
Infringement of Treaty Rights	Blood /Siksika	Have discussions to develop protection of Treaty rights and traditional use VOITs and to define site specific areas and potential plans for avoidance, minimization, or mitigation.
Project does impact Treaty rights and Traditional uses. The specific concerns cannot be provided due to intellectual property and protocol concerns. More time and capacity is needed to review the project and a project map was requested.	Stoney Nakoda Bearspaw, Chiniki and Goodstoney Bands	Completed SIL application and sent email indicating the project map is located within the information package and requested site specific concerns impacting treaty rights and traditional uses.

Appendix I Indigenous Consultation (November 2022 to October 2025)

- November 8th, 2022 Mailed FMP notification information packages to all of the Treaty 7 Nations.
- On November 22nd and 30th sent first and second follow-ups to Nations that did not respond to the information package.
- December 6, 2022 Siksika and Blood sent concerns letter.
- January 9, 2023 CFP sent a response letter to the Siksika and Blood.
- May 8, 2023 CFP sent Treaty 7 Nations FMP VOIT update, record of Consultation Log (RoC) log and Community Concerns and Response Table (CCRT) for Nations review. Recorded concerns and proposed future commitments.
- July 27, 2023 Sent Treaty 7 Nations FMP VOIT update, RoC log and CCRT for Nations review. Recorded concerns and proposed future commitments.
- November 15, 2023 sent Treaty 7 Nations FMP VOIT update, RoC log and CCRT for Nations review. Recorded concerns and proposed future commitments.
- January 23, 2024 sent Treaty 7 Nations FMP VOIT update, RoC log and CCRT for Nations review. Recorded concerns and proposed future commitments.
- March 6, 2024 sent Treaty 7 Nations FMP VOIT update, RoC log and CCRT for Nations review. Recorded concerns and proposed future commitments.
- June 21, 2024 sent Treaty 7 Nations FMP VOIT update, RoC log and CCRT for Nations review. Recorded concerns and proposed future commitments.
- October 3 2024 Siksika wanting to meet, develop a work plan, funding for consultation, filed a Treaty Infringement claim.
- November 7, 2024 CFP sent a review consultation milestones/timelines and offered times to meet Siksika and Blood.
- December 24, 2024 CFP sent Siksika a review of consultation milestones/timelines and offered times to meet.
- December 30, 2024 CFP sent an FMP VOIT update, RoC log and CCRT for Nations review. Recorded concerns and proposed future commitments.
- January 29, 2025 Offered Blood Nation dates to meet to discuss FMP milestones 1, 2, and 3 and treaty infringement concerns, indicated legal counsel to be present.
- February 27, 2025 CFP sent Treaty 7 Nations FMP update, RoC log and CCRT for Nations review.
- April 7, 2025 CFP and Siksika met to discuss overview of the planning area and consultation milestones and timelines.

Appendix II PAC Meeting Notes

Spray Lake Sawmills

Crowsnest Forest Products
Public Advisory Committee
Kanata (Blairmore)
Oct 26th, 2022 Finalized Meeting Notes

Present: Gary Clark, Brenda Davison, Bill Skene, Dianne Sawley, Larry Sears, Bruce Mowat, Annette Mahieux-Bone, Don Scott, Shannon Frank, David Whitten, Matt Denney (SLS), Erroll Kutcher (SLS), Jake Guay (SLS), Jason Mogilefsky (SLS), Kyle Rast, Jim Lynch Staunton, Alix Hennig

Absent: Ron Davis, John Kinnear, Brian Gallant, Vicki Kubik

Meeting started at 11:00 a.m.

Agenda item – Welcome and Round Table introductions

- Round table of introductions.

Agenda item – Who is SLS & What is the Alberta Forest Management Planning Process?

- Matt Denney: Presented introduction to SLS\CFP, planning hierarchy model and FMP process and timelines.
- Bill Skene: Does Spray Lake Sawmills get any more landbase to harvest timber when the tenure was converted to a FMA in the FMU?
- CFP – No it's the same landbase, we just have the responsibility for a Forest Management Plan (FMP).
- Diane Sawley: How does the conversion to a FMA from a quota affect the rights to timber on the landbase (quota holders, other industry etc.)?
- CFP – The Companies' rights are the same except for withdrawal from the landbase, then CFP is entitled to compensation, which is a standardized process.
- Brenda Davison: How many hectares of forest land are removed per year in the C5 area
- CFP – from CFP's it is appx 500-800 ha per year.
- Larry Sears/Diane Sawley: How does the planning process for roads and their reclamation take place (organizational structure). Concern with closing access roads used for fence maintenance and salting.

- CFP – Issue would involve working with the Range Management division of the GoA. CFP is required to reclaim their roads unless we have approval not to.
- Diane Sawley – Grazing land is being lost to tree cover encroachment is there anything that can be done in the FMP to address it?
- CFP – probably not, as those areas are typically unmerchantable/non commercial forest, and are not included in our AAC landbase calculations. We agree, this is a big problem and we discussed this same issue in the B12 FMP. There's all of this open aspen forest that isn't being managed and isn't commercial forest so a forest products company isn't operating in those stands. In C5, there's not even a deciduous (aspen) allocation provided in the Forest Management Agreement. Range improvement is the jurisdiction of the Range Management Division rather than Forestry Division.
- Brenda Davison: When the tenure is converted who is responsible for monitoring the VOITs
- CFP – this becomes a company responsibility and will be apart of future stewardship reporting & FMPs
- Bill Skene: How is the timber supply affected by natural disturbances
- CFP – If the disturbance is over a certain amount (2.5% of the productive forest area) the harvest level must be dropped by the disturbance amount or the company can choose to rerun timber supply analysis to determine the new harvest level.

Agenda item – Public Consultation Program & Public Advisory Terms of Reference

- Jason Mogilefsky: Explained the history of the Forest Service in North America- Its about fire management, protection of air water and wildlife habitat, and the economy that our society needs a sustainable wood supply:
  - There are multiple objectives and it's about making sure forest management doesn't negatively impact the environment. We respect the knowledge the public and stakeholders have and we want to learn what the emerging issues and opportunities are.
  - The public consultation process is meaningful as we want to hear all of the potential issues and we promise to thoughtfully respond to each of them and if the concern is incorporated into the plan we will communicate how.
  - It doesn't mean we will agree on how to deal with all of the concerns; however, we will thoughtfully address the concerns. If there are any concerns, please bring them up at the meetings or directly with us so we have an opportunity to deal with them as early as possible to avoid conflict.
  - We want to build constructive working relationships, whereby we learn of emerging concerns and opportunities early on the planning process looking for potential win/win solutions.
  - FMP development is a slow process, there are three FMP milestones we are consulting on, this is the first item that we need to conclude by January 2023. The VOITs are then computer modelled in a timber supply model that's an iterative approach that takes a year and a half to complete, so the second item to consult on is the draft spatial harvest sequence expected by May 2024. The third item we will be consulting on is the Draft FMP- it should be completed by September 2024.
  - Every dataset, model and outcome is reviewed by GoA before we move to the next step.
  - We ask that meeting notes are not shared outside of the PAC until approved.

- Alix Hennig and others – How can the details of the meetings appropriately be shared with their collective organizations represented in the PAC.
- CFP – Once PAC members have reviewed the meeting notes for accuracy and the final meetings notes are distributed, they will be posted on the company website and then they can be shared.
- Bruce Mowat: Is concerned with the amount (lack) of coordination that could be taking place between CFP, the PAC and between members of the PAC in between meetings and with so few meetings taking place."
- CFP – Lets get through this first meeting to get a feel of the process, the next meeting is set for January, this is a very, very slow process, we have until January 2023 to capture your input, we will go over examples of the VOITs next to get an idea of how they work to drive the plan. Please feel free to contact us anytime outside of the meetings with any questions etc. The VOITs set the targets and are the performance measures of the FMP, so we want to make sure we capture as much as we can and double check the VOITs."
- Diane Sawley: Preliminary meeting times in May and November and May are not great for people in the ranching industry.
- CFP – we need to stick to the identified consultations schedules, if someone cant make a meeting, there's an option to send an alternate. If a meeting is missed that's okay to, as all of the meeting agendas and information will be sent and members can still participate by emailing or calling us to answer any questions.
- David Whitten: Does the PAC accurately portray the public from the area? where are the government representatives?
- CFP: There are two PAC members representing local governments (the MD of Crowsnest Pass (Vicki Kubik) and Ranchland #66 Ron Davis (Alt-Robert Strauss)).
- Alix Hennig: Seems like a disproportionate amount of Ranchers on the PAC (in terms of voting)?
- CFP: We considered that as well, however given cattle grazing is the dominate land use, we felt the representation on the PAC is appropriate.
- PAC discussion that perhaps trappers should be added as a stakeholder on the terms of reference.
- Shannon Frank: it's a bit confusing how the word consensus is used in the terms of reference as compared to how it sounds voting will be done.
- CFP: (Jason) asks the group if 51% is the measure of a consensus without CFP having a vote.
- Shannon Frank: Consensus means everyone agrees rather than a simple majority so if it's a simple majority the ToR should be edited to reflect that.
- Alix Hennig: Is concerned with the proportion of groups represented if voting becomes common practice.
- PAC: Will the SLS staff who are present also be voting?
- CFP: Only PAC members vote and voting is centered around acceptance of the business rules in the PAC terms of reference. We won't be voting on VOITs or anything to do with the FMP. If something comes up where we decide there's a need to change the terms of reference we will be voting to accept the changes.
- Gary Clark – This committee doesn't have power its about participating in the process.
- Larry Sears: Motion to approve the Terms-of-Reference for the Public Advisory Group with the replacement of "consensus" with "simple majority" and changing the phrase "no other personal" to "only PAC" in in decision making section of the document.
    - Seconded- Gary Clark
    - 100% voted in favour to accept the PAC ToR

Agenda item – FMP Milestones and Timelines

- Bill Skene: Is there a possibility to have another PAC or something to review the Annual operations.
- CFP the current purpose of the PAC is for the forest management plan development, there will still be the open house to review the annual operations, operational maps are always up on our website and you can reach out to us anytime in regard to learning more about operations.

Agenda item – Open Discussion-VOITs identifying issues and opportunities

- Jason Mogilefsky - We are hoping to learn what the emerging issues and opportunities are to incorporate early into the planning process to avoid conflicts. Is there anything missing from the VOITs? Please review the VOITs and feel free to provide a written submission. We will be consulting on VOITs through January 2023 and need to finalize VOITs in order to begin running the timber supply model, an iterative process that takes a year and a half to complete.
- VOIT 29: David Whitten: restoration of existing bike trails post-harvest
    - More discussion related to trails
- Brenda Davison: The forest is not supposed to serve only people and if trails are created without approval there should be no effort to re-establish and conserve them post-harvest.
    - What are the controls for limiting the amount of disturbance in the FMA area. How is the SSRP going to affect the amount of disturbance in the area.
    - Jason used VOIT ID 29 to show the starting point for how this can be captured in the VOITs.
    - Discussion around integration with other users and the science to establish acceptable levels of disturbance on the landbase, concerned with the effectiveness of the targets related to grizzly bears.
    - Jason used VOIT 4 as an example that addresses forestry road footprint and VOIT 14 addressing threatened species habitat.
- Alix Hennig: There was a proposal by the government to increase the amount of linear disturbance in the porcupine hills, pointed out that the government can change their targets but this group cannot.
- Annette Mahieux-Bone asked if there could be an option to have the meetings available on zoom.
- CFP at this point the plan is to hold in person meetings.

Meeting wrap up – Anticipate the next meeting will be some time in the January 2023

Adjourn: 2:07 pm

Spray Lake Sawmills

Crowsnest Forest Products
Public Advisory Committee
Kanata (Blairmore)
January 25th, 2023 Meeting Notes

Present: Brian Gallant**,** John Kinnear**,** Larry Sears, Ron Davis, Shannon Frank, Glen Girhiny (for Vicki Kubik), Gary Clark, Alix Hennig, Jim Lynch Staunton, Annette Mahieux-Bone, Dianne Sawley, Don Scott, Duncan Abercombi, Matt Denney (SLS), Jake Guay (SLS), Jason Mogilefsky (SLS), Cade Nixdord (SLS) Michael Wagner (GoA)

Absent: Brenda Davidson, Bruce Mowat, David Whitten, Kyle Rast

Meeting started at 11:00 a.m.

Agenda item – Welcome and Round Table introductions

- Round table of introductions.

Review of last meeting

- Review of forest management planning process and the consultation timelines
- Purpose of the Public Advisory Committee (PAC), intent of the PAC
- Brief overview of the ongoing Public Consultation Program
    - Public Advisory Committee
    - Public Consultation
- PAC member brought forward a map of cross-country ski trails and multi purpose trails in the Allison/Chinook area they are concerned with.
- CFP will connect with the PAC member to capture the information.
- PAC: noted that the trails are formally recognized by the Province.
- PAC: How do harvesting activities affect motorized recreation and access within the PLUZ
- CFP: explained that access issues are dealt with during operational planning as per the Timber Harvesting Planning and Operating Ground Rules (OGR's). Designated roads/trails are protected, and temporary forestry access controls are implemented. Forestry roads are required to be fully reclaimed within 3 years.

- PAC (new member) – question about what a VOIT is and the timelines associated with the VOITS, and what can be included in the VOITS.
- CFP: Explained what VOITs are and initiated a VOITs discussion as per the agenda.

Agenda item – VOITs identifying potential issues and opportunities

- CFP distributed a handout with the current wording of the VOITs and started discussion around the current state of the VOITs.
- PAC: How is the Linear disturbance on the landscape and its associated limits determined?
- CFP: By the existing linear disturbances along with the sub regional plans that address linear footprint for the area.
- PAC – Looking for a value that explicitly takes into account the integration with other users – specifically as it relates to grazing and their tenure rights on the landbase. Within their range management plan, they are guaranteed a certain amount of AUM in their disposition.
- PAC: Expressed concern that the VOITS on this table should represent the values of the other users on the landbase.
- CFP: There is an opportunity to add to the VOITs and CFP is willing to work with parties to address their concerns.
- PAC: Tourism operators are rarely recognized as an actual land use and is not given any credit for those trails and developments they make.
- PAC: Would it be possible to buffer water springs in the management plan? Is it properly captured in VOIT #26 (Effective riparian habitats)?
- GoA: The goal is to identify collectively values that can be measured and implemented on a broad scale. Discussed how VOITs are strategic values and not tactical decision, tactical items are better handled by the Operating Ground Rules (OGRs).
- PAC: How are the effects of harvesting monitored? Expressed concerns specifically about their area-of-interest and how this spring, when things start to melt, deleterious material will start to move down.
- GoA: There are regulations in place and lots of legislation to deal with deleterious material (both organic and inorganic). Part of the GoA program is to inspect CFPs operations for these sort of things.
- PAC: Concerned about how streams are assessed and if they are done at the correct time of year.
- CFP: clarified how streams are assessed and that classification is based on wetted width and not the amount of water present.
- GoA described the intent of the best management practices and how they are developed to mitigate possible impacts of harvesting operations and the intent is that through following and implementing the best management practices further monitoring is not a responsibility of the tenure holder.
- PAC: Water quality is not specifically a VOIT?
- GoA: Water quantity is addressed through 3 different VOITs, specifically around effective riparian habitat and then through water quantity and with riparian management.
- PAC: Looking to add some content to the VOITs or the Plan around the Grazing Timber Agreement (GTA) process but recognizes that a lot of a GTA is the responsibility of the Range Management division of the GoA.

Agenda item – FMP Progress Report

- CFP provided an updated GANTT chart to the group and describe the current stage of the Forest Management Plan.
- PAC: How do smaller forestry firms fit into this landbase

- CFP: CFP is required to work with the smaller firms to identify where they will be harvesting in the future, to the amount required in their tenure. This is also the case with the Community Timber Program (CTP). However we are not responsible for the firms.
- PAC: Would like to understand if there can be an indicator for the success or failure of things that are mentioned in the creation of GTAs.
- PAC: Relating to trapping, there is a lot of data collected.
- CFP: The current species listed in the VOITs relate to a keystone/indicator species approach for modeling habitat and monitoring forestry.
- PAC: Discussion on current forest health risks and how it might be interesting to have a Forest Health office present to the group.

Agenda item – FMP Watershed Management – Mike Wagner Alberta Forestry

- Michael Wagner started his presentation discussing how forest are managed in Alberta, where the VOITs come from.
- PAC: There's no mention of grasslands in the VOITs
- GoA: This somewhat relates to a scope of control for forest management. Grassland tie to a bunch of different values. Typically, forestry focus on forest stand vegetation management and their change through time.
- GoA continued to present on Forests and watersheds and how forest management and silviculture (the practice of growing trees) is applied. Roads are part of forest management so that is also a large focus area.
- Described the different processed for water movement.
- Reviewed what the scope of the forest management plan is and what are the Timber Harvest Planning and Operating Ground Rules (OGRs) and how Alberta manages their processes.
- PAC: Concerned about how invasive species are addressed.
- GoA: There are specific guidelines and legislation for invasive species. GoA does monitor for this and requires specific measures by the company. Detection can require a work plan.
- GoA continued presentation to review what a forest management plan is and how watershed management is addressed. Discussed how water quantity, quality and healthy riparian habitat are all components of the forest management plan. Wildfire values, and the impact of catastrophic wildfire on drinking water and other values are also items the GoA manages for.

Meeting adjourned at 2 p.m. Anticipate the next meeting will be some time in the May of 2023.

Spray Lake Sawmills

Crowsnest Forest Products
Public Advisory Committee
Kanata (Blairmore)
May 30th, 2023, Meeting Notes

Present: Alix Hennig, Dave Whitten, Brenda Davidson, Shannon Frank, Annett Mahieux-Bone, Dianne Sawley, Larry Sears, Duncan Abercombie, Kate Hamilton, Brian Gallant, Vicki Kubik, Jim Lynch Staunton, Bruce Mowat, Cade Nixdorf (SLS), Jason Mogilefsky (SLS), Errol Kutcher (SLS), Matt Denney (SLS)

Absent: Gary Clark, Kyle Rast, Ron Davis

Meeting started at 11:00 a.m.

Agenda item – Welcome and Round Table introductions

- Round table of introductions.

VOIT identification potential issues and opportunities

- Crowsnest Forest Products (CFP) is still working on the VOITs (Values Objectives, Indicators and Targets). CFP anticipated turning in the VOITs to the GoA in the Spring of this year, however the GoA is looking at adding additional items that are related to the South Saskatchewan Regional Plan and the Livingston Porcupine Hills Land Footprint Management Plan and as a result CFP is still working on the VOITs. Anticipate turning the VOITs in in the fall of 2023. VOITs are one of the building blocks of the FMP and provide a means of balancing values. They were not developed by the company, or the Government of Alberta, but rather come from the Canadian Council of Forest Ministers and are largely present across most Provinces in Canada.
- Anticipate having another meeting with the group in November. VOITs will be shared with the group.
- As requested by the PAC, forest health and fire management experts were invited to the meeting, but because of the Provincial election, a representative was not able to attend.
- PAC – Question about how consultation with the First Nations and Metis is proceeding?
- CFP – It is moving along well as a parallel process.
- PAC – How important is the formatting for the VOITs when providing input?
- CFP – Format is not that important. Finding the correct scope is more important.
- PAC – Interested to see what other have put in.
- CFP – The intent is not to openly share what others have provided, but PAC members are able to email or communicate with other members freely.
- PAC – Wondered if there is any water testing happening in the Forest?

- PAC – Addressed the question with current activities and efforts for monitoring.
- PAC – Interested in how water values are managed within Forest Management Area
- CFP – Described the ECA process that is used in the management plan, as well as the buffers and setbacks that are required for creeks/other water bodies, as well as best management practices.

FMP Update

- CFP described the current efforts for the forest management plan (FMP). The Company is working on the technical items which will then be submitted to the GoA for agreement at the end of September of this year, that is the inventory and the yield curves. Initially we were working on the forest inventory and now are focusing a lot of effort on how the forest grows (yield curves). This area has a lot of historic forestry by different companies, so the company is reviewing how some of those older stands are growing.
- PAC – interested in the Local Timber Permit/ Community Timber Program (LTP/CTP).
- CFP – The areas of the CTP will be selected within the CTP and provided to the Government of implementation of the program.
- PAC – interested in seeing some Douglas Fir as part of the CTP.
- PAC –Forest Encroachment in to range and historic tree line levels.
- PAC – Has the company reviewed carbon credits at all, could provide a business opportunity?
- CFP – SLS/CFP is more looking at carbon to understand the carbon balance of the forest and operations.
- PAC – Could there be an alternative method for a fire break where grazing is shifted to specific areas & forestry converts some rangeland?
- PAC – Addressed the question. Current management focus is on keeping land use the same.

Agenda item – General discussion

- PAC requested a guest speaker for the group. Did not specify a topic.

Meeting adjourned around 1.30 p.m. Anticipate the next meeting will be some time in the November of 2023.

Spray Lake Sawmills

Crowsnest Forest Products
Public Advisory Committee
Kanata Inn (Blairmore)
November 30th, 2023 Meeting Notes

Present: Alix Hennig, Brenda Davidson, Shannon Frank, Annett Mahieux-Bone, Wade Aebli, Dianne Sawley, Larry Sears, Duncan Abercombie, Gary Clark, Jason Mogilefsky (SLS), Errol Kutcher (SLS), Matt Denney (SLS)

Absent: Kyle Rast, Ron Davis, Dave Whitten, Kate Hamilton, Kelly McDonald, Brian Gallant, Vicki Kubik, Jim Lynch Staunton, Bruce Mowat

Meeting started at 11:00 a.m.

Welcome

- CFP provided an update on the change of ownership for the company, indicating that Spray Lake Sawmills/Crowsnest Forest Products is now owned by West Fraser. The Company is excited to be part of West Fraser and are not anticipating any changes to the committee or the FMP development timelines.
- There was a planning development team meeting last week and we are close to wrapping up the draft VOITs. As emailed to the PAC yesterday, the draft VOITS are just about completed and haven't changed much since our last review. The updates to the VOITs have been to align the wording with the SSRP and the LFMP.
- The plan for the meeting is to provide a brief FMP update, review timelines, and to focus the majority of the meeting on capturing draft VOIT input.
- Next steps are to review the PACs VOIT input and finalize the draft VOITS and begin developing the spatial harvest sequence. We will review the draft spatial harvest sequence at our next meeting, May of 2024.

Round Table introductions

- Participants engaged in a round table of introductions.

FMP Update

- CFP described the current efforts for the forest management plan (FMP). The company has submitted key building blocks for the plan. This includes the landbase (inventory) and yield curves (growth tables) to the GoA at the end of September. The company was hoping for feedback by Nov 15, but the GoA is still reviewing the items. The company is looking for agreement-in-principal to ensure the plan is on track. The next step is to start building the draft SHS scenarios finding the one that best balances the VOITs. The various SHS scenarios will have associated VOIT outputs that can be compared. The objective is finding the SHS that best balances sometimes competing objectives.

VOITs

- The VOITs are still in draft form and the Company is still looking for input and working with GoA to obtain agreement in principal. The latest draft version was provided to the group, but it is still not a public document.
- PAC – Discussion on grizzly bear and how historic range has significantly been reduced. Was 2000 kms now down to only 20 kms. Same is true for elk & wolves. Apex predators and indicator species should be studied. If the Apex species are present- all of the other species will be intact. There is a challenge of trade-offs when working with everything from; forestry, mining, recreation, ranching, hunting all share the same area. WWF study showed a historic 70% decline in most species compared to the preindustrial condition. The point is that the activities on the Livingstone area should be well thought out as it is the last refuge for wildlife.
- PAC – Will the acquisition result in a change to harvesting practices, specifically stumpside processing
- CFP – It may, if a suitable alternative prescription can be generated. Stumpside processing helps retain moisture and protect seedlings from desiccating winds. North and east slopes probably don't need as much slash as moisture is less limiting on the spruce sites. In some places, there may be too much debris.
- PAC – Ranchers are supportive of alternative prescription to try and reduce some of the slash in the harvest areas and are in favor of not leaving slash on spruce sites.
- PAC – Support the creation of small mammal habitat by using within block brush piling to the extent that is it not a fire hazard. The piles make great hotels for small mammals.
- PAC- Cut to length gives more options rather than treating every sites the same.
- PAC-Do practices change because of drought conditions?
- CFP- Yes when conditions are very dry and fire hazard goes up we operate at night and at times there are forest closures.

Forest Encroachment

- CFP- Aspen encroachment is a problem and slash is a problem for grazing.
- CFP – The company's plan for addressing encroachment is to establish a baseline of grasslands, using the AVI info collected for the FMP and that the company will not be implementing afforestation on grasslands. The challenge really is the deciduous as there is so much of it out there that is dead and dying and no market to warrant commercial harvest.
- CFP – Weve heard from ranchers and biologist in terms of encroachment on our B12 plan and the biggest challenge was that aspen forests are not being renewed and as a result, there's habitat and range loss. If there was a biofuels or gasification plant or some other financial incentives to remove deciduous that would make it more feasible to manage deciduous.
- PAC – Concerned about the loss of grass in old stands and they are converted to regenerating stands. In some, the tree densities are too thick.
- PAC – Also concerned about deciduous encroachment. Some estimate this as high as 5% loss per year in grasslands when comparing todays landscape to the 1920 photos.
- PAC - B.C. land management handbook includes details on climate change. Will this be included in the FMP or how is it being managed on the landscape.

- CFP – there are a number of progeny sites that are assessing how trees grow and survival over time, but the data will not be used for the timber supply model. The growth data for the timber supply model comes from updated tree measurements across the forest.
- PAC- we did a prescribed burn project near Lyndon creek southwest of Claresholm that showed some promise but more burning was needed along with water and fencing for cattle. There needed to do a third burn. Need to have the area set up with water and fencing to have grazing pressure to keep the aspen young and browsed down.
- PAC-Aspen coming back in is then tender and breaks off in your hand and is good forage.
- PAC-Managing aspen encroachment overtime mechanically or with prescribed fire is too expensive. Spraying and grazing is likely the way to keep it managed.
- PAC – Not may controlled burns have happened as often when the conditions are right to burn, the crews are staged in case an uncontrolled fire starts somewhere else.
- PAC – is there potentially open funds available for FRIAA that could be use in a aspen ecosystem restoration project?
- CFP – Agreed there's potential for sure, to look at a ecosystem restoration/agro forestry project focusing on aspen encroachment and moving that forest type towards an open conifer savanna forest type that would benefit grazing and wildlife.
- PAC – Agreed a pilot project dealing with how to manage for aspen encroachment on the landbase while taking into consideration environmental and ecological requirement the trees provide is a worthwhile joint project.
- PAC- Young aspen is preferred by Moose, would we leave some of the aspen?
- CFP – yes, wouldn't want to try and do a total removal.

Invasive Plants

- PAC- Any disturbance spreads weeds, out of province quads on trails and staging areas is where you see the worst of it.
- PAC-Not an easy issue when it comes to invasive weeds.
- PAC- what comes in first after logging?
- PAC- Fireweed, than natural forbs and shrubs, then grass and trees.
- PAC – recognized the current rules that are in place for the company such as washing equipment between moves to prevent spread of weeds.
- PAC – big problem seems to be with thistle & how with any disturbance, including mole hills, the plant establishes. Another problem unfortunately is timothy as it out compete native grasses but has no nutrients as forage. If it can be grazed early in the season it can be knocked back a bit.
- PAC – scarification can lead to issues. Hawkweed, blue weed are issues. Birds and deer spread the plants. Purple bells are an issue but not frequent in the forest reserve.
- PAC – Thistle can have a benefit to soil. Reduce compaction and may have a limited lifespan.
- CFP – we currently participate with Ranchland county (there was an industrial cooperative program) where we identify sites of noxious weeds and they chemically treat the weeds. Theres a meeting scheduled with the manager of the program next week to review our role in the program.
- PAC –Theres challenges with seed mixes & finding native seed mixes not having timothy or smooth brome. Seed mixes need to be weed free certified.

- PAC - Rough fescue is the important plant that the community wants to see on the landscape. Often establishment is done with plugs.
- PAC – Castle Crown Wilderness coalition has hired students to action weed problems, both in the parks & the forest reserve that coordinate a weed pull. Maybe they can coordinate with ranchers.
- PAC- on lease land, it's the ranchers responsibility to complete weed control. Theres about 15 years of grazing inventories and range health information on the grazing lands.
- Currently CFP is spending $25k per year on chemical to control weeds with Ranchland County PAC – range health assessments could be used to identify where weed problems exist.

Recreation

- PAC- There was a RAG headed up by Jason Nixon, was on the committee, we never heard the outcome of that work.
- PAC- That's right there was the Livingstone Porcupine Hills Footprint Management Plan- to do with trail density, a rec management plan, and a PLUs plan.
- PAC – concern about the cross-country ski trails around the Chinook/Allision PRA that leave the PRA boundary.
- CFP- Current VOIT focus on trails identified through the trails act and the ministerial order that identify the trails.
- PAC- Nordic Club has worked hard on the trails we have and we want them left intact. The PRA is the campground and not all of the trails are in the PRA.
- CFP-Our maps show the Nordic ski trails are primarily within the PRA. Not planning to harvest within the PRA.
- PAC- Nordic club sent maps and information on the trails of concern. The trails are sanctioned and some are multi-purpose trails.
- CFP – We do have the spatial location of the trails in question and can see if any of the stands will be sequenced in the 10/20-year spatial harvest sequence and see if there will be any overlap.
- PAC – Concern about non mapped disposition holder trails that are for use when operating.
- PAC – Previous experience had been to work with the GoA and the company to identify these trails and protect them from harvesting operations. Normally happens through the GTA process or consultation ahead of harvesting.
- PAC- Sent a letter from the minister to CFP indicating other tenure holders need to have historical access kept on the landscape and not reclaimed.
- PAC- Sometimes cutlines are used by CFP and are used by tenure holders for access. These should not be reclaimed.
- PAC- What do you do with non-designated trails? Do you use those? Seems like there are recreational trails all over.
- CFP –Theres a cap on how many roads can be kept open as per the LFMP.

Meeting adjourned around 2.20 p.m. Anticipate the next meeting will be sometime in May of 2024.

Spray Lake Sawmills

Crowsnest Forest Products
Public Advisory Committee
Kanata Inn (Blairmore)
May 15th, 2024 Meeting Notes

Present: Alix Hennig, Brenda Davidson, Rick Cooke, Annett Mahieux-Bone, Vicki Kubik, Ron Davis, Bruce Mowat, Duncan Abercombie, Gary Clark, Brian Gallant, David Whitten, Tim Juhlin, Jim Lynch Staunton, Kate Hamilton, Jason Mogilefsky (WF), Errol Kutcher (WF), Matt Denney (WF), Cade Nixdorf (WF), Tyler Steneker (WF) and Kirk Hawthorn (GoA)

Absent: Kyle Rast, Larry Sears, Dianne Sawley

Meeting started at 11:00 a.m.

Welcome

- CFP provided an update and overview of the FMP timelines and intentions of sharing draft plans for input and to identify issues prior to plan finalization. Plan is a bit behind but gaining momentum and the timelines associated with plan milestones are achievable. Focus of the FMP development is on alignment with the South Saskatchewan Plan and the associated subregional plans. The focus is on protection of communities from wildfire and watershed protection while ensuring all of the other resource values including grazing, bio-diversity and recreation are protected.
- CFP presented a timber supply presentation including the steps taken to arrive at a preliminary draft spatial harvest sequence that meets the VOIT performance measures.
  CFP invited the PAC to review the SHS to get their initial opinion.
- Next steps, June of 2024, is the draft spatial harvest sequence public review and comment period. CFP will be sending a website link with the draft SHS. Our next meeting will be in the Fall of 2024.

Round Table introductions

- Participants engaged in a round table of introductions.

FMP Update

- CFP has been working on timber supply modelling to meet the performance metrics identified in the VOITs and has arrived at a preliminary spatial harvest sequence that was shared with the PAC. CFP presented a slide deck highlighting the steps required to develop the preliminary draft SHS including precautionary modelling requirements including but not limited to:
    - Watershed assessments

- Sustainable timber harvest
- Maintenance of old growth habitat & seral stage levels
- Wildfire management planning priorities
- Structure retention
- Identified indicator animal species

- PAC- Is the Company planning on harvesting deciduous? CFP- the company doesn't have the rights to deciduous other than harvesting incidental deciduous. GoA - Deciduous is being modelled in the TSA to quantify the growing stock; track and charge tenure holders for dues; and to monitor deciduous growth compared to the incidental harvest.
- PAC- In a mixed stand, does the company avoid deciduous? CFP-yes except for some incidental harvesting.
- Any idea what the future watercourse buffers will be? GoA- the science suggests that the current stream buffers are working to protect watersheds in terms of measured water quality attributes such as temperature, turbidity, oxygen levels etc. Variable width buffers may be something that is used in the future. The FMP's are completed every 10 years, so if there are changes to buffer widths, the changes would be reflected in future FMP's.
- PAC-Are pine beetle infestations or forest health issues anticipated in the model? GoA- The science suggests, old contiguous patches are considered to be higher risk so by proxy these stands are given a Mountain Pine Beetle risk rating and then the FMP reporting will indicate how the SHS has reduced Mountain Pine Beetle risk. Forest management strives to create a diverse forested landscape with different age classes helping with forest health resiliency.
- PAC- Are coal mines accounted for? GoA- if a coal mine was approved there would be changes to the size of the forest tenure, rather than the FMP. PAC-what percent of the FMA could be impacted by Coal mines? CFP that would depend on the particular mine, however, most of the mining proposals suggest the mines would be operating above tree line so maybe not having a huge impact.
- PAC-the Nordic Club has received substantial provincial grants for trail building enhancements with more on the horizon, doesn't make sense that the government would then have the forestry companies log the enhancements? CFP- we need to find a balance of targeting the high fire risk areas while protecting the trail networks. The forest tenure holders are required to integrate operations to work with recreation so trails will be protected.
- PAC- Concerns within the MD of Crowsnest Pass with uncontrolled access to the backcountry. Theres significant issues with dumping sewage and random camping and squatting in the back country. People are living in tree forts they have accessed from mining exploration roads. Theres not enough law enforcement or conservation officers to keep up with the issues. Need to make sure all access roads are closed. CFP- access roads built are temporary and kept closed with locked gates. The temporary roads are fully reclaimed and recontoured within 3 years.
- PAC- why not plant threatened whitebark pine and limber pine to make the world a better place? CFP- we are protecting and avoiding limber and whitebark pine. Typically these species are growing higher in elevation than where we operate however limber pine is naturally regenerating in some of our cutblocks with the help of the Clarks Nutcracker. The company also works with external groups to support whitebark pine protection and enhancement, such as the Whitebark Pine Ecosystem Foundation of Canada.
- PAC-In addition to old pine stands, poplars are important for pine marten.

- PAC-What about Bull trout and Westslope Cutthroat Trout? CFP, we follow the recovery plans, in addition to a strategy for protection of the cold water fish, there will likely be a cold-water fish VOIT in the FMP.
- PAC- who is monitoring the fish populations? CFP- GoA monitors fish and wildlife populations, the FMP models forest growth and associated indicator wildlife habitat.
- PAC- What about water quality? GoA- That's within scope for the government not the companies. Forestry is conservative with planning and operations. This results in not allowing forestry operations to change water flows, chemistry, temperature or sediment delivery. Regulations and enforcement are ensuring bared areas are minimized and that sediment is not being delivered to water courses. When sediment does reach a water course, the regulatory measures kick in. Because of the precautionary approach with operations involves avoidance of water, the discussion is around what are the upslope impacts, not with the water below. The expectation is, there is no impact to water as from a regulatory perspective there isn't much opportunity for sediment to make it to a stream. As soon as sediment reaches a stream, it's an enforcement issue. Typically, when sediment does enter a stream the instances are negligible because of all of the regulatory requirements in place.
- PAC- What are the alarms that set off that sediment is being delivered to a stream? GoA- Sites are regularly inspected by GoA and high risk sites based on physiographic and climate attributes are prioritized. Industry is also required to self-report.
- PAC-There's lots of culvert reparations going on, there needs to be controls in place. CFP: Only open bottom structures and bridges are used to cross watercourses.
- PAC-Seems like industry has too much control, how do we know what's actually going on? GoA: When issues come up, the Company can be shut down and ordered to repair damage. We're not seeing big, long term issues. Zero sediment delivery is the expectation and the foresters out there are licensed with professional designations and are required to follow the regulations.
- PAC-The Oldman River is very low and is a muddy mess with sediment which is a big problem for fish.
- PAC- Forestry changes the dynamics of fish habitat, will there be a change to the harvest levels based on drought? CFP- the plan would be the same for drought conditions.
- PAC-What are the economic benefits of the Forest Industry to the people living in Crowsnest Pass? CFP- we can look into the specifics and get back with you.
- Did some checking into the economic benefits of the forest industry, specific to Pincher Creek and the MD of Crowsnest Pass. Here's what we learned:
    - Theres approximately 50 folks employed in the forest industry
        - $4.5 million in labour income
        - $8.4 million in economic output (so another, 50 jobs at the Alberta average wage of $77,000)
    - For the broader Lethbridge-Medicine Hat Economic Region (includes the MD Crowsnest Pass), forestry created:
        - 1,989 jobs
        - $148.8 million in labour income
        - $593M in economic output
    - The broader region information is contained in the AFPA *Economic Impact Report*.
- PAC- Is there a program to fund grants for the local community? PAC- yes there have been donations for lumber and cash for various community groups including the library, trail benches, fish and game club, and lumber donations for trail improvement projects.

VOITs

- CFP-Theres a few outstanding VOITs we've been busy working through.
- CFP-Discussed its draft invasive plant strategy that hasn't been submitted to GoA yet and includes:
    - Enhancements to support the MD Ranchlands invasive plants program
    - Data share with MD Ranchlands
    - Enhanced contractor training and incentives to report invasive plants
- CFP-Forest Encroachment, discussed a GoA forest encroachment document and model that was developed to help the PDT address encroachment concerns & areas. It provides a rough guide and CFP is working through the methodology and drilling down further to locate stands it can target for harvest to help with restoring grassland transitional areas. There are some details to work out as when we have done this in the past, the area restored was removed from the company's active landbase, which is something we want to avoid in the future. We also want to identify and get credit for the areas in cutblocks that provide grassland attributes and significant grazing/browsing opportunities for cattle, moose, deer and elk. We are trying to find the areas & strategy that creates a 'win-win' situation on the landbase.
- PAC- Aspen encroachment is the biggest problem for grazing; can't something be done about that? GoA- CFP doesn't have harvesting right for deciduous, however coniferous encroachment is an issue as well and the company has the rights to operate within coniferous stands.
- PAC – The pine encroachment is a big problem as well. Some areas of the alpine are too thick with trees, changing where forage is available. Additionally, need to recognize the young forest and the value it brings to rangelands. In the areas we are grazing in (north of Blairmore and in Dutch Creek) about 30% of the areas we are grazing in are cutblocks so we need the cutblocks for grazing.

Meeting adjourned around 2.30 p.m. The next meeting will be in the Fall of 2024.

Spray Lake Sawmills

Crowsnest Forest Products
Public Advisory Committee Kanata Inn
(Blairmore)
Dec 5th, 2024 Meeting Notes

Present: Dianne Sawley,"Alix Hennig, Brenda Davidson, Rick Cooke, Annett MahieuxBone, Vicki Kubik, Ron Davis, Bruce Mowat, Gary Clark, Brian Gallant, David Whitten, Tim Juhlin, Jim Lynch Staunton, Jason Mogilefsky (WF), Matt Denney (WF), Cade Nixdorf (WF), Mercer Bahrey (WF) and Taylor Andersen (GoA)

Absent: Kyle Rast, Larry Sears, Duncan Abercombie, Kate Hamilton

Meeting started at 10:00 a.m.

- Round Table introductions-participants engaged in a round table of introductions.
- Opened meeting with discussion that the FMP is to be a balanced and sustainable approach to forest management. The technical process is driven by the SSRP and Livingstone-Porcupine Hills land Footprint Management Plan. It's as detailed and slow process to ensure the Forest Management Planning Standards are followed, and that specific regional and subregional plan requirements are incorporated into the analysis and reporting.
- CFP is looking for the PAC's opinion and to provide input to help with avoiding conflicts with other forest users. What does the PAC think of the latest draft of the VOITs and the SHS? We would like to hear back from the PAC in the next week with any comments to help with the roll out of the draft SHS and VOITs for public review and feel free to provide comments at any time throughout the process on any parts of the FMP.

  CFP provided an update on the project and how we intended to have a meeting in the fall, but were delayed with challenges related to: ○ Establishment of natural range of variability old growth targets Forest encroachment SHS targets ○ Stand retention targets
- CFP emailed SHS maps, VOIT tables and VQ maps ahead of the meeting and provided printed spatial harvest sequence and visual quality maps for comments and copies of the latest VOITs at the meeting.
- CFP discussed status of the VOITs and how the targets have been populated based on the draft spatial harvest sequence provided. Discussed the visual quality inventory and associated rankings. This is a more refined inventory compared to the previous plan.
- PAC asked about ECA (equivalent clearcut area) and CFP explained that maintaining water quality and water yield have been identified as VOIT values. GoA has mapped micro watersheds and the ECA analysis constrains the number of hectares harvested such that the risk of localized flooding has been addressed. As canopy coverage is removed from snow dominated watersheds less snow

sublimates from the canopy (loss of canopy storage) and the snow accumulates on the ground. This can change the timing and intensity of snowmelt runoff potentially increasing water yield.

- CFP Highwood Bridge update, been working with DFO and will be replacing the existing bridge with a larger bridge. The company is working closely with DFO on all watercourse crossings to ensure compliance with DFO permitting process.
- CFP has hired a fish biologist which is helping the Division with DFO authorizations and crossing BMP's.
- CFP has updated its watercourse crossing procedures.
- PAC asked about West Bragg Creek and the forestry proposal potentially impacting trail users. CFP indicated there has been ongoing work with the trail user groups and an updated plan is available on our website at https://www.westfraser.com/sustainability/forest-management/public-involvement/westfraser-cochrane
- PAC encroachment has become a significant issue where big game animals are heading east to find more grass on private land.
- CFP Encroachment isn't just a grazing issue it's a biodiversity issue that's impacting native grassland species.
- PAC invasive plants are a big issue; we are seeing weeds come into the grasslands from public roads that are being graveled. In Pincher Creek there may be weed seed coming from rock pits that may not be certified. Certified pits are required for use in the MD of Pincher Creek and Ranchlands.
- CFP there's been some developments with respect to range management with an updated invasive plant VOIT that requires contractor equipment storage yards have weed control, additional MD support for managing weeds on the forest (inspections), incentives for contractors to report weeds and additional education as to identification of invasive plants like Blue Weed and a forest encroachment VOIT. Continued avoidance strategy of native grasslands
- CFP met with a local rancher in jumpingpound to review and get feedback on new site preparation options including mounding, screefing, ripping and dragging. Hoping to attend the forest grazing association annual meeting to discuss silviculture strategies.
- PAC General discussion around the natural history of the region and the effects of approximately 100 years of fire suppression has had on the landscape. The PAC indicated Dr. Dave Sauchyn has done some excellent research using tree rings to understand historic drought cycles and that John Pomeroy has also completed some excellent research for the Bow River Basin and the risks associated with having the majority of the headwaters within a protected area. If the Calgary Herald article discussing this specific research is available, it should be forwarded out to the PAC for reference.
- CFP Discussed the company's change in silviculture process by transitioning from stumpside to roadside processing. Slash will now be piled and burned as opposed to left in the blocks.
- PAC raised concerns about the condition of the first 2 km of the Atlas Road and the idea of moving the disposition to be a regularly maintained government of Alberta recreational road as it's a primary access route to a backcountry staging area. The Pass community is looking for government financial support to maintain the 2 kms of road as it's a popular recreation area and the provincial government is promoting tourism.

- This was followed by a general discussion around roads and access management and how for some users, leaving roads on the landscape is valuable. Other areas within the Pass that are near towns are being abused by the public and need closed and patrolled.
- PAC discussed the review process for the SSRP & how the plan can be too broad some time, describing what various users want to hear, but not identifying where this will happen.
- PAC completed a drive on the trunk road and many of the areas there's nothing coming back.
- PAC, CFP is doing too good of a job reforesting sites and there's too much regrowth.
- CFP Is not perfect and we are still learning on how best to regenerate the forest to get the best growth survival and growth possible. Now that we are West Fraser, we have additional support and knowledge to leverage from and are looking forward to increasing seedling survival and growth.
- PAC-Would like to see the current cutblocks on the map along with the planned SHS.
- Next steps, CFP will be compiling the draft FMP and will be sending a draft in the winter/spring 2025. At that point, there will be another meeting and an open house scheduled to review and discuss the draft FMP and to provide input.

Meeting adjourned around 1:00 p.m.

FORCORP - Project Number: P877

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FINAL DRAFT

Chapter 3 – Forest Landscape Assessment

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	**3**	**Forest Landscape Assessment**
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	II	Communication Plan
	Annex	III	Stewardship Report (2010-2015)
	Annex	IV	Yield Curve Development
	Annex	V	Net Landbase Development
Three	Annex	VI	TSA – Timber Supply Analysis
	Annex	VII	SHS – Spatial Harvest Sequence
	Annex	VIII	Growth and Yield Plan

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1 Introduction

This chapter describes the landscape of the Crowsnest Forest Products Ltd. (a subsidiary of Spray Lake Sawmills (1980) Ltd.) Defined Forest Area (DFA). It assesses the current administrative, physical, climatic, ecological, and sociological characteristics of the area. This chapter is laid out in a similar format to the Regional Forest Landscape Assessment of the South Saskatchewan Region (Forcorp Solutions Inc., 2012) to aid with comparisons to regional land-use planning and other forest management plans.

The sources of data are referenced with the use of end notes. The full list of datasets is shown in Section 8, and data source references in the document are identified using the format (1) where the number indicates the numerical reference of the dataset. Maps within this chapter display each metric at a broad scale and are not intended for operational use.

Area calculations in this chapter were done using the NAD83 UTM Zone 11 projection and may not agree with other published information within or outside of this report. The presentation of area estimates to the nearest hectare and percentage estimates to the nearest percentile may result in the tabulated sums of some tables appearing to total incorrectly; however, this is simply due to rounding. The effective date of this analysis is the same as the effective date of the classified landbase, May 1, 2023.

2 Administrative Boundaries

2.1 Defined Forest Area

The Defined Forest Area (DFA) is located in southwestern Alberta and covers 350,348 hectares, representing the full landbase extent for the FMP. The DFA is formed by the boundary of Forest Management Unit C5 (Figure 2-1).

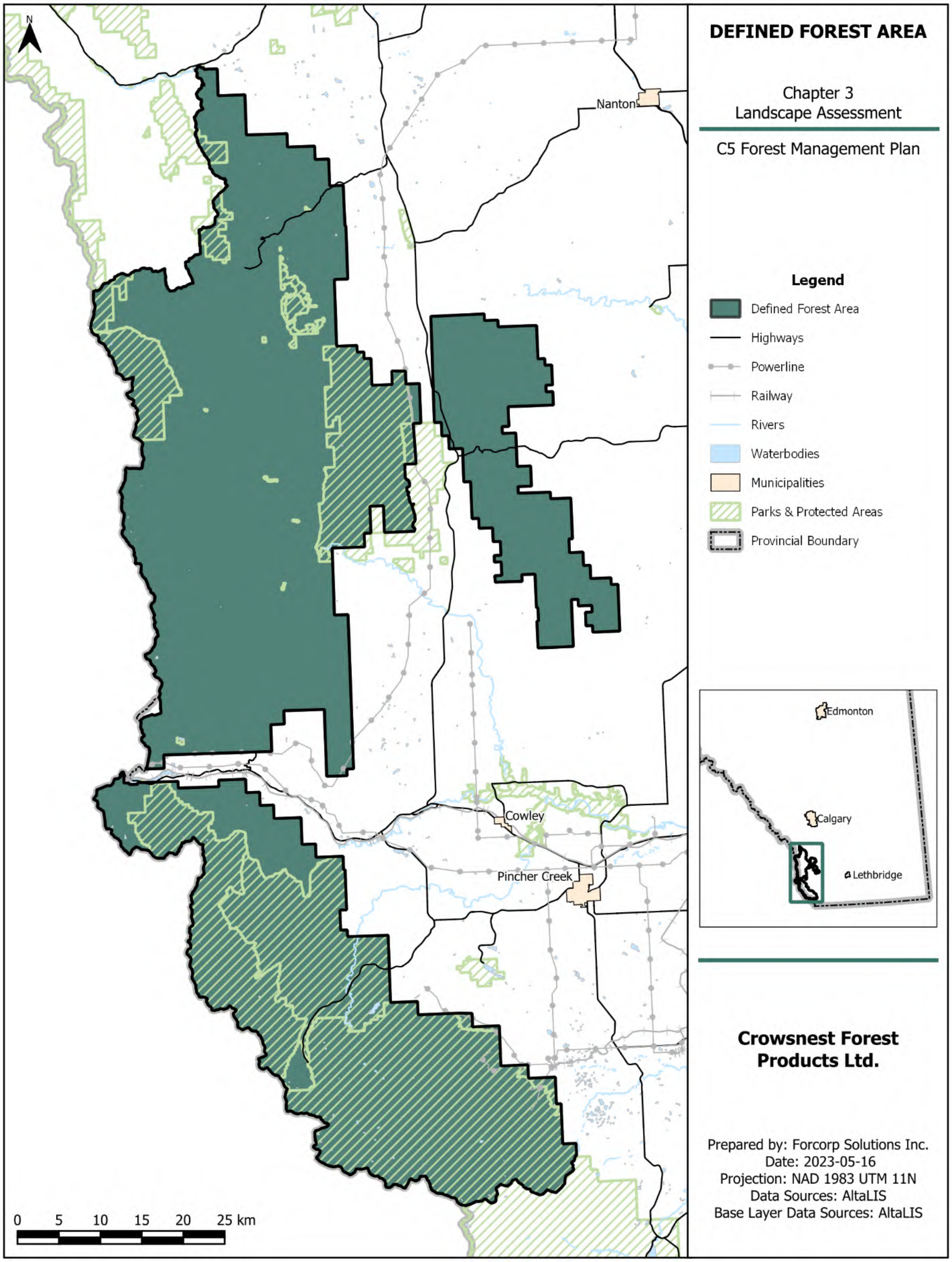

Figure 2-1. Defined Forest Area (DFA) boundary for the Crowsnest Forest Products Ltd. Defined Forest Area.

2.2 Green/White Areas

The province of Alberta is divided into two areas for land use decision making [1]. The white area consists primarily of private land, often related to agricultural use. The green area, also referred to as Crown land, is managed for natural resource development, recreation, and conservation. Federal lands are excluded from these two areas, which includes national parks and military areas. The DFA is exclusively located in the green area of the province, though much of the eastern side of the DFA borders the white area (Figure 2-2). Discussion on the Rocky Mountain Forest Reserve and Range Allotments is included in Section 5.11.

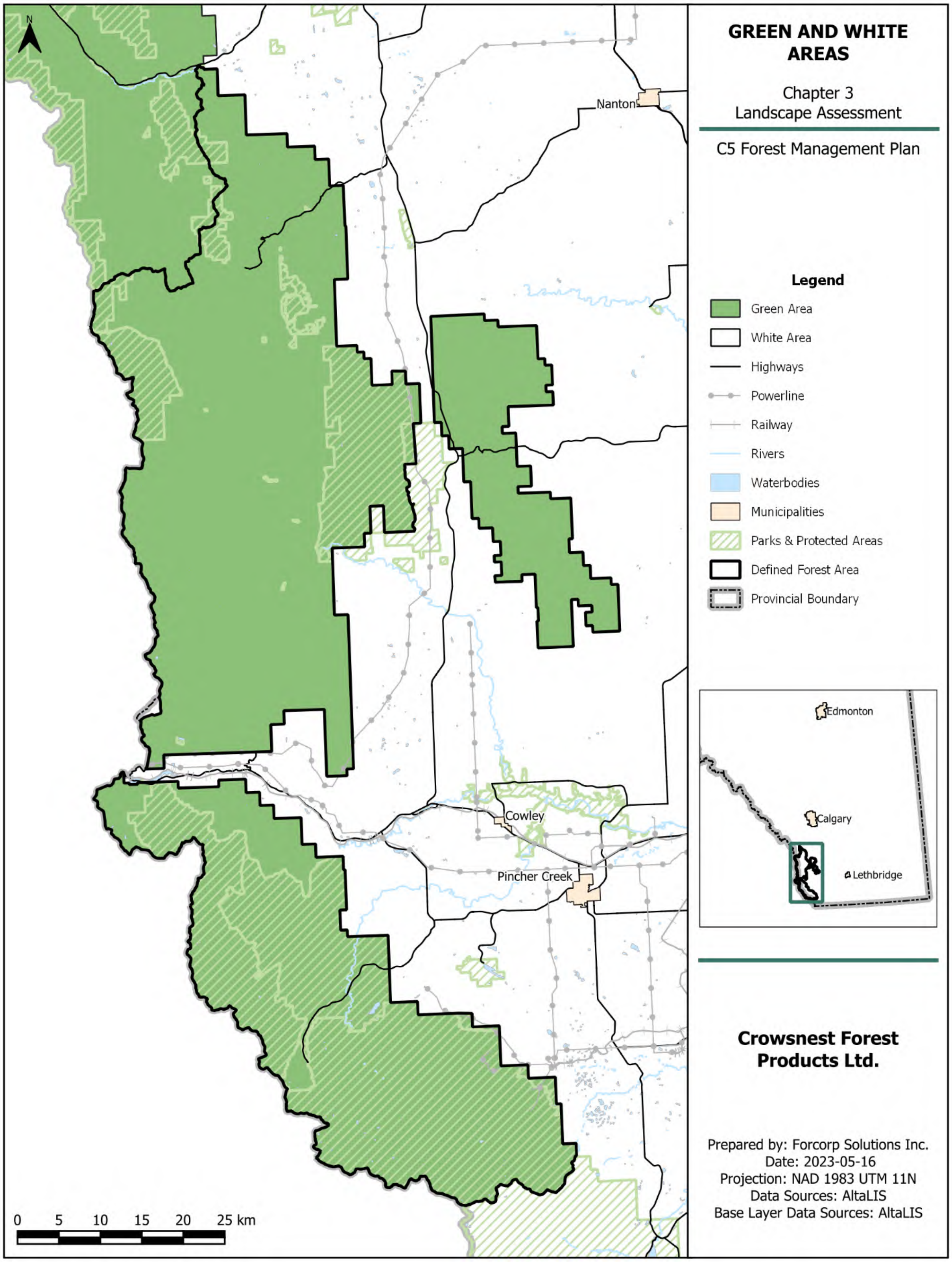

Figure 2-2. Alberta's Green and White areas in relation to the DFA.

2.3 Forest Management Units (FMU)

The boundary of the DFA is formed by the C5 FMU boundary [(2)] (Figure 2-3). Five other FMUs share a boundary with the DFA (BO1, B11, B12, CO1, and CO2).

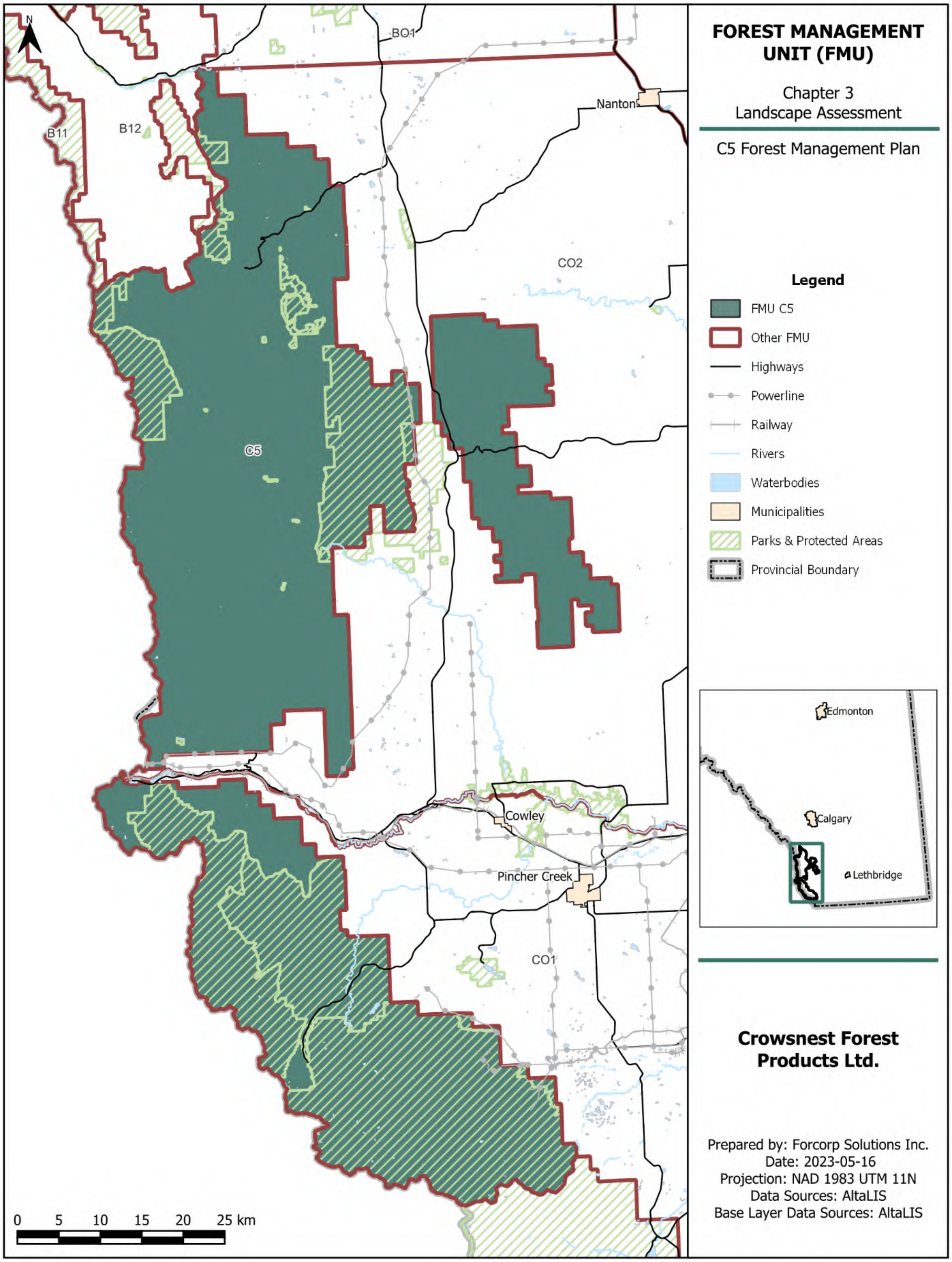

Figure 2-3. Forest Management Units within and surrounding the DFA.

2.4 Forest Management Agreement (FMA)

The Crowsnest Forest Products Ltd. Forest Management Agreement (FMA) (#2100047) area [3] encompasses 54% (190,665 ha) of the DFA (Figure 2-4). The DFA is bordered in part by the Spray Lake Sawmills (1980) Ltd. FMA (#0100038) to the north.

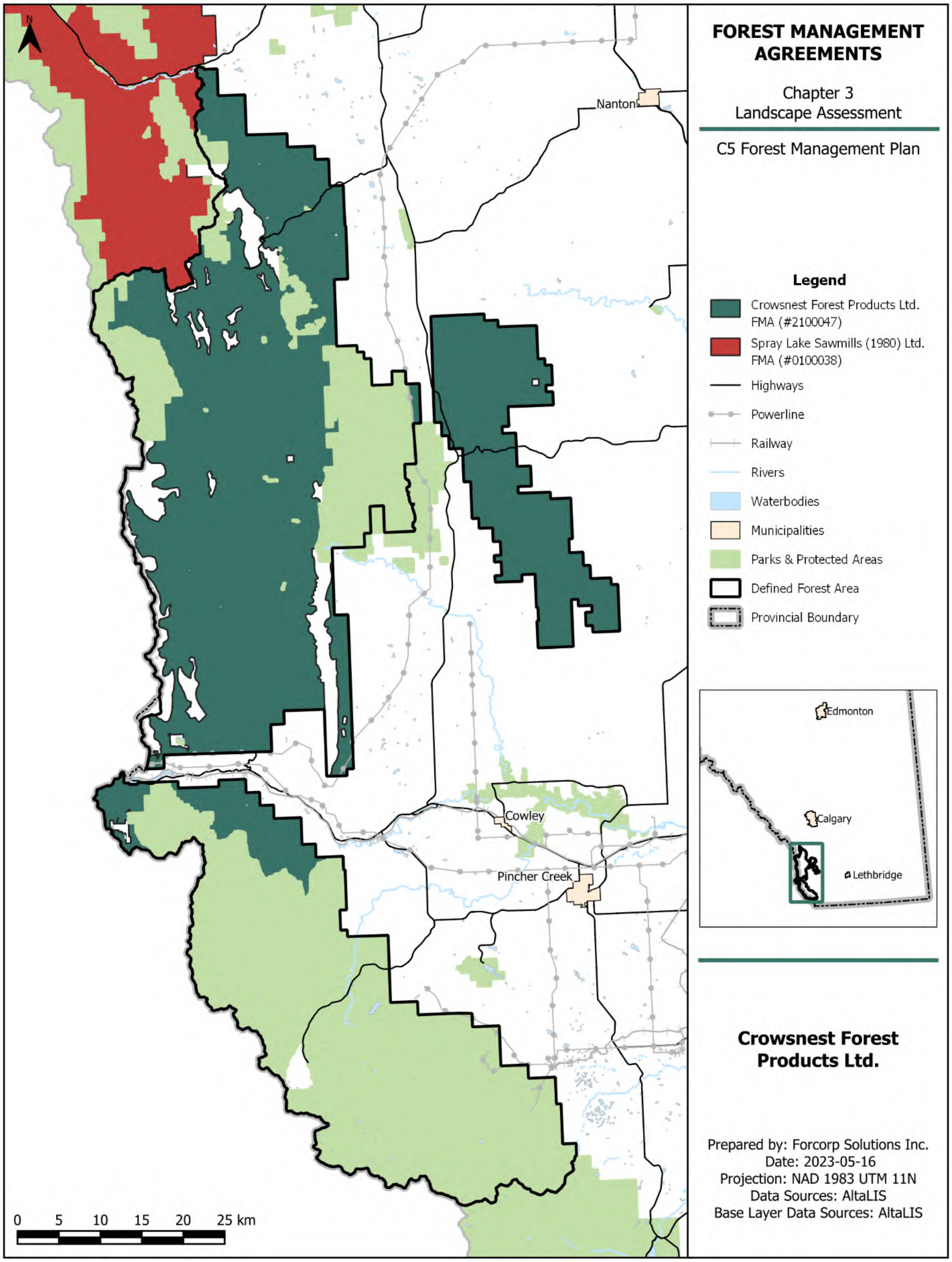

Figure 2-4. Forest management agreements within and surrounding the DFA.

2.5 Compartments

The DFA is separated into six compartments [4] (Table 2-1, Figure 2-5). These compartments divide the DFA into smaller units to provide a link between the strategic level Forest Management Plan and operational implementation.

Table 2-1. Compartments within the DFA.

Compartment Name	Area (ha)	% of DFA
Crowsnest River	29,905	16
Livingstone River	27,921	15
Oldman River	25,931	14
Porcupine Hills	39,871	21
Racehorse Creek	42,842	22
Willow Creek	24,195	13
Total	**190,665**	**100**

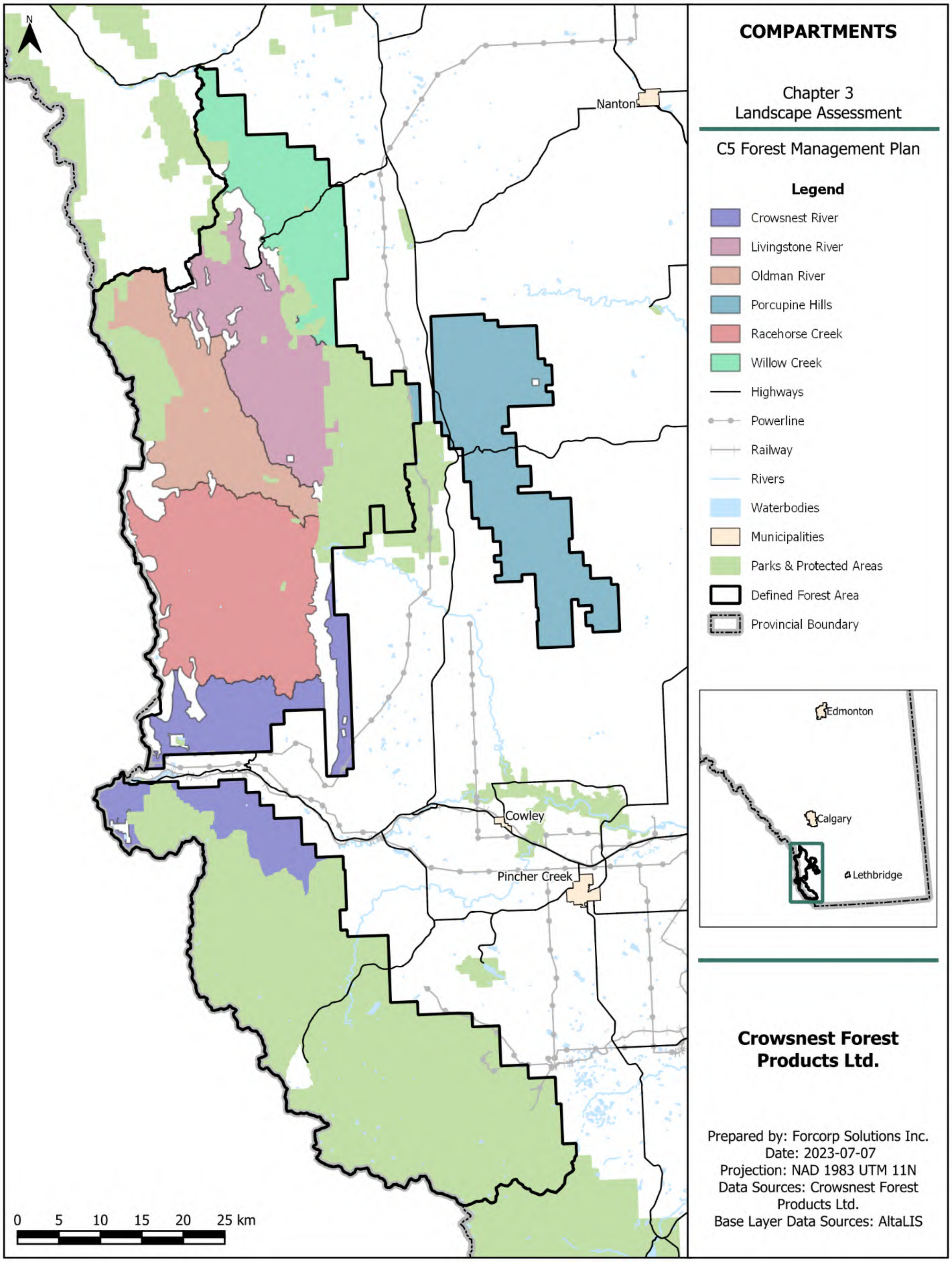

Figure 2-5. Compartments within the DFA.

2.6 Land-use Framework Regions

Alberta's Land-use Framework (LUF) divides the province into seven land-use regions to develop strategic regional land-use plans that balance social and environmental goals [5]. The DFA is entirely within the South Saskatchewan region (100%) (Table 2-2), which covers the southernmost portion of the province (Figure 2-6). The 2014-2024 South Saskatchewan Regional Plan was released in 2014 and amended in 2017 and on May 31, 2018 (Government of Alberta, 2018). 100% of the DFA falls within the boundaries of the South Saskatchewan Regional Plan.

Table 2-2. Land-use Framework regions within the DFA.

Land-use Region	Total Region Area in Alberta (ha)	Area of Region in DFA (ha)	% of Region in DFA	% of DFA
South Saskatchewan	8,398,090	190,665	2	100
Total	**8,398,090**	**190,665**	**2**	**100**

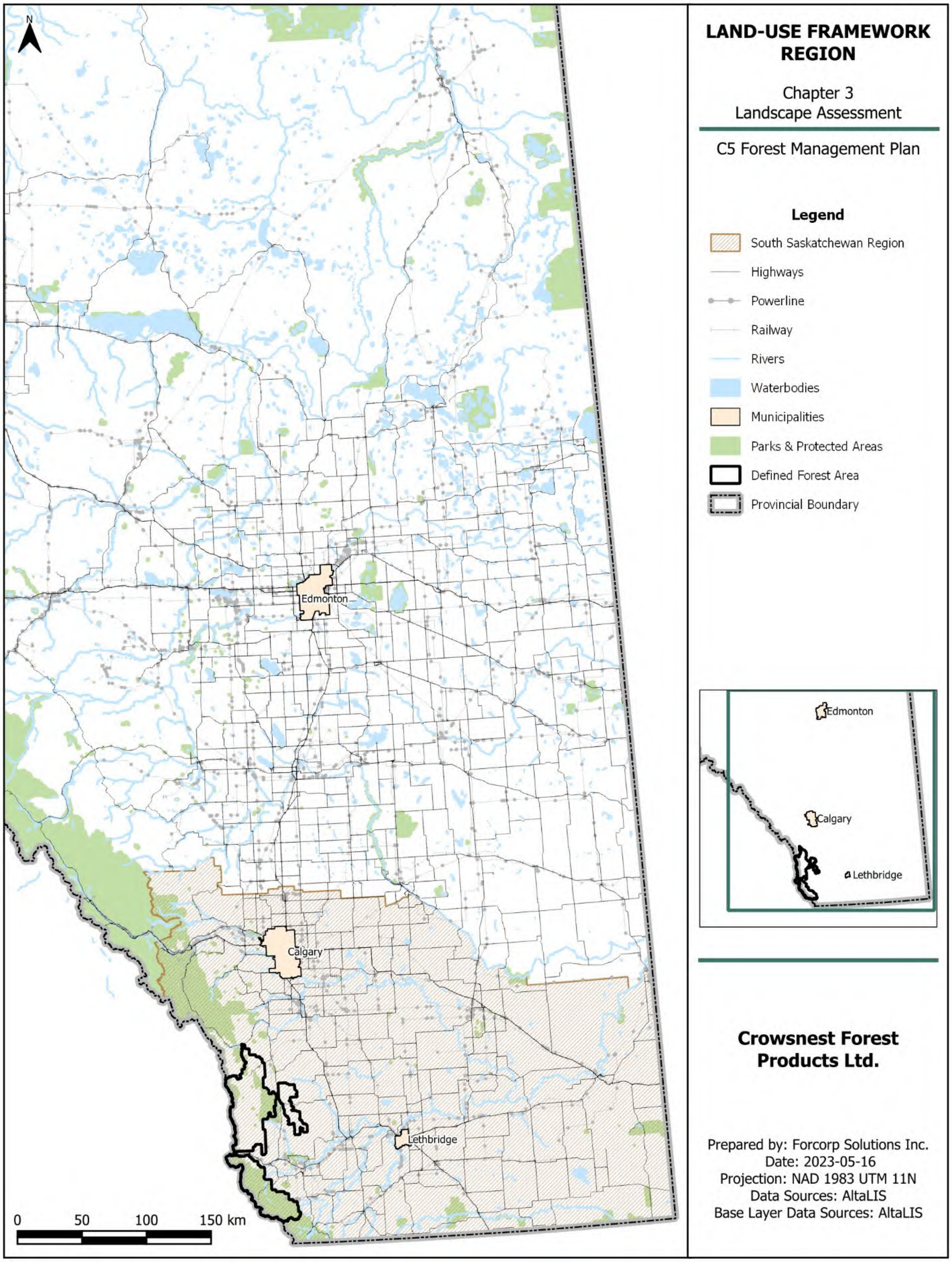

Figure 2-6. The South Saskatchewan Land-use Framework region.

2.6.1 Livingstone-Porcupine Hills Land Footprint Management Plan

The Livingstone-Porcupine Hills Land Footprint Management Plan (LPH-LFMP) became effective as a subregional plan under the South Saskatchewan Regional Plan in 2018 in accordance with Section 13(5) of the *Alberta Land Stewardship Act*. The LPH-LFMP was created to guide development and manage the long-term cumulative effects of human footprint on public lands in the Eastern Slopes. The LPH-LFMP utilizes Integrated Land Management tools such as zoning (Table 2-3), management thresholds, siting to avoid valued features, and restoration and reclamation and includes direction on managing for motorized access, forestry operations, wildfire risk, energy development, recreation and tourism, grazing allotments, and the preservation of biodiversity and watershed integrity (Alberta Environment and Parks, 2018). The LPH-LFMP applies to the Livingstone and Porcupine Hills Public Use Land Zones, which cover 50% of the DFA (see Section 2.14).

Table 2-3. LFMP Footprint Planning Zones.

Zone	Definition
Zone 1 - Conservation	This zone identifies existing or proposed protected or conservation areas and is characterized by limited development, limited disturbance, and low impact recreation. These zones are not managed by the LFMP.
Zone 2 - Enhanced	This zone prioritizes high value landscapes while enabling lower impact economic and social opportunities. This zone is characterized by low-intensity land use and requires operational planning to reduce the extent and duration of industrial and commercial footprint.
Zone 3 - Extensive	This zone enables a broad range of economic and social opportunities with emphasis on reclamation and responsible footprint development that considers ecological values.

Details on the Livingstone-Porcupine Hills Recreation Management Plan, which encompasses the same area as the LPH-LFMP and provides direction for recreation management including infrastructure (e.g., trails, camping, and day use areas), can be found in Section 6.3.1.

2.7 Natural Subregions

In 1994, an ecological landscape classification system was developed for the province of Alberta (Achuff, 1994), referred to as the Natural Regions and Subregions of Alberta [(6)]. It is widely used by land-management programs, such as the parks and protected areas network and in the development and application of ecologically-based forest management tools. In the fall of 2000, the Alberta government initiated a project to refine and update the classification. This project took advantage of Geographic Information System (GIS) technology. The updated classification changed a significant portion of the south DFA from lower foothills to montane. The subregion descriptions that follow are taken from or based on documentation dating from 2006 (Natural Regions Committee, 2006).

The province is divided into six geographic areas known as natural regions based on landscape patterns such as vegetation, soils and physiographic features. These are further subdivided into natural subregions, depending on vegetation, climate, elevation, topography, latitude and physiographic differences.

The DFA is made up of three distinct natural regions. Predominantly this is the Rocky Mountain region, but there is also a small sliver of the Parkland region in the north-east of the DFA and small slivers of both the Parkland region and Grassland region within the Porcupine Hills compartment in the east. The Rocky Mountain region can be further divided into subregions, and contains a mix of subalpine and montane, with a small proportion of alpine (Table 2-4, Figure 2-7). The small components of Parkland and Grassland natural regions only consist of a single natural subregion each.

Table 2-4. The distribution of natural regions and subregions in the DFA.

Natural Region	Natural Subregion	Area (ha)	% of DFA
Rocky Mountain	Alpine	23,531	7
	Montane	106,310	30
	Subalpine	220,047	63
	Subtotal	**349,888**	**100**
Parkland	Foothills Parkland	331	0
Grassland	Foothills Fescue	129	0
Total		**350,348**	**100**

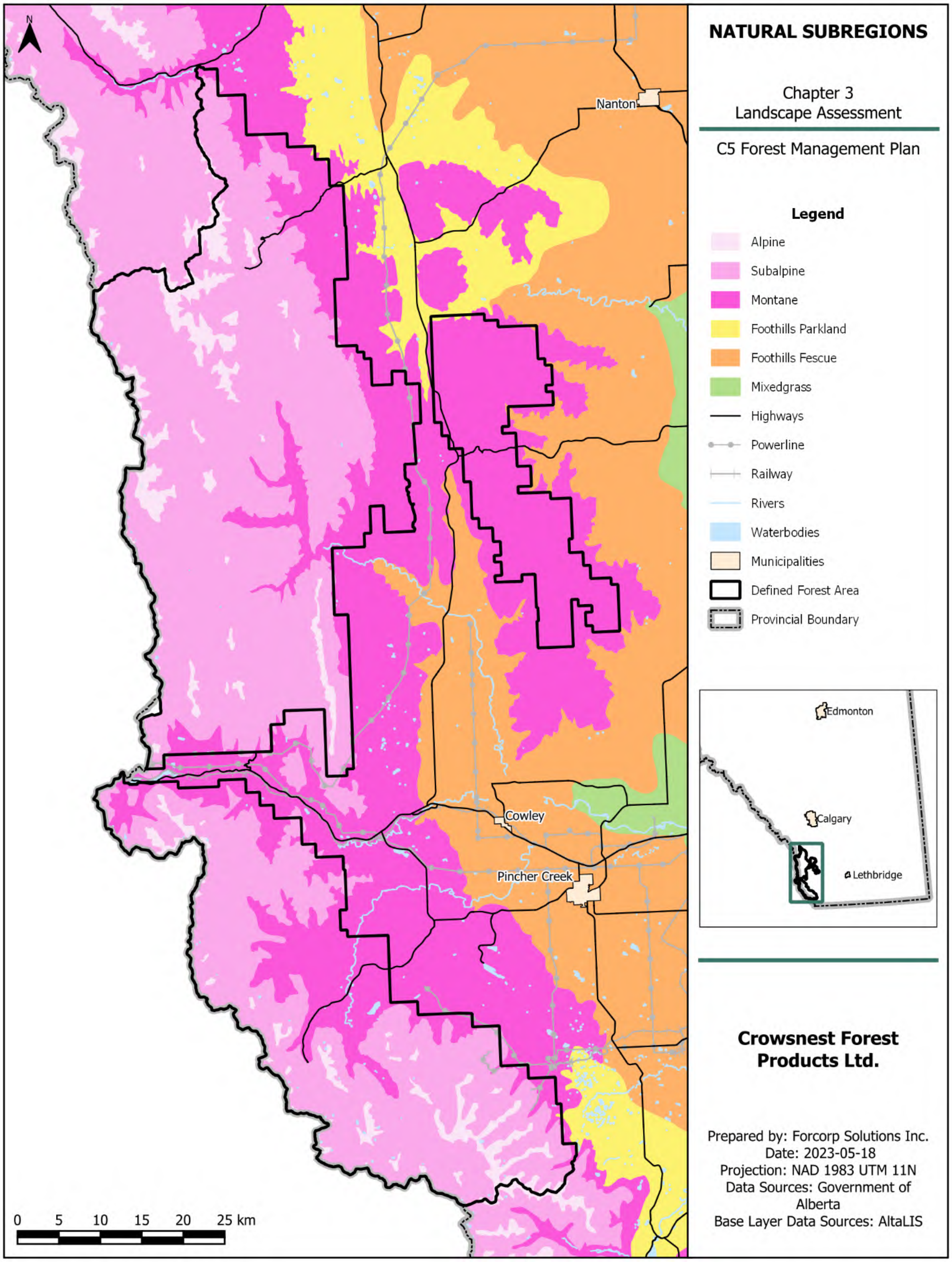

Figure 2-7. Natural subregion boundaries within and surrounding the DFA.

2.7.1 Alpine

The Alpine natural subregion is the third most common in the DFA but the proportion is minimal with only some isolated high elevation areas within the western portion DFA falling within this category (Figure 2-7). The subregion is characterised by mountains, glaciers and snowfields, with trees mostly absent. Because the area of this subregion within the DFA is so small (7%, Table 2-4), it has minimal relevance to the FMP.

2.7.2 Montane

The Montane natural subregion is the second most common in the DFA at 30% of the total area (Table 2-4), which is located in the eastern half of the south DFA and the southern portion of the north DFA (Figure 2-7). It is characterized by its cool summers and warm winters, as well as its location in the lower slopes and valley bottoms of the Front Ranges.

Lodgepole pine, Douglas-fir and trembling aspen stands occur on easterly and northerly aspects, while grasslands occur on southerly and westerly aspects at lower elevations. Closed mixedwood and coniferous forests, dominated by lodgepole pine, occur at higher elevations. The diverse aspects, slope positions and wind exposures result in highly variable microclimates and abrupt changes in vegetation composition. Forest productivity is generally good, but regeneration can be slow due to the potential for dry conditions and calcareous soils.

2.7.3 Subalpine

The Subalpine natural subregion is the most common in the DFA at 63% of the total area (Table 2-4), and is located predominantly in the western portions of the DFA (Figure 2-7). The subregion is characterized by high elevations below the Alpine subregion, occurring on the mid-slopes of the Front Ranges and lower slopes of the western Central Ranges. There are highly variable microclimates as a result of differing aspects, wind exposures, elevations and substrates.

Summers are short, cool and wet while winters are long, cold and have heavy snowfall. At higher elevations closer to the boundary of the Alpine subregion the growing season is particularly short, and trees are typically widely spaced and stunted (krummholz). Forests are predominantly coniferous throughout the subalpine, consisting of open Engelmann spruce, subalpine fir and subalpine larch forests, interspersed with herb-rich meadows at higher elevations and young fire-origin lodgepole pine stands at lower elevations. Forest productivity is low compared to the foothills, with slow regeneration. Forest harvesting conditions are often difficult due to steep slopes.

2.7.4 Foothills Parkland

The proportion of the Foothills Parkland natural subregion in the DFA is minimal with this subregion only just overlapping the DFA in the far northeast and small portions of the Porcupine Hills compartment in the east (Figure 2-7). The subregion is characterized by rolling to hilly grasslands, with aspen and willow growing in low-lying areas and along northerly slopes, and cooler summer and warmer winters than other Parkland subregions. Because the area of this subregion within the DFA is so small (< 1%, Table 2-4), it has minimal relevance to the FMP.

2.7.5 Foothills Fescue

The proportion of the Foothills Fescue natural subregion in the DFA is minimal with this subregion only just overlapping the DFA in small portions of the Porcupine Hills compartment in the east (Figure 2-7). The subregion is characterized by level plains in the north and high elevation grassy uplands in the south, with diverse grasses and herbaceous species, and cooler summers and warmer winters than other Grassland subregions. Because the area of this subregion within the DFA is so small (< 1%, Table 2-4), it has minimal relevance to the FMP.

2.8 Municipal Districts, Counties and Improvement Districts

There are no municipalities (7) within the DFA (Figure 2-8), but three municipal districts overlap the DFA (8). The northernmost portion of the DFA includes the Kananaskis Improvement District (6%) (9), which is a large multi-use district with many parks and protected areas. The Waterton Improvement District shares a boundary with the FMU but does not overlap the DFA. The Special Municipality of Crowsnest Pass also overlaps 6% of the southernmost portion of the DFA. The majority of the area attributed to a municipal district is within the Municipal District of Ranchland No. 65, which covers 55% of the DFA. The Municipal District of Pincher Creek No. 9 overlaps to a lesser extent, at 29% of the DFA, and the Municipal District of Willow Creek No. 26 overlaps 4% of the DFA (Table 2-5, Figure 2-9). Foothills County shares a boundary with the FMU but does not overlap the DFA.

Table 2-5. Municipal districts and counties and improvement districts within the DFA.

Type	Name	Area (ha)	% of DFA
Municipal districts	M.D. of Pincher Creek No. 9	100,706	29
	M.D. of Ranchland No. 66	191,444	55
	M.D. of Willow Creek No. 26	13,674	4
	Subtotal	**305,824**	**87**
Improvement district	Kananaskis I.D.	21,862	6
Special municipality	Municipality of Crowsnest Pass	22,660	6
Total		**350,347**	**100**

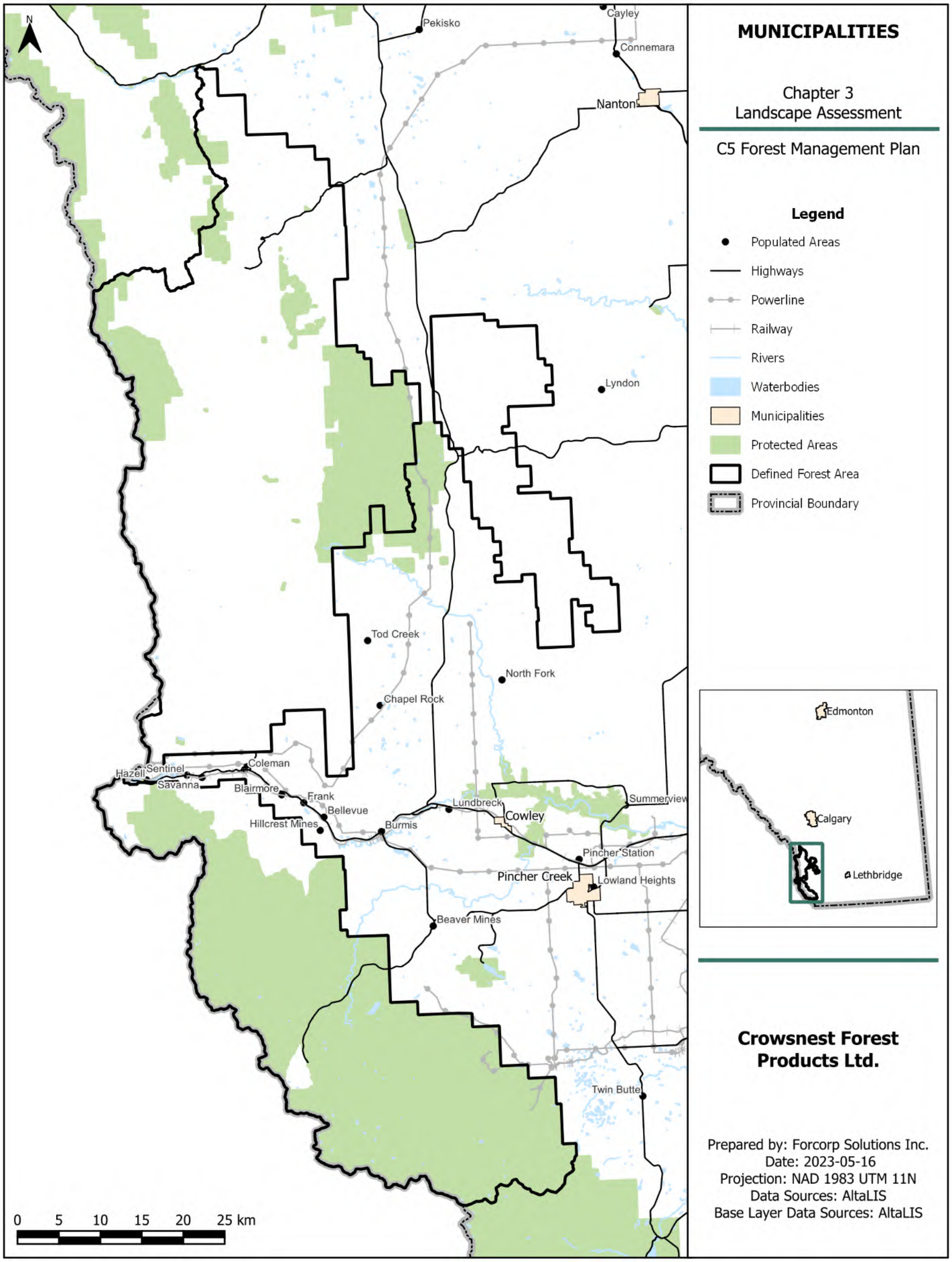

Figure 2-8. Municipalities in the vicinity of the DFA.

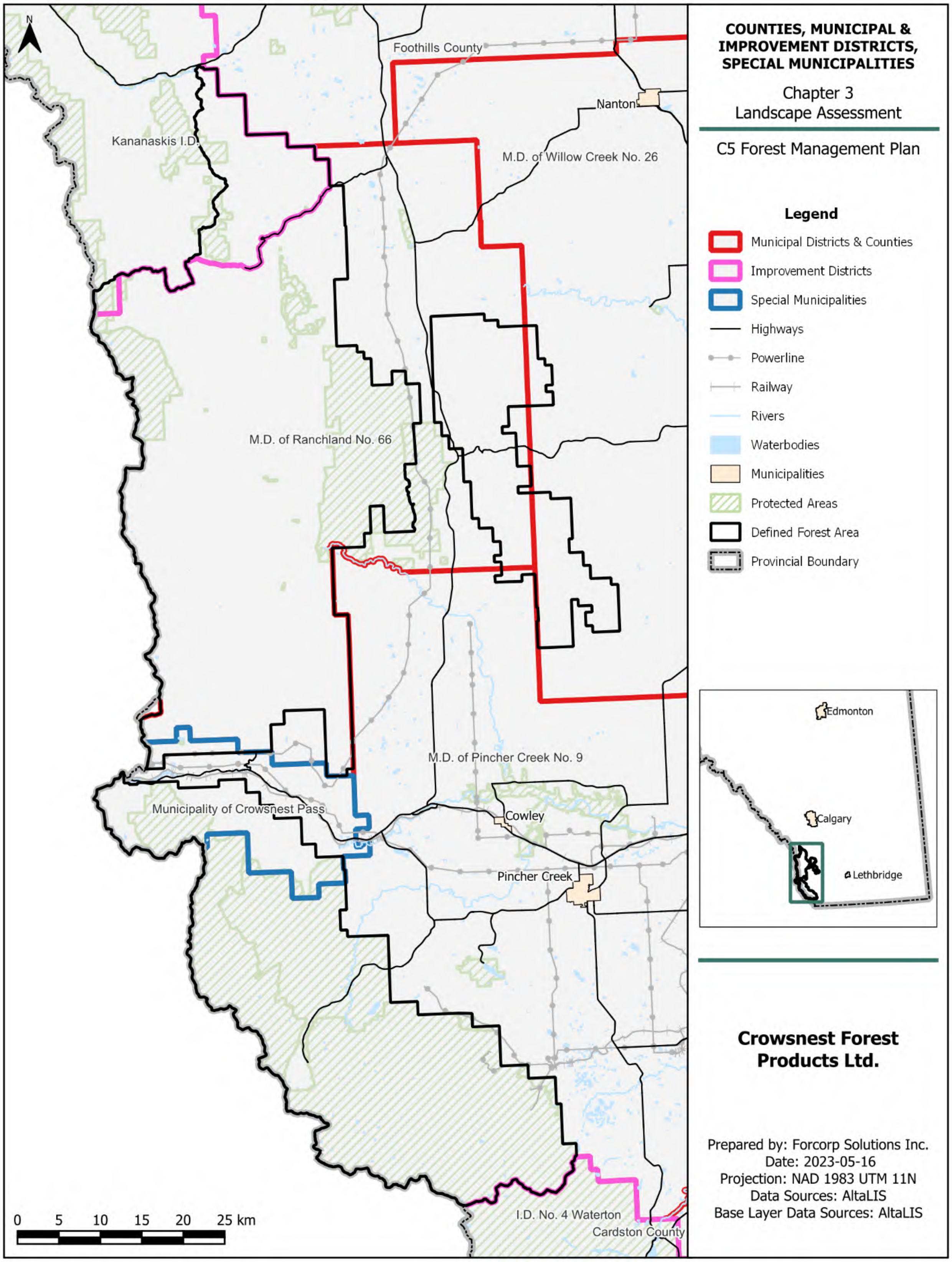

Figure 2-9. Counties, municipal districts, improvement districts, and special municipalities in the vicinity of the DFA.

2.9 Federal Government and Private Lands

There are no federal government or private lands located within the DFA.

2.10 First Nations Reserves

There are no First Nations reserves [11] within the DFA, but a portion of the Eden Valley No. 216 reserve and the Peigan Timber Limit “B” reserve both border the DFA (Figure 2-10). Additionally, there are First Nations that are not adjacent to the DFA but have traditional use territory within the DFA. For a list of First Nations with traditional use that overlaps the DFA, please refer to the Alberta Aboriginal Consultation Office website.

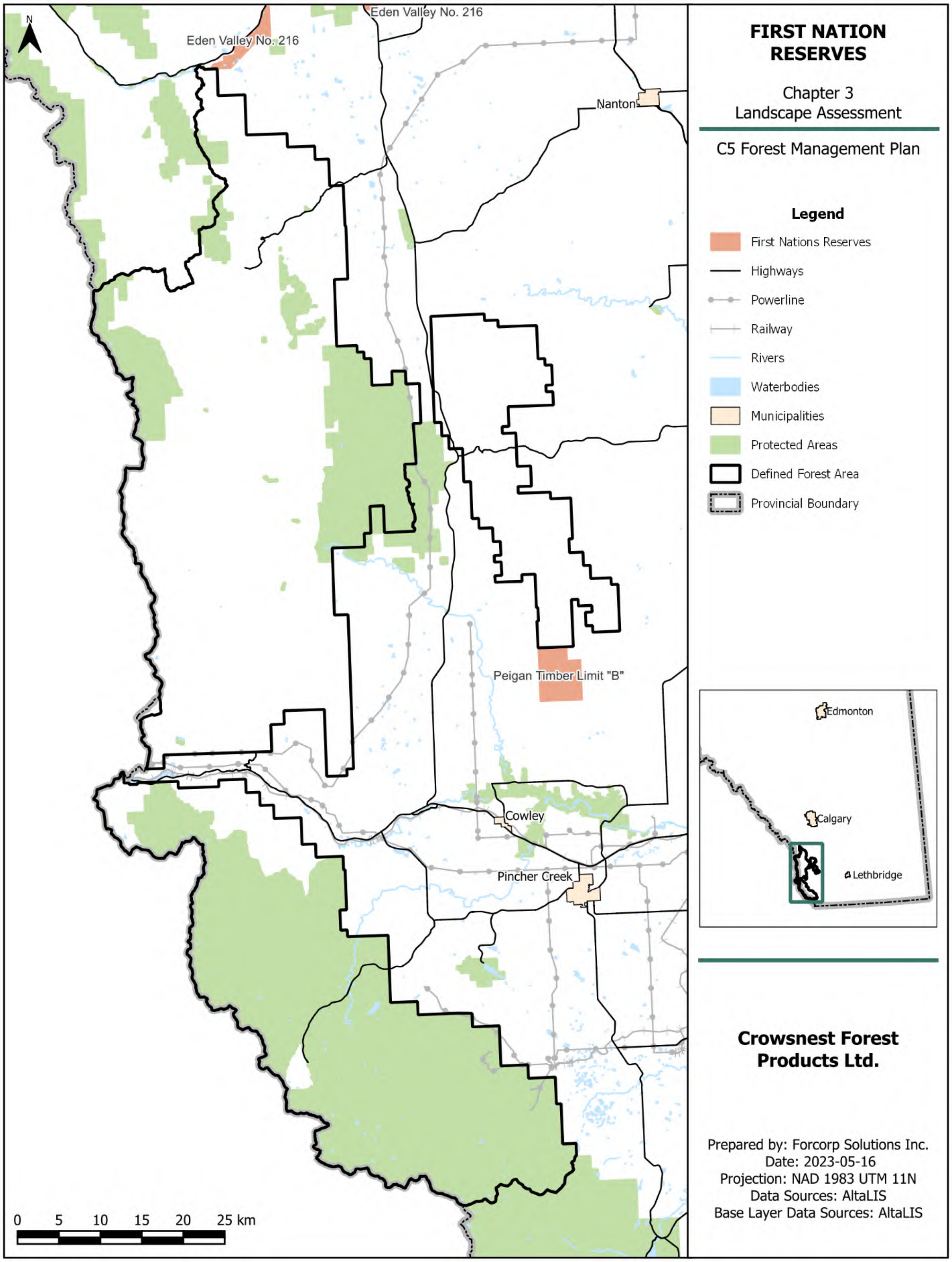

Figure 2-10. First Nation reserves in the vicinity of the DFA.

2.11 Métis Settlements

There are no Métis settlements [12] within or in the vicinity of the DFA; however, Métis Nation of Alberta Region 3 has an office for Southern Alberta in Calgary.

2.12 Parks and Protected Areas

Of the many different types of parks and protected areas within Alberta (Alberta Parks, 2018), there are two Ecological Reserves, one Heritage Rangeland, two Natural Areas, one Provincial Park, seven Provincial Recreation Areas, and three Wildland Provincial Parks found within the DFA [13] (Table 2-6, Figure 2-11).
In total, 40% of the DFA (139,525 ha) is categorized as a park or protected area (Table 2-7). The majority of this protected area is designated as Wildland Provincal Park (30%), followed by Provincial Parks (7%) and Natural Areas (2%). Ecological Reserves, Heritage Rangelands, and Provincal Recreation Areas make up an additional 2,456 ha of the DFA (<1%).

Table 2-6. Descriptions of the parks and protected areas designations that occur within the DFA.

Type	Definition
Ecological Reserve	Ecological Reserves exist to preserve and protect natural heritage in an undisturbed state for scientific research or education. There reserves contain representative, rare, and fragile landscapes, plants, animal, and geological features and their primary intent is the preservation of natural ecosystems and their associated biodiversity. These areas can only be accessed by foot and are open to the public for low-impact activities such as photography and wildlife viewing.
Heritage Rangeland	Heritage Rangelands exist to preserve and protect natural heritage that is representative of Alberta's grasslands. Carefully managed cattle grazing is used to maintain the grassland ecology. Recreational activities must be compatible with preservation of natural values and access to lands under grazing lease is permitted only with permission from the leaseholder.
Natural Areas	Natural areas exist to preserve and protect natural and near-natural sites of local significance and provide opportunities for low-impact nature-based recreation and heritage appreciation activities.
Provincial Park	Provincial Parks exist to preserve areas of natural heritage. They support outdoor recreation, heritage tourism, and natural heritage appreciation activities that depend upon and are compatible with environmental protection.
Provincial Recreation Area	Provincial Recreation Areas support outdoor recreation and tourism. They often provide access to lakes, rivers, reservoirs, and adjacent Crown land and are established under the Provincial Parks Act. They support a range of outdoor activities in natural, modified, and man-made settings and are managed with outdoor recreation as the primary objective. Some areas are intensively developed while others remain largely undeveloped. Many recreation areas play a significant role in management of adjacent Crown lands and waters, serving as staging areas to provide access to a range of outdoor recreation opportunities on adjacent lands and water bodies.
Wildland Provincial Park	Wildland Provincial Parks are established to preserve and protect natural heritage while providing opportunities for backcountry recreation. They are large, undeveloped natural landscapes that retain their primeval character. Trails and primitive backcountry campsites are provided in some wildland parks to minimize visitor impacts, and some include designated trails for off-highway vehicle riding and snowmobiling.

Table 2-7. Parks and protected areas within the DFA.

Type	Number	Area (ha)	% of DFA
Ecological Reserve	2	1,637	0
Heritage Rangeland	1	658	0
Natural Areas	2	7,339	2
Provincial Park	1	25,542	7
Provincial Recreation Area	7	161	0
Wildland Provincial Park	3	104,188	30
Total	**16**	**139,525**	**40**

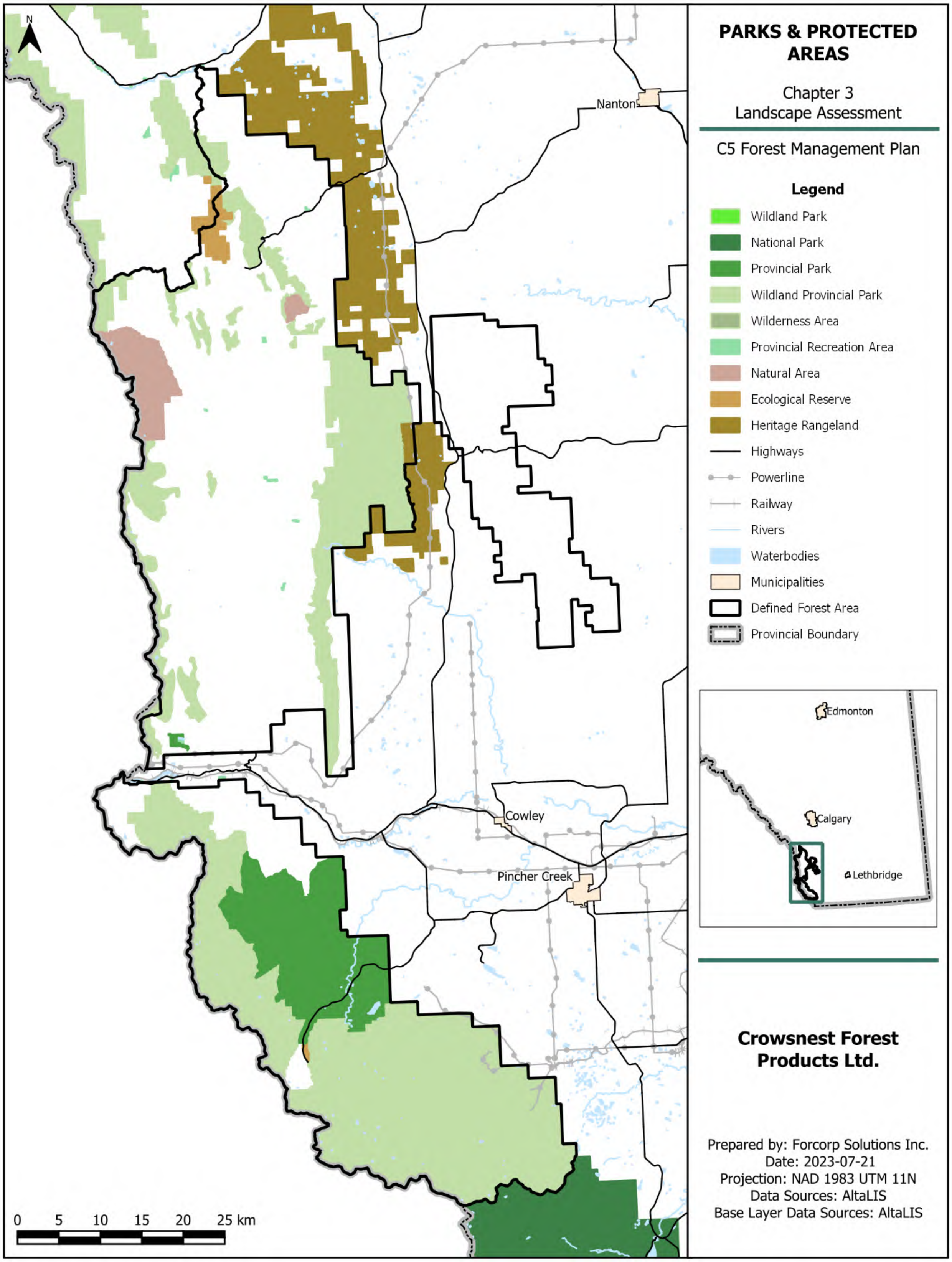

Figure 2-11. Parks and protected areas in the vicinity of the DFA.

2.13 Regional Parks and Protected Areas

A considerable portion of the greater area of Crown land surrounding the DFA falls within protected areas. A spatial analysis of the area available for harvest and areas protected from harvest was conducted. This analysis helps to add context to the amount of the forest within the forest management agreement related to the amount designated with some form of formal protection and a corresponding conservation mandate.

Table 2-8 and Figure 2-12 present the Crowsnest Forest Products' forest management agreement area and surrounding protected areas in the region. The analysis boundary encompasses the DFA and adjacent protected areas (see Section 2.13). Overall, 48% of this analysis area is protected. If the analysis boundary is expanded north to include the B12 FMA which is held by Spray Lake Sawmills (the parent company of Crowsnest Forest Products) and the adjacent protected areas including Banff, the balance increases to 29% unprotected and 71% protected area. Table 2-9 shows this breakdown and Figure 2-13 shows the spatial extent of this analysis.

Table 2-8. Area protected or managed in and surrounding the DFA.

Protected Status	Type	Area (ha)	% of Total
Protected	Ecological Reserve	93	0
	Heritage Rangeland	7,727	2
	Natural Area	7,339	2
	Provincial Park	25,763	6
	Provincial Recreation Area	210	0
	Waterton Lakes National Park of Canada	49,958	12
	Wildland Provincial Park	119,707	30
	Parks Subtotal	**210,797**	**52**
Unprotected	FMA Area Outside of Parks	190,665	47
	FMU Area Outside of Parks and FMA	2,072	1
	Subtotal	**192,737**	**48**
Total		**403,534**	**100**

Table 2-9. Area protected or managed in the wider area surrounding the DFA.

Protected Status	Type	Area (ha)	% of Total
Protected	Banff National Park of Canada	685,532	38
	Ecological Reserve	2,430	0
	Heritage Rangeland	42,083	2
	Natural Area	7,339	0
	Provincial Park	113,447	6
	Provincial Recreation Area	4,641	0
	Waterton Lakes National Park of Canada	49,958	3
	Wilderness Area	15,236	1
	Wildland Provincial Park	340,928	19
	Parks Subtotal	**1,261,593**	**71**
Unprotected	C5 FMA Area Outside of Parks	190,665	11
	B12 FMA Area Outside of Parks	284,134	16
	B12 Quota Area Outside of Parks and FMA	46,796	3
	FMA and Operable Areas Subtotal	**521,595**	**29**
	C5 FMU Area Outside of Parks and FMA	2,072	0
	B12 FMU Area Outside of Parks and Operable Area	57	0
	Non-FMA and Non-Parks Subtotal	**2,129**	**0**
Total		**1,785,318**	**100**

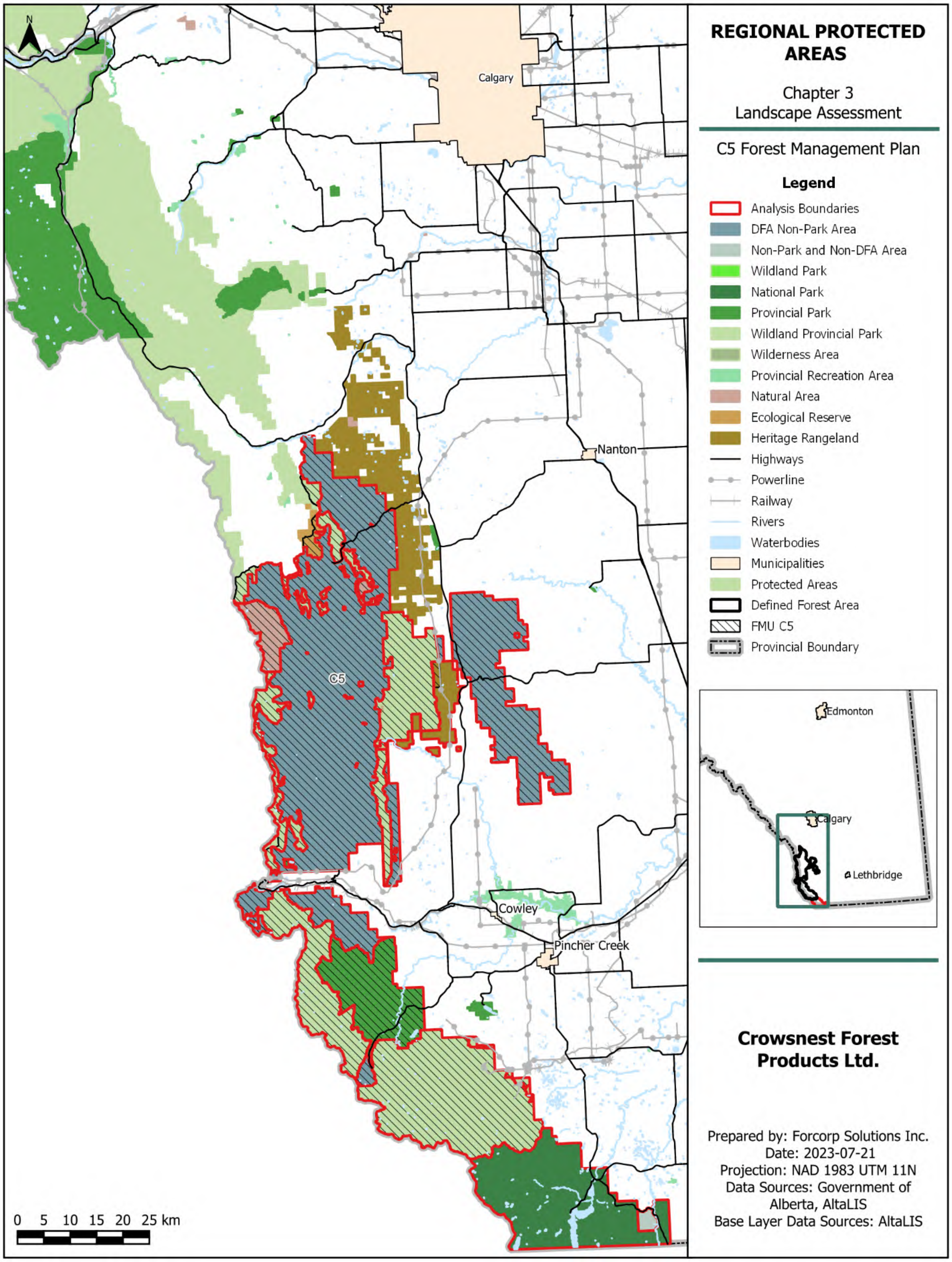

Figure 2-12. Regional protected and unprotected areas within and surrounding the DFA.

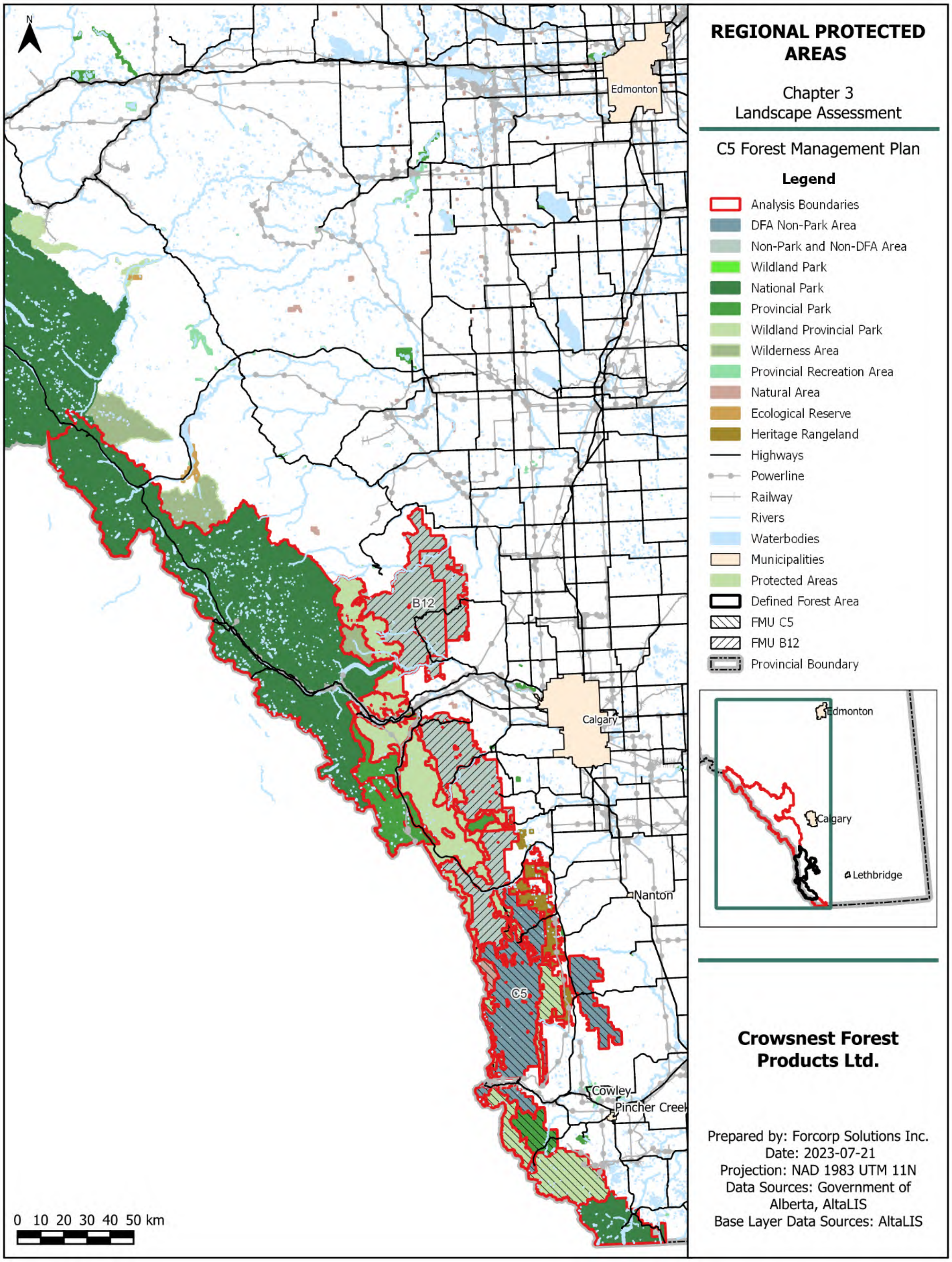

Figure 2-13. Protected areas in the wider area surrounding the DFA.

2.14 Public Land Use Zones and Public Land Recreation Areas

Public Land Use Zones [14] in Alberta are established to manage recreational activities under the authority of the Public Lands Act. Each Public Use Land Zone has regulations specific to that landbase which include identifying trails, areas, and time-periods during which off-highway vehicle (OHV) and snow vehicle use is permitted. Five Public Land Use Zones overlap with the DFA, covering 56% of the total area. The largest zones in the DFA are the Livingstone and Porcupine Hills zones, covering 71% and 21% of the DFA respectively (Table 2-10, Figure 2-14).

Alberta also establishes Public Land Recreation Areas (PLRA) [15] under the authority of the Public Lands Administration Regulation. PLRAs are small areas that provide amenities for camping, staging and information sharing in areas with high intensity recreational use. There is one PLRA located within the DFA. The Allison Day Use/Cross Country Ski Staging PLRA is located just to the southeast of the Chinook Provincial Recreation Area (Table 2-11, Figure 2-15).

Table 2-10. Public Land Use Zones within the DFA.

Public Land Use Zone	Total Area (ha)	Area in DFA (ha)	% of Zone in DFA	% of DFA
Castle Special Management Area	1,312.52	1,312.52	100.00	0.37
Cataract Creek Snow Vehicle	46,394.10	19,077.98	41.12	5.45
Livingstone	140,667.77	134,936.69	95.93	38.52
Porcupine Hills	39,273.80	39,260.04	99.96	11.21
The Kananaskis Country	112,923.04	1,616.94	1.43	0.46
Total	**340,571.22**	**196,204.17**	**57.61**	**56.00**

Table 2-11. Public Land Recreation Areas within the DFA.

Type	Number	Area (ha)	% of DFA
Public Land Recreation Area	1	3	0
Total	**1**	**3**	**0**

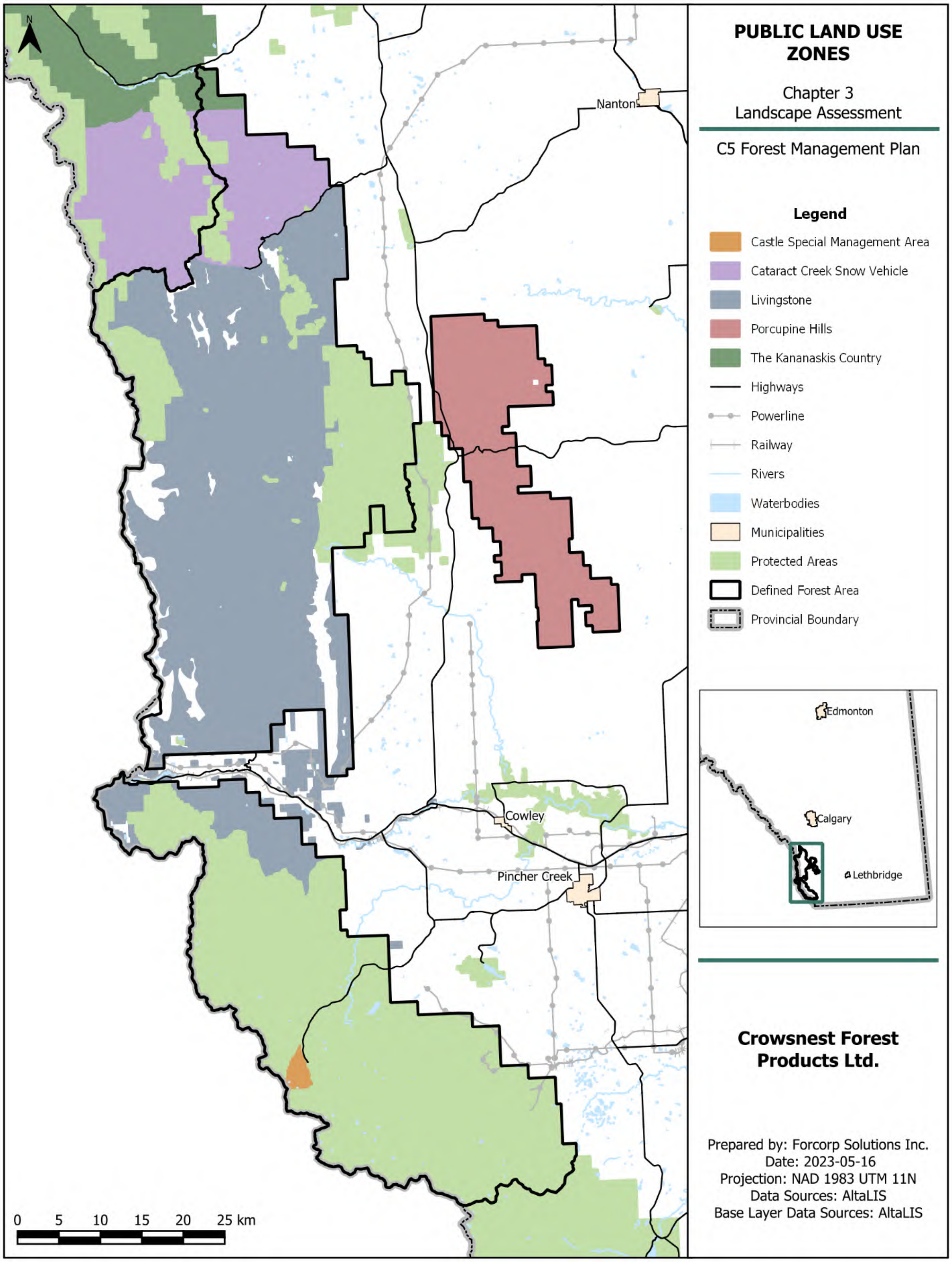

Figure 2-14. Public Land Use Zones within and surrounding the DFA.

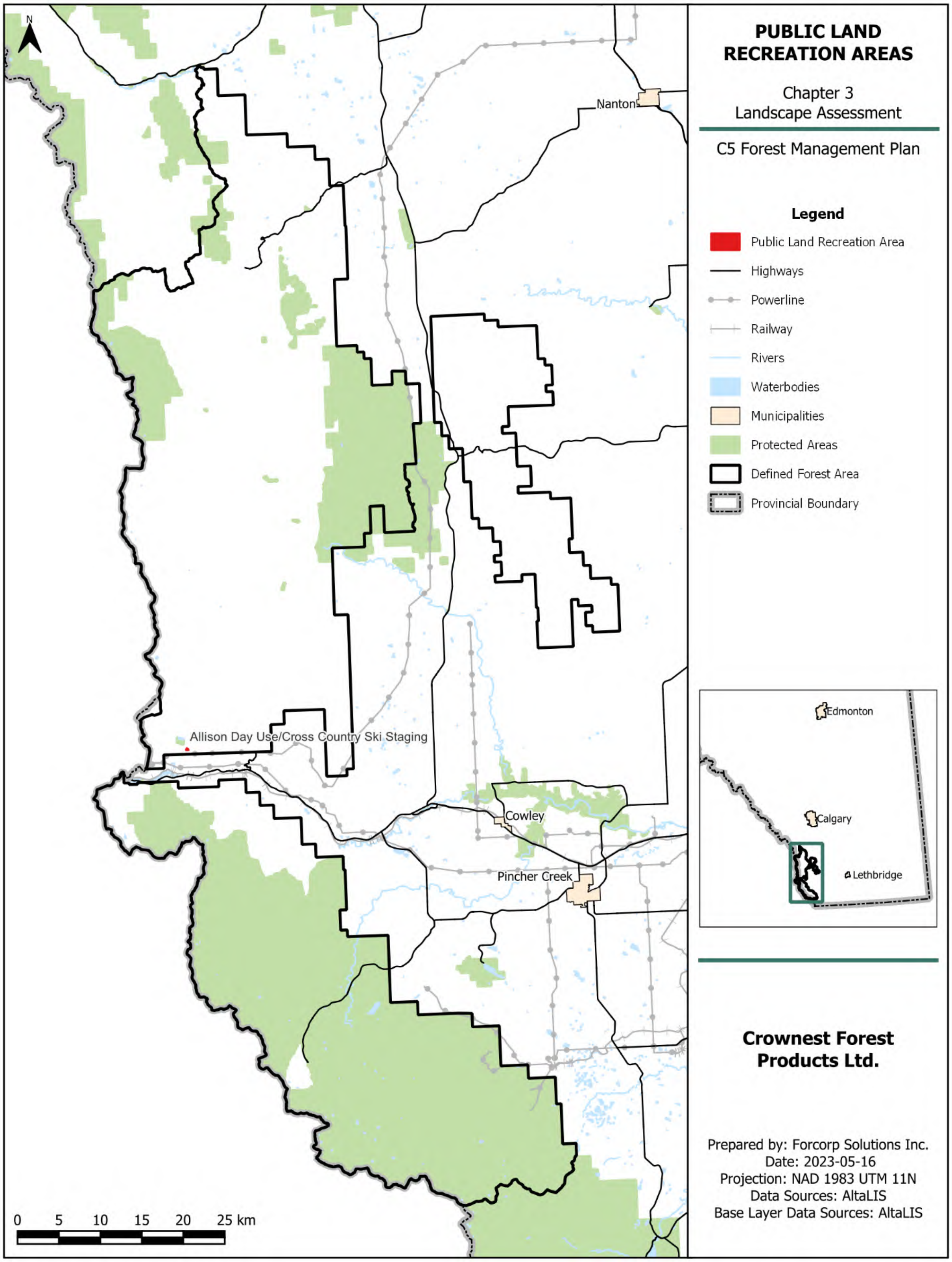

Figure 2-15. Public Land Recreation Areas and Trails in the vicinity of the DFA.

2.15 Wildfire Management Areas

Wildfire Management Areas are used by the Government of Alberta to define wildfire management responsibilities [16]. The entirety of the DFA is within the Calgary Wildfire Management Area (Table 2-12, Figure 2-16).

Table 2-12. Wildfire Management Area within the DFA.

Wildfire Management Area	Area (ha)	% of DFA
Calgary WMA	350,348	100
Total	**350,348**	**100**

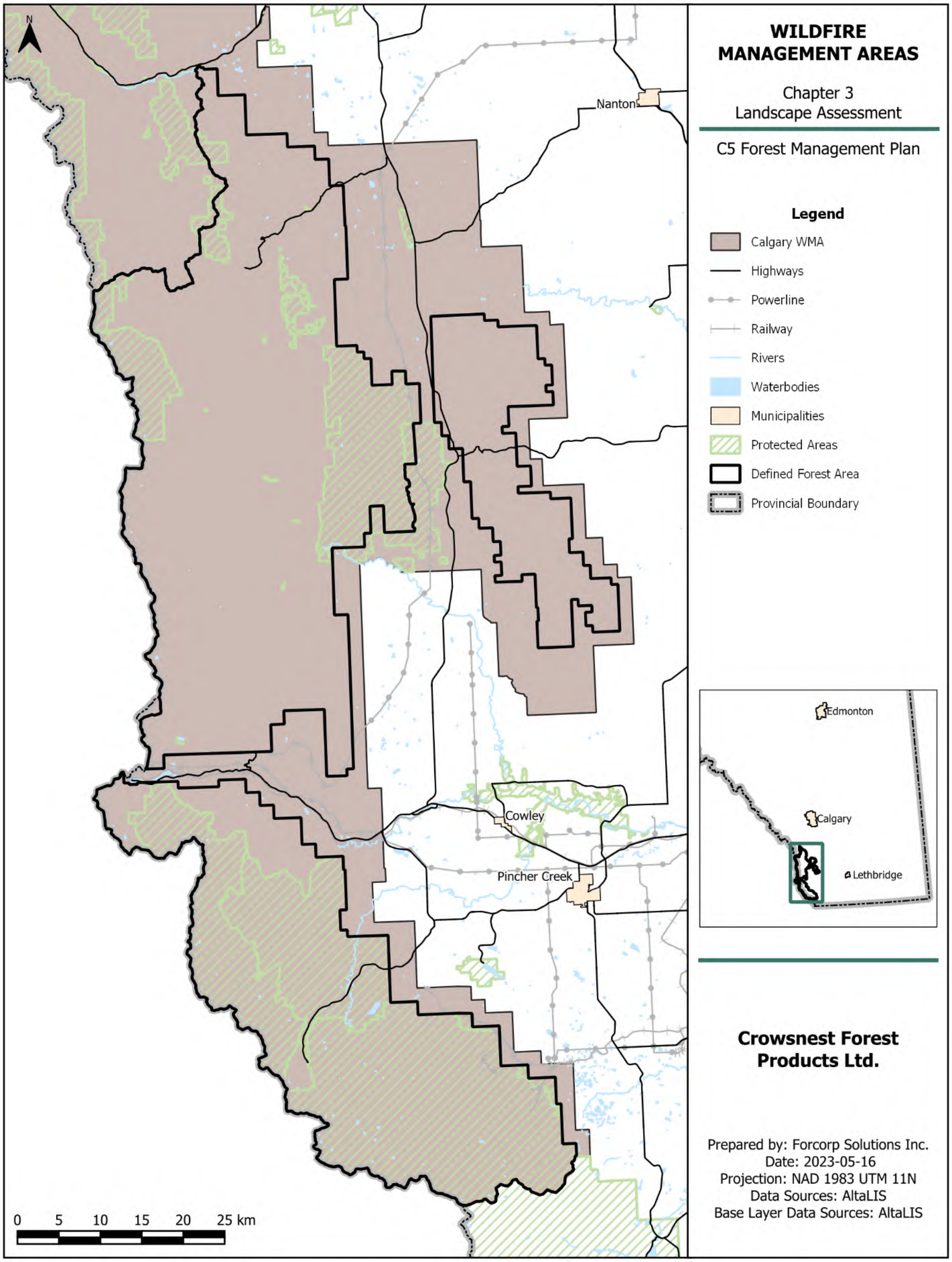

Figure 2-16. Calgary Wildfire Management Area.

3 Physical Conditions

3.1 Topography

Located in the Rocky Mountain, Parkland, and Grasslands regions of the province, the C5 DFA has highly variable topography [17] (Figure 3-1). The highest point in the DFA is 2,997 metres (9,833 feet) above sea level, which is found along the mountainous Alberta-British Columbia border to the west of the Oldman River compartment. The lowest point is 1,286 metres (4,219 feet) above sea level, which is found along the valleys of the Castle River in the northern area of Castle Provincial Park.

Slope and aspect are important topography factors for natural resource management, as they have an important relationship in forest development. These factors are reviewed in greater detail in the Natural Subregions section (see Section 2.7). However, slope is also an important factor in defining machine operability and erosion potential. Five slope classes were calculated based on generally accepted thresholds for operability, with slopes 45% or less considered operable for machinery and less susceptible to severe erosion [18]. Steeper slopes may require specialized equipment for timber harvesting and additional erosion mitigation measures, or may be unharvestable. The majority of the DFA (76%) has easily operable land with slopes of 45% or less (Table 3-1). Slopes greater than 45% are spread throughout the DFA (Figure 3-2).

Table 3-1. Slope class distribution within the DFA.

Slope Class (%)	Area (ha)	% of DFA
0-19	72,258	38
20-34	57,753	30
35-39	5,879	3
40-44	9,561	5
45+	45,213	24
Total	**190,665**	**100**

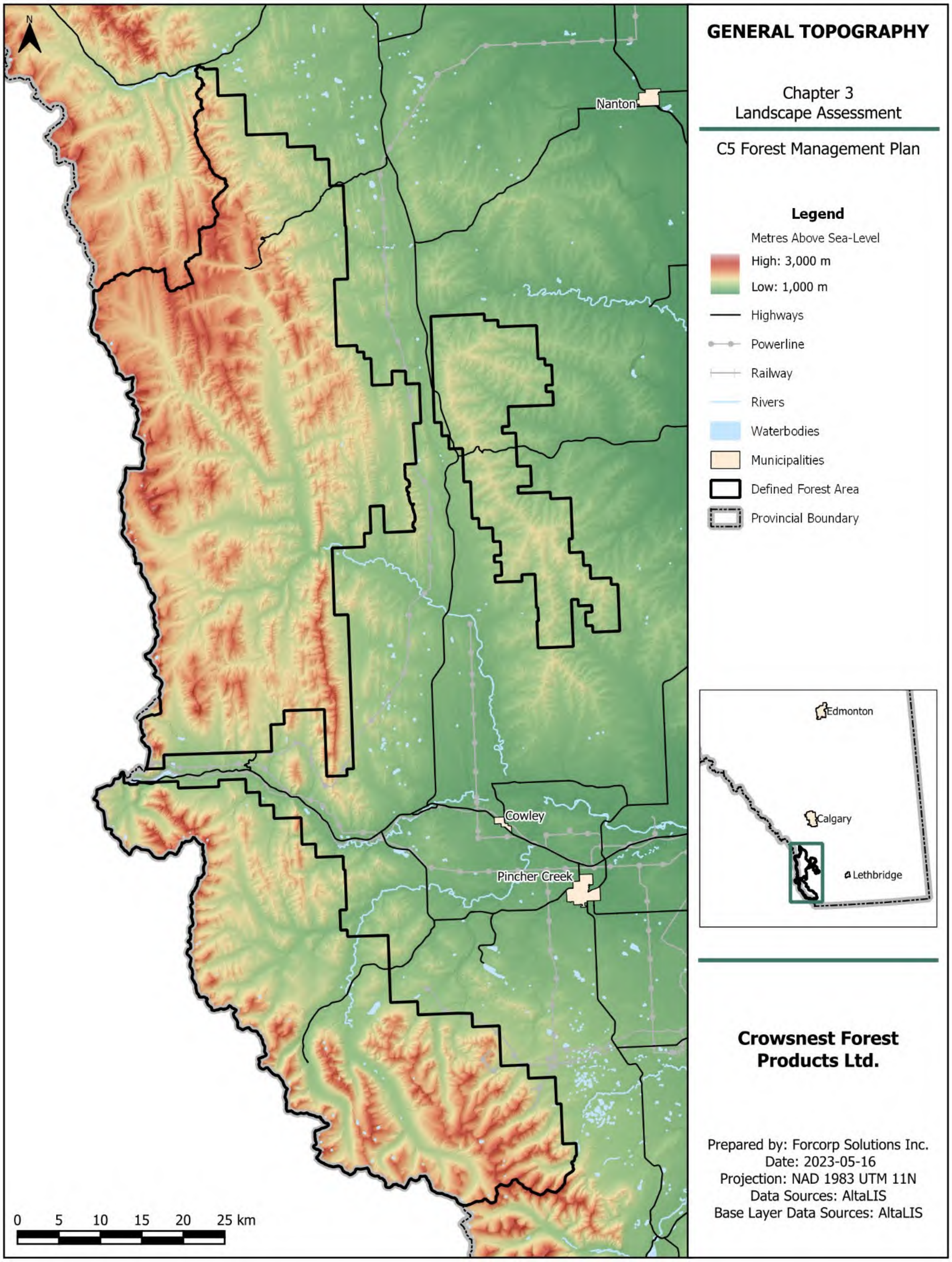

Figure 3-1. General topography within and surrounding the DFA.

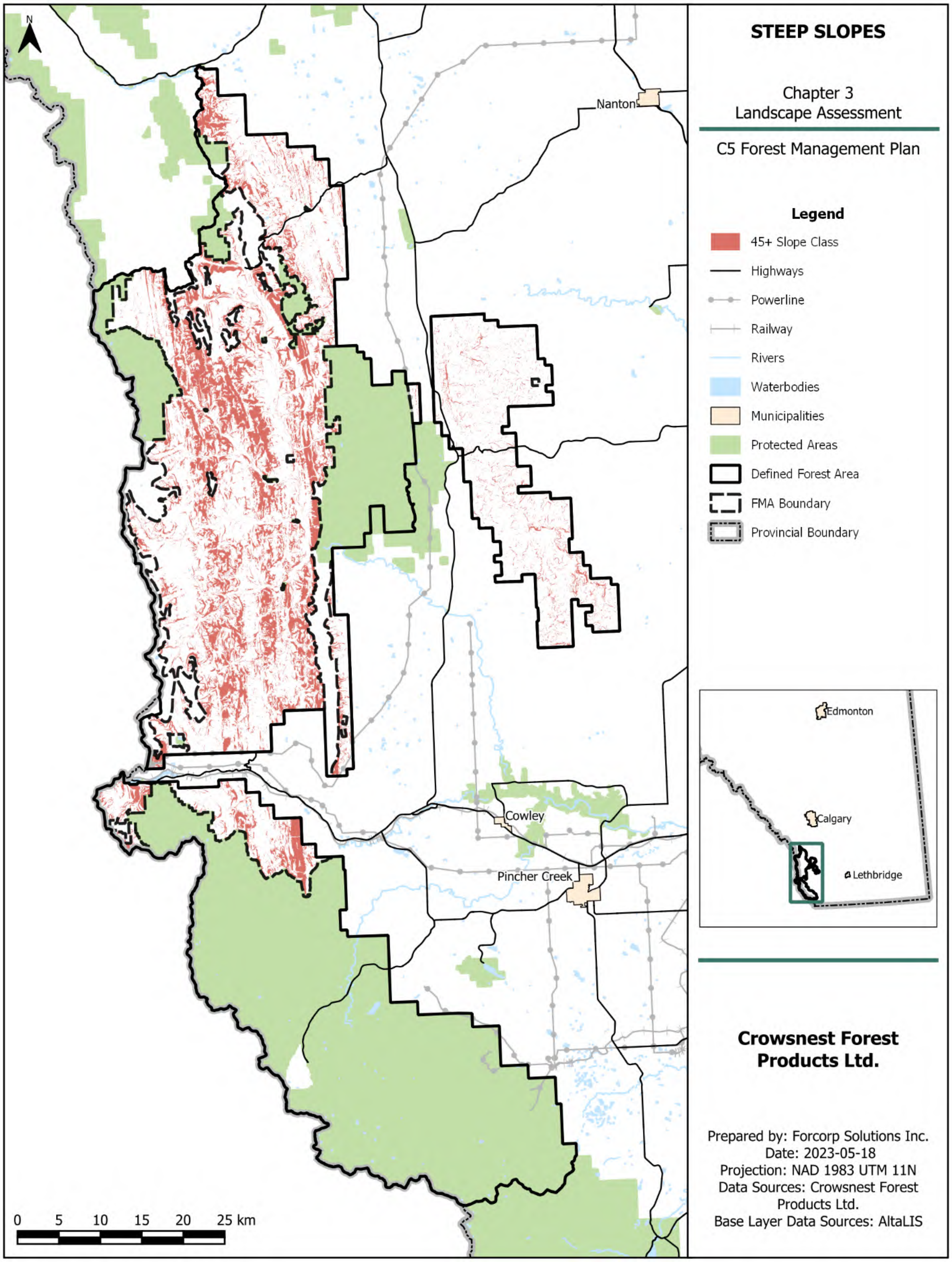

Figure 3-2. Areas within the FMA with slopes >45%.

3.2 Soils

There are ten soil orders in Canada [19], four of which are typically associated with forested landscapes: Luvisolic, Brunisolic, Podzolic and Organic (Table 3-2). The Brunisolic soil order is the dominant soil of the region, covering approximately 52% of the DFA (Table 3-3). Regosolic soils cover an additional 10% of the DFA, while the remainder is made up of Chernozemic soils (5%), Luvisolic soils (<1%), Organic Soils (<1%), ice (<1%), water (<1%), and unclassified areas (4%). Brunisolic soils are widespread across the the DFA, while Chernozemic soils are found in the east. Regosols are found in areas of higher elevation along the transition zone between the Montane and Subalpine subregions (Figure 3-3). Physical Land Classification (PLC) mapping has been completed by Alberta Environment and Parks for specific study areas only and does not cover the entirety of the DFA.

Table 3-2. Description of soil orders within the DFA (University of Saskatchewan, 2016).

Soil Order	Description
Brunisol	Brunisolic soils have sufficient development and typically have a brownish coloured B horizon. These soils tend to form under forests, giving them their colour, but can exist in a wide range of environments, including the Boreal forest, mixed forest, shrubs, grass, heath and tundra. They are usually well to imperfectly drained. Brunisolic soils are typically interpreted as a "transitional" soil, falling between generally unweathered parent material (common to Regosols) and mature forest soils represented by the Podzolic or Luvisolic orders.
Chernozem	Chernozemic soils are generally dark coloured and are dominant in the Canadian Prairies. These soils are typically found in areas with water deficits during the growing season. They are well developed and have a variety of parent materials from coarse sands to fine-textured silts and clay loams.
Luvisol	Luvisolic soils are generally light coloured and usually occur in well to imperfectly drained areas. They are located under forest vegetation, where the climate is sub-humid to humid and mild to very cold. They are well developed and have sandy loam to clay parent materials.
Regosol	Regosolic soils are characterized by a poorly developed or absent B horizon. These soils are commonly associated with landforms where the surface is or has been unstable, including sand dunes, river floodplains, and hillslopes with high rates of runoff.
Organic	Organic soils are the dominant wetland soils found in forested areas of Canada and also occur in upland sites where leaf litter accumulates. In wetlands, prolonged water saturation causes these soils to become anaerobic or anoxic, preventing or ceasing decomposition of organic materials. In upland sites, these soils are composed of leaf litter and other woody debris.

Table 3-3. Soil taxonomy within the DFA (where available).

Order Name	Group Name	Subgroup Name	Area (ha)	% of DFA
Brunisol	Eutric Brunisol	Eluviated Eutric Brunisol	34,782	10
		Orthic Eutric Brunisol	146,852	42
		Subtotal	**181,634**	**52**
Chernozem	Black Chernozem	Orthic Black Chernozem	16,824	5
		Rego Black Chernozem	1,128	0
		Subtotal	**17,953**	**5**
Luvisol	Gray Luvisol	Dark Gray Luvisol	858	0
Regosol	Regosol	Cumulic Regosol	1,243	0
		Orthic Regosol	32,301	9
		Subtotal	**33,544**	**10**
Organic			57	0
Ice			60	0
Water			63	0
Unclassified			14,151	4
Total			**248,319**	**71**

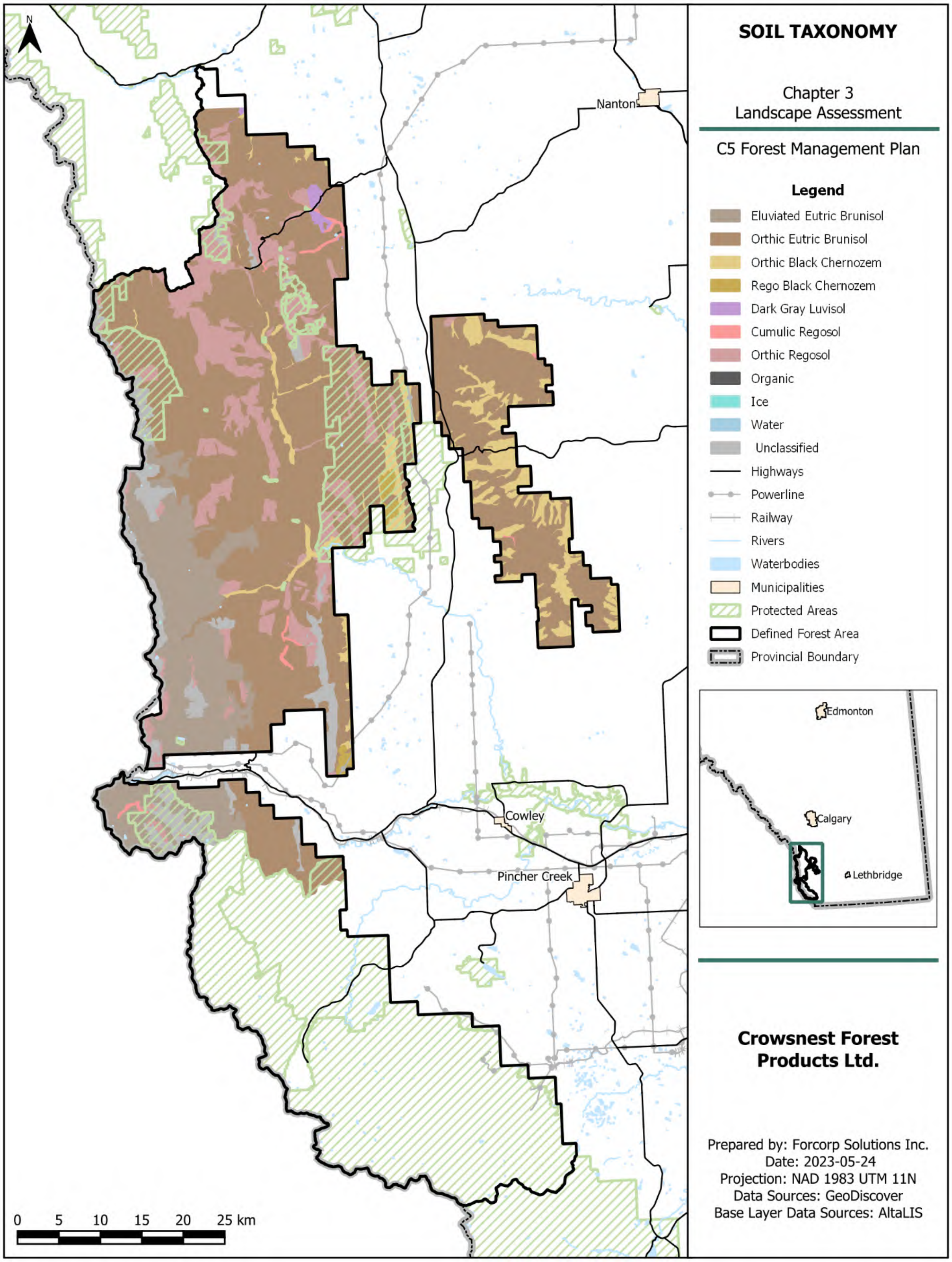

Figure 3-3. Soil taxonomy within the DFA (where available).

3.3 Hydrography

3.3.1 Water Basins

There are seven major drainage basins in Alberta that are closely tied to the Land-use Framework Regions [21]. The DFA is entirely within the South Saskatchewan drainage basin (watershed region) and includes two separate river basins (Figure 3-4). The vast majority of the DFA (97%) is within the Oldman River Basin and a small section (3%) in the northern portion of the DFA overlaps with the Bow River Basin (Table 3-4).

Table 3-4. Major Alberta river basins in the DFA.

Watershed Region	Alberta River Basin	Entire Basin Area (ha)	Portion of Basin in DFA		Portion of DFA Occupied by Basin (%)
			Area (ha)	(%)	
South Saskatchewan	Bow River	2,559,344	12,107	0	3
	Oldman River	2,641,714	338,241	13	97
Total		**5,201,058**	**350,348**	**7**	**100**

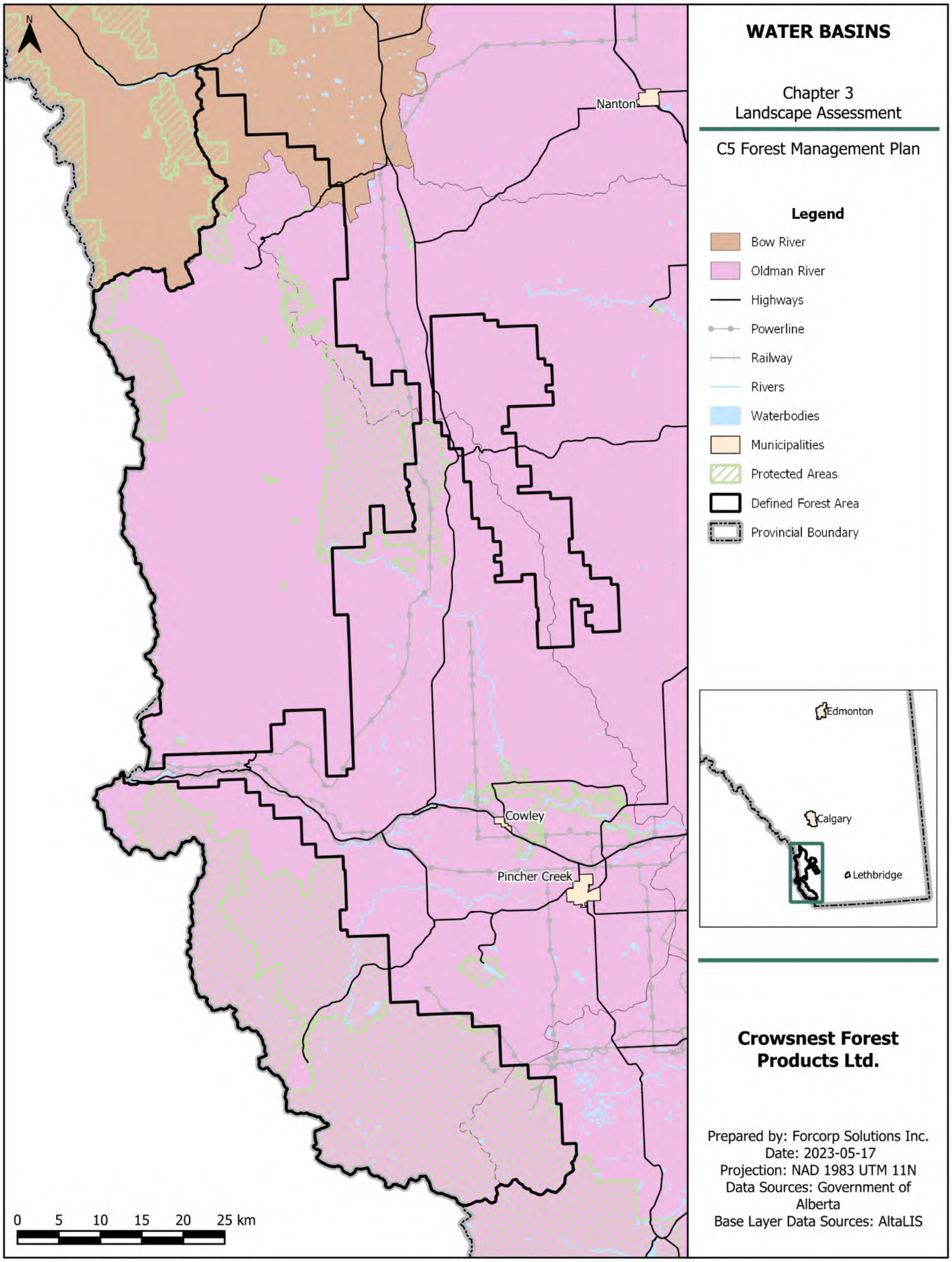

Figure 3-4. Alberta River Basins within and surrounding the DFA.

3.3.2 Equivalent Clearcut Area Watersheds

Equivalent Clearcut Area (ECA) is an index of watershed disturbance used by the Government of Alberta to assess forest recovery after harvest [22]. ECA analysis is a required part of the timber supply analysis in a forest management plan and is one element that is used to address potential impacts of forest harvest on water resources. Some watersheds within the DFA will have modified harvest plans to ensure that fish, drinking water, and other water related attributes are protected. There are 90 watersheds either partially or fully within the FMA area (Figure 3-5). Of these watersheds, there are 9 slivers < 500 ha that are excluded from the impact assessment as only a small proportion of the total watershed is located within the FMA. The area of the watersheds that will be assessed ranges from 543 ha to 8,271 ha with the average watershed size being 3,114 ha (Table 3-5).

Table 3-5. ECA Watersheds in the DFA.

ECA Watershed Size	Count	Area (ha)			
		Total	Minimum	Maximum	Average
< 500 ha	9	1,432	3	428	159
> 500 ha	81	252,229	543	8,271	3,114
Total	**90**	**253,660**	**3**	**8,271**	**2,818**

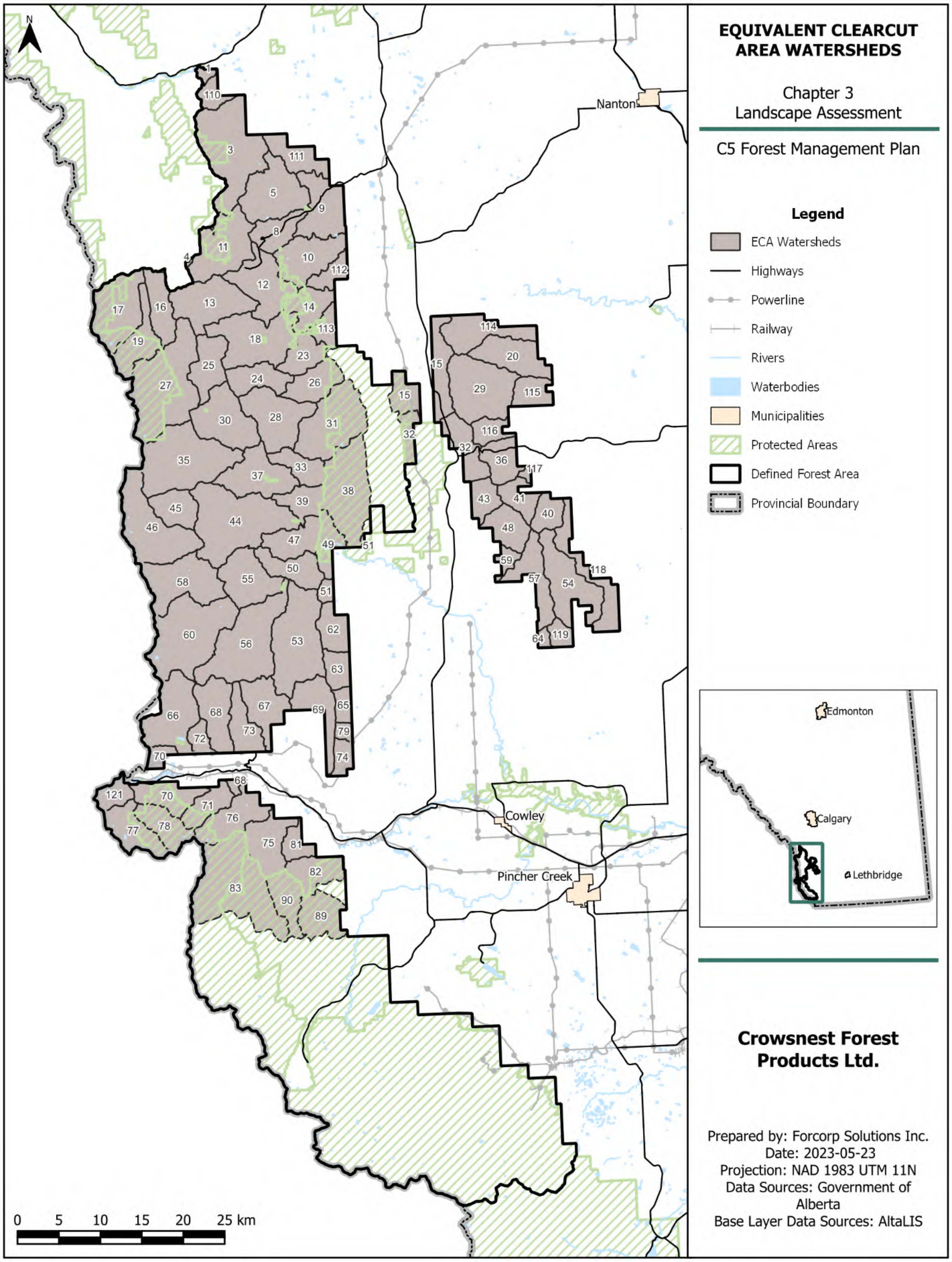

Figure 3-5. ECA Watershed units within the C5 Defined Forest Area.

3.3.3 Rivers, Streams, and Waterbodies

The main water features [23, 24] within and surrounding the DFA are displayed in Figure 3-6 and Table 3-6 and Table 3-7 provide area and distance summaries of waterbody and stream classes within the DFA. The largest lake in the DFA is Beaver Mines Lake. Major rivers within the DFA include the Highwood River, Oldman River, Castle River, and Livingstone River.

Table 3-6. Area of waterbodies within the DFA.

Waterbody Class	Area (ha)
Lake (Permanent)	203
Lake (Recurring)	65
Major River	67
Island	2
Icefield	87
Total	**423**

Table 3-7. Length of streams and rivers by classification within the DFA.

Stream Class	Length (km)
Major River (Primary)	19
Major River (Secondary)	1
Stream (Permanent)	493
Stream (Recurring)	5,178
Stream (Indefinite)	1,816
Oxbow (Permanent)	1
Oxbow (Recurring)	1
Lake (Primary)	8
Icefield	1
Arbitrary Flow (Manual)	32
Arbitrary Flow (DEM)	24
Total	**7,573**

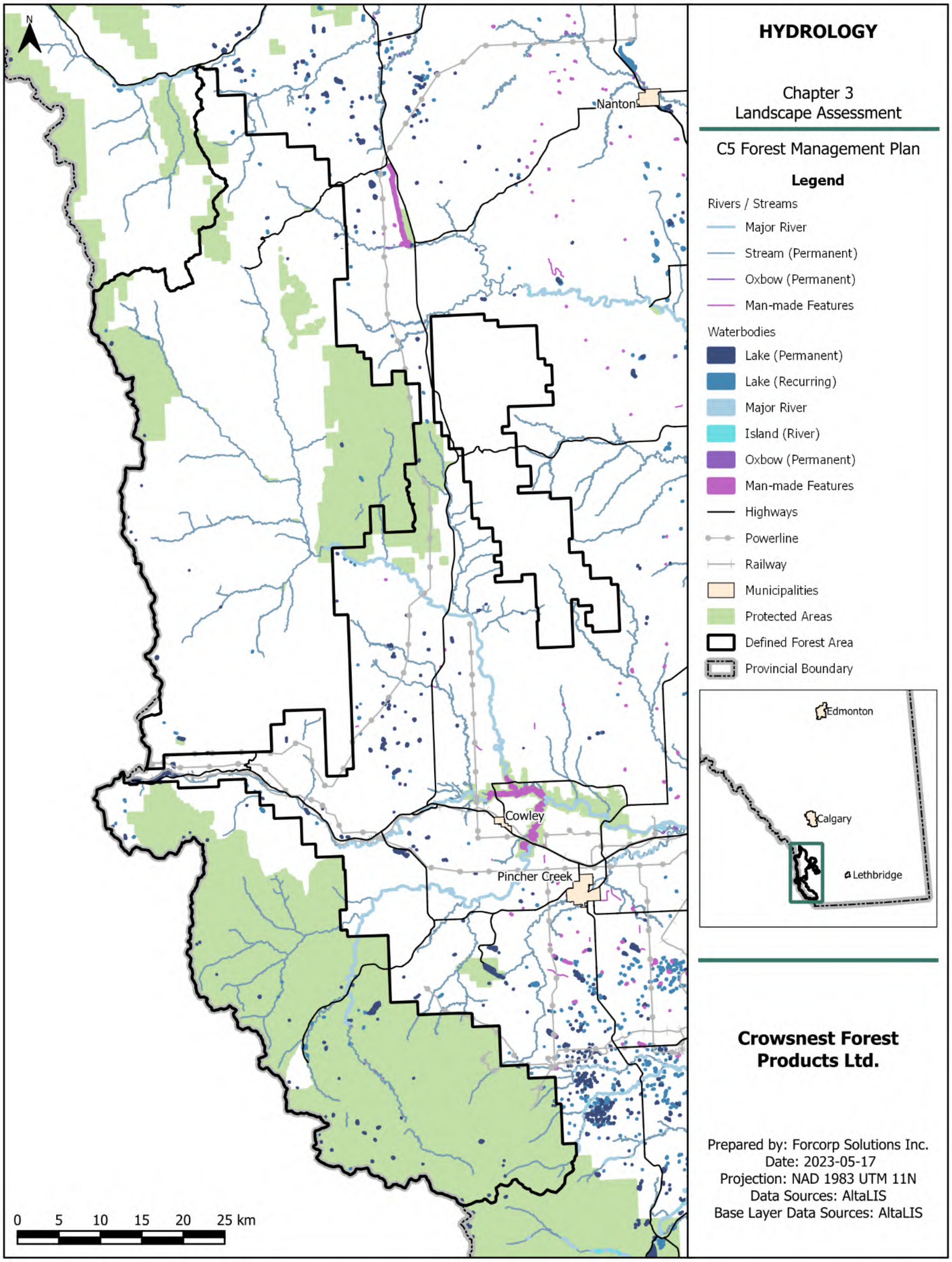

Figure 3-6. Permanent waterbodies and rivers within and surrounding the DFA.

3.3.4 Wetlands

Forest wetlands in Alberta are typically bogs, fens and marshes that have little to no tree cover. Forestry operations avoid wetlands and saturated soils that do not support commercial sized trees. There are only 137 hectares of wetlands identified in the DFA according to the AVI [(25)] which is significantly less than the amount of wetlands recorded on the DFA by the Alberta Biodiversity Monitoring Institute (ABMI). The AVI focuses on classifing broad upland vegetation classifications and was not designed as a wetland or range management inventory. The moisture regime field in the AVI was used in the net landbase development to remove areas too wet for harvesting, by removing polygons with a subhydric or hydric moisture regime. There are no areas classified as wetland within the DFA according to the provincial hydrography dataset.

The ABMI province-wide wetland inventory was released in 2019 and has been used to supplement the AVI wetland data [(26)]. There is an additional 189 ha of wetlands within the DFA as classified by the ABMI layer (Table 3-8, Figure 3-7).

Table 3-8. Number and area of wetlands in the DFA, classified by AVI and based on the provincial hydrography layer and ABMI wetland inventory.

Wetland Classification	Number	Area (ha)
AVI Wetlands - Bog (Subhydric)	2	3
AVI Wetlands - Fen (Subhydric)	77	134
Hydrography Wetlands Layer	0	0
ABMI - Wetland General	133	165
ABMI - Open Water	58	161
Total	**270**	**463**

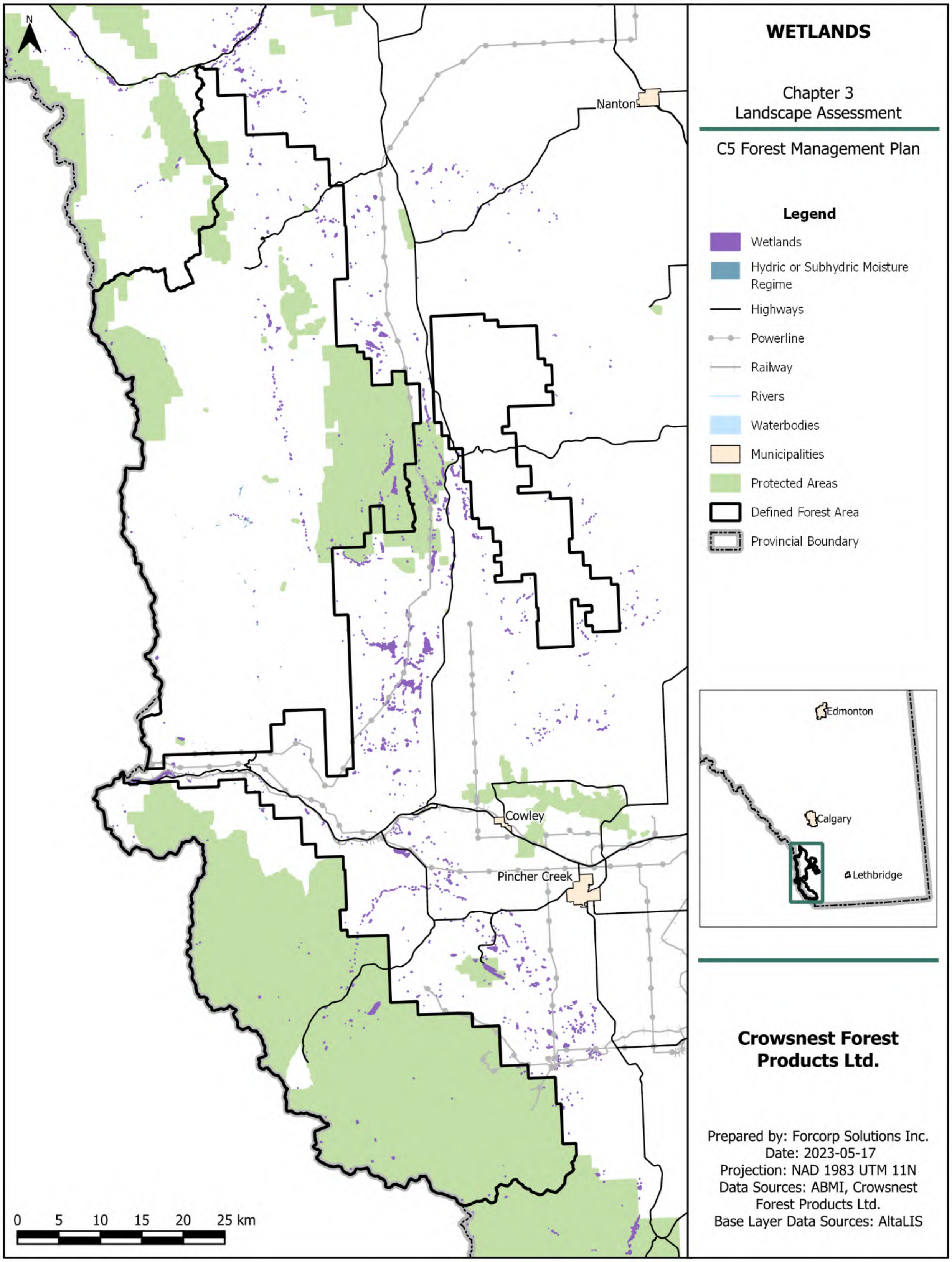

Figure 3-7. Wetlands in the DFA.

3.4 Climate

Alberta has a cool continental climate characterized by a large variation between winter and summer temperatures. The DFA has a variable climate due to variability in elevation, aspect, topography and latitude. The DFA receives more precipitation than much of the province [(27)] with much of the area receiving upwards of 550 mm in mean annual precipitation (Figure 3-8). Precipitation in the DFA tends to increase as you move southward and westward, following the general trend of increasing elevation (see Section 3.1). The DFA also experiences cooler summers and warmer winters than much of the rest of the province. There is little variation in mean January temperature in the DFA, though the mean July temperature is slightly cooler in the western portion of the DFA (Figure 3-8).

The Alberta government recognizes that the climate is changing and globally we are experiencing impacts such as an increasing temperature, rising ocean levels and more frequent drought, floods, and forest fires. In the forestry context, the Alberta government has identified that warmer temperatures and reduced soil moisture creates conditions for continued mountain pine beetle infestations, grasslands displacing existing forest ecosystems, and greater incidences of forest fires (Government of Alberta, 2023).

During a fire event, greenhouse gases such as carbon dioxide (and to a lesser extent methane), long-chain hydrocarbons, nitrogen compounds, and carbon particulate matter are emitted. Forest soils sequester and store mercury in addition to carbon. During large fire years, volatilized mercury released into the atmosphere approached industrial mercury emissions equal to those across all North America. The bulk of the fire-related mercury emissions are likely transported to the Polar Regions, presenting long term consequences to the health of northern food chains (Flannigan M., 2007).

According to Natural Resources Canada, in recent years Canada’s forests have become carbon sources rather than sinks as they typically release more carbon into the atmosphere than they are accumulating in any given year. Key reasons for this are increased wildfire activity and unprecedented insect outbreaks.

The Intergovernmental Panel on Climate Change (IPCC) recognizes sustainable development as the overarching context for climate change policy. The IPCC has identified sustainable forestry management as a cost-effective climate change mitigation and adaptation strategy to conserve existing carbon pools by reducing deforestation and forest degradation and preventing wildfire.

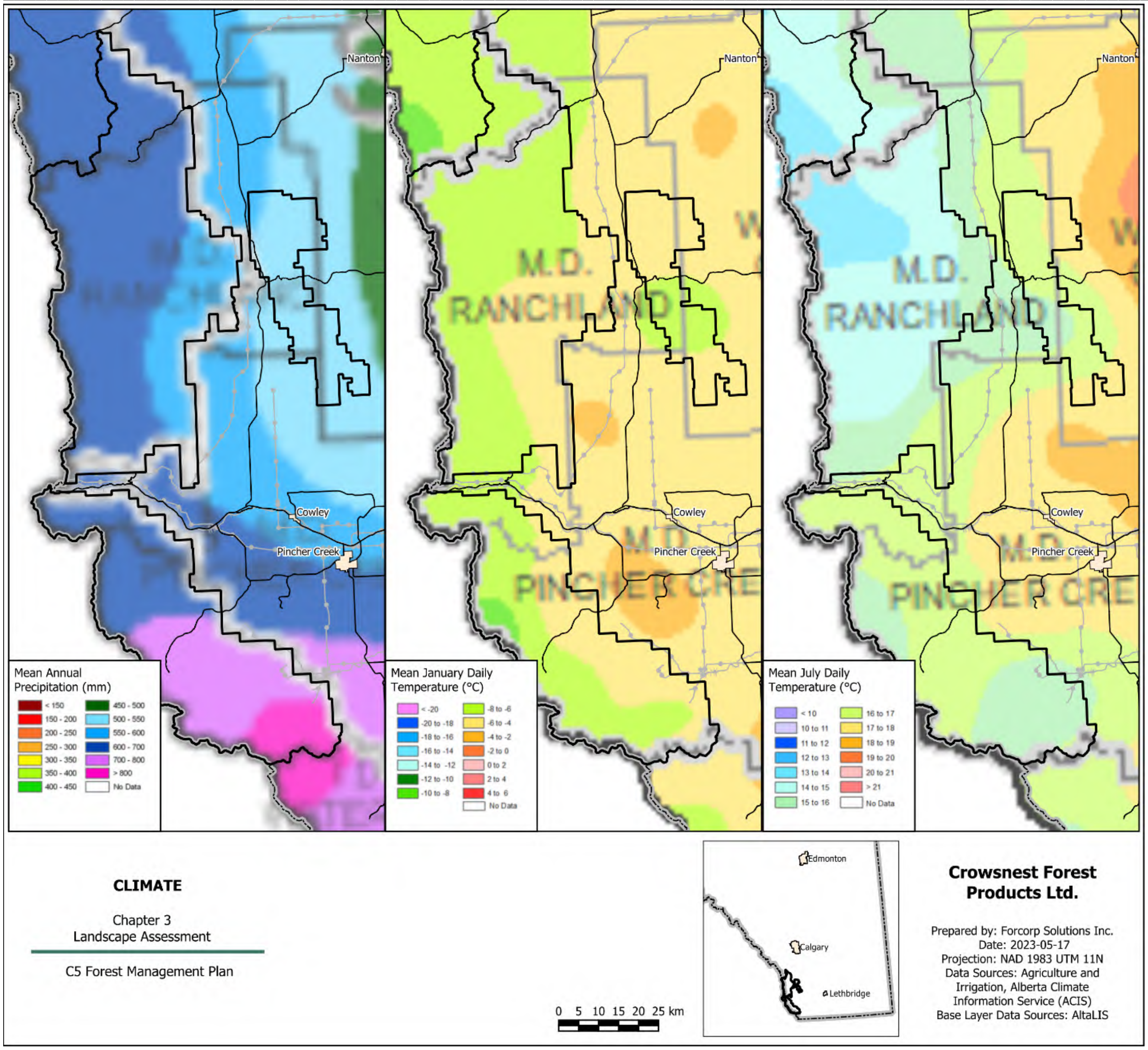

Figure 3-8. Mean annual precipitation and temperatures within and surrounding the DFA measured at a provincial scale.

4 Landscape Pattern and Structure

Detailed forest inventory data are required to review landscape patterns of vegetation. Older Alberta Vegetation Inventory (AVI) inventory data in this area were compiled from orthophotos taken in the mid-1990s and were used for the previous landbase and DFMP [28]. New AVI data were compiled for the new landbase and FMP based on new imagery flown in 2022 [25]. The differences between the new and old AVI can be used to identify changes in forest patterns and structure in the DFA over the last ~25 years. However, the old AVI covers an additional 27,771 ha (or 8% of the DFA) as compared to the new AVI and the change in extent of the inventory may account for some of these changes.

4.1 Forest Species

There are thirteen leading species classified in the DFA in either the new or old AVI datasets (Table 4-1). Lodgepole pine is the most prevalent species in both the new and old AVI (45% and 47% cover, respectively), followed by Engelmann spruce (14% cover for each, Table 4-2). The new AVI also includes western larch as a leading species, which was not classified as such in the previous inventory. There are no stands classified as undifferentiated hardwood, undifferentiated pine, jack pine, or paper birch in either the new or old AVI. Much of the central and western portions of the DFA are covered by coniferous species such as lodgepole pine and Engelmann spruce, while much of the trembling aspen leading forest is on the northeastern fringes of the DFA (Figure 4-1). The non-forested area of the DFA decreased from 21% to 13% from the old to the new AVI.

Table 4-1. Leading species classifications in the DFA in the old and new AVI.

Common name	Latin name	Abbreviation
Trembling aspen	*Populus tremuloides*	Aw
Alpine fir	*Abies lasiocarpa*	Fa
Balsam fir	*Abies balsamea*	Fb
Douglas-fir	*Pseudotsuga menziesii*	Fd
Alpine larch	*Larix lyallii*	La
Western larch	*Larix occidentalis*	Lw
Whitebark pine	*Pinus albicaulis*	Pa
Balsam poplar	*Populus balsamifera*	Pb
Limber pine	*Pinus flexilis*	Pf
Lodgepole pine	*Pinus contorta*	Pl
Black spruce	*Picea mariana*	Sb
Engelmann spruce	*Picea engelmannii*	Se
White spruce	*Picea glauca*	Sw

Table 4-2. Leading forest species found within the DFA (old and new AVI).

	Old AVI		New AVI		Net Change in Area from Old to New AVI (%)
Leading Species	Area (ha)	Area (%)	Area (ha)	Area (%)	
Aw	13,871	7	17,001	9	3
Fa	7,479	4	5,961	3	0
Fb	44	0	0	0	0
Fd	20,998	11	18,162	10	0
La	389	0	511	0	0
Lw	0	0	20	0	0
Pa	906	0	2,160	1	1
Pb	147	0	586	0	0
Pf	104	0	337	0	0
Pl	88,811	47	85,308	45	4
Sb	22	0	22	0	0
Se	26,007	14	27,370	14	2
Sw	20,739	11	8,027	4	-5
Non-forested	38,918	21	25,200	13	-5
Total	**218,436**	**115**	**190,665**	**100**	**0**

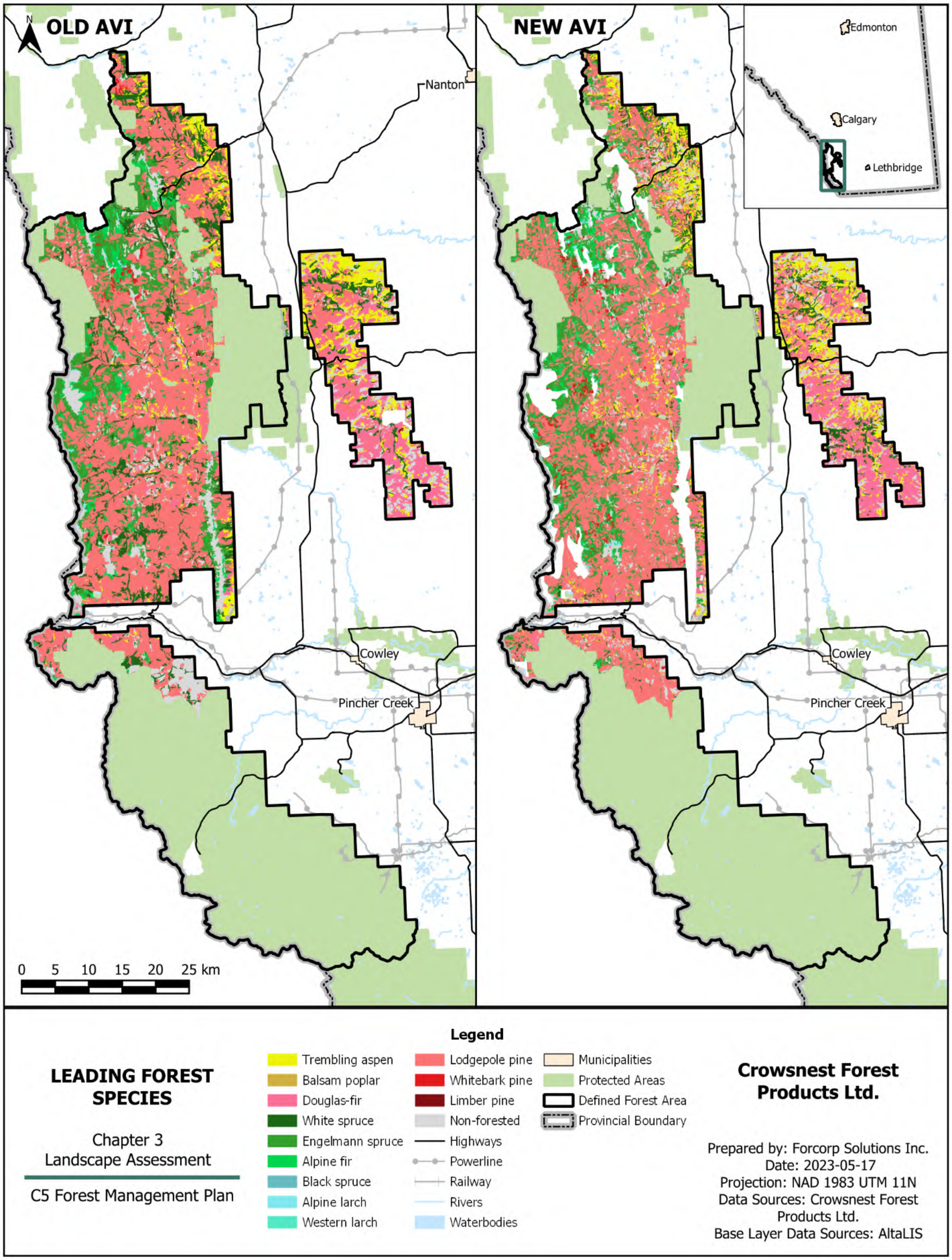

Figure 4-1. Comparison of leading tree species in the DFA from old AVI to new AVI.

4.2 Forest Cover Types

Forest cover types are based on the provincial base 10 strata defined in the yield projection section of the Alberta Forest Management Planning Standard (Alberta Sustainable Resource Development, 2006). These classifications are hierarchical, based on the broad cover group (coniferous, coniferous-deciduous, deciduous-coniferous, deciduous) and by leading coniferous species for stands that are not pure deciduous. The DFA is dominated by pure coniferous forests, which make up 77% of the DFA area in the new AVI (Table 4-3). Coniferous-Deciduous and Deciduous-Coniferous stands each make up 1% of the DFA, while the remaining 8% of the forested portion are pure deciduous stands (Figure 4-2). There was a 2% increase in pure coniferous stands and a 3% increase in pure deciduous stands while the proportion of mixed stands remained the same. Pure coniferous forests cover much of the western half of the DFA, while mixed and deciduous leading stands are found in the northeastern half of the DFA and Douglas-fir stands are found in the southeast (Figure 4-3).

Table 4-3. Summary of forest cover types within the DFA for the old and new AVI.

Broad Cover Group	B10 Strata number	Cover Type	Old AVI Area (ha)	Old AVI Area (%)	New AVI Area (ha)	New AVI Area (%)	Net Change in Area from Old to New AVI (%)
D	I	HW	11,693	5	15,405	8	3
DC	II	HWPL	1,019	0	878	0	0
	III	HWSX	1,413	1	1,228	1	0
	Subtotal		**2,432**	**1**	**2,106**	**1**	**0**
CD	IV	SWHW	742	0	763	0	0
	V	PLHW	908	0	1,255	1	0
	VI	SBHW	0	0	0	0	0
	Subtotal		**1,650**	**1**	**2,018**	**1**	**0**
C	VII	SW	53,762	25	40,641	21	-3
	VIII	PL	88,927	41	86,817	46	5
	IX	SB	411	0	553	0	0
	X	FD	20,642	9	17,924	9	0
	Subtotal		**163,743**	**75**	**145,935**	**77**	**2**
Non-forested			38,918	18	25,200	13	-5
Total			**218,436**	**100**	**190,665**	**100**	**0**

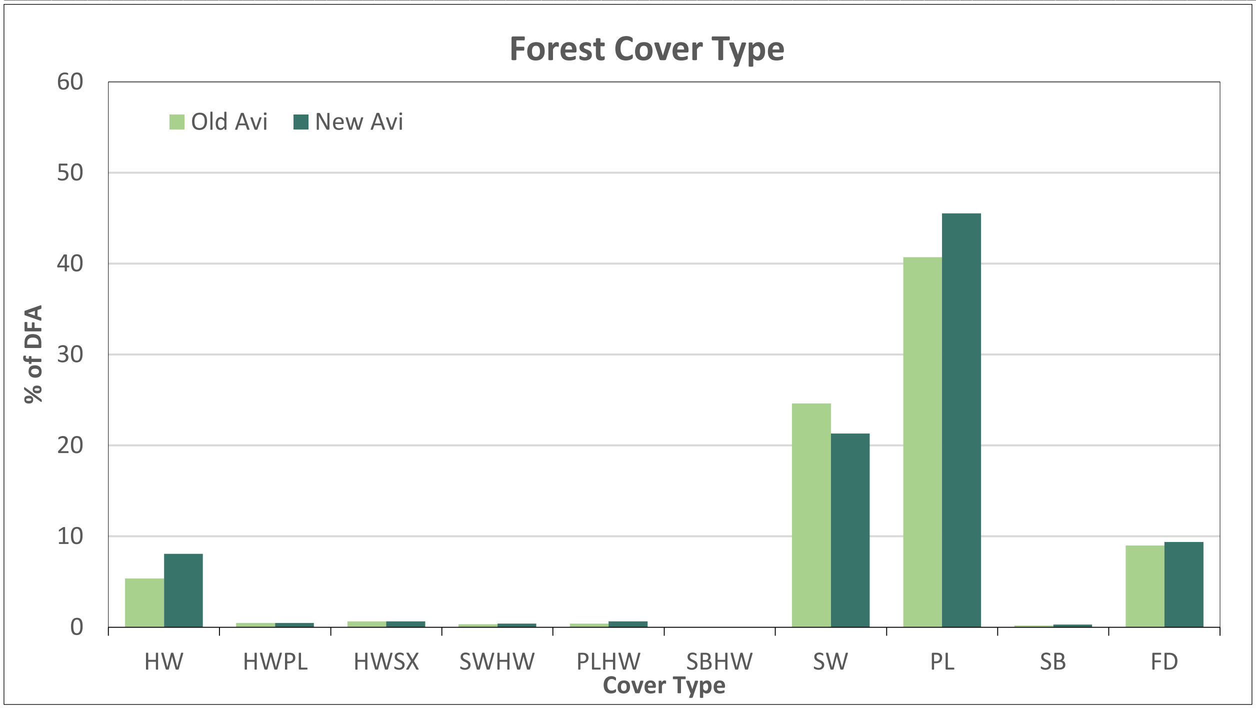

Figure 4-2. Percent area of forest cover types within the DFA (old and new AVI).

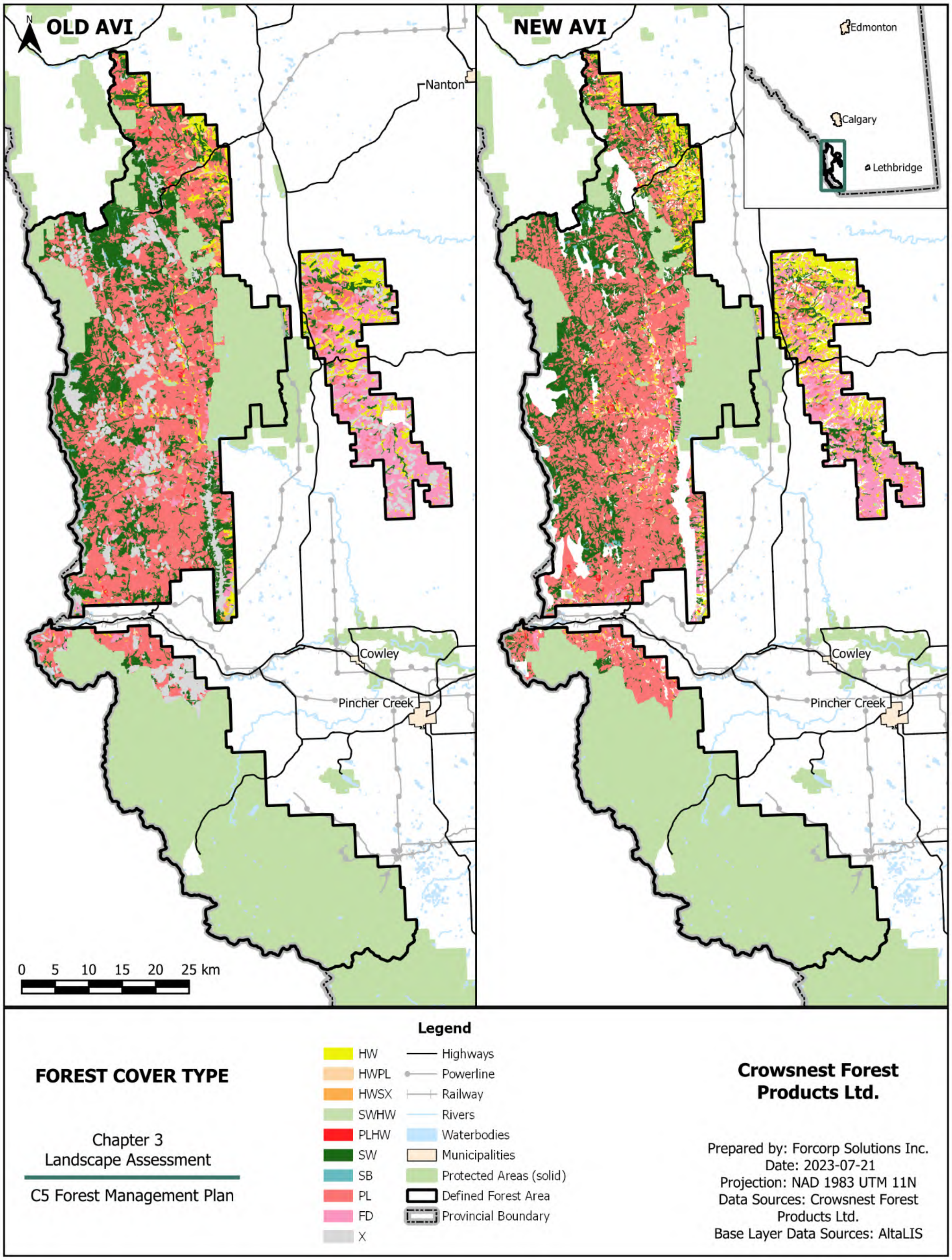

Figure 4-3. Forest cover type distribution in the DFA (old and new AVI).

4.3 Ecosites

Ecosites are ecological units that develop under similar environmental conditions including climate, elevation, aspect, moisture regime and nutrient regime (Alberta Agriculture and Forestry, 2017a). The most predominant ecosite in the DFA is the e ecosite (36%), which includes the false azalea-grouseberry and thimbleberry/pine grass ecosite phases. Overall, 81% of the DFA is classified as being b, c, d, or e ecosites (Table 4-4). The drier ecosites (a, b) are more prevalent in the western part of the DFA (Figure 4-4).

Polygons are given a value of 'x' to indicate no ecosite assignment. These are typically non-forested polygons and may include hydrology features, naturally non-vegetated areas, or anthropogenically vegetated and non-vegetated areas. Within the DFA, rock/barren areas, pipelines and powerlines seeded to grass, and permanent right-of-ways are the most common reasons for the classification.

Table 4-4. Ecosite classification in the DFA (new AVI).

Ecosite	Description	Area (ha)	% of DFA
a	Lichen; limber pine / juniper	17,218	9
b	Bearberry / hairy wild rye; bearberry	28,159	15
c	Canada buffaloberry / hairy wild rye; subalpine larch / heather	24,633	13
d	Creeping mahonia - white meadowsweet; spruce / heather	31,822	17
e	False azalea - grouseberry; thimbleberry / pine grass	68,001	36
f	Balsam poplar; thimbleberry	4,097	2
g	Dwarf birch / tufted hair grass; horsetail	328	0
h	Grassland; horsetail	5,577	3
i	Grassland; meadow	5,086	3
j	Subhygric-poor	7	0
k	Bog; fen	67	0
l	Fen	70	0
x	No ecosite assignment	5,600	3
Total		**190,665**	**100**

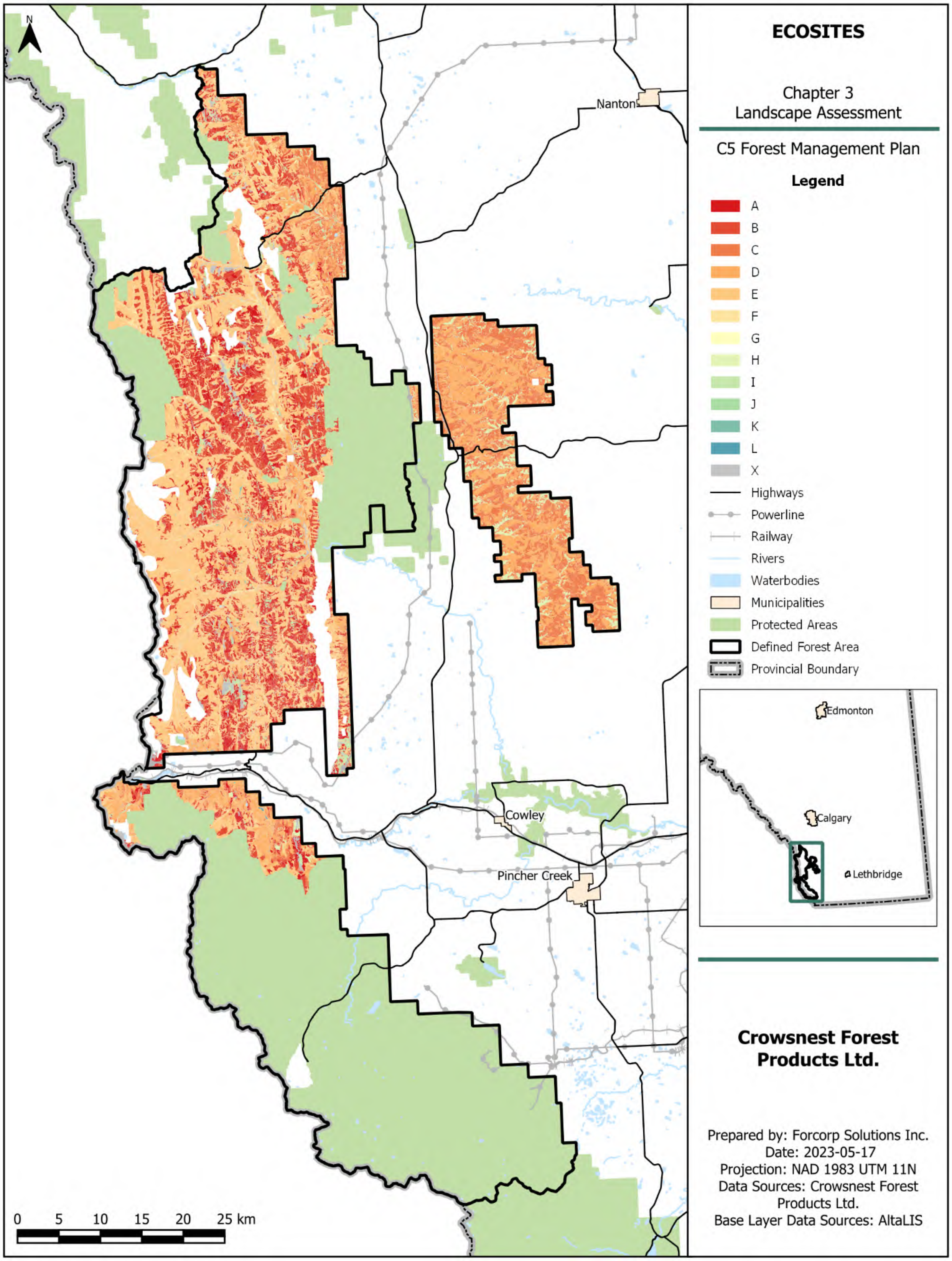

Figure 4-4. Ecosite classification in the DFA (new AVI).

4.4 Forest Age Classes

The old and new AVI provide snapshots of the DFA's forest age class distribution at the time of their capture (1997 and 2022 respectively) and provide insight into how the forest has changed over the last ~25 years. The new AVI demonstrates a shift towards a slightly older forest age distribution, though with more area in the youngest age classes as well (Table 4-5, Figure 4-5). Forest stands in the DFA currently range from 1 to 422 years old, with 39% of the DFA currently classified as being between 80-120 years old. The prevalence of the 91-100 year old age class (10%) is consistent with the wildfire history, as 10% of the DFA burned in the 1930s (see Section 5.5). Mid-age stands are spread throughout the DFA, with the largest section of young stands occuring in the southernmost portion and older stands occuring primarily in the northwestern section of the DFA (Figure 4-6). Stand ages are based on AVI standards and do not always represent on the ground sampling.

Table 4-5. Forest age class distribution in the DFA (old and new AVI).

	Old AVI		New AVI		Net Change in Area from Old to New AVI (%)
Age Class	Area (ha)	Area (%)	Area (ha)	Area (%)	
1 - 10	7,715	4	5,826	3	0
11 - 20	5,122	2	8,670	5	2
21 - 30	1,928	1	5,348	3	2
31 - 40	3,391	2	4,030	2	1
41 - 50	5,412	2	3,384	2	-1
51 - 60	6,115	3	5,463	3	0
61 - 70	22,711	10	7,796	4	-6
71 - 80	22,376	10	6,015	3	-7
81 - 90	32,281	15	14,873	8	-7
91 - 100	15,646	7	19,477	10	3
101 - 110	14,639	7	36,894	19	13
111 - 120	12,115	6	3,830	2	-4
121 - 130	16,403	8	17,890	9	2
131 - 140	4,944	2	1,162	1	-2
141 - 150	3,812	2	11,290	6	4
151 - 160	2,813	1	3,067	2	0
161 - 170	1,375	1	3,374	2	1
171 - 180	369	0	2,134	1	1
181 - 190	1,476	1	2,525	1	1
191 - 200	163	0	16	0	0
201+	4,479	2	8,084	4	2
Undefined	33,154	15	19,516	10	-5
Total	**218,436**	**100**	**190,665**	**100**	**0**

Figure 4-5. Forest age class distribution in the DFA (old and new AVI).

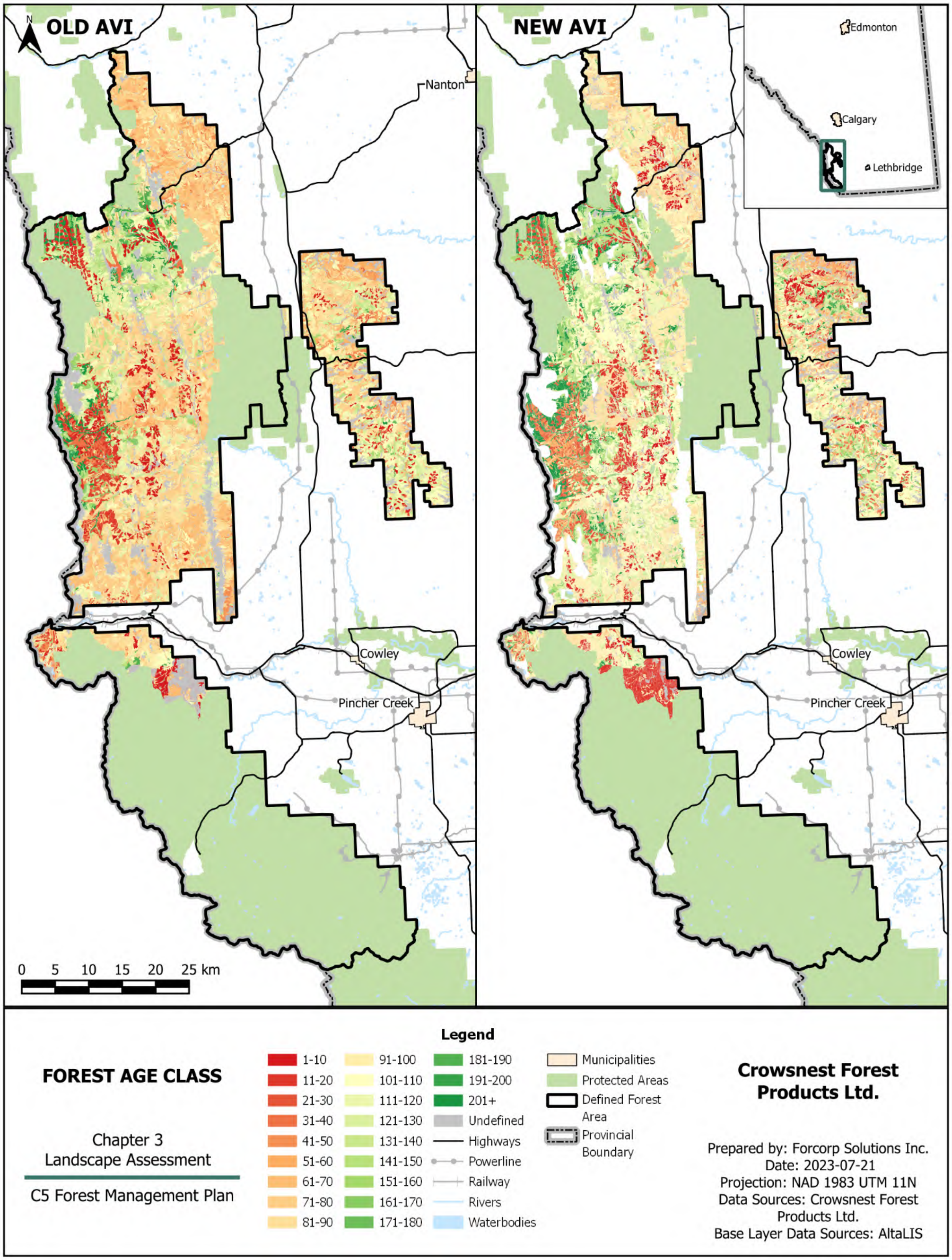

Figure 4-6. Forest age class distribution in the DFA (old and new AVI).

4.5 Seral Stages

Seral stages refer to stages in forest succession that are characterized by plant community conditions. Seral stages were delineated by stand age.

- Young: stands between disturbance date and 20 years old, representing the period from disturbance until initial crown closure
- Immature: stands between 21 and 80 years old, when stands first begin to reach merchantable age
- Mature: stands between 81 and 120 years old
- Old: stands between 121 and 180 years
- Very old: stands greater than 180 years old

The majority of the DFA consists of mature or older forests in the new AVI (65%, Table 4-6). The current distribution of young stands in the DFA is reflective of recent timber harvesting (see Section 5.6) and fires, including the Lost Creek Wildfire that occurred within the southern portion of the FMA, Castle Provincial Park, and Castle Wildland in 2003 (see Section 5.5) (Figure 4-8). The area in all seral stages has increased from the old to the new AVI, except for a decrease in the immature and undefined seral stages.

Table 4-6. Seral stages in the DFA (old and new AVI).

	Old AVI		New AVI		Net Change in Area from Old to New AVI (%)
Seral Stage	Area (ha)	Area (%)	Area (ha)	Area (%)	
Young	12,837	6	14,496	8	2
Immature	61,931	28	32,037	17	-12
Mature	74,680	34	75,074	39	5
Old	29,715	14	38,917	20	7
Very old	6,118	3	10,625	6	3
Undefined	33,154	15	19,516	10	-5
Total	**218,436**	**100**	**190,665**	**100**	**0**

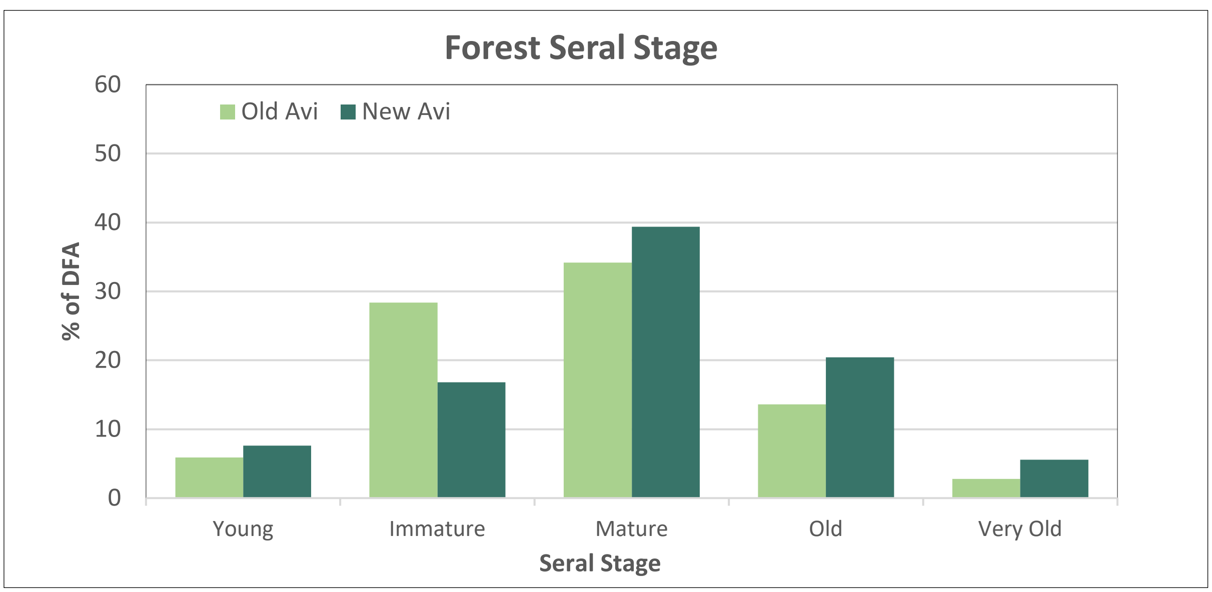

Figure 4-7. Seral stage distribution in the DFA (old and new AVI).

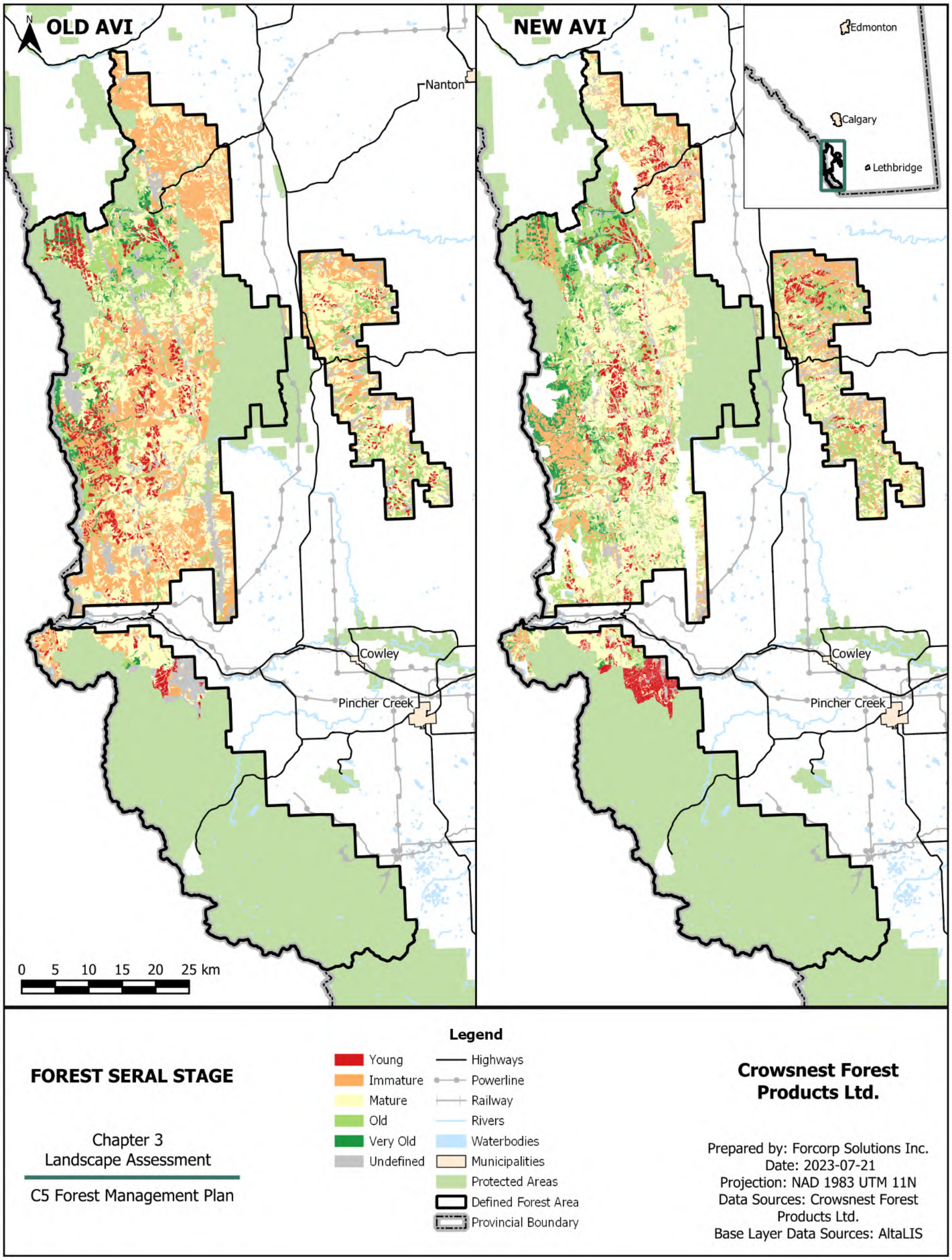

Figure 4-8. Seral stage distribution in the DFA (old and new AVI).

4.6 Forest Patches

4.6.1 Young Forest Patches

Young forest patches are contiguous areas of forest in the young seral stage, greater than 0.1 hectares in area, that are not separated by any linear feature greater than 8 metres in width. The majority of young forest patches are less than 20 ha in size, though patches from 20 – 100 hectares in size make up the most area in the DFA for the new AVI (Table 4-7). The shifts in total young forest area from the old to the new AVI corresponds to the changes in the number and total area of young forest patches (Table 4-7), which are now slightly more common throughout the DFA (Figure 4-9). The average young patch size has increased, with patches 250+ ha representing 45% of young patches currently found within the DFA.

Table 4-7. Young forest patches in the DFA (old and new AVI).

	Old AVI			New AVI		
Patch Size Class	Number of Patches	Total area (ha)	Average Patch Size (ha)	Number of Patches	Total area (ha)	Average Patch Size (ha)
0 - 20	364	2,947	8	313	1,962	6
20 - 100	104	3,807	37	74	2,770	37
100 - 250	6	1,046	174	1	147	147
250+	3	857	286	3	3,933	1,311
Total	**477**	**8,657**	**18**	**391**	**8,812**	**23**

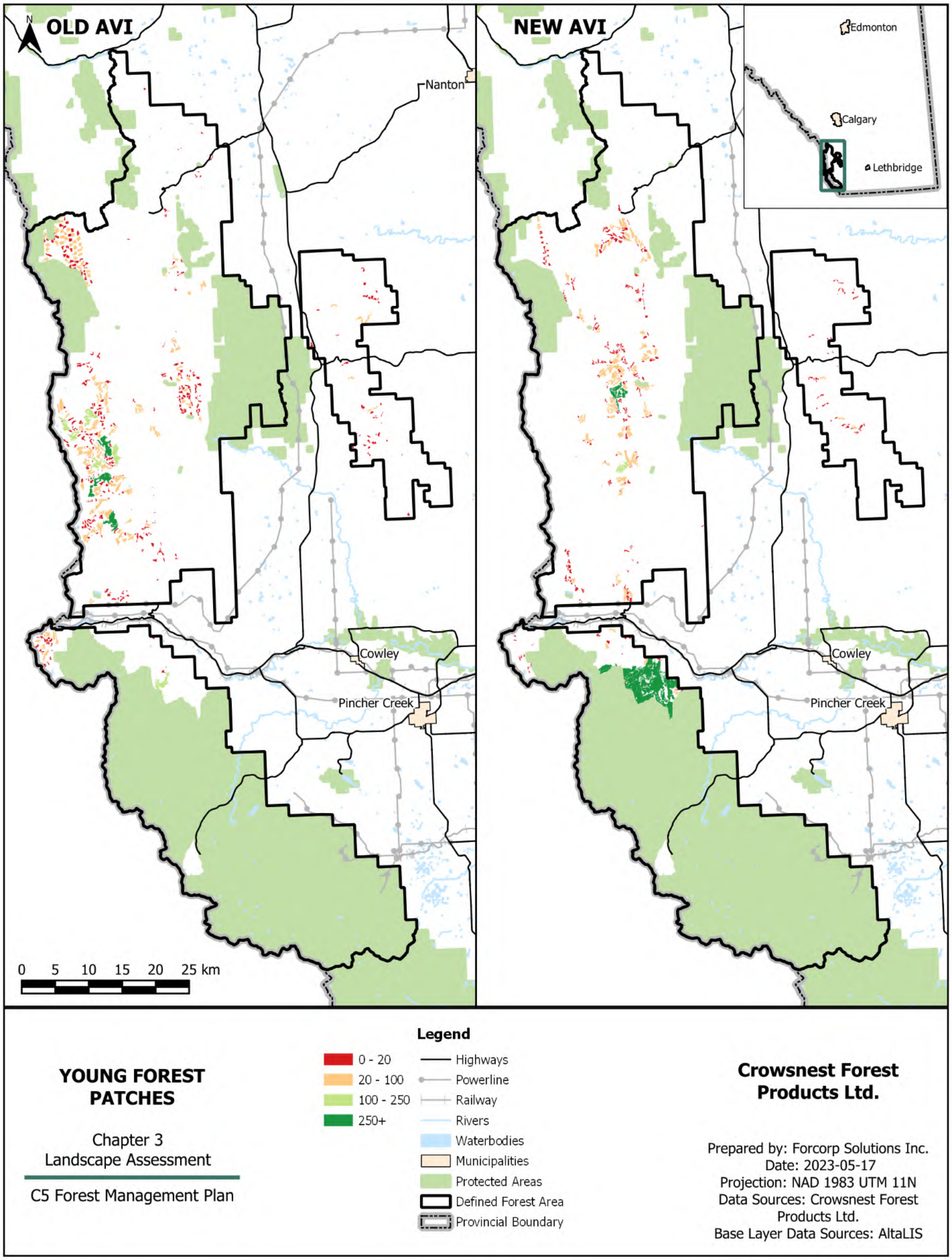

Figure 4-9. Young forest patch distribution in the DFA (old and new AVI).

4.6.2 Old Interior Forest

Monitoring the condition of interior forests is one of two FMP reporting requirements specified by the GoA. The GoA definition of interior forest is contiguous forested areas greater than 100 hectares located beyond a defined edge buffer zone. The edge buffer zone is applied in two cases:

- Along any stand that shares a common boundary with a linear disturbance greater than 8 metres in width; or
- A stand edge along which the seral stage changes.

The edge buffer is calculated as:

- 60 metres, where the adjacent area is non-forested, or forested but less than or equal to 40-years old; and
- 30 metres, where the adjacent forest stand is greater than 40-years old but not yet mature forest.

There is no edge applied where adjacent stands are mature, old, or very old.

Using these rules, 14% of the DFA in the old AVI and 39% in the new AVI is old interior forest (Table 4-8, Figure 4-10). The increase in area of old interior forest from the old to the new AVI can be explained by the increase in overall area of the mature, old, and very old seral stages.

Table 4-8. Old interior forest in the DFA by seral stage (old and new AVI).

	Old AVI		New AVI		Percentage Change in
Seral Stage	Area (ha)	% of DFA	Area (ha)	% of DFA	Area from Old to New AVI
Mature	17,933	5	44,856	13	150
Old	6,761	2	24,031	7	255
Very old	2,307	1	6,144	2	166
Total	**27,002**	**14**	**75,031**	**39**	**178**

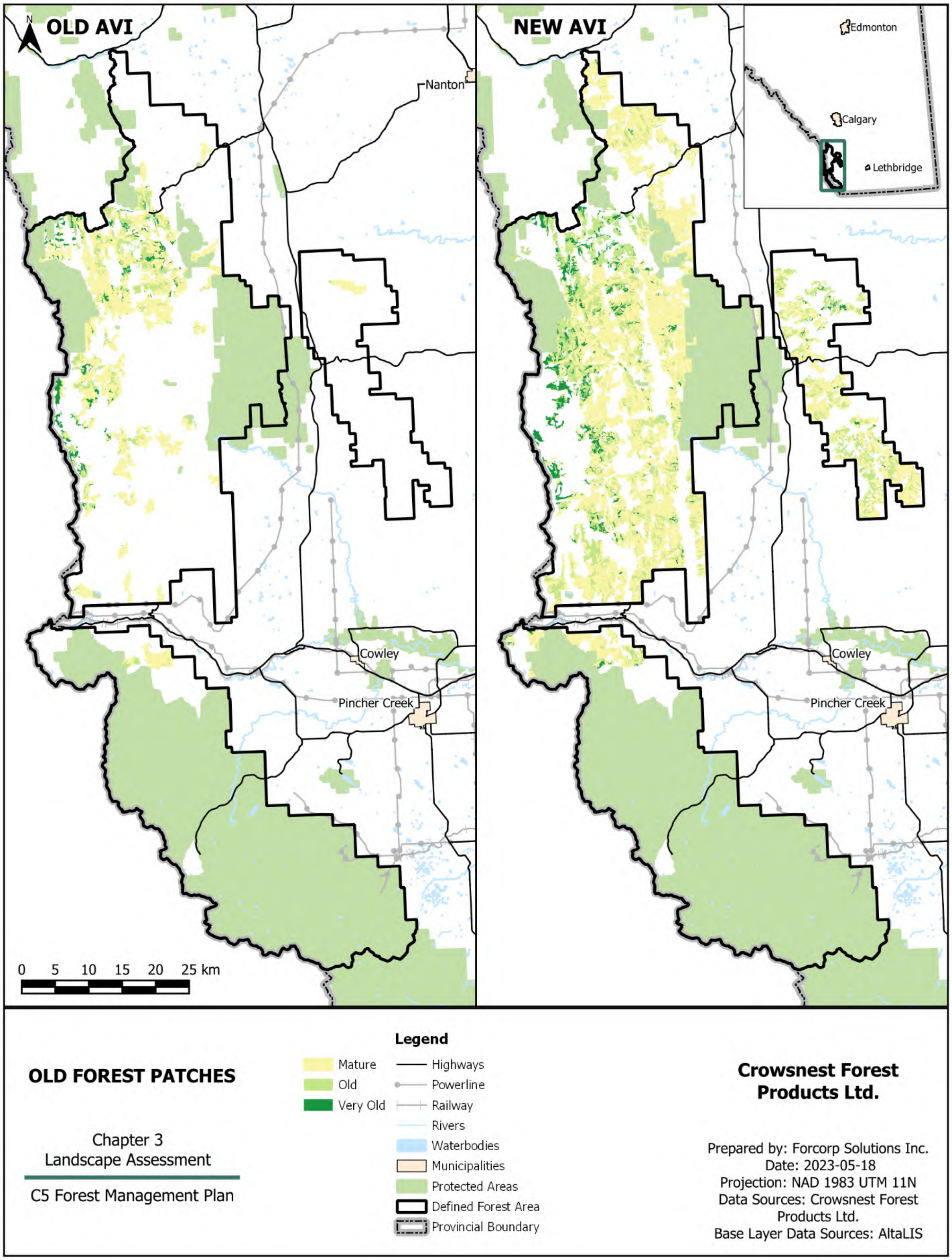

Figure 4-10. Old interior forest in the DFA by seral stage (old and new AVI).

5 Landscape Disturbance and Succession

5.1 Inherent Disturbance Regime

The natural disturbance regime of the Crowsnest Forest Products' DFA consists of wildfire and other damaging agents, with wildfire being the dominant natural factor shaping the composition and distribution of species. Anthropogenic activities are now the dominant source of landscape disturbances in the DFA due to the supression of fire. Government regulation and policy also influence the landscape by limiting the impact of anthropogenic and natural disturbances through regional and sub-regional planning, wildfire prevention, wildfire control, and insect suppression programs.

5.2 Insects and Diseases

5.2.1 Mountain Pine Beetle

The mountain pine beetle (*Dendroctonus ponderosae*) is the most destructive insect threat to mature pine forests in North America (Alberta Sustainable Resource Development, 2007). Mature and over-mature pine under stress are the preferred host, but as beetle populations increase, smaller-sized and healthy trees can also be attacked. Outbreaks continue as long as a food source is available and climatic conditions are favourable. The beetle kills trees by clogging and destroying the conductive tissue of the tree. Its larvae feed in the phloem of the tree, disrupting the flow of water and nutrients. In addition, the larvae introduce a blue-stain fungus which prevents the tree from using its pitch to repel the attacking beetles.

The Stand Susceptibility Index (SSI) measures the physical characteristics of a stand that determine its MPB habitat suitability, without considering the climate or location of the particular stand. For example, a stand may have a high SSI but be located in an area that would give it no real capacity to produce new beetle populations (e.g. higher elevation). Approximately one third of the DFA has been assigned an SSI value (35%) and the greatest area is made up of stands in the Moderate susceptibility category (Table 5-1, Figure 5-1).

Mountain pine beetle attacks have declined since 2009 [29] when there were large infestations throughout the DFA and there has been minimal disturbance in the past four years (Figure 5-2).

Table 5-1. Stand Susceptibility Index (SSI) within the DFA.

SSI Range	Susceptibility Category	Area (ha)	% of DFA
1 - 22	Low	27,559	8
23 - 63	Moderate	93,468	27
64 - 100	High	1,507	0
Total		**122,534**	**35**

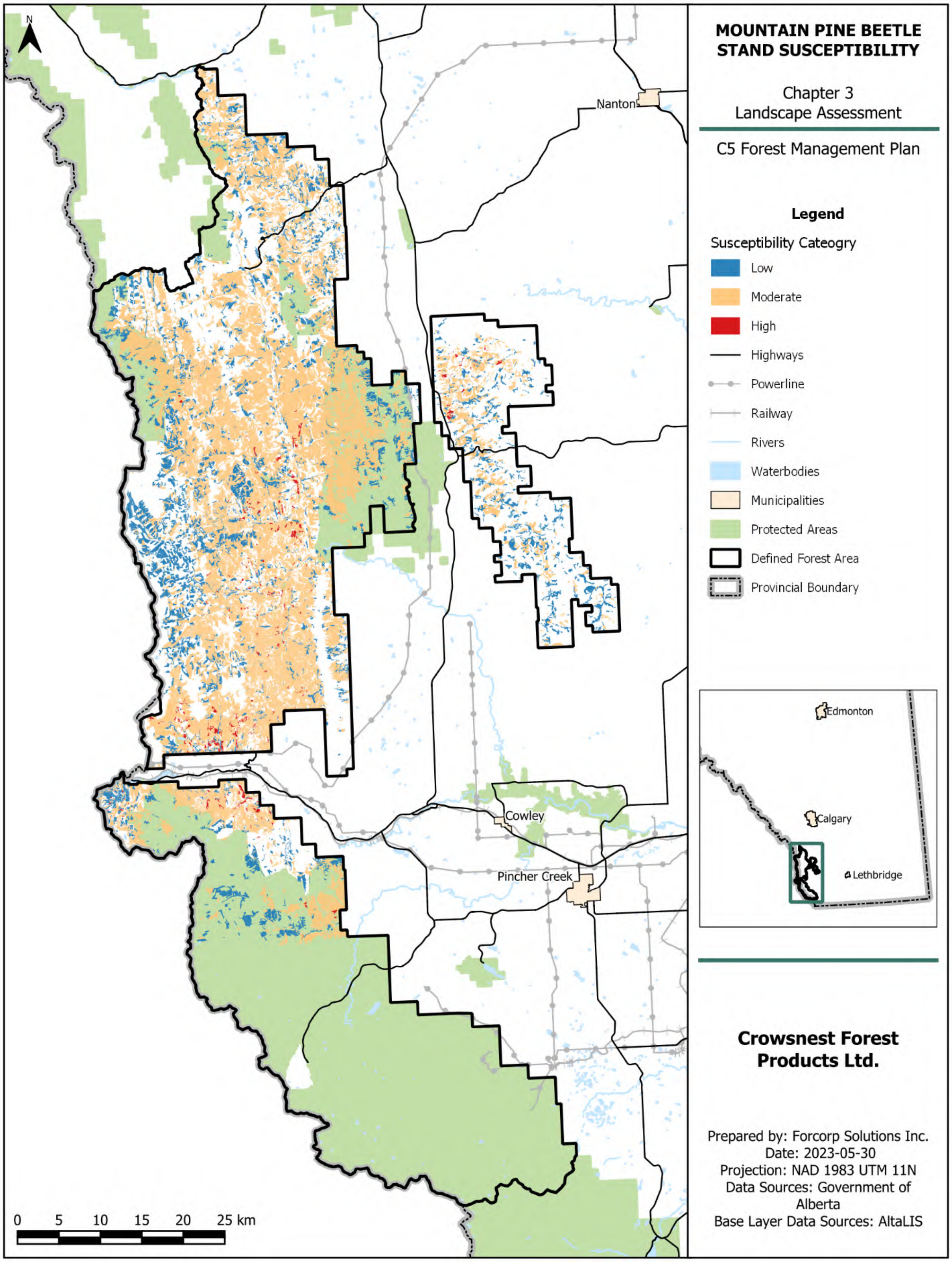

Figure 5-1. Mountain pine beetle Stand Susceptibility Index (SSI) in the DFA.

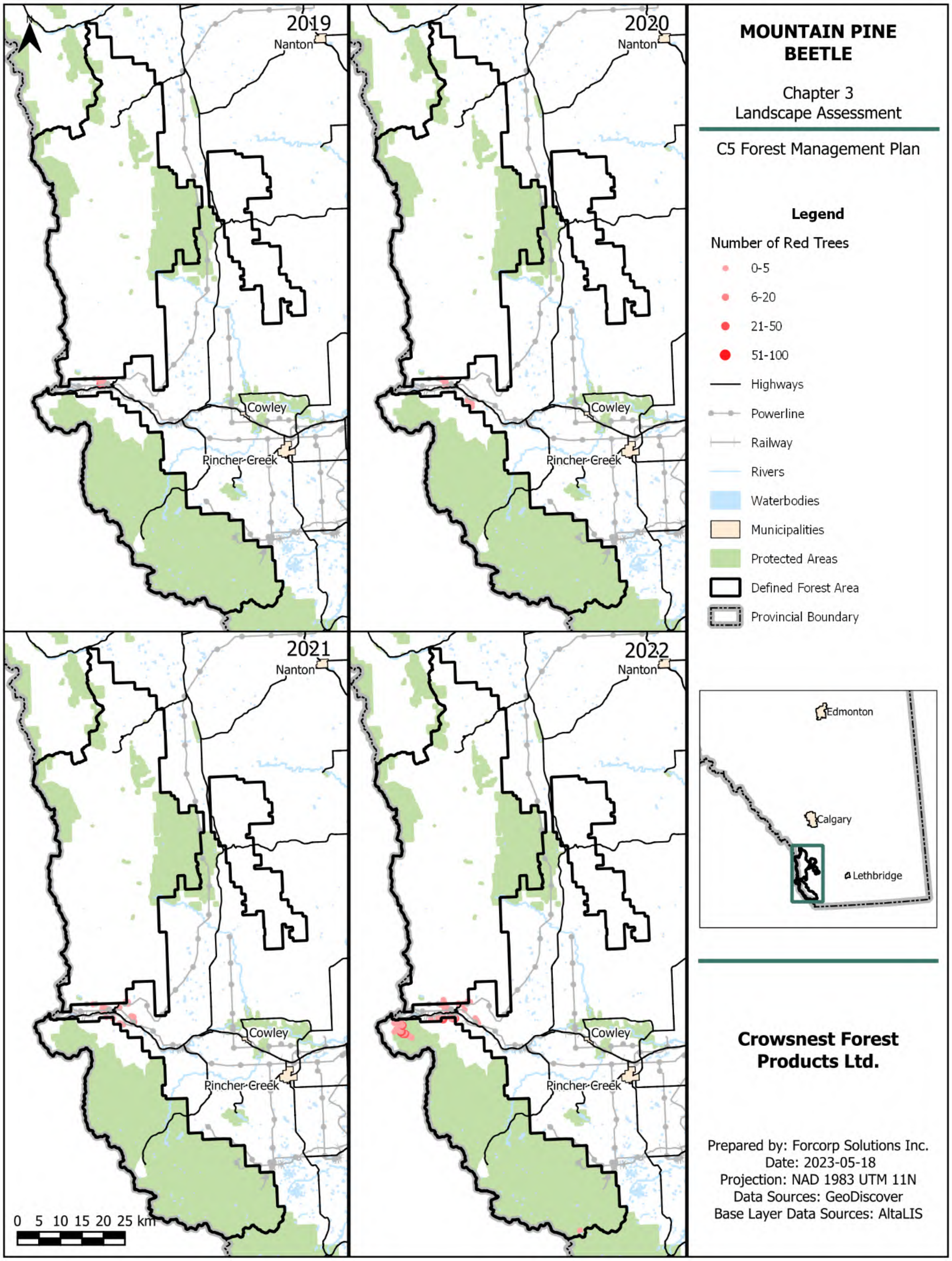

Figure 5-2. Historical spread of mountain pine beetle within and surrounding the DFA: 2019 to 2022.

5.2.2 Hardwood Defoliators

5.2.2.1 Large Aspen Tortrix

Large aspen tortrix (*Choristoneura conflictana*) is one of the main insect pests affecting trembling aspen. Defoliated trees are typically able to produce new foliage, as damage generally occurs early in the spring (Canadian Forest Service, 2015b). This pest caused damage to 23% of the DFA between 2015 and 2021 [(30)] (Table 5-2). The largest infestations occurred in 2015 and 2016, which affected 8% and 11% of the DFA, respectively. The locations of these infestations are similar to the distribution of pure hardwood and mixed forests in the DFA (see Section 4.2) (Figure 5-3).

Table 5-2. Area damaged by large aspen tortrix in the DFA from 2015 to 2022 (Note: years not shown during this time frame had no reported damage in the DFA).

Survey year	Severity	Area (ha)	% of DFA
2015	Light	28,248	8
2016	Light	37,428	11
2017	Moderate	9,199	3
2018	Moderate	6,973	2

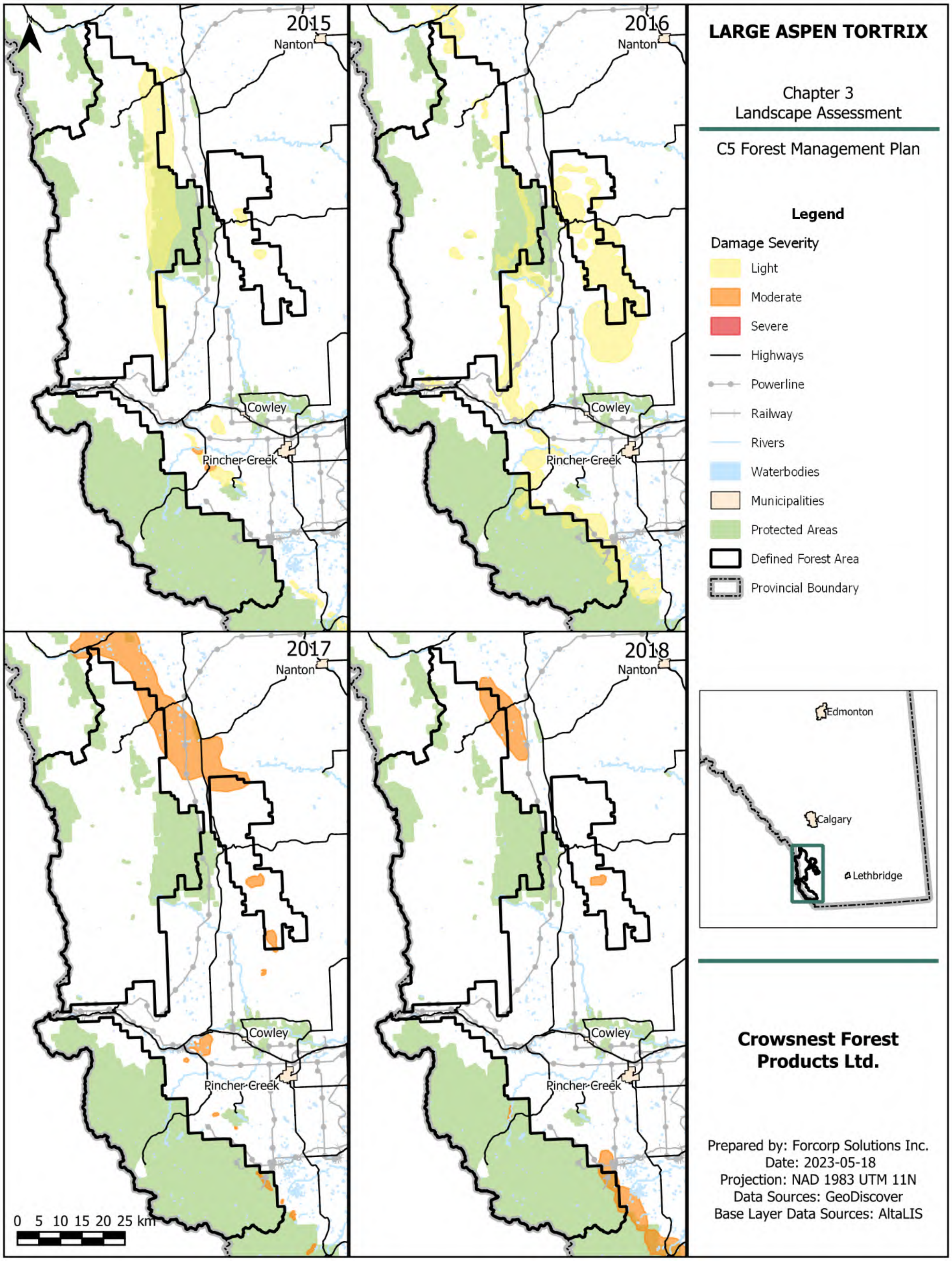

Figure 5-3. Large aspen tortrix damage within and surrounding the DFA by severity class from 2015 to 2022 (Note: years not shown during this time frame had no reported damage in the DFA).

5.2.3 Spruce Budworm

The spruce budworm (*Choristoneura fumiferana*) is a defoliating insect whose larvae feed primarily on white spruce and balsam fir. Because the caterpillars preferentially feed on new growth, damage is most noticeable on crowns and branch tips. Spruce budworm typically does not kill trees over a single year but mature trees may die after consecutive years of severe defoliation (Alberta Agriculture and Forestry, 2021). In 2016 and 2017, infestations by spruce budworm affected 3,152 ha of the DFA [30] (Table 5-3, Figure 5-4).

Table 5-3. Area damaged by the spruce budworm within the DFA.

Survey year	Severity	Area (ha)	% of DFA
2016	Light	188	0
2017	Moderate	2,964	1

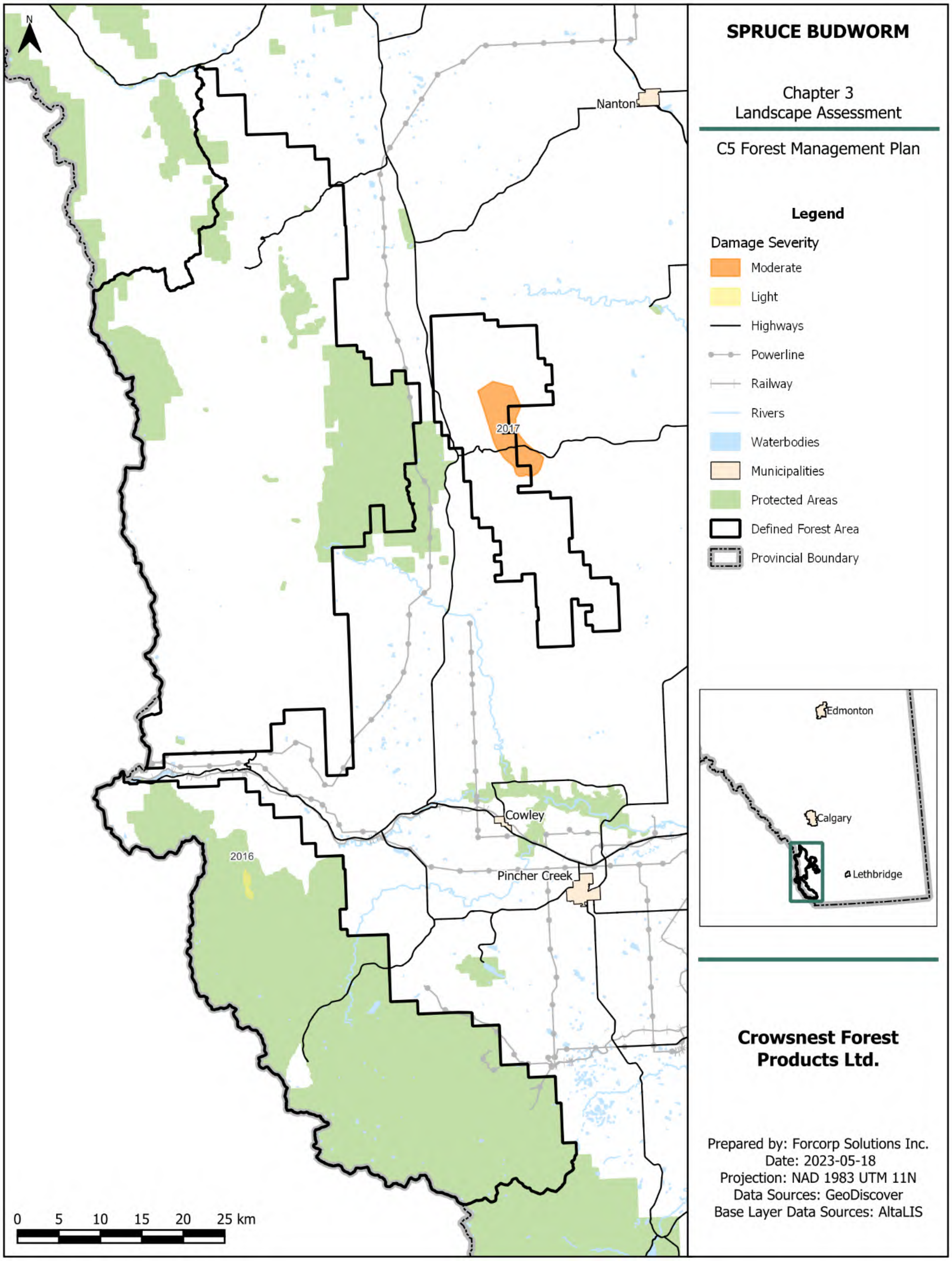

Figure 5-4. Spruce budworm damage within and surrounding the DFA.

5.2.4 Spruce Beetle

The spruce beetle (*Dendroctonus rufipennis*) is a bark beetle that mainly affects the forests of British Columbia. However, government aerial surveys discovered damage caused by this beetle within the DFA in 2022 [(30)]. Outbreaks of this pest typically last 2-5 years and they can cause significant mortality of mature spruce in affected stands (Canadian Forest Service, 2015d). These infestations are currently restricted to a single location in Castle Wildland Provincial Park and have affected 175 ha of the DFA (<1%) (Table 5-4, Figure 5-5).

Table 5-4. Area damaged by the spruce beetle within the DFA.

Survey year	Severity	Area (ha)	% of DFA
2022	Severe	175	0

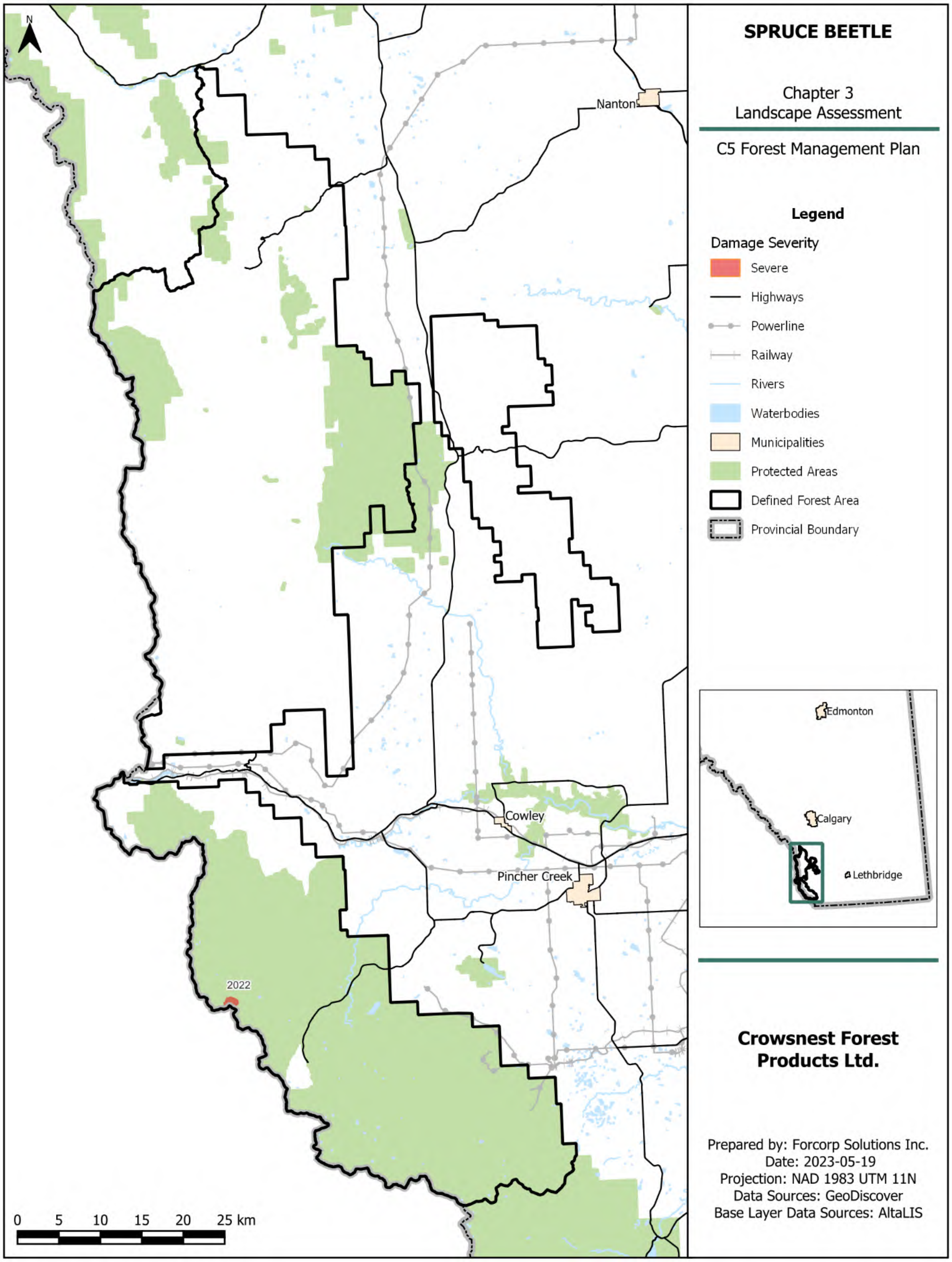

Figure 5-5. Spruce beetle damage within and surrounding the DFA.

5.2.5 Pine Needle Cast

Pine needle cast (*Lophodermella concolor*) is a fungus that causes defoliation of pine trees. Moist summer weather makes trees susceptible to infection, and repeated epidemics can cause incremental loss and mortality of young trees (Canadian Forest Service, 2015c). This disease has been recorded in the DFA from 2016 to 2022 [30] and has caused damage to 24,064 ha of the DFA during that time (Table 5-5, Figure 5-6).

Table 5-5. Area damaged by pine needle cast within the DFA (Note: years not shown during this time frame had no reported damage in the DFA).

Survey year	Area (ha)	% of DFA
2016	7,375	2
2017	1,452	0
2018	8,201	2
2019	6,028	2
2020	6,474	2
2022	4,209	1

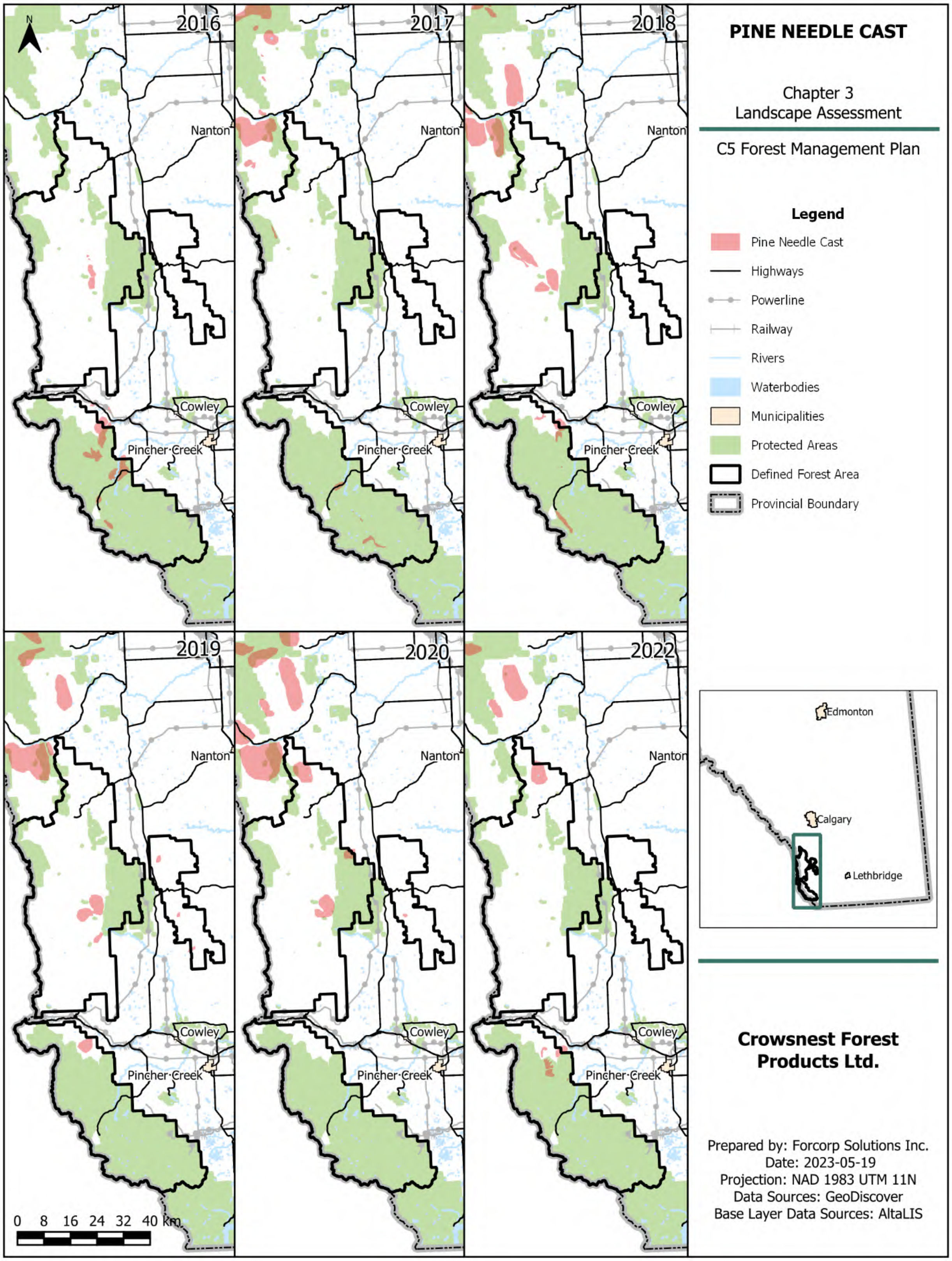

Figure 5-6. Pine needle cast damage within and surrounding the DFA from 2016 to 2022 (Note: years not shown during this time frame had no reported damage in the DFA).

5.2.6 Other Forest Health Agents

Other forest health agents that have been found in the DFA from government aerial surveys [29] are listed in Table 5-6. In total, these other forest health agents have caused damage to 63,141 ha of the DFA (Table 5-7, Figure 5-7).

Table 5-6. Description of other forest health agents found within the DFA.

Category	Damage agent	Description of damage
Abiotic	Blowdown	Tree mortality due to windstorms.
	Flooding	Waterlogged roots can cause tree mortality.
	Winter desiccation/red belt	Needles dry out and die due to lack of water during the winter.
Biotic	Aspen serpentine leafminer (*Phyllocnistis populiella*)	Foliage discolouration and leaf drop.
	Douglas fir beetle (*Dendroctonus pseudotsugae*)	Foliage discoloration, needle drop, girdling, and eventual mortality.
	Forest tent caterpillar (*Malacosoma disstria*)	Defoliation; radial growth loss and twig dieback may occur on trembling aspen.
	Tomentosus root rot (*Inonotus tomentosus*), root rot rings	Red butt rot in roots and the lower part of the trunk of spruce trees.
	Western spruce budworm (*Choristoneura occidentalis*)	Defoliation, reduced increment, top die-back, bole deformity, and sometimes mortality.
Other	Aspen die-back	Above ground deterioration or death of aspen clonal trees.
	Multiple agents	Damage or mortality caused by multiple agents.
	Subalpine fir mortality	Mortality of subalpine fir.
	Willow die-back	Above ground deterioration or death of willow trees.
	Willow drought	Damage or mortality caused by drought.
	Unknown	Undetermined cause of damage/mortality.

Table 5-7. Area affected by other forest health agents within the DFA.

Category	Damage agent	Years recorded	Area (ha)	% of DFA
Abiotic	Blowdown	2010	202	0
	Flooding	2017	4	0
	Winter desiccation	2016	826	0
Biotic	Aspen serpentine leafminer	2022	783	0
	Douglas-fir beetle	2018, 2019, 2020, 2021, 2022	2,012	1
	Forest tent caterpillar	2007, 2008	8,502	2
	Red belt	2010, 2015	4,943	1
	Satin moth	2020, 2021, 2022	5,691	2
	Tomentosus root rot/ root rot rings	2010, 2017	64	0
	Western spruce budworm	2010, 2011	1,283	0
Other	Aspen die-back	2010	2,660	1
	Dead/dying sub-alpine fir	2010	128	0
	Multiple agents	2022	7,778	2
	Red belt/winter desiccation	2019	5,942	2
	Subalpine fir mortality	2016	4,891	1
	Unknown	2017, 2018, 2019, 2020, 2021	17,329	5
	Willow die-back	2010	103	0
	Willow drought	2007	0	0

Table 5-8. Area and species affected by damage agents classified as 'Unknown' within the DFA.

Damage agent	Species	Years recorded	Area (ha)	% of DFA
Unknown	Fir	2017, 2018, 2019, 2021	20,137	6
	Fir, subalpine	2020, 2021	6,640	2
	Pine	2018	27	0
	Poplar	2017	6	0
	Spruce	2018	175	0

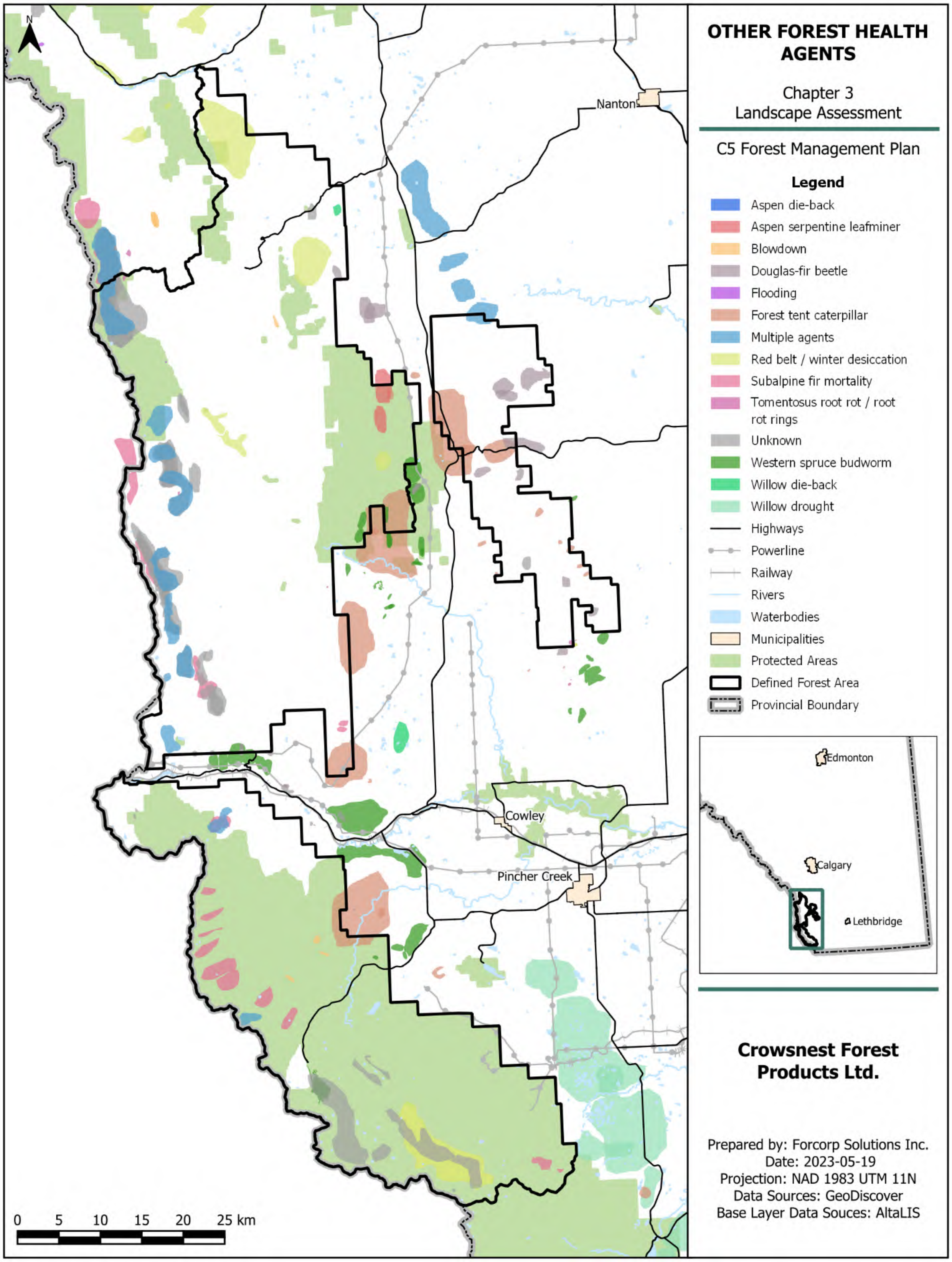

Figure 5-7. Damage due to other forest health agents within and surrounding the DFA.

5.3 Invasive Exotic Species

5.3.1 Satin Moth

The satin moth (*Leucoma salicis*) is an invasive species introduced into North America from Europe whose larvae feed on all species of poplar and willow. Larvae can consume whole leaves except for the major veins and petioles, causing thin-looking and browning foliage and skeletonized leaves. Severe infestations and repeated defoliation can lead to top-kill, reduced radial growth of stems, and branch and tree mortality. The impact of defoliation can be more severe on drought-stressed trees and can leave weakened trees vulnerable to attack by fungi and other insects (Natural Resources Canada, 2015). In 2020, 2021, and 2022, infestations by satin moth affected 5,691 ha of the DFA [30] (Table 5-9, Figure 5-8).

Table 5-9. Area damaged by the satin moth in the DFA.

Survey year	Severity	Area (ha)	% of DFA
2020	Moderate	1,015	0
	Severe	62	0
2021	Moderate	5,346	2
2022	Moderate	1,423	0

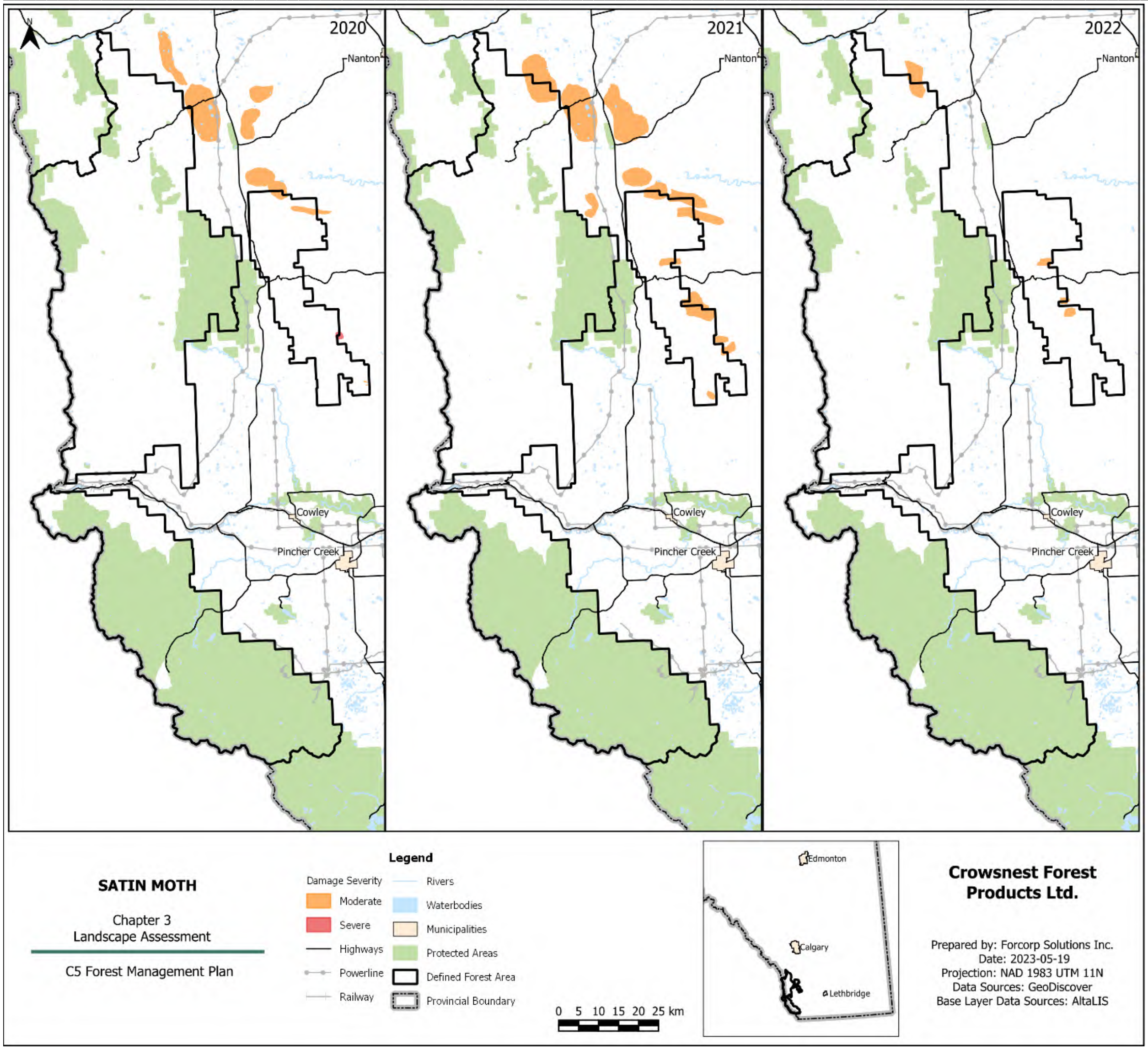

Figure 5-8. Satin moth damage within and surrounding the DFA.

5.3.2 White Pine Blister Rust

White pine blister rust is an important exotic disease caused by the rust fungus *Cronotarium ribicola* that affects five-needle pines in Canada (Canadian Forest Service, 2015e). Two five-needle pines affected by this disease are found in the DFA, whitebark pine and limber pine. In 2008, whitebark pine and limber pine were listed as Endangered under Alberta's *Wildlife Act* and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has recommended an Endangered status for both species, with whitebark pine being listed under Schedule 1 of the *Species at Risk Act* in 2012 and a decsision on limber pine pending (Alberta Environment and Parks, 2022). A formal inventory of white pine blister rust in Alberta was first completed in 2020. This disease was recorded in the DFA in 2020 and 2022 [30] and caused damage to 4% of the DFA during that time (Table 5-10, Figure 5-9).

Whitebark pine leading stands (defined as stands in the 2022 AVI where the leading species = 'PA') within the western portion of the DFA were impacted by the disease. In total, 206 ha of whitebark pine leading stands within the DFA received a severity description of 'Very Severe' (Figure 5-10).

Table 5-10. Area damaged by white pine blister rust within the DFA.

Survey year	Severity	Area (ha)	% of DFA
2020	Light	9	0
	Moderate	130	0
	Severe	1,149	0
	Very Severe	5,893	2
2022	Moderate	1,060	0
	Severe	3,702	1
	Very Severe	2,195	1

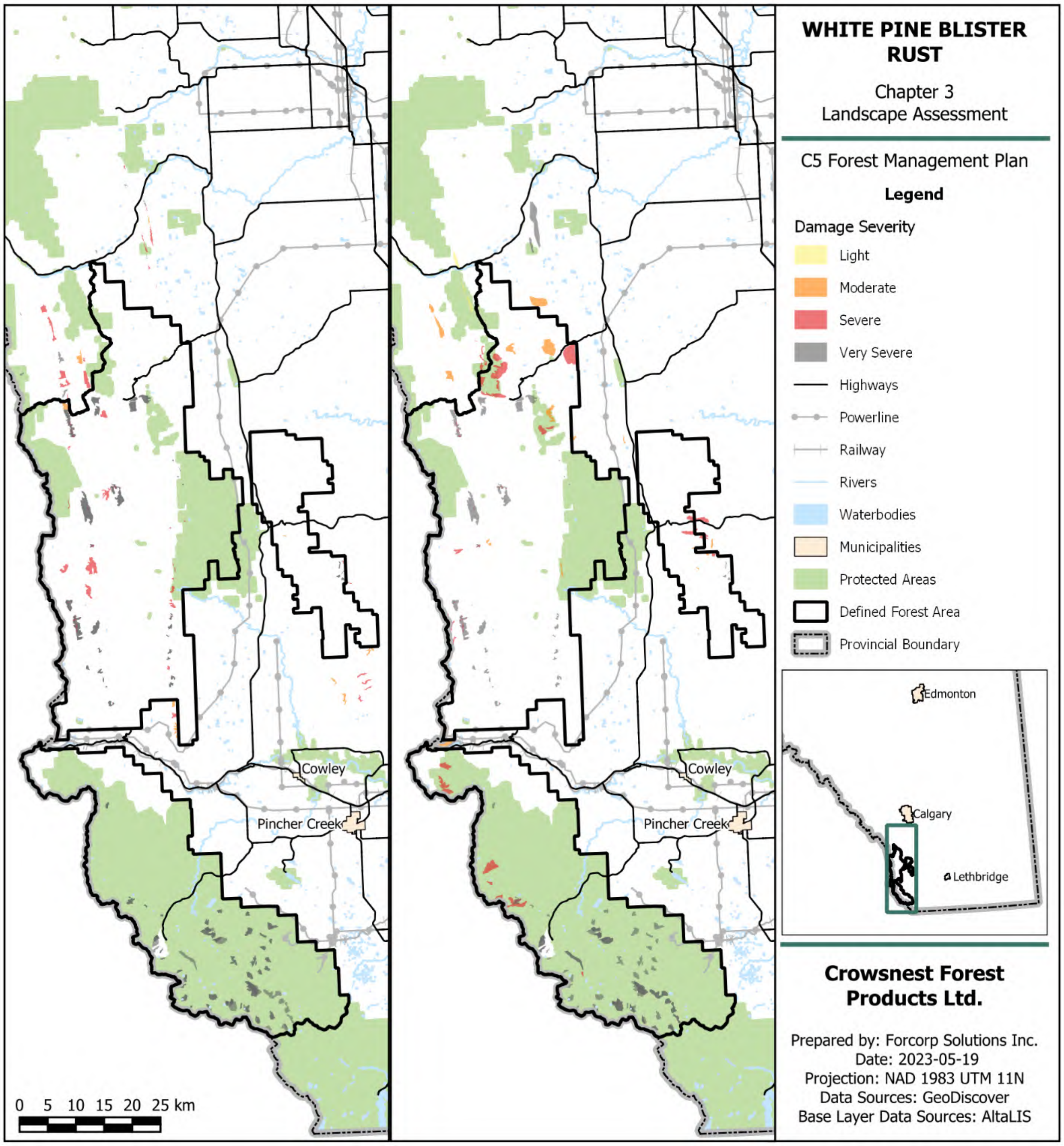

Figure 5-9. White pine blister rust damage within and surrounding the DFA.

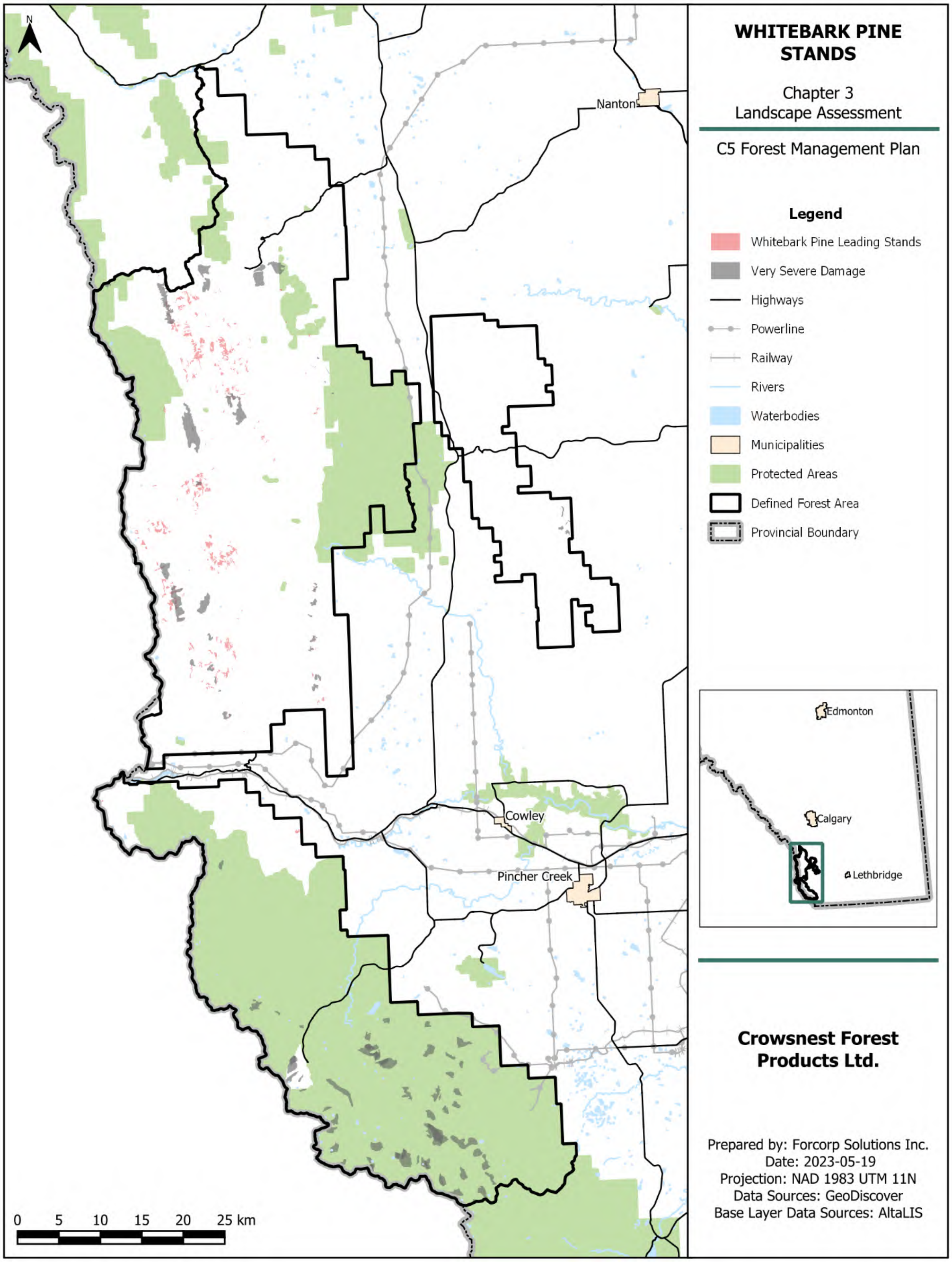

Figure 5-10. Whitebark pine leading stands within the DFA.

5.3.3 Noxious and Prohibited Noxious Plant Species

The 2010 Alberta Weed Control Act categorizes weeds as either noxious, referring to species which are considered too widely distributed to eradicate but require control disposition, or prohibited noxious, referring to species which are not yet (or only locally) established in the province and must be destroyed if detected (Alberta Agriculture and Rural Development, 2013). Table 5-11 lists the noxious and prohibited noxious weed species that have been recorded in the DFA from Government of Alberta surveys [(31)]. Wild caraway (*Carum carvi*) is included as it has been elevated to a noxious weed in the Municipality of Crowsnest Pass[1].

Table 5-11. Invasive and noxious weed species found in the DFA.

Common name	Latin name	Provincial Designation
Black Henbane	*Hyoscyamus niger*	Noxious
Blueweed	*Echium vulgare*	Noxious
Canada Thistle	*Cirsium arvense*	Noxious
Common Mullein	*Verbascum thapsus*	Noxious
Dalmatian Toadflax	*Linaria dalmatica*	Noxious
Downy Brome	*Bromus tectorum*	Noxious
Hounds Tongue	*Cynoglossum officinale*	Noxious
Lesser Burdock	*Arctium minus*	Noxious
Meadow Hawkweed	*Hieracium caespitosum*	Prohibited Noxious
Orange Hawkweed	*Hieracium aurantiacum*	Prohibited Noxious
Oxeye Daisy	*Leucanthemum vulgare*	Noxious
Perennial Sowthistle	*Sonchus arvensis*	Noxious
Scentless Chamomile	*Tripleurospermum inodorum*	Noxious
Spotted Knapweed	*Centaurea stoebe ssp. micranthos*	Prohibited Noxious
Tall Buttercup	*Ranunculus acris*	Noxious
Tall Hawkweed	*Hieracium piloselloides*	Not currently designated
Wild Caraway	*Carum carvi*	Noxious*
Yellow Hawkweed	*Hieracium spp.*	Prohibited Noxious
Yellow Toadflax	*Linaria vulgaris*	Noxious

* Has been elevated to a noxious weed in the Crowsnest Pass

5.4 Forest Succession Trajectories

Forest succession is the composition of vegetation communities on a site and how they change over time. Succession results in different structural components (e.g., density by species, crown closure, understory composition, snags and downed logs) at various time periods during forest progression. Many of these structural components undergo a somewhat predictable pattern of change as stands age.

Moisture regime has the greatest influence on forest composition succession (Boreal Centre, 2002), and the influence of moisture regime on forest composition in association with elevation and aspect is reviewed in greater detail in Section 3.1.

[1] https://www.crowsnestpass.com/public/download/files/221527

The DFA is dominated by pure coniferous forests. Pure coniferous forests are likely to keep a similar composition of species to their pre-disturbance condition following disturbance by wildfire. Lodgepole pine, the dominant tree species in the DFA (see Section 4.1), has serotinous cones that are opened by the heat of wildfires allowing them to quickly colonize a site after disturbance (B.C. Government, n.d.). Mature spruce stands will often have subalpine fir in the understorey, as this species is shade tolerant (Alberta Parks, 2015). Natural regeneration can be slower at higher elevations because of a shorter growing season (Alberta Parks, 2015).

Aspen can regenerate aggressively after wildfires on mesic sites, and this species is normally present in regenerating stands at lower elevations. Natural regeneration of white spruce on mesic sites is more variable and is dependant on factors such as the seed production of neighbouring trees, number of seed trees and distance from seed sources.

The transition of stands to the mature stage is triggered by the closure of the canopy (Stelfox, 1995). Self-thinning begins at this stage. Transition from mature to old stands is more gradual and occurs as the canopy breaks up. This stage is characterised by the presence of understorey vegetation, snags and downed logs beginning to accumulate due to the mortality of mature trees from competition (Stelfox, 1995). Due to the natural disturbance regime, succession is typically reset by fire before gap recruitment can occur.

5.5 Wildfire History

5.5.1 Wildfire Statistics

Wildfire disturbances [32] have been tracked by the Government of Alberta since 1931 using historical publications, digitized photos and more recently satellite imagery (Alberta Wildfire, 2019). There has been a total of 24 wildfires that overlapped with the DFA since records began, and 67% of the area burned by those fires has been within the DFA. A total of 19% of the DFA has burned since 1930, 6% of which can be attributed to the 2003 Lost Creek Wildfire. The Lost Creek Wildfire was a significant event in the area with a total area of approximately 20,400 ha burned within the DFA (Table 5-12, Figure 5-12). The two most recent decades have had more wildfire occurrences than most previous decades (Figure 5-11), likely due to increasing human activity on the landscape.

Table 5-12. Wildfire statistics by decade (note: decades not listed have no recorded wildfires in the DFA).

			Within the DFA					
Year	Number of Wildfires	Total Wildfire Area (ha)	Area Burned (ha)	Average Wildfire Size (ha)	Median Wildfire Size (ha)	Maximum Wildfire Size (ha)	Wildfire in DFA (%)	DFA Area Burned (%)
1930-1939	7	78,674	46,506	6,644	2,375	27,500	59	13
1980-1989	1	349	143	143	143	143	41	0
2000-2009	5	21,008	20,398	4,080	271	18,339	97	6
2010-2019	9	206	190	21	5	149	92	0
2020-2022	2	25	25	12	12	17	100	0
Total	**24**	**100,261**	**67,262**	**2,803**	**271**	**27,500**	**67**	**19**

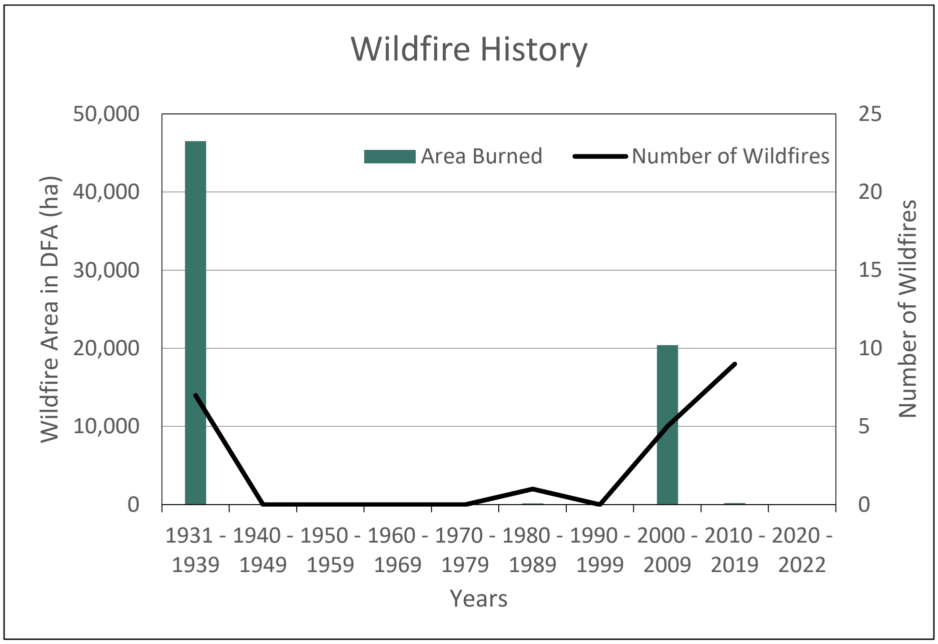

Figure 5-11. Wildfire size and frequency within the DFA since 1930.

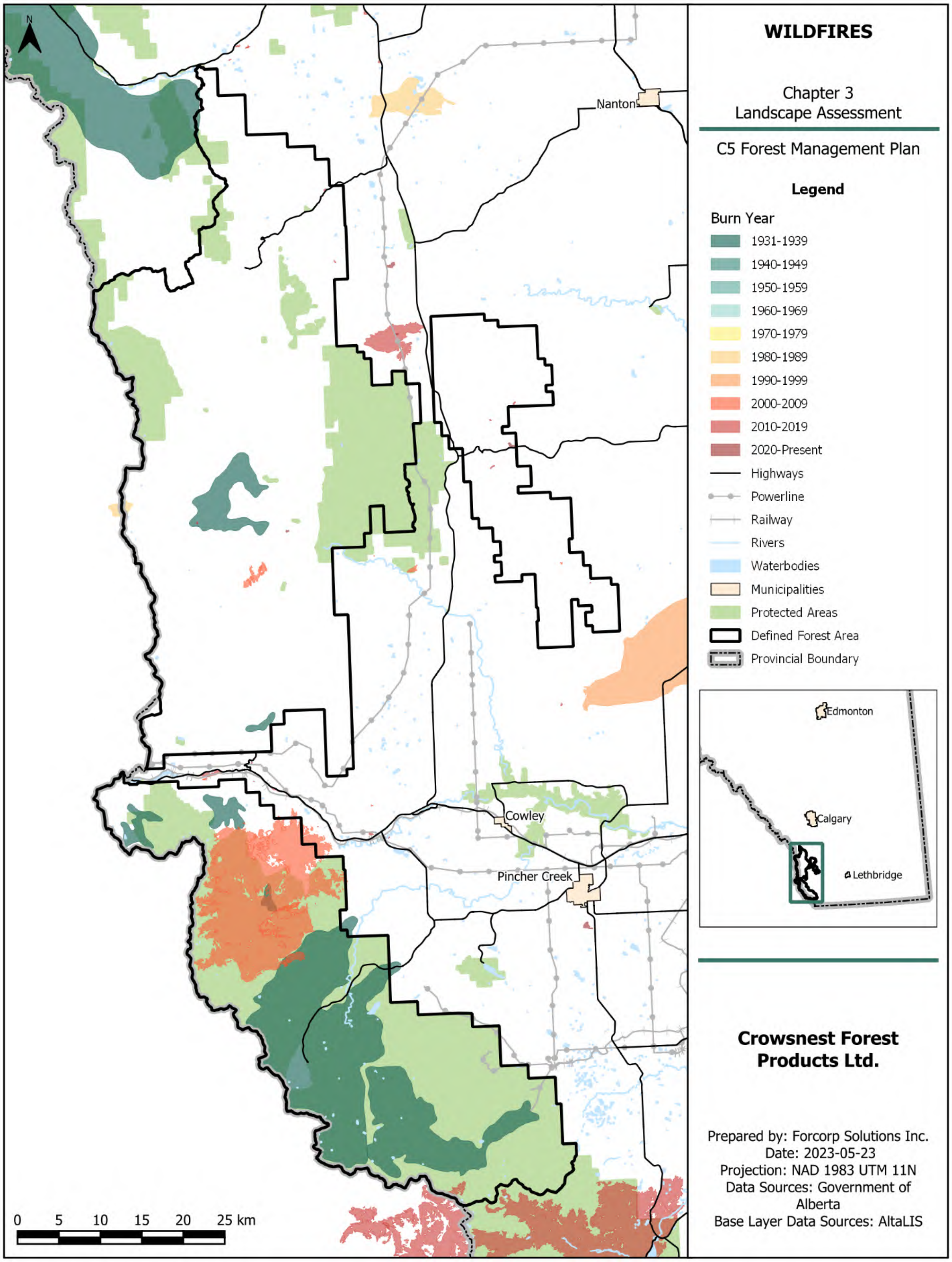

Figure 5-12. Wildfire history within and surrounding the DFA.

5.5.2 Wildfire Risk Indicator

The wildfire risk indicator (WRI) class with the greatest area in the DFA is continuous improvement (63%), followed by risk reduction (2%), and intolerable (1%) (Table 5-13). Areas with intolerable risk are located in the Crowsnest River compartment near populated centres (Figure 5-13).

Table 5-13. Area of wildfire risk indicator classes within the DFA.

Wildfire Risk Indicator	Area (ha)	% of DFA
Intolerable	1,369	1
Risk Reduction	4,100	2
Continuous Improvement	119,896	63
Total	**125,365**	**66**

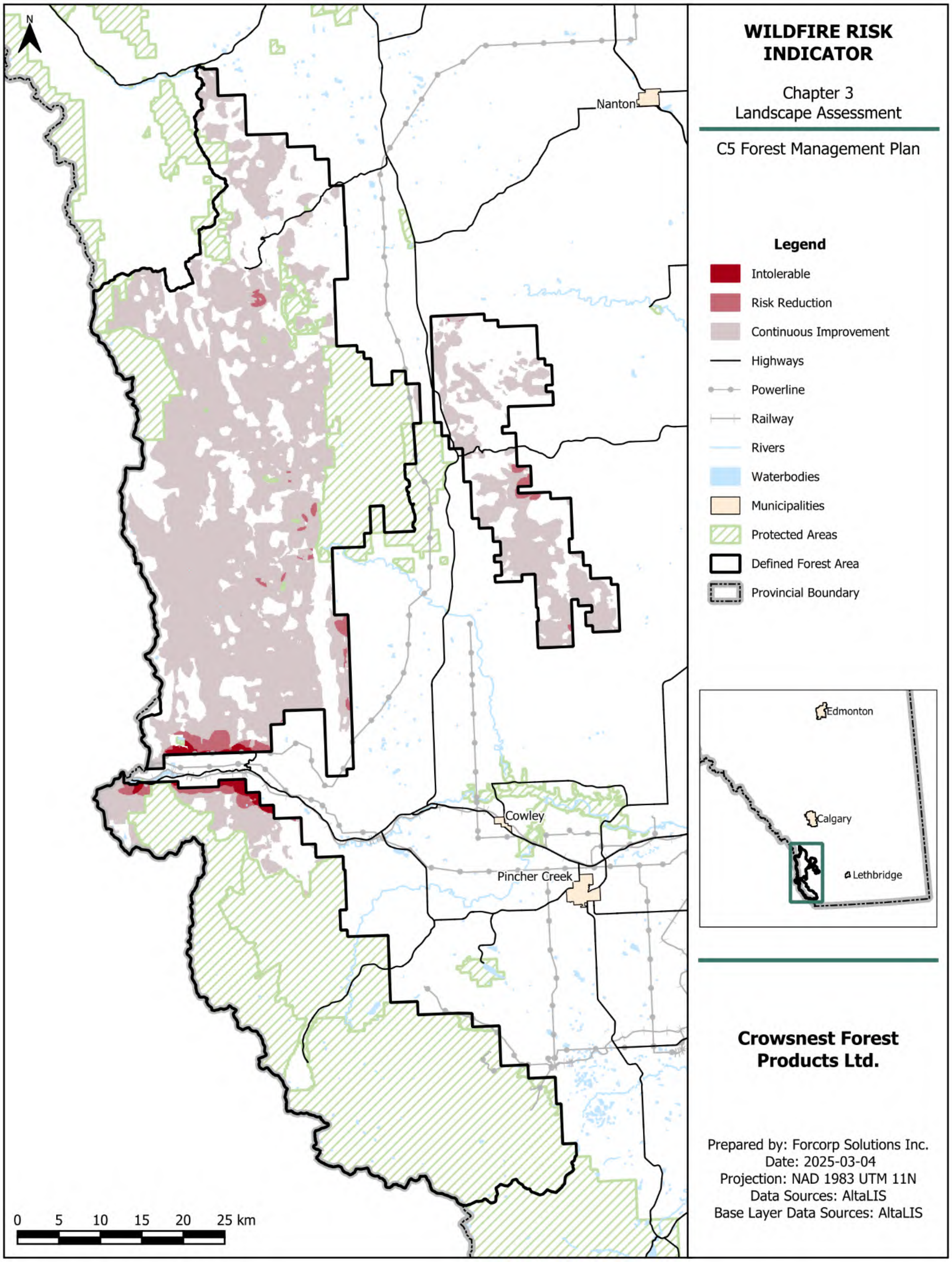

Figure 5-13. Wildfire risk indicator classes within the DFA.

5.6 Timber Harvesting

Timber harvesting [25, 34] has been an important source of disturbance in the DFA area since the founding of the province. Early harvesting in the area from about 1930 until the mid-1950's was generally for local or regional use. Early harvesting also reflected historical species preferences (for example, coniferous trees removed from mixedwood stands) or product based on tree size (for example, sawlogs instead of other products).

Establishment of permanent forest product manufacturing facilities, such as the Spray Lake Sawmills dimensional sawmill in Cochrane (established in 1970) has resulted in more consistent forestry activity in recent years (Table 5-14, Figure 5-14).

Figure 5-15 displays the harvesting activities in the DFA since 1960.

Table 5-14. Summary of timber harvesting within the DFA by decade.

	Total Harvest Area		Number of Harvest Areas		Average Cutblock Size
Harvest Year	(ha)	(%)	Count	(%)	(ha)
1960-1969	2,640	10	402	13	7
1970-1979	3,115	12	464	15	7
1980-1989	2,400	9	321	11	7
1990-1999	5,549	20	647	22	9
2000-2009	6,518	24	672	22	10
2010-2019	5,493	20	401	13	14
2020-Present	1,365	5	101	3	14
Total	**27,079**	**100**	**3,008**	**100**	**9**

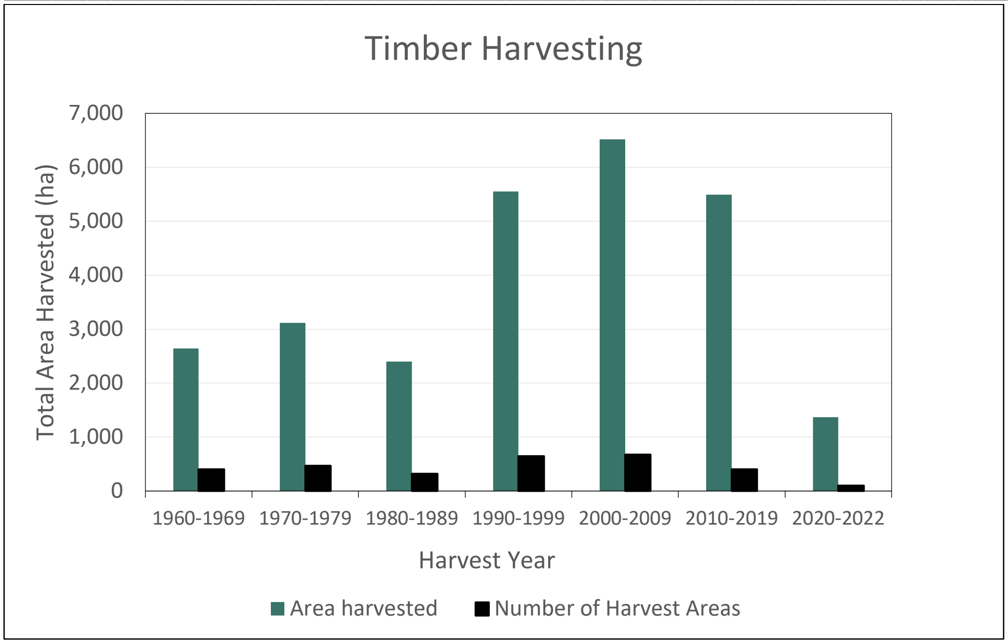

Figure 5-14. Total harvest area and number of harvest areas by decade.

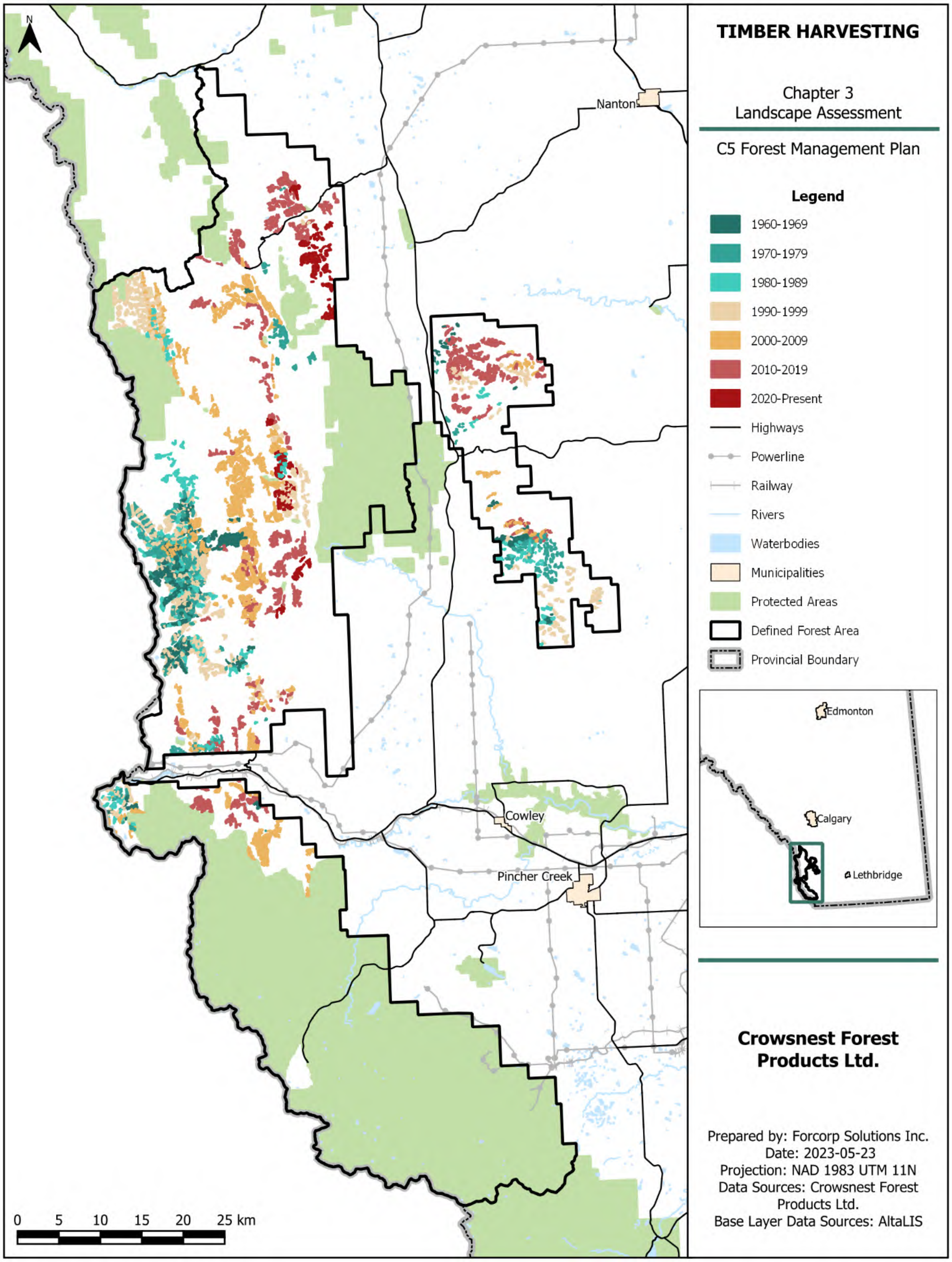

Figure 5-15. Timber harvesting within the DFA by decade.

5.7 Forest Industry Access

The DFA road network [35] is primarily related to resource extraction. Several unpaved roads traverse through the DFA with the main ones being: Highway 40 (Forestry Trunk Road) which bisects the western portion of the DFA, Highway 532 in the northernmost portion, Highway 520 in the east, and Range Road 52A, often referred to as the Atlas road (Figure 5-16). Highway 774 is a paved secondary highway that crosses through Castle Provincial Park to access the Castle Special Management Area. Access (and other types of human footprint) is managed for much of the DFA by the Livingstone-Porcupine Hills Land Footprint Management Plan (LPH-LFMP) (see Section 2.6.1). Stands of timber for harvest are commonly accessed through temporary forestry roads (1-3 years), which are not shown on the map below. Sometimes temporary forestry roads are called AOP roads.
A road density analysis was completed to assess the current densities of roads in the DFA. Table 5-15 shows the road density for the DFA. Table 5-16 summarizes road density for the portions of the Livingstone and Porcupine Hills Public Land Use Zones found within the DFA. Data from the provincial roads layer was used to populate both tables.

Table 5-15. Road density in the DFA by compartment.

Compartment	All Roads	
	Total Distance (km)	Density (km/km^2)
Crowsnest River	77	0.04
Livingstone River	70	0.02
Oldman River	58	0.02
Porcupine Hills	113	0.04
Racehorse Creek	116	0.06
Willow Creek	17	0.01
Total	**450**	**0.13**

Table 5-16. Road density in the Livingstone and Porcupine Hills Public Land Use Zones.

Public Land Use Zone	All Roads	
	Total Distance (km)	Density (km/km^2)
Livingstone	308	0.09
Porcupine Hills	113	0.03

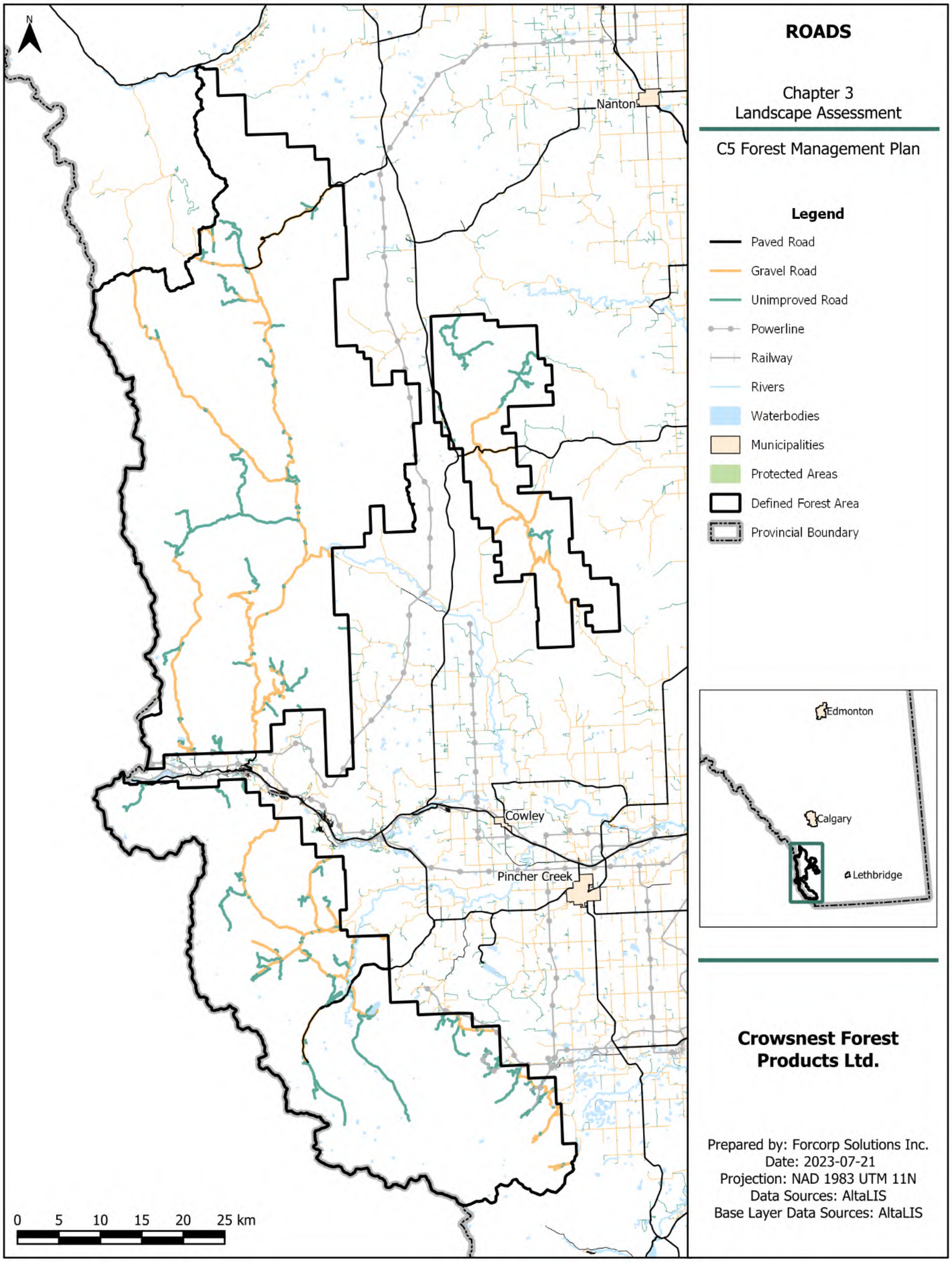

Figure 5-16. Roads within and surrounding the DFA by road class.

5.8 Industrial Development

The DFA has many types of non-road industrial development [36], most of which are associated with oil and gas extraction. The highest proportion of these dispositions by number and area are pipeline agreements and mineral surface leases that are typically issued for oil or gas wellsites (Table 5-17, Figure 5-17). As of May 1, 2023, the total area taken up by non-road industrial dispositions in the DFA is 3%.

Table 5-17. Non-road industrial development in the DFA.

Disposition Type	Code	Number of Dispositions	Area (ha)	Percent of All Dispositions (by number)	Percent of All Dispositions (by area)	% of DFA
Disposition Reservation	PRS, DRS, RDS	59	379	10	8	0
Easement	PEZ, REA, EZE	77	283	13	6	0
Grazing	GRP, GRL	46	649	8	13	0
License of Occupation	PLC, DLO, LOC	88	1,816	15	37	1
Mineral Surface Lease	PMS, MSL, DMS	86	598	14	12	0
Miscellaneous Lease	PML, MLL, DML	24	128	4	3	0
Miscellaneous Permit	MLP	8	8	1	0	0
Pipeline Agreement	DPL, PLA, PPA	125	643	21	13	0
Pipeline Installation Lease	DPI, PIL	36	29	6	1	0
Recreation Lease	REC	6	165	1	3	0
Right of Entry Agreement	ROE	43	185	7	4	0
Surface Material Lease	SML	5	79	1	2	0
Surface Material License	PSM	1	3	0	0	0
Vegetation Control Easement	RVC	1	0	0	0	0
Total		**606**	**4,967**	**100**	**100**	**3**

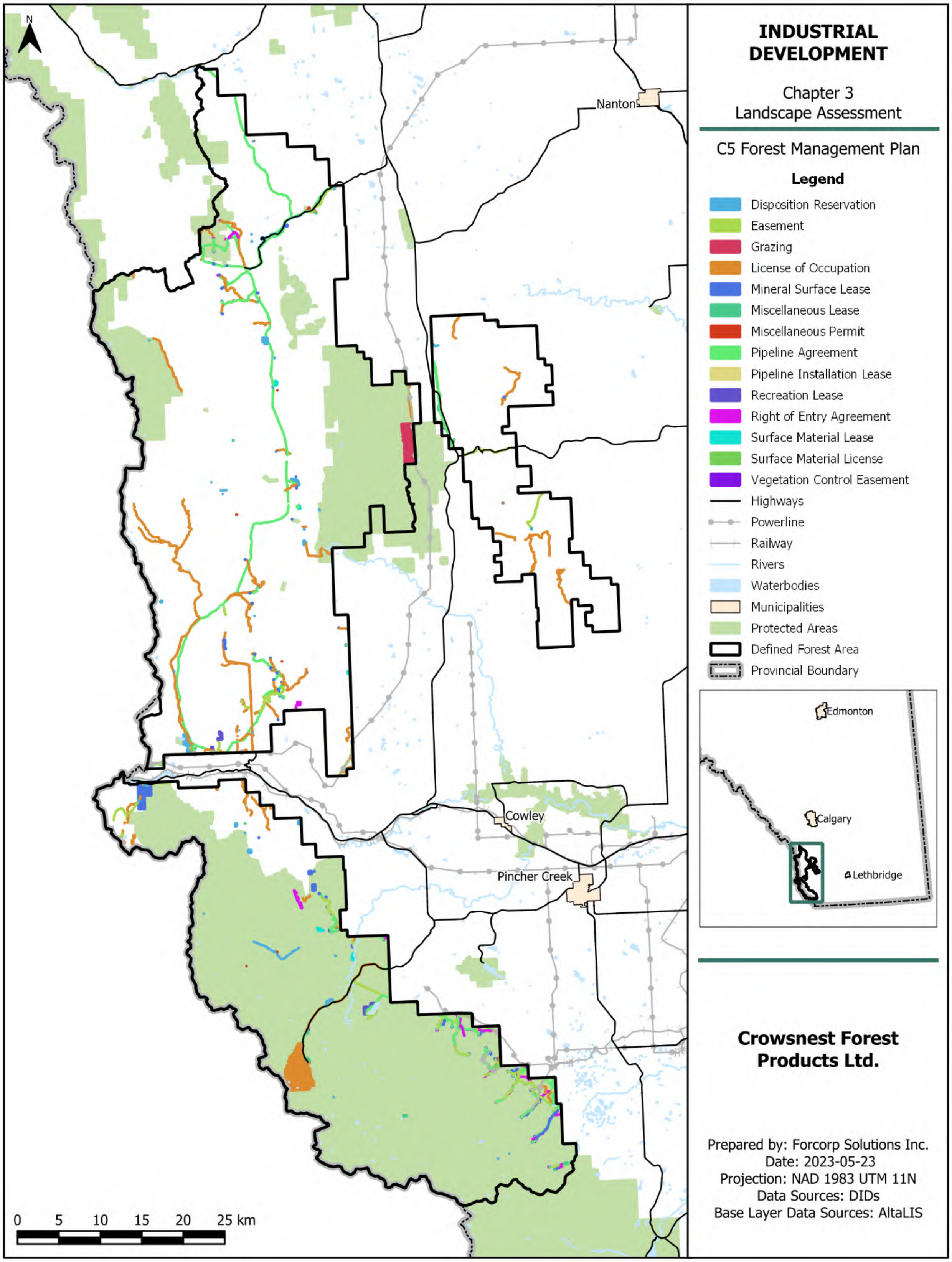

Figure 5-17. Industrial non-road dispositions in the DFA.

5.9 Monitoring Sites

Permanent monitoring sites have been established in the DFA through a variety of programs and include Research Sample Plots, Study Areas, and Rangeland Reference Areas [37]. The Government of Alberta uses data on forest growth and mortality collected from Research Sample Plots (RSP) to help determine sustainable harvest levels and monitor pest activity. The GoA has established 95 RSPs in the DFA (Figure 5-18). Forestry companies also establish RSPs to support their Growth and Yield Monitoring Programs. Crowsnest Forest Products has not established any monitoring sites within the DFA to date.

Study Areas located within the DFA include the Southern Rockies Watershed Project and the Southern Rockies Watershed Study. The Southern Rockies Watershed Project examines the cumulative effects of wildfire, prescribed burning, and forest management activities on the quality and quantity of water resources and overall stream ecosystem health. The Southern Rockies Watershed Study examines the effect of the Lost Creek Fire on watershed quality.

The Alberta Biodiversity Monitoring Institute (ABMI) has established a network of plots across the province using a 20x20km grid to support decision making regarding biodiversity in the province. The exact locations of these sites are kept confidential, though publicly available coordinates are disclosed to within 5.5 kilometres of each of the sites [38]. There are seven of the disclosed site locations within the DFA boundaries, and an additional six locations within a 5.5 km buffer of the DFA (Figure 5-18).

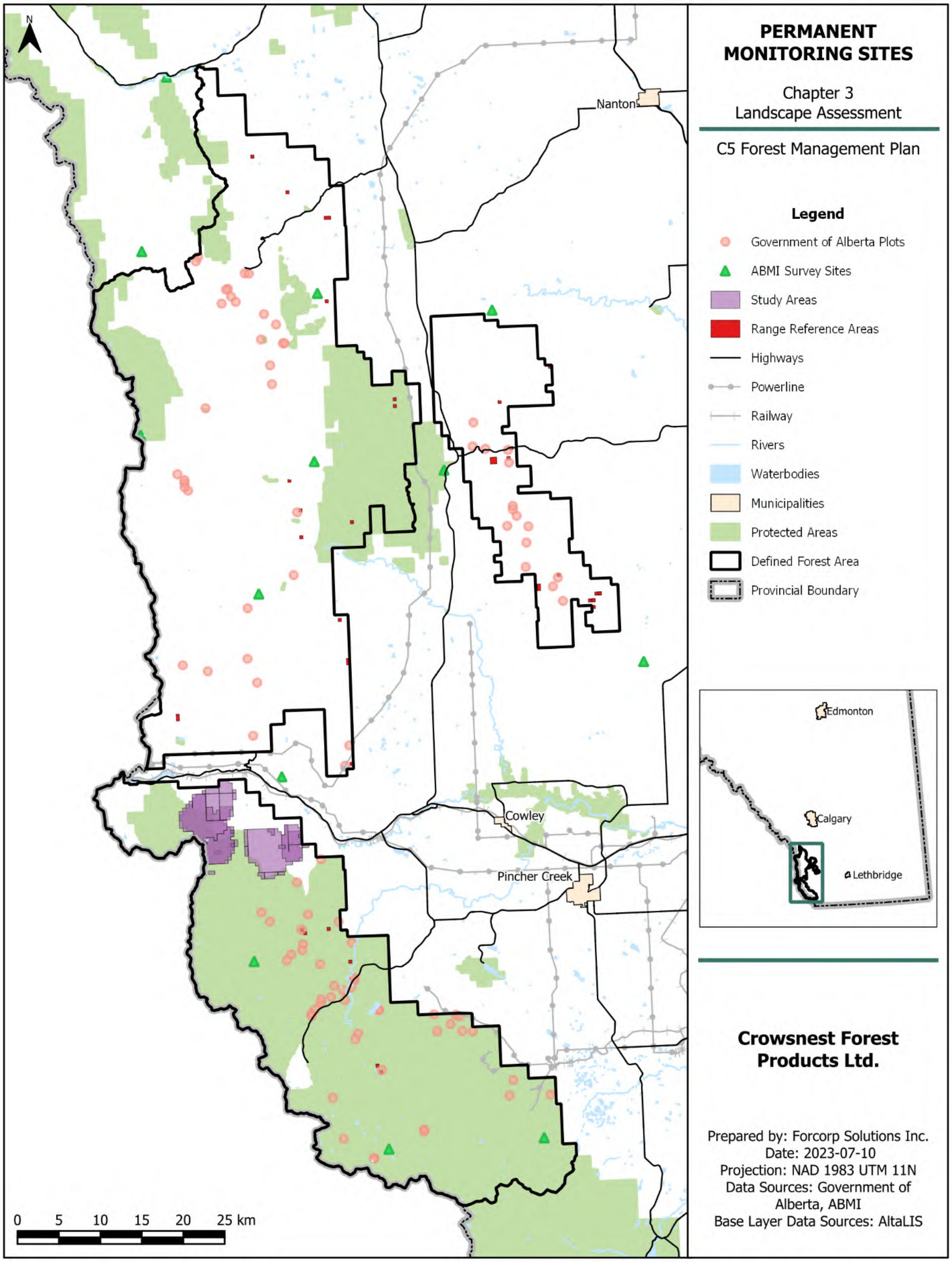

Figure 5-18. Location of study areas and permanent monitoring sites within the DFA.

5.10 Crown Land Reservations

In June 2022, the Government of Alberta introduced a new type of reservation called a Crown Land Reservation (CLR) which replaced nine types of dispositions previously contained within the Digital Integrated Dispositions service, including Consultative Notations, Holding Reservations, Industrial Sample Plots, Protective Notations, and several other legislated designations. A CLR is a record within the public land registry that identifies and provides notice to users that a specified management intent as supported by policy and government programs applies to a parcel of crown land. Multiple CLRs can be assigned to a single unit of land.

In total, there are 258 reservations within the DFA, with Land Use Plans (120%) and Land Management reservations (73%) covering the largest proportion by area (Table 5-18, Figure 5-19) [(37)]. Research Sample Plots are the most common type of reservation found in the DFA (excluding Range Allotments, see Section 5.11).

Table 5-18. Crown Land Reservations in the DFA (excluding Range Allotments).

Purpose Type Description	Number of Dispositions	Area (ha)[1]	Percent of All Dispositions (by number)	Percent of All Dispositions (by area)	% of DFA
Fish and Wildlife Resources	10	716	4	0	0
Forest Management	6	8,765	2	1	3
Land Management	21	256,841	8	31	73
Land Use Plans	15	420,093	6	50	120
Park or Protected Area	14	11,216	5	1	3
Public Works	4	901	2	0	0
Range Management	33	670	13	0	0
Recreation and Tourism Potential	3	26,892	1	3	8
Research Sample Plots	142	1,950	55	0	1
Unique Site Feature	1	16	0	0	0
Wildfire Management	9	113,016	3	13	32
Total	**258**	**841,077**	**100**	**100**	**240**

1 Due to overlapping reservations, area totals can exceed the total area of the DFA

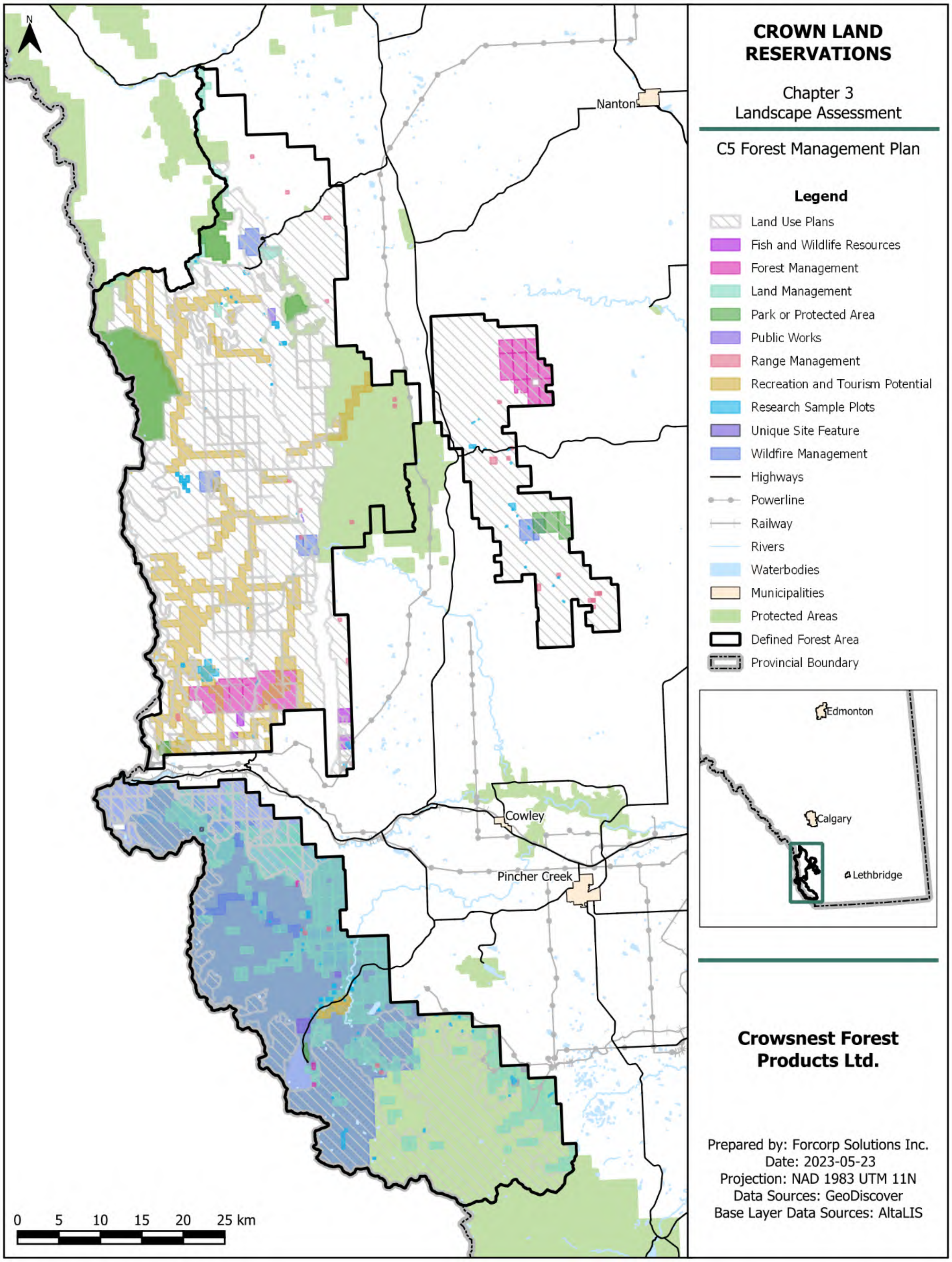

Figure 5-19. Crown Land Reservations within the DFA (excluding Range Allotments).

5.11 Grazing

Grazing dispositions and Range Allotments are issued to allow livestock grazing on Crown land in Alberta. As the Rocky Mountains Forest Reserve covers the entire DFA, livestock grazing is managed under the *Forest Reserves Act*. The grazing dispositions are Preference Quotas which guarantee a specific amount of annual forage within defined range allotments. Range Allotments, with terms up to 10 years, are issued to enable use of these dispositions. The identification numbers from Table 5-19 correspond with the Forest Reserve Crown Land Reservation numbers associated with each Range Allotment found in Figure 5-20.

Table 5-19. Range Allotments within the DFA.

ID	Reservation	Area (ha)	% of Grazing Area	% of DFA
1	CLR940271	210	0	0
2	CLR930378	9,424	3	3
3	CLR930235	384	0	0
4	CLR930233	3,695	1	1
5	CLR930286	9,187	2	3
6	CLR930256	5,209	1	1
7	CLR940305	1,439	0	0
8	CLR970504	19,639	5	6
9	CLR970499	3,697	1	1
10	CLR940318	41,338	11	12
11	CLR930230	10,668	3	3
12	CLR930234	1,504	0	0
13	CLR930240	514	0	0
14	CLR940274	2,188	1	1
15	CLR930238	444	0	0
16	CLR940279	385	0	0
17	CLR940300	2,935	1	1
18	CLR930284	3,228	1	1
19	CLR930244	7,735	2	2
20	CLR930242	4,479	1	1
21	CLR940262	4,170	1	1
22	CLR970500	3,686	1	1
23	CLR930236	3,425	1	1
24	CLR940278	3,394	1	1
25	CLR930239	3,278	1	1
26	CLR030455	2,208	1	1
27	CLR930250	2,212	1	1
28	CLR940281	2,592	1	1
29	CLR930252	1,085	0	0
30	CLR940315	1,597	0	0
31	CLR970554	870	0	0
32	CLR930305	53,641	14	15
33	CLR930248	776	0	0
34	CLR930229	454	0	0
35	CLR940264	7,196	2	2

ID	Reservation	Area (ha)	% of Grazing Area	% of DFA
36	CLR930261	905	0	0
37	CLR930272	2,826	1	1
38	CLR930280	971	0	0
39	CLR930237	3,927	1	1
40	CLR930257	129	0	0
41	CLR930374	712	0	0
42	CLR940273	9,227	2	3
43	CLR930377	3,192	1	1
44	CLR930267	18,843	5	5
45	CLR930249	4,099	1	1
46	CLR930241	4,028	1	1
47	CLR930379	4,080	1	1
48	CLR940306	75,310	20	21
49	CLR940280	1,094	0	0
50	CLR930247	9,399	3	3
51	CLR940263	16,841	4	5
Total		**374,465**	**100**	**107**

1 Due to overlapping reservations, area totals can exceed the total area of the DFA

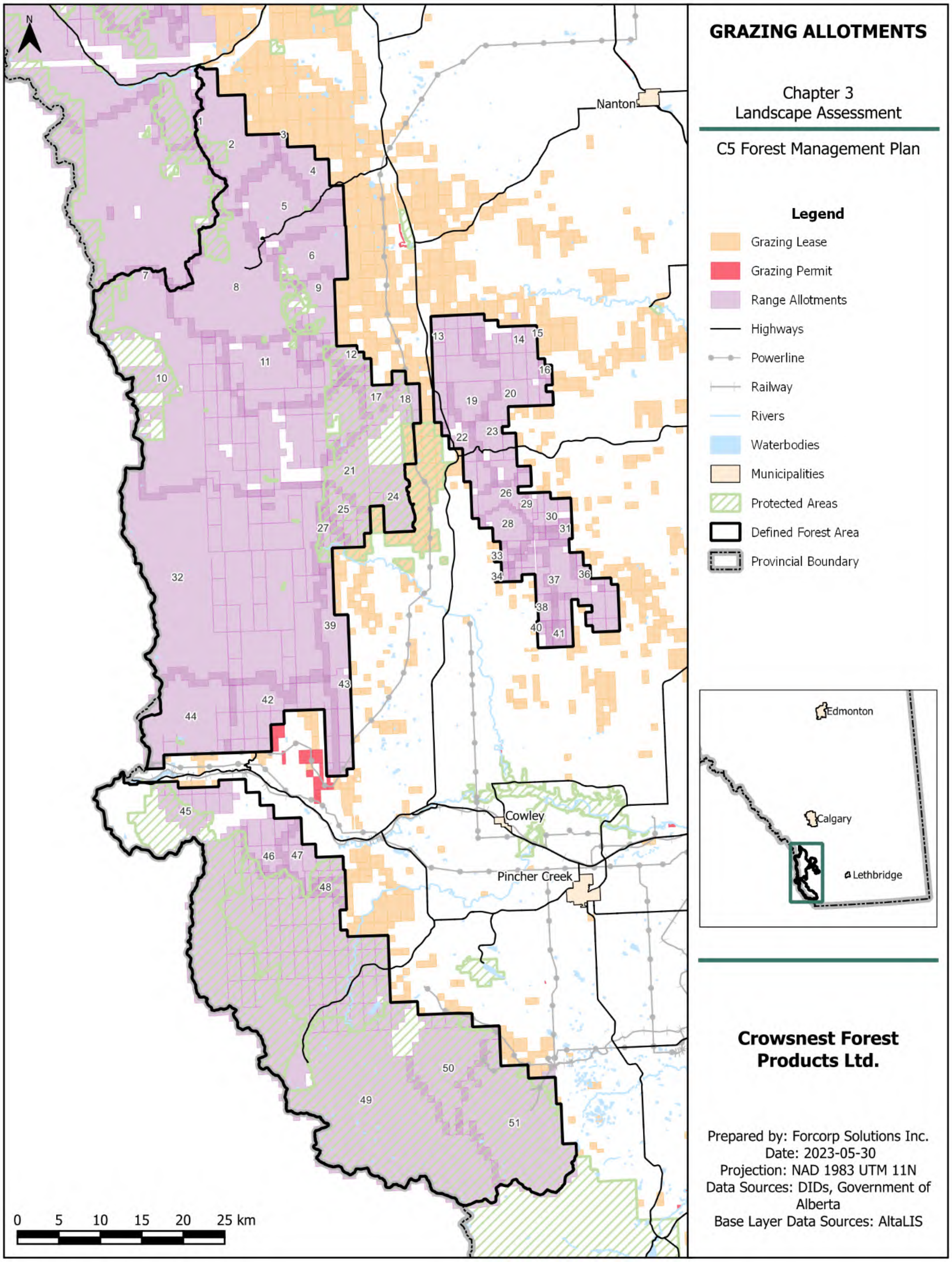

Figure 5-20. Grazing dispositions and range allotments within and surrounding the DFA.

6 Land Use

6.1 Timber

Forestry is an important sector for the economic well-being of the province and the DFA area. Forestry creates jobs for over 40,000 people and contributes over $7 billion to the provincial economy (Alberta Forest Products Association, 2019a). The forest sector also generates an average of $836 million in taxes, $44 million in stumpage fees paid to the province annually and 70 Alberta communities directly or indirectly rely on the industry for their livelihoods (Alberta Forest Products Association, 2019b).

Annual Allowable Cut (AAC) is the maximum volume of timber that can be sustainably harvested year-over-year within an area. Annual Allowable Cut levels are calculated for coniferous and deciduous timber by FMU and are approved by the Government of Alberta. On July 15, 2010, the Alberta Government approved the 2006-2026 C5 FMU Forest Management Plan (FMP) and established the AAC levels identified in Table 6-1. The AAC levels were reduced in 2017 with the creation of the Castle Provincial/Wildland Parks within the C5 FMU. A deciduous AAC was not calculated in the 2006-2026 C5 FMP because the deciduous trees found within the C5 FMU are believed to have greater value for meeting aesthetic and wildlife habitat objectives than though commercial timber harvesting.

Table 6-1. Approved AAC for the 2006 – 2026 C5 FMU.

	Annual Allowable Cut (m^3/year)		
Period	Coniferous	Deciduous	Total
2006-2017	209,414	-	209,414
2017-2026	157,800	-	157,800

6.2 Trapping

The fur trade in Western Canada dates back centuries and was a driving factor in the early occupation and settlement of modern-day Canada. Trapping is now controlled through licensing and regulations defined by the Alberta Wildlife Act. The DFA overlaps with 19 Registered Fur Management Areas (RFMA) [(39)] totaling 349,622 hectares, approximately 100% of the DFA (Figure 6-1). The average size of an individual trapline is 18,401 ha and the largest covers 44,465 ha. The trapping of fisher and otter is prohibited within Fur Management Zone 6 [(40)], which is the only fur management zone that overlaps with the DFA. All other furbearer species are allowed to be trapped during their respective seasons (Government of Alberta, 2018a).

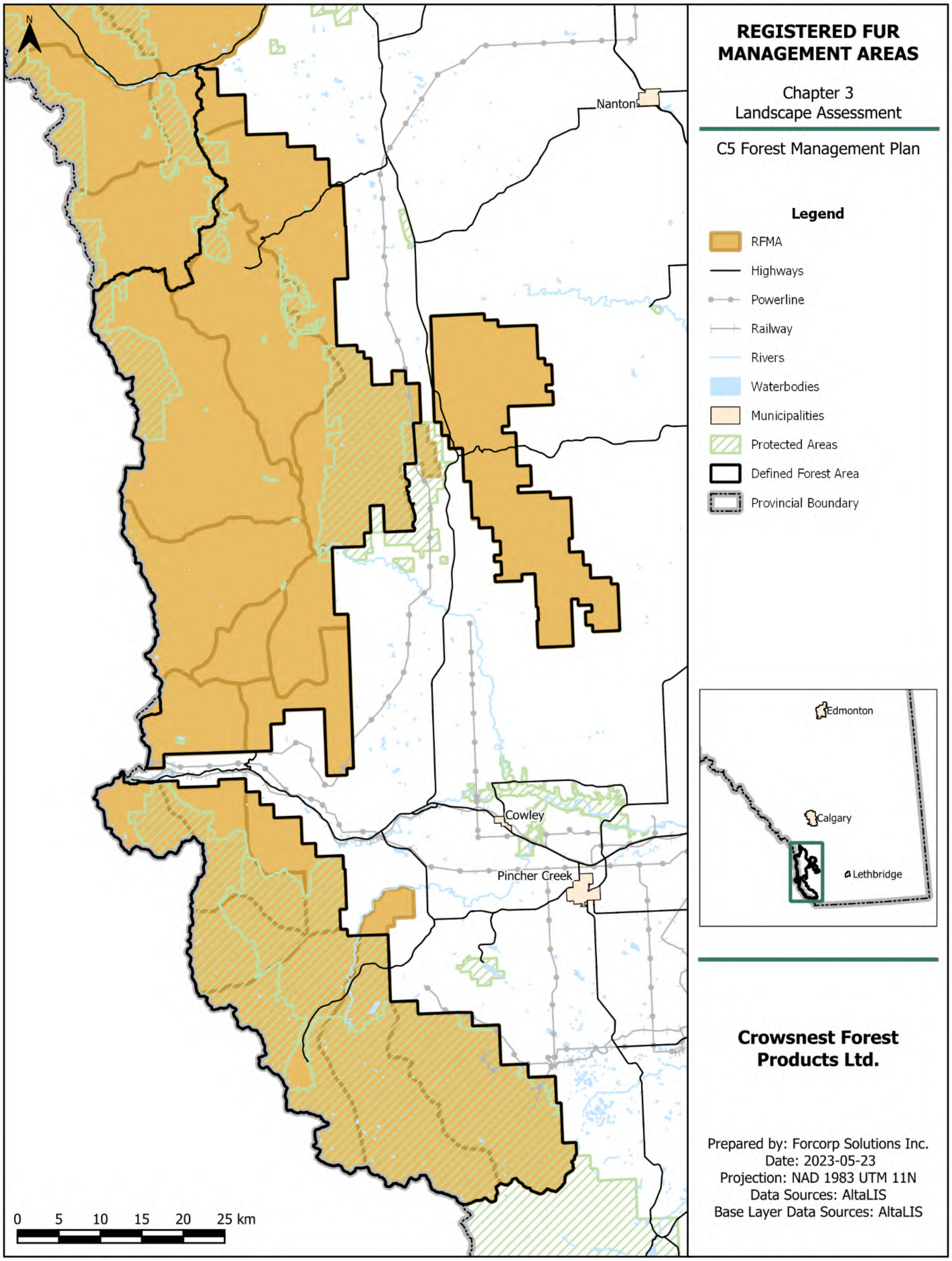

Figure 6-1. Registered Fur Management Areas within and surrounding the DFA.

6.3 Recreation

Recreation in Alberta is managed through legislation, regional and subregional planning, and the establishment of Public Land Use Zones (PLUZs). PLUZs are a tool used to manage recreational activity, including motorized access, in the DFA (see Section 2.14).

6.3.1 Livingstone-Porcupine Hills Recreation Management Plan

The Livingstone-Porcupine Hills region, composed of the Livingstone and Porcupine Hills Public PLUZs, is an area of high recreational use that covers a large portion of the DFA. The Livingstone-Porcupine Hills Recreation Management Plan (RMP) addresses the priorities for outdoor recreation expressed in the South Saskatchewan Regional Plan and came into effect on May 14, 2018. The RMP provides direction for recreational opportunities while managing impacts on other land uses and ecological values and commits to establishing a designated motorized trail system that meets access limits prescribed by the Livingstone-Porcupine Hills Land Footprint Management Plan and developing best practices and guidelines for siting recreational infrastructure including trails, camping, and day use areas. Diverse recreational activities including hiking, backcountry camping, mountaineering, skiing, mountain biking, horseback riding, OHV use, and hunting are supported and enabled through the RMP (Alberta Environment and Parks, 2017).

Castle Provincial Park and Castle Wildland Provincial Park were established by the Government of Alberta in 2017 and are located in the southern portion of the DFA adjacent to the Livingstone PLUZ. These two parks are managed by the Castle Management Plan: Castle Provincial Park and Castle Wildland Park, with the RMP designed to complement management objectives in these protected areas.

6.3.2 Recreation Trails

Trail development, access, and use is guided by both the RMP and higher-level legislation. The *Trails Act* establishes a system for motorized and non-motorized trail management on public lands (Government of Alberta, 2022). The *Public Lands Administrative Regulation* addresses land management, access, and compliance and enforcement concerns on public lands in Alberta, including authorizing activities for trail maintenance under the *Trails Act* and outlining disposition holders' responsibilities for addressing damages to trails (Government of Alberta, 2023b).

The DFA encompasses a well-developed trail system that supports a variety of motorized and non-motorized recreational activity. Recreation trails on crown land [41] are classified as provincial or designated trails and have restrictions related to motorized access and seasonal use (Figure 6-2).

6.3.3 Off-Highway Vehicle Recreation

Off-highway vehicle (OHV) use is an important recreational activity in the DFA. The RMP addresses priorities for outdoor recreation expressed in the South Saskatchewan Regional Plan, including establishing a designated motorized trail system and improving recreation infrastructure such as water crossings (Alberta Environment and Parks, 2017c). PLUZs designate trails acceptable for OHV use and regulate the types of vehicles that can be used on individual trails. There are well developed networks of designated OHV trails in the Livingstone and Porcupine Hills public land use zones. In the Cataract Creek Snow Vehicle PLUZ, OHV use is not permitted but snowmobiles are permitted on designated trails.

6.3.4 Camping and Day Use Areas

Backcountry (tent) camping is permitted throughout the Livingstone and Porcupine Hills PLUZs, excepting restrictions related to safety, environmentally sensitive areas, and adjacent dispositions and/or activities. Motorized camping is allowed in established designated locations.

Public Land Recreation Areas serve as designated areas for camping, trail access, day use, and staging for non-motorized access (see Section 2.14).

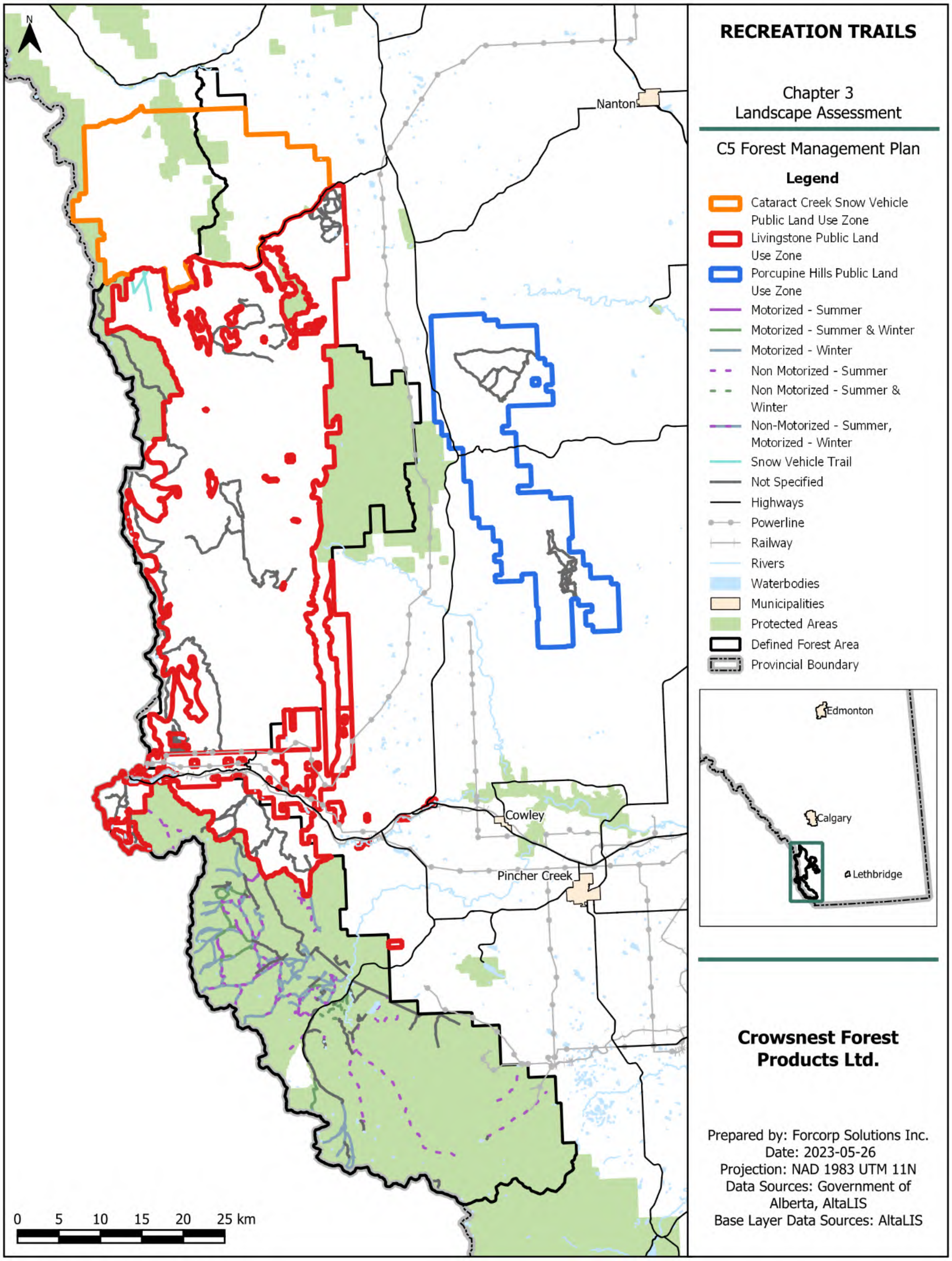

Figure 6-2. Recreation trails in the Cataract Creek Snow Vehicle, Livingstone, and Porcupine Hills public land use zones.

6.4 Tourism

The South Saskatchewan Regional Plan includes recreation and tourism objectives for the South Saskatchewan Land-use Framework Region, which encompasses 100% of the DFA (see Section 2.6). The very north of the DFA is part of the Kananaskis tourism destination area defined in the regional plan (Government of Alberta, 2017a). Broad objectives have been defined for this and other tourism destination areas that include tourism investment and infrastructure development, promoting scenic byways near areas with recreation and tourism features (no specific locations are defined yet), providing long-term security for tourism and recreation investment opportunities and development of regional tourism strategies for each destination.

6.5 Guiding and Outfitting

Hunting is a popular recreational pastime in Alberta, with over 150,000 resident hunters living in the province in 2021. According to the most recent survey, a total of 4,226 big game animals were harvested from the eight wildlife management units (see Section 6.8.1.2) overlapping the DFA in 2021 (Table 6-2). Hunters had the highest success rate hunting moose (average 48% success rate) and the lowest success rate hunting black bear (average 9% success rate) (Alberta Environment and Parks, 2022b; Alberta Environment and Parks, 2022c; Alberta Environment and Parks, 2022d; Alberta Environment and Parks, 2022e; Alberta Environment and Parks, 2022f) White-tailed deer and mule deer were the most frequently harvested species. Compulsory registration of harvested bighorn sheep is required in Alberta; 15 sheep were registered in WMUs overlapping the DFA in 2021. Five of the WMUs overlapping the DFA (Crowsnest Pass, Happy Valley, Highwood, Livingstone, and Willow Valley) have draws for non-trophy sheep hunting licences. No WMUs overlapping the DFA had draws for non-resident (non-Canadians) trophy sheep special licences in 2021 (Alberta Environment and Parks, 2022a).

Table 6-2. Big game harvest estimates in WMUs overlapping the DFA in 2021.

Species	Total Harvested	Estimated Average Hunter Success (%)
Black bear	184	9%
Elk	973	13%
Moose	89	48%
Mule deer	1,481	42%
White-tailed deer	1,499	23%
Total	**4,226**	**27%**

6.6 Cultural Resources and Historical Resources

Alberta Culture maintains a provincial GIS database that records sites that contain or are believed to contain historic resources [(42)], which includes archaeological and paleontological sites, Indigenous peoples traditional-use of a historical resource, and historic structures. Each land parcel in the listing is assigned a Historical Resource Value (HRV) ranging from 1 to 5, reflecting its historical importance. HRV 2 was formerly used to designate sites as a Registered Historic Resource but is no longer assigned.

- HRV 1: Designated under the HRA as a Provincial Historic Resource
- HRV 3: Contains a significant historic resource that will likely require avoidance
- HRV 4: Contains a historic resource that may require avoidance

- HRV 5: High potential to contain a historic resource

The DFA contains all levels of HRV (Table 6-3). There are three locations of HRV 1 in the south DFA (Figure 6-3). Locations with HRV of 3 through 5 are spread throughout the DFA, with HRV 5 sites covering most of the eastern boundary of compartments Racehorse Creek, Oldman River, and Willow Creek and almost the entirety of Porcupine Hills.

Table 6-3. Area containing historical resources, by category and assigned HRV.

	Relative Importance Ranking (HRV)									
	HRV 1		HRV 3		HRV 4		HRV 5		Total[1]	
Category	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Archaeological	-	-	814	41	4,584	27	100,723	40	106,120	74
Cultural	-	-	-	-	10,440	62	-	-	10,440	7
Historical	97	50	178	9	232	1	-	-	508	0
Geological	97	50	78	4	-	-	-	-	176	0
Natural	-	-	-	-	-	-	23,854	10	23,854	17
Paleontological	-	-	926	46	1,693	10	261	0	2,879	2
Total[1]	**195**	**0**	**1,996**	**1**	**16,949**	**12**	**124,838**	**87**	**143,978**	**100**

[1] Some categories and features overlap so total area is not additive

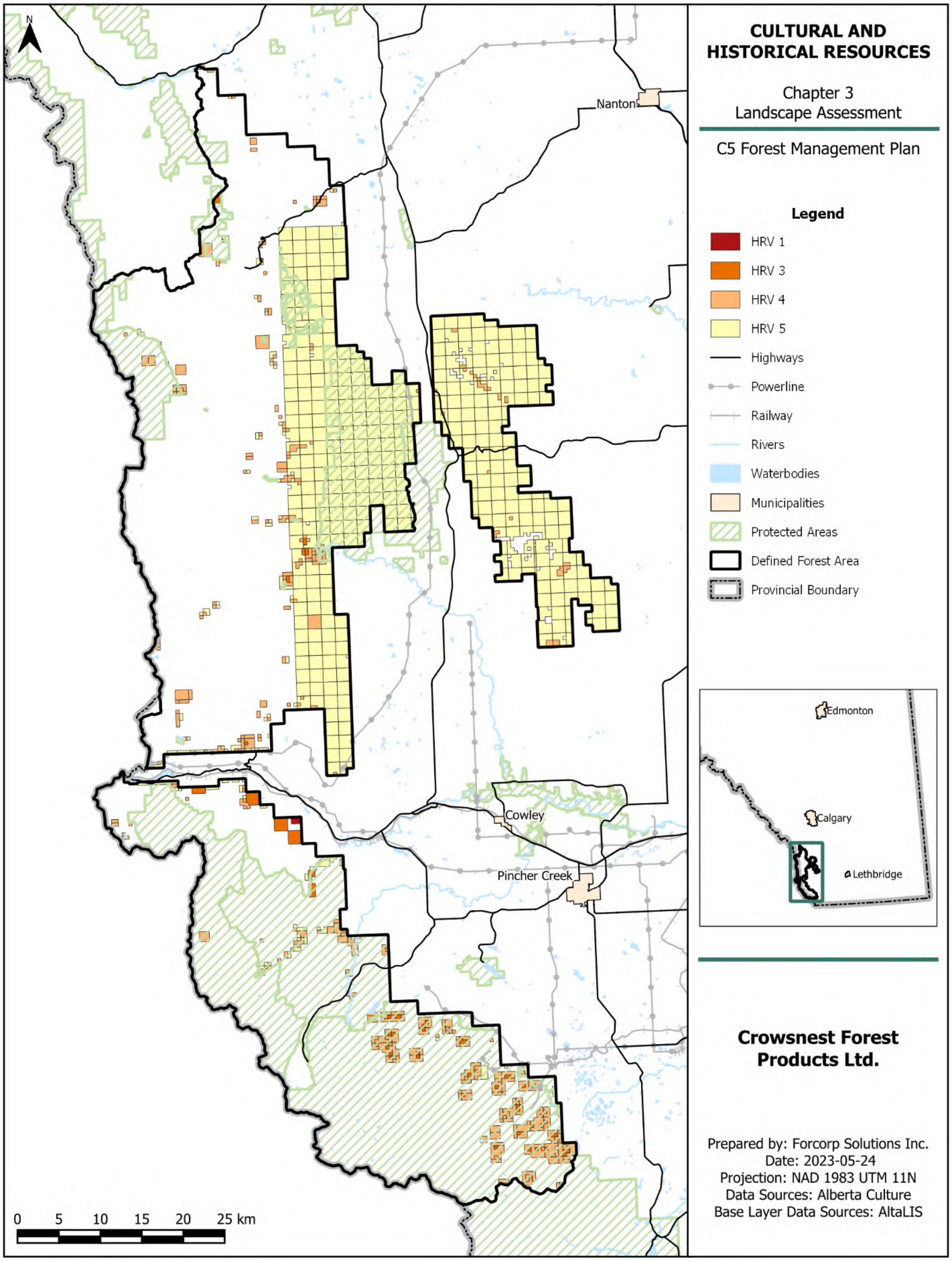

Figure 6-3. Areas with Historic Resource Value within the DFA.

6.7 Visual Resources

The diverse topography (see Section 3.1), variety of vegetation types and leading forest species (see Section 4.1), and the presence of many parks and protected areas (see Section 2.12) in the DFA creates numerous high value visual areas. A visual quality inventory for the DFA was completed to identify areas of high visual quality by determining potential viewer locations (e.g., roadways, trails, recreation areas, rivers and lakes). The visibility from selected features was then determined for the foreground (0 – 0.8 km), midground (0.8 – 5 km) and the background (5+ km). Figure 6-4 shows the DFA areas modelled as having high visual quality for the foreground, midground, and background classifications.

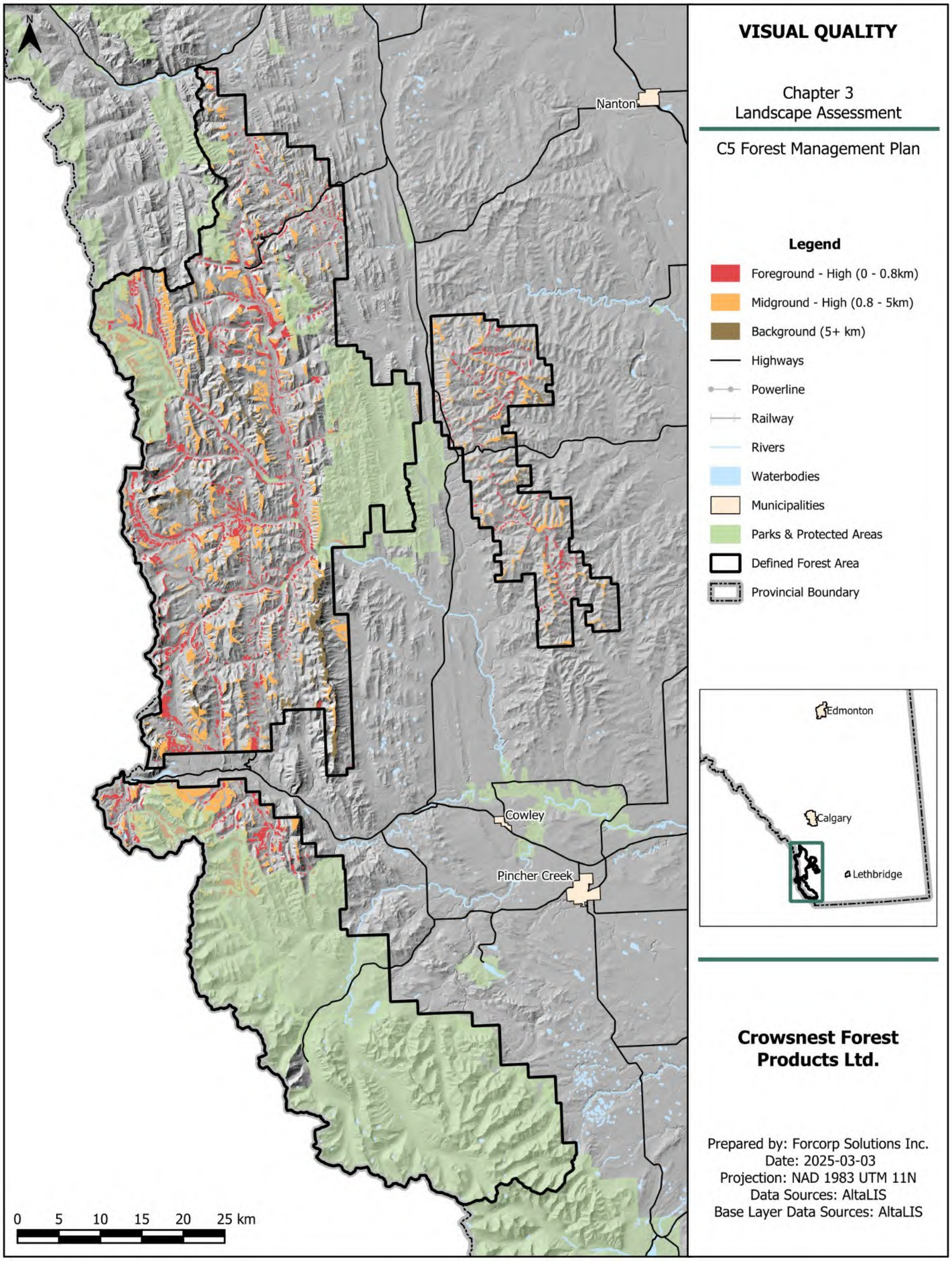

Figure 6-4. Modelled areas of high visual quality within the DFA.

6.8 Fish and Wildlife Resources

6.8.1 Management Zones

6.8.1.1 Fish and Wildlife Districts

Alberta is divided into five Fish and Wildlife Management Areas, which are further divided into 60 Fish and Wildlife Districts [43] for regulation and enforcement purposes. Four Fish and Wildlife Districts overlap with the DFA (Figure 6-5), with the Blairmore district covering the largest area (75%, Table 6-4).

Table 6-4. Fish and Wildlife districts in the DFA.

District Name	Entire District Area (ha)	Portion of District in DFA		Portion of DFA Occupied by District (%)
		Area (ha)	(%)	
Blairmore	327,684	263,260	80	75
Claresholm	545,955	38,833	7	11
High River	519,914	20,731	4	6
Pincher Creek	286,122	27,509	10	8
Total	**1,679,675**	**350,334**	**21**	**100**

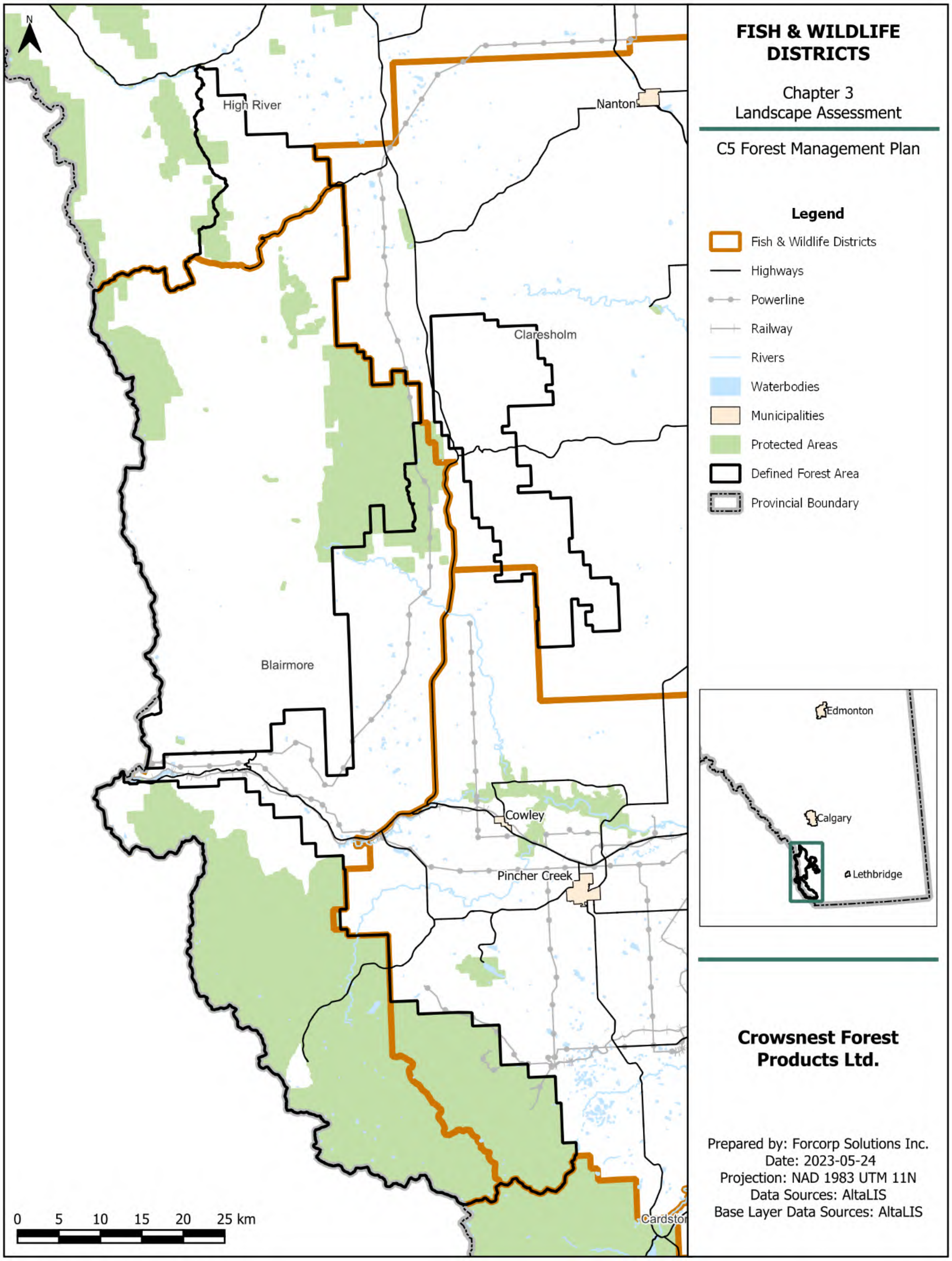

Figure 6-5. Fish and Wildlife Districts surrounding the DFA.

6.8.1.2 Wildlife Management Units

The Government of Alberta manages wildlife resources using Wildlife Management Units (WMUs) [44]. Hunting regulations are defined by WMU with different rules, timing and harvest levels for each WMU. There are eight WMUs that overlap the DFA area (Figure 6-6), with the Livingstone WMU covering the largest area (38%, Table 6-5).

Table 6-5. Wildlife management units in the DFA.

WMU Name	Entire Unit Area (ha)	Portion of Unit in DFA		Portion of DFA Occupied by Unit (%)
		Area (ha)	(%)	
Castle-Carbondale	120,400	120,380	100	34
Crowsnest Pass	16,049	865	5	0
Happy Valley	65,570	30,404	46	9
Highwood	93,484	20,731	22	6
Livingstone	132,989	132,636	100	38
North Porcupine Hills	154,520	17,977	12	5
South Porcupine Hills	212,497	20,905	10	6
Willow Valley	41,959	6,450	15	2
Total	**837,469**	**350,348**	**42**	**100**

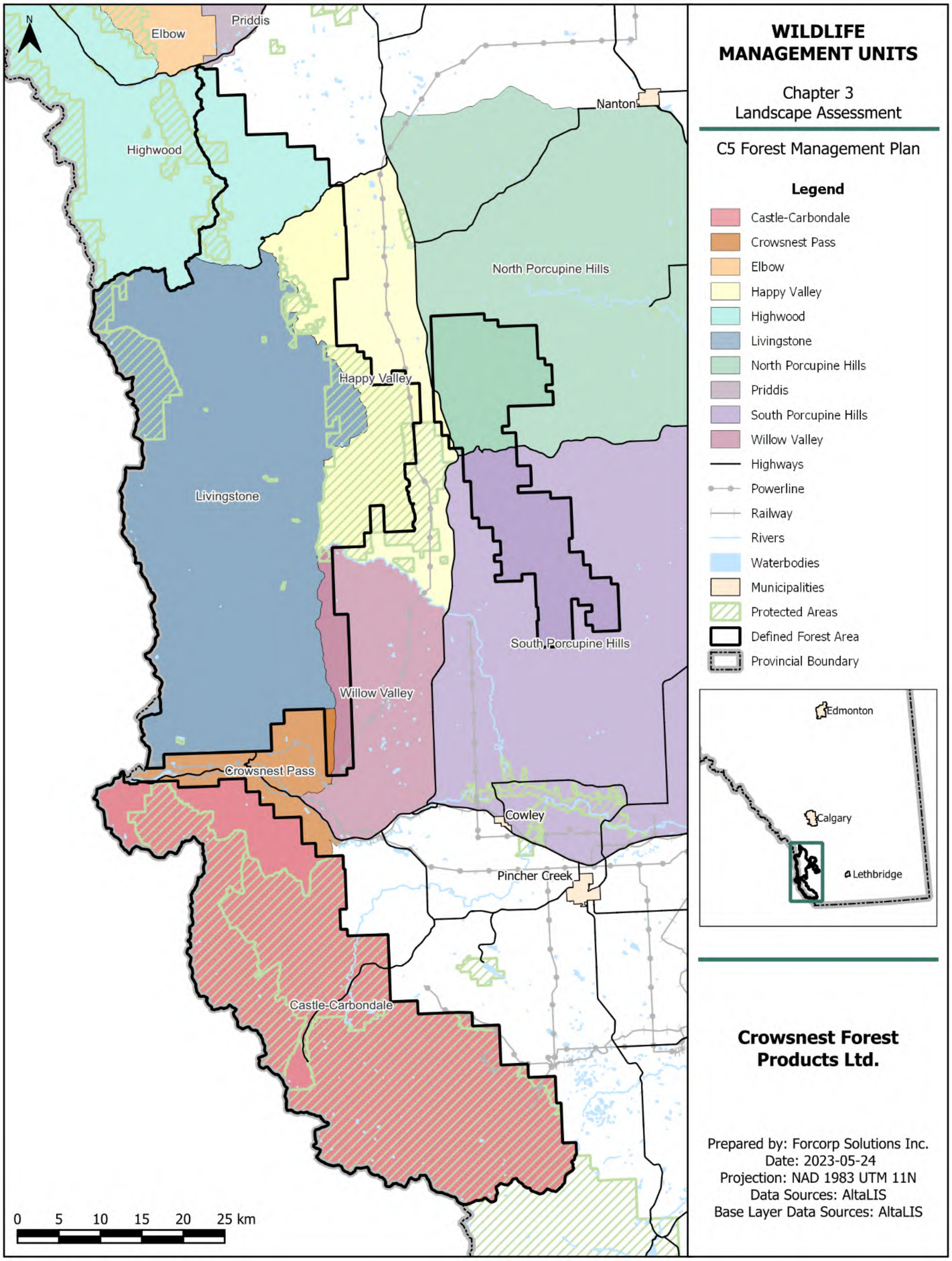

Figure 6-6. Wildlife Management Units within and surrounding the DFA.

6.8.1.3 Hydrologic Unit Code (HUC)

The Hydrological Unit Code (HUC) watersheds of Alberta [45] represent a collection of four nested hierarchically structured drainage basin feature classes and are used to meet fisheries management objectives. Fish Sustainability Indexes (FSIs) are developed and selected for cold water fish species based on the HUCs. Figure 6-7 shows the HUC 10 watersheds that overlap and surround the DFA. The Livingstone River watershed occupies the greatest area of the DFA (10%, Table 6-6).

Table 6-6. HUC 10 watersheds that overlap the DFA.

HUC 10 Watershed ID Number	HUC 10 Watershed Name	Entire Watershed Area (ha)	Portion of Watershed in DFA Area (ha)	Portion of Watershed in DFA (%)	Portion of DFA Occupied by Watershed (%)
401010202	Allison Creek	5,140	4,497	87	1
401010502	Beaver Creek	29,180	6,359	22	2
401010203	Blairmore Creek	5,026	2,859	57	1
401030202	Blakiston Creek	15,683	3	0	0
401010108	Bob Creek	7,366	6,019	82	2
401010109	Callum Creek	21,327	7,586	36	2
401010107	Camp Creek	5,706	5,517	97	2
401010304	Carbondale River	30,943	30,429	98	9
402120102	Cataract Creek	23,385	222	1	0
401030204	Drywood Creek	28,775	13,071	45	4
401010105	Dutch Creek	15,526	15,526	100	4
401010204	Gold Creek	6,334	2,607	41	1
401010111	Heath Creek	6,605	2,741	41	1
401010102	Hidden Creek	6,902	6,902	100	2
401010103	Livingstone River	35,819	35,807	100	10
401010205	Lower Crowsnest River	27,009	4,105	15	1
401010110	Lower Oldman River Above Reservoir	27,925	336	1	0
401020107	Meadow Creek	12,577	1,212	10	0
401010303	Middle Castle River	21,266	6,218	29	2
402120103	Middle Highwood River	31,875	485	2	0
401010104	Middle Oldman River Above Reservoir	20,104	6,481	32	2
401020103	Middle Willow Creek	56,524	718	1	0
401010305	Mill Creek	18,979	10,540	56	3
401010401	Pincher Creek	28,790	2,955	10	1
401010106	Racehorse Creek	30,648	30,648	100	9
401010206	Rock Creek	4,748	713	15	0
401020102	South Willow Creek	27,983	13,441	48	4
402120107	Stimson Creek	48,805	11,493	24	3
401010207	Todd Creek	24,557	3,918	16	1
401020105	Trout Creek	44,491	16,619	37	5
401010301	Upper Castle River	24,246	24,220	100	7
401010201	Upper Crowsnest River	30,597	23,321	76	7
401010101	Upper Oldman River Above Reservoir	27,479	27,475	100	8
401020101	Upper Willow Creek	37,597	12,493	33	4
401010302	West Castle River	12,812	12,812	100	4
Total		**802,725**	**350,348**	**44**	**100**

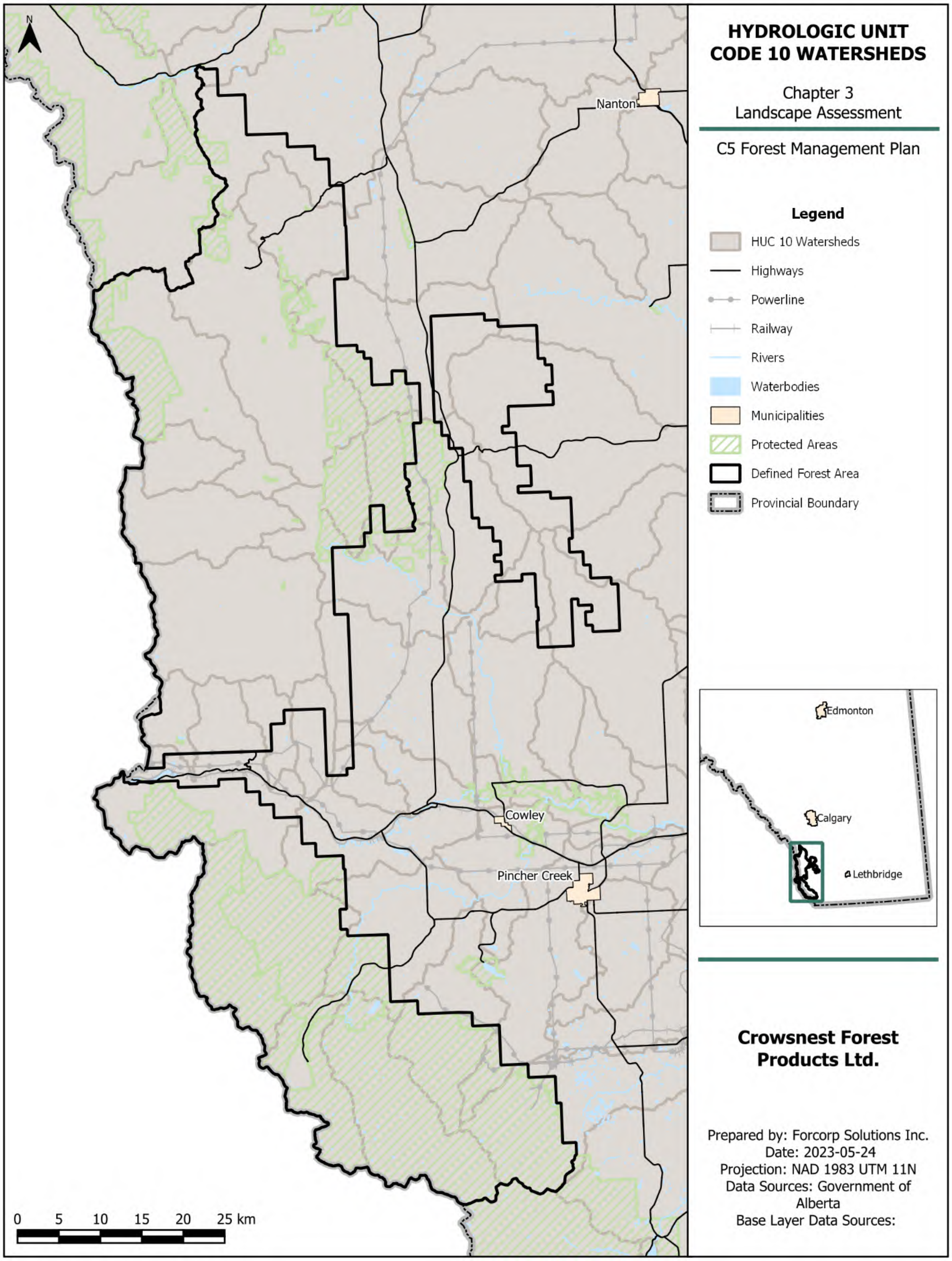

Figure 6-7. HUC10 watersheds within and surrounding the DFA.

6.8.2 Fish Management Zones

Three Fish Management Zones [(46)] have been designated in Alberta to determine fisheries health, regulate sport and commercial fishing, and determine fish stocking. Fish Management Zones are further subdivided into Fish Watershed Units based on specific river basins. The DFA is entirely within the Eastern Slopes Fish Management Zone (Figure 6-8), and includes the Watershed Unit ES1 (Oldman River and Bow River) and ES2 (Red Deer and North Saskatchewan Rivers).

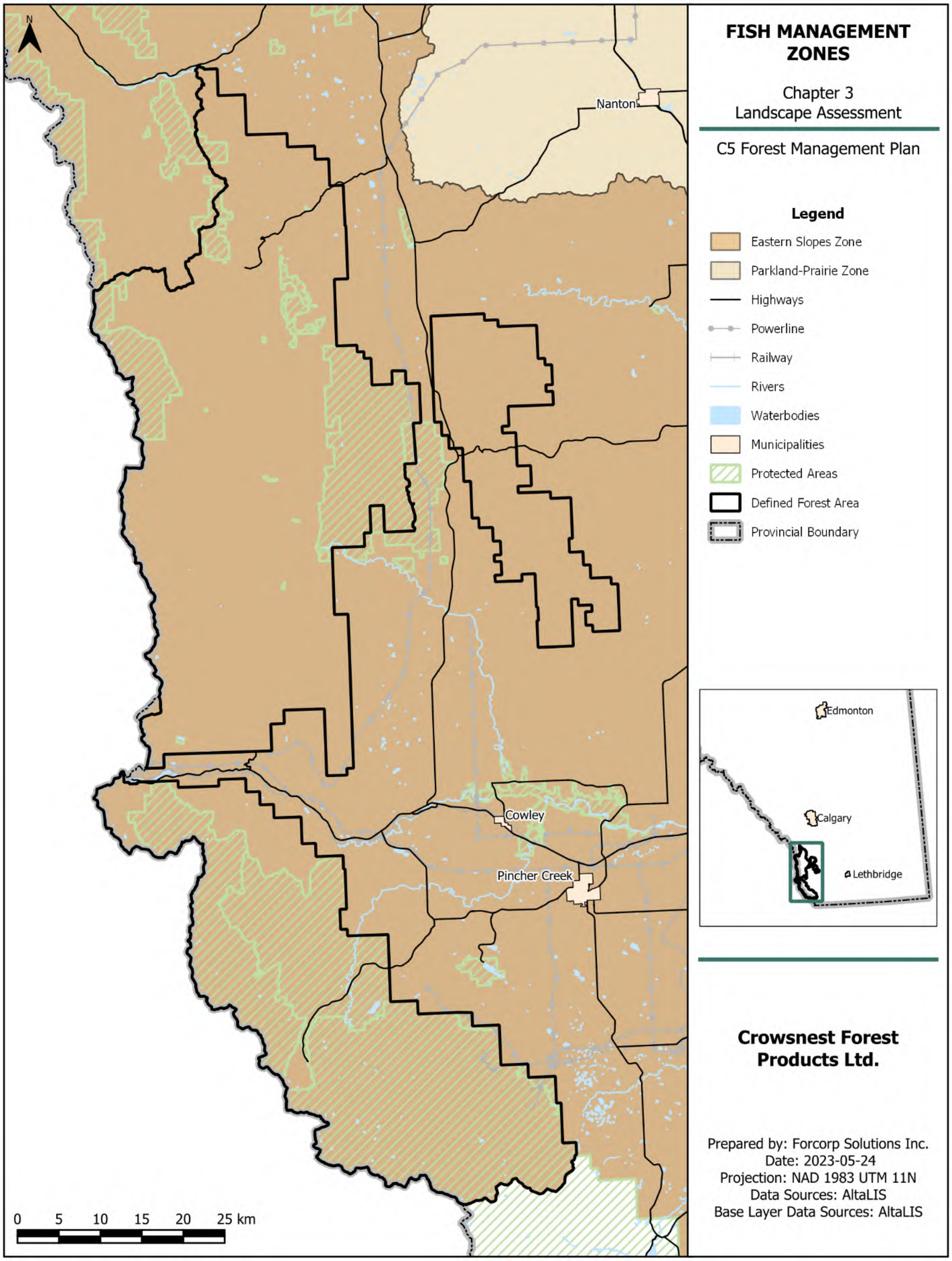

Figure 6-8. Fish Management Zones surrounding the DFA.

6.8.3 Wildlife

6.8.3.1 Wildlife Sensitivity Zones

Wildlife sensitivity zones are derived from aerial surveys, historical information, movements of collared animals and specific habitat type requirements (Government of Alberta, 2019b). They are used by industrial operators and government departments in operational decision making on Crown land, primarally for oil and gas development, whereas forestry focuses on operating ground rules (OGRs) for these areas.

Table 6-7. Wildlife sensitivity zones within the DFA.

Wildlife Species		Wildlife Sensitivity Zone within Alberta (ha)	Portion of Sensitivity Zone in DFA (ha)	Portion of Sensitivity Zone in DFA (%)	Portion of DFA occupied by Sensitivity Zone (%)
Grizzly bear (*Ursus arctos horribilis*)	Core habitat zone	3,729,349	329,127	9	94
	Secondary habitat zone	4,973,300	20,905	0	6
	Habitat linkage zone	528,671	15,723	3	4
	Support zone	6,175,960	301	0	0
	Subtotal	**15,407,281**	**366,056**	**2**	**104**
Mountain goat (*Oreamnos americanus*) and sheep (*Ovis canadensis*)		1,247,007	138,009	11	39
Key wildlife biodiversity zone		4,695,030	124,834	3	36

Grizzly bear (*Ursos arctos horribilis*) is a threatened species in Alberta, and grizzly bear sensitivity zones (47, 48, 49, 50) have been established to reduce sources of human-caused mortality, reduce human-bear conflicts, avoid development within key habitats and seasons and avoid development of grizzly bear attractants (Government of Alberta, 2008). The grizzly bear zones are divided into core habitat (areas of high habitat value and low mortality risk), secondary habitat (areas of good habitat, reflecting the broader range of grizzly bears), habitat linkage (highway corridors where there is a need to maintain or enhance connectivity between bear management areas), and support (areas designed to maintain bear populations, particularly females with or without cubs). Grizzly bear management areas have also been identified for the province to create regional recovery priorities and actions. The majority of the DFA area is classified as core grizzly bear habitat (94%) (Table 6-7), while an additional 6% of the area is secondary grizzly habitat and 4% is classified as a habitat linkage zone. Most of the core grizzly habitat is within the western compartments, while the southern portion of compartment Porcupine Hills is secondary grizzly habitat (Figure 6-9). The habitat linkage zone buffers a portion of Highway 3 and connects the Crowsnest River North and Crowsnest River compartments. The north DFA is within the Livingstone bear management area (BMA 4) and the south DFA is within the Waterton bear management area (BMA 5).

Mountain goat (*Oreamnos americanus*) and bighorn sheep (*Ovis canadensis*) are alpine ungulates that are potentially sensitive to human disturbance. The majority of goat and sheep ranges in Alberta (51) are in areas where industrial activity is not permitted. However, 11% of the DFA is occupied by this zone (Table 6-7, Figure 6-9).

Key wildlife and biodiversity zones (52) have been established by the Government of Alberta. Many of these zones follow major river valleys as they contain topographic variation, high site productivity and riparian vegetation complexes. Figure 6-10 shows the distribution of Wildlife Biodiversity Zones across the DFA, which occupies a total of 3% of the DFA (Table 6-7).

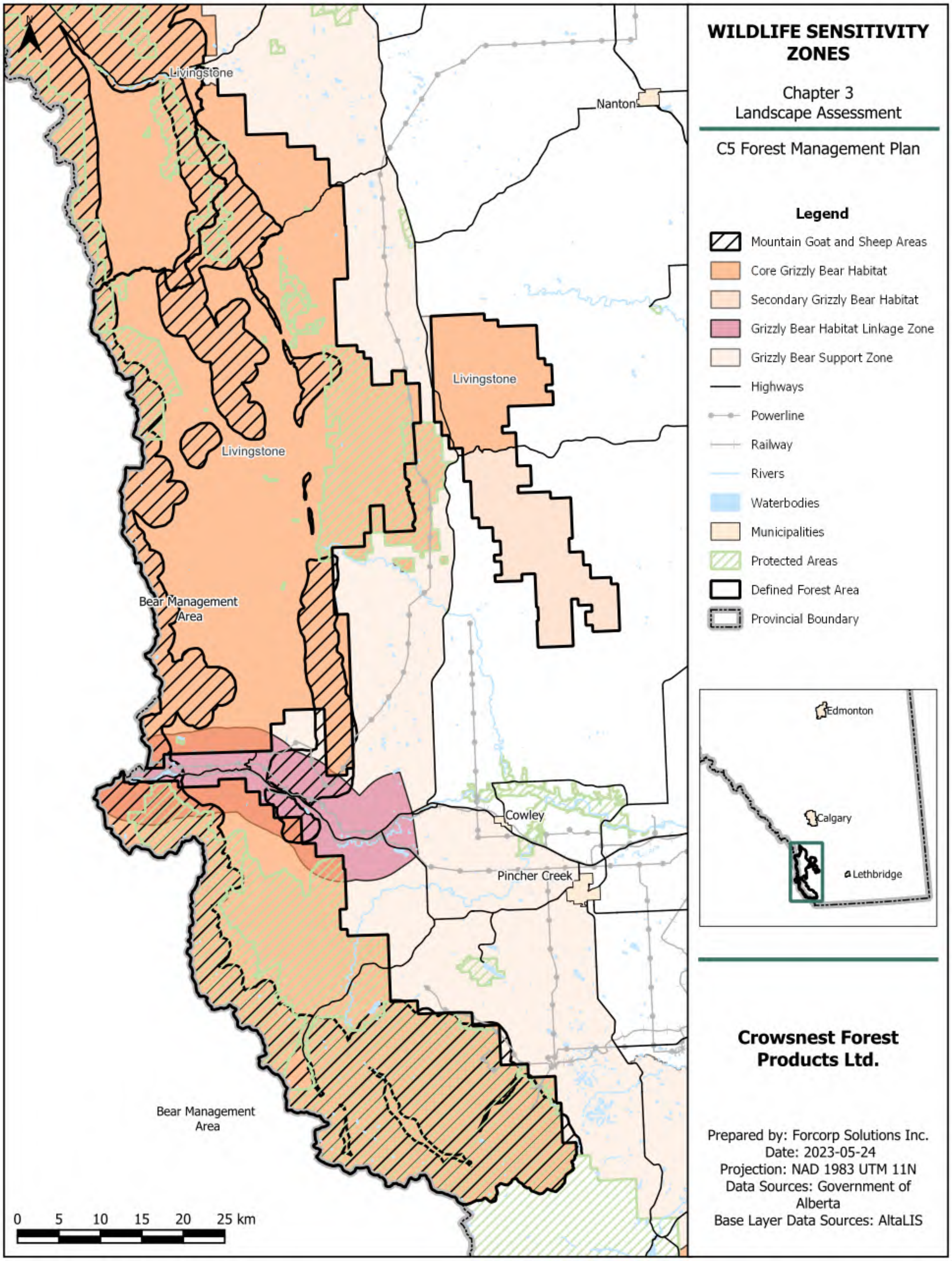

Figure 6-9. Wildlife species sensitivity zones within and surrounding the DFA.

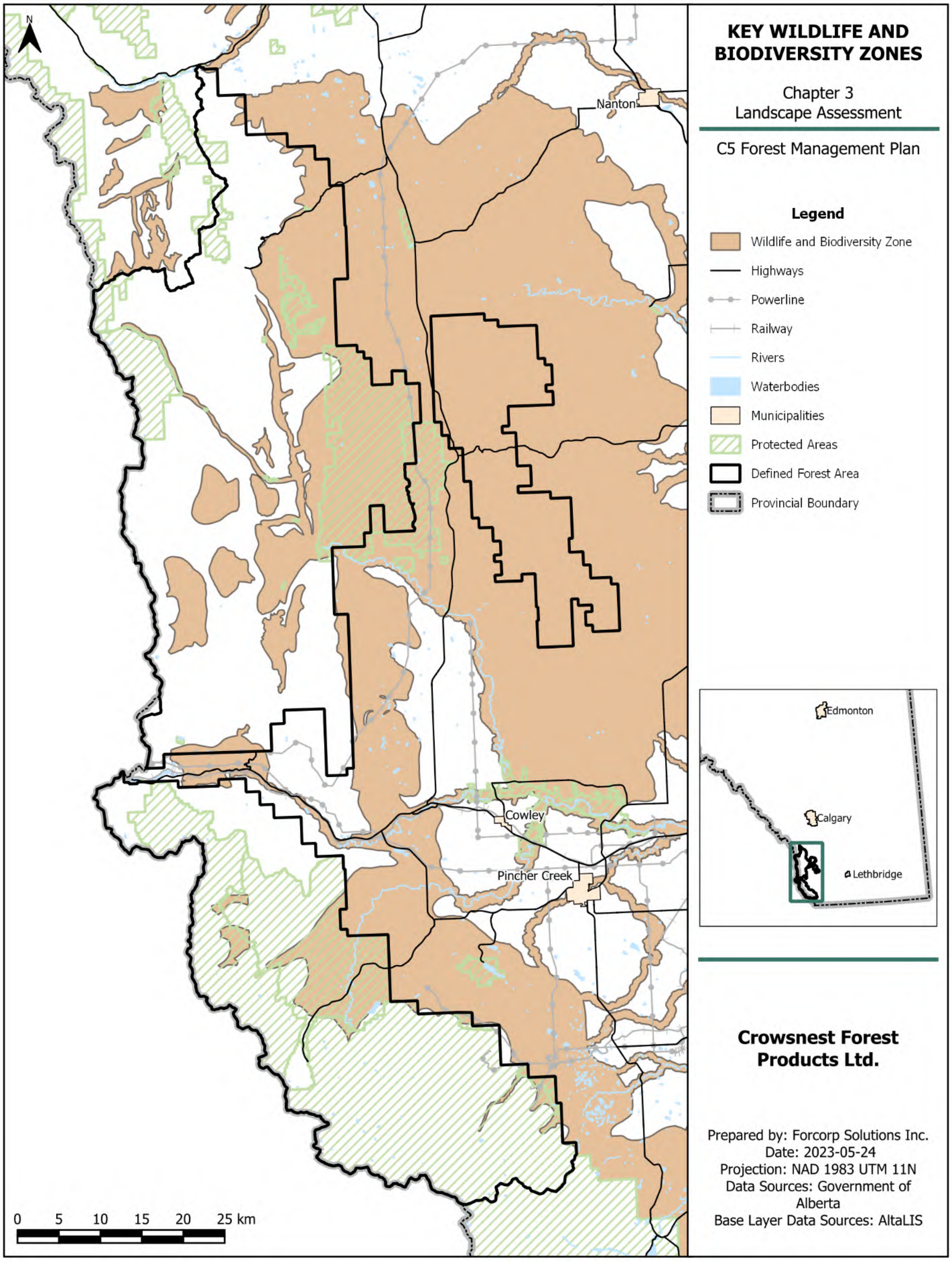

Figure 6-10. Key Wildlife and Biodiversity Zones within and surrounding the DFA.

6.8.3.2 Species of Special Concern

Table 6-8 lists the species classified under the Alberta Wildlife Act as Endangered, Threatened, or Special Concern that have either been found in the DFA or could potentially be found in the DFA based on range maps and other data sources.

Table 6-8. Species at risk that occur or are likely to occur in the DFA.

Species Classification	Species	Confirmed inside DFA	Likely inside DFA	Possibly inside DFA
Endangered	Limber pine (*Pinus flexilis*)	X		
	Whitebark pine (*Pinus albicaulis*)	X		
	Porsild's bryum (*Bryum porsildii*)			X
	Subtotal	**2**	**0**	**1**
Threatened	Grizzly bear (*Ursus arctos*)	X		
	Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*)	X		
	Bull trout (*Salvelinus confluentus*)	X		
	Peregrine falcon (*Falco peregrinus*)		X	
	Sprague's pipit (*Anthus spragueii*)			X
	Lake sturgeon (*Acipenser fulvescens*)			X
	Subtotal	**3**	**1**	**2**
Special Concern	Harlequin duck (*Histrionicus histrionicus*)		X	
	Ferruginous hawk (*Buteo regalis*)		X	
	Long-billed curlew (*Numenius americanus*)			X
	Long-toed salamander (*Ambystoma macrodactylum*)			X
	Northern leopard frog (*Lithobates pipiens*)			X
	Prairie falcon (*Falco mexicanus*)			X
	Trumpeter swan (*Cignus buccinator*)			X
	Western blue flag (*Iris missouriensis*)			X
	Western grebe (*Aechmophorus occidentalis*)			X
	Subtotal	**0**	**2**	**7**
Total		**5**	**3**	**10**

6.8.3.3 Critical Habitat for Aquatic Species at Risk

Critical habitat is identified for species listed as Endangered or Threatened under the federal *Species at Risk Act* and where federal critical habitat protection orders are in effect. Critical habitat is defined as the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as such in the recovery strategy or action plan for the species. The *Species at Risk Act* makes it illegal to destroy any part of the critical habitat of a listed species and may impose restrictions on development and construction.

Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) are ranked as Threatened both under Alberta's *Wildife Act* and by the national Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Threats to sustainability include hybridization with non-native trout, harvest, and habitat change. There are 141 waterbodies covering 29% of the DFA that are classified as critical habitat for westslope cutthroat trout [53] (Table 6-9, Figure 6-11).

Table 6-9. Critical habitat for aquatic species at risk within the DFA.

Species at Risk	Number of Waterbodies	Total area in Province (ha)	Area in DFA (ha)	Portion of zone in DFA (%)	Portion of DFA (%)
Westslope Cutthroat Trout	141	219,158	102,218	47	29

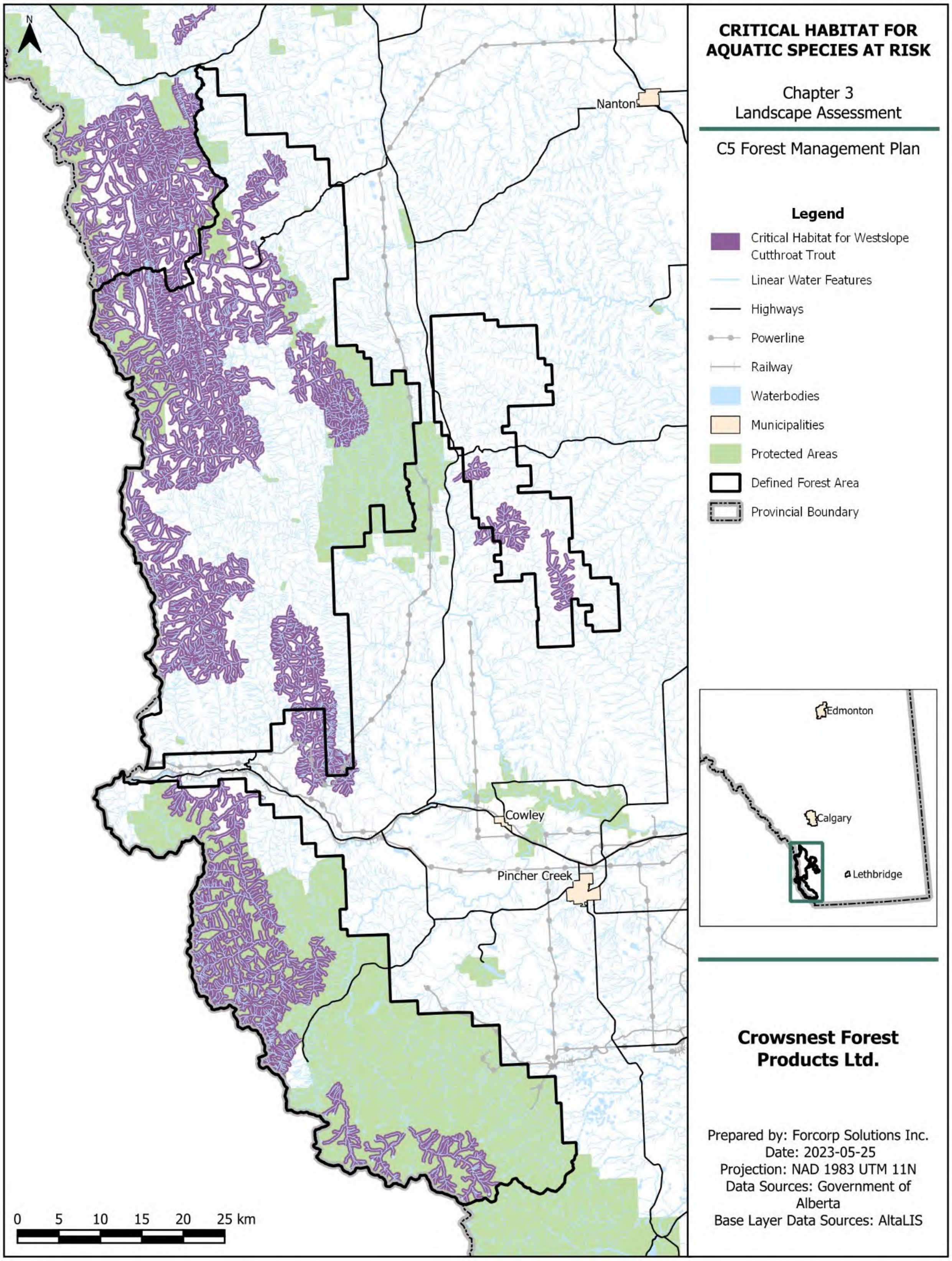

Figure 6-11. Critical habitat for westslope cutthroat trout within and surrounding the DFA.

6.8.3.4 *Rare Species and Ecological Communities*

The Alberta Conservation Information Management System (ACIMS) is a spatial database of species and ecological communities that are considered rare or of conservation concern (Alberta Parks, 2019). Element occurrences are divided into sensitive element occurrences [54] with the location provided by township, and non-sensitive element occurrences [55] with a more exact location provided. The status definitions used by ACIMS, which are adapted from the NatureServe ranking methodology, are summarized below (Table 6-10).

Table 6-10. ACIMS status definitions.

Rank	Definition
SX	Taxon is believed to be extirpated from the province and is unlikely to be rediscovered.
SH	Taxon is known only from historical records but there is a possibility of rediscovery.
S1	Taxon is known from 5 or fewer occurrences or is especially vulnerable to extirpation due to other factor(s).
S2	Taxon is known from 20 or fewer occurrences or especially vulnerable to extirpation due to other factor(s).
S3	Taxon is known from 100 or fewer occurrences or especially vulnerable to extirpation due to other factor(s).
S4	Taxon is apparently secure and uncommon but not rare. There may be some cause for long-term concern due to declines or other factors.
S5	Taxon is secure, common, widespread, and abundant.
S#S#	A numeric range rank indicates a range of uncertainty about the status of a taxon (e.g., S2S3).
SU	Taxon is currently unrankable due to a lack of information or conflicting information.
SNR	Taxon is not ranked as conservation status has not been assessed.
SNA	A rank is not applicable as the taxon is not a suitable target for conservation activities (e.g., introduced species).
S#?	An inexact numeric rank is applied when there is conflicting information or unresolved questions on the status of the taxon.

There are a total of 895 non-sensitive element occurrences within the DFA for 261 species or ecological communities. The ACIMS database contains both rare plant occurences (Table 6-11) and rare butterfly occurrences (Table 6-12). Non-sensitive element occurrences are found throughout the DFA with a noticeable concentration of locations at the northern boundary of the Oldman River compartment and the southern portion of the DFA.

There are two sensitive element occurrences (*Aquilegia jonesii* and *Microseris nutans*) that occur within the DFA, both found along the southern boundary within Castle Wildland Provincial Park (Table 6-13, Figure 6-12).

Table 6-11. ACIMS non-sensitive plant occurrences within the DFA.

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Abies bifolia - Pinus albicaulis - Picea engelmannii / Empetrum nigrum forest	subalpine fir - whitebark pine - Engelmann spruce / crowberry forest	S2	2
Abies bifolia - Pinus flexilis - Populus tremuloides / Thalictrum venulosum forest	subalpine fir - limber pine - aspen / veiny meadow rue forest	S2?	1
Adenocaulon bicolor	Pathfinder	S2	2
Adiantum aleuticum	western maidenhair fern	S2	2
Allantoparmelia alpicola	rock grubs	S2S3	1
Allocetraria madreporiformis	finger lichen	S2S3	3
Anoectangium aestivum	moss (no common name provided)	S2S3	1
Antennaria aromatica	scented pussytoes	S3	1
Antennaria corymbosa	corymbose everlasting	S2	1
Aquilegia jonesii	Jones' columbine	S1	2
Arnica parryi	nodding arnica	S2	5
Artemisia borealis ssp. borealis	northern wormwood	S2S3	2
Artemisia tridentata	big sagebrush	S2	2
Artemisia tridentata ssp. vaseyana - Amelanchier alnifolia shrubland	big sagebrush - saskatoon shrubland	S1	5
Artemisia tridentata ssp. vaseyana - Rhamnus alnifolia shrubland	big sagebrush - alder-leaved buckthorn shrubland	S1	2
Aspicilia pergibbosa	sunken disc lichen	S1S2	1
Aspicilia sublapponica	sunken disc lichen	S1	1
Athyrium distentifolium var. americanum	alpine lady fern	S1	1
Aulacomnium androgynum	little groove moss	S2S3	4
Bacidia hegetschweileri	dot lichen	S1	2
Biatora globulosa	lichen (no common name provided)	S1	1
Boechera calderi	Calder's rockcress	S2	1
Boechera lemmonii	Lemmon's rockcress	S3	2
Botrychium ascendens	ascending grape fern	S3	2
Botrychium campestre	field grape fern	S3	2
Botrychium hesperium	western grape fern	S3	1
Botrychium lineare	straight-leaf moonwort	S1	1
Botrychium michiganense	Michigan grapefern	SU	1
Botrychium spathulatum	spatulate grape fern	S3	2
Brachythecium frigidum	moss (no common name provided)	S1S2	1
Brickellia grandiflora	large-flowered brickellia	S2	1
Bucklandiella sudetica	moss (no common name provided)	S2S3	1
Buxbaumia piperi	moss (no common name provided)	S1	1
Buxbaumia viridis	green shield moss	S1	1
Caloplaca chrysophthalma	firedot lichen	S1	1
Caloplaca citrina	powdery jewel lichen	S1S2	2
Caloplaca cladodes	firedot lichen	S1	1
Caloplaca flavovirescens	sulphur-firedot lichen	S2S3	1

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Camassia quamash var. quamash	blue camas	S3	2
Carex geyeri	Geyer's sedge	S2	1
Carex infirminervia	weak-nerved sedge	S1	1
Carex mertensii	purple sedge	S2	4
Carex paysonis	Payson's sedge	S2	2
Carex petasata	pasture sedge	S3	1
Carex scoparia var. scoparia	broom sedge	S2	1
Catillaria nigroclavata	lichen (no common name provided)	S2	3
Ceanothus velutinus	snowbrush ceanothus	S2	6
Cetraria arenaria	sand-loving Iceland lichen	S1S2	3
Chaenotheca trichialis	stubble lichen	S2	1
Chaenotheca xyloxena	stubble lichen	S1	1
Cirsium scariosum	meadow thistle	S2	9
Clevea hyalina	liverwort (no common name provided)	S3	1
Collema crispum	crinkled jelly lichen	S1S2	1
Collema subparvum	jelly lichen	S1	1
Collema undulatum var. granulosum	jelly flakes lichen	S2S3	1
Conimitella williamsii	conimitella	S2	15
Conocephalum salebrosum	cat-tongue liverwort	S2S4	1
Crepis atribarba	slender hawk's-beard	S2	2
Cynodontium strumiferum	moss (no common name provided)	S2S3	1
Cyphelium inquinans	cupped soot lichen	S2	2
Cypripedium montanum	mountain lady's-slipper	S2	2
Dermatocarpon intestiniforme	leather lichen	S3	1
Deschampsia elongata	slender hair grass	S2	5
Dichodontium olympicum	moss (no common name provided)	S1	1
Dicranella crispa	curl-leaved fork moss	S2S3	1
Dicranella heteromalla	silky fork moss	S2S3	1
Dicranum pallidisetum	alpine curly heron's bill moss	S1S2	2
Dicranum tauricum	broken-leaf moss	S1S3	12
Didymodon tophaceus	blunt-leaved hair moss	S2S3	1
Didymodon vinealis	moss (no common name provided)	S2S3	1
Diplophyllum taxifolium	liverwort (no common name provided)	SU	1
Downingia laeta	downingia	S3	2
Draba densifolia	dense-leaved draba	S2	4
Draba porsildii	Porsild's draba	S3	1
Elymus elymoides ssp. elymoides	squirreltail	S2S3	2
Elymus scribneri	Scribner's wheat grass	S2	13
Encalypta brevicollis	candle-snuffer moss	S2S3	1
Encalypta spathulata	candle-snuffer moss	S2S3	1
Endocarpon tortuosum	stippled lichen	S1S2	2
Epilobium glaberrimum ssp. fastigiatum	glaucous willowherb	S1	1
Erigeron divergens	diffuse fleabane	S1	1
Erigeron flagellaris	creeping fleabane	S2	1

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Erigeron lackschewitzii	front-range fleabane	S1	1
Erigeron ochroleucus	buff fleabane	S1	2
Erigeron trifidus	trifid-leaved fleabane	S3	1
Farnoldia hypocrita	lichen (no common name provided)	S1	1
Festuca minutiflora	tiny-flowered fescue	S2	1
Festuca occidentalis	western fescue	S2	6
Festuca subulata	bearded fescue	S1	3
Fissidens crispus	moss (no common name provided)	S2	1
Fontinalis neomexicana	moss (no common name provided)	S1S2	1
Galium bifolium	two-leaved bedstraw	S1	2
Gayophytum racemosum	racemose groundsmoke	S1	2
Gentiana calycosa	mountain gentian	S2	1
Grimmia alpestris	alpine grimmia moss	SU	2
Grimmia anomala	mountain forest grimmia moss	S2S3	1
Grimmia donniana	Donian grimmia moss	S1S2	5
Grimmia ramondii	spreading fringe moss	S1S2	1
Hennediella heimii	long-stalked beardless moss	S2S3	1
Homalothecium nevadense	moss (no common name provided)	S1S2	2
Hygrohypnum styriacum	moss (no common name provided)	S1S2	2
Hypogymnia wilfiana	deflated tube lichen	S2S3	1
Hypopitys monotropa	pinesap	S3	4
Jaffueliobryum wrightii	moss (no common name provided)	S1S2	1
Juncus parryi	Parry's rush	S2	6
Juncus regelii	Regel's rush	S1	2
Jungermannia atrovirens	liverwort (no common name provided)	SU	2
Jungermannia leiantha	liverwort (no common name provided)	SU	1
Jungermannia sphaerocarpa	liverwort (no common name provided)	SU	1
Larix occidentalis	western larch	S2	3
Larix occidentalis / Rubus parviflorus forest	western larch / thimbleberry forest	S1	3
Lecanora hypoptoides	rim-lichen	S2	1
Lecanora pringlei	rim-lichen	S1S2	1
Lecidea lithophila	disk lichen	S2	1
Lecidella patavina	disk lichen	S1S2	2
Lecidoma demissum	brown earth-crust	S2	2
Lepraria incana	dust lichen	S3	2
Leptogium gelatinosum	jellyskin lichen	S2S3	1
Leptosiphon septentrionalis	northern linanthus	S2	1
Leskeella nervosa	moss (no common name provided)	S2S3	1
Lewisia pygmaea	alpine lewisia	S2	11
Lithophragma glabrum	rockstar	S2	3

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Lithophragma parviflorum	small-flowered rockstar	S2	7
Lupinus lepidus	alpine lupine	S2	3
Lupinus minimus	least lupine	S2	5
Lupinus wyethii	Wyeth's lupine	S1	1
Melanohalea subelegantula	camouflage lichen	S3	1
Melica smithii	Smith's oniongrass	S2	2
Melica spectabilis	onion grass	S2	9
Mertensia lanceolata	lance-leaved lungwort	S2	9
Mertensia longiflora	large-flowered lungwort	S2	11
Micarea assimilata	assimilative dot lichen	S2	1
Micranthes odontoloma	brook saxifrage	S2	8
Microseris nutans	nodding microseris	S2	7
Microsteris gracilis ssp. gracilis	slender phlox	S1	9
Mimulus floribundus	small yellow monkeyflower	S2	2
Mimulus tilingii	large mountain monkeyflower	S1	4
Montia linearis	linear-leaved montia	S2	1
Montia parvifolia	small-leaved montia	S1	1
Mycoblastus sanguinarius	bloody-heart lichen	S2	2
Mycocalicium subtile	lichen (no common name provided)	S2S4	2
Myurella tenerrima	moss (no common name provided)	S2S3	2
Nemophila breviflora	small baby-blue-eyes	S3	17
Neottia banksiana	western twayblade	S2	5
Neottia convallarioides	broad-lipped twayblade	S2	6
Nodobryoria abbreviata	tufted foxtail lichen	S1S2	3
Nodobryoria subdivergens	foxtail lichen	SU	1
Nothocalais cuspidata	prairie false dandelion	S2	1
Ochrolechia frigida	arctic saucer lichen	SU	2
Orthotrichum pallens var. pallens	moss (no common name provided)	S2S3	1
Packera contermina	Arctic butterweed	S2	13
Packera subnuda var. subnuda	alpine meadow groundsel	S2	6
Papaver pygmaeum	dwarf alpine poppy	S1	7
Pellaea glabella ssp. simplex	smooth cliff brake	S2	1
Peltigera cinnamomea	cinnamon dog pelt lichen	S2S3	1
Penstemon eriantherus	crested beardtongue	S2	2
Phacelia linearis	linear-leaved scorpionweed	S3	3
Phacelia lyallii	Lyall's scorpionweed	S2	3
Phaeophyscia sciastra	dark shadow lichen	S3	1
Phaeorrhiza sareptana	lichen (no common name provided)	SU	1
Physcomitrium pyriforme	urn moss	S2	1

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Pinus albicaulis	whitebark pine	S3	149
Pinus albicaulis / Juniperus communis - Arctostaphylos uva ursi woodland	whitebark pine / ground juniper - common bearberry woodland	S2S3	2
Pinus flexilis	limber pine	S3	84
Pinus monticola	western white pine	S2	1
Piperia unalascensis	Alaska bog orchid	S2	5
Piptatherum exiguum	little rice grass	S2	5
Placidium lachneum	earthscale lichen	S1S2	1
Placynthium asperellum	ink lichen	SU	1
Poa stenantha	narrow-flowered bluegrass	S2	1
Pohlia atropurpurea	moss (no common name provided)	S2	1
Pohlia longicollis	moss (no common name provided)	S2	1
Polygonum austiniae	Austin's knotweed	S1	1
Polygonum engelmannii	Engelmann's knotweed	S2	2
Polygonum minimum	least knotweed	S2	4
Polysporina arenacea	cobblestone lichen	S2	1
Populus tremuloides / Rubus parviflorus forest	aspen / thimbleberry forest	S2	4
Porella cordaeana	liverwort (no common name provided)	SU	4
Porella platyphylla	liverwort (no common name provided)	SU	1
Potentilla flabellifolia	fanleaf cinquefoil	S1	1
Potentilla multisecta	smooth-leaved cinquefoil	S2	4
Potentilla pulcherrima	soft cinquefoil	S1	1
Potentilla villosa	hairy cinquefoil	SU	3
Pseudognaphalium macounii	Macoun's rabbit-tobacco	SH	1
Pseudoleskea patens	moss (no common name provided)	S1S2	2
Pseudoleskea stenophylla	moss (no common name provided)	S2S3	2
Pseudotsuga menziesii - Pinus flexilis / Juniperus communis / Festuca campestris woodland	Douglas-fir - limber pine / ground juniper / mountain rough fescue woodland	S2	2
Psora globifera	blackberry scale	S1S2	1
Psora nipponica	butterfly scale	S2S3	3
Pteridium aquilinum var. pubescens	bracken fern	SU	1
Ptychostomum calophyllum	matted bryum	S2	1
Pyrola picta	white-veined wintergreen	S1	2
Radula complanata	liverwort (no common name provided)	SU	2
Ramboldia elabens	crimson dot lichen	S2	1
Ranunculus glaberrimus	early buttercup	S3	2
Rhamnus alnifolia Shrubland	alder-leaved buckthorn shrubland	S1S2	1
Rhizocarpon badioatrum	lichen (no common name provided)	S1	1

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Rhizocarpon pusillum	map lichen	S1?	1
Rhizocarpon superficiale	map lichen	S2	1
Rhizocarpon umbilicatum	map lichen	S1	1
Rhizomnium magnifolium	moss (no common name provided)	S2S3	1
Rhizomnium nudum	moss (no common name provided)	S2S3	4
Rhytidiadelphus squarrosus	pipecleaner moss	S1S2	1
Ribes inerme var. inerme	mountain gooseberry	S2?	1
Rinodina archaea	brown pepper-spore lichen	S2	1
Rinodina colobina	pepper-spore lichen	S1	1
Rinodina confragosa	pepper-spore lichen	S1	1
Romanzoffia sitchensis	Sitka romanzoffia	S2	7
Rorippa tenerrima	slender cress	S3	1
Salix drummondiana / Calamagrostis canadensis Shrubland	Drummond's willow / bluejoint shrubland	S1	1
Sarcogyne privigna	stepdaughter grain-spored lichen	S1	1
Sarcogyne regularis	grain-spored lichen	S1S3	1
Saxifraga mertensiana	Merten's saxifrage	S1	3
Scapania curta	liverwort (no common name provided)	S2S3	2
Scapania cuspiduligera	liverwort (no common name provided)	SU	1
Scapania subalpina	liverwort (no common name provided)	SU	2
Schistidium pulvinatum	moss (no common name provided)	SU	1
Sciuro-hypnum hylotapetum	moss (no common name provided)	S1S3	10
Sciuro-hypnum reflexum	cedar moss	S2S3	2
Sedum divergens	spreading stonecrop	S2	1
Seligeria campylopoda	moss (no common name provided)	S2S3	1
Seligeria donniana	Donian beardless moss	S2S3	1
Senecio megacephalus	large-flowered ragwort	S1	3
Stereocaulon rivulorum	snow foam lichen	S3	1
Suksdorfia ranunculifolia	suksdorfia	S1	7
Suksdorfia violacea	blue suksdorfia	S1	2
Tellima grandiflora	fringe-cups	S1	1
Tephromela atra	black-eye lichen	S2S4	1
Tetraplodon urceolatus	alpine lemming moss	S2S3	1
Thamnolia vermicularis	whiteworm lichen	S2S3	1
Thrombium epigaeum	epigeal clot lichen	S2	1
Thuja plicata	western red cedar	S2	10
Tortula leucostoma	moss (no common name provided)	S2S3	1
Tortula systylia	moss (no common name provided)	S2S3	2
Townsendia condensata	alpine townsendia	S2	7
Trisetum canescens	tall trisetum	S2	3

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Trisetum cernuum	nodding trisetum	S2	6
Umbilicaria americana	American rock tripe lichen	S2S3	3
Umbilicaria angulata	rock tripe	S1S2	2
Umbilicaria lyngei	rock tripe	SU	1
Viola glabella	yellow wood violet	S2	5
Viola praemorsa ssp. linguifolia	broad leaved yellow prairie violet	S2	4
Vulpicida canadensis	brown-eyed sunshine lichen	S2S3	2
Xerophyllum tenax Herbaceous Vegetation	bear-grass herbaceous vegetation	S1S2	1

Table 6-12. ACIMS non-sensitive butterfly occurrences within the DFA.

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Boloria astarte	Astarte Fritillary	S3	2
Boloria epithore	Western Meadow Fritillary	S2	10
Callophrys mossii	Moss's Elfin	S1	3
Callophrys sheridanii	Sheridan's Green Hairstreak	S1	7
Callophrys spinetorum	Thicket Hairstreak	S1S2	1
Celastrina echo nigrescens	Purple Azure	S1	1
Euphydryas gillettii	Gillette's Checkerspot	S2	6
Limenitis lorquini	Lorquin's Admiral	S2	5
Lycaena heteronea heteronea	Blue Copper	S2	1
Lycaena hyllus	Bronze Copper	S2	1
Lycaena phlaeas	Little Copper	S2	7
Ochlodes sylvanoides	Woodland Skipper	S2	3
Papilio eurymedon	Pale Swallowtail	S2	1
Plebejus icarioides	Icarioides Blue	S2S3	1
Polygonia oreas	Orea’s Comma	S1S2	1
Satyrium acadica	Acadian Hairstreak	S2	3
Satyrium sylvinus	Sylvan Hairstreak	S1	1

Table 6-13. ACIMS sensitive occurrences within the DFA.

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Aquilegia jonesii	Jones' columbine	S1	1
Microseris nutans	nodding microseris	S2	1

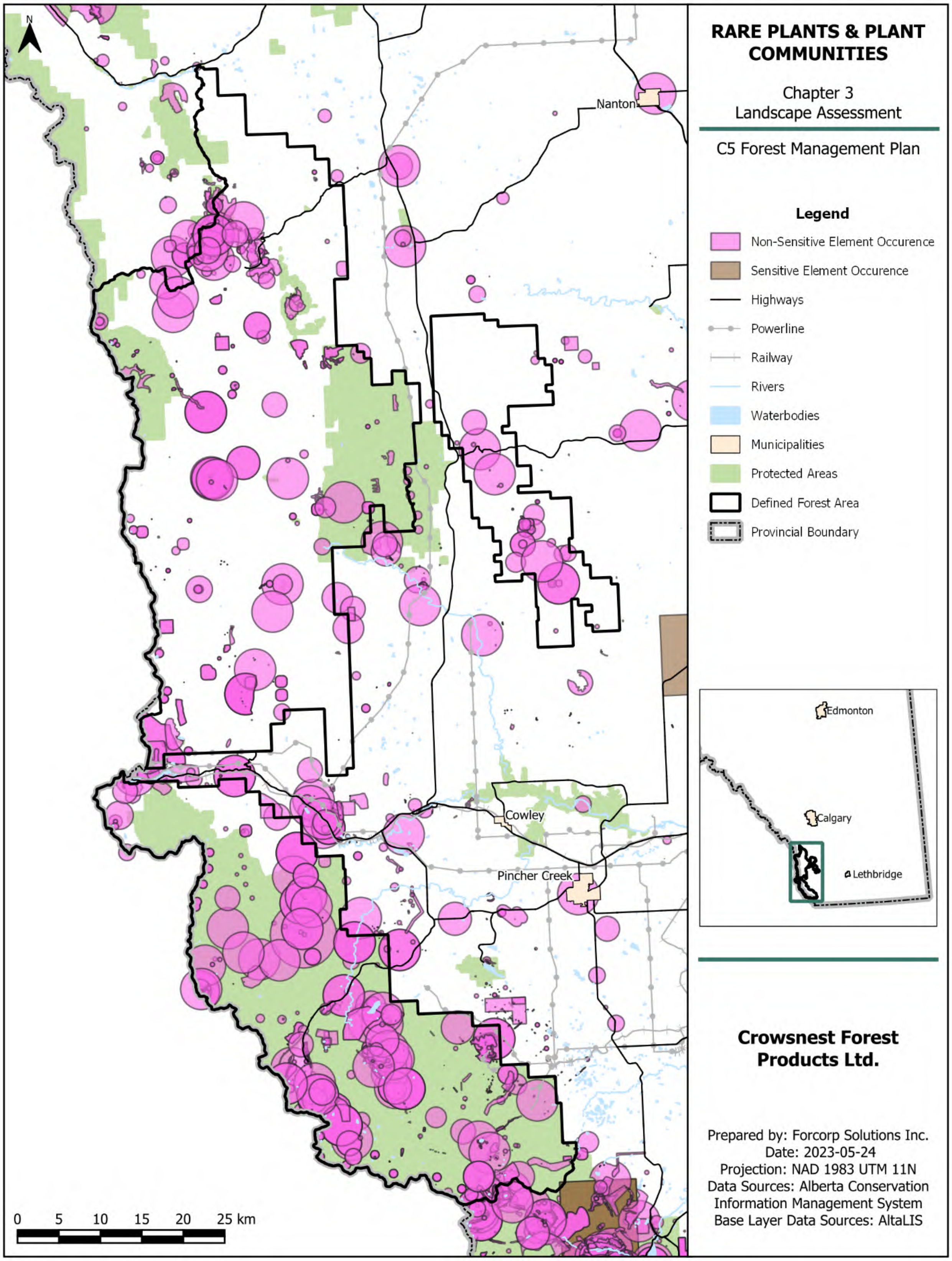

Figure 6-12. ACIMS non-sensitive and sensitive occurrences within and surrounding the DFA.

6.9 Eastern Slopes Land Use Zones

The Eastern Slopes Land Use Zones of Alberta [56] cover much of the Rocky Mountain and the Foothills regions of Alberta and are used to identify, analyze and nominate areas for designation and protection (Government of Alberta, 1984). While the South Saskatchewan Regional Plan (SSRP) has largely replaced this policy, the land use zones still provide guidance for Integrated Resource Plans that have not been rescinded. The Livingstone-Porcupine Hills Land Foorprint Management Plan and the Livingstone-Porcupine Hills Recreation Management Plan also provide direction for footprint and recreation planning across much of the DFA (see Section 2.6.1).

Nearly the entire DFA is within the Eastern Slopes Land Use Zone (99.6%), most of which is classified as Multiple Use zones (52%) (Table 6-14). Multiple Use zones aim to provide for the management and development of all available resources while meeting watershed management and environmental protection objectives. An additional 20% of the DFA is classified as Critical Wildlife zones, which are areas of terrestrial and aquatic habitats crucial for the maintenance of fish and wildlife populations. The General Recreation and Prime Protection zones make up 10% and 5% of the DFA respectively, while the Special Use zones make up 2% of the area. The remainder of the zones each cover less than 1% (Figure 6-13).

The Prime Protection zone contains high-elevation forests and steep rocky slopes, and was established with the intent of preserving environmentally sensitive terrain and valuable ecological and aesthetic resources. This includes the area's rugged mountain scenery, its critical wildlife ranges, especially for bighorn sheep and mountain goats and its importance as a key source of water. This zone receives the greatest amounts of precipitation and produces most of the streamflow of the Eastern Slopes.

Table 6-14. Eastern slopes land use zones within the DFA.

Eastern Slopes Land Use Code	Eastern Slopes Land Use Name	Total area in Province (ha)	Area in DFA (ha)	Portion of zone in DFA (%)	Portion of DFA (%)
Zone 1	Prime Protection	1,396,772	70,637	5	20
Zone 2	Critical Wildlife	720,057	69,979	10	20
Zone 3	Special Use	50,415	6,651	13	2
Zone 4	General Recreation	191,658	18,316	10	5
Zone 5	Multiple Use	4,973,864	182,159	4	52
Zone 6	Agriculture	39,042	0	0	0
Zone 7	Industrial	10,314	433	4	0
Zone 8	Facility	12,029	659	5	0
Total		**7,394,152**	**348,834**	**5**	**100**

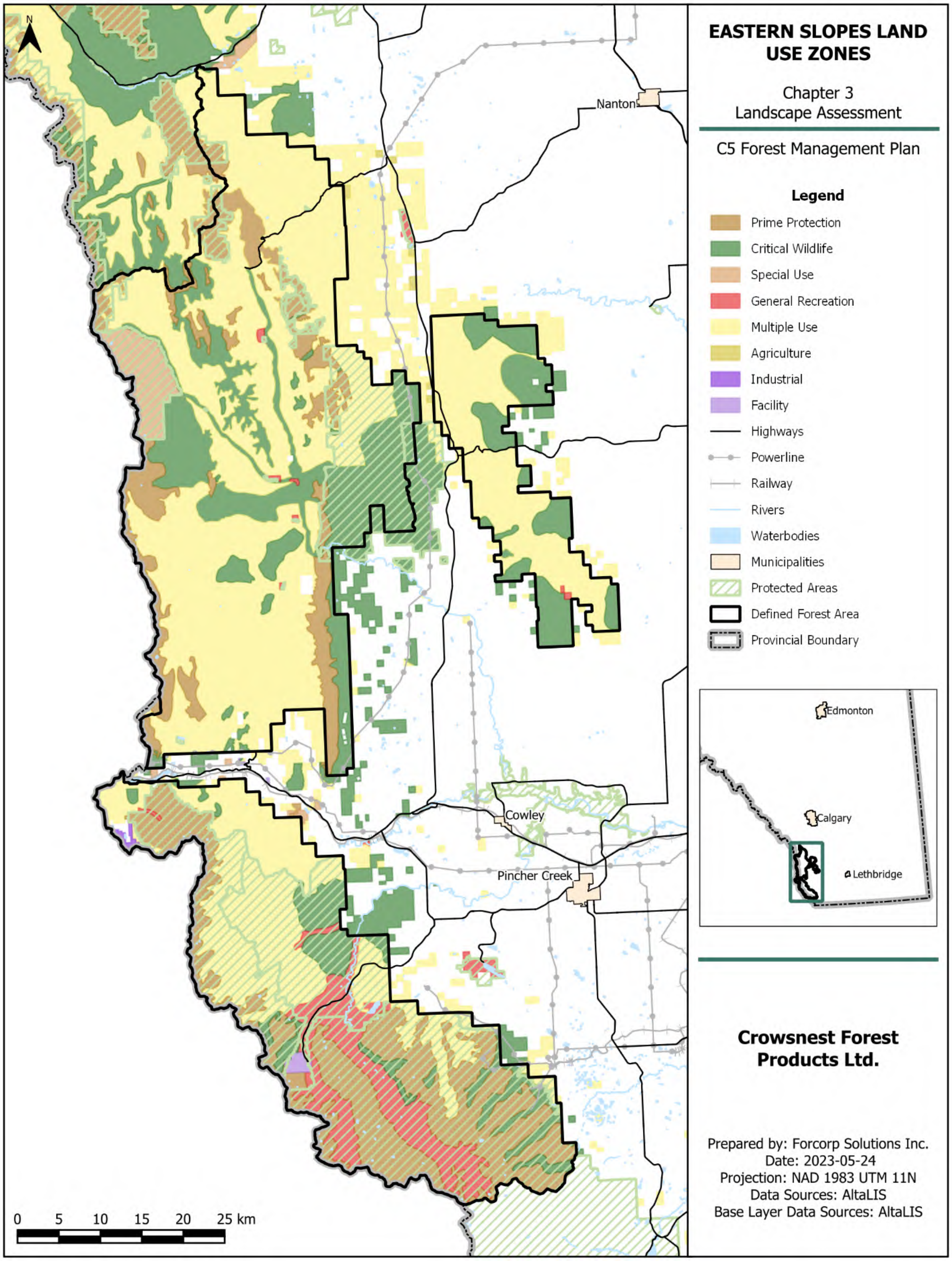

Figure 6-13. Eastern Slopes Land Use Zones within and surrounding the DFA.

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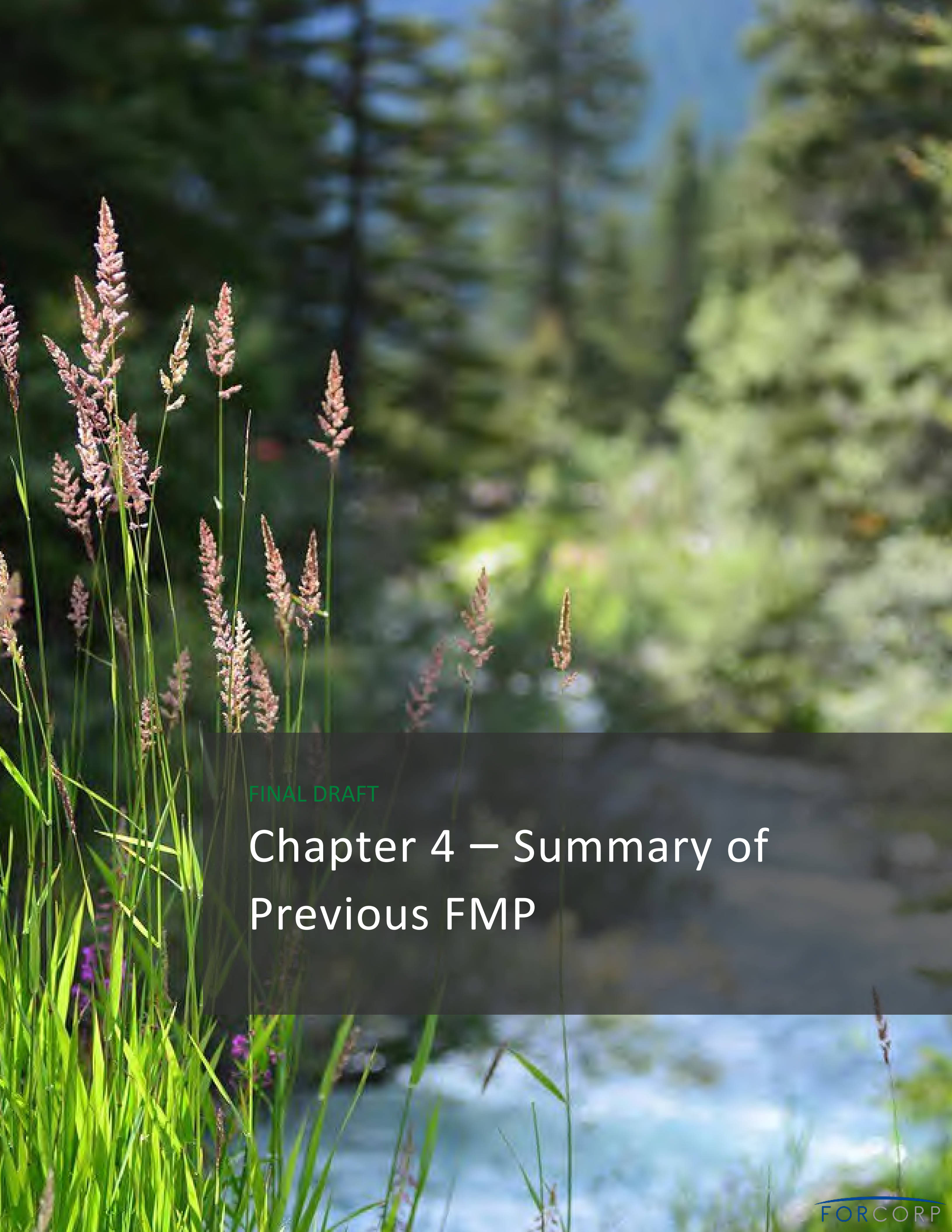

FINAL DRAFT

Chapter 4 – Summary of Previous FMP

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	**4**	**Summary of Previous FMP**
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1 Introduction

The contents of this chapter are designed to address the requirements of Section 2.2.2 of the Alberta Forest Management Planning Standard: A Summary of any Previous Forest Management Plan and the Management Outcomes Including the Learning Associated with Management Review. As outlined in Section 1.1, the previous Forest Management Plan (FMP) and its implementation were the responsibility of the Crown until 2021. The achievement of the previous FMP is detailed in the following sections:

- FMP development history;
- Approval conditions;
- Performance monitoring and plan implementation; and
- Significant events.

1.1 FMP Development History

The first FMP for the C5 Forest Management Unit (FMU) was approved in 1987 with revisions to the conifer AAC in 1999 and again in 2003 to account for timber losses resulting from the 2003 Lost Creek wildfire. In July of 2021, Crowsnest Forest Products Ltd. (CFP) was granted the Forest Management Agreement (FMA) with an effective date of May 1st of the same year. As the previous plan was before the FMA was approved, the FMP was prepared by the crown, while Spray Lake Sawmills, and its subsidiary Crowsnest Forest Products, were quota holders within the FMU.

A condition of the FMA was that CFP shall submit an FMP in accordance with the Alberta Forest Management Planning Standard (April 2006) for the Minister's approval on or before May 1st, 2025.

1.2 About this Chapter

The basis of this chapter is to compare the objectives of the Resource Management Objectives and Strategies chapter of the C5 Forest Management Plan 2006-2026 to the achievements from the effective date of the previous FMP (May 1, 2010) to the effective date of the net landbase of this FMP (May 1, 2023). When possible, analysis is included up to the end of the 2023/2024 timber year and inputs for calculation use the most current data (i.e., ARIS reconciled blocks) and capture activity by quota holders and the Coniferous Community Timber Permit Program (CCTP).

2 Status of Past FMP

This section provides a general description of the C5 Forest Management Plan 2006-2026 that was approved in 2010 as well as a summary of the Government of Alberta's (GoA) approval conditions and their current status.

2.1 Contents of the C5 Forest Management Plan 2006-2026

The previous FMP included five chapters:

1. Introduction;
2. C5 Forest Management Unit;
3. Resource Management Framework;
4. Desired Future Forest; and
5. Performance Monitoring and Plan Implementation.

The C5 Forest Management Plan 2006 can be found at: https://open.alberta.ca/publications/0778545458

2.2 Approval Conditions

The approval of the C5 Forest Management Plan 2006-2026 in 2010 was accompanied by a number of approval conditions. These conditions are listed in Table 2-1. Section 2.3 describes the condition and status in further detail.

Table 2-1. Summary of C5 FMP 2006-2026 approval conditions.

Condition	Requirement	Due Date	Status
Approval Condition 6.1	Public Consultation	On-going	Complete
Approval Condition 6.2	First Nation Consultation	On-going	Complete
Approval Condition 7.1	Mountain Pine Beetle	On-going	Complete
Approval Condition 10.1	Spatial Harvest Sequence	On-going	Complete
Approval Condition 12.1	Grazing Timber Agreement	On-going	Ongoing
Approval Condition 13.1	Industrial Timber Salvage	On-going	Ongoing
Approval Condition 15.1	Performance Monitoring	October 31, 2015	Complete

2.3 Approval Condition Details

2.3.1 Approval Condition 6.1 – Public Consultation

The Area Manager, Southern Rockies shall ensure the disposition holders;

i. *Ensure meaningful public consultation is conducted by the disposition holder at key points in the FMP implementation.*

Status: Open houses have been held by Spray Lake Sawmills / Crowsnest Forest Products annually and on an as-needed basis to provide the public with access to annual harvest information, including harvest block locations and timing.

ii. *Ensure the disposition holder keep written documentation of all issues and comments raised during operational plan consultation, as well as response and action taken to address the concerns.*

Status: Consultation is recorded and submitted to the GoA annually as outlined in the provincial guidelines. Additionally, as noted in the 2017 Stewardship Report (see *Annex III – Stewardship Report)*, local Alberta Agriculture and Forestry staff attended open houses to observe and confirm the use of sign-in sheets and written comment cards.

2.3.2 Approval Condition 6.1 – Indigenous Consultation

The Area Manager, Southern Rockies shall ensure the disposition holders;

i. *Conduct meaningful consultation with aboriginal groups during development of General Development Plans.*

Status: Timber disposition holders are compliant with provincial guidelines and follow the consultation processes outlined in The Government of Alberta's Proponent Guide to First Nations, Metis Settlements, and Credibly Asserted Métis Communities Consultation Procedures (August 2024). Disposition holders are actively engaging in meaningful consultation on an ongoing basis.

ii. *Meet the requirements of Alberta's First Nation Consultation Guidelines on Land Management and Resource Development for future plans and approvals.*

Status: The General Development Plan (GDP) is consulted on and undergoes thorough assessment for consultation compliance before adequacy is provided by the Aboriginal Consultation Office (ACO).

iii. *Keep written documentation of all issues and comments raised during consultations, as well as response and actions taken to address the concerns.*

Status: All Indigenous consultation records are kept in the Aboriginal Consultation Information System (ACIS) and response management is under the purview of the GoA.

2.3.3 Approval Condition 7.1 – Mountain Pine Beetle

The Area Manager, Southern Rockies shall;

i. *Coordinate the department management efforts for MPB control and forest renewal activities.*

Status: Coordination falls under the jurisdiction of the GoA. According to the 2017 Stewardship Report, the MPB population in C5 experienced a significant decline in 2010, resulting in minimal MPB control activities since the implementation of the FMP.

ii. *Determine the operational implementation of the Timber Harvest Planning and Operating Ground Rules Addendum – Mountain Pine Beetle Operations.*

Status: As reported in the 2017 Stewardship Report, the swift decline of MPB in C5 during 2009-2010 resulted in the Addendum not being integrated into the Operating Ground Rules (OGRs) and not influencing operational or planning practices during the reporting period.

2.3.4 Approval Condition 10.1 – Spatial Harvest Sequence

i. *All operators shall follow the mapped 20-year harvest sequence as presented in the FMP.*

Status: Operators have generally followed the mapped 20-year sequence outlined in the FMP, with some variances in the actual timing of Spatial Harvest Sequence (SHS) implementation as compared to the projected harvest period. CFP is now well into the second decade of the 20 year sequence. A summary of current SHS variance is detailed in *Annex III – Stewardship Report*.

ii. *To address operational planning concerns, all timber disposition holders are authorized to modify the SHS by deleting no more than 20% of the total sequenced area in each compartment by decade, while harvesting no more than 100% of the total area within the SHS by compartment, by decade.*
   a. *Preference shall be given to selecting stands from the second 10-year period of the SHS (years 2017-2026) when replacements may be from any other stands identified in the approves net landbase of the FMP, with priority given to pine stands that are ranked highly susceptible to MPB infestations.*

Status: Operators have predominantly favored wood from the second decade of the SHS over other stands. While pine remains a target for harvest, the decline of MPB in 2010 has led to a shift away from prioritizing MPB objectives.

iii. *Should timber operators exceed the variance described in (ii), the Area Manager, Southern Rockies may require the completion of a Compartment Assessment and the Senior Manager Forest Planning Section may recommend the adjustment of the approved AAC to reflect the impact of the variance.*

Status: Compartment assessments have been conducted as necessary. Only a limited number have been required due to operators largely adhering to the SHS.

iv. *The department requires the variance from the SHS to be reported annually, and for the 5-year Stewardship Report to analyze the cumulative variance for the SHS and describe the potential impacts of the actual variance on the forecasts made in the FMP.*

Status: A summary of variance was included in the 2017 Stewardship Report (refer to Table 3.2.3 in *Annex III – Stewardship Report*). Variance submissions have historically been part of Forest Harvest Plans, but with recent updates to provincial operating ground rules variance reporting is now a required component of the annual GDPs.

v. *The department will generally not modify the approved harvest sequence for the first 15 years of the planning period unless required by a change in legislation or a policy approved by the Minister (e.g. SSRP).*

Status: Modifications to the approved SHS associated with the establishment of new conservation areas have necessitated adjustments to the sequence. Additionally, this modification corresponded to a reduction in the Annual Allowable Cut (AAC) for the C5 FMU in 2017.

2.3.5 Approval Condition 13.1 – Grazing Timber Agreement

i. *The Area Manager, Southern Rockies may require GTAs be developed where a proposed activity of one disposition holder may affect the interests of the other disposition holder(s).*

Status: Grazing Timber Agreements (GTAs) have been implemented to facilitate coordinated activities.

ii. *GTAs shall meet the requirements of the Grazing and Timber Integration Manual.*

Status: The formulation of GTAs has strictly complied with the requirements delineated in the Grazing and Timber Integration Manual.

2.3.6 Approval Condition 13.1 – Industrial Timber Salvage

i. *All industrial timber salvage produced in the FMU shall be accounted and reported as drain against each timber operator's disposition based on the disposition holders allocated percentage of the AAC.*

Status: Industrial salvage is reported to the Alberta government through the FOREST system.

2.4 Performance Monitoring and Plan Implementation

Section 5 of the 2010 FMP details the performance monitoring and plan implementation items identified in the C5 Forest Management Plan 2006-2026.

2.4.1 Plan Implementation

This section states that the plan would take effect on May 1, 2006, at which point its provisions would be observed by ASRD and the timber disposition holders operating in the C5 forest. Additionally, the section specifies that the Southern Rockies Management Area (PLFD, ASRD) will provide oversight during plan implementation and assume primary responsibility for plan administration.

The section identifies that a comprehensive plan review will be undertaken before May 2016 (plan midpoint) and on or before May 1st, 2026 at the end of the 20-year plan lifespan.

The C5 Stewardship Report was completed by Alberta Agriculture and Forestry in the spring of 2017. The Stewardship Report provides a review of progress towards the objectives and targets contained in the management plan.

The renewal of the C5 Forest Management Plan contains a new, wall-to-wall vegetation inventory, the use of new technology for defining the operable landbase (e.g., slope deletions and hydrology buffers), new growth measurement data to support yield estimates, integration with the South Saskatchewan Regional Plan, the Livingstone-Porcupine Hills Land Footprint Management Plan (LPH-LFMP), and the Alberta Forest Management Planning Standard, including Values, Objectives, Indicators and Targets (VOITs) which were not in effect for the development of the previous management plan.

2.4.2 Access Planning

Section 3.2 of the LPH-LFMP outlines how human activities in the area are managed. Specifically, Section 3.2.1 focuses on the impact of forest management and planning. Forestry-specific targets are set out in Chapter 5, specifically in VOITs #5-1, #5-2, & #5-3. This section provides a historical analysis to support these targets.

Analysis was undertaken to assess historical levels for the three access categories identified in the LPH-LFMP: Open Motorized Access, Restricted Motorized Access, and Near Stream Motorized Access. Access and permanent roads were analyzed from 2008 to the 2022 timber year. This was done by assessing the road status as of the beginning of each timber year, for the years noted above. Eligibility hinged upon the status of road construction and reclamation status. Appropriate attributes were also tagged to each road, including public land-use zones, footprint planning zones, permanent vs. restricted motorized access, and near stream motorized access.

The results of the company analysis are presented in the following tables.

Table 2-2. Forestry permanent motorized access by Management unit and PLUZ.

PLUZ	Management Zone	Open Motorized Access (km) – Permanent Roads	Restricted Motorized Access (km) – Permanent Roads
Livingstone	Zone 2	31.3	10.82
	Zone 3	47.86	8.91
Porcupine Hills	Zone 2	5.48	2.25
	Zone 3	10.88	11.32
	Zone 2	36.78	13.07
	Zone 3	58.74	20.23

Note: Approximately 36.44 km of the forestry open motorized road is under the Atlas road disposition (DLO 1198) which is currently held by Crowsnest Forest Products, but in the process of being transferred to the Government of Alberta. The Atlas road is entirely within the Livingstone PLUZ with 19.95 km located in Priority Management Zone 3 and 16.49 km located in Priority Management Zone 2.

Table 2-3. Forestry Restricted Motorized Access by Management Zone.

PLUZ	Management Zone	Average (km)	Average – Last 5 years (km)	Standard Deviation
Livingstone	Zone 2	52.0	44.4	18.1
	Zone 3	45.3	32.5	13.9
Porcupine Hills	Zone 2	14.1	4.0	12.0
	Zone 3	14.9	12.9	3.2
	Zone 2	66.1	48.3	20.4
	Zone 3	60.2	45.4	14.2

Note: Includes permanent and temporary restricted motorized access.

Table 2-4. Forestry Near Stream Motorized Access by analysis unit.

Analysis Unit	Average (km/km^2)	Average – Last 5 years (km/km^2)
Crowsnest Watershed	0.00007	0.00000
Dutch Creek	0.00109	0.00092
Livingstone Range	0.00000	0.00000
Livingstone River	0.00120	0.00194
North Porcupine Hills	0.00025	0.00000
Racehorse Creek	0.00044	0.00082
South Porcupine Hills	0.00000	0.00000
Upper Oldman River	0.00160	0.00010
Upper Willow Creek	0.00020	0.00060
Average	0.00054	0.000487
Max	0.003779	0.003092
Standard Deviation	0.000859	0.000724

Table 2-5. Livingstone-Porcupine Hills Land Footprint Management Plans regulated limits – Open Access Limits.

Management Zone	Area (km^2)	Limit (km/km^2)	Limit (km)
Zone 2	1266.0	0.4	503.8
Zone 3	513.2	0.6	311.7

Table 2-6. Livingstone-Porcupine Hills Land Footprint Management Plans regulated limits – Restricted Access.

Management Zone	Area (km^2)	Limit (km/km^2)	Limit (km)
Zone 2	1266.0	0.6	759.6
Zone 3	513.2	0.6	307.92

Table 2-7. Livingstone-Porcupine Hills Land Footprint Management Plans regulated limits – Restricted Access.

Analysis Unit	Area (km^2)	Limit (km/km^2)	Limit (km)
Crowsnest Watershed	283.31	0.04	11.3324
Dutch Creek	168.16	0.04	6.7264
Livingstone Range	53.72	0.04	2.1488
Livingstone River	263.84	0.04	10.5536
North Porcupine Hills	183.69	0.04	7.3476
Racehorse Creek	275.96	0.04	11.0384
South Porcupine Hills	208.35	0.04	8.334
Upper Oldman River	242.91	0.04	9.7164
Upper Willow Creek	99.18	0.04	3.9672

Table 2-8. Livingstone-Porcupine Hills Land Footprint Management Plans regulated limits and forestry specific targets.

VOIT	Area of Management	Size (km^2)	Forestry Roads (km)	Regulated limit (km/km^2)	Target Forestry Densities (km/km^2)
VOIT 5-1	Zone 2	1266.0	36.78	0.40	0.035
	Zone 3	513.2	58.74	0.60	0.137
VOIT 5-2	Zone 2 & 3	1779.2	93.7	0.60	0.072
VOIT 5-3	Nine Analysis units	1879.1	3.7	0.04	0.007

2.4.3 Stewardship Reporting

2.4.3.1 Structure Retention - Retain Stand Level Structure Attributes

Identifying and maintaining structural components at the landscape and stand level is an important part of ecosystem-based management. The dynamic arrangement of living and dead trees and other vegetation has the potential to contribute the necessary habitat elements for a variety of species over space and time.

Strategies for the retention of these structural components are identified in Appendix 7 of the C5 FMP 2006-2026 and were first formalized in the 2012 Spray Lake Sawmills and C05 FMU Timber Harvest Planning and Operating Ground Rules (OGRs). The OGRs require that an average of 3% of the merchantable stems in a stand remain on site, preferably in clumps rather than as single trees. The average structure retention can range from 0 to 5% with small harvest blocks (< 20 ha in size) nearing zero retention and larger blocks approaching the 5% retention target. The retention of whitebark pine, limber pine, alpine fir, alpine larch, and deciduous species can contribute to this stand structure. Structure may be retained near coarse woody debris piles, near the harvest boundary, around known wildlife features, and near intermittent and ephemeral streams so as to provide a gradual ecotone and increase opportunities for species dispersion. Ideally, downed woody debris >7.5 cm, standing topped trees > 7.5 cm DBH, and existing snags should be retained at levels similar to pre-harvest conditions (as estimated by conditions in the adjacent forest stands).

Table 2-9 describes the post-harvest, in-block patch area retained on the landbase. Additionally, single stem retention within openings is a component of CFP's OGRs and the majority of openings have single stem retention post-harvest. However, at this time, a survey to determine in-block single stem retention has not been completed and single stem retention levels are not reported.

Table 2-9. Structure retention by timber year post Stewardship Report.

Timber Year	Total Cutblock Area (ha)	Avg Block Size (ha)	Avg. In Block Patch Retention (From Photography) (ha)	Total Retention Area	Average Percent of Block Area Retained (From Photography)
2016/2017	531	11.29	1.39	65.4	12.32%
2017/2018	746	20.73	1.68	60.6	8.12%
2018/2019	650	16.26	1.11	44.6	6.85%
2019/2020	727	22.02	2.53	83.5	11.49%
2020/2021	776	13.85	1.97	110.5	14.25%
2021/2022	595	13.22	2.04	91.8	15.44%
2022/2023	568	9.47	0.90	53.7	9.46%
Total	**4,592**	**15**	**1.661**	**510**	**11.1%**

Structure retention was assessed using aerial photography linked to final harvest area digital data submissions and by verifying whether single tree retention was recorded in the company's data management system. The standards for final harvest areas do not provide an AVI call for the patch or an associated volume; however, the retention left behind is representative of pre-harvest stand composition and with overall area exceeding the volume targets.

2.4.3.2 *Spatial Harvest Sequence Variance*

Though the effective date of the previous FMP was May 1, 2007, the SHS was backdated to 2006 with the periods being managed as period 1 (2006-2016) and period 2 (2016-2026).

Table 2-9 & Table 2-10 describe the variance of harvest compared with the approved spatial harvest sequence. This includes all known harvesting, including CFP and other operators. Quota holders were contacted (September 2023) to provide deletions and deferrals information; however, none were received because their operations were small enough that deletions and deferrals are not tracked. For the current FMA boundary, the total additions were 23.77% in the first period (2006-2016) and 35% in the second period (2016-2024). Removing the timing difference for when the harvest occurred, the overall variance was 21.31% in the first two periods.

Parts of stands classified as deciduous that were harvested (Table 3-1, Table 3-2) are mainly due to inaccuracies with the old AVI information (i.e., slivers of deciduous stands) or inaccuracies in species composition (i.e., there was enough conifer content within the stand to justify harvest activities).

Some of the reasons for SHS variance include:

- Changing in operating plan timing because of the creation of two substantial parks in the FMU;
- Inaccuracies in vegetation inventories;
- Inaccuracies in spatial landbase/TSA deletion layers;
- Operational and economic considerations not identified in the TSA;
- Accessibility of the SHS polygon compared to the FHP area;
- TSA modeling capabilities of the time;
- Change in harvest due to stakeholder and GoA consideration outside of the approved SHS; and
- Operational considerations at time of harvest.

Table 2-10. Spatial harvest sequence variance for the C5 FMU by strata for the twenty-year SHS (2006-2026), compared to harvest from 2006 to 2024.

SHS Profile		Harvested (ha)						Variance: Substantial		Variance: Slivers				SHS Assessment (Excluding Slivers)		
Strata	Approved Decades 1-2 SHS	SHS 1 - 10 yr	SHS 10 - 20 yr	SHS 21 - 40 yr	Non-SHS Active Landbase	Passive Landbase	Total	Add	Un-harvested SHS	Add	Un-harvested SHS	Total	Total (%)	Variance (Add %)	Area Difference (Add - D&D)	Area Difference (Harvested - Approved SHS)
D	0	0	0	0	155	20	175	80	0	96	0	96	55		80	175
DC	0	0	0	0	61	20	81	55	0	25	0	25	32		55	81
CD	347	68	50	7	53	20	197	64	212	15	16	31	16	18.54	-148	-150
C-Fd	887	75	19	35	60	14	202	93	768	16	11	27	13	10.48	-675	-685
C-Px	19,006	2,739	1,833	207	2,690	985	8,454	3,535	13,682	347	731	1,078	13	18.60	-10,148	-10,552
C-Sx	4,553	253	315	76	434	214	1,292	674	3,744	49	238	287	22	14.81	-3,070	-3,261
Non-Forested	0	0	0	0	5	129	135	63	0	72	0	72	53		63	135
Total	**24,794**	**3,135**	**2,217**	**324**	**3,459**	**1,402**	**10,536**	**4,564**	**18,407**	**620**	**996**	**1,617**	**15**	**18.41**	**-13,843**	**-14,258**

Table 2-11. Spatial harvest sequence variance by 2006 FMP compartment for the first and second decade of SHS (2006-2026), compared to harvest from 2006 to 2024.

SHS Profile		Harvested (ha)						Variance: Substantial		Variance: Slivers				SHS Assessment (Excluding Slivers)	
Compartment	Approved Decades 1-2 SHS	SHS 1 - 10 yr	SHS 10 - 20 yr	SHS 21 - 40 yr	Non-SHS Active Landbase	Passive Landbase	Total	Add	Un-Harvested SHS	Add	Un-Harvested SHS	Total	Total (%)	Variance (Add %)	Area Difference (Harvested - Approved SHS)
Crowsnest River	4,514	825	8	228	394	181	1,636	702	3,278	104	404	508	31.05	15.54	-2,878
Livingstone River	3,930	107	513	0	809	538	1,968	1,267	2,947	80	362	443	22.50	32.25	-1,962
Oldman River	2,740	561	103	0	353	236	1,254	519	1,771	71	305	375	29.94	18.93	-1,486
Porcupine Hills	2,366	916	294	84	568	27	1,890	557	981	122	174	296	15.67	23.54	-476
Racehorse Creek	5,242	221	707	11	848	257	2,045	1,000	3,814	116	500	616	30.14	19.07	-3,197
Willow Creek	2,681	504	591	1	486	162	1,744	533	1,298	116	287	403	23.12	19.87	-937
Total	**21,471**	**3,135**	**2,217**	**324**	**3,459**	**1,402**	**10,536**	**4,577**	**17,206**	**610**	**2,032**	**2,642**	**25.07**	**21.31**	**-10,935**

3 Significant Events

The C5 Forest Management Plan 2006-2026 was developed by the Government of Alberta to direct harvest activities in the crown-managed C5 FMU. The plan was approved on October 20, 2010 (effective May 1, 2010) and replaced the previous FMP approved on March 6, 1987. The previous plan remained in effect until the approval of this FMP.

As the previous plan was not completed by the company, lessons learned from the previous plan will be completed in the next FMP.

3.1 South Saskatchewan Regional Plan

The South Saskatchewan Regional Plan (SSRP) was created in alignment with Alberta's Land-use Framework, which introduced seven new land-use regions, each intended to have its own regional plan directing economic, environmental, and social outcomes. Forestry-specific strategies contained in the plan include promoting diversification of the forest industry, delivering an effective forest management program to mitigate risks to timber supply and forest health, and incorporating wildfire management planning into forest management initiatives. The SSRP came into effect on September 1, 2014 (Government of Alberta, 2018c).

3.2 FMU C5 SSRP AAC Adjustment

On September 1, 2014, the primary coniferous annual allowable cut for FMU C5 was reduced 5.82% from 209,414 m^3 to 197,226 m^3 due to the SSRP conservation areas.

3.3 New and Expanded Castle Conservation Areas

The establishment of Castle Provincial Park and the expansion of Castle Wildland Provincial Park added 105,179 ha of protected area to the Alberta Parks' network. The primary purposes of the two parks are the conservation of natural values, the respect of Indigenous rights, and the enhancement and development of recreation and tourism (Government of Alberta, 2018a). On February 16, 2017, the coniferous annual allowable cut for FMU C5 was reduced by 19.97%, decreasing from 197,226 m^3 to 157,800 m^3 due to the creation of Castle Provincial Park and the expansion of Castle Wildland Provincial Park.

3.4 Livingstone-Porcupine Hills Land Footprint Management Plan

The Livingstone-Porcupine Hills Land Footprint Management Plan (LPH-LFMP) was established in 2018 as a subregional plan under the South Saskatchewan Regional Plan. Designed to guide development and address the long-term cumulative impact of human activity on public lands in the Eastern Slopes, the LPH-LFMP employs Integrated Land Management strategies. These include zoning, management thresholds, strategic site selection to protect valued features, and restoration and reclamation efforts. The plan also provides guidance on motorized access, forestry operations, wildfire risk management, energy development, recreation and tourism, grazing allotments, and the conservation of biodiversity and watershed health (Government of Alberta, 2018b).

3.5 Forest Management Agreement

A renewable Forest Management Agreement (FMA2100047) was signed by Crowsnest Forest Products Ltd. and the province on July 17, 2021 (effective May 1, 2017), allocating FMU C5 to the company for a 20-year period expiring on April 30, 2041. The agreement replaced the existing Commercial Timber Quotas held by SLS and CFP and granted CFP rights to harvest and reforest trees on crown land within the FMA area. This agreement was the first new FMA signed by Alberta since 2009.

3.6 Acquisition by West Fraser Timber Co Ltd.

West Fraser Timber Co Ltd. acquired Spray Lake Sawmills, and its subsidiary Crowsnest Forest Products Ltd., on November 17, 2023. All tenure held by the companies, including two FMAs with a total Annual Allowable Cut of approximately 500,000 m^3, are now operated as West Fraser Cochrane.

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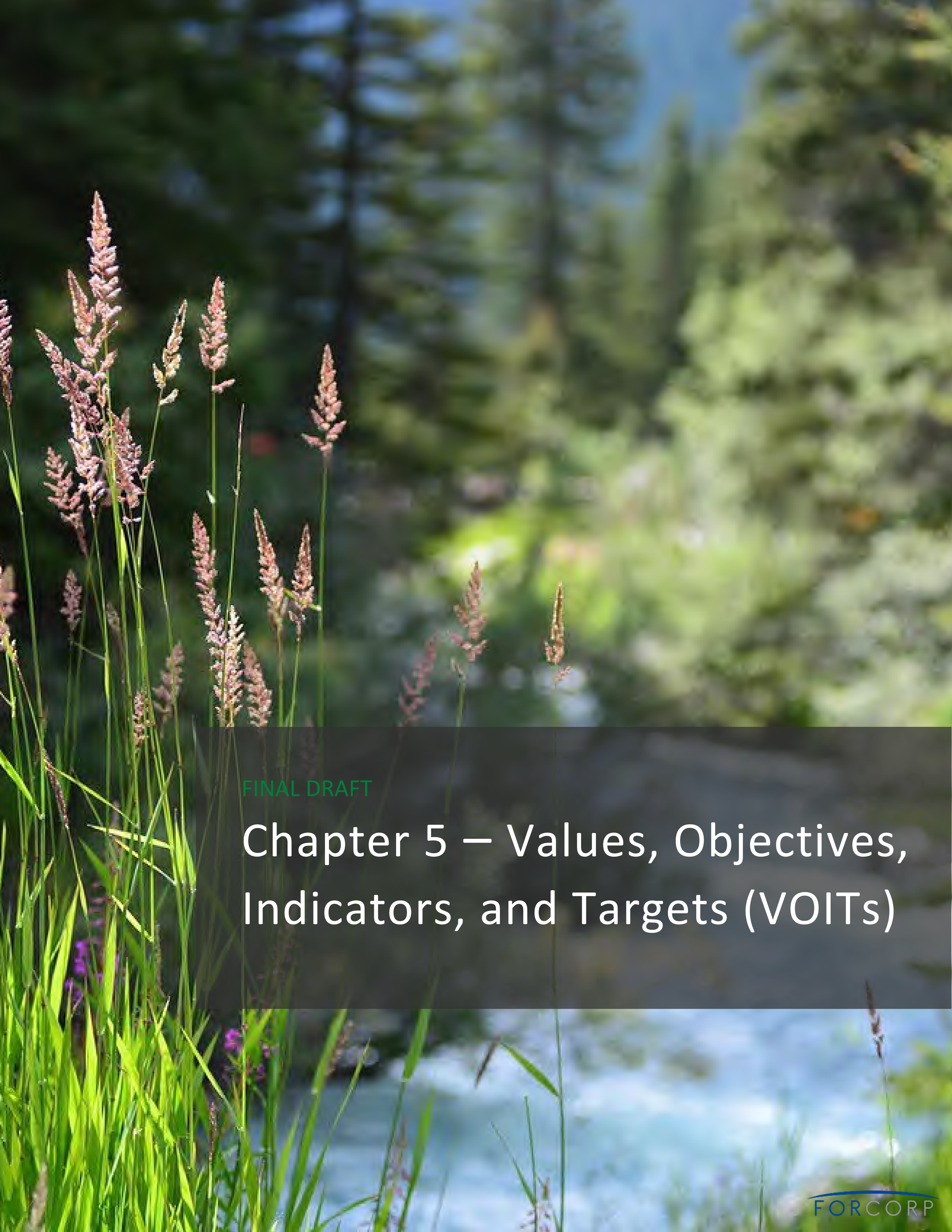

FINAL DRAFT

Chapter 5 – Values, Objectives, Indicators, and Targets (VOITs)

FORCORP

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1 Introduction

One of the first steps in the Forest Management Plan (FMP) development process is the assembly and verification of the Values, Objectives, Indicators and Targets (VOITs). This shapes how the Preferred Forest Management Strategy (PFMS) is developed, which effects how the landbase and Timber Supply Analysis (TSA) are completed. They also serve as a tool to measure the success of the execution of the FMP. The VOITs establish linkages between social, economic and ecological values identified for the FMP area and their application in forest management activities.

The Government of Alberta (GoA) provides a base set of VOITs required for forest management plans through the Alberta Forest Management Planning Standard version 4.1 (Planning Standard), which is revised on an ongoing basis to reflect policy updates. With government approval, Forest Management Agreement (FMA) holders can modify or add to these VOITS to address values and objectives specific to their operating area.

The Crowsnest Forest Product Ltd. (CFP) Plan Development Team (PDT) began the process of developing VOITs for the 2025 FMP by reviewing the provided government VOITs to ensure they aligned with CFP forest management strategies. Input from stakeholders and First Nation communities was also sought and incorporated. VOITs were developed to align with higher level regional and sub-regional plans such as the South Saskatchewan Regional Plan (SSRP) and the Livingstone-Porcupine Hills Land Footprint Management Plan (LPH-LFMP). Note that plan commitments, including those derived from VOITs (e.g. strategies), are consolidated in *Chapter 7 – Plan Implementation and Monitoring*.

1.1 Development Approach

The approach to VOIT development was to review the base GoA VOITs internally as well as through the PDT. In March 2023, the GoA provided CFP with wording updates to the original VOITs included in the Planning Standard. Following agreement within CFP and the PDT, VOITs were reviewed with the public and with First Nation communities. This approach provided a review from a broad range of stakeholders to ensure the FMP incorporated new government expectations, multiple perspectives, emerging science, and regional forest management priorities, as identified through consultation. Each VOIT underwent extensive review and discussion internally as well as at the PDT meetings and, if necessary, was amended to comply with new policies or directives, and/or ensure clarity and practicality of obligations, including monitoring and reporting requirements.

VOITs that had agreement from CFP, the PDT, and the GoA were shared with stakeholders and First Nation communities through separate consultation processes that were initiated in September 2022. As described in greater detail in *Chapter 2 – FMP Development*, the draft VOITs were reviewed by CFP's Public Advisory Committee (PAC) and made available at open houses. First Nations consultation was conducted according to the requirements established by the province's Aboriginal Consultation Office (ACO).

1.2 Agreement in Principle

Agreement In Principle (A-I-P) was granted on July 24, 2024 for VOITs. Conditions of the approval include:

- Agreement in principle (A-I-P) pertains to wording only and does not cover targets yet to be established;

- Wording may change based on input provided by the quota holder, public, interest groups and through Indigenous consultation; and
- VOIT approval will not occur until review of the final submission of the 2025 FMP is completed.

1.3 VOIT Development Progress and Status Summary

This section summarizes the key interactions in the VOIT development and acceptance process. Below is a brief summary of the dates in which meaningful events took place regarding VOIT development and acceptance:

November 10, 2022: At the PDT meeting, CFP discussed the starting point of the VOITs being the FMU B12 VOITs that were approved. The GoA noted that higher level plans may result in additional changes between the B12 and C5 VOITs. After the meeting, CFP distributed the current version of the VOITs, with the B12-specific targets removed.

February 1, 2023: The current version of the VOITs was sent to quota holder for input, a response was received on February 3, 2023 and there were no concerns.

March 21, 2023: The GoA provided an updated version of the working version of the VOITs that incorporated additional content related to alignment with the LPH-LFMP and the SSRP.

April 11, 2023: With additional details being added to the VOITs due to the SSRP and the LPH-LFMP, a meeting was held to review the new timelines for getting agreement-in-principle (A-I-P) for the VOITs wording. A target date was set for September 1, 2023.

June 1, 2023: The VOITs were reviewed at the PDT meeting. The group accepted the wording for the following VOITs: #1, #2, #3, #4-1, #4-2 , #5-1, #6, #7, #8, #9, #11, #12, #13, #15, #16, #17, #18, #19, #21, and #22. In general, and when a sub-unit was required in the VOIT and the term DFA was previously specified, DFA was changed to FMA. The acronym for the Livingstone Porcupine Hills Land footprint management plan (LPH-LFMP) was also reviewed for correctness.

June 13, 2023: CFP provided an updated version of the VOIT document to the GoA for review following the PDT meeting. Feedback was provided on VOIT #10, #13, #23, and #25.

June 14, 2023: A meeting was held to discuss CFP's concerns related to the LPH-LFMP and changes to the water VOITs; specifically, #5-1, #5-2, #5-3 , #9, and #23.

June 28, 2023: Wording for the new forest encroachment VOIT (#29-3) was provided to CFP by the GoA and included in the VOIT review document.

June 29, 2023: A meeting was held to review forest encroachment details and VOIT #29-3.

July 13, 2023: Input was received from a subject matter expert for VOIT #14 (specific to Pa/Pf).

July 17, 2023: Input was received from a subject matter expert for VOITs #18 & #19.

July 20, 2023: A summary of the VOITs was distributed to the PDT one week in advance of the PDT meeting.

July 25, 2023: Input was received from a subject matter expert for VOITs #15 & #16.

July 27, 2023: During the PDT meeting, the following VOITs were reviewed: #29-3 (forest encroachment), #14 (specifically regarding Pa/Pf), #18 (reforesting harvest areas), and #23 (roads and barred areas).

August 30, 2023: The complete table of all VOITs was provided to the GoA and A-I-P for wording was requested.

September 8, 2023: The GoA recommended wording change for the Pa/Pf in VOIT #14.

October 25, 2023: A response was received from the GoA regarding the A-I-P request. A-I-P for all VOITs could not be provided as there were still VOITs that required wording changes and further discussion.

November 6, 2023: There was additional discussion for VOITs #5-1, #5-2, and #5-3 specific to the reporting column. These three VOITs were then sent to the GoA with additional tracked changes on November 9, 2023. A response was received on November 15, 2023, indicating that the changes are agreeable.

November 23 , 2023: During the PDT meeting, the following VOITs were reviewed: #7, #21, #22, #23, #24, #29, #29-3, #31, and #32.

January 25, 2024: During the PDT meeting, the following VOITs were reviewed: #3, #22, #23, and #29-3.

February 13, 2024: Additional wording for the wildfire VOIT (#28) was provided by the GoA.

February 26, 2024: Feedback on proposed forest encroachment strategy provided by GoA to the company, directing the company to discuss what CFP can do to manage forest encroachment onto grasslands based on the initial recommendations and VOIT provided (May 2023).

April 1, 2024: Changes to the silviculture matrix, specifically the non-strata treatments provided to GoA and approved.

May 16, 2024: CFP provided an updated invasive plant program to the GoA for review. Response on May 28, 2024 indicating that there has been significant improvement and additional comments for consideration were provided.

May 30, 2024: Discussion of #29-3 at PDT meeting. Additional wording sent to the GoA on May 31, 2025.

1.4 VOIT Terms and Definitions

Value: A DFA characteristic, component or quality considered by an interested party to be important in relation to the Canadian Standards Association (CSA) Sustainable Forest Management (SFM) element or other locally identified element.

Objective: A broad statement describing a desired future state or condition of values.

Indicator: A variable that measures or describes the state of condition of a value.

Target: A specific statement describing a desired future state of condition of an indicator. Targets should be clearly defined, time-limited, and quantified, if possible.

Means to identify target: The methodology employed to set the target(s).

Legal/policy requirements: Regulatory or policy instruments.

Means of achieving objective and target: The tools and approaches that will be used in the implementation of the VOIT.

Monitoring and measurement: The methods by which implementation and success will be measured.

Reporting: How CFP intends to report on the VOIT.

Acceptable variance: The amount of variation from the stated target that is considered to have still met the objective while not having precisely met the target.

Response: The action(s) to be taken when the variance from the stated target exceeds acceptable tolerances.

2 VOIT Summary Table

For reference purposes, Table 2-1 provides a summary of the 2025 FMP VOITs. Additional details for each VOIT is presented in Section 3.

Table 2-1. Summary of the 2025 FMP VOITs.

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
CCFM Criterion 1. Biological Diversity											
CSA SFM Element 1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)											
1	1.1.1 Landscape scale biodiversity	1.1.1.1 Maintain biodiversity by retaining the full range of cover types and seral stages[3] Creation of resilient, healthy forests within a natural range of variation	Area of old, mature, and young forest in the Forest Management Agreement (FMA) area by cover class[2].	Over the 200-year planning horizon: a) Gross landbase: greater than 25% old forest, greater than 31% mature plus old forest, less than 13% young forest; and b) Net landbase: greater than 13% old forest, greater than 23% mature plus old forest, less than 20% young forest Note: Old forest retention shall include the full natural range of ages	Targets and seral stage definitions shall be based on sound science, ecological considerations, wildlife zones, and disturbance regimes. Target shall ensure representation of natural range of ecosystem attributes (e.g., productivity class)	Planning Standard Alberta Land Stewardship Act (ALSA), South Saskatchewan Regional Plan (SSRP) and Livingstone-Porcupine Hills Land Footprint Management Plan (LPH-LFMP)	Minimize variance by developing and implementing an operationalized Spatial Harvest Sequence (SHS)	Regular updates to inventory Planning and submission of a General Development Plan (GDP), adherence to SHS, tracking and reporting variance	FMP: Tables of indicators (values and targets) at 0, 10, 50, 100 and 200 years. Maps of indicators at 0, 10 and 50 years Performance: 10-year Stewardship Report - Compare time 0 of 2025 FMP to Classified Landbase (CLB) of new FMP	Area (ha) of old and mature forests in the FMA by cover class shall be between 90% and 100% of target areas. Area of young forest in the FMA by cover class shall not exceed 110% of target area	Adjust strategies in subsequent Forest Management Plan (FMP)
2	1.1.1 Landscape scale biodiversity	1.1.1.2 Maintain biodiversity by avoiding landscape fragmentation	Range of patch[3] sizes for forest that is 20 years of age and less for the FMA	A distribution of harvest area sizes that will result in a patch size pattern over the 200-year planning horizon that is increasing in patch size.	Targets shall be based on sound science, ecological considerations, wildlife zones, and disturbance regimes. Target shall ensure representation of natural range of ecosystem attributes (e.g. productivity class)	Planning Standard ALSA, SSRP, LPH-LFMP	Spatial and temporal harvest planning. Patch size distribution targets are set for forest patches less than 20 years old Minimize variance by developing and implementing an operationalized SHS	Regular updates to forest inventory Planning and submission of a GDP, adherence to SHS, track and report variance	FMP: Tables of area of forest in each patch size class by subunit at 0, 10, and 50 years (or end of first rotation). Maps of patch size classes at 0, 10, and 50 years, (or end of first rotation) Performance: 10-year Stewardship Report - Compare time 0 of 2025 FMP to CLB of new FMP	a) At the end of the 10-year FMP term the target distribution is achieved; or demonstrated progress to achieving target in one rotation where the pattern has deviated significantly from the target	Adjust strategies in subsequent FMP
3	1.1.1 Landscape scale biodiversity	1.1.1.2 Maintain biodiversity by avoiding landscape fragmentation	Area of old interior forest[4] in the FMA by cover class.	b) Area of old interior forest will not be less than 11% of Pl stands, 31% of SW stands, 13% of FD stands, 2% of MIX stands, over the next 200 years.	Targets shall be based on sound science, ecological considerations, wildlife zones, and disturbance regimes. Target shall ensure representation of natural range of ecosystem attributes (e.g., productivity class)	Planning Standard ALSA, SSRP, LPH-LFMP	Spatial and temporal harvest planning Minimize variance by developing and implementing an operationalized SHS	Regular updates to forest inventory Planning and submission of a GDP, adherence to SHS, track and report variance	FMP: Maps and Tables of indicator at 0, 10, and 50 years Cover class will be comprised of FMP natural stand yield stratum: Hw, Fd, Mix_Pl, MIX_Sx, Pl & Sw Performance: 10-year Stewardship Report - Compare time 0 of 2025 FMP to CLB of new FMP	b) Target is achieved for at least 80% of the planning period with variance not exceeding 20% below target	Adjust strategies in subsequent FMP

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
4-1	1.1.1 Landscape scale biodiversity	1.1.1.3 Maintain biodiversity by minimizing access	a) Open permanent forestry road (Department License of Occupation - DLO) density outside the LPH-LFMP area.	a) Less than 0.00 km/km^2	Targets shall be based on sound science, ecological considerations, harvest planning, wildlife zones, and social values	Planning Standard ALSA, SSRP, Public Lands Act	Develop a strategy that coordinates access with other resource users, spatial/temporal sequencing of harvest, road construction and reclamation. (SHS and long-term corridor access plan)	Regular updates to forest inventory and Digital Integrated Dispositions (DIDs).	FMP: Table of road density outside LPH-LFMP area at 0 and 10 years. Map of existing and proposed open and closed forestry roads. Report forestry roads and total (all users) roads Performance: Stewardship Reports - Table and map of permanent open forestry road densities (km/km^2) outside LPH-LFMP area.	A variance not exceeding +/-20% must be achieved	Adjust strategies in subsequent FMP
4-2	1.1.1 Landscape scale biodiversity	1.1.1.3 Maintain biodiversity by minimizing access	b) Open seasonal/temporary forestry road length outside LPH-LFMP area.	a) Less than 18 km for the FMA area outside the LPH-LFMP area	Targets shall be based on sound science, ecological considerations, harvest planning, wildlife zones, and social values	Planning Standard, ALSA, SSRP, Forests Act, Alberta Timber Harvest Planning and Operating Ground Rules (OGRs), Spatial Data Directive (SDD)	Road construction, maintenance, and reclamation activities	Road planning OGR	FMP: Table and map of existing open seasonal/temporary forestry roads at time zero Performance: Stewardship Reports - Table open seasonal / temporary forestry roads for each timber year for outside LFH-LFMP.	A variance not exceeding +/-20% must be achieved	Adjust strategies in subsequent AOPs
5-1	1.1.1 Landscape scale biodiversity	1.1.1.3a Maintain biodiversity by minimizing access per direction from LPH-LFMP	a) Open motorized access by Footprint Planning Zone	a) Less than 0.04 km/km^2 in Zone 2 and less than 0.14 km/km^2 in Zone 3	Historical road construction and reclamation data, targets shall be forest sector specific based on guidance from LPH-LFMP	Planning Standard, ALSA, SSRP, LPH-LFMP, Public Lands Act, OGRs, SDD	Road construction, maintenance and reclamation activities Develop a strategy to coordinate access with other resource users, spatial/temporal sequencing of harvest, road construction and reclamation (SHS and long-term corridor access plan)	Road plan (Operating Ground Rules (OGR)) Government of Alberta Decision Support Tool	FMP: Current open motorized access density by zone (open forestry DLOs). Performance: Stewardship Reports - Road density and km by zone per year for Open Motorized Access (open forestry DLOs).	None	Removal of open motorized access when appropriate Adjust strategies in subsequent FMPs

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
5-2	1.1.1 Landscape scale biodiversity	1.1.1.3a Maintain biodiversity by minimizing access per direction from LPH-LFMP	b) Restricted motorized access by Footprint Planning Zone	b) Less 0.09 km/km² in Zone 2 & 3	Historical road construction and reclamation data, targets shall be forest sector specific based on guidance from LPH-LFMP	Planning Standard, ALSA, SSRP, LPH-LFMP, Public Lands Act, OGRs, SDD	Road construction, maintenance and reclamation activities Government of Alberta Decision Support Tool Develop a strategy to coordinate access with other resource users, spatial/temporal sequencing of harvest, road construction and reclamation (SHS and long-term corridor access plan) All temporary forestry roads will be managed as Restricted Motorized Access per LFH-LFMP	Regular updates to forest inventory Government of Alberta Decision Support Tool	FMP: Current restricted motorized access density by zone. (Forestry Access roads and DLOs) Performance: Stewardship Reports - Restricted motorized access density by zone per year	None	Adjust timing of road reclamation program Adjust strategies in subsequent FMPs
5-3	1.1.1 Landscape scale biodiversity	1.1.1.3a Maintain biodiversity by minimizing access per direction from LPH-LFMP	c) Near stream motorized access disturbance limit (within 100 m of a stream on erodible soils)	c) <0.01 km/km² in each analysis unit	Historical road construction and reclamation data, targets shall be forest sector specific based on guidance from LPH-LFMP	Planning Standard, ALSA, SSRP, LPH-LFMP, Public Lands Act, OGRs, SDD	Develop a strategy that coordinates access with other resource users, spatial/temporal sequencing of harvest, road construction and reclamation (SHS and long-term corridor access plan)	Regular updates to forest inventory Government of Alberta Decision Support Tool	FMP: Current near stream motorized access density by analysis unit (Forestry Access roads and DLOs) Performance: Stewardship Reports - Near stream motorized density by analysis unit per year	None	Adjust timing of road reclamation program Adjust strategies in subsequent FMPs.
6	1.1.1 Landscape scale biodiversity	1.1.1.4 Maintain plant communities uncommon in FMA or province	Area or occurrence of each uncommon plant community within FMA	Conserve uncommon plant communities for 100% of known encountered occurrences.	Geographic Information System (GIS) analysis, Alberta Vegetation Inventory (AVI), ecosite phases, Alberta Conservation Information Management System (ACIMS), plant community classification and tracking list. Predict and identify occurrence of uncommon plant community	Planning Standard	Coordinating with other resource users, spatial planning of harvest and road construction, OGRs Apply operational procedures	Annual ACIMS database updates, regular updates to inventory.	FMP: Table with descriptive list and targets. Map(s) displaying known locations of uncommon plant communities. Performance: Stewardship Reports - Summary of action taken in all areas where uncommon plant communities have been identified.	At the end of the 10-year FMP term the target is achieved	Adjust strategies in subsequent AOPs

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
7	1.1.1 Landscape scale biodiversity	1.1.1.5 Maintain unique habitats provided by wildfire and blowdown events	a) Area of unsalvaged burned forest	Live trees: Retain unburned trees in green islands and retain patches recognizing timber condition, access, non-timber needs according to the directive "Fire Salvage Planning and Operations - Directive No. 2007-01".	Targets based on Fire Salvage Planning and Operations - Directive No. 2007-01. Ensure consistency with FireSmart objectives	Fire Salvage Planning and Operations - Directive No. 2007-01	Salvage planning	Organization reports, air photo interpretation, ground surveys, post-harvest assessments, General Development Plan (GDP).	FMP: Table and map of wildfire events within the last 10 years showing area (ha) and proportion (%) of salvaged and unsalvaged Performance: Stewardship Reports: Table and map of fire disturbance with percent salvaged. Table and map show total burn area, portions salvaged by burn severity class, and the unburned green islands kept as retention.	At the end of the 10-year FMP term the target is achieved or exceeded	Adjust strategies in subsequent AOPs
8	1.1.1 Landscape scale biodiversity	1.1.1.5 Maintain unique habitats provided by wildfire and blowdown events	b) Area of unsalvaged blowdown	In areas of significant blowdown (>= 100 ha) greater than 10% will be left unsalvaged	Targets are to be based on sound science, ecological considerations and disturbance regimes	Planning Standard	Salvage planning	Inventory updates, GDP.	FMP: Table and map of blowdown event within the last 10 years showing area (ha) and proportion (%) of salvaged and unsalvaged. Performance: Stewardship Reports – table and map of blowdown disturbance and percent unsalvaged and salvaged for events greater than 100 ha in the FMA.	At the end of the 10-year FMP term the target is achieved or exceeded	Adjust strategies in subsequent AOPs
9	1.1.1 Landscape scale biodiversity	1.1.1.6 Retain ecological values and functions associated with riparian zones	Protection of aquatic and riparian areas	Consistent with OGRs	OGRs	Federal Fisheries Act, Timber Management Regulation (TMR), Forests Act, Grazing and Timber Integration Manual, ALSA, SSRP	Planning and operations, Timber Supply Analysis (TSA), OGRs	FOMP reports, Company monitoring/audits, tracking of OGR deviation requests, and non-standard submissions	Performance: Stewardship Reports - Number of FOMP variances related to specific OGRs, number of Company self-reports, number of OGR deviations requested under applicable OGRs	No variance	Demonstrate that aquatic and riparian ecosystem objectives are being met through an effective monitoring program based on aquatic and riparian function in areas of concern.
10	1.1.2 Local/stand scale biodiversity	1.1.2.1 Retain stand level structure	% area of residual structure (both living and dead), within a harvest area, as outlined in CFPs structure retention strategy by FMA	3% of the Lodgepole pine/other non-Douglas fir Forest and; 15-20% of the Douglas fir forest. Structure retention is by area, to be within the contributing landbase, internal to each harvest area (individual openings), and representative of the pre-harvest stand composition. Note: A wide range in variability in harvest area level retention within the FMA is desired as long as the target level is achieved	Wildlife zones, roadside vegetation screens, recreational values, aesthetics, local knowledge. ACIMS, Alberta Biodiversity Monitoring Institute (ABMI) and Fisheries and Wildlife Management Information System (FWMIS), previous FMP structure retention results	Occupational Health and Safety Act, Forest and Prairie Protection Act Planning Standard, ALSA, SSRP, LPH-LFMP, OGRs	Implement CFP structure retention strategy and OGRs	Organization reports, cutover photography, air photo interpretation, ground surveys, post-harvest assessments	Performance: Stewardship Reports - Table of the percent of structure retention by year for the FMA.	At the end of the 10-year FMP term the target is achieved or exceeded	Adjust strategies in subsequent FMP.

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
11	1.1.2 Local/stand scale biodiversity	1.1.2.1 Retain stand level structure	b) Percentage of harvested area within the FMA with downed woody debris[5] equivalent to preharvest conditions	b) 75% of harvest areas having downed woody debris retained on site	Recording utilization of downed woody debris post-harvest.	Planning Standard ALSA and SSRP	Organization developed standards	Organization developed during FMP planning	Performance: Stewardship Reports - Table showing percent of harvest areas by year that have not received treatments that reduces downed woody debris (e.g. brush raking and prescribed burns)	None	Adjust strategies in subsequent FMP.
12	1.1.2 Local/stand scale biodiversity	1.1.2.2 Maintain integrity of sensitive sites	Sensitive sites (e.g. mineral licks, major game trails) by FMA	Strategies to maintain consistent with provincial guidelines / OGRs	Sensitive sites identified through local knowledge, public consultation, Indigenous consultation, ACIMS, ABMI, GDPs, FWMIS, OGRs	Planning Standard	Organization developed standards for sensitive site protection.	Organization reports, air photo interpretation, ground surveys	Performance: Stewardship Reports - Summary of identified sites and action taken.	None	Adjust strategies in subsequent FMPs
13	1.1.2 Local/stand scale biodiversity	1.1.2.3 Maintain aquatic biodiversity by minimizing impacts of watercourse crossings	a) Permanent forestry watercourse crossings in compliance with Code of Practice for Watercourse Crossings b) Temporary forestry watercourse crossings in compliance with OGRs	a) Permanent forestry watercourse crossing designs meet standards of the Code of Practice for Watercourse Crossings b) Temporary forestry watercourse crossings meet standards in the OGRs	a) Code of Practice for Watercourse Crossings b) OGRs	a) Water Act, Water (Ministerial Regulation) and Code of Practice for Watercourse Crossings b) Forests Act, TMR and OGRs	Road and watercourse planning, construction, monitoring, maintenance and reclamation activities	Watercourse Crossing Management Directive OGRs Company watercourse crossing monitoring program	Performance: Stewardship Reports - Report on all company watercourse crossing monitoring results, number of FOMP variances related to relevant OGRs, number of Company self-reports related to relevant OGRs	None	Based on stewardship reporting results, a causal factor review and the frequency and severity of reported incidences a third-party review of watercourse crossing monitoring programs and operations standards may be required

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
14-1	1.2.1 Viable populations of identified plant and animal species	1.2.1.1 Maintain habitat for identified high value species (i.e. economically valuable, socially valuable, species at risk, species of management concern)	a) Number of hectares of primary and secondary habitat from the fRI Grizzly Bear model, as measured at time 0 (1 May 2023) by FMA; b) Percent change in the Barred owl potential breeding pairs and Resource Selection Function (RSF) value from (1 May 2023) by FMA; c) Percent change in American marten habitat suitability index from (1 May 2023) by FMA; and d) Percent change in relative abundance value of three songbird species (Brown Creeper, Ovenbird and Varied Thrush) from May 1, 2023 by FMA; e) Maintain identified Whitebark and Limber Pine trees, saplings, and seedlings.	a) Maintain or increase the number of hectares of primary and secondary habitat from the fRI Grizzly Bear model, as measured at time 0; b) Maximum 15% reduction in the breeding pairs indicator over the 200 year planning horizon and 15% reduction in the RSF indicators over the 200 year planning horizon; c) Maximum 15% reduction in the indicator over the 200 year planning horizon; and d) Maximum 15% reduction in the indicator over the 200 year planning horizon. e) A minimum of 95% protection of all known Whitebark and Limber Pine trees, saplings, and seedlings. 100% protection of GoA long term monitoring installations, research/restoration and plus tree sites.	Habitat models (provided by the Government of Alberta (GoA)). Based on sound science, ecological considerations, wildlife zones, Committee on the Status of Endangered Wildlife in Canada (COSEWIC) list, provincially listed species, ABMI, ACIMS, recovery plans, government priorities, public consultation, habitat suitability analysis, literature review, observation data, local and traditional knowledge. For Whitebark and Limber pine, use AVI in combination with company and GoA long term monitoring installations, research / restoration and plus trees sites data. Consult with WPEFC for most current spatial data identifying presence and absence of Whitebark and Limber Pine trees, saplings, and seedlings .	Recovery plans for species at risk, Federal Species at Risk Act	Harvesting plans, road construction, OGR, planning and implementation, adherence to provincial wildlife guidelines. Minimize variance by developing and implementing an operationalized SHS. For Whitebark and Limber pine, ensure protection of trees, saplings, and seedlings through careful operational planning of roads and harvest areas. Maintain consistency with current approved Alberta Whitebark and Limber Pine Recovery Plan and best management practices. Operational guidance on Pa/Pf content from subjective deletions process in classified landbase. Collaboration with Whitebark Pine Ecosystem Foundation of Canada (WPEFC) for support, mitigation and expertise as needed. Clark's nutcracker modelling.	Updates to vegetation inventory and habitat modelling. Planning and submission of a GDP, adherence to SHS, track and report variance.	FMP: a) Table and maps of current (time zero) and future (10 and 20 years) landscape conditions for core and secondary habitat zones, core and secondary sink zones, non-critical habitat and road density; b) Tables of breeding pairs and RSF at 0, 10, 20, 50, 100 and 200 years and maps of RSF value and breeding pairs at 0, 10, 20 and 50 years; c) Tables of habitat suitability at 0, 10, 20, 50, 100 and 200 years and maps of habitat suitability at 0, 10, 20 and 50 years; and d) Tables of relative abundance at 0, 10, 20, 50, 100 and 200 years and maps of relative abundance at 0, 10, 20 and 50 years. e) Map of Whitebark and Limber Pine distribution (contributing/non-contributing), long term monitoring installations, research/restoration and plus tree sites. Performance: Items a-d 10-year Stewardship Report - Compare time 0 of previous FMP to CLB of new FMP) Item e 5 and 10-year Stewardship Reports - Number of Whitebark and Limber pine trees, saplings and seedlings that have been damaged and/or destroyed.	At the end of the 10-year FMP term the target is achieved or exceeded.	Adjust strategies in subsequent FMP.

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
14-2	5.2.1 Viable populations of identified plant and animal species	To assist with the recovery of native trout species that are federally listed as species at risk under the Species at Risk Act.	a) ECA in bull and Westslope cutthroat trout watersheds b) Roads in Westslope cutthroat trout and bull trout watersheds i. Road density ii. Stream crossings c) Habitat Conservation Strategy	Target ECA in trout watersheds is <30%. If ECA is >30%, alter timber harvest scenario with strategic mitigations until ECA is <30%. If existing disturbance, at year 0, already exceeds 30%, then ECA values must demonstrate a downwards trend or will not exceed 30% ECA in modelled years 0-20. Report on all permanent and temporary forestry road densities, in bull trout and Westslope cutthroat trout watersheds (HUC8) to limit access. Report on number of crossings in all watersheds (HUC8) and in critical habitat to understand cumulative footprint. Develop Habitat Conservation Strategy for native trout species, including BMPs, operational mitigations, and commitments to fish recovery.	ECA model provided by Government of Alberta. Internal and other forestry operators data (remote sensing, planned blocks, site assessments, etc.). Government data for HUC watersheds and respective species critical habitat. literature review, recovery plans.	Species at Risk Act including Bull Trout Federal Recovery Strategy, Recovery Strategy and Action Plan for the Westslope Cutthroat Trout Alberta Population, Critical Habitat Orders, Fisheries Act, Alberta Wildlife Act and species recovery plans, OGRs	ECA modelling Harvesting plans, road construction, OGR, planning and implementation Adherence to provincial wildlife guidelines Adherence to SHS Adherence to Habitat Conservation Strategy	Tracking ECA, road densities, and crossings. Progress on commitments in Habitat Conservation Strategy.	Performance: Stewardship Reports - a) Tables showing the current ECA in bull trout and Westslope cutthroat trout watersheds. b) Table of current road densities for permanent, and temporary forestry roads (open and restricted) in bull trout and Westslope cutthroat trout watersheds. Tables of number of crossings built in critical habitat each year. c) Report on progress of commitments in Habitat Conservation Strategies in Stewardship Reports	None	Adjust strategy as required
15	1.3.1 Genetic integrity of natural tree populations	1.3.1.1 Retain "wild"[6] forest populations" for each native tree species in each seed zone through establishment of in situ reserves by Alberta and tenure holders	Where applicable, number and area (ha) of in situ genetic conservation areas	Wild forest populations are retained as per requirements set forth in the Alberta Forest Genetic Resource Management and Conservation Standards (FGRMS) and as guided in the Gene Conservation Plan for Native Species of Alberta Second Edition (GCP) Targets to be determined in accordance with FGRMS	Gaps and needs as identified in GCP and requirements set for forth in FGRMS	Timber Management Regulation (TMR) 144.2(1), Requirements to meet this TMR are provided by Alberta Forest Genetic Resource Management and Conservation Standards (FGRMS).	GCP, FGRMS and GOA/Industry Tree Improvement Cooperatives. Identified conservation areas are designated by a protective disposition in coordination between GoA and the Company	Stewardship Reporting and FGRMS mandatory reports	FMP: If applicable, table showing number and status of gene conservation areas and number provided in the DFA. If applicable, map showing locations of gene conservation areas. Performance: Stewardship Reports - Report progress towards target.	At the end of the 10-year FMP term the target is achieved or exceeded. No variance	Where needed adjust strategies as per Forest Health and Adaptation Section requirement and in subsequent FMP.

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
16	1.3.1 Genetic integrity of natural tree populations	1.3.1.2 Retain wild forest genetic resources through *ex situ* conservation	Where applicable, number or amount of genetic materials conserved ex situ as field trials, experiments, clonal banks, arboretum, and long-term seed storage .	Wild forest genetic resources through ex situ conservation are retained as per requirements set forth in FGRMS and as guided by the Ex situ Conservation Plan for Forest Genetic Resources in Alberta (Ex situ CP) Targets to be determined in accordance with FGRMS	Gaps and needs as identified in ex situ CP and requirements set forth in FGRMS	TMR 144.2(1). Requirements to meet this TMR are provided by FGRMS	FGRMS and GoA/Industry Tree Genetics Cooperatives.	Needs for ex situ gene conservation will be continuously identified as provincial forest management priorities and environmental challenges arise	FMP: If applicable, table and map showing number of provenances, genotypes and seedlots and their origin within the DFA Performance: Stewardship Reports - Not applicable until a controlled parentage program becomes active.	Where ex situ gene conservation is set up, no variance from targets as set by FGRMS is acceptable unless identified and approved in the FMP approval process. Adjustment to targets and objectives are allowable as more research and development bring new data and parameters forward	GoA approved plan to address variance
17	1.4.1 Areas with minimal human disturbances within managed landscapes	1.4.1.1 Integrate trans-boundary values and objectives into forest management	Consultation with relevant stakeholders.	Ongoing consultation with relevant protected area agencies	Link to consultation objective in Planning Standard or other existing consultation processes	Planning Standard	Management planning and operational planning.	Documentation of consultation processes	Performance: Stewardship Reports - Summary of consultation with relevant protected area agencies.	None	Adjust strategies in subsequent FMP
CCFM Criterion 2. Ecosystem Productivity											
CSA SFM Element 2.1 Ecosystem resilience											

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
18	2.1.1 Reforested harvest areas	2.1.1.1 Reforest all harvested areas	Annual % of openings that: a) meet or exceed the Reforestation Standard of Alberta (RSA) establishment survey minimum stocking and species composition standards for the declared regenerated yield stratum; b) meet or exceed the RSA establishment survey minimum stocking and species composition standards for an alternate regenerated yield stratum; and c) do not achieve the RSA establishment survey minimum stocking and/or species composition standards for any regenerated yield strata and are re-treated within one year. Indicators a, b and c are to be reported separately	The sum of Indicators a, b and c = 100% of openings	Direction from GoA	TMR 141.6(1) and 141.6(2); RSA	Implementation of silviculture strategies that ensure the target stocking and species composition is achieved for the opening	RSA establishment survey protocols	Performance: ARIS - Updates to Alberta Regeneration Information System (ARIS) tables. Stewardship Reports - Tables summarizing indicators a, b, and c	None	Adjust silviculture strategies
19	2.1.1 Reforested harvest areas	2.1.1.2 Meet or exceed the C and D Mean Annual Increment (MAI) standard for the population of openings surveyed in a given quadrant	Summed difference between target and actual C MAIs and D MAIs for openings surveyed in a five year quadrant, as reported to ARIS	100% of target	Direction from GoA	TMR 141.7(1) and 141.7(2);RSA	Implementation of silviculture strategies that ensure the target productivity is achieved for the population of openings	RSA performance survey protocols	Performance: ARIS - Updates to ARIS tables. Stewardship Reports - Summarize the difference between target and actual C and D MAIs for each opening then sum the differences across all openings in the five-year quadrant	Meet or exceed the target C and D MAI for the FMA	Adjust silviculture strategies
20	2.1.2 Maintenance of forest landbase	2.1.2.1 Limit conversion of productive forest landbase to other uses	Amount of change in forest landbase	Net change of the gross forested landbase area within the FMA.	Forest inventory and land use data	Planning Standard	Maintain current forest cover inventory and land use updates. Promote the minimization of non-forested impacts to the landbase.	Inventory and land use systems	Performance: Stewardship Reports - Number of dispositions and area of disposition withdrawn from the landbase, number of dispositions returned, and area of dispositions returned to the landbase, net change to landbase area.	Report actuals	Adjust net landbase projections in next TSA

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
21	2.1.2 Maintenance of forest landbase	2.1.2.2 Recognize lands affected by insects, disease or natural calamities	Amount of area affected	Area (ha) affected by significant forest disturbances such as insect infestations, fire, windthrow or other disturbance event.	GoA and Company forest health surveys, inventory updates, fire reporting.	Planning Standard, Alberta Forest Health Strategy and Shared Roles and Responsibilities between GoA and the Forest Industry	Maintain up-to-date information	GoA annual forest health surveys and Company detections	Performance: Stewardship Reports - Maps showing areas impacted by fire, insects, windthrow and other natural events and any subsequent treatment	Report actuals	Event specific
22	2.1.3 Control invasive species	2.1.3.1 Control invasive plants	Invasive plant program	Implement the CFP invasive plant program	Monitoring, controlling, and reporting on infestations	Weed Management in Forestry Operations Directive 2001-06	Follow CFP Invasive Plant Program	Adherence to OGRs, Field inventories	Performance: Stewardship Reports - Invasive plant inspections summarized in Stewardship report	Report actuals	Continually Improve invasive plant program
CCFM Criterion 3. Soil and water											
CSA SFM Element 3.1 Soil quantity and quality											
23	3.1.1 Soil productivity	3.1.1.1 Minimize impacts of roads, landings and bared areas in forest operations	Compliance with OGRs directing both decompaction where necessary as well as compliance with the FMP Reforestation Strategy Table	Complete compliance with OGRs	Direction from GoA	OGRs and Soils Guidelines	Effective planning and supervision of operations	Field inspection reports and audits	Performance: Stewardship Reports - Summary of total area of roads, landings and bared areas that were not reforested with a rationale as to why.	None	Immediate remedial action to correct
24		3.1.1.2 Minimize incidence of soil erosion and slumping	Incidence of soil erosion and slumping	Complete compliance with OGRs	Direction from GoA OGRs related to soils and erosion control	OGRs and other guidelines for soil erosion and sediment control	Effective planning and supervision of operations and adherence to relevant OGRs	Field inspection reports and audits	Performance: Stewardship Report - Report on all Company monitoring results, number of FOMP variances related to relevant OGRs, number of Company self-reports related to relevant OGRs	None	Immediate remedial action to correct and review of causal factors associated with erosion or slumping events.

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
25	3.2.1 Water quantity	3.2.1.1 Limit impact of timber harvesting on water yield	Forecast impact of timber harvesting (over 200 years) on water yield.	a) Snow sensitive zones will have ECAs multiplied by 1.5 b) Mean annual water yield increase < = 15% or Equivalent clearcut area (ECA) < = 30% in approved watersheds	a) Identifying high runoff areas during peak streamflow on the Eastern Slopes of the southern Canadian Rocky Mountains[7] b) ECA and hydrological modelling using approved watersheds Watershed sensitive values assessment Direction from Alberta	Planning Standard, ALSA, SSRP and LPH-LFMP	Minimize variance by developing and implementing an operationalized SHS Incorporate knowledge from hydrological modelling and watershed research Direction from Alberta	SHS area variance as per OGRs.	FMP: Table showing ECA at 0, 10, 50, 100 and 200 years and maps showing ECA at year 0, 10 and 50 years Performance: 5-year Stewardship Report - If SHS variance exceeds 20% in compartments that fall within a watershed, ECA must be remodeled. 10-year Stewardship Report - Table comparing ECA values at year 0 from 2025 FMP to year 10 of new FMP by approved watershed	< 20 percent SHS variance	5 year - adjust timing and harvest of remaining SHS to allow for hydrologic recovery of watersheds to meet targets (ECA < = 30%) 10 year - adjust ECA targets to allow for hydrologic recovery of watersheds to meet targets (ECA < = 30%)
26	3.2.2 Effective riparian habitats	3.2.2.1 Minimize impact of operations in riparian areas	Aquatic and riparian management areas maintained as outlined in OGRs	Compliance with relevant OGR sections pertaining to aquatic and riparian protection	Direction from GoA, OGRs	Federal Fisheries Act, TMR, Forests Act, ALSA, SSRP, LPH-LFMP, OGRs	Effective planning and supervision of operations and adherence to relevant OGRs.	Field inspection reports and GoA FOMP reporting. Company monitoring/audits. Tracking of OGR deviation requests, and non-standard submissions.	Performance: Stewardship Reports - Number of FOMP variances related to relevant OGRs, number of Company self-reports for relevant OGR contraventions, number of relevant OGR deviation requests in operational plans	None	Response will be determined by the frequency and severity of reported incidence at the discretion of Alberta Demonstrate that aquatic and riparian habitat objectives are being met through an effective monitoring program based on aquatic and riparian function
CCFM Criterion 5. Multiple Benefits to Society											
CSA SFM Element 5.1 Timber and non-timber benefits											

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
27	5.1.1 Sustainable timber supplies	5.1.1.1 Establish appropriate Annual Allowable Cuts (AACs)	Process described in Annex 1 is followed and standards are met	Complete compliance	Consultation in planning process	Forests Act and TMR	Effective implementation of planning process	Multiple means: Forest Revenue Scaling and Tenure System (FOREST), ARIS, AOPs, Stewardship Reports, filed inspection	Performance: 10-year Stewardship Report: Compare time 0 of previous FMP to CLB of new FMP	Issue specific	Adjust AAC using most current and relevant information
28	5.2.1 Risk to communities and landscape values from wildfire is low.	5.2.1.1 To assist the GoA in reducing wildfire threat potential by reducing fire behavior, fire occurrence, threats to values at risk and enhancing fire suppression capability	a) Harvested area in Wildfire Risk Indicator (WRI) classes (Risk Reduction, Continuous Improvement, and Intolerable) (ha) within the CFP FMA Community Zone b) Harvested area in WRI classes (ha) within the CFP FMA Landscape Zone now and over the planning horizon	a) Harvest 30% of the area in WRI classes within the CFP FMA Community Zones over 20 years b) Harvest 10% of the area in WRI classes within the CFP FMA Landscape Zone over 20 years.	Annex 3 Report, data and recommendations provided to FMA Holder FMA Holder assessment of the SHS developed using recommendations from Annex 3 Report	Planning Standard, ALSA, SSRP, LPH-LFMP	SHS, thinning, partial harvest techniques, FireSmart Treatments.	AOPs, Compartment Assessments	FMP: Maps of WRI, Fuel Grid, Historical Wildfires and Natural Subregions. Performance: Stewardship Reports - Report harvest area and percent by year for a) and b) from time zero of the 2025 FMP	Issue specific	Adjust harvest sequence
29-1	5.2.2 Provide opportunities to derive benefits and participate in use and management	5.2.2.1 Integrate other uses and timber management activities	Designated and Provincial trail integration.	Integrate designated and Provincial trails as indicated in the Timber Harvest Planning and Operating Ground Rules.	Consultation and co-operation. Designated and Provincial trails that are identified in the Trails Designation Order.	Planning Standard, OGRs, Trails Act, applicable Ministerial Order	Effective implementation of plans.	Consultation tracking.	Performance: Stewardship Report - Report length (m) of trail protected that overlaps harvested areas	Issue specific	Adjust activities
29-2	5.1.2 Scenic values	5.1.1.2 Commercial forestry supports the maintenance of scenic values through integrating recreation and tourism considerations in planning and operations	Minimize impacts to high scenic values in high visual quality areas	The SHS will not include more than 12% of the identified high scenic values in the first two decades.	Consultation in planning process, Visual Quality Assessment	ALSA, LPH-LFMP, Livingstone-Porcupine Hills Recreation Management Plan	Effective implementation of plans, Visual Quality Strategy.	As-built harvest area boundaries	FMP: Map of areas identified with high scenic value and how much SHS area (ha) is scheduled in the first two decades. Performance: Stewardship Reports - Report actual percent harvested within the high scenic value areas	20% - variance	Adjust strategies in subsequent FMP

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
29-3	5.2.2 Provide opportunities to derive benefits ad participate in use and management	5.2.2.2 Reduce forest encroachment onto grasslands	Forest encroachment onto grasslands is reduced in successional transitional areas	a) Reduce forest encroachment onto grasslands by the inclusion of 125 ha of successional transition areas in each of the first decade of the SHS (79 ha of contributing & 46 ha of non-contributing landbase). b) Slow the transition from grassland to forest in harvested successional transition areas by implementing alternative silviculture strategies.	Consultation in planning process, GoA provided recommendations in the document titled "Minimizing Forest Encroachment in Successional Transition Areas in the Crowsnest Forest Products Ltd. 2025 Forest Management Plan". Further refinement and direction from the GoA on eligible successional transition areas to treat encroachment	ALSA, SSRP, LPH-LFMP, AFMPS	Develop the SHS considering successional transition areas to reduce forest encroachment onto grasslands. Include alternative silviculture strategies to reduce forest encroachment onto grasslands such as, but not limited to, partial harvest, pre commercial thinning, leave for natural and/or reduced planting densities.	AOPs, Reforestation Standard of Alberta, Reforestation survey audit results, AVI	FMP: Map showing identified successional transition areas planned for treatment on the contributing (planned SHS) and non-contributing landbases in the first decades. Performance: 5-year Stewardship Report - a) Report harvested successional transition areas in the contributing (actual SHS) and non-contributing landbases (Map and table indicating the harvest areas and what alternative silviculture strategy was implemented in each). 10-year Stewardship Report - a) Report harvested successional transition areas in the contributing (actual SHS) and non-contributing landbases (Map and table indicating the harvest areas and what alternative silviculture strategy was implemented in each); and b) Report outcomes of each alternative silviculture strategy implemented to slow the transition from grassland to forest in successional transition areas.	None	Adjust in subsequent FMP
29-4	5.2.2 Provide opportunities to derive benefits and participate in use and management	5.3.3.3 Acknowledgment of Grazing Permit Holder Rights.	Consultation with grazing permit holders with operational planning (GDP)	a) Consultation with grazing permit holders b) Grazing/timber integration stipulations identified in Grazing Timber Agreements (GTA's)	a) Consultation with grazing permit holders b) Stipulations identified in the GTAs	Forest Reserve Act, Forest Act, AFMPS, OGRs, Grazing and Timber Integration Manual	Adherence to GTA stipulations	Adherence to GTA monitoring stipulations	Performance: 5-year Stewardship Report - a) Report number of completed GTAs 10-year Stewardship Report - a) Report number of completed GTAs	None	Consultation with grazing permit holders. Adjust in subsequent FMP
30	5.2.3 Forest Productivity	5.2.3.1 Maintain Long Run Sustained Yield Average (LRSYA)	Regenerated stand yield compared to natural stand yield	No net decrease from the natural stand productivity	FMP TSA	Planning Standard	Effective implementation of plans	Future FMP RSA (MAI).	FMP: TSA Performance: 10-year Stewardship Report - Compare time 0 of previous FMP to CLB of new FMP	Report actual	Adjust AAC using most current and relevant information
CCFM Criterion 6. Accepting society's responsibility for sustainable development											
CSA SFM Element 6.1 Indigenous and treaty rights and Indigenous forest values											

ID	Value	Objective	Indicator	Target	Means to Identify Target	Legal / Policy Requirements	Means of Achieving Objective and Target[1]	Monitoring and Measurement	Reporting	Acceptable Variance	Response
31	6.1.1 Compliance with government regulations and policies	6.1.1.1 Implement Indigenous Consultation Process	Meet Alberta's current expectations for Indigenous consultation	Perform adequate consultation at the community level with designated representatives of affected Indigenous communities	GoA Indigenous Consultation and Policy Guidelines	Planning Standard, GoA Indigenous Consultation Policy and Guidelines	Effective implementation of Indigenous Consultation Process	GoA FMP and GDP consultation adequacy letters CFP Indigenous communication database	FMP: Summary of input provided during Indigenous consultation, how it was incorporated into the FMP and if it wasn't, provide an explanation why. Performance: Stewardship Reports - Summary of Indigenous consultation with input and responses during FMP implementation.	None	Adjust activities
32	6.2.1 Meaningful public participation is achieved	6.2.1.1 Implement Public Participation Process	Meet expectations of Section 5 of CSA Z809-02	Implementation of Crowsnest Forest Products' (CFP) Public Participation Program. Annual opportunity for public input on harvest plans.	CFP public participation program.	Planning Standard	Effective implementation of Public Participation Process	CFP public communication database.	FMP: Summary of public input, how it was incorporated into the FMP and if it wasn't, provide an explanation why. Performance: Stewardship Reports - Update on the revised Terms of Reference for the Public Advisory Committee and the Public Participation Program. Summary of Public Participation Program activities and input from the Public Advisory Committee, public and interest groups into harvest plans	None	Adjust activities

Footnotes:

[1] Items noted under the "Means to Identify Targets" and "Means of Achieving Objectives and Targets" are intended as suggestions and not meant to limit potential approaches. The list is not comprehensive or mandatory.
[2] Cover classes: The definition will be developed through FMP planning. In general, cover-class is a coarser grouping than the cover type (AVI stand label) but provides finer resolution than the cover groups (C, CD, DC, D) and will reflect leading species and mixedwood types.
[3] Patch: A stand of forest in the same seral stage and not split by a linear feature greater than 8m wide. Linear features in this definition include roads, pipelines, power lines, and rivers, but does not include seismic lines.
[4] Old Interior Forest: Old interior forest patches are defined as any patch greater than 120 ha that is composed of stands greater than 120 years old, using an 8m adjacency distance.
[5] Downed woody debris: Wood lying at an angle of less than 45 degrees from the ground and having a diameter greater than 7.5 cm.
[6] Wild: Genetic materials of native species originating from natural regeneration (FGRMS).
[7] FRIAA/FRIP report EOI FFI-17-15 (March 2020)

3 Detailed VOITs

The following section provides more detailed information regarding each of the VOITs in the 2025 FMP than the VOIT table summary in Section 2. It also provides expanded indicator definitions and context on the past history of each VOIT from the C5 Forest Management Plan (2006-2026).

The VOITs are presented in the same order as in the VOIT table provided in Section 2 of this chapter and can be quickly referenced using the information in heading level 2:

- VOIT index number;
- GoA VOIT hierarchy numbering; and
- A short descriptive name.

3.1 Biological Diversity

3.1.1 VOIT 1 – Seral Stages

3.1.1.1	*CCFM Criterion*	1 Biological Diversity
3.1.1.2	*CSA SFM Element*	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.1.3	*Value*	1.1.1 Landscape scale biodiversity
3.1.1.4	*Objective*	1.1.1.1 Maintain biodiversity by retaining the full range of cover types and seral stages. Creation of resilient, healthy forests within a natural range of variation.

3.1.1.5 Indicator

Area of old, mature, immature, and young forest in the Forest Management Agreement Area (FMA) by cover class.

3.1.1.6 Target

Over the 200-year planning horizon:

a) Gross landbase: Greater than 25% old forest, greater than 31% mature plus old forest, less than 13% young forest; and

b) Net landbase: Greater than 13% old forest, greater than 23% mature plus old forest, less than 20% young forest.

Note: Old forest retention shall include the full natural range of ages.

3.1.1.7 Means to Identify Target

Targets and seral stage definitions shall be based on sound science, ecological considerations, wildlife zones, and disturbance regimes. Target shall ensure representation of natural range of ecosystem attributes (e.g., productivity class).

3.1.1.8 Legal/Policy Requirements

Planning Standard, Alberta Land Stewardship Act (ALSA), South Saskatchewan Regional Plan (SSRP), and Livingstone-Porcupine Hills Land Footprint Management Plan (LPH-LFMP).

3.1.1.9 Means of Achieving Objective and Target

Minimize variance by developing and implementing an operationalized Spatial Harvest Sequence (SHS).

3.1.1.10 Target Monitoring and Measurement

Regular updates to inventory. Planning and submission of a General Development Plan (GDP), adherence to SHS, tracking and reporting variance.

3.1.1.11 Reporting

FMP: Tables of indicators (values and targets) at 0, 10, 50, 100 and 200 years. Maps of indicators at 0, 10 and 50 years.

Performance:

- 10-year Stewardship Report: Compare time 0 of 2025 FMP to Classified Landbase (CLB) of new FMP.

3.1.1.12 Acceptable Variance

Area (ha) of old and mature forests in the FMA by cover class shall be between 90% and 100% of target areas. Area of young forest in the FMA by cover class shall not exceed 110% of target area.

3.1.1.13 Response

Adjust strategies in subsequent Forest Management Plan (FMP).

3.1.1.14 Definitions

Seral Stages: A stage in forest succession. The 2025 FMP uses the GoA directed seral stage classes shown in Table 3-1.

Table 3-1. Seral stage definitions used for reporting

Stratum	Young	Immature	Mature	Old	Very Old
FD	1 - 19	20 - 79	80 - 119	120 - 179	180+
HW	1 - 19	20 - 79	80 - 119	120 - 179	180+
HWPL	1 - 19	20 - 79	80 - 119	120 - 179	180+
HWSX	1 - 19	20 - 79	80 - 119	120 - 179	180+
PL	1 - 19	20 - 79	80 - 119	120 - 179	180+
PLHW	1 - 19	20 - 79	80 - 119	120 - 179	180+
SB	1 - 19	20 - 79	80 - 119	120 - 179	180+
SW	1 - 19	20 - 79	80 - 119	120 - 179	180+
SWHW	1 - 19	20 - 79	80 - 119	120 - 179	180+

Yield Curve Strata: The yield curve strata are HW (hardwood), MIX (mixedwood, includes MIXPL and MIXSW), PL (lodgepole pine), SW (white spruce).

3.1.1.15 History

VOIT 1 is similar to *Objective 1, 1.1.1. – To maintain the full range of cover groups and seral stages* in the C5 Forest Management Plan (2006-2026).

3.1.2 VOIT 2 – Patch Sizes

3.1.2.1	*CCFM Criterion*	1 Biological Diversity
3.1.2.2	*CSA SFM Element*	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.2.3	*Value*	1.1.1 Landscape scale biodiversity
3.1.2.4	*Objective*	1.1.1.2a Maintain biodiversity by avoiding landscape fragmentation

3.1.2.5 Indicator

Range of patch sizes for forest that is 20 years of age and less for the FMA.

3.1.2.6 Target

A distribution of harvest area sizes that will result in a patch size pattern over the 200-year planning horizon that is increasing in patch size.

3.1.2.7 Means to Identify Target

Targets shall be based on sound science, ecological considerations, wildlife zones, and disturbance regimes. Target shall ensure representation of natural range of ecosystem attributes (e.g. productivity class).

3.1.2.8 Legal/Policy Requirements

Planning Standard ALSA, SSRP, LPH-LFMP.

3.1.2.9 Means of Achieving Objective and Target

Spatial and temporal harvest planning. Patch size distribution targets are set for forest patches less than 20 years old. Minimize variance by developing and implementing an operationalized SHS.

3.1.2.10 Target Monitoring and Measurement

Regular updates to forest inventory. Planning and submission of a GDP, adherence to SHS, tracking and reporting variance.

3.1.2.11 Reporting

FMP: Tables of area of forest in each patch size class for the DFA at 0, 10, and 50 years. Maps of patch size classes at 0, 10, and 50 years, (or end of rotation).

Performance:

- 10-year Stewardship Report: Compare time 0 of previous FMP to CLB of new FMP.

3.1.2.12 Acceptable Variance

At the end of the 10-year FMP term the target distribution is achieved; or demonstrated progress to achieving target in one rotation where the pattern has deviated significantly from the target.

3.1.2.13 Response

Adjust strategies in subsequent FMP.

3.1.2.14 Definitions

Patch: A stand of forest in the same seral stage and not split by a linear feature greater than 8m wide. Linear features in this definition includes roads, pipelines, powerlines, and rivers, but does not include seismic lines.

3.1.2.15 History

VOIT 2 is similar to *Objective 2, 1.1.2 – To minimize landscape fragmentation* in the C5 Forest Management Plan (2006-2026). The indicator, target, acceptable variance, and monitoring procedures for distribution of patch sizes by seral stage are detailed in this previous objective.

3.1.3 VOIT 3 – Old Interior Forest

3.1.3.1	***CCFM Criterion***	1 Biological Diversity
3.1.3.2	***CSA SFM Element***	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.3.3	***Value***	1.1.1 Landscape scale biodiversity
3.1.3.4	***Objective***	1.1.1.2b Maintain biodiversity by avoiding landscape fragmentation

3.1.3.5 Indicator

Area of old interior forest in the FMA by cover class.

3.1.3.6 Target

Area of old interior forest will not be less than 11% of Pl stands, 31% of SW stands, 13% of FD stands, 2% of MIX stands, over the next 200 years.

3.1.3.7 Means to Identify Target

Targets shall be based on sound science, ecological considerations, wildlife zones, and disturbance regimes. Target shall ensure representation of natural range of ecosystem attributes (e.g., productivity class).

3.1.3.8 Legal/Policy Requirements

Planning Standard, ALSA, SSRP, LPH-LFMP.

3.1.3.9 Means of Achieving Objective and Target

Spatial and temporal harvest planning. Minimize variance by developing and implementing an operationalized SHS.

3.1.3.10 Target Monitoring and Measurement

Regular updates to forest inventory. Planning and submission of a GDP, adherence to SHS, tracking and reporting variance.

3.1.3.11 Reporting

FMP: Maps and tables of indicator at 0, 10, and 50 years.

- Cover class will be comprised of FMP natural stand yield stratum: Hw, Fd, Mix_Pl, MIX_Sx, Pl & Sw.

Performance:

- 10-year Stewardship Report: Compare time 0 of 2025 FMP to CLB of new FMP.

3.1.3.12 Acceptable Variance

A variance not exceeding +/- 20% must be achieved.

3.1.3.13 Response

Adjust strategies in subsequent AOPs.

3.1.3.14 Definitions

Old Interior Forest: Old interior forest patches are defined as any patch greater than 120 ha that is composed of stands greater than 120 years old, using an 8m adjacency distance.

3.1.3.15 History

VOIT 3 is similar to *Objective 2, 1.1.2 – To minimize landscape fragmentation* in the C5 Forest Management Plan (2006-2026). The indicator, target, acceptable variance, and monitoring procedures for old interior forest levels are detailed in this previous objective.

3.1.4 VOIT 4-1 – All-Weather Permanent Forestry Roads

3.1.4.1	***CCFM Criterion***	1 Biological Diversity
3.1.4.2	***CSA SFM Element***	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.4.3	***Value***	1.1.1 Landscape scale biodiversity
3.1.4.4	***Objective***	1.1.1.3a Maintain biodiversity by minimizing access

3.1.4.5 Indicator

Open permanent forestry road (Department Licence of Occupation - DLO) density outside the LPH-LFMP area.

3.1.4.6 Target

Less than 0.0 km/km^2.

3.1.4.7 Means to Identify Target

Targets shall be based on sound science, ecological considerations, harvest planning, wildlife zones, and social values.

3.1.4.8 Legal/Policy Requirements

Planning Standard, ALSA, SSRP, Public Lands Act.

3.1.4.9 Means of Achieving Objective and Target

Develop a strategy that coordinates access with other resource users, spatial/temporal sequencing of harvest, road construction and reclamation (SHS and long-term corridor access plan). See Section 5 of the CFP Timber Harvest Planning and Operating Ground Rules for further details.

3.1.4.10 Target Monitoring and Measurement

Regular updates to forest inventory and Digital Integrated Dispositions (DIDs).

3.1.4.11 Reporting

FMP: Table of road density outside LPH-LFMP area at 0 and 10 years. Map of existing and proposed open and closed forestry roads. Report forestry roads and total (all users) roads.

Performance:

- Stewardship Reports: Table and map of permanent open forestry road densities (km/km^2) outside LPH-LFMP area.

3.1.4.12 Acceptable Variance

A variance not exceeding +/-20% must be achieved.

3.1.4.13 Response

Adjust strategies in subsequent FMP.

3.1.4.14 History

VOIT 4-1 is similar to *Objective 3, 1.1.3 – To minimize the impacts of motorized access* in the C5 Forest Management Plan (2006-2026). The indicator, target, and acceptable variance for "open road" density are detailed in this previous objective. Monitoring procedures are summarized in *Objective 32, 5.1.7 – To provide reasonable access for recreational and industrial purposes while maintaining the ecological integrity of the forest.*

3.1.5 VOIT 4-2 – Seasonal / Temporary Forestry Roads

3.1.5.1	***CCFM Criterion***	1 Biological Diversity
3.1.5.2	***CSA SFM Element***	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.5.3	***Value***	1.1.1 Landscape scale biodiversity
3.1.5.4	***Objective***	1.1.1.3a Maintain biodiversity by minimizing access

3.1.5.5 Indicator

Open seasonal/temporary forestry road length outside the LPH-LFMP area.

3.1.5.6 Target

Less than 18 km for the FMA area outside the LPH -LFMP area

3.1.5.7 Means to Identify Target

Targets shall be based on sound science, ecological considerations, harvest planning, wildlife zones, and social values.

3.1.5.8 Legal/Policy Requirements

Planning Standard, ALSA, SSRP, Forests Act, Alberta Timber Harvest Planning and Operating Ground Rules (OGRs), Spatial Data Directive (SDD).

3.1.5.9 Means of Achieving Objective and Target

Road construction, maintenance, and reclamation activities.

3.1.5.10 Target Monitoring and Measurement

Road planning OGR.

3.1.5.11 Reporting

FMP: Table and map of existing open seasonal/temporary forestry roads at time 0.

Performance:

- Stewardship Reports: Table of open seasonal/temporary forestry roads for each timber year for outside LFH-LFMP.

3.1.5.12 Acceptable Variance

A variance not exceeding +/-20% must be achieved.

3.1.5.13 Response

Adjust strategies in subsequent AOPs.

3.1.5.14 History

VOIT 4-2 is similar to *Objective 3, 1.1.3 – To minimize the impacts of motorized access* in the C5 Forest Management Plan (2006-2026). The indicator, target, and acceptable variance for "open road" density are detailed in this previous objective. Monitoring procedures are summarized in *Objective 32, 5.1.7 – To provide reasonable access for recreational and industrial purposes while maintaining the ecological integrity of the forest.*

3.1.6 VOIT 5-1 – Open Motorized Access by Footprint Planning Zone

3.1.6.1	***CCFM Criterion***	1 Biological Diversity
3.1.6.2	***CSA SFM Element***	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.6.3	***Value***	1.1.1 Landscape scale biodiversity
3.1.6.4	***Objective***	1.1.1.3a Maintain biodiversity by minimizing access per direction from LPH-LFMP

3.1.6.5 Indicator

Open motorized access by Footprint Planning Zone.

3.1.6.6 Target

Less than 0.04 km/km^2 in Zone 2 and less than 0.14 km/km^2 in Zone 3.

3.1.6.7 Means to Identify Target

Historical road construction and reclamation data, targets shall be forest sector specific based on guidance from LPH-LFMP.

3.1.6.8 Legal/Policy Requirements

Planning Standard, ALSA, ALSA, SSRP, LPH-LFMP, Public Lands Act, OGRs, SDD.

3.1.6.9 Means of Achieving Objective and Target

Road construction, maintenance and reclamation activities. Develop a strategy to coordinate access with other resource users, spatial/temporal sequencing of harvest, road construction and reclamation (SHS and long-term corridor access plan).

3.1.6.10 Target Monitoring and Measurement

Road plan (Operating Ground Rule; OGR), Government of Alberta Decision Support Tool.

3.1.6.11 Reporting

FMP: Current open motorized access density by zone (Open Forestry Department License of Occupation; DLOs).

Performance:

- Stewardship Reports: Road density and km by zone per year for open motorized access (open forestry DLOs).

3.1.6.12 Acceptable Variance

None.

3.1.6.13 Response

Removal of open motorized access when appropriate. Adjust strategies in subsequent FMPs.

3.1.6.14 History

VOIT 5-1 is similar to *Objective 3, 1.1.3 – To minimize the impacts of motorized access* in the C5 Forest Management Plan (2006-2026). The indicator, target, and acceptable variance for "open road" density are detailed in this previous objective. Monitoring procedures are summarized in *Objective 32, 5.1.7 – To provide reasonable access for recreational and industrial purposes while maintaining the ecological integrity of the forest.* Targets were not previously given for specific planning zones.

3.1.7 VOIT 5-2 – Restricted Motorized Access by Footprint Planning Zone

3.1.7.1	*CCFM Criterion*	1 Biological Diversity
3.1.7.2	*CSA SFM Element*	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.7.3	*Value*	1.1.1 Landscape scale biodiversity
3.1.7.4	*Objective*	1.1.1.3a Maintain biodiversity by minimizing access per direction from LPH-LFMP

3.1.7.5 Indicator

Restricted motorized access by Footprint Planning Zone.

3.1.7.6 Target

Less 0.09 km/km^2 in Zone 2 & 3.

3.1.7.7 Means to Identify Target

Historical road construction and reclamation data, targets shall be forest sector specific based on guidance from LPH-LFMP.

3.1.7.8 Legal/Policy Requirements

Planning Standard, ALSA, ALSA, SSRP, LPH-LFMP, Public Lands Act, OGRs, SDD.

3.1.7.9 Means of Achieving Objective and Target

Road construction, maintenance and reclamation activities. Government of Alberta Decision Support Tool. Develop a strategy to coordinate access with other resource users, spatial/temporal sequencing of harvest, road construction and reclamation (SHS and long-term corridor access plan). All temporary forestry roads will be managed as restricted motorized access per the LFH-LFMP.

3.1.7.10 Target Monitoring and Measurement

Road plan (Operating Ground Rule; OGR), Government of Alberta Decision Support Tool.

3.1.7.11 Reporting

FMP: Current restricted motorized access density by zone (forestry access roads and DLOs).

Performance:

- Stewardship Reports: Restricted motorized access density by zone per year.

3.1.7.12 Acceptable Variance

A variance not exceeding +/- 20% must be achieved.

3.1.7.13 Response

Adjust timing of road reclamation program. Adjust strategies in subsequent FMPs.

3.1.7.14 History

VOIT 5-2 is similar to *Objective 3, 1.1.3 – To minimize the impacts of motorized access* in the C5 Forest Management Plan (2006-2026). The indicator, target, and acceptable variance for "open road" density are detailed in this previous objective. Monitoring procedures are summarized in *Objective 32, 5.1.7 – To provide reasonable access for recreational and industrial purposes while maintaining the ecological integrity of the forest.* Targets were not previously given for specific planning zones.

3.1.8 VOIT 5-3 – Near Stream Motorized Access

3.1.8.1	***CCFM Criterion***	1 Biological Diversity
3.1.8.2	***CSA SFM Element***	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.8.3	***Value***	1.1.1 Landscape scale biodiversity
3.1.8.4	***Objective***	1.1.1.3a Maintain biodiversity by minimizing access per direction from LPH-LFMP

3.1.8.5 Indicator

Near stream motorized access disturbance limit (within 100 m of a stream on erodible soils).

3.1.8.6 Target

<0.01 km/km^2 in each analysis unit.

3.1.8.7 Means to Identify Target

Historical road construction and reclamation data, targets shall be forest sector specific based on guidance from LPH-LFMP.

3.1.8.8 Legal/Policy Requirements

Planning Standard, ALSA, ALSA, SSRP, LPH-LFMP, Public Lands Act, OGRs, SDD.

3.1.8.9 Means of Achieving Objective and Target

Develop a strategy that coordinates access with other resource users, spatial/temporal sequencing of harvest, road construction and reclamation (SHS and long-term corridor access plan).

3.1.8.10 Target Monitoring and Measurement

Regular updates to forest inventory, Government of Alberta Decision Support Tool.

3.1.8.11 Reporting

FMP: Current near stream motorized access density by analysis unit (forestry access roads and DLOs).

Performance:

- Stewardship Reports: Near stream motorized density by analysis unit per year.

3.1.8.12 Acceptable Variance

None.

3.1.8.13 Response

Adjust timing of road reclamation program. Adjust strategies in subsequent FMPs.

3.1.8.14 History

VOIT 5-3 is similar to *Objective 3, 1.1.3 – To minimize the impacts of motorized access* in the C5 Forest Management Plan (2006-2026). The indicator, target, and acceptable variance for “open road” density are detailed in this previous objective. Monitoring procedures are summarized in *Objective 32, 5.1.7 – To provide reasonable access for recreational and industrial purposes while maintaining the ecological integrity of the forest.* Targets were not previously given for specific analysis units.

3.1.9 VOIT 6 – Uncommon Plant Communities

3.1.9.1	*CCFM Criterion*	1 Biological Diversity
3.1.9.2	*CSA SFM Element*	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.9.3	*Value*	1.1.1 Landscape scale biodiversity
3.1.9.4	*Objective*	1.1.1.4 Maintain plant communities uncommon in FMA or province.

3.1.9.5 Indicator

Area or occurrence of each uncommon plant community within FMA.

3.1.9.6 Target

Conserve uncommon plant communities for 100% of known and encountered occurrences.

3.1.9.7 Means to Identify Target

Geographic Information System (GIS) analysis, Alberta Vegetation Inventory (AVI), ecosite phases, Alberta Conservation Information Management System (ACIMS), plant community classification and tracking list. Predict and identify occurrence of uncommon plant community.

3.1.9.8 Legal/Policy Requirements

Planning Standard.

3.1.9.9 Means of Achieving Objective and Target

Coordinating with other resource users, spatial planning of harvest and road construction, OGRs. Apply operational procedures.

3.1.9.10 Target Monitoring and Measurement

Annual ACIMS database updates, regular updates to inventory.

3.1.9.11 Reporting

FMP: Table with descriptive list and targets. Map(s) displaying known locations of uncommon plant communities.

Performance:

* Stewardship Reports: Summary of action taken, based on direction received from ACIMS, in the areas where uncommon plant communities have been identified.

3.1.9.12 Acceptable Variance

At the end of the 10- year FMP term the target is achieved.

3.1.9.13 Response

Adjust strategies in subsequent AOPs.

3.1.9.14 History

VOIT 6 is similar to *Objective 13, 1.4.3 – To maintain rare plant communities* in the C5 Forest Management Plan (2006-2026).

3.1.10 VOIT 7 – Unsalvaged Burnt Forest

3.1.10.1 CCFM Criterion	1 Biological Diversity
3.1.10.2 CSA SFM Element	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.10.3 Value	1.1.1 Landscape scale biodiversity
3.1.10.4 Objective	1.1.1.5a Maintain unique habitats provided by wildfire and blowdown events

3.1.10.5 Indicator

Area of unsalvaged burned forest.

3.1.10.6 Target

Live trees: Retain unburned trees in green islands and retain patches recognizing timber condition, access, non-timber needs according to the directive "Fire Salvage Planning and Operations - Directive No. 2007-01".

3.1.10.7 Means to Identify Target

Targets based on "Fire Salvage Planning and Operations - Directive No. 2007-01" Ensure consistency with FireSmart objectives.

3.1.10.8 Legal/Policy Requirements

Fire Salvage Planning and Operations - Directive No. 2007-01.

3.1.10.9 Means of Achieving Objective and Target

Salvage planning.

3.1.10.10 Target Monitoring and Measurement

Organization reports, air photo interpretation, ground surveys, post-harvest assessments, General Development Plan (GDP).

3.1.10.11 Reporting

FMP: Table and map of wildfire events fire within the last 10 years showing area (ha) and proportion (%) of salvaged and unsalvaged, report on area in hectares (ha).

Performance:

- Stewardship Reports: Table and map of fire disturbance with percent salvaged. Table and map shows total burn area, portions salvaged by burn severity class, and the unburned green islands kept as retention.

3.1.10.12 Acceptable Variance

At the end of the 10-year FMP term the target is achieved or exceeded.

3.1.10.13 Response

Adjust strategies in subsequent AOPs.

3.1.10.14 History

VOIT 7 is similar to *Objective 5, 1.1.5 – To retain forest structure associated with wildfire and blowdown events* in the C5 Forest Management Plan (2006-2026). The indicator, target, and acceptable variance for the area of naturally disturbed forest to be left unsalvaged are detailed in this previous objective.

3.1.11 VOIT 8 – Unsalvaged Blowdown

3.1.11.1 CCFM Criterion	1 Biological Diversity
3.1.11.2 CSA SFM Element	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.11.3 Value	1.1.1 Landscape scale biodiversity
3.1.11.4 Objective	1.1.1.5b Maintain unique habitats provided by wildfire and blowdown events

3.1.11.5 Indicator

Area of unsalvaged blowdown.

3.1.11.6 Target

In areas of significant salvageable blowdown (>= 100 ha) a minimum of 10% will be left unsalvaged.

3.1.11.7 Means to Identify Target

Targets are to be based on sound science, ecological considerations and disturbance regimes.

3.1.11.8 Legal/Policy Requirements

Planning Standard.

3.1.11.9 Means of Achieving Objective and Target

Salvage planning.

3.1.11.10 Target Monitoring and Measurement

Inventory updates, GDP.

3.1.11.11 Reporting

FMP: Table and map of blowdown event within the last 10 years showing area (ha) and proportion (%) of salvaged and unsalvaged.

Performance:

- Stewardship Reports: Table and map of blowdown disturbance and percent unsalvaged and salvaged for events >= 100 ha in the FMA.

3.1.11.12 Acceptable Variance

At the end of the 10-year FMP term the target is achieved or exceeded.

3.1.11.13 Response

Adjust strategies in subsequent AOPs.

3.1.11.14 History

VOIT 8 is similar to *Objective 5, 1.1.5 – To retain forest structure associated with wildfire and blowdown events* in the C5 Forest Management Plan (2006-2026). The indicator, target, and acceptable variance for the volume or area of blowdown to be left unsalvaged are detailed in this previous objective.

3.1.12 VOIT 9 – Protection of Aquatic and Riparian Areas

3.1.12.1 CCFM Criterion	1 Biological Diversity
3.1.12.2 CSA SFM Element	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.12.3 Value	1.1.1 Landscape scale biodiversity
3.1.12.4 Objective	1.1.1.6 Retain ecological values and functions associated with riparian zones

3.1.12.5 Indicator

Protection of aquatic and riparian areas.

3.1.12.6 Target

Consistent with OGRs.

3.1.12.7 Means to Identify Target

OGRs.

3.1.12.8 Legal/Policy Requirements

Federal Fisheries Act, Timber Management Regulation (TMR), Forests Act, Grazing and Timber Integration Manual, ALSA, SSRP .

3.1.12.9 Means of Achieving Objective and Target

Planning and operations, Timber Supply Analysis (TSA), OGRs.

3.1.12.10 Target Monitoring and Measurement

FOMP reports, company monitoring/audits, tracking of OGR deviation requests, and non-standard submissions.

3.1.12.11 Reporting

Performance:

- Stewardship Reports: Number of FOMP variances related to specific OGRs, number of company self-reports, number of OGR deviations requested under applicable OGRs.

3.1.12.12 Acceptable Variance

No variance.

3.1.12.13 Response

Demonstrate that aquatic and riparian ecosystem objectives are being met through an effective monitoring program based on aquatic and riparian function in areas of concern.

3.1.12.14 History

VOIT 9 is similar to *Objective 23, 3.2.1 – To ensure that all forest industry practices are conducted in a manner that places a priority on the protection of water resources* and *Objective 24, 3.2.2 - To manage forest cover in a manner that places a priority on the conservation and protection of watersheds* in the C5 Forest Management Plan (2006-2026).

3.1.13 VOIT 10 – Structure Retention

3.1.13.1 CCFM Criterion	1 Biological Diversity
3.1.13.2 CSA SFM Element	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.13.3 Value	1.1.2 Local/stand scale biodiversity
3.1.13.4 Objective	1.1.2.1a Retain stand level structure

3.1.13.5 Indicator

% area of residual structure (both living and dead) within a harvest area, as outlined in CFP's structure retention strategy by FMA.

3.1.13.6 Target

3% of the Lodgepole pine/other non-Douglas fir Forest and;

15-20% of the Douglas fir forest.

Structure retention is by area, to be within the contributing landbase, internal to each harvest area (individual openings), and representative of the pre-harvest stand composition.

Note: A wide range in variability in harvest area level retention within the FMA is desired as long as the target level is achieved.

3.1.13.7 Means to Identify Target

Wildlife zones, roadside vegetation screens, recreational values, aesthetics, local knowledge. ACIMS, Alberta Biodiversity Monitoring Institute (ABMI) and Fisheries and Wildlife Management Information System (FWMIS), previous FMP structure retention results.

3.1.13.8 Legal/Policy Requirements

Occupational Health and Safety Act, Forest and Prairie Protection Act, Planning Standard, ALSA, SSRP, LPH-LFMP, OGRs.

3.1.13.9 Means of Achieving Objective and Target

Implement CFP structure retention strategy and OGRs.

3.1.13.10 Target Monitoring and Measurement

Organization reports, cut-over photography, air photo interpretation, ground surveys, post-harvest assessments.

3.1.13.11 Reporting

Performance:

- Stewardship Reports: Table of the percent of structure retention by year for the FMA.

3.1.13.12 Acceptable Variance

At the end of the 10-year FMP term the target is achieved or exceeded.

3.1.13.13 Response

Adjust strategies in subsequent FMPs.

3.1.13.14 History

VOIT 10 is similar to *Objective 4, 1.1.4 – To retain stand level structural attributes* in the C5 Forest Management Plan (2006-2026). The indicator, target, and acceptable variance for the merchantable volume of standing trees are detailed in this previous objective.

3.1.14 VOIT 11 – Downed Woody Debris

3.1.14.1 CCFM Criterion	1 Biological Diversity
3.1.14.2 CSA SFM Element	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.14.3 Value	1.1.2 Local/stand scale biodiversity
3.1.14.4 Objective	1.1.2.1b Retain stand level structure

3.1.14.5 Indicator

Percentage of harvested area within the FMA with downed woody debris[5] equivalent to preharvest conditions.

3.1.14.6 Target

75% of harvest areas having downed woody debris retained on site.

3.1.14.7 Means to Identify Target

Recording utilization of downed woody debris post-harvest.

3.1.14.8 Legal/Policy Requirements

Planning Standard, ALSA and SSRP.

3.1.14.9 Means of Achieving Objective and Target

Organization developed standards.

3.1.14.10 Target Monitoring and Measurement

Organization developed during FMP planning.

3.1.14.11 Reporting

Performance:

- Stewardship Reports: Table showing % of harvest areas by year that received treatments that reduces downed woody debris (e.g. brush raking and prescribed burns).

3.1.14.12 Acceptable Variance

None.

3.1.14.13 Response

Adjust strategies in subsequent FMPs.

3.1.14.14 Definitions

Downed Woody Debris: Wood lying at an angle of less than 45 degrees from the ground and having a diameter greater than 7.5cm.

3.1.14.15 History

VOIT 11 is similar to *Objective 4, 1.1.4 – To retain stand level structural attribute*s in the C5 Forest Management Plan (2006-2026). The indicator, target, and acceptable variance for the level of downed woody debris, standing topped trees, and snags to be maintained are detailed in this previous objective.

3.1.15 VOIT 12 – Sensitive Sites

3.1.15.1 CCFM Criterion	1 Biological Diversity
3.1.15.2 CSA SFM Element	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.15.3 Value	1.1.2 Local/stand scale biodiversity
3.1.15.4 Objective	1.1.2.2 Maintain integrity of sensitive sites

3.1.15.5 Indicator

Sensitive sites (e.g., mineral licks, major game trails) by FMA.

3.1.15.6 Target

Strategies to maintain consistency with provincial guidelines / OGRs.

3.1.15.7 Means to Identify Target

Sensitive sites identified through local knowledge, public consultation, Indigenous consultation, ACIMS, ABMI, GDPs, FWMIS, and OGRs.

3.1.15.8 Legal/Policy Requirements

Planning Standard.

3.1.15.9 Means of Achieving Objective and Target

Organization developed standards for sensitive site protection.

3.1.15.10 Target Monitoring and Measurement

Organization reports, air photo interpretation, ground surveys.

3.1.15.11 Reporting

Performance:

- Stewardship Reports: Summary of identified sites and actions taken.

3.1.15.12 Acceptable Variance

None.

3.1.15.13 Response

Adjust strategies in subsequent FMPs.

3.1.15.14 History

VOIT 12 is similar to *Objective 12, 1.4.2 – To retain specific wildlife features* in the C5 Forest Management Plan (2006-2026).

3.1.16 VOIT 13 – Water Crossings

3.1.16.1 CCFM Criterion	1 Biological Diversity
3.1.16.2 CSA SFM Element	1.1 Ecosystem Diversity: Conserve ecosystem diversity at the landscape level by maintaining the variety of communities and ecosystems that occur naturally in the Defined Forest Area (DFA)
3.1.16.3 Value	1.1.2 Local/stand scale biodiversity
3.1.16.4 Objective	1.1.2.3 Maintain aquatic biodiversity by minimizing impacts of watercourse crossings

3.1.16.5 Indicator

a) Permanent forestry watercourse crossings in compliance with the Code of Practice for Watercourse Crossings.

b) Temporary forestry watercourse crossings in compliance with the OGRs.

3.1.16.6 Target

a) Permanent forestry watercourse crossing designs meet standards of the Code of Practice for Watercourse Crossings.

b) Temporary forestry watercourse crossings meet standards in the OGRs .

3.1.16.7 Means to Identify Target

a) Code of Practice for Watercourse Crossings.

b) OGRs.

3.1.16.8 Legal/Policy Requirements

a) Water Act, Water (Ministerial Regulation) and Code of Practice for Watercourse Crossings.

b) Forests Act, TMR, and OGRs.

3.1.16.9 Means of Achieving Objective and Target

Road and watercourse planning, construction, monitoring, maintenance and reclamation activities.

3.1.16.10 Target Monitoring and Measurement

Watercourse Crossing Management Directive, OGRs, company watercourse crossing monitoring program.

3.1.16.11 Reporting

Performance:

- Stewardship Reports: Report on all company watercourse crossing monitoring results, number of FOMP variances related to relevant OGRs, number of Company self-reports related to relevant OGRs.

3.1.16.12 Acceptable Variance

None.

3.1.16.13 Response

Based on stewardship reporting results, a causal factor review and the frequency and severity of reported incidences a third-party review of watercourse crossing monitoring programs and operations standards may be required.

3.1.16.14 History

VOIT 13 is similar to *Objective 23, 3.2.1 – To ensure that all forest industry practices are conducted in a manner that places a priority on the protection of water resources* in the C5 Forest Management Plan (2006-2026).

3.1.17 VOIT 14 – Species at Risk

3.1.17.1 CCFM Criterion	1 Biological Diversity
3.1.17.2 CSA SFM Element	1.2 Species Diversity: Conserve species diversity by ensuring that habitats for the native species found in the DFA are maintained throughout time
3.1.17.3 Value	1.2.1 Viable populations of identified plant and animal species
3.1.17.4 Objective	1.2.1.1 Maintain habitat for identified high value species (i.e., economically valuable, socially valuable, species at risk, species of management concern)

3.1.17.5 Indicator

a) Number of hectares of primary and secondary habitat from the fRI grizzly bear model, as measured at time 0 (May 1, 2023) by FMA;
b) Percent change in the barred owl potential breeding pairs and Resource Selection Function (RSF) value from (May 1, 2023) by FMA;
c) Percent change in American marten habitat suitability index from (May 1, 2023) by FMA;
d) Percent change in relative abundance value of three songbird species (brown creeper, ovenbird and varied thrush) from May 1, 2023 by FMA; and
e) Maintain identified whitebark and limber pine trees, saplings, and seedlings.

3.1.17.6 Target

a) Maintain or increase the number of hectares of primary and secondary habitat from the fRI grizzly bear model, as measured at time 0;
b) Maximum 15% reduction in the breeding pairs indicator over the 200-year planning horizon and 15% reduction in the RSF indicators over the 200-year planning horizon;
c) Maximum 15% reduction in the indicator over the 200-year planning horizon;
d) Maximum 15% reduction in the indicator over the 200-year planning horizon; and
e) A minimum of 95% protection of all known whitebark and limber pine trees, saplings, and seedlings.

100% protection of GoA long term monitoring installations, research/restoration, and plus tree sites.

3.1.17.7 Means to Identify Target

Habitat models (provided by the GoA). Based on sound science, ecological considerations, wildlife zones, Committee on the Status of Endangered Wildlife in Canada (COSEWIC) list, provincially listed species, ABMI, ACIMS, recovery plans, government priorities, public consultation, habitat suitability analysis, literature review, observation data, local and traditional knowledge.

For whitebark and limber pine, use AVI in combination with company and GoA long term monitoring installations, research/restoration and plus trees sites data. Consult with Whitebark Pine Ecosystem Foundation of Canada (WPEFC) for most current spatial data identifying presence and absence of whitebark and limber pine trees, saplings, and seedlings.

3.1.17.8 Legal/Policy Requirements

Recovery plans for species at risk, federal Species at Risk Act.

3.1.17.9 Means of Achieving Objective and Target

Harvesting plans, road construction, OGR, planning and implementation, adherence to provincial wildlife guidelines.

Minimize variance by developing and implementing an operationalized SHS.

For whitebark and limber pine, ensure protection of trees, saplings, and seedlings through careful operational planning of roads and harvest areas.

Maintain consistency with the current approved Alberta Whitebark and Limber Pine Recovery Plan and best management practices.

Operational guidance on Pa/Pf content from subjective deletions process in classified landbase.

Collaboration with WPEFC for support, mitigation and expertise as needed.

Clark’s nutcracker modelling.

3.1.17.10 Target Monitoring and Measurement

Updates to vegetation inventory and habitat modelling. Planning and submission of a GDP, adherence to SHS, tracking and reporting variance.

3.1.17.11 Reporting

FMP:

a) Table and maps of current (time zero) and future (10 and 20 years) landscape condition for Core and Secondary habitat zones, core and secondary sink zones, non-critical habitat and road density;

b) Tables of breeding pairs (habitat) and RSF at 0, 10, 20, 50, 100 and 200 years and maps of RSF value and breeding pairs at 0, 10, 20 and 50 years;

c) Tables of habitat suitability at 0, 10, 20, 50, 100 and 200 years and maps of habitat suitability at 0, 10, 20 and 50 years;

d) Tables of relative abundance at 0, 10, 20, 50, 100 and 200 years and maps of relative abundance at 0, 10, 20 and 50 years;

e) Map of whitebark and limber pine distribution (contributing/non-contributing), long-term monitoring installations, research/restoration and plus tree sites.

Performance:

Items a-d

10-year Stewardship Report: Compare time 0 of previous FMP to CLB of new FMP.

Item e

5 and 10-year Stewardship Reports: Number of whitebark and limber pine trees, saplings and seedlings that have been damaged and/or destroyed.

3.1.17.12 Acceptable Variance

At the end of the 10-year FMP term the target is achieved or exceeded.

3.1.17.13 Response

Adjust strategies in subsequent FMP.

3.1.17.14 History

VOIT 14 is similar to *Objective 7, 1.2.2 – To retain, create and enhance habitats capable of supporting selected species* in the C5 Forest Management Plan (2006-2026).

3.1.18 VOIT 15 – In-Situ Wild Forest Populations

3.1.18.1 CCFM Criterion	1 Biological Diversity
3.1.18.2 CSA SFM Element	1.3 Genetic Diversity: Conserve genetic diversity by maintaining the variation of genes within species
3.1.18.3 Value	1.3.1 Genetic integrity of natural tree populations
3.1.18.4 Objective	1.3.1.1 Retain "wild forest populations" for each native tree species in each seed zone through establishment of in-situ reserves by Alberta and tenure holders

3.1.18.5 Indicator

Where applicable, number and area (ha) of in situ gene conservation areas.

3.1.18.6 Target

Wild forest populations are retained as per requirements set forth in the Alberta Forest Genetic Resource Management and Conservation Standards (FGRMS) and as guided in the Gene Conservation Plan for Native Species of Alberta Second Edition (GCP).

Targets to be determined in accordance with FGRMS.

3.1.18.7 Means to Identify Target

Gaps and needs as identified in GCP and requirements set for forth in FGRMS.

3.1.18.8 Legal/Policy Requirements

Timber Management Regulation (TMR) 144.2(1). Requirements to meet this TMR are provided by the Alberta Forest Genetic Resource Management and Conservation Standards (FGRMS).

3.1.18.9 Means of Achieving Objective and Target

GCP, FGRMS, and GoA/Industry Tree Improvement Cooperatives.

Identified conservation areas are designated by a protective disposition in coordination between GoA and the company.

3.1.18.10 Target Monitoring and Measurement

Stewardship reporting and FGRMS mandatory reports.

3.1.18.11 Reporting

FMP: If applicable, table showing number of genetic conservation areas required in each seed zone and number provided in DFA. If applicable, map showing locations of genetic conservation areas.

Performance:

- Stewardship Reports: Report progress towards target.

3.1.18.12 Acceptable Variance

At the end of the 10-year FMP term the target is achieved or exceeded. No variance.

3.1.18.13 Response

Where needed, adjust strategies as per Forest Health and Adaptation Section requirement and in subsequent FMPs.

3.1.18.14 History

VOIT 15 is similar to *Objective 8, 1.3.1 – Retain wild forest genetic resources for each species through in situ conservation* in the C5 Forest Management Plan (2006-2026).

3.1.19 VOIT 16 – Ex-Situ Wild Forest Populations

3.1.19.1	***CCFM Criterion***	1 Biological Diversity
3.1.19.2	***CSA SFM Element***	1.3 Genetic Diversity: Conserve genetic diversity by maintaining the variation of genes within species
3.1.19.3	***Value***	1.3.1 Genetic integrity of natural tree populations
3.1.19.4	***Objective***	1.3.1.2 Retain wild forest genetic resources through ex-situ conservation

3.1.19.5 Indicator

Where applicable, number or amount of genetic materials conserved ex-situ as field trials, experiments, clonal banks, arboretum, and long-term seed storage.

3.1.19.6 Target

Wild forest genetic resources through ex situ conservation are retained as per requirements set forth in FGRMS and as guided by the ex-situ Conservation Plan for Forest Genetic Resources in Alberta (ex-situ CP). Targets to be determined in accordance with FGRMS.

3.1.19.7 Means to Identify Target

Gaps and needs as identified in ex-situ CP and requirements set forth in FGRMS.

3.1.19.8 Legal/Policy Requirements

TMR 144.2(1), as directed by FGRMS.

3.1.19.9 Means of Achieving Objective and Target

FGRMS and GoA/Industry Genetics Cooperatives.

3.1.19.10 Target Monitoring and Measurement

Needs for ex-situ gene conservation will be continuously identified as provincial forest management priorities and environmental challenges arise.

3.1.19.11 Reporting

FMP: If applicable, table and map showing number of provenances, genotypes and seedlots and their origin within the DFA.

Performance:

- Stewardship Reports: Not applicable until a controlled parentage program becomes active.

3.1.19.12 Acceptable Variance

Where ex-situ gene conservation is set up, no variance from targets as set by FGRMS is acceptable unless identified and approved in the FMP approval process. Adjustment to targets and objectives are allowable as more research and development bring new data and parameters forward.

3.1.19.13 Response

GoA will direct any required amendments or adjustments to target.

3.1.19.14 History

VOIT 16 is similar to *Objective 9, 1.3.2 – Retain wild forest genetic resources through ex situ conservation* and *Objective 10, 1.3.3 – To maintain adequate genetic diversity in seedlots used for reforestation plantings* in the C5 Forest Management Plan (2006-2026).

3.1.20 VOIT 17 – Trans-Boundary Values (Stakeholder Consultations)

3.1.20.1 CCFM Criterion	1 Biological Diversity
3.1.20.2 CSA SFM Element	1.4 Protected Areas: Respect protected areas identified through government processes
3.1.20.3 Value	1.4.1 Areas with minimal human disturbances within managed landscapes
3.1.20.4 Objective	1.4.1.1 Integrate trans-boundary values and objectives into forest management

3.1.20.5 Indicator

Consultation with relevant stakeholders.

3.1.20.6 Target

Ongoing consultation with relevant protected area agencies.

3.1.20.7 Means to Identify Target

Link to consultation objective in Planning Standard or other existing consultation processes.

3.1.20.8 Legal/Policy Requirements

Planning Standard.

3.1.20.9 Means of Achieving Objective and Target

Management and operational planning.

3.1.20.10 Target Monitoring and Measurement

Documentation of consultation processes.

3.1.20.11 Reporting

Performance:

- Stewardship Reports: Summary of consultation with relevant protected area agencies.

3.1.20.12 Acceptable Variance

None.

3.1.20.13 Response

Adjust strategies in subsequent FMP.

3.1.20.14 History

VOIT 17 is similar to *Objective 11, 1.4.1 – To adopt forest management practices that maintain the ecological integrity of established protected areas and the passive landbase in C5* in the C5 Forest Management Plan (2006-2026).

3.2 Ecosystem Productivity

3.2.1 VOIT 18 – Reforestation

3.2.1.1	*CCFM Criterion*	2 Ecosystem Productivity
3.2.1.2	*CSA SFM Element*	2.1 Ecosystem resilience
3.2.1.3	*Value*	2.1.1 Reforested harvest areas
3.2.1.4	*Objective*	2.1.1.1 Reforest all harvested areas

3.2.1.5 Indicator

Annual % of openings that:

a) Meet or exceed the Reforestation Standard of Alberta (RSA) establishment survey minimum stocking and species composition standards for the declared regenerated yield stratum;
b) Meet or exceed the RSA establishment survey minimum stocking and species composition standards for an alternate regenerated yield stratum; and
c) Do not achieve the RSA establishment survey minimum stocking and/or species composition standards for any regenerated yield strata and are re-treated within one year.

Indicators a, b, and c are to be reported separately.

3.2.1.6 Target

The sum of indicators a, b, and c = 100% of openings.

3.2.1.7 Means to Identify Target

Direction from GoA.

3.2.1.8 Legal/Policy Requirements

TMR 141.6(1) and 141.6(2); RSA.

3.2.1.9 Means of Achieving Objective and Target

Implementation of silviculture strategies that ensure the target stocking and species composition is achieved for the opening.

3.2.1.10 Target Monitoring and Measurement

RSA establishment survey protocols.

3.2.1.11 Reporting

Performance:

- ARIS: Updates to Alberta Regeneration Information System (ARIS) tables.
- Stewardship Reports: Tables summarizing indicators a, b, and c.

3.2.1.12 Acceptable Variance

None.

3.2.1.13 Response

Adjust silviculture strategies.

3.2.1.14 History

VOIT 18 is similar to *Objective 14, 2.1.1 – Sustain the capacity of the ecosystem to recover from both natural and human-caused disturbances* and *Objective 28, 5.1.3 – To ensure all harvested areas are re-forested* in the C5 Forest Management Plan (2006-2026).

3.2.2 VOIT 19 – Mean Annual Increment

3.2.2.1	***CCFM Criterion***	2 Ecosystem Productivity
3.2.2.2	***CSA SFM Element***	2.1 Ecosystem resilience
3.2.2.3	***Value***	2.1.1 Reforested harvest areas
3.2.2.4	***Objective***	2.1.1.2 Meet or exceed the C and D Mean Annual Increment (MAI) standard for the population of openings surveyed in a given quadrant

3.2.2.5 Indicator

Summed difference between target and actual C MAIs and D MAIs for openings surveyed in a five-year quadrant, as reported to ARIS.

3.2.2.6 Target

100% of target.

3.2.2.7 Means to Identify Target

Direction from GoA.

3.2.2.8 Legal/Policy Requirements

TMR 141.7(1) and 141.7(2); RSA.

3.2.2.9 Means of Achieving Objective and Target

Implementation of silviculture strategies that ensure the target productivity is achieved for the population of openings.

3.2.2.10 Target Monitoring and Measurement

RSA performance survey protocols.

3.2.2.11 Reporting

Performance:

- ARIS: Updates to ARIS tables.
- Stewardship Reports: Summarize the difference between target and actual C and D MAIs for each openings then sum the differences across all openings in the five year quadrant .

3.2.2.12 Acceptable Variance

Meet or exceed the target C and D MAI for the DFA.

3.2.2.13 Response

Adjust silviculture strategies.

3.2.2.14 History

VOIT 19 is not directly comparable to any of the objectives in the C5 Forest Management Plan (2006-2026).

3.2.3 VOIT 20 – Limit Forest Landbase Conversion

3.2.3.1	***CCFM Criterion***	2 Ecosystem Productivity
3.2.3.2	***CSA SFM Element***	2.1 Ecosystem resilience
3.2.3.3	***Value***	2.1.2 Maintenance of forest landbase
3.2.3.4	***Objective***	2.1.2.1 Limit conversion of productive forest landbase to other uses

3.2.3.5 Indicator

Amount of change in forest landbase.

3.2.3.6 Target

Net change of the gross forested landbase area within the FMA.

3.2.3.7 Means to Identify Target

Forest inventory and land use data.

3.2.3.8 Legal/Policy Requirements

Planning Standard.

3.2.3.9 Means of Achieving Objective and Target

Maintain current forest cover inventory and land use updates. Promote the minimization of non-forested impacts to the landbase.

3.2.3.10 Target Monitoring and Measurement

Inventory and land use systems.

3.2.3.11 Reporting

Performance:

- Stewardship Reports: Number of dispositions and area of disposition withdrawn from the landbase, number of dispositions returned, and area of dispositions returned to the landbase, net change to landbase area.

3.2.3.12 Acceptable Variance

Report actuals.

3.2.3.13 Response

Adjust net landbase projections in next TSA.

3.2.3.14 History

VOIT 20 is similar to *Objective 27, 5.1.2 – To maintain or increase the net forest (commercial timber harvesting) landbase in the C5 FMU* in the C5 Forest Management Plan (2006-2026).

3.2.4 VOIT 21 – Forest Health Program

3.2.4.1	*CCFM Criterion*	2 Ecosystem Productivity
3.2.4.2	*CSA SFM Element*	2.1 Ecosystem resilience
3.2.4.3	*Value*	2.1.2 Maintenance of forest landbase
3.2.4.4	*Objective*	2.1.2.1 Limit conversion of productive forest landbase to other uses

3.2.4.5 Indicator

Amount of area affected.

3.2.4.6 Target

Area (ha) affected by significant forest disturbances such as insect infestations, fire, windthrow or other disturbance events.

3.2.4.7 Means to Identify Target

GoA and company forest health surveys, inventory updates, fire reporting.

3.2.4.8 Legal/Policy Requirements

Planning Standard, Alberta Forest Health Strategy and shared roles and responsibilities between the GoA and the forest industry.

3.2.4.9 Means of Achieving Objective and Target

Maintain up-to-date information.

3.2.4.10 Target Monitoring and Measurement

GOA annual forest health surveys and company detections.

3.2.4.11 Reporting

Performance:

- Stewardship Reports: Maps showing areas impacted by fire, insects, windthrow and other natural events and any subsequent treatment.

3.2.4.12 Acceptable Variance

Report actuals.

3.2.4.13 Response

Event specific.

3.2.4.14 History

VOIT 21 is similar to *Objective 16, 2.1.3 – To minimize the impacts of pests (i.e., insects and disease), which have the ability to kill healthy trees* in the C5 Forest Management Plan (2006-2026).

3.2.5 VOIT 22 – Invasive Plants Program

3.2.5.1	***CCFM Criterion***	2 Ecosystem Productivity
3.2.5.2	***CSA SFM Element***	2.1 Ecosystem resilience
3.2.5.3	***Value***	2.1.3 Control invasive species
3.2.5.4	***Objective***	2.1.3.1 Control invasive plants

3.2.5.5 Indicator

Invasive plant program.

3.2.5.6 Target

Implement the CFP invasive plant program.

3.2.5.7 Means to Identify Target

Monitoring, controlling, and reporting on infestations.

3.2.5.8 Legal/Policy Requirements

Weed Management in Forestry Operations Directive 2001-06.

3.2.5.9 Means of Achieving Objective and Target

Follow CFP Invasive Plant Program.

3.2.5.10 Target Monitoring and Measurement

Adherence to OGRs, field inventories.

3.2.5.11 Reporting

Performance:

- Stewardship Reports: Invasive plant inspections summarized in Stewardship Report.

3.2.5.12 Acceptable Variance

Report actuals.

3.2.5.13 Response

Continually improve invasive plant program.

3.2.5.14 History

VOIT 22 is similar to *Objective 18, 2.1.5 – To prevent the establishment of and control the spread of restricted and noxious weed species* in the C5 Forest Management Plan (2006-2026).

3.3 Soil and Water Resources

3.3.1 VOIT 23 – Roading and Bared Areas

3.3.1.1	*CCFM Criterion*	3 Soil and water
3.3.1.2	*CSA SFM Element*	3.1 Soil quantity and quality
3.3.1.3	*Value*	3.1.1 Soil productivity
3.3.1.4	*Objective*	3.1.1.1 Minimize impact of roading and bared areas in forest operations

3.3.1.5 Indicator

Compliance with OGRs directing both decompaction where necessary as well as compliance with the FMP Reforestation Strategy table.

3.3.1.6 Target

Complete compliance with OGRs.

3.3.1.7 Means to Identify Target

Direction from GoA.

3.3.1.8 Legal/Policy Requirements

OGRs and Soils Guidelines.

3.3.1.9 Means of Achieving Objective and Target

Effective planning and supervision of operations.

3.3.1.10 Target Monitoring and Measurement

Field inspection reports and audits.

3.3.1.11 Reporting

Performance:

- Stewardship Reports: Summary of total area of roads, landings, and bared areas that were not reforested with a rationale as to why.

3.3.1.12 Acceptable Variance

None.

3.3.1.13 Response

Immediate remedial action to correct.

3.3.1.14 History

VOIT 23 is not directly comparable to any of the objectives in the C5 Forest Management Plan (2006-2026).

3.3.2 VOIT 24 – Soil Erosion and Slumping

3.3.2.1	***CCFM Criterion***	3 Soil and water
3.3.2.2	***CSA SFM Element***	3.1 Soil quantity and quality
3.3.2.3	***Value***	3.1.1 Soil productivity
3.3.2.4	***Objective***	3.1.1.1 Minimize impact of roading and bared areas in forest operations

3.3.2.5 Indicator

Incidence of soil erosion and slumping.

3.3.2.6 Target

Complete compliance with OGRs.

3.3.2.7 Means to Identify Target

Direction from GoA, OGRs related to soils and erosion control.

3.3.2.8 Legal/Policy Requirements

OGRs and other guidelines for soil erosion and sediment control.

3.3.2.9 Means of Achieving Objective and Target

Effective planning and supervision of operations and adherence to relevant OGRs.

3.3.2.10 Target Monitoring and Measurement

Field inspection reports and audits.

3.3.2.11 Reporting

Performance:

Stewardship Reports: Report on all company monitoring results.

a) Number of FOMP variances related to relevant OGRs.
b) Number of company self-reports related to relevant OGRs.

3.3.2.12 Acceptable Variance

None.

3.3.2.13 Response

Immediate remedial action to correct and review of causal factors associated with erosion or slumping events.

3.3.2.14 History

VOIT 24 is similar to *Objective 22, 3.1.2 – To minimize soil erosion and slope failure* in the C5 Forest Management Plan (2006-2026).

3.3.3 VOIT 25 – Forecasted Water Yield Impacts

3.3.3.1	*CCFM Criterion*	3 Soil and water
3.3.3.2	*CSA SFM Element*	3.2 Water quantity and quality
3.3.3.3	*Value*	3.2.1 Water quantity
3.3.3.4	*Objective*	3.2.1.1 Limit impact of timber harvesting on water yield

3.3.3.5 Indicator

Forecast impact of timber harvesting (over 200 years) on water yield.

3.3.3.6 Target

a) Snow sensitive zones will have Equivalent Clearcut Areas (ECAs) multiplied by 1.5.
b) Mean annual water yield increase < = 15% or ECA < = 30% in approved watersheds.

3.3.3.7 Means to Identify Target

a) Identifying high runoff areas during peak streamflow on the Eastern Slopes of the southern Canadian Rocky Mountains.

b) ECA and hydrological modelling using approved watersheds, Watershed sensitive values assessment.

Watershed sensitive values assessment, direction from Alberta.

3.3.3.8 Legal/Policy Requirements

Planning Standard, ALSA, SSRP, and LPH-LFMP.

3.3.3.9 Means of Achieving Objective and Target

Minimize variance by developing and implementing an operationalized SHS.

Incorporate knowledge from hydrological modelling and watershed research.

Direction from Alberta.

3.3.3.10 Target Monitoring and Measurement

SHS area variance as per OGRs.

3.3.3.11 Reporting

FMP: Table showing ECA at 0, 10, 50, 100 and 200 years and maps showing ECA at year 0, 10, and 50 years.

Performance:

- 5-year Stewardship Report: If SHS variance exceeds 20% in compartments that fall within a watershed, ECA must be remodelled.
- 10-year Stewardship Report: Table comparing ECA values at year 0 from 2025 FMP to year 10 of new FMP by approved watershed.

3.3.3.12 Acceptable Variance

< 20% SHS variance.

3.3.3.13 Response

5-year: Adjust timing and harvest of remaining SHS to allow for hydrologic recovery of watersheds to meet targets (ECA <= 30%).

10-year: Adjust ECA targets to allow for hydrologic recovery of watersheds to meet targets (ECA <= 30%).

3.3.3.14 History

VOIT 25 is similar to *Objective 24, 3.2.2 – To manage forest cover in a manner that places a priority on the conservation and protection of watersheds* in the C5 Forest Management Plan (2006-2026).

3.3.4 VOIT 26 – Riparian Buffers

3.3.4.1	*CCFM Criterion*	3 Soil and water
3.3.4.2	*CSA SFM Element*	3.2 Water quantity and quality
3.3.4.3	*Value*	3.2.2 Effective riparian habitats
3.3.4.4	*Objective*	3.2.2.1 Minimize impact of operations in riparian areas

3.3.4.5 Indicator

Aquatic and riparian management areas as outlined in OGRs.

3.3.4.6 Target

Compliance with relevant OGR sections pertaining to aquatic and riparian protection.

3.3.4.7 Means to Identify Target

Direction from GoA, OGRs.

3.3.4.8 Legal/Policy Requirements

Federal Fisheries Act, TMR, Forests Act, ALSA, SSRP, LPH-LFMP, OGRs.

3.3.4.9 Means of Achieving Objective and Target

Effective planning and supervision of operations and adherence to relevant OGRs.

3.3.4.10 Target Monitoring and Measurement

Field inspection reports and GoA FOMP reporting. Company monitoring/audits, tracking of OGR deviation requests, and non-standard submissions.

3.3.4.11 Reporting

Performance:

- Stewardship Reports: Number of FOMP variances related to relevant OGRs, number of company self-reports for relevant OGR contraventions, number of relevant OGR deviation requests in operational plans.

3.3.4.12 Acceptable Variance

None.

3.3.4.13 Response

Response will be determined by the frequency and severity of reported incidence at the discretion of Alberta.

Demonstrate that aquatic and riparian habitat objectives are being met through an effective monitoring program based on aquatic and riparian function.

3.3.4.14 History

VOIT 26 is similar to *Objective 23, 3.2.1 – To ensure that all forest industry practices are conducted in a manner that places a priority on the protection of water resources* and *Objective 24, 3.2.2 - To manage forest cover in a manner that places a priority on the conservation and protection of watersheds* in the C5 Forest Management Plan (2006-2026).

3.4 Multiple Benefits to Society

3.4.1 VOIT 27 – Establish Appropriate Annual Allowable Cut

3.4.1.1	*CCFM Criterion*	5 Multiple Benefits to Society
3.4.1.2	*CSA SFM Element*	5.1 Timber and non-timber benefits
3.4.1.3	*Value*	5.1.1 Sustainable timber supplies
3.4.1.4	*Objective*	5.1.1.1 Establish appropriate Annual Allowable Cut (AACs)

3.4.1.5 Indicator

Process described in Annex 1 is followed and standards are met.

3.4.1.6 Target

Complete compliance.

3.4.1.7 Means to Identify Target

Consultation in planning process.

3.4.1.8 Legal/Policy Requirements

Forests Act and TMR.

3.4.1.9 Means of Achieving Objective and Target

Effective implementation of planning process.

3.4.1.10 Target Monitoring and Measurement

Multiple means: Forest Revenue Scaling and Tenure System (FOREST), ARIS, AOPs, Stewardship Reports, and field inspections.

3.4.1.11 Reporting

Performance:

- 5-year Stewardship Report: None.
- 10-year Stewardship Report: Compare time 0 of previous FMP to CLB of new FMP.

3.4.1.12 Acceptable Variance

Issue specific.

3.4.1.13 Response

Adjust AAC using most current and relevant information.

3.4.1.14 History

VOIT 27 is similar to *Objective 26, 5.1.1 – To maintain sustainable timber harvest levels; i.e., timber harvesting shall not exceed the forest's productive (renewal) capacity* in the C5 Forest Management Plan (2006-2026).

3.4.2 VOIT 28 – Wildfire Risk

3.4.2.1	***CCFM Criterion***	5 Multiple Benefits to Society
3.4.2.2	***CSA SFM Element***	5.2 Communities and Sustainability
3.4.2.3	***Value***	5.2.1 Risk to communities and landscape values from wildfire is low
3.4.2.4	***Objective***	5.2.1.1 To assist the GoA in reducing wildfire threat potential by reducing fire behaviour, fire occurrence, threats to values at risk and enhancing fire suppression capability

3.4.2.5 Indicator

a) Harvested area (ha) in Wildfire Risk Indicator (WRI) classes (Risk Reduction, Continuous Improvement, and Intolerable) within the CFP FMA Community Zone.
b) Harvested area in WRI classes (ha) within the CFP FMA Landscape Zone now and over the planning horizon.

3.4.2.6 Target

a) Harvest 30% of the area in WRI classes within the CFP FMA Community Zones over 20 years.
b) Harvest 10% of the area in WRI classes within the CFP FMA Landscape Zone over 20 years.

3.4.2.7 Means to Identify Target

Fire Behaviour Potential and Fuel Grid Assessment (Annex 3 Report Provided to FMA Holder).

FMA Holder assessment of the SHS developed using recommendations from Annex 3 Report.

3.4.2.8 Legal/Policy Requirements

Planning Standard. ALSA, SSRP, LPH-LFMP.

3.4.2.9 Means of Achieving Objective and Target

SHS, thinning, partial harvest techniques, FireSmart treatments.

3.4.2.10 Target Monitoring and Measurement

AOPs, compartment assessments.

3.4.2.11 Reporting

FMP: Maps of Fire Behaviour Potential, Fuel Grid, Historical Wildfires and Natural Subregions (generated by the GoA).

Performance:

- Stewardship Reports: Report on actual harvested area (a and b).

3.4.2.12 Acceptable Variance

Issue specific.

3.4.2.13 Response

Adjust harvest sequence.

3.4.2.14 History

VOIT 28 is similar to *Objective 15, 2.1.2 – To minimize losses to human life, communities, soil, watersheds, natural resources, and infrastructure from wildfire* in the C5 Forest Management Plan (2006-2026).

3.4.3 VOIT 29-1 – Trails

3.4.3.1	***CCFM Criterion***	5 Multiple Benefits to Society
3.4.3.2	***CSA SFM Element***	5.2 Communities and Sustainability
3.4.3.3	***Value***	5.2.2 Provide opportunities to derive benefits and participate in use and management
3.4.3.4	***Objective***	5.2.2.1 Integrate other uses and timber management activities

3.4.3.5 Indicator

Designated and provincial trail integration.

3.4.3.6 Target

Integrate designated and Provincial trails as indicated in the Timber Harvest Planning and Operating Ground Rules.

3.4.3.7 Means to Identify Target

Consultation and co-operation. Designated and provincial trails that are identified in the Trails Designation Order.

3.4.3.8 Legal/Policy Requirements

Planning Standard, OGRs, Trails Act, applicable Ministerial Order.

3.4.3.9 Means of Achieving Objective and Target

Effective implementation of plans.

3.4.3.10 Target Monitoring and Measurement

Consultation tracking.

3.4.3.11 Reporting

Performance:

- Stewardship Reports: Report length (m) of trail protected that overlaps harvested areas.

3.4.3.12 Acceptable Variance

Issue specific.

3.4.3.13 Response

Adjust activities.

3.4.3.14 History

VOIT 29-1 is similar to *Objective 35, 5.1.10 – To integrate recreational activities with forest management practices* in the C5 Forest Management Plan (2006-2026), which discusses maintenance and expansion of cross-country trails systems.

3.4.4 VOIT 29-2 – Scenic Values

3.4.4.1	*CCFM Criterion*	5 Multiple Benefits to Society
3.4.4.2	*CSA SFM Element*	5.2 Communities and Sustainability
3.4.4.3	*Value*	5.1.2 Scenic values
3.4.4.4	*Objective*	5.1.1.2 Commercial forestry supports the maintenance of scenic values through integrating recreation and tourism considerations in planning and operations

3.4.4.5 Indicator

Minimize impacts to high scenic values in high visual quality areas.

3.4.4.6 Target

The SHS will not include more than 12% of the identified high scenic values in the first two decades.

3.4.4.7 Means to Identify Target

Consultation in planning process, Visual Quality Assessment.

3.4.4.8 Legal/Policy Requirements

ALSA, LPH-LFMP, Livingstone-Porcupine Hills Recreation Management Plan.

3.4.4.9 Means of Achieving Objective and Target

Effective implementation of plans, Visual Quality Strategy.

3.4.4.10 Target Monitoring and Measurement

As-built harvest area boundaries.

3.4.4.11 Reporting

FMP: Map of areas identified with high scenic value and how much SHS area (ha) is scheduled in the first two decades.

Performance:

- Stewardship Reports: Report actual percent harvested within the high scenic value areas.

3.4.4.12 Acceptable Variance

20% variance.

3.4.4.13 Response

Adjust strategies in subsequent FMPs.

3.4.4.14 History

VOIT 29-2 is similar to *Objective 30, 5.1.5 – To consider visual impacts during the development of harvest plans* in the C5 Forest Management Plan (2006-2026).

3.4.5 VOIT 29-3 – Forest Encroachment

3.4.5.1	*CCFM Criterion*	5 Multiple Benefits to Society
3.4.5.2	*CSA SFM Element*	5.2 Communities and Sustainability
3.4.5.3	*Value*	5.2.2 Scenic Values
3.4.5.4	*Objective*	5.2.2.2 Reduce forest encroachment onto grasslands

3.4.5.5 Indicator

Extent of various uses: Identify merchantable forest encroachment onto grassland areas to be treated within the non-contributing (transition) landbase.

3.4.5.6 Target

Timber harvest operationally feasible, merchantable forest encroachment onto transitional grassland areas within the non-contributing and contributing landbase.

3.4.5.7 Means to Identify Target

Consultation in planning process, GoA provided recommendations in the document titled, "Minimizing Forest Encroachment in Successional Transition Areas in the Crowsnest Forest Products Ltd. 2025 Forest Management Plan".

3.4.5.8 Legal/Policy Requirements

ALSA, SSRP, LPH-LFMP, AFMPS.

3.4.5.9 Means of Achieving Objective and Target

Develop the SHS considering successional transition areas to reduce forest encroachment onto grasslands.

Include alternative silviculture strategies to reduce forest encroachment onto grasslands such as, but not limited to, partial harvest, pre commercial thinning, leave for natural and/or reduced planting densities.

3.4.5.10 Target Monitoring and Measurement

AOPs, Reforestation Standard of Alberta, Reforestation survey audit results, AVI.

3.4.5.11 Reporting

Performance:

Stewardship Reports: Report number of forest encroachment onto grassland transitional areas treated for the contributing and non-contributing landbase, report all hectares harvested within the contributing landbase within the last 14 years.

These areas are naturally transitioning from early seral to forested and provide significant grazing/foraging opportunities for livestock and ungulates.

3.4.5.12 Acceptable Variance

None.

3.4.5.13 Response

Adjust in subsequent FMPs.

3.4.5.14 History

VOIT 29-2 is similar to *Objective 36, 5.1.11 – To integrate rangeland management activities with forest management practices such that long-term relationships between grazing disposition holders and forest operators are developed to sustain fiber and forage resources* in the C5 Forest Management Plan (2006-2026).

3.4.6 VOIT 30 – Long Run Sustained Yield Average (LRSYA)

3.4.6.1	***CCFM Criterion***	5 Multiple Benefits to Society
3.4.6.2	***CSA SFM Element***	5.2 Communities and Sustainability
3.4.6.3	***Value***	5.2.3 Forest Productivity
3.4.6.4	***Objective***	5.2.3.1 Maintain Long Run Sustained Yield Average (LRSYA)

3.4.6.5 Indicator

Regenerated stand yield compared to natural stand yield.

3.4.6.6 Target

No net decrease from the natural stand productivity.

3.4.6.7 Means to Identify Target

FMP TSA.

3.4.6.8 Legal/Policy Requirements

Planning Standard.

3.4.6.9 Means of Achieving Objective and Target

Effective implementation of plans.

3.4.6.10 Target Monitoring and Measurement

Future FMP RSA (MAI).

3.4.6.11 Reporting

FMP: TSA.

Performance:

- 5-year Stewardship Report: None.
- 10-year Stewardship Report: Compare time 0 of previous FMP to CLB of new FMP.

3.4.6.12 Acceptable Variance

Report actuals.

3.4.6.13 Response

Adjust AAC in next FMP using most current and relevant information.

3.4.6.14 History

VOIT 30 is not directly comparable to any of the objectives in the C5 Forest Management Plan (2006-2026).

3.5 Accepting Society's Responsibility for Sustainable Development

3.5.1 VOIT 31 – First Nations Consultation Plan

3.5.1.1	*CCFM Criterion*	6 Accepting Society's Responsibility for Sustainable Development
3.5.1.2	*CSA SFM Element*	6.1 First Nation and Treaty rights and First Nation Forest Values
3.5.1.3	*Value*	6.1.1 Compliance with Government Regulations and Policies
3.5.1.4	*Objective*	6.1.1.1 Implement Indigenous Consultation Process

3.5.1.5 Indicator

Meet Alberta's current expectations for Indigenous consultation.

3.5.1.6 Target

Consult at the community level with designated representatives of affected Indigenous communities.

3.5.1.7 Means to Identify Target

The GoA Indigenous Consultation and Policy Guidelines.

3.5.1.8 Legal/Policy Requirements

Planning Standard, GoA Indigenous Consultation Policy and Guidelines .

3.5.1.9 Means of Achieving Objective and Target

Effective implementation of Indigenous Consultation Process.

3.5.1.10 Target Monitoring and Measurement

GoA FMP and GDP consultation adequacy letters, CFP Indigenous communication database.

3.5.1.11 Reporting

FMP: Summary of input provided during Indigenous consultation, including how it was incorporated into the FMP, and if it wasn't, provide an explanation why.

Performance:

- Stewardship Reports: Summary of Indigenous consultation with input and responses during FMP implementation.

3.5.1.12 Acceptable Variance

None.

3.5.1.13 Response

Adjust activities.

3.5.1.14 History

VOIT 31 is similar to *Objective 43, 6.1 – "The Alberta Government is committed to meeting all of its treaty, constitutional and legal obligations respecting the use of public lands." (p.14) Strengthening Relationships – The Government of Alberta's Aboriginal Policy Framework* and *Objective 44, 6.2.1 – To undertake effective and meaningful consultation with relevant Aboriginal communities* in the C5 Forest Management Plan (2006-2026).

3.5.2 VOIT 32 – Public Participation Process

3.5.2.1	***CCFM Criterion***	6 Accepting Society's Responsibility for Sustainable Development
3.5.2.2	***CSA SFM Element***	6.2 Public Participation and Information for Decision-Making
3.5.2.3	***Value***	6.2.1 Meaningful Public Participation is Achieved
3.5.2.4	***Objective***	6.2.1.1 Implement Public Participation Process

3.5.2.5 Indicator

Meet expectations of Section 5 of CSA Z809-02.

3.5.2.6 Target

Implementation of Crowsnest Forest Products' (CFP) Public Participation Program.

Annual opportunity for public input on harvest plans.

3.5.2.7 Means to Identify Target

CFP public participation program.

3.5.2.8 Legal/Policy Requirements

Planning Standard.

3.5.2.9 Means of Achieving Objective and Target

Effective implementation of Public Participation Process.

3.5.2.10 Target Monitoring and Measurement

CFP public communication database.

3.5.2.11 Reporting

FMP: Summary of public input, how it was incorporated into the FMP, and if it wasn't, provide an explanation why.

Performance:

- Stewardship Reports: Update on the revised Terms of Reference for the Public Advisory Committee and the Public Participation Program, summary of Public Participation Program activities and input from the Public Advisory Committee, public and interest groups into harvest plans.

3.5.2.12 Acceptable Variance

None.

3.5.2.13 Response

Adjust activities.

3.5.2.14 History

VOIT 32 is similar to *Objective 45, 6.3.1 – To proactively and meaningfully involve directly affected users and the interested public in forest planning and decision-making processes* and *Objective 47, 6.3.3 – To be responsive to local and regional input concerning forestry planning and operations* in the C5 Forest Management Plan (2006-2026).

4 FMP VOIT Reporting (2025)

4.1 Biological Diversity

4.1.1 VOIT 1 – Seral Stages

Reporting Requirement:

- Tables of indicators (values and targets) at 0, 10, 50, 100, and 200 years.
- Maps of indicators at 0, 10, and 50 years.

Reporting is completed by yield curve strata. Note that while there is no yield curve used for SB (Black Spruce) and it is not harvested, it is included in the gross landbase by yield curve strata summary (Table 4-1) as an additional category (SB) for completeness.

Table 4-1. Gross landbase: area by seral stage.

Year	Young		Immature		Mature		Old		Very Old		Non-Contributing		Total	
	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
2023	12,420	4	40,276	12	72,140	21	35,568	10	8,307	2	179,379	52	348,090	100
2033	16,951	5	38,299	11	71,147	20	33,624	10	8,689	2	179,379	52	348,090	100
2073	19,695	6	50,084	14	22,030	6	59,981	17	16,920	5	179,379	52	348,090	100
2123	21,724	6	60,920	18	11,545	3	19,030	5	55,492	16	179,379	52	348,090	100
2223	23,480	7	66,892	19	12,726	4	2,100	1	63,512	18	179,379	52	348,090	100

Table 4-2. Active landbase: area by seral stage.

Year	Young		Immature		Mature		Old		Very Old		Total	
	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
2023	12,149	12	31,368	30	39,947	38	18,731	18	3,037	3	105,233	100
2033	16,738	16	31,975	30	37,683	36	16,098	15	2,739	3	105,233	100
2073	19,629	19	47,388	45	17,944	17	17,748	17	2,523	2	105,233	100
2123	21,712	9	60,129	26	10,979	5	10,122	4	2,291	1	105,233	100
2223	22,566	21	62,179	59	10,765	10	1,309	1	8,413	8	105,233	100

Table 4-3. Gross landbase: area by seral stage and yield curve strata.

		HW		HWSX		HWPL		SWHW		PLHW		SW		PL		FD		SB		Total	
	Year	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
Young	2023	236	0	16	0	48	0	29	0	201	0	979	0	10,829	3	82	0	0	0	12,420	4
	2033	394	0	11	0	20	0	31	0	25	0	3,055	1	11,747	3	1,668	0	0	0	16,951	5
	2073	604	0	136	0	71	0	128	0	65	0	4,070	1	14,900	4	1,750	1	0	0	21,724	6
	2123	1,318	0	64	0	94	0	76	0	113	0	4,554	1	15,152	4	2,105	1	5	0	23,480	7
	2223	409	0	143	0	124	0	265	0	91	0	3,814	1	11,859	3	2,990	1	0	0	19,695	6
Immature	2023	13,370	4	750	0	480	0	636	0	245	0	5,591	2	17,800	5	1,376	0	25	0	40,276	12
	2033	10,364	3	546	0	420	0	326	0	365	0	4,677	1	20,557	6	1,021	0	22	0	38,299	11
	2073	1,307	0	528	0	371	0	673	0	450	0	12,028	3	37,982	11	7,577	2	4	0	60,920	18
	2123	2,065	1	560	0	362	0	656	0	438	0	15,978	5	39,368	11	7,434	2	31	0	66,892	19
	2223	1,284	0	107	0	135	0	113	0	308	0	8,014	2	36,309	10	3,801	1	13	0	50,084	14
Mature	2023	1,530	0	392	0	329	0	541	0	559	0	12,926	4	46,166	13	9,532	3	165	0	72,140	21
	2033	4,376	1	599	0	388	0	826	0	579	0	12,961	4	42,241	12	9,020	3	159	0	71,147	20
	2073	599	0	35	0	23	0	26	0	75	0	2,997	1	6,438	2	1,339	0	13	0	11,545	3
	2123	712	0	68	0	41	0	98	0	38	0	3,063	1	7,234	2	1,456	0	17	0	12,726	4
	2223	9,395	3	435	0	298	0	246	0	116	0	3,312	1	7,282	2	925	0	22	0	22,030	6
Old	2023	8	0	28	0	9	0	106	0	60	0	14,087	4	15,229	4	5,773	2	269	0	35,568	10
	2033	11	0	30	0	38	0	129	0	95	0	12,827	4	15,550	4	4,673	1	272	0	33,624	10
	2073	11,439	3	322	0	249	0	231	0	136	0	1,884	1	4,185	1	558	0	25	0	19,030	5
	2123	311	0	31	0	6	0	32	0	19	0	950	0	459	0	289	0	4	0	2,100	1
	2223	4,056	1	495	0	309	0	663	0	546	0	14,787	4	30,410	9	8,410	2	306	0	59,981	17
Very Old	2023	0	0	0	0	0	0	0	0	0	0	6,455	2	1,587	0	217	0	49	0	8,307	2
	2033	0	0	0	0	0	0	0	0	0	0	6,518	2	1,517	0	599	0	55	0	8,689	2
	2073	1,196	0	164	0	151	0	254	0	338	0	19,060	5	28,107	8	5,756	2	466	0	55,492	16
	2123	10,739	3	462	0	363	0	450	0	456	0	15,495	4	29,399	8	5,697	2	451	0	63,512	18
	2223	0	0	6	0	0	0	24	0	3	0	10,112	3	5,753	2	855	0	167	0	16,920	5

Table 4-4. Active landbase: area by seral stage and yield curve strata.

		HW		HWSX		HWPL		SWHW		PLHW		SW		PL		FD		Total	
	Year	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
Young	2023	208	0	16	0	45	0	28	0	201	0	975	1	10,603	10	73	0	12,149	12
	2033	392	0	11	0	20	0	31	0	25	0	3,047	3	11,603	11	1,610	2	16,738	16
	2073	604	1	136	0	71	0	128	0	65	0	4,058	4	14,900	14	1,750	2	21,712	21
	2123	1,318	1	64	0	94	0	75	0	113	0	4,045	4	14,983	14	1,874	2	22,566	21
	2223	409	0	143	0	124	0	265	0	91	0	3,754	4	11,854	11	2,990	3	19,629	19
Immature	2023	10,672	10	460	0	270	0	446	0	112	0	3,900	4	14,646	14	863	1	31,368	30
	2033	8,257	8	356	0	243	0	229	0	267	0	3,715	4	18,208	17	700	1	31,975	30
	2073	1,307	1	528	1	371	0	673	1	450	0	11,341	11	37,882	36	7,577	7	60,129	57
	2123	2,065	2	560	1	362	0	655	1	435	0	12,642	12	38,312	36	7,147	7	62,179	59
	2223	1,023	1	104	0	131	0	113	0	284	0	7,732	7	34,268	33	3,733	4	47,388	45
Mature	2023	1,132	1	249	0	191	0	360	0	276	0	4,976	5	27,041	26	5,722	5	39,947	38
	2033	3,363	3	356	0	231	0	564	1	292	0	4,639	4	23,101	22	5,136	5	37,683	36
	2073	571	1	35	0	21	0	25	0	75	0	2,807	3	6,163	6	1,281	1	10,979	10
	2123	712	1	68	0	41	0	98	0	38	0	1,613	2	6,763	6	1,433	1	10,765	10
	2223	7,547	7	248	0	125	0	150	0	41	0	2,439	2	6,781	6	614	1	17,944	17
Old	2023	8	0	14	0	5	0	41	0	30	0	6,518	6	8,077	8	4,039	4	18,731	18
	2033	8	0	16	0	18	0	51	0	35	0	5,321	5	7,571	7	3,078	3	16,098	15
	2073	8,740	8	31	0	39	0	41	0	4	0	192	0	1,030	1	44	0	10,122	10
	2123	311	0	31	0	6	0	32	0	19	0	263	0	359	0	289	0	1,309	1
	2223	3,040	3	243	0	133	0	344	0	203	0	3,362	3	7,144	7	3,280	3	17,748	17
Very Old	2023	0	0	0	0	0	0	0	0	0	0	2,383	2	518	0	136	0	3,037	3
	2033	0	0	0	0	0	0	0	0	0	0	2,029	2	401	0	308	0	2,739	3
	2073	797	1	8	0	10	0	8	0	25	0	354	0	909	1	180	0	2,291	2
	2123	7,614	7	15	0	10	0	14	0	14	0	190	0	468	0	89	0	8,413	8
	2223	0	0	1	0	0	0	3	0	0	0	1,466	1	838	1	216	0	2,523	2

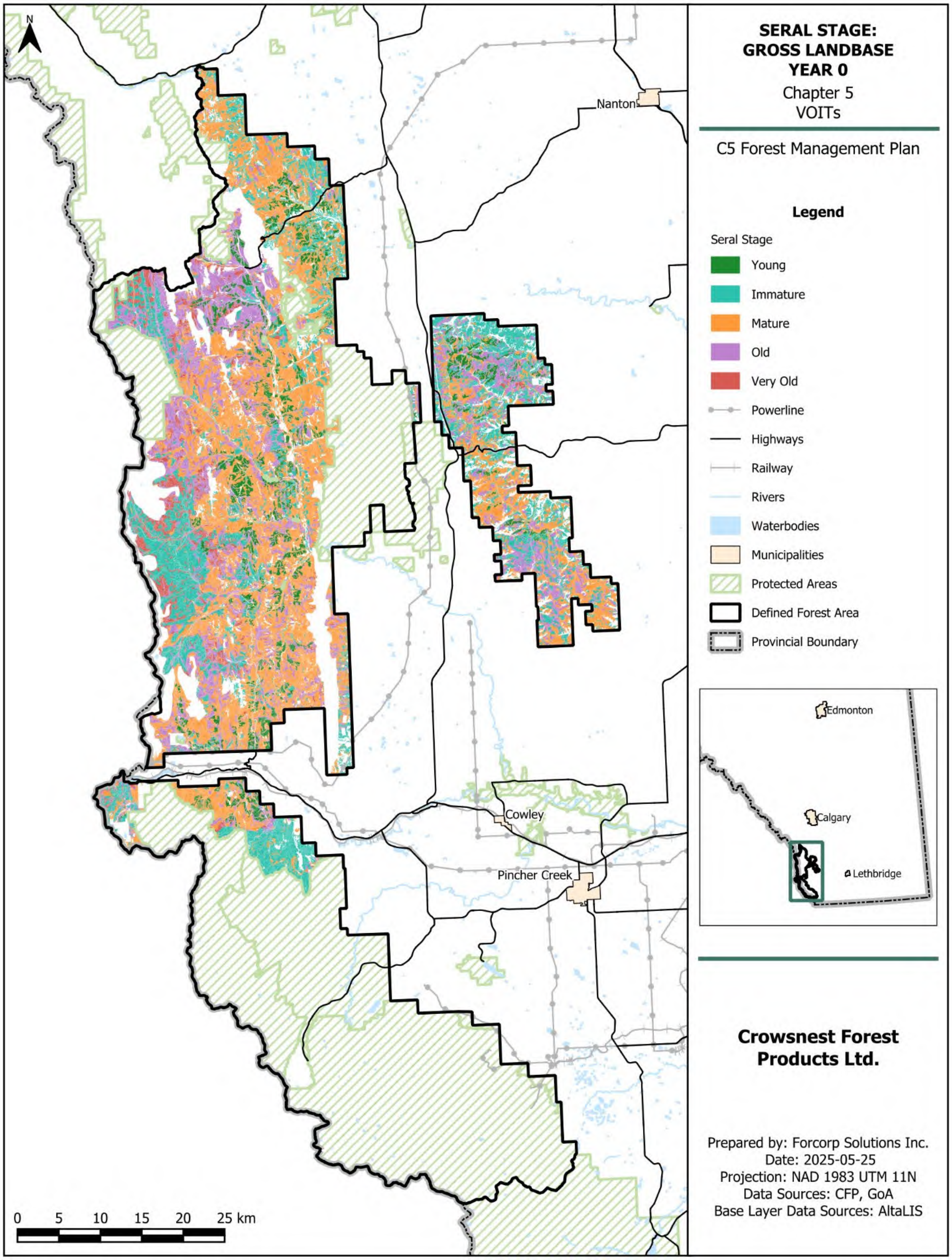

Figure 4-1. Seral stages on the gross landbase in 2023.

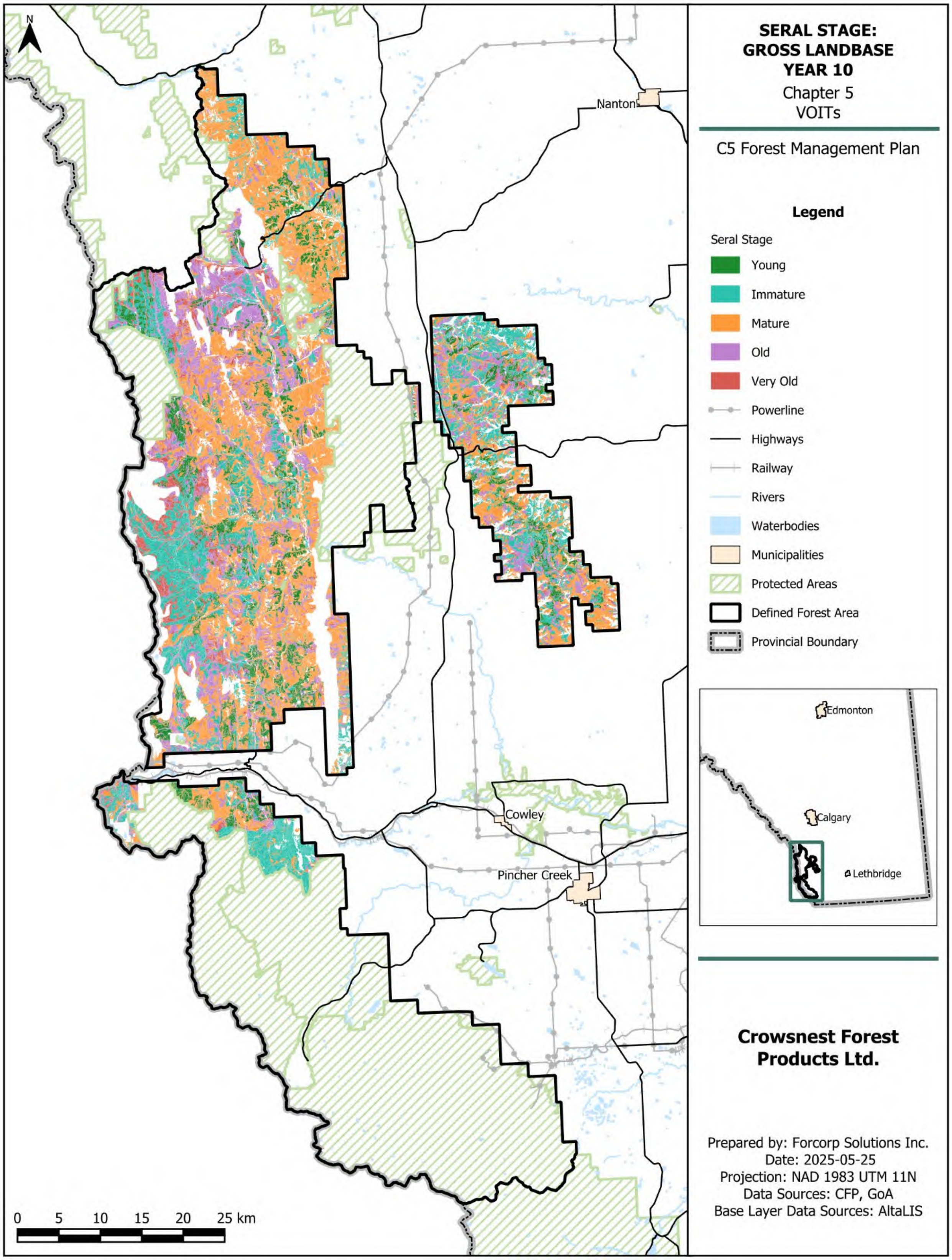

Figure 4-2. Seral stages on the gross landbase in 2033.

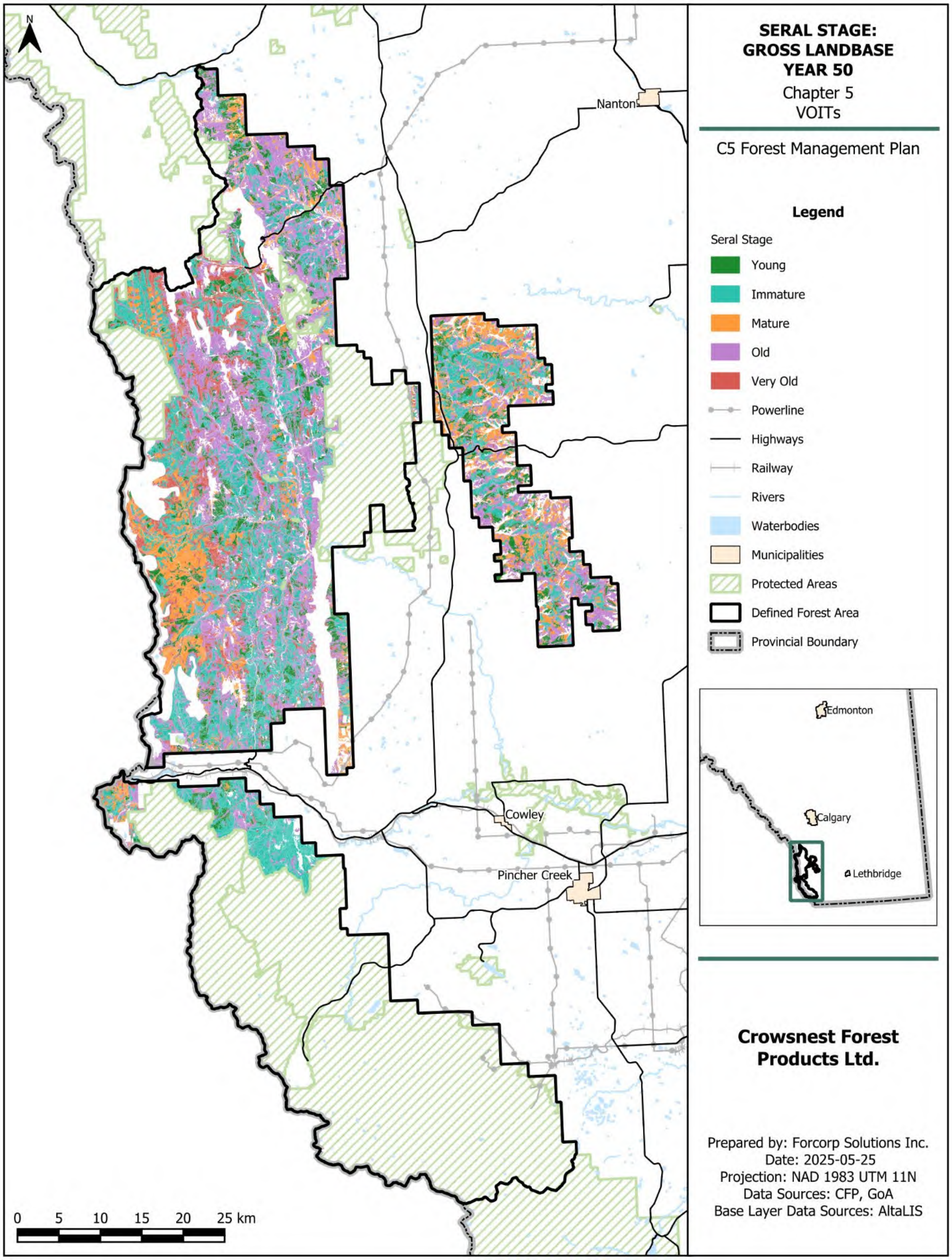

Figure 4-3. Seral stages on the gross landbase in 2073.

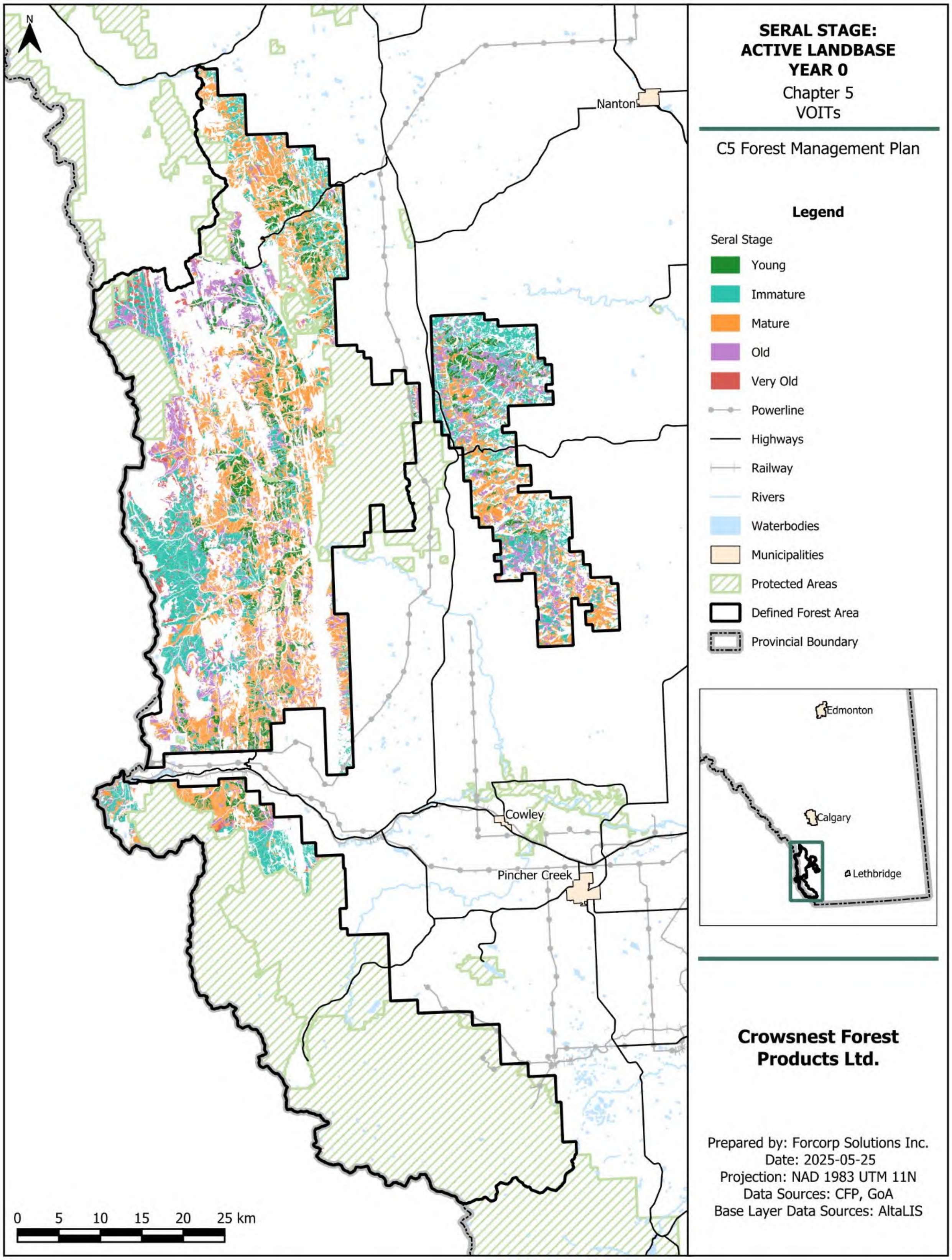

Figure 4-4. Seral stages on the active landbase in 2023.

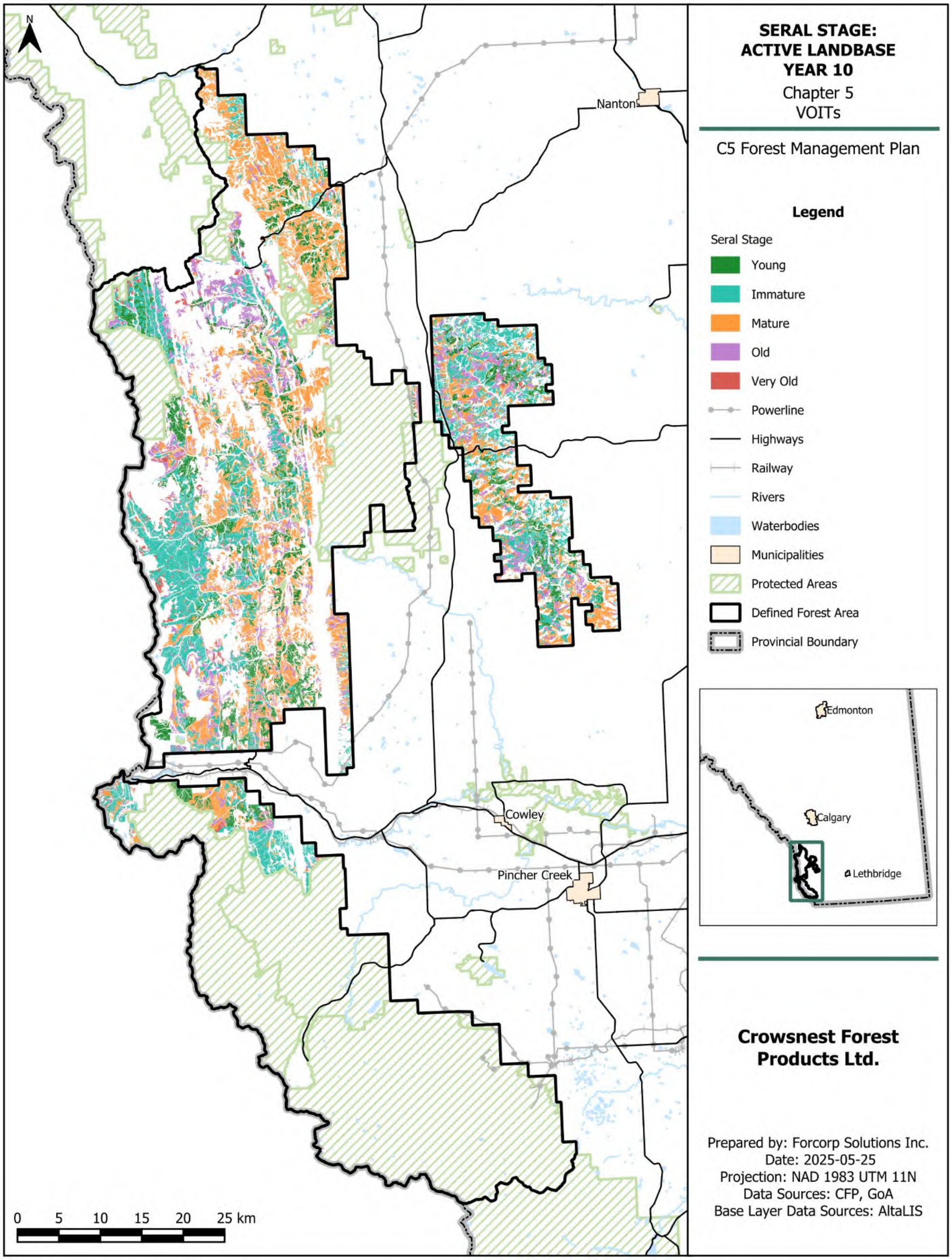

Figure 4-5. Seral stages on the active landbase in 2033.

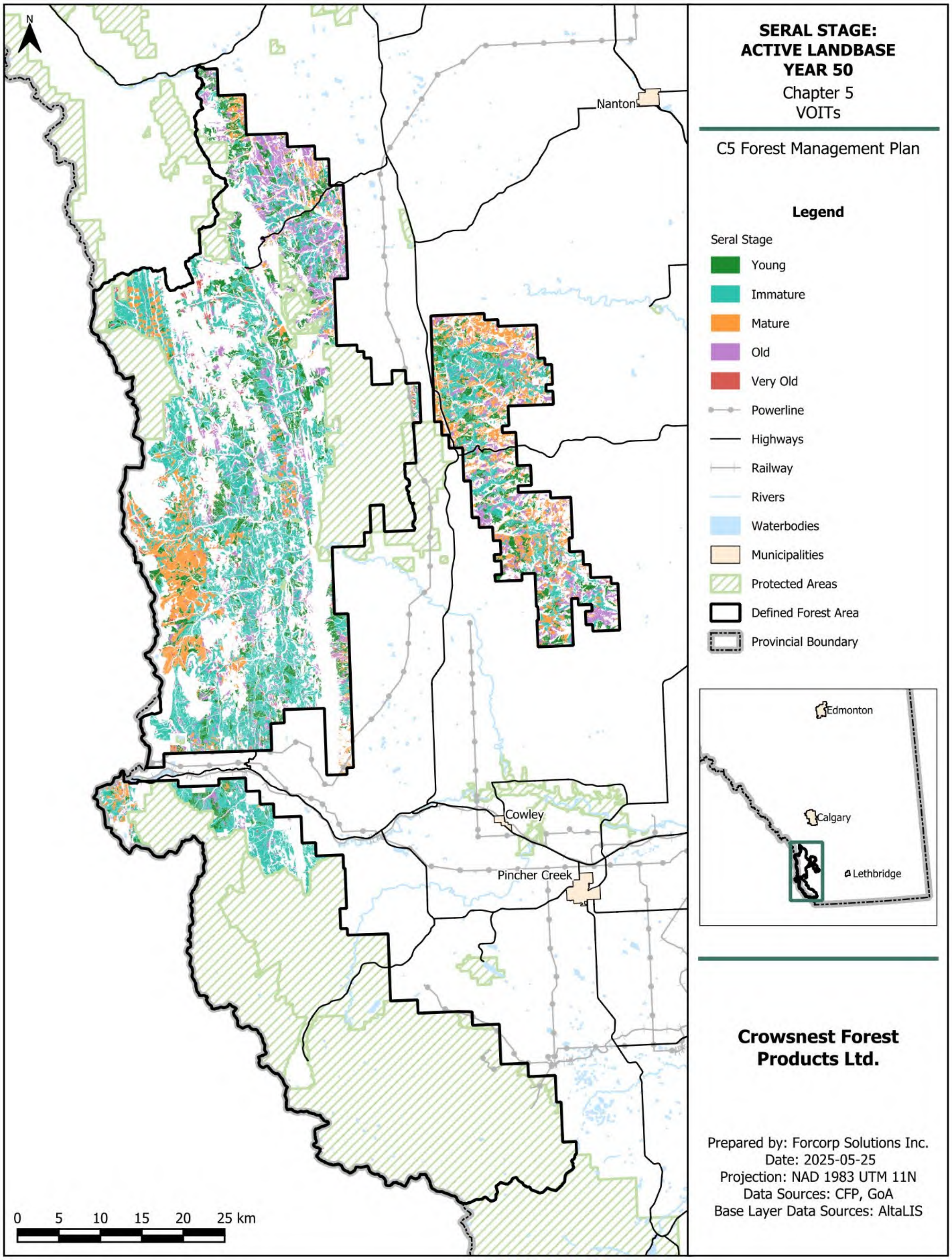

Figure 4-6. Seral stages on the active landbase in 2073.

4.1.2 VOIT 2 – Patch Sizes

Reporting Requirement:

- Tables of area of forest in each patch size class at 0, 10, and 50 years (or end of first rotation).
- Maps of patch size classes at 0, 10, and 50 years (or end of first rotation).

The patch size pattern over the reporting period is one of maintaining existing patch sizes (Table 4-5), with the exception of the largest patch size class which increases over a ten year period but drops to zero by year 50.

Table 4-5. Area by patch size class.

Patch Size	2023			2033			2073		
	Area (ha)	%	Avg. Size (ha)	Area (ha)	%	Avg. Size (ha)	Area (ha)	%	Avg. Size (ha)
<20 ha	4,338	36	8	4,751	28	9	6,846	35	7
20-100 ha	6,988	58	41	8,296	49	46	9,244	47	47
100-250 ha	544	4	132	2,821	17	143	2,992	15	137
>250 ha	279	2	271	919	5	459	542	3	262
Total	**12,149**	**100**	**30**	**16,787**	**100**	**75**	**19,624**	**100**	**43**

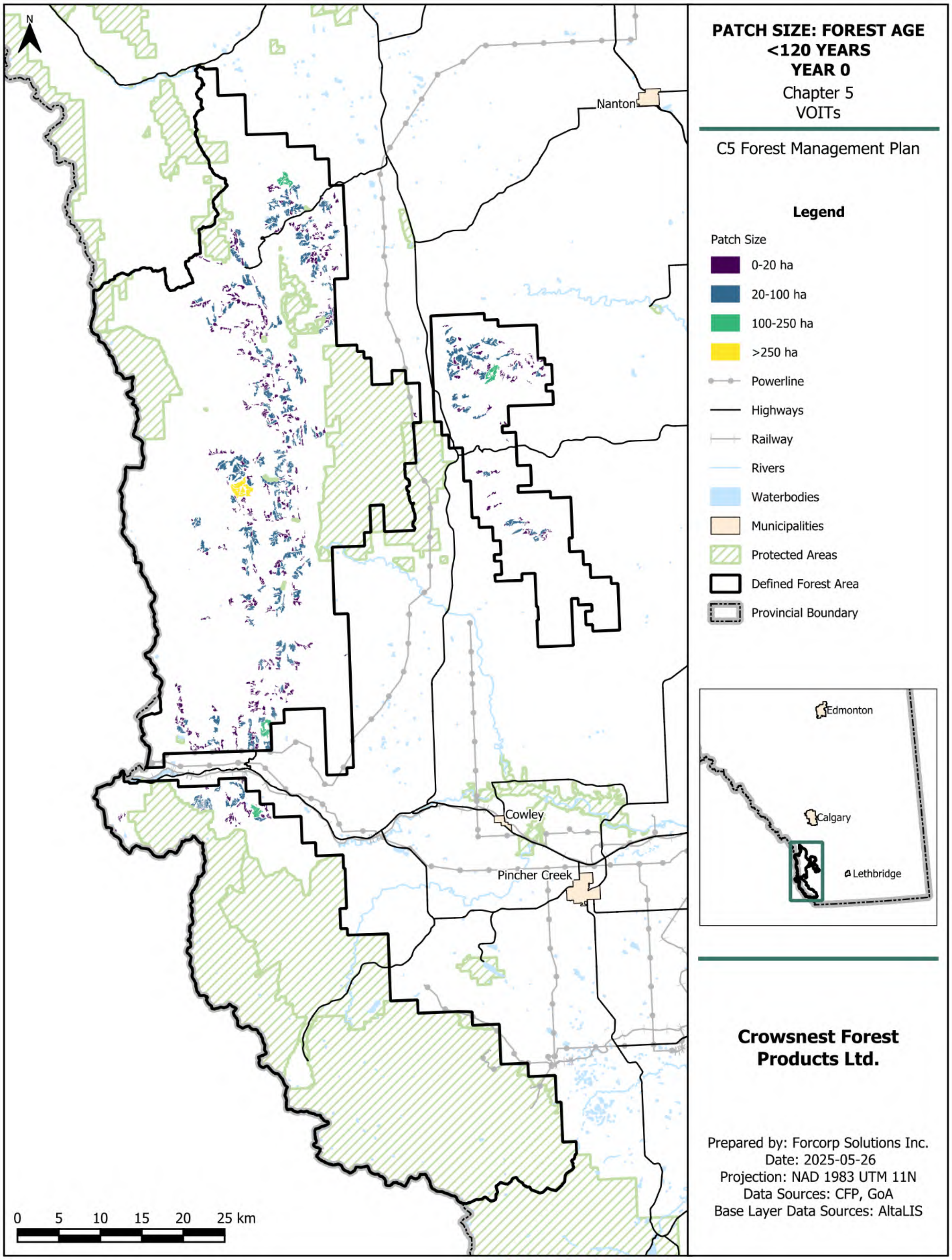

Figure 4-7. Patch size distribution for forest less than 20 years old in 2023.

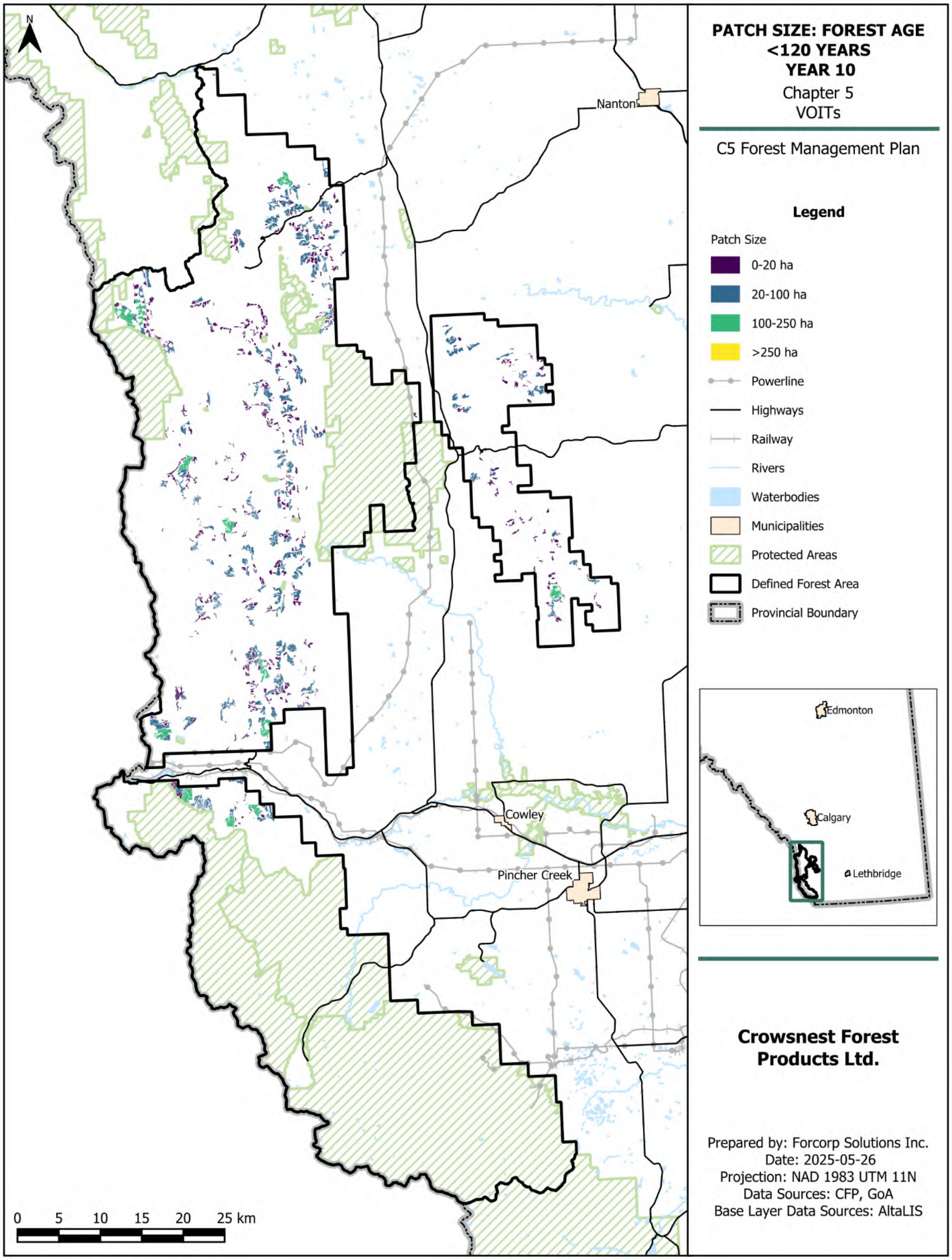

Figure 4-8. Patch size distribution for forest less than 20 years old in 2033.

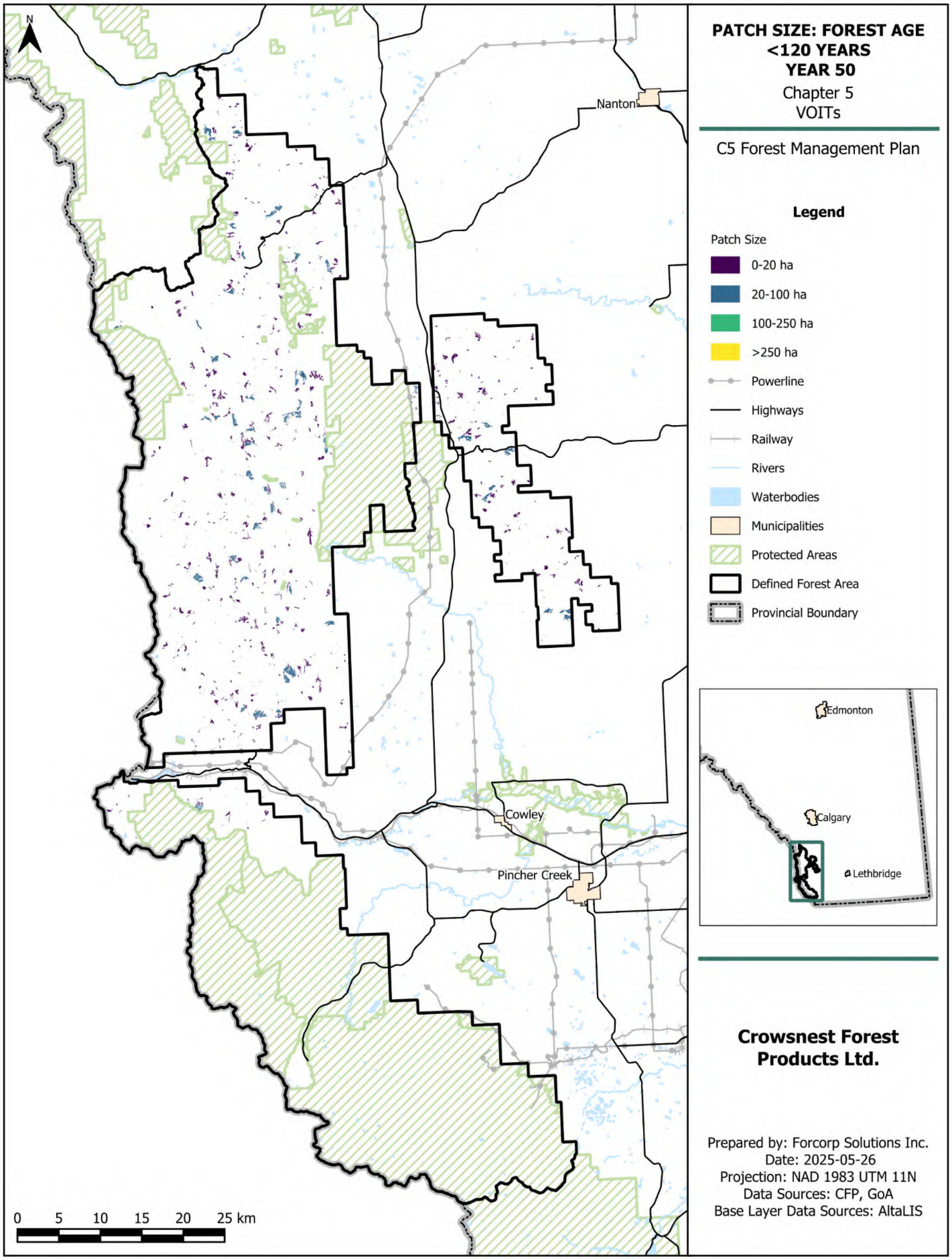

Figure 4-9. Patch size distribution for forest less than 20 years old in 2073.

4.1.3 VOIT 3 – Old Interior Forest

Reporting Requirement:

- Tables of indicators (values and targets) at 0, 10, and 50 years.
- Maps of indicators at 0, 10, and 50 years.

Reporting is completed overall (Table 4-6) and by yield curve strata (Table 4-7). Note that while there are no yield curves used for SB (Black Spruce), it is included in the yield curve strata summary as an additional category (SB) for completeness. There are 318 ha in the SB category at time 0, and these are not harvested. Over time they age to become part of the old seral stage and interior core.

Table 4-6. Summary of old and old interior forest.

Year	Forest >120 Years Old		Forest > 120 Years Old in Patches >120 Ha	
	Area (ha)	% Change	Area (ha)	% Change
2023	43,875	-	25,831	-
2033	42,313	-4	24,566	-5
2073	76,901	82	68,212	178

Table 4-7. Area of old interior forest by yield curve strata.

Year	HW		HWSX		HWPL		SWHW		PLHW		SW		PL		FD		SB		Total	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
2023	0	0	0	0	0	0	32	0	11	0	13,527	52	9,705	38	2,315	9	239	1	25,831	100
2033	0	0	16	0	5	0	47	0	32	0	12,343	50	9,955	41	1,922	8	245	1	24,566	100
2073	3,336	5	428	1	261	0	549	1	452	1	21,932	32	33,186	49	7,635	11	432	1	68,212	100

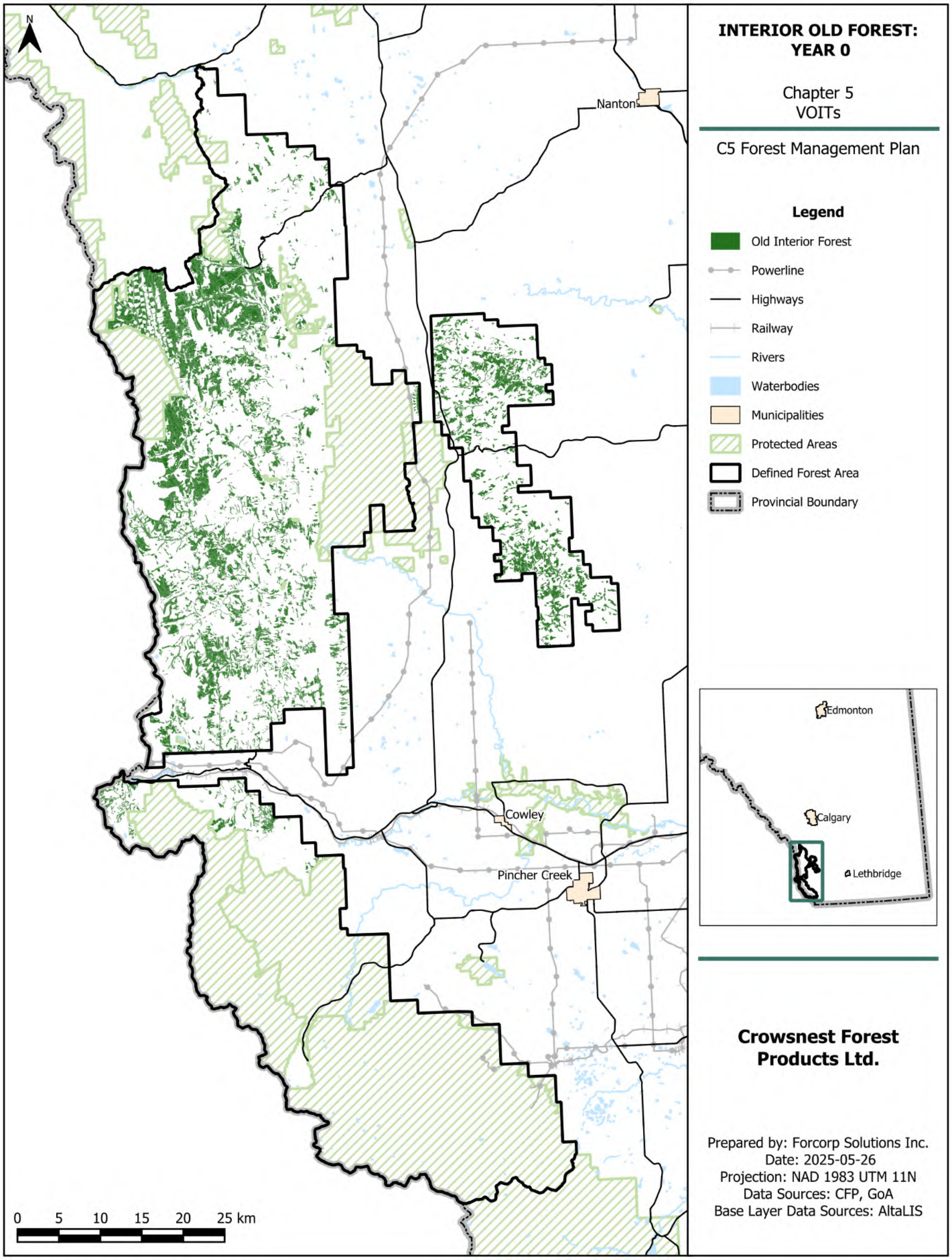

Figure 4-10. Interior old forest (forest greater than 120 years old in patches greater than 120 ha) distribution in 2023.

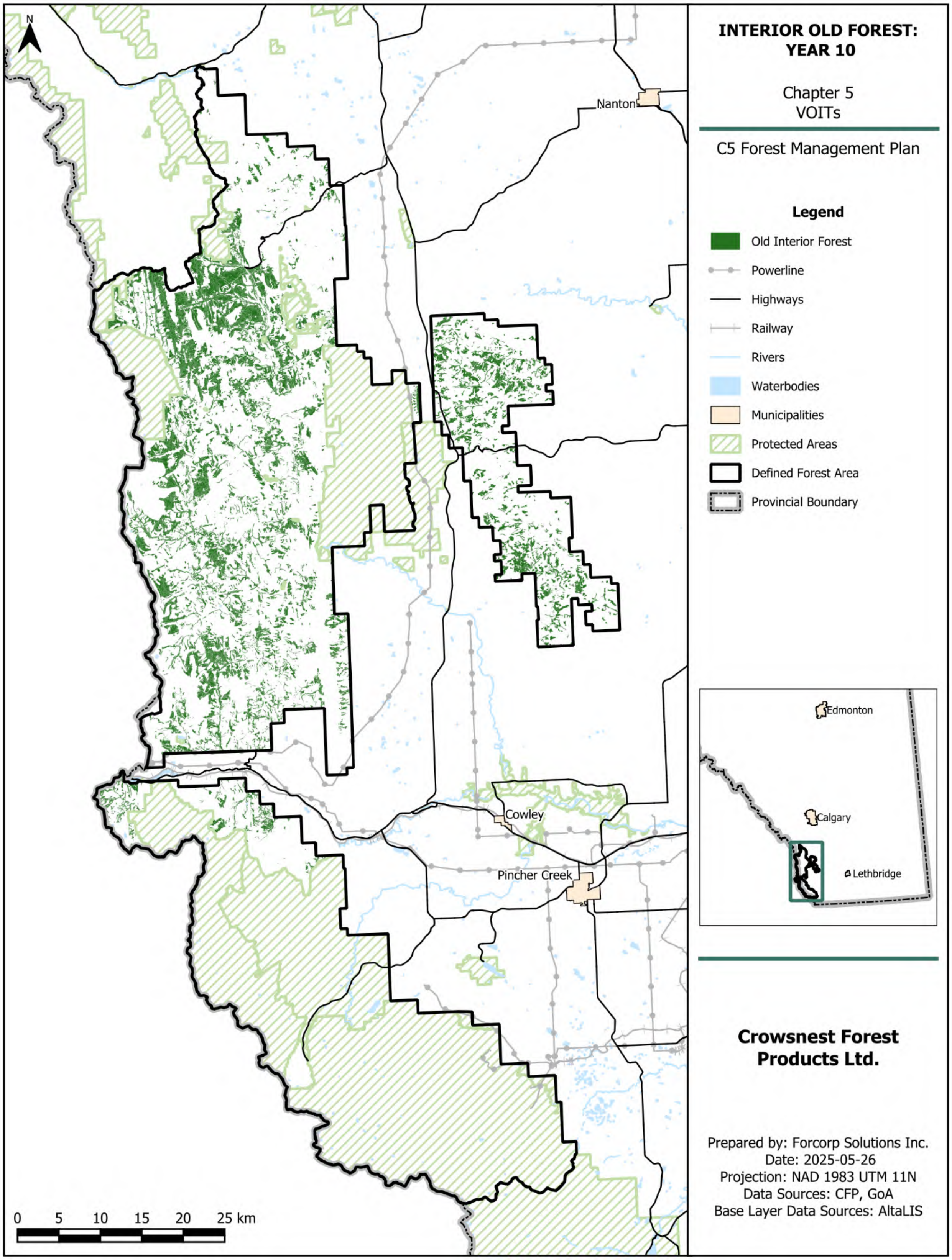

Figure 4-11. Interior old forest (forest greater than 120 years old in patches greater than 120 ha) distribution in 2033.

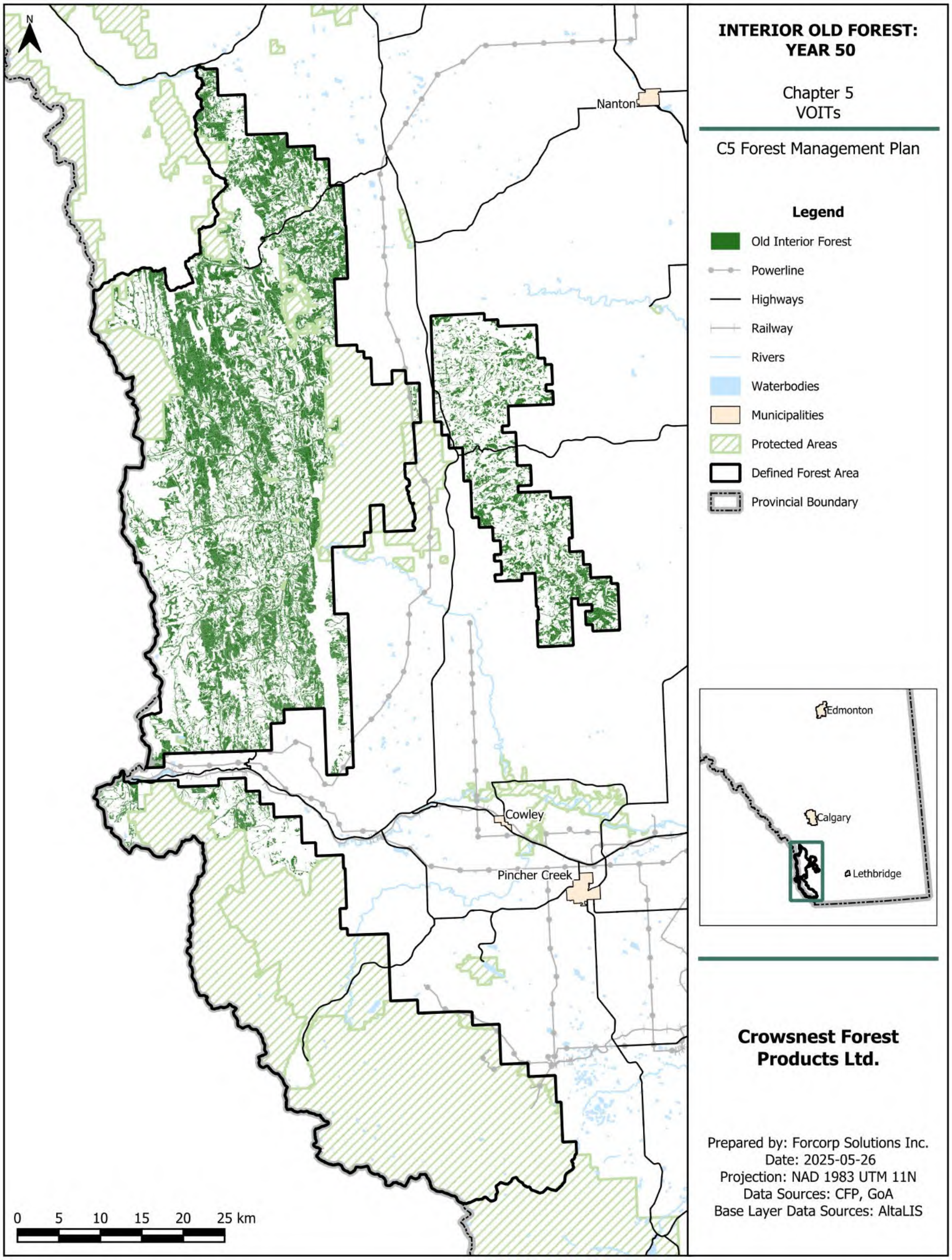

Figure 4-12. Interior old forest (forest greater than 120 years old in patches greater than 120 ha) distribution in 2073.

4.1.4 VOIT 4-1 – All-Weather Permanent Forestry Roads

Reporting Requirement:

- Table of road density outside LPH-LFMP at 0 and 10 years.
- Map of existing and proposed open and closed and forestry roads (DLO).
- Report forestry roads and total (all users) roads.

Road density for all-weather permanent forestry roads was calculated using the Digital Integrated Dispositions (DIDs) system using the following steps:

- Select DIDs entries from the DIDs layer extracted for the purposes of landbase construction (see *Annex V – Net Landbase Development* Section 2.4.41) that have a disposition type of 'DLO'.
- Select only those DLO entries assigned to company 'CROWSNEST FOREST PRODUCTS LTD.', '793128 ALBERTA LTD.', or '770538 ALBERTA LTD.'. Other DLOs in the area are not forestry roads.
- Calculate centerlines for the selected DLOs. This is required because DIDs is polygon-based and does not contain information about road length. The process was carried out using the PostGIS function *ST_ApproximateMedialAxis.*
- Finally, road density was calculated from the resulting centerlines, by summing the total length (km) of DLO and dividing by the area of the DFA outside LPH-LFMP (km^2).

The estimated length and density of roads classified as DLO outside the LPH-LFMP, split by whether they are forestry or non-forestry roads, is provided in Table 4-8. Forestry DLOs within the DFA are shown spatially in Figure 4-13. One additional DLO road with a length of 9.1km is proposed within LPH-LFMP but there are no roads being constructed outside of LPH-LFMP.

Table 4-8. The length and density for forestry and non-forestry DLOs on the portion of the DFA outside LPH-LFMP.

	Year 0		Currently Proposed (Year 10)		Total	
Type	Road Length (km)	Density (km/km^2)	Road Length (km)	Density (km/km^2)	Road Length (km)	Density (km/km^2)
Forestry	3.8	0.002	0.0	0.000	3.8	0.002
Non-Forestry	33.5	0.019	-	-	-	-
Total	**37.3**	**0.021**	**0.0**	**0.000**	**3.8**	**0.002**

Total all-user road length and density is provided in Table 4-9. See *Chapter 3 – Landscape Assessment* Section 5.7 for additional details.

Table 4-9. Total all-user road length and density in the DFA by compartment.

Compartment	All Roads	
	Total Distance (km)	Density (km/km^2)
Crowsnest River	77	0.04
Livingstone River	70	0.02
Oldman River	58	0.02
Porcupine Hills	113	0.04
Racehorse Creek	116	0.06
Willow Creek	17	0.01
Total	**450**	**0.13**

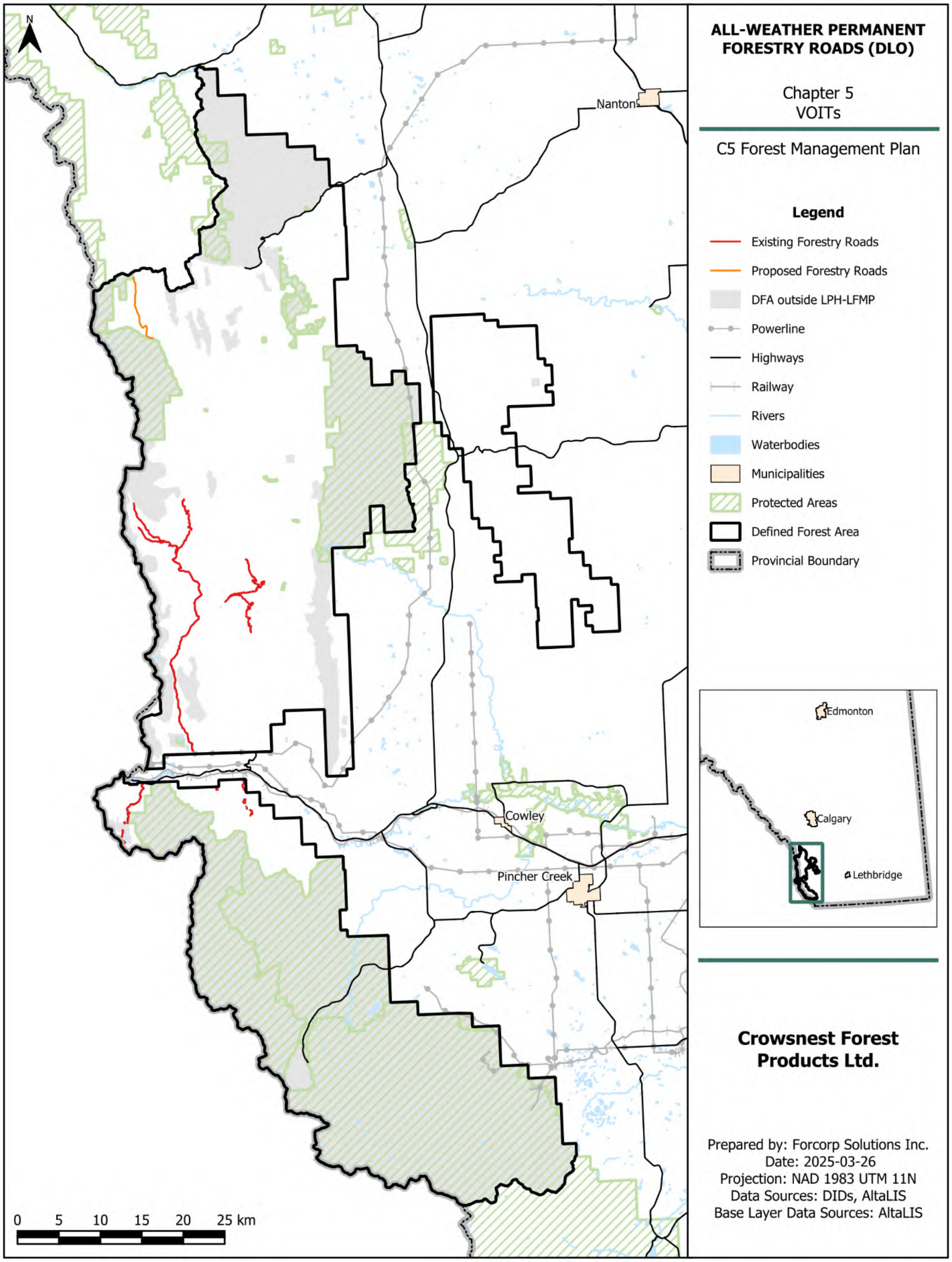

Figure 4-13. Existing and proposed all-weather permanent forestry roads (DLOs) on the DFA.

4.1.5 VOIT 4-2 – Open Seasonal / Temporary Forestry Roads

Reporting Requirement:

- Table of existing open seasonal/temporary forestry roads at time zero.
- Map of existing open seasonal/temporary forestry roads at time zero.

There are currently 70.5 km of open seasonal/temporary forest roads in the DFA (Table 4-10, Figure 4-14).

Table 4-10. The length of temporary forest roads on the DFA.

Type	Road Length (km)
Temporary Forestry Road	70.5

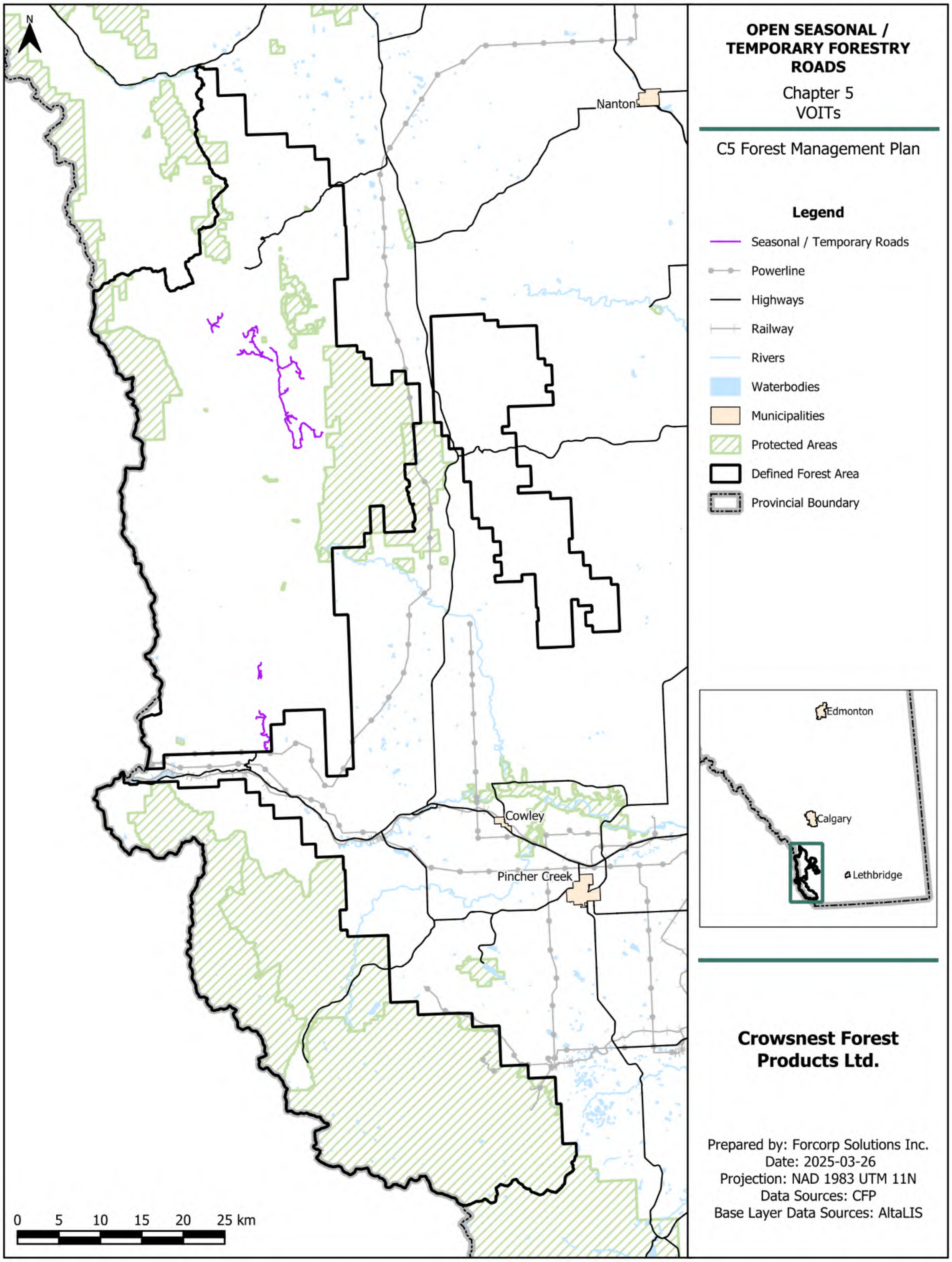

Figure 4-14. Open seasonal / temporary forestry roads on the DFA.

4.1.6 VOIT 5-1 – Open Motorized Access by Footprint Planning Zone

Reporting Requirement:

- Table with current open motorized access density by zone (open forestry DLOs).

Table 4-11. Open motorized access (forestry DLO) density by Footprint Planning Zone on the DFA.

Footprint Planning Zone	Road Length (km)	Total Area (km^2)	Density (km/km^2)
Zone 2	40.8	1,225.7	0.033
Zone 3	47.0	516.8	0.091
Total	**87.8**	**1,742.5**	**0.124**

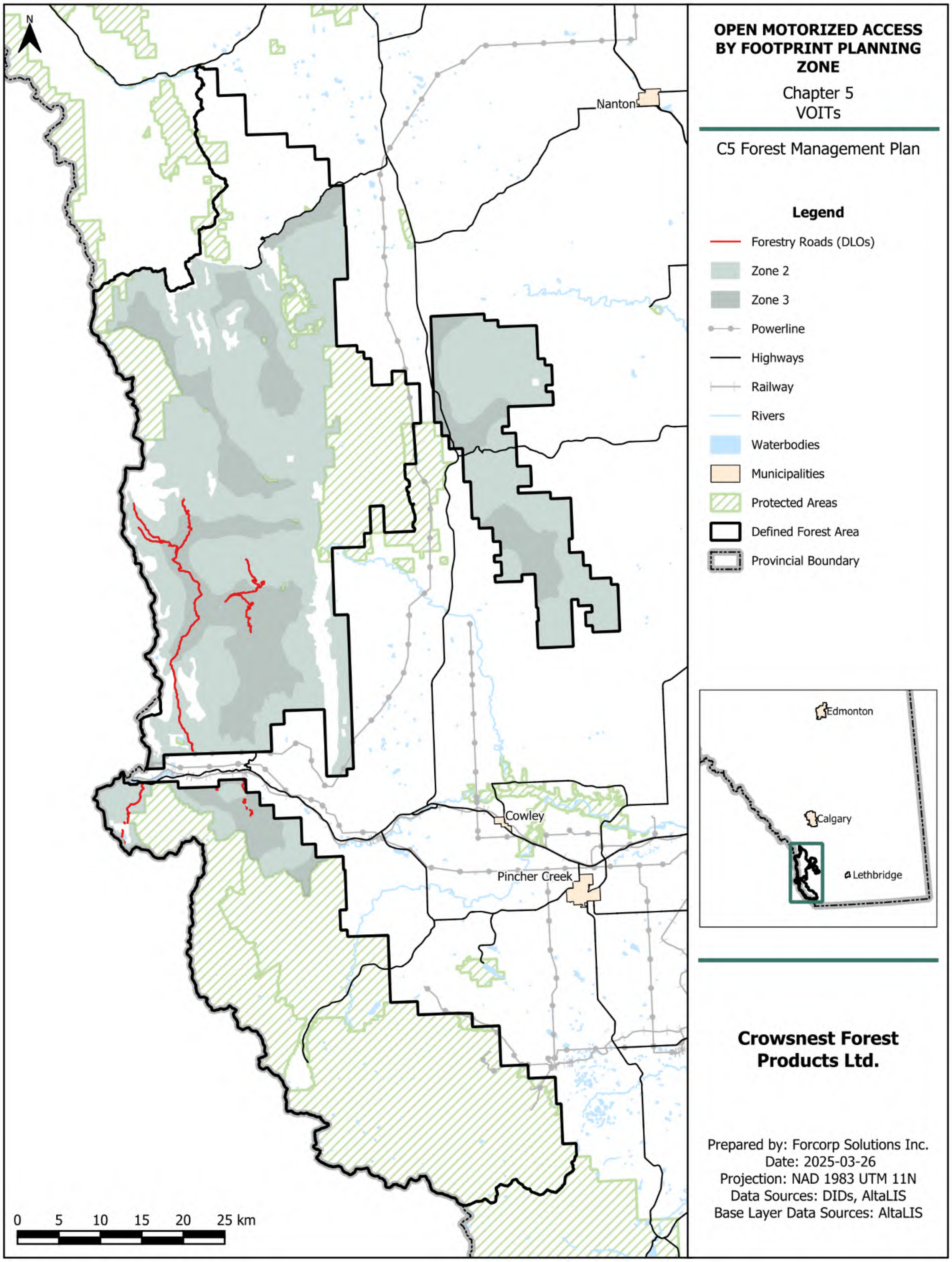

Figure 4-15. Open motorized access (forestry DLOs) by Footprint Planning Zone on the DFA.

4.1.7 VOIT 5-2 – Restricted Motorized Access by Footprint Planning Zone

Reporting Requirement:

- Table with current restricted motorized access density by zone (forestry access roads and DLOs).

Table 4-12. Restricted motorized access (forestry access roads and DLOs) density by Footprint Planning Zone.

Footprint Planning Zone	Road Length (km)	Total Area (km^2)	Density (km/km^2)
Zone 2	87.0	1,225.7	0.071
Zone 3	77.8	516.8	0.151
Total	**164.8**	**1,742.5**	**0.222**

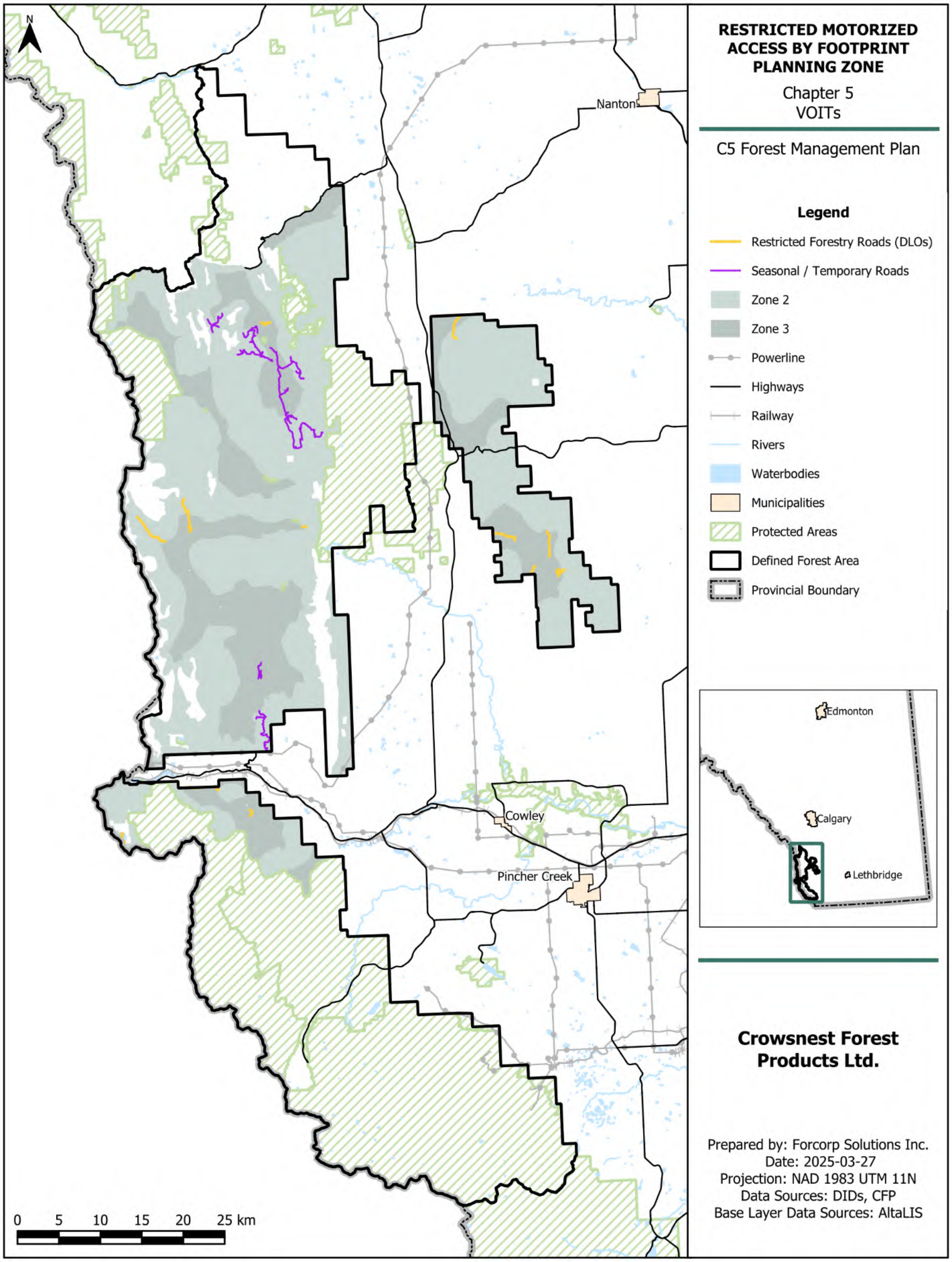

Figure 4-16. Restricted motorized access (forestry access roads and DLOs) density by Footprint Planning Zone.

4.1.8 VOIT 5-3 – Near Stream Motorized Access

Reporting Requirement:

- Table with current near stream motorized access density by analysis unit (forestry access roads and DLOs).

Table 4-13. Near stream motorized access (forestry access roads and DLOs) density by analysis unit.

Analysis Unit	Road Length (km)	Total Area (km^2)	Density (km/km^2)
Crowsnest Watershed	19.0	236.7	0.080
Dutch Creek	10.7	168.5	0.064
Livingstone River	58.4	264.2	0.221
Racehorse Creek	3.8	276.5	0.014
South	7.1	106.2	0.067
Upper Oldman River	0.7	243.1	0.003
West	6.5	113.9	0.057
Total	**106.2**	**1,409.1**	**0.506**

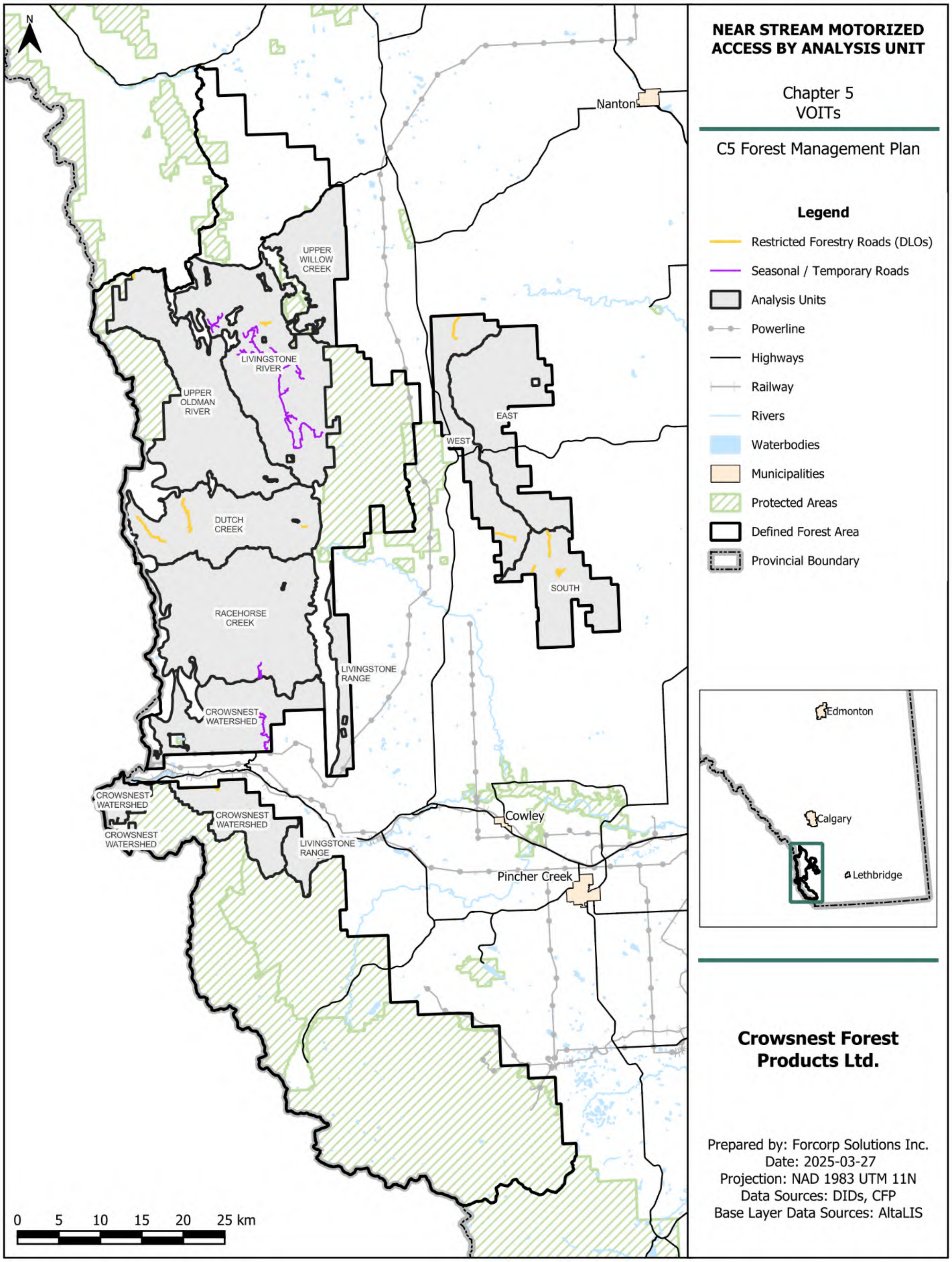

Figure 4-17. Near stream motorized access (forestry access roads and DLOs) density by analysis unit.

4.1.9 VOIT 6 – Uncommon Plant Communities

Reporting Requirement:

- Table with descriptive list and targets.
- Map(s) displaying known locations of uncommon plant communities.

Table 4-14. ACIMS non-sensitive occurrences within the DFA.

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Abies bifolia - Pinus albicaulis - Picea engelmannii / Empetrum nigrum forest	subalpine fir - whitebark pine - Engelmann spruce / crowberry forest	S2	2
Abies bifolia - Pinus flexilis - Populus tremuloides / Thalictrum venulosum forest	subalpine fir - limber pine - aspen / veiny meadow rue forest	S2?	1
Adenocaulon bicolor	pathfinder	S2	2
Adiantum aleuticum	western maidenhair fern	S2	2
Allantoparmelia alpicola	rock grubs	S2S3	1
Allocetraria madreporiformis	finger lichen	S2S3	3
Anoectangium aestivum	moss (no common name provided)	S2S3	1
Antennaria aromatica	scented pussytoes	S3	1
Antennaria corymbosa	corymbose everlasting	S2	1
Aquilegia jonesii	Jones' columbine	S1	2
Arnica parryi	nodding arnica	S2	5
Artemisia borealis ssp. borealis	northern wormwood	S2S3	2
Artemisia tridentata	big sagebrush	S2	2
Artemisia tridentata ssp. vaseyana - Amelanchier alnifolia shrubland	big sagebrush - saskatoon shrubland	S1	5
Artemisia tridentata ssp. vaseyana - Rhamnus alnifolia shrubland	big sagebrush - alder-leaved buckthorn shrubland	S1	2
Aspicilia pergibbosa	sunken disc lichen	S1S2	1
Aspicilia sublapponica	sunken disc lichen	S1	1
Athyrium distentifolium var. americanum	alpine lady fern	S1	1
Aulacomnium androgynum	little groove moss	S2S3	4
Bacidia hegetschweileri	dot lichen	S1	2
Biatora globulosa	lichen (no common name provided)	S1	1
Boechera calderi	Calder's rockcress	S2	1
Boechera lemmonii	Lemmon's rockcress	S3	2
Botrychium ascendens	ascending grape fern	S3	2
Botrychium campestre	field grape fern	S3	2
Botrychium hesperium	western grape fern	S3	1
Botrychium lineare	straight-leaf moonwort	S1	1
Botrychium michiganense	Michigan grapefern	SU	1
Botrychium spathulatum	spatulate grape fern	S3	2
Brachythecium frigidum	moss (no common name provided)	S1S2	1
Brickellia grandiflora	large-flowered brickellia	S2	1

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Bucklandiella sudetica	moss (no common name provided)	S2S3	1
Buxbaumia piperi	moss (no common name provided)	S1	1
Buxbaumia viridis	green shield moss	S1	1
Caloplaca chrysophthalma	firedot lichen	S1	1
Caloplaca citrina	powdery jewel lichen	S1S2	2
Caloplaca cladodes	firedot lichen	S1	1
Caloplaca flavovirescens	sulphur-firedot lichen	S2S3	1
Camassia quamash var. quamash	blue camas	S3	2
Carex geyeri	Geyer's sedge	S2	1
Carex infirminervia	weak-nerved sedge	S1	1
Carex mertensii	purple sedge	S2	4
Carex paysonis	Payson's sedge	S2	2
Carex petasata	pasture sedge	S3	1
Carex scoparia var. scoparia	broom sedge	S2	1
Catillaria nigroclavata	lichen (no common name provided)	S2	3
Ceanothus velutinus	snowbrush ceanothus	S2	6
Cetraria arenaria	sand-loving Iceland lichen	S1S2	3
Chaenotheca trichialis	stubble lichen	S2	1
Chaenotheca xyloxena	stubble lichen	S1	1
Cirsium scariosum	meadow thistle	S2	9
Clevea hyalina	liverwort (no common name provided)	S3	1
Collema crispum	crinkled jelly lichen	S1S2	1
Collema subparvum	jelly lichen	S1	1
Collema undulatum var. granulosum	jelly flakes lichen	S2S3	1
Conimitella williamsii	conimitella	S2	15
Conocephalum salebrosum	cat-tongue liverwort	S2S4	1
Crepis atribarba	slender hawk's-beard	S2	2
Cynodontium strumiferum	moss (no common name provided)	S2S3	1
Cyphelium inquinans	cupped soot lichen	S2	2
Cypripedium montanum	mountain lady's-slipper	S2	2
Dermatocarpon intestiniforme	leather lichen	S3	1
Deschampsia elongata	slender hair grass	S2	5
Dichodontium olympicum	moss (no common name provided)	S1	1
Dicranella crispa	curl-leaved fork moss	S2S3	1
Dicranella heteromalla	silky fork moss	S2S3	1
Dicranum pallidisetum	alpine curly heron's bill moss	S1S2	2
Dicranum tauricum	broken-leaf moss	S1S3	12
Didymodon tophaceus	blunt-leaved hair moss	S2S3	1
Didymodon vinealis	moss (no common name provided)	S2S3	1
Diplophyllum taxifolium	liverwort (no common name provided)	SU	1
Downingia laeta	downingia	S3	2
Draba densifolia	dense-leaved draba	S2	4
Draba porsildii	Porsild's draba	S3	1

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Elymus elymoides ssp. elymoides	squirreltail	S2S3	2
Elymus scribneri	Scribner's wheat grass	S2	13
Encalypta brevicollis	candle-snuffer moss	S2S3	1
Encalypta spathulata	candle-snuffer moss	S2S3	1
Endocarpon tortuosum	stippled lichen	S1S2	2
Epilobium glaberrimum ssp. fastigiatum	glaucous willowherb	S1	1
Erigeron divergens	diffuse fleabane	S1	1
Erigeron flagellaris	creeping fleabane	S2	1
Erigeron lackschewitzii	front-range fleabane	S1	1
Erigeron ochroleucus	buff fleabane	S1	2
Erigeron trifidus	trifid-leaved fleabane	S3	1
Farnoldia hypocrita	lichen (no common name provided)	S1	1
Festuca minutiflora	tiny-flowered fescue	S2	1
Festuca occidentalis	western fescue	S2	6
Festuca subulata	bearded fescue	S1	3
Fissidens crispus	moss (no common name provided)	S2	1
Fontinalis neomexicana	moss (no common name provided)	S1S2	1
Galium bifolium	two-leaved bedstraw	S1	2
Gayophytum racemosum	racemose groundsmoke	S1	2
Gentiana calycosa	mountain gentian	S2	1
Grimmia alpestris	alpine grimmia moss	SU	2
Grimmia anomala	mountain forest grimmia moss	S2S3	1
Grimmia donniana	Donian grimmia moss	S1S2	5
Grimmia ramondii	spreading fringe moss	S1S2	1
Hennediella heimii	long-stalked beardless moss	S2S3	1
Homalothecium nevadense	moss (no common name provided)	S1S2	2
Hygrohypnum styriacum	moss (no common name provided)	S1S2	2
Hypogymnia wilfiana	deflated tube lichen	S2S3	1
Hypopitys monotropa	pinesap	S3	4
Jaffueliobryum wrightii	moss (no common name provided)	S1S2	1
Juncus parryi	Parry's rush	S2	6
Juncus regelii	Regel's rush	S1	2
Jungermannia atrovirens	liverwort (no common name provided)	SU	2
Jungermannia leiantha	liverwort (no common name provided)	SU	1
Jungermannia sphaerocarpa	liverwort (no common name provided)	SU	1
Larix occidentalis	western larch	S2	3
Larix occidentalis / Rubus parviflorus forest	western larch / thimbleberry forest	S1	3
Lecanora hypoptoides	rim-lichen	S2	1
Lecanora pringlei	rim-lichen	S1S2	1
Lecidea lithophila	disk lichen	S2	1
Lecidella patavina	disk lichen	S1S2	2

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Lecidoma demissum	brown earth-crust	S2	2
Lepraria incana	dust lichen	S3	2
Leptogium gelatinosum	jellyskin lichen	S2S3	1
Leptosiphon septentrionalis	northern linanthus	S2	1
Leskeella nervosa	moss (no common name provided)	S2S3	1
Lewisia pygmaea	alpine lewisia	S2	11
Lithophragma glabrum	rockstar	S2	3
Lithophragma parviflorum	small-flowered rockstar	S2	7
Lupinus lepidus	alpine lupine	S2	3
Lupinus minimus	least lupine	S2	5
Lupinus wyethii	Wyeth's lupine	S1	1
Melanohalea subelegantula	camouflage lichen	S3	1
Melica smithii	Smith's oniongrass	S2	2
Melica spectabilis	onion grass	S2	9
Mertensia lanceolata	lance-leaved lungwort	S2	9
Mertensia longiflora	large-flowered lungwort	S2	11
Micarea assimilata	assimilative dot lichen	S2	1
Micranthes odontoloma	brook saxifrage	S2	8
Microseris nutans	nodding microseris	S2	7
Microsteris gracilis ssp. gracilis	slender phlox	S1	9
Mimulus floribundus	small yellow monkeyflower	S2	2
Mimulus tilingii	large mountain monkeyflower	S1	4
Montia linearis	linear-leaved montia	S2	1
Montia parvifolia	small-leaved montia	S1	1
Mycoblastus sanguinarius	bloody-heart lichen	S2	2
Mycocalicium subtile	lichen (no common name provided)	S2S4	2
Myurella tenerrima	moss (no common name provided)	S2S3	2
Nemophila breviflora	small baby-blue-eyes	S3	17
Neottia banksiana	western twayblade	S2	5
Neottia convallarioides	broad-lipped twayblade	S2	6
Nodobryoria abbreviata	tufted foxtail lichen	S1S2	3
Nodobryoria subdivergens	foxtail lichen	SU	1
Nothocalais cuspidata	prairie false dandelion	S2	1
Ochrolechia frigida	arctic saucer lichen	SU	2
Orthotrichum pallens var. pallens	moss (no common name provided)	S2S3	1
Packera contermina	Arctic butterweed	S2	13
Packera subnuda var. subnuda	alpine meadow groundsel	S2	6
Papaver pygmaeum	dwarf alpine poppy	S1	7
Pellaea glabella ssp. simplex	smooth cliff brake	S2	1

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Peltigera cinnamomea	cinnamon dog pelt lichen	S2S3	1
Penstemon eriantherus	crested beardtongue	S2	2
Phacelia linearis	linear-leaved scorpionweed	S3	3
Phacelia lyallii	Lyall's scorpionweed	S2	3
Phaeophyscia sciastra	dark shadow lichen	S3	1
Phaeorrhiza sareptana	lichen (no common name provided)	SU	1
Physcomitrium pyriforme	urn moss	S2	1
Pinus albicaulis	whitebark pine	S3	149
Pinus albicaulis / Juniperus communis - Arctostaphylos uva ursi woodland	whitebark pine / ground juniper - common bearberry woodland	S2S3	2
Pinus flexilis	limber pine	S3	84
Pinus monticola	western white pine	S2	1
Piperia unalascensis	Alaska bog orchid	S2	5
Piptatherum exiguum	little rice grass	S2	5
Placidium lachneum	earthscale lichen	S1S2	1
Placynthium asperellum	ink lichen	SU	1
Poa stenantha	narrow-flowered bluegrass	S2	1
Pohlia atropurpurea	moss (no common name provided)	S2	1
Pohlia longicollis	moss (no common name provided)	S2	1
Polygonum austiniae	Austin's knotweed	S1	1
Polygonum engelmannii	Engelmann's knotweed	S2	2
Polygonum minimum	least knotweed	S2	4
Polysporina arenacea	cobblestone lichen	S2	1
Populus tremuloides / Rubus parviflorus forest	aspen / thimbleberry forest	S2	4
Porella cordaeana	liverwort (no common name provided)	SU	4
Porella platyphylla	liverwort (no common name provided)	SU	1
Potentilla flabellifolia	fanleaf cinquefoil	S1	1
Potentilla multisecta	smooth-leaved cinquefoil	S2	4
Potentilla pulcherrima	soft cinquefoil	S1	1
Potentilla villosa	hairy cinquefoil	SU	3
Pseudognaphalium macounii	Macoun's rabbit-tobacco	SH	1
Pseudoleskea patens	moss (no common name provided)	S1S2	2
Pseudoleskea stenophylla	moss (no common name provided)	S2S3	2
Pseudotsuga menziesii - Pinus flexilis / Juniperus communis / Festuca campestris woodland	Douglas-fir - limber pine / ground juniper / mountain rough fescue woodland	S2	2
Psora globifera	blackberry scale	S1S2	1
Psora nipponica	butterfly scale	S2S3	3
Pteridium aquilinum var. pubescens	bracken fern	SU	1

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Ptychostomum calophyllum	matted bryum	S2	1
Pyrola picta	white-veined wintergreen	S1	2
Radula complanata	liverwort (no common name provided)	SU	2
Ramboldia elabens	crimson dot lichen	S2	1
Ranunculus glaberrimus	early buttercup	S3	2
Rhamnus alnifolia Shrubland	alder-leaved buckthorn shrubland	S1S2	1
Rhizocarpon badioatrum	lichen (no common name provided)	S1	1
Rhizocarpon pusillum	map lichen	S1?	1
Rhizocarpon superficiale	map lichen	S2	1
Rhizocarpon umbilicatum	map lichen	S1	1
Rhizomnium magnifolium	moss (no common name provided)	S2S3	1
Rhizomnium nudum	moss (no common name provided)	S2S3	4
Rhytidiadelphus squarrosus	pipecleaner moss	S1S2	1
Ribes inerme var. inerme	mountain gooseberry	S2?	1
Rinodina archaea	brown pepper-spore lichen	S2	1
Rinodina colobina	pepper-spore lichen	S1	1
Rinodina confragosa	pepper-spore lichen	S1	1
Romanzoffia sitchensis	Sitka romanzoffia	S2	7
Rorippa tenerrima	slender cress	S3	1
Salix drummondiana / Calamagrostis canadensis Shrubland	Drummond's willow / bluejoint shrubland	S1	1
Sarcogyne privigna	stepdaughter grain-spored lichen	S1	1
Sarcogyne regularis	grain-spored lichen	S1S3	1
Saxifraga mertensiana	Merten's saxifrage	S1	3
Scapania curta	liverwort (no common name provided)	S2S3	2
Scapania cuspiduligera	liverwort (no common name provided)	SU	1
Scapania subalpina	liverwort (no common name provided)	SU	2
Schistidium pulvinatum	moss (no common name provided)	SU	1
Sciuro-hypnum hylotapetum	moss (no common name provided)	S1S3	10
Sciuro-hypnum reflexum	cedar moss	S2S3	2
Sedum divergens	spreading stonecrop	S2	1
Seligeria campylopoda	moss (no common name provided)	S2S3	1
Seligeria donniana	Donian beardless moss	S2S3	1
Senecio megacephalus	large-flowered ragwort	S1	3
Stereocaulon rivulorum	snow foam lichen	S3	1
Suksdorfia ranunculifolia	suksdorfia	S1	7
Suksdorfia violacea	blue suksdorfia	S1	2
Tellima grandiflora	fringe-cups	S1	1
Tephromela atra	black-eye lichen	S2S4	1

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Tetraplodon urceolatus	alpine lemming moss	S2S3	1
Thamnolia vermicularis	whiteworm lichen	S2S3	1
Thrombium epigaeum	epigeal clot lichen	S2	1
Thuja plicata	western red cedar	S2	10
Tortula leucostoma	moss (no common name provided)	S2S3	1
Tortula systylia	moss (no common name provided)	S2S3	2
Townsendia condensata	alpine townsendia	S2	7
Trisetum canescens	tall trisetum	S2	3
Trisetum cernuum	nodding trisetum	S2	6
Umbilicaria americana	American rock tripe lichen	S2S3	3
Umbilicaria angulata	rock tripe	S1S2	2
Umbilicaria lyngei	rock tripe	SU	1
Viola glabella	yellow wood violet	S2	5
Viola praemorsa ssp. linguifolia	broad leaved yellow prairie violet	S2	4
Vulpicida canadensis	brown-eyed sunshine lichen	S2S3	2
Xerophyllum tenax Herbaceous Vegetation	bear-grass herbaceous vegetation	S1S2	1

Table 4-15. ACIMS sensitive occurrences within the DFA.

Latin Name(s)	Common Name	Species Rank	Number of Occurrences
Aquilegia jonesii	Jones' columbine	S1	1
Microseris nutans	nodding microseris	S2	1

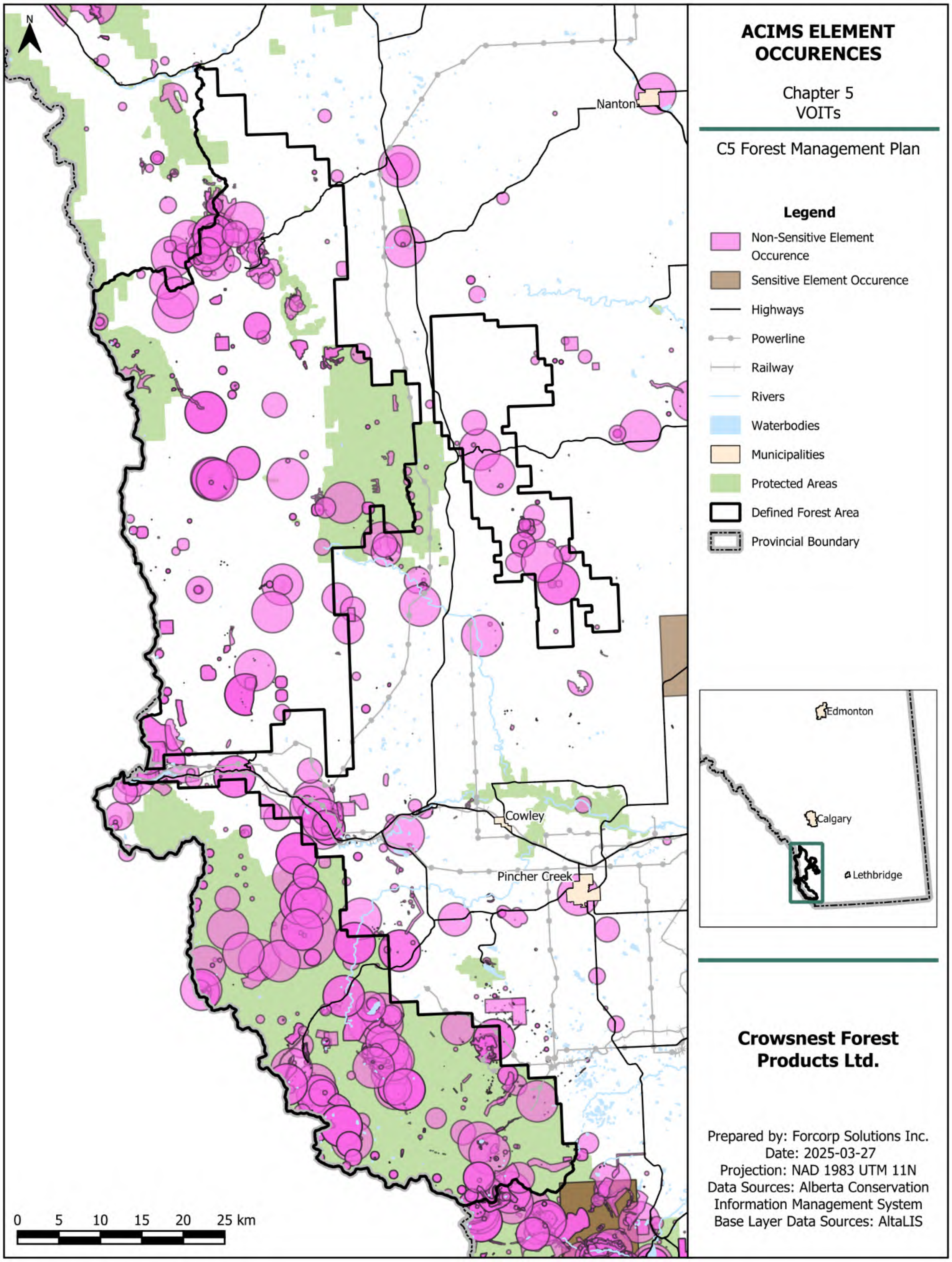

Figure 4-18. ACIMS non-sensitive and sensitive occurrences within and surrounding the DFA.

4.1.10 VOIT 7 – Unsalvaged Burned Forest

Reporting Requirement:

- Table of wildfire events within the last 10 years showing area (ha) and proportion (%) of salvaged and unsalvaged.
- Map(s) displaying wildfire events within the last 10 years showing salvaged and unsalvaged.

See *Chapter 3 – Landscape Assessment* Section 5.5. In the DFA, a total of 215 ha burned from 2013 to 2022 (Table 4-16) and none of this area was salvage logged.

Table 4-16. Number and size of wildfires within the DFA.

			Within the DFA			
Year	Number of Wildfires	Total Wildfire Area (ha)	Area Burned (ha)	Average Wildfire Size (ha)	Maximum Wildfire Size (ha)	Wildfire in DFA (%)
2015	2	7	7	3	4	100
2017	2	173	157	79	149	91
2018	4	25	24	6	10	99
2019	1	1	1	1	1	100
2021	2	25	25	12	17	100
Total	**11**	**231**	**215**	**20**	**36**	**98**

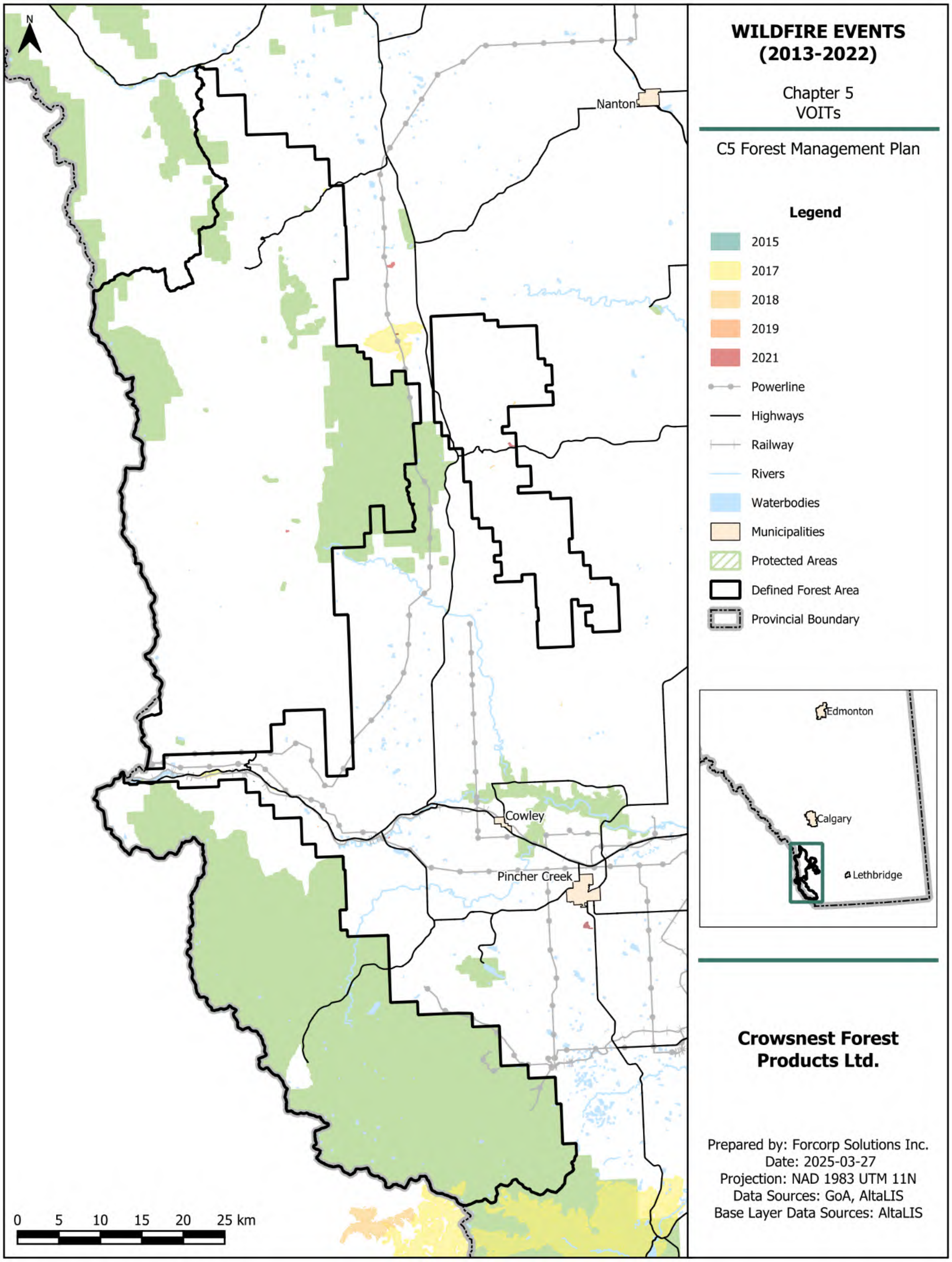

Figure 4-19. Wildfire events within the past 10 years.

4.1.11 VOIT 8 – Unsalvaged Blowdown

Reporting Requirement:

- Table of blowdown events within the last 10 years showing area (ha) and proportion (%) of salvaged and unsalvaged.
- Map(s) displaying blowdown events within the last 10 years showing salvaged and unsalvaged.

There were no blowdown events reported in the DFA from 2013 to 2022.

4.1.12 VOIT 14-1 – Species at Risk

Reporting Requirement:

- Table and maps of current (time zero) and future (10 and 20 years) landscape condition for core and secondary habitat zones, core and secondary sink zones, non-critical habitat, and road density.
- Tables of breeding pairs (habitat) and RSF at 0, 10, 20, 50, 100 and 200 years and maps of RSF value and breeding pairs at 0, 10, 20 and 50 years for barred owl.
- Tables of habitat suitability at 0, 10, 20, 50, 100 and 200 years and maps of habitat suitability at 0, 10, 20 and 50 years for marten.
- Tables of relative abundance at 0, 10, 20, 50, 100 and 200 years and maps of relative abundance at 0, 10, 20 and 50 years for varied thrush, ovenbird, and brown creeper.
- Map of Whitebark and Limber Pine distribution (contributing/non-contributing), long term monitoring installations, research/restoration, and plus tree sites.

4.1.12.1 Grizzly Bear

The grizzly bear (*Ursus arctos horribilis*) was officially classified as *Threatened* in Alberta in 2010. The main sources of mortality for grizzly bears are poaching, accidental collisions with highway vehicles or trains, self-defence kills, and mistaken identity kills from black bear hunters (Government of Alberta, 2016).

In response to declining populations in Alberta, a 5-year recovery plan was developed (Alberta Sustainable Resource Development, Fish and Wildlife Division, 2008), followed by an updated plan in 2016 (Alberta Environment and Parks, 2016). This plan builds on the previous one by creating clearly defined grizzly bear management zones and by setting road density thresholds. Within these zones, the density of open routes is to be maintained below 0.6 km/km^2 in core areas, and below 0.75 km/km^2 in secondary areas (Government of Alberta, 2019). Open routes are defined in the Recovery Plan as “roads and trails (including seismic lines) on which motorized travel is possible and permissible.”

fRI Research has provided the 2018 GBTools model package, which includes several different tools to help assess the potential impact of the planned harvest outlined in the FMP on Grizzly Bear habitat metrics. For reporting we used the *Habitat States* tool (fRI Research Grizzly Bear Program, 2019). The *Habitat States* tool combines a Resource Selection Function (RSF) model, which is used to represent habitat quality, and a mortality risk model, which is used to represent habitat security (or more specifically risk of human-caused mortality). Habitat quality is classified as non-critical, secondary, or primary habitat. However, if mortality risk is high, primary and secondary habitat are classified as primary or secondary sink (i.e. good quality but high risk, Figure 4-20).

There are some model limitations to consider when reviewing the model outputs:

- Outside of the Natural Region of Upper Foothills, which makes up 0% of the DFA, the fRI model may result in unrealistic outputs (Government of Alberta, 2019).
- The mortality risk model relies upon a ‘proximity to roads and trails’ dataset. We were unable to adjust this dataset and it contains some open roads and trails that are closed or have been removed from the landscape. These inconsistencies may affect model outputs for habitat state.

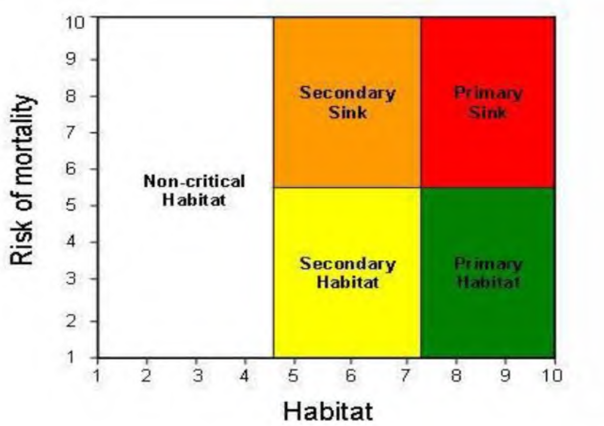

Figure 4-20. The possible classifications of habitat in the Habitat States model, depending on the values for mortality risk and habitat quality (fRI Research Grizzly Bear Program, 2019).

Road Density

Road density calculations are based on AltaLIS base features. Roads considered impassable to vehicle traffic because of reclamation or gates were classified as closed. Total road densities in the portions of the grizzly bear population units overlapping the DFA, were between 0.027 and 0.255 km/km^2, well under the 0.6 km/km^2 open road threshold identified in the recovery plan (Table 4-17).

Table 4-17. Current road density in the parts of the DFA overlapping with the Livingstone and Waterton grizzly bear population units.

Population Unit	Habitat Zone	Total Road Length (km)	Total Road Density (km/km^2)
Livingstone	Core	365	0.175
	Secondary	53	0.255
Waterton	Core	32	0.027

Habitat State

Of the seven bear management areas, two overlap the CFP DFA: Livingstone and Waterton. The total size of the Livingstone population unit is 493,575 ha (Core: 472,708 ha and Secondary: 20,867 ha), of which 229,584 ha or 46.5% (Core: 208,769 ha and Secondary 20,905 ha) falls within the DFA. The total size of the Waterton population unit is 131,485 ha (Core: 131,485 ha, Secondary: 0 ha), of which 120,368 ha or 91.5% (Core: 13,121 ha and Secondary: 0 ha) falls within the DFA. Summaries of the output from the *Habitat States* model are presented in Table 4-18 and Table 4-19.

Table 4-18. Grizzly bear Habitat States model summary for the Livingstone management zone.

Habitat Zone	Habitat Type	2021 Area (ha)	2031 Area (ha)	2031 Difference from Year 0 (ha)	2031 Change from Year 0 (%)	2041 Area (ha)	2041 Difference from Year 0 (ha)	2041 Change from Year 0 (%)
Core	Primary	81,293	84,828	3,535	4	84,617	3,324	4
	Secondary	11,550	8,495	-3,055	-26	7,995	-3,554	-31
	Non-Critical	19,210	18,788	-422	-2	20,329	1,119	6
	Secondary Sink	11,010	7,143	-3,867	-35	6,726	-4,284	-39
	Primary Sink	33,227	37,034	3,807	11	36,623	3,395	10
Secondary	Primary	2	2	0	0	2	0	0
	Secondary	14	13	-1	-7	13	-1	-7
	Non-Critical	20,676	20,687	11	0	20,689	13	0
	Secondary Sink	154	143	-11	-7	141	-13	-8
	Primary Sink	23	24	1	4	24	0	0

Table 4-19. Grizzly bear Habitat States model summary for the Waterton management zone.

Habitat Zone	Habitat Type	2021 Area (ha)	2031 Area (ha)	2031 Difference from Year 0 (ha)	2031 Change from Year 0 (%)	2041 Area (ha)	2041 Difference from Year 0 (ha)	2041 Change from Year 0 (%)
Core	Primary	4,087	4,785	698	17	5,535	1,447	35
	Secondary	2,058	2,551	493	24	2,641	584	28
	Non-Critical	4,349	3,220	-1,130	-26	2,398	-1,951	-45
	Secondary Sink	1,106	1,061	-45	-4	1,074	-32	-3
	Primary Sink	1,521	1,504	-16	-1	1,472	-48	-3

In the Livingstone population, the *Habitat States* model predicted an increase in primary habitat and primary sink and a decrease in secondary habitat and secondary sink over the 20 years analyzed. This is primarily due the conversion of non-critical habitat to either primary habitat or primary sink, depending on mortality risk. Overall, the PFMS resulted in mixed responses to habitat quality with quality increasing in some areas but decreasing in others (Figure 4-21) and minimal overall change to both habitat quality and mortality risk (Figure 4-22).

In the Waterton population, the *Habitat States* model predicted an increase in primary and secondary habitat and small reductions in sink habitat. Habitat quality increased in most areas though some areas showed a reduction (Figure 4-23). There was an overall reduction in mortality risk (Figure 4-24).

Based on the projected changes in modelled habitat, the PFMS risk to grizzly bears is considered low.

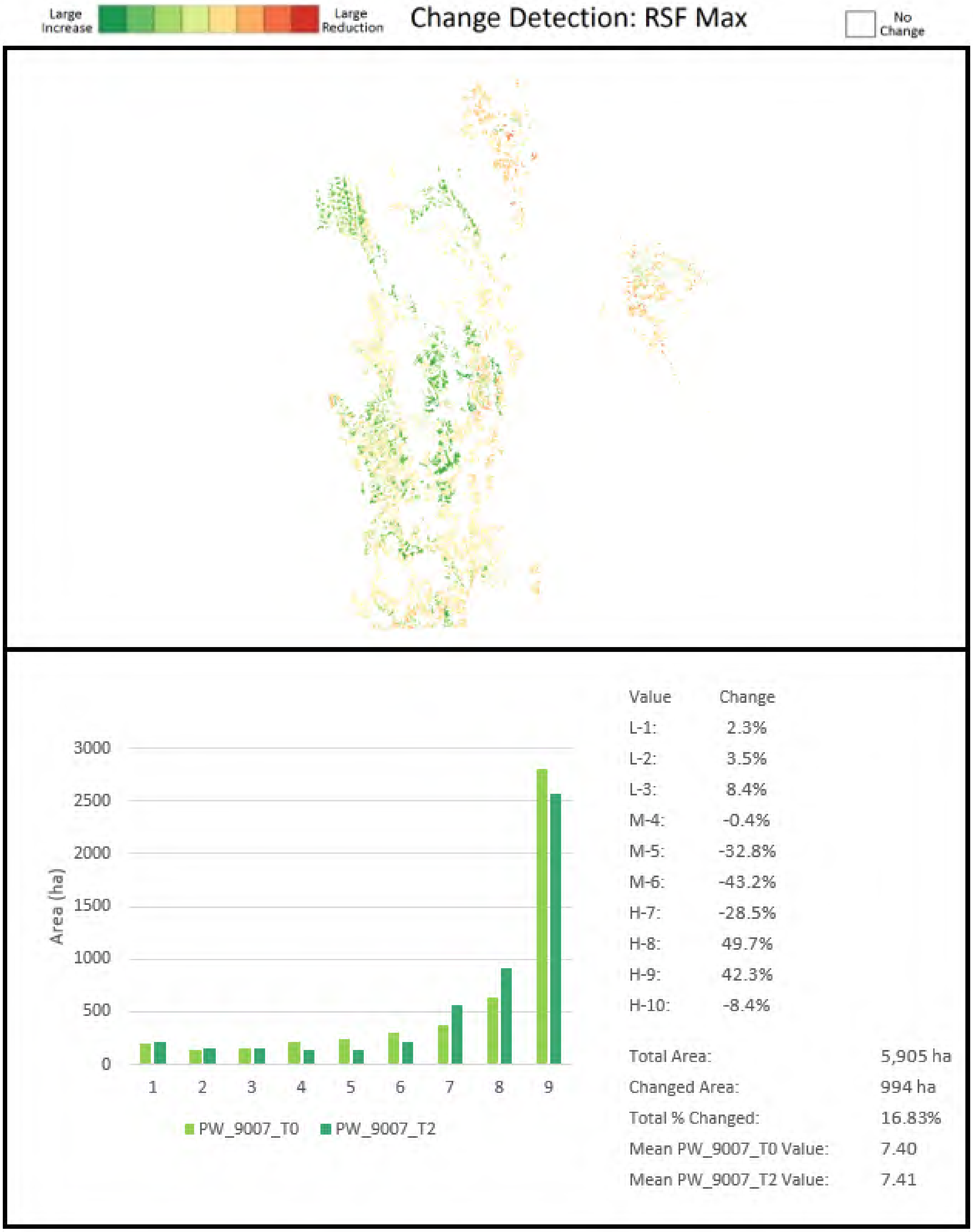

Figure 4-21. The change in forecasted RSF Max for the Livingstone population between 2023 and 2043 as a result of the PFMS.

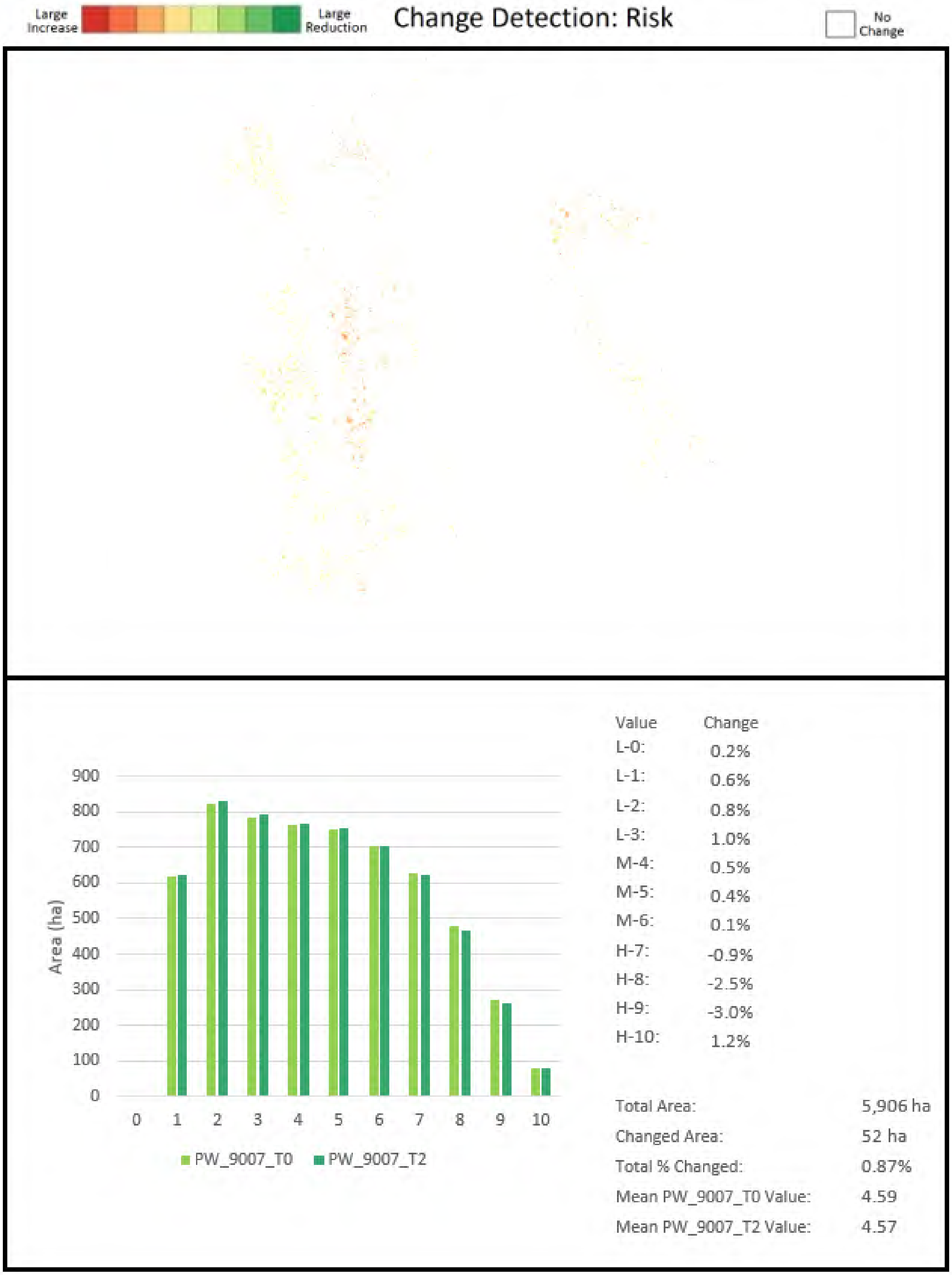

Figure 4-22. The change in forecasted Mortality Risk for the Livingstone population between 2023 and 2043 as a result of the PFMS.

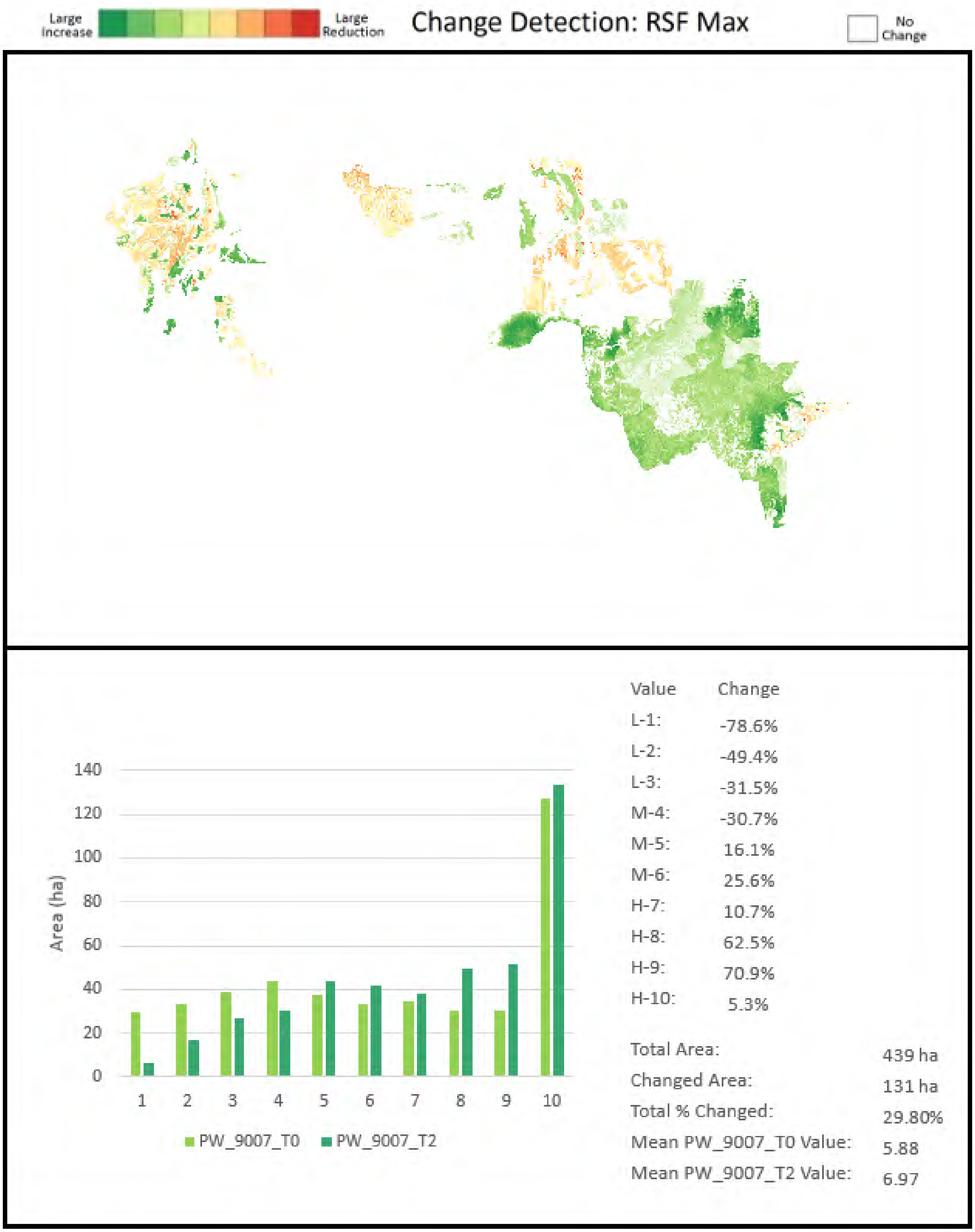

Figure 4-23. The change in forecasted RSF Max for the Waterton population between 2023 and 2043 as a result of the PFMS.

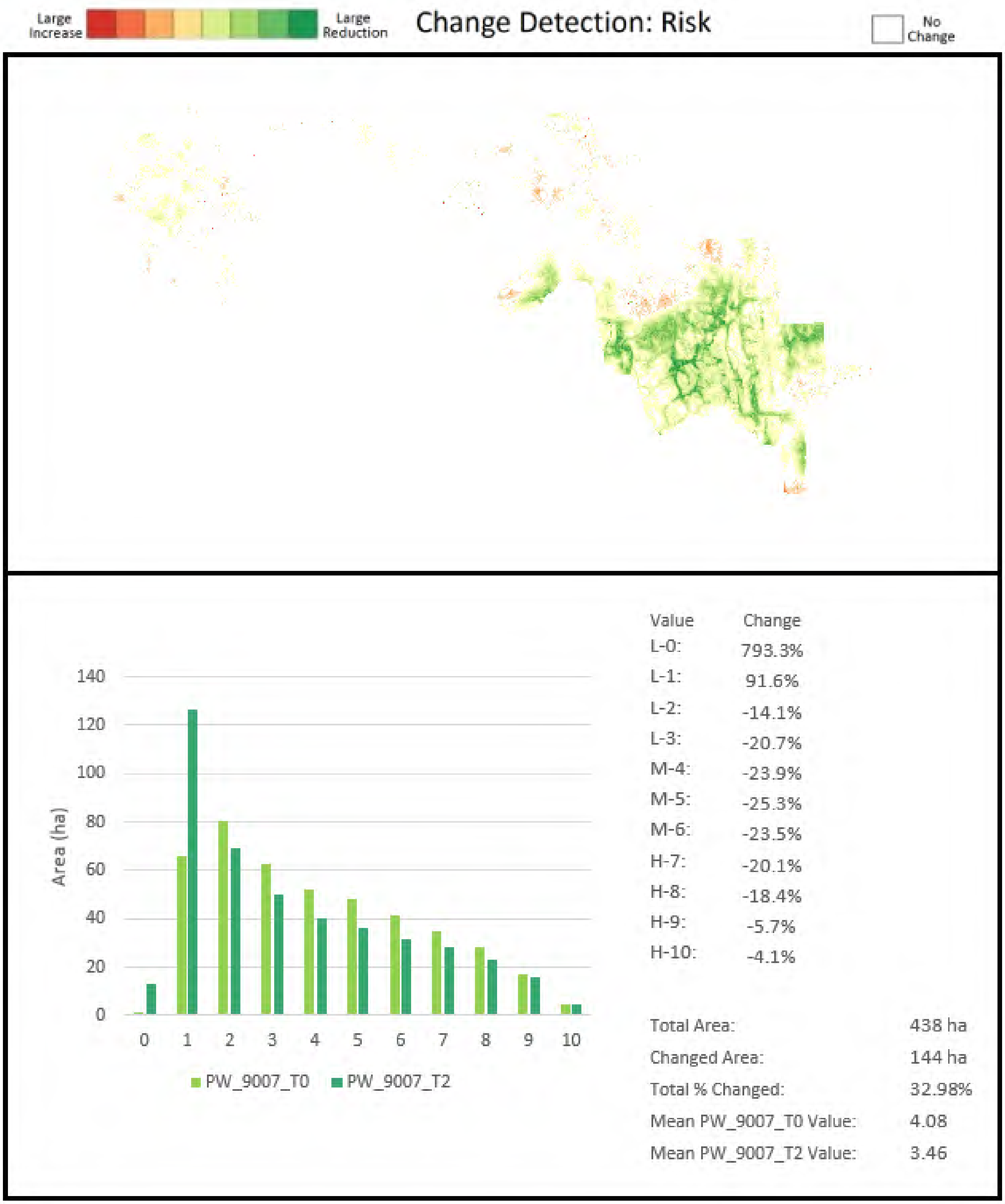

Figure 4-24. The change in forecasted Mortality Risk for the Waterton population between 2023 and 2043 as a result of the PFMS.

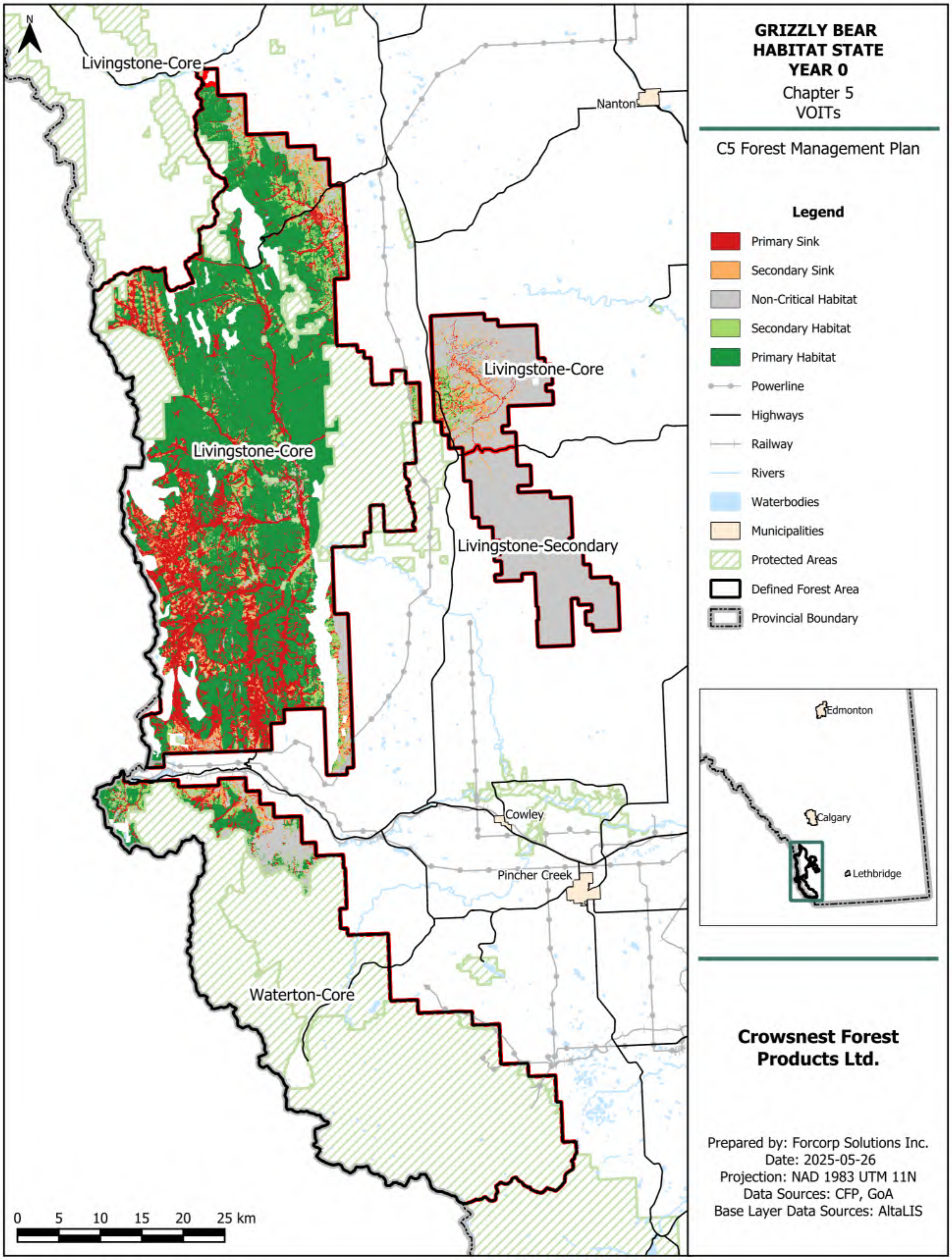

Figure 4-25. Grizzly bear habitat state in 2023.

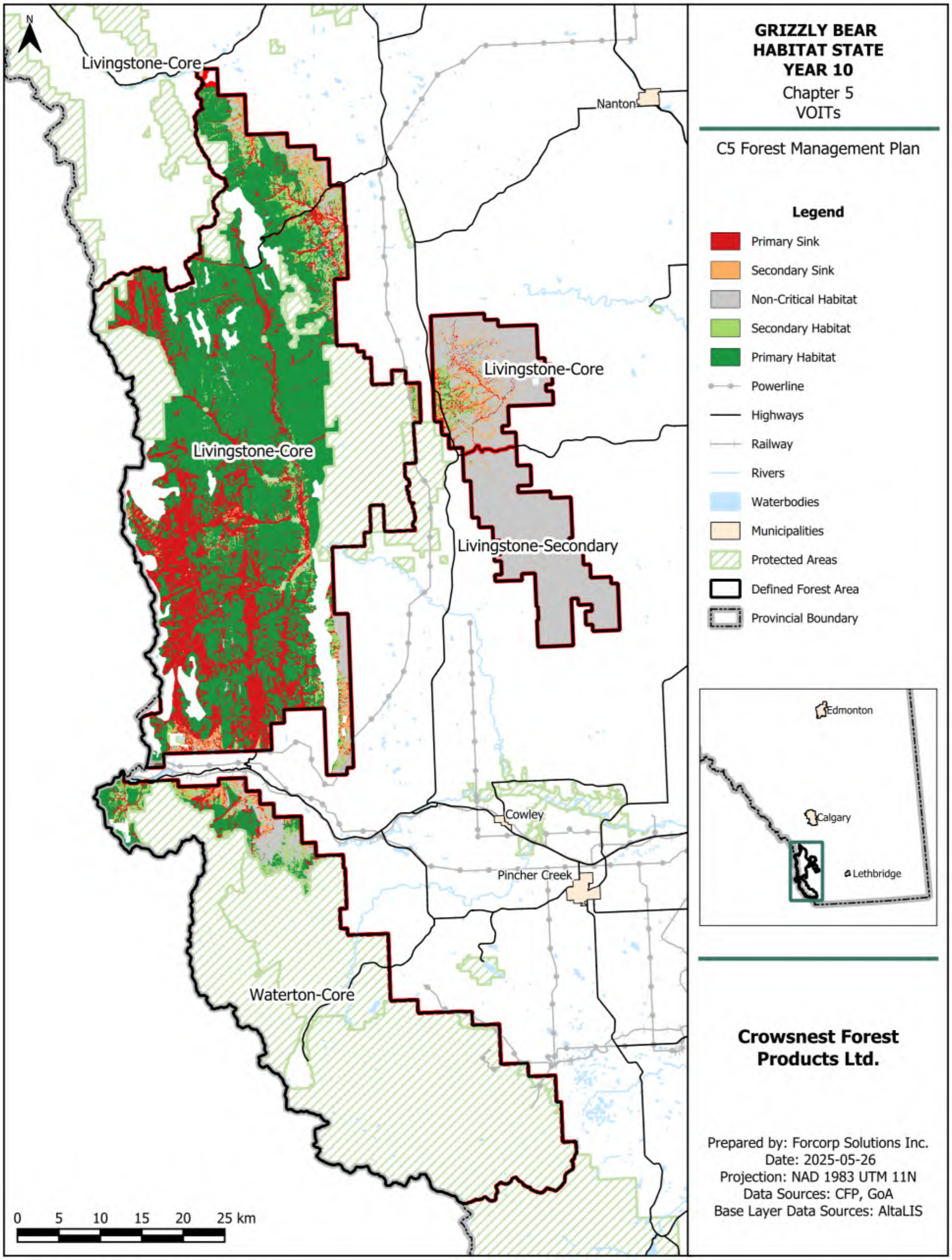

Figure 4-26. Grizzly bear habitat state in 2033.

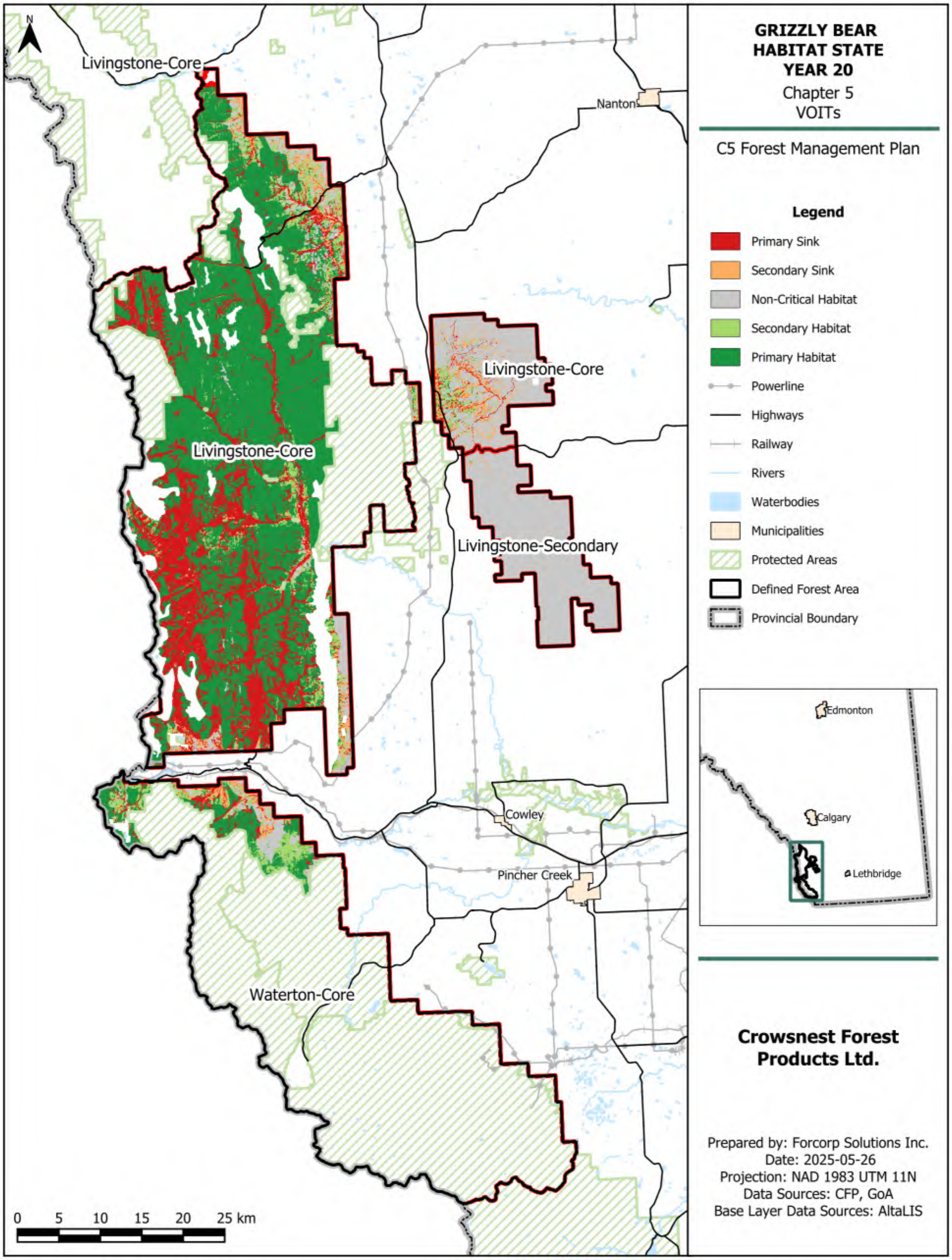

Figure 4-27. Grizzly bear habitat state in 2043.

4.1.12.2 Barred Owl

The barred owl (*Strix varia*) has been listed as a *Species of Special Concern* in Alberta and a conservation management plan is available for the species. Barred owls prefer old forests with a mix of large deciduous trees and snags, and old conifer forest. They nest in natural cavities of large balsam poplar and trembling aspen. The barred owl's large territories make it an indicator or focal species for the wider assemblage of species that rely on old mixedwood forests (Alberta Environment and Parks, 2016).

The GoA provided models for assessing habitat value (using an RSF) and predicting the potential number of breeding pairs as the landscape changes. Results are displayed in Table 4-20.

To determine the number of breeding pairs, the following post-processing calculation was carried out:

Using the "BREEDPAIR" raster, take the number under "Count" for Value 1 (e.g. 4,793,719), multiple it by the raster grid size (15m by 15m = 225 m^2) and then divide by 10,000 to get the number in hectares.

e.g. (4,793,719 x 225)/10,000 = 107,858.7

Then divide this number by 562 ha (Russel, 2008).

e.g. 107,858.7/562 = 191.9

Round the number, and this gives you the number of breeding pairs.

e.g. 192

The time 10, 20, 50, 100 and 200 outputs of the model were post-processed from the Patchworks model output for the preferred forest management scenario (PFMS) and time period. All time periods were run on the gross landbase, which was aged for each time period processed.

Table 4-20. Results from the barred owl habitat model for breeding pairs and RSF.

	Metric	Year 0	Year 10	Year 20	Year 50	Year 100	Year 200
Breeding	Raster Value Total	126,681	213,934	272,600	298,413	304,399	295,703
	Potential No. Breeding Pairs	5	9	11	12	12	12
	% Change from Time 0	0	80	120	140	140	140
RSF	Mean	0.05	0.051	0.051	0.051	0.05	0.049
	Standard Deviation	0.064	0.067	0.07	0.074	0.074	0.071
	% Change from Time 0	0	3	3.2	2.4	1.5	-0.9

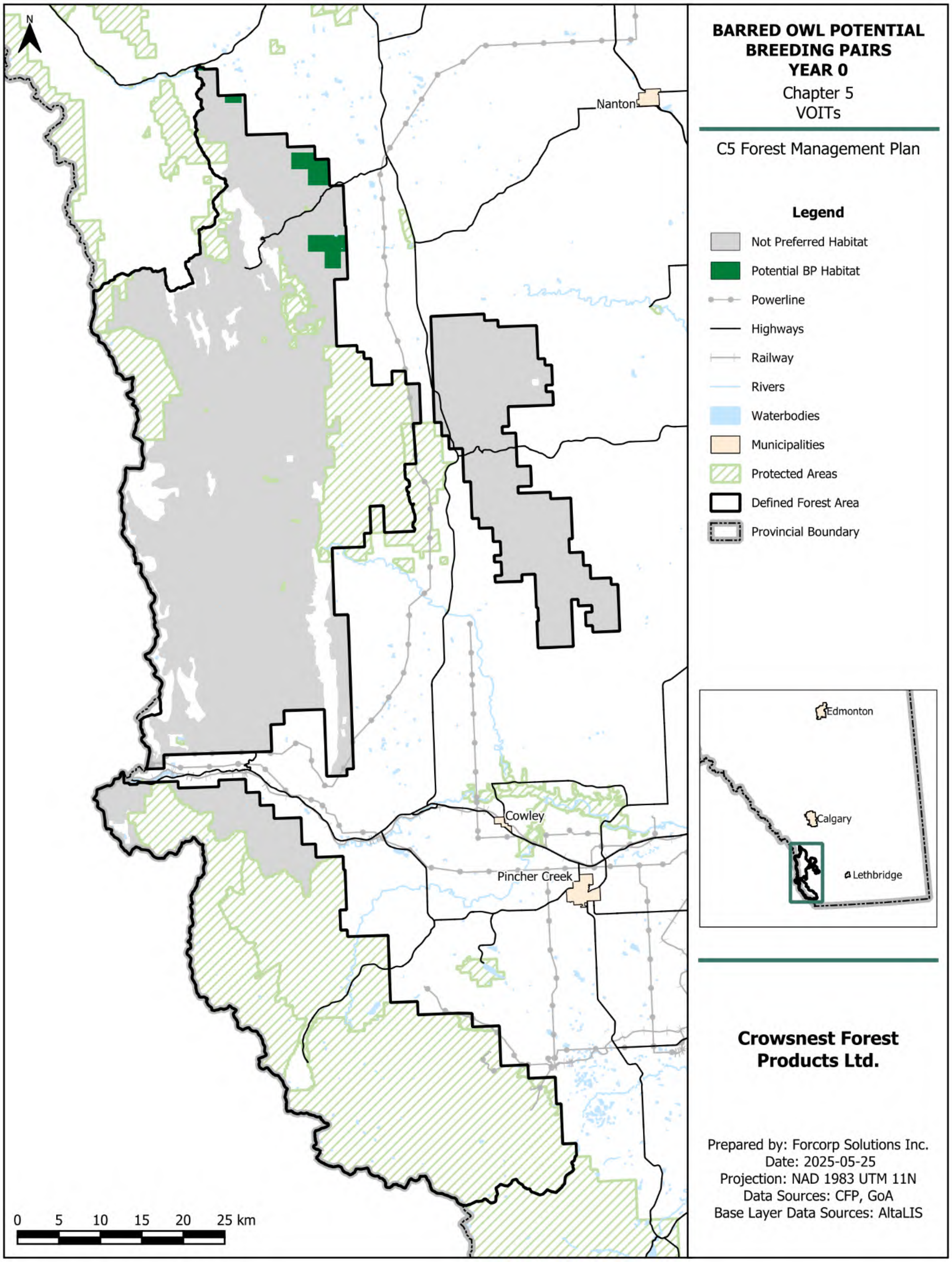

Figure 4-28. Barred owl potential breeding pairs in 2023.

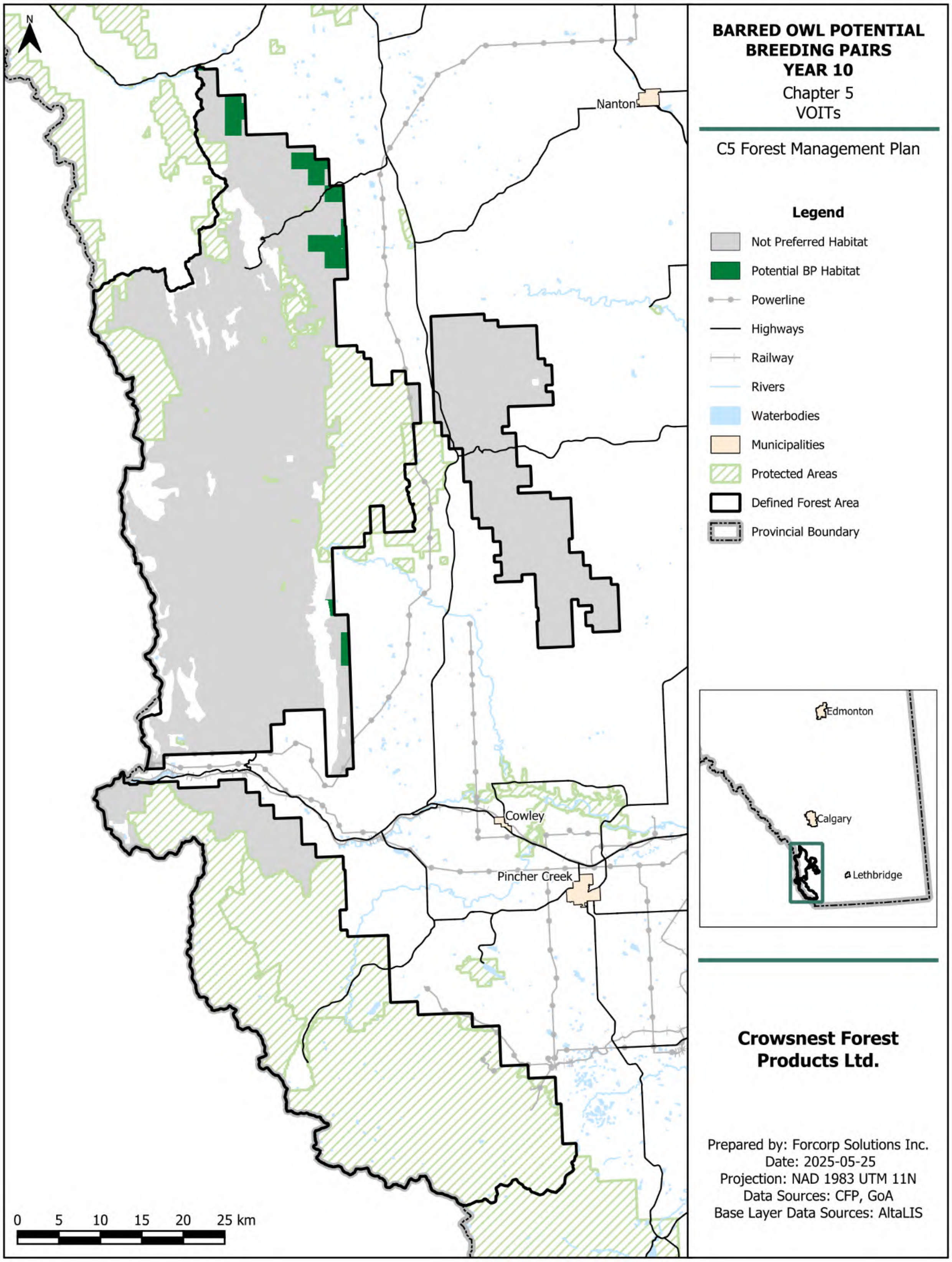

Figure 4-29. Barred owl potential breeding pairs in 2033.

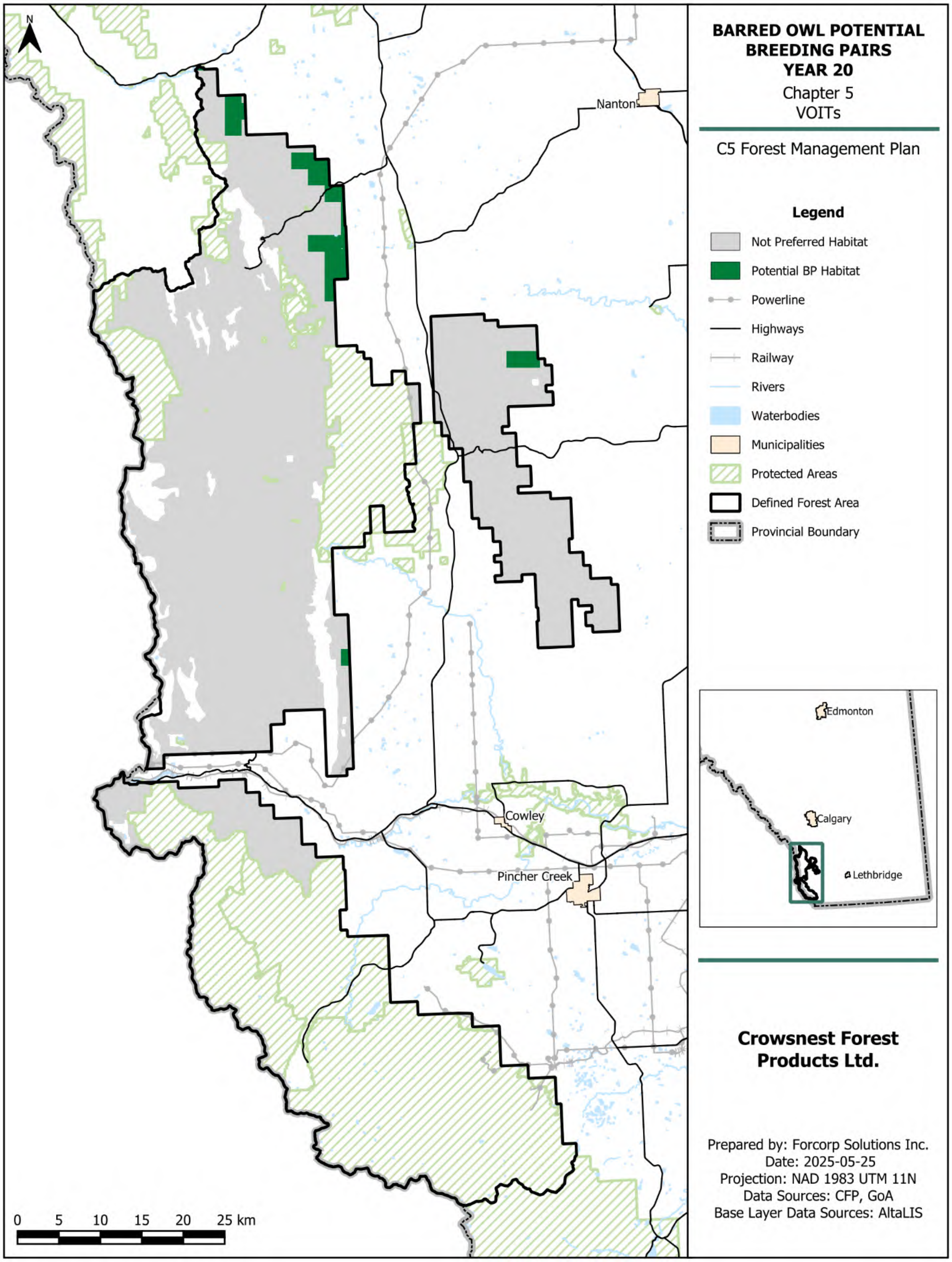

Figure 4-30. Barred owl potential breeding pairs in 2043.

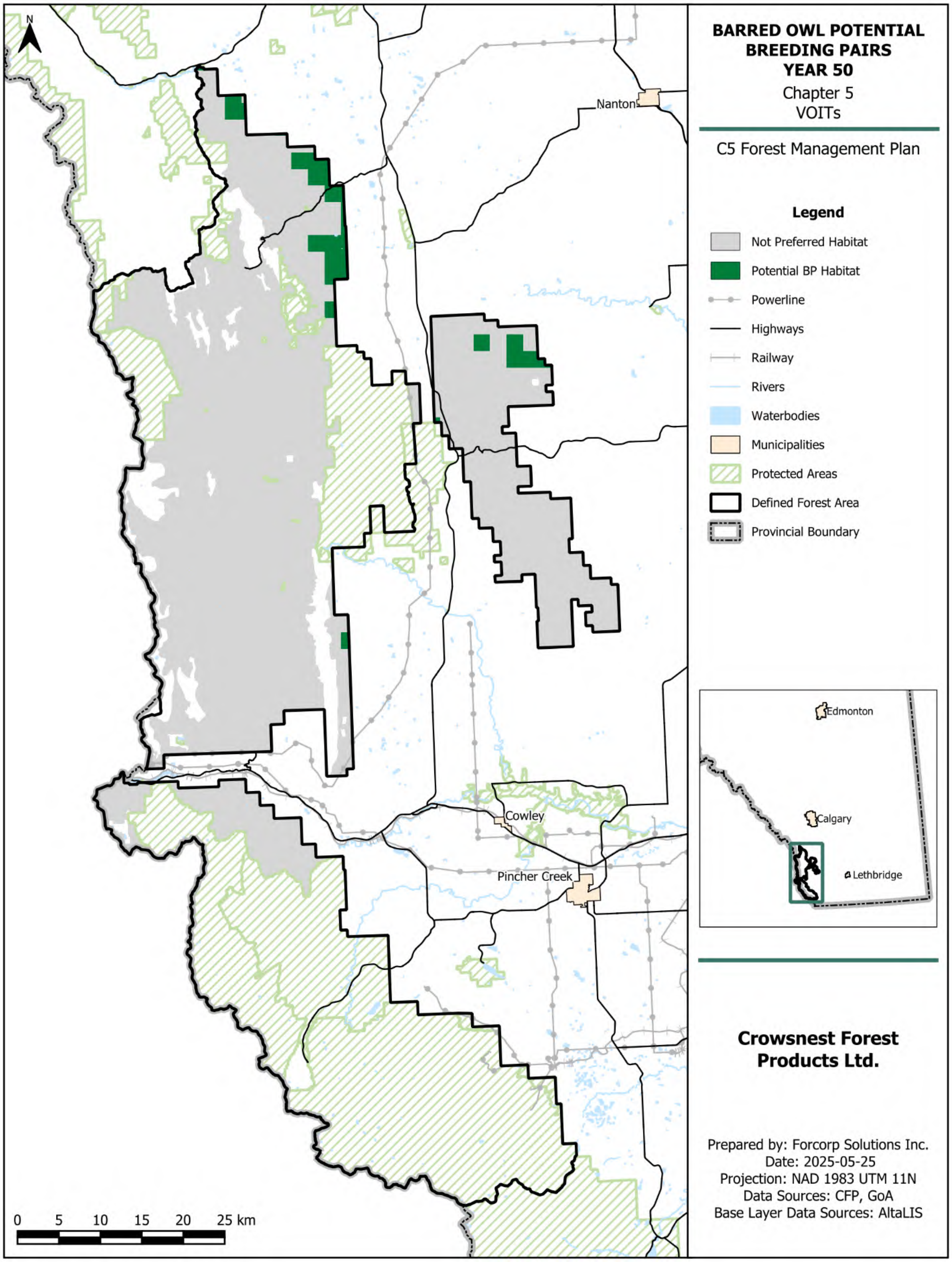

Figure 4-31. Barred owl potential breeding pairs in 2073.

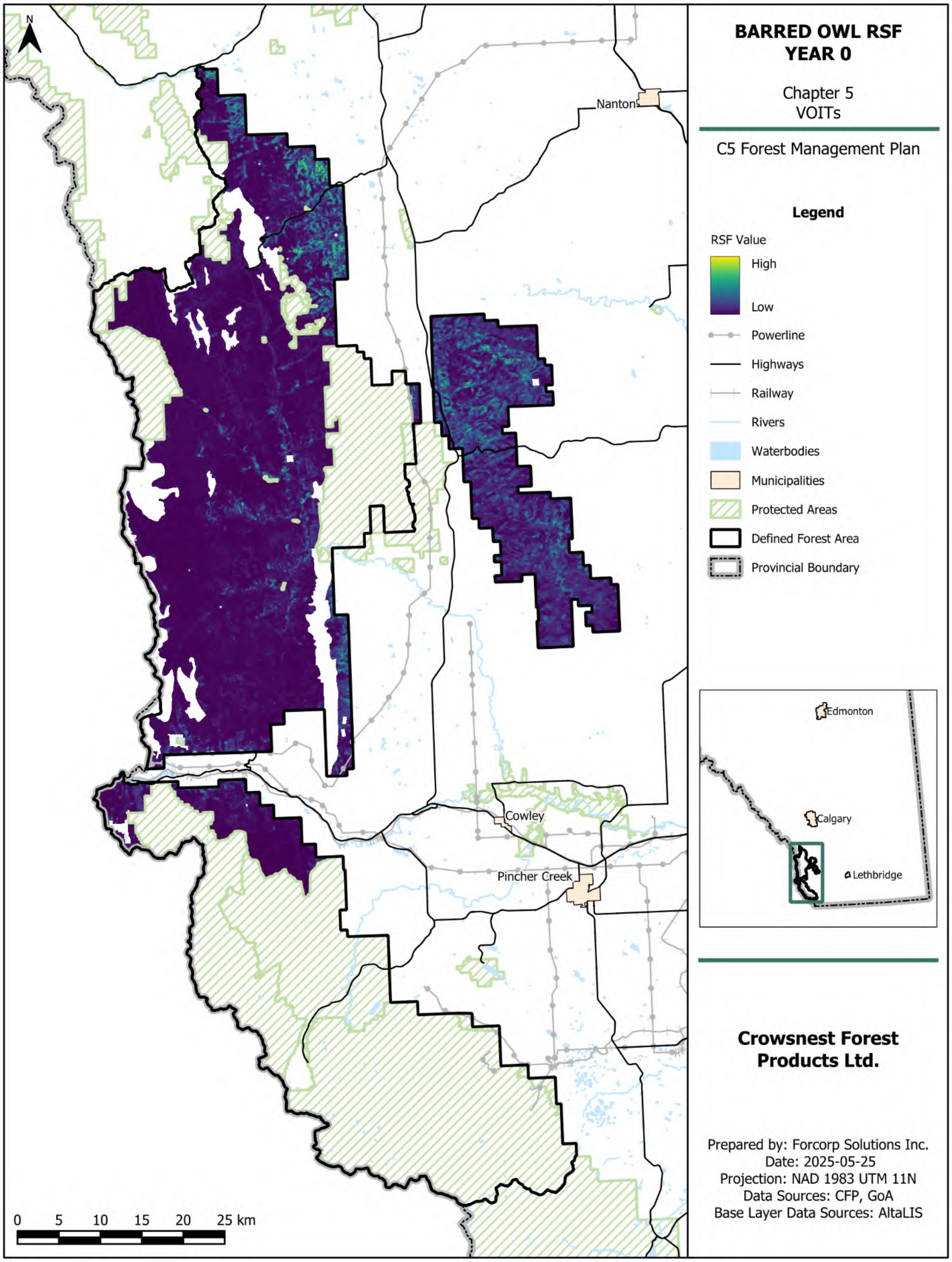

Figure 4-32. Barred owl RSF values in 2023.

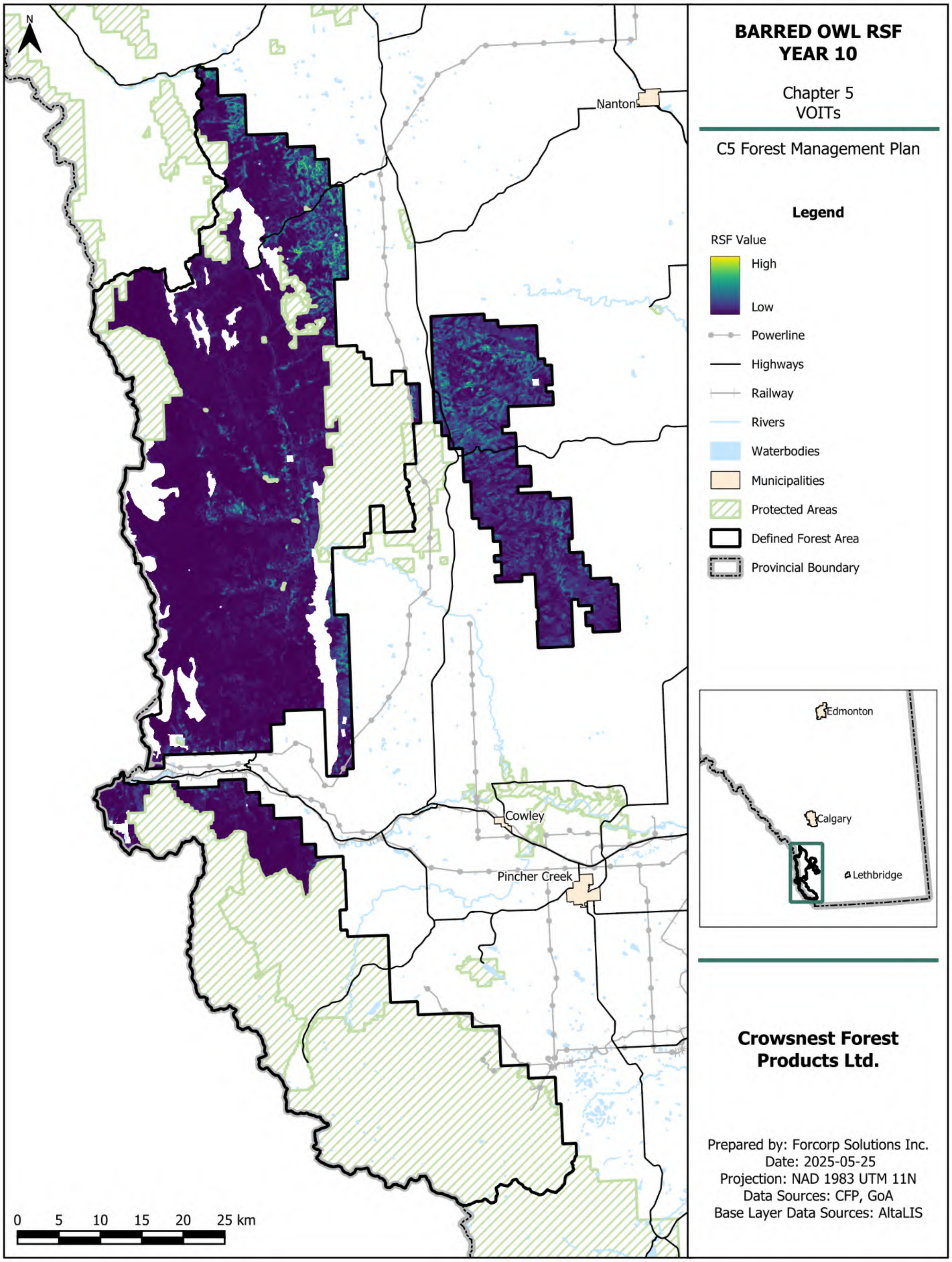

Figure 4-33. Barred owl RSF values in 2033.

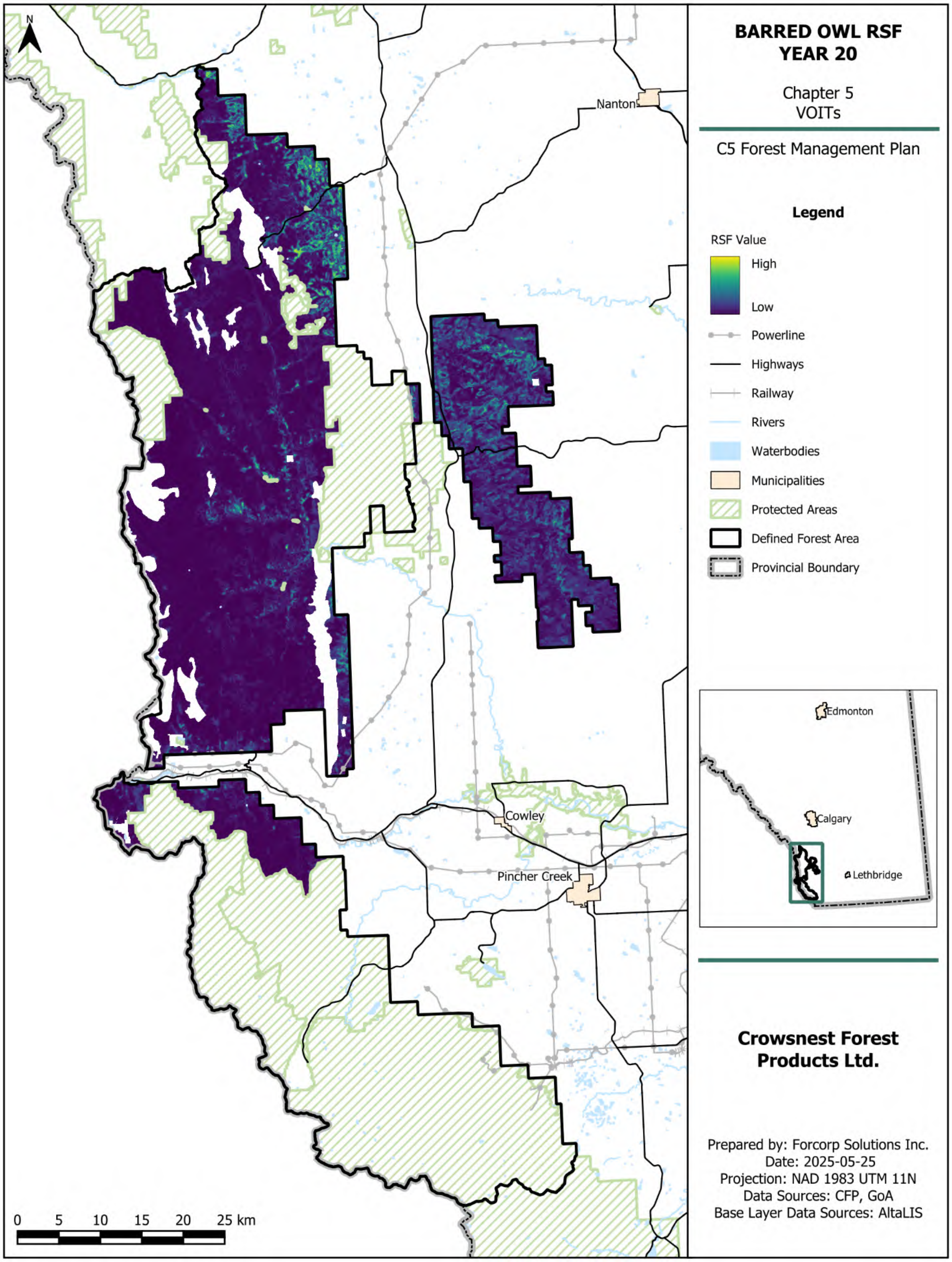

Figure 4-34. Barred owl RSF values in 2043.

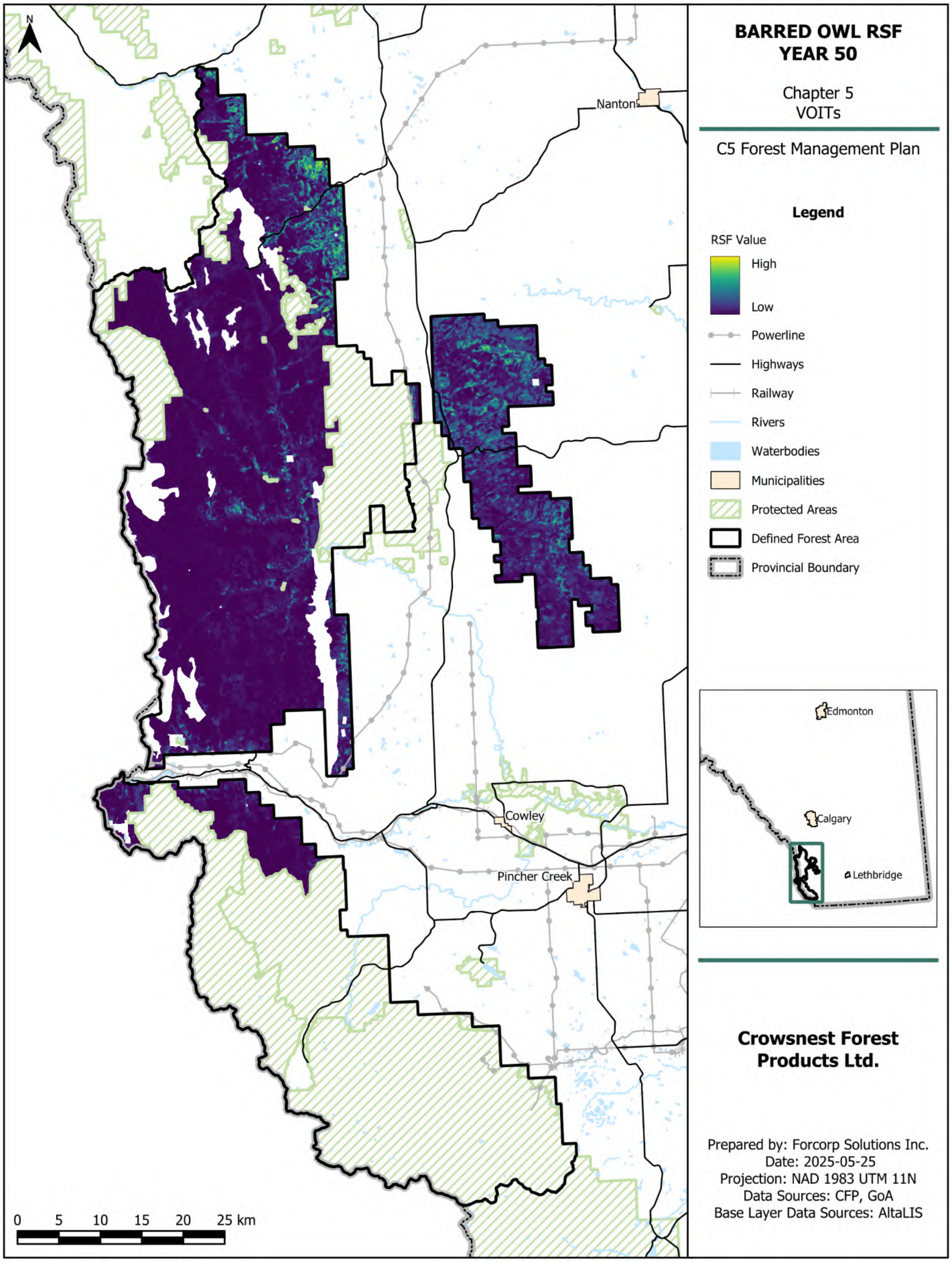

Figure 4-35. Barred owl RSF values in 2073.

4.1.12.3 Marten

The American marten (*Martes americana*) is listed as *Secure* in Alberta (Government of Alberta, 2017). Marten require forests that are structurally capable of providing cover, protective thermal microenvironments, and protection from predators. Although marten are sometimes found in young forests with these characteristics, typically they are found in late-successional coniferous forests. These mature forests also provide habitat for many other species mammalian and avian species (Government of Alberta, 2019).

To forecast future marten habitat, Habitat Suitability Index (HSI)-age curves are incorporated directly into timber supply modeling. First, height-age curves were developed using the GYPSY model's species-specific top height-age equations. Curves are delineated by species group and timber productivity rating and split into two density classes. These height-age curves were then converted to HSI-age curves by calculating HSI at each age as a function of height. Variables in the calculation include tree canopy closure, tree canopy height, and percent of different species in the canopy. Similar curves were grouped together to reduce the number of inputs for timber supply modeling.

Modeling results are presented in Table 4-21 and Figure 4-36. The green shading represents a change of +/- less than 15% from current levels (low risk); the yellow indicates a -15 to 30% change (moderate risk); and red shows a greater than -30% change (high risk). All time periods were run on the gross landbase, which was aged for each time period processed.

Table 4-21. Habitat Suitability Index values for marten.

Metric	Year 0	Year 10	Year 20	Year 50	Year 100	Year 200
Mean Habitat Suitability Index	75,401	73,664	70,893	63,881	63,289	59,712
% Change	-	-2.3	-6.0	-15.3	-16.1	-20.8

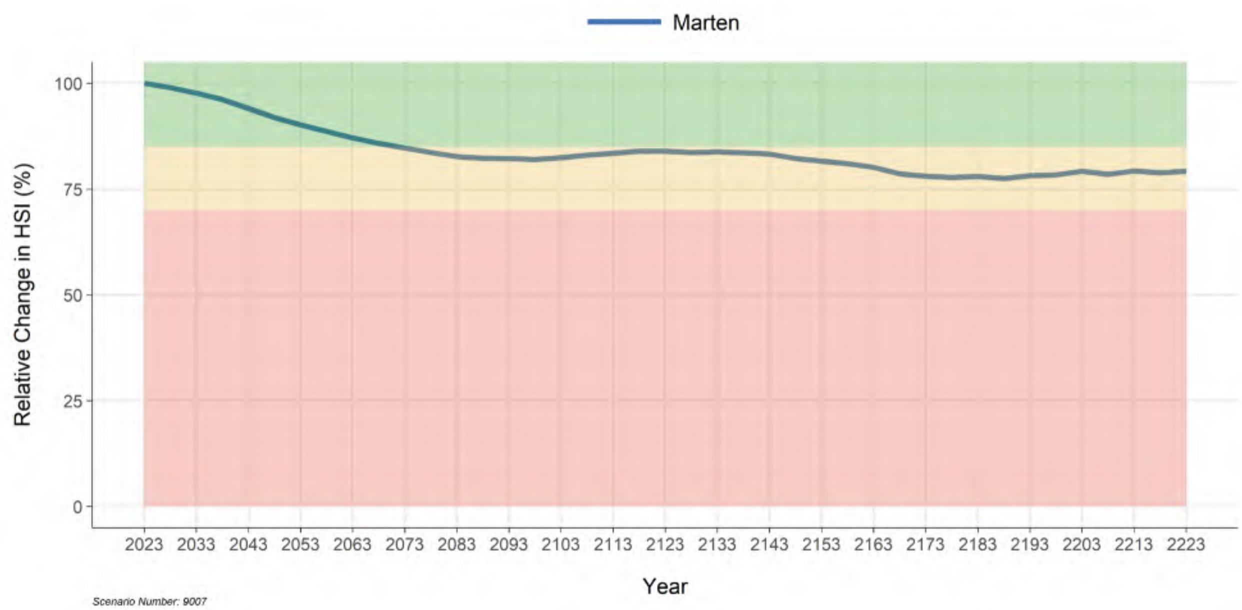

Figure 4-36. Marten Habitat Suitability Index (HSI) over 200 years.

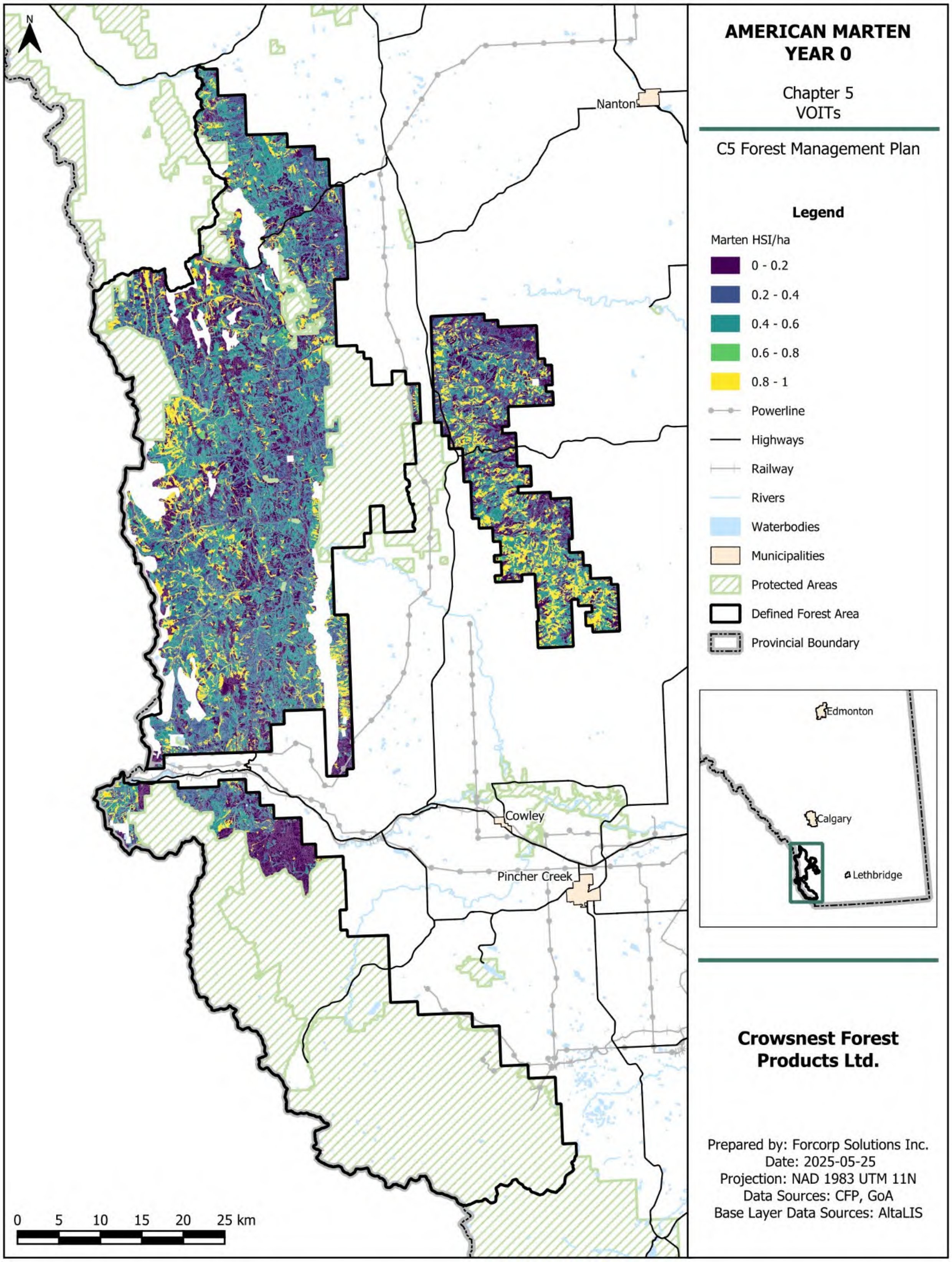

Figure 4-37. Marten Habitat Suitability Index values in 2023.

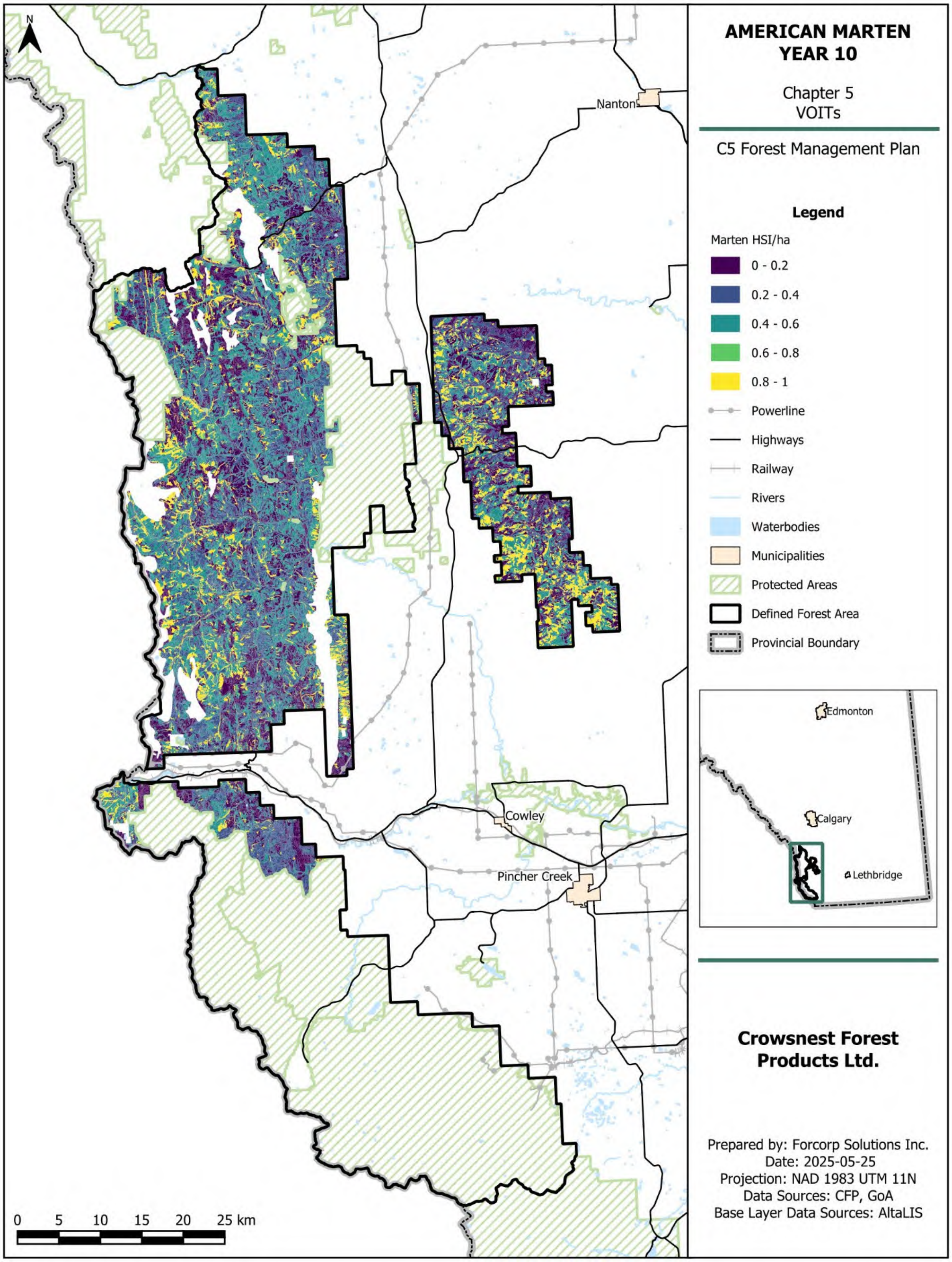

Figure 4-38. Marten Habitat Suitability Index values in 2033.

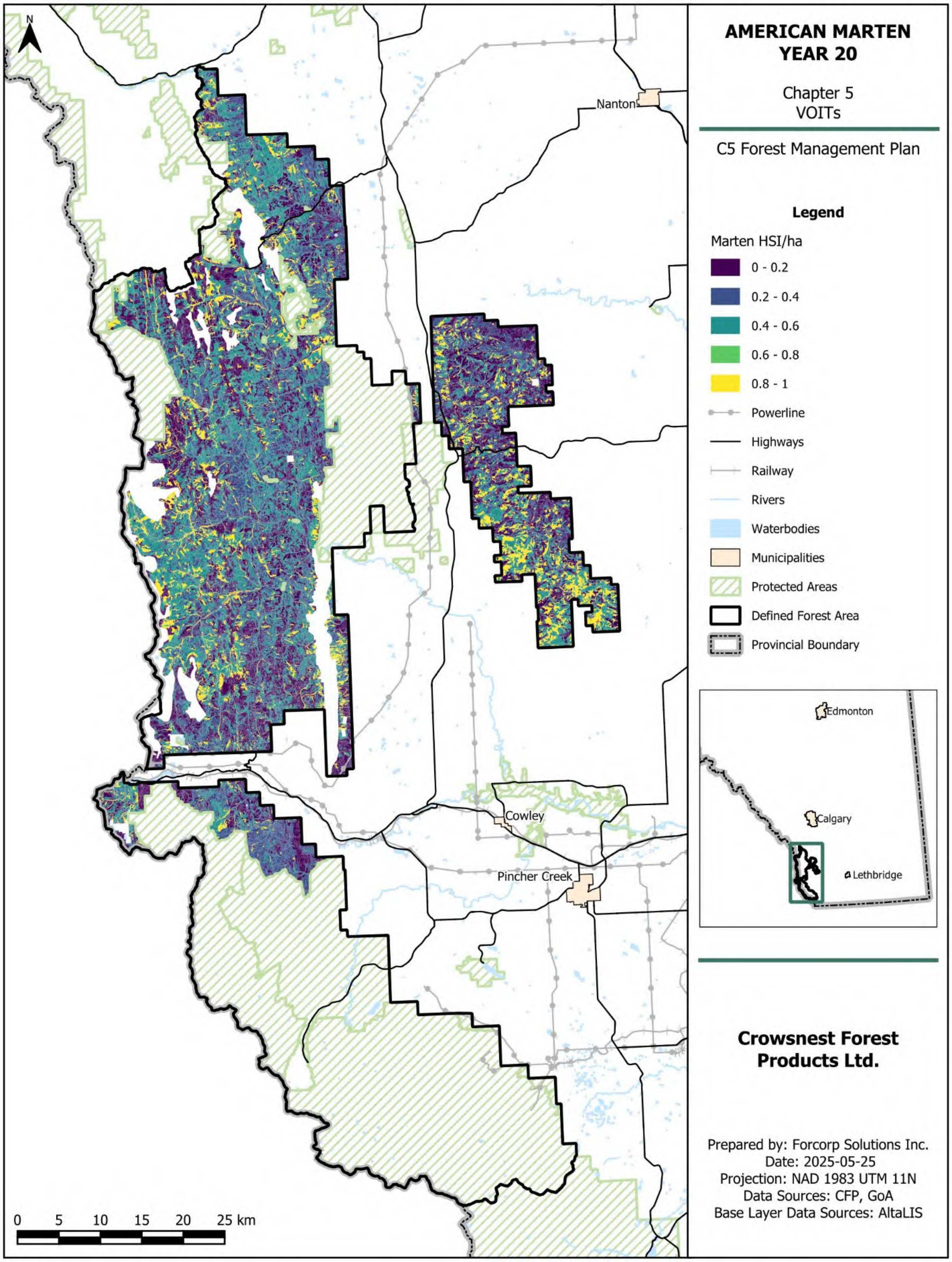

Figure 4-39. Marten Habitat Suitability Index values in 2043.

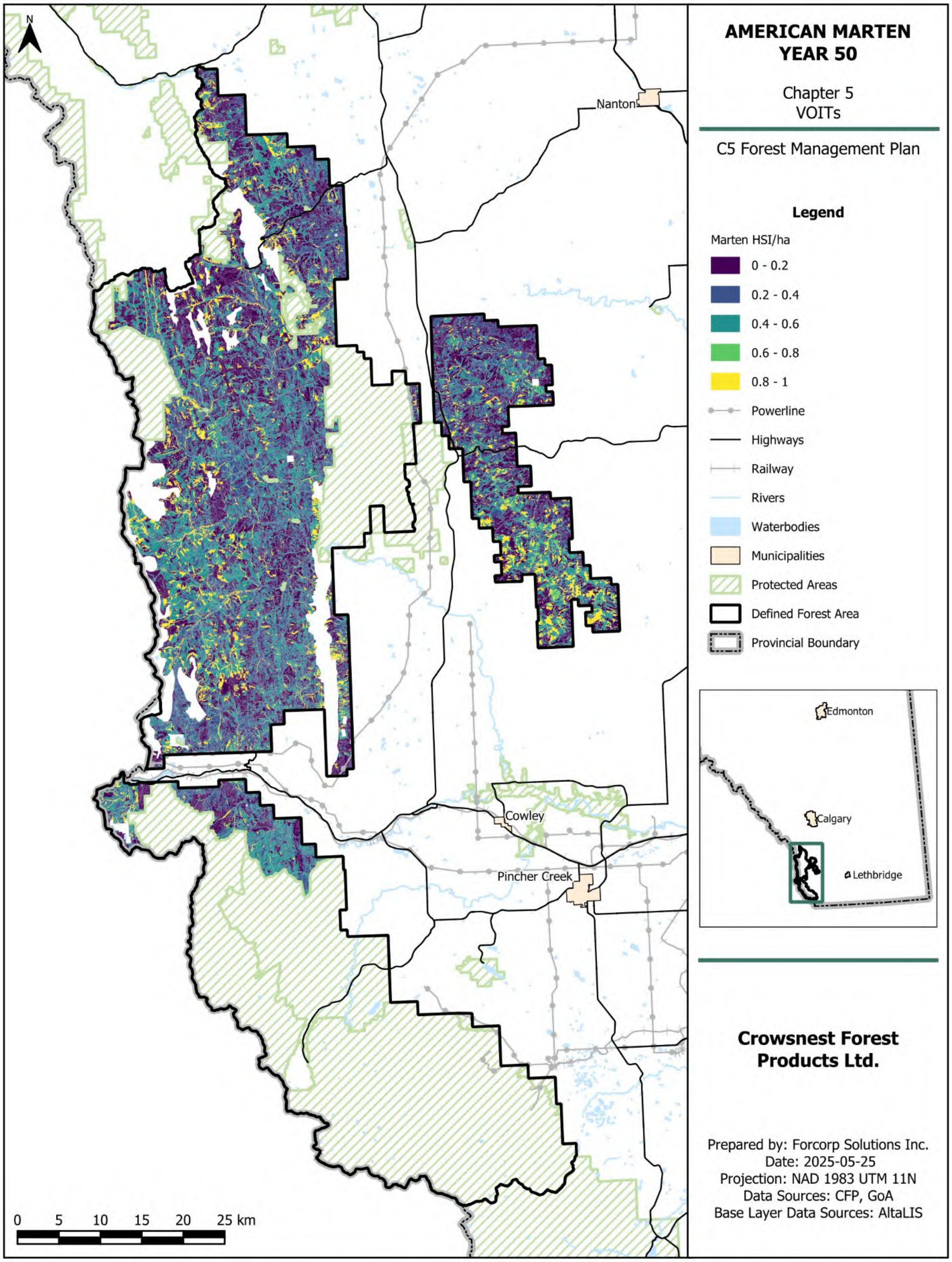

Figure 4-40. Marten Habitat Suitability Index values in 2073.

4.1.12.4 *Songbirds*

Four species were selected by the PDT to be modeled: the varied thrush (*Ixoreus naevius*), the ovenbird (*Seiurus aurocapilla*), the brown creeper (*Certhia americana*), and Clark's nutcracker (*Nucifraga columbiana*). Both the varied thrush and the ovenbird are listed as *Secure* in Alberta, while the brown creeper is listed as *Sensitive* (Government of Alberta, 2017). Each of the identified species was incorporated into the PFMS model based on coefficients provided by the GoA. All time periods were run on the gross landbase, which was aged for each time period processed. Results, measured as Relative Abundance (RA) are provided in Table 4-22.

Table 4-22. Relative abundance values for selected songbirds

Species	Metric	Year 0	Year 10	Year 20	Year 50	Year 100	Year 200
Varied Thrush	Relative Abundance	3,359	3,394	3,361	3,107	2,867	2,673
	% Change	-	1.0	0.1	-7.5	-14.7	-20.4
Ovenbird	Relative Abundance	26,267	25,812	25,160	22,324	20,001	21,523
	% Change	-	-1.7	-4.2	-15.0	-23.9	-18.1
Brown Creeper	Relative Abundance	16,100	17,511	18,822	20,564	19,259	17,428
	% Change	-	8.8	16.9	27.7	19.6	8.3
Clarks Nutcracker	Relative Abundance	15,778	15,848	16,223	15,610	14,842	14,222
	% Change	-	0.4	2.8	-1.1	-5.9	-9.9

The varied thrush is associated with mature conifer forests and is found in highest abundance in mature pine and mature white spruce. Abundance is higher in harvested pine and white spruce stands compared to similarly aged, naturally disturbed stands of the same type in the forested region. It prefers large, continuous stands over small patches (Alberta Biodiversity Monitoring Institute and Boreal Avian Modelling Project, 2019). Trends over the 200-year forecasting period are displayed in Figure 4-41 and shown spatially for selected timepoints below.

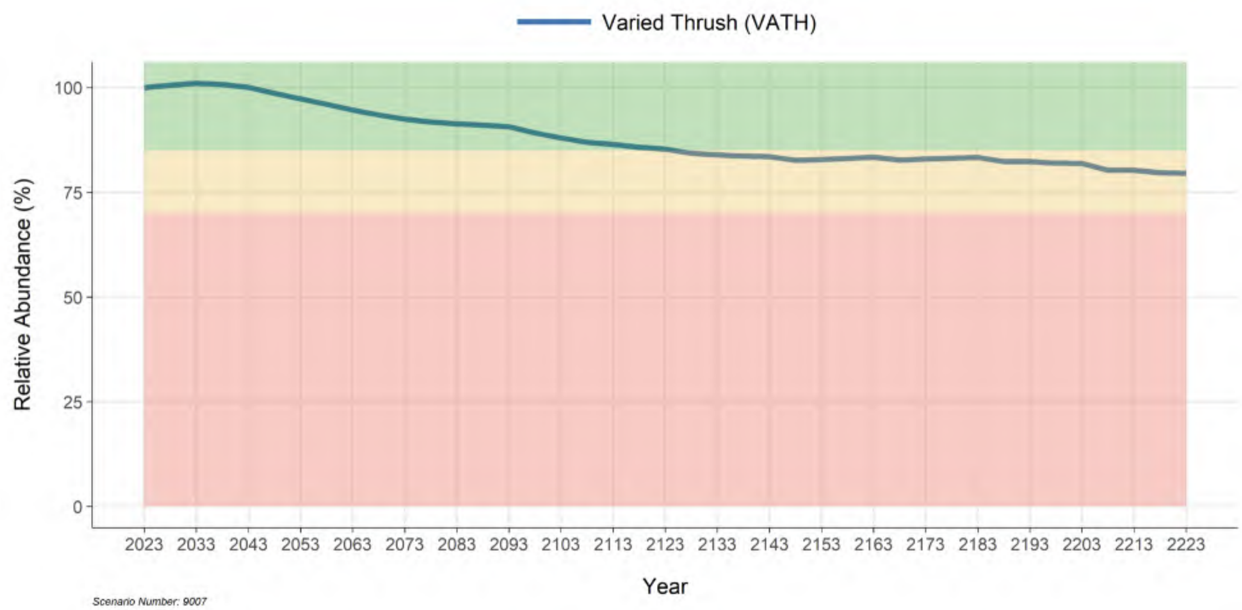

Figure 4-41. Varied thrush Relative Abundance (RA) over 200 years.

The ovenbird is primarily associated with large mature/old deciduous or mixedwood forests but is also found in white spruce stands and to a lesser extent in other forest types. It prefers large areas of contiguous forest for breeding but is relatively insensitive to linear footprint density. (Alberta Biodiversity Monitoring Institute and Boreal Avian Modelling Project, 2019). Trends over the 200-year forecasting period are displayed in Figure 4-42 and shown spatially for selected timepoints below.

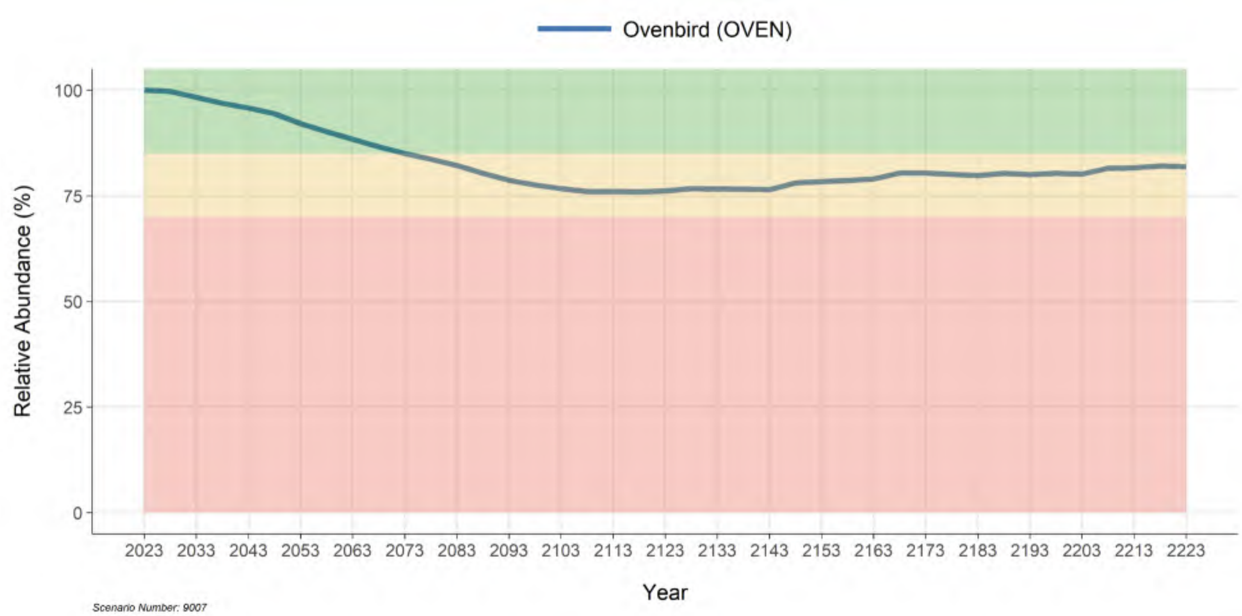

Figure 4-42. Ovenbird Relative Abundance (RA) over 200 years.

The brown creeper is an old forest and forest interior specialist, preferring the largest available trees and snags for nesting and foraging. However, it will also live in deciduous or marshy forests, if suitable nesting habitat is available. It nests under the peeling bark of dead and dying trees, or wherever it can find a sheltered overhang. Abundance increases with stand age in all forest types (Alberta Biodiversity Monitoring Institute and Boreal Avian Modelling Project, 2019). Trends over the 200-year forecasting period are displayed in Figure 4-43 and shown spatially for selected timepoints below.

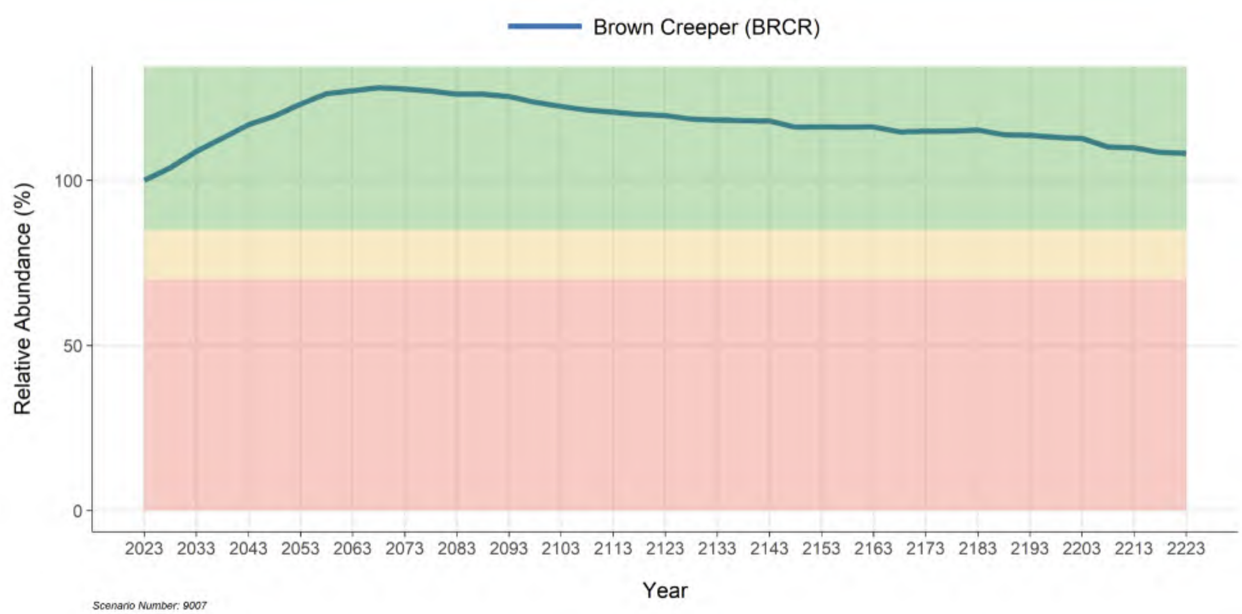

Figure 4-43. Brown creeper Relative Abundance (RA) over 200 years.

The Clark's nutcracker inhabits open to semi-open pine-dominated and Douglas-fir leading stands in the montane and subalpine regions. Their distribution is limited by the presence of five-needle pines (i.e., whitebark and limber pine), with Douglas fir playing a lesser role. The Clark's nutcracker has a symbiotic relationship with the endangered pines, caching seeds up to 30 km away and effectively aiding in seed dispersal and regeneration. The Clark's nutcracker model is based on the HSI model developed by Blouin, et al. (2004). Trends over the 200-year forecasting period are displayed in Figure 4-43 and shown spatially for selected timepoints below.

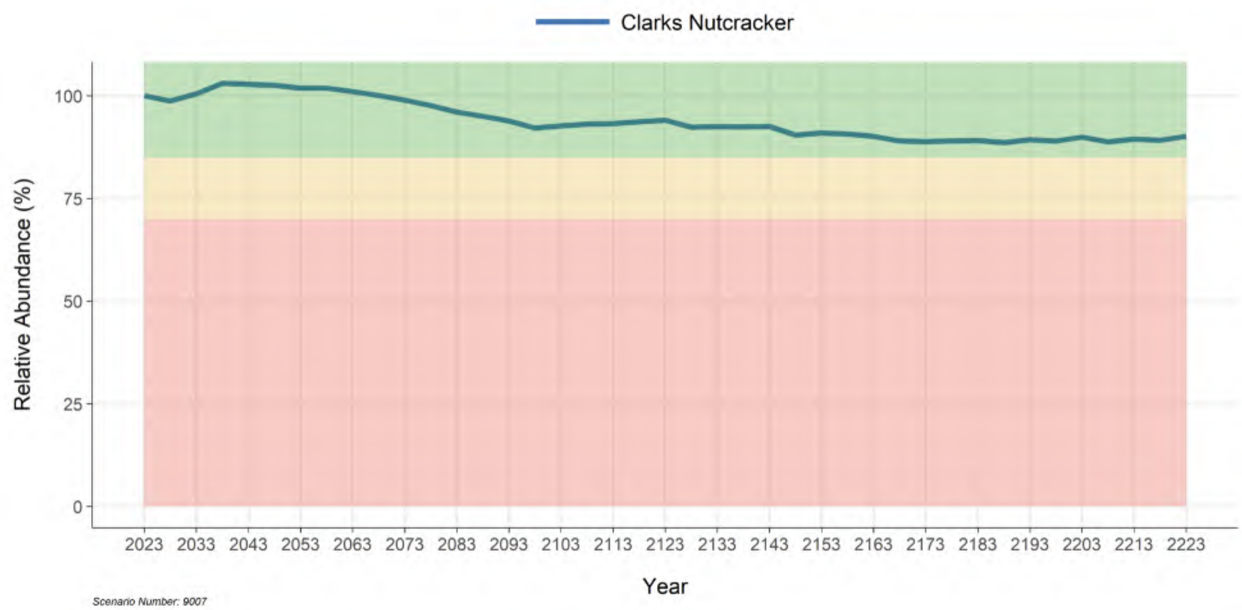

Figure 4-44. Clark's nutcracker Relative Abundance (RA) over 200 years.

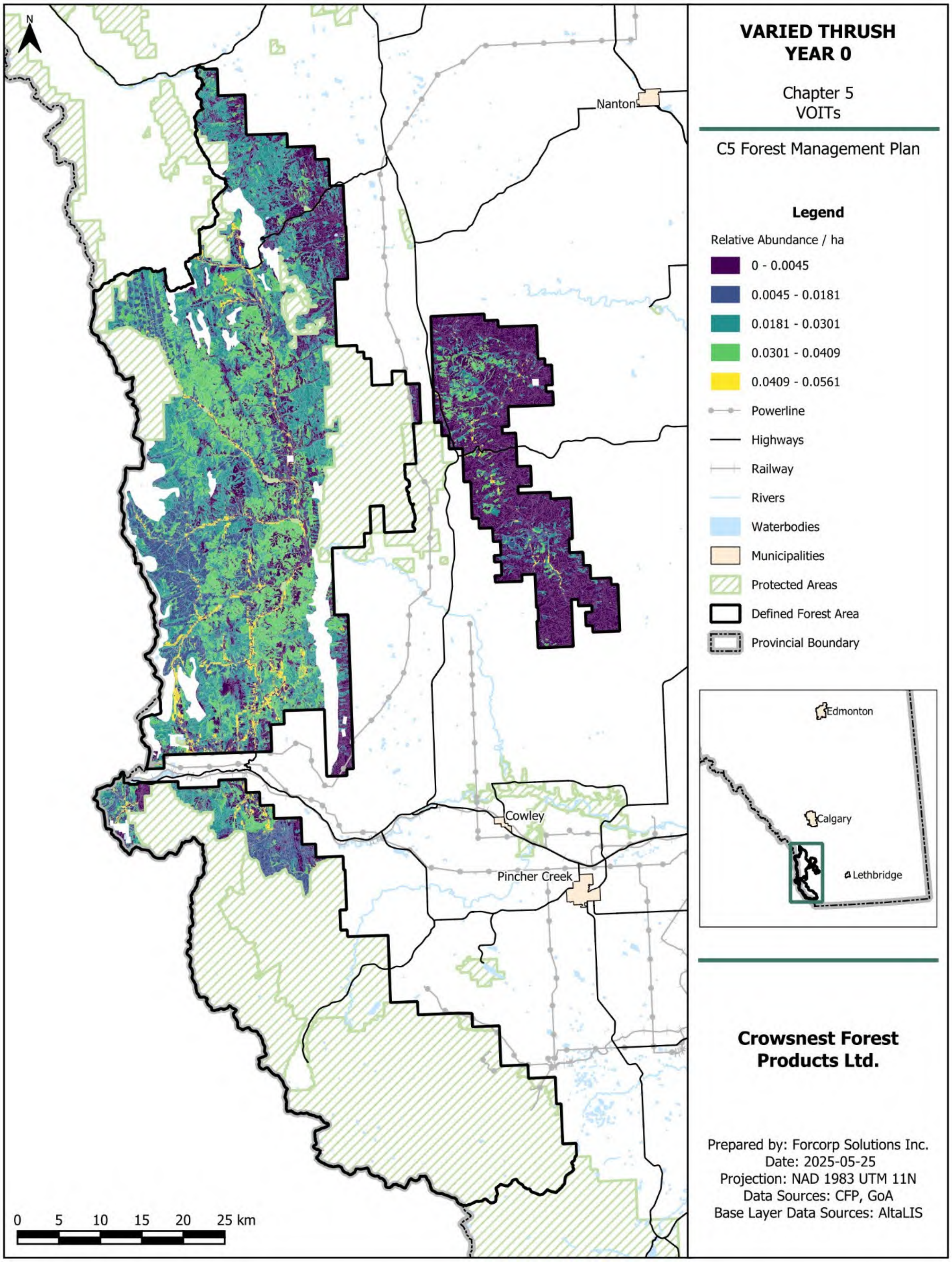

Figure 4-45. Varied thrush Relative Abundance (RA) values in 2023.

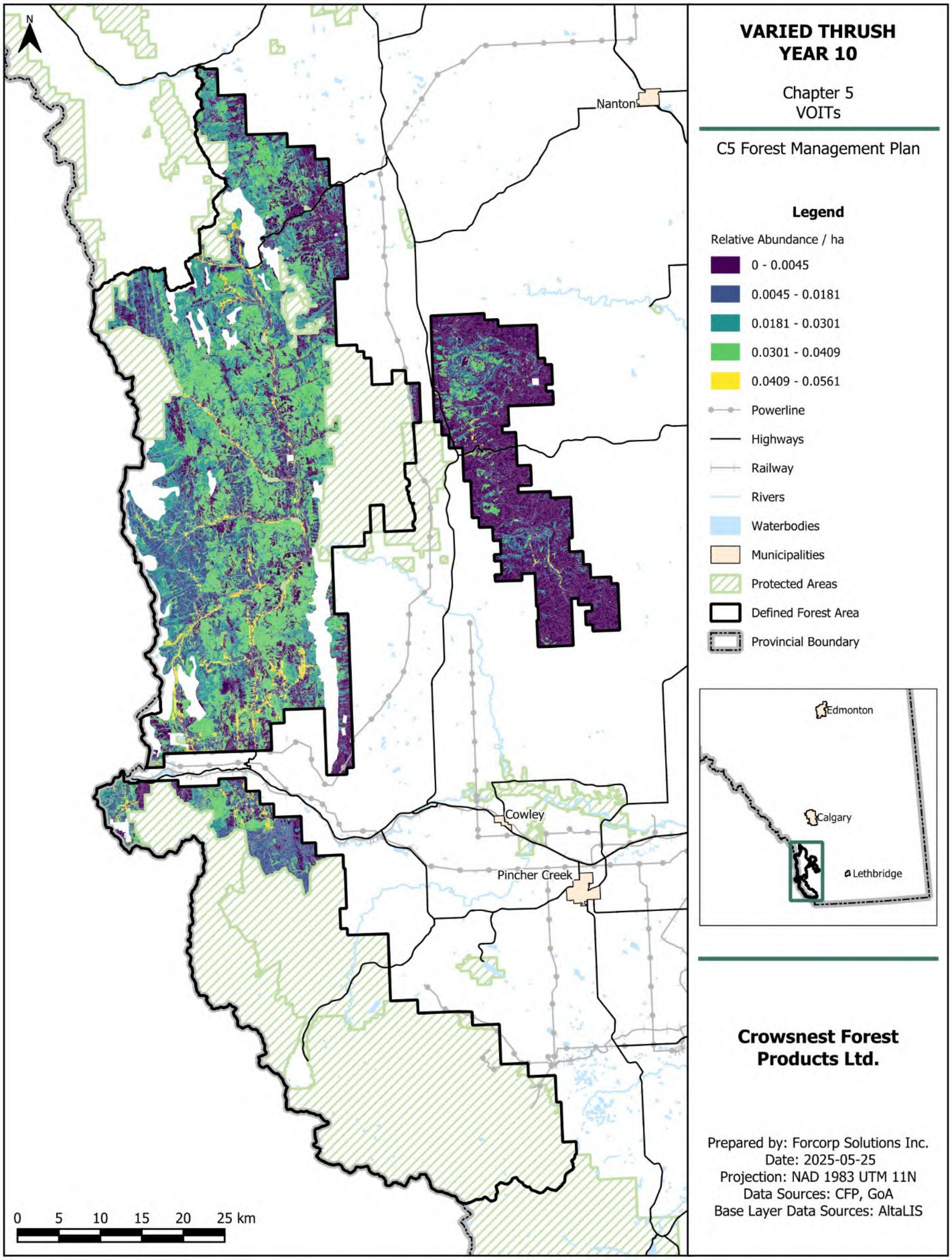

Figure 4-46. Varied thrush Relative Abundance (RA) values in 2033.

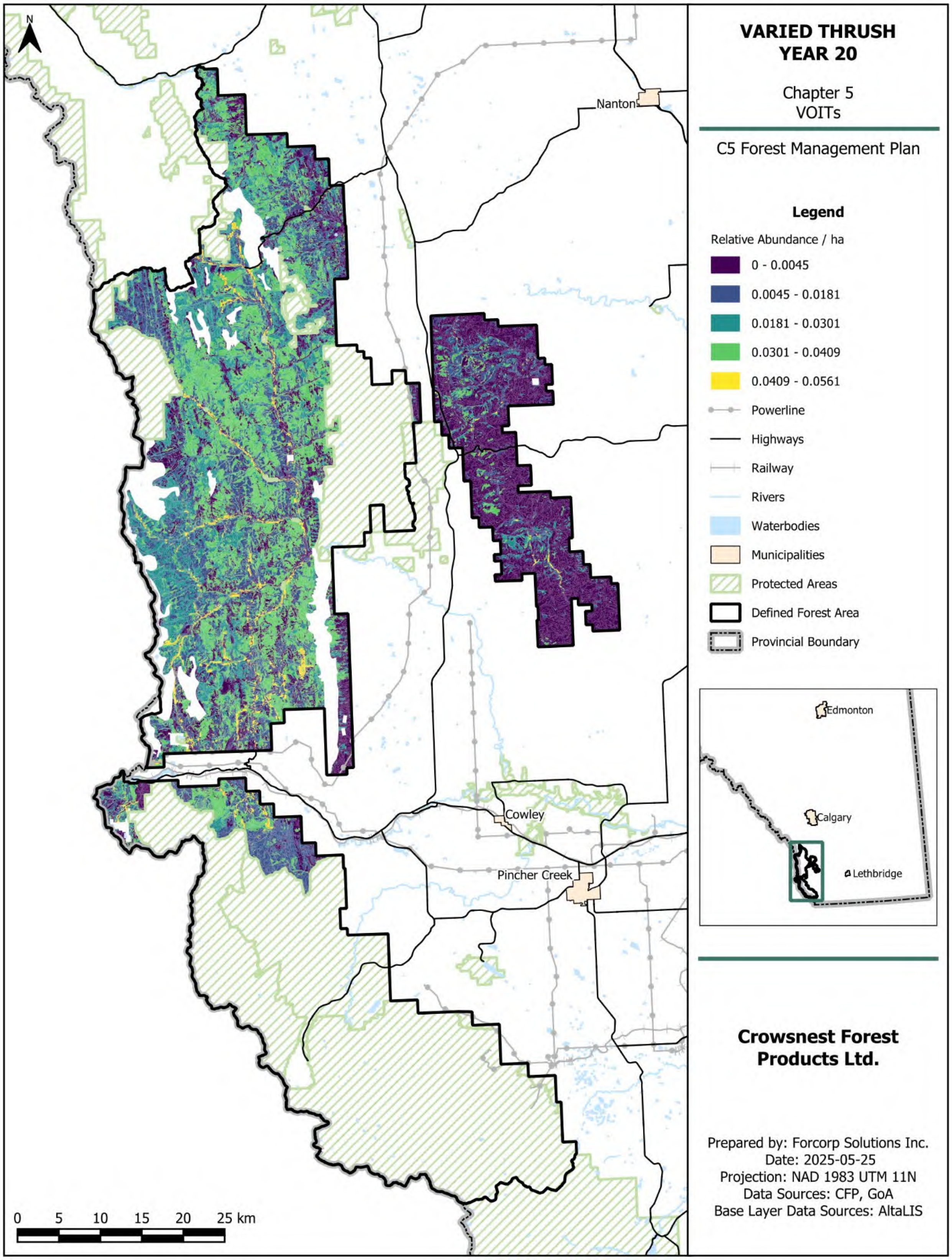

Figure 4-47. Varied thrush Relative Abundance (RA) values in 2043.

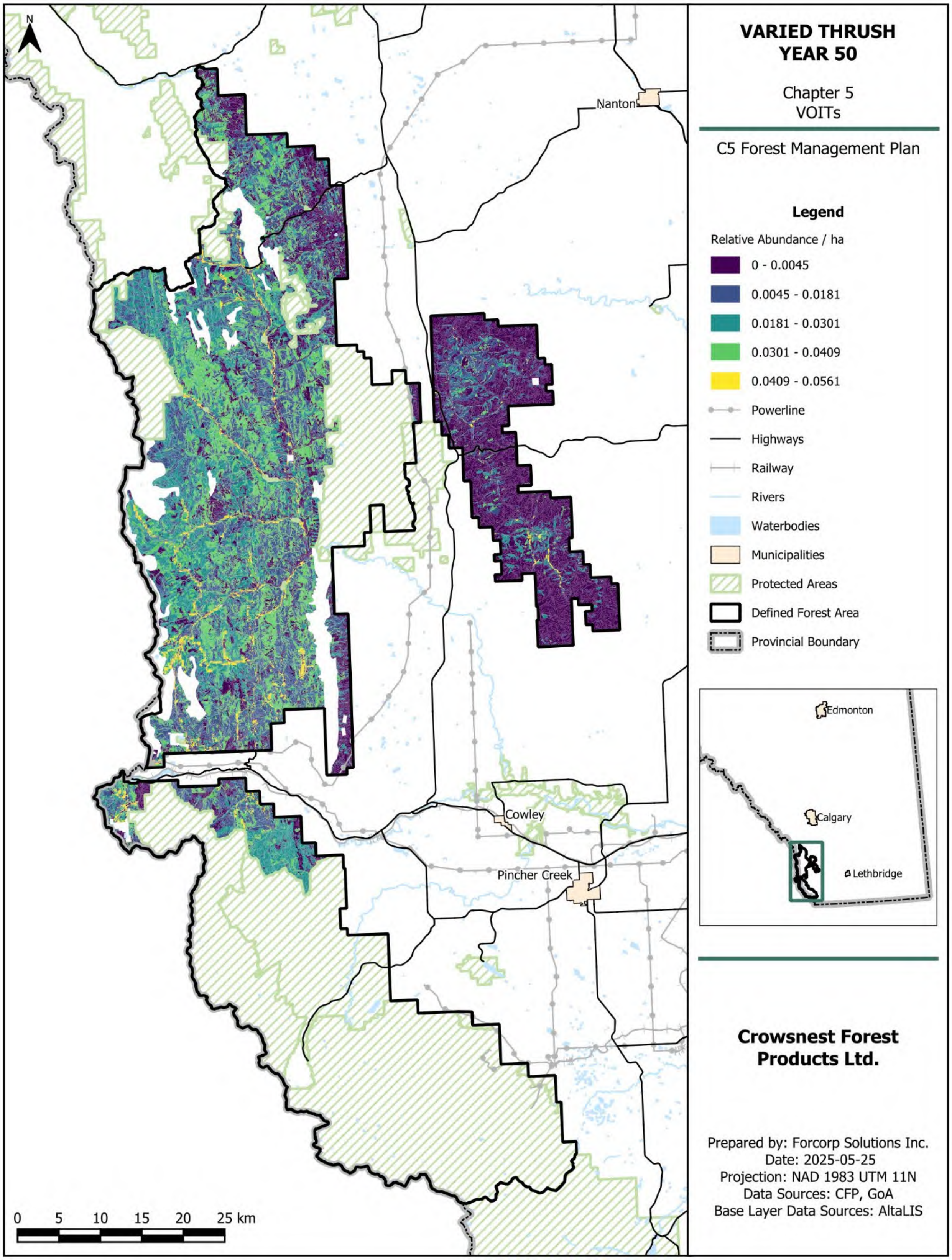

Figure 4-48. Varied thrush Relative Abundance (RA) values in 2073.

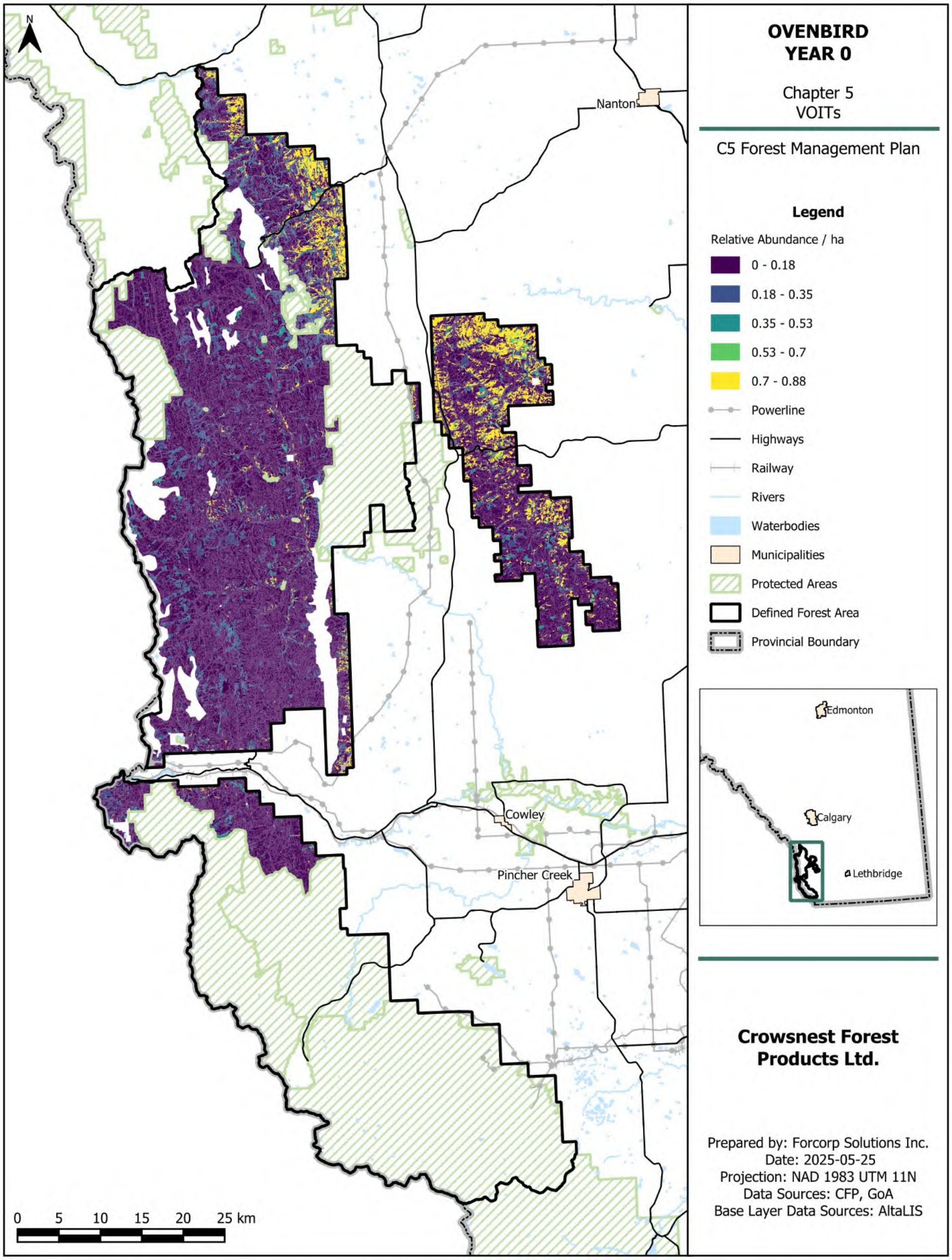

Figure 4-49. Ovenbird Relative Abundance (RA) values in 2023.

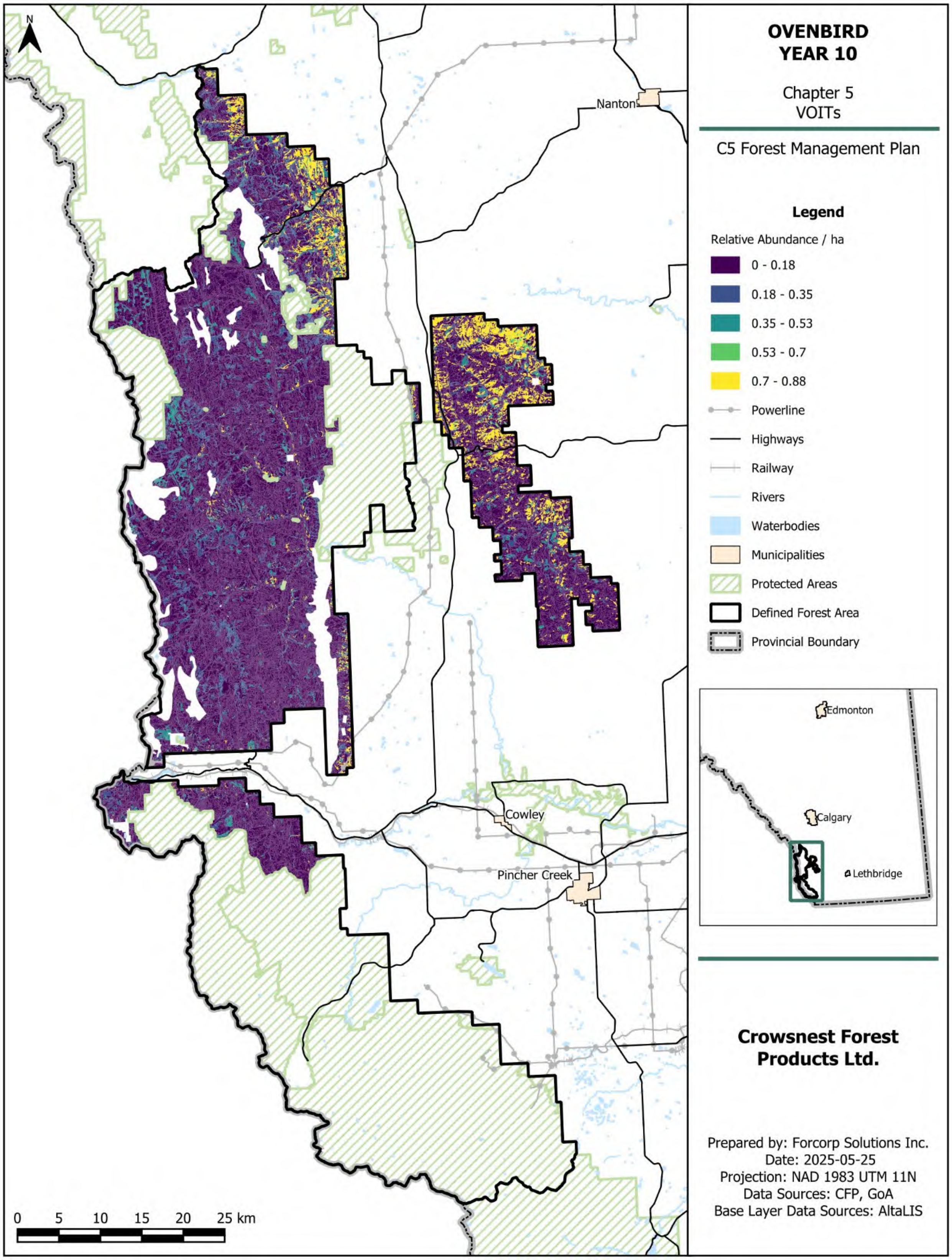

Figure 4-50. Ovenbird Relative Abundance (RA) values in 2033.

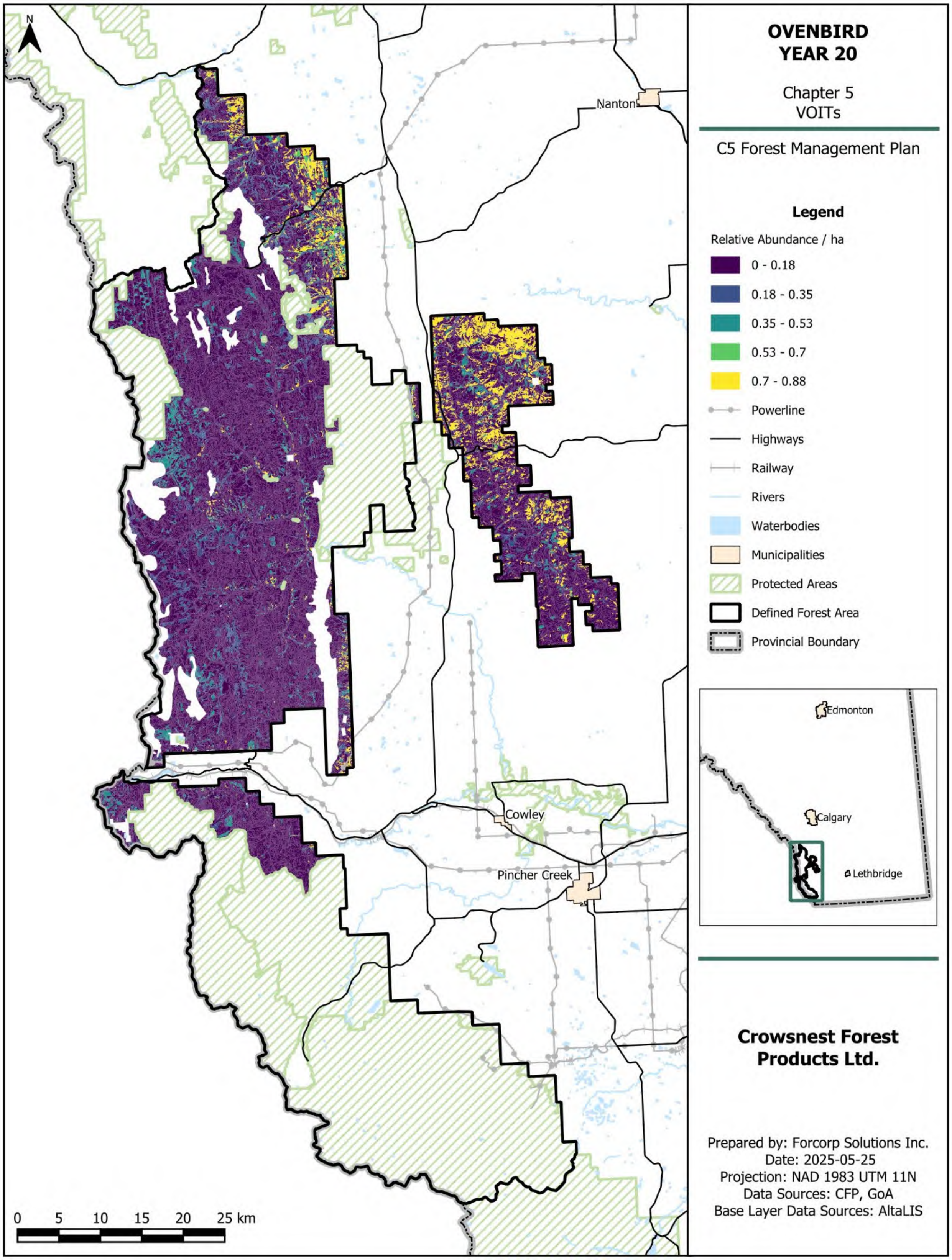

Figure 4-51. Ovenbird Relative Abundance (RA) values in 2043.

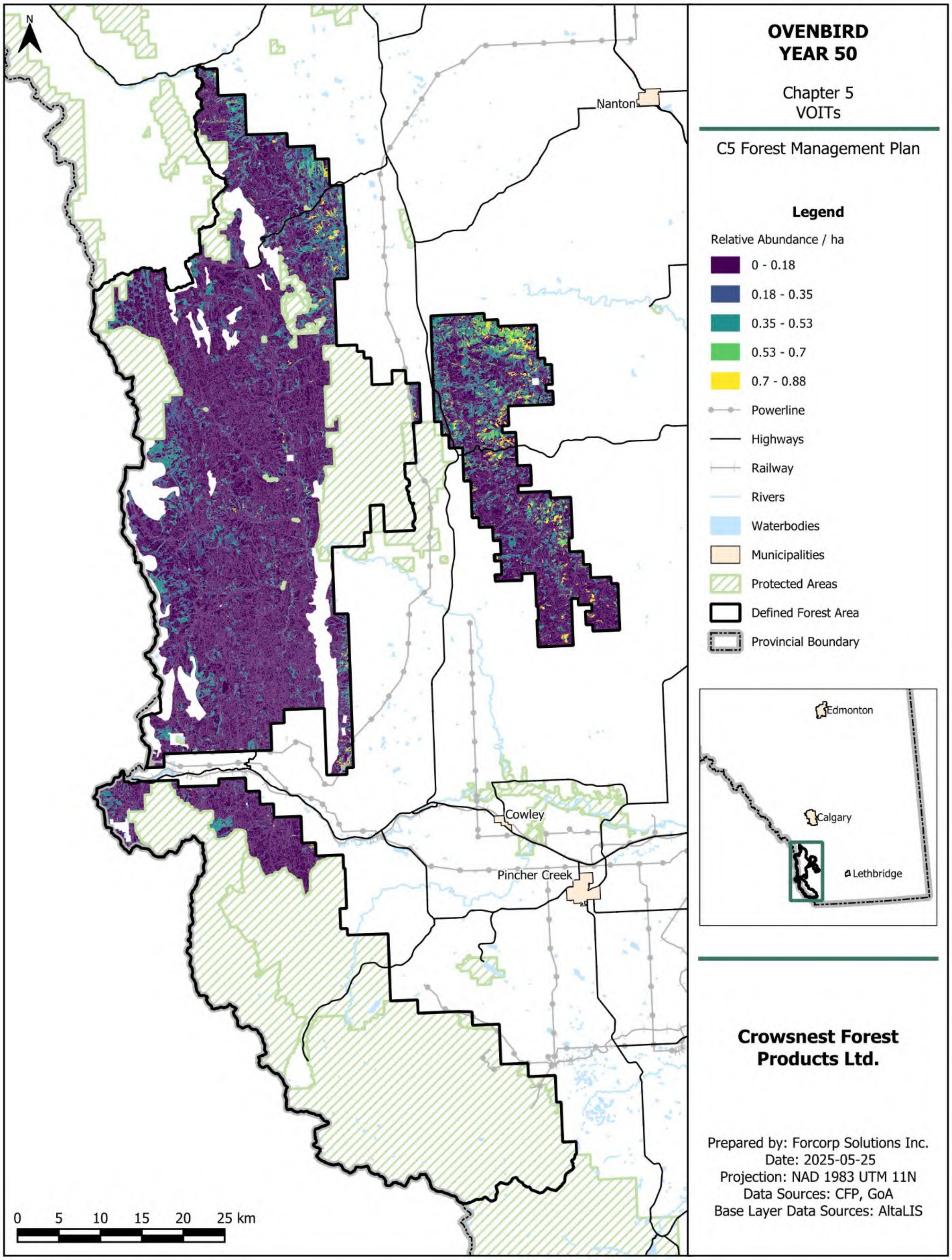

Figure 4-52. Ovenbird Relative Abundance (RA) values in 2073.

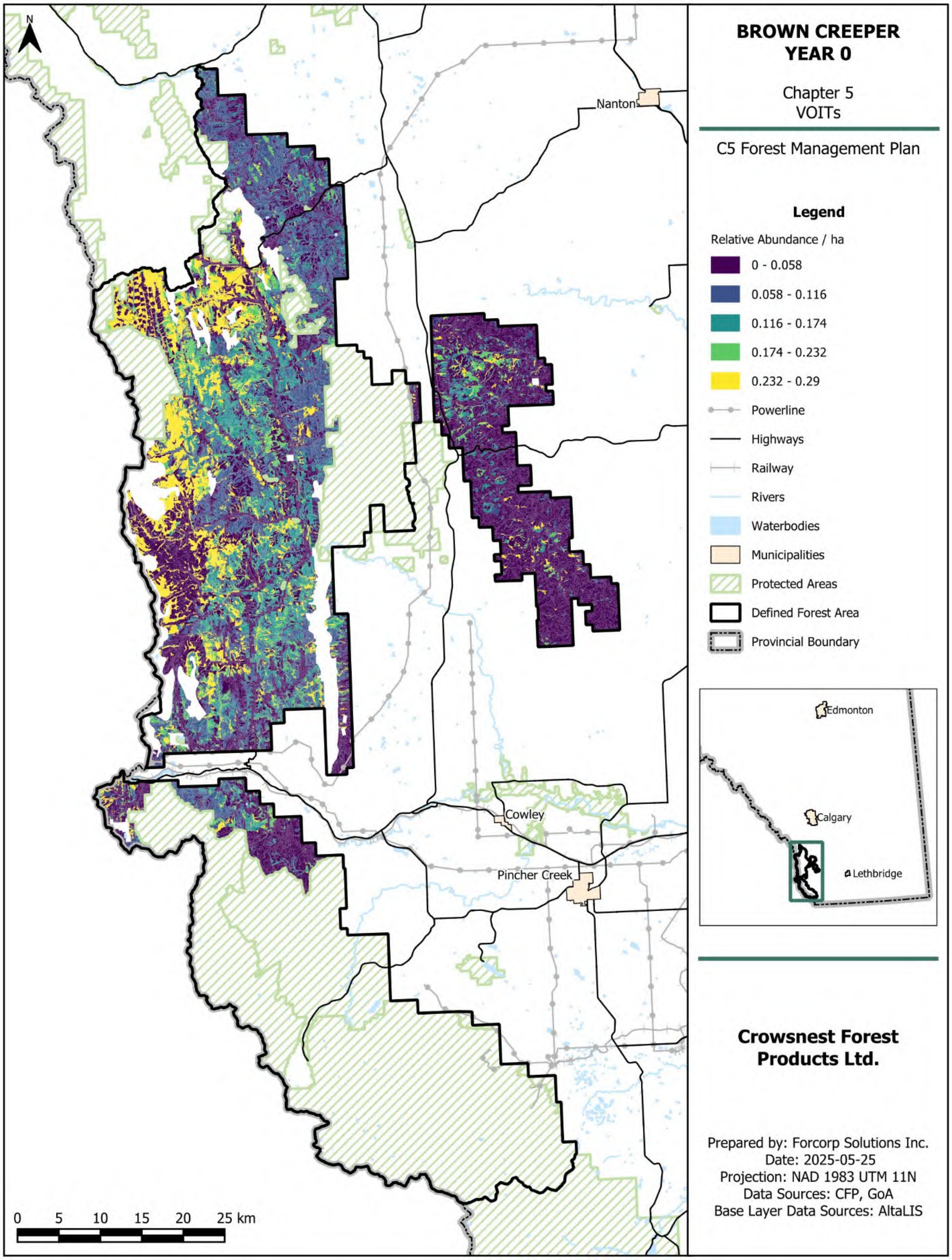

Figure 4-53. Brown creeper Relative Abundance (RA) values in 2023.

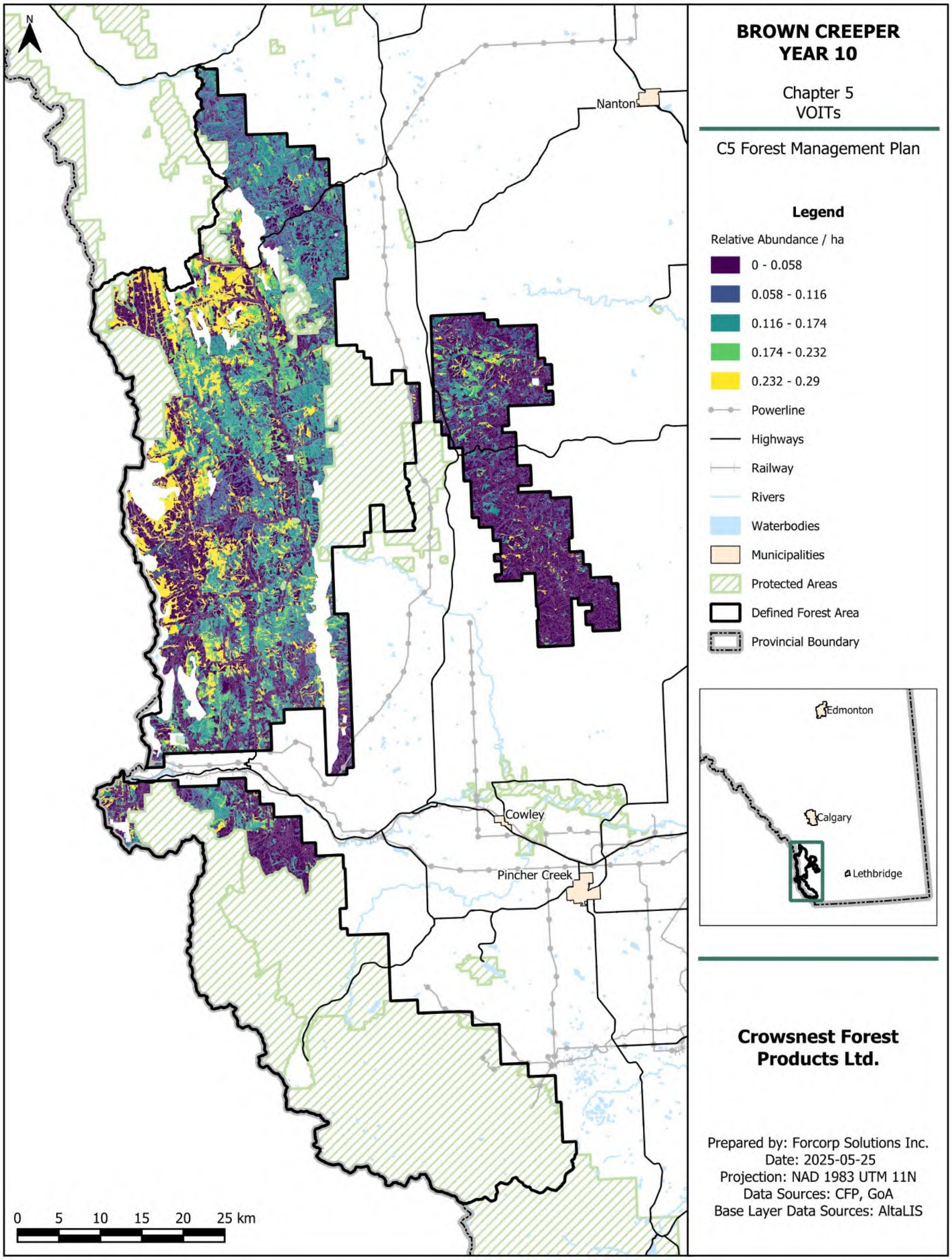

Figure 4-54. Brown creeper Relative Abundance (RA) values in 2033.

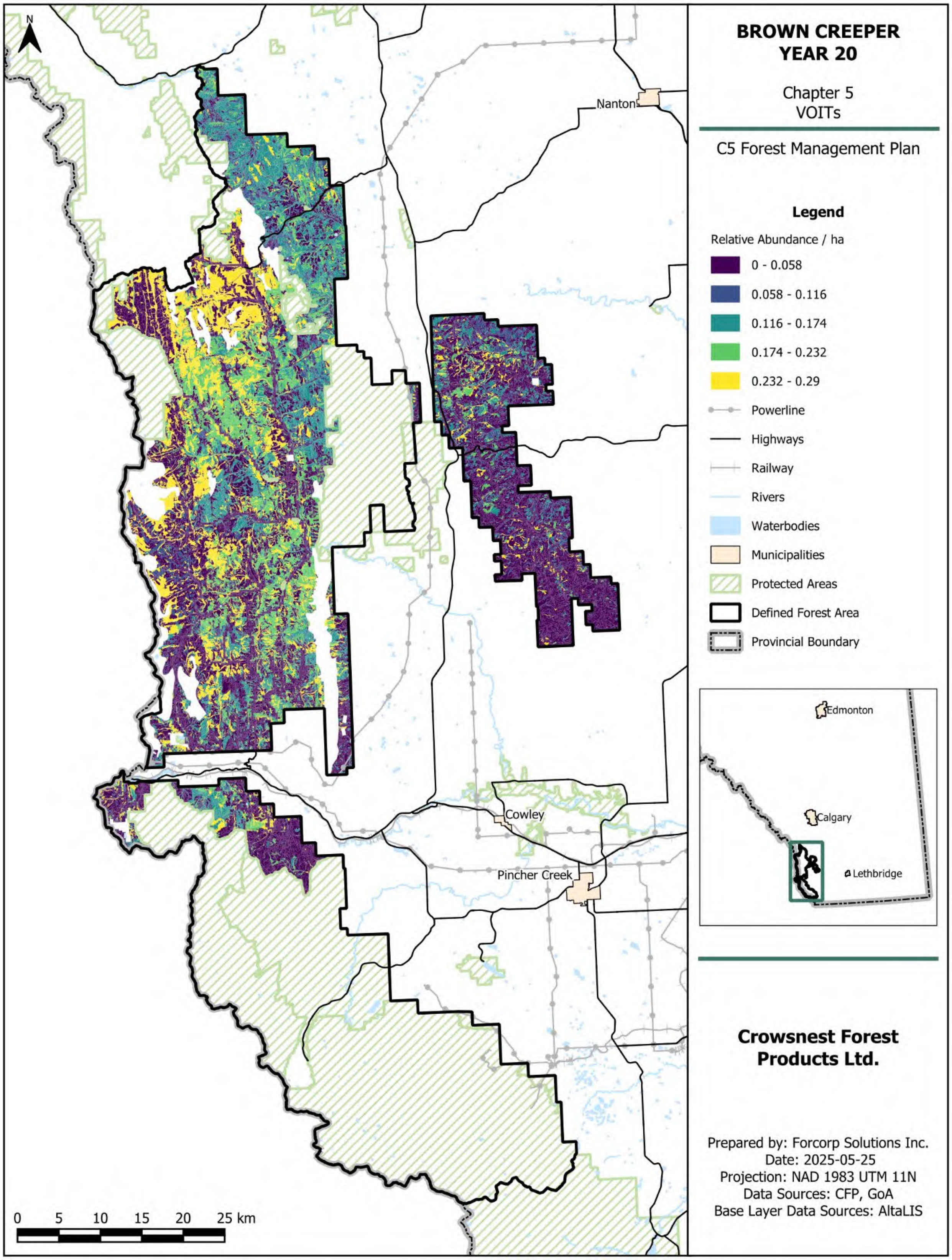

Figure 4-55. Brown creeper Relative Abundance (RA) values in 2043.

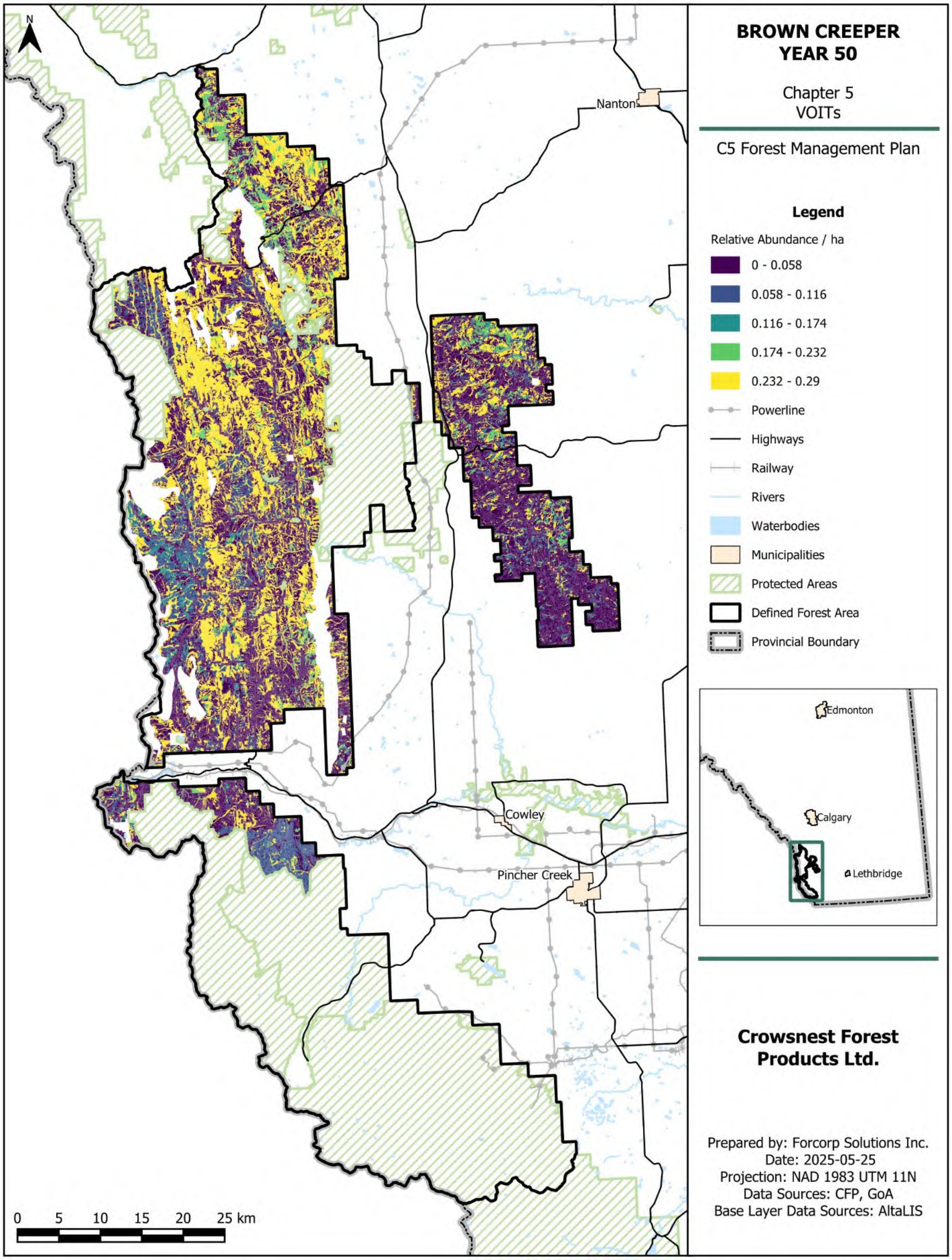

Figure 4-56. Brown creeper Relative Abundance (RA) values in 2073.

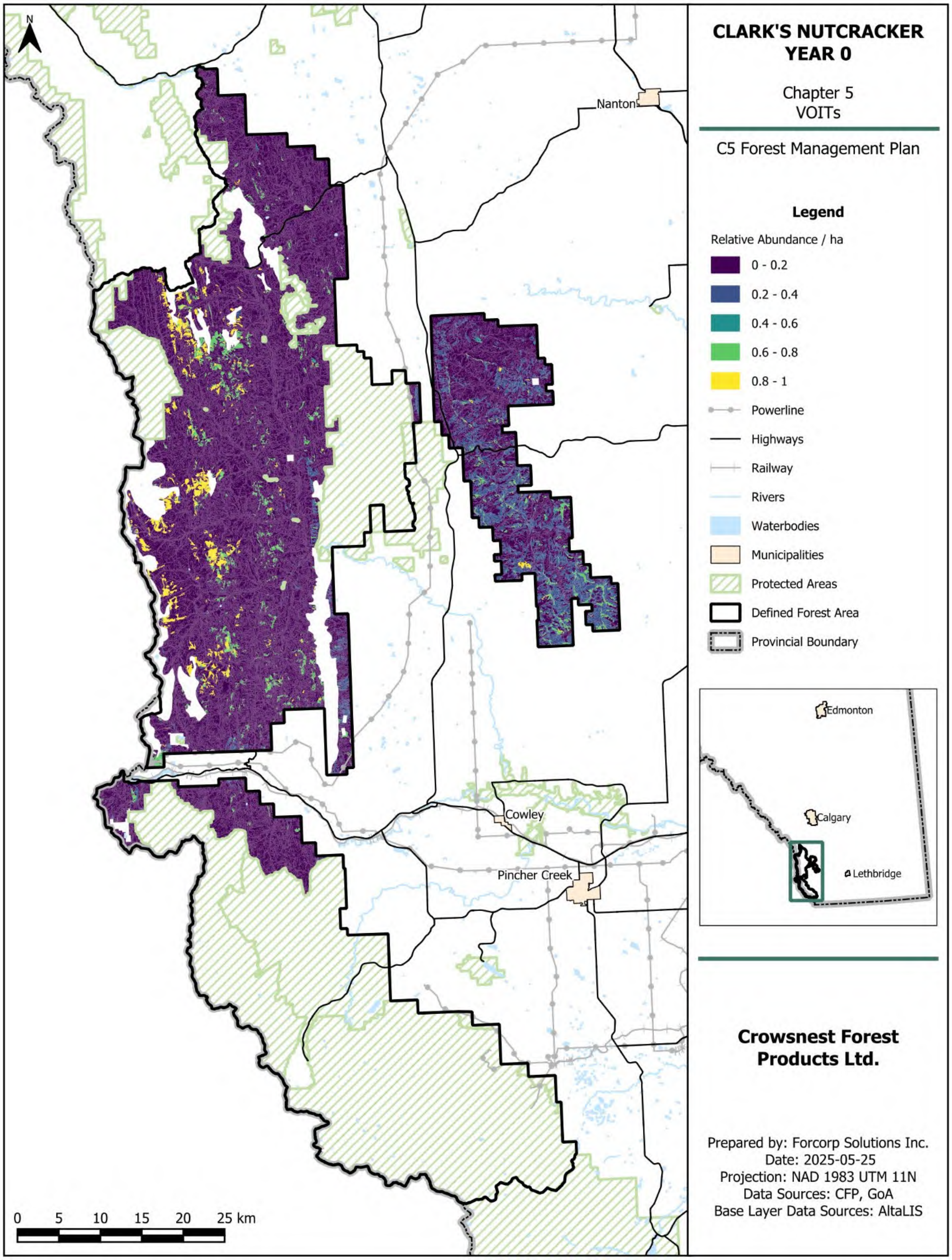

Figure 4-57. Clark's nutcracker Relative Abundance (RA) values in 2023.

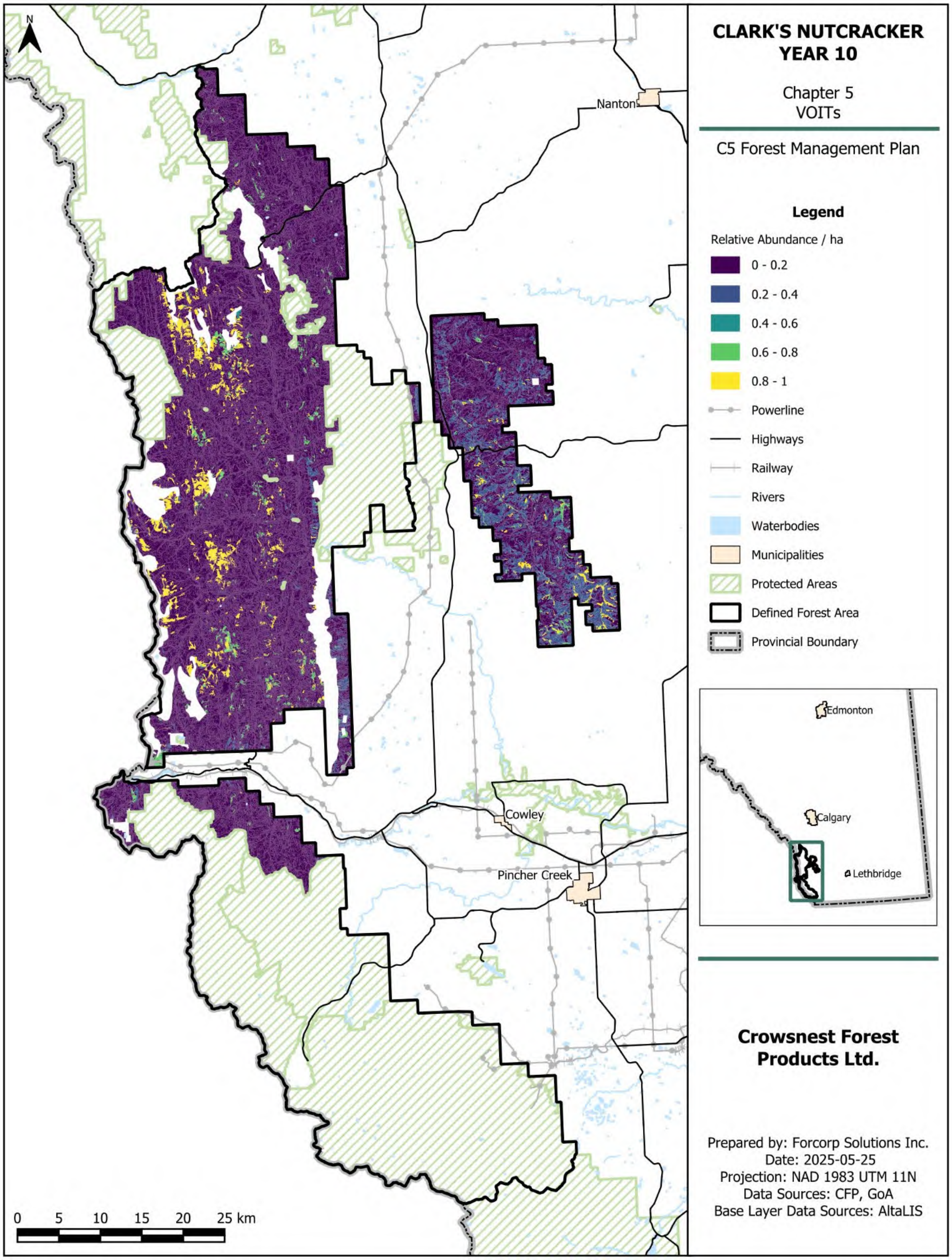

Figure 4-58. Clark's nutcracker Relative Abundance (RA) values in 2033.

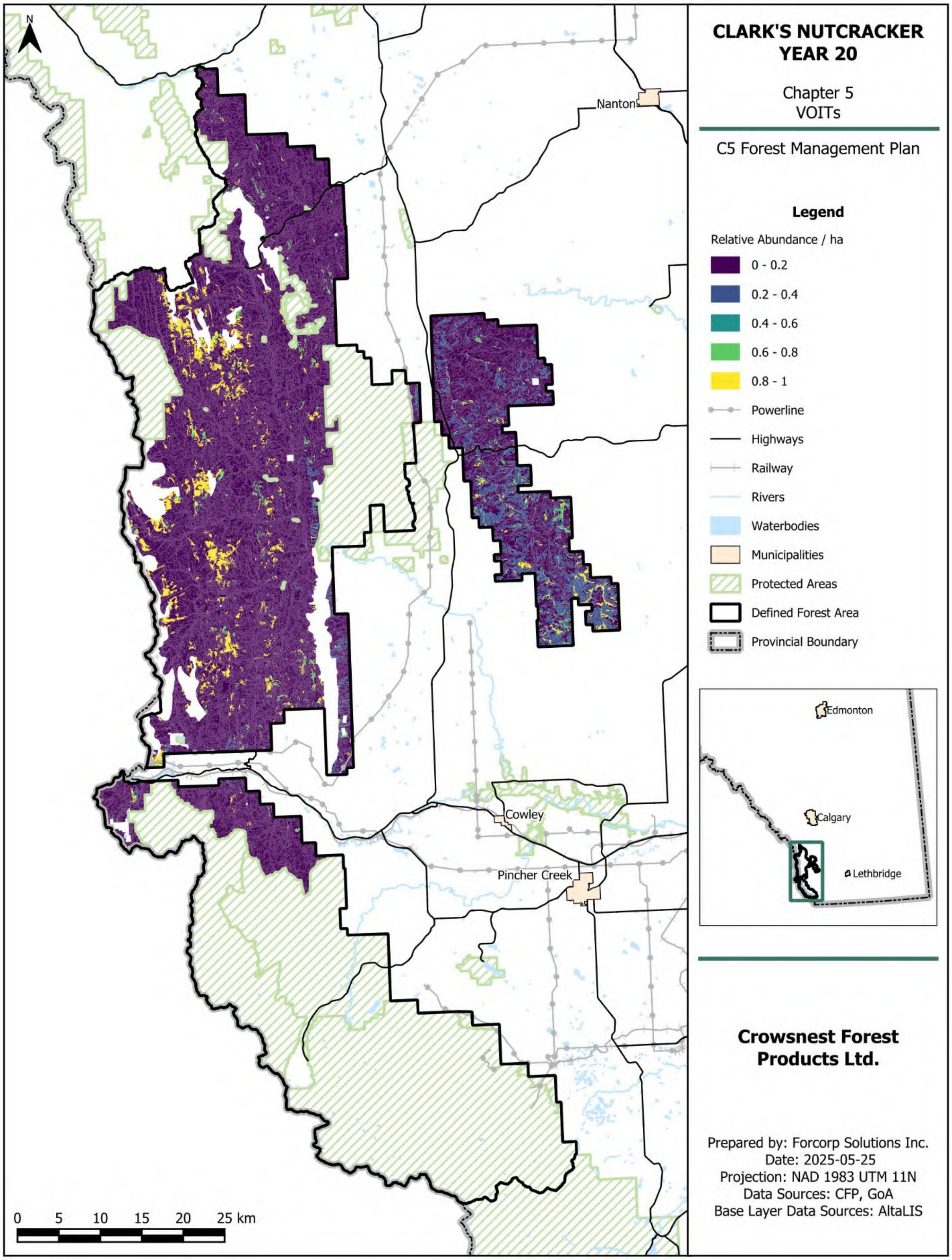

Figure 4-59. Clark's nutcracker Relative Abundance (RA) values in 2043.

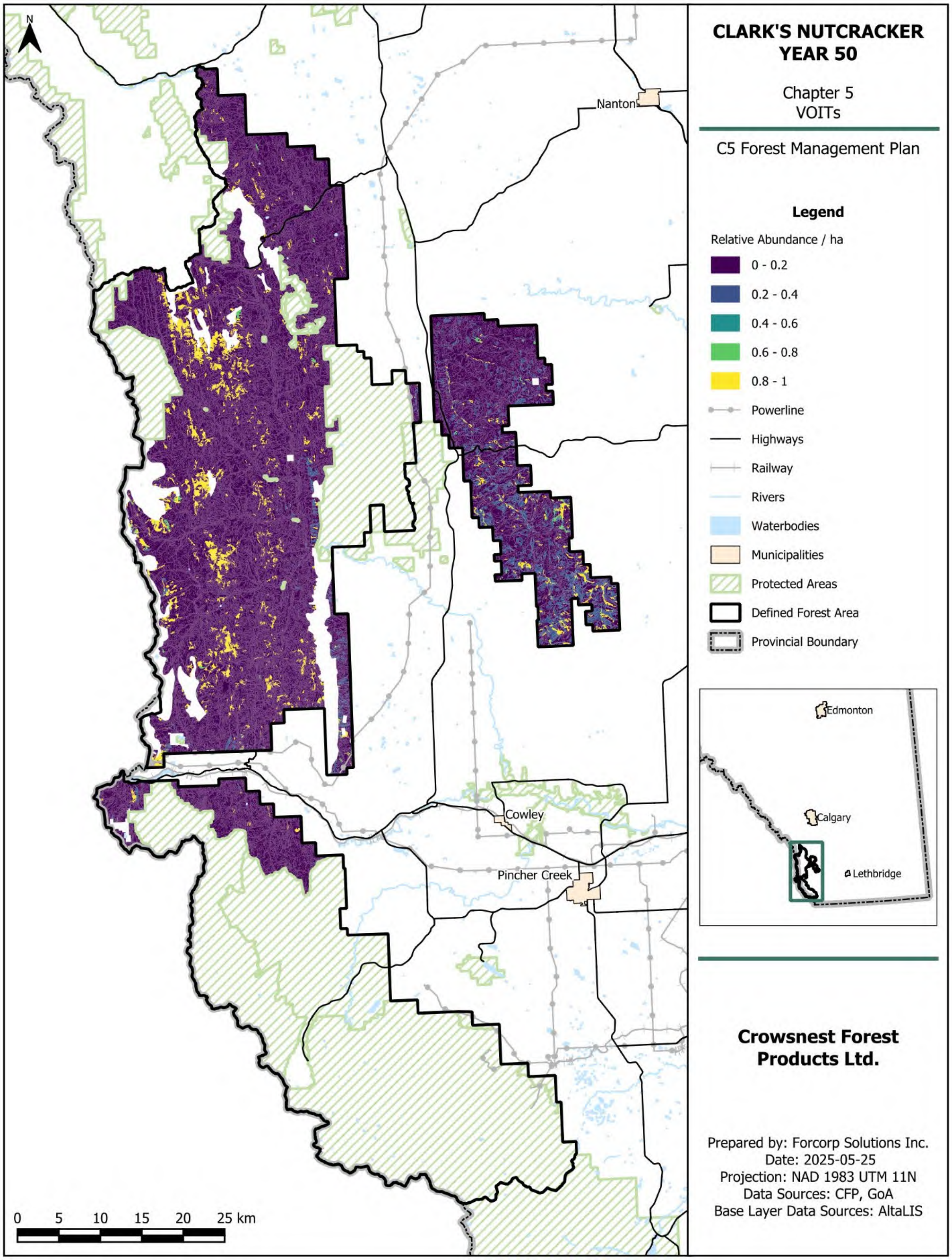

Figure 4-60. Clark's nutcracker Relative Abundance (RA) values in 2073.

4.1.13 VOIT 15 – In-Situ Wild Forest Populations

Reporting Requirement:

- If applicable, table showing number and status of gene conservation areas and number provided in the DFA.
- If applicable, map(s) displaying locations of gene conservation areas in the DFA.

At this time, CFP does not have an ongoing tree breeding program. If one is established, it will be reported on in the Stewardship Reports as required.

4.1.14 VOIT 16 – Ex-Situ Wild Forest Populations

Reporting Requirement:

- If applicable, table showing number of provenances, genotypes, and seedlots and their origin within the DFA.
- If applicable, map(s) displaying locations of provenances, genotypes, and seedlots in the DFA.

At this time, CFP does not have an ongoing tree breeding program. If one is established, it will be reported on in the Stewardship Reports as required.

4.2 Soil and Water Resources

4.2.1 VOIT 25 – Forecasted Water Yield Impacts

Reporting Requirement:

- Table showing Equivalent Clearcut Area (ECA) at 0, 10, 50, 100, and 200 years.
- Map(s) displaying ECA at 0, 10 and 50 years.

The run-off from watersheds was evaluated using the Equivalent Clearcut Area (ECA) methodology. See *Chapter 6 – Preferred Forest Management Strategy* Section 3.10.6 for modeling methodology. The forecasted overall changes in average ECA % over the 200-year time period are summarized in Figure 4-61. The ECA % of each watershed (for the area of that watershed that is within the DFA) is provided in Table 4-23. The colouring is based on the following thresholds:

- **Green:** Less than 30%;
- **Yellow:** Equal or greater than 30% and less than 50%; or
- **Red:** Equal or greater than 50%.

The primary focus was to minimize impacts to watersheds in the first 20 years. While there are occasional yellow forecasted watersheds beyond 20 years, it is not expected that these impacts will actually occur because a new FMP will be developed every 10 years, at which point controls will be applied over the first 20 years to ensure impacts are minimized. Further details on mitigation strategies for yellow medium risk watersheds are described in *Chapter 7 – Plan Implementation and Monitoring* Section 7.2.

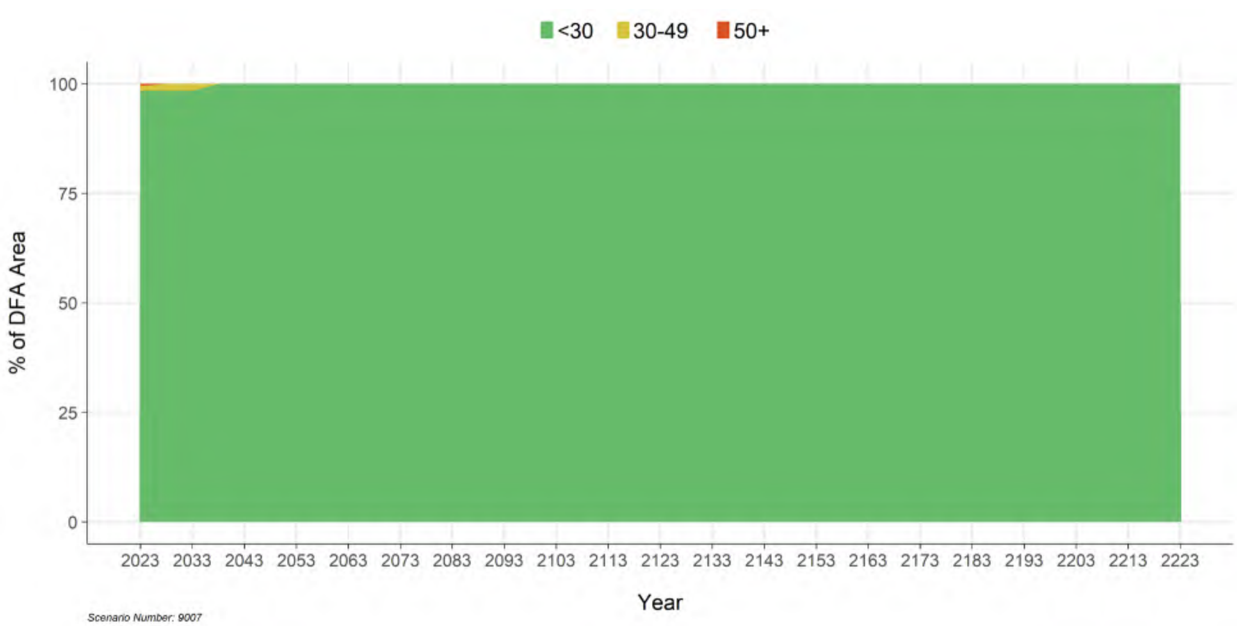

Figure 4-61. Area-weighted watershed ECA value over 200 years.

Table 4-23. The ECA %s for each watershed and key time period.

Watershed ID	Area in DFA (ha)	ECA % Year 0	ECA % Year 10	ECA % Year 50	ECA % Year 100	ECA % Year 200
3	7,055	0	0	20	3	5
5	4,463	13	11	14	18	16
8	2,003	9	8	10	12	11
9	3,532	10	10	14	13	17
10	3,523	13	13	15	18	19
11	4,487	8	7	11	9	9
12	4,001	10	7	12	12	16
13	4,338	13	9	19	12	21
14	2,084	1	1	12	8	11
15	3,895	1	1	18	3	12
16	2,273	14	13	10	26	27
17	4,367	10	18	9	25	21
18	5,287	10	10	21	12	18
19	2,650	11	16	2	20	13
20	3,161	18	15	9	19	22
23	1,834	7	6	9	8	12
24	2,196	7	6	23	9	19
25	2,542	0	1	10	4	12
26	2,368	4	4	20	10	15
27	7,827	3	8	5	8	13
28	4,247	18	16	17	19	26
29	5,272	17	15	19	21	25
30	4,170	3	4	15	11	21
31	5,289	3	3	8	3	10
32	3,306	2	3	12	8	9
33	1,800	12	9	9	14	15
35	6,954	5	17	15	24	24
36	2,027	4	12	13	8	10
37	3,784	24	22	13	24	24
38	5,570	0	0	1	1	1
39	1,692	13	9	9	19	21
40	1,391	1	9	5	12	15
41	1,533	1	10	17	13	13
43	1,442	3	8	17	13	8
44	7,707	11	15	19	20	25
45	2,106	14	9	15	26	21
46	5,629	12	7	6	24	17
47	2,348	16	13	16	16	26
48	2,129	8	6	21	18	16
49	1,623	0	0	1	0	1
50	2,351	12	10	16	13	19
51	544	0	0	12	2	4
53	6,373	9	14	15	18	24

54	4,340	6	15	15	21	18
55	3,562	21	19	14	25	24
56	6,721	9	12	12	18	24
57	2,736	7	14	15	21	18
58	4,611	11	6	19	26	24
59	652	6	3	24	22	26
60	7,073	8	7	11	19	20
62	1,789	0	0	24	11	25
63	1,336	1	1	14	4	4
65	834	1	0	16	4	15
66	4,439	4	15	7	19	20
67	2,888	22	23	25	26	26
68	3,308	7	15	18	24	28
69	2,617	0	22	9	17	17
70	3,028	1	11	5	10	6
71	1,818	12	9	27	12	21
72	872	12	7	27	23	21
73	2,119	13	19	16	24	24
74	961	1	0	0	1	0
75	2,985	50	31	7	25	21
76	3,085	22	26	15	18	23
77	2,694	5	3	7	8	7
78	2,209	1	1	0	1	1
81	1,161	58	34	0	18	7
82	2,236	25	15	2	7	2
83	8,272	0	0	0	0	0
89	2,575	0	0	0	0	0
90	2,155	0	0	0	0	0
110	936	0	0	29	9	17
111	2,096	0	2	5	7	13
112	1,174	9	10	16	14	17
113	1,148	14	13	12	20	12
114	3,035	9	7	6	9	12
115	1,547	2	11	8	12	17
116	1,189	4	2	12	11	14
118	2,861	1	5	10	7	11
119	814	6	6	15	13	8
121	1,214	10	4	21	26	29

4.3 Multiple Benefits to Society

4.3.1 VOIT 28 – Wildfire Risk

Reporting Requirement:

- Maps of Wildfire Risk Indicator (WRI) classes, fuel grid, historical wildfires, and natural subregions.

Details, including maps, on historical wildfires and natural subregions can be found in *Chapter 3 – Landscape Assessment* (Section 5.5 for wildfire history and Section 2.7 for natural subregions).

Predicted reductions for the parts of FireSmart Community Zones that overlap the DFA are provided in Table 4-24. The predicted reductions for each WRI class based on the 20-year SHS are provided in Table 4-25 for the remainder of the FMA. The current WRI classes within the DFA are displayed in Figure 4-63.

Additional information on the forecasted impacts of the PFMS on wildfire risk and the CFP Fire Protection Strategy is provided in *Chapter 7 – Plan Implementation and Monitoring* Section 6.1.

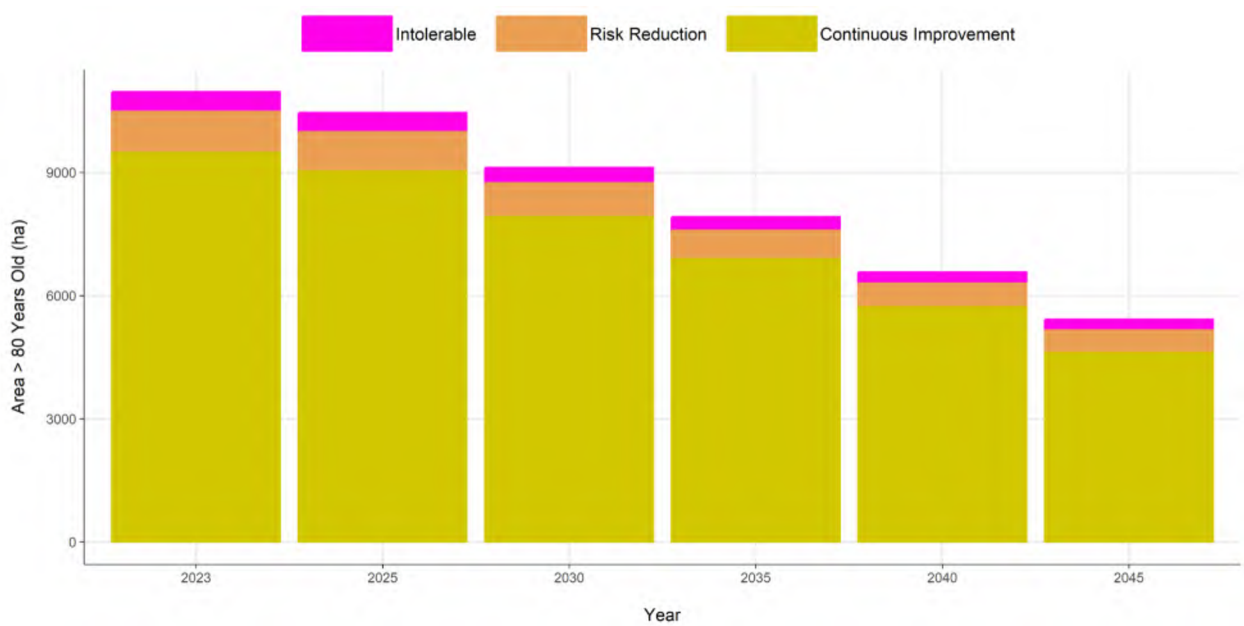

Figure 4-62. Reduction in fire risk for the FireSmart Community Protection Zone.

Table 4-24. Decade 1 and 2 area scheduled by WRI class for the FireSmart Community Zones.

	Net Landbase		Decade 1 Harvest		Decade 2 Harvest		Decade 1 and 2 Harvest	
Wildfire Risk Category	Area (ha)	%	Area (ha)	% of Initial	Area (ha)	% of Initial	Area (ha)	% of Initial
Intolerable	696	3.6%	137	19.7%	67	9.6%	204	29.3%
Risk Reduction	1,532	7.9%	250	16.3%	155	10.1%	405	26.4%
Continuous Improvement	13,300	68.9%	2,129	16.0%	2,280	17.1%	4409	33.2%
Subtotal Categorized	*15,528*	*80.4%*	*2,516*	*16.2%*	*2,502*	*16.1%*	*5,018*	*32.3%*
Non-Categorized	3,776	19.6%	124	3.3%	274	7.3%	398	10.5%
Total	**19,304**	**100.0%**	**2,640**	**13.7%**	**2,776**	**14.4%**	**5,416**	**28.1%**

Table 4-25. Decade 1 and 2 area scheduled by WRI class for the remainder of the FMA.

	Net Landbase		Decade 1 Harvest		Decade 2 Harvest		Decade 1 and 2 Harvest	
Wildfire Risk Category	Area (ha)	%	Area (ha)	% of Initial	Area (ha)	% of Initial	Area (ha)	% of Initial
Risk Reduction	776	1.0%	0	0.0%	200	25.8%	200	25.8%
Continuous Improvement	52,896	65.1%	5,078	9.6%	4,835	9.1%	9913	18.7%
Subtotal Categorized	*53,672*	*66.1%*	*5,078*	*9.5%*	*5,035*	*9.4%*	*10,113*	*18.8%*
Non-Categorized	27,569	33.9%	1069	3.9%	948	3.4%	2017	7.3%
Total	**81,241**	**100.0%**	**6,147**	**7.6%**	**5,983**	**7.4%**	**12,130**	**14.9%**

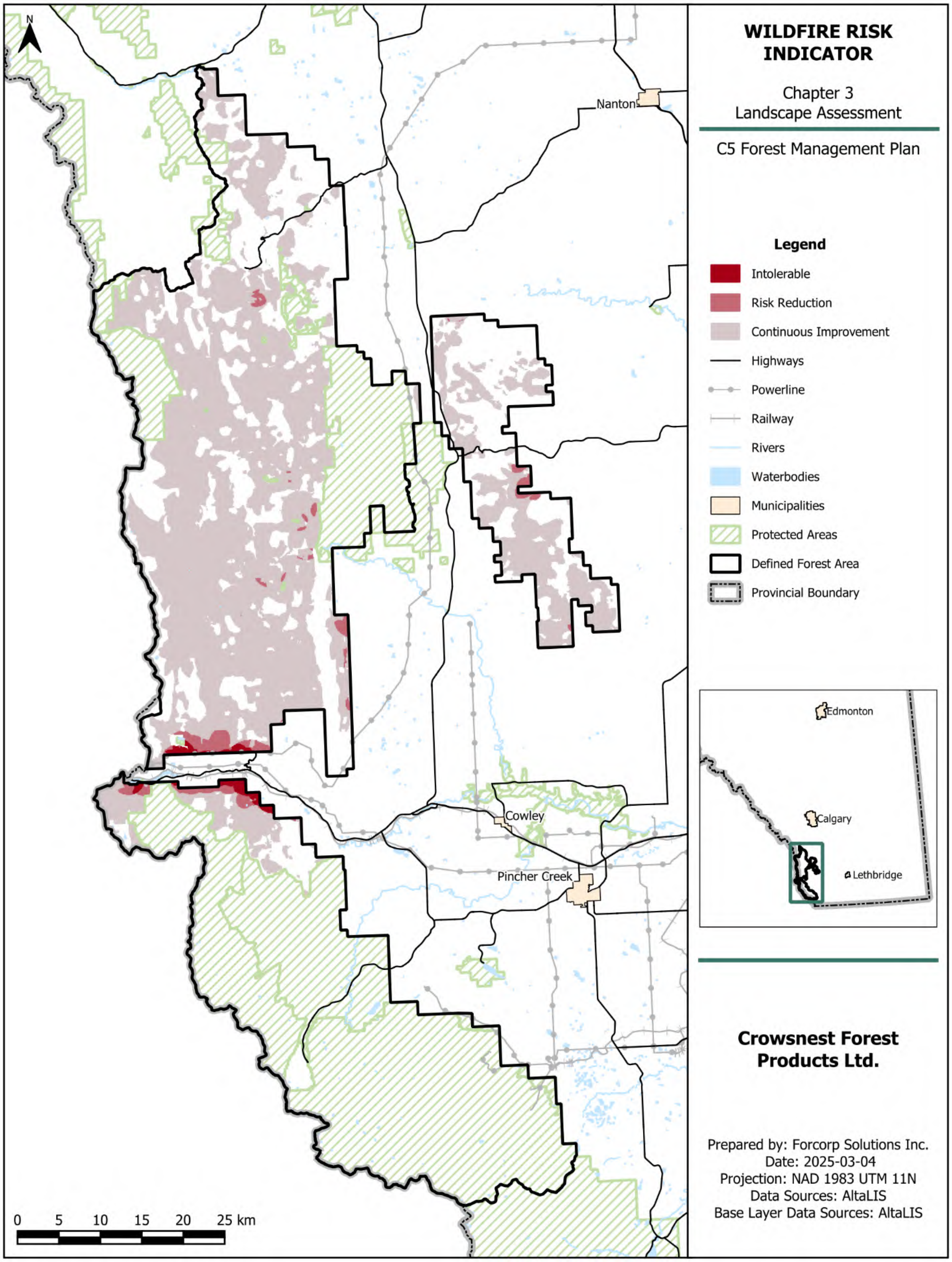

Figure 4-63. Wildfire risk indicator classes within the DFA.

4.3.2 VOIT 29-2 – Scenic Values

Reporting Requirement:

- Table of SHS area (ha) scheduled in the first two decades.
- Map of areas identified with high scenic value in the DFA.

Table 4-26. Decade 1 and 2 area scheduled within modelled areas of high visual quality.

Visual Quality	Decade 1		Decade 2	
	Area (ha)	%	Area (ha)	%
High	1,841	20	1,261	14
Other	7,543	80	7,978	86
Total	**9,385**	**100**	**9,238**	**100**

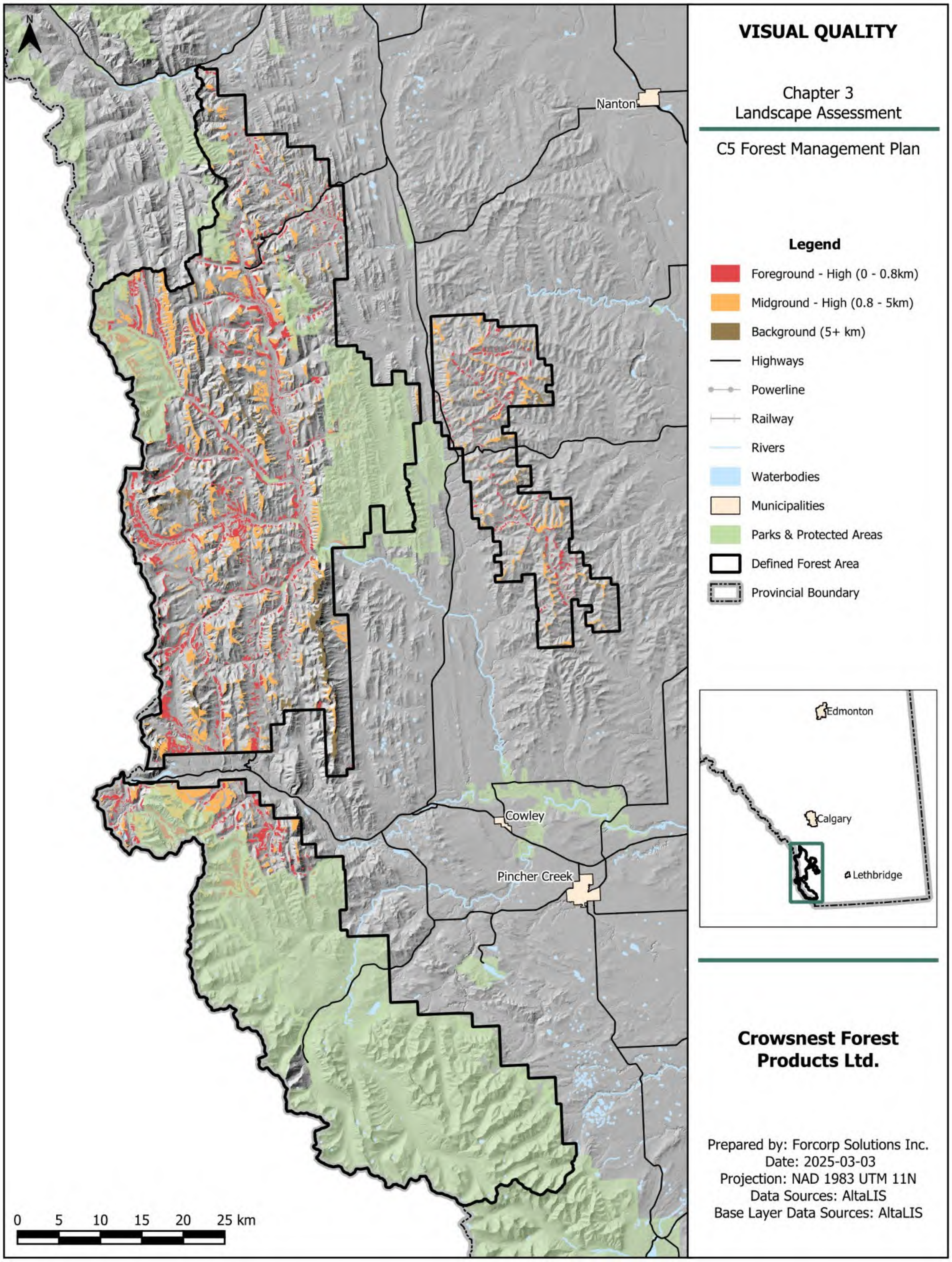

Figure 4-64. Modelled areas of high visual quality within the DFA.

4.3.3 VOIT 29-3 – Forest Encroachment

Reporting Requirement:

- Map displaying identified successional transition areas planned for treatment on the contributing (planned SHS) and non-contributing landbases in the first decades.

Figure 4-65 displays the identified successional transition areas planned for treatment on the contributing and non-contributing landbases in the first decade. In total, there is 58 ha within the contributing landbase (planned SHS) and 49 ha within the non-contributing landbase scheduled for treatment in the first 10 years of the plan.

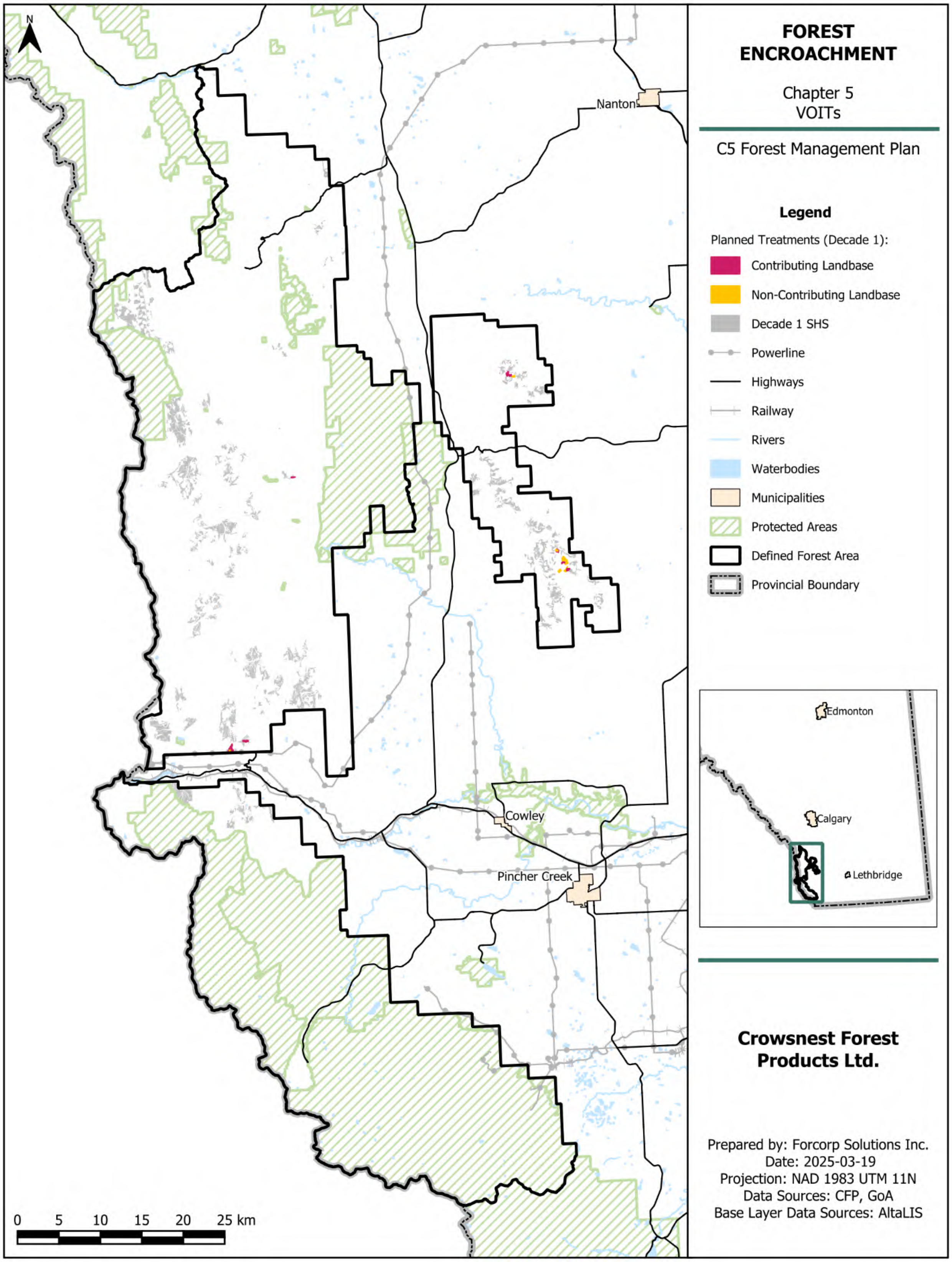

Figure 4-65. Identified successional transition areas planned for treatment in the first 10 years of the SHS.

4.3.4 VOIT 31 – Long Run Sustained Yield Average (LRSYA)

Reporting Requirement:

- Table of comparison of natural versus managed MAI.

The LRSYA results are described in *Chapter 6 – Preferred Forest Management Strategy* Section 2.3.

4.4 Accepting Society's Responsibility for Sustainable Development

4.4.1 VOIT 31 – First Nations Consultation Plan

Reporting Requirement:

- Summary of input provided during Indigenous consultation, how it was incorporated into the FMP and if it wasn't, provide an explanation why.

The First Nations Consultation Plan, its results, and details of incorporation into the FMP is described in detail in *Chapter 2 – FMP Development.*

4.4.2 VOIT 32 – Public Participation Process

Reporting Requirement:

- Summary of public input, how it was incorporated into the FMP and if it wasn't, provide an explanation why.

The Public Participation Program, its results, and details of incorporation into the FMP is described in detail in *Chapter 2 – FMP Development.*

5 References

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FINAL DRAFT

Chapter 6 – Preferred Forest Management Scenario

FORCORP

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	**6**	**PFMS – Preferred Forest Management Scenario**
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	II	Communication Plan
	Annex	III	Stewardship Report (2010-2015)
	Annex	IV	Yield Curve Development
	Annex	V	Net Landbase Development
Three	Annex	VI	TSA – Timber Supply Analysis
	Annex	VII	SHS – Spatial Harvest Sequence
	Annex	VIII	Growth and Yield Plan

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1 Introduction

Innovative, detailed modeling is a large part of the Crowsnest Forest Products (CFP) planning and decision making process and the 2025 Forest Management Plan (FMP) continues this tradition. In developing a recommended management approach for the current FMP, numerous scenarios were modeled and evaluated by the Plan Development Team (PDT), in order to gain insight into the implications and trade-offs of different management alternatives. The outcome from the modeling process is the Preferred Forest Management Scenario (PFMS), which contains the timber harvesting and regeneration activities planned for the next ten years, as well as predictions for the impacts on other values.

The modeling, or forecasting and Timber Supply Analysis (TSA), was undertaken in a series of spatially explicit landscape level Patchworks (Spatial Planning Systems) scenarios. Scenarios were completed to evaluate various management issues, which ranged from non-timber values (e.g., changes in wildlife habitat) that were addressed through Non-Timber Assessments (NTA), to operational objectives such as harvest block size and block patterns.

Issues evaluated throughout the forecasting process include:

Landscape level objectives:

- Seral stages;
- Habitat analysis using Government of Alberta (GoA) NTA tools; and
- Watershed analysis using the Equivalent Clearcut Area (ECA) model.

Operational Concerns:

- Spatial Harvest Sequence (SHS) design;
- Timing of compartment sequencing; and
- Reduce SHS variance in the first decade by creating an operationally feasible SHS.

The scenarios were discussed and reviewed by CFP in Technical Team (TT) meetings, as well as at PDT meetings, which were also attended by quota holders and GoA representatives. Of the 15 PDT meetings held from October 2022 until April 2025, seven meetings included presentations and/or discussion on TSA analysis results and providing direction to the next analysis. This allowed all PDT members to participate and provide input into the TSA and, ultimately, the PFMS.

The purpose of this chapter is to describe and document the PFMS. The details on the scenarios leading up to the PFMS are described separately in *Annex VI – Timber Supply Analysis*. The PFMS is the final scenario resulting from the series of scenarios completed in that process. It describes the harvesting and silviculture actions that CFP and quota holders plan to take over the next ten years, and the predicted response of the forest to these actions over a 200-year planning horizon. The outputs derived from the PFMS are directly used to provide indicators and targets for the VOITs (*Chapter 5 – Values, Objectives, Indicators and Targets*) and are incorporated into the guidelines for FMP implementation over the 10-year period, from May 1, 2025, to April 30, 2035, as documented in *Chapter 7 – Plan Implementation and Monitoring*.

This chapter summarizes the forest management objectives and the linkages to the PFMS. It also contains summaries of the landbase and yield curves, details of which are provided in *Annex IV – Yield Curve*

Development and *Annex V – Net Landbase Development*. The assumptions and inputs used to develop the PFMS are described separately from the predicted outcomes, which are used to support FMP implementation.

1.1 Management Philosophy

The management philosophy for the PFMS is to implement forest management practices that result in a sustainable flow of economically viable fiber to sustain mill operations while employing a sustainable forest management approach that maintains biodiversity and ecological integrity.

The management objectives that were used to guide PFMS development are:

- Establish sustainable harvest levels that balance ecological, economic and social objectives;
- Manage forest structure through a coarse filter approach using seral stages and patch targets;
- Mitigate impacts on non-timber habitat values using a fine filter approach for a selected set of species;
- Promptly regenerate harvest areas to establish productive coniferous and mixedwood stands to support and grow sustainable harvest levels;
- Plan and promptly adapt harvesting and regeneration to mitigate impacts from insects and other infestations; and
- Spatially define FMA and quota holder harvesting operations to reduce the annual footprint and access requirements.

1.1.1 PFMS Strategies

To implement PFMS objectives, the following strategies were deployed during PFMS development:

- Model a 200-year planning horizon to estimate strategic implications;
- Establish sustainable harvest levels that balance ecological, economic and social objectives;
- Use a divided coniferous and deciduous landbase;
- Model even flow total conifer harvest volumes over the planning horizon;
- Deciduous harvest level is not being assigned from pure deciduous stands;
- Apply operational sequencing constraints on harvest volumes;
- Incorporate existing planned blocks into the SHS to improve operability and reduce variance;
- Retain stand level structure retention within harvest areas;
- Apply silviculture treatments to achieve Reforestation Standard of Alberta (RSA) predicted yields;
- Manage harvest sequencing to achieve desirable thresholds in the change in predicted habitat levels using GoA NTA tools;
- Manage predicted impacts on watershed runoff using the ECA model; and
- Reduce wildfire risk by harvesting > 30% of identified higher risk stands in areas surrounding communities.

1.1.2 Landbase Summary

The CFP Forest Management Agreement (FMA) area includes one Forest Management Unit (FMU): C5. As part of the 2025 FMP development process, a netdown landbase was developed to support planning, forecasting and TSA for C5. The total land area is 350,348 hectares (ha).

The netdown landbase is a spatial representation of the FMP area as of May 1, 2023. Initially developed for the TSA, the landbase contains traditional TSA information such as stand age, planning compartments, timber yield strata, timber productivity, as well as areas deferred or excluded from timber harvesting activity. Landbases have evolved and now support an ever-expanding array of non-timber values such as terrestrial and aquatic wildlife habitats; at the same time, the required linkages to other datasets (such as ARIS and DIDs) have tightened. The netdown landbase is one of the key products of the 2025 FMP; Agreement-in-Principle (A-I-P) for the landbase was received from the GoA on December 15, 2023, representing a significant milestone in FMP development. Development of the netdown landbase used in the forecasting and TSA is described in detail in *Annex V – Net Landbase Development*.

Table 1-1 provides a summary of the FMP area by deletion category and the area suitable for timber harvesting by broad cover group (BCG), resulting from the netdown process. The column ***sum_grp*** in the netdown landbase dataset reflects the classification in the following table, which is a combination of ***f_del*** (deletions in the passive landbase) and ***f_bcg*** (broad cover group classification in the active landbase). Active landbase distribution by yield strata is summarized in Table 1-2. Figure 1-1 maps the distribution of the deletion categories comprising the passive landbase, and Figure 1-2 maps the distribution of the active landbase by BCG.

Table 1-1. Summary of the classified CFP landbase.

Landbase Category		Area (ha)
	Non-Contributing Landbase	
Administrative Restrictions		
PPA	Parks and Protected Areas	157,612.1
ESLUZ	Eastern Slopes Land Use Zone 1	3,102.1
HRV	Historic Resource Values	1,215.7
DIDS-FOR	Forest DIDs Dispositions	266.3
DIDS-NONFOR	Non-Forested DIDs Dispositions	2,939.1
CLR	Crown Land Reservations	414.6
GOA_PSP	GOA Permanent Sample Plots	116.9
ANTH_NON	Non-Vegetated Anthropogenic Features	526.1
ANTH_VEG	Vegetated Anthropogenic Features	173.5
AVI	Areas with no AVI Interpretation	700.3
Administrative Total		**167,066.7**
Landscape Restrictions		
LAKES_RIVERS	Lakes and Rivers	661.9
FLOOD	Flood Prone Areas	6.4
HYDROBUF	Hydrology Buffers	10,701.2
NNV	Natural Non-Vegetated Areas	2,627.4
NNF	Natural Non-Forested Areas	11,924.8
BURN	Burned Areas	12.8
OTHER_DIST	Areas Affected by Other Natural Disturbances	30.0
NFCC	Non-Forested Cutblocks (Outstanding ARIS Reconciliation)	0.0
Landscape Restrictions Total		**25,964.6**
Operational Restrictions		
SLOPE	Areas with Slopes >45%	32,584.1
MOISTURE	High Soil Moisture	216.8
TPR	Low Timber Productivity Rating	4,785.2
DENSITY	Low Stand Density	9,025.0
LT	Larch/Tamarack	265.9
FD	Douglas-Fir	225.5
PA_PF	Whitebark/Limber Pine	1,302.1
WHITEBARK PINE PLUS	Whitebark Pine Plus protection	17.4
OPERATIONAL	Operational Deletions	1,742.4
ISO	Isolated Stands	23.6
PAR	Perimeter to Area Deletions	985.4
SEISMIC	Seismic Lines	46.0
Operational Restrictions Total		**51,219.4**
Non-Contributing Landbase Total		**244,250.7**
	Contributing Landbase	
C	Coniferous	91,217.2
CD	Coniferous Leading Mixedwood	1,507.1
DC	Deciduous Leading Mixedwood	1,258.8
D	Deciduous	12,114.4
Contributing Landbase Total		**106,097.4**
Grand Total		**350,348.1**

Table 1-2. Net landbase (active) yield class area summary.

Yield Stratum	Contributing Landbase Area (ha)	Non-Contributing Landbase Area (ha)	Total Area (ha)
N_HW	12,114.4	3,153.3	15,267.6
N_PLMIX	1,139.9	807.2	1,947.2
N_SXMIX	1,625.9	893.3	2,519.2
N_PL	39,780.2	30,577.1	70,357.4
N_SW	16,395.8	21,426.5	37,822.3
N_FD	10,909.2	6,179.0	17,088.1
J_PL	8,082.7	69.8	8,152.4
J_SW	2,530.3	6.2	2,536.5
R_PL	13,519.1	293.8	13,812.9
X	0.0	180,844.4	180,844.4
Total	**106,097.4**	**244,250.7**	**350,348.2**

The deletion map shows the spatial arrangement of the values in the *f_del* field (Figure 1-1). The largest categories are parks and protected areas, steep slopes, naturally non-forested areas, and hydrology buffers. FMU C5 is conifer dominated, with the pure pine stratum comprising the largest proportion of the active landbase (Figure 1-2).

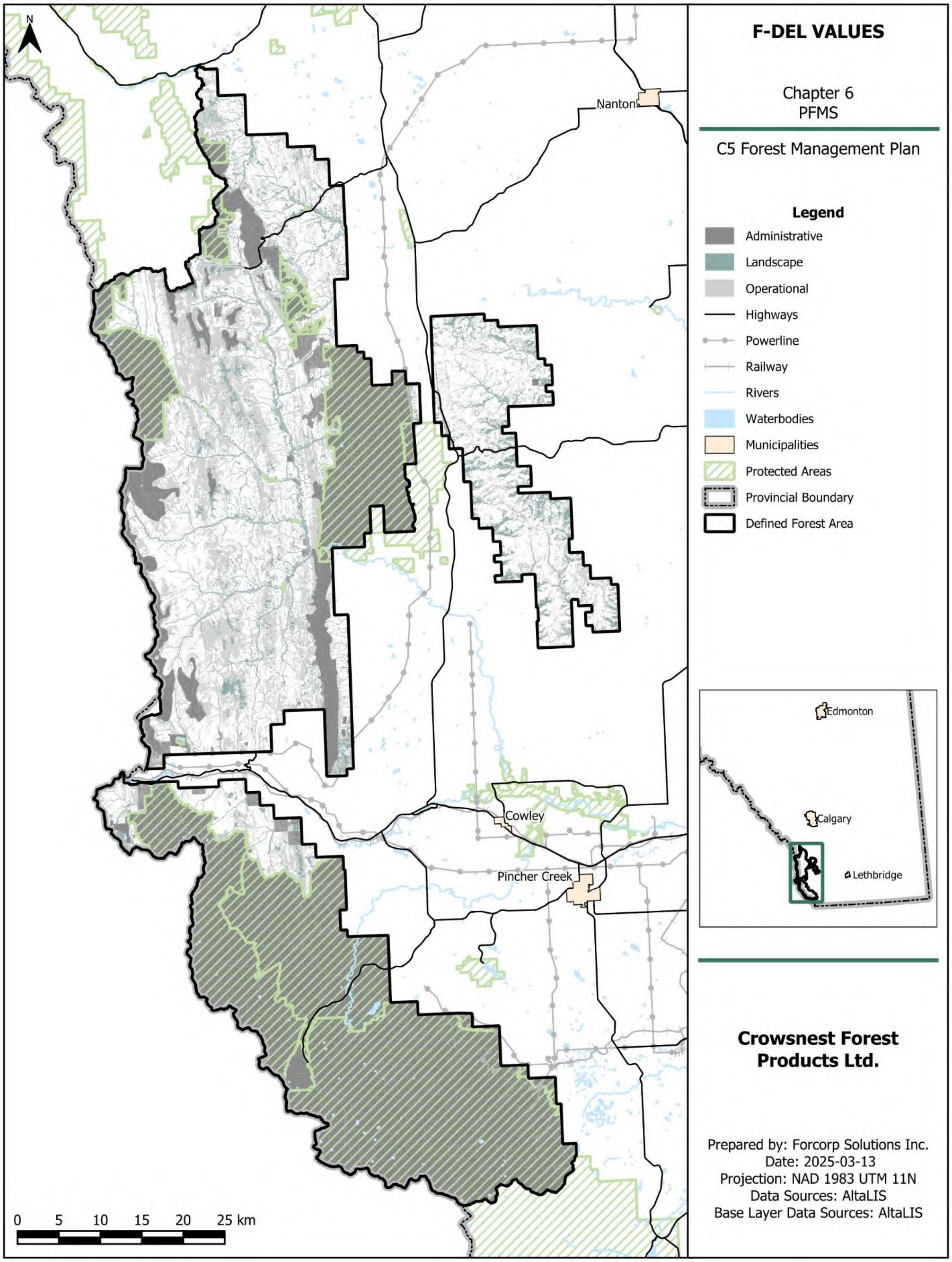

Figure 1-1. Final deletion categories for the modeling landbase.

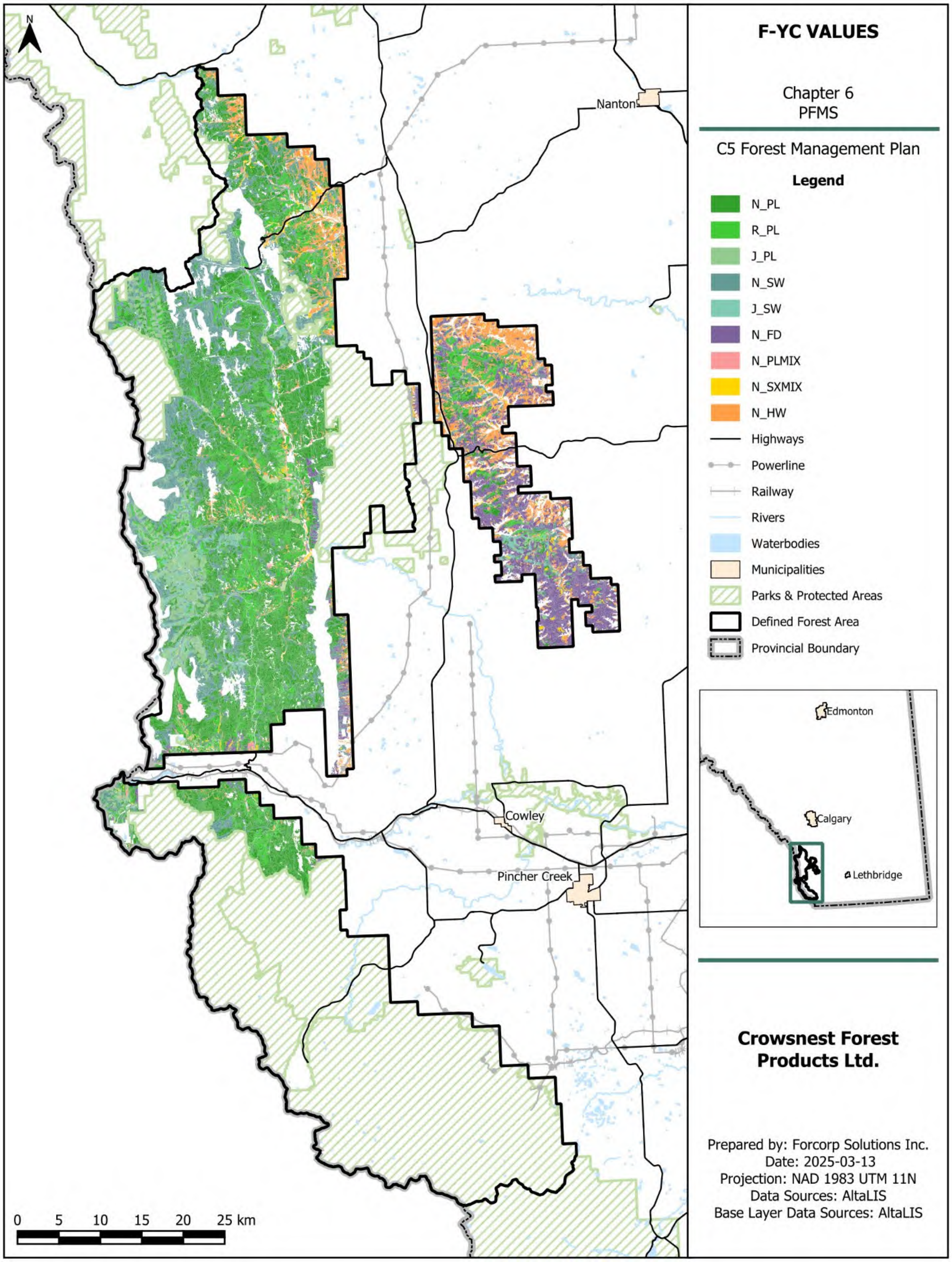

Figure 1-2. Final yield strata on the active landbase as used in the modeling landbase.

2 Yield Curve Summary

2.1 Overview

Yield curves describe the change in merchantable timber yields over the life of a forest stand. A detailed description of the yield curve development process is provided in *Annex IV – Yield Curve Development*. The yield curves which received A-I-P on December 15, 2023 are those used in the TSA process. Cull deductions were applied in the TSA processes to adjust from gross merchantable to net merchantable timber yields.

Yield curves used in the PFMS were developed from temporary sample plot (TSP), permanent sample plot (PSP), and data from RSA performance survey programs across the FMP area. Stratification was based on the six CFP base yield strata assigned through the net landbase development process. Yield strata are a modification of Alberta's base 10 yield strata.

2.2 Timber Yield Curves

CFP has identified three groups of stands within the net landbase for yield curve development:

- **Natural Stands (NAT)**: Include all fire-origin stands that are within the active landbase. Modeling was based on non-linear regression of gross merchantable volume as a function of inventory age using natural stand TSPs. Strata were based on the AVI polygon.
- **Pre-96 Managed Stands (Juvenile):** Represent all existing post-harvest regenerated stands that were harvested prior to May 1, 1996. Modeling was based on the provincial Growth and Yield Projection System (GYPSY) projection using data from the Juvenile Temporary Sample Plot (TSP) program.
- **RSA Managed Stands (RSA)**: Represent all existing openings that were harvested on or after May 1, 1996. Modeling was based on the provincial GYPSY projection of RSA performance survey data for the lodgepole pine (PL) stratum. The projections were averaged by yield strata using the proper sample weights by RSA program year and population areas as per RSA protocols. All other regenerating strata were based on the respective natural stand yield curves.

2.2.1 Utilization

Gross merchantable tree length volumes were compiled to a utilization standard of 10 centimetre (cm) top diameter inside bark for deciduous species and 11 cm for coniferous species, 15 cm stump diameter outside bark at a 30 cm stump height using a 4.88 metre (m) minimum merchantable length for both coniferous and deciduous species groups. These standards are outlined in Table 2-1 below, and the curves are shown in Figure 2-1.

Table 2-1. FMA utilization standards.

Utilization Attribute	Conifer	Deciduous
Top Diameter Inside Bark (cm)	11	10
Stump Diameter Outside Bark (cm)	15	15
Stump Height (cm)	30	30
Minimum Merchantable Length (m)	4.88	4.88

2.2.2 Cull

Cull information was developed based on the document titled "*Tree Length Utilization in Harvest Operations*" (Alberta Agriculture & Forestry, 2015) that speaks to the importance of all yield estimates being compiled to a tree length utilization standard and the scaling system being dependent on all harvested timber crossing an approved scale.

In the previously approved FMP for FMU B12, CFP submitted a cull proposal to the GoA (Spray Lake Sawmills, 2019) quantifying the estimates of conifer cull based on scale data from 2007-2017. There was no deciduous scale information available therefore the deciduous cull estimate from Weyerhaeuser Pembina Timberlands was proposed.

The proposed conifer cull based on the analysis of scale data is 1.23% and the proposed deciduous cull based on the Pembina operations is 9.00% for all stand types for the 2025 FMP.

Net volumes are calculated by deducting cull from the projected gross merchantable volumes. Cull deductions need to apply directly to yield projections, not post-hoc AAC as defined in Section 4.2.7(d) of the Planning Standard. Cull is included here for reference only, and the application of yield reductions to account for cull is applied within the TSA.

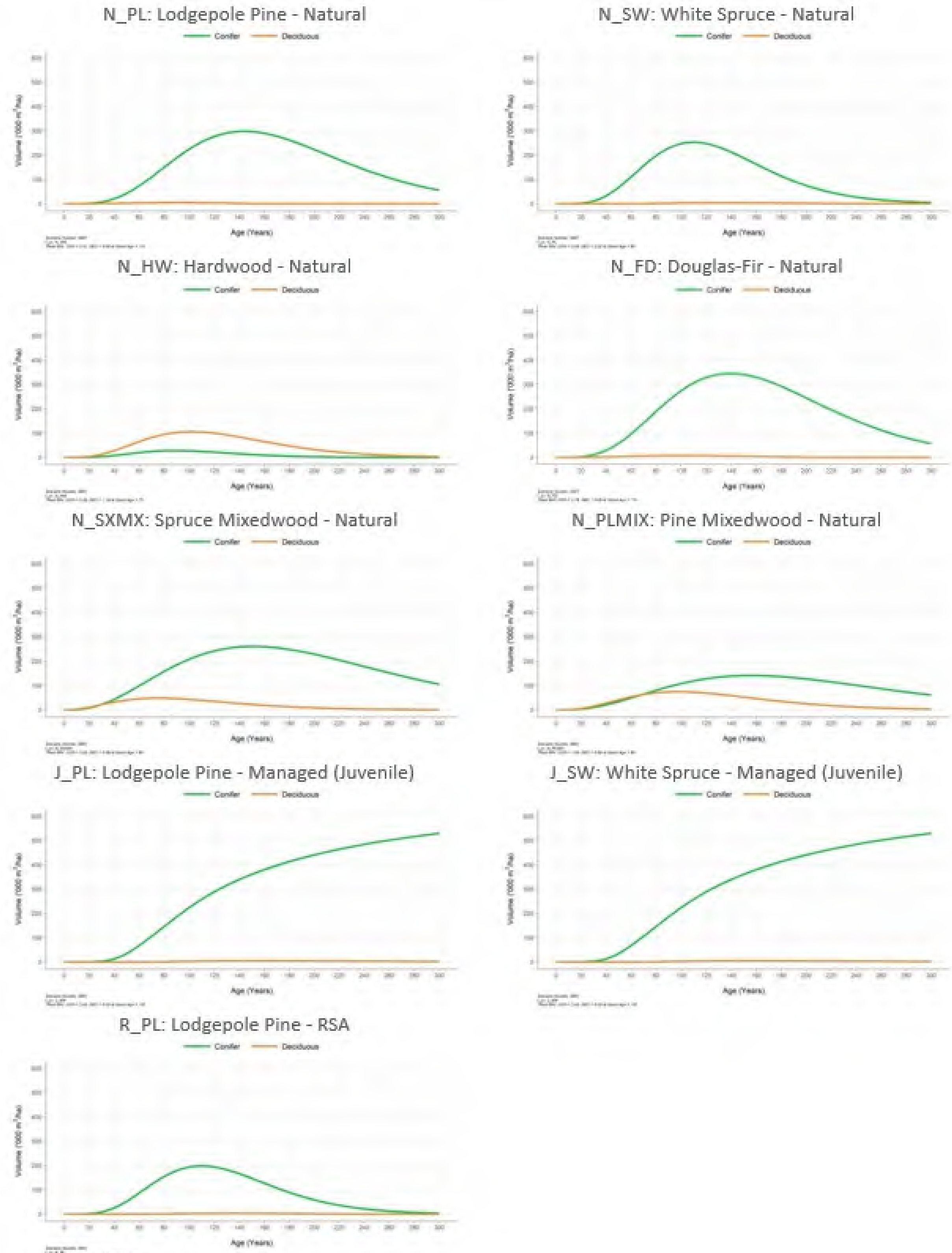

Figure 2-1. Volume yield curves as used in the TSA modeling for FMU C5.

2.3 LRSYA

Long Run Sustainable Yield Average (LRSYA) is a theoretical yield that is attainable once a regulated state of the forest has been achieved, and all stands are harvested at their maximum merchantable volume production as measured by the peak Mean Annual Increment (MAI) at culmination age. LRSYA provides a theoretical maximum AAC that the forest can sustain. Due to spatial and temporal constraints, even-flow, or accelerated cut assumptions in the TSA the long term AAC is expected to be lower than the LRSYA.

The LRSYA is calculated by multiplying the net area by the peak MAI of each yield stratum. The sum of all yield calculations is the LRSYA-derived AAC for the DFA.

LRSYA may be calculated for different scenarios based on transition assumptions implemented in the TSA. CFP is showing two different scenarios:

- Back to natural (Table 2-2): All stands are assumed to regenerate back to natural and follow natural yield projections. This is the approach used in the TSA.
- Back to itself (Table 2-3): Stands regenerate to their current status, so existing managed stands will follow the managed stand yield projections.

All LRYSA calculations ignore all model constraints, therefore this comparison is in theory and assumes a regulated forest situation.

Table 2-2. LRSYA calculation - 'back to natural' scenario.

Current Yield Stratum	Regenerate To	Area (ha)	Culmination MAI (m^3/ha/yr) Age	CON	DEC	Long Run Sustained Yield (m3/yr) CON	DEC
N_Hw	N_Hw	12,114	77	0.35	1.19	4,191	14,358
N_Fd	N_Fd	10,909	109	2.78	0.07	30,348	715
N_PLMIX	N_MIX_Pl	1,140	106	1.09	0.70	1,239	795
N_SXMIX	N_MIX_Sx	1,626	101	2.09	0.43	3,390	693
N_Pl	N_Pl	39,780	90	2.54	0.02	101,153	956
N_Sw	N_Sw	16,396	114	2.32	0.04	37,995	618
J_Pl	N_Pl	8,083	90	2.54	0.02	20,553	194
J_Sw	J_Sw	2,530	134	2.43	0.03	6,139	85
R_Pl	N_Pl	13,519	90	2.54	0.02	34,376	325
Total		**106,097**				**239,385**	**18,739**

Table 2-3. LRSYA calculation - 'back to itself' scenario.

Current Yield Stratum	Regenerate To	Area (ha)	Culmination MAI (m^3/ha/yr)			Long Run Sustained Yield (m3/yr)	
			Age	CON	DEC	CON	DEC
N_Hw	N_Hw	12,114	77	0.35	1.19	4,191	14,358
N_Fd	N_Fd	10,909	109	2.78	0.07	30,348	715
N_PLMIX	N_MIX_Pl	1,140	106	1.09	0.70	1,239	795
N_SXMIX	N_MIX_Sx	1,626	101	2.09	0.43	3,390	693
N_Pl	N_Pl	39,780	90	2.54	0.02	101,153	956
N_Sw	N_Sw	16,396	114	2.32	0.04	37,995	618
J_Pl	J_Pl	8,083	113	2.62	0.01	21,140	43
J_Sw	J_Sw	2,530	134	2.43	0.03	6,139	85
R_Pl	R_Pl	13,519	90	1.99	0.02	26,903	250
Total		**106,097**				**232,499**	**18,513**

3 PFMS Assumptions and Targets

This section describes the inputs, assumptions and targets applied in the modeling exercise to produce the PFMS. The PFMS is not simply the result of a computer simulation based on model targets but, rather, a combination of numerical targets and manual intervention to address concerns and issues that are not included in the model. FMU C5 was treated as one sustained yield unit (SYU) and therefore one PFMS was produced.

3.1 Basic Timber Supply Assumptions

The following basic assumptions were applied in the PFMS:

- Even flow of total coniferous harvest volumes;
- Application of a 200-year planning horizon, with model reporting in five-year periods; and
- Operable coniferous growing stock constrained to not decline in the last quarter of the planning horizon.

3.2 Harvest and Regeneration Treatments

Clearcut harvesting, with 3% structure retention (17.5% for Douglas-fir), was a uniform silviculture system applied across the entire FMU C5.

The PFMS assumes that all stands will be promptly regenerated following harvest. After harvest, coniferous and mixedwood stands will be regenerated using combinations of scarification, planting and natural regeneration and tending.

In FMU C5, all strata regenerate back to the same species strata, and to the natural stand yield curve. While the model applied strict deterministic regeneration rules (e.g., all pine stands are regenerated to pine), flexibility for individual blocks is permitted on the ground, provided that strata-balancing objectives are achieved. Refer to *Chapter 7 – Plan Implementation & Monitoring* for more information.

3.2.1 Minimum Harvest Age

The Minimum Harvest Age (MHA) of 80 years was uniformly applied across the entire FMU C5 and all strata. The MHA of 80 is younger than the maximum MAI ages, excluding N_HW (Table 3-1), but the volumes and piece sizes at 80 years of age meet the minimum requirements for the sawmill.

Table 3-1. Minimum harvest ages as compared to the maximum MAI of the yield curves used in 2025 FMP.

Yield Curve	Min. Harvest Age	Maximum MAI	Age at Max MAI
N_FD	80	2.85	109
N_HW	80	1.53	77
N_PL	80	2.57	90
N_PLMIX	80	1.79	106
N_SW	80	2.35	114
N_SXMIX	80	2.52	101
J_PL	80	2.62	113
J_SW	80	2.46	134
R_PL	80	2.01	90

3.2.2 Succession and Lifespan

Succession in the modeling is the change between strata to address natural species conversion and stand breakup over time. The PFMS continued the same approach from the previous FMP, where stands did not change strata due to aging within the planning horizon. Instead, all forested stands have declining volume curves, which maintain a low volume as they progress past the age of 300 years.

In the PFMS, 8,046 ha of active landbase was not harvested within the 200-year timespan of the model forecast (811 ha of conifer landbase). This unharvested area is a direct result of reducing harvest from the theoretical maximum to meet other objectives and ensure an operational feasible sequence.

3.3 Seral Stages

Seral stages classify the forest into ecological stand development phases that represent a stand's life cycle. They are commonly used as a coarse filter management tool. The seral stage classification used in the 2025 FMP (Table 3-2) is based on the Government of Alberta simplified seral stage definitions. The GOA recommended seral stage targets based on the natural range of variation[1] are shown in Table 3-3.

A separate analysis of the natural range of variation of seral stages and old growth specific to FMU C5 was completed and is included in *Appendix I – Annex VI – Timber Supply Analysis*. This analysis determined that the median NRV old growth percentage for the DFA is ~25%, with Q12.5 at 18% and Q87.5 at 38%.

[1] Government of Alberta. 2025. Seral stage objective: A Guide for Forest Management Planning.

Table 3-2. Seral stages used in 2025 FMP.

Stratum	Young	Immature	Mature	Old	Very Old
FD	1 - 19	20 - 79	80 - 119	120 - 179	180+
HW	1 - 19	20 - 79	80 - 119	120 - 179	180+
HWPL	1 - 19	20 - 79	80 - 119	120 - 179	180+
HWSX	1 - 19	20 - 79	80 - 119	120 - 179	180+
PL	1 - 19	20 - 79	80 - 119	120 - 179	180+
PLHW	1 - 19	20 - 79	80 - 119	120 - 179	180+
SB	1 - 19	20 - 79	80 - 119	120 - 179	180+
SW	1 - 19	20 - 79	80 - 119	120 - 179	180+
SWHW	1 - 19	20 - 79	80 - 119	120 - 179	180+

The reported seral stages used three landbase definitions; gross landbase, active landbase and an on-par landbase.

Table 3-3. Seral stage reference levels for the Upper Foothills, Montane, and Subalpine natural subregions.

Natural Subregion	Min	NRV Reference for Net Landbase (Q25 - 0.03)	NRV Reference for Gross Landbase (Q25)	MED	Q75	Max
Upper Foothills	18.8%	21.8%	24.8%	28.4%	32.3%	41.7%
Montane[1]	17.0%	28.8%	31.8%	33.6%	41.8%	52.6%
Subalpine[1]	32.8%	36.2%	39.2%	43.0%	46.5%	56.3%

[1] Montane and Subalpine NRV outputs are not well validated, and the Upper Foothills levels are used instead.

3.3.1 Standard Analysis, Gross and Active Landbase

The main evaluation of seral stage on the old and very old seral stages is to determine if an acceptable amount of each forest condition is represented through time. Normally, the analysis is completed on the gross landbase (all areas regardless of operability) and the active landbase (areas allowed to be harvested). The gross and active landbases are the standard method of controlling and analyzing the seral stages. Targets and reports were developed and used in the PFMS scenario. Seral stage targets for both gross and active landbases were set for a minimum amount of area in the old and very old stages. The PFMS also applied patch targets to FMU C5 to achieve the objectives for the combined old and very old seral stage area.

3.3.2 On-Par Landbase Analysis

The third landbase type is the on-par landbase, used to report the seral stages for an area larger than the active landbase. It includes stands of similar stand composition to the active landbase that have been excluded from the active landbase based on administrative or operational restrictions, rather than stand condition (i.e., excluded productive land).

To determine the amount of productive land that is on the gross landbase, an "on-par" (equivalent) analysis was completed. To be considered as an on-par polygon in the landbase, the polygon would otherwise have been active landbase that could have been harvested if ground rules and various dispositions were not applied. For example, productive forest in water buffers would be considered 'on-par' and equal to the active landbase in terms of ecological value. A full list of the area removed from each landbase deletion and added to the active landbase for the purposes of the on-par analysis is presented in Table 3-4. The areas under the Subjective deletion category are those not considered to be on-par, while all other forested landbase is.

This on-par landbase allows portions of the gross landbase to be reported in the on-par portion of the seral stage analysis.

Table 3-4. On-par (equivalent) area by landbase category.

Deletion Category	f_del	Description	Strata Group: Fd Area (ha)	Fd %	Conifer Landbase (Not Fd) Area (ha)	Conifer Landbase (Not Fd) %	Deciduous Landbase Area (ha)	Deciduous Landbase %
Administrative / Landuse	PPA	Parks and Protected Areas	0	0.0	0	0.0	0	0.0
	ESLUZ	Eastern Slopes Land Use Zone 1	1	0.0	1,306	0.0	25	0.0
	HRV_GOA	Historic Resource Values	13	0.0	778	0.0	30	0.0
	DIDS-FOR	Forest DIDs Dispositions	9	0.0	181	0.0	13	0.0
	DIDS-NONFOR	Non-Forested DIDs Dispositions	0	0.0	0	0.0	0	0.0
	CLR	Crown Land Reservations	37	0.0	234	0.0	0	0.0
	GOA_PSP	GOA Permanent Sample Plots	22	0.0	386	0.0	3	0.0
	ANTH_NON	Non-Vegetated Anthropogenic Features	0	0.0	7	0.0	0	0.0
	ANTH_VEG	Vegetated Anthropogenic Features	0	0.0	1	0.0	0	0.0
	AVI	Areas with no AVI Interpretation	0	0.0	0	0.0	0	0.0
	Subtotal		*82*	*0.0*	*2,893*	*0.0*	*71*	*0.0*
Landscape / Ground Rules	LAKES_RIVERS	Lakes and Rivers	0	0.0	3	0.0	0	0.0
	FLOOD	Flood Prone Areas	0	0.0	0	0.0	0	0.0
	HYDROBUF	Hydrology Buffers	182	0.0	6,853	0.0	590	0.0
	NNV	Natural Non-Vegetated Areas	0	0.0	0	0.0	0	0.0
	NNF	Natural Non-Forested Areas	0	0.0	0	0.0	0	0.0
	BURN	Burned Areas	0	0.0	1	0.0	2	0.0
	OTHER_DIST	Areas Affected by Other Natural Disturbances	0	0.0	15	0.0	0	0.0
	NFCC	Non-Forested Cutblocks (Outstanding ARIS Reconciliation)	0	0.0	0	0.0	0	0.0
	Subtotal		*182*	*0.0*	*6,872*	*0.0*	*593*	*0.0*
Operational	SLOPE	Areas with Slopes >45%	1,386	0.1	22,453	0.2	816	0.1
	OPDEL	Operational Deletions	17	0.0	816	0.0	37	0.0
	ISO_DEL	Isolated Stands	1	0.0	11	0.0	11	0.0
	PAR_DEL	Perimeter to Area Deletions	40	0.0	906	0.0	68	0.0
	Subtotal		*1,444*	*0.1*	*24,186*	*0.2*	*931*	*0.1*

Deletion Category	f_del	Description	Strata Group Fd Area (ha)	%	Conifer Landbase (Not Fd) Area (ha)	%	Deciduous Landbase Area (ha)	%
Subjective	MOISTURE	High Soil Moisture	0	0.0	18	0.0	0	0.0
	TPR	Low Timber Productivity Rating	132	0.0	9,468	0.1	43	0.0
	DENSITY	Low Stand Density	3,938	0.2	9,291	0.1	1,521	0.1
	LT	Larch/Tamarack	0	0.0	397	0.0	0	0.0
	FD	Douglas-Fir	254	0.0	2	0.0	0	0.0
	PA_PF	Whitebark/Limber Pine	217	0.0	2,024	0.0	0	0.0
	Subtotal		*4,541*	*0.3*	*21,201*	*0.2*	*1,564*	*0.1*
Subtotal Passive			6,249	0.4	55,152	0.4	3,159	0.2
Active Landbase	X		10,829	0.6	82,369	0.6	12,112	0.8
Total			**17,078**	**1.0**	**137,521**	**1.0**	**15,271**	**1.0**

3.4 Interior Old Forest

In the TSA modeling, interior old forest patches are patches greater than 120 ha that are composed of stands greater than 120 years old. Patches include both the active and passive forested areas of the landbase and all strata. In the PFMS, the interior old forest patch target was applied to the gross landbase for FMU C5.

3.5 Landbase Losses

Deterministic modeling processes were used in the TSA. This approach does not permit effective incorporation of fire, which is properly addressed through stochastic processes. No fire loss factor was included in the PFMS. Landbase losses that were not accounted for, such as fire or other factors, will be addressed through the application of triggers that initiate a re-planning process. The mechanism that accounts for large scale losses of productive forest on the landbase is an AAC recalculation trigger. When the managed landbase is reduced by 2.5% or more from the current level, the GoA will evaluate the impact and, if appropriate, apply a reduction to the AAC.

3.6 Natural Disturbances

In the Patchworks model, patch size targets were applied in the PFMS to control the spatial harvest patterns. Patch targets were applied to the regenerating seral stage to control the sizes of openings created across the landscape. Most harvest area was in patches between 10 and 200 ha to encourage the model to group harvesting operations and to provide a desirable range of opening sizes.

3.7 Mountain Pine Beetle

Currently there is no significant Mountain Pine Beetle (MPB) infestation within the CFP DFA. Future forest management plans may need to re-focus on MPB risk and the Alberta Management Strategy (Alberta Sustainable Resource Development, 2007), as large areas of mature pine age and become more vulnerable to MPB infestation (see *Chapter 7 – Plan Implementation and Monitoring* Section 6.2.1 for further information).

3.8 Wildfire Risk Reduction

The GOA conducted a landscape wildfire threat assessment to identify areas of higher wildfire risk and associated damage to communities, and other values. This report is included in the FMP in chapter 7 Appendix III. In the risk assessment process, the DFA was separated into the following risk categories to provide the opportunity to prioritize areas of higher risk for harvest: Intolerable, Risk Reduction, and Continuous Improvement, and minor. The GOA also provided the following recommended targets for wildfire risk reduction:

1. Within FireSmart community zones, harvest 30% of the active landbase in the Risk Reduction, Continuous Improvement, and Intolerable categories over the 20-year SHS.
2. Outside of the FireSmart community zones, harvest 10% of the active landbase in the Risk Reduction and Continuous Improvement categories over the 20-year SHS.

3.9 Operational Considerations

Developing a 20-year SHS as part of the forecasting exercise supports forest sustainability by strengthening the relationship between strategic planning and field operations. It ensures that the long-term consequences of field operations are incorporated into the forecasting and that harvesting activity reflects the strategically determined AAC. For this to be effective, the SHS must be operationally feasible. As part of this process, CFP invested considerable time and effort in determining operability thresholds for the new AVI that could be effectively applied in the PFMS and operationally implemented in the SHS.

All operators in the FMP area requested that annual harvesting operations be more or less grouped together and that merchantable patches left behind for future harvest be large enough to warrant a return at a later date. These operational considerations were addressed in the forecasting process in the following manner.

3.9.1 Annual Harvest Patches

Annual harvesting was controlled by creating patch goals made up of only recently harvested stands with an age of zero or one year. By setting the topology distance to 50 m and constraining the harvest area across a range of patch sizes, the model was encouraged to create several clusters of stands each year. Existing blocks in the landbase would in theory not contribute toward the patch goals. This technique reduced the reliance on restricting harvest to annually identified operating unit boundaries.

3.9.2 Road Network

A road network consisting of current and potential future road segments was included in the model. Every road segment was assigned costs associated with construction, maintenance and hauling, which were then constrained to reduce the number of roads used in each period. This approach works in conjunction with harvest patches and operating units to group harvest into operationally feasible patterns.

3.10 Wildlife Habitat

For the 2025 FMP, CFP used non-timber assessment (NTA) tools that were provided by the GoA, with the objective of enabling consistent predictions of habitat to support planning processes across the province. However, it is important to note that the accuracy of the models is considerably lower later in the planning horizon and the results past 50 years should be interpreted with caution.

Where possible, these tools were incorporated directly into the TSA models. This included the marten, songbird, and Clarks nutcracker models. This approach reduces the time between scenario development and habitat prediction while permitting targets to be established directly into the TSA model and PFMS. The barred owl and grizzly bear models could not be processed directly in Patchworks due to the spatial modeling requirements for these species and therefore were post-processed using the Patchworks outputs.

The habitat objective in the TSA was to limit the impact of timber management activities on wildlife habitat. The majority of habitat metrics did not require active control in the model to achieve results within the thresholds required by the GoA.

3.10.1 Songbirds

Songbird metrics were derived from curves provided by the GoA (Figure 3-1) that define the relative abundance of each songbird within each forest strata. These curves were then incorporated directly into the Patchworks model to allow control and reporting within the model.

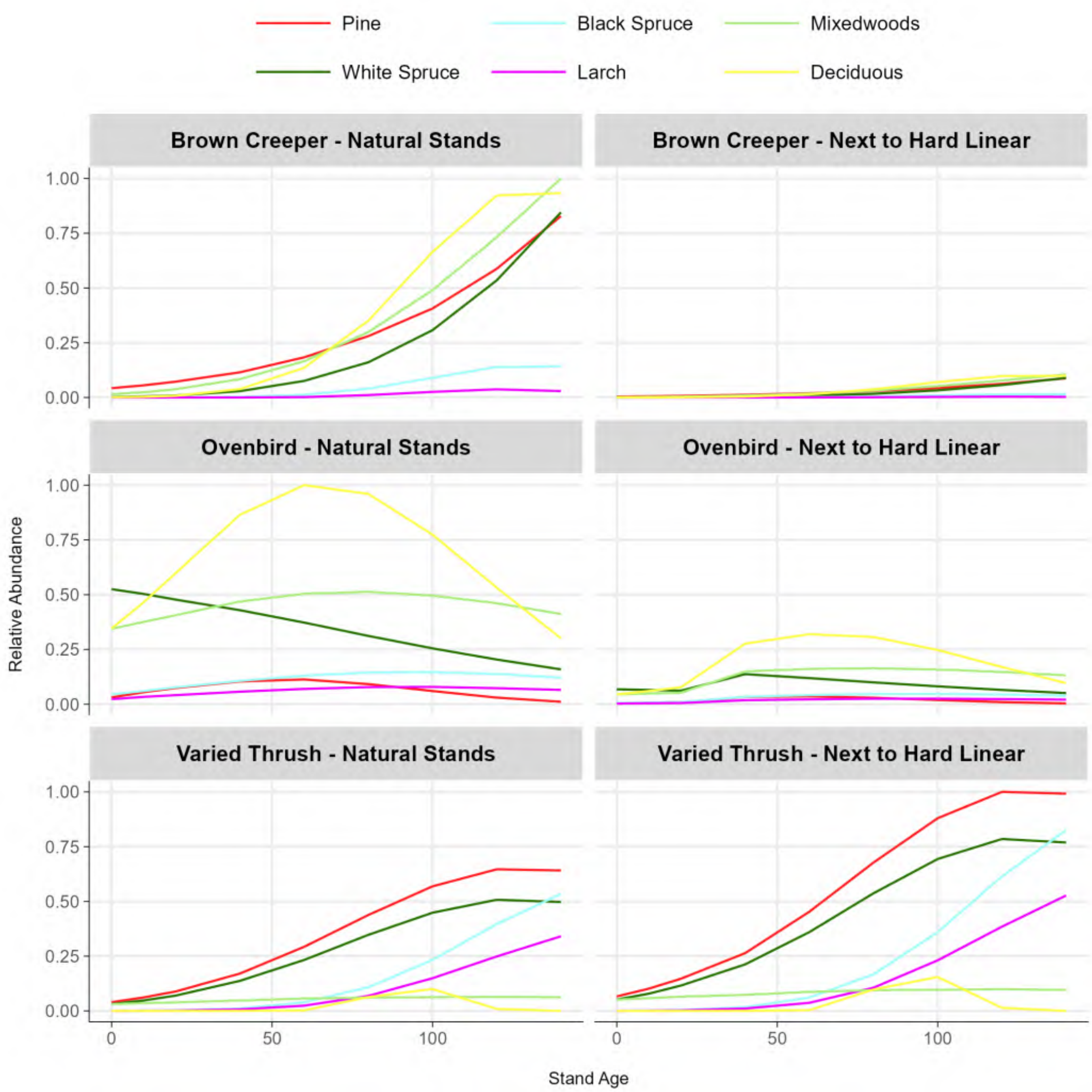

Figure 3-1. Songbird relative abundance curves (values shown here are scaled relative to the maximum RA in each species).

The curves provided by the GoA are delineated by distance from hard linear (HLIN) features, which are defined as roads above a 0.5% density on a 7-ha grid. Each songbird species has a separate curve for each forest strata, which describe the bird's relative abundance over the life of each stratum.

The reporting for songbirds is non-spatial, using an area-weighted average relative abundance for each FMU. These are tracked through the planning horizon and measured against the current conditions. If a species drops more than 15% from its current condition, management actions, either strategic or operational, are to be considered.

3.10.2 Clarks Nutcracker

Clark's Nutcracker was identified as a species of interest to model as an indicator species for the C5 DFA, for the following reasons:

- Clark's Nutcracker are currently ranked in Alberta as a Sensitive species and are highly correlated with presence of 5-pine needle species (Limber and Whitebark Pine)
- Current distribution of Clark's Nutcracker covers a large portion of the CFP FMA, thus making it an appropriate indicator for inclusion
- While models for Clark's Nutcracker are currently not within the Non-Timber Assessments, HSI model from the Southern Headwaters At Risk Project (SHARP) for the same range as the Crowsnest FMA is available (See Below)
- Clark's Nutcracker is a landscape indicator of semi-open, pine-dominated and Douglas fir leading stands, which represents a gap that is not suitably covered by the current fine-filter indicator species.
- Clark's Nutcracker was previously represented in both the C5 Forest management Plan as an indicator used to inform the SHS, and the C5 Operating Ground Rules
- Clark's Nutcracker exhibits correlation with both Limber and Whitebark Pine (both listed as Endangered), as well as Grizzly bear (due to its seed caching behaviour). It has a symbiotic relationship with both whitebark and limber pine, as the Clark's Nutcracker caches seeds up to 30km away, thus dispersing seeds to new environments.

3.10.2.1 Model

The Clark's Nutcracker model is based on the HSI model developed by Blouin, et al. (2004)[2]. The model was based on published and unpublished literature and expert opinion. The model has been further updated to provide a better fit within the forestry context.

Clark's Nutcracker are limited in their distribution by the presence of large-seeded pines, such as whitebark and limber pine, and Douglas fir to a lesser extent. Whitebark and limber pine cones, can make up as much as 85% of the nutcracker's diet, whereas Douglas fir can comprise up to 33%. The Clark's nutcracker occupies

[2] Blouin, F., B.N. Taylor and R.W. Quinlan. 2004. The southern headwaters at risk project. A multi-species conservation strategy for the headwaters of the Oldman River. Volume 2: Species Selection and Habitat Suitability Models. Alberta Sustainable Resource Development, Fish and Wildlife Division. Alberta Species at Risk Reports, No 90. 99pp. Edmonton AB.

open to semi-open coniferous forest (montane and sub-alpine). The open areas are used for caching of seeds and subsequent retrieval by the birds. In the original model, Density classes (A, B, C, D) were linked to crown closure for purpose of modelling. In this model, crown closures of greater than 70% (Density class D), are not as suitable for Clark's nutcracker, but some use may still occur. Crown Closure of less than 6% is not considered forested in the AVI but may be used by birds for seed caching. As forest 'openness' changes with time after harvest, a relationship between Clark's nutcracker suitability and stand age was estimated, emulating the above relationship. Clark's nutcracker tend to cache seeds in proximity to the 'parent' tree, with distances ranging from a tens of meters to kilometers away. As distances from whitebark or limber pine increases, the use by nutcracker's decreases.

The model is based on 2 factors:

- Species, Crown Closure and age **(V2):** In the HSI model, crown closure between 6%-50% (Density Class A and B) represent open and semi-open habitats was given suitability of '1', closures between 51%-70% (Class C) had a suitability of '0.5', closures of >70% had suitability of '0.25' and crown closure of less than 6% were given an index value of '0.1'. Species for this parameter is used to interpolate growth rates, and not the species' food used in V1.
  The habitat suitability was estimated based on the age of forest and density (Open, A, B, C, D), and it assumed that density would remain constant (planted at C densities, without thinning).
    - For 5-needle pine (Pa) stands, it was assumed that stands naturally occur at A/B density, and became suitable habitat once cones begin producing cones (> 20 years), generally increasing to prime cone producing years (> 120 years)
    - For Douglas fir (Pd) stands, it was assumed that similarly there is no value until after 20 years, generally increasing in value to prime cone producing years (> 120 years). Density was assumed to have a null effect.
    - All Pi and Sw stands have value of 10% of total value for Clark's Nutcracker. These stands provide no forage, but values remain for caching potential. The expected rate of growth for these species changes the timing for when the spruce/pine stand is most suitable for Nutcracker. As a young spruce/pine stand grows in height, the maximum habitat potential is reached by year 30-40 in low density stands, then declines as the spaces in the stand fill in.
- Distance from 5-Needle Pines **(V3):** An inverse linear relationship between Clark nutcrackers suitability and distance from whitebark/limber pine in km is assumed by the model. An index value of '1' for distance of 0km, decreasing linearly to an index value of '0' at distances of 12km. Any overlap of distance between stands should default to the closest stand.

Figure 3-2 shows the V2 curves in relation to stand density and species. For this purpose, mixedwood strata are grouped with their associated leading conifer species (i.e. HwPl and PlHw -> Pl, HwSx and SxHw -> Sw).

Figure 3-3 visualizes the relationship between distance to whitebark / limber pine stands and the V3 variable. Nearly all forested landbase in C5 is within 2.5 km of a five-needle pine stand based on the AVI.

The calculation to determine habitat suitability is:

- **HSI = V2*V3**

The HSI model represents the capability of the forested landbase to support Clark's Nutcracker and is the ratio of the total habitat conditions divided by the optimal conditions. Unsuitable habitat has a HSI value of '0', while optimal suitability is represented by a value '1'.

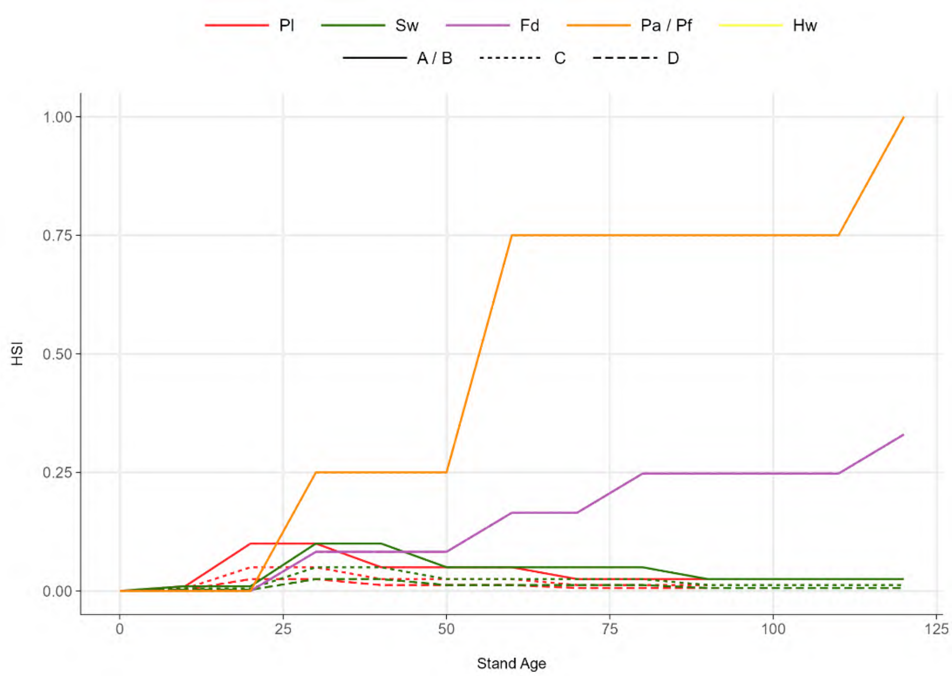

Figure 3-2. Clark's Nutcracker HIS in relation to stand density and species.

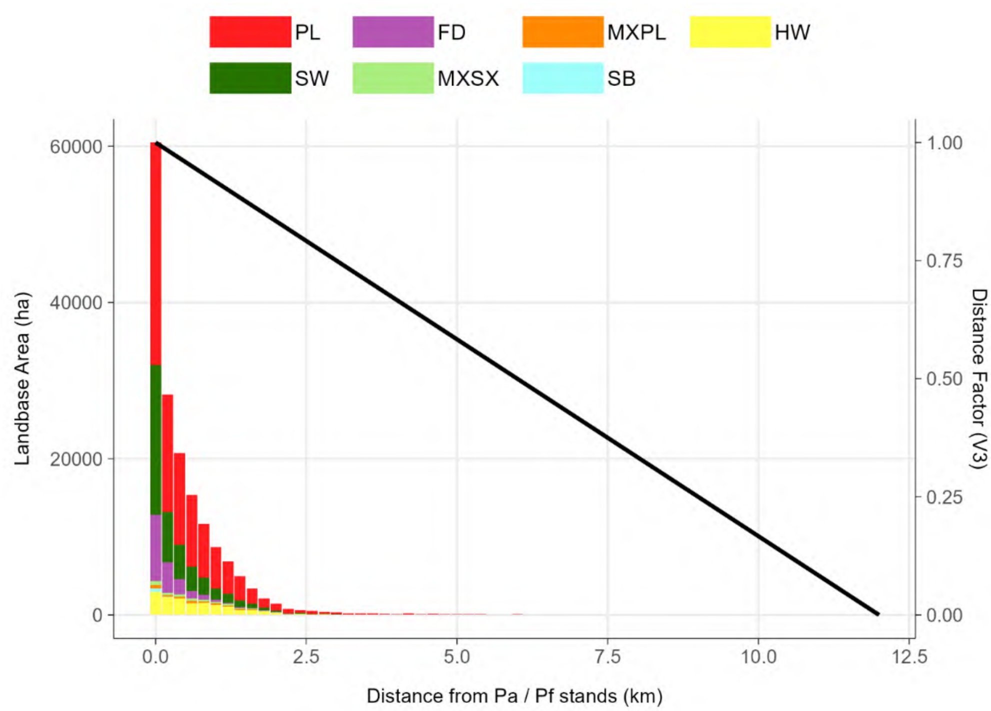

Figure 3-3. Summary of the distance to five-needle pine stands for the forested landbase.

3.10.3 Marten

The marten metric is included in the TSA models in the same fashion as the songbirds. The marten model uses a Habitat Suitability Index (HSI) in place of relative abundance, but the methodology of reporting is the same. The curves provided by the GoA are based on a set of strata defining combinations of aspen, pine and white spruce, further split by site condition (Figure 3-4).

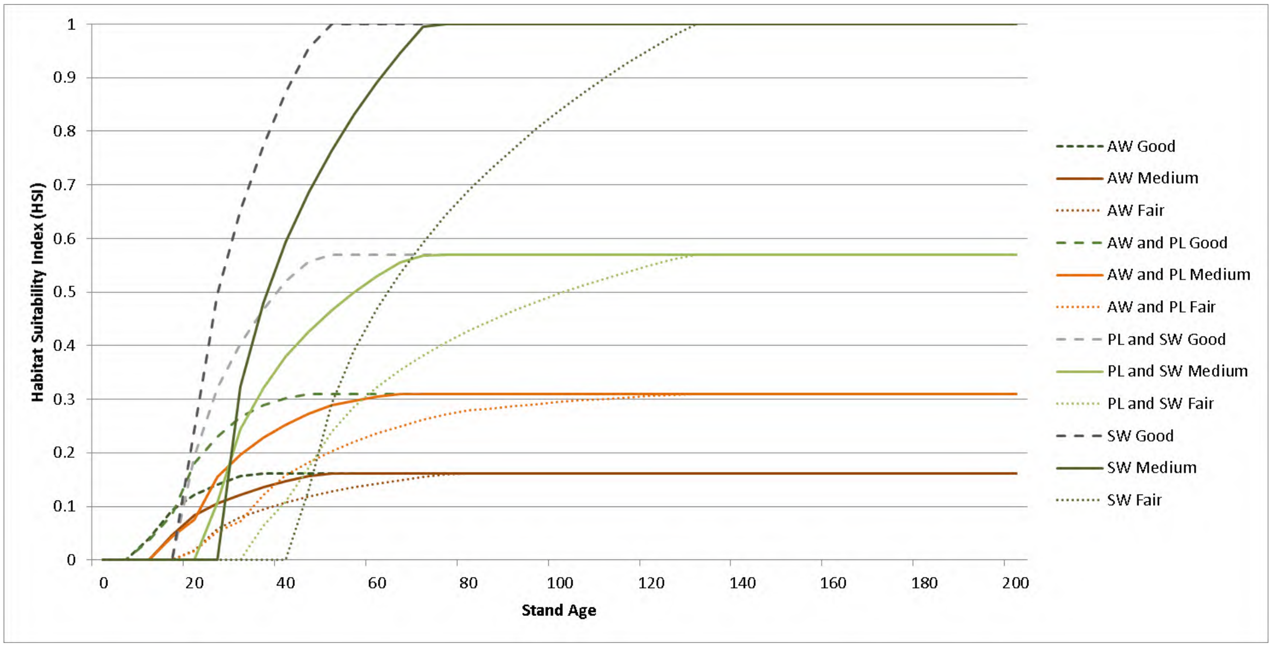

Figure 3-4. Marten Habitat Suitability Index curves.

3.10.4 Barred Owl

For barred owl, a separate habitat model is run outside of Patchworks using current and future landbase conditions exported from the Patchworks model. Landbase conditions were then used to generate a series of raster layers that define the following metrics:

1. Amount and distribution of older hardwood;
2. Amount and distribution of older white spruce;
3. Distance of each raster cell to disturbances (blocks younger than 30 years old);
4. Distance of each raster cell to old hardwood and white spruce (older than 90 years old); and
5. Area to perimeter ratio of forested stands greater than 30 years old.

Once these rasters were generated, they were combined together to generate a Resource Selection Function (RSF) raster. The final step was to generate a breeding pair raster layer, which groups the RSF raster into 562 ha cells to determine if a breeding pair could exist within the larger area. The larger raster cells require a specific combination of the five original raster values to count as a breeding pair.

As the barred owl model cannot be directly mimicked within the Patchworks model, direct control on constraining for breeding pairs is not an option. In lieu of direct control, modifications were made to the harvest sequence to minimize impacts to the barred owl.

3.10.5 Grizzly Bear

Grizzly bear habitat was modeled using the fRI Research 2018 grizzly bear assessment tools (fRI Research Grizzly Bear Program, 2019). Grizzly bear habitat was not explicitly modeled in the TSA, as the majority of strategies are operational level strategies and the tools were not designed for direct incorporation in the TSA. To capture the advice from GoA to mitigate impacts on grizzly bear, the TSA model controlled harvest block patterns to be grouped as much as possible in the PFMS. While this is beneficial from an operations perspective, it is also advantageous to grizzly bears as condensed harvesting reduces the amount of time that roads are left open and used. A grizzly bear habitat strategy was developed for the PFMS (*Chapter 7 – Plan Implementation and Monitoring* Section 8.2.1).

3.10.6 ECA Watersheds

Runoff from watersheds was evaluated by using the Equivalent Clearcut Area (ECA) methodology as outlined in the Alberta Non-Timber Assessments in Forest Management Planning procedures. This method uses ECA curves that match each volume strata curve. Each is based on using a value of one (1) at stand age zero, and a value of zero (0) when the total volume yield curve reaches maximum periodic annual increment (PAI). An example curve showing the volume and resulting ECA curve for the PL natural strata in FMU C5 is shown in Figure 3-6. In this example, the ECA curve reaches zero at age 53. For all volume curve types, PAI is reached between the ages of 50 and 75 (Figure 3-7).

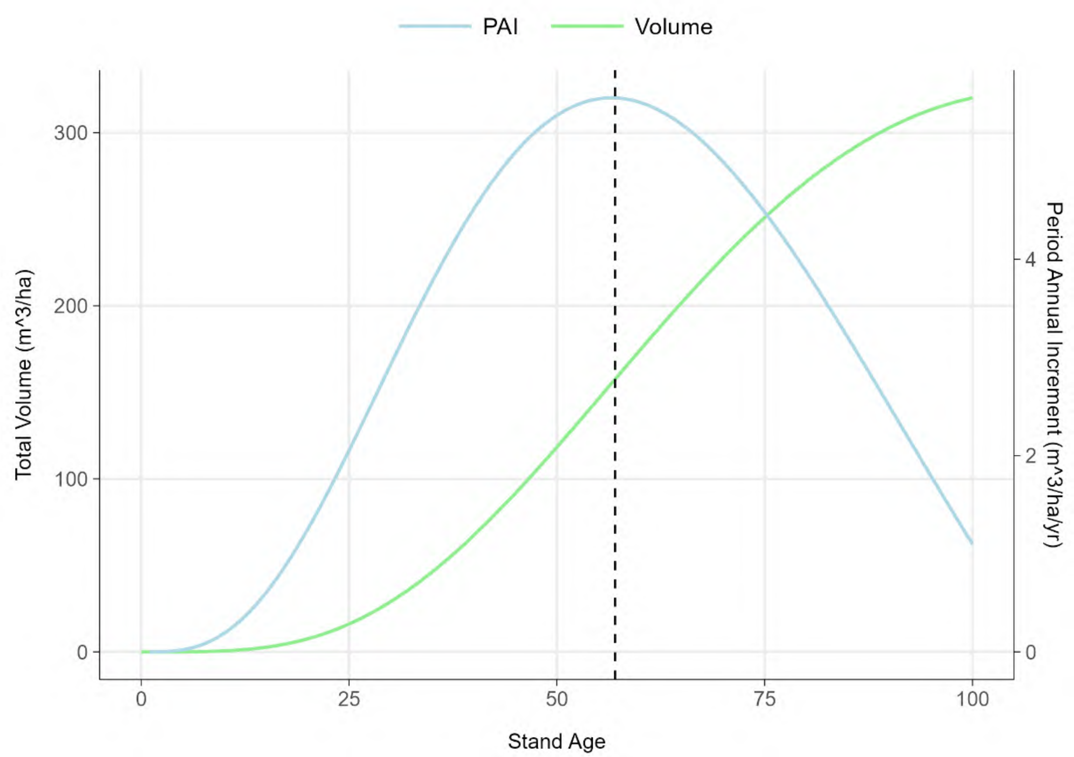

Figure 3-5. Relationship between total volume and period annual increment for the natural stand pine curve.

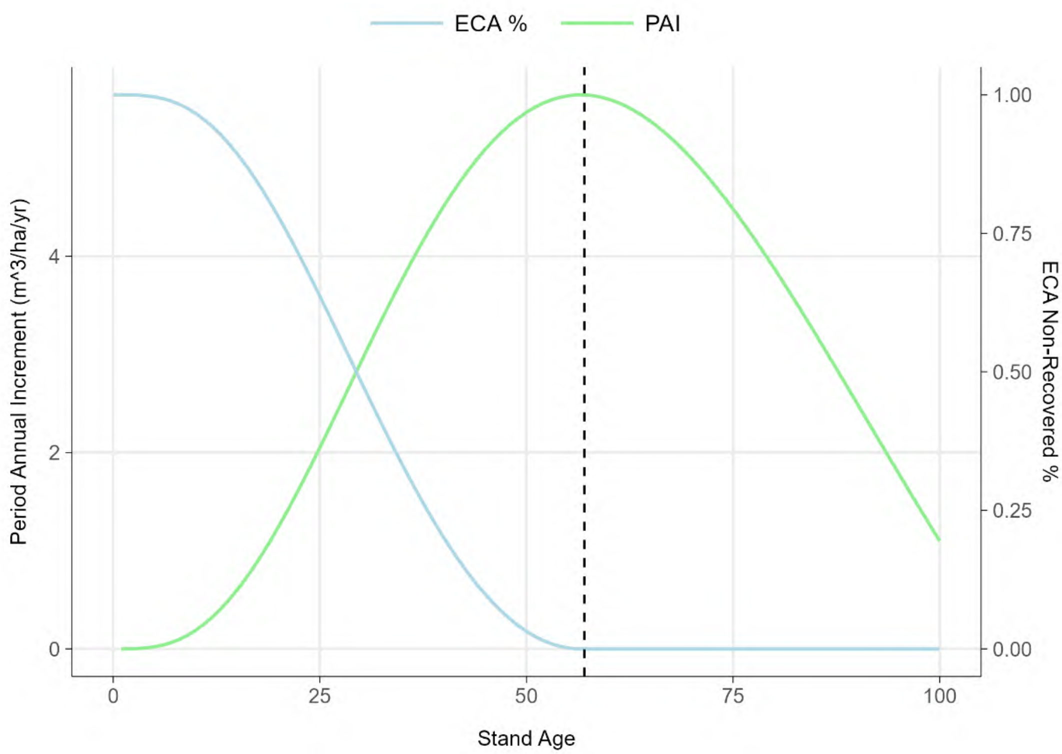

Figure 3-6. Example of ECA curve using the natural stand pine curve.

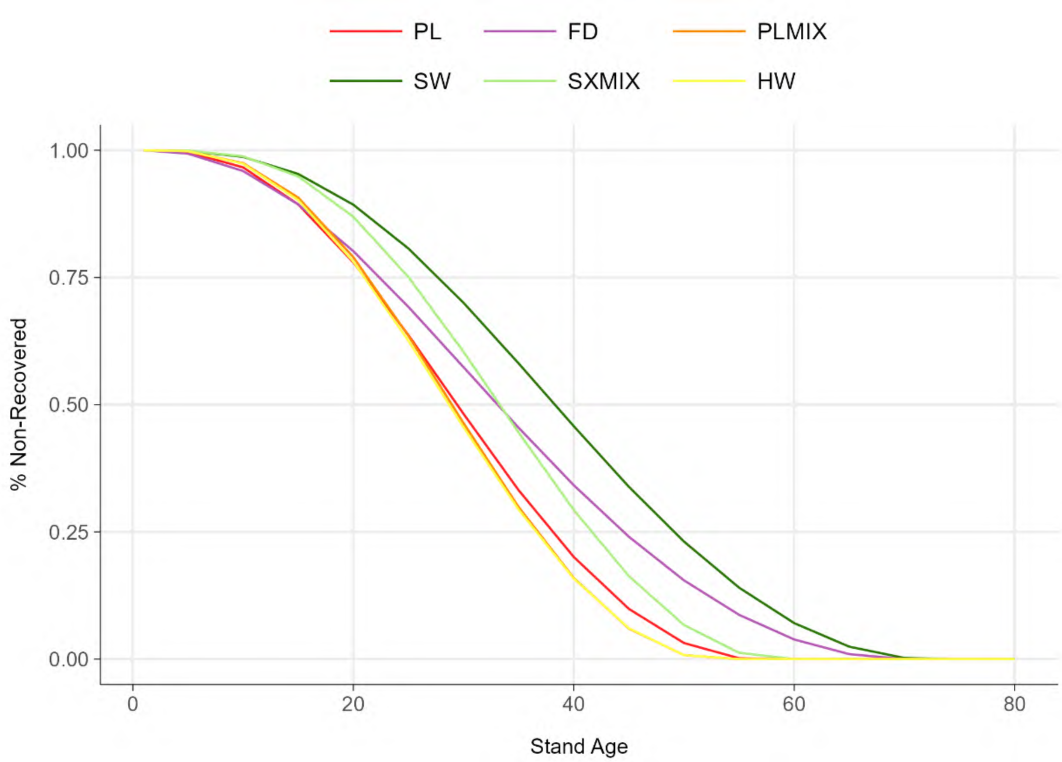

Figure 3-7. All ECA curves for FMU C5.

Reporting for watershed ECA values is by watershed and for all watersheds in total. The total ECA value (∑(curve value * stand area)) for each watershed is divided by the total area of each watershed. The result is a percentage where lower percentages represent watersheds with older forest and larger percentages represent watersheds with young forests. These percentages are then classified into three classes:

1. Less than 30%;
2. Equal or greater than 30% and less than 50%; or
3. Equal or greater than 50%.

The initial conditions for ECA show one watershed above the 30% threshold, and one above 50% (Figure 3-8), which are due to the Lost Creek wildfire. In the PFMS, the 20-year SHS was refined to mitigate the impact on runoff by modifying harvest patters so that no watersheds were greater than 30% due to forest harvesting (see *Chapter 7 – Plan Implementation and Monitoring* Section 7.2 for more information).

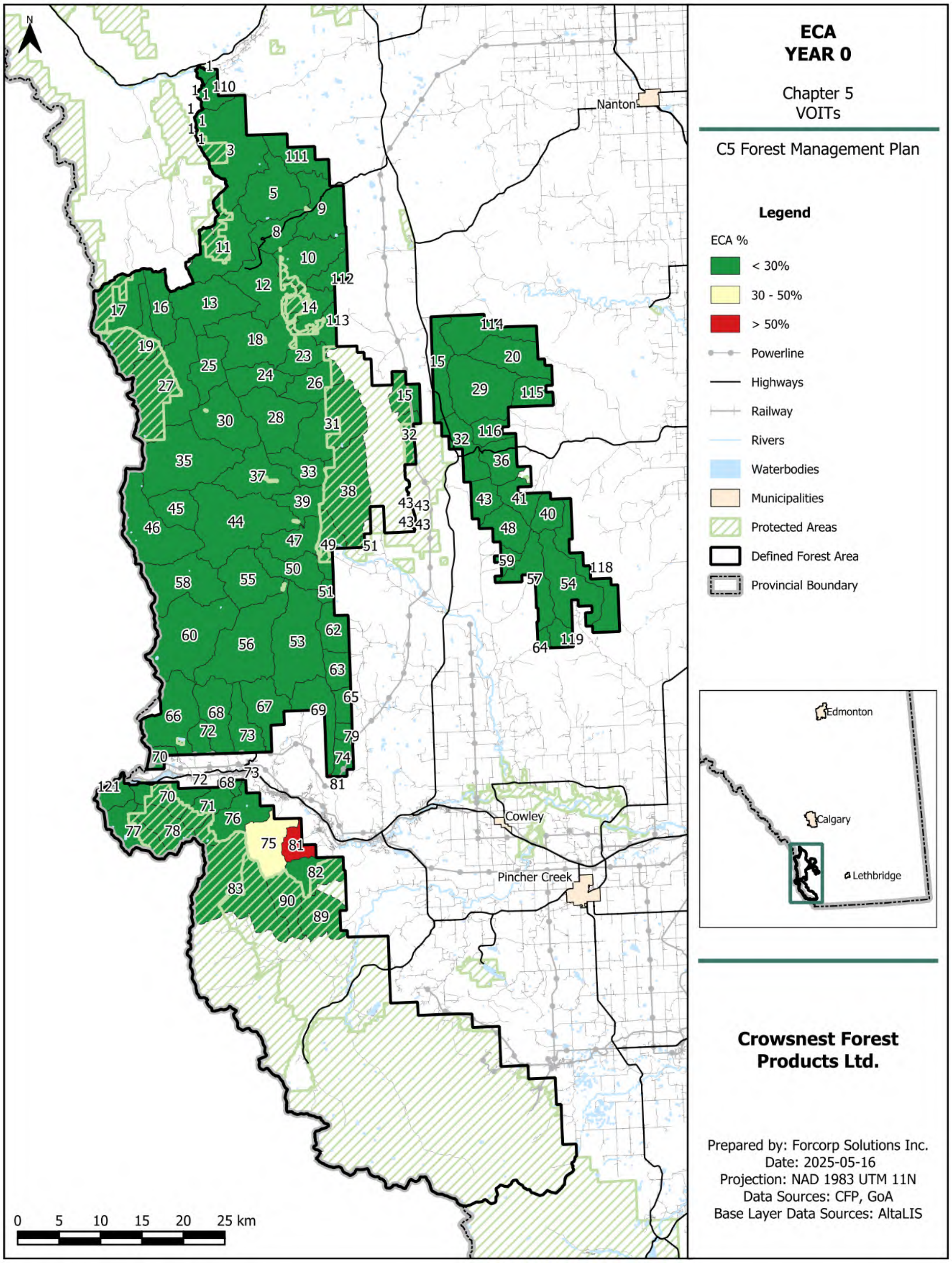

Figure 3-8. Forest management watersheds with their initial ECA class.

3.11 Target Weightings

The weighting of individual targets impacts the model's ability to achieve the target values desired by the management team. Greater weighting, relative to another value's weighting, increases the probability a target will be achieved. However, the weighting of the targets is not a mathematical process of determining the actual weights but a process of attempting to obtain the desired outcome of the target values. Some targets are desired to be even flow; some are required to meet a minimum or maximum, with fluctuations allowed above or below the minimum or maximum; and still others can have significant deviation from the target value and still be within accepted values. Once the desired effect is agreed upon, the weights are adjusted to achieve the targets.

Some targets are difficult to achieve, and their weighting will be higher than that of other targets. Other targets will achieve their values with very little encouragement, so very little weighting is required. The relative weighting between targets does not reflect their relative importance but simply the weighting required to achieve the desired outcome.

4 Preferred Forest Management Scenario

The Preferred Forest Management Scenario (PFMS) is the recommended forest management approach to be implemented over the next ten years. Once approved by the GoA, it will direct the amount and location of timber harvesting and regeneration activities by all forest operators on the DFA for the period 2025 - 2035.

The PFMS was developed within the context of forest sustainability, representing a balance between timber and non-timber values. It was developed and refined by CFP and the PDT over several months and it was influenced by input from a wide range of interests, including representatives of Crowsnest Forest Products, Alberta Forestry and Parks, Alberta Environment and Protected Areas, quota holders, First Nations from in and around the FMP area, CFP's Public Advisory Committee (PAC), and other public stakeholders. It reflects a combination of previous decisions, numerical targets for values of interest, and biological and anthropogenic assumptions with operational considerations. The PFMS is not solely the result of computer analysis but rather an iterative refinement of model projections combined with human direction. PDT members combined model projections with their knowledge of the forest and forest management to refine each successive scenario until the overall results were deemed satisfactory to all involved.

The PFMS combines human-refined modeled outputs with implementation rules, such as those provided in operational guidance provided throughout the 2025 FMP, updated Operating Ground Rules (OGRs), best management practices and applicable federal and provincial legislation, regulations and policy. Implementation and reporting guidance for the FMP is described in *Chapter 7 – Plan Implementation and Monitoring*, along with all of the model outputs required for implementation.

There are two primary products derived from the PFMS that are required for FMP implementation: the recommended harvest level and the SHS. While the PFMS contains a 200-year harvest sequence for long-term modeling purposes, the SHS identifies harvesting locations for only the first 20 years of the harvest sequence: it begins with the 2025/26 timber year and is divided into two periods representing years 1-10 (timber years 2025/26 to 2034/35) and 11-20 (timber years 2035/36 to 2044/45). SHS stands have been allocated to all disposition holders, (i.e., CFP, 793128 Alberta Ltd., 770538 Alberta Ltd., and the CTPP program) based on timber rights and operating area negotiations.

This section presents the PFMS in detail, including both strategic and operational targets, and their associated results. The section is organized by indicator, with the action-based indicators presented first, followed by the inventory indicators and the patch targets. The PFMS is represented by Scenario 9007. It was generated in the Patchworks modeling environment using the yield curves, landbase, and timber supply assumptions described in this chapter. *Appendix VI TSA – Timber Supply Analysis* contains a summary of scenarios leading up to the PFMS for FMU C5.

4.1 Forest Products – Harvest Volume

Harvest volume is a major consideration in the development of the PFMS. This volume provides the supply of logs to forest companies to operate their mills in an efficient and cost-effective manner. The coniferous landbase for FMU C5 was used to determine even flow conifer harvest volumes.

Harvest volumes reported in this chapter were calculated directly from Patchworks outputs. While strict even flow targets were modeled, the PFMS has some small variation in 5-year periods, which is typical of Patchworks and spatial models more generally.

The harvest levels from the PFMS and the associated allocations are summarized in Table 4-1. This table is a subset of the complete table in Appendix I. These values are recommended for approval as the AAC levels for the 2025 FMP.

Table 4-1. Recommended harvest levels for the PFMS.

Company	Disposition	AAC Volume Allocation		Quadrant
		%	m^3/yr	Volume[1]
Conifer Allocations				
Crowsnest Forest Products	FMA2100047	87.8%	182,541	912,704
793128 Alberta Ltd.	CTQC050002	1.7%	3,432	17,160
770538 Alberta Ltd.	CTQC050005	4.4%	9,110	45,552
CTPP	CTPP	6.2%	12,917	64,584
Total Coniferous			208,000	1,040,000

[1] Quadrant periods: May 1, 2026 - April 30, 2031 & May 1, 2031 - April 30th, 2036

4.1.1 Coniferous Harvest

The primary conifer harvest volume is even flow, on the total conifer volume (Figure 4-1).

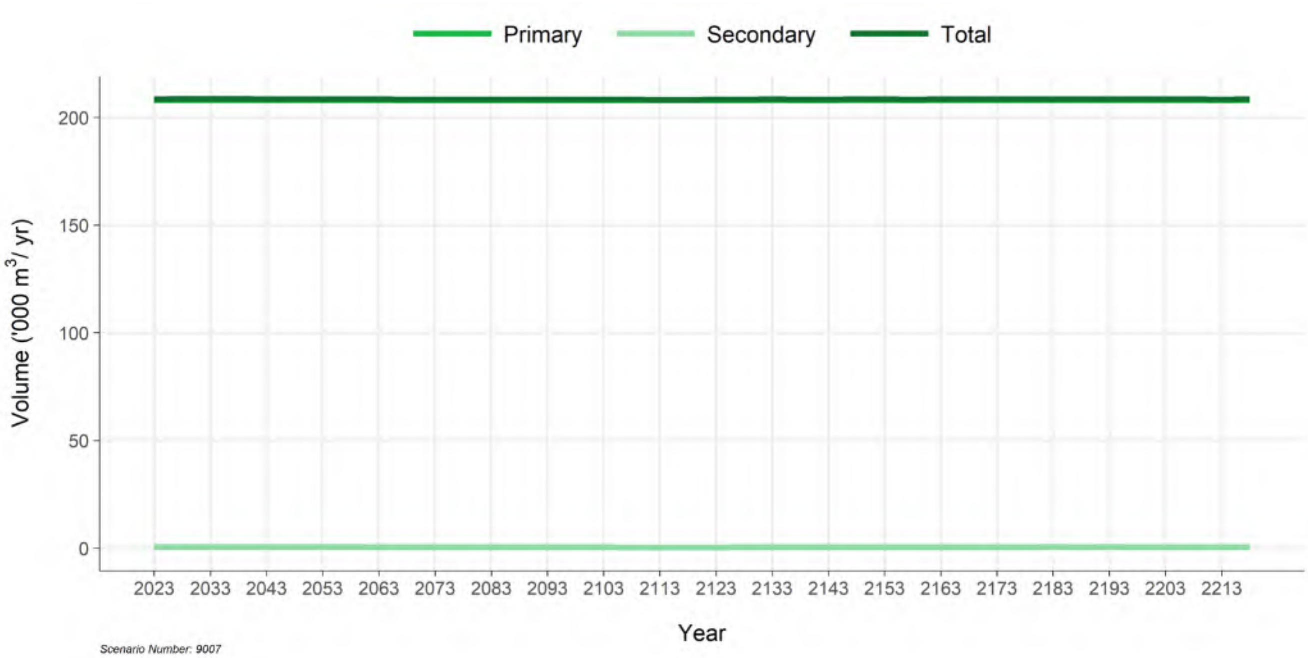

Figure 4-1. Annual coniferous harvest volume for FMU C5.

4.1.2 Deciduous Harvest

While no deciduous allocation currently exists for C5, a small area of deciduous landbase harvest was sequenced in order to provide an AAC to drain against for road building and small harvests of the deciduous landbase. The deciduous harvest sequenced in the PFMS is an even flow of 2,000 m^3/yr from the deciduous landbase. Secondary deciduous volume from the conifer landbase are also shown in Figure 4-2.

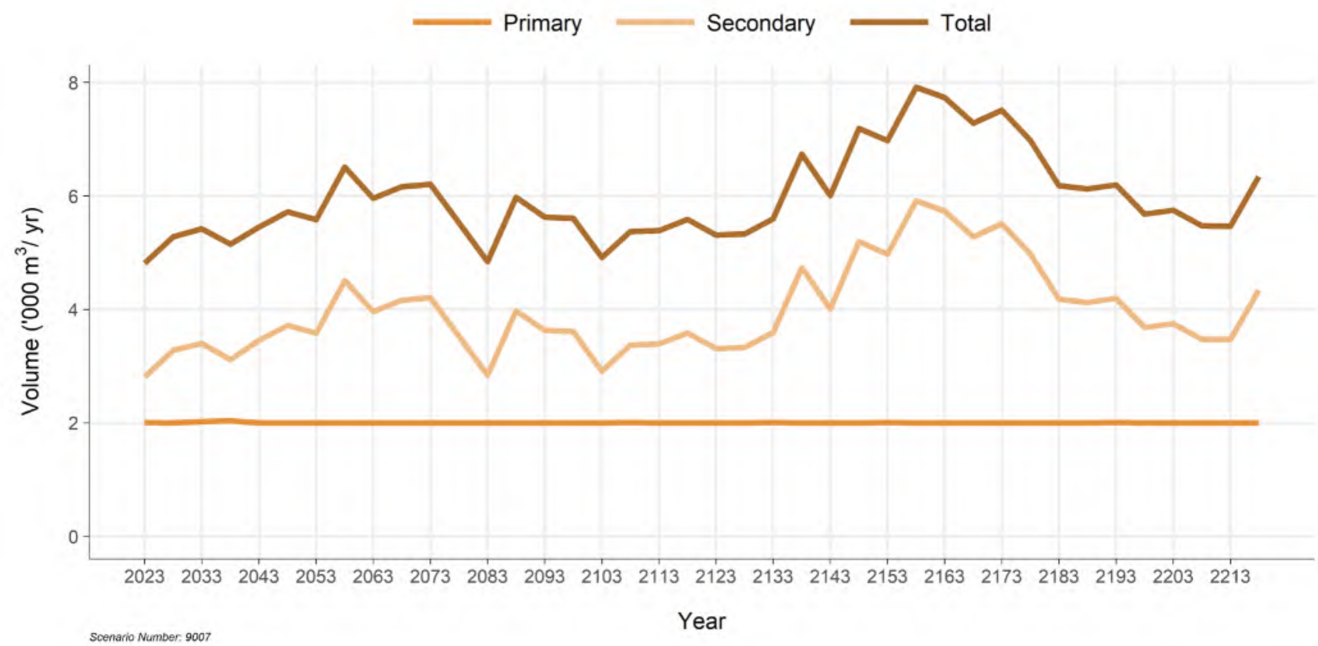

Figure 4-2. Annual deciduous harvest volume for FMU C5.

4.2 Forest Products – Harvest Area

4.2.1 Strata

The harvest strata are relatively evenly distributed (Figure 4-3). Pure pine (PL) provides the largest contribution to the harvest area, followed by white spruce (SW) and Douglas-fir (FD). The harvest area by compartment, strata, and age class is presented in Table 4-2.

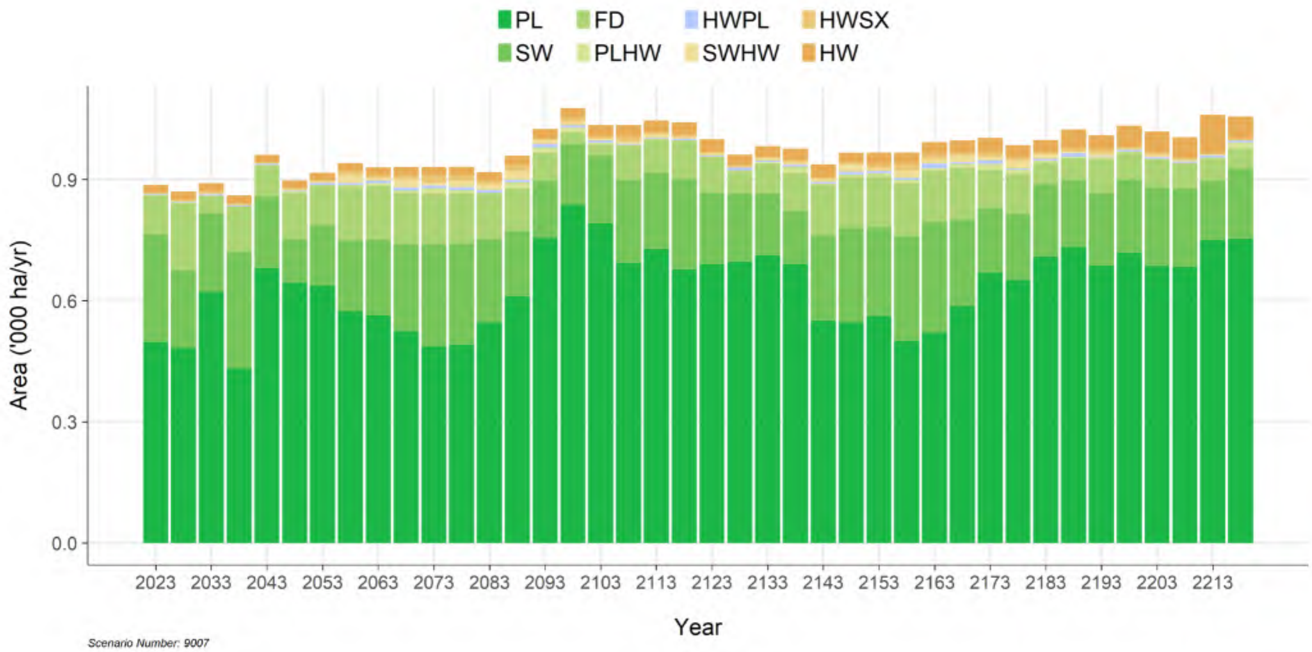

Figure 4-3. Area harvested by strata for FMU C5.

Table 4-2. SHS Area in each compartment by strata and age class (conifer landbase only).

Compartment and Yield Strata	Decade 1 Harvest by Age Class (Area (ha))						Decade 2 Harvest by Age Class (Area (ha))					
	80 - 99	100 - 119	120 - 139	140 - 159	160 +	Total	80 - 99	100 - 119	120 - 139	140 - 159	160 +	Total
Crowsnest River												
Pl	585	878	338	32	38	1,871	13	902	487	83	50	1,536
Sw	14	131	99	78	43	364	54	129	164	91	163	601
FD	1	32	35	3	0	72	5	197	49	50	28	329
MIX_PL	11	1	0	2	0	14	0	1	19	1	0	21
MIX_SX	1	0	8	0	0	9	3	14	10	0	0	27
Subtotal	*612*	*1,043*	*480*	*115*	*80*	*2,331*	*74*	*1,244*	*729*	*225*	*241*	*2,513*
Livingstone River												
Pl	12	15	2	11	0	40	11	418	117	8	17	570
Sw	0	3	0	0	6	9	1	17	108	8	37	171
FD	0	0	0	0	0	0	0	0	0	0	0	0
MIX_PL	0	0	0	0	0	0	0	3	0	0	0	3
MIX_SX	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	*12*	*18*	*2*	*11*	*6*	*49*	*12*	*438*	*225*	*16*	*54*	*745*
Oldman River												
Pl	158	295	103	596	154	1,307	13	189	93	182	159	636
Sw	16	146	64	333	720	1,278	21	81	181	126	429	839
FD	0	0	0	0	0	0	0	0	0	0	1	2
MIX_PL	0	6	2	0	0	8	1	9	0	0	0	10
MIX_SX	0	7	0	0	0	7	10	4	1	0	0	15
Subtotal	*174*	*454*	*170*	*929*	*874*	*2,601*	*45*	*284*	*275*	*308*	*590*	*1,502*
Porcupine Hills												
Pl	10	225	111	0	0	346	15	155	287	116	41	614
Sw	19	75	50	112	61	318	10	37	122	182	56	406
FD	105	614	541	86	189	1,534	19	50	288	176	81	614
MIX_PL	0	0	0	0	0	0	0	0	0	0	0	0
MIX_SX	12	3	7	0	0	22	8	4	0	0	0	12
Subtotal	*146*	*917*	*709*	*199*	*250*	*2,220*	*51*	*246*	*697*	*473*	*179*	*1,646*
Racehorse Creek												
Pl	439	732	107	199	71	1,549	13	847	861	217	187	2,125
Sw	70	44	17	84	192	407	8	107	53	100	212	480
FD	0	0	0	0	0	1	0	0	0	0	3	4
MIX_PL	2	6	0	0	0	8	3	3	1	0	0	7
MIX_SX	2	1	0	0	0	3	3	0	2	0	0	5
Subtotal	*513*	*784*	*125*	*283*	*263*	*1,967*	*27*	*957*	*917*	*318*	*402*	*2,621*
Willow Creek												
Pl	0	0	0	0	0	0	0	0	0	0	0	0
Sw	0	0	0	0	0	0	0	0	0	0	0	0
FD	0	0	0	0	0	0	0	0	0	0	0	0
MIX_PL	0	0	0	0	0	0	0	0	0	0	0	0
MIX_SX	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
DFA Total												
Pl	1,205	2,146	661	839	262	5,112	65	2,510	1,845	605	455	5,481
Sw	118	399	231	607	1,022	2,376	94	371	628	506	898	2,498
FD	106	647	576	90	189	1,607	23	246	338	227	114	948
MIX_PL	13	13	3	2	0	31	3	17	20	1	0	41
MIX_SX	15	12	15	0	0	42	24	23	13	0	0	59
Total	***1,457***	***3,217***	***1,485***	***1,537***	***1,473***	***9,168***	***210***	***3,167***	***2,844***	***1,340***	***1,467***	***9,027***

4.2.2 Harvest Age

The harvest age for FMU C5 follows a pattern of general decrease starting at year 50, stabilising at around 100 years old for the last 100 years of the planning horizon (Figure 4-4). The minimum harvest age is 80 years old for all strata, and the average stays above this minimum, indicating that the harvest level allows for active growing stock to grow older than 80 years old.

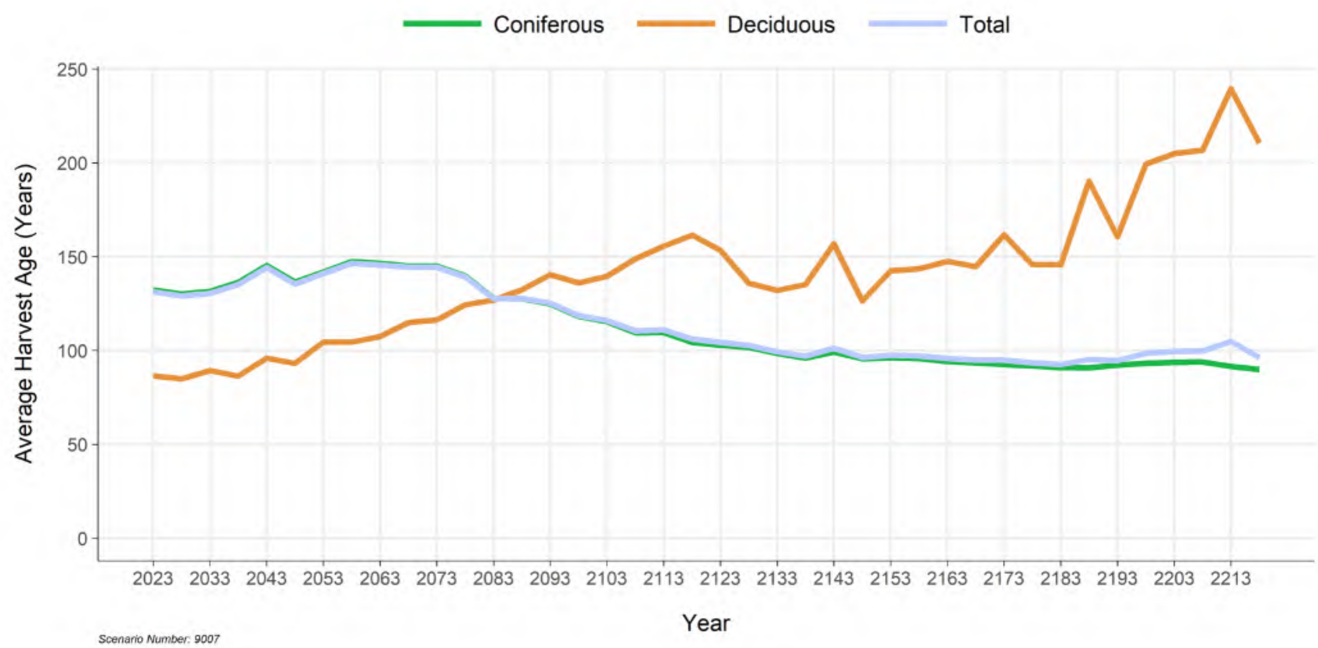

Figure 4-4. Harvest ages by strata for FMU C5.

4.2.3 Piece Size

The coniferous piece size in C5 remains between 2 and 3.5 trees/m^3 over for the planning horizon (Figure 4-5). Piece size is lower at the beginning due to harvesting more older forest with larger trees, and piece size increases as the average harvest age decreases. This piece size is acceptable to CFP operational specifications, keeping in mind that this metric is an average based on yield curves and has been shown to be a very coarse indicator of actual piece sizes.

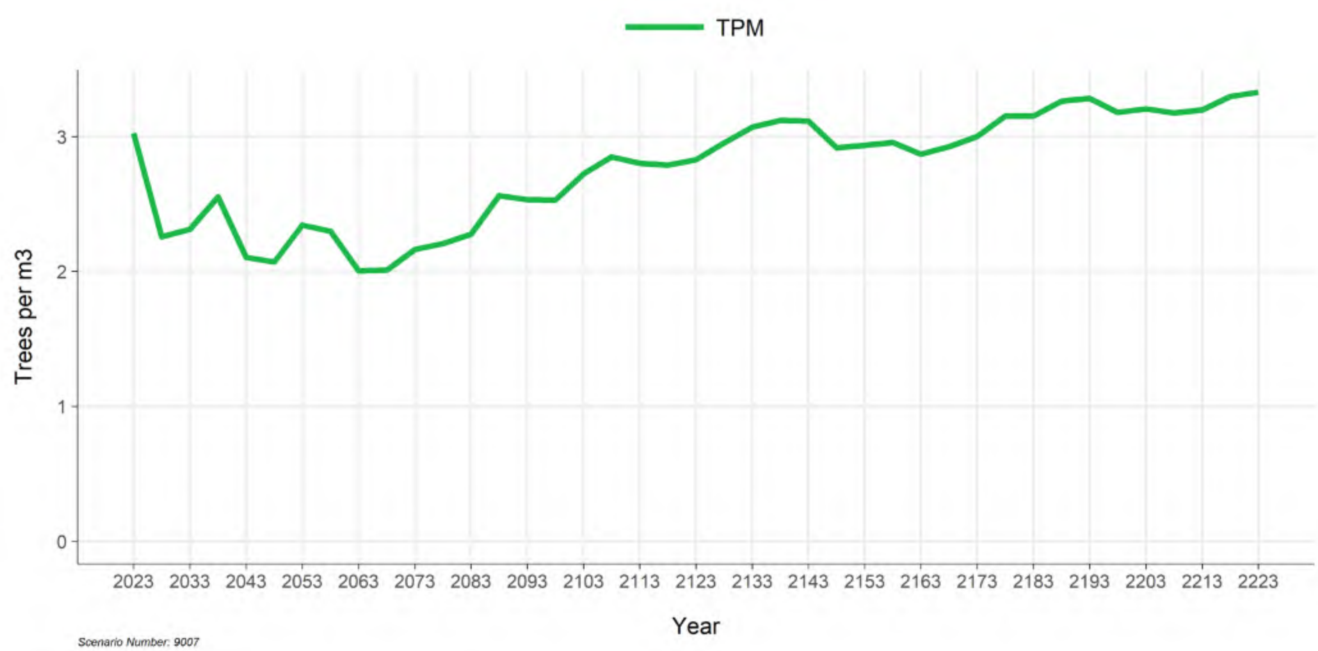

Figure 4-5. Coniferous piece size for FMU C5.

4.3 Forest Condition – Growing Stock

Two types of growing stock are reported: active and active operable growing stock. Active growing stock is the total coniferous merchantable volume present on the active landbase at each point in time. The active operable growing stock represents the merchantable volume from only those stands on the active landbase that are above the minimum harvest age in that period, and thus represent the volume that is actually available to be harvested in that period.

In general, the active operable growing stock is lower than the active growing stock. The two are very close initially, as most of the forest is currently over 80 years old. Over time, the span widens as the forest moves to a more regulated condition (Figure 4-7).

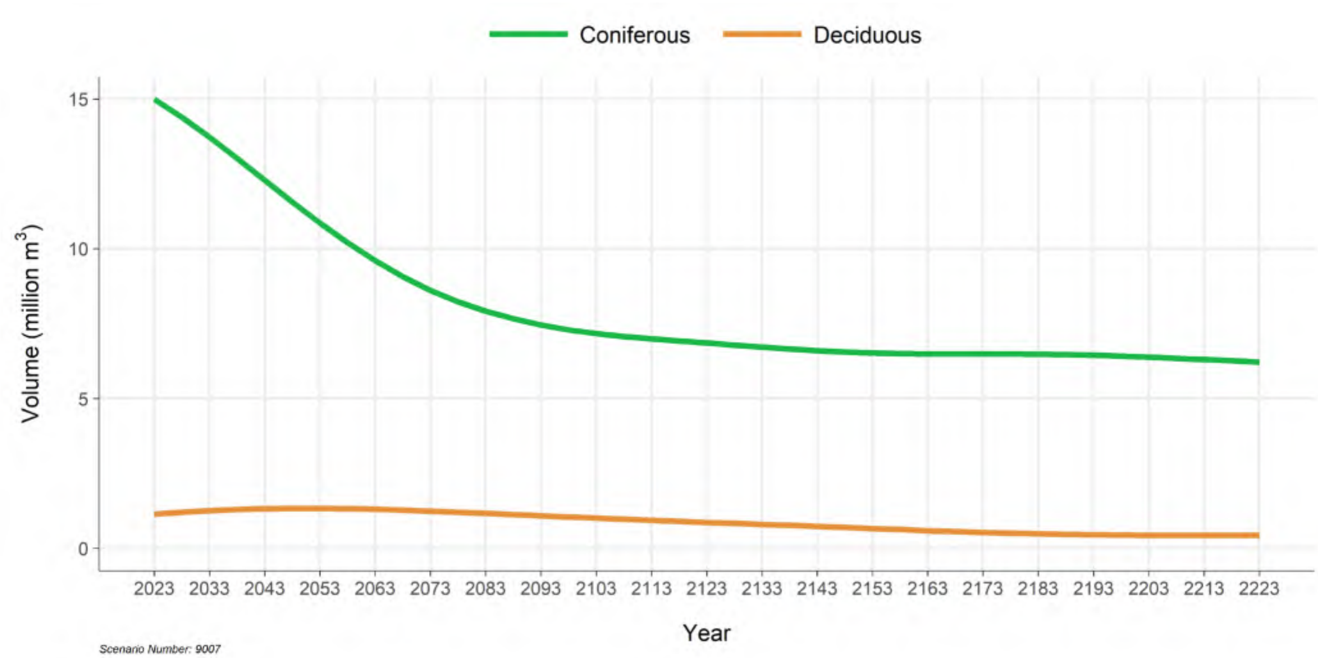

Figure 4-6. Active growing stock for FMU C5.

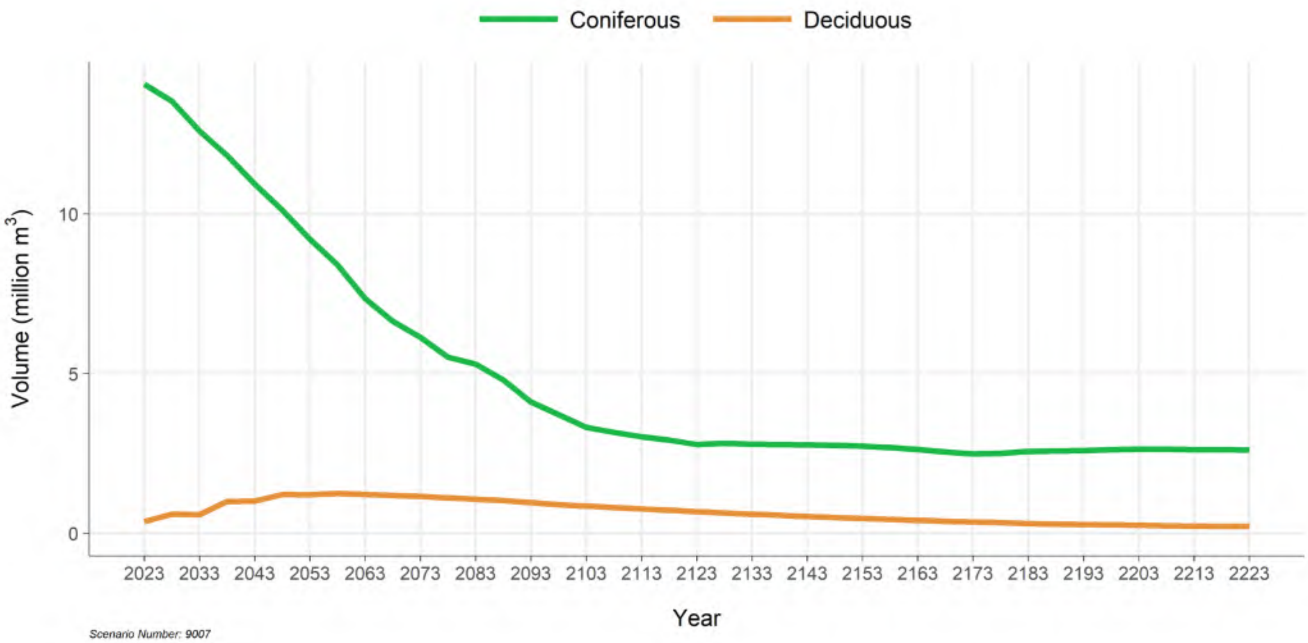

Figure 4-7. Active operable growing stock for FMU C5.

The distribution of the active operable growing stock by strata can provide insight into forest dynamics. For the FMU C5 coniferous operable growing stock, all strata follow a similar pattern of a steady decrease in the first 70 – 90 years, followed by a stabilization for the remainder of the 200 years (Figure 4-8).

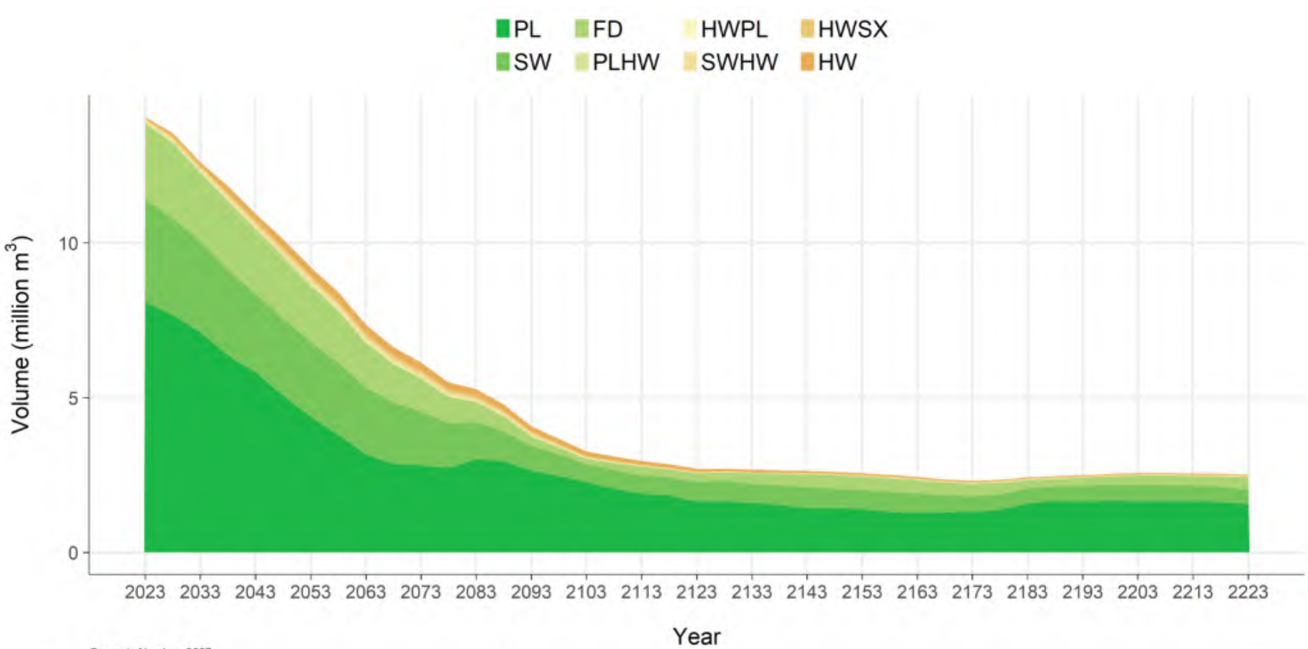

Figure 4-8. Operable conifer growing stock by strata for FMU C5.

4.4 Forest Condition – Area Summaries

Forest condition summaries describe attributes as they are forecasted to exist under the PFMS on the active, passive, and gross landbase over the planning horizon. The attributes describe the forest using age, strata, and seral stage, in addition to non-timber attributes such as songbird and marten metrics.

4.4.1 Strata

The landbase area in each stratum on the active landbase is stable over time, as there is no conversion or transitions between strata (Figure 4-9).

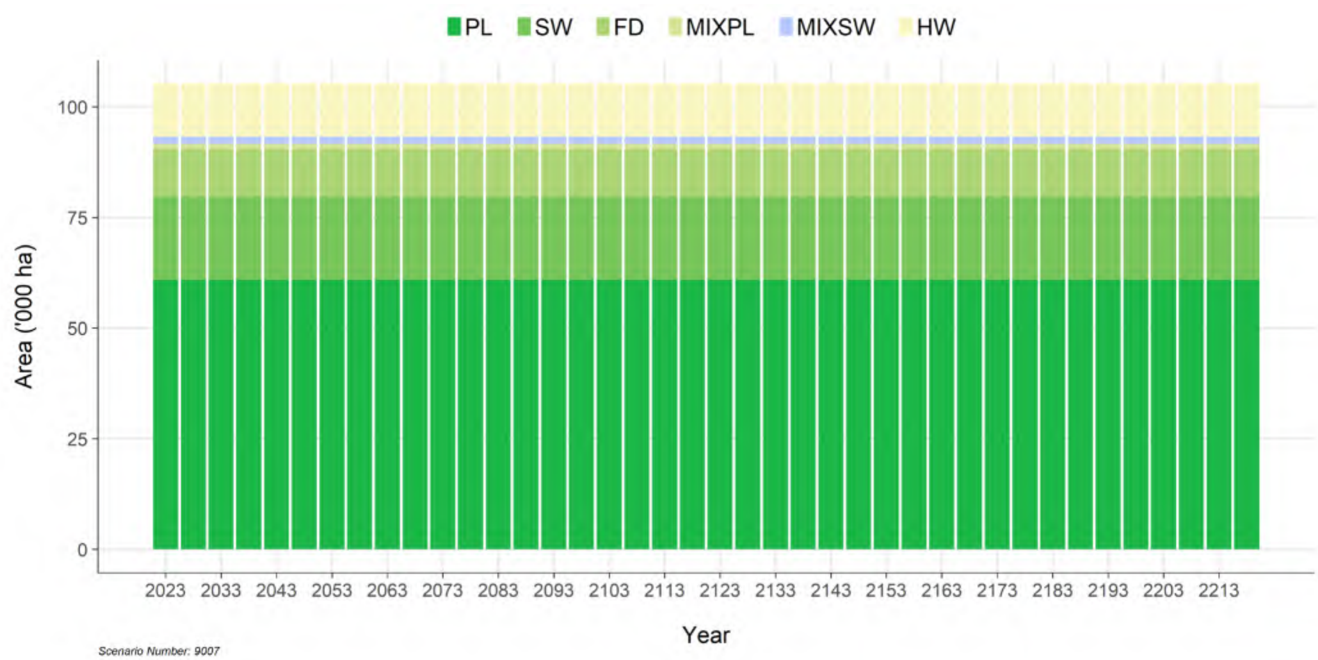

Figure 4-9. Strata area on active landbase for FMU C5.

4.4.2 Seral Stage

The forecasted seral stage distribution on the active landbase shows a general increase in immature stands and a decrease in mature and old stands over the first 80 years. By year 130 the seral stages remain relatively constant. The mature and very old stages are a significant portion of the area during this time, while the young and immature stages dominate most of the planning horizon (Figure 4-10).

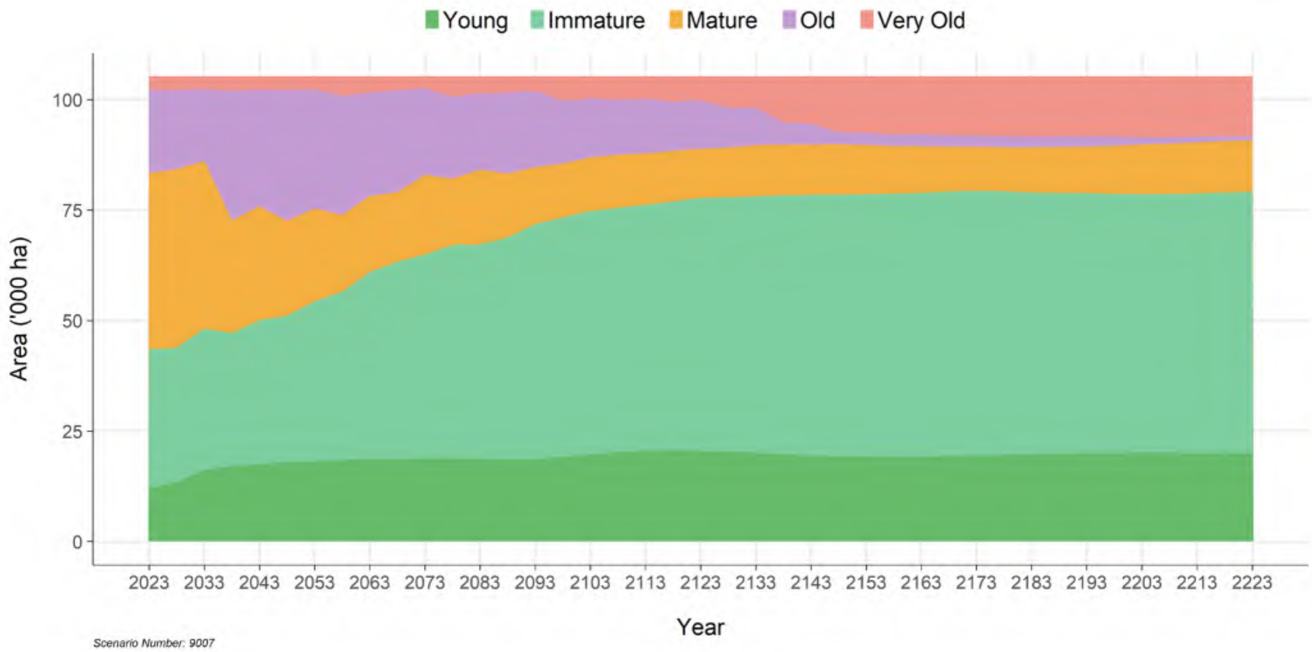

Figure 4-10. Active landbase seral stages for FMU C5.

Looking only at the percentage of the active landbase that is in the old and very old seral stages, the pine, spruce and mixedwood strata are all in the 4 – 6% range, while Douglas-fir is around 19% towards the end of the planning horizon (Figure 4-12). Deciduous is much higher due to the lower level of deciduous harvest sequenced. By area (excluding deciduous), pine has the most area of old and very old active landbase, followed by Douglas-fir and white spruce.

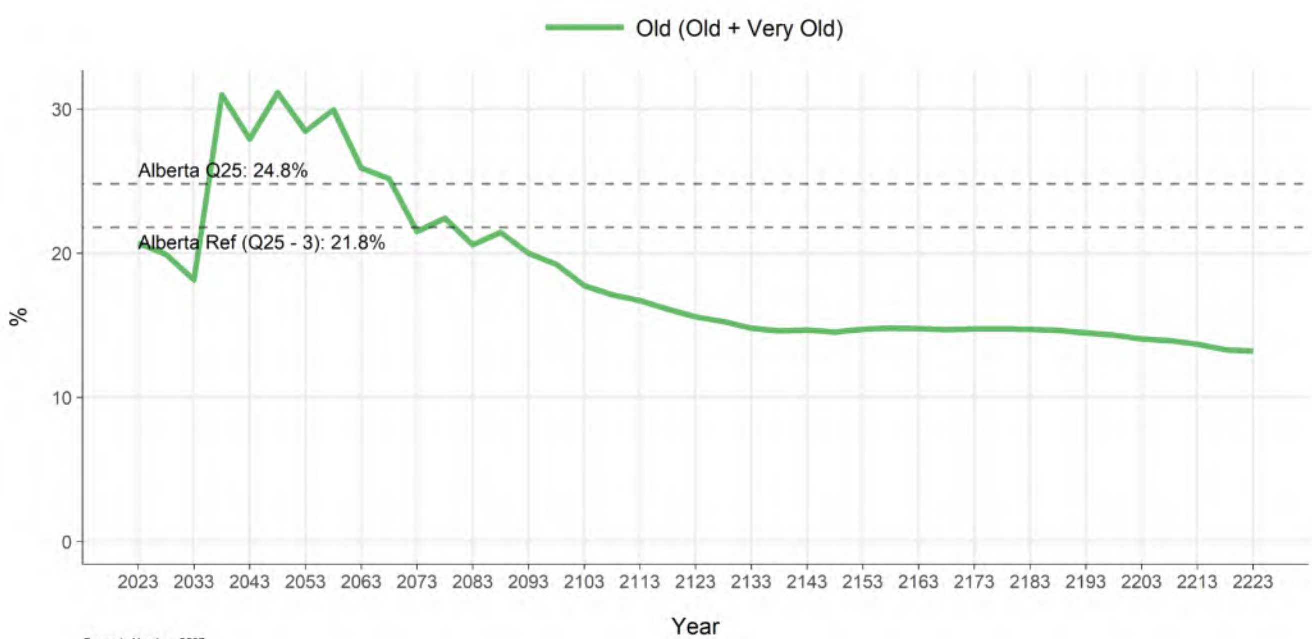

Figure 4-11. Percent area of active landbase in Old and Very Old seral stage for FMU C5.

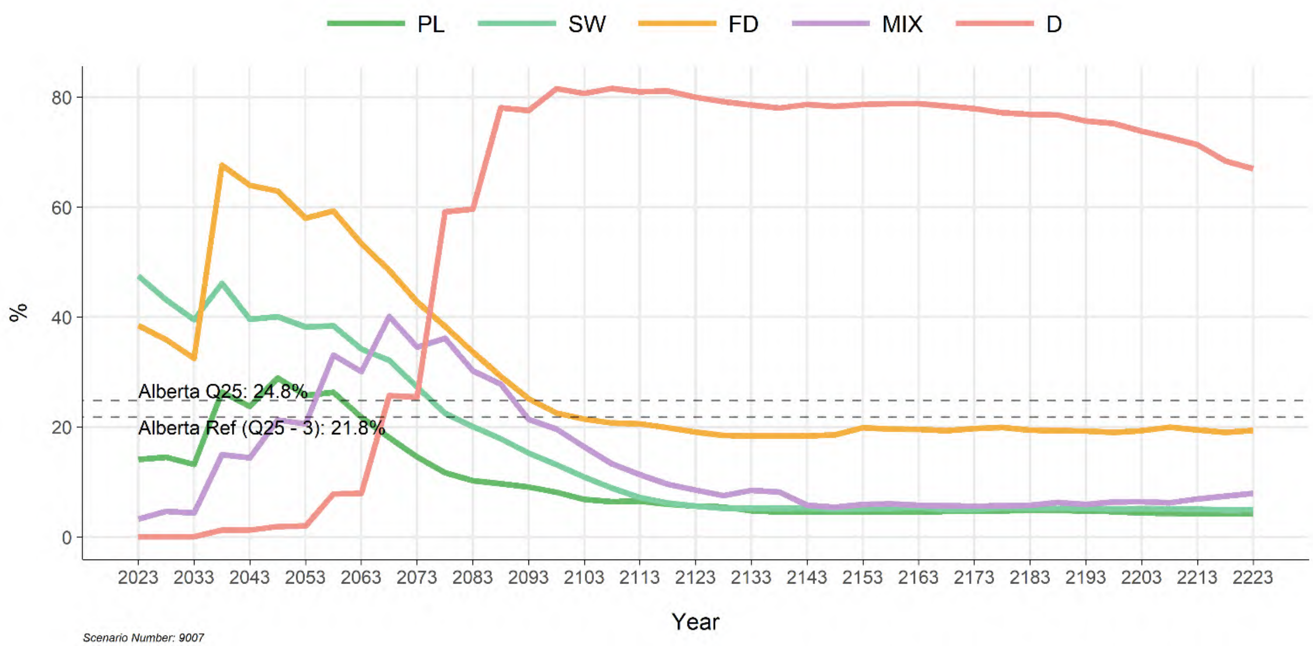

Figure 4-12. Percent area of active landbase in Old and Very Old seral stage by strata for FMU C5.

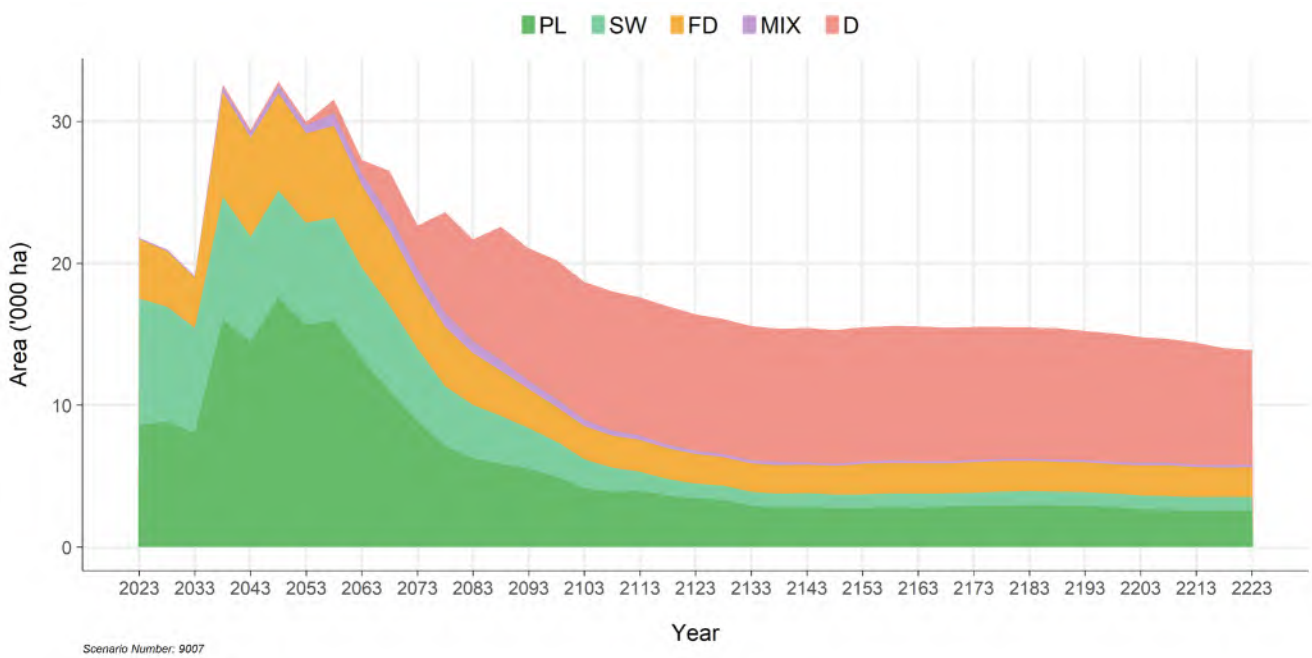

Figure 4-13. Total area of active landbase in Old and Very Old seral stage by strata for FMU C5.

The overall percent of on-par conifer landbase that is in the old growth seral stage is between 28-32% towards the end of the planning horizon (Figure 4-15) for conifer and mixedwood strata, which is above the provincial Q25 threshold. The Q12.5 and 87.5 thresholds from the C5 specific NRV analysis (*Appendix I – Annex VI – Timber Supply Analysis*) are shown in this figure as well.

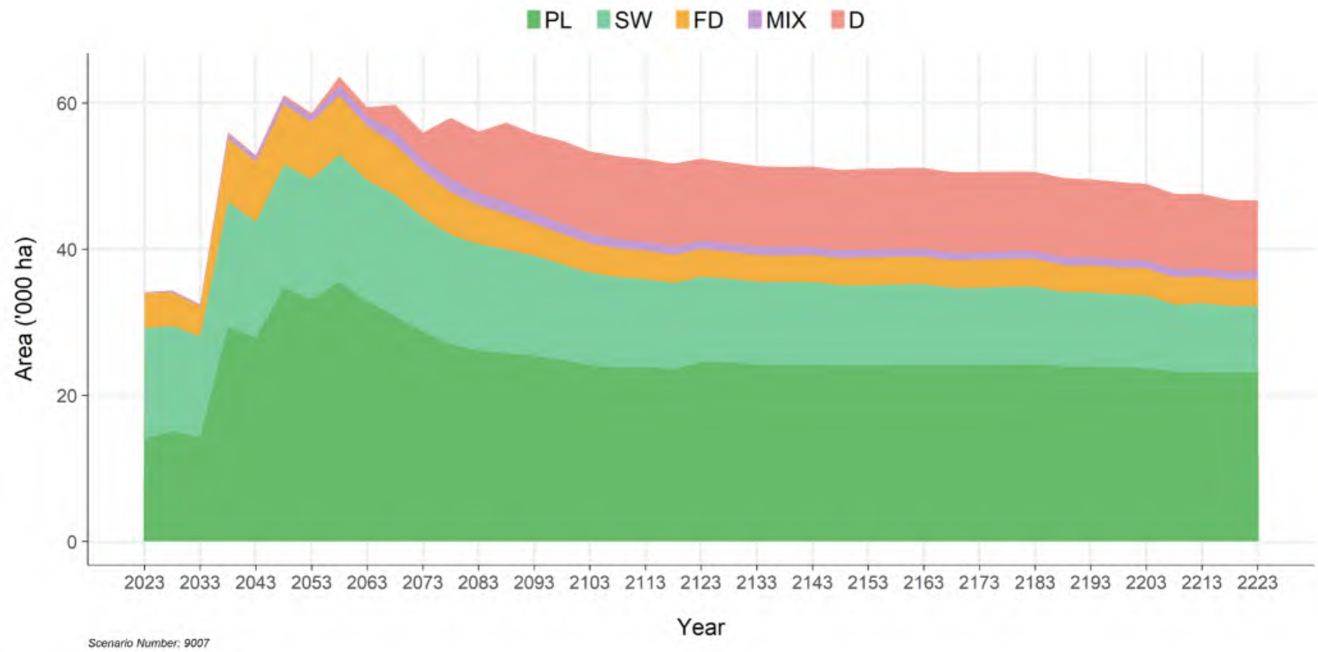

Figure 4-14. Area of 'on-par' landbase in Old and Very Old seral stage by strata.

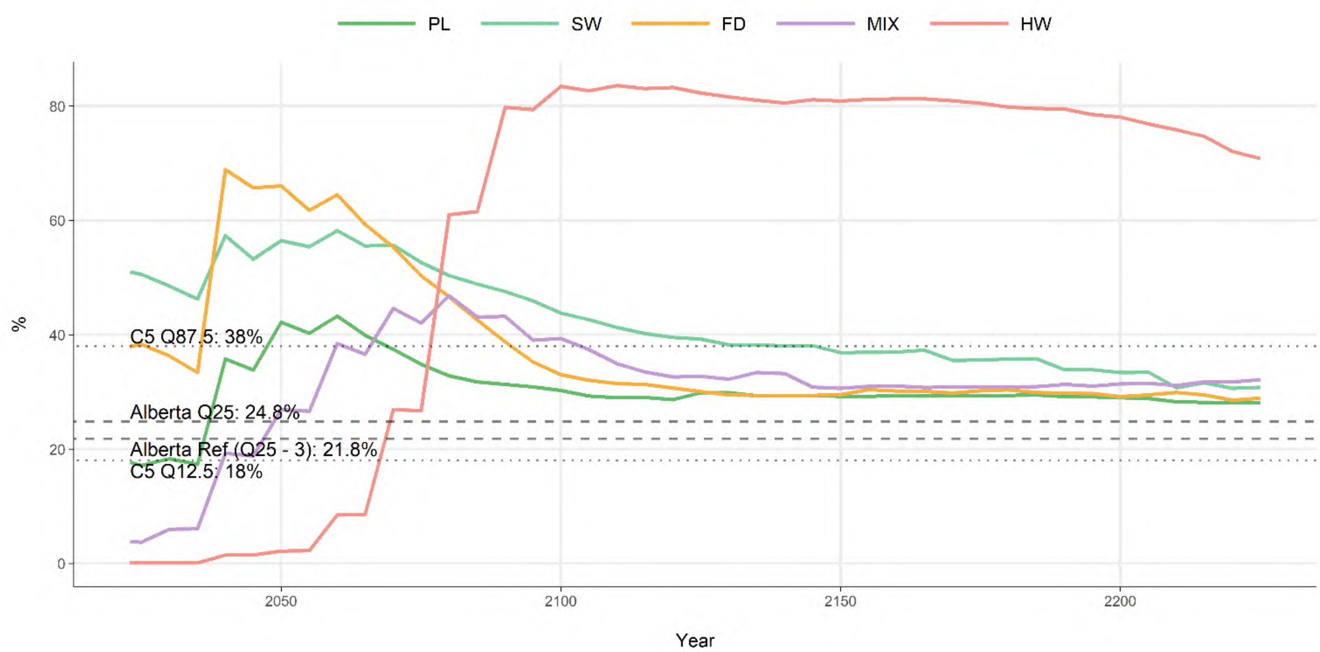

Figure 4-15. Percent of 'on-par' landbase in Old and Very Old seral stage by strata.

4.4.3 Wildlife Habitat

This section provides a summary of the outputs for each of the wildlife habitat models. More in-depth reporting on wildlife metrics is found in *Chapter 5 – Values, Objectives, Indicators and Targets*.

4.4.3.1 Songbirds, Marten, and Clark's Nutcracker

Figure 4-16 through Figure 4-20 illustrate the C5 relative abundance (RA) of the four songbirds and the habitat suitability index (HSI) of marten over the planning horizon. The green shading represents a change of +/- less than 15% from current levels (range of low risk); the yellow indicates a -15 to 30% change (range of moderate risk); and red shows a greater than -30% change (range of high risk). The brown creeper (BRCR) and the Clark's nutcracker maintain a relatively constant abundance over the 200-year horizon within the low risk range. The varied thrush (VATH) RA and the marten HIS drop below the moderate risk threshold for periods within the planning horizon but are within the low risk range for the majority of the 200-year period. Results of sensitivity analyses that were conducted for moderate risk species are presented in *Annex VI – Timber Supply Analysis.*

The ovenbird (OVEN) RA decreases over the 200-year period and is in the moderate risk category for much of the planning horizon. As relative abundance for ovenbird is generally the highest in deciduous forests (Figure 3-1), but with lower values in older forest, lack of harvesting in deciduous forests is causing the reduction of ovenbird relative abundance. As discussed in *Annex VI – Timber Supply Analysis*, a sensitivity analysis was conducted that illustrates that higher deciduous harvest levels keep relative abundance for ovenbird in the low risk range. No other strategic mitigation strategies can be expected to have a positive impact on ovenbird relative abundance in the absence of deciduous harvest.

Operational and strategic mitigation strategies will be applied for the species that do not meet the 15% threshold (*Chapter 7 – Plan Implementation and Monitoring* Section 8.2.4 and 8.2.5).

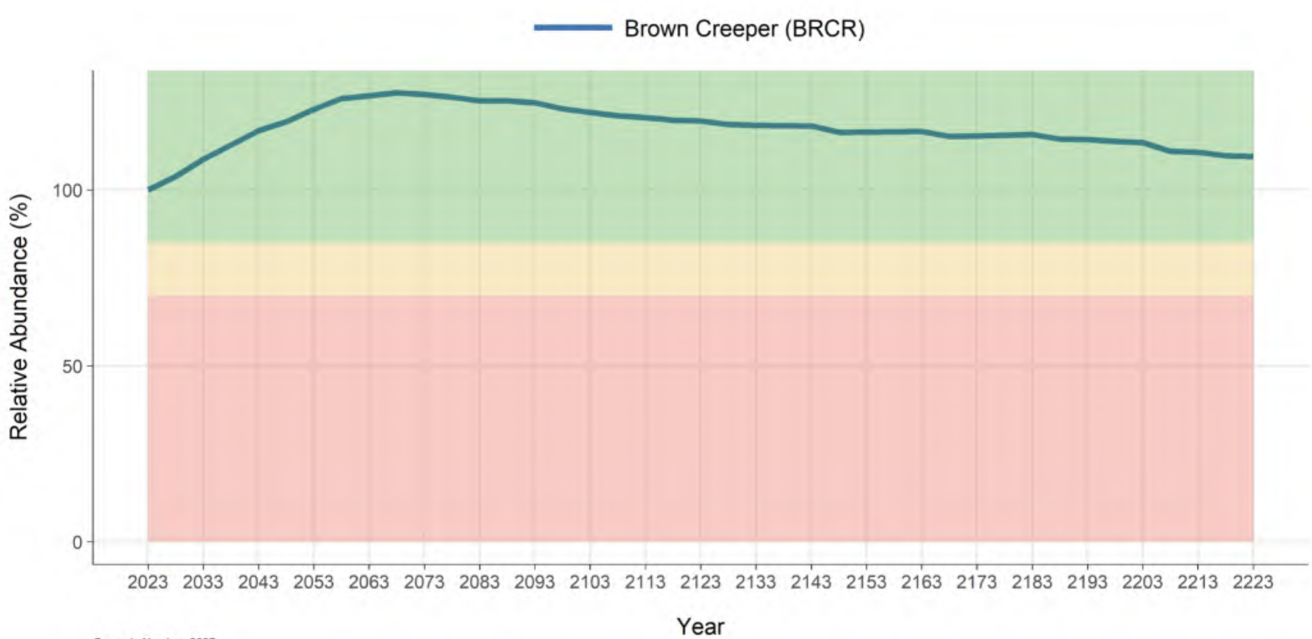

Figure 4-16. Brown creeper relative abundance for FMU C5.

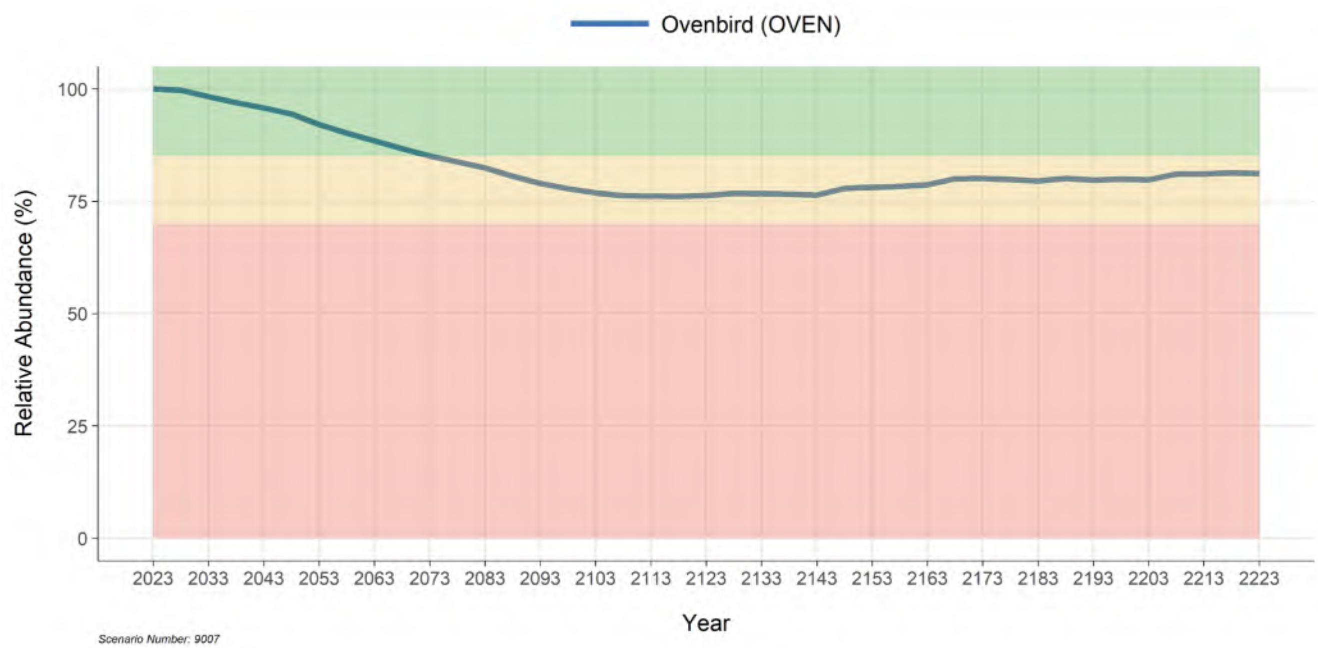

Figure 4-17. Ovenbird relative abundance for FMU C5.

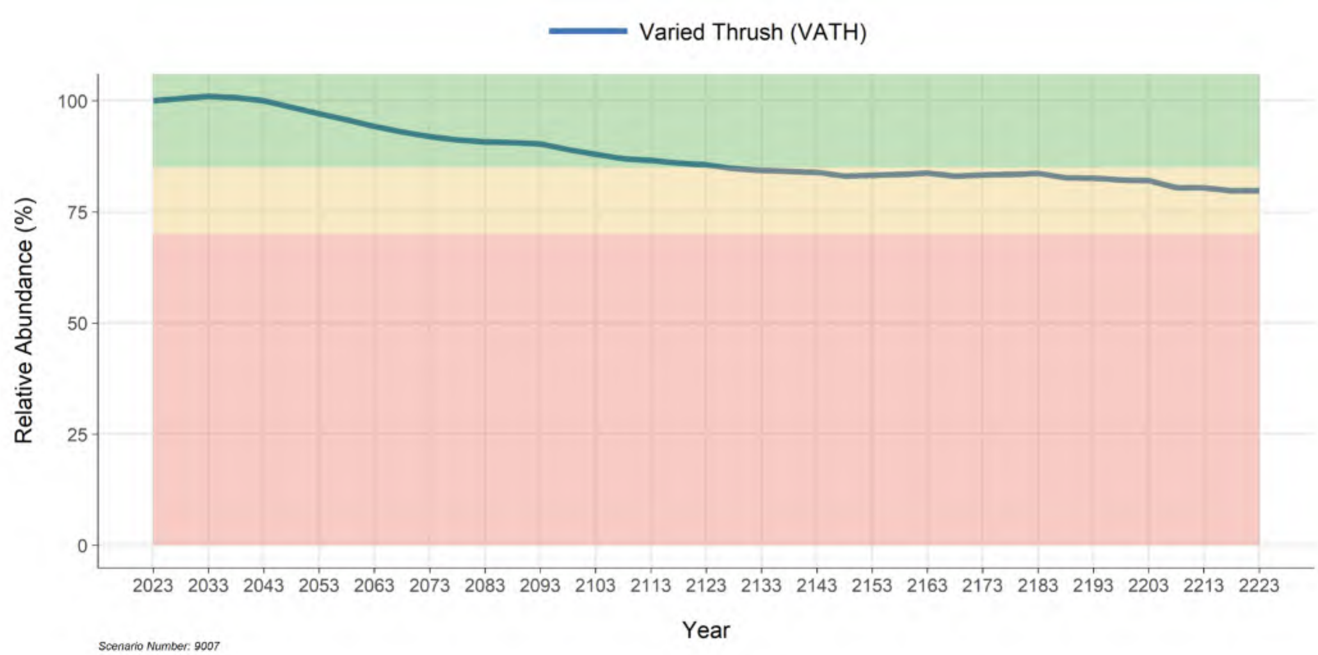

Figure 4-18. Varied thrush relative abundance for FMU C5.

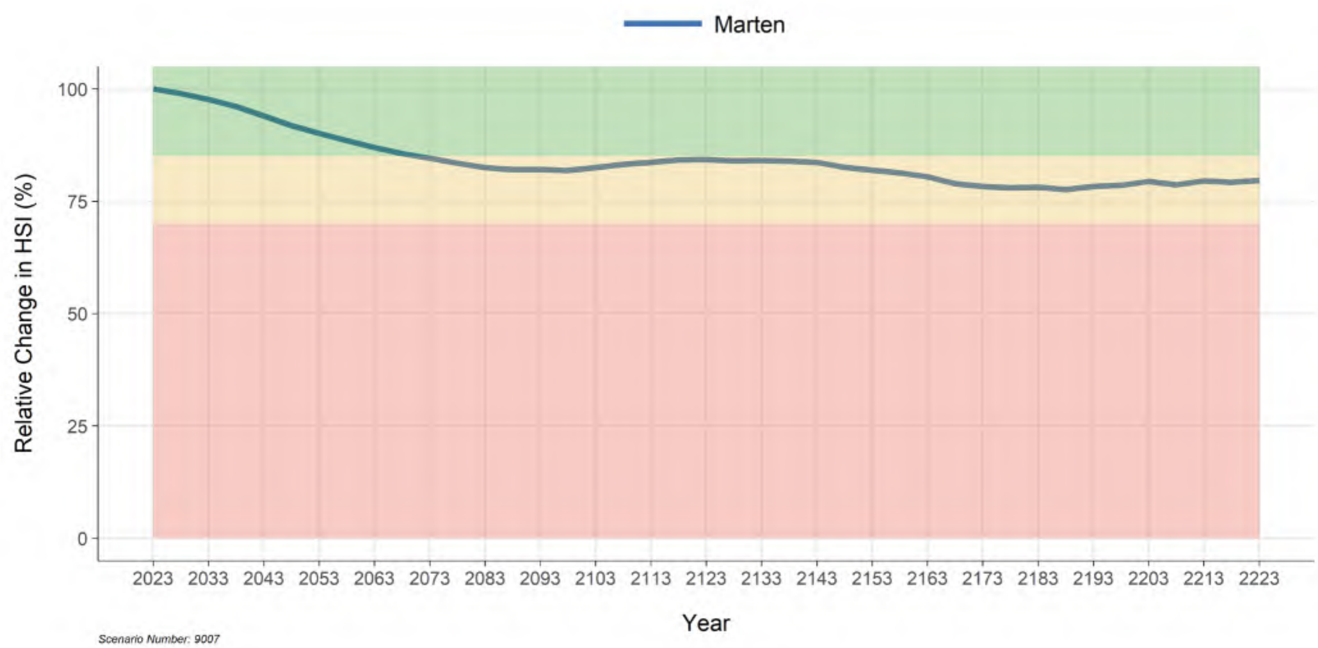

Figure 4-19. Marten habitat suitability index for FMU C5.

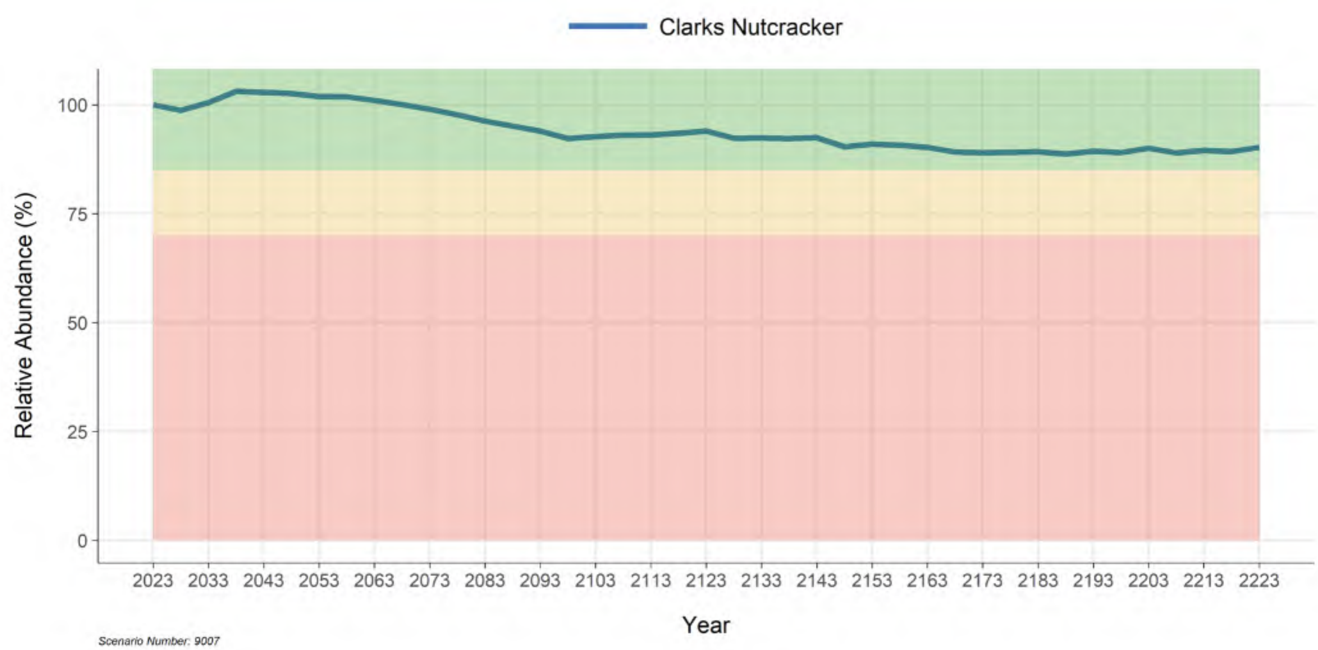

Figure 4-20. Clark's nutcracker relative abundance for FMU C5.

4.4.3.2 Barred Owl

Barred owl results were compiled for the time periods of year 0, 10, 20, 50, 100 and 200. The barred owl model was post-processed from Patchworks PFMS outputs. All time periods were run on the gross landbase, which was aged appropriately for each time period processed.

Figure 4-21 displays the number of potential breeding pairs and RSF values over the specified time periods. The overall number of breeding pairs increases while the RSF values are fairly stable over time. The overall level of barred owl in FMU C5 is small, and is expected to increase as a result of the PFMS, as the majority of the FMU is pure coniferous strata and the deciduous forest that exists is mostly not harvested. The Barred Owl strategy is presented in *Chapter 7 – Plan Implementation and Monitoring* Section 8.2.2.

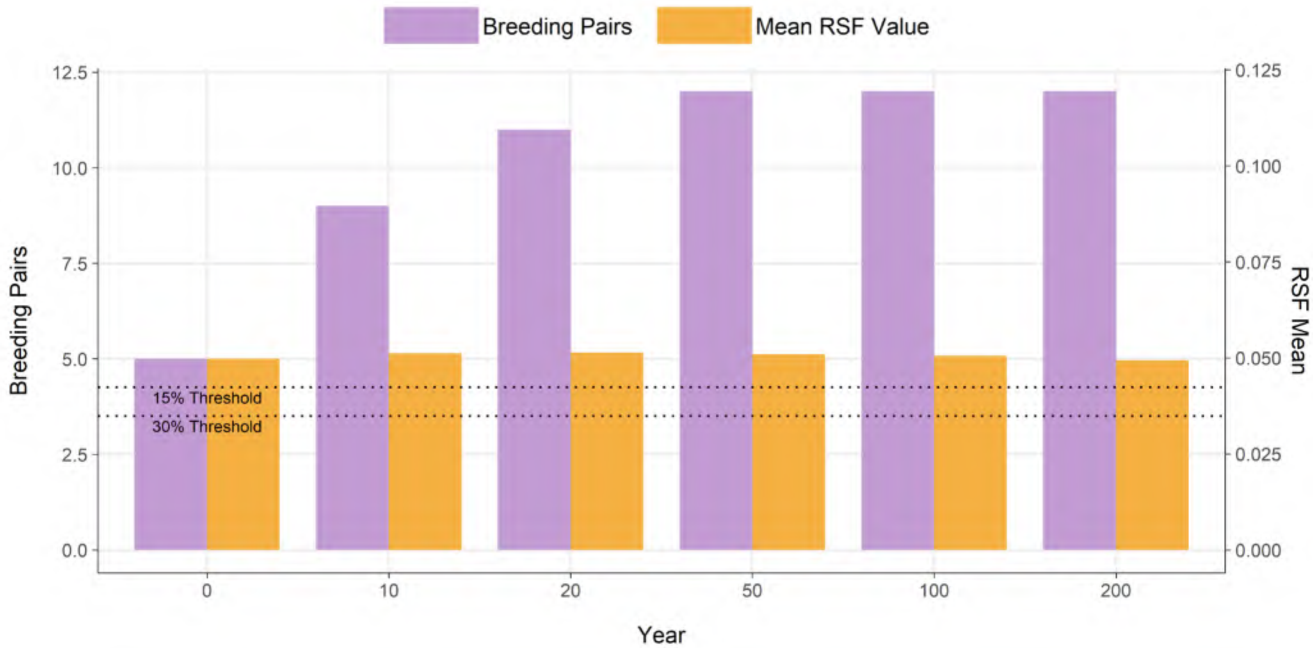

Figure 4-21. Trend of barred owl potential breeding pair and RSF values over time and the percent change relative to time zero.

4.4.3.3 Grizzly Bear

As directed by the GoA, specific reporting metrics are required for grizzly bear modeling (Table 4-3). The grizzly model results generally shown an increase in primary habitat in the core zones, though also an increase in primary sink in the Livingstone core zone.

Table 4-3. Grizzly bear *Habitat States* model summary.

Population Unit	Habitat Zone	Habitat Type	2025	Year 10 (2035)			Year 20 (2045)		
			Area (ha)	Area (ha)	Difference from Year 0 (ha)	Change from Year 0 (%)	Area (ha)	Difference from Year 0 (ha)	Change from Year 0 (%)
Livingstone	Core	Primary	81,293	84,828	3,535	4.3	84,617	3,324	4.1
		Secondary	11,550	8,495	-3,055	-26.5	7,995	-3,555	-30.8
		Non-Critical	19,210	18,788	-422	-2.2	20,329	1,119	5.8
		Secondary Sink	11,010	7,143	-3,867	-35.1	6,726	-4,284	-38.9
		Primary Sink	33,227	37,034	3,807	11.5	36,623	3,396	10.2
	Secondary	Primary	2	2	0	0.0	2	0	0.0
		Secondary	14	13	-1	-7.1	13	-1	-7.1
		Non-Critical	20,676	20,687	11	0.1	20,689	13	0.1
		Secondary Sink	154	143	-11	-7.1	141	-13	-8.4
		Primary Sink	23	24	1	4.3	24	1	4.3
Waterton	Core	Primary	4,087	4,785	698	17.1	5,535	1,448	35.4
		Secondary	2,058	2,551	493	24.0	2,641	583	28.3
		Non-Critical	4,349	3,220	-1,129	-26.0	2,398	-1,951	-44.9
		Secondary Sink	1,106	1,061	-45	-4.1	1,074	-32	-2.9
		Primary Sink	1,521	1,504	-17	-1.1	1,472	-49	-3.2

4.4.4 ECA Watersheds

In the first 10 years, there is a small area that falls into the 50+ and 30+ ECA disturbance categories due to a previous wildfire (Figure 4-22). After the first 20 years though, there are no watersheds that exceed the 30% threshold.

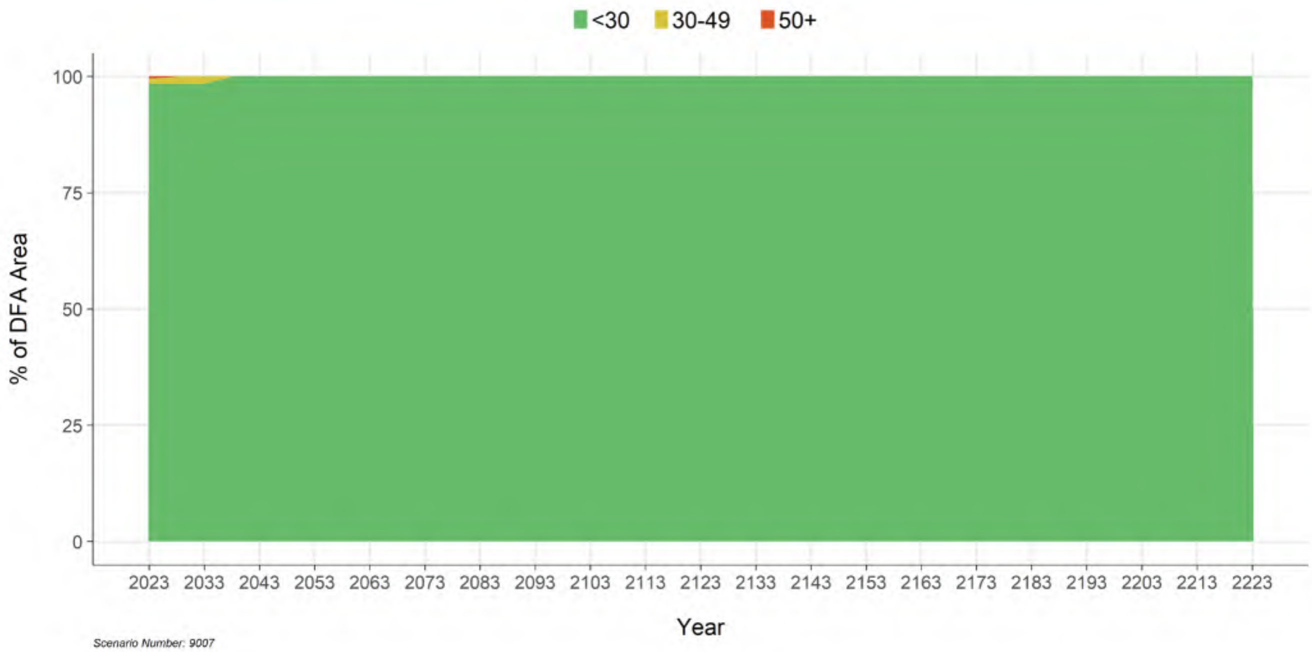

Figure 4-22. Area weighted ECA values over 200 years for FMU C5.

4.4.5 HUC 10 Watersheds

The HUC 10 has no area over the 50% or 30% threshold over the 200 years, except for one watershed at year 0 which is due to a previous wildfire (Figure 4-23).

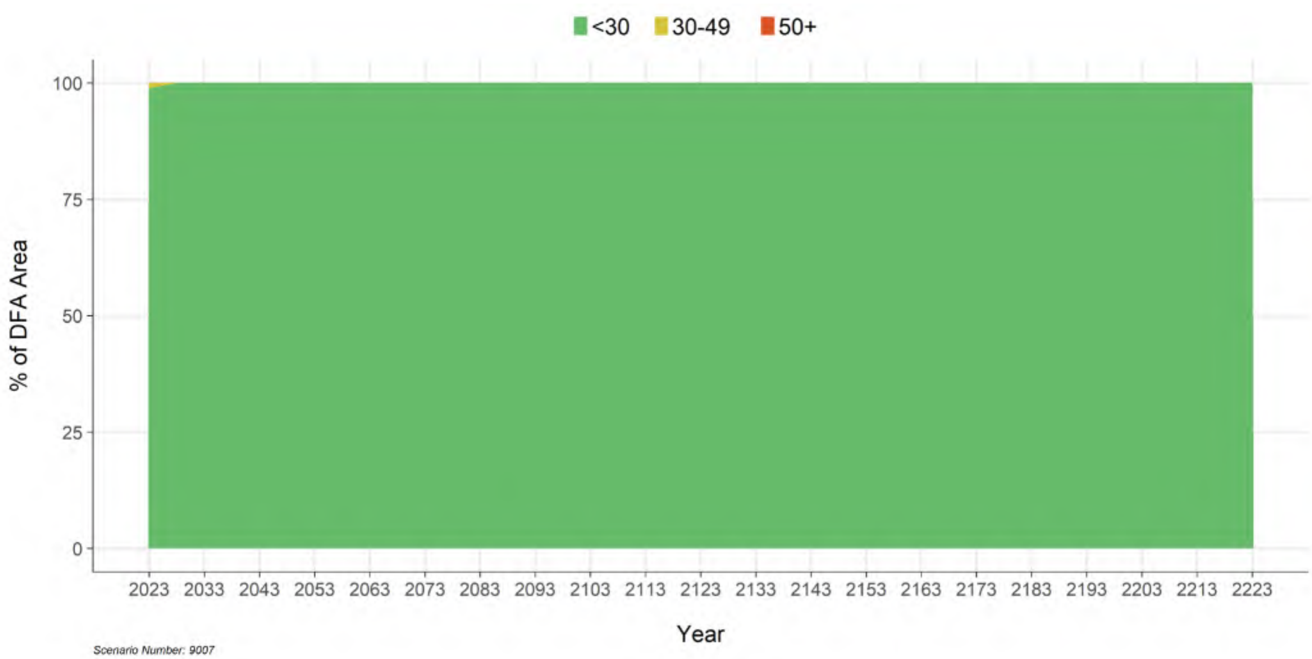

Figure 4-23. HUC 10 watershed analysis values over 200 years for FMU C5.

4.4.6 Interior Old Forest

The interior old forest metric is the area on the gross forested landbase that is greater than 120 years old and is in patches greater than 120 ha in size (Figure 4-24). As this metric is produced as the model is actually running, it is used as a proxy for the actual buffered metric. The area in interior core patches increases in the first 40 years of the planning horizon and then maintains approximately the same level for the remainder of the planning horizon.

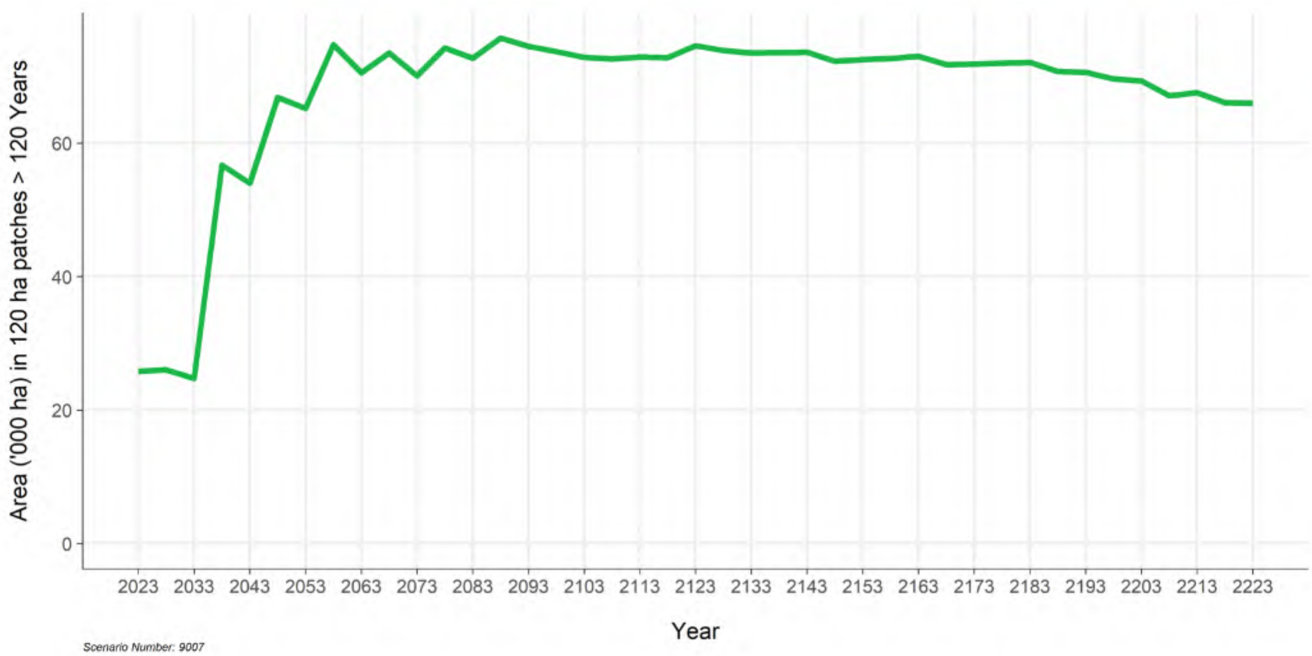

Figure 4-24. Interior old forest (area greater than 120 years old in patches greater than 120 ha).

4.5 Operational Constraints

Two modeling tools were used to improve the operability of the PFMS during and beyond the SHS period. Improved operability beyond the SHS period was undertaken to incorporate the AAC impacts of current operational behavior.

4.5.1 Opening Patch Size

Harvest blocks were controlled to achieve a distribution of sizes. Small harvest blocks less than 2 ha were discouraged, with the majority of harvest blocks targeted for between 10 and 200 ha in size. The harvest patch size is slightly larger in the first 20 years due to the operationalisation of the SHS. Figure 4-25 represents the distribution of harvest block sizes in FMU C5.

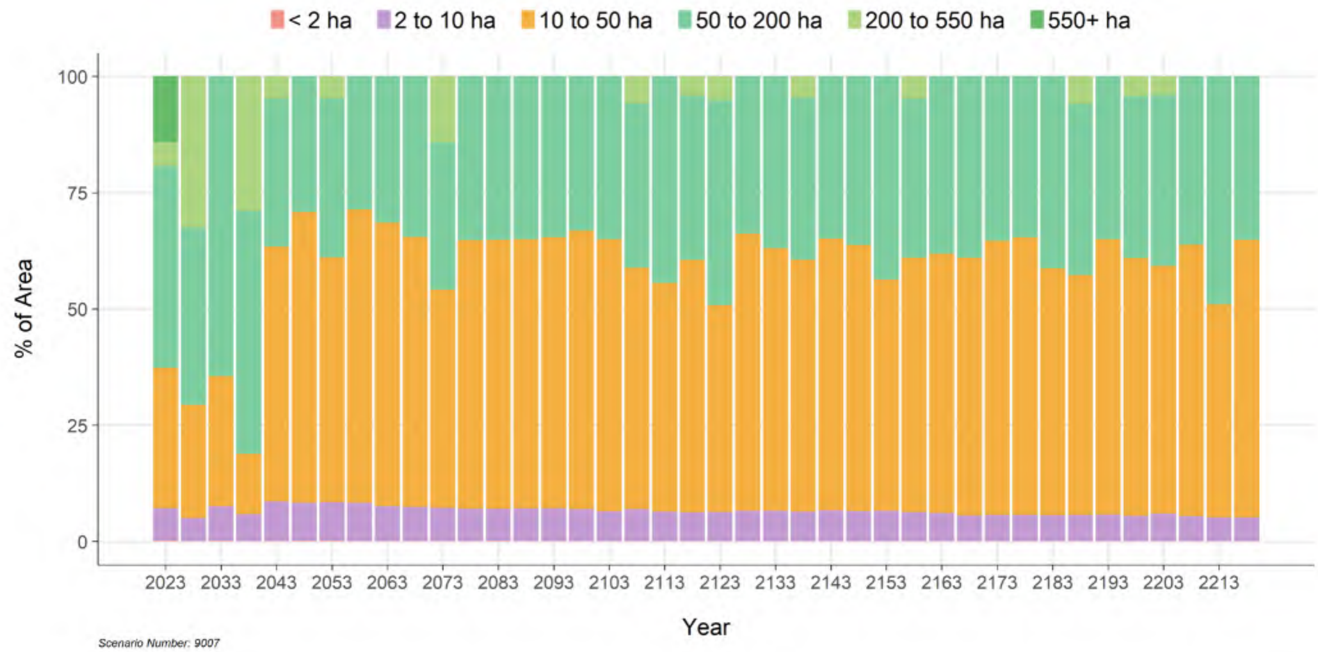

Figure 4-25. Harvest block size distribution for FMU C5.

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Appendix I – PFMS AAC Tables

This appendix contains the tables comprising Table 1 of Annex 1 from the Planning Standard required for AAC approval. Draft table values are included and will be revised and completed during FMP review.

Table 5-1. C5 2025 FMP Recommended AAC.

Company	Disposition	AAC Volume Allocation %	AAC Volume Allocation m^3/yr	Quadrant Volume[1]
Conifer Allocations				
Crowsnest Forest Products	FMA2100047	87.8%	182,541	912,704
793128 Alberta Ltd.	CTQC050002	1.7%	3,432	17,160
770538 Alberta Ltd.	CTQC050005	4.4%	9,110	45,552
CTPP	CTPP	6.2%	12,917	64,584
Total Coniferous			208,000	1,040,000

[1] Quadrant periods: May 1, 2026 - April 30, 2031 & May 1, 2031 - April 30th, 2036

Table 5-2. Chargeability.

Disposition Number	Coniferous Species Used in AAC	Species Not Chargeable to AAC	Rights to Species Not Chargeable to AAC	Structure Retention (%)	Structure Retention (%) Accounted for in AAC	Net Landbase Variations (net landbase not included in AAC, by covertype or by species)	Net Landbase Variation: Rights to Timber	Industrial Salvage Accounted for in AAC
FMA0100038	Fb, Pl, Sb, Sw, & Lt	N/A		3.0%	3.0%	0	0	N/A
	Fd	N/A		17.5%	17.5%	0	0	N/A
793128 Alberta Ltd.	Fb, Pl, Sb, Sw, & Lt	N/A		3.0%	3.0%	0	0	N/A
	Fd	N/A		17.5%	17.5%	0	0	N/A
770538 Alberta Ltd.	Fb, Pl, Sb, Sw, & Lt	N/A		3.0%	3.0%	0	0	N/A
	Fd	N/A		17.5%	17.5%	0	0	N/A
CTPP	Fb, Pl, Sb, Sw, & Lt	N/A		3.0%	3.0%	0	0	N/A
	Fd	N/A		17.5%	17.5%	0	0	N/A

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FINAL DRAFT

Chapter 7 – Plan Implementation and Monitoring

FORCORP

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	**7**	**Plan Implementation and Monitoring**
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	II	Communication Plan
	Annex	III	Stewardship Report (2010-2015)
	Annex	IV	Yield Curve Development
	Annex	V	Net Landbase Development
Three	Annex	VI	TSA – Timber Supply Analysis
	Annex	VII	SHS – Spatial Harvest Sequence
	Annex	VIII	Growth and Yield Plan

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1 FMP Components

1.1 Introduction

Previous chapters describe the process that led to the Preferred Forest Management Scenario (PFMS), which prescribes forest management activities for the next 20 years and outlines the general planning direction for the longer term.

Once approved, this Forest Management Plan (FMP) will replace the current C5 FMP 2006-2026. The strategies outlined in this FMP will be followed by Crowsnest Forest Products Ltd. (CFP) and quota holders within the C5 Forest Management Unit (FMU). This chapter provides details for implementation of the PFMS, including strategies to ensure objectives and targets are met.

The forest management strategies focus on the health and resiliency of the forest and its ability to support biodiversity, watershed health, recreation, and a vibrant forest industry. As knowledge about forest management and forest ecology increases through advances in research and development, and technology, strategies can be adapted and improved with the ultimate goal of creating a healthier and more resilient forest landscape.

1.2 About this Chapter

This chapter summarizes the following information to successfully implement the FMP:

- FMP implementation commitments;
- Alberta's forest management planning hierarchy; and
- Operational planning guidance.

This chapter begins with a review of the planning hierarchy followed by a summary of the products developed during the planning process that will guide FMP implementation. The chapter concludes by addressing:

- Access management;
- Timber harvesting;
- Silviculture;
- Forest protection;
- Protection of forest resources;
- Biodiversity;
- Monitoring; and
- Management strategies.

1.3 Performance Monitoring and FMP Commitments

This chapter focuses on FMP implementation commitments and strategies. The commitments and strategies will become effective upon FMP approval and will remain effective for the duration of the FMP.

1.4 Managing Uncertainty

The FMP implementation period spans 20 years and therefore must be flexible to deal with the uncertainty that is inherent in any long-term planning process. Developments that may affect implementation include:

- New advancements, research results, events, and other changes not accounted for during FMP development; and
- Inaccuracy of long-term predictions.

The FMP includes strategies to deal with uncertainty, including allowable variance levels and associated reporting (e.g., Spatial Harvest Sequence). Examples of potential events, and their impacts and responses are described in Table 1-1.

Another approach for managing unexpected events is adaptive management (D'Eon, 2008), which is described as a six-step cycle that involves assessing the problem, designing the plan, implementing the plan, monitoring the results, evaluating the outcomes, and then adjusting subsequent plans.

The following examples demonstrate how adaptive management applies to FMP implementation:

- Research and development – New knowledge and improved technology.
- Stewardship reporting – Produced after the fifth year of FMP implementation and can trigger needed changes for the remaining period.
- Public and First Nations consultation – Ongoing engagement with stakeholders allows opportunities to identify and assess issues and design plans to addresses concerns.

Table 1-1. FMP uncertainty and potential responses.

Event	Potential Impact and Response
Biodiversity management framework	Regional Land-Use Framework plans may set thresholds and reporting requirements.
Droughts, high severity wildfire, snow damage, floods, insect and disease outbreaks and other natural disasters	In the event of significant natural disasters, plans for the salvage and successful rehabilitation of those areas may include the involvement of other operators. Government of Alberta support and approval will be required for this strategy to be successfully implemented.
Mountain Pine Beetle	Given the age of DFA pine forests, and the proximity to known infestations, there is potential for a future MPB outbreak.
Climate change policies	Forest management in Alberta is a highly regulated industry and changes to policy related to climate change could have a potential impact. Monitoring and developing a process to meet any changes to policy may materialize over the life of this plan.
Species recovery and or species decline	Changes in an individual plant or animal species population could influence changes in forest management approaches.

2 Planning Hierarchy

The Government of Alberta (GoA) is responsible for defining the forest management planning structure in Alberta. In addition to area-based planning, it has also introduced provincial strategies, such as Integrated Land Management (ILM) and regional planning, to guide lower-level plans and achieve more coordination between land users, with a view to minimizing environmental impacts and improving forest stewardship.

These concepts are embodied in lower-level plans required of timber harvesting operators within Alberta, including Forest Management Agreement (FMA) holders: General Development Plans (GDP) and Annual Operating Plans (AOP). GoA approval of these plans authorizes the companies to execute planned forest management activities for the stated timeframe.

Based upon a GoA framework and FMP direction, CFP works with the other operators and the GoA to develop timber harvest planning and operating ground rules (OGRs). OGRs guide the content and implementation of all operational plans.

2.1 Integrated Land Management

ILM is Alberta's strategic planned approach to managing and reducing the human-caused footprint on public land (Government of Alberta, Accessed March 2024). It is an over-arching strategy that guides all levels in the planning hierarchy. The goals of ILM are to foster a stewardship ethic among all land users and reduce land-use disturbances and footprint by requiring shared resource planning. Alberta's ILM policy informed the Land-Use Framework (LUF) regional plans that in turn steer the direction of the FMP and lower-level plans.

2.2 Regional Planning

Alberta's LUF regional plans provide direction for ILM throughout the province. The Defined Forest Area (DFA) is entirely within the South Saskatchewan region (100%) The 2014 – 2024 regional plan for the South Saskatchewan region was released in 2014 and it underwent amendments in 2017 and 2018. (*Chapter 3 – Landscape Assessment* Section 2.6 for more details). At the time of writing the FMP, the South Saskatchewan Regional Plan is undergoing a 10 year review , as required.

The South Saskatchewan Regional Plan (SSRP) provided strategic direction for this FMP. The SSRP sets the stage for robust growth, vibrant communities, and a healthy environment within the region over the next 50 years. Specifically, the plan specifies that in the Green Area, public land is managed for timber production, wildfire protection, watershed, resource development, wildlife and fisheries, tourism recreation and other uses. Alignment between this FMP and the SSRP was a driving force when reassessing the Values Objectives Indicators and Targets for the management plan (see *Chapter 1 – Corporate Overview and Forest Management Approach,* Section 4.1 and *Chapter 5 – Values, Objectives, Indicators, and Targets* for more detail on SSRP integration).

2.3 Integrated Resource Plans

The DFA is influenced by several sub-regional and local integrated resource plans that provide strategic direction for the FMP.

Integrated Resource Plan – Sub-Regional:

- Livingstone-Porcupine Hills Land Footprint Management Plan;
- Livingstone-Porcupine Hills Recreation Management Plan;
- Castle River Sub-Regional Integrated Resource Plan; and
- Livingstone-Porcupine Hills Sub-Regional Integrated Resource Plan.

Integrated Resource Plan – Local (surrounding the DFA):

- Eden Valley Local Integrated Resource Plan; and
- Crowsnest Corridor Local Integrated Resource Plan.

2.4 Forest Management Plan

The Forest Management Plan (FMP) is a long-term, forest-level plan that:

- Provides long-term, general direction for forest management within the DFA, with more specific guidance for the FMP period;
- Establishes a set of values and objectives for the DFA and identifies indicators and targets (i.e., VOITs) for measuring the success of forest management activities over the FMP period (the preferred forest management scenario (PFMS) is derived from the VOITs);
- Identifies the monitoring requirements necessary to evaluate FMP indicators and targets;
- Determines the annual allowable cut (AAC); and
- Generates the spatial harvest sequence (SHS) for the FMP period that is consistent with the PFMS.

Successful implementation of the FMP relies on coordinated operational planning to translate the forest-level values, objectives and strategies into operational realities. Operational constraints may impact the ability of operators to fully implement the FMP. The impact of these constraints should be evaluated within the context of the overall FMP management objectives.

2.5 General Development Plan

The General Development Plan (GDP) provides a comprehensive description of proposed forestry operations for up to the next five years. The plan guides integration with other timber disposition holders defining where forestry operations will occur to assist in communication to the public, interested parties, and Indigenous consultation.

The GDP reflects the objectives of the FMP while providing operational flexibility to allow changes to address emerging situations. The primary components are the spatially delineated harvest areas, access roads, watercourse and waterbody crossings, and variance from the SHS.

2.6 Annual Operating Plan

The Annual Operating Plan (AOP) provides a comprehensive description and operating schedule for proposed activities for the current year. The AOP is the stage of the operational planning process in which activities approved in the GDP are further refined to meet all required expectations and are ready for implementation.

The plan includes fire control and silviculture components which can be submitted individually under a separate cover.

The approval of an AOP authorizes the timber disposition holder to proceed with the proposed forest management activities.

2.6.1 Fire Control Plan

A fire control plan is submitted annually to the GoA. It outlines all activities and preparations related to fire prevention, detection, reporting, pre-suppression and suppression.

The plan describes proposed operations, such as harvesting, planting, and surveying during the fire season, as well as locations of bush inventory and satellite volumes. Suppression training activities and fire equipment inventory are identified and included, along with detailed emergency contact information.

2.6.2 Silviculture Component

The reforestation program (or silviculture program) contains reforestation prescriptions by stratum, and a schedule of treatments for the upcoming year. It identifies silviculture systems, strategies and tactics, and operational silviculture details for all new harvest areas.

It also may describe any silviculture treatments planned for existing regeneration, such as manual tending, as well as any reclamation activities that may be undertaken. The annual reforestation program is essential to ensuring all blocks receive adequate reforestation within the provincially mandated timeframe of two years following harvest.

2.6.3 Road Use and Reclamation Plan

Roads are one of the most significant components of forest harvesting operations. Coordination and integration of road design and construction plans with other resource operators is part of the road planning process. Roads are constructed and reclaimed within the required time period, otherwise a disposition will be applied for.

2.7 Alberta Timber Harvest Planning and Operating Ground Rules

The Alberta Timber Harvest Planning and Operating Ground Rules (OGRs) define the practices used in planning and conducting timber harvest operations that constitute the methods used to implement decisions made in the FMP. Their purpose is to provide direction to timber operators, setting standards and guidelines for timber harvest, road development, reclamation, reforestation and integration of timber harvesting with other forest uses.

The standards direct almost all components within the forest management planning hierarchy, including the GDP, AOP, and reforestation program. The GoA provides a provincial framework for the OGRs but requires FMA holders to develop FMP area-specific addendums, usually within six months of FMP approval. The area-specific addendum for Crowsnest Forest Products was updated in April of 2024. After submission of this FMP the current addendum will need to be appropriately updated.

2.8 Reporting

Performance monitoring and reporting will be conducted at both the operational and strategic levels through GDPs, AOPs, and the Stewardship Report. Reporting requirements were established as a component of the VOITs (*Chapter 5 – Values, Objectives, Indicators and Targets*).

CFP and the Plan Development Team (PDT), along with First Nations, the Public Advisory Committee, and public stakeholders, all had roles in developing the VOITs. Chapter 5 provides the implementation and monitoring commitments for each VOIT, including details on reporting requirements, responsibilities, and timeframe (i.e., FMP or Stewardship Report). For VOITs where it was required, reporting based on the PFMS forecasting can be found in *Chapter 5 – Values, Objectives, Indicators and Targets,* Section 4.

Many of the VOITs are addressed through successful implementation of the OGRs but some require specific strategies and procedures to guide successful implementation. All the VOITs are summarized in Table 2-1with the specific strategies provided later in this chapter. VOIT reporting is completed by CFP. Where required, all operators will provide the necessary data upon request.

Table 2-1. Overview of VOIT implementation.

VOIT	VOIT Description	Influences What?	Strategy to Implement
1 - 1.1.1.1	Seral stage distribution	FMP – PFMS & SHS	Follow SHS, report at next FMP
2 - 1.1.1.2a	Opening patch sizes	FMP – PFMS & SHS	Follow SHS, report at next FMP
3 - 1.1.1.2b	Landscape fragmentation	FMP – PFMS & SHS	Follow SHS, report at next FMP
4 - 1.1.1.3a	Minimize primary access (DLO)	Access & Road Corridor Plan; OGR	Access strategy (Access & Road Corridor Plan), reporting at next Stewardship Report and FMP
4-2 - 1.1.1.3a	Minimize access to maintain biodiversity	Access & Road Corridor Plan; OGRs	Access strategy, annual tracking, and reporting at next Stewardship Report
5 - 1.1.1.3b	Minimize seasonal/temporary motorized access	OGRs - Access	Access strategy, annual tracking, and reporting at next Stewardship Report
5-2 - 1.1.1.3b	Minimize seasonal/temporary footprint access	OGRs - Access	Access strategy, annual tracking, and reporting at next Stewardship Report
5-3 - 1.1.1.3b	Minimize seasonal/temporary near stream access	OGRs - Access	Access strategy, annual tracking, and reporting at next Stewardship Report
6 - 1.1.1.4	Uncommon plants	OGRs - Harvesting	Pre-harvest block assessment, annual tracking, and reporting at next Stewardship Report
7 - 1.1.1.5a	Wildfire habitat	OGRs - Harvesting	Fire Salvage Planning and Operations - Directive No. 2007-01, reporting at next Stewardship Report
8 - 1.1.1.5b	Blowdown habitat	OGRs - Harvesting	GDP, reporting at next Stewardship Report
9 - 1.1.1.6	Riparian habitat	OGRs - Harvesting & tending	OGRs, reporting at next Stewardship Report
10 - 1.1.2.1a	Stand level retention	OGRs - Harvesting	Structure Retention Strategy, reported at Stewardship Report

VOIT	VOIT Description	Influences What?	Strategy to Implement
11 - 1.1.2.1b	Downed woody debris	OGRs - Harvesting	OGRs, reporting at next Stewardship Report
12 - 1.1.2.2	Sensitive sites: mineral licks, nests, dens	OGRs - Harvesting & silviculture	OGRs, SOP, reporting at next Stewardship Report
13 - 1.1.2.3	Minimize water crossing impacts	OGRs - Water crossings	OGRs, Code of Practice for Watercourse Crossings, reporting at AOP and next Stewardship Report
14 - 1.2.1.1	Wildlife species and fish habitats	PFMS - Wildlife strategies SHS, OGR: access	Follow SHS, access strategy, wildlife strategies (grizzly bear, barred owl, marten, songbird, whitebark and limber pine) report at next FMP
15 - 1.3.1.1	In-situ genetic conservation	CPP, SHS	Coordinate with CPP partners, reporting at next Stewardship Report
16 - 1.3.1.2	Ex-situ genetic conservation	CPP, seed requirements and collection	Once a controlled parentage program becomes available, collect seeds from underrepresented seed zones and species combination, reporting at next Stewardship Report
17 - 1.4.1.1	Transboundary values	PFMS	Summary of consultation (as applicable) at next Stewardship Report
18 - 2.1.1.1	Reforest all harvested areas	PFMS, OGRs - Silviculture	Annual Reforestation program, updating ARIS, reporting at next Stewardship Report
19 - 2.1.1.2	Obtain MAI targets	PFMS, regenerated yield curves, reforestation program	AOP, FMP Silviculture direction, reforestation program, Reforestation Standards of Alberta, updating ARIS, reporting at next Stewardship Report
20 - 2.1.2.1	Limit conversion of productive landbase	PFMS	GoA tracking of withdrawals and areas returned to the landbase, reporting at next Stewardship Report
21 - 2.1.2.2	Track insect and disease	GoA health surveys	Reporting at next Stewardship Report
22 - 2.1.3.1	Control non-native plants	Noxious weed program	Adherence of the OGRs, tracking summary of OGRs at next Stewardship Report
23 - 3.1.1.1	Minimize roading and bared area	OGR - Access	OGRs, GDP, reporting of ground rule deviation at Stewardship Report
24 - 3.1.1.2	Minimize soil erosion	OGR - Soil guidelines	OGRs, reporting at Stewardship Report
25 - 3.2.1.1	Limit water yield increases	PFMS, SHS, OGR	Follow SHS, reporting at next Stewardship Report and FMP
26 - 3.2.2.1	Maintain riparian buffers	OGR – Riparian, SHS	OGRs, reporting at next FMP
27 - 5.1.1.1a	Appropriate AAC	PFMS	FMP approval
28 - 5.2.1.1	(a) Reduce Fire Behavior Potential (FBP) in community zones (b) Reduce FBP across the DFA	PFMS, SHS PFMS, SHS	Follow SHS, reporting on area harvested at Stewardship Report Follow SHS, reporting on area harvested at Stewardship Report

VOIT	VOIT Description	Influences What?	Strategy to Implement
29 - 5.2.2.1	Integrating other uses	Operational planning (GDP, AOP)	FMP Communications Implementation Plan, FMP Chapter 7, reporting at next Stewardship Report
29-2 - 5.1.1.2	Maintenance of scenic values	Operational planning (GDP, AOP)	FMP Chapter 7, Visual Quality Strategy, reporting at next Stewardship Report
29-3 - 5.2.2.2	Encroachment onto grasslands	Operational planning (GDP, AOP)	FMP Chapter 7, Forest Encroachment Strategy, reporting at next Stewardship Report
30- 5.2.3.1	Maintain LRSYA	Regenerated yields, silviculture	Post-harvest transitions, reforestation program, RSA program, reporting at next Stewardship Report and FMP
31 - 6.1.1.1	Indigenous Consultation	VOITs, Indigenous consultation plan	Consultation plan, Record of Consultation (ROC) log for the GDP, reporting at next Stewardship Report
32 - 6.2.1.1	Public input opportunities	VOITs, Public consultation plan	Public Involvement Program, reporting at next Stewardship Report

2.9 Strategies for Guidance

The following list represents some of the primary strategies and guidance documents that were developed as part of the FMP process:

- Annual Allowable Cut (Section 4.1);
- Communication and Consultation Plans (Annex II);
- Fire Protection Strategy (Section 6.1);
- Forest Health Strategy (Section 6.2);
- Watershed Management Strategy (Section 7.2);
- Structure Retention Strategy (Section 4.6 and Appendix I – Structure Retention Strategy).
- Grizzly Bear Habitat Strategy (Section 8.2.1);
- Barred Owl Habitat Strategy (Section 8.2.3);
- American Marten Strategy (Section 8.2.4)
- Songbird Strategy (Section 8.2.5)
- Westslope Cutthroat Trout and Bull Trout Habitat Management Strategy (Section 8.2.6 and Appendix IV – Habitat Conservation Strategy: Cold-Water Fish);
- Whitebark Pine and Limber Pine Strategy (Section 8.2.8)
- Visual Quality Strategy (Section 4.9 and Appendix II – Visual Quality Strategy);
- FireSmart Strategy (Appendix III – C5 FMU FireSmart Management Process);
- Forest Encroachment Strategy (Appendix V and Appendix VI); and
- Invasive Plants Program (Appendix VII).

2.10 Preferred Forest Management Scenario

The Preferred Forest Management Scenario (PFMS) is the outcome of the planning process and represents the forest management objectives and strategies developed for the 2025 FMP. VOITs guide both the development of the PFMS and its implementation.

The PFMS is modeled in the forecasting stage and implemented using strategies and tactics described throughout Chapter 7. The AAC, SHS, road access, and harvesting and reforestation strategies are all part of the PFMS. The PFMS will be successfully implemented through the forest management strategies referenced in this chapter, enabling CFP to achieve its sustainable forest management objectives.

2.10.1 Annual Allowable Cut

The GoA establishes the annual allowable cut (AAC) based on the timber supply analysis, which is part of the PFMS. Upon approval of the timber supply analysis, an AAC will be established for FMU C5 and allocated to each operator based on their timber rights. The AAC is regulated through 5-year or 10-year time periods, determined by the GoA for each operator. Strategies for charging the timber harvested by each operator are included in Section 4.1.4.

2.10.2 Spatial Harvest Sequence

The Spatial Harvest Sequence (SHS) is a key component of the FMP, providing linkages from the FMP to operational planning and implementation on the ground. The SHS describes the stands that are to be harvested over the first decade (i.e., timber years 2025 to 2035) and the stands that are likely to be harvested over the second decade (i.e., timber years 2035 to 2045). Crowsnest Forest Products, Company 793128 Alberta Ltd., and Company 770538 Alberta Ltd. have timber rights within the C5 FMU at the time of writing this plan and have SHS associated with their rights. There has also been SHS allocated to the Coniferous Community Timber Program (CCTP).

The SHS is derived from the PFMS and reflects the selected management strategies, VOITs, and the AAC. Adherence to the SHS on the ground ensures that FMP targets can be achieved.

3 Access Planning and Development

The planning, construction, maintenance, and reclamation of access roads plays a key role in forest management. Roads provide access for personnel and equipment to plan, harvest, reforest, and monitor activities. Road construction, maintenance, and reclamation are conducted while minimizing erosion and protecting water quality.

3.1 Access Planning

Currently, a combination of forestry, oil and gas, and municipal and provincial roads provide access to and throughout the FMP area. In keeping with past practices, operators intend to limit construction of new permanent access within the FMP area.

Access planning strategies are utilized by the operators to ensure planned access meets the following objectives:

1. Minimize area of productive forest lost to access development;
2. Integrate road use;
3. Maintain soil and water quality;
4. Maintain habitat, wildlife and other resource values (i.e., limiting open access);
5. Provide safe roads for staff, contractors, other commercial users and the public;
6. Minimize access development costs;
7. Reclaim roads when appropriate; and
8. Minimize impacts to wetlands.

Access planning strategies include:

- Reuse of existing access;
- Improve/upgrade existing access (if required);
- Minimize length of new road construction;
- Joint access development;
- Minimize the number of watercourse crossings;
- Select appropriate watercourse crossing locations and structures;
- Use of best management practices;
- Reclaim temporary roads that are no longer needed; and
- Follow requirements associated with access control, timing constraints, etc.

Strategies that address safety concerns include:

- Appropriate road signage; and
- Stakeholder consultation/communication regarding log haul.

Evaluation of the of length of time an access road is needed is a part of forest management and situations may arise where existing access options do not meet the needs of CFP. In this situation CFP would review options based on current legislative, forest policy and OGR requirements to determine the best access strategy.

Additional details regarding CFP road planning, construction, maintenance, reclamation and monitoring can be found in the Operating Ground Rules.

3.2 Watercourse Crossings

Watercourse crossings, if not properly designed, can create physical barriers to the movement of fish and other aquatic biota along watercourses. Roads and ditches are designed to intercept and transport sediments away from crossing sites to maintain watercourse integrity. Bridges with sediment trapping wing wall structures are used to protect the integrity of perennial watercourses.

3.3 Corridor Plan

Existing access infrastructure throughout the DFA was reviewed to determine how the SHS can be accessed. Using GIS, a review was conducted on how the midpoints of different watersheds within the compartments could be accessed.

As the SHS is being implemented, CFP will review if long-term or short-term access is needed along with ground truthing of the potential access path. Figure 3-1 shows the location of existing access infrastructure that will be utilized on the DFA area, including possible new access corridors.

There is a 9km portion of historic constructed road (Lost Creek Road, 33km total length) identified on Figure 3-1 which is not currently held under a disposition. To access the SHS, CFP is pursuing a DLO disposition with the intent of maintaining long-term access along this route.

The roads presented on the map below may not be drivable by an on-highway vehicle due to access controls or unmaintained sections. Access management strategy for control of access is a complicated and dynamic process in terms of both implementation and enforcement, involving road reclamation, gates and other physical barriers. As new roads are developed, CFP will work with the GoA to ensure that access controls are being put into place as required.

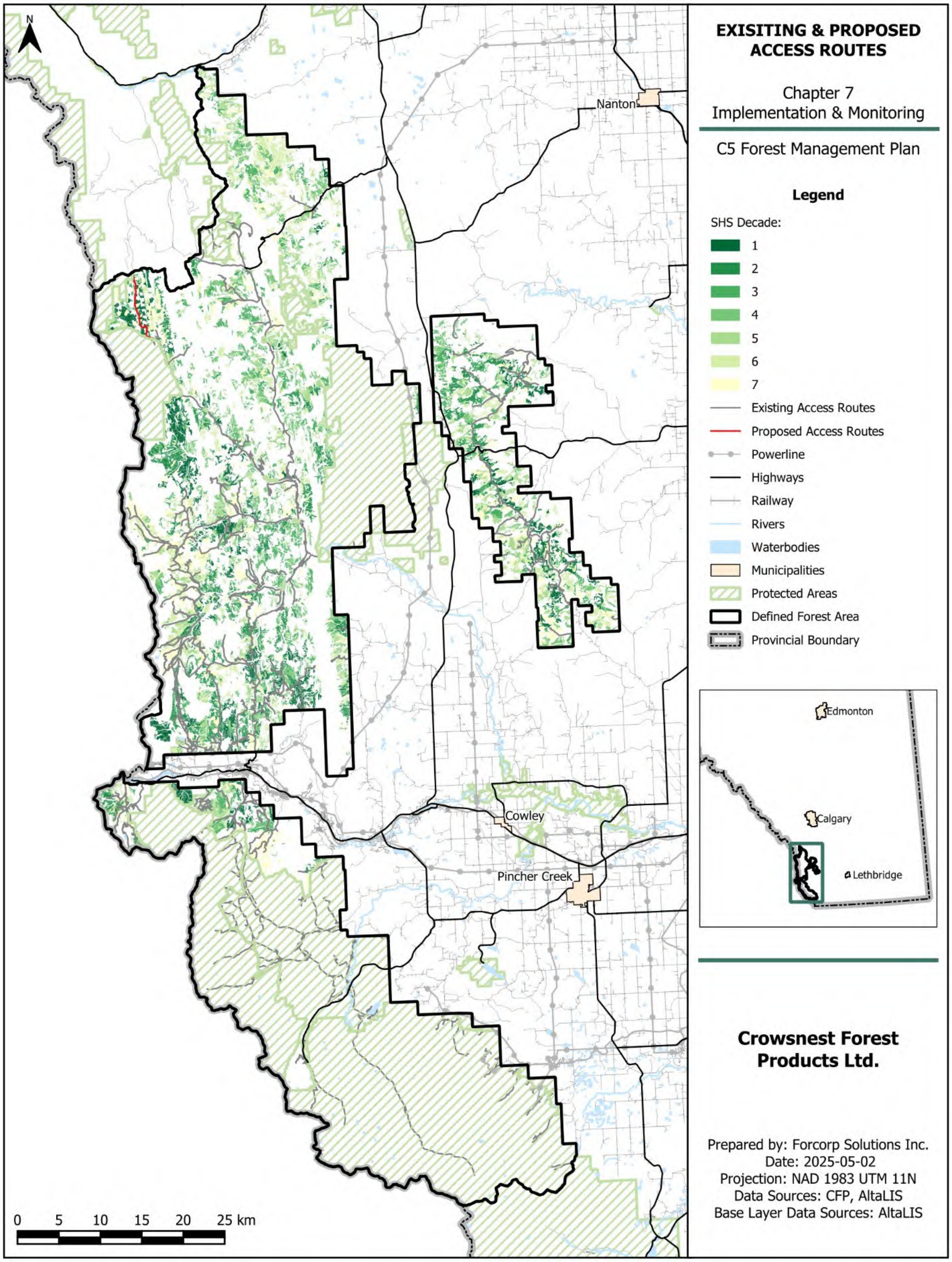

Figure 3-1. Crowsnest Forest Products' access corridors.

4 Timber Harvesting

4.1 Annual Allowable Cut

Upon the GoA's approval of the FMP, the Annual Allowable Cut (AAC) will be established from the recommended harvest levels associated with the PFMS.

4.1.1 Recommended AAC Levels

The recommended coniferous and deciduous AAC levels for the 2025 FMP period (May 1, 2025 to April 30, 2035) for FMU C5, at 15/11/30 utilization for conifer, are summarized in

Table 4-1. There is currently no deciduous allocation within the C5 FMU. Further details on the harvest levels and AAC determination are documented in *Chapter 6 – Preferred Forest Management Strategy*.

Table 4-1. Crownest Forest Products' 2025 FMP Recommended AAC.

Company	Disposition	AAC Volume Allocation		Quadrant Volume[1]
		%	m^3/yr	
Conifer Allocations				
Crowsnest Forest Products	FMA2100047	87.8%	182,541	912,704
793128 Alberta Ltd.	CTQC050002	1.7%	3,432	17,160
770538 Alberta Ltd.	CTQC050005	4.4%	9,110	45,552
CTPP	CTPP	6.2%	12,917	64,584
Total Coniferous			**208,000**	**1,040,000**

[1] Quadrant periods: May 1, 2026 - April 30, 2031 & May 1, 2031 - April 30th, 2036

4.1.2 Deciduous Volume Management

As outlined in Section 14(1) of the Forest Management Agreement, deciduous timber will be managed for its contribution to other resource values on a landscape level. There is no obligation to utilize or salvage deciduous timber resources.

Additionally, Clause 7(1)(d) states that the Company has the right to harvest deciduous timber from stands managed for coniferous production, provided that the deciduous harvest has been approved under the Annual Operating Plan (AOP).

An estimate of potential incidental deciduous volume will be included in the AOP, and CRP will track, report, and pay dues for any felled or destroyed deciduous volume.

4.1.3 AAC Reductions in TSA

The following AAC reductions were accounted for in the modeling process during PFMS development:

- Cull (1.23% conifer, 9% deciduous).
- Seismic lines (applied as a polygon level area reduction). Roughly 1% across the forested landbase.
- Structure Retention – refer to the Stand Level Structure Retention Strategy (Appendix I):
  - Douglas-Fir stratum (Fd): 17.5%
  - All other strata: 3%

4.1.4 AAC Tracking

All timber harvested on the DFA will be charged according to the following procedures:

- Mill Deliveries – Each operator must deplete the volume harvested from FMU C5 against their AAC allocation. This volume is determined through an approved GoA methodology.
- Watercourse and Pipeline Crossings – Each disposition holder will tally the number of box cribs built each year. A merchantable volume per crossing will be calculated. Deciduous timber used counts toward the deciduous AAC depletion. Volume is submitted on a TM-7 at the end of each timber year or other date sanctioned by the GoA, as long as all volume is reported by the end of the quadrant.
- Other Land-use Industrial Dispositions – If industrial salvage is processed by CFP[CFP will deplete 100% of the land-use volume. This volume is based on actual deliveries and is determined through weigh scaling and sampling and submitted on a TM-7 at the end of the timber year. Salvaged timber from industrial dispositions that is delivered to other mills will need to be tracked by the GoA if applicable.

4.2 Harvest System and Methods

CFP uses a variable edge, patch harvest system that seeks to follow existing natural stand patterns whereby structure is left standing throughout the harvest areas (structure retention). Both tree-length and cut-to-length systems are used, but currently, tree-length is the predominant system.

4.3 Spatial Harvest Sequence

The SHS is a product of the FMP process that supports non-timber assessment values that have been modeled (e.g., grizzly bear, songbirds). Adherence to the SHS ensures these values are being maintained according to thresholds approved by the GoA. The SHS describes the stands that are to be harvested over the first decade (i.e., timber years 2025 to 2035) and the stands that are likely to be harvested over the second decade (i.e., timber years 2035 to 2045). Operators have been assigned SHS stands, dictating where harvesting will occur over the designated timeframes. The SHS acts as the initial harvest design, to be refined during plan development to address additional, detailed non-timber values.

4.3.1 SHS Variance Tracking

During development of the GDP, the SHS is refined to meet the operational requirements. Factors outside of CFP control or knowledge at the time of FMP development (e.g. Mountain Pine Beetle, forest fires, sensitive sites, operational constraints) lead to SHS variances. If these variances occur, they will be managed through processes outlined in the CFP OGRs. Pre-harvest, a summary of the variance is provided in the GDP submission. Post-harvest, a summary of the variance is reported in the Stewardship Report. Variance is monitored and reported by compartment, by period, and by strata with deletions and deferrals reviewed during future FMP development for incorporation into subsequent spatial harvest sequences.

4.4 Harvest Season

CFP conducts its harvest operations year-round with the exception of spring break-up. Harvesting that occurs during the summer months will be conducted in areas that have soil characteristics that are naturally resistant to disturbance. Harvesting efforts in the winter allows CFP to operate in a greater variety of sites because of frozen ground conditions.

4.5 In-Block Roads

Conducting forest harvesting operations requires the development of temporary roads within harvest blocks. CFP will attempt to minimize the amount of area that is disturbed during operations. In-block roads that are reclaimed are considered part of the block for silviculture operations and when RSA surveys are completed.

The total area covered by temporary roads, bared processing areas, and soil displaced during timber harvesting operations shall not exceed 5% of each harvest area without Alberta's approval. Blocks less than 7 ha or narrow blocks (averaging less than 100 metres from boundary to boundary) may exceed 5% with these blocks reported on the as-built.

4.6 Structure Retention

Emulating natural disturbances is a key component of sustainable forest management. In the Rocky Mountain forests of Alberta, fire is the predominant natural disturbance agent. Historical fire patterns, along with the forest structures and patterns they create, serve as a guide for replicating natural disturbances in forest management activities.

The structure retention strategy aims to emulate natural patterns, provide diverse wildlife habitat, contribute to maintain biodiversity, provide operational flexibility and ensure safety, incorporate both in-block and proximal (out-of-block) retention, and balance economic and environmental trade-offs.

CFP recognizes the importance of structure retention on the landbase. In collaboration with the PDT, CFP developed a structure retention strategy to guide retention placement, measurement, and reporting within the DFA. This strategy establishes distinct retention targets for the Douglas fir forests (Fd forests) and Lodgepole pine/other non-Douglas fir forests (non-Fd forests).

The structure retention strategy applies to all timber operators harvesting in the DFA. For further details, refer to *Appendix I – Structure Retention Strategy*.

4.7 Harvest Opening Inspections

Companies carry out inspections of active timber operations and report this information to the GoA, to demonstrate compliance with the OGRs. Minimum inspection criteria includes:

- Area associated with in-block roads and landings;
- Presence of rutting;
- Adherence to utilization requirements;
- Maintenance of riparian buffers;
- Adherence to structure retention targets; and
- Adherence to any special conditions.

CFP continually monitors its harvest and silviculture operations to ensure compliance with the Timber Harvest Planning and OGRs and conducts formal post-harvest inspections.

4.8 Non-Timber Assessment Values

Non-timber assessment (NTA) values were modelled during SHS development but must also be addressed during the various stages of FMP implementation such as GDP and AOP development. In addition to the OGRs, FMP-specific strategies were developed to guide harvest planning. These strategies are described in Sections 6, 7, and 8.

4.9 Visual Quality

CFP's approach to visual quality is to plan forest activities that are compatible with the character of the DFA landscape. A healthy forest ecosystem depends on a continuous cycle of renewal. Disturbances such as fire, insects, disease and blowdown are natural events that create forest renewal and ecosystem diversity.

In a managed forest such as the DFA, harvesting emulates natural disturbance patterns because harvesting removes merchantable trees to create forest renewal. A well-managed forest compliments natural disturbance with wise use of forest resources. Many of the areas within the DFA are at risk to mountain pine beetle infestation and high severity wildfire. Both disturbances present the most significant threat to visual quality.

4.9.1 Visual Quality Mitigation

Visual quality management measures are to be considered for high visual sensitivity harvest areas, located within the foreground. As operational plans are drafted; harvest areas with high foreground visual quality rankings will be assessed and consulted on to identify mitigation measures and to reduce potential adverse visual quality impacts.

4.9.2 Visual Quality Measures

The following measures will be taken:

- High sensitivity visual quality inventory and consultation as completed as part of the 2025 FMP;
- High mid-ground and background areas will not be considered visually sensitive unless re-designated as sensitive during operational planning and public consultation;
- The primary means by which visual quality measures will be accomplished is through operational planning. Visual quality was not incorporated into SHS development.
- Mitigation measures to reduce the impacts to 'high sensitivity visual quality' foreground harvest areas may include:
    - Modification of harvest boundaries;
    - Utilization of topography;
    - Application of various structure retention approaches;
    - Modification of road locations; and
    - Use of visualization computer modeling to evaluate various layout options.

Full details on the Visual Quality Strategy can be found in *Appendix II - Visual Quality Strategy*.

4.10 Seismic Lines

Historical footprints that are adjacent to or within a harvest block will be evaluated for reforestation capacities. As part of the timber supply analysis, seismic lines were not assumed to regenerate (see *Annex VI –*

Timber Supply Analysis Section 4.6). The decision is a precautionary approach as several of the linear features are used by ATVs when the Public Land Use Zone (PLUZ) permits motorized recreation. Operationally, CFP will evaluate seismic lines on a case-by-case basis and reforest seismic lines that are not active trails as practicable. Legislated regeneration surveys (RSA) will be applicable to both reclaimed and un-reclaimed seismic lines within harvest areas.

5 Silviculture Program

This section formalizes CFP's reforestation objectives for the DFA. Silviculture strategies are aligned with harvesting and strata transitions used in the PFMS (*Chapter 6 – Preferred Forest Management Scenario*) and Timber Supply Analysis (TSA, *Annex VI – Timber Supply Analysis*).

5.1 Reforestation

5.1.1 Objectives

The reforestation objectives are twofold:

- To ensure that harvested areas are prepared to establish and grow conifer seedlings according to the assumptions used in forecasting and the PFMS; and
- To ensure that the legislated requirements are met as per the *Forests Act*, the Timber Management Regulations, and the Forest Management Agreement.

Lodgepole pine, white spruce and Douglas-fir cones are sourced from local forests, suited to harvest site growing conditions. Cones are processed and the seed is extracted and then stored at the Alberta Tree Improvement and Seed Center. The seed is used as required to grow seedlings in Alberta tree nurseries. Presently, CFP does not use herbicides to manage deciduous trees.

During the harvest process, debris is managed to ensure adequate site preparation can occur, this can include the returning of slash to specific areas. Scarification creates favorable seed beds for natural regeneration and ideal planting spots for planted seedlings. The seedling microsites provide added moisture and shade as well as wind and frost protection. Native herbaceous plants, hardwoods and shrubs also benefit from scarification, thereby increasing harvest area biodiversity.

Scarification also has added benefits in breaking down fuel continuity, thereby enhancing fire prevention and control efforts. Every June, when soil temperatures and soil moisture are favorable, trees are planted by hand in microsites, to promote reforestation success.

Establishment surveys are legislated requirements detailed in the Timber Management Regulation. The surveys must be completed no sooner than four years and no later than eight years after the end of the timber year of harvest. Reforested areas must achieve both a specified stocking level and a minimum level of growth performance.

Performance surveys are also legislated requirements detailed in the Timber Management Regulation. The surveys must be completed by the fourteenth year after harvest.

5.1.2 Responsibilities

The Timber Management Regulation 141.1(1) requires reforestation treatment within two years, beginning after the end of the year of harvest. Reforestation levels must meet GoA reforestation standards.

5.1.3 Growth Targets

PFMS reforestation targets were developed following the GoA Reforestation Standard of Alberta (RSA) policies. Targets are expressed as Mean Annual Increment (MAI) values for each of the reforested strata (Table 5-1). All operators are required to adhere to the currently approved RSA program to manage MAI targets.

Table 5-1. RSA MAI performance targets.

Yield Stratum	GoA Stratum	Treatment	Curve Type	Culmination MAI (m^3/ha/yr)			
				Age	CON	DEC	TOT
Hw	Hw	Normal	Basic	77	0.35	1.19	1.53
Fd	Fd	Normal	Basic	109	2.92	0.07	2.98
MIX_Pl	HwPl	Normal	Basic	106	1.12	0.71	1.83
	PlHw	Normal	Basic	106	1.14	0.71	1.84
MIX_Sx	HwSx	Normal	Basic	101	2.16	0.43	2.59
	SwHw	Normal	Basic	101	2.17	0.43	2.60
Pl	Pl	Normal	Basic	90	2.61	0.02	2.63
SW	Sw	Normal	Basic	114	2.36	0.04	2.39

In addition to the MAI targets, the operators are expected to meet species proportions for conifer and deciduous, as detailed in each of the regenerated stand trajectories documented in the silviculture matrix (Table 5-2).

5.2 Treatments

5.2.1 Silviculture Systems

Harvest systems are designed to maximize sunlight for the establishment of regeneration. Sequence patch cutting (also known as clear-cut with retention) is the primary system.

Silvicultural systems focus on both the harvest and reforestation components of forest operations. Both are carefully chosen with sustainability as the key consideration. Harvesting addresses all of the steps from cutting the trees to moving the logs to roadside for loading and hauling. Selected systems must match the biological needs of the tree species planned for harvesting and the specific growing conditions of the harvest site.

The amount of light, moisture, and frost exposure of the forest floor following harvest are key factors that can affect reforestation success. The goal is to ensure each area harvested can be successfully regenerated so that new forests can grow.

Lodgepole pine leading stands are the dominant forest cover type found on the DFA. As such, sequenced patch cutting is the preferred harvest method. This approach best emulates stand replacement fire dominated natural disturbance regimes, provides the conditions preferred by lodgepole pine, and ensures growth and yield targets are met.

Lodgepole pine seedlings have a biological need for direct sunlight in order to survive and thrive. A disturbance that removes the forest canopy, such as patch cutting or fire, will promote lodgepole pine regeneration.

Spruce grows in either full sunlight or partial shade and harvest systems can be adapted to address this characteristic. Regardless of species, appropriate harvest systems must consider the other values to be protected as well as promoting rapid regeneration of the harvested area.

Most harvested areas will be replanted to ensure adequate stocking of the site. Generally planting relies on a mix of white spruce and lodgepole pine, collected from mature trees within the same seed zone.

Douglas-fir (Fd) stands are component of the forest landscape within the DFA, primarily found in the Porcupine Hills area of the forest management unit. Ecologically, this region shares characteristics with forest types in British Columbia, including the Ponderosa Pine/Bunchgrass zone, Interior Douglas-fir forests, and Douglas-fir reforestation areas in western Montana and Idaho.

Douglas-fir thrives in well-drained soils and benefits from management approaches that balance light availability with protection from extreme environmental conditions. While it can regenerate in shaded conditions, increased light exposure following harvest can enhance growth rates.

The primary harvesting method for Douglas-fir leading stands will be clearcutting with reserves to promote natural regeneration. A seed-tree regeneration method will be used, incorporating single trees or small groups of trees within standard harvest areas. Douglas-fir seeds will be collected in accordance with regulations, and seedlings will be deployed to maintain desired species composition. The use of genetically improved Douglas fir seeds will also be explored. To promote regeneration, mild scarification methods, such as light screefing with machinery, drags, or disturbance from dispersed skidding, will be applied.

Douglas-fir faces several environmental challenges, including pressure from domestic and natural grazing, early- and late-season frosts—particularly on exposed high-elevation plateaus and in low-lying valley positions where cold air collects—summer drought during establishment, and winter desiccation. An adaptive management approach will be key to ensuring successful regeneration and long-term stand health.

For the Conifer Community Timber program, regeneration strategies will be the responsibility of the owner of the harvest area, who have the option of paying the reforestation levy to the Forest Resource Improvement Association of Alberta (FRIAA) to complete the silviculture requirements.

The operators are to meet the harvesting and seedling density commitments made in Table 5-2 for FMU C5. In some cases, harvesting and seedling density commitment adjustments may be made for a variety of reasons, such as:

- Ecological site conditions;
- Reforestation strata balancing requirements;
- Insect or disease considerations;
- FMP strata transitions assumptions; and
- Availability of seedlings.

A summary of the proposed silviculture treatments, by strata, is presented in Table 5-2 and the current seed supply inventory is provided in Table 5-3. Table 5-3 represents the minimum density when planting, actual densities planted are often higher, typically around 1,600 stems/ha.

Table 5-2. Silviculture Matrix for FMU C5.

Important Note	CFP makes all silviculture treatment decisions for each block harvested based on a post harvest assessment. These are ideal, general silviculture strategies. Local site conditions may require different site-specific strategies.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	**Hw**
FMP Yield Strata Transition Sources (Regenerating Strata)	N_HW
Managed FMP Yield Strata land base Designation Code	N/A
Stand Structure (Species Proportions)	Deciduous (D) by stocking at Establishment and by crown closure/density at Performance. >80% Deciduous
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Clearcuts. Clearcuts with retention. Understorey avoidance of conifer where feasible. Maintain optimal debris levels. Deciduous avoidance and / or little harvesting of deciduous planned.
Site Preparation	leave for natural without site prep is an option or mechanical site prep to create microsites and expose mineral soil for existing seed on site to germinate. Debris is required on site to provide micro sites for seedling establishment and nutrient availability. Site preparation can be used but may not be completed due to extreme steepness or sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef.
Seedling Establishment (includes LFN)	LFN
Seedling Density (SPH target per species type)	Deciduous = expect natural growth dynamics of pioneer deciduous to yield densities >10,000 sph from suckering to capture site and reduce effects of competition, 1,000 conifer.
Reforestation Phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	**HwSx**
FMP Yield Strata Transition Sources (Regenerating Strata)	N_MIX_SX
Managed FMP Yield Strata land base Designation Code	N/A
Stand Structure (Species Proportions)	Mixed coniferous (DC) by stocking at Establishment and by crown closure/density at Performance. >50% Deciduous & > 30% conifer (SW/ SE leading)
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	HwSx
Silviculture System	Clearcuts. Clearcuts with retention. Understorey avoidance where feasible. Deciduous avoidance and / or little harvesting of deciduous Planned. Maintain optimal debris levels.
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing Seed on site to germinate. Debris required on site to provide micro sites for Seedling establishment and nutrient availability. Site preparation is Planned for all areas but may not be completed due to extreme steepness or Sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef.
Seedling Establishment (includes LFN)	Deciduous LFN, Plant SW, SE. Manage site preparation to promote natural Seed germination.
Seedling Density (SPH target per species type)	Coniferous = Plant between 1,200 and 1,800 sph of SW/SE, Deciduous LFN minimum 400 sph.
Reforestation Phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant SW, SE or PL where required to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	HwPl
FMP Yield Strata Transition Sources (Regenerating Strata)	N_MIX_PL
Managed FMP Yield Strata land base Designation Code	N/A
Stand Structure (Species Proportions)	Mixed coniferous (DC) by stocking at Establishment and by crown closure/density at Performance. >50% Deciduous & > 30% PL
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Clearcuts. Clearcuts with retention. Understory avoidance where feasible. Deciduous avoidance where possible. Maintain optimal debris levels.
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing Seed on site to germinate. Debris required on site to provide micro sites for Seedling establishment and nutrient availability. Site preparation is Planned for all areas but may not be completed due to extreme steepness or Sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef.
Seedling Establishment (includes LFN)	Deciduous LFN, Plant species applicable for site. Manage site preparation to promote natural Seed germination.
Seedling Density (SPH target per species type)	Deciduous LFN 400 sph. Coniferous = Plant between 1,200 and 1,800 sph of Pl/SW/SE.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	HwPl
Reforestation Phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant SW, SE or PL where required to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	SwHw
FMP Yield Strata Transition Sources (Regenerating Strata)	N_MIX_SX
Managed FMP Yield Strata land base Designation Code	N/A
Stand Structure (Species Proportions)	Mixed coniferous (CD) by stocking at Establishment and by crown closure/density at Performance. >50% SW, SE & Deciduous & > 30%
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Clearcuts. Clearcuts with retention. Understorey avoidance where feasible. Deciduous avoidance where possible. Maintain optimal debris levels.
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing Seed on site to germinate. Debris required on site to provide micro sites for Seedling establishment and nutrient availability. Site preparation is Planned for all areas but may not be completed due to extreme steepness or Sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef.
Seedling Establishment (includes LFN)	Plant conifer. Manage site preparation to promote natural Seed germination. Deciduous LFN.
Seedling Density (SPH target per species type)	Deciduous LFN 400 sph. Coniferous = Plant between 1,200 and 1,800 sph of Pl/SW/SE.
Reforestation Phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant SW, SE or PL where required to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	PlHw
FMP Yield Strata Transition Sources (Regenerating Strata)	N_MIX_PL
Managed FMP Yield Strata LandbaSe Designation Code	N/A
Stand Structure (Species Proportions)	Mixed coniferous (CD) by stocking at Establishment and by crown closure/density at Performance. >50% PL & Deciduous & > 30%

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	PlHw
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Clearcuts. Clearcuts with retention. Understorey avoidance where feasible. Deciduous avoidance where possible. Maintain optimal debris levels.
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing Seed on site to germinate. Debris required on site to provide micro sites for Seedling establishment and nutrient availability. Site preparation is Planned for all areas but may not be completed due to extreme steepness or Sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef.
Seedling Establishment (includes LFN)	Plant conifer. Manage site preparation to promote natural Seed germination. Deciduous LFN.
Seedling Density (SPH target per species type)	Deciduous LFN 400 sph. Coniferous = Plant between 1,200 and 1,800 sph of Pl/SW/SE.
Reforestation Phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant SW, SE or PL where required to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	SbHw
FMP Yield Strata Transition Sources (Regenerating Strata)	N_MIX_SX
Managed FMP Yield Strata land base Designation Code	N/A
Stand Structure (Species Proportions)	Mixed coniferous (DC) by stocking at Establishment and by crown closure/density at Performance.
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Clearcuts. Clearcuts with retention. Understorey avoidance where feasible. Deciduous avoidance and / or little harvesting of deciduous Planned. Maintain optimal debris levels.
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing Seed on site to germinate. Debris is required on site to provide micro sites for Seedling establishment and nutrient availability. Site preparation is Planned for all areas but may not be completed due to extreme steepness or Sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef.
Seedling Establishment (includes LFN)	Deciduous LFN, Plant SW. SE. Manage site preparation to promote natural Seed germination.
Seedling Density (SPH target per species type)	Coniferous = Plant between 1,200 and 1,800 sph of SW/SE, Deciduous LFN 400 sph.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	SbHw
Reforestation Phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant Supplement Plant with SW, SE or PL where required to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Sw
FMP Yield Strata Transition Sources (Regenerating Strata)	N_SW
Managed FMP Yield Strata land base Designation Code	N/A
Stand Structure (Species Proportions)	Pure coniferous (SW) by stocking at Establishment and by crown closure/density at performance. > 80% conifer (SW leading).
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Clearcuts. Clearcuts with retention. Understorey avoidance where feasible. Deciduous avoidance where possible. Maintain optimal debris levels.
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing Seed on site to germinate. Debris required on site to provide micro sites for Seedling establishment and nutrient availability. Site preparation is Planned for all areas but may not be completed due to extreme steepness or Sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef.
Seedling Establishment (includes LFN)	Plant SW. Manage site preparation to promote natural Seed germination. Leave for natural only considered on request from government for unique situations (FireSmart). Areas may be scarified and left for natural Seed if post-harvest survey assessment and conditions are favorable.
Seedling Density (SPH target per species type)	Coniferous = Plant between 1,200 and 1,800 sph of SW, SE. May Plant higher densities in unique situations (straight Plant). Densities may be supplemented with natural ingress from seeds remaining on site during harvest and from adjacent SW stands.
Reforestation Phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant SW, SE or PL where required to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Pl
FMP Yield Strata Transition Sources (Regenerating Strata)	R_PL
Managed FMP Yield Strata land base Designation Code	N/A

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Pl
Stand Structure (Species Proportions)	Pure coniferous (PL) by stocking at Establishment and by crown closure/density at performance. > 80% conifer (Pl leading)
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Clearcuts. Clearcuts with retention. Understory avoidance where feasible. Deciduous avoidance where possible. Maintain optimal debris levels.
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing Seed on site to germinate. Debris required on site to provide micro sites for Seedling establishment and nutrient availability. Site preparation is Planned for all areas but may not be completed due to extreme steepness or Sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef.
Seedling Establishment (includes LFN)	Plant PL. Manage site preparation to promote natural Seed germination. Leave for natural only considered on request from government for unique situations (FireSmart). Areas may be scarified and left for natural Seed if post-harvest survey assessment and conditions are favorable.
Seedling Density (SPH target per species type)	Coniferous = Plant between 1,200 and 1,800 sph of PL. May Plant higher densities in unique situations (straight Plant). Densities may be supplemented with natural ingress from seeds remaining on site during harvest and from adjacent SW stands. Deciduous LFN 400 sph.
Reforestation Phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant SW, SE or PL where required to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Sb
FMP Yield Strata Transition Sources (Regenerating Strata)	-
Managed FMP Yield Strata Land Base Designation Code	N/A
Stand Structure (Species Proportions)	Black Spruce is not targeted for harvest and not Sequenced in the SHS. However, because of differences between the AVI and actual stand edge fringe areas appear to be harvested. The intent is to manage these areas with the adjacent stand.
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, grass.
Silviculture System	Clearcuts. Clearcuts with retention. Understorey avoidance where feasible. Deciduous avoidance where possible. Maintain optimal debris levels.
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing Seed on site to germinate. Debris is required on site to provide micro sites for Seedling establishment and nutrient availability. Site preparation is Planned for all areas

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Sb
	but may not be completed due to extreme steepness or Sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef, excavator mounding.
Seedling Establishment (includes LFN)	Plant PL, SW, SE (based on adjacent stand prescription). Manage site preparation to promote natural Seed germination. Leave for natural only considered on request from government for unique situations (FireSmart). Areas may be scarified and left for natural Seed if post-harvest survey assessment and conditions are favorable.
Seedling Density (SPH target per species type)	Coniferous = Plant between 1,200 and 1,800 sph of PL, SW, SE. May Plant higher densities in unique situations (straight Plant). Densities may be supplemented with natural ingress from seeds remaining on site during harvest and from adjacent SW stands. Deciduous LFN 400 sph.
Reforestation Phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant SW, SE or PL where required to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Fd
FMP Yield Strata Transition Sources (Regenerating Strata)	N_Fd
Managed FMP Yield Strata land base Designation Code	N/A
Stand Structure (Species Proportions)	Pure coniferous (FD Leading) by stocking at Establishment and by crown closure/density at performance.
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Partial harvesting should be used that are specific to the stand. Single seed seed tree, group seed tree, uniform shelterwoods, clearcuts with retention. Fd understorey avoidance. Deciduous avoidance where possible. Maintain optimal debris levels. Even distribution of dominants and co-dominants over openings as majority of Douglas-fir seeds fall within 100 m of a seed tree or stand edge
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing Seed on site to germinate. Debris is required on site to provide micro sites for Seedling establishment and nutrient availability. Site preparation is Planned for all areas but may not be completed due to extreme steepness or Sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef.
Seedling Establishment (includes LFN)	Natural regeneration needs to be encouraged. Plant Fd to ensure Fd is the leading conifer species. Supplement Plant with SW, SE, PL if required. Manage site preparation to promote natural Seed germination and avoidance/protection of residual Seedtrees. Leave for natural only considered on request from government for unique situations (FireSmart). Areas may be scarified and left for natural Seed if post-harvest survey assessment and conditions are favorable.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Fd
Seedling Density (SPH target per species type)	Coniferous = Plant between 1,200 and 1,800 sph of FD. May Plant higher densities in unique situations (straight Plant). Densities need to be supplemented with natural ingress from Seed trees, Seed from adjacent FD stands and Seed remaining on site during harvest. Deciduous LFN 400 sph.
Reforestation Phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant FD (SW, SE, or PL may be required for specific site conditions) to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Temporary in-block roads and landings
FMP Yield Strata Transition Sources (Regenerating Strata)	Based on exterior stand (as identified above).
Managed FMP Yield Strata land base Designation Code	Based on exterior stand (as identified above).
Stand Structure (Species Proportions)	Based on exterior stand (as identified above).
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Clearcuts.
Site Preparation	Decompaction of road surface, recontour to natural slope conditions, rolling back topsoil and debris. Use debris to limit motorized access.
Seedling Establishment (includes LFN)	Utilizing post harvest assessments either seed PL on inblock roads or plant SW on inblock roads. LFN may be viable strategy where natural seed source is available.
Seedling Density (SPH target per species type)	Coniferous = Plant between 1,200 and 1,800 sph of conifer. May Plant higher densities in unique situations (straight Plant). Densities may be supplemented with natural ingress from seeds remaining on site during harvest. Deciduous LFN 400 sph.
Reforestation Phase Intervention (Post-Seedling establishment)	Roads and landings are surveyed as part of the block. May fill-in Plant SW, SE or PL if required to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	X_STRATA (non- forested areas)
FMP Yield Strata Transition Sources (Regenerating Strata)	Based on exterior stand (as identified above).
Managed FMP Yield Strata Land base Designation Code	Based on exterior stand (as identified above).
Stand Structure (Species Proportions)	Non-Forested area (i.e. without a stratum) are not Sequenced in the SHS. However, because of differences between the AVI and actual stand edge (AVI stand boundary vs. boundary identified during operation), fringe areas appear to be harvested. The intent is to manage these areas with the adjacent stand.
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	X_STRATA (non- forested areas)
Silviculture System	Clearcuts
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing Seed on site to germinate. Debris required on site to provide micro sites for Seedling establishment and nutrient availability. Site preparation is Planned for all areas but may not be completed due to extreme steepness or Sensitive areas. Site preparation may not be completed where there are specific conflicting land uses or direction from the government. Mechanical site preparation treatment can include modified blade, teeth, heavy drags, excavator screef.
Seedling Establishment (includes LFN)	When fringe area harvested Seedling establishment will be completed as the stratum associated with the adjacent harvested stand.
Seedling Density (SPH target per species type)	Coniferous = Potentially Plant between 1,200 and 1,800 sph of SW, SE, FD or PL. Higher densities in unique situations (straight Plant). Densities may be supplemented with natural ingress from seeds remaining on site during harvest. Deciduous LFN 400 sph.
Reforestation phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant SW, SE or PL where required to meet 80% minimum stocking standards (RSA). Let it Grow (LIG) strategy is viable where under height Seedlings occur. Density controls mechanical, chemical or biological would be used if required.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Reduced density to reduce fire risk.
FMP Yield Strata Transition Sources (Regenerating Strata)	Based on original FMP yield stratum (as identified above).
Managed FMP Yield Strata Land base Designation Code	TBD
Stand Structure (Species Proportions)	As defined above (based on pre harvest yield strata).
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Clearcuts – roadside processing for limbs and tops. Pile and burn mandatory
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing seed on site to germinate. Debris remaining after road side processing required on site to provide micro sites for seedling establishment and nutrient availability. Site preparation is planned for all areas but may not be completed due to extreme steepness or sensitive areas. Mechanical site preparation treatment can include modified blade(s), teeth, heavy drags, excavator screef, ripping, mounding or as appropriate.
Seedling Establishment (includes LFN)	When fringe area harvested seedling establishment will be completed as the stratum associated with the adjacent harvested stand.
Seedling Density (SPH target per species type)	Coniferous – Reduce planting densities - potentially plant a maximum of 1,200 sph of SW, SE, FD or PL. Densities may be supplemented with natural ingress from seed remaining on site from road side processing harvest system.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Reduced density to reduce fire risk.
Reforestation phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant SW, SE or PL where required to meet 50% minimum stocking standards. Let it Grow (LIG) strategy is viable where under height seedlings occur. Density controls mechanical, chemical or biological may be used for non-conifer species control.

FMP Yield Strata Transition Sources (Current Yield Group) (Natural Yield Types)	Reduced density for Forest Encroachment Areas.
FMP Yield Strata Transition Sources (Regenerating Strata)	Based on original FMP yield stratum (as identified above).
Managed FMP Yield Strata Land base Designation Code	TBD
Stand Structure (Species Proportions)	As defined above (based on pre harvest yield strata).
Limitations to Crop Establishment (Site, Climate)	Shallow soils, winter desiccation, moisture deficit, drying winds, livestock, wildlife, grass.
Silviculture System	Clearcuts – roadside processing for limbs and tops. Pile and burn mandatory
Site Preparation	Mechanical site prep to create microsites and expose mineral soil for existing seed on site to germinate. Debris remaining after road side processing required on site to provide micro sites for seedling establishment and nutrient availability. Site preparation is planned for all areas but may not be completed due to extreme steepness or sensitive areas. Mechanical site preparation as appropriate.
Seedling Establishment (includes LFN)	When fringe area harvested seedling establishment will be completed as the stratum associated with the adjacent harvested stand.
Seedling Density (SPH target per species type)	Coniferous – Reduce planting densities - potentially plant a maximum of 1,200 sph of SW, SE, FD or PL. Densities may be supplemented with natural ingress from seed remaining on site from road side processing harvest system.
Reforestation phase Intervention (Post-Seedling establishment)	Vegetative competition may be a factor affecting survival in the regenerating stand. Fill-in Plant SW, SE or PL where required to meet 50% minimum stocking standards. Let it Grow (LIG) strategy is viable where under height seedlings occur. Density controls mechanical, chemical or biological may be used for non-conifer species control.

Table 5-3. Seed supply matrix for FMU C5.

Base 10 Strata	Operator (SHS)	Species	Seed Zone	Current Inventory (kg)	Number of seedlings that could be planted with current inventory	Area that could be planted with current inventory (ha)	10 Year Spatial Harvest Seq. (ha)	Minimum density (sph)	Seedlings Required	Seed required for next 10 yrs (kg)	Seed collection required for next 10 yrs (kg)
SW/SWHW/HWSW	CRFP	SW	A 1.4	0.000	0	0	9.0	1,200	10,749	0.09	0.09
		SW	M 4.5	0.000	0	0	46.7	1,200	55,981	0.47	0.47
		SW	M 5.4	14.912	1,770,487	1,475	0.4	1,200	472	0.00	0.00
		SW	M 5.5	10.432	1,238,581	1,032	280.4	1,200	336,513	2.83	0.00
		SW	M 5.6	31.810	3,776,769	3,147	56.6	1,200	67,958	0.57	0.00
		SW	SA 3.2	19.681	2,336,705	1,947	809.7	1,200	971,679	8.18	0.00
		SW	SA 3.3	0.000	0	0	46.8	1,200	56,211	0.47	0.47
		SW	SA 4.2	9.590	1,138,611	949	1,113.8	1,200	1,336,575	11.26	1.67
	CTPP	SW	M 4.5		0	0	13.1	1,200	15,668	0.13	0.13
		SW	M 5.6		0	0	0.5	1,200	614	0.01	0.01
		SW	SA 3.2		0	0	19.8	1,200	23,798	0.20	0.20
		SW	SA 4.2		0	0	0.0	1,200	23	0.00	0.00
	CNKC	SW	M 5.6		0	0	17.2	1,200	20,682	0.17	0.17
		SW	SA 3.3		0	0	3.9	1,200	4,714	0.04	0.04
PL/PLHW/HWPL	CRFP	PL	A 1.4	0.000	0	0	0.2	1,200	245	0.00	0.00
		PL	M 4.5	0.000	0	0	13.5	1,200	16,204	0.21	0.21
		PL	M 5.4	5.460	422,549	352	65.1	1,200	78,115	1.01	0.00
		PL	M 5.5	25.938	2,007,342	1,673	296.6	1,200	355,902	4.60	0.00
		PL	M 5.6	6.597	510,542	425	135.2	1,200	162,273	2.10	0.00
		PL	SA 3.2	52.287	4,046,491	3,372	2,624.9	1,200	3,149,893	40.70	0.00
		PL	SA 3.3	0.000	0	0	86.6	1,200	103,950	1.34	1.34
		PL	SA 4.2	21.725	1,681,298	1,401	1,074.4	1,200	1,289,250	16.66	0.00
		PL	SA 4.3	0.000	0	0	5.6	1,200	6,744	0.09	0.09
	CTPP	PL	M 5.5		0	0	35.7	1,200	42,818	0.55	0.55
		PL	M 5.6		0	0	5.4	1,200	6,462	0.08	0.08
		PL	SA 3.2		0	0	247.9	1,200	297,505	3.84	3.84
		PL	SA 4.2		0	0	29.1	1,200	34,917	0.45	0.45
	CNKC	PL	M 5.6		0	0	345.0	1,200	413,967	5.35	5.35
		PL	SA 3.2		0	0	96.2	1,200	115,395	1.49	1.49

Base 10 Strata	Operator (SHS)	Species	Seed Zone	Current Inventory (kg)	Number of seedlings that could be planted with current inventory	Area that could be planted with current inventory (ha)	10 Year Spatial Harvest Seq. (ha)	Minimum density (sph)	Seedlings Required	Seed required for next 10 yrs (kg)	Seed collection required for next 10 yrs (kg)
		PL	SA 3.3		0	0	71.9	1,200	86,317	1.12	1.12
		PL	SA 4.2		0	0	9.7	1,200	11,635	0.15	0.15
FD	CRFP	FD	M 4.5	1.970	197,000	164	322.4	1,200	386,860	3.87	1.90
		FD	M 5.5	0.000	0	0	1,018.3	1,200	1,222,010	12.22	12.22
		FD	M 5.6	1.850	185,000	154	21.5	1,200	25,850	0.26	0.00
		FD	SA 3.2	0.000	0	0	23.1	1,200	27,749	0.28	0.28
	CTPP	FD	M 4.5		0	0	131.5	1,200	157,817	1.58	1.58
		FD	M 5.5		0	0	62.2	1,200	74,649	0.75	0.75
	CNKC	FD	M 5.6		0	0	27.7	1,200	33,260	0.33	0.33

6 Forest Protection

Wildfire and insect infestations are natural disturbance events that establish forest renewal. The DFA forests are comprised of predominately fire origin stands. Presently, surveys indicate insect populations to be at endemic levels. However, severe infestations by insects such as Mountain Pine Beetle (MPB) could reach outbreak levels, particularly if changing environmental conditions (e.g., drought) create conditions suited for rapid spread.

CFP's forest protection strategies are aimed at reducing the risk, occurrence and severity of wildfire and insect infestations, primarily by harvesting old stands before they are lost to insects and/or fire. The company also addresses the risk associated with windthrow, which has the potential to affect standing timber adjacent to forest harvesting operations.

6.1 Fire Protection Strategy

Ecosystems change over time, driven by natural and anthropogenic disturbances. Wildfire suppression is known to have changed the natural fire regime across the DFA, changing the timing and nature of fire as a natural disturbance factor. Due to this reduction of fire on the landscape, some ecosystems have become more susceptible to fire disturbance due to factors such as fuel loading and in-growth.

The main trends that will influence wildfire risk over the next few years include:

- Climate change – impacts wildfire incidence, wildfire behavior and fuel conditions, including warming and drying trends and a reduction in fire return intervals; and
- Forest fuels – result in increased probability of larger wildfires due in part to effectiveness of historic fire suppression.

The key values at risk to high severity wildfire include:

- Human life – residences, facilities;
- Communities – community infrastructure;
- Watersheds – drinking water and sensitive soils;
- Natural Resources:
    - terrestrial species at risk;
    - plants/vegetation at risk;
    - fish species at risk;
    - critical habitat;
    - indigenous and historical/cultural sites;
    - timber; and
- Infrastructure – transmission lines, highways, railroads, oil and gas assets.

The incorporation of FireSmart principles in forest management planning aims to minimize catastrophic wildfires to communities on the landscape through a joint effort between industry and the Government of Alberta (GoA). During development of the Forest Management Plan, the GoA completed the Annex 3 report providing four recommendations to reduce the regional risk of catastrophic wildfires. The Annex 3 report is provided in Appendix III within this chapter. The status of these recommendations is as follows:

Recommendation #1 – In the Crowsnest Forest Products Landscape Zone (CFPLZ), incorporate identified wildfire risk indicator (WRI) risk classes of risk reduction, continuous improvement, and intolerable into the development of the spatial harvest sequence to reduce fire hazard by harvesting 30% of the active landbase over 20 years starting at time zero of the CFP 2025 FMP.

This recommendation played a pivotal role in developing the spatial harvest sequence for the first two decades. The challenge associated with the scheduling of this target are that not all of the all the active landbase in the community zone is eligible for harvest. A large portion (~21%) is under the minimum harvest age, and a smaller area (~8%) falls within the Southern Rockies Watershed Project (CLR100288), which is subject to a 20-year harvest deferral. Additionally, harvest activities from the 2024 timber year were excluded from the target.

Despite these area constraints, a goal was integrated into the timber supply model, scheduling ~33% of the active landbase for harvest within the 20-year period. The identified harvest sequence was also reviewed operationally to ensure feasibility and alignment with management objectives.

Table 5-4. Decade 1 and 2 Area Harvested by Wildfire Risk Category for the Community Zones.

	Net Landbase		Net Landbase (Operable)		Decade 1 Harvest			Decade 2 Harvest			Decade 1 and 2 Harvest		
Wildfire Behaviour Category	Area (ha)	%	Area (ha)	%	Area (ha)	% of Initial	% of Operable	Area (ha)	% of Initial	% of Operable	Area (ha)	% of Initial	% of Operable
Intolerable	696	3.61	481	3.88	140	20.14	29.13	67	9.65	13.96	207	29.79	43.09
Risk Reduction	1,532	7.94	944	7.6	259	16.93	27.47	155	10.1	16.38	414	27.03	43.86
Continuous Improvement	13,300	68.9	9,530	76.74	2,135	16.05	22.4	2,280	17.14	23.92	4,415	33.19	46.33
Subtotal Categorized	*15,528*	*80.44*	*10,955*	*88.22*	*2,534*	*16.32*	*23.13*	*2,502*	*16.11*	*22.84*	*5,036*	*32.43*	*45.97*
Non-Categorized	3,776	19.56	1,463	11.78	124	3.29	8.49	274	7.26	18.74	398	10.55	27.22
Total	**19,304**	**100**	**12,418**	**100**	**2,659**	**13.77**	**21.41**	**2,776**	**14.38**	**22.35**	**5,435**	**28.15**	**43.76**

Overall, this provided a reduction in wildfire risk indicators for the first 20 years of the spatial harvest sequence. A portion of the 20 year sequence within the community zone represents the volume requirement for the community timber program and the two timber quota within the forest management agreement area.

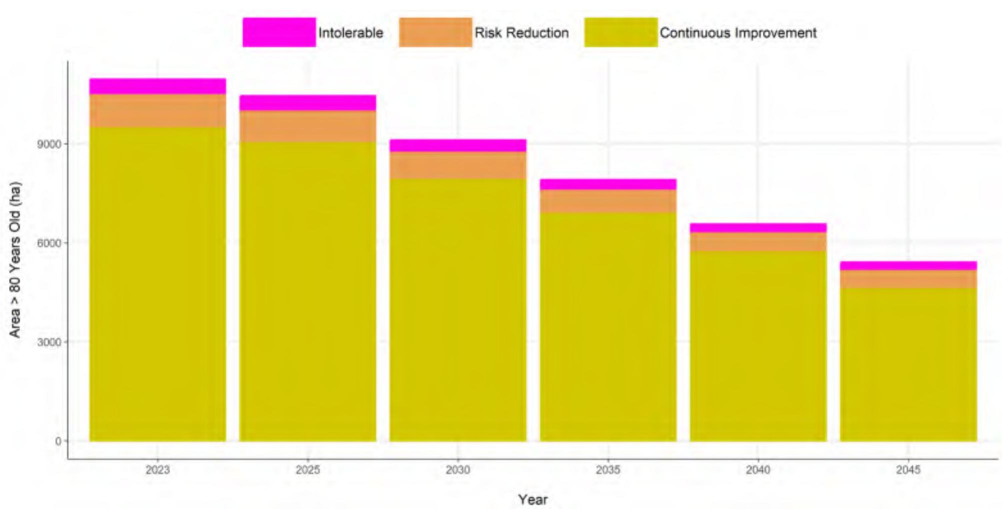

Figure 6-2. Reduction in Fire Risk within the FireSmart Community Zones.

Recommendation #2 – In the Crowsnest Forest Products Landscape Zone (CFPLZ), incorporate identified WRI risk classes of risk reduction, continuous improvement and intolerable into the development of the spatial harvest sequence to reduce fire hazard by harvesting 10% of the active landbase over 20 years starting at time zero of the CFP 2025 FMP.

The following table summarizes the scheduled harvest within the community zone. Because of the CFPCZ's larger size and active landbase, this recommendation did not require explicit goalsetting in the timber supply model. Approximately 18% of the active landbase is scheduled for harvest over the next 20 years, with prioritization guided by WRI categories.

Table 5-5. Decade 1 and 2 Area Harvested by Wildfire Risk Category for the Landscape Zone.

Wildfire Behaviour Category	Net Landbase		Net Landbase (Operable)		Decade 1 Harvest			Decade 2 Harvest			Decade 1 and 2 Harvest		
	Area (ha)	%	Area (ha)	%	Area (ha)	% of Initial	% of Operable	Area (ha)	% of Initial	% of Operable	Area (ha)	% of Initial	% of Operable
Risk Reduction	776	0.96	501	1.04	0	0	0	200	25.74	39.92	200	25.74	39.92
Continuous Improvement	52,884	65.13	35,804	74.7	5,085	9.62	14.2	4,833	9.14	13.5	9,918	18.75	27.7
Subtotal Categorized	*53,660*	*66.08*	*36,305*	*75.74*	*5,085*	*9.62*	*14.2*	*5,033*	*9.38*	*13.86*	*10,118*	*18.86*	*27.87*
Non-Categorized	27,542	33.92	11,629	24.26	1,051	3.82	9.04	948	3.44	8.15	1,999	7.26	17.19
Total	**81,202**	**100**	**47,934**	**100**	**6,136**	**7.56**	**12.8**	**5,980**	**7.36**	**12.48**	**12,117**	**14.92**	**25.28**

Recommendation #3 – In the Crowsnest Forest Products Community Zone (CFPCZ), consider developing strategies for reducing the risk of wildfires to communities such as but not limited to: (a) Pre-commercial thinning and /or harvest design (e.g., strip cut) adjacent to communities to create fuel breaks to reduce wildfire spread potential; (b) leave for natural and/or reduced planting densities.

Strategic Mitigation:

An alternative silviculture strategy has been developed to address wildfire risk, focusing on:

- Reducing on-site debris through roadside processing and pile-and-burn techniques to dispose of the debris generated during harvesting;
- Reduced planting densities, targeting the minimum viable threshold of 1,200 stems/ha (as outlined in the silviculture matrix); and
- The company will work with the Government of Alberta to identify specific areas where this prescription will be most effective.

During the operational planning stage, the company will work with the Government of Alberta to address the possibility for pre-commercial thinning or modified harvest designs. This review should occur prior to the submission of the AOP to ensure strategies align with both ecological goals and wildfire risk mitigation.

Recommendation #4 – In the Crowsnest Forest Products Landscape Zone and Crowsnest Forest Products Community Zone, consider preserving fire resistant Douglas-fir leading stands by promoting ecological restoration through selective harvest methods.

Strategic Mitigation:

There are 68 ha of Fd leading stands scheduled in the community zone and 1,428 ha of Fd leading stands scheduled landscape zone for the next 10 years

- The current prescription for harvesting in Fd leading stands calls for a retention level of 15-20% of the volume in the stand.

- The focus will be on removing non-dominant trees and non-Fd species while retaining dominant Fd trees in the overstorey.

The company will work jointly with the GoA to identify specific areas where selective harvesting is the most appropriate prescription. This approach should aim to mitigate wildfire risks in both landscape and community zones.

This strategy supports wildfire resilience and ecological sustainability while ensuring the dominant fire-resistant Douglas-fir trees are preserved in critical areas.

6.2 Forest Health Strategy

6.2.1 Mountain Pine Beetle

Insects and diseases are a natural part of the DFA ecosystem. Changing environmental conditions such as warmer winter temperatures, aging forests, declines in forest health and droughts can lead to significant increases in pest populations, such as the Mountain Pine Beetle (*Dendroctonus ponderosae*, MPB). MPB is one of the most destructive pests affecting mature pine. Adults emerge from host trees and attack green trees in midsummer, inflicting serious damage in the form of blue stain and checking. Infested trees usually die within a year. Since the mid-1990s MPB is estimated to have killed 730 million m^3 (approximately 55%) of the merchantable pine in British Columbia, and since the mid-2000s large outbreaks have occurred throughout northwestern Alberta (Bleiker, Boisvenue, & Erbilgin, 2019).

Mature and over-mature pine under stress are the preferred host, but as beetle populations increase, smaller-sized and healthy trees can also be attacked. Outbreaks continue as long as a food source is available and climatic conditions are favourable.

Climate change and warmer winter temperatures have allowed MPB to spread further north and to higher elevations. The expansion potential has raised new threats to Alberta's Lodgepole pine, Limber pine and Whitebark pine ecosystems. A large-scale outbreak could put many forest resources and socio-economic values at risk, including watersheds, high value riparian areas, sensitive sites and important wildfire habitat. Resulting MPB outbreak mortality dramatically increases fuel loads adding potential for more wildfires, with greater size and intensity (Alberta Sustainable Resource Development, 2007).

MPB is now established in lodgepole–jack pine forests in northern Alberta and threatens to spread east across Canada's boreal forest if conditions are favorable (Government of Canada Factsheets).

The susceptibility of lodgepole pine stands can be measured using the a Stand Susceptibility Index (SSI), developed by the Canadian Forest Service (Shore & Safranyik, 1992). The SSI is calculated based on stand age, density, and percentage of susceptible pine basal area (derived from % pine in the stand, tree height and growth and yield data). All stands are rated between 1 and 100 where stands rated as 100 have the highest amount of suitable host trees. It is a relative measure of the attributes of the stand and its suitability as MPB habitat without considering the location of the stand or the climate the stand experiences. Rather than an indicator of MPB probibility, SSI becomes a factor when environmental conditions promote active MPB growth within the DFA. Approximately 35% of the DFA has been assigned an SSI value. Of this, 8% was categorized as having low susceptibility, while the remaining 27% was classified as having moderate susceptibility. Mountain pine beetle attacks in the DFA has decreased since 2009 following widespread infestation. Over the past four years, there has been minimal disturbance (*Chapter 3 – Landscape Assessment* Section 5.2.1).

6.2.2 Strategies

The CFP Forest Health Strategy focuses on early detection of insect and disease outbreaks and has the following objectives:

- Assist AFP in assessing the status and control of insect and disease concerns. Examples include Spruce Budworm, Spruce Beetle, Dwarf Mistletoe and MPB;
- Increase forest health awareness among staff and contractors;
- Reduce the spread of insect species that can kill trees;
- Reduce the impact of insects and diseases that cause reduced growth, tree deformities or mortality; and
- Assist in the prevention, detection and control of noxious and prohibited noxious plant species.

The CFP Forest Health Strategy includes the following actions:

- Continue to review forest health survey data;
- Continue insect and disease training for logging contractors and woodlands staff;
- Address forest health issues through the harvest/silviculture planning process;
- Spruce Beetle is currently at endemic levels. However, should Spruce Beetle become a concern, control strategies will be developed in consultation with AFP;
- If MPB populations increase, additional harvest areas not identified in the PFMS may be planned;
- Use only weed-free seed for reclamation projects; and
- Communicate emerging forest health concerns to the public.

6.3 Windthrow

Windthrow, also known as blowdown, is a natural event in which trees are uprooted. It can occur in any forest and is influenced by factors including:

- Wind speed and direction;
- Tree form and size;
- Topography;
- Soil type;
- Soil moisture levels;
- Forest health (root rot and stem decay); and
- Tree species.

Generally, the likelihood of windthrow increases as stands age and grow taller. There is little that can be done to prevent windthrow from occurring in natural origin stands. However, forest operators can address the potential of increased windthrow associated with forestry operations using strategies such as:

- Incorporation of windthrow concerns into the structure retention strategy, considering distribution and placement to promote wind firmness; and

- Designing harvest areas to reduce potential windthrow by considering topography, soil types and tree species selection.

Significant natural windthrow events will be reported in the Stewardship Report.

6.4 Noxious, Prohibited Weeds and Invasive Plants

Invasive plant species are known to cause negative environmental impacts as they adapt, grow, and reproduce quickly. If invasive species are not controlled from spreading, they can cause serious damage to ecosystems by pushing out native, rare, or endangered plants, competing with them for resources, making it harder to restore disturbed areas, slowing down forest growth, and degrading valuable wildlife habitat and range.

The law requires that these weed species be controlled or eliminated in forested areas under Section 63 of the Public Lands Act, Section 31 of the *Weed Control Act*, and Directive 2001-06: Weed Management in Forestry Operations.

The C5 FMU area is known for having some of the most severe invasive plant infestations in the province, due in part to the constant risk of new species entering from British Columbia and Montana. In 2012, the discovery of invasive yellow hawkweed in the Lost Creek area demonstrated the seriousness of the invasive plant problem in this part of the province.

All land-use dispositions that are held by CFP are subject to noxious weed legislation. The OGRs have a series of procedures to minimize the impact and spread of noxious and prohibited noxious weeds.

CFP has established an Invasive Plants Program (Appendix VII). The objectives of CFP's Invasive Plant Program are as follows:

- Eliminate prohibited noxious weeds and control the spread of invasive plants on CPF dispositions (including cut blocks).
- Ensure staff and contractors are actively participating in the CFP Invasive Plant Program.
- Participate and support MD co-operative invasive plant control initiatives such as the M.D. of Ranchland No. 66 Integrated Weed Management Plan. Other MD's include Willow Creek, Foothills and Crowsnest Pass.

7 Protection of Forest Resources

7.1 Forest Soils

Soil conditions influence nutrient and water storage and capacity, directly impacting the productivity of forests. Therefore, maintenance of forest soil quality is crucial.

Forestry staff and contractors annually attend OGR training. The operational soil conservation training module includes:

- Soil characteristics and identification;
- Importance of soil fertility and conservation;
- Identification of sensitive so
- Road maintenance and erosion control practices;
- Techniques to minimize soil compaction and rutting; and
- Stop work procedures.

Woodlands staff are trained to practice soil conservation practices including:

- Designation of harvest season;
- Identification of sensitive sites and development of protection plans;
- Site inspections;
- Initiation of stop work procedures as necessary
- Soil disturbance mitigation plans; and
- Development of action plans to remediate unsatisfactory soil disturbance levels.

High severity wildfire presents a significant threat to forest soils. Severe wildfire events are known to burn up the organic matter soil surface and organic soil horizon. Both soil horizons are important for soil moisture holding capacity and nutrient exchange required for healthy plant growth. After a high severity wildfire, soils often become hydrophobic, increasing erosion and releasing dissolved carbon into the watershed. It can take many decades for soils to recover from high severity wildfire (Flannigan M., 2007). The PFMS is expected to help reduce fire behaviour potential across the DFA (see Section 6.1).

7.1.1 Soil Compaction

CFP conducts its forest harvesting and site preparation operations during frozen or dry ground conditions. Avoidance of wet conditions reduces the risk of compaction and rutting from equipment. In-block roads and landings are subjected to repeated machine traffic and are more likely to be compacted compared to other areas of the harvest block. In cases where compaction occurs, the affected areas will be treated to enable reforestation.

7.1.2 Erosion and Slumping

There are several potential strategies for reducing the risk of soil erosion and slumping:

- Conducting forestry operations during frozen or dry ground conditions;

- Limiting road or skid trail construction on steep slopes;
- Avoidance of unbalanced over steepened fills;
- Maintaining effective erosion and sediment controls;
- Scarification practices that minimize soil disturbance;
- Retention of natural levels of coarse woody debris;
- Rapidly regenerating harvested areas; and
- Use of temporary roads and effective road reclamation procedures.

7.2 Watershed Management

Forest hydrology research has demonstrated a direct correlation of hydrologic recovery with leaf area index (LAI). LAI in turn depends on above ground primary productivity (Brabender, 2005), which is influenced largely by water and nutrient availability. Reduction in LAI is therefore used as a surrogate for hydrologic disturbance and recovery. CFP carried out hydrologic disturbance evaluation using the Equivalent Clearcut Area (ECA) method (Silins, 2003; Winkler & Boon, 2017). This approach is based on the timing of a tree's maximum periodic annual increment (PAI) (Silins, 2003; Brabender, 2005).

The literature has shown that maximum growth coincides with maximum LAI at a particular time in a tree's lifecycle (Watertight Solutions, 2009). Other factors including tree species and site variability create multiple growth curves that create net primary production variability across the landscape. Equivalent Clearcut Area (ECA) is used as an index of disturbance for the watershed. The process of hydrologic recovery occurs annually. This process initiates after reforestation. As an example, if 1 hectare of land was reforested 15 years ago, the hectare of land is functioning at approximately 50% of the full hydrologic level, assuming maximum LAI is achieved at 30 years. There are different growth curves that result in varying ECA ages potentially applied across the DFA (Watertight Solutions, 2009).

ECA analysis used in Alberta is precautionary. Although projections have been made 200 years into the future, this modelling work is repeated with updated data every 10 years. Approximately 83% of the forest management area is located outside of snow sensitive zones, and snow sensitive zones within forest management area have a 1.5 times multiplier (that is increase by 50%) is applied to reflect increased hydrological sensitivity (Anderson, 2019). Significant efforts have been made to adjust the SHS in the 20-year PFMS in order to minimize impacts to watersheds. Harvest impacts were tested on different watersheds and harvest patterns and timing were adjusted as required. Additional details on how ECA analysis was conducted are available in *Chapter 6 – Preferred Forest Management Scenario* Section 4.1.1 and results of the analysis are available in *Chapter 5 – Values, Objectives, Indicators, and Targets* Section 4.2.

In addition, an analysis of Alberta Hydrologic Unit Code 10 (HUC10) watersheds was conducted and the PFMS was designed in such a way as to also minimize impacts to watersheds by this definition. We are confident that the CFP approach to watershed management results in responsible and conservative harvest thresholds. There are two general approaches used within the DFA to protect watershed processes:

Strategic Mitigation:

- Iterative development of the SHS to ensure low to moderate risk ECA model outputs, with particular focus on the first 20 years; and
- GoA and AVI identified watercourse buffers have been excluded from the active landbase including large and small permanent watercourses and lakes.

Operational Mitigation:

- Ensuring that watercourse crossings adhere to OGRs and Code of Practice;
- Use of watercourse, waterbody and water source vegetation buffers as classified in the OGRs; and
- Rigorous erosion control measures:
- Avoidance or timing restrictions of sensitive and wet soil areas, to minimize site disturbance associated with road construction and skidding (using tools such as wet areas mapping);
- Suitable timing and location of proposed operations; and
    - Timely reclamation of temporary roads.

Site-Specific Mitigation to Reduce Moderate 10-year ECA Risk:

- To the fullest extent possible, avoidance of permanent roads and permanent watercourse crossings; and
- Assessments by qualified professionals to identify and address risks and/or enhanced monitoring for newly constructed, permanent road watercourse crossings.

Forest soils are capable of reducing run-off on a local scale, through enhanced infiltration and storage capacities. However, forests generally have only a limited influence on major downstream flooding, such as the large-scale 2013 floods in Southern Alberta (City of Calgary, 2014). During a major rainfall event (like those that result in massive flooding), especially after prolonged periods of preceding rainfall, the forest soil becomes saturated and water no longer filters into the soil but instead runs off along the soil surface (FAO & CIFOR, 2005).

7.3 Historical Resources and Unique Features

CFP works to identify and protect unique resources within our planning areas. Historic features, sites with archaeological potential, rare plants or plant communities, and other unusual natural attributes are considered during planning and operations.

Alberta Arts, Culture and Status of Women maintains a provincial database that records sites that contain or have a high potential to contain historic resources. These include archaeological sites, paleontological sites, Aboriginal traditional use sites of a historic resource nature (burials, ceremonial sites, etc.), and/or historic structures. For further details on classifications and known locations in the CFP DFA, see *Chapter 3 – Landscape Assessment* Section 6.7.

In recognizing the valuable and non-renewable nature of historic resources, Section 37 of the *Historical Resources Act* provides the framework for Historic Resource Impact Assessments (HRIA) and mitigation studies. As historic resources are often not visible, the potential for forestry activities to impact these resources may not be apparent.

Within the HRIA framework, CFP submits its proposed harvest and road building data for review by subject-area experts prior to commencement of operations. If any potentially impacted historical resource sites are identified, the sites are documented, submitted for HRIA approval, field reviewed, and protected or avoided as necessary.

Should any historic resources be encountered during harvest and/or road development activities, the activity will stop immediately, and Alberta Arts, Culture and Status of Women will be contacted.

7.4 Wetlands

In 2013, the Government of Alberta released *Alberta's Wetland Policy* to provide strategic direction and the tools to make informed management decisions regarding wetlands. Initially the Policy was applicable only to the White Area of the province but was expanded to the Green Area in spring of 2016.

The Alberta Wetland Mitigation Directive is applicable to operations that result in permanent loss of wetland area. Permanent loss of wetlands due to forestry operations are subject to the replacement requirements as described in the directive. The most common example of this is through a permanent road (DLO) development.

Most forestry operations are temporary in nature where reclamation and reforestation is required through regulation. Avoidance of wetlands and mitigation of impacts are core considerations in forest planning and operations. OGRs and applicable directives provide the standards to protect wetlands.

7.5 Climate Change

During a fire event, greenhouse gases such as carbon dioxide, and to a lesser extent methane, long-chain hydrocarbons, nitrogen compounds and carbon particulate matter are emitted. Similarly to carbon, forest soils sequester and store mercury. During large fire years, volatilized mercury released into the atmosphere approached industrial mercury emissions equal to those across all of North America. The bulk of the fire-related mercury emissions are likely transported to the polar regions, presenting long-term consequences to the health of northern food chains (Flannigan M., 2007).

According to Natural Resources Canada, in recent years Canada's forests have become carbon sources rather than sinks as they typically release more carbon into the atmosphere than they are accumulating in any given year. Key reasons for this are increased wildfire activity and unprecedented insect outbreaks.

The Intergovernmental Panel on Climate Change (IPCC) recognizes sustainable development as the overarching context for climate change policy. The IPCC has identified sustainable forestry management as a cost-effective climate change mitigation and adaptation strategy to conserve existing carbon pools by reducing deforestation, forest degradation, and preventing wildfire.

In 2014, the IPCC recommended policy support in favor of sustainable forestry and forest certification programs. Existing forests can only provide reliable greenhouse gas (carbon) mitigation if there's a forest management policy that supports an aggressive fire prevention program and a perpetual removal of carbon (wood). In turn, the forests are renewed, promoting sustainable carbon capture, building watershed resiliency and enhancing biodiversity (IPCC).

Adaptation Management Strategies

- Managing wildfire risk to communities was of the highest priority in the development of the 2025 FMP. Strategies outlined in the FMP to reduce risk include harvesting old coniferous stands and replacing them with young resilient forests, integration of AAF FireSmart initiatives, and adherence to prevention and salvage measures.

- Every 10 years forest inventories and non-declining allowable annual harvest levels are modelled for 200 years using government approved yield curves and growth models. The most accurate changes in growth are directly tied to current climate conditions and directly measured in the field at year 14. The error associated with projecting modelled tree growth based on the Alberta Climate Change Model would greatly exceed any potential value in the estimates.
- Currently the Provence of Alberta, along with subject matter experts and the Alberta Forest Genetics Resource Council are working on a climate-based seed transfer program to anticipate and guide the selection and movement of tree seed sources for reforestation based on current and projected future climate conditions, rather than just geographic or administrative seed zones.
- The Sustainable Forestry Initiative (SFI) introduced a new section on Climate Smart Forestry in its 2022 SFI Forest Management Standard. This addition reflects the growing recognition of forestry's role in both mitigating and adapting to climate change. West Fraser Cochrane is currently certified under SFI and seeking to build the resilience of the forests that we manage relative to the challenges and uncertainties presented by climate change
- WF Cochrane is developing of a white spruce and lodgepole pine tree breeding program that selects trees for drought adaptation, growth and vigor with respect to a changing climate. The program will include research, testing, evaluation and deployment of improved planting stock.
- Establish or encourage new mixes of native species. SLS is introducing spruce seedlings into stands previously dominated by lodgepole pine.

At present, Alberta Agriculture and Forestry does not have a climate change directive for forest management planning available. CFP will ensure that its operations stay up to date with provincial policies, recommendations and directives in regard to climate change.

8 Biodiversity

CFP has the following biological diversity goals:

- Renew forests to promote broad species diversity in balance with social and economic needs and;
- Continue building knowledge of ecological relationships through research.

In 1995, the Canadian Council of Forest Ministers recognized three distinct yet interrelated components of biodiversity:

- **Ecosystem diversity** deals with species distribution and community patterns. Ecosystems are, to some extent, dictated by regional landforms and climate and their interactions. Diverse landforms occur across the DFA, setting the stage for a wide range of vegetation and related wildlife communities. This is the least understood component of biodiversity, due to the complexity of interactions within the natural environment.
- **Species diversity** refers to the range of plant and wildlife species present within an area. Maintaining species diversity is important, as species can be considered to have a particular "role" in the ecosystem, so the addition or loss of single species may have consequences for the system as a whole.
- **Genetic diversity** addresses the inherent variability within the genes of an individual species. Genetic diversity reflects the evolutionary history of a species and its historic and current distribution. Species can demonstrate significant genetic variability. More genetic diversity in a species or population means a greater ability for some of the individuals in it to adapt to changes in the environment. Less diversity leads to uniformity, which can adversely affect their ability to adapt to changing conditions.

8.1 Ecosystem Diversity

Over the last 20 years, CFP has expanded its knowledge of ecological relationships through supporting research on the FMA.

The FMA's forest ecology is dominated by wildfire disturbance. Before fire suppression programs were established, fires shaped our forest, wetland, and grassland landscapes. This time in ecological history is referred to as the pre-industrial period. Pre-industrial landscapes were generally comprised of younger vegetation and significantly more area was occupied by early seral species including aspen, mixedwood, and lodgepole pine forests. Without a disturbance agent on the landscape, forests tend to move toward older age classes and more shade tolerant species such as spruce. This leads to increased fuel loading across the landscape, which creates additional wildfire risk.

Deciduous, mixedwood, and riparian forests are known to be the most biologically diverse forests on the DFA. In the absence of wildfire, or some other form of vegetation management, our most ecologically important and productive forest lands are at risk to high severity wildfire.

Carbon dioxide emissions, public health concerns, public safety concerns and lack of funding largely disqualify prescribed fire as a viable approach to managing a healthy landscape in the CFP DFA. However, careful forest management promotes forest renewal, ecosystem diversity, and enhances ecological functioning at all scales.

Due to the lack of natural and/or anthropogenic disturbance, the ecosystems are losing both resiliency (becoming more susceptible to stand replacing fire events) and the ability to provide a range of socioeconomic and ecological benefits such as habitat for Species at Risk (SAR) or forage for wildlife or cattle.

The encroachment issues within these ecosystems are quite complex and influenced by a wide range of factors, including but not limited to fire regime, extent of grazing or other land use activities, invasive species, and climate change. Multiple management initiatives specific to this plan could help with forest encroachment and a forest encroachment VOIT has been developed. Details and targets are available in Chapter 5, Section 3.4.5 (VOIT 29-3). The Forest Encroachment Strategy can be found in Appendix VI.

8.1.1 Landscape Biodiversity

A considerable portion of the greater area of Crown land surrounding the DFA falls within protected areas. A spatial analysis of the area available for harvest and areas protected from harvest was conducted. This analysis helps to add context to the amount of the forest within the forest management agreement related to the amount designated with some form of formal protection and a corresponding conservation mandate.

The figure below presents the Crowsnest Forest Products' FMA area and surrounding protected areas in the region. The analysis boundary encompasses the DFA and adjacent protected areas. Overall, 48% of this analysis area is protected. If the analysis boundary is expanded north to include the B12 FMA and the adjacent protected areas including Banff, the balance increases to 29% unprotected and 71% protected area.

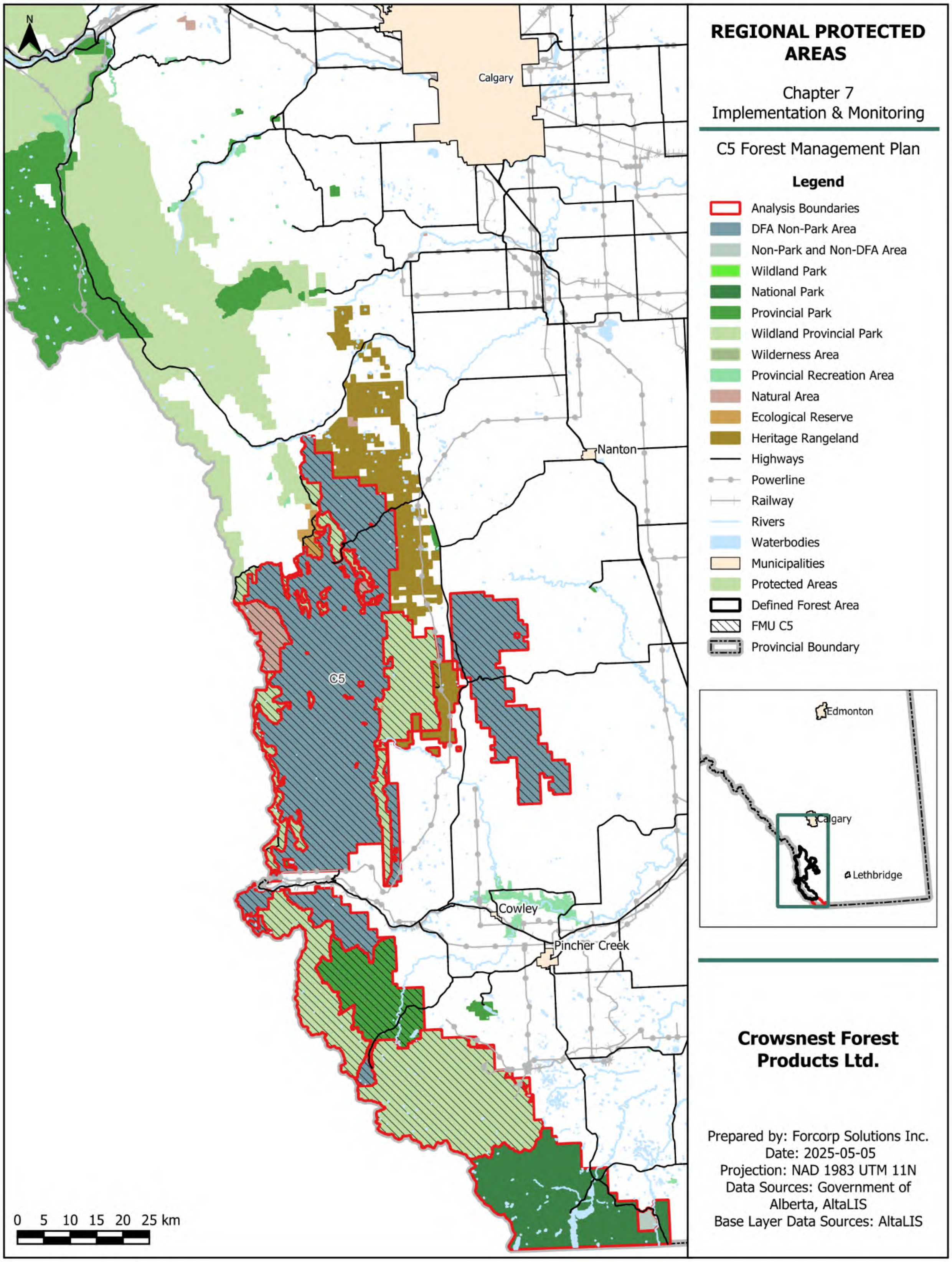

Figure 8-1. Protected areas adjacent to the DFA.

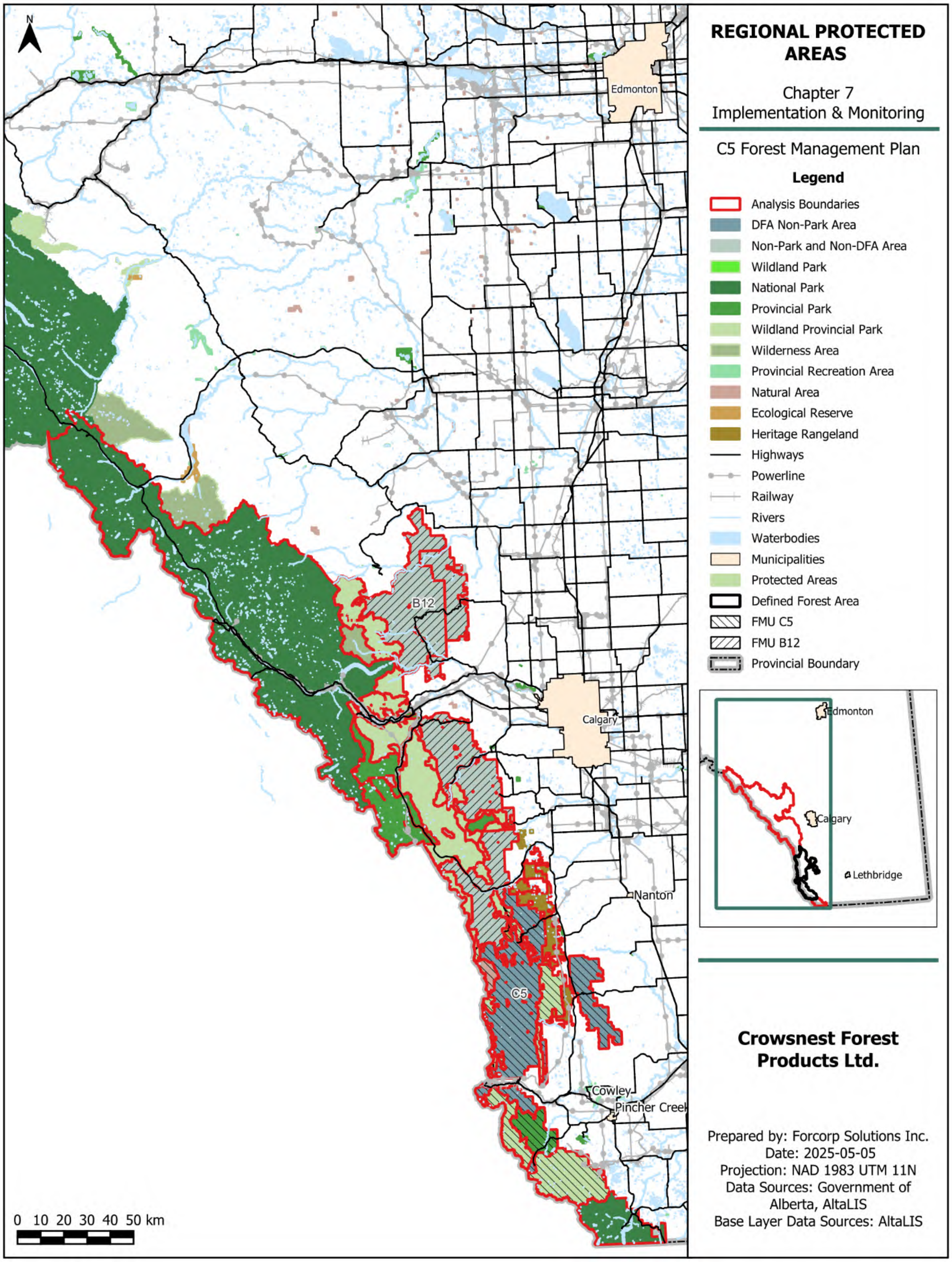

Figure 8-2. Protected areas in the wider area surrounding the DFA.

8.1.2 Seral Stage Representation

The PFMS modeling process, described in *Chapter 6 – Preferred Forest Management Strategy*, addresses the distribution of representative seral stages over the 200-year planning horizon. Seral stage targets were included in PFMS development and reported on in *Chapter 5 – Values, Objectives, Indicators and Targets*. Figure 4-10 displays the proportion of old and very old forest on the gross landbase, excluding subjective deletions. This is the area of forest that would be representative of the contributing landbase.

8.1.3 Old Interior Forest

Maintenance of old interior forest over the 200-year planning horizon was addressed through the PFMS. An old interior forest target was included in PFMS development and reported on in *Chapter 5 – Values, Objectives, Indicators and Targets*.

In addition, to better understand the DFA's historical forest ecology process, a pre-industrial condition evaluation was complete in 2025 to understand in what way the current condition of the FMU area aligns with the historical, pre-industrial "natural" range (Andison D., 2025), also available in *Annex VI – Timber Supply Analysis* Appendix I . The evaluation presents a view into the past of what the DFA likely looked like prior to modern forest management practices (i.e., approximately 70 years of fire suppression).

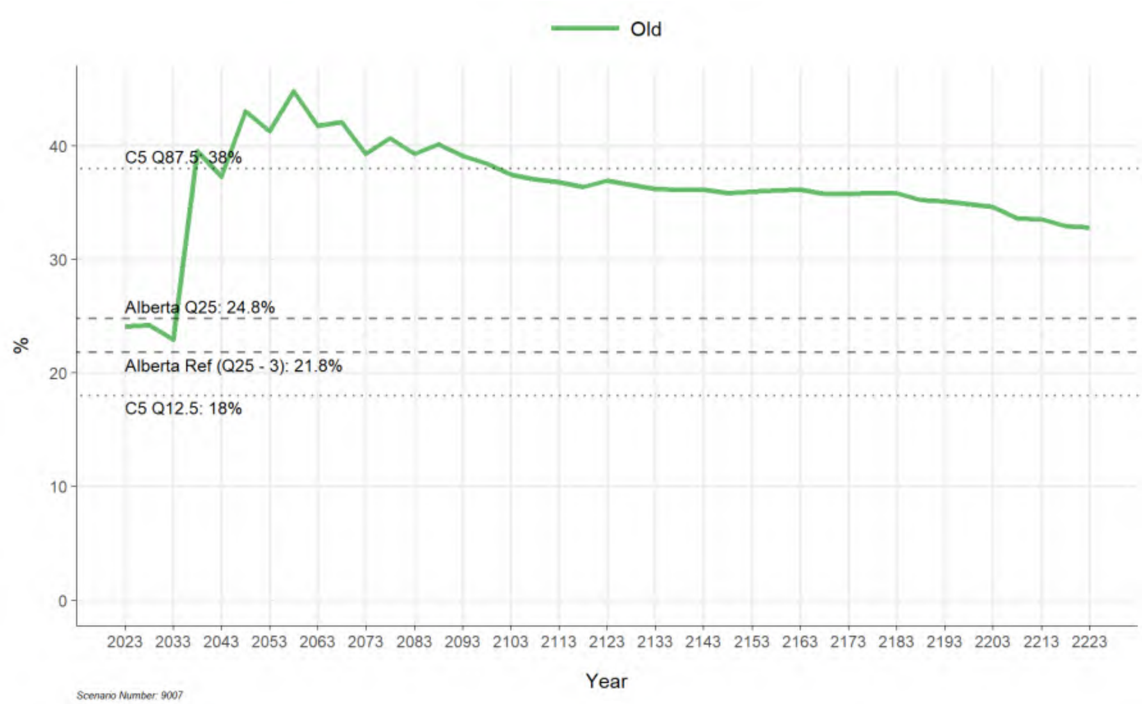

Figure 8-3. Seral stage amounts on the gross landbase, when non-representative stands (subjective deletions) are excluded.

8.1.4 Stand Level Biodiversity

fRI Research Natural Disturbance Program Quicknote #23 (Nov 2003) concluded that after a forest burned approximately 1% of the burned area remained green. The 1% stand level retention is further enhanced by connectivity with edge islands and old seral landscapes that join parks and protected areas.

Quicknote #23 concluded that approximately 66% of the landscape burned and that 34% of the forested landscape contained matrix, edge, island, and interior detached remnants. The company can demonstrate that past and current forest management practices are emulating that general landscape disturbance pattern proportion of 66% and 34% respectively and will continue to do so into the future.

All of CFP's harvest areas connect to undisturbed forested landscapes comprised of both the passive and active landbase. The passive and active landbases connect with millions of hectares of undisturbed forest comprised of both provincial and federal parks.

Definitions:

- Retention – Standing trees left after harvest (live and dead).
- Single Stem Retention – Individual trees left standing in a harvest area.
- Interior Patches, Clumps, Islands – Un-harvested groups of trees detached from the harvest boundary.
- Edge Islands and Peninsular Islands – Un-harvested groups of trees protruding into the harvest area and attached to the harvest boundary.
- Matrix Remnants – Un-disturbed individuals and groups of trees both detached and unattached from the disturbance event.

Stand-level biodiversity considerations for harvest openings:

- Harvest boundaries follow natural vegetation patterns, containing significant edge island remnant;
- There is connectivity with the harvest opening structure retention via the edge island remnants, the forested active landbase, the matrix retention (the passive landbase) and the geographically dominant protected areas network;
- The DFA is immediately connected to a significant protected areas biodiversity network including but not limited to: Don Getty Wildland Provincial Park, Bob Creek Wildland Provincial Park, Castle Wildland Provincial Park, Castle Provincial Park, Plateau Mountain Ecological Reserve, Mt. Livingstone Natural Area, Beehive Natural Area, Black Creek Heritage Rangeland, Pekisko Heritage Rangeland, and multiple Provincial Recreation Areas located within the DFA boundary.
- Natural Disturbance Program Quicknote #23 (Nov 2003) research indicates for blocks less than 100 hectares, retention of individual trees and detached island remnants of approximately 1% of the area/volume is sufficient. For the 2025 FMP, CFP will be retaining at least 3% representative of the pre harvest stand.
- The structure retention strategy establishes distinct retention targets for the Douglas fir forests (Fd forests) and Lodgepole pine/other non-Douglas fir forests (non-Fd forests).

The following list of important stand level biodiversity structure is generally ranked in order of greatest importance to biological diversity values in consideration of regulatory and biological diversity characteristics. Retention will include as available within the harvest opening, trees representative of the pre-harvest stand including:

- Cultural site buffers;
- Mature and immature whitebark pine;
- Mature and immature limber pine;
- Watercourse buffers;

- Sensitive site buffers (e.g., bird nests, dens, hibernacula, mineral licks);
- Springs and ground water seepage/source area buffers;
- Wildlife trees such as green culls (rotten, broken tops, forked tops, dry sides, severe sweep and crook);
- Sufficiently large patches of standing dead trees (e.g., grey attack snags) are retained during salvage, where possible;
- Snags – In the absence of natural or safe snags, as safety permits, top 2 to 6 green culls or dead trees per hectare, preferably 30 cm or greater DBH to 3-5 m tall;
- Wolf trees, with heavy branching or poor form (snag replacement);
- Deciduous patches and forested stands;
- Mature and immature balsam poplar (dispersed);
- Mature and immature aspen (dispersed);
- Mature and immature white birch (dispersed);
- Douglas-fir remnants, patches and stands (snag replacement);
- Mature and immature Douglas-fir trees (dispersed, snag replacement);
- Mature and immature sub-alpine larch;
- Treed rocky outcrops;
- Advanced regeneration and sub-merchantable coniferous trees;
- Shrubs (willow, dogwood, alder, buffalo berry, rose, Labrador tea etc.); and
- 100% of the pre-harvest levels of coarse woody debris, including stumps well distributed across the harvest opening are retained.

A structure retention strategy that outlines structure retention accounting and reporting procedures is available in *Appendix I – Structure Retention Strategy*.

8.1.5 Uncommon Plant Communities

Identified sites will be handled through the harvest planning process. The Alberta Conservation Information Management System (ACIMS) plant community classification and tracking list data will be assessed to identify uncommon plant communities within the DFA. ACIMS data will be updated at the time of harvest planning.

Strategic Mitigation:

- Map and list known locations of uncommon plant communities.

Operational Mitigation:

- Reference ACIMS and other available rare ecosite data during operational design and layout;
- At the review stage, the local Forestry Division can alert CFP to any local knowledge for rare or uncommon plants;
- Note species in preharvest assessment (PHA) should they be identified; and
- Contractors are trained on rare/uncommon plants.

Where uncommon plant communities are field verified, they will be maintained. The Stewardship Report will summarize action taken based on direction received from ACIMS, in areas where uncommon plant communities have been identified (VOIT #6).

8.1.6 Disturbance Patterns

The PFMS contains specific targets for the creation of a range of disturbance patches, and the outcomes are reflected in the SHS. Implementation of the SHS will create a distribution of disturbance patches that meets management objectives and targets (see *Chapter 5 – Values, Objectives, Indicators and Targets,* Section 4.1.2.)

8.1.7 Downed Woody Debris

Current levels of forest snags and coarse woody debris are generally at much higher levels as compared to pre-industrial forest conditions. CFP acknowledges the importance of these structural attributes at both the landscape and at the stand level. Coarse woody debris and snags are particularly important for marten and fisher, cavity nesting birds, biodiversity, soil conservation and for reforestation success.

8.2 Species Diversity

Both coarse and fine filter management approaches will be relied upon to promote species diversity. Species specific management strategies address provincially identified at risk, threatened or species of concern relevant to forest management, as identified below.

8.2.1 Grizzly Bear Habitat Management Strategy

The grizzly bear (*Ursus arctos horribilis*) was officially classified as *Threatened* in Alberta in 2010. The main sources of mortality for grizzly bears are poaching, accidental collisions with highway vehicles or trains, self-defence kills, and mistaken identity kills from black bear hunters (Government of Alberta, 2016b).

The CFP DFA and surrounding region offers primary habitat for grizzly bears (Herrero, 2005; AESRD & ACA, 2010) and the DFA lies within two grizzly bear population units; the Waterton and the Livingstone. Further details are available in *Chapter 5 – Values, Objectives, Indicators and Targets,* Section 4.1.12.1.

The effects of timber harvest on grizzly bears involves a trade-off between habitat quality and mortality risk. Generally, there are positive effects on forage availability and use in early-seral cutblocks, yet potentially negative effects relating to increased human-caused mortality. Resource Selection Functions (RSFs) show that radio-collared grizzly bears select clearcuts (mainly edges) and areas adjacent to roads (Nielsen, Boyce, & Stenhouse, 2004; Roever, Boyce, & Stenhouse, 2008), primarily due to increased food resources.

Grizzly bears are often used as a coarse-filter focal or umbrella species for biodiversity conservation (Carroll, Noss, & Paquet, 2001; Hannon & McCallum, 2004). Carnivores with large area requirements are suggested to be umbrella species using the assumption that the area of habitat required to support viable populations will protect sufficient habitat for other species with lesser area requirements (Noss, Quigley, Hornocker, Merrill, & Paquet, 1996). For example, Carroll, Noss & Paquet (2001) reported that the habitat requirements of grizzly bears overlap significantly with those of wolverines. Hence, regional management approaches intended to protect grizzly bear populations should have positive benefits for wolverines.

Grizzly bear habitat state was assessed using tools provided by fRI Research (fRI Research Grizzly Bear Program, 2019). Habitat state results were mixed. Based on the direction and magnitude of percent changes in primary, secondary habitats and sinks, the risk to grizzly bears is considered low. Detailed results are provided in *Chapter 5 – Values, Objectives, Indicators and Targets* Section 4.1.12.1. Road density on the DFA was also assessed and is below target thresholds in both population units. Additionally, it has been noted by the fRI

Grizzly Bear Program lead that in Alberta there is no evidence of grizzly bears being limited by habitat supply, but rather by human caused mortality, so focusing on motorized access control is the best mitigation action to pursue when new areas are planned (*Gordon Stenhouse, personal communication, June 03 2020*).

To minimize impacts on grizzly bears, CFP has identified the following mitigation measures:

Strategic Mitigation:

- Implement recovery plan recommendations through implementation OGRs, including targeting open road densities at or below 0.6 km/km^2 in core habitat and 1.2 km/km^2 in secondary habitat.
- Clustering and minimizing footprint from the PFMS (harvest and access); and
- Incorporate existing plans, zones, other resource values (e.g., fish, wildlife, recreation and other commercial interests) and consultation with government authorities regarding access.

Operational Mitigation:

- Pursuit of joint Road Use Agreements with energy sector companies and other forest users to reduce the overall access footprint;
- Reduction of sightlines in blocks parallel to permanently open roads by use of vegetated buffers;
- Avoidance of loop roads;
- Reclamation of unused access including barriers to deter motorized access; and
- Targeting structure retention in areas of concentrated grizzly bear rub trees.

8.2.2 Bighorn Sheep and Mountain Goat Strategy

There are several populations of bighorn sheep and mountain goats that have been identified within or adjacent to the CFP FMA area. Mountain goat populations have declined in this area since monitoring began almost 50 years ago. Maintaining viable populations in these areas is an immediate conservation challenge. While populations of bighorn sheep have been relatively stable in the overlapping ranges, the ease of access to bighorn sheep range by off highway vehicles has potential for impacts. It has been noted that removal of treed vegetation in some areas of sheep and goat could aid with sheep habitat enhancement, however the requirements to regenerate a stand to a specific standard can reduce this long-term benefit. Crowsnest Forest Products is committed to following the Mountain Goat and Bighorn Sheep assessment completed by Fish and Wildlife Stewardship Branch. The assessment detailed stratifying the Mountain Goat and Sheep Areas landscape into high, moderate and low risk categories (Figure 8-4).

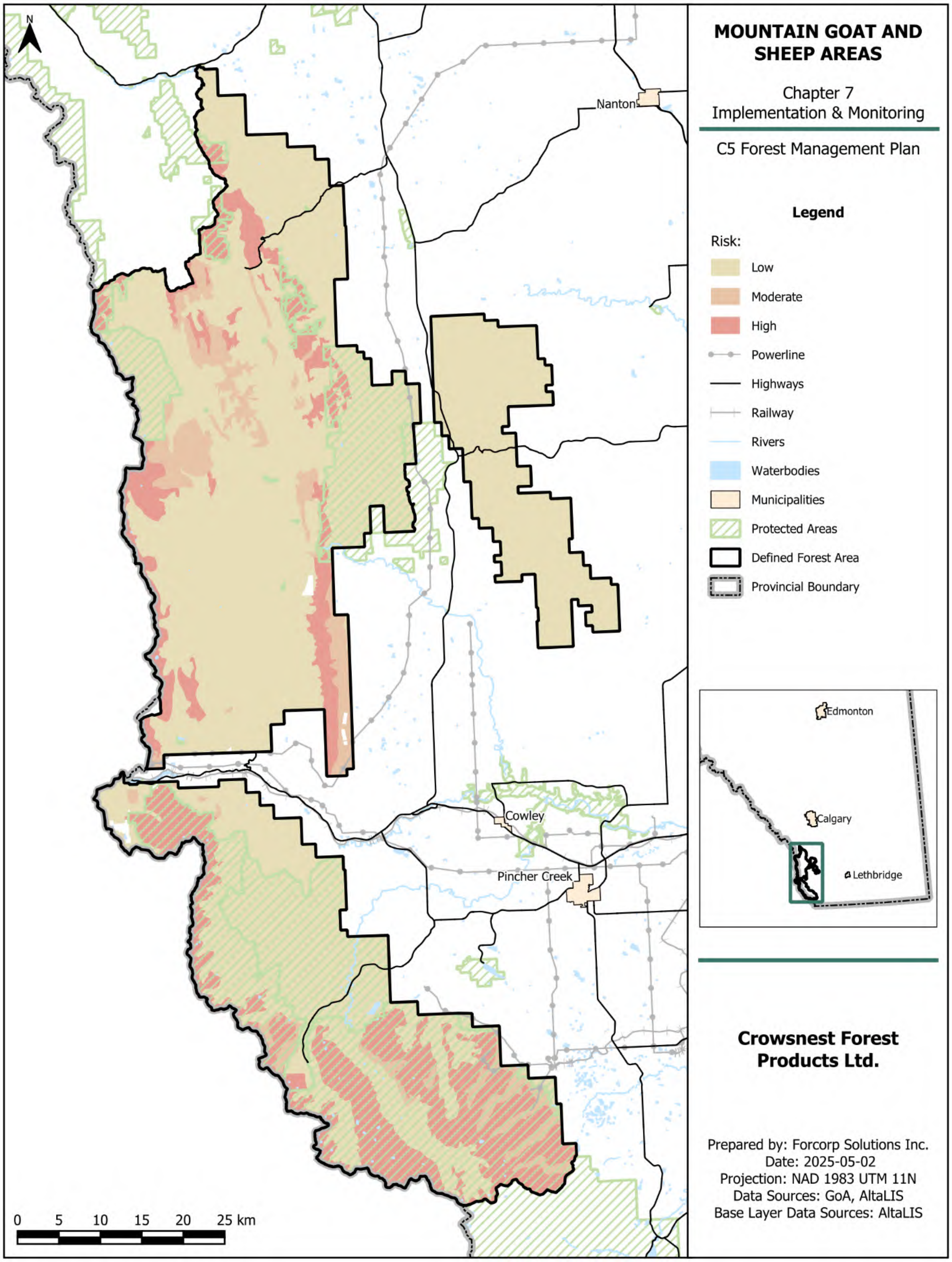

Figure 8-4. Mountain goat and sheep areas by risk category.

Strategic Mitigation:

- High Risk Areas are defined as Mountain Goat and Sheep Zone areas overlapping Category 1 Lands ("Prime Protection Zone") defined in the existing Integrated Resource Plans (IRPs). High Risk Areas have been removed from the contributing landbase and do not have any forest harvesting scheduled.

Operational Mitigations

- Moderate Risk Areas are defined as the remaining portions of Category 2 Lands ("Critical Wildlife Zone") with the IRPs that adjoin and overlap the Mountain Goat and Sheep Range. The following strategies are applicable to the Moderate Risk Areas.
    - No new disposition roads shall be constructed within this Moderate Risk zone.
    - Harvest areas that extend more than 1000m from an existing road[1] need to use the following mitigation strategies:
        - All roads shall be blocked to public access, and limited to forestry use only. Effective forms of public access control for vehicles shall be maintained.
        - All roads shall be reclaimed as soon as timber operations are complete or within three years of construction as measured from the start of the timber year following the timber year in which the Annual Operating Plan was approved.
    - Road location and mitigation strategies should be discussed with the local wildlife biologist at the General Development Plan stage.
    - Conduct harvesting operations in early winter between Nov 1st and Feb 15th.
- Harvesting operations that cannot be conducted between Nov 1st and Feb 15th will need to apply the following mitigation strategies. These mitigation strategies are based upon existing Operating Ground Rules and Mountain Goat and Bighorn Sheep Range guidelines.
    - No activities are permitted within sheep and goat habitat where herds are active. Conduct daily activities outside of a 400m buffer from any observed sheep or goats (individual animals or groups of animals). A general walkthrough prior to commencement of activities to determine presence of sheep or goats, is recommended.
    - No temporary camps, or other facilities are permitted.
    - Mineral licks are important features for sheep and goats. Per the Alberta Timber Harvest Planning and Operating Ground Rules (OGRs) Section 2.8.8, a 100m buffer is required.
    - As use of mineral licks is higher after February, if identified mineral licks are present within the proposed harvest block then no harvest operations are permitted.
    - Access and harvest roads that are built sooner than one year prior to harvesting operations will be deactivated until operations commence.
- Low Risk Areas are defined as areas outside Mountain Goat and Sheep Range, along with other lands identified in the IRPs as "Multiple Use" and "Industrial," where logging is a compatible use.
    - Habitat conservation measures for sheep and goat in Low Risk Areas is not required.

[1] Existing roads include all roads described under the Public Lands Act (e.g., DLOs, LOCs), all public roads (secondary highways, FRDs) and all designated/Provincial ATV or 4x4 trails.

- Operational measures to minimize disturbance should be considered in Low Risk Areas where sheep and goats are present.
- Additionally, refer to OGRs Section 1.4 concerning the use of domestic sheep and goats and minimizing impacts to wild sheep and goats.

8.2.3 Barred Owl Habitat Strategy

The barred owl (*Strix varia*) has been listed as a *Species of Special Concern* in Alberta (Alberta Environment and Parks, 2016). Barred owl nesting pair habitat is one of four fine filter old growth species habitats modelled for development of the 2025 FMP. Barred owls are numerous across North America and considered a low concern in terms of conservation risk with a rating of 7 (low concern) out of 20 on the 2016 State of North America's Birds Report (North American Bird Conservation Initiative, Accessed May 2020). The North American Breeding Bird Survey estimates their populations increased by 3% per year between 2005 and 2015 (USGS, Accessed May 2020).

Until the twentieth century, barred owls were residents of old, undisturbed forests in eastern North America and were likely restricted from moving into northwestern boreal forests because of frequent forest fires. A combination of successful boreal forest fire suppression and Great Plains tree planting programs allowed for northward and westward habitat expansion. This allowed the species to expand across the west coast, where they compete and hybridize with Spotted Owl (*Strix occidentalis*) populations (The Cornell Lab, Accessed March 2024).

Predicted habitat value and the potential number of breeding pairs over the 200-year timeframe were assessed using GoA models. Methodology and detailed results are available in *Chapter 5 – Values, Objectives, Indicators and Targets,* Section 4.1.12.2.

There is little deciduous harvest (incidental only) on the DFA and most barred owl habitat occurs on the eastern edge of the DFA. Over the 20-year timeframe, an increase in mean habitat value and number of potential breeding pairs is forecasted.

Although modeling suggests that barred owls will not be unduly impacted by the PFMS over the 200-year timeframe, CFP will still enact certain mitigation strategies to minimize any potential impacts.

Strategic Mitigation:

- Reduce wildfire risk on the DFA over 20 years (see Section 6.1); and
- Explore mixedwood silvicultural treatments to promote old forest development characteristics at younger age classes.

Operational Mitigation:

- Avoid the harvest of aspen and poplar trees;
- From March 14 to July 15 avoid harvest operations within 500m of known nesting sites;
- If a known nest site is within a harvest opening, then retain a 100m buffer, as practicable; and
- Adhere to the structure retention strategy.

8.2.4 American Marten Habitat Management Strategy

The American marten (*Martes americana*), a small mesocarnivore in the weasel family, is native to the boreal forests of North America. In Alberta, martens are typically associated with mature or old-growth conifer-dominated forests. Their habitat preferences are driven by both protection from predation and presence of prey. Key habitat features are those that provide security to martens and their prey, including high canopy cover, abundant coarse woody debris (CWD), and wildlife trees. Sometimes referred to as Canadian sable (Natural Resources Canada, Accessed May 2020), martens have traditionally been prized by trappers for their high value fur and are often used as an indicator of forest ecosystem integrity.

American marten are a focal species known to prefer mature coniferous forest habitat and are one of the four fine-filter old growth species habitats modelled for development of the 2025 FMP. Martens have both terrestrial and aerial predators; therefore, habitat that provides security from predation is a strong driver of habitat selection. A primary factor in habitat suitability is forest stands with high canopy closure that offer cover from predators. When canopy closure is limited, continuity of cover via shrub cover and CWD plays an important role in security. Variety in the structure of available debris, whether large single tree deadfall or piles of variably sized debris, is needed to meet habitat requirements and allow martens to safely forage, den, and rest. Martens will most often select denning sites in hollowed deadfall, root balls, or piled woody materials. Standing wildlife trees with cavities and hollows also offer secure locations to rest and den and will contribute to CWD recruitment over time. Occasionally, martens will choose other features such as squirrel middens or rock features for safe denning locations. Variation in the overall habitat structure and complexity increases opportunities for martens to avoid predators.

A large field study was initiated in 2000 by the Canadian Forest Service, the Ontario Ministry of Natural Resources, and the University of Guelph to investigate marten populations in managed and unmanaged forests. Marten responded positively, but in low numbers, in managed areas that had been replanted with conifer trees about 50 years previously, suggesting that basic silviculture can eventually provide habitat favorable to marten. Marten populations also showed a higher susceptibility to commercial trapping in managed forests, likely due in part to the higher density of road networks that provide increased access to trappers. They conclude that populations can also persist at lower levels in mature regenerating forests, but only if trapping is controlled. The authors also suggest that a range of forest ages distributed across the landscape with varying sizes of uncut areas is likely the best method to ensure viable marten populations (Natural Resources Canada, Accessed May 2020).

Cover is equally important for the small mammals that marten prey upon, as these animals rely on similar structures for protection. This overlap in habitat requirements reinforces the marten's preference for areas with varied and connected cover. Importantly, the spatial arrangement of cover matters: for smaller prey species, the distance between secure locations must be short enough to allow safe movement. For instance, a CWD pile situated too far from tree or shrub cover may not function effectively as shelter or foraging habitat.

CWD also provides important functional connectivity across a site; it allows martens and their prey to move safely between habitat patches. In winter, CWD is particularly valuable as it provides access to the subnivean space (beneath the snow surface), which many prey species use during this season. This winter connectivity is a key factor influencing marten habitat use.

A Habitat Suitability Index (HSI) model was directly incorporated into the modeling framework in order forecast habitat state change over time. Methodology and detailed results are available in *Chapter 5 – Values, Objectives, Indicators and Targets* Section 4.1.12.3. Over 20 years, a decline in HSI is forecasted, but this decline remains within the 15% change from current levels threshold that is considered low risk. Over the 200-year timeframe, the forecast indicates a decline in HSI between 30% and 15%, considered moderate risk. The sensitivity analysis included in *Annex VI – Timber Supply Analysis* contains additional timber supply scenarios related to marten.

In order to reduce potential impacts to marten habitat, CFP will implement the following mitigation measures intended to collectively serve as a species-specific approach to addressing potential habitat risks, with the goal of supporting the continued presence of American marten across the forest management area.

Strategic Mitigation:

- Raise the area of old interior forest over time (see *Chapter 5 – Values, Objectives, Indicators and Targets,* Section 4.1.3); and
- Reduce wildfire risk on the DFA over 20 years (see Section 6.1).

Operational Mitigation:

- Refer to the GoA habitat suitability models to understand landscape-level marten habitat availability and guide planning decisions.
- Adherence to Timber Harvesting and Operating Ground Rules Section 2.6;
- Retain wildlife trees – Damaged or dead trees retained as single standing trees or within retention patches to maintain safe sites for marten and contribute to coarse woody debris recruitment.
    - In the absence of natural or safe snags, the best management practice is for 1–6 dead, declining, or green trees that are 3–5 m tall and greater than 30 cm DBH (if available) as an average per ha;
- Connectivity among cover types – CWD should be retained and distributed to enhance connectivity between forest stands, shrub patches, and other CWD locations. This ensures that both martens and their prey can safely use the landscape. CWD needs to be consistent with silviculture objectives for the site;
- Identify and retain special sites including springs, seeps, weeps and other water source areas. Also retain wildlife trees, clusters of large-diameter downed logs, unnaturally old forest remnants, and treed rocky outcrops as retention patches; and
- Retain coarse wood debris – Consider maintaining both large single-tree deadfall or natural piles of CWD, as both forms are valuable for cover, movement, and denning. Debris piles need to be consistent with Alberta's Debris Disposal Strategy standards.

8.2.5 Songbirds

Three species were selected by the PDT to be modeled: the varied thrush (*Ixoreus naevius*), the ovenbird (*Seiurus aurocapilla*), and the brown creeper (*Certhia americana*). This analysis focused primarily on the 50-year period, given the uncertainty to landscapes and conditions and model results past 50 years. (Government of Alberta, 2017). Each of the identified species was incorporated into the PFMS model based on coefficients provided by the GoA. Detailed results are available in *Chapter 5 – Values, Objectives, Indicators and Targets,* Section 4.1.12.4.

Both the varied thrush and the ovenbird are listed as *Secure* in Alberta, while the brown creeper is listed as *Sensitive* (Government of Alberta, 2017).

Brown creepers are found in old forest interiors, preferring old, large trees for nesting and foraging requirements. Selection is strongest for forest age class, rather than stand species. Practices that remove mature and dead trees negatively affect brown creeper abundance (Alberta Biodiversity Monitoring Institute and Boreal Avian Modelling Project, 2023a).

Varied thrushes prefer areas of old, large, and continuous conifer forests with shrubby understory. They avoid small forest patches and forest edges (Alberta Biodiversity Monitoring Institute and Boreal Avian Modelling Project, 2023c).

Ovenbirds are associated with mature to old stands of deciduous or mixedwood forests and prefer large areas of continuous forest. Ovenbirds will avoid including forest edges in their territories, and relative abundance declines as linear footprint increases (Alberta Biodiversity Monitoring Institute and Boreal Avian Modelling Project, 2023b).

Brown creeper relative abundance is forecasted to increase or remain steady over a 50-year timeframe. The degree of change overall for the varied thrush and ovenbird through the PFMS results in a decrease greater than 15%, thus requiring the implementation of mitigation strategies. The sensitivity analyses in *Annex VI – Timber Supply Analysis* includes additional timber supply scenarios related to these species.

The ovenbird decreased in relative abundance over the initial 50 years before crossing the -15% decline threshold and continuing in the moderate risk category for the next 150 years (though indicating some level of increase in relative abundance at 120 years). With no dedicated deciduous harvest occurring on the FMA, the age of deciduous stands will continue to increase, which makes them less optimal for ovenbird, which prefer mature deciduous stands. Currently, there are no deciduous rights for harvest allocated within the FMA. However, as discussed in Section 4.4.31 of *Chapter 6 – Preferred Forest Management Scenario*, renewal of deciduous stands through harvest would create forest conditions associated with high relative abundance of ovenbird.

The varied thrush showed stability in relative abundance over the initial 20 years, before declining 8.8% modelled over 50 years of harvest. The decline in relative abundance continues, crossing into moderate risk (-15%) after 110 years. Environment and Protected Areas (EPA) recommended maintaining patches of mature to old conifer forest in patches larger than 16 ha as a strategic mitigation for varied thrush. The PFMS results in patches that meet these criteria being maintained at high levels (>50,000 ha) throughout the planning horizon (Figure referenced). However, it is worth noting that relative abundance values for varied thrush (*Chapter 6 – Preferred Forest Management Scenario*, Figure 31) are highest adjacent to linear features. This suggests a disconnect between the habitat model inputs and recommended strategic mitigation strategies.

To order minimize potential impacts to varied thrush and ovenbird populations, CFP will enact the following mitigation measures.

Strategic Mitigation:

- Permanent road density will be minimized (see *Chapter 5 – Values, Objectives, Indicators and Targets* Section 4.1.4);

- Raise the area of old interior forest over time (see *Chapter 5 – Values, Objectives, Indicators and Targets,* Section 4.1.3);
- Reduce wildfire risk on the DFA over 20 years (see Section 6.1);

Operational Mitigation:

- Adhere to structure retention strategy;
- Temporary road density will be minimized (see *Chapter 5 – Values, Objectives, Indicators and Targets* Section 4.1.5); and
- Timing of tree felling – Within old growth spruce stands, CFP will aim to avoid the nesting and fledgling periods between May 15-August 15th, as practicable with meeting required operational constraints, such as road reclamation timelines, log delivery targets, etc.

8.2.6 Westslope Cutthroat Trout and Bull Trout Habitat Management Strategy

The westslope cutthroat trout (*Oncorhynchus clarkii lewis*) is a subspecies of cutthroat trout native to western North America. In Alberta, it is classified as Threatened (Alberta Environment and Parks, Accessed May 2020). This cold-water species thrives in clean, well-oxygenated freshwater habitats with abundant in-stream cover. Due to its sensitivity to temperature fluctuations and sediment loads, the westslope cutthroat trout serves as an indicator species for overall ecosystem health (COSEWIC, 2006).

Historically, pure westslope cutthroat trout occupied much of the Bow and Oldman River drainages within the South Saskatchewan River basin. However, their populations have been severely reduced due to hybridization with non-native cutthroat and rainbow trout, overfishing, habitat fragmentation, and land-use activities that degrade aquatic and riparian ecosystems.

Crowsnest Forest Products' Cold-Water Fish Strategy is outlined in Appendix IV of this chapter.

8.2.7 Clark's Nutcracker Habitat Management Strategy

Clark's nutcracker (*Nucifraga columbiana*) is a key species in high-elevation coniferous forests, particularly in relation to whitebark pine (*Pinus albicaulis*) and limber pine (*Pinus flexilis*). These pines rely on Clark's nutcracker for seed dispersal, making the species an integral component of forest regeneration and ecosystem resilience. While Clark's nutcracker populations are declining, it is not currently listed as a species of special concern in Alberta. However, whitebark pine is designated as *Endangered* under Alberta's *Wildlife Act* and Canada's *Species at Risk Act* (SARA), and limber pine is *Endangered* under Alberta's Wildlife Act and assessed as *Endangered* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Because of this close ecological relationship, conservation and management strategies for Clark's nutcracker habitat are essential to supporting both listed pine species and the broader biodiversity and ecosystem health.

Historically, Clark's nutcracker populations have fluctuated in response to cone crop availability and habitat conditions. Whitebark and limber pine populations have declined due to white pine blister rust (*Cronartium ribicola*), mountain pine beetle (*Dendroctonus ponderosae*), and fire suppression, which has altered natural successional processes. Given these challenges, a habitat strategy that maintains and enhances cone-bearing tree populations is critical to supporting both Clark's nutcracker and its associated ecosystem functions.

Predicted habitat value and potential breeding pair estimates over a 200-year timeframe were assessed using GoA models. Methodology and detailed results are available in *Chapter 5 – Values, Objectives, Indicators, and Targets*, Section 4.1.8.3 and outputs showed stability in the relative abundance (%) of the Clark's nutcracker habitat.

Over the 200-year timeframe, successful mitigation measures should contribute to a stable or increasing habitat availability trend.

Although modeling suggests that Clark's nutcracker populations will not be significantly impacted by planned forest management activities, CFP will implement targeted strategies to support their habitat and associated species.

Strategic Mitigation:

- Incorporate whitebark and limber pine conservation objectives into forest management planning (see Section 8.2.8 for the whitebark and limber pine strategy);
- Support restoration initiatives, including planting and protection of whitebark and limber pine in key habitat areas;
- Follow the spatial harvest sequence to maintain connectivity between high-elevation coniferous stands to facilitate seed dispersal and movement of Clark's Nutcracker populations; and
- When appropriate, collaborate with research and conservation organizations to monitor Clark's Nutcracker population trends and habitat use.

Operational Mitigation:

- Retain cone-bearing whitebark and limber pine trees within harvest areas where possible;
- Adhere to the Whitebark and Limber pine strategy for protection of these key species;
- Adhere to structure retention strategies that maintain key habitat elements such as mature and cone-producing trees; and
- In harvest areas near limber and whitebark pine stands, leave scattered conifer on the outskirts of the opening, preferably on south facing slopes, or sites protected from the wind. These conifers are useful for caching and sometimes foraging behaviour.

By integrating these strategies into the forest management plan, CFP aims to support the long-term sustainability of Clark's Nutcracker populations and the critical ecosystem functions they provide.

8.2.8 Whitebark and Limber Pine

In 2008, Alberta listed whitebark pine and limber pine, both known as "five-needle pines," as Endangered under the *Wildlife Act*. This designation was due to observed and projected population declines across the province, primarily caused by white pine blister rust and mountain pine beetle infestations. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed whitebark pine in 2010 and limber pine in 2014, recommending Endangered status for both species. Whitebark pine was officially listed under Schedule 1 of the Species at Risk Act in 2012, while a decision on limber pine's listing is still pending.

Whitebark pine thrives in the high mountain forests of western Alberta, particularly at treeline and in upper Subalpine regions. Its range extends from the U.S. border to the northernmost reaches of the Alberta Rocky

Mountains. This species is known for its slow growth and longevity, often living up to 500 years, with some individuals surpassing 1,000 years.

Limber pine, on the other hand, grows from the upper treeline to the montane lower treeline in the foothills and Rocky Mountains. In Alberta, its range stretches from the David Thompson corridor to the US border. Limber pine shares the slow growth and long lifespan of whitebark pine, typically reaching 400 years and occasionally exceeding 1,000 years.

Both whitebark pine and limber pine play crucial ecological roles and are considered keystone and foundation species. Whitebark pine has a unique, obligate relationship with Clark's nutcracker, which is the primary seed disperser for both species. Limber pine also heavily relies on Clark's nutcracker for seed dispersal and regeneration.

In October of 2022, Alberta Environment and Parks published the Alberta Whitebark Pine and Limber Pine Recovery Plan. The recovery plan can be summarized as follows (AEP, 2022):

- Purpose: The plan aims to restore and maintain populations of whitebark pine and limber pine, which are listed as endangered due to threats like white pine blister rust and mountain pine beetle.
- Goals: Establish self-sustaining metapopulations of these species within their historical range and support adaptation to future conditions.
- Key Strategies:
  - Identify, Protect, and Test Plus Trees:
    - Selection: Plus trees are selected from stands with high levels of blister rust.
    - Protection: These trees are protected from threats like mountain pine beetle and fire.
    - Testing: Seeds from plus trees are tested for disease resistance.
  - Develop Seed Orchards:
    - Establishment: Seed orchards are created to supply seeds for restoration.
    - Management: Orchards are managed to maximize seed production.
  - Restore Populations:
    - Planting: Seedlings are planted in suitable habitats.
    - Monitoring: Regular monitoring to assess health and progress.
- Implementation and Monitoring:
  - Collaboration: The plan involves cooperation among various agencies, stakeholders, and Indigenous communities.
  - Periodic Review: The plan is reviewed every five years to evaluate progress and adapt strategies as needed.

The most significant threats to whitebark pine include climate change, wildfire and wildfire suppression, blister rust, and Mountain Pine Beetle (Environment and Climate Change Canada, 2017). Mining and land use was also identified as a significant threat to limber pine (AEP, 2022).

As described in the wildfire mitigation Section, the PFMS is expected to reduce wildfire and MPB risk, which can be expected to benefit five needle pines. In addition, CFP has identified strategies to minimize impacts to these species. CFP's five needle pine strategy can be summarized into three parts:

- Provide financial and in-kind support in alignment with the Provincial Recovery Strategy:

- Apply for Forest Resource Improvement Program (FRIP) funding to support recovery strategies including identification, protection, testing plus trees, and supporting restoration with selected/improved material until seed orchards are productive.
- Develop Seed Orchards:
    - Establishment: Seed orchards are managed and expanded for more grafts, as well as potential for new orchards to supply seeds for restoration.
    - Management: Orchards are managed to maximize seed production.
- Restore Populations:
    - Support/facilitate seed collection (tree and stand health surveys, plus tree ID, cone caging & collection, cone processing, seedlot registration) and genetic screening for disease resistance.
- Planting: Disease-resistant seedlings are planted in suitable habitats.
- Monitoring: Seedlings are typically monitored every 1, 3, 5, 10, and 15 years after planting.
    - Regular monitoring to assess health and progress and adaptive management. For example, based on local/regional trends, site selection and practices are adjusted for climate change impacts for Limber Pine along its eastern range limit. Exposed, hot and dry sites require altered protocols, and climate resilient planting options compared to current typical habitats.

Strategic Mitigation:

- 14,121 ha out of a total 18,750 ha of known whitebark pine and limber pine stands were removed from the active (managed) landbase;
- Reduce wildfire risk on the DFA over 20 years (see Section 6.1);
- Reduce MPB risk on the DFA (see Section 6.2.1); and
- Support the Whitebark Pine Ecosystem Foundation of Canada with efforts to:
    - Find new disease-resistant trees.
    - Apply verb/GLV if MPB hazard is moderate to high.
    - Collect cones.
    - Plant disease-resistant seedlings.
    - Use manual brushing to remove competing stems around whitebark and limber pines.

Operational Mitigation (for the remaining 4,629 ha within the active landbase):

- Establish spatially identified protective retention areas on the ground, as most whitebark pine and limber pine tend to grow along ridge tops and rock outcrops;
- Identify spatial area within the AOP;
- Protect and retain mature and healthy individuals and small groups as encountered during harvest operations;
- Follow the Alberta Whitebark Pine Recovery Plan (AEP, 2022); and
- Follow the CFP Timber Harvest Planning and Operating Ground Rules.

With the combination of operational avoidance and deletions, CFP has reduced the risk of negative impacts on whitebark pine and limber pine populations. VOIT 14e specifies indicators and targets for whitebark and limber pine (*Chapter 5 – Values, Objectives, Indicators, and Targets)*.

8.3 Genetic Diversity

Genetic diversity of the coniferous tree species within the DFA are maintained as:

- Natural regeneration is promoted by processing systems that retains wild cones/seeds on site, evenly distributed across the harvest opening;
- Wild seeds are collected broadly across the DFA to support the planting program; and
- The Alberta Forest Genetic Resource Management and Conservation Standards (FGRMS) controls the development and deployment of controlled parentage seed and seedlings (Stream 2 material).

9 Monitoring Program

The 2025 FMP is a long-term, forest-level plan that sets the general direction for forest management within the DFA for the FMP period (May 1, 2025 through April 30, 2035). Successful implementation of the 2025 FMP relies, in part, on ongoing monitoring to ensure that the targets established for the FMP are attained.

Monitoring is an important tool in adaptive forest management because it links forest management activities with their outcome. This ensures forest management techniques improve and also increase the ability to predict outcomes for forest management activities which, in turn, leads to improved forecasting.

CFP is committed to implementing monitoring programs to track progress toward attainment of FMP targets, as well as to ensure efficacy of its forest management activities. Monitoring programs are required to:

- Maintain forest certification accreditation;
- Meet regulatory requirements;
- Achieve FMP objectives; and
- Meet FMP reporting requirements.

FMA quota holders are also required to conduct monitoring associated with regulatory requirements and to meet commitments of the 2025 FMP.

The following sections outline the monitoring commitments associated with implementation of the 2025 FMP for the DFA.

9.1 Regulatory Requirement Summary

To meet the GoA's regulatory requirements, several sampling and/or monitoring programs are completed by CFP and the FMA quota holders. These reporting requirements are linked but are not specific to the 2025 FMP.

Regulatory reporting is required at ongoing periodic specified intervals, such as during AOP and the GDP submissions. While the 2025 FMP does not alter these reporting requirements, a few products developed as part of the 2025 FMP process clarify regulatory reporting and are identified in this section. The information provided below is intended to serve as a listing of the requirements and to guide the reader to the relevant portion of the FMP.

9.1.1 Timber Volume Harvested

Procedures to charge all timber harvested on the DFA were developed and summarized in the AAC tracking section of this document (Section 4.14).

9.1.2 RSA Targets

Reforestation targets were developed following the policies described in the Reforestation Standards of Alberta (RSA). Targets are expressed as Mean Annual Increment (MAI) values for each of the reforested strata. All operators are required to adhere to the RSA program to manage MAI targets. Refer to Section 5.1.3 for more information.

9.1.3 Seed Requirements

In order to ensure an adequate supply of seed is available to carry out the reforestation requirements as a result of this harvesting plan, refer to Section 5 of this document for a summary by seed zone. Included are the amount of seed available and the amount of seed required.

9.1.4 Tree Improvement Program

Crowsnest Forest Products is establishing a Controlled Parentage Program (CPP) for both lodgepole pine and white spruce in the foothills of southern Alberta, covering the B12 and C5 FMA areas.

In Alberta, CPPs manage tree improvement activities and regulate the deployment of improved seed within defined regional boundaries. Their primary objectives are to ensure the genetic adaptation of seedlots to local environments, which is essential for tree survival, health, and growth, and to produce seed with enhanced productivity, including increased height and diameter growth, known as genetic gain, for operational deployment.

Because CPPs operate on provincial public land alongside timber harvesting tenures, they require formal approval from the Government of Alberta and are regulated under the Alberta Forest Genetic Resource Management and Conservation Standards (FGRMS) (Government of Alberta, 2016a).

Key efforts for this program include selecting and collecting superior tree material, such as scion and seed, establishing a tree orchard in partnership with West Fraser's Sundre division, and setting up progeny test sites across B12 and C5 to assess tree growth performance. In March 2024, West Fraser Sundre acquired a new seed orchard site to support the program. The success of these efforts will be assessed as part of the five-year stewardship report.

9.2 FMP Monitoring Requirements

Monitoring requirements derived from the 2025 FMP are identified in Table 2-1. Each VOIT provides a detailed description of the values, objectives, indicators and targets, as well as its reporting requirements. Refer to *Chapter 5 – Values, Objectives, Indicators, and Targets (VOITs)* for more information.

9.3 Growth and Yield Program

CFP's Growth and Yield Program is outlined in a separate document and included in *Annex VIII – Growth and Yield Plan*. The program describes required commitments for growth and yield as outlined in the Forest Management Planning Standard. The Growth and Yield Program is a working document and will be periodically updated as the program is implemented, or cooperative commitments change (e.g., Provincial Growth and Yield Initiative).

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Appendix I Structure Retention Strategy

Overview

All tenure holders' operations within the C5 Forest Management Unit (FMU) will plan and carry out operations to achieve the structure retention targets outlined in this document. The structure retention targets are set separately for Douglas-fir (Fd) and for the non-Douglas-fir (non-Fd) stands. Structure retention shall be within the contributing landbase, internal to each harvest area, representative of the pre-harvest stand composition, and reported in the Stewardship Report. A harvest area is defined as one opening with a corresponding opening number.

Retention Target	Forest Type	Stratum – Base 10	Stratum – 2025 Forest Management Plan
3%	Non-Fd	Hw, HwPl, HwSw, SwHw,PlHw, Sw, Pl	Hw, Mix_Pl, Mix_Sx, Pl, Sw
15-20%	Fd	Fd	Fd

Based on the Preferred Forest Management Scenario (PFMS) that defines the amount of each stratum to be harvested, the approximate structure retention at the end of Period 1 should be 4.75%. The performance indicator for this target will be evaluated in the five-year Stewardship Report, which will include a table of the percentage of structure retention by year for the Crowsnest Forest Products (CFP) Forest Management Agreement (FMA) area.

The structure retention requirement has been applied to the timber supply analysis, and the Annual Allowable Cut (AAC) has been reduced accordingly for the 2025 FMP.

Definitions:

- Retention – Standing trees left after harvest (live and dead).
- Single stem retention – Individual trees left standing in a harvest area.
- Interior patches, clumps, and islands – Unharvested groups of trees detached from the harvest boundary.
- Peninsular patch – Unharvested groups of trees protruding into the harvest area and attached to the harvest boundary. Peninsular patches can contribute to the retention target if the unharvested area has a 3:1 length to width ratio.

Procedures

Structure retention shall be internal to each harvest area, representative of the pre-harvest stand composition, and within the contributing landbase.

Stand structure retention is intended to maintain pre-disturbance legacies as close as possible to natural disturbance patterns within each area. Retention objectives are:

- Structural complexity and old growth attributes;
- Snag recruitment in the short and long term;
- Temporary refuge and habitat for some biota associated with naturally disturbed habitat;

- The opportunity for wildlife thermal protection, travel corridors, hiding and line of sight cover;
- Variability of shapes, sizes, amount and forms of retention across the landscape to contribute towards emulating natural disturbance; and
- Visual quality within an area.

Structure retention targets will be achieved using the following methods:

1. Safety will be a primary concern when leaving structure retention standing in a harvest area.
2. Structure retention will include pre-harvest layout and/or contractor selected.
3. Overall structure retention will be representative of the species and size of the trees removed during harvest.
4. For the non-Fd forest type, retain Douglas-fir trees found as single trees or clumps, particularly in the Crowsnest Pass corridor where excessive wind is a concern.
5. Candidates for structure retention include merchantable and non-merchantable trees within the contributing landbase representative of the pre-harvest stand composition:
   a. Green culls (rotten, broken tops, forked tops, dry sides, severe sweep and crook);
   b. Snags (as safety permits);
   c. Wolf trees (with heavy branching or poor form);
   d. Within the Douglas-fir forest type, retain the larger Fd veteran tree throughout the harvest area;
   e. All deciduous trees and patches;
   f. Sub-merchantable trees;
   g. Advanced regeneration;
   h. Whitebark pine, limber pine and alpine larch;
   i. Tree patches found during operations that were too small to have been picked up by the AVI and subjectively deleted that cannot be reasonably operated due to environment and safety considerations such as rock outcrops, steep slopes, wet areas, etc.;
   j. Tree patches for source water areas, such as springs and ground water seepage areas, ephemeral or intermittent watercourse (can be considered peninsular patch);
   k. Tree patches for cultural sites (e.g., cultural artifacts);
   l. Tree patches for sensitive sites (e.g., bird nests, dens, hibernacula, mineral licks);
   m. Tree patches to screen important recreational view sheds; and
   n. Tree patches along permanent public roads (DLOs, LOCs, and numbered highways) to screen within block grizzly bear habitat or visual resources (see Visual Quality Strategy for details).
   o. Large conifer >110 cm dbh with low foliage density near the top, near water or drainages and on steep slopes represent potential posts for varied thrush habitat.
6. Deciduous areas, areas with higher moisture content, areas of non-merchantable size and/or dead standing trees, or trees that appear to have survived multiple fire cycles are good examples of candidate structure retention.
7. For single stem retention, in the absence of natural or safe snags and as safety permits:
   a. Top 2 to 6 trees per hectare;
   b. ≥30 cm diameter breast height; and
   c. 3-5 m tall.

8. On an individual harvest unit basis (i.e., opening number), peninsular patches may contribute up to two-thirds of the target (i.e., 2%).
    a. For Douglas-fir harvest areas, peninsular parches are not preferred. However, if a peninsular patch can provide the silviculture objective required from retention (i.e., seed trees), peninsular patches may contribute to up to one third of the target.
9. Harvest areas smaller than 10 ha in size may have less than target retention level, including as low as 0%, due to operational constraints (i.e., long narrow blocks).

A wide range in variability in harvest area retention levels is acceptable, as long as the annual target is achieved or exceeded. Below is an example of the different types of structural retention that may occur in a harvest area.

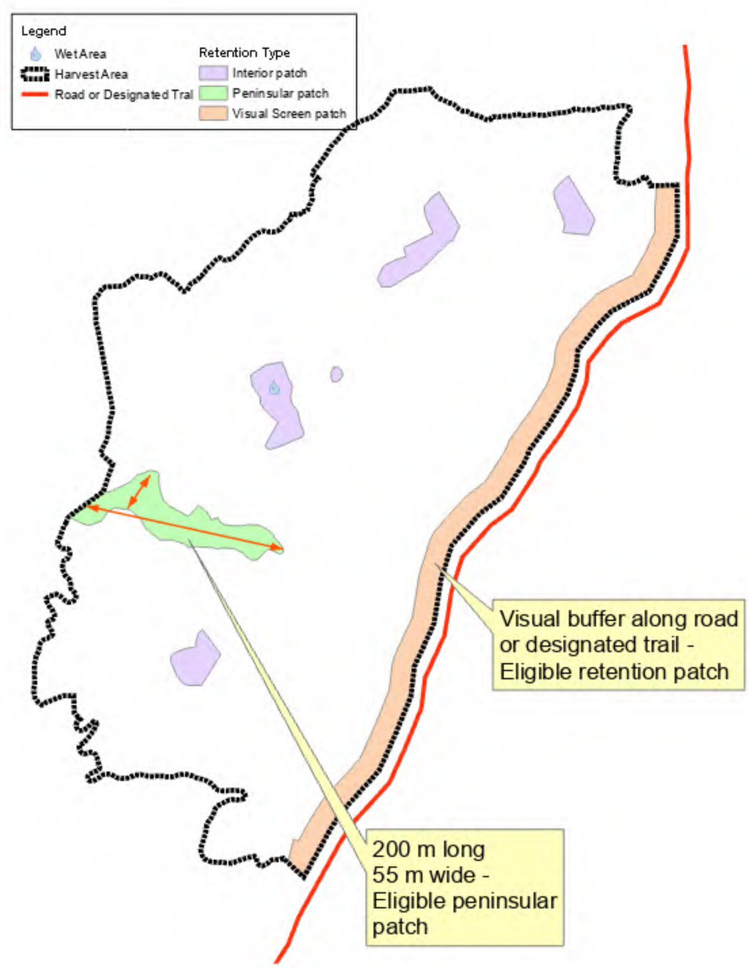

Figure 1: Example of structure retention.

Stand Level Structure Retention Targets

The retention percentage area target shall be reported in the 5-year Stewardship Report. Annual and landscape variation are permitted, provided the 5-year target is achieved (refer to VOIT #10, 1.1.2.1a).

Monitoring Measuring and Reporting Structure

Structure retention is measured on an area basis. All tenure holders on the FMA must calculate the amount of area harvested and area left for structure retention by the operator's sphere. The results will be reported at the FMA level.

The primary means of capturing structure retention levels will be through aerial photography and photo interpretation. The objective is to precisely identify the boundaries of a harvest area and the associated retention. There is no minimum polygon size for capturing retention patches, provided it can accurately be delineated. Other sources for capturing interior patches, such as ground GPS, are an option and will contribute towards the harvest area's retention target.

If single stem retention is employed in a harvest area, an estimate of retention area will need to be completed and tracked for the block. This should be completed around the time of skid clearing for the block. The following formula can be used:

$$Area\ = \frac{Number\ of\ standing\ trees}{Block\ Predicted\ Piece\ Size} \div Average\ gross\ volume\ per\ ha$$

For example, if there are 100 retained trees, the predicted piece size for the block was 3.7 trees/m^3, and the average gross volume was 180 m^3/ha, then:

$$\frac{100\ trees}{3.7\ trees/m^3} \div 180\, {}^{m^3}\!/_{ha}\ =\ 0.15\ ha$$

Retention levels will be tracked annually and reported in the 5-year Stewardship Report.

All structure retention contributing to the target will be excluded from harvesting for a full rotation and will be accounted for in the classified landbase and future timber supply analysis in the next FMP.

Appendix II Visual Quality Strategy

Introduction

The Visual Quality Strategy's objective is to plan forest activities that are compatible with the character of the Defined Forest Area (DFA) landscape.

The DFA's visual landscape is characterized by patches of large and small forested areas, along with large and small openings including grasslands, meadows, bog areas, shrub lands, and rock-strewn areas. The DFA's western side is dominated by forested and large open areas interrupted by treeless, rocky mountain tops. Often, the most scenic portions of the DFA are the broad vistas from roads, looking west toward the treeless Rocky Mountain Front Range. The eastside is a combination of large grassland meadows and a patchwork of forested foothills and regenerating cutblocks.

The DFA has a long history of integrated resource management, also known as mixed use, and the forest is predominately a patchwork of coniferous forest, grasslands, aspen forest, regenerating cutblocks, roads, and fence lines.

The recreational footprint has also had a significant impact on the natural appearance including areas cleared for roads, picnic areas, and campgrounds. A myriad of designated and non-designated trails, which include historical coal exploration roads, are also present. This extensive trail network includes both legal and illegal trails and is frequented by motorized users, equestrian enthusiasts, mountain bikers, and hikers as specified in the various public land use zones.

Designated camping areas known as Public Recreation Areas (PRAs) and random camping areas are also heavily used and common throughout the DFA. Cattle roam freely throughout the DFA, including in the recreational areas. The PRAs and random camping areas are characterized by roads and pullouts and generally surrounded by clumps of trees, meadows, and/or riparian areas. Many of the forested areas within the PRAs are comprised of patches of overmature trees with high levels of fuels and blowdown.

A healthy forest ecosystem depends on a continuous cycle of renewal. Disturbance such as fire, insects, disease, and blowdown are natural events that create forest renewal and a diversity of forest ecosystems.

In a managed forest such as the DFA, harvesting emulates natural disturbances where harvesting removes merchantable trees to create forest renewal. A well-managed forest compliments natural disturbance with wise use of forest resources. Many of the areas within the DFA are at risk to mountain pine beetle infestation and high severity wildfire.

Given the history of integrated resource management on the DFA and the nature and condition of its visual features, timber harvesting is visually compatible with the existing vegetation patterns. However, specific areas have been inventoried that presently do not have a recent history of cutblocks, are frequented by large numbers of the public, and potentially have high foreground visual sensitivity. These potentially high visual sensitivity areas within the foreground will be consulted on at the operational planning level to address appropriate site-specific visual mitigation measures.

Visual Quality Inventory

In 2023, a visual quality inventory was completed using the viewshed toolbar through ESRI ArcMap Spatial Analyst. The DFA has been designated into three visual zones[2] as follows:

- Foreground, 0-0.8 km;
- Middle ground, 0.8 km to 5 km; and
- Background, greater than 5 km.

Given the general suitability of forestry to blend with the DFA's landscape, the inventory focuses on high sensitivity visual quality areas located within the unobstructed viewable foreground. Areas of high visual quality from this inventory are shown in Figure 1.

AVI polygons not identified as having high visual sensitivity may later be assigned as having high visual sensitivity as discovered through FMP and General Development Plan (GDP) consultation processes as described in the Timber Harvest Planning and Operating Ground Rules.

Visual Sensitivity Inventory

ESRI ArcMap Spatial Analyst was used to designate viewpoints (a-d):

a) Within, adjacent to, or viewed from all designated DFA recreational sites and tourist developments. Designated DFA recreation sites include designated random camping areas and are defined as areas identified on Alberta published maps and/or are designated by Alberta with signage;

b) Viewed from *designated viewpoints;*

c) Adjacent to or viewed from lakes, major rivers; rural/urban forest interface areas (small private property home sites <20 acres); and

d) Adjacent to primary and secondary highways in Alberta.

Determination of Visual Quality

The general process for determining visual quality can be summarized in four steps:

1. Determine viewer locations;
2. Calculate viewsheds of each viewer;
3. Tabulate the number of times a location is observed (visibility); and
4. Summarize observed areas by proximity to viewer.

Specifically, visual quality determination must consider the following questions:

1. What are the viewer locations?
2. What is the value of each viewer location to the observer?

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[2] Foreground, midground and background distances based on: *USFS Forest Landscape Description and Inventories a Basis for Landscape Planning and Design.*

3. How does proximity affect quality?

Determination of Viewer Locations

The points along or within viewer locations are determined using a 50m point spacing analysis. Potential viewer locations are placed every 50m along linear features. Viewer locations are placed using a 50m spacing grid within area-based features. Points were removed if surrounded by vegetation greater than 2m and moved along the road or river up to 25m for a better vantage point (higher elevation).

Value of Viewer Locations

A viewer location's value is dependent upon the proximity of what is being observed when compared to other viewing points in the vicinity and the amount of time that the viewer has to observe. As one travels along a road, not all locations hold equal visual value—for instance, emerging from a densely enclosed forest into a stretch that overlooks a valley offers a more impactful view. This heightened visual experience should be recognized accordingly, especially when considering the amount of time a viewer has to take it in.

A road can be said to have high 'opportunity' to observe as there are many viewing locations along the road (availability) and roadways are highly accessible. Opportunity here refers to the relative number of viewer locations within an area and their availability and accessibility. When comparing this high opportunity along a roadway to a viewer location on a ridge in a recreational area where time to observe increases but its relative opportunity to observe is limited, the value of the ridge in the recreational area increases.

Locations where there are fewer viewpoints become more valuable compared to a higher density of viewpoints, such as is found along roads and rivers. When a viewer travels on a roadway, each viewpoint is observed for a short period of time when compared to more stationary viewpoints such as campgrounds. In the analysis, the relative value of viewer locations changes depending on the density of each viewpoint compared to its neighbours. The first pre-processing step calculates the density of viewpoints and then creates an inverse relationship between the highest density and lowest density, where the lowest density has the highest value. The second pre-processing step determines how much area each viewpoint can 'see' using the foreground distance of 800m, where viewpoints that can 'see' more landscape are weighted higher. The two pre-processing products are then combined to generate a final weighted value for each viewpoint. Value equates to increased viewers at a location in analyses of visibility.

To process the visibility, each viewpoint then assigns its value to each position on the landscape that it can 'see'. Each position on the landscape is the sum of values for all viewpoints that can see it. In processing the midground and background, we use the value of visibility from the previously calculated foreground to remove the lowest 50% of viewpoints. This was done to improve the processing speed of the midground and background layers.

Visual Quality Mitigation

Visual quality management measures are to be considered for high visual sensitivity harvest areas located within the foreground. As operational plans are drafted, harvest areas having high foreground visual quality rankings will be assessed and consulted on to identify mitigation measures and to reduce potential adverse visual quality impacts.

Visual Quality Measures

- High visual quality inventory and consultation completed as part of the 2025 FMP;
- High midground and background areas will not be considered visually sensitive unless re-designated as visually sensitive during operational planning and public consultation;
- Mitigation measures to reduce the impacts to high visual quality foreground harvest areas may include:
    - Modification of harvest boundaries;
    - Utilization of topography;
    - Application of various structure retention approaches;
    - Modification of road locations; and
    - Use of visualization computer modeling to evaluate various layout options.

Reporting

- Documentation of high visual sensitivity block strategies as identified in the GDP.

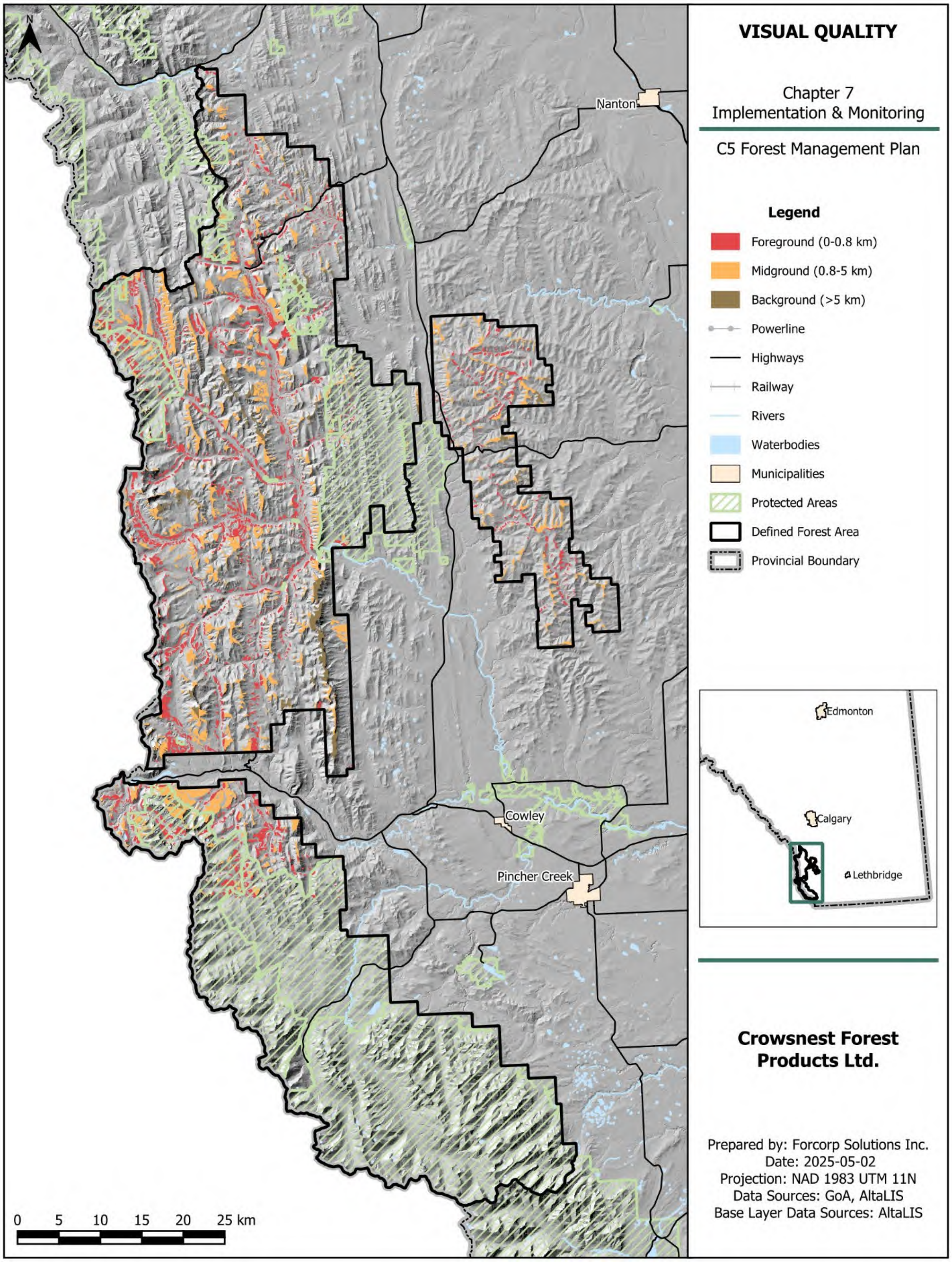

Figure 1. Modelled areas of high foreground, midground and background visual quality on the DFA.

Appendix III C5 FMU FireSmart Management Process

Crowsnest Forest Products Ltd.
2025 Forest Management Plan

ANNEX 3 REPORT

Government of Alberta

February 13, 2024

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Introduction

Wildfires are part of the natural disturbance regime of the Canadian landscape. They shape and form the landscape biodiversity. In Alberta, wildfire management aims to balance the ecological role of wildfire while protecting human life, communities, watersheds and sensitive soils, natural resources, and infrastructure. This report will address the importance of minimizing wildfire impacts on communities and the landscape and its link to the South Saskatchewan Regional Plan (SSRP) and Livingstone-Porcupine Hills Land Footprint Management Plan (LPH-LFMP). These plans have prioritized wildfire as the highest priority, along with watershed management and headwaters protection.

The incorporation of FireSmart principles in forest management planning aims to minimize catastrophic wildfires to communities and on the landscape through a combination of:

- Reducing wildfire behaviour potential,
- Reducing the exposure of resources and assets to the negative impacts of a wildfire,
- Targeted timber harvest in locations with problematic forest fuel types,
- Consideration of species conversion and reduce coarse woody debris retention in locations harvested near FireSmart Community Zones, and
- Ensuring linkages to other FireSmart strategies such as the Guidebook for Community Protection (Wildfire Mitigation Strategies and Wildfire Preparedness Guide).

Incorporating natural disturbance emulation through designing and integrating fire, forest and land management planning activities is the cornerstone of protecting many values, achieving safety, meeting planning objectives, and attaining sustainable forest management. FireSmart seeks to mitigate significant, high-intensity, high-severity wildfires. By recognizing the interaction between ecological, economic, and social impacts while identifying timber harvest opportunities and other disturbance strategies, FireSmart aims to build resilient communities and healthy, productive ecosystems. These are the building blocks of all elements of wildfire prevention (engineering, education, and enforcement) and identifying opportunities to use prescribed burning as a natural disturbance management strategy to meet ecological objectives through ecological restoration.

The report intended to utilize the catastrophic wildfire indicator (CFI) as the primary metric for measuring the potential for damaging fire on the landscape and as a tool to show mitigation and harvest targets to remove the potential for catastrophic wildfires. However, the CFI was unavailable for this report. Instead, this report utilizes an updated wildfire risk layer from the Calgary Wildfire Risk Management Plan (CWRMP). This output, the wildfire risk indicator (WRI), shows the elevated wildfire risk during the summer months and the overall wildfire hazard for the landscape based on fuel type and environmental conditions.

Area of Interest

The Crowsnest Forest Products Ltd. (CFP) forest management agreement (FMA) is in the southern half of the Calgary Forest Area (Figure 1). The CFP FMA encompasses around 54% of the C5 forest management unit (FMU), with land identified as parks and protected areas removed, as well as land not feasible for timber harvesting (i.e., passive landbase). The analysis of the forest composition used the updated Alberta Vegetation Inventory standard version 2.1.5 (Agriculture, Forestry and Rural Economic Development, 2022).

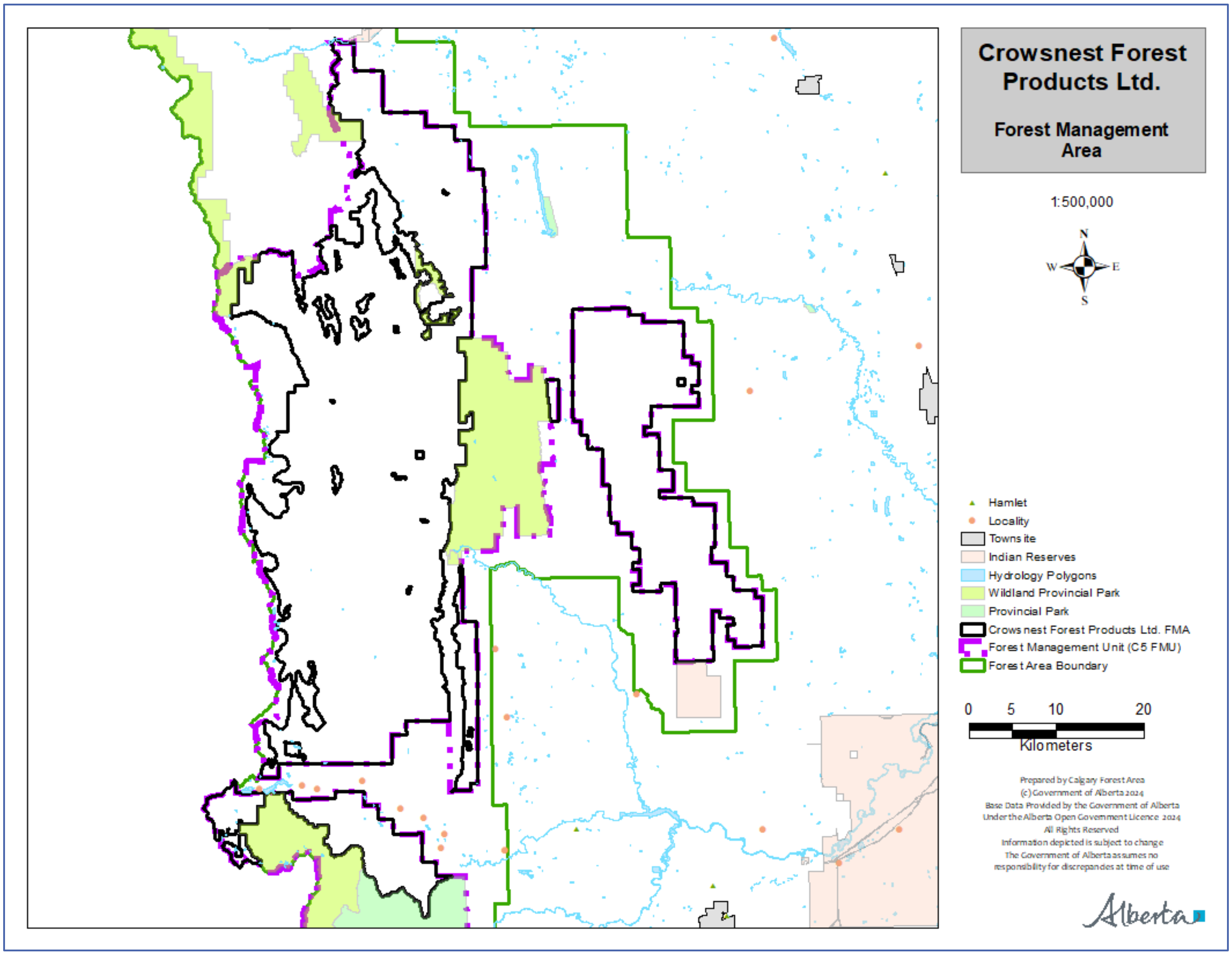

Figure 1. Location of the CFP FMA in the southern half of the Calgary Forest Area.

Natural Subregions

The CFP FMA is within the Rocky Mountain Natural Region, which includes the Alpine, Subalpine and Montane Natural Subregions (Figure 2).

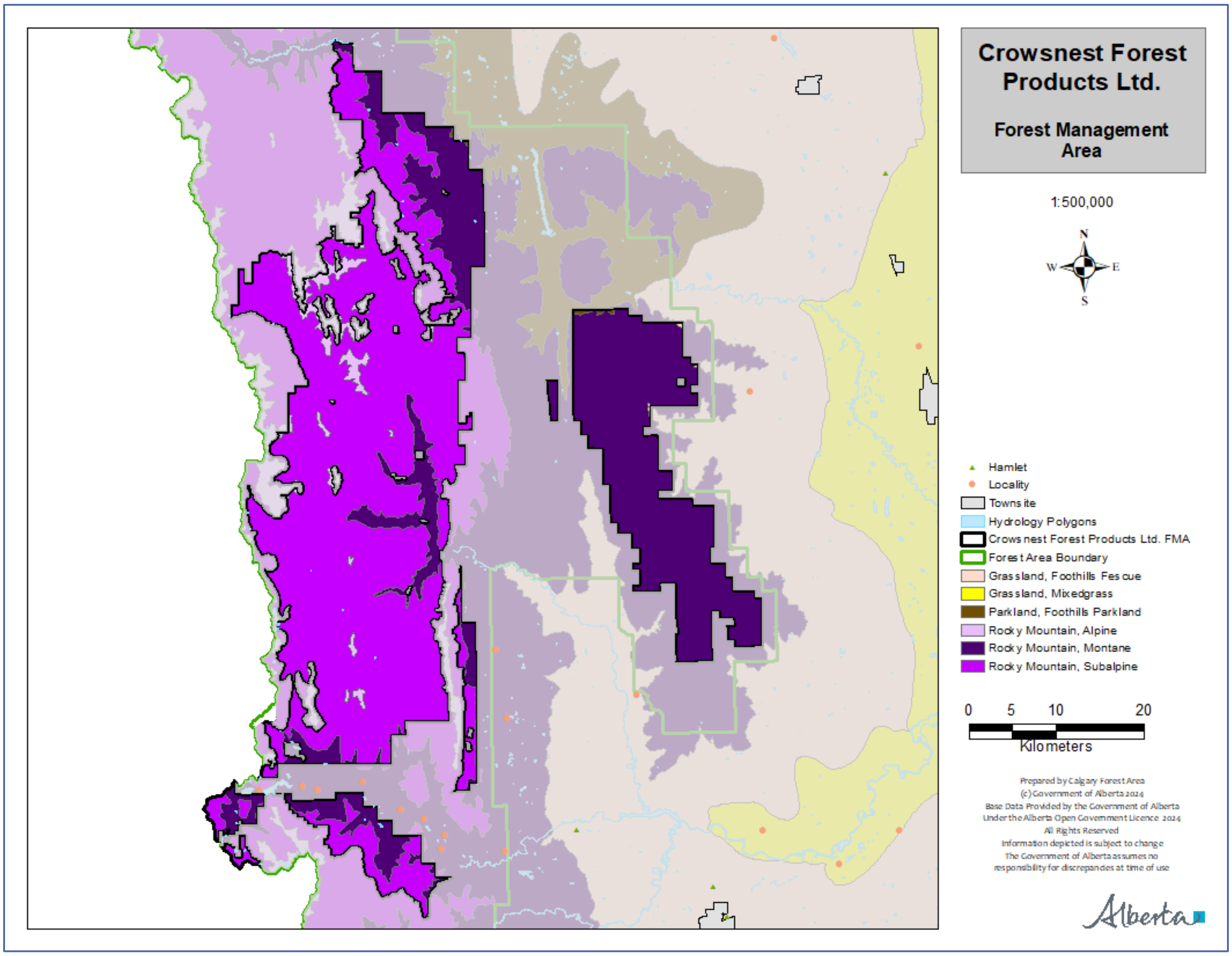

Figure 2. Rocky Mountain Natural Region and Natural Subregions within the administrative boundaries of the CFP FMA.

Historical Wildfire

Between 2003 and 2022, the CFP FMA had 935 wildfires (Figure 3), which accounted for 18,634.12 hectares burnt (Figure 4, Figure 5).

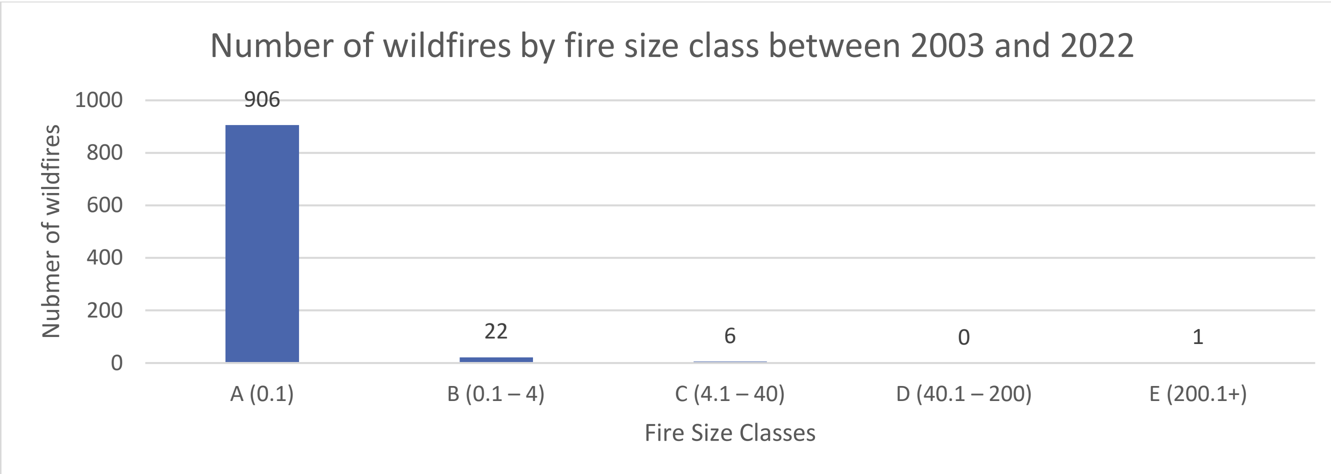

Figure 3. Historical wildfires between 2003 and 2022 by fire size class within the administrative boundaries of CFP FMA.

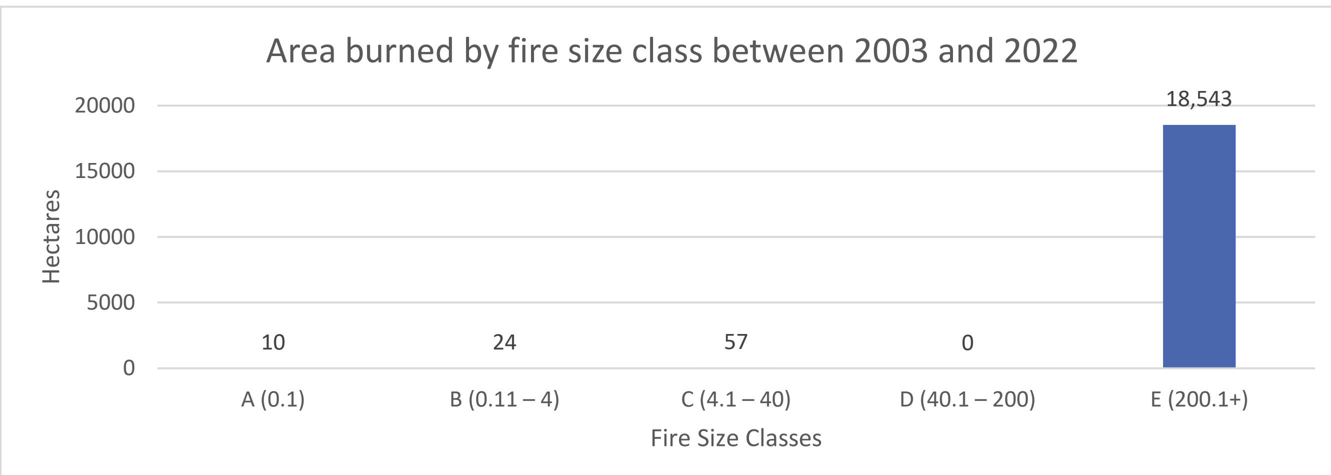

Figure 4. The area burned between 2003 and 2022 by fire size class within the administrative boundaries of CFP FMA.

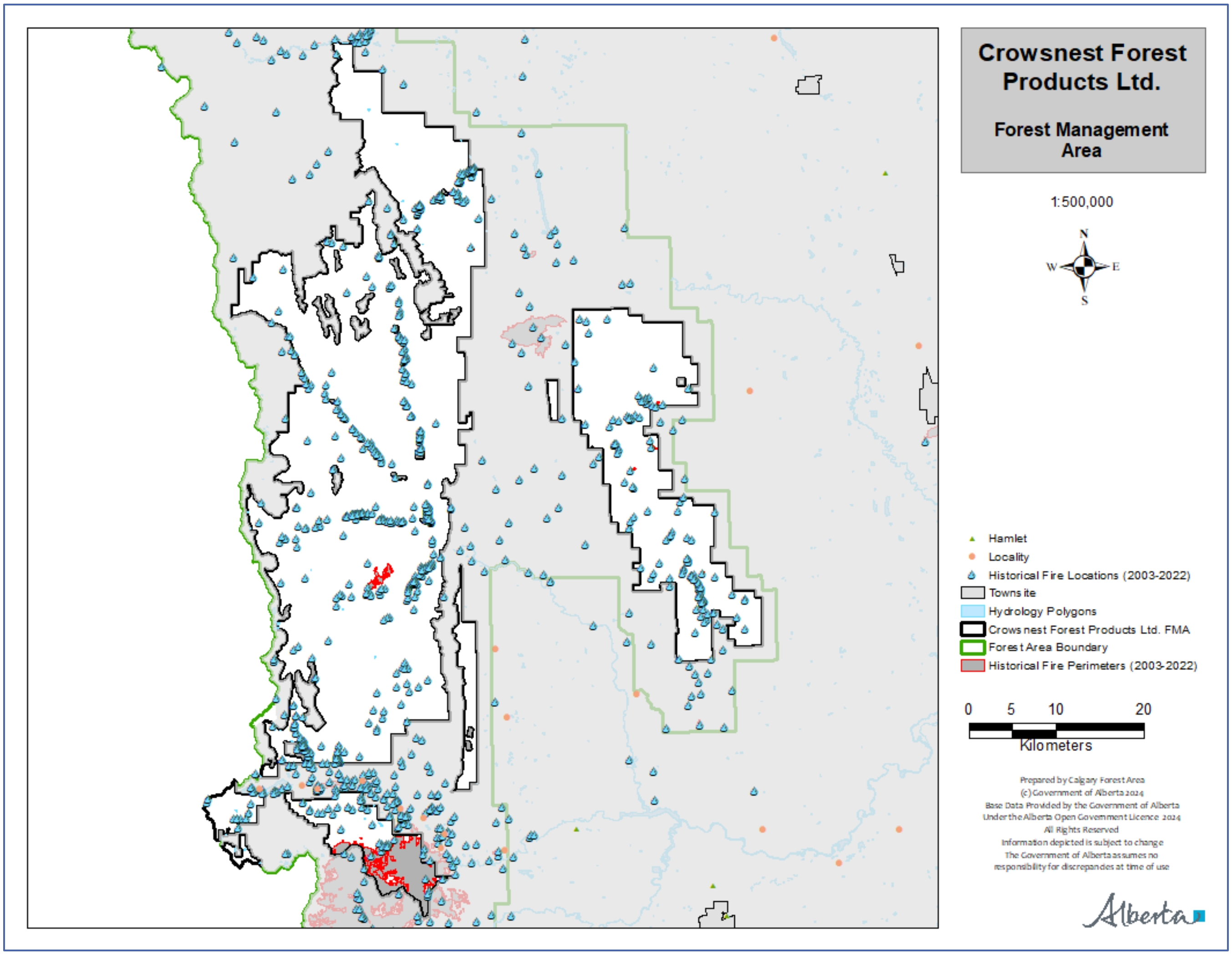

Figure 5. Historical wildfires between 2003 and 2022 within the administrative boundaries of CFP FMA.

Forest Fuel Types

As fuels can influence ignition, rate of spread (ROS), buildup, intensity, and thus overall fire behaviour, they are components in both fire weather indices and fire behaviour models. Qualitative descriptions of fuel types include stand structure and composition, surface and ladder fuels, forest floor cover and an organic layer, with each fuel type displaying characteristic fire behaviour under defined burning conditions (Forestry Canada, 1992). Table 1 lists the hectares and percentage of CFP FMA covered by each Canadian Forest Fire Behaviour Prediction (FBP) System eighteen benchmark fuel types (Wotton, Alexander, & Taylor, 2009). With the majority of the province's FBP fuel types derived from the Alberta Vegetation Inventory (AVI), modification and exception are created within the AVI to FBP (AVI2FBP) calculation model to ensure that it represents the characteristics of the "best fit" fuel type (Figure 6).

Table 1. Area and percentages of the FBP eighteen benchmark fuel types in the CFP FMA.

Fuel Type	Hectares	Percentage
C-1 Spruce-lichen woodland	5,512	2.90
C-2 Boreal spruce	40,015	21.03
C-3 Mature jack or lodgepole pine	44,083	23.17
C-4 Immature jack or lodgepole pine	21,183	11.13
C-5 Red and white pine	388	0.20
C-6 Conifer plantation	0	0.00
C-7 Ponderosa pine/Douglas-fir	20,459	10.75
D-1 Leafless aspen / D-2 Green aspen	11,796	6.20
M-1 Boreal mixedwood – leafless / M-2 Boreal mixedwood – green < 50% conifer	6,427	3.38
M-1 Boreal mixedwood – leafless / M-2 Boreal mixedwood – green >= 50% conifer	8,816	4.63
S-1 Jack or lodgepole pine slash	440	0.23
S-2 White spruce/balsam slash	69	0.04
S-3 Coastal cedar/hemlock/Douglas-fir slash	0	0.00
O-1a Matted grass / O-1b Standing grass	27,196	14.29
Non-fuel	3,473	1.83
Water	331	0.17
Vegetated non-fuel	105	0.06
Total	**190,293***	**100.00**

* The actual CFP FMA area is 190,357.4 ha; however, when converted to a raster (FBP Fuel Layer), 64 ha are lost, accounting for 0.03% of the area.

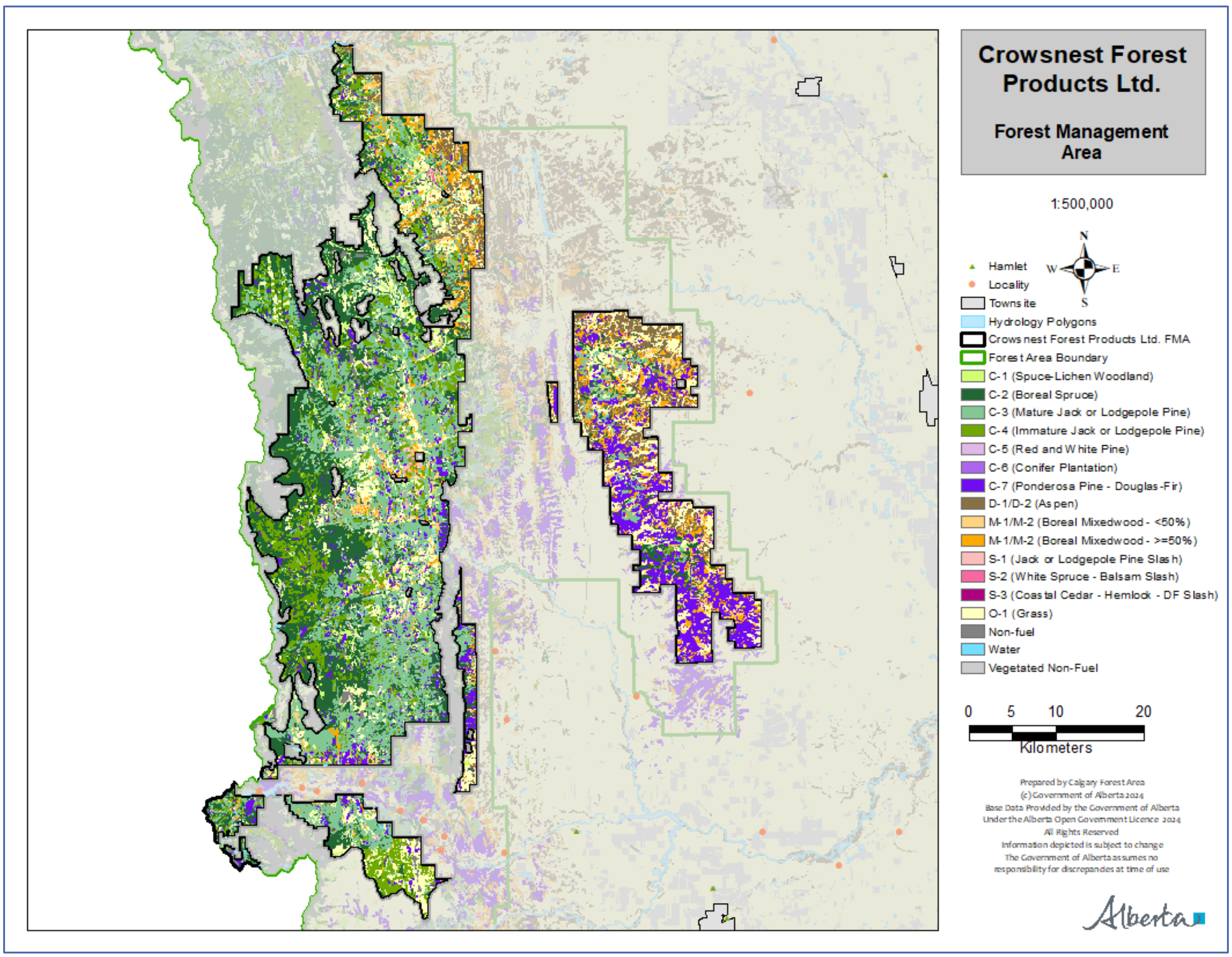

Figure 6. FBP fuel types within the administrative boundary of the CFP FMA.

Calgary Wildfire Risk Management Plan

Completed in 2016, the CWRMP used the CAN/CSA-ISO 31000-10 Risk Management - Principles and Guidelines, which define risk based on the “effect of uncertainty on objectives” (CAN/CSA-ISO 31000-10, 2010).

In 2024, to align with other recently completed wildfire management plans within the province, the consequence layer used to derive the wildfire risk layer changed from the Burn-P3 model to the ignition exposure model, dramatically reducing the time to generate outputs.

The difference between the two consequence models is:

- Burn-P3 (probability, prediction, and planning), a spatial fire simulation model, was generated by inputs of fuels (e.g., vegetation), topography, weather, and patterns of fire ignition using a Monte Carlo simulation.
- Ignition Exposure, a simple metric of landscape fire exposure, uses FBP fuel types, head fire intensity and ROS representing 95th-percentile weather, and a distance-weighted formula.

Ignition Exposure Model

The ignition exposure model (IEM) (Beverly, McLoughlin, & Chapman, 2021) determines the extent to which the landcover type in the vicinity of a location will either contribute to or resist fire transmission to that location. The IEM is a simple landscape metric based solely on stable physical fuel properties. The IEM uses the FBP fuel types and 95th-percentile weather.

The 95th-percentile fire weather index indices are used in the model to show the possible hazard to resource managers over the landscape based on historical weather and current vegetation conditions. Wildfires under these conditions are challenging to manage and pose the greatest threat to resources and assets.

Catastrophic Fire Indicator

In 2015, the CFI was developed from a pilot project to identify “contiguous areas where the occurrence of intense wildfire that is uncontrollable with conventional suppression methods (≥4,000 kw/m - air suppression is less effective) is more likely to occur. The size threshold used to define large contiguous areas will vary based on desired land uses within a region and their tolerance for wildfire disturbance.”

In 2018, the CFI was identified as a performance metric within the LPH-LFMP to “reduce the area identified by the CFI” (Alberta Environment and Parks, 2018). The CFI was based on Burn-P3 model outputs and used a 3-kilometre buffer inside and outside to remove islands.

In 2019, the CFI was discontinued due to the limited provincial availability of the Burn-P3 model layer.

Wildfire Risk Indicator

During the risk assessment process within the CWRMP, the WRI was generated by combining the consequences (40%) and likelihood (60%). This output represents areas threatened by wildfire and is denoted by four risk classes (Minor, Continuous Improvement, Risk Reduction, and Intolerable).

The WRI risk classes (Table 2, Figure 7) provide a practical opportunity to prioritize and focus attention on the higher cumulative risk in the CFP FMA.

Table 2. Area and percentages of the risk classes within the administrative boundary of the CFP FMA.

WRI Risk Classes	Hectares	Percentage
Minor	64,955	34.13
Continuous Improvement	119,822	62.97
Risk Reduction	4,119	2.16
Intolerable	1,397	0.73
Total	**190,293**	**100.00**

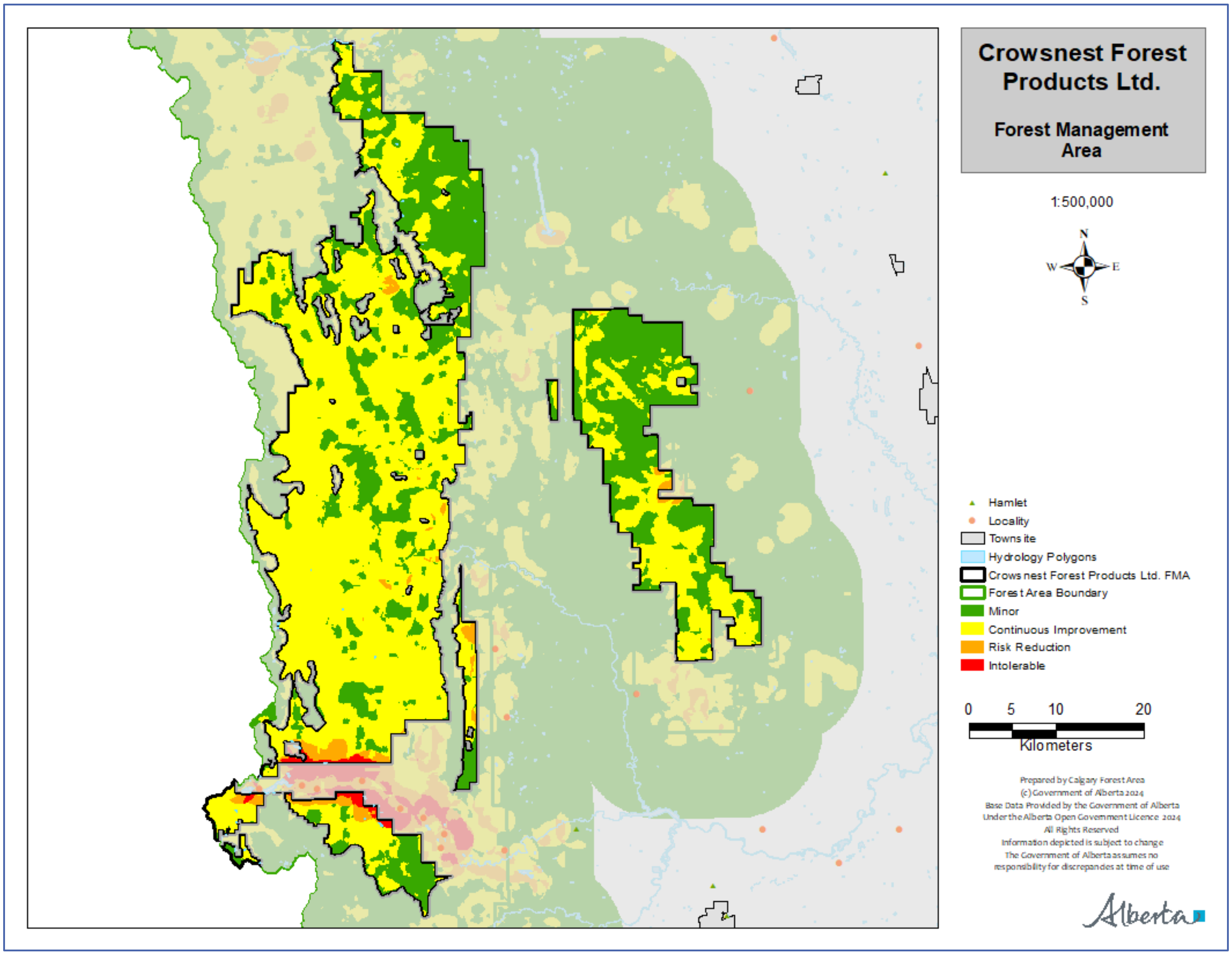

Figure 7. WRI within the administrative boundary of the CFP FMA.

Regional Planning

In 2014, the SSRP set the stage for robust growth, vibrant communities, and a healthy environment within the region over the next 50 years (Alberta Government, 2018). The following three excerpts from the SSRP speak directly to the importance of addressing wildfire risk and management in the region:

1. Pages 35 and 36, under the Human Development section, state: *"Some urban communities, native grasslands and forested areas in the region are at risk from wildfires. Alberta will continue its program of wildfire prevention and the Community FireSmart program to reduce wildfire hazards near communities. The FireSmart program includes education, vegetation management, legislation and planning, development considerations, interagency cooperation, cross- training and emergency planning."*
2. Page 49, under Forestry – Strategies 1.16. section, state: *"Incorporate wildfire management planning into forest management initiatives including the development of landscape wildfire risk assessments, landscape disturbance planning and FireSmart strategies. Forest management activities – such as prescribed burning, thinning and timber harvesting – will support meeting community and landscape-level FireSmart objectives."*
3. Page 58, under Integrated Management of Crown Land – Management Intent for Green Area and White Area Public Land section states: *"Practices to manage wildfire risk to communities will be equal in priority to headwaters protection."*

The SSRP adopted the wildfire risk (burn probability X potential) indicator (Page 52) as one of the two forestry indicators to monitor and understand the trends occurring in the region related to economic growth and diversification.

FireSmart Zones

FireSmart Canada recognizes strategic planning across three overlapping zones: Community, Interface, and Landscape (Figure 8). These three zones, FireSmart Zones, are based primarily on human-made improvements and developments with measurable or intrinsic worth. Human life, communities, and critical infrastructure receive the highest priority regarding provincial fire suppression efforts, followed by the values associated with watersheds/soils, natural resources (i.e., timber, protected areas, fish and wildlife habitat, threatened/endangered species), and infrastructure.

The CFP FMA FireSmart Zones were generated based on Alberta's municipal and governmental structure and point-of-interest dataset values using criteria outlined in FireSmart Canada's Protect Your Community (Partners in Protection, 2003) and Lynn Johnston's Mapping Canadian Wildland Fire Interface Areas (Johnston, 2016) and clipped to the administrative boundary of the CFP FMA.

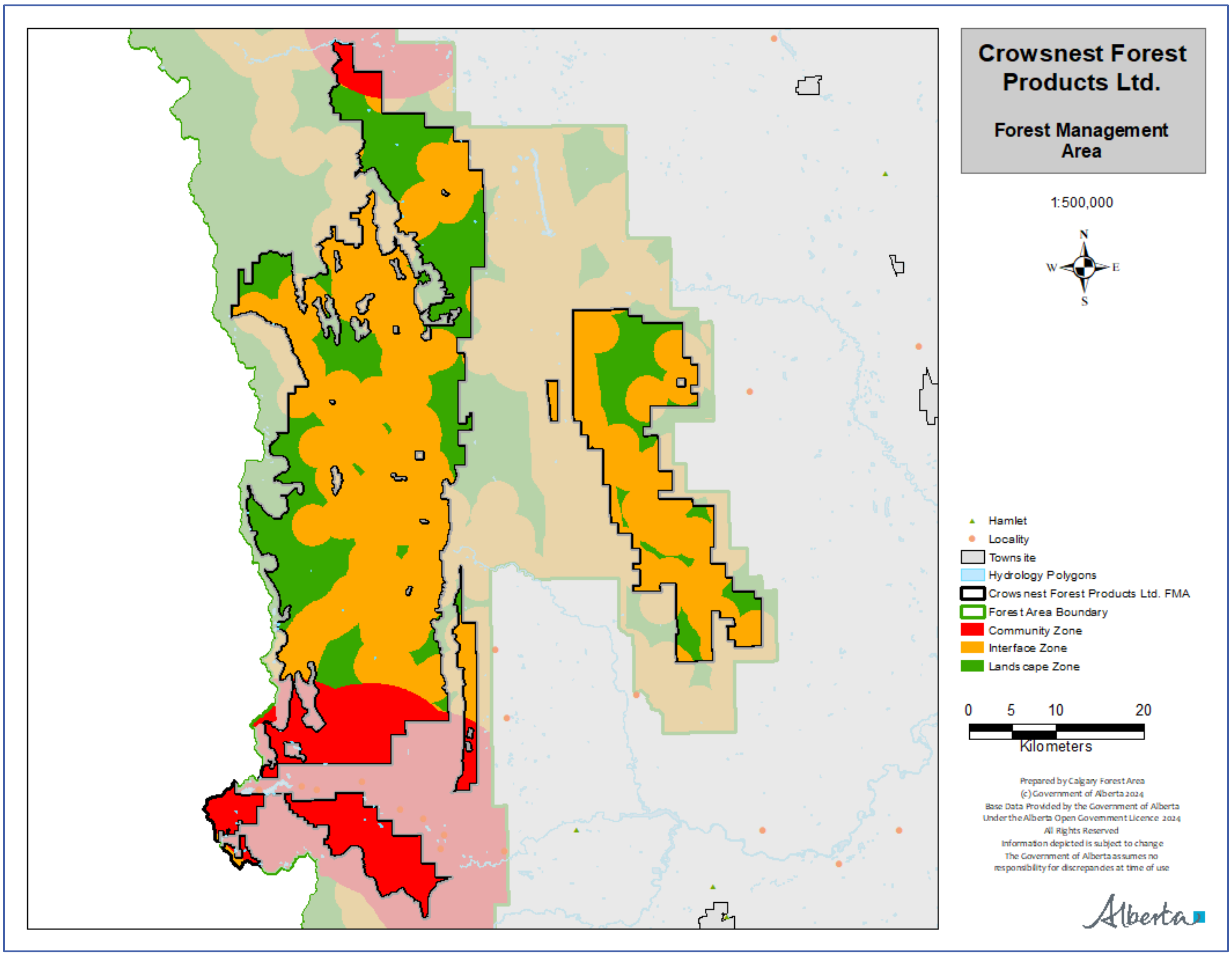

Figure 8. CFP FMA FireSmart Zones within the administrative boundary of the CFP FMA.

Wildfire VOITs

Two wildfire Values, Objectives, Indicators, and Targets (VOITs) were generated based on the WRI risk classes and FireSmart Zones clipped to the CFP FMA (Table 3). The first zone is the CFP FMA Community Zone (CFPCZ) and includes only the active landbase versus the traditional FireSmart Community Zone, which includes both the active and passive landbase. The second zone, CFP FMA Landscape Zone (CFPLZ), combines only the active landbase of the FireSmart Interface Zone and FireSmart Landscape Zone.

Table 3. Area and percentages of the CFP FMA, CFPCZ and CFPLZ.

	FMA		CFPCZ		CFPLZ	
WRI Risk Classes	**Hectares**	**Percentage**	**Hectares**	**Percentage**	**Hectares**	**Percentage**
Minor	64,955	34.13	9,376	26.85	55,579	35.84
Continuous Improvement	119,822	62.97	21,473	61.49	98,349	63.42
Risk Reduction	4,119	2.16	2,676	7.66	1,143	0.74
Intolerable	1,397	0.73	1,397	4.00	0	0.00
Total	**190,293**	**100.00**	**34,922**	**100.00**	**155,071**	**100.00**

Data Used

For this report and analysis, the new AVI dataset approved on September 19, 2022, was used to update the FBP fuel layer (2023). The 2023 FBP fuel layer was used in the IEM. The IEM output was combined with the likelihood layer, as per the CWRMP, to generate the wildfire (cumulative) risk layer.

The draft classified landbase submitted on October 3, 2023, was used to generate WRI risk classes from the active landbase area. Appendix 1 describes the methodology used to determine the Wildfire VOITs.

Recommendations

This report focuses on reducing the regional risk of catastrophic wildfires by incorporating the WRI into strategic landscape planning to reduce the impact on human life, communities, natural resources, and critical infrastructure in the South Saskatchewan Region. As wildfire seasons worsen, a changing landscape of increased human development emphasizes fire's crucial role in ecosystem productivity and forest health. Historical fire suppression policies have been beneficial in containing wildfire size and spread but have affected forest stand age structure and overall forest health. With an increase in the number of human-caused fires (power line, industrial, resident, and arson), wildfires are becoming more frequent at a time of year when catastrophic wildfire events are more likely. These human-caused wildfires affect the historical wildfire regime where forest stands have adapted to burn during the summer months, which corresponds with higher lightning activity. Current land-use policies and management decisions will directly impact the outcomes of such disturbances.

Harvesting mature coniferous stands to produce younger stands reduces the flammability and intensity of wildfire, providing a better opportunity for success with wildfire control and allowing for age stratification across the landscape, creating a mosaic of young and old stands better emulating natural disturbances. In addition to following the Debris Management Standards for Timber Harvest Operations, AF-FDP-2017-07, the following recommendations provide direction to reduce the risk of wildfires to communities:

1. Wildfire VOIT 1: In the CFPCZ, incorporate identified WRI risk classes of Risk Reduction, Continuous Improvement, and Intolerable into the development of the spatial harvest sequence to reduce fire hazard by harvesting 30% of the active landbase over 20 years starting at time zero of the CFP 2025 FMP (Appendix 1: Wildfire VOIT Validation, Table 5).

2. Wildfire VOIT 2: In the CFPLZ, incorporate identified WRI risk classes of Risk Reduction, Continuous Improvement, and Intolerable into the development of the spatial harvest sequence to reduce fire hazard by harvesting 10% of the active landbase over 20 years starting at time zero of the CFP 2025 FMP (Appendix 1: Wildfire VOIT Validation, Table 5).

3. In the CFPCZ, consider developing strategies for reducing the risk of wildfires to communities such as but not limited to:

    a. Pre commercial thinning and/or harvest design (e.g., strip cut) adjacent to communities to create fuel breaks to reduce wildfire spread potential.

    b. Leave for natural and/or reduced planting densities.

4. In the CFPLZ and CFPCZ, consider preserving fire resistant Douglas-fir leading stands by promoting ecological restoration through selective harvest methods.

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Appendix 1: Wildfire VOIT Validation

This appendix describes the methodology used to determine the Wildfire VOITs.

To determine the Wildfire VOITs, the WRI risk classes were calculated for the entire CFP FMA, as shown in Table 1.

Table 4. WRI risk classes hectares and percentages for the CFP FMA.

WRI Risk Classes	CFP FMA (Hectares)	CFP FMA (Percentage)
Minor	64,955	34.13
Continuous Improvement	119,822	62.97
Risk Reduction	4,119	2.16
Intolerable	1,397	0.73
Total	190,293	100.00

After calculating the WRI risk classes on the CFP FMA, the passive landbase was removed and split into two zones, CFPLZ and CFPCZ, as shown in Table 2.

Table 5. Total hectares for the draft active landbase of the CFP FMA.

WRI Risk Classes	CFPLZ (Hectares)	CFPCZ (Hectares)
Minor	28,775	3,768
Continuous Improvement	56,366	13,613
Risk Reduction	842	1,551
Intolerable	-	705
Total	85,983	19,637

To calculate the total area for Wildfire VOITs, the summation of the three WRI risk classes, Continuous Improvement, Risk Reduction, and Intolerable, was calculated as shown in Table 3.

Table 6. Total Area of Wildfire VOITs.

	CFPLZ (Hectares)	CFPCZ (Hectares)
Total Area for Wildfire VOITs	74,208	15,869

A zone percentage was calculated for the two zones based on historical harvesting practices in the region, as shown in Table 4. Historically, approximately 140,000 m^3 of timber is harvested annually, which equates to 200 m^3 per hectare, resulting in 700 hectares harvested annually. Based on the regional planning priorities for wildfire management, a greater focus was placed on the CFPCZ.

Table 7. Zone percentages for the Wildfire VOITs Target per zone.

	CFPLZ (Percentage)	CFPCZ (Percentage)
Zone Percentages	10	30

The total area for the 20-year target was calculated by multiplying the total area for Wildfire VOITs (Table 3) by the Zone Percentages (Table 4) for each WRI risk class and an annual target as shown in Table 5.

Table 8. Total Area for 20-year Target and Annual Target for the Wildfire VOITs per Zone.

WRI Risk Classes	CFPLZ (Hectares)	CFPCZ (Hectares)	Total (Hectares)
Continuous Improvement	5,637	4,084	9,721
Risk Reduction	84	465	550
Intolerable	-	212	212
20-year Target	**5,721**	**4,761**	**10,482**
Annual Target	*286*	*238*	*524*

To achieve the Wildfires VOITs over 20 years and to allow for flexibility in the spatial harvest sequence and unexpected uncertainty, the 20-year Target and Annual Target areas represent around 75% of the total area harvested on the active landbase based on harvesting 700 hectares annually.

Statistics based on the percentage of area harvested were calculated. If the targets are achieved over the 20 years, Table 6 shows two statistics for the CFPCZ: the percentage of area harvested in the active landbase and the percentage of area harvested in the CFP FMA.

Table 6. Statistics for CFP FMA Community Zone.

24.2%	% of area harvested in the active landbase
2.5%	% of area harvested in the CFP FMA

Table 7 shows two statistics for the CFPLZ: the percentage of area harvested in the active landbase, and the percentage of area harvested in the CFP FMA.

Table 7. Statistics for CFP FMA Landscape Zone.

6.7%	% of area harvested in the active landbase
3.0%	% of area harvested in the CFP FMA

Table 8 shows two statistics for the total CFP FMA: the percentage of area harvested in the active landbase, and the percentage of area harvested in the CFP FMA.

Table 8. Statistics for total CFP FMA.

9.9%	% of area harvested in the active landbase
5.5%	% of area harvested in the CFP FMA

Appendix IV Habitat Conservation Strategy: Cold-Water Fish

Overview

The Crowsnest Forest Products (CFP) Forest Management Area (FMA) operates in the Eastern Slopes of the Rocky Mountains. Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) and bull trout (*Salvelinus confluentus*) are native fish species with populations that are provincially and federally listed as Threatened. These cold-water fish and their critical habitat are found throughout watersheds in the FMA. While West Fraser incorporates mitigation strategies for cold-water fish and fish habitat into planning and operations and supports restoration initiatives and research, the province of Alberta has the responsibility to manage fish populations within the FMA.

Cold-water fish share similar habitat requirements, which is why a Habitat Conservation Strategy that will pertain to several species of fish and their habitat has been developed. The strategy within this plan primarily addresses the issues for westslope cutthroat trout and bull trout, but in doing so inherently provides protection for all fish present within the FMA area. Collectively, these native fish require cold, clean, complex, and connected habitat to complete all phases of their life cycle. This Habitat Conservation Strategy acknowledges the status and significance of westslope cutthroat trout and bull trout in Alberta's aquatic ecosystems and outlines key conservation strategies and management considerations.

Species Background

Westslope Cutthroat Trout

The westslope cutthroat trout (WSCT) species is separated into two designatable units (DU). The Pacific populations occur in British Columbia and the Saskatchewan-Nelson Rivers populations occur in south-western Alberta and is the DU of focus in this strategy. In 2005, WSCT were listed as Threatened under the Alberta *Wildlife Act*. The Government of Alberta first released the Alberta Westslope Cutthroat Trout Recovery Plan in 2013 (The Alberta Westslope Cutthroat Recovery Team, 2013). In 2005, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) originally assessed WSCT Saskatchewan-Nelson populations as Threatened, and the population was listed as Threatened under the *Species at Risk Act* in 2013. The Government of Canada released a recovery strategy, including Critical Habitat (Figure 1), in 2014 (Fisheries and Oceans Canada, 2014).

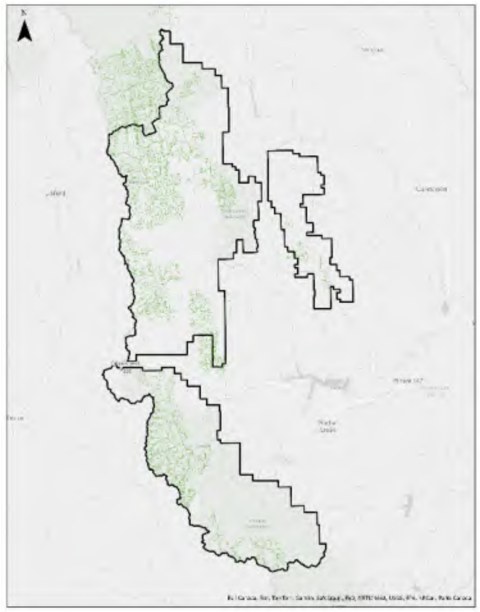

Figure 1: Westslope cutthroat trout mapped critical habitat (green) in C5 Forest Management Unit.

Typical colouration of WSCT is dark green flanks with a white or cream belly, and small, dark spots along their body (Figure 2). They are a medium sized fish, with body size ranging from 30-50 cm, depending on life history. There are three life history forms, the smaller stream-residents, fluvial or adfluvial forms, or river- or lake-based fish, which tend to be larger.

WSCT trout spawn in the spring, between May and July when temperatures become suitable, in both main stem and tributaries. Redds are dug into gravel beds to lay eggs; eggs require clean, flowing water to develop. Fry will emerge in early summer to occupy headwater streams.

Figure 2: Image[3] of a westslope cutthroat trout (Oncorhynchus clarkii lewisi).

WSCT require cold, clean, complex, and connected habitat to support all stages of their life cycle.

[3] https://canmorefishingadventures.com/groups/Cutthroat-Trout/

Cold: They have a thermal preference between 9-18.6 °C and optimal incubation temperatures between 6-11 °C (Sinnatamby et al., 2020).

Clean: Gravel or cobble substrate that are free from sediment or silt are required in every life stage (Fisheries and Oceans Canada, 2014).

Complex: Habitat complexity is also required for every life stage, with riffles being especially important, and pool and backwaters used in most stages. In addition to riffle systems, large woody debris, boulders, undercut banks, and riparian vegetation are important attributes of habitat complexity. WSCT require groundwater seeps and deep pools to overwinter (Fisheries and Oceans Canada, 2014).

Connected: The migratory forms of WSCT require connectivity between rivers and lakes and headwater streams to access habitats required for different life stages (Fisheries and Oceans Canada, 2014).

Historically, WSCT inhabited most streams in southwestern Alberta (Figure 3). Genetically pure strains of this species now only occupy a small fraction of this historical range and are largely restricted to the Rocky Mountains and Foothills Natural Regions of Alberta (Environment and Parks, 2018a). They now have disconnected and relatively small populations, occupying only the uppermost reaches of mainstem rivers and the extreme headwaters of a few major tributaries (Fisheries and Oceans Canada, 2014), having been extirpated from the eastern watersheds of their distribution. While WSCT are limited to cold streams and lakes in southwestern Alberta, cutthroat trout have been stocked extensively into waterbodies across the province, creating a conservation issue for the native population.

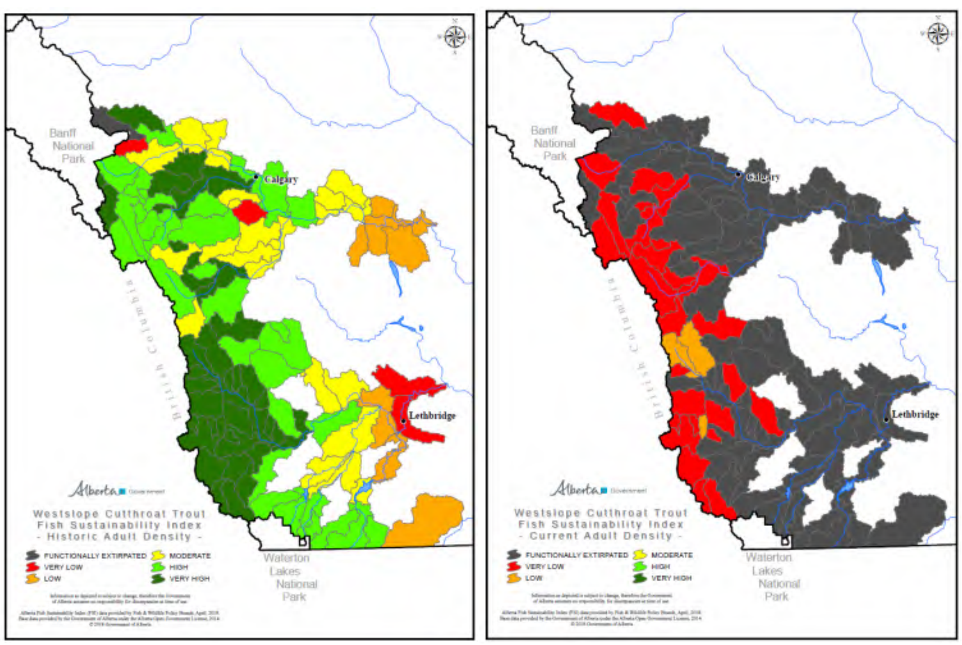

Figure 3: Fish sustainability index (FSI) for historic adult density (left) and current adult density for westslope cutthroat trout, as of 2018.

Bull Trout

There are also two bull trout (BLTR) DUs: the Western Arctic populations which are the northern distribution of BLTR in Alberta and extend north through British Columbia into the Northwest Territories and Yukon, and the Saskatchewan-Nelson Rivers populations representing the southern half of the Alberta BLTR distribution. The Saskatchewan-Nelson Rivers populations are the focus of this strategy. In 2015, BLTR were listed as Threatened under the Alberta *Wildlife Act*. While BLTR were still listed as Sensitive, the Government of Alberta released the Alberta Bull Trout Conservation Management Plan (Alberta Sustainable Resource Development, 2012). The Government of Alberta has since released the bull trout recovery plan in 2023 (Government of Alberta, 2023). COSEWIC assessed Bull Trout Saskatchewan-Nelson population as Threatened in 2012 and the Government of Canada listed BLTR as Threatened under the *Species at Risk Act* in 2019. The recovery strategy, which included critical habitat (Figure 4), was released in 2020 (Fisheries and Oceans Canada, 2020).

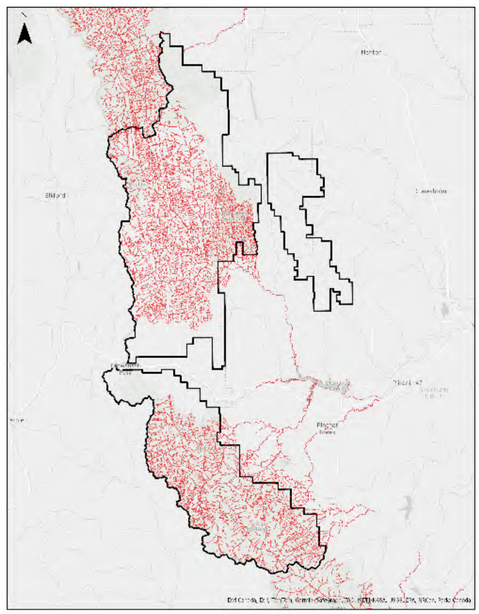

Figure 4: Bull trout mapped critical habitat (red) in C5 Forest Management Unit.

BLTR are a member of the char genus (*Salvelinus*), rather than a true trout, despite their name. They typically have a darker back and lighter sides, with a cream or white belly and pale yellow or white spots (Figure 5). Adults reach 30-40 cm in length, with stream residents being smaller and fluvial and adfluvial forms being larger on average (Sinnatamby et al., 2020).

BLTR spawn in late fall, between mid-August to late October, when temperatures reach 7-15 °C. Eggs will hatch in early spring, under the colder incubation temperatures. BLTR also build redds in gravel beds, requiring clean and flowing water for egg development.

Figure 5: An image[4] of a bull trout (Salvelinus confluentus).

BLTR require cold and clean water with complex and connected habitat to support all life stages.

Cold: Water temperature preference is between 6-11 °C, and between 2-4 °C for egg incubation (Sinnatamby et al., 2020).

Clean: Clean water with low sedimentation is required; however, in addition to cobble and gravel substrates, silt can be used by juveniles and sand may be used for cover (Fisheries and Oceans Canada, 2020).

Complex: Pool and run habitats are preferred by fry and parr, however adults will also use run reaches for reproduction. Additional habitat complexity is used for cover, such as overhanging vegetation, undercut banks, woody debris, and substrate variety. Groundwater upwellings are important for redd site selection and overwintering (Fisheries and Oceans Canada, 2020).

Connected: BLTR required unrestricted passage throughout stream networks at all life stages including migration to spawning habitats, migrating between spawning and rearing sites, and to overwintering areas. Passage can also be limited by gradients over 15% (Fisheries and Oceans Canada, 2020).

Historically, BLTR had high densities along the Eastern Slopes and extended further downstream into parkland and prairie areas (Figure 6). Current densities are low or very low in most watersheds and have been extirpated in some of the eastern watersheds. The central Alberta populations are showing the greatest declines, while the northern populations remain more stable (Environment and Parks, 2018b).

[4] https://canmorefishingadventures.com/groups/Bull-Trout/

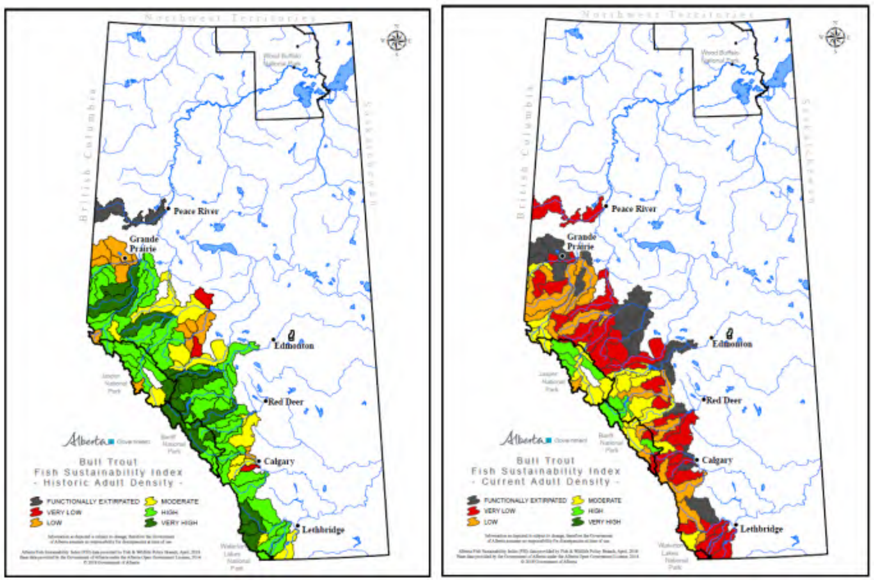

Figure 6: Fish sustainability index (FSI) for historic adult density (left) and current adult density for bull trout, as of 2018 (Government of Alberta).

Species Threats

WSCT and BLTR both require a variety of habitats to complete their life cycles. Disturbance regimes, such as wildfires and floods, are integral to these ecosystems, as they help maintain the dynamic processes that support these species. For example, wildfires can introduce a flux of nutrients that stimulate food production and contribute coarse woody debris to streams, which serves as both shelter and a food source for aquatic life. Floods can significantly alter stream channels by moving substrate, removing fine sediments that create unsuitable habitats, and changing bank structure, which can form new cover or pool habitats.

While natural disturbances can be beneficial for maintaining healthy aquatic systems, land-use disturbances often create unsuitable habitats. For instance, roads and crossings can introduce harmful materials, remove riparian vegetation, and create barriers to fish passage. The cumulative effects of these and other impacts can degrade habitat by altering or removing the cold, clean, complex, and connected environments required by species like WSCT and BLTR. Forestry activities can contribute to these disturbances, therefore mitigation strategies and best management practices for work near water are implemented to minimize negative impacts on fish habitats.

There are several resources that provide detailed information on the threats affecting the populations of these fish species. Recovery strategies and plans developed by the federal and provincial governments, respectively, outline the known pressures on these populations. In addition to these recovery strategies, watershed-level threats can be assessed for individual species using the Joe Model, created by the Government of Alberta (MacPherson et al. 2020) for tactical restoration planning. This model ranks the relative importance of various threats within each watershed, offering valuable insights into the specific challenges faced in an area of interest. To gain a more comprehensive understanding of how different activities in and around water impact fish and fish habitats, Fisheries and Oceans Canada has developed a series of Pathways of Effects as a resource (Fisheries and Oceans Canada 2024).

Not all threats to these species are directly related to forestry, as multiple stakeholders using the land base may contribute the same or different threats to native fish populations. The specific threats to WSCT and BLTR and their critical habitats are outlined below, based on provincial recovery plans and federal recovery strategies.

Westslope Cutthroat Trout

Major threats and activities likely to disturb or destroy critical habitat or interrupt life processes (Fisheries and Oceans Canada 2019):

A. Changes in flow from dams, forest cover removal (harvesting and fire), and water extraction resulting in a reduction of available habitat for spawning, overwintering, feeding, migration, and cover.
B. Sedimentation from forest harvest, linear disturbance, urbanization, mining, agriculture, OHV use, instream construction, etc. resulting in a reduction of habitat for spawning, overwintering, feeding, and cover.
C. Habitat loss (fragmentation and alteration) from dams, dam structures, improper crossing structures, etc. resulting in loss of access to habitat and reduction in available habitat for spawning, overwintering, feeding, and cover.

Activities related to forestry that could impact or destroy critical habitat (Fisheries and Oceans Canada 2019):

A. Changes in flow via mechanical forest removal reduces habitat for spawning, nursery, overwintering, feeding, and cover.
B. Sedimentation from forest removal and linear disturbance (roads and crossings) that reduces habitat available for spawning, nursery, overwintering, feeding, and cover.
C. Habitat loss, fragmentation, or alteration from linear disturbances that reduce available habitat for spawning, nursery, overwintering, feeding, and cover.

Bull Trout

Major threats and activities likely to destroy critical habitat (Fisheries and Oceans Canada 2020):

A. Habitat alteration and removal from linear disturbance, forest cover removal (harvesting and fire), other land use such as agriculture, livestock, oil and gas exploration and extraction, and water extraction resulting in loss of habitat for spawning and overwintering and reduction of quality of habitat.
B. Habitat fragmentation from linear disturbance and change in water flow resulting in a loss of habitat affecting reproduction and overwintering.

Activities related to forestry that could impact or destroy critical habitat Fisheries and Oceans Canada 2020):

A. Habitat alteration and removal from linear disturbance of road and crossing construction and maintenance resulting in loss of habitat for spawning and overwintering, loss of cover, loss of terrestrial food sources, and sedimentation.
B. Habitat alteration and removal from temporary diversions or permanent removal of a watercourse resulting in loss of habitat.
C. Habitat alteration and removal via forestry operations resulting in loss of cover, loss of terrestrial food sources, sedimentation, and a reduction on quality of habitat.
D. Habitat fragmentation from linear disturbances resulting in loss of habitat.

Alberta Recovery Plan (Government of Alberta 2023):

A. Sedimentation from unpaved resource extraction roads and watercourse crossings.
B. Barriers to movement from road crossing failures (i.e., hanging culverts) or improper installation (i.e., small diameter results in too high-water velocity).
C. Angling mortality and poaching via increased access to remote areas.

Other Factors Affecting Native Trout

Non-native species introduced to the FMA waterbodies include brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), cutthroat trout (*Oncorhynchus clarkii*), and rainbow trout (*Oncorhynchus mykiss*). Stocked species can directly compete for resources with native species and have expanded beyond the waters where they were introduced. Hybridization can occur between native and non-natives species and result in mixing of genetic material. This impacts the gene pool and population size of native species, which is a threat to population persistence and recovery.

Whirling disease and infectious pancreatic necrosis are two diseases that affect salmonid species. Forestry operations have the potential to spread disease during in-stream work if best management practices and decontamination guidelines are not followed. Mitigating the spread of whirling disease should be a priority for forestry operators, as the disease can have devastating impacts on native salmonid species.

Angling (both consumptive and non-consumptive) poses significant pressure to native fish in Alberta. Waters with good angler access typically experience higher angling pressure and therefore have an increased risk of direct, human-caused mortality. Forestry operations have the potential to influence angling pressure by increasing public access through the creation of access roads required for harvest operations.

Other limiting factors may include climate change, natural disturbance (i.e., mountain pine beetle and fire), and accidents (i.e., railcar derailments, tailing breaches, etc.). These factors are not easily quantified, and there is limited understanding of the severity of their direct and indirect impacts, as well as interacting effects with other threats or current distributions. Climate change is assessed as a medium-low threat for westslope cutthroat and medium-high threat for bull trout, based on the IUCN threat assessment (see Sinnatamby et al. 2020).

Another important factor to consider is the cumulative effect of landscape-wide disturbances. With multiple users of the landbase, a variety of disturbances—such as industrial development, agriculture, urbanization, and recreational activities—can have significant and overlapping effects on fish and their habitats. While each individual stressor may have a direct or indirect impact on the species, cumulative impacts refer to the combined effect of these stressors interacting with one another. These impacts can arise from factors such as habitat loss, climate change, pollution, over-exploitation, invasive species, and other human activities. The additive effects and interactions among these disturbances make it difficult to quantify the total impacts on fish and their habitats, presenting significant challenges for effective management and conservation.

Potential Forestry Impacts to Fish and Fish Habitat

The effects of forestry activities can have a direct or indirect impact on fish and fish habitat. The ways in which forestry most frequently interacts with fish habitat are through the alteration of riparian vegetation, working in water during the installation of certain crossings, and water level or flow modification. Regular operations have low likelihood of directly interacting with fish. While some of the activities pose a risk of direct mortality to fish, the risk can be mitigated by working outside of the restricted activity period whenever possible and adhering to codes of practice.

Removing or disturbing riparian vegetation primarily relates to changes in water flow and changes to bank and channel characteristics, which can impact various aspects of fish habitat. Riparian vegetation regulates both groundwater and surface drainage pattern. When these flows are impacted, particularly a decrease in baseflow, there are potential consequences to fish habitat through changes to temperature regimes, habitat availability and connectivity, habitat complexity, and food supply. When bank stability is altered, or channel structure changes, there is potential for water quality and habitat availability to decrease.

The influence of forestry on water level or flow modification also relates to the extent of harvested area in the watershed. Removing tree volume can increase surface flow and alter ground water flow patterns. In stream, this effect can result in changes to timing and volume of peak flows. These flow characteristics are important for timing of life stages, such as migration and spawning, and for habitat factors, such as regulating stream temperature and creating complex habitat features.

Working in water can directly alter channel morphology and water quality. Installing structures like culverts can directly affect bed and bank morphology, and changes in water flow caused by these structures can further alter these features. The physical disturbance of the stream and changes to the banks can introduce harmful materials and increase sediment load in the water, negatively affecting water quality and fish habitat.

<u>Water Temperature</u>

Water temperature plays a crucial role in determining the distribution of aquatic species, with rising annual average maximum temperatures potentially restricting their ranges further. Key factors regulating water temperature include groundwater inputs, riparian shading, and watershed disturbances that alter water yield. Groundwater plays an essential role in temperature regulation; it is particularly important for egg incubation and maintaining high-quality overwintering habitat.

The removal of riparian vegetation can affect temperature in different ways. While riparian vegetation would normally moderate direct exposure to sunlight, removing riparian vegetation reduces shading over watercourses. A reduction in riparian vegetation can also alter land drainage flows, impacting baseflow levels. In combination with alterations of cold-water inputs from groundwater, these can contribute to elevated stream temperatures. On a watershed scale, forest harvest further modifies surface and groundwater flows, also contributing to altered stream flows and expected temperature regimes.

<u>Habitat Complexity</u>

BLTR and WSCT rely on complex habitats throughout their life cycles, though each species and life stage will interact with these features in different ways. Both species are commonly associated with flowing streams featuring complex channels, riffles, pools, spawning sites with clean gravel, cover found under cut banks and coarse woody debris. The presence of a variety of substrates and functional riparian vegetation enhances habitat complexity, which is critical for supporting migration, overwintering sites, and cover.

Forestry activities can reduce habitat complexity by impacting the riparian zone and in-stream features. The removal of riparian vegetation, for example, diminishes important aquatic organic structures, such as overhanging vegetation and coarse woody debris, that provide essential cover and contribute to habitat complexity. When riparian vegetation is disturbed or removed, it also disrupts bank function, altering groundwater and surface water flows. These changes can lead to channel and bank scouring altering channel morphology and wetted areas critical for fish habitat. Changes to substrate composition and deposition will also affect available cover habitat. Higher rates of sediment deposition will eliminate the spaces found among larger substrates, such as boulders and cobbles, that are used as cover.

Habitat Connectivity

BLTR and WSCT have complex life cycles that require fish to move freely through connected waterways at different life stages. Both species have migratory forms that will travel to suitable habitat during the spawning period, and return to larger rivers or lakes afterwards. Migration also occurs between hatching and rearing grounds. Passage barriers can disrupt migration, block access to essential habitats, and fragment populations. These barriers may not always be physical obstructions, such as poor stream crossings, dams, or waterfalls. They can also include unsuitable habitat conditions, such as elevated water temperatures in stream reaches, altered flow through culverts, or steep gradients, all of which can discourage or prevent fish movement.

A common issue on the landscape is poorly designed or poorly maintained crossing structures, such as culverts, which create physical barriers to movement and restrict fish access to essential habitats. Additionally, forest harvesting can indirectly affect fish movement by altering water flows, which impacts the natural flow regime and disrupts habitat quality and connectivity. The removal of riparian vegetation and the resulting changes in flow can also impede fish movement, limiting access to critical habitats. These modifications may alter migration patterns, as fish tend to avoid areas with low flows or elevated temperatures caused by these changes.

Water Quality

Both species require clean, cold water throughout their life stages. Water quality factors that influence fish habitat suitability include suspended sediment, nutrients (such as different forms of phosphorus and nitrogen), pH, dissolved oxygen, and temperature. The addition of organic and inorganic materials, particularly fine sediments, can negatively impact water quality and degrade habitat conditions.

Forestry harvest activities can degrade water quality through several mechanisms that introduce deleterious materials into watercourses. The removal of riparian vegetation and the resulting slope alterations or bank instability expose soils leads to increased erosion and runoff. Changes to flow regimes, such as those caused by altered stream channels or altered water volumes, can further exacerbate these effects, resulting in bed and bank scouring. Combined with ongoing erosion, these disturbances can disrupt channel stability and morphology, altering sediment supply and deposition patterns.

In-water forestry activities can also cause substrate disturbances, resuspend sediments, and potentially introduce harmful substances into the water. Whenever forestry activities interact with water, there is the potential for the introduction of deleterious materials. Maintaining proper erosion and sediment control measures is essential to mitigate these risks and protect water quality for fish habitat.

Water Flow Regimes

Water flow regimes are crucial for cold-water trout because they directly influence habitat quality, availability, and connectivity. Consistent and stable flows help maintain key habitat features like riffles, pools, and spawning areas with clean gravel, which are essential for different life stages of these species. Proper flow regimes also regulate water temperature and dissolved oxygen levels—both critical for the survival of cold-water species. Furthermore, natural flow patterns support migration by ensuring pathways remain accessible and free from barriers.

Disruptions in flow, such as reduced baseflows or sudden fluctuations, can fragment habitats, increase sedimentation, elevate water temperatures, and reduce the quality of spawning or rearing areas. These changes ultimately reduce habitat quality, impacting cold-water fish populations and their ecosystems.

The timing and magnitude of peak flows are critical for cold-water trout as they shape the physical and ecological characteristics of their habitats. Peak flows, typically occurring during spring snowmelt or after heavy rains, are essential for maintaining channel structure, flushing fine sediments from gravel beds, and creating diverse habitat features like riffles and pools. These habitats are crucial for spawning, rearing, and feeding. The timing of peak flows is equally important. If they occur outside of natural seasonal patterns due to altered flow regimes, it can disrupt key life stages like spawning or migration. For example, late or excessively high peak flows can wash away eggs or disturb fry, while early peak flows may not align with the availability of suitable habitats.

Water velocity also plays a key role in habitat suitability for fish. Changes in water velocity can result from alterations to peak flows or modifications to channel structure, including natural barriers like woody debris or human-made structures like riprap and culverts. While adult WSCT and BLTR can tolerate velocities up to 1.0 m/s (Sinnatamby et al. 2020), their fry and parr require slower-moving waters and often use backwaters and side channels for refuge.

Changes in peak flow following forest harvest are variable, depending on the location of roads, location and size of cut blocks, and watershed characteristics. However, in general, forestry activities tend to increase peak flows and shift their timing earlier. The removal of riparian vegetation due to forestry operations disrupts both ground and surface water flows, altering baseflow patterns and modifying land drainage systems, all of which can further impact flow regimes and habitat quality.

Food Supply

Food supply is generally not considered a major limiting factor for species BLTR and WSCT, as these fish primarily feed on invertebrates from both aquatic and terrestrial sources. Their food comes from three main sources: drift, benthos, and terrestrial inputs from overhanging vegetation. Organic nutrient inputs and warmer temperatures can increase the productivity of watercourses, which in turn supports invertebrate communities. These organic inputs can come from various sources, including runoff (especially following wildfire), aquatic and terrestrial vegetation, and other organic matter contributions.

Forestry harvest activities can impact fish food supply by altering organic contributions to watercourses, changing nutrient levels, and affecting overall productivity, which can alter the abundance and types of food sources. Additionally, changes in water temperature resulting from forestry operations can influence the productivity of a watercourse, further impacting food supply. Forestry activities that disturb substrates, such as those associated with road construction or stream crossings, can also harm benthic invertebrate habitats. Loss of interstitial space due to changes in substrate composition, compaction, or sediment deposition of harmful materials can degrade invertebrate habitat, reducing the abundance and diversity of macroinvertebrate food sources for fish.

Current Research and Future Commitments

West Fraser supports research and monitoring related to fish habitat and fish recovery, across the Eastern Slopes. These programs are supported through our partnerships, collaborations with subject matter experts, and in-house monitoring. West Fraser commits to the following research programs, with the goals of 1) filling knowledge gaps related to the impacts of forestry activities on cold water fish and fish habitat, and 2) continuous adaptive management by applying research outcomes to forestry practices.

Current projects:

1) *Stream temperature monitoring*
   Stream temperature monitoring has been occurring in Alberta as early as 1987. Temperature data has been consolidated and is being managed by fRI Research (fRI) and modelling conducted by MacDonald Hydrology Consultants Ltd. (MacHydro). Data has been contributed by several stakeholders, with 1002 unique monitoring locations and deployment durations from 1 year to 33 years (Figure 7). fRI is continuing to collect stream temperature data to fill in gaps in locations in the Eastern Slopes. In the Crowsnest Fores Products FMA, there are 32 temperature sites, deployed from 1 to 3 years (Figure 7).

   This long-term temperature data set provides information on baseline temperatures and trends over time. On-going monitoring will help understand the threat of increasing stream temperatures, and how that relates to both the cumulative effects of land-use practices and climate change.

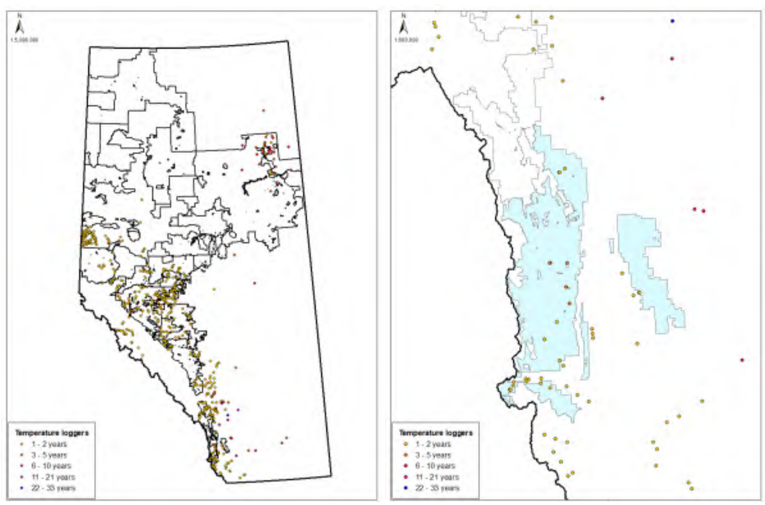

Figure 7: Locations of temperature loggers deployed in Alberta and in C5, respectively. Loggers have been deployed at the same location for between 1 to 33 years.

2) *Riparian sensitivity modelling*
   MacHydro has built a model to describe the sensitivity of riparian areas (Figure 8), using LiDAR-derived digital elevation models. A model for each West Fraser division will be created; C5 has been completed. Training will also be provided by MacHydro to learn model interpretation and limitations of the data. The implementation of this model into forestry practices will be for strategic planning, operations, and restoration of riparian areas. This tool can be applied when planning harvest blocks and during road building, to avoid sensitive riparian areas and maintain water connectivity. The model

can also be used to inform riparian restoration, selecting highly impacted sensitive areas to restore riparian areas beyond a standard 30 m buffer.

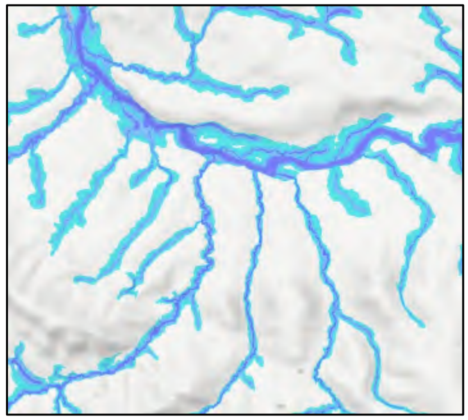

Figure 8: Riparian sensitivity modelling output for the Hinton FMA and a close-up view of a watercourse system. Connectivity is scaled low, medium, and high.

3) *Southern Rockies Watershed Project (SRWP)*
The SRWP, established by the University of Alberta under the direction of Dr. Uldis Silins, seeks to understand hydrological responses to wildfire and harvest disturbances in Eastern Slopes headwaters. West Fraser supports the research being conducted in the SRWP and will apply the relevant results to harvest practices.

4) *Research on the effects of crossings on water quality*
Through fRI and their Fish and Water Program, a study was completed with MacHydro, and Dr. Dan Moore in Crowsnest Pass in summer 2024 to understand the effects of resource roads on stream temperatures. The objectives are to understand 1) effects of crossings on stream temperature, and 2) if there is an effect on temperature, what is the distance downstream where temperature recovers.

5) *Collaborations with other organizations*
West Fraser will foster connections and support opportunities to collaborate with local organizations on their work related to fish and fish habitat recovery. Specific examples include:
- fRI Water and Fish program support.
- Native Trout Symposium support.
- Membership in the Foothills Stream Crossing Partnership (FSCP) to comply with the Alberta Watercourse Crossing Management Directive .
- Coordination with provincial and federal governments to align research and project development, including for offsetting work.
- Support aquatic biomonitoring efforts by Watershed Planning and Advisory Councils (WPACs).
- Freshwater Conservation Canada support.
- Previous and ongoing relationships and financial support with researchers at the University of Alberta and Calgary.

Projects under development:

6) *Whirling disease research*

   Whirling disease is a risk to trout in the Eastern Slopes, causing reduced fitness and death. West Fraser is working with Dr. Patrick Hanington (University of Alberta) to conduct research on whirling disease to better understand the disease in different watersheds and potential for fish infection. Project development is underway for a five-year research program. This work will answer questions relating to disease risk, which can be directly applied to species recovery assessments.

7) *Watershed monitoring program*

   West Fraser Cochrane is developing a watershed assessment program in C5 to understand changes to hydrology and aquatic habitat in response to timber harvest. The two main objectives are: 1) to assess and validate hydrological risk, 2) assess impacts to aquatic habitat, and 3) monitor for long-term impacts under different harvest scenarios.

   To address the first objective, WFC is engaging MacHydro to conduct a watershed assessment and partial risk analysis for the C5 FMA. This work will provide higher level of detail related to potential changes to flow, relative to an equivalent clearcut area analysis.

8) *Watershed restoration inventory*

   WFC is developing a project to inventory disturbances and restoration opportunities in the Eastern Slopes. This work is supported by the Government of Alberta and Fisheries and Oceans Canada (DFO), to ensure restoration is collaborative and coordinated. This work will indicate priority watersheds and restoration priorities within watersheds that can be used by members interested in restoring fish habitat, and will be especially useful for pursuing meaningful offsetting projects.

9) *Modelling applications to guide management in the eastern slopes*

   fRI is developing a web-hosted hydrological modelling application that assesses the cumulative effects of forest harvest and climate change on hydrological indicators of watersheds. This tool will be used for risk-based assessments to support forest management strategies to mitigate hydrological impacts to streams in the Rocky Mountains and Foothills. This tool can be used by forestry professionals, WPACs, and government to understand cumulative effects of proposed harvest plans.

Mitigation

Given our understanding of how forestry activities can affect fish and fish habitat, both strategic and operational strategies are employed to mitigate negative impacts. Strategies and practices will evolve over time as new knowledge and techniques are acquired. This section will review strategic and operational opportunities for mitigation and best management practices for working near water.

Strategic Mitigation

- Aquatic and Riparian Area Protection: The timber supply landbase includes predicted buffers around watercourses and lakes. Buffer sizes range from 10 m to 100 m, as required by regulations. This information was used in spatial harvest sequence development and will be verified in the field before operations, following both the company's ground rules and, if applicable, the approved recovery strategy. Buffers that exceed requirements may be applied in some cases.
- Access Management**:** Access for forestry purposes will adhere to the thresholds for Open and Restricted Motorized access identified in the Livingstone Porcupine Hills Land Footprint Management Plan.
    - Control access by avoiding parallel roads to streams.
    - Control access by closing roads to public access.
    - Reduce road density by deactivating and reclaiming roads.
- Wildfire Risk Reduction: Timber supply modeling evaluates the goal of reducing wildfire risk on the forest management area of the designated forest area (DFA) and the resulting wildfire threat and its effects on fish habitat.
- Changes in Water Quantity**:** Equivalent clearcut area (ECA) calculations are used in forest harvest planning to understand water yields in successional forests and to balance benefits and risk to water flow regimes in watersheds. Evaluating the goal in the timber supply model to maintain equivalent clearcut area (low risk category) below 30% to mitigate impacts on changes to water quantity and aquatic habitat in ECA units that overlap identified critical habitat (as per Crowsnest Forest Products FMA 2100047 Watershed Values Assessment, May 2023).
- Disturbance Limits on Erodible Soil: Minimizing the amount and duration of roads that are within 100 m of a stream with highly erodible soil, as per the limits set in Section 3.1 of the Livingstone Porcupine Hills Land Footprint Management plan and erosion and sediment control BMPs.
- Federal/Provincial Recovery Document Adherence: Adhering to relevant federal and provincial recovery strategies and plans, respectively, for species at risk. This may include the use of professional biologists to aid with compliance and implementation of the Recovery Strategies and authorization following federal legislation for the *Fisheries Act* and *Species at Risk Act*.
- Watercourse Crossing Program (WCP)**:** Members of Foothills Stream Crossing Partnership to comply with the Watercourse Crossing Management Directive, record inspections of status and progress towards remediation.
- Best Management Practices (BMP): Employing best management practices to ensure highest standards are being used and met, and continuously adapting practices as new information becomes available.

Operational Mitigation

- Follow *Fisheries Act* and *Species at Risk Act* procedures for authorization to work in Critical Habitat and guidance from Fisheries and Oceans Canada, wherever applicable.
- Follow best available guidance, operating ground rules, and management plans from the Government of Alberta, wherever applicable.
- Disinfecting equipment to prevent spread of disease.
- Road building and crossing installation:
    - Employ best available BMPs.
    - Following federal and provincial codes of practice when applicable.
    - Use best tools and information available for identifying sensitive areas to avoid, such as:

        - LiDAR bare earth models.
        - Riparian Sensitivity model.
        - Wet areas mapping.
    - Adhere to timing restriction windows for sensitive and wet soil areas and fish.
    - Use of clear span structures when flowing water is present at time of installation, or when site conditions dictate the need for an open bottom structure.
    - Timely reclamation of temporary roads, as required in the provincial or company specific operating ground rules.
    - Minimize permanent roads and permanent watercourse crossings.
- Environment and Sediment Controls (ESC):
    - Employ best available BMPs.
    - Employ avoidance and mitigation measures.
    - Progressive installation of ESC measures as roads and crossings are built and on exposed ground. Multiple ESC measures to be used, as needed.
    - Maintenance of ESC measures throughout their lifespan.
    - Ongoing monitoring and inspection program of roads and crossings to identify and prevent ESC issues.

Best Management Practices

Best management practices (BMPs) are proactive and voluntary practical methods of practices used during forest management to achieve results related to sustainable forest management. BMPs are provided to identify good planning techniques and procedures that will reduce undesirable impacts of forest management activities on Crown land and its competing resources (Alberta Timber Harvest Planning and Operating Ground Rules 2024). BMPs continually adapt and improve by incorporating new information through adaptive management. Examples of BMPs that can be implemented include the following.

Roads

- When selecting road locations:
    - Avoid the creation of negative approaches.
    - Avoid long sections of road that are parallel watercourses.
- Limit watercourse crossings.
- Minimize sizes of clearings and road widths where possible.
- Additional tools can be used for planning, such as READI model.

Road Maintenance

- Cross ditches tied to cut banks and in place on all inactive roads at all times of the year. Cross ditches maintained during site preparation and tree planting operations. They will be installed at appropriate intervals, dependent on road grades.
- Active roads regularly graded to maintain functionality of rolling dips and crowned surfaces so road drainage is functioning during active operations.

Crossings

- Avoid placing fill or other temporary or permanent structures below the high ordinary water mark.
- All types of crossing structures have positive approaches, where terrain permits.

- Surface approaches and crossings have woven geotextile underlayment on subgrade.

Erosion and Sediment Controls

- When ditches are used, install ditch relief as needed.
    - Ditch relief structures should be installed before a watercourse crossing, to disconnect road and ditch drainage from watercourses.
- Installation of surfaced rolling dips (only effective on grades less than 10%) must have full grade reversal to remove water of road. Install rock armoring/surfacing at outlet as needed.
- Installation of rubber water diverter (flapper, driveable) cross drains on grades greater than 10%.
- Minimize road grades and prolonged distances in steep terrain.
- When road grade is greater than 8%, or inslope roads (3-5%), install ditch relief as needed.
- Cross drain culverts should be skewed 20-30 degrees for efficiency, be tipped down 4% and be long enough to not be covered by the fill slope. Culvert outfalls may require rock armouring. Compact fill around culvert openings to prevent leakage.
- Construct catch basins with stable side slopes and rock armour them to prevent undercutting and water running under the culvert.
- Installation of slash filter windrows.
- Compact topsoil at toe of fill (above slash filter windrow).
- Grass seed fill slopes.

Forest Management Plan

A native trout VOIT (14-2) was created to track watercourse crossings and road density in trout bearing watersheds (HUC 8). This resulting information from this VOIT will contribute to understanding and managing access and road densities.

Ground Rules Implication (Company Specific Addendum):

- Equivalent clearcut area (ECA) analysis shall be recalculated during AOP development for any watershed.
- If there is potential for near stream motorized access levels to exceed the company specific target, analysis will be undertaken to determine actual density (relates to the company specific VOIT #5-3).

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Appendix V Forest Encroachment Strategy

Background

The CFP 2025 FMP has been developed to align with the vision, outcomes, strategic direction, objectives, and priorities set out in the South Saskatchewan Regional Plan (SSRP) and associated subregional plans, including the Livingstone-Porcupine Hills Land Footprint Management Plan.

The Livingstone-Porcupine Hills Land Footprint Management Plan has identified commercial forestry as a technology to mitigate forest encroachment onto grasslands. As such, the CFP has developed a forest encroachment strategy.

The forests began to see impacts from the Industrial Revolution in the late 1800s, and fire suppression programs were fully established by the 1920s as fire lookouts, aerial surveillance systems, and wildland firefighting crews were widely established. In Alberta, the time prior to the 1800s is referred to as the pre-industrial period.

Pre-industrial landscapes were generally comprised of younger vegetation, and significantly more area was occupied by early seral species, including grasslands, brushlands/grasslands comprised of young aspen stands and grass, mixedwood, and lodgepole pine forests.

Given that significantly more of the landscape was comprised of early successional stages, there was likely much more grass contributing to the composition of all vegetation communities—including forests. Native grasslands saw the largest reduction in total area since the post-industrial era.

Without a disturbance agent on the landscape, forests tend to move toward older age classes and more shade-tolerant species such as spruce. Forests also tend to expand into areas they likely didn't occupy historically, such as native grasslands and wetlands. This leads to increased fuel loading across the landscape, potential increases in forest health issues, loss of early seral habitat important to ungulates, and an increase in high-severity wildfire risk.

Encroachment issues within these ecosystems are influenced by a wide range of factors, including but not limited to soil type and moisture, fire regime, extent of grazing or other land use activities, invasive species, and climate change.

Some examples of plant communities impacted by tree and shrub encroachment include:
- Native grasslands;
- Open forest lodgepole pine and Douglas-fir ecosystems (savannah);
- Young aspen brushlands/grasslands that are now overmature aspen brushlands, often with spruce or Douglas-fir seedlings/saplings in the understory; and
- Willow and brush dominated wetlands – brush is old, large and dying out, often with spruce seedlings/saplings in the understory.

On May 26, 2023, the Government of Alberta, Forestry, Parks and Tourism wrote a document entitled *Minimizing Forest Encroachment in Successional Transition Areas in the Crowsnest Forest Products Ltd. 2025 Forest Management Plan* (Annex VII) . The purpose of the document was to help guide the FMP planning process in alignment with the 2018 South Saskatchewan Regional Plan (SSRP) and the 2018 Livingstone-

Porcupine Hills Land Footprint Management Plan. The document provided a modelling approach to help identify potential forest encroachment onto grassland areas known as successional transition areas.

The document states:

> *Multiple management initiatives could reduce forest encroachment and help restore healthy, biodiverse ecosystems. Restoration treatments should work with natural systems; and recognize that successional transitional areas can be multiple vegetation types depending on the timing and severity of its last disturbance. Rather than holding areas to certain vegetation types, restoration treatments should assess a successional transition area's successional potential and set back portions to previous successional markers. The intention is not to intervene in natural processes and permanently maintain vegetation types but to maintain a mosaic of ever-changing succession stages from grasslands to forests.*

Discussion

From a commercial forestry standpoint there are challenges when it comes to harvesting timber in encroachment areas including but not limited to:

- Timber harvesting in nonmerchantable stands is not commercially feasible;
- Current lack of waste to energy, wood pellet, or biomass facilities that create demand for unconventional feed stocks such as small trees and shrubs; and
- Areas harvested and not regenerated according to the Alberta Reforestation Standards have historically been removed from the companies timber supply.

However, there are forest encroachment transitional areas that can be operationally feasible having the following attributes:

- Areas have been identified as potential transition areas in the GoA model;
- Are greater than 100 years old (the period of time originating to effective fire suppression);
- Have the minimum merchantability standards of 80 m^3/hectare but less than 130 m^3/hectare (assumption is that transitional grassland plant communities will not likely accrue volumes greater than 130 m^3/ha.);
- No less than 80 m^3/ha is harvested (in stands having greater than 80 m^3/ha some overstorey retention may be possible); and
- Field verification attributes:
    - Area is immediately adjacent to grasslands.
    - Receding bunch grass community.
    - Overstorey stand stagnation.
    - Stagnated leader growth (flattening/rounding of crowns).
    - Stagnated radial growth (diameter cores indicate more than 10 rings per cm).Areas are located within the contributing or noncontributing landbase and are adjacent to planned SHS.

Harvest Prescriptions

There are challenges with using traditional silviculture prescriptions as the prescriptions are designed for forest renewal and involve fully stocked, mature stands. Therefore, the below modified harvesting approaches could be used in conjunction with GoA participation, including but not limited to:

- Overstory removal (taking all merchantable stems from the overstory); and
- Whole tree skid to roadside and pile.

CFP Values, Indicators, Objectives, and Targets identified for the 2025 FMP

Value	Objective	Indicator	Targets	Reporting
5.2.2 Provide opportunities to derive benefits and participate in use and management	5.2.2.2 Reduce forest encroachment onto grasslands	Forest encroachment onto grasslands is reduced in successional transitional areas	a) Reduce forest encroachment onto grasslands by the inclusion of 125 ha of successional transition areas in each of the first decade of the SHS (79 ha of contributing & 46 ha of non-contributing landbase). b) Slow the transition from grassland to forest in harvested successional transition areas by implementing alternative silviculture strategies.	FMP: Map showing identified successional transition areas planned for treatment on the contributing (planned SHS) and non-contributing landbases in the first decades. Performance: 5 year Stewardship Report a) Report harvested successional transition areas in the contributing (actual SHS) and noncontributing landbases (map and table indicating the harvest areas and what alternative silviculture strategy was implemented in each). 10 year Stewardship Report a) Report harvested successional transition areas in the contributing (actual SHS) and noncontributing landbases (map and table indicating the harvest areas and what alternative silviculture strategy was implemented in each), and b) Report outcomes of each alternative silviculture strategy implemented to slow the transition from grassland to forest in successional transition areas.

Appendix VI Minimizing Forest Encroachment in Successional Transition Areas in the Crowsnest Forest Products Ltd. 2025 Forest Management Plan Strategy

Minimizing Forest Encroachment in Successional Transition Areas in the Crowsnest Forest Products Ltd. 2025 Forest Management Plan

Introduction

The South Saskatchewan Regional Plan (SSRP) was established to provide guidance for land use decisions in the southern portion of Alberta. Sustaining the intactness of native grasslands is a key objective in attaining the outcome that biodiversity and ecosystems are sustained through shared stewardship (Alberta Government 2018). This includes enhancing and restoring native grassland habitat to contribute to the recovery of key wildlife species. Integrated Crown land management is imperative to achieve SSRP objectives and one of the strategies highlighted is the implementation of the Livingstone-Porcupine Hills Land Footprint Management Plan. Integrated land management practices within this subregional plan includes commercial forestry supporting management of non-timber resources including forest encroachment onto grasslands. This document highlights that forest management planning and operations could be influential in minimizing forest encroachment in key areas and promote healthy, biodiverse ecosystems.

In this context, forest encroachment is the advancement of trees onto areas that were historically maintained as treeless (Page 2002). This includes the ingrowth of smaller shade tolerant trees into savanna types that have low-density larger diameter trees dispersed throughout grassland species dominated communities. Once established, encroached trees change the ground level vegetation as well as productivity to forest vegetation types. As forest encroachment increases across the landscape, diversity of species and habitat decreases due to the landscape transitioning to one vegetation type.

Alberta's landscape has changed considerably over the last 150 years. Forest encroachment has had an effect throughout, including the eastern slopes. Forest encroachment is the result of less frequent fires and modified grazing regimes from historic free ranging large herbivores. Trees and shrubs have encroached into areas historically maintained as grasslands, and shrubs and trees have increased in understories of mature fire-resistant forests.

Present day natural landscapes particularly where grasslands, shrublands and forests form a mosaic are now significantly out of balance compared to what was historically maintained through natural processes. Although dry areas still maintain grasslands, and mesic to subhygric areas remain forests, the transitory spaces between these that have the potential to be either grassland or forest are now commonly the latter. Remote sensing measurements suggest grassland losses to tree and shrub encroachment averaged 10% between 1949 to 2006 (Didkowsky et al. 2010). In southeast British Columbia it is estimated that 1% of grassland and open forests are lost annually (Page 2002). This has resulted in historically maintained grasslands or dry forest savannahs now having understories changed from primarily grass and forb species to woody species (Page 2014). These changes have reduced diverse wildlife habitat and grazing opportunities and increased the risk of more intense and destructive fires.

Multiple management initiatives could reduce forest encroachment and help restore healthy, biodiverse ecosystems. Restoration treatments should work with natural systems; and recognize that successional transitional areas can be multiple vegetation types depending on the timing and severity of its last disturbance. Rather than holding areas to certain vegetation types, restoration treatments should assess a successional transition area's successional potential and set back portions to previous successional markers. The intention is not to intervene in natural processes and permanently maintain vegetation types but to maintain a mosaic of ever-changing succession stages from grasslands to forests. In all cases, restoration treatments should maintain soil structure to promote natural progression, reduce risk of soil erosion, and undesired vegetation changes by introduced species or weeds (Alberta Sustainable Resource Development 2010, Adams et al. 2016). For example, practices that cause surface disturbance in fescue grasslands result in the introduction and dominance of non-native grasses.

To identify locations suitable for ecosystem restoration, this document discusses a study that partitioned the landscape into three general categories: areas most commonly grasslands, permanently forested areas, and the successional transition areas where restoration treatments are most likely to be beneficial. Permanent grasslands and shrublands (including encroached grasslands that are becoming shrubby) usually persist on dry southwest facing grasslands and top slope knolls. These typically do not attain enough annual moisture to grow forests. Permanent forest cover commonly occurs on more moist northeast slopes, as well as mesic south facing slopes. After a disturbance, higher annual moisture allows these to recover quickly back to forest cover. Removing these two permanent ecosystem types leaves a significant area that can be both forest or grassland phases, depending on the timing and severity of its last disturbance. These most commonly occur on southwest facing slopes, and dry northeast upper slopes. Without disturbance, these successional transition areas will eventually move to a forested state, often to low-density coniferous species, or aspen particularly on mesic southwest facing slopes. Once disturbed, they do not quickly move back to forests, but rather change slowly through successional stages.

The Alberta Vegetation Inventory (AVI), coupled with aspect attributes is a useful tool to highlight these three vegetation types on Alberta’s eastern slopes mosaic landscape. Areas that are still naturally occurring grasslands or shrublands, even after a century of fire suppression or other disturbance are considered as permanently open. In turn, permanent forests are most commonly northeast facing forests, or mesic and moister southwest facing aspects. These areas are often selected for timber harvesting as their rapid response ensures timely regeneration of trees. These are attributed as northeast facing mesic and all but the lowest density dry forests, and southwest mesic dense coniferous stands. The remainder of the natural landscape is identified as successional transition areas. This are attributed as northeast dry, low-density forests, southwest dry and low-density mesic forests, and mesic high density aspen stands. The following utilizes these criteria for meaningful interpretation of a portion of the eastern slopes landscape and highlights successional transition areas.

Methods

To show the utilization of AVI coupled with aspect attributes can identify potential locations for ecosystem restoration treatments, a portion of the Porcupine Hills was used to partition the landscape into broad delineations. The forest management unit C5 AVI and a 10 m aspect raster were clipped to an area approximately 12,161 ha within the central portion of the Porcupine Hills (Figure 1). The aspect raster was then split into two broad categories according to individual pixel values: 315° to 135° to northeast aspect, and 135° to 315° for southwest aspects (Figure 2). The Porcupine Hills generally have a hilltop crest from the southeast to the northwest of the selected areas, creating a macro level southwest and northeast aspects, however the land on either side of the crest undulates, causing several interspersed north and south facing micro-slopes (Figure 3). The most common aspect was then attributed for each AVI polygon.

AVI attributes utilized for this model included Moisture Regime, Density, Species, NFL (non-forested land), and Modified (AFRED 2022). Three categories were created named “permanent open”, “permanent forest”, and “successional transition areas”. The values of each attribute used to identify these categories are listed in Table 1. Areas excluded from the study included naturally non-vegetated, wetlands and anthropogenic features such as modified clearings and roads. The latter includes new harvest areas still labelled as herbaceous grasslands.

Results

In total, 6,313 ha of the study area was attributed northeast facing aspects, and 5,848 ha southwest (Figure 3). The permanent open category comprised of 2,502 ha which was 20% of the study area (Figure 4). Permanent forests totaled 5,393 ha (44% of study area), to which 92% fell within northeast aspects (Figure 5). The remaining 8% was mostly higher density (C, D) southwest facing coniferous forests. Interestingly, 73% of cutblocks since 2005 were located on northeast aspects. Lastly, 4,054 ha were identified as successional transition areas (33% of area, Figure 6). Of this area, 12% was located on northeast aspects. All three categories were interspersed with one another showing the study area's mosaic of slopes and vegetation types.

Table 1. AVI and aspect attributes utilized for permanent grasslands, permanent forests, and successional transition areas.

Category	AVI / Aspect Attributes	Area
Permanent Open (grasslands and shrublands)	Non-Forested Land (HG, SO, SC) without any modifiers	2,502 ha
Permanent Forests	NE Mesic A, B, C, D density forests NE Dry B, C, D density forests SW Mesic C, D density coniferous forests	5,393 ha
Successional Transition Areas	NE Dry A density forests SW Dry A, B, C, D density forests SW Mesic A, B density forests SW Mesic C, D density deciduous forests	4,054 ha

Discussion

This study showed that a model can be made to delineate the landscape into three categories that help identify permanent forests and grasslands, as well as the transition in between. In the mosaic studied, the successional transition area became the area between permanent forested and permanent grasslands. This successional transition area is typically marginally drier or less dense forest than permanently forested areas and are also defined range plant community ecological sites that can have more than one succession phase of dominant vegetation (Baker et al. 2020, Willoughby and Alexander 2007). These are areas that require ecosystem restoration treatments, where the suppression of natural disturbances has allowed forest encroachment to occur and tree vegetation has become the most common phase.

This model's primary task was identifying and quantifying the location and abundance of successional transition areas for restoration treatments. Specific treatments would require further planning to include narrowing the scope to establish goals and ground truthing. A successional transition area may meet this model's criteria, however planning and operations should look at each site independently and utilize traits such as how far it has advanced in succession, its physical site and understory characteristics, and what the expected ramification of change would be to aid in restoration treatment decisions.

The study area was based within a lower elevation Montane natural subregion within the Porcupine Hills. As these hills are independent of the mountains to the west, they have both northeast and southwest facing macro-slopes, as well as north and south facing micro-slopes occurring throughout. Much of Alberta's eastern slopes to the west are also within the Montane natural subregion, but transitions to Subalpine and even Alpine subregions occur as elevation increases moving into the mountainous and predominantly east facing slopes. There is however, still many north and south facing micro-slopes. The same analysis completed for the entire Crowsnest Forest Products Ltd. (CFP) Forest Management Agreement (FMA) Area (Appendix 1) indicated small changes to the amount of open and forested areas. Results showed that permanent open areas decreased in overall prevalence, most likely due to permanent grasslands being most often linked to dry south facing slopes occurring less frequently in the Subalpine subregion, or wetter meadows that were excluded from the analysis (AVI Moisture = “w”) (Willoughby and Alexander 2007). Interestingly the proportion of successional transition area remained relatively the same at 34% for the entire FMA area indicating that ecological restoration opportunities exist throughout.

Dividing the landscape into the three categories and identifying successional transition areas show there is opportunity for ecosystem restoration treatments. Traditionally, both natural and anthropogenic fires would have maintained stands or caused successional retrogression. For example, frequent moderate intensity fires would kill small trees and some shrubs and maintain a more open grassland or savannah state (Page 2002). These frequent fires would not become intense enough to kill all mature trees, especially on cooler aspects or where tree bark was thick enough to withstand the heat. These fires also typically do not affect soil structure. However, in the absence of fire, understory vegetation has increased, providing more fuel and risk of high intensity, stand-replacing fires. These more intense fires become catastrophic rather than ecosystem maintaining and can set large areas back to non-vegetated states with high soil exposure. Also, the risk of destroying anthropogenic infrastructure has increased such that prescribed fires are commonly confined to small areas and limited seasonal windows for execution.

Prescribed fire should be utilized where feasible, however, timber harvesting could be a useful substitute. Although identified successional transition areas may not be preferred permeant forest stands, some of the timber is merchantable, providing a source of revenue to aid in cost recovery of restoration treatments. Various types of harvesting treatments could be explored, from pre-commercial thinning to clearcut, depending on the goal and attributes of a site. After harvesting, variable reforestation treatments could be used such as lower density planting to enable the site to go through natural successional progression. Maintaining soil structure is important with all restoration treatments as soil disturbance often causes negative impacts to grassland health and integrity (Alberta Sustainable Resource Development 2010, Adams et al. 2016). Without added future disturbances, the site would eventually come back to forest, just not on the timelines prescribed in normal forestry regeneration standards. In that time however, forage, wildlife habitat, and ecosystem diversity would all be attained. When these restoration treatments are created across the landscape, a better ecosystem mosaic can be maintained. Cumulatively, these restoration treatments would also benefit fire risk because fuel would be removed lessening the probability of high intensity catastrophic fires.

Conclusion

In the eastern slopes, ecosystem restoration should be geared toward creating a mosaic landscape of grasslands, shrublands and forest in a variety of successional stages. Numerous methods to achieve these goals should be explored. Prescribed fire is commonly mentioned as a tool; however, a variety of strategic forestry practices aimed at minimizing forest encroachment could be utilized that would promote minimum ground disturbance and allow the site to progress naturally through its grassland to forest phases. In successional transition areas where business-as-usual harvesting and reforestation are applied, forest encroachment is only partially minimized.

Recommendations for forest management planning and operations to minimize forest encroachment:

1. Use the successional transition area data and documentation to inform the development of the spatial harvest sequence (SHS) in the CFP 2025 Forest Management Plan (FMP).
2. For a proportion of SHS polygons that fall within successional transition areas; develop strategies for minimizing forest encroachment such as but not limited to partial harvest, pre commercial thinning, leave for natural and/or reduced planting densities. Include a specific target in the Forest Encroachment VOIT (*To be determined through the FMP development process*).
3. Ground disturbance in all successional transition areas should be minimized to limit impact to understory vegetation.
4. Yield curves must be developed for any strategies that differ from business-as-usual reforestation. These treatments tied to these strategies must be identified in the Reforestation Strategy Table.
5. Discuss with Forest Stewardship and Trade Branch the assessment of strategy specific outcomes per the Reforestation Standard of Alberta.

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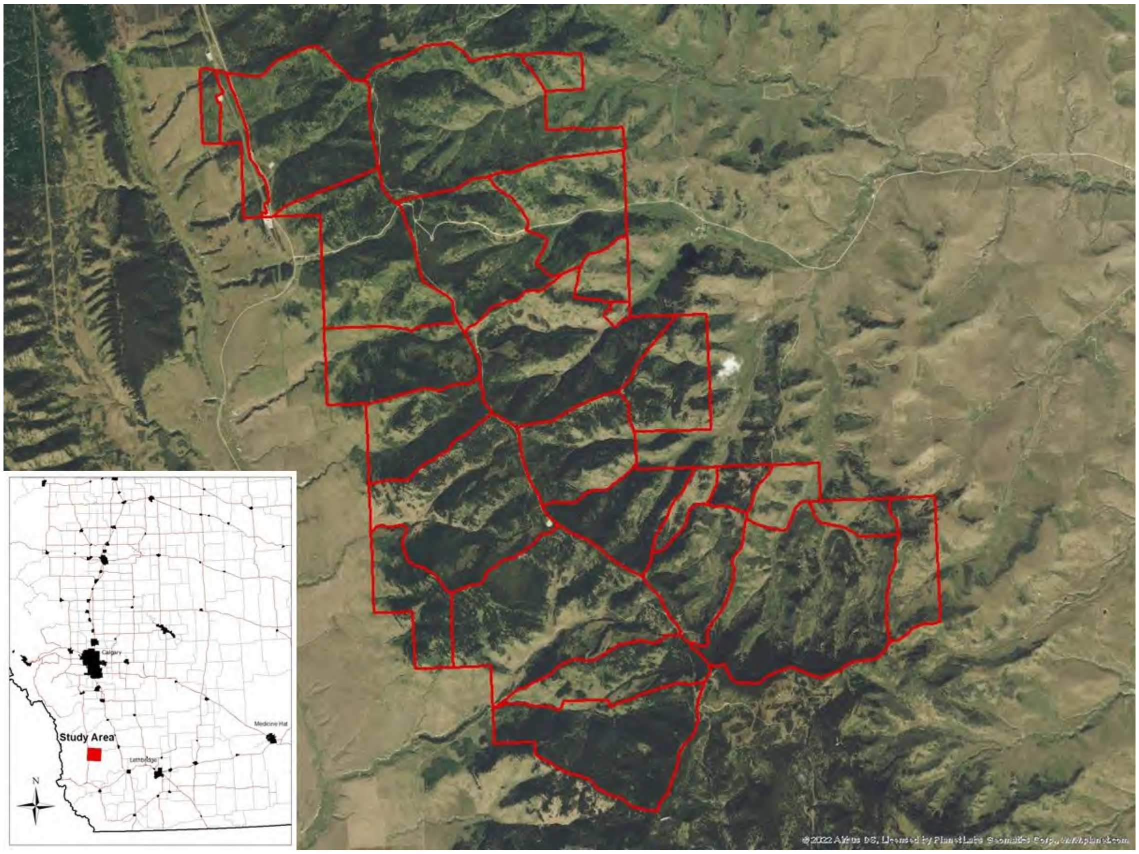


Figure 1. Location of study area selected for using AVI and aspect to model locations for ecosystem restoration treatments.

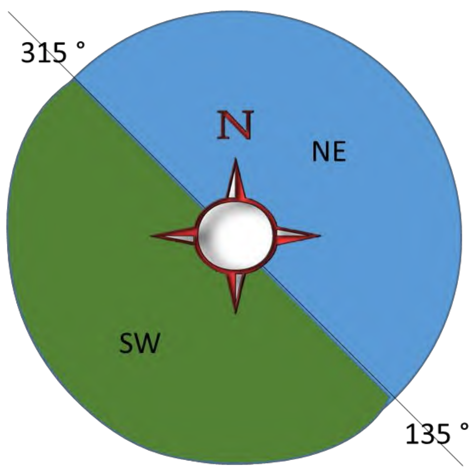


Figure 2. Aspect delineations utilized for attributing each AVI polygon. All aspects between 315-135° were attributed NE, all 135-315° were SW.

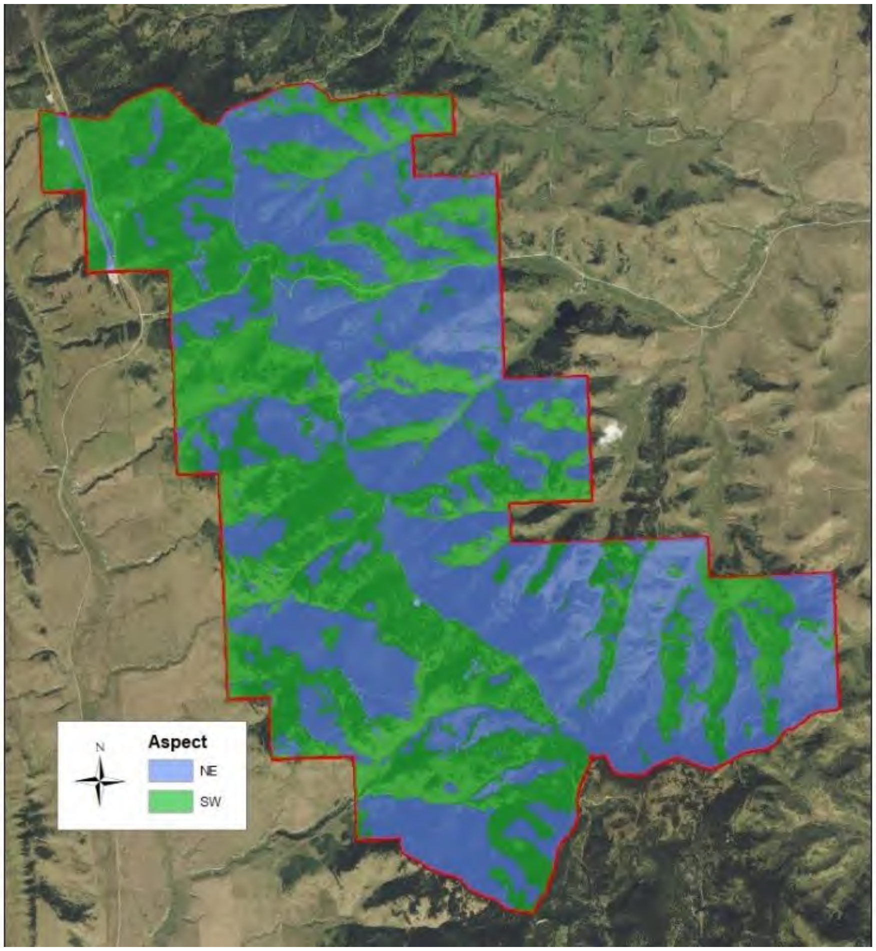


Figure 3. Predominant aspect provided for each AVI polygon within study area.

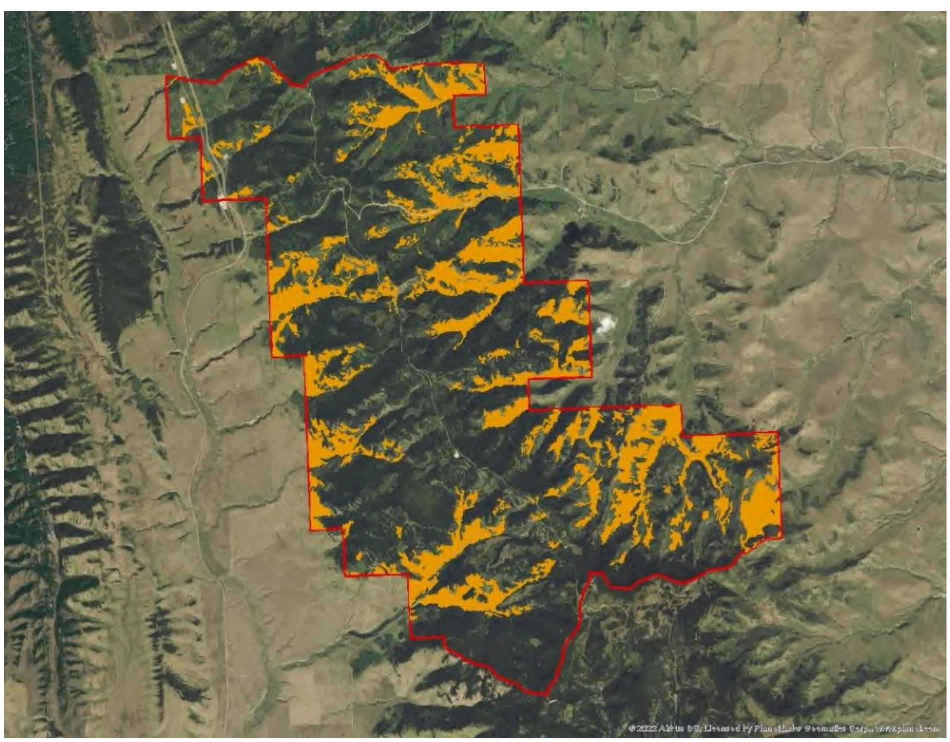


Figure 4. Polygons identified as permanent grasslands and shrublands using AVI attributes.

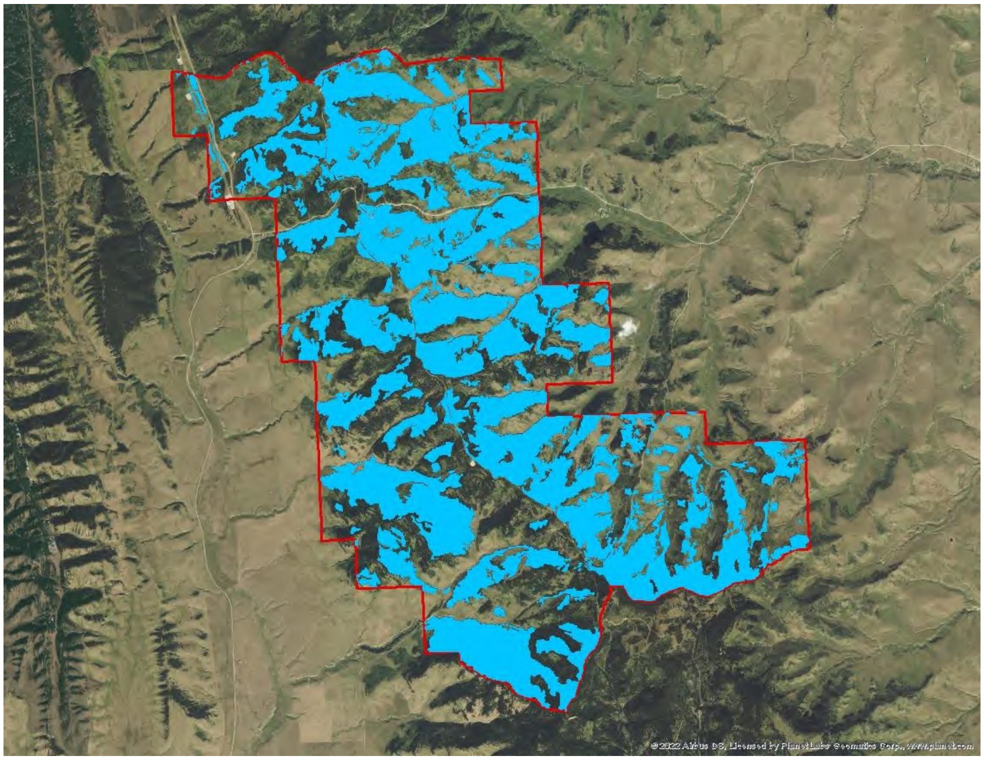


Figure 5. Polygons identified as permanent forests using AVI and aspect attributes.

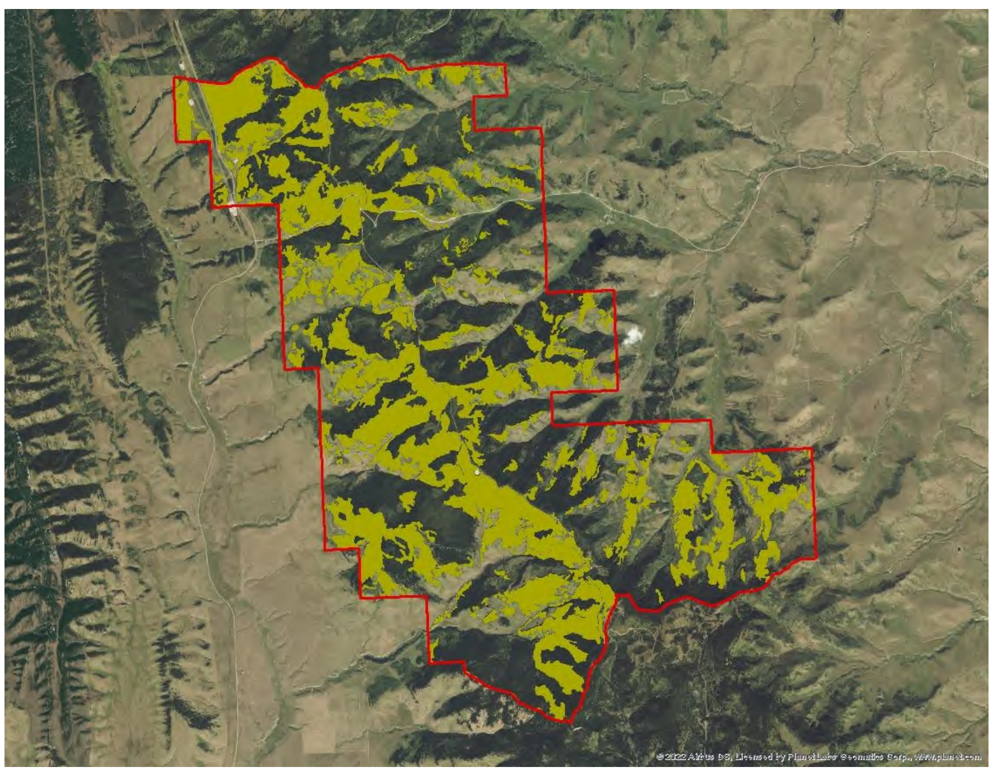
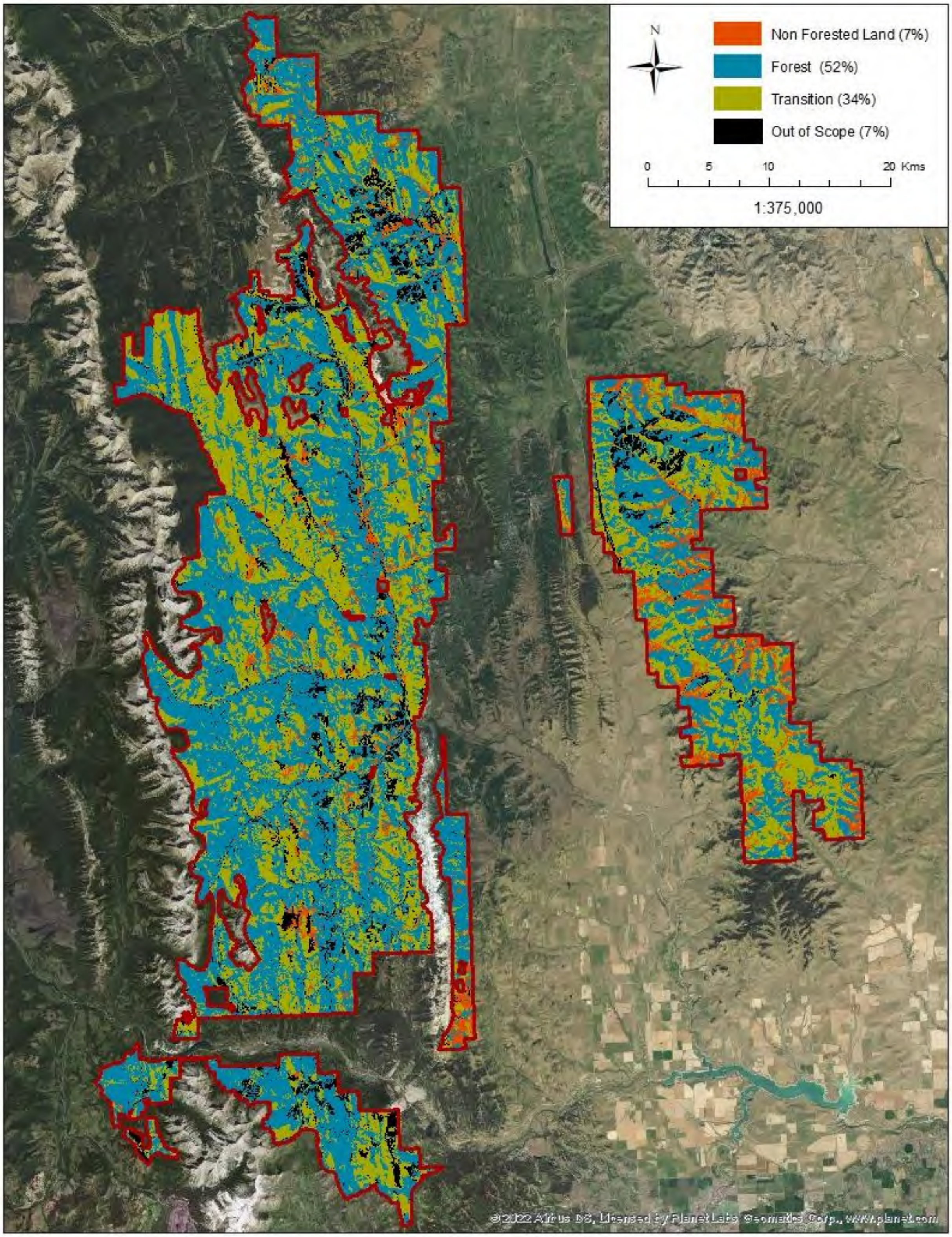


Figure 6. Polygons identified as successional transition areas for ecosystem restoration using AVI and aspect attributes.

Appendix 1. Map of the entire CFP FMA area utilizing the described AVI attributes and aspects model.



Appendix VII Invasive Plants Program

Background

Invasive plant species are known to cause negative environmental impacts as they adapt, grow, and reproduce quickly. If invasive species are not controlled from spreading, they can cause serious damage to ecosystems by pushing out native, rare, or endangered plants, competing with them for resources, making it harder to restore disturbed areas, slowing down forest growth, and degrading valuable wildlife habitat and range.

The law requires that these weed species be controlled or eliminated in forested areas under Section 63 of the Public Lands Act, Section 31 of the *Weed Control Act* and Directive 2001-06: Weed Management in Forestry Operations.

The C5 FMU area is known for having some of the most severe invasive plant infestations in the province, due in part to the constant risk of new species entering from British Columbia and Montana. In 2012, the discovery of invasive yellow hawkweed in the Lost Creek area demonstrated the seriousness of the invasive plant problem in this part of the province.

Objectives of CFP's Invasive Plant Program

- Eliminate prohibited noxious weeds and control the spread of invasive plants on CFP dispositions (including cut blocks);
- Ensure staff and contractors are actively participating in the CFP Invasive Plant Program; and
- Participate and support MD co-operative invasive plant control initiatives such as the MD of Ranchland No. 66 Integrated Weed Management Plan. Other MD's include Willow Creek, Foothills and Crowsnest Pass.

Strategies

- Train CFP staff and contractors to recognize and report invasive plants and prohibited noxious weeds and update the noxious weed training module to include additional invasive plants such as blue weed.
- Incentivize the reporting of weeds by CFP contractors by paying a bounty for the reporting of new infestations.
- Communicate to forestry contractors, harvest, road building, reclamation and site prep contractors when worksites are located adjacent or in known infestation areas.
- Communicate with MD on road reclamation timing so area can be inspected and accessed before road is removed.
- Include a clause in CFP contracts requiring contractors with heavy equipment, pickups and OHVs to keep equipment storage yards weeds free. The yards will be subject to inspections during the summer months to ensure and staging areas are free of invasive plants.
- Include a clause in CFP contracts for regeneration surveys and other summer field worker contracts that require the contractor to report any weeds that are found during their work.
- Formalize the cooperation of CFP and the MD Ranchland and Integrated Weed Management Plans by:
    - Additional financial support for MD inspections and chemical applications associated with CFP activity.

- Establish a spatial invasive plant data share agreement including areas sprayed and being monitored by the MD. An updated shapefile of the invasive plant database to be shared with CFP annually.
  - An inventory of weed sightings made by our staff and contractors will be reported to the MD and included in the invasive plant GIS database.
  - While working within the MD of Ranchlands, and any other counties, CFP will cooperate and support the invasive plant inventory all of our forestry and disposition roads annually. Any infestations of invasive plants and prohibited noxious weeds will be documented in the shared MD of Ranchlands invasive plants GIS database.
  - As per the MD Integrated Weed Management Plan, each location that is discovered to have invasive plants will be individually assessed for type, species and risk of spread.
- An action plan will be developed which may include but is not limited to active controls such as spraying or picking or passive controls such as monitoring with the expectation that other vegetation will occupy the site.
- Seed purchased for reclamation and re-vegetation will have a seed test analysis completed. Only certified seed (weed free) will be used.
- Contractors are required to wash all equipment used in the white zone during the summer months prior to being hauled to the green zone. If equipment works in an infested site in the green zone it will be washed before it moves to another site. This clause has been inserted into the logging, hauling and scarification contracts. Off road equipment that is used or stored in the white zone will be washed prior to being used in the green zone.

Responsibility and Timelines

Areas of company responsibility include harvest areas and logging roads. Once the forestry road is reclaimed and the adjacent or nearest harvest area is declared free to grow, the invasive plant control responsibility reverts to the Crown.

CFP will work with grazing operators including but not limited to:

- Completing regular status assessments, to monitor grazing and forestry integration activities to be consistent with the objectives identified in the Grazing Land Timber Integration Manual. Items to be reviewed include but are not limited to:
  - Amount of grazing use;
  - Limited well defined livestock trails;
  - Limited mineral soil exposure;
  - Seedlings are well distributed and undamaged;
  - Livestock use is not impaired; and
  - There are no noxious or restricted weeds present.

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Chapter 8 – Research

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	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
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1 Introduction

Crowsnest Forest Products (CFP) is committed to utilizing management strategies and practices based on new research and monitoring results. To enable this, CFP supports a variety of research initiatives and technical studies that drive towards sustainable forest management. In addition to financial investments, CFP also participates on a variety of boards, committees, and task forces.

This chapter lists the projects, committees, and co-operative efforts that CFP has been or is currently involved with. It does not represent commitments to participation or research over the life of the 2025 Forest Management Plan.

1.1 Activities

Table 1-1. CFP FRIAA projects.

Project
Understanding Historical Landscape Patterns on the C5 FMU Area of Alberta
Characterizing the Regenerating Forest Landbase
Critical Fisheries Habitat Assessment Tool
LiDAR-Based Forest Inventory
Establishment of a Controlled Parentage Program (Tree Improvement and Adaptation Program)
Strategic Watershed Assessment for the C5 Forest Management Unit
Impact of Forest Management Practices and Severe Wildfire on Water Metrics

Table 1-2. CFP co-operative efforts & committee participation.

Project / Committee
Oldman Headwaters Aquatic Monitoring – Partnership with the Oldman Watershed Council (Ongoing)
Freshwater Conservation Canada (formerly Trout Unlimited Canada) Sponsorship – Restoration Efforts in the Porcupine Hills
fRI Research (formerly Foothills Model Forest/Foothills Research Institute) – Grizzly Bear Research Program
fRI Research – Water and Fish Program
Forest Growth Organization of Alberta (FGRoW) – Lodgepole Pine Regeneration Trial, Comparison of Pre-harvest and Post-harvest Stand Development, Cooperative Management of Historic Research Trials, Enhanced Management of Lodgepole Pine, Regeneration Management in a MPB Environment, Regional Yield Estimators
Grizzly Bear Monitoring in BMA 5 – Alberta Conservation Association
Engelmann and White Spruce Extreme Climate Genomics
Outland Youth Employment Sponsorship
Love AB Forest Sponsorship
Inside Education Sponsorship
Ecosystem Based Management Cooperative – fRI Research Healthy Landscapes Program
Oldman Watershed Council – Board of Directors member
Alberta's Feral Horses Advisory Committee
Provincial Silviculture Working Group

1.2 Research Priorities - Watershed Monitoring

West Fraser is committed to understanding the effects of timber harvesting on hydrology and aquatic ecosystems. The company is intending to understand various approaches to track and assess impacts, continuously adapting management practices to improve outcomes. Monitoring efforts include stream temperature tracking, crossing inspections, and research on watershed impacts. The development of a watershed monitoring program involves engaging stakeholders, consulting experts, and establishing long-term data collection efforts. Research initiatives focus on hydrological modeling, water quality assessment, and habitat monitoring using bioindicators. Key metrics for evaluation include streamflow changes, sediment levels, riparian health, and aquatic habitat conditions. Through adaptive management, West Fraser remains committed to protecting water resources while refining sustainable forestry practices.

1.3 Riparian Sensitivity Model

A hydrological model was developed to delineate and classify sensitivity in riparian zones to guide forest management planning. Terrain modelling was completed on a Digital Elevation Model (DEM) derived from LiDAR. This modelling method uses hydrologic and terrain-based principles, such as sinuosity, stream gradient, and bankfull width, that are representative of connectivity with regional drainage systems to approximate the sensitivity of riparian regions at high precision over large areas. This model can be used for strategic planning, to avoid sensitive areas during harvest and road construction layout. Additionally, it can support remediation efforts by providing insights into hydrologic connectivity, helping to optimize wholistic restoration for sensitive riparian areas.

1.4 Crossing Effects on Stream Temperature

Through our support of fRI and the Water and Fish Program, research is to be conducted to guide forest management related to hydrology and aquatic habitat. A local example is a study that was developed to assess the effects of crossings on stream temperatures in the Crowsnest Pass area. It uses detailed monitoring at relevant spatial and temporal scales to quantify the effects of stream crossings on stream thermal regimes. There is a near-term goal to understand the primary drivers and likely effects of stream crossings on temperature and a comprehensive study will be used to quantify stream crossing effects on temperature in the study area. This project serves multiple objectives, ultimately improving resource management in Alberta and our understanding of forestry-related effects on native trout habitat. This project will:

1. Conduct a field study along the Eastern Slopes of the Rocky Mountains of Alberta within Forest Management Agreement areas, building on existing stream temperature monitoring.

2. Understand the effect of stream crossings (and associated riparian openings) on thermal regimes.

3. Provide critical information on thermal conditions and responses to crossing type (permanent vs. temporary) for improving forest management.

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1 Glossary of Terms

A

Adaptive Management: A structured process designed to improve management policies and practices by learning from the outcomes of operational programs. Focuses on deliberately designing management to enhance learning.

Age Class: The classification of stands in a forest, or trees in a stand, into a series of age categories.

Alberta Conservation Information Management System: A spatial database of species and ecological communities that are considered rare or of conservation concern.

Alberta Vegetation Inventory: A photo-based digital inventory used to identify the type, extent and conditions of vegetation. Creation of the inventory is based on the Alberta Vegetation Inventory Standards (2005) and subsequent updates and enhancements.

Annual Allowable Cut: The volume of timber that can be harvested under sustainable forest management in any one year.

Annual Operating Plan: Plans prepared and submitted annually by timber operators describing how, where and when to develop roads and harvest timber. They describe the integration of operations with other resource users, the mitigation of the impacts of logging, the reclamation of disturbed sites and the reforestation of harvested areas.

B

Berm: A raised mound of soil.

Biodiversity: The variety, distribution and abundance of different plants, animals and other living organisms, the ecological functions and processes they perform, and the genetic diversity they contain at local, regional and landscape levels of analysis.

Broad Cover Group: Defined by the occurrence of coniferous as determined by AVI. Coniferous - stands with at least 80% conifer. Coniferous/Deciduous - stands with at least 50% and less than 80% conifer, and leading species conifer. Deciduous/Coniferous - stands with at least 30%, and no more than 50% conifer, and leading species deciduous. Deciduous - stands with less than 30% conifer.

Brunisolic: Brunisolic soils have sufficient development and typically have a brownish coloured B horizon. These soils tend to form under forests, giving them their colour, but can exist in a wide range of environments, including the boreal forest, mixed forest, shrubs, grass, heath and tundra. They are usually well to imperfectly drained. Brunisolic soils are typically interpreted as a “transitional” soil, falling between generally unweathered parent material (common to Regosols) and mature forest soils represented by the Podzolic or Luvisolic orders.

Buffer: A protected strip of vegetated land beside roads, watercourses, mineral licks or other important features.

C

Canadian Council of Forest Ministers: Collection of ministers responsible for forest management in the provinces and territories of Canada that meet to exchange information, work cooperatively, provide leadership and generate action on matters related to forestry and forest management.

Chernozem: Chernozemic soils are generally dark coloured and are dominant in the Canadian Prairies. These soils are typically found in areas with water deficits during the growing season. They are well developed and have a variety of parent materials from coarse sands to fine-textured silts and clay loams.

Chinook: A warm dry wind that blows east from the Rockies.

Clear Cut System: A silviculture system that removes an entire stand of trees from an area of one hectare or more, and greater than two heights in width, in a single harvest operation.

Coarse Filter Management: Conservation of land areas and representative habitats with the assumption that the needs of all associated species, communities, environments and ecological processes will be met.

Coarse Down Woody Debris: Sound and rotting logs and stumps that provide habitat for plants and animals, and a source of nutrients for soil structure and development. Generally classified as material greater that 10 centimeters in diameter.

Committee on the Status of Endangered Wildlife in Canada: Independent advisory panel to the Minister of Environment and Climate Change Canada that meets to assess the status of wildlife species at risk of extinction. Members are wildlife biology experts from academia, government, non-governmental organizations and the private sector responsible for designating wildlife species in danger of disappearing from Canada.

Commercial Timber Permit: A timber disposition issued under section 22 of the Forests Act authorizing the permittee to harvest public timber.

Community Timber Program: A term used to describe a category of timber use that provides for those operators who harvest volumes through permits. The volume can vary but are generally for less than 5,000 m^3 and are issued to operators harvesting less than 21,000 m^3 of timber annually.

Compartment: A subsection of an FMA for which operational plans are developed.

Coniferous Species: Cone bearing seed plants (Pinophyta).

Coniferous Stands: Forest stands that consist predominately (> 70%) of coniferous tree species.

Coniferous Timber Quota: A tenure mechanism to allocate allowable cut of coniferous timber within a forest management unit.

Constraint: The restrictions, limitations, or regulation of an activity, quality, or state of being to a predetermined or prescribed course of action or inaction. Constraints can arise from the influence of policies, political will, management direction, attitudes, perceptions, budgets, time, personnel, data availability limitations, or complex interaction of all these factors.

Criterion: A distinguishable characteristic of sustainable forest management; a value that must be considered in setting objectives and in assisting performance.

Cross-Ditching: The practice of constructing ditches across roads to allow for the movement of water from one side of the road to the other.

Crown Charges: Amounts paid to the Province as a royalty or in consideration of services rendered.

Crown Land: Land with no private ownership that is managed by the government of Alberta. Also known as public land.

Cumulative Impact: Additive nature of individual effects.

Cut Control Period: A period of five consecutive forest management operating years or as otherwise agreed to by the Minister and a Company.

D

Deciduous: Refers to tree species that seasonally shed leaves.

Deciduous Stands: Forest stands that consist predominately (> 70%) of deciduous tree species.

Deciduous Timber Allocation: Amount of the deciduous annual allowable cut for a management unit, based on either volume or area.

Deleterious: Harmful.

Defined Forest Area: The physical extent to which a Forest Management Plan applies.

Denning Sites: Areas where animals hibernate or raise their young.

Detailed Forest Management Plan: A term used for previous plans, now called simply a Forest Management Plan.

Desiccation: The drying out of or removal of moisture from something.

Digital Terrain Model: The computerized portrayal of a landform in three dimensions. Can also be called a digital elevation model.

Disposition: A lease, license, permit or letter of authority issued under provincial legislation for activities either surface or sub-surface.

Disturbance: A force that causes significant change in structure and or composition of a habitat.

Diversity: An assessment of the number of species present, their relative abundance in an area, and the distribution of individuals among the species.

E

Eastern Slopes Land Use Zones: Designation covering much of the Rocky Mountain and the Foothills regions of Alberta and used to identify, analyze and nominate areas for designation and protection.

Ecology: The science that studies the interrelationships, distribution, abundance, and contexts of all organisms and their interconnections with their living and non-living environment.

Ecological Integrity: Unimpaired, functional ecological processes.

Ecoregion: A geographic area that has a distinctive, mature ecosystem on reference sites plus specified edaphic variations as a result of a given regional climate.

Ecosite: Ecological units that develop under similar environmental influences (climate, moisture, and nutrient regime). It is a functional unit defined by moisture and nutrient regime.

Ecosystem: A dynamic complex of plants, animals, and micro-organisms and their non-living environment interacting as a functioning unit.

Ecotone: A transition area between two communities which has characteristics of both as well as characteristics of its own.

Edaphic: Pertains to the soil, particularly with respect to its influence on plant growth and other organisms together with climate.

Element: A concept used to define the scope of each CCFM SFM criteria. The elements serve to elaborate and specify the scope of their associated criterion.

Endangered: A high risk of extinction in the wild in the immediate future.

Endangered, Threatened and Rare species: Classifications of the status of species populations as determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Endangered indicates any indigenous species of fauna or flora that is threatened with imminent extirpation or extinction throughout all or a significant portion of its Canadian range. Threatened indicates any indigenous species of fauna or flora that is likely to become endangered in Canada if the factors affecting it vulnerability do not become reversed. Rare indicates an indigenous species of fauna or flora that, because of its biological characteristics or because it occurs at the fringe of its range, or for some other reasons, exists in low numbers or in very restricted areas in Canada but is not a threatened species.

Equivalent Clearcut Area: An index of watershed disturbance developed by the Government of Alberta and required for non-timber assessments of forests across the province.

Establishment Period: The time elapsing between initiation of regeneration and its acceptance according to defined reforestation standards in the Timber Management Regulation.

Establishment Stage: The early stage of reforestation where a crop of trees is initiated.

Even-Aged Stand: A forest stand where the dominate component of the trees are of similar age.

Even Flow: In harvest scheduling, the requirement that the harvest level in each period be equal to the harvest level in the preceding period.

F

Fine Filter Management: Specific habitat management for a single or a few species rather than broad management at a landscape level to maintain a range of habitat opportunities for all wildlife species (coarse filter).

Fire Behaviour Potential: A measure of how fuels ignite, flames develop and fire spreads, influenced primarily by fuels, topography, fire weather, and climate.

Fire Cycle: The number of years required to burn over an area equal to the entire area of interest. During one cycle, some areas may burn more than once, while others may not burn at all.

Fire Regime: The fire activity or pattern of fires that characterize a given area.

Fish Management Zone: Designated in Alberta to determine fisheries health, regulate sport and commercial fishing, and determine fish stocking. Fish Management Zones are further subdivided into Fish Watershed Units based on specific river basins.

FireSmart: A government-funded program involved in development of resources and programs designed to empower the public and increase community resilience to wildfire across Canada.

FireSmart Community Zone: A standard 10km radius around a FireSmart community used to direct community protection planning under the FireSmart program.

Fish Sustainability Index: Alberta Fish and Wildlife's method of assessing fish stocks on a provincial scale. The FSI was developed to bring consistency to individual fish stock assessments and provide a province-wide evaluation of the status and sustainability of Alberta fish species.

Forecast: A prediction of future conditions and occurrences based on the perceived functioning of a forest system. A forecast differs from a "projection" which is a prediction of anticipated future conditions based on an extrapolation of past trends.

Forest: A collection of stands that occur in similar space and time.

Forest Access Zone: An area designated by the Provincial government that has specific access constraints in place.

Forest Area: Designation used by the Government of Alberta to define wildfire management responsibilities.

Forest Connectivity: A measure of how well different landscape are connected.

Forest Health: As a specific condition, the term refers to a growing forest having many or all of its native species of plants and animals. As a management objective, it refers to maintaining or restoring the capacity of a forest to achieve health.

Forest Management Agreement: A long-term (20 year), renewable, area-based form of forest tenure. Through the FMA, a company is given certain rights, including the right to establish, grow, harvest and remove Crown timber, in exchange for various responsibilities.

Forest Management Plan: A strategic long-term plan that is the foundation for all forest management activities upon the FMA. "Forest Management Plan" is a generic term referring to both Forest Management Unit plans prepared by the government, and Forest Management Plans prepared by industry.

Forest Management Unit: A defined area of forest land located in the Green Area of the province designated by the Department to be managed for sustainable forest management.

Forested Land: Land is considered to be forested if it supports tree growth, including seedlings and saplings.

Forests Act: Revised Statutes of Alberta 1980, Chapter F-16 as amended from time to time. It establishes the authority and means by which the Minister of Environment administers and manages timber on public land for sustained yield. It describes how timber allocations can be made on crown land and empowers the Minister to enforce the Act and associated regulations.

Fragmentation: The process of transforming large continuous forest patches into one or more smaller patches surrounded by disturbed areas. This includes loss of stand area, loss of stand interior area, changes in relative and absolute amounts of stand edge, and changes in insularity. This occurs naturally through such agents as fire, landslides, windthrow and insect attack. It also occurs due to anthropogenic activities such as timber harvesting, road building and wellsite development.

Furbearer: Animals whose pelts have or had a legal trade value.

G

General Development Plan: A five-year operating plan prepared, updated and submitted annually by the timber harvest operator.

Grazing Disposition: An authorization issued under authority of the Public Lands Act for the purpose of domestic livestock grazing on Crown land. Includes grazing permits, grazing leases, and forest grazing licenses.

Green Area: An Alberta designation identifying land primarily managed for natural resource development, recreation and conservation. Federal lands are excluded.

Green-up: The process of re-establishment of vegetation following logging.

Green-up Period: The time needed to re-establish vegetation after disturbance. Specific green-up periods may be established to satisfy visual objectives, hydrological requirements, or as a means of ensuring re-establishment of vegetation (for silviculture, wildlife habitat, or hydrological reasons) before adjacent stands can be harvested.

Ground Rules: Provide direction to timber operators and employees of Alberta Agriculture and Forestry for planning, implementing and monitoring timber operations on the area specified. They highlight important management principles, define operating and planning objectives, and present standards and guidelines for timber harvest, road development, reclamation, reforestation and integration of timber harvesting with other forest users.

Growing Stock: The sum (by number, basal area, or volume) of trees in the forest or a specified part of it.

Growth & Yield: In timber management, the "yield" is the volume of wood available for harvest at the end of a rotation, usually measured as unit volume per unit area (e.g. cubic meters per hectare). The "growth" is the rate and yield of biomass produced by plants regardless of function or use.

Guidelines: A set of recommended or suggested methods or actions that should be followed in most circumstances to assist administrative and planning decisions, and their implementation in the field. Note that guidelines cannot, by definition, be mandatory.

H

Habitat: The place where a plant or animal naturally or normally lives and grows.

Harvest Area: A cutblock or cutover.

Harvest Design: A forest harvesting plan for a given area which may include in addition to the initially sequenced cutblocks, reserves for fish and wildlife or protection of unique sites, a reforestation program, watershed and riparian area protection, and roading and reclamation requirements.

Harvest Design Area: Geographically defined area for planning purposes.

Hectare: Area of land measuring 10,000 square meters.

Historic Resources: Includes archaeological and paleontological sites, Indigenous peoples traditional-use of a historical resource, and historic structures. Alberta Culture and Tourism maintains a provincial databased of such resources.

Historical Resource Value: A classification used by Alberta Culture and Tourism that reflects the likely historical importance of a site.

Hydrological Unit Code: The Hydrologic Unit Code (HUC) Watersheds of Alberta represents a collection of four nested hierarchically structured drainage basin feature classes that have been created using the Hydrologic Unit Code system of classification developed by the United States Geological Survey (USGS) with accommodation to reflect the pre-existing Canadian classification system.

I

Increment: Increase in volume of a particular tree or stand overtime.

Inoperable: A classification of a forest site based on the potential to harvest timber on that site, as affected by physiographic characteristics, moisture regime and harvesting equipment/technology.

Integrated Resource Management: A cooperative and comprehensive approach to the establishment of plans and to the delivery of benefits from the resource base in an efficient and effective manner.

Integrated Resource Plan: A regional plan developed by provincial government agencies in consultation with the public and local government bodies. It provides strategic policy direction for the use of public land and its resources within the prescribed planning area. It is used as a guide for resource planners, industry and publics with responsibilities or interests in the area.

Improved Stock: The result of long-term tree breeding programs geared towards selecting for heritable characteristics that are desired.

J, K & L

Landbase: A database containing spatial delineations and attributes that describe the condition of the forest and is assembled to meet the requirements of the Alberta Forest Management Planning Standard (v4.1 – April 2006).

Landscape: A heterogeneous land area with interacting ecosystems.

Landscape Diversity: The size, shape, and connectivity of different ecosystems across a large area.

Linear Disturbance: The removal of vegetation in a narrow and generally long pattern, such as a road, pipeline, or seismic line.

Livingstone-Porcupine Hills Land Footprint Management Plan: A strategic initiative by the Government of Alberta, released in May 2018, aimed at managing and mitigating the cumulative impacts of human activities—such as industrial development, recreation, and infrastructure expansion—on public lands within the Livingstone and Porcupine Hills regions.

Long Run Sustained Yield Average: The hypothetical timber harvest that can be maintained indefinitely from a management area once all stands have been converted to a managed state under a specific set of management activities.

Land-Use Framework: Sets out an approach to manage public and private lands and natural resources to achieve Alberta's long-term economic, environmental and social goals. Divides the province into seven land-use regions for developing strategic regional land-use plans.

Luvisol: Luvisolic soils are generally light coloured and usually occur in well to imperfectly drained areas. They are located under forest vegetation, where the climate is sub-humid to humid and mild to very cold. They are well developed and have sandy loam to clay parent materials.

M

Mean Annual Increment: The total increment to a given age in years, divided by that age.

Mean Fire Return Interval: A measure of the average number of years between fires under the presumed historical fire regime.

Merchantable: A standard applicable to stands of timber or to individual trees indicating net usable volume.

Mixedwood stands: Stands containing both deciduous and coniferous species. Species content of either/or would be greater than or equal to 20% or less than or equal to 80% of the total cover in the canopy.

N

Natural Range of Variation: Refers to the spectrum of natural conditions possible in ecosystem structure, composition, and function, when considering both temporal and spatial scales. Most interpretations of an NRV strategy focus strongly on disturbance and associated NRV indicators of landscape change.

Natural Regeneration: The renewal of a forest stand by natural rather than human means, such as seeding-in from adjacent stands, with the seed being deposited by wind, birds, or animals. Regeneration may also originate from sprouting, suckering, or layering.

Natural Process: Naturally occurring function, such as decomposition, fire, etc.

Non-forested land: Land is considered to be non-forested if it does not support tree growth, including seedlings and saplings.

Non-Productive Land: Forested land currently incapable of producing a merchantable stand within a reasonable length of time.

Noxious Weed: Refers to weed species which are considered too widely distributed to eradicate and are controlled at the discretion of municipalities.

Nutrient Cycling: The circulation or exchange of elements and compounds, such as nitrogen and carbon dioxide, between nonliving and living portions of the environment.

O

Old Growth Forest: Forest older than rotation age that contains live and dead trees of various sized, species, composition, and age class structure.

Old Interior Forest: Old interior forest patches are defined as any patch greater than 120 ha that is composed of stands greater than 120 years old, using an 8m adjacency distance.

Operable: A classification of a forest site based on the potential to harvest timber on that site, as affected by physiographic characteristics, moisture regime and harvesting equipment/technology.

Operating Ground Rules: See *Ground Rules*.

Operating Guidelines: Rules that define forest management practices.

Order-in-Council: A order-in-council is a statutory instrument by which the governor general (the executive power of the governor-in-council), acting on the advice and consent of the Queen's Privy Council, expresses a decision. In practice, orders-in-council are drafted by Cabinet and formally approved by the governor general.

P

Patch: A relatively homogenous area that differs from its surroundings. Can be defined in a variety of ways but typically refers to contiguous areas of forest with a similar age class.

Patch Retention: Islands of timber retained within a clearcut area.

Permanent Sample Plot: Plots established for long-term timber growth and yield studies.

Physiography: Pertains to physical landform characteristics, also known as geomorphology.

Predictive modeling: Computational models that forecast outcomes of defined actions.

Preferred Forest Management Scenario: A harvesting plan that balances the environmental, economic, and social values of the forest. Computer modelling is used to identify what stands to harvest when. Companies are required to plan over a 200-year timeline to ensure sustainability.

Pre-Harvest Assessment: Survey of area prior to harvest to determine pre- and post-logging requirements, such as season of harvest, reforestation tactics, etc.

Pre-Industrial Condition: Refers to the state of the forest prior to being significantly affected by human use. In the case of the SLS DFA this refers to a time period prior to 1930, before fire suppression became very effective.

Prescribed Burn: Controlled applications of fires on a specific land area to accomplish a resource management objective (e.g. removing fuel to reduce potential wildfire intensity).

Productive Landbase: Area deemed to support sufficient forest growth for economically viable harvest.

Prohibited Noxious Weed: Weed species that are not yet (or only locally) established in the province and must be destroyed if detected.

Public Land Recreation Area: Small areas that provide amenities for camping, staging and information sharing in areas with high intensity recreational use.

Public Land Recreation Trail: Trails designated by the Minister of Alberta Environment and Parks and managed for recreational use by the department.

Public Land Use Zone: Established under the authority of the Public Lands Act to identify trails, areas and time-periods during which off-highway vehicle (OHV) and snow vehicle use is permitted.

Q

Quadrant Volumes: Five year's accumulation of AAC.

Quota: A form of timber disposition defined by the Forests Act that allows for the allocation of a portion of the sustainable harvest level determined for a given forest management unit.

Quota Certificate: A certificate that entitles the owner to a percentage share of the AAC of a forest Management Unit. This percentage is translated into a fixed round wood volume.

R

Reforestation: The process of reestablishing trees on a previously harvested area.

Reforestation Lag Period: The time between completion of timber harvest operations and the establishment of a regenerated stand, based on current procedures for evaluating successful stand establishment.

Regeneration: The renewal of a forest or stand of trees by natural or artificial means.

Registered Fur Management Areas: A parcel of public land with a Registered Fur Management Licence, which permits the licence holder to hunt and trap fur-bearing animals in that area.

Retention Period: The length of time between harvesting passes.

Right-of-way: A strip of land over which a power line, railway line, road, or other linear disturbance extends.

Riparian Areas: Terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and /or intermittent water, associated high water tables, and soils that exhibit some wetness characteristics.

Roll-back: Strippings and debris returned to disturbed areas for reclamation purposes.

Rotation: The period of years required to establish and grow timber crops to a specified condition of maturity.

Rotation Age: The planned number of years between regeneration of a forest stand and its final harvest.

S

Salvage Cut: A cutting method to remove dead or damaged trees with merchantable wood.

Scarification: Silvicultural practice involving the mechanical disruption of the ground surface to expose mineral soil.

Sedimentation: Deposit of waterborne material.

Sensitive Sites: Sites that have soil, water, slope, aesthetic, vegetation or wildlife characteristics that require special protection beyond the normal precautions described in the ground rules.

Sensitivity Analysis: An analytical procedure in which the value of one or more parameters is varied and the resulting changes are analyzed in a series of iterative evaluations. If a small change in a parameter results in a proportionately larger change in the results, the results are said to be sensitive to the parameter.

Seral Stages: The stages of ecological succession that are characterized by plant community conditions. This is the characteristic sequence of biotic communities that successively occupy and replace each other.

Silviculture: The theory and practice of controlling the establishment, composition, structure and growth of forests.

Silviculture Regimes: Tactics to establish a crop of trees.

Single-tree Retention: Process of leaving single trees standing in generally clearcut area.

Site Index: A measure of forest site productivity expressed as the average height of the tallest trees in the stand at a defined index age, typically less than the planned rotation ages. For this FMP, a site index age of 50 years was used.

Site Preparation: Mechanical preparation of forest soils for reforestation purposes.

Site Productivity: The mean annual increment in merchantable volume which can be expected for a forest area, assuming it is fully stocked by one or more species best adapted to the site, at or near rotation age.

Slash: Coarse and fine woody debris generated during logging operations and left on the ground after trees have been cut.

Snag: A standing dead tree from which the leaves and most of the branches have fallen.

Spatial Database: Data referenced to a set of geographical coordinates and encoded in digital format so that they can be sorted, selectively retrieved, statistically and spatially analyzed.

Stand: A continuous group of trees or other growth occupying a specific area and sufficiently uniform in composition, age, arrangement, and conditions as to be distinguishable from the forest or other growth on adjoining areas.

Stand Structure: The various horizontal and vertical physical elements of the forest. The physical appearance of canopy and subcanopy trees and snags, shrub and herbaceous strata, and down woody material.

Stand Tending: Activities such as thinning, spacing, removal of diseased trees, and weed or brush control, carried out in already established stands.

Stewardship: Obligation to manage.

Stewardship Report: A report that accounts for all activities, undertaken as a steward of a given article, resource, area or process, related to strategies to achieve stated stewardship goals. Measures of performance are included and linked to plans that express the desired goals.

Structure Retention: Forest structural elements that are retained during harvest for at least one rotation in order to preserve environmental values associated with structurally complex forests.

Stocking: A measure of the proportion of an area occupied by trees/seedlings, expressed in terms of percentage of occupied fixed area sample plots.

Sub-Regional Integrated Resource Plans: A system of Cabinet approved plans incorporating a cooperative and comprehensive approach to decision making relative to the allocation and use of Crown land and resources.

Succession: The replacement of one plant community by another in a progressive development towards climax vegetation.

Sustainable Development: Development of a resource while maintaining other values.

Sustainable Forest Management: The maintenance of the ecological integrity of the forest ecosystem while providing for social and economic values such as ecosystem services, economic, social and cultural opportunities for the benefit of present and future generations.

Sustainable Timber Management: Managing the forest to provide a perpetual supply of timber now and into the future.

Sustained-Yield Timber Management: The yield a forest can produce continuously at a given intensity of management.

T

Target: A specific statement describing a desired future state or condition of an indicator. Targets should be clearly defined, time-limited and quantified, if possible.

Temporary Sample Plot: an area of established size used in the measurement of trees and other physical characteristics.

Threatened Species: A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Timber Harvesting Landbase: The timber harvesting landbase is the portion of the total land area of the FMA that can be considered to contribute to and be available for long-term timber supply. It is the landbase remaining after deductions for areas that cannot, should not, or will not be managed for timber production.

Timber Management: The activity involving the allocation of forested lands for harvesting of the timber on that land. Timber management may involve planning, road building, logging extraction of merchantable timber for processing off-site, and varying intensities of silvicultural activity to encourage another stand of trees to grow back. Timber management is an important subset of forest management, but it is not an equivalent activity.

Timber Management Regulation: The legislative stature that describes the mechanism and regulations by which the forested lands of Alberta are managed.

Timber Operations: Includes all activities related to timber harvesting including site assessment, planning, road construction, harvesting, reclamation and reforestation.

U

Understorey: Those trees or vegetation in a forest stand below the main canopy level.

Understorey Protection: Avoidance of damaging immature tree species during harvesting operations.

Uneven Aged Stands: Stands in which the trees differ markedly in age, usually with a span greater than 20 years.

Ungulate: A clade of primarily large hoofed mammals.

Unique Areas: Sites that contain natural features or special values for wildlife and plant species. Also includes significant historical and archeological areas.

Utilization Standards: Standards establishing stand and tree merchantability.

V

Value: A DFA characteristic, component or quality considered to be important in relation to an important sustainable forest management element.

Viewshed: The visible area, as it appears from one or more viewpoints.

Visual Resources: Areas of high visual quality identified by determining potential viewer locations (e.g. roadways, trails, recreation areas, rivers and lakes).

Volume Table: A table, graph or equation showing the estimated average tree or stand volume corresponding to selected values of more easily measured tree or stand variables.

W, X, Y & Z

Water Source Areas: That portion of a watershed where soils are water saturated and/or surface flow occurs and contributes directly to stream flow.

Water Yield: The quantity of water derived from a unit area of watershed.

Watershed: An area of land that collects and discharges water into a single creek or river through a series of smaller tributaries.

White Area: An Alberta designation identifying primarily private land, often managed for agriculture or grazing. In some cases, there can be some sustainable timber production within the white area.

Wildlife Management Unit: Alberta is divided into a series of Wildlife Management Units. Wildlife within the boundaries of each WMU is managed by Alberta Environment & Parks according to the regulations established in Alberta's Wildlife Act.

Woody Debris: Live or dead, standing or downed, woody material left on a site after logging.

Yield Curve: Graphical representation of a yield table.

Yield Table: A summary table showing, for stands (usually even aged) of one or more species on different sites, characteristics at different ages of the stand.

2 Acronym List

AAC:	Annual Allowable Cut
AAF:	Alberta Agriculture and Forestry
ABMI:	Alberta Biodiversity Monitoring Institute
ACIMS:	Alberta Conservation Information Management System
AEP:	Alberta Environment & Parks
AFGO:	Alberta Forest Growth Association
AFPA:	Alberta Forest Products Association
AIP:	Agreement In Principle
AOP:	Annual Operating Plan
ARIS:	Alberta Regeneration Information System
ASL:	Above Sea Level
AVI:	Alberta Vegetation Inventory
BCG:	Broad Cover Group
CDWD:	Coarse Down Woody Debris
COSEWIC:	Committee on the Status of Endangered Wildlife in Canada
CNT:	Consultative Notation
CTPP:	Community Timber Permit Program
CTQ:	Coniferous Timber Quota
DEM:	Digital Elevation Model
DFA:	Defined Forest Area
DIDs:	Digital Integrated Dispositions
DFMP:	Detailed Forest Management Plan:
DTA:	Deciduous Timber Allocation
DTM:	Digital Terrain Model
ECA:	Equivalent Clearcut Area
ESLUZ:	Eastern Slopes Land Use Zones
FBP:	Fire Behaviour Potential
FHP:	Forest Harvest Plan
FGL:	Forest Grazing License
FGROW:	Forest Growth Organization of Western Canada
FGYA:	Foothills Growth and Yield Association

FMA:	Forest Management Agreement
FMP:	Forest Management Plan
FMU:	Forest Management Unit
FRIAA:	Forest Resource Improvement Association of Alberta
FRIP:	Forest Resource Improvement Program
FSI:	Fish Sustainability Index
FTG:	Free-to-Grow
GDP:	General Development Plan
GIS:	Geographic Information System
GOA:	Government of Alberta
GPS:	Global Positioning System
GRL:	Grazing Lease
GRP:	Grazing Permit
GYMP:	Growth and Yield Monitoring Plot
GYP:	Growth and Yield Program
GYPSY:	Growth and Yield Projection System
HRV:	Historical Resource Value
HSI:	Habitat Suitability Index
HUC:	Hydrological Unit Code
IRM:	Integrated Resource Management
IRP:	Integrated Resource Plan
LPH-LFMP:	Livingstone-Porcupine Hills Land Footprint Management Plan
LRSYA:	Long Run Sustained Yield Average
LUF:	Land-Use Framework
MAI:	Mean Annual Increment
MPB:	Mountain Pine Beetle
MFRI:	Mean Fire Return Interval
NLB:	Net Landbase
NRV:	Natural Range of Variation
NTA:	Non-Timber Assessment
OHV:	Off-Highway Vehicle
PAC:	Public Advisory Committee
PFMS:	Preferred Forest Management Scenario

PGYI: Provincial Growth and Yield Initiative

PDT: Plan Development Team

PHR: Post-Harvest Regenerated

PIC: Pre-Industrial Condition

PLRA: Public Land Recreation Area

PLRT: Public Land Recreation Trail

PLUZ: Public Land Use Zone

PSP: Permanent Sample Plot

PNT: Protective Notation

RFMA: Registered Fur Management Areas

RSA: Reforestation Standard of Alberta

RSF: Resource Selection Function

SFI: Sustainable Forestry Initiative

SFM: Sustainable Forest Management

SLS: Spray Lake Sawmills

SHS: Spatial Harvest Sequence

SSI: Stand Susceptibility Index

SSRP: South Saskatchewan Regional Plan

SYU: Sustained Yield Unit

TDA: Timber Damage Assessment

TOR: Terms of Reference

TSA: Timber Supply Analysis

TSP: Temporary Sampling Plot

TT: Technical Team

VOITs: Values, Objectives, Indicators and Targets

WMU: Wildlife Management Unit

FORCORP - Project Number: P877

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FINAL DRAFT

Annex I – Forest Management Agreement (FMA)

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	**Annex**	**I**	**FMA – Forest Management Agreement**
	Annex	II	Communication Plan
	Annex	III	Stewardship Report (2010-2015)
	Annex	IV	Yield Curve Development
	Annex	V	Net Landbase Development
Three	Annex	VI	TSA – Timber Supply Analysis
	Annex	VII	SHS – Spatial Harvest Sequence
	Annex	VIII	Growth and Yield Plan

GOVERNMENT OF ALBERTA

FORESTS ACT
FOREST MANAGEMENT AGREEMENT

MEMORANDUM OF AGREEMENT
FMA2100047

BETWEEN:

HER MAJESTY THE QUEEN in right of the Province of Alberta, as represented by the Minister of Agriculture and Forestry, (hereinafter referred to as "the Minister"),

OF THE FIRST PART

and

Crowsnest Forest Products Ltd. a body corporate, registered under the laws of Alberta, with a business office in Cochrane, Alberta, (hereinafter referred to as the "Company"),

OF THE SECOND PART

WHEREAS the Company is a wholly owned subsidiary of Spray Lake Sawmills (1980) Ltd. which owns and operates a major lumber production facility (the "Facility") at Cochrane, Alberta for the manufacturing of lumber, wood chips and other forest products; and

WHEREAS it has been mutually agreed by the parties hereto that it is desirable to enter into this forest management agreement to replace the existing Commercial Timber Quotas CTQC050008 and CTQC050009.

WHEREAS the Minister desires to provide for the fullest possible economic utilization of forest stands, and employment in local communities; and to ensure a perpetual supply of benefits and products while maintaining a forest environment of high quality;

NOW THEREFORE THIS AGREEMENT WITNESSETH that in consideration of the premises, terms, conditions, covenants, stipulations, agreements and provisions herein contained, the Minister and the Company hereby agree as follows:

1

DEFINITIONS

1 (1) In this Agreement

(a) "Agreement" means this forest management agreement, including all appendices attached hereto, and any written amendments made hereto from time to time by agreement of both parties;

(b) "annual allowable cut" is the amount of timber that may be harvested in any one forest management operating year as stipulated in the pertinent forest management plan approved by the Minister;

(c) "commencement date" has that meaning provided for in subparagraph 2(1);

(d) "Crown" means Her Majesty the Queen in right of Alberta;

(e) "cubic metre" shall have the same meaning as that prescribed by the Timber Management Regulation;

(f) "cut control period" means a period of five (5) consecutive forest management operating years or as otherwise mutually agreed to, in writing, by the Minister and the Company;

(g) "Department" means the Department of Minister of Agriculture and Forestry;

(h) "dollar" means Canadian currency of the value of one (1) Canadian dollar, or the Canadian equivalent value in any other currency;

(i) "forest management area" refers to the tract of forest land as specifically defined in paragraph 3;

(j) "forest management operating year" shall mean the operating year established pursuant to subparagraph 18(1);

(k) "forest planning standards" shall mean those forest planning standards published by the Minister as amended from time to time;

(l) "initial net forest management area" means the net area of the forest management area established as of the commencement date and agreed upon, in writing, by the Company and the Minister;

(m) "periodic allowable cut" is the total of the annual allowable cuts approved for a five-year (5) cut control period or such other period as otherwise mutually agreed to, in writing, by the Minister and the Company;

(n) "Public Lands Administration Regulation" means Alberta Regulation 187/2011;

(o) "timber" means all trees living or dead, of any size or species and whether standing, fallen, cut or extracted; and

(p) "Timber Management Regulation" means Alberta Regulation 60/1973.

(2) Any reference in this Agreement to an Act or regulation of Alberta shall mean for the purposes of this Agreement, those Alberta Acts and the regulations thereunder as each may from time to time be amended respectively or such Acts or regulations as may from time to time be substituted therefor, and terms defined by the *Forests Act* c. F-22 RSA 2000 or the *Public Lands Act* c. P-40 RSA 2000, or the regulations made thereunder shall, for the purposes of this Agreement, have the meaning given to them by those Acts and regulations as each may be amended or substituted from time to time.

2 (1) This Agreement shall commence on the first day of May, 2021 (hereinafter referred to as the "commencement date"), and shall expire on the last day of April, 2041 unless renewed under the provisions of subparagraph 2(3).

(2) It is the intention of the parties hereto to continue the rights of the Company under paragraph 7 to establish, grow, harvest and remove timber on the forest management area for additional terms of twenty (20) years.

(3) Subject to section 16 of the *Forests Act* and provided that the Company is not in default as to any of the terms, conditions, stipulations, covenants, agreements or provisions of this Agreement, the Company shall be entitled to a renewal of this Agreement whereby its rights under paragraph 7 to establish, grow, harvest, and remove timber are continued on condition that:

(a) the Company gives notice to the Minister during or after the eighth (8^{th}) year following the commencement date of its desire to renew this Agreement; and

(b) mutually acceptable terms, conditions, stipulations, covenants, agreements and provisions (including further renewal provisions or other requirements) can be negotiated at the time of renewal.

(4) Within sixty (60) days of the Company giving notice under subparagraph 2(3)(a), the Company and the Minister shall commence good faith negotiations in an attempt to agree on renewal of the Agreement with a term of twenty (20) years.

(5) The Company and the Minister may agree to commence negotiations at times other than that provided for in subparagraph 2(3).

FOREST MANAGEMENT AREA

3 The Minister and the Company hereby enter into this Agreement in respect of the forest management area comprising, subject to paragraphs 4, 5, and 6, public lands within the boundaries shown outlined on the map, which is annexed hereto as Appendix "A".

4 Out of the area shown within the boundaries outlined in Appendix "A" the following are excepted:

(a) lands which are the subject of a disposition issued pursuant to the *Public Lands Act*, other than a Forest Grazing Licence, prior to the commencement date or lands in respect of which a disposition under the *Public Lands Act,* other than a Forest Grazing Licence, has been approved but which issuance is pending prior to the commencement date;

(b) lands which have been reserved under Section 18(c) of the *Public Lands Act* prior to the commencement date or in respect of which a reservation has been approved but which has not been granted prior to the commencement date;

(c) the beds and shores of all permanent and naturally occurring bodies of water and all naturally occurring rivers, streams, watercourses and lakes; and

(d) lands under the legislative authority of the Provincial Parks Act and the Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act prior to the commencement date.

5 (1) Whenever any of the land excepted under paragraph 4 or subsequently withdrawn pursuant to paragraph 6 from the forest management area becomes available for disposition, and where such land is intended to be returned to timber production by the Minister, the Minister shall notify the Company when such land becomes available and the Minister shall return these lands back to the forest management area in a productive or potentially productive state.

(2) If the Company has not received a notification pursuant to subparagraph 5(1) and the Company becomes aware that land that had been excepted under paragraph 4 or subsequently withdrawn pursuant to paragraph 6 may be available for disposition, the Company may request the Minister to return such land to timber production. Upon receipt of such a request, the Minister may, in the Minister's discretion, return such land to timber production. In the event the lands are returned to timber production, the Minister will thereafter return the lands back to the forest management area in a productive or potentially productive state.

WITHDRAWALS

6 (1) The Minister may, at any time, in the Minister's discretion, after consultation with the Company with respect to the effect any such withdrawal may have on the forest management area, either permanently or for a specified term, withdraw from the forest management area:

(a) any land which cannot be harvested without causing substantial harm to the water table or to lakes, rivers, streams or other bodies of water, or to the margins of water courses;

(b) any lands required for rights-of-way or water resource development;

(c) any lands required for any other purposes deemed by the Minister to be required for the human or physical resource development of the Province;

(d) any lands required for commercial or industrial purposes; and

(e) any lands that are not capable of producing timber unless those lands are required to support forest management planning objectives in the approved forest management plan.

(2) A withdrawal shall take effect:

(a) on the date that a notice of withdrawal is given by the Minister to the Company, or

(b) where the notice given to the Company states that the withdrawal shall take effect on a future date, on the date stated in the notice.

(3) In the event, from time to time, after consultation with the Company, of any withdrawal or withdrawals of land from the forest management area by the Minister under subparagraph 6(1):

(a) for disposition to users other than the Crown, the Company shall be entitled to reasonable compensation from the users of the area withdrawn for any increased costs reasonably incurred by the Company in replacing the lost volume of timber and for any loss or damage suffered by the Company, including by way of example, but without limitation, damage to timber, improvements, regeneration, forest growth, or to its operations on the forest management area resulting from such withdrawals;

(b) for use by the Crown wherein the cumulative net aggregate area withdrawn does not exceed one half of one (0.5) percent of the initial net forest management area, the Minister shall determine the compensation and arrange for reimbursement to the Company for the actual loss or damage resulting from such withdrawal to any improvements created by the Company's efforts, but not for any loss of profit, inconvenience nor increased costs reasonably incurred by the Company in harvesting an equivalent volume of timber elsewhere; and

(c) for use by the Crown wherein the cumulative net aggregate area withdrawn over the term of this Agreement does exceed one half of one (0.5) percent of the initial net forest management area, the Minister shall determine the compensation in respect of such excess and arrange for reimbursement to the Company for any increased costs reasonably incurred by the Company in replacing the lost volume of timber and for any loss or damage suffered by the Company, including damage to timber, improvements, regeneration, forest growth, or to its operations on the forest management area.

(4) The Minister may, from time to time, designate a withdrawal of lands under subparagraph 6(1) as exempt from subparagraph 6(3)(a) and where the Minister has so designated, the compensation with respect to such withdrawal shall be paid by the user requesting the withdrawal as prescribed by the appropriate Alberta timber damage assessment table. Such designated withdrawals shall contribute to the cumulative net aggregate area withdrawn in subparagraphs 6(3)(b) and 6(3)(c).

(5) Compensation under subparagraphs 6(3)(b) and 6(3)(c) may be monetary or by the addition of available productive or potentially productive public land to the forest management area or a combination of both.

(6) If the administration and control of any of the lands comprising the forest management area is transferred to the Crown in right of Canada, the Company shall be entitled to compensation under subparagraph 6(3) as if the lands were withdrawn for use by the Crown.

(7) For the purposes of applying subparagraphs 6(3)(b) and 6(3)(c), the cumulative net aggregate area withdrawn shall be calculated taking into consideration all exceptions and additions to the initial net forest management area under subparagraph 6(5) and paragraphs 4 and 5 and all withdrawals under subparagraph 6(1) for use by the Crown.

(8) Monetary compensation received by the Company under subparagraphs 6(3)(a) and 8(1)(b) shall only be used to replace loss of property, to repair damage to improvements, to replace lost timber resource, to compensate for lost annual allowable cut, for activities contributing towards maintaining or increasing annual allowable cut beyond obligations under existing forest management standards and to reforest public lands returned to the forest management area.

(9) The Company shall maintain complete and accurate records of the receipt and use of all compensation funds received under subparagraphs 6(3)(a) and 8(1)(b) for a period of five (5) years.

(10) The Minister may, from time to time, at the Minister's discretion request verifiable documentation of the use of compensation funds received under subparagraphs 6(3)(a) and 8(1)(b) and the Company shall comply with any such request.

RIGHTS OVER THE LAND

7 (1) Subject to all the terms and conditions of this Agreement, the Minister grants to the Company the right, during the term of this Agreement, to enter upon the forest management area to:

(a) establish, grow, harvest, and remove coniferous timber thereon as provided for in the approved forest management plan;

(b) carry out silviculture and other programs that are approved by the Minister in accordance with this Agreement;

(c) construct, operate and maintain roads, bridges, camps, timber processing operations, wood concentration yards, and other installations necessary and incidental to the Company's right to establish, grow, harvest, and remove timber from the forest management area; and

(d) The Company shall have the right to harvest deciduous timber on the forest management area from stands which are managed for coniferous production where deciduous timber has been approved for harvest under the approved annual operating plan.

(2) For the purpose of interpreting the *Surface Rights Act* c. S-24 RSA 2000, the Company is an occupant of the public lands comprising the forest management area.

(3) The Company shall be required to pay all fees prescribed pursuant to the *Public Lands Act* with respect to any Company dispositions issued to, renewed or amended for the company on or after the commencement date. However, the Company shall not be required to pay such fees with respect to any disposition held by it before the commencement date until such time as that disposition is renewed or amended.

(4) The Company may obtain sand and gravel needed for its operations under this Agreement from any vacant public land on the forest management area pursuant to the Public Lands Administration Regulation, subject to the payment by the Company of all required fees and royalties. In no case, however, shall the Company be required to pay fees or royalties for *in situ* right-of-way material located and used where it is found within the right-of-way.

(5) It is recognized by the Minister that the use of the forest management area to establish, grow, harvest, and remove timber is to be the primary but not exclusive use thereof in keeping with the principles of sustainable forest management.

8 (1) The Minister reserves all rights on the forest management area not specifically given hereby to the Company in this Agreement, including by way of example, but without limiting the generality of the foregoing:

(a) the right of others to travel, hunt, fish, trap and otherwise use the said lands for recreational purposes, subject to any necessary restrictions approved by the Minister for the purpose of prevention of accidents, fire control, protection of wildlife and seasonal protection of roads;

(b) the right to authorize any person to conduct any work in connection with or incidental to geological or geophysical exploration pursuant to the *Mines and Minerals Act* c. M-17 RSA 2000, or the Exploration Regulation (Alberta Regulation 284/2006); provided that the Company shall be entitled to reasonable compensation, from the person or company that holds authorization to conduct the exploration, for any loss or damage suffered by the Company and resulting from such exploration including by way of example but without limitation, for any damage to timber, forest growth, regeneration, improvements or to any of its operations on the forest management area; and provided further that the Company shall not be entitled to compensation for damage to timber or forest growth caused by any such geological or geophysical exploration where the right to such timber has been granted to a third party under a timber disposition;

(c) the right to maintain and enhance forest resources, including fish and wildlife resources, provided the Company's right to establish, grow, harvest, and remove timber is not significantly impaired; and

(d) the right to authorize trapping and, after consultation with the Company, to authorize domestic stock grazing provided that the domestic stock grazing will not damage regeneration of managed species to the point where growth performance and overall stocking are reduced below the reforestation standards provided for in or agreed to pursuant to the Timber Management Regulation and provided that the Company's right to establish, grow, harvest, and remove timber is not significantly impaired.

(2) The Minister also reserves the following rights to the timber on the forest management area:

(a) the right, after consulting with the Company, provided it follows the approved forest management plan spatial harvest sequence, to issue short-term timber dispositions from within the forest management area to provide timber for local use in construction and maintenance of public works by any local authority, municipality, county, the Crown in the right of Alberta or Canada, and for local residents for their own use and sale provided, however, that the total volume of timber cut under the authority of such dispositions in any timber operating year does not exceed one half of one (0.5) percent of the Company's approved annual allowable cut;

(b) the right, after consulting with the Company, provided it follows the approved forest management plan spatial harvest sequence, to issue short-term timber dispositions on the forest management area to those timber holders listed in Appendix "B" and to increase the existing quota certificates, or issue new or additional quota certificates, for the annual allowable cut as set out in the forest management plan;

(c) the right, after consulting with the Company, provided it follows the approved forest management plan spatial harvest sequence, to issue short term timber dispositions from within the forest management area, to maintain the Community Timber Program and provide the public access to timber, provided that the total volume of timber cut or made available annually under authority of such dispositions does not exceed 9,799 m^3 of coniferous timber from the management unit as depicted in Appendix A;

(d) the right, after consulting with the Company, to manage and reforest tree species on any lands that may be required to meet the Minister's obligations to those disposition holders referred to in subparagraphs 8(2)(a), 8(2)(b) and 8(2)(c) in accordance with the approved forest management plan; and

(e) should the volume of timber available under subparagraphs 8(2)(a) and 8(2)(c) remain unused in a forest management operating year, that volume will accrue to the Company.

(3) The Minister and the Company agree to provide, each to the other, in confidence, such available information as the Minister and the Company may reasonably request concerning the operations on the forest management area that are authorized under timber dispositions. The Minister shall consult with the Company on an ongoing basis as may be required to minimize any conflict on the forest management area between the operations authorized under the timber dispositions issued pursuant to subparagraph 8(2) and the operations of the Company.

FOREST MANAGEMENT

A. GENERAL PROVISIONS

9 (1) On the forest management area the Company shall, in accordance with the approved forest management plan, follow sound forest management practices designed to provide a yield consistent with sustainable forest management principles and practices while not reducing the productivity of the land.

(2) The Company shall ensure that they satisfy all consultation obligations with First Nations and Métis that may be delegated to them by the Minister in accordance with the applicable current Consultation Policies and Guidelines.

10 (1) The Company shall submit a forest management plan in accordance with the forest planning standards for the Minister's approval on or before May 1, 2025.

(2) Each forest management plan developed under subparagraph 10(1), when approved, shall replace the previously approved forest management plan.

(3) Before the Company submits a forest management plan referred to in subparagraph 10(1) to the Minister for review and approval, the Company shall make the necessary arrangements required for and shall conduct presentations and reviews of their proposed forest management plans with the public and timber disposition holders in accordance with the forest planning standards.

(4) After such presentations, reviews and consultation referred to in subparagraphs 9(2) and 10(3), the Company shall incorporate in the forest management plan its response to the public, First Nations, Métis and timber disposition holders respecting the proposed forest management plan.

(5) The Minister may require the Company, after consulting with the Company, to alter any of the methods described in its forest management plans before approving such plans provided, however, that the changes required by the Minister are consistent with the forest planning standards.

(6) The Minister agrees that so long as a forest management plan required under this paragraph has been submitted by the Company within the time periods herein specified and provided such plan complies with the requirements of this Agreement, unless the Minister has sent a notice under paragraph 12, the Company is hereby authorized to continue to carry on its operations pursuant to the existing approved plan, pending approval being granted by the Minister to the newly submitted plan.

(7) Should the Company fail to submit a forest management plan on the dates identified in subparagraph 10(1) or the submitted plan is not satisfactory to the Minister, without in any way limiting the Minister's other rights or remedies hereunder, the Minister may set new dates by reasonable notice in writing for revised forest management plan submissions.

(8) The Company shall co-operate with the development and implementation of integrated land management initiatives to the satisfaction of the Minister.

11 (1) The Company shall not deviate from the approved forest management plans without the Minister's consent in writing, with the understanding that the Minister shall provide a full explanation whenever consent is withheld.

(2) Notwithstanding subparagraph 11(1), the Company may continue operations under approved plans, such as FMU C5 Forest Management Plan effective May 1, 2010 until such time as those plans are either replaced by plans approved under this Agreement or the Minister deems the existing plans obsolete or inadequate pursuant to paragraph 12.

12 (1) When, in the opinion of the Minister, any approved plan becomes obsolete or inadequate from a good forest management perspective, the Minister may, by reasonable notice in writing, require the Company to submit a revised plan for approval within a specified time, or within any extended time the Minister may subsequently allow.

(2) In the event the Minister's dates for forest management plan submission under subparagraph 10(1) or revised dates under subparagraph 10(7) are not met or the Minister requires the Company to submit a revised plan under subparagraph 12(1), the Minister may, after consulting with the Company, impose remedies until such time as a new revised plan is approved. The remedies may include but are not limited to any, or a combination of any or all, of the following:

(a) imposition of an annual allowable cut;

(b) modification of the approved harvest sequence;

(c) adjustment of the yield curves used in the approved forest management plan; and

(d) the requirement to develop co-operative landscape objectives.

(3) If the Minister adjusts the dates for forest management plan submission under subparagraph 10(7), the Company may continue to carry out operations in accordance with the approved forest management plan as modified by any remedies imposed by the Minister under subparagraph 12(2).

13 (1) The Company shall recommend, in its forest management plans, areas available for harvesting by other timber disposition holders on the forest management area.

(2) The Minister shall consult with the Company concerning proposed areas and methods of harvesting by holders of timber dispositions on the forest management area before designating the areas in which their operation may be carried out.

(3) The Company shall, through sustainable forest management planning, make reasonable efforts to integrate and coordinate the management of the forest resources with all timber disposition holders operating on the forest management area.

(4) The Minister shall, through sustainable forest management planning, require timber disposition holders operating within the forest management area to conduct all harvesting operations and management of forest resources in accordance with the Company's approved plans and to refrain from hindering or obstructing the lawful operations of the Company.

14 (1) The Company shall conduct such forest inventories of the forest management area as are reasonably necessary to prepare the plans required by this Agreement.

(2) The Company shall maintain a reasonably complete and accurate forest inventory in accordance with forest planning standards.

(3) Unless otherwise agreed to by the parties in writing, the Company shall maintain or participate in a deciduous and coniferous growth and yield program consistent with prevailing standards and policies and acceptable to the Minister.

(4) The deciduous timber will be managed for its contribution towards other resource values on a landscape basis. There is no obligation to utilize or salvage the deciduous timber resource. Any harvest and utilization of deciduous timber from the forest management area shall be managed according to the requirements set out in the forest planning standards.

15 All information and data related to the forest management area that has been collected or generated by the Company or the Minister including forest inventory, other resource uses, growth and yield data, reforestation results, and operational and detailed planning maps shall be made available to the Minister, or the Company, whichever is the case, free of charge upon request and on a timely and, subject to subparagraph 48(2) of this Agreement, confidential basis.

9

16 (1) The Company shall conduct its timber harvesting and reforestation operations in accordance with the approved ground rules jointly developed by the Company and the Minister until such time as they are replaced by the new set of ground rules developed in accordance with subparagraphs 16(2) or 16(3), following which the Company shall conduct its timber harvesting and reforestation operations in accordance with the new set of ground rules.

(2) Concurrently with the development of the forest management plans developed under subparagraph 10(1), or at such time as may be agreed to, in writing, by the Minister and the Company, the Minister and the Company shall jointly develop a new set of ground rules consistent with the forest management plans.

(3) If a set of ground rules, or a revision to a set of ground rules, cannot be established by mutual agreement, the Minister may establish or revise a set of ground rules which are consistent with the approved forest management plans and the "Timber Harvest Planning and Operating Ground Rules Framework for Renewal" published by the Minister, as amended from time to time.

(4) At the initiative of either party, the Minister and the Company shall jointly review the ground rules. These ground rules may be altered by mutual agreement of the Minister and the Company.

17 (1) The term of this Agreement shall be divided into four (4) cut control periods each with a duration of five (5) years, or as otherwise agreed to in writing by the Minister and the Company.

(2) If the Company overcuts the periodic allowable cut, the Minister may, after consulting with the Company, reduce the periodic allowable cut during the subsequent cut control period by any amount up to the entire over cut volume at the Minister's sole discretion.

(3) Where production is lower than the periodic allowable cut, the Company may submit a program satisfactory to the Minister making up the undercut volume in the subsequent cut control period, or such other period as may be approved by the Minister.

18 (1) Following the commencement date of this Agreement, the forest management operating year shall commence on May 1 and end on April 30.

(2) The Company shall submit to the Minister annual operating plans in accordance with the ground rules referred to in paragraph 16.

(3) Each annual operating plan shall be prepared in accordance with the approved forest management plan and include operating projections showing the proposed harvesting operation intended by the Company. Such operating projections shall be in accordance with the forest planning standards and shall cover the period of time specified in the ground rules referred to in paragraph 16.

(4) The Minister may approve such plans as are submitted, or may require the Company, after discussing any proposed changes with the Company, to alter any harvesting operations described in the plans, provided that the Minister shall not thereby alter the ground rules and acts promptly so as to avoid delay in the Company's operations. The Company shall not commence operations until an annual operating plan has been approved by the Minister and the Company shall comply with the plan and any amendments approved by the Minister.

(5) When the annual operating plan does not provide for the salvage of dead, damaged, diseased or decadent timber, the Minister may give notice to the Company that the Minister requires provision for its salvage in such a plan. The Company shall amend its plan, or justify the exclusion of such timber from its plan within the notice period specified below. If the Company fails or elects not to do either within such period, the Company shall not be deemed to be in default and the Minister may dispose of such timber to any person by a timber disposition without compensating the Company and the volume of timber so disposed will be charged by the Minister as production under this Agreement for the purpose of cut control under paragraph 17. For the purposes of this subparagraph, "notice period" shall mean thirty(30) days, unless the timber disposition exceeds two (2) years, in which case "notice period" shall mean one (1) year.

(6) When the annual operating plan does not provide for the utilization of all fibre generated as a result of the Company's harvesting operations, the Minister may give notice to the Company that the Minister requires provision for its utilization in such a plan. The Company shall amend its plan, or justify the exclusion of such fibre from its plan within the notice period specified below. If the Company fails or elects not to do either within such period, the Company shall not be deemed to be in default and the Minister may dispose of such unutilized fibre to any person by a disposition without compensating the Company. For the purposes of this subparagraph, "notice period" shall mean thirty (30) days, unless the disposition exceeds two years, in which case "notice period" shall mean one (1) year. No such disposition shall authorize any activities that might reasonably be expected to hinder or obstruct the lawful timber operations of the Company or create any additional costs or liabilities to the Company.

19 The Company shall utilize all merchantable timber cut in road construction and other incidental operations of the Company unless otherwise permitted in writing by the Minister.

20 (1) The Company shall not hinder or obstruct the lawful operations of other timber disposition holders operating within the forest management area.

(2) It is recognized that during their operations, other timber disposition holders may cause some incidental damage to timber on the forest management area. No claim shall be made by the Company against any timber disposition holder, or the Minister, for reasonably unavoidable incidental damage to timber.

(3) The Minister shall ensure that all timber dispositions issued on the forest management area after the commencement date shall include a provision preventing a claim against the Company for reasonably unavoidable incidental damage to timber.

(4) The Minister shall require other timber disposition holders operating within the forest management area to follow the approved forest management plan and conduct all harvesting operations in accordance with the Company's approved ground rules and to refrain from hindering or obstructing the lawful operations of the Company.

B. REFORESTATION

21 (1) The Company shall reforest at its own expense all lands cut over by the Company under this Agreement and previously held timber quotas, CTQC050008 and CTQC050009 (as amended from time to time) to the required reforestation standard and shall describe its reforestation program in its forest management plans and annual operating plans.

(2) In this Agreement the required reforestation standard means the reforestation standards provided in or agreed to pursuant to the Timber Management Regulation.

(3) As part of its operations under this Agreement, the Company shall, at its sole expense, furnish all of the seedling trees and propagules required for its reforestation needs.

(4) Seed, seedling trees and propagules used for reforestation programs under this Agreement shall be produced in accordance with the rules established by the Minister governing the source and type of tree seed and species used to reforest public land.

22 (1) The Company shall be solely responsible for reforesting to the required reforestation standard all productive forested lands burned by fire within the forest management area, when the fire has been caused by or arises out of any operations or activities conducted on the forest management area by the Company, its employees, agents or contractors.

(2) The Company shall not be required to reforest lands cut over or burned after the commencement date unless such cutting or burning was caused by or arises out of any of the operations or activities conducted on the forest management area by the Company, its employees, agents or contractors.

23 The Minister shall be responsible for ensuring that forest lands on the forest management area cut over after the commencement date by persons other than the Company, its employees, agents or contractors, are reforested to the required reforestation standard.

24 The Company may devise and implement enhanced forest management programs. The Company and the Minister may enter into an agreement that will define the programs and conditions that, in the Minister's opinion, will establish a sustainable increase in the annual allowable cut approved by the Minister in the Company's forest management plans submitted under paragraph 10 (1).

FOREST PROTECTION

25 (1) The Minister agrees to provide and maintain an organization of people and equipment necessary for the protection of the forest from and suppression of forest fires on the forest management area and, except as herein otherwise provided, to pay the cost of fighting any forest fire that originates on the forest management area on the understanding that the Minister shall not be liable for damages to the Company resulting from a failure to prevent, control or suppress any fire.

(2) Notwithstanding subparagraph 25(1), the Company shall pay the cost of suppressing any forest fire that originates on the forest management area if the fire is caused by or arises out of any of the operations or activities conducted on the forest management area by the Company, its employees, agents or contractors; provided, however, that in no event shall the liability of the Company exceed the liability provided for in a separate fire control agreement that has been negotiated and entered into by the Minister and the Company. If the cause of any fire is disputed by the Company, the dispute shall be resolved by means of civil suit in the Courts of Alberta.

(3) If a fire control agreement between the Minister and the Company is more than five (5) years old at the commencement date, then notwithstanding any provision in that fire control agreement, that fire control agreement will terminate on the first anniversary of the commencement date unless it has been replaced by a new fire control agreement or the Minister has directed otherwise.

(4) Where there is no fire control agreement in effect, the Company agrees to have on hand in good working order such fire fighting equipment as specified in the Forest and Prairie Protection (Ministerial) Regulation and shall train its employees in fire suppression as reasonably specified by the Minister.

(5) Notwithstanding anything contained in this Agreement, the Company shall not be liable for loss of or damage to Crown timber by fire that is caused by or arises out of any of the operations or activities conducted on the forest management area by the Company, its employees, agents or contractors.

(6) In the event of an occurrence of insect damage of epidemic nature to forest growth or a disease epidemic affecting forest growth on the forest management area the parties hereto will cooperate in suppressing the epidemic.

RECORDS AND SCALING

26 (1) All scaling and measuring of timber weights and volumes by or on behalf of the Company shall be conducted in accordance with the *Forests Act*, its regulations and the published instructions of the Department.

(2) Consistent with subparagraph 26(1), the Company shall maintain, in the form and in the manner approved by the Minister, complete and accurate records of the operations it conducts on the forest management area.

(3) The Minister, or any person authorized by the Minister, may inspect the records maintained by the Company pursuant to subparagraph 26(2).

27 (1) Unless otherwise prescribed in the Timber Management Regulation, within thirty (30) days of the termination of every calendar quarter, the Company shall submit to the Minister in writing, on a form prescribed by the Minister, a return reporting:

(a) the volume of timber cut by and for the Company;

(b) the volume of timber cut or destroyed by others for which the Company is entitled to compensation under this Agreement;

(c) at the request of the Minister, the volumes of primary timber products manufactured and sold by and for the Company from its operations in Alberta;

(d) at the request of the Minister and, subject to subparagraph 48(2) of this Agreement, on a confidential basis, the volumes of timber and primary timber products purchased for use in its facilities, the names of all persons from whom timber and primary timber products were purchased, and the land from which the timber was cut; and

(e) at the request of the Minister and, subject to subparagraph 48(2) of this Agreement, on a confidential basis, the geographic destination of timber and primary timber products sold by the Company from its operations in Alberta.

(2) The Company or its agent shall remit to the Minister with each timber return the amount of all dues payable by the Company for the volume of timber shown on such returns and when done by the Company's agent, it shall not relieve the Company of this responsibility.

CHARGES AND DUES

28 (1) Once a year during the term of this Agreement, the Company shall pay to the Minister on or before a date specified by the Minister, a holding and forest protection charge.

(2) (a) Initially, the charge in subparagraph 28(1) will be $101,927.

(b) The holding and forest protection charge established in subparagraph 28(2)(a) shall be adjusted upon renewal of this Agreement.

(3) Subsequent holding and forest protection charges shall be adjusted annually on the anniversary of the commencement date using the Annual Implicit Price Index for government current expenditure on goods and service, as published by Statistics Canada, in the following formula:

$$\text{Charge for Year Of Payment} = \text{Charge for Previous Year} \times \frac{\text{Index for Year Prior to Year of Payment}}{\text{Index for Second Year Prior to Year of Payment}}$$

Example:

$$\text{2021 Holding and Forest Protection Charge} = \$101{,}927 \times \frac{\text{2021 Index}}{\text{2020 Index}}$$

In the event that the Annual Implicit Price Index is no longer published or in the event of a change in the method used to calculate the Index, the Minister and the Company shall mutually and reasonably agree on a comparable published index to be used in the above formula.

29 (1) For all timber on the forest management area cut by or for the Company, or for which the Company is entitled to compensation, the Company shall pay to the Minister timber dues at the rates established under the Timber Management Regulation.

(2) The Company shall co-operate with the reconciliation of timber production and dues associated with the timber production on an annual basis or as mutually agreed upon in accordance with the methods prescribed by and to the satisfaction of the Minister.

30 (1) The Company shall maintain a program or programs to enhance its ability to establish, grow, harvest, and remove timber and the level of understanding of forest resources and forest products within Alberta. The minimum annual expenditure by the Company in respect of such a program or programs shall equal or exceed, on average, during each five (5) year term of this Agreement, $0.25 per cubic metre per year based on all timber cut by or for the Company from the forest management area. The annual funding shall be comprised of direct funding of Canadian research or academic institutes, co-operatives, consultants, in-Company innovations in manufacturing and harvesting technology, silviculture, tree improvement and costs associated with the hiring of scientific personnel in the Company.

(2) The Company shall annually or as otherwise requested by the Minister provide a report that details the activities of the program or programs referred to in subparagraph 30(1).

FACILITY OPERATION

31 The Company shall notify the Minister, in writing, of any intended reduction in consumption levels of twenty (20) percent annual fibre capacity or more of its manufacturing facility and such notification shall be submitted to the Minister at least six (6) weeks prior to the intended reduction taking effect.

32 (1) Subject to subparagraph 32(1)(b), if at any time the Company's facilities referred to in paragraph 31 cease to consume fibre and operate for a period of twelve (12) consecutive months, the Minister shall have the right to:

(a) (i) suspend the Company's right to consume fibre on the forest management area on written notice to the Company;

(ii) issue short-term coniferous and deciduous timber dispositions to third parties on the forest management area for up to one-hundred (100) percent of the Companies approved coniferous annual allowable cuts; and

(iii) charge as production under this Agreement the volume of timber harvested under short-term timber dispositions issued to third parties under this subparagraph.

(b) The Minister shall restore the Company's rights to consume fibre on the forest management area if at any time:

(i) the Company advises the Minister in writing of its intention to resume fibre consumption and operation of the facilities and the Company resumes operation of the facilities within ninety (90) days of delivery of the notice; or

(ii) the Company submits a proposal to the Minister (the "Proposal"), within thirty-six (36) months from the date on which the facilities cease to consume fibre and operate, for the utilization of timber harvested from the forest management area in another facility in Alberta, and the Proposal is acceptable to the Minister, and the Company implements the Proposal within a period of time satisfactory to the Minister.

(2) Upon restoration of the Company's right to harvest coniferous timber, on the forest management area:

(a) the Minister shall not issue any further short-term timber dispositions to third parties on the forest management area pursuant to subparagraph 32(1)(a)(ii); and

(b) the Company shall be entitled to the return of any of the timber temporarily disposed of by the Minister that remains un-harvested on expiry of the short-term coniferous and deciduous timber dispositions.

(3) Notwithstanding subparagraphs 32(1) and 32(2), if the Company's facilities referred to in subparagraphs 32(1) or 32(2) cease to consume fibre and operate for a cumulative, but not necessarily consecutive, period of thirty-six (36) months (where each such shutdown is at least two (2) months in duration), the Minister shall have the right to cancel this Agreement.

(4) At the Minister's request, the Company shall report on value added initiatives in relation to new product development, strategic partnerships, forest management and fibre utilization. Subject to subparagraph 48(2) of this Agreement, the Minister agrees to keep confidential any reports provided by the Company to the Minister under this subparagraph.

GENERAL PROVISIONS

33 (1) If the Company at any time is in default under any of the covenants, terms, conditions, provisions, agreements or stipulations in this Agreement, the Minister may give written notice to the Company setting out the default complained of and requiring the Company to remedy the default within six (6) months, or a period of time mutually agreed to in writing, of the giving of notice.

(2) The Minister may, from time to time, extend the period during which the Company is required to remedy any default complained of in a notice given pursuant to subparagraph 33(1).

34 If the period of time to remedy the default in paragraph 33(1) or 33(2), as applicable, has expired, and in the opinion of the Minister the Company has failed to remedy the default, the Minister may:

(a) require the Company perform all of their respective covenants, terms, conditions, stipulations, provisions, agreements and obligations as contained in this Agreement;

(b) bring a civil action for damages for breach of contract and/ or any other cause of action recognized at law; and / or

(c) cancel this Agreement as it applies to the Company according to the mechanism described in paragraph 36.

35 When any default or delay by the Company in the performance or observance of any of the terms, conditions, provisions, agreements, covenants or stipulations of this Agreement is occasioned in whole or in part through:

(a) industrial disputes,

(b) governmental review or judicial proceedings respecting the possible environmental impact of the forest products manufacturing facilities or woodlands operations; or

(c) interruption which is not the result of any wilful or negligent act or omission by the Company, such as power failure, fire, sabotage, tempest, war or acts of God;

and not avoidable by reasonable effort or foresight, the Company shall not be deemed in default under this Agreement and the time for performance or observance of such term, condition, provision, agreement, covenant or stipulation shall be extended by such reasonable period of time as the Minister may specify in writing to the Company.

36 (1) Except as otherwise provided for in paragraphs 32, 33 and 35, the Minister may, by giving the Company ninety (90) days notice in writing, cancel this Agreement when:

(a) any goods or chattels of the Company, located in Alberta, and which constitute a material part of the Company's assets located thereat, are lawfully seized or taken in execution by a creditor of the Company, and the Company has failed to take any legal action to contest the same within ninety (90) days after such seizure or taking, or

(b) the Company makes any general assignment for the benefit of its creditors or an assignment in bankruptcy or takes the benefit of any Act in force for bankrupt or insolvent debtors, or

(c) the Company fails from time to time to observe or perform any of the covenants, stipulations, terms, conditions, provisions or agreements required to be observed or performed by the Company under this Agreement, and having been given written notice of such failure under paragraph 33 of this Agreement, fails to remedy such failure within the time allowed by the said paragraph for so doing, or any extension thereof given by the Minister.

(2) Subparagraphs 36(1)(a) and 36(1)(b) do not apply if a trustee for the holders or receiver managers or the holders themselves of bonds, debentures, or other securities of the Company exercises any rights or remedies contained in any deed of trust or mortgage or other agreement under which such bonds, debentures or other securities are issued or secured, including but without restricting the generality of the foregoing, the taking of possession by the trustee, receiver managers or the holders themselves of the Company's properties and assets and the operation or disposition thereof for the benefit of the holders of the Company's bonds, debentures or other securities.

(3) Subparagraphs 36(1)(a) and 36(1)(b) do not apply when the Company proposes a compromise or arrangement or otherwise brings proceedings under or becomes subject to the provisions of the *Companies' Creditors Arrangement Act* (Canada) or any successor or similar legislation thereto.

37 The Minister does not guarantee any quality or quantity of timber on the forest management area.

38 No implied contract of any kind by or on behalf of the Minister shall arise or be construed from anything contained in this Agreement and the only rights, powers and privileges granted to the Company are those contained in this Agreement and any applicable fire control agreement.

39 The Minister and the Company agree that the lines on the map shown in Appendix "A" hereunto annexed are intended, where those lines outline areas that are not surveyed, to be the survey lines of the townships, sections, or half sections, as the case may be, that would exist if such areas were surveyed under the system of township surveys prescribed by the *Surveys Act* c. S-26 RSA 2000.

40 The Company shall comply with and observe all the provisions and requirements of all Acts of the Province of Alberta and the regulations thereunder in force from time to time that apply to the Company or to this Agreement.

41 The Company shall, during the term of this Agreement, maintain a business office in Alberta and be in compliance with the requirements of the *Business Corporations Act* c. B-9 RSA 2000 and its regulations or other legislation pursuant to which the Company was incorporated.

42 (1) Except for a dispute as to the cause of any fire referred to in subparagraph 25(2), where any dispute arises between the parties to this Agreement concerning the application or interpretation of this Agreement, the dispute may be referred to arbitration pursuant to the *Arbitration Act* c. A-43 RSA 2000, but only upon the mutual agreement of the parties involved.

(2) Where the parties to a dispute do not agree to refer a dispute concerning this Agreement to arbitration as provided in subparagraph 42(1), the dispute shall be resolved by means of civil action, before the Courts of the Province of Alberta.

43 (1) The Company shall not assign this Agreement or any of the rights granted by this Agreement without the consent of the Minister in writing and such consent may, in the Minister's sole discretion, be withheld. Where the Minister refuses to consent to an assignment, the Minister shall advise the Company in writing of the reasons for so refusing.

(2) Subparagraph 43(1) does not apply to:

(a) the employment of one or more contractors in the normal conduct of its operations;

(b) an assignment or transfer of this Agreement by way of mortgage or charge or the grant of a security interest in this Agreement to lenders to or trustees for lenders to the Company; or

(c) an assignment or transfer to a person, firm or corporation upon the sale or other disposition by or on behalf of lenders to or trustees for lenders referred to in subparagraph 43(2)(b) in the course of realization or enforcement of security against the manufacturing facilities, provided that such assignment, transfer, or other disposition shall not be made without the consent of the Minister in writing. Where the Minister refuses to consent to an assignment, the Minister shall advise the lenders or trustees for lenders, as the case may be, in writing of the reasons for so refusing.

44 Any waiver by the Minister of the strict performance by the Company of its covenants or of any term, condition, stipulation, agreement or provision under this Agreement is not binding upon the Minister unless such waiver is expressed in writing under the authority of the Minister and any such waiver or any extension of time granted by the Minister hereunder shall not abrogate such or any covenant, term, condition, stipulation, agreement or provision herein or constitute a waiver or extension of time as to any subsequent breach of the same or any other covenant, term, condition, stipulation, agreement or provision herein.

45 The Company covenants and agrees to observe, perform and keep all covenants, terms, conditions, stipulations, agreements and provisions herein on its part to be observed, performed and kept and time shall be and remain of the essence thereof and notwithstanding any binding waiver given by the Minister as referred to in paragraph 44 or any extensions of time given by the Minister under this Agreement that thereby may affect the time for performing any particular act, covenant, term, condition, stipulation, agreement or provision of this Agreement herein, time shall remain of the essence pertaining to all subsequent performance by the Company of any and all acts, covenants, terms, conditions, stipulations, agreements and provisions herein contained and to this entire Agreement.

46 (1) The Company assumes liability for and shall pay all claims of the Minister for all damages to any real or personal property (other than timber) of the Crown that was caused by, or arises out of, any of the operations or activities conducted on the forest management area by the Company, or any of its employees, agents, or contractors, whether or not the damage so caused is due to the negligence of the Company, its employees, agents, or contractors, as the case may be, provided that such liability under this subparagraph shall not include economic loss or incidental and consequential loss and damage.

(2) Subparagraph 46(1) shall not restrict, in any manner, the ability of the Minister to pursue the Company under the common law (as opposed to pursuant to this Agreement) for economic loss or incidental and consequential loss and damage, which liability may be resolved by means of arbitration pursuant to the Arbitration Act with the mutual agreement of both parties, or failing such agreement, by civil action before the Courts of the Province of Alberta.

47 (1) The Company agrees to hold the Minister harmless against any and all third party claims, demands, or actions for which the Company is legally responsible, including those arising out of negligence, wilful harm, or crimes by the Company or its employees or agents.

(2) Subparagraph 47(1) does not apply to any claim alleging interference with an aboriginal right or title by the Company, its employees, agents or contractors provided the claim does not relate to a breach by the Company, its employees, agents, or contractors of this Agreement or the approved forest management plan or annual operating plans during the period of the alleged interference.

48 (1) The Company shall submit, in confidence, to the Minister, when required, any information, data, or documents the Minister may reasonably request in respect of matters relating to this Agreement for the purpose of verifying the Company's continued compliance with the terms of this Agreement.

(2) Where any information, data, or documents are provided to the Minister in confidence under this Agreement that confidentiality is subject to any restriction on disclosure or obligation to disclose imposed on the Minister by law including, without limitation, the *Freedom of Information and Protection of Privacy Act* c. F-25 RSA 2000.

49 Any notice required to be given under this Agreement shall be deemed to be well and sufficiently given if delivered to the addresses set out below or if mailed at any post office in Canada by prepaid registered mail addressed as follows:

(1) to the Company:

Crowsnest Forest Products
Ltd. 305 Griffin Road West
Cochrane, Alberta
T4C 2C4

(2) to the Minister:

Minister of Agriculture and Forestry
Legislature Building
Edmonton, Alberta
T5K 2B6

or to such other address either party may from time to time inform the other party in writing, and any such notice shall be deemed to have been received on the fourth business day after the mailing thereof, or if delivered, when delivered; provided that if mailed should there be between the time of mailing and the actual receipt of the notice of a mail strike, slow down or other labour dispute that might affect the delivery of such notice then such notice shall only be effective if and when actually delivered.

50 Notwithstanding any other clause in this Agreement, this Agreement is subject to the *Forests Act* and any amendments to the *Forests Act*.

51 In the event that this Agreement is cancelled for any reason and if the Department provides written notice that the Agreement will not be reinstated in response to an application by the Company, the Company may no later than six (6) months after the date of the Department's written notice, request, in writing, that the Minister grant to the owner(s) of the lumber production facility located at Cochrane, Alberta, for the sum of $1.00, a coniferous quota for the percentage of coniferous timber that the Company is entitled to under the approved forest management plan. Upon receipt of said request, the Minister shall grant the coniferous quota on such terms and conditions the Minister considers appropriate.

52 The obligation of the Minister to grant a coniferous timber quota under paragraph 51 shall survive the cancellation of this Agreement.

53 This Agreement inures to the benefit of and is binding upon the Crown and Her assigns, and the Company and its successors and assigns if approved by the Minister in accordance with the provisions of this Agreement.

54 This Agreement shall be construed as having been made in the Province of Alberta and the laws of the Province of Alberta shall be applied in the event of any action or arbitration mutually agreed to, respecting any dispute arising from this Agreement, its formulation, interpretation, and each and every other aspect pertaining to or resulting from its entire contents.

IN WITNESS WHEREOF the party of the first part executes this Agreement under the hand of the Minister subscribed hereunder at COCHRANE, Alberta, Canada this 17th day of JULY, 2021.

HER MAJESTY THE QUEEN in Right of Alberta

Witness

Minister of Agriculture and Forestry

and the party of the second part executes this Agreement by subscribing hereunder the signature of its duly authorized corporate officer at COCHRANE, Alberta, Canada this 17th day of JULY, 2021.

Crowsnest Forest Products Ltd.

Witness

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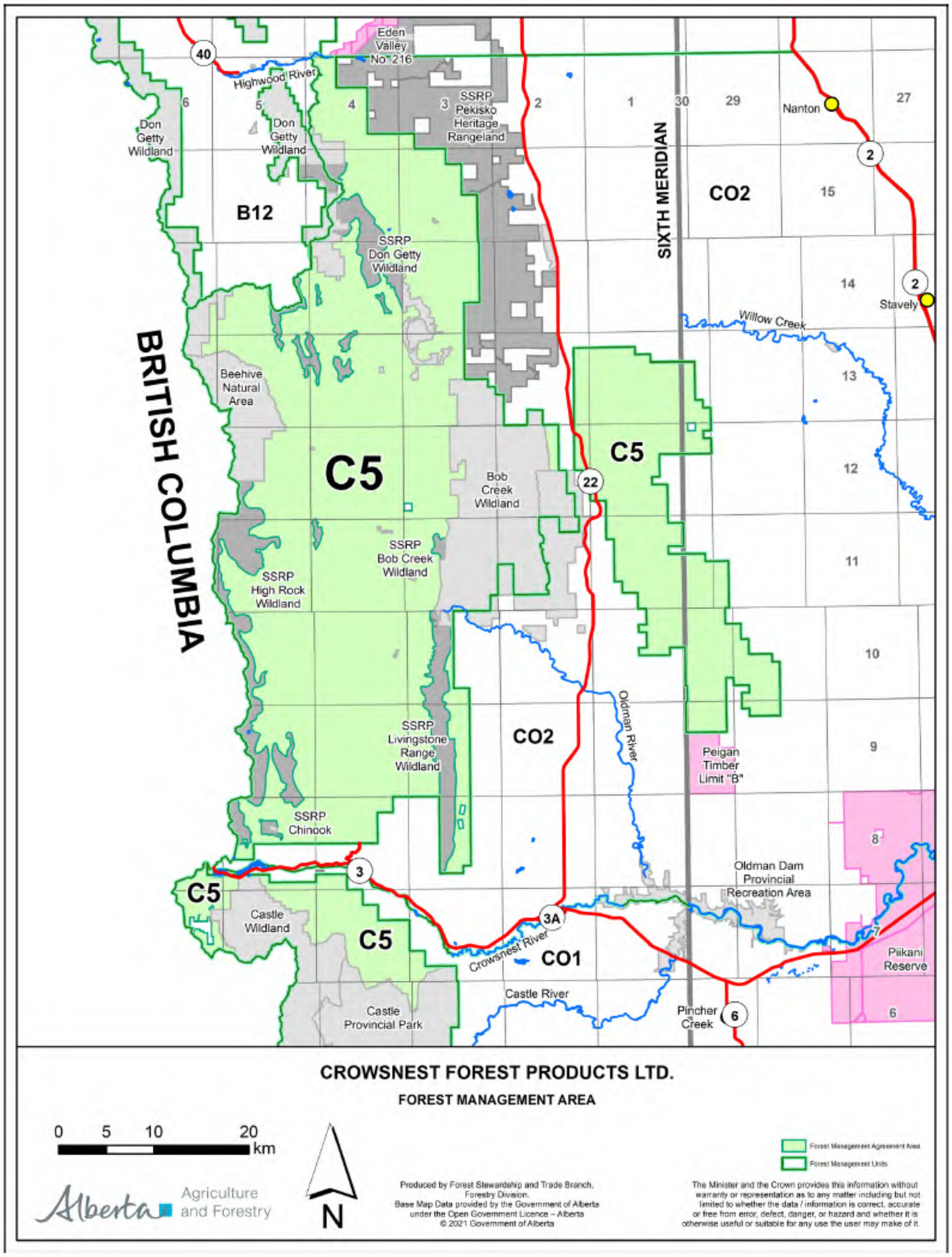
APPENDIX "A"



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APPENDIX "B"

CROWSNEST FOREST
PRODUCTS Ltd.

CONIFEROUS TIMBER QUOTA CERTIFICATE HOLDERS ISSUED WITHIN THE FOREST MANAGEMENT AREA

1.	793128 Alberta Ltd	CTQC050002
2.	770538 Alberta Ltd.	CTQC050005

Where a coniferous timber quota listed in this Appendix is merged with one or more coniferous timber quotas, the new coniferous timber quota shall be deemed to be listed in Appendix "B" for the purpose of subparagraph 8(2)(b) of this Agreement.

FORCORP - Project Number: P877

For additional information, please contact:
FORCORP Solutions Inc.
15015 123 Ave
Edmonton, AB
T5V 1J7
(780) 452-5878
www.forcorp.com

FINAL DRAFT

Annex II – Communication Plan

FORCORP

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	**II**	**Communication Plan**
	Annex	III	Stewardship Report (2010-2015)
	Annex	IV	Yield Curve Development
	Annex	V	Net Landbase Development
Three	Annex	VI	TSA – Timber Supply Analysis
	Annex	VII	SHS – Spatial Harvest Sequence
	Annex	VIII	Growth and Yield Plan

Crowsnest Forest Products Public Participation Program

Spray Lake Sawmills

Crowsnest Forest Products

A Subsidiary of Spray Lake Sawmills

Public Participation Program

Submitted to:
Agriculture, Forestry and Rural Economic Development

August 30, 2022

Table of Contents

1. Introduction

Crowsnest Forest Products (CFP) was granted a Forest Management Agreement (FMA) within the C5 Forest Management Unit (FMU) in July of 2021. This agreement requires CFP to renew and implement a forest management plan (FMP) for the C5 FMU. The previous FMP was developed by the Government of Alberta for the years of 2006 – 2026. An essential component of an FMP is a strategy for First Nations and public involvement and participation. This document will provide a framework for solicitation of stakeholder and general public input for the development of the C5 FMP. There is a separate FMP document outlining First Nations consultation. Public participation for the FMP, is in addition to existing consultation that supports annual operations (GDP/AOP). Communication efforts will focus on the following:

- Other industrial forest users, such as grazing permit holders
- Non-industrial forest users, such as recreation groups
- The general public, both local and regional

Public consultation will focus on sharing and obtaining feedback on the following key Forest Management Plan decision milestones:

- Milestone 1- Values, Objectives, Indicators and Targets (VOITs)
- Milestone 2- The Draft Spatial Harvest Sequence
- Milestone 3- Draft Forest Management Plan

2. Background

Sections 10 (3) of Crowsnest Forest Products (CFP) Forest Management Agreement outline the requirement for the company to conduct presentations and public reviews of their proposed Forest Management Plan prior to submission to the Crown.

The Alberta Forest Management Planning Standard requires companies to have a public participation program that addresses the standards specified in CSA Z809-02 Section 5.0. CSA Z809-02 Section 5.0 provides a more detailed listing of public participation requirements and has left it up to the individual organizations to define how to address the requirements.

The Provincial Planning Standard defines meaningful consultation as requiring consultation in good faith, with honest communication and an open exchange of relevant information before decisions are made. This document provides an outline for such a process; one that will provide an opportunity for input for anyone who has an interest through one of several mechanisms.

3. Objectives

CFP's public involvement policy is to:

- broadly share draft plans

- solicit feedback
- thoughtfully consider feedback and provide a response that addresses concerns
- record changes to a plan as a result of public input and communicate it to the interested party

The public participation program coincides with the timeline for development of the Forest Management Plan (FMP). The FMP covers the area as defined in the Forest Management Agreement and is shown in Appendix A. CFP is committed to providing opportunities for interested parties to review and provide input to the forest management plan at key decision milestones identified in figure 2.

The FMP must conform to higher order planning documents, such as the 2014-2024 South Saskatchewan Regional Plan, which is required by the Alberta Land Stewardship Act, and the various other integrated resource management plans or sub-regional plans that cover the FMP planning area. The FMP must also abide by provincial and federal legislation, the terms of the Forest Management Agreement and the current Alberta Forest Management Planning Standard.

4. Proposed Structure

In general, the consultation process begins with the Public Advisory Committee providing feedback to CFP's proposed information packages. The PAC may also provide feedback on proposed open house (general content) or workshop (issue based) consultation opportunities. The focus is to provide the most useful information to the public that fosters understanding and facilitates meaningful participation.

Next, various public notices are placed and the interested parties are cataloged on CFP's contact list (outlined below) and are provided access to the FMP specific information packages (generally via email). As more publics become known, their contact information is added to the interested parties contact list.

The interested parties contact list is categorized accordingly:

- Public at large
- Stakeholders (includes ENGO's, adjacent landowners and motorized and non-motorized recreation)
- Government (e.g. municipalities);
- Industry (includes mining, oil and gas and the forest industry)
- Trappers (having FMA trapping dispositions)
- Ranchers (having FMA grazing dispositions)

4-1: Public Advisory Committee (PAC)

Crowsnest Forest Products will share its draft plans with the Public Advisory Committee and solicit Committee input and advice on key FMP decision milestones. Membership for the current Crowsnest Forest Products PAC was sought by placing ads in local newspapers, and emailing interested parties, including local environmental non-governmental organizations. Approximately 85 percent of the Crowsnest Forest Products PAC membership has decided to continue with their committee membership to assist CFP with the development of the 2025 FMP.

CFP will be searching for additional committee member volunteers through various known organizations having an interest in C5 land use and by advertising to the general public in the local newspapers.

The terms of reference for the PAC was revisited in May of 2022 to focus on renewal of the FMP and to ensure its consistency with the FMP renewal process. PAC meetings will be held as indicated in the PAC ToR. Summary notes are prepared following each meeting and once the Committee has approved the notes, they are posted on the Spray Lake Sawmills website. CFP provides the meeting space and administrative support as may be required to conduct PAC business. CFP also provides information to the PAC and outside expertise as may be required to have a well-informed discussion.

The composition of the C5 PAC is intended to represent a diverse cross section of community members such as:

- Environmental organizations
- Motorized recreation
- Non-motorized recreation
- Ranching
- Coal mining
- Community members
- Landowners
- Municipalities / Municipal Districts
- Oil and Gas
- Harvest Contractor

The committee will review and provide feedback on a range of FMP development activities, including (but not limited to):

- Milestone 1- Values, Objectives, Indicators and Targets
- Milestone 2- The Draft Spatial Harvest Sequence
- Milestone 3- Draft Forest Management Plan
- Public Participation Activities

As per the Public Advisory Committee (PAC) terms of reference, the Public Advisory Committee members are expected to monitor the stakeholders and public they represent to help identify issues and opportunities that may need to be considered by the planning team.

The Public Advisory Committee will remain intact as a standing committee for the duration of the FMP development. Once the FMP is complete and approved, the terms of reference will need to be revised and a new role established for the Committee to continue.

4-2: Dispute Resolution

CFP works openly and directly with interested parties to try and reach broad consensus before disputes arise. Initiating dispute resolution requires that the interested party has previously consulted with CFP on the matter, and that CFP has had a reasonable amount of time to address the concern. Initiating dispute resolution is only a last resort, after consultation efforts by both CFP and the interested party have reached an impasse.

Dispute resolution includes the following steps:

1) A written request is submitted to CFP requesting dispute resolution as the interested party has previously consulted with CFP regarding the dispute and reached an impasse.
2) If step 1 is unsuccessful, the interested party will be asked to provide a written narrative supporting grounds to continue with dispute resolution.
3) Within 30 days of receipt of the written narrative, CFP will complete a written assessment in response to the interested party. If the evidence provided in the written narrative supports a corrective action, a corrective action plan will be developed with PAC input. The corrective action plan will be provided to the interested party within 30 days of the PAC review. If the written assessment finds corrective action is not warranted, the interested party will be provided the assessment along with notification that dispute resolution is closed.
4) Any dispute resolution records including CFP responses will be maintained as part of the public consultation record.

4-3: Website

The SLS website will contain information on the CFP FMP page where users can:

- learn about the C5 FMP development process
- learn about upcoming public participation opportunities
- read the Public Participation Program document
- view approved Public Advisory Committee meeting notes
- sign up for the email subscription list
- provide plan input

The website also provides informational videos covering: forest management planning, FMA planning, and the FMA planning hierarchy. The website also has written information covering CFP's public involvement process, the Public Advisory Committee (PAC), the latest PAC meeting notes, the PAC members, and the PAC terms of reference. Other relevant website content includes: the Forest Management Agreement, the current Forest Management Plan, the forest management life cycle, forest planning considerations, planning for mixed use and the Mountain Pine Beetle.

4-4: Open House Information Sessions

Open houses will be held for milestones 1, 2 and 3. As the planning development team completes milestones, informational sessions will be held to provide opportunities for all interested parties including the general public to review developments, ask questions and provide input for further consideration.

4-5: Questionnaires and Surveys

Questionnaires or surveys may be used to solicit feedback, help document public views on specific issues and or to monitor the performance of the Public Participation Program.

4-6: Media Plan

The company advertises in communities adjacent to the C5 FMA to communicate with the public at large. The Spray Lake Sawmills Facebook page and website are also used to post Crowsnest Forest Products FMP content for the public at large and for interested parties. Both newspaper ads and Facebook posts will be used in coordination with plan milestones for the public to:

- learn about the FMP renewal process
- access informational packages available on the company website
- email subscribe to the website to stay updated on FMP developments
- learn about an upcoming FMP open house
- provide FMP feedback

Public Participation Timeline

The timeline for delivery of key FMP milestones and corresponding public participation opportunities are indicated in Figure 2.

Figure 1: Consultation Events

Milestone #	Audience	Consultation Type	Key Elements/Content	Consultation Activity/Outcome	Consultation Start	Consultation End
1- Values, Objectives, Indicators and Targets Information Package	Public at large	Newspaper Ad entitled 'Forest Management plan development'. Publish in Crowsnest Herald, Pincher Creek and Claresholm newspapers for two weeks. The ad will also be posted on Facebook.	The ad will state: CFP is initiating the FMP renewal process; written description of the area; first step is to share draft VOITs; provide invitation to visit FMP specific website and a request for input. Website content provides FMP renewal VOIT information package. Invitation provided to join News and Events email subscription, to stay informed throughout process.	Notify Public at large of FMP renewal planning process, provide information package and to solicit VOIT input. Update C5 interested party contacts to keep informed throughout the planning process. CFP to provide a response to input received.	October 2022	January 2023

Milestone #	Audience	Consultation Type	Key Elements/Content	Consultation Activity/Outcome	Consultation Start	Consultation End
	All Interested Parties	Informational email with website link to information package on C5 FMP draft VOITs.	CFP is initiating the FMP renewal process; written description of the area; first step is to share draft VOITs; invitation to visit FMP specific website and a request for VOIT input. Website content provides FMP draft VOITs.	Notify interested parties of the FMP renewal process and to solicit VOIT input. CFP to provide a response to input received.	October 2022	January 2023
	All Interested Parties	Website Open House (Place milestone 1 information package on the company website).	CFP is initiating the FMP renewal process; written description of the area; first step is to share draft VOITs; invitation to visit FMP specific website and a request for VOIT input. Website content provides FMP draft VOITs.	Notify interested parties of the FMP renewal process and to solicit VOIT input. CFP to provide a response to input received.	October 2022	January 2023
	All Interested Parties	Open House	Share Draft VOITS, FMA map and highlights of FMP planning process.	Notify interested parties of the FMP renewal process and to solicit VOIT input. CFP to provide a response to input received.	October 2022	January 2023
	All Interested Parties	Informational email with finalized VOITs.	Summary of input received, if it is within scope, and strategy for inclusion, non-inclusion or additional notes.	Participants provided FMP VOIT response, and CFP catalogs response. Notification of modelling process and that milestone 2 consultation begins June 15 of 2024.	March 2023	March 2023
2. Preliminary Spatial Harvest Sequence /Timber Supply	All interested Parties	Open House	Draft SHS with linkage to VOITs. Map outlining draft 20-year SHS and draft Visual Quality Strategy.	Solicit site specific concerns and identify opportunities for avoidance or mitigation. CFP to provide a response to input received.	June 2024	Sept 2024
	All interested Parties	Website Open House (Place milestone 2 information package on the company website).	Draft SHS with linkage to VOITs. Map outlining draft 20-year SHS and draft Visual Quality Strategy. Both documents made publicly available on SLS website.	Solicit site specific concerns and identify opportunities for avoidance or mitigation. CFP to provide a response to input received.	June 2024	Sept 2024
3. Final Draft Plan	All Interested Parties	Open House	Outline of Preferred Forest Management Strategy, modelling of other resource values. Linkage/coordination with South Saskatchewan Regional Plan.	Final review & identification of potential impacts. Final review of opportunities for avoidance or mitigation. CFP to provide a response to input received.	October 2024	December 2024

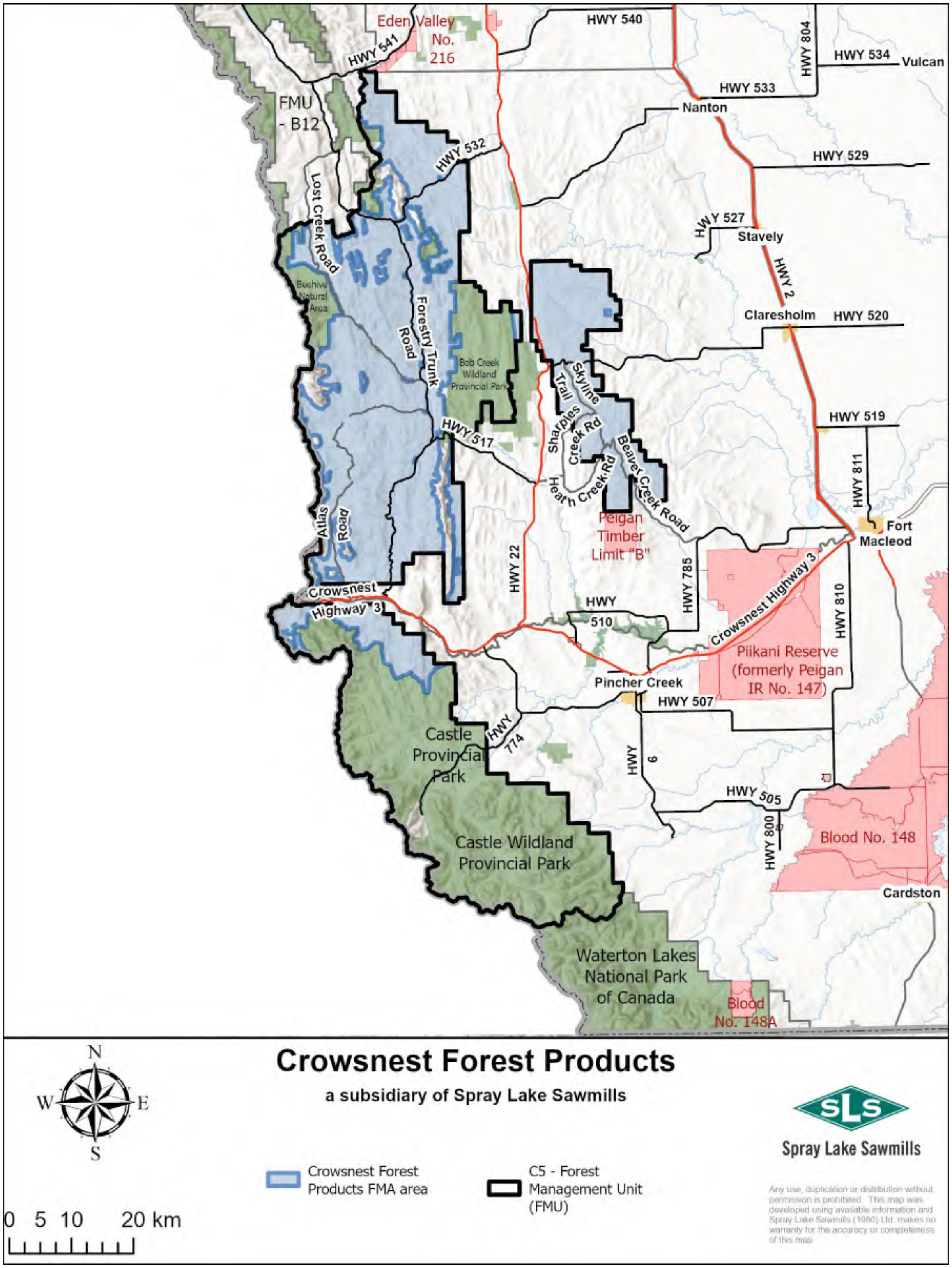
Milestone #	Audience	Consultation Type	Key Elements/Content	Consultation Activity/Outcome	Consultation Start	Consultation End
	All Interested Parties	Website Open House (Place milestone 3 information package on the company website).	Final draft of the C5 Forest Management plan.	Final review of final draft before submission of the plan to AFRED. CFP to provide a response to input received.	October 2024	December 2024

4-7: Documentation/Reporting

CFP records public consultation activities throughout the FMP planning process including its responses to input received. A company public communications database is used to record and track activities and to assist follow-up communication from CFP representatives. Changes to the FMP as a result of public input are recorded by CFP and communicated to the interested party. Documented public consultation activities will be documented in the Forest Management Plan available on the company's website.

Appendix A

MAP 1 – CFP Forest Management Agreement Area and C5 Forest Management Unit



FORCORP - Project Number: P877

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(780) 452-5878
www.forcorp.com

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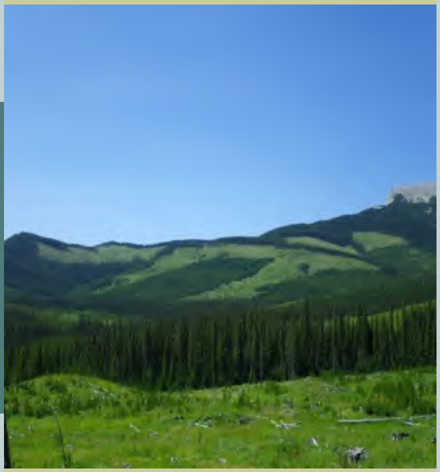
Annex III – Stewardship Report (2010-2015)

FORCORP

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	II	Communication and Consultation Plans
	Annex	**III**	**Stewardship Report (2010-2015)**
	Annex	IV	Yield Curve Development
	Annex	V	Net Landbase Development
Three	Annex	VI	TSA – Timber Supply Analysis
	Annex	VII	SHS – Spatial Harvest Sequence
	Annex	VIII	Growth and Yield Plan

C5 Forest Management Plan Stewardship Report 2010 - 2015

C5 Forest Management Plan Stewardship Report 2010 - 2015



Alberta Agriculture and Forestry

C5 Forest Management Plan Stewardship Report: 2010 - 2015

A requirement of the *C5 Forest Management Plan*

March 15, 2017

Published by
Alberta Agriculture and Forestry

Preface / Acknowledgements

Preparation of five-year stewardship reports is a requirement of the C5 Forest Management Plan. It also reflects Alberta Agriculture and Forestry's (AAF) commitment to the long-term sustainable use and management of provincial forest lands in the C05 forest management unit of south-western Alberta.

This stewardship report was prepared over a seven-year period from 2010 to 2017. In some instances reporting has only occurred for the mandated 5-year period 2010-2014. During that period of time significant organizational changes occurred within the provincial government. This report will reference provincial departments and agencies using names and titles that were in place at the beginning of 2016.

This report has been prepared to identify progress that was made in achieving the objectives and targets contained in the 2010 C5 Forest Management Plan. As well, AAF would like to share important information on environmental, landscape and government policy changes that occurred during the implementation of the approved forest management plan.

Preparation of this stewardship report could not have happened without the involvement of many individuals. The contributions of numerous government staff — who are subject matter experts in the various environmental and social disciplines that are addressed in this document — are gratefully appreciated. As well, users of the C5 forest management unit, particularly timber quote holders, shared important data and information that is presented in this report.

Table of Contents

List of Common Acronyms

AAC	Annual Allowable Cut
AAF	Alberta Agriculture and Forestry
AEP	Alberta Environment and Parks
AOP	Annual Operating Plan
ARIS	Alberta Regeneration Information System
ARTS	Action Request Tracking System
ATRL	Alberta Tourism Recreational Leasing Program
AVI	Alberta Vegetation Inventory
BMP	Beneficial Management Practices
CNP	Crowsnest Pass
CSA	Canadian Standards Association
CTP	Community Timber Program
DBH	Diameter at Breast Height
FHP	Forest Harvest Plan
FLUZ	Forest Land Use Zone
FMA	Forest Management Area
FMB	Forest Management Branch
FMP	Forest Management Plan
FMU	Forest Management Unit
FOM	Forest Operations Monitoring
FOMP	Forest Operations Monitoring Program
GoA	Government of Alberta
GDP	General Development Plan
GTA	Grazing Timber Agreement
HSI	Habitat Suitability Index
IRP	Integrated Resource Plan
ISO	International Organization for Standardization
LFMP	Linear Footprint Management Plan
LMU	Landscape Management Unit
MPB	Mountain Pine Beetle
NSR	Not Satisfactorily Restocked
OGR	Operating Ground Rules
PAC	Public Advisory Committee
PLUZ	Public Land Use Zone
QAAC	Quadrant Annual Allowable Cut
RFMA	Registered Fur Management Areas
RSA	Reforestation Standard of Alberta
RSF	Resource Selection Function
SAM	Silviculture-ARIS Monitoring
SHARP	Southern Headwaters At Risk Program
SHS	Spatial Harvest Sequence
SLS	Spray Lakes Sawmills
SOP	Standard Operating Procedures
SFM	Sustainable Forest Management
SRWP	Southern Rockies Watershed Project
SSRP	South Saskatchewan Regional Plan
TDA	Timber Damage Assessment
TFA	Temporary Field Authorization
TSA	Timber Supply Analysis
VQO	Visual Quality Objectives

Introduction

C5 Forest Management Unit

The C5 Forest Management Unit (FMU) is located in southwestern Alberta, lying to the north of Waterton Lakes National Park and to the south of Kananaskis Country. It encompasses approximately 3,522 km^2 of provincial Crown land. The landscape consists largely of foothills and mountainous terrain within Alberta's Eastern Slopes. Forest management in the C5 FMU is predominantly managed by Alberta Agriculture and Forestry (AAF), the department that is responsible for the administration of provincial forests throughout the Rocky Mountain Forest Reserve.

The C5 FMU is being sought out by a diverse group of users because of its location, the presence of many desirable forest attributes, and for the wide-ranging benefits that can be derived from this land base. As use levels continue to increase, AAF will maintain a multiple use approach in managing this highly sought after area. In keeping with the principles of sustainable forest management, the C5 forest will be managed to provide social, economic, and environmental benefits for Albertans, now and in the future.

Forest Management Planning and Reporting

In May 2006, the provincial government completed a new 20-year plan for the C5 Forest Management Unit. This plan replaced the previous forest management plan that was adopted in 1986. The new plan was developed in accordance with current sustainable forest management principles and approaches that have been adopted by the Government of Alberta. Following a lengthy period of consultation the C5 Forest Management Plan (FMP) was approved by AAF in July of 2010. The approved forest management plan stipulated that stewardship reports be completed at five-year intervals over the lifespan of the plan. This report (and future stewardship reports) will fulfill that requirement.

Understanding and documenting changes over time is a key component of stewardship reporting. Stewardship reports will, among other things, identify: results achieved during plan implementation; findings from monitoring activities; the suitability of plan performance measures; progress made in implementing management strategies; any variances from FMP standards and targets; emerging resource management issues; problems encountered in implementing the plan; new and ongoing research projects and associated findings, and; public participation that has occurred.

This stewardship report is a useful tool in determining the level of success that has been achieved in implementing various FMP commitments and for assessing the plan's ongoing relevancy. The report may propose changes to objectives, targets, indicators, and management strategies in the FMP where these are deemed to be necessary. These recommendations will provide a basis for making revisions to the C5 FMP at the mandated plan review and update period in 2016. By adopting and incorporating new recommendations, the forest management plan will be embracing the principle of adaptive management. "Adaptive management" operates on the premise that responsible resource management requires a willingness by managers to modify existing management direction and prescriptions in response to new knowledge and insights that are gained through monitoring, observation, and research, and to reflect changing societal values. Adaptive management will ensure the C5 FMP remains responsive to monitoring results, new information, and any improved resource management approaches that may emerge in the future.

For more information on the C5 Forest Management Plan, please access the following link:
http://aep.alberta.ca/lands-forests/forest-management/forest-management-plans/default.aspx

Introduction (continued)

History of Logging in the C5 Forest Management Unit

Logging operations began in the Porcupine Hills and Castle River areas during the late 1800s to provide timber framing, poles, railway ties and dimension lumber for railroad construction and human settlement. A growing coal mining industry in the Crowsnest Pass during the early 1900s placed additional demands on local forest stands for posts and beams to be used in local mining operations. Extensive salvage logging was undertaken in the region following a period of forest fire activity during the mid-1930s. Salvage logging was also initiated following insect outbreaks that occurred in the 1970s (affecting spruce stands) and the 1980s (affecting pine stands).

Commercial timber harvesting began within three newly established provincial forest management units (C1, C2, and C3) in southwestern Alberta in the mid-1960s. In response to recommendations contained in the 1986 C5 FMP, the provincial government consolidated the three existing management units to form a single new forest management entity, the C5 FMU. A timber supply analysis (TSA) was then completed by the provincial government to establish the annual allowable cut (AAC) for the C5 FMU.

The 1986 coniferous AAC for the C5 FMU was 165,753 m^3 based on a productive coniferous landbase of 115,511 ha. In 1999, an increase in the AAC occurred and the coniferous AAC was re-established at 181,400 m^3. Over the years the ACC has fluctuated to account for large natural disturbances such as fire and blowdown events. One such event was the Lost Creek Fire in 2003, which resulted in the AAC being significantly reduced. A timber supply analysis was again undertaken in 2006 that was based on the preferred future forest management strategy for the C5 FMU; it established a productive coniferous landbase of 114,184 ha and an annual allowable cut of 209,414 m^3.

C5 Forest Management Plan Matrix

In this stewardship report, each resource management “objective” will include a reference number; that number pertains to a planning matrix which can be found in Appendix 5A of the C5 Forest Management Plan. The matrix was created as an intermediate step in the development of the C5 plan. The matrix was based on the Canadian Council of Forest Ministers “criteria and indicators framework” and the Z809-02 Canadian Standard Association - Sustainable Forest Management Standard. By adopting these two national standards, both the matrix and the C5 Forest Management Plan were developed in accordance with accepted forest management approaches. Adherence to these forest management standards played a significant role in the development of objectives, indicators, targets, strategies, and monitoring requirements that comprise the C5 Forest Management Plan and this stewardship document.

Stewardship Reporting

Stewardship reporting for the C5 FMU occurred through the contributions of numerous provincial government staff. A C5 Stewardship Core Team was established to oversee monitoring activities and assemble, analyze and present relevant data and information. This

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Introduction (continued)

team was comprised of government staff that represented various divisions within AAF and Alberta Environment and Parks (AEP). The first meeting of the C5 Stewardship Core Team was held on January 15, 2013.

This 5-year stewardship report was developed to satisfy forest management plan performance reporting requirements of AAF's Forest Management Branch (FMB) and to provide a means for sharing information with the general public, forest users, and various stakeholders.

This stewardship report follows the outline used in the C5 FMP. Information will be presented for the following 6 themes:

- Conservation of Biodiversity
- Maintenance and enhancement of forest ecosystem condition and productivity
- Conservation of soil and water resources
- Forest ecosystem contributions to global ecological cycles
- Multiple benefits of forests to society
- Accepting society's responsibility for sustainable development

A number of specific forest management objectives are listed for each theme area. General background information that is necessary to understand each objective is provided. Occasionally this is supported by technical information that is necessary for a critical evaluation of results achieved and progress being made in attaining plan targets. Each objective is presented with its corresponding performance measures to facilitate assessment. Most of the performance measures that are being used were identified in the C5 Forest Management Plan. Other unique performance measures were identified by the Forest Management Branch. In some cases performance measures may be absent as none have yet been decided upon. Performance measures are followed by results achieved and monitoring data that is specific to the 2010-2014 (and sometimes 2015) reporting period. Where fiscal or manpower limitations precluded the achievement of a given objective or prevented adequate monitoring of the associated indicator(s), alternative measures may be discussed to help guide revisions in the subsequent FMP.

It should be noted that stewardship reporting helps support future adaptive management within the C5 forest management unit.

Alberta FMP Mandatory Stewardship Reporting Components

The first portion of this report is designed to work in conjunction with the C5 FMP VOITS reporting document. References to tables and appendices in the VOIT document occur in this report.
This report was completed using the 2014 ***Forest Management Plan Stewardship Reporting Standard*** as a guide.

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Introduction (continued)

FMP Approval Decision Accomplishment Report

Approval Condition	Requirement	Date(s) Completed	Comments
6.1 Public Consultation			
6.1.1	Ensure meaningful public consultation is conducted by forest disposition holders at key points during FMP implementation.	ongoing and reoccurring	See Appendices B and C of the Stewardship Report for a list of consultation and communication activities
6.1.2	Ensure the disposition holders keep written documentation of all issues and comments raised during operational plan public consultation, as well as responses and actions being taken to address identified concerns.	NA	Local AAF staff attended open houses to observe and confirm the use of sign-in sheets and written comment cards.
6.2 First Nations (FN) Consultation			
6.2.1	Conduct meaningful FNs consultation with aboriginal groups during development of General Development Plans.	NA	See Appendix A of the Stewardship report for letters indicating that FNs consultation has been adequate.
6.2.2	Meet the requirements of *Alberta's First Nations Consultation Guidelines on Land Management and Resource Development* for future timber operational plans and approvals.	NA	See Appendix A of the Stewardship Report
6.2.3	Keep written documentation of all issues and comments raised during consultations, as well as responses and actions taken to address the concerns in C5 FMP FNs Consultation Logs.	NA	All records of FN consultation are kept in the Aboriginal Consultation Information System (ACIS)
7.1 Mountain Pine Beetle (MPB)			
7.1.1	Coordinate the department management efforts for MPB control and forest renewal activities.	NA	The MPB population in C5 experienced a precipitous decline in 2010. Very little MPB control activity was required since the implementation of the FMP.

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3.2.1 FMP Approval Decision Accomplishment Report (continued)

Approval Condition	Requirement	Date(s) Completed	Comments
Coordinate the department management efforts for MPB control and forest renewal activities.	NA	The MPB population in C5 experienced a precipitous decline in 2010. Very little MPB control activity was required since the implementation of the FMP.	
Determine the operational implementation of the *Timber Harvest Planning and Operating Ground Rules Addendum - Mountain Pine Beetle Operations.*	NA	The rapid decline of MPB in C5 that occurred in 2009-2010 led to the Addendum not being adopted into the OGRs and not being reflected in operational or planning practices during the reporting period.	
10.1 Spatial Harvest Sequence (SHS)			
All operators shall follow the mapped 20-year harvest sequence as presented in the FMP.	Ongoing	See tables in 3.2.3	
To address operational planning concerns, all timber disposition holders are authorized to modify the SHS by deleting no more than 20% of the total sequenced area in each compartment by decade, while harvesting no more than 100% of the total area within the SHS by compartment, by decade.	Ongoing	See tables in 3.2.3	
Preference shall be given to selecting stands from the second 10-year period of the SHS (years 2017-2026) when replacing deleted stands (from 10.1.2 above). Where this is not feasible, replacements may be from any other stands identified in the approved net landbase of the FMP, with priority given to pine stands that are ranked highly susceptible to MPB infestations.	Ongoing	See tables in 3.2.3	
Should timber operators exceed the variance described in 10.1.2, The Area Manager, Calgary Forest Area, may require the completion of a Compartment Assessment and the Senior Manager, Forest Planning Section, may recommend the adjustment of the approved AAC to reflect the impact of the variance.	Ongoing	Variance does exceed 20% in some compartments.	

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Introduction (continued)

3.2.1 FMP Approval Decision Accomplishment Report (continued)

Approval Condition	Requirement	Date(s) Completed	Comments
10.1.3	Should timber operators exceed the variance described in 10.1.2, The Area Manager, Calgary Forest Area, may require the completion of a Compartment Assessment and the Senior Manager, Forest Planning Section, may recommend the adjustment of the approved AAC to reflect the impact of the variance.	Ongoing	Variance does exceed 20% in some compartments.
10.1.4	AAF requires the variance from the SHS to be reported annually, and for the 5-year Stewardship Report to analyze the cumulative variance from the SHS and describe the potential impacts of the actual variance on the forecasts made in the FMP.	Submitted with AOP	See Objective one- SHS variance summary Table 1.2 for an overview of variance by compartment.
10.1.5	The department will generally not modify the approved harvest sequence for the first 15 years of the planning period unless required by a change in legislation or a policy approved by the Minister (*e.g.* SSRP or new sub-regional plans).	NA	The SHS was changed (due to a reduction in the landbase area) resulting from the adoption of the SSRP 2014 and the creation of four new conservation areas. A loss of 5.82% of the net area, and an AAC reduction of 12,188m^3/yr was incurred in C5 in 2014.
12.1 Grazing Timber Agreement (GTA)			
12.1.1	The Area Manager, Calgary Forest Area, may require that GTAs be developed where the proposed activity of one disposition holder may affect the interests of other disposition holder(s).	NA	Full compliance in regard to GTAs occurred over the reporting period.
12.1.2	GTAs shall meet requirements that are set out in the ***Grazing and Timber Integration Manual***.	NA	
13.1 Industrial Timber Salvage			

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3.2.1 FMP Approval Decision Accomplishment Report (continued)

Approval Condition	Requirement	Date(s) Completed	Comment
13.1.1	All industrial timber salvage produced in the FMU shall be accounted for and reported as a drain against each timber operator's disposition based on the disposition holder's allocated percentage of the AAC.		No industrial timber salvage occurred over the reporting period.
15.1 Performance Monitoring			
15.1.1	The Area Manager, Calgary Forest Area, shall prepare the first Stewardship Report by October 31, 2015.	June 2017 public release	An edit of the draft C5 FMP Stewardship Report was completed on 24th May 2016. Subsequent minor edits followed.

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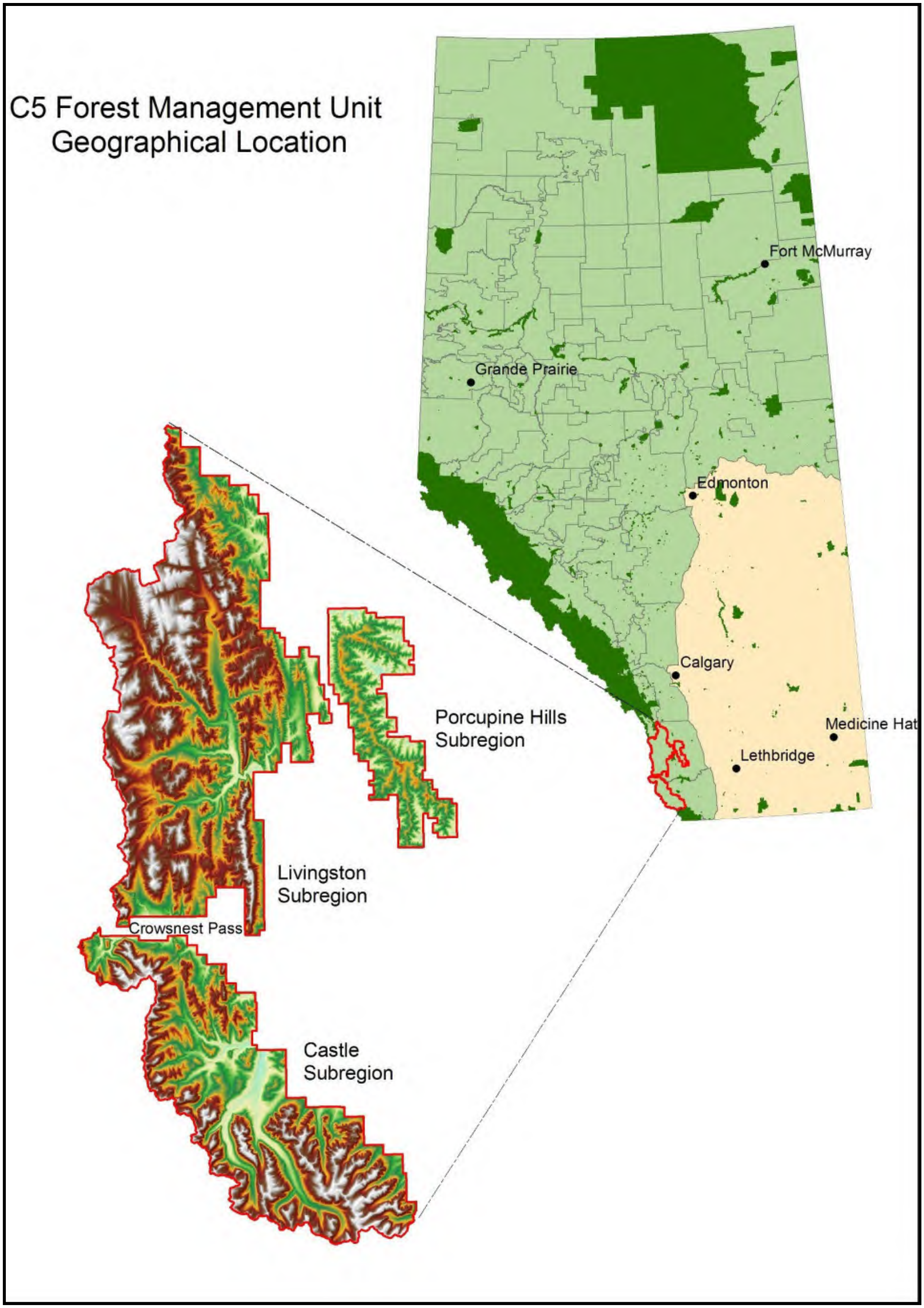
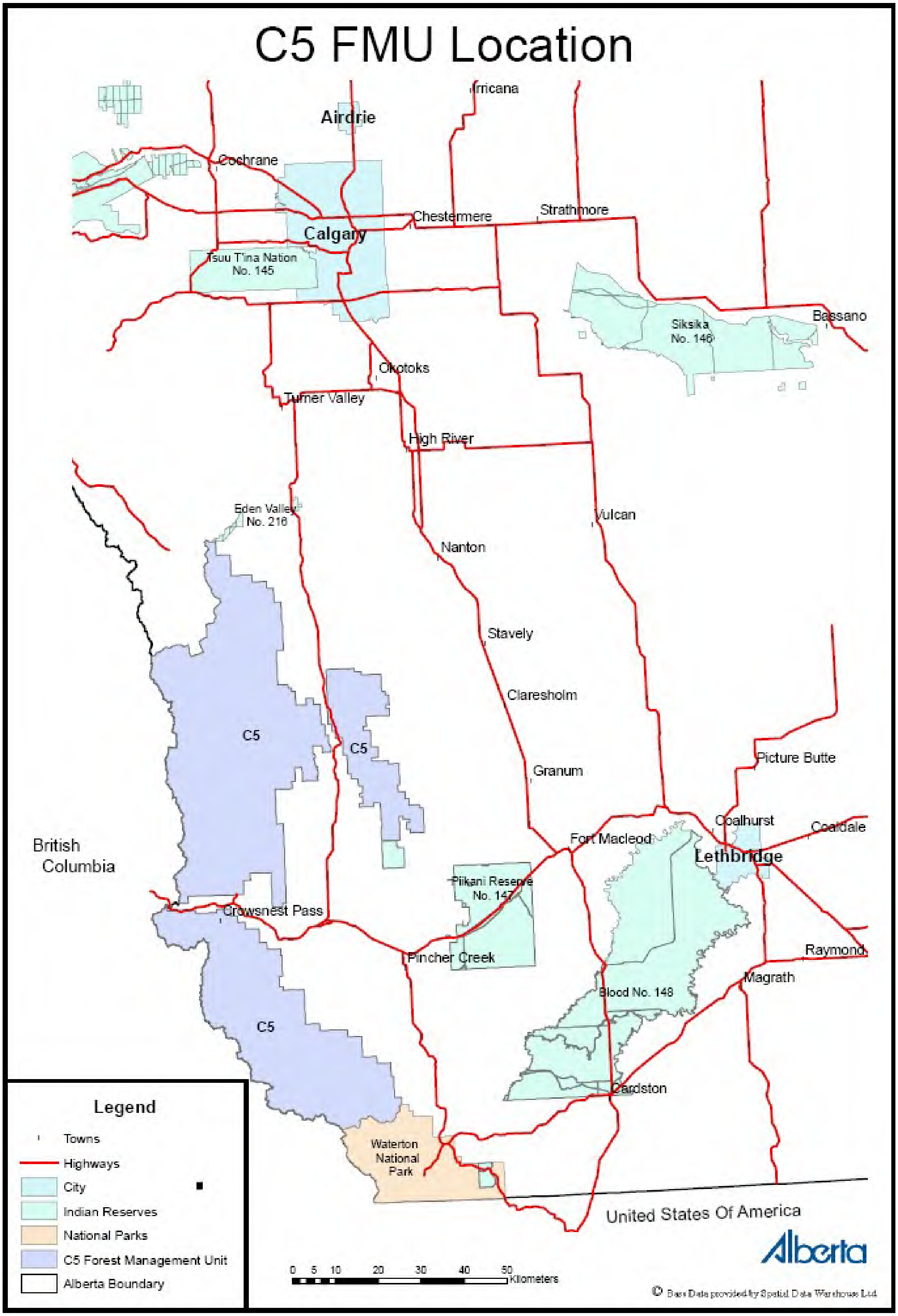
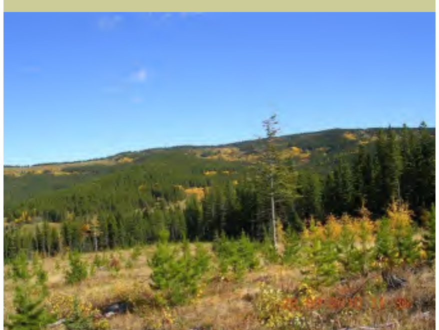

C5 Forest Management Unit
Geographical Location
Fort McMurray
Grande Prairie
Edmonton
Calgary
Medicine Hat
Lethbridge
Porcupine Hills
Subregion
Livingston
Subregion
Crowsnest Pass
Castle
Subregion


C5 FMU Location
Irricana
Airdrie
Cochrane
Calgary
Chestermere
Strathmore
Tsuu T'ina Nation
No. 145
Siksika
No. 146
Bassano
Okotoks
Turner Valley
High River
Eden Valley
No. 216
Vulcan
Nanton
Stavely
Claresholm
C5
C5
Granum
Picture Butte
Coalhurst
Coaldale
Fort Macleod
Lethbridge
British
Columbia
Piikani Reserve
No. 147
Crowsnest Pass
Pincher Creek
Raymond
Magrath
Blood No. 148
C5
Cardston
Waterton
National
Park
United States Of America
Legend
Towns
Highways
City
Indian Reserves
National Parks
C5 Forest Management Unit
Alberta Boundary
0 5 10 20 30 40 50
Kilometers
Alberta
© Base Data provided by Spatial Data Warehouse Ltd.

Conservation of Biodiversity

Objective 1



Early seral stage on the forestry landscape.

1.1.1 Maintain the full range of cover groups and seral stages.

Performance Measures:

1. *conformity to the Spatial Harvest Sequence (SHS)*
2. *hectares of old-growth forest as a percent of the C5 sub-region (seral stage analysis will be completed by the FMB)*
3. *yield strata achievement from Alberta Regeneration Inventory System (ARIS)*

Achieving the desired future forest outlined in the C5 FMP will require the adoption of harvest patterns, logging intensity, and logging schedules identified in the FMP and the SHS. The original timber supply analysis (TSA) —which reflects the "preferred forest management strategy", a strategy that attempts to best balance social, economic, and environmental values —was completed in 2006 (see Appendix 6B in the C5 FMP). The associated SHS identified forest harvest spatial patterns for both the first and second ten -year periods (i.e., 2006 - 2015; 2016 - 2025). A comparison of the actual yield strata (i.e., cover groups) and seral stages that result from timber harvesting to the predicted TSA outputs typically occurs at the midpoint of a 20-year FMP when the TSA is updated. However, with the adoption of the South Saskatchewan Regional Plan (SSRP) and the proposed creation of new protected areas in the Castle, a component of the TSA , the Landbase determination had to be modified earlier than anticipated.

The development of a TSA is a significant, complex and costly undertaking. For this reason, the next comprehensive TSA will be prepared sometime between 2017 (i.e., ten years into FMP and SHS implementation cycle) and 2020 (i.e., ten years after FMP approval) . The completion of a full TSA, the reassessment of social, economic, and environmental values and societal preferences for the C5 forest, and a revision of the C5 FMP will be influenced by the SSRP (approved in 2014), new sub-regional plans and resource management frameworks, and other provincial policy initiatives. Thus, Objective #1 will be addressed when a fully revised TSA is completed in the future.

The creation of new protected areas (an expanded Wildland Provincial Park and a new Provincial Park) in the Castle region necessitated an earlier than expected update to the Annual allowable cut (AAC) to reflect a large reduction in the timber harvesting land base. The two new parks were proposed in the fall of 2015; they will likely be formally approved sometime in 2016. To support the creation of these new protected areas, forestry staff were asked to update the Landbase and reflect the landbase area loss in the AAC determination. The assumptions and principles contained in the 2006 C5 FMP were observed while preparing the simplified AAC revision. The AAC reduction still allows for use of the current SHS with exclusion of the Wildland Provincial Park and new Provincial Park areas.

Conservation of Biodiversity

Objective 1

Objective 1 Continued:
An updated yield strata composition table was produced (shown in Table 1.1) to reflect new land use changes that were identified in the approved SSRP. Please note that Table 1.1 does not reflect the timber land base changes that have occurred with the new parks in the Castle area approved.

	2006		2014		Landbase Change	
Strata	**Area (ha)**	**%**	**Area (ha)**	**%**	**Area (ha)**	**%**
C-Fd-All	11,920	10.4	11,422	8.9	-498	-1.6
C-Pl-All-M	19,827	17.4	26,097	20.2	6270	2.9
C-Pl-AB-SA	8386	7.3	14,309	11.1	5923	3.7
C-Pl-CD-SA	27,692	24.3	40,823	31.6	13,131	7.4
C-Sx-All-M	8452	7.4	9493	7.4	1041	0.0
C-Sx-AB-SA	14,738	12.9	18,486	14.3	3748	1.4
C-Sx-CD-SA	9379	8.2	6545	5.1	-2834	-3.1
CD-All	2013	1.8	1866	1.4	-147	-0.3
Non-forested	0	0.0	2	0.0	2	0.0
Regen	11778	10.3			-11778	-10.3
Total	**114,185**		**129,045**		**14,860**	**13.0**

Table 1.1. C5 managed land base yield strata changes from 2006 to 2014.

It is important to note that some of the changes shown in the above table result from an updated data management protocol, not actual land base changes. The "regeneration" strata, which existed in 2006 is no longer identified in the yield strata process and, is now distributed among other strata in which the regenerating tree stands belong to; therefore the "regeneration" strata does not appear in 2014. The increase in total land base area is the result of two factors: 1)using updated Alberta Vegetation Inventory (AVI) data —which better identifies forested and productive stands; and 2)using a more accurate digital elevation model —which has reduced the area that was formerly identified (and deleted) as being too steep to operate on. Generally, only small changes in yield strata area figures occurred. The largest land base change was a 7.4% increase of the dominant C-Pl-CD-SA strata.

Section 2.2.5 in Appendix 6B of the FMP defines the seral stages for each yield strata in the C5 Forest Management Unit. The current seral stage targets are found in Tables 8 and 9 of Objective 1 in the C5 FMP .

Conservation of Biodiversity

Objective 1

Spatial Harvest Sequence (SHS) Variance: To achieve the desired future forest, the pattern and sequence of harvest is identified in the SHS. Timber disposition holders may modify the SHS to address operational constraints. Below is an example map of the C5 SHS in the Porcupine Hills, detailing polygons scheduled for harvest over time.

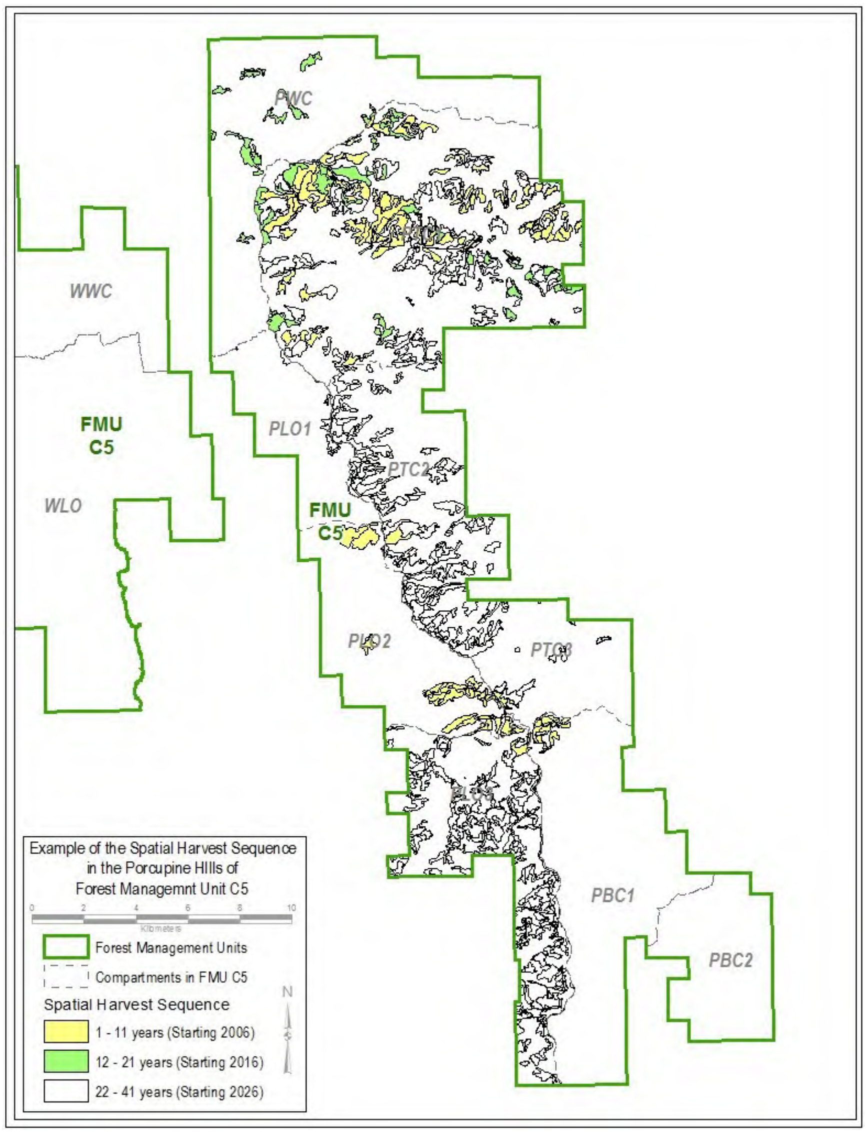


Figure 1.1. SHS in Porcupine Hills compartments of C5 FMU.

Spatial Harvest Sequence Variance

Table 1.2. C5 FMU 10-year SHS variance by compartment. Acronyms are spelled out in Table 2-11 of Appendix 6B in the C5 FMP.

Compart-ment	10 year SHS (ha)	Total Area Harvested (ha)	Additions (ha)	10yr SHS Variance (%)	Harvests Exceed 10yr SHS (ha)	Comments
BC	106.0	0.0	0.0	0.0	-106.0	No harvests in Assessed Area
BCR	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
BMC	206.5	0.0	0.0	0.0	-206.5	No harvests in Compartment
BMI1	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
BMI2	586.2	211.8	69.1	11.8	-374.4	Significant undercut
BML	0.0	1.0	1.0	n/a	1.0	Harvests in non-scheduled compartment*1
BPC	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
CCR1	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
CCR2	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
CPC	366.1	157.0	39.5	10.8	-209.1	Significant undercut
CWG1	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
CWG2	45.5	0.0	0.0	0.0	-45.5	No harvests in Compartment
CWM	12.0	0.0	0.0	0.0	-12.0	No harvests in Compartment
CWU1	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
CWU2	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
CWU3	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
CWW	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
FCR	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
HEC1	428.2	164.6	94.8	22.1	-263.7	Significant undercut
HEC2	211.4	35.4	32.7	15.5	-175.9	Significant undercut
HED1	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
HED2	0.0	12.4	12.4	n/a	12.4	Harvests in non-scheduled compartment
HER1	0.0	0.3	0.3	n/a	0.3	Harvests in non-scheduled compartment
HER2	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
HEU1	1.9	0.0	0.0	0.0	-1.9	No harvests in Compartment
HEU2	7.1	0.0	0.0	0.0	-7.1	No harvests in Compartment
HOS	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
IRA	0.1	14.9	14.9	10481.8	14.8	Very little harvest scheduled
IRC1	922.7	199.8	111.9	12.1	-722.9	Significant undercut
IRC2	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
IRH	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
LIL	61.9	417.0	410.4	663.2	355.1	Large exceedance of SHS area
MIC1	761.8	374.1	172.7	22.7	-387.6	Significant undercut
MIC2	472.8	58.4	38.5	8.2	-414.4	Significant undercut

Table 1.2 is continued on the next page.

Table 1.2 cont. C5 FMU 10-year SHS variance by compartment. (Acronyms are spelled out in Table 2-11 of Appendix 6B in C5)FMP.

Compart-ment	10 year SHS (ha)	Total Area Harvested (ha)	Additions (ha)	10yr SHS Variance (%)	Harvests Exceed 10yr SHS (ha)	Comments
MID1	363.6	156.6	122.6	33.7	-206.9	
MID2	347.4	211.9	145.4	41.9	-135.5	
MIL	22.6	288.5	288.5	1276.1	265.9	Large exceedance of SHS area
MIR1	216.8	93.2	43.6	20.1	-123.7	
MIR2	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
MIR3	426.8	1.8	0.0	0.0	-425.0	
MIU1	43.9	0.0	0.0	0.0	-43.9	No harvests in Compartment
MIU2	156.8	53.2	53.2	33.9	-103.7	
MIU3	1101.7	702.2	314.2	28.5	-399.5	
NLL	1013.9	95.5	62.3	6.1	-918.4	
NLO	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
NWC	537.6	0.0	0.0	0.0	-537.6	No harvests in Compartment
PBC1	87.1	0.0	0.0	0.0	-87.1	No harvests in Compartment
PBC2	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
PLO1	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
PLO2	357.4	0.0	0.0	0.0	-357.4	No harvests in Compartment
PLO3	55.0	0.0	0.0	0.0	-55.0	No harvests in Compartment
PTC1	1211.44	708.2	556.2	45.9	-503.24	10 year summary
PTC1	1746.84	708.2	556.2	31.8	-996.1	*20 year summary for this compartment
PTC2	34.5	0.0	0.0	0.0	-34.5	No harvests in Compartment
PTC3	24.3	0.0	0.0	0.0	-24.3	No harvests in Compartment
PWC	0.0	12.7	12.7	n/a	12.7	Harvests in non-scheduled compartment
SAW1	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
SAW2	82.9	0.0	0.0	0.0	-82.9	No harvests in Compartment
SED	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
SFRD	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
SFRM	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
SOLC	290.8	0.0	0.0	0.0	-290.8	No harvests in Compartment
WLO	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
WWC	0.0	0.0	0.0	0.0	0.0	No harvests in Compartment
Total	**10564.74**	**3970.7**	**2596.9**	**24.6**		

In Table 1.2 the "10yr SHS Variance" denotes levels of variance. The overall variance for the FMU is 24.6%, a level consistent with most FMUs and FMAs across the province. This level of variance is highly influenced by a few compartments that experienced large area additions however the overall harvested area was about 37.6 percent of the Spatial Harvest Sequence allowable area, which is a significant undercut.

The compartments of greatest concern are LIL, and MIL which exhibit harvest levels exceeding the area sequenced in the SHS.

*One harvest area has been recorded as a volume over 20 years of SHS. PTC1 Porcupine Hills-Trout Creek values assess the first two decades , harvest timing was such that activity was near the end of the first 10 year period. The decision was made to minimize impacts by planning to harvest both the first and second 10 yr. period volumes to avoid reentry thus minimizing the number and duration of open roads in the area (second set of PTC1 numbers not included in totals).

Many compartments with high levels of variance (e.g., IRA) result from small additions in compartments with little or no harvest scheduled. These contribute relatively little to the overall FMU 10-year SHS variance.

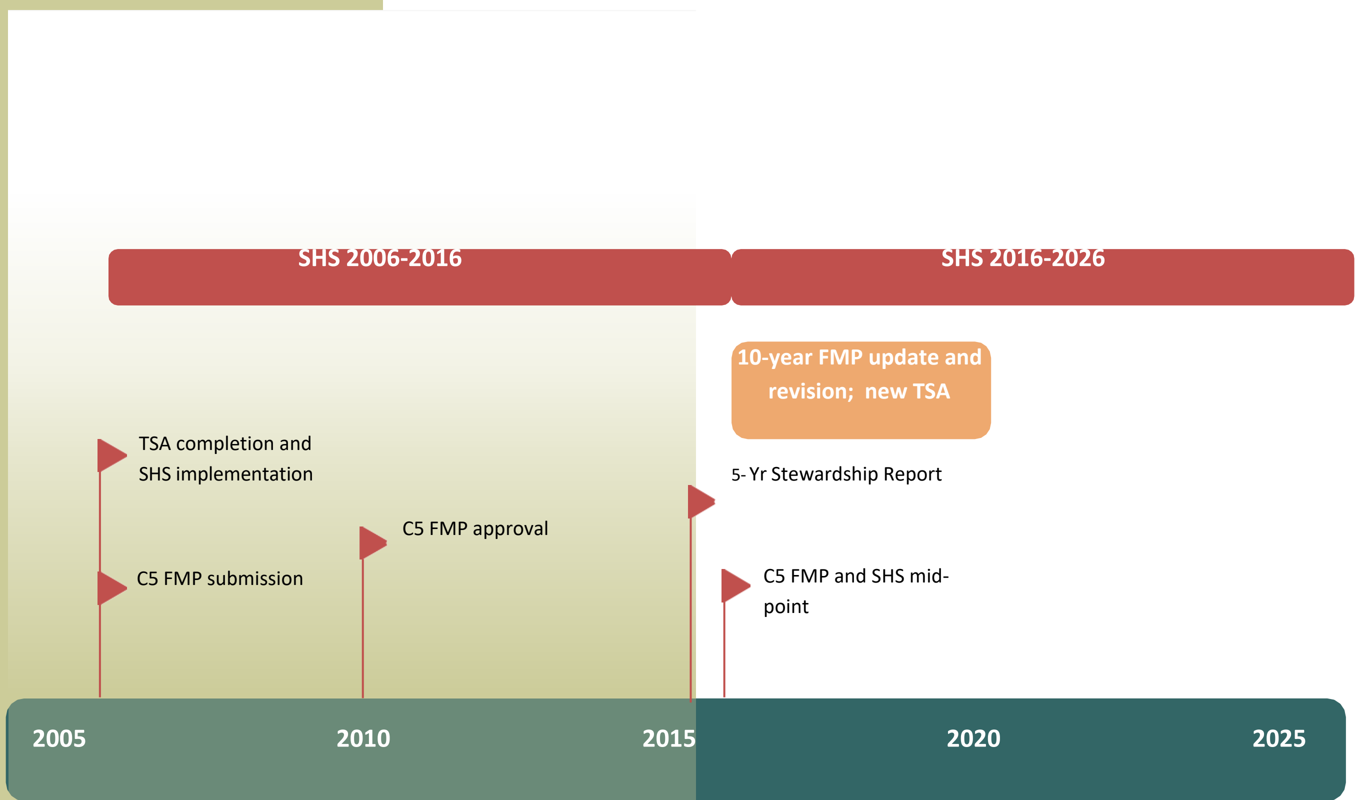
Objective 1

Objective 1 (continued)

Table 1.2 above revealed a concern in the C5 FMU regarding variance tracking. The issue of variance tracking by license rather than SHS compartment has arisen because of a long, complex history of forest dispositions in the FMU. The C5 quota volumes are allocated through numerous forest harvest licenses, which traditionally have been the planning and reporting units rather than compartments. These licenses typically span multiple compartments, therefore the variance within a license may be acceptable, yet some of the additions may fall in compartments with little area identified, causing the variance within that compartment to be high. This issue needs to be addressed by AAF and the disposition holders. The TSA and resulting SHS are based on compartments as planning units. Any variance tracking and reporting should be consistent with these units in order to effectively achieve desired future forest conditions.

Objective 1

Figure 1.2. Timeline illustrating the important starting dates for the C5 FMP, TSA, SHS and this Stewardship Report



Objective 2

New harvest block with leave timber in mid-ground in Porcupine Hills

Timber harvest cut blocks near Gould Dome on the Atlas road. Foreground and mid ground are reforested harvest blocks from different decades and the background shows forests for future harvest.

1.1.2 Minimize landscape fragmentation.

Performance Measures:

1. *Report frequency distribution of harvest area (ha)*
2. *Report outcomes of interior forest analysis*

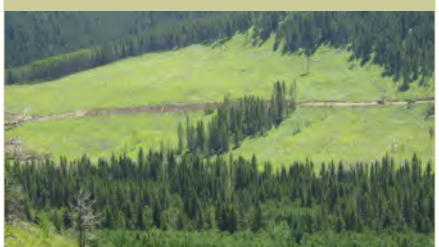
Landscape fragmentation results from human activity, land use change and natural disturbances on the landscape. These can result in the following: overall habitat reductions, an increase in the number of habitat patches, a decrease in the size of habitat patches, and an increase in the isolation of patches. Connectivity between habitat patches is important to maintain species diversity, abundance, density, distribution, reproduction, and movement patterns. While some species will benefit from the creation of more edge habitat, the maintenance or creation of interior habitat conditions may be necessary for species that are negatively affected by landscape fragmentation and which are dependent on large contiguous habitat areas.

In Objective 2 of the C5 FMP, Table 10 identifies the patch size targets for the preferred forest management scenario from 2006 to 2026. Interior forest patches were identified as those patches of early and late old growth forest that exceed 100 ha after the edge was buffered inward. Maximum harvest block sizes, which will ultimately create larger habitat patch sizes and interior forest conditions, are subject to constraints based on social acceptance. In the C5 FMP the maximum block size was set at 500 ha for the Middle Ridge Landscape Management Units (LMUs) and 250 ha for all other LMUs.

Interior forest patches of 100 ha or larger will be assessed through an interior forest analysis conducted in conjunction with the next TSA which is required before the year 2026. For future analysis the current percent area of interior old forest patches in each cover type will be compared to the targets that were set out in the original TSA. The distribution of patch sizes by seral stage in each sub-region will also be assessed against initial targets to inform the next TSA process.

Objective 3

Logging road in the Porcupine Hills



Road reclamation the summer after harvest in a block in the Lyndon Creek area of C5.

1.1.3 Minimize the impacts of motorized access.

Performance Measure

1. Open road density

Roads and trails can enhance recreational activities and have direct and indirect impacts on wildlife and wildlife habitat.

When development of access roads or trails is unavoidable, impacts must be minimized. Mitigation measures can include:

- use of existing or temporary access that is promptly and appropriately reclaimed,
- coordination among different users in route selection and road development,
- adoption of lower grade road construction standards to minimize habitat damage (i.e., less soil disturbance, narrower corridor width),
- avoidance of sensitive periods and areas for wildlife (e.g., no construction of water-course crossings during spawning season; avoidance of riparian areas, known bear dens, elk wintering areas), and
- access management on roads/trails through the use of gates, seasonal closures, and restrictions on motorized access.

Objective 6 provides greater detail on open road density as it relates to habitat quality for wide-ranging species, particularly grizzly bears and elk. Objective 32 provides a discussion on how access development and access management plans will be used in the C5 FMU to ensure that motorized access and associated impacts are minimized as well as a summary on work completed to date on these initiatives. Information on existing road and trail locations and their status (open/closed/temporary, accessible to on- or off-highway vehicles, etc.) is still being collected. Future access development planning was to identify open road density targets for LMUs based on industry needs, motorized recreational objectives, and wildlife management needs. However, since the FMP's approval, access management and planning in the FMU have been superseded by the following SSRP initiatives that are currently underway:

- Biodiversity Management Framework
- Linear Footprint Management Plan for the Porcupine Hills and Livingstone area
- Recreation Management Plans (for the Porcupine Hills, Livingstone, Willow Creek, Allison/Chinook areas.
- creation of new Public Land Recreation Areas

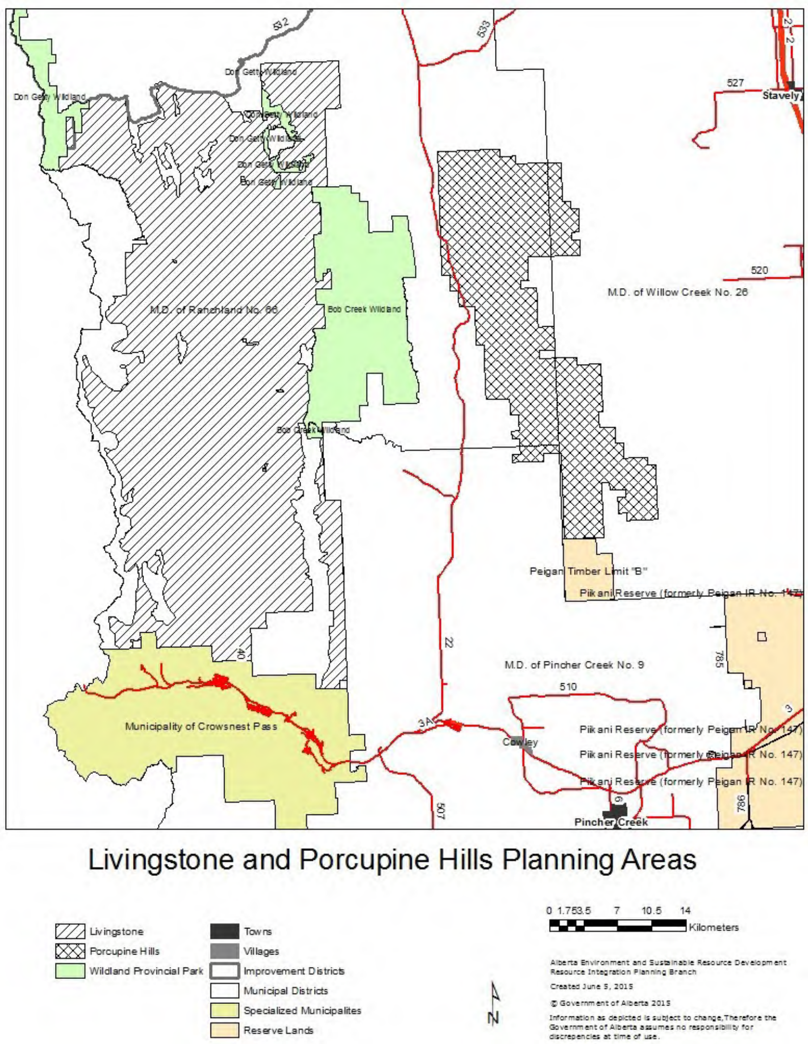
Objective 3

1.1.3 Continued

Linear Footprint Management Planning

The South Saskatchewan Regional Plan (SSRP) commits the Government of Alberta to create linear footprint management plans (LFMPs). Linear footprint is defined in the SSRP as "Any footprint that creates a linear 'edge' and can be described as a corridor or patch of land disturbance that is created for various purposes including a recreation trail, roadway, well-site, land clearing, power transmission line, natural gas or oil transmission pipeline, industrial sites, seismic exploration, or utility line." The creation of a LFMP for the Porcupine Hills and Livingstone areas is currently underway and completion is expected by 2017. LFMPs are intended to minimize the extent, duration and rate of linear footprint development, and also describe a practical system for monitoring, measuring and reporting on linear footprint. A complete inventory of linear features (including open route densities) are required for LFMPs. This information will be critical for assessing the impacts of motorized access and the success of objectives 3, 6 and 32.

Roads and trails mapped for the purpose of the Livingstone/Porcupine Hills Linear Footprint Management Plan.



Objective 3

1.1.3 Continued

Backcountry Flood and Rehabilitation Program

Following extensive flooding in southern Alberta in June of 2013, AEP developed the Backcountry Trail Flood Rehabilitation Program to restore and repair backcountry trail systems on public lands. The program aims to restore priority trails along the Eastern Slopes for both motorized and non-motorized recreational users.

In 2014 the program inventoried more than 1800 km of designated and recognized trails in the C5 FMU that were prioritized for restorative action. During the 2014 field season approximately 28 km of trails were restored and 4 bridges were installed in the Castle PLUZ, Crowsnest Pass area, the Allison-Chinook PLUZ and Livingstone area. In 2015 efforts were focused primarily in the Castle PLUZ and the Crowsnest area to the south of Highway 3. Approximately 25 flood damaged bridges needed to be replaced and additional trail restoration work needed to occur in this area.

Restoration actions will increase the recreational value of existing trail systems as well as reduce and prevent future erosion and sedimentation. Appropriate ditching, trail relocation and hardening, the creation of water drainage features, placement of geotextiles, and the replacement of water crossing structures will improve trail sustainability and minimize impacts to creeks and streams.

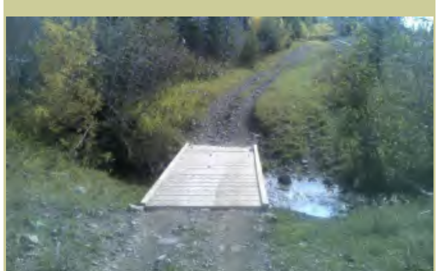
Further updated information on the Backcountry Flood and Rehabilitation Program is available at: http://aep.alberta.ca/water/programs-and-services/2013-flood-recovery-programs/backcountry-trail-flood-rehabilitation-program/completed-projects.aspx
Here you will find updated information sheets on the following:

Allison/Chinook PLUZ
Allison Chinook Area (March 26, 2015)
Castle PLUZ
Bovin (Blue) Lake Trail (March 2016)
Carbondale Area (February 22, 2016)
Goat Creek Area (March 2016)
Goat Creek to Lost Creek Loop (February 22, 2016)
Lynx Creek Area (March 26, 2015)
North Lost Creek (February 22, 2016)
O'Hagen Area (March 2016)
O'Hagen/Carbondale Connector Trail (March 2016)
South Lost Creek (February 22, 2016)
South York Creek Loop (March 2016)
Table Mountain Trail (February 23, 2016)
Crowsnest Pass
Lyons Creek to Willoughby Ridge (March 2016)
Livingstone
Great Divide Trail (February 22, 2016)
South Hidden Creek Area (March 2016)

The Backcountry Flood and Rehabilitation Program is scheduled to continue through to 2017. An updated map of access restoration work can be accessed here:
https://maps.srd.alberta.ca/FloodRecovery/TermsOfUseRequired=true&Viewer=FloodRecovery

Bridge installed over Hidden Creek in 2014

Backcountry Trail Flood Rehabilitation crew installing a bridge in the Castle PLUZ



New bridge in place.

Objective 4

1.1.4 Retain stand level structural attributes.

Performance Measures:

1. *estimated average volume per hectare (m^3/ha) of stand structure (sub-unit structure retention achieved as a % of the FMP target - calculated by FMB)*
2. *area (in hectares) of harvest blocks meeting the pre-harvest equivalent condition for coarse, downed, woody debris*

Stand Structure patch in the Livingstone areas of the C5.

Example of residual stand structure and stream buffering

Residual live or dead standing trees and coarse woody debris left in cutblocks after harvesting form important structural habitat elements for many species and create conditions more analogous to those that are left following natural disturbances. Although stand structure was historically considered to be a detriment to worker safety and reforestation efforts, these structural attributes fulfill key ecological functions in regenerating cutblocks such as providing cover, creating microclimates, creating source habitats or reproduction sites, facilitating species dispersion, controlling erosion, contributing to nutrient cycling, etc.

The C5 FMP recognized five components that contribute to structure retention: snags, single tree/small clumps (<0.1 ha), large clumps (0.1-15 ha), coarse woody debris (slash piles and individual pieces > 7.5 cm in diameter), and unique sites. Strategies for the retention of these structural components are identified in Appendix 7 of the C5 FMP and formalized in the 2012 Spray Lake Sawmills and C05 FMU Timber Harvest Planning and Operating Ground Rules (OGR). The OGRs require that an average of 3% of the merchantable stems in a stand remain on site, preferably in clumps rather than as single trees. The average structure retention can range from 0 to 5% with small harvest blocks (i.e., < 20 ha) in size nearing zero retention and larger blocks approaching the 5% retention target. Retention of whitebark pine, limber pine, alpine fir, alpine larch, and deciduous species can contribute to this stand structure. Structure may be retained near coarse woody debris piles, near the harvest boundary, around known wildlife features, and near intermittent and ephemeral streams so as to provide a gradual ecotone and increase opportunities for species dispersion. Ideally, downed woody debris > 7.5 cm, standing topped trees > 7.5 cm DBH, and existing snags should be retained at levels similar to pre-harvest conditions (as estimated by conditions in the adjacent forest stands).

Structure retention was assessed using aerial and satellite photography, capturing both clump and single-tree elements. Volume for large clumps was assigned using AVI values. The volume for single trees was estimated by assigning a mean average volume for individual trees and then counting the number of individual trees.

The target for structure retention (averaging 3% of merchantable volume) was exceeded during the reporting period. As shown in the table below, over 23,000 m^3 of stand structure was retained in C5 during the reporting period, representing 8.6% of the harvested area and 6.6% by volume.

Total Retention (Single Tree and Patch)			
	Harvested	**Retained**	**% Retention**
Area (ha)	1390.45	119.46	8.59
Volume (m^3)	352,778.00	23,284.05	6.60

Objective 5

1.1.5 To retain forest structure associated with wildfire and blow-down events.

Performance Measure:

- *number of natural disturbance events (e.g., wildfire, blowdowns) and the percent of the total disturbed area that was salvaged through logging*

In areas scheduled for harvesting, timber salvage operations following a natural disturbance event represents an attempt to recover merchantable timber before a significant loss of wood fibre quality occurs, coupled with the need to retain structural forest elements for ecological purposes. Salvage operations following wildfire are guided by Directive 2007-01 Fire Salvage Planning and Operations, which provides structural retention targets based on the area of productive land base affected:

- < 1000 ha — structural retention as per OGRs
- 1000 – 10,000 ha — 10-25% retention of merchantable burned trees
- > 10,000 ha — 25% retention of merchantable burned trees

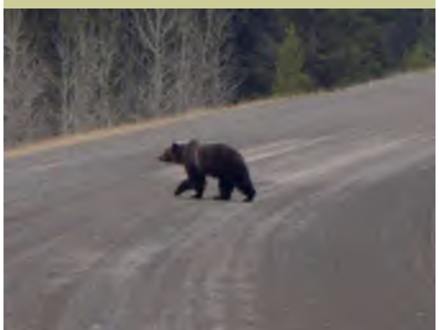
For blowdown events, the C5 FMP outlines a target of > 20% of merchantable blowdown to be retained on site in blowdown event areas that exceed 10 ha.

Since the 2003 Lost Creek fire and a smaller fire in the Racehorse Creek drainage in the same year, there have been no significant fire events that would trigger salvage planning and operations in the C5 FMU. During the reporting period, a total of 6 ha of forest was burnt by wildfires, with no fires larger than 0.25 ha.

Minor blowdown of stand structure in blocks was noted, however, blowdown was not extensive enough to consider any salvage planning. Accessible downed trees are often utilized as domestic firewood for home heating or for use by random campers.

Minor blowdown in retention patch within a cutblock in C5 FMU.

Objective 6



Grizzly bear crossing a permanent road

Core habitat areas have essential food, security, and connectivity with high habitat quality and low mortality risk, while **secondary habitat areas** provide linkages and buffers that help promote dispersal and population security.

1.2.1 Maintain habitat quality for species which are dependent on larger landscapes.

Performance Measures:

1. *open motorized road density*
2. *high and medium-high habitat quality for large carnivores*
3. *average mortality risk within each watershed*
4. *average Resource Selection Function (RSF) value for each watershed*
5. *number of elk calving/wintering in the C5 area*

Ungulate species such as elk, mule deer, bighorn sheep, and moose within the C5 landscape have social and economic value for recreational hunting and wildlife viewing, as well as ecological value as large herbivores and prey species. Habitats created by forest harvesting or wildfires generally benefit these species as they favour early successional vegetation for forage. High berry and Hedysarum spp. production in early seral stages can also contribute to high quality habitat for bears, provided the associated mortality risk is low. Given their high profile, habitat associations, large home ranges, as well as considerable research effort and available data have resulted in the selection of elk and grizzly bear as representative ungulate and carnivore species in the C5 FMP.

Grizzly Bear

Following the approval of the C5 FMP in July 2010, grizzly bears were designated as a 'threatened' species in Alberta because of the small size of the breeding population, restricted dispersal from adjacent jurisdictions, and the expectation that current and future land use and human activity will lead to population declines. The primary mortality source for bears in Alberta is human-caused mortality, specifically human use of motorized access routes and the ensuing increased frequency of contact between people and bears through hunting, poaching, or self-defence mortalities. The approved Alberta Grizzly Bear Recovery Plan 2008-2013 (March 2008) contains population estimates, priority conservation area maps, and targets to direct management actions. The 2010 update to the Status of Grizzly Bear (Ursus arctos) in Alberta provides population parameters for different regions of the province.

The Alberta Grizzly Bear Recovery Plan 2008-2013 outlined several objectives for recovery actions, two of which have direct relevancy to the C5 FMP:

OBJECTIVE: Limit the rate of human-caused mortality per Bear Management Area (BMA) to within scientifically established values.

- Measure: Open route densities ≤0.6 km/km^2 in high quality grizzly bear habitat designated as core areas and open route densities ≤1.2 km/km^2 in all remaining secondary areas.

OBJECTIVE: Identify, track, and maintain habitat for grizzly bears.

- Measure: Maintain quality and quantity of foraging habitat, linked by effective movement corridors.

Two grizzly bear population units span the C5 Forest Management Unit: the Livingstone population unit which runs approximately from Hwy 1 south to Hwy 3 (i.e., Bear Management Area 5) and the Castle population unit which runs approximately from Hwy 3 south to the US border (i.e., Bear Management Area 6). The 2006/2007 total population estimate for the Livingston population unit was 90 bears, while the Castle population unit was estimated to have 51 bears (and one of the highest grizzly bear densities in the province).

Objective 6

Southwest Alberta Grizzly Bear Monitoring Project

The Southwest Alberta Grizzly Bear Monitoring Project is a three year (2011 to 2014) pilot project to monitor grizzly bear populations and distributions locally and at the ecosystem scale by non-invasively collecting DNA from hair samples left at rub sites (e.g., trees, posts). Working in collaboration with Parks Canada, Alberta Environment and Parks, and United States Geological Survey, this University of Alberta study should help determine a current population estimate and trend for the Castle population unit and begin to examine genetic flow with populations to the south. Results from 2013 showed a minimum of 128 bears using the study area at some point. More information is available at: http://esrd.alberta.ca/fish-wildlife/wildlife-management/grizzly-bear-research/southwest-alberta-grizzly-monitoring.aspx

Primary mortality sources in these population units are thought to be self-defence and problem wildlife removals. Bear removals are often necessary due to depredation conflicts and property damage associated with agricultural operations. Bear relocations often occur within the animals home range.

Highway 3 presents a significant barrier to bear movement and genetic flow between bear population units. Female bears, in particular, are reluctant to cross the highway. Genetic migration with neighbouring British Columbia and Montana populations is likely —the Castle population unit is well connected to the grizzly bear population in the Northern Continental Divide Ecosystem of northwestern Montana, where the population is known to be increasing at approximately 3% per year (see sidebar: Southwest Alberta Grizzly Bear Monitoring Project).

Grizzly bear watershed units are management units within each provincial bear management area. These units follow heights of land and watercourses within each major watershed and approximate an average female grizzly bear's home range (i.e., about 700 km^2). All grizzly bear watershed units within the C5 FMU fall within core habitat areas, with the exception of one area in the Porcupine Hills.

The Alberta Foothills Research Institute has developed several GIS-based tools to help predict changes in grizzly bear habitat resulting from land management activities and industrial development, including

- Land Cover Maps – show landscape configuration and plant phenology over time for large landscape areas, based on satellite/remote sensing imagery
- Resource Selection Function (RSF) Maps – show the relative probability of grizzly bear occurrence on the landscape, derived from GPS collar locations, land cover habitat maps, and other data layers such as the presence of access roads
- Mortality Risk Maps – show the probability of human-caused grizzly bear mortality over the landscape based on known mortality data as well as data on roads and right-of-ways that are used by motorized vehicles
- Safe Harbours and Attractive Sinks – combines RSF maps with mortality risk maps to show safe harbours and attractive sinks. Safe harbours are areas having a high RSF score and low mortality risk, while attractive sinks have high RSF scores and high mortality risk.
- Grizzly Bear Movement Corridors – are determined when RSF maps are combined with graph theory to show the location and relative rank of important movement corridors on the landscape.

These tools will continue to be used to assess changes in grizzly bear habitat quality and mortality risk within the C5 FMU.

Recent graduate study work on grizzly bears in southwestern Alberta may have relevance to the impacts of industrial activity on associated habitat quality. Joe Northrup and Dr. Mark Boyce examined grizzly bear habitat selection and movement in relation to roads and access, while a study initiated by Andrew Baird and Dr. Scott Nielsen will examine the distribution and seasonality of grizzly bear food resources, the impacts of harvesting and silvicultural techniques on grizzly bear food resources, and the viability of using enhancement plantings to accelerate reestablishment of key grizzly bear foods following disturbance.

Northrup et al. (2012) suggested that below a threshold of 20 vehicles per day grizzly bears in southwestern Alberta were more likely to select areas near roads and, particularly at night, move across roads or even use them as movement corridors. Above this traffic volume, less frequent bear occurrences near roads were usually direct and quick straight-line movements across the road corridor. Northrup et al. suggested that the most effective management approach is to maintain low open road densities and install

Objective 6

gates on new industrial roads until such roads can be reclaimed. In areas with moderate to high road density, access management and low traffic volume (< 20 vehicles/day) may be effective in increasing security and perceived habitat suitability for bears attracted to preferred forage items near roadside areas — despite the higher mortality risk.

Elk

Similar to grizzly bear, significant research on elk has been ongoing through the Southwest Alberta Montane Research Project. Cuiti et al. (2012) examined elk behaviour in southwestern Alberta in response to roads and human activity and found that elk behaviour was most strongly influenced by land use type/season and distance to the nearest road with a traffic volume ≥ 12 vehicles per day (i.e., 1 vehicle every 2 hours). The highest levels of vigilance were found in elk on public land during the hunting season, while the lowest levels of vigilance were found in elk on private land during the winter-spring season and in Waterton Lakes National Park during the summer months. Within 250 m of roads with ≥ 12 vehicles/day, elk behaviourally traded off foraging time for increased vigilance and increased travel time. The potential impacts of this loss of feeding time on growth, survival, or reproduction in elk has yet to be determined.

Graduate work by Dale Paton (2012) identified movement corridors and stopover areas during spring and fall migration for elk from the Castle-Carbondale herd (note that Paton collected analogous data for other elk herds within the C5 FMU: future analyses of migration corridors and stopover areas for these herds will be conducted as financial resources and time allow). Approximately 95% of the Castle-Carbondale herd migrates between 10 and 34 km from lower elevation winter range to higher elevation summer range. Migration from one range to the other occurred gradually over several weeks by way of relatively quick movements between and prolonged stays at stopover areas. Although some larger stopover areas were used in both migratory seasons, spring stopover areas were characterized by rugged terrain, southerly aspects, low canopy cover (mean=28%), lower elevation (mean=1490 m), road densities of < 1 km/km^2 within a 3 km radius, and an average distance-to-road of 525 m. Fall stopover areas showed increased distances to roads (mean=678 m), canopy cover (mean=32%), elevation (mean=1547 m), and terrain ruggedness. The largest concentration of stopover areas was within the 2003 Lost Creek fire. Elk showed strong annual fidelity to migration routes between stopover areas, but some of the routes varied between the spring and fall migrations. Segregation between males and females on these transition ranges was evident. Paton (2012) stressed the importance of conserving migration corridors in ensuring the elk herd remains migratory, thereby avoiding the potential ecological and economic problems caused by non-migratory elk that remain on winter range year-round. Suggested management practices include implementing access control strategies within core summer and winter range and within 300 to 1000 m of migration corridors, and using prescribed burning or selective harvesting to maintain existing or create new stopover areas with relatively low canopy cover.

Data from AEP winter elk surveys were not available for inclusion in this report.

References

Ciuti, S., J. Northrup, T. Muhly, S. Simi, M. Musiani, J. Pitt, and M. Boyce. 2012. Effects of humans on behaviour of wildlife exceed those of natural predators in a landscape of fear. PLoS ONE 7(11): e50611.

Northrup, J., J. Pitt, T. Mulhy, G. B. Stenhouse, M. Musiani, and M. Boyce. 2012. Vehicle traffic shapes grizzly bear behaviour on a multiple-use landscape. Journal of Applied Ecology 49 (5): 1159-1167.

Objective 7

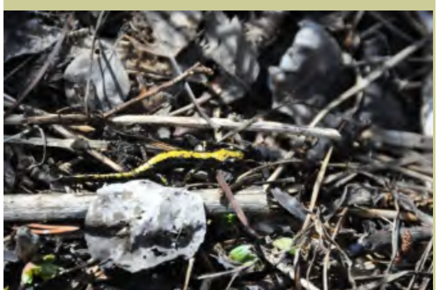
1.2.2 Retain, create, and enhance habitats capable of supporting selected species.

Performance Measures:

1. *hectares of high quality habitat used by SHARP species*
2. *exclusion from harvest of selected tree species.*
3. *number of low density Douglas-fir ("A" & "B") stands burned in the Porcupine Hills*
4. *number of relevant species recovery plans that have been approved (FMB)*

Selected Wildlife Species – SHARP Species

Focal species identified in the Southern Headwaters at Risk Project (SHARP) represented vertebrate species whose habitat requirements encompass that of a large number of species at risk within the headwaters area of the Oldman River. Of 16 species identified, 7 species that have overlapping ranges in the C5 FMU were selected as the species of management concern in the C5 FMP, namely: wolverine, grizzly bear, Harlequin duck, long-toed salamander, western toad, pileated woodpecker, and Clark's nutcracker. Note: grizzly bears were addressed in Objective 6; primary reporting for grizzlies will occur under that objective.



Long toed Salamander near Castle River

Updates to Habitat Suitability Index (HSI) maps for SHARP species are to be prepared by Fish and Wildlife staff at 10-year intervals prior to the next TSA. At that time, the area of high and medium-high quality habitat will be evaluated relative to the area of habitat that existed in 2006.

Since the implementation of the FMP, Alberta has moved on from SHARP and has adopted a slightly different strategy for managing species at risk. See http://aep.alberta.ca/fish-wildlife/species-at-risk/default.aspx for more complete information on Alberta's new strategy for managing species at risk.

Recovery plans are prepared for 'threatened' and 'endangered' species listed under Alberta's Wildlife Act. Provincial conservation management plans have been prepared for Harlequin ducks and long-toed salamanders to identify preventative conservation measures (see Harlequin Duck Conservation Management Plan 2010-2015 and Long-toed Salamander Conservation Management Plan 2010-2015).

Harlequin Ducks

Select Beneficial Management Practices (BMP) identified in Blouin (2006) were incorporated into the OGRs for wolverine, pileated woodpecker, and Clark's nutcracker. The chosen BMPs focused on nesting habitat for the bird species, recognizing that foraging habitat for Clark's nutcracker is highly related to the retention of whitebark and limber pine (see below). The BMPs adopted for wolverine similarly focus on harvesting in relation to potential denning habitat, though management activities that benefit ungulate species (i.e., their primary food source) and the control of human access and disturbance may also benefit the wolverine and their preferred habitat. No BMPs were identified in Blouin (2006) for Harlequin duck, long-toed salamander, or western toad; however, buffer areas around known nesting areas or breeding ponds (as identified by F&W staff) were deleted from the net harvestable land base during the land base determination process of the TSA.

Objective 7

Distinctive needles of a whitebark pine tree.

Cones on a whitebark pine tree.

Whitebark pine tree at Emerald Lake.

Selected Tree Species – Whitebark and Limber Pine

Whitebark and limber pine were listed as an endangered species under the Alberta Wildlife Act in 2009. Federally, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed whitebark pine as endangered under the Species at Risk Act (SARA), affecting activity on all federal lands. AAF has committed to not harvesting these endangered species. White pine blister rust, mountain pine beetle, and climate change are the biggest threat to whitebark and limber pine. White pine blister rust is the primary cause of population decline in Alberta and has been spreading rapidly. Blister rust affects all age classes and causes the loss of reproductive potential in some stands entirely. Though Alberta has some of the healthiest stands of whitebark and limber pine in North America, the health of these stands is rapidly declining.

A Whitebark and Limber Pine Recovery Team was established and is being led by the Alberta Forestry Division and the Fish & Wildlife Division. A recovery plan for whitebark pine is complete and can be accessed at http://aep.alberta.ca/fish-wildlife/species-at-risk/species-at-risk-publications-web-resources/plants/documents/SAR-WhitebarkPineRecoveryPlan-Jan-2014.pdf .

The recovery goal is to ensure a viable, self-sustaining population of whitebark and limber pine. To reach this goal AAF and AEP are adopting a number of different strategies, including the protection of high value stands and individual trees, performing population inventory and assessments, propagating and deploying populations, habitat and regeneration management, facilitating research, and conducting information and outreach programs.

Stands with a leading or secondary whitebark or limber pine component were identified as subjective deletions from the net forest land base in the C5 FMP. These species are nonetheless encountered as a minor forest component of proposed harvest blocks or along planned roads. Under Section 7.4 Structure Retention of the 2011 Spray Lake Sawmills and C05 FMU Timber Harvest Planning and Operating Ground Rules (OGR), Ground Rule 7.4.5 states that whitebark and limber pine found as single trees or as clumps must be retained. In view of the clear OGR requirements for not harvesting whitebark and limber pine, any destruction or cutting of these species is treated as a ground rules deviation requiring specific approval in the AOP.

A new approval process was implemented beginning in 2010 to assist timber companies in the planning of road construction and harvesting activities where whitebark or limber pine removal may be unavoidable. After completing the field layout of planned roads and harvest blocks, timber companies can make a formal Final Harvest Plan AOP amendment request to remove whitebark or limber pine that is incidental to operations. This request must provide a site description including GPS location, photos, and description of the number of stems to be destroyed or cut. AAF reviews the request, conducts a field inspection if necessary, and performs other internal checks before a formal response is issued. After harvest, a joint AAF/timber disposition holder field tour may be used to facilitate information transfer regarding successes and challenges associated with harvest in stands containing whitebark and limber pine. If required, the Spray Lakes and C5 OGR can be amended on an annual basis using an adaptive management approach to address new legislation, landscape strategies, and operational guidelines. Input can also be provided to assist the Whitebark and Limber Pine Recovery Team's development of landscape strategies and operational recommendations.

Objective 7

Selected Tree Species – Douglas-fir

Interior Douglas-fir is a climax species historically dependent on wildfires to increase seed germination by reducing litter accumulation and exposing mineral soil. Mature Douglas-fir trees have a thick bark, which supports relatively high survival compared to other adjacent shrub and tree species during low- to moderate-intensity wildfires and promotes the development of low density Douglas-fir stands. Unique in Alberta however, interior Douglas-fir in the Porcupine Hills can be found as a dominant component of both early and late successional stands. Successful regeneration of these stands after harvest is challenging to accomplish and often dependent on micro/meso climate factors during the initial reforestation period (i.e., summer frost, summer drought, winter desiccation and other factors; see Appendix 9B of the C5 FMP).
In the C5 FMP Douglas fir received considerations:
>To serve as a seed source for natural regeneration and to protect their inherent social and aesthetic values, large veteran Douglas-fir trees (those greater than 80 cm DBH) were maintained in harvest blocks in the Porcupine Hills, except in the case of unavoidable road-alignment conflicts.
> Furthermore, low density Douglas-fir ("A" and "B" density) stands lacking a coniferous understory were deleted from the net productive landbase in the Porcupine Hills as the grassland communities associated with these stands can provide valuable forage for ungulate species. Prescribed burns are used as a preferred management tool in low density stands in the Porcupine Hills.

Douglas fir being left as stand structure. Note the felled timber is yet to be skidded.

During harvest operations Douglas fir has often been left as stand structure because it is more windfirm than most species.

References

Blouin, F. 2006. The Southern Headwaters At Risk Project: A Multi-Species Conservation Strategy for the Headwaters of the Oldman River, Volume 4: Beneficial Management Practices and Land Use Guidelines for Focal Species. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species At Risk Report No. 106. Edmonton, AB.

Objective 8

Douglas fir cones.

1.3.1 Retain wild forest genetic resources for each species through in situ conservation

Performance Measure:

- *number and area of gene conservation areas by species*

The 2009 Gene Conservation Plan for Native Trees of Alberta identifies a gene conservation strategy designed to protect the natural genetic variability of Alberta tree species. Maintaining genetic variation is important because this variation allows tree species to adapt to environmental changes, including climate change and pest epidemics. The strategy focuses on in situ conservation by identifying natural habitats where genetic variability can be protected, determining the number of trees to be protected for each species, and delineating necessary buffer zones to protect the wild trees. Seed zones, closely aligned the Natural Subregions of Alberta, have been identified within which seed (to be used for reforestation) can be collected and freely deployed without any significant loss of adaptation and growth potential.

There are currently two gene conservation areas in C5, both are Douglas fir stands, totalling approximately 85 ha. Each area has Protective Notations applied to ensure they remain intact. This falls short of the goals outlined in the C5 FMP, and it is recommended that in the next iteration of the FMP a more detailed strategy is provided to help guide the establishment of in situ conservation areas for each tree species across the various Natural Sub-regions.

Objective 9

Heli-assisted tree topping for seed cone collection.

1.3.2 Retain wild forest genetic resources through ex situ conservation

Performance Measures:

1. *number of provenances and/or genetic lines in ex situ gene banks and trials for Douglas fir, western larch, limber pine, and whitebark pine*
2. *number of conservation seed lots by species and number of individuals by native species in clone banks (FMB)*

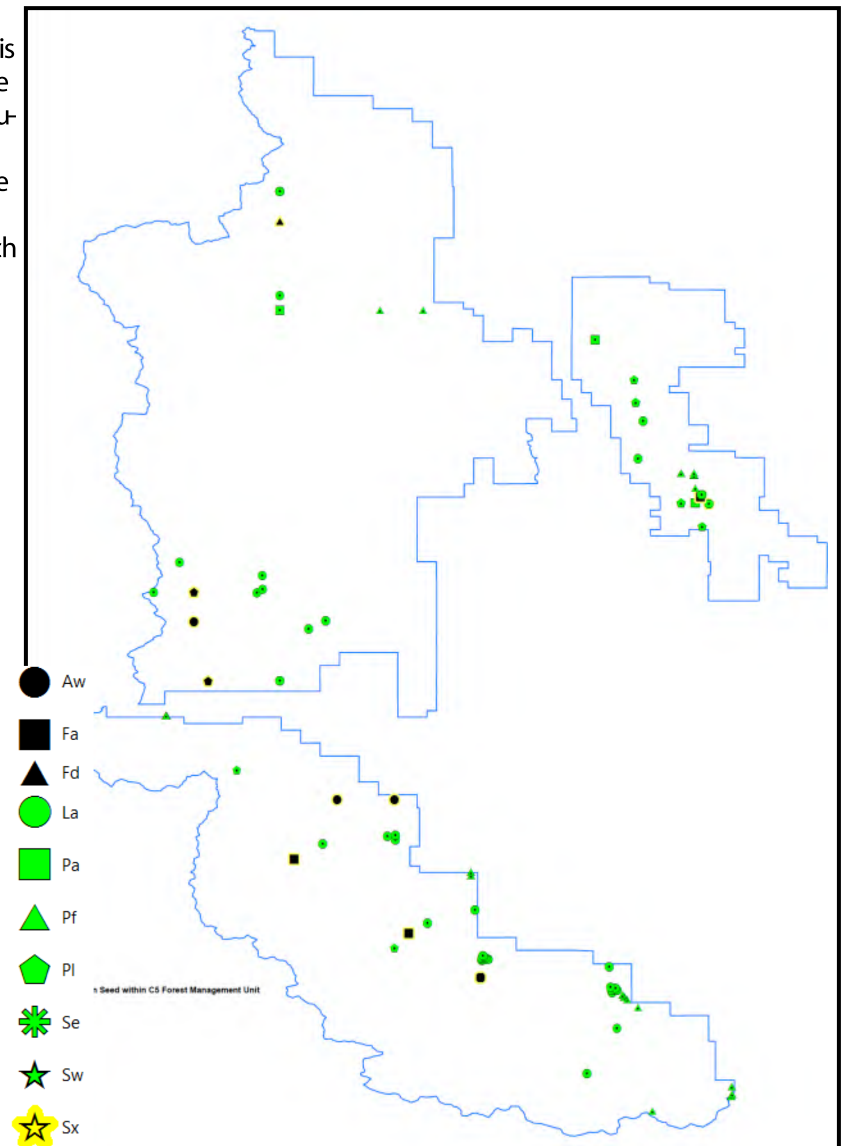
Ex situ gene conservation consists of conserving representative samples of wild tree genes away from their original location and usually outside their natural habitat. Most commonly this is done through seed collection and storage, but can also include pollen collection and storage, cutting (i.e., scion) collections, the establishment of plantations, and tree species promotion through research trials. Off-site or ex situ conservation of species, such as in seed banks at the Alberta Tree Improvement and Seed Centre, are sometimes required to supplement on-site efforts and may be necessary for rare or endangered species or populations or in cases where the natural habitat is threatened.

The number of provenances for each species in ex-situ gene banks was not available for this report, however, it is believed that adequate ex-situ gene conservation is occurring due to the number and distribution of collection areas as well as the quantity of seed represented by each species.

Table 9.1. Quantity of ex-situ conservation seed by species from C5 FMU as of 2014.

Species	Number of Collection Areas	Quantity of seed (g)
Aspe	1	8.4
Sub pine fir	4	4252.5
Douglas fir	5	2179.4
Larc	1	6.1
Whitebark pine	9	12,034.(
Limb er pine	8	7389.8
Lodg epole pine	6	503.1
Spuc (Sw, Se, Sx)	10	2397.1
Total	**44**	**28,771**

Figure 9.1. Locations of ex situ gene conservation collection areas by species in C5.



Objective 10

1.3.3 Maintain adequate genetic diversity in seedlots used for reforestation plantings.

Lodgepole pine cones on the forest floor of a harvested area.

Performance Measures:

1. *number of unrelated parent trees represented in the seedlots used for reforestation*
2. *number of seedlots used by species and average number of parents per seedlot (FMB)*

To ensure the ecological adaptability, genetic diversity, and health of both wild and managed forests, the Standards for Tree Improvement in Alberta regulate the type and quality of tree material used for reforestation. There are two reforestation material types: material collected from wild or regenerated stands of native species, and material resulting from genetic selection and breeding (i.e., usually obtained from seed orchards or through mass vegetative propagation). The origin and genetic integrity of reforestation material is carefully tracked through the various stages of collection, processing, registration, storage, greenhouse/field growing, and deployment. Registration of reforestation materials with AAF helps ensure compliance with genetic diversity requirements.

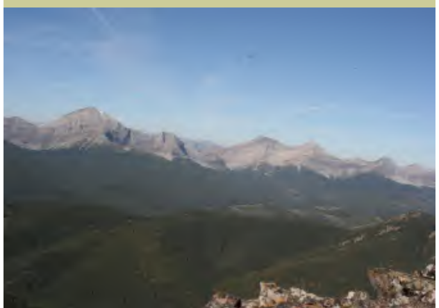
To provide reforestation material for use in C5, seedlots must be regenerated from wild stand collections with a minimum of 30 trees or, in the case of seed orchard seedlots, seedlots must maintain an effective population size of at least 18 unrelated parents. Restricted registration material (i.e., less than 18 unrelated parents) may only be used for planting under special approval.

The exact number of parent trees per seedlot is not available, however, all seedlots used in the C5 FMU over the reporting period were unrestricted, meaning that a minimum of 30 unrelated parent trees were represented in each seedlot. Table 10.1 details the number of seedlots used by species in the C5 FMU over the reporting period.

Table 10.1. C5 reforestation seedlots by species

Species	Number of Seedlots Used
Lodgepole pine	51
Engelmann spruce	6
White spruce	19
White/Engelmann spruce	9
Total	85

Objective 11


Beehive Natural Area

1.4.1 Adopt forest management practices that maintain the ecological integrity of established protected areas and passive landbase in C5.

Performance Measures:

1. *number of (or progress made towards) agency coordination agreements*

Six protected areas are currently found within the C5 FMU: Don Getty Wildland, Bob Creek Wildland, West Castle Wetlands Ecological Reserve, Plateau Mountain Ecological Reserve, Beehive Natural Area, and Mount Livingstone Natural Area. These protected area are managed by AEP. Waterton Lakes National Park —immediately to the south of the FMU —is managed by Parks Canada.

In response to direction contained in the 2014 South Saskatchewan Regional Plan, two new protected areas were created within the Castle area.

Although protected areas were historically influenced by similar ecological processes and disturbances operating at a landscape scale, current management goals and approved disturbance methods may vary among management agencies that are responsible for these areas. The development of agency coordination agreements, as identified in the C5 FMP, ensures activities implemented by one agency do not adversely impact those of an adjacent land manager. Issues addressed in coordination agreements (involving AAF, AEP, Parks Canada, BC Ministry of Environment—Parks Agency) can include forest health, wildfire impacts, habitat connectivity for particular species, roads, invasive species, recreational activities, and logging impacts.

No such agreements have yet been formalized with management agencies responsible for "embedded" or adjacent protected areas. Timber harvesting and land development that is occurring in close proximity to protected areas is currently being addressed on a case-by-case basis.

Objective 12

Wildlife Habitat Initiative in Low-Disturbance Zones (WHILDZ)

The WHILDZ project, led by Alberta Conservation Association in partnership with AESRD – Fish and Wildlife Division, Anatum Ecological Consulting, and Devon Canada, is identifying habitat features in areas of low disturbance and documenting wildlife use of those features using trail cameras. The primary study area covers much of the C5 FMU. Initial work in 2011 and 2012 identified a number of mineral licks and monitored seasonal variation in their use. Future work will continue to identify additional wildlife habitat features and relate their use to disturbance levels in the study area.

1.4.2 Retain specific wildlife features

Performance Measures:

1. *number of unique finds for specific wildlife features (mineral licks, denning sites, nesting sites) and any compliance violations of associated OGRs*
2. *area of meadows and wildlife habitat/cover adjacent to natural meadows and actions being taken to maintain meadow complexes*
3. *number of unique finds for specific wildlife features (i.e., long-toed salamander and western toad breeding ponds) and any compliance violations of associated OGRs*
4. *number of AOPs implemented as per approved OGRs (FMB)*

In addition to general habitat available within a given landscape, some wildlife species may depend on discrete, localized habitat features or unique sites during particular stages of their life cycle. These important features or sites can include mineral licks, den sites, raptor nests, hibernacula, major movement corridors, bear rub trees, cliff faces, meadow complexes, amphibian breeding ponds, etc. The locations of known wildlife features and sites are maintained in AEP's Fish and Wildlife Division data base (i.e., Fisheries and Wildlife Management Information System — FWMIS), with new locations being submitted by government staff, researchers, consultants, or contractors when these are encountered during the course of fieldwork. Timber disposition holders may identify previously unknown locations of wildlife habitat features or unique sites during block layout or harvesting activities: they are obligated to report these locations for inclusion in FWMIS. Additional locations within the C5 FMU will likely be identified through the Wildlife Habitat Initiative in Low-Disturbance Zones (WHILDZ) project (see sidebar).

When subject to natural or human disturbances, the general integrity and associated wildlife use of habitat features or unique sites will vary with the type of site, type of disturbance, and species' tolerance for change. For example, a wet meadow may not burn during a wildfire or a prescribed fire and thus continue to provide ungulate forage opportunities, but could be negatively impacted by the careless placement of a skid trail during harvesting activities. Conversely, harvest planning can retain a bear rub tree within the harvest area that would otherwise be lost in a fire-disturbed landscape. The Spray Lake Sawmills and C05 FMU Timber Harvest Planning and Operating Ground Rules (OGR) delineate measures to be taken in relation to specific wildlife features or unique sites and are summarized in the table 12.1 below.

No ground rule variances pertaining to wildlife features occurred during the reporting period. As can be seen in table 12.2, 50 Annual Operating Plans were approved in accordance to the approved OGRs.

Objective 12

Table 12.1 BMPs for specific wildlife features.

Beneficial Management Practices included in Operating Ground Rules for specific wildlife features		
Operating Ground Rule #	Wildlife Feature/Site	Beneficial Management Practices incorporated into OGRs
5.4.2	Meadows	Avoid use of silviculture treatments in natural meadows and other non-forested rangeland areas occurring within cutblocks unless otherwise approved by Alberta. High stumps (<1 m) or structure retention can be retained around meadows to identify them.
7.2.8	Meadows > 5 ha	Ensure at least 50% of the meadow's lineal edge is bordered by un-harvested leave stands of at least 50 m wide.
7.4.9	Known wildlife features	Retain structure around known wildlife features.
7.7.1.8	Bear rub trees	Retain structure to protect areas of concentrated grizzly bear rub trees.
7.7.3.1	Potential wolverine denning areas	Retain minimum 60 m treed buffer near cirque basins, talus slopes, boulder fields and avalanche paths in sub-alpine forest.
7.7.3.4	Long-toed salamander and western toad breeding ponds	Ponds found during field operations> Retain 100 m treed buffer from high water mark of the pond. (Note: known sites for TSA were permanently removed from the net harvestable landbase during FMP development.)
7.7.3.5	Long-toed salamander and western toad ponds	Retain 100 m treed buffer around ponds found during field operations.
7.7.3.7	Pileated woodpecker cavity nesting trees	Retain large (> 30 cm diameter breast height) live or dead deciduous or dead coniferous trees that have rectangular nesting holes on the trunk.
7.7.3.13	Breeding sites and hibernacula of amphibian or reptile species-at-risk	Retain 100 m undisturbed forested buffer
	Bat hibernacula	Retain 100 m undisturbed forested buffer
	Colonial bird nesting area	Retain 100 m undisturbed forested buffer
	Sandhill crane nesting area	Retain 100 m undisturbed forested buffer
	Wolverine den	Retain 100 m undisturbed forested buffer
	Mineral licks	Retain 100 m undisturbed forested buffer
	Bear den	Retain 100 m undisturbed forested buffer
	Raptor nest tree	Retain 100 m undisturbed forested buffer
	Natural springs, beaver ponds with no outflow channel, other natural ponds	Retain 20 m undisturbed forested buffer
11.3.1.3	Natural meadows	Avoid natural meadows during construction of roads and landings unless approved by Alberta.

Objective 12

Table 12.2 Approved Annual Operating Plans that were implemented during the reporting period

Approved AOPs implemented annually as per approved OGRs						
	Quota Holders					
	793128 Alberta Ltd.	770538 Alberta Ltd.	Crowsnest Forest Products	Spray Lake Sawmills	Community Timber Program	Total
2010	1	1	5	0	4	11
2011	1	1	4	0	2	8
2012	1	1	4	1	3	10
2013	1	1	6	2	3	13
2014	1	1	0 *	1 *	5	8
Total	**5**	**5**	**20**	**3**	**17**	**50**

* All Spray Lake Sawmills and Crowsnest Forest Products plans for numerous licenses were approved under a single AOP in 2014.

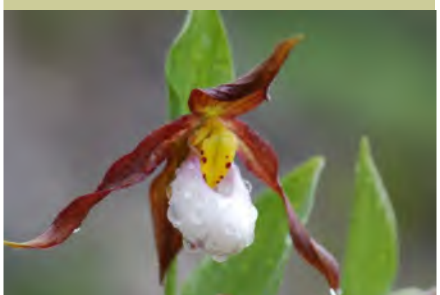
Objective 13

1.4.3 Maintain rare plant communities.

Performance Measures:

1. *rare plant communities identified in Alberta Natural Heritage Information Centre (ANHIC) are retained.*

The C5 FMU contains an extremely rich ecological diversity owing to its geographical location in the eastern slopes, the unique conditions created by diverse topography, strong and frequent southwesterly winds, relatively high precipitation rates in the southern valleys, and relatively mild winters. This climatic transition zone, and sometimes abrupt landform change from prairie to mountains, supports an associated overlap in species, including many species rarely found elsewhere in the province.



Mountain lady's slipper (Cypripedium montanum)

Rare plants and vegetation communities within the C5 FMU are officially tracked through the Alberta Conservation Information Management System (ACIMS). Originally established in 1996 as Alberta Natural Heritage Information Centre or ANHIC, ACIMS is a provincial biodiversity database that provides accurate and accessible information necessary for making informed natural resource management decisions (http://www.albertaparks.ca/albertaparksca/management-land-use/alberta-conservation-information-management-system-acims/). ACIMS continually collects, updates, analyzes, and disseminates information about the location, condition, status and trends of selected elements, including species and plant communities, using globally recognized methodologies.

Prior to the Stewardship document planning period the AAF contracted with David McIntyre to conduct general surveys for rare trees and plants within particular areas in the FMU, including the western Allison Creek valley, Saddle Mountain, West Castle, and the Crowsnest River valley.

Western red cedar (Thuja plicata) found in the Crowsnest valley near the great divide.

There were insufficient resources during the reporting period to effectively locate, map and monitor rare plant communities. ACIMS is an excellent resource, however, if it were able to report element existence within forest management units and forest plan boundaries it would increase its effectiveness to forest managers.

It should also be noted that different views exist on whether a "coarse" or "fine filter" approach is more suited to managing and maintaining rare vegetation communities on the C5 landscape. The C5 Forest Management Plan, has established cover type, seral stage and patch size distribution objectives to maintain the diversity of forest community types and their spatial patterns across the landscape. Diversity at the stand scale is addressed through structure retention and coarse woody material objectives. Maintenance of streamside buffers (as per the Operational Ground Rules) will protect an ecosystem type that is an important contributor to biodiversity. Alberta Agriculture and Forestry (AAF) believes that implementing these "coarse filter" management strategies is the best approach to maintaining the ecological integrity of forest landscapes in the context of many uncertainties including large natural disturbance events and climate change.

Forest Ecosystem and Productivity

Objective 14

> 2.1.1 Sustain the capacity of the ecosystem to recover from both natural and human-caused disturbances.

Performance Measures:

1. *summary of audit findings*
2. *number of FOMP inspection findings for soils and water (FMB)*
3. *hectares of harvested areas that are successfully replanted/seeded per year*
4. *percentage of an area reforested within two years (FMB)*

Recent harvest on the C5FMU timber landbase.

The C5 landscape can provide ongoing economic opportunities through the use of its renewable forest resource, but only if timber disposition holders adhere to approved legislation, polices, standards, and monitoring procedures that have been developed to minimize the effects of disturbance during harvest activities and ensure adequate reforestation occurs following harvest activities. Implicit here is the assumption that ecosystem resiliency, in response to future natural or human-caused disturbances, will be promoted by minimizing harvest-related disturbance during both harvesting and reforestation activities and by maintaining post-harvest tree species diversity at the stand and landscape levels. To create this necessary diversity, harvested areas will be returned to a yield strata reflective of pre-harvest proportions, and the cover group and seral stage distribution over the landscape will be maintained within the projected range identified through the TSA (as shown in Appendix 7, Tables 1-6 of the C5 FMP).

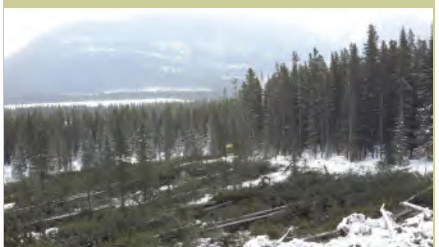
The Forest Operations Monitoring Program (FOMP) was launched in May 2008 to provide standardized field assessments of timber harvesting and reforestation activities, and received International Organization for Standardisation (ISO) 9001 certification a year later. The two main components of FOMP are:

- Forest Operations Monitoring (FOM), under which field inspections of timber harvesting and reforestation activities are conducted to ensure they are in compliance with plans and regulations, and
- Silviculture - ARIS Monitoring (SAM), under which observations from AAF field assessments and the disposition holder's plan are compared to sample records from the Alberta Regeneration Information System—ARIS (the database used to track whether harvest areas are transitioning to the listed cover group and density that existed at the time of harvest).

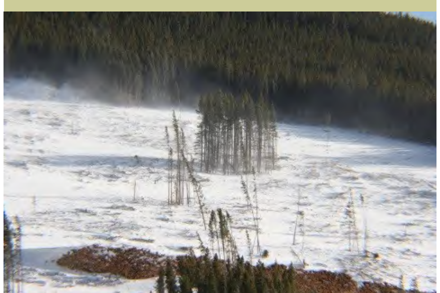
The tables below show the results of FOMP and SAM inspections conducted each year during the stewardship reporting period. Reforestation information is available in objective 28 of this report. Cover group and seral stage distribution will be assessed at the next TSA run and reporting will be done under Objective 1.

The **Forest Operations Monitoring Program** (FOMP) addresses numerous objectives within the C5 Forest Management Plan. Sections of the FOMP findings table can be found throughout this document.

Objective 14



Active timber harvesting in the C5 FMU.



An example of stand structure that is retained during timber harvesting (in this instance, a clump of trees).

Table 14.1 FOMP Inspection Summary					
Year	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**
Number of Inspections (Harvesting/Active Reforestation)	27	26	39	57	69
Final Clearance	2	3	14	1	1
No variances	17	21	36	46	57
Variance found	10	5	3	7	12

Table 14.2 FOMP Inspection Variances					
	Number of findings and action taken				
FOMP Category	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**
Riparian	0	0	0	0	1
Watercourse	1	0	0	0	1
Roads	1	0	2	3	4
Utilization	2	3	0	1	4
Soils	1	0	0	0	0
Forest Protection	2	0	1	0	0
Structure	0	0	0	3	0
Integration	3	0	0	0	2
Camps	0	0	0	0	0
Reforestation	0	2	0	0	0
Operating Year Totals>	10	5	3	7	12
Follow up with Company*	10	5	3	7	12
Forest Management Enforcement Incident Reporting					
Enforcement expired	**0**	**0**	**1**	**1**	**1**
Enforcement Warning Letter	**0**	**0**	**0**	**1**	**1**
Enforcement Penalty**	**3**	**0**	**0**	**0**	**0**

*Most variances detected by the FOM and SAM programs were dealt with in a collaborative fashion between license holders and AAF. This approach serves to mitigate or eliminate developing issues as well as educate license holders and reduce future variances.

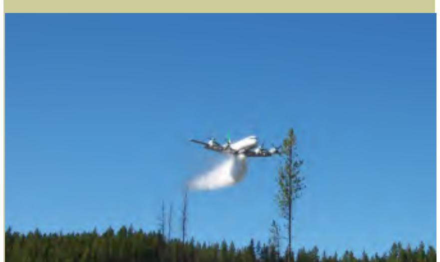
**Three incidents of enforcement penalties were administered in the C5 FMU during the reporting period. All three incidents were related to variances found before the start of the reporting period for this Stewardship document and are therefore not included in the variance portion of the table above but are identified in the Enforcement Reporting. One 'integration' variance of the 2014/15 operating year identified above received an enforcement penalty however this occurred after the reporting period.

Objective 14

Table 14.3 Target Number of Blocks to be FOM Inspected Compared to Actual Number of Blocks Checked							
Year	2010/11	2011/12	2012/13	2013/14	2014/15	Total	% Completed Target
Target number of blocks/ treatments to be inspected	10	16	21	13	17	77	-
Number of blocks/treatments checked	21	20	16	21	32	110	142.9

Table 14.4 Target Number of Blocks to be SAM Inspected Compared to Actual Number of Blocks Checked							
Year	2010/11	2011/12	2012/13	2013/14	2014/15	Total	% Completed Target
Target number of blocks/ treatments to be inspected	20	12	18	25	19	94	100%
Number of blocks/treatments checked	20	12	18	25	19	94	100%

Objective 15



2.1.2 Minimize losses to human life, communities, soil, watersheds, natural resources, and infrastructure from wildfire.

Performance Measures:

1. percent reduction in extreme and high Fire Behaviour Potential area within the FireSmart Community Zone
2. percent reduction in extreme and high Fire Behaviour Potential area across the entire FMU
3. number and area of FireSmart projects completed (FMB)
4. number and area of wildfires controlled

One of AAF's mandates within the C5 FMU is the suppression of wildfires to protect values-at-risk including human lives, communities, sensitive watersheds and soils, natural resources and infrastructure. Over the 2010 to 2015 stewardship reporting period, 514 wildfires totalling 6 ha were suppressed within the C5 FMU. The majority of these fires were Class A fires (under 0.1 hectares in size). Another AAF requirement under the FireSmart program the removal of harvest debris piles within a 10-kilometre zone around communities. Piles in this zone demonstrate a strong correlation with (increased) fire intensity and the movement or spread of wildfire.

Table 15.1 Annual number and cause of wildfires in C5 FMU

Year	Cause	Number	Area (ha)
2010	Human	72	0.81
	Lightning	2	0.11
Total		**74**	**0.92**
2011	Human	68	0.68
	Lightning	3	0.22
Total		**71**	**0.9**
2012	Human	123	1.32
Total		**123**	**1.32**
2013	Human	130	1.54
Total		**130**	**1.54**
2014	Human	112	1.19
	Lightning	2	0.11
	Under Investigation	2	0.02
Total		**116**	**1.32**
Total human-caused fires		**505**	**5.54**
Total lightning fires		**7**	**0.44**
Other		**2**	**0.02**
Grand Total		**514**	**6**

Table 15.2 Number of Wildfires by Class

Year	Class A	Class B	Class C	Class D	Class E
2010	74	0	0	0	0
2011	70	1	0	0	0
2012	123	0	0	0	0
2013	129	1	0	0	0
2014	116	0	0	0	0
Total	**512**	**2**	**0**	**0**	**0**

Objective 15


CL-215 Airtanker


Prescribed burning of grassland.

Fire Behaviour Potential is defined as the manner in which fuel ignites, flame develops, and fire spreads and exhibits other related phenomena as determined by the interaction of fuel, weather, and topography.

FireSmart planning increases the ability to successfully balance the efficient protection of values-at-risk with the positive ecological impacts of wildfire by considering various factors including:

- access management
- suppression capability
- fuel management
- harvest and silviculture sequencing, design, and layout
- risk management
- use of prescribed fire to enhance post-fire habitats and the health, structure, and integrity of forests
- wildland/urban interface initiatives
- communication, education, training
- identification and enhancement or creation of barriers to fire spread
- planning with uncertainty
- fire behavior potential
- fire occurrence risk
- values at risk
- regeneration strategies
- slash, grass, and debris management

Three zones have been delineated for the purposes of FireSmart planning:
(1) Wildland Urban Interface Zone – encompasses the area where infrastructure and human developments meet or are interspersed with combustible vegetation
(2) Community Zone – generally comprises a 10-km radius around a given community extending out from the Wildland Urban Interface Zone
(3) Landscape Zone – extends beyond the Community Zone, often on overlapping multiple jurisdictions at a broad landscape level, and focusses on mitigating the likelihood of large, high-intensity, high-severity fires.

FireSmart planning and initiatives are ongoing within the Crowsnest Pass Community Zone, the Castle Community Zone and within the larger C5 landscape. Over the reporting period, 300 hectares of FireSmart projects were completed. In the Crowsnest Pass Community Zone, 297 hectares of mechanical harvesting (cutblocks) took place. Approximately 3 hectares of thinning was conducted in the Castle Community Zone. As well, a significant amount of harvesting occurred in the Crowsnest Pass Community zone immediately prior to this reporting period.

Table 15.3 C5 Completed FireSmart Projects

Year	Area (ha)	Type
2010	-	-
2011	296.8	Fuel removal, mechanical harvesting
2012	3.2	Fuel reduction, thinning
2013	-	-
2014	-	-
Total	**300.0**	

At the landscape scale, a fire regime analysis was conducted for the C5 FMU (Appendix 10A in C5 FMP) and is being used in prescribed burn planning to achieve FireSmart objectives on the passive landbase. The use of prescribed fire is reported under Objective 20. Timber harvesting is the primary management activity used to achieve FireSmart objectives on the net productive landbase. The wildfire threat assessment (Appendix 10B of the C5 FMP) determined that the predicted harvest under the SHS would result in a decrease in the area of high or extreme fire behaviour potential across the C5 landscape and within the community zones.

Objective 16

2.1.3 Minimize the impacts of pests (i.e., insects and disease), which have the ability to kill healthy trees.

Performance Measures:

1. *hectares of trees killed each year by mountain pine beetle, spruce beetle, Douglas fir beetle, and other pests*
2. *insect and disease programs completed (number of programs, number trees in each program, and program area (FMB)*

Mountain pine beetle pitch tubes

Western spruce budworm damage

Insects and diseases that kill mature trees are a natural part of Alberta's forests and play an important role in forest ecosystem processes. Generally, weakened or old trees are targeted due to their increased susceptibility. Ecological factors such as host tree defenses and local climate typically limit the damage to healthy trees caused by native forest health agents. However, environmental changes such as climate change and the introduction of non-native forest health agents (with few natural controls) alter the ecosystem's vulnerability to insect or disease outbreaks. Active intervention through control measures may be deemed necessary to protect merchantable timber and native tree species within the C5 FMU.

AAF conducts annual forest health aerial surveys from late June to early September to detect and assess damaging agents. Ground surveys often follow to provide further information on the extent, severity, or causal agent. These data are compiled annually and maintained by AAF's Forest Health Section in Edmonton. Pest outbreaks may also be noted by the timber disposition holder when completing pre-harvest assessments, block layouts and silviculture surveys. Where necessary, adjustments can be made to Annual Operating Plans to help facilitate the use of control measures.

Annual summaries of insect and disease outbreaks within the C5 FMU and associated control programs are presented below. The C5 forest area experienced very low numbers of forest pests, including mountain pine beetle (MPB), over the reporting period and incurred almost no damage to forest resources. Mountain pine beetle numbers dropped precipitously in 2010,and have remained extremely low since. For perspective, in 2008 over 13,000 MPB infested trees were treated, in 2010 only four trees were located. No trees have been located or treated for mountain pine beetle since. Considerable areas of forest that were infested with western spruce budworm were located in 2010 and 2011 with the severity of infestation varying from light to heavy (not every single tree was damaged or killed). Western spruce budworm is endemic to the area and no control measure was sought. This outbreak subsided naturally by 2012.

Table 16.1. C5 Forest Pest Control Summary

	Mountain Pine Beetle		Douglas Fir Beetle		Western Spruce Budworm	
Year	Trees Located	Trees Treated	Area Located (ha)	Area Treated (ha)	Area Located (ha)	Area Treated (ha)
2010	4	0	0	0	2893	0
2011	0	0	1.4	0	6914	0
2012	0	0	0	0	0	0
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0

Objective 17

Dwarf mistletoe on lodgepole pine

Western gall rust on lodgepole pine

2.1.4 Maintain the long-term sustainability of the landbase by managing those forest health agents that can reduce growth, alter form, or kill trees after several years of infection/attack.

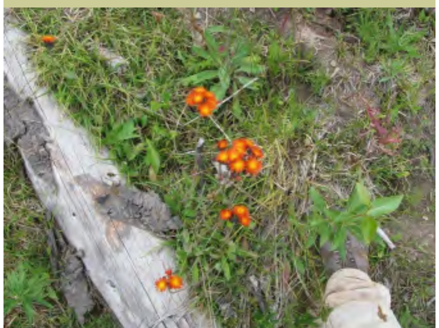
Performance Measures:

1. *change in forest health agent impacts before and after harvest to determine if pests are continuing to spread*
2. *insect and disease programs completed (see Objective 16 – FMB)*

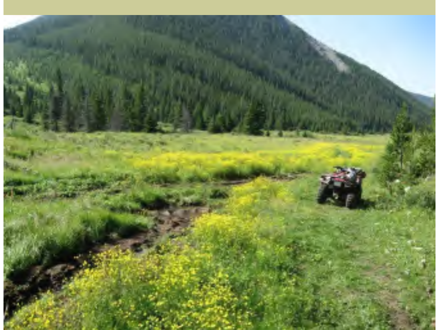
While some insect and disease outbreaks can occur as a widespread phenomenon and/or result in rapid tree decline and death, other forest health agents have localized, sub-lethal effects through growth loss and form damage and may only result in tree mortality after prolonged attack or infection. Examples include Armillaria root rot, dwarf mistletoe, or weed infestations that impede seedling establishment. These forest health agents are monitored as required through AAF's Forest Health program, and AAF works in conjunction with timber disposition holders to identify and implement appropriate management techniques to control the spread.

No active management of sub-lethal forest health agents occurred during the reporting period, with the exception of invasive plants (See objective 18). Agents such Armillaria root rot and dwarf mistletoe are present in the FMU but have not affected forest heath or timber values enough to warrant the resources required for active management. The Forest Health program documents such agents when they are encountered.

Objective 18


Orange hawkweed


Toadflax infestation


Tall buttercup infestation

2.1.5 Prevent the establishment of and control the spread of restricted and noxious weed species.

Performance Measures:

1. *area and severity of noxious and prohibited noxious weed infestations*
2. *number and area of noxious and prohibited noxious weed programs completed*

Noxious and prohibited noxious weed species are typically very adaptable, very aggressive, and have a high reproductive capacity (e.g., hawkweed, toadflax, oxeye daisy, Canada thistle). Failure to prevent such species from establishing can result in weed proliferation that has detrimental impacts on ecosystems including displacement of native, threatened, or endangered species, increased competition for native or desired species, hindrance of the successful reclamation of disturbed sites, delays in forest succession, and alteration of wildlife habitat. The control or eradication of noxious and prohibited noxious weeds within forested areas is regulated by Section 63 of the Public Lands Act, Section 31 of the Weed Control Act, and Directive 2001-06: Weed Management in Forestry Operations.

Weed identification, monitoring, and control activities within the C5 FMU are primarily the responsibility of AAF as most of the land is "unoccupied". Disposition holders, including timber companies, have responsibility for the disturbances they create and subsequent weed management for the duration of the disposition. Although harvest blocks are not dispositions, timber companies share some responsibility with AAF for weed management in these blocks. Municipalities are responsible for areas under their jurisdiction (e.g., secondary road rights-of-way, gravel pits).

The C5 FMU area has some of the worst invasive plant infestations in the province. The imminent threat of new species introductions from bordering jurisdictions (British Columbia and Montana) is always present. In 2012, invasive yellow hawkweed was discovered in the Lost Creek area. This prolific invader, which is estimated to cost British Columbia $13 million dollars annually, highlighted the issue of invasive plants and motivated AAF to allocate more resources to the Forest Health program to improve both survey and control measures. Specifically, Forest Health hired a full-time invasive plants technician in the area and increased funding for survey and control work. AAF has implemented invasive plant survey and control programs annually since the approval of the C5 FMP (see below table), investing over $400,000 to date. Unfortunately, up until 2013 data collection methods were not standardized. In 2014, a custom application was created for collecting invasive plant data on a tablet in the field; this will allow consistent data collection in future years. Pre-2014 data identifies whether an invasive plant species was present but no information was provided on its abundance, density or whether it was controlled. Post-2014 data will be much more robust and will include information on invasive plant species abundance, density, distribution, control measure and survey effort.

	Table 18.1. C5 Invasive Plant Survey and Control Expenditure					
Year	2010	2011	2012	2013	2014	Total
Cost	$36,000	$72,500	$58,000	$107,100	$127,400	$401,000

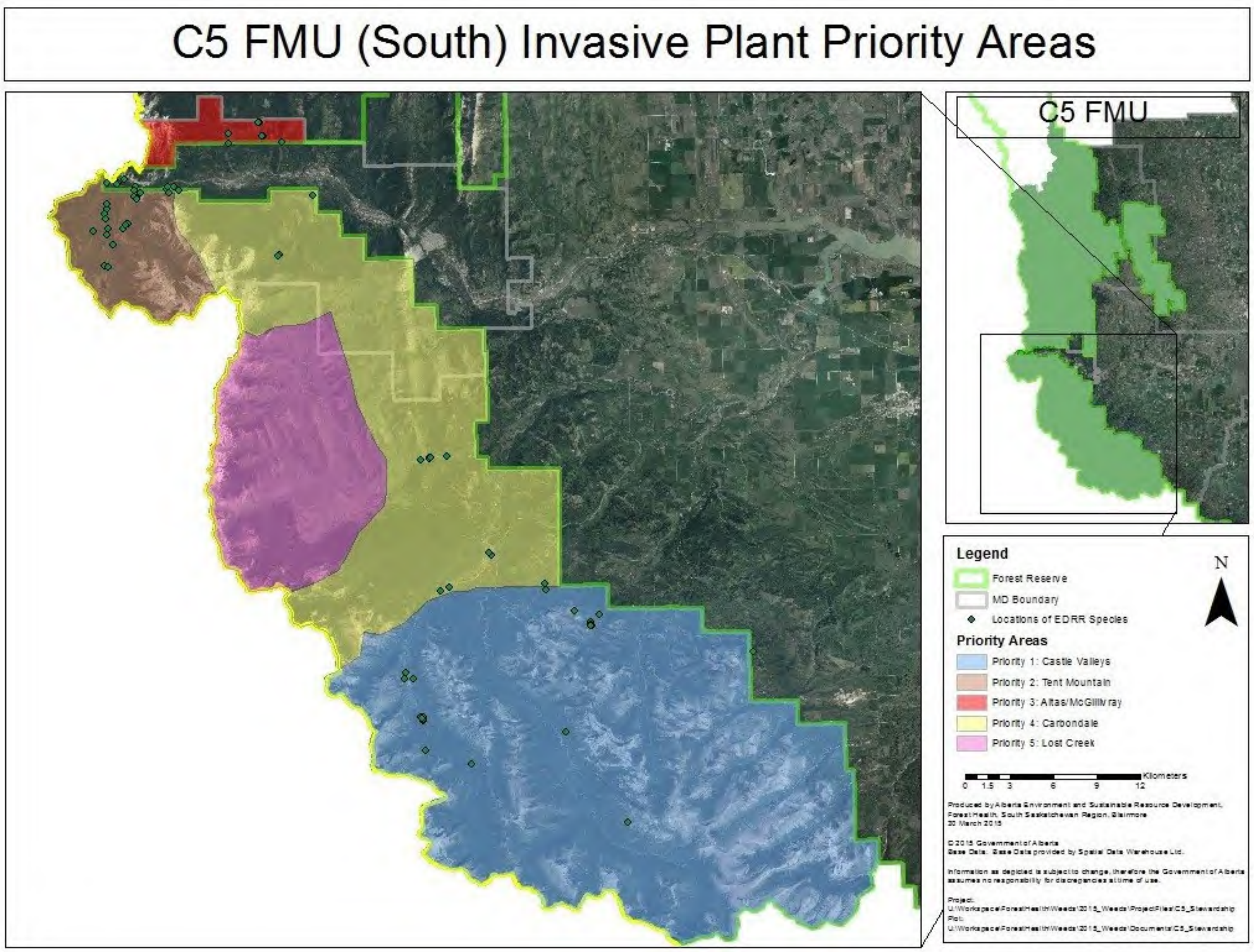
In 2014, $127,000 was allocated to contractors to survey and control invasive plants on 115 km of trails in the C5 FMU. Areas were prioritized so that available resources were being effectively used; areas with the fewest invasive plant infestations were targeted first and those with the worst infestations were targeted last. The strategy that was employed entailed the adoption of a perimeter approach around areas having major infestations with the aim to 'keep weed free areas clean'. Two specific successes from the 2014 season were the discovery of field bindweed (Convolvulus arvensis), a Noxious species, not previously observed in the area, and a previously undetected patch of spotted knapweed (Centaurea stoebe), a particularly aggressive Prohibited Noxious species. Both of these species were treated and the sites will be monitored in future years.

Objective 18

During the 2015 season staff prioritized 5 areas having invasive plant species (see map below). Of particular note are the areas prioritized as 'Early Detection Rapid Response' (EDRR). These areas contain eradicable species that are currently present at low densities but which pose a high risk to the ecosystem and the economy. Detecting and controlling invasive species at an early stage in the invasion cycle is known to be an effective means for managing these plants. Nine species fall within the EDRR category within the C5 FMU and all previous known locations of these plants will be monitored in future years.

Figure 18.1. C5 Invasive Plant Priority Areas

The next priority was the survey and control of invasive plants at all designated and undesignated staging areas. These are high traffic areas where the likelihood of plant spread is high. Another priority was surveying and controlling invasive plants along off-highway vehicle, hiking and equestrian trails within the C5 FMU, working from the perimeter of the Lost Creek Fire area inward through the different invasive plant management areas.



Objective 18

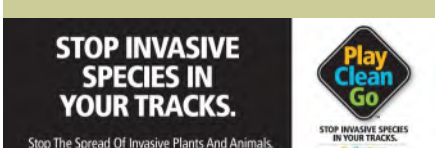
Communicating with neighboring jurisdictions is a key component of the C5 invasive plant management strategy. Within the C5 FMU, AAF has initiated a working group of stakeholders that includes the Municipality of Crowsnest Pass, the MD of Ranchland, MD of Pincher Creek, MD of Willow Creek, Cardston County, Glacier County (Montana), the East Kootenay Invasive Plant Council (British Columbia), Parks Canada and Alberta Parks Division. This working group will be holding annual workshops for land managers (including forest industry and AAF Forest Officers) in the region. Workshops will address prevention strategies, invasive plant control and management, early detection, and site reclamation. Communication with disposition holders is also seen to be important.

A staff member from AAF's Forest Health will also attend pre-layout meetings with timber-disposition holders. At these meetings timber-disposition holders will be made aware of previous invasive plant infestations and will be informed of best management practices, (e.g., washing machinery before entry).

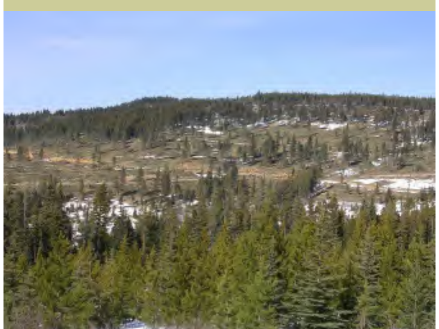
In an effort to promote public awareness about the impacts of invasive plants, Forest Health Branch (along with the Alberta Invasive Species Council and various municipalities) has adopted the 'Play Clean Go' campaign. This is an education and outreach campaign that was developed in the United States to showcase best management practices that all user groups can use to help prevent the spread of invasive species.

Spotted Knapweed

Leafy Spurge



Objective 19



Views of the Porcupine Hills semi-uniform shelterwood harvesting trial.

2.1.6 Incorporate new research findings or recommendations (where applicable) into future forest management strategies and practices that are responsive to climatic and environmental factors and large disturbance events.

Performance Measure:

- *summary of ongoing or completed research projects*

The ability to regenerate forests following timber harvesting depends not only on soil conditions and silviculture practices but also on climatic variables (e.g., precipitation, temperature, atmospheric composition), physical stresses (e.g., moisture deficit, heat load, frost, fire, flood) and biotic stresses (e.g., insects, pathogens, competitive interaction). To promote resistant and resilient forests which are able to adapt to dynamic conditions requires the inclusion of those practices that retain landscape and stand level structure, mitigates harvest effects on stream and riparian habitats, maintains biodiversity, and increase timely regeneration of disturbed habitats. Any harvest and silviculture systems implemented within the C5 FMU must further address specific tree species requirements and local climate or microclimate conditions that vary spatially across this landscape (e.g., extreme temperature fluctuation, aridity/drought, heavy snow accumulations, Chinook winds, high rainfall, etc.)

Appendix 9B in the C5 FMP presents a strategy entitled Porcupine Hills Harvesting and Silviculture Strategies: Minimizing the Risks to Successful Regeneration of Cutovers that identifies harvesting and silviculture practices which are most likely to result in successful reforestation of Douglas-fir in the Porcupine Hills. A subsequent operational trial in the Porcupine Hills employed a semi-uniform shelterwood system on a 5 ha harvest area where the volume or number of trees left standing was higher than a typical harvest block with residual wildlife or seed trees, and the residual stems were spread throughout the harvest area rather than grouped as patches. The residual trees will provide both a seed source and shelter (i.e., modification of micro/mesoclimate) for the regenerating stand. Regeneration surveys will ultimately provide data on the protective benefits of this shelterwood system in Douglas-fir regeneration relative to traditional harvesting practices.

The Southern Rockies Watershed Project - Phase I provided information on how disturbances such as wildfire (i.e., 2003 Lost Creek Fire) and the associated salvage logging affected a range of watershed values and their immediate recovery post-disturbance. Phase II of the project is currently examining how different harvesting strategies impact hydrology within the previously un-harvested watersheds (see Objective 24 of this report for more details on the Southern Rockies Watershed Project). New research or modelling work and associated changes in management strategies will be incorporated in the next C5 Forest Management Plan.

Objective 20

A **prescribed burn** is defined as the deliberate use of fire within a specific land area to accomplish predetermined forest management or other land use objectives, usually set by qualified fire management personnel according to a predetermined burning prescription.

Prescribed burn in the Calgary wildfire management area.

2.1.7 Use prescribed fire for achieving forest protection, forest productivity, forest health and biodiversity objectives.

Performance Measures:

1. *area of non-active landbase treated (as % of the FMU and the C5 subregion)*
2. *number of prescribed fires, area burned, and rationale*
3. *number and area of FireSmart projects completed (see also Obj 15) (FMB)*

Although timber harvest is the primary forest management technique applied within the active landbase of the C5 FMU, prescribed burns represent an additional management tool that can be used on the full landbase to achieve other objectives (e.g., community protection, improved forest health, enhanced biodiversity, ecological restoration, research on hazard reduction). Depending on the particular objectives and location, prescribed burns in Alberta are often implemented through partnerships between AAF, AEP, Alberta Conservation Association, or Parks Canada. Strong, shifting, and unpredictable winds coupled with an even-aged forest limit the safe and successful use of prescribed fires in the C5 FMU. Meeting the proper criteria outlined in a burn prescription is frequently difficult due to the lack of disturbance, age class distribution, and natural breaks in forest cover. For this reason, AAF's Wildfire Management Branch continues to work with local timber disposition holders at the harvest block design stage to create key breaks in the forest cover that will serve as fire guards and anchor points in future prescribed burn operations.

A summary of prescribed burns conducted over the 2010 to 2015 reporting period is presented below. The area of identified "high" and "extreme hazard" stands receiving fire treatment on the non-active landbase will be analyzed at the FMP's 10-yr interval.

Table 20.1 Annual C5 Prescribed Burns

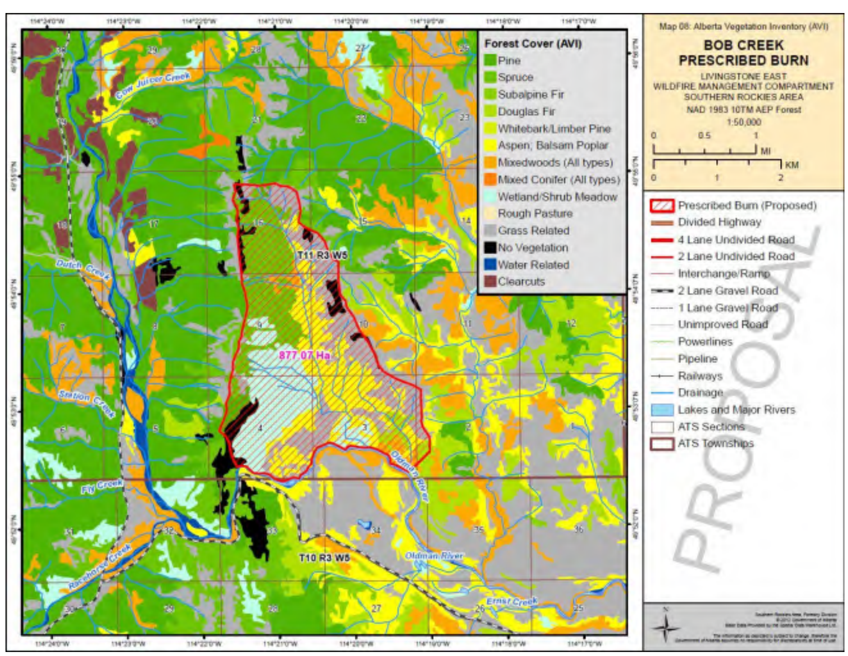
Year	# of projects	Area burned (ha)	Rationale
2010	1	44.03	West Castle Mtn-Fuel management,
2011	1	32.78	Lyndon Ck-Range, wildlife habitat management
2012	1	199.13	Lyndon Ck-Range, wildlife habitat management
2013	0	0	-
2014	0	0	-
Total	**3**	**275.93**	-

Objective 20

Below is a list of planned prescribed burns in the C5 FMU, intended to meet a range of goals from wildfire hazard management to habitat improvement. These projects will be undertaken when conditions permit and adequate resources are available to conduct the burn safely and effectively.

Figure 20.1. Map of the planned Bob Creek prescribed burn.

Table 20.2. Planned C5 FMU Prescribed Burns				
Project Name	**Location**	**Area**	**Fuel Type**	**Purpose**
Bathing Lake	SED	86.6	Deciduous (D1)	Vegetation management. Limit aspen encroachment and improve ungulate habitat.
Beaver Creek	PBC1	1.1	Grass (O1)	Fire hazard reduction in popular random camping area.
Bob Creek	WLO	877.1	Mixed	Rangeland management. Reduce aspen encroachment, improve/ restore rangeland ecosystems.
Caesars Flats	MID2	8.8	Grass (O1)	Fire hazard reduction in popular random camping area.
Porcupine Hills LO	PLO2	1	Grass (O1)	Fire hazard reduction around Porcupine Lookout and fuel cache.
Racehorse Creek	MIR2	6.7	Grass (O1)	Fire hazard reduction burn in area with high incidence of human-caused fires.
West Castle	CWW	60.0	Coniferous (C2, C3)	Fire hazard reduction burn to protect high value resources at Castle Mountain Resort.
Yarrow Creek	SFRD	260.0	Coniferous (C2, C3)	Wildlife habitat and range improvement, specifi-
Total		**1301.3**		



Conservation of Soil and Water Resources

Objective 21

3.1.1 Conserve soil and organic matter, and maintain soil productivity.

Performance Measures:

1. *number of compliance issues related to soils*
2. *Course woody debris*

Soils – a crucial medium for the growth and development of forest vegetation – are complex, dynamic systems that have physical and chemical properties. Features such as rooting depth, bulk density, moisture retention, texture, structure, nutrients, and pH interact to form unique soils that vary spatially and temporally throughout the C5 forest management area. Soil disturbance by heavy equipment can easily impact future soil productivity. Given the wide variety of soil types and conditions that exist and the fact that soil productivity is a key component in the sustainability of forest ecosystems, timber disposition holders must adhere to practices that minimize soil displacement, compaction or rutting during road construction, harvesting, and silviculture operations. The conservation of coarse woody debris on-site is also important as the organic matter from decomposing debris contributes critical nutrients necessary for soil composition and ultimately for stand development. Processes such as Operating Ground Rules(OGR) and the Forest Operations Monitoring Program (FOMP) are in place to ensure that site degradation does not occur and, if it does, that prompt remedial actions are taken where possible.

The Spray Lake Sawmills and C05 FMU Timber Harvest Planning and Operating Ground Rules provide guidelines to protect soils during pre-harvest activity, harvesting operations, and the post-harvest reforestation period, to minimize displacement of forest floor materials and limit mineral soil exposure, to ensure logging debris is left on-site where feasible, and to prevent soil, debris, and deleterious materials from entering watercourses. Annual Operating Plans are developed in accordance with the Operating Ground Rules and upon approval by AAF they authorize harvest activity. Between 2010 and 2015, fifty Annual Operating Plans were approved.

Field inspections, which occur under the Forest Operations Monitoring Program (FOMP), ensure compliance with the soil protection measures outlined in the OGRs. Two FOMP findings occurred related to soils during the reporting period (See table 14.2). Soil erosion is also associated with additional FOMP categories such as reforestation, road construction, riparian buffers, and watercourse crossings. Inspection findings in these categories are addressed in subsequent C5 FMP objectives.

Objective 21

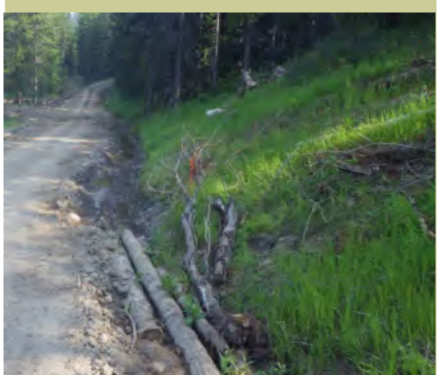
Example of coarse woody debris greater than 7.5cm diameter

The amount of coarse woody debris >7.5cm diameter remaining on-site following timber harvesting is typically assessed visually by the timber disposition holder. As the practice of stump-side processing ensures significant debris remains scattered throughout the harvest area, insufficient debris relative to pre-harvest conditions is rarely a problem. In fact, the retention of coarse woody debris to mitigate soil erosion, increase nutrient input, and provide protected seedling establishment sites must be balanced with its risk as potential fuel during a wildfire. Improvements could be made to develop an effective, consistent method of assessing, recoding and reporting coarse woody debris levels to ensure that they meet pre-harvest levels.

Stump-side processing leaves ample coarse woody debris in harvested areas

Objective 22


Road reclamation and re-contouring


Cut-slope stabilization measures used by a disposition holder to prevent erosion (hydroseeding, debris placement, native vegetation staking)

3.1.2 Minimize soil erosion and slope failure.

Performance Measures:

1. *number of compliance issues*
2. *erosion control and reclamation strategies identified.*

Forest cover, understory vegetation and ground litter generally counter erosional processes in mountainous landscapes. Accelerated natural erosion is triggered by relatively rare events such as wildfires and prolonged or intense storms. The construction of access roads associated with timber harvesting operations pose the highest risks for sediment production.

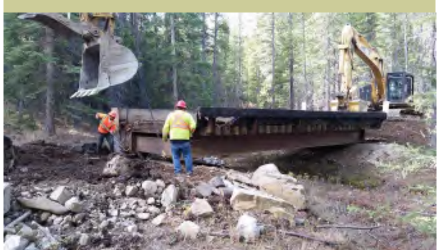
Surface erosion (i.e., the movement of individual soil particles) depends on the extent, continuity, and cohesion of bared soil surfaces and can be accelerated by disturbances that expose mineral soil such as wildfire and logging or the disruption of natural drainage patterns due to skid trails, log processing sites and roads. Mass erosion events (i.e., downslope movement of soil and parent material) depend in large part on the geologic parent material and are especially susceptible to human disturbance factors such as road fill failures or drainage diversions. Both surface and mass erosion events may be triggered by heavy rainfall or rapid snowmelt that creates saturated soils. This occurred in the spring of 2013 and 2014 and notable challenges with road structures were noted in the Porcupine hills.

Avoidance of unstable soils during road planning and the minimization of disturbance area represent the most effective approach to prevent soil erosion issues. Timber disposition holders in the C5 FMU consider strategies to minimize the impacts of their required access and harvest block road network during the planning process in the General Development Plan, Annual Operating Plan, Forest Harvest Plan, block layout plan, road maintenance and abandonment plan, etc. Annual Operating Plans detail erosion control and reclamation strategies, while detailed harvest area plans (which among other things assess slope stability) are required for harvest areas having a sustained slope of greater than 45%. Timber disposition holders must self-report erosion or slope failure events, implement remedial plans and monitor the success of these actions.

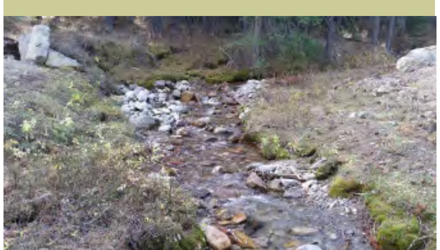
Numerous OGRs detailed in Spray Lake Sawmills and C05 FMU Timber Harvest Planning and Operating Ground Rules are intended to prevent soil, debris, and deleterious materials from entering watercourses. Compliance with OGRs is assessed through FOMP inspections. FOMP data show few (only 2) issues related to soils over the entire reporting period (see table 14.2).

Objective 23

Temporary bridge with silt fencing.



Temporary bridge being removed during class 4 road reclamation



Same watercourse as above, immediately after bridge removal. Bank structure and vegetation undisturbed.

For more information on FOMP inspection categories, refer to Objective 14.

3.2.1 To ensure that all forest industry practices are conducted in a manner that places a priority on the protection of water resources.

Performance Measures:

1. *compliance with regulations/standards/policies pertaining to road construction and maintenance, stream crossings, and buffer retention, i.e., number of compliance issues (FMB)*
2. *adverse changes to fish habitat*

Increasing demand, the full allocation of water within the Oldman River basin through water licenses, an unpredictable water supply and the potential impacts of climate change make water a critically important natural resource in southern Alberta. As the C5 FMU encompasses the headwaters of a substantial portion of the South Saskatchewan River basin, forest management activities must be conducted using the best management practices possible to maintain long-term water supply and quality.

Forestry companies operating in Alberta must comply with all federal and provincial regulations related to watercourse protection. This includes the federal Fisheries Act, the Alberta Water Act, the Alberta Watercourse Crossing Code of Practice, the provincial Timber Harvest Planning and Operating Ground Rules as well as all regional operating ground rules (i.e., Spray Lake Sawmills and C05 FMU Timber Harvest Planning and Operating Ground Rules). Section 6 of the regional OGRs defines stream classes and identifies operating practices to protect water quality and riparian values. The OGRs promote a coarse filter approach to watercourse protection that manages the impacts of forest operations on water quality, quantity, and flow regime by:

- minimizing the potential for sedimentation in watercourses
- preventing soil, logging debris, and deleterious substances from entering watercourses
- maintaining aquatic and terrestrial habitat
- ensuring compliance with the Water Act

Forest Harvest Plans and AOPs contain more detailed information on harvest design and access. Roads, watercourse crossings, and riparian buffers are carefully considered and these plans are reviewed in order to minimize the impacts on water resources. Timber harvest operators are required to conduct an annual watercourse crossing inspection program that monitors and documents the current condition, repair requirements, and removal date for all crossing structures. Prompt reforestation also plays a key role in reducing the effect of logging operations on watercourses. The application of proper silviculture techniques ensures soil stability and hydrological recovery.

The Forest Operations Monitoring Program examines compliance with OGRs and AOPs. FOMP inspections address several different categories that relate to watershed protection including riparian buffers, watercourse crossings, roads, and reforestation. When a FOMP inspection identifies a variance, the disposition holder is immediately notified and steps to correct the variance are reviewed and implemented. If variances are found to be significant, AAF may pursue enforcement actions depending on the type and/or severity of the variance.

Objective 23

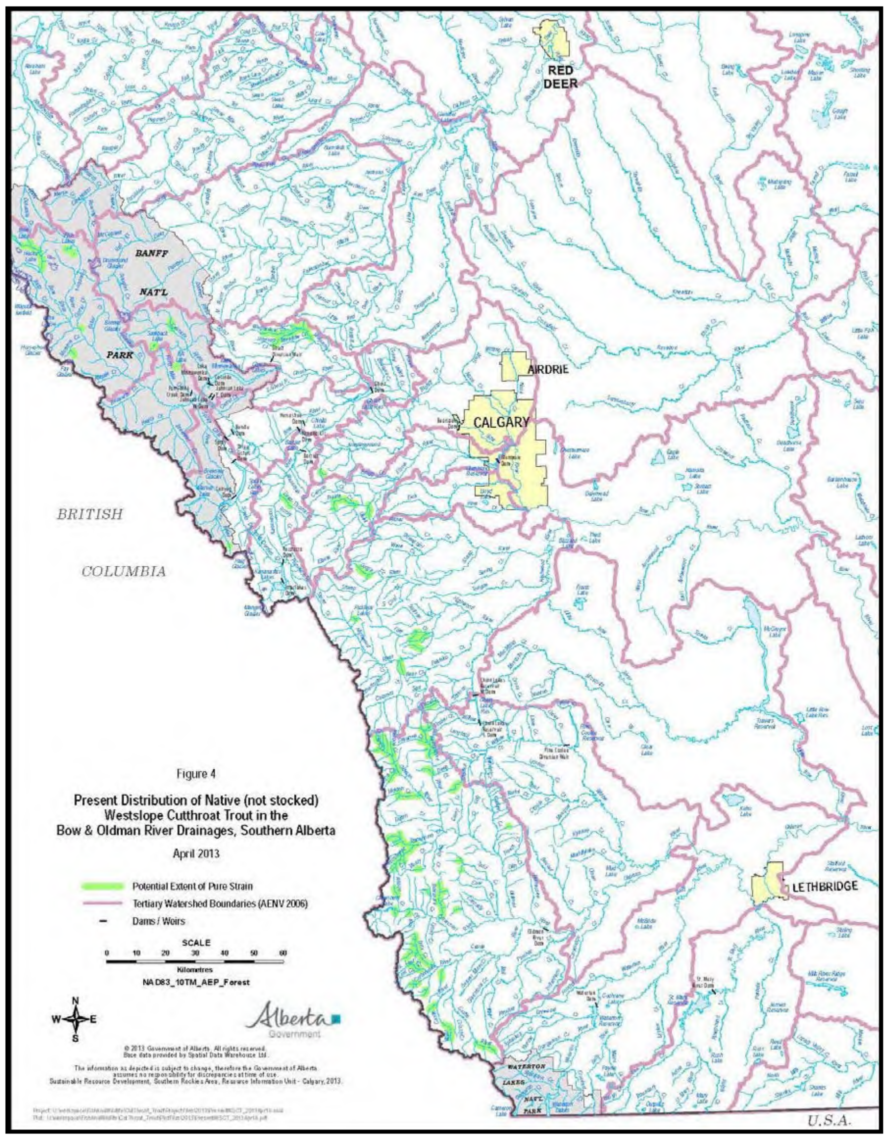
Native timber bridge constructed in

the C5 FMU.

Six watercourse issues were detected by the FOMP program over the course of the reporting period (See table 14. 2). This represents the greatest number of incidents in any FOMP category during the reporting period and thus is an area of concern. Vigilance by AAF staff that conduct field inspections along with the ongoing education of disposition holders and equipment operators is required to maintain the integrity of natural watercourses.

Fish habitat monitoring provides a complementary fine filter management approach for assessing drainage systems and water quality. Any change to the integrity of aquatic environments has the potential to affect fish and fish habitat. Alberta fisheries biologists are continually updating fish habitat distribution inventories, particularly for west slope cutthroat trout and bull trout (see below map). Fish species distribution mapping and aquatic assessments are enabling resource managers to better evaluate the affects of disturbance activities on fish habitat. The ability to directly measure trends in the quantity or quality of fish habitat over large spatial scales such as the C5 FMU, at five-year intervals, simply doesn't exist at this time.

Figure 23.1 2013 distribution of native west slope cutthroat trout in southern Alberta.



Objective 24

For more information on **ECA Alberta** and **WRENSS** watershed models refer to Appendix 6C of the C5 Forest Management Plan.

3.2.2 Manage forest cover in a manner that places a priority on the conservation and protection of watersheds.

Performance Measures:

1. *effective disturbance area (as expressed in ECA Alberta)*
2. *compliance with stream crossing requirements*
3. *integrity of water source areas, watercourses, and water bodies*

While ground rules and monitoring are effective tools used in protecting watercourses, they are limited in their spatial and temporal capacity. Broader landscape planning is needed to ensure sensitive areas are avoided and that watersheds in the entire C5 Forest Management Unit receive the least impact possible over the long term. The South Saskatchewan Regional Plan, and subsequent water-focused sub-regional plans that will be prepared in the future, will make significant contributions to protecting watersheds.

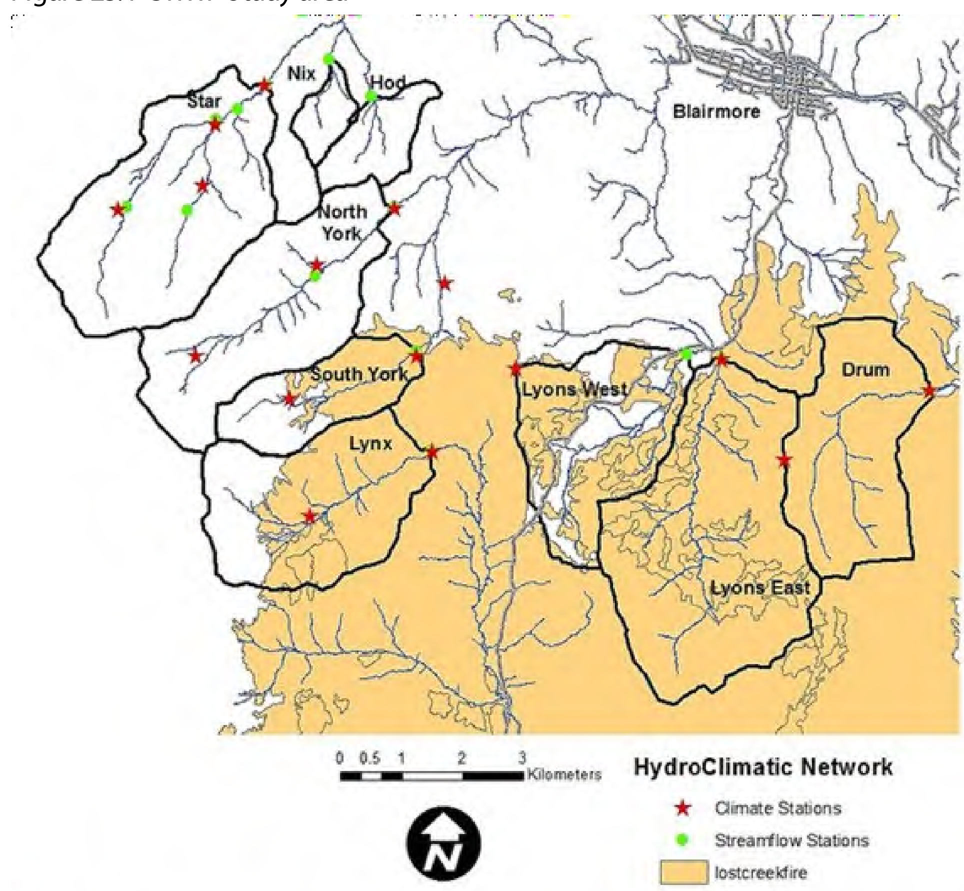
The Spatial Harvest Sequence (SHS) is a tool used in forest management to identify economically and ecologically sustainable harvest areas over time. The creation of the SHS is a complex process requiring multiple models, parameters, and assumptions to identify harvestable areas within ten-year periods. (For more information on how the SHS is created, and the parameters, assumptions, and models used, see Appendices 6A and 6B of the C5 FMP.) Some parameters used in the creation of the SHS limit harvestable polygons to areas where harvesting will cause the least hydrological impact. To test the effect the SHS would have on large scale watersheds, an Equivalent Clearcut Area watershed analysis (ECA Alberta, Silins 2000) was performed. The analysis confirmed that forecasted harvest levels in the SHS will not produce significant flow increases. A more detailed model called Water Resource Valuation of Non-point Silviculture Sources – Alberta (WRENSS-AB; Swanson 2000) was also performed on seven small sub-basins: this model found that projected water yield increases for Allison Creek, Blairmore Creek, Crowsnest Creek, McGillivray Creek, Pelletier Creek, Star Creek, and York Creek were very low if future timber harvesting followed the SHS.

While the SHS is a valuable tool in minimizing logging impacts on watersheds, it needs to be augmented by field assessments. A Forest Harvest Plan (FHP) is the output of ground surveys performed on a harvestable area identified in the SHS. FHPs are site-specific whereas the SHS, Annual Operating Plans, and General Development Plans focus on broader landscape-based goals and objectives. FHPs primarily consist of a map and report that identify harvest boundaries, roads, and watercourse crossings. The FHP follows the SHS as closely as possible but variance is allowed to account for inventory anomalies, operational constraints, excessive slopes, or a reduction in the access footprint. Any variances from the SHS are recorded as deletions, deferrals, or additions. When the total FHP area is divided by the planned SHS area, the resulting figure gives the degree to which the spatial harvest sequence was followed. Timber disposition holders are allowed a 20% deviation from the SHS identified in the C5 FMP but additional alterations may be approved with justification. Over the last five years there was a 74% correspondence between the FHPs and the SHS. This exceeds the maximum variance permitted by the OGRs, but is in-line with provincial averages. See Obj. 1 for more information on variances to the SHS.

Southern Rockies Watershed Project (SRWP)

The Southern Rockies Watershed Project (SRWP) was established in response to the need for information on how disturbances such as wildfire and associated salvage logging affect a range of watershed values (Silins et al. 2009). The Lost Creek Fire in 2003 burned over 21,000 hectares of forest in the headwaters of the Oldman River basin. The fire burned for 26 days, and as a result of very dry conditions and high fuel loads, it consumed virtually all forest stands within the burn boundary (Silins et al. 2009). The objectives of the SRWP are to describe the immediate effect of this wildfire on the hydrology, water quality, and aquatic ecology of the disturbed watersheds and to assess early recovery in subsequent years.

Figure 23.1 SRWP study area



SRWP Study Area

Map of Southern Rockies Watershed Project study area.

In order to quantify the effect of the Lost Creek Fire on hydrology, seven watersheds were chosen and instrumented to enable both automated and manual hydrometric, water quality, and stream ecology monitoring (Silins et al. 2009). Three burned watersheds (Lynx, Drum, and South York Creeks), two post-fire salvage logged watersheds (Lyons West and Lyons East Creeks), and two unburned reference watersheds (Star and North York Creeks) were chosen for monitoring. Each watershed has been closely monitored since project establishment in March 2004 in order to calibrate each watershed and to determine the extent and duration of impact that the Lost Creek Fire and subsequent salvage logging are having on the watersheds.

To date, the initial phase of the SRWP has provided substantial information on the impacts of wildfire and salvage logging that was previously lacking. For example, increases in mean sediment, total nitrogen, and total phosphorous concentrations were evident following the fire, peaking in 2005 and declining in the following years. Salvage logging had further significant impacts on water quality, depending on the parameter measured. Publications resulting from this project are listed on the SRWP website at http://www.srwp.ualberta.ca/Publications. Forest managers can use this information in the future to better understand the effects of wildfire and salvage logging on water resources and make informed decisions on fire suppression priorities or managing salvage logging activities.

In phase two of the SRWP, a paired catchment study was undertaken to provide a comparative analysis on how different harvesting strategies are impacting hydrology within the watersheds. The two reference watersheds (Star and North York Creeks) from the first phase of SRWP provided a unique opportunity to assess change as the previous years of reference monitoring activity provided baseline, pre-disturbance data. Different disturbances (harvesting methods) were then applied to three sub-catchments of Star Creek, and the hydrological response was monitored for each disturbance. This second phase of the SRWP will provide data on the comparative effects of logging operations on hydrology and yield new information that will help resource managers identify alternative methods of harvesting that protect water resources in southwestern Alberta.

Alternative harvesting techniques used as a part of Southern Rockies Watershed Project

The Government of Alberta realizes the need for projects such as Southern Rockies Watershed Project and will continue to support such research projects in the future. The data and research findings that are obtained will help resource managers make informed decisions when selecting forest management strategies in the future.

References

Silins, U., K.D. Bladon, A. Anderson,J. Diiwu, M.B. Emelko, M. Stone, and S. Boon. (2009). Alberta's Southern Rockies Watershed Project—How Wildfire and Salvage Logging Affect Water Quality and Aquatic Ecology. Streamline, Volume 12, Issue 2, 1-7

Swanson, R.H. 2000. WrnsSdr User's Manual, Using and Applying the USEPA WRENSS hydrologic procedures for all snow dominated regions of Canada. Peak flow analyses applicable to the Athabasca, North, and South Saskatchewan Riversheds of Western Alberta. Version 1.021.1, Swanson Hydrology Consultant, Canmore, AB.

UNIVERSITY OF ALBERTA

Southern Rockies Watershed Project http://srwp.ualberta.ca/Research-Areas

Global Ecological Cycles

Objective 25

At the end of this process our conclusion is that while many Albertans are ready and willing to be a part of a greener future many also remain uncertain about what the future holds and the trade-offs implicit in carbon policy.

Alberta's Climate Change Advisory Panel Nov. 20, 2015

Alberta Climate Leadership Plan: https://www.alberta.ca/climate-leadership-plan.aspx

4.1.1 Adopt and implement provincial carbon protocols as they are developed.

In January 2008 the Government of Alberta released a Climate Change Strategy, building on Alberta's 2002 Climate Change Action Plan. In 2015 the GoA commenced with the development of a revised strategy for addressing climate change that is based on recommendations put forward by a newly formed Climate Change Advisory Panel. On November 22, 2015 the GoA released a Climate Leadership Plan . For most current details go to https://www.alberta.ca/climate-leadership-plan.aspx .

Operational changes to forest management activities conducted on-site can reduce atmospheric CO_2 emissions. Forest management strategies can also contribute to carbon emission reduction. Between 2010 and 2015 the Government of Alberta conducted various mountain pine beetle programs and suppressed 514 wildfires. Taken together these activities (i.e., reductions in tree decay and death, and the suppression of forest fires) have reduced the release of carbon into the atmosphere. Effective timber management and rapid forest regeneration strategies can help reduce the C5 FMU carbon footprint by promoting a quick growing, healthy forest that accelerates carbon fixation through photosynthesis — enabling the forest to become a carbon sink rather than a carbon source.

AAF will continue to develop and implement forest management strategies that are aligned with current research on forest responses to climate change as well as with current provincial climate change policies and targets.

Objective 26

Table 26.1 Timber harvesting levels and the AAC

Reporting period summary of AAC vs. Total Timber Production (*Source: FMU C05 TPRR204*)						
Year	2010	2011	2012	2013	2014	Total
Total Timber production (m^3)	78,180	40,113	63,033	82,807	228,602	492,753
Annual Allowable cut (m^3)	209,414	209,414	209,414	209,414	197,226	1,034,882
Percent of AAC (%)	**37**	**19**	**30**	**40**	**116**	**48**

During the five-year reporting period annual harvested volumes were generally well below the AAC level (see Table 26.1 above). The exception was 2014, where the AAC was exceeded due to an approved over-allocation for the Community Timber Program (CTP). This type of exceedance of the AAC is permitted as long as the Quadrant Authorized Allowable Cut (QAAC) is not exceeded.

Over the five year reporting period, less than 50% of the allocated harvest volume was harvested in the C5 FMU. Unfavorable economic conditions and a long log-hauling distance to sawmills may have contributed to the relatively low cut levels in C5 FMU during most of the reporting period. It is surmised that certain criteria pertaining to the "desired future forest" may not be achieved if harvest levels continue to remain well below the target cut levels adopted in the C5 FMP. Negative consequences could include less young seral stages which would limit some species, increased biomass buildup hence increased wildfire risks (ignition and spread rate potential), and exceedance of old growth targets.

Benefits of Forests to Society

Objective 26

5.1.1 Maintain sustainable timber harvest levels; i.e., timber harvesting shall not exceed the forest's productive (renewal) capacity.

Performance Measures:

1. Amount of wood harvested in relation to the approved AAC on a quadrant basis.

AAF strives to manage provincial forests in a sustainable manner that provides ecological, economic and social benefits to present and future generations. Sustainable harvesting means that timber harvesting during a given quadrant (i.e., harvesting that occurs over a five-year period as established by the Province) does not exceed the cut limit that has been established in the approved annual allowable cut (AAC). The AAC is determined through AAF's Timber Supply Analysis and reflects direction that is contained in the C5 Forest Management Plan. If followed, the AAC will yield a continuous, sustainable supply of wood fibre in future years.

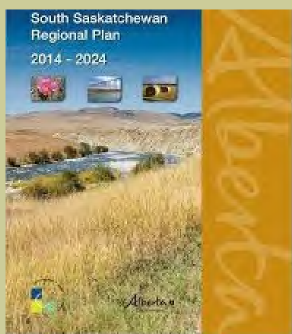
Setting timber harvest levels and the development of the spatial harvest sequence were, in the broadest sense, guided by the three pillars of sustainability that are mentioned above. Numerous factors were considered when determining the AAC (e.g., species at risk habitat requirements, riparian areas, wildlife buffers, terrain and slope considerations, etc.). Maximization of the AAC was sacrificed by the GoA to ensure that diverse forest values are protected and that the "desired future forest" is achieved.

The approved AAC for the C5 forest management unit was originally set at 209,414m^3. The AAC is tracked yearly and is periodically adjusted. In the past the AAC has been altered in response to new information or in response to large disturbance events that have occurred in the forest. For example, when the SSRP was approved in September 2014, the net landbase in the C5 FMU was reduced by 5.82% due to conservation and recreation area land withdrawals. The AAC was reduced by a corresponding 5.82% (i.e., to 197,226m^3) to ensure that timber harvesting would remain sustainable.

Dutch Creek timber harvest landscape

Regenerating cutblock in the C5

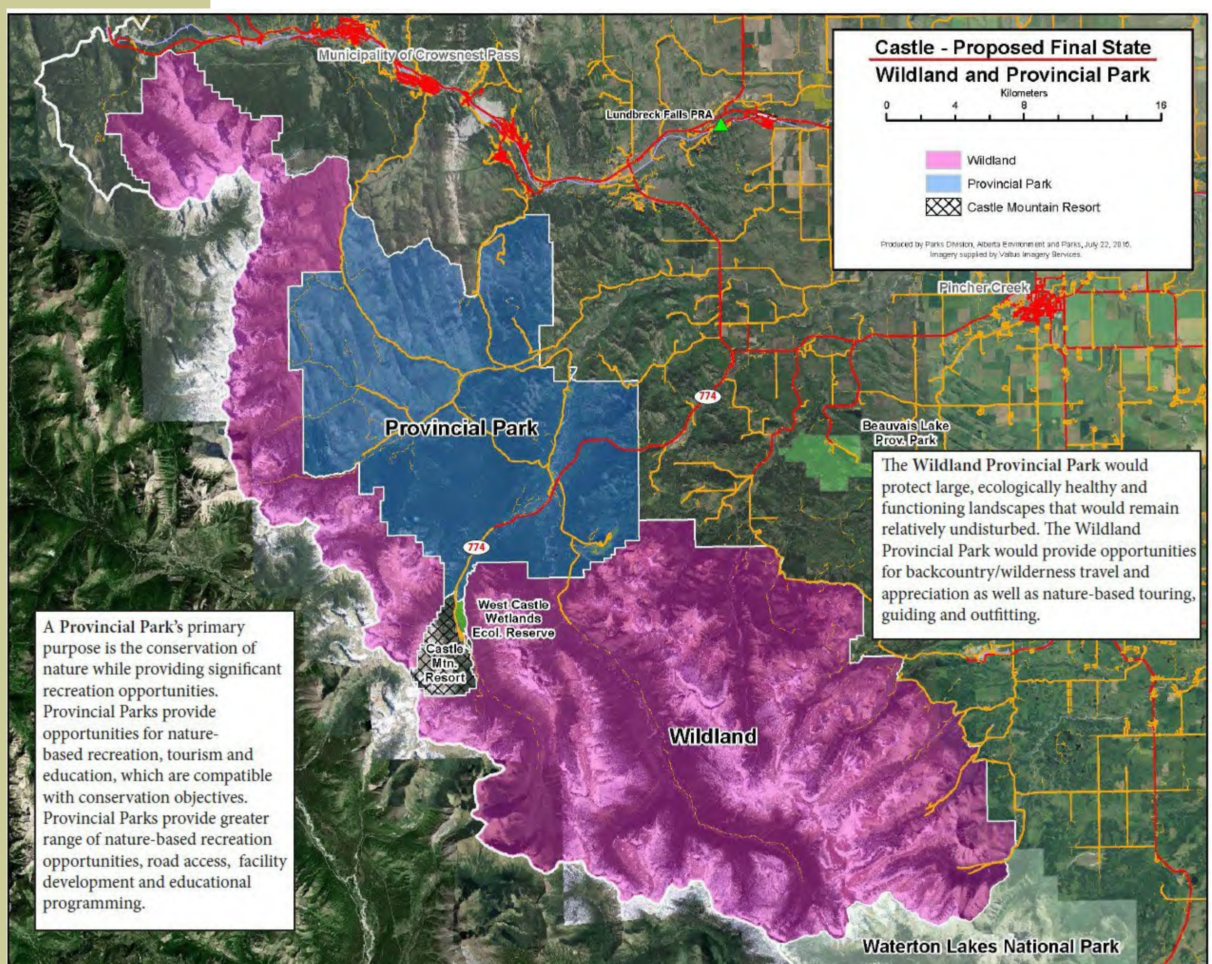
Objective 27



> 5.1.2 Maintain or increase the net forest (commercial timber harvesting) landbase in the C5 FMU.

This objective was not met during the reporting period. The implementation of the South Saskatchewan Regional Plan (SSRP) in 2014 resulted in the expansion of four conservation areas, five provincial parks, and a provincial recreation area, along with the creation of four new conservation areas and two provincial recreation areas. These new protected areas necessitated a reduction in the net forest landbase in C5 FMU by 6650 ha, representing a 5.82% loss to the original net area. This reduction in the net forest landbase triggered a corresponding reduction in the annual allowable cut.

Proposed protected areas in the southern portion of the FMU will further reduce the net forest landbase. In September 2015 the GoA announced it was proceeding with an expanded Wildland Provincial Park and a new Provincial Park in the Castle area. A formal announcement on their establishment was made January 2017. The map below shows the areas under consideration.
The erosion of the net forest landbase through land use changes potentially reduces the available volume for timber harvest.



Objective 28

Reforestation signage along Atlas Rd.

Seedlings ready for planting

Established seedling

The Forest Operations Monitoring Program is another tool that AAF uses in order to ensure reforestation is adequate and occurs using proper methods and practices.

5.1.3 Ensure all harvested areas are re-forested.

Performance Measures:

1. *Percentage of area successfully reforested.*

The Reforestation Standard of Alberta (RSA) was designed to calculate the regeneration status of young tree stands relative to an assumed condition, i.e., the growth of a tree stand at a given age with reference to a growth and yield curve. By comparing reforestation progress to growth curves it is possible to determine the adequacy and success of reforestation efforts.

The purpose of the RSA is:

- to provide the standards and procedures to assess reforestation levels in managed stands following harvest
- to assess the adequacy of stocking, tree survival and growth rates
- to assess reforestation performance relative to yields assumed in the FMP's timber supply analysis

The provincial reforestation goal is the successful regeneration of 100% of any harvested area. Two surveys are undertaken to ensure that the RSA goals are achieved:

Establishment Survey: occurs 4-8 years after reforestation. This survey is undertaken to determine if regeneration is occurring in accordance with reforestation standards. The establishment survey determines the success of early silviculture activities.

Performance Survey: occurs 11-14 years after reforestation. This survey is undertaken to determine if new tree stands are continuing to grow and to establish whether these stands are healthy, vigorous and capable of generating yields similar to the post harvest yields assumed in the Timber Supply Analysis.

Table 28.1 Number of Seedlings Planted in Harvested Areas by

Year	Pine	Spruce	Other	Total
2010	660,945	279,450	0	940,395
2011	889,915	109,780	0	999,695
2012	392,355	159,965	0	552,320
2013	429,690	153,400	0	583,090
2014	27,270	25,870	0	53,140

The table below identifies the number of seedlings planted in the C5 FMU during the reporting period. Planting of seedlings is a significant component of reforestation.

To assess the success of reforestation in the C5 FMU since the implementation of the FMP, the following two tables have been generated. Table 28.2 is an update of Table 17 from the FMP. It was generated using current ARIS information, which shows the reforestation progress of blocks harvested between 1995 and 2005. Table 28.3 is a reiteration of table 28.2, but for areas that were harvested from 2005 to 2015.

Objective 28

Table 28.2 shows that 72% of blocks harvested between 1995 and 2005 currently are satisfactorily stocked, with 10% of blocks awaiting a performance survey —which may not happen until 14 years after harvest (i.e., 2019).

Only limited conclusions can be drawn from table 28.3. The eight-year delay between skid-clearance and a regeneration survey means that most of the harvesting done in this time frame has not yet been assessed (i.e., 61% of blocks are not surveyed). This table will be reconsidered in future stewardship reports.

Table 28.2 Reforestation status of areas harvested April 30, 1995 to May 1, 2005

	Total Harvested Blocks	Satisfactorily Restocked			Not Satisfactorily Restocked			Survey Pending		
		Industry	PLFD	FRIAA	Industry	PLFD	FRIAA	Industry	PLFD	FRIAA
Number of Blocks	535	327	0	61	76	0	16	50	2	3
Percentage of Total Blocks	100%	61%	0%	11%	14%	0%	3%	9%	0%	1%
Area (ha)	7,338.9	4,446.5	0	572.1	1,201.3	0	113.4	962.3	13.9	29.9

The reforestation success rate that is indicated in table 28.2 (72%) needs to be monitored. It could climb as high as 82%, depending on the results of pending surveys. Not Satisfactorily Restocked (NSR) blocks are probably not complete reforestation failures; it is quite likely that these regeneration blocks are just below the required height or density standards that need to be met to achieve the "fully stocked" rating.

Further information on the implementation of the Forest Operations Monitoring (FOM) and Siliviculture ARIS Monitoring (SAM) programs can found in Objective 14.

Table 28.3 Reforestation status of areas harvested May 1, 2005 to April 30, 2015

	Total Harvested Blocks	Satisfactorily Restocked			Not Satisfactorily Restocked			Survey Pending		
		Industry	PLFD	FRIAA	Industry	PLFD	FRIAA	Industry	PLFD	FRIAA
Number of Blocks	313	78	0	2	34	0	7	183	0	9
Percentage of Total Blocks	100%	25%	0%	1%	11%	0%	2%	58%	0%	3%
Area (ha)	5,473.1	1,755.1	0	4.5	498.7	0	38.3	3,107.2	0	69.3

Objective 29

Feller buncher at work

Top-size measurement during FOMP inspection

For more information on how the Government of Alberta assesses timber utilization see Standard Operating Procedure (SOP) 20 on the Government of Alberta website

5.1.4 Achieve optimal utilization of wood fiber during logging operations.

Alberta Agriculture and Forestry has created guidelines to ensure that the optimum amount of merchantable timber which has been felled is being utilized. The coniferous utilization standards below apply to the C5 Forest Management Unit. These utilization standards are a component of the SLS C05 Operating Ground Rules, to which all timber disposition holders in C5 must adhere.

Merchantable Tree: has a minimum diameter of 15 cm outside bark at stump height (30cm) and a usable length of 4.88 m or greater to a 11 cm top diameter (inside bark).

Merchantable Piece: is 2.44 m (plus 5cm trim allowance) or longer in length, with a 11 cm (inside bark) small end, and where stem rot or stem form does not render it unusable.

The 15/11 cm standard is confirmed through the Forest Operations Monitoring Program. When a harvested area is assessed for timber utilization a Forest Officer will first conduct an visual evaluation of the site. If an unacceptable level of waste is present or consistently poor fiber utilization occurs, a formal waste survey may be necessary. A formal waste survey uses a transect method to estimate the total volume and the volume per hectare of wasted merchantable timber.

Table 29.1 Timber utilization surveys undertaken in the C5 FMU.

FOMP Category	**Number of findings**				
	2010/11	**2011/12**	**2012/13**	**2013/14**	**2014/15**
Utilization	3	0	0	0	3

The table above reveals that between 2010 and 2015 there were six timber utilization evaluations undertaken through the Forest Operations Monitoring Program.

The FOMP variances for timber utilization were infrequent during the reporting period and represented a range of issues from improper topping (top size exceeding the 11cm standard defined in the SLS C05 OGRs) to incorrect defect bucking practices. No clear trend in utilization variances was noted. The increase in popularity of cut-to-length processing in the C5 has increased the potential for wood fiber under-utilization; this will require increased vigilance from Forest Officers to ensure utilization standards are being met.

Dangle-head processor at work.

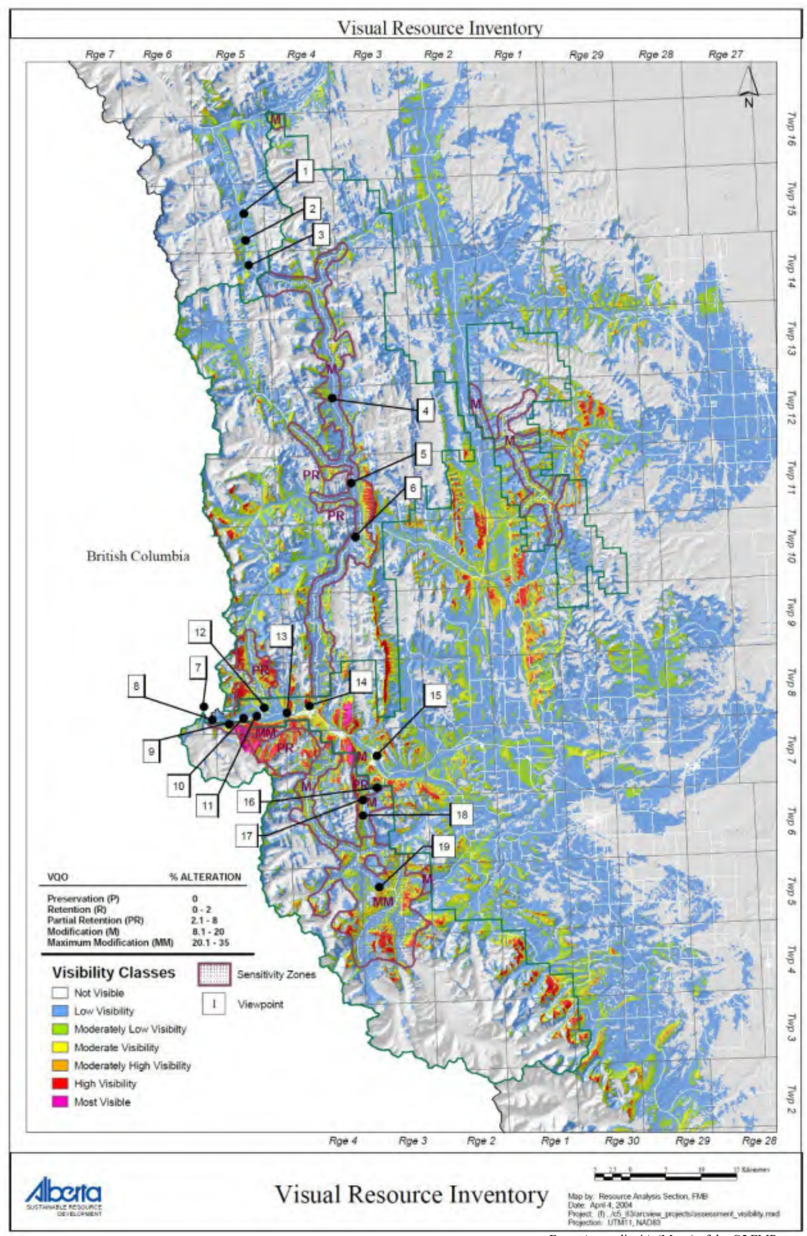
Objective 30

5.1.5 Consider visual impacts during the development of harvest plans.

It is the aim of AAF to minimize the impacts of timber operations on the scenic quality of forest landscapes. Visual resources in areas of high public use and in areas known for their scenic quality are of particular concern.

In the C5 FMU, A Field Guide to Visual Resource Assessment is used in conjunction with the Forest Landscape Management Strategies for Alberta for visual resource management. These manuals provide a number of criteria for identifying areas of concern and outline various methods that are used to reduce visual forest operation effects on the landscape.

Following the identification of key viewpoints, computer models were used to prepare a visual resource inventory, which in turn was used to create the visual sensitivity map seen below.



From Appendix 4A (Maps) of the C5 FMP

For more information on visual resources in the forest management unit see Objective 30 (Page 137) of the C5 Forest Management Plan

Year	2010	2011	2012	2013	2014
Number of visual quality assessments as outlined in the C5 visual map	1	1	1	1	0

Four visual assessments were performed during the five year reporting period at Beaver Mines/Castle Falls, York Creek, Star Creek, and the Todd Creek area.

Computer modelling makes it possible to use data from topographic maps, photos and planning maps to create realistic perspectives of a view-shed showing the effects of logging and forest regeneration. Model outputs allows us to assess how landscape alterations would appear from different viewpoints. Computer imagery is being used by foresters to develop harvest designs and cut block configurations that minimize visual impacts to scenic resources within the landscape. Below is a photo of existing natural conditions in the Beaver Mines and Castle Falls area, followed by computer images of the same site showing harvesting operations that have been superimposed on the photo. (Though a good example these plans were curtailed due to land use change in the Castle.)

Before photo — looking south from the Castle Falls Recreation Area Parking Lot

“Before” computer generated image — looking south from the Castle Falls Recreational Area parking lot

“After” computer generated image showing logging effects — looking south from the Castle Falls Recreation Area parking lot.

Objective 31

5.1.6 Allow the general public and various user groups to benefit from the C5 forest.

Performance Measures:

1. *number of user permits and land/resource dispositions issued*
2. *approved AOPs align with the South Saskatchewan Regional Plan (FMB)*

Within the C5 FMU, access to and use of public land or its resources may be granted for, among other things, the following activities:

- Timber harvesting (e.g., logs, Christmas trees, poles, rails, firewood)
- Livestock grazing
- Trapping
- Surface access (i.e., roads)
- Utility corridors (e.g., power lines, pipelines)
- Exploration and recovery of mineral resources
- Exploration and recovery of oil, gas, coal, and coal-bed methane resources
- Extraction of surface materials (e.g., sand and gravel)
- Extraction of historical resources
- Commercial ventures (e.g., ski hills, tourism facilities)
- Recreational-based activities (e.g., guiding and outfitting)
- Scientific research

Authorization for these uses is granted through a variety of permits, leases, licenses, agreements or other mechanisms, with new applications undergoing a referral process to appropriate AAF and AEP divisions and other government agencies. The referral process ensures conformity with current government policies and plans including existing and new sub-regional plans and integrated watershed management plans. Sections 3.1 and 3.2 of the C5 FMP summarize relevant plans and policies that provide federal, provincial, and municipal direction or legal authority for activities occurring within the C5 FMU. This list of plans and policies would need to be updated to include the South Saskatchewan Regional Plan and new sub-regional plans and management frameworks that are under development.

The South Saskatchewan Regional Plan provides a blueprint to manage economic development, support vibrant communities, and maintain a healthy environment. Following the release of the SSRP in 2014, the GoA is now undertaking various sub-regional planning initiatives that will affect portions or much of the C5 FMU. A list of strategies that are being developed under the regional plan can be found at this link:
https://landuse.alberta.ca/RegionalPlans/SouthSaskatchewanRegion/SSRPProgress/Pages/default.aspx
These strategies will supersede the Eastern Slopes Policy and Integrated Resource Plans (which originated from 1984 to 1991).
Continued use of the C5 FMU by multiple user groups during the 2010 to 2015 stewardship reporting period can be demonstrated with data on the annual issuance of permits or land and resource dispositions. Note, however, that many public uses that occur in the C5 FMU require no permit or authorization, including: hiking, climbing, wildlife viewing, nature photography, off-roading on designated trails, mountain biking, horseback riding, picnicking, etc.

Objective 32

Atlas road sign and Invasive alien plant educational sign at the two km staging area on the Atlas road north west of Coleman.

5.1.7 Provide reasonable access for recreational and industrial purposes while maintaining the ecological integrity of the forest.

Performance Measures:

1. *number of entry points into the C5 FMU*
2. *kilometers of forestry access roads*
3. *plans in place to manage forestry-related access.*

Past and ongoing industrial activity has created an extensive access network on the C5 landscape. These roads and trails provide opportunities for recreational activities but can simultaneously lead to environmental degradation and a decline in ecological integrity and function of surrounding habitats if motorized use is not properly controlled. The C5 FMP committed to retaining all major public access points into the FMU (barring safety or environmental concerns), while monitoring motorized access, determining existing access densities, and establishing an access development plan. However, under the approved South Saskatchewan Regional Plan, direction has been provided to address access management in the Green Area through new planning initiatives including: Biodiversity Management Plan, Linear Footprint Management Plan, Recreation Management plans, and the creation of new public land recreation areas. These various initiatives are currently under development and will provide guidance on access management that supersedes access related provisions contained in the C5 FMP. As well, other planning and policy initiatives of the GoA (i.e., species recovery plans).may constrain future access development and trail use

Initiated during the first stewardship reporting period was the cataloguing of open/closed/temporary industrial roads, motorized recreational trails that are accessible to on-highway vehicles and/or off-highway vehicles, and other linear disturbances (e.g., seismic lines, reclaimed roads). Analysis of road densities at the C5 subregion or LMU levels will be completed at ten-year intervals as part of the TSA, or more frequently as required for particular projects. Under the direction of the SSRP, portions of C5 (Porcupine Hills and Livingstone subregions) are undergoing Linear Footprint Management Planning (see Objective 3). The LFMP will provide updated inventories of linear disturbances and guide future road, trail and linear feature planning in some parts of the C5 FMU.

Objective 33

5.1.8 Promote cooperation between forest harvesting operators and other forest users.

Performance Measures:

1. *number of Action Requests (ARs) issued by the Minister's office*
2. *number of complaints received*

The C5 FMP was developed with considerable public consultation and expert input on how to balance forest management activities with environmental, biological, social, cultural, and economic values that are represented within the landscape. Recognizing the inherent challenge in this task – and in response to uncertainties, conflicting values and changing priorities – AAF strives to address input received from the general public and users of the C5 landbase that could help inform future adaptive management strategies.

Opportunities to review and provide feedback on forest harvesting activities are provided where possible during operational planning stages. For example, Spray Lake Sawmills holds an annual open house in the Crowsnest Pass where the public can view and respond to operational plans. See Objective 45 for more information on public cooperation with forest disposition holders.

Formal concerns or complaints can also be submitted at any time over the lifespan of the C5 FMP. Formal written complaints that are sent to the Minister's Office of AAF are recorded and flagged for a timely response using the Government of Alberta's Action Request Tracking System (ARTS).

At the time of C5 FMP implementation, ARTS could be queried for various information,

Annual Action Requests Issued by the Minister's Office of AAF *(Source: ARTS)*

Year	Number of Correspondents	General Recreation	Commercial Recreation & Tourism	Grazing & Rangeland	Trapping	Energy & Mineral Exploration & Development	No Stated Concern - Against harvest, Want protected status	Environmental Concerns - Wildlife, Watersheds	Want More Info; Unclear about what is being presented in media	Support Harvesting for Forest Health & Economy
2010/11	278	57	29	0	0	0	27	225	2	0
2011/12	224	32	24	2	0	0	84	108	5	6

and issues could be categorically reviewed by geographical area. ARTS became less effective for monitoring public feedback starting in 2013 as a result of fundamental changes to the data base. This has limited ARTS usefulness in determining how the public and users are reacting to implementation and operational activities within the FMU.

Many issues that are being brought to the attention of AAF staff are being addressed where possible through discussion with concerned individuals and groups and through education efforts (e.g., clarifying direction contained in the C5 FMP; explaining why and how harvesting practices or silviculture techniques are being used). The number of forest user concerns that are being resolved through these efforts is not currently being tracked but is significant.

Objective 34

5.1.9 Ensure broad participation of disposition holders in forest management decision-making processes.

Performance Measures:

1. *number of consultations with disposition holders*

Consistent with the principles of sustainable forest management contained in the Canadian Council of Forest Ministers criteria, the Alberta Forest Management Planning Standard, and the regional Spray Lake Sawmills and C05 FMU Timber Harvest Planning and Operating Ground Rules, the C5 Forest Management Plan recognizes that economic and non-economic benefits are accrued by those with land and resource, wildlife, recreational and other interests in the C5 FMU. Various engagement formats, including a public advisory committee (i.e., CrowPAC), quota holder involvement, stakeholder participation, public open houses, and a web page to facilitate information transfer, were used to encourage broad participation and to gather input during the original C5 FMP public consultation process.

Consultation with particular disposition holders is ongoing throughout the implementation of forest management activities outlined in the C5 FMP. The individual stakeholders requiring notification and consultation (e.g., trappers, grazing lease holders, grazing associations, municipalities, oil and gas disposition holders, outfitters, special interest groups) varies with the geographic area of interest in the C5 FMU as well as the particular proposed activity (e.g., harvest planning, access development, bridge repair). AAF maintains current contact information for all disposition holders in the FMU and shares necessary stakeholder information with timber quota holders proposing forestry activities within an overlapping disposition.

See appendices B and C in this report for examples of consultation activities involving disposition holders in the C5 FMU.

Objective 35

5.1.10 Integrate recreational activities with forest management practices.

Performance Measures:

1. number of Action Requests issued by the Minister's office

From nationally significant caving systems and world-class fly fishing streams and rivers to extensive and popular snowmobile and off-highway vehicle trail networks, personal, family-oriented and group recreational opportunities abound year-round in the C5 FMU. Recreational pressures are increasing as more people are seeking physical, social, psychological, and spiritual benefits (even economic rewards) from this 'natural' landscape. Thus, forest management activities must be conducted in a manner to ensure continued provision of quality recreational experiences. It should be noted that some recreational activities may not be compatible with timber harvesting or silvicultural activities at particular points in time.

CNP Quad Squad
www.quadsquad.ca

The C5 FMP focused on two particular components of the extensive recreational activities being pursued within the FMU: the cross-country ski trail system in the Allison Chinook Public Land Use Zone (PLUZ) and traditional random campsites. Several harvesting provisions for the Allison Chinook PLUZ were delineated in the C5 FMP as part of an integrated management approach to maintain opportunities for current and future facilities or development in the PLUZ, particularly the cross-country ski trail system. Additionally, to manage recreational and aesthetic values around random campsites commonly located along major travel corridors and at staging areas, high-use random campsites were inventoried for the original TSA. Traditional random campsites were then buffered by 100 m and removed from net productive landbase to allow continued future use of these sites by campers. The future of random camping and the provision of new camping (and other recreational) opportunities will be addressed within new subregional plans and through the implementation of SSRP provisions.

Recreational user attitudes toward C5 forest management activities are difficult to assess without conducting detailed surveys or directed interviews across the broad range of recreational user groups. Rigorous and standardized survey methodologies are costly to implement and fall outside the scope of the current C5 FMP. Instead, opportunities for recreational users to review and comment on proposed operational forestry plans as well as the number of Action Requests issued in response to concerns from recreational users provide an indication of FMP success in integrating recreational activities with ongoing forest management activities.

Recreation stakeholders (e.g., Crowsnest Pass Quad Squad, Crow Snow Riders, Hillcrest Fish and Game Association) have been involved during the public consultation processes at GDP,FHP and AOP levels throughout the reporting period. Many of these recreation groups are sent AOP letters and given the opportunity to review operation plans and provide feedback to disposition holders. The Action Requests related to recreation in C5 were relatively numerous in the 2010 and 2011. The high recreational demand and recreational pressures being faced in the C5 FMU requires that the GoA remain proactive in integrating timber harvesting and other land uses with recreational activities.

Annual Action Requests issued by the Minister's Office of AAF *(Source: ARTS)*

Year	Number of Correspondents	General Recreation
2010/11	278	57
2011/12	224	32

Objective 36

> 5.1.11 Integrate rangeland management activities with forest management practices.

Performance Measures:

1. *number of Action Requests issued by the Minister's office of AESRD*
2. *number of Grazing Timber Agreements in place*
3. *summary of livestock management infrastructure or rangeland improvements*
4. *livestock grazing levels/grazing capacity – AUMs*

Considerable portions of the productive forested landbase in the C5 Forest Management Unit (in addition to grasslands, pasturelands, shrublands, and riparian areas) are considered grazeable and provide significant forage for cattle producers. Since the completion of the original C5 Forest Management Plan in 2006, AAF and AEP have developed a policy and manual to provide formal direction on how to integrate grazing and forest management activities occurring on the same land base. The Grazing and Timber Integration Manual (last revised in April 2011) and Directive 2011-03 Integration of Grazing and Timber Activities outline the requirements for planning, operations, agreements, monitoring, and dispute resolution.

In areas of high grazing demand with unallocated forage or regions where a high level of integration with timber interests is required, Regional Grazing Plans are prepared by stakeholder committees. These plans identify potential grazing opportunities at a landscape scale, and consider sustainable forage and fibre resources based on forest and range growth and timber harvest plans. Regional Grazing Plans outline strategies for the integration of timber harvesting and grazing and identify any new grazing opportunities. All forage resources are currently allocated within the C5 FMU, rendering it a lower priority for the preparation of a Regional Grazing Plan.

Cattle grazing in the C5 FMU.

Grazing Timber Agreements (GTA) represent one of the primary operational-level tools for minimizing the impact of timber harvesting and silviculture operations on infrastructure and carrying capacity of rangelands for domestic livestock grazing and, conversely, for minimizing the impact of grazing operations on regeneration and site productivity of forest re-establishment areas. A GTA is a written agreement between grazing and timber disposition holders that addresses the following:

- how the parties will operate on a common land base
- potential impacts and associated mitigation strategies pertaining to infrastructure, timber harvesting, grazing, reforestation and reclamation
- responsibilities for fence construction and any cost sharing arrangement
- access requirements and provision
- communication protocols
- dispute resolution procedures

Cattle guard installed on a temporary haul road as part of a Grazing Timber Agreement.

GTAs must be initiated two years before timber harvesting activities commence and must be submitted as a component of the AOP before a given AOP can be approved. Full compliance with regard to GTA completion has been achieved in C5 FMU over the reporting period.

Objective 36

Examples of Forestry-Rangeland Integration

During the reporting period numerous instances of integration and cooperation occurred, beyond the scope of Grazing Timber Agreements. Specific examples of ongoing successful integration between grazing and timber disposition holders is provided.

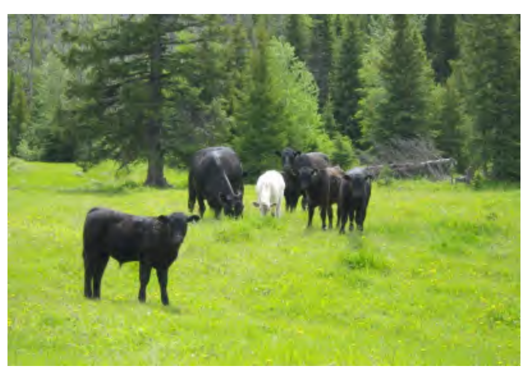
2010-2011 - CTLC020025 near Spears Creek (Lower Livingstone). Rig mats were installed by Spray Lakes Sawmills over rangelands to access blocks 5040122425 and 5040122409. Grazing allotment holders had expressed concerns over a proposed access road across a large meadow. To avoid damage to this grassland feature the following occurred: rig mats were installed after freeze-up; in-block roads were constructed; timber blocks were harvested; wood was removed from the timber blocks; in-block roads were reclaimed, and; rig mats were removed prior to spring thaw. [The above photo shows rig mats being removed following completion of in-block operations.]

Location of the rig mat access road in spring 2011.

2010-2011 – CTLC020025, Spears Creek area (Lower Livingstone).
Grazing allotment holder concerns over the adverse effects of using Hensely Teeth for scarification resulted in the selection of alternate methods, i.e., scarification was restricted to the use of chain drags by Spray Lake Sawmills.

2013-2014 – CTLC050015, Beaver Mines. The Castle Grazing Allotment obtained a Temporary Field Authorization and requested that Spray Lake Sawmills construct a parking lot adjacent to their corrals off Highway #774.

2014-2015 – No License; south of the Gap Ranger Station. The Gap Grazing Allotment obtained a Temporary Field Authorization, requesting that Spray Lake Sawmills harvest an approved fence line right-of-way.



Objective 37


Trapper's set

For more information on the Alberta Trappers Association and the trappers compensation program, please check their website at www.albertatrappers.com

5.1.12 Integrate trapping with forest management practices.

Performance Measures:

1. *number of Action Requests issued by the Minister's office of AEP*

Seventeen Registered Fur Management Areas (RFMA) are overlapped by the C5 Forest Management Unit boundary. Timber disposition holders must attempt to minimize their impact on trapping activities and avoid damage to associated trapline infrastructure. Successful integration of timber harvest and trapping activities occurs through effective communication and cooperation at the planning stage, as per the current Spray Lake Sawmills and C05 FMU Timber Harvest Planning and Operating Ground Rules. During the preparation of General Development Plans and Forest Harvest Plans, a representative of the forest operator personally contacts or sends a registered letter detailing proposed plans to the senior partners of RFMAs found in the particular compartment under consideration. Trappers then provide information on cabin locations, trails, trapline locations, and other improvements or concerns, which are noted and integrated into the harvest plan. In addition, senior trapline holders are notified at least ten days before the commencement of any timber harvesting operations.

The Alberta Trappers Compensation Board administers the Alberta Trappers Compensation Program, a program funded annually by a number of different stakeholders that include AAF, Alberta Trappers Association, Alberta Forest Products Association, ATCO Electric, and multiple oil and gas industry organizations. Under the various program components, eligible trappers can receive compensation either directly from the responsible company or from a compensation fund for losses that include damage, theft, or vandalism to equipment or other assets, extra expenses to adjust to industrial activity, and reduced short-term or long-term income. Industrial companies are required to pay compensation in the case of direct damage to trapper assets, temporary disruptions to trapping operations, or a trapline that is liquidated as a result of projected long-term impacts of industrial activity on furbearer harvest within the RFMA.

As the details of compensation packages negotiated between trapping disposition holders and forest companies are not made public, the most applicable AAF data on the successful integration of these two sectors are the number of consultations held with trapping disposition holders and the number of Action Requests issued by the Minister's office of AAF regarding trapping concerns. Action Requests are stored in a database that is no longer queriable, however it was confirmed that no Action Requests were issued related to Trapping in C5 during the first two years of the reporting period, suggesting effective integration between Trappers and other C5 stakeholders. A number of instances have seen timber disposition holders take measures to assist trappers beyond that which is outlined in the OGRs:

- Spray Lake Sawmills, while operating in CTLC020025, repaired access to a Trapper's cabin (TPA 1877) that had been severely degraded by recreational use on a trail. The trail was repaired to a condition that allowed for reasonable access for the Trapper and was more resistant to future degradation.
- Spray Lake Sawmills, upon request, provided raw lumber and logs salvaged from reclamation operations (log-fill culverts, timber bridges, etc.) to a trapper (TPA 1877) periodically throughout the entire reporting period.

Objective 38

5.1.13 Integrate energy/mineral (exploration and development) activities with forest management practices.

Performance Measures:

1. *integrated access development plan*
2. *number of Action Requests issued by the Minister's office of AAF*

Management direction on compatible uses (e.g., motorized or non-motorized recreation, commercial recreation, agriculture, timber harvest, energy/mineral exploration and development, utility corridors, residential development) and management priorities (e.g., watershed protection, critical wildlife habitat protection, sustainable timber production, energy exploration and development, tourism development) for particular areas within the C5 FMU was provided by Integrated Resource Plans dating back to the late 1980s and early 1990s.

An integrated access development map was not produced during the reporting period.

The South Saskatchewan Regional Plan, and the new sub-regional plans and management frameworks that will be prepared under the authority of the regional plan, will provide new and updated land use direction for the C5 FMU.

Specific consultations that were held with oil and gas disposition holders during operational planning stages as well as other opportunities to review plans and provide meaningful input are summarized in Objectives 34 and 33 respectively. Concerns between these two resource users are often resolved through consultation and planning as few complaints are recorded in Government of Alberta databases. Over the 2010 to 2015 stewardship reporting period, zero known Action Requests were issued by the Minister's office of AAF with respect to conflicts between forest management activities and mineral/energy exploration and development.

Objective 39

5.1.14 Integrate the commercial recreation and tourism sectors with forest management practices.

Performance Measures:

1. *number of Action Requests issued by the Minister's office of AAF*

Commercial recreation and tourism-related ventures that are active in the C5 Forest Management Unit include: guided fly-fishing and hunting, guided eco-adventures (i.e., hiking, mountain biking, caving, photography tours), trail riding, snowmobile and off-highway vehicle adventures, ski hills, and vacation property rentals. Tourism operators desiring to operate on public lands and requiring long-term tenure, permanent structures, public review, or integration with existing land uses may be subject to AEP's Alberta Tourism Recreational Leasing Program (ATRL) process. However, tourism-related operations without facilities do not require any type of permitting. AEP recognizes that there are several operators falling into this latter category, but no GoA agency tracks their activities on the C5 landbase.

When commercial recreation or tourism-related operators are known by AAF to operate in an area planned for timber harvesting (e.g., through ATRL or local knowledge), the timber company is made aware of any disposition holders or operators that may be impacted by timber harvesting operations. Consultation and mitigation of impacts are then the responsibility of the timber company. The Operating Ground Rules require that designated recreational trails and associated watercourse crossings must be restored following harvesting and silviculture activities, while roads or trails constructed for the purpose of harvesting must be reclaimed to prevent the creation of additional access (unless these roads or trails were previously approved as part of a planned, sustainable recreational trail network).

A total of 53 Action Requests were issued by the Minister's office of AAF over the 2010 to 2012 period with respect to complaints or conflicts between forest management activities and the commercial recreation or tourism sectors. The annual breakdown is shown in the table below. Additional years of data was not available due to changes to the Government's ARTS system. The number of Action Requests in the first 2 years of the reporting period alone indicate that more may need to be done to better integrate the commercial tourism and forest management sectors.

Sign on a designated trail network in the C5 forest.

Annual Action Requests Issued by the Minister's Office of AAF *(Source: ARTS)*

Year	Number of Correspondents	Commercial Recreation & Tourism
2010/11	278	29
2011/12	224	24

Objective 40

5.2.1 Ensure that local/regional businesses have an opportunity to share in the economic benefits that can be derived from the C5 forest.

Community Timber Program

A small percentage (6.2%) of the AAC from the C5 FMU has been allocated to the Community Timber Program, which is made up of small manufacturers, loggers and an open competitive category. The program is divided into two categories of permits, Commercial Timber Permits (CTP) and Local Timber Permits (LTP). AAF forest management staff allocate the timber volume, plan harvesting, and ensure that Forest Resource Improvement Association of Alberta receives necessary information to fulfill the reforestation component of the program. Areas to be harvested within the CTP program occur within C5 Spatial Harvest Sequence (SHS) polygons, ensuring that CTP harvest aligns with the broader goals of the C5 FMP.

In order to be considered eligible as a Community Timber Manufacturer in the C5 FMU, the applicant must have resided either within the MD of Cardston, Pincher Creek, Ranchlands or Crowsnest Pass during the last 6 month period. The applicant must also own an operating sawmill and provide proof of operations. This requirement helps ensure that economic benefits derived from the C5 forest are shared within the region.

Community Timber Program: Volume - Production (m^3)						
Allocation Holder	**Category**	**Year**				
		2010	**2011**	**2012**	**2013**	**2014**
Robert Moore	Manufacturer	0	0	0	0	0
Southwind Forest Products*	Manufacturer	0	0	0	0	0
Carmen Rinke	Manufacturer	0	0	0	0	2104
Kerry Smyke*	Manufacturer	0	0	0	0	0
Aaron Moore	Logger	455	634	1247	1524	1149
Egbert Veldmon	Logger	965	2618	0	0	0
Henry Veldmon	Logger	0	0	0	0	1954
Personal Use	LTP, TM66	1363	0	0	0	0
Other	Open Competitive	0	0	0	0	24432
Total		**2783**	**3252**	**1247**	**1524**	**29,639**
AAC**		10,863	13,005	13,005	13,005	12,248
% of AAC Harvested		**26**	**25**	**10**	**12**	**242**

* Southwind Forest Products and Kerry Smyke received manufacturer allocations in Sept 2014
** AAC volumes were adjusted twice during the reporting period (the AAC was increased to 13,005 m^3 in 2011 and decreased to 12,248 m^3 in 2014).

To accommodate Phase II of the Southern Rockies Watershed Project (See Objective 24), a relatively large timber volume was allocated to Canfor (within the "Open Competitive" CTP category) in 2014. The annual allowable cut is tracked yearly but balanced over a 5-year period. A variance of up to 500 percent of the AAC can occur in a single year provided the 5-year quadrant volume does not exceed 109.90 percent. In the case of the CTP program, timber harvest was at approximately 45 percent of the volume allowed —which represents a significant under-cut for the reporting period.

Objective 41

A log deck along the Atlas Road.

5.2.2 Maintain the ongoing (long-term) viability of the forest sector by encouraging companies to consider value-added manufacturing and/or improved wood utilization and processing.

Several C5 disposition holders have pursued value-added manufacturing processes that improve fibre utilization, in particular Spray Lake Sawmills and Carmen Rinke.

- Spray Lake Sawmills opened Top Spray in 1996, a division that manufactures erosion control, reclamation and landscaping products from bark mulch, chips and other traditionally non-merchantable fibre. More information can be obtained at the Top Spray website: http://www.topspray.com/

Hydroseeding with top-spray mulch for erosion-control (Photo: www.topspray.com)

Slope reclaimed using Top Spray erosion-control products (Photo: www.topspray.com)

- Carmen Rinke opened a small post and rail manufacturing mill in the Crowsnest Pass in 2014. The facility produces primarily fence posts and rails (for use by agricultural producers) as well as firewood. The mill is capable of processing logs smaller than the 15/11 utilization standard, making use of logs with tops as small as 7cm.

Rinke Sawmill, peeled rails ready for shipping in foreground.

Objective 42

5.2.3 Provide economic opportunities for forest dependent businesses while maintaining the integrity of the C5 forest ecosystem.

Over the course of the reporting period at least 23 local and regional businesses were in some way dependent on the C5 forest. This includes 14 businesses that were focused on timber harvesting and the creation of wood products, and 9 businesses that were focused on recreational pursuits within the FMU. All of these businesses must operate within the constraints of ecological integrity and forest sustainability as outlined in the C5 FMP.

Since the implementation of the FMP, one value-added industry (Rinke Post and Rail) has been established which uses wood derived from C5 FMU to create a number of different products .

Since the implementation of the C5 FMP, no socio-economic assessments have been published which shed light on the number of individuals employed by the regional forest sector. Data from 2002 indicates that there were 238 residents employed in the forestry sector and the forestry industry contributed $56 million to the local economy. Until updated information is made available, it is difficult to assess trends in both direct and indirect employment from the forest sector.

Objective 43

> 6.1.1 "The Government of Alberta is committed to meeting all of its treaty, constitutional and legal obligations respecting the use of public lands." (p. 14) Strengthening Relationships – The Government of Alberta's Aboriginal Policy Framework

Performance Measures:

1. *Opportunities provided for input by Aboriginal Communities.*
2. *Aboriginal attendance at public events, scheduled meetings and Public Advisory Committee (PAC) meetings*

The Government of Alberta recognizes and respects the treaty rights and traditional uses of First Nations. More recently, the Government has also recognized that Metis Settlement members use un-occupied Crown land for gathering and other traditional use activities. Since activities on provincial Crown lands within the C5 FMU often coincide with the interests and rights of First Nations, consultation with First Nations (and where appropriate, with Metis) are necessary in order to minimize impacts to treaty rights, harvesting, and traditional land uses. The Government of Alberta's policies and guidelines for consulting First Nations and Metis can be accessed at:
http://www.indigenous.alberta.ca/policy-guidelines.cfm

In Crown-managed Forest Management Units such as the C5 FMU, AAF Forestry Division staff will consult with First Nations to review planned forest operations. Plans to be reviewed include, but are not limited to:

- Forest Management Plans
- General Development Plans

First Nation consultation on C5 forest management activities may involve the following Treaty 7 First Nations: Blood Tribe, Piikani Nation, Siksika Nation, Stoney Tribal Administration (Bearspaw, Chiniki, and Wesley Bands), and Tsuu T'ina Nation.

As is pointed out in the GoA's 2014 First Nations Consultation Guidelines, consultation is a shared responsibility involving Government of Alberta ministries and forestry proponents. The duty to consult rests with the GoA. Thus the GoA is responsible for overseeing and managing all substantive aspects of consultation. The GoA may however delegate some procedural aspects of consultation to another party, such as project proponents (i.e., forest disposition holders). Forest companies may be asked to notify and engage with First Nations on proposed timber harvesting activities, to discuss project specific issues that may adversely affect First Nations, and how these impacts can be mitigated.

Objective 43

No GOA organized Public Advisory Committee (PAC) was established during the reporting period.

During the reporting period the GOA completed a moderate impact Standard consultation regarding the C5 Community Timber Program and for the Community Timber Program in other locations within the Calgary Forest Area.

The Consultation Guidelines provide clarity on the levels of consultation that may pertain to various sectors. Appendix "A" of the Consultation Guidelines (page A2) indicates that for forest management activities, the following levels of consultation will generally prevail.

Low Impact **STREAMLINED CONSULTATION** ***These activities are typically short duration (less than 2 years), small in size (less than 5 ha), and have low or limited environmental impacts.***	**Moderate Impact** **STANDARD CONSULTATION** ***These activities are typically moderate in duration (more than 2 years), moderate in size (greater than 5 ha), and have moderate environmental impacts.***	**High Impact** **EXTENSIVE CONSULTATION** ***These activities are typically long in duration (more than 10 years), large in size and scale or complexity, have extensive environmental impacts, and include approvals from multiple regulatory authorities.***
FireSmart plans (vegetation management component only) Herbicide plans where there was no previous consultation) Temporary roads that are new routes with no previous consultation	Forest management agreement (FMA) renewal New quota New FMA Forest management plan (FMP) amendment (e.g., mountain pine beetle amendment) General development plan (GDP), Community Timber Permit Program (CTPP), FMA, and quota-holders Prescribed burn[2] (Types 1 and 2) All weather roads (mainlines)	Forest management plans

Objective 44

First Nations traditional site that was avoided as a result of field planning in Spray Lake Sawmills CTLC050016 Allison.

6.2.1 Undertake effective and meaningful consultation with Indigenous communities.

Performance Measures:

1. *early consultation before decisions are made*
2. *number of meaningful indigenous consultations completed (FMB – see Obj 43).*

As stated under Objective 43 in this report, the Government of Alberta's has established policies and guidelines for consulting with First Nations and Metis. These documents address how consultation is to occur. The GoA's consultation policies and guidelines will be adhered to whenever consultation is undertaken within the C5 FMU. These document can be accessed at: http://www.indigenous.alberta.ca/policy-guidelines.cfm

Treaty 7 First Nations were engaged in the development and review of the C5 FMP. Over the course of the stewardship reporting period First Nations input was received and incorporated into particular decisions or forestry plans in advance of implementation. First Nation consultation activities are summarized in Appendix A.

Objective 45

6.3.1 Proactively and meaningfully involve directly affected users and the interested public in forest planning and decision-making processes.

Extensive public consultation was pursued during the creation and implementation of the C5 FMP.

In addition, specific communication with directly affected users or adjacent landowners was sought out at various stages of the planning process, particularly in those areas where harvesting was expected to be contentious. See appendix B for a record of communication between Alberta forestry staff and the public during the reporting period.

Spray Lake Sawmills, the largest timber disposition holder in the C5 FMU (and its subsidiary Crowsnest Forest Products), established a Public Advisory Committee (PAC) with which it has met regularly (8 times) over the reporting period. Open houses are held in the community on an annual basis where the public can view and provide feedback on General Development Plans, Forest Harvest Plans and Annual Operating Plans. Additionally, a broad group of stakeholders and affected users receive letters on an annual basis to notify them of upcoming operational plans and inviting them to provide feedback. Appendix C provides examples of Spray Lake Sawmills PAC minutes and open house notifications.

A formal PAC was not formed following the completion of the C5 FMP as was intended by the GoA —Two members of the previous CrowPAC joined the Spray Lake Sawmills PAC. This objective will not be completely achieved and there are no plans to create a new public advisory committee.

MD of Crowsnest Pass Council members meet with AAF Forest Management staff to discuss timber harvesting in the Star Creek area, February 2015.

Objective 46

6.3.2 Raise public awareness of forest management issues and activities.

Educational signage in the C5 FMU (erected in 2011).

A significant number of events were held, presentations were given, and information disseminated to user groups and the general public during the implementation period of the C5 FMP. See Appendix B for a record of public engagement activities by Alberta forest management staff, including activities that were undertaken to raise public awareness.

Objective 47

Alberta forest management staff discussing timber harvesting and forest management activities in the field with local Municipal officials.

6.3.3 Be responsive to local and regional input concerning forestry planning and operations.

This objective was met through continual public and stakeholder engagement over the course of the reporting period (see also Objectives 45 and 46) however, not in a manner that was anticipated by the C5 FMP. Two explanations are offered in this regard:

1. A formal public advisory committee was not created to replace the CrowPAC that was in place during the development of the C5 FMP.
2. Spray Lake Sawmills initiated a Crowsnest Pass Public advisory committee and two members from the original C5 Public Advisory Committee (CrowPAC) were included.
3. The provincial government's Action Request Tracking System (ARTS) was not developed or refined to be a database which could be queried and analyzed by Alberta forest management staff to better track and respond to forest management issues.

It is recommended that a successor public advisory committee be created to contribute to the next iteration of the C5 Forest Management Plan process.

Objective 48

Ongoing harvest operations in the forest management unit.

6.3.4 Be responsive to changing social values concerning sustainable forest management.

Performance Measure:

Adoption of pertinent future revisions to the CSA SFM Z809-02 Standard

The C5 FMP was developed using the CCFM's Criteria and Indicators Framework and the CSA SFM Z809-02 Standard to reflect national societal values for sustainable forest management. To stay current with changing public perceptions and values regarding forest management Alberta must be cognizant of societal shifts reflected in national, regional and local forest management initiatives. In this case, revisions to the CSA Sustainable Forest Management Z809 Standard represent changes in social values and preferences related to forest management. New knowledge should be taken into account and shifts in societal preferences should be reflected in C5 FMP management strategies.

There has been one revision (in 2008) to the CSA SFM Z809-02 Standard since the creation and implementation of the FMP. The 2008 revised version was then reaffirmed in 2013 for a further three year term. Changes that occurred in the 2008 Standard dealt with sustainable forest management performance requirements, public participation, aboriginal concerns, community sustainability, and system requirements.

The 2013 sustainable forest management Standard (CSA SFM Z809-09; R 2013) is available on the CSA website: http://www.csasfmforests.ca/forestmanagement.htm

Changes that were introduced into the Standard will be reviewed and addressed in the next update of the C5 Forest Management Plan.

Canadian Sustainable Forest Management

PEFC

PEFC/01-4-16

Supporting CSA Z809 – Canada's SFM Standard

Objective 49

6.4.1 Pursue "active" adaptive management when managing forest resources in the C5 FMU.

Performance Measures:

1. *monitoring programs in place*
2. *development of 5-year stewardship report (i.e., this document)*

Monitoring is a key component of plan implementation and is necessary for adaptive forest management. The results of monitoring activities allow for self assessment and provide the a basis for making informed changes to management strategies to best meet plan objectives.

This Stewardship Report is an important component of the various monitoring programs that are occurring in the C5 FMU. The results from numerous individual monitoring initiatives have been compiled and are presented in this report. Monitoring findings presented in this report will guide adaptive management in future years.

It should be noted that monitoring is a multi-faced endeavor, involving a number of different organizations and interests. Some monitoring is undertaken by local Alberta forestry staff or head-office AAF staff, some monitoring occurs by other government specialists (e.g., Fish and Wildlife biologists), other monitoring was undertaken by a provincial monitoring agency (i.e., Alberta Environmental Monitoring, Evaluation and Reporting Agency —which was dissolved in April 2016), some monitoring is being performed by forest disposition holders, and still other monitoring could entail information gathering and sharing by forest user groups. While some monitoring occurs following strict protocols to obtain “scientific” findings, other monitoring entails information gathering that does not require empirical rigor.

The availability of funding and resources often acts as a constraint on what can be obtained through monitoring. While this objective was largely met by AAF, agreement exists that there are many areas in which monitoring activities could be more clearly defined and structured. Among other things, this would entail the identification of suitable indicators and performance standards that could be measured or effectively detected, and the clear identification of monitoring procedures where these might be absent. It is recommended that additional resources be allocated to monitoring programs by the Government during of the next reporting period. This will allow for more thorough and consistent data collection, which would provide the basis for improved forest management in future years.

Objective 50

6.4.2 Remain informed of scientific advances, emerging technologies, and new knowledge in managing our forest ecosystems.

Performance Measure:

- adopt best management practices

A number of research projects and emerging technologies have been adopted since the implementation of the C5 FMP. Below are examples that are currently being used by AAF staff to increase knowledge, efficiency and effectiveness in managing the C5 forest.

- FRI Research: The GOA is one of many supporters of the Foothills Research Institute (FRI) Research. For detailed listings of research projects go to: https://friresearch.ca/.

- LiDAR: Alberta has acquired the largest inventory of aerial LiDAR (light detection and ranging) imagery of any province in Canada. Complete LiDAR coverage exists for the entire C5 FMU. This high-resolution spatial data has many applications and is extremely useful in the creation of accurate digital elevation models, in hydrologic modelling and in land-use planning. Forest disposition holders and Alberta Government staff are using LiDAR data to plan and model various activities and management scenarios on the FMU landbase.

- Wet Areas Mapping: Development of this tool began in 2004 through a partnership between the Government of Alberta, academia and industry. This initiative uses digital elevation models derived from LiDAR to predict "wetness" as a function of depth to groundwater. This approach is now available for use by disposition holders and GOA staff and has proven useful in determining how to effectively minimize the intrusion of logging features (roads, trails, cutblocks, etc).into wet areas

- Tablets: A project that was spearheaded by Alberta Forestry staff in the Crowsnest Pass was the use of information Tablets to improve the efficiency and accuracy of data collection in the field while in engaged in inspections and for planning related work. Tablets (and the customized applications which are being used) are replacing the field notebook, hand-held GPS and the laptop computer for data collection while undertaking re-occurring field activities. This has reduced the amount of time spent in the field, improved data entry in the office, and has reduced error inputs that were often associated with older approaches.

- UAVs: Near the end of the reporting period Forest Area staff began using an unmanned aerial vehicle (UAV), equipped with a camera, to undertake inspections of forestry operations as well for use in forest planning work. UAVs are able to provide high-resolution imagery while operating over difficult terrain. The area that can be covered by drones is impressive. This technology has the potential to significantly increase the efficiency and capabilities of field personnel —at a fraction of the cost of using helicopters. Worker safety is also improved as staff do not need to traverse steep or hazardous terrain.

An example of a wet areas mapping modelled output.

Photo of stump-side processing from a UAV.

Objective 51

6.4.3 Protect historical resources where appropriate.

First Nations prayer site

All timber disposition holders are required to comply with the Historical Resources Act by identifying and protecting historical resources on provincial Crown land.

Alberta Culture and Tourism (Historic Resource Management Branch), maintains an inventory of all known significant heritage resources in the FMU. This database is available to disposition holders to be referred to during planning of future harvest and roadbuilding activities.

Additionally, all timber disposition holders in the FMU are subject to the C05 SLS OGR 5.6.2 which states: If a previously unknown historical resource is discovered during road building or harvesting, or silviculture operations, then operations that may directly affect the historical resource shall cease and Alberta Culture shall be notified.

Spray Lake Sawmills has ensured that Historical Resource Impact Assessments (HRIA) are conducted by professional consultants for all proposed roads and cutblocks. If any significant historical resources are identified during the HRIA or during operations, they are afforded protection (generally through avoidance and/or buffering) and if previously unknown, reported to Alberta Culture and Tourism.

Proposed operations for the Community Timber Program during the reporting period were reviewed by the Historic Resources Management Branch and no areas of concern were brought to the attention of regional AAF staff.

The following historic resource sites were discovered in the FMU during the reporting period:

- 2010-11: CTLC050016 - Alison Creek, below Crowsnest Mountain, field #s 5050091037 and 5050091041; prayer trees were identified and given 100 meter buffers.
- 2013-14: CTLC050005 - Trout Creek, reconstruction of the Honey Coulee Road; 3 prehistoric camp sites were avoided.

During the reporting period, no variances to Historical Resources ground rules were recorded by the FOMP program, which indicates the effective identification and protection of historical resources in the FMU.

Objective 52

6.4.4 Obtain current information on forest resources.

Performance Measure:

updating of forest resource inventories

The management of information on forest resources is largely conducted outside of the C5 administrative region by the Forest Management Branch (FMB) in Edmonton. Spatial information was updated over the reporting period for a number of different resource management categories and was made available to local C5 forest management staff.

Aerial Photography: Aerial photography is updated in part annually. Specific portions of the FMU are photographed each year to capture significant changes to the landbase, particularly where new cutblocks are created.

Alberta Vegetation Inventory (AVI): AVI is a photo-based digital inventory developed to identify the type, extent and condition of vegetation, where it exists, and what changes are occurring to vegetation communities. The AVI for the C5 FMU was updated in 2007. This represents a significant update from the 1994-2001 AVI that was used in the development of the FMP.

LiDAR: Light detection and ranging (LiDAR) data has been obtained for much of the province, including the C5 FMU. See objective #50 for more information in this regard.

Spatial Digital Data Submission Directives:
AAF Forest Management Branch approved a the Spatial Digital Data Submission Directives in March 2015. These directives became voluntary as of May 15, 2015 and effective (mandatory) as of May 15, 2016. The Directives help ensure that forest activity reporting and monitoring meet legislated requirements. Forest company activity reporting will confirm that approved activities have occurred, and where and when they occurred. Spatial data will also enable AAF to accurately monitor and report on approved activities including: total area (hectares) harvested annually; harvest area boundaries; inter-block roads, watercourse crossings, the location and number of openings created annually; variances from the SHS; cutblock harvest; and silvicultural activities undertaken.

Objective 53

6.4.5 Manage the C5 FMU as part of a larger regional landscape.

Performance Measure:

contact/communication with other resource managers and jurisdictions

The South Saskatchewan Regional Plan (SSRP) was released in September 2014. This statutory plan aligns provincial policies at the regional level to balance Alberta's economic, environmental, and social goals, and "sets the stage for robust growth, vibrant communities and a healthy environment within the region for the next 50 years." The C5 FMU falls with the SSRP planning area. As such, land uses in the forest management unit will need to conform with direction contained in the SSRP and with sub-regional plans that are being prepared under the authority of the regional plan. This means that timber harvesting plans (GDP, FHP, AOP, etc.) need to comply with the SSRP and the following plans that are currently under development: Biodiversity Management Framework and the Linear Footprint Management Plan.

C5 foresters maintained close communication with forestry staff that are responsible for the forest administrative region immediately to the north of the C5 FMU during the reporting period. Monthly conference calls and bi-annual meetings between regional forestry staff allowed for the exchange of information, sharing of issues being faced, and strategies being taken to resolve issues.

Meetings involving regional resource management staff were held on an ad-hoc basis to discuss numerous regional issues and resource management initiatives. These included meetings with the Crown Managers Partnership, a collaboration between land managers that seeks to address environmental management challenges in the "Crown of the Continent Region". The "Crown" encompasses the continental divide regions of southern Alberta, British Columbia and northern Montana. Information on the Crown Managers Partnership is available online: http://crownmanagers.org/

Communication with resource managers from other jurisdictions occurred frequently. Such regular contact ensures that matters of common interest between neighboring jurisdictions can be explored, discussed and addressed, and presents opportunities for finding collaborative approaches in addressing mutual challenges. Managing natural landscapes and heritage resources as part of a larger regional ecosystem is now accepted as a best practice and will continue in the future.

Appendix A

First Nations Consultations

Consultation Letters of Adequacy

The C5 FMU falls within the traditional territories of Treaty 7 First Nations. Band Councils from the adjoining Piikani First Nation (Indian Reserve (IR) 147, 147B), Stoney (Bearspaw, Chiniki and Wesley) First Nation (IRs 216 142,142B,143, 144), Siksika First Nation (IR 146) and Tsuu T'ina First Nation(IR145) and the Blood First Nation (IR 148,148A) were encouraged to participate in the forest management planning process throughout the reporting period. More specifically, these First Nations were invited each year to provide feedback on the draft General Development Plans that were being put forward by timber disposition holders.

The following letters from GoA foresters indicate that First Nations consultation activities which were undertaken during the reporting period to obtain First Nations input on C5 General Development Plans were deemed to be adequate (i.e., First Nations consultation was in conformance with Alberta's First Nation Consultation Guidelines).

AAF has prepared First Nation consultation logs (these are internal documents) which contain a detailed record of C05 Community Timber Program engagements that occurred with interested First Nations during the reporting period.

Government of Alberta ■
Sustainable Resource Development

Forestry Division
8660 Bearspaw Dam Road
Calgary, AB
T3L 1S4

Oct 21, 2010

Tiffany Morning Bull, Consultation Coordinator
Piikani First Nations
P.O. Box 70
Brocket, AB
T0K 0H0

RE: SPRAY LAKE SAWMILLS: 2010 GENERAL DEVELOPMENT PLAN

With respect to the above captioned plan submission, this letter is to inform that, in accordance with the Government of Alberta's *First Nations Consultation Guidelines on Land Management and Resource Development*, consultation is deemed adequate.

The application described above has been approved, and SRD encourages continued and ongoing communications regarding current and future General Development Plan review submissions.

If you have any questions, please contact Darcy Evanochko, Resource Management Advisor at (403) 845-8201or Robert Mueller, Forester at (403) 297-8844.

Sincerely,

Morgan Kehr
Area Manager (Acting)
Southern Rockies Area

cc: Robert Mueller, Area Planning Forester
Darcy Evanochko, Resource Advisor, Clearwater
Spray Lake Sawmills

Government of Alberta ■
Sustainable Resource Development

Southern Rockies Area
8660 Bearspaw Dam Road NW
Calgary, Alberta T3L 1S4
Telephone: 403-297-8800
Fax: 403-297-8803
www.alberta.ca

Sept 9, 2011

File: 2011/12 GDP

Spray Lake Sawmills
305 Griffin Road W
Cochrane, Alberta
T4C 2C4

Attention: Mr. Gord Lehn

Re: Approval: 2011-2012 Spray Lake Sawmills C05 and FMA General Development Plan

With respect to the above captioned plan submission, this letter is to inform that, in accordance with the Government of Alberta's First Nations Consultation Guidelines, on Land Management and Resource Development, consultation is deemed adequate.

The application described above is approved, and SRD encourages continued and ongoing communications regarding current and future General Development Plans review submissions.

If you have any comments or concerns regarding the above, please contact Foresters, Robert Mueller at (403) 297-8844 or Tim Juhlin at (403) 562 3141.

Sincerely,

Morgan Kehr
Forestry Manager
Southern Rockies Area

cc: Jean Lussier, Senior Forester Calgary
Rob Mueller, Planning Forester Calgary
Tim Juhlin, Planning Forester Blairmore

Alberta Environment and Sustainable Resource Development

Division
Forestry Division, Southern Rockies Area
8660 Bearspaw Dam Road NW
Calgary, AB
T3L 1S4
Canada
Telephone: (403) 297-8800
Fax: (403) 297-8847
www.alberta.ca

October 22, 2012

File: 793128 Ab. Ltd 2012/13 GDP

793128 Alberta Ltd.
P.O. Box 135
Hillcrest, Alberta
T0K 1C0

Attention: Dale Linderman

RE: 793128 Alberta Limited CTQC050002 GENERAL DEVELOPMENT PLAN 2012-13 Operating Period

With respect to the above captioned plan submission, this letter is to inform that in accordance with the Government of Alberta's First Nations Consultation Guidelines on Land Management and Resource Development, consultation is deemed adequate.

The application described above is approved as per the Spray Lake Sawmills and C05 Operating Ground Rules (2012). ESRD encourages continued and ongoing communication regarding current and future General Development Plan review submissions.

If you have any comments or concerns regarding the above, please contact Area Forester, Tim Juhlin at (403) 562-3141.

Sincerely

Morgan Kehr, RPFT
Forestry Program Manager
Southern Rockies Area

cc: Jean Lussier, Senior Area Forester, Calgary
Tim Juhlin, Area Forester, Blairmore

Government of Alberta

South Saskatchewan Region
8660 Bearspaw Dam Road NW
Calgary, Alberta T3L 1S4
Telephone: 403-297-8800
Fax: 403-297-8803
www.alberta.ca

February 21, 2014

2013-2014 SLS GDP

Rob Berndt, Operation Manager
Spray Lake Sawmills
305 Griffin Road W.
Cochrane, Alberta
T4C 2C4

RE: SPRAY LAKE SAWMILLS C05 AND FMA 2013-2014 GENERAL DEVELOPMENT PLAN

With respect to the above captioned plan submission, this letter is to inform that in accordance with the Government of Alberta's First Nations Consultation Guidelines, on Land Management and Resource Development, consultation is deemed adequate.

The application described above is approved as per the Spray Lake Sawmills and C05 Operating Ground Rules (2012). SRD encourages continued and ongoing communication regarding current and future General Development Plan review submissions.

If you have any questions, please contact Robert Mueller at (403) 297-8844.

Sincerely,

Jean Claude Lussier

Jean C. Lussier, RPF
Acting Approvals Manager, Forest Management
South Saskatchewan Region
Operations Division
Alberta Environment and Sustainable Resource Development

Alberta

Freedom To Create. Spirit To Achieve.

Government of Alberta ■

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Calgary, Alberta T3L 1S4
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December 4, 2014

2014-2015 SLS GDP

Rob Berndt, Operation Manager
Spray Lake Sawmills
305 Griffin Road W.
Cochrane, Alberta
T4C 2C4

RE: SPRAY LAKE SAWMILLS C05 AND FMA 2014-2015 GENERAL DEVELOPMENT PLAN

With respect to the above captioned plan submission, this letter is to inform that in accordance with the Government of Alberta's First Nations Consultation Guidelines, on Land Management and Resource Development, consultation is deemed adequate.

The application described above is approved as per the Spray Lake Sawmills and C05 Operating Ground Rules (2012). SRD encourages continued and ongoing communication regarding current and future General Development Plan review submissions.

If you have any questions, please contact Robert Mueller at (403) 297-8844.

Sincerely,

Jean Claude Lussier

Jean C. Lussier, RPF
Senior Forester, Forest Management

Cc: Robert Mueller, Area Forester
Tim Juhlin, Area Forester

Alberta
Freedom To Create. Spirit To Achieve.

Appendix B

Alberta Public Consultation Log

Type of Event	Year	Date	Event	Participants
Field Tour	2010	July 6	OWC and Bow WC tour of C5 and watershed study area	Area Forester and ~ 40 people attended this event and discussed water management in the region.
SLS/AAF Open House	2010	Oct 28	A public open house information session was held jointly Between SLS and AAF in Pincher Creek specifically to review the C5L15 Plan.	Approximately 85 participants attended.
CNP School Talk	2011	Spring	Forest Fire Safety talk to middle school students in Crowsnest Pass	Forestry staff member addressed ~125 middle school students.
Signage	2011	Summer 2011	Three signs were installed in the Castle area; one at the Beaver Mines Lake Turnoff, one at the Castle Falls PRA and the last at the Lynx Creek Carbondale junction. Signs provided information on harvest planning in the area.	Signs shared information with all users of the Castle area,
Field Day	2011	July 28	Undertook Allison Creek rare tree inventory work with Junior Forest Rangers.	Two Forestry Staff worked on a survey for rare trees with ~12 Junior Forest Ranger members.
Meeting	2011	Fall	Area Forester met with Beaver Mine residents to review harvest plans.	Three concerned residents of Beaver Mines were present.
Hall meeting	2011	Fall	Meeting occurred at Willow Valley School to discuss harvesting in the Todd Creek area (C5L18 FHP) with concerned stakeholders.	More than 40 residents met with 2 Forestry Staff and 2 SLS representatives.
Meeting	2011	Nov 7	Area Forester delivered a presentation on C5 forest management planning at a CNP municipal planning committee meeting.	About 7 Committee members attended, there was also an audience present.
Meeting	2012	Jan 4	Meeting occurred between Forest Management staff and concerned local residents regarding the Beaver Mine (C5L15) harvest plans.	Area Forester met with 4 residents.

Public consultation log continued.

Type of Event	Year	Date	Event	Participants
News Release	2012	Jan 20	A notice of development for harvesting in the Castle Special Management Area was delivered on CBC Radio.	Available to all radio listeners in southern Alberta.
CNP School Talk	2012	Winter	Forest Management Planning talk was given to Grade 6 students at middle school in the Crowsnest Pass.	Class of Grade 6 students.
Hall Meeting	2012	May 22	Meeting at Willow Valley School regarding C5L18 FHP (Todd Creek). Visualization maps were presented and public concerns were discussed.	Forestry and SLS staff made presentations to ~ 45 attendees.
Field Tour	2012	June 14	Trout Creek field tour to discuss road network design with Trout Unlimited members.	1 Trout Unlimited member, 2 Forestry staff, 2 Range Management staff, 1 SLS staff members.
School Field Trip	2013	Feb 7	Forest Management Specialist took Lethbridge Catholic High School students on a field tour of harvesting operations in the Beaver Mines area.	~ 30 Grade 12 students.
Meeting	2013	April 24	SLS staff and GoA staff (Range Management; Forestry) met with grazing lease holders at Todd Creek to discuss the C5L18 FHP.	10 grazing lease holders attended.
Field Tour	2013	Aug 1	Crowsnest Pass Promoter editor was given a tour of C5L15 Beaver Mines harvest operations to provide information for a subsequent news article (published Aug 28, 2013).	Area Forester and CNP Promoter editor.
Field Meeting	2013	Sept 18	Area Forester addressed Lethbridge College students on a field trip about Forest Management .	11 Lethbridge College students and an instructor attended.
Meeting	2014	April 1	Area Forester spoke at an MD of Ranchlands Council meeting regarding forestry practices.	~10 people from the MD were present.
Interview	2014	July 28	Interview occurred on harvesting in the Trout Creek area of the Porcupine hills.	Lethbridge Global news report was made available to the public.
Field meeting	2014	Sept 17	Area Forester speaks to Lethbridge College students on a field trip about land use planning.	6 Lethbridge College students and an instructor attended.

Public consultation log continued.

Southern Rockies Watershed Project Tour	2015	Feb 5 2015	Tour of Phase 2 operations of the Southern Rockies Watershed Project (SRWP) for CNP Mayor and 2 Councilors.	3 Crowsnest Pass Council members attended, with 2 Forestry staff.
Southern Rockies Watershed Project Tour	2015	March 4	Tour of Phase 2 operations of the Southern Rockies Watershed Project (SRWP) for local GoA staff.	4 Forestry staff, 2 Fisheries staff, 1 GoA communications specialist attended.
Southern Rockies Watershed Project Tour	2015	Aug 20	Tour of Phase 2 operations of the Southern Rockies Watershed Project (SRWP) for local GOA staff and an original CrowPAC member.	Area Forester, 3 Public Lands staff, 1 former CrowPAC member.
Southern Rockies Watershed Project Tour	2015	Aug 26	Tour of Phase 2 operations of the Southern Rockies Watershed Project (SRWP) for local Fish and Wildlife staff.	Area Forester and 3 Fish and Wildlife staff.
Southern Rockies Watershed Project Tour	2015	Aug 27	Tour of Phase 2 operations of the Southern Rockies Watershed Project (SRWP) for CNP Councilor, original PAC members and a CNP Herald reporter.	3 GOA staff, 2 CrowPAC members, 1 Crowsnest Pass Councillor, and 1 Reporter.
GOA web Page	2010-2015	Ongoing	C5 Forest Management Plan web page is prepared. https://www.agric.gov.ab.ca/app21/forestrypage?cat1=Forest%20Management&cat2=Forest%20Management%20Plans&cat3=Forest%20Management%20Unit%20(FMU)%20C5	Available to all viewers.
GOA web Page	2010-2015	Ongoing	A web page was developed and maintained by GoA Communications Branch regarding C5L15 Beaver Mines harvest planning https://www.agric.gov.ab.ca/app21/forestrypage?cat1=Forest%20Management&cat2=Castle%20Area%20Timber%20Harvesting	Available to all viewers.

Considerable additional public consultation happens on an ad-hoc basis through emails and phone calls with stakeholders and the public. Many of these forms of communication are not recorded in any database, but are an important component of Forest Management staff responsibilities in sharing information about the C5 activities with interested parties.

Appendix C

Spray Lake Sawmills Public Consultation

Spray Lake Sawmills public notice for annual Open House: 2010, 2011, 2012, 2013, 2014.

Example of a Spray Lake Sawmills stakeholder letter to a C5 user group (i.e., Crowsnest Pass Quad Squad). Spray Lakes contacted an average of 139 stakeholders (groups and individuals) annually during the reporting period.

Spray Lake Sawmills

305 Griffin Road W
Cochrane, Alberta T4C 2C4
Phone (403) 932-2234
Fax (403) 932-6675

March 6, 2014

Crowsnest Pass Quad Squad
Box 308
Bellevue, AB
T0K 0C0

Subject: Notification of Spray Lake Sawmills Harvest Plans

On April 1, 2014 Spray Lake Sawmills (SLS) will be submitting its Annual Operating Plans (AOP) to Alberta Environment and Sustainable Resource Development (ESRD) for approval.

While operating plans are not finalized, below, is a list of operating area licenses that tentatively may include harvesting operations for the 2014/2015 operating year.

License #	2014 Operating Areas
CTLC050003	Spoon Valley – 20km up Atlas Road
CTLC050005	North Porcupine Hills – Trout Creek / Lyndon Creek
CTLC050006	Dutch Creek
CTLC020026	Speers Creek / Coat Creek / Isolation Creek
CTLC050009	Savanna Creek / Upper Livingstone River
CTLC050015	Beaver Mines – Beaver Lake Road / Castle Falls Road / O'hagan

In addition, SLS is developing future "operating areas" that will be scheduled for harvesting beyond the 2014 operating year. Refer to the below table for areas that are to be developed or in the process of being developed. Also, to review our current year's harvest plans and future operating areas please go to our 5 year General Development Plan (GDP) located on our website at http://www.spraylakesawmills.com/.

License #	Future Operating Areas
CTLC050005	South Porcupine Hills – Sharples Creek / Heath Creek
CTLC050018	Todd Creek / Ernst Creek
CTLC050019	West Chain Lakes – Riley Creek / Westrup Creek / Langford Creek / Timber Creek / Johnson Creek / Iron Creek
CTLC020025	East Lower Livingstone – Snake Creek / White Creek
CTLC020026	East Upper Livingstone – Deep Creek / Ridge Creek / Beaver Creek
CTLC050015	Gladstone Creek / Mill Creek / Whitney Creek

If you wish to personally view or discuss the proposed operating plans please contact me at your earliest convenience or visit our office in Blairmore. We also encourage anyone interested to attend our Open House scheduled for the first week in May every year. Confirmation of the Open House date will be finalized and announced in local papers towards the end of April.

Respectfully,

Errol Kutcher, RPF
SLS Harvest Planning and Silviculture Forester – Crowsnest Forest Products
Phone: (403) 562-8520
Cell: (403) 563-4099
Fax: (403) 562-8521
errol.kutcher@spraylakesawmills.com

Website: www.spraylakesawmills.com Email: info@spraylakesawmills.com

Example of Spray Lakes Sawmills Public Advisory Committee meeting minutes from a November 2010 meeting. Public Advisory Committee meetings were held annually with additional meetings scheduled as required. Meeting minutes from other PAC

ees & Affiliation:

Gord Lehn – SLS
Errol Kutcher – SLS
Martin Wilson – SLS
David Green - SASCI
Wade Aebli – Hillcrest Fish & Game Club
Brian Gallant – Non-motorized Recreation
Dave Welsh – Public at Large
Bill Kinnear – Crowsnest Forest Stewardship Society
Tom Lynch-Staunton – Northfork Grazing Allotment
Tim Juhlin – SRD

Absentees & Affiliation:

John Slupsky – Devon Canada
Ron Davis – MD of Ranchlands
John Kinnear – Crowsnest Conservation Society
Larry Mitchell – Crowsnest Municipal Council
Glen French – Motorized Recreation
Andrew Rusynyk – Castle Mountain Resort

Welcome	Welcomed new PAC members. David Green representing the Southwest Alberta Sustainable Community Initiative (SASCI) was introduced as a new member of the C5 PAC. Andrew Rusynyk representing the Castle Mountain Resort has also become a PAC member; however, due to unforeseen events he could not attend tonight's meeting. SLS also extended an invitation to the MD of Pincher Creek to be a C5 PAC member. To date, SLS has received no response to that invitation.
Review of March 15th Minutes	PAC was satisfied with content of the March 15th minutes; therefore, no revisions will be made and they will be posted on the SLS website.
SLS Roads Program Presentation	There are 4 classes of roads: Class I – permanent, all weather, >20year life. Class II – permanent, all weather, 5-20year life. Class III – permanent, frozen or dry conditions, <20year life. Class IV – temporary, frozen or dry conditions, <5yr life. Class I to III roads: Construction schedule must be 5 yr forecast. Phased planning process: Corridors are identified. Integration with other users. Potential impacts on other forest resources highlighted. LOC application. Construction. Class IV roads: Roads built as per approved AOP. Less than 5 yr life span. Road maintenance and abandonment plan showing all temporary roads older than 2 yrs. Submission date of June 15th. Road Construction: Objective is to minimize environmental impact. Use existing access wherever feasible. Construction to avoid meadows, wet areas, unstable slopes, excessive soil disturbance. Erosion control and prevention. Reclamation to take place after reforestation activity.

SLS Roads Program Presentation – (Con't)	Water course crossings: Protection of water quality, fish passage, bank stability and aquatic environment. Water Act Code of Practices followed for culverts >1.5m and multi span bridges. All other structures approved through AOP with fish bearing crossing also requiring DFO approval. On FHP, all intermittent and permanent streams classified and all crossing structures located. Erosion control structures in place during construction. All intermittent/permanent streams have open bottom structures. 2010 Road construction to occur in: McGillivray, Nez Perce, Hidden, Isolation and Savanna Crk. Occur from June to March. Approx. 30km of road to construct. Road Reclamation involves: Road surface de-compacted and re-sloped. Crossings removed – stream banks stabilized & monitored. Top soil rolled back and slash spread. Roads are reforested. Where SLS upgrades "historical access" (ie. Old roads, rec trails) the road will be put back to the same condition as it was found. If the trail was accessible for 4X4 traffic prior to the road upgrades than that trail will be accessible to 4X4 traffic after harvesting.
	2010 Reclamation involves: Oldman, McGillivray Creek, Nez Perce Creek and Dutch Creek. Approx. 30km of road to be reclaimed. Startup will be in June and likely continue to early December.
PAC Comments arising from the Roads Program Presentation	PAC asked what defined "historical access". SLS stated that SRD would decide whether or not a road and/or recreational trails are deemed as historical access. Gord talked about how the amount of roads can impact the "road density thresholds" with regards to the Grizzly Bear Management Plan. Gord also talked about the need for a universal access management plan that covers all of the southern east slopes. PAC had concerns with reclaimed roads that were still impassible by foot due to the amount of slash layed on top of the re-contoured slopes. PAC member pointed out that some of these areas they were referring to were not from SLS activities. Discussed the long term plans of the Atlas road and the need for an access management plan. Talked more about SLS having to pull three crossings this August as a result of a road inspection completed by SRD. The three crossings include an old box culvert at 18km, a bridge at 20km and another bridge at 23.5km.

SLS Annual Operating Plan Presentation	An Annual Operating Plan (AOP) is a detailed form created by SRD – referred to as a TM118 Form. The TM118 Form outlines in detail all the activities proposed for the current timber year for each license. Activities include harvesting, road construction/reclamation, site preparation and planting. Timber year is from May 1st to April 30th. The purpose of the AOP is to allow SRD to "annually authorize all road, harvest and forest management activities for the operator". Information within an AOP consists of: Operating schedule and timber production. Applicable Final Harvest Plans. Compartment Assessments (if applicable). Reforestation program. Fire control plan. Road plan. Copies of all referral letters to stakeholders. Copies of all signed Grazing Timber Agreements (GTA). Listing of all necessary Road Use Agreements (RUA). AOP submission deadline to SRD is April 1st. AOP approval or conditions to approval from SRD is 30 days within the submission date. Lower Livingstone AOP Submission includes: Working Area – west side of Kan. from 45-50km Blocks – 6 Harvest Area – 106 hectares Volume – 20,192m3 (480 loads) Upper Livingstone AOP Submission includes: Working Area – west side of Kan. from 55-64km Blocks – 26 Harvest Area – 256 hectares Volume – 51,072m3 (1,216 loads) Racehorse Creek AOP Submission includes: Working Area – Spoon Valley Blocks – unknown Harvest Area – estimated 133 hectares Volume – estimated 20,000m3 (476 loads) Still being layed out and will be submitted into SRD by the end of May. Area has small component of white bark pine which is listed as an endangered species. SLS has contacted SRD and is awaiting direction before continuing anymore development. Dutch Creek AOP Submission includes: Working Area – SW of old Johnson's Mill Site Blocks – 1 Harvest Area – 45 hectares Volume – 8,940m3 (213 loads)

SLS Annual Operating Plans Presentation (Con't)	Oldman AOP Submission includes: Working Area – Hidden Creek Blocks – 7 Harvest Area – 109 hectares Volume – 18,841m3 (449 loads) Savanna Creek AOP Submission includes: Working Area – along Kan from 64km-Wilkinson Summit Blocks – 8 Harvest Area – 108 hectares Volume – 21,105m3 (503 loads) Allison/Chinook AOP Submission includes: Working Area – McGillivray/Nez Perce Creek Blocks – 21 Harvest Area – 381 hectares Volume – 64,761m3 (1,542 loads)
Comments arising from AOP Presentation	PAC suggested that SLS increase signage along the road adjacent to active cutblocks near rivers such as the Livingstone and the Oldman. Content of sign should illustrate how water is being protected through proper forest management strategies. PAC suggested to discuss the presence of white bark pine in the Spoon Valley area in the form of a press release in the papers and that SLS has notified SRD to get direction. Currently, SLS is awaiting a decision to use the McGillivray road by the municipality of Crowsnest Pass. (Note: a road use agreement has since been finalized between SLS and the municipality). SLS has been denied access to use the "Prospects Road" owned by the McGillivray Land Development Corporation. No reason was provided.
C5 Crowsnest Communication Plan	Gord handed out copies of the SLS C5/Crowsnest Pass – Communication Plan to all members for comments. The plan strategically discusses how SLS will try to become an "important, integral and accepted part of the Crowsnest Pass" through various forms of communication. PAC is to review the draft plan and provide comment.
C5/Crowsnest Newspaper Articles	Gord handed out a list of proposed C5/Crowsnest Newspaper Articles list for review by the PAC. PAC members are to review the topics and provide comments. Articles will be submitted to the local paper on a weekly basis. PAC suggested submitting articles to Pincher Creek Echo and alternate every week between the Crowsnest Pass Herald and the Crowsnest Pass Promoter. The first article will be submitted to all three papers as it will introduce the C5 PAC to the community.

Letters to the Editor	The recent letters to the editor were discussed. It was agreed that instead of providing a response via a "letter to the editor", SLS would work on providing correct information to the public through the media plan/articles. Some correspondence has also been received which objects to the proposed future harvesting in the Beaver Mines area. SRD has been contacted and has advised SLS that it is not a protected area and that unless directed otherwise by Cabinet that we should proceed as planned. Harvest activities are currently being planned for the 2011/2012 season.	Gord PAC
Next Meeting	No date set unless requested by PAC until the upcoming C5 PAC Field Tour early this summer.	All
	The purpose of the field tour is to review some of the "discussion items" discussed in the previous PAC meetings that are applicable to the field. Some of the activities that we will be focusing on include: Block & Road layout Stream Classification & Riparian Buffers Harvesting Techniques Road Construction/Reclamation Crossing Installations Site Preparation & Planting	
	As operational plans for 2010 are confirmed, SLS will be able to better coordinate the activities for the upcoming year and provide the best possible dates. Confirmation of the field tour date should be provided to PAC members by mid May and the actual tour date will likely occur between mid June to mid July.	

Action Items

- SLS will be putting an article into the Pincher Creek Echo, the Crowsnest Pass Herald and the Crowsnest Pass newspapers within the n nouncing the creation of the C5 PAC as well as introducing its' members to the community.
- PAC to review C5/Crowsnest Pass - Communication Plan and provide feedback to SLS.

FORCORP - Project Number: P877

For additional information, please contact:
FORCORP Solutions Inc.
15015 123 Ave
Edmonton, AB
T5V 1J7
(780) 452-5878
www.forcorp.com

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FINAL DRAFT

Annex IV – Yield Curve Development

FORCORP

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	II	Communication Plan
	Annex	III	Stewardship Report (2010-2015)
	Annex	**IV**	**Yield Curve Development**
	Annex	V	Net Landbase Development
Three	Annex	VI	TSA – Timber Supply Analysis
	Annex	VII	SHS – Spatial Harvest Sequence
	Annex	VIII	Growth and Yield Plan

Executive Summary

The Crowsnest Forest Products Ltd (Crowsnest) 2025 Forest Management Plan (FMP) Defined Forest Area (DFA) encompasses Forest Management Unit (FMU) C5.

As part of the 2025 C5 Forest Management Plan (FMP), new timber volume yield curves were developed for the DFA. These curves will be applied in the Timber Supply Analysis (TSA) component of the 2025 C5 FMP. This document describes the data, methods, and assumptions applied to develop yield estimates for natural and managed stands. The final yield curves presented here will be incorporated into the TSA process where additional changes or assumptions may be applied. Any changes applied to the yield curves before use in TSA modeling will be documented in Chapter 6: Preferred Forest Management Scenario or in Annex VI: Timber Supply Analysis.

Stratification was based on the Alberta Forest Management Planning Standard (Version 4.1, April 2006). Base 10 strata were assigned through the net landbase development process using either Alberta Vegetation Inventory (AVI) attributes for natural stands or a combination of silviculture declaration plus treatment information, as well as Reforestation Standard of Alberta (RSA) performance survey data for managed stands. Yield strata are a modification of the Alberta's Base 10 yield strata. For natural stands, as pure black spruce and black spruce-aspen mixedwood stands were a landbase deletion, the Sb stratum and SbHw stratum were excluded from sampling.

Crowsnest does not harvest the pure deciduous stratum (Hw), and it has been excluded from sampling and yield curve development. However, a deciduous curve must be produced to determine a deciduous AAC. The same Hw curve from the previous 2006 -2026 C5 FMP is presented in this document.

The yield curves are based on information collected in Temporary Sample Plot (TSP) and RSA performance survey programs across the DFA.

Gross merchantable tree length volumes were compiled to a utilization standard of 10 centimetre (cm) top diameter inside bark for deciduous species and 11 cm for coniferous species, 15 cm stump diameter outside bark at a 30 cm stump height using a 4.88 metre (m) minimum merchantable length for both coniferous and deciduous species groups. Cull and stand retention were not accounted for during yield curve development and will be addressed in the TSA.

Crowsnest identified three categories for yield curve development:

Natural stands (NAT): Includes all fire-origin stands. The natural stand yield curves were developed based on TSP data using an empirical approach. Strata assignment was based on AVI attributes.

Pre-1996 managed stands (Pre96): Represents the population of managed stands harvested before May 1, 1996. Modeling was based on juvenile TSP data projected using GYPSY in a semi-empirical fashion whereby top height and basal area at inventory age were used to constrain model projections. Strata assignment was based on the AVI attributes. This category was limited to pure white spruce (Sw) and pure pine (Pl) yield strata. All other Pre96 managed stands in FMU C5 will follow natural stand yield curves (NAT).

Post-1995 managed stands (Post95): Represents the population of managed stands that are harvested on or after May 1, 1996. Modeling was based on RSA performance survey data projected using GYPSY. Strata were assigned using RSA sampling units and AVI reconciled with ARIS. This category was limited to pure pine (Pl) yield strata. All other Post95 managed stands in FMU C5 will follow natural stand yield curves (NAT).

The set of final yield curves constructed for consideration in the TSA process are summarized in Table 1.

Table 1. TSA Yield curve set

Yield Stratum	Natural	Pre96		Post95	
		Basic [1]	Juvenile	Basic [1]	RSA
Hw	Yes	Yes		Yes	
Fd	Yes	Yes		Yes	
PLMIX	Yes	Yes		Yes	
SXMIX	Yes	Yes		Yes	
Pl	Yes	Yes	Yes	Yes[3]	Yes[2]
Sw	Yes	Yes	Yes	Yes	

[1] Basic curves are duplicates of the Natural curves.

[2] An RSA curve was built, but the curve to be used in the TSA is based on a % reduction of the natural curve

[3] The existing post-95 population uses the RSA curve, but future cutblocks use the Basic curve

Mean Annual Increment (MAI) values (gross merchantable 15/10 for deciduous and 15/11 for coniferous) for the yield curves to be used in the TSA process are summarized in Table 2.

Table 2. TSA yield curve set cumulative MAI summary

Yield Stratum	Natural Culmination MAI			Pre96 and Post95 Basic Culmination MAI			Pre96 Juvenile Culmination MAI			Post95 RSA Culmination MAI		
	Age	CON	DEC	Age	CON	DEC	Age	CON	DEC	Age	CON	DEC
Hw	77	0.35	1.19	77	0.35	1.19						
Fd	109	2.78	0.07	109	2.78	0.07						
PLMIX	106	1.09	0.70	106	1.09	0.70						
SXMIX	101	2.09	0.43	101	2.09	0.43						
Pl	90	2.54	0.02	90	2.54	0.02	113	2.62	0.01	90	1.99	0.02
Sw	114	2.32	0.04	114	2.32	0.04	134	2.43	0.03			

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1 Overview

New yield curves projecting the growth of timber volumes were required for the Timber Supply Analysis (TSA) component of the 2025 C5 FMP. This document describes the data, methods, and assumptions applied to develop timber volume yield estimates for natural and managed stands.

To capture the current status of the forest, a new Alberta Vegetation Inventory (AVI) for the Forest Management Agreement (FMA) portion of FMU C5 was completed (AVI approved September 19th, 2022). Both mature timber and juvenile regenerated stand volume sampling programs were subsequently undertaken in order to characterize the standing timber components of the new AVIs and to support development of applicable timber yield projections. The volume sampling data were used to create yield projections.

Yield strata are largely based on the GOA Base 10 with the dropping of the black spruce and black spruce-aspen strata. Yield strata assignments, including species, treatment, and stand age were obtained from the net landbase (Annex V). A combination of AVI, Alberta Regeneration Information System (ARIS), Reforestation Standard of Alberta (RSA) and other disturbance information was used to assign strata. Refer to Annex V: Landbase Development Document for a complete description of the strata assignment process and the landbase to which the curves are applicable.

Yield curves for each stratum were constructed using either an empirical approach, or a model-based approach, i.e. applying Alberta's Growth and Yield Projection System (GYPSY), from the data of Temporary Sample Plots (TSPs) and RSA performance survey results as applicable. Yield curves were created for each yield stratum in the FMU C5 and three distinct yield categories:

- Natural stands;
- Pre-1996 managed stands; and
- Post-1995 managed stands.

Gross merchantable timber yields were based on a common tree length utilization standard of:

- 15 cm diameter at stump height;
- 10 cm top diameter for deciduous and 11 cm top diameter for coniferous;
- 30 cm stump height; and
- 4.88 m minimum merchantable tree length.

Individual coniferous and deciduous projections were completed for each yield strata and yield category combination. Cull deduction factors are not included in the timber volumes in this document and will be applied as the curves are input into the TSA. Similarly, a strata based scaling process will be used to reduce merchantable timber volumes in the TSA process to account for clearing and reforestation of seismic lines.

Table 3 summarizes the final gross merchantable yield curves to be applied in the TSA. In the table, the term 'Basic' represents situations where natural yield projections are applied to managed stand conditions.

Table 3. Matrix of yield curves to be used in the TSA

Yield Stratum	Current Landbase			Future Blocks
	Natural	Pre-1996 Managed	Post-1995 Managed	
Hw	Natural	Basic	Basic	Basic
Fd	Natural	Basic	Basic	Basic
PLMIX	Natural	Basic	Basic	Basic
SXMIX	Natural	Basic	Basic	Basic
Pl	Natural	Juvenile	RSA	Basic
Sw	Natural	Juvenile	Basic	Basic

1.1 About this Document

This document has been prepared as part of the required submissions to GOA for the development of the 2025-2035 FMP.

It contains a complete set of the yield curves that will be considered in the TSA.

The overview section provides background information on the datasets and common technical specifications. The curve creation process is organized by the three yield categories: natural stands, Pre96 managed stands and Post95 managed stands. Each category describes the applicable data, data compilation, curve modeling, required curve adjustments and outcomes. Final curves are presented in a separate appendix for each category as are area weighted and piece size curves.

1.2 Landbase Classification and Base Yield Strata

The net landbase describes the condition of the FMA areas when a new Alberta Vegetation Inventories (AVIs) were completed for the FMU C5 in year 2022. The landbase was created by combining AVI polygons, cutblocks, ARIS treatment records, RSA performance survey information, disturbances such as fires, disposition boundaries, and administrative and management layers. An outcome of this process is the current 'active' landbase assignment, i.e. the stands eligible for forest management activities and the remaining or 'passive' landbase assignment. The timber yield curves described in this document are applicable to only the active portion of the landbase.

Net landbase creation is a complex process involving integrated rules and data manipulation; details of the process are described in the Annex V Net Landbase Development document. This document provides an overview of the landbase creation process and a summary of the outcome. From the perspective of yield curve development, key considerations are that:

- Spatial links to the growth and yield plot data were maintained throughout the landbase creation process, thus permitting landbase attribute assignment to all plot data including strata, age, and active landbase; and
- Original RSA performance survey plot assignment information was maintained for RSA plot data for use in yield curve development, e.g. sampling unit attributes.

Where it existed, RSA performance information was used to assign landbase attributes, overriding other information. ARIS information was linked to all cutblocks harvested after May 1, 1996 and used for assignment of strata, treatment, and age. AVI attributes supported by other data layers, e.g. company cutblock information or wildfire, were used to assign attributes to the remaining forested polygons.

Crowsnest developed new stratification rules for the 2025 FMP after investigating how the new AVI attributes related to proposed management actions. The new stratification was based on the following guiding principles:

- Use the latest AVI for natural stand stratification;
- Use broad cover group (BCG) and major species group as part of the strata;
- Use the GOA extended strata as building blocks for the FMP yield strata;
- Aggregate extended strata into modified Base 10 strata and aggregate further to address small areas;
- Ensure that the strata "can be collapsed on different scales" with considerations given to the size of the resulting strata;
- Reflect the story of primary management (SoPM) in the selection of overstorey or understorey; and
- Incorporate learnings from previous FMPs and balance the needs of harvesting and silviculture operations, TSA, and yield curve development.

GOA Base 10 strata (Table 4) was the basis for yield curve stratification in the 2025 FMP.

Table 4. GOA Base 10 strata

Broad Cover	Stratum No.	GoA Stratum	Stratum Label
D	I	Deciduous	Hw
DC	II	Hardwood/Pine	HwPl
	III	Hardwood/Spruce	HwSw
CD	IV	White Spruce/Hardwood	SwHw
	V	Pine/Hardwood	PlHw
	VI	Black Spruce/Hardwood	SbHw
C	VII	Leading White Spruce	Sw
	VIII	Leading Pine	Pl
	IX	Leading Black Spruce	Sb
	X	Leading Douglas-fir	Fd

Yield strata were assigned based on a set of characteristics derived from AVI attributes (e.g. BCG, overstorey and/or understorey species composition, crown class, etc.) using the GOA Base 10 strata definitions (Table 5). The following modifications were made:

- For natural stands, as pure black spruce and black spruce-aspen mixedwood stands were a landbase deletion, the Sb stratum and SbHw stratum were excluded.

Table 5. FMP modified Base 10 strata

Stratum No.	Yield Stratum	GoA Stratum	Broad Cover	Crown Closure[1]	Leading Conifer	Description
1	Hw	Hw	D	A, B, C, D	any	Pure deciduous stand.
2	PLMIX	HwPl	DC	A, B, C, D	Pl	Pine-aspen mixedwood, deciduous leading.
3		PlHw	CD	A, B, C, D	Pl	Pine-aspen mixedwood, pine leading.
4	SXMIX	HwSw	DC	A, B, C, D	Sw	Spruce-aspen mixedwood, deciduous leading.
5		SwHw	CD	A, B, C, D	Sw	Spruce-aspen mixedwood, white spruce leading.
6	Sw	Sw	C	A, B, C, D	Sw	Pure coniferous stand, white spruce leading.
7	Pl	Pl	C	A, B, C, D	Pl	Pure coniferous stand, pine leading
8	Fd	Fd	C	A, B, C, D	Fd	Pure coniferous stand, Douglas-fir leading

[1] Stands with den_int <= 20 are density deletions for natural fire origin stands. A density only includes stands with den_int > 20 and den_int <= 30.

Crowsnest does not harvest the pure deciduous stratum (Hw), and it has been excluded from sampling and yield curve development. CFP will use Hw natural stand yield curves in 2006 – 2026 FMP because a deciduous curve must be produced to determine a deciduous AAC.

Due to the small area present within the mixedwood stratum it was decided to combine the following strata for sampling:

- HwPl with PlHw; and
- HwSw with SwHw.

This strata amalgamation was initially for plot sampling to support yield curve modelling. Empirical regression modelling with a dummy variable were initially used to create separate pine mixedwood yield curves (HwPl vs. PlHw) and separate spruce mixedwood yield curves (HwSw vs. SwHw), but it was subsequently decided to group the DC/CD pine and spruce together (MIX_Pl and MIX_Sx) due to the small landbase area and sample size, and insignificant differences between the non-grouped yield curves.

The pine stratum was previously divided by natural subregion (Montane and Subalpine) but has since been combined back together for a single pine stratum due to limited area, a lack of older stands sampled in the Montane.

The Douglas-fir stratum was previously divided into pure Douglas-fir (GOA extended stratum C13) and Douglas-fir leading (GOA extended stratum C14), but it was subsequently decided to combine these two due to the small landbase area and similar management strategies for the strata.

This results in 8 sampling and 6 final natural yield strata (Table 6).

Table 6. Final sampling and yield strata

Sampling Stratum	Yield Stratum	GoA Stratum	Yield Stratum Description
Hw[1]	Hw	Hw	Pure deciduous stand.
PLMIX	PLMIX	HwPl	Pine-aspen mixedwood, deciduous leading.
		PlHw	Pine-aspen mixedwood, pine leading.
SXMIX	SXMIX	HwSw	Spruce-aspen mixedwood, deciduous leading.
		SwHw	Spruce-aspen mixedwood, white spruce leading.
Sw	Sw	Sw	Pure coniferous stand, white spruce leading.
Pl - Subalpine[2]	Pl	Pl	Pure coniferous stand, pine leading in Sub Alpine natural subregion.
Pl - Montane[3]		Pl	Pure coniferous stand, pine leading in Montane natural subregion.
Fd - Pure	Fd	Fd	Pure coniferous stand, pure Douglas-fir
Fd - Leading		Fd	Pure coniferous stand, Douglas-fir leading.

[1] - No sampling was done .

[2] - Sub Alpine and Alpine NSRs were grouped.

[3] - Montane and Foothills Fescue were grouped.

1.3 Growth and Yield Categories

Crowsnest identified 3 broad growth and yield categories within the DFA for the purposes of yield curve development. Categories are based upon a combination of natural or anthropogenic stand origin and silviculture regulations.

1.3.1 Natural Stands

Natural stands are defined as all fire-origin stands in the DFA; specifically, all stands that are not managed, i.e. created through anthropogenic activity.

1.3.2 Pre-1996 Managed Stands (Pre96)

Pre-1996 managed stands are the population of managed stands harvested before, or with the last activity creating an origin before, May 1, 1996. For instance, a stand harvested and regenerated in 1980 but subsequently retreated in 1998 would be a 1998 stand and not a Pre96 stand.

1.3.3 Post-1995 Managed Stands (Post95)

Post-1995 managed stands are the population of managed stands that are harvested, or with the last origin creating activity on or after May 1, 1996.

Active landbase area distribution by yield strata and yield category is presented in Table 7.

Table 7. Active landbase areas by yield strata and yield category

Yield Stratum	Active Landbase Area (ha)			
	Natural	Pre96	Post95	Total
Hw	11,928	148	39	12,114
Fd	10,228	611	70	10,909
PLMIX	793	98	249	1,140
SXMIX	1,346	204	76	1,626
Pl	39,780	8,083	13,519	61,382
Sw	15,185	2,530	1,211	18,926
Total	***79,259***	***11,675***	***15,163***	***106,097***

Areas in Table 7 are final net landbase areas to which the curves will be applied in the TSA.

1.4 GYPSY Growth Model

The Growth and Yield Projection System (GYPSY) model is a stand-level growth model developed by the Province of Alberta (Huang et al. 2009a, 2009b). Model inputs include stand age plus species group[1]-specific inputs: top height or site index (SI), age, density, stocking (optional), and basal area (optional).

Spatial patterning is modeled via an (optional) stocking input, which modifies both the density and basal area increment functions within the GYPSY model. If stocking is not provided to the model, a non- spatial version of GYPSY is used. Huang at al. (2009a) recommend using the non-spatial version of GYSPY for fire origin stands, and wherever possible, the spatial version for post-harvest stands.

Basal area inputs are used to localize (constrain) predicted basal area increment curves to observed plot data. Where basal area inputs are not available (for example, regeneration surveys without diameter measurements), basal area increment is predicted solely by the model.

Competition between species is built into the model's structure in two ways: via a species composition function (species group density relative to total density) as well as through interactions within several of the model functions. Aspen and black spruce species groups are unaffected by the presence of other species except via species composition equations embedded in the model. White spruce and pine species groups are affected by the presence of other species groups via modifiers to the density, basal area increment, and percent stocking models.

1.5 Technical Specifications

1.5.1 Yield Curve Summary

1.5.1.1 Natural Stand Yield Curves

Natural stand yield curves were developed to predict growth and yield projections for the natural stands as classified by the new AVI and associated mature stand TSP data. TSP data collected in year 2022 under the Natural Stand Volume Sampling Plan (April 2022) were used to create all the natural stand yield curves.

[1] Species groups: AW (aspen, birch and poplar), PL (pines + larch), SB (black spruce), SW (white spruce + fir).

1.5.1.2 Pre-1996 Managed Stand Yield Curves

Pre-1996 managed stand (Pre96) yield curves were developed for the stands that were harvested before May 1, 1996. The Juvenile TSP data collected in year 2022 under the Managed Stand Volume Sampling Plan (April 2022) were used to create Pre-1996 managed stand yield curves. Pre96 managed stand yield curves were applicable only to the targeted sampled population of stands which are restricted to Pl and Sw yield strata with sufficient area. All other Pre96 managed stands will follow natural stand yield curves.

1.5.1.3 Post-1995 Managed Stand Yield Curves

Post-1995 managed stand (Post95) yield curves were developed for the stands that were harvested on or after May 1, 1996. Data collected under RSA performance survey protocols were used to create Post95 yield curves for the stratum Pl where sufficient data is available from RSA.

A summary of all yield curves, including the model used for yield curve development, scale of application, and method of stratum assignment for the plot level data is provided in Table 8.

Table 8. Yield Strata, models, scale and stratum assignment methods

Yield Curve	Yield Stratum	Model	Scale	Stratum Assignment
Natural Stand	Hw	Empirical	AVI Polygon	AVI attributes
	Fd	Empirical	AVI Polygon	AVI attributes
	PLMIX	Empirical	AVI Polygon	AVI attributes
	SXMIX	Empirical	AVI Polygon	AVI attributes
	Pl	Empirical	AVI Polygon	AVI attributes
	Sw	Empirical	AVI Polygon	AVI attributes
Pre-1996 Managed Stand	Pl	GYPSY	Opening	AVI & ARIS attributes
	Sw	GYPSY	Opening	AVI & ARIS attributes
Post-1995 Managed Stand	Pl	GYPSY[1]	RSA Sampling Unit	RSA attributes

[1] RSA curve was built using GYPSY, but the final curve to be applied in the TSA is based on a percentage reduction of the natural stand empircal curve

1.5.2 Eligible Species and Species Groups

Table 9 lists the tree species present in the Crowsnest's DFA area and which species were used, i.e. contributed to merchantable volumes, in yield curve development. For GYPSY modeling purposes, species groups were used rather than individual species as shown in Table 9. Species contributing to merchantable volume in the yield curves are identified under the acceptable species column.

Table 9. Species types and groups based on species and acceptability

Species Type	Species Group	Species Code	Common Name	Latin Name	Acceptable
Deciduous	AW	Aw	Aspen	*Populus tremuloides*	Y
		Bw	White birch	*Betula papyrifera*	Y
		Pb	Balsam poplar	*Populus balsamifera*	Y
Coniferous	PL	Pl	Lodgepole pine	*Pinus contorta*	Y
		Pj	Jack pine	*Pinus banksiana*	Y
		Lt	Tamarack	*Larix laricina*	Y
	SB	Sb	Black spruce	*Picea mariana*	Y
	SW	Sw	White spruce	*Picea glauca*	Y
		Se	Englemann spruce	*Picea englemannii*	Y
		Fb	Balsam fir	*Abies balsamea*	Y
		Fa	Subalpine fir	*Abies lasiocarpa*	Y
		Fd	Douglas fir	*Pseudotsuga menziesii*	Y

1.5.3 Utilization Standards

The utilization standards applied to all yield curves are presented in Table 10. The GYPSY model permits users to specify stump height, top diameter, and stump diameter, but log length is fixed at 3.66 m (not explicitly stated in the model but was used for developing merchantable volume equations within GYPSY).

Table 10. Utilization standards

Utilization Characteristic	Coniferous	Deciduous
Minimum top diameter inside bark	11 cm	10 cm
Minimum stump diameter outside bark	15 cm	15 cm
Stump height	30 cm	30 cm
Minimum log length	4.88 m	4.88 m

1.5.4 Seismic Lines

Mature timber volume sampling plots avoided seismic lines during installation. Consequently, natural stand yield curves do not contain allowances for seismic lines. To account for the yield implications of seismic lines, seismic reduction factors will be derived from the seismic areas carried in the net landbase and applied as yield reduction factors in the TSA.

Field plots established under RSA protocols account for seismic lines in sampling and will not require seismic line reduction factors in the TSA. Refer to Annex VI: TSA and Chapter 6: Preferred Forest Management Scenario for more information.

1.5.5 Cull

Cull will be applied directly to the yield curves to project net merchantable volumes. Cull percentages will be calculated from recent scale tree length data collected from 2012-2022. The methodology and results will be provided under separate cover when all data becomes available and the analysis is completed.

For the 2025 FMP, cull reduction factors will be applied directly to the yield curves in the TSA process in order to project net merchantable timber volumes. Cull allowance is not reflected in the yields described in this document. Refer to Annex VI: TSA and Chapter 6: Preferred Forest Management Strategy for more information on cull reduction factors.

1.5.6 Regeneration Lag

Regeneration lag in managed stands was implicitly defined as it is incorporated into the RSA sampling protocols and age assignment process based upon skid clearance dates in the net landbase. No regeneration lag was calculated for the 2025 FMP.

1.5.7 Stocking Input in GYPSY

The draft Pre-1996 managed stand yield curves (juvenile) were reviewed with the GOA. GOA expressed concerns about the higher yields in the Pre-1996 managed stand yield curves that may be the result of lack of stocking information for modelling TSP data in GYPSY. GOA indicated that in younger stands, stocking information is very important to GYPSY modelling. It is critical, especially for any species groups with relatively low densities. Since the stocking data is not available for the juvenile TSPs, yields for the pre-96 stands may be overestimated.

As part of their feedback, the GOA recommended the integration of a stocking estimate into the modeling process. Based on GOA's suggestion, the relationships between stocking and density were developed from the RSA data, which were used in developing Post-1995 managed stand yield curves (RSA), using regression models. These relationships were then applied to juvenile TSPs in younger stands (stand age<=40 years) to estimate the stocking from the observed density. The Pre-1996 managed stand yield curves were reconstructed by incorporating the stocking estimate in GYPSY projections.

Crowsnest submitted an analysis - Juvenile Curves with Stocking Inputs In GYPSY (Issue Number: GY-007) on September 6, 2023. The analysis indicated that coniferous yields were reduced through the integration of stocking into GYPSY projections.

1.6 Volume Sampling

Early in the FMP development process, Crowsnest identified the need for improved volume sampling of both natural and managed stands to support the development of yield curves. The FMP targeted volume sampling programs were developed and approved by the GOA to provide data for the 2025 FMP (Table 11).

Table 11. Available data summary by volume sampling programs

Data Collection Program	Protocols	Number of Plots
Natural Stand Volume Sampling TSP Program	2022	382
Managed Stand Volume Sampling Juvenile TSP Program	2022	375
RSA[1]	2012 - 2023	145
Total		***902***

[1]Number of sampling units.

Details of the volume sampling programs which produced the available datasets are summarized below. Volume sampling manuals are included with the yield curve submission package.

1.6.1 Natural Stand Volume Sampling TSP Program

The objectives of the 2025 C5 FMP natural stand volume sampling plan are to:

- Collect sufficient unbiased data for the creation of robust defensible natural stand yield curves and operational timber volume estimates that can be approved for use in the C5 FMP;
- Guide the installation of sufficient new Temporary Sample Plot (TSP) installations to produce yield curves; and
- Minimize the amount of required future monitoring and reporting.

Temporary sample plots (TSPs) were used to achieve the targeted sample size for all strata. The sampling population included natural stands that are either merchantable or approaching merchantability based on minimum stand age threshold of 40 years for all strata.

Stands were selected randomly by stratum within the FMA with probability of selection proportional to stand area. Distribution across merchantable age classes was incorporated into the stratified sampling to account for variation with age.

Three temporary sample plots were sampled within each randomly selected stand. 200 m^2 circular TSPs (radius=7.98 m) were established where all live trees greater than 9.0 cm diameter at breast height (DBH) were measured.

Species, DBH, height, and condition code are measured for each live tree. The data collection was undertaken in 2022 across the FMA. A total of 382 TSPs were established.

The Temporary Sample Plot Manual – Natural Stands (FORCORP, April, 2022) for this program is provided in digital format with the submission package in the "VolumeSamplingProgramManuals" folder.

1.6.2 Managed Stand Volume Sampling Juvenile TSP Program

Crowsnest developed and completed a juvenile stand sampling program designed to characterize older regenerating stands and compare trajectories to both fire origin and recently regenerated stands. The company intends to utilize data collected in this program to represent stand growth trajectories for Pre-1996 managed stands.

Juvenile TSPs were used for the Pl and Sw strata. The sampling population only included the PHR stands that were harvested prior to May 1, 1996. The population was defined as any polygon with mod1 = 'CC', mod1_ext >= 4, and mod1_yr <= 1995.

Stands were selected randomly by stratum and age class with probability of selection proportional to stand area.

Three plots were sampled within each randomly selected stand. The volume sampling plot was comprised of four nested, fixed radius plots. A tree plot is used to collect tree data (live trees ≥ 1.3m in height with a diameter at breast height (DBH) ≥ 5.1 cm), primarily for volume sampling purposes. The tree plots are circular with a size of 100m^2 (5.64m radius). The sapling plot is 25m^2 in size (2.82m radius), and is intended to sample all saplings (live trees ≥ 1.3m in height and ≤ 5.0cm DBH). The sapling plot is superimposed on the centre of the tree plot. The regen plot is 10m^2 (1.78 m radius) and is used to count all coniferous regeneration trees (≥ 0.3 m and <1.3 in height). It is also superimposed on the centre of the tree plot. The top height tree plot is 200m^2 in size (7.98m radius), and is intended to sample top height trees. It is superimposed on the centre of the tree plot.

Species, DBH, height, and condition code were measured for each live tree or sapling. Ages are measured from the top height trees.

Top height stems are defined as the 100 largest DBH stems of a given species per hectare that satisfy the following criteria:

- Live and healthy looking
- No broken or dead top
- Not an advanced/remnant/veteran or a super-dominant from a previous generation
- Not leaning ≥ 20°, not a wolf tree or of obvious poor form (e.g., crook, sweep, fork)
- No severe damage to more than 1/3 of bole, crown and/or root.

Top height trees were sampled for all species groups present within the tree plot. The species groups are:

- Aw = Aw + Pb; 2
- Fd = Fd,
- Pl = Pl + Pj + Lt;
- Sw = Sw + Se + Fb + Fa; and,
- Sb = Sb.

If the largest DBH tree has a lost or broken top that has not yet been replaced by a new leader, then the next largest DBH tree of that species was selected.

The data collection was undertaken in 2022 within the FMA area. A total of 375 juvenile TSPs were established.

The Temporary Sample Plot Manual - Juvenile Managed Stands (FORCORP, April, 2022) for this program is provided in digital format with the submission package in the "VolumeSamplingProgramManuals" folder.

1.6.3 Reforestation Standard of Alberta Performance Surveys

RSA performance survey data was used to develop Post-1995 managed stand yield curves. The essential features of sample selection and data collection procedures used for yield curve development are briefly summarized here.

RSA performance surveys collect detailed plot information within sampling units which can be at the opening or sub-opening level (AAF 2018). The sampling frame for performance surveys in a given year was defined as all openings between 12 and 14 years of age belonging to a specific sustained yield unit[3].

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[2] Bw is not eligible for top height trees for the Aw species group in GYPSY.

[3] A sustained yield unit is defined as the unit upon which an annual allowable cut is calculated; *i.e.*, the area within which a single timber supply analysis was run.

Openings were subdivided into sampling units (SUs) either via aerial photography (for larger programs) or field reconnaissance (for smaller programs, also called non-photo programs). Aerial programs employ a subsampling method in which a smaller subset of SUs were selected for ground sampling, whereas non-photo programs require a full ground sample (census) of SUs.

Within SUs selected for ground sampling, 10 m^2 plots were established using a grid-based method, with the number of plots varying depending on SU size and type of program. Generally, the number in aerial programs ranged from 32-64 plots, and in non-photo programs ranged from 41 plots up to 2.77 plots/ha in larger SUs.

Data was collected on coniferous ≥ 0.3 m in height and deciduous ≥ 1.3 m in height. The following information was collected:

- Every plot: Tally trees by species and type (seedling vs. advanced), with a separate tally for pine with western gall rust.
- Every 4th plot: Within a 100 m2 plot centered around the 10 m2 plot, select the largest DBH tree by species group and record height, DBH (optional), and total age.
- Every 4th plot (optional): Within the 10 m2 plot, measure DBH and height (optional) of the first three trees by species group and type (seedling or advanced) and tally the number of seedling conifers above and below 1.3 m by species (to allow for calculation of basal area).

For more details on RSA performance survey programs and protocols, please refer to the *Reforestation Standard of Alberta* (AAF 2018).

Crowsnest intends to use all available RSA survey data for C5 that were submitted to the Forest Stewardship and Trade Branch by May 15, 2023[4]. This includes all company, and Quota Holder and FRIAA cutblocks where aerial or non-photo RSA programs have been completed from post-95 openings since 2012.

Data consisting of 125 ground-sampled SUs in C5 was collected from the years of 2010 to 2021 and utilized in yield curve development. Refer to Section 4.2.1 for more information.

[4] The effective date of the landbase is May 1, 2023. RSA survey data submitted by May 15, 2023, includes programs where the photo interpretation and ground survey were completed in the 2022 season or earlier.

2 Natural Stand Yield Curves

2.1 Approach

The natural stand yield curves were developed using an empirical (regression-based) approach. Data from the Natural Stand Volume Sampling Program TSPs were used to fit natural stand yield curves. Natural stand yield curves were fit using one of two regression models presented below:

- 2-parameter model (2P):
  - $Volume = a(Age)^b e^{(-a*Age)}$
- 2-parameter model with constant (2P+k):
  - $Volume = a(Age)^b e^{\left(-Age/k\right)}$

Where:

- Volume = Gross merchantable stand volume (m3/ha)

  Age = Stand age at year of measurement

  a, b, k = Coefficients

Coniferous and deciduous compiled merchantable gross volumes were fit separately using one of the two model forms. Where the constant *k* was required to achieve a biologically reasonable curve form, values between 10 and 100 were tested to achieve the most biologically reasonable result that also fit to the data. Total stand volume curves were calculated by summing coniferous and deciduous volumes.

For three coniferous yield strata, the regression to fit deciduous volume would not converge. Therefore, total volume was fit instead, and deciduous volume was calculated by subtracting coniferous volume from total volume. Where predicted coniferous volume was greater than predicted total volume, total volume was set equal to coniferous volume.

2.2 Input Datasets

2.2.1 Source Data

Crowsnest developed and received GOA approval of a Natural Stand Volume Sampling Plan Program designed to characterize the new AVI and support the development of natural stand yield curves. The natural stand TSP data collected by Crowsnest in year 2022 were used for yield curve construction.

2.2.2 Yield Stratum Assignment

Strata assignment and age attributes for each plot were obtained via a spatial linkage to the net landbase. For natural stands, assignment of yield strata was based primarily on AVI overstorey attributes. The stratum lists are presented in Table 6.

2.2.3 Data Exclusions and Used

The 382 temporary sample plots (TSP) installed in natural fire-origin stands in the net landbase of the FMA were used in natural stand yield curve development. A few plots changed strata due to adjustments to the switch-stand landbase rules, and nine plots fell into landbase subjective deletions - hydrology buffers that were applied after the original sampling landbase was created, leaving 373 plots available for yield curve development.

From the 373 eligible plots, twelve plots were considered influential points and they were removed from creating both the coniferous and deciduous yield curves. Table 12 presents the twelve influential points that were removed from the final dataset and the reason for their deletion.

Table 12. Influential points deletion and reason for the deletion

Plot Number	Yield Stratum	Stand Age	Merchantable Volume (m3/ha) Coniferous	Deciduous	Total	Reason for Deletion
FD_LD_A2_10_TARGET_1	Fd	102	814	0	814	Outlier
FD_LD_A2_10_TARGET_2	Fd	102	690	0	690	Outlier
FD_LD_A2_6_TARGET_3	Fd	132	703	0	703	Outlier
FD_LD_A3_1_TARGET_1	Fd	172	618	0	618	Outlier
FD_P_A2_10_TARGET_1	Fd	102	709	0	709	Outlier
FD_P_A2_12_TARGET_1	Fd	122	696	0	696	Outlier
FD_P_A2_3_TARGET_1	Fd	102	740	0	740	Outlier
PL_M_A2_6_TARGET_3	Pl	102	571	0	571	Outlier
PL_M_A3_1_TARGET_2	Pl	152	659	7	666	Outlier
PL_SA_A1_8_TARGET_2	Pl	92	642	0	642	Outlier
SW_A2_7_TARGET_3	Sw	102	760	0	760	Outlier
SW_A3_6_TARGET_2	Sw	263	511	0	511	Outlier

These outlier plots with very high coniferous volumes were subjectively removed as well due to concerns that the yield curve volume estimates were too high. The volume thresholds used to exclude plots were determined subjectively, and were as follows:

- Fd: 610 m3/ha (7 plots excluded)
- Pl: 570 m3/ha (3 plots excluded)
- Sw: 760 m3/ha (1 plot excluded), and 510 m3/ha for plot stand age = 263 years old (1 plot excluded)

This left 361 plots remaining that were used in the development of the natural stand yield curves presented in this document. The number of sampled plots, and the final number of plots available for yield curve development is presented in Table 13. The net landbase areas by yield stratum are also presented in the table.

Table 13. Number of TSPs used in natural stand yield curve development

Yield	Area		Sampled Plots		Deletion		Final Plots	
Stratum	ha	%	#	%	Passive	Outlier	#	%
Hw	11,928	15						
Fd	10,228	13	90	24	2	7	81	22
PLMIX	793	1	30	8	3		24	7
SXMIX	1,346	2	30	8			30	8
Pl	39,780	50	156	41	1	3	152	42
Sw	15,185	19	76	20	3	2	74	20
Total	***79,259***	***100***	***382***	***100***	***9***	***12***	***361***	***100***

2.2.4 Landbase Representation

The representation of the net landbase by the TSP data is shown by height class in Table 14 and by age class in Table 15.

Table 14. Distribution of natural stand TSPs and landbase area by AVI height class

Yield		Actual by Height Class (m)						Percentage by Height Class					
Stratum	Metric	1-5	6-10	11-15	16-20	21-26	26+	1-5	6-10	11-15	16-20	21-26	26+
Fd	Area (ha)	4	132	1,129	5,200	3,224	538	0	1	11	51	32	5
	# Plot	0	6	9	27	38	1	0	7	11	33	47	1
PLMIX	Area (ha)	24	90	240	343	94	3	3	11	30	43	12	0
	# Plot	0	3	6	12	3	0	0	13	25	50	13	0
SXMIX	Area (ha)	1	162	568	476	136	2	0	12	42	35	10	0
	# Plot	6	12	3	6	3	0	20	40	10	20	10	0
Pl	Area (ha)	1,620	811	11,047	20,669	5,458	176	4	2	28	52	14	0
	# Plot	2	0	27	97	26	0	1	0	18	64	17	0
Sw	Area (ha)	120	863	3,349	6,672	3,287	892	1	6	22	44	22	6
	# Plot	2	15	12	32	13	0	3	20	16	43	18	0

Table 15. Distribution of natural stand TSPs and landbase area by age class

Yield		Actual by Age Class (years)					Percentage by Age Class				
Stratum	Metric	1-50	51-100	101-150	151-200	200+	1-50	51-100	101-150	151-200	200+
Fd	Area (ha)	11	1,446	7,855	839	77	0	14	77	8	1
	# Plot	0	15	60	5	1	0	19	74	6	1
PLMIX	Area (ha)	52	521	221	0	0	7	66	28	0	0
	# Plot	3	12	9	0	0	13	50	38	0	0
SXMIX	Area (ha)	14	1,063	267	1	0	1	79	20	0	0
	# Plot	0	24	6	0	0	0	80	20	0	0
Pl	Area (ha)	1,652	15,812	21,066	1,017	234	4	40	53	3	1
	# Plot	0	65	82	2	3	0	43	54	1	2
Sw	Area (ha)	62	3,173	7,627	2,561	1,761	0	21	50	17	12
	# Plot	0	15	42	9	8	0	20	57	12	11

In the natural Stand Volume Sampling Program, TSP sampling was conducted based on several principals as below:

1. The goal is to install 382 new TSPs across the region, the intent is also to ensure that sufficient plots are included within each stratum to allow localized variations in timber yields to be captured.

2. The plots were sampled from the natural stands that were either merchantable or approaching merchantability based on age.

As empirical natural stand yield curves were developed, a distribution across age classes was more important in the fitting of the curves. The sampled TSPs show a reasonably close representation of the landbase across height and age classes.

2.3 Data Preparation

2.3.1 Deletions

All trees with "dead" or "missing" or "disqualified" status codes were removed from the dataset. The disqualified code is used by field crews to drop trees which were incorrectly entered in the data collection software as trees cannot be deleted.

2.3.2 Missing Heights

Missing tree heights were predicted using Huang et al.'s Population and Plot-Specific Individual Tree Height-Diameter Models for Major Alberta Tree Species (Huang et al. 2013). The ratio of means approach as described in Huang et al. were used to adjust (localize) predicted heights based on available trees with measured heights.

2.4 Data Compilation

2.4.1 Volume Compilation

The merchantable volumes were determined for each tree in the dataset. Volume compilation followed a standardized process developed based on equations and coefficients provided in Huang's (1994) *Ecologically Based Individual Tree Volume Estimation for Major Alberta Tree Species*. Trees with zero merchantable volume were assigned a value of 0 m^3.

The merchantable volumes were then multiplied by each tree factor (number of stems represented by each sampled tree). Resulting values were summed by species group (coniferous and deciduous) for each TSP plot.

2.4.2 Stand Age

Stand age was calculated for each plot measurement using the difference between AVI stand origin and measurement year.

2.5 Modelling

2.5.1 Yield Curve Development

Natural stand yield curves were built for each yield strata using a regression-based approach. In Fd and Pl yield strata, which were sampled by sampling stratum (Fd-Pure vs. Fd-Leading, and Pl-Subalpine vs. Pl-Montane. Table 6), weighting factor by sampling stratum was used as a weight in the regression model fitting. The weighting factor was calculated as sampling stratum active landbase area divided by number of plots in the sampling stratum.
Coniferous and deciduous volume were modelled using one of the two equations. Total volume was calculated by summing coniferous and deciduous volume.

For three coniferous yield strata – Fd, Pl and Sw, the regression to fit deciduous volume would not converge. Therefore, total volume was fit instead, and deciduous volume was calculated by subtracting coniferous volume from total volume. Where predicted coniferous volume was greater than predicted total volume, total volume was set equal to coniferous volume.

The no tree plots were included in empirical model fitting. Nine influential points were excluded from the dataset during natural stand empirical yield curve development. Sample size, model form, and coefficients by yield stratum are presented in Table 16.

Table 16. Model form and coefficients of natural stand yield curves

Yield Stratum	Total Plots	Final Plots	Species Type	Model Form	Model Coefficients a	b	k
Fd	88	81	Coniferious	2P+k	0.0000039	4.6449793	30
			Total	2P+k	0.0000047	4.6120086	30
PLMIX	24	24	Coniferious	2P+k	0.0004587	3.1209044	50
			Deciduous	2P+k	0.0006576	3.2514377	30
SXMIX	30	30	Coniferious	2P+k	0.0013957	3.0214449	50
			Deciduous	2P+k	0.0116821	2.5089507	30
Pl	155	152	Coniferious	2P+k	0.0000004	5.4882520	20
			Total	2P+k	0.0000004	5.5096051	20
Sw	76	74	Coniferious	2P+k	0.0000016	4.7982083	30
			Total	2P+k	0.0000021	4.7478003	30
Total	***373***	***361***					

2.5.2 Validation Statistics

Validation statistics were calculated using the plot data. Bias and percent bias were calculated using the formulae below.

The statistics results present the levels of underprediction or overprediction of the natural stand yield curves compared to the observed plot data used to generate the curve.

Bias

$$Bias = \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)}{n}$$

Percent bias

$$Bias\% = \frac{Bias}{\bar{y}} \times 100$$

Where:

y_i = The i^{th} observed value

$\hat{y}_i$ = The i^{th} predicted value

$\bar{y}$ = The mean of the observed values

n = The total number of observations

2.6 Results

Natural stand yield curves were built for yield stratum. For strata Fd and Pl, which include two groups of sampling strata, the data was combined to develop the yield strata natural stand yield curves. To ensure that the representation of plots was in proportion to the landbase, the area weighted yield curves were built for each of yield strata by using sampling stratum active landbase area divided by number of plots in the sampling stratum as a weight in these two yield strata.

For stratum Hw, which was excluded from sampling and yield curve development, the curves from the previous 2006 -2026 FMP were used.

2.6.1 Natural Stand Yield Curves

The natural stand yield curves are presented in Appendix I. Individual plot volumes and 20-year averages are plotted with coniferous, deciduous, and total volume curves. MAI values are included with the largest MAI value for each volume component highlighted in yellow. The reported areas represent those from the net landbase file applicable to the sampling population for the strata included.

For stratum Hw, individual plot volumes and 20-year averages are not presented as the plot data were not available.

2.6.2 Validation Statistics

The summary of the validation statistics is provided in Table 17. The validation statistics were not calculated for Hw stratum as the plot data were not available.

Table 17. Validation statistics summary for natural stand yield curves

		Coniferous Volume (m^3/ha)				Deciduous Volume (m^3/ha)			
		Mean				Mean			
Yield Stratum	N of Plots	Observed	Predicted	Bias	Bias%	Observed	Predicted	Bias	Bias%
Fd	80	300.0	297.1	2.9	1.0	6.8	6.6	0.1	2.0
PLMIX	24	81.8	80.8	0.9	1.2	64.1	64.6	-0.5	-0.8
SXMIX	30	153.7	156.1	-2.4	-1.5	44.8	45.0	-0.3	-0.6
Pl	152	234.1	228.6	5.5	2.4	2.7	2.8	-0.1	-2.3
Sw	68	244.5	246.7	-2.2	-0.9	3.0	3.0	0.0	-1.6

Percent bias is generally low; less than 10% for all yield curves except deciduous volume in Pl stratum.

2.7 Natural Stand Deciduous (Hw) Curve

Crowsnest does not harvest the pure deciduous stratum (Hw), and it was excluded from sampling and yield curve development. This FMP uses the deciduous curve built for the 2006 FMP in order to provide volume estimates from the deciduous landbase for the TSA. Refer to Appendix 8A in the previous FMP documentation[5] for detailed documentation on the previous yield curve development. A brief summary is provided here:

- Curve number 9 from the 2006 FMP, which included the D and DC cover group, is used as the pure deciduous curve for this FMP. Though this curve includes plots from the DC cover group as well, the overall area of mixedwoods in the landbase is minimal (Table 7), and the conifer volume estimates are also low, and thus this curve is likely appropriate for characterisation of the D cover group without adjustment.
- Utilisation standards in the C5 2006 FMP were 15/11/30/2.44. No adjustments were made to convert this to the 2025 FMP utilisation (15/10/30/4.88 for deciduous) given that it is not expected than deciduous landbase will actually be harvested.
- Empirical curves were fit to data from TSPs sampled across C5. There were 64 plots sampled in the D/DC cover group.
- Several curve forms were used across the yield strata for conifer and deciduous volumes. For the deciduous curve, the following two forms were used:
    - Model form [3]c (same as 2P+k form in this FMP):
        - volume = $(B_1*[Age^B_2]*exp[-Age/N])$
    - Model Form [4]a:
        - volume = $([B_1*Age^B_2]* exp[-B_3*Age])$
- The final coefficients used are shown in Table 18, and the curve MAI summary is included alongside the others in Table 28

Table 18. Model form and coefficients of deciduous yield curves

Yield Stratum	# Plots	Species Type	Model Form	Model Coefficients B1	B2	B3	N
DEC	64	Coniferous	[4]a	0.00000044	5.15367822	0.05813277	
		Deciduous	[3]c	0.00004056	4.07623762		25

[5] Government of Alberta. 2006. C5 Forest Management Plan 2006–2026. https://open.alberta.ca/dataset/9850a9de-169f-4e26-a918-32296c5f8b08/resource/e682af24-2b1c-4a02-aeb7-f66425fa02aa/download/af-c5-forest-management-plan-2006-2026-combined.pdf.

3 Pre-1996 Managed Yield Curves

3.1 Approach

Pre-1996 managed stand (Pre96) yield curves were developed for the managed stands harvested before May 1, 1996.

Pre96 yield curves were only developed for the regenerated cutblocks in the Pl and Sw yield strata. All other Pre91 managed stands will follow natural stand yield curves.

Pre96 yield curves were developed using the GOA GYPSY growth model. The juvenile Volume Sampling Program Temporary Sample Plot (TSP) data was used for developing Pre-1996 managed stand yield curves based on the following general steps:

- Compile applicable TSP data to GYPSY required inputs. Only plots located in the active landbase were used;
- Assign strata and stand age based on the attributes of the net landbase polygon in which the plot falls;
- Make forecasts for each plot individually;
- Basal area is required in the GYPSY forecasts (thus projections are adjusted to observed basal area);
- Estimated percent stocking is included into GYPSY projections for the plots younger than 40 years;
- Create a stratum average yield curve by averaging the plot-based forecasts;
- Yield curves are linked to the stand via net landbase stand age but plot based species age were used wherever available for the GYPSY projections.

3.2 Input Datasets

3.2.1 Source Data

The data from Juvenile TSPs collected in 2022 were used to develop yield curves for the Pre-1996 cutblocks in FMU C5.

3.2.2 Yield Stratum Assignment

The stratification was based on the new AVI and followed similar stratification rules applied to the natural fire-origin stands. The population was defined as any polygon with mod1 = 'CC', mod1_ext >= 4, and mod1_yr <= 1995. The GOA base 10 strata from the new AVI were used for stratification, and only the Pl and Sw strata were sampled due to insufficient area in other strata.

3.2.3 Data Excluded and Used

The 375 TSPs installed in pre-96 cutblocks were used for juvenile yield curve development. The Pl curves were previously separated by natural subregion (Montane and Subalpine) but have since been re-combined to match the process used for the natural stand curves. The number of plots installed by strata is shown in Table

19. Eleven plots fell into landbase deletions that were added after the original sampling landbase was created, leaving 364 plots available for yield curve development.

Table 19. Number of plots by yield stratum used in pre-96 managed stand yield curves development

Yield	Active Area		Sampled Plots		Final Plots	
Stratum	Ha	%	#	%	#	%
Sw	2,544	25	45	12	45	12
Pl	7,647	75	330	88	319	88
Total	***10,191***	***100***	***375***	***100***	***364***	***100***

3.3 Data Compilation

Data were compiled to create species group-level inputs for the GYPSY model. To obtain growth projections, GYPSY requires several input variables: Total age, Top Height, Site Index, Density, Basal Area and Percent Stocking.

Each of these variables was compiled for each plot using the Juvenile TSP to produce plot-level GYPSY inputs.

3.3.1 Density

In GYPSY, stand density is defined differently for different stand types and species (coniferous versus deciduous).

GYPSY defines stand density for *Post-harvest stand* as follows:

1. For deciduous tree species, density refers to stems per hectare of the subject tree species >130 cm in height; and
2. For coniferous tree species, density refers to stems per hectare of the subject tree species >30 cm in height.

The total densities of each plot were calculated by tree species group and were used as plot-level inputs for plot-input based GYPSY yield projections.

3.3.2 Basal Area

Diameter at breast height (DBH) measurements were used to compute basal area (m^2 per hectare).

The total basal areas of each plot were calculated by tree species group and were used as plot-level inputs for plot-input based GYPSY yield projection.

3.3.3 Top Height

Top height trees were sampled in the top height tree plot and were used to calculate top height. The top heights of each plot were calculated by tree species group and were used as plot-level inputs for plot-input based GYPSY yield projection.

3.3.4 Percent Stocking

The relationships between stocking and density were developed using a regression-based methodology based on RSA data, which were used to build the Post-1995 managed stand yield curves.

The species group-specific stocking and density models were applied in juvenile TSPs to derive the stocking estimate from the observed density by tree species group where stand ages were up to 40 years.

Refer to the document GY-007 -Juvenile Curves with Stocking Inputs in GYPSY (September 6, 2023) for details (Appendix II – Juvenile Curves with Stocking Inputs in GYPSY).

3.3.5 Species Group Age

Total age refers to the number of years since time of germination. It was measured on the top height trees from the top height tree plots.

3.3.6 Site Index

Site index is determined using the top height and total age data collected in top height tree plots. The site index equations from the GYPSY were used to calculate individual site index.

3.3.7 Stand Age

Stand age was calculated for each plot using the difference between AVI stand origin and measurement year.

3.4 Modelling

GYPSY model version 1.0 released in December 2009 (SRD 2009) was used to create all projections using the compiled data. GYPSY uses four species groups to project any given stand into the future from age 0 years to any total age defined by the user, using the input variables to localize the growth trajectories. The projection length was set to 300 years for the yield curves. Steps applied were:

1. Use the observed plot top height and the observed age by species group to calculate the site index by species group and by plot;
1. Use the observed top height, age, density, and basal area, as well as the estimated percent stocking, by species group to create individual plot projections;
2. Average all the projections within each stratum;
3. For both Pl and Sw yield strata, which were sampled by natural subregion, area weighted averages were calculated. The weighting factor was calculated as natural subregion active landbase area divided by number of plots in the natural subregion.
4. Calculate the difference between stand age (AVI based) and the maximum total age observed in the plot – "age differential" by stratum;
5. Average the "age differential" calculated at point 4 across all plots within stratum; and
6. Shift the average projection from point 3 with the average "age differential" at point 5 to generate stratum yield curves.

The no tree plots were included and counted and their yield projections were considered as zeros when generating stratum yield curves.

3.5 Results

No yield curve adjustments were applied to the GYPSY projections. The final Pre-1996 managed stand yield curves were created for Pl and Sw yield strata. Figures of the curves are presented in Appendix III.

Yield curves were constructed for each of the three volume components within each stratum: hardwood, softwood, and total.

3.5.1 Validation Statistics

The summary of the validation statistics is provided in Table 20. The volumes were underestimated compared to the observed for both strata, though given the similar culmination MAI between the juvenile and natural curves, it is possible that the predicted volumes will be closer to observed once the stands reach a merchantable age.

Table 20. Validation statistics summary for pre-96 yield curves

		Coniferous Volume (m^3/ha)				Deciduous Volume (m^3/ha)			
Yield	N of	Mean				Mean			
Stratum	Plots	Observed	Predicted	Bias	Bias%	Observed	Predicted	Bias	Bias%
Pl	362	37.0	24.7	12.4	33.4	0.0	0.0	0.0	24.3
Sw	45	84.9	41.7	43.2	50.9	0.2	0.0	0.2	96.4

4 Post-1995 Managed Yield Curves

4.1 Approach

Based upon Plan Development Team (PDT) discussions, an approach to post-performance yield curves was developed that maintained sampling unit (SU) assignments from aerial performance surveys and stratification from photo-interpreted labels. Yield curve development was therefore at the SU level (scale), although in many cases there was only one SU per opening. The GYPSY model was applied for yield projections, aligning with RSA protocols and projections for the other yield curve categories.

All stands that were harvested stands on or after May 1, 1996 will be projected using Post95 yield curves. Data collected under RSA protocols were used to create Post95 yield curves. In this section, the detailed development procedure for Post95 yield curves is provided.

4.2 Input Datasets

4.2.1 Source Data

All RSA survey data for C5 that were submitted to the Forest Management Branch by May 15, 2023[6] have been used to the curves presented. This includes all company, and Quota Holder and FRIAA cutblocks where aerial or non-photo RSA programs have been completed since 2010.

The use of the RSA performance survey information for all existing post-1995 cutblocks permits development of yield projections from observed performance survey data based on consistent data collection protocols, sound statistical sampling design and stratification scheme. The summary of the available RSA data to date is presented in Table 21.

[6] The effective date of the landbase is May 1, 2023. RSA survey data submitted by May 15, 2023, includes programs where the photo interpretation and ground survey were completed in the 2022 season or earlier.

Table 21. Summary of RSA data status by data sources and survey year

Disposition Holder	Survey Year	Skid Year From	Skid Year To	N of SUs	System Type
770 538 AB LTD	2012	1998	1998	1	Non-Photo
	2014	2000	2000	1	Non-Photo
	2015	2001	2001	3	Non-Photo
	2016	2002	2002	6	Non-Photo
	2017	2004	2003	6	Non-Photo
	2018	2006	2004	2	Non-Photo
	2019	2007	2006	4	Non-Photo
793 128 AB LTD	2019	2007	2007	1	Non-Photo
Atlas Lumber	2013	2002	1999	81	Aerial
	2015	2005	2002	88	Aerial
	2018	2005	2005	5	Aerial
CNKC	2021	2008	2007	5	Non-Photo
Crowsnest Forest Products	2018	2007	2005	50	Aerial
	2021	2009	2007	54	Aerial
FRIAA	2014	2001	2000	9	Non-Photo
	2015	2003	2001	5	Non-Photo
	2016	2004	2004	3	Aerial
	2019	2008	2005	12	Non-Photo
Spray Lake Sawmills	2010	1998	1996	127	Aerial
	2013	2001	1999	34	Aerial
	2015	2005	2002	70	Aerial
	2018	2007	2005	51	Aerial
	2021	2009	2007	27	Aerial
Total				***645***	

Table 22 summarizes the number of ground-sampled SUs and the associated area by program type (aerial vs. non-photo) and yield stratum.

Table 22. Number of ground-sampled sampling units and associated area by stratum

RSA Yield Stratum	Aerial SUs	Aerial Area (ha)	Non-photo SUs	Non-photo Area (ha)	Total SUs	Total Area (ha)
HwPl	4	36	2	18	6	55
Pl	62	714	24	219	86	934
PlHw	9	86	6	31	15	117
Sw	15	153	20	193	35	346
SwHw			3	16	3	16
Total	***90***	***990***	***55***	***478***	***145***	***1,468***

The number of total eligible SUs and total eligible areas in the survey population by RSA yield strata are provided in Table 23. The number and area of the ground-sampled SUs, along with their percentages out of the sampling population, are also provided in Table 23.

Table 23. Summary of total eligible SUs vs. ground-sampled SUs in the survey population by stratum

RSA Yield Stratum	Total Eligible SUs #	%	Area (ha)	%	Ground-Sampled SUs #	% of Pop.	Area (ha)	% of Pop.
HwPl	6	1	55	1	6	100	55	100
Pl	566	88	7,268	91	86	15	934	13
PlHw	16	2	125	2	15	94	117	93
Sw	54	8	521	7	35	65	346	66
SwHw	3	0	16	0	3	100	16	100
Total	***645***	***100***	***7,985***	***100***	***145***	***22***	***1,468***	***18***

4.2.2 Yield Stratum Assignment

All Post-1995 managed stands are linked to ARIS via the cutblock reconciliation process described in the Annex V: Net Landbase Development document. Where RSA performance survey data is present, it supersedes ARIS information in the net landbase. Only the RSA performance survey information and the strata derived from it were used to create the Post95 yield curves. Processes for assignment of the managed stand landbase are described in the landbase development document.

Strata were based on the GOA Base 10 strata. Yield strata were assigned at the sampling unit level, rather than at the opening level. For aerial programs, yield stratum was obtained from the photo-interpreted “species class” (SP_CL) assignment. For non-photo programs, each SU was re-assigned to an equivalent yield stratum based on ground survey data. There were two key reasons for re-assignment:

- Ground-interpreted labels are sometimes inaccurate relative to observed ground data; and
- Ground-based labels are at a coarser resolution than aerial labels (e.g. HwPl and PlHw in aerial programs are combined as MxPl in non-photo programs).

For non-photo programs, compiled densities from the GYPSY_INPUT table (RSA compiler) were used to assign a yield stratum based on proportion of density, following the rules for aerial stratum assignment outlined in the RSA survey manual (AESRD, 2013).

For consistency with the NLB and TSA, the RSA yield stratum names were changed to the corresponding yield stratum names (Table 24).

Table 24. Final RSA yield strata conversion

RSA Yield Stratum	N of SUs	Final Yield Stratum	N of SUs	Curved considered for TSA
HwPl	6	MIX_Pl	21	
PlHw	15			
HwSx	0	MIX_Sx	3	
SwHw	3			
Sw	35	Sw	35	Yes
Pl	86	Pl	86	Yes
Total	***145***		***145***	

RSA curves were only constructed for the Pl and Sw strata which has a sufficient number of SUs sampled. The frequency summary of ground-sampled SUs used in the final RSA yield curve development is presented in Table 25.

Table 25. Number of ground-sampled sampling units used in the final RSA yield curve development

Final Yield Stratum	N of SUs
Pl	86
Sw	35
Total	***121***

4.3 Data Compilation

Data from the RSA compiler were used for yield curve development. SU-level density, basal area, site index, and age (stand and species-level) were obtained from the GYPSY_INPUT table. The methods used for compiling data are documented in the Regeneration Standard of Alberta (AESRD 2013)[7].

4.4 Modelling

4.4.1 Growth Modelling Approach

The GYPSY model was used for growth projections. Although the RSA compiler stored yield table outputs, this data is provided in 10-year increments which are unsuitable for timber supply analysis needs. Compiled RSA data were therefore re-projected using GYPSY to obtain 5-year outputs.

4.4.2 Yield Curve Development

The GYPSY 2009 model was used as per current RSA protocols. The following process was used to develop Post-95 managed stand yield curves:

1. Assembled RSA compiler data for all programs;
2. Verified compiled information against original submissions;
3. Verified populations of openings against ARIS within the Defined Forest Area (DFA);
4. Converted RSA compiler data to SAS 9.4 for analysis.
5. Compiled RSA data are re-projected using SAS GYPSY to obtain 5-year yield outputs. The main data is in the GYPSY_INPUT table which provides SU-level density, basal area, site index and age by species group. Although the RSA compiler stores actual yield table outputs, these data are only compiled in 10-year increments which is not suitable for timber supply analysis purposes;
6. Projected all sampling units to age 300 using SAS GYPSY;
7. Aerial programs: Calculated the average yield for each aerial program by sampling stratum using the composite weights for the specific RSA program to roll-up individual SU projections to the aerial program/sampling stratum level.

[7] Note that changes to sample selection protocols and compilation routines occurred in 2014, therefore the 2013 manual is specifically being referenced here.

Where sampling strata represent more than one yield stratum, *e.g.* a combined SwHw/SbHw sampling stratum, separate yield curves were created for each stratum with identical yields. The total population area was assigned to each yield stratum within its respective program;

8. Non-photo programs: Each sampling unit had its own yield stratum assignment (based on the re-assigned stratum from plot data as per the proposal), yield projection, and area. Selection weights were all 1 for non-photo programs; therefore SU area alone defines the composite weights; and

9. Yield curves were generated by calculating area-weighted averages for all yield strata, combining program-level averaged yields from aerial programs and individual SU-level yields from non-photo programs.

All program-level averaged yields from aerial programs (#6) and all individual SU-level yields from non-photo programs (#7), that are within the same yield stratum, were averaged by weighting the areas to generate the yield curves for each yield stratum. The total population area assigned to each yield stratum within its respective program was used as area weight for aerial programs, while SU area was used as area weight for non-photo programs.

4.5 Results

No yield curve adjustments were applied to the GYPSY projections. The final Post-1995 managed stand yield curves were created for Pl yield stratum. Figures of the curves are presented in Appendix IV.

Yield curves were constructed for each of the three volume components within each stratum: hardwood, softwood, and total.

Table 26. Peak MAI and culmination age of yield curves built using RSA data

RSA Yield	N of Sus	Culmination Age	Maximum MAI (m^3/ha/yr)			MAI at Stand Age 80 (m^3/ha/yr)		
			CON	DEC	TOT	CON	DEC	TOT
Pl	86	111	1.99	0.07	2.06	1.68	0.09	1.78
Sw	35	112	2.33	0.02	2.35	2.00	0.04	2.04

5 Curves for TSA

This section summarizes and provides justification for the set of final yield curves that will be utilized in the TSA. This set was derived based upon a combination of the minimum GOA requirements for yield curves and discussions at PDT meetings and between Crowsnest and the GOA.

Further adjustments will be applied to the yield curves in the TSA process, (*e.g.* cull allowance), which is described in *Annex VI – TSA – Timber Supply Analysis*. Table 27 summarizes the final yield curves to be applied in the TSA, which are presented graphically in Appendix I, Appendix III, and Appendix IV. The source for the curves in Table 27 are described by yield category below, and the peak MAI of the curves is shown in Table 28.

Table 27. Yield curve sets to be applied in the TSA process

Yield	Current Landbase			
Stratum	Natural	Pre-1996 Managed	Post-1995 Managed	Future Blocks
Hw	Natural	Basic	Basic	Basic
Fd	Natural	Basic	Basic	Basic
MIX_Pl	Natural	Basic	Basic	Basic
MIX_Sx	Natural	Basic	Basic	Basic
Pl	Natural	Juvenile	RSA[1]	Basic
Sw	Natural	Juvenile	Basic	Basic

[1] An RSA curve was built, but the curve to be used in the TSA is based on a % reduction of the natural curve

Table 28. Peak MAI and culmination age of yield curves to be used in the TSA process

Stand Type	Yield Stratum	N of Plot / SU	Culmination Age	Maximum MAI MAI (m^3/ha/y) CON	DEC	TOT	MAI (m^3/ha/y) at Stand Age 80 CON	DEC
Natural	Hw[1]	64	77	0.35	1.19	1.53	0.34	1.18
	Fd	81	109	2.78	0.07	2.85	2.37	0.08
	MIX_Pl	24	106	1.09	0.70	1.78	1.01	0.88
	MIX_Sx	30	101	2.09	0.43	2.51	1.98	0.60
	Pl	152	90	2.54	0.02	2.57	2.47	0.02
	Sw	74	114	2.32	0.04	2.36	1.87	0.06
Pre-1995	Pl	319	113	2.62	0.01	2.62	2.27	0.01
	Sw	45	134	2.43	0.03	2.46	1.83	0.01
Post-1995	Pl	86 [2]	90	1.99	0.02	2.01	1.93	0.01

[1] - Curves from previous FMP.

[2] - Number of sampling units was 86, though the final curve is a % reduction of the natural stand yield curve

5.1 Natural Stand Yield Curves

The natural stand yield curves are the curves directly obtained from the empirical yield curves. For Hw stratum the curves were obtained from the previous FMP, which are the empirical yield curves too. The strata with no natural yield curve, i.e. Sb and SbHw, were never sampled and are not on the active landbase.

5.2 Pre-1996 Managed Stand Yield Curves

These stands consist of the population of cutblocks harvested before May 1, 1996. There are two sets of growth projections for Pre-1996 managed stands: Basic and Juvenile.

5.2.1 Basic Yield Curves

Basic yield curves are copies of the above final natural stand yield curves for TSA.

5.2.2 Juvenile Yield Curves

The GYSPY juvenile yield curves for the two strata Pl and Sw will be used in the TSA process for gross merchantable volume yield predictions. They will be applied only to the sampled population.

5.3 Post-1995 Managed Stand Yield Curves

Post-1995 managed stands are the population of managed stands that were harvested or with a retreatment date of May 1, 1996 or after.

5.3.1 Basic Yield Curves

The basic yield curves for the Post-1995 managed blocks are the same as the Pre-1996 managed basic yield curves.

5.3.2 RSA Yield Curves

Post-1995 RSA curves were built for the Pl and Sw strata; however, these curves will not be used in the TSA.

The Sw RSA curve had a nearly identical peak MAI to the natural stand yield curve for spruce (2.33 m^3/ha/yr vs. 2.32 m^3/ha/yr), and Post-1995 spruce cutblocks have a relatively small landbase area (~1,200 ha), so it was decided to use the natural stand curve to represent Post-1995 and future harvest areas for this strata.

For the Pl strata, the RSA yield MAI projections came out lower than the natural stand projections (peak MAI of 1.99 m^3/ha/yr vs. 2.54 m^3/ha/yr) for the current population. Additional analysis was undertaken to review the MAI for this RSA population, and as a result of the analysis and subsequent discussion, CFP decided to use the natural yields with an adjustment informed by the RSA results for the Post-1995 and future harvest areas. A modified curve was built that used a 21.75% reduction of the volumes (both conifer and deciduous) in the natural stand curve. This was determined based on the 21.75% difference in peak MAI between the curves. This is the curve that will be used in the TSA to represent post-1995 Pl harvest areas, and is shown in Appendix V. Future blocks harvested after the SHS effective date will transition back to the natural stand curve, due to silvicultural commitments CFP has made that intend to improve the regrowth of post-harvest blocks compared to the results shown here.

5.4 Future Cutblock Assignments

All cutblocks harvested after the SHS effective date (2025-05-01) will transition back to the same stratum, and the Natural / Basic curve. This includes pre-96 spruce stands currently on the juvenile curve, and pre-96 or post95 pine stands that are currently on the juvenile or RSA curve. Pine stands harvested in the bridging period between the landbase effective date and SHS effective date (i.e. 2023 and 2024 timber years) will transition to the post-95 pine curve.

Detailed information on silviculture prescriptions, treatment and transition are included in the reforestation strategy table in the final C5 FMP document - Chapter 7 - Plan Implementation and Monitoring.

6 Additional Analysis

6.1 Area Weighted Yield Curves

Area-weighted yield curves were created at the broad cover group level, for the conifer landbase, and for the total net landbase for the natural stand yield curves. The natural area weighted curves used the natural stand (standing timber) landbase areas. The PLMIX stratum was split into HwPl stratum and PlHw stratum, and the SXMIX stratum was split into HwSw stratum and SwHw stratum, based on net landbase areas. HwPl and HwSw strata were included in the DC broad cover group, while PlHw and SwHw strata were included in the CD broad cover group. The summary of net landbase areas is provided in Table 7 in the Natural column. Area weighted yield curves are presented in Appendix V. Plot volume averages shown in these figures are also area weighted.

6.2 Piece Size Curves

Piece size (cubic meters of gross merchantable volume per tree) curves were created for natural and RSA stand yield projections. The same plots used in the yield curve development were used for piece size curve development.

6.2.1 Natural Stands

Both coniferous and deciduous piece curves for natural stands were built using the empirically fitted piece size over age approach based on the same dataset used in the natural stand empirical yield curve development.

For each plot, piece size was calculated by dividing the gross merchantable volume by the number of merchantable trees in the plot. An equation to predict the m^3 per trees as a function of age was then fit directly using plot data:

$$PieceSize = a(Age^{b})$$

Where:

PieceSize = m^3 of gross merchantable volume per tree

Age = Stand age at the year of measurement

a, b = Coefficients

Twelve influential points (plots) that were excluded from the dataset during natural stand empirical yield curve development were also excluded during piece size development. Plots with no merchantable trees were excluded since piece size could not be calculated (dividing by 0). Five influential points (plots) were also removed containing extreme values that affected curve fit.

The final number of plots by yield stratum was different for coniferous and deciduous curves, since there could be coniferous merchantable trees with no deciduous merchantable trees, or vice versa. The majority of plots do not have deciduous merchantable trees in the three coniferous yield strata. The number of plots used in developing natural stand piece size curves is summarized in Table 29.

Table 29. Number of plots used for fitting natural stand piece size curves

Yield Stratum	Total Plots	Eligible Plots	Coniferous Curve Zero Volume Plots	Coniferous Curve Final Number of Plots	Deciduous Curve Zero Volume Plot	Deciduous Curve Final Number of Plots
Fd	88	81	3	78	66	15
MIX_Pl	24	22	4	18	9	13
MIX_Sx	30	29	5	24	9	20
Pl	155	152	1	151	134	18
Sw	76	72	0	72	62	10
Total	***373***	***356***	***13***	***343***	***280***	***76***

Model coefficients are presented in Table 30.

Table 30. Model coefficients for natural stand piece size curves

Yield Stratum	Coniferous Curve a	Coniferous Curve b	Deciduous Curve a	Deciduous Curve b
Fd	0.043843	0.598261	0.207657	0.028776
MIX_Pl	0.014311	0.696197	0.000053	1.913882
MIX_Sx	0.007183	0.972094	0.003936	0.968995
Pl	0.022251	0.559845	0.054293	0.407962
Sw	0.145861	0.228390	0.138880	0.085391

In the development of natural stand piece size curves in Fd and Pl yield strata, which were sampled by sampling strata, the area weighting of sampling strata was applied to ensure that the representation of plots is proportional to the landbase.

Piece size curves were developed for all yield strata in natural stand yield curves except Hw stratum. For Hw stratum, piece size curves were not available in the previous FMP.

6.2.2 Pre-96 and Post-95 Managed Stands

Merchantable density and merchantable volume and merchantable density were obtained from GYPSY model projections by species group, and then summed across species groups to create estimates for deciduous and coniferous species types.

First, the data was cleaned to remove implausible observations and obvious errors. Two specific issues were common to most yield strata. The first was unusually large piece size estimates at the beginning of the time series available for certain stands, which fell rapidly towards zero, before rising more predictably for the remainder of the series. This appears to be an artifact of the GYPSY model; in some cases (usually stands with low site index and low volume) the estimates of density are very low and hence piece size is unexpectedly large, despite low overall volumes. These anomalies were removed by setting piece size to a missing value at stand age below 40 years.

The second case was implausibly large piece size as stands age. This also appears to be an artifact of the model, which seems to decrease in density faster than volume in certain stands. Again, this usually occurs in stands with low site index and low initial volume. These anomalies were removed by setting piece size to a missing value at stand ages over 160 years.

For GYPSY yield projections, an average merchantable density and merchantable volume were calculated for each yield stratum. Piece size was then calculated as m^3/tree (dividing merchantable volume by merchantable density) and plotted by stand age to create the piece size curve.

All piece size curves developed are presented in Appendix VI. The piece size estimates were set to zero for stand ages less than 40 years.

6.3 MAI Summary and MAI Targets

Mean Annual Increment (MAI) values for natural stand, Pre-1996 managed stand and Post-1995 managed stand yield curves are summarized in this section. In addition, the MAI targets required for RSA targets and silviculture management for each managed strata used in the TSA are summarized at the end of this section.

As each FMU is anticipated to be a Sustained Yield Unit (SYU), culmination MAI targets were developed specific to FMU C5. MAI targets were selected as follows:

- HW yield strata are managed for deciduous yield, and therefore deciduous culmination age was used to select the year for MAI targets; and
- All coniferous and mixedwood strata are managed primarily for coniferous yield, and therefore coniferous culmination age was used to select MAI targets.

Culmination MAIs for each yield curve type are presented in Table 31 through Table 33. Note these MAI values are based on gross merchantable timber volumes which does not include cull allowance and are only the curves to be used in the TSA.

Table 31. Culmination Mean Annual Increments of yield curve for natural stand

Yield Stratum	N of Plot	Culmination Age	Maximum MAI MAI (m^3/ha/y) CON	DEC	TOT	MAI (m^3/ha/y) at Stand Age 80 CON	DEC
Hw[1]	64	77	0.35	1.19	1.53	0.34	1.18
Fd	81	109	2.78	0.07	2.85	2.37	0.08
MIX_Pl	24	106	1.09	0.70	1.78	1.01	0.88
MIX_Sx	30	101	2.09	0.43	2.51	1.98	0.60
Pl	152	90	2.54	0.02	2.57	2.47	0.02
Sw	74	114	2.32	0.04	2.36	1.87	0.06

[1] - Curves from previous FMP.

Table 32. Culmination mean annual increments of juvenile yield curve for Pre-1996 managed stand

Yield Stratum	N of Plot	Culmination Age	Maximum MAI MAI (m^3/ha/y) CON	DEC	TOT	MAI (m^3/ha/y) at Stand Age 80 CON	DEC
Pl	319	113	2.62	0.01	2.62	2.27	0.01
Sw	45	134	2.43	0.03	2.46	1.83	0.01

Table 33. Culmination Mean Annual Increments of RSA yield curve for Post-1995 managed stand

Yield Stratum	N of SUs	Culmination Age	Maximum MAI MAI (m^3/ha/y) CON	DEC	TOT	MAI (m^3/ha/y) at Stand Age 80 CON	DEC
Pl	86 [1]	90	1.99	0.02	2.01	1.93	0.01

6.4 Managed Stand Sensitivity Analysis

MAI values for all the curves to be used in the TSA are summarized in Table 34.

Table 34. TSA yield curve set cumulative MAI summary

Yield Stratum	Natural Culmination MAI			Pre96 and Post95 Basic Culmination MAI			Pre96 Juvenile Culmination MAI			Post95 RSA Culmination MAI		
	Age	CON	DEC	Age	CON	DEC	Age	CON	DEC	Age	CON	DEC
Hw	77	0.35	1.19	77	0.35	1.19						
Fd	109	2.78	0.07	109	2.78	0.07						
MIX_Pl	106	1.09	0.70	106	1.09	0.70						
MIX_Sx	101	2.09	0.43	101	2.09	0.43						
Pl	90	2.54	0.02	90	2.54	0.02	113	2.62	0.01	90	1.99	0.02
Sw	114	2.32	0.04	114	2.32	0.04	134	2.43	0.03			

Cumulative MAI RSA performance survey targets derived from the yield curves to be considered in the TSA process are summarized in Table 34. These are taken from the natural stand curves, as all harvest areas in the TSA transition back to the natural stand curves.

Note the values in this table were derived from gross merchantable volume based on a 15/11/30 cm utilization standard using a 4.88 m minimum merchantable tree length. For deciduous the minimum top dimeter is 10 cm instead of 11 cm for coniferous.

In Table 34, CFP yield strata were mapped to GOA Base 10 yield strata; any Crowsnest strata that represent combined Base 10 strata were reported separately when representing final RSA yield strata. The SbHw strata is not included as it does not exist on the landbase.

The final MAI targets were also adjusted from the company-specific utilization 15/11/30/4.88 to a 15/10/30/3.66 utilization standard using the Provincial Utilization Conversion Tool (January 2014).

This tool contains an Excel spreadsheet with lookup tables. It provides a volume multiplier by Base 10 stratum to generate a MAI at the desired utilization after plugging in the natural subregion, current utilization, and desired utilization. Based on the GOA's exercise of determining the natural subregion, "Foothills" natural subregion was used for FMU C5.

The MAI target adjustment results are provided in Table 35.

Table 35. Culmination MAI for RSA performance targets

Yield Stratum	GoA Base 10 Stratum	Treatment	Curve Type	Age	MAI (m^3/ha/yr) Util:15/11/30/4.88 CON	DEC[1]	TOT	Util:15/10/30/3.66 CON	DEC	TOT	Conversion Ratio CON	DEC
Hw[2]	Hw	Normal	Basic	77	0.35	1.19	1.53	0.35	1.19	1.54	1.01	1.00
Fd	Fd	Normal	Basic	109	2.78	0.07	2.85	2.83	0.07	2.89	1.02	1.00
MIX_Pl	HwPl	Normal	Basic	106	1.09	0.70	1.78	1.10	0.70	1.79	1.01	1.00
	PlHw	Normal	Basic	106	1.09	0.70	1.78	1.10	0.70	1.80	1.01	1.00
MIX_Sx	HwSx	Normal	Basic	101	2.09	0.43	2.51	2.11	0.43	2.53	1.01	1.00
	SwHw	Normal	Basic	101	2.09	0.43	2.51	2.11	0.43	2.54	1.01	1.00
Pl	Pl	Normal	Basic	90	2.54	0.02	2.57	2.61	0.02	2.63	1.03	1.00
SW	Sw	Normal	Basic	114	2.32	0.04	2.36	2.36	0.04	2.39	1.02	1.00

[1] - Deciduous utilization is: 15/10/30/4.88.

[2] - Curves obtained from 2006 - 2026 FMP and both coniferous and deciduous utilization is: 15/11/30/2.44.

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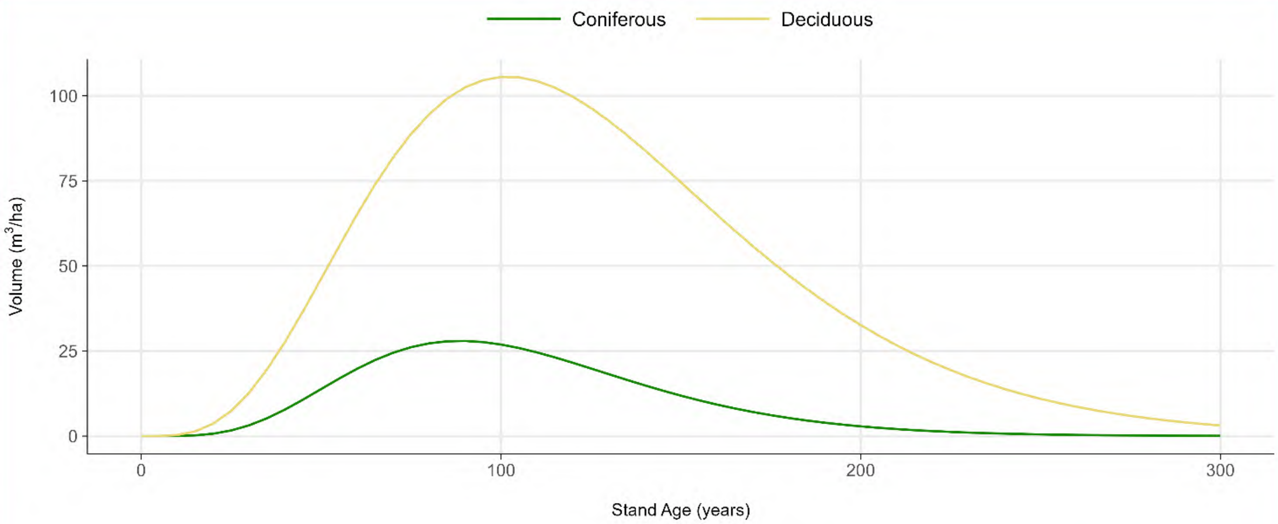
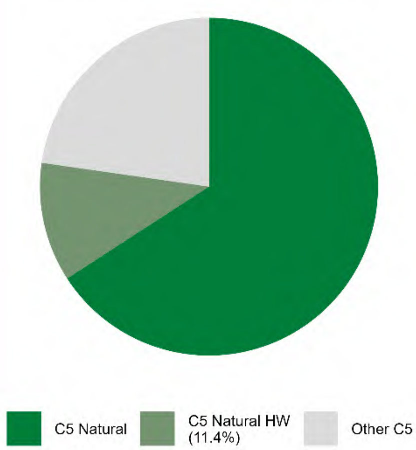
Appendix I – Natural Stand Yield Tables

Natural - HW



	Area (ha)	%
C5 Active Landbase	106,097	100.00
C5 Natural	81,965	77.25
C5 Natural HW	12,114	11.42

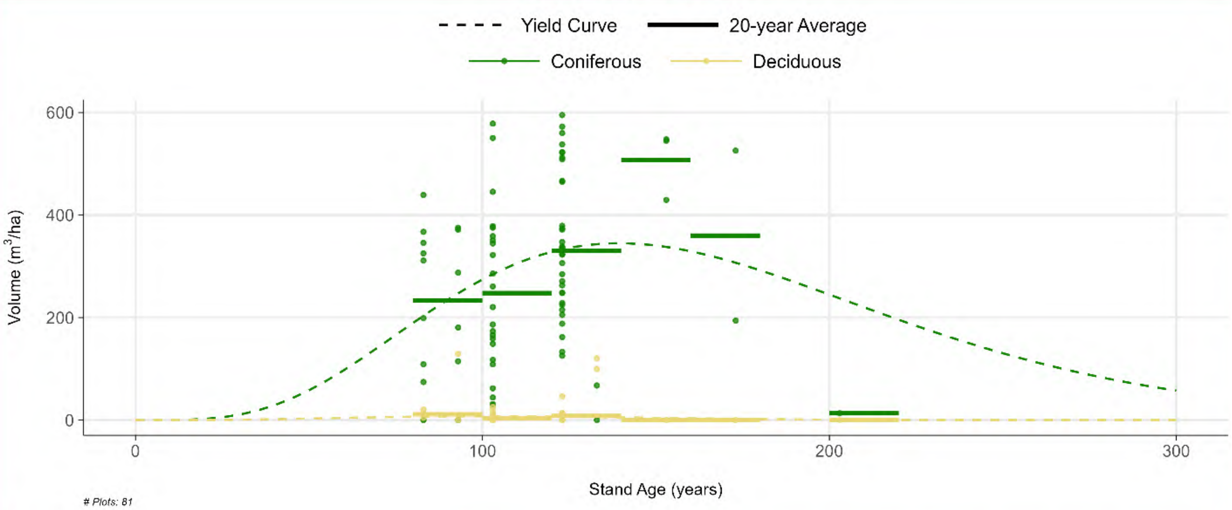
Stratum as a % of the active landbase:



Stand Age	Predicted Gross Merchantable Volume (m^3/ha)			Mean Annual Increment (m^3/ha/yr)		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
0	0.00	0.00	0.00	0.00	0.00	0.00
10	0.04	0.32	0.36	0.00	0.03	0.04
20	0.70	3.66	4.37	0.04	0.18	0.22
30	3.18	12.83	16.00	0.11	0.43	0.53
40	7.83	27.77	35.60	0.20	0.69	0.89
50	13.83	46.23	60.06	0.28	0.92	1.20
60	19.79	65.16	84.95	0.33	1.09	1.42
70	24.49	81.88	106.36	0.35	1.17	1.52
80	27.25	94.59	121.84	0.34	1.18	1.52
90	27.96	102.47	130.43	0.31	1.14	1.45
100	26.91	105.54	132.45	0.27	1.06	1.32
110	24.59	104.33	128.92	0.22	0.95	1.17
120	21.53	99.71	121.24	0.18	0.83	1.01
130	18.18	92.62	110.81	0.14	0.71	0.85
140	14.90	83.98	98.88	0.11	0.60	0.71
150	11.89	74.58	86.47	0.08	0.50	0.58
160	9.27	65.04	74.30	0.06	0.41	0.46
170	7.08	55.82	62.90	0.04	0.33	0.37
180	5.32	47.23	52.55	0.03	0.26	0.29
190	3.93	39.47	43.39	0.02	0.21	0.23
200	2.86	32.61	35.47	0.01	0.16	0.18
210	2.06	26.67	28.72	0.01	0.13	0.14
220	1.46	21.61	23.07	0.01	0.10	0.10
230	1.03	17.36	18.39	0.00	0.08	0.08
240	0.72	13.84	14.56	0.00	0.06	0.06
250	0.49	10.96	11.45	0.00	0.04	0.05
260	0.34	8.62	8.96	0.00	0.03	0.03

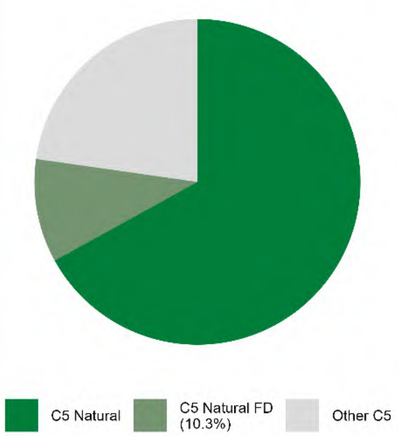
Note:
Gross volume is calculated at the utilization standards specified on this page with no deductions for cull.
Maximum MAI is highlighted in yellow.

Natural - FD



	Area (ha)	%
C5 Active Landbase	106,097	100.00
C5 Natural	81,965	77.25
C5 Natural FD	10,909	10.28

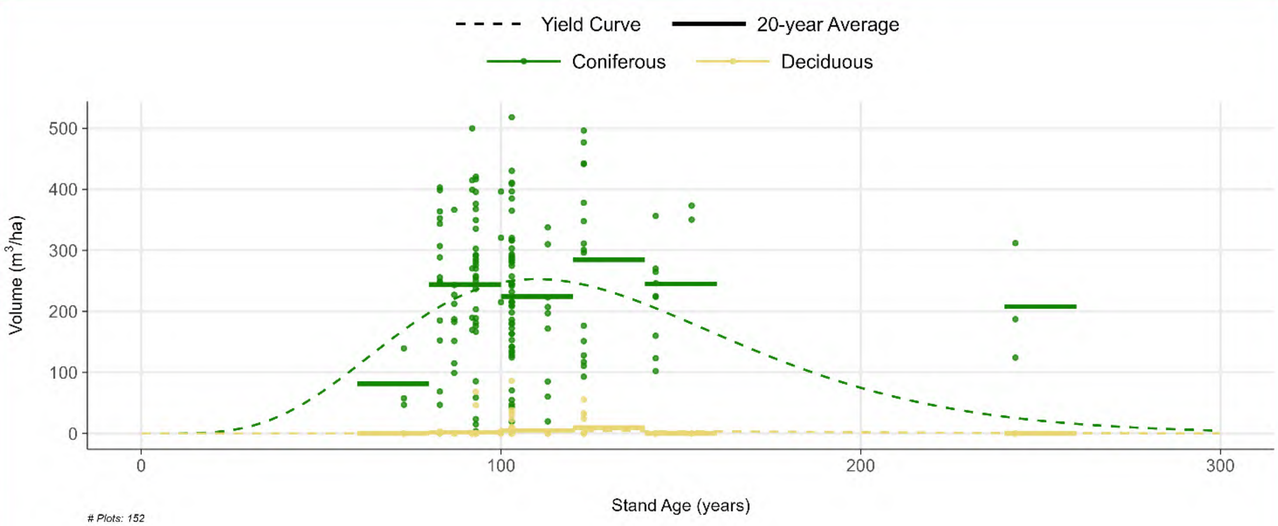
Stratum as a % of the active landbase:



Stand Age	Predicted Gross Merchantable Volume (m^3/ha)			Mean Annual Increment (m^3/ha/yr)		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
0	0.00	0.00	0.00	0.00	0.00	0.00
10	0.12	0.01	0.14	0.01	0.00	0.01
20	2.24	0.18	2.42	0.11	0.01	0.12
30	10.54	0.72	11.26	0.35	0.02	0.38
40	28.73	1.67	30.40	0.72	0.04	0.76
50	58.04	2.91	60.96	1.16	0.06	1.22
60	97.00	4.26	101.26	1.62	0.07	1.69
70	142.23	5.49	147.72	2.03	0.08	2.11
80	189.49	6.46	195.95	2.37	0.08	2.45
90	234.66	7.05	241.71	2.61	0.08	2.69
100	274.29	7.26	281.56	2.74	0.07	2.82
110	306.00	7.12	313.11	2.78	0.06	2.85
120	328.46	6.68	335.13	2.74	0.06	2.79
130	341.34	6.02	347.36	2.63	0.05	2.67
140	345.08	5.23	350.31	2.46	0.04	2.50
150	340.66	4.38	345.04	2.27	0.03	2.30
160	329.42	3.52	332.95	2.06	0.02	2.08
170	312.82	2.72	315.53	1.84	0.02	1.86
180	292.30	1.98	294.28	1.62	0.01	1.63
190	269.24	1.34	270.58	1.42	0.01	1.42
200	244.82	0.81	245.62	1.22	0.00	1.23
210	220.04	0.37	220.41	1.05	0.00	1.05
220	195.69	0.03	195.72	0.89	0.00	0.89
230	172.38	0.00	172.38	0.75	0.00	0.75
240	150.51	0.00	150.51	0.63	0.00	0.63
250	130.37	0.00	130.37	0.52	0.00	0.52
260	112.08	0.00	112.08	0.43	0.00	0.43

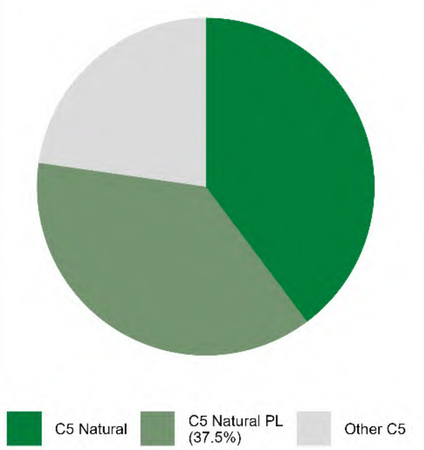
Note:
Gross volume is calculated at the utilization standards specified on this page with no deductions for cull. Maximum MAI is highlighted in yellow.

Natural - PL



	Area (ha)	%
C5 Active Landbase	106,097	100.00
C5 Natural	81,965	77.25
C5 Natural PL	39,780	37.49

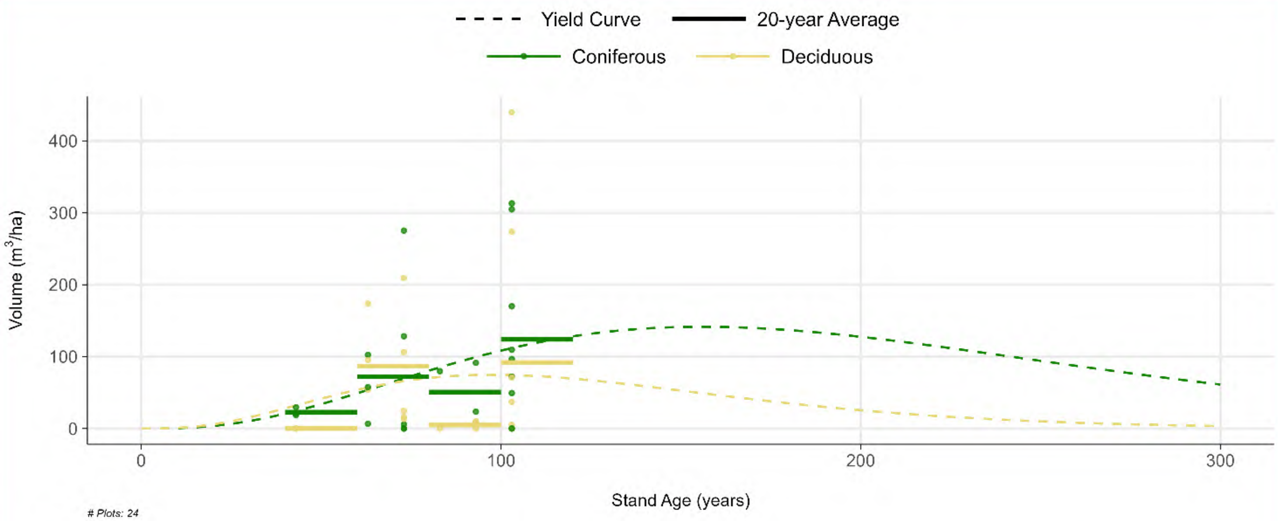
Stratum as a % of the active landbase:



Stand Age	Predicted Gross Merchantable Volume (m^3/ha)			Mean Annual Increment (m^3/ha/yr)		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
0	0.00	0.00	0.00	0.00	0.00	0.00
10	0.07	0.00	0.07	0.01	0.00	0.01
20	1.97	0.00	1.97	0.10	0.00	0.10
30	11.06	0.00	11.06	0.37	0.00	0.37
40	32.54	0.00	32.54	0.81	0.00	0.81
50	67.17	0.00	67.17	1.34	0.00	1.34
60	110.81	0.08	110.89	1.85	0.00	1.85
70	156.62	0.63	157.25	2.24	0.01	2.25
80	197.68	1.37	199.05	2.47	0.02	2.49
90	228.85	2.16	231.01	2.54	0.02	2.57
100	247.48	2.90	250.38	2.47	0.03	2.50
110	253.26	3.49	256.75	2.30	0.03	2.33
120	247.63	3.88	251.51	2.06	0.03	2.10
130	233.05	4.06	237.10	1.79	0.03	1.82
140	212.29	4.04	216.33	1.52	0.03	1.55
150	188.03	3.86	191.89	1.25	0.03	1.28
160	162.52	3.56	166.09	1.02	0.02	1.04
170	137.49	3.20	140.69	0.81	0.02	0.83
180	114.12	2.80	116.91	0.63	0.02	0.65
190	93.13	2.39	95.52	0.49	0.01	0.50
200	74.85	2.01	76.86	0.37	0.01	0.38
210	59.34	1.65	60.99	0.28	0.01	0.29
220	46.46	1.34	47.80	0.21	0.01	0.22
230	35.96	1.07	37.04	0.16	0.00	0.16
240	27.55	0.85	28.40	0.11	0.00	0.12
250	20.91	0.66	21.57	0.08	0.00	0.09
260	15.73	0.51	16.24	0.06	0.00	0.06

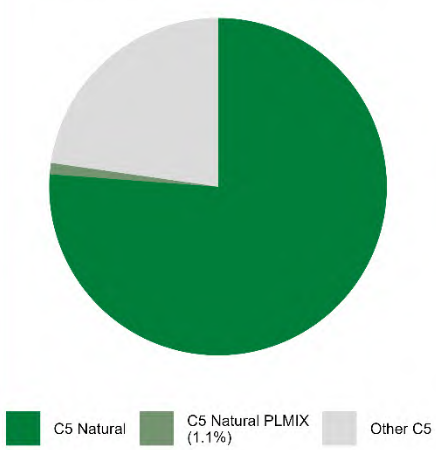
Note:
Gross volume is calculated at the utilization standards specified on this page with no deductions for cull.
Maximum MAI is highlighted in yellow.

Natural - PLMIX



	Area (ha)	%
C5 Active Landbase	106,097	100.00
C5 Natural	81,965	77.25
C5 Natural PLMIX	1,140	1.07

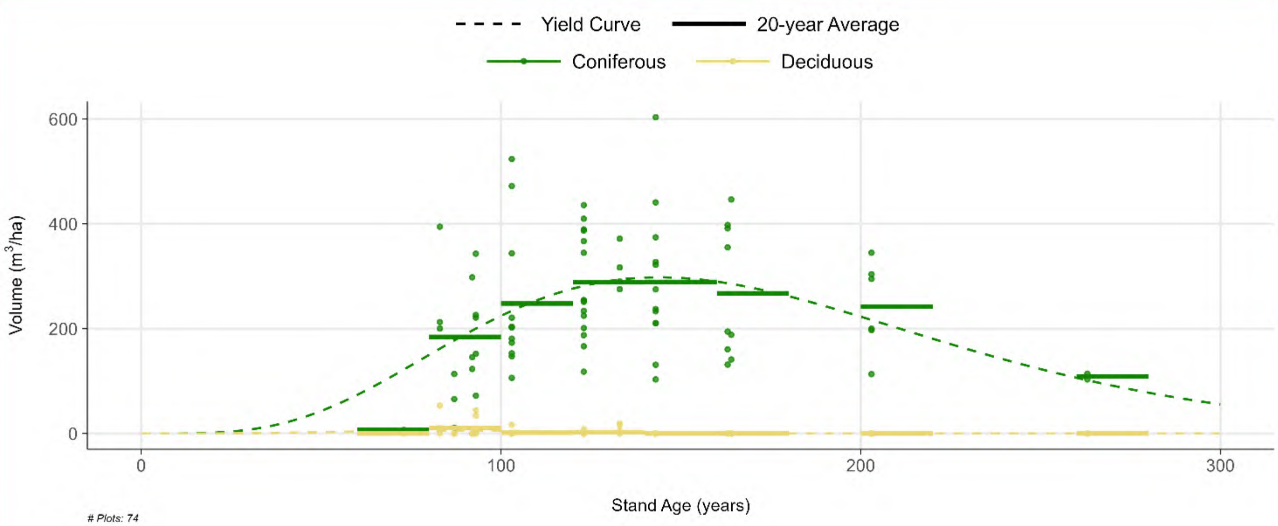
Stratum as a % of the active landbase:



Stand Age	Predicted Gross Merchantable Volume (m^3/ha)			Mean Annual Increment (m^3/ha/yr)		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
0	0.00	0.00	0.00	0.00	0.00	0.00
10	0.50	0.84	1.34	0.05	0.08	0.13
20	3.53	5.74	9.27	0.18	0.29	0.46
30	10.25	15.36	25.62	0.34	0.51	0.85
40	20.60	28.05	48.65	0.52	0.70	1.22
50	33.85	41.52	75.37	0.68	0.83	1.51
60	48.96	53.82	102.77	0.82	0.90	1.71
70	64.85	63.65	128.50	0.93	0.91	1.84
80	80.54	70.41	150.95	1.01	0.88	1.89
90	95.23	73.99	169.22	1.06	0.82	1.88
100	108.33	74.68	183.00	1.08	0.75	1.83
110	119.42	72.95	192.36	1.09	0.66	1.75
120	128.27	69.36	197.63	1.07	0.58	1.65
130	134.83	64.47	199.30	1.04	0.50	1.53
140	139.11	58.78	197.89	0.99	0.42	1.41
150	141.26	52.71	193.97	0.94	0.35	1.29
160	141.46	46.59	188.05	0.88	0.29	1.18
170	139.94	40.66	180.59	0.82	0.24	1.06
180	136.95	35.08	172.03	0.76	0.19	0.96
190	132.73	29.97	162.70	0.70	0.16	0.86
200	127.54	25.37	152.91	0.64	0.13	0.76
210	121.59	21.30	142.90	0.58	0.10	0.68
220	115.11	17.76	132.86	0.52	0.08	0.60
230	108.27	14.70	122.97	0.47	0.06	0.53
240	101.23	12.10	113.33	0.42	0.05	0.47
250	94.14	9.90	104.04	0.38	0.04	0.42
260	87.11	8.06	95.17	0.34	0.03	0.37

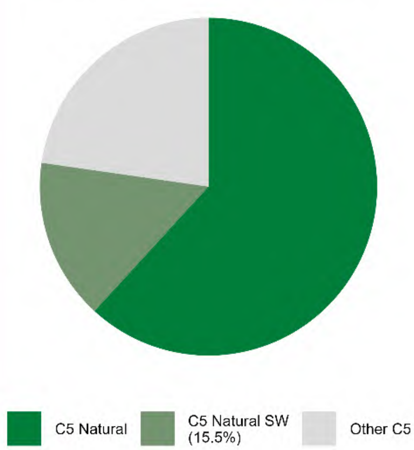
Note:
Gross volume is calculated at the utilization standards specified on this page with no deductions for cull.
Maximum MAI is highlighted in yellow.

Natural - SW



	Area (ha)	%
C5 Active Landbase	106,097	100.00
C5 Natural	81,965	77.25
C5 Natural SW	16,396	15.45

Stratum as a % of the active landbase:

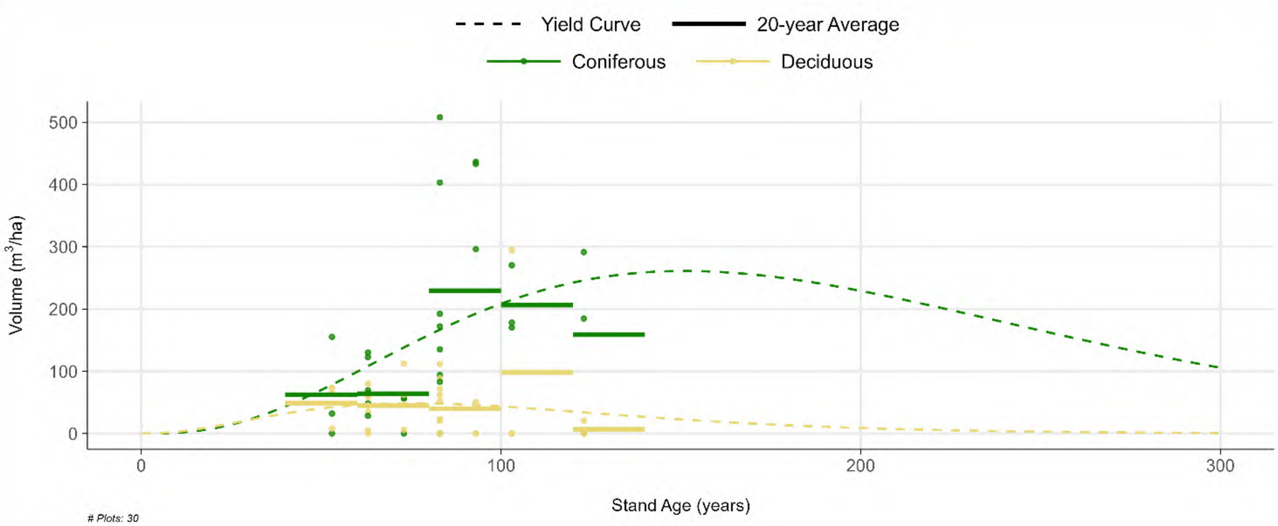


Stand Age	Predicted Gross Merchantable Volume (m^3/ha)			Mean Annual Increment (m^3/ha/yr)		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
0	0.00	0.00	0.00	0.00	0.00	0.00
10	0.07	0.01	0.08	0.01	0.00	0.01
20	1.43	0.16	1.59	0.07	0.01	0.08
30	7.18	0.62	7.80	0.24	0.02	0.26
40	20.45	1.46	21.91	0.51	0.04	0.55
50	42.75	2.54	45.29	0.86	0.05	0.91
60	73.47	3.65	77.12	1.22	0.06	1.29
70	110.30	4.58	114.88	1.58	0.07	1.64
80	149.99	5.18	155.18	1.87	0.06	1.94
90	189.12	5.38	194.50	2.10	0.06	2.16
100	224.66	5.17	229.83	2.25	0.05	2.30
110	254.32	4.60	258.92	2.31	0.04	2.35
120	276.65	3.77	280.42	2.31	0.03	2.34
130	291.05	2.78	293.83	2.24	0.02	2.26
140	297.60	1.72	299.32	2.13	0.01	2.14
150	296.91	0.68	297.60	1.98	0.00	1.98
160	289.97	0.00	289.97	1.81	0.00	1.81
170	277.92	0.00	277.92	1.63	0.00	1.63
180	261.98	0.00	261.98	1.46	0.00	1.46
190	243.31	0.00	243.31	1.28	0.00	1.28
200	222.99	0.00	222.99	1.11	0.00	1.11
210	201.93	0.00	201.93	0.96	0.00	0.96
220	180.87	0.00	180.87	0.82	0.00	0.82
230	160.41	0.00	160.41	0.70	0.00	0.70
240	140.98	0.00	140.98	0.59	0.00	0.59
250	122.87	0.00	122.87	0.49	0.00	0.49
260	106.27	0.00	106.27	0.41	0.00	0.41

Note:

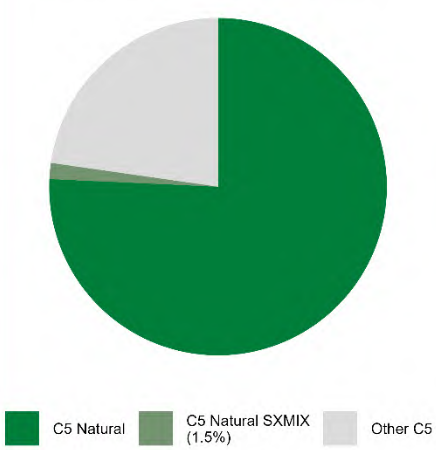
Gross volume is calculated at the utilization standards specified on this page with no deductions for cull.
Maximum MAI is highlighted in yellow.

Natural - SXMIX



	Area (ha)	%
C5 Active Landbase	106,097	100.00
C5 Natural	81,965	77.25
C5 Natural SXMIX	1,626	1.53

Stratum as a % of the active landbase:



Stand Age	Predicted Gross Merchantable Volume (m^3/ha)			Mean Annual Increment (m^3/ha/yr)		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
0	0.00	0.00	0.00	0.00	0.00	0.00
10	1.20	2.70	3.90	0.12	0.27	0.39
20	7.98	11.02	19.00	0.40	0.55	0.95
30	22.25	21.84	44.09	0.74	0.73	1.47
40	43.44	32.21	75.65	1.09	0.81	1.89
50	69.80	40.39	110.19	1.40	0.81	2.20
60	99.13	45.73	144.87	1.65	0.76	2.41
70	129.31	48.24	177.55	1.85	0.69	2.54
80	158.49	48.32	206.81	1.98	0.60	2.59
90	185.22	46.53	231.75	2.06	0.52	2.58
100	208.49	43.43	251.92	2.08	0.43	2.52
110	227.67	39.52	267.19	2.07	0.36	2.43
120	242.45	35.23	277.68	2.02	0.29	2.31
130	252.81	30.86	283.66	1.94	0.24	2.18
140	258.93	26.63	285.55	1.85	0.19	2.04
150	261.13	22.69	283.81	1.74	0.15	1.89
160	259.82	19.11	278.93	1.62	0.12	1.74
170	255.49	15.94	271.43	1.50	0.09	1.60
180	248.61	13.19	261.79	1.38	0.07	1.45
190	239.66	10.82	250.48	1.26	0.06	1.32
200	229.11	8.82	237.93	1.15	0.04	1.19
210	217.38	7.14	224.52	1.04	0.03	1.07
220	204.83	5.75	210.58	0.93	0.03	0.96
230	191.81	4.61	196.42	0.83	0.02	0.85
240	178.59	3.67	182.26	0.74	0.02	0.76
250	165.41	2.92	168.33	0.66	0.01	0.67
260	152.46	2.31	154.77	0.59	0.01	0.60

Note:
Gross volume is calculated at the utilization standards specified on this page with no deductions for cull.
Maximum MAI is highlighted in yellow.

Appendix II – Juvenile Curves with Stocking Inputs in GYPSY

Background

Crowsnest Forest Products Ltd (Crowsnest) recent Forest Management Agreement requires submission of a Forest Management Plan (FMP) for FMU C5 in 2025. One of the FMP components is developing timber yield curves to support TSA and ultimately AAC determination. Yield curves must be derived from data collected in approved volume sampling programs and correlated with net landbase assumptions.

The draft Pre-1996 managed stand yield curves (juvenile) were reviewed with the GoA. GoA expressed concerns about the higher yields in the Pre-1996 managed stand yield curves that may be the result of lack of stocking information for modelling TSP data in GYPSY. GoA indicated that in younger stands, stocking information is very important to GYPSY modelling. It is critical, especially for any species groups with relatively low densities. Since the stocking data is not available for the juvenile TSPs, yields for the pre-96 stands may be overestimated.

As part of their feedback, the GoA recommended the integration of a stocking estimate into the modeling process. Based on GOA's suggestion, the relationships between stocking and density were developed from the RSA data, which were used in developing Post-1995 managed stand yield curves (RSA), using regression models. These relationships were then applied to juvenile TSPs to estimate the stocking from the observed density. The Pre-1996 managed stand yield curves were reconstructed by incorporating the stocking estimate in GYPSY projections.

This document provides the summaries of the approach and results of developing the stocking-density relationships. Additionally, it presents the revised Pre-1996 managed stand yield curves, which now incorporate the estimated stocking as an input within the GYPSY model.

Results

Relationships Between Density and Stocking

The relationships between stocking and density were developed using a regression-based methodology based on RSA data, which were used to build the Post-1995 managed stand yield curves. The species-specific stocking and density models were fit using the equation below:

$$Stocking = a(Density)/(b + Density)$$

Where:

- *Stocking* = Percent Stocking (%)
- *Density* = Species Density (stems/ha)
- *a, b* = Coefficients

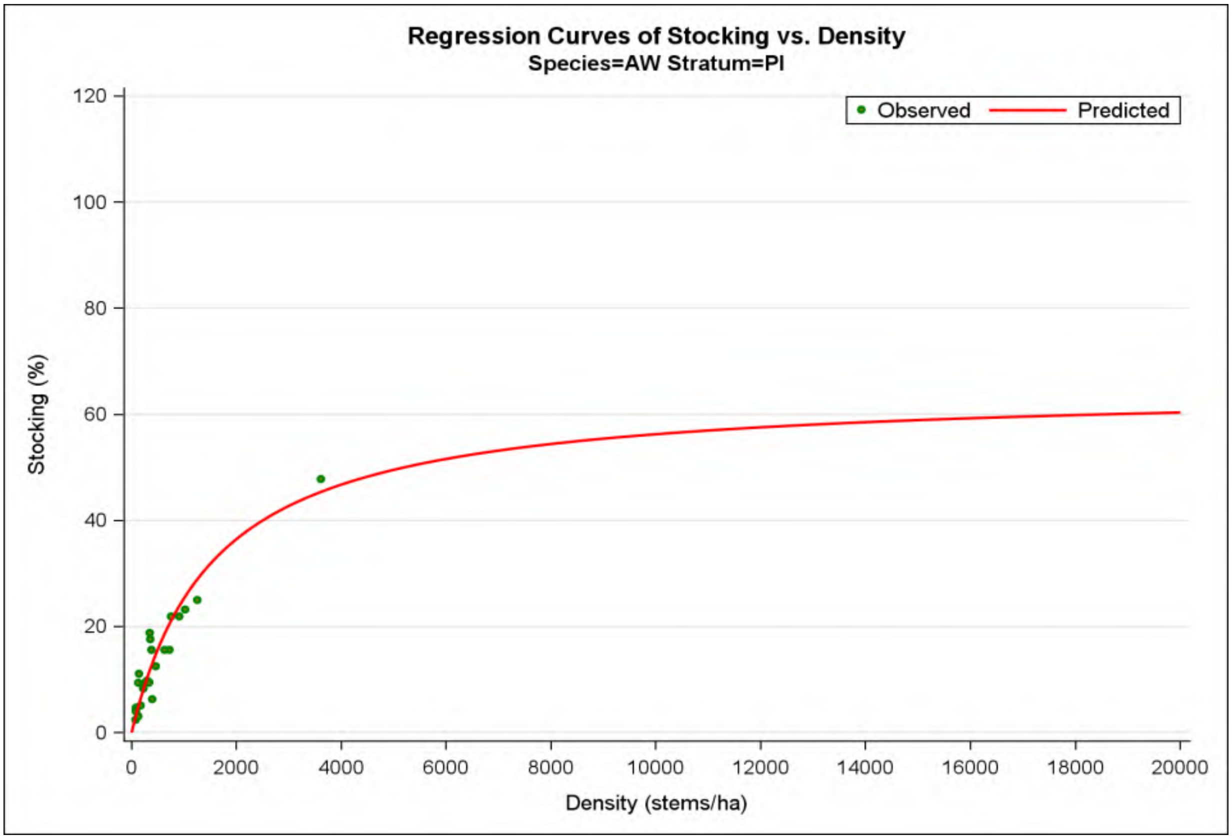
For species PL and SW, the regression models were fit for the yield strata Pl and Sw separately. Due to limitations in the available sample size, the regression model was fit based on the combined yield strata for species AW. The regression model was not built for species SB due to the absence of any SB trees within the RSA dataset.

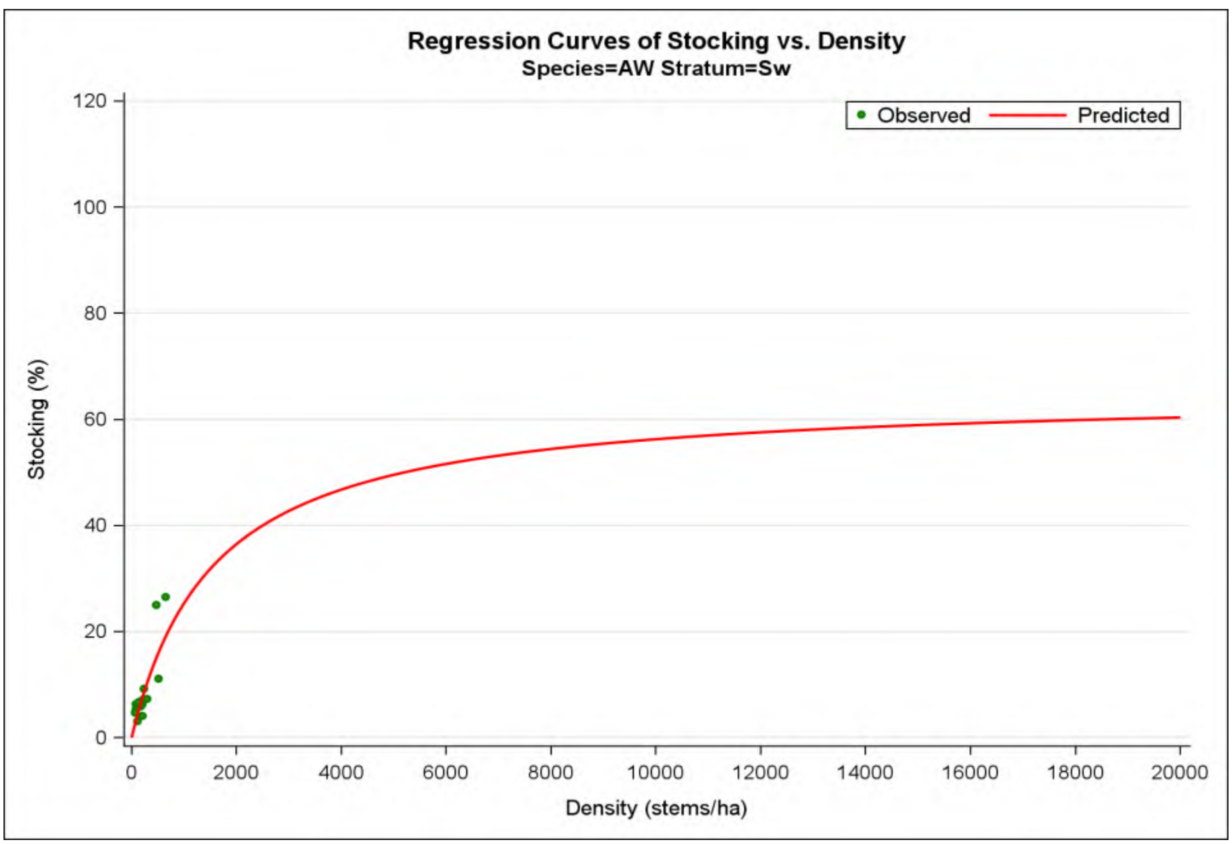
Sample size and coefficients associated with each species and yield stratum are presented in Table 36.

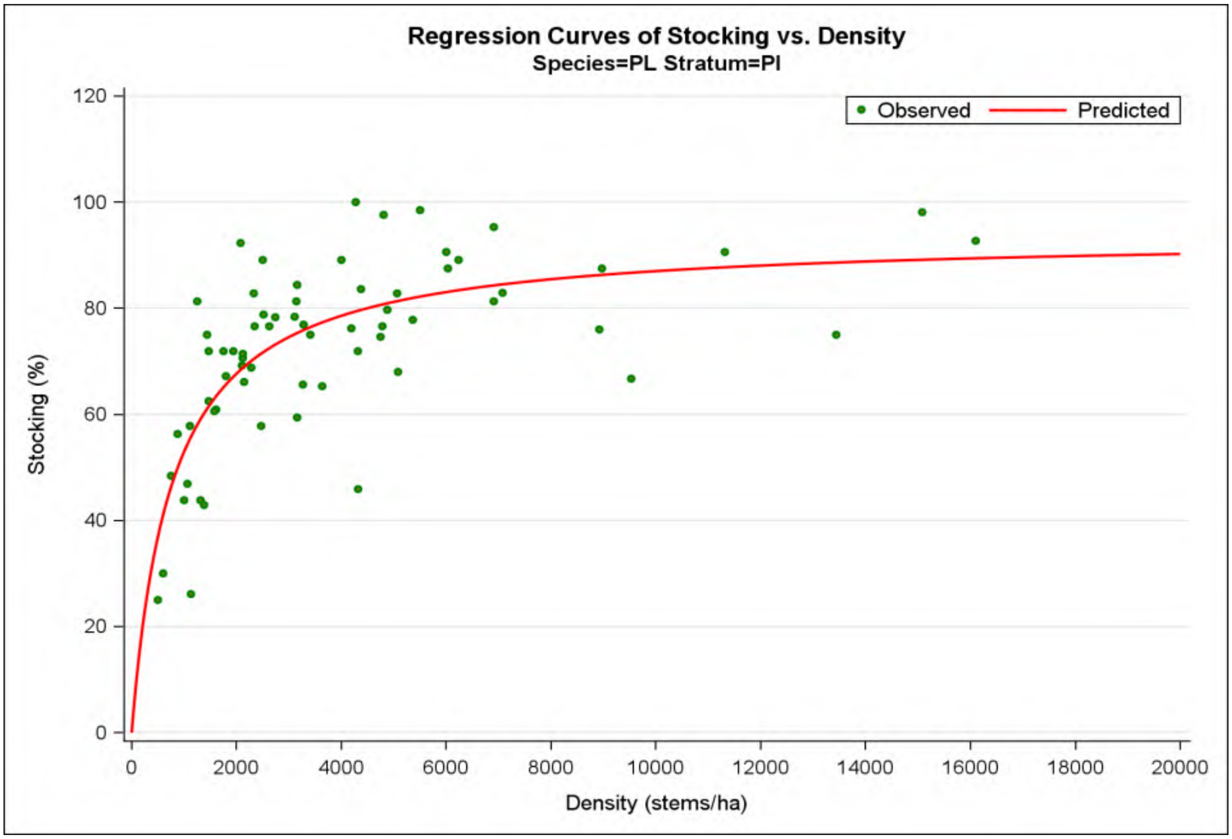
Table 36. Coefficients of stocking - density models by species and yield stratum

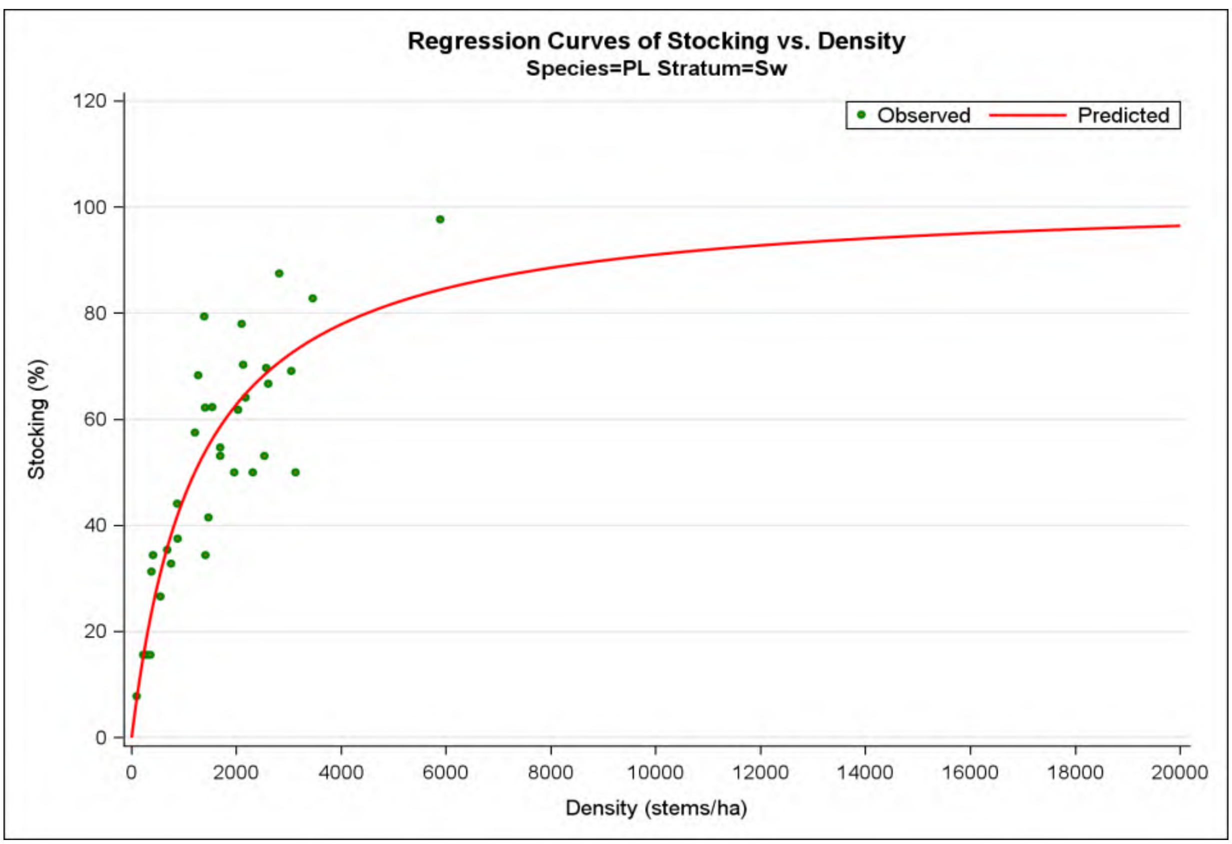
Species	Yield Stratum	Number of SUs	Model Coefficients	
			a	b
AW	Pl/Sw	39	65.057	1566.706
PL	Pl	70	93.680	769.023
	Sw	34	102.579	1266.237
SW	Pl	70	100.167	1328.075
	Sw	35	100.081	869.180

The figures of the predictions of stocking versus density superimposed with the corresponding observed stocking and density values are presented below.

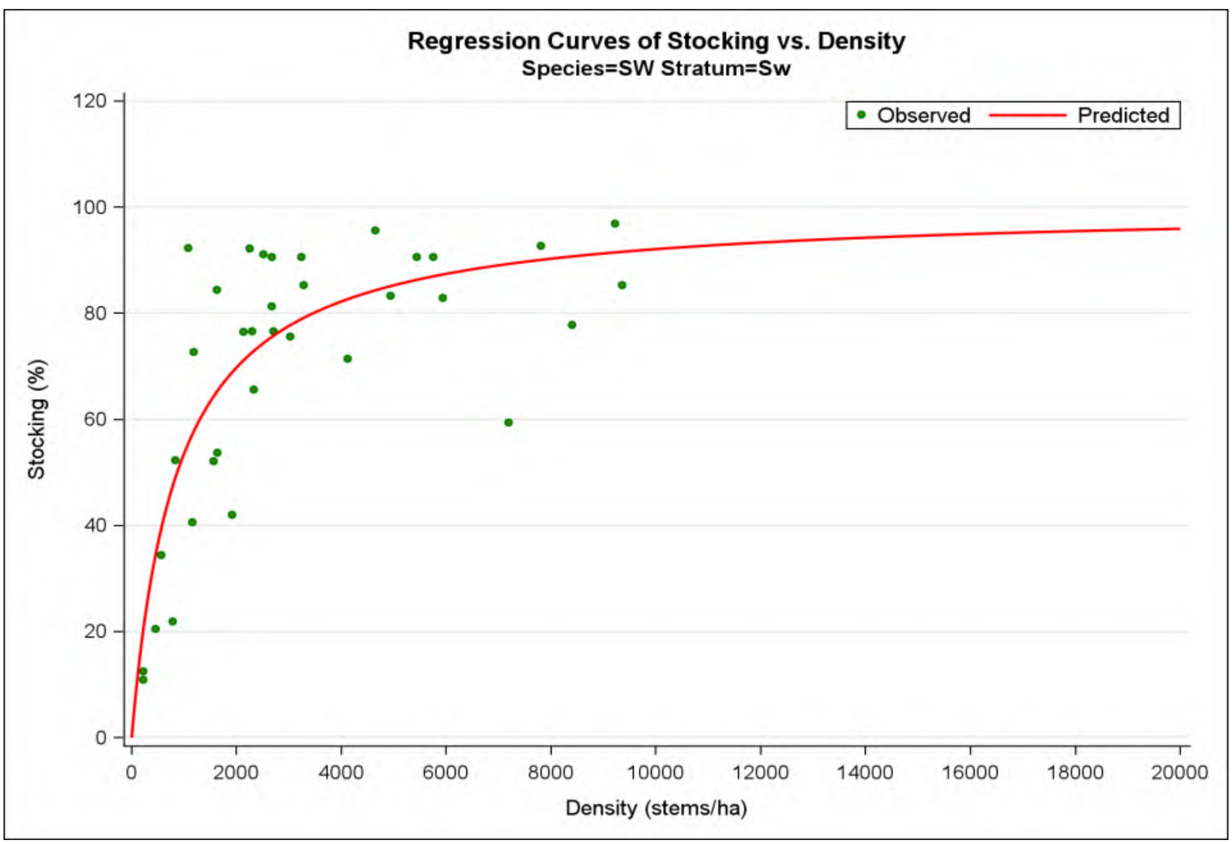

Regression Curves of Stocking vs. Density
Species=AW Stratum=Pl
Observed
Predicted
Stocking (%)
Density (stems/ha)
0
20
40
60
80
100
120
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000


Regression Curves of Stocking vs. Density
Species=AW Stratum=Sw
Observed
Predicted
Stocking (%)
Density (stems/ha)
0
20
40
60
80
100
120
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000


Regression Curves of Stocking vs. Density
Species=PL Stratum=Pl
Observed
Predicted
Stocking (%)
Density (stems/ha)
0
20
40
60
80
100
120
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000


Regression Curves of Stocking vs. Density
Species=PL Stratum=Sw
Observed
Predicted
Stocking (%)
Density (stems/ha)
0
20
40
60
80
100
120
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000

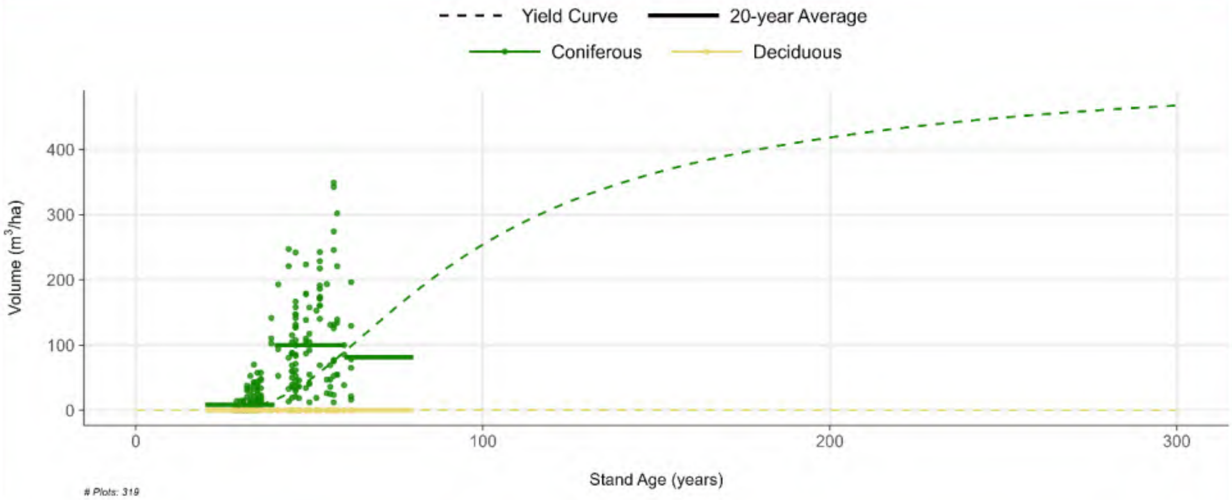
Regression Curves of Stocking vs. Density
Species=SW Stratum=Pl
Observed
Predicted
Stocking (%)
Density (stems/ha)
0
20
40
60
80
100
120
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000



Regression Curves of Stocking vs. Density
Species=SW Stratum=Sw
Observed
Predicted
Stocking (%)
Density (stems/ha)
0
20
40
60
80
100
120
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000

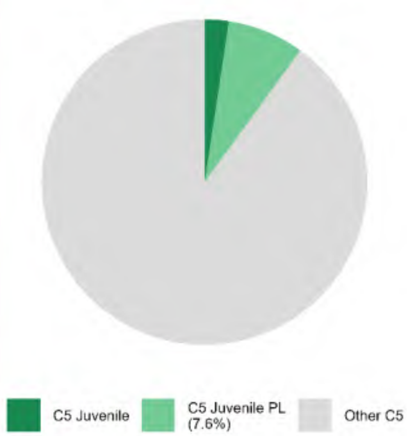
Appendix III – Pre-1996 Managed Stand Yield Tables

Juvenile - PL



	Area (ha)	%
C5 Active Landbase	106,097	100.00
C5 Juvenile	10,613	10.00
C5 Juvenile PL	8,083	7.62

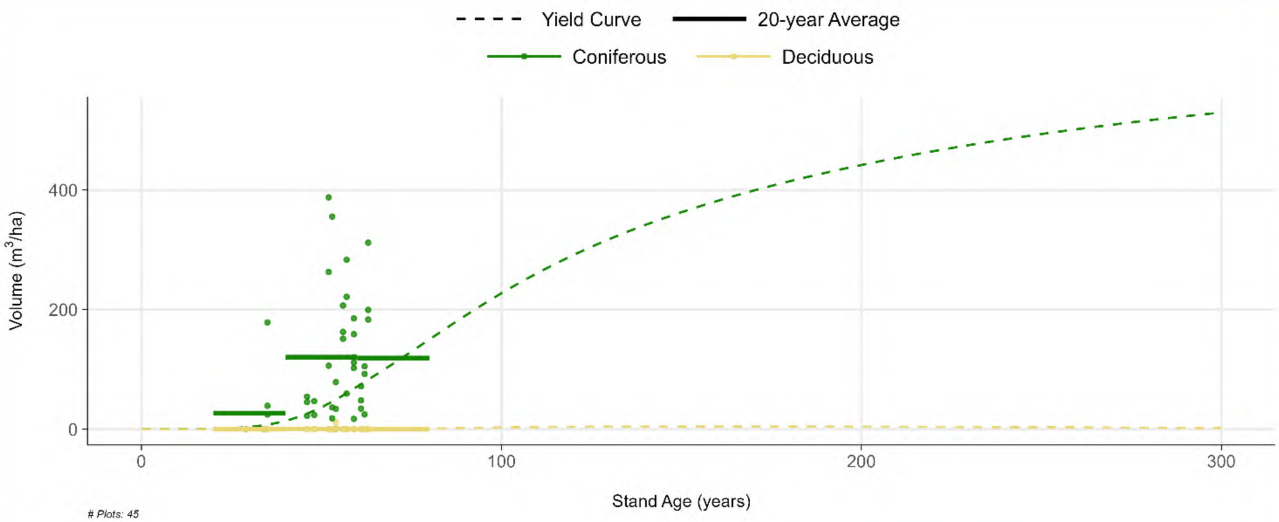
Stratum as a % of the active landbase:



Stand Age	Predicted Gross Merchantable Volume (m^3/ha)			Mean Annual Increment (m^3/ha/yr)		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
0	0.00	0.00	0.00	0.00	0.00	0.00
10	0.03	0.00	0.03	0.00	0.00	0.00
20	0.13	0.00	0.13	0.01	0.00	0.01
30	2.52	0.00	2.52	0.08	0.00	0.08
40	15.54	0.01	15.55	0.39	0.00	0.39
50	46.37	0.04	46.42	0.93	0.00	0.93
60	89.32	0.14	89.46	1.49	0.00	1.49
70	135.44	0.28	135.72	1.93	0.00	1.94
80	179.83	0.42	180.25	2.25	0.01	2.25
90	219.69	0.53	220.22	2.44	0.01	2.45
100	254.31	0.59	254.90	2.54	0.01	2.55
110	283.93	0.60	284.53	2.58	0.01	2.59
120	309.12	0.57	309.69	2.58	0.00	2.58
130	330.55	0.50	331.05	2.54	0.00	2.55
140	348.86	0.41	349.27	2.49	0.00	2.49
150	364.61	0.33	364.94	2.43	0.00	2.43
160	378.27	0.27	378.53	2.36	0.00	2.37
170	390.21	0.23	390.43	2.30	0.00	2.30
180	400.73	0.18	400.91	2.23	0.00	2.23
190	410.06	0.14	410.19	2.16	0.00	2.16
200	418.38	0.09	418.46	2.09	0.00	2.09
210	425.83	0.03	425.86	2.03	0.00	2.03
220	432.53	0.00	432.53	1.97	0.00	1.97
230	438.56	0.00	438.56	1.91	0.00	1.91
240	444.02	0.00	444.02	1.85	0.00	1.85
250	448.96	0.00	448.96	1.80	0.00	1.80
260	453.43	0.00	453.43	1.74	0.00	1.74

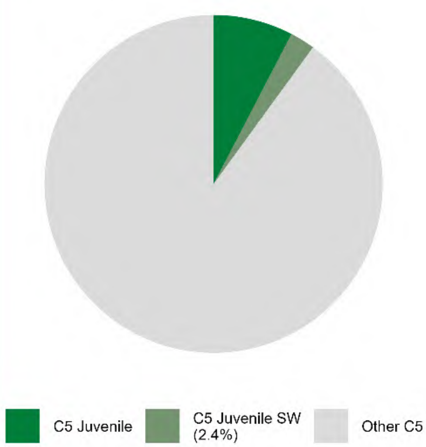
Note:
Gross volume is calculated at the utilization standards specified on this page with no deductions for cull. Maximum MAI is highlighted in yellow.

Juvenile - SW



	Area (ha)	%
C5 Active Landbase	106,097	100.00
C5 Juvenile	10,613	10.00
C5 Juvenile SW	2,530	2.38

Stratum as a % of the active landbase:

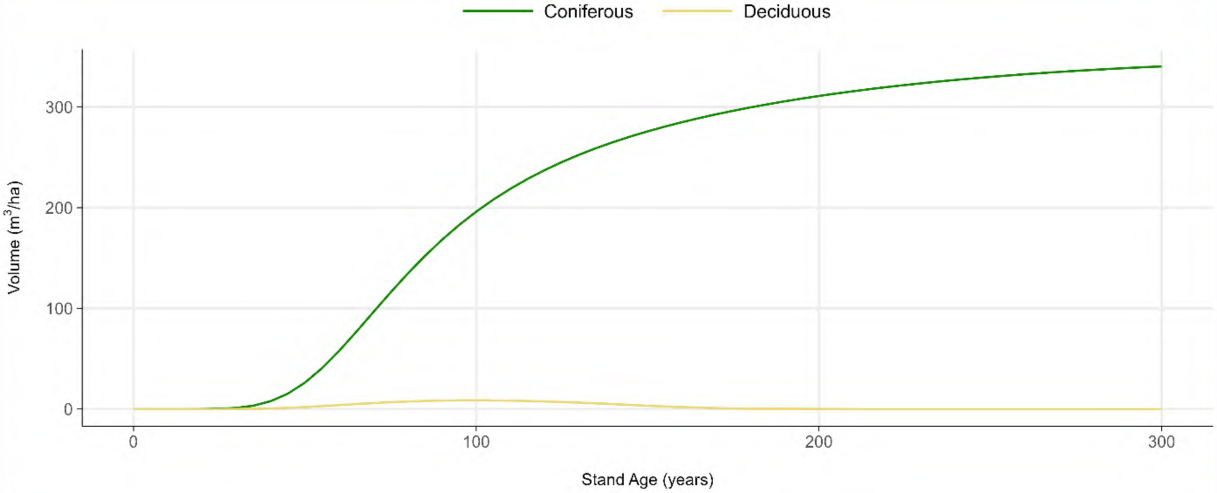


Stand Age	Predicted Gross Merchantable Volume (m^3/ha)			Mean Annual Increment (m^3/ha/yr)		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
0	0.00	0.00	0.00	0.00	0.00	0.00
10	0.42	0.00	0.42	0.04	0.00	0.04
20	1.00	0.00	1.00	0.05	0.00	0.05
30	3.61	0.00	3.61	0.12	0.00	0.12
40	13.68	0.00	13.68	0.34	0.00	0.34
50	36.43	0.00	36.44	0.73	0.00	0.73
60	71.55	0.02	71.57	1.19	0.00	1.19
70	109.81	0.22	110.03	1.57	0.00	1.57
80	150.10	0.92	151.02	1.88	0.01	1.89
90	190.03	1.99	192.02	2.11	0.02	2.13
100	227.40	2.93	230.33	2.27	0.03	2.30
110	261.20	3.61	264.81	2.37	0.03	2.41
120	291.30	4.05	295.35	2.43	0.03	2.46
130	317.97	4.32	322.29	2.45	0.03	2.48
140	341.65	4.47	346.13	2.44	0.03	2.47
150	362.78	4.54	367.32	2.42	0.03	2.45
160	381.75	4.55	386.30	2.39	0.03	2.41
170	398.90	4.51	403.40	2.35	0.03	2.37
180	414.48	4.43	418.91	2.30	0.02	2.33
190	428.71	4.32	433.03	2.26	0.02	2.28
200	441.77	4.19	445.96	2.21	0.02	2.23
210	453.79	4.03	457.82	2.16	0.02	2.18
220	464.88	3.86	468.74	2.11	0.02	2.13
230	475.15	3.67	478.82	2.07	0.02	2.08
240	484.67	3.46	488.13	2.02	0.01	2.03
250	493.52	3.24	496.76	1.97	0.01	1.99
260	501.76	3.01	504.76	1.93	0.01	1.94

Note:
Gross volume is calculated at the utilization standards specified on this page with no deductions for cull.
Maximum MAI is highlighted in yellow.

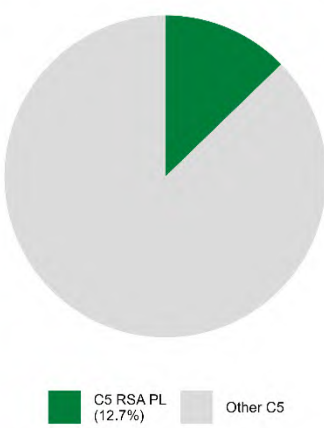
Appendix IV – Post-1995 Managed Stand Yield Tables

RSA - PL



	Area (ha)	%
C5 Active Landbase	106,097	100.00
C5 RSA	13,519	12.74
C5 RSA PL	13,519	12.74

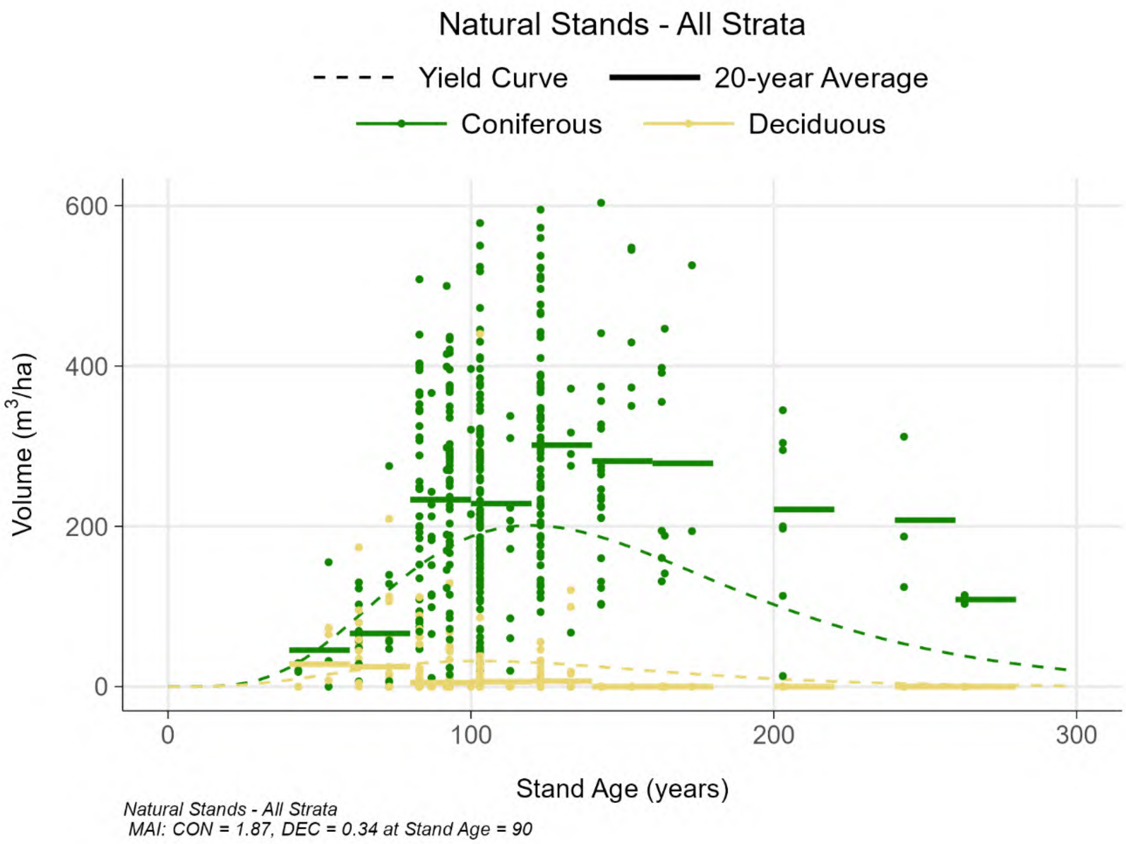
Stratum as a % of the active landbase:



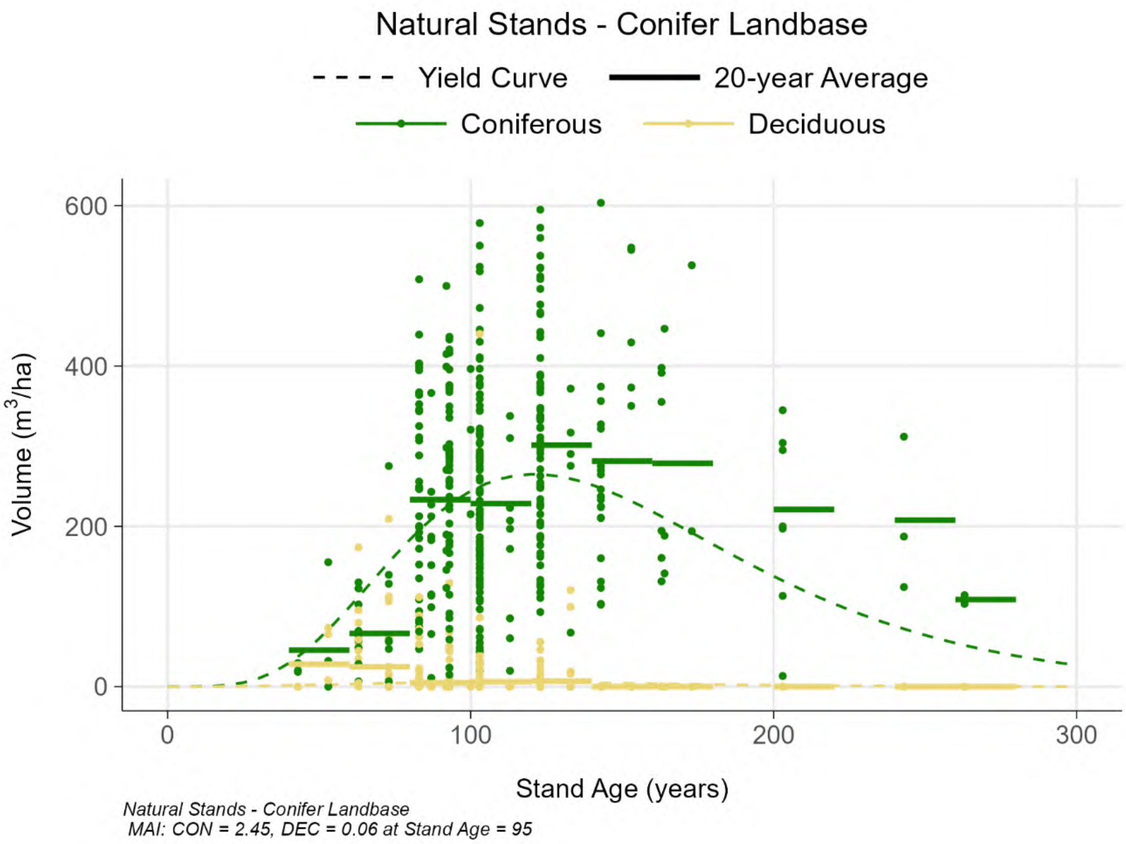
Stand Age	Predicted Gross Merchantable Volume (m^3/ha)			Mean Annual Increment (m^3/ha/yr)		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
0	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
20	0.04	0.00	0.04	0.00	0.00	0.00
30	1.20	0.10	1.30	0.04	0.00	0.04
40	7.85	0.64	8.50	0.20	0.02	0.21
50	26.26	2.01	28.27	0.53	0.04	0.57
60	57.85	3.97	61.82	0.96	0.07	1.03
70	96.40	5.96	102.36	1.38	0.09	1.46
80	134.51	7.53	142.04	1.68	0.09	1.78
90	168.10	8.47	176.58	1.87	0.09	1.96
100	196.08	8.74	204.82	1.96	0.09	2.05
110	218.86	8.39	227.25	1.99	0.08	2.07
120	237.38	7.55	244.93	1.98	0.06	2.04
130	252.55	6.39	258.94	1.94	0.05	1.99
140	265.16	4.93	270.09	1.89	0.04	1.93
150	275.79	3.32	279.11	1.84	0.02	1.86
160	284.87	1.95	286.82	1.78	0.01	1.79
170	292.72	0.99	293.71	1.72	0.01	1.73
180	299.57	0.39	299.96	1.66	0.00	1.67
190	305.59	0.26	305.86	1.61	0.00	1.61
200	310.92	0.13	311.05	1.55	0.00	1.56
210	315.64	0.01	315.65	1.50	0.00	1.50
220	319.83	0.00	319.83	1.45	0.00	1.45
230	323.56	0.00	323.56	1.41	0.00	1.41
240	326.89	0.00	326.89	1.36	0.00	1.36
250	329.84	0.00	329.84	1.32	0.00	1.32
260	332.47	0.00	332.47	1.28	0.00	1.28

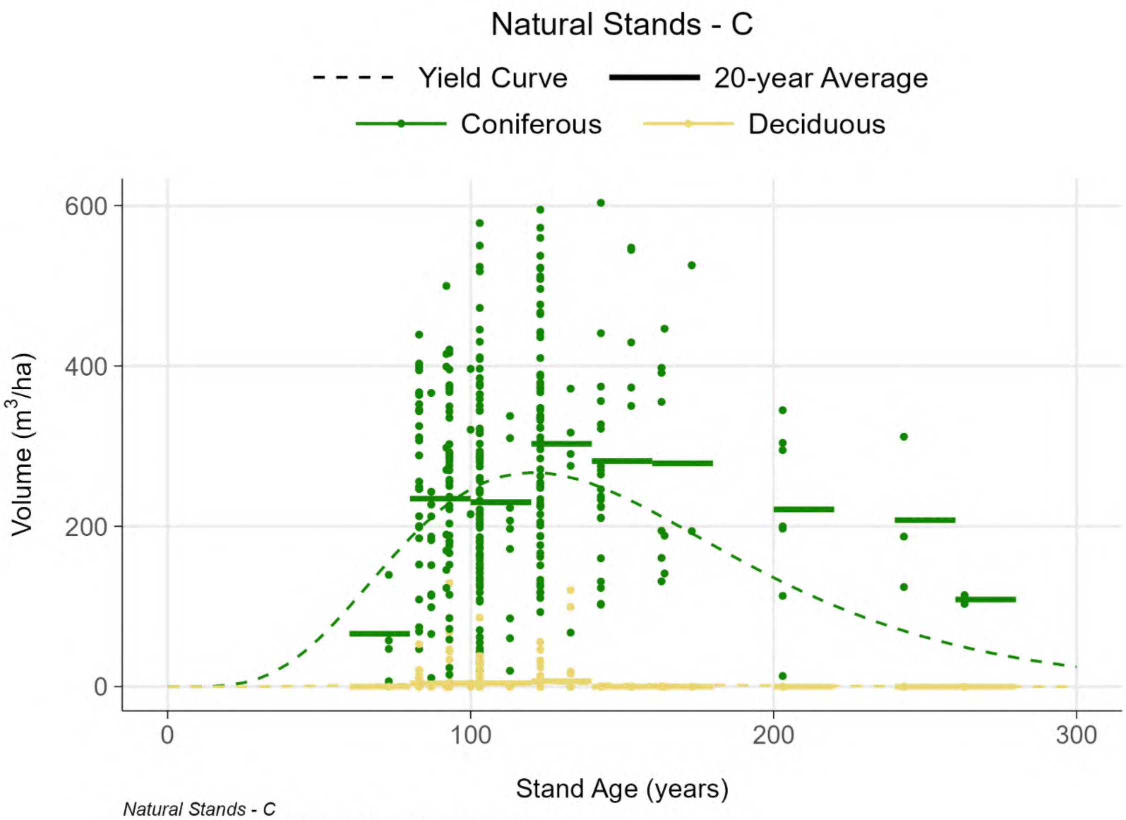
Note:
Gross volume is calculated at the utilization standards specified on this page with no deductions for cull.
Maximum MAI is highlighted in yellow.

Appendix V – Area-Weighted Yield Curves

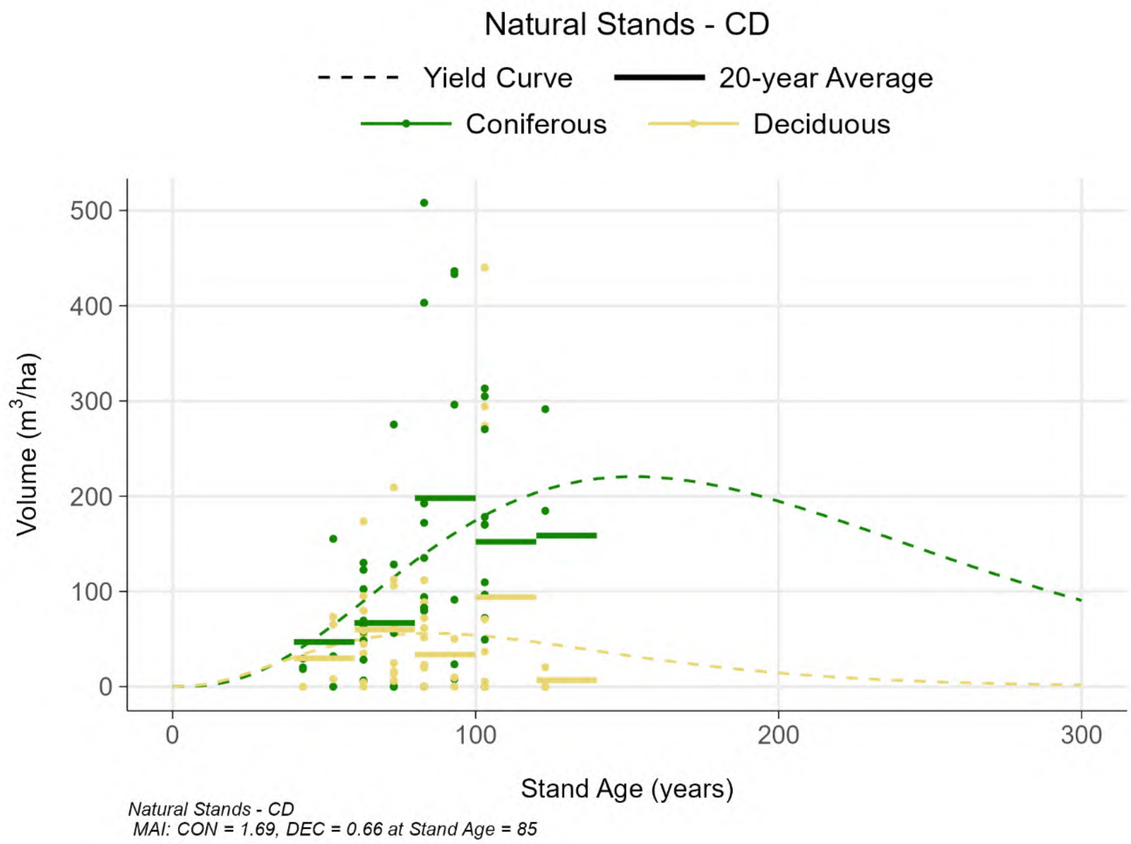


Natural Stands - All Strata
Yield Curve
20-year Average
Coniferous
Deciduous
Volume (m3/ha)
600
400
200
0
0
100
200
300
Stand Age (years)
Natural Stands - All Strata
MAI: CON = 1.87, DEC = 0.34 at Stand Age = 90

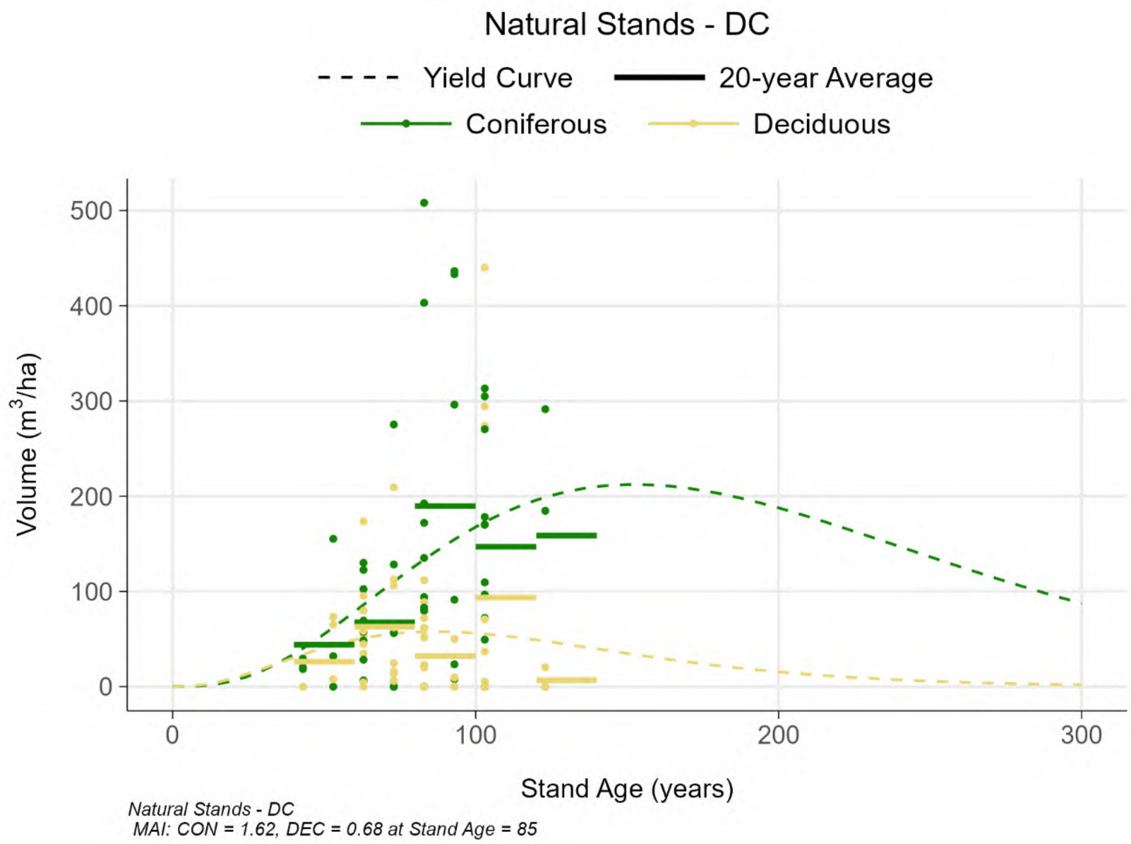

Natural Stands - Conifer Landbase
Yield Curve
20-year Average
Coniferous
Deciduous
Volume (m3/ha)
600
400
200
0
0
100
200
300
Stand Age (years)
Natural Stands - Conifer Landbase
MAI: CON = 2.45, DEC = 0.06 at Stand Age = 95

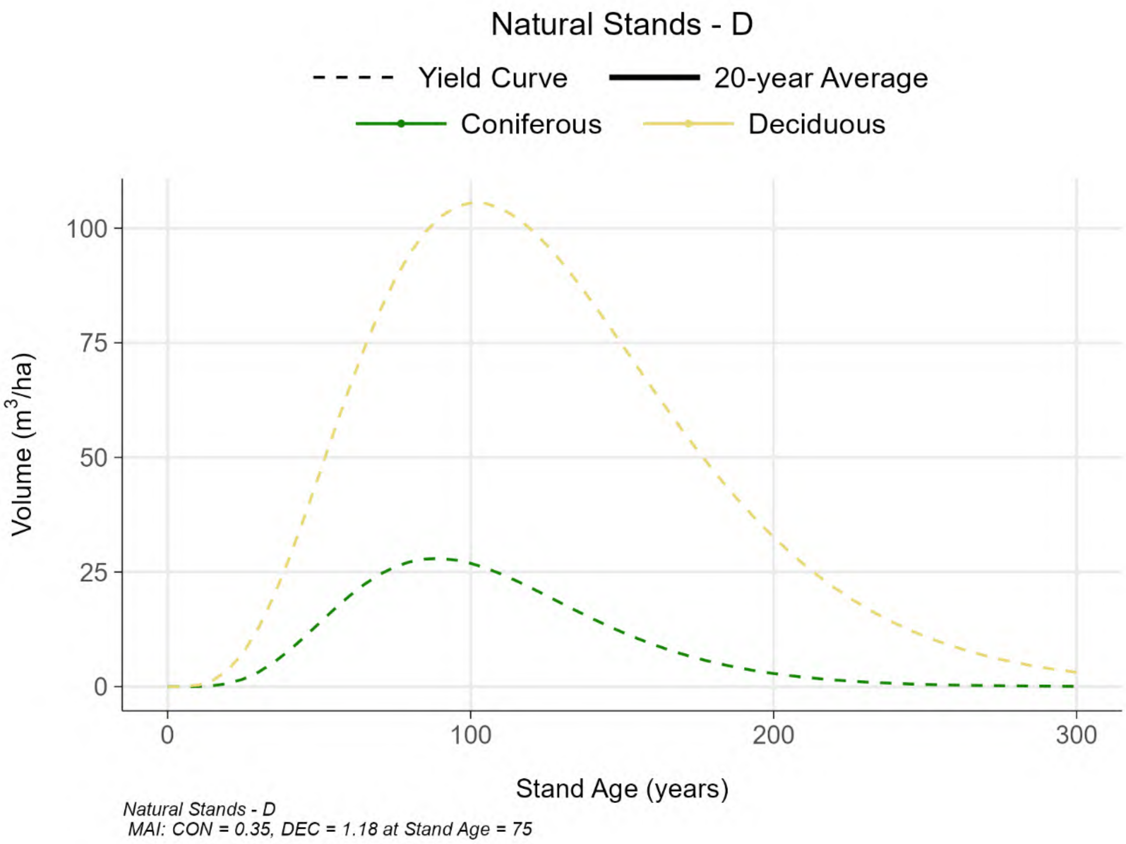


Natural Stands - C
MAI: CON = 2.47, DEC = 0.04 at Stand Age = 95

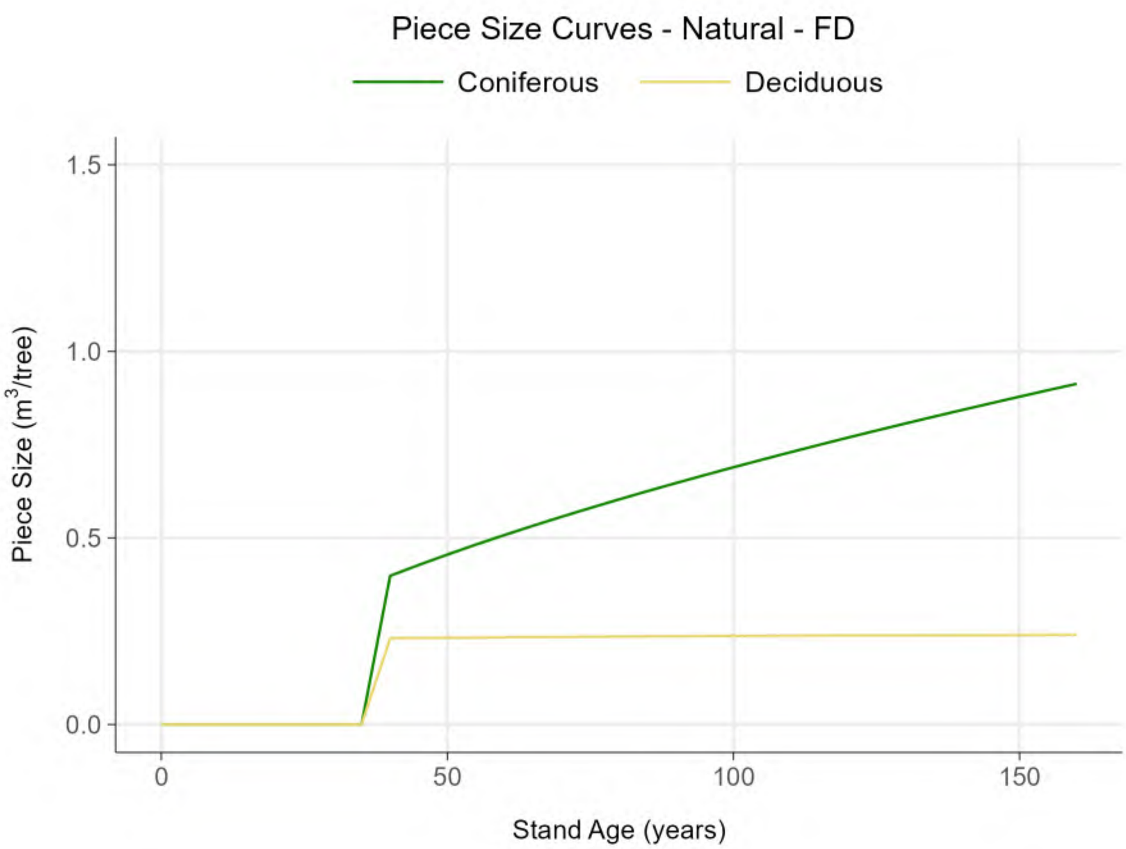


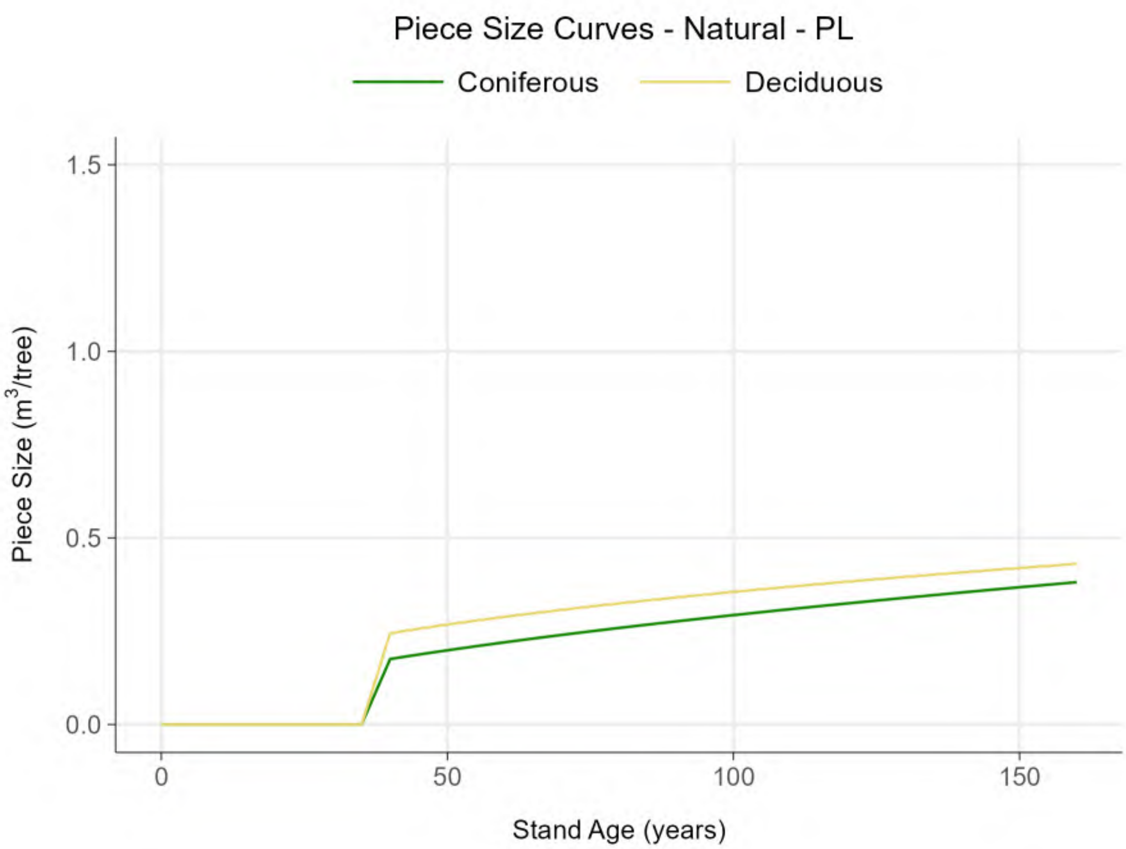
Natural Stands - CD
Yield Curve
20-year Average
Coniferous
Deciduous
Volume (m3/ha)
500
400
300
200
100
0
0
100
200
300
Stand Age (years)
Natural Stands - CD
MAI: CON = 1.69, DEC = 0.66 at Stand Age = 85

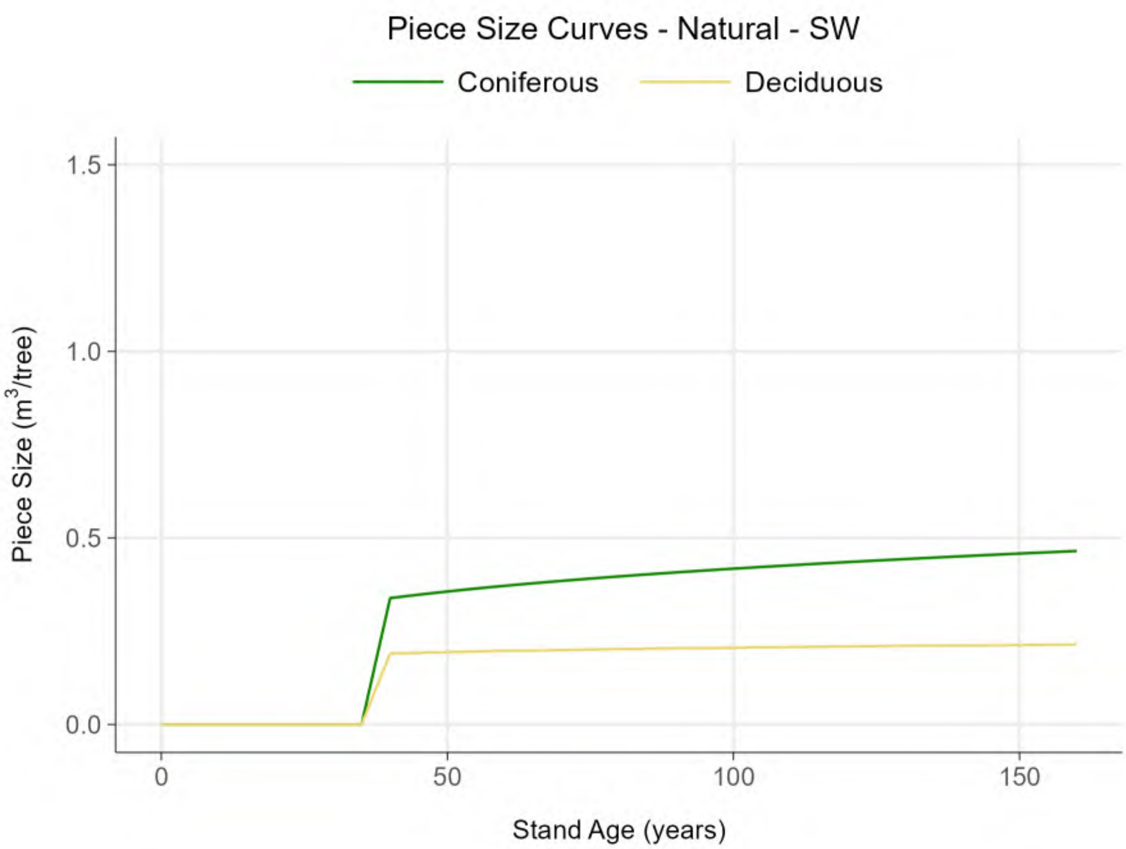

Natural Stands - DC
Yield Curve
20-year Average
Coniferous
Deciduous
Volume (m3/ha)
500
400
300
200
100
0
0
100
200
300
Stand Age (years)
Natural Stands - DC
MAI: CON = 1.62, DEC = 0.68 at Stand Age = 85

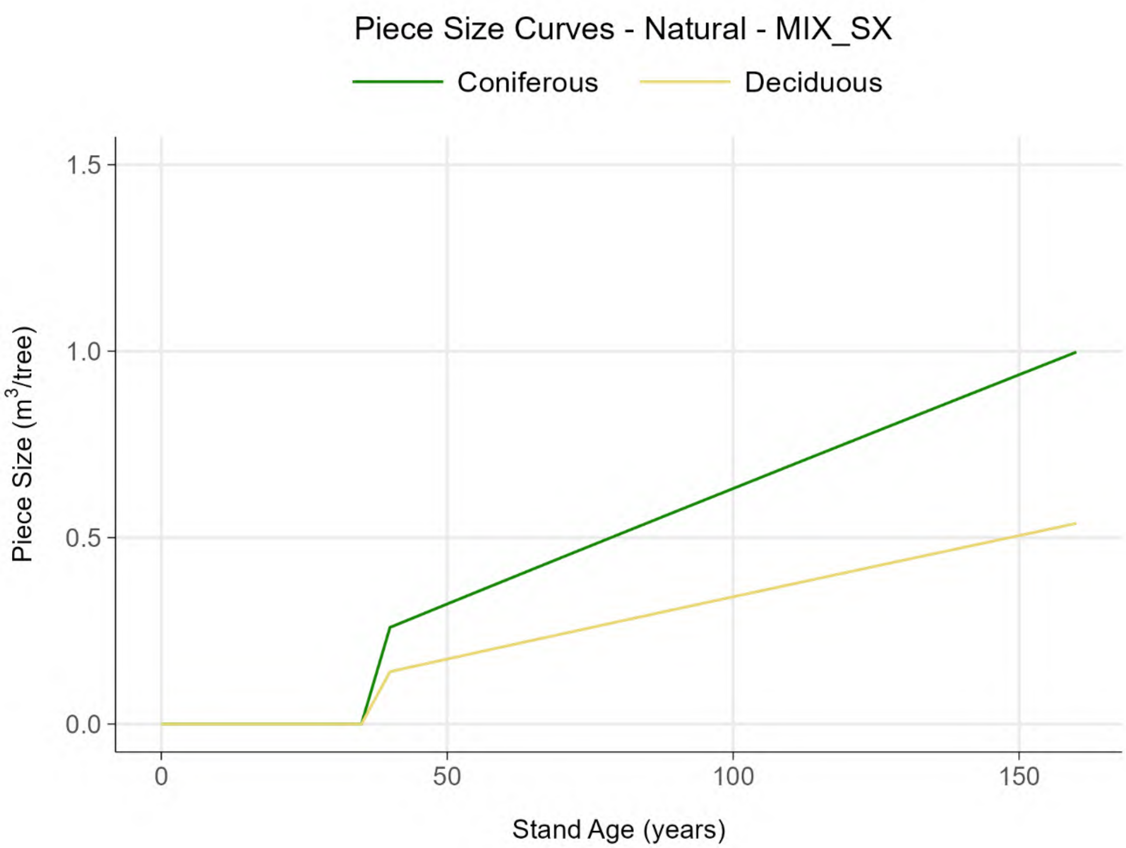

Natural Stands - D
Yield Curve
20-year Average
Coniferous
Deciduous
Volume (m3/ha)
100
75
50
25
0
0
100
200
300
Stand Age (years)
Natural Stands - D
MAI: CON = 0.35, DEC = 1.18 at Stand Age = 75

Appendix VI – Piece Size Curves

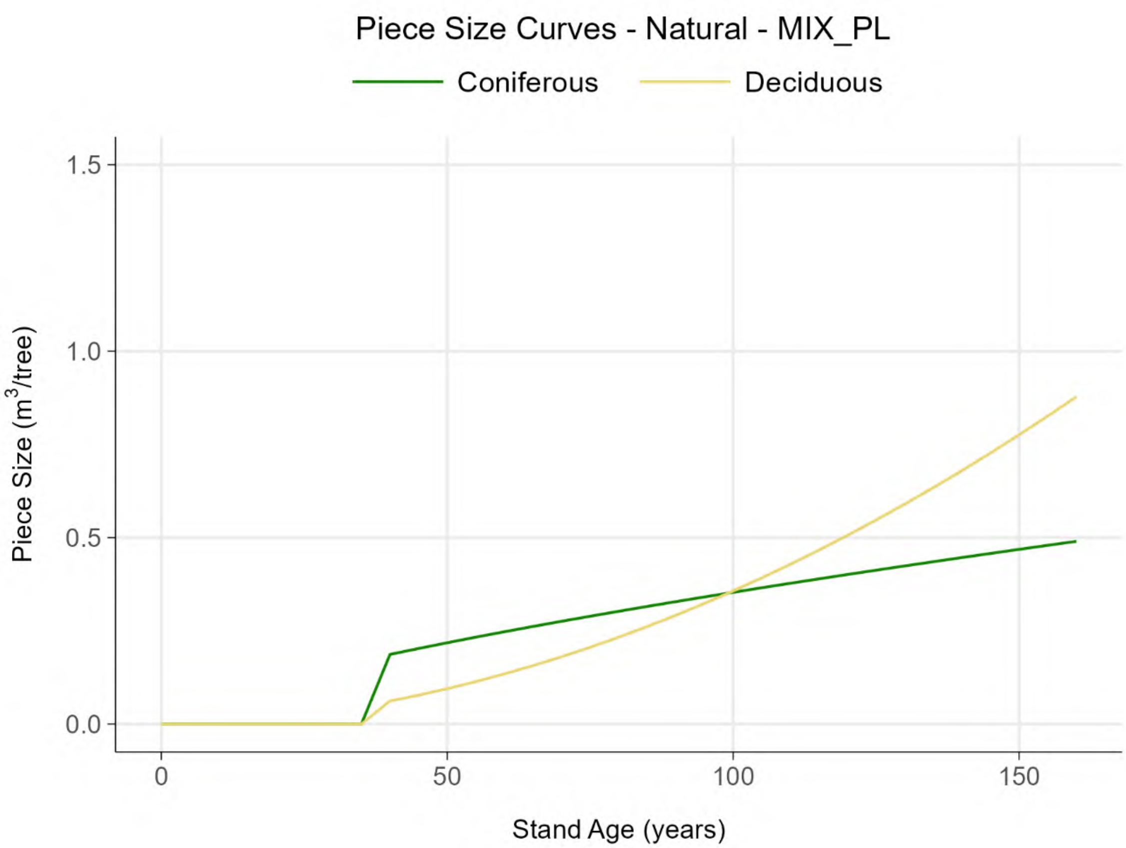

Piece Size Curves - Natural - FD
Coniferous
Deciduous
Piece Size (m3/tree)
1.5
1.0
0.5
0.0
0
50
100
150
Stand Age (years)


Piece Size Curves - Natural - PL
Coniferous
Deciduous
Piece Size (m3/tree)
1.5
1.0
0.5
0.0
0
50
100
150
Stand Age (years)

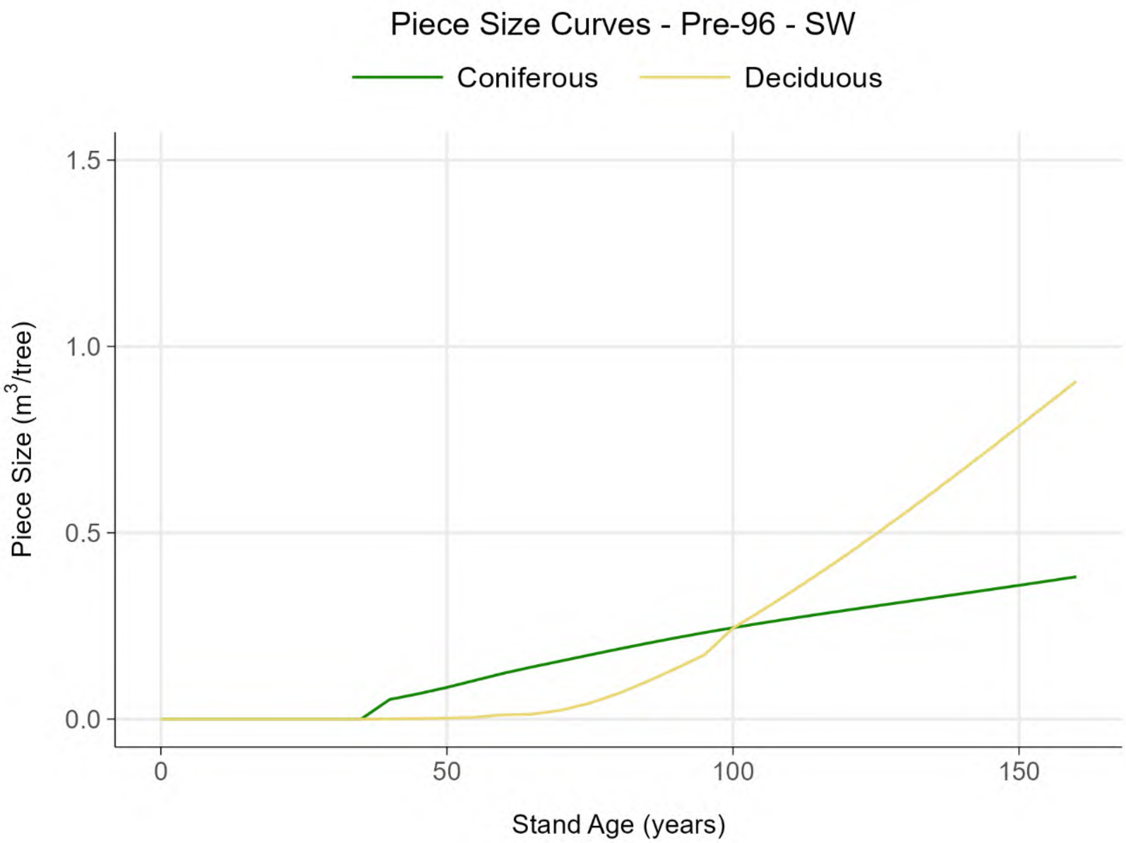

Piece Size Curves - Natural - SW
Coniferous
Deciduous
Piece Size (m3/tree)
1.5
1.0
0.5
0.0
0
50
100
150
Stand Age (years)

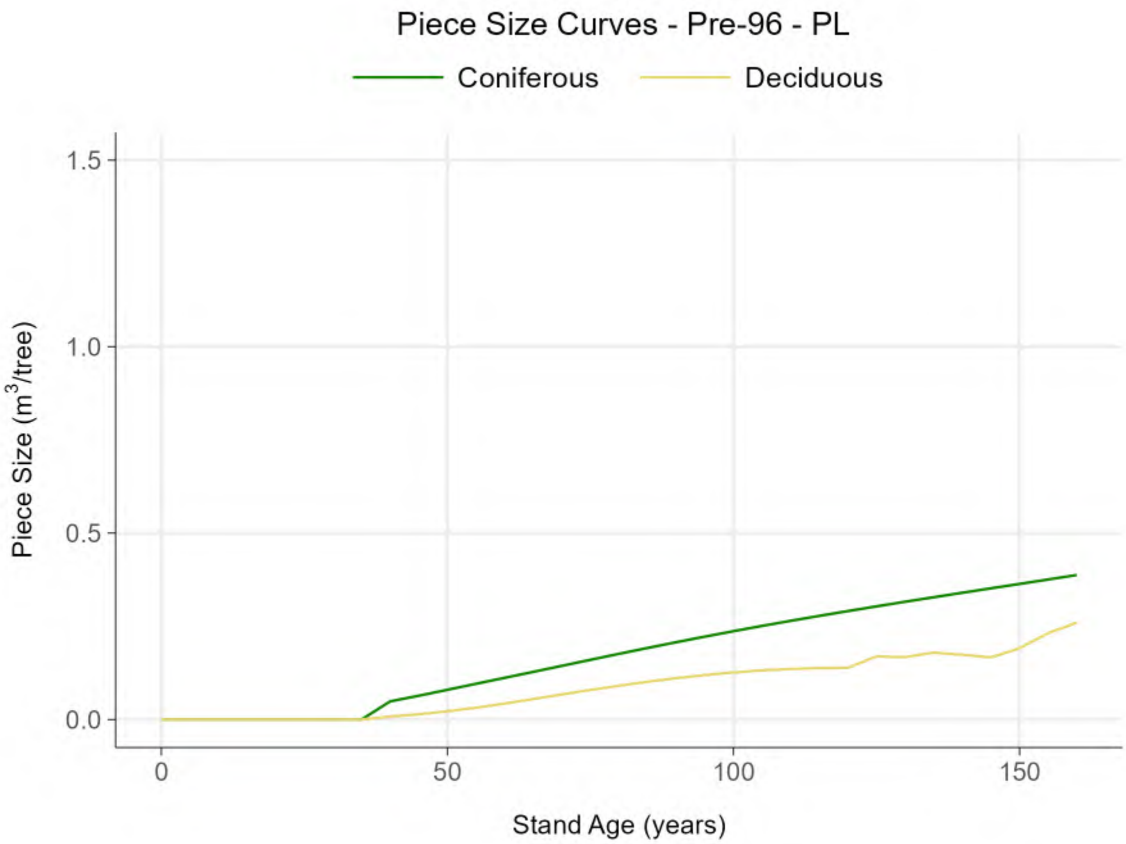


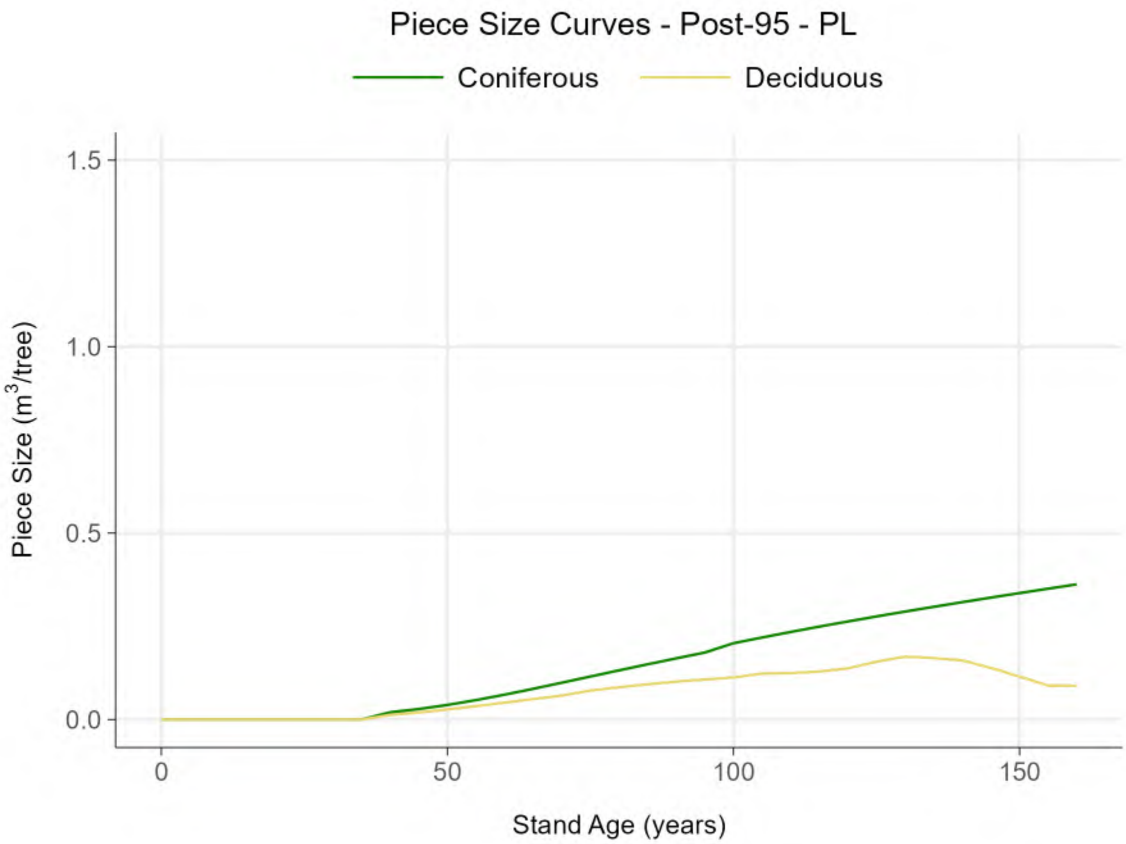
Piece Size Curves - Natural - MIX_SX
Coniferous
Deciduous
Piece Size (m3/tree)
1.5
1.0
0.5
0.0
0
50
100
150
Stand Age (years)



Piece Size Curves - Natural - MIX_PL
Coniferous
Deciduous
Piece Size (m3/tree)
1.5
1.0
0.5
0.0
0
50
100
150
Stand Age (years)


Piece Size Curves - Pre-96 - SW
Coniferous
Deciduous
Piece Size (m3/tree)
1.5
1.0
0.5
0.0
0
50
100
150
Stand Age (years)


Piece Size Curves - Pre-96 - PL
Coniferous
Deciduous
Piece Size (m3/tree)
1.5
1.0
0.5
0.0
0
50
100
150
Stand Age (years)



Piece Size Curves - Post-95 - PL
Coniferous
Deciduous
Piece Size (m3/tree)
1.5
1.0
0.5
0.0
0
50
100
150
Stand Age (years)

Appendix VII – Approval Letters

Alberta Forestry and Parks

Forestry and Parks
Forestry Division
Forest Stewardship and Trade Branch
Suite 303, 7000 - 113 Street
Edmonton, Alberta T6H 5T6
Telephone: 780-427-6807
Fax: 780-415-1509
www.alberta.ca

File: 06296 R01 02

December 14, 2023

Mr. Matt Denney, RPF
Planning Forester
Crowsnest Forest Products Ltd.
305 Griffin Road West
Cochrane, Alberta T4C 2C4

Dear Mr. Denney:

Subject: AGREEMENT-IN-PRINCIPLE – CROWSNEST FOREST PRODUCTS LTD. 2025 FOREST MANAGEMENT PLAN YIELD PROJECTIONS

Thank you for the October 3, 2023 Crowsnest Forest Products Ltd. (CFP) 2025 Forest Management Plan (FMP) Yield Projections submission.

The department has reviewed the submission and agreement-in-principle (AIP) is granted subject to the following 21 conditions being addressed in the FMP:

1. Although CFP does not plan to harvest in the pure Hw stratum and did not sample any pure Hw stands, yield estimates are required for the pure Hw stratum to support a deciduous annual allowable cut (AAC). All tables throughout the Yield Curve Development document must include the Hw stratum.

   ACTION: Tables 14 and 15 must include a line for Hw, Table 16 must include what model was used in 2006 for the Hw yield estimation and Table 17 must include a row for Hw stating that no validation statistics are available.

2. It is unclear what the intended strategy for A density stands is. The treatment of these stands in the contributing landbase documentation is inconsistent and it may be interpreted differently than what was considered for the sampling landbase.

   In the Natural Stand Volume Sampling Program document, the sampling landbase for FMU C5 excluded low density stands as defined by crown closure of 20% or less. The Yield Curve Development document outlines that yield stratification is derived from Alberta Vegetation Inventory attributes, including crown closure and that B, C, D crown closures are included for FMP stratification. However, it is unclear how stands with 21-30% crown closure are treated. These stands would be considered A density, yet there is no A density designation for crown closure in the stratification rules in Table 5 of the Yield Curve Development document.

Based on a preliminary analysis of the plot distribution, it appears that the low density stand types (with overstorey crown closure of 30%), in at least one stratum, were not part of the sample. Additionally, in Section 2.2.3: Data Exclusions and Used, CFP describes that "some plots switched strata due to adjustments to switch-stand landbase rules".

In the Net Landbase Development document, there is a discrepancy between the document text and the code description relating to A density stand removals. The text for Section 4.4.3.5 refers to "stands with a crown closure of 30% or less are considered to be non-operable", while the flowcharts only remove stands with a crown closure of 20% or less. The description of Switch Stands in Section 4.3.3 uses "overstorey density integer is less than 30" when determining an undesired overstorey.

Spot checks indicate that some A density stands are present in the contributing landbase and represented by the overstorey attributes.

If the contributing landbase has been adjusted since the sampling efforts used for yield estimation, CFP must ensure that the samples reflect the final contributing landbase. In addition, changes to switch stand landbase rules resulting in areas that were not originally part of the contributing landbase being brought back in need to be reviewed.

ACTION:

a. Confirm what the strategy is for A density stands with up to 30% crown closure.

   i. If the contributing landbase has been adjusted since yield estimation sampling to include a portion of the A density stands, CFP must re-visit yield estimation to ensure that samples appropriately represent the final contributing landbase.
   ii. If the yield estimations for A density stands are not adequately represented by ground samples, the area must be removed from the contributing landbase.
   iii. If this process affects switch stand landbase rules, the landbase must be revisited prior to FMP submission.

b. Ensure consistency between all sources of documentation on how the strategy for A density stands was implemented for both yield projections and the classified landbase.

3. The Natural Stand Yield Estimates in Appendix I include both plot volumes as well as 20-year averages against yield estimates. These metrics are not included for Pre96 or Post95 yield estimates and must be included as per the Alberta Forest Management Planning Standard (AFMPS) Section 4.2.7. Additionally, area-weighted composite yield estimates are calculated in Appendix VI, but area-weighted 20-year averages are not included in these figures. This is an AFMPS requirement.

ACTION:

a. CFP must add plot volumes as well as 20-year averages to all yield estimates figures in Appendix III and IV for Pre96 and Post95 yield estimates, and

b. CFP must provide area-weighted 20-year averages by age class alongside area-weighted composite yield curves.

4. There are differences in utilized log lengths. A 4.88 m log length was used instead of 3.66 m in the utilization standards. For yield estimates derived from Growth and Yield Projection System (GYPSY), the model assumes a log length of 3.66 m and this parameter cannot be adjusted. It is not explicitly stated that the provincial utilization standard conversion tool was used in Pre96 or Post95 yield estimates derived from GYPSY. CFP must provide documentation on how this difference in log length was accounted for during yield estimation.

   ACTION: Since GYPSY was used to create yield estimates for Post96 and Pre95 managed stands, CFP must provide additional information on how the difference in log length was accounted for.

5. Yield estimates for natural stands have bias calculated as a metric of goodness of fit for yield estimates compared with observed values. Both Pre96 and Post95 stands have no bias calculated.

   ACTION: CFP must calculate bias or provide another metric to determine goodness of fit for both managed stand yield estimates in Pre96 and Post95 stands.

6. Section 5.3.2 explains that Reforestation Standard of Alberta (RSA) curves will not be used in the timber supply analysis (TSA) for Sw and Pl strata. No explanation is provided as to why managed stand yields using RSA data (Post95) are lower than natural stand yields. Additionally, the details provided as to how a reduced curve was decided (it appears to be 23% but it is not explicit) are minimal. This must be clearly documented in the Yield Curve Development document.

   ACTION:
   a. CFP shall provide details regarding why RSA-based managed stand yields in Pl stratum are lower than natural yields in the Pl stratum, and

   b. CFP shall include in the Yield Curve Development document the details outlined in the GY-009 Pl RSA Curve document submitted to Forest Stewardship and Trade Branch on August 30, 2023 that explains in depth how the reduction to natural stand yields was determined, and how this will be applied for Pl stratum in Post95 managed stands in the TSA.

7. There is uncertainty in differences between RSA yield curves and the reduced natural yield curves. There are various inconsistencies throughout the Yield Curve Development document with the distinction between modeled RSA-based yield curves and the reduced natural yields to be applied in the TSA. Examples include Table 1-3 "summarizes the final gross merchantable yield curves to be applied in the TSA", the Table 1-3 caption states "Matrix of yield curves to be considered in the TSA", and for the Pl stratum in both Post-95 and future managed stands the table lists RSA instead of natural/basic curves. In addition, Table 25 outlines the yield curve sets to be applied in the TSA, with RSA listed for Pl stratum in both Post95 Managed Stands and Future blocks. The footnote explaining that reduced natural yield curves will be applied in the TSA is only included for Future Blocks, it is unclear whether reduced natural yields will be used for both Post95 and future managed stands. Section 5.3.2: RSA Yield Curves states that the reduced natural yield curve for Pl "will be used in the TSA to represent the post-1995 and future Pl harvest areas".

ACTION: Update all instances where the distinction between RSA yield curves and the reduced natural yield curves is unclear. All references in the text must reflect that although there was an attempt to create RSA-based yield curves for the PI stratum, the TSA will utilize reduced natural yield curves for the PI stratum in both Post95 managed stands and future blocks.

8. At the end of Section 6.4: Managed Stand Sensitivity Analysis: Cumulative mean annual increment (MAI) targets "may be adjusted after the TSA is completed to account for subsequent adjustments". Note that MAI targets are obtained from yield estimates, so this statement is interpreted as meaning yield estimates may be adjusted. Also note that it is not the role of the TSA to determine whether yields should be adjusted.

   ACTION: If yield estimates are adjusted, CFP must document the rationale for these changes and provide both updated yield tables and updated MAI standards as part of the final FMP submission.

9. No piece sizes were documented for Pre96 managed stands. The GY-001 document in Appendix VIII states in Section 4.3: Model Development of juvenile managed stand yield curves, "piece size calculation for FMP purposes is required," however there are no piece sizes provided in the submission for Pre96 managed stands. Additionally, in the submitted data package there is no corresponding data for Post95 RSA PI stand piece sizes to check against.

   ACTION:
   a. CFP shall provide piece size estimates for Pre96 managed stands, and

   b. Include the corresponding datasets used for piece sizes in Post95 PI RSA stands.

10. Yield estimates did not incorporate cull reductions, this should be accomplished in the TSA document. CFP must describe the method used to account for cull deductions and this must be applied to the yield estimates within the model of the TSA. This must be submitted with the FMP.

    ACTION: CFP must provide the method used and final cull deductions to be applied in the TSA with the FMP submission.

11. A Growth and Yield Program must be submitted with the FMP and should follow the draft *Guidelines for Growth and Yield Programs* (2016). The program must address the following priorities:

    a. A sampling program in standing timber that focuses on capturing a full sample across the Forest Management Agreement (FMA) area is required for all strata in the contributing landbase. CFP is an FMA holder, and it is expected that samples are collected for all strata in the contributing landbase. CFP must include Hw stratum in the Growth and Yield Program and sample at minimum 30 temporary sample plots (TSPs), but this amount must be proportional to the contributing landbase (i.e., if the Hw stratum comprises a significant proportion of the contributing landbase area for the FMA, the sample must reflect the size of the stratum in proportion to the contributing landbase); and

    b. Due to past silviculture failures, CFP must develop an understanding as to why yields in managed stands are decreased when compared to natural stand yields. The population of RSA stands that are regenerating with lower yields than natural stands must be accounted for in the Growth and Yield Program as a separate population. For the next FMP, CFP must collect new data in these stands and evaluate how they are growing.

ACTION: CFP shall submit a Growth and Yield Program with the FMP that addresses the above priorities in addition to standard requirements to ensure that the growth assumptions used for yield estimation are supported by robust data. To ensure best outcomes of the FMP review it is recommended that CFP submit a Growth and Yield Program for review and AIP prior to FMP submission.

12. Table 34 shows the culmination MAI for RSA performance targets. There are six yield strata, eight associated Base 10 strata, FMP CON and DEC MAI at culmination age, utilization standards, and converted MAIs for RSA purposes. The six yield strata are Hw, Fd, MIX_Pl, MIX_Sx, Pl, and Sw. The MIX_Pl and MIX_Sx yield strata are split into Base 10 strata (e.g., MIX_Pl = HwPl and PlHw and MIX_Sx = HwSx and SwHw).

    RSA requires reforestation standards be developed to a minimum of Base 10 strata.

    ACTION: As required by RSA, CFP must further split both the MIX_Sx yield stratum to include the SbHw Base 10 stratum and the Sw yield stratum to include the Sb Base 10 stratum. MAIs from each yield stratum shall be appropriately applied to each additional Base 10 stratum (see Attachment 1).

13. RSA requires CON and DEC MAI at culmination age based on the primary species of management (CON or DEC). In all cases, the productivity of the forest must be maintained as planned to a minimum of natural yields. In Table 34 and Section 5.3.2, the CON MAI standards for the Pl yield stratum (RSA curve type) reflects a 23% reduction in the natural Pl yield curve. In addition, the CON and DEC MAI for the Sw yield stratum are based on an RSA yield curve type. However, Tables 1-3 and 25 and Section 5.3.2 suggest that the Sw - Natural (Basic) yield curve will be used in the TSA for future harvest areas (i.e., RSA).

    ACTION:

    a. Use the culmination MAI of the Pl – Natural yield curve (Basic curve type), not reduced by 23%, as the reforestation standard for the Pl yield stratum (see Attachment 1),

    b. Use for RSA the culmination MAI for the Sw yield stratum that is consistent with the Sw yield curve used in the TSA (the Basic curve appears to be the intent; see Attachment 1), and

    c. Update Table 34 and relevant sections within the yield curve document to reflect a) and b) above.

14. RSA requires that the MAIs used for reforestation standards be converted from the FMP CON and DEC utilization to RSA 15/10/30/tree length (TL) CON and DEC utilization. As described in Section 6.4, the conversion ratios described in Table 34 were used to adjust the MAIs from the CFP specific utilization of 15/11/30/4.88 to a 15/10/30/3.66 utilization standard for the Foothills Natural Region using the Provincial Utilization Conversion Tool (January 2014). This conversion of MAIs from FMP utilization to RSA utilization is incorrect. Cut-to-length conversions (4.88 and 3.66) were applied instead of TL. The required conversion of CON MAIs is from FMP 15/11/30/TL utilization to RSA 15/10/30/TL utilization. D MAI conversions are not necessary, as the FMP utilization is already to a 15/10/30/TL standard (see Yield Curve Development document Executive Summary and Section 1 Overview).

ACTION: CFP shall use the appropriate CON conversion ratios to convert CON MAIs from FMP 15/11/30/TL to RSA 15/10/30/TL utilization (see Attachment 1). For those yield strata with more than one Base 10 strata, conversion ratios shall reflect an area weighted average based on the planned harvest in spatial harvest sequence (SHS) Period 1.
Note: conversion ratios in Attachment 1 reflect the average only as the SHS for Period 1 is not currently available.

15. Direct linkages between the objectives of forest management and reforestation standards are a fundamental requirement of RSA.

    ACTION: After the preferred forest management strategy/SHS stage and prior to FMP submission for approval, CFP must:

    a. Update the reforestation standards table and relevant sections of Annex IV or other more appropriate location within the FMP to include:
        i. Items 12, 13, and 14 above and 15 b below,
        ii. Planned stratum transition proportions (area or % of area cut) as assumed by the SHS/TSA (see Attachment 1), and
        iii. Landbase designation codes for each FMP yield/Base 10 stratum based on the FMU (e.g., C5), the year of the AAC effective date once determined (e.g., 25 if the AAC effective date is May 1, 2025) and sequential numbers that reflect the AFMPS Base 10 strata (e.g., 01 for Deciduous, 02 for HwPl, etc.; see Attachment 1).
    b. Ensure that reforestation standards and requirements are developed that directly and quantitatively link to and align with the objectives of forest management for FMU C5 including but not limited to forest management objectives (timber and non-timber) originating from higher level plans, wildfire prevention/management plans, and/or the FMP.

16. Roads are required to be reforested for a variety of reasons (including access and habitat objectives). Using entire opening stocking as a measure of road reforestation success does not meet the intent of goals and policy specific to road reforestation. CFP was directed to provide documentation on the success of road reforestation during a meeting held on September 25, 2023, this has not yet been received. While the Silviculture Matrix provides treatments for roads as expected, successful reforestation tactics for roads need to be demonstrated as well.

    ACTION: Road reforestation must be ensured, and documentation provided to demonstrate that this objective is being pursued and met through appropriate treatments.

17. The stated species proportions in the Stand Structure of the Silviculture Matrix are inaccurate. All pure strata currently have ">80%" species proportion, it should be >= 80%. Similarly, the mixedwoods are >50% and >30% proportions; but should be >= 50% as the case dictates.

    ACTION: Update the species proportion in the Silviculture Matrix.

18. The deciduous density of 400 stems per hectare (sph) for DC strata with a planting density of 1200-1800 sph conifer will likely not lead to a DC stratum. It is understood that CFP intends to achieve the D component through natural ingress.

    ACTION: Change wording to "minimum 400 sph" and ensure that the proposed planting density of conifer and natural ingress of deciduous will indeed lead to a DC stand.

19. The current wording for the Fd stratum “Plant Fd as leading species” is ambiguous.

    ACTION: Change wording to “Plant Fd to ensure Fd is the leading conifer species”.

20. MAIs may be impacted by changes in silviculture practices. This should be acknowledged in the Silviculture Matrix.

    ACTION: Include a final statement acknowledging that MAIs may be impacted by changes in silviculture practices: “Changes in silviculture practices may positively or negatively impact realized MAI’s”.

21. Verify all values in Table 33 and Table 34 (MAIs, culmination year, utilization conversion factor) as there are inconsistencies between the two tables.

If you have any questions or require further information, please contact Liana Luard, Planning Forester at (780) 427-0395.

Yours truly,

Janis Braze, RPF
Director, Forest Planning

Attachment (1)

cc: Erica Samis, Forest Area Manager, Calgary Forest Area
Kirk Hawthorn, Senior Forester, Calgary Forest Area
Darren Aitkin, Director, Reforestation, Inventory and Biometrics
Rosanise Odell, Resource Analyst, Reforestation, Inventory and Biometrics
Andrew Shandro, Provincial Silviculture Specialist, Reforestation, Inventory and Biometrics
Lee Martens, Forest Reforestation Specialist, Reforestation, Inventory and Biometrics
Greg Greidanus, Senior Resource Analyst, Forest Planning

Attachment 1

Pre-harvest FMP[1]	Post-Harvest FMP[1]						Conversion Factor[5]		RSA[7]				
Yield (AVI) Strata	TSA Prop[2] (%)	Yield Strata	Primary Species	Age	CMAI[3]	DMAI[4]	CON[6]	DEC	Strata	Age	CMAI	DMAI	Code[8]
Hw-Natural (D)	100	Hw-Natural	DEC	77	0.35	1.19	1.014	1.000	D	77	0.35	1.19	C052501
MIX_Pl-Natural (HwPl)	100	MIX_Pl-Natural	CON	106	1.09	0.70	1.011	1.000	HwPl	106	1.10	0.70	C052502
MIX_Pl-Natural (PlHw)	100								PlHw				C052505
MIX_Sx-Natural (HwSx)	100	MIX_Sx-Natural	CON	101	2.09	0.43	1.012	1.000	HwSx	101	2.12	0.43	C052503
MIX_Sx-Natural (SwHw)	100								SwHw				C052504
MIX_Sx-Natural (SbHw)	100								SbHw				C052506
Sw-Natural (Sw)	100	Sw-Natural	CON	114	2.32	0.04	1.022	1.000	Sw	114	2.37	0.04	C052507
Sw-Natural (Sb)	100								Sb				C052509
Pl-Natural (Pl)	100	Pl-Natural	CON	90	2.54	0.02	1.025	1.000	Pl	90	2.60	0.02	C052508
Fd-Natural (Fd)	100	Fd-Natural	CON	109	2.78	0.07	1.017	1.000	Fd	109	2.83	0.07	C052510

[1] Crowsnest Forest Products, A Subsidary of Spray Lake Sawmills, Annex IV - Yield Curve Development, C5 Forest Management Plan, September 2023

[2] Yield strata transitions are like to like, but base 10 strata proportions are needed for the MIX-Pl-Natural, MIX-Sx-Natural, and Sw-Natural yield strata based on TSA/SHS assumptions

[3] FMP CMAI (m^3/ha/year) at 15/11/30/TL (SDOB/TDIB/StumpHt/process) utilization

[4] FMP DMAI (m^3/ha/year) at 15/10/30/TL (SDOB/TDIB/StumpHt/process) utilization

[5] Provincial Utilization Standard Conversion Tool, January 2014 for the FOOTHILLS Natural Region

[6] average conversion factor used for yield strata with >1 Base 10 strata; conversion factor for final FMP submission must be an area weighted average based on Base 10 strata proportion in Period 1 of SHS

[7] RSA C and D MAI (m^3/ha/year) at 15/10/30/TL (SDOB/TDIB/StumpHt/process) utilization

[8] Land base codes are tentative pending final determination of AAC approval date

Alberta Agriculture, Forestry and Rural Economic Development

Forestry Division
Forest Stewardship and Trade Branch
Suite 303, J.G. O'Donoghue Building
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Edmonton, Alberta T6H 5T6
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Telephone: 780-427-6807
www.alberta.ca/forestry.aspx

File: 06296 R01 01

June 7, 2022

Matt Denney, RPF
Planning Forester
Spray Lake Sawmills (1980) Ltd.
305 Griffin Road West
Cochrane, Alberta T4C 2C4

Dear Mr. Denney:

Subject: APPROVAL - CROWSNEST FOREST PRODUCTS LTD. 2025 FOREST MANAGEMENT PLAN VOLUME SAMPLING PLANS

Thank you for the May 13, 2022 submission of the Crowsnest Forest Products Ltd. 2025 Forest Management Plan (FMP) volume sampling plans.

The following documents were reviewed:
- *SLS Natural Stand Volume Sampling Plan (April 2022)*
- *SLS Temporary Sample Plot Manual – Natural Stands (April 2022)*
- *SLS Managed Stand Volume Sampling Plan (April 2022)*
- *SLS Temporary Sample Plot Manual – Juvenile Managed Stands (April 2022)*

Approval is granted for volume sampling as proposed, subject to the following:

1. The Natural Stand Volume Sampling Plan does not address sampling in pure hardwood (Hw) stands, which may be required to support annual allowable cut determination. Additional direction will be provided by Forest Stewardship and Trade Branch under separate cover.

2. Proposed sampling as described in the SLS Managed Stand Volume Sampling Plan, sections 4 and 5, is understood to be for informational purposes only and is not intended for use in FMP development; as such, this approval does not apply to those sections.

If you have any questions or require further information, please contact Liana Luard, Lead, Forest Planning and Performance Monitoring at (780) 427-0395.

Yours truly,

Janis Braze, RPF
Director, Forest Resource Management

cc: Distribution list

Alberta Forestry, Parks and Tourism

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File: 06296 R01 01

January 31, 2023

Matt Denney, RPF
Planning Forester
Spray Lake Sawmills (1980) Ltd.
305 Griffin Road West
Cochrane, Alberta T4C 2C4

Dear Mr. Denney:

Subject: AGREEMENT-IN-PRINCIPLE - CROWSNEST FOREST PRODUCTS LTD. 2025 FOREST MANAGEMENT PLAN GY-001 APPROACH FOR FMP YIELD CURVE DEVELOPMENT

Thank you for the December 27, 2022 submission of the Crowsnest Forest Products Ltd. (CFP) 2025 Forest Management Plan (FMP) GY-001 Approach for FMP Yield Curve Development document.

Agreement in principle is granted subject to the following:

1. CFP's proposal to use existing information from the FMU B12 FMP is not approved.

2. A volume sampling program for pure deciduous stands will not be required at this time. This is due to deciduous being managed for its contribution towards other resource values per Forest Management Agreement Clause 14(4). An unallocated deciduous annual allowable cut must be generated in the FMP to account for incidentally harvested deciduous due to operational realities. CFP shall work with Forest Stewardship and Trade Branch to determine a suitable approach for determining estimates of yield for the pure deciduous stratum based on existing information available.

If you have any questions or require further information, please contact Liana Luard, Lead, Forest Planning and Performance Monitoring at (780) 427-0395.

Yours truly,

Braze

Janis Braze, RPF
Director, Forest Planning

cc: Distribution list

Issue Number: GY-001

Approach for FMP Yield Curve Development

Type: √ Requires Resolution □ Discussion Item

1 Background

The terms of reference to develop Crowsnest Forest Products Ltd (Crowsnest) 2025 Forest Management Plan (FMP) for Forest Management Unit (FMU) C5 was approved on August 29, 2022. One of the FMP development milestones is Government of Alberta's (GoA) acceptance of the approach to developing timber yield curves to support Timber Supply Analysis (TSA) and ultimately Annual Allowable Cut (AAC) determination. The yield curve development approach must be correlated with the data collected from volume sampling programs and net landbase assumptions.

This document outlines Crowsnest's proposed approach to developing yield curves for natural fire-origin stands and post-harvest regenerated (PHR) managed stands for the 2025 FMP. The proposed approach meets the requirements of the 2006 Alberta Forest Management Planning Standard version 4.1 (the Planning Standard) and subsequent supporting documentation. Technical details regarding specifics of the actual yield curve development will be submitted as required in the FMP Yield Curve Development document.

Crowsnest recently completed a new Alberta Vegetation Inventory (AVI) for the Forest Management Agreement (FMA) portion of FMU C5 (AVI approved September 19th, 2022) and has also completed mature timber and juvenile regenerated stand volume sampling programs (both plans were approved on June 7, 2022, with field sampling completed by October 2022). These volume sampling programs were developed to characterize the new AVI for timber attributes in order to support yield curve development.

Crowsnest is requesting Agreement-in-Principle (A-I-P) from the Government of Alberta (GoA) on the yield curve development approach.

Proposed yield curve sets to be developed for the FMP are listed below with the applicable timelines for each yield curve set presented in Figure 1:

- Natural stand yield curves (NAT)
- Older regenerated yield curves harvested before 1996 (juvenile)
- Post 1995 regenerated yield curves (RSA)
- Regenerated yield curves which are not juvenile or RSA; copy of NAT (basic).

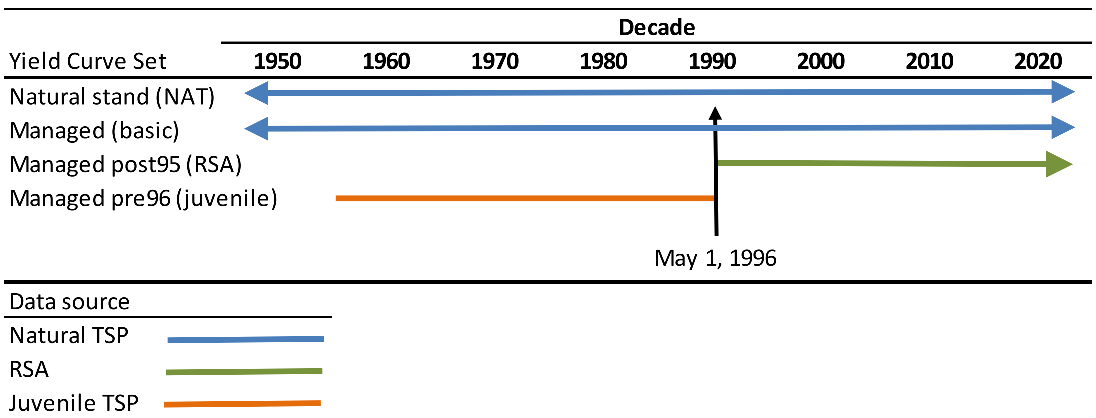

Figure 1. Yield curve application time frames and data source

2 Objectives

The main objective of this document is to describe Crowsnest's approach to developing timber yield curves for use in the 2025 FMP and to obtain A-I-P on the direction from the (GoA). Timely A-I-P will permit decisions and actions early in the process without jeopardizing FMP timelines.

3 Natural Stand Yield Curves (NAT)

For the purposes of yield curves, natural stands are defined as all fire-origin stands in the CFP Forest Management Agreement (FMA) area that are within the net landbase. Growth and yield projections of merchantable timber will be developed using natural stand yield curves (NAT).

3.1 Stratification

Stratification will be based on the Alberta Forest Management Planning Standard (Version 4.1, April 2006) base 10 strata derived from a roll up of the extended stratification (Table 1). As pure black spruce and black spruce-aspen mixedwood stands are a landbase deletion, the Sb stratum and SbHw stratum will be excluded from sampling.

Table 1. Proposed Yield Strata from draft landbase

Sampling Stratum	Yield Stratum	GoA Stratum	Broad Cover	Crown Closure	Leading Conifer	Description	Active Area Ha	Active Area %
Hw	Hw	Hw	D	B, C, D	any	Pure deciduous stand.	12,514	11.87
PlMx	HwPl	HwPl	DC	B, C, D	Pl	Pine-aspen mixedwood, deciduous leading.	579	0.55
	PlHw	PlHw	CD	B, C, D	Pl	Pine-aspen mixedwood, pine leading.	877	0.83
SwMx	HwSw	HwSw	DC	B, C, D	Sw	Spruce-aspen mixedwood, deciduous leading.	827	0.78
	SwHw	SwHw	CD	B, C, D	Sw	Spruce-aspen mixedwood, white spruce leading.	917	0.87
Sw	Sw	Sw	C	B, C, D	Sw	Pure coniferous stand, white spruce leading.	20,212	19.17
Pl - Alpine*	Pl - Alpine	Pl	C	B, C, D	Pl	Pure coniferous stand, pine leading in Sub Alpine natural subreg	46,444	44.05
Pl - Montane**	Pl - Montane	Pl	C	B, C, D	Pl	Pure coniferous stand, pine leading in Montane natural subregio	11,753	11.15
Fd Pure	Fd Pure	Fd	C	B, C, D	Fd	Pure coniferous stand, pure Douglas-fir	6,828	6.48
Fd - Leading	Fd - Leading	Fd	C	B, C, D	Fd	Pure coniferous stand, Douglas-fir leading.	4,494	4.26
Total							**105,444**	**100**

*Sub Alpine and Alpine NSRs were grouped. There were also ~23 ha of area not assigned to an NSR. These were also grouped here due to proximity.
**Montane and Foothills Fescue were grouped.

Due to the small area present within the mixedwood stratum it was decided to combine the following strata for sampling:

- ✓ HwPl with PlHw; and
- ✓ HwSw with SwHw.

This strata amalgamation is for plot sampling to support yield curve modelling. Empirical regression modelling with a dummy variable will be fit to create separate pine mixedwood yield curves (HwPl vs. PlHw) and separate spruce mixedwood yield curves (HwSx vs. SwHw). Broad Cover Group categories will not be aggregated in the development of pine and spruce yield curves.

The large area in the pine strata, will be divided by Natural Subregion (NSR) to create two separate pure pine yield curves.

The Douglas fir stratum (Fd) consists of GoA's extended strata C13 and C14 (pure Fd plus Fd leading)

3.2 Data

3.2.1 Sampling Design

Temporary sample plots (TSPs) were used to achieve the targeted sample size for all strata. The sampling population included natural stands that are either merchantable or approaching merchantability based on minimum stand age threshold of 70 years for all strata. Further details on the NLB rules were included in the Natural Stand Volume Sampling Plan (A-I-P on June 7th, 2022).

382 new TSPs were installed across the FMA in the summer of 2022. In the SW stratum, 75 plots were proposed but 76 were actually installed. Stands were selected randomly by stratum within the FMA with probability of selection proportional to stand area. Distribution across merchantable age classes was incorporated into the stratified sampling to account for variation with age.

Three plots were sampled within each randomly selected stand. Eight plot locations were pre-selected within each stand using GIS routines, allowing plot locations to be moved to the next pre-selected location if the plot area is intersected by a mappable disturbance. Mappable disturbances include clearings identified by AVI as well as DIDs, traditional seismic layer and harvested areas. If the plot is intersected by an unmappable seismic disturbance *(i.e.* narrow low impact or avoidance seismic lines) then the plot was not moved.

Plot procedures are focused on the determination of live gross merchantable volume per hectare by species. 200 m^2 circular TSPs (radius=7.98 m) were established where all live trees greater than 9.0 cm DBH were measured. The FMA utilization is 15/11/30 cm with a 4.88 m usable length for coniferous species which means that even at 10 cm DBH there is no merchantable piece in the tree.

At each plot the following data was collected:

- ✓ Polygon Number
- ✓ Plot Number
- ✓ GPS Location (NAD83, UTM11)
- ✓ Tie Point (direction to the plot from the last main access point + GPS track log)
- ✓ Access Code
- ✓ Plot Access Notes
- ✓ Measurement Date
- ✓ Crew Initials
- ✓ Plot Comments (e.g., plot movement decisions, windy day etc.)

For each live tree >9.0 cm DBH in the plot the following data was collected:

- ✓ Species
- ✓ DBH to the nearest 0.1 cm
- ✓ Total Height to the nearest 0.1 m (one by every five trees)
- ✓ Dead or broken top indicator
- ✓ Tree Comments (e.g., DBH measurement height moved from 1.3 m)

Additional detail regarding the TSP field data collection protocols is provided in the approved field manual.

3.2.2 *Sample Size*

The 382 temporary sample plots (TSP) installed in natural fire-origin stands in the net landbase of the FMA will be used in natural stand yield curve development. The number of sampled plots versus the active area available for sampling was summarized by yield stratum as presented in Table 2. Note areas are based on the sampling landbase and have not been updated.

Table 2. Number of sampled plots by sampling stratum

Sampling Stratum	Yield Stratum	GoA Stratum	Active Area Ha	Active Area %	Proposed Plots #	Proposed Plots %
Hw	Hw	Hw	12,514	11.9	0	0
PlMx	HwPl	HwPl	579	0.5	30	8
	PlHw	PlHw	877	0.8		
SwMx	HwSw	HwSw	827	0.8	30	8
	SwHw	SwHw	917	0.9		
Sw	Sw	Sw	20,212	19.2	76	20
Pl -Alpine	Pl -Alpine	Pl	46,444	44.0	96	25
Pl -Montane	Pl -Montane	Pl	11,753	11.1	60	16
Fd - Pure	Fd - Pure	Fd	6,828	6.5	45	12
Fd - Leading	Fd - Leading	Fd	4,494	4.3	45	12
Total	**Total**		**105,444**	**100**	**382**	**100**

Forest Management Agreement (FMA) Clause 7(d) gives Crowsnest Forest Products Ltd. (CFP) the right to harvest deciduous generated from coniferous stands; however, CFP does not have rights to deciduous, the intent is to manage deciduous for its contribution towards other resource values [(FMA Clause 14(4)]. CFPs intent is not proposing to not sample deciduous stands, but rather yield projection will use existing information from the B12 forest management plan (Approved in 2021) and the currently approved C5 forest management plan (Approved in 2010).

FMA2100047 does not provide The Forest Management Agreement

3.2.1 Data Compilation

Missing tree heights will be predicted using Huang et al.'s Population and Plot-Specific Individual Tree Height-Diameter Models for Major Alberta Tree Species (Huang et al. 2013). The ratio of means approach as described in Huang et al. will be used to adjust (localize) predicted heights based on available trees with measured heights.

Individual tree gross merchantable volumes will be compiled using taper equations. Taper coefficients are from Huang's (1994) Ecologically Based Individual Tree Volume Estimation for Major Alberta Tree Species. Taper coefficients use the Alberta township based subregion assignment as per generally accepted compilation protocols. Trees with no merchantable volume will be assigned a value of 0 m^3.

Tree expansion factors (number of stems represented by each sampled tree) will be assigned to each tree based on the inverse of plot size.

Individual tree gross merchantable volumes will be then multiplied by the tree factor. Resulting values will be summed by species and major species group (coniferous and deciduous) for each TSP.

3.3 Model Development

Crowsnest proposes to model gross merchantable volume as a function of inventory age by yield group in natural stands using empirical modeling of the TSP data.

Selection of the appropriate model form will be based on the following criteria:

- ✓ be biologically reasonable;
- ✓ maintain low volumes at young age classes;
- ✓ have a reasonable inflection point regarding timing of peak mean annual increment (MAI);
- ✓ have the ability to capture stand decline or asymptotic growth; and
- ✓ provide a good statistical fit.

The proposed model forms will include:

i. 3-parameter model (3P): $Volume = a(Age)^b e^{(-c*Age)}$

ii. 2-parameter model (2P): $Volume = a(Age)^b e^{(-a*Age)}$

iii. 2-parameter model with constant (2P+k): $Volume = a(Age)^b e^{(-Age/k)}$

Where:

Volume = Gross merchantable stand volume (m^3/ha)

Age = Stand age at year of measurement

a, b, c, k = Coefficients

Coniferous and deciduous compiled merchantable gross volumes will be fit separately using one of the three model forms. Additional model forms will also be explored based on the volume-age scatter plots.

Outliers and influential points will be identified using the scatter plots and statistical measures (e.g. Cook's distance, points outside of three standard deviations etc.). Outliers that are removed will be clearly identified and listed in the FMP yield curve development documentation.

Regression statistics will be provided including percent bias, root mean squared error (RMSE) and the goodness of fit index (GoFI). Formulae are shown as below. The average observed plot volumes by 20-year age class will also be plotted against the yield projections for each natural yield group.

i. Bias

$$Bias = \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)}{n}$$

ii. Percent bias

$$Bias\% = \frac{Bias}{\bar{y}} \times 100$$

iii. Root mean square error (of prediction)

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{n}}$$

iv. Goodness-of-fit index

$$GoFI = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2}$$

3.4 Piece Size Curves

Piece size curves are required to predict changes in the harvested piece size over time. Piece size curves will be created for the natural stand yield projections. The same plots used in the natural stand yield curve development will be used for piece size curve development. The process to build these curves for natural stands is described as follows. The process for Managed stand piece size development is described in section 4.3.

Piece size may be directly modelled using the merchantable volume and merchantable density or using quadratic mean diameter (QMD) as a proxy which was used in other FMPs. Given the variability of piece size and QMD by stand age, it is likely that we will need to pool like-strata together. The similar approach to develop natural stand yield curves will be used. That is to use a dummy variable to create separate piece size estimates from pooled data. Average piece size will only be used as a reporting tool and not a constraining factor in the determination of AAC in the timber supply analysis.

3.5 Other Items

3.5.1 Cull Deductions

Cull will be applied directly to the yield curves to project net merchantable volumes. Cull percentages will be calculated from recent scale tree length data collected from 2012-2022. The methodology and results will be provided under separate cover when all data becomes available and the analysis is completed.

3.5.2 Utilization Standard

The FMA utilization will be used to develop the FMP natural stand yield curves as presented in Table 3. All species present in the FMA are acceptable for the purposes of yield curve development. All FMP AAC calculations are based on tree length (TL) processing.

Table 3. Proposed Utilization Standards

Utilization Characteristic	Coniferous	Deciduous
Minimum top diameter inside bark	11 cm	10 cm
Minimum stump diameter outside bark	15 cm	15 cm
Stump height	30 cm	30 cm
Minimum log length	4.88 m	4.88 m

3.5.3 Tree Species

Table 4 lists the species present in FMU C5 and which species are acceptable for yield curve development. Species contributing to merchantable volume in the yield curves are identified under the acceptable species column.

Table 4. Species and acceptability for yield curve development

Species Type	Species Code	Common Name	Latin Name	Acceptable Species
Deciduous	Aw	Aspen	*Populus tremuloides*	Y
	Bw	White birch	*Betula papyrifera*	Y
	Pb	Balsam poplar	*Populus balsamifera*	Y
Coniferous	Pl	Lodgepole pine	*Pinus contorta*	Y
	Pj	Jack pine	*Pinus banksiana*	Y
	Lt	Tamarack	*Larix laricina*	Y
	Sb	Black spruce	*Picea mariana*	Y
	Sw	White spruce	*Picea glauca*	Y
	Se	Englemann spruce	*Picea englemannii*	Y
	Fb	Balsam fir	*Abies balsamea*	Y
	Fa	Subalpine fir	*Abies lasiocarpa*	Y
	Fd	Douglas fir	*Pseudotsuga menziesii*	Y

4 Pre-1996 Managed Stand Yield Curves (Juvenile)

Although not required under the current planning standard, Crowsnest collected data to understand the growth trajectory of existing post-harvest regenerated (PHR) stands that were harvested prior to May 1, 1996. This data will support development of pre-1996 managed stand yield curves for the sampled population (juvenile).

Crowsnest developed and completed a juvenile stand sampling program designed to characterize older regenerating stands and compare trajectories to both fire origin and recently regenerated stands. The company intends to utilize data collected in this program to represent stand growth trajectories for pre-1995 managed strata. Juvenile managed stand yield curves will be applicable only to the sampled population of stands in FMU C5. All other pre96 managed stands in FMU C5 will follow natural stand yield curves (NAT).

4.1 Stratification

The stratification will be based on the new AVI and will follow similar stratification rules applied to the natural fire-origin stands.

For the 2025 FMP, in juvenile managed stands in FMU C5, Crowsnest intends to use the GoA base 10 strata using the new AVI.

4.2 Data

Established 375 plots to achieve the targeted sample for juvenile temporary sample plots in Pl, and Sw strata to support the development of yield curves for the pre-1996 cutblocks (Table 5). Note, area values were derived from the sampling landbase and have not been updated.

Table 5. Number of sampled juvenile TSPs by yield stratum

Yield	GoA	Active Area		Proposed Plots	
Stratum	Stratum	Ha	%	#	%
Sw	Sw	2,159	21.41	45	12
Pl	Pl	7,926	78.59	330	88
Total		**10,086**	**100**	**375**	**100**

4.2.1 Proposed Sampling Design

Juvenile TSPs were used for the selected strata. The sampling population only included the PHR stands that were harvested prior to May 1, 1996.

Stands were selected randomly by stratum and age class with probability of selection proportional to stand area.

Three plots were sampled within each randomly selected stand. Eight plot locations were pre-selected within each stand using GIS routines, allowing plot locations to be moved to the next pre-selected location if the plot area is intersected by a mappable disturbance. Mappable disturbances include clearings identified by AVI as well as DIDs, traditional seismic layer and harvested areas. If the plot is intersected by an unmappable seismic disturbance (*i.e.* narrow low impact or avoidance seismic lines) then the plot was not moved.

Plot design supports the use of the Provincially approved Growth and Yield Projection System Growth model; GYPSY. Four nested, fixed radius plots were collected and proposed plot sizes and tagging limits are described in Table 6.

Table 6. Plot sizes and tagging limits

Tree Cohort Description and Tagging Limit	Plot Size (m^2)	Radius (m)
Tree Plot (> 5.0 cm DBH, live only)	100	5.64
Sapling Plot (≥1.30 m in heigh and ≤ 5.0 cm DBH, live only)	25	2.82
Regen (≥ 0.30 m and <1.3 m in height, live coniferous only)	10	1.78
Top Height Tree Plot	200	7.98

A tree plot is used to collect tree data (live trees ≥ 1.3m in height with a diameter at breast height (DBH) ≥ 5.1 cm with the potential to increase to 7.1 for stands older than 40 or 50 years), primarily for volume sampling purposes. The tree plots are circular with a size of 100m^2 (5.64m radius).

The sapling plot is 25m^2 in size (2.82m radius), and is intended to sample all saplings (live trees ≥ 1.3m in height and ≤ 5.0cm DBH). The sapling plot is superimposed on the centre of the tree plot.

The regen plot is 10m^2 (1.78 m radius) and is used to count all coniferous regeneration trees (≥ 0.3 m and <1.3 in height). It is also superimposed on the centre of the tree plot.

The top height tree plot is 200m^2 in size (7.98m radius), and is intended to sample top height trees. It is superimposed on the centre of the tree plot.

Species, DBH, height, and condition code were measured for each live tree or sapling.

Top height stems are defined as the 100 largest DBH stems of a given species per hectare that satisfy the following criteria:

- ✓ Live and healthy looking
- ✓ No broken or dead top
- ✓ Not an advanced/remnant/veteran or a super-dominant from a previous generation
- ✓ Not leaning ≥ 20^o, not a wolf tree or of obvious poor form (e.g., crook, sweep, fork)
- ✓ No severe damage to more than 1/3 of bole, crown and/or root.

Top height trees were sampled for all species groups present within the tree plot. The species groups are:

- ✓ Aw = Aw + Pb; [1]
- ✓ Fd = Fd,
- ✓ Pl = Pl + Pj + Lt;
- ✓ Sw = Sw + Se + Fb + Fa; and,
- ✓ Sb = Sb.

If the largest DBH tree has a lost or broken top that has not yet been replaced by a new leader, then the next largest DBH tree of that species was selected.

Additional detail regarding the juvenile TSP field data collection protocols is provided in the approved field Temporary Sample Plot Manual for Juvenile Managed Stands.

4.2.2 Data Compilation

Data will be compiled to create species group-level inputs for the GYPSY model. Density, basal area, top height, site index, and total age will be calculated on a unit-area (per hectare) basis by species group for each plot.

To obtain growth projections, GYPSY requires several input variables: total age, top height, site index, density, and basal area. Each of these variables will be compiled for each plot using the juvenile TSP to produce plot-level GYPSY inputs.

[1] Bw is not eligible for top height trees for the Aw species group in GYPSY.

Density

In GYPSY, stand density is defined differently for different stand types and species (coniferous versus deciduous).

GYPSY defines stand density for Post-harvest stand as follows:

i. For deciduous tree species, density refers to stems per hectare of the subject tree species >130 cm in height; and
ii. For coniferous tree species, density refers to stems per hectare of the subject tree species >30 cm in height.

The total densities of each plot are calculated by tree species group and are used as plot-level inputs for plot-input based GYPSY yield projections.

Basal Area

Diameter at breast height (DBH) measurements is used to compute basal area (m^2 per hectare).

The total basal areas of each plot are calculated by tree species group and are used as plot-level inputs for plot-input based GYPSY yield projection.

Top Height

Top height trees are sampled in the top height tree plot and are used to calculate top height. The top heights of each plot are calculated by tree species group and are used as plot-level inputs for plot-input based GYPSY yield projection.

Species Group Age

Total age refers to the number of years since time of germination. It is measured using the top height tree measurements from the top height tree plots.

Missing ages are calculated based on the average site index by stand (where more than one plot is available per stand), or the average by yield stratum and the observed plot top height.

Site Index

Site index is determined using the top height and total age data collected in top height tree plots. The site index equations from GYPSY are used to calculate individual site index.

Stand Age

Stand age will be calculated for each plot measurement using the difference between AVI stand origin and measurement year.

4.3 Model Development

The juvenile managed stand yield curves will be developed using Alberta's GYPSY growth model (version: May 21, 2009) using data from a Juvenile Temporary Sample Plot (TSP) Program. This program will be designed to collect traditional mensuration information for juvenile post-harvest stands within C5 area. For Pre95 cutblocks outside the juvenile sampling population, natural stand yield curves have been used.

Within yield strata, plot yields will be projected individually by GYPSY and then averaged to generate a representative yield curve.

The juvenile managed stand yield curves will be developed based on the following general steps:

- Compile applicable juvenile TSP data to GYPSY required inputs;
- Assign strata and stand age based on the attributes of the net landbase polygon in which the plot falls;
- Make forecasts for each plot individually;
- Basal area is required in the GYPSY forecasts (thus projections are adjusted to observed basal area);
- Create a stratum average yield curve by averaging the plot-based forecasts;
- Yield curves are linked to the stand via net landbase stand age but plot based species age is used wherever available for the GYPSY projections;
- Piece size calculation for FMP purposes is required. GYPSY will provide this information for the managed strata indirectly from merchantable volumes and merchantable stems per hectare.

4.4 Other Items

- ✓ Cull will follow the same approach used for the natural yield curves.
- ✓ The utilization standards for natural stand yield curves will be used to develop the M95 managed stand yield curves.

5 Post-1995 Managed Stand Yield Curves (RSA)

For the strata where sufficient data is available from the Regeneration Standards (RSA) of Alberta, existing and future PHR stands that were harvested on or after May 1, 1996 will be projected using post-1995 managed stand yield curves (RSA). All other managed strata, with insufficient sample size, will use NAT stand yield curves. Data collected under RSA protocols will be used to create RSA yield curves.

5.1 Stratification

All Post 95 managed stands are linked to ARIS via the cutblock reconciliation process described in "Reference guide for ARIS auditing and application" dated January 17th 2017. Only the RSA performance survey information and the strata derived from it will be used to create the RSA yield curves.

Strata will be based on the GoA 10 base strata.

RSA performance survey subunit (SU) will be retained and yield strata will be assigned at the SU-level. Aerial programs use the photo-interpreted species class label (SP_CL) as the basis for the yield stratum assignment.

Given that ground-interpreted labels are sometimes inaccurate[2] when compared to observed ground data, and that ground-based labels are at coarser resolution than aerial program labels (e.g., MxPl), we propose that non-photo programs be re-assigned based on the ground survey information. Ground survey densities, by species, will be used for stratum assignment, using the rules of aerial stratum assignment as per the RSA survey manual (Albert Agriculture Forestry, 2021).

5.2 Data

All RSA survey data for C5 that were submitted to the Forest Stewardship and Trade Branch by May 15, 2023[3] will be used. This includes all company, and Quota Holder and FRIAA cutblocks where aerial or non-photo RSA programs have been completed from post-95 openings.

The use of the RSA performance survey information for all existing post-1995 cutblocks will permit development of yield projections from observed performance survey data based on consistent data collection protocols, sound statistical sampling design and stratification scheme. The summary of the available RSA data to date is presented in Table 7. Some amalgamation of strata will be required to provide sufficient data to support yield curve development.

[2] Early non-photo programs tend to have some discrepancies between ground interpreted labels and observed ground data.
[3] The effective date of the landbase is May 1, 2023. RSA survey data submitted by May 15, 2023, includes programs where the photo interpretation and ground survey were completed in the 2022 season or earlier.

Table 7. Summary of RSA data status by data sources and survey year

Disposition Holder	Survey Year	Skid Year From	Skid Year To	N of SUs	System Type
770 538 AB LTD	2012	1998	1998	1	No-Photo
	2014	2000	2000	1	No-Photo
	2015	2001	2001	3	No-Photo
	2016	2002	2002	6	No-Photo
	2017	2003	2004	6	No-Photo
	2018	2004	2006	2	No-Photo
	2019	2006	2007	4	No-Photo
793 128 AB LTD	2019	2007	2007	1	No-Photo
ATLAS LUMBER	2013	2000	2001	5	Aerial
	2018	2005	2005	1	Aerial
ATLAS LUMBER (ALBERTA) LTD	2015	2002	2004	13	Aerial
CNKC	2021	2007	2008	5	No-Photo
CRFP	2021	2007	2009	5	No-Photo
CROWSNEST FOREST PRODUCTS	2018	2005	2007	12	Aerial
SPRAYLAKESAWMILLS(1980)LTD	2013	1999	2002	41	Aerial
	2013	2000	2002	2	No-Photo
	2014	1999	1999	1	No-Photo
	2015	2002	2005	12	Aerial
	2018	2005	2007	13	Aerial
Total				**134**	

The total area and number of ground-sampled SUs by program type (aerial vs. non-photo) and yield stratum are presented in Table 8. Strata with low number of SUs could be dropped or merged. RSA yield curves will be developed for yield strata that contain at least 30 ground sampled SUs. For strata HwPl and PlHw, samples may be combined to achieve this minimum to develop the curves.

Table 8. Number of ground-sampled sampling units and associated area by program type and stratum

RSA Yield Stratum	Aerial SUs	Aerial Area (ha)	Non-photo SUs	Non-photo Area (ha)	Total SUs	Total Area (ha)
Hw	1	4			1	4
HwPl	18	228	3	37	21	265
HwSx			1	10	1	10
Pl	48	574	15	170	63	744
PlHw	18	190	2	22	20	211
Sw	12	133	16	169	28	301
Total	**97**	**1,129**	**37**	**407**	**134**	**1,536**

Minimum sample size for yield estimation for a stratum is 30 sample units. Crowsnest may seek to amalgamate appropriate units to achieve the minimum sample size (i.e. mixedwood strata) or split strata by natural subregion is enough sample units are available. Under the current RSA protocol, Douglas Fir (Fd) is not a separate yield stratum, but rather falls under the Sw stratum, and most likely will not have a RSA yield projection developed.

5.3 Model Development

Where sufficient data exists, stands that were harvested on or after May 1, 1996 will be projected using RSA yield curves. Data collected under RSA protocols will be used to create all RSA yield curves.

The GYPSY 2009 model will be used as per current RSA protocols. For managed stands, this will ensure that the linkage between regeneration targets (derived from yield curves) and assessment of regeneration success (derived from GYPSY model projections) is as tight as possible.

The process is proposed as follows:

1) Assemble RSA compiler data for all programs.
2) Verify compiled information against original submissions.
3) Verify populations of openings against ARIS within the Defined Forest Area (DFA).
4) Convert RSA compiler data to SAS 9.4 for analysis.

   The main data is in the GYPSY_INPUT table which provides SU-level density, basal area, site index and age by species group. Although the RSA compiler stores actual yield table outputs, these data are only compiled in 10-year increments which is not suitable for timber supply analysis purposes. Compiled RSA data will be re-projected using SAS GYPSY to obtain 5-year yield outputs.

5) Project all sampling units to age 300 using SAS GYPSY.
6) Aerial programs: calculate the average yield for each aerial program by sampling stratum using the composite weights for the specific RSA program to roll-up individual SU projections to the aerial program/sampling stratum level.

   Where sampling strata represent more than one yield stratum, e.g. a combined SwHw/SbHw sampling stratum, separate yield curves will be created for each stratum with identical yields. The total population area will be assigned to each yield stratum within its respective program[4].

7) Non-photo programs: Each sampling unit will have its own yield stratum assignment (based on the re-assigned stratum as per our proposal), yield projection, and area. Selection weights are all 1 for non-photo programs, therefore SU area alone defines the composite weights.
8) Yield curves will be generated by calculating area-weighted averages for all yield strata, combining program-level averaged yields from aerial programs and individual SU-level yields from non-photo programs.

   All program-level averaged yields from aerial programs (#6) and all individual SU-level yields from non-photo programs (#7), that are falling within the same yield stratum, will be averaged by weighting the areas to generate the yield curves for each yield stratum. The total population area

[4] Starting in 2014, the RSA sample selection protocols switched to a stratified random sampling approach, resulting in the selection weights equal to 1 for all SUs therefore composite weights in newer programs will be based on the SU area.

Classification: Protected A

assigned to each yield stratum within its respective program will be used as area weight for aerial programs, while SU area will be used as area weight for non-photo programs.

5.4 Other Items

- ✓ Cull will follow the same approach used for the natural yield curves.
- ✓ The scale cull percentages for natural stand yield curves will be used.
- ✓ Regeneration lag will not be explicitly defined as it is incorporated into the RSA protocols and yield curves by design.
- ✓ The utilization standards for natural stand yield curves will be used to develop the MGD managed stand yield curves.

6 Future Managed Stand Yield Curves

All future Post Harvest Regenerations (PHR) stands that will be harvested under the regime of the new FMP (harvested after the effective date of the plan) will be projected using the future yield curves. The future yield curves will follow Basic or RSA yield curves for the respective regenerating strata.

Strata will be based on the silviculture matrix (strata transitions) that will be developed for the FMP. Regenerating strata will be based on the Base 10 strata.

The target MAI at the RSA utilization standard (15/10/30) will be produced using the Provincial Utilization Standard Conversion Factors for all regenerating strata.

Table 10 summarizes the yield curves to be applied in the TSA. This table will be updated after the strata to be sampled under the juvenile TSP program and which strata have sufficient RSA data are known.

Table 9. Yield curve sets to be applied in the TSA process

Sampling Stratum	Yield Stratum	Landbase Origin/Era			
			Managed stands		
		Natural	Pre-1996	Post-1995 (RSA)[2]	Future Blocks
Hw	Hw	Natural	Basic	Basic	Basic
PlMx	HwPl	Natural	Basic[1]	Basic	Basic
	PlHw	Natural	Basic	Basic	Basic
SxMx	HwSw	Natural	Basic	Basic	Basic
	SwHw	Natural	Basic	Basic	Basic
Sw	Sw	Natural	Juvenile, Basic	Basic	Basic
Pl -Alpine[3]	Pl -Alpine	Natural	Juvenile, Basic	RSA	RSA
Pl -Montane	Pl -Montan	Natural	Juvenile, Basic	RSA	RSA
Fd - Pure	Fd - Pure	Natural	Basic	Basic	Basic
Fd - Leading	Fd - Leadin	Natural	Basic	Basic	Basic

[1] Basic curves are duplicates of the Natural curves

[2] SLS intends to develop RSA curves for the strata with 30 or more SU. Use of RSA or Basic curves is pending review of sample size and MAI projections. Strata assigmentment will be documented in

[3] the decision to separate by subregions will be based on avaliable data and MAI projections

7 Milestones

Table 10 presents proposed milestones for yield curve development and review. Timelines will be subject to PDT acceptance.

Table 10. Yield curve development milestones

Task	Start Date	End Date
Mature TSP Sampling (field data collection)	May 1, 2022	October 15, 2022
Juvenile TSP Sampling (field data collection)	May 1, 2022	October 30, 2022
Obtain RSA data	April 1, 2022	July 15, 2023
Assign draft NLB attributes	April 1, 2022	May 1, 2022
Construct draft natural stand yield curves	January 1, 2023	June 1, 2023
Construct draft managed stand yield curves	February 1, 2023	June 1, 2023
Finalize NLB for A-I-P	May 1, 2023	July 1, 2023
Create yield curves for A-I-P	July 1, 2023	September 23, 2023
Submit yield curves for A-I-P		September 30, 2023
GoA A-I-P review	December 31, 2023	

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FINAL DRAFT

Annex V – Net Landbase Development

FORCORP

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous DFMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	II	Communication and Consultation Plans
	Annex	III	Stewardship Report (2007-2012)
	Annex	IV	Yield Curve Development
	Annex	**V**	**Net Landbase Development**
Three	Annex	VI	TSA – Timber Supply Analysis
	Annex	VII	SHS – Spatial Harvest Sequence
	Annex	VIII	Growth and Yield Plan

Executive Summary

Crowsnest Forest Products, a subsidiary of West Fraser Mills Ltd. has undertaken the process of classifying the company's forest management agreement area (FMA #2100047) for forest management planning purposes. This FMA plus the associated forest management unit (FMU), C5, are collectively referred to as the Defined Forest Area (DFA). As part of the forest management plan (FMP), the net landbase is created to classify the forest area within the DFA. This landbase is subsequently used in the timber supply analysis (TSA). The total land area of the DFA is 350,348 ha with 190,665 ha located within the FMA.

This document summarizes the process used to create the classified landbase (CLS), which describes the condition of the forest as of 1 May 2023 and was assembled to meet the requirements laid out in the Alberta Forest Management Planning Standard (Version 4.1 – April 2006). The document describes the process used to determine the contributing landbase that was used for the development of yield curves and the TSA. The final classified landbase for Crowsnest Forest Products consists of 309,796 polygons.

Alignment between the FMP and the South Saskatchewan Regional Plan (SSRP) was facilitated through the landbase process by the inclusion of integrated resource planning zones and provincial park areas, as identified in the SSRP:

- 157,612 ha of the C5 FMU have been designated as provincial parks, protected areas, or park amendments. This area has been assigned to the non-contributing landbase.
- 70,637 ha of the C5 FMU have been designated as Eastern Slopes Prime Protection Zone 1 with 3,102 ha of that area being classified as such in the classified landbase. The remaining area within the prime protection zone falls within parks and protected areas mentioned above and was assigned to the non-contributing landbase as parks.

Table 1-1 shows a breakdown of the classified landbase into non-contributing and contributing landbase areas resulting from the net down process. The effective date of the landbase is 1 May 2023 and it is described in this document as the "2023 Landbase", although the effective date of the FMP is 2025.

Table 1-1: Summary of the areas assigned to the non-contributing and contributing landbases in the classified landbase.

Landbase Category		Area (ha)
	Non-Contributing Landbase	
	Administrative Restrictions	
PPA	Parks and Protected Areas	157,612.1
ESLUZ	Eastern Slopes Land Use Zone 1	3,102.1
HRV	Historic Resource Values	1,215.7
DIDS-FOR	Forest DIDs Dispositions	266.3
DIDS-NONFOR	Non-Forested DIDs Dispositions	2,939.1
CLR	Crown Land Reservations	414.6
GOA_PSP	GOA Permanent Sample Plots	116.9
ANTH_NON	Non-Vegetated Anthropogenic Features	526.1
ANTH_VEG	Vegetated Anthropogenic Features	173.5
AVI	Areas with no AVI Interpretation	700.3
Administrative Total		**167,066.7**
	Landscape Restrictions	
LAKES_RIVERS	Lakes and Rivers	661.9
FLOOD	Flood Prone Areas	6.4
HYDROBUF	Hydrology Buffers	10,701.2
NNV	Natural Non-Vegetated Areas	2,627.4
NNF	Natural Non-Forested Areas	11,924.8
BURN	Burned Areas	12.8
OTHER_DIST	Areas Affected by Other Natural Disturbances	30.0
NFCC	Non-Forested Cutblocks (Outstanding ARIS Reconciliation)	0.0
Landscape Restrictions Total		**25,964.6**
	Operational Restrictions	
SLOPE	Areas with Slopes >45%	32,584.1
MOISTURE	High Soil Moisture	216.8
TPR	Low Timber Productivity Rating	4,785.2
DENSITY	Low Stand Density	9,025.0
LT	Larch/Tamarack	265.9
FD	Douglas-Fir	225.5
PA_PF	Whitebark/Limber Pine	1,302.1
WHITEBARK PINE PLUS	Whitebark Pine Plus protection	17.4
OPERATIONAL	Operational Deletions	1,742.4
ISO	Isolated Stands	23.6
PAR	Perimeter to Area Deletions	985.4
SEISMIC	Seismic Lines	46.0
Operational Restrictions Total		**51,219.4**
Non-Contributing Landbase Total		**244,250.7**
	Contributing Landbase	
C	Coniferous	91,217.2
CD	Coniferous Leading Mixedwood	1,507.1
DC	Deciduous Leading Mixedwood	1,258.8
D	Deciduous	12,114.4
Contributing Landbase Total		**106,097.4**
Grand Total		**350,348.1**

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1 Overview

1.1 Objective

The forest management agreement (FMA) between Crowsnest Forest Products Ltd. (CFP) and the Province of Alberta for FMA 2100047 came into effect on 17 July 2021. The outer boundaries of the defined forest area (DFA) for this landbase correspond to the C5 forest management unit (FMU). It is recognized that not all areas within the DFA are available for timber harvest for a variety of social, economic, and environmental reasons. The purpose of the net landbase is to classify the DFA into areas of contributing (managed or active) and non-contributing (non-managed or passive) landbase. The forested stands within the contributing landbase are stratified by cover type which forms the basis for forecasting growth and yield for the duration of the forest management plan (FMP). The landbase then becomes an input layer of the timber supply analysis (TSA) to determine the sustainable harvest level. Only forested stands classified as contributing landbase will contribute to the future timber harvesting activities and annual allowable cut (AAC) determination.

The objective of this document is to describe the datasets that were used to generate the net landbase (NLB), describe the processing steps completed on those datasets to prepare them for the net down process, and describe the business rules applied to the product of the spatial processing to stratify the landbase and classify it for the purposes of FMP development. The level of detail provided in this document should be sufficient and transparent enough to allow any qualified individual to repeat the process using the prepared input datasets provided with the submission (*i.e.,* cutblocks, ARIS, *etc*.) and achieve the same results as reported in Section 0.

1.2 Landbase Effective Date

The landbase effective date is 1 May 2023. All data layers used to create the net landbase were sourced on or after this effective date. This effective date will be within two years of the effective date of the FMP (1 May 2025) which aligns with the requirements outlined in the Alberta Forest Management Planning Standard[1].

1.3 Landbase Products

Three versions of the net landbase were created as part of the landbase development process. Each landbase represents the same information in slightly different ways. Each landbase was developed for a specific purpose and has the same geographic extent and distribution of forest strata.

1.3.1 TSA Landbase

The Timber Supply Analysis (TSA) landbase is an intermediate product that is created in the landbase development process. This landbase is spatial and contains all the fields that are found in the input

[1] Alberts Sustainable Resource Development, Public Lands and Forests Division, Forest Management Branch. Alberta Forest Management Planning Standard. Version 4.1 – April 2006.

datasets described in Section 2.4 and contains all the linework from the primary datasets. Seismic lines and designated trails are the only two layers not incorporated in this version of the net landbase. With all the base information present in this product, most error checking is conducted on this landbase before the final landbase products are created. To create the classified and modelling landbases this version of the landbase is supplemented with additional data.

1.3.2 Classified Landbase

The purpose of this landbase is to satisfy the requirements of the Alberta Forest Management Planning Standard. This landbase is spatial and is generated by combining the TSA landbase with seismic line and designated trail layers. The classified landbase is also used to calculate the area and distribution of all features within the DFA, particularly to generate summaries of seismic exploration and carry this into the modelling landbase. The classified landbase contains the greatest number of spatial polygons.

1.3.3 Modelling Landbase

The modelling landbase is a copy of the TSA landbase, maintaining all linework presented in that layer. The goal of this landbase is to present the data necessary to conduct a timber supply analysis using modelling software. This layer is supplemented with seismic line and designated trail data that is calculated from the classified landbase so that the extents of these features can be accounted for in the analysis without requiring the additional linework seen in the classified landbase. To improve model performance, extraneous data fields not directly used by the timber supply analysis are removed from this layer.

1.4 Spatial Landbase Process

Developing the net landbases for the Crowsnest Forest Products FMP has five distinct steps:

1. Identify and assemble all required data to support the landbase classification process (Section 2.4)
2. Spatial processing of input data sets to generate the spatial landbases (Section 3)
3. Process attributes to characterize/stratify the landbase (Sections 4.3 and 4.4)
4. Identify area available for forest management activities (Section 4.5)

Figure 1-1 illustrates these processing steps.

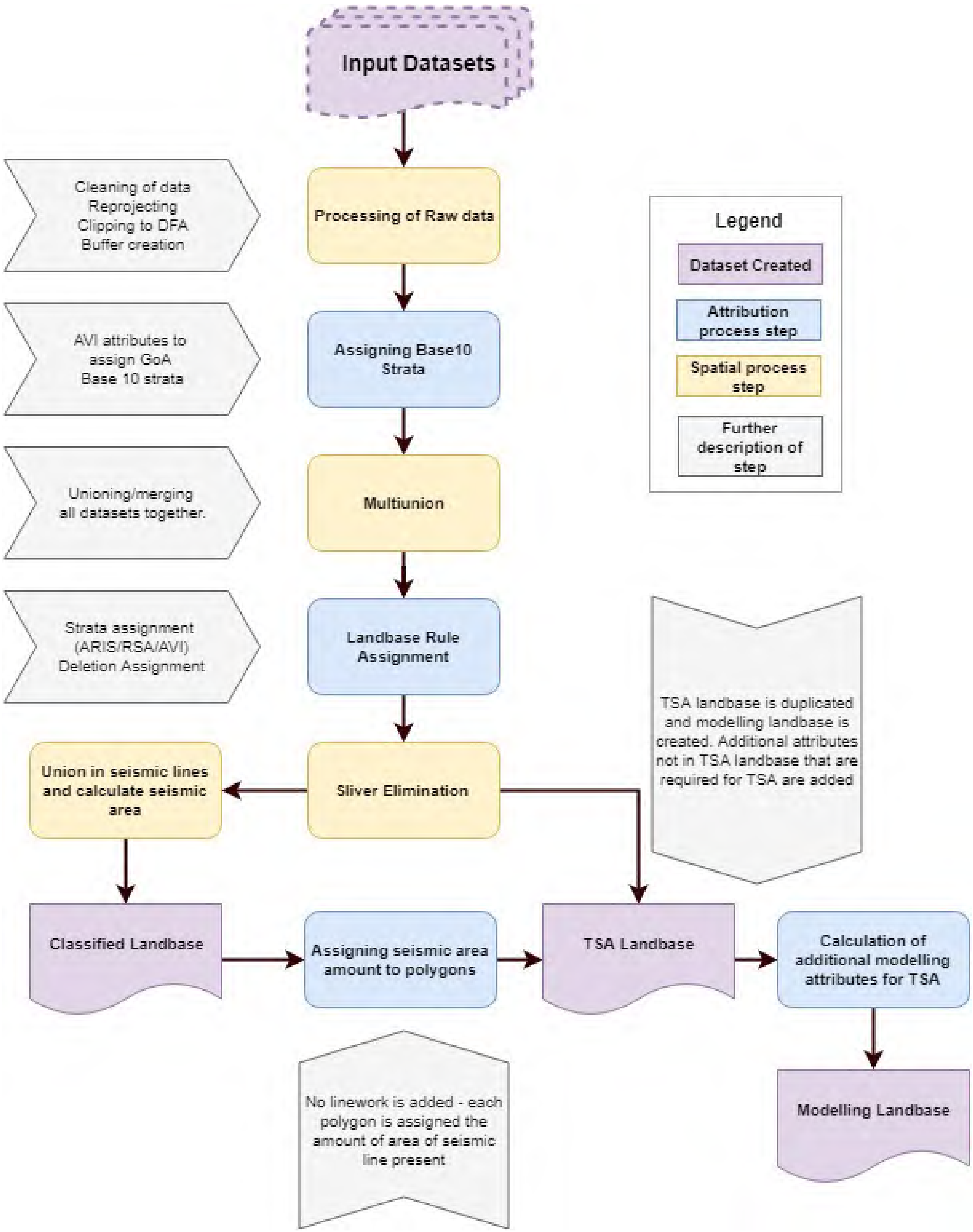

Figure 1-1: Landbase data processing overview.

2 Summary of Datasets

2.1 Overview

This section describes all input datasets and the associated processing necessary to prepare the data for inclusion into the landbase for analysis. Each dataset is described as to its source, content, processing, and important attributes for the net down process. A full data dictionary of the input datasets will be provided in Appendix **Error! Reference source not found.**VI**Error! No bookmark name given.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.**.

2.2 Summary Landbase Input Datasets

The input datasets are the raw source datasets that are processed and assembled into the spatial landbase. The standard processing of the input datasets involves:

- Ensuring all attribute fields names are valid (no reserved words, duplicate keys, etc.)
- Carrying important fields through to the output dataset and dropping all non-required fields
- Clipping data layers to the DFA boundary and projecting to Universal Transverse Mercator (UTM) Zone 11N, North American Datum (NAD) 83 (Spatial Reference ID: 26911), units = meters
- Importing into a spatial database (PostgreSQL), using x,y tolerance = 0, and cleaning topology when polygon or polyline

Table 2-1 provides an overview of the input datasets. The list of datasets contains the following:

- Data Layer: A general layer name
- Source(s): The source (supplier) of the input dataset
- Description: A short description of the dataset contents
- Usage: The method for bringing the dataset into the landbase
- Reference: The heading number in this document, where this data layer is described in more detail

Table 2-1: List of data layers and tables used to develop the Crowsnest Forest Products net landbase. The reference column refers to the location in this document where the full descriptions for each layer can be found.

Data Layer	Source	Description	Usage	Reference
		Administrative Boundaries		
FMU Boundary	AltaLIS	C5 Forest Alberta Forest Management Unit (FMU) boundary	Primary Linework	2.4.1
FMA Boundary	AltaLIS	Crowsnest Forest Products Forest Management Agreement (FMA) boundary	Primary Linework	0
DFA Boundary	AltaLIS	Defined Forest Area (DFA) Boundary for the Forest Management Plan	Primary Linework	2.4.3
Parks and Protected Areas	AltaLIS and GOA	Parks and protected areas. Includes park amendments identified as part of the South Saskatchewan Regional Plan	Primary Linework	0
ATS Grid	AltaLIS	Alberta Township System grid	Proxy	2.4.7
Land Use Framework	AltaLIS	Land Use Framework Planning Boundary	Proxy	0
Eastern Slopes Land Use Zones	AltaLIS	Eastern Slopes Land Use Zones (Zone 1: Prime Protection)	Primary Linework	0
Public Land Use Zones	AltaLIS		Primary Linework	2.4.10
Footprint Planning Zones	GOA	Livingstone and Porcupine Hills Footprint Planning Zones	Primary Linework	2.4.11
Analysis Units	GOA	Livingstone and Porcupine Hills Analysis Units	Primary Linework	2.4.12
RFMAs	AltaLIS	Registered fur management areas (traplines)	Proxy	2.4.32
First Nations Reserves	AltaLIS		Primary Linework	2.4.37
Municipal Districts	AltaLIS	Municipal Districts, Counties, Improvement Districts and Special Municipalities	Primary Linework	2.4.38
Ownership	GOA	Land ownership (Federal, Provincial, Municipal, Private)	Primary Linework	2.4.39
		Forest Inventory		
Alberta Vegetation Inventory (AVI)	GreenLink Forestry	Completed AVI dataset for the C5 FMU including ARIS reconciliation revisions	Primary Linework	2.4.5
		Anthropogenic Features		
HRVs	GOA	Historic Resource Values	Primary Linework	2.4.40
DIDs – Non-forested	GOA	Non-forested Digital Integrated Dispositions	Primary Linework	2.4.41
DIDs - Forested	GOA	Forested Digital Integrated Dispositions	Primary Linework	2.4.42
PSPs	GOA	Provincial and Federal Permanent Sample Plots	Primary Linework	2.4.43
CLRs	GOA	Crown Land Reservations	Primary Linework	2.4.44

Data Layer	Source	Description	Usage	Reference
Seismic Lines	AltaLIS	Seismic lines and cutlines	Primary Linework	2.4.48
Designated Trails	GOA	Designated and Provincial Trails	Primary Linework	2.4.49

		Natural Features		
Natural Regions and Subregions	GOA		Proxy	2.4.13
Tree Seed Zones	GOA	Source zones for tree seeds	Proxy	2.4.14
Controlled Parentage – Region F1	GOA	Controlled Parentage Program – Region F1 (Douglas-fir)	Proxy	2.4.15
Controlled Parentage – Region M	GOA	Controlled Parentage Program – Region M (western larch)	Proxy	0
ECA Watersheds	GOA	Equivalent Clearcut Area (ECA) Watersheds	Primary Linework	2.4.17
HUC Watersheds	GOA	Hydrologic Unit Code 10 (HUC) Watersheds	Proxy	2.4.18
Hydrology Features	AVI and AltaLIS	Hydrology Features within the AVI and Provincial Layer	Primary Linework	2.4.19
Hydrology Buffers	CFP, AVI and AltaLIS	Buffered hydrology features and Terrainworks model lines	Primary Linework	2.4.20
Snow Sensitive Zones	GOA	Portions of watersheds where snow sensitivity needs to be considered.	Primary Linework	2.4.21
Visual Quality	CFP	Areas where viewsheds protection is being considered	Proxy	2.4.22
Erosion Risk	GOA	Areas where erosion risk around streams is considered.	Primary Linework	2.4.23
		Wildlife Layers		
Fish Management Zones	AltaLIS		Proxy	2.4.24
Wildlife Management Units	AltaLIS		Proxy	2.4.25
Big horn sheep and Mountain goat range	AltaLIS and GOA	Sheep and goat range and related range risk	Primary Linework	2.4.26
Grizzly Bear Zones	GOA	Grizzly bear habitat zones used in timber supply analysis	Primary Linework	2.4.27
Grizzly Bear Watersheds	GOA	Grizzly bear watersheds used in timber supply analysis	Proxy	2.4.28
MPB SSI	GOA	Calculated mountain pine beetle stand susceptibility index	Proxy	2.4.30
MPB Predicted r Value	GOA	Predicted r-value is an estimate of female MPB productivity as determined by tree size, stand location and weather	Proxy	2.4.31
Hard Linear Features	AltaLIS, CFP and GOA	7 ha grid identifying hard linear features	Primary Linework	2.4.50

Data Layer	Source	Description	Usage	Reference
		Operability Considerations		
Compartments	CFP and GOA	Company defined harvest compartments including MPB compartment risk	Primary Linework	2.4.6
Steep Slopes	CFP	Areas with slopes assessed at 45% or greater	Primary Linework	2.4.46
Operational Deletions	CFP	Operational Deletions and Deferrals	Primary Linework	2.4.47
Cutblocks	CFP	Cutblocks harvested after the AVI photo date in the ARIS reconciliation population	Primary Linework	2.4.51
Planned Cutblocks	CFP	Planned cutblocks and blocks harvested that weren't part of the ARIS reconciliation population	Primary Linework	2.4.52
RSA Survey Boundaries	CFP	Blocks surveyed as part of the Reforestation Standard of Alberta program	Primary Linework	2.4.53
		Additional Data Layers		
Whitebark Pine Plus	WPEFC	Buffered points identifying locations of whitebark and limber pine trees	Proxy	2.4.29
Wildfire Management Zones	AltaLIS		Proxy	2.4.33
Wildfire Risk	GOA	Calculated wildfire risk	Proxy	2.4.34
FireSmart Community Zones	GOA		Proxy	2.4.35
Recent Wildfires	GOA	Areas burned after the AVI photo date	Primary Linework	2.4.36
Forest Encroachment	GOA	Risk of forest encroachment on forested rangeland	Proxy	2.4.45
ARIS Data	GOA	ARIS	Tables	2.4.54

2.3 Processing of Landbase Input Datasets

The management and processing of the input datasets was completed using the PostgreSQL/PostGIS platforms via SQL scripting, except for the ARIS dataset which was processed partially through Microsoft Excel. The use of scripts to process data from start to finish allows a fully transparent process to be applied and ensures that the process is repeatable.

Datasets are described in terms of:

- Source(s): Where the dataset(s) was sourced from
- Source Filename(s): The names of the dataset(s) used in the creation of the output
- Description of the Source File: A description of the dataset(s) described in the Source Filename(s) section
- Projected Coordinate System: Projection of the source file
- Important Attributes: Attributes that are brought forward to the landbase
- Required Processing: Methods of processing the source file to create the landbase layer
- Assumptions/Processing Issues: Identified issues and assumptions that had to be resolved to create the final layer
- Programs: A list of the processing programs/tools used to create the layer
- Output Filename: Name of the landbase input layer after the processing steps
- Output Description: A description of what the output is utilized for
- Output Attributes: Resulting attributes after the processing of the source file
- Polygon area: Calculated area in hectares of the layer attributes

Input datasets are typically scale independent, meaning that each layer was derived at a specific level of detail to serve a specific purpose at that time. Large scale datasets, when overlaid and compared to small scale datasets, do not offer the same level of detail and boundaries are often imprecise and can complicate the landbase process through the creation of slivers. One of the objectives of the landbase net down process is to minimize the size of the spatial file to make the spatial data easier and faster to query and transfer from system to system, as well as to ensure that the polygons created "have meaning" in the context of resource management. This creates two types of input data: Primary Linework (direct), and Proxy (indirect). Table 2-1 distinguishes between these two data types within the "Usage" column. Proxy features are linked to AVI polygons by identifying which AVI polygons have their centroid within the feature to be added. Proxy layers are also identified in the layer assumptions section for each layer description.

2.4 Summary of Submission of Landbase Input Datasets

The input datasets listed in Table 2-1 are described in the following sections. For each layer a brief description of the data is provided, along with the steps taken to process the raw data to create the submission dataset. The "Reference" column in Table 2-1 indicates the heading number in this section. For each layer, an overview map is also provided. The maps are intended only to put the data into context within the DFA boundary. Small features may not be visible at the scale the maps were created at, and features that fall outside of the DFA may not be identified.

2.4.1 Forest Management Unit (C5)

Item	Description
Source:	AltaLIS
Source Filename:	bf_geoadmin_22-09-2021.gdb/ForestManagementUnit (effective date: 26 January 2022)
Description of the Source File:	Forest Management Units (FMUs) within the Province of Alberta
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	FMU_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Select the polygons from this projection where FMU_NAME = 'C5' and create a new layer from this selection 3. Rename the FMU_NAME field as FMU and remove all other fields 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_fmu
Output Description:	Boundary of the C5 FMU
Output Attributes:	FMU
Polygon Area:	Total Area: 350,348 ha

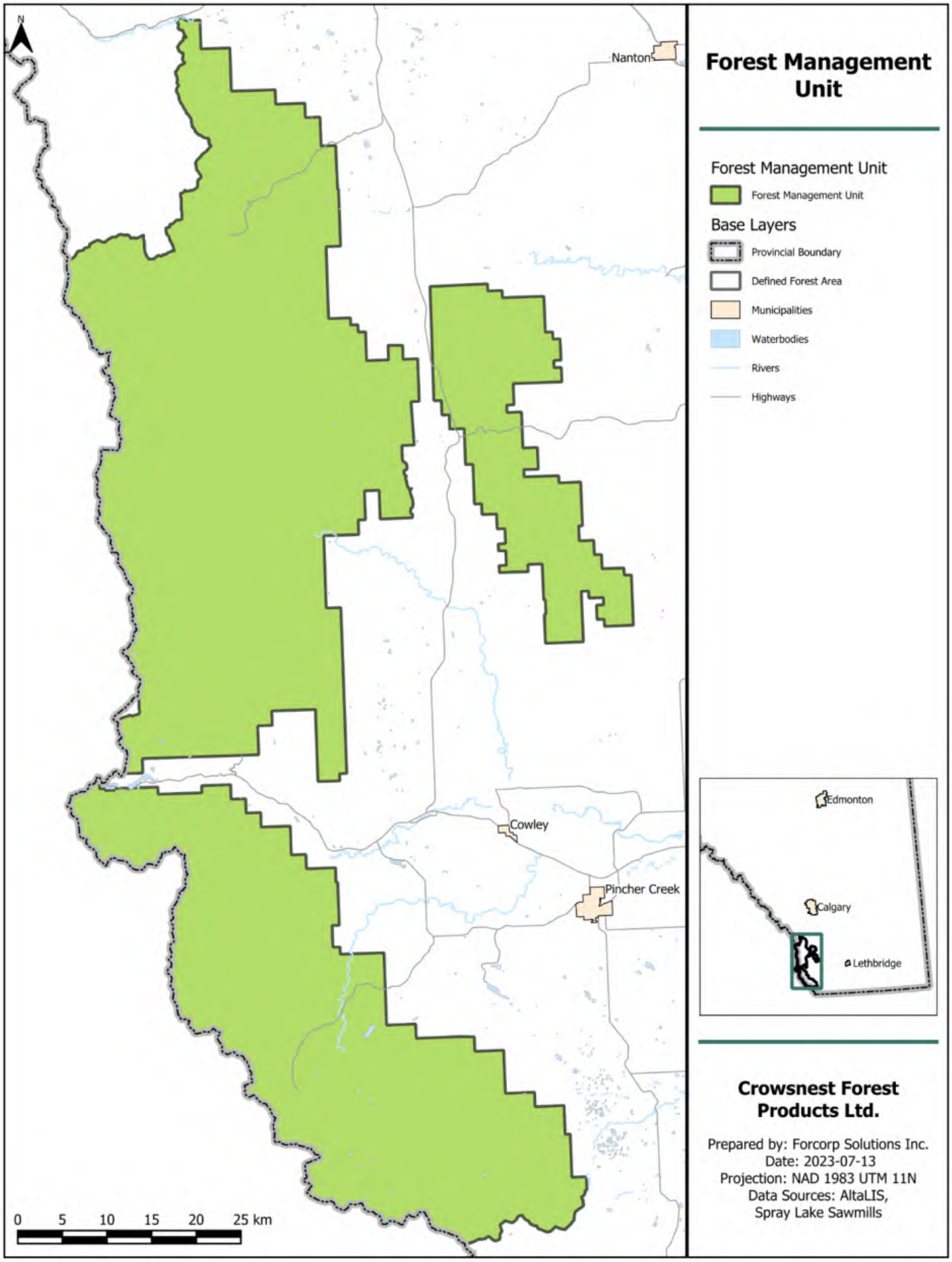

Figure 2-1: The C5 forest management unit (FMU) boundary.

2.4.2 Forest Management Agreement Area

Item	Description
Source:	AltaLIS
Source Filename:	bf_geoadmin_22-09-2021.gdb/ForestManagementAgreementArea (effective date: 25 March 2022)
Description of the Source File:	Forest Management Agreement Areas (FMAs) within the Province of Alberta
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	FMA_NAME, FMA_NUM
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Select the polygons from this projection where FMA_NUM = 2100047 and create a new layer from this selection 3. Rename the FMA_NAME field as FMA and remove all other fields 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_fma
Output Description:	Boundary for the Crowsnest Forest Products FMA (FMA number 2100047)
Output Attributes:	FMA
Polygon Area:	Total Area: 190,665 ha

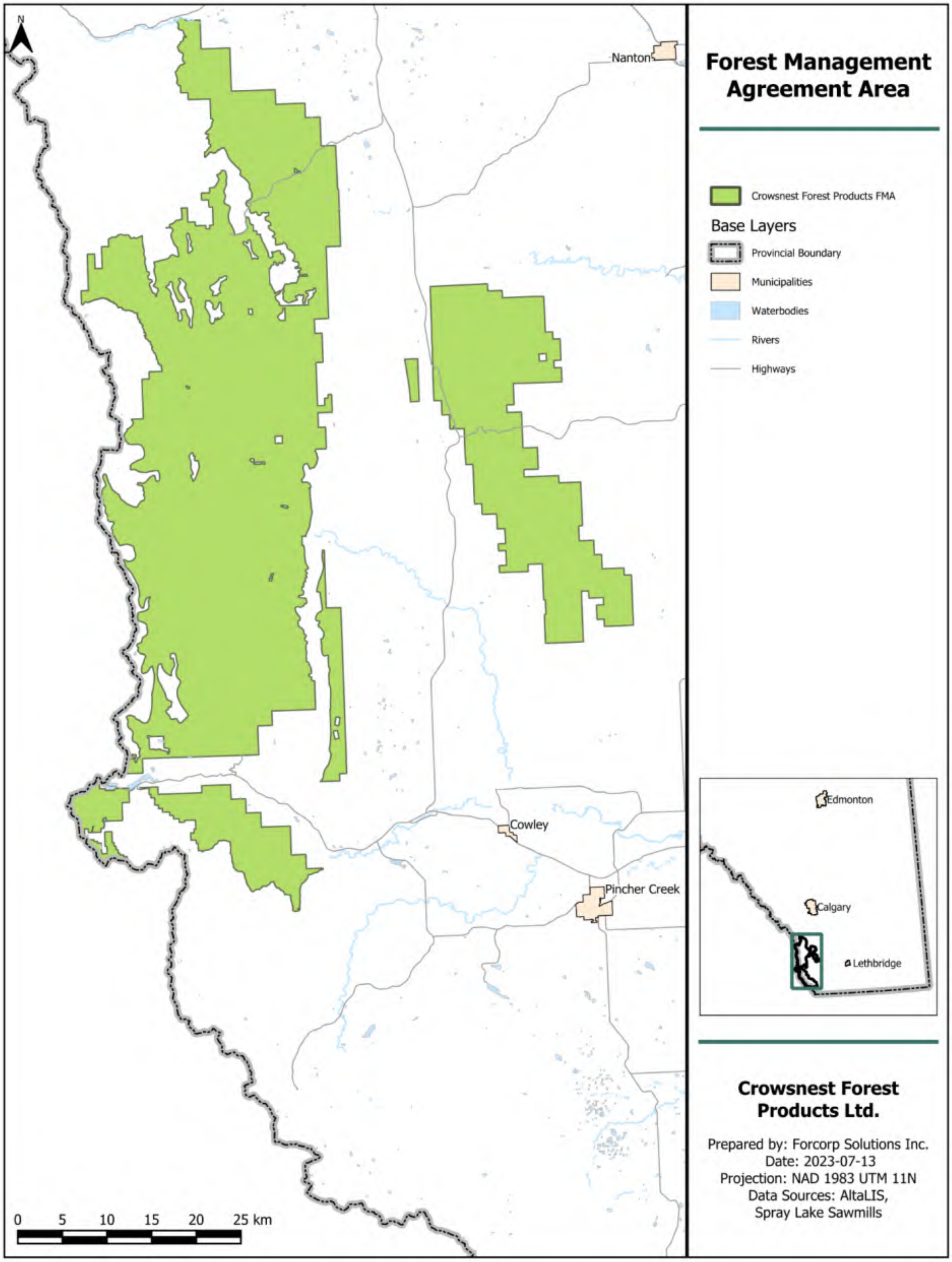

Figure 2-2: Forest management agreement (FMA) area boundary for Crowsnest Forest Products.

2.4.3 Defined Forest Area

Item	Description
Source:	AltaLIS
Source Filename:	bf_geoadmin_22-09-2021.gdb/ForestManagementUnit (effective date: 26 January 2022)
Description of the Source File:	Forest Management Units (FMUs) within the Province of Alberta
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	FMU_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Select the polygons from this projection where FMU_NAME = 'C5' and create a new layer from this selection 3. Create a new field named DFA and populate it with the value "DFA" Remove all other fields 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Section 1, CSA – 7.0 of the Alberta Forest Management Planning Standard defines the defined forest area (DFA) as "the geographic boundaries of the FMA and any associated FMUs as a minimum…". This layer will be used as the outer boundary in the creation of the landbase. For this net landbase the DFA boundary will be limited to the full extent of the FMU. There are a few small slivers in the FMA layer that fall outside of the FMU boundary that are not substantial enough to require consideration. To simplify processing the FMU will be used as the DFA boundary, and these sliver areas will not be included as part of the DFA.
Program:	PostgreSQL/PostGIS
Output Filename:	i_dfa
Output Description:	Boundary of the Crowsnest Forest Products Defined Forest Area
Output Attributes:	DFA
Polygon Area:	Total Area: 350,348 ha

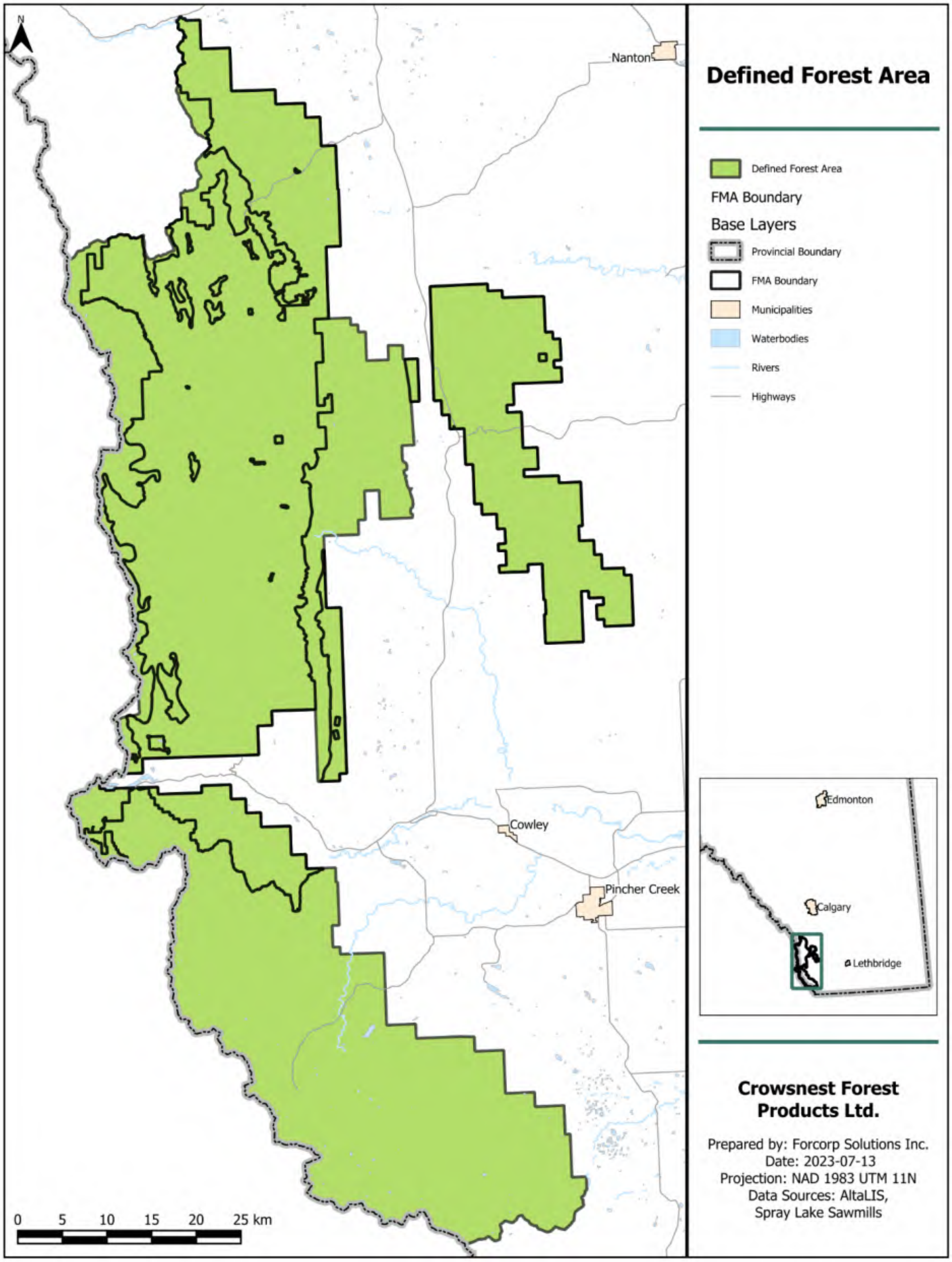

Figure 2-3: Defined Forest Area (DFA) for the 2025 Crowsnest Forest Products forest management plan.

2.4.4 Parks and Protected Areas

Item	Description
Sources:	AltaLIS and Government of Alberta
Source Filenames:	bf_geoadmin_22-09-2021.gdb/ParksProtectedAreasAlberta (effective date: 24 March 2023) SSRP_AMENDED_CONSERVATION_AND_RECREATION_AREAS_20170216.shp (effective date: 16 February 2017)
Description of the Source Files:	Parks and protected areas located within the province of Alberta and park amendments identified as part of the South Saskatchewan Regional Plan.
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	AREANAME, TYPE
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Combine the two source layers into a single layer 3. Clip projected layer to the DFA boundary 4. Rename the AREANAME field as PARK_NAME and the TYPE field as PARK_TYPE 5. Delete fields except for the PARK_NAME and PARK_TYPE field 6. Repair any irregular geometries that may be present 7. Create a singlepart layer 8. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Park amendments identified as part of the development of the South Saskatchewan Regional Plan were included in this layer if they were not identified in the AltaLIS source layer. These amendments primarily fall within the Prime Protection portion of the Eastern Slopes Land Use Zone.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_ppa
Output Description:	Parks and protected areas that intersect the C5 FMU
Output Attributes:	PARK_NAME, PARK_TYPE

Item	Description
Polygon Area:	Total Area: 157,620 ha Ecological Reserve: 1,637 ha Heritage Rangeland: 663 ha Natural Areas: 7,339 ha National Park: 2 ha Provincial Parks: 25,763 ha Provincial Recreation Areas: 161 ha Wildland Provincial Parks: 122,055 ha

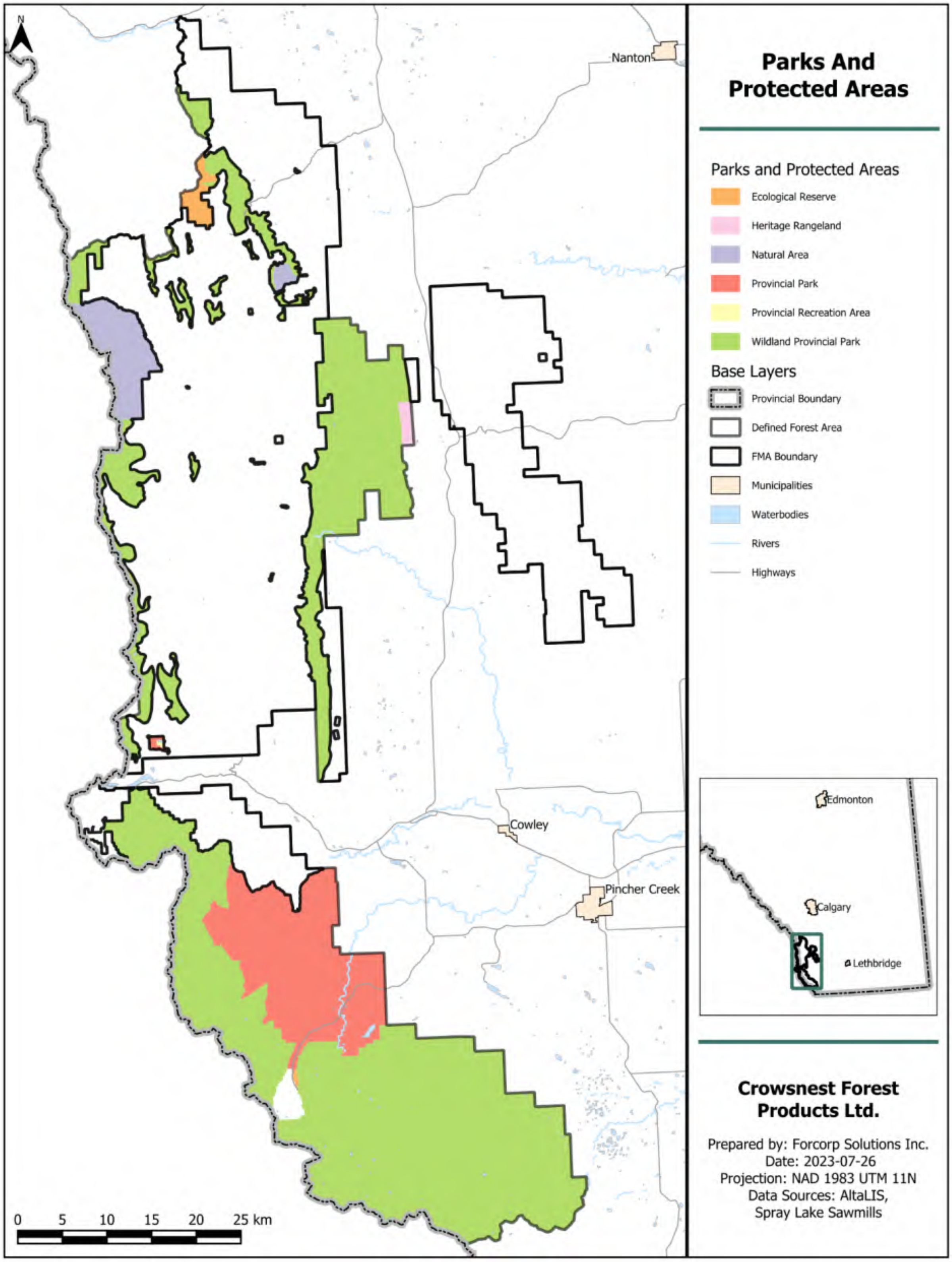

Figure 2-4: Parks and protected areas within the Crowsnest Forest Products defined forest area. Parks and protected areas in this layer include park amendments that were identified as part of the development of the South Saskatchewan Regional Plan.

2.4.5 Alberta Vegetation Inventory

Item	Description
Source:	Crowsnest Forest Products (developed by GreenLink Forestry)
Source Filenames:	FMU_C5_AVI_AUDIT_SUBMISSION_CSRS_Z11.gdb\FMU_C5_AVI_POLY FMU_C5_AVI_AUDIT_SUBMISSION_CSRS_Z11.gdb\EXTRA_ATTRIBUTES (Approval Date: 19 September 2022)
Description of the Source Files:	Alberta Vegetation Inventory for the Crowsnest Forest Products FMA.
Projected Coordinate Systems:	NAD_1983_CSRS_UTM_Zone_11N (SRID 2955)
Important Attributes:	All AVI attributes are maintained
Required Processing:	1 Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2 Repair any irregular geometries that may be present 3 Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Following the AVI approval, GreenLink Forestry conducted several revisions to the AVI to ensure that cutblocks were in compliance with ARIS reconciliation requirements. These revisions may require a future approval by the GOA.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_avi
Output Description:	Alberta Vegetation Inventory for the Crowsnest Forest Products FMA
Output Attributes:	All AVI attributes
Polygon Area:	Total Area: 190,665 ha 2018 photo year: 188,821 ha 2019 photo year: 525 ha 2020 photo year: 694 ha 2021 photo year: 625 ha

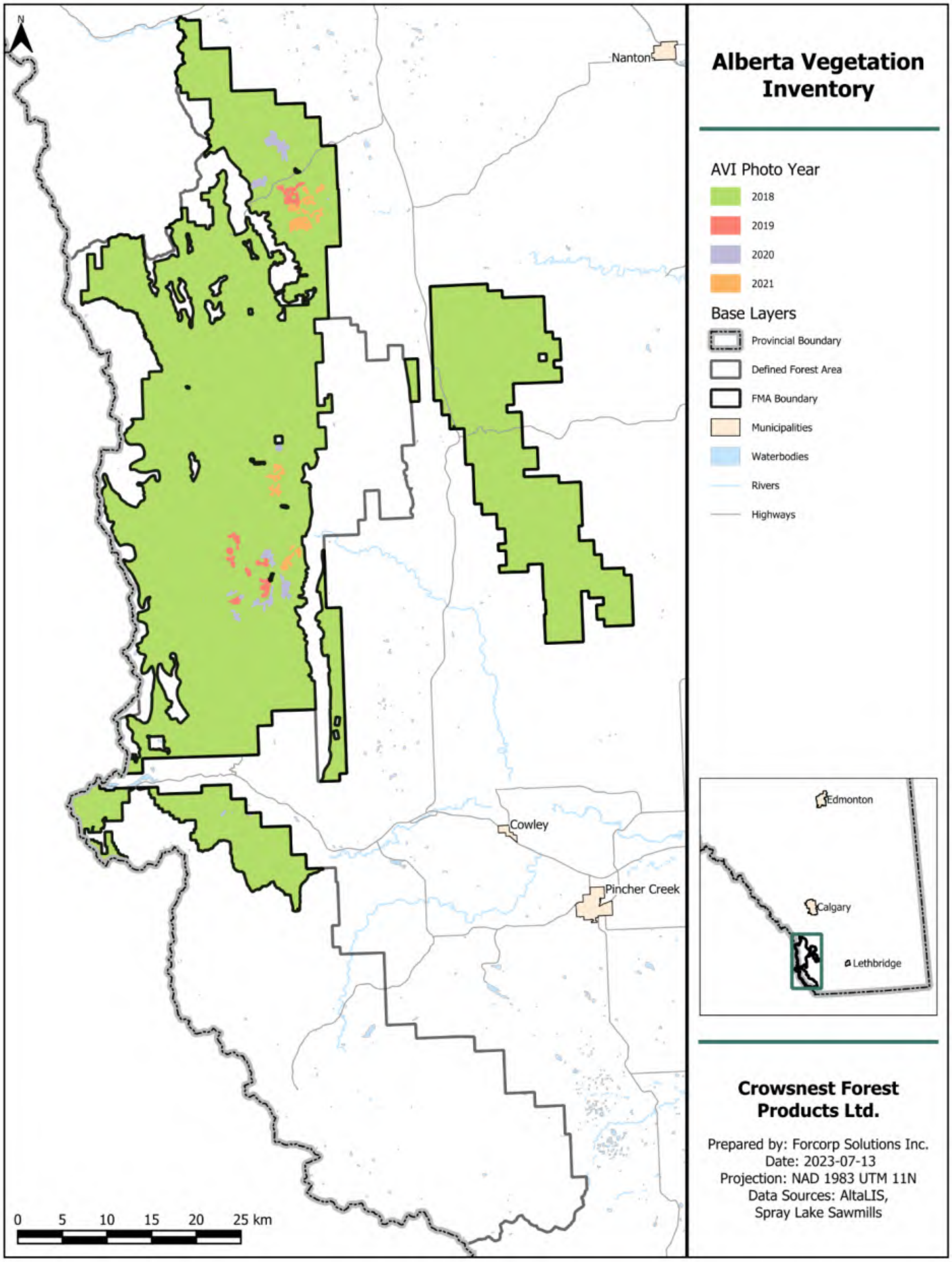

Figure 2-5: Alberta Vegetation Inventory (AVI) extents within the Crowsnest Forest Products forest management agreement area.

2.4.6 Compartments

Item	Description
Sources:	Government of Alberta and Crowsnest Forest Products
Source Filenames:	Compartments_Prelim_V1_woParks.shp CFP_FMA_watersheds.shp and MPB compartment risk map
Description of the Source Files:	Compartment boundaries and ECA watershed boundaries and a map showing the mountain pine beetle compartment risk.
Projected Coordinate Systems:	NAD_1983_UTM_Zone_11N (SRID 26911)
Important Attributes:	Name, COMPART
Required Processing:	1. Project the ECA source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Create a field named "COMPARTMENT" 4. Select ECA watersheds that correspond to the draft compartment boundaries and assign names to the COMPARTMENT field based on those designated by CFP 5. Create a COMP_RISK field and assign the following risk values to each compartment based on the map received a. Very High – Crowsnest River b. High – Racehorse Creek c. Low – Oldman River, Livingstone River, Willow Creek, Porcupine Hills 6. Dissolve boundaries and create a singlepart layer 7. Repair any irregular geometries that may be present 8. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Compartments are reporting areas that are used to calculate variance for stewardship reporting. All FMA area is assigned to a compartment. Compartments boundaries were designed by Crowsnest Forest Products and then adjusted to align with the Equivalent Clearcut Area Watersheds. ECAs with several distinct polygons were split across multiple compartments to ensure compartments were spatially contiguous. MPB compartment risk was assigned to each compartment by the GOA after the final boundaries were determined.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_compartments

Item	Description
Output Description:	Compartments created for the Crowsnest Forest Products defined forest area
Output Attributes:	COMPARTMENT, COMP_RISK
Polygon Area:	Total Area: 190,743 ha Crowsnest River: 29,930 ha Livingstone River: 27,935 ha Oldman River: 25,940 ha Porcupine Hills: 39,883 ha Racehorse Creek: 42,851 ha Willow Creek: 24,204 ha

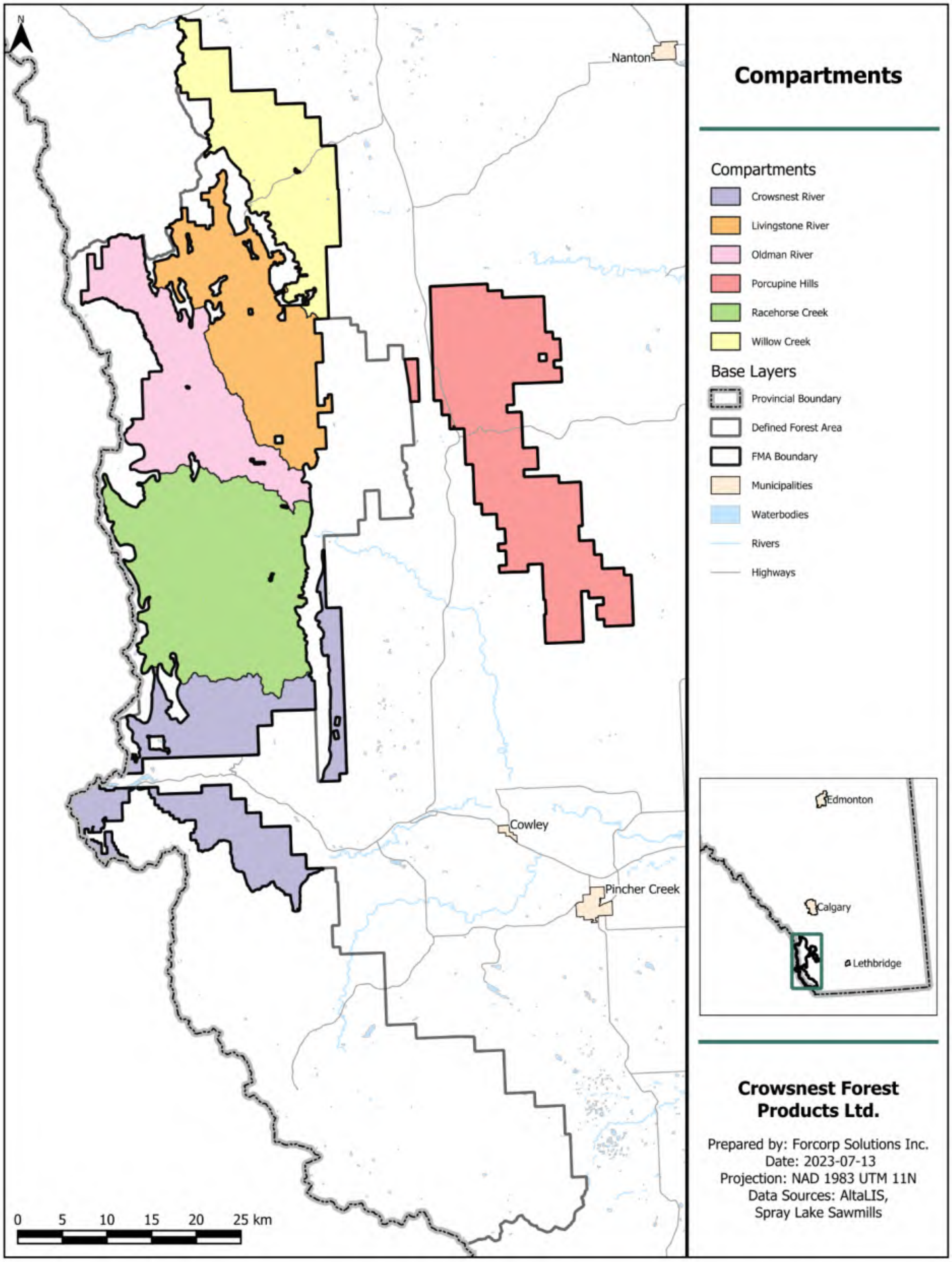

Figure 2-6: Compartments within the Crowsnest Forest Products forest management agreement area.

2.4.7 Alberta Township System

Item	Description
Source:	AltaLIS
Source Filename:	bf_ats_19-08-2020/ATS v4_1_Polygons_Township_Index.shp
Description of the Source File:	Townships layer for Alberta presenting the Meridian, Range and Townships without road allowances or other divisions
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	M, RGE, TWP
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the M, RGE and TWP fields 4. Rename M field to MER 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_ats
Output Description:	Alberta ATS townships that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	MER, RGE, TWP
Polygon Area:	Total Area: 350,317 ha

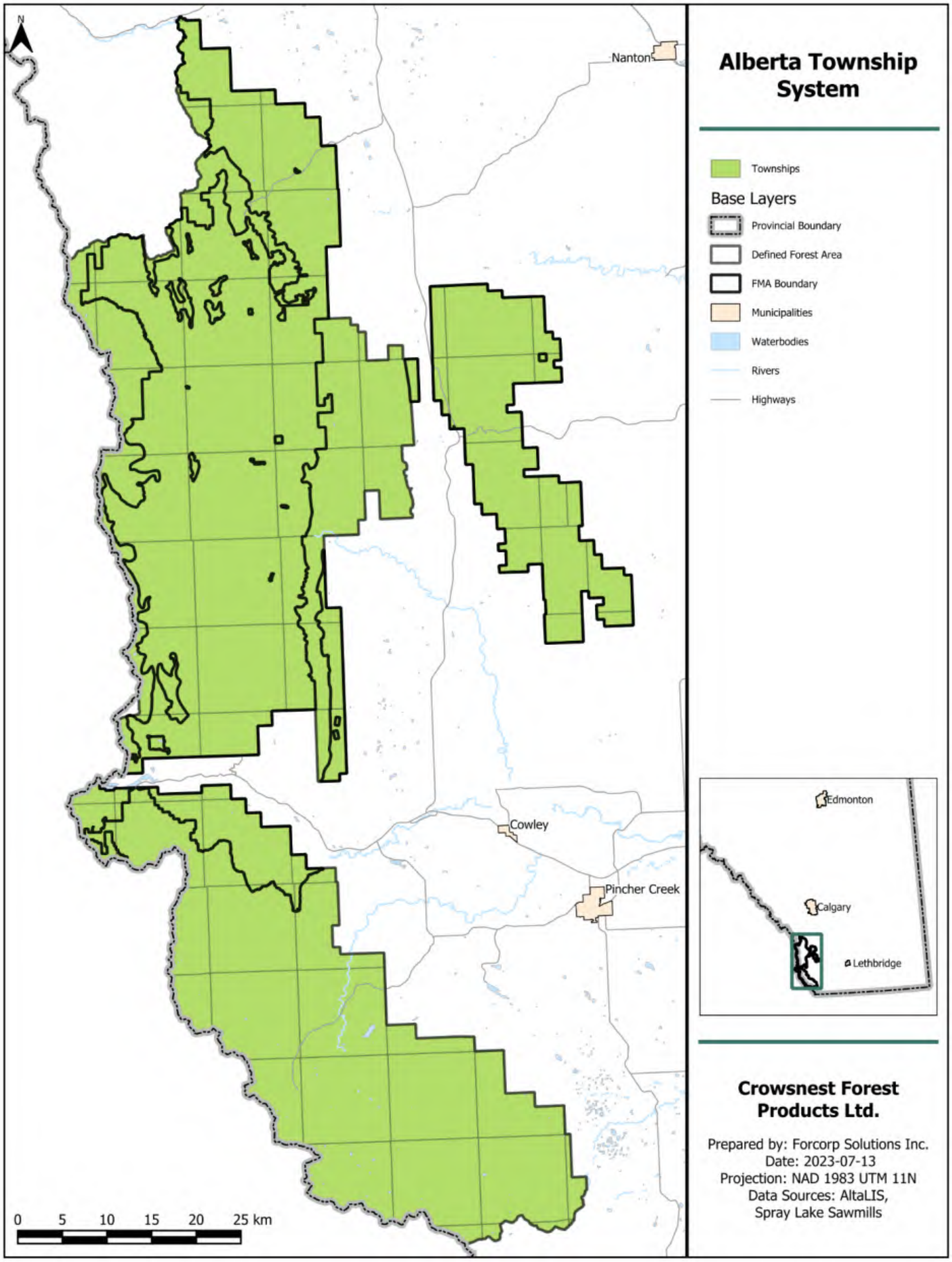

Figure 2-7: Alberta Township System townships within the Crowsnest Forest Products defined forest area.

2.4.8 Land Use Framework Planning Regions

Item	Description
Source:	AltaLIS
Source Filename:	bf_geoadmin_26-10-2020.gdb/LanduseFameworkPlanningRegions (effective Date: 1 October 2012)
Description of the Source File:	Landuse Framework Planning Regions
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	LUF_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the LUF_NAME field 4. Rename LUF_NAME to LUF 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry. The area within the DFA that is not assigned to a planning region is found along the western edge of the DFA and is present due to different interpretations of the provincial boundary.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_luf
Output Description:	Land use framework planning regions that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	LUF
Polygon Area:	Total Area: 350,334 ha South Saskatchewan: 350,334 ha

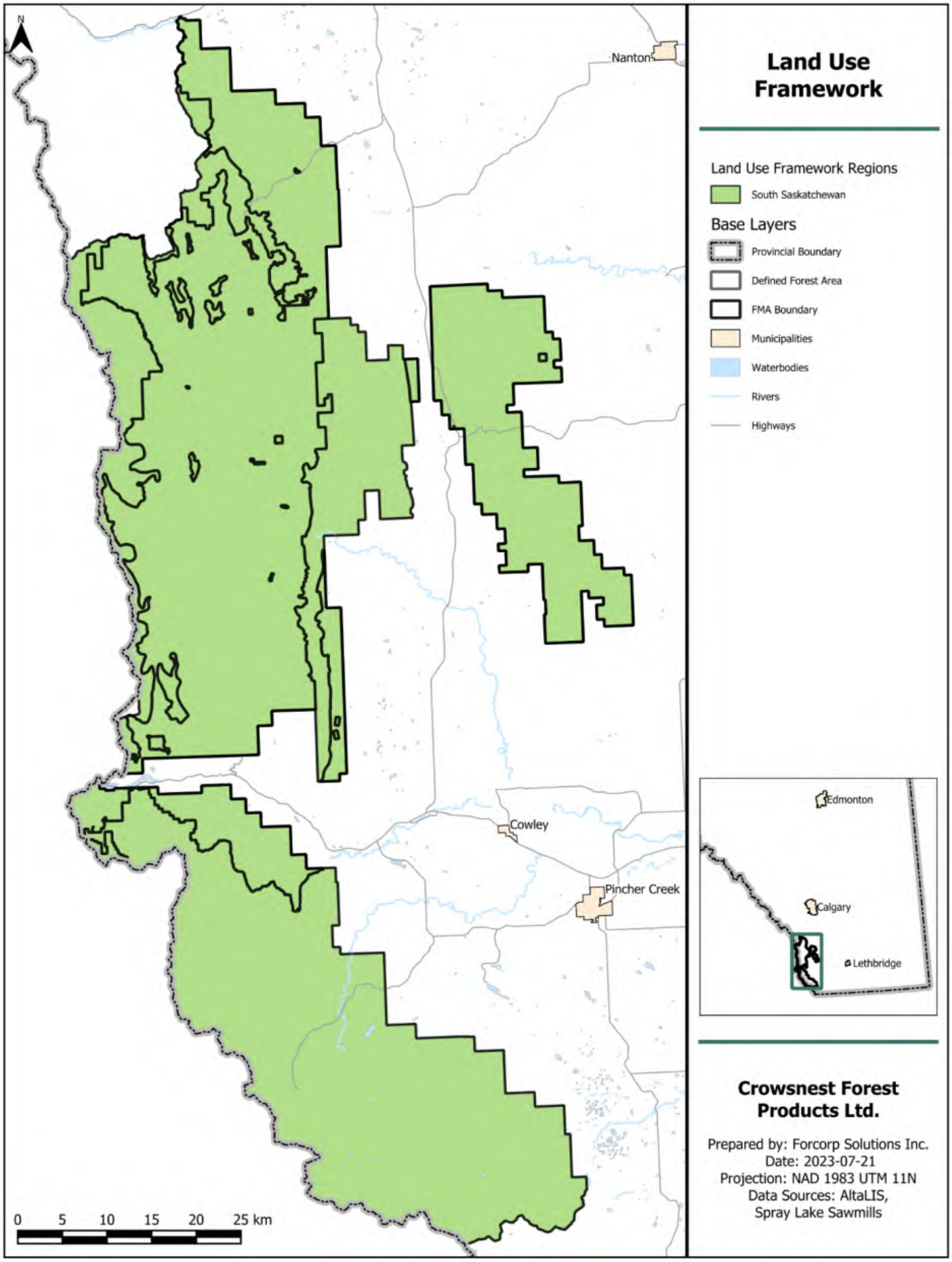

Figure 2-8: Land Use Framework regions within the Crowsnest Forest Products defined forest area.

2.4.9 Eastern Slopes Land Use Zones

Item	Description
Source:	AltaLIS
Source Filename:	bf_geoadmin_22-09-2021.gdb/EasternSlopesLandUseZoning (effective date: 1 Feburary 2017)
Description of the Source File:	Eastern Slopes Land Use Zones within the province of Alberta
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	ESLUZ_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the ESLUZ_NAME field 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	All polygons with a NULL value were removed from the layer as they were considered as not currently assigned to a land use zone. The prime protection zone is the only layer that will be treated as a deletion within the net landbase.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_eastern_slopes
Output Description:	Eastern Slopes Land Use Zones that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	ESLUZ_NAME
Polygon Area:	Prime Protection: 70,640 ha

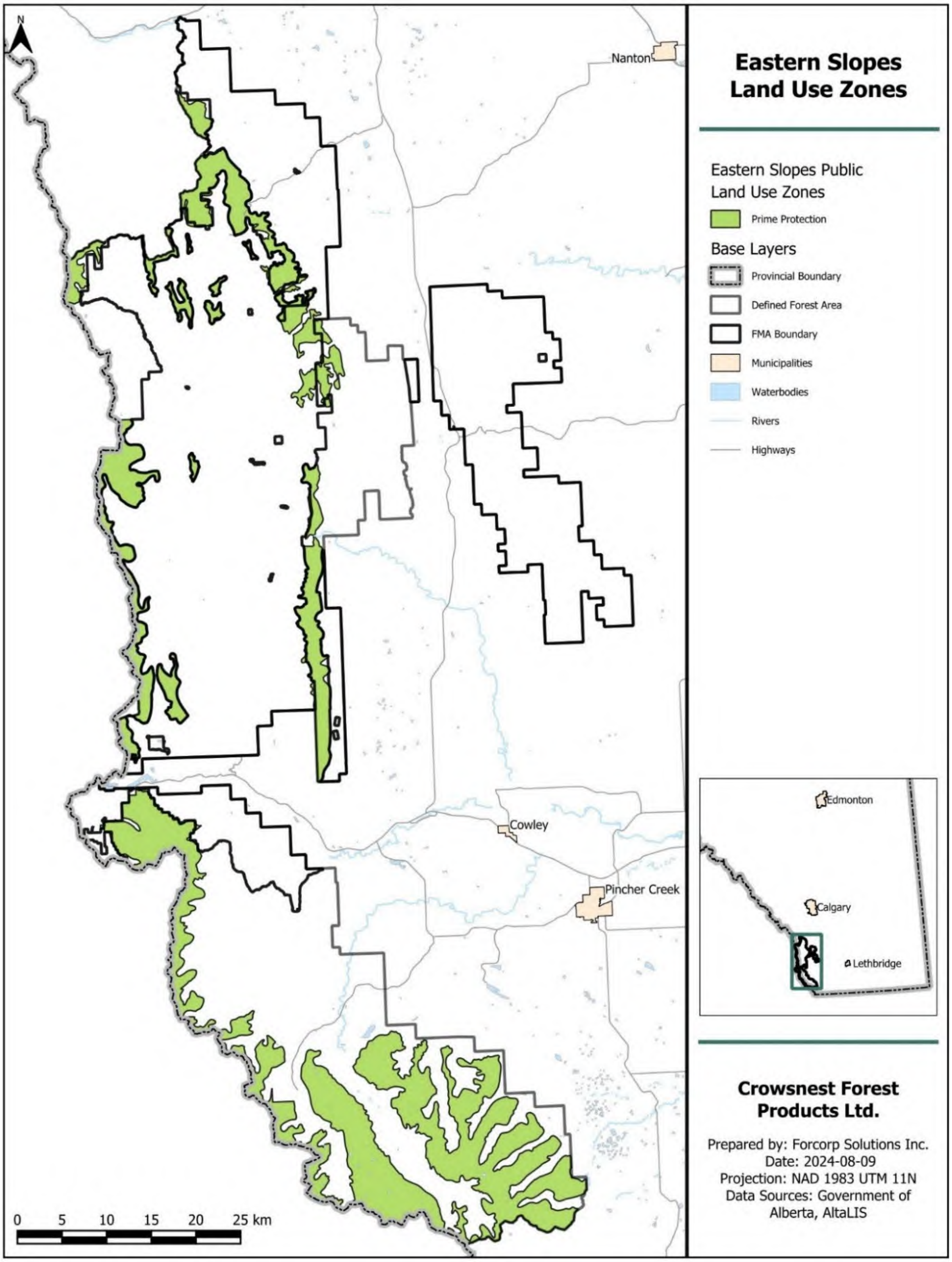

Figure 2-9: Eastern slopes public land use prime protection zone that fall within the Crowsnest Forest Products defined forest area.

2.4.10 Public Land Use Zones

Item	Description
Source:	AltaLIS
Source Filename:	bf_geoadmin_22-09-2021.gdb/PublicLandUseZone (effective date: 16 May 2018)
Description of the Source File:	Public Land Use Zones in the Province of Alberta
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	PLUZ_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the PLUZ_NAME field 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_pluz
Output Description:	Public Land Use Zones that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	PLUZ_NAME
Polygon Area	Total Area: 196,204 ha Castle Special Management Area: 1,312 ha Cataract Creek Snow Vehicle: 19,078 ha The Kananaskis Country: 1,617 ha Livingstone: 134,937 ha Porcupine Hills: 39,260 ha

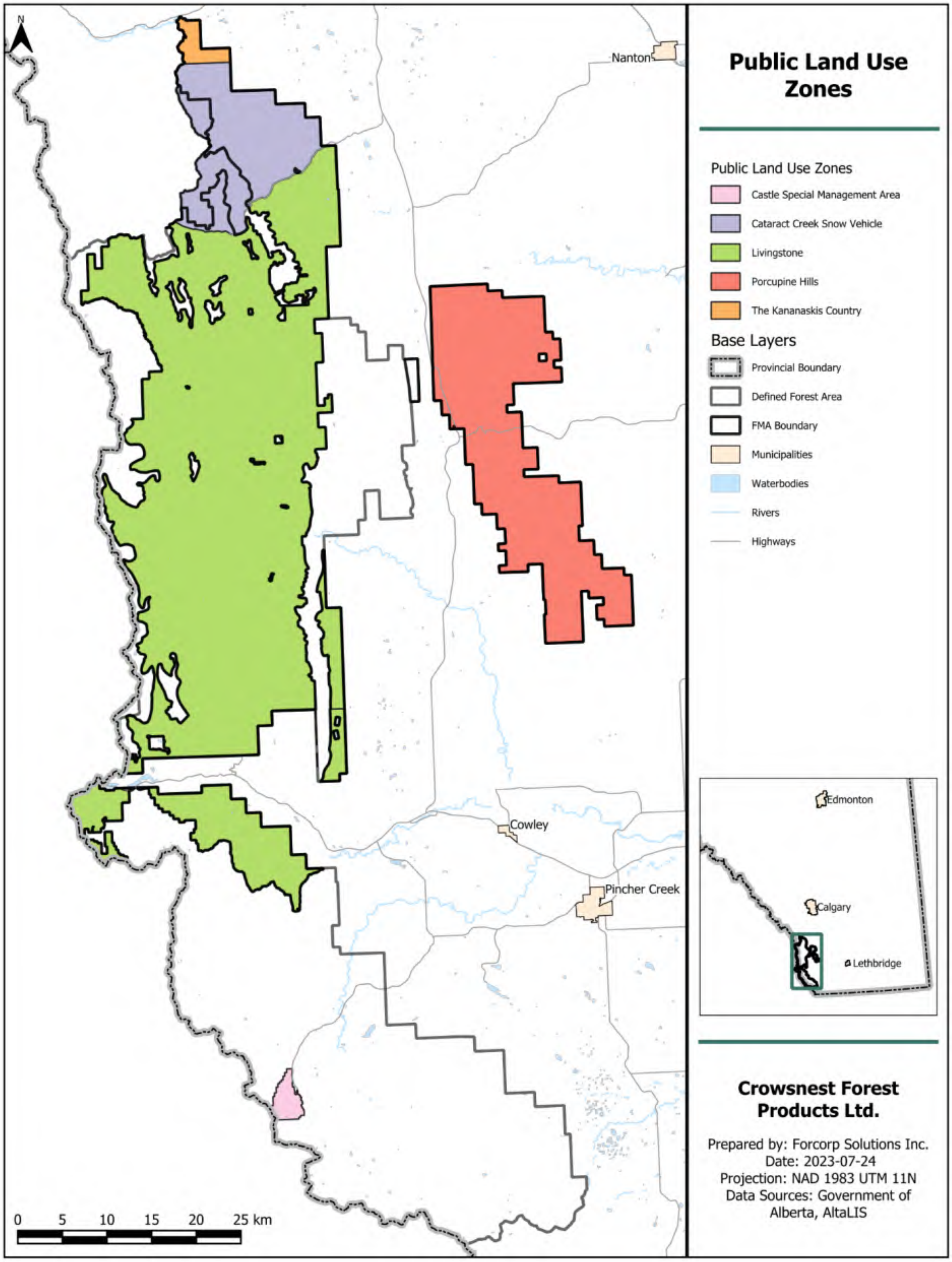

Figure 2-10: Public land use zones that intersect the Crowsnest Forest Products defined forest area.

2.4.11 Livingstone and Porcupine Hills Footprint Planning Zones

Item	Description
Source:	Government of Alberta
Source Filenames:	LIVINGSTONE_ZONES.shp PORCUPINE_HILLS_ZONES.shp (both received: 15 December 2022)
Description of the Source Files:	Livingstone and Porcupine Hills footprint planning zones
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	PZONE_NAME
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Delete fields except for the PZONE_NAME field 4. Merge projected layers into a single layer 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_priorityzones
Output Description:	Livingstone and Porcupine Hills footprint planning zones within the Crowsnest Forest Products defined forest area
Output Attributes:	PZONE_NAME
Polygon Area	Total Area: 174,249 ha Zone 2: 122,566 ha Zone 3: 51,683 ha

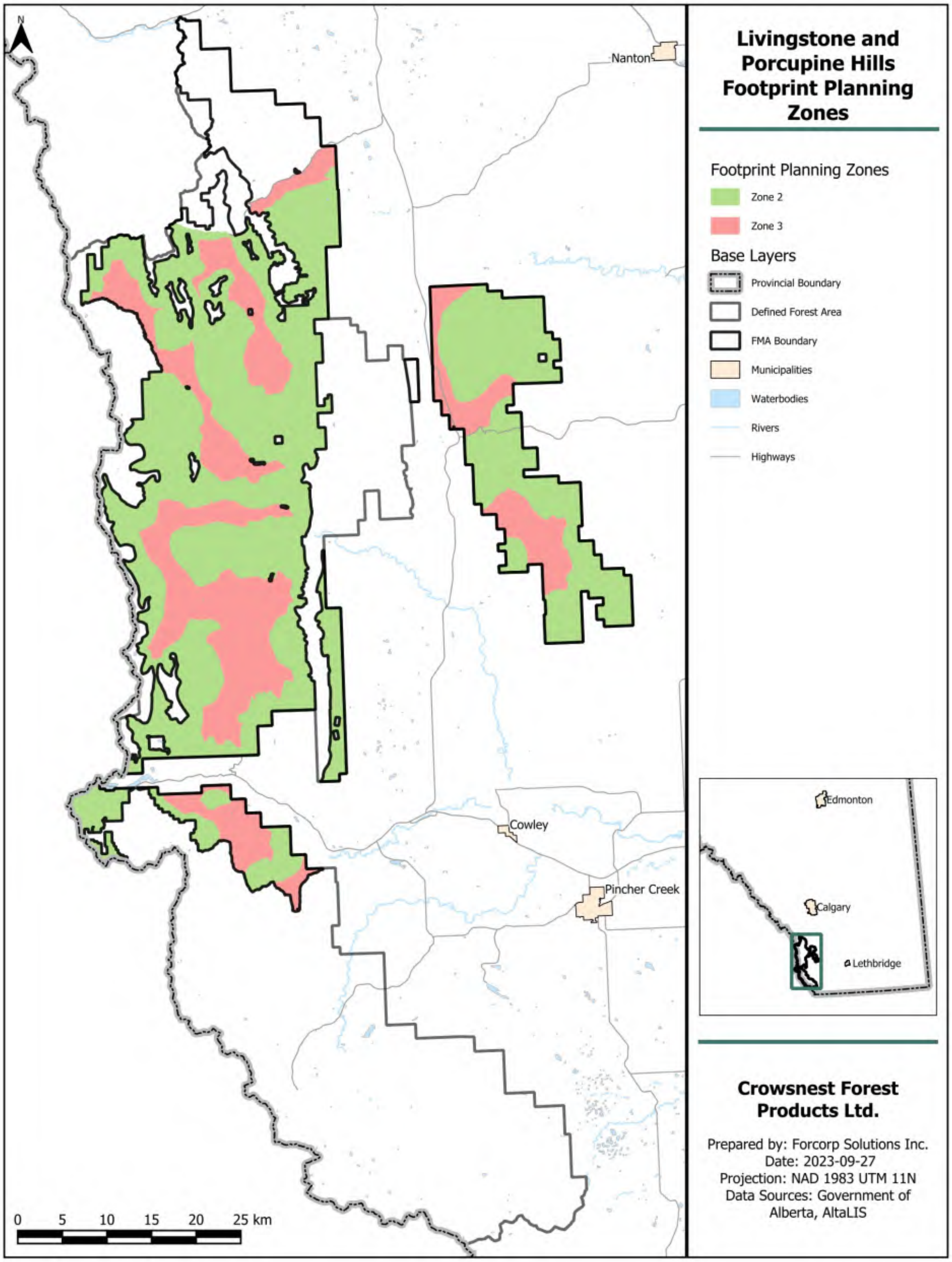

Figure 2-11: Livingstone and Porcupine Hills Priority Management Zones within the Crowsnest Forest Products defined forest area.

2.4.12 Livingstone and Porcupine Hills Analysis Units

Item	Description
Source:	Government of Alberta
Source Filenames:	LIVINGSTONE_ANALYSIS_UNITS.shp and PORCUPINE_ANALYSIS_UNITS.shp (both received: 15 December 2022)
Description of the Source Files:	Livingstone and Porcupine Hills Analysis Units
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	ANA_UNITS
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Delete fields except for the ANA_UNITS field 4. Merge projected layers into a single layer 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_analysisunits
Output Description:	Livingstone and Porcupine Hills Analysis Units that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	ANA_UNITS
Polygon Area	Total Area: 174,402 ha Crowsnest Watershed: 23,668 ha Dutch Creek: 16,871 ha Livingstone Range: 6,156 ha Livingstone River: 26,435 ha Racehorse Creek: 27,666 ha Porcupine Hills East: 17,269 ha Porcupine Hills South: 10,648 ha Porcupine Hills West: 11,436 ha Upper Oldman River: 24,319 ha Upper Willow Creek: 9,934 ha

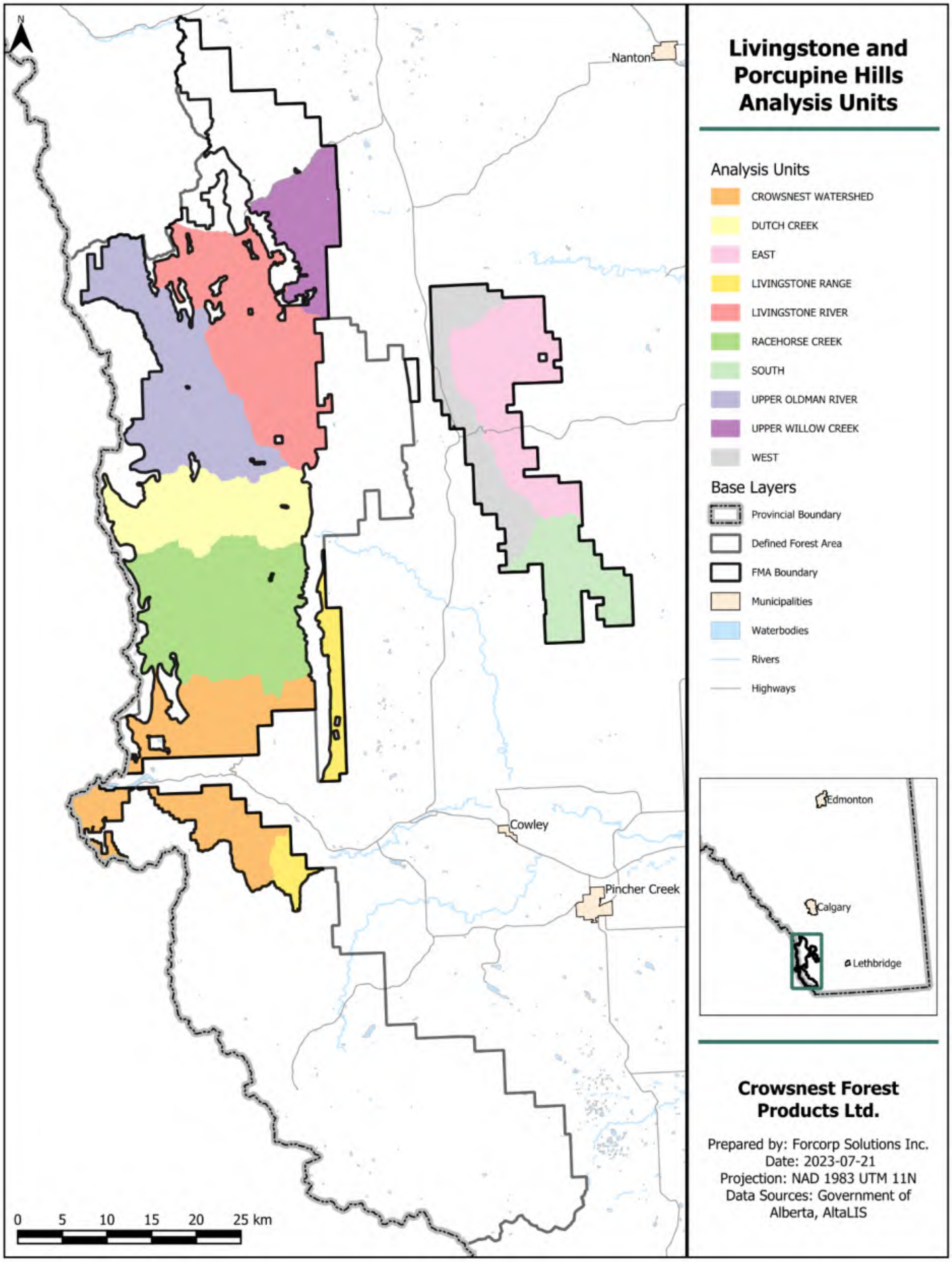

Figure 2-12: Livingstone and Porcupine Hills Analysis Units within the Crowsnest Forest Products defined forest area.

2.4.13 Natural Regions and Subregions

Item	Description
Source:	Government of Alberta
Source Filename:	Natural_Regions_Subregions_of_Alberta.shp (revision date: 31 August 2022)
Description of the Source File:	Alberta natural regions and subregions, 2005 interpretation
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	NRNAME, NSRNAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the NRNAME, NSRNAME and NSRCODE fields 4. Rename NRNAME field as "NAT_REG" and NSRNAME field as "NAT_SREG" 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_natregions
Output Description:	Natural regions and subregions that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	NAT_REG, NAT_SREG
Polygon Area:	Total Area: 350,348 ha Grassland, Foothills Fescue: 129 ha Parkland, Foothills Parkland: 331 ha Rocky Mountain, Alpine: 23,531 ha Rocky Mountain, Subalpine: 220,047 ha Rocky Mountain, Montane: 106,310 ha

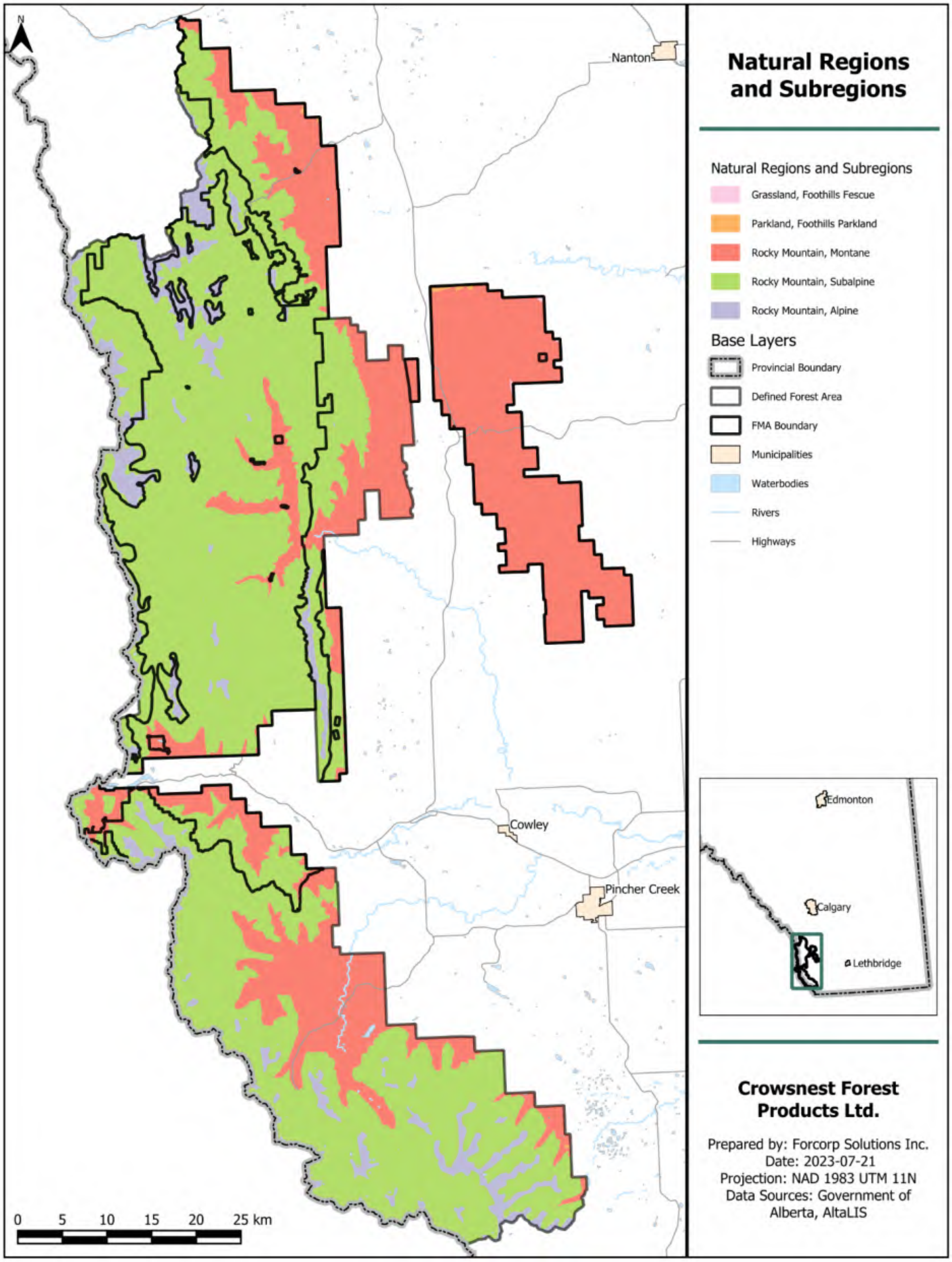

Figure 2-13: Natural regions and subregions that fall within the Crowsnest Forest Products defined forest area.

2.4.14 Tree Seed Zones

Item	Description
Source:	Government of Alberta
Source Filename:	SeedZonesOfAlbertaIndex.shp (effective date 1 July 2005)
Description of the Source File:	Tree seed zones within the province of Alberta
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	SEEDZONE
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the SEEDZONE field 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_seed_zones
Output Description:	Tree seed zones that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	SEEDZONE
Polygon Area:	Total Area: 350,348 ha A 1.4: 14,396 ha A 1.5: 9,135 ha SA 3.2: 82,828 ha SA 3.3: 51,074 ha SA 4.2: 57,493 ha SA 4.3: 28,652 ha M 4.4: 4,410 ha M 4.5: 26,201 ha M 5.4: 23,068 ha M 5.5: 20,274 ha M 5.6: 32,357 ha FF 1.1: 129 ha FP 1.1: 276 ha FP 1.2: 55 ha

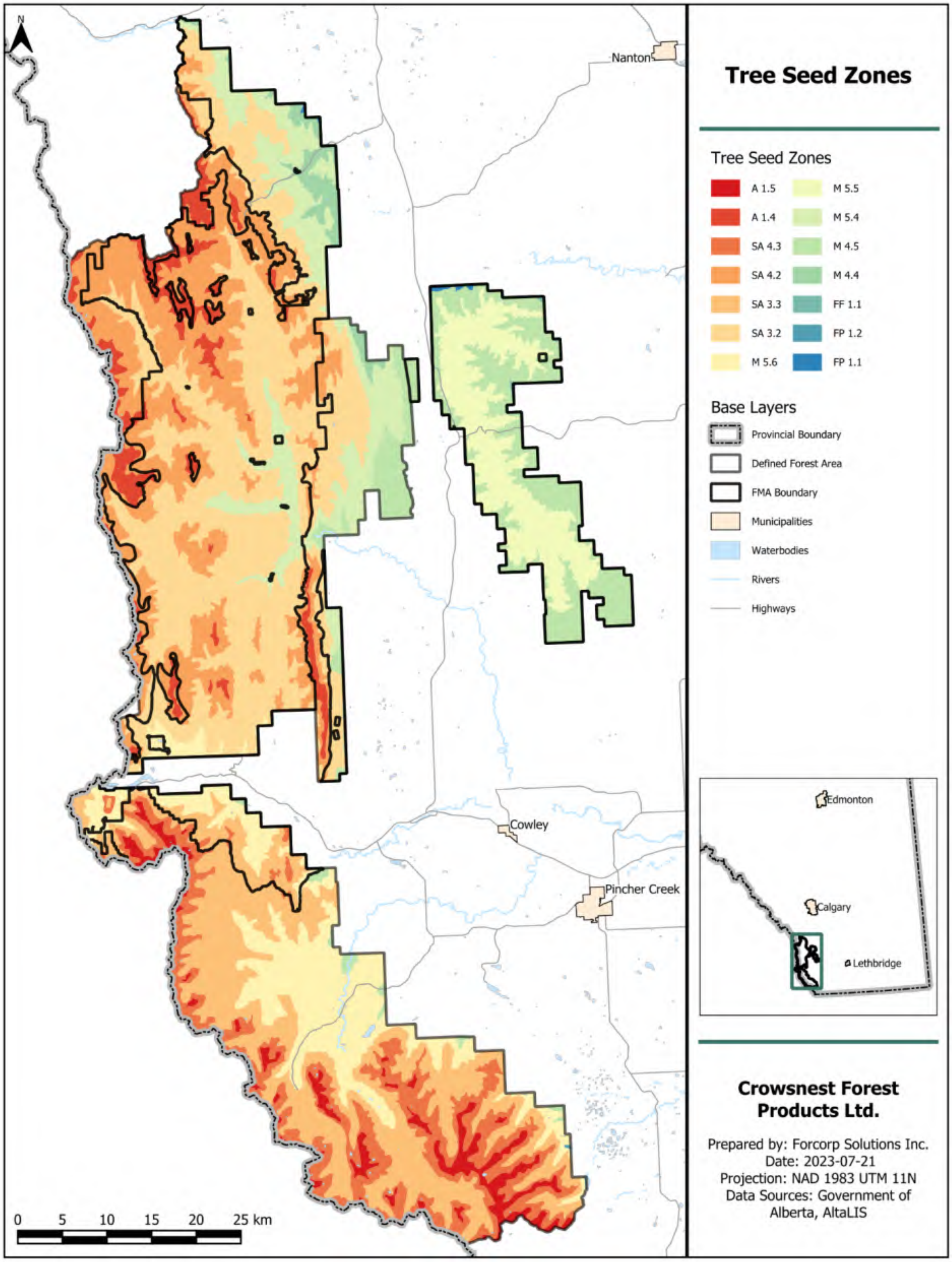

Figure 2-14: Tree Seed Zones within the Crowsnest Forest Products defined forest area.

2.4.15 Controlled Parentage Program – Region F1

Item	Description
Source:	Government of Alberta
Source Filename:	CPPF1.shp (date received: 22 February 2017)
Description of the Source File:	Controlled parentage program Region F1 for the Province of Alberta. This region is a Douglas-fir region.
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	IN_RANGE
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Create new field named CCPF1 and populate the field with a value of F1 4. Delete fields except for the CPPF1 field 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_cpp_f1
Output Description:	Controlled Parentage Program Region F1 area that intersects the Crowsnest Forest Products defined forest area
Output Attributes:	CPPF1
Polygon Area	Region F1: 86,636 ha

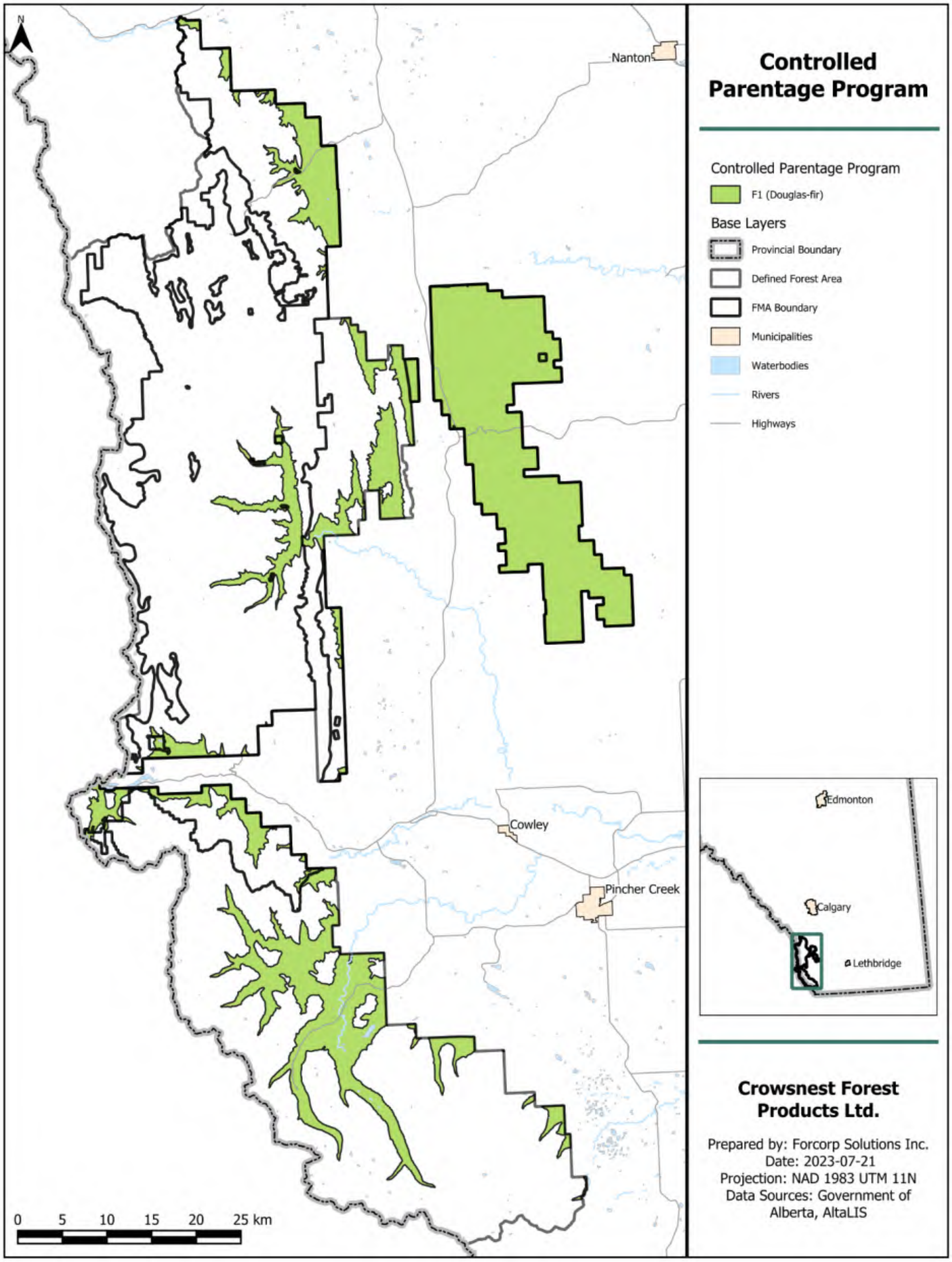

Figure 2-15: The extents of controlled parentage program zone F1 that intersect the Crowsnest Forest Products defined forest area. Zone F1 is a Douglas-fir parentage program.

2.4.16 Controlled Parentage Program – Region M

Item	Description
Source:	Government of Alberta
Source Filename:	CPPM.shp (date received: 22 February 2017)
Description of the Source File:	Controlled parentage program Region M for the Province of Alberta. This region is a western larch region.
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	IN_RANGE
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Create new field named CCPM and populate the field with a value of M 4. Delete fields except for the CPPM field 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_cpp_m
Output Description:	Controlled Parentage Program Region M area that intersects the Crowsnest Forest Products defined forest area
Output Attributes:	CPPM
Polygon Area	Region M: 51,531 ha

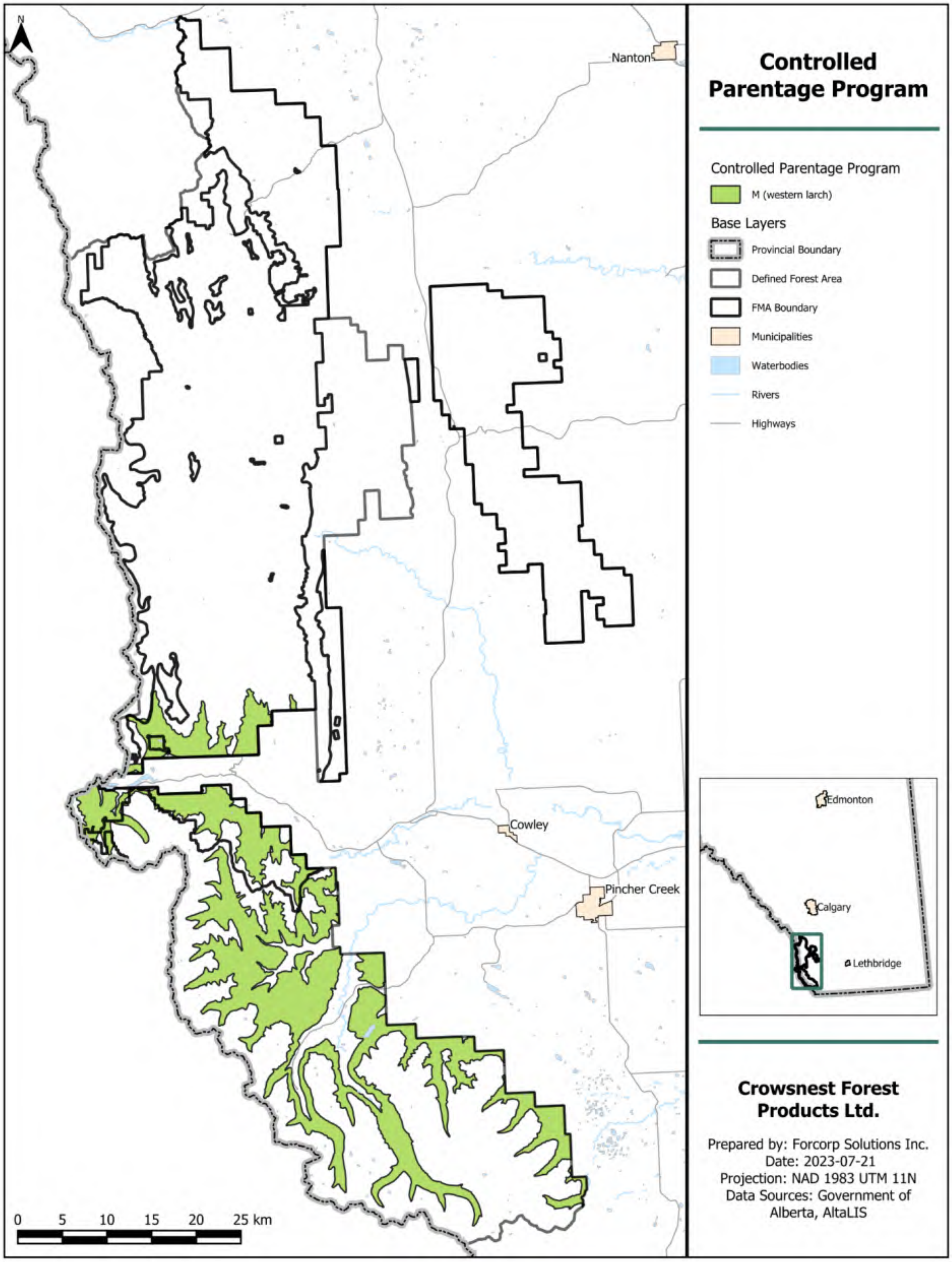

Figure 2-16: The extents of controlled parentage program zone M that intersect the Crowsnest Forest Products defined forest area. Zone M is a western larch parentage program.

2.4.17 Equivalent Clearcut Area (ECA) Watersheds

Item	Description
Source:	Government of Alberta
Source Filename:	CFP_FMA_watersheds.shp (Received:1 November 2022)
Description of the Source File:	Equivalent Clearcut Area Watersheds
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	OBJECTID
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Create new field named ECA and populate the field with the values from the OBJECTID field 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	All polygon slivers will be maintained within this layer regardless of size. No amalgamations will occur to combine small portions of watersheds with neighbouring watersheds. In cases where watershed area within the DFA is 500 ha or less, no impact assessment will be required for that watershed. Fire risk by watershed was appended to this layer based on additional data provided by the GOA. Fire risk is set to either low, medium, hig
Programs:	PostgreSQL/PostGIS
Output Filename:	i_eca
Output Description:	Equivalent Clearcut Area watersheds within the Crowsnest Forest Products defined forest area
Output Attributes:	ECA, FS_RISK
Polygon Area:	Total Area: 190,665 ha Watershed Count: 90 Average Watershed Area: 2,118 ha Count of Watersheds smaller than 500 ha: 16

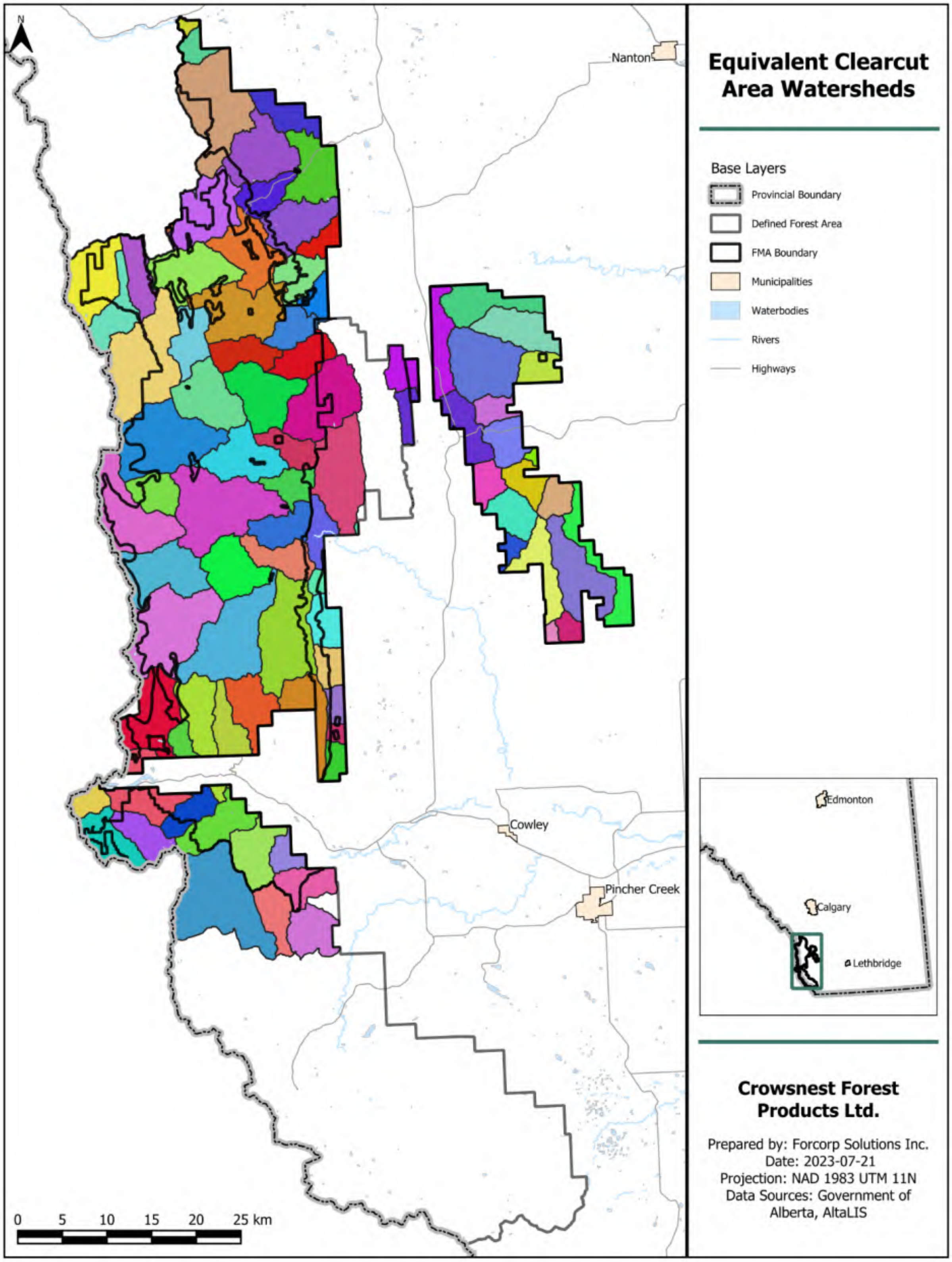

Figure 2-17: Watersheds used in the Equivalent Clearcut Area analysis that intersect the Crowsnest Forest Products forest management agreement area.

2.4.18 Hydrologic Unit Code 10 (HUC10) Watersheds

Item	Description
Source:	Government of Alberta
Source Filename:	HUCWatershedsOfAlberta.shp (effective date: 31 May 2017)
Description of the Source File:	Hydrologic Unit Code Watersheds within the Province of Alberta
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attribute:	HUC10
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the HUC10 field 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_huc10
Output Description:	HUC10 watersheds that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	HUC10
Polygon Area	Total Area: 350,348 ha Count of HUC10 Watersheds: 35 Average HUC10 Watersheds Area: 10,010 ha

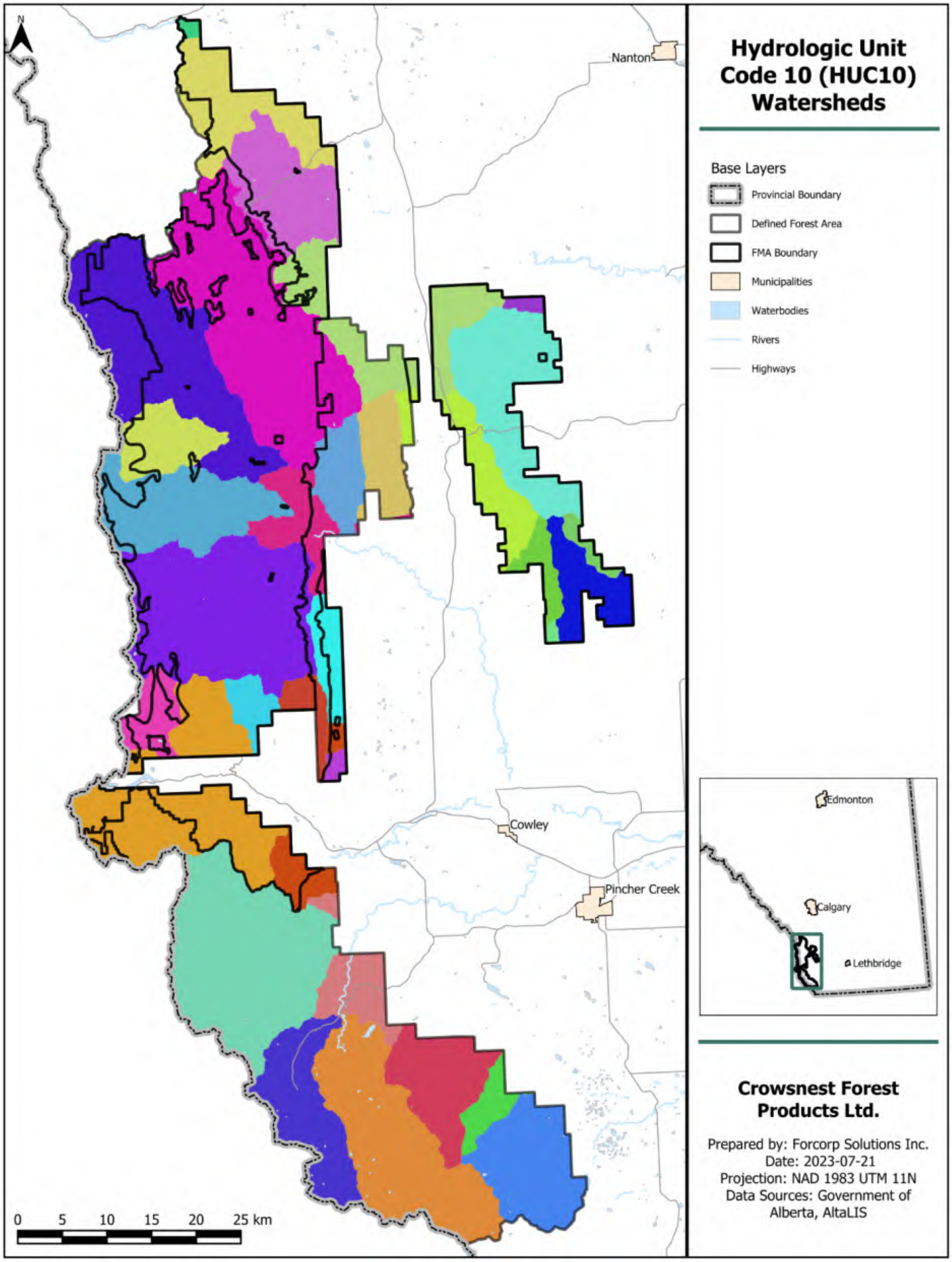

Figure 2-18: Hydrologic Unit Code 10 (HUC10) watersheds that intersect the Crowsnest Forest Products defined forest area.

2.4.19 Hydrology Features

Item	Description
Sources:	Crowsnest Forest Products and AltaLIS
Source Filenames:	AVI (Section 2.4.5) AltaLIS_base_waterbody_19961231 (publication date 31 December 1996)
Description of the Source Files:	Alberta Vegetation Inventory for the Crowsnest Forest Products FMA and AltaLIS hydrology polygon layer
Projected Coordinate Systems:	NAD 1983 10TM AEP Forest
Important Attributes:	FEATURE_TY, NAT_NON
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Buffer the DFA boundary by 100 meters 3. Select the AltaLIS polygons that fall within the buffered DFA boundary 4. Select all hydrology features from the AVI layer (NAT_NON IN ('NWR', 'NWL')) 5. Merge the polygons from the AltaLIS and AVI selections to create a single working layer 6. Create a new field named "FEATURE_TY" 7. Populate the FEATURE_TY field with the FEATURE_TY values and NFL values of the features 8. Delete fields except for the FEATURE_TY field 9. Repair any irregular geometries that may be present 10. Create a singlepart layer 11. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Hydrology features within 100 meters of the DFA are included in this source layer to ensure that any features outside of the DFA with buffers that could fall within the DFA are included. Hydrology features present in the DFA that are not shown in either of these source layers were too small to be identified in the source layers using the photo interpretation standards that were used at the time of the source layer creation. These features will not have their stream channels identified in the net landbase but will have their buffers included in the hydrology buffer layer.
Programs:	PostgreSQL/PostGIS
Output Filename:	p_hydrologyfeatures
Output Description:	Hydrology features that are located within the Crowsnest Forest Products defined forest area

Item	Description
Output Attribute:	3
Polygon Area	Total Area: 965 ha Lake Polygons: 281 ha River Polygons: 684 ha

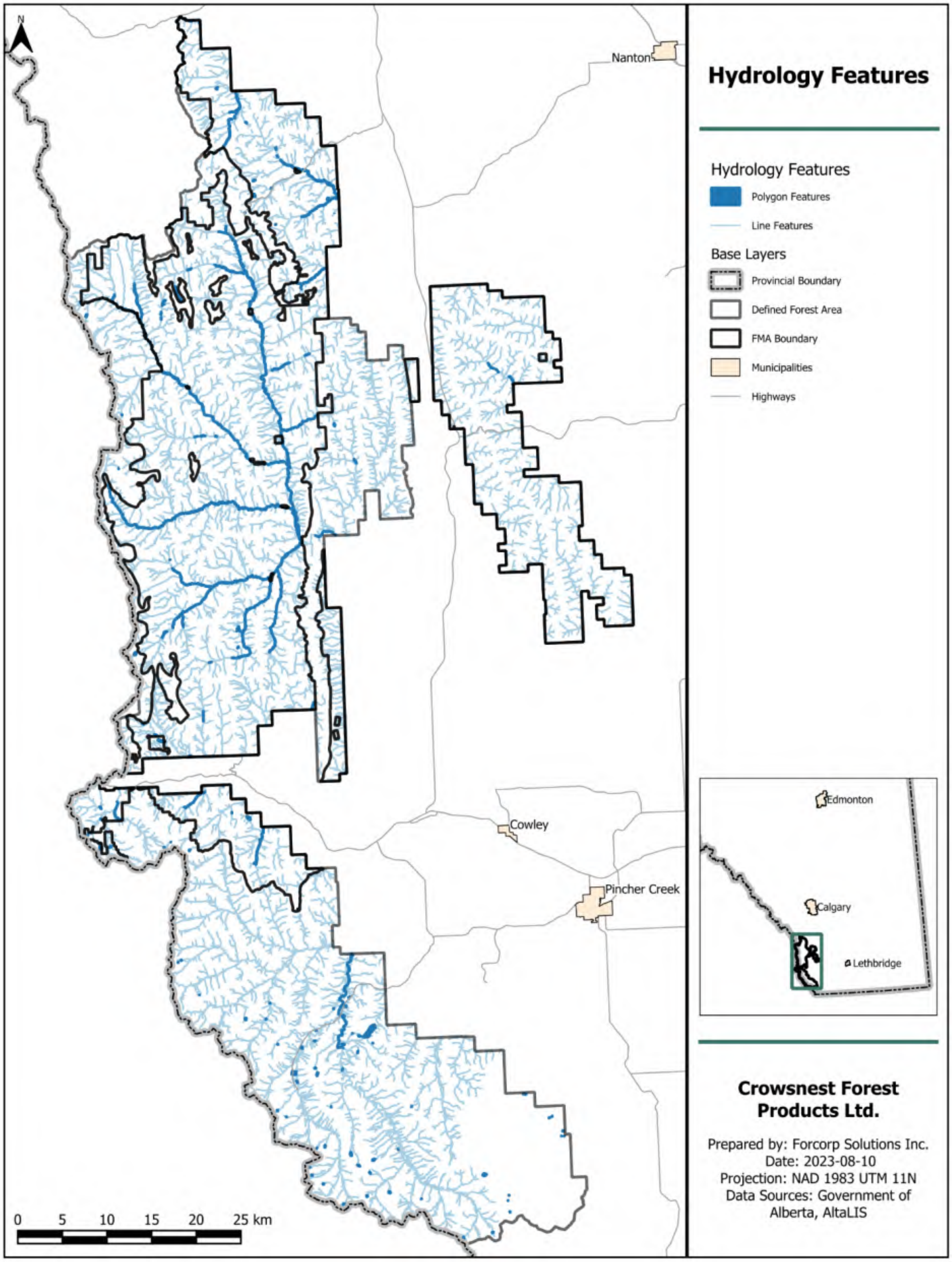

Figure 2-19: Hydrology features that intersect the Crowsnest Forest Products defined forest area. The polygon features will be represented directly in the net landbase, while the line features will be represented by buffers of these features.

2.4.20 Hydrology Buffers

Item	Description
Sources:	AltaLIS, CFP, Government of Alberta
Source Filenames:	HydrologyFeatures (FORCORP, produced in Section 2.4.19) Terrainworks hydrology line layer (received 27 July 2023)
Description of the Source Files:	Hydrology polygon layer and predicted line layer for hydrology features in the C5 DFA
Projected Coordinate Systems:	NAD 1983 Zone 11N (SRID 26911)
Important Attributes:	FEATURE_TY, WIDTH_M
Required Processing:	1. Buffer the DFA boundary by 100 meters and and clip the Terrainworks layer to the buffered DFA boundary 2. Buffer the features in the clipped Terrainworks layer based on the WIDTH_M attribute. a. Features > 5 meters in width: 60 meters b. Features <= 5 meters and > 1 meters: 30 meters c. Features <= 1 meters and > 0.5 meters: 10 meters 3. For the hydrology features, Create a new field named "BUFFER_WIDTH" 4. Buffer features based on the following criteria: a. Lakes > 4 ha: 100 meters b. Lakes <= 4 ha: 30 meters c. Large Permanent Watercourses: 60 meters d. Small Permanent Watercourses: 30 meters e. Oxbow Lake: 20 meters 5. Combine the buffered hydrology features with the buffered Terrainworks layer 6. Review layer and fill in all regions isolated by buffers that are smaller than 15 ha 7. Delete fields with the exception of the FEATURE_TY and BUFFER_WIDTH field 8. Repair any irregular geometries that may be present 9. Create a singlepart layer 10. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Buffer widths are determined based on the Alberta Timber Harvest Planning and Operating Ground Rules Framework for Renewal (OGR's) company specific addendum for Crowsnest Forest Products. Smaller hydrology features present within the DFA are not buffered in this layer. These features are identified during the annual operating plan phases of harvest.

Item	Description
Programs:	PostgreSQL/PostGIS
Output Filename:	p_hydrobuffer
Output Description:	Hydrology buffers that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	BUFFER_WIDTH
Polygon Area:	Total Area: 12,935 ha Lake Buffers: 343 ha Large Permanents: 3,686 ha Small Permanents: 6,580 ha Transitional: 2,267 ha Isolated Islands: 59 ha

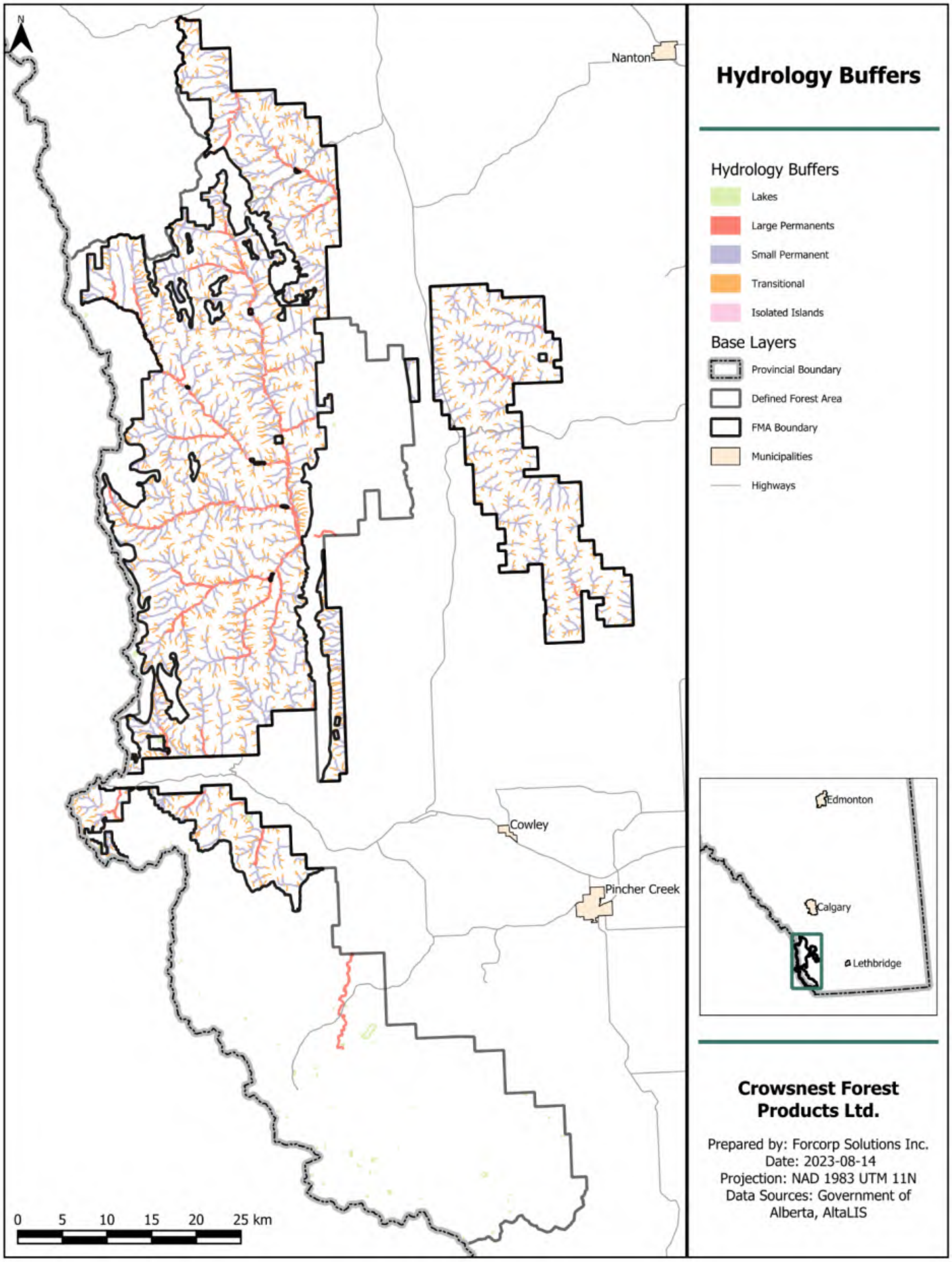

Figure 2-20: Hydrology buffers that fall within the Crowsnest Forest Products defined forest area.

2.4.21 Snow Sensitive Zones

Item	Description
Source:	Government of Alberta
Source Filename:	CFP_FMA_WatershedValues.gdb/SnowSenseZone_PolyElev
Description of the Source File:	Snow sensitive zones
Projected Coordinate System:	NAD 1983 10TM AEP Forest
Important Attributes:	zone
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Create new field named SNOWZONE and populate the field with the value “snowzone” 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_snowsensitivezones
Output Description:	Snow sensitive areas within the Crowsnest Forest Products defined forest area
Output Attributes:	SNOWZONE
Polygon Area:	Total Area: 60,436 ha

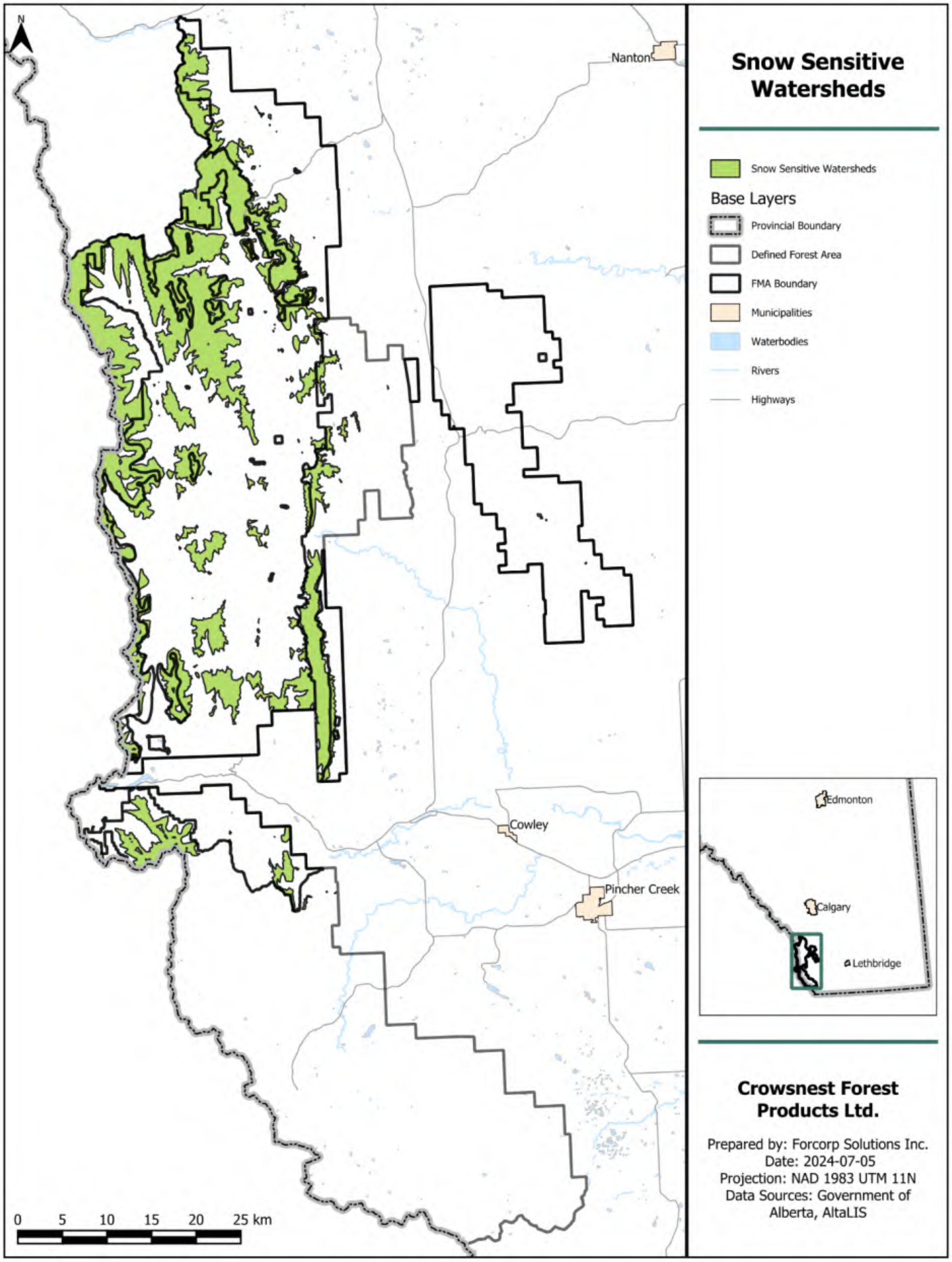

Figure 2-21: Snow sensitive areas within the Crowsnest Forest Products defined forest area.

2.4.22 Visual Quality

Item	Description
Source:	Forcorp
Source Filename:	Visualquality_20230508
Description of the Source File:	Visual quality assessment of forest polygons within the Crowsnest Forest Products defined forest area
Projected Coordinate System:	NAD 1983 Zone 11N
Important Attributes:	VISUALQUALITY, VIEWSHED
Required Processing:	1. Clip projected layer to the DFA boundary 2. Repair any irregular geometries that may be present 3. Create a singlepart layer 4. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	The visual quality was assessed by identifying areas of high visual quality and then determining how far these polygons are from the nearest viewpoints. Polygons were classified based on the distance from the target area to the viewpoint.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_visualquality
Output Description:	High visual quality areas within the Crowsnest Forest Products defined forest area
Output Attributes:	VISUALQUALITY, VIEWSHED
Polygon Area:	Total Area: 39,109 ha High visual quality, short distance from viewpoint: 16,535 ha High visual quality, middle distance from viewpoint: 19,768 ha High visual quality, long distance from viewpoint: 2,806 ha

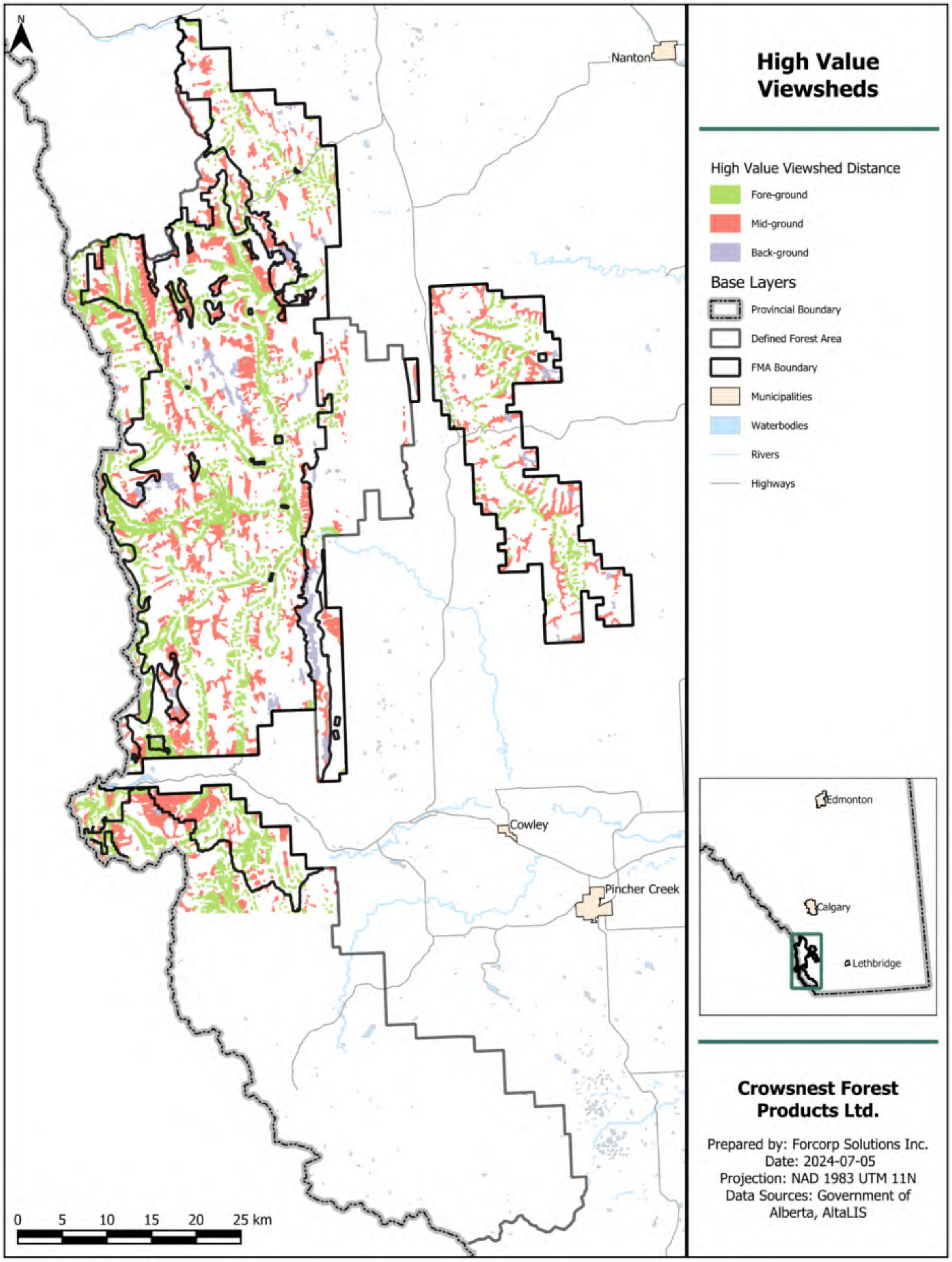

Figure 2-22: High visual quality viewsheds within the Crowsnest Forest Products defined forest area.

2.4.23 Near Stream Erosion Risk

Item	Description
Source:	Government of Alberta
Source Filename:	NearStreamAccess_ErodibleSoils_PorcupineUnits.shp
Description of the Source File:	Equivalent Clearcut Area Watersheds
Projected Coordinate System:	NAD 1983 Zone 11N
Important Attributes:	Spatial location is the important attribute.
Required Processing:	1. Buffer road layer by 100 meters 2. Clip projected layer to the DFA boundary 3. Repair any irregular geometries that may be present 4. Create a singlepart layer 5. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_erosionrisk
Output Description:	Areas of high erosion risk within 100 meters of an identified stream within the Crowsnest Forest Products defined forest area.
Output Attributes:	erosionrisk
Polygon Area:	Total Area: 1,974 ha

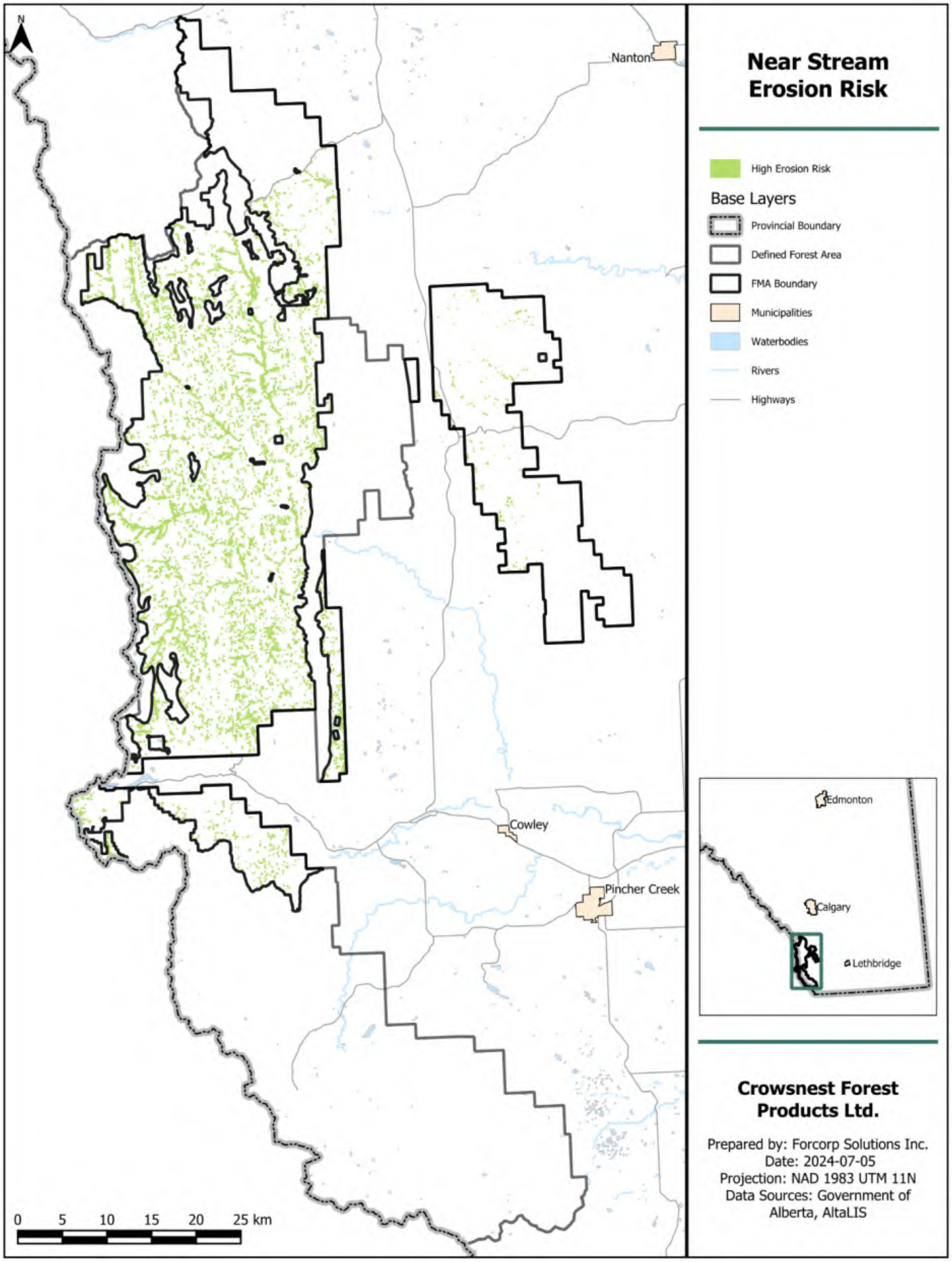

Figure 2-23: Areas of high erosion risk near streams within the Crowsnest Forest Products defined forest area.

2.4.24 Fish Management Zones

Item	Description
Source:	AltaLIS
Source Filename:	bf_geoadmin_26-10-2020.gdb/FishManagementZone (effective date: 1 May 2008)
Description of the Source File:	Fish Management Zones within the Province of Alberta
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	FISH_MGMT_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Rename the FISHMGMT_NAME field as FISHMGMT 4. Delete fields except for the FISHMGMT field 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_fishmgmt
Output Description:	Fish Management Zones that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	FISHMGMT
Polygon Area:	Total Area: 350,348 ha Eastern Slopes Zone: 350,348 ha

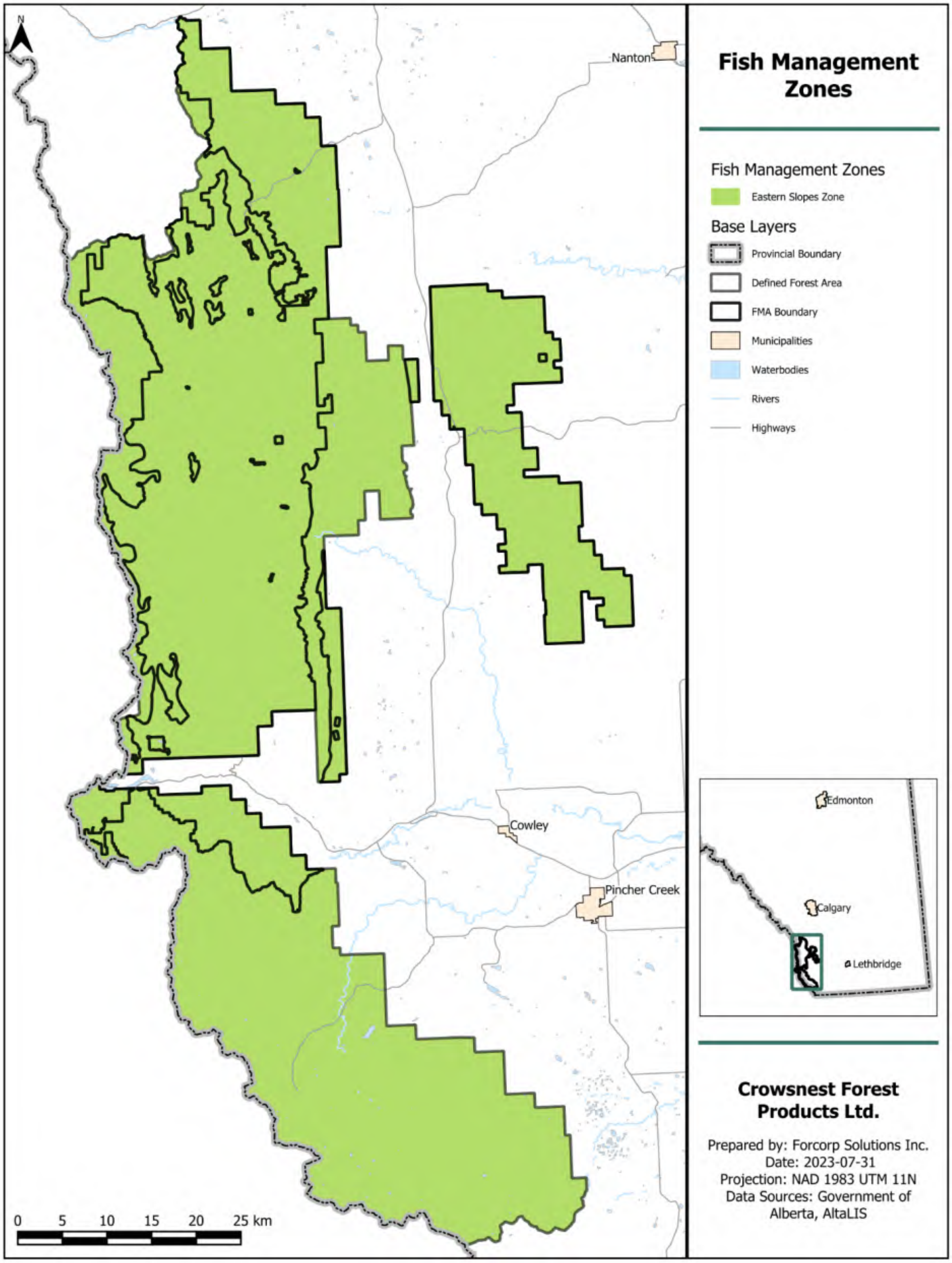

Figure 2-24: Fish management zones that intersect the Crowsnest Forest Products defined forest area.

2.4.25 Wildlife Management Units

Item	Description
Sources:	AltaLIS
Source Filenames:	bf_geoadmin_22-09-2021.gdb/WildlifeManagementUnit (effective date 20 August 2021)
Description of the Source Files:	Wildlife Management Units for the Province of Alberta
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	WMUNIT_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the WMUNIT_NAME field 4. Rename WMUNIT_NAME to WM_UNIT 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_wildlifemanagement
Output Description:	Wildlife Management Units that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	WM_UNIT
Polygon Area:	Total Area: 350,348 ha Castle-Carbondale: 120,380 ha Crowsnest Pass: 865 ha Happy Valley: 30,404 ha Highwood: 20,731 ha Livingstone: 132,636 ha North Porcupine Hills: 17,977 ha South Porcupine Hills: 20,905 ha Willow Valley: 6,450 ha

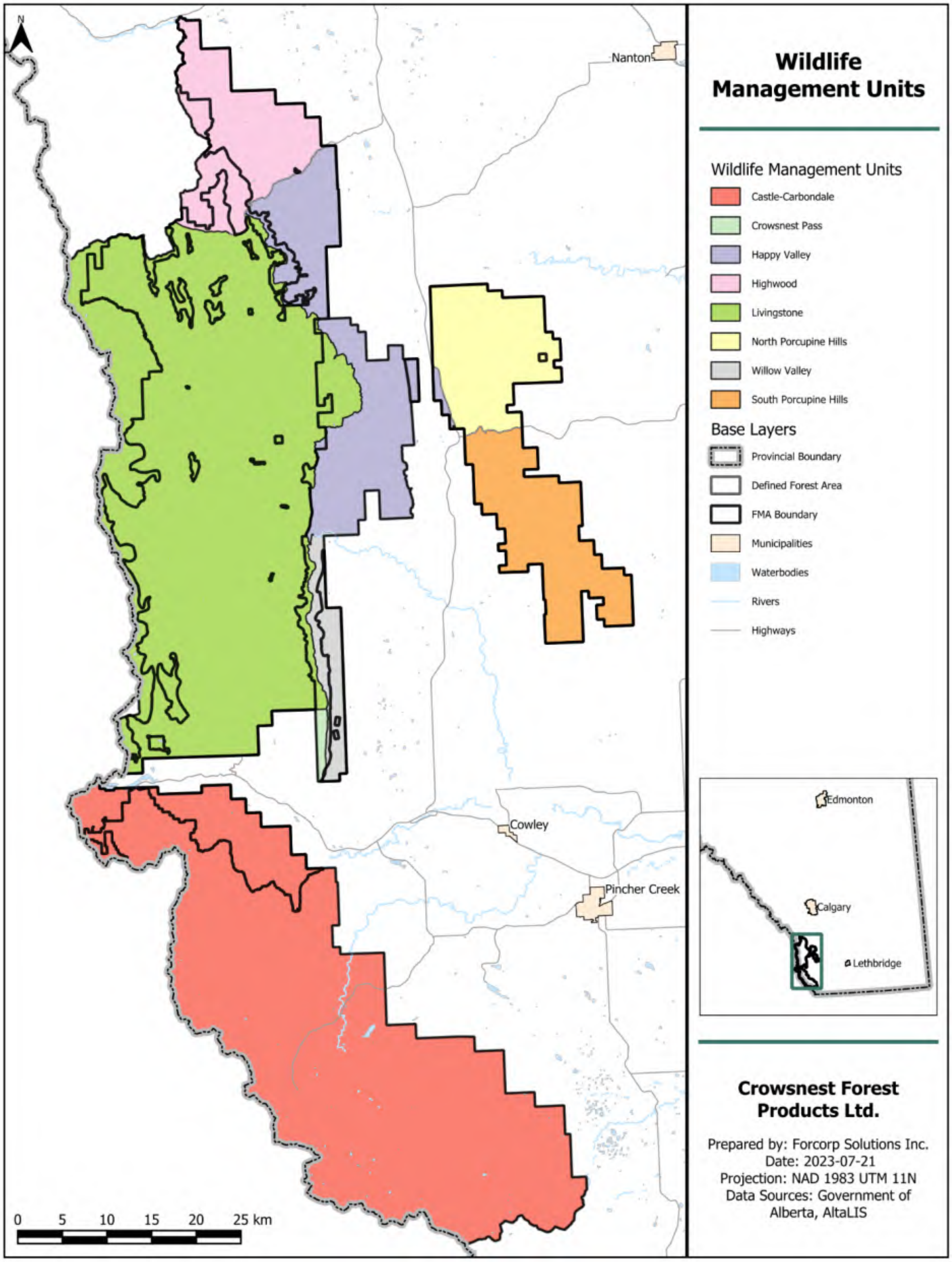

Figure 2-25: Wildlife management units that intersect the Crowsnest Forest Products defined forest area.

2.4.26 Big Horn Sheep and Mountain Goat Range

Item	Description
Sources:	Government of Alberta and AltaLIS
Source Filenames:	MountainGoatAndSheepAreas.shp (upload date: 8 November 2022) bf_geoadmin_22-09-2021.gdb/EasternSlopesLandUseZoning (effective date: 1 Feburary 2017)
Description of the Source Files:	Big horn sheep and mountain goat range, and Eastern Slopes land use zones
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	RANGE, HERD, ESLUZ_NAME
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Create the "High Priority" sheep risk area through the following steps: a. Combine the source layers where the sheep range intersects the Eastern Slopes Prime Protection area b. Clip product to the DFA boundary and name it the High area 3. Create the "Moderate Priority" sheep risk area through the following steps: a. Buffer the sheep range by 1 km b. Intersect this buffer area with the Eastern Slopes Critical Wildlife area c. Combine the buffer area with the areas where the sheep range intersects the Eastern Slopes Critical Wildlife area and name it the Moderate area 4. Create the "Low Priority" Area a. All areas that were not identified as Moderate or High Priority areas should be identified as Low Priority 5. Delete fields except for the sheep range, herd and range type fields 6. Repair any irregular geometries that may be present 7. Create a singlepart layer 8. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	The design of the eastern slopes land use layer results in some secondary range areas not being contiguous with the identified sheep range.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_sheeprange

Item	Description
Output Description:	Big horn sheep and mountain goat range areas within the Crowsnest Forest Products defined forest area with the associated range risk
Output Attributes:	SHEEP_HERD, SHEEP_RISK
Polygon Area	Total Area within Sheep Range: 143,620 ha Total Area Assigned to a Population Risk Area: 349,524 ha High Risk Population Area: 70,640 ha Moderate Risk Population Area: 24,730 ha Low Risk Population Area: 254,154 ha

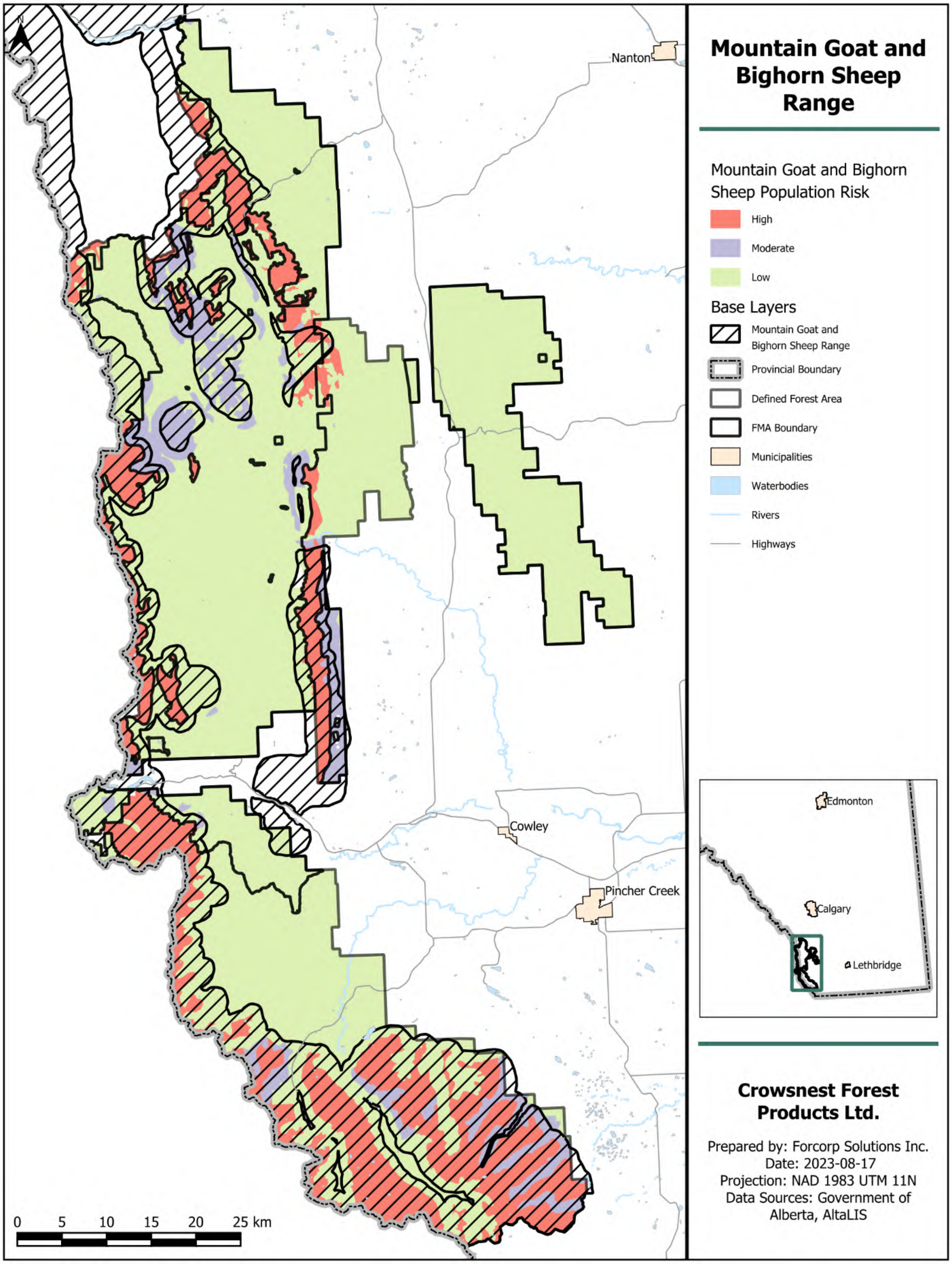

Figure 2-26: Mountain goat and bighorn sheep herd range that intersects the Crowsnest Forest Products defined forest area and the population risk assigned based on the proximity to the herd range and the eastern slopes land use zone assigned.

2.4.27 Grizzly Bear Habitat Zones

Item	Description
Sources:	Government of Alberta
Source Filenames:	GrizzlyBearZone.shp (effective date: 24 September 2008)
Description of the Source Files:	Grizzly bear habitat zones across the province of Alberta
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	GB_POPUNIT, GB_ZONE, TYPE
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the GB_POPUNIT, GB_ZONE and TYPE fields 4. Rename the TYPE field to GB_POPTYPE 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_grizzly_zones
Output Description:	Grizzly bear habitat zones within the Crowsnest Forest Products defined forest area
Output Attributes:	GB_POPUNIT, GB_POPTYPE, GB_ZONE
Polygon Area	Total Area: 350,333 ha Livingstone – Core: 208,760 ha Livingstone – Secondary: 20,905 ha Waterton – Core: 120,367 ha Support – 301 ha

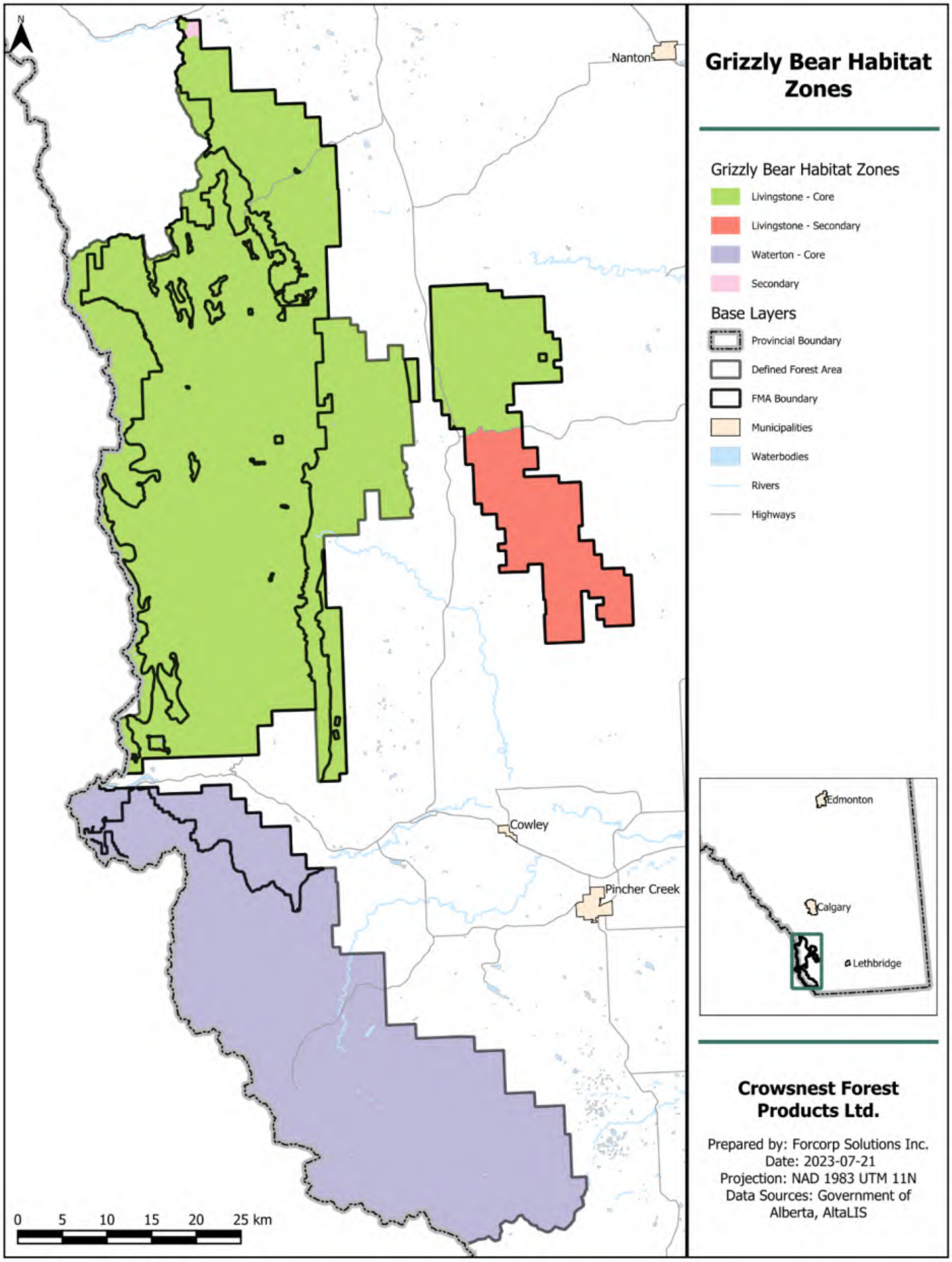

Figure 2-27: Grizzly bear habitat zones that intersect the Crowsnest Forest Products defined forest area.

2.4.28 Grizzly Bear Watersheds

Item	Description
Source:	GBTools2018 (FRI Grizzly Bear Tool)
Source Filename:	Access.mdb (effective date: 21 September 2020)
Description of the Source File:	Access database containing a spatial file of the grizzly bear watersheds, part of grizzly bear modelling
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	GBWU
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the GBWU field 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_grizzly_watersheds
Output Description:	Grizzly bear watersheds that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	GBWU
Polygon Areas:	Total Area: 350,032 ha L148: 389 ha L160: 20,905 ha L150: 11,416 ha L162: 21,946 ha L151: 21,057 ha W163: 20,061 ha L152: 70,187 ha W164: 72,152 ha L155: 18,515 ha W165: 12,138 ha L157: 64,269 ha W166: 2,952 ha L159: 981 ha W167: 13,064 ha

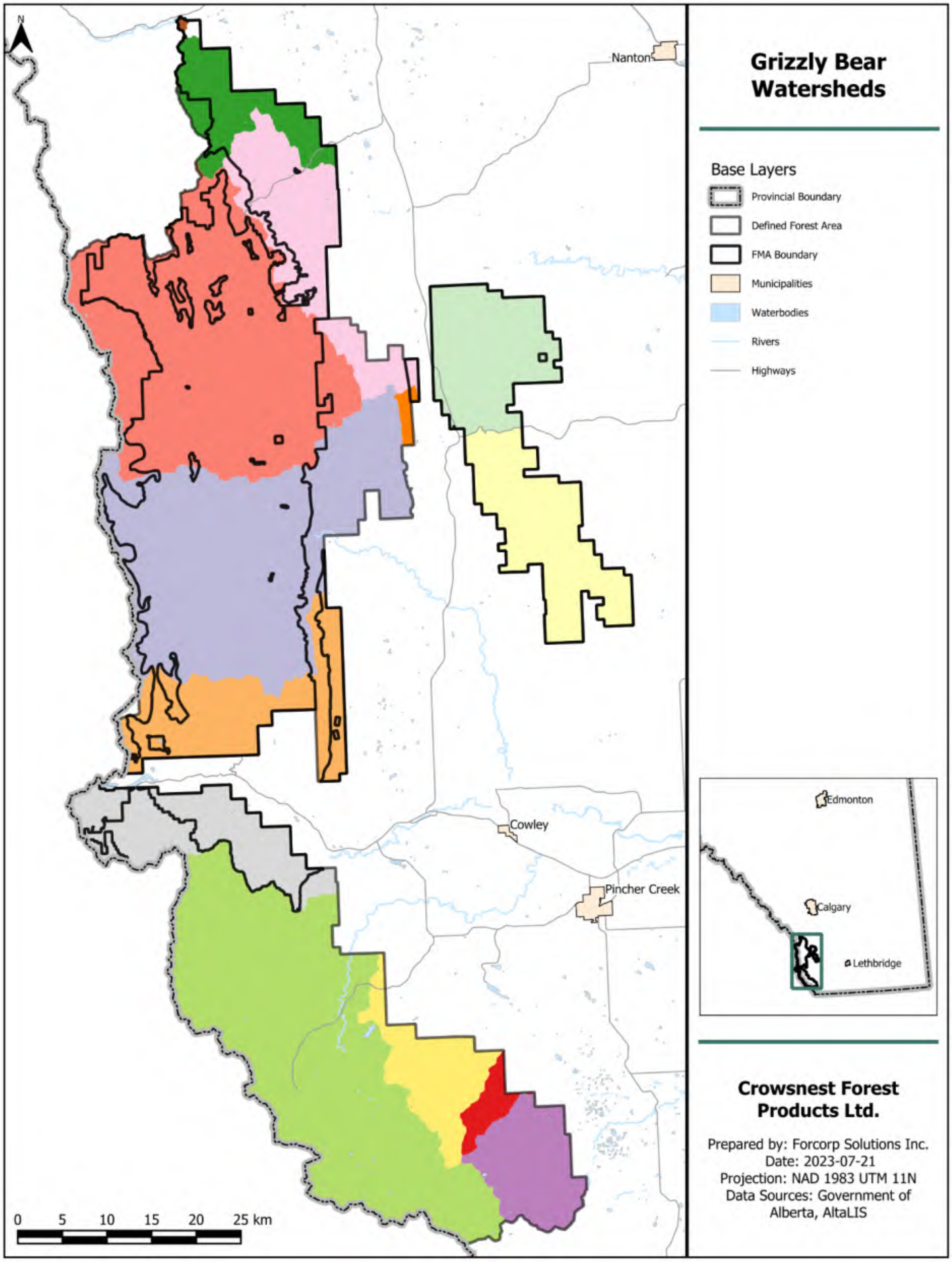

Figure 2-28: Grizzly bear watersheds that intersect the Crowsnest Forest Products defined forest area.

2.4.29 Whitebark Pine Plus

Item	Description
Source:	Whitebark Pine Ecosystem Foundation
Source Filename:	plustrees_distribution.gdb/
Description of the Source File:	Whitebark pine plus tree locations
Projected Coordinate System:	WGS 84
Important Attributes:	Spatial point location
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Buffer points by 30 meters 3. Clip layer to the DFA boundary 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_whitebarkplus
Output Description:	Buffered whitebark pine plus tree locations
Output Attributes:	Whitebark_plus
Polygon Area:	Total Area: 27 ha

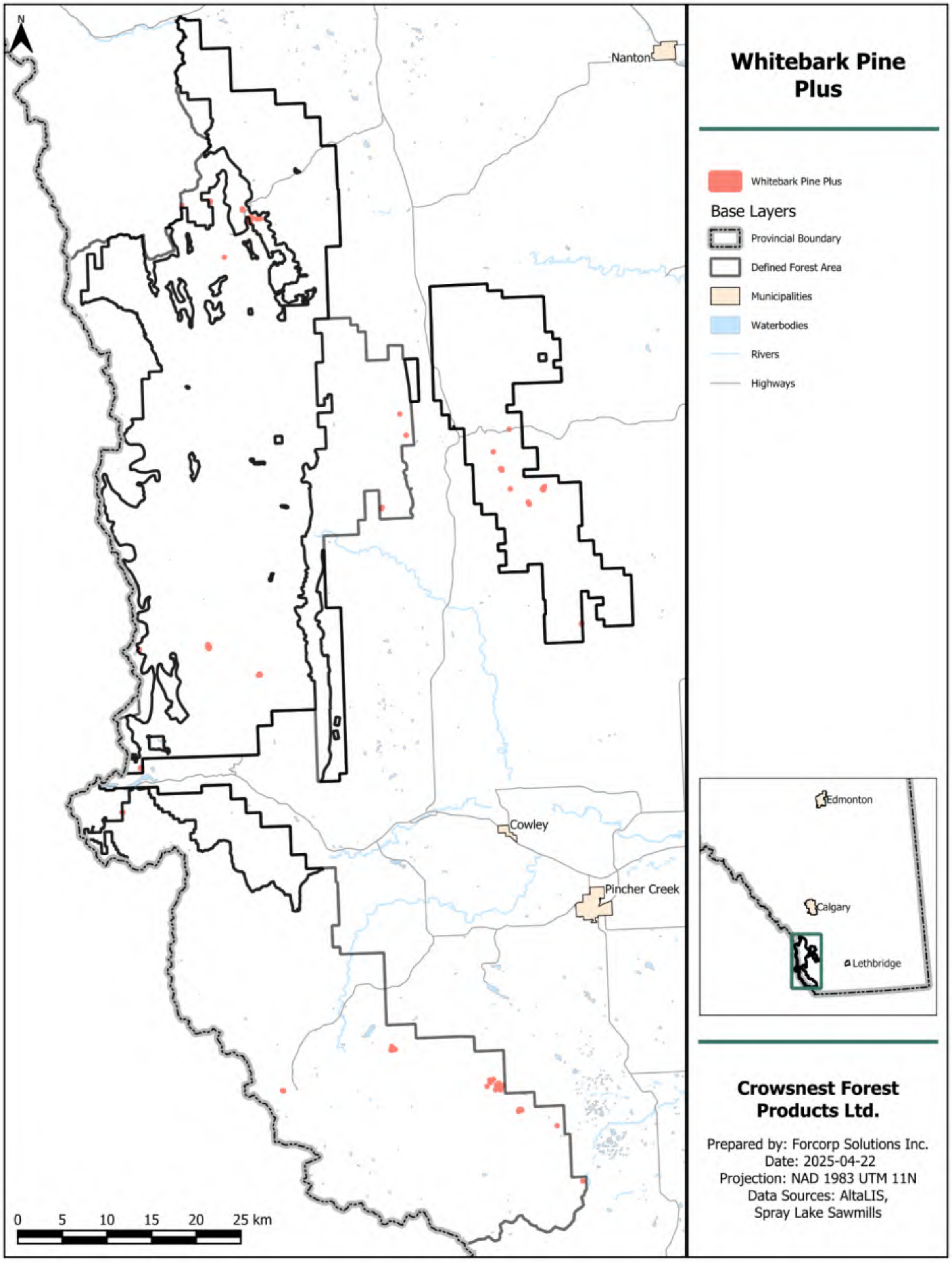

Figure 2-29: Whitebark Pine Plus tree locations within the Crowsnest Forest Products defined forest area collected by the Whitebark Pine Ecosystem Foundation.

2.4.30 Mountain Pine Beetle Stand Susceptibility Index (SSI)

Item	Description
Source:	Government of Alberta
Source Filename:	MPB_SSI_2023.gdb\MPB_SSI_2023 (date received: 29 May 2023)
Description of the Source File:	Mountain pine beetle stand susceptibility index for the C5 defined forest area
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	MPB_SSI
Required Processing:	7. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 8. Clip projected layer to the DFA boundary 9. Delete fields except for the MPB_SSI field 10. Repair any irregular geometries that may be present 11. Create a singlepart layer 12. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. The overstorey stand susceptibility is the only value that was used to determine stand susceptibility in this layer. The understorey SSI was not incorporated. SSI values are categories so that the can be used to help determine the mountain pine beetle risk for a given polygon.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_mpb_ssi
Output Description:	Mountain pine beetle stand susceptibility index for the Crowsnest Forest Products defined forest area
Output Attributes:	MPB_SSI
Polygon Area:	Total Area: 162,172 ha Category 1 (1 – 22): 27,559 ha Category 2 (23 – 63): 93,468 ha Category 3 (64 – 100): 1,507 ha No SSI Value: 39,638 ha

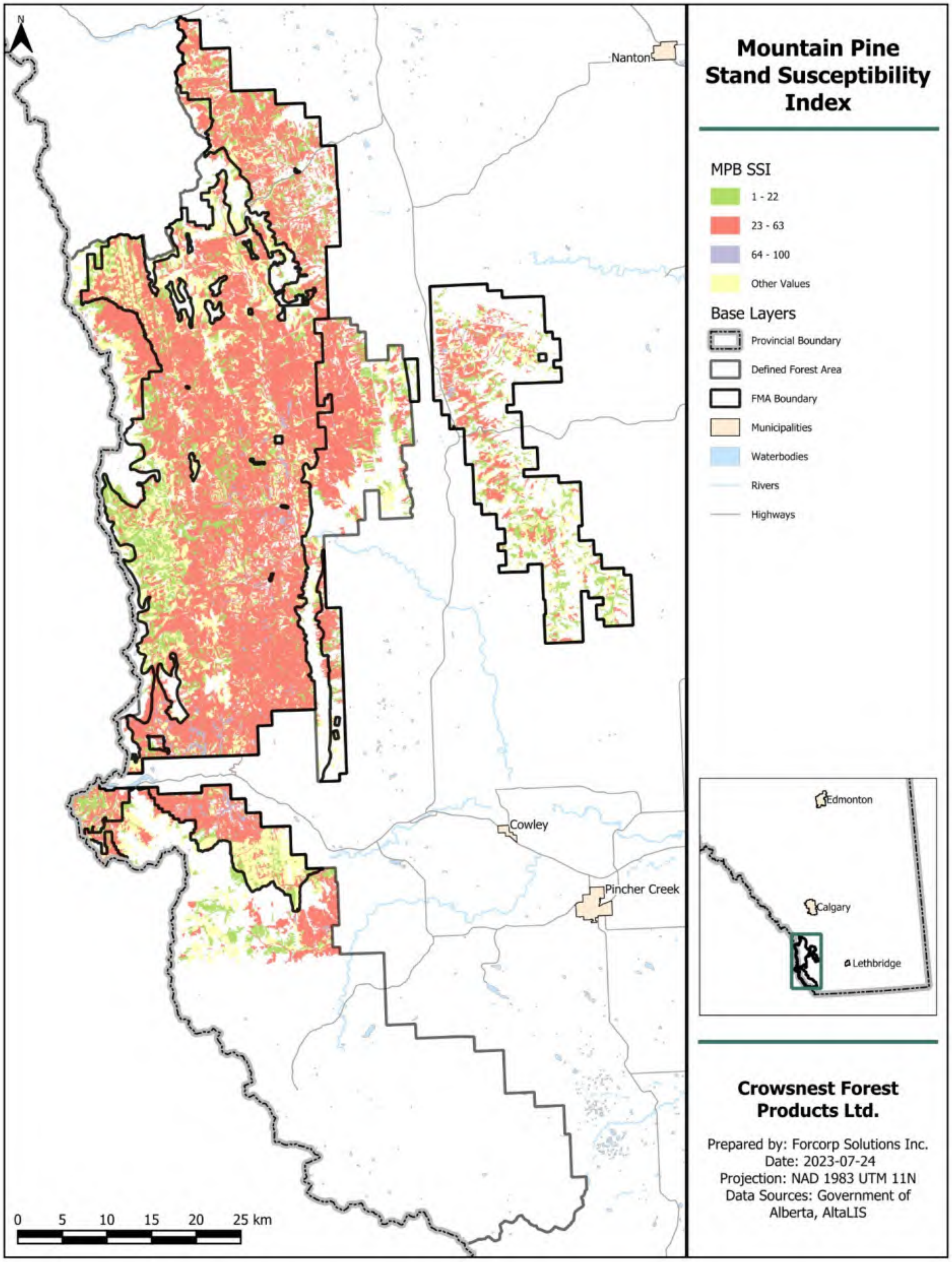

Figure 2-30: Mountain pine beetle stand susceptibility index (SSI) for forested stands within the Crowsnest Forest Products defined forest area.

2.4.31 Mountain Pine Beetle R-Value

Item	Description
Source:	Government of Alberta
Source Filename:	MPB_Pred_r.gdb\MPB_Pred_r (date received: 29 May 2023)
Description of the Source File:	Mountain pine beetle predicted r-value for the C5 defined forest area
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	PREDICTED_R
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the PREDICTED_R field 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Predicted r-value stands are categorized to assist in determining the mountain pine beetle risk for a given stand
Programs:	PostgreSQL/PostGIS
Output Filename:	i_mpbrvalue
Output Description:	Mountain pine beetle predicted r-value for the Crowsnest Forest Products defined forest area
Output Attributes:	PREDICTED_R
Polygon Area	Total Area: 114,645 ha Moderate (2.1 – 4.5): 88,208 ha High (4.6 – 5.8): 26,309 ha Very High (5.9 – 9.2): 128 ha

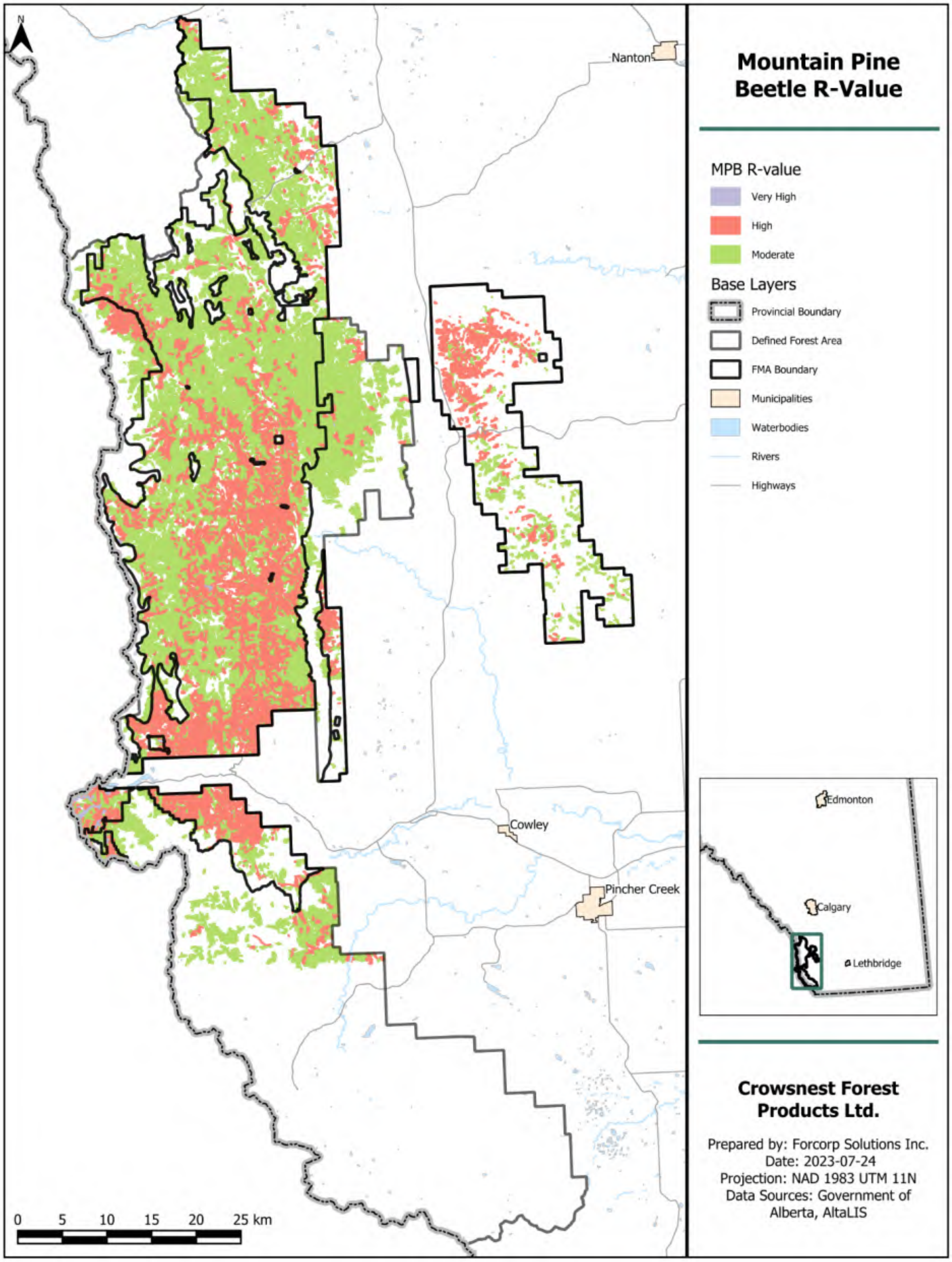

Figure 2-31: Mountain pine beetle R-Value for forested stands within the Crowsnest Forest Products defined forest area.

2.4.32 Registered Fur Management Areas

Item	Description
Source:	AltaLIS
Source Filename:	bf_geoadmin_22-09-2021/RegisteredFurManagementArea (effective date: 10 October 2017)
Description of the Source File:	Registered fur management areas within the Province of Alberta
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	RFMA_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the RFMA_NAME field 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_fur_management
Output Description:	Registered fur management areas within the Crowsnest Forest Products defined forest area
Output Attributes:	RFMA
Polygon Area	Total Area: 349,622 ha 297: 3,602 ha 1245: 7,108 ha 1308: 24,839 ha 1677: 10,386 ha 1726: 14,634 ha 1774: 39,325 ha 1877: 29,065 ha 1880: 25,069 ha 1882: 6,563 ha 2025: 10,602 ha 2165: 26,004 ha 2178: 9,410 ha 2286: 7 ha 2426: 9,884 ha 2448: 10,336 ha 2836: 27,115 ha 2841: 27,531 ha 2842: 23,677 ha 2895: 44,465 ha

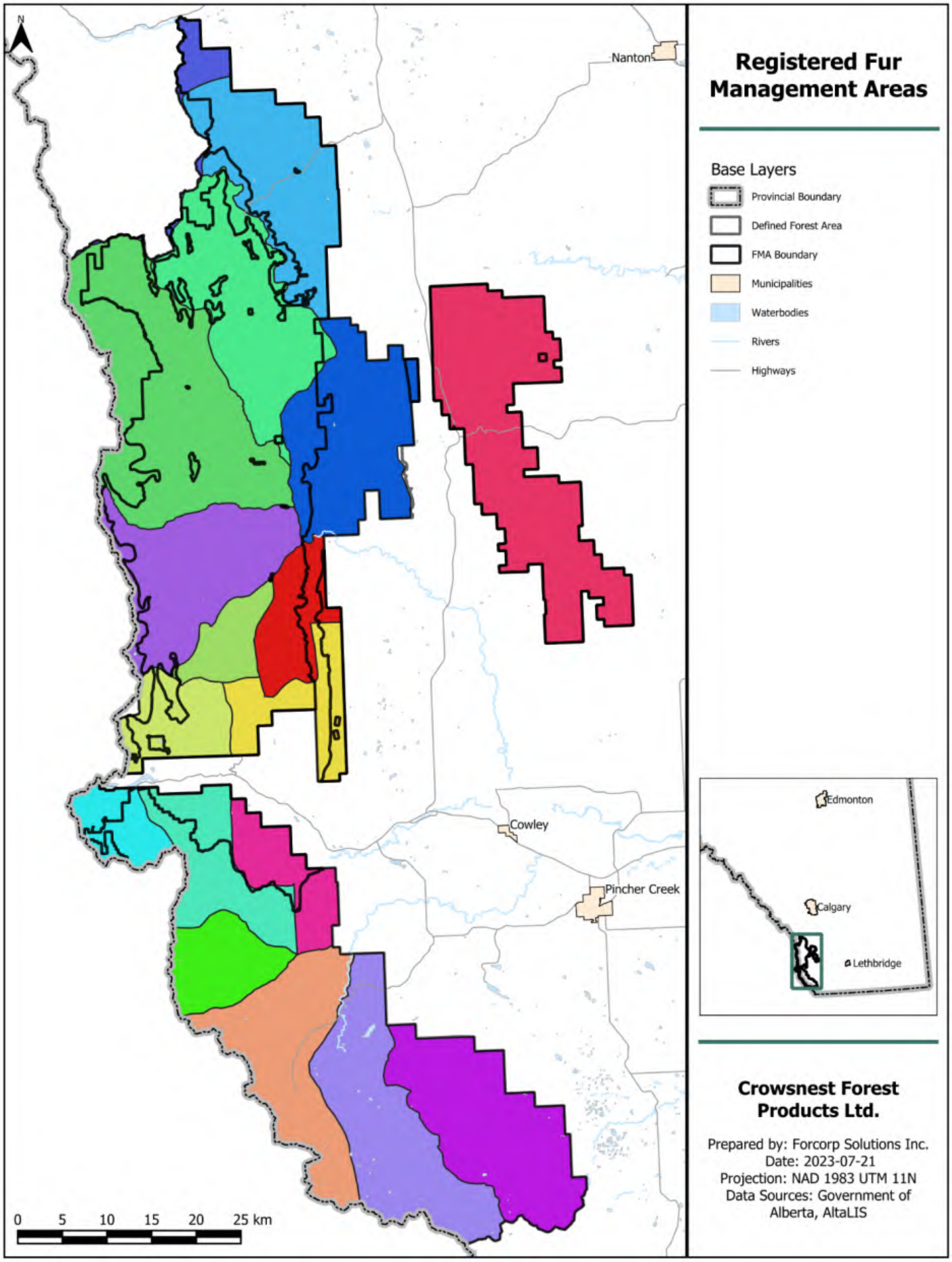

Figure 2-32: Registered fur management areas that intersect the Crowsnest Forest Products defined forest area.

2.4.33 Wildfire Management Zones

Item	Description
Source:	AltaLIS
Source Filename:	BF_WILDFIRE_MGMT_POLYGON.shp (download date: 11 May 2018)
Description of the Source File:	Wildfire Management Zones with the Province of Alberta
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	WMA_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Delete fields except for the WMA_NAME field 4. Rename the WMA_NAME field as FIREMGMT 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_wildfire_management
Output Description:	Wildfire Management zones that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	FIREMGMT
Polygon Area:	Total Area: 350,348 ha Calgary: 350,348 ha

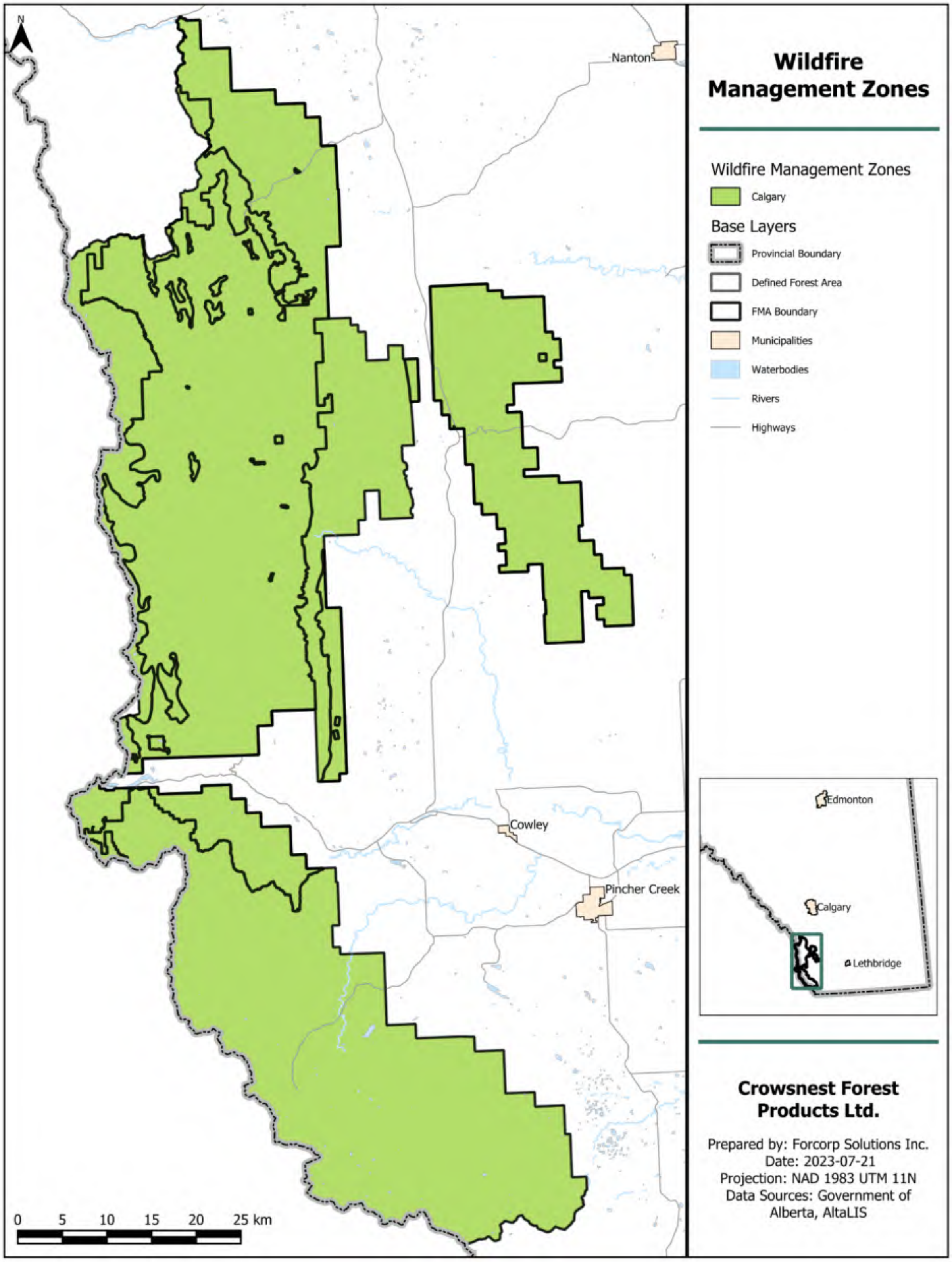

Figure 2-33: Wildfire management zones that intersect the Crowsnest Forest Products defined forest area.

2.4.34 Wildfire Risk

Item	Description
Source:	Government of Alberta
Source Filename:	20240214.gdb/i_wildfirerisk
Description of the Source File:	Raster layer of wildfire risk for the Crowsnest Forest Products FMA
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	CLASS
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Convert the raster layer to a polygon layer 3. Clip polygon layer to the DFA boundary 4. Delete fields except for the class field 5. Rename the CLASS field as WILDFIRE_RISK 6. Delete all polygons classed as “Minor” risk 7. Repair any irregular geometries that may be present 8. Create a singlepart layer 9. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	The source layer was generated using the FMA boundary as the outer bounds for the layer calculation. The limitations of generating raster layers means that some portions of the contributing landbase do not have a wildfire risk value. Minor risk polygons are deleted as these polygons are not part of the VOIT consideration.
Programs:	QGIS; PostgreSQL/PostGIS
Output Filename:	i_wildfirerisk
Output Description:	Wildfire risk within the Crowsnest Forest Products defined forest area
Output Attributes:	WILDFIRE_RISK
Polygon Area	Total Area: 125,358 ha Continuous Improvement: 119,891 ha Risk Reduction: 4,099 ha Intolerable: 1,368 ha

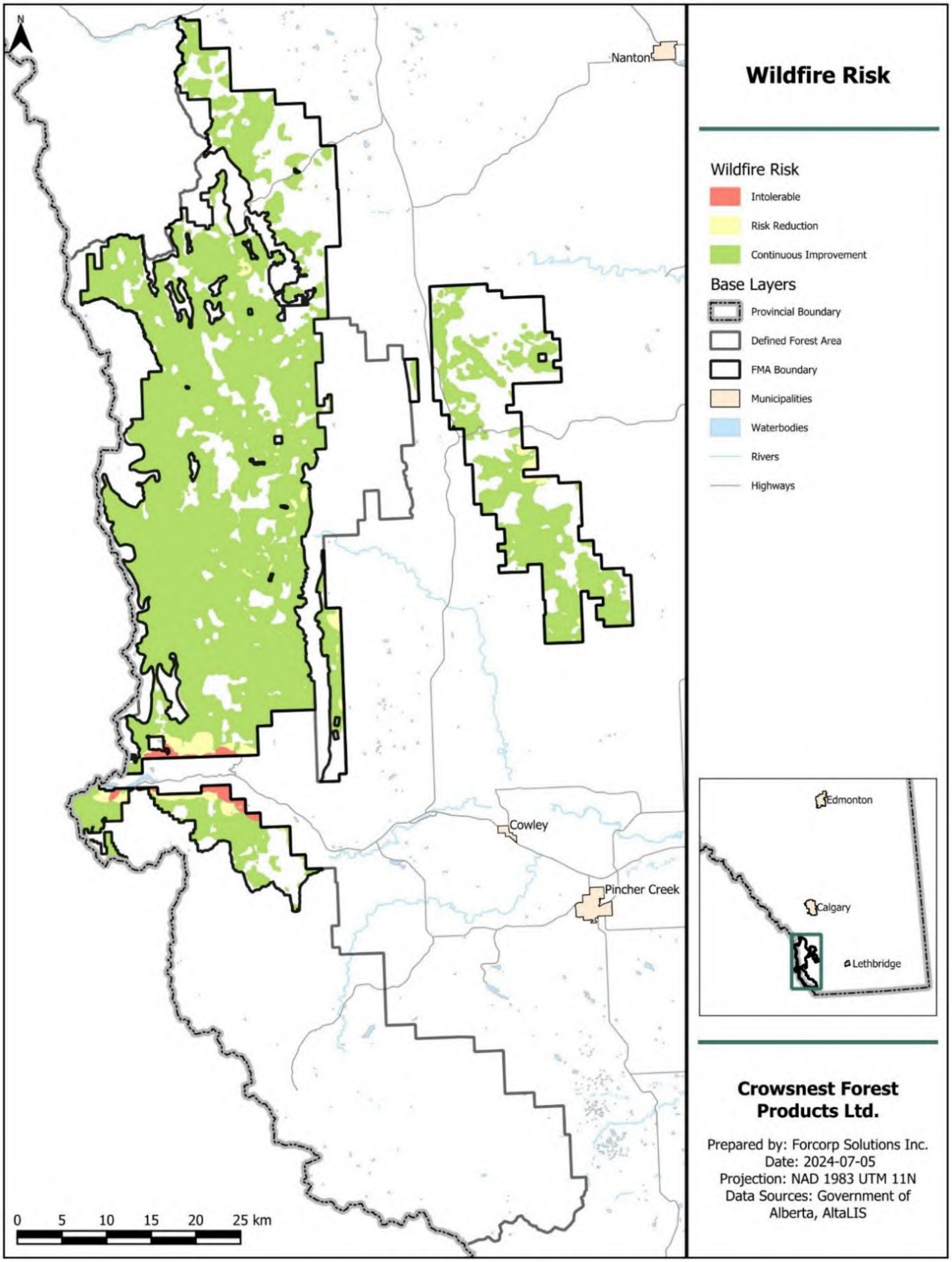

Figure 2-34: Fire behaviour potential for polygons within the Crowsnest Forest Products forest management agreement area.

2.4.35 FireSmart Community Zones

Item	Description
Source:	Government of Alberta
Source Filename:	FSCZ_20200506.shp (received 12 October 2022)
Description of the Source File:	FireSmart Community Zones within the Province of Alberta
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	CZ_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Rename the CZ_NAME field as FIRESMART 4. Delete fields except for the FIRESMART field 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_firesmart_boundaries
Output Description:	FireSmart Community Zones that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	FIRESMART
Polygon Area:	Total Area: 107,444 ha Crowsnest: 56,226 ha Eden Valley: 2,049 ha West Castle Beaver Mines: 49,168 ha

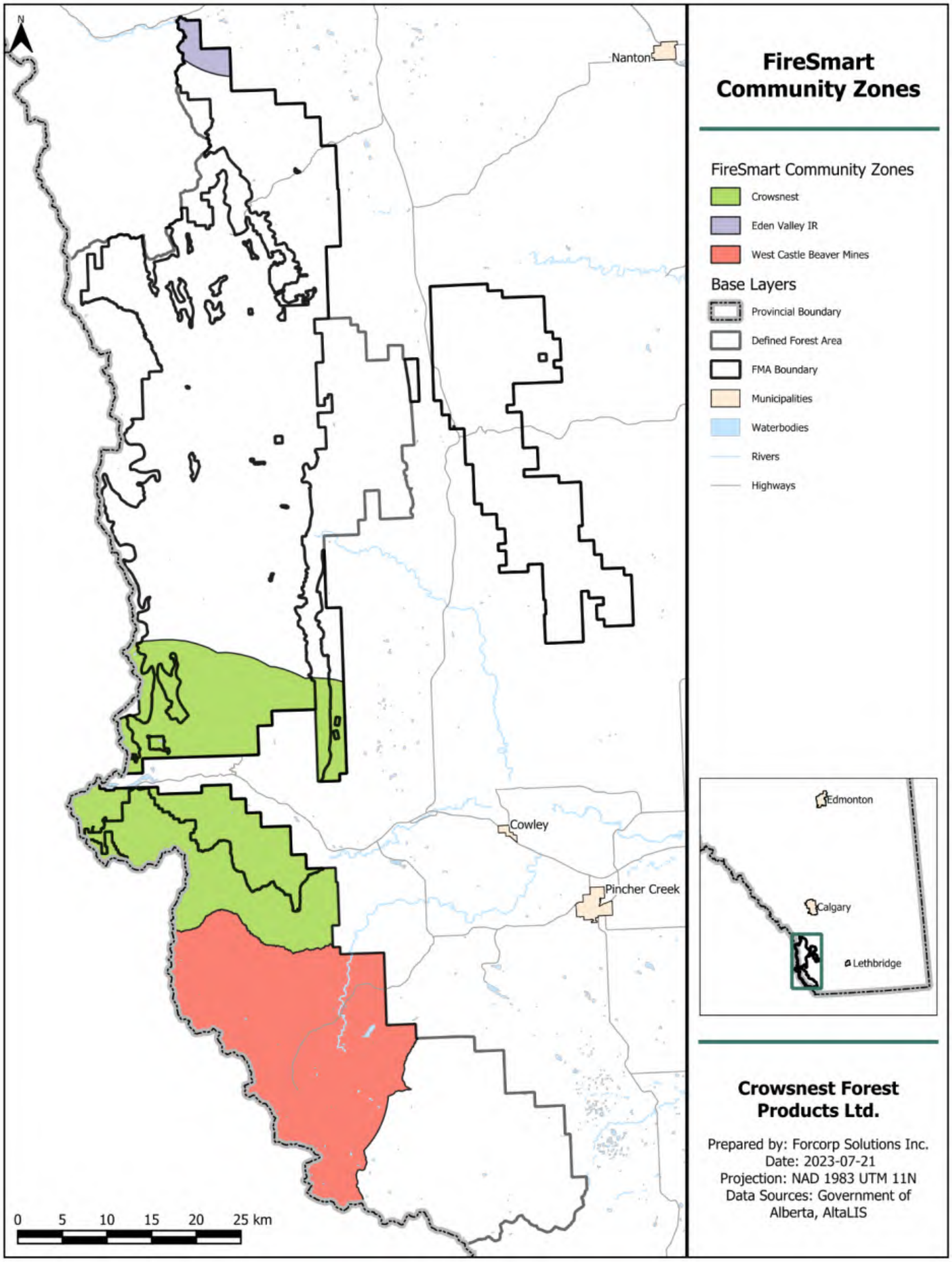

Figure 2-35: FireSmart community zones that intersect the Crowsnest Forest Products defined forest area.

2.4.36 Recent Wildfires

Item	Description
Source:	Government of Alberta
Source Filename:	wildfires_1931to2022.shp (effective date: 1 January 2023)
Description of the Source File:	Wildfire boundary history from 1931 through the 2020 fire year
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	FIRENUMBER, FIRE_CLASS, YEAR
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layer to the DFA boundary 3. Select wildfires where the FIRE_YEAR is greater than or equal to 2018. 4. Delete fields except for the FIRENUMBER, FIRE_CLASS, and YEAR fields 5. Rename FIRENUMBER to FIRE_NO, and YEAR to FIRE_YEAR 6. Repair any irregular geometries that may be present 7. Create a singlepart layer 8. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	The fire year is the same year as the photo year of the AVI. This may mean that the fire is visible in both the AVI and the wildfire layer.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_wildfire
Output Description:	Wildfires that have occurred since 2018 within the Crowsnest Forest Products defined forest area
Output Attributes:	FIRE_NO, FIRE_CLASS, FIRE_YEAR
Polygon Area	Total Area: 50 ha CWF-006-2018: 9 ha CWF-007-2018: 1 ha CWF-013-2018: 10 ha CWF-096-2018: 5 ha CWF-043-2019: 1 ha CWF-009-2021: 17 ha CWF-159-2021:7 ha

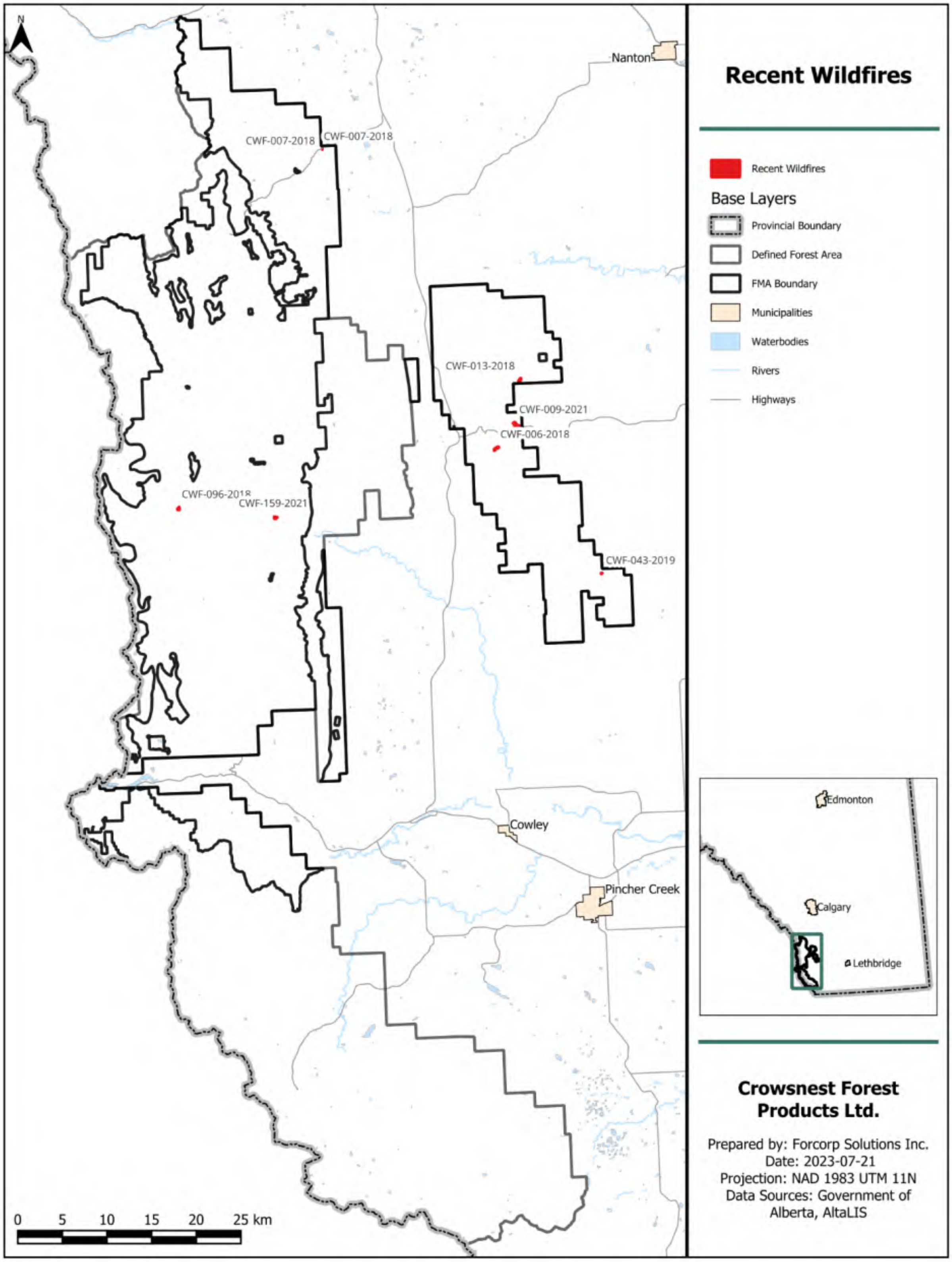

Figure 2-36: Recent wildfires that occurred within the Crowsnest Forest Products defined forest area. Wildfires identified were included in this layer if they occurred after the photos used to interpret the AVI were taken.

2.4.37 First Nations Reserves

Item	Description
Source:	AltaLIS
Source Filename:	bf_geoadmin_22-09_2021.gdb/IndianReserve (effective date: 27 August 2020)
Description of the Source File:	First Nations reserves within the Province of Alberta
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	IRES_NAME
Required Processing:	1. Project the source layer to NAD 1983 Zone 11N (SRID 26911) 2. Select the Eden Valley No. 236 and Peigan Timber Land "B" reserves 3. Delete fields except for the IRES_NAME field 4. Rename IRES_NAME to FIRSTNATION 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	There are no First Nations Reserves that intersect the DFA. The extents of this layer are included in this document to ensure compliance with the Planning Standard.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_firstnations
Output Description:	First Nations reserves that intersect or border the Crowsnest Forest Products defined forest area
Output Attributes:	FIRSTNATION

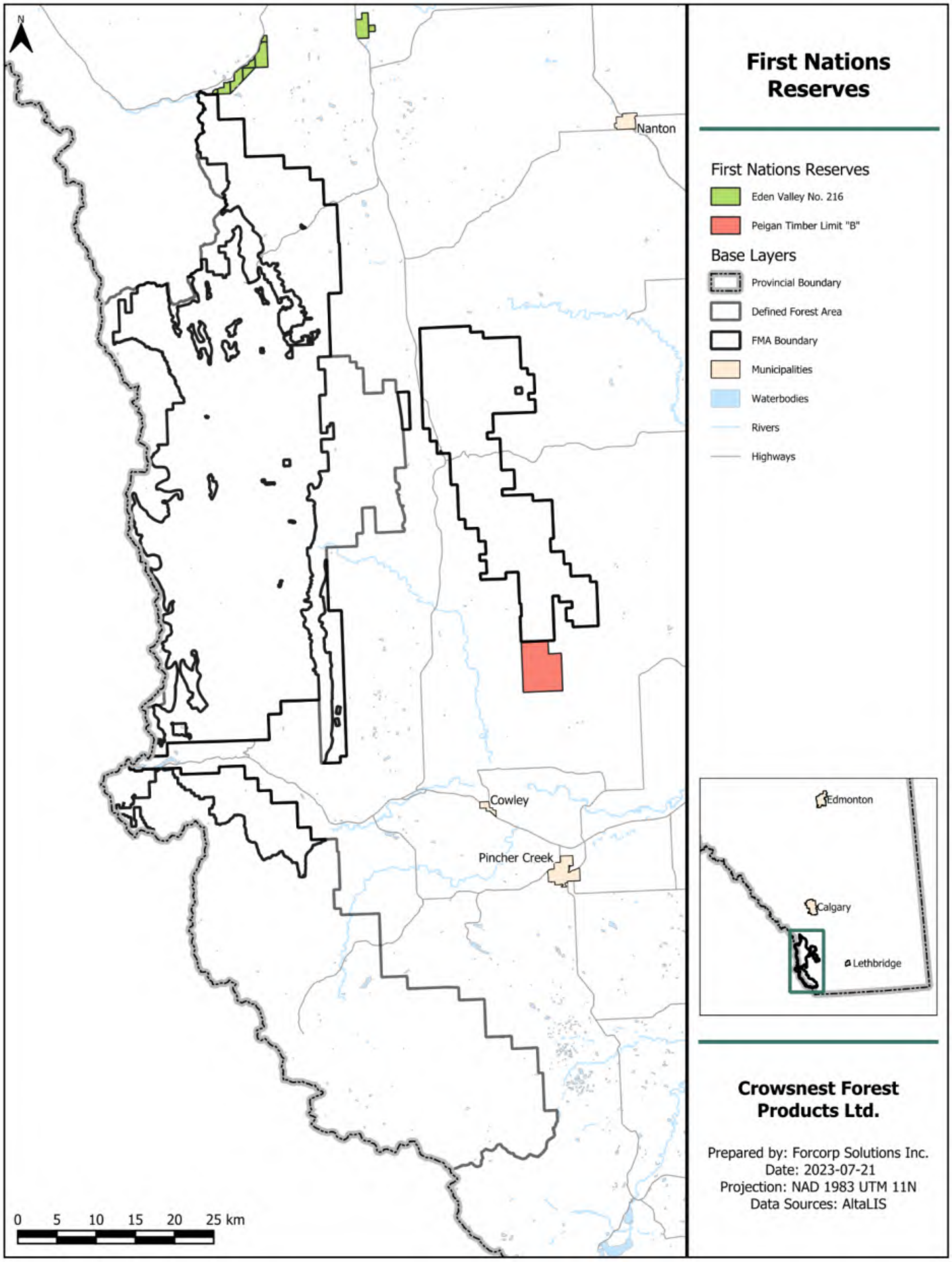

Figure 2-37: First Nations reserves that border the Crowsnest Forest Products defined forest area.

2.4.38 Municipal Districts, Improvement Districts, and Special Municipalities

Item	Description
Source:	AltaLIS
Source Filenames:	bf_geoadmin_22-09-2021.gdb/ImprovementDistrict (effective date: 15 June 2021) bf_geoadmin_22-09-2021.gdb/MunicipalDistrictandCounty (effective date: 21 September 2021) bf_geoadmin_22-09-2021.gdb/SpecializedMunicipality (effective date: 3 September 2019)
Description of the Source Files:	Improvement Districts, Municipal Districts and Specialized Municipalities within the Province of Alberta.
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	ID_NAME, MD_NAME, SPMUN_NAME
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Merge the projected layers into a single layer 4. Combine the ID_NAME, MD_NAME, and SPMUN_NAME field values into a single field named MD_NAME 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_municipal
Output Description:	Special Municipalities, Municipal Districts and Improvement Districts that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	MD_NAME
Polygon Area:	Total Area: 350,348 ha Kananaskis Improvement District: 21,863 ha M.D. of Pincher Creek No. 9: 100,707 ha M.D. of Ranchland No. 66: 191,444 ha M.D. of Willow Creek No. 26: 13,674 ha Municipality of Crowsnest Pass: 22,660 ha

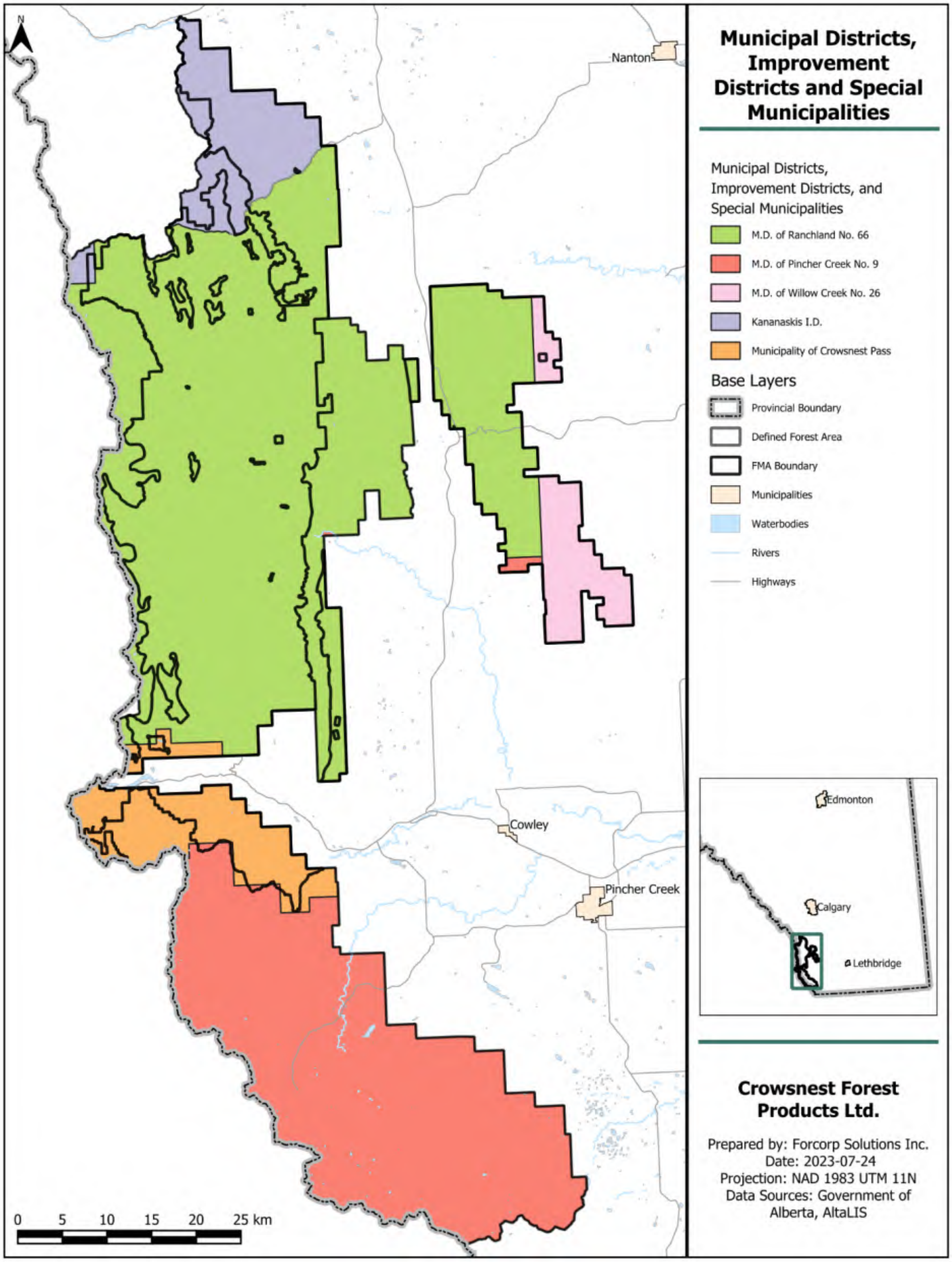

Figure 2-38: Municipal districts, improvement districts and special municipalities that intersect the Crowsnest Forest Products defined forest area.

2.4.39 Ownership Layer

Item	Description
Source:	Government of Alberta
Source Filename:	CRFP_Land_Ownership.gdb/LandOwnership (delivery date: 8 May 2023)
Description of the Source File:	Ownership summary for land within the Crowsnest Forest Products defined forest area
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	CROWNCLASS, TITLECLASS
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Repair any irregular geometries that may be present 4. Create a singlepart layer 5. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Ownership was only provided for the FMA area within the defined forest area. The area assigned as private, titled land consists of two small slivers. These slivers will likely be removed from the landbase as part of the sliver elimination process as they total less than 0.1 ha. As a result, no private land area will be visible in the classified landbase. The mention of their presence in this section is to ensure transparency of the landbase development process.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_ownership
Output Description:	Ownership summary for land within the Crowsnest Forest Products defined forest area
Output Attributes:	CROWNCLASS, TITLECLASS
Polygon Area	Total Area: 186,091 ha Provincial, Untitled: 167,333 ha Provincial, Non-Patent: 2,261 ha Provincial, Titled: 16,496 ha Private, Titled: < 1 ha

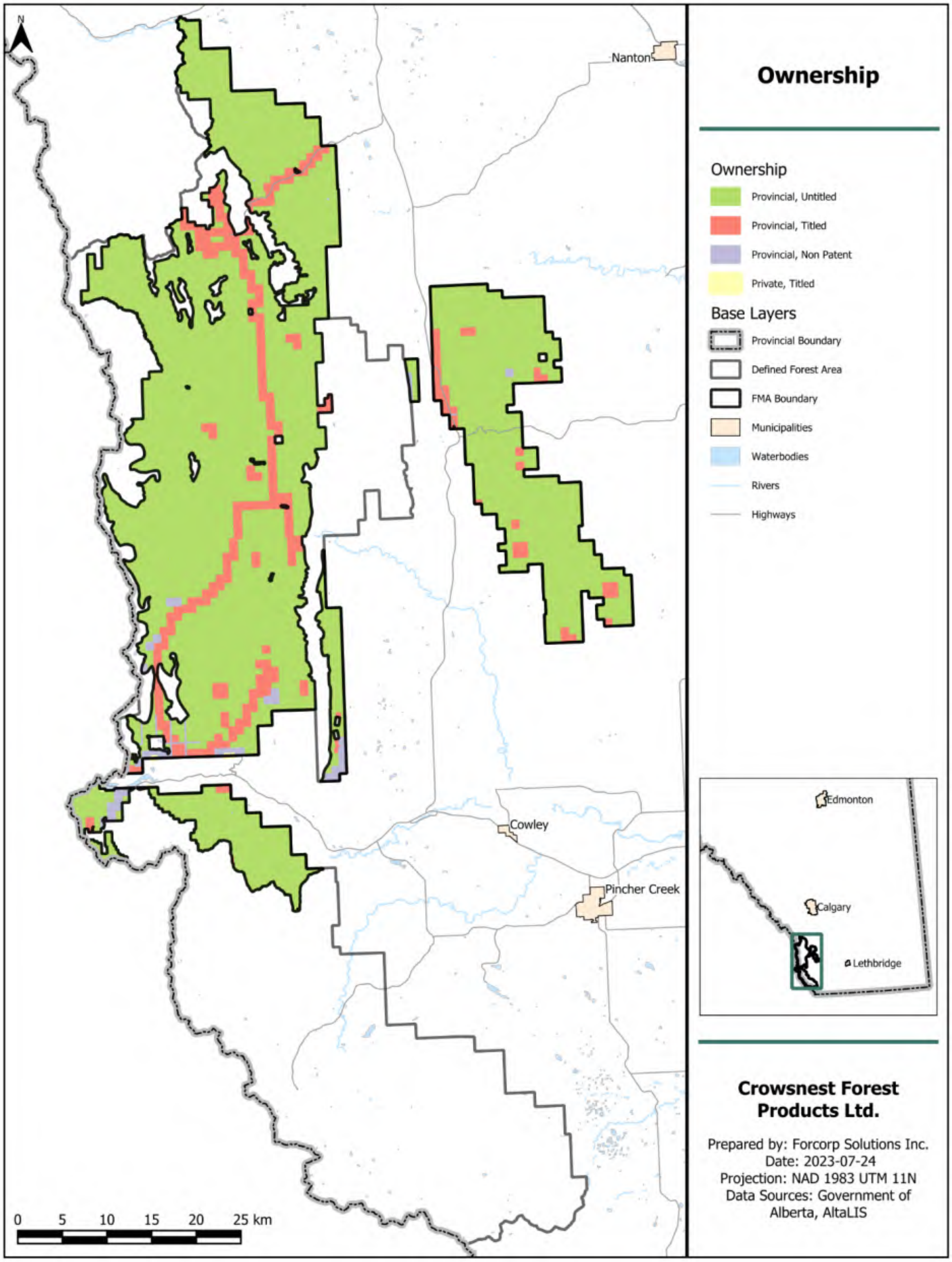

Figure 2-39: Ownership assignments for the area within the Crowsnest Forest Products forest management agreement area.

2.4.40 Historic Resource Values

Item	Description
Sources:	Government of Alberta
Source Filenames:	LHR_Fall2021_Public.shp (effective date 1 October 2021)
Description of the Source Files:	Historic Resource Values within the Province of Alberta
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	HRV
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Delete fields except for the HRV field 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	HRV 1 and 3 features are the only features that are treated as deletions in the net landbase. HRV 4, and 5 are not included in the landbase.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_hrv
Output Description:	Historic Resource Values that fall within the Crowsnest Forest Products defined forest area
Output Attributes:	HRV
Polygon Area	Total Area: 1,214 ha HRV 1: 97 ha HRV 3: 1,117 ha

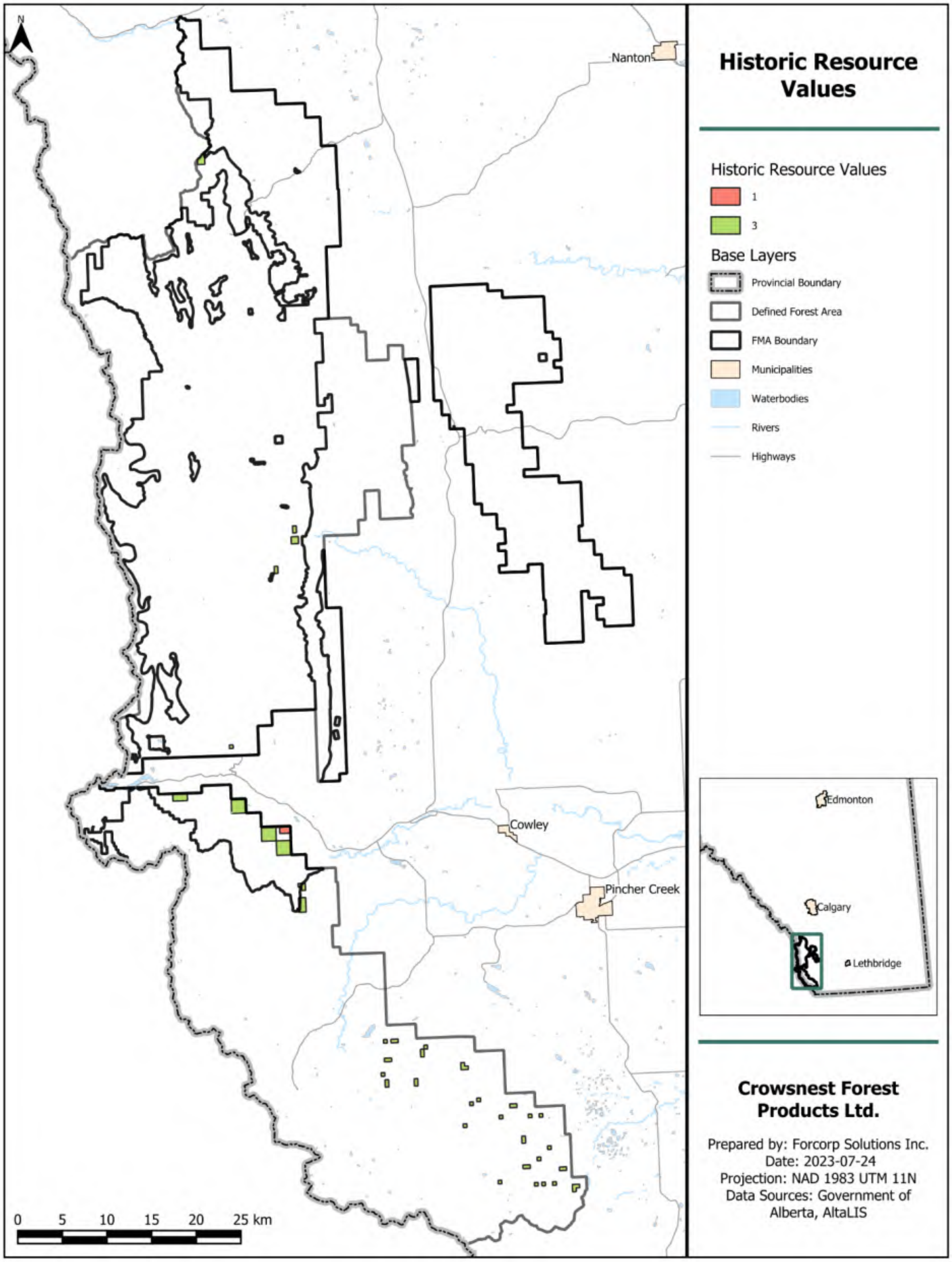

Figure 2-40: Historic Resource Values (HRVs) with values of 1 or 3 that intersect the Crowsnest Forest Products defined forest area. HRVs with values of 1 or 3 are considered non-contributing landbase in the net landbase.

2.4.41 DIDs – Non-Forested Dispositions

Item	Description
Source:	Government of Alberta
Source Filename:	DAB_APPL.shp (download date: 1 May 2023)
Description of the Source File:	DIDs Dispositions within the Province of Alberta
Geographic Coordinate System:	GCS_North_American_1983
Important Attributes:	DISP_TYPE
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Select features from this layer where DISP_TYPE IN ('DLO', 'DML', 'DMS', 'DPI', 'DPL', 'EAS', 'EZE', 'FRD', 'LOC', 'MLL', 'MSL', 'PEZ', 'PIL', 'PLA', 'PLC', 'PML', 'PMS', 'PPA', 'PPI', 'PRA', 'PRD', 'PRE', 'PSM', 'RDS', 'REA', 'RML', 'ROE', 'ROW', 'RRD', 'RSC', 'RVC', 'SMC', 'SML', 'VCE') 4. Create a new field named "DIDS-NONFOR" and populate it with 'DIDs-NONFOR' for all polygons that were selected 5. Dissolve the polygons to remove internal linework 6. Repair any irregular geometries that may be present 7. Create a singlepart layer 8. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Dispositions in this layer are types identified by the GOA that have no forest cover or have forest cover that is not expected to be maintained over the long run. The input layer dissolves the individual disposition types into a single polygon assignment (DIDS-NONFOR) as the individual disposition types are not used as part of the timber supply analysis.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_dids_nonfor
Output Description:	Non-forested dispositions that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	DIDS_NONFOR

Item	Description	
Polygon Area:	Total Area: 4,619 ha	
	DLO: 1,647 ha	PLA: 563 ha
	DML: 71 ha	PLC: 10 ha
	DMS: 362 ha	PML: 55 ha
	DPI: 2 ha	PMS: < 1 ha
	DPL: 79 ha	PPA: 1 ha
	EZE: 252 ha	PSM: 3 ha
	FRD: 487 ha	RDS: 73 ha
	LOC: 159 ha	REA: 15 ha
	MLL: 2 ha	ROE: 185 ha
	MSL: 236 ha	RRD: 295 ha
	PEZ: 16 ha	RVC: < 1 ha
	PIL: 27 ha	SML: 79 ha

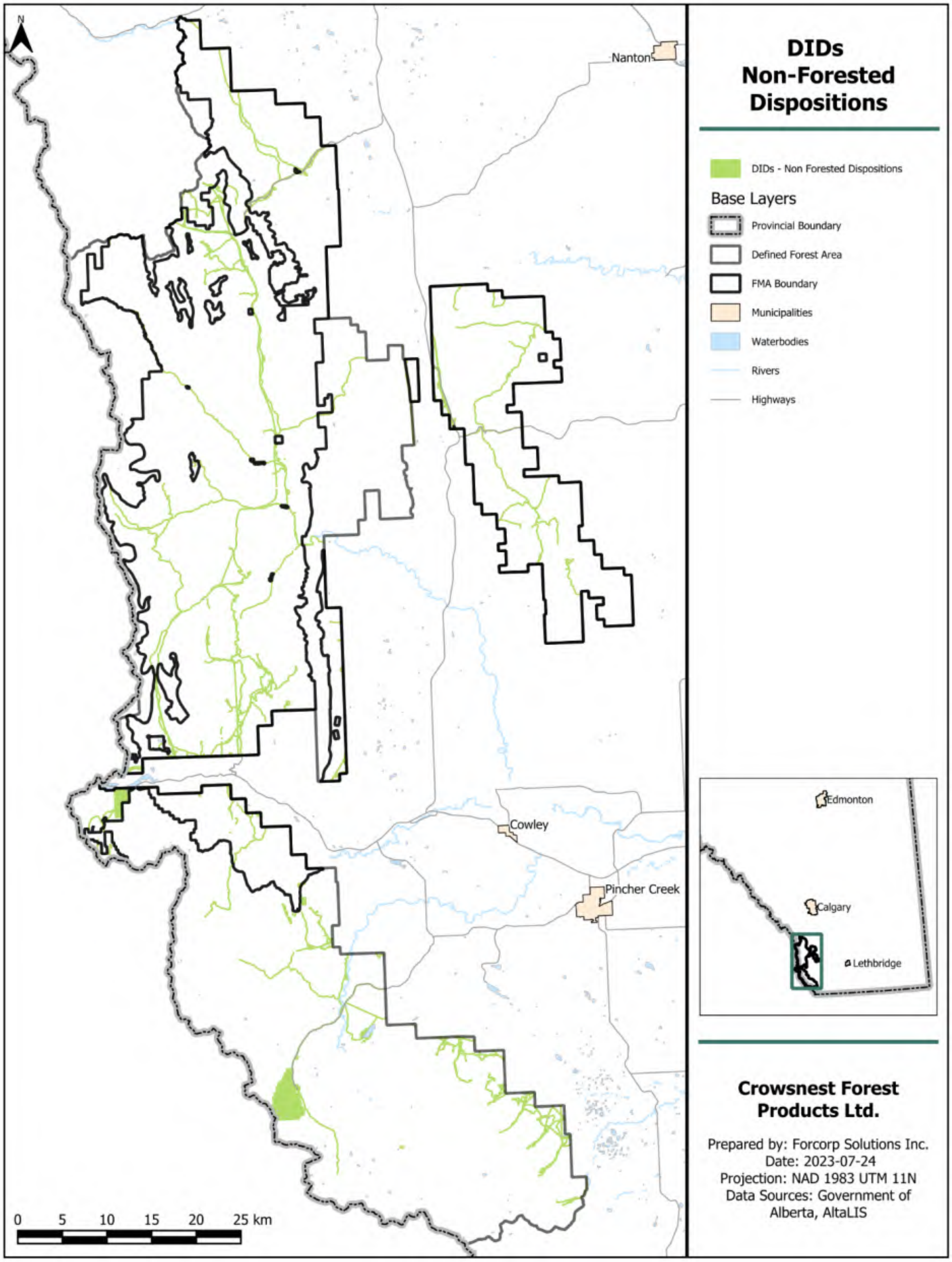

Figure 2-41: Non-forested DIDs dispositions that intersect the Crowsnest Forest Products defined forest area.

2.4.42 DIDs – Forested Dispositions

Item	Description
Source:	Government of Alberta
Source Filename:	DAB_APPL.shp (download date: 1 May 2023)
Description of the Source File:	DIDs Dispositions within the Province of Alberta
Geographic Coordinate System:	GCS_North_American_1983
Important Attributes:	DISP_TYPE
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Select features from this layer where DISP_TYPE IN ('CUP', 'DRS', 'FDL', 'FDS', 'GRR', 'KRS', 'MLP', 'MTS', 'PLS', 'PMP', 'PRL', 'PRS', 'REC', 'TCL') 4. Create a new field named "DIDS_FOR" and populate it with 'DIDs-FOR' for all polygons that were selected 5. Dissolve the polygons to remove internal linework 6. Repair any irregular geometries that may be present 7. Create a singlepart layer 8. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Dispositions in this layer are types where forest cover is present and is likely to be maintained for the long run. The input layer dissolves the individual disposition types into a single polygon assignment (DIDS_FOR) as the individual disposition types are not used as part of the timber supply analysis.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_dids_for
Output Description:	Forested dispositions that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	DIDS_FOR
Polygon Area:	Total Area: 480 ha DRS: 305 ha MLP: 8 ha PRS: 1 ha REC: 165 ha

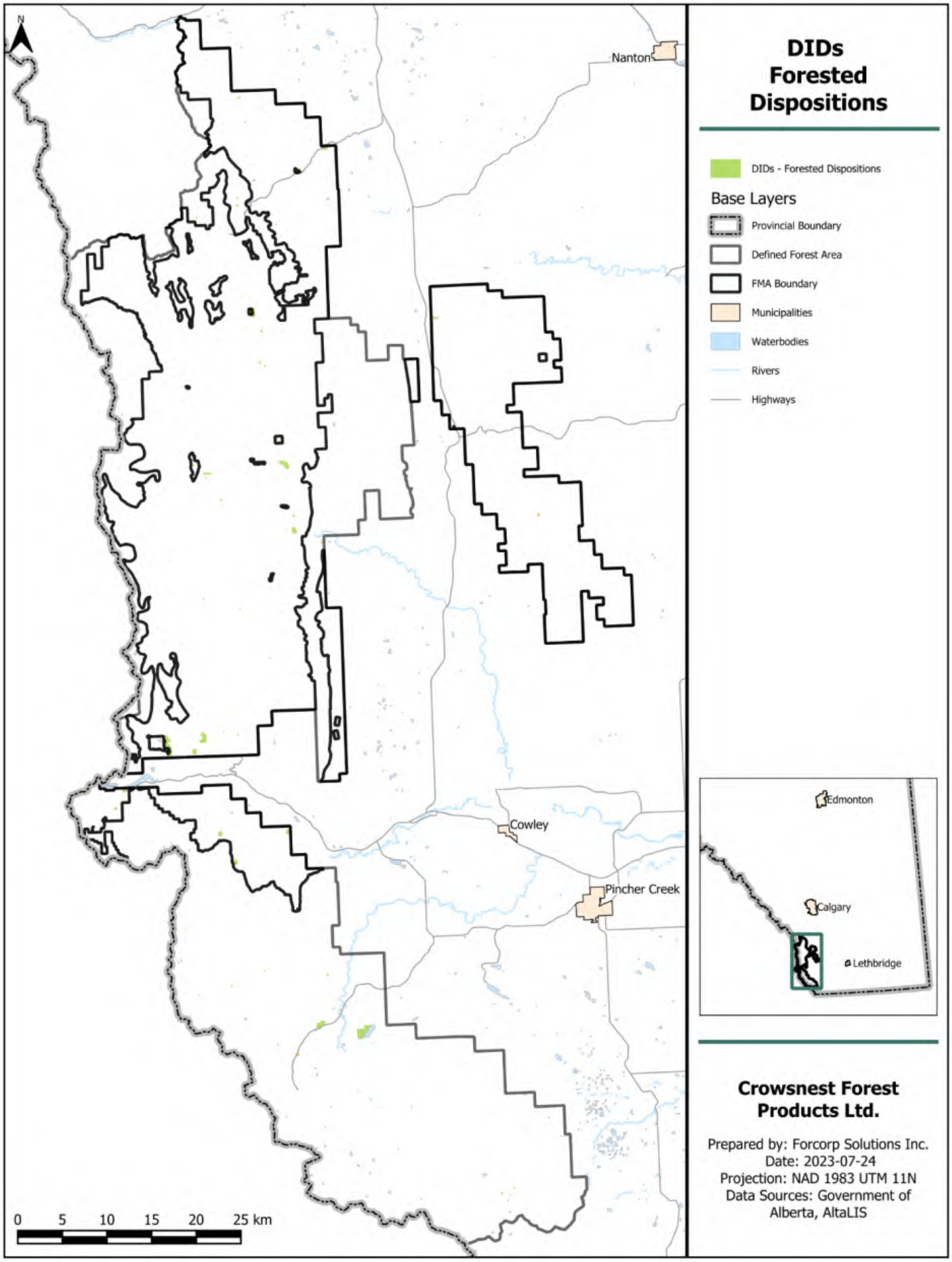

Figure 2-42: Forested DIDs dispositions that intersect the Crowsnest Forest Products defined forest area.

2.4.43 Permanent Sample Plots

Item	Description
Sources:	Government of Alberta
Source Filenames:	PSP_Plot_Reserves.shp (delivery date: 9 November 2022) PSP_7200_PlotBuffer.shp (date received 27 July 2023)
Description of the Source Files:	Government of Canada and Government of Alberta permanent sample plots within the Province of Alberta
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	PSP_GROUP
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Merge the projected layers into a single layer 4. Rename PSP_GROUP to PSP 5. Repair any irregular geometries that may be present 6. Create a singlepart layer 7. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	In the PSP Plot Reserves layer, there is one large PSP boundary, which includes several plots. This large boundary was dropped in favour the plot buffers for the individual plots provided in the PSP 7200 Plot buffer layer.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_psp
Output Description:	Government of Canada and Government of Alberta Permanent Sample Plots within the Crowsnest Forest Products defined forest area
Output Attributes:	PSP
Polygon Area	Total Area: 306 ha Count of PSPs: 92 Average PSP size: 3 ha

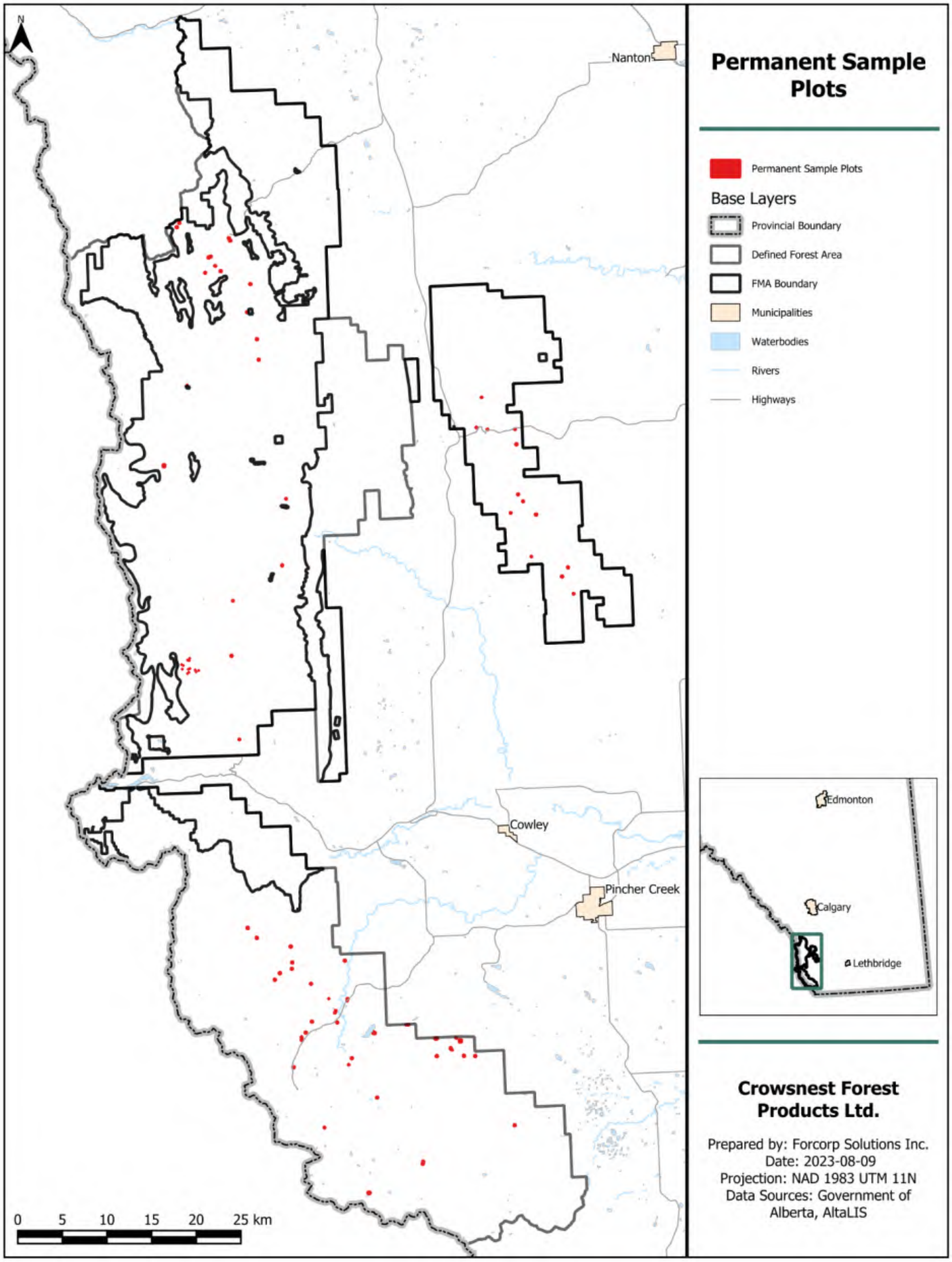

Figure 2-43: Permanent sample plots that intersect the Crowsnest Forest Products defined forest area.

2.4.44 Crown Land Reservations

Item	Description
Sources:	Government of Alberta
Source Filenames:	CrownLandReservations.shp (effective date: 24 October 2022)
Description of the Source Files:	Crown Land Reservations within the Province of Alberta
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	Reservatio, Effective Date
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Select dispositions that have listed either "All Sectors" or "Forestry" as not allowing surface dispositions. Include CLR 100288 in addition to these dispositions that do not allow surface disturbance 4. Create a new field named "CLRES" and populate the field with the crownland reservation number 5. Delete all other fields and dissolve the layer to minimize the internal linework in the layer 6. Repair any irregular geometries that may be present 7. Create a singlepart layer 8. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	CLR 100288 is allocated the Southern Rockies Watershed project. All area designated to this project will be treated as a 20-year deferral. If the action code for a sector is assigned as "referral" or "clearance" then the reservation is not included in this layer.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_clr
Output Description:	Crown Land Reservations within the Crowsnest Forest Products defined forest area
Output Attributes:	CLRES
Polygon Area:	Total Area: 10,366 ha Fish and Wildlife Resources: < 1 ha Land Management: 514 ha Park or Protected Area: 9,835 ha Unique Site Feature: 16 ha

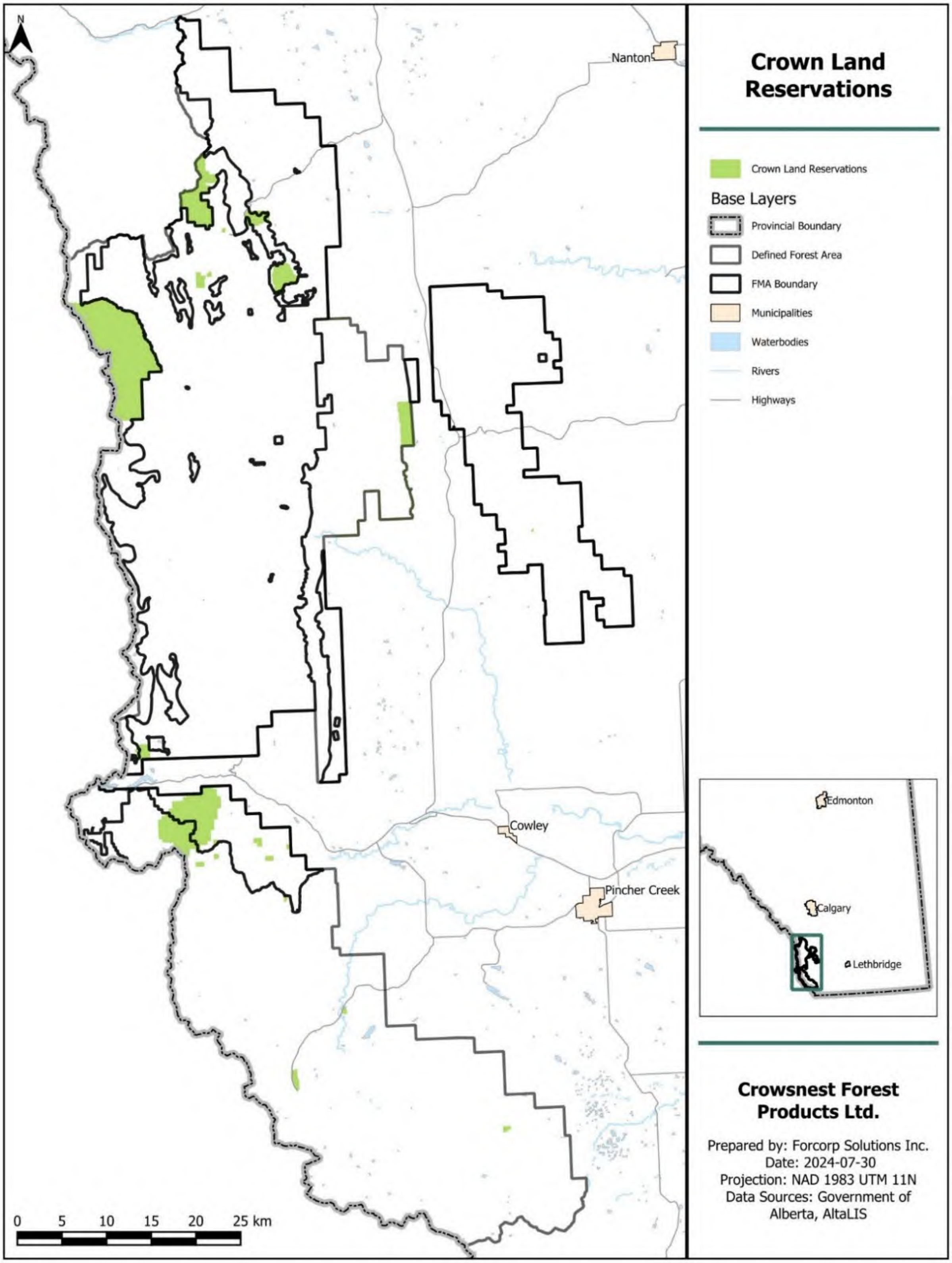

Figure 2-44: Crown land reservations that intersect the Crowsnest Forest Products defined forest area.

2.4.45 Forest Encroachment

Item	Description
Source:	Government of Alberta
Source Filenames:	CFP_Transition.gdb\CFP_Forest CFP_Transition.gdb\CFP_Ecorest CFP_Transition.gdb\CFP_NFL CFP_Transition.gdb\out_Scope (All received: 26 May 2023)
Description of the Source Files:	AVI polygon assignments for forest, transition, non-forest, and out of scope regarding range transition from grassland to forest.
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	No attributes in these source files assign important values. The polygon geometry is the key attribute
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Add a field to each layer named "Encroachment" and assign the appropriate value (Forested, Transition, Non-Forest, Out of Scope) for all polygons in each layer 3. Merge the projected layers into a single layer 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Layer will be used as a proxy. Polygons that intersect the DFA will be selected in their entirety, instead of being clipped to the DFA boundary, to ensure that all polygons are assigned values during the proxy process regardless of geometry
Programs:	PostgreSQL/PostGIS
Output Filename:	i_encroachment
Output Description:	Risk of forest encroachment into grasslands for the Crowsnest Forest Products defined forest area
Output Attributes:	ENCROACHMENT
Polygon Area	Total Area: 190,656 ha Forested: 99,504 ha Transition: 65,649 ha Non-Forest: 12,608 ha Out of Scope: 12,895 ha

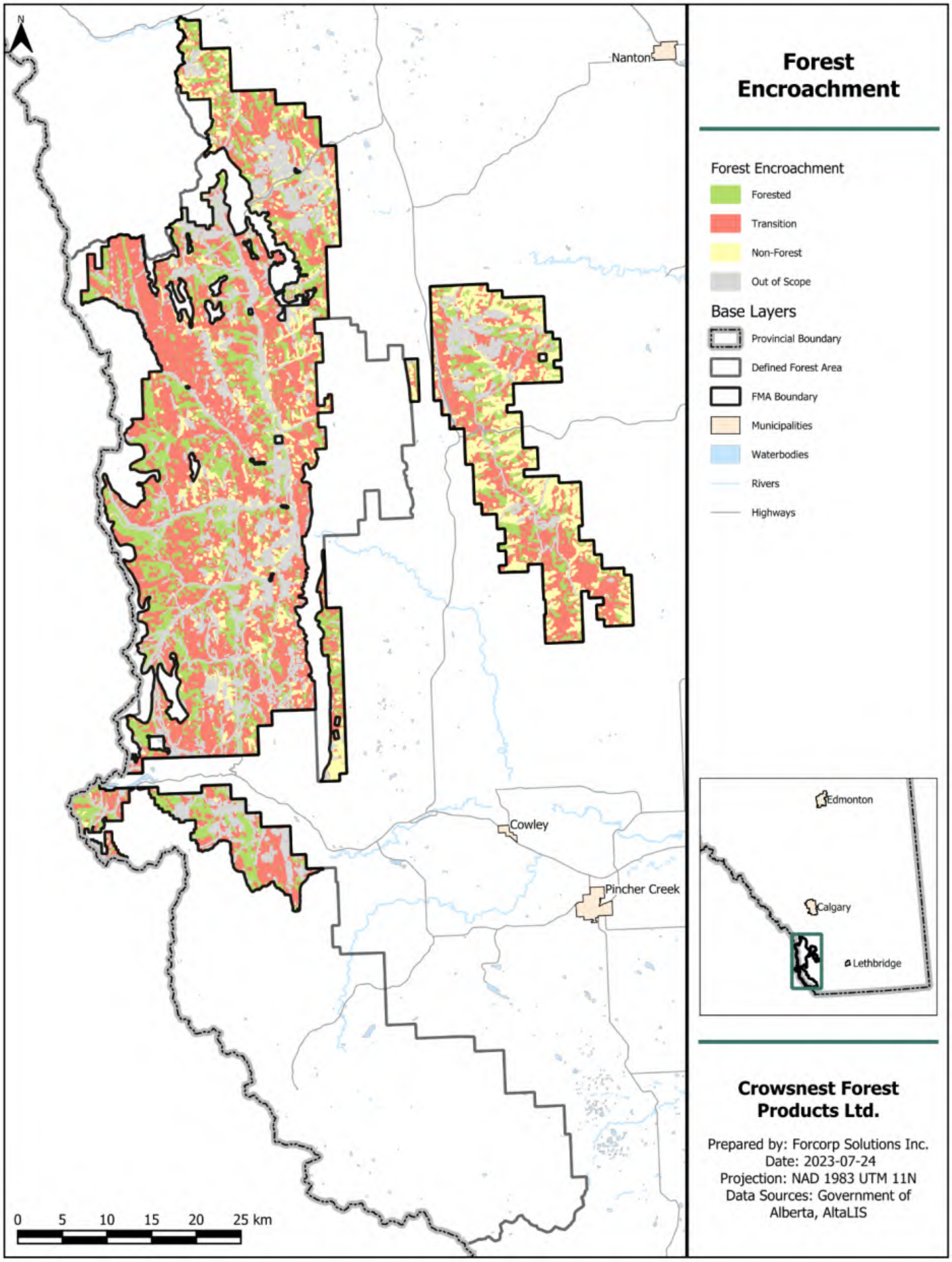

Figure 2-45: Areas of concern that may be at risk of forest encroachment on rangeland within the Crowsnest Forest Products defined forest area.

2.4.46 Steep Slopes

Item	Description
Sources:	Crowsnest Forest Products
Source Filenames:	CFP 1mDEM_eastblock/eastblock (19 November 2021)
Description of the Source Files:	ESRI Grid file, 1 meter Digital Elevation Model (DEM) of the DFA
Geographic Coordinate System:	GCS_North_American_1983
Important Attributes:	Spatial coordinates for each point in the point cloud
Required Processing:	1. Calculate the slope percent for each pixel in the DEM 2. Select pixels where the slope percent is 45% or greater and remove all remaining pixels from the layer, or small polygons that are isolated within areas that are 45% or greater 3. Convert raster layer to a polygon layer and dissolve the layer 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Steep slope layer is an estimate of the steep slopes within the DFA. The operability of the area within each polygon will be determined at the time of layout/harvest and may not fully align to this layer.
Programs:	ArcPro, PostgreSQL/PostGIS
Output Filename:	i_steepslopes
Output Description:	Polygons where steep slopes have been identified as 45% or greater within the Crowsnest Forest Products defined forest area
Output Attributes:	SLOPE_CLASS
Polygon Area:	Total Area: 41,799 ha

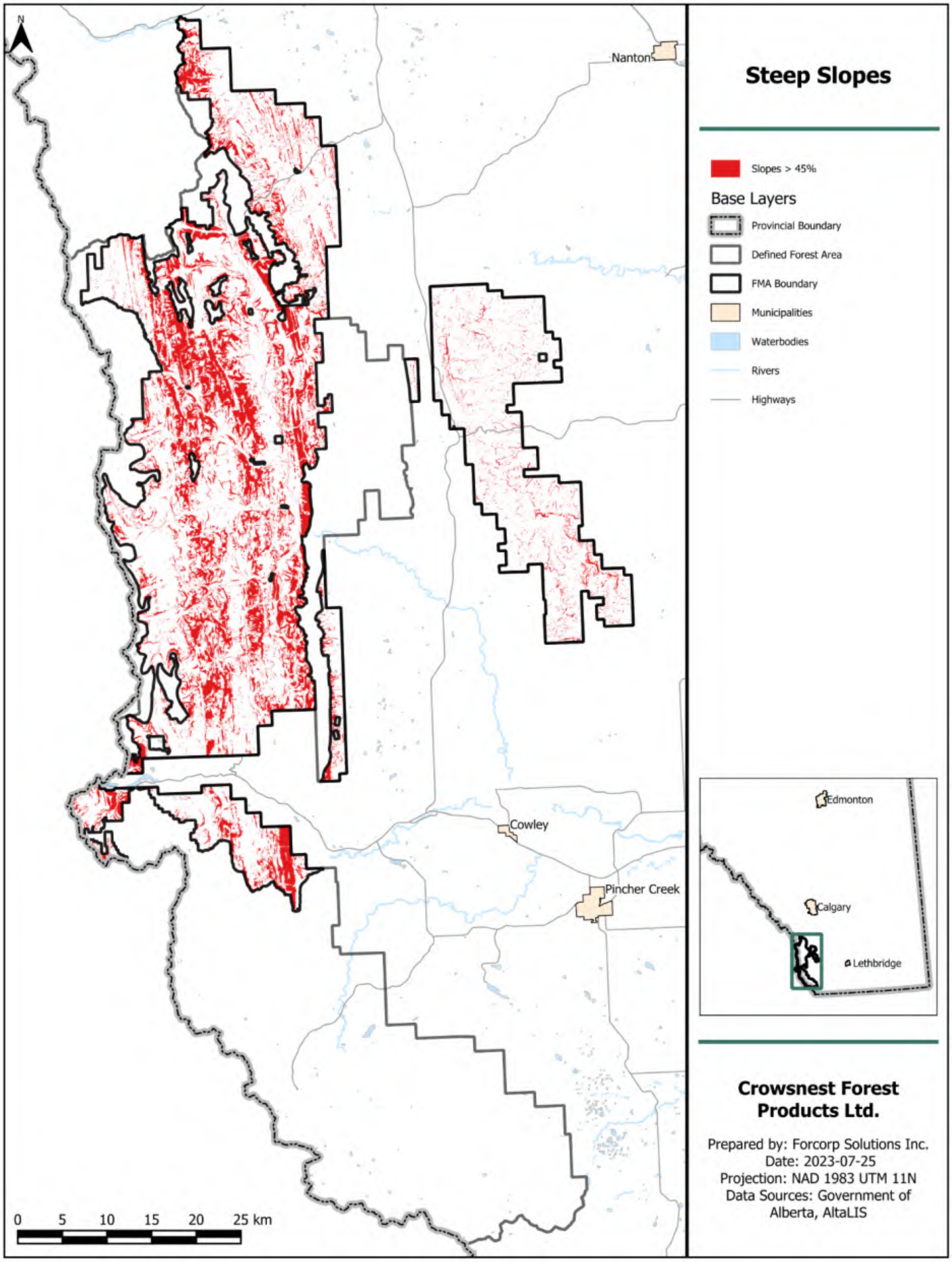

Figure 2-46: Areas with slopes greater than 45% that intersect the Crowsnest Forest Products forest management agreement area.

2.4.47 Operational Deletions and Deferrals

Item	Description
Sources:	Crowsnest Forest Products
Source Filenames:	Opdeletions_20230811_toForcorp_20230906.shp (received 6 September 2023)
Description of the Source Files:	Operational Deletions identified by Crowsnest Forest Products within the C5 defined forest area.
Projected Coordinate Systems:	NAD 1983 UTM Zone 11N
Important Attributes:	OP_DELETION, OP_DEFERRAL
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_opdeletions
Output Description:	Operational Deletions and deferrals identified by Crowsnest Forest Products within the Crowsnest Forest Products defined forest area
Output Attributes:	OP_DELETION, OP_DEFERRAL
Polygon Area	Total Area: 6,328 ha Operational Deletions: 2,547 ha Operational Deferrals: 3,781 ha

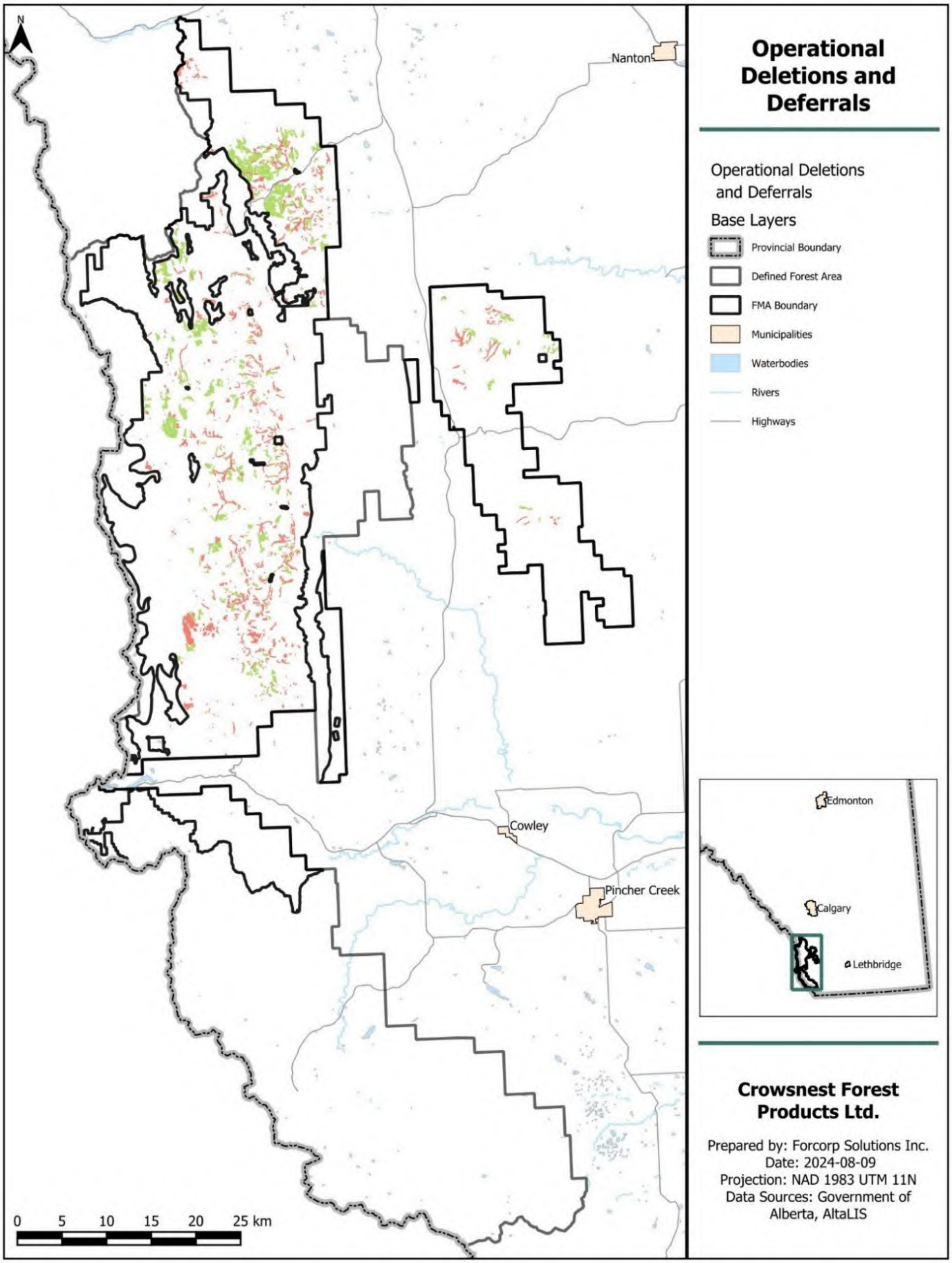

Figure 2-47: Operational deletions that have been identified within the Crowsnest Forest Products defined forest area.

2.4.48 Seismic Lines and Cutlines

Item	Description
Source:	AltaLIS
Source Filename:	Access.gdb\cutline (publication date: 13 August 2021)
Description of the Source File:	Seismic Lines and Trails for the Province of Alberta
Projected Coordinate System:	NAD_1983_10TM_AEP_Forest
Important Attributes:	FEATURE_TY
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Create new field named SEISMIC 4. Populate SEISMIC field with "SEISMIC 5. Buffer seismic line and trail layer by 3 meters on either side to create a 6-meter seismic line polygon layer 6. Repair any irregular geometries that may be present 7. Create a singlepart layer 8. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	This Layer will not be included in the TSA landbase but will be incorporated into the classified landbase. For the modelling landbase an area calculation for the gross polygon area, and the amount of seismic and forest area will be calculated so that the amount of seismic area can be incorporated in the Timber Supply without requiring this linework.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_seismic
Output Description:	Seismic lines and trails that intersect the Crowsnest Forest Products defined forest area
Output Attributes:	SEISMIC
Polygon Area	Total Area: 2,265 ha Linear Distance: 3,776 km

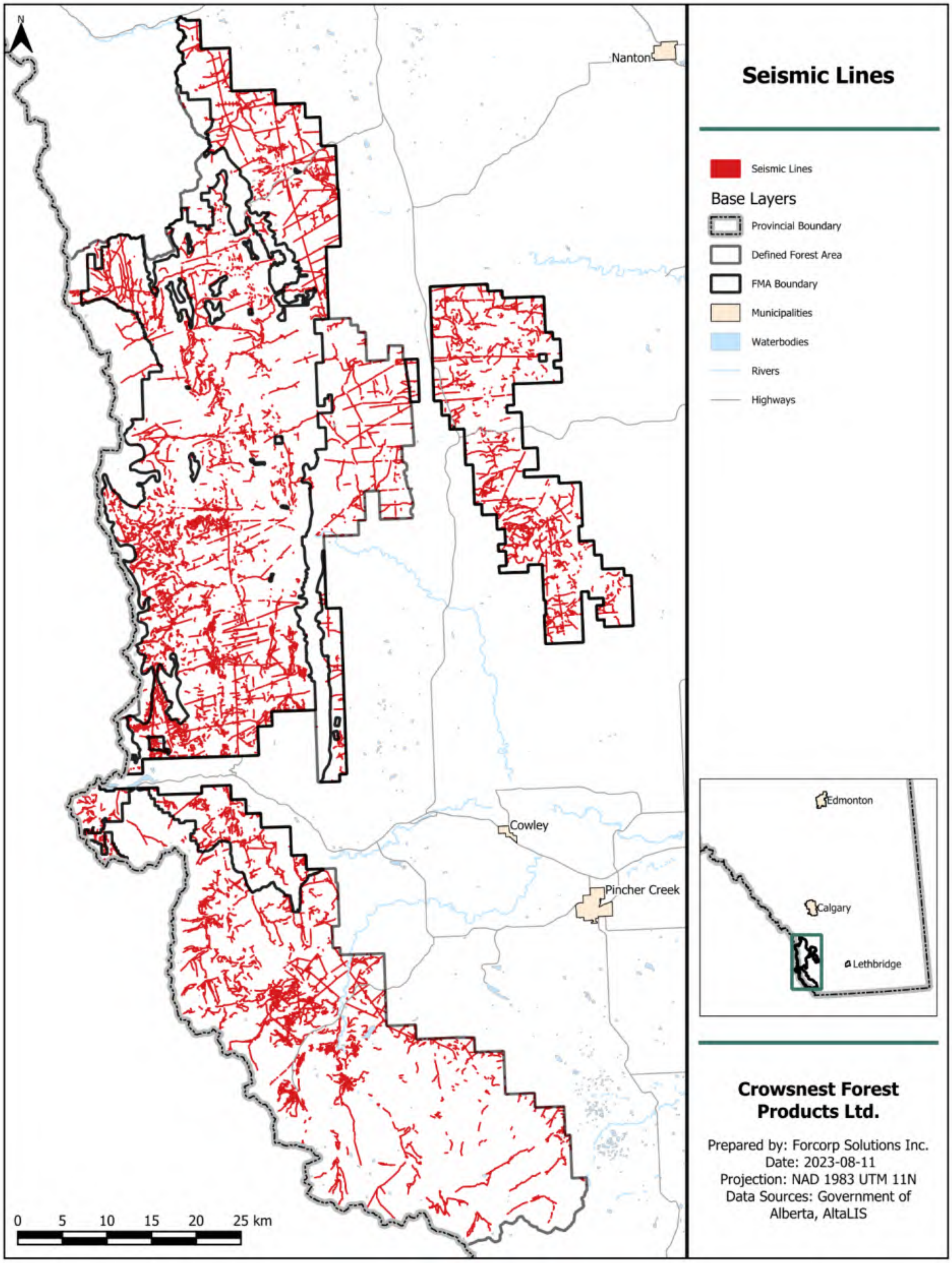

Figure 2-48: Seismic lines and cutlines that are located within the Crowsnest Forest Products defined forest area.

2.4.49 Designated Trails

Item	Description
Sources:	Government of Alberta
Source Filenames:	CrownLandTrails.shp
Description of the Source Files:	Designated and Provincial Trails in Alberta
Projected Coordinate Systems:	WGS 1984 Web Mercator (auxiliary sphere)
Important Attributes:	Designatio
Required Processing:	1. Project the source layers to NAD 1983 Zone 11N (SRID 26911) 2. Clip projected layers to the DFA boundary 3. Create new field named TRAIL 4. Populate TRAIL field with "TRAIL" 5. Buffer trails lines by 10 meters on either side to create a 20-meter-wide trail polygon layer 6. Repair any irregular geometries that may be present 7. Create a singlepart layer 8. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	This Layer will not be included in the TSA landbase but will be incorporated into the classified landbase.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_trails
Output Description:	Provincial and designated trails within the Crowsnest Forest Products defined forest area
Output Attributes:	TRAIL
Polygon Area	Total Area: 1,805 ha Linear distance: 912 km

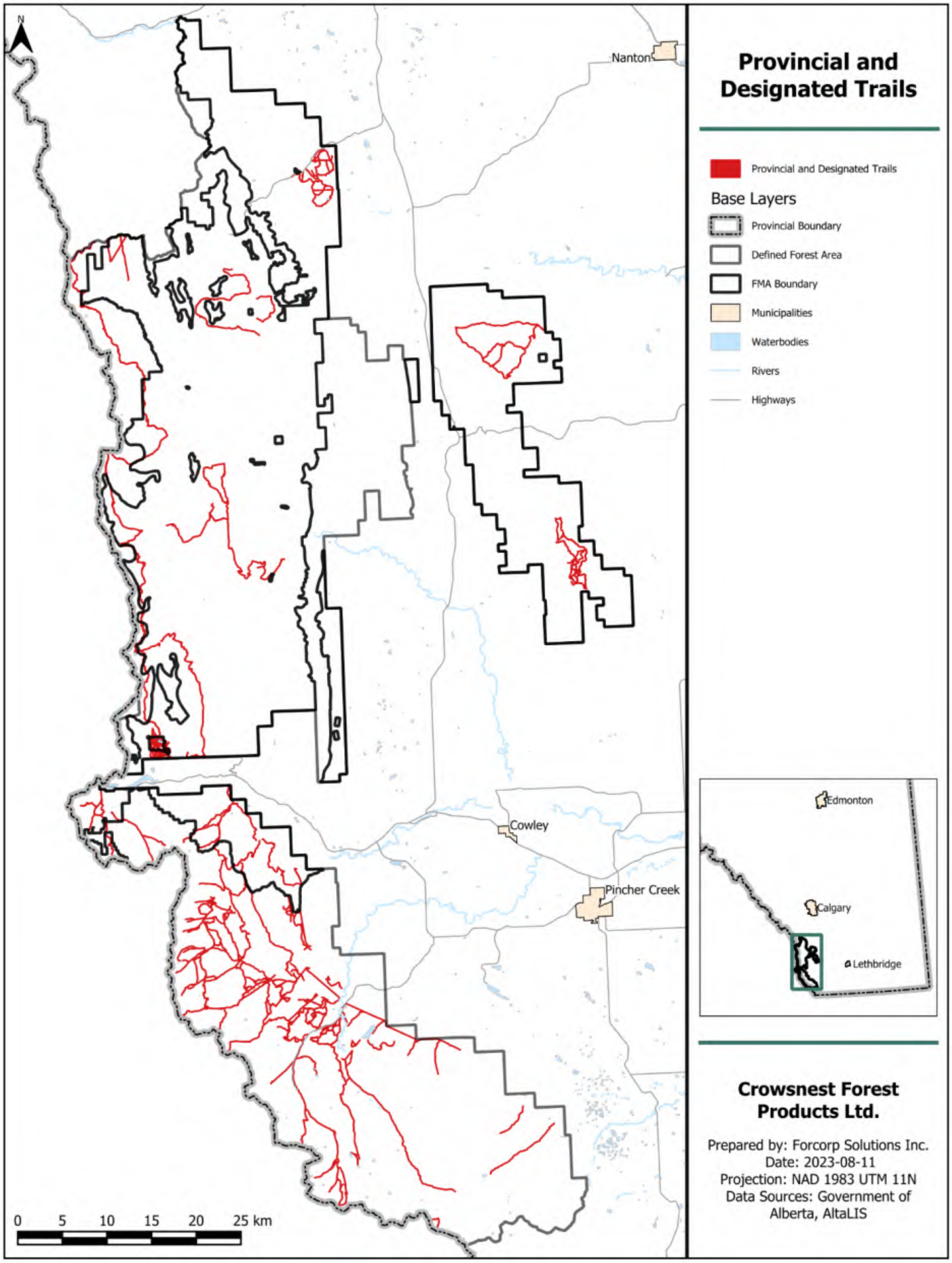

Figure 2-49: Designated trails that are located within the Crowsnest Forest Products defined forest area.

2.4.50 Hard Linear Features

Item	Description
Sources:	Crowsnest Forest Products, AltaLIS, Government of Alberta
Source Filenames:	Layers were created in Sections 2.4.1 and 2.4.5 for the AVI and FMU Access.gdb\cutline for the Seismic layer (as presented in 2.4.44) ProvincialGrid.gdb for the 7-ha grid
Description of the Source Files:	AVI, unbuffered seismic lines, 7 ha grid, FMU boundary
Projected Coordinate Systems:	NAD_1983_10TM_AEP_Forest
Important Attributes:	HLIN
Required Processing:	1. Use the source layers as inputs to run the songbird grid tool that is included in the Non-Timber Assessments tool package 2. Select the polygons where hard linear feature coverage is >= 1% 3. Dissolve the product layer to remove internal linework 4. Repair any irregular geometries that may be present 5. Create a singlepart layer 6. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	This layer is created as an input for the Songbirds Non-Timber Assessment Model
Programs:	ArcGIS 10.3; PostgreSQL/PostGIS
Output Filename:	i_hlin
Output Description:	Polygons where hard linear feature coverage is > 1%
Output Attributes:	HLIN
Polygon Area:	Total Area: 14,118 ha

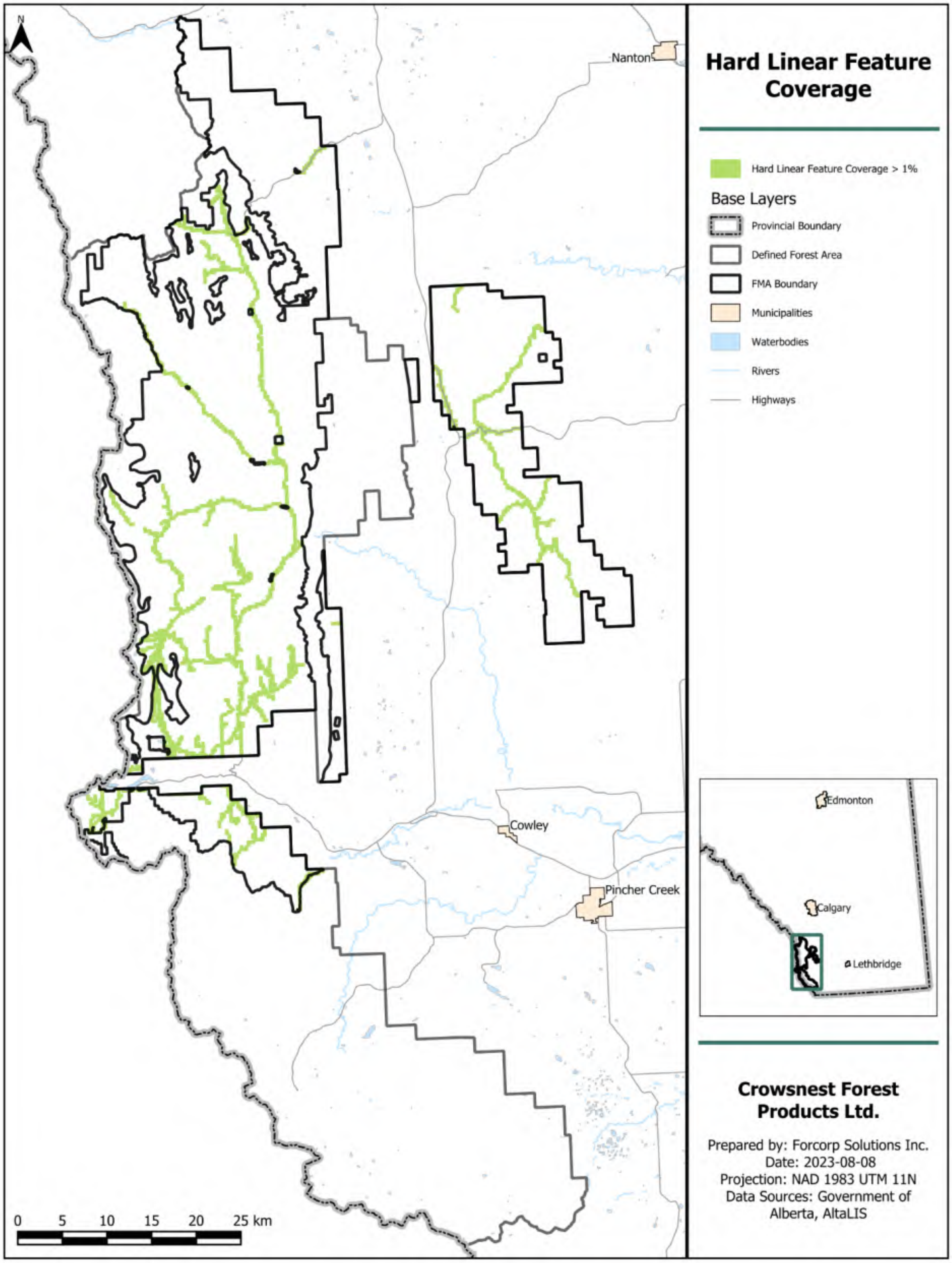

Figure 2-50: Polygons from a 7-hectare grid overlay within the Crowsnest Forest Products forest management agreement area where hard linear feature coverage is greater than 1% of the total polygon area.

2.4.51 Cutblocks – Post-AVI Cutblocks

Item	Description
Sources:	Crowsnest Forest Products
Source Filenames:	Several source files from the operators
Description of the Source Files:	Cutblock boundaries
Projected Coordinate Systems:	NAD 1983 Zone 11N
Important Attributes:	OPENING NUMBER, HARVEST CODES, OWNERSHIP, HARVEST YEAR, HARVEST STRATUM
Required Processing:	1. Merge source layers into a single input layer 2. Dissolve the product layer to resolve internal linework 3. Repair any irregular geometries that may be present 4. Create a singlepart layer 5. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Post AVI cutblocks include all cutblocks that are part of the ARIS reconciliation population that were not visible in the AVI. The unmapped retention of some cutblocks that were visible in the AVI were included to allow ARIS reconciliation to be conducted.
Programs:	PostgreSQL/PostGIS
Output Filename:	i_cutblocks
Output Description:	Harvested Cutblocks in the Crowsnest Forest Products defined forest area
Output Attributes:	CC_OPEN, CC_HARVCODE, CC_OWNER, CC_YEAR, CC_STATUS
Polygon Areas:	Total Area: 1,340 ha

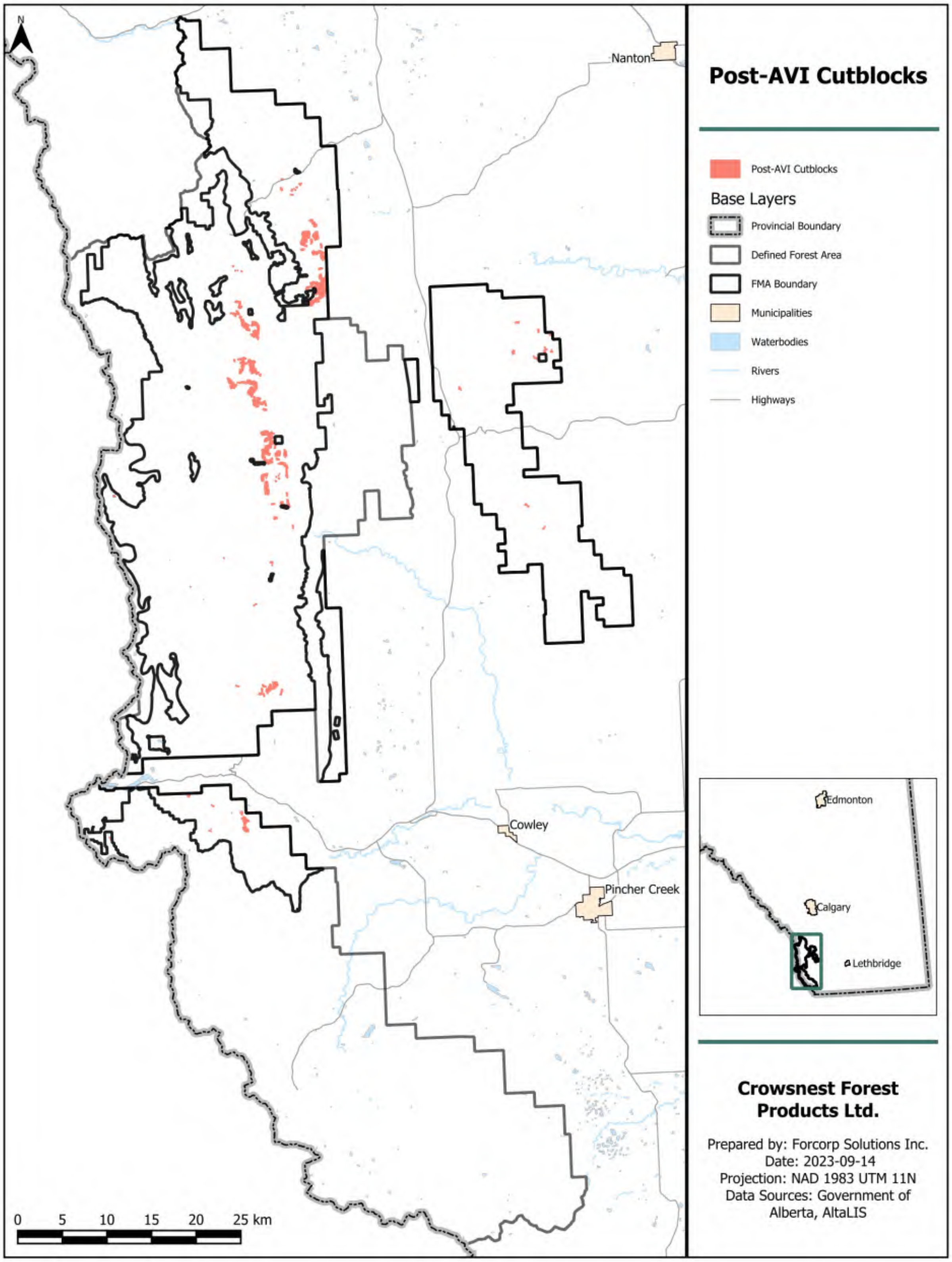

Figure 2-51: Cutblocks within the Crowsnest Forest Products defined forest area that are part of the ARIS reconciliation population and were harvested after the AVI photo date.

2.4.52 Planned Cutblocks

Item	Description
Sources:	Crowsnest Forest Products
Source Filenames:	Several source files from the operators
Description of the Source Files:	Planned cutblocks
Projected Coordinate Systems:	NAD 1983 Zone 11N
Important Attributes:	Opening number, Ownership
Required Processing:	1. Merge source layers into a single input layer 2. Dissolve the product layer to resolve internal linework 3. Repair any irregular geometries that may be present 4. Create a singlepart layer 5. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	Blocks in this layer are either planned for harvest or harvested after 1 May 2023
Programs:	PostgreSQL/PostGIS
Output Filename:	i_plannedblocks
Output Description:	Planned cutblocks within the Crowsnest Forest Products defined forest area
Output Attributes:	PLCC_OPEN, PLCC_OWNER, PLCC_YEAR, PLCC_STATUS
Polygon Areas:	Total Area: 2,975 ha

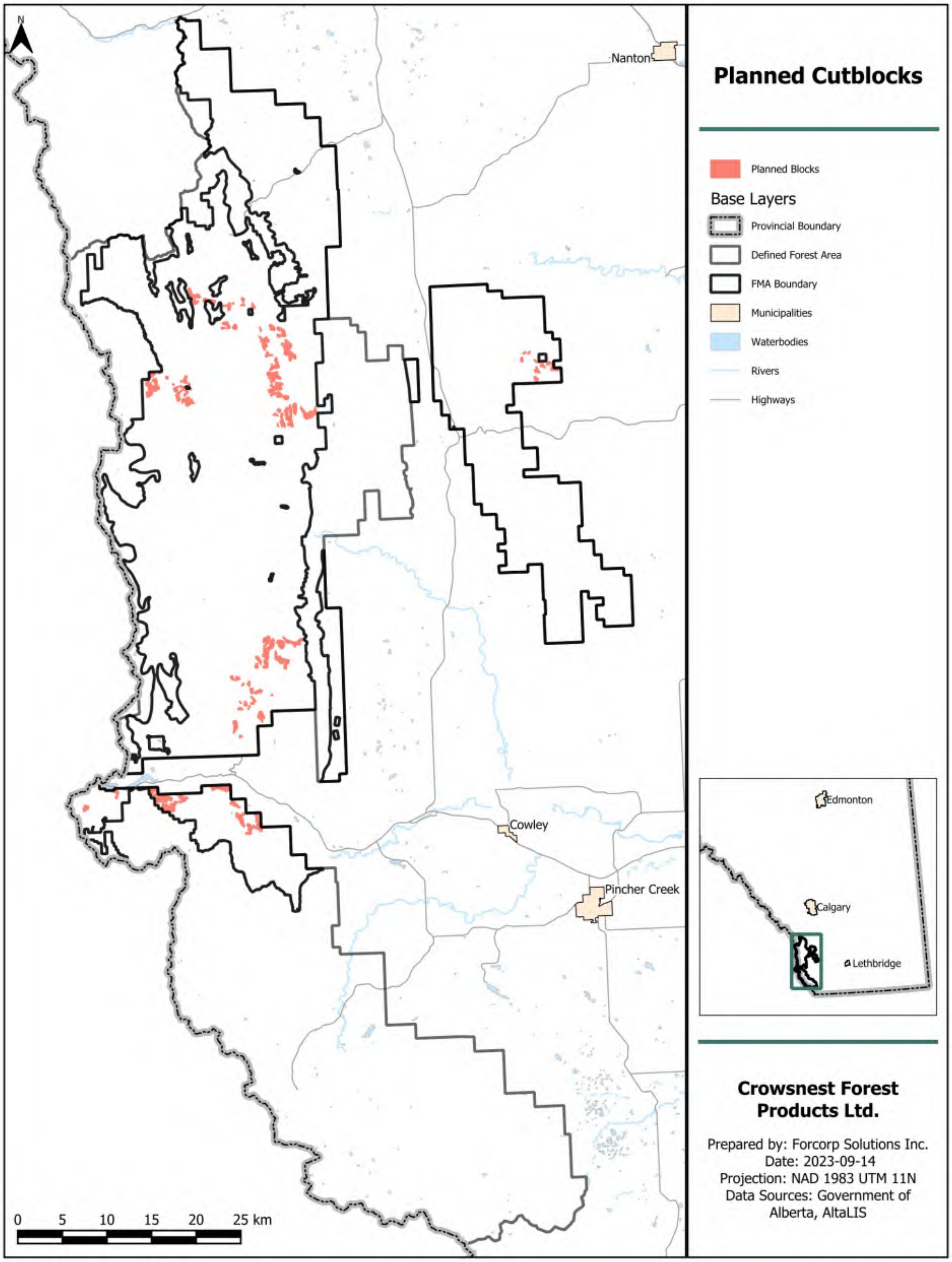

Figure 2-52: Planned cutblocks within the Crowsnest Forest Products defined forest area.

2.4.53 RSA Survey Boundaries

Item	Description
Sources:	Crowsnest Forest Products
Source Filenames:	Several source layers from forestry operators
Description of the Source Files:	RSA Survey data
Projected Coordinate Systems:	NAD 1983 Zone 11N
Important Attributes:	RSA ID number, Survey Year, Stratum
Required Processing:	1. Merge source layers into a single input layer 2. Dissolve the product layer to resolve internal linework 3. Repair any irregular geometries that may be present 4. Create a singlepart layer 5. Recalculate polygon areas and perimeters
Assumptions/Processing Issues:	None
Programs:	PostgreSQL/PostGIS
Output Filename:	i_rsa
Output Description:	RSA survey boundaries within the Crowsnest Forest Products defined forest area
Output Attributes:	RSA_ID, RSA_YEAR, RSA_STRATUM
Polygon Areas:	Total Area: 5,253 ha

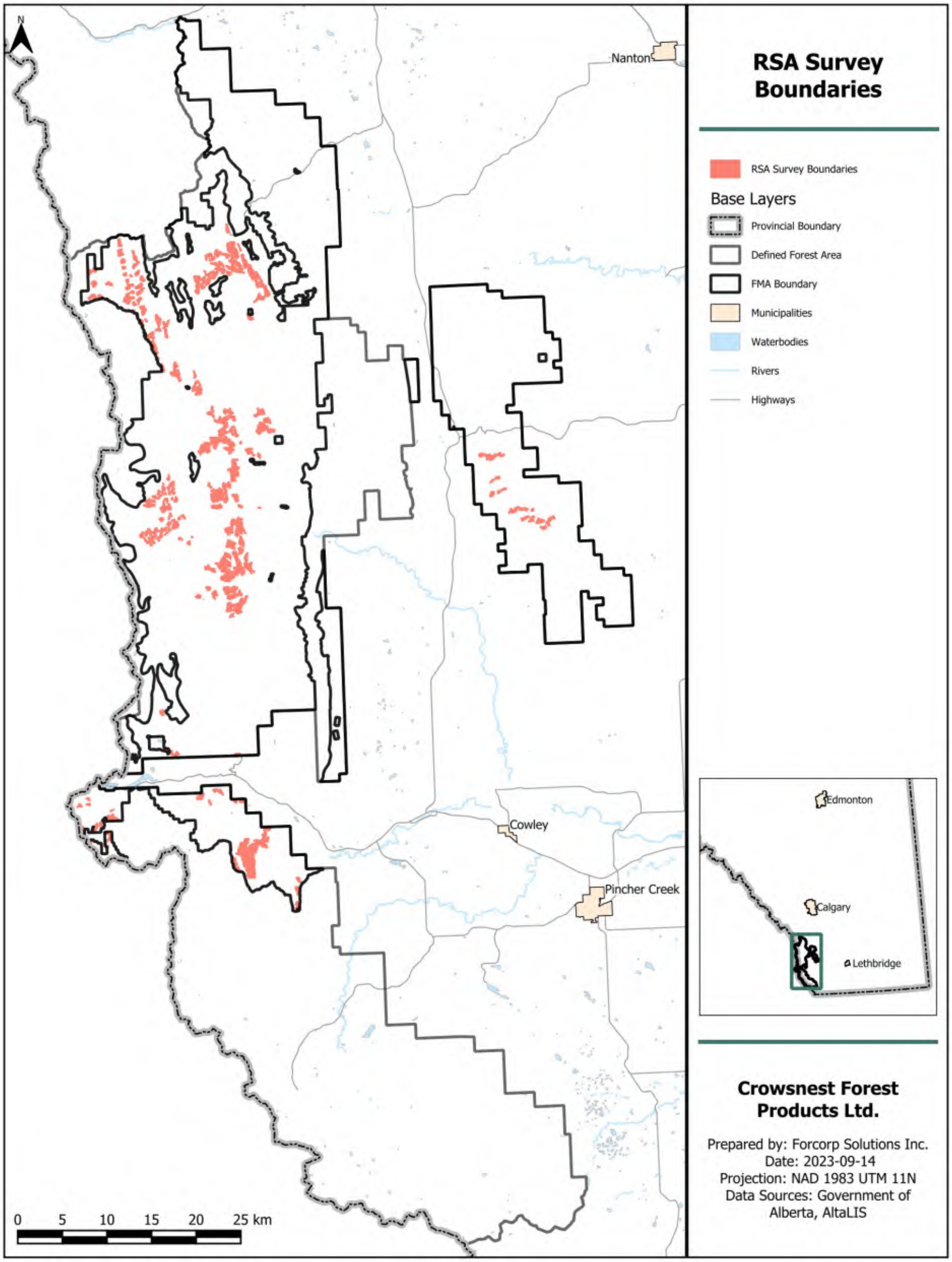

Figure 2-53: Regeneration Survey of Alberta (RSA) survey boundaries located within the Crowsnest Forest Products defined forest area.

2.4.54 ARIS Data

Item	Description
Sources:	Government of Alberta
Source Filenames:	Source ARIS data from GOA
Description of the Source Files:	Tabular ARIS database extract
Important Attributes:	All ARIS attributes
Required Processing:	1. Review the ARIS data and compare it to the harvest areas in the AVI 2. Resolve the inconsistencies between the ARIS data and AVI and fill out the ARIS spreadsheet 3. Extract the important attributes listed below
Assumptions/Processing Issues:	With each opening having multiple records in the database it is difficult to summarize block history for some of the fields
Programs:	Microsoft Excel, PostgreSQL/PostGIS
Output Filename:	Excel file and i_aris (which is joined to the landbase)
Output Description:	ARIS Reconciliation Spreadsheet
Output Attributes:	ARIS_OPENING, ARIS_FIELDNUM, ARIS_OPERATOR, ARIS_SKIDCLEAR, ARIS_RESETYEAR, ARIS_AGE, ARIS_STRATUMDECL, ARIS_LBDESIG, ARIS_YCSTRATUM, ARIS_NHHAREA

3 Assembly of the Landbase

3.1 Overview

This section describes the methods and procedures used to create the final landbase files. Figure 3-1 illustrates the conceptual process for creating the three landbase datasets previously described (Section 1.3). The process of bringing the various data layers together is called a 'multi-union'. This section describes this concept, the clean up process of the resulting multi-union layer, and details how seismic lines and designated trails are handled in the resulting landbases.

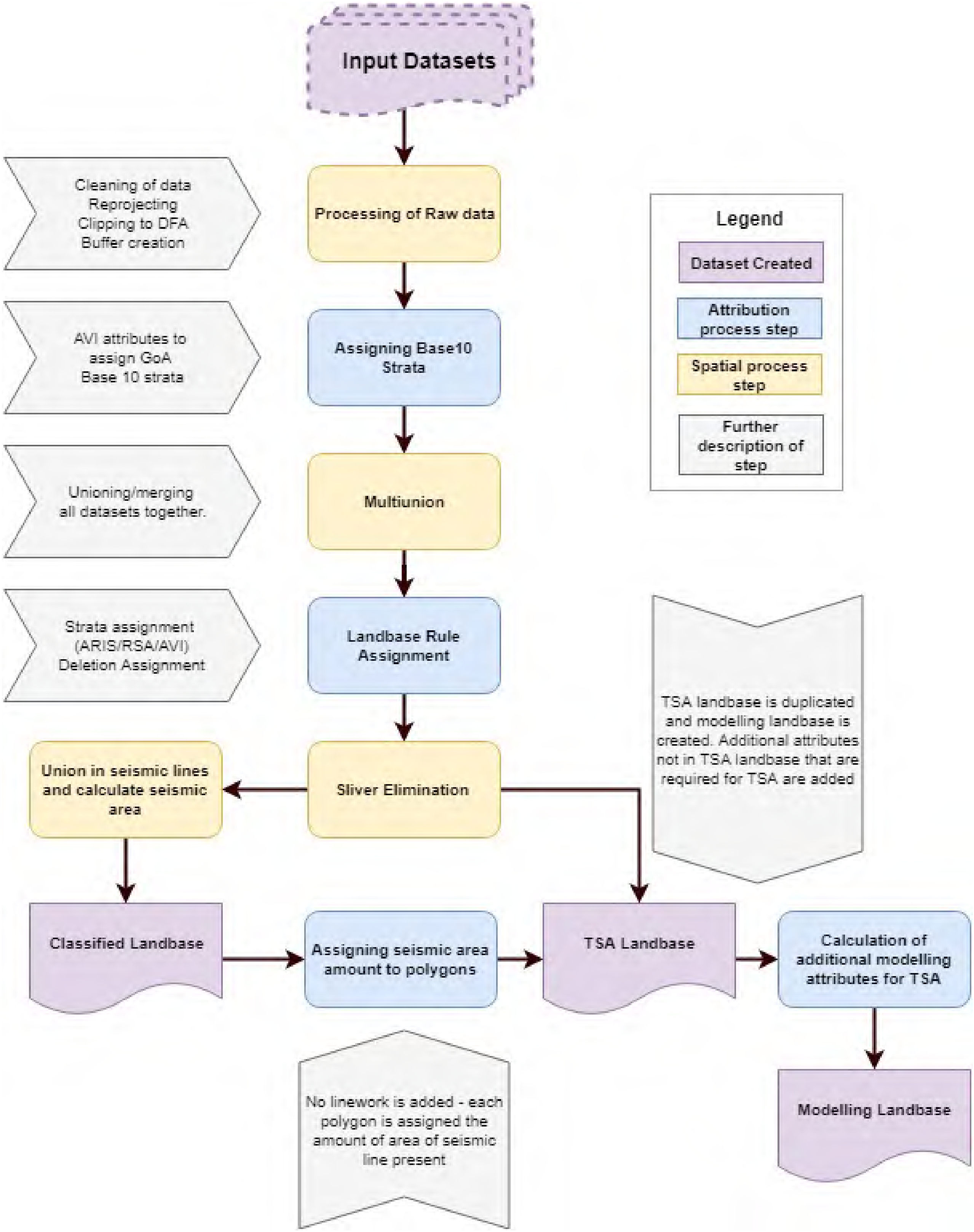

Figure 3-1: Overview of the landbase creation process.

3.2 Multi-Union

The underlying structure of each of the landbases is the Alberta Vegetation Inventory (AVI). To meet ARIS reconciliation objectives, modifications to the approved AVI were conducted by photo interpreters. These modifications included updates to opening numbers as well as other attributes. These changes to the AVI will be subject to a further approval process outside of the development of this forest management plan. All the other primary linework datasets, as presented in Section 2.4, are combined with the AVI using a union function to create a product that contains all linework and attributes from these source layers. Following the completion of the union processing temporary field values are assigned to summarize the landbase attributes. Once these values have been processed, polygon sliver elimination occurs. Table 2-1 lists the layers that are a part of the spatial multi-union as well as the layers that have been included as proxies.

3.3 Polygon Reduction

The process of amalgamating spatial datasets from various sources results in the creation of many sliver polygons that are artifacts of spatial processing. Typically, these slivers do not identify any unique characteristic on the landbase and can be eliminated with no significant impact on subsequent analyses.

For the landbase assessment, slivers were deleted using the following rule set:

1. Any polygon < 0.01 ha can be dissolved into any adjacent feature
2. Polygons between 0.01 ha and 0.1 ha are subject to elimination based on group assignments
3. Any slivers identified as part of a harvested cutblock can only be eliminated into another cutblock polygon with the same opening number
4. Any boundary between polygons with different landbase deletion code groups cannot be eliminated (Table 3-1)

Table 3-1: Summary of elimination groups used for sliver elimination.

Group Code	Deletions associated with the group code
Group 1	D_ADMIN, D_AVI
Group 2	D_ANTHRO
Group 3	D_HYDRO, D_BUF, D_NONFOR
Group 4	D_MOIST, D_TPR, D_DENSITY, D_SLOPE, D_OPDEL, D_SP
Group 5	D_NATDIST, D_BLOCK, D_STRUC

During the multi-union process, slivers less than 0.01 ha are eliminated as each layer is added to the landbase. This reduces the number of polygons that need to be eliminated at the end of the process and reduces the processing time required to remove them. Slivers between 0.01 ha and 0.1 ha are eliminated after the landbase is created and the polygons have been classified. Once the sliver elimination process is completed, the resulting file is checked for topology errors such as gaps or overlaps created in the multi-union process. If overlaps or gaps were created, they are manually cleaned without a bias as to what feature takes priority as the area of overlap or gaps are minimal (usually less than 0.01 ha). Such issues are rare occurrences. Table 3-2 summarizes the difference in sliver count and area for DFA before and after the elimination process. It shows that total landbase areas have been changed very little due to sliver elimination, but that the polygon reduction was substantial.

Table 3-2: Summary of the sliver elimination process based on the elimination groups. Slivers are identified as any polygon smaller than 0.1 ha in area.

Elimination Group	Pre-elimination		Post-elimination	
	Sliver Count	Total Area (ha)	Sliver Count	Total Area (ha)
Group 1	7,047	253.8	49	0.6
Group 2	12,169	468.9	442	18.0
Group 3	40,169	1,555.1	2,552	102.6
Group 4	56,231	2,218.8	8,574	349.4
Group 5	409	16.9	404	16.6
X	40,297	1,568.7	40,297	1,568.7
Total	**156,322**	**6,082.2**	**52,318**	**2,056.0**

3.4 Seismic Line and Designated Trail Approach

Seismic lines and designated trails are linear feature layers that are located throughout the DFA. Seismic lines and designated trails are required to be included in the Classified Landbase as spatial features. With the presence of this linework in the landbase, creating a spatial harvest sequence becomes difficult as contiguous forest areas can be split into multiple polygons that the timber supply could identify as independent units. To account for this, separate approaches have been developed for the classified landbase and the modelling landbase.

3.4.1 Classified Landbase

Seismic lines, when combined with the landbase, created a 50% increase in polygon count across the DFA. Therefore, in keeping with other FMP processes, seismic lines are only cut into the classified landbase. However, the seismic lines in the classified landbase are identified as non-contributing which is a fundamental change on how seismic lines are integrated into the landbase process. Table 3-3 summarizes the coverage of seismic lines on both the active and passive within the classified landbase. The 865 ha of seismic area classified as “Active Landbase” are categorized as such because the area falls within previous cutblocks, planned cutblocks, or has another assignment that overrides the polygon being assigned as passive landbase.

Table 3-3: Summary of the amount of area in the classified landbase found within seismic lines based on the assigned yield stratum.

Yield Stratum	Active Landbase Seismic Area (ha)	Active Landbase Total Area (ha)	Passive Landbase Seismic Area (ha)	Passive Landbase Total Area (ha)	Total Landbase Seismic Area (ha)	Total Landbase Total Area (ha)
N_HW	95.2	12,114.4	28.0	3,153.3	123.2	15,267.6
N_PLMIX	9.1	1,139.9	8.0	807.2	17.1	1,947.2
N_SXMIX	12.7	1,625.9	9.0	893.3	21.7	2,519.2
N_PL	275.8	39,780.2	212.1	30,577.1	487.9	70,357.4
N_SW	103.7	16,395.8	146.7	21,426.5	250.5	37,822.3
N_FD	76.9	10,909.2	30.7	6,179.0	107.6	17,088.1
J_PL	122.8	8,082.7	0.6	69.7	123.4	8,152.4
J_SW	69.8	2,530.3	0.0	6.2	69.8	2,536.5
R_PL	98.5	13,519.1	1.4	293.8	99.9	13,812.9
X	0.0	0.0	957.3	180,844.4	957.3	180,844.4
Total	**864.5**	**106,097.4**	**1,393.8**	**244,250.7**	**2,258.4**	**350,348.1**

3.4.2 Modelling Landbase

To reduce model memory and computational overhead, seismic lines are represented in the modelling landbase through area reductions. The modelling landbase takes the polygons from the TSA landbase and reassigns the total polygon area for each polygon as 'ha_gross'. The amount of seismic area within each polygon and the net forest area within each polygon is then calculated based on the classified landbase and these areas are assigned to the 'ha_seismic' and 'ha_net' fields. In addition to this, if a seismic line or designated trail is present within a modelling landbase polygon then this is noted in the 'seismic' and 'trail' fields. No area adjustment is calculated when designated trails are present.

3.5 Variance between 2005 and 2025 Landbases

The 2005 and 2025 FMP landbases were compared to identify noteworthy changes on landscape classifications. The spatial extent of the two landbases is different, resulting in an assessment where both datasets overlap. The main change that resulted in the boundary difference is the addition of parks and protected areas that removed operable landbase from the FMU. The area now under parks and protected areas (Figure 2-4) within the C5 FMU is approximately 160,000 ha, leaving approximately 190,000 ha for comparison between the plans. Two other changes were identified that indicate changes in how data is collected and stored:

- AVI Update: 2.1.1 standard
- Forest Management Practice: ARIS reconciliation, RSA programs, and structure retention

Over 85,000 ha of landbase has transitioned to a different SP1 call from the 2005 data source. Lodgepole pine (PL) was the target destination for over 90% of the transition. Grouping pine species (Px) from the 2005 landbase into one category (i.e., Pa to Pl), the total transitioned area was 28,000 ha. Englemann spruce to pine was the largest transition outside of the Px-to-Pl change (12,000 ha) with Px into Se representing the second largest with 9,000 ha.

A net decrease in administrative deletions was observed within the 2025 operating areas of the DFA (-2,000 ha). Most change came from change in policies and orders-in-council (75%). A total of 1,000 ha of new administrative boundaries has been added in the 2025 landbase that were not part of the 2005 dataset.

A total of 77,000 ha of landbase has remained active/operable since 2005. A total of 29,000 ha of passive landbase in the 2005 dataset has been changed to active in the 2025 landbase mostly due to the reduction of subjective deletions (30%). A total of 26,000 ha has been removed from the active landbase in 2025, 30% of which is now classified as steep slopes.

Fire deletions in the 2005 landbase accounted for 4,000 ha of passive area, while only 50 ha of land is classed as fire deletion in 2025 as the previous fire area is now classified as vegetated stands in the new AVI.

With the new operating ground rules (OGRs) and new watercourse layer used in the 2023 landbase, there is a net increase of 9,000 ha in the overall hydrological buffer deletions, however many of these are in spatially different locations due to the increased accuracy of the water feature data.

Areas classified as unproductive (TPR) was reduced by 49% from the 2005 landbase. 10% of unproductive area is shared between landbases. 27% of total unproductive area between the two plans are newly assigned to the 2025 landbase, and 62% have been switched to productive from the 2005 landbase.

In both landbases, the largest deletion sources based on landform and vegetation were from steep slopes and non-forested land.

Table 3-4 outlines the main changes between the two landbases. This table uses the discrete categories, not the landbase hierarchy values and therefore does not match the hierarchy values in Table 5-2.

Table 3-4: Main differences between 2005 and 2025 landbases.

Category	2005	2025	Net Difference
Operable Landbase	133,894	106,097	-27,797
Hydrological Buffers	2,585	12,637	10,052
AVI TPR U	18,680	9,863	-8,817
Parks and Protected Areas	2,301	2,571	270
Steep Slope Classification	84,563	41,578	-42,985
Classified Fire	4,000	50	-3,950
MPB High + Extreme	32,961	34,330	1,369
AVI Lead Species Transition	Se	Pl	

* All units in Hectares (ha)

4 Development of the Net Landbase

4.1 Overview

This section describes how the AVI data, and the combination of all spatial overlays were used to stratify and then classify the landbase for the purpose of determining the contributing (active or managed) landbase and the yield strata that will contribute to Annual Allowable Cut (AAC). This section is divided into parts that will allow the reader to review the specific data and business rules that contribute to the landbase classification. A combination of tables, flow charts, and narratives are used to describe the process and the data. The specific scripts and models used to perform these calculations are presented graphically in Figure 3-1 and are provided in the submission package.

The order in which flowcharts and other information are presented in this section represents the order in which they were applied and is thus highly important in processing. Values that come first will be at the forefront when conflicts arise between values. For example, spatial resolution of datasets can create results that are not intuitive in the coding world. Slivers and misalignments of datasets will result in the need to place caveats within the code to handle them (e.g. RSA blocks on top of rivers). The location as to where these caveats occur affects the result, and instances of these caveats will be seen in the provided figures and scripts.

The general procedure for developing the net down database is as follows:

1. Develop yield classes (Section 4.3)
2. Apply exclusion rule sets (Section 4.4)
3. Create final stratification fields (Section 4.5)
4. Create final landbases (Section 4.6)

All input fields in the sections to follow are sourced from the input datasets "important attributes" in Section 2.4.

4.2 Assignment of Opening Numbers and ARIS Reconciliation.

There are multiple sources of opening numbers throughout the landbase including the AVI (Section 2.4.5), cutblocks layer (Section 2.4.51), planned blocks layer (Section 2.4.52), RSA (Section 2.4.53), and ARIS reconciliation table (Section 2.4.54). Opening numbers in the cutblocks layer will override values in the AVI as there are instances where events such as post-fire salvage have resulted in new opening numbers superseding an older opening number. Opening numbers in the planned blocks layer are only assigned if no other opening number has been assigned to the polygon. The ARIS numbers are used to join the tabular ARIS data to the landbase so that the data field required to complete ARIS reconciliation are present.

4.3 Development Of Yield Classes

As discussed, the stratification of the landbase is dependent upon the data that goes in. As part of the multi-union, RSA and ARIS data are linked to the AVI attribute data. The order in which datasets are added to the stratification process affects final strata calls. For the C5 landbase, AVI underlies all other information so that when other information does not exist the AVI data provides the strata calls. For any post-1995 cutblock, ARIS data overwrites the AVI data, and if there is existing RSA performance survey block information, RSA will overwrite both the AVI and ARIS information.

4.3.1 AVI Stratification

Stratification relies on coding which uses the information from the AVI dataset. To stratify the AVI, the fields shown below are calculated. From these fields, a final stratum call can be made on each polygon in each dataset.

- <sp>_ORD: overstorey species order (ranking), where <sp> represents the various species.
- U<sp>_ORD: understorey species order (ranking), where <sp> represents the various species.
- <sp>_PCT: overstorey species percent (based on crown closure), where <sp> represents the various species.
- U<sp>_PCT: understorey species percent (based on crown closure), where <sp> represents the various species.
- HARDPCT: total overstorey deciduous component expressed as a proportion of 10.
- UHARDPCT: total understorey deciduous component expressed as a proportion of 10.
- SOFTPCT: total overstorey coniferous component expressed as a proportion of 10.
- USOFTPCT: total understorey coniferous component expressed as a proportion of 10.
- LEAD_DEC: leading overstorey deciduous species based on order of deciduous species (<sp>_ORD variables).
- ULEAD_DEC: leading understorey deciduous species based on order of deciduous species (U<sp>_ORD variables).
- LEAD_CON: leading overstorey coniferous species based on order of coniferous species (<sp>_ORD variables).
- ULEAD_CON: leading understorey coniferous species based on order of coniferous species (U<sp>_ORD variables).
- C_CODE: Broad cover group for the stand overstorey (based on sum of <sp>PCT values).
- UC_CODE: Broad cover group for the stand understorey (based on sum of U<sp>PCT values).
- DRULE: the leading overstorey deciduous assignment for the purpose of determining the GOA Strata (function of <sp>_ORD variables).
- UDRULE: the leading understorey deciduous assignment for the purpose of determining the GOA Strata (function of U<sp>_ORD variables).
- CRULE: the leading overstorey coniferous assignment for the purpose of determining the GOA Strata (function of C_CODE and <sp>_PCT variables).

- UCRULE: the leading understorey coniferous assignment for the purpose of determining the GOA Strata (function of UC_CODE and U<sp>_PCT variables).
- B10_STRATA_GOA: the extended GOA planning strata code for the stand overstorey (derived as a function of C_CODE, DRULE, CRULE, <sp>_ORD, and <sp>_PCT variables).
- B10_USTRATA_GOA: the extended GOA planning strata code for the stand understorey (derived as a function of UC_CODE, UDRULE, UCRULE, U<sp>_ORD, and U<sp>_PCT variables).
- B10_STRATA_CODE: the overstorey strata assigned based on the B10_STRATA_GOA code.
- B10_USTRATA_CODE: the understorey strata assigned based on the B10_USTRATA_GOA code.
- B10_STRATA_NAME: the name of the overstorey strata assigned based on B10_STRATA_GOA and B10_STRATA_CODE.
- B10_USTRATA_NAME: the name of the understorey strata assigned based on B10_USTRATA_GOA and B10_USTRATA_CODE.
- AGE: age of the overstorey stand, calculated using the reference year or landbase effective year (2023) minus ORIGIN.
- UAGE: age of the understorey stand, calculated using the reference year or landbase effective year (2023) minus UORIGIN.

4.3.2 ARIS and RSA Stratification

ARIS and RSA stratifications occur outside of Postgres processing. In both instances the stratification is provided by external source data. Both RSA and ARIS data tables are described in Sections 2.4.53 and 2.4.54. The tabular ARIS data are joined according to an opening number (aris_opening) and RSA data are joined to the landbase through the multi-union process. Strata calls originating from ARIS are initially placed in a field named “aris_ycstratum” while calls originating from RSA are placed in a field named “rsa_stratum”. This ensures that all possible strata calls are maintained in the landbase.

4.3.3 Defining Managing Layers

Stands in the landbase have both overstorey and understorey characteristics. Crowsnest Forest Products has identified a selection of AVI polygons where stands will be managed for the understorey that is based on a defined rule set. This section creates the field that will be referenced in further sections for stratification purposes.

- ***AVI_Storey***: This field identifies whether the AVI polygon is to be managed for the:
  - Overstorey (1) or
  - Understorey (2) – understorey is utilized when an AVI polygon has been identified by Crowsnest Forest Products as a ‘switch stand’.
- The rules used to define stands that become a switch stand:
  - There is a valid understorey (b10_ustrata_name)

- The Base 10 understorey cover code (uc_code) is C or CD
    - The Base 10 understorey stratum is not black spruce
    - Overstorey density integer is less than 30
    - Understorey density integer is greater than 40
    - Understorey height is greater than or equal to 5 meters
    - Understorey TPR is not "unproductive"
    - The understorey pattern (upattern) is greater than or equal to 3;
    - The understorey TPR (utpr) is not equal to "U"; and
    - Not an existing cutblock or harvest area (f_block).

Figure 4-1 presents the program logic used to assign AVI storey to the net landbase and values are defined in Table 4-1.

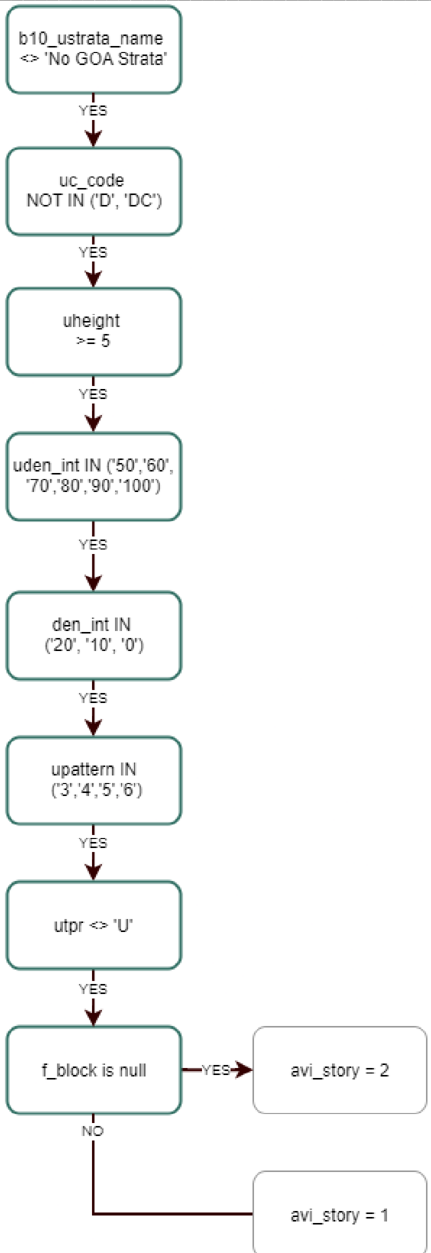

Figure 4-1: Methodology for assigning AVI storey (avi_storey) to the polygons in the net landbase.

Table 4-1: Field definitions for the avi_storey field.

AVI_STOREY	Description
1	Overstorey
2	Switch Stand - Understorey

4.3.4 Descriptive Data Fields

Key attributes are created for use throughout the development of the landbase. These fields are used in assigning deletion criteria and final landbase classifications. The following fields are calculated and described in the sub-sections to follow:

- • ***yield_source***: The source to which stratification originates (AVI, ARIS, or)
- • ***blockera***: Classifies harvested stands into specific age groups
- • ***strata***: Forest strata assignment

4.3.4.1 Strata Source (yield_source)

The landbase has three sources from which polygons can receive a yield stratification: AVI, ARIS, and RSA. RSA stratification will be applied for all managed stands that have had a completed RSA survey. ARIS stratification will be applied to all harvested stands that are harvested during the 1996 timber year or later and do not have an RSA survey completed. AVI stratification will be used for all natural stands as well as harvested stands that are harvested prior to 1996, are identified in ARIS as blocks that are not sufficiently stocked, or do not have an RSA or ARIS stratification. Figure 4-2 presents the program logic used to assign yield source to the net landbase, and values are defined in Table 4-2.

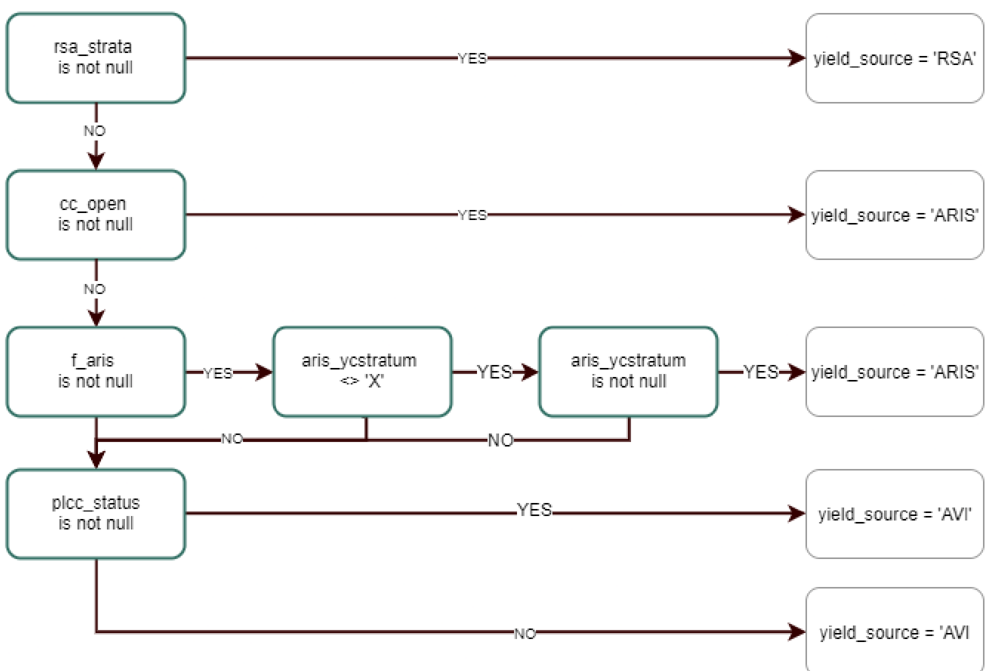

Figure 4-2: Methodology for assigning values to the yield_source field in the net landbase.

Table 4-2: Field definitions for the yield_source field.

Yield Source	Description
RSA	Polygons with an RSA performance survey completed
ARIS	Polygons harvested or post harvest disturbed in 1991 or later with a valid ARIS record
AVI	Polygons that have no alternative source data, and a valid AVI stratum assigned

4.3.4.2 Harvest Block Era (block_era)

Block era represents time periods of different silviculture practices and requirements and were created to guide volume sampling. POST95 is an era where RSA surveys were completed, while PRE96 is an era when a variety of other silviculture practices had been used. Any polygons that are not part of a harvested cutblock will not be assigned a block era. Figure 4-3 presents the program logic used to assign block era to the net landbase, and values are defined in Table 4-3.

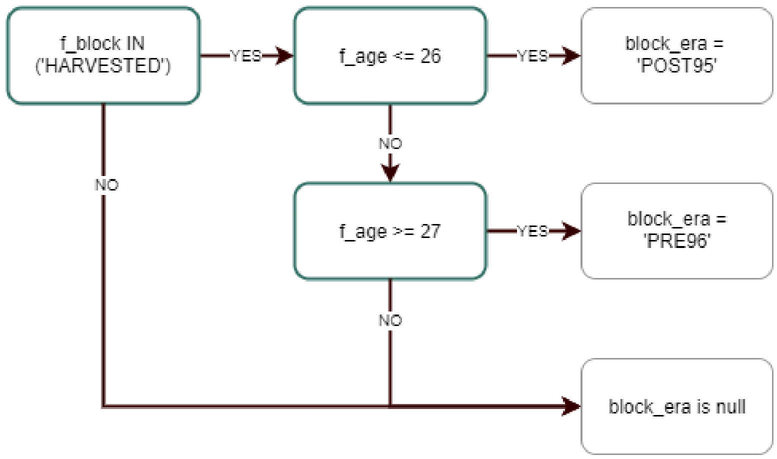

Figure 4-3: Methodology for assigning values to the block_era field in the net landbase.

Table 4-3: Field definitions for the block_era field.

Block_era	Description
POST95	Stands harvested after 1995
PRE96	Stands harvested on or before 1995
null	Polygons that have not been harvested

4.3.4.3 Strata assignment (strata)

The strata field presents the forest stratification assignment for each polygon. Polygons can be assigned a stratum based on RSA survey data, ARIS yield curve stratum declaration or the AVI. Polygons with both an overstorey and understorey classification will have strata assigned for both the overstorey and understorey. With some source data using slightly different naming conventions there are some strata represented in this field represented by multiple values. These values will be standardized when the final stratum is assigning in F_Strata field. Figure 4-4 presents the program logic used to assign stratum to the net landbase, and values are defined in Table 4-4.

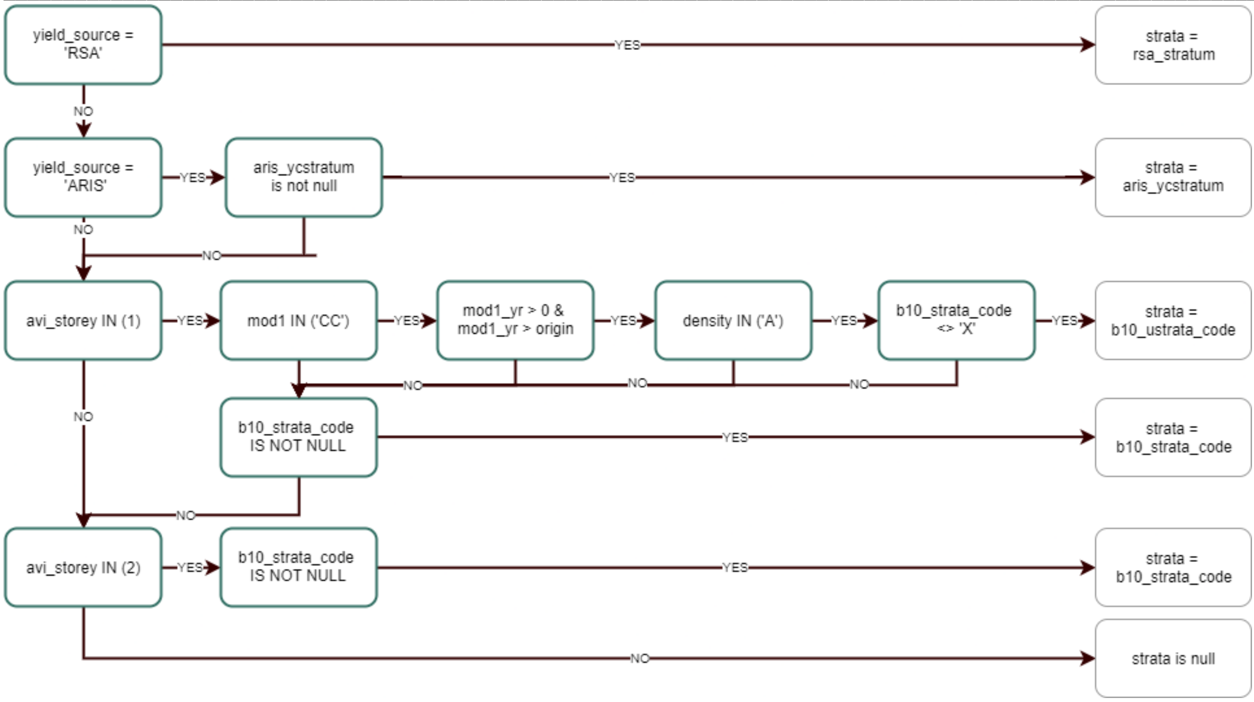

Figure 4-4: Methodology for assigning values to the strata field in the net landbase.

Table 4-4: Field definitions for the Strata field.

Strata	Description
AW	Hardwood leading
AWPL or HWPL	Hardwood/Pine mixedwood
AWSW or HWSX	Hardwood/Spruce mixedwood
FD	Douglas-fir leading
PL	Pine leading
PLAW or PLHW	Pine/Hardwood mixedwood
SB	Black spruce leading
SW	White spruce leading
SWAW	White spruce/Hardwood mixedwood
null	Polygons with no stratum assignment

4.3.5 Mountain Pine Beetle

The mountain pine beetle (*Dendroctonus ponderosae*) is a threat to mature pine forests Alberta. Mature and over-mature pine under stress are the preferred host, but as beetle populations increase, smaller-sized and healthy trees can also be attacked. Outbreaks continue as long as a food source is available and climatic conditions are favourable. To determine the potential threat that the beetle poses to any given pine stand, a stand risk rank is calculated. This calculation is based on stand susceptibility index, predicted r-value and compartment risk.

4.3.5.1 Stand Susceptibility Index (SSI)

The mountain pine beetle (MPB) Stand Susceptibility Index (SSI) is calculated from the physical characteristics of a stand and determines its MPB habitat suitability, without considering the climate, or location of a particular pine stand. SSI values range from 1 to 120, where higher numbers indicate a higher susceptibility. The SSI is calculated using the following formula:

$$SSI = P * A * D$$

Where:

P = percentage of susceptible pine basal area

A = age factor

D = density factor

For each factor in the SSI, calculations are completed using AVI attributes. For the susceptible pine basal area factor the percentage of pine in a polygon along with the height are used to calculate this input. For the age factor the overstorey age is used to calculate this input. For the density factor the stand density is used to calculate this input. The SSI values (mpb_ssi) were provided by the GOA and then categorized into four categories. The categories used to define mpb_ssi_cat are defined in Table 4-5 and the distribution across the DFA is shown in Section 2.4.29.

Table 4-5: Field definitions for the mpb_ssi_cat field.

MPB_SSI_CAT	Description
1:1-22	Polygons with a mpb_ssi that is between 0 and 22
2:23-63	Polygons with a mpb_ssi that is between 23 and 63
3:64-100	Polygons with a mpb_ssi that is between 64 and 100
X	Polygons without a mpb_ssi value

4.3.5.2 Predicted r-value

The predicted r-value is an estimate of the female MPB fecundity that is determine by three factors: tree size, stand location, and weather. This is a relative measure and does not necessarily translate directly into percent population increase. The model was developed by Carroll *et al.* (2016) and the dataset was provided by the GOA. The predicted r-values in the provided dataset were categorized to create the mpb_r_cat field. The categories used to define mpb_r_cat are defined in Table 4-6 and the distribution across the DFA is shown in Section 2.4.31.

Table 4-6*: Field definitions for the mpb_r_cat field.*

MPB_R_CAT	Description
LOW	Polygons with a ***predicted_r*** that is between 0 and 2
MODERATE	Polygons with a ***predicted_r*** that is between 2.1 and 4.5
HIGH	Polygons with a ***predicted_r*** that is between 4.6 and 5.8
VERY HIGH	Polygons with a ***predicted_r*** that is between 5.9 and 9.2
X	Polygons without a ***predicted_r*** value

4.3.5.3 Compartment Risk

The C5 compartment risk assessment was completed by the GOA. Based on the knowledge of current MPB population distributions within the province a risk was assigned to each harvest compartment. This risk was based on the distance between the MPB populations and the boundaries of each compartment.

The maximum distances between a compartment and a known MPB population are defined in Table 4-7 and compartment risk assignments are presented in Figure 4-5.

Table 4-7: Field definitions for the mpb_risk field.

MPB_RISK	Description
VERY HIGH	Compartments where any part is located within 6 kilometers from a MPB population.
HIGH	Compartments where any part is between 6 and 12 kilometers from a MPB population.
MODERATE	Compartments where any part is between 12 and 20 kilometers from a MPB population.
LOW	Compartments where any part is located further than 20 kilometers from a MPB population.

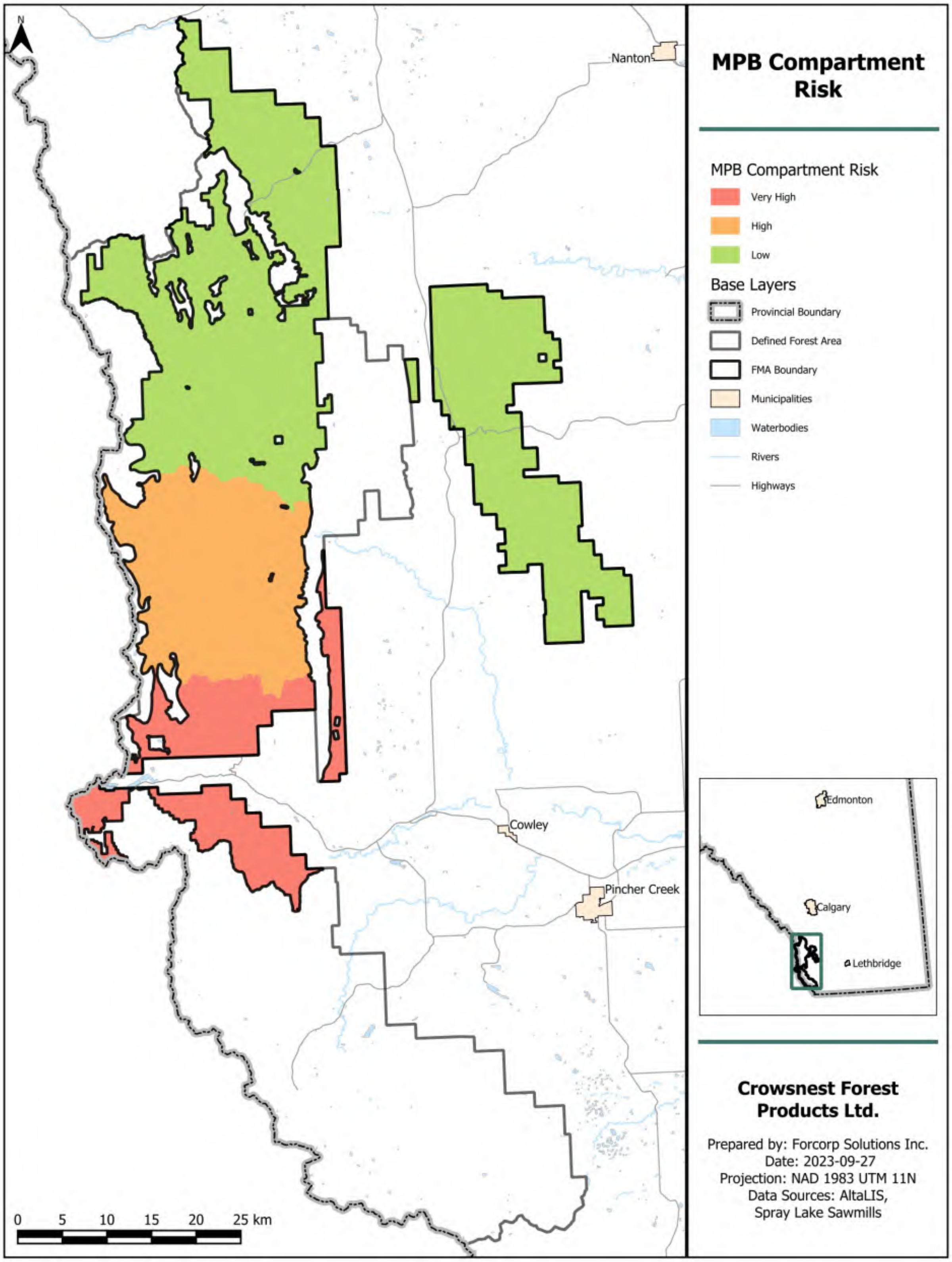

Figure 4-5: Mountain pine beetle compartment risk assignments for each harvest compartment in the Crowsnest Forest Products defined forest area.

4.3.5.4 MPB Rank

MPB ranking is a pine stand ranking system for pine strategy forest management planning and implementation. Table 4-8 summarizes the guidance from the GOA on how the SSI category, the R-value category and the compartment risk are used to assign the MPB Rank value. The definitions of each rank are summarized in Table 4-9 and the distribution of pine stands based on the MPB Ran are presented in Figure 4-6.

Table 4-8: Pine stand ranking system for pine strategy forest management planning and implementation (GOA, 2019).

Stand Level	Alberta Stand Susceptibility Index			Compartment
Predicted r-value	1 to 22	23 to 63	64 to 100	Risk
Low	Rank 3	Rank 3	Rank 3	Low
	Rank 3	Rank 3	Rank 3	Moderate
	Rank 3	Rank 3	Rank 2	High
	Rank 3	Rank 2	Rank 2	Very High
Moderate	Rank 3	Rank 3	Rank 3	Low
	Rank 3	Rank 3	Rank 2	Moderate
	Rank 3	Rank 2	Rank 2	High
	Rank 3	Rank 2	Rank 2	Very High
High	Rank 3	Rank 3	Rank 3	Low
	Rank 3	Rank 2	Rank 2	Moderate
	Rank 3	Rank 2	Rank 1	High
	Rank 2	Rank 1	Rank 1	Very High
Very High	Rank 3	Rank 2	Rank 2	Low
	Rank 3	Rank 2	Rank 1	Moderate
	Rank 2	Rank 1	Rank 1	High
	Rank 2	Rank 1	Rank 1	Very High

Table 4-9: Field defintions for the mpb_rank field.

MPB_RANK	Description
RANK 1	Polygons that fall within Rank 1 conditions
RANK 2	Polygons that fall within Rank 2 conditions
RANK 3	Polygons that fall within Rank 3 conditions
X	Polygons that fall outside of ranking conditions and are not applicable

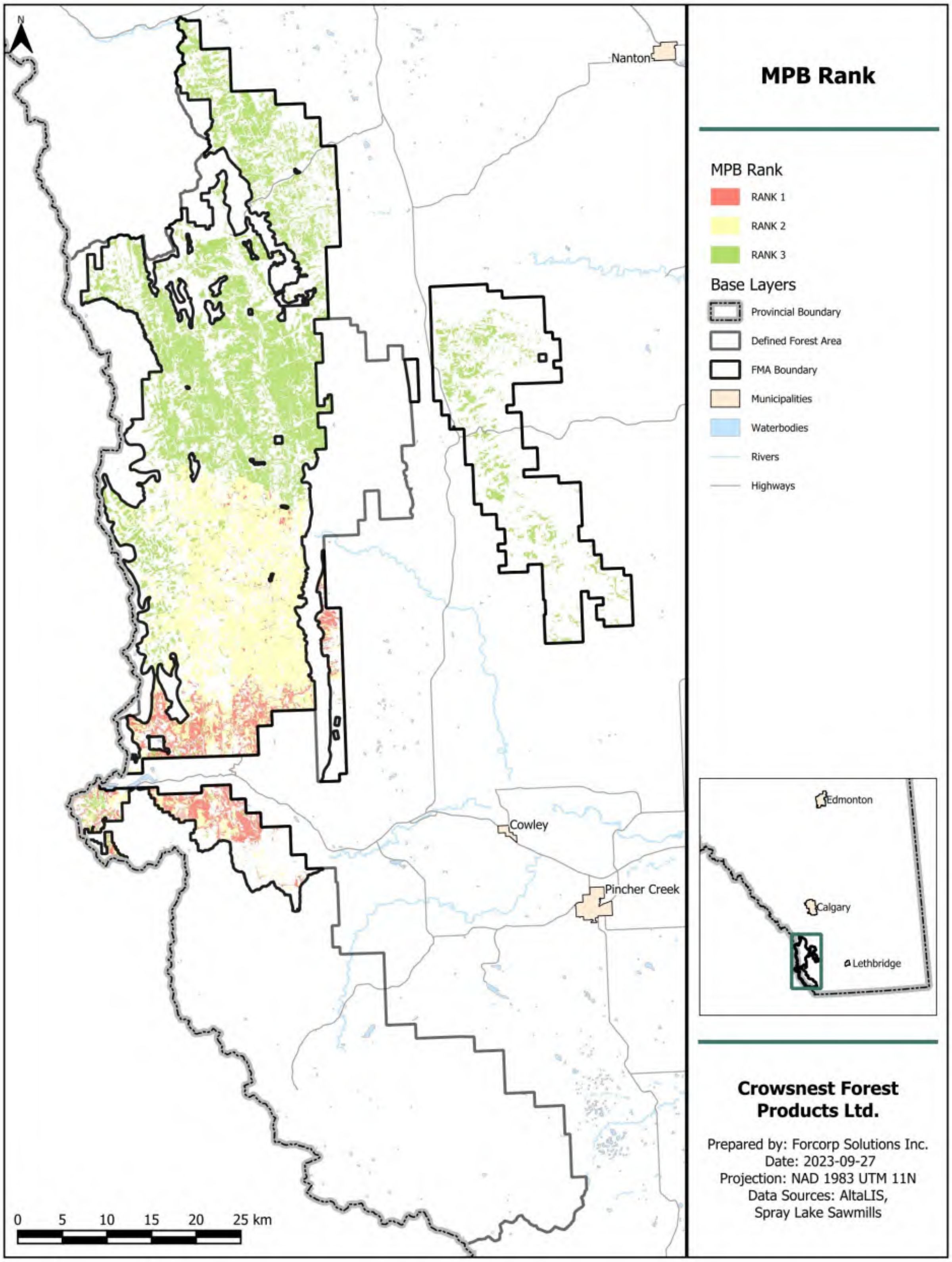

Figure 4-6: Distribution of pine stands based on the calculated mountain pine beetle stand ranking.

4.4 Application of Deletion Rulesets

Deletions are a part of any landbase. Deletions can be sourced from the base AVI or from the data that have been multi-unioned with the AVI. There can be forested and non-forested deletions. The deletion types affect this consideration differently. The types can be sourced from the following hierarchal restriction sets:

1. Administrative
2. Landscape
3. Operational

4.4.1 Administrative Restrictions

Administrative restrictions are sourced from strategic land management decisions to limit harvesting within certain areas. These areas often contain vegetation but are removed from the timber harvesting landbase. This section focuses on how the net down landbase handles this type of restriction.

4.4.1.1 Administrative Deletions (D_Admin)

Administrative deletions are areas that have been identified as parks and protected areas (PPA), eastern slopes land use prime protection area, areas that are not under ownership jurisdiction by the provincial government, and areas that have been identified as containing historic resource values. Figure 4-7 presents the program logic used to assign administrative deletions to the net landbase and values are defined in Table 4-10. In this DFA there were no polygons that had ownership assigned to private, municipal or federal land.

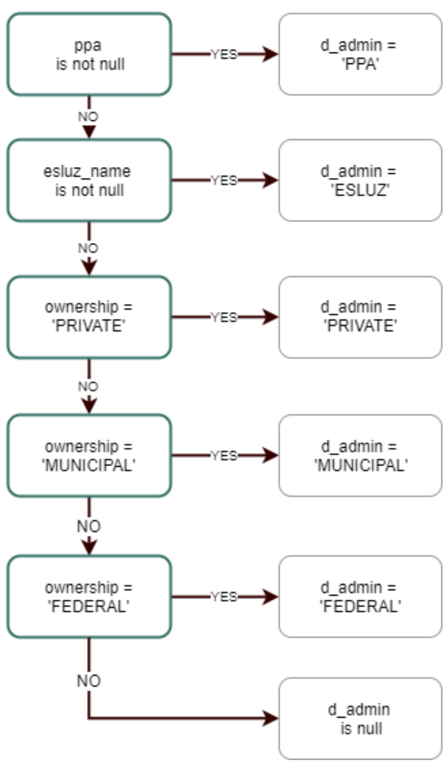

Figure 4-7: Methodology for assigning administrative deletions (D_Admin) to polygons in the net landbase.

Table 4-10: Field definitions for the D_Admin field.

D_Admin	Description
PPA	Polygons within parks and other protected or recreational areas. Removed from the active landbase
ESLUZ	Polygons within eastern slopes land-use zone 1. Removed from the active landbase
PRIVATE	Polygons identified as being privately owned. Removed from the active landbase
MUNICIPAL	Polygons identified as being owned by a municipal entity. Removed from the active landbase
FEDERAL	Polygons identified as being owned by a federal entity. Removed from the active landbase
HRV_GOA	Polygons identified with a historic resource value of 1,2 or 3. Removed from the active landbase
null	Polygons not within this deletion type

4.4.1.2 Anthropogenic Deletions (D_Anthro)

Anthropogenic features are sourced from disposition layers created by the GOA and from the AVI. The disposition boundaries are sourced from Digital Integrated Dispositions (DIDs), Crown Land Reservations (CLRs) and from the compiled layer of federal and provincial permanent sample plots (PSPs) that is maintained by the GOA. Vegetated and non-vegetated anthropogenic features identified in the AVI are also identified in this deletion category. Figure 4-8 presents the program logic used to assign administrative deletions to the net landbase and values are defined in Table 4-11.

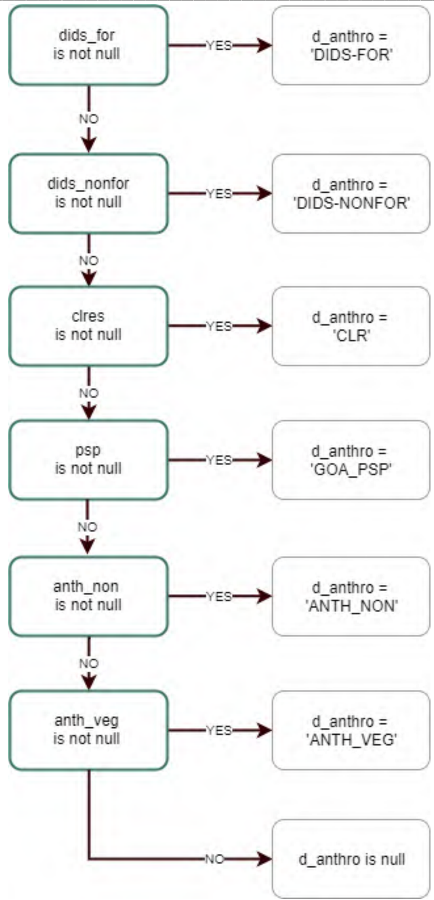

Figure 4-8: Methodology for assigning anthropogenic deletions (D_Anthro) to polygons in the net landbase.

Table 4

D_Anthro	Description
DIDS-FOR	Polygons defined as having anthropogenic disturbances originating from DIDs data. The forest cover in these polygons can contribute to forest cover calculations. Removed from active landbase
DIDS-NONFOR	Polygons defined as having anthropogenic disturbances originating from DIDs data. The forest cover in these polygons cannot contribute to forest cover calculations. Removed from active landbase
CLRES	Polygons defined as having anthropogenic disturbances originating from crown land reservations. Removed from active landbase
PSP	Polygons defined as GOA permanent sample plots. Removed from the active landbase
ANTHNON	Polygons defined as having un-vegetated anthropogenic disturbances originating from the AVI. Removed from active landbase
ANTHVEG	Polygons defined as having vegetated anthropogenic disturbances originating from the AVI. Removed from active landbase
null	Polygons not within this deletion type

4.4.1.3 No AVI Interpretation (D_AVI)

AVI deletions are areas within the DFA where no AVI interpretation has been completed. Without AVI no forest cover can be interpreted for these polygons. These areas primarily correspond to areas outside of the FMA. Figure 4-9 presents the program logic used to assign administrative deletions to the net landbase and values are defined in Table 4-12.

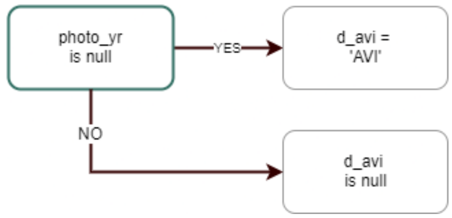

Figure 4-9: Methodology for assigning AVI deletions (D_AVI) to polygons in the net landbase.

Table 4-12: Field definitions for the D_AVI field.

D_AVI	Description
AVI	Polygons have no AVI interpretation. Removed from active landbase
null	Polygons not within this deletion type

4.4.2 Landscape Restrictions

Landscape restrictions are areas where the land condition is not conducive to timber harvesting. These features include hydrology features and their related buffers, areas that are identified as non forested in the AVI, and areas that have been affected by natural disturbance. This restriction category also includes cutblocks that could not be reconciled against ARIS. This sub-section details how landscape restrictions are handled in the landbase.

4.4.2.1 Hydrology Features (D_Hydro)

Hydrological deletion types identify hydrological features found within the AVI and the provincial hydrology polygon layer. This includes lakes, rivers, flood prone areas and aquatic areas. Figure 4-10 presents the program logic used to assign hydrology deletions to the net landbase, and the values are defined in Table 4-13.

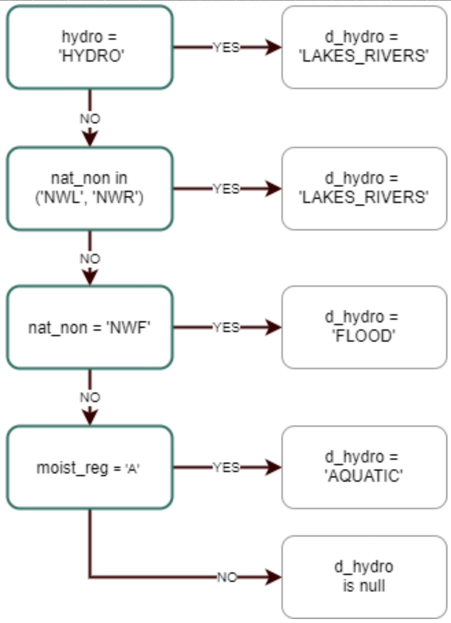

Figure 4-10: Methodology for assigning hydrology deletions (D_Hydro) to polygons in the net landbase.

Table 4-13: Field definitions for the D_Hydro field.

D_Hydro	Description
AQUATIC	Polygons defined as being Aquatic. Removed from forest management landbase
FLOOD	Polygons defined as being Flooded. Removed from forest management landbase
LAKES_RIVERS	Polygons defined as being a Lake or River. Removed from forest management landbase
null	Polygons not within this deletion type

4.4.2.2 Hydrology Buffers (D_Buffer)

Operating ground rules stipulate that hydrology buffers will be removed from the operable landbase. Buffer widths are specified in Section 2.4.20. Figure 4-11 presents the program logic used to assign hydrology buffer deletions to the net landbase, and the values are defined in Table 4-14.

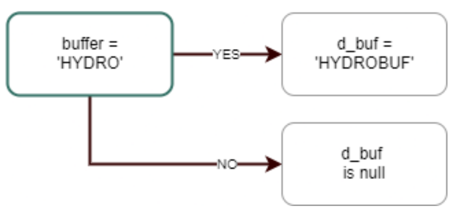

Figure 4-11: Methodology for assigning hydrology buffer deletions (D_Buf) to polygons in the net landbase.

Table 4-14: Field definitions for the D_Buf field.

D_Buf	Description
HYDROBUF	Polygons within defined hydrology buffers. Removed from the active landbase
null	Polygons not within this deletion type

4.4.2.3 Non-Forest Areas (D_Nonfor)

Non-forest area deletions include non-forested or non-vegetated areas that have been identified in the AVI. Naturally non-vegetated features include cutbanks, rock and sand, while natural non-forest areas include areas covered with bryophytes, forbs, grass, and shrub. Figure 4-12 presents the program logic used to assign non-forest deletions to the net landbase, and values are defined in Table 4-15

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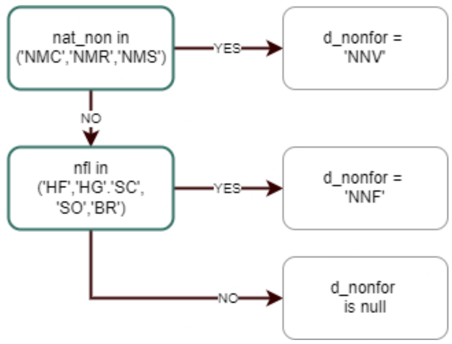

Figure 4-12: Methodology for assigning non-forest deletions (d_Nonfor) to polygons in the net landbase.

Table 4-15: Field definitions for D_Nonfor.

D_NonFor	Description
NNV	Polygons defined as being Naturally Non-Forested. Removed from active landbase
NNF	Polygons defined as being Naturally Non-Vegetated. Removed from active landbase
null	Polygons not within this deletion type

4.4.2.4 Natural Disturbances (D_NatDist)

Natural disturbance deletions include forest fires and other naturally occurring phenomenon including windfall, insect damage, weather, or other agents. Recent wildfire data is sourced from the Provincial fire records, from 2018 to May 2021, as described in Section 2.4.36. Other natural disturbances are sourced from the modifier fields in the AVI. Figure 4-13 presents the program logic used to assign natural disturbance deletions to the net landbase and values are defined in Table 4-16.

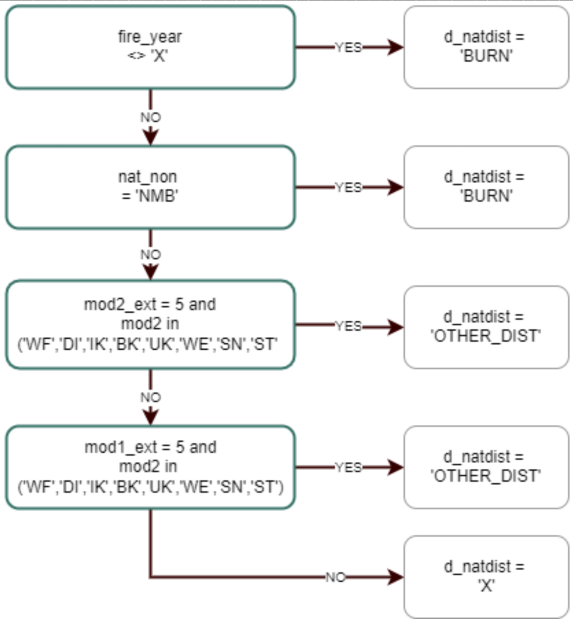

Figure 4-13: Methodology for assigning natural disturbance deletions (D_NatDist) to polygons in the net landbase.

Table 4-16: Field definitions for the D_NatDist field.

D_NatDist	Description
BURN	Polygons defined as having been burned. Removed from active landbase
OTHER_DIST	Polygons defined as having been affected by other natural disturbance events. Removed from active landbase.
X	Polygons not within this deletion type

4.4.3 Operational Restrictions

Operational restrictions are areas where the land condition is not conducive to timber harvesting. Typically, this restriction type is comprised of areas that are forested but are not feasible for harvesting (e.g. low densities, inoperable slopes, etc.). This sub-section details how operational restrictions are handled in the landbase.

4.4.3.1 Steep Slopes (D_Slope)

In areas identified as having steep slopes, landbase polygons with slopes equal to or greater than 45% have limited operability and hence these areas are deleted from the landbase. Figure 4-14 presents the program logic used to assign steep slope deletions to the net landbase and the values are defined in Table 4-17.

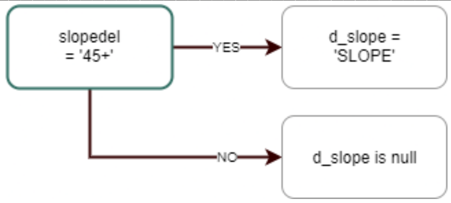

Figure 4-14: Methodology for assigning steep slope deletions (D_Slope) to polygons in the net landbase.

Table 4-17: Field definitions for the D_Slope field.

D_Slope	Description
SLOPE	Polygons defined as being inside of a delineated high slope area; removed from the active landbase
X	Polygons not within this deletion type

4.4.3.2 Operational Deletions (D_OpDel)

Operational deletions are assigned areas that have been identified as inoperable during previous planning or harvest activities. Polygons assigned to this deletion class may consist of entire AVI polygons where harvest is considered infeasible or of portions of AVI polygons that remained unharvested after operations in a block have been completed. These polygons are assigned as operational deletions to ensure that they are not revisited during the development of the next spatial harvest sequence. Figure 4-15 presents the program logics used to assign operational deletions and values are defined in Table 4-18.

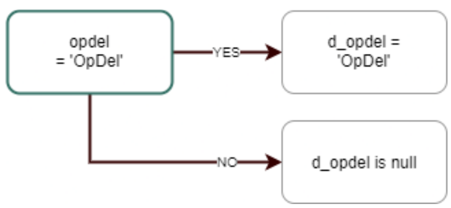

Figure 4-15: Methodology for assigning operational deletions (D_OpDel) to polygons in the net landbase.

Table 4-18: Field definitions for the D_OpDel field.

D_OpDel	Description
OpDel	Polygons defined as being part of an operational deletion
X	Polygons not within this deletion type

4.4.3.3 Moisture Regime Deletions (D_Moist)

Moisture regime deletions include areas in the AVI with a moisture regime of 7 or greater; this includes moisture regimes categorized as hygric, subhygric and hydric. These moisture levels limit the productivity and operability of the land. Figure 4-16 presents the program logic used to assign moisture regime deletions and values are defined in Table 4-19.

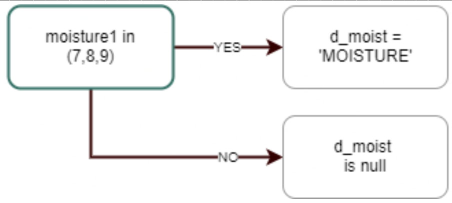

Figure 4-16: Methodology for assigning moisture deletions (D_Moist) to polygons in the net landbase.

Table 4-19: Field definitions for the D_Moist field.

D_Moist	Description
MOIST	Polygons defined as having high soil moisture; removed from active landbase
X	Polygons not within this deletion type

4.4.3.4 Unproductive Forest (D_TPR)

Timber Productivity Rating (TPR) is an estimate of the productivity of forest polygons. Stands can be assigned values of good, medium, fair or unproductive. Deletions are assigned where the timber productivity of the managing layer has been identified as unproductive (TPR = U). Figure 4-17 presents the program logic used to assign TPR deletions and values are defined in Table 4-20.

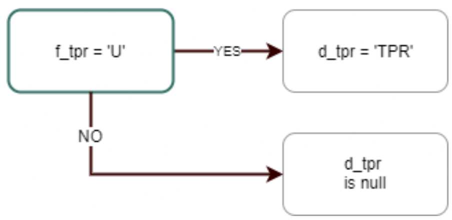

Figure 4-17: Methodology for assigning TPR deletions (d_TPR) to polygons in the net landbase.

Table 4-20: Field definitions for the D_TPR field.

D_TPR	Description
TPR	Polygons defined as having an unproductive timber productivity rating; removed from the active landbase
X	Polygons not within this deletion type

4.4.3.5 Low Density (D_Denisty)

Stands with a crown closure density of 30% or less are considered to be non-operable. The density integer of the managing layer is used to determine if a density deletion is to be assigned. Figure 4-18 presents the program logic used to assign density deletions and values are defined in Table 4-21.

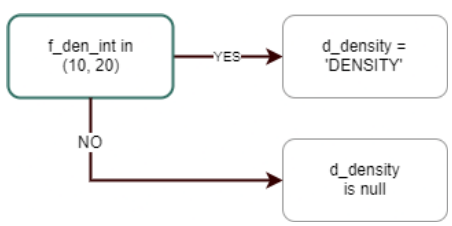

Figure 4-18: Methodology for assigning density deletions (D_Density) to polygons in the net landbase.

Table 4-21: Field definitions for the D_Density field.

D_Density	Description
DENSITY	Polygons defined as having an un-merchantable density; removed from the active landbase
X	Polygons not within this deletion type

4.4.3.6 Species Deletions (D_Sp)

Certain tree species, *i.e.* larch, and black spruce, can only be processed in limited quantities. Hence larch and black spruce dominated stands are eliminated from the active landbase. Whitebark pine and limber pine are Species of Concern in Alberta and stands where forest cover of these two species is 40% or greater are removed from the active landbase. Figure 4-19 presents the program logic used to assign species deletions and values are defined in Table 4-22: Field definitions for the D_Sp field.

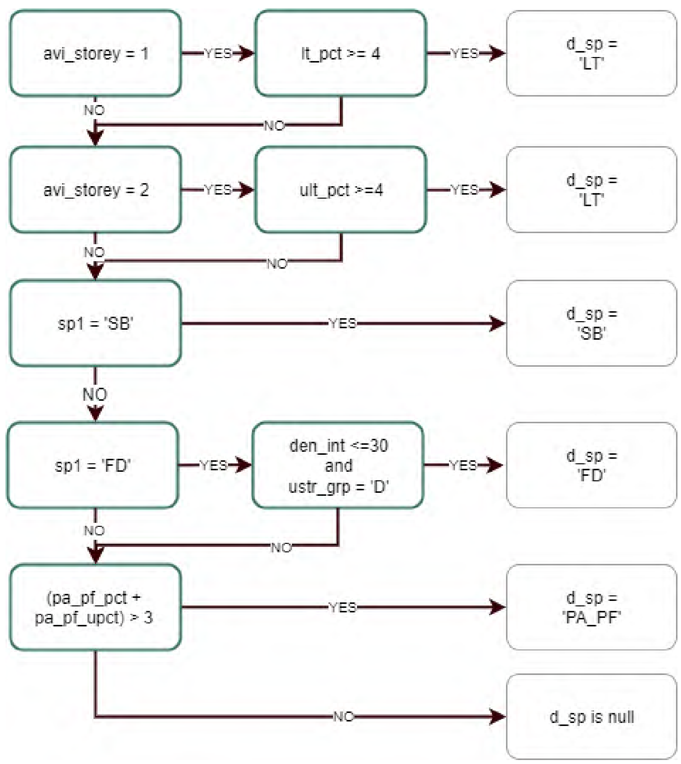

Figure 4-19: Methodology for assigning species deletions (D_Sp) to polygons in the net landbase.

Table 4-22: Field definitions for the D_Sp field.

D_Sp	Description
LT	Polygons defined as being un-merchantable due to larch presence; removed from active landbase
SB	Polygons defined as being un-merchantable due to black spruce presence; removed from active landbase
FD	Polygons defined as being un-merchantable due to Douglas-fir presence; removed from active landbase
PA_PF	Polygons defined as containing species of concern - whitebark pine and limber pine; polygons with >= 40% are removed from active landbase
X	Polygons not within this deletion type

4.4.3.7 Block Deletions (D_Block)

There are three types of block deletions identified. The first one is a “NFCC” (non-forested clearcut) call, which is where a post 1991 cutblock is identified in the landbase but there is no ARIS match for the opening number identified. The second type is “CUTBLOCK”, where a post 1991 cutblock is identified in the landbase and no opening number was assigned to it. The third is DELETION where a polygon that was assigned “DELETION” in the f_block field is identified. Figure 4-20 presents the program logic used to assign block deletions and values are defined in Table 4-23.

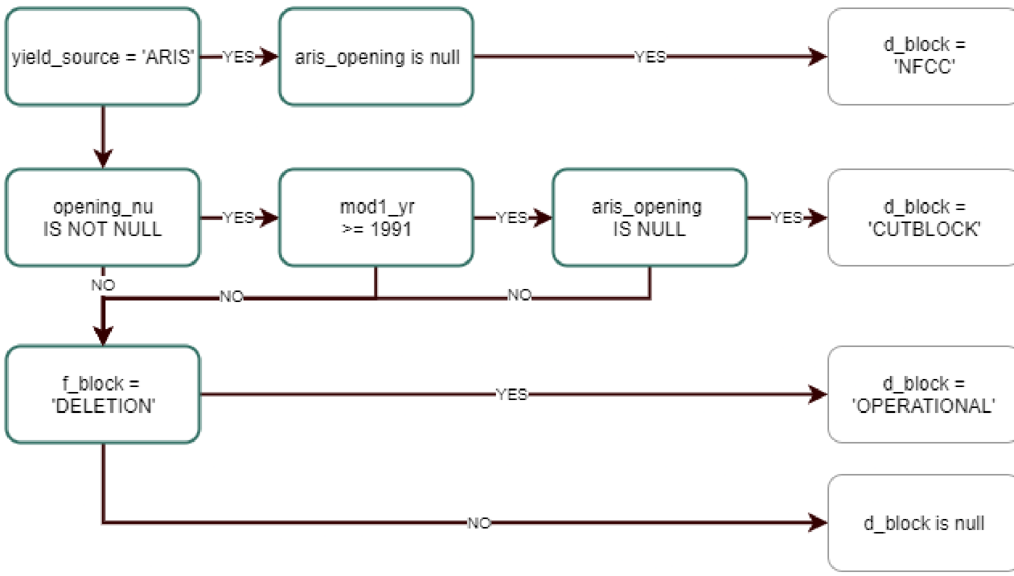

Figure 4-20: Methodology for assigning block deletions (D_Block) to polygons in the net landbase.

Table 4-23: Field definitions for the D_Block field.

D_Block	Description
NFCC	Polygons identified as post 1991 cutblocks with an assigned opening number that do not have a match in the ARIS database
CUTBLOCK	Polygons identified as post 1991 cutblocks that do not have an opening number assigned
DELETION	Polygons defined as being an additional block deletion
X	Polygons not within this deletion type

4.4.3.8 Forest Structure (D_Struc)

Polygons identified as having horizontal structure have two or more distinct strata but are often inoperable due to spatial distribution of the forest. The assignment of horizontal structure in AVI is limited as photo interpreters will usually create multiple polygons when complex forest structure such as this is present, but it is assigned occasionally. All stands with horizontal structure are deleted from the net landbase. Figure 4-21 presents the program logic used to assign structure deletions to the net landbase and values are defined in Table 4-24.

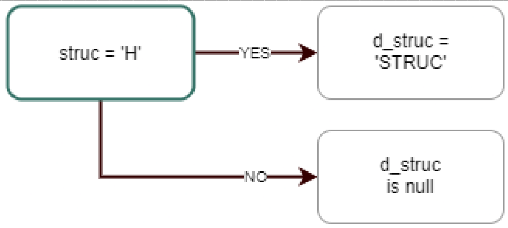

Figure 4-21: Methodology for assigning structure deletions (D_Struc) to polygons in the net landbase.

Table 4-24: Field definitions for the D_Struc field.

D_Struc	Description
STRUC	Polygons defined as horizonal structures; removed from the active landbase
X	Polygons not within this deletion type

4.4.3.9 Isolated Stands (D_Iso)

Isolated stands are polygons that are isolated in terms of accessibility or feasibility for harvest operations. There are 2 types of isolated stands identified within the landbase: (i) isolated stand deletions, and (ii) isolated stand deferrals (Table 4-25 and Figure 4-22).

There are two methods used to identify which type the isolated stand is:

A. A perimeter to area ratio (PTA) function which identifies polygons that, due to their shape, are likely to be artifacts from the multi-union process resulting from the intersection of harvest blocks. The PTA ratio is compared to that of a circle of the same size (area); the larger the difference the more irregular the polygon shape and therefore the greater the probability that the polygon is an artifact.
   PTA is calculated as follows:
   ((Perimeter / Area) - ((2 * pi() * SQRT (Area / pi())) / Area)) * 10000

B. A set of rules based on isolated stand size and their proximity to roads.

The first method (A) is applied as follows:

1. Polygons that have PTA values of >500 become an isolated stand deletion (see ISO_PTA1 in Table 4-25 and Figure 4-22), otherwise they move to criteria 2;

2. Polygons that have PTA values of <150 with areas <=2ha, become an isolated stand deletion (see ISO_PTA2 in Table 4-25 and Figure 4-22), otherwise they move to criteria 3;

3. Polygons that have PTA values of >=200 with areas <=10ha, become an isolated stand deferral (see ISO_PTA3 in Table 4-25 and Figure 4-22).

The second method (B) is applied as follows:

1. Polygons are grouped with stands that are within 59m of other harvestable stands, where available. Any group or polygon that is <2 ha becomes an isolated stand deletion (see ISO_DEL1 in Table 4-25 and Figure 4-22);

2. Grouped (or not grouped) polygons from criteria 1 that are between 2 and 4 ha and are within 500m of existing access (road, seismic) are operable and are left in the active landbase (see Figure 4-22), remaining stands move to criteria 3; and

3. Grouped (or not grouped) polygons from criteria 2 that are grouped with other grouped (or not grouped) polygons within 59 m if this group is < 5 ha then each individual grouped (or not grouped) polygon < 2ha becomes an isolated stand deletion (see ISO_DEL2 in Table 4-25 and Figure 4-22).

In the net landbase the Iso groups are simplified so that only If any of these conditions are not true, the polygon is (or group of polygons are) considered operable and are left in the active (managed) landbase.

The final landbase attributes (f_*) are updated according to d_iso values:

- ***F_del*** = d_iso when d_iso in ('ISO_DEL','PAR_DEL')
- ***F_block*** = 'DEFERRAL_ISO' when d_iso in ('PAR_DEF', 'ISO_DEF'')

Table 4-25: Field definitions for the D_ISO field.

D_ISO	Description
PAR_DEL	Polygons defined as having a PTA > 500; removed from active landbase
PAR_DEF	Polygons defined as having a PTA < 150 and an area <= 2; removed from active landbase
PAR_DEF	Polygons defined as having a PTA >= 200 and an area <= 10; will be a deferral
ISO_DEL	Polygons defined as < 2 ha and not within 59 metres of other harvestable stands which grouped is larger than 2 ha; removed from active landbase
ISO_DEF	Polygons defined as between 2-4 ha and not within 500 metres of access or within 59 metres of other harvestable stands which grouped is larger than 5 ha; will be a deferral
X	Polygons not within this deletion type

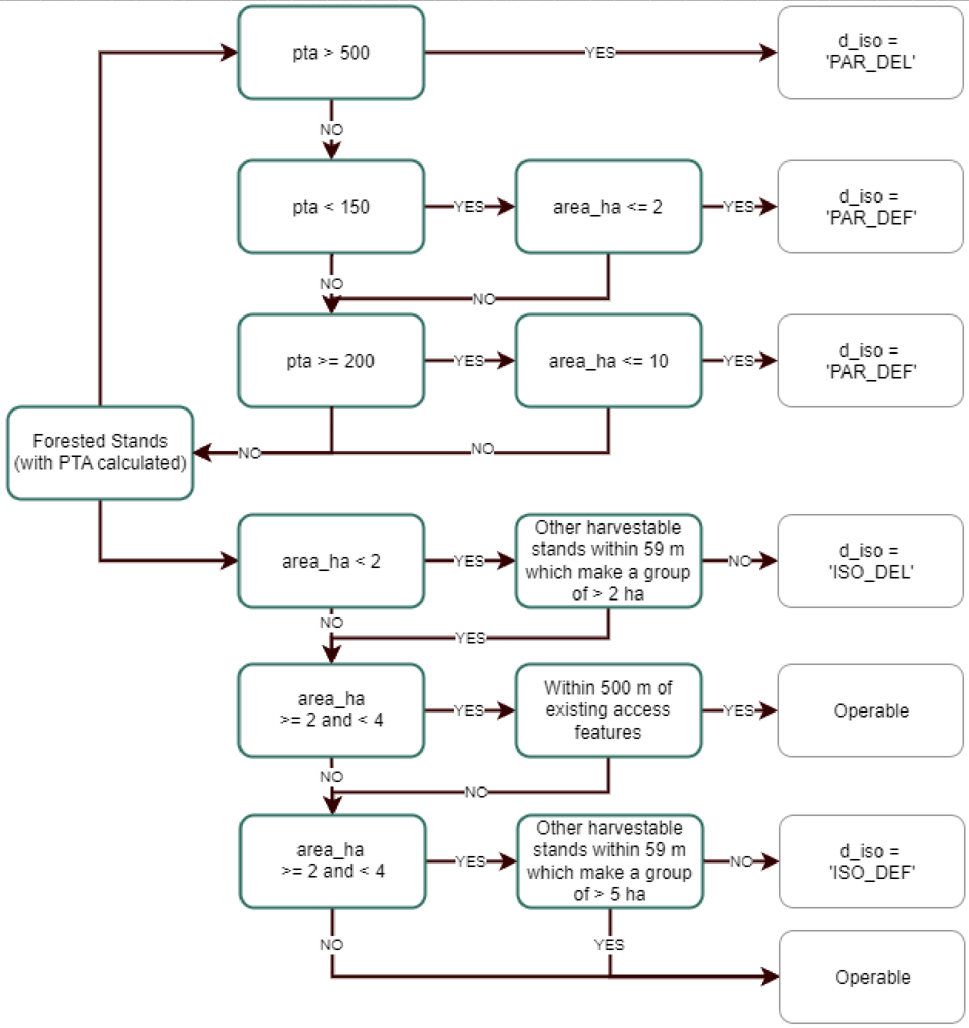

Figure 4-22: Methodology for assigning isolated stand deletions (d_iso) to polygons in the net landbase.

4.4.4 Group Elimination Assignments (D_Group)

For the sliver elimination process to correctly eliminate slivers based on relative importance, deletions were classified based on the deletion similarities. For example, all subjective deletions identifying stands that are deemed inoperable are grouped together. The program logic used to assign deletion groups is presented in Figure 4-23 and field values are presented in Table 4-26.

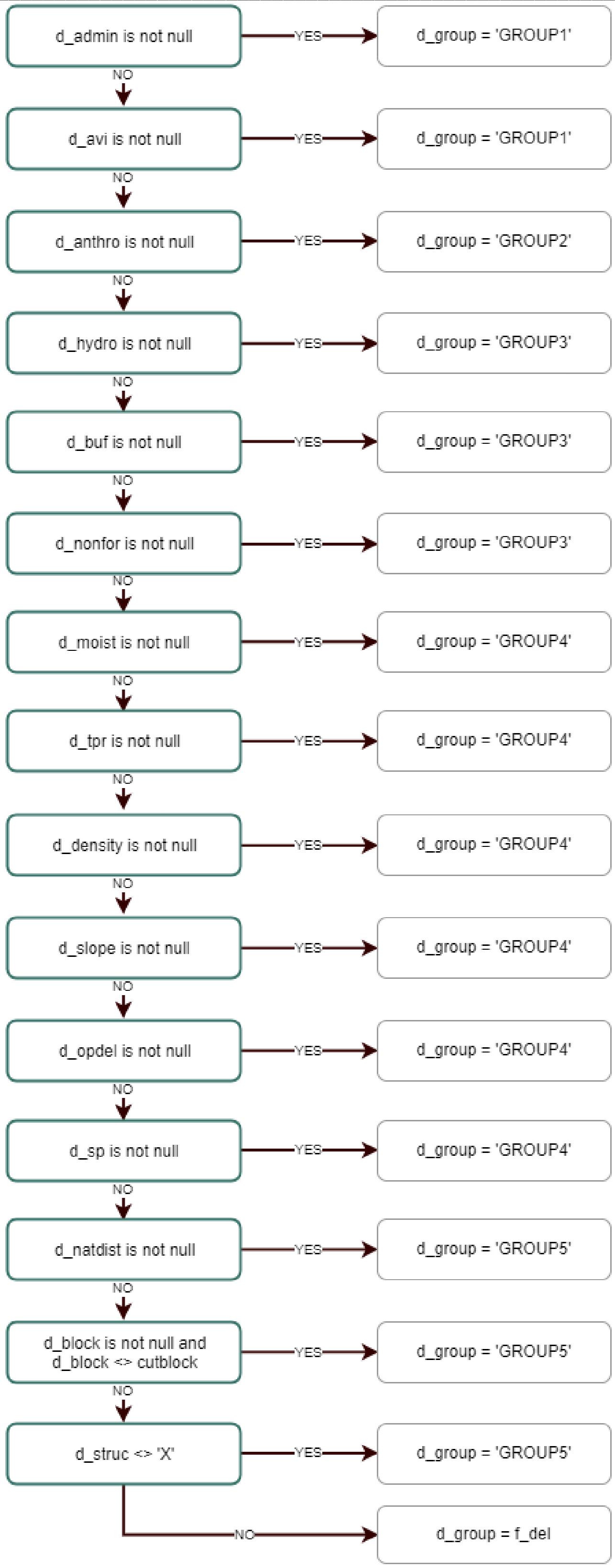

Figure 4-23: Methodology for assigning polygons to deletion groups (D_Group) in the net landbase.

Table 4-26: D_Group exclusion group hierarchy.

Group Code	Deletions associated with the group code
Group 1	D_ADMIN, D_AVI
Group 2	D_ANTHRO
Group 3	D_HYDRO, D_BUF, D_NONFOR
Group 4	D_MOIST, D_TPR, D_DENSITY, D_SLOPE, D_OPDEL, D_SP
Group 5	D_NATDIST, D_BLOCK, D_STRUC
X	Polygons not within this deletion type

4.5 Final Landbase Classifications

After assigning the stratum for each polygon and determining if the polygon falls under any deletion criteria, the attributes of the polygon can then be used to assign the final landbase calculations. These final assignments are used to determine if the polygon will be part of the contributing or non-contributing landbase and will be used to inform the timber supply analysis.

4.5.1 F_Block: Final Block Stage Assignment

The F_Block field identifies any polygons that have been harvested, planned for harvest, or identified as a harvest deferral. The values in this field will be used in part to inform other final landbase classifications such as the yield curve assignment and the block status and also inform the timber supply analysis so that the harvest age can be determined. The program logic used to assign the final F_Block status is presented in Figure 4-24.

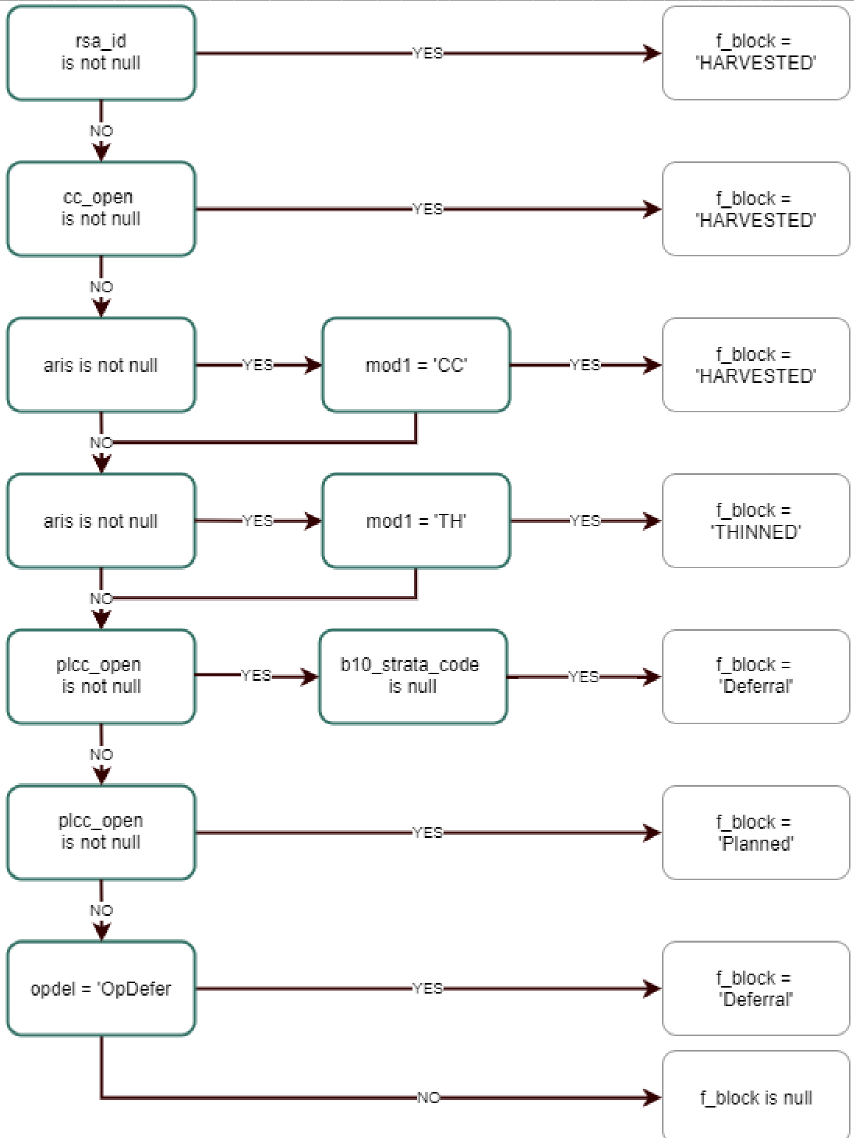

Figure 4-24: Methodology for assigning values to the F_Block field in the net landbase.

4.5.2 F_ARIS: Final ARIS Opening Number Assignment

The F_ARIS field identifies the final ARIS opening number that is to be assigned to a polygon. With opening numbers potentially coming from the AVI, cutblock layer and planned block layer, the logic used to assign a value to this field will ensure that the correct opening number is assigned if the source layers unintentionally overlap. For planned cutblocks, preliminary opening numbers have been assigned when known and opening numbers were only assigned to polygons with an assigned forest stratum.

This field is also used to determine which polygons are part of the ARIS reconciliation population. In the AVI and cutblocks layers a harvest code is assigned to each portion of a harvest polygon (harv_code and cc_harvcode). The harvest code is used to indicate the areas of active harvest and leave areas that were not part of the net harvest area. To properly reconcile an opening against the ARIS only the areas where the harvest code has been assigned as ‘H’ or ‘A’ should be counted as part of the reconcilable area. In cases where the harvest code has been incorrectly assigned the value for F_ARIS will be directly assigned. The program logic used to assign the final ARIS opening number is presented in Figure 4-25.

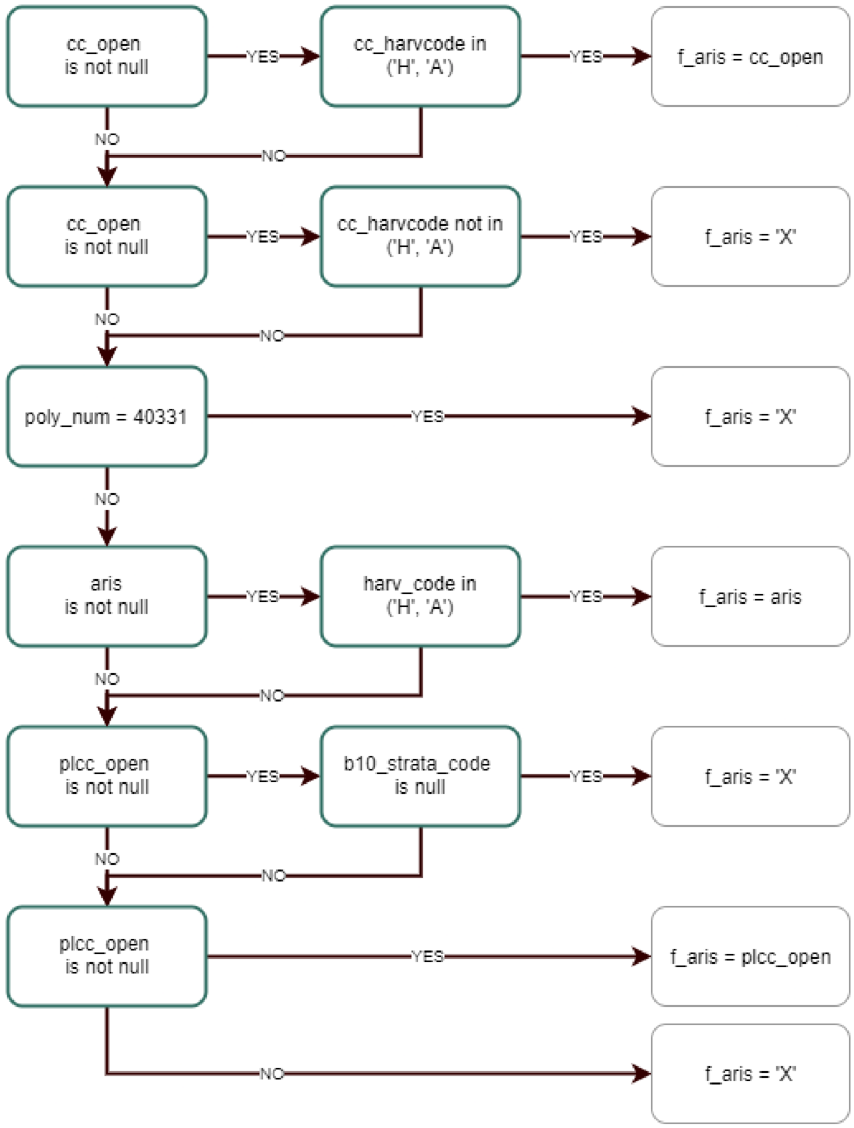

Figure 4-25: Methodology for assigning values to the F_ARIS field in the net landbase.

4.5.3 F_FMA: FMA Area Assignment

The F_FMA field identifies polygons within the DFA that fall within the Crowsnest Forest Products Forest Management Agreement (FMA) area. With the DFA consisting of the FMA plus all associated FMU area, it is important to distinguish between the two areas. Polygons will be assigned a value of 'FMA' when they fall within the FMA boundary and 'NONFMA' when the polygon falls outside of the FMA boundary. The program logic used to assign the final FMA value is presented in Figure 4-26.

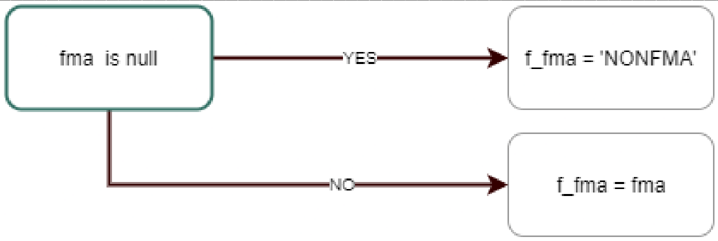

Figure 4-26: Methodology for assigning values to the F_FMA field in the net landbase.

4.5.4 F_Density and F_Den_Int: Final Stand Density and Final Stand Density Integer

The F_Density and F_Den_Int fields present the final density and density integer assignments for each polygon. Polygons receive a density and density integer value for the overstorey and understorey when sufficient tree cover is present. The final density and density integer values are then assigned based on the AVI storey of primary management that is assigned to the polygon. In cases where a stand was recently harvested or surveyed then a default value of 'C' or 70% stand density is assigned. The program logic used to assign the final density and density integer values is presented in Figure 4-27 and Figure 4-28.

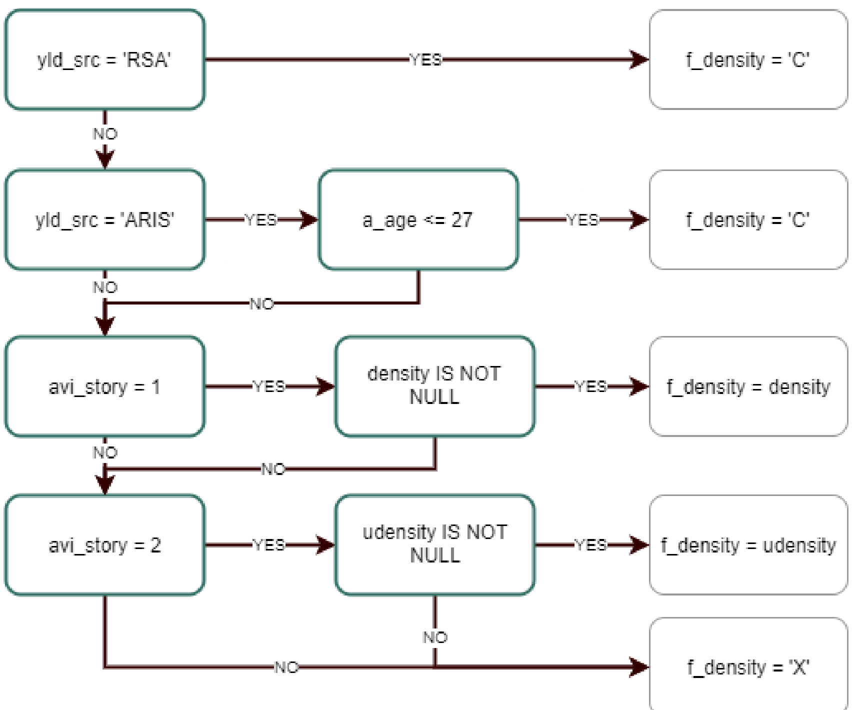

Figure 4-27: Methodology for assigning values to the F_Density field in the net landbase.

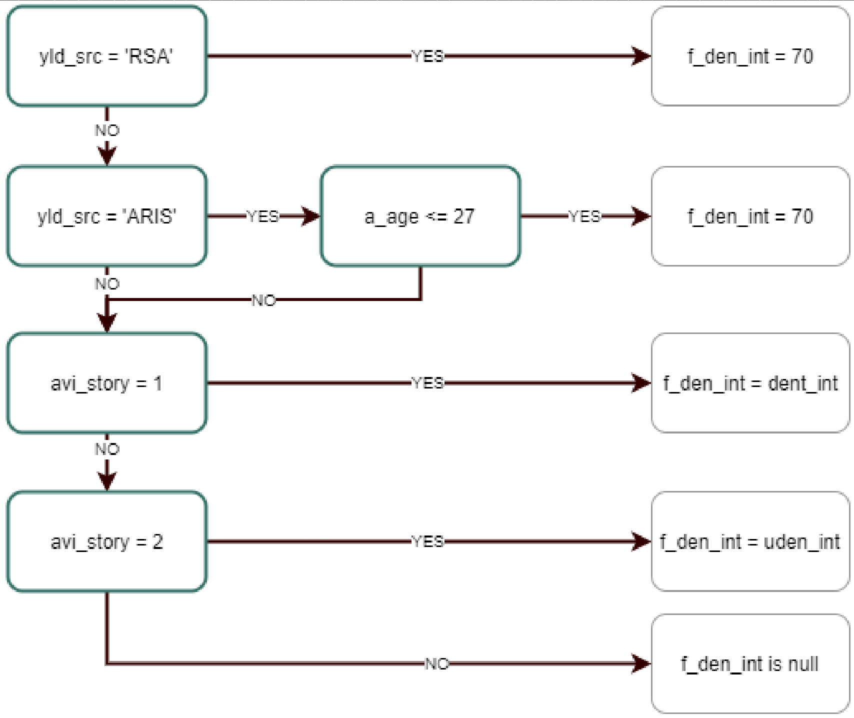

Figure 4-28: Methodology for assigning values to the F_Den_Int field in the net landbase.

4.5.5 F_Height: Final Stand Height

The F_Height field presents the final stand height, in meters, for each polygon. Polygons receive a height value from the AVI for both the overstorey and understorey when present. The final height is then assigned based on the AVI storey of primary management (AVI_STOREY) that is assigned to the polygon. In cases where a stand was harvested or burned after the AVI photo date, a height of 0 overrides the interpreted height from the AVI. This indicates that the stand has been altered and that the timber has been removed, and we are uncertain of the actual stand height. The program logic used to assign the final density and density integer values is presented in Figure 4-29.

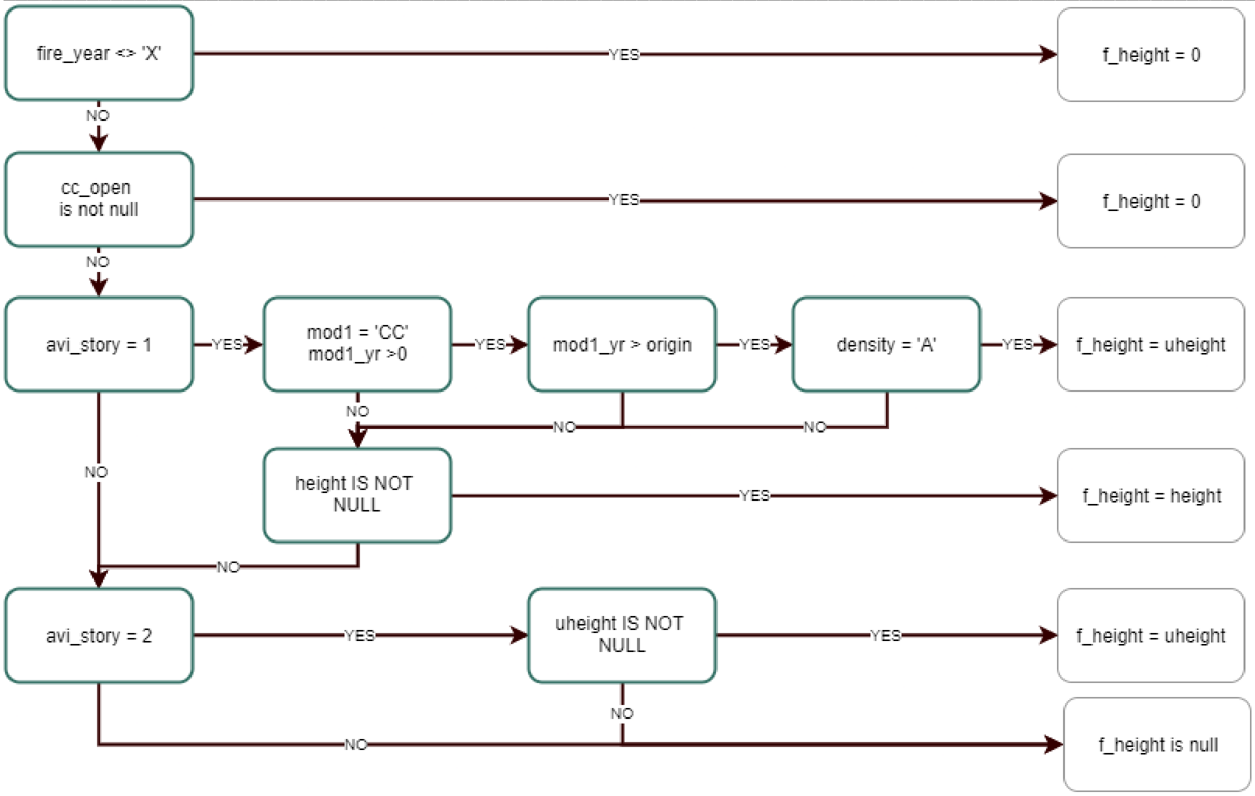

Figure 4-29: Methodology for assigning values to the F_Height field in the net landbase.

4.5.6 F_Origin and F_Age: Final Stand Origin and Age

The F_Origin and F_Age fields present the final stand origin and stand age for each polygon. Polygons receive an origin value from the AVI for both the overstorey and understorey when present. The origin is then used to determine the overstorey and understorey age by subtracting the origin from the year of the effective date of the net landbase (2023). The final age is then assigned based on the AVI storey of primary management (AVI_Storey) that is assigned to the polygon. For stands that have been harvested and have ARIS data we interpret the origin and age based off the ARIS records. If a polygon has been affected by fire or had been harvested since the AVI was interpreted and ARIS data is unavailable, then the age is overridden with an age of 0. The program logic used to assign the final density and density integer values is presented in Figure 4-30 and Figure 4-31.

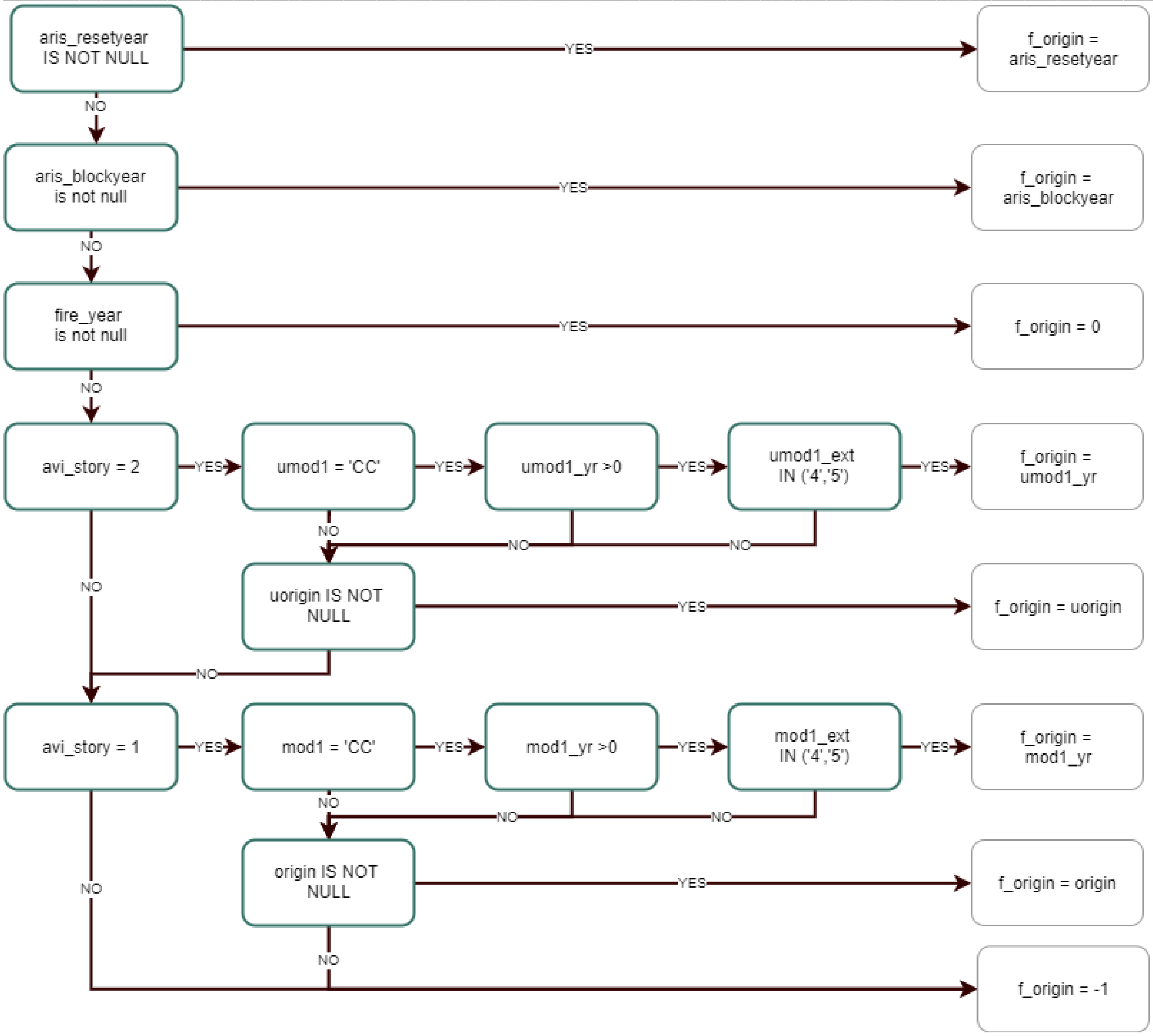

Figure 4-30: Methodology for assigning values to the F_Origin field in the net landbase.

Figure 4-31: Methodology for assigning values to the F_Age field in the net landbase.

4.5.7 F_Age_Class: Age Class

The F_Age_Class field presents the final age class for each polygon. Age class is assigned in 10-year classes and is based on the age that is assigned in the F_Age field. For the 685 ha or forested area that has been assigned an age greater than 300 years the stands were grouped in a "301+" age class.

4.5.8 F_TPR: Final Timber Productivity Rating

The F_TPR field presents the final timber productivity rating (TPR) for each polygon. Polygons are assigned a TPR in the AVI for both the overstorey and understorey when the layer is present. The final TPR is then assigned based on the AVI storey of primary management that is assigned to the polygon. If a TPR has not been assigned to the polygon, then a NULL value is assigned. The program logic used to assign the final TPR values is presented in Figure 4-32.

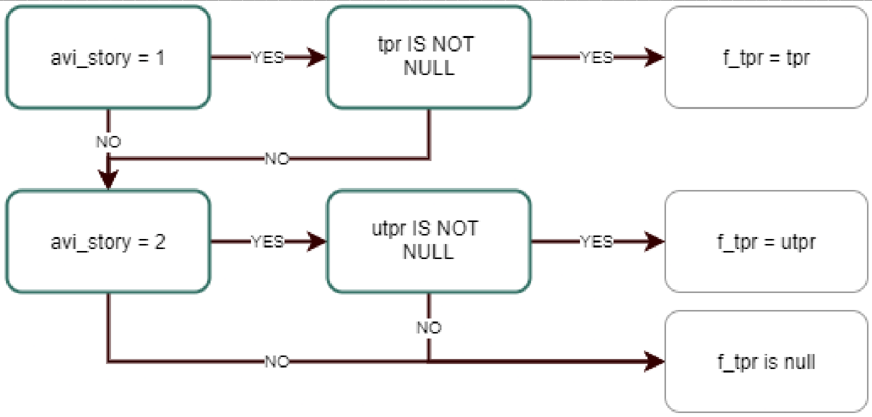

Figure 4-32: Methodology for assigning values to the F_TPR field in the net landbase.

4.5.9 F_Strata: Final Stratification Assignment

The F_Strata field presents the final forest stratification assignment for each polygon. Polygons were assigned an initial stratum in the strata field based on source data from the RSA, ARIS and AVI data. This field consolidates the stratum value to one of nine strata values that will link to the yield curve assignments. Additionally, any forest area that falls within a non-forested DIDs disposition will have the stratum removed. This is done as it is assumed that the long-term development of the disposition will result in the removal of the forest area. The program logic used to assign the final stratum values is presented in Figure 4-33. Field definitions match the values presented in Section 4.3.4.3.

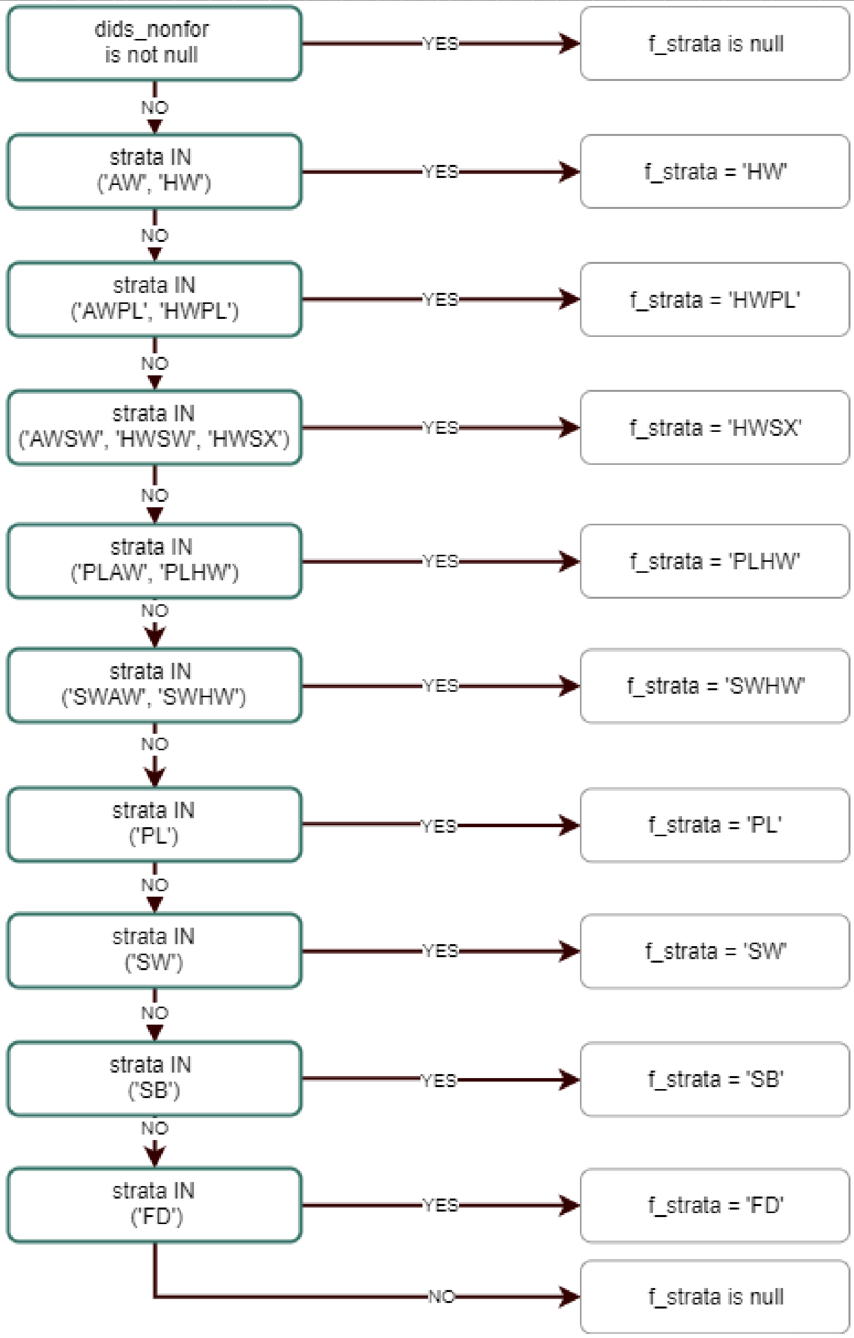

Figure 4-33: Methodology for assigning values to the F_Strata field in the net landbase.

4.5.10 F_BLK_STAT: Block Status Assignment

The F_BLK_STAT field presents the block status for each polygon. Polygons are assigned a 'Managed' status if they had previously been harvested and 'Natural' if the stand has not been harvested. All unforested stands receive a NULL value assignment. The program logic used to assign the final block status values is presented in Figure 4-34.

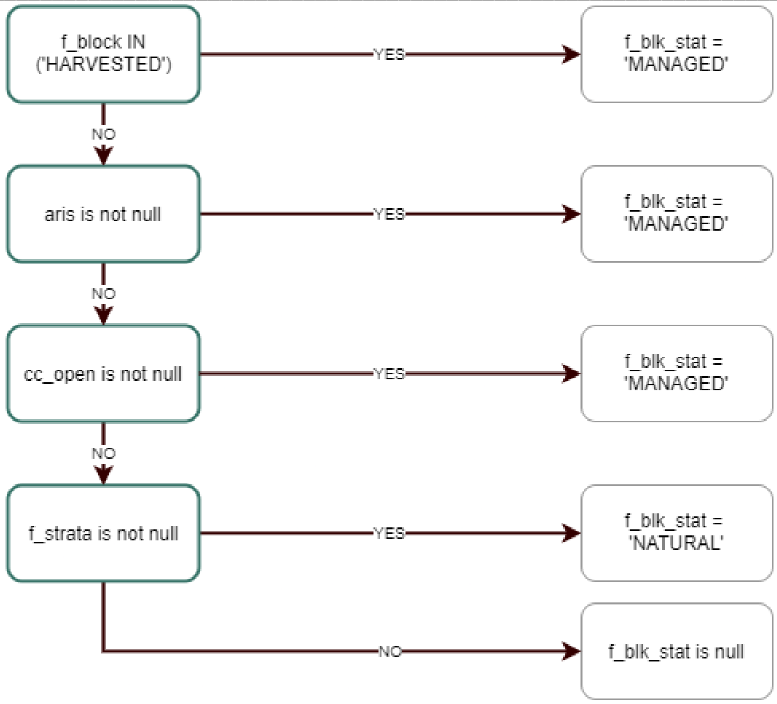

Figure 4-34: Methodology for assigning values to the F_BLK_STAT field in the net landbase.

4.5.11 F_Curve: Final Yield Curve Type

The F_Curve field presents the yield curve type that will be assigned to each polygon. The curve type will be combined with the final stratum assignment to assign the final yield classes in the net landbase. For pine stands harvested in the last 26 years an 'RSA' curve will be assigned to the polygon. For pine and spruce stands that have been harvested outside but were not assigned an RSA curve a 'PRE96' curve will be assigned. All other polygons in the net landbase will be assigned a 'Natural' yield curve. The program logic used to assign the final curve values is presented in Figure 4-35.

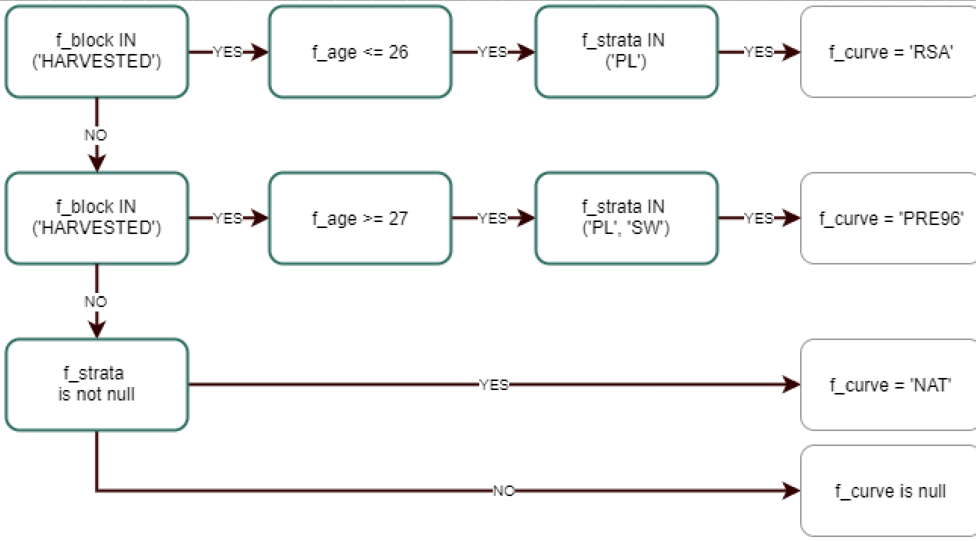

Figure 4-35: Methodology for assigning values to the F_Curve field in the net landbase.

4.5.12 F_BCG: Final Broad Cover Group Assignment

The F_BCG field presents the final Broad Cover Group assignment for each polygon. Polygons are assigned to a broad cover group based on the AVI stratification and the primary storey of management The program logic used to assign the final broad cover group is presented in Figure 4-36.

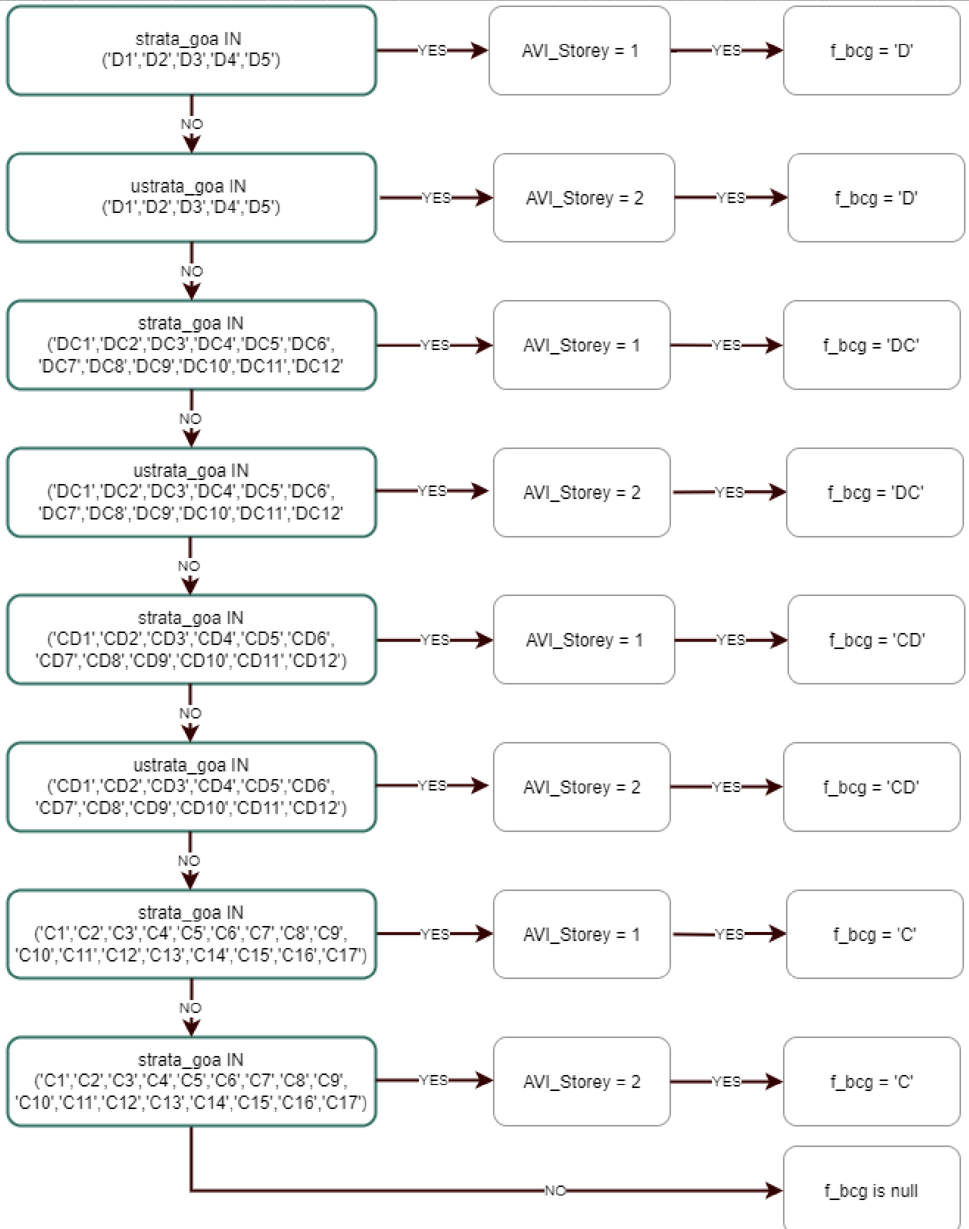

Figure 4-36: Methodology for assigning values to the F_BCG field in the net landbase.

4.5.13 F_Del: Deletion Assignment

F_del contains the amalgamation of all landbase deletion codes into one field. There are multiple deletion type opportunities per polygon thus requiring the determination of an exclusion hierarchy for precedence. The exclusion hierarchy can be observed in Table 4-27.

F_del is calculated at two distinct points in program logic. F_del is preliminarily executed to assess the landscape for deletion groupings for sliver elimination – part 2. Once sliver elimination is processed, isolated stands (see Section 4.4.3.9 under d_iso) are calculated at this stage and is a deletion type thus needing to be accounted for in the f_del code. F_del is run again, accounting for isolated stands in this iteration. The processing of f_del is the same in both the preliminary and secondary execution of the code.

Ordering of the hierarchy is by design to ensure certain deletion types are on the surface for mapping purposes. Please review the respective sub-sections in Section 4.4 for field definitions of f_del.

Table 4-27: F_Del field definitions.

Exclusion Hierarchy	Deletion Type	Restriction Type
1	When d_admin present, d_admin	Administrative
2	When d_anthro present, d_anthro	Administrative
3	When d_avi present, d_avi	Administrative
4	When d_block = 'HARVESTED" present, 'X';	
5	When d_hydro present, d_hydro	Landscape
6	When d_buf present d_buf	Landscape
7	When d_block = 'PLANNED ' present 'X'	
8	When d_nonfor present, d_nonfor	Landscape
9	When d_natdist present, d_natdist	Landscape
10	When d_slope present, d_slope	Operational
11	When d_block present d_block	Operational
12	When d_opdel present d_opdel	Operational
13	When d_moist present, d_moist	Operational
14	When d_tpr present, d_tpr	Operational
15	When d_density present, d_density	Operational
16	When d_struc present, d_struc	Operational
17	When d_sp present, d_sp	Operational
18	When d_iso present, d_iso	Operational
X	If no deletion is present	

4.5.14 F_YC: Yield Stratum

The F_YC field presents the yield stratum assignment for each polygon in the landbase. This is a rollup of the curve type assigned in the f_curve field and the stratum assigned in the f_strata field. The species groups are based on the strata definitions in Section 4.5.9. The program logic used to assign the final yield curves is presented in Figure 4-37 and field definitions are presented in Table 4-28.

Table 4-28: F_YC field definitions.

F_yc	Description
N_HW	Polygon defined as having a natural hardwood yield curve
N_MIX_PL	Polygon defined as having a natural Pine mixedwood yield curve
N_MIX_SX	Polygon defined as having a natural Spruce mixedwood yield curve
N_PL	Polygon defined as having a natural Pine yield curve
N_SW	Polygon defined as having a natural White Spruce yield curve
R_PL	Polygon defined as having an RSA Pine yield curve
X_STRATA	Polygon defined as having no yield curve assigned

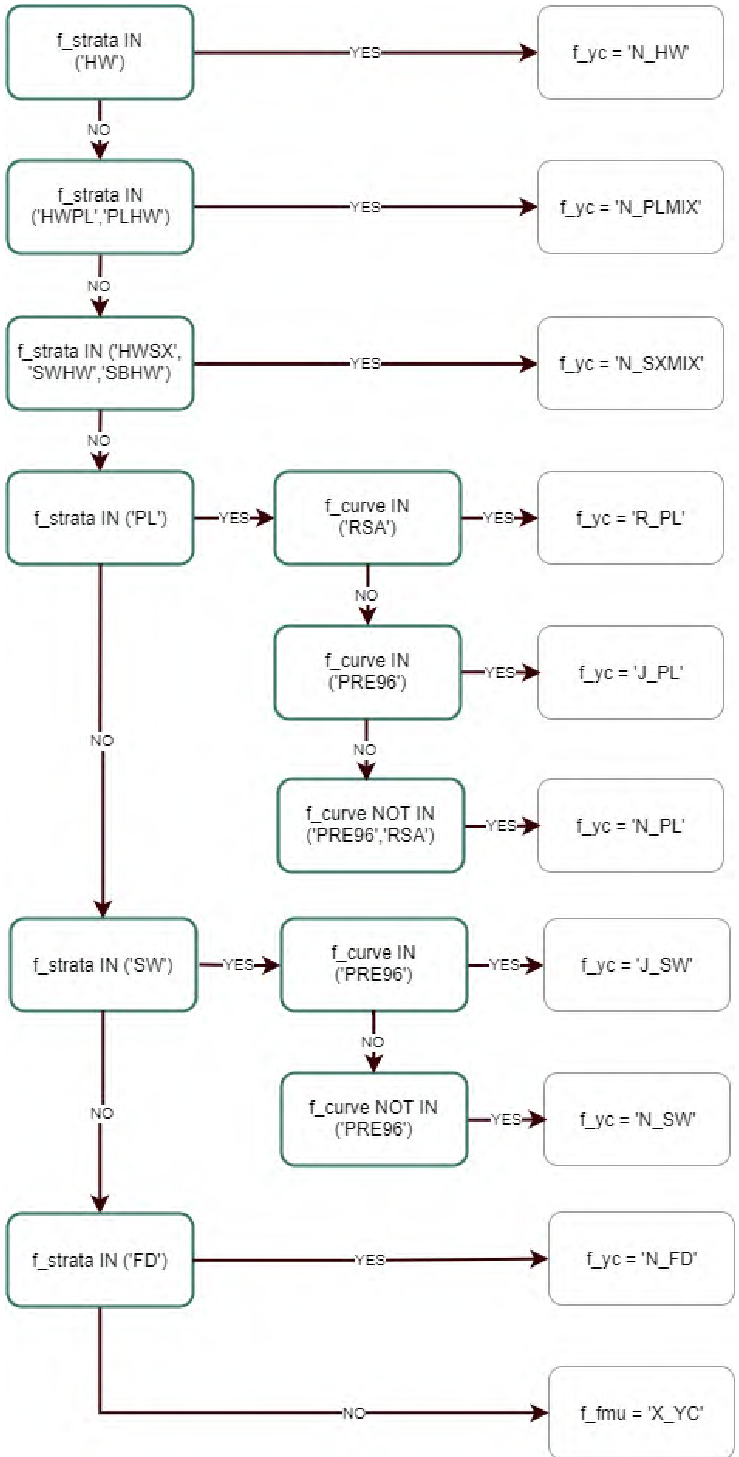

Figure 4-37: Methodology used to assign values to the F_YC field in the net landbase.

4.5.15 F_Landbase: Final Landbase Assignment

This field identifies whether a polygon belongs to the Coniferous or Deciduous landbase. With Crowsnest Forest Products having timber rights for conifer in this FMA all stands containing conifer become part of the conifer landbase. All stands identified as being part of the deciduous broad cover group will be assigned to the deciduous landbase. The program logic used to assign the final landbase is presented in Figure 4-38.

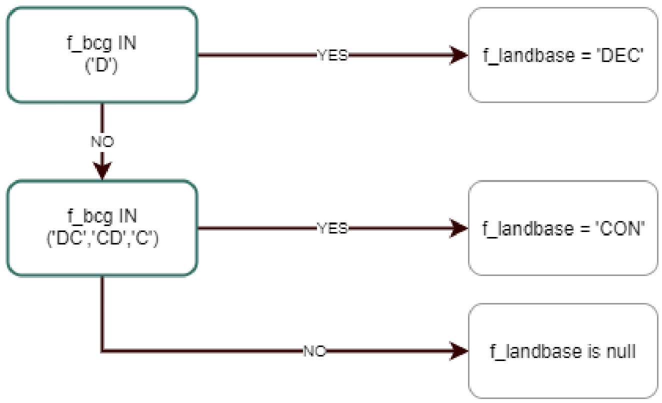

Figure 4-38: Methodology used to assign the final landbase (F_Landbase) to polygons in the net landbase.

4.5.16 F_Active: Contributing/Non-Contributing Landbase Assignment

This field identifies whether a polygon belongs to the contributing (active) landbase and the non-contributing (passive) landbase. This is determined based on the assigned values in the F_Del field. If a polygon is assigned a deletion then it will be part of the non-contributing landbase and all other polygons will be part of the contributing landbase. The program logic used to assign the final landbase is presented in Figure 4-39.

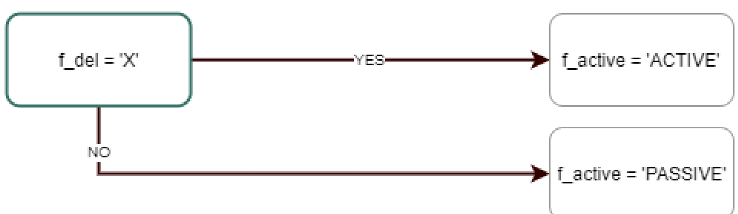

Figure 4-39: Methodology used to assign contributing (active) and non-contributing (passive) landbase assignments to the net landbase.

4.6 Final Landbase Creation

Final landbase creation and area assignments for the different landbases change with the type of landbase in question.

4.6.1 TSA Landbase

The Timber Supply Analysis (TSA) Landbase is a result of linking the multiunion landbase, sliver elimination process, and the proxy datasets together. The tsa_ukey field is a unique identifier that is assigned to each polygon in this landbase. The other two landbase products will be linked to this landbase through this unique key.

4.6.2 Classified Landbase

The Classified Landbase is the result of the unioning of the TSA landbase with the seismic line features. This landbase contains the most linework and polygon features of all the landbases. In addition to the TSA landbase fields, the fields seismic, trails and cls_ukey are created as part of the union. cls_ukey is a unique identifier of this landbase. Seismic and trails are binary type identifiers of whether the polygon in question represents a seismic line feature or designated trail on the landbase. tsa_ukey is also retained so that there is linkage between all landbases.

4.6.3 Modelling Landbase

The modelling landbase uses the same spatial data that was created for the TSA landbase. It maintains the same tsa_ukey values that were created for the TSA landbase. The landbase was then modified to include area adjustments to account for the calculated seismic area within each polygon. This area reduction was then used to calculate area estimates of the forested area (ha_net), seismic area (ha_seismic) and gross polygon area (ha_gross). To improve processing efficiency, any landbase fields not required in the timber supply analysis are removed from the landbase.

5 Landbase Summary

The following is a summary each of the Crowsnest landbases according to the rulesets applied in previous sections.

5.1 TSA Landbase Results

Table 5-1 is a summary of the gross contributing and non-contributing TSA landbase area by yield stratum. Table 5-2 is a summary of the net landbase based on the assigned deletions and broad cover groups.

Table 5-1: Summary of the area assigned to the contributing and non-contributing landbase by yield stratum for the TSA Landbase.

Yield Stratum	Contributing Landbase Area (ha)	Non-Contributing Landbase Area (ha)	Total Area (ha)
N_HW	12,117.4	3,150.2	15,267.6
N_PLMIX	1,141.0	806.2	1,947.2
N_SXMIX	1,626.5	892.7	2,519.2
N_PL	39,814.0	30,543.3	70,357.3
N_SW	16,402.5	21,419.8	37,822.3
N_FD	10,909.9	6,178.2	17,088.1
J_PL	8,082.7	69.8	8,152.4
J_SW	2,530.3	6.2	2,536.5
R_PL	13,519.1	293.8	13,812.9
X	0.0	180,844.4	180,844.4
Total	**106,143.4**	**244,204.7**	**350,348.1**

Table 5-2: Summary of the areas assigned to the non-contributing and contributing landbases in the TSA landbase.

Landbase Category		Area (ha)
	Non-Contributing Landbase	
	Administrative Restrictions	
PPA	Parks and Protected Areas	157,612.1
ESLUZ	Eastern Slopes Land Use Zone 1	3,102.1
HRV	Historic Resource Values	1,215.7
DIDS-FOR	Forest DIDs Dispositions	266.3
DIDS-NONFOR	Non-Forested DIDs Dispositions	2,939.1
CLR	Crown Land Reservations	414.6
GOA_PSP	GOA Permanent Sample Plots	116.9
ANTH_NON	Non-Vegetated Anthropogenic Features	526.1
ANTH_VEG	Vegetated Anthropogenic Features	173.5
AVI	Areas with no AVI Interpretation	700.3
Administrative Total		167,066.7
	Landscape Restrictions	
LAKES_RIVERS	Lakes and Rivers	661.9
FLOOD	Flood Prone Areas	6.4
HYDROBUF	Hydrology Buffers	10,701.2
NNV	Natural Non-Vegetated Areas	2,627.4
NNF	Natural Non-Forested Areas	11,924.8
BURN	Burned Areas	12.8
OTHER_DIST	Areas Affected by Other Natural Disturbances	30.0
NFCC	Non-Forested Cutblocks (Outstanding ARIS Reconciliation)	0.0
Landscape Restrictions Total		25,964.6
	Operational Restrictions	
SLOPE	Areas with Slopes >45%	32,584.1
MOISTURE	High Soil Moisture	216.8
TPR	Low Timber Productivity Rating	4,785.2
DENSITY	Low Stand Density	9,025.0
LT	Larch/Tamarac	265.9
FD	Douglas-Fir	225.5
PA_PF	Whitebark/Limber Pine	1,302.1
WHITEBARK PINE PLUS		17.4
OPDEL	Operational Deletions	1,742.4
ISO	Isolated Stands	23.6
PAR	Perimeter to Area Deletions	985.4
Operational Restrictions Total		51,173.4
Non-Contributing Landbase Total		244,204.7
	Contributing Landbase	
C	Coniferous	91,258.5
CD	Coniferous Leading Mixedwood	1,508.1
DC	Deciduous Leading Mixedwood	1,259.3
D	Deciduous	12,117.4
Contributing Landbase Total		106,143,4
Grand Total		**350,348.1**

5.2 Classified Landbase Results

Table 5-3 is a summary of the gross contributing and non-contributing Classified landbase area by yield stratum. Table 5-4 is a summary of the net landbase based on the assigned deletions and broad cover groups.

Table 5-3: Summary of the area assigned to the contributing and non-contributing landbase by yield stratum for the Classified Landbase.

Yield Stratum	Contributing Landbase Area (ha)	Non-Contributing Landbase Area (ha)	Total Area (ha)
N_HW	12,114.4	3,153.3	15,267.6
N_PLMIX	1,139.9	807.2	1,947.2
N_SXMIX	1,625.9	893.3	2,519.2
N_PL	39,780.2	30,577.1	70,357.3
N_SW	16,395.8	21,426.5	37,822.3
N_FD	10,909.2	6,179.0	17,088.1
J_PL	8,082.7	69.8	8,152.4
J_SW	2,530.3	6.2	2,536.5
R_PL	13,519.1	293.8	13,812.9
X		180,844.4	180,844.4
Total	**106,097.4**	**244,250.7**	**350,348.1**

Table 5-4: Summary of the areas assigned to the non-contributing and contributing landbases in the classified landbase.

Landbase Category		Area (ha)
	Non-Contributing Landbase	
	Administrative Restrictions	
PPA	Parks and Protected Areas	157,612.1
ESLUZ	Eastern Slopes Land Use Zone 1	3,102.1
HRV	Historic Resource Values	1,215.7
DIDS-FOR	Forest DIDs Dispositions	266.6
DIDS-NONFOR	Non-Forested DIDs Dispositions	2,939.1
CLR	Crown Land Reservations	414.6
GOA_PSP	GOA Permanent Sample Plots	116.9
ANTH_NON	Non-Vegetated Anthropogenic Features	526.1
ANTH_VEG	Vegetated Anthropogenic Features	173.5
AVI	Areas with no AVI Interpretation	700.3
Administrative Total		167,066.7
	Landscape Restrictions	
LAKES_RIVERS	Lakes and Rivers	616.9
FLOOD	Flood Prone Areas	6.4
HYDROBUF	Hydrology Buffers	10,701.2
NNV	Natural Non-Vegetated Areas	2,627.4
NNF	Natural Non-Forested Areas	11,924.8
BURN	Burned Areas	12.8
OTHER_DIST	Areas Affected by Other Natural Disturbances	30.0
NFCC	Non-Forested Cutblocks (Outstanding ARIS Reconciliation)	0.0
Landscape Restrictions Total		25,964.6
	Operational Restrictions	
SLOPE	Areas with Slopes >45%	32,584.1
MOISTURE	High Soil Moisture	216.8
TPR	Low Timber Productivity Rating	4,785.2
DENSITY	Low Stand Density	9,025.0
LT	Larch/Tamarac	265.9
FD	Douglas-Fir	225.5
PA_PF	Whitebark/Limber Pine	1,302.1
WHITEBARK PINE PLUS		17.4
OPDEL	Operational Deletions	1,742.4
ISO	Isolated Stands	23.6
PAR	Perimeter to Area Deletions	985.4
SEISMIC	Seismic Lines	46.0
Operational Restrictions Total		51,219.4
Non-Contributing Landbase Total		244,250.7
	Contributing Landbase	
C	Coniferous	91,217.2
CD	Coniferous Leading Mixedwood	1,507.1
DC	Deciduous Leading Mixedwood	1,258.8
D	Deciduous	12,114.4
Contributing Landbase Total		106,097.4
Grand Total		**350,348.1**

Appendix I AVI Approval from GOA

Alberta Agriculture, Forestry and Rural Economic Development

Forestry Division
Forest Stewardship and Trade Branch
Suite 303, J.G.O'Donoghue Building
7000 113 Street
Edmonton, Alberta T6H 5T6
Canada
Telephone: 780-427-6807
www.alberta.ca/forestry.aspx

File: *06296 F01 04*

September 19, 2022

Jason Mogilefsky, RPF
Forestry Manager
Crowsnest Forest Products Ltd.
305 Griffin Rd W,
Cochrane, AB
T4C 2C4

Dear Mr. Mogilefsky:

Subject: **Alberta Vegetation Inventory for FMU C5 – FMA2100047**

Reforestation, Inventory & Biometrics Section (RIBS) staff have completed the final review of the Alberta Vegetation Inventory (AVI) submitted (March 7, 2022) by Crowsnest Forest Products Ltd. for the area in Forest Management Unit (FMU) C5 under Forest Management Agreement (FMA) 2100047.

The spatial, attribute, and interpretation audits conducted for the submitted inventory indicated that AVI are within acceptable range of accuracy as stated in the AVI Standard 2.1.5. The final AVI submitted (May 2, 2022) is officially approved for use in forest management planning and operational planning. Attached is the final audit report on the AVI for FMU C5.

A cursory evaluation of openings in this AVI submission compared to ARIS records indicated some outages. A comprehensive ARIS reconciliation will be required as part of the classified landbase development as part of your forest management plan. Final sign-off of the reconciliation must be completed as part of the planning process. Any changes made to the AVI because of the forest management planning process must be submitted to the RIBS once the forest management plan is approved.

This AVI submission from Crowsnest Forest Products, an affiliate of Spray Lake Sawmills, falls under the data sharing agreement between Spray Lake Sawmills and the Department, signed in November 21, 2016. Should you have any questions regarding this approval, please contact Greg Sather (greg.sather@gov.ab.ca) or myself (darren.aitkin@gov.ab.ca).

Yours truly,

Darren Aitkin, RPF
Director, Reforestation, Inventory & Biometrics

cc: Matt Denney, Planning Forester, Spray Lakes Sawmill
Liana Luard, Lead, Forest Planning & Performance Monitoring, FSTB
Greg Sather, Vegetation Inventory Analyst, FSTB

Appendix II Updates to AVI

The following list describes the changes that have occurred to the AVI since it's approval on 19 September 2022. All changes were completed so that interpreted harvest boundaries aligned to the actual harvest boundaries. The approved AVI interpretations did not always align to the original harvest boundaries as forest dynamics often blurs the edges of cutblocks over time. These changes allow the boundaries to better reflect the harvest boundaries even if the boundaries were not visible in the aerial photos. These changes will improve the ability of the operators to reconcile these cutblock boundaries against the Alberta Regeneration Information System (ARIS) data.

1. Poly_num = 39092 – Small section of permanent road separated from harvest area 5040073083A.
2. Poly_num = 39183 – Internal retention patch added to AVI.
3. Poly_num = 38472 – Outer boundary adjusted to account for areas that were rock outcrops, not harvest areas.
4. Poly_num = 37793 – Attributed to block 5060081175A, was mistakenly characterized as low-density forest in original AVI.
5. Poly_num = 38081, 38023, 38589 – Adjusted to incorporate boundary changes for block 5060073685A.
6. Poly_num = 38204 – North part of polygon removed because it is a natural meadow.
7. Poly_num = 39029 – Right-of-way area removed from block.
8. Poly_num = 40122 – natural clearing removed from middle of harvest area. Outer boundary adjusted to capture missed section of harvest area.
9. Poly_num In (38714, 38723, 38776, 38782, 38792, 38873, 38893, 38901, 38903, 38907, 38914, 38915, 38916, 38928, 38931, 38939, 38947, 38951, 38954, 38963, 38971, 38978, 38996, 39023, 39026) – Added opening number 5050073641 & 'RT' to Mod1 field.
10. Poly_num = 38787 – Linework change, boundary of patch that is not considered part of the partial harvest area was split from harvest area.
11. Poly_num = 38586 – Attributed to opening num 5050073641, RT was not added to the mod 1 field because it is a partial cut block, and this is not considered part of the block.
12. Poly_num In (38736, 38746, 38750, 38755, 38759, 38762, 38768, 38772, 38775, 38791, 38794, 38796, 38802, 38804, 38809, 38812, 38814, 38816, 38824, 38827, 38831, 38833, 38838, 38843, 38844, 38849, 38861, 38865, 38867, 38876, 38881, 38883, 38889, 38890, 38892, 38895, 38899, 38912, 38921, 38933, 38953, 38958, 38964, 38975, 38979, 38982, 38983, 38995, 39003) – Added opening number 5050073630 & 'RT' to Mod1 field.
13. Poly_num = 38993 – Attributed to opening num 5050073630, RT was not added to the mod 1 field.

14. Poly_num = 9799 – Boundary of opening 5010123239A expanded to the east based on records from a field survey.

15. Poly_num = 24064 – Attribute change for ARIS and OPEN_NUM field to 5050101139A, SCD: 1/7/1992 is the correct SCD and is currently still wrong in the AVI.

16. Poly_num = 22540 – Attribute updated for MOD1 = BU, HARV_code = blank, as it is a burn, TIMBER_YR = blank, OPEN_NUM and ARIS changed to blank.

17. Poly_num = 22437 – Attribute updated for ARIS and OPEN_NUM field to 5050102532 and SCD = 7/1/1991 & HARV_YR = 1991.

18. Poly_num = 17219 – Attribute updated for ARIS and OPEN_NUM field to 5050112372A and SCD = 10/6/1999 & HARV_YR = 1999.

19. Poly_num = 7274 – Attribute change Mod_1 is RT.

20. Poly_num = 7225 – Attribute change for ARIS and OPEN_NUM field to 5050132208A.

21. Poly_num = 30225 – Attribute for ARIS and OPEN_NUM field to 5040090494A and HARV_YR = 2011 and SCD = 8/30/2011.

22. Poly_Num = 22327 – Timber year is 1973.

23. Poly_Num = 8298 – Attribute needs updated for ARIS and OPEN_NUM field to 5010131095A and SCD 1/11/2023 & HARV_YR = 2022, Timber year 2022.

24. Poly_num = 40331 – Was mistakenly tagged as Harv_Code = 'A', Harv_Code should be Null for this polygon. Not in current AVI.

Appendix III Changes from AIP Submission

Agreement in Principle was granted to CFP for the initial landbase submission on 15 December 2023. As part of the AIP, several conditions were listed. These conditions were addressed as follows:

1. Plus-tree spatial data added to the landbase to identify polygons that contain these points. The small size of the buffered points prevents them from being identified as non-contributing landbase as almost all the resulting polygons are dissolved as part of the sliver removal process. To address the layer is used as a proxy in the landbase and CFP will identify the trees and buffer them as part of operational planning.
2. Summary Tables have been updated. Any misalignments between tables and datasets previously identified are resolved.
3. All contributing landbase now has a corresponding forest stratum assigned.
4. Reforestation Exemptions: Two openings were given reforestation exemptions 5030151733A and 5030152043A. These two openings are now assigned to the passive landbase.
5. Documentation inconsistencies regarding feature classes are resolved.
6. Permanent Sample Plots (i_psp): The layer was modified to replace PSP 7200 with a smaller series of polygons that correspond with the actual permanent sample plots and not the larger outer buffer.
7. Operational Deletions and Deferrals were updated to reflect current landbase conditions.
8. Snow sensitive areas (i_snowsensitivezones) are identified in the landbase. These are areas between 1800 m and 2500 m in elevation that were identified as sensitive by the GOA.
9. Company specific addendum for hydrology.
10. Crown Land Reservations (i_clr): The addition of CLR 100288 to the CLR input layer. This CLR corresponds to the Southern Rockies Watersheds Study. As part of this inclusion, this CLR will be treated as a 20-year deferral

In addition to the conditions listed in the AIP letter, the following changes have also occurred:

- Erosion risk (i_erosionrisk) was added to the landbase as a primary data layer. This layer identifies areas within 100 meters of identified streams where erosion risk is high.
- Wildfire Risk (i_wildfirerisk) was added to the landbase as the layer was not received prior to the AIP submission. In the previous version of the landbase the fire behaviour potential based on the previous version of the AVI was included.
- Reforestation Exemptions: Two openings were given reforestation exemptions 5030151733A and 5030152043A. These two openings were assigned to the passive landbase. This was listed as a condition in the Agreement-In-Principle letter for the initial landbase submission.
- Permanent Sample Plots (i_psp): The layer was modified to replace PSP 7200 with a smaller series of polygons that correspond with the actual permanent sample plots and not the larger

outer buffer. This was listed as a condition in the Agreement-In-Principle letter for the initial landbase submission.

ARIS reconciliation was completed. This resulted in some changes to the cutblocks layer and the ARIS tabular data.

Appendix IV Species Coding Detail

This appendix provides additional detail on how the AVI forest cover calls were stratified.

IV.1 Species Percent

(AW_PCT, BW_PCT, PB_PCT, FB_PCT, FD_PCT, LT_PCT, PL_PCT, SB_PCT, SW_PCT and

UAW_PCT, UBW_PCT, UPB_PCT, UFB_PCT, UFD_PCT, ULT_PCT, UPL_PCT, USB_PCT, USW_PCT)

Species percentages interpreted in the AVI are used to assign percentages for each species group in the landbase stratification. AVI species percentages are assigned in 10% classes. Species percentage fields group similar species into a single category and calculate a total percentage if multiple species of the same group are present in a single AVI polygon. For example, the pine percentage field (PL_PCT) is calculated by summing the total percentage for all pine species identified in a polygon. In polygons where multiple pine species are present (*e.g.* lodgepole pine, whitebark pine, and limber pine) the PL_PCT field will be the sum of the pine species percentages. An example of how species percentages were calculated for aspen is presented in Table IV-1. This rule is applied for all species groups in both the overstorey (fields *_PCT) and understorey (fields U*_PCT).

Table IV-1: Example of species percent assignment.

AW_PCT	Description	Selection Criteria
SP1_PER	Species 1 percent class	SP1 = 'AW'
SP2_PER	Species 2 percent class	SP2 = 'AW'
SP3_PER	Species 3 percent class	SP3 = 'AW'
SP4_PER	Species 4 percent class	SP4 = 'AW'
SP5_PER	Species 5 percent class	SP5 = 'AW'
'0'	No 'AW' present	

IV.2 Species Type Percent

(HARDPCT, SOFTPCT, UHARDPCT, USOFTPCT)

After species group percentages are calculated, the species type percentages for deciduous (hardwood) and coniferous (softwood) species types are calculated using the following equations. Note that species type percent is calculated for both the overstorey and understorey.

HARDPCT = AW_PCT + BW_PCT + PB_PCT

SOFTPCT = FB_PCT + FD_PCT + LT_PCT + PL_PCT + SB_PCT + SW_PCT

UHARDPCT = UAW_PCT + UBW_PCT + UPB_PCT

USOFTPCT = UFB_PCT + UFD_PCT + ULT_PCT + UPL_PCT + USB_PCT + USW_PCT

IV.3 Species Order

(AW_ORD, BW_ORD, PB_ORD, FB_ORD, FD_ORD, LT_ORD, PL_ORD, SB_ORD, SW_ORD and

UAW_ORD, UBW_ORD, UPB_ORD, UFB_ORD, UFD_ORD, ULT_ORD, UPL_ORD, USB_ORD, USW_ORD)

The order of species groups is also calculated after the species percent is calculated. This field is used to determine which species groups are most prominent in each polygon. An example of how species percents are used to calculate species order for aspen is presented in Table IV-2. This rule is applied for all species groups in both the overstorey (fields *_ORD) and understorey (fields U*_ORD).

Table IV-2: Example of species order assignment for under and overstorey.

AW_ORD	Description	Selection Criteria
1	Species 1	SP1 = 'AW'
2	Species 2	SP2 = 'AW'
3	Species 3	SP3 = 'AW'
4	Species 4	SP4= 'AW'
5	Species 5	SP5 = 'AW'
9	No 'AW' present	

IV.4 Leading Species

(LEAD_DEC, LEAD_CON, ULEAD_DEC, ULEAD_CON)

Using the species order field, the leading deciduous species is determined (*i.e.* the deciduous species group with the highest species percentage). The logic for determining leading deciduous species is presented in Table IV-3. In a similar way, the leading coniferous species is also determined based on the species order. The logic for determining leading coniferous species is presented in

Table IV-4.

Table IV-3: Assignment of deciduous leading species.

LEAD_DEC	Description	Selection Criteria
'AW'	Aspen leading deciduous	AW_ORD < BW_ORD and AW_ORD < PB_ORD
'BW'	Birch leading deciduous	BW_ORD < AW_ORD and BW_ORD < PB_ORD
'PB'	Poplar leading deciduous	PB_ORD < AW_ORD and PB_ORD < BW_ORD
'NO'	No deciduous present	HARDPCT = 0

Table IV-4: Assignment of coniferous leading species.

LEAD_CON	Description	Selection Criteria
'FB'	Balsam fir leading conifer	FB_ORD < FD_ORD and FB_ORD < LT_ORD and FB_ORD < PL_ORD and FB_ORD < SB_ORD and FB_ORD < SW_ORD
'FD'	Douglas fir leading conifer	FD_ORD < FB_ORD and FD_ORD < LT_ORD and FD_ORD < PL_ORD and FD_ORD < SB_ORD and FD_ORD < SW_ORD
'LT'	Larch leading conifer	LT_ORD < FD_ORD and LT_ORD < FB_ORD and LT_ORD < PL_ORD and LT_ORD < SB_ORD and LT_ORD < SW_ORD
'PL'	Pine leading conifer	PL_ORD < FD_ORD and PL_ORD < LT_ORD and PL_ORD < FB_ORD and PL_ORD < SB_ORD and PL_ORD < SW_ORD
'SB'	Black spruce leading conifer	SB_ORD < FD_ORD and SB_ORD < LT_ORD and SB_ORD < PL_ORD and SB_ORD < FB_ORD and SB_ORD < SW_ORD
'SW'	White spruce leading conifer	SW_ORD < FD_ORD and SW_ORD < LT_ORD and SW_ORD < PL_ORD and SW_ORD < SB_ORD and SW_ORD < FB_ORD
'NO'	No deciduous present	SOFTPCT = 0

Note: the leading understorey deciduous (ULEAD_DEC) and understorey coniferous (ULEAD_CON) species were also calculated using the appropriate values from the species-based U*_ORD variables.

IV.5 Broad Cover Group

(C_CODE, UC_CODE)

The Broad Cover Group (BCG) is assigned using the rules outlined in Table IV-5. Note that the BCG is calculated for the overstorey (C_CODE) and the understorey (UC_CODE) using the appropriate SOFTPCT/HARDPCT/SP1 or USOFTPCT/UHARDPCT/USP1 fields as necessary.

Table IV-5: BCG assignment.

C_CODE	Label	Description	Selection Criteria
D	Pure Deciduous	Deciduous >= 80%	HARDPCT >= 8
DC	Deciduous-Coniferous	Coniferous > 20% and Deciduous > 20%	(HARDPCT > 5 and HARDPCT < 8) or (HARDPCT = 5 and SP1 is ('AW','PB','BW'))
CD	Conifer-Deciduous	Coniferous > 20% and Deciduous > 20%	(SOFTPCT > 5 and SOFTPCT < 8) or (SOFTPCT = 5 and SP1 is not ('AW','PB','BW'))
C	Pure Coniferous	Coniferous >= 80%	SOFTPCT >= 8
NULL	No cover group	Not a forested type	SOFTPCT = 0 and HARDPCT = 0

IV.6 Strata Decision Rules

(DRULE, CRULE, UDRULE, UCRULE)

Extended strata are defined in the Alberta Forest Management Planning Standard (Alberta Sustainable Resource Development, 2006). To assign extended strata, the leading deciduous species and leading coniferous species were required. The leading deciduous species was the species with the lowest species order value. Note that the leading deciduous rule is calculated for both overstorey (DRULE) and understorey (UDRULE) layers of each stand. The rules for DRULE and UDRULE assignment are presented in Table IV-6.

Table IV-6: Assignment of leading deciduous strata decision rule.

DRULE	Description	Selection Criteria
'AW_LEAD'	Aspen leading deciduous	HARDPCT > 0 and AW_ORD < BW_ORD and AW_ORD < PB_ORD
'BW_LEAD'	Birch leading deciduous	HARDPCT > 0 and BW_ORD < AW_ORD and BW_ORD < PB_ORD
'PB_LEAD'	Poplar leading deciduous	HARDPCT > 0 and PB_ORD < AW_ORD and PB_ORD < BW_ORD
'NO_D'	No deciduous present	HARDPCT = 0

Assignment of leading coniferous species was more complex and based on relative percent composition by species. Note that the leading coniferous rule was calculated for both overstorey (CRULE) and understorey (UCRULE) layers of each stand. The rules for CRULE and UCRULE assignment are presented in Table IV-7.

Table IV-7: Assignment of leading coniferous strata decision rule.

CRULE	Description	Selection Criteria
'FB_LEAD'	True fir leading coniferous in pure stand	C_CODE = ('C', 'D') and ((FB_PCT > FD_PCT and FB_PCT > LT_PCT and FB_PCT > PL_PCT and FB_PCT > SB_PCT and FB_PCT > SW_PCT) or (LEAD_CON = 'FB' and FB_PCT >= FD_PCT and FB_PCT >= LT_PCT and FB_PCT >= PL_PCT and FB_PCT >= SB_PCT and FB_PCT >= SW_PCT))
'FD_LEAD'	Douglas-fir leading coniferous in pure stand	C_CODE = ('C', 'D') and ((FD_PCT > FB_PCT and FD_PCT > LT_PCT and FD_PCT > PL_PCT and FD_PCT > SB_PCT and FD_PCT > SW_PCT) or (LEAD_CON = 'FD' and FD_PCT >= FB_PCT and FD_PCT >= LT_PCT and FD_PCT >= PL_PCT and FD_PCT >= SB_PCT and FD_PCT >= SW_PCT))
'FBFD_LEAD_MW'	True fir or Douglas-fir leading coniferous in mixedwood	C_CODE = ('DC', 'CD') and (((FB_PCT + FD_PCT) > PL_PCT and (FB_PCT + FD_PCT) > (SB_PCT + LT_PCT) and (FB_PCT + FD_PCT) > SW_PCT) or (LEAD_CON = ('FB','FD') and (FB_PCT + FD_PCT) >= PL_PCT and (FB_PCT + FD_PCT) >= (SB_PCT + LT_PCT) and (FB_PCT + FD_PCT) >= SW_PCT))
'LT_LEAD'	Larch leading coniferous in pure stand	C_CODE = ('C', 'D') and ((LT_PCT > FB_PCT and LT_PCT > FD_PCT and LT_PCT > PL_PCT and LT_PCT > SB_PCT and LT_PCT > SW_PCT) or (LEAD_CON = 'LT' and LT_PCT >= FB_PCT and LT_PCT >= FD_PCT and LT_PCT >= PL_PCT and LT_PCT >= SB_PCT and LT_PCT >= SW_PCT))
'PL_LEAD'	Pine leading coniferous in pure stand	C_CODE = ('C', 'D') and ((PL_PCT > FB_PCT and PL_PCT > FD_PCT and PL_PCT > LT_PCT and PL_PCT > SB_PCT and PL_PCT > SW_PCT) or (LEAD_CON = 'PL' and PL_PCT >= FB_PCT and PL_PCT >= FD_PCT and PL_PCT >= LT_PCT and PL_PCT >= SB_PCT and PL_PCT >= SW_PCT))
'PL_LEAD_MW'	Pine leading coniferous in mixedwood	C_CODE = ('DC', 'CD') and ((PL_PCT > (FB_PCT + FD_PCT) and PL_PCT > (SB_PCT + LT_PCT) and PL_PCT > SW_PCT) or (LEAD_CON = 'PL' and PL_PCT >= (FB_PCT + FD_PCT) and PL_PCT >= (SB_PCT + LT_PCT) and PL_PCT >= SW_PCT))

CRULE	Description	Selection Criteria
'SB_LEAD'	Black spruce leading coniferous in pure stand	C_CODE = ('C', 'D') and ((SB_PCT > FB_PCT and SB_PCT > FD_PCT and SB_PCT > LT_PCT and SB_PCT > PL_PCT and SB_PCT > SW_PCT) or (LEAD_CON = 'SB' and SB_PCT >= FB_PCT and SB_PCT >= FD_PCT and SB_PCT >= LT_PCT and SB_PCT >= PL_PCT and SB_PCT >= SW_PCT))
'SBLT_LEAD_MW'	Black spruce or larch leading coniferous in mixedwood	C_CODE = ('DC', 'CD') and (((SB_PCT + LT_PCT) > (FB_PCT + FD_PCT) and (SB_PCT + LT_PCT) > PL_PCT and (SB_PCT + LT_PCT) > SW_PCT) or (LEAD_CON = ('SB', 'LT') and (SB_PCT + LT_PCT) >= (FB_PCT + FD_PCT) and (SB_PCT + LT_PCT) >= PL_PCT and (SB_PCT + LT_PCT) >= SW_PCT))
'SW_LEAD'	White spruce leading coniferous in pure stand	C_CODE = ('C', 'D') and ((SW_PCT > FB_PCT and SW_PCT > FD_PCT and SW_PCT > LT_PCT and SW_PCT > PL_PCT and SW_PCT > SB_PCT) or (LEAD_CON = 'SW' and SW_PCT >= FB_PCT and SW_PCT >= FD_PCT and SW_PCT >= LT_PCT and SW_PCT >= PL_PCT and SW_PCT >= SB_PCT))
'SW_LEAD_MW'	White spruce leading coniferous in mixedwood	C_CODE = ('DC', 'CD') and ((SW_PCT > (FB_PCT+FD_PCT) and SW_PCT > PL_PCT and SW_PCT > (SB_PCT + LT_PCT)) or (LEAD_CON = 'SW' and SW_PCT >= (FB_PCT+FD_PCT) and SW_PCT >= PL_PCT and SW_PCT >= (SB_PCT + LT_PCT)))
'NO_C'	No coniferous present	SOFTPCT = 0

IV.7 Extended Strata

(B10_STRATA_GOA, B10_USTRATA_GOA)

Based on the leading species, BCG, and species composition, polygons are then assigned to an extended stratum (see Table IV-8). Note that the extended GOA strata are calculated for both the overstorey (B10_STRATA_GOA) and understorey (B10_USTRATA_GOA) strata using the appropriate input variables representing the proper layer.

Table IV-8: Assignment of extended strata.

STRATA_GOA	Description	Selection Criteria
'D1'	Pure aspen	C_CODE = 'D' and AW_PCT >= 9
'D2'	Aspen leading with poplar	C_CODE = 'D' and DRULE = 'AW_LEAD' and AW_PCT < 9 and PB_PCT > 1
'D3'	Aspen leading without poplar	C_CODE = 'D' and DRULE = 'AW_LEAD' and AW_PCT < 9 and PB_PCT <= 1
'D4'	Poplar leading	C_CODE = 'D' and DRULE = 'PB_LEAD'
'D5'	Birch leading	C_CODE = 'D' and DRULE = 'BW_LEAD'
'DC1'	Aspen/white spruce	C_CODE= 'DC' and DRULE = 'AW_LEAD' and CRULE = 'SW_LEAD_MW'
'DC2'	Aspen/pine	C_CODE= 'DC' and DRULE = 'AW_LEAD' and CRULE = 'PL_LEAD_MW'
'DC3'	Aspen/black spruce	C_CODE = 'DC' and DRULE = 'AW_LEAD' and CRULE = 'SBLT_LEAD_MW'
'DC4'	Aspen/fir	C_CODE = 'DC' and DRULE = 'AW_LEAD' and CRULE = 'FBFD_LEAD_MW'
'DC5'	Poplar/white spruce	C_CODE = 'DC' and DRULE = 'PB_LEAD' and CRULE = 'SW_LEAD_MW'

STRATA_GOA	Description	Selection Criteria
'DC6'	Poplar/pine	C_CODE = 'DC' and DRULE = 'PB_LEAD' and CRULE = 'PL_LEAD_MW'
'DC7'	Poplar/black spruce	C_CODE = 'DC' and DRULE = 'PB_LEAD' and CRULE = 'SBLT_LEAD_MW'
'DC8'	Poplar/fir	C_CODE = 'DC' and DRULE = 'PB_LEAD' and CRULE = 'FBFD_LEAD_MW'
'DC9'	Birch/white spruce	C_CODE = 'DC' and DRULE = 'BW_LEAD' and CRULE = 'SW_LEAD_MW'
'DC10'	Birch/pine	C_CODE = 'DC' and DRULE = 'BW_LEAD' and CRULE = 'PL_LEAD_MW'
'DC11'	Birch/black spruce	C_CODE = 'DC' and DRULE = 'BW_LEAD' and CRULE = 'SBLT_LEAD_MW'
'DC12'	Birch/fir	C_CODE = 'DC' and DRULE = 'BW_LEAD' and CRULE = 'FBFD_LEAD_MW'
'CD1'	White spruce/aspen	C_CODE = 'CD' and CRULE = 'SW_LEAD_MW' and DRULE = 'AW_LEAD'
'CD2'	White spruce/poplar	C_CODE = 'CD' and CRULE = 'SW_LEAD_MW' and DRULE = 'PB_LEAD'
'CD3'	White spruce/birch	C_CODE = 'CD' and CRULE = 'SW_LEAD_MW' and DRULE = 'BW_LEAD'
'CD4'	Pine/aspen	C_CODE = 'CD' and CRULE = 'PL_LEAD_MW' and DRULE = 'AW_LEAD'
'CD5'	Pine/poplar	C_CODE = 'CD' and CRULE = 'PL_LEAD_MW' and DRULE = 'PB_LEAD'
'CD6'	Pine/birch	C_CODE = 'CD' and CRULE = 'PL_LEAD_MW' and DRULE = 'BW_LEAD'
'CD7'	Black spruce/aspen	C_CODE = 'CD' and CRULE = 'SBLT_LEAD_MW' and DRULE = 'AW_LEAD'
'CD8'	Black spruce/poplar	C_CODE = 'CD' and CRULE = 'SBLT_LEAD_MW' and DRULE = 'PB_LEAD'
'CD9'	Black spruce/birch	C_CODE = 'CD' and CRULE = 'SBLT_LEAD_MW' and DRULE = 'BW_LEAD'
'CD10'	Fir/aspen	C_CODE = 'CD' and CRULE = 'FBFD_LEAD_MW' and DRULE = 'AW_LEAD'
'CD11'	Fir/poplar	C_CODE = 'CD' and CRULE = 'FBFD_LEAD_MW' and DRULE = 'PB_LEAD'
'CD12'	Fir/birch	C_CODE = 'CD' and CRULE = 'FBFD_LEAD_MW' and DRULE = 'BW_LEAD'
'C1'	Pure white spruce	C_CODE = 'C' and SW_PCT >= 9
'C2'	White spruce leading with pine	C_CODE = 'C' and CRULE = 'SW_LEAD' and SW_PCT < 9 and PL_PCT > 1
'C3'	White spruce leading without pine	C_CODE = 'C' and CRULE = 'SW_LEAD' and SW_PCT < 9 and PL_PCT <= 1
'C4'	Pure pine	C_CODE = 'C' and PL_PCT >= 9
'C5'	Pine leading with white spruce	C_CODE = 'C' and CRULE = 'PL_LEAD' and PL_PCT < 9 and SW_PCT > 1 and SW_ORD < FB_ORD and SW_ORD < SB_ORD
'C6'	Pine leading with black spruce	C_CODE = 'C' and CRULE = 'PL_LEAD' and PL_PCT < 9 and SB_PCT > 1 and SB_ORD < FB_ORD and SB_ORD < SW_ORD
'C7'	Pine leading with fir	C_CODE = 'C' and CRULE = 'PL_LEAD' and PL_PCT < 9 and FB_PCT > 1 and FB_ORD < SB_ORD and FB_ORD < SW_ORD
'C8'	Pine leading without spruce and fir	C_CODE = 'C' and CRULE = 'PL_LEAD' and PL_PCT < 9 and FB_PCT <= 1 and SB_PCT <=1 and SW_PCT <= 1
'C9'	Pure black spruce	C_CODE = 'C' and SB_PCT >= 9
'C10'	Black spruce leading with pine	C_CODE = 'C' and CRULE = 'SB_LEAD' and SB_PCT < 9 and PL_PCT > 1
'C11'	Black spruce leading without pine	C_CODE = 'C' and CRULE = 'SB_LEAD' and SB_PCT < 9 and PL_PCT <= 1
'C12'	Larch leading	C_CODE = 'C' and CRULE = 'LT_LEAD'
'C13'	Pure Douglas fir	C_CODE = 'C' and FD_PCT >= 9
'C14'	Douglas fir leading	C_CODE = 'C' and CRULE = 'FD_LEAD' and FD_PCT < 9
'C15'	Pure balsam fir	C_CODE = 'C' and FB_PCT >= 9

STRATA_GOA	Description	Selection Criteria
'C16'	Balsam fir leading with pine	C_CODE = 'C' and CRULE = 'FB_LEAD' and FB_PCT < 9 and PL_PCT > 1
'C17'	Balsam fir leading without pine	C_CODE = 'C' and CRULE = 'FB_LEAD' and FB_PCT < 9 and PL_PCT <= 1
'XX0'	Non-forested	C_CODE = NULL

Appendix V Data Dictionaries

Data Dictionary

FORCORP Solutions

Last Updated: 22 May 2025

lb__20241107__cls

Projection: NAD__1983__UTM__Zone__11N Datum: D__North__American__1983
Units: Meters Geometry: POLYGON

ABMISTRATA (text): Abmi stratum

AW	Trembling Aspen
FD	Douglas-fir
GRASSHERB	Grass/Herb Mix (not forested)
LT	Larch/Tamarack
MX	Mixed Forest
PL	Lodgepole Pine
SB	Black Spruce
SHRUB	Shrub Cover (not forested)
SW	White Spruce
X	No ABMI Stratum Assigned

AGE (numeric): Age of overstorey based on avi origin and the effective date of the landbase

1 - X	Stand age in years

ANA__UNITS (character varying): Livingstone and porcupine hills analysis units. Listed by name provided

CROWSNEST WATERSHED	
DUTCH CREEK	
EAST	
LIVINGSTONE RANGE	
LIVINGSTONE RIVER	
RACEHORSE CREEK	
SOUTH	
UPPER OLDMAN RIVER	
UPPER WILLOW CREEK	
WEST	
NA	Not part of an analysis unit

ANTH__NON (text): Non-vegetated areas created by man

AIF	Farmyards
AIG	Gravel/borrow pits
AIH	Permanent right-of-way
AII	Industrial sites, sewage lagoons
AIM	Surface mines
ASC	Cities, towns, subdivisions
ASR	Ribbon development
NA	No value present

ANTH__VEG (text): Vegetated cover types directly influenced by man, usually in areas that have been planted with cultivated species

CA	Annual crops (farmland)
CIH	A modified AIH call in which there is no actual road bed but it remains under disposition e.g.
CIP	Pipelines, powerlines etc. seeded to grass
CIW	Geophysical activities e.g. wellsites seeded to grass
CP	Perennial forage crops
NA	No value present

AREA__HA (double precision): Area of polygon in hectares

NA	Calculated Area value

(continued)

ARIS (text): A unique identifier assigned to a cutblock to enable tracking within the alberta regeneration information system. This number is generated from a point roughly derived from the centre of the cutblock. The number is a concatenation of the point's legal description plus a grid cell number. The format is mmrrtttssgg where m - meridian, rr - range, ttt - township, ss - section, gg - grid cell. The mrrttss information is derived with reference to the alberta township system. The grid cell is derived from a 10 by 10 grid that is overlaid on the section that the centre of the cutblock is contained in. Grid cells are numbered between 00 - 99 with the grid origin at the bottom left corner of the section and anchored to the centre of grid cell 00. The first digit represents the grid column and the second digit is the grid row of the 10 by 10 matrix. Note that in some cases a letter may be appended to the end of the opening number where an opening number had to be split between two cutblocks for some reason. For example, cutblocks may have the same basic opening number but one is differentiated from the other with one having an a and the other having a b appended to the end of the base opening number.

Variable values	ARIS unique identifier

ARIS_AGE (integer): Aris block age

Variable values	Age of stand calculated using ARIS data

ARIS_LBDESIG (text): Aris landbase designation

DD	Deciduous Mixedwood to Deciduous Mixedwood (D to D)
FC51005	Pine Hardwood
FC51007	White Spruce
FC51008	Lodgepole Pine
FC51010	Douglas fir
SC	S/W to Conf M/W - C to CD
SS	Coniferous Softwood to Coniferous Softwood (S to S)
NA	No value present

ARIS_NHHAREA (numeric): Aris net harvested hectares

0 - X	Listed ARIS NHH Area in ha

ARIS_OPERATOR (text): Aris operator

CFPL	Canadian Forest Products Ltd.
CHIN	Chinook Lumber Ltd.
CNKC	770538 ALBERTA LTD.
CRFP	Crowsnest Forest Products Ltd.
DLIN	793128 ALBERTA LTD.
FRIA	Forest Resource Improvement Association of Alberta
JOHN	Johnson Bros. Sawmills Ltd.
LFS	Land and Forest Service
NATA	Natal Forest Products Ltd.
SOSN	Sosnowski, Mike
SPRA	Spray Lake Sawmills (1980) Ltd.
NA	No operator

1960 - X

ARIS_STRATUMDECL (text): Aris stratum declaration

C-2000	Coniferous 2000
CD-2000	Coniferous - Deciduous 2000
CONF	Coniferous (No Modifiers) (Historical Record)
DC-2000	Deciduous - Coniferous 2000
HIGH	High Elevation (Historical)
PR91	Pre 1991 Blocks (Historical)
NA	No Stratum Declaration

(continued)

ARIS_YCSTRATUM (text): Aris yield curve stratum

Conifer	Undifferentiated conifer
Conifer Mixedwood	Undifferentiated conifer leading mixedwood
Decidous Mixedwood	Undifferentiated deciduous leading mixedwood
FD	Douglas-fir
PL	Lodgepole Pine
PLHW	Pine Hardwood
SW	White Spruce
NA	No Yield Curve Stratum

AVI_STOREY (integer): Avi layer used for strata assignment

1	Overstorey is layer of primary management
2	Understorey is layer of primary management

AW_ORD (numeric): Aspen order for species assignment (overstory)

1 - X	Aspen order in species assignment

AW_PCT (numeric): Aspen percent in species distribution (overstory)

0 - X	Aspen percent in species distribution

B10_STRATA_CODE (text): Base 10 strata code (overstory)

Aw	Pure or leading aspen
AwPl	Aspen and pine mixedwood
AwSw	Aspen and white spruce mixedwood
Fd	Pure or leading douglas fir
Pl	Lodgepole Pine
PlAw	Pine and aspen mixedwood
Sb	Pure or leading black spruce
Sw	Pure or leading white spruce
SwAw	White spruce and aspen mixedwood
NA	No Base 10 Stratum Assigned

B10_STRATA_GOA (text): Base 10 strata type (overstory)

I	Deciduous
II	Hardwood/pine
III	Hardwood/spruce
IV	White spruce/hardwood
IX	Black spruce pure or leading
V	Pine/hardwood
VII	White spruce pure or leading
VIII	Pure pine or leading
X	Douglas fir pure or leading
NA	No B10 strata assigned

B10_STRATA_NAME (text): Base 10 strata name (overstory)

Black Spruce pure or leading	Black Spruce pure or leading
Deciduous	Deciduous
Deciduous/Pine	Deciduous/Pine
Deciduous/Spruce	Deciduous/Spruce
Douglas Fir pure or leading	Douglas Fir pure or leading
No GOA Strata	No GOA Strata
Pine/Deciduous	Pine/Deciduous
Pine pure or leading	Pine pure or leading
White Spruce/Deciduous	White Spruce/Deciduous
White Spruce pure or leading	White Spruce pure or leading

(continued)

NA	No Base 10 Stratum Assigned

B10_USTRATA_CODE (text): Base 10 strata code (understory)

Aw	Pure or leading aspen
AwPl	Aspen and pine mixedwood
AwSw	Aspen and white spruce mixedwood
Fd	Pure or leading douglas fir
Pl	Lodgepole Pine
PlAw	Pine and aspen mixedwood
Sb	Pure or leading black spruce
Sw	Pure or leadingwhite spruce
SwAw	White spruce and aspen mixedwood
NA	No Understorey Base 10 Stratum Assigned

B10_USTRATA_GOA (text): Base 10 strata type (understory)

I	Deciduous
II	Hardwood/pine
III	Hardwood/spruce
IV	White spruce/hardwood
IX	Black spruce pure or leading
V	Pine/hardwood
VII	White spruce pure or leading
VIII	Pure pine or leading
X	Douglas fir pure or leading
NA	No B10 strata assigned

B10_USTRATA_NAME (text): Base 10 strata name (understory)

Black Spruce pure or leading	Black Spruce pure or leading
Deciduous	Deciduous
Deciduous/Pine	Deciduous/Pine
Deciduous/Spruce	Deciduous/Spruce
Douglas Fir pure or leading	Douglas Fir pure or leading
No GOA Strata	No GOA Strata
Pine/Deciduous	Pine/Deciduous
Pine pure or leading	Pine pure or leading
White Spruce/Deciduous	White Spruce/Deciduous
White Spruce pure or leading	White Spruce pure or leading
NA	No Understorey Base 10 Stratum Assigned

BLOCK_ERA (text): Era the block was harvested in

POST95	Harvested block cut on or after May 1, 1996
PRE96	Harvested block cut before May 1, 1996
NA	Not a harvest block

BUFFER (character varying): Buffered water features with buffer distance dependent on feature type

HYDRO	Hydrology Buffer
ISOLATED ISLAND	Polygon is isolated by hydrology buffers
NA	No value present

BW_ORD (numeric): White birch order for species assignment (overstory)

1 - X	White birch order in species assignment

BW_PCT (numeric): White birch percent in species distribution (overstory)

0 - X	White birch percent in species distribution

CC_HARVCODE (character varying): Post avi cutblock harvest code

H	Harvested portion of block boundary

(continued)

MR	Merchantable retention within original block boundary
NR	Non merchantable retention within original block boundary
RD	Road
NA	No harvest code assigned

CC_OWNER (character varying): Post avi cutblock operator

CNKC	770538 ALBERTA LTD.
CRFP	Crowsnest Forest Products
CTPP	Community Timber Permit Program
DLIN	793128 ALBERTA LTD.
FRIA	FRIAA
SPRA	Spray Lake Sawmills (1980) Ltd.
NA	

CC_STATUS (character varying): Post avi cutblock harvest status

CUT	Harvested
NA	

CC_YEAR (integer): Post avi cutblock harvest year

NA

CLRES (character varying): Crown land reservations

CLRXXXX	Crown Land Reservation is present

CLS_UKEY (integer): Classified landbase unique identier

1 - X	Unique identifier

COMPARTMENT (text): Operational compartment name

Crowsnest River	Crowsnest River
Livingstone River	Livingstone River
Oldman River	Oldman River
Porcupine Hills	Porcupine Hills
Racehorse Creek	Racehorse Creek
Willow Creek	Willow Creek
NA	No Compartment

CPPF1 (character varying): Controlled parentage program zone f1 (douglas-fir)

f1	Within the F1 Controlled Parentage Program Zone
NA	

CPPM (character varying): Controlled parentage program zone m (western larch)

m	Within the M Controlled Parentage Program Zone
NA	

CRULE (text): Conifer strata decision rule (overstory)

FBFD_LEAD_MW	Fir leading mixedwood
FB_LEAD	Balsam fir leading
FD_LEAD	Douglas fir leading
LT_LEAD	Larch leading
NO_C	No leading conifer
PL_LEAD	Pine leading
PL_LEAD_MW	Pine leading mixedwood
SB_LEAD	Black spruce leading
SW_LEAD	White spruce leading
SW_LEAD_MW	White spruce leading mixedwood
NA	

C_CODE (text): Coniferous code assignment for base10 stratification assignment

(continued)

C	Conifer
CD	Conifer-Deciduous Mixedwood
D	Deciduous
DC	Deciduous-Conifer Mixedwood
NA	No broad cover group assigned

DATA (text): Confirmation of attributes using existing stand data from other sources. When avi attributes have been confirmed from other information sources or existing stand data are available to confirm attributes, codes are used to describe the data source.

F	Interpretor plot
I	Interpreted TPR
S	Supplementary Photography
NA	No data source call applied

DATA_YR (integer): Reference year for data used to confirm attributes

0 - X	Reference year for data used to confirm attributes

DENSITY (text): Percentage of ground area covered by a vertical projection of tree crowns onto the ground

A	6 to 30 %
B	31 to 50 %
C	51 to 70 %
D	71 to 100 %
NA	

DEN_INT (integer): Stand density (overstory)

0	No value present
10	Crown closure 1-10%
20	Crown closure 11-20%
30	Crown closure 21-30%
40	Crown closure 31-40%
50	Crown closure 41-50%
60	Crown closure 51-60%
70	Crown closure 61-70%
80	Crown closure 71-80%
90	Crown closure 81-90%
100	Crown closure 91-100%

DFA (text): Identifies the extent of the defined forest area (dfa)

DFA	Polygon is located within the Defined Forest Area

DIDS_FOR (text): Dids dispositions that have forest cover

DIDS-FOR	Forested DIDs Dispositions
NA	

DIDS_NONFOR (character varying): Dids dispositions that do not have forest cover

DIDS-NONFOR	Non-forested DIDs Dispositions
NA	

DIST_PTRN (integer): Distribution pattern of the overstory canopy

0	No DIST_PTRN assigned
1	Single to very few (1-3) occurrences understory trees covering <10% of the area of the overstor
2	Several (>= 4) sporadic occurrences of understory trees covering <30% of the area of the overs
3	Intimately intermixed units, often with gradational transitions from one to another. The under
4	Continuous understorey occurances with several gaps. 51-79% of the overstpry stand area has a
5	Continuous understorey occurrence (>=80%) throughout the overstory stand area with very fe
6	Understory with regularly spaced trees as a result of silvicultural practices

(continued)

DRULE (text): Deciduous strata decision rule (overstory)

AW_LEAD	Aspen leading
BW_LEAD	Birch leading
NO_D	No deciduous leading species
PB_LEAD	Balsam poplar leading
NA	

D_ADMIN (text): Administrative deletion

ESLUZ	Eastern Slopes Land Use Zone 1 feautre present
HRV_GOA	Historic Resource Value
PPA	Parks and protected areas
NA	No value present

D_ANTHRO (text): Anthropogenic deletion

ANTH_NON	Non-vegetated anthropogenic disturbances
ANTH_VEG	Vegetated anthropogenic disturbances
CLR	Crown Land Reservation
DIDS-FOR	Forested DIDs Dispositions
DIDS-NONFOR	Non-forested DIDs Dispositions
GOA_PSP	GoA permanent sampling plots (replaces DRS dispositions)
NA	No value present

D_AVI (text): Avi deletion (no avi present)

AVI	AVI Deletion - No AVI interpretation available
NA	

D_BLOCK (text): Cutblock deletion

NFCC	Features identified as post 1991 cutblocks with an assigned opening numbers that does not hav
OPERATIONAL	SHS or operational deletion from the previous FMP process
NA	No value present

D_BUF (text): Hydrology buffer deletion

HYDROBUF	Hydrological buffers (rivers, lakes, trumpeter swan lakes, etc.)
NA	No value present

D_DENSITY (text): Density deletion

DENSITY	Un-merchantable density
NA	No value present

D_GROUP (text): Deletion group assignment (for sliver elimination process)

GROUP1	Includes d_admin deletions
GROUP2	Includes d_access and d_anthro deletions
GROUP3	Includes d_hydro, d_buf, and d_nonfor deletions
GROUP4	Includes d_moist, d_tpr, d_density, d_slope, and d_sp deletions
GROUP5	Includes d_natdist, d_block, d_struc and d_iso deletions

RFMA (character varying): Registered fur management area (trap line) number

X

D_HYDRO (text): Hydrology deletion

FLOOD	Flooded area
LAKES_RIVERS	Lake or River
NA	No value present

D_ISO (character varying): Isolated stands deletion

ISO_DEF	Isolated Stand Deferral
ISO_DEL	Isolated Stand Deletion

(continued)

PAR_DEF	Perimeter to Area Deferral
PAR_DEL	Perimeter to Area Deletion
NA	No value present

D_MOIST (text): Moisture deletion

MOISTURE	Moisture Regime Deletion
NA	No value present

D_NATDIST (text): Natural disturbance deletion

BURN	Area burned post AVI
OTHER_DIST	Non-Fire Natural Disturbance
NA	No value present

D_NONFOR (text): Non forested deletion

NNF	Naturally Non-Forested
NNV	Naturally Non-Vegetated
NA	No value present

D_OPDEL (text): NA

OPERATIONAL	Operational Deletion
NA	

D_SLOPE (text): Steep slope deletion

SLOPE	Slope >=45%
NA	

D_SP (text): Species type deletion

FD	Features identified as being Douglas Fir
LT	Larch/Tamarack Deletion
PA_PF	Whitebark and/or Limber Pine
SB	Features identified as being Black Spruce
WHITEBARK_PLUS	Whitebark Pine Plus deletion
NA	No value present

D_STRUC (text): Horizontal stands deletion

STRUC	Horizontal structure
NA	No value present

D_TPR (text): Timber productivity rating deletion

TPR	Unproductive TPR rating
NA	No value present

ECA (integer): Equivalent clearcut area watershed

NA

ECO1 (character varying): Ecosite code

a	a ecosite
b	b ecosite
c	c ecosite
d	d ecosite
e	e ecosite
f	f ecosite
g	g ecosite
h	h ecosite
i	i ecosite
j	j ecosite
k	k ecosite
l	l ecosite

(continued)

x	No ecosite applied
NA	
ECO1NAME (character varying): Ecosite name	
balsam poplar (subhygric/rich)	balsam poplar (subhygric/rich)
bearberry/hairy wild rye (subxeric/medium)	bearberry/hairy wild rye (subxeric/medium)
bearberry (submesic/poor)	bearberry (submesic/poor)
bog (subhydric/very poor)	bog (subhydric/very poor)
Canada buffalo-berry/hairy wild rye (submesic/medium)	Canada buffalo-berry/hairy wild rye (submesic/medium)
creeping mahonia-white meadowsweet (mesic/medium)	creeping mahonia-white meadowsweet (mesic/medium)
dwarf birch/tuffed hair grass(hygric/rich)	dwarf birch/tuffed hair grass(hygric/rich)
false axalea-grouse-berry (mesic/medium)	false axalea-grouse-berry (mesic/medium)
false azalea-grouse-berry (mesic/medium)	false azalea-grouse-berry (mesic/medium)
fen (subhydric/rich)	fen (subhydric/rich)
grassland (subxeric/medium)	grassland (subxeric/medium)
horsetail (hygric/rich)	horsetail (hygric/rich)
horsetail (subhydric/rich)	horsetail (subhydric/rich)
lichen (xeric/poor)	lichen (xeric/poor)
limber pine/juniper (subxeric/poor)	limber pine/juniper (subxeric/poor)
meadow (subhygric/very rich)	meadow (subhygric/very rich)
NoEco	No ecosite applied
spruce/heather (mesic/poor)	spruce/heather (mesic/poor)
subalpine larch/heather (submesic/poor)	subalpine larch/heather (submesic/poor)
subhygric-poor(subhygric/poor)	subhygric-poor(subhygric/poor)
thimbleberry/pine grass (mesic/rich)	thimbleberry/pine grass (mesic/rich)
thimbleberry (subhygric/rich)	thimbleberry (subhygric/rich)
NA	
ECO2 (character varying): Secondary ecosite code	
a	a ecosite
b	b ecosite
c	c ecosite
d	d ecosite
e	e ecosite
f	f ecosite
g	g ecosite
h	h ecosite
i	i ecosite
j	j ecosite
k	k ecosite
l	l ecosite
NA	
ECO2NAME (character varying): Secondary ecosite name	
balsam poplar (subhygric/rich)	balsam poplar (subhygric/rich)

(continued)

bearberry/hairy wild rye (subxeric/medium)	bearberry/hairy wild rye (subxeric/medium)
bog (subhydric/very poor)	bog (subhydric/very poor)
Canada buffalo-berry/hairy wild rye (submesic/medium)	Canada buffalo-berry/hairy wild rye (submesic/medium)
creeping mahonia-white meadowsweet (mesic/medium)	creeping mahonia-white meadowsweet (mesic/medium)
false axalea-grouse-berry (mesic/medium)	false axalea-grouse-berry (mesic/medium)
false azalea-grouse-berry (mesic/medium)	false azalea-grouse-berry (mesic/medium)
fen (subhydric/rich)	fen (subhydric/rich)
grassland (subxeric/medium)	grassland (subxeric/medium)
horsetail (hygric/rich)	horsetail (hygric/rich)
lichen (xeric/poor)	lichen (xeric/poor)
limber pine/juniper (subxeric/poor)	limber pine/juniper (subxeric/poor)
meadow (subhygric/very rich)	meadow (subhygric/very rich)
spruce/heather (mesic/poor)	spruce/heather (mesic/poor)
subalpine larch/heather (submesic/poor)	subalpine larch/heather (submesic/poor)
subhygric-poor(subhygric/poor)	subhygric-poor(subhygric/poor)
thimbleberry/pine grass (mesic/rich)	thimbleberry/pine grass (mesic/rich)
thimbleberry (subhygric/rich)	thimbleberry (subhygric/rich)
NA	No ecosite applied

ENCROACHMENT (character varying): Risk of forest encroachment on rangeland

forested	Area is forested
nonforest	Area is not forested
outofscope	Areas is out of scope for encroachment assessment
transition	Areas is a forest/range transition zone
NA	

EROSIONRISK (text): Areas of high erosion risk

High	
NA	

ESLUZ_NAME (character varying): Eastern slopes land use zone name

Prime Protection	Eastern Slopes Land Use Zone 1 feature present
NA	

EXTENT1 (integer): Mapcode extent

0	No value present
5	41 - 50%
6	51 - 60%
7	61 - 70%
8	71 - 80%
9	81 - 90%
10	91 - 100%

EXTENT2 (integer): Secondary mapcode extent

0	No value present
1	1 - 10%
2	11 - 20%

(continued)

3	21 - 30%
4	31 - 40%
5	41 - 50%

FB_ORD (numeric): Balsam fir order for species assignment (overstory)

1 - X	Balsam fir order in species assignment

FB_PCT (numeric): Balsam fir percent in species distribution (overstory)

0 - X	Balsam fir percent in species distribution

FD_ORD (numeric): Douglas fir order for species assignment (overstory)

1 - X	Douglas fir order in species assignment

FD_PCT (numeric): Douglas fir percent in species distribution (overstory)

0 - X	Douglas fir percent in species distribution

FIREMGMT (character varying): Fire management zone

Calgary	Calgary Fire Management Zone
NA	

FIRESMART (character varying): Identifies firesmart community zones. The firesmart program uses preventative measures to reduce wildfire threat to albertans and their communities while balancing the benefits of wildfire on the landscape.

Crowsnest	Crowsnest FireSmart Community Zone
Eden Valley IR	Eden Valley IR FireSmart Community Zone
West Castle Beaver Mines	West Castle/Beaver Mines FireSmart Community Zone
NA	No Firesmart

FIRE_CLASS (character varying): Wildfire class type

B	B class > 0.1 ha to 4.0 ha
C	
NA	No fire class assigned

FIRE_NO (character varying): Post avi fire number

CWF-006-2018
CWF-007-2018
CWF-009-2021
CWF-013-2018
CWF-043-2019
CWF-096-2018
CWF-159-2021
NA

FISHMGMT (character varying): Fish management zone

Eastern Slopes Zone
NA

FMA (character varying): Defines fma boundary

FMA	Inside the FMA boundary
NA	Outside the FMA boundary

FS_RISK (character varying): Firesmart compartment risk

High	FireSmart CZ has a High Risk of Fire
Low	FireSmart CZ has a Low Risk of Fire
Low - Burnt	FireSmart CZ has a Low Risk of Fire - Previously Burnt
Moderate	FireSmart CZ has a Moderate Risk of Fire
NA	

F_ACTIVE (text): Active/passive condition

(continued)

ACTIVE	Active (Contributing) Landbase
PASSIVE	Passive (Non-contributing) Landbase

F_AGE (numeric): Final age of the stand based on avi storey field and associated storey age

0 - X	Age (years)

F_AGE_CLASS (text): Final age class assignment based on the avi storey field and associated storey age

Variable values	Age range categories

F_BCG (text): Final broad cover group (bcg) assignment based on the avi storey field and associated storey bcg

C	Coniferous
CD	Coniferous with deciduous mixedwood
D	Deciduous
DC	Deciduous with coniferous mixedwood
NA	No value present

F_BLK_STAT (text): Final block status

MANAGED	Feature is harvested
NATURAL	Feature is not harvested and has a valid strata
NA	No value present

F_BLOCK (text): Final block type assignment

DEFERRAL_20	DFMP SHS deferrals as well as operational deferrals for 20 years
DEFERRAL_ISO	Deferral identified through isolated stand routine
DELETION	SHS deletion
HARVESTED	Harvested block
PLANNED	Planned block (harvest between 2018-2020)
RETENTION	Retention Patch
NA	No value present

F_CURVE (text): Final yield curve assignment

NAT	Natural stands (not harvested) with valid strata
PRE96	Harvested block cut before May 1, 1996
RSA	Harvested block cut on or after May 1, 1996
NA	No value present

F_DEL (text): Final stand deletion assignment based on the deletion hierarchy

ANTH_NON	Anthropogenic Non-Vegetated Land
ANTH_VEG	Anthropogenic Vegetated Land
AVI	No AVI Interpreted
BURN	Burned areas
CLR	Crown Land Reservation
DENSITY	Low density stands
DIDS-FOR	Forested DIDs Disposition
DIDS-NONFOR	Non Forested DIDs Disposition
ESLUZ	Eastern Slopes Land Use Zone 1 feautre present
FD	Features identified as being Douglas Fir
FLOOD	Flooded area
GOA_PSP	Government of Alberta Permanent Sample Plot
HRV_GOA	Historic Resource Blaue
HYDROBUF	Hydrological buffers (rivers, lakes, trumpeter swan lakes, etc.)
ISO_DEL	Isolated Stand Deletion
LAKES_RIVERS	Lakes and Rivers
LT	Features identified as being Larch

(continued)

MOISTURE	Moisture Regime Deletion
NNF	Naturally Non-Forested
NNV	Naturally Non-Vegetated
OPERATIONAL	SHS or operational deletion from the previous FMP process
OTHER_DIST	Non Fire Natural Disturbance deletion
PA_PF	Whitebark or Limber Pine Present
PAR_DEL	Perimter to Area Deletion
PPA	Parks and protected areas
SEISMIC	Seismic line deletion
SLOPE	Steep slope deletion
TPR	Unproductive TPR rating
WHITEBARK_PLUS	Whitebark pine plus deletion
X	No deletion

F_DENSITY (text): Final stand density assignment based on the avi storey and the associated storey density

A	6 to 30 %
B	31 to 50 %
C	51 to 70 %
D	71 to 100 %
NA	No value present

F_DEN_INT (integer): Final stand density assignment (integer value) based on the avi storey and the associated storey density

NA

F_FMA (text): Final fma assignment

FMA	Forest Management Agreement area
NONFMA	Outside of the Forest Management Agreement area

F_HEIGHT (integer): Final stand height assignment based on the avi storey and the associated storey density

0 - X	Height (m)

F_LANDBASE (text): Final landbase assignment

CON	Coniferous landbase
DEC	Deciduous landbase
NA	No value present

F_ORIGIN (integer): Final origin of the stand based on the avi storey and the associated storey density

0 - X	Calendar year

F_STRATA (text): Final strata assignment based on the avi storey and the associated forest stratum of that storey

FD	Douglas fir stratum
HW	Hardwood Stratum
HWPL	Hardwood/Lodgepole Pine mixedwood stratum
HWSX	Hardwood/Spruce mixedwood stratum
PL	Lodgepole Pine
PLHW	Pine/Hardwood mixedwood stratum
SB	Black Spruce stratum
SW	White Spruce stratum
SWHW	Spruce/Hardwood mixedwood stratum
NA	No stratum assigned

(continued)

F_TPR (text): Final stand timber productivity assignment based on the avi storey and the associated tpr

F	Fair
G	Good
M	Medium
U	Unproductive
NA	No TPR assigned

F_YC (text): Final yield curve strata assignment based on the avi storey and the associated yield curve assignment

J_PL	Juvenile Pine yield Curve
J_SW	Juvenile Spruce yield Curve
N_FD	Natural Douglas-fir Yield Curve
N_HW	Natural Hardwood yield curve
N_PL	Natural Pine yield curve
N_PLMIX	Natural Mixed Pine Yield Curve
N_SW	Natural White Spruce yield curve
N_SXMIX	Natural Mixed Spruce Yield Curve
R_PL	RSA Pine yield curve
NA	

GBWU (character varying): Grizzly bear watershed unit

L148
L150
L151
L152
L155
L157
L159
L160
L162
W163
W164
W165
W166
W167
NA

GB_POPUNIT (character varying): Grizzly bear population name

Livingstone	Livingston Grizzly Bear population
Waterton	Waterton Grizzly Bear population
NA	

GB_TYPE (character varying): Grizzly bear zone type

Core	Core Grizzly Bear area
Secondary	Secondary Grizzly Bear area
Support	Supporting Grizzly Bear area
NA	

GB_ZONE (character varying): Grizzly bear zone type

Grizzly bear	Grizzly Bear habitat zone
NA	

HARDPCT (numeric): Deciduous species percent (overstory)

0 - X	Deciduous species percent (overstory)

(continued)

HARV_CODE (character varying): Harvest code - identification of harvested area, anthropogenic area, retention	
A	Current anthropogenic disturbance as part of original block boundary
H	Harvested portion of block boundary
MR	Merchantable retention within original block boundary
N	
NR	Non merchantable retention within original block boundary
NA	
HA_SEISMIC (numeric): Area of the of the seismic line present in the polygon	
Numeric	Area (ha) - Area within the polygon attributed to seismic lines
HEIGHT (integer): Interpreted or determined through field measurements and recorded to the nearest metre. Stand height is the average height of the dominant and codominant trees of the leading species	
0 - 40	Stand height in metres
HLIN (character varying): Hard linear feature - songbird nta input	
HLIN	Hard linear corridor
NA	
HYDRO (character varying): Hydrology feature	
HYDRO	Hydrology Feature (Lake/River)
NA	
INITIALS (text): Interpreter initials	
Initials	AVI interpreter's initials
LEAD_CON (text): Leading conifer species (overstory)	
FB	Balsam fir leading
FD	Douglas fir leading
LT	Larch leading
NO	No leading conifer
PL	Pine leading
SB	Black spruce leading
SW	White sprice leading
NA	
LEAD_DEC (text): Leading deciduous species (overstory)	
AW	Aspen leading
BW	Birch leading
NO	No leading deciduous
PB	Balsam poplar leading
NA	
LT_ORD (numeric): Larch order for species assignment (overstory)	
1 - X	Larch order in species assignment
LT_PCT (numeric): Larch percent in species distribution (overstory)	
0 - X	Larch percent in species distribution
LUF (character varying): Land-use framework region	
South Saskatchewan	South Saskatchewan land-use framework region
NA	No landbase-use framework assigned
MAPCODE1 (character varying): Ecological site edaptopic grid	
2B	Xeric/Poor
3B	Subxeric/Poor

3C	Subxeric/Medium
5B	Mesic/Poor
5C	Mesic/Medium
5D	Mesic/Rich
6E	Subhygric/Very Rich
7B	Hygric/Poor
7C	Hygric/Medium
7D	Hygric/Rich
9B	Hydric/Poor
9C	Hydric/Medium
9D	Hydric/Rich
NA	

MAPCODE2 (character varying): Secondary ecological site edaptopic grid

2B	Xeric/Poor
3B	Subxeric/Poor
3C	Subxeric/Medium
5B	Mesic/Poor
5C	Mesic/Medium
5D	Mesic/Rich
6E	Subhygric/Very Rich
7B	Hygric/Poor
7C	Hygric/Medium
7D	Hygric/Rich
9B	Hydric/Poor
9C	Hydric/Medium
9D	Hydric/Rich
NA	

MART_STRATA (integer): American marten stratum

NA

MD_NAME (character varying): Municipal districts and counties

Foothills County	County
Kananaskis I.D.	Improvement District
M.D. of Pincher Creek No. 9	Municipal District
M.D. of Ranchland No. 66	Municipal District
M.D. of Willow Creek No. 26	Municipal District
Municipality of Crowsnest Pass	Special Municipality
NA	

MER (integer): Meridian

1 - X	Alberta Township System Meridian. Location is "West of" indicated meridian

MOD1 (text): Stand condition modifiers

BT	Broken tops
BU	Burn/partial burn
CC	Clearcut/partial cut
CL	Clearing
RT	Retention
SN	Snags
UK	Unknown kill
WF	Windfall
NA	No stand condition modifiers

MOD1_EXT (integer): Extent of the modifer

(continued)

0	No stand condition modifier extent
1	1 to 25% loss of crown closure or land area affected
2	26 to 50% loss of crown closure or land area affected
3	51 to 75% loss of crown closure or land area affected
4	76 to 94% loss of crown closure or land area affected
5	94 to 100% loss of crown closure or land area affected
NA	No stand condition modifier extent

MOD1_YR (integer): Year associated with modifier event

0 - X	Year associated with modifier event

MOD2 (text): Secondary stand condition modifiers

BU	Burn/partial burn
SN	Snags
WF	Windfall
NA	No secondary stand condition modifier extent

MOD2_EXT (integer): Extent of the modifer

0	No secondary stand condition modifier extent
1	1 to 25% loss of crown closure or land area affected
2	26 to 50% loss of crown closure or land area affected
3	51 to 75% loss of crown closure or land area affected
4	76 to 94% loss of crown closure or land area affected
5	94 to 100% loss of crown closure or land area affected

MOD2_YR (integer): Year associated with modifier event

0 - X	Year associated with modifier event

MOISTURE1 (integer): Soil moisture regime

0	No value present
2	Xeric
3	Subxeric
4	Submesic
5	Mesic
6	Subhygric
7	Hygric
8	Subhydric
9	Hydric

MOISTURE2 (integer): Secondary soil moisture regime

0	No value present
2	Xeric
3	Subxeric
4	Submesic
5	Mesic
6	Subhygric
7	Hygric
8	Subhydric
9	Hydric

MOIST_REG (text): Assessment of soil moisture regime based on plant indicators or environmental factors and soil properties

D	Dry - rapidly drained substratum
M	Mesic - moderately well drained substratum
W	Wet - poorly drained to flooded
NA	No moisture regime assigned

(continued)

MPB_RANK (text): Mountain pine beetler rank

RANK 1	Rank 1 stands present a high priority
RANK 2	Rank 2 stands present a moderate priority
RANK 3	Rank 3 stands present a low priority and need to be avoided in planning for purposes of suscep
NA	No Mountain Pine Beetle Stand Ranking

MPB_RISK (text): Mountain pine beetle risk assessment

High	Mountain Pine Beetle compartment high compartment risk (between 6-12 km of a active MPB
Low	Mountain Pine Beetle compartment low compartment risk (greater than 20 km of a active MPI
Very High	
NA	

MPB_R_CAT (text): Mountain pine beetle predicted r category

HIGH	Mountain Pine Beetle predicted R value between 4.61 and 5.8
MODERATE	Mountain Pine Beetle predicted R value between 2.1 and 4.5
VERY HIGH	
NA	

MPB_SSI (integer): Mountain pine beetle stand susceptibility code

1 - X	Mountain pine beetle Stand Susceptibility Index (SSI) value

MPB_SSI_CAT (text): Mountain pine beetle stand suceptibility index category

1:1-22	Alberta Stand Susceptibility Index values between 1 to 22
2:23-63	Alberta Stand Susceptibility Index values between 23 to 63
3:64-100	Alberta Stand Susceptibility Index values between 64 to 100
NA	No Alberta Stand Susceptibility Index values assigned

NAT_NON (text): Natural cover types that have less than 6% plant cover

NMC	Cutbank
NMR	Rock/barren
NMS	Sand
NWF	Flooded
NWL	Lake
NWR	River
NA	No naturally non forested values (overstory)

NAT_REG (character varying): Natural region name

Grassland	Grassland Natural Region of Alberta
Parkland	Parkland Natural Region of Alberta
Rocky Mountain	Rocky Mountain Natural Region of Alberta
NA	

NAT_SREG (character varying): Natural subregion

Alpine	Alpine Natural Subregion of Alberta
Foothills Fescue	Foothills Fescue Natural Subregion of Alberta
Foothills Parkland	Foothills Parkland Natural Subregion of Alberta
Montane	Montane Natural Subregion of Alberta
Subalpine	Subalpine Natural Subregion of Alberta
NA	

NFL (text): Non forested land - vegetated cover types with equal to or greater than 6% plant cover but less than 6% tree cover

BR	Bryophyte (mosses)
HG	Herbaceous grassland
SC	Closed shrub (crowns of most shrubs interlocking)
SO	Open shrub (crowns of most shrubs not touching each other)

(continued)

NA	No value for non forested land

NFL_PER (integer): Percentage to nearest 10% indicating shrub crown closure within the polygon

0	No value assigned
1	1 - 10%
2	11 - 20%
3	21 - 30%
4	31 - 40%
5	41 - 50%
6	51 - 60%
7	61 - 70%
8	71 - 80%
9	81 - 90%
10	91 - 100%

NSRCODE (text): Natural subregion code

A	Alpine Natural Subregion of Alberta
FF	Foothills Fescue Natural Subregion of Alberta
FP	Foothills Parkland Natural Subregion of Alberta
M	Montane Natural Subregion of Alberta
SA	Subalpine Natural Subregion of Alberta
NA	

NUTRIENT1 (character varying): Soil nutrient regime

B	Poor
C	Medium
D	Rich
E	Very rich
NA	No values for nutrient regime

NUTRIENT2 (character varying): Secondary soil nutrient regime

B	Poor
C	Medium
D	Rich
E	Very rich
NA	No values for nutrient regime

OP_DEFERRAL (character varying): Operational deferral

Op_Deferral	Operational Deferral
NA	

OP_DELETION (character varying): Operational deletion

Op_Deletion	Operational Deletion
NA	

ORIGIN (integer): Average "birth year" of stand using 10-year origin classes. In some cases this may represent the actual year if this value is known

1600 to present year	Decadal classes or exact year of stand origin

PARK_NAME (text): Park or protected area name

Beehive
Black Creek
Bob Creek Wildland
Castle
Castle Wildland
Chinook
Don Getty Wildland

(continued)

Dutch Creek	
High Rock	
Honeymoon Creek	
Indian Graves	
Livingstone Falls	
Livingstone Range	
Mt. Livingstone	
Oldman River North	
Pekisko	
Plateau Mountain	
Racehorse	
Waterton Lakes	
West Castle Wetlands	
NA	

PARK_TYPE (text): Park or protected area classification

ER	Ecological Reserve
HR	Heritage Rangeland
NP	National Park
PP	Provincial Park
PRA	Provincial Recreation Area
WPP	Wildland Provincial Park
NA	No Park Assignment

PATTERN (integer): Distribution pattern of the overstory canopy

0	No DIST_PTRN assigned
1	Single to very few (1-3) occurrences understory trees covering <10% of the area of the overstor
2	Several (>= 4) sporadic occurrences of understory trees covering <30% of the area of the overs
3	Intimately intermixed units, often with gradational transitions from one to another. The under
4	Continuous understorey occurances with several gaps. 51-79% of the overstpry stand area has a
5	Continuous understorey occurrence (>=80%) throughout the overstory stand area with very fe
6	Understory with regularly spaced trees as a result of silvicultural practices
NA	No value assigned

PB_ORD (numeric): Balsam poplar order for species assignment (overstory)

1 - X	Balsam poplar order in species assigment

PB_PCT (numeric): Balsam poplar percent in species distribution (overstory)

0 - X	Balsam poplar percent in species distribution

PHASE1 (character varying): Ecosite phase code

a1	a1 ecosite phase
b1	b1 ecosite phase
b2	b2 ecosite phase
b3	b3 ecosite phase
c1	c1 ecosite phase
c2	c2 ecosite phase
c3	c3 ecosite phase
c4	c4 ecosite phase
c5	c5 ecosite phase
d1	d1 ecosite phase
d2	d2 ecosite phase
d3	d3 ecosite phase
d4	d4 ecosite phase
d5	d5 ecosite phase

(continued)

e1	e1 ecosite phase
e2	e2 ecosite phase
e3	e3 ecosite phase
e4	e4 ecosite phase
e5	e5 ecosite phase
f1	f1 ecosite phase
f2	f2 ecosite phase
f3	f3 ecosite phase
g1	g1 ecosite phase
g2	g2 ecosite phase
h1	h1 ecosite phase
i1	i1 ecosite phase
i2	i2 ecosite phase
j1	j1 ecosite phase
k1	k1 ecosite phase
k2	k2 ecosite phase
k3	k3 ecosite phase
l1	l1 ecosite phase
l2	l2 ecosite phase
l3	l3 ecosite phase
x	No ecosite phase applied
NA	

PHASE1NAME (character varying): Ecosite phase name

balsam poplar Pb	balsam poplar Pb
bearberry Aw-Sw-Pl	bearberry Aw-Sw-Pl
bearberry/hairy wild rye Pl	bearberry/hairy wild rye Pl
bearberry/hairy wild rye Shrub/Grass	bearberry/hairy wild rye Shrub/Grass
bearberry Pl	bearberry Pl
Canada buffalo-berry/hairy wild rye Aw	Canada buffalo-berry/hairy wild rye Aw
Canada buffalo-berry/hairy wild rye Aw-Sw-Pl-Fd	Canada buffalo-berry/hairy wild rye Aw-Sw-Pl-Fd
Canada buffalo-berry/hairy wild rye Fd	Canada buffalo-berry/hairy wild rye Fd
Canada buffalo-berry/hairy wild rye Pl	Canada buffalo-berry/hairy wild rye Pl
Canada buffalo-berry/hairy wild rye Shrub/Grass	Canada buffalo-berry/hairy wild rye Shrub/Grass
creeping mahonia-white meadowsweet Aw	creeping mahonia-white meadowsweet Aw
creeping mahonia-white meadowsweet Fd	creeping mahonia-white meadowsweet Fd
creeping mahonia-white meadowsweet Pl	creeping mahonia-white meadowsweet Pl
creeping mahonia-white meadowsweet Shrub/Grass	creeping mahonia-white meadowsweet Shrub/Grass
creeping mahonia-white meadowsweet Sw	creeping mahonia-white meadowsweet Sw
false azalea-grouse-berry Fa	false azalea-grouse-berry Fa
false azalea-grouse-berry Pl	false azalea-grouse-berry Pl
false azalea-grouse-berry Pw	false azalea-grouse-berry Pw

(continued)

false azalea-grouse-berry Se	false azalea-grouse-berry Se
false azalea-grouse-berry Shrub/Grass	false azalea-grouse-berry Shrub/Grass
forb meadow	forb meadow
graminoid fen	graminoid fen
grassland	grassland
horsetail Se	horsetail Se
horsetail Sw	horsetail Sw
horsetail Sw-Pb	horsetail Sw-Pb
Labrador tea-hygric Sb	Labrador tea-hygric Sb
lichen Pl	lichen Pl
limber pine/juniper Fd-Pf	limber pine/juniper Fd-Pf
NoPhase	NoPhase
shrubby fen	shrubby fen
shrubby meadow	shrubby meadow
spruce/heather Se	spruce/heather Se
subalpine larch/heather La-Fa	subalpine larch/heather La-Fa
thimbleberry Fa-Se	thimbleberry Fa-Se
thimbleberry/pine grass Aw	thimbleberry/pine grass Aw
thimbleberry/pine grass Pl	thimbleberry/pine grass Pl
thimbleberry/pine grass Shrub/Grass	thimbleberry/pine grass Shrub/Grass
thimbleberry/pine grass Sw	thimbleberry/pine grass Sw
thimbleberry Pl	thimbleberry Pl
thimbleberry shrub	thimbleberry shrub
treed bog	treed bog
treed fen	treed fen
NA	
PHASE2 (character varying): Secondary ecosite phase code	
a1	a1 ecosite phase
b1	b1 ecosite phase
b2	b2 ecosite phase
c1	c1 ecosite phase
c2	c2 ecosite phase
c3	c3 ecosite phase
c4	c4 ecosite phase
c5	c5 ecosite phase
d1	d1 ecosite phase
d2	d2 ecosite phase
d3	d3 ecosite phase
d4	d4 ecosite phase
d5	d5 ecosite phase
e1	e1 ecosite phase
e2	e2 ecosite phase
e3	e3 ecosite phase
e4	e4 ecosite phase
e5	e5 ecosite phase
f1	f1 ecosite phase
f2	f2 ecosite phase
f3	f3 ecosite phase
g1	g1 ecosite phase
h1	h1 ecosite phase

(continued)

i1	i1 ecosite phase
i2	i2 ecosite phase
j1	j1 ecosite phase
k1	k1 ecosite phase
k2	k2 ecosite phase
l1	l1 ecosite phase
l2	l2 ecosite phase
NA	No ecosite phase applied

PHASE2NAME (character varying): Secondary ecosite phase name

balsam poplar Pb	balsam poplar Pb
bearberry/hairy wild rye Pl	bearberry/hairy wild rye Pl
bearberry/hairy wild rye Shrub/Grass	bearberry/hairy wild rye Shrub/Grass
Canada buffalo-berry/hairy wild rye Aw	Canada buffalo-berry/hairy wild rye Aw
Canada buffalo-berry/hairy wild rye Aw-Sw-Pl-Fd	Canada buffalo-berry/hairy wild rye Aw-Sw-Pl-Fd
Canada buffalo-berry/hairy wild rye Fd	Canada buffalo-berry/hairy wild rye Fd
Canada buffalo-berry/hairy wild rye Pl	Canada buffalo-berry/hairy wild rye Pl
Canada buffalo-berry/hairy wild rye Shrub/Grass	Canada buffalo-berry/hairy wild rye Shrub/Grass
creeping mahonia-white meadowsweet Aw	creeping mahonia-white meadowsweet Aw
creeping mahonia-white meadowsweet Fd	creeping mahonia-white meadowsweet Fd
creeping mahonia-white meadowsweet Pl	creeping mahonia-white meadowsweet Pl
creeping mahonia-white meadowsweet Shrub/Grass	creeping mahonia-white meadowsweet Shrub/Grass
creeping mahonia-white meadowsweet Sw	creeping mahonia-white meadowsweet Sw
false azalea-grouse-berry Fa	false azalea-grouse-berry Fa
false azalea-grouse-berry Pl	false azalea-grouse-berry Pl
false azalea-grouse-berry Pw	false azalea-grouse-berry Pw
false azalea-grouse-berry Se	false azalea-grouse-berry Se
false azalea-grouse-berry Shrub/Grass	false azalea-grouse-berry Shrub/Grass
forb meadow	forb meadow
grassland	grassland
horsetail Sw-Pb	horsetail Sw-Pb
Labrador tea-hygric Sb	Labrador tea-hygric Sb
lichen Pl	lichen Pl
limber pine/juniper Fd-Pf	limber pine/juniper Fd-Pf
shrubby bog	shrubby bog
shrubby fen	shrubby fen
shrubby meadow	shrubby meadow
spruce/heather Se	spruce/heather Se
subalpine larch/heather La-Fa	subalpine larch/heather La-Fa
thimbleberry Fa-Se	thimbleberry Fa-Se
thimbleberry/pine grass Aw	thimbleberry/pine grass Aw

(continued)

thimbleberry/pine grass Pl	thimbleberry/pine grass Pl
thimbleberry/pine grass Shrub/Grass	thimbleberry/pine grass Shrub/Grass
thimbleberry/pine grass Sw	thimbleberry/pine grass Sw
thimbleberry Pl	thimbleberry Pl
thimbleberry shrub	thimbleberry shrub
treed fen	treed fen
NA	

PHOTO_YR (integer): The year the imagery used to compile the inventory was acquired. This is the effective date of the inventory

1960 to present year	The year the imagery used to compile the inventory was acquired

PLCC_OWNER (character varying): Planned cutblock operator

CFRP	CROWSNEST FOREST PRODUCTS LTD.
CRFP	Crowsnest Forest Products
CTP	Community Timber Permit
DLIN	793128 ALBERTA LTD.
NA	

PLCC_STATUS (character varying): Planned cutblock harvest status

Harvested	Stand has been harvested
Laid	Stand has been laid out in the field
Planned	Block is planned for harvest
NA	

PLCC_YEAR (double precision): Planned cutblock harvest year

NA

PLUZ_NAME (character varying): Public land use zone name

Castle Special Management Area	
Cataract Creek Snow Vehicle	
Livingstone	
Porcupine Hills	
The Kananaskis Country	
NA	

PL_ORD (numeric): Lodgepole pine order for species assignment (overstory)

1 - X	Lodgepole pine order in species assignment

PL_PCT (numeric): Lodgepole pine percent in species distribution (overstory)

0 - X	Lodgepole pine percent in species distribution

POLY_NUM (integer): Original primary key linking forest polygon to attribute record

Variable values	Unique identifier for AVI data (provided as part of AVI submission)

PREDICTED_R (double precision): Mountain pine beetle predicted r

NA

PSP (bigint): Goa permanent sampling plots

PSP	Permanent sampling plot
X	No Permanent sampling plot
PSP	Permanent sampling plot
X	No Permanent sampling plot

PZONE_NAME (character varying): Livingstone and porcupine hills priority management zones

Priority Management Zone 2	Livingstone-Porcupine Priority Management Zone 2

(continued)

Priority Management Zone 3	Livingstone-Porcupine Priority Management Zone 3
NA	

X

RGE (integer): Range

NA	Alberta Township System Range

RSA_ID (text): Rsa unique identification number

NA

RSA_STRATUM (text): Rsa strata

HwPl	Hardwood Pine RSA Stratum
HwSx	Hardwood Spruce RSA Stratum
Pl	Pine RSA Stratum
PlHw	Pine Hardwood RSA Stratum
Sw	White Spruce Stratum
NA	

RSA_YEAR (integer): Rsa year

NA

SB_ORD (numeric): Black spruce order for species assignment (overstory)

1 - X	Black spruce order in species assignment

SB_PCT (numeric): Black spruce percent in species distribution (overstory)

0 - X	Black spruce percent in species distribution

SEEDZONE (character varying): Seed zone

A 1.4	Alpine 1.4
A 1.5	Alpine 1.5
FF 1.1	Foothills Fescue 1.1
FP 1.1	Foothills Parkland 1.1
FP 1.2	Foothills Parkland 1.2
M 4.4	Montane 4.4
M 4.5	Montane 4.5
M 5.4	Montane 5.4
M 5.5	Montane 5.5
M 5.6	Montane 5.6
SA 3.2	Subalpine 3.2
SA 3.3	Subalpine 3.3
SA 4.2	Subalpine 4.2
SA 4.3	Subalpine 4.3
NA	

SEISMIC (text): Identification of presence of seismic line within the polygon

seismic	Feature contains seismic line
NA	No seismic line identified

SHEEP_HERD (text): Mountain goat and big horn sheep herd name

Southern Rockies	Southern Rockies Herd
NA	

SHEEP_RISK (text): Mountain goat and big horn sheep range risk

High	High Risk to Sheep herd
Low	Low Risk to Sheep herd
Moderate	Moderate Risk to Sheep herd
NA	

(continued)

SLOPE_CLASS (character varying): Percent of each polygon with slope > 45%

45+%	Slopes greater than or equal to 45%
NA	

SNOWZONE (text): Watersheds identified as being snow sensitive

snowzone	Snow sensitive watershed
NA	

SOFTPCT (numeric): Coniferous species percent (overstory)

0 - X	Coniferous species percent (overstory)

SP1 (text): Tree species 1 where order is determined through crown closure

AW	Trembling aspen (Populus tremuloides)
FA	Alpine fir (Abies lasiocarpa)
FD	Douglas fir (Pseudotsuga menziesii)
LA	Alpine larch (Larix lyallii)
LW	Western larch (Larix occidentalis)
PA	White-bark pine (Pinus albicaulis)
PB	Balsam poplar (Populus balsamifera)
PF	Limber pine (Pinus flexilis)
PL	Lodgepole pine (Pinus contorta)
SB	Black spruce (Picea mariana)
SE	Engelmann spruce (Picea engelmannii)
SW	White spruce (Picea glauca)
NA	No sp1 assigned

SP1_PER (integer): The percentage of species 1 to the nearest 10% based on crown closure

0 - 10	AVI species 1 percent

SP2 (text): Tree species 2 where order is determined through crown closure

AW	Trembling aspen (Populus tremuloides)
BW	Paper (white) birch (Betula papyrifera)
FA	Alpine fir (Abies lasiocarpa)
FD	Douglas fir (Pseudotsuga menziesii)
LA	Alpine larch (Larix lyallii)
LW	Western larch (Larix occidentalis)
PA	White-bark pine (Pinus albicaulis)
PB	Balsam poplar (Populus balsamifera)
PF	Limber pine (Pinus flexilis)
PL	Lodgepole pine (Pinus contorta)
SB	Black spruce (Picea mariana)
SE	Engelmann spruce (Picea engelmannii)
SW	White spruce (Picea glauca)
NA	No sp2 assigned

SP2_PER (integer): The percentage of species 2 to the nearest 10% based on crown closure

0 - 10	AVI species 2 percent

SP3 (text): Tree species 3 where order is determined through crown closure

AW	Trembling aspen (Populus tremuloides)
BW	Paper (white) birch (Betula papyrifera)
FA	Alpine fir (Abies lasiocarpa)
FD	Douglas fir (Pseudotsuga menziesii)
LA	Alpine larch (Larix lyallii)
LW	Western larch (Larix occidentalis)
PA	White-bark pine (Pinus albicaulis)

(continued)

PB	Balsam poplar (Populus balsamifera)
PF	Limber pine (Pinus flexilis)
PL	Lodgepole pine (Pinus contorta)
SB	Black spruce (Picea mariana)
SE	Engelmann spruce (Picea engelmannii)
SW	White spruce (Picea glauca)
NA	No sp3 assigned

SP3_PER (integer): The percentage of species 3 to the nearest 10% based on crown closure

0 - 10	AVI species 3 percent

SP4 (text): Tree species 4 where order is determined through crown closure

AW	Trembling aspen (Populus tremuloides)
FA	Alpine fir (Abies lasiocarpa)
FD	Douglas fir (Pseudotsuga menziesii)
LA	Alpine larch (Larix lyallii)
LW	Western larch (Larix occidentalis)
PA	White-bark pine (Pinus albicaulis)
PB	Balsam poplar (Populus balsamifera)
PF	Limber pine (Pinus flexilis)
PL	Lodgepole pine (Pinus contorta)
SE	Engelmann spruce (Picea engelmannii)
SW	White spruce (Picea glauca)
NA	No sp4 assigned

SP4_PER (integer): The percentage of species 4 to the nearest 10% based on crown closure

0 - 10	AVI species 4 percent

SP5 (text): Tree species 5 where order is determined through crown closure

AW	Trembling aspen (Populus tremuloides)
FA	Alpine fir (Abies lasiocarpa)
LA	Alpine larch (Larix lyallii)
PA	White-bark pine (Pinus albicaulis)
PB	Balsam poplar (Populus balsamifera)
PF	Limber pine (Pinus flexilis)
PL	Lodgepole pine (Pinus contorta)
SE	Engelmann spruce (Picea engelmannii)
NA	No sp5 assigned

SP5_PER (integer): The percentage of species 5 to the nearest 10% based on crown closure

0 - 10	AVI species 5 percent

STEMSHA (integer): Stems per hectare (overstory)

1 - X	Count of stems per hectare

STRATA (text): Strata call based on the yield source identified

AW	Aspen stratum
AWPL	Aspen/Pine mixedwood stratum
AWSW	Aspen/Spruce mixedwood stratum
FD	Douglas Fir stratum
HWPL	Hardwood/Pine mixedwood stratum
HWSX	Hardwood/Spruce mixedwood stratum
PL	Pine stratum (Lodgepole, Whitebark, Limber)
PLAW	Pine/Aspen mixedwood stratum
PLHW	Pine/Hardwood mixedwood stratum
SB	Black Spruce stratum

(continued)

SW	White Spruce stratum
SWAW	White Spruce/Aspen mixedwood stratum
NA	No stratum assigned
STRATA_GOA (text): Avi extended strata (overstory)	
C1	Pure White Spruce
C11	Black Spruce Leading without Pine
C12	Larch Leading
C13	Douglas-fir
C14	Douglas-fir Leading
C15	Pure Balsam Fir
C16	Balsam Fir Leading with Pine
C17	Balsam Fir Leading without Pine
C2	White Spruce Leading with Pine
C3	White Spruce Leading without Pine
C4	Pure Pine
C5	Pine Leading with White Spruce
C7	Pine Leading with Fir
C8	Pine Leading without Spruce and Fir
C9	Pure Black Spruce
CD1	White Spruce/Aspen
CD10	Fir/Aspen
CD11	Fir/Poplar
CD2	White Spruce/Poplar
CD3	White Spruce/Birch
CD4	Pine/Aspen
CD5	Pine/Poplar
CD6	Pine/Birch
D1	Pure Aspen
D2	Aspen Leading with Poplar
D3	Aspen Leading without Poplar
D4	Poplar Leading
DC1	Aspen/White Spruce
DC2	Aspen/Pine
DC4	Aspen/Fir
DC5	Poplar/White Spruce
DC6	Poplar/Pine
DC8	Poplar/Fir
NA	
STRUC (text): Indicator of the vertical or horizontal structure of the stand	
H	Horizontal (homogeneous stand with scattered pockets)
M	Multi-layer canopy (2 storey)
NA	No structure assigned
STRUC_VAL (integer): Dependent on struc: if h then value indicates percentage of stand area covered by taller or forested component. If structure is c then value indicates the height range in metres from the midpoint of the upper layer to the mid-point of the lower layer.	
0 - 10	Stand structure value (used only with 'H' above (e.g., 80% Pl, 20% Aw pockets would be Pl8 /
STR_GRP (text): Strata broad cover group (overstory)	
C	Conifer
CD	Conifer leading mixedwood
D	Deciduous
DC	Deciduous leading mixedwood

(continued)

NA	No strata group assigned (overstory

SW__ORD (numeric): White spruce order for species assignment (overstory)

1 - X	White spruce order in species assignment

SW__PCT (numeric): White spruce present in species distribution (overstory)

0 - X	White spruce percent in species distribution

TIMBER__YR (integer): Timber year of a harvested block

0 - X	Timber year of cutblock

TPR (text): The potential productivity rating of a stand based on height and age of dominant and codominant trees of the leading species

F	Fair
G	Good
M	Medium
U	Unproductive
NA	

TRAIL (text): Provincial and designated trails

trail	Designated Trail
NA	

TSA__UKEY (integer): Unique identification number for each landbase polygon

Variable values	Unique identifier for tsa landbase

TWP (integer): Township

NA	Alberta Township System township

UAGE (numeric): Age of understory based on avi processing

1 - X	Understory age in years (understory)

UANTH__NON (text): Non-vegetated areas created by man in the understorey

NA	No understory anthropogenic non-vegetated value assigned

UANTH__VEG (text): Vegetated cover types directly influenced by man, usually in areas that have been planted with cultivated species, in the understorey

NA	No understory anthropogenic vegetated value assigned

UAW__ORD (numeric): Aspen order for species assignment (understory)

1 - X	Aspen order in species assignment (understory)

UAW__PCT (numeric): Aspen percent in species distribution (understory)

0 - X	Aspen percent in species distribution (Understory)

UBW__ORD (numeric): White birch order for species assignment (understory)

1 - X	White birch order in species assignment (Understory)

UBW__PCT (numeric): White birch percent in species distribution (understory)

0 - X	White birch percent in species distribution (understory)

UCRULE (text): Conifer strata decision rule (understory)

FBFD__LEAD__MW	Fir leading mixedwood (understory)
FB__LEAD	Balsam fir leading (understory)
FD__LEAD	Douglas fir leading (understory)
LT__LEAD	Larch leading (understory)
NO__C	No leading conifer (understory)
PL__LEAD	Lodgepole pine leading (understory)
PL__LEAD__MW	Lodgepole pine leading mixedwood (understory)
SB__LEAD	Black spruce leading (understory)

(continued)

SW_LEAD	White spruce leading (understory)
SW_LEAD_MW	White spruce leading mixedwood (understory)
NA	No coniferous strata decision rule (overstory) assigned

UC_CODE (text): Coniferous code assignment for bas10 stratification assignment (understory)

C	Conifer (understory)
CD	Conifer with deciduous mixedwood (understory)
D	Deciduous (understory)
DC	Deciduous with conifer mixedwood (understory)
NA	

UDATA (text): Deciduous strata decision rule (overstory)

F	Interpretor plot (understory)
I	Interpreted TPR (understory)
S	Supplementary Photography
NA	No data source call applied (understory)

UDATA_YR (integer): Reference year for data used to confirm attributes

1960 - present year	Reference year for data used to confirm attributes (understory)

UDENSITY (text): Percentage of ground area covered by a vertical projection of tree crowns onto the ground

A	6 to 30 % (understory)
B	31 to 50 % (understory)
C	51 to 70 % (understory)
D	71 to 100 % (understory)
NA	

UDEN_CL (integer): Density class (understory)

NA	No understory density class assigned (understory)

UDEN_INT (integer): Stand density integer (understory)

0	No value present (understory)
10	Crown closure 1-10% (understory)
20	Crown closure 11-20% (understory)
30	Crown closure 21-30% (understory)
40	Crown closure 31-40% (understory)
50	Crown closure 41-50% (understory)
60	Crown closure 51-60% (understory)
70	Crown closure 61-70% (understory)
80	Crown closure 71-80% (understory)
90	Crown closure 81-90% (understory)
100	Crown closure 91-100% (understory)

UDRULE (text): Deciduous strata decision rule (understory)

AW_LEAD	Aspen leading (understory)
BW_LEAD	Birch leading (understory)
NO_D	No deciduous leading species (understory)
PB_LEAD	Balsam poplar leading (understory)
NA	No deciduous strata decision rule (overstory) assigned

UFB_ORD (numeric): Balsam fir order for species assignment (understory)

1 - X	Balsam fir order in species assignment (understory)

UFB_PCT (numeric): Balsam fir percent in species distribution (understory)

0 - X	Balsam fir percent in species distribution (understory)

UFD_ORD (numeric): Douglas fir order for species assignment (understory)

(continued)

1 - X	Douglas fir order in species assignment (understory)

UFD_PCT (numeric): Douglas fir percent in species distribution (understory)

0 - X	Douglas fir percent in species distribution (understory)

UHARDPCT (numeric): Deciduous species percent (understory)

0 - X	Deciduous species percent (understory)

UHEIGHT (integer): Interpreted or determined through field measurements and recorded to the nearest metre. Understorey stand height is the average height of the dominant and codominant trees of the leading species in the understorey

NA	No understory height assigned (understory)

UINITIALS (text): U interpreters initials

Initials	AVI interpreter's initials (understory)

ULEAD_CON (text): Leading conifer species (understory)

FB	Balsam fir leading (understory)
FD	Douglas fir leading (understory)
LT	Larch leading (understory)
NO	No leading conifer (understory)
PL	Pine leading (understory)
SB	Black spruce leading (understory)
SW	White sprice leading (understory)
NA	

ULEAD_DEC (text): Leading deciduous species (understory)

AW	Aspen leading (understory)
BW	Birch leading (understory)
NO	No leading deciduous (understory)
PB	Balsam poplar leading (understory)
NA	

ULT_ORD (numeric): Larch order for species assignment (understory)

1 - X	Larch order in species assignment

ULT_PCT (numeric): Larch percent in species distribution (understory)

0 - X	Larch percent in species distribution

UMOD1 (text): Stand condition modifiers for the understory

NA	No stand condition modifier extent (understory)

UMOD1_EXT (integer): Context specific value that can represent: percent loss of crown closure, percent land areas affected, or snag density

0	No stand condition modifier extent (understory)
1	1 to 25% loss of crown closure or land area affected (understory)
2	26 to 50% loss of crown closure or land area affected (understory)
3	51 to 75% loss of crown closure or land area affected (understory)
4	76 to 94% loss of crown closure or land area affected (understory)
5	94 to 100% loss of crown closure or land area affected (understory)

UMOD1_YR (integer): Year associated with modifier event

0 - X	Year associated with modifier event (understory)

UMOD2 (text): Secondary stand condition modifiers for the understory

NA	No secondary stand condition modifier extent (understory)

UMOD2_EXT (integer): Context specific value that can represent: percent loss of crown closure, percent land areas affected, or snag density

(continued)

0	No secondary stand condition modifier extent (understory)
1	1 to 25% loss of crown closure or land area affected (understory)
2	26 to 50% loss of crown closure or land area affected (understory)
3	51 to 75% loss of crown closure or land area affected (understory)
4	76 to 94% loss of crown closure or land area affected (understory)
5	94 to 100% loss of crown closure or land area affected (understory)

UMOD2_YR (integer): Year associated with modifier event

0 - X	Year associated with modifier event (understory)

UMOIST_REG (text): Assessment of understorey soil moisture regime based on plant indicators or environmental factors and soil properties

D	Dry - rapidly drained substratum (understory)
M	Mesic - moderately well drained substratum (understory)
W	Wet - poorly drained to flooded (understory)
NA	No understory moisture regime assigned (understory)

UNAT_NON (text): Natural cover types that have less than 6% plant cover in the understorey

NWF	Flooded (understory)
NWL	Lake (understory)
NWR	River (understory)
NA	No naturally non forested values (understory)

UNFL (text): Vegetated cover types with equal to or greater than 6% plant cover but less than 6% tree cover in the understorey

BR	Bryophyte (mosses) (understory)
HF	Herbaceous forbs (understory)
HG	Herbaceous grassland (understory)
SC	Closed shrub (crowns of most shrubs interlocking) (understory)
SO	Open shrub (crowns of most shrubs not touching each other) (understory)
NA	No Vegetated cover types values (understory)

UNFL_PER (integer): ăPercentage to nearest 10% indicating shrub crown closure within the polygon in the understorey

0	No data (understory)
1	1 - 10% (understory)
2	11 - 20% (understory)
3	21 - 30% (understory)
4	31 - 40% (understory)
5	41 - 50% (understory)
6	51 - 60% (understory)
7	61 - 70% (understory)
8	71 - 80% (understory)
9	81 - 90% (understory)
10	91 - 100% (understory)

UORIGIN (integer): Average "birth year" of the understorey of the stand using 10-year origin classes

1600 to present year	Decadal classes or exact year of stand origin (understory)

UPATTERN (integer): Distribution pattern of the underrstory canopy

0	No DIST_PTRN assigned (understory)
1	Single to very few (1-3) occurrences (understory)
2	Several (>= 4) sporadic occurrences (understory)
3	Intimately intermixed units (understory)
4	Continuous understorey (understory)
5	Continuous understorey occurrence (understory)

(continued)

6	Understory with regularly spaced trees as a result of silvicultural practices (understory)

UPB_ORD (numeric): Balsam poplar order for species assignment (understory)

1 - X	Balsam poplar order in species assignment (understory)

UPB_PCT (numeric): Balsam poplar percent in species distribution (understory)

0 - X	Balsam poplar percent in species distribution (understory)

UPL_ORD (numeric): Lodgepole pine order for species assignment (understory)

1 - X	Lodgepole pine order in species assignment (understory)

UPL_PCT (numeric): Lodgepole pine percent in species distribution (understory)

0 - X	Lodgepole pine percent in species distribution (understory)

USB_ORD (numeric): Black spruce order for species assignment (understory)

1 - X	Black spruce order in species assignment (understory)

USB_PCT (numeric): Black spruce percent in species distribution (understory)

0 - X	Black spruce percent in species distribution (understory)

USOFTPCT (numeric): Coniferous species percent (overstory)

0 - X	Coniferous species percent (understory)

USP1 (text): Understorey tree species 1 where order is determined through crown closure

AW	Trembling aspen (Populus tremuloides) (understory)
BW	Paper (white) birch (Betula papyrifera) (understory)
FA	Alpine fir (Abies lasiocarpa) (understory)
FD	Douglas fir (Pseudotsuga menziesii) (understory)
LA	Alpine larch (Larix lyallii) (understory)
LW	Western larch (Larix occidentalis)
PA	White-bark pine (Pinus albicaulis) (understory)
PB	Balsam poplar (Populus balsamifera) (understory)
PF	Limber pine (Pinus flexilis) (understory)
PL	Lodgepole pine (Pinus contorta) (understory)
SB	Black spruce (Picea mariana) (understory)
SE	Engelmann spruce (Picea engelmannii) (understory)
SW	White spruce (Picea glauca) (understory)
NA	No sp1 assigned (understory)

USP1_PER (integer): The percentage of understorey species 1 to the nearest 10% based on crown closure

0 - 10	AVI understory species 1 percent

USP2 (text): Understorey tree species 2 where order is determined through crown closure

AW	Trembling aspen (Populus tremuloides) (understory)
BW	Paper (white) birch (Betula papyrifera) (understory)
FA	Alpine fir (Abies lasiocarpa) (understory)
FB	Balsam fir (Abies balsamea) (understory)
FD	Douglas fir (Pseudotsuga menziesii) (understory)
LA	Alpine larch (Larix lyallii) (understory)
PA	White-bark pine (Pinus albicaulis) (understory)
PB	Balsam poplar (Populus balsamifera) (understory)
PF	Limber pine (Pinus flexilis) (understory)
PL	Lodgepole pine (Pinus contorta) (understory)
SB	Black spruce (Picea mariana) (understory)
SE	Engelmann spruce (Picea engelmannii) (understory)
SW	White spruce (Picea glauca) (understory)
NA	No sp2 assigned (understory)

(continued)

USP2_PER (integer): The percentage of understorey species 2 to the nearest 10% based on crown closure

0 - 10	AVI understory species 2 percent

USP3 (text): Understorey tree species 3 where order is determined through crown closure

AW	Trembling aspen (Populus tremuloides) (understory)
BW	Paper (white) birch (Betula papyrifera) (understory)
FA	Alpine fir (Abies lasiocarpa) (understory)
FD	Douglas fir (Pseudotsuga menziesii) (understory)
LA	Alpine larch (Larix lyallii) (understory)
PA	White-bark pine (Pinus albicaulis) (understory)
PB	Balsam poplar (Populus balsamifera) (understory)
PF	Limber pine (Pinus flexilis) (understory)
PL	Lodgepole pine (Pinus contorta) (understory)
SB	Black spruce (Picea mariana) (understory)
SE	Engelmann spruce (Picea engelmannii) (understory)
SW	White spruce (Picea glauca) (understory)
NA	No sp3 assigned (understory)

USP3_PER (integer): The percentage of understorey species 3 to the nearest 10% based on crown closure

0 - 10	AVI understory species 3 percent

USP4 (text): Understorey tree species 4 where order is determined through crown closure

AW	Trembling aspen (Populus tremuloides) (understory)
FA	Alpine fir (Abies lasiocarpa) (understory)
FD	Douglas fir (Pseudotsuga menziesii) (understory)
LA	Alpine Larch
PA	Whitebark Pine
PB	Balsam poplar (Populus balsamifera) (understory)
PF	Limber pine (Pinus flexilis) (understory)
PL	Lodgepole pine (Pinus contorta) (understory)
SE	Englemann Spruce
SW	White spruce (Picea glauca) (understory)
NA	No sp4 assigned (understory)

USP4_PER (integer): The percentage of understorey species 4 to the nearest 10% based on crown closure

0 - 10	AVI understory species 4 percent

USP5 (text): Understorey tree species 5 where order is determined through crown closure

LA	Alpine Larch
PF	Limber pine (Pinus flexilis) (understory)
PL	Lodgepole pine (Pinus contorta) (understory)
NA	No sp5 assigned (understory)

USP5_PER (integer): The percentage of understorey species 5 to the nearest 10% based on crown closure

0 - 10	AVI understory species 5 percent

USTRATA_GOA (text): Avi extended strata (understory)

C1	Pure White Spruce
C11	Black Spruce Leading without Pine
C12	Larch Leading
C13	Douglas-fir
C14	Douglas-fir Leading

(continued)

C15	Pure Balsam Fir
C16	Balsam Fir Leading with Pine
C17	Balsam Fir Leading without Pine
C2	White Spruce Leading with Pine
C3	White Spruce Leading without Pine
C4	Pure Pine
C5	Pine Leading with White Spruce
C7	Pine leading with fir
C8	Pine Leading without Spruce and Fir
C9	Pure Black Spruce
CD1	White Spruce/Aspen
CD10	Fir/Aspen
CD2	White Spruce/Poplar
CD3	White Spruce/Birch
CD4	Pine/Aspen
CD5	Pine/Poplar
D1	Pure Aspen
D2	Aspen Leading with Poplar
D3	Aspen Leading without Poplar
D4	Poplar Leading
D5	Birch Leading
DC1	Aspen/White Spruce
DC10	Birch/Pine
DC2	Aspen/Pine
DC4	Aspen/Fir
DC5	Poplar/White Spruce
NA	

USTRUC (text): Indicator of the vertical or horizontal structure of the stand

H	Horizontal (homogeneous stand with scattered pockets) (understory)
M	Multi-layer canopy (2 storey) (understory)
NA	No understory structure value assigned (understory)

USTRUC_VAL (integer): Dependent on ustruc: if h then value indicates percentage of stand area covered by shorter or non-forested component

1 - X	Dependent on USTRUC: if H then value indicates percentage of stand area covered by shorter

USTR_GRP (text): Strata broad cover group (understory)

C	Conifer (understory)
CD	Conifer leading mixedwood (understory)
D	Deciduous (understory)
DC	Deciduous leading mixedwood (understory)
NA	No strata group assigned (understory)

USW_ORD (numeric): White spruce order for species assignment (understory)

1 - X	White spruce order in species assignment (understory)

USW_PCT (numeric): White sprice percent in species distribution (understory)

0 - X	White spruce percent in species distribution (understory)

UTPR (text): The potential productivity rating of the understorey of the stand based on height and age of dominant and codominant trees in the understorey

F	Fair (understory)
G	Good (understory)
M	Medium (understory)
U	Unproductive (understory)

(continued)

NA	
VIEWSHED (character varying): Distance from a viewpoint to a stand	
Back-ground	Viewshed is a long distance from the viewpoint
Fore-ground	Viewshed is a short distance from the viewpoint
Mid-ground	Viewshed is a medium distance from the viewpoint
NA	
VISUALQUALITY (text): Importance of the viewshed	
High	High value stand
NA	
WHITEBARK_PLUS (character varying): Areas identified as whitebark pine or limber pine	
PA	Whitebark pine tree location
PF	Limber pine tree location
NA	
WILDFIRE_RISK (character varying): Wildfire risk assessment	
Continuous Improvement	Lowest risk
Intolerable	Highest risk
Risk Reduction	Medium risk
NA	
WM_UNIT (character varying): NA	
Castle-Carbondale	
Crowsnest Pass	
Happy Valley	
Highwood	
Livingstone	
North Porcupine Hills	
South Porcupine Hills	
Willow Valley	
NA	
YIELD_SOURCE (text): Data source where final yield strata was derived	
ARIS	Yield source coming from ARIS data
AVI	Yield source coming from AVI data
RSA	Yield source coming from RSA data

FORCORP - Project Number: P877

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FINAL DRAFT

Annex VI – Timber Supply Analysis (TSA)

FORCORP

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	II	Communication Plan
	Annex	III	Stewardship Report (2010-2015)
	Annex	IV	Yield Curve Development
	Annex	V	Net Landbase Development
Three	**Annex**	**VI**	**TSA – Timber Supply Analysis**
	Annex	VII	SHS – Spatial Harvest Sequence
	Annex	VIII	Growth and Yield Plan

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1 Overview

As part of the 2025 Forest Management Plan (FMP), forecasting was conducted to guide the development of the Preferred Forest Management Scenario (PFMS). The forecasting process involved evaluation of management alternatives and selection of a PFMS, with an associated Annual Allowable Cut (AAC).

The Plan Development Team (PDT) created the PFMS with the support of computational forecasting. This involves modeling the management actions to be undertaken with a high level of detail for the next 20 years and a lower level of detail for the following 180 years. Forecasting also predicts, under the proposed management actions, what the condition of the forest will be over the 200-year planning horizon. Computer based modeling is part of the adaptive forest management process that is required for sustainable forest management and was undertaken so that the proposed forest management actions did not compromise forest sustainability.

This annex describes the forecasting process and sensitivity analysis undertaken for the development of the 2025 Forest Management Plan (FMP). It details the forecasting assumptions, methods and results, the knowledge gained, and the application of the results leading up to the development of the PFMS. A description of the data files supporting the TSA and the PFMS is included here. The PFMS itself is described in *Chapter 6 – Preferred Forest Management Scenario*.

1.1 Indicators

The Canadian Standards Association defines a forecast as "an explicit statement of the expected future condition of an indicator". Forecasting in the context of the 2025 FMP is the process that creates the predicted future condition of FMP indicators. Indicators describe the forest condition, the products derived, and the values present in the forest.

Examples of indicators are patches of old growth forest and the amount of timber harvested. These example indicators are non-complementary in that increasing levels of old growth will decrease the amount of timber that can be harvested. This highlights the essence of forecasting within the forest management planning context; it is necessary to make tradeoffs between the desired amounts of each indicator in order to achieve a preferred scenario. Usually, it is not possible to obtain everything that is desired and often undesirable outcomes are predicted for some of the indicators no matter what actions are proposed. Forecasting is a complex process and was used by the forest managers and the PDT to predict the outcomes of specific forest management activities. It assisted the managers in deciding what activities, at what level, should be proposed in a PFMS that best meets forest management objectives.

2 Forecasting Methods

Forecasting is a complex process requiring numerous inputs and assumptions. This section describes the 2025 FMP forecasting process including a description of the modeling tools, inputs, assumptions, outcomes, and trade-offs required to develop the Preferred Forest Management Scenario (PFMS).

2.1 Objective

The objective of forecasting is to create a reasonable prediction of the forest attributes and non-timber values using timber harvesting as the main agent of change, which leads to the creation of the PFMS that best achieves the forest management objectives.

2.2 Process

Developing a forecast involves combining data, in the form of spatial landbases and yield curves, with management assumptions, into a coherent spatial model that is capable of both fine and coarse scale analysis. Following a structured progressive approach, scenarios were developed to explore the impacts of the options available, guided by the existing operability limitations and the 2006 Alberta Forest Management Planning Standard, Version 4.1 (Planning Standard) specifications that balance social, economic and ecological forest management objectives.

The development of landbases and yield curves, the refinement of indicators and goals, and the process of evaluating scenario output to derive new scenarios are all iterative processes and are interdependent. Figure 2-1 outlines the process involved in developing the PFMS. Any one of the cycles shown can be repeated as many times as necessary to ensure the best possible solution is achieved.

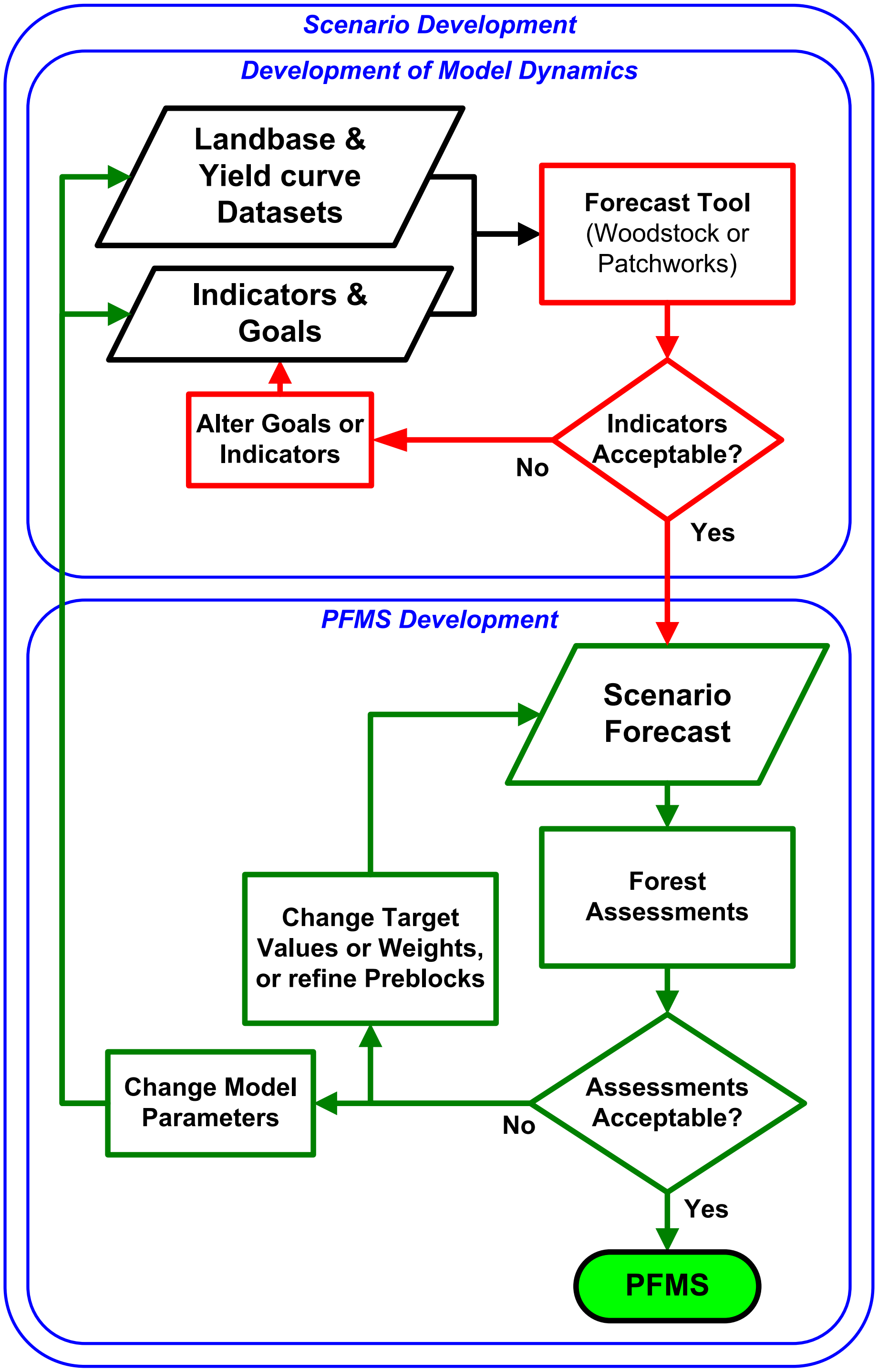

Figure 2-1. Forecast planning process.

2.2.1 Development of the Model Dynamics

The forecasting process begins with the development of the model inputs; the landbase, yield curves, and initial indicators and goals. These inputs were then used to construct the model within the forecasting tools framework. Model results were analyzed to ensure the indicators correctly represent the metrics to be evaluated and that the model dynamics are realistic. If any metric or assumption was deemed to be inaccurate or insufficient, it was re-worked, and the model was rebuilt.

2.2.2 Scenario Development

Scenarios were developed to test the implications of specific management strategies. Each scenario's impact on the forest and its associated values was examined, as well as differences between scenarios. By altering the types, locations and levels of management actions in a scenario, or by altering the desired future forest condition, the PDT was able to determine the long-term forest dynamics, desirable activities and assess the forest management trade-offs.

Scenarios were developed within a structured process. The PDT identified forest management issues that could be addressed through forecasting. Scenarios were created to address identified issues and results were summarized in issue documents for the PDT to review and act upon. Through this process, the primary trade-off decisions such as old growth level and timber yield assumptions were resolved.

2.2.3 PFMS Development

After the management issues were resolved, a series of scenarios were generated to work towards the PFMS. These scenarios were primarily focused on changes to the Spatial Harvest Sequence (SHS) to ensure operability and that the proposed harvest blocks met the non-timber objectives.

2.3 Limitations

There are limitations in any forecasting process. The primary limitations related to the development of the PFMS are the generalization of inputs and the inability to directly address stochastic events, such as wildfire, in the timber supply models.

2.3.1 Landbase

The landbase is built with the best information available, but it is a snapshot of the current status of many attributes such as forest fires, roads, towns, and oil and gas activity. Future changes to the landbase for fires, land-use or other industrial infrastructure development were not incorporated into the modeling.

2.3.2 Yield Curves

Yield curve development used an empirical (regression-based) yield curve approach to model gross merchantable volume as a function of inventory age by yield group in natural fire-origin stands using non-linear empirical regression of TSP data collected in the summer of 2022, and on GYPSY built curves for Pre-96 cutblocks for the Pl and Sw strata. Post-95 harvested Pl stands use a percentage reduction from the natural stand curve due to lower than expected RSA survey MAI estimates, as described in Annex IV – Yield Curve Development, and all stands harvested after the SHS effective date transition back to the natural stand curves. The resulting yield curves represent averages across the landscape. While this approach produces reasonable results for strategic planning, the variation between individual polygons of the same strata can be large. Large variations will be observed in recovered individual block level volumes compared to volumes predicted from the yield curves. However, over large areas, the harvested volumes will be close to the predicted volumes.

2.3.3 Stochastic Events

Stochastic, or random, events such as fire or insect outbreaks are not explicitly modeled in this process. Stochastic events, by their very nature, are unpredictable and even less predictable when spatial location is required as it is for the development of the SHS. For these reasons, stochastic events are excluded from the forecasting. The FMP process addresses stochastic events through re-planning when unplanned events cumulatively impact 2.5% or more of the net landbase.

2.4 Modelling Tools

One forecasting modelling tool was used for this analysis, Patchworks.

2.4.1 Patchworks

Patchworks (v2019.08), is a spatially explicit forest estate modeling tool developed and serviced by Spatial Planning Systems. It is designed to provide the user with operational-scale decision-making capacity within a strategic analytical environment. Trade-off analysis of alternative operational decisions are quickly determined and visually displayed.

Patchworks operates at the polygon level. In Patchworks terminology, polygons are the smallest element, which in this case are the subdivided Alberta Vegetation Inventory (AVI) stands in the modeling landbase. The treatments applied to each polygon are an all or nothing decision for the model. There is only one post-treatment transition for each polygon. When Patchworks operates, one or more polygons adjacent to each other that meet specific criteria can be combined to form “patches”. The modeling landbase is comprised of small polygons to allow for more options in creating patches.

The tool is fully spatial through time and the impact on an adjacent polygon 200 years into the future is considered in the first year of the simulation. Patchworks decision space can be thought of as a matrix consisting of each polygon and each potential outcome for every time slice in the planning horizon.

Patchworks is a heuristic model that provides close to optimal solutions for the defined goals or targets by applying simulated annealing and generic algorithms. In this analysis, a variety of goals were included such as harvest levels, minimum growing stock levels, minimum seral stage areas, maximum block size and range of regeneration patch sizes by period.

Goals were represented by different features (elements present on the landscape) or products (something produced from the landscape, e.g. cubic meters of timber or hectares of habitat) and multiplied by weighting factors, which ranked the importance and contribution of each feature or product towards the modeling objective. The weighting does not represent the relative importance of each goal but rather represents the weighting required to achieve an acceptable solution.

Patchworks solves in annual periods but was set up to model and report in 40 five-year periods. There was a two-year period at the start of the simulation to advance the landbase to the beginning of the planning horizon, May 1, 2025. The model covers the entire 200-year planning horizon, beginning in 2025 and ending in 2225. Patchworks have been successfully applied in previous FMPs approved in Alberta for over a decade.

3 Equivalent Clearcut Area (ECA)

As part of the FMP process, GoA commonly conducts watershed assessments on the SHS using the Equivalent Clearcut Area (ECA) model. The ECA model predicts the change in water runoff due to changes in the vegetation condition within the watershed. For FMPs, the GoA provides an option of incorporating ECA into the timber supply models to provide faster feedback on ECA results. For the 2025 FMP, CFP chose to build ECA into Patchworks. This section describes the steps that were used to conduct a watershed assessment with Patchworks.

3.1 Description

GoA has developed a watershed assessment application that uses the net landbase, the SHS and a watershed layer as spatial input along with non-recovered percent curves to calculate watershed impact hazard over time as described in the Watershed Hazard Assessment (WHA) section of the *Non-Timber Assessments in Forest Management Planning* document (Government of Alberta, 2019). The WHA assesses the level of impact each watershed undergoes over time with the current SHS plan. When a watershed is disturbed, it is possible to calculate the percent of the watershed that is not yet recovered. The non-recovered percent of the watershed is equated to Equivalent Clearcut Area (ECA).

The Patchworks modeling environment uses “yield” curves to assign values to indicators that change over time. In this case, ECA or non-recovered percent of watershed is the indicator of watershed hazard. It is assigned to each watershed based on the cumulative impact of each stand that is within a watershed boundary for each time period of interest.

The GoA WHA uses the net landbase with the SHS as the principle disturbance layer to assess hazard over time. Disturbances are classified into 2 classes: permanent and recoverable. Non-recovered percents (or ECA) are assigned a value from 0 to 1 where 0 is fully recovered and 1 is recently disturbed. A permanent disturbance is given a non-recovered percent value of 1 from its date of disturbance onward.

For recoverable disturbances, the non-recovered percents are assigned through the ECA value as described in the GoA documentation (Government of Alberta, 2019).

3.2 Development of Stand ECA Curves

1. Calculate the Periodic Annual Increment (PAI) from the Yield Curves
2. Full recovery (ECAs = 0) when age of stand is greater than or equal to maximum PAI (PAI_{max})
3. Calculate the ECAs for stand age (i) less than PAI_{max}:

$$ECA_s^i = \frac{PAI_{\max} - PAI_i}{PAI_{\max}}$$

All polygons within the landbase are assigned an ECA value. Permanent disturbances such as pipelines, roads and other anthropogenic non-vegetated areas are assigned a static value of 1; non forested stands that have not been disturbed for a long time such as natural grass and scrubland are given a static value of 0, while forested areas are assigned a non-recovered percent based on time since disturbance.

The non-recovered percent or ECA values are based on stand age and are yield curves. An ECA value is calculated for each yield strata in the landbase for each stand age. The non-recovered percent yield curve is used to assign indicator values over time in Patchworks in the same fashion as volume yield curves. Each is based on using a value of one (1) at stand age zero, and a value of zero (0) when the total volume yield curve reaches maximum periodic annual increment (PAI). While different yield curves were built for Pre-96 Pl and Sw stands, and post-95 Pl stands, a single ECA curve was used for each strata for simplicity as all stands transition back to the natural stand curves. This was done by building a total volume yield curves from the natural stand curve TSP data. An example curve showing the volume, PAI, and resulting ECA curve for the PL natural strata in FMU C5 is shown in Figure 3-1 and Figure 3-2. In this example, the ECA curve reaches zero at age 53. For all strata, the maximum PAI is reached between the ages of 50 and 75 (Figure 3-3).

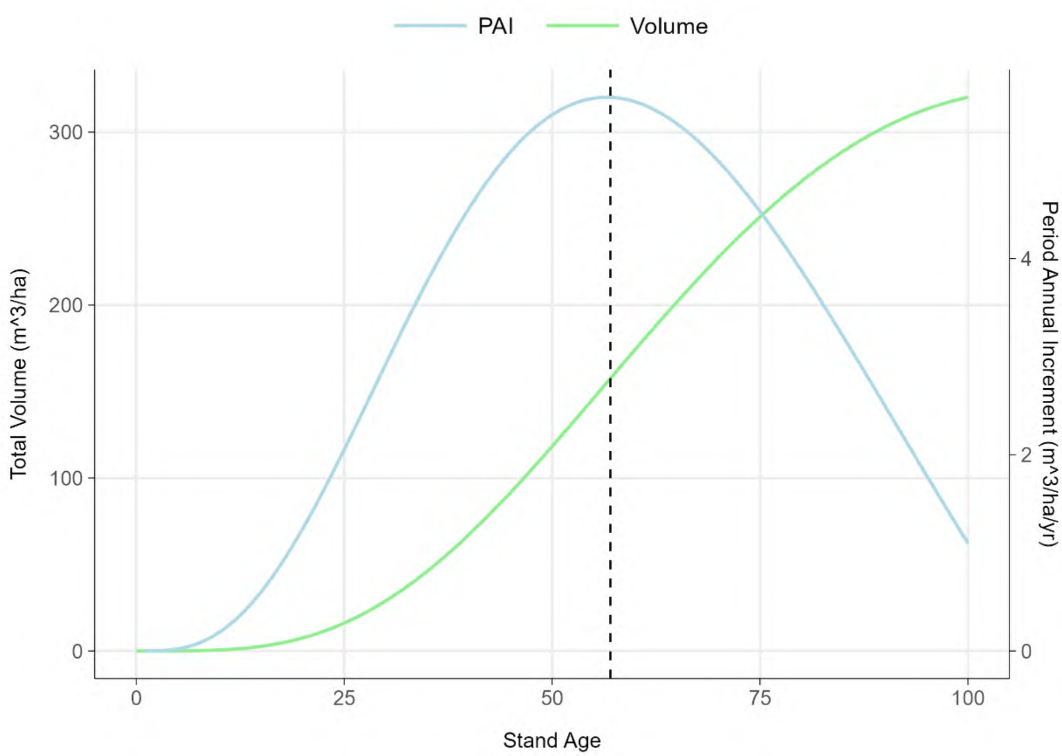

Figure 3-1. Relationship between total volume and period annual increment for the natural stand pine curve.

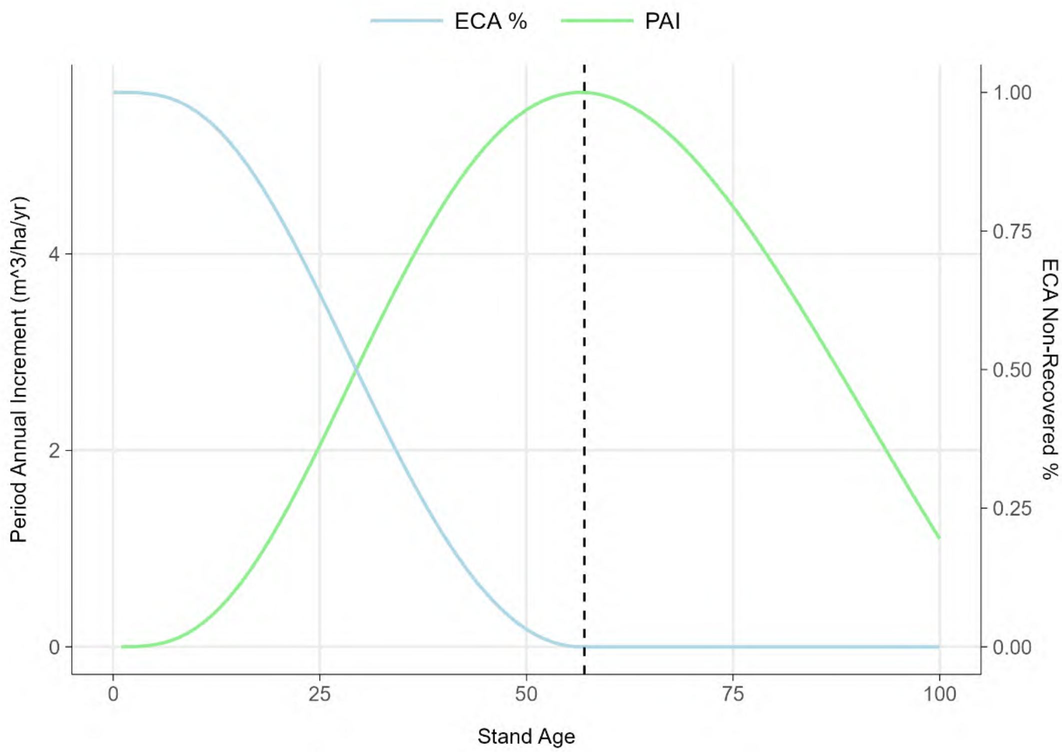

Figure 3-2. Example of ECA curve from the natural stand PL curve.

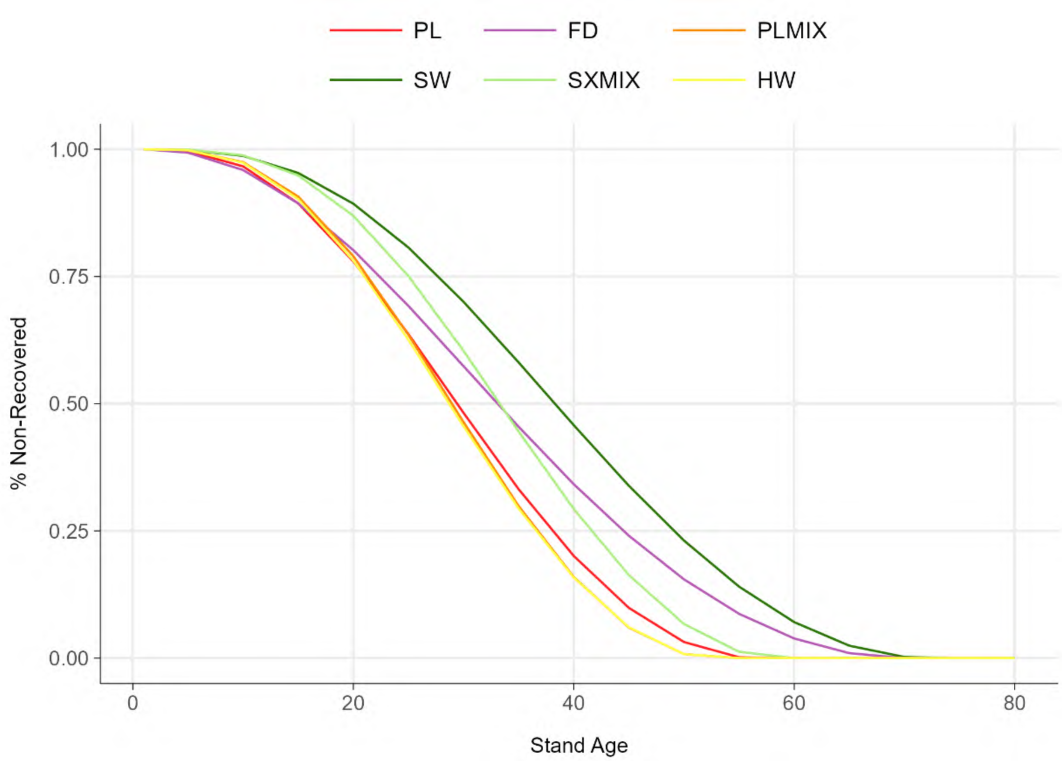

Figure 3-3. All ECA curves for all strata.

Reporting for watershed ECA values is by watershed, and for all watersheds in total. The total ECA value (∑(curve value * stand area)) for each watershed is divided by the total area of each watershed. The result is a percentage, where a lower percentage represent watersheds with older forest, and a larger percentage represent watersheds with young forests. These percentages are then classified into the three classes:

1. Less than 30%;
2. Equal or greater than 30% and less than 50%; or
3. Equal or greater than 50%.

These categories are used to compare between scenarios and evaluate watershed condition over time.

3.3 GoA ECA Assessment

The GoA WHA required inputs are:

1. Watershed layer with watershed ID;
2. Disturbance spatial layer – originating with net Landbase and SHS; and
3. Non-recovered percent lookup table (i.e. yield curve) – with lookup key based on yield strata and region where required with values by stand age.

A large part of the assessment for the GoA application is compiling the disturbance dataset. An overview for the GoA ECA Assessment is provided in Figure 3-4.

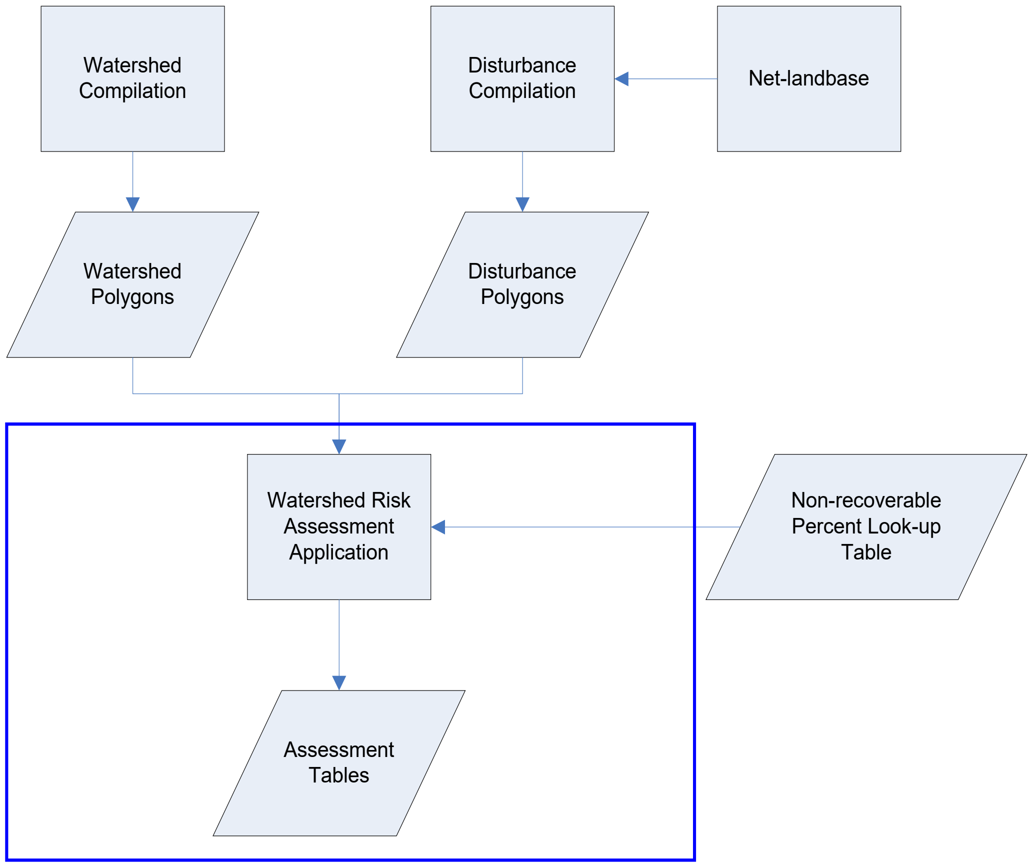

Figure 3-4. GoA watershed assessment data preparation

The watershed layer is incorporated into the net landbase. Watershed ID number is carried forward into the net landbase so that all data can be summarized by watershed ID.

The disturbance layer is the net landbase with the required fields assigned. Within the WHA application, the non-recovered percent lookup table is used during the iterative process to assign values over time. The disturbance layer includes the disturbance date, which is used with the lookup table.

3.3.1 Snow Sensitive Zones

The GoA also identified Snow Sensitive Zones for this FMP, which are areas that contribute the most to snowmelt runoff at the time of peak annual streamflow. For polygons overlapping these zones, the ECA curve is multiplied by 1.5 (i.e. starting at 1.5, and returning to 0 at the same age as the normal ECA curve). This is implemented using an *eca_factor* field in the modelling landbase and Patchworks, that is set to either 1 or 1.5 depending on whether or not the polygon is within a snow sensitive zone.

3.4 Patchworks ECA Assessment

The data preparation for the ECA assessment built into Patchworks is shown in Figure 3-5. The non-recovered percents are yield curves that are incorporated into Patchworks. The watershed boundaries are incorporated into the TSA landbase and used in Patchworks with an ECA value output created for each polygon which is exported for each period of interest.

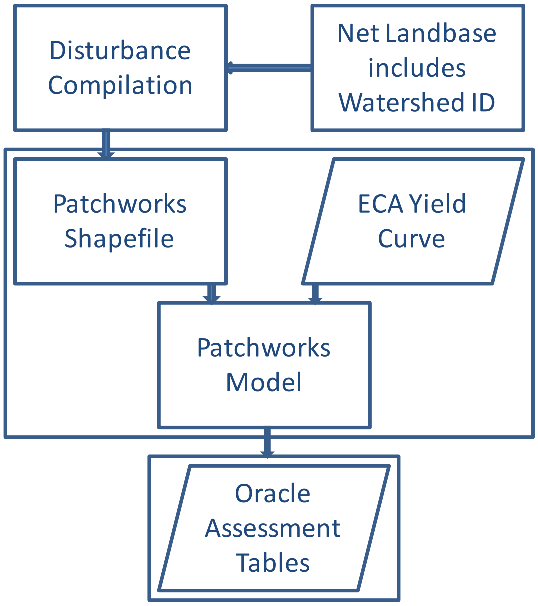

Figure 3-5. CFP watershed assessment data preparation.

3.5 Outputs

The GoA WHA application produces two main output tables:

1. Watershed Hazard Assessment table with a non-recovered percent value for each watershed for each assessment period and
2. Watershed Maximum Assessment table with the maximum non-recovered percent for each watershed with its associated assessment period.

These tables can then be used to link to the watershed spatial layer and be symbolized based on non-recovered percent. The tables are used to assess the critical period for each watershed.

3.6 Difference Between GoA and Patchworks Assessment

The main difference in watershed hazard assessment is that the GoA application requires and uses fields assigned to the disturbance layer and the recovery lookup table whereas the Patchworks model uses a set of yield curves. The GoA application does the calculations and outputs two main summary tables for non-recovered percents by watershed. The Patchworks model uses the yield curve to assign non-recovered percents to each polygon and the outputs are reported by polygon for each period of interest. The results are then summarized by watershed.

4 Timber Supply Analysis

This section outlines the scenarios and sensitivity analysis examined in the lead up to the PFMS. It includes scenarios completed in Patchworks. Sensitivity analyses were completed using different inputs assumptions such as landbase versions. For this reason, these results are not intended for direct comparison with the PFMS but reviewed within the appropriate context.

4.1 Model Parameters

The model parameters are summarized in Table 4-1.

Table 4-1. Summary of model parameters for the Patchworks model.

Parameter	2025 FMP
1. DFA	FMU C5 Boundary
2. Modelling platform	Patchworks
3. AAC Effective date	May 1, 2025
4. Landbase	lb_20241107_mdl
5. Planning Period	
• Horizon	200 years
• Period length	5 years
6. Objective	Maximize Conifer AAC
7. Accelerated Cut	N/A
8. Flow Constraints	Even flow ± 5%.
9. Operability Criteria	
• Min harvest age	80 years – all strata (ensures a minimum harvest m^3/ha)
• Height	N/A
• Species	No SB or SBHW strata
10. Utilization Standard	Coniferous 15/11/30, Deciduous 15/10/30 4.88 MML
11. Lifespan	350 years
12. Transition	All stands return to their natural stand stratum, except for pine stands harvested in the bridging period, which transition to the post-95 pine curve.

Parameter	2025 FMP
	Reduced yields applied to “encroachment” polygons with alternative silvicultural treatments, where the post-harvest stand received an 85% yield reduction compared to the natural curve.
13. Regeneration delay	None
14. Cull deductions	Reduction applied in Forest Model/xml (1.23% C, 9% D)
15. Retention	17.5% for FD strata, 3% for all other
16. Growing Stock	Non-declining over the last 50 years of the planning horizon
17. Seral Stage[1] Constraints	Minimum levels of old/very old seral stage by strata
18. Caribou	N/A
19. MPB	No constraints in model
20. Adjacency Distance	None
21. Green-up length	None
22. Min block size	Avoid blocks < 2 ha. Control distribution across other size classes.
23. Max block size	N/A
24. Block size distribution target	Majority in 20-150 ha
25. Interior Old Forest	Include as proxy in PW.
26. Watershed analysis	ECA included in Patchworks. All watersheds constrained to < 30% ECA disturbance.
27. Non-timber Values	3 songbirds (brown creeper, ovenbird, and varied thrush), Marten, and Clarks Nutcracker included in PW. Barred Owl and Grizzly Bear completed post-modelling.
28. Compartment Sequencing	Used to control for operational concerns
29. Include Roads	Yes

4.2 Bridging Period

When running a timber supply model, there is a gap in time between when the landbase is built and when the plan actually starts. For CFP this gap, or “Bridge Period”, is two years. The amount of harvest area scheduled for harvest in the bridge period is required to provide enough volume to satisfy all of the volume commitments for the FMA holder, quota holders and the community timber program (CTP).

When plan development is initiated, all of the harvest blocks are planned and then as the plan is developed many of these planned blocks are replaced by actual blocks. As the plan nears completion, there will always be a certain percentage of the bridge period blocks that are still planned.

CFP has applied for and received carryover volume to be harvested in the first 5 years of the new SHS. This carryover volume will not be included in the bridge period volume.

This section is intended to describe the volume commitments by operator that are included as actual and planned blocks for May 2023 to May 2025, and for each of the first two decades of the PFMS.

4.3 Quota Holders and CTP

The volume allocations and scheduled volumes for Quota Holders and CTP are presented in Table 4-2. The columns 'Decade 1' and 'Decade 2' outline the volume allocated in the SHS to the first two decades of the PFMS. While there are two quotas present (CTQC050002 and CTQC050005), they have the same owner and operator and are thus grouped for SHS and volume assignment. The volumes are derived from the SHS using the 'operator' field to summarize the operator, and the decade field to define the SHS harvest decade.

Table 4-2. Quota Holder and CTP volume allocations and scheduled volume.

Quoata Holder / CTPP	Scenario 9007 Scheduled 2023-2024	Decade 1 (2025-2034)	Decade 2 (2035-2044)	Requirements / Decade
793128 Alberta Ltd. (CTQC050002) 770538 Alberta Ltd. (CTQC050005)	24,737	125,419	125,424	125,424
CTPP	1,565	129,168	129,168	129,168

4.4 Crowsnest Forest Products

The CFP volume allocations and scheduled volumes are presented in Table 4-3 in a similar format.

Table 4-3. CFP volume allocation and scheduled volume.

FMA Holder	Scenario 9007 Scheduled 2023-2024	Decade 1 (2025-2034)	Decade 2 (2035-2044)	Requirements / Decade
Crowsnest Forest Products (FMA 2100047)	356,800	1,825,038	1,825,404	1,825,408

4.5 Scenarios Explored During Development of the PFMS

Numerous scenarios were completed in the timeline leading up to the PFMS. Many of the early scenarios tested the impact on harvest level of controlling various targets. These included scenarios exploring the impacts of the following:

- Harvest patch size constraints
- Douglas-fir harvest strategies and levels
- ECA constraints
- Steep slope constraints

- Carryover volume
- Wildfire risk reduction
- Old growth seral stage constraints
- NTA constraints

Many of these scenarios were completed on landbases developed before the AIP landbase, and on earlier versions of the Patchworks model. The exact metrics and results of all scenarios are not all comparable to the PFMS and will not all be presented here. Once the PFMS was completed, required or selected sensitivity analyses were re-run and their results are presented in this annex.

Once the landbase was complete and Agreed-To-In-Principle (AIP), much of the analysis turned to making an operationally feasible SHS. This involved many scenarios where parameters such as patch sizes and road optimization were tested with repeated review by CFP forest operations staff. The final series of scenarios focused on achieving a balance of harvest levels and NTA outputs.

4.5.1 PFMS Development and Sensitivity Analyses

The final scenarios to develop the PFMS were focused on operational concerns for the 20-year SHS.

The scenarios initially focused on generating balanced small, medium and large profile timber classified by piece size to meet sawmill operating requirements. From there, several iterations of modelling were completed with various weighting on harvest patch size targets and road cost targets to generate concentrated harvest block patterns. Then the ops team manually selected specific polygons, from the various iterations that met their operations objectives of having concentrated 1 pass system patterns, where possible. These concentrated patches are required to support the 100% reclamation of forestry roads in support of species at risk, biodiversity (maximizing patch sizes) and watershed objectives.

The selected polygons from the different runs were then joined manually and hardcoded to provide the draft initial PFMS. This initial PFMS was then tested with NTA models and was modified to balance desired operational objectives with acceptable NTA outcomes.

4.5.1.1 Sensitivity Analysis

Five sensitivity analyses were completed to compare the final PFMS with specific circumstances. These scenarios, along with the PFMS are described below.

PFMS (9007)

The chosen PFMS (scenario 9007) aims to achieve a balance between harvest levels and NTA targets, while having an operationally feasible 20-year SHS.

Achieve Minimum Levels of Non-Timber Assessment (NTA) targets (9002)

This scenario assesses the impact of achieving the maximum of 15% reduction in the NTA targets. Constraints were applied to prevent the varied thrush, marten, and ovenbird from declining below the 15% threshold compared to year 0. Since the varied thrush and marten prefer mature conifer forest, there is a direct trade-off between the habitat and harvest levels. As the ovenbird is most abundant in deciduous stands 40 – 100 years old, there was no even-flow constraint for deciduous harvest applied to this scenario, to allow the model to achieve the NTA objectives while not controlling deciduous harvest.

Achieve GOA Recommended Targets for Old Growth Seral Stage (9004)

The Government of Alberta has identified a provincial strategy to setting old and very old seral stage targets, based on the natural range of variation[1]. The GOA recommends that seral stage targets be set at the 25th percentile (Q25) of the natural range of variation for the associated natural subregion for the gross landbase, and to 3% less than Q25 for the contributing landbase. While the DFA primarily covers, the Montane and Subalpine, the NRV outputs for these natural subregions are not well validated. For this reason, the reference level from the Upper Foothills natural subregion is used instead, which is 24.8% for the gross landbase (Q25) and 21.8% for the contributing landbase (21.8%). This is shown in Table 4-4.

Table 4-4. Seral stage reference levels for the Upper Foothills, Montane, and Subalpine natural subregions.

Natural Subregion	Min	NRV Reference for Net Landbase (Q25 - 0.03)	NRV Reference for Gross Landbase (Q25)	MED	Q75	Max
Upper Foothills	18.8%	21.8%	24.8%	28.4%	32.3%	41.7%
Montane[1]	17.0%	28.8%	31.8%	33.6%	41.8%	52.6%
Subalpine[1]	32.8%	36.2%	39.2%	43.0%	46.5%	56.3%

[1] Montane and Subalpine NRV outputs are not well validated, and the Upper Foothills levels are used instead.

In this scenario, old growth levels on the contributing landbase were constrained to remain above 21.8% for strata other than Douglas-fir, and above 28.5% (Montane reference level) for Douglas-fir.

Structure Retention (9008)

The PFMS uses 3% structure retention for all strata other than Douglas-fir (Fd), and 17.5% for the Fd strata. This scenario evaluates the impact of changing the structure retention to 5% for non-Fd strata. The 200-year harvest sequence are identical between this scenario and the PFMS.

Deciduous Harvest (9006)

While there is currently no deciduous allocation in C5, all scenarios modelled a small amount of deciduous harvest to account for incidental deciduous due to road building and slivers harvested from the deciduous landbase. Scenario 9006 had the identical harvest from the conifer landbase as the PFMS while modelling a higher level of even flow level of deciduous harvest. This is done to provide context to what a deciduous allocation could potentially be. As this scenario had identical conifer harvest to the PFMS, it is excluded from certain comparisons where the results would be identical (e.g. conifer harvest, conifer growing stock).

4.5.2 Sensitivity Analyses Results

4.5.2.1 Conifer Harvest Levels

Comparisons between the PFMS and other scenarios demonstrate that there are trade-offs between harvest levels and other values (Table 4-5 and Figure 4-1). Achieving the GOA recommended seral stage targets would

[1] Government of Alberta. 2025. Seral stage objective: A Guide for Forest Management Planning.

result in a 17.8% reduction in conifer harvest, while constraining the NTA species to avoid any declines > 15% compared to year 0 would result in a 6.8% reduction in conifer harvest compared to the PFMS. Increasing structure retention to 5% for strata other than Douglas-fir would result in a ~1.8% reduction compared to the PFMS.

Table 4-5. Primary conifer harvest volumes of sensitivity analysis scenarios with percentage change from the PFMS.

Scenario	Primary Conifer Harvest Volume (m^3/yr)					
	1-10 Years	%	11-200 Years	%	1-200 Years	%
9007 (PFMS)	207,963	0.0%	207,961	0.0%	207,961	0.0%
9004 (GoA Seral Stages)	171,000	-17.8%	171,000	-17.8%	171,000	-17.8%
9002 (Songbird / Marten Constraints)	195,002	-6.2%	194,974	-6.2%	194,975	-6.2%
9008 (5% Structure Retention)	204,525	-1.7%	203,950	-1.9%	203,979	-1.9%

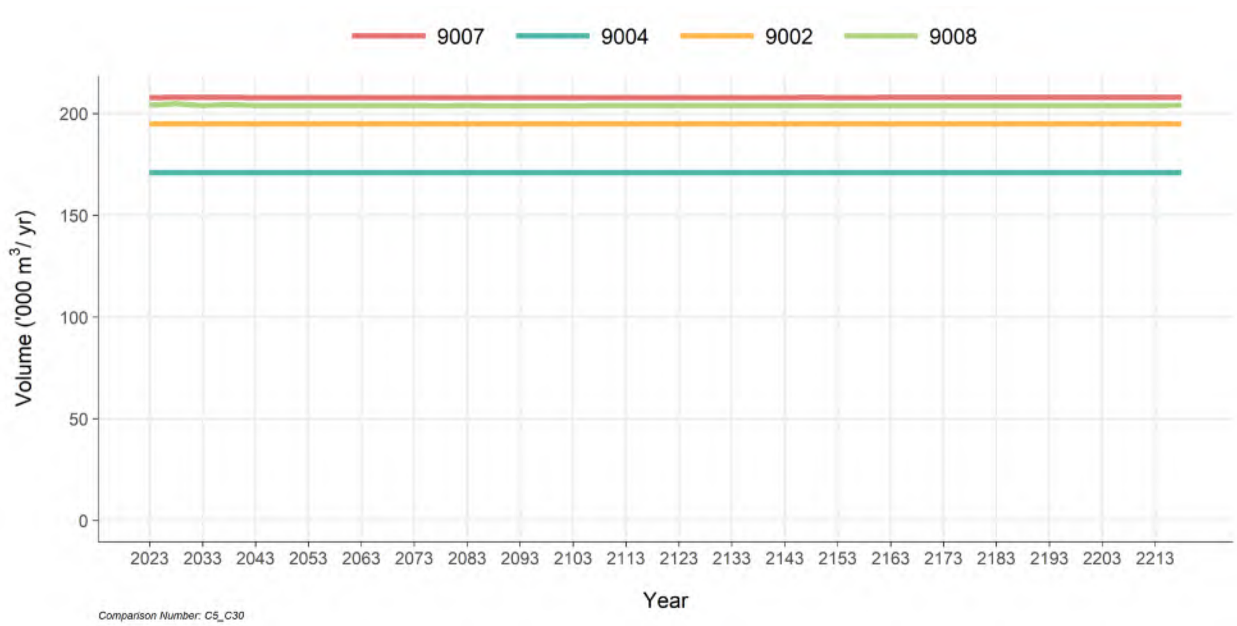

Figure 4-1. Comparison of primary conifer harvest volume.

4.5.2.2 Deciduous Harvest Levels

Deciduous harvest was generally not a focus of the TSA, as there is no deciduous allocation in FMU C5, and the deciduous harvest profile for scenarios 9007, 9004 and 9008 are identical. Scenario 9002 had no even flow constraint placed on deciduous harvest and demonstrates a variable rate of harvest the model used to avoid the ovenbird declining beyond < 15% from the initial level. Scenario 9006 which explored what a higher level of deciduous harvest could theoretically be, has an even flow deciduous primary AAC of 11,000 m^3/yr.

Table 4-6. Primary deciduous harvest volumes of sensitivity analysis scenarios with percentage change from PFMS.

Scenario	Primary Deciduous Harvest Volume (m^3/yr)					
	1-10 Years	%	11-200 Years	%	1-200 Years	%
9007 (PFMS)	2,000	0.0%	2,002	0.0%	2,002	0.0%
9004 (GoA Seral Stages)	2,000	0.0%	2,000	-0.1%	2,000	-0.1%
9002 (Songbird / Marten Constraints)	3,085	54.3%	7,098	254.5%	6,897	244.5%
9008 (5% Structure Retention)	1,959	-2.1%	1,970	-1.6%	1,970	-1.6%
9006 (Increase Deciduous Harvest)	10,999	450.0%	10,999	449.4%	10,999	449.4%

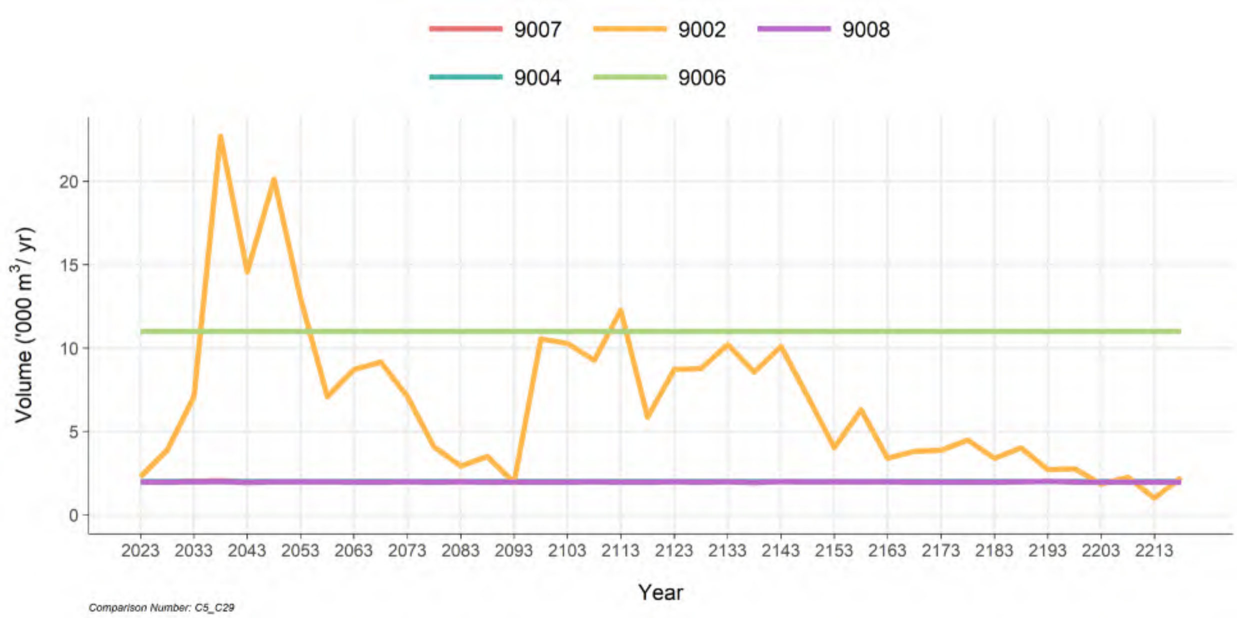

Figure 4-2. Comparison of primary deciduous harvest volume.

4.5.2.3 Other Harvest Metrics

Scenario 9004 has less harvest area than the PFMS in order to meet the GOA old growth seral stage targets (Figure 4-3). Scenario 9002 has more variable harvest areas due to the lack of an even-flow constraint on the deciduous landbase, and scenario 9006 has the most harvest area due to the higher harvest levels on the deciduous landbase. All scenarios generally have a similar average harvest age for the conifer landbase, which is generally 125 – 150 years old for the first 50 years, after which it declines to ~ 95 – 100 years old for the last 100 years of the planning horizon (Figure 4-4). Average deciduous harvest age generally increases through the planning horizon, except for scenario 9006 which stabilises at ~100 years old for the last 100 years

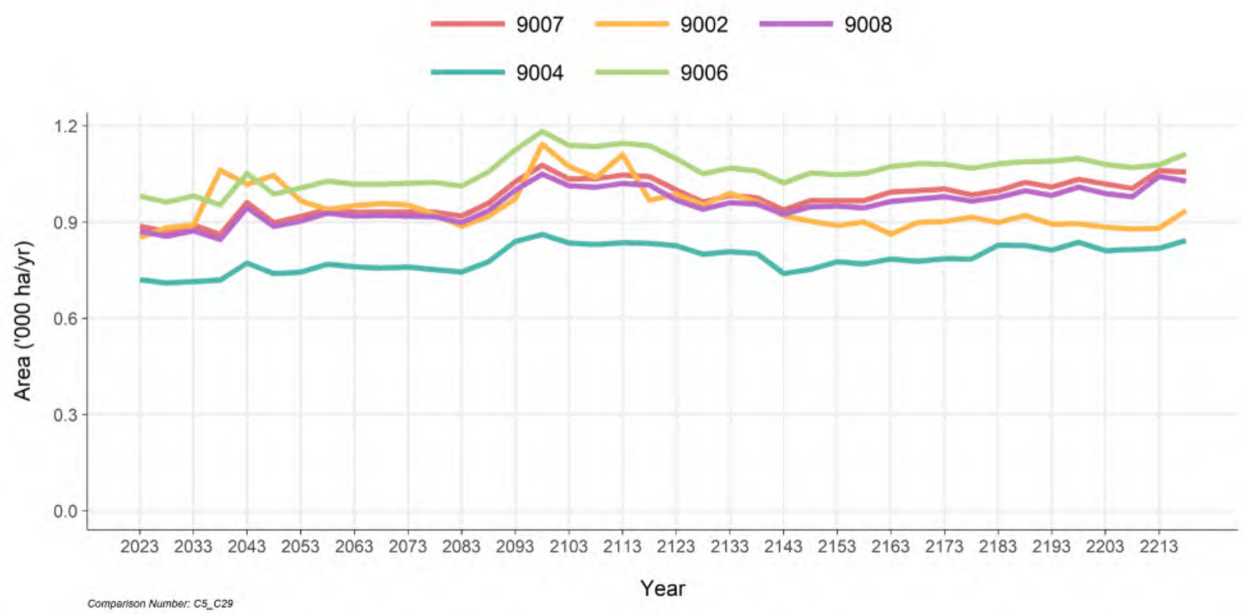

Figure 4-3. Comparison of harvest area.

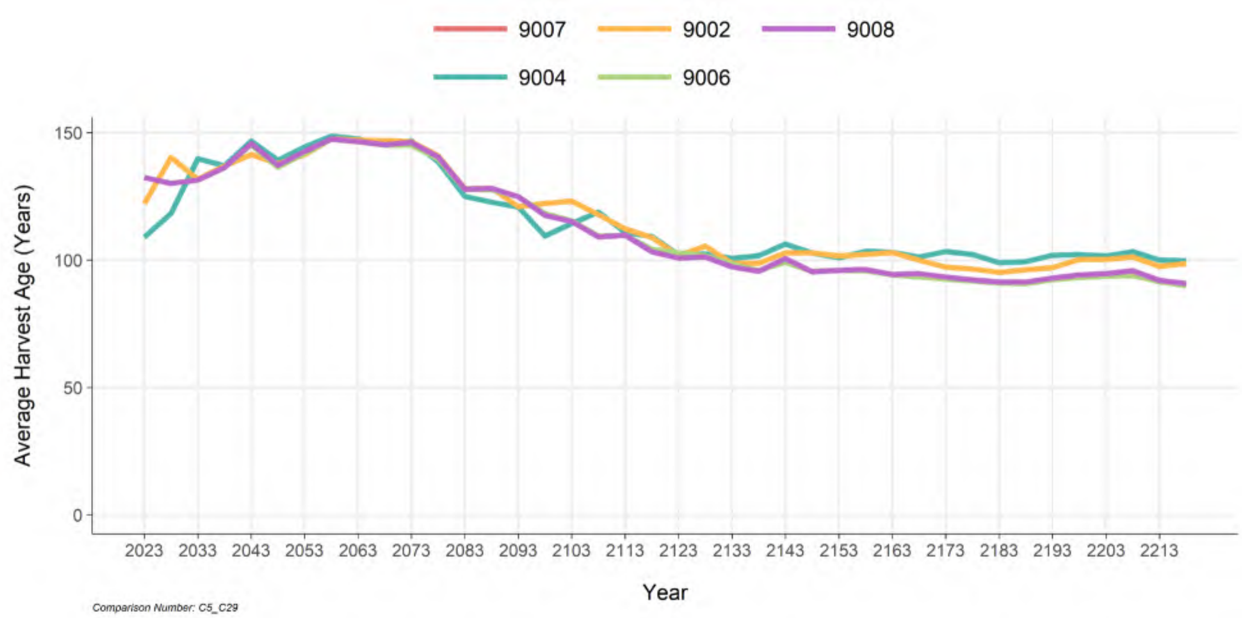

Figure 4-4. Comparison of harvest age (conifer landbase).

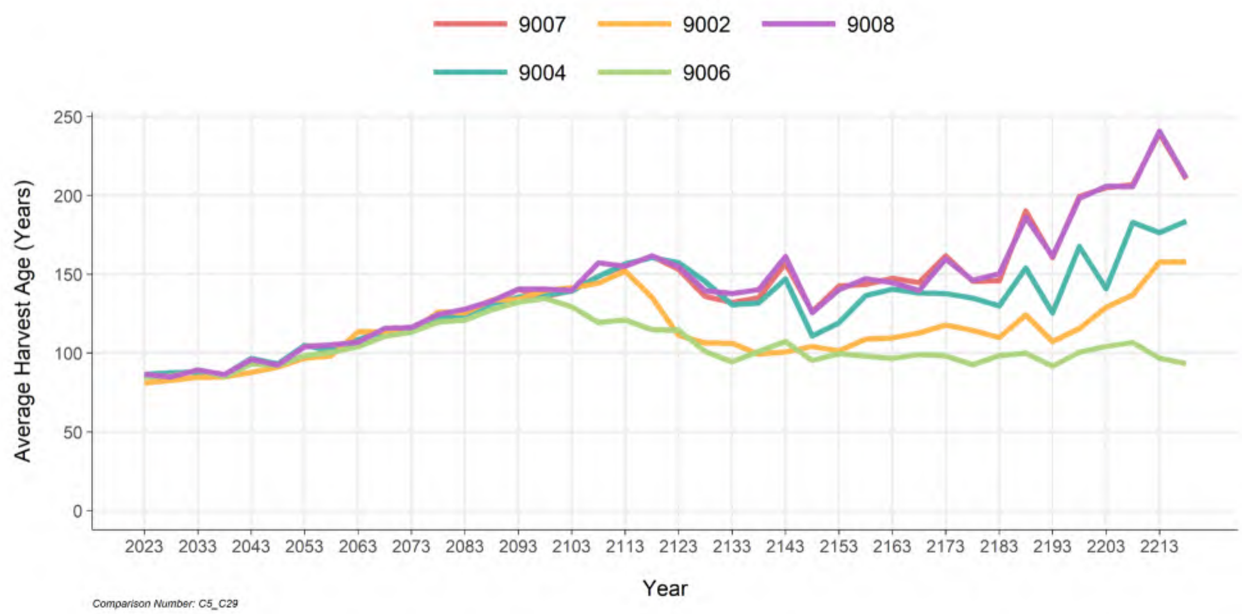

Figure 4-5. Comparison of harvest age (deciduous landbase).

4.5.2.4 Growing Stock

The operable conifer growing stock is higher for 9002 and 9004 due to the reduced harvest levels compared to the PFMS (Figure 4-6). All scenarios had a non-declining conifer growing stock constraint placed on the last 50 years of the planning horizon.

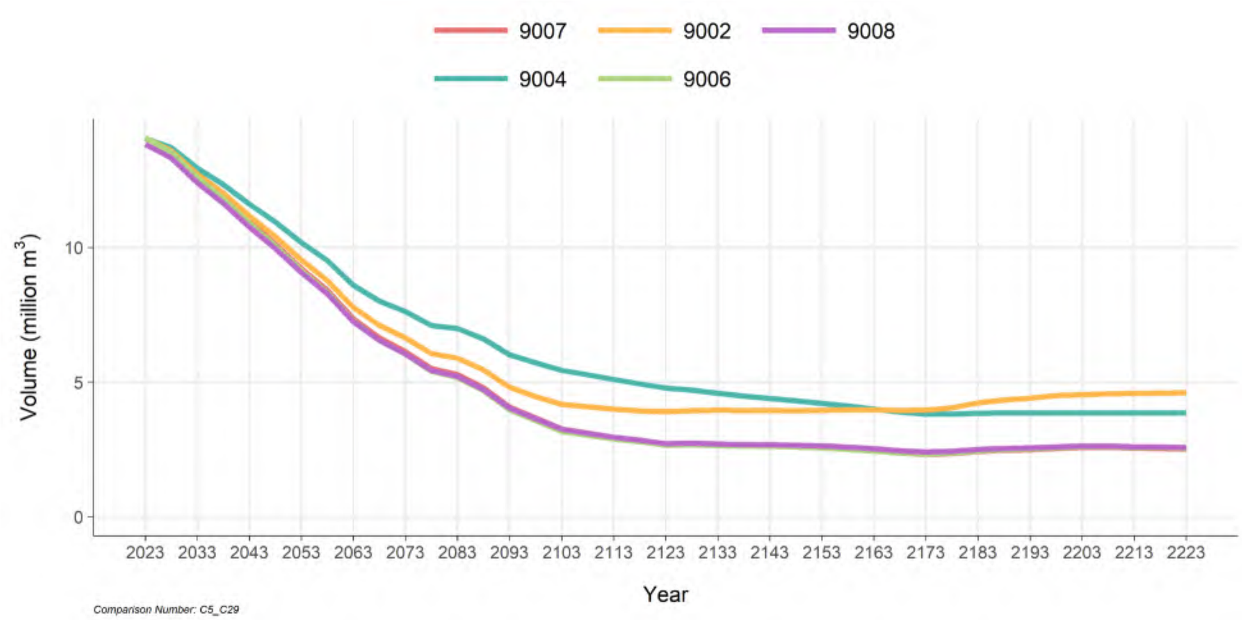

Figure 4-6. Comparison of operable conifer growing stock.

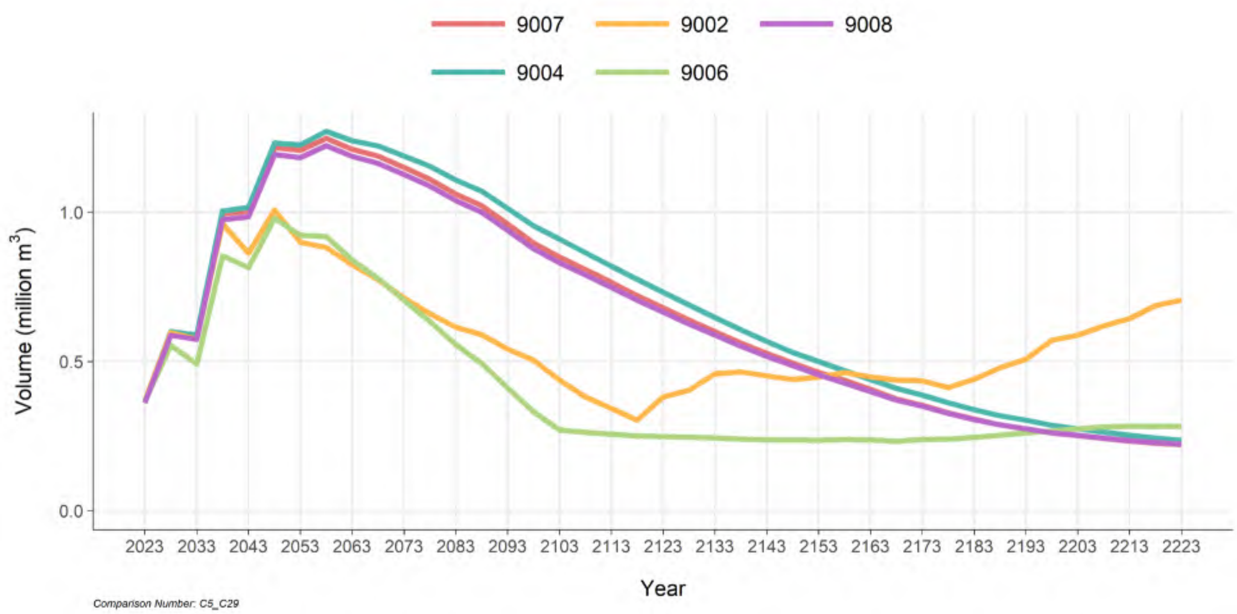

Figure 4-7. Comparison of operable deciduous growing stock.

4.5.2.5 Seral Stage and Interior Old Forest

Figure 4-8 and Figure 4-9 display the proportion of old and very old forest on the contributing and gross landbase for each scenario, in comparison to the GOA reference levels. Scenario 9004 has the highest old growth levels on the contributing landbase, as it was constrained to meet the GOA recommended targets. Scenarios 9007, 9008, and 9002 all have similar levels of old growth at the end of the planning horizon. Scenario 9006 has the lowest level of old growth due to the higher harvesting of the deciduous landbase. Old growth on the gross landbase and interior old forest display a similar pattern between scenarios (Figure 4-10), with 9004 having the most and scenarios 9002 and 9008 being very similar to the PFMS. As scenario 9004 was constrained such that each individual cover group was above the NRV threshold, the overall area of old growth is closer to 30% due to the underutilisation of deciduous (which is much higher), while other cover groups are closer to the NRV threshold.

A separate analysis of the natural range of variation of seral stages and old growth specific to FMU C5 was completed and is included in Appendix I. This analysis determined that the median NRV old growth percentage for the DFA is ~25%, with Q12.5 at 18% and Q87.5 at 38%. While some scenarios are below the Q12.5 on the contributing landbase, all are well above the median and most are above the Q87.5 threshold on the gross landbase.

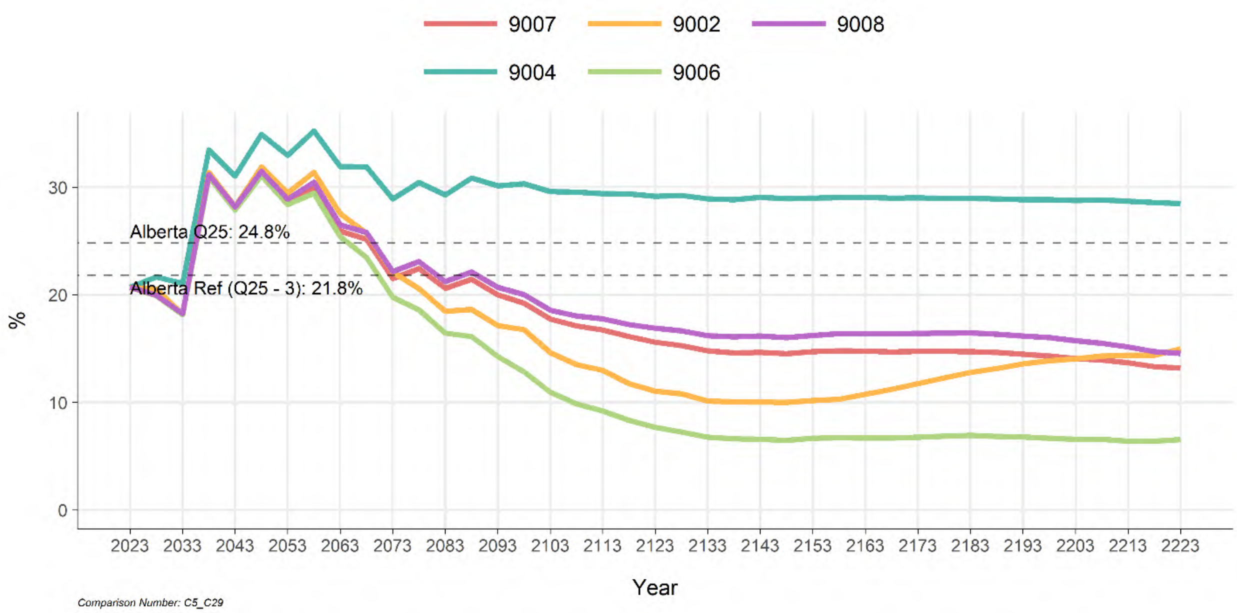

Figure 4-8. Comparison of old / very old seral stage on the contributing landbase.

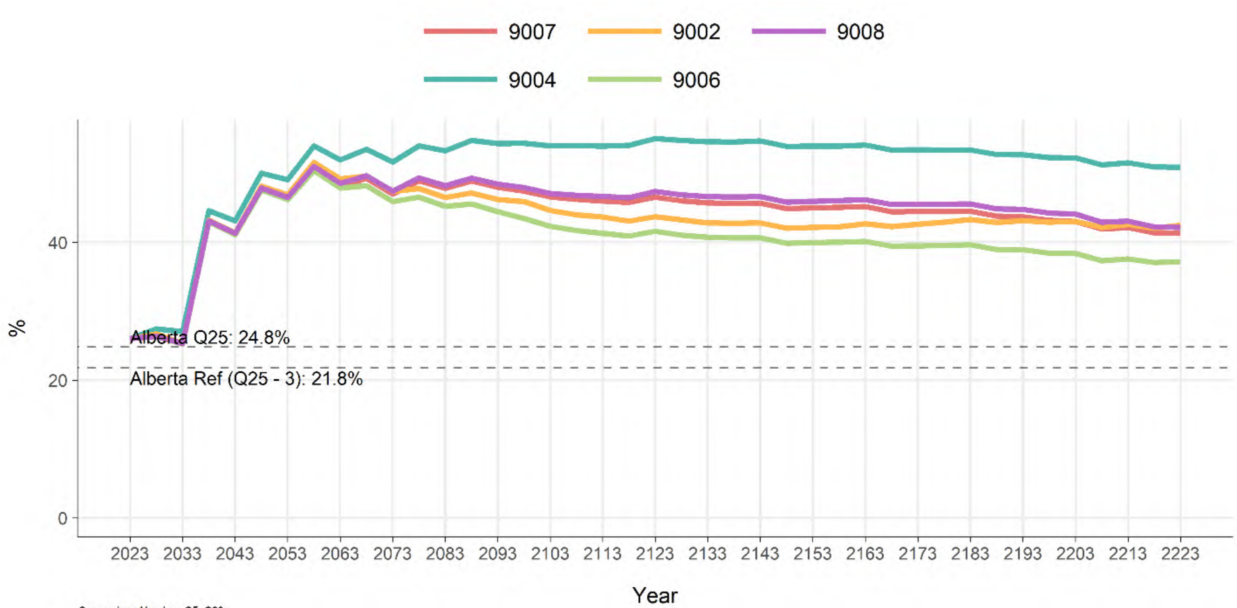

Figure 4-9. Comparison of old / very old seral stage on the gross landbase.

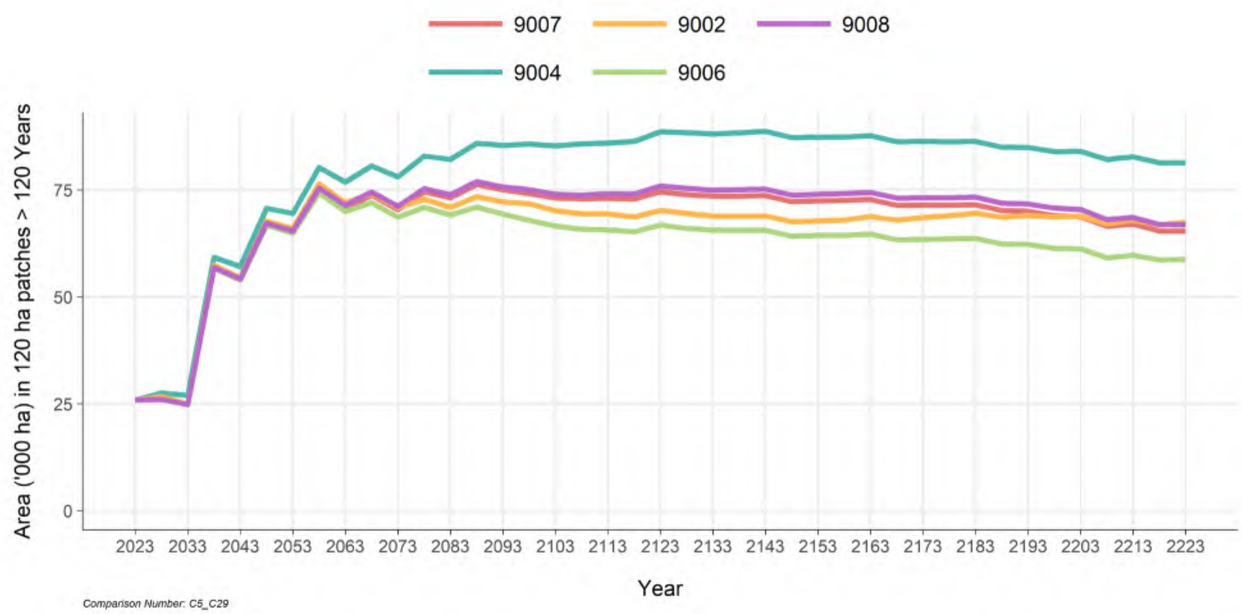

Figure 4-10. Comparison of interior old forest.

4.5.2.6 Songbirds and Marten

Brown creeper relative abundance generally remains at or above the initial level for all scenarios (Figure 4-11). Ovenbird decreases to 15-20% below initial levels for scenarios other than 9002 and 9006, where higher levels of deciduous harvest were modelled (Figure 4-12). Varied thrush relative abundance displays a steady decline throughout the planning horizon for all scenarios, with the PFMS and scenarios 9006 and 9008 dipping below the 15% threshold in the last 50 years (Figure 4-13). Marten habitat suitability declines in the first 50 years for all scenarios, followed by a relative steady period, and another period of decline in the last 100 years with the PFMS and scenarios 9006 and 9008 dipping below the 15% threshold in the last ~80 years of the planning horizon (Figure 4-14). Clark's nutcracker relative abundance is generally fairly similar for all scenarios (Figure 4-15) as its abundance is the highest in stands with a five-needle pine component, nearly all of which is outside of the contributing landbase.

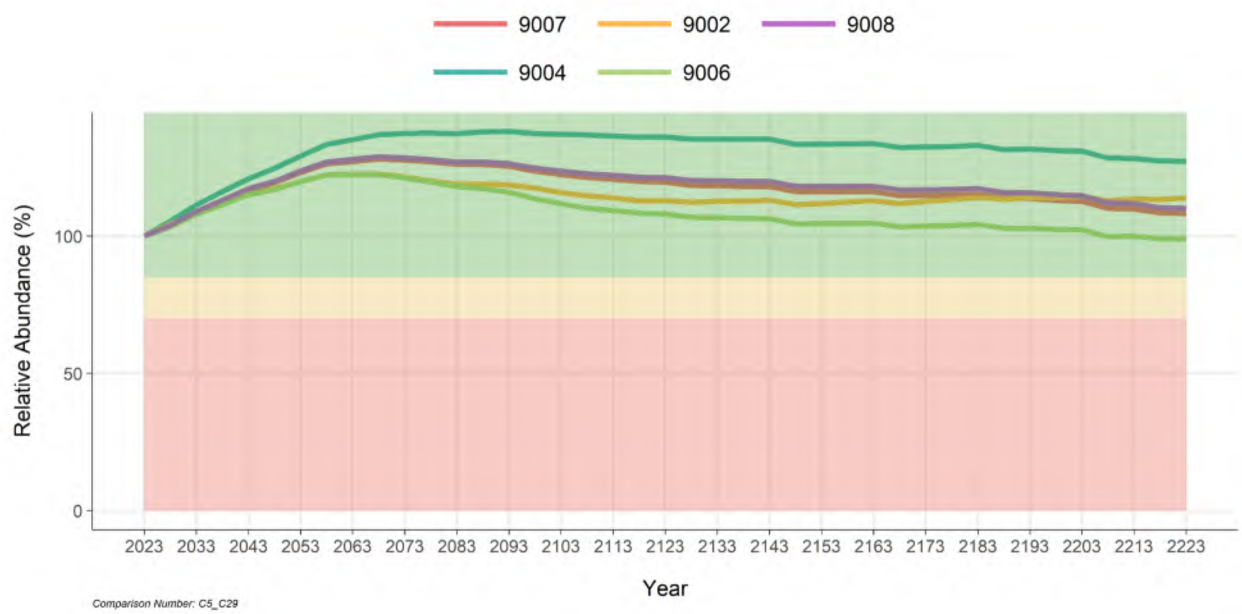

Figure 4-11. Comparison of brown creeper relative abundance.

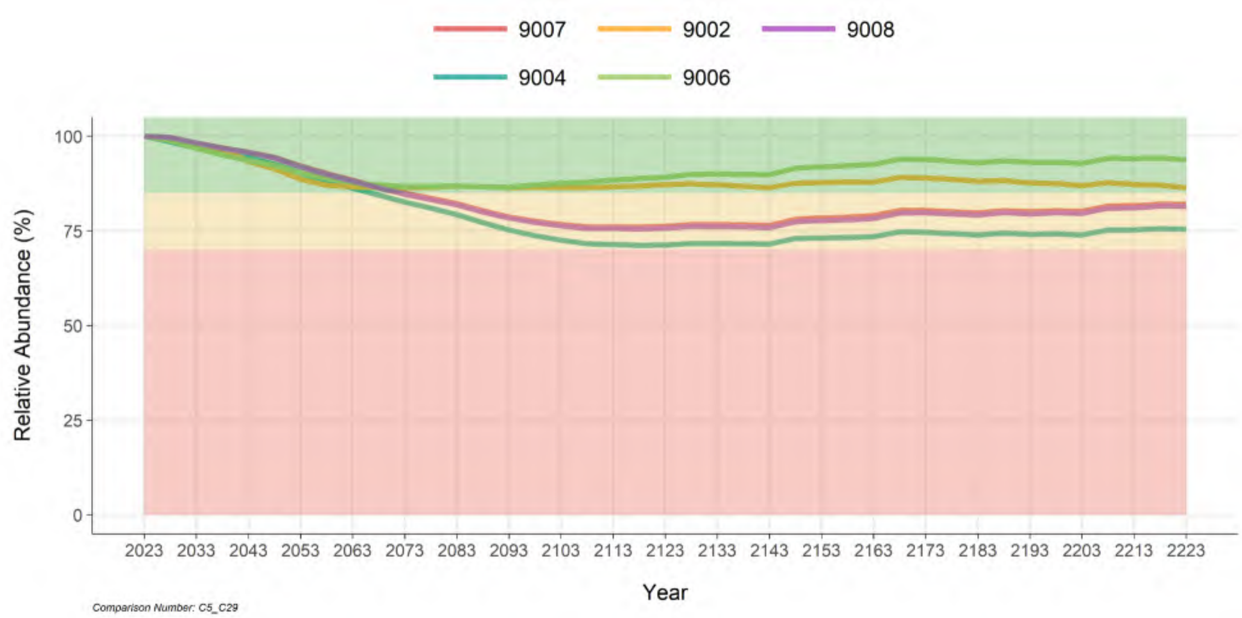

Figure 4-12. Comparison of ovenbird relative abundance.

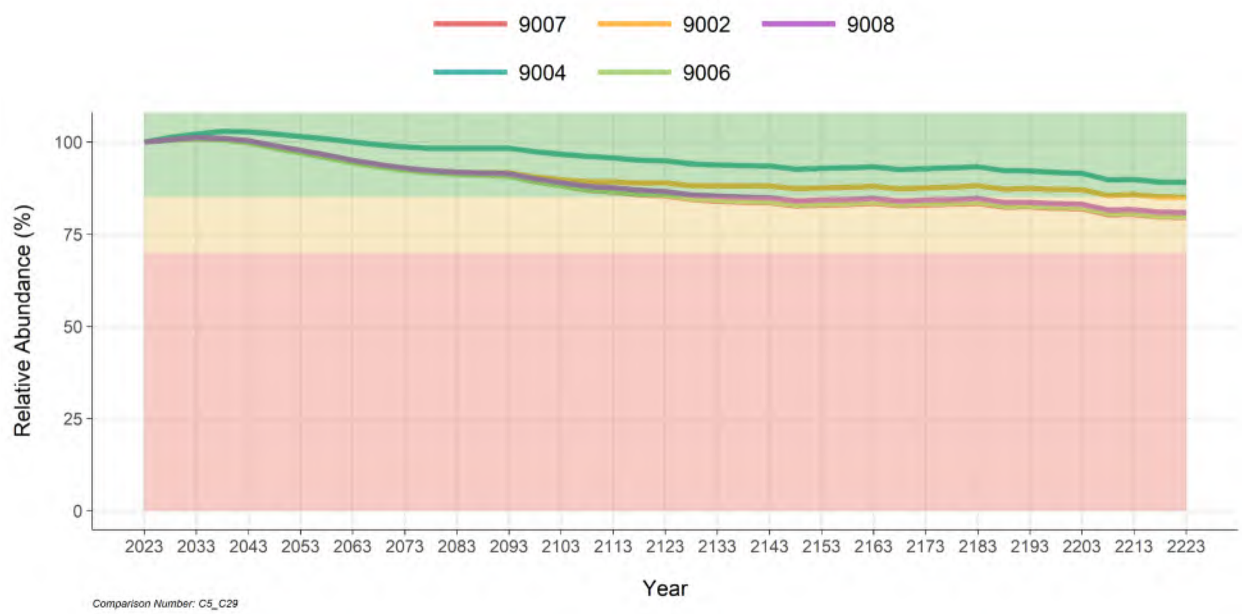

Figure 4-13. Comparison of varied thrush relative abundance.

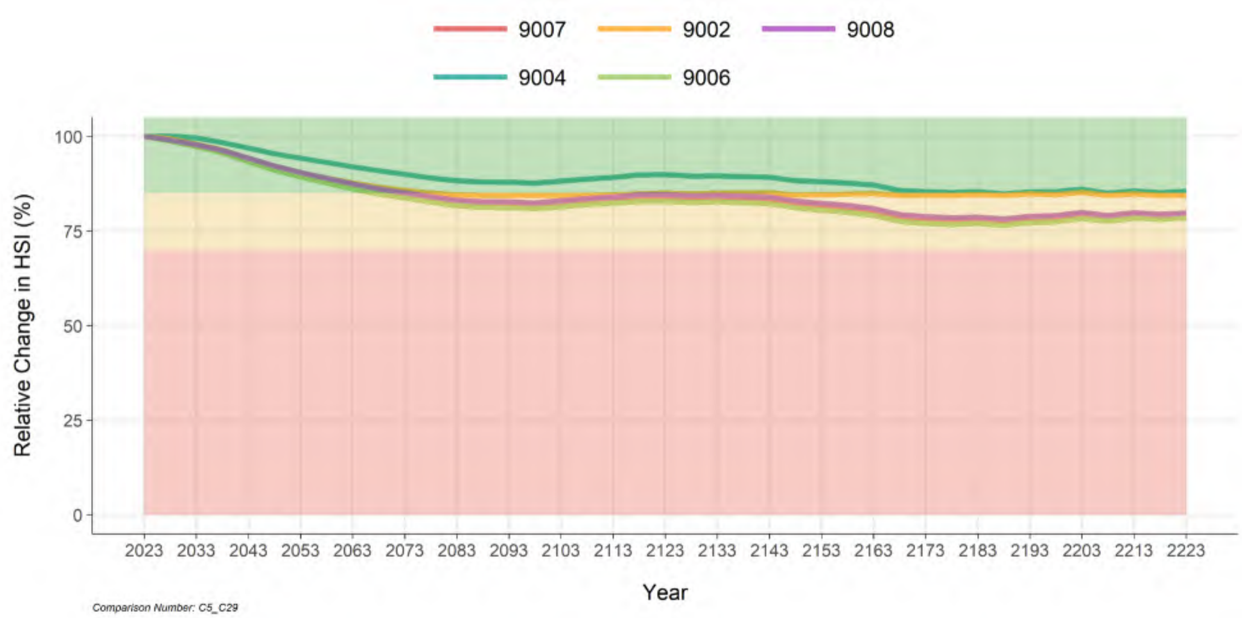

Figure 4-14. Comparison of marten habitat suitability index.

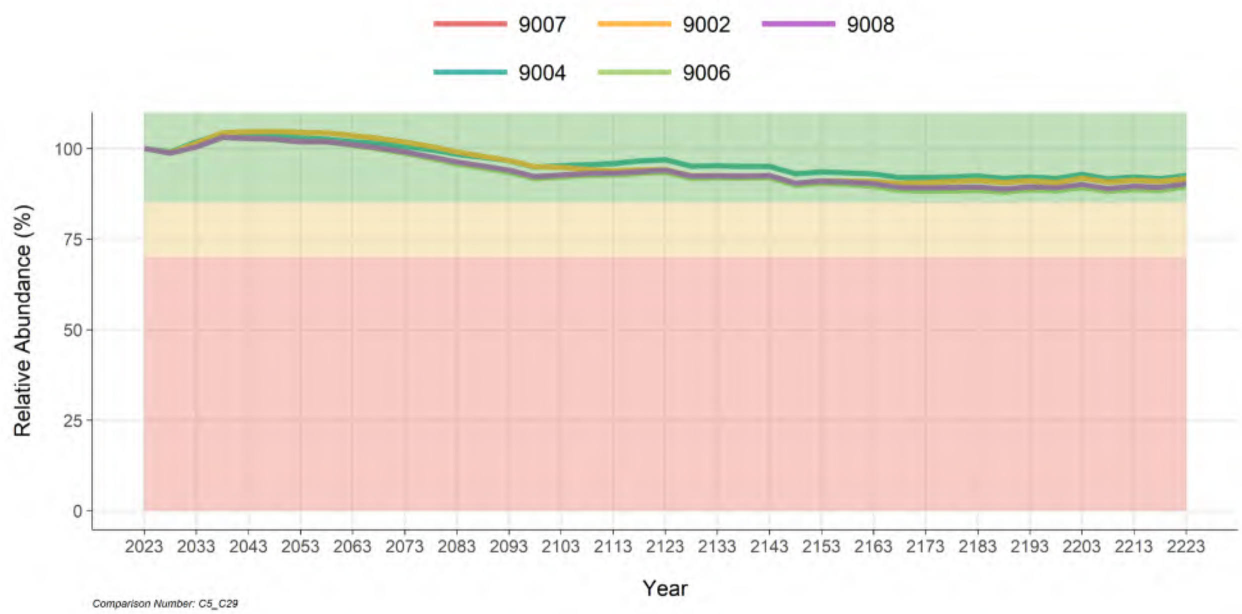

Figure 4-15. Comparison of Clark's nutcracker relative abundance.

4.5.2.7 Equivalent Clearcut Area

All scenarios were generally constrained to have attempt to avoid having any watersheds with ECA > 30%, which is achieved for all scenarios except for 9006. The watersheds with ECA > 30% at in the first two decades are due to the Lost Creek wildfire (Figure 4-16).

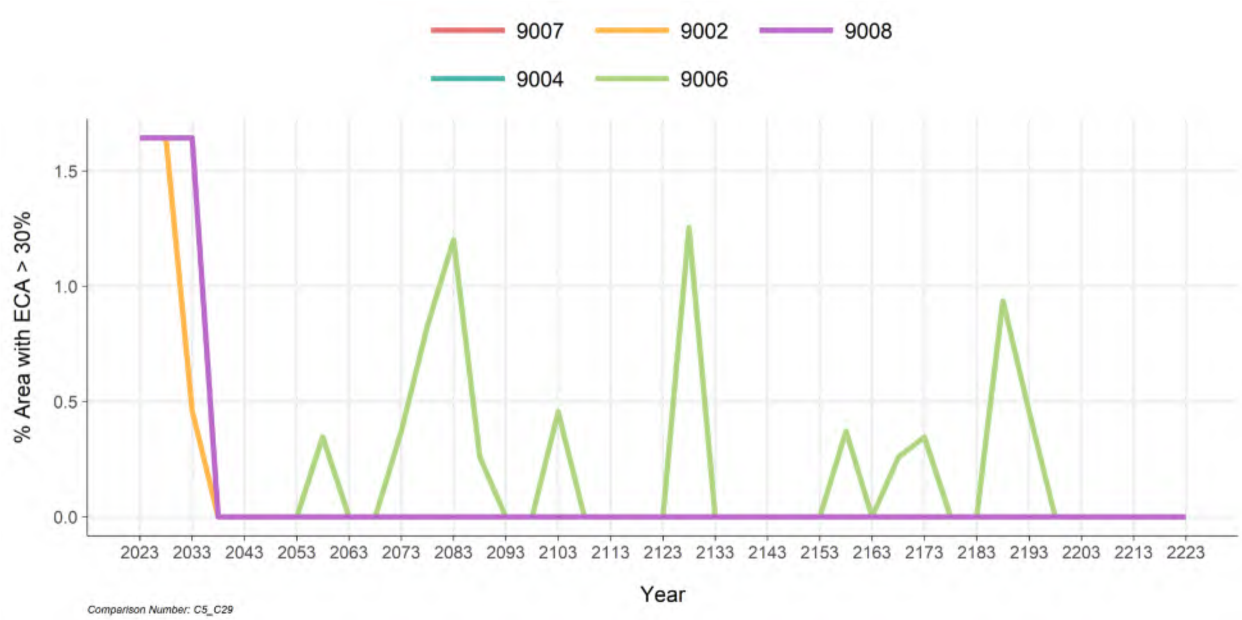

Figure 4-16. Comparison of ECA.

5 PFMS Datasets

The input and output datasets used in the Patchworks model are described in this section. The datasets are only included in the submission to GoA technical review staff.

5.1 Patchworks

5.1.1 Analysis Directory

The analysis directory contains much of the model formulation input files.

zAnnexVI_TSA\Patchworks\Round9\analysis

The pin file controls the formulation of the model. It determines the input files, the patch targets and the length of the planning horizon. It uses the information in the 'tracks' directory.

- **CFP_FMP_round9.pin**

Forest Model – an excel spreadsheet that defines the majority of the yield curves and actions within the model.

- **ForestModel_C5_FMP_round9.xlsm**

XML file – created from Forest model and used to generate base patchworks files

- **C5_FMP_round9.xml** – raw file generated from the forest model spreadsheet

5.1.2 Tracks

The files in the 'tracks' directory contain most of the information needed to open a Patchworks model.

- Accounts information – used to define summary targets
    - Protoaccounts.csv
- Base Patchworks files – system files to define the model matrix
    - Blocks.csv
    - Curves.csv
    - Features.csv
    - Products.csv
    - Strata.csv
    - Tracknames.csv
    - Treatments.csv
- Groups files - define groups to allow finer control of targets

- Groups.csv
- Other groups are created on the fly within the pin file

zAnnexVI_TSA\Patchworks\Round9\tracks

5.1.3 Landbase

The modeling landbase shapefile as used in the final PFMS is located in this directory.

zAnnexVI_TSA\Patchworks\Round9\landbase\lb_20241107_mdl.shp

The landbase directory contains the topology file – define the spatial distance of polygons from each other

- topology_5_100_all.csv – forested landbase – used for patches defining groups of blocks

5.1.4 Road Network

The road network is used to evaluate haul and road construction costs that are used to help the model aggregate harvesting. The files for this function are located here:

zAnnexVI_TSA\Patchworks\Round9\roads

5.2 Patchworks PFMS Outputs

5.2.1 Standard Patchworks Outputs

The standard Patchworks files produced when a scenario is saved are contained in this directory.

zAnnexVI_TSA\Patchworks\Round9\scenarios\9007\scenario

These are used when re-loading an existing scenario into Patchworks. The three files that are critical are;

- Schedule.csv – contains the timing and treatment of every action;
  - Schedule_operators.csv – is a modified schedule for the first 20 years which contains the operator for each harvested polygon;
- TargetStatus.csv – contains a list of targets that are being controlled; and
- TargetSummary.csv – contains the minimum and maximum values and weightings, as well as the achieved values for each target.

Calculation of AAC from model outputs can be done from the targetSummary.csv file. Using the *product.dfa.vol.managed.con.primary* target, the 200-year average (periods 2 to 41) divided by five to obtain the raw annual harvest level. This is then rounded to the nearest 100 m^3/year to arrive at the AAC.

5.2.2 Target Files

The files in this directory contain the same information as the targetsummary.csv file but are split into one file for each target.

zAnnexVI_TSA\Patchworks\Round9\scenarios\9007\targets

5.2.3 Future Forest Conditions

The files in this directory describe the future forest condition in every period of the model. These contain the information as required in section 5.10 in the Alberta Forest Management Planning Standard, Version 4.1.

zAnnexVI_TSA\Patchworks\Round9\scenarios\9007\Detailed Reports

5.2.4 Harvest Schedule

The files in this directory describe the harvested stands in every period of the model. These contain the information as required in section 5.11 in the Alberta Forest Management Planning Standard, Version 4.1.

zAnnexVI_TSA\Patchworks\Round9\scenarios\9007\Harvest_Schedule_5_11

5.2.5 Shapefile

This is the final SHS shapefile for the PFMS, including operator assignment for each block. Decade 0 refers to the bridging period in the model, and operators are only assigned for the bridging period and decades 1 and 2. Decades 3 onwards are all assigned to CFP.

zAnnexVI_TSA\SHS\CFP_SHS70_scn9009.shp

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Appendix I C5 NRV Report

FINAL REPORT

Understanding Historical Landscape Patterns on the C5 FMU Area in Alberta

Final Report

Bandaloop Landscape Ecosystem Services Ltd.

January 3, 2025

David W. Andison, Bandaloop Landscape Ecosystem Services Ltd.

Alex M. Chubaty, FOR-CAST Research and Analytics

Eliot J.B. McIntire, Canadian Forestry Service

DISCLAIMER

Any opinions expressed in this report are those of the authors, and do not necessarily reflect those of the organizations for which they work.

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We would like to thank Ian Eddy, Tati Micheletti, Ceres Barros, and Yong Luo for useful modelling and SpaDES discussions, help describing and documenting each of the SpaDES modules, as well as their code contributions to the R packages and SpaDES modules used in this project. We also thank John Wilmshurst for help in preparing some of the graphics and editing.

We also thank CFS and Compute Canada for computing resources.

More specifically to this project, we would like to thank West Fraser Timber Co. and FRIAA for their support.

CONTENTS

EXECUTIVE SUMMARY

This project was a spatial modelling exercise that created coarse-scale, pre-industrial landscape metrics for the C5 FMU area in Alberta. The primary goal was to understand if, or in what ways the current conditions of the FMU area align with the historical, pre-industrial "natural" range.

The C5 area was not part of the original formulation or calibration of LandWeb. It is also unique in terms of its geography and vegetation. For example, fire regimes change significantly over very short distances, part of the landscape experienced mixed-severity fire regimes, and the landscape includes some grassland ecosystems. Not only did the model have to be adapted multiple times to deal with the challenges, but a map of average long-term fire cycle (LTFCs) had to be created and used as new model input. In the end, it was not possible to fix or add all of the required new functionality within the resources of this project. The results presented are a mix of model output of the best functioning model version with a-spatial data from a simple negative exponential model.

The results suggest that this landscape is close to if not within its natural range, particularly given how active fire has been on this landscape historically. More specifically, although old forest levels are below the 12.5th percentile of NRV, the current condition data is almost 20 years old, and there is a large amount of mature forest, some of which will already be in the old class today.

The lack of young forest types is the only real concern ecologically. A large number of specialized species are dependent on disturbance, creating a smaller, but unique diversity peak in biodiversity within a few years after disturbance thanks to the sudden physical, chemical, and environmental changes. We know from other research that some parts of this landscape have experienced extremely high wildfire levels historically.

Lastly, it should be noted that the model was not able to capture partial severity fires, although we know from other research that these did occur in places. For this reason, and others, this landscape is an ideal candidate for the integration of wildfire and harvesting.

1.0 INTRODUCTION

The evolution of forest management in North America has been an ongoing process, but one that has inevitably been moving towards the goal of sustaining all forest values. Forest management is now expected to manage for a wide range of biological values including water and soil conservation, toxin filtration, carbon cycling, fish and wildlife habitat, food, pharmaceuticals, and timber (Davis 1993).

Under the auspices of this evolution, the concept of the using (pre-industrial) forest patterns created by natural processes as management guides is gaining favour in North America (Franklin 1993), and is one of the foundations of an ecosystem-based management (EBM) approach (Booth et al. 1993, Grumbine 1994, Long 2009). The theory is attractive: by maintaining the type, frequency, and pattern of change on a given landscape, we are more likely to sustain historical levels of the various biological goods and services. So-called “coarse-filter” knowledge can also be applied directly to planning and management programs at all levels and scales. Thus, defining the historical range of various ecosystem patterns is a fundamental requirement of a natural pattern-based approach to forest management.

Developing coarse-filter, pre-industrial knowledge is perhaps most challenging at landscape scales. Reliable, pre-industrial landscape snapshots are rare to non-existent due to the combined impacts of fire control, cultural disturbance activities, and lack of historical records or data. What we do know about the disturbance history of Canadian boreal landscapes suggests that they are highly dynamic in time (Turner and Dale 1991, Payette 1993) and space (Andison and McCleary 2014). This means that historical levels of old forest are also likely to be both highly dynamic and spatially variable.

In the absence of detailed and repeated historical data and/or photos, the only means left to explore the dynamics of forest ecosystem patterns at the landscape scale is spatial simulation modelling. In its simplest form, spatial models allow us to explore how known (observed, recorded) probabilities of key variables intersect in time and space to create multiple possible landscape scenes or snapshots. When a sufficient number of landscape snapshots have been created by the model, each one is measured in a number of ways to capture the desired metrics, and then summarized to generate NRV.

This report describes a modelling process by which we generated multiple possible historical landscape scenes, summarized their patterns, and compared those to the current landscape condition for the C5 FMU area. The larger modelling project is LandWeb; *Landscape dynamics of Western Boreal Canada*.

2.0 GOAL

D.W. Andison

The goal of the LandWeb project is: ***to understand some simple pre-industrial landscape-scale patterns in the western boreal forest relative to the current condition***. Note that this goal is both narrow (it will capture only landscape scale patterns) and humble (it will capture only a small number of simple metrics). This report includes the results for the C5 FMU area.

3.0 Desired Conditions and Outcomes

D.W. Andison

3.1 Indicators

LandWeb project partners collectively identified two main classes of output/indicators as part of this project; 1) the area in each seral-stage × major vegetation types, and, 2) patch sizes of old forest × major vegetation types. Through a consultation process as part of this project, the LandWeb partners agreed to the following technical protocols:

- ***Major vegetation types*** were defined by polygons with at least 80% leading species of black spruce, white spruce, pine, deciduous, or fir (*Abies* spp.). All other forested areas that did not meet the 80% rule were classified as mixedwood.
- ***Seral stages*** were defined by the government of Alberta (GoA) provincial standard, and agreed to by everyone: young (<40 years), immature (40–80 years), mature (81–120 years), and old (>120 years).

In terms of old forest (i.e., >120 year old) patch sizes, the LandWeb partners also agreed that this project should report on the following patch sizes; >100 ha, >500 ha, >1,000 ha, and >5,000 ha. Patches should be reported by all forest types combined.

The LandWeb partners also asked to have NRV results summarized within several different geographic boundaries including a) jurisdiction (including the C5 FMU area), b) ecological natural sub-regions (NSRs), and c) existing caribou habitat range areas.

3.2 Current Conditions as a Reference Point

The relevance of NRV modelling output is increased significantly when it is compared to the current condition since this provides a relevant reference point in time. These data must be provided in exactly the same format, using exactly the same rules as defined above.

In theory, current condition data exist in the form of inventories and updates. However, for the purposes of this project, the most recent data are notoriously challenging and time-consuming to a) acquire and b) summarize in a universal format. This is only magnified by the fact that the study area includes five different provincial / territorial jurisdictions, 15 different forest management areas, multiple provincial and federal parks, and provincially-managed areas. Moreover, the vintage of the most recent updates varies considerably across the study area. Acquiring and compiling these spatial data from scratch would have exceeded the entire budget of this project.

Instead, we took advantage of an existing initiative to compile forest inventory data from across Canada. The CASFRI (Common Attribute Schema for Forest Resource Inventories) is the first and only known initiative to collect and standardize inventory data from multiple jurisdictions across Canada (Cosco

2011). Although this database was not 100% complete, and some of the data were outdated, it still saved us considerable time and costs. We acquired outstanding data directly from partners.

3.3 Creating a Pre-Industrial Condition Baseline

Given that the goal of the modelling is to construct the NRV, the spatial data involved need to be free of all industrial human influence, including permanent and semi-permanent land use changes (e.g., infrastructure, agriculture), harvesting, and fire control. This can be done in two ways. Some NRV modelling exercises start with an existing landscape — complete with anthropogenic influences — and run the model forward hundreds to thousands of years to *fill in* the areas influenced by human activity. Alternatively, it is possible to re-create a single natural vegetation conditions on a single landscape scene *via* a GIS exercise that uses the following, hierarchical, rules: 1) historical (pre-disturbance) vegetation information in digital format, 2) historical (pre-disturbance) vegetation information from available maps, 3) rules and/or an algorithm that calculates the most likely vegetation type of missing polygons based on neighbours. For this project, we chose to go with the second option.

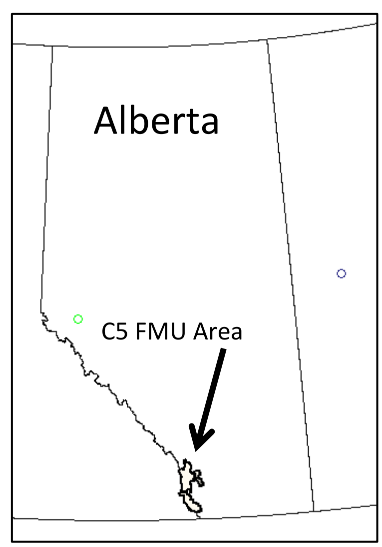
To create an initial pre-industrial landscape, we first obtained the oldest digital version of the forest inventory (with the least amount of cultural disturbance). Then we used digital data, records, and maps to replace cultural features with pre-disturbed vegetation types. Any remaining culturally modified polygons were filled with the age and cover-type attributes of the adjacent polygon with the greatest length shared boundary. Thus, all towns, roads, cut blocks, mines, and other human developments were replaced by attributes of the last known or the most likely forest type. The “natural” pre-industrial snapshot created by this process still included biases and inaccuracies from a) fire control b) using data from different eras, and/or c) aging errors from forest inventories, all of which could influence the subsequent model output for centuries. To eliminate this risk, the model was run forward several thousands of years before landscape snapshots were collected and measured.

4.0 Study Area

D.W. Andison

The area of concern for this report was the C5 FMU area, covering a total of almost 332,000 ha separated into three pieces (Figure 1).

Figure 1. Study area map showing the C5 FMU area.



Ecologically, most of the FMU area is Sub-alpine natural subregion (NSR) (63%), with another 27% in the Montane and 8% in highly discontinuous areas of Alpine. There are also very small areas of the Forest Parkland and Forest Fescue NRSs (Table 1).

Despite its small size, the C5 represents a wide range of ecological conditions. The eastern edge is grassland, and the western edge is high altitude alpine (Table 2). This diversity is an important driver of historical wildfire dynamics.

Table 1. Summary of C5 FMU area by Natural Subregion (NSR)

Natural Subregion	FMU Area	
	Hectares	%
Alpine	27,102	8
Forest Fescue	791	<1
Forest Parkland	6,469	2
Montaine	95,687	27
Sub-Alpine	221,632	63
TOTAL	**351,681**	**100**

Table 2. Summary of biotic and abiotic conditions across the study area.

Natural Region	Natural Subregion	Elevation	Topography	Climate	Vegetation	Soils	Growing Degree Days >5^{0}C	Mean annual Precip (mm)	Relative Summer Moisture Index
Parkland	Foothills Parkland	1025 -1400m	Rolling to hilly	Short, cool summers	Mix of grasslands, herbvs, aspen, and willow	Chernozems			
Rocky Mountain	Alpine	1900-3650m	Steep to vertical	Abbreviated, cold summers, long, cold, snowy winters	Occasional shrubs, no trees	Non-soil, with some brunisols and regosols	300	1000	0.8
	Subalpine	1300-2300m	Rolling to very steep	Very short cool wet summers, long snowy winters. Highly variable microclimate	Closed Pl forest (low el) opening to mixed Se, L, and Abies forest & krummholz (high el). Wetlands and open water uncommon	Brunisols, with some regosols and non-soil	800	760	1.7
	Montane	825-1850m	Flat mountain valleys to moderate slopes	Cool summers, warm winters. Microclimate important	Closed mixed Pl, Sw, or At forest and grasslands (low el) to Pl forest (high el). Small area in wetlands and open water.	Brunisols, with some chernozems, luvisols and gleysols	1,000	590	2.8

4.1 Historical Long Term Fire Cycles for C5

The process of identifying pre-industrial LTFCs in the original LandWeb study area was thorough and extensive, including a) an informal review of historical local records, b) a literature review, c) a two-day expert workshop, and, d) four iterations of a LTFC map from anonymous expert opinion over four years (see Andison 2019). In the end, the LTFC map represents the best available science; although the confidence level of the final LTFCs varied by region. However, the original version of LandWeb did not include the C5 study area. Nor did it include the Sub-alpine zone. The LTFC mapping exercise used 140 years as part of the LandWeb input for any marginal areas of the Sub-alpine as a (deliberately attempt to be on high end) estimate for the edges of the modelling area (Andison 2019). Thus, the first step in this project was to develop a defendable LTFC map of the C5 study area.

Towards that, it soon became apparent that this particular study area was unique for several other reasons as it relates to wildfire. First, the east-west distance between major ecological zones is extremely narrow. The distance between rolling grasslands and alpine is only 20-30km. Over that distance elevation rises from 1,200m in the east to over 2,000m in the west = which means the growing and fire seasons become much shorter. Fuel type changes from grassland to open shrub to closed forest and then again to open forest and topography, all of which have unique fire behaviour. Topography moves from flat to highly complex, which create varying opportunities for fire refugia (Rogeau and

Armstrong 2017). Lighting activity also declines significantly from east to west, which is relevant for fire ignition.

There are three relevant research studies in this area, all of them in the ecotone between the Sub-alpine and the Montane. Using GIS analyses of vegetation types from oblique aerial photography Stockdale et al. (2019) found that vegetation communities ~100 years ago had 40-80% less forest cover in favour of grass and shrub. Naficy et al. (in prep) found that this same broad ecotonal area experienced a mixture of ~70% high severity fires every 70-80 years, and 30% low to moderate severity fires every 25-30 years using cross-dated tree ring analyses. They also found that the sites of mixed severity burning were predictable based on topographic position. Rogeau et al. (2016) also found evidence of mixed-severity fire in a similar ecotonal landscape to the north. They found historical fire cycles of 65-85 years in the lower parts of the Sub-alpine, 39 years in the Upper Foothills, and 26-35 years in the Montane. Rogeau and Armstrong (2017) also found that topographic complexity was directly related to local variations in fire return intervals.

We also know that the grassland zone to the east of the study area can/did not support forests and was dominated by grass fires every 10-20 years. Our understanding of fire dynamics further west is more challenging. High elevation forests can still have closed canopies, but have very short growing / fire seasons and do not get much lighting activity. At very high elevations forest cover can become more discontinuous, which makes it more difficult for fires to grow very large. We also know that forest and fire conditions just within the Sub-alpine zone can change dramatically. Further north, Jasper National Park split the Sub-alpine NSR into Upper and Lower zones due to observed significant differences in ecological, climatic, topographic conditions (Holland et al. 1982). Andison (2000) found that the estimated average age in 1930 of the Lower and Upper zones were 82 years and 217 years respectively.

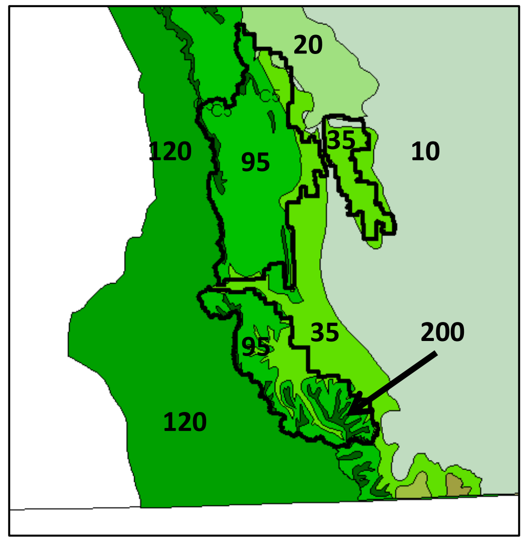
In summary, the frequency of pre-industrial fire increases dramatically and over very short distances as one moves from west to east – even within Natural Subregions. As the topography becomes more complex as one moves upslope the probability of mixed severity fires and fire refugia increases and peaks at the ecotone between the Montane and the Sub-alpine where climatic and topographic conditions combined with frequent lighting activity created suitable ignition and burning conditions. The presence of Douglas Fir in this area is further evidence that lower to moderate severity fires occurred historically. Lastly, the evidence suggests that the natural range of conditions (and thus fire activity) for this landscape is very wide. Stockdale et al. (2019) clearly shows a landscape that is more savannah than forest existed only 100 years ago.

These are all useful pieces of information, but they pose several challenges for modelling historical wildfire dynamics. First, LandWeb is a model designed and built to capture stand-replacing fire. There is a beta version of a partial mortality module for LandWeb (Barros et al. 2020), but it is not fully functional or calibrated at this point. Partial burning not only complicates the modelling, but the reporting. Right now, LandWeb groups forest pixels together based on the year of the last disturbance, and there is no option for reporting on mullti-aged forests. The succession module is also not calibrated for Douglas Fir.

This would require a separate research study to do properly, and thus was not possible for this project. The west boundary of the study area is also the BC border and height of land. I could not find any reliable vegetation information for that area let alone fire regime estimates. Although the results do not include this area, because the model is spatial, it needs a substantial boundary on all sides of several tens of km to function properly.

After taking all of this information into account, I re-created a LTFC shapefile for the study area as shown in Figure 2. Estimates of the average pre-historical long-term fire cycle ranges from 35-200 years across the study area, although the majority is 35-95 years (Figure 2). For reference, the 20 year LTFC in Figure 2 is associated with the Foothills Parkland, the 35 year LTFC with Montane, the 95 year LTFC with the Sub-alpine, the 200 year with Alpine, and the 120 year LTFC with Sub-alpine areas on the BC side.

Figure 2. Long-term-fire-cycles for the study area (From Andison 2019).



I chose these numbers for several reasons. First, remember that these are just averages of model *inputs*, not the *realized* LTFCs. Some parts of some fires that ignite in one fire regime zone and will migrate into an adjacent one, effectively creating a fire regime ecotone between zones with different LTFC averages. For example, the model will realize LTFCs in the Sub-alpine of 100-110 years in the west to ~50-60 years in the east, which is closer to reality. The 95 year average LTFC for the Sub-alpine is lower than that further north in the Jasper-Hinton area, but it is a) lower elevation, and b) in a more temperate climate. I also chose LTFC numbers that were on the high side thinking that this may be a way of resolving how to track areas that burn at lower severities (See Section 6.0 ahead for more on that).

5.0 Methods: Choosing a Spatial Model

D.W. Andison

By definition, models are simple, incomplete representations of reality (Hammah and Curran 2009). There is also a key trade-off between complex models and simple ones. The "best" model is not necessarily the most complex or realistic one, but rather the model that best suits the purpose. The rule of parsimony for any modelling exercise ***is as complex as necessary, but no more***. In other words, each modelling exercise should focus on achieving the desired objectives with the least possible number of explanations, equations, and assumptions (Hammah and Curran 2009). In this case, modelling objectives were very simple and general in nature; to define the natural, pre-industrial range of a) seral-stage levels and b) patch sizes by broad vegetation types, and broad geographic zones. This requires a model with the following attributes:

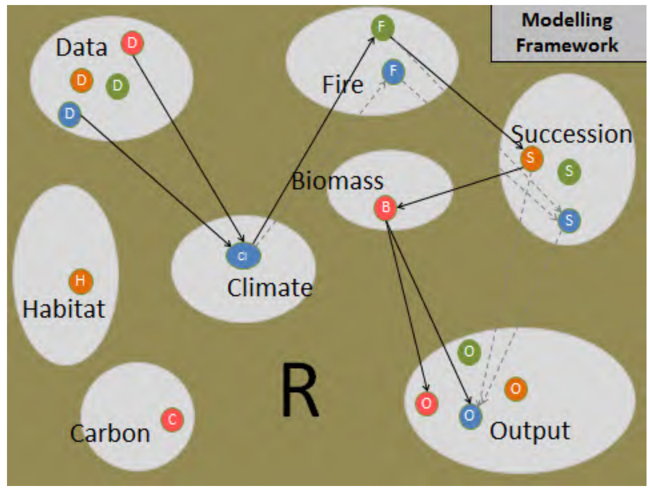
1. Fully spatial,
2. Fully stochastic,
3. Able to function at multiple scales,
4. Very good at capturing known fire patterns,
5. Able to accurately capture /represent known disturbance regime parameters (mostly frequency, size, and severity),
6. Able to generate results in a timely manner, and
7. Work at massive spatial scales (i.e., over 100 million ha).

These requirements were quite restrictive, and narrowed our options considerably since it meant the model must be a) raster-based at a scale of no larger than 10 ha, b) able to function across multiple fire regimes, c) able to handle and integrate multiple spatial data sources, and d) highly efficient in terms of language, memory and processing capacity.

At the outset of this project, there was no existing model that met all of these requirements. However, several were close enough that they could have been adapted with some effort (i.e., Landis, Bfolds, Landmine, Alces, and SELES). As part of the process for this project, the pros and cons of each model were researched and summarized, the likely costs associated with adapting each to suit the new parameters calculated with the help of local experts, and the risks of each not achieving the desired outcomes and objectives identified (e.g., what were the chances that scaling up model X to 100 million ha and adding component Y would even run on a computer, let alone produce output in a timely manner?). The cost and time estimates to upgrade any of the existing model options were considerable.

Another option presented itself at the same time. A CFS-Laval academic partnership (Drs. McIntire and Cumming respectively) were fleshing out the architecture of, and starting to write code for, an ensemble modelling framework called SpaDES (Spatially Discreet Event Simulator). Ensemble models are not models *per se*, but rather frameworks within which multiple models, and/or model components (i.e., modules) can interact (Krueger et al. 2012). In this case, the idea was to create a universal scheduling environment in R that would allow model modules (even ones from existing models) to communicate and be interchangeable. For example, in Figure 3, there are four different spatial data modules, two fire spread modules, and three forest succession modules to choose from (see below).

Figure 3. The SpaDES environment (brown shaded area) allows various modules to communicate and even be exchanged for other, parallel modules. The black lines represent one possible configuration of modules — out of dozens.



Thus, the alternative to investing in upgrading an existing model was to invest in the development of a new, potentially far more powerful modelling framework that is SpaDES, within which a specific module configuration would be developed to achieve the goals of this project.

There were several benefits of going with the SpaDES option. First, by design, the final product would be open source. This means the final product can be used, modified and shared openly and free of charge to anyone — as opposed to proprietary software, which is not only unavailable for independent review, but must be purchased. Second, because LandWeb would be associated with a larger, open source product it also creates a legacy. LandWeb partners are thus able to use the model for future, and different research and forecasting needs, as opposed to a one-off static model. Thus, the investment in the objectives of LandWeb could result in payoffs in terms of access to, and use of, a universal spatial model for multiple purposes. Third, the plan for LandWeb in SpaDES was to create a stand-alone app available (free of charge) online to anyone. Finally, the various modules necessary to fulfill the objectives of this project would be adapted from existing, proven models, as opposed to writing new modules from scratch.

The greatest risk of going with the SpaDES option was the unknown amount of time and effort required to not only design, build, test, and validate a new modelling framework, but to be the first to attempt to build a specific configuration and app within that framework. Writing, validating and error-checking code is notoriously challenging and time-consuming, and in this case there was no shortage of technical challenges to potentially overcome. So, although the original time and cost estimates from the modelling team were well within the timelines of the project, the resources to complete a LandWeb configuration within SpaDES could well have been significantly greater than we had. In the worst case scenario, resources would be depleted before the end of the project, and with no results to show for the effort. On the other hand, this same risk also existed for the existing model upgrade option. For example, model architecture aside, the sheer effort required to acquire, compile, validate, overlay, and access the massive spatial databases required is without precedent.

In the end, the HL Program Lead chose to support the work of the SpaDES modelling team to develop a needs-specific, LandWeb configuration.

6.0 Methods: LandWeb and SpaDES

A.M. Chubaty and E.J.B. McIntire

6.1 LandWeb Study area

The study area for LandWeb includes the western-most 125 million ha of the Canadian boreal forest extending west from the Rocky Mountains to beyond the Manitoba border to the east, and from the southern boundary of the forest-grassland interface approximately to the 62nd parallel into the Northwest Territory. The area includes 73 million ha of Boreal Plain, 25 million ha of Taiga Plain, 20 million ha of Boreal Shield, and 7 million ha of transitional areas of Prairie, Montane Cordillera, Taiga Shield and Boreal Cordillera (Wilken 1986) (Figure 4).

The study area also includes several woodland caribou ranges (Figure 5). Note also that the area that was modelled extends well beyond the boundary of the study area. This is to avoid bias associated with edge effects, and common practice for spatial modelling (Figure 5).

Figure 4. Map of the LandWeb study area ecozones.

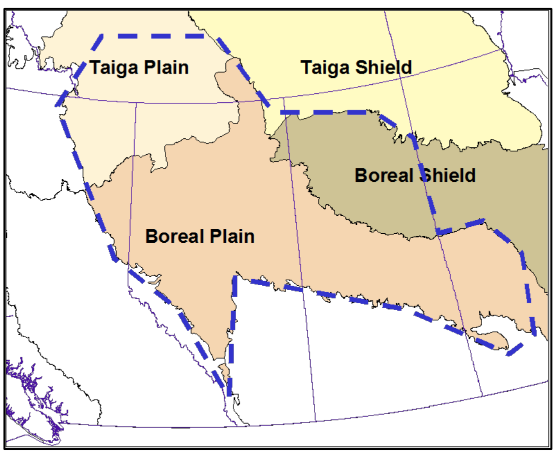
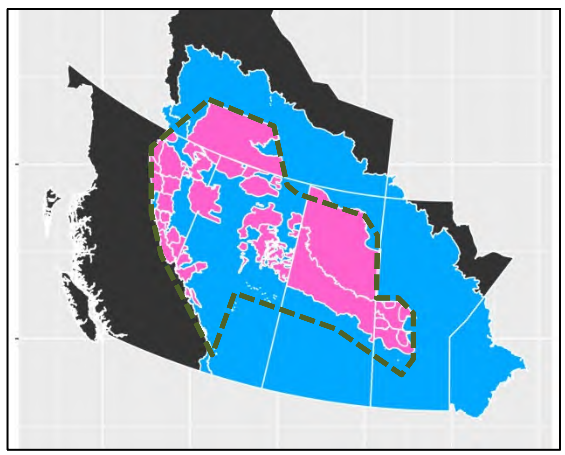


Figure 5. Map of the LandWeb Study Area showing the modelling area (blue) and current caribou range (pink).



6.2 SpaDES

SpaDES is collection of packages for the R Statistical and Data Language used to develop and run spatially explicit simulation model (Chubaty and McIntire 2018; 2019a; McIntire and Chubaty 2019; Chubaty and McIntire 2019b). There are three key features of the SpaDES platform that make it an excellent choice for the implementation of the LandWeb model. The first is that SpaDES leverages the availability in R of a vast number of robust scientific computing and data visualization packages. Second, using R for data preparation, analysis, *and simulation*, provides a streamlined data-model pipeline and workflow. Finally, SpaDES is built with the explicit notion of model components that are interchangeable and easily updatable (i.e., modular). In this sense, SpaDES simply schedules and run various model components (i.e., modules).

Although individual modules are designed to be standalone units, their design includes several features that facilitate use with other modules (i.e., module integration). Each module includes metadata that define its parameter values, as well as data inputs and outputs. These data dependencies are used by SpaDES to calculate module interconnectedness *via* the data objects shared among modules. The specific collection of modules (with their parameterizations and data dependencies) used by LandWeb (i.e., configuration) incorporate and build on models developed for and reusable in other research contexts. We describe each module used in LandWeb simulations in more detail below.

6.3 Data Sources

Data used for the model are derived from multiple sources, and include both open (and freely available) data as well as proprietary partner-supplied data. Data sources for each module are identified in the module descriptions below (Table 3).

Table 3. Summary of spatial data sources used

Data product	Source URL
Pickell land cover and forest inventory data (Pickell and Coops 2016)	N/A
"kNN data" (Beaudoin et al. 2014)	http://tree.pfc.forestry.ca/
LCC2005 v1.4 (Latifovic and Pouliot 2005)	ftp://ftp.ccrs.nrcan.gc.ca/ad/NLCCLandCover/LandcoverCanada2005_250m/LandCoverOfCanada2005_V1_4.zip
Forest Resource Inventory (LandWeb partners, prepared by Silvacom)	N/A
CASFRI v4 (2016) (described in Cosco 2011)	N/A

6.4 Model Code

All modules are written in R and all model code was developed collaboratively using GitHub (https://github.com), with each module contained in its own (private) git repository (Table 4). Code that is shared among modules was bundled into R packages, and hosted in open git repositories. All package code is automatically and regularly tested using cross-platform continuous integration frameworks to ensure the code is reliable and free of errors.

Table 4. Module and package code repositories used for the LandWeb project. Module code repositories are currently private; package code repositories are open.

Code Repository	Description	URL
Modules		
LandMine	A reimplementation of Andison's fire model, simulating fire ignition and spread.	https://github.com/PredictiveEcology/LandMine
LandR Biomass_speciesData	Prepares species input layers from multiple data sources.	https://github.com/PredictiveEcology/Biomass_speciesData
LandR Biomass_core	Simulates vegetation growth, mortality, aging, and dispersal. Updates biomass following other modules' events, and produces summary figures and tables.	https://github.com/PredictiveEcology/Biomass_core
LandR Biomass_regeneration	Simulates post-disturbance (e.g. fire) biomass regeneration.	https://github.com/PredictiveEcology/Biomass_regeneration
LandR Biomass_borealDataPrep	Prepares multiple data objects used by Biomass_core; customized for Canadian Boreal Forests.	https://github.com/PredictiveEcologyeliotmcintire/Biomass_borealDataPrep
LandWeb_output	Summarizes and prepares model outputs specifically for the LandWeb project.	https://github.com/fRI-Research/LandWeb_output
LandWeb_preamble	Creates study areas, including all FMA polygons, and prepares inputs for the main LandWeb simulation.	https://github.com/fRI-Research/LandWeb_preamble
timeSinceFire	Keeps track of forest pixel ages during the simulation.	https://github.com/fRI-Research/timeSinceFire
Packages		
LandR	Landscape Ecosystem Modelling in R	https://github.com/PredictiveEcology/LandR
LandWebUtils	Additional utilities for LandWeb analyses	https://github.com/PredictiveEcology/LandWebUtils
map	Defines a meta class of geographical objects, the 'map' class, which is a collection of map objects (sp, raster, sf), with a number of metadata additions to enable powerful methods (e.g., for leaflet, reproducible GIS, etc.)	https://github.com/PredictiveEcology/map
pemisc	Miscellaneous utilities developed by the Predictive Ecology Lab Group	https://github.com/PredictiveEcology/pemisc

6.5 LandWeb Simulation Model

6.5.1 Overview

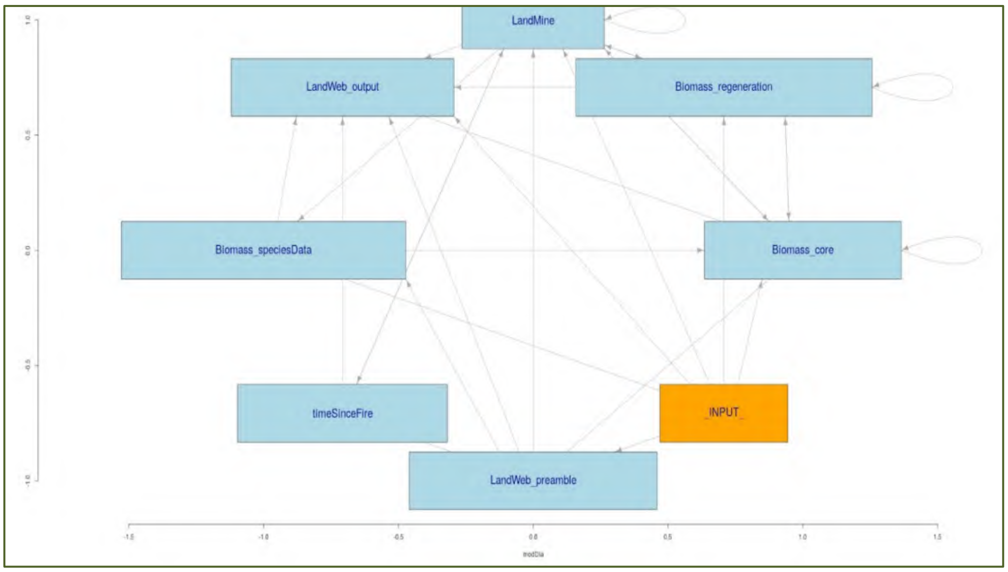
To our knowledge, LandWeb is the first large scale, data-driven approach to simulating historical NRV. In developing the model, analyses, as well as the infrastructure to host data, we strived to implement a single, reproducible workflow to facilitate running simulations, analyses, model reuse and future expansion. This tight linkage between data and simulation model was made possible *via* its implementation using the SpaDES[1] family of packages (Chubaty and McIntire 2018; 2019a; 2019b)

[1] Packages used includes, SpaDES, SpaDES.core, SpaDES.tools, reproducible, quickPlot, LandR, LandWebUtils, amc, pemisc, map, raster, sp, sf, and data.table

within the R Statistical Language and Environment (R Core Team 2018). SpaDES facilitates the development of large-scale spatial simulation models.

The LandWeb model integrates two well-used models for forest stand succession and fire simulation, implemented in the SpaDES simulation platform as a collection of sub-models implement as SpaDES modules. Each of these modules are generally categorized by their primary purpose, summarized in Figure 6 and are further described below.

Figure 6. Schematic diagram of the modules within the LandWeb model.



Data preparation. Simulations were run for the entire LandWeb study area, which spans most of the western Canadian boreal forest. Input data were derived from several publicly available, remote-sensed datasets (Beaudoin et al. 2014), as well as proprietary data compiled by Pickell and Coops (2016).

Vegetation dynamics were modeled using a re-implementation of the LANDIS-II Biomass model, a widely used and well-documented dynamic vegetation succession model (Scheller et al. 2007; Scheller and Mladenoff 2004; 2007). Our re-implemented model largely follows the original LANDIS-II source code (v 3.6.2), but with some modifications.

Fire dynamics were modeled using a re-implementation of the fire sub-model of Andison's (1996; 1998) Landmine model of landscape disturbance.

Summary maps and statistics were produced/calculated from simulation outputs, and consist of maps showing the time since fire as well as histogram summaries of 1) number and/or total area of large patches (i.e., patches above the number of hectares specified by the user) contained within the selected spatial area; and 2) the vegetation cover within the selected spatial area. Histograms are provided for each spatial area by polygon, age class, and species. Authorized users can additionally overlay current stand conditions onto these histograms. Simulation outputs were summarized for several publicly available reporting polygons (including Alberta Natural Ecoregions and woodland caribou ranges).

6.5.2 Data preparation

The following describe the modules used for LandWeb.

6.5.2.1 LandWeb_preamble Module

This module performs several GIS data preparation steps to 1) define the study area for LandWeb, and 2) to ensure that all downstream geospatial objects are converted to use the same geospatial geometries (e.g., projection, extent, resolution). Furthermore, this module implements several automated methods for ensuring the validity and the compatibility of input data layers with the downstream simulation components. In particular, it removes non-tree pixels form the Land Cover Classification 2005 and Forest Resource Inventory data sets, and overlays these inventory data into individual forest inventory (by species) and land cover layers (Table 5).

The module defaults to processing cover data for five species/genera: fir (*Abies spp*), white spruce (*Picea glauca*), black fir (*Picea mariana*), pine (*Pinus sp*p), and trembling aspen (*Populus tremuloides*).

Table 5. Data sources used by LandWeb_preamble module

Forest Cover Layer(s)	Source URL
Pickell land cover and forest inventory data (Pickell and Coops 2016)	N/A
"kNN data" (Beaudoin et al. 2014)	http://tree.pfc.forestry.ca/
LCC2005 v1.4 (Latifovic and Pouliot 2005)	ftp://ftp.ccrs.nrcan.gc.ca/ad/NLCCLandCover/LandcoverCanada2005_250m/LandCoverOfCanada2005_V1_4.zip
Forest Resource Inventory and Land Cover data (LandWeb partners, prepared by a.k.a. "Current Conditions" data	N/A
CASFRI v4 (2016); described in (Cosco 2011)	N/A

6.5.2.2 Biomass_speciesData Module

This module downloads and extracts several species cover data layers (Table 5) and overlays them to produce single cover layers by species. It also performs several data pre-processing steps to ensure 1) all data use the same geospatial geometries, 2) are cropped to the study area, and 3) attempts to correct or fill-in any inconsistent or missing data are based on the data from the other layers. The details of how the layers used in this module were initially developed are reported in their respective reports and publications cited above (Table 5).

As above, this module defaults to processing cover data for five species/genera: fir (*Abies spp.*), white spruce (*Picea glauca*), black fir (*Picea mariana*), pine (*Pinus sp*p), and trembling aspen (*Populus tremuloides*).

6.5.2.3 Biomass_borealDataPrep Module

This module converted open datasets that were available for all of Canada's forests into the input requirements for Biomass_core, a forest landscape succession model derived from the Landis-II Biomass

Succession Model (Scheller et al. 2007; Scheller and Mladenoff 2004). It was primarily used to estimate vegetation growth parameters including maximum biomass, maximum aboveground net primary productivity (aNPP), and seedling establishment probability, and to simulate the tree cohorts necessary for Biomass core. This module also provided other parameters, such as species tolerances to shade, and other plant traits (e.g., longevity, ability to re-sprout, etc.). These traits are the same as those derived from LANDIS-II, though the specific values used in the LandWeb simulations were 1) selected to produce relative species abundances that resemble the initial conditions data (Table 6); and 2) others were determined using linear mixed effects models fit to the LandWeb study area (described below).

The module makes use of many datasets from the National Forest Inventory , including aboveground biomass, stand age, and species cover, (Beaudoin et al. 2014) as well as the 2005 National Land Cover of Canada (Latifovic and Pouliot 2005), and the Ecological Land Classification of Canada (LCC) (Statistics Canada 2018) (Table 7).

Table 6. Species traits values modified from LANDIS-II for LandWeb.

Species	Abie_sp	Pice_gla	Pice_mar	Pinu_sp	Popu_sp
Area	BSW	BP	BP	BP	BP
longevity	200	400	250	150	140
sexualmature	20	30	30	15	20
shadetolerance	3	2	3	1	1
firetolerance	1	2	2	2	1
seeddistance_eff	250	100	320	300	500
seeddistance_max	1250	1250	1250	3000	3000
resproutprob	1	1	1	1	1
resproutage_min	0	0	0	0	0
resproutage_max	400	400	400	400	400
postfireregen	resprout	resprout	resprout	resprout	resprout
leaflongevity	2	3	3	2	1
wooddecayrate	0.02	0.02	0.02	0.01	0.07
mortalityshape	15	15	15	15	25
growthcurve	0	1	1	0	0
leafLignin	0.2	0.2	0.2	0.2	0.1
hardsoft	soft	soft	soft	soft	hard

Table 7. Data sources used by Biomass borealDataPrep module.

Data Source	URL
Land cover and forest inventory data (Pickell and Coops 2016)	N/A
"kNN data" (Beaudoin et al. 2014)	http://tree.pfc.forestry.ca/
LCC2005 v1.4 (Latifovic and Pouliot 2005)	ftp://ftp.ccrs.nrcan.gc.ca/ad/NLCCLandCover/LandcoverCanada2005_250m/LandCoverOfCanada2005_V1_4.zip
Forest Resource Inventory and Land Cover data (LandWeb partners, prepared by Silvacom; 2016) a.k.a. "Current Conditions" data	N/A
CASFRI v4 (2016); described in (Cosco 2011)	N/A
Initial communities (Landis-II)	https://github.com/LANDIS-II-Foundation/Extensions-Succession-Archive/master/biomass-succession-archive/trunk/tests/v6.0-2.0/
Species traits (Landis-II)	https://github.com/dcyr/LANDIS-II_IA_generalUseFiles

A number of data cleaning operations were used to treat pixels with problematic sample sizes and logical inconsistencies. First, land cover classes (LCC) corresponding to recent burns, old burns, and cities were reclassified by searching the focal neighbourhood and using adjacent cover classes. These pixels were omitted from the subsequent fitting of statistical models, but were assigned predicted values from these models. Other situations arose where cover was 10% but biomass was zero, or biomass was 25 tons/ha but age was zero.

In these instances, tree species occupying fewer than 5 pixels (< 1 ha) were removed. Both age and biomass required fidelity to species cover, since cover was presumed to be the most accurately estimated variable. Species-specific above-ground biomass (AGB) was estimated for each tree species present in a given pixel by multiplying the relative cover of the tree by the total AGB of the pixel (this method assumed all tree species had identical cover/biomass relationships). Stand age also had to be corrected with respect to species longevity parameters. This was achieved by fitting a statistical model relating “correct” age observations (i.e., those already corrected for zero cover and with age estimates not exceeding longevity) against the interaction of observed biomass (totalB), species (speciesCode) and percent cover (cover), accounting for the random effect of combination of ecodistrict and LCC (ecoregionCode):

$$age \sim totalB * speciesCode + cover + (1 \mid ecoregionCode) \text{ [Eq. 1]}$$

R^2 marginal = 0.38, R^2 conditional = 0.45

Predicted ages were subsequently bounded to zero on the lower limit. Parameters maxB and aNPP were then estimated from a linear mixed effects model reflecting the response of species-specific biomass (B) to the interaction between age (on the log scale, logAge) and species and % cover and species, accounting for the random effect of ecoregionGroup on the calculated slopes (per species) and intercepts:

$$B \sim logAge * speciesCode + cover * speciesCode + (logAge + cover + speciesCode \mid ecoregionGroup) \text{[Eq. 2]}$$

The maximum aNPP was derived from the formula maximum aNPP = maximum AGB / 30, similar to LANDIS-II. Estimates of Species Establishment Priority were based on a generalized linear mixed effects model relating percent cover and species, accounting for the random effect of ecoregionGroup on the intercepts. In this case, species percent cover was treated as the number of times a species was observed (no. of pixels with cover > 0) per ecoregionGroup, thus following a binomial distribution that was accounted for in the model with a logit link function:

$$logit(\pi) \sim speciesCode + (1 \mid ecoregionGroup) \text{ [Eq. 3]}$$

where π is the probability of finding a species (cover > 0) in an ecoregionGroup,
Or, the proportion of pixels that it occupied.

For both models, coefficients were estimated by maximum likelihood and model fit was calculated as the proportion of explained variance explained by fixed effects only (marginal R^2) and by the entire model (conditional R^2). For the biomass model (Eq. 2), marginal and conditional R^2 were 0.52 and 0.79, respectively; for the percent cover model (Eq. 3), they were 0.07 and 0.13. To estimate maxB we predicted biomass for unique combinations of species and ecoregion code assuming maximum age (i.e., longevity) and maximum cover (100%).

Parameters for the ‘Recent burn’ and ‘Urban’ LCC were input from the ecodistrict and LCC of neighbouring pixels using a focal window that iteratively expanded until a valid ecodistrict/LCC was returned.

One of the advantages of this module (and of using SpaDES/R more generally), is that the parameters used for the vegetation succession modules could also be directly estimated from data within the context of the simulation. This is achieved "automatically" should the data or study area change. As with any model, this means that model predictions need to be calibrated every time the study area changes.

6.5.2.4 Vegetation model (LandR Biomass) Module

LandR Biomass is a dynamic landscape vegetation model. As such, it simulated landscape-scale forest dynamics in a spatio-temporally explicit manner, using cohorts of tree species within each pixel. Multiple ecological processes were captured by the model, including vegetation growth, mortality, seed dispersal, and post-disturbance regeneration. These dynamics followed those of the LANDIS-II Biomass Succession module v3.2.1 (Scheller and Mladenoff 2004; Scheller and Miranda 2015), but were modified to improve general utility and computational performance (Barros et al. in prep). In brief, the LandR modules reproduced forest biomass dynamics in a spatially explicit manner at the landscape scale. They simulated biomass changes by cohort (species-age combinations) as a function of age, between-cohort competition for light resources, seed dispersal, germination, and regeneration following a disturbance, and background or fire-related mortality.

6.5.2.5 Biomass_core Module

This module provided the core vegetation dynamics, simulating vegetation growth and mortality processes. The functions that determine growth and mortality were unchanged from LANDIS-II. Growth and mortality dynamics were simulated in units of biomass (g/m^2) for each cohort within a stand at an annual time step, regardless of the successional time step used for other processes, such as dispersal or regeneration. Growth was dependent upon the maximum annual primary productivity of a species, cohort age, and competition. Species-specific growth curves dictated the maximum growth for a cohort as it aged. Young cohorts had lower maximum growth, as small trees were not as productive as large, mature trees. Competition acted to reduce growth by limiting the available growing space, while recent disturbances (i.e., from the previous year) increased the available growing space. Competition occurred when a stand contained more than one species-age cohort.

Mortality was derived from two sources, senescence (age-related mortality) and development-related mortality due to the ongoing loss of individual trees and branches from a cohort (Scheller and Mladenoff, 2004). Mortality was dependent upon the living biomass of a cohort, while development-related mortality could not exceed aNPP. As cohorts near their longevity age, age-related mortality increased exponentially, eventually reaching the entirety of the cohort's biomass at the maximum lifespan of the cohort species. Age-related mortality was determined by pre-defined mortality curves that vary by species.

6.5.2.6 Biomass_regeneration Module

This module simulated post-disturbance (in this case fire) regeneration, assuming fires were stand-replacing. In each burnt pixel, the module reset pixel biomass to zero and activated post-fire re-sprouting and/or serotiny depending on species' abilities to re-sprout, their seed establishment probabilities (SEP) in that pixel (i.e., the pixel's ecodistrict and land-cover classes), and their tolerance to shading conditions (which, in this case is zero given all biomass was totally removed after fire) (see Table 8 for species trait values). The module algorithm first determined for which species serotiny would be activated according to shading and SEP (light-loving species and higher SEP increased the probability of serotiny being activated). It then assessed which species rely on re-sprouting and will do so depending on their re-sprouting age limits, shading and re-sprouting probability (i.e., light-loving species and higher re-sprouting probability increased the probability of re-sprouting). For any given pixel, re-sprouting was limited to species that rely on re-sprouting for which serotiny was not activated. This provided an advantage to serotinous species that would otherwise be out-competed by species that rely on re-sprouting.

Table 8. Mean parameter values (and SE) for all geographically varying species inputs and map regions.

Species	Species Establishment	Maximum ANPP	Maximum Biomass
BETU.PAP	0.78 (0.09)	478.76 (77.77)	3,655.17 (694.24)
LARI.LAR	0.60 (0.17)	260.48 (228.97)	1,004.48 (849.30)
PICE.GLA	0.68 (0.02)	929.87 (154.36)	10,559.91 (2,163.76)
PICE.MAR	0.37 (0.15)	551.85 (367.85)	3,816.86 (2,668.30)
PINU.BAN	0.78 (0.06)	1,129.29 (201.95)	12,177.80 (1,088.17)
POPU.BAL	0.82 (0.03)	988.64 (177.21)	7,843.75 (1,254.53)
POPU.TRE	0.82 (0.03)	988.64 (177.21)	7,843.75 (1,254.53)

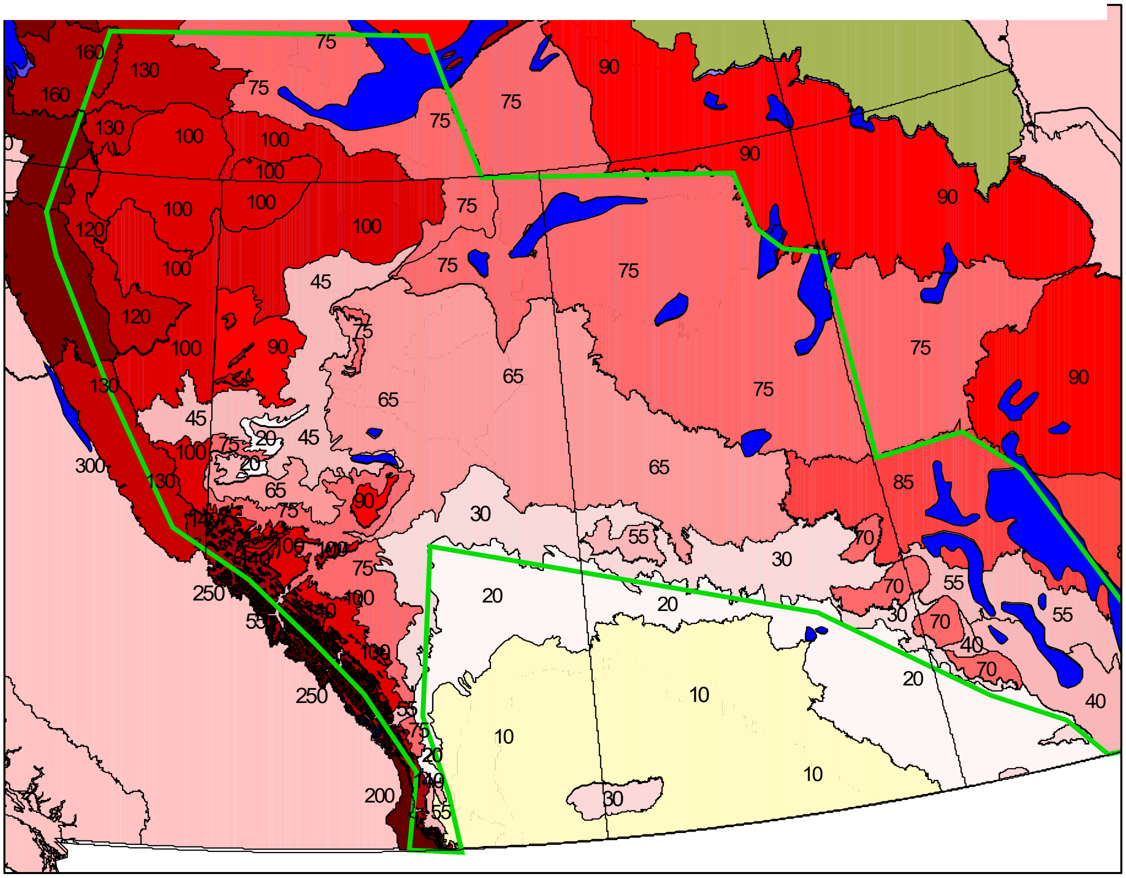
Having insufficient data to draw from, we assumed that the overall proportion of each species in the landscape doesn't change much over the course of the simulation. Our previous simulation runs showed that stand regeneration — using the LANDIS-II defaults when coupled with the fire dynamics (described below) — was inadequate to ensure that the proportion of each species across the entire landscape remained consistent with current condition data. Rather than re-engineer the underlying LANDIS-II approach to simulating these dynamics, we instead focussed on re-parameterizing the species traits that underlie these dynamics. In particular, we increased dispersal distances and regeneration rates for all species to ensure recolonization of burned pixels, resulting in a *de facto* state-transition model formulation, used successfully in ecological simulations.

6.5.2.7 Fire model Module

The LandR model has been designed to handle any number of generic disturbance events by accepting a disturbance layer and removing vegetation in those pixels. LandWeb considers fire as the only source of disturbance, as historically, fire is the dominant disturbance agent in boreal ecosystems.

LandWeb uses the fire initiation and spread module from the Landmine model. Landmine is a Monte Carlo based, spatially-explicit simulation model created for predicting the NRV for landscapes in the boreal forest (Andison 1996; 1998; Clarke et al. 1994), and has been widely used in various contexts both in the public and private sectors. It takes as an input a map of the Long-Term Historical Fire Cycles (LTHFC; Figure 7) (Andison 2019) and simulates fire ignition and spread, and can be used to generate maps of forest disturbance (i.e., removes vegetation it burns). The LTHFCs are used as fire return intervals in the simulations (Table 9).

Figure 7. Map of long-term historical fire cycles (in years) for the LandWeb study area (from Andison 2019).



For the LandWeb project, we re-implemented Landmine as a SpaDES module, with some modifications. Ignition is randomly assigned with a general area defined by fire return interval. Once a fire starts in a pixel its spread is affected by the vegetation type of neighbouring pixels (e.g., less likely to move into aspen). It "snakes" around searching neighbourhood for burnable pixels until it reaches its assigned fire size. If it gets stuck, it "jumps" to nearby pixels after a maximum number of tries. All burned pixels have their vegetation removed (i.e., all cohorts removed). The LandWeb implementation of Landmine differs slightly from the original in two ways: 1) fire sizes were drawn from a Truncated Pareto distribution (instead of a negative exponential); and 2) other parameters have not been fitted to the landscapes that are under study in the LandWeb project.

Table 9. Data sources used by Landmine fire module.

Data product	Source URL
Fire cycle map v6 (Andison 2019)	N/A (fix)

We tracked proportion of area burned and compared against the area that was supposed to burn each year, noting that in the current version, we under-burn in many instances due to fires reaching the maximum number of "jumps" permitted. In other words, some fires simply cannot continue spreading/growing due to spatial restrictions imposed by neighbouring pixels that have inflammable cover classes or have already been burned. Even when only underburning by 1–2%, the area burned dictated by the fire return interval (LTHFC) map is not achieved. Despite this, our earlier simulations showed very high disturbance causing excessive removal, coupled with insufficient regeneration of burned pixels. As mentioned above, these interactions required re-parameterization of the species traits to ensure sufficient regeneration post-fire.

6.5.2.8 LandWeb_output Module

This module produces raster maps of the leading vegetation types, as well as calculating the average time since fire over the course of the simulation.

6.5.2.9 timeSinceFire Module

This module updates the pixel-level stand age (i.e., time since fire), by incrementing the age of unburned pixels, and resetting the ages of burned pixels to 0. It also produces raster maps of time since fire as outputs.

6.5.2.10 Post-processing

Outputs from all simulation reps were used to calculate and report the NRV metrics identified by the partners, and generate custom maps for specific geographic areas (i.e., 'reporting polygons') within the study area. The collection of reporting polygons used in model post-processing reflects the principal considerations of forest managers and provincial government scientists, and can be classified into two main categories. First, there are reporting polygons corresponding to administrative boundaries such as provincial, park, and FMA/FMU boundaries. Second, there are reporting polygons that correspond to ecological boundaries such as ecological zones and caribou ranges. See Table 10 for a summary of reporting polygons used.

Table 10. Summary of reporting polygons used in presenting LandWeb simulation model results.

Reporting polygon	Source URL
Administrative boundaries	
Provincial boundaries	https://biogeo.ucdavis.edu/data/gadm3.6/Rsp/gadm36_CAN_0_sp.rds https://biogeo.ucdavis.edu/data/gadm3.6/Rsp/gadm36_CAN_1_sp.rds
Parks boundaries	https://www.altalis.com/map:id=117
FMA area boundaries (2015)	https://www.albertaparks.ca/albertaparksca/library/downloadable-data-sets/
Ecological boundaries	
Ecological Land Classifications (Statistics Canada 2018)	http://sis.agr.gc.ca/cansis/nsdb/ecostrat/district/ecodistrict_shp.zip http://sis.agr.gc.ca/cansis/nsdb/ecostrat/region/ecoregion_shp.zip http://sis.agr.gc.ca/cansis/nsdb/ecostrat/zone/ecozone_shp.zip
Alberta Natural Subregions (2005)	https://www.albertaparks.ca/media/429607/natural_regions_subregions_of_alberta.zip
Boreal Caribou Ranges (Environment Canada 2012)	http://data.ec.gc.ca/data/species/protectrestore/boreal-caribou-ranges-in-canada/?lang=en
Alberta Caribou Ranges	https://extranet.gov.ab.ca/srd/geodiscover/srd_pub/LAT/FWDSensitivity/CaribouRange.zip
British Columbia Caribou Ranges	https://catalogue.data.gov.bc.ca/dataset/caribou-herd-locations-for-bc

6.5.3 Running the Model

To ensure sample independence, the model was run for several thousand years, measuring snapshots at every 100 years for a total of 60 snapshots.

6.6 General Model Validation

6.6.1 Vegetation Dynamics

One of the ultimate measures of confidence in model output is the degree to which it compares to existing knowledge. One of the critical model assumptions imposed at the start of the project was that the current, existing proportion of vegetation types should reflect the ***average*** proportions from the modelling simulation runs. Although not a perfect assumption, it sufficiently captures reality notwithstanding climate change impacts. In this case, LandWeb created landscapes that shifted some vegetation types well beyond that which was expected. More specifically, the model was replacing conifer species with pioneer hardwood species and *abies* at an unrealistic rate.

This suggested one or more model parameters, assumptions, or data inputs were not being accurately represented. This prompted a thorough and lengthy review of code and algorithms, input-data, parameters and other model assumptions. No major "bugs" were found in the code, although several data issues were identified. In the interests of time, the short-term fix was to ask the succession module to maintain (on average) the proportion of vegetation types observed on the landscape today.

After several months of attempting to reconcile this through error checking and manipulating parameters, the solution was to simplify the succession module from a vital attributes architecture (Noble and Slatyer 1980) to emulate a *de facto* state transition model (Stringham et al. 2003). However, this still created some unlikely vegetation type shifts.

There are several possible explanations for this inconsistency between actual and expected results.

1) The assumption that the average pre-industrial landscape conditions reflect current vegetation conditions was in error. Natural dynamics (such as fire frequency and severity) are constantly changing, and the model may in fact be accurately reflecting shifts in species based on the historical input assumptions.
2) The LTFC estimates (used as model inputs) were significantly wrong.
3) The model was under-estimating fire severity in the form of the amount and type of remnant vegetation. As the amount of unburned forest increases within individual fires, the lower the reliance on the youngest cohort to provide seed, and the greater the chances of later successional species such as white spruce to invade.
4) There are still un-discovered errors in the (one or more) model modules.
5) There are missing parameters in (one or more) of the modules that may be relevant.
6) The resolution (i.e., pixel size) of the model was too coarse to capture the scale at which the relevant dynamics (of mortality, forest dynamics, and succession) occur.

7) The succession module was not calibrated to properly reflect the ecological diversity across the larger LandWeb study area.

While some of these possibilities are more likely than others, there are arguments for and against each as follows (mirroring the same numbering reference as above):

1) There is merit to the possibility that vegetation types today do not reflect those of the past. However, the degree to which the model shifted vegetation types was well beyond anything expected.
2) Long-term-fire-cycle is a highly influential model parameter influencing successional dynamics. The frequency and coverage of definitive, empirical studies across the LandWeb study area is highly variable. In an effort to address these gaps, a related but independent research project developed the LTFC map used here as input for the model using a combination of the available empirical evidence. The opinion of a large number of fire regime experts over four years of input was also solicited (Andison 2019). The quality of the evidence varies across the LandWeb study area. This study area is in an area with lower than average LTFC evidence quality, but the likelihood of being significantly wrong is low.
3) The boreal forest has for many years assumed to be a "stand-replacing" ecosystem in which natural disturbances such as wildfire kill all or most of the trees resulting in single-aged forest (Johnson 1992). Most, or all, simulation models (including LandWeb) reflect this perception and a) kill 100% of the vegetation within any cell that is disturbed, and b) do not prioritize residual levels as either an input or output parameter. However, more recent evidence suggests that historical boreal wildfires are a mix of low, moderate and high severity fires (Andison and McCleary 2014). This is relevant to this study because as fire severity decreases, the amount of surviving forest increases, which changes the dynamics of regeneration, competition, and relative growth rates. For example, a fire in which only 20% of the trees survive will look very different than one in which 80% of the trees survive. It will also have very different species attributes as regards regeneration and growth.
4) It is not possible to be completely sure that there are not errors or logical inaccuracies. Case in point is that during the process of translating the succession module from LANDIS, the modelling team found a systematic error — in a model that has been used hundreds of times, with dozens of publications over the last 20+ years. As a reminder, models are representations of reality, and thus always wrong (to some degree). They are also notoriously under-tested against empirical data (Beverly and McLoughlin 2019). We use models because they are useful, not because they are perfect.
5) The possibility of the model not including key parameters is difficult to evaluate, which makes it a constant source of error of unknown influence. Just because a module is mechanistic (i.e., captures actual detailed functions) does not mean that the list of mechanisms is complete or the assumptions in terms of their influence to the output is accurate. In fact, more sophisticated mechanistic models necessitate a significantly higher level of understanding of system processes, and thus a higher level of trust. What is the impact of parameter three (of 20+) on

the outcome? What is the impact of not including parameter X, or getting it "right"? It is easier to be confident that individual model parameters are functioning as expected than it is to be confident that the various parameters fit together to create robust results.

6) One of the ways in which LandWeb is unique is that it attempted to blend fine-scale dynamics with coarse-scale ones. For example, the pixel size chosen for LandWeb was 6.25 ha — largely to accommodate computational efficiency. That corresponds to a square box with 250 m per side, and at least 125 m from the pixel centroid. In contrast, seeding distances for white spruce (for example) are 15–30 m. So the dispersal of white spruce seed is partly *within* pixels, and partly *between* pixels. How the model deals with such issues is critical. Similarly, the survival of individual (seed-bearing conifer) trees may not be accurately represented at a scale of 6.25 ha.
7) The succession module was calibrated to represent the entire LandWeb study area. In fact, the climatic, ecological, and wildfire dynamics conditions vary widely. So, while there may be places where the module performs very well, the LandWeb study area may require multiple, unique calibrations.

As important as it is to find the source(s) of the inconsistencies described above, this issue was unlikely to significantly impact the results in this case. Recall that the output metrics were both simple and broad. For example, when all vegetation types are combined (for both seral-stage levels and patch sizes) the results do not differ significantly from the vegetation type results. Thus, the LandWeb output will only marginally affected by this unresolved problem. However, this issue may be more significant if/when the model is used for other purposes where the details of stand type parameters are important (e.g., habitat types, impact of climate change on species shifts, etc.).

6.7 Model Upgrades for the C5 Study Area

By D.W. Andison

The modelling for C5 required several model changes and upgrades. For this project, we were not able to find effective solutions for all of them.

1) Expand the study area.

The LandWeb study area had to be extended south and west to include not just C5, but a buffer zone of at least 20km on every side.We obtained available forest vegetation spatial files from Spray Lakes Sawmills and the government of Alberta for C5 and adjacent areas in Alberta. On the BC side, we used National Forest Inventory KNN data (Beaudoin et al. 2014).

2) New current condition data

This came from a 2006 Alberta Vegetation Inventory.

3) The inclusion of Doug Fir as a tree species.

The information required by the biomass module for each species is extensive (e.g., Table 6, Table 8) and calibration can take weeks to months and considerable field data.

4) Changes to the original long-term fire cycle map.

Those changes are discussed and summarized above in Section 4.1

5) Fix the existing problem with tree species successional dynamics.

As described in the previous Section, previous versions of the model struggled with capturing the dynamics of arboreal succession in a realistic manner. After more than a year, the model is better at doing this, but the output still does not align with expectations. A part of this issue is likely linked to issue #6 below.

6) Fix the inability of the model to spread in discontinuous fuels.

This is also introduced in the previous Section, and is perhaps the most serious model deficiency as it potentially impacts not only successional dynamics, but introduces bias in terms of what the model burns and how often. The problem is that the spread algorithm has trouble spreading fires in areas where there are pixels with no vegetation to burn (i.e., water, rock, ice, etc). To be clear, fuel discontinuity is proven limiting factor in the spread of wildfire, but further investigation revealed that some pixels in LandWeb were escaping fires for more than 500 years, which is not supported by any available empirical evidence. This helps – at least in part - to explain why the model also is unable to create realistic successional dynamics as per point #5 above.

The original fire spread module used in LandWeb was borrowed and convert to R from C++ from the Landmine model (Andison 1996). It includes a routine for “skipping” over pixels with no available fuel on a distance-deteriorating basis. In other words, when the model gets “stuck” because its neighbours have already burned, or have no fuel, it triggers a sub-routine that attempts to spread beyond its immediate neighbours. So our first attempt at resolving this problem was to relax the rules for if and when and how fires can “skip” beyond neighbours. After several attempts with improved, but still not realistic outcomes, we moved on to another solution that involved assigning a small but positive spread value. In other words, we told the model it was ok to spread into and through pixels without vegetation. The spread value we gave pixels with no vegetation was very low (to represent the low probability of a fire skipping vs spreading), but it seemed to – mostly – resolve the problem.

In the end, the number and degree of model changes for the C5 area were considerable, and well beyond the scope of this project. We managed to resolve some of them, but not all. This is relevant as regards interpreting the model output (see ahead).

7) Dealing with fire and vegetation dynamics in grasslands.

This formulation of LandWeb is a forest-based model. It does not include any provision for the fire behaviour or successional dynamics in grassland ecosystems. This is far too complex a topic to be including in this project and no attempt was made to address it.

7.0 Results

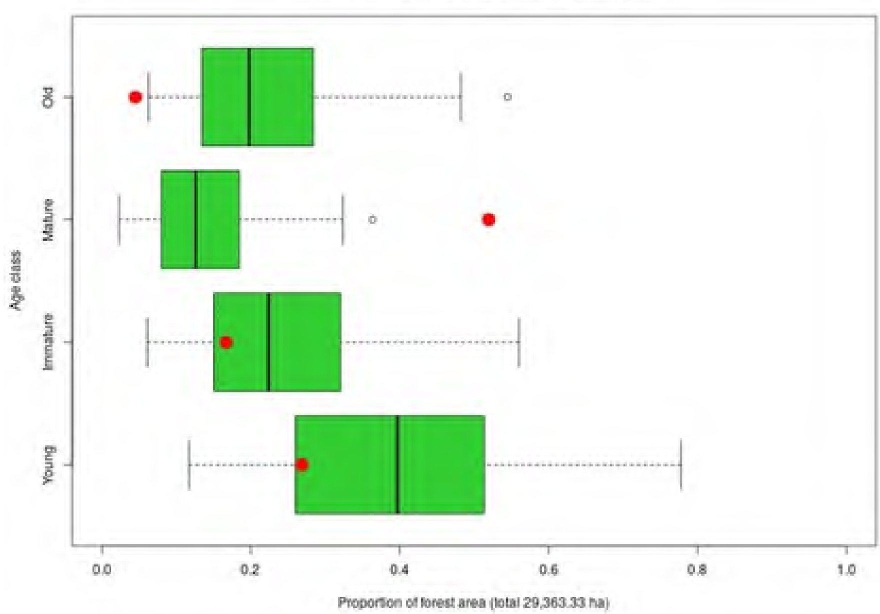
D.W. Andison

We adapted and tested and ran many different versions of LandWeb for this project. The challenge is that LandWeb has many moving parts, and changing one input can have a cascading effect on other parts of the model or other modules. And when there are enough of these interconnected inputs, mapping and tracking what is going on and why becomes very difficult. The version of the model that generated these outputs (version X) combined attempts at fixing grassland burning, species succession, and fire spread at the same time and was considered the best overall performer.

7.1 Results

The non-spatial results from the NRV modelling results are presented as *box and whisker plots (Figure 8)*. Box and whisker plots divide dozens, hundreds, or thousands of measurements into four evenly spaced groups (quartiles), each one representing 25% of the total number of measurements. For example, if the observations of the metric of concern were 2, 3, 4, 5, 9, 11, 16, 23, 25, 26, 27, 30, 40, 50, 70, and 100, the first quartile would be 2–7, the second 7–24, the third 24–35, and the fourth 35–100. The 50th percentile is the median. In Figure 8, the first quartile is the 'whisker' dotted line on the left, the second quartile is the green box left of the black vertical line (median), the third quartile is the green box on the right, and the fourth quartile is the (dotted line) whisker on the right. Note also in Figure 8 there are small open circles. These are known as *outliers* because they are significantly higher or lower than the rest of the data.

Figure 8. Historical ranges (box plot) and current levels (red dot) of pine forest on a sample study area — just for demonstration.



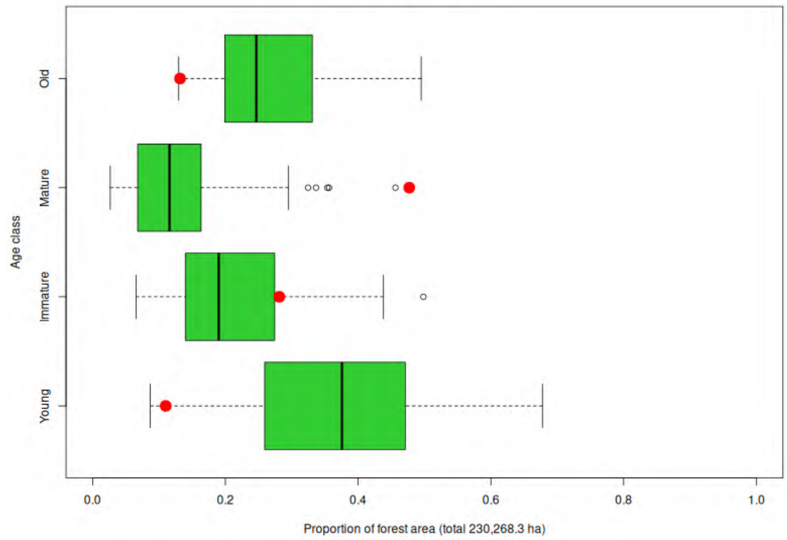
Box and whisker plots not only simplify output into a more visually intuitive form, but also allow simultaneous viewing of all seral stages. For example, each set of four quartiles represents all four seral-stages of a specific vegetation type. The associated area (ha) of the vegetation type is shown in parentheses in the x-axis label. In this case, there were just over 29,000 ha of forest in the area of interest, and every set of data points from every one of the 60 landscape scenes added up to 29,000 ha across the four seral stages.

Lastly, the red dot in each graph represents the current condition. So in the "old" seral stage in Figure 8, the current condition is below even the minimum level of NRV.

The tables associated with each of the Figures shown in this section are given in Appendix A.

The current seral-stage distribution of all forest types on the study a rea is unbalanced relative to the NRV data from modelling. The 11% currently in young forest is just above the 9% lower NRV threshold, and the 48% immature is well beyond the 30% upper threshold of NRV. The 13% of old forest is at the very low end of NRV and the 28% immature forest sits at the 75th percentile of NRV (Figure 9).

Figure 9. Historical ranges (box plot) and current levels (red dot) of all forest on the C5 FMU area.



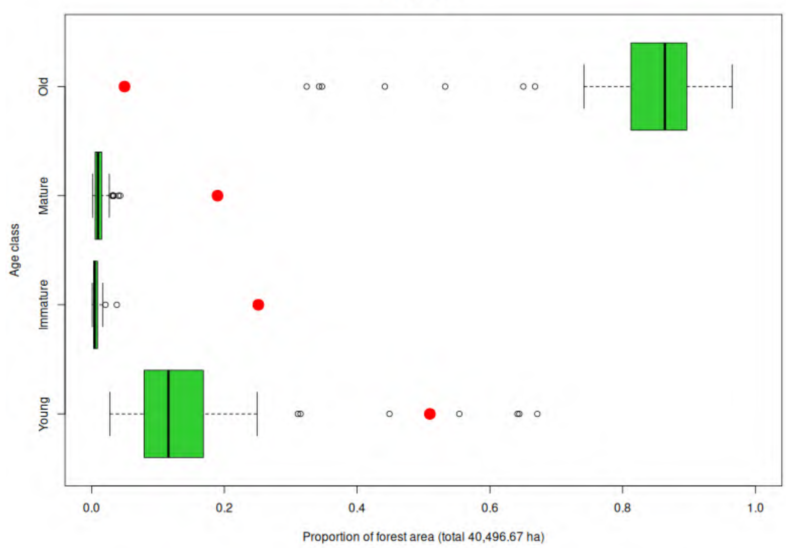
7.1.1 Major Vegetation Types

The following results break down the C5 FMU area of the four major forest types.

Current NRV levels of Douglas Fir from the model are well beyond anything observed today, but also well beyond anything resembling reasonable expectations. The median level of old forest from LandWeb was 86%, the amount of young only 12%, and the other 2% split between immature and mature (Figure 10).

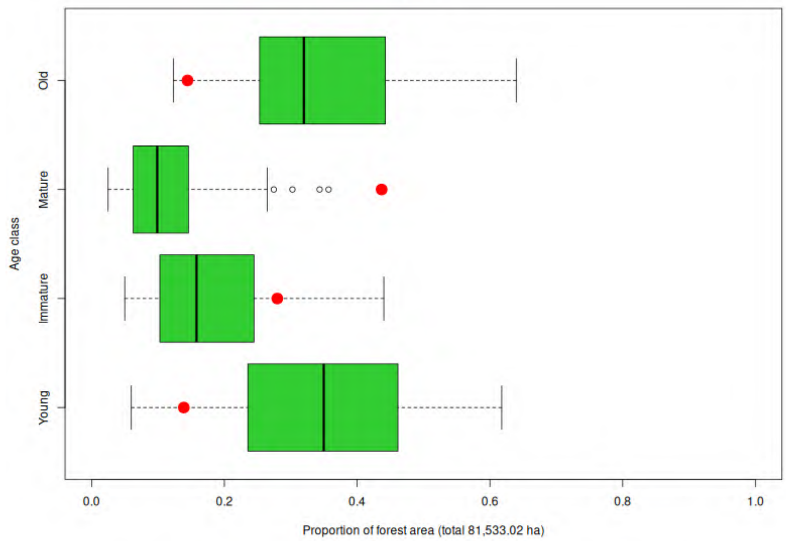
This result is likely a combination of a) the inability of the model to deal with stand-maintaining fires and b) the fact that it is not calibrated for Douglas Fir.

Figure 10. Historical ranges (box plot) and current levels (red dot) of Douglas FIr forest on the C5 FMU area.



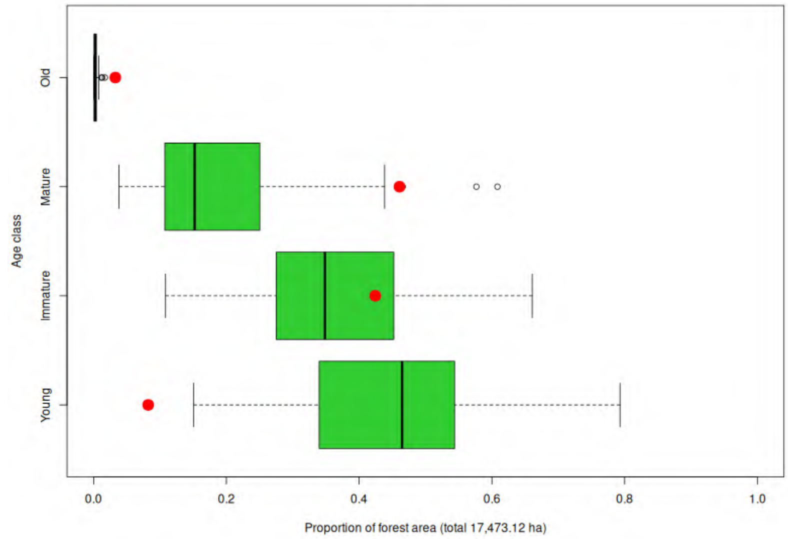
Current levels of Abies dominated forest also deviate significantly from NRV based on modelling. As with Doug. Fir, current levels of old and young forest are on very low end of NRV and the current level of mature forest is well beyond NRV (Figure 11).

Figure 11. Historical ranges (box plot) and current levels (red dot) of Abies forest on the C5 FMU area.



Current levels of mixedwood forest are inconsistent with NRV, but in different ways. Current levels of young mixedwood forest (8%) are well below the lower threshold of NRV (15%) and significantly below median levels (46%) predicted by the model. The model projects old forest levels between 0-1% which is not entirely inconsistent with the 3% observed today (Figure 12). However, this should be considered together with the fact that the amount of mature forest on this landscape is 46%, which is just beyond the upper thr4eshold of 44%, and triple the long-term median of 15% (Figure 12).

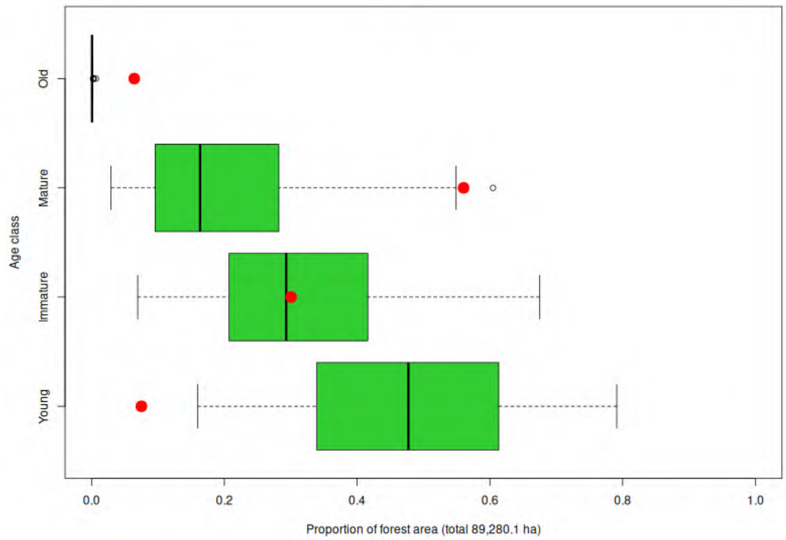
Figure 12. Historical ranges (box plot) and current levels (red dot) of mixedwood forest on the C5 FMU area.



NRV age patterns for pine-dominated forests are consistent with what one expects from that part of a study area where pine is mixed with Douglas Fir in a mid-elevation environment.

Young forest levels today at 8% contrast sharply with NRV estimates of 16% minimum and 48% median (Figure 13). There is also a very high current level of mature forest relative to NRV, coupled with very low levels of old forest predicted from modelling.

Figure 13. Historical ranges (box plot) and current levels (red dot) of jack pine forest on the C5 FMU area.

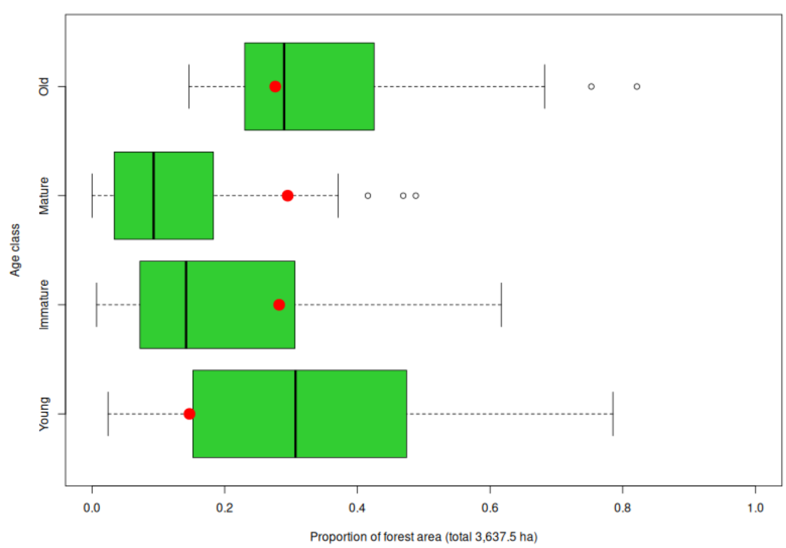


7.1.2 Ecological Natural Subregions

The C5 FMU area includes five NSRs. However, only the Alpine, Sub-alpine, Foothills Parkland and the Montane NSRs account for more than 10,000 ha.

The Alpine fire regime zone is only just over 27,000 ha and is highly spatially distributed on the western edge of the study area. As a result, it should be considered ecotonal to the Sub-alpine zone. LandWeb runs suggested that old forest in this area averages 29%, versus the 28% observed. The 15% currently observed in young forest is at the 25th percentile of NRV from the model (Figure 14).

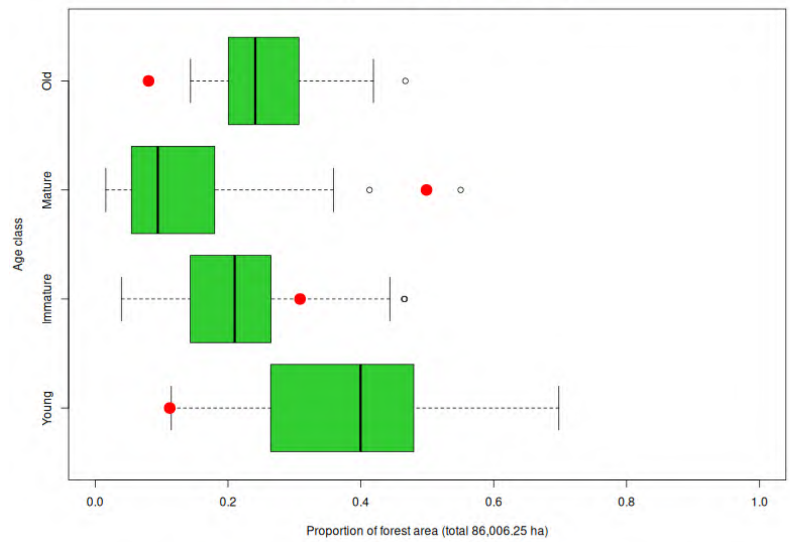
Figure 14. Historical ranges (box plot) and current levels (red dot) for the Alpine NSR on the C5 FMU area.



Pre-industrial levels of young forest in the Montane NSR fire regi me zone of the study area from the model output ranges between 11-70%, compared to the 11% oberved today (Figure 15).

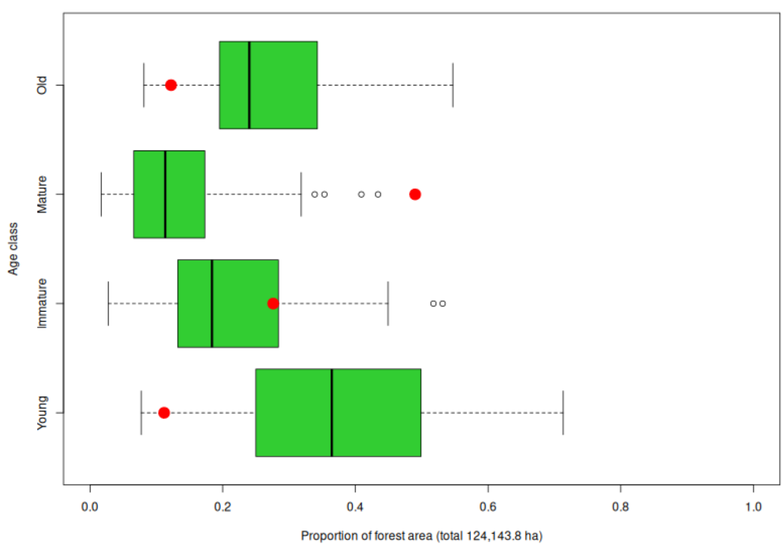
Mature forest current covers 50% of the Montane zone, which is more than five times the median level predicted by the model. Old forest levels of 8% are well below the minimum level of 14% predicted by the model (figure 15)

Figure 15. Historical ranges (box plot) and current levels (red dot) for the Montane NSR on the C5 FMU area.



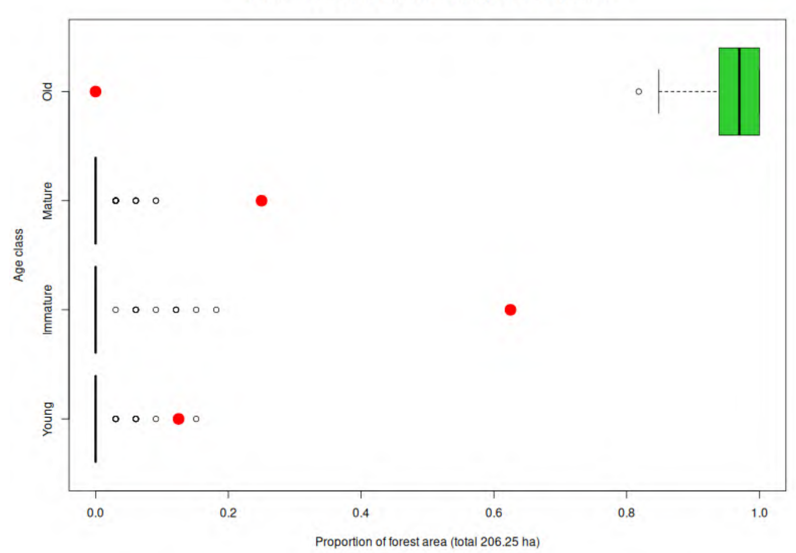
The Sub-alpine bits of the study area from modelling suggest that disturbance is historically quite active, but old forest is still prominent. The amount of mature forest is current very high relative to the range predicted from the model (Figure 16).

Figure 16. Historical ranges (box plot) and current levels (red dot) for the Sub-alpine NSR on the C5 FMU area.



The predicted pre-industrial range of old forest was 85-100 percent averaging 97% (Figure 17).

Figure 17. Historical ranges (box plot) and current levels (red dot) for the Foothills Parkland NSR on the C5 FMU area.



7.2 Interpretation

The modelling results reveal how and where the model is under-performing. I am going to compare some of the model results to that predicted from a negative exponential equation (sensu Van Wagner 1978), which has been used for decades to predict average ages of even-aged forests (Johnson and Van Wagner 1985). In other areas of the LandWeb study area the median levels of seral stages predicted from the model are consistently within 3-5% of that predicted from a negative exponential equation. While it does not validate the results, it at least provides a simple red flag benchmark. One would not expect deviations from the negative exponential model of more than 8-10 percent.

For example, we know fire activity in the Foothills Parkland was very high given its position between grassland and forest. One would therefore expect a lot of young forest, and very little old forest. With an average LTFC of 20 years the negative exponential model predicts nothing over 40 years of age. In contract the model predicted almost all of the forest is old. As described earlier, the model was never calibrated to burn in grasslands, and it would take considerable effort to add that feature. So this tells us that the model was virtually unable to start and spread fires in this zone.

The reason this is so important is that in reality many of the fires that impact the eastern edge of the Montane will originate from the Parkland area – creating a logical fire regime ecotone. But the models' inability to start and/or spread fires in the Parkland zone means that fire activity in the Montane will actually be negatively impacted. In other words, it will likely be much lower than that expected.

The model also predicts a median of 24% old forest and 9% mature in the Montane, but the negative exponential predicts an average of only 3% old and 10% mature based on a 35 year fire cycle. There are likely three things going on. First, as mentioned above, the model was unable to ignite and spread fires from the eastern boundary of the Montane (from the Foothills Parkland zone). This likely created the exact opposite of what one would expect: a zone of *lower* fire activity next to the Parkland instead of one with *higher* fire activity.

The second factor is the model is unable to ignite or burn through Doug Fir dominated pixels. Again, recall that Doug For was never calibrated for LandWeb. In fact, the model predicts a median of 86% old Doug. Fir, which is extremely unlikely given that LandWeb can only create even-aged stands.

Thirdly, The large amount of old relative to the mature forest further suggests that there some proportion of the Montane have “orphan” pixels into which the model was unable to spread fire. The only reason one observes large amounts of old forest relative to mature forest is when the age-class “tail” of any older-than seral stage extends out several decades or centuries and gathers a large amount of area. The best example of this phenomenon is coastal forests in BC where natural forests are commonly several hundreds of years old. However, on a landscape with a 35 year fire cycle, there should be no age-class tail for a seral stage that starts at 120 years. Moreover, while fire refugia (i.e., locations that survive more than one fire in a row) are not uncommon, they are generally related to areas with fairly complex topography (Rogeau et al. 2019). We did expend considerable effort to fix this issue, but clearly there is still work to be done.

On the other hand, it is encouraging to note that the model predicts zero old pine dominated forest and massive amounts of young. So in the Montane, pine stands are burning at a rate more consistent with that predicted by the negative exponential equation. The model output also aligns better with the negative exponential check for the Sub-alpine zone. LandWeb predicted a median level of 24% old forest, compared to 28% from the negative exponential equation.

In the Alpine, LandWeb predicted an average of 29% old forest, which contrasts sharply with the 55% predicted from the negative exponential equation. However, the Alpine on this study area is highly spatially discreet and surrounded on all sides by Sub-alpine. So the most likely reason for the discrepancy is that most of the fires that burned through the Alpine came from the Sub-alpine. In this case LandWeb may be informing us of an important spatial dynamic that is very real – the Alpine on this landscape is almost all ecotonal, and fires in this area behave more like those in the Sub-alpine.

Overall, this version of the model burned too much forest in some places (e.g., the Alpine), and not nearly enough in others (e.g. the Montane). LandWeb was also unable to burn some vegetation types (e.g., grassland, Doug Fir). But these biases seem to average out over the study area. The weighted average (by area) of the LTFCs used as input for LandWeb for this study area is about 86 years. The negative exponential equation suggests that should correspond to an average amount of forest older than 120 years of 25%, which is exactly the median level of old forest predicted from LandWeb.

In terms of how to apply these results to inform strategic planning, this means the most reliable result is Figure 9 – the overall numbers from the model and the landscape. As soon as one starts to break the NRV results down by zone or species type, the defensibility of the results deteriorates. For example, even though the results for the Sub-alpine look fairly reasonable, those results are still likely being biased by model issues impacting other zones.

I propose that the most defendable way forward from a science perspective is a blend of the LandWeb output with that of the output from the negative exponential model. More specifically, I applied the ranges from LandWeb representing the 12.5th and 87.5th percentiles to more defendable medians / averages from the results from the negative exponential model for the same zones (highlighted in green in Table 11).

Table 11. Summary of LandWeb results with those from a negative exponential model for the amount of forest in the "old" seral stage. Also shown are the long-term fire cycle averages from Section 4.1 and the current amount of old forest. Note that the 12.5th and 87.5th percentiles from the LandWeb output are included, and were used to estimate the same ranges for the Negative Exponential model output (highlighted in green).

Zone	LTFC	Percent Forest >120 Years Old						
		Current Condition	LandWeb Model			Negative Exponential		
			Median	12.50%	87.50%	Average	12.50%	87.50%
All	86	13	25	18	38	25	18	38
Alpine Original	200	28	29	19	54	55	45	80
Alpine Ecotonal	150	29	n/a	n/a	n/a	45	35	70
Sub-Alpine	95	12	24	14	39	28	18	43
Montane	35	8	24	17	35	3	0	14
Foothills Parkland	20	0	97	0	0	0	0	0

First and foremost, note that the overall picture does not change. Because the LandWeb and negative exponential (NE) results align for the landscape overall, the proposed thresholds do not either. For example, using a baseline threshold of 12.5 percent (or the first octile) old forest levels overall should be maintained at 18% as a minimum and a 38% maximum (Table 11)

Beyond that overall goal, it gets more complicated. As previously discussed, most or all of forest in the Alpine zone is ecotonal to the Sub-alpine and exists in highly spatially discontinuous pockets. As described above, fires from one zone to another are a common and natural occurrence, which in this case means the Alpine is heavily influenced by fires from the Sub-alpine. In an effort to represent that dynamic I included an "Ecotonal" version of the Alpine that reduced the LTFCs from 200 to 150 years (Table 11).

The most significant shift in fire activity based on Table 11 is in the Montane. There is no possible scenario where a 35 year fire cycle can result in more than about 6-8% old forest, let alone 24% - as suggested from LandWeb. This stark contrast suggests that the averages from the negative exponential model are far more realistic than the medians from the LandWeb output. In other words, NRV is *far* more likely to be 0-14% with a median of 3% than it is 17-35% with a median of 24%. The caveat in this case is that these results only account for stand-replacing disturbances. In other words, the amount of multi-aged stands would be additive to this.

8.0 Discussion

D.W. Andison

8.1 Overall Patterns

Overall, the current age profile of the C5 is likely a reasonably reflection of pre-industrial conditions. Current levels of old forest overall are below most of the 12.5th percentiles of the adapted NRV estimates using the negative exponential averages as NRV medians. The exception is the Montane, which is well within NRV for old (However, note that these estimates cover only even-aged stands and do not include multi-aged stands created by low to moderate severity disturbance). However, there is a huge amount of forest currently in the mature seral stage, particularly in the Montane and Sub-alpine. Keep in mind that the current condition (i.e., red dots in the graphs) were calculated using a forest inventory from 2006, which means those estimates are almost 20 years out of date. So it is likely that a significant portion of the area in mature forest is in fact now old, and if it is not, will be very soon.

The only real red flag in this case is the very low levels of young forest. The current level of young forest is on the very low end of NRV for most of the landscape (again, mostly in the Montane and Sub-alpine), which further suggests that at the current rate of disturbance this landscape will only continue to get older and denser. As Stockdale et al (2019) found, there is strong evidence that at times this landscape experienced extremely high levels of wildfire – to the point of not even supporting full forest cover. Allowing this landscape to get older and denser indefinitely will only further increase wildfire risk.

8.2 Possible Sources of Error in the Model

One of the most widely known quotes about modelling is from George Box: "*all models are wrong, but some are useful*". What he meant by that is, a) models are only representations of reality, b) every model (should) has a very specific purpose, and c) precise models are not necessarily "better" than accurate ones (Hammah and Curran 2009). This leads to the concept of parsimony: The best models should have the minimum number of parameters and assumptions necessary to address the objectives and explain the phenomenon, but no more (Haag and Kaupenjohann 2001). In other words, what is the bare minimum number of pieces moving parts to achieve the modelling goal? Parsimony also suggests that not all those parts or pieces influence the output equally.

Keeping in mind both Box's advice and the concept of parsimony, recall that the purpose of this modelling exercise was to define some broad and simple landscape-scale, pre-industrial pattern metrics. Thus, the question is not so much whether the model simulated fire patterns, the probability of vegetative sprouting, or the distance of seed dispersal flawlessly, but rather which factors, parameters, or assumptions are mostly likely to *significantly* influence the desired output. Thanks to the simplicity of the model — and its purpose — the range of possibilities is limited. The most significant factor driving the area of different seral-stages is the frequency of disturbance (i.e., the LTFC). To illustrate, using a simple negative exponential mathematical model that is broadly associated with representing age-class distributions in the boreal forest (Johnson 1992), the average amount of forest older than 120 years with a 65 year long-term fire cycle (LTFC) is 16%, compared to 20% for a LTFC of 75 years, and 26% for a landscape with a LTFC of 90 years.

As previously noted, this study area was not included in the original analyses of LTFCs in the Andison (2019) document. Instead, I took the time to extend the original LandWeb LTFC map as per Figure 2 and as described in Section 4.1. Until there is other evidence, that map is the best available science for LTFCs for this landscape. Having said that, if anything, the model could have expanded the range of fire activity in each decade. In other words, do not change the average LTFC, but rather the degree to which the model can probabilistically choose actual decadal burning levels. As discussed, part of the unique nature of this landscape is that it has experienced a much broader range of fire activity than (for example) boreal landscapes. This would not change the medians, but it would change the percentiles.

Another likely source of error is the under-representation of low and moderate severity fires in the model. As with every other landscape-scale model today, the fire spread module in LandWeb captures and represents severity in a simplistic, binary fashion: Either a pixel burns completely or not at all. However, evidence suggests that some percentage of historical fires left behind significant areas of partially burned forest (Andison 2004). This could influence succession dynamics in a number of ways. First, as residual forest levels increase, the "regeneration" components of the LANDIS succession model are less relevant, based on time-since-fire alone. For example, a 70 year old forest that experiences only 30% mortality from a fire will clearly be functioning as a sexually mature forest type, with a shade tolerant and re-sprouting understorey. Second, the introduction of low to moderate severity fires challenges, and suggests expanding on, simple definitions of a seral-stage to capture more complex forest age structures such as definitions of "old growth". Partial mortality is also likely to complicate the definition of habitat types (Amoroso et al. 2011), perhaps most notably as it relates to woodland caribou.

The last potential sources of error in the results are the current condition estimates. As discussed in Section 8.1, these numbers were calculated using inventory data almost 20 years of age. Aside from that are concerns about the accuracy and precision of inventory age data. While the vegetation Inventory captures age data for every forest polygon, identifying the exact stand age is not a high priority for forest inventories. Comparisons suggest that accuracy is more of a concern than bias (Andison 1999a, 1999b). Moreover, inventory age estimates of older stands decreases in accuracy, and increases in bias

(Andison 1999a, 1999b). In other words, the ages are less likely to be accurate in the oldest part of the landscape (i.e., the Alpine).

9.0 RECOMMENDATIONS

D.W. Andison

The following are the opinions of the section author, and do not necessarily reflect the opinions of the LandWeb modelling team.

1) **Use the results from this study as an early warning system for ecosystem health concerns.** If nothing else, this project reveals if and how patterns at landscape patterns have momentum towards a wide range of negative social, economic, and ecological consequences that may now seem benign or even entirely dismissed. The impacts of those pattern changes (negative or otherwise) on fine filter values such as species and wildfire risk are often only obvious many years or decades later, at which point management become reactionary. Our current, "value-based" management systems force us to continually be responding to known, existing threats. Shifting to a more proactive NRV-based management paradigm that tracks early-warning metrics is the ultimate manifestation of a precautionary principle.
2) **Change the channel on the role / importance of disturbance**. One could argue that this landscape needs more disturbance activity relative to NRV. For too long, disturbance has been largely associated with negative social, economic, and ecological consequences. From an ecological perspective the boreal is now, and always will be, a disturbance-dependent ecosystem. This means one of the ultimate measures of a healthy ecosystem (and thus sustainability, and thus social and economic values as well) is the *quality* of disturbance activities, not the *existence* of them in the form of simplistic thresholds (for example).
3) **Do a sensitively analyses.** Debating whether the LTFC averages are the "right" ones is inevitable, and can always be tested via a sensitivity analyses in LandWeb by creating a new LTFC map. However, a more informative sensitivity analyses using LandWeb would be to change the equation that estimates decadal fire activity so that it can allow for more breadth of landscape conditions that is more likely to reflect the reality of this landscape. The median NRV numbers would not change, but the percentiles would.
4) **Finalize model testing and validation.** While Doug Fir is not common across most of the other LandWeb areas, there may be opportunities to collaborate with other SpaDES groups to calibrate this tree species better. More universally, the model still has issues with dealing with Abies and Black Spruce and well as fire spread in discontinuous fuels. These challenges are more likely to be supported by other LandWeb partners.
5) **Upgrade current condition.** The results are likely to change based on this information alone. This in turn may change the implications.
6) **Consider creating "disturbance plans" by integrating prescribed fire with harvesting.** This landscape is an ideal candidate.

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APPENDIX A: TABULAR QUARTILE RESULTS

Table A1. Historical quartile and current range of major vegetation types on the C5 FMU area.

Vegetation Type	Age-Class	Current Condition (%)	Pre-Industrial Modelling Results (Percentile)						
			MIN	12.5%	25%	50%	75%	87.5%	MAX
All species	Young	11	9	23	26	38	47	54	68
	Immature	28	7	11	14	19	27	35	44
	Mature	48	3	6	7	12	16	25	30
	Old	13	13	18	20	25	33	38	50
Douglas Fir	Young	51	3	6	8	12	17	24	25
	Immature	25	0	0	0	0	1	1	2
	Mature	19	0	0	1	1	2	2	3
	Old	5	74	75	81	86	90	92	96
Abies	Young	14	6	19	24	35	46	51	62
	Immature	28	5	8	10	16	24	34	44
	Mature	44	2	4	6	10	15	22	26
	Old	14	12	22	25	32	44	51	64
MIxedwood	Young	8	15	28	34	46	54	59	79
	Immature	42	11	19	28	35	45	51	66
	Mature	46	4	6	11	15	25	34	44
	Old	3	0	0	0	0	0	1	1
Pine	Young	8	16	30	34	48	61	67	79
	Immature	30	7	18	21	29	42	50	67
	Mature	56	3	7	10	16	28	39	55
	Old	6	0	0	0	0	0	0	0

Table A2. Historical quartile and current range by ecological natural subregion types on the C5 FMU area.

NSR	Age-Class	Current Condition (%)	Pre-Industrial Modelling Results (Percentile)						
			MIN	12.5%	25%	50%	75%	87.5%	MAX
Alpine	Young	15	2	9	15	31	47	58	79
	Immature	28	1	5	7	14	31	44	62
	Mature	29	0	2	3	9	18	28	37
	Old	28	15	19	23	29	43	54	68
Foothills Parkland	Young	13	0	0	0	0	0	6	0
	Immature	63	0	0	0	0	0	6	0
	Mature	25	0	0	0	0	0	3	0
	Old	0	85	88	94	97	100	100	100
Montane	Young	11	11	24	26	40	48	56	70
	Immature	31	4	13	14	21	26	34	44
	Mature	50	2	4	5	9	18	25	36
	Old	8	14	17	20	24	31	35	42
Sub-alpine	Young	11	8	21	25	36	50	56	71
	Immature	28	3	10	13	18	28	41	45
	Mature	49	2	5	7	11	17	27	32
	Old	12	8	14	20	24	34	39	55

FORCORP - Project Number: P877

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Annex VII – Spatial Harvest Sequence (SHS)

FORCORP

Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	II	Communication Plan
	Annex	III	Stewardship Report (2010-2015)
	Annex	IV	Yield Curve Development
	Annex	V	Net Landbase Development
Three	Annex	VI	TSA – Timber Supply Analysis
	Annex	**VII**	**SHS – Spatial Harvest Sequence**
	Annex	VIII	Growth and Yield Plan

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List of Figures

1 Quota Holder Sign-Offs

2 Spatial Harvest Sequence Maps

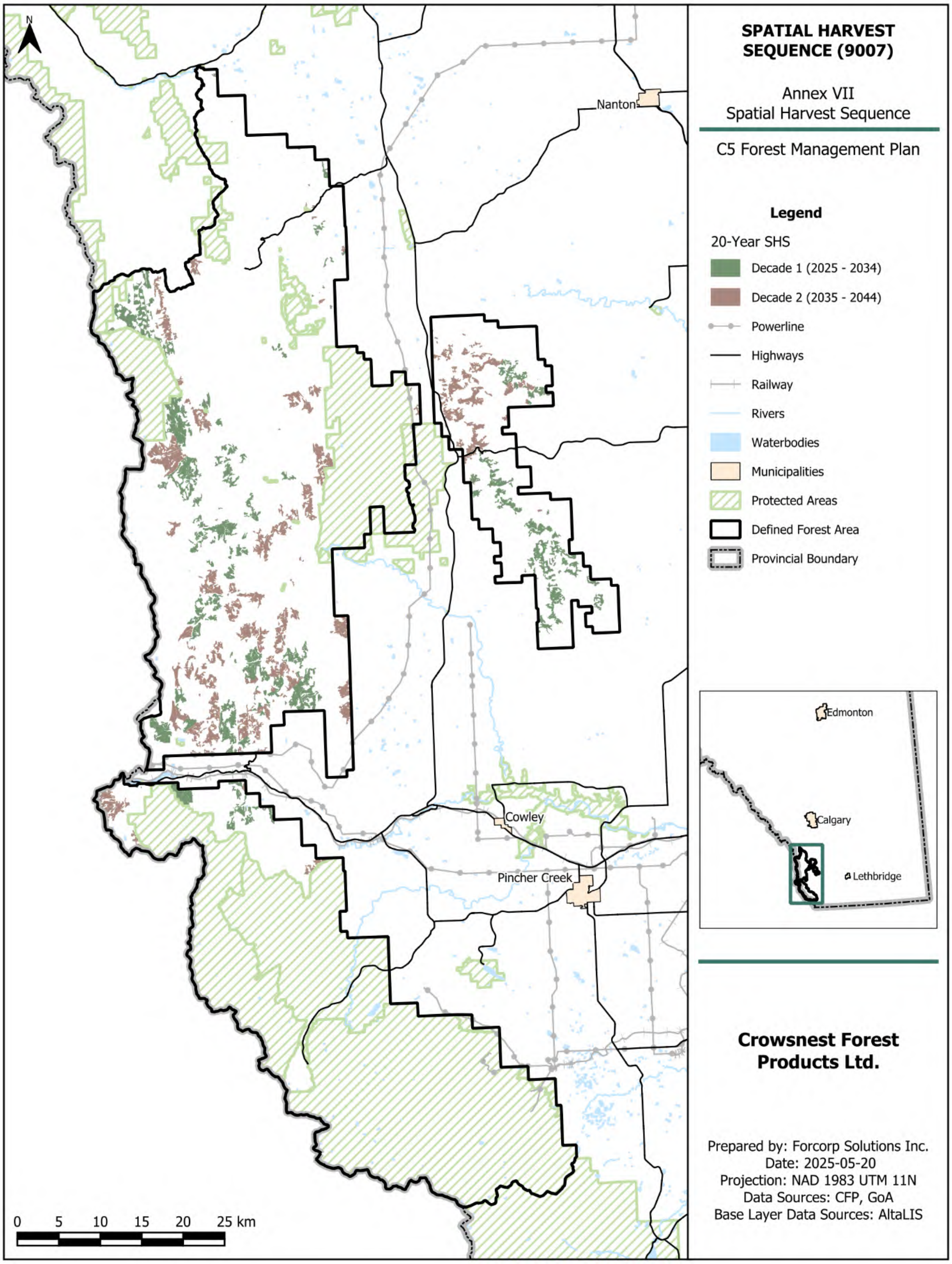

Figure 1. The 20-year spatial harvest sequence for the C5 DFA.

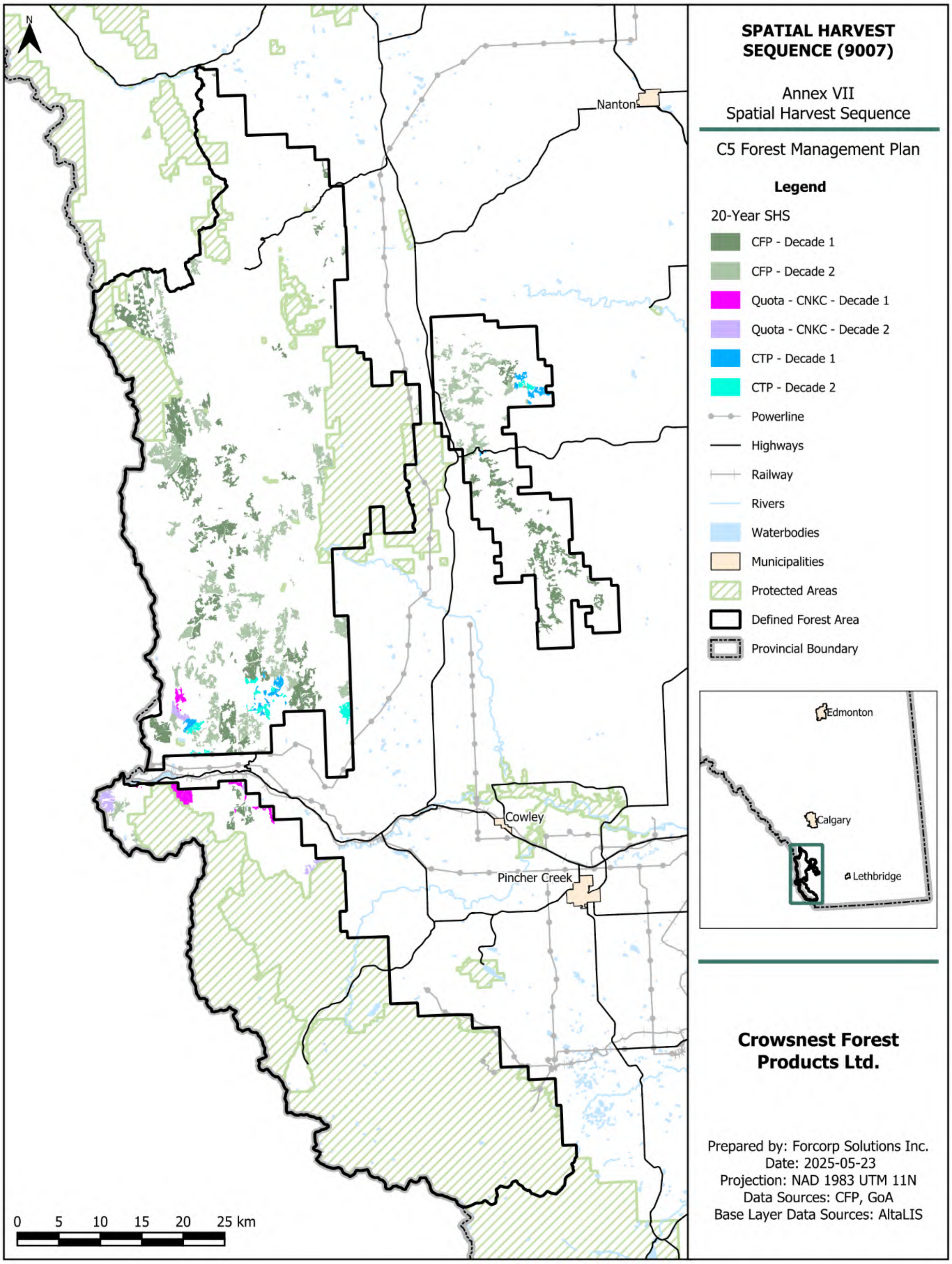

Figure 2. The 20-year spatial harvest sequence for the C5 DFA by operator.

3 SHS Data Dictionary

Data Dictionary

FORCORP Solutions

Last Updated: 23 May 2025

e_shs_9007

Projection: NAD_1983_UTM_Zone_11N Datum: D_North_American_1983 Units: Meters Geometry: POLYGON

COMP_NM (text): Operational compartment name

Crowsnest River	Crowsnest River
Livingstone River	Livingstone River
Oldman River	Oldman River
Porcupine Hills	Porcupine Hills
Racehorse Creek	Racehorse Creek
Willow Creek	Willow Creek

CONVOL (double precision): Conifer volume harvested (m^3)
0 - X

CONVOLHA (double precision): Average conifer volume (m^3/ha)
0 - X

DECVOL (double precision): Deciduous volume harvested (m^3)
0 - X

DECVOLHA (double precision): Average deciduous volume (m^3/ha)
0 - X

ECA (integer): Equivalent clearcut area watershed
1 - 121

FIRE_RISK (text): Wildfire risk assessment

CONTINUOUS_IMPROVEMENT	Lowest risk
INTOLERABLE	Highest risk
RISK_REDUCTION	Medium risk
X	Not ranked

F_LANDBASE (text): Final landbase assignment

CON	Coniferous landbase
DEC	Deciduous landbase

F_STRATA (text): Final base 10 strata

FD	Douglas fir stratum
HW	Hardwood Stratum
HWPL	Hardwood/Lodgepole Pine mixedwood stratum
HWSX	Hardwood/Spruce mixedwood stratum
PL	Lodgepole Pine
PLHW	Pine/Hardwood mixedwood stratum
SW	White Spruce stratum
SWHW	Spruce/Hardwood mixedwood stratum

F_YC (text): Final yield curve strata

J_PL	Juvenile Pine yield Curve
J_SW	Juvenile Spruce yield Curve
N_FD	Natural Douglas-fir Yield Curve
N_HW	Natural Hardwood yield curve
N_PL	Natural Pine yield curve
N_PLMIX	Natural Mixed Pine Yield Curve
N_SW	Natural White Spruce yield curve
N_SXMIX	Natural Mixed Spruce Yield Curve
R_PL	RSA Pine yield curve

(continued)

HARVESTAGE (integer): Age of stand at the time of harvest
Variable Values

HA_NET (double precision): Net landbase polygon area (ha)
0 - X

OPERATOR (character varying): Operator assigned to harvested stand

CNKC	Quota - 793128 Alberta Ltd. (CTQC050002) / 770538 Alberta Ltd. (CTQC050005)
CRFP	Crowsnest Forest Products Ltd.
CTPP	CTPP

TREATMENT (text): Harvest treatment type

CC	Clearcut
CC_EN1	Clearcut - alternative encroachment treatment on contributing landbase
CC_EN2	Clearcut - alternative encroachment treatment on non-contributing landbase
CC_RSA	Clearcut - pine stands harvested before SHS effective date, transitioning to R_PL curve

TSA_UKEY (integer): Unique tsa / modelling landbase primary key
1 - X

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Annex VIII – Growth and Yield Plan

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Binder	Type	ID	Name
One	Executive Summary		
	Chapter	1	Corporate Overview and Forest Management Approach
	Chapter	2	FMP Development
	Chapter	3	Forest Landscape Assessment
	Chapter	4	Summary of Previous FMP
	Chapter	5	VOITS – Values, Objectives, Indicators and Targets
	Chapter	6	PFMS – Preferred Forest Management Scenario
	Chapter	7	Plan Implementation and Monitoring
	Chapter	8	Research
	Glossary		
Two	Annex	I	FMA – Forest Management Agreement
	Annex	II	Communication Plan
	Annex	III	Stewardship Report (2010-2015)
	Annex	IV	Yield Curve Development
	Annex	V	Net Landbase Development
Three	Annex	VI	TSA – Timber Supply Analysis
	Annex	VII	SHS – Spatial Harvest Sequence
	Annex	**VIII**	**Growth and Yield Plan**

Executive Summary

This annex describes the data collection and reporting activities to be implemented over the duration of the Crowsnest Forest Products Ltd.'s 2025 Forest Management Plan encompassing Forest Management Unit C5. This growth and yield plan has been designed to meet the requirements of the Government of Alberta's *Alberta Forest Management Planning Standard Version 4.1 – April 2006* (GOA 2006) and the draft *Growth and Yield Guideline Series: Growth and Yield Programs* (GOA 2016).

Growth and yield plans are a critical component of an FMP. Growth and yield plans guide data collection to meet growth and yield objectives and ensures that the necessary data are available for yield estimation in subsequent forest management plans. The data also provide the ability to assess previous yield estimates and guide improvements to subsequent yield estimation activities.

This growth and yield plan is intended to provide the data required to monitor yield assumptions in the current FMP and to support yield estimation for the next FMP. It will also provide repeat measurement data to support development of forest growth models. This will be accomplished through the following data collection activities:

- Establishment and remeasurement of 40 permanent sample plots (PSPs), 20 in natural stands and 20 in managed stands, focused primarily on understanding growth of Douglas-fir;
- Establishment of 146 new temporary sample plots (TSPs) in natural stands;
- Establishment of 120 new temporary sample plots (TSPs) in managed stands; and
- Collection of Reforestation Standard of Alberta (RSA) performance surveys in younger managed stands.

This document also outlines the measurement schedule and planned reporting, and provides details on field sampling programs including detailed plot protocols.

Contents

List of Tables

1 Overview

This annex describes the data collection and reporting activities to be implemented over the duration of the Crowsnest Forest Products Ltd.'s (CFP) 2025 Forest Management Plan (FMP) encompassing Forest Management Unit (FMU) C5. This growth and yield plan has been designed to meet the requirements of the Government of Alberta's (GOA) *Alberta Forest Management Planning Standard Version 4.1 – April 2006* (GOA 2006) and the draft *Growth and Yield Guideline Series: Growth and Yield Programs* (GOA 2016).

Growth and yield plans are a critical component of an FMP. Growth and yield plans guide data collection to meet growth and yield objectives and ensures that the right data are available for yield estimation in subsequent forest management plans. The data also provide the ability to assess previous yield estimates and guide improvements to subsequent yield estimation activities.

This growth and yield plan is intended to provide the data required to monitor yield assumptions in the current FMP and to support yield estimation for the next FMP. It will also provide repeat measurement data to support development of forest growth models. This document also outlines the measurement schedule and planned reporting and provides details on current and future sampling programs.

2 Past Activities and Learnings

It is important to ensure that commitments are upheld plan-over plan and that learnings from past growth and yield activities, including the work undertaken in previous FMPs, inform improvements to future growth and yield program management. This section provides an examination of past activities and learnings to provide context for development of this growth and yield plan.

2.1 Reconciliation to the Previous Growth and Yield Plan

This is the first Forest Management Plan completed under the new C5 Forest Management Agreement; prior to this the C5 FMU was managed by the Government of Alberta and no formal growth and yield plan was in place.

2.2 The Current Forest Management Plan

Yield estimation in the current FMP follows the provincial base 10 stratification, with some grouping of mixedwoods due to the relatively small areas that these strata comprise (Table 1). Details on yield stratification are provided in the landbase section of this FMP (Annex V).

Three separate populations were identified for yield curve development:

- Natural stands;
- Pre96 managed stands (harvested prior to May 1, 1996); and
- Post95 managed stands (harvested from May 1, 1996 to April 30, 2009).

Post95 managed stands in this context have a skid clearance cutoff of April 30, 2009 which aligns with Reforestation Standard of Alberta (RSA) performance surveys completed by April 30, 2023. This in turn is in alignment with the effective date of the landbase (May 1, 2023).

This is an important cutoff because it represents the population of openings that will need an updated sample prior to the next forest management plan, since the RSA data will be more than 10 years old at the next landbase's effective date.

For more details on yield populations, refer to the yield curve section of this FMP (Annex IV).

Table 1. Yield stratification in the current FMP including associated landbase areas (ha).

Stratum	Natural	Pre-1996	Post-1995	Total	Description
Hw	11,928	148	39	12,114	Pure hardwood
Mix_Pl	793	98	249	1,140	Mixedwood, pine leading
Mix_Sx	1,346	204	76	1,626	Mixedwood, spruce leading
Sw	15,185	2,530	1,211	18,926	Pure coniferous, white spruce leading
Pl	39,780	8,083	13,519	61,382	Pure coniferous, pine leading
Fd	10,228	611	70	10,909	Pure coniferous, Douglas-fir leading
Total	**79,259**	**11,675**	**15,163**	**106,097**	

Yield estimates were developed using both TSP data (collected in 2022) and RSA performance survey data (collected from 2010 through 2023). The sampling intensity for TSPs, relative to the amount of area in the C5 FMU, is very high (Table 2). It should be noted that the pure Hw stratum was not sampled in 2022 and a modification of the previous FMP's deciduous yield curve was used as a proxy for this FMP. There is currently no allocation of deciduous AAC and deciduous stands in the C5 FMU are of generally poor quality; as such, this has not been a priority for sampling.

Table 2. Plots sampled for the current FMP.

	TSP		RSA	
Stratum	Natural	Pre-1996	Post-1995[1]	Description
Hw	-	-	-	Pure hardwood
Mix_Pl	24	-	16	Mixedwood, pine leading
Mix_Sx	30	-	4	Mixedwood, spruce leading
Sw	74	45	35	Pure coniferous, white spruce leading
Pl	152	319	70	Pure coniferous, pine leading
Fd	81	-	-	Pure coniferous, Douglas-fir leading
Total	**361**	**364**	**125**	

[1]Total number of sampling units (SUs).

The yield curve section (Annex IV) describes the development of RSA-based yield estimates for the Post95 Sw and Pl yield strata; however, the Sw yield estimate was virtually identical to the natural stand yield estimates and was not used. The Pl yield estimate was lower than the natural yield estimate and as such, a modified natural stand yield was used to represent these stands. The yield estimates actually used in timber supply analysis are listed in Table 3.

Table 3. Yield estimates used in timber supply analysis.

Stratum	Natural	Pre-1996	Post-1995
Hw	Natural	Natural	Natural
Mix_Pl	Natural	Natural	Natural
Mix_Sx	Natural	Natural	Natural
Sw	Natural	Pre-1996	Natural
Pl	Natural	Pre-1996	Modified Natural
Fd	Natural	Natural	Natural

2.3 Learnings from the Current Forest Management Plan

There are several learnings from the current FMP that have informed this growth and yield plan.

2.3.1 Natural Stands

The TSP data collected in 2022 represent a very robust sample. There were no identified concerns regarding representativeness of these data and as such, these data will be suitable for use in the next FMP. However, an updated sample will be required for the next FMP to provide data needed for validating natural stand yields (i.e. validating "current" standing timber). In addition, the GOA has directed that sampling in pure Hw stands must be addressed prior to the next FMP.

2.3.2 Post95 Stands

The lower performance in Post95 stands relative to natural stands triggered an in-depth internal review of silviculture practice in the C5 FMU. Although there were no indications that poor silviculture practices were generally being employed, some observations were made such as the use of seeding instead of planting container seedlings, reduced ground scarification in harvest areas for grazing concerns, mismanagement of slash & debris generated from harvest operations and fiscal challenges associated with 2008 economic downturn.

A careful review of silviculture practice was undertaken and modifications were implemented in 2025 by focusing on improving site prep prescriptions & equipment, improvements in deadwood and slash management, improved seedling handling and deployment and planting of temporary roads after reclamation (when feasible). It is expected that the performance in managed stands will increase over time as these stands become old enough for performance surveys, which will not be until approximately 2034. In the meantime, CFP will need to continue measurements in their existing managed stands to get a refreshed understanding of stand conditions, including the establishment of PSPs to monitor growth over time.

2.3.3 Douglas-Fir

Information on the growth and reforestation needs of Douglas-fir is less robust than for other stand types in Alberta. Data are needed to inform growth modelling efforts in order to improve these models, both for yield estimation purposes as well as for use in evaluating RSA performance survey outcomes.

Due to some uncertainties regarding the management of Douglas-fir, additional subjective deletions rules were used for Douglas-fir in the current FMP. There is a possibility that these deletion rules may be relaxed in subsequent FMPs depending on what is learned about these stand types over the timespan of the current FMP. As such, plans for future sampling must accommodate the possibility of changes to the Douglas-fire subjective deletion rules to ensure that the full sample population is represented in the dataset used for yield estimation.

3 Forward Planning

Once an FMP is complete, forest management enters a new cycle of implementation and data collection in anticipation of future forest management needs. In particular, growth and yield data collection is needed to ensure that fresh data are available to inform future FMPs. This section provides a description of the principles guiding the plans for future data collection, specifies numbers and types of plots and outlines a schedule for implementation.

3.1 Goals, Objectives, and Strategies

Under the GoA's *Growth and Yield Guidelines* (GoA 2016), all growth and yield plans are expected to meet a base set of goals and objectives. Per the guidelines "*The primary goal of any Growth and Yield Program is provide reliable data for accurate estimation of growth over time, such that harvest can be set at or below the actual growth, in order to ensure sustainable forest management*". From this falls the base set of objectives (from GoA 2016):

1) To collect repeated measurement data suitable for continued growth model development in support of yield estimation and evaluation of performance survey results. In particular, to increase the number of plots in managed stands for improving growth models.
2) To obtain data sufficient to develop natural stand yield estimates that are representative of the mean current yield observed on the current contributing landbase. To ensure that data are collected during each new planning cycle to support new inventories and to ensure currency of yield estimates.
3) To obtain data sufficient to develop managed stand yield estimates that are representative of past and current silviculture practices.
4) To monitor growth and yield assumptions underlying Forest Management Plan annual allowable cut determination and also to allow corrective actions to be taken in a timely manner, if necessary.

The strategies needed to meet these goals and objectives are described in Section 3.2.

3.2 Planned Activities

Planned activities have been designed assuming that yield stratification at the next FMP will be the same as in the current FMP. Refer to Table 1 for a summary of yield strata and current landbase areas; for additional details refer to the landbase section of this FMP (Annex V).

3.2.1 Growth and Yield Modelling (Objective #1)

CFP will support growth model development via participation in the Provincial Growth and Yield Initiative (PGYI). CFP will become a signatory on the planned 2025 Memorandum of Understanding and has recently been approved for a PGYI allocation by the PGYI subcommittee.

PGYI Allocation

The PGYI allocation for CFP will be 20 PSPs in natural stands and 20 PSPs in managed stands. The typical allocation for a small FMA has historically been 25 PSPs in natural stands and 38 PSPs in managed stands, however given the size of the C5 FMU area, a smaller allocation was approved.

Natural PGYI Plots

All natural stand PGYI plots will be allocated to the Douglas-fir (Fd) stratum since these data are needed for growth model development and are currently lacking in Alberta. The only existing Fd PSPs are 9 PSPs in natural stands maintained by GOA, all of which are located in the Porcupine Hills. The other dominant stratum in the FMU, pure pine (Pl), is already being sampled by GOA, who maintains 27 PSPs in the C5 FMU. The GOA provides all of their PSPs to PGYI to support growth model development.

Managed PGYI Plots

Managed stand PGYI plots will focus on both Fd and Pl, since there are currently no managed PSPs in either of these strata in FMU C5. Fd is the primary priority due to its rarity on the landscape, however, very little area in managed stands currently exists for sampling.

Ten plots will be allocated in existing Fd stands, seeking to sample across the range of available ages (roughly 8 in Pre96 and 2 in Post95 based on the current area distribution). Some representation of Pl growth at the far south of its range is also desirable from a modelling perspective, and as such ten plots will be established in pure Pl (5 in Pre96 and 5 in Post95).

At the next FMP, once additional harvesting of Fd has taken place, the growth and yield plan will address whether additional Fd plots will be feasible for sampling and whether additional samples are required.

Establishment and Remeasurement of PGYI Plots

A breakdown of the planned plot allocation is provided in Table 4. Note that most of the landbase is in the Subalpine natural subregion, however the majority of the Douglas-fir stratum is in the Montane. While PGYI targets are usually allocated by species and natural subregion, in this specific case PGYI plots will be established without consideration to natural subregion since the primary focus of the allocation is 1) capturing Fd and 2) capturing pine in the far south of its range.

All PSPs will be established within the next 6 years, allowing one year for FMP approval, approval of the PGYI allocation by the PGYI subcommittee, sample selection and program start up. Remeasurements will be scheduled according to the PGYI-prescribed remeasurement intervals (every 5 years for stands under 40 years of age and 10 years for stands ≥ 40 years of age).

Table 4. Proposed PGYI allocation.

Stratum	Natural	Pre-1996	Post-1995	Total
Hw	-	-	-	0
Mix_Pl	-	-	-	0
Mix_Sx	-	-	-	0
Sw	-	-	-	0
Pl	-	5	5	10
Fd	20	8	2	30
Total	**20**	**13**	**7**	**40**

3.2.2 Yield Estimation and Monitoring – Natural Stands (Objectives #2 and #4)

A combination of PSP and TSP data will be used to monitor natural stand yield estimates and to provide new data needed to support yield estimation in the next FMP.

Based on a review of the existing data and the learnings from the current forest management plan, the TSP data collected for the current FMP represents a robust and representative sample in natural stands. These data will be used in yield estimation for the next FMP along with a new sample that will capture an updated snapshot of standing timber yields and will be used for validation the next set of yield estimates.

All PGYI PSPs will be established prior to the next FMP and the most recent measurement of each PGYI PSP will be also used for yield estimation as well as contributing to the population of plots for validation.

This will result in a total of 527 total observations in natural stands, with 166 new measurements as shown in Table 5. No sampling is planned for the Mix_Pl and Mix_Sx due to the small size of these strata. Regional yields localized to the C5 FMU will be used to represent these strata.

Note that new TSP plots will be 200 m^2 in size and will be established using grid-based methods and as such, this sample represents a robust sample size combining larger plots with a superior spatial distribution as compared to a program that employs a 100 m^2, 3-plot-per-polygon approach.

Table 5. Planned sampling in natural stands.

		Existing	New				
Stratum	Area (ha)	TSP	TSP	PSP	Estimation	Validation	Notes
Hw	11,928	-	33	-	33	33	
Mix_Pl	793	24	-	-	24	0	Use adjusted regional yield estimates
Mix_Sx	1,346	30	-	-	30	0	Use adjusted regional yield estimates
Sw	15,185	74	33	-	107	33	
Pl	39,780	152	60	-	212	60	
Fd	10,228	81	20	20	121	40	
Total	**79,259**	**361**	**146**	**20**	**527**	**16**	

A new AVI will be required prior to the next FMP as per the *Alberta Forest Management Planning Standard* (GOA 2006). The plan for a revised AVI is outside of the scope of growth and yield plan commitments, however, CFP will ensure that the new inventory is used to inform the population for the next TSP sampling program as part of meeting objective #2.

3.2.3 Yield Estimation and Monitoring – Managed Stands (Objectives #3 and #4)

In the next FMP, the same population splits in managed stands will be employed. Pre96 (harvested prior to May 1, 1996) managed stands will be separated from Post95 (harvested on or after May 1, 1996) managed stands based on differences in silviculture between these two eras. However, the Post95 population will be split into two subpopulations: Post95A, comprised of openings skid cleared up to April 30, 2009 and which require a refreshed sample prior to the next FMP, and Post95B, which will be represented by new RSA performance survey data collected during the FMP implementation period.

A combination of PSP and TSP data will be collected to monitor both Pre96 and Post95A yield estimates for the Sw and Pl strata and to provide new data needed to support yield estimation in the next FMP. In addition to establishing and maintaining their PGYI allocation, CFP will establish 30 x 200 m^2 TSPs in each of the Sw and Pl strata for Pre96 and Post95.

The total planned sample will be 73 plots in Pre96 stands and 67 plots in Post95 stands as shown in Table 6 and Table 7. This includes the 10 Fd PGYI plots that are intended to provide data for monitoring and growth model development rather than yield estimation. The first rremeasurements of most of the PGYI PSPs will occur prior to the next FMP which will increase the power of these as monitoring plots.

RSA data will also continue to be collected in managed stands and will provide the data needed to support yield estimates in newer Post95B managed stands. RSA data from openings skid cleared between May 1, 2009 and the effective date of the next landbase will be used for yield estimation in the next FMP. Assuming comparable silviculture, the two sub-populations (Post95A and Post95B) will be combined (using appropriate weighting) to create a single set of yield estimates for Sw and Pl managed stands in the next FMP.

Yield strata that are not sampled will be put on a natural stand yield trajectory.

Table 6. Planned sampling in Pre96 era managed stands.

Stratum	Area (ha)	TSP	PSP	Total	Notes
Hw	148	-	-	0	Use natural yield estimates
Mix_Pl	98	-	-	0	Use natural yield estimates
Mix_Sx	204	-	-	0	Use natural yield estimates
Sw	2,530	30	-	30	
Pl	8,083	30	5	35	
Fd	611	-	8	8	Use natural yield estimates
Total	**11,675**	**60**	**13**	**73**	

Table 7. Planned sampling in Post95 era managed stands.

Stratum	Area (ha)	TSP	PSP	Total	Notes
Hw	39	-	-	0	Use natural yield estimates
Mix_Pl	249	-	-	0	Use natural yield estimates
Mix_Sx	76	-	-	0	Use natural yield estimates
Sw	1,211	30	-	30	
Pl	13,519	30	5	35	
Fd	70	-	2	2	Use natural yield estimates
Total	**15,163**	**60**	**7**	**67**	

3.3 Schedule of Measurements and Reporting

The schedule for growth and yield measurements during FMP implementation is provided in Table 8. The workplan will focus on first completing the establishment and remeasurement of PGYI PSPs. The TSP program will be timed based on the expected completion date of a new AVI and will take place approximately two years prior to the next FMP.

Please note that West Fraser's Cochrane Forest Products division manages both the FMU C5 and FMU B12 PSP programs. During program start up, there may be some adjustments to this schedule to balance workflows between FMUs. GOA will be notified of adjustments to the planned schedule if any occur.

Table 8. Establishment and measurement schedule for all plots.

Year	FMP Event	PSP Establish	PSP Remeasure	TSP	Total	Notes
2025		-	-	-	0	Program setup and PSP sample selection
2026		8	-	-	8	Establish 4 natural and 4 managed PSPs
2027		8	-	-	8	Establish 4 natural and 4 managed PSPs
2028		8	-	-	8	Establish 4 natural and 4 managed PSPs
2029		8	-	-	8	Establish 4 natural and 4 managed PSPs
2030	Stewardship	8	-	-	8	Establish 4 natural and 4 managed PSPs
2031		-	4	-	4	Remeasure 4 managed PSPs
2032	New AVI	-	4	-	4	Remeasure 4 managed PSPs
2033		-	4	266	270	Remeasure 4 managed PSPs
2034		-	4	-	4	Remeasure 4 managed PSPs
2035	Next FMP	-	4	-	4	Remeasure 4 managed PSPs
Total		**40**	**20**	**266**	**326**	

The Stewardship Reporting Requirements (GOA 2017) outline the requirements for reporting on progress against growth and yield data collection commitments. However, monitoring of yields requires actions beyond simply collecting data. Prior to the next FMP, CFP will undertake analysis to compare yields from the 2025 FMP to new plot data in order to assess how well the existing yield estimates compare to new data. This information will be used to inform the yield estimates developed for the next FMP.

4 Field Programs

Field programs are the foundation for all growth and yield activities. Proper sample selection procedures and detailed field and quality control protocols are critical to ensure that data meet the needs of the growth and yield plan objectives and are representative of the target population such that the appropriate conclusions may be drawn from the data. This section defines each sample population, outlines the sample selection methods to be followed and provides an overview of field protocols for each field program. Full protocols are provided in the Appendices referenced in this chapter.

4.1 Permanent Sample Plots

Sample selection for PSPs will be undertaken using the current landbase classification and yield stratification. Plots will be selected by establishing a 500 x 500 m grid across the landbase and using a random method for selecting the target number of grid points by population (natural, Pre95 and post96) and yield stratum.
The number of selected plots will be examined to ensure that at least 13 of the natural Fd PSPs are in the contributing landbase, and if not the number of Fd TSPs may need to be increased to ensure a minimum of 33 plots are available in the contributing landbase at the next FMP.

All PSPs will follow the Cochrane Forest Products' PSP manual which is also used for PSP programs in FMU B12 (Spray Lakes 2021). PSP plots are comprised of a series of nested circular plots with a 400 m^2 main plot, a 100 m^2 sapling plot and a 50 m^2 regeneration plot. There is a 200 m^2 age plot located outside the main plot in the northwest portion of the plot buffer.

All trees ≥ 5.1 cm are measured in the main plot and saplings ≥ 1.3 m in height and < 5.1 cm DBH are measured in the sapling plot. Regeneration 0.3-1.29 m in height are tallied by species. The two largest diameter trees by species are selected and measured for height and age. The field manual is included with this submission. See Appendix I for detailed protocols.

4.2 Temporary Sample Plots

Sample selection for TSPs will be undertaken using a best approximation landbase that will be developed using the new (~2032) AVI, removing operational deletions extracted from the 2025 FMP landbase, and overlaying updated disposition, harvest and wildfire information. Yield stratification and switch stand classification will be applied to the new AVI along with updated subjective deletion rules to define the contributing landbase for sample selection. Full details on this process will be defined as part of the sampling design submission to GOA prior to commencement of field sampling. Plots will be selected by establishing a 500 x 500 m grid across the best approximation landbase and using a random method for selecting the target number of grid points by yield stratum. Stands under 50 years of age and deciduous stands over 120 years of age will be excluded from the sample population.

Natural stand TSPs will follow the protocols outlined in the *West Fraser Alberta Provincial TSP and pPSP Manual*. Plots will be 200 m^2 in size with a nested 50 m^2 sapling plot. All trees ≥ 5.1 cm will be measured in the main plot and saplings ≥ 1.3 m in height and < 5.1 cm DBH will be measured in the sapling plot. In managed stands, a 25 m^2 plot will be used to tally coniferous regeneration by species. The two largest diameter trees by species will be measured for height and age according to the protocols outlined in the *West Fraser Alberta Field Measurement Guide*. Both documents are included with this submission in Appendix II and Appendix III.

4.3 Reforestation Standard of Alberta Performance Surveys

Managed stand RSA surveys follow the protocols described in the Reforestation Standard of Alberta (GOA 2024), as updated by the GOA from time to time.

5 References

Government of Alberta. 2006. Alberta Forest Management Planning Standard Version 4.1 – April 2006. Edmonton, Alberta.

Government of Alberta. 2016. Growth and Yield Guidelines Series: Growth and Yield Programs (Draft). Edmonton Alberta.

Government of Alberta. 2017. Forest Management Planning Standard Interpretive Bulletin: Stewardship Reporting Requirements, Edmonton, Alberta.

Government of Alberta. 2024. Reforestation Standard of Alberta. Edmonton, Alberta.

Spray Lake Sawmills. 2021. Permanent Sample Plot Field Procedure Manual. Edmonton, Alberta

Appendix I Spray Lakes Permanent Sample Plot Field Procedure Manual

Spray Lake Sawmills

Permanent Sample Plot Field Procedure Manual

July 2021

Prepared By:
Spray Lake Sawmills.

Table of Contents

List of Tables

List of Figures

I. Introduction

Spray Lake Sawmills (1980) Ltd. (SLS) is revising its permanent sample plot (PSP) field manual as part of the 2021 Forest Management Plan (FMP) their Forest Management Agreement area (FMA #0100038) and B12 quota areas.

This document is an update to the procedures from the 2007 PSP manual, which was a part of the 2006 Detailed Forest Management Plan. When necessary the 2006 procedures have been modified to satisfy *Minimum Standards and Suggested Protocol and Priorities for Establishing and Measuring Permanent Sample Plots in Alberta* (July 22, 2015) (referred to as the PGYI manual). The SLS manual is designed to be used by field crews when establishing or re-measuring a PSP. This manual does not describe the stratification used in allocating plots or the criteria used to establish plot locations within the selected stands.

II. Plot Establishment

1. Company Plot Number

A unique plot identifier must be clearly labeled on markers at the plot as well as on all tally sheets for that plot. The company plot number will be determined before the plot is established, using the reverse of the legal land location; that is Lsd-Sec-Twp-Rge-M, e.g: 7303175. The plot identifier should be unique.

2. Plot Location

At establishment, plot locations will be provided on an ortho photo with AVI. Additional larger scale reference maps can be provided, if required.

Locations of the plots are predetermined to contain a certain cover type stratum. The stands the plots occur in are relatively large to ensure the plot and most of the associated buffer can be established.

3. Tie point and plot access information

The plot centre is located using two reference points: the tie-point and the witness tree. The tie-point should be a permanent land feature, such as the intersection of a road and a bridge, the intersection of two permanent roads, etc. Detailed directions to the plot centre should be given from this tie point. The directions should include intermediate landmarks such as seismic lines. A witness tree is located at a logical point between the tie point and the plot centre. Witness trees should be flagged and painted in blue and have a small metal plate which identifies the plot number nailed to the tree.

All instructions for locating the plot, in relation to the tie-point and the witness tree are recorded on the PSP Plot Form, along with any information that will help with access in the future. Record the GPS location of both the tie point and witness tree for future reference. Record the declination used during plot establishment in the instructions. Within the access information describe the method for accessing the plot (all weather road, ATV only, lengthy walk etc.).

4. Plot Center & Boundary

The plot center will be marked with a permanent marker pole and sign identifying the plot. The top 12 to 18 inches of the post should be painted blue to facilitate its relocation. The plot boundary in the four cardinal directions will also be marked with permanent markers (aluminum conduit preferred) to facilitate checking and re-measurement.

The plot area should be free of lineal disturbance (cutlines, trails, pipelines, roads, etc.). Lineal disturbance through the buffer may be acceptable where the edge of the disturbance is no closer than 30-meters from plot center. Plots that land within the 30-meters of the high water mark of (large or small) permanent streams (as defined by the Spray Lake Sawmills Ground Rules) should **not** be installed. Plots should also fall completely within the target stratum type and should not cross the boundaries between stands.

Managed stand plots follow the same guidelines for linear disturbance. The entire plot needs to fall within the harvested area; however, the buffer may fall into adjacent stand-types (i.e. block edge) if the edge of the disturbance is 30 m away. If the plot is close to internal structure retention within the block, the entire plot must fall within the harvest area, but there is no minimum distance for the edge of the retention. (i.e. retention can be with in 30 m, but the plot can not contain any of the retention patch).

If unacceptable damage is present, or the plot is not located in the target strata the plot may need to be moved. Some examples of criteria or features that may require a plot to be moved include:

a) Large openings, drastic density shifts and site differences;

b) Unmapped stand type changes or drastic species composition changes;

c) Roads, pipelines, transmission lines and seismic lines;

d) Well sites, archaeological and historic sites; and,

e) Riparian areas, or large water features and boulders in the plot.

If required, use the following protocols to move a plot (same as described in the PGYI manual):

1). From the original centre, move plot centre north 30 m – check location
2). From the original centre, move plot centre northeast 30 m – check location
3). From the original centre, move plot centre east 30 m – check location
4). From the original centre, move plot centre southeast 30 m – check location
5). From the original centre, move plot centre south 30 m – check location
6). From the original centre, move plot centre southwest 30 m – check location
7). From the original centre, move plot centre west 30 m – check location
8). From the original centre, move plot centre northwest 30 m – check location

If no suitable location is found, evaluate whether the stand should be abandoned. If not, it is permissible to keep adding another 30 m sequentially to the north, northeast, east, southeast, south, southwest, west and northwest and repeat this progress as necessary until a suitable location is found. Reasons for re-locating the plot must be clearly described and consistently applied when the same situations arise. Plots located in a harvest area should never be moved out of the harvest area.

Plots dropped from the planned grid require a detailed description of why the location is unsuitable.

5. Plot Size, Shape and Tagging Limit

Three nested circular subplots are used to capture detail on the range of tree sizes (germinates to mature trees). The three plots include a main tree plot, a sapling tree plot and a regeneration tree plot. The sapling and regen subplots will have the same centre as the main plot.

- Main tree plot: 0.04ha (400 m^2 or 11.28 m radius)

- Sapling tree plot 0.01ha (100 m^2 or 5.64 m radius)

- Regeneration tree plot 0.005ha (50m^2 or 3.99 m radius)

Table 1: PSP Size

Plot Type	**Plot Size**	**Tagging Limit**
Main Tree Plot	0.04ha (400m^2) -11.28m radius	DBH ≥ 5.1cm
Sapling Tree Plot	0.01ha (100 m^2) - 5.64m radius	Ht ≥ 1.3m & DBH < 5.1cm
Regen Tree Plot	0.005ha (50 m^2) - 3.99m radius	Tallied

In the main plot, all trees with a diameter at breast height greater than the Main Tree Plot tagging limit (≥5.1 new, ≥7.1 historic) need to be tagged and measured. In the sapling plot all trees equal to or taller than 1.3 m with a dbh less than the main plot-tagging limit will be measured and recorded; in the regeneration plot all live trees taller than 0.3 m and shorter than 1.3 m will be tallied by species.

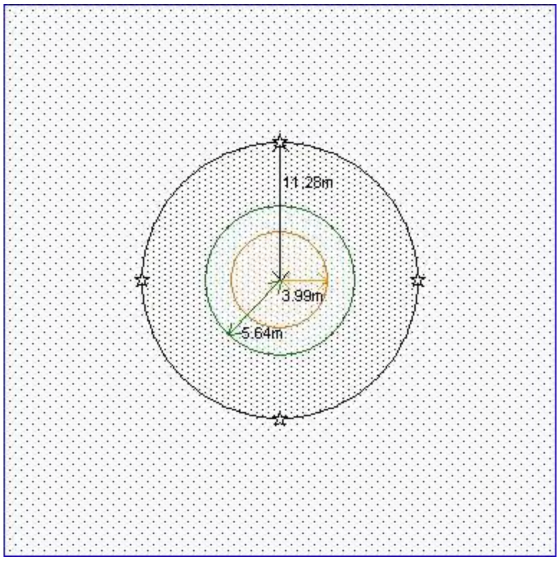


Figure 1: Layout of the main, sapling and regen plots.

The diagram shows a 400 m^2 main plots, 100 m^2 sapling plot, and 50 m^2 regen plot

When establishing the plot boundaries, horizontal distance should be used for all measurements. Each measurement should be corrected for slope, either by holding the tape horizontally in low slope situations, or by using slope correction factors to convert horizontal distance to slope distance (see Appendix II – Slope Conversion Factors).

6. Plot Buffer

A square buffer will be established approximately 45-meters from the plot center (90m by 90m, or 0.81ha in area). Trees on the perimeter of the buffer will be painted (using blue tree paint) at eye level on the outside side of tree, to ensure that the buffer is readily identifiable. All corners of the buffer will be identified with metal tags, and have their location captured by GPS point and noted on the plot documents.

Post-harvest plots will utilize aluminum conduit to mark the buffer boundary within the cutblock area. For regenerating stands less than 1.5-meters in height, a minimum of five conduit posts per buffer side is required; conduit to be spaced at 22.5-meters, painted blue, with blue (winter-weight) flagging to be hung between posts.

7. Tree Numbering

A unique number will be assigned to each stem in the plots starting from 1 and going up sequentially regardless of whether the stem is a tree (≥5.1 cm in DBH) or a sapling (> 1.30 m in HT and < 5.1 cm in DBH). Tree numbering will never change over the life of the plot.

Table 2 - Tree number identification

Number sequence	Tree type
#s 0-6999	Trees (DBH ≥ tagging limit)
	Saplings (≥1.3 HT & < tagging limit)
#s ≥9000	Age trees

Trees will be ‘cabled’ using aluminum or galvanized wire (1/16th inch) with a numbered aluminum tree tag placed on the table. Tags should be cabled to the tree around 1.3m of height. In managed stands, leave lots of cable to allow for diameter growth of the trees.

Tagging and stem mapping is done in an orderly fashion to facilitate subsequent measurements. For the circular plot tree tagging, divide the plot into pie shaped pieces. For the first pie shaped piece starting at the center tag the trees in consecutive order by weaving through the plot. Continue consecutively tagging trees in the adjacent pie shaped piece weaving back toward the plot center. Weave in and out of each pie shaped piece until all main plot trees are tagged. See Figure 2: Tagging Layouts

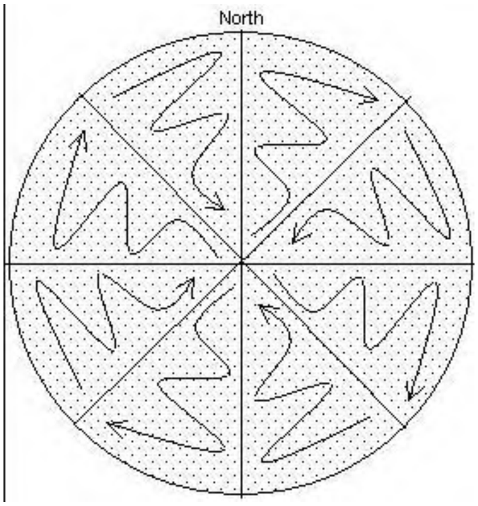


Figure 2: Tagging Layouts

Tree/sapling numbers should never be changed or moved.

Occasionally, trees may be missed when the initial numbering is carried out. These trees may be noticed further along the tagging process or after, as the trees are being measured. If this occurs, the tree should be numbered with the next consecutive number in the series for the plot. For example, if the PSP has 204 trees and one was missed, it will become tree 205. The stem mapping information will be used in future measurements to find the out of sequence tree/sapling.

Borderline trees must have their distance from plot centre checked to ensure that they are within the Tree Plot. Measure the horizontal distance from plot center to the point of germination to determine if they are “in” (Figure 3).

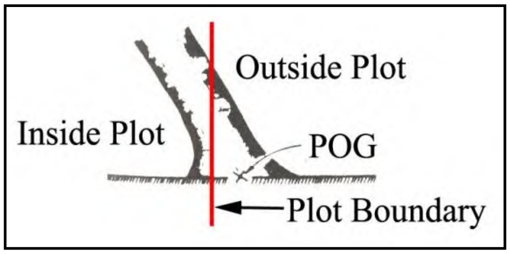


Figure 3. Example of a tree that is "out"

Forked trees (i.e. trees with multiple leading stems) are treated as a single stem or two stems depending on the height at which the fork occurs. If the fork occurs below 1.3 m (breast height), it is treated as two separate stems. Each fork will be numbered, tagged and measured separately. Trees forked above breast height are treated as a single stem.

If a plot has no tagged trees, a tree number of 0 is to be used to demark nil tally plots, along with species code ="No"

8. Stand Origin

Stand origin is used to denote the primary origin of the stand at the time of plot establishment:

C — Sucker (from the roots or base of a tree) or Coppice (from downed logs, stumps/snags)
L — Layering (from the rooting of un-detached branches)
F — Fill-planted (in areas of inadequate stocking to achieve the desired level of stocking)
P — Planted
B — Both plant and coppice
R — Residual stand
N — Natural (fire-origin)
S — Naturally seeded (i.e., a conifer block that was left for natural)
A — Artificially seeded

An origin of "Natural (fire origin" (N) should be used for all natural stands, while other stand origins should be used for all post-harvest stands.

9. Stand Type

Used to indicate if the plot is located in fire-origin natural or regenerated (post-harvest) stand:

1 — Fire-origin natural
2 — 1st rotation post-harvest
3 — 2nd rotation post-harvest

The stand type is determined prior to plot establishment.

10. GPS Location

GPS reading of the plot centre, UTM 11, NAD83,

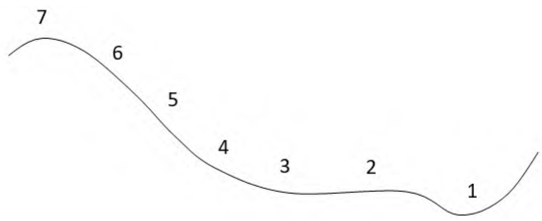
Easting, i.e., eastward-measured distance (also known as the x- coordinate).

Northing, i.e., northward-measured distance (the y-coordinate).

The plot center must be confirmed using GPS coordinates from a device with an accuracy of +/- 0.5 meters. Always take a field GPS point at plot center so the accuracy of the planned vs actual location can be determined.

11. Topographic Position

A number from 1 to 7 used to indicate the relative topographic position of the plot, in a hydrological sense, when compared to the general immediate area surrounding the plot (see illustration below). It is related to soil drainage class.



1 — Hollow or depression, for plots located in local topographic depressions (collecting water)
2 — Flat or level, for plots located on flat terrain (receiving water)
3 — Toe, for plots at the bottom of the slope
4 — Lower slope, for plots on low slope (shedding water)
5 — Middle slope, for plots on mid slopes (shedding water)
6 — Upper slope, for plots on upper slopes (shedding water)
7 — Hilltop or crest, for plots located on ridge crests (shedding water)

12. Slope

A number representing the average percent slope for the plot, recorded to the nearest ±1%. If there is no slope, zero is recorded. Make sure the slope measurement is in %, not in degrees.

13. Aspect

The predominant aspect, i.e., the direction that the slope faces, of the plot:

N — North,	E— East,	S — South,	W — West,
NE — Northeast,	SE — Southeast,	SW — Southwest,	NW — Northwest,

NA — No aspect or not applicable (i.e., when slope = 0)

14. Elevation

Elevation is the height above mean sea level, taken at the plot centre and recorded to the nearest ±1 m (e.g., 1368 m).

15. Natural subregion

Most recent (2006) Natural regions and subregions of Alberta – will be determined from GPS location in a GIS system.

16. Opening info

Opening number applies to post-harvest stands only. It is a unique number assigned based on the legal location of the centroid of the harvest area. Information will be provided for plot establishment.

III. Plot Measurement

Plot

If the plot is being re-measurement, use the existing plot center post to re-establish the plot boundary. If the post is missing, re-establish it using the surrounding witness trees. Any other missing posts should also be replaced. All plot posts should be repainted blue.

Check the buffer and repaint the buffer trees if necessary. Check both the plot and the buffer for any damage (e.g., seismic line, logging) that may have occurred since the previous measurement and record these on the PSP Plot Form

17. Additional Plot tie point info

Record any changes to the plot access which have occurred since the previous measurement.

18. Plot Measurement Date

Year-Month-Day plot measurement were started. Plot measurements must be completed within a week of starting measurement.

19. Plot Measurement Number

Number denoting measurement -1 (establishment), 2, 3 and up representing the measurement number.

20. Contractor and Crew Members

Record the name of the field contractor who undertook data collection. Record the first initial plus the last name of field crew members (up to two members).

21. Confirm Slope

Confirmation of slope from previous measurement. Follows convention outlined in plot establishment, # 12.

22. Confirm Aspect

Confirmation of aspect from previous measurement. Follows convention outlined in plot establishment, # 13.

23. AVI Field Call

AVI field-call is made by a trained field crew member. Year of call is taken from the plot measurement date. In stands with more than one distinct layer of trees, a separate AVI call for the overstorey and the understorey shall be made.

Table 3: AVI Field Call Variables

Moisture Regime	Density	Stand Height	SP1-5 with %
d = dry; m = mesic; w = wet; a = aquatic	A = 6 to 30% B = 31 to 50% C = 51 to 70% D = 71 to 100%	Average height (m) of the layer	Tree species *X*, Tree % (to the nearest 10%)

A More detailed descriptions about the variables are provided in PGYI Manual (July 2015).

Examples (standard format): mC14Aw5Pb3Sw2 (overstorey AVI field call), mD28Aw5Pb2Sw2Fb1 / mA8Sw6Fb3Sb1 (overstorey and understorey AVI field call), xX00No00 (non-treed e.g. post-harvest prior to reforestation).

24. Ecosite & Ecosite Phase

Ecosites and ecosite phases are determined using the *Field Guide to Ecosites of Southwestern Alberta* (1996) and the most recent natural subregion information (2006).

25. Surface Vegetation Cover

Percent of the ground that is covered by the crown closure of all shrubs, herbs/forbs, grasses and moss/lichen from a 10 m^2 circular area around the plot centre. This is recorded to ±5%. The sum of the percentage for the four groups can exceed 100%, but the individual values cannot exceed 100%.

26. Plot Status and Condition

The most obvious general status and condition of the plot at the time of measurement.

Table 4: Plot Status and condition code

1	Active and no obvious damage	12	Destroyed (fire)
2	Natural damage (severe wind)	13	Destroyed (climate/weather)
3	Natural damage (flood and water)	14	Plot closed and reopened
4	Natural damage (defoliation)	15	Burned
5	Man-made damage (road, seismic, pipeline)	16	Missing or lost
6	Man-made damage (herbicide or any treatment)	17	Mistletoe
7	Natural and man-made damage (cause unknown)	18	Mountain pine beetle
8	Harvested or cut down	19	Spruce bud worm
9	Horse logged or partially harvested	20	Plot harvested & re-established
10	Inactive, closed or abandoned	21	Closed for other reason(s)
11	Destroyed (anthropogenic or man-made)		

27. Plot disturbance

Disturbances that have occurred in the plot following establishment. Severe level of plot disturbance is denoted as “destroyed” or “missing or lost”:

Table 5: Plot disturbance code

BU	Partially burned	DA	Destroyed (anthropogenic or man-made)
DC	Destroyed (climate/weather)	DF	Destroyed (fire)
HL	Partially harvested	MI	Missing or lost
MLU	Man-made (seismic, pipeline)	MU	Cause unknown

NDC	Natural (climate)	NDD	Natural (defoliation)
NDI	Natural (insect, disease)	NDW	Natural (defoliation)

Plot disturbances are distinguished from plot treatments because plot disturbances are typically unplanned events. Plot disturbance codes (and associated years, months and days) should be used in the order in which the disturbances occurred.

If possible, record the disturbance date YYYY-MM-DD.

28. New Plot comments

Any new comment or notes for any unusual or unique information observed in the field by field crew.

29. Action items for re-measurement

If there are items identified on the remeasurement plot card, the items MUST be double checked or corrected at the measurement.

Tree and Sapling Plot

30. Tree Number

As new trees/saplings grow into the minimum tagging limits, based on the plot which they are located within, the stem will need to be tagged. Use the protocol in #7 on page 4 to establish the tree number. New stems are not added to the regeneration plot. Note- in some cases the remaining stamped tags are left at the plot center post. Do not use "Butter-soft" tags or tags where a pen impression is used to form the number.

31. Tree type identifier

T — Regular tree measured in the main tree plot to the specified tree tagging limit
S — Sapling tree measured in the sapling plot to the specified sapling tagging limit
R1 — R10 regeneration tree measured in regeneration plot 1 to 10 to the regeneration tagging limit
B — Tree measured in the plot buffer or outside the main plot (i.e. age trees)

Note that tree type can only change irreversibly from 'R' to 'S' to 'T', even if the height or DBH of a stem changes to below a relevant tagging limit at re-measurements, unless the previous recorded value was in error.

32. Tree Origin

Each tagged stem is assigned an origin (only needs to be done during plot establishment & when new trees/Saps are added to a plot).

0 — Unknown
1 — Naturally seeded
2 — Sucker (from the roots or base of a tree) or Coppice (from downed logs, stumps/snags)
3 — Layering (from the rooting of un-detached branches)
4 — Natural but unknown or not sure
5 — Artificially seeded

6 — Planted, regular stock
9 — Advanced prior to the date of harvest
10 — Veteran/remnant or super-dominant from a previous generation

33. Species

Each tagged tree will be defined by their appropriate species code as provided below

Table 6: Species Codes

Code	Common Name	Scientific Name
Sw	White spruce	Picea glauca (Moench) Voss
Se	Engelmann spruce	Picea engelmanii Parry
Sb	Black spruce	Picea mariana (Mill) B.S.P.
Pl	Lodgepole pine	Pinus contorta var. latifolia Dougl.
Pw	White bark pine	Pinus albicaulis Engelm.
Pf	Limber pine	Pinus flexilis James
Pj	Jack pine	Pinus banksiana Lamb.
Fb	Balsam fir	Abies balsamea (L.) Mill
Fa	Alpine fir	Abies lasiocarpa (Hook) Nutt.
Fd	Douglas fir	Pseudotsuga menziesii (Mirb.) Franco
Lt	Tamarack	Larix laricina Nutt.
Lw	Western larch	Larix occidentalis Nutt.
La	Alpine larch	Larix lyalli Parl.
Aw	Trembling aspen	Populus tremuloides Michx.
Pb	Balsam poplar	Populus balsamifera L.
Bw	White birch	Betula papyrifera Marsh.
Dd	dead deciduous	-
Dc	dead conifer	-
Du	dead unknown	-
No	No tree	-

Shrub species are not identified, nor measured or recorded.

34. DBH

Unless specified otherwise, diameter breast height (DBH) always refers to the tree diameter (cm) at the breast height of 1.30 m above ground from the point of germination. DBH is not taken from vertical because of the possible changes in the amount of lean over time; also, note that ground level may rise with time due to subsidence of adjacent ridges and litter accumulation. Defects or whorls will be avoided by measuring diameter immediately above or below the distortion and recording the height of DBH below. Examples of DBH anomalies and the procedures to measure the DBH in those cases are shown in Appendix III – DBH Measurement. Record diameter to the tenth of a nearest millimetre.

DBH is measured for all numbered stems in the main tree plot and sapling plot. It is recorded to the nearest 0.1 cm. DBH is measured and recorded for all dead but standing trees that can be found in the plot.

35. Height of DBH

Refers to the height (to 0.01 m) along the bole at which the DBH is measured. The default is always 1.30 m. Where DBH is measured, the height at which the DBH is measured must be recorded. Height of DBH may differ from 1.30 m in some special cases (e.g., swelling, forked trees).

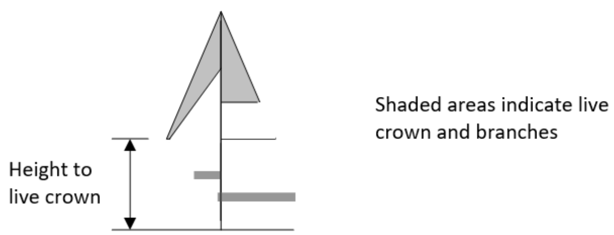
36. Height

Tree height will be measured for every tree and sapling stem. Height refers to the total tree height (m), taken from the ground to the tip of the tree, regardless if the tip is alive or dead. Height is not recorded for dead trees. Height must be measured to the nearest 1 cm if a tree is shorter than 2 m. Taller trees can be measured to the nearest 10 cm. For leaning trees, the height should be taken from the direction perpendicular to the lean of the tree, as shown in Appendix IV – Height Measurement

An 'X' with a lumber crayon, or a dot should be marked in the direction from which tree height was recoded. This will facilitate quality control on height measurement.

37. Height to Live (HTLC)

Height to live crown refers to the height (m) from the ground to the lowest point of the continuous live crown, recorded to the nearest ±10 cm (or ±1 cm if a tree is <2 m The lowest point of the continuous live crown refers to where live crown begins a continuous progression to the top of the tree. It is not necessarily the first live branch above ground, nor a full or near-full live crown circling the stem, as the live crown could be asymmetric due to inter- and intra-specific competition (see illustration below).



38. Crown Class

Crown class refers to the position of an individual tree with the canopy of the stand inside the plot. Crown class is recorded for all tagged trees except those recorded as dead or found missing (in subsequent measurements).

Dominant (D) — crowns extend above the general level of the canopy
Co-dominant (C) — crowns form the general level of the canopy
Intermediate (I) — below dominants and co-dominants, but extend below bottom of the canopy
Suppressed (S) — crowns entirely below the general level of the canopy
No crown class (N) — e.g., tree with severe lean, broken top, broken stem, dead, standing dead

39. Degrees of Lean

If the tree is leaning by more than 10 degrees, record the amount of lean (degrees).

40. Condition Codes

Trees will be assigned up to 3 tree condition codes and their associated causes and severities. The codes are listed below and are assigned in the general order of severity with which they appear on the tree. Each set of tree condition codes consists of a condition, a cause, and a severity. Condition is the effect, the resulting condition seen on the tree. Cause is a description of what happened to put the tree in that condition. Severity is how much the condition is expected to impact a tree's long-term growth and survival.

When multiple causes are suspected for the same condition, crew members can choose to either record the most obvious cause or record the same condition more than once and assign it different causes. For example, a tree can have all 3 condition codes assigned as “bole damage” but have 3 different associated causes “mountain pine beetle”, “western gall rust” and “stem disease”.

Table 7: Tree condition code look-up table

Condition		Cause		Severity	
0	Live and healthy	1	Spruce budworm	1	Minor
1	Dead but standing	2	Defoliator	2	Moderate
2	Dead and down (@ re-meas.)	3	Mountain pine beetle (MPB)	3	Severe
3	Broken or dead top	4	Root collar weevil	9	Unknown or N/A
4	Bole damage	5	Terminal weevil		
5	Crown damage	6	Armillaria root disease		
6	Root damage	7	Shepherd’s crook		
7	Crook	8	Dwarf Mistletoe		
8	Sweep	9	Stem disease		
9	Fork (e.g., multiple leaders above DBH)	10	Western gall rust (WGR)		
10	Lean	11	Animal damage		
11	Poor form	12	Wind damage		
12	Same stump (e.g., fork below DBH)	13	Snow/ice/frost damage/cracks		
13	Harvested tree or cut down tree	14	Hail damage		
14	Missing tree	15	Fire damage		
15	Disqualified tree	16	Mechanical damage		
16	Newly qualified tree	17	Improper planting		
17	Re-numbered tree	18	Poor ground conditions		
		19	Competition		
		20	Insect (other)		
		21	Disease (other)		
		22	Climate/weather/flood damage		
		23	Anthropogenic damage		
		99	Unknown or N/A (not applicable)		

Healthy trees are assigned a condition code of 0-99-9

41. Azimuth

Azimuth describes the direction of the base of a stem, in degrees, measured clockwise from the north from the main plot centre. A tree due north has an azimuth of 360.0°, one due east has 90.0°, south 180.0° and west 270.0°. Azimuth is usually recorded to the nearest ±1 or ±0.5 degree if possible. Note – 360.0° is used for trees due north of the plot centre, and not 0.0°. All tagged stems need to be stem mapped.

42. Distance

Distance from plot centre refers to the distance (m) from the centre of the main plot to the centre of a stem. This is recorded to ±0.01 m where possible. All tagged stems need to be stem mapped.

Regeneration Plot Data

43. Regenerating Species

Regen sized tree species present in the regeneration subplot. Refer to Table 6: Species Codes on 11 for the list of possible species.

44. Regenerating Density

Number of live regen sized trees (≥0.30 m and < 1.30m) present in the regeneration subplot by species.

IV. Tree Age

Age for Natural Stands

This procedure for determining age of the stand in natural stands follows the PGYI protocol. Age measurements for each species will typically be done once only, unless a specific *Action item for re-measurement* is noted on the plot card.

1. The two largest diameter trees per species are aged, for up to five most abundant tree species with 10% or more species composition in the stand, where species composition is determined by stand density (stems/ha) proportion.
2. If aging is difficult due to rot etc., a minimum of one tree age is required in pure species stands, and a minimum of two tree ages for two species are required in mixed-species stands. No effort will be made to find smaller trees to replace the suitable age trees.
3. To avoid damaging trees, affecting tree growth, and/or introducing insects and diseases, aging must be done outside the main plot.
4. Aging shall be done in a 200 m^2 (7.98 m radius) circular age plot placed in the northwest corner of the main plot buffer. The nearest edge of this 200 m^2 age plot should be about 20 m away from the edge of the main plot to avoid any potential edge effect. In some cases, the age plot may be extended to outside the plot buffer if the area is representative of the main plot.
5. If the minimum requirement of one tree age for pure species stands and two tree ages for two species in mixed-species stands is not met, the original location of the 200 m^2 age plot is abandoned, and a new age plot is attempted, sequentially, to the north, northeast, east, southeast, south, southwest, and west of the plot, until the minimum requirement is met. The entire plot installation is abandoned if the minimum requirement is not met.
6. Breast height age is the preferred age to collect. If breast height age is not available (e.g. whorl or fork) and the tree selected is the best age tree, the stump age should be collected.
7. In addition to age(s), all age trees must have the species, origin, DBH, height, height to live crown, crown class, and condition/cause/severity codes recorded. The distance and azimuth to plot center should also be estimated.
8. All age measurements must be verified from cores in the office. Ages from trees with rot are unacceptable.

To be considered suitable age trees, the two largest diameter trees per species must satisfy:

a) Live and healthy looking;

b) No broken or dead top;

c) Not an advanced/remnant/veteran or a super-dominant from a previous generation;

d) No leaning ≥45^0, not a wolf tree or of obvious poor form (e.g., crook, sweep, fork); and

e) No severe damage to more than 1/3 of bole, crown and/or root.

Note that crown class is not used as a criterion in selecting suitable age trees, as the largest diameter trees for a species may be in different layers/cohorts during different stand development stages. Crown class could also be subjective or difficult to tell, especially in mixed-species stands.

Age for Managed Stands

For plot establishment, the five largest diameter trees per species are aged, for up to five most abundant tree species. Ages can be done on the trees inside the PSP itself with no need to establish an adjacent circular plot in the PSP buffer. The five largest diameter trees / species only need to be aged at plot establishment.

For plot remeasurements, a maximum of five largest trees / species needs to be aged if stem has moved into the tree size category (i.e. DBH ≥ tagging limit). Example – when remeasuring a plot, seven pine and three spruce have increased in diameter and are now greater than 5.1 cm at DBH. The five largest pine and the three spruce need to have their age recorded at the remeasurement.

The procedures for total age follow the RSA protocol. Harvest area treatment information needs to be referred to before assessing age (i.e. harvest date, planting date, fill plant date or tending information etc.).

Total age is the number of years since germination. To field-age a tree:

1. Count the number of branch whorls on coniferous trees or bud scars on deciduous trees.
    a. Lammas growth (advanced growth or cases where the tree puts two whorls in one year) do not contribute towards age determination.
    b. In dense stands be aware not to miss whorls that have died back.
2. From the current season's growth (i.e., terminal leader) down to the root collar node;
3. Add one year (germination to cotyledon); and,
4. Record age.

For surveys conducted during the active height growth period (May, June, and July), the age of the tree shall not incorporate the current year's growth. Height measurements during this period must correspond with the appropriate aging point on the stem, which is at the terminal bud set the previous year.

For surveys conducted after August 1, include the current year's growth in determining tree age. For any seedlings planted prior to June 20, the growing season in the year the seedling was planted may be counted as one year.

As a check, total age of top height trees, as determined in the field, may be compared to the opening age or silviculture treatment activities. Total age should not exceed the number of growing seasons since harvest (plus age at out-planting for planted stock).

V. Data Collection summary

Data reporting

In the table below the *italic* only needs to be captured at time of establishment & should be present on remeasurement plot card. The black text needs to be captured at every measurement (including plot establishment) unless it is a confirmation from the previous measurement (i.e. additional TP info). Sample tally sheets used to collect the data are provided in Appendix I – Sample Measurement Cards

Table 8: Summary of data collected

Item #	Plot Data Collection	Examples and notes	Page
Plot info, size and tagging limits			
1	*Company Plot Number*	Company generated #	Page 2,
3	*Tie Pont info*	Description of how the plot is accessed	Page 2
5	*Tree plot size*	400.0 m² or 800.0 m²	Page 3
	Minimum tree tagging limit	5.1 cm (7.1 cm historic)	
	Sapling plot size	100.0 m² or 50.0 m²	
	Sapling tagging limit – DBH	0.1 cm	
	Sapling tagging limit – height	1.30 m	
	Regeneration plot size	50.0 m²	
	Regeneration tagging limit (C)	not tagged (but tallied)	
	Regeneration tagging limit (D)	not tagged (but tallied)	
8	*Stand origin*	e.g., C=Coppice/sucker, P=Planted, R=Residual stand	Page 6
9	*Stand type*	Natural (1), or post-harvest (2, 3, etc.)	Page 6
10	*GPS – easting (x-coordinate)*	GPS of plot centre	Page 6
	GPS – northing (y-coordinate)	GPS of plot centre	
11	*Topographic position*	e.g., 1=Hollow or depression, 7=Hilltop or crest, etc.	Page 7
12	*Slope*	Average percent (%) slope of the plot	Page 7
13	*Aspect*	e.g., N=North, NW=Northwest, NA=No aspect (slope = 0)	Page 7
14	*Elevation*	Height above mean sea level	Page 7
15	*Natural subregion*	LF, UF, M, A	Page 7
16	*Opening number*	e.g., 5230755229A	Page 7
Plot Measurement info			
17	Additional Tie Point info	Additional info not noted	Page 8
18	Measurement Date	YYYY-MM-DD	Page 8
19	Measurement Number	1 (establishment), 2, 3 and up sequentially	Page 8
21	Confirm Slope	Confirmation of pervious record	Page 8
22	Confirm Aspect	Confirmation of pervious record	Page 8
23	AVI Field Call	Description of stand from the ground	Page 8
24	ecosite & ecosite phase	Using Field Guide (Southwestern Alberta)	Page 9
25	Surface Vegetation	Forb and herb cover	Page 9
26	Plot status and condition	Status and condition noted at time of field measurement	Page 9
27	Plot disturbance	Disturbance noted at time of field measurement	Page 9

28	New comments	Notes or comments for unusual or unique information	Page 10
20	Contractor	Name of field contractor	Page 8
	Crew member 1	First initial plus the last name of field crew number 1	
	Crew member 2	First initial plus the last name of field crew number 2	
Tree and sapling measurements			
30	*Tree number*	0-6000 for trees and saplings, 9000+ for age stems	Page 10
31	*Tree type identifier*	Identifies the type of tree in the specific plot area	Page 10
32	*Tree origin*	0=Unknown, 1=Naturally seeded, 10=Veteran	Page 10
32	Species	Tree/Sapling or Regenerating species type	Page 10
34	DBH	Diameter Breast Height in cm	Page 11
35	*Height of DBH*	Height of DBH, default is 1.30 m	Page 11
36	Height	Total height (In meters)	Page 12
37	Height to live crown (HTLC)	Lowest level of continuous crown (in meters)	Page 12
38	Crown class (CC)	D=Dominant, C=Co-dominant, etc.	Page 12
39	Lean	Lean in degrees, for trees over 10 degrees	Page 12
40	Condition code 1 (condition)	General tree health by assessing condition, cause and severity	Page 12
	Condition code 1 (cause)		
	Condition code 1 (severity)		
	Condition code 2 (condition)		
	Condition code 2 (cause)		
	Condition code 2 (severity)		
	Condition code 3 (condition)		
	Condition code 3 (cause)		
	Condition code 3 (severity)		
0	Azimuth	Azimuth (in degrees) from plot centre	Page 13
42	Distance	Distance in metres from plot centre	Page 13
Regeneration Density counts			
43	Regenerating species	Species of regen sized trees located in the regen plot	Page 14
44	Regenerating density count	Number of live regen sized trees in the regen plot by species	Page 14
Tree Age			
IV	Breast height Age	Age of the tree recorded at 1.30 m	Page 15
	Stump Age	Age of the tree recorded at 0.30 m	
	Total Age	Total age of the tree determined using the RSA	

Additional Condition code information

Table 9: Tree Condition Codes

CC	Tree Condition	Description of Use
0	Live and healthy	A tree is live and has no noticeable defect or damage.
1	Dead but standing	A tree is completely dead (i.e., no live buds or foliage) but remains standing.
2	Dead and down (at re-measurements)	Used in plot re-measurements when a tree is dead and no longer supported by its root system. The tree must be located in order to use this code.
3	Broken or dead top	The upper portion of the tree has died or broken off.
4	Bole damage	The main stem of a tree is damaged as a result of mechanical or abiotic factors or from animal, insect, disease or anthropogenic activity.
5	Crown damage	A tree's crown is damaged as a result of mechanical or abiotic factors or from animal, insect, disease or anthropogenic activity.
6	Root damage	The root system of a tree is damaged as a result of mechanical or abiotic factors or from animal, insect, disease or anthropogenic activity.
7	Crook	The bole of a tree exhibits an abrupt curvature.
8	Sweep	The bole of a tree exhibits a gradual curvature. This includes "pistol grip" trees which have a large horizontal displacement at their base.
9	Fork	Used for all prominent forks above DBH. Forks occur where there has been damage to the main leader and must not be confused with the natural branching patterns on hardwoods. Stems which have multiple leaders originating above DBH will also be given this code.
10	Lean	A tree that is leaning a minimum of 10 degrees from vertical.
11	Poor form	This applies to trees which have form defects other than crooks, sweeps and forks. This includes excessively limby trees (wolf trees), trees with multiple leaders (where no distinct fork is present) and various other tree form anomalies.
12	Same stump	Used when two or more trees share the same stump (i.e., forked below DBH). Note that all trees originating from the same stump receive the 12 code.
13	Harvested tree	Used in plot re-measurements when a tree has clearly been harvested. The location of the stump will have to be verified with the previous data before a 13 code can be assigned.
14	Missing tree	Used in plot re-measurements to represent a tree that can no longer be located.
15	Disqualified tree	Used in plot re-measurements when a tagged tree no longer satisfies the necessary criteria under current PSP protocols to be tallied as a tree.
16	Newly qualified tree	Used in plot re-measurements, when a tree was clearly missed during a previous measurement.
17	Re-numbered tree	Used in plot re-measurements when a tree was clearly not missed during a previous measurement, but the tree tag is sucked into the bole, missing or unrecognizable, or a different number is assigned under current PSP protocols.

Table 10: Causal Agents

Code	Cause	Description of Use
1	Spruce Budworm	Tree shows evidence of Eastern Spruce Budworm (*Choristoneura fumiferana* (*Clemens*)) attack. Symptoms include: webbing, frass and rust colouring on the tree crown. Primary hosts are white spruce, black spruce and balsam fir.
2	Defoliator	Tree shows evidence of attack from any defoliating insect other than spruce budworm.
3	Mountain Pine Beetle	Tree shows evidence of mountain pine beetle attack (*Dendroctonus ponderosae* (*Hopkins*)). Symptoms include: evidence of entrance or exit holes and accumulations of pitch and sawdust. Primary hosts are lodgepole pine and jack pine.
4	Root Collar Weevil	Tree shows evidence of attack from any species of root collar weevil. Identified by presence of resin flow and tunnels in the bark and cambium at or below the duff layer. Most conifer species are susceptible to root collar weevil attack.
5	Terminal Weevil	Tree shows evidence of attack from any species of terminal weevil. Identified by presence of bent-over leaders with obvious exit holes. Most conifer species are susceptible to terminal weevil attack.
6	Armillaria Root Disease	Tree shows evidence of attack from Armillaria root disease (*Armillaria spp*.). Identified by the presence of mycelial fans around the root collar.
7	Shepherd's Crook	Tree shows evidence of aspen leaf and twig blight (*Venturia spp*.) which causes terminal shoots and leaves to wilt and turn black, ultimately forming a shepherd's crook.
8	Dwarf Mistletoe	Tree shows evidence of dwarf mistletoe (*Arceuthobium spp*.), notably the characteristic witches broom associated with this parasitic plant. Most species of conifer are susceptible.
9	Stem Disease	Tree shows evidence of a stem pathogen typically caused by canker, heart rot and sap rot diseases. Evidence is usually in the form of a canker (sunken or swollen lesion), conk or other fruiting body on the stem.
10	Western Gall Rust	Tree shows evidence of western gall rust (*Endocronartium harknessii* (*J.P. Moore*) *Y. Hairatsuka*) most notably woody swellings (galls) on the main stem and/or branches. Primary hosts are lodgepole pine and jack pine.
11	Animal Damage	Tree has been damaged by any type of mammal or bird. This includes small mammal feeding, ungulate rubs, ungulate browsing, beaver damage, woodpecker and sapsucker damage, etc.
12	Wind Damage	Tree exhibits signs of wind damage.
13	Snow/Ice/Frost Damage	Tree has been damaged by snow, ice or frost. This may result from ice build-up, heavy snow loads and early or late frosts which damage trees that are not properly hardened off. This includes: snow press, frost cracks and frost heave.
14	Hail Damage	Tree has been damaged by hail. Signs of hail damage may include stripped branches and extensive scarring on stems and branches. Damage is greatest on younger shoots, making younger trees more susceptible.
15	Fire Damage	Tree has been damaged as a result of burning or scorching
16	Mechanical Damage	Tree has been damage by the natural mechanical action of trees contacting each other, resulting in scarring or crown damage.
17	Improper Planting	Tree has been planted in a manner that is adversely affecting growth. This includes J-rooted trees, shallow or deeply planted trees, trees that are planted loosely or trees planted at an acute angle.
18	Poor Ground Conditions	Tree has been planted in an inappropriate location (i.e., poor microsite selection) or where the seedbed is unsuitable for growing trees (i.e., hardpan, rotten logs, deep organic soil, etc.).
19	Competition	Tree is suffering from excessive competition from herbaceous or woody vegetation. It typically applies only to seedlings shorter than 1.30 m.
20	Insect (Other)	Tree shows evidence of attack from an insect other than those listed in 1 through 5 or from an unidentified insect.
21	Disease (Other)	Tree shows evidence of disease other than those listed in 6 through 10 or from an unidentified disease.
22	Climate, Weather or Flood Damage	Tree exhibits damage resulting from climate, weather or flooding. This includes damage caused by lightning, drought, sunscald and desiccation
23	Anthropogenic Damage	Tree exhibits damage resulting from some type of human activity. This includes damage from harvesting, land clearing, herbicide and other human caused activities.
99	Unknown	Tree has been damaged but cause could not be determined.

Table 11: Severity Codes

Code	Severity	Description of Use
1	Minor	Condition is noticeable but is unlikely to have an adverse impact on the long-term survival, growth or form of the tree. Impacts on fibre quality and yield at the time of harvest are expected to be negligible.
2	Moderate	Condition is obvious and could potentially have an adverse impact on the long-term survival, growth or form of the tree. If the tree survives, some minor to moderate impacts on fibre quality and yield at the time of harvest can be expected.
3	Severe	Condition is prominent and is almost certain to affect the long-term survival, growth or form of the tree (e.g., gull rust circling $^{3}50\%$ of the main stem, leaning $^{3}20^{0}$ off the vertical axis). If the tree survives, major impacts on fibre quality and yield at the time of harvest can be expected.
9	Unknown/ Not Applicable	The severity of the condition is not known, not applicable or unquantifiable.

VI. Plot Check Procedures

Plot checks are required to ensure that data collected meets or exceeds the desired standard. A minimum of 10% of the plots will be targeted for plot checks to ensure that allowable measurement errors are met.

Procedure to check permanent sample plot establishment and measurement:

1. Before proceeding to the field, record the data from the original tally sheets, for approximately 10% of the tagged trees including the tree number, dbh, crown class, condition codes, and tie point azimuth and distance (when recorded) on the sheet. In addition, 10% of the measured height should be checked.
2. The selected 'check' trees are measured and tallied directly below the copied data measured by the field crew. The two measurements are compared and should be within the allowable error limits (see Allowable Errors). On the Check Tally Sheet, only measurements not within the allowable error shall be "blocked in" red. If the two measurements are not within the allowable error limits, always assume the check cruise is correct. If measurement errors are common, additional trees may be checked. Other tree plot items that may be checked include buffer painting, recorded elevations, tag labeling, etc. Data pertaining to plot establishment, plot assessment, and stem mapping are also checked.
3. It is important to show the field crew the original tally sheets and the check crew sheets in order to point out any discrepancies. Any problems with the plot measurements should be discussed in a timely manner in order to prevent future errors.
4. When the Check Plot has been completed, the overall evaluation of the PSP is graded. The following is a guide used to evaluate the plot.

Excellent	no mistakes have been found in the check cruise
Very good	an occasional, minor error has been found in the check cruise
Satisfactory	a few errors have been found but their severity is minimal
Fair	errors are frequent and of a greater severity; additional fieldwork is required to correct the major mistakes
Unsatisfactory	errors are common and judged to be severe; fieldwork is required as the errors constitute an unacceptable plot and must be redone

Plots that have a grade of satisfactory or above can have any necessary corrections made on the tally sheets. The tally sheets are used to correct records in the original data set.

Plot Information Quality Control

The following is a guideline used to judge the correctness of each measurement type or required duty.

Plot Location	
Tie Point	Permanent location, visibly identifiable in the field (road intersection, bridge, cutline, wellsite, pipeline, *etc.*)

Tie Plate Tree	Clearly visible, painted blue and adequately flagged
Tie Line	GPS quadrants are captured correctly
Location of Plot Center	clearly marked, within +/-2% of the tie line horizontal distance
Access Notes, Access Map	access condition and directions to the plot clearly noted

Plot Size	
Main Tree Plot	+/-8% (radius); bearings from each plot center to each corner post must be within 2-degrees of specified bearings
Sapling Tree Plot	+/-8% (radius)
Regen Tree Plot	+/-8% (radius)
Plot Markers	Permanent markers and tags must be correctly marked and well-established (sturdy, durable to facilitate future re-measurement)
Buffer	Well-marked (highly visible) with blue paint

Plot Assessment

Field overstorey and understorey (where appropriate) must be correctly identified using the procedures described in section 22. Plot site attributes (slope, slope position, aspect) must be reasonably estimated. GPS coordinates and elevation must accurately describe plot location.

Tree and Plot Measurement Quality Control

No. Trees Tallied	
Main Tree Plot	No allowable error: all trees identified as within or outside the plot
Sapling Tree Plot	+/-5% of the total number of saplings sampled
Regen Tree Plot	More than 2 regen trees missed per species present

Species Identified	
Main Tree Plot	no allowable error
Sapling Tree Plot	no allowable error
Regen Tree Plot	No more than 2 of regen tallied may be incorrectly identified per species present

Measurements	
Diameter at Breast Height (DBH)	breast height should be correctly located at ± 6.5 cm from the recorded height of DBH; allowable error for the tree DBH is ±1.0cm
Height and Height to Live Crown	allowable error +/-3% with discretion used for identification of where the live crown begins
Crown Class	5% of the stems tallied may have an incorrect crown class or condition code
Stem Mapping	allowable error for azimuth is +/-2 degrees, for distances +/-0.5 meters except age trees

Remeasurement triggers

The checker will target a minimum of 10% of the stems within a plot. More than 10% may be checked at the checker discretion.

Diameters	If more than 3% of the total tagged trees checked (within the plot) are not within the 1.0 cm error range the entire plot/subplot will have the diameters remeasured this includes dead trees). Included in this are tags that are not readable, cables too tight, mislabeled tags
Heights	If more than 20% of those heights checked are out, the heights for that plot/subplot will be rejected.
Condition Codes	If more than 5% of the condition codes checked are missed or incorrect, the condition codes for that plot shall be re-done. A "missed" code will count as an error.
Crown Class	If more than 5% of the crown classes checked are incorrect, all the crown classes for that plot will be re-done.
Stem Mapping	If more than 5% of the combined check of azimuths and distances are incorrect, stem mapping will have to be re-done.

Appendix I – Sample Measurement Cards

SLS
Spray Lake Sawmills

Permanent Sample Plot Tally Sheet

Plot #: ______________
Meas #: ______________
Contractor: ______________

Meas Date
YYYY/MM/DD
___/__/__

Crew Members:
1: ________________
2: ________________

Page ____ of ____

Stand Origin: ______________

Plot Type: ______________

Stand Type: ______________

Plot Status: ______________

AVI Field Call: ______________

Natural Subregion: ______________

Topo Position: ________
Slope %: ________
Aspect: ________
Elevation: ________
Ecosite + Phase: ______________

GPS Easting (x): ______________

GPS Northing (y): ______________

Tree Plot Size: ______________
Min Tree tag limit: 5.1 cm dbh

Sapling Plot Size: ____________
Sap. tag Limit: > 0.1 cm; <5.1 cm dbh, >1.3 m height

Regen Plot Size: ____________

Disturbance Type: ______________
Disturbance Date: ___/__/__

Establishment Date: ___/__/__

Opening Number: ______________

Tie point Access info: ______________

Comments: ______________

Figure 4: Example Plot Header card

Spray Lake Sawmills

Permanent Sample Plot Tally Sheet

Plot Number: ______________

Meas Date YYYY/MM/DD ___/__/__

Crew Members:
1: _______________
2: _______________

Page ____ of ____

Regeneration tally (0.3 - 1.3 m)

record count of live conifer and deciduous species or NO

Pl ___ Aw ___
Sw ___ Pb ___
Se ___ Bw ___
Sb ___ ______ ___
Fa ___ ______ ___
Fb ___ ______ ___
Fd ___
Pw ___

Surface Veg Ground Cover:

% Shrubs ____
% Herbs/Forbs:
% Grass ____
% Moss/Lichen: ____

Age Trees

Tree #	Tree type	tree origin	Sp.	DBH	DBH Ht	Ht	Ht to Live	CC	Condition Codes						Az. fr. PC	Dis. Fr. PC	Tree Age		Comments
									CC1 con.	CC1 caus.	CC1 sev.	CC2 con.	CC2 caus.	CC2 sev.			Age	BH or Stump age?	

Figure 5: Example age and regen tally plot card

SLS Spray Lake Sawmills **Permanent Sample Plot Tally Sheet**

Plot Number: ____________

Meas Date YYYY/MM/DD ____/__/__

Crew Members:
1: ____________
2: ____________

Page ____ of ____

										Condition Codes											
Tree #	tree type	Tree Origin	Sp.	DBH	DBH Ht	Height	Ht to Live	CC	Deg. Lean	CC1 con.	CC1 caus.	CC1 sev.	CC2 con.	CC2 caus.	CC2 sev.	CC3 con.	CC3 caus.	CC3 sev.	Az. fr. PC	Dis. Fr. PC	Comments

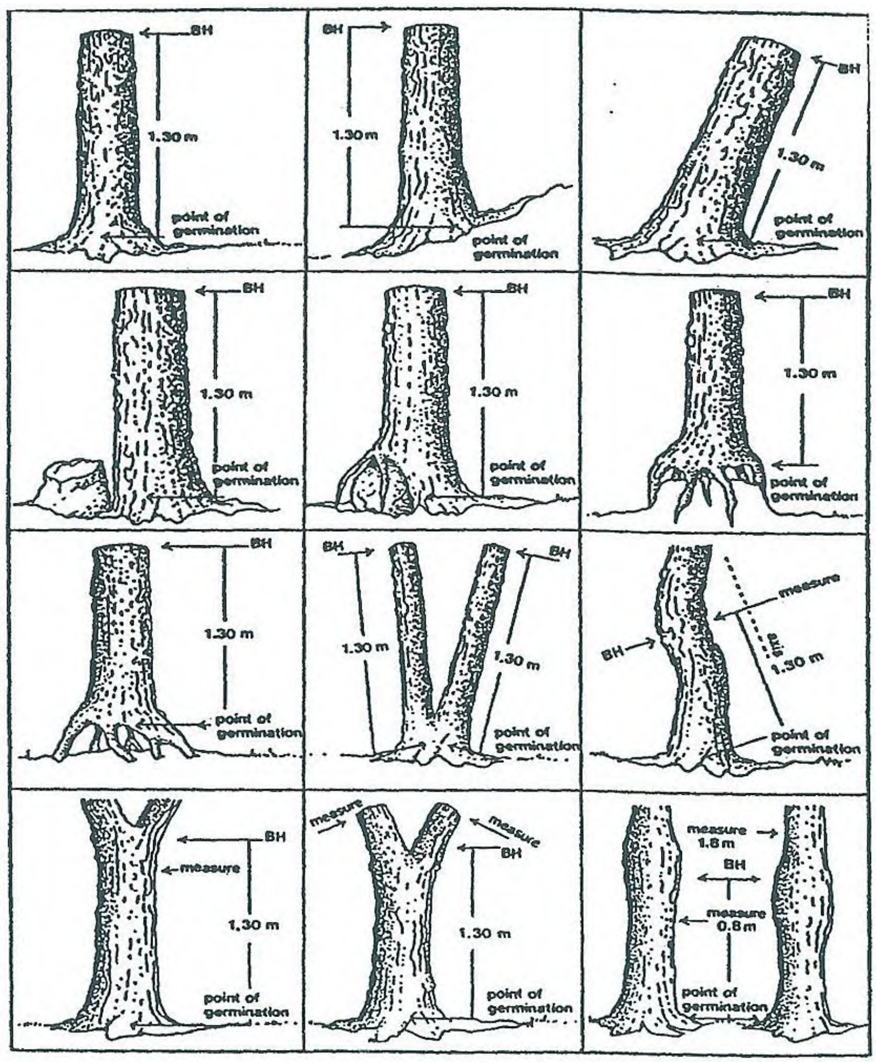
Figure 6: Example Tree and Sapling card

Appendix II – Slope Conversion Factors

Percent Slope	Slope Correction	Plot Radius (Horizontal Distance)			Percent Slope	Slope Correction	Plot Radius (Horizontal Distance)		
		7.98 m	5.64 m	2.82 m			7.98 m	5.64 m	2.82 m
10	**0.995**	8.02	5.67	2.83	55	**0.876**	9.11	6.44	3.22
11	**0.994**	8.03	5.67	2.84	56	**0.873**	9.15	6.46	3.23
12	**0.993**	8.04	5.68	2.84	57	**0.869**	9.19	6.49	3.25
13	**0.992**	8.05	5.69	2.84	58	**0.865**	9.23	6.52	3.26
14	**0.990**	8.06	5.70	2.85	59	**0.861**	9.27	6.55	3.27
15	**0.989**	8.07	5.70	2.85	60	**0.857**	9.31	6.58	3.29
16	**0.987**	8.08	5.71	2.86	61	**0.854**	9.35	6.61	3.30
17	**0.986**	8.09	5.72	2.86	62	**0.850**	9.39	6.64	3.32
18	**0.984**	8.11	5.73	2.87	63	**0.846**	9.43	6.67	3.33
19	**0.982**	8.12	5.74	2.87	64	**0.842**	9.47	6.70	3.35
20	**0.981**	8.14	5.75	2.88	65	**0.838**	9.52	6.73	3.36
21	**0.979**	8.15	5.76	2.88	66	**0.835**	9.56	6.76	3.38
22	**0.977**	8.17	5.77	2.89	67	**0.831**	9.61	6.79	3.39
23	**0.975**	8.19	5.79	2.89	68	**0.827**	9.65	6.82	3.41
24	**0.972**	8.21	5.80	2.90	69	**0.823**	9.70	6.85	3.43
25	**0.970**	8.23	5.81	2.91	70	**0.819**	9.74	6.88	3.44
26	**0.968**	8.25	5.83	2.91	71	**0.815**	9.79	6.92	3.46
27	**0.965**	8.27	5.84	2.92	72	**0.812**	9.83	6.95	3.47
28	**0.963**	8.29	5.86	2.93	73	**0.808**	9.88	6.98	3.49
29	**0.960**	8.31	5.87	2.94	74	**0.804**	9.93	7.02	3.51
30	**0.958**	8.33	5.89	2.94	75	**0.800**	9.98	7.05	3.53
31	**0.955**	8.35	5.90	2.95	76	**0.796**	10.02	7.08	3.54
32	**0.952**	8.38	5.92	2.96	77	**0.792**	10.07	7.12	3.56
33	**0.950**	8.40	5.94	2.97	78	**0.789**	10.12	7.15	3.58
34	**0.947**	8.43	5.96	2.98	79	**0.785**	10.17	7.19	3.59
35	**0.944**	8.45	5.98	2.99	80	**0.781**	10.22	7.22	3.61
36	**0.941**	8.48	5.99	3.00	81	**0.777**	10.27	7.26	3.63
37	**0.938**	8.51	6.01	3.01	82	**0.773**	10.32	7.29	3.65
38	**0.935**	8.54	6.03	3.02	83	**0.769**	10.37	7.33	3.66
39	**0.932**	8.57	6.05	3.03	84	**0.766**	10.42	7.37	3.68
40	**0.928**	8.59	6.07	3.04	85	**0.762**	10.47	7.40	3.70
41	**0.925**	8.62	6.10	3.05	86	**0.758**	10.53	7.44	3.72
42	**0.922**	8.66	6.12	3.06	87	**0.754**	10.58	7.48	3.74
43	**0.919**	8.69	6.14	3.07	88	**0.751**	10.63	7.51	3.76
44	**0.915**	8.72	6.16	3.08	89	**0.747**	10.68	7.55	3.78
45	**0.912**	8.75	6.18	3.09	90	**0.743**	10.74	7.59	3.79
46	**0.908**	8.78	6.21	3.10	91	**0.740**	10.79	7.63	3.81
47	**0.905**	8.82	6.23	3.12	92	**0.736**	10.84	7.66	3.83
48	**0.902**	8.85	6.26	3.13	93	**0.732**	10.90	7.70	3.85
49	**0.898**	8.89	6.28	3.14	94	**0.729**	10.95	7.74	3.87
50	**0.894**	8.92	6.31	3.15	95	**0.725**	11.01	7.78	3.89
51	**0.891**	8.96	6.33	3.17	96	**0.721**	11.06	7.82	3.91
52	**0.887**	8.99	6.36	3.18	97	**0.718**	11.12	7.86	3.93
53	**0.884**	9.03	6.38	3.19	98	**0.714**	11.17	7.90	3.95
54	**0.880**	9.07	6.41	3.20	99	**0.711**	11.23	7.94	3.97

Appendix III – DBH Measurement[1]

The following images show examples of DBH anomalies and how to measure DBH:



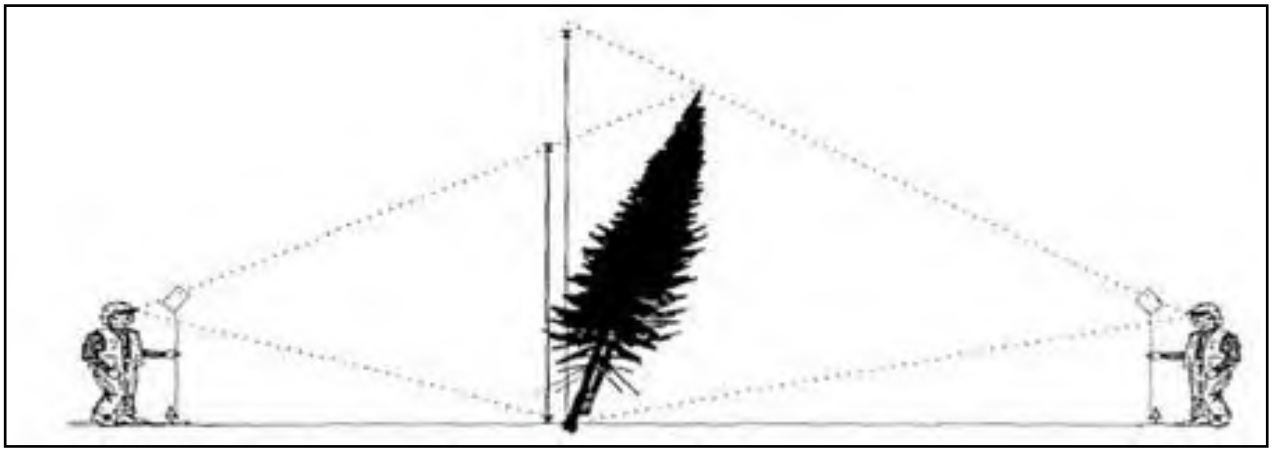
Where the bole size is "abnormal" at breast height (*e.g.*, oversized due to swelling or forking at breast height), the location of measurement must be moved:

1. Down if forked above breast height and up if forked below breast height.
2. Where swelling is present at breast height, move either up or down, depending on which is the shortest distance to a "normal" bole. Moving up is more conservative.

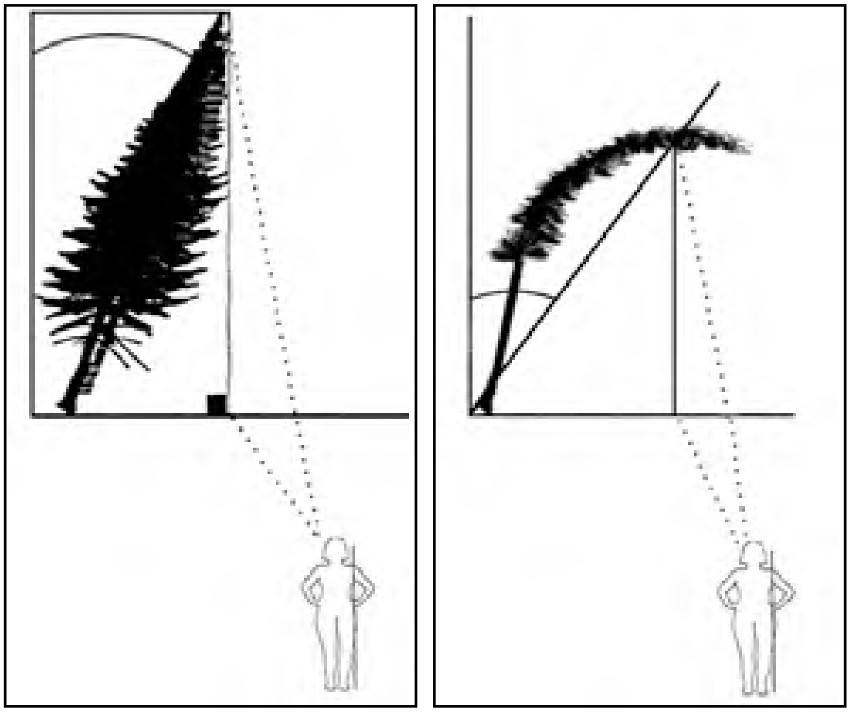
[1] Images taken from Alberta Sustainable Resource Development (2002).

Appendix IV – Height Measurement

Incorrect: observers are parallel to the lean of the tree.



Correct: observer is perpendicular to the lean of the tree.



Appendix II West Fraser Provincial TSP and PSP Manual

West Fraser Alberta Provincial

TSP and pPSP Manual

September 7, 2023

Updated September 11, 2024

[formatted for double sided printing]

Contents

List of Tables and Figures

Applicability

This manual is applicable to all Alberta West Fraser (WF) divisions except where other protocols apply (currently, the Tolko-West Fraser joint FMA (FMU F26) and the Lesser Slave Lake region: Tolko-Vanderwell-West Fraser (FMU S17), Slave Lake Pulp (FMU S20) and West Fraser Tolko (FMU S21).

Plot Design

A grid will be used to randomly select plot centre points. At each plot centre point, one plot will be established as follows (Figure 1):

- One 200 m^2 tree plot with a 50 m^2 sapling plot;
- An age plot coincident with the tree plot (i.e. 200 m^2 age plot); and
- In managed and very young natural stands, an additional 25 m^2 regeneration plot (used for sampling conifer regeneration only).

Plots will be either temporary sample plots (TSPs) or pseudo-permanent sample plots (pPSPs). The data collected are the same, the only difference is how the plot is monumented (pPSPs will have permanent posts and additional tree markings compared to TSPs).

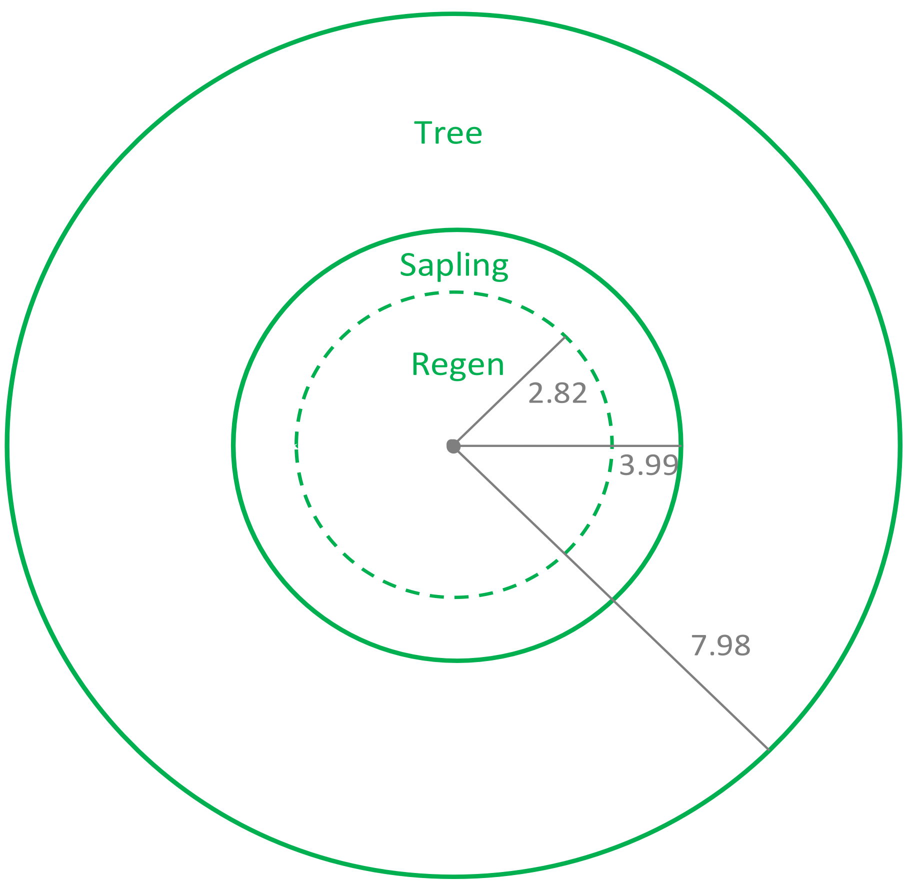


Figure 1. Plot and subplot dimensions (radius in metres).

Field Packages

Field crews will be provided with the following information:

- GPS coordinates for all selected plot.
- A list of plots with relevant information:
    - Program ID, plot number, stand type (natural vs. managed), stratum (Hw, HwPl, HwSx, etc.), stand age, plot type (TSP vs. pPSP) and regeneration plot (Y/N).
- West Fraser Alberta Provincial TSP and pPSP Manual (this document).
- West Fraser Alberta Provincial Field Measurements Guide (“Field Measurements Guide”).
- Optional: pdf maps of plot locations including AVI polygon and harvest opening boundaries to assist with evaluating suitability of plot locations for sampling.

The Field Measurements Guide provides detailed information on allowable codes for data recording, protocols for field measurements, standards for equipment use and data accuracy standards. This document must be reviewed prior to field work and will be the basis for determining the acceptability of field measurements.

Plot Establishment

Determining Plot Location

All plots must be located using a GPS unit and established at the coordinates provided. Use caution to avoid the natural tendency to confirm GPS coordinates when standing in an open space to prevent biasing the placement of plot centres into gaps.

The plot may be moved if it is too close to a stand edge or near a feature that would typically be removed from the landbase used in a forest management plan, including:

- Permanent water features and the applicable buffer zone around them[1]; and/or
- Anthropogenic disturbances such as roads, pipelines, well sites and mappable seismic lines.

Too close is defined as the applicable *age* plot falling fully or partially outside of the target AVI polygon or harvest opening[2], or being intersected by a feature as described above.

The protocol for moving plots is to try moving 10 m to the N of the original planned location. If the plot still cannot be established, try 10 m to the E, S or W, in order, until a suitable location is found. If no suitable location can be found, the plot must be abandoned and an alternate plot location used.

[1] Large permanent streams (>5 m wide; 60 m buffer); small permanent streams (>0.7 m and ≤5 m wide; 30 m buffer); transitional streams (>0.4 m and ≤0.7 m wide; 10 m buffer); lakes (100 m buffer).

[2] Plots will generally be pre-screened to ensure they fit within AVI polygon or opening boundaries.

Please note:

- Plots in regenerating stands should not be offset from seismic lines or in-block roads unless they are currently in use.
- Natural stand plots that fall within an unmapped harvest opening should be abandoned and replaced with an alternate plot unless only a portion of the target stand has been harvested and the “move” rules put it back into the target stand.
- Plots should not be moved to avoid smaller disturbances that would not be removed from a landbase, such as hand cut seismic or transitional/intermittent/ephemeral water features.
- Plots should not be moved off natural gaps or due to changes in stand composition as long as the entire plot falls within the target AVI polygon boundary/harvest opening.

If a plot is moved, a note must be made in the comments documenting the rationale and the direction of move. Updated XY coordinates for the new location must be captured.

Using Alternates

Plot alternates must be used in the order they are provided (e.g., use alternate #1 before #2), and must not be selected based on proximity to the original plot. Contact the WF representative to obtain alternate plot coordinates. Document why the alternate was needed in the comments for the *alternate* plot, e.g., “replacing plot SFP00006-1 which was intersected by a large permanent stream”.

Documenting Access

Tie points are not required for TSP or pPSP programs. If there are any issues or complexities with access that WF should be aware of, this should be documented in the comments field.

Monumenting TSPs

Mark the plot centre with a steel pin or pigtail. Add blue flagging and write the program and plot number (e.g. SFP0006-1), date and field crew initials on it. Add blue and pink flagging extending from the pin/pigtail to a nearby branch at around 2 m to facilitate plot relocation for QC purposes.

Monumenting pPSPs

Mark the plot centre with 1.5 m rebar or aluminum conduit hammered at least 0.5 m into the ground and painted blue. Secure a metal tag to the centre post labelled with program and plot number (e.g., SFP0006-1). Tie blue flagging to the rebar/conduit and write the date and field crew initials on it. Add blue and pink flagging extending from the rebar/conduit to a nearby branch at around 2 m to facilitate plot relocation for QC purposes.

Mark borderline trees that have been measured and confirmed as “out” of the plot using a blue “X” on the bole at 2 m above ground, facing inwards towards plot centre. This is necessary to prevent borderline trees from switching “in” and “out” of the plot from measurement to measurement, therefore care should be taken at establishment to properly assess and mark the correct trees.

Mark all advance regeneration and/or veteran trees by spray painting them with pink paint in a wide band around the bole below breast height and adding pink flagging to a branch at breast height.

Data Collection

Plot and Measurement Information

Complete the required plot and measurement information according to the specifications in Table 1.

For TSP plots, the GPS coordinates provided by WF can be used for reporting unless the plot has been moved, in which case revised GPS coordinates must be captured and reported. For pPSPs, high accuracy GPS of the actual plot location (centre post) is required; see the Field Measurements Guide for details on acquisition methods and specifications.

Use the comments field to document plot movement (rationale and direction) or use of alternates, any issues regarding plot access, and/or general plot measurement issues.

Table 1. Data recording specifications for plot and measurement information.

Field	Description
Program ID	Unique field program identifier (provided, e.g. HWP0008)
Plot Number	Unique plot identifier (provided)
Plot Type	Type of plot (provided)
	TSP (temporary sample plot), PPSP (pseudo permanent sample plot)
Regen Plot	Include a conifer regen plot (Y/N)
X Coordinate	X coordinate collected for the plot, recorded to 5 decimal places
Y Coordinate	Y coordinate collected for the plot, recorded to 5 decimal places
UTM Zone	UTM zone used for collecting XY coordinates (must use NAD 83 projection)
Measurement Number	Measurement number (set to 1 for all TSPs and first measurement of pPSPs)
Measurement Year	Measurement year in YYYY format e.g. 2023
Measurement Month	Measurement month in MM format e.g. 8
Measurement Day	Measurement day in DD format e.g. 28
Company	Name of the company doing field work
Crew Initial 1	Initials of primary crew member
Crew Initial 2	Initials of secondary crew member
Plot Access Code	The access that is most constraining to reaching the plot
	1 (all weather road), 2 (dry weather road), 3 (deteriorating road), 4 (ATV), 5 (heli), 6 (lengthy walk), 7 (boat)
Plot Status Code	Status of the plot based on the current measurement
	1 (active), 4 (destroyed)
Comments	Notes that may be relevant for QC and access purposes

Tree, Sapling and Regeneration Measurements

Trees, saplings and regeneration are defined as follows:

- Trees are all live stems ≥ 5.1 cm DBH inside the tree plot.
- Saplings are all live stems ≥ 1.3 m in height and < 5.1 cm DBH inside the sapling plot.
- Regeneration are all live *coniferous* stems 0.3-1.29 m in height inside the regen plot.

Complete the following:

1. Measure all trees and saplings according to the specifications in Table 2.
2. In managed and young natural stands, sample conifer regeneration as follows:
   a. Tally conifer regeneration by species and record data according to the specifications in Table 3. If there is no regen, add one record with species='No' and a count of 0.
   b. Measure a subset of tallied regeneration using the specifications in Table 2 (measure every 5th regen by species with a minimum of 5 regen per species).
   c. No measurement of regeneration is required in mature natural stands.

Trees, saplings and regeneration that are measured must be numbered to facilitate QC. Where size permits, spray paint the tree number on the bole above breast height using blue paint, then paint a blue line below the number at breast height. If trees are too small to paint the number on the bole, write the number on a piece of blue flagging and tie to a lateral branch near breast height. If measured for height, add a dot of pink paint to the bole on the side where height has been taken.

Additional notes:

- For nil tally plots (no trees, saplings and/or regen), create a single record with tree number= 0 and species ="No", and leave all other information blank.
- **In pPSPs, take care not to trample regeneration when working around plot centre**. These plots will be remeasured and trampling regeneration will impact future growth.

Age Measurements

The two largest DBH stems of ***each species***[3] within the plot are to be selected for aging. These largest diameter trees can be trees, saplings or regeneration.

To be eligible for selection, trees must be:

- Live and healthy looking;
- No broken or dead top (unless top has recovered);
- Not advanced regeneration or a veteran tree from a previous generation;
- Does not have western gall rust encircling ≥ 50% of the main stem;
- Not leaning ≥ 20°, not a wolf tree or of obvious poor form (e.g., crook, sweep, fork); and
- No severe damage to more than 1/3 of bole, crown and/or root.

In young stands, additional criteria apply:

- At least 0.3 m in height; and
- ≥ 8 years *total* age for deciduous, pine and larch and ≥ 10 years *total* age for fir and spruce.

For each selected age tree, measure according to the specifications in Table 2. The only additional work for age trees is to ensure that height and age related information are recorded. Note:

[3] Revised February 15, 2024 to change from selection by species group to selection by species.

- Ages sampled inside pPSPs can only be taken using cores or whorl/bud scale counts.
- Ages sampled inside TSPs can include destructive sampling (cutting down and taking cookies).

Carefully review the section on aging in the Field Measurements Guide prior to commencing field sampling. That section includes critical information on methods for aging trees and how “Age Representative” is defined and assessed.

Table 2. Measurement and data recording specifications for trees, saplings, regen and age trees.

Field	Description
Program ID	As previously described
Plot Number	As previously described
Tree Number	Tree number, assigned starting from 1 (0 for nil tally plots)
Tree Location	Physical location of the stem within the series of nested plots (e.g., tree plot = inside the tree plot but outside of the sapling plot)
	1 (tree plot), 2 (sapling plot), 4 (regen plot)
Tree Origin	Whether a stem is advance, veteran or other
	9 (advance), 10 (veteran), blank
Species	Species code (code "No" is only to be used for nil tally plots)
	Aw, Bw, Fa, Fb, Fd, La, Lt, Lw, No, Pa, Pb, Pf, Pl, Pj, Pw, Sb, Se, Sw
DBH	Diameter at beast height in cm, recorded to the nearest 0.1 cm
Height	Vertical height in m to the nearest 0.1 m if ≥ 2 m tall, and 0.01 m if < 2 m tall
	Measure every 5th tree/sapling/regen, plus additional random samples to obtain a minimum of 5 measured heights by species for each of [trees + saplings] and regeneration (e.g. for Sw, min 5 regen and 5 trees/saplings)
	In addition, measure heights on all trees with a broken or dead top (these do not count towards the 5 height minimum)
	Measure height on age trees if not already measured as part of subsampling
	Do not measure heights on trees leaning ≥ 20 degrees (~35%) off of vertical
Crown Class	Relative position of the crown within the canopy of the stand
	D (dominant), C (codominant), I (intermediate), S (suppressed)
Condition Code 1	Condition (codes 0-19); required for all age trees
Cause 1	Cause of condition (codes 1-24, 99); if healthy, record 99
Severity 1	Severity of condition (codes 1-3, 9); if healthy, record 9
Condition Code 2	See condition 1
Cause 2	See cause 1
Severity 2	See severity 1
Breast Height Age	[Age trees only] Breast height age; record for trees in stands ≥ 40 years of age
Stump Height Age	[Age trees only] Stump height age; record for trees in stands < 40 years of age unless total age has been obtained (see next)
Total Age	[Age trees only] Total age; record when using reference ages or whorl/bud counts
Age Representative	[Age trees only] Whether or not the selected age tree is representative of the age of the applicable species group
	N or blank

Table 3. Measurement and data recording specifications for regeneration tallies.

Field	Description
Program ID	As previously described
Plot Number	As previously described
Species	Species code (code "No" is only to be used for nil tally plots)
	Fa, Fb, Fd, La, Lt, Lw, No, Pa, Pf, Pl, Pj, Pw, Sb, Se, Sw
Count	Count of conifer regen within the regen plot, **including measured regen**

Plot Remeasurement (pPSPs Only)

The commitment for how long each pPSP will be maintained will be division- and program-specific and typically is documented as part of a company's growth and yield program. However, the measurement schedule will be the same for all pPSP programs:

- Every 5 years in stands < 40 years of age and every 10 years in stands ≥ 40 years of age.

At each remeasurement, complete the following:

- Refresh the plot markings as outlined under Plot Establishment. Pay special care to refreshing markings on borderline trees, advance regeneration and veterans. Check the plot centre post and make sure it is still secure; refresh or replace as required.
- If tree numbering is still visible, refresh and reuse the tree numbers, otherwise trees may be renumbered. *Tree numbers do not have to be maintained from measurement to measurement*.
- Collect data following the protocols in the Data Collection section, considering the following:
  - Plot and Measurement Information: Confirm the XY coordinates and update if required. Update plot access codes if the access has changed.
  - Tree, Sapling and Regen: Measure as per the listed protocols. If the pPSP previously had a regen plot, continue to measure regeneration regardless of stand age.
  - Age Trees: Age trees will not be remeasured except if plots reach age 50, i.e. around the age of "realized" site index. In those cases, measure as per the documented protocols.
- If a plot cannot be relocated for remeasurement, contact the WF representative to discuss.

Quality Control

All data collected under this protocol must meet the data standards outlined in the Field Measurements Guide. The *first plot* completed by each field crew will be QC'd to ensure that crews understand the measurement protocols. Crews must make these data available to the WF representative immediately upon completion to facilitate QC. Additional plots will be QC'd throughout the duration of the program to ensure continued quality of data, targeting a cross section of field crews, with a minimum of:

- TSPs: 5 plots or 5% of plots, whichever is larger.
- pPSPs: 5 plots 10% of plots, whichever is larger.

Document Changes

September 11, 2024:

- Revised wording on measurement of regeneration for clarity.
- Adjustment to QC section to align with WF Alberta's Field Measurements Guide.
- No changes to field protocols.

Appendix III West Fraser Provincial Field Measurements Guide

West Fraser

West Fraser Alberta Provincial
Field Measurement Guide

September 20, 2023
Updated August 21, 2024

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Contents

List of Tables and Figures

Introduction

The goal of this document is to provide clear and consistent expectations for the measurement and reporting of ground sampled data. Note this document is expected to evolve over time.

This document will be applicable to all Alberta West Fraser (WF) divisions except where other protocols apply (currently, the Tolko-West Fraser joint FMA (FMU F26) and the Lesser Slave Lake collective which includes Tolko-Vanderwell-West Fraser (FMU S17) and West Fraser Tolko (FMU S21).

Plot and Site Information

Plot Access

Plot access should document the access that is the most constraining to reaching the plot.

Table 1. Plot access codes and descriptions.

Code	Name	Description
1	All Weather Road	Well paved or well traveled gravel road. Well drained with little possibility of washing out or flooding in heavy rain situations. In winter, plowed on a regular basis.
2	Dry Weather Road	Can be slippery in the spring and fall and tends to become heavily rutted when wet.
3	Deteriorating Road	Not often used and starting to grow over. During heavy rains, can be easily washed out of heavily rutted. May be difficult to drive even with a four wheel drive truck.
4	All Terrain Vehicles	Can include seismic lines, old trails, roads inaccessible using a four wheel drive truck.
5	Helicopter Only	Heli access only; requires suitable location for helicopter landing and take off.
6	Lengthy Walk	Walk-in access only; walk exceeding 1000 m.
7	Boat	Boat access only.

Program Type

Applicable type of plot; information will be provided by WF staff.

Table 2. Program codes and descriptions.

Code	Description
MPB	Mountain pine beetle permanent sample plot
PGYI	PGYI permanent sample plot
PPSP	Pseudo-permanent sample plot
PSP	Non-PGYI permanent sample plot
RGT	Realized gains trials
TSP	Temporary sample plot

Stand Type

Type of stand; information will be provided by WF staff.

Table 3. Stand types and descriptions.

Code	Description
F	Fire origin (natural stand)
I	Managed stand planted to improved stock, first rotation post-harvest
I2	Managed stand planted to improved stock, second rotation post-harvest
R	Managed stand planted to wild stock or left for natural, first rotation post-harvest
R2	Managed stand planted to wild stock or left for natural, second rotation post-harvest

Plot Disturbance

Any plot disturbances are to be assessed and documented using the following codes. Where plot disturbance has occurred, document the disturbance severity and note any specific details in the plot measurement comments (e.g., southwestern corner of the plot all trees destroyed by well site; approx. 10% of the plot area affected). If possible, estimate the year of disturbance (generally based on any regeneration that has occurred in the disturbed area, condition of the soils and understory vegetation).

Table 4. Plot disturbance codes and descriptions.

Code	Description
BU	Burned
MA	Miscellaneous anthropogenic (e.g., seismic, pipeline, well pad, road)
MI	Missing
MU	Miscellaneous unknown
NDC	Natural disturbance - climate (windthrow, snow/ice loading)
NDD	Natural disturbance - defoliator
NDI	Natural disturbance - insect/disease
NDM	Natural disturbance - mountain pine beetle
NDW	Natural disturbance - water (e.g., beaver dam, flooding, flood erosion)

Table 5. Plot disturbance severity codes and descriptions.

Code	Description
0	Disturbance is present in the plot (or immediately next to it) but is ≤ 5% of the plot area or is of no long-term concern
1	6-20% of plot area affected or a larger area but minor long-term impact (e.g. a light defoliation in a healthy stand)
2	21-40% of area affected or larger area with moderate impact (e.g. a ground fire scorched the lower bark of many trees but did not kill them)
3	41-60% of area affected or larger area with moderate to heavy impact
4	61-80% of area affected, heavy impact
5	81-100% of area affected, severe impact
9	Severity not known or not reported (historic data only)

Topography

The topography should be assessed relative to the plot's location in the overall landscape.

Table 6. Topographic codes and descriptions.

Code	Name	Water Relationship	Description
0	Unknown	N/A	Missing data.
1	Hollow/Depression	Collecting	Any areas that is concave in all directions, usually at the toe of a slope or within level topography with no distinct aspect.
2	Flat/Level	Receiving	Any level area excluding toe slopes, generally horizontal, with no distinct aspect.
3	Toe	Receiving	The lowermost portion of the slope immediately below and adjacent to the lower slope where the slope shape is concave grading rapidly to level with no distinct aspect.
4	Lower Slope	Either	The lower portion of the slope immediately above the toe where the slope shape is usually concave with a distinct aspect.
5	Middle Slope	Shedding	The area of the slope between the upper and lower slopes where the slope shape is usually straight with a distinct aspect.
6	Upper Slope	Shedding	The upper portion of the slope immediately below the crest, typically with a convex slope shape and a distinct aspect.
7	Hilltop/Crest	Shedding	The uppermost portion of a slope, shape is usually convex in all directions with no distinct aspect.

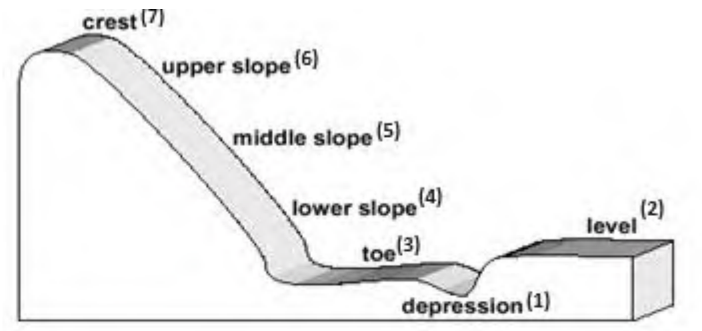

Figure 1. Topographic features.

Elevation

Elevation is to be captured at the plot centre and recorded to the nearest m. Elevation must be taken using GPS units only (do not obtain from maps or nearby elevation markers). A minimum of 4 satellites must be obtained in order to measure elevation; if crews cannot obtain 4 satellites, do not measure elevation; make a note on the tally sheet indicating that too few satellites were available.

Always confirm elevation even if elevation is already present; previous measurements may have been obtained from elevation maps or less accurate methods.

Slope

Evaluate the percent slope across the main plot using a clinometer. Percent slope may be measured either facing uphill or downhill but record as a positive percent. Slope is measured using a clinometer and sighting across the plot at to a point which is the same height above ground as eye height.

If the plot is flat or there is no discernible aspect (variable slope), record 0.

Aspect

The aspect is the direction that the slope faces; evaluate the general bearing of the aspect in the predominant direction of the slope. The recorded code should be one of: N, NE, E, SE, S, SW, W, NW or “NA”. If the plot is flat or there is no discernible aspect, record “NA”.

Ecological Information

Ecological information is to be collected only: 1) at plot establishment, 2) if ecological information previously collected is clearly incorrect, or 3) at the direction of WF staff.

Natural Subregion and Field Guides

Ecosite is specific to natural subregion. Ensure that WF staff have provided the correct natural subregion (based on 2005 boundaries) and choose the appropriate field guide based on the plot location. If in doubt on whether to use the SW or WC field guide, contact WF staff.

Ecosite and Ecosite Phase

Determine ecosite and ecosite phase using the applicable field guide. The most important components of the ecosite call are moisture and nutrient regime. Ecosite, in terms of moisture-nutrient position does not change with phase (or ought not), and thus is an important predictor of stand growth. Emphasis should be placed on ensuring this information is as accurate as possible. A soil pit (minimum 50 cm deep) must be used to obtain an accurate assessment of nutrient and moisture regime.

The following may be helpful (simplified approach based on field training exercise with Dave Downing).

Evaluate the soils for:

- Presence of mottling – tells you if the soil tends to hold moisture.
- Presence of seepage – again tells you if the soil tends to hold moisture.
- Type of soil cap – mor, moder or mull – tells you something about nutrients (see Figure 2):
  - Mor indicates slow biological activity therefore likely poor to medium nutrients. A Mor has a very abrupt transition between the litter and subsequent layers and is characteristic of conditions under spruce canopies.
  - Moder indicates a soil between Mor and Mull, ranging in nutrients from medium very rich.
  - Mull indicates very biologically active soils, therefore a nutrient regime to rich to very rich. A Moder-Mull has a more gradual transition between layers and is more characteristic of conditions under aspen canopies.

Next, list the key species present on-site in each of five layers:

- Treed layer (trees over 5 m in height)
- Shrub Layer
- Herb and Forb Layer
- Grass Layer
- Mosses

Based on soils information and the presence of indicator species on the list (certain species are indicative of moist vs. dry sites, or nutrient rich vs. poor sites), answer the following question:

- Is the moisture regime mesic, wetter than mesic or drier than mesic?
- Is the nutrient regime mesic, richer than mesic or poorer than mesic?

Based on this information, look up the possible range of ecosites that correspond with the approximate moisture/nutrient location on the edatopic grid. From there, use tree and understory species information to identify one or more potential ecosite phases/communities. Select the best match based on the information available

Note that if a treed layer is under 5 m in height, it is generally considered to be part of the shrub (rather than treed) layer, except in managed stands where:

1. There are no taller treed layers present (i.e., don't assign it to a non-treed ecosite just because trees are still short: a true non-treed ecosite is unable to support trees; these are just young); or
2. There is a taller layer with a second layer <5 m in height, but the shorter treed layer is dense/closed enough to be affecting the understory vegetation.

In case #1 ecosite would be called according to the phase it would almost certainly develop into based on the trees present.

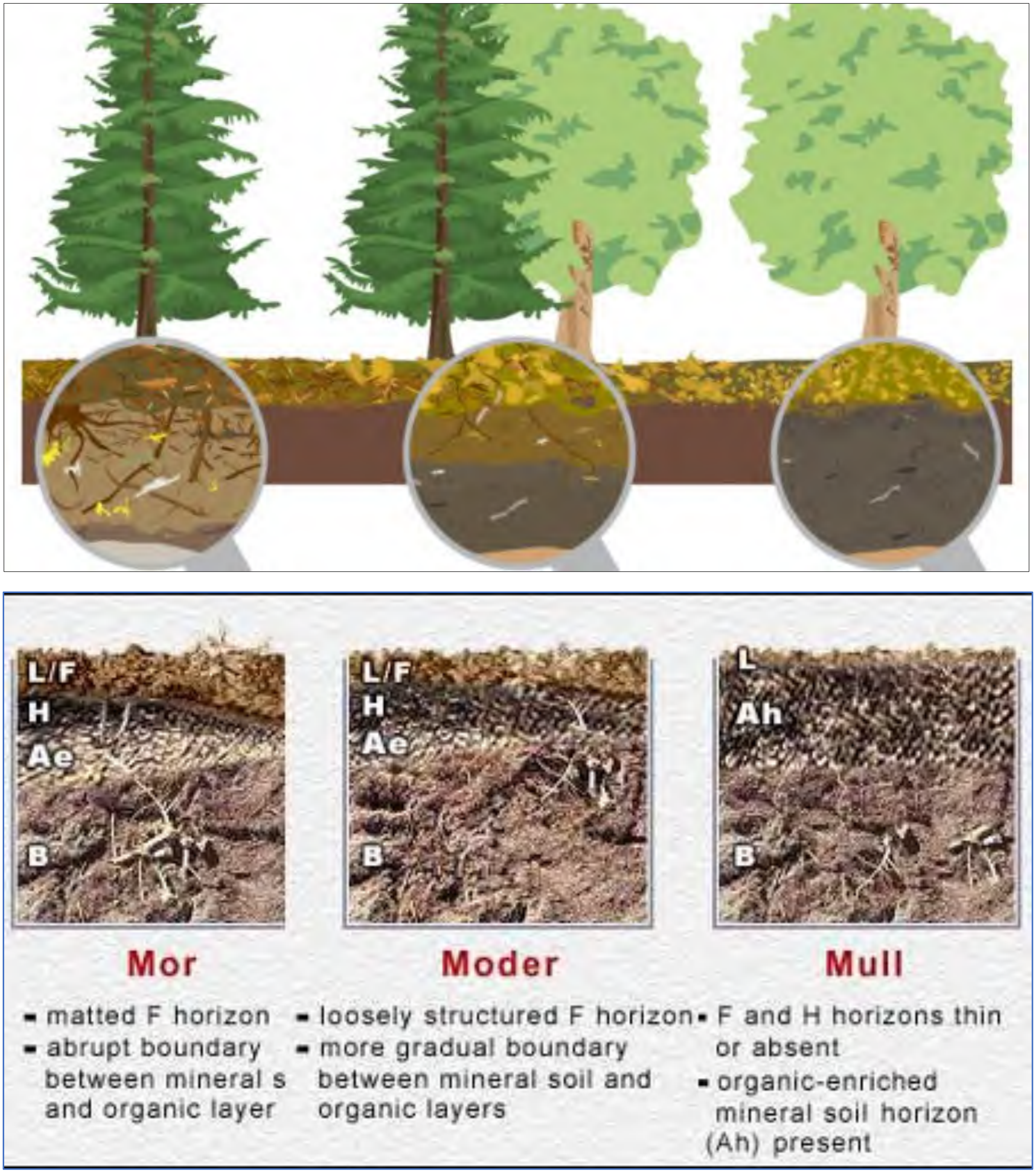

Figure 2. Soil horizons (mor, moder, mull)[1].

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[1] Image Sources: top: https://blogs.ubc.ca/jchan/2015/11/04/what-do-mor-moder-mull-and-multiple-factor-analysis-have-in-common/ bottom: Centre for Teaching, Learning and Technology, UBC

Soil Moisture Regime

The key used for moisture regime assignment is provided here for reference. For further information on evaluation and assignment of moisture regime, refer to Appendix 1 of the applicable Ecosite guide (Beckingham et. al. 1996, Beckingham and Archibald 1996).

Table 7. Soil moisture regime classification tables.

Moisture regime	Description	Primary water source	Topographic position	Effective texture[a]	Soil drainage	Depth to impermeable layer	Surface organic thickness	Slope gradient
Very xeric (1)	Water removed extremely rapidly in relation to supply; soil is moist for a negligible time after precipitation	Precipitation	Ridge, crest, shedding	Very coarse (gravel-S); abundant coarse fragments (>50%)	Very rapid	Very shallow (<0.5 m)	Very shallow (<3 cm)	Very steep (>70%)
Xeric (2)	Water removed very rapidly in relation to supply; soil is moist for brief periods following precipitation	Precipitation	Ridge, crest, shedding		Very rapid to rapid	Very shallow (<0.5 m)	Very shallow (<3 cm)	Very steep (>70%)
Subxeric (3)	Water removed rapidly in relation to supply; soil is moist for short periods following precipitation	Precipitation	Upper slopes shedding	Coarse to moderately coarse (LS-SL); moderate coarse fragments	Rapid	Shallow (<1.0 m)	Shallow (3–5 cm)	Steep (31–70%)
Submesic (4)	Water removed readily in relation to supply; water available for moderately short periods following precipitation	Precipitation	Upper slopes shedding		Rapid to well	Shallow (<1.0 m)	Moderately shallow (6–9 cm)	Steep (31–70%)
Mesic (5)	Water removed somewhat slowly in relation to supply; soil may remain moist for significant but sometimes short periods of the year; available soil water reflects climatic input	Precipitation in moderate to fine-textured soils and limited seepage in coarse-textured soils	Midslope rolling to flat	Medium (SiL-L) to fine (SCL-C); few coarse fragments	Well to moderately well	Moderately deep (1–2 m)	Moderately deep (10–15 cm)	Slight to Moderate (2–30%)

Moisture regime	Description	Primary water source	Topographic position	Effective texture[a]	Soil drainage	Depth to impermeable layer	Surface organic thickness	Slope gradient
Subhygric (6)	Water removed slowly enough to keep the soil wet for a significant part of the growing season; some temporary seepage and possible mottling below 20 cm	Precipitation and seepage	Lower slopes receiving	Variable depending on seepage	Moderately well to imperfect	Deep (>2 m)	Moderately deep to deep (10–40 cm)	Slight (2–9%)
Hygric (7)	Water removed slowly enough to keep the soil wet for most of the growing season; permanent seepage and mottling present; possibly weak gleying	Seepage	Lower slopes receiving	Variable depending on seepage	Imperfect to poor	Variable	Deep (16–40 cm)	Slight (2–9%)
Subhydric (8)	Water removed slowly enough to keep the water table at or near the surface for most of the year; organic and gleyed mineral soils; permanent seepage less than 30 cm below the surface	Seepage or permanent water table	Depressions and level receiving	Variable depending on seepage	Poor to very poor	Variable	Very deep (>40 cm)	Slight (2–9%)
Hydric (9)	Water removed so slowly that the water table is at or above the soil surface all year; organic and gleyed mineral soils	Permanent water table	Depressions and level receiving	Variable depending on seepage	Very poor	Variable	Very deep (>40 cm)	Flat (<2%)

[a] Symbols under effective texture are as follows: L = loam, S = sand, Si = silt, C = clay.

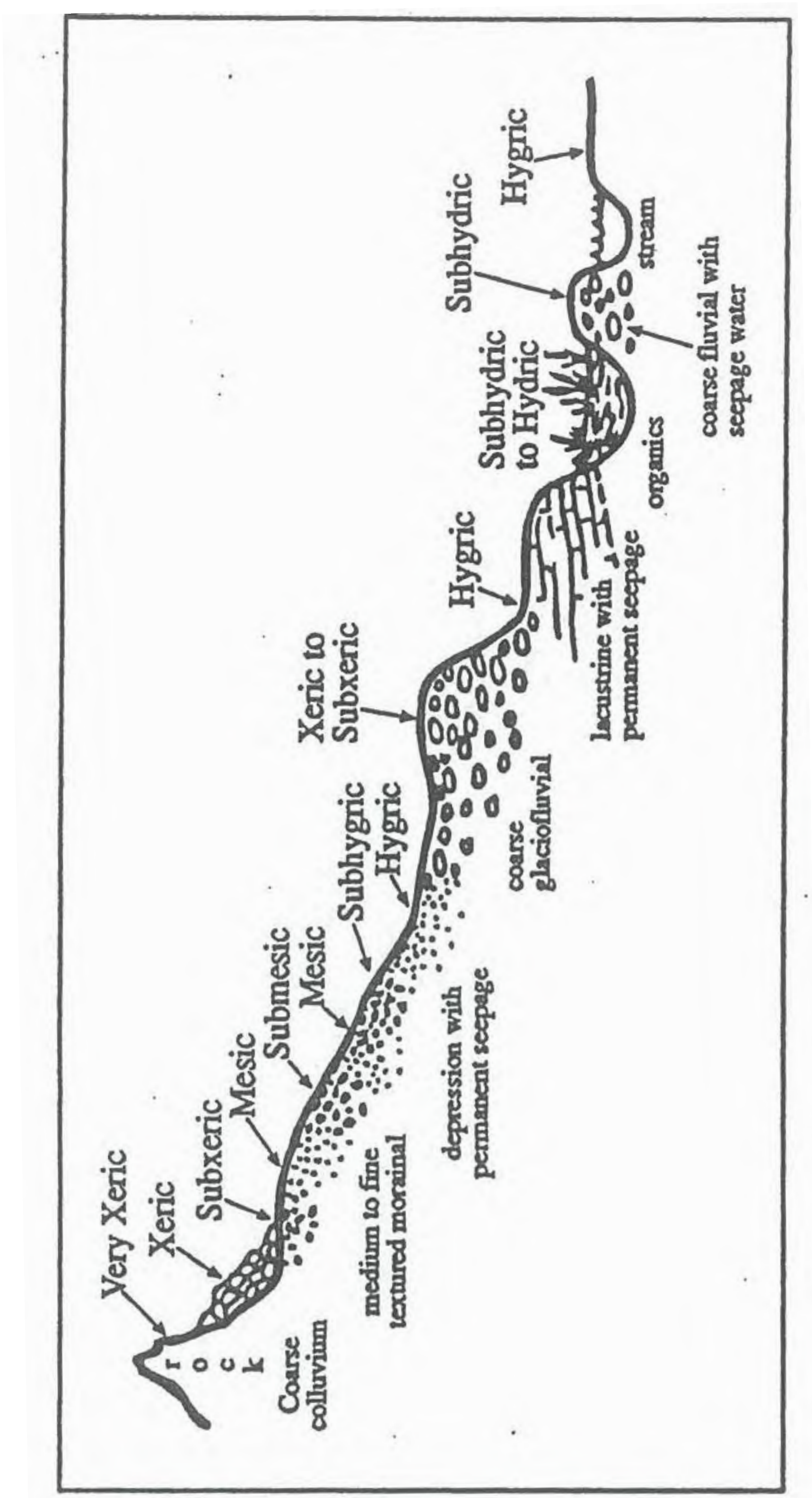


Figure 3. Soil moisture regime - topography - soil relationships[2].

Soil Nutrient Regime

The key used for nutrient regime assignment is provided here for reference. For further information on evaluation and assignment of nutrient regimes, refer to the applicable Ecosite guide (Beckingham et. al. 1996, Beckingham and Archibald 1996).

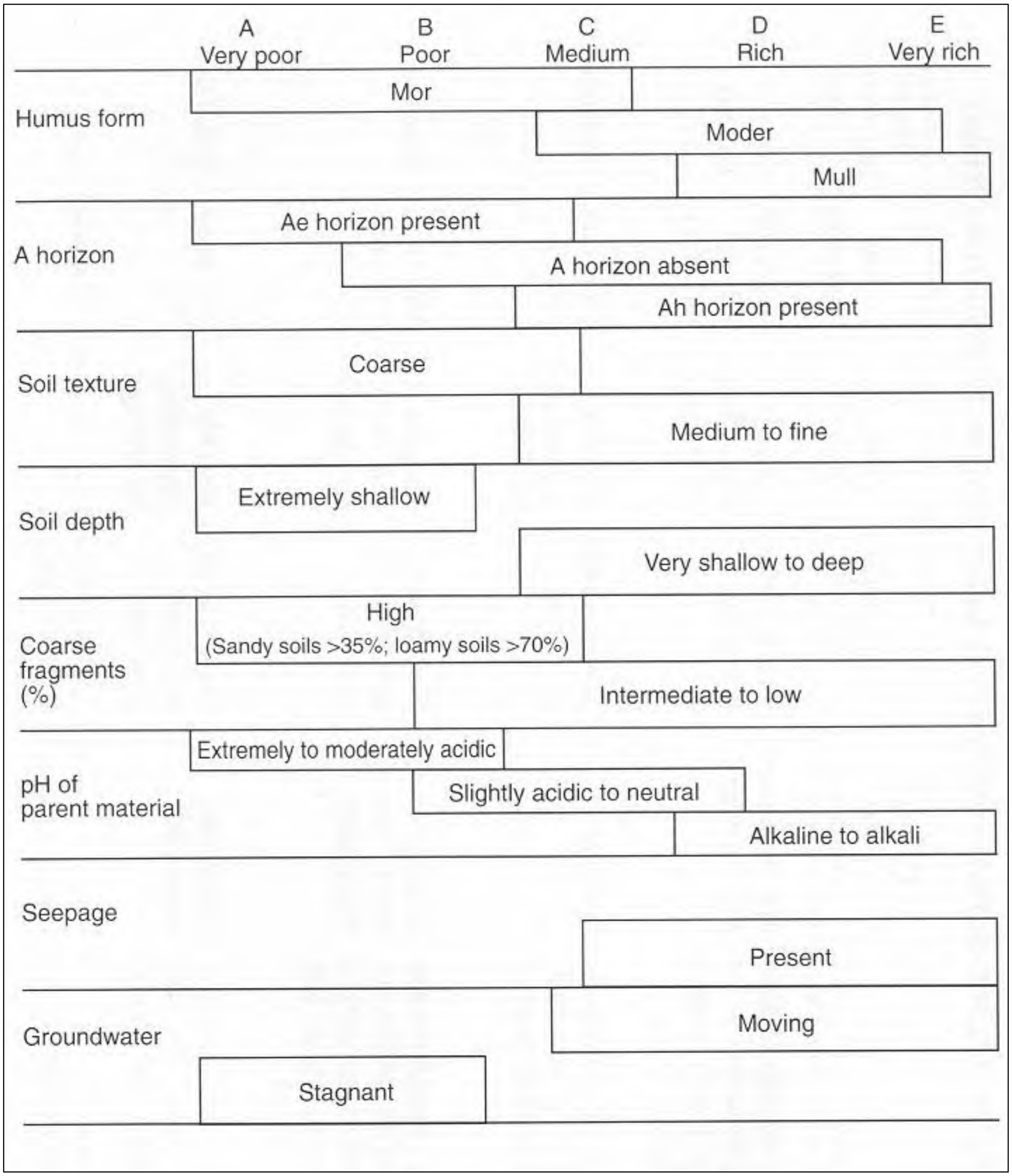


Figure 4. Soil nutrient regime key.

[2] From Alberta Environmental Protection 1994.

Vegetation Assessments - % Cover

Vegetation percent cover is evaluated separately for each of four separate classes: shrubs, herbs/forbs, grass and moss/lichen. Record percent cover to the nearest 5%. Note:

- Each class is evaluated separately: the sum of the four classes will typically be more than 100% due to overlapping vegetation layers.
- It doesn't matter if point of germination is outside of the plot, as long as vegetation (leaves, branches etc.) extends into the plot.
- The maximum value is 100% for each layer.
- There is no minimum height for including shrubs in the assessment of percent cover.

Guidance for assessing percent cover is provided on page 37.

AVI Field Call (Canopy Assessment)

Canopy assessment is undertaken on the ground to provide data to compare to photo-based canopy assessment data (AVI), and in PSP programs, to provide a time sequence documenting change in canopy composition over time. Canopy assessment is evaluated based on the main plot area and its immediate surroundings.

- Evaluation of the canopy is only to be completed after sampling is completed and crews have an overall sense of the stand composition and height. Look within the plot and the nearby area when characterizing the stand.
- The canopy assessment allows up to two layers to be assessed (overstory and understory).
- In order to be considered separate layers, the layer heights (defined later in this section) must differ by at least 3 m; otherwise, all trees should be evaluated as a single layer.
- The uppermost layer is always considered the overstory, even in young short stands.

Crown closure refers to the percentage of ground area covered by a vertical projection of the tree crown areas onto the ground. In other words, it is percent cover of the tree canopy if it were viewed from above. Guidance for assessing percent cover is provided on page 37.

Table 8. Crown closure class codes.

Code	Percent Crown Closure
V	1-5%
A	6-30%
B	31-50%
C	51-70%
D	71% +

Overstory height is the average height in metres of the dominant and codominant trees of the leading species in the layer. In understory layers, it is the average height in metres of the leading species in that layer (to the nearest 1 m in mature stands, and to the nearest 0.5 in younger stands/shorter layers i.e., under 5 m in height).

Species composition is expressed in percent crown closure (10% classes) that an individual species contributes to the overall species composition. Species are to be included in order of abundance, e.g. SP1=Aw, SP1%=7, SP2=Sw, SP2%=2, SP3=Pj, SP3%=1. Species codes are provided on page 14.

Measurement Information

<u>There should be no pPSP, PSP or RGT measurements undertaken within the period of active height growth (May-July) unless it is otherwise unavoidable.</u>

Determining "In" Trees

Stems[3] are considered inside a plot if their point of germination is inside the plot. Consider the POG to be at the centre of the bole at the bottom of the stem, as illustrated in the figures here.

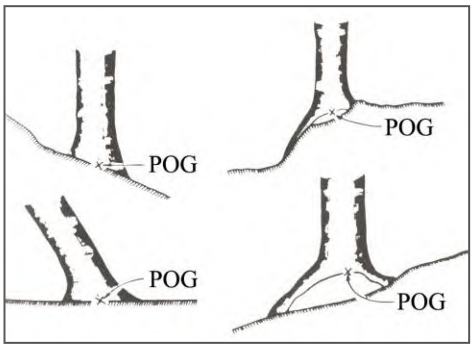


Figure 5. Location of the point of germination.

See below. The stem is considered "out" even though its stem is within the plot boundary because its point of germination is located outside of the plot boundary.

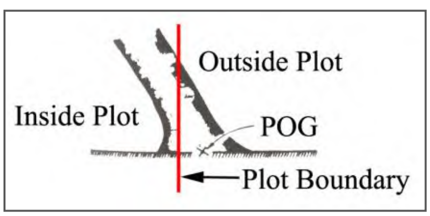


Figure 6. Example of an "out" tree.

Please note:

- In remeasured plots, stems typically should not move from "in" to "out" of a plot or subplot from measurement to measurement. Careful assessment at first measurement will minimize this, but if at remeasurement a previously tagged stem is found to be outside the plot, it should be marked as such. Record condition code 15 (disqualified) and make a note in the comments.
- Smaller plots have a more edge relative to plot area, and each stem represents relatively more on a per hectare basis (1 tree in a 10 m^2 plot represents 1,000 stems per hectare whereas 1 tree in a 400 m^2 plot represents 25 stems per hectare). As such, regeneration or saplings in smaller subplots are just as important as data collected from the tree plot.
- Any stems with a split below DBH are treated as two separate stems (e.g., two trees). Splits above DBH are treated as forks (e.g., one tree).

[3] The term "stem" is used to refer to any of trees, saplings and/or regeneration.

Tree Location

Tree location is the subplot a stem is physically located within, *regardless of the size of the stem*.

Table 9. Tree location codes.

Code	Tree Location	Description
1	Tree	Stem is located in the tree plot but outside the sapling and regeneration plots
2	Sapling	Stem is located in the sapling plot but outside the regeneration plot
4	Regen Plot #1	Stem is located in regeneration plot #1 or there is only 1 regeneration plot
5	Regen Plot #2	Stem is located in regeneration plot #2
6	Regen Plot #3	Stem is located in regeneration plot #3
7	Regen Plot #4	Stem is located in regeneration plot #4
8	Outside	Stem is located outside the tree plot, such as in the buffer

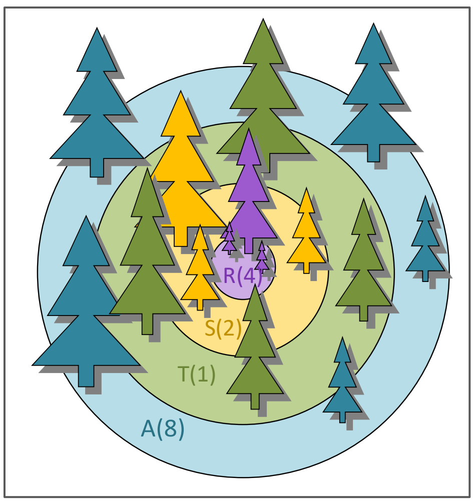


Figure 7. Tree location codes for a plot with age (A), tree (T), sapling (S) and regen (R) subplots.

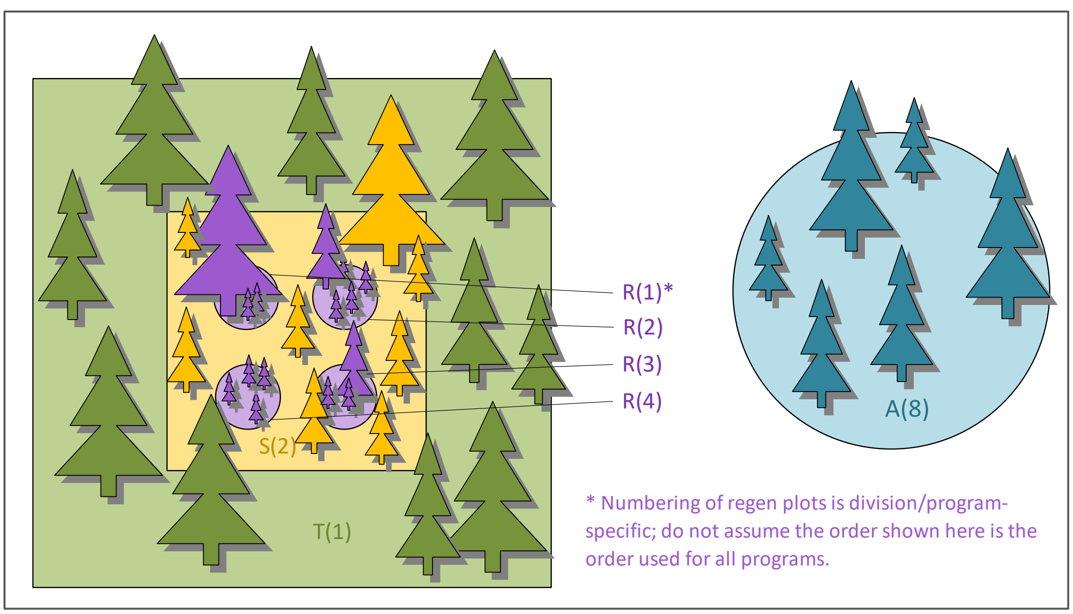


Figure 8. Tree location codes for a plot with an external age plot and 4 regen subplots.

Tree Origin

For TSPs and pPSPs, only record a tree origin for stems with origin code 9 or 10.

Table 10. Tree origin codes and when to record.

Code	Description	PSP	TSP/pPSP
0	Unknown	Y	-
1	Naturally seeded	Y	-
2	Coppice (from downed logs, stumps/snags) or sucker (from the roots or base of a tree)	Y	-
3	Layering (from the rooting of un-detached branches)	Y	-
4	Natural but unknown or not sure	Y	-
5	Artificially seeded	Y	-
6	Planted, regular stock	Y	-
7	Planted, genetically improved stock	Y	-
8	Planted but stock unknown or mixed	Y	-
9	Advanced prior to the date of harvest	Y	Y
10	Veteran/remnant or super-dominant from a previous generation	Y	Y

Species Codes

Species codes are listed in the table below. Notes:

- Dead species codes are only to be used when a species code from a previous measurement is not available – i.e., when a stem is dead at first measurement and species cannot be discerned.
- The code "NO" is only to be used for nil tally plots (plots with no stems) and cannot be used to represent an unknown species code.

Table 11. Species codes, common and scientific names.

Code	Common Name	Scientific Name
AW	Trembling aspen	*Populus tremuloides*
BW	White (paper) birch	*Betula papyrifera*
FA	Alpine fir	*Abies lasiocarpa*
FB	Balsam fir	*Abies balsamea*
FD	Douglas-fir	*Pseudotsuga menziesii*
LA	Alpine larch	*Larix lyallii*
LT	Tamarack	*Larix laricina*
LW	Western larch	*Larix occidentalis*
PB	Balsam poplar	*Populus balsamifera*
PF	Limber pine	*Pinus flexilis*
PJ	Jack pine	*Pinus banksiana*
PL	Lodgepole pine	*Pinus contorta*
PW	Whitebark pine	*Pinus albicaulis*
SB	Black spruce	*Picea mariana*
SE	Engleman spruce	*Picea engelmannii*
SW	White spruce	*Picea glauca*
DD	Dead deciduous	*Should only be used for trees that are dead at first measurement*
DC	Dead conifer	
DU	Dead unknown	
NO	Nil tally plot	

Diameter at Breast Height

Always ensure that DBH is taken at 1.3 m *above the point of germination*. Remove the snowpack as required to achieve this. Where swelling is present at BH (e.g., oversized due to swelling or forking), move up to obtain a measurement unless movement upwards is illogical (such as a fork above breast height resulting in an abnormality), in which case move down. Record the location at which diameter was taken if required by the applicable protocols.

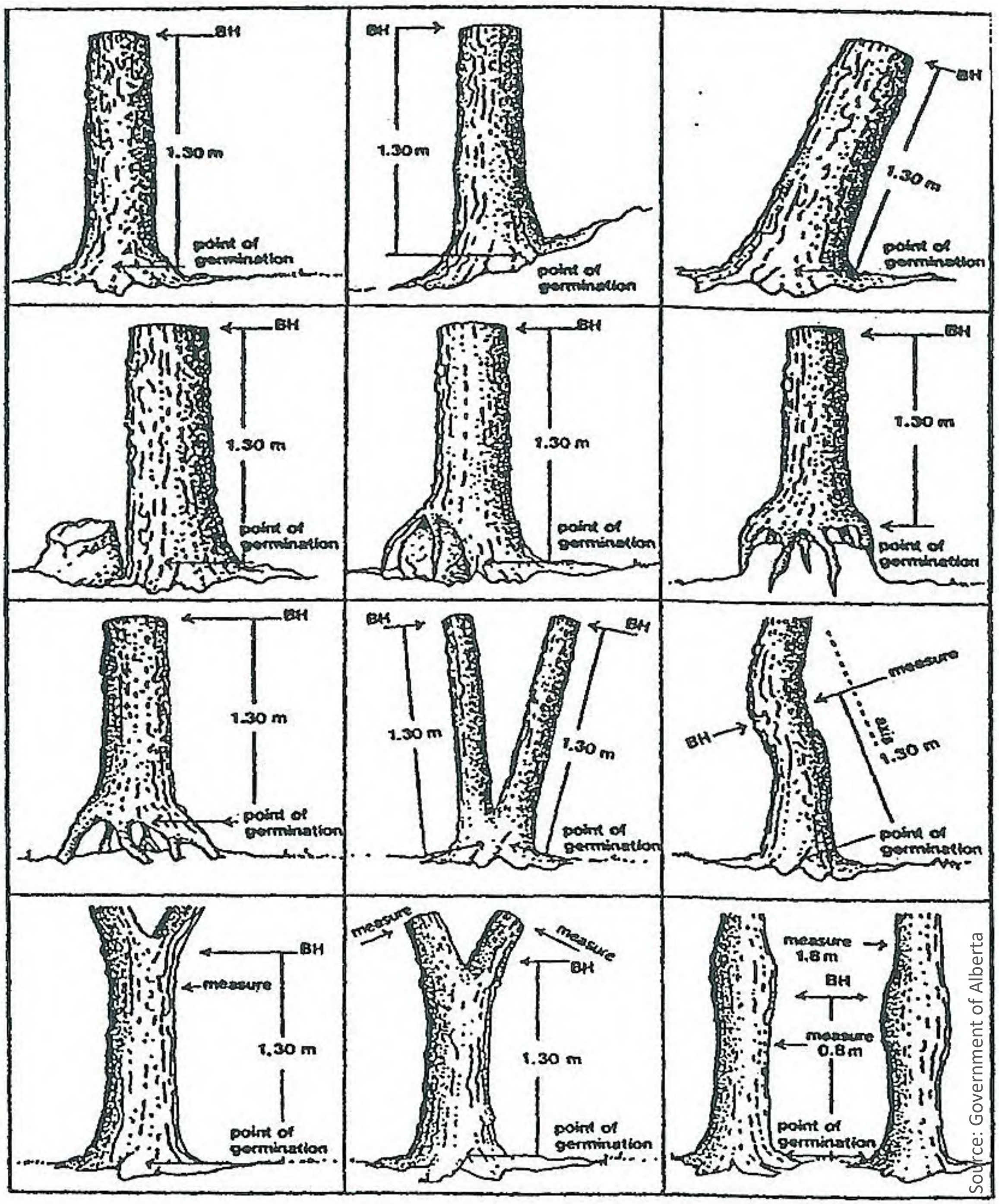


Figure 9. DBH relative to the point of germination and how to measure around abnormalities.

Vertical Height

Measure vertical height (not bole length) to the top of the tree based on its branches (not leaves). For trees with a dead top, measure height to top of the tree, not to the top of the green. Height poles should be held vertical if used. Ensure that the appropriate sight lines to the top of the tree are obtained (Figure 10). For stems with a lean, measurements should be taken from the side (Figure 11). Always add a dot of paint to the bole to mark the direction height was taken from. Also see vertex use.

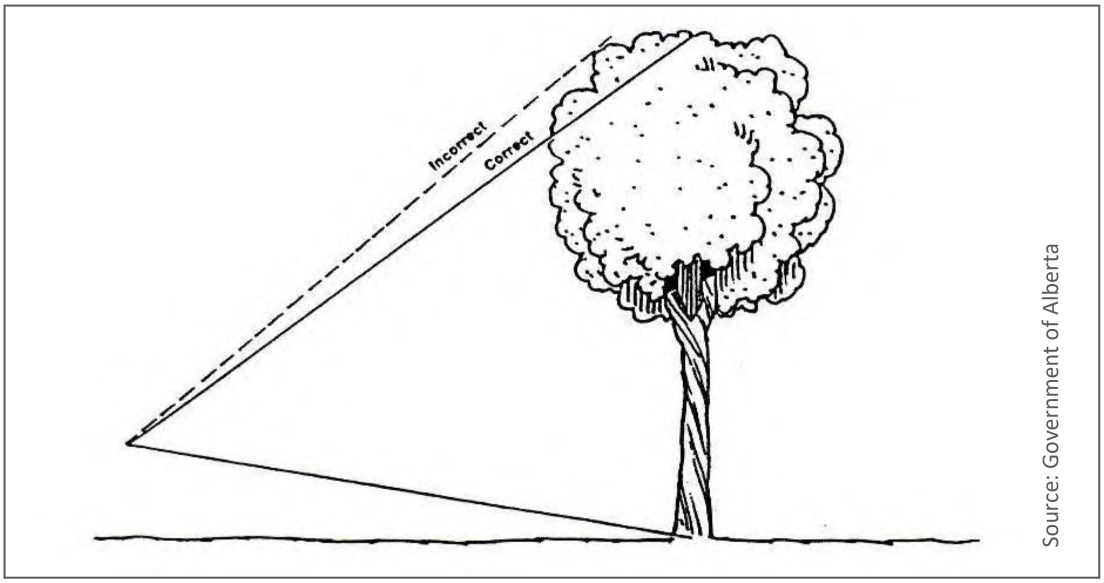


Figure 10. Correct sighting to top of deciduous trees for height measurement.

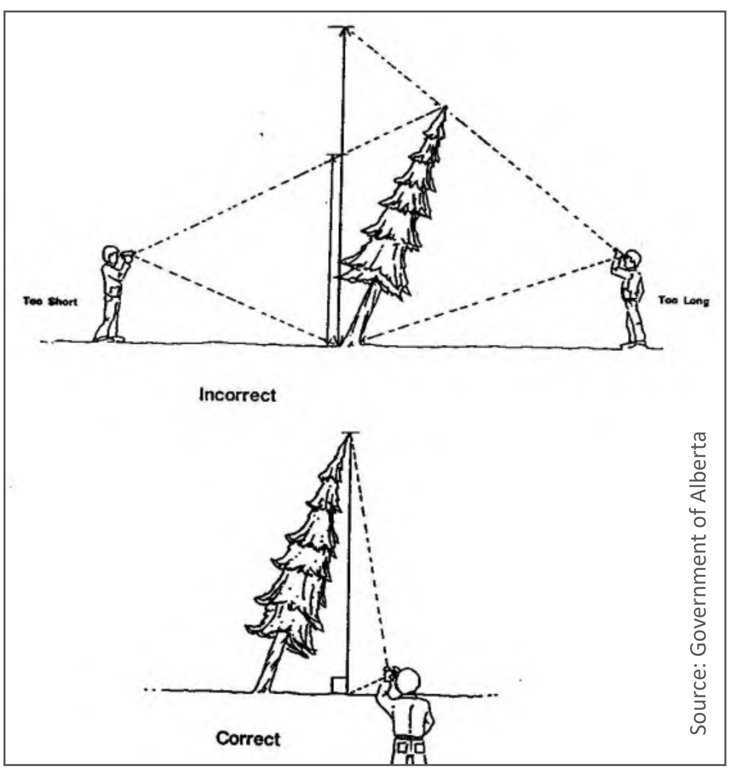


Figure 11. Correct sighting for measurement of leaning trees.

Percent Lean

Lean is to be recorded in PSPs only. Lean is to be measured on all trees leaning ≥ 20° (~35%) off of vertical and must be recorded as a percentage. Lean can be measured by sighting a clinometer along the bole of the tree and recording the angle percentage. Ensure that the percent lean is for departure from vertical (e.g., completely vertical is 0% lean).

Height to Live Crown

The live crown is the portion of the tree responsible for photosynthesis and growth. It is defined as the continuously branched portion of the tree, excluding sporadic branches that do not contribute much to growth. Height to live crown is measured to the base of the green, not where those branches attach to the bole. Where possible, measure height to live crown from the same direction as height was taken.

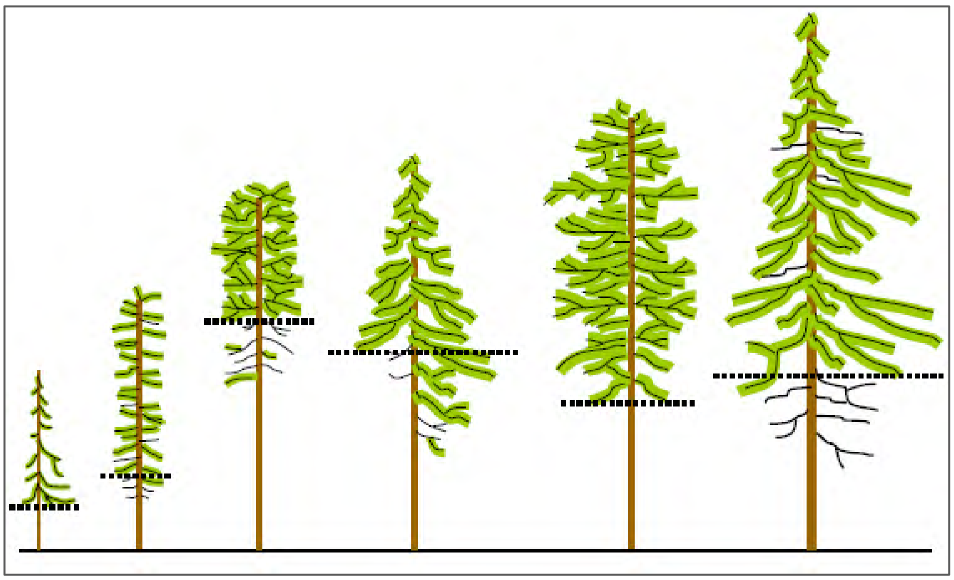


Figure 12. Height to live crown measurement.

Crown Class

Crown class in mature stands is generally related to a tree's position within the canopy (Figure 13). In younger stands, it may be easier to consider the light environment of the tree (Figure 14).

Table 12. Crown class codes and description.

Code	Name	Description
D	Dominant	Crowns extending above the general level of the canopy, receiving full light from above and partial to full light from the sides. Generally taller than the average trees in the stand and typically have the largest, fullest crowns in the canopy.
C	Codominant	Crowns forming the general level of the canopy and receiving full light from above, but comparatively little from the sides. Typically have medium-sized crowns more or less crowded from the sides.
I	Intermediate	Shorter and more subordinate than those of the two preceeding classes, with crowns either below or just extending into the main canopy. Crowns receive some direct light from above but none on the sides, and usually have small crowns that are narrow or one-sided.
S	Suppressed	Crowns entirely below the general level of the canopy, receiving no direct light either from above or from the sides.

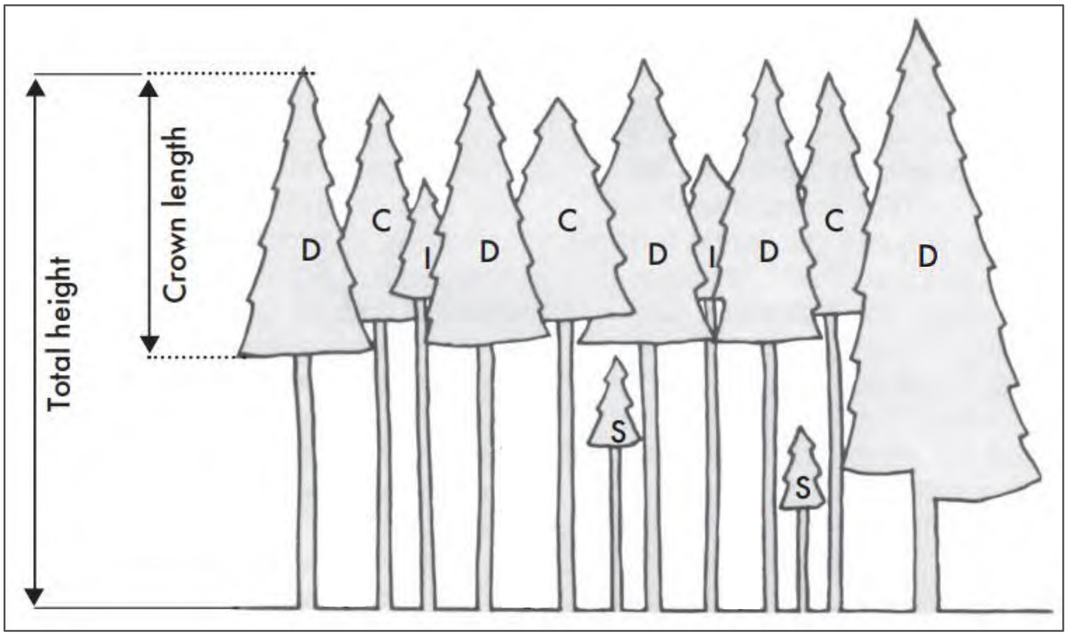


Figure 13. Examples of crown class in mature stands[4].

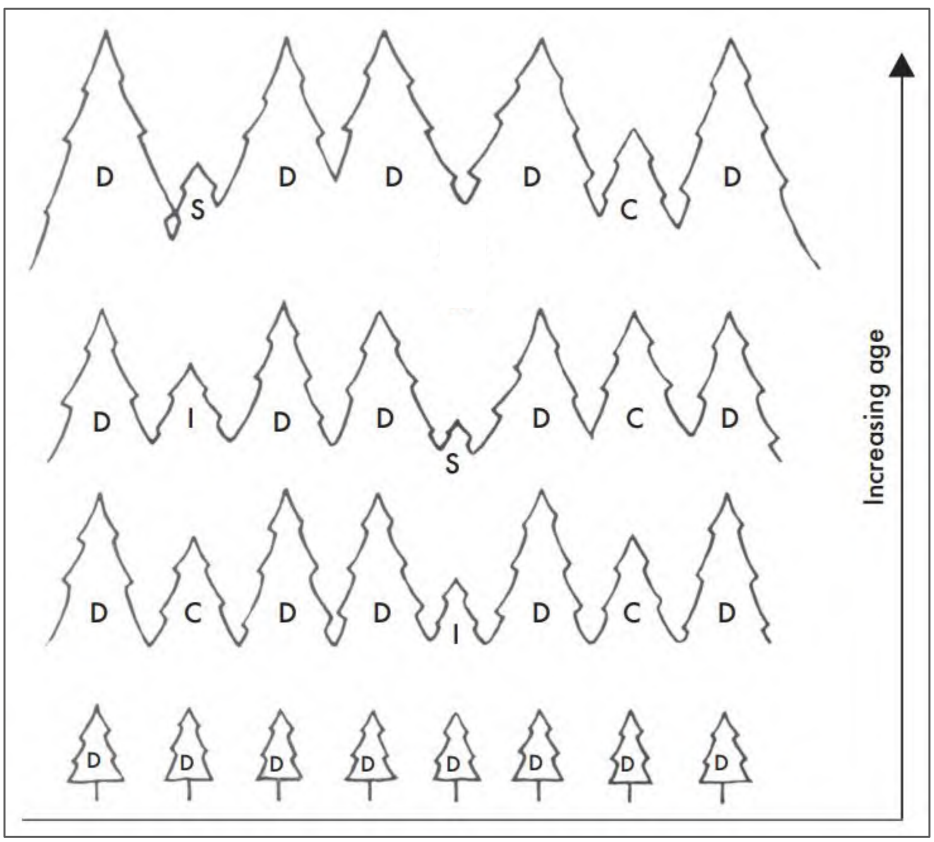


Figure 14. Example of crown class in young stands over time.

[4] Emmingham, W.H. and N.E. Elwood. 1993. Thinning: an important timber management tool. In: The Woodland Workbook. Stand Management. PNW Extension Pub. PNW 184. 6 pp.

Condition Codes

Record up to 3 condition codes for RGT/PSPs and 2 condition codes for TSPs/pPSPs. At least one condition code/cause/severity must be recorded for each tagged stem.

- Where condition 1 is 0 (healthy), set cause 1 to 99 and severity 1 to 9 (unknown or not applicable). There should not be any additional codes recorded under condition 2 or condition 3 (the tree is healthy and undamaged) except for administrative codes (e.g., codes 15-18).
- Where the condition is one of: dead (condition 1 or 2), same stump (12), felled or cut down (13), missing (14), or an administrative code (15-18), fill the associated severity with 9. Assign the associated cause either in condition 1 or in condition code 2, where possible, otherwise use 99.
- Healthy (condition 0), dead (condition 1 or 2), harvested (13), missing (14), or disqualified (15) condition codes should never be recorded in condition code 2 or 3.

Table 13. Condition codes.

Code	Condition	Description
0	Live and healthy	A tree is live and has no noticeable defect or damage.
1	Dead but standing	A tree is completely dead (i.e., no live buds or foliage) but remains standing.
2	Dead and down (at remeasurement)	At remeasurements, a tree is dead and no longer supported by its root system. The tree must be relocated in order to use this code.
3	Broken or dead top	The upper portion of the tree has died or broken off.
4	Bole damage	The main stem of a tree is damaged as a result of mechanical or abiotic factors or from animal, insect, disease or anthropogenic activity.
5	Crown damage	A tree's crown is damaged as a result of mechanical or abiotic factors or from animal, insect, disease or anthropogenic activity.
6	Root damage	The root system of a tree is damaged as a result of mechanical or abiotic factors or from animal, insect, disease or anthropogenic activity.
7	Crook	The bole of a tree exhibits an abrupt curvature.
8	Sweep	The bole of a tree exhibits a gradual curvature. This includes "pistol grip" trees which have a large horizontal displacement at their base.
9	Fork	Used for all prominent forks above DBH. Forks occur where there has been damage to the main leader and must not be confused with the natural branching patterns on hardwoods. Stems which have multiple leaders originating above DBH will also be given this code.
10	Lean	A tree that is leaning a minimum of 10 degrees from vertical.
11	Poor form	This applies to trees which have form defects other than crooks, sweeps and forks. This includes excessively limby trees (wolf trees), trees with multiple leaders (where no distinct fork is present) and various other tree form anomalies.
12	Same stump	Used when two or more trees share the same stump (i.e., forked below DBH). Note that all trees originating from the same stump receive the 12 code.
13	Harvested tree	Used in plot re-measurements when a tree has clearly been harvested. The location of the stump will have to be verified with the previous data before a 13 code can be assigned.
14	Missing tree	Used in plot re-measurements to represent a tree that can no longer be located.
15	Disqualified tree	Used in plot re-measurements when a tagged tree no longer satisfies the necessary criteria under current PSP protocols to be tallied as a tree. Measurements are not required for disqualified trees.
16	Newly qualified tree	Used in plot re-measurements, when a tree was clearly missed during a previous measurement.
17	Renumbered tree	Used in plot re-measurements when a tree was clearly not missed during a previous measurement, but the tree tag is sucked into the bole, missing or unrecognizable, or a different number is assigned under current PSP protocols.
18	Changed in office	Used to denote trees that had their data changed in the office.
19	Multi-stem clump	Multiple stems originating from one location, with origin at or below the mineral soil/organic horizon. Not to be confused with cases where a tree has multiple forks above the soil but below breast height.

Table 14. Cause codes.

Code	Cause	Description
1	Spruce budworm	Tree shows evidence of Eastern Spruce Budworm (Choristoneura fumiferana (Clemens)) attack. Symptoms include: webbing, frass and rust colouring on the tree crown. Primary hosts are white spruce, black spruce and balsam fir.
2	Defoliator	Tree shows evidence of attack from any defoliating insect other than spruce budworm.
3	Mountain pine beetle	Tree shows evidence of mountain pine beetle attack (Dendroctonus ponderosae (Hopkins)). Symptoms include: evidence of entrance or exit holes and accumulations of pitch and sawdust. Primary hosts are lodgepole pine and jack pine.
4	Root collar weevil	Tree shows evidence of attack from any species of root collar weevil. Identified by presence of resin flow and tunnels in the bark and cambium at or below the duff layer. Most conifer species are susceptible to root collar weevil attack.
5	Terminal weevil	Tree shows evidence of attack from any species of terminal weevil. Identified by presence of bent-over leaders with obvious exit holes. Most conifer species are susceptible to terminal weevil attack.
6	Armillaria root disease	Tree shows evidence of attack from Armillaria root disease (Armillaria spp.). Identified by the presence of mycelial fans around the root collar.
7	Shepherd's crook	Tree shows evidence of aspen leaf and twig blight (Venturia spp.) which causes terminal shoots and leaves to wilt and turn black, ultimately forming a shepherd's crook.
8	Dwarf mistletoe	Tree shows evidence of dwarf mistletoe (Arceuthobium spp.), notably the characteristic witches broom associated with this parasitic plant. Most species of conifer are susceptible.
9	Stem disease	Tree shows evidence of a stem pathogen typically caused by canker, heart rot and sap rot diseases. Evidence is usually in the form of a canker (sunken or swollen lesion), conk or other fruiting body on the stem.
10	Western gall rust	Tree shows evidence of western gall rust (Endocronartium harknessii (J.P. Moore) Y. Hairatsuka) most notably woody swellings (galls) on the main stem and/or branches. Primary hosts are lodgepole pine and jack pine.
11	Animal damage	Tree has been damaged by any type of mammal or bird. This includes small mammal feeding, ungulate rubs, ungulate browsing, beaver damage, woodpecker and sapsucker damage, etc.
12	Wind damage	Tree exhibits signs of wind damage.
13	Snow/ice/frost damage/cracks	Tree has been damaged by snow, ice or frost. This may result from ice build-up, heavy snow loads and early or late frosts which damage trees that are not properly hardened off. This includes: snow press, frost cracks and frost heave.
14	Hail damage	Tree has been damaged by hail. Signs of hail damage may include stripped branches and extensive scarring on stems and branches. Damage is greatest on younger shoots, making younger trees more susceptible.
15	Fire damage	Tree has been damaged as a result of burning or scorching.
16	Mechanical damage	Tree has been damaged by the natural mechanical action of trees contacting each other, resulting in scarring or crown damage.
17	Improper planting	Tree has been planted in a manner that is adversely affecting growth. This includes J-rooted trees, shallow or deeply planted trees, trees that are planted loosely or trees planted at an acute angle.
18	Poor ground conditions	Tree has been planted in an inappropriate location (i.e., poor microsite selection) or where the seedbed is unsuitable for growing trees (i.e., hardpan, rotten logs, deep organic soil, etc.).
19	Competition	Tree is suffering from excessive competition from herbaceous or woody vegetation. It typically applies only to seedlings shorter than 1.30 m.
20	Insect (other)	Tree shows evidence of attack from an insect other than those listed in 1 through 5 or from an unidentified insect.
21	Disease (other)	Tree shows evidence of disease other than those listed in 6 through 10 or from an unidentified disease.
22	Climate/weather/flood damage	Tree exhibits damage resulting from climate, weather or flooding. This includes damage caused by lightning, drought, sunscald and desiccation.
23	Anthropogenic damage	Tree exhibits damage resulting from some type of human activity. This includes damage from harvesting, land clearing, herbicide and other human caused activities.
99	Unknown or N/A	Tree has been damaged but cause could not be determined.

Table 15. Severity codes.

Code	Severity	Description
1	Minor	Condition is noticeable but is unlikely to have an adverse impact on the long-term survival, growth or form of the tree. Impacts on fibre quality and yield at the time of harvest are expected to be negligible.
2	Moderate	Condition is obvious and could potentially have an adverse impact on the long-term survival, growth or form of the tree. If the tree survives, some minor to moderate impacts on fibre quality and yield at the time of harvest can be expected.
3	Severe	Condition is prominent and is almost certain to affect the long-term survival, growth or form of the tree (e.g., gull rust circling ≥ 50% of the main stem, leaning ≥ 45° off the vertical axis). If the tree survives, major impacts on fibre quality and yield at the time of harvest can be expected.
9	Unknown or N/A	The severity of the condition is not known, not applicable or unquantifiable.

Tree Ages – Site Index

Age Selection

There are two objectives of age sampling:

1. To obtain height-age measurements in order to estimate site index (stand productivity); and
2. To obtain ages representative of stand and species cohort initiation.

This means that not only do trees need to be free of rot and be in good condition (no broken tops, severe lean, etc.) but they must also be reflective of the correct cohort:

- Deciduous and pine that initiated immediately after fire or harvest; and/or
- Spruce or fir that are not advanced or veteran trees, but which represent the first wave of ingress following disturbance.

<u>This topic is to be discussed during field training to ensure a consistent approach to tree selection.</u>

For each species, select one "largest diameter" tree per 100 m^2 of plot size (typically largest diameter at breast height, except where trees are very small – in which case the largest diameter at stump height is used). For example, if the age tree plot is 300 m^2, sample 3 trees per species and if the age tree plot is 200 m^2, sample 2 trees per species.

In order to be eligible for selection, trees must be:

- Live and healthy looking;
- No broken or dead top (unless the top has recovered);
- Not advanced regeneration or a veteran tree from a previous generation;
- Does not have western gall rust encircling ≥ 50% of the main stem;
- Not leaning ≥ 20°, not a wolf tree or of obvious poor form (e.g., crook, sweep, fork); and
- No severe damage to more than 1/3 of bole, crown and/or root.

In young stands, additional criteria apply:

- At least 30 cm in height; and

- ≥ 8 years *total* age for deciduous, pine and larch and ≥ 10 years *total* age for fir and spruce.

If most trees are younger than the minimum ages above, defer aging until the majority of trees are over the threshold i.e., at a subsequent remeasurement.

Types of Ages

The type of age data to be collected will vary depending on stand age, size of the tree and the tree's origin (planted, sucker or seed). These recommendations are based on the idea that:

1. The closer to the ground that the age is measured, the more accurate the estimate of site index and stand age will be (fewer assumptions around things like years to breast height); and
2. In some stands we can rely on known events such as wildfire year, skid clearance or planting dates to obtain total ages.

In general, the guidelines are as follows:

- Stands < 40 years of age:
  - If using a reference age, record the reference age under total age.
  - For trees with clear bud scale scars or easy to count whorls, count and record total age.
  - For all other cases, measure age at stump height.
- Stands ≥ 40 years of age:
  - Measure age at breast height.

Note that in young stands, the same type of age does not have to be used for all trees within a plot. The choice of age (stump height or total) should be based on other factors such as ability to count whorls, and reliability of reforestation records to assist in aging, etc.

General Notes

- Account for snowpack – remove snow as required to ensure age is taken at the correct height above point of germination (e.g., 30 cm for stump height, 1.3 m for breast height).
- If there is any uncertainty on age counts, cores/cookies must be taken to the office for counting. Use of a consultant who has specialty equipment for aging (such as Carson) is strongly recommended.
- Depending on the program, crews may be asked to store cores/cookies for QC purposes. If this is required, all cores should be placed in a straw (cookies in a plastic bag) and labelled with program ID, plot ID and tree number. Store in a freezer if there will be a delay in delivery.
- *Age accuracy is critically important to estimates of site index, which in young stands can be highly influenced by outages of even one or two years. Take the time to count ages carefully, including destructively sampling trees outside the plot to better understand age-size relationships where there has been multiple planting or ingress events or to understand what advance regeneration looks like.*
- *<u>Advance regeneration must be excluded from age sampling</u>.*

Reference Ages

Aging of juvenile trees in managed stands can be greatly aided by harvest, tending and planting information, since they can provide good information on potential origin ages for trees ("reference ages"). It is highly recommended that WF provide crews with silviculture information and reference ages prior to commencing field work.

Reference ages are calculated by counting the number of eligible growing seasons since harvest. For surveys conducted during the active height growth period (May-July), do not include the current growing season in calculation of reference ages (since this will not be included in measurement, see "Aging During the Growing Season"). Include the following when calculating reference ages:

For naturally seeded regeneration (both coniferous and deciduous):

- Use total number of growing seasons post-harvest.
- For stands skid cleared prior to July 15th, count the growing season immediately following harvest.
- Reference age is a theoretical maximum age only; seeded ingress could be much younger than the number of growing seasons since skid clearance (depending on year of seeding).

For deciduous suckering:

- Post-harvest: for skid clear prior to July 15th, count the growing season immediately following harvest.
- Post-wildfire: for fires extinguished prior to July 15th, count the growing season immediately following wildfire.
- Post-manual tending: for stands manually tended prior to July 15th, count the growing season immediately following harvest.

For planted conifers:

- Do not count growing season in the year of planting.

This is simplified in the following formulae:

Type	Calculation	Skid Clear/Tend/ Burn Before July 15?
Seeded Species	Year of Last Full Growing Season - Skid Year	Add 1
Deciduous Post Harvest	Year of Last Full Growing Season - Skid Year	Add 1
Deciduous Post Wildfire	Year of Last Full Growing Season - Skid Year	Add 1
Deciduous Post-Manual Tending	Year of Last Full Growing Season - Tend Year	Add 1
Planted Species	Year of Last Full Growing Season - Plant Year + Stock Age	NA

Maximum Expected Ages in Managed Stands

Selected age trees must be seedlings (originated after harvest), therefore tree ages for top height trees in managed stands should never exceed the following:

- Deciduous: number of growing seasons since1) wildfire or 2) skid clearance date.
- Coniferous: number of growing seasons since either 1) wildfire or 2) skid clearance date, plus age at outplanting (planting stock age) for planted conifers.

Aging in Young Stands (< 40 Years of Age)

Because use of fire records, skid clearance and/or planting records can, in cases, result in more reliable estimates of age than field measurements (particularly when these would otherwise be taken at stump height and require assumptions regarding years to stump height in order to calculate total age), the following guidelines are recommended for determining age in young post-fire and managed stands:

- Aspen (sucker origin):
  - Use reference age (unless it's obviously seed origin – rare) and record under total age.
- Poplar and birch stump sprouts:
  - If obviously tied to a harvest or tending event, use reference age and record under total age.
- Poplar and birch not evidently a stump sprout, and seed origin aspen:
  - If fairly young (4-5 years of age), use bud scar counts to get total age.
  - If bud scars are not obvious, collect cores/cookies at stump height.
- Planted conifers:
  - Use reference age and record under total age; count whorls to verify approximate age and if in doubt, treat as a natural conifer (see next).
  - If relying on planting information for ages *be certain it's planted and not advance* – test this by cutting similar size trees outside the plot and doing a quick check on age.
- Natural conifers:
  - Take cores/cookies (also do a whorl count as a 2nd check) or, for very young trees (under ~15 years of age) with obvious whorls, do a whorl count.

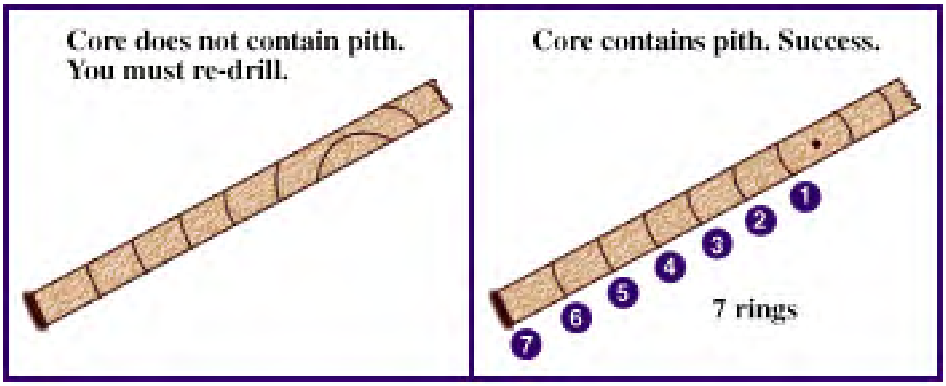
Sampling Using Cores and Cookies

Unless relying on reference ages as described in the previous section, collection of cores and/or cookies will primarily be used to determine ages. Coring involves using an increment borer to extract a core from a tree for aging. Cookies are obtained by cutting a tree down and taking a cross section ("cookie") for aging purposes; this is typically done when trees are too small for coring.

- For coring, the increment borer must be held horizontal at the correct height (breast or stump height). The pith must be captured by the increment bore otherwise the bole should be re-cored.
- For destructive sampling, cut using a folding pruning saw or chainsaw (a chainsaw will require more sanding in order to be able to read rings). Ensure equipment is held horizontal at the target height above the point of germination (e.g., for stump height age, at 30 cm above point of germination): do not cut at an angle.
  - Mark the side of the cookie that correlates with the right section height (e.g., one side will be from 30 cm above the POG) so that the correct side is counted for age.
  - Cookies often need to be sanded in order to count the rings, so it is particularly important that cookies are correctly labelled with program ID, plot ID and tree number.

- If necessary, use a preferred material to increase contrast especially for deciduous species. Various approaches include chainsaw oil, grape juice, white chalk dust, or a fluorescent felt marker plus UV penlight.

- As previously stated, using a contractor with specialized equipment for determining ages is strongly recommended due to the importance of accuracy in age counts.



Whorl/Bud Scar Counting

To field-age a tree, the rules will follow the Regeneration Standard of Alberta:

- Count the number of branch whorls on coniferous trees or bud scars on deciduous trees from the current season's growth (i.e., terminal leader) down to the stump height node; and

- Add one year (germination to cotyledon).

Field crews should be aware of the potential for lammas growth, false whorls and hidden whorls in conifer trees that may throw off whorl counts. Bud scale counts are typically only reliable for 4-5 years. For whorl counts use the following guidelines:

- On many trees, lower branches are dropped due to shading as trees grow. Ensure that the bottom most stubs are included in assessing tree whorls.

- Small single branches between whorls are "false whorls" and should not be counted.

- A very short distance between whorls may indicate "lammas growth", that is years where the tree flushed twice in response to certain growing conditions. Ignore those extra whorls unless it appears that the tree was damaged resulting in a shorter distance between whorls.

- If there is not an obvious whorl count near the base and guessing is required to estimate the age (as shown in Figure 15), sample at stump height using a core or cookies instead.

Aging During the Growing Season

Aging trees during the growing season is not recommended, however, for certain programs (e.g., TSP sampling), measurements during the growing season may occur.

For any measurements of age taken during the growing season, age should be measured to end of the last full growing season (i.e., the previous year). This also applies to bud scar/whorl counts. Height measurements taken on age trees should also correspond to the last full growing season and exclude new leader growth. For surveys conducted after July 15, the current year's growth may be included in determining age and height.

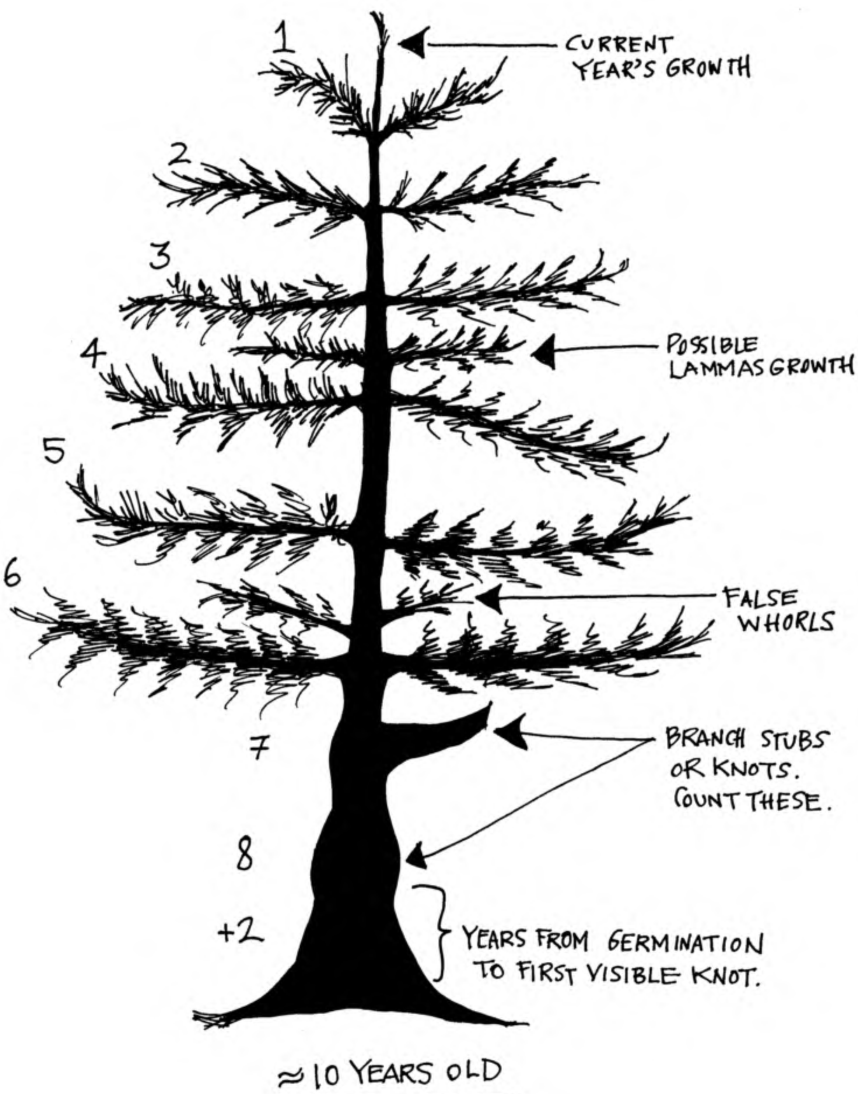


Figure 15. Examples of whorl counting[5].

Dealing with Rot

Never record partial or inaccurate ages dues to rot (e.g., "55+" or comments such as "added 10 years to account for area with rot"). Rot is common in mature deciduous trees, as evidenced by the presence of conks. Where rot is encountered in a tree selected for aging, try the following in order:

1. Try coring the stem from different angles (often rot does not extend around the entire stem).
2. Try coring either 15 cm above or below breast height.
3. Select the next largest stem, for up to three additional stems, in the age plot.
4. For PSPs and PPSPs plots only: If no suitable trees are found within the age plot, select replacement trees from outside the plot (within 200 m of plot centre), as long as they are in a similar stand type and

[5] From: https://openoregon.pressbooks.pub/forestmeasurements/chapter/4-4-field-technique-tips-for-counting-whorls/

are of similar size. Take up to 1 hour in the buffer, maximum, before giving up. Note "age tree from outside age plot" in the comments.

Lastly, if no suitable trees can be found, make a note in the plot measurement comments.

Age Representative

As previously stated, plots are used for two purposes: collecting information to be used for estimating site index and collecting information on the age of initiation of the new cohort or trees after harvest. Circumstances may arise where the age tree is suitable for estimating site index, but not suitable for representing the age of the species group being sampled.

The "Age Representative" field documents whether the age is representative of the *cohort that represents the first influx of regeneration following a stand-replacing disturbance*. This may vary by species group, such as in cases where aspen regenerates immediately following disturbance and spruce regeneration occurring 15 years later.

An example would be in older stands with substantial rot in aspen trees, where in order to obtain a rot-free age code, a smaller (younger) aspen tree is aged. This tree would be suitable for site index, but it likely younger than the rest of the aspen. The field "Age Representative" is used to ensure these trees are not used to calculate average age for the aspen cohort.

In general, if the selected age tree is distinctly smaller (slimmer or shorter) than other trees of the same species group, it is likely not representative and should have Age Representative set to "N".

Azimuth and Distance

Where required, azimuth (bearing) and distance from the plot centre to the centre of the stem must be recorded. In these cases, the following rules apply:

- At first measurement, bearings should be obtained using either a staff compass or stem mapping device such as a Haglof Postex. Ingress at subsequent measurements may be stem mapped using a compass set to the appropriate declination (see Equipment Quality Standards).
- If high quality stem mapping is required by WF, a Haglov PosTex must be used[6].
- Note that steel posts will interfere with compass readings, so if a compass is being used, any steel posts must be removed prior to stem mapping (preference is to use aluminum posts). Alternatively, crews may take an azimuth <u>from</u> the tree <u>to</u> plot centre and then reverse the reading.
- For consistency distance is to be measured to the front of the bole.

<u>Field crews must ensure the proper declination is set if using compasses for stem mapping of trees.</u> <u>See the Declination section on page 32.</u>

Crown Width

Crown width is not required for TSPs and will no longer be a required measurement in PSPs unless otherwise specified in an applicable field manual.

[6] PosTex® Laser | Haglöf Sweden AB (haglofsweden.com)

Plot Establishment, Tree Numbering and Tagging

This section outlines recommended best practices. Each division will have their own field manual which may specify a different approach. This section applies only if not otherwise specified in the field manual. However, accuracy standards for plot establishment will apply to all WF programs.

All distances used for plot establishment must be horizontal distance adjusted for slope.

Plot Centre

Plot centres must be established using a GPS unit at *exactly* the coordinates provided (according to that unit). The tolerance of +/- 10 m for plot location in the Quality Control section is *only* intended to account for differences between GPS capture on the day of measurement and GPS capture on date of QC. It is critical to use an unbiased method for plot location to avoid the tendency, for example, to locate plot centres in gaps which could result in underestimates of density and/or volume. Requirements for centre posts are program specific.

Establishing Square Plots

Main plots will be laid out using the following method:

- Calculate the plot's diagonal length (e.g., distance from the NW corner to the SE corner diagonally across the plot) using $Diag = \sqrt{Length^2 + Width^2}$.
- For example, a 20 x 20 m^2 plot would have a diagonal length of $\sqrt{20^2 + 20^2} = 28.28\ m$.
- Divide this number by 2 to get distance from plot centre to plot corner (in our example, 14.14 m)
- After marking plot centre, proceed at a bearing of 45° for the proscribed distance (e.g., 14.14 m); pound in a post and mark as the NE corner.
- Repeat at three additional bearings from plot centre: 135° (SE corner), 225° (SW corner) and 315° (NW corner).

The main plot must then be checked for accuracy, and adjusted if it fails to meet any of the following criteria:

- Take a sight or pull tape from the NE corner to the SW corner; the line of sight/tape should include the plot centre post. Measure the diagonal length (28.28 m in this example); the diagonal length must be within 1% of the target (0.28 m in this example).
- Repeat from the SE corner to the NW corner.
- Measure all four sides of the plot: the length and width of each side should be within 1% of the target (0.20 m in this example).

Nested sapling subplots can then be established, with methods depending on the plot configuration:

- For square sapling plots nested around the main plot centre, use the same methods as for the main plot and check for accuracy with a tolerance of 1% (e.g., 0.10 m for a 10x10 m plot).
- For square sapling plots nested in the NW corned of the main plot, measure to the E and S along the main plot boundary to establish the SW and NE corner posts. Calculate the diagonal length of the subplot as previously described and measure from the NW corner towards plot centre to establish the

SE corner post (see example Figure 16). Check for accuracy by measuring the lengths of each side as well as diagonal lengths, with a tolerance of 1%.

- For circular subplots, use a tape to measure and establish plot boundaries with a *minimum* of 16 measurements to confirm the boundaries. Accuracy tolerance will be +/- 1%.

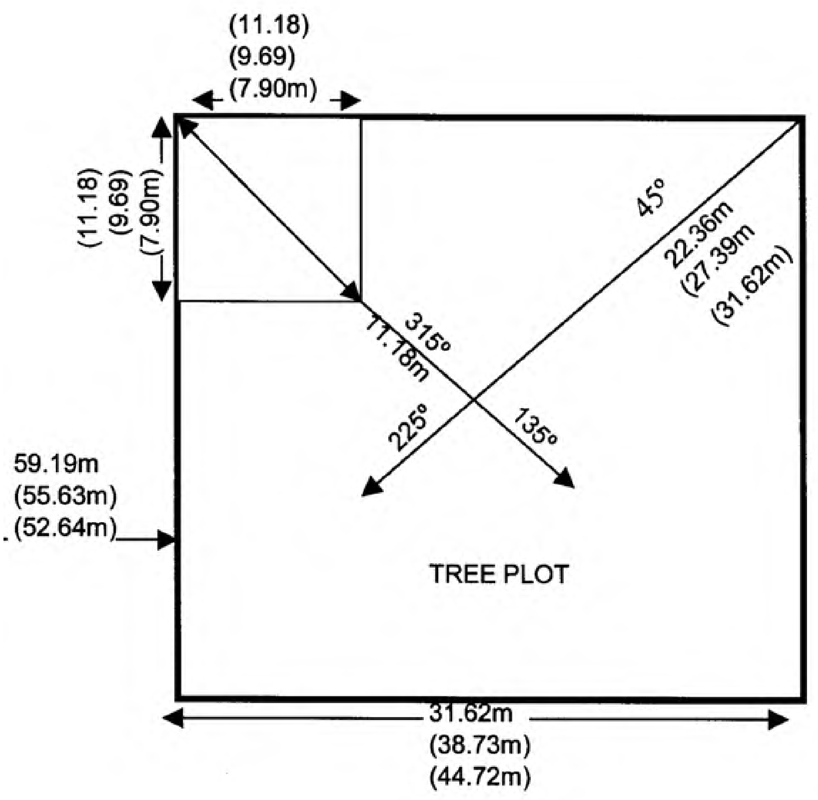


Figure 16. Example of laying out a sapling plot nested in the NW corner of the main plot[7].

Establishing Circular Plots

Circular plots are typically comprised of a circular plot with a nested sapling subplot that shares a common plot centre. Use a tape to measure and establish plot boundaries with a minimum of 16 measurements to confirm plot boundaries. The accuracy tolerance is 1% in all cases.

Because circular plots are more prone to boundary issues, care must be taken to check *every* borderline tree to ensure it is in the correct plot (both inside/outside the tree plot, but also inside/outside the sapling plot).

Establishing Regeneration Plots

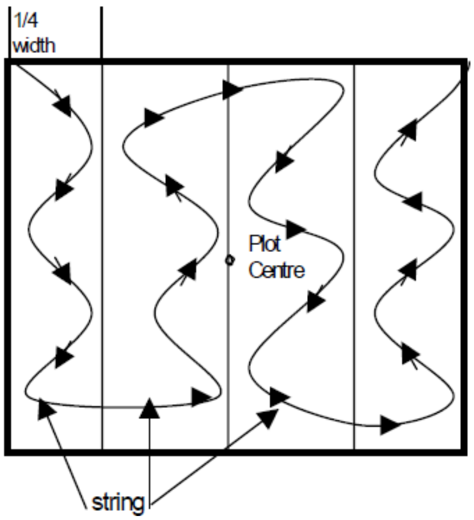
The establishment of regeneration subplots will vary depending on plot design, size of the main plot and size/location of the sapling plot; due to the large number of potential configurations, the layout for these subplots will be described in each applicable division-specific field manual.

General principles for establishing and checking boundaries apply with the same 1% tolerance.

[7] From Alberta Sustainable Resource Development 2005.

Swathing for Tree Numbering

Square plots should be divided into strips each ¼ the width of the main plot. Trees should be tagged starting at one corner of the plot, moving in a swath pattern as shown in the examples in Figure 17. To facilitate relocation of trees, it is recommended that the quadrant (NE, SE, SW, NW) of the plot also be recorded.



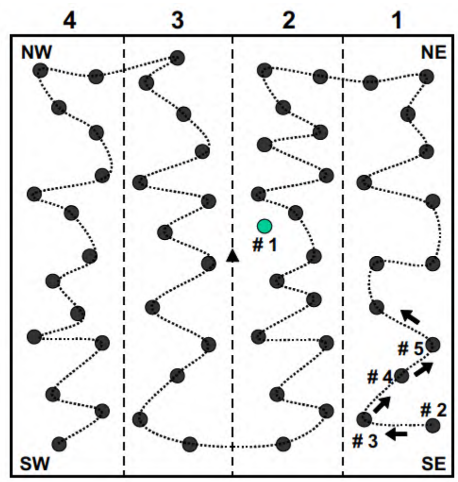
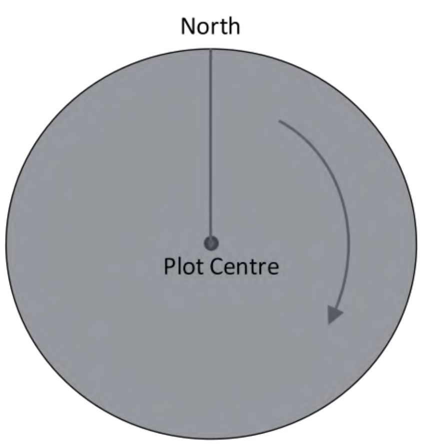


Figure 17. Example swathing method for main plots[8].

In small circular plots, tree tagging should commence in the north, generally using a plot cord (with confirmed accuracy) attached at plot centre to ensure all trees are captured and sweeping in a clockwise fashion. In larger circular plots, using a swathe by sector is recommended.



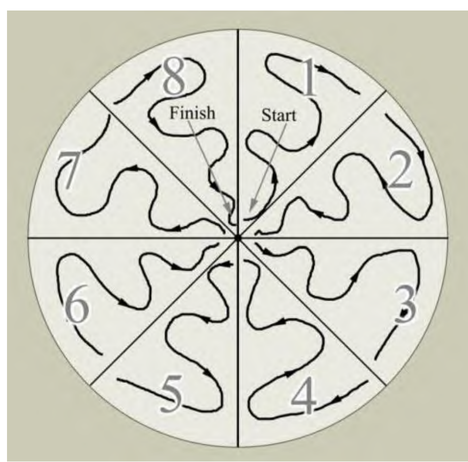


Figure 18. Examples of swathing for circular plots.

Methods for Affixing Tree Tags

In the past, nails were used to attach tree tags to larger trees in permanent sample plots. Recommended best practice is to use snare wire or copper wire looped around sturdy branches of conifer trees, or looped around the bole for deciduous trees or smaller trees lacking suitable branches.

[8] In example 2 (right) tree one is a plot centre tree (see Plot Centre and Witness Trees section).

- All wire should leave enough space for 10-20 years' growth, even if tags are affixed to branches. It is essential to leave enough room for tree growth. Several PSPs now have issues with ingrown nails and girdled stems because of tree tags; some plots may be closed due to impacts on tree growth and mortality.
- Deciduous trees have a tendency to lose branches; therefore, a loop around the bole is recommended. After the loop is created, twist the wire loosely into a figure eight; this will prevent the loop from falling to the ground, but will allow the wire to "untwist" and expand as the tree grows.
- Conifers with sturdy branches will have tags affixed to a branch. Again, ensure sufficient space is left to prevent girdling branches.
- Smaller conifers lacking sturdy branches will be marked in a manner similar to deciduous trees.
- Smaller regen may be marked using pigtails with tree tags. Place the pigtail on the <u>outside</u> of the regen such that the regen is between the pigtail and the centre of the regen plot.

Tree numbers will typically need to be written on the tags; for any tree numbers with a 6 or 9, there must be an underline (<u>6</u> or <u>9</u>) to prevent confusion.

Never re-use tag numbers from dead/missing trees, assign duplicate tag numbers, or assign tree numbers with letters (e.g., 4a).

Marking Buffers

Standards for marking plots and buffers are provided in each individual field manual. Please refer to these manuals for more information. The recommended best practices for buffers are:

- A minimum 20 m buffer is required around all PSPs and research plots.
- Mark the trees at 5-10 m intervals using blue paint.
- Avoid dead trees, windblown trees and trees with thick, low hanging branches.
- Paint trees using blue paint at eye height around at least 2/3 of the bole, facing outward from the plot. Paint should be at least 30-40 cm in height. Tie blue flagging around smaller trees.
- At each corner of the buffer, paint the trees with a double band of blue spray paint at breast height to indicate a change in buffer direction.

Plot Centre and Witness Trees (Optional Recommended Best Practice)

A plot centre tree is used to help locate the plot centre while witness trees are intended to help locate plot corners. If plot centre and/or witness trees are used, the recommended best practices are:

- Plot centre tree: Select a live healthy tree near plot centre. Add a double band of blue paint 2 m up the bole and a single band 0.2 m from the ground. Affix an extra tag at stump height indicating that it is a plot centre tree and providing the distance and bearing to plot centre.
- Witness trees: Select three trees outside the main plot around each plot corner. Mark one tree with corner (NEC, SEC, NWC, SWC) written vertically on the bole with three blue bands above and below. The other two trees should be painted with an X facing towards the main plot corner.

Equipment Quality Standards

GPS Accuracy

GPS locations (x and y coordinates) must be delivered in NAD 83 projection, using either zone 11 or 12 depending on where in Alberta the data are collected.

High accuracy GPS locations are required for all pPSP and PSP plots centres including RGT plots. GPS coordinates must be obtained at each remeasurement since GPS technology is constantly improving. High accuracy GPS may be required for other field programs (e.g., TSPs) as directed by WF staff. If high accuracy GPS is required, one of two approaches must be followed:

1. Strongly preferred: Use a Trimble or similar *mapping grade* GPS unit and obtain at least 60 point samples at each waypoint. Perform differential correction and provide the *.cor file or equivalent. This map-grade approach is the most desirable.

2. Use a Garmin (or other) device with waypoint averaging capacity. Typically, a 10-minute sample is required at each waypoint. Record the averaged point. A second 10-minute average must be taken at least 90 minutes later (to allow a different satellite configuration). If the two points differ by more than 3 m (latitude or longitude difference >0.00003 degrees), sample again 90 minutes later. Continue until the two averages are <3 m apart.

Check accuracy of GPS equipment here (may not contain all makes and models):

USDA Forest Service Global Positioning System: MTDC Accuracy Reports

Additional information may be required to ensure plots centre locations will be sufficiently accurate for use in enhanced forest inventory (EFI) or LiDAR-based work. Direction will be provided by WF staff but will include the requirement for:

- High quality GPS coordinates, with differential correction, of four “reference trees” spread throughout the plot. Reference trees should be distinctive such that they could be easily picked out in aerial imagery (e.g. a large deciduous tree in an otherwise pine plot, or a veteran white spruce tree that extends above the canopy). They should also be spread around the plot to be used to help triangulate the plot centre.
    - Specifications must meet or exceed those outlined under option 1, above.
- High quality azimuth and distance plus percent slope from plot centre must be recorded for each reference tree (see Measurement Information section for details on requirements for collecting high quality azimuth and distance).

Compass Declination

Compass declination is used for measuring distances and bearings (e.g., for recording directions to the plot and/or for stem mapping where high accuracy is not required).

Compass declination must be correctly set for each field program using the latitude and longitude from the closest site or town, or lat/long of the area being sampled. Current declinations by city or town are listed in Table 16. Because declinations change over time, they should be periodically confirmed using the link below.

NCEI Geomagnetic Calculators (noaa.gov)

Table 16. Compass declination setting by town/city (updated August 20, 2024).

Town/City	Declination
Athabasca	14°00' E
Blue Ridge	14°45' E
Cochrane	13°46' E
Drayton Valley	14°24' E
Edson	15°01' E
Fort McMurray	13°26' E
Grande Cache	15°56' E
Grande Prairie	16°10' E
High Level	16°25' E
High Prairie	15°28' E
Hinton	15°22' E
Lac La Biche	13°23' E
Manning	16°13' E
Peace River	15°56' E
Pincer Creek	13°12' E
Rocky Mountain House	14°11' E
Slave Lake	14°46' E
Sundre	13°57' E
Whitecourt	14°53' E

Height Measurement Equipment and Vertex Calibration/Use

For height measurement, the recommended best practice is to use a calibrated vertex for trees over ~2-3 m in height and a height pole (which can be a simple straight stick with measurement markings) for smaller trees.

The following minimum specifications must be met when using a vertex to measure heights and/or height to live crown:

- Each vertex is to be calibrated at the beginning of each day, and for every 3° change in temperature.
- To obtain the first distance, the unit must be held pointing at the receiver (puck). The puck must be held to the front of the bole, 1.3 m above the point of germination of the tree.
- Make sure the vertex is pointing at the actual top of the tree, especially for deciduous species (see Height Measurement).
- The crew member using the vertex must stand, at a minimum, at least 1 tree length away from the tree being measured (angle of the vertex must be 45°/100% or less).

Quality Control

Each field program may define its own procedures around quality control; however all data must meet the data quality standards listed in this section. WF staff or an independent contractor will complete quality control unless otherwise specified. It is recommended that the contractor and crews are notified of any upcoming plot audits so that they have the option to be present.

The *first plot* completed by each field crew must be QC'd to ensure that crews understand the measurement protocols. Additional plots must be QC'd throughout the duration of the program, targeting a cross section of field crews, in order to ensure continued quality of data, and meet the following minimum QC sample size:

- TSPs: a minimum of 5 plots or 5% of plots, whichever is larger.
- PPSPs: a minimum of 5 plots or 10% of plots, whichever is larger.
- PSP: a minimum of 5 plots or 10% of plots, whichever is larger.

Plot and Measurement Information

All information is expected to be complete and accurate. Missing information may be returned to crews for completion and may require a revisit to the plot to obtain missing data.

Table 17. Quality standards for plot establishment.

Plot Establishment	Tolerance	Re-Work Trigger
Access documentation	As per individual field manual specifications	at QC staff discretion
Plot posts and monumenting	As per individual field manual specifications	at QC staff discretion
Buffer marking	As per individual field manual specifications	at QC staff discretion
Tree tagging and numbering	As per individual field manual specifications	at QC staff discretion
Use of correct declination	As per individual field manual specifications	at QC staff discretion
Location of plot centre	Within 10 m of planned location	exceeds tolerance
Main tree plot size	±1% for distance, e.g., 20.00 m ± 0.20 m for each side	exceeds tolerance
Sapling plot size	±1% for distance, e.g., 5.64 m ± 0.06 m for radius	exceeds tolerance
Regeneration plot size	±1% for distance, e.g., 3.57 m ± 0.04 m for radius	exceeds tolerance

Table 18. Quality standards for plot and site information.

Plot and Site Information	Tolerance	Re-Work Trigger
Plot access code	None	N/A
Plot location information	Correct datum and UTM zone used	N/A
Plot disturbance information	Completed where disturbance is present	N/A
Stand origin	Correct	N/A
Topography	1 class	exceeds tolerance
Elevation	±20 metres	exceeds tolerance
Slope	±5%	exceeds tolerance
Aspect	1 class	exceeds tolerance
Ecosite/ecosite phase	1 class	exceeds tolerance
Soil moisture	1 class	exceeds tolerance
Soil nutrient	1 class	exceeds tolerance
Ecosite guide	Correct	exceeds tolerance
AVI field call	Follows specifications +/- 1 class for all	exceeds tolerance
Ground cover % (shrubs)	±10%	exceeds tolerance
Ground cover % (herbs/forbs)	±10%	exceeds tolerance
Ground cover % (grass)	±10%	exceeds tolerance
Ground cover % (moss/lichen)	±10%	exceeds tolerance

Tree, Sapling and Regeneration Information

A 10-10-10 rule will be followed: 10% of the trees, 10% of the saplings and 10% of the regeneration in the selected PSPs are randomly or systemically selected for verification, or a minimum of 10 stems in each of the three categories (trees, saplings, and regeneration) whichever is greater. If fewer than 10 stems are present in a category, then all stems will be assessed.

Table 19. Quality standards for measurements.

Measurement	Tolerance	Re-Work Trigger
Correct trees identified	None (i.e., must be correct)	>2 stems incorrect
Correct saplings identified	None	>2 stems incorrect
Correct regeneration identified	None	>2 stems incorrect
Regeneration density count	±10%	exceeds tolerance
Tree location	None	>2 stems incorrect
Tree quadrant	None	>2 stems incorrect
Tree origin	None	>2 stems incorrect
Species	None	>2 stems incorrect
DBH	±0.2 cm or ±2%, whichever is greater	exceeds tolerance on >5% of stems
Correct DBH	DBH measured within 3 cm of correct BH (1.3 m)	exceeds tolerance on >5% of stems
Height (≥2 m)	±0.20 m or ±3%, whichever is greater	exceeds tolerance on >5% of stems
Height (<2 m)	±0.05 m	exceeds tolerance on >5% of stems
% Lean	+/-5%	exceeds tolerance on >5% of stems
Height to live crown	±0.50 m or ±10%, whichever is greater	exceeds tolerance on >5% of stems
Crown class	±1 class	>5% misclassed by 1 class or any misclassed by more than 1 class
Condition codes	None	exceeds tolerance on >5% of stems
Correct age tree selected	None	>2 age trees incorrect
Ages	±1 year or ±5%, whichever is greater	exceeds tolerance on >2 age stems
Age representative	None	>1 stem incorrect
Azimuth	±2 degrees	exceeds tolerance on >5% of stems
Distance	±0.30 m or ±2%, whichever is greater	exceeds tolerance on >5% of stems

Protocol for Failed Audits (Recommended Best Practice)

A plot will fail the audit if a single plot attribute is outside of the allowable error on 5% of the checked trees or 10% of checked trees have one or more failed attributes as outlined in Table 19. It will be at the discretion of WF staff to find the option to best ensure the submitted data are accurate.

If any plot fails the QC procedure, WF staff will:

1. Meet with the project manager/crews to discuss the issue.
2. Request that crews fix the failed plot at their own expense.
3. Undertake additional QC in plots that have been completed either:
    a. By the same individuals who measured the first failed plot, or
    b. Around the same time the failed plot was completed.
4. If further issues are found in these additional checks, request that those plots also be re-measured at the expense of the contractor including and any further QC'd plots at the discretion of WF staff.

Field Program Planning and Management

Camps

Some contractors may wish to base their operations out of camps. The following requirements will apply:

- Follow the rules for camping on crown lands: aep-camping-on-crown-land (alberta.ca).
- Obtain a Public Lands Camping Pass | Alberta.ca if camping outside of a designated campground on the eastern slopes of the Rocky mountains.
- If a camp is outside of a designated campground and will be in one location for more than 14 days, a Disposition Operational Approval (DOA) or a Temporary Field Authorization (TFA) will be required[9] unless it will be established at an already approved camp such as a silviculture camp. Due to long processing times, the recommended approach is to apply for the DOA/TFA at least four weeks or more prior to establishing a camp. Note[10]:
  - If the camp is to be placed in an existing disposition such as a gravel put, a TFA would be required as the *purpose* of the original disposition has changed.
  - A separate approval from the municipality or county may be required for waste water; grey/black water must be tanked and hauled in most situations.

All camps on WF FMAs must meet the requirements of the Alberta Operating Ground Rules[11], including:

- Keep camps clean and minimize potential for problems with wildlife by proper storage of camp food and garbage and following the Human-Bear Conflict Management Plan[12].
- Place sites out of visual and auditory range from mineral licks and key wildlife areas or use a default of one kilometer.
- Facilities, camps and other infrastructure should be located to minimize disturbance, traffic and risk of human-wildlife conflicts in woodland caribou ranges, grizzly bear access management areas and key wildlife and biodiversity zones[13].

In addition, all fuels must be stored at least 100 m from a watercourse.

Notifications for Access

WF staff will be responsible for notifying affected stakeholders regarding upcoming field work and obtaining necessary codes for gates. If a stakeholder would like a courtesy call the day before entry, crews will be provided with a contact name and contact number and will be responsible for notification.

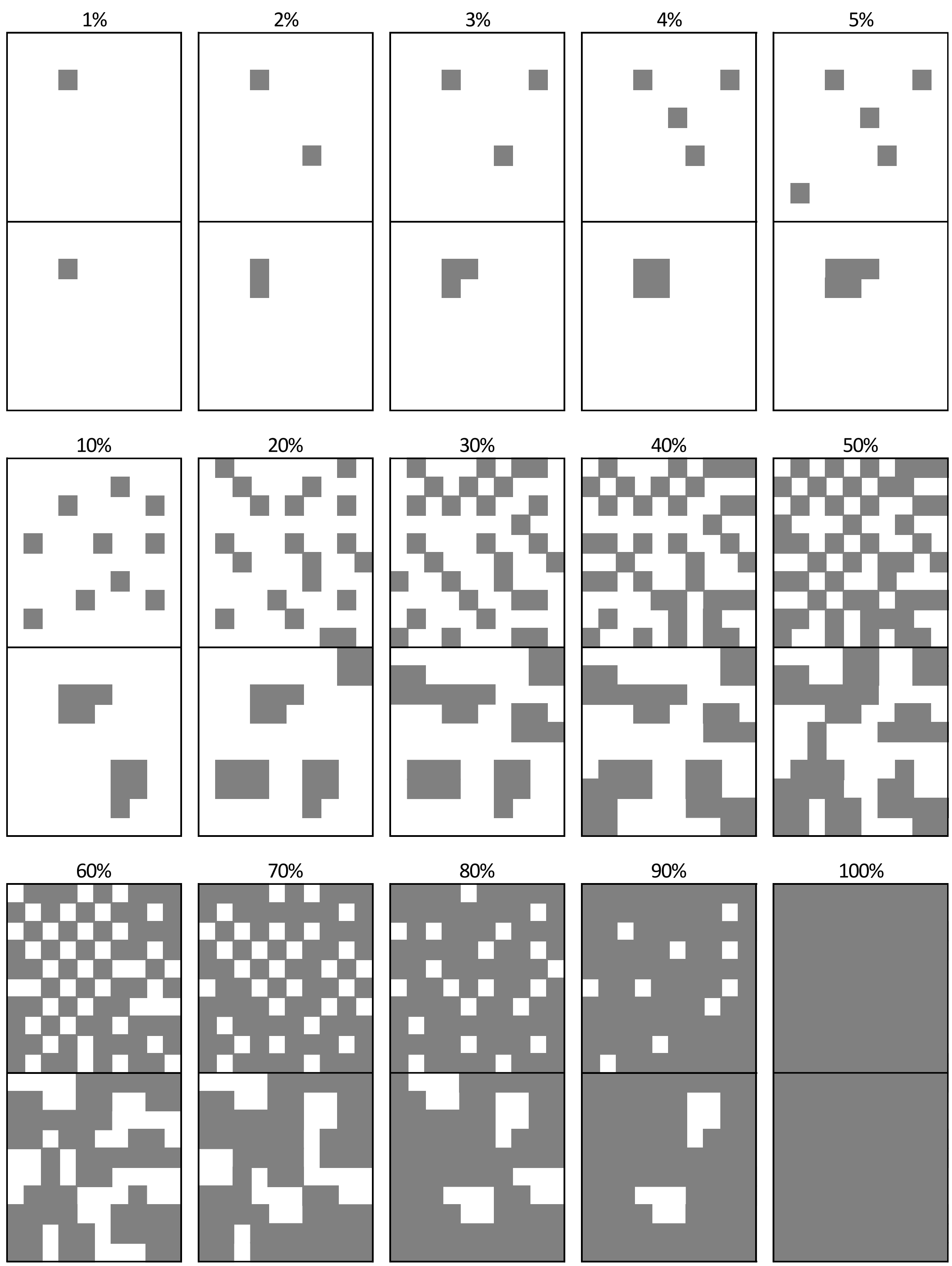
If a crew encounters a gate and does not have an entry code, call WF staff. Do not enter without getting approval from a WF staff member.

[9] PLAR industrial and commercial work camps on public land directive - Open Government (alberta.ca)
[10] Amy Wotton, Alberta Forestry and Parks, pers. Comm August 19, 2024.
[11] Section 2.12 of the Alberta timber harvest planning and operating ground rules [2024] - Open Government.
[12] https://open.alberta.ca/publications/human-bear-conflict-management-plan
[13] Section 2.8 of the Alberta timber harvest planning and operating ground rules [2024] - Open Government.

Helpful Information

Estimating Area Percentages

Two different types of area percentages are shown below. The top image shows a more randomly distribution of elements, while the bottom image shows a clustered distribution of elements. If percent is under 5%, round to the nearest 5% (either 0% or 5%).



Which Trees to Measure With Particular Relevance to Young Stands

In young stands, there can be cases where there are multiple stump sprouts, multiple stems originating from the same point of germination, layering or multiple potential leaders. The general rule is:

- If multiple stems originate at or below the ground, measure/tag all stems that meet the minimum size for the applicable subplot.
- If there are multiple stems or potential leaders[14] originating above ground but below breast height, and these meet the minimum size for the applicable subplot, measure/tag one and count the rest. In TSPs or pPSPs, the count is not required.

A more detailed decision key is provided in Figure 19 and examples are shown in Figure 20 (both figures are taken from the PGYI manual).

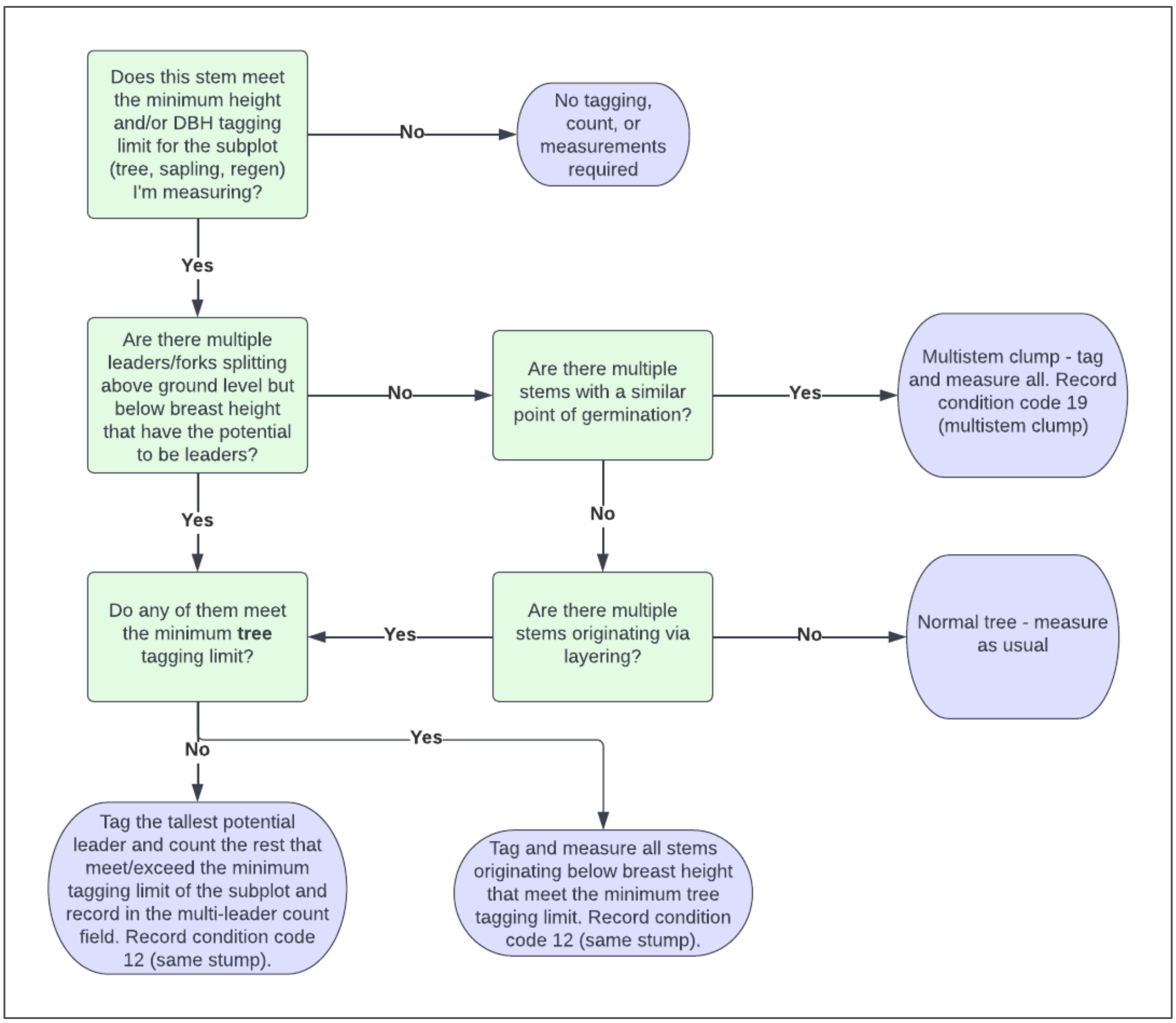
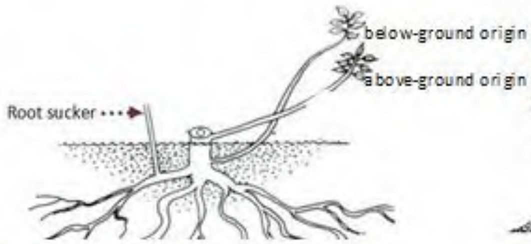


Figure 19. Juvenile stems - flow chart for deciding what to measure/tag.

[14] Rule of thumb: potential leaders must be at least 1/3 the diameter of the main stem and branch out from the main stem at an angle of ≤ 45°, AND must be judged to have an obvious "tree like" form and function as opposed to more "branch like". If there is any doubt it should be called a branch instead of a potential leader.



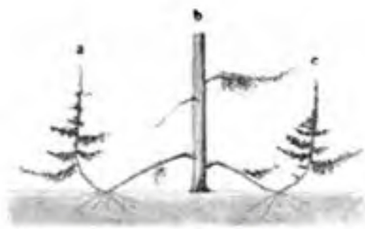
Root sucker and stump sprouts - here, 3 stems would be tagged since each could potentially develop a separate root system

Multistem clump - 3 stems would be tagged

Above-mineral stump sprouts - 1 tag + 1 undersize fork count

Low forks: the dominant is tagged + 3 more undersize forks are counted

Layering: 2 tags here, the left stem would have 1 undersize fork count



Layering: 3 stems would be tagged here

Figure 20. Juvenile stems - examples of various regeneration and how to tag/measure.

Slope Correction Factors Including Values for Common Plot Radii

Percent Slope	Slope Correction	Horizontal Distance (m)										
		28.28	20.00	11.28	10.00	9.77	7.98	5.64	3.99	3.57	2.82	1.78
10	**0.995**	28.42	20.10	11.34	10.05	9.82	8.02	5.67	4.01	3.59	2.83	1.79
12	**0.993**	28.48	20.14	11.36	10.07	9.84	8.04	5.68	4.02	3.60	2.84	1.79
14	**0.990**	28.56	20.20	11.39	10.10	9.87	8.06	5.70	4.03	3.60	2.85	1.80
16	**0.987**	28.64	20.25	11.42	10.13	9.89	8.08	5.71	4.04	3.62	2.86	1.80
18	**0.984**	28.73	20.32	11.46	10.16	9.93	8.11	5.73	4.05	3.63	2.87	1.81
20	**0.981**	28.84	20.40	11.50	10.20	9.96	8.14	5.75	4.07	3.64	2.88	1.82
22	**0.977**	28.96	20.48	11.55	10.24	10.00	8.17	5.77	4.09	3.66	2.89	1.82
24	**0.972**	29.08	20.57	11.60	10.28	10.05	8.21	5.80	4.10	3.67	2.90	1.83
26	**0.968**	29.22	20.66	11.66	10.33	10.09	8.25	5.83	4.12	3.69	2.91	1.84
28	**0.963**	29.37	20.77	11.71	10.38	10.15	8.29	5.86	4.14	3.71	2.93	1.85
30	**0.958**	29.53	20.88	11.78	10.44	10.20	8.33	5.89	4.17	3.73	2.94	1.86
32	**0.952**	29.69	21.00	11.84	10.50	10.26	8.38	5.92	4.19	3.75	2.96	1.87
34	**0.947**	29.87	21.12	11.91	10.56	10.32	8.43	5.96	4.21	3.77	2.98	1.88
36	**0.941**	30.06	21.26	11.99	10.63	10.38	8.48	5.99	4.24	3.79	3.00	1.89
38	**0.935**	30.25	21.40	12.07	10.70	10.45	8.54	6.03	4.27	3.82	3.02	1.90
40	**0.928**	30.46	21.54	12.15	10.77	10.52	8.59	6.07	4.30	3.85	3.04	1.92
42	**0.922**	30.67	21.69	12.23	10.85	10.60	8.66	6.12	4.33	3.87	3.06	1.93
44	**0.915**	30.90	21.85	12.32	10.93	10.67	8.72	6.16	4.36	3.90	3.08	1.94
46	**0.908**	31.13	22.01	12.42	11.01	10.75	8.78	6.21	4.39	3.93	3.10	1.96
48	**0.902**	31.37	22.18	12.51	11.09	10.84	8.85	6.26	4.43	3.96	3.13	1.97
50	**0.894**	31.62	22.36	12.61	11.18	10.92	8.92	6.31	4.46	3.99	3.15	1.99
52	**0.887**	31.87	22.54	12.71	11.27	11.01	8.99	6.36	4.50	4.02	3.18	2.01
54	**0.880**	32.14	22.73	12.82	11.36	11.10	9.07	6.41	4.53	4.06	3.20	2.02
56	**0.873**	32.41	22.92	12.93	11.46	11.20	9.15	6.46	4.57	4.09	3.23	2.04
58	**0.865**	32.69	23.12	13.04	11.56	11.29	9.23	6.52	4.61	4.13	3.26	2.06
60	**0.857**	32.98	23.32	13.15	11.66	11.39	9.31	6.58	4.65	4.16	3.29	2.08
62	**0.850**	33.27	23.53	13.27	11.77	11.50	9.39	6.64	4.69	4.20	3.32	2.09
64	**0.842**	33.58	23.75	13.39	11.87	11.60	9.47	6.70	4.74	4.24	3.35	2.11
66	**0.835**	33.88	23.96	13.52	11.98	11.71	9.56	6.76	4.78	4.28	3.38	2.13
68	**0.827**	34.20	24.19	13.64	12.09	11.81	9.65	6.82	4.83	4.32	3.41	2.15
70	**0.819**	34.52	24.41	13.77	12.21	11.93	9.74	6.88	4.87	4.36	3.44	2.17
72	**0.812**	34.85	24.64	13.90	12.32	12.04	9.83	6.95	4.92	4.40	3.47	2.19
74	**0.804**	35.18	24.88	14.03	12.44	12.15	9.93	7.02	4.96	4.44	3.51	2.21
76	**0.796**	35.52	25.12	14.17	12.56	12.27	10.02	7.08	5.01	4.48	3.54	2.24
78	**0.789**	35.87	25.36	14.31	12.68	12.39	10.12	7.15	5.06	4.53	3.58	2.26
80	**0.781**	36.22	25.61	14.45	12.81	12.51	10.22	7.22	5.11	4.57	3.61	2.28
82	**0.773**	36.57	25.86	14.59	12.93	12.63	10.32	7.29	5.16	4.62	3.65	2.30
84	**0.766**	36.93	26.12	14.73	13.06	12.76	10.42	7.37	5.21	4.66	3.68	2.32
86	**0.758**	37.30	26.38	14.88	13.19	12.89	10.53	7.44	5.26	4.71	3.72	2.35
88	**0.751**	37.67	26.64	15.03	13.32	13.01	10.63	7.51	5.31	4.76	3.76	2.37
90	**0.743**	38.05	26.91	15.18	13.45	13.14	10.74	7.59	5.37	4.80	3.79	2.39
92	**0.736**	38.43	27.18	15.33	13.59	13.28	10.84	7.66	5.42	4.85	3.83	2.42
94	**0.729**	38.81	27.45	15.48	13.72	13.41	10.95	7.74	5.48	4.90	3.87	2.44
96	**0.721**	39.20	27.72	15.64	13.86	13.54	11.06	7.82	5.53	4.95	3.91	2.47
98	**0.714**	39.60	28.00	15.79	14.00	13.68	11.17	7.90	5.59	5.00	3.95	2.49
100	**0.707**	39.99	28.28	15.95	14.14	13.81	11.28	7.97	5.64	5.05	3.99	2.52

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Revisions

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- Added Plot and Site information section
- Added section on Plot Establishment, Tree Numbering and Tagging
- Added section of Field Program Planning and Management
- Updated GPS Accuracy section including requirements for EFI-compatible plots
- Added References and Revisions sections
- Updated declinations
- Revised quality control specifications to align with new maintenance sheets
- Minor editorial updates

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