Regional Forest Landscape Assessment

Lower Athabasca Region

Prepared for:

Forest Management Branch
Alberta Environment and Sustainable Resource Development

Prepared by:

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EXECUTIVE SUMMARY

The Lower Athabasca Region is one of the seven land-use regions defined in Alberta's Land-use Framework. Spanning the entire east side of the Province, from the Cold Lake north to the Northwest Territories border, it includes the lower portion of the Athabasca River and Lake Athabasca.

The Region is known primarily for the development of oil sands deposits. There is only one Forest Management Agreement holder in the Region, but there are other smaller forestry operations. Conventional well sites and pipelines are abundant. There is a small agricultural presence in the extreme southern portion of the Region.

In total, parks and protected areas cover 7% of the Region. The most prevalent protected areas are Wildland Parks which are distributed across the central and northern parts of the Region. The Region also contains a variety of Provincial Parks, Provincial Recreation Areas, Natural Areas and Ecological Reserves.

The topography of the Region is mostly gradual, although there are pockets of steep-sided river valleys. The Birch Hills provide the highest elevations in the Region.

Forests are mostly in the immature to mature stages of seral stage development, with 34% of the forested area classified as immature or mature. In addition, the age class distribution indicates that 20% of the Region's forests are in age classes 70 to 100.

The forest is threatened by natural populations of several pests. Historically, forest tent caterpillar has been the most destructive. Mountain pine beetle has not yet been observed in the Region.

NOTICES AND DATA SOURCES

The information presented in this report is current as of the report date. For further information, please contact the Government of Alberta, Department of Environment and Sustainable Resource Development.

The source of data for each topic is referenced with the use of end notes. The full data list is presented in APPENDIX II with appropriate references included in each section. All data source references are identified by the format (1) where '1' represents the reference in a numerical sequence, listed in APPENDIX II . All initialisms used in the report are defined in the glossary. Maps included herein reflect a broad representation of each metric, and are not intended for operational use. For more detailed examination of map information, double click on the legend of any map. This will open a separate window where you may zoom into the map.

Where areas are presented, they are expressed as hectares and were calculated using the projection known as "NAD_1983_10TM_AEP_Forest" which is a Transverse Mercator projection using the1983 North American Datum. For this reason, some area estimates may not agreed with other published information. The presentation of area estimates to the nearest hectare may result in the tabulated sums of some tables to appear to not total correctly; however, this is simply due to rounding.

Information is compiled at the Land-use Framework regional level and as such represent broad estimates over the Region. Extrapolation or interpolation of results at other levels of resolution (e.g.: forest management unit, municipal district) are not appropriate without further analysis. The information which relies on forest inventory data is summarized only over the areas for which there is available forest inventory data and for which Alberta has provincial forest management responsibilities. This excludes all federal lands, First Nations and Metis settlement areas.

The Minister and the Crown provides this information without warranty or representation, as to any matter including but not limited to whether the data/information is correct, accurate or free from error, defect, danger or hazard and whether it is otherwise useful or suitable for any use the user may make of it.

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1. Administrative Boundaries

1.1 Lower Athabasca Region

The Lower Athabasca Region (1), one of seven land-use regions defined in Alberta's Land-use Framework (Alberta 2008), spans the eastern portion of Alberta, from the Cold Lake area north to the Northwest Territories border. (see Figure 1-1). The southern part of the Region contains the Cold Lake Air Weapons range; the central portion is the hub of the oil sands development and the northern area is virtually undeveloped. The Region is largely known for its oil sands infrastructure, but there is also a large forest industry presence. In the very far south, the Region includes some agricultural development.

The Lower Athabasca Region has an area of approximately 9,325,767 hectares.

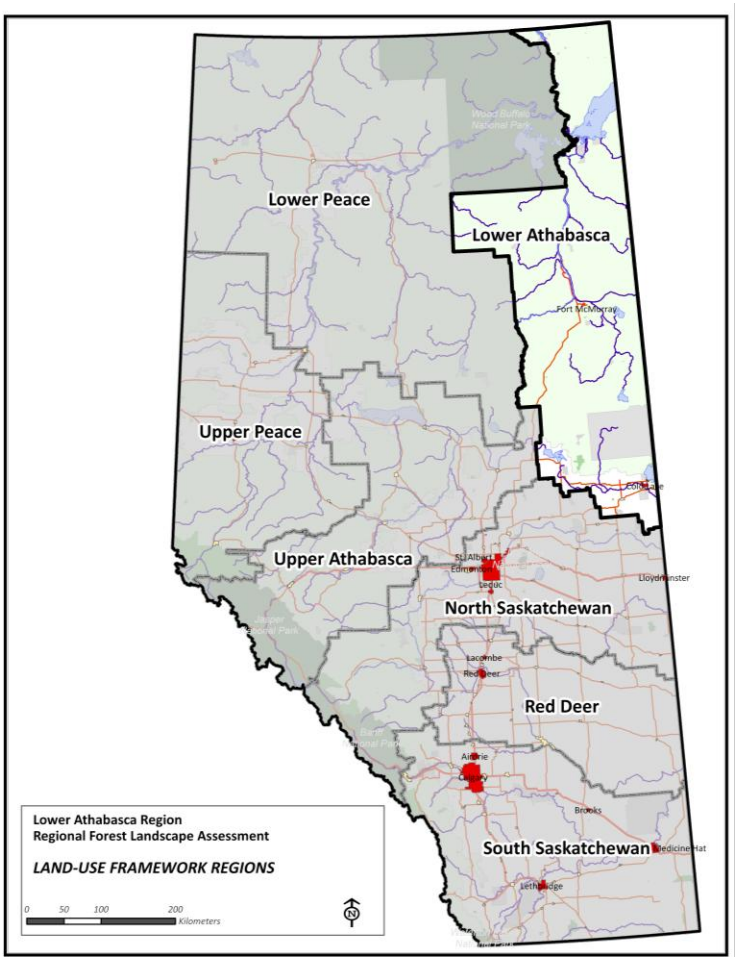


Figure 1-1 Lower Athabasca Region

1.2 Green / White Area

In 1948, the Province divided Alberta into two zones for the purposes of land use decision making. This resulted in the creation of the two areas commonly known as the Green and White Areas (2). The White Area consists primarily of private land holdings related to agricultural use. The Green Area is Crown land, and managed for natural resource development, recreation and conservation. Specifically excluded from the Green and White Areas are lands not administered by Alberta (e.g.: national parks, military installations and bases).

As summarized in Table 1-1, approximately 84% of the Lower Athabasca Region is Green Area, 9% is White Area and the remaining 7% are under federal administration.

Table 1-1 Green / White Area summary

Area Name	Area (ha)	Percentage (%)
Green Area	7,856,699	84
White Area	815,648	9
Federal Land	653,420	7
Total	9,325,767	100

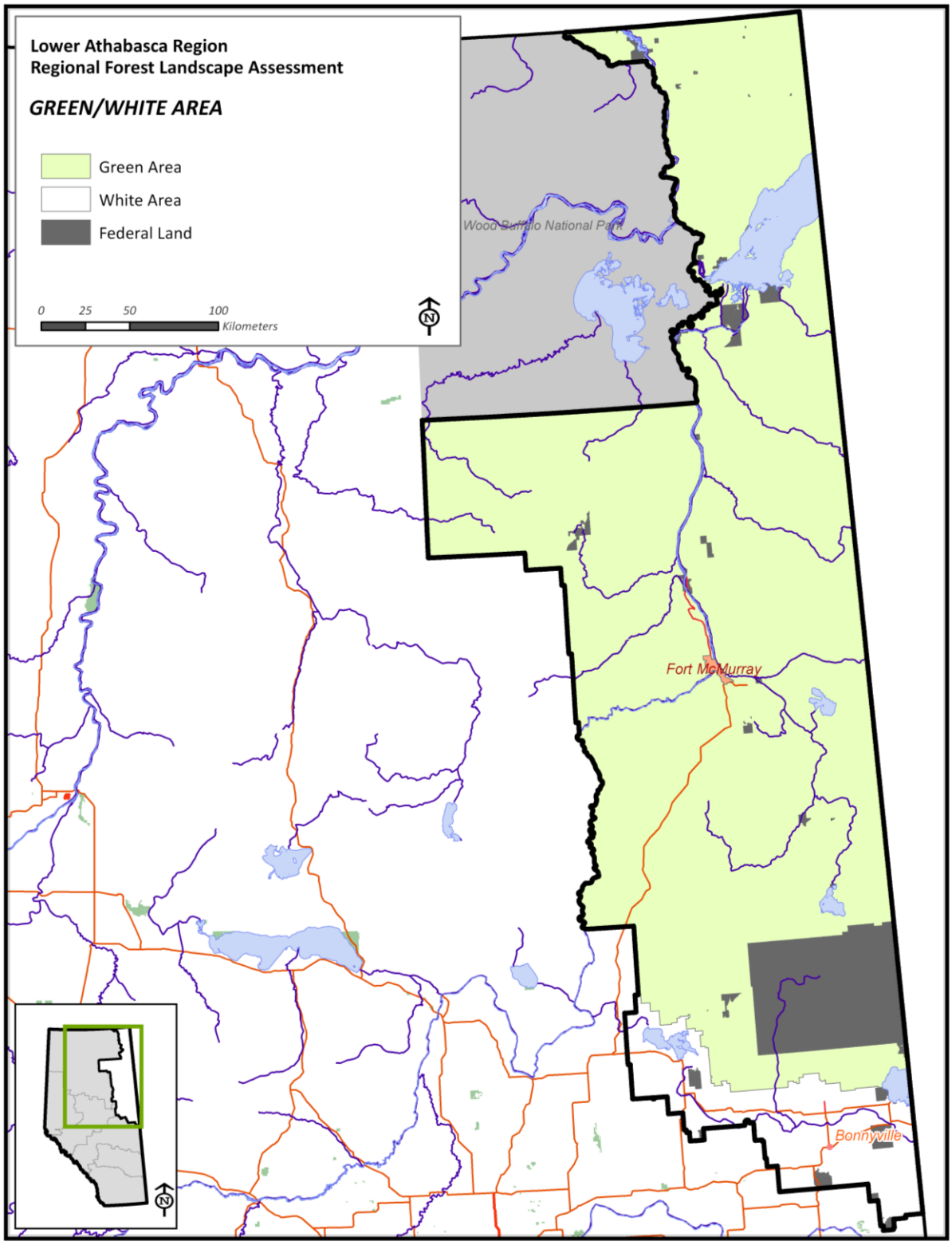


Figure 1-2 Green/White Area Distribution

1.3 Forest Management Agreement Areas

The Lower Athabasca Region only contains a single Forest Management Agreement (FMA) (3) which occupies the central part of the Region.

Table 1-2 lists the FMA name, the percentage of each FMA inside the Region, as well as the proportion of the Lower Athabasca Region which is covered by the respective FMA.

Figure 1-3 shows the FMA boundary.

Table 1-2 Forest Management Agreement Area summary

FMA Code	Company Name	Entire FMA	Portion of FMA located in Lower Athabasca		Proportion of Lower Athabasca occupied by FMA
		Area (ha)	Area (ha)	% of FMA	% of Lower Athabasca
ALPAC	ALPAC Forest Products Incorporated	6,552,127	3,715,317	57	40
Sub-total		6,552,127	3,715,317		40
No Forest Management Agreement Area			5,610,450		60
Total			9,325,767		100

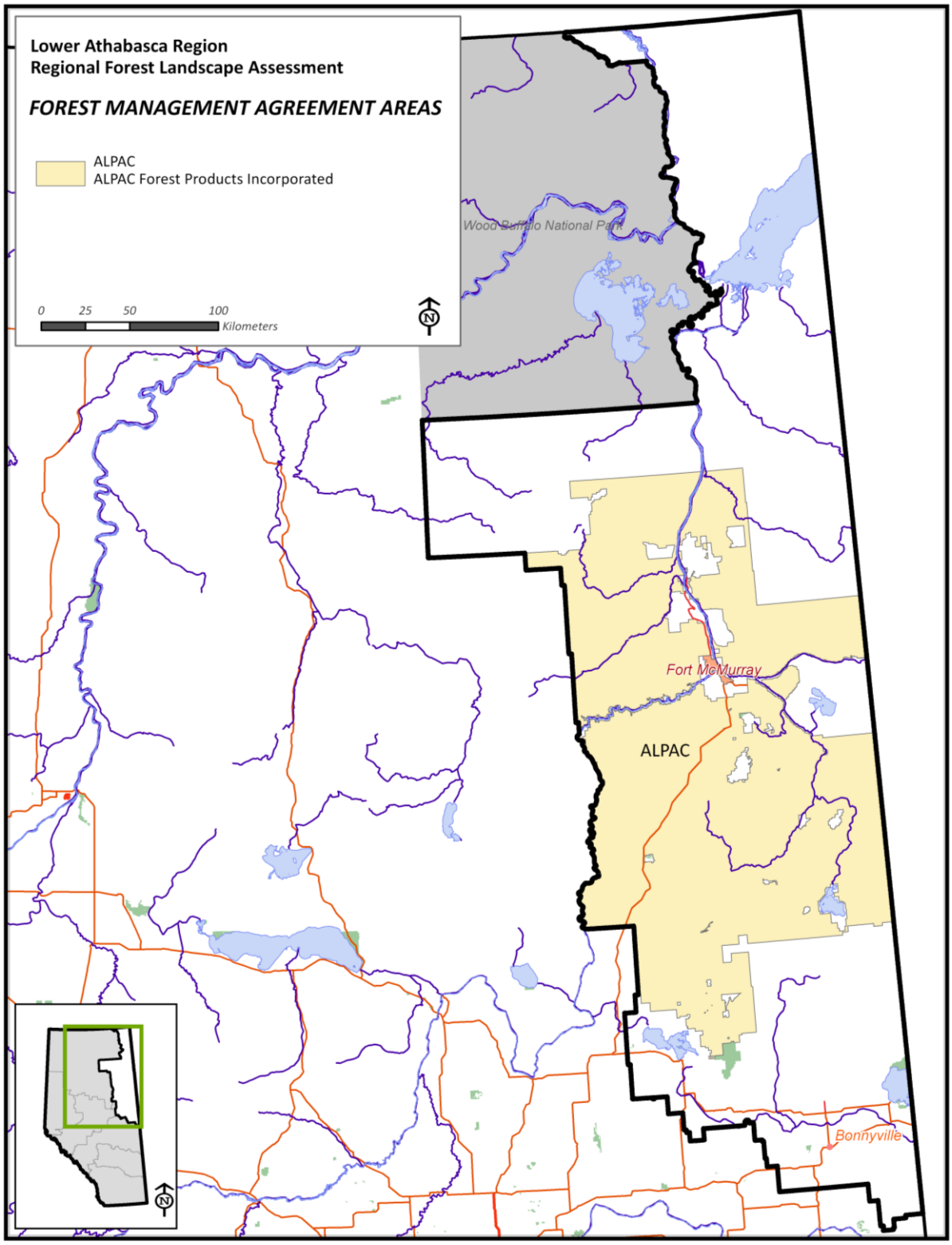


Figure 1-3 Forest Management Agreement Areas

1.4 Forest Management Units

The Lower Athabasca Region contains 15 Forest Management Units (FMU) (4), of which 9 are fully within inside the Region (Table 1-3). The largest FMU in the Region is A15 which comprises 14% of the Lower Athabasca. Of the 15 FMUs, 8 are managed by the Crown and 7 are managed under an FMA (see section 1.3). The FMUs M7, M9 and M10 are coincident with the Metis Settlements of Elizabeth, Fishing Lake and Kikino, which will be described in section 1.8. While the Metis Settlements are allocated an FMU number, Alberta does not have the mandate for forest management on these lands.

The largest Crown-managed unit (LO1) is located in the White Area. The largest FMU managed as an FMA is A15 (ALPAC Forest Product Incorporated).

A map of the FMUs within the Lower Athabasca Region appears as Figure 1-4.

Table 1-3 List of Forest Management Units

FMU		Entire FMU	Portion of FMU located in Lower Athabasca		Proportion of Lower Athabasca occupied by FMU
Name	Managed by	Area (ha)	Area (ha)	% of FMU	% of Lower Athabasca
Available for Provincial Forest Management					
A15	FMA	1,437,516	1,295,159	90	14
A14	FMA	1,178,072	1,102,603	94	12
L11	FMA	1,048,699	1,048,699	100	11
A13	Crown	1,006,023	1,006,023	100	11
LO1	Crown	2,579,926	1,003,405	39	11
A12	Crown	787,479	787,479	100	8
A9	Crown	605,145	605,145	100	6
L9	Crown	539,035	539,035	100	6
A10	Crown	379,830	379,830	100	4
L3	FMA	588,356	376,664	64	4
L1	FMA	359,135	359,135	100	4
A11	Crown	342,390	342,390	100	4
A6	Crown	341,932	341,932	100	4
L8	FMA	126,796	64,216	51	1
S22	FMA	801,696	9,497	1	0
Sub-total		12,122,030	9,261,213		99
Not Available for Provincial Forest Management					
M7		80,967	175	0	0
M9		25,766	25,766	100	
M10		38,614	38,614	100	0
Sub-total		145,347	64,555		1
Total			9,325,768		100

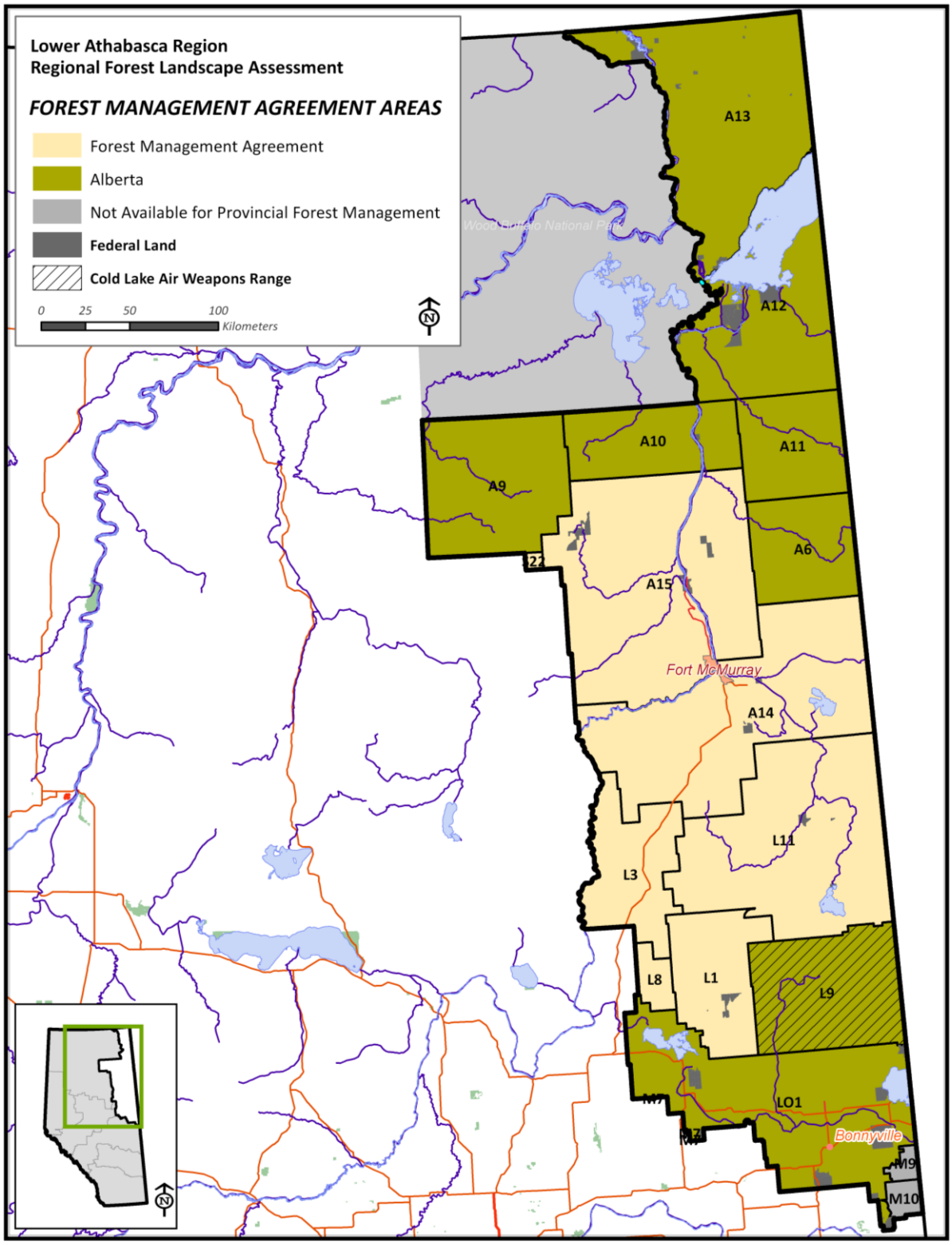


Figure 1-4 Forest Management Units

1.5 Natural Subregions

In Alberta, a landscape classification system referred to as the Natural Regions and Subregions of Alberta (5) is widely used for land management programs (e.g., parks and protected areas network, ecologically-based forest management tools). The system was originally developed in 1994 (Alberta 1994). A project to refine and update the classification was initiated in the fall of 2000 to take advantage of GIS technology and an increased knowledge of the ecology of the province. Subregion descriptions that follow are based on the 2006 documentation (Natural Regions Committee 2006)

Natural Regions contain similar landforms, hydrology, geology, soils, climate, plants and wildlife. The Natural Regions are further divided into subregions, on the basis of similar landscape patterns. The Lower Athabasca Region contains portions of 8 Natural Subregions. A summary of subregion distribution is in Table 1-4 (presented in order of prevalence in the Lower Athabasca Region) and a map showing the subregions in the Lower Athabasca Region appears as Figure 1-5.

Table 1-4 Natural Subregion Distribution

Natural Subregion	Area (ha)	Percentage (%)
Central Mixedwood	4,812,348	52
Athabasca Plain	1,300,445	14
Lower Boreal Highlands	1,113,644	12
Kazan Uplands	937,633	10
Dry Mixedwood	510,439	5
Upper Boreal Highlands	452,314	5
Peace-Athabasca Delta	121,027	1
Northern Mixedwood	77,916	1
Total	9,325,767	100

The Central Mixedwood Subregion dominates the Lower Athabasca Region by occupying 52% of its area (Table 1-4). The Athabasca Plain, Lower Boreal Highlands and Kazan Uplands Subregions are the next most prevalent, accounting for 14%, 12% and 10% of the Region, respectfully. The remaining 12% of the Region is made up of parts of the Dry Mixedwood, Upper Boreal Highlands, Peace-Athabasca Delta and Northern Mixedwood Subregions.

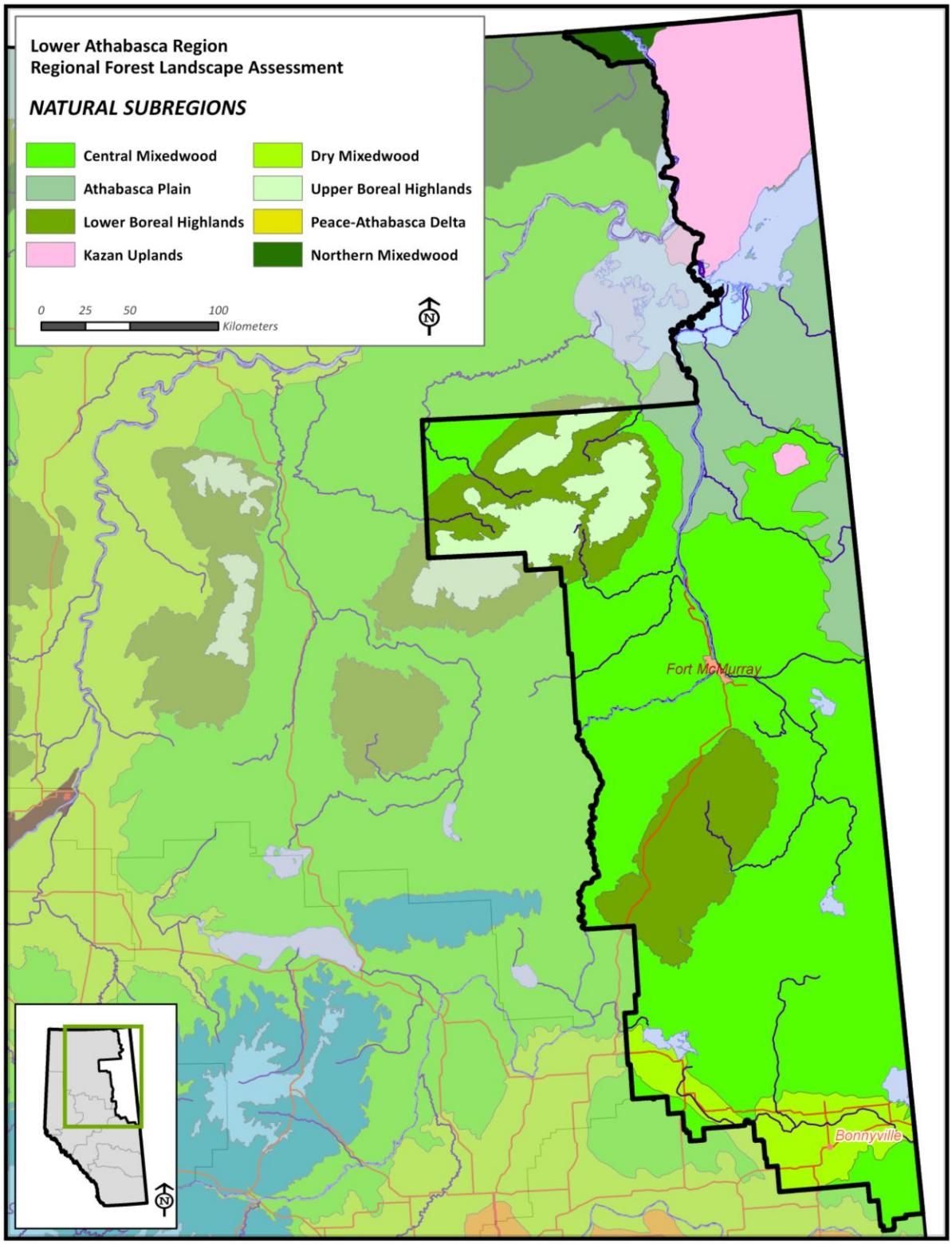


Figure 1-5 Alberta Natural Subregions

1.5.1 Central Mixedwood Natural Subregion

The Central Mixedwood Natural Subregion is the largest subregion making up 52% of the Lower Athabasca Region. It is represented by undulating plains with some hummocky uplands. Its climate is continental, with warm summers and cold winters. The northern part of this subregion has lower mean annual temperature and precipitation compared to the southern part of the subregion. This is most likely due to the increasingly strong influence of dry and cold continental arctic weather systems in these northern areas.

Parent materials in the Subregion are a combination of glacial till, lacustrine and fluvial materials. Orthic Gray Luvisolic soils are predominant, with Brunisols occurring on sands. Wetlands are often extensive and are generally associated with Mesisols, although Fibrisols and Gleysols also occur.

On upland areas, a mix of aspen-dominated deciduous stands, aspen-white spruce stands and white-spruce dominated stands are typical of till and lacustrine areas. Jack pine forests occur on coarse materials. Black spruce is dominant in fens and bogs.

1.5.2 Athabasca Plain Natural Subregion

The Athabasca Plain Natural Subregion occurs south of Lake Athabasca along the border with Saskatchewan. Strongly hummocky and rolling sandy and gravelly uplands occur in the eastern and southern portions. Level to undulating sandy fluvial and eolian plains with some prominent dune fields occur to the east and north. Dune areas have unique plant communities that stabilize the dune surfaces, but areas of bare sand do exist.

Soils are typically Brunisols on the uplands, Regosols on the active dunes, and Mesisols in the wetlands. The Subregion has warmer summers than any of the other boreal-type Subregions. Winters are very cold, reflecting the influence of continental polar and continental arctic weather systems.

Very dry, gravelly plains and sand dunes are largely unvegetated. Dry jack pine stands with sparse understories are the dominant upland vegetation occurring on well to moderately well drained medium textured soils. Moist, rich sites are uncommon, occurring mainly along rivers and in narrow zones around small lakes. Here, pure or mixed stands of aspen, balsam poplar and white birch occur, sometimes with white spruce or black spruce.

1.5.3 Lower Boreal Highlands Natural Subregion

This Subregion is characterized by diverse mixedwood forests on moist lower slopes of northern hill systems and extensive wetlands at slope bases and on adjacent lowlands. Grey Luvisols are the dominant soil type, with Organic soils and Gleysols in the wetlands.

The climate in this Subregion is cooler and slightly more moist than Dry Mixedwood and Central Mixedwood Natural Subregions. July sees the majority of precipitation and summers are warmer but winters are much colder than in comparable Lower Foothills Natural Subregion.

This Subregion is a major zone of pine hybridization as well as having distinct pure white birch stands at upper elevations. Diverse young forests of aspen, balsam poplar, black and white spruce, white birch and pine hybrids occur on the slopes.

1.5.4 Kazan Upland Natural Subregion

The Kazan Upland Natural Subregion occurs in the far northeastern corner of Alberta, lying mostly north of Lake Athabasca. This Subregion is part of the Canadian Shield Natural Region. On average, 60 percent of the landscape is exposed bedrock. Topography is hummocky to rolling, with little local relief.

Parent materials are ice-scoured bedrock and coarse textured glacial drift. Bedrock barrens are interspersed with pockets of vegetation consisting mostly of lichens, mosses and drought-tolerant ferns. The area has cold winters and short summers in which July is the warmest month. July is also the month of the highest precipitation. Winter snowfall accounts for approximately 40 percent of the total annual precipitation.

Various lichen communities occupy south-facing and steep rock faces. Stunted jack pine and birch form open stands with sparse shrub understories in pocket communities where mineral soil has accumulated and moisture conditions are better. Bog communities are the dominant wetland type. Black spruce form open-to-dense stands on organic soils. Permafrost is discontinuous but widespread.

1.5.5 Dry Mixedwood Natural Subregion

The Dry Mixedwood Natural Subregion is characterized by undulating plains, aspen dominated forests and fens. There are two geologically different areas of Dry Mixedwood Subregion in the Province, but only the south eastern part of the Subregion occurs in the Lower Athabasca. Here, the topography consists more of gently rolling plains. Gray Luvisols are the dominant soils on uplands and Gleysols and Organics are dominant in wetlands.

The Subregion has the warmest summers and highest number of growing degree day accumulations of any of the boreal-type subregions. About 70% of the annual precipitation falls during the April to August period with peak precipitation in June and July.

Aspen forests with mixed understories of rose, low-bush cranberry, beaked hazelnut and buffaloberry are typical on uplands. Treed, shrubby or sedge-dominated fens occupy low-lying areas. In the extreme eastern range, one may find jack pine stands on dry, well to rapidly drained glaciofluvial and eolian parent materials.

1.5.6 Upper Boreal Highlands Natural Subregion

The Upper Boreal Highlands Natural Subregion is completely surrounded by the Lower Boreal Highlands Natural Subregion. Medium textured glacial till deposits occur on slopes, with colluvial and residual materials on steep slopes. Organic deposits occur in depressions on the plateaus. Luvisols and gleyed subgroups occur on well to imperfectly drained upland sites. Organic soils, Cryosols and Gleysols occur on poorly drained areas.

This Subregion has shorter, cooler summers and lower growing degree-day accumulations than the surrounding Lower Boreal Highlands Natural Subregion. Peak precipitation occurs in July and precipitation patterns are very similar to the Lower Boreal Natural Subregion.

Forests are predominantly coniferous, consisting of lodgepole pine, lodgepole pine-jack pine hybrids, white spruce and black spruce. At the highest elevations in the Clear Hills, pure lodgepole pine with species-poor understories are common and there are no aspen-leading mixedwood stands nor pure aspen forests. Black spruce often establishes at the same time as pine, but forms a secondary canopy below the main canopy owing to slower growth.

1.5.7 Peace-Athabasca Delta Natural Subregion

The Peace-Athabasca Delta Natural Subregion lies south and west of Lake Athabasca. It is the lowest elevation Subregion in the province and is nearly flat. Water is the dominant feature. Most of the vegetation throughout the Subregion is a mixture of submerged and emergent aquatic communities, sedge fens and willow shrublands.

Soils are Regosols and Gleysols. Only very minor parts of the Subregion are occupied by deep, medium texture, well drained soils and their associated vegetation.

Extensive sedge meadows occur where the water table is near or at the surface. Shrub communities composed of willow, alder and dogwood develop on slightly elevated sites adjacent to streams and ponds, where the water table is below the surface. Less recently disturbed sites support pure or mixed stands of balsam poplar, white birch and white spruce with understories of alder, dogwood and horsetail.

1.5.8 North Mixedwood Natural Subregion

The Northern Mixedwood Natural Subregion occurs in the far north, occupying lowlands adjacent to the border with the Northwest Territories. Gently undulating plains are the dominant topographic form, with some hummocky inclusions and areas of karst topography. Where organic deposits are less extensive, fine textured glaciolacustrine and sandy eolian materials are common.

The Northern Mixedwood Natural Subregion is characterized by short, warm, and on average, dry summers and long, very cold winters. Moisture deficits may be significant in summer, especially on south-facing sites with coarse textured soils. Winters in this Subregion are the coldest of any of the boreal Subregions, possibly because the cold air associated with continental arctic and continental polar outbreak tends to pool at lower elevations.

White and black spruce stands are typical on upland areas and black spruce is a persistent seral species on upland sites. Mixedwood aspen/white spruce-black spruce stands occur on better drained soils along rivers and on local, well-drained elevated areas. Much of the Subregion is wetland and is vegetated with open, stunted black spruce, often in association with frozen organic soils.

1.6 Municipal Districts/Counties

The Lower Athabasca contains types of municipal jurisdictions (6):

- 2 Municipal Districts (MD);
- 1 Improvement District (ID);
- 1 Special Municipality;
- 1 city;
- 1 town;
- 1 village, and
- Numerous smaller populated areas.

A list of the registered municipal entities is presented in Table 1-5 which also includes the population of each of the registered areas according to the most recent census (7). Figure 1-6 shows the ID, MD and Special Municipality boundaries. Figure 1-7 shows the location of the city, town, hamlets and other smaller populated centers (e.g.: 19 hamlets, 63 localities) in the Lower Athabasca Region. The population of these locations is rolled up into the MD to which they belong.

Note that all the MD and ID boundaries are coincident with the Region boundary; no MD or ID is split by the Region.

Improvement District No. 349 was created in January 2012 and incorporates the Cold Lake Air Weapons Range. Part of its lands were separated from the Lac La Biche county and the Regional Municipality of Wood Buffalo. Due to its recent creation, there are no population statistics for that ID.

Fort McMurray is contained within the Regional Municipality of Wood Buffalo..

Table 1-5 Summary of Municipal Locations

Municipal Classification	Name	Population (2010)
Municipal District	Bonnyville No. 87, M.D. of	9,047
	Lac La Biche County	9,123
	Sub-total	18,170
Improvement District	I.D. No. 349[1]	0
Special Municipality	Regional Municipality of Wood Buffalo	91,612
City	Cold Lake	13,924
Town	Bonnyville	6,470
Village	Glendon	483
Total		130,659

[1] I.D. No. 349 was created in January 2012. The latest census was 2011 so there is no population data.

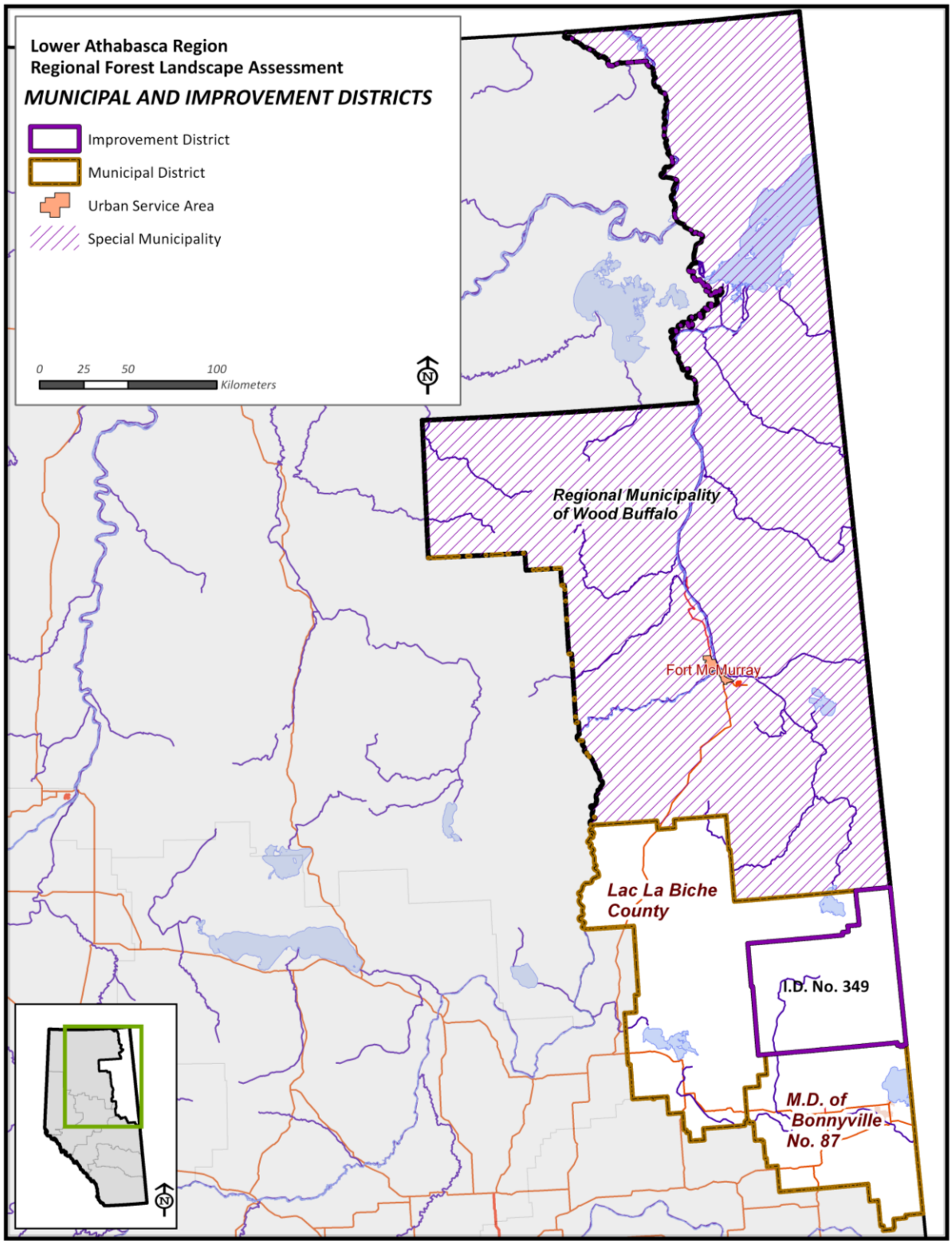


Figure 1-6 Municipal Jurisdictions

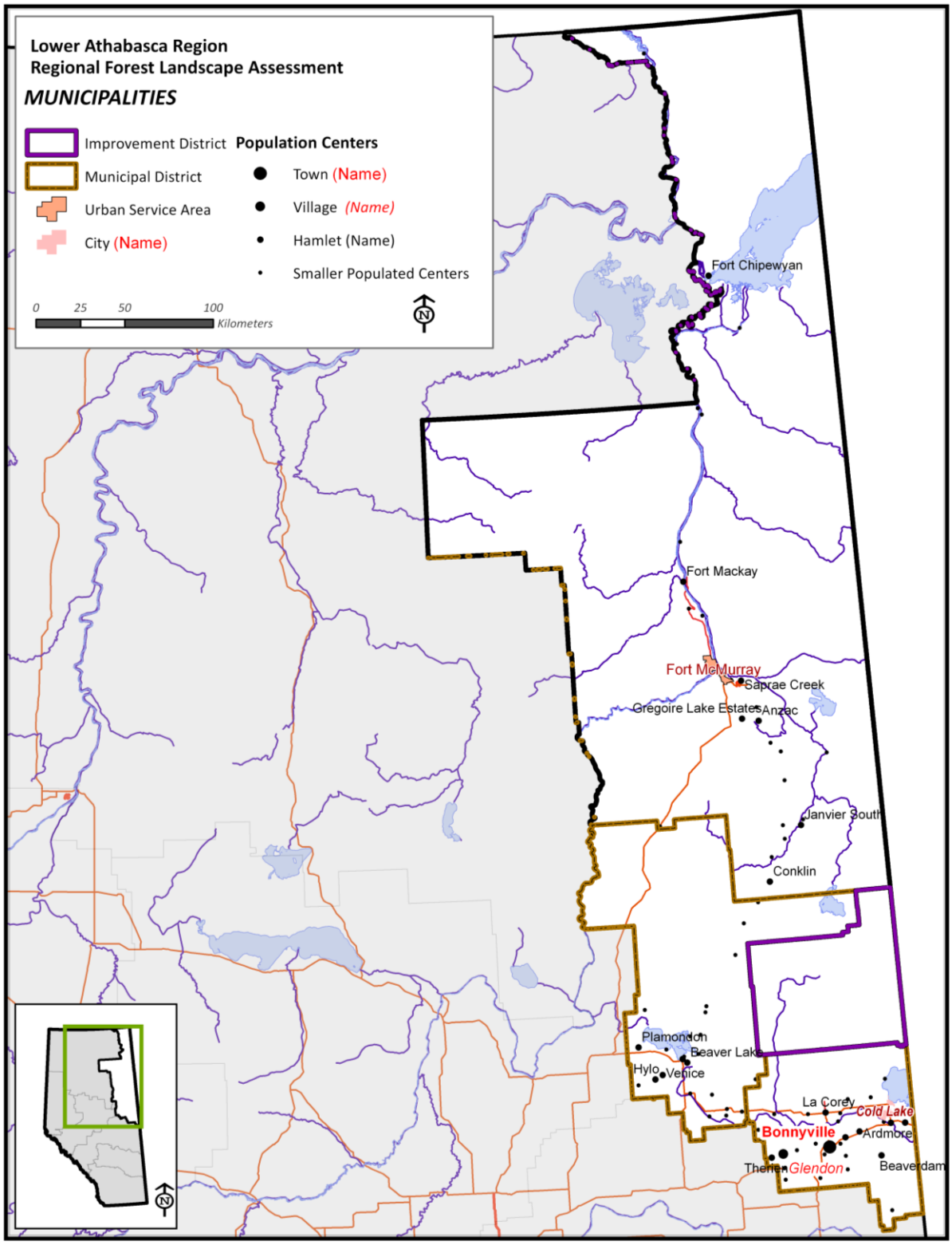


Figure 1-7 Towns and Other Populated Centers

1.7 Federal Government Lands

With the exception of First Nations lands (see section 1.8), the only federally managed land in the Lower Athabasca Region is the Cold Lake Air Weapons Range (9), which was recently created into ID No 349 (see Figure 1-6). Figure 1-8 indicates the locations of First Nations and Federal military installations in the Lower Athabasca Region.

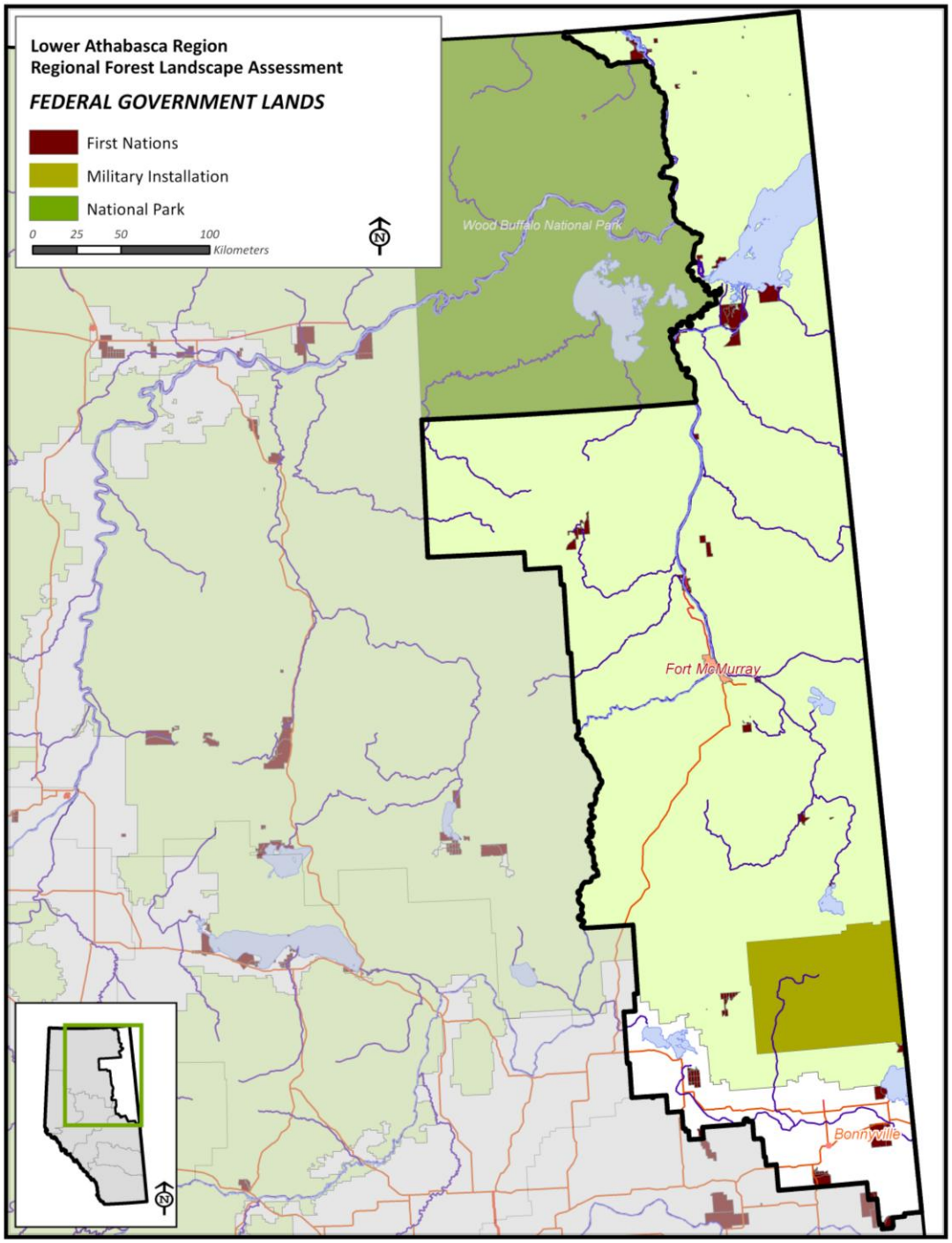


Figure 1-8 Federal Lands

1.8 First Nations

First Nation communities (10) cover 114,385 hectares of the Lower Athabasca Region. The geographic distribution of these communities appears in Figure 1-9.

Each First Nation is listed in Table 1-6, with its number of reservations. The population and source of population details are provided for each First Nation. A population survey was completed in 2011 by the Federal government, but some bands were not represented. In those cases, the 2009 census data from Alberta (Alberta 2010) was used.

First Nation lands represent 1.2% of the Lower Athabasca Region. The largest single First Nation is Chipewyan at 31,928 hectares, and is comprised of 8 separate reserves located across the Region. First Nations lands occur in both the Green and White Areas of the Region.

The majority of the First Nations (79%) are under Treaty 8. Only 1 is covered by Treaty 10 (Cold Lake 149C). The remaining are under Treaty 6 of 1876.

Table 1-6 First Nation Communities

First Nation Name	Treaty Number	Area (ha)	Percentage of all First Nations (%)	Number of Reserves	Population	Population Source
Allison Bay	8 (1899)	1,854	2	1	84	Canada (n.d.)
Beaver Lake	6 (1876)	6,140	5	1	423	Canada (n.d.)
Charles Lake	8 (1899)	66	0	1	2841 [1]	Canada (2012)
Chipewyan	8 (1899)	31,928	28	8	5 [2]	Canada (n.d.)
Clearwater [3]	8 (1899)	932	1	1	-	
Cold Lake [4]	6 (1876)/ 10(1906)	20,993	18	4	1,260	Alberta(2010)
Collin Lake	8 (1899)	42	0	1	-	Alberta(2010)
Cornwall Lake	8 (1899)	58	0	1	-	
Cowper lake	8 (1899)	146	0	2	-	
Devil's Gate	8 (1899)	815	1	1	-	
Dog Head	8 (1899)	30	0	1	111	Canada (n.d.)
Fort McKay	8 (1899)	7,054	6	3	337	Alberta(2010)
Gregoire Lake	8 (1899)	2,299	2	3	274	Canada (n.d.)
Heart Lake	8 (1899)	4,480	4	2	194	Alberta(2010)
Hokedhe Túe	8 (1899)	446	0	1	331 [5]	Canada (2012)
House River Indian Cemetery	8 (1899)	1	0	1	-	
Janvier	8 (1899)	2,502	2	2	815 [6]	Canada (2012)
K'I Túe	8 (1899)	484	0	1	-	
Kehiwin	6 (1876)	8,061	7	1	1,076	Alberta(2010)
Li Dezé	8 (1899)	726	1	1	-	
Namur Lake	8 (1899)	3,140	3	1	0	Canada (n.d.)
Namur River	8 (1899)	4,640	4	1	0	Canada (n.d.)
Old Fort	8 (1899)	1,524	1	1	-	Canada (n.d.)
Puskiakiwenin	6 (1876)	2,123	2	1	484	Canada (n.d.)
Sandy Point	8 (1899)	215	0	1	-	
Thabacha Nare	8 (1899)	402	0	1	-	
Thebathi	8 (1899)	6,396	6	1	30	Canada (n.d.)
Tsu K'adhe Túe	8 (1899)	238	0	1	-	
Tsu Túe	8 (1899)	40	0	1	-	
Tthe Jere Ghaili	8 (1899)	400	0	1	-	
Unipouheos	6 (1876)	4,644	4	1	813	Canada (n.d.)
White Fish Lake	6 (1876)	1,101	1	1	1,136	Alberta(2010)
Winefred Lake	6(1876)	465	0	1	-	
Total		114,385	100	50	6,222	

[1] population for Mikisew Cree First Nation (includes Charles Lake, Collin Lake, Cornwall Lake, Devil's Head, Dog Head, Old Fort, Sandy Point)

[2] population data includes only Chipewyan 201A

[3] Fort McMurray First Nation includes Clearwater 175 and Gregoire Lake 176, 176A and 176B

[4] Cold Lake No. 149C is under treaty 10(1906)

[5] population for Smith's Landing First Nation (including Hokedhe Tue, K'I Tue, Li Deze, Thabacha Nare, Tsu K'adhe Tue, Tsu Tue, The Jere Ghaili)

[6] population for Chipewyan Prairie First Nation (including Cowper Lake, Janvier, Winefred Lake)

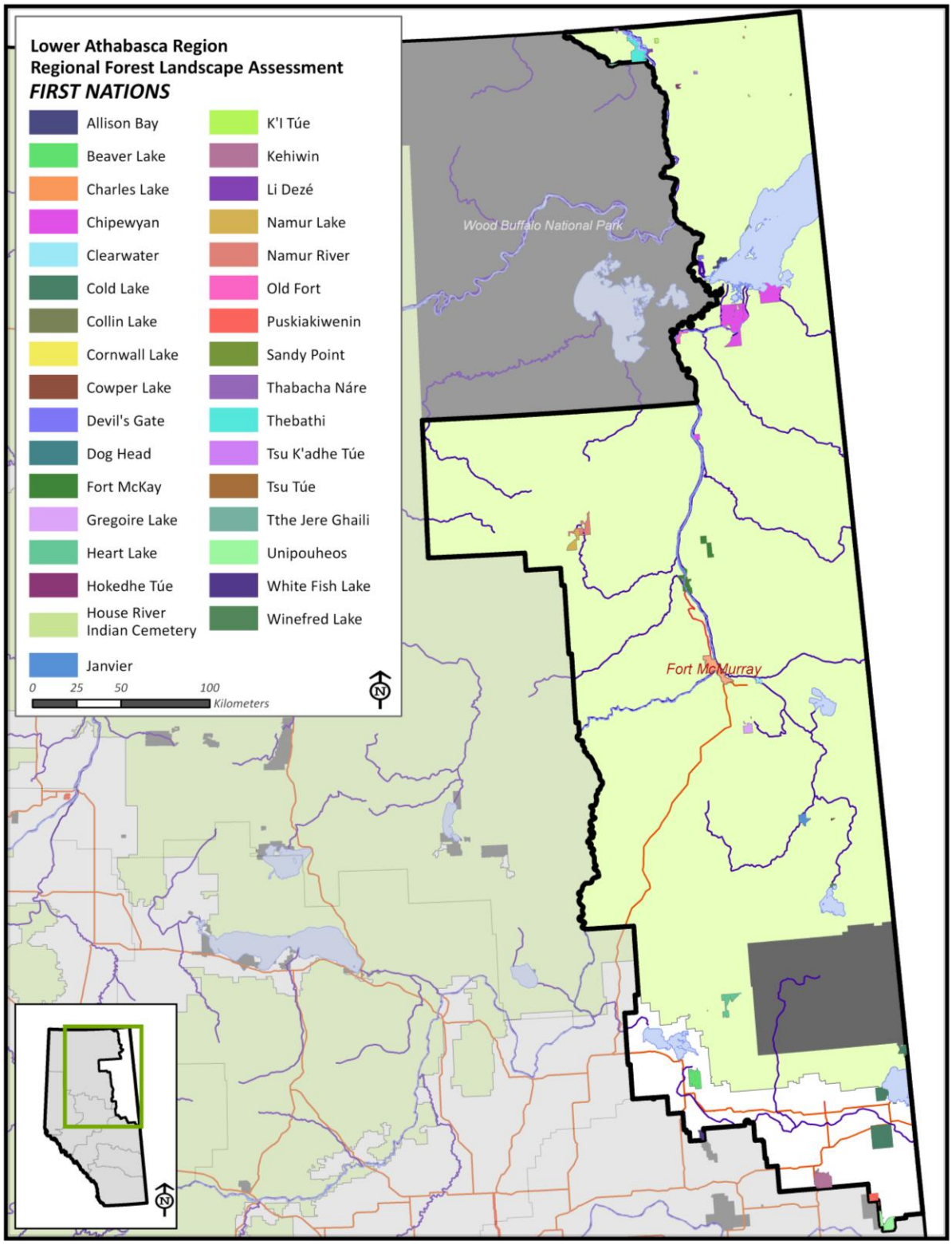


Figure 1-9 First Nations

1.9 Metis Settlements

There are 3 Metis settlements (11) contained in the Lower Athabasca Region and these are listed in Table 1-7, together with population figures.

Elizabeth and Fishing Lake settlements are located in the MD of Bonnyville, in the south-eastern corner of the Region (Figure 1-10). Kikino is at the south end of Lac La Biche County on the south-western side of the Region. The area of Metis settlements is less than the total of First Nations lands with 64,893 hectares, or about 1% of the Region's area.

Table 1-7 Metis Settlements

Metis Settlement	Area (ha)	Percentage of Metis (%)	Percentage of Region (%)	Population	Population Source
Elizabeth	26,171	40	0	820	Alberta (2010)
Fishing Lake	38,614	60	0	952	Alberta (2010)
Kikino	108	0	0	1,113	Alberta (2010)
Total	64,893	100	1	2,885	

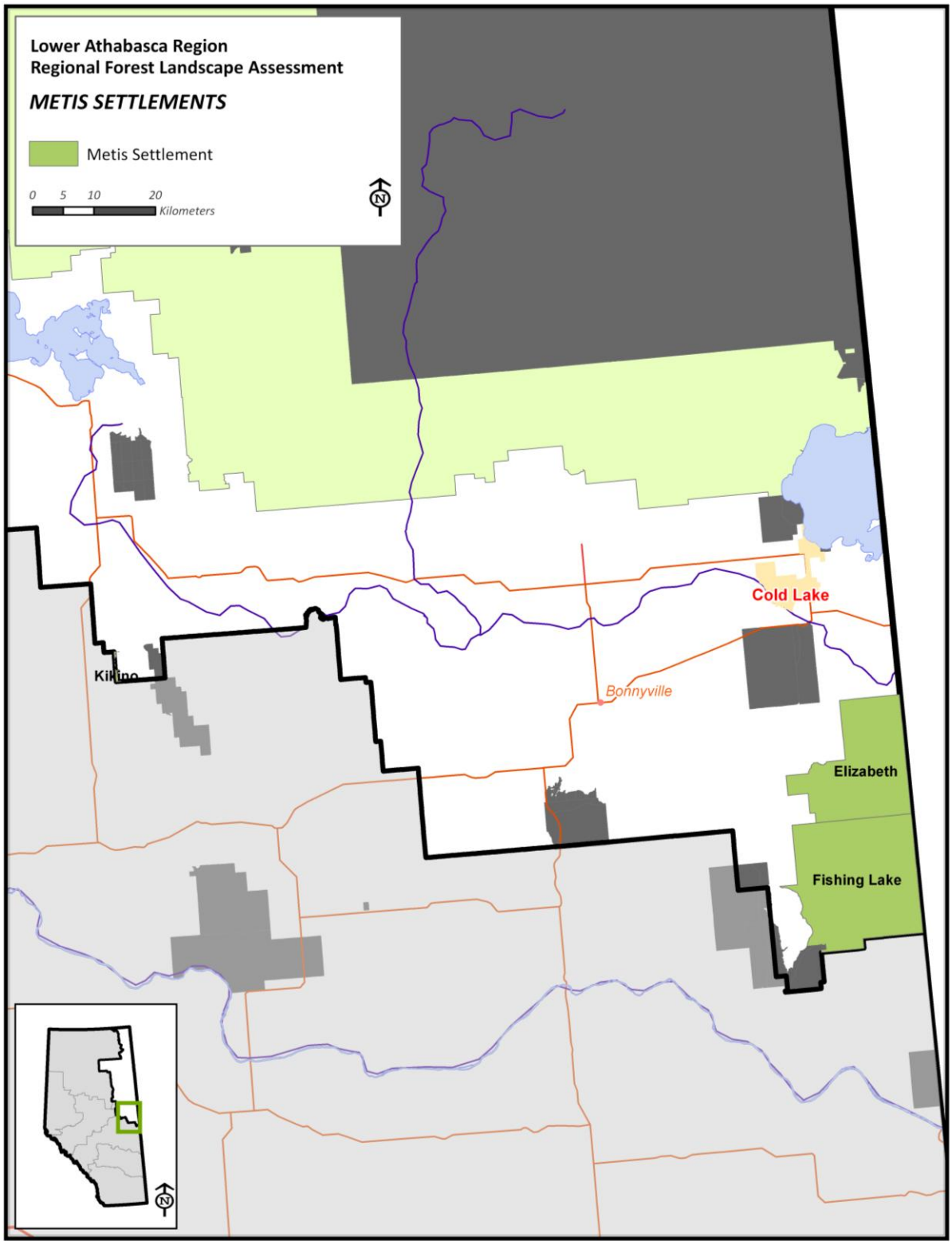


Figure 1-10 Metis Settlements

1.10 Parks and Protected Areas

There are many different designations of parks and protected areas in Alberta (13). These are defined in Table 1-8.

Table 1-8 Park and Protected Area Designations (14)

Type	Definition
Provincial Park	A Provincial Park represents areas which preserve natural heritage. They support outdoor recreation, heritage tourism, and natural heritage appreciation activities that depend upon,, and are compatible with, environmental protection where natural, historical and cultural landscapes and features are protected under the Provincial Parks Act in Alberta.
Provincial Recreation Area	A Provincial Recreation Area represents the recreation areas in Alberta that support outdoor recreation and tourism and often provide access to lakes, reservoirs and adjacent Crown land. Recreation areas support a range of outdoor activities in natural, modified and man-made settings. They are managed with outdoor recreation as the primary objective.
Wilderness Area	Wilderness Areas are for preservation and protection of natural heritage providing opportunities for non-consumptive, nature-based outdoor recreation. No developments of any kind are permitted. Travel in wilderness areas is by foot only. Collection, destruction and removal of plant or animal material, fossils or other object of geological, ethnological, historical or scientific interest, are prohibited. Hunting, fishing and use of horses are not permitted.
Wildland Park	Wildland Parks exist to preserve and protect natural heritage and provide opportunities for backcountry recreation. Wildland parks are typically large, undeveloped natural landscapes that retain their primeval character. Trails and primitive backcountry campsites are provided in some wildland parks to minimize visitor impacts. Some wildland parks provide considerable opportunities for eco-tourism and adventure activities such as back packing, backcountry camping, wildlife viewing, mountain climbing and trail riding. Access and use of wilderness and wildland parks is not as restrictive as in wilderness areas.
Wilderness Park	Wilderness Parks and Wildland Parks have the same intent: to preserve and protect natural heritage and provide opportunities for backcountry recreation. The sole Wilderness Park in the Province has its own body of legislation (“Willmore Wilderness Park Act” of 1959)
Natural Area	A Natural Area represents natural and near-natural landscapes of regional and local importance for nature-based recreation and heritage appreciation. Natural areas are typically quite small; however, larger sites can be included. Most natural areas have no facilities and in those that do, facilities are minimal and consist mainly of parking areas and trails.
Ecological Reserve	An Ecological Reserve represents areas set aside for strict preservation of natural ecosystems, habitats and features, and associated biodiversity. These areas contain representative, rare and fragile landscapes, plants, animals and geologic features. Ecological reserves serve as outdoor laboratories and classrooms for scientific studies related to the natural environment. Public access is by foot only; public road and other facilities do not normally exist and will not be developed. Most ecological reserves are open to the public for low-impact activities such as photography and wildlife viewing.
Special Management Zone	A special management zone is a buffer around an existing feature that is used to protect the core feature of interest. These may or may not have access restrictions.
Crown Reservations	In some cases, areas of unique significance may not be named as a park, recreation area, wildland area or reserve. However the uniqueness of the site, or its proximity to a named park or protected area may result in the application of a protective (PNT) or consultative notation (CNT) within the Province’s land-use disposition system. A PNT or CNT designation implies that the Province must be informed of any potential industrial development within the area. The Province may then apply specific conditions in order to protect the integrity of the land.

The Lower Athabasca Region contains several of the park and protected area designations noted above. A total of 7% of the Region (632,402 hectares) is under some form of protection. In addition, another 0.23% of the Region (21,814 ha) is under protective or consultative notations to allow Alberta to evaluate potential development near current parks or protected areas, or on other unique areas not yet designated under park or wilderness legislation. (see Table 1-10).

The largest protected area category is Wildland Parks, of which there are 11 in the Region, totalling 556,918 hectares, or 88% of all the designated parks and protected areas in the Region.

The location of parks and protected areas in the Lower Athabasca Region is presented in Figure 1-11.

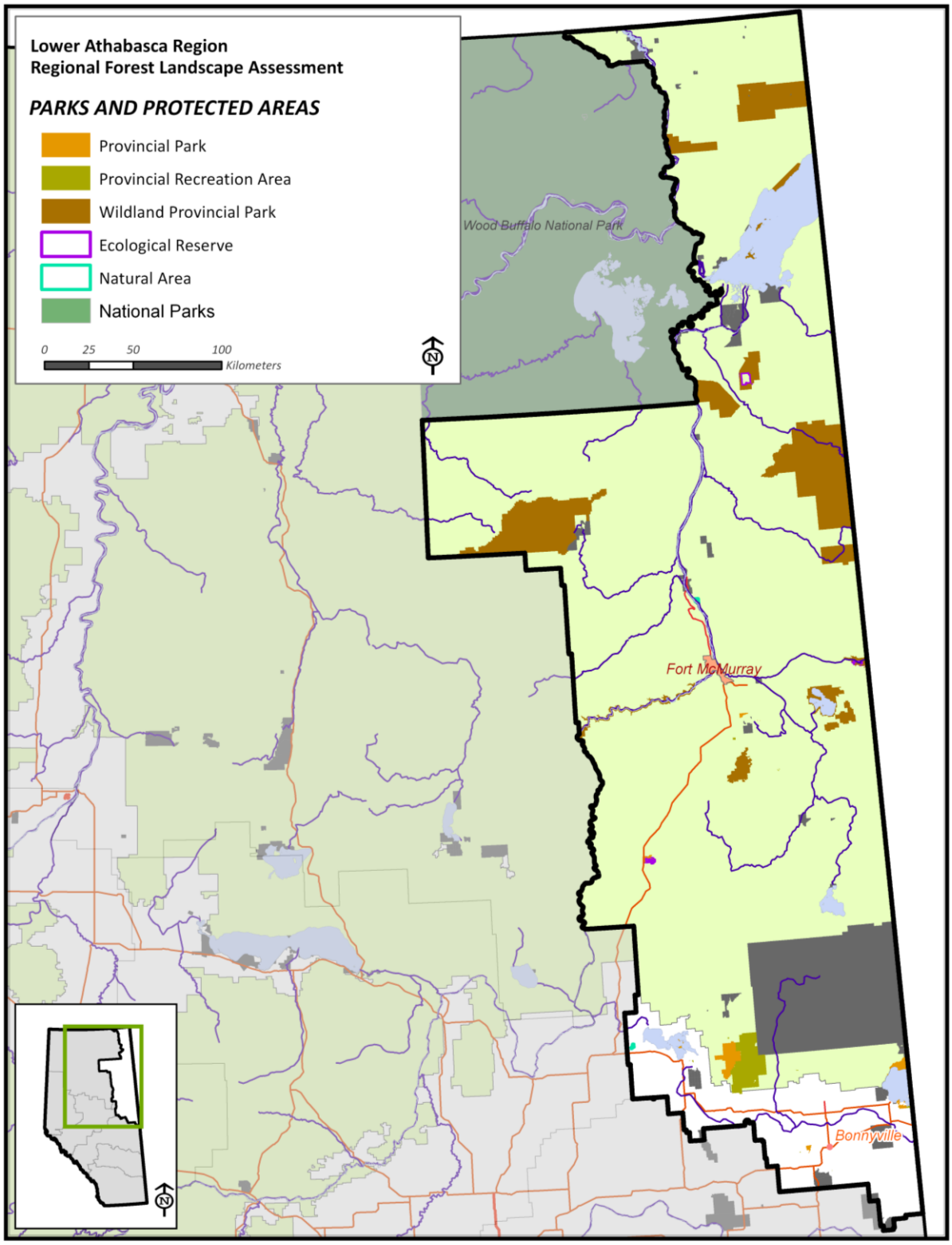


Figure 1-11 Parks and Protected Area

Table 1-9 Park and Protected Area Allocations

Classification	Type of Park/Protected Area	Number	Area in Region (ha)	Percentage of PPA (%)	Percentage of Region (%)
Parks	Provincial Park	6	23,493	4	0
	Provincial Recreation Area	11	45,695	7	0
	Wildland Park	11	556,918	88	6
	Sub-total	28	626,106	99	7
Protected Areas	Natural Area	2	578	0	0
	Ecological Reserve	4	5,718	1	0
	Sub-total	6	6,296	1	0
Total		34	632,402	100	7

Table 1-10 Areas under Protective or Consultative Notation

Classification	Type of Park/Protected Area	Number	Area in Region (ha)	Percentage of Reservations (%)	Percentage of Region (%)
Parks	Provincial Park	3	1,261	6	0
	Provincial Recreation Area	4	3,659	17	
	Sub-total	3	1,261	6	0
Protected Areas	Natural Area	9	2,771	13	0
	Special Management Zone Buffer	1	17,782	82	
	Sub-total	9	20,553	94	0
Total		12	21,814	100	0

A detailed list of individual parks, recreation areas, wildland parks, natural areas and ecological reserves can be found in APPENDIX I .

1.11 Wildfire Management Areas

Wildfire management areas (15) are those areas which define wildfire management responsibilities. These areas are listed in Table 1-11 (sorted by the area within the Lower Athabasca Region) and mapped in Figure 1-12.

The two dominant wildfire management areas are Waterways and Lac La Biche, together occupying almost 100 % of the Lower Athabasca Region. A very small component of the Lesser Slave area is included in this Region.

Table 1-11 Alberta Wildfire Management Areas

	Entire Region	Portion of ESRD Region located in Lower Athabasca		Proportion of Lower Athabasca occupied by ESRD Region
ESRD Region Name	Area (ha)	Area (ha)	(%)	(%)
Waterways	6,078,388	5,796,833	95	37
Lac La Biche	6,380,629	2,866,018	45	63
Lesser Slave	5,614,687	9,497	0	0
Sub-total	18,073,704	8,672,348		100
Area not managed by Alberta		653,420		7
Total		9,325,768		100

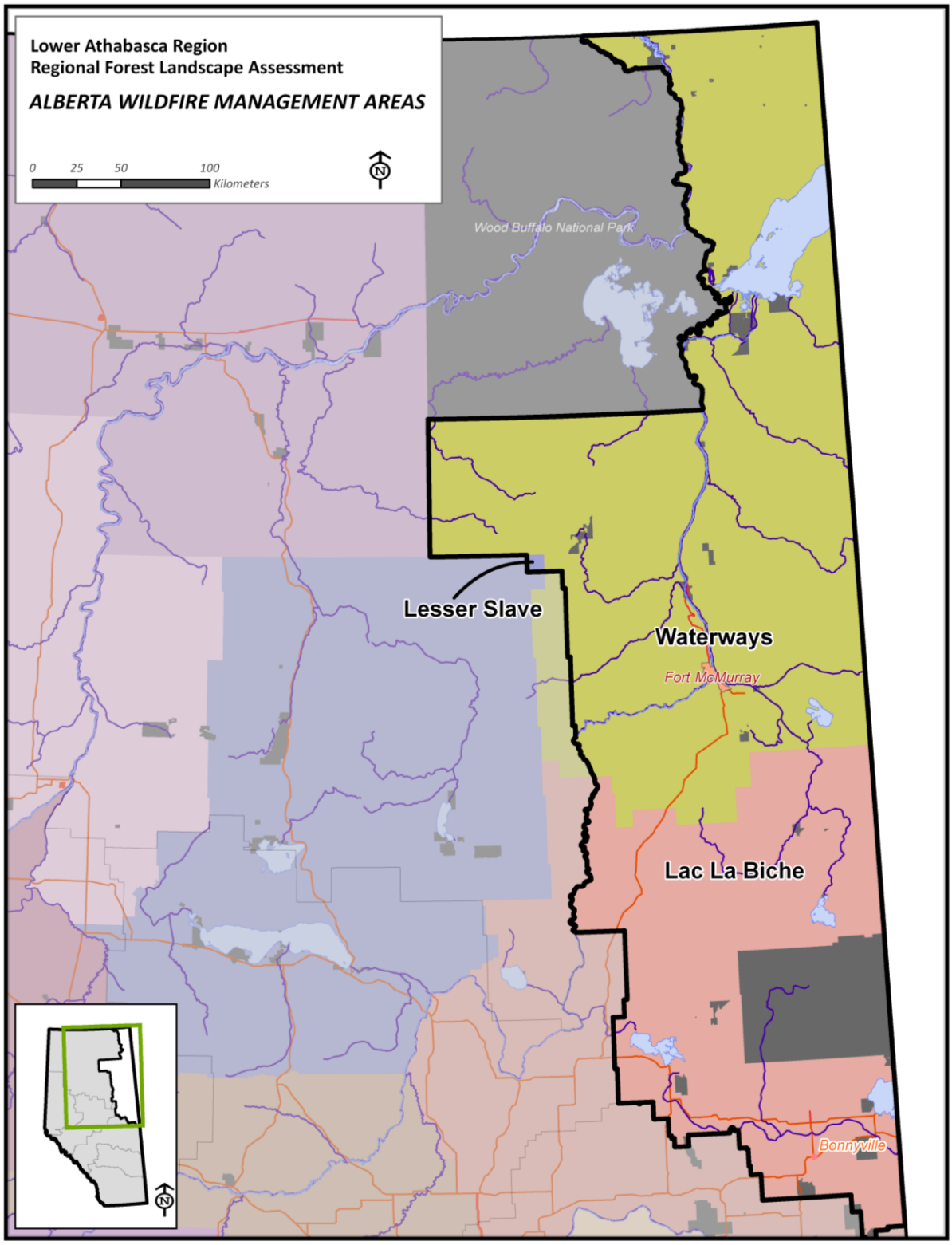


Figure 1-12 Alberta Wildfire Management Areas

2. Physical Conditions

2.1 Topography

The Lower Athabasca Region has a wide range of landscapes (16) as it follows the Athabasca River downstream. Several major rivers (e.g.: Athabasca, Firebag, Steepbank, Richardson) are deep channelled. The northern part of the Region is lowland with a high component of wetlands.

The highest elevation in the Region is 868 meters, located in the Birch Mountains, east-northeast of Fort McMurray. The lowest elevation is approximately 163 meters where the Athabasca River leaves the Region. Figure 2-1 illustrates the general topography of the Region.

Important elements of topography for natural resource management are slope and aspect and their relationship with forest development. Those aspects are reviewed in the section regarding Natural Subregions (see section 1.5). However, slope is also an important factor in terms of defining machine operability as well as potential for erosion.

Four classes of slope percent were calculated based on generally accepted thresholds for operability:

0 – 30 percent	Operable
31 – 45 percent	Generally operable but may require special equipment or systems.
46 – 60 percent	Generally inoperable without special systems
60 + percent	Inoperable

There is virtually no inoperable area within the Green Area portion of this Region (Table 2-1), meaning that there should be very few constraints to mechanical operations. The majority of steep slopes will be found along major river drainages.

Table 2-1 Slope Class Distribution

	Slope Class (percentage)								Total	
	0 - 30%		31 - 45%		46 - 60%		60% +			
General Location	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
Green Area	7,852,486	100	3,982	0	227	0	4	0	7,856,699	100
White Area	815,639	100	9	0		-		-	815,648	100
Federal Lands	653,376	100	43	0	1	0		-	653,420	100
Total	9,321,501	100	4,033	0	229	0	4	0	9,325,767	100

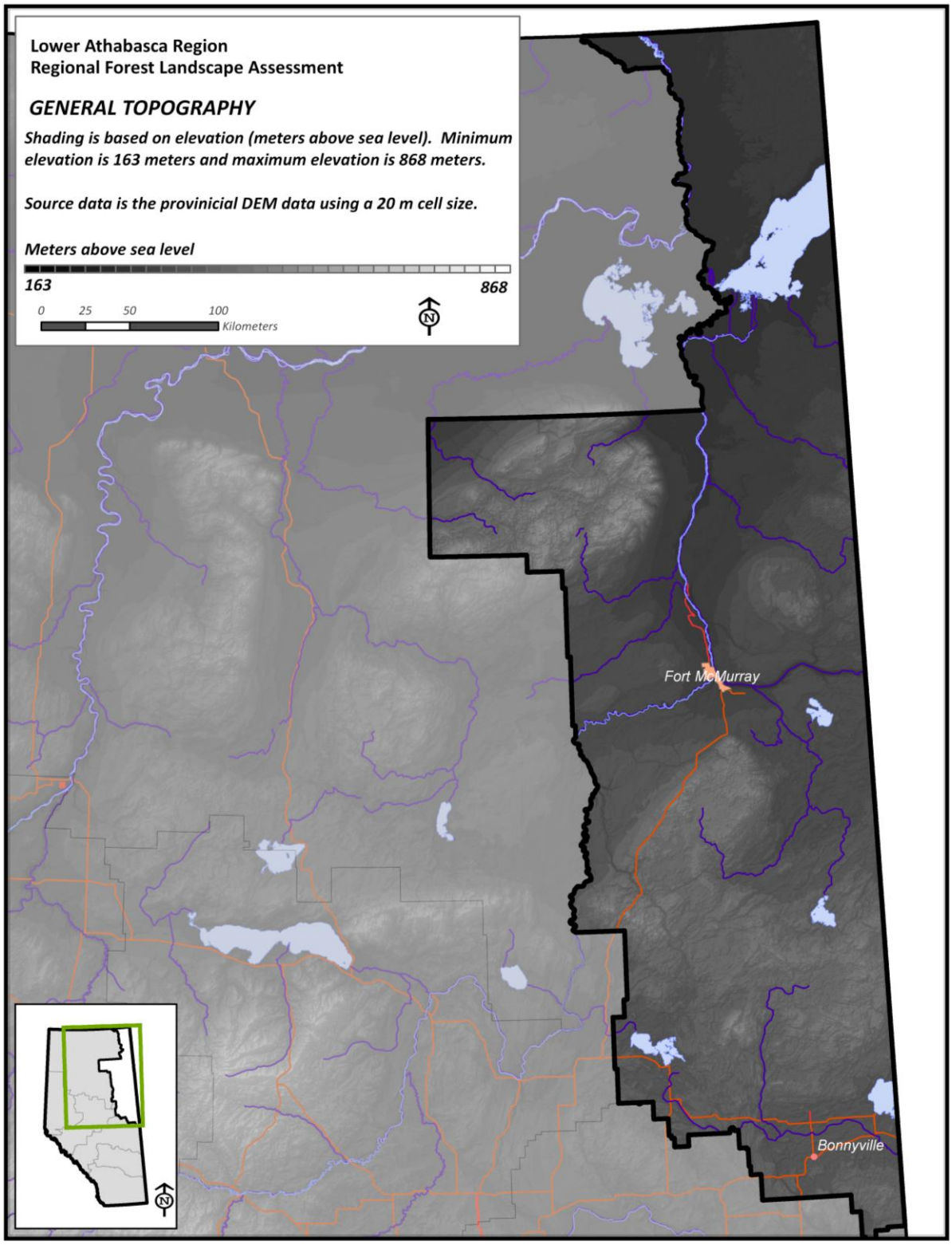


Figure 2-1 Topography

2.2 Soils and Landforms

A general description of soil orders present in the province are described in the glossary (18). The dominant soil order is Luvisolic (17), which covers approximately 38% of the Region (Table 2-2). Luvisols, along with Brunisols (the second most common soil order in this Region) and Podzolic soils are the three soil orders for forest soils in Canada. Brunisolic soils are typically interpreted as a "transitional" soil between generally unweathered parent material (common to Regosols) and mature forest soils represented by the Podzolic or Luvisolic orders.

Table 2-2 Soil Types

Soil Type			Area (ha)	Percentage (%)
Soil Order	Soil Group	Soil Subgroup		
Brunisolic	Dystric Brunisol	Eluviated Dystric Brunisol	2,097,410	22
Brunisolic	Eutric Brunisol	Eluviated Eutric Brunisol	50,697	1
Sub-total			2,148,108	23
Chernozemic	Black Chernozem	Eluviated Black Chernozem	36,958	0
Chernozemic	Black Chernozem	Rego Black Chernozem	74,052	1
Sub-total			111,010	1
Cryosolic	Organic Cryosol	Mesic Organic Cryosol	258,146	3
Gleysolic	Gleysol	Orthic Gleysol	203,422	2
Gleysolic	Gleysol	Rego Gleysol	42,016	0
Gleysolic	Luvic Gleysol	Orthic Luvic Gleysol	200,196	2
Sub-total			445,634	5
Luvisolic	Gray Luvisol	Dark Gray Luvisol	220,992	2
Luvisolic	Gray Luvisol	Orthic Gray Luvisol	3,284,238	35
Sub-total			3,505,230	38
Organic	Mesisol	Terric Humic Mesisol	97,872	1
Organic	Mesisol	Terric Mesisol	52,356	1
Organic	Mesisol	Typic Mesisol	1,435,359	15
Sub-total			1,585,587	17
Regosolic	Regosol	Cumulic Regosol	58,535	1
Regosolic	Regosol	Gleyed Cumulic Regosol	133,184	1
Regosolic	Regosol	Orthic Regosol	17,830	0
Sub-total			209,548	2
Solonetzic	Solodized Solonetz	Gray Solodized Solonetz	171,921	2
No Significant Soil Development			890,583	10
Total			9,325,767	100

Luvisolic soils are dominant in forested landscapes and are generally underlain by loamy tills. Brunisolic soils are primarily found on sand-dominated parent materials throughout the Boreal forest. The presence of many gleyed subgroups indicates that much of the Region is exposed to prolonged or frequent water saturation of the soil profile.

Figure 2-2 illustrates the distribution of soil order in the Region. Notable is the distribution of Cryosols and Organics in addition to the wide distribution of Luvisols as evidenced by their dominance in total area.

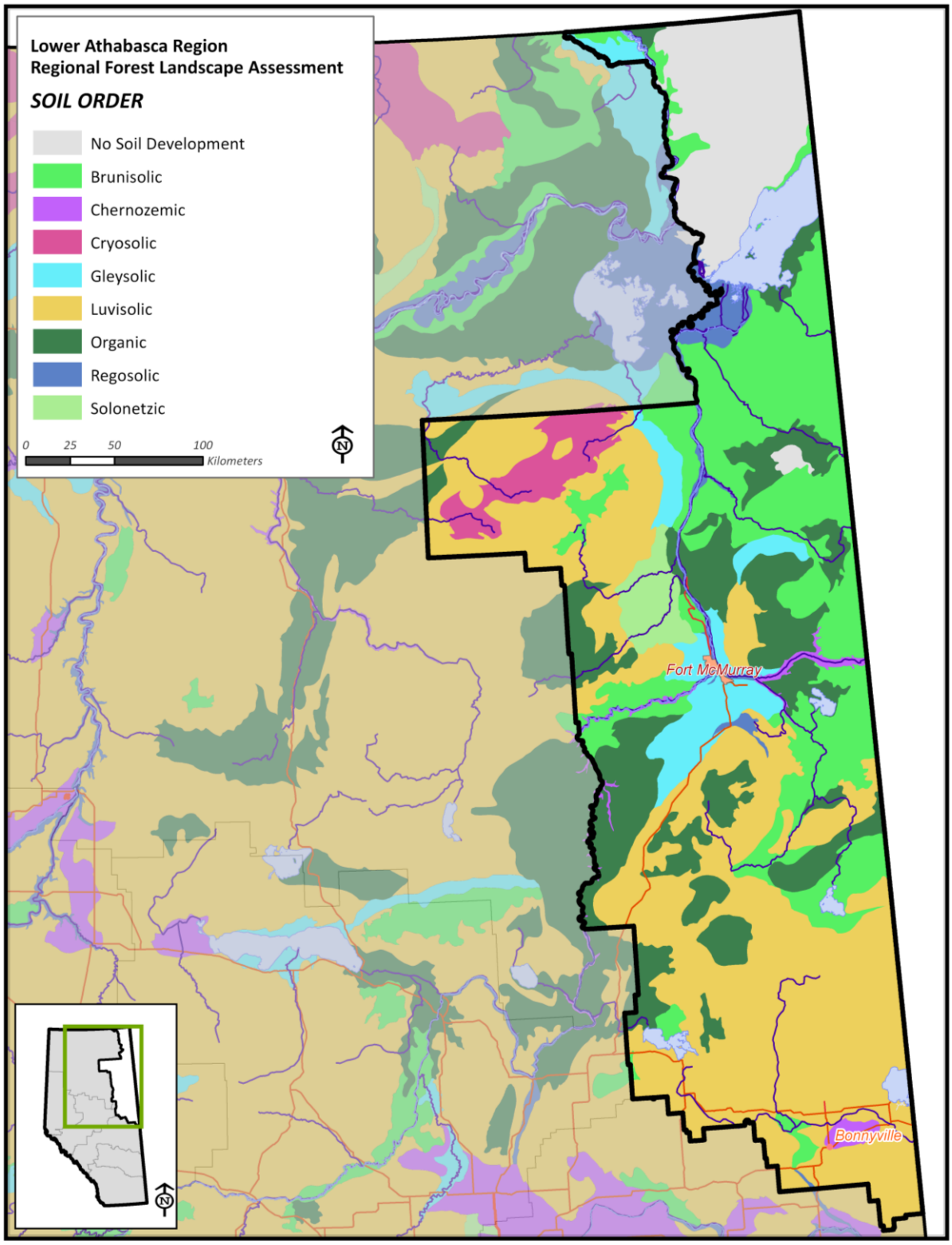


Figure 2-2 Soil Order

2.3 Hydrography

2.3.1 Water Basins

Figure 2-3 Major Water Basins

There are seven major drainage basins in the province (Figure 2-3).

The Land-use Framework regions are loosely based on these drainage boundaries. The Lower Athabasca Region (shown in ***red*** on Figure 2-3) represents the lower reaches of the Athabasca River basin, which (in its entirety) stretches the entire width of the Province from west to east.

2.3.2 Rivers, Streams and Waterbodies

Hydrologic features (19) are mapped by Alberta and are classified according to their water status (e.g.: permanent, recurring). Many man-made features are identified by type (e.g.: canal, reservoir, quarry), but for the purposes of this summary are grouped together as one category labelled “Man-made features”.

Table 2-3 summarizes the area of waterbodies in the Lower Athabasca Region within each of the Green and White Areas as well as on Federal lands. Similarly, Table 2-4 details the length of rivers and streams by their class, for each of the Green and White Area and on Federal lands. The summary of water features excludes wetlands as these are described separately in subsequent sections.

Table 2-3 Waterbody Classification

	Area of Waterbody Features (ha)			
Waterbody Class	**Green Area**	**White Area**	**Federal Lands**	**Total**
Major River	41,963	1,402	558	43,922
Lake (Permanent)	554,503	111,554	21,800	687,857
Lake (Recurring)	18,809	5,931	1,979	26,719
Oxbow (Permanent)	509	53	80	643
Oxbow (Recurring)	514	13	83	611
Man-made Features	2,755	222	11	2,987
Total	619,053	119,175	24,511	762,739

Table 2-4 River/Stream Network Classification

	Length of River/Streams (km)			
River/Stream Class	**Green Area**	**White Area**	**Federal Lands**	**Total**
Stream (Permanent)	14,885	416	1,153	16,454
Stream (Recurring)	4,147	252	266	4,666
Stream (Indefinite)	36,977	2,813	1,941	41,732
Oxbow (Permanent)	21	2	6	29
Oxbow (Recurring)	61	3	6	71
Man-made Features	92	163	2	257
Total	56,184	3,650	3,375	63,209

Figure 2-4 shows the distribution of *permanent* water features in the Lower Athabasca Region. In addition, the significant rivers draining the Region are labeled. Of all the named lakes in the Region, the largest is Lake Athabasca (215,661 hectares inside the Region). The 10 most significant river and lakes are listed in Table 2-5.

Table 2-5 List of Significant Water Features[1]

Significant Water Features			
Lake Name	**Area (ha)**	**River Name**	**Length (km)**
Lake Athabasca	215,661	Christina River	459
Cold Lake	25,316	Athabasca River	359
Lac la Biche	23,666	Sand River	300
Athabasca River	15,984	Beaver River	297
Winefred Lake	12,619	Horse River	283
Gordon Lake	11,872	House River	255
Slave River	10,968	Firebag River	243
Richardson Lake	7,783	Birch River	238
Muriel Lake	6,902	Richardson River	218
Charles Lake	6,338	Marguerite River	218

[1] Area of the significant lakes, and length of the significant rivers, refer only to the portion within the Lower Athabasca Region

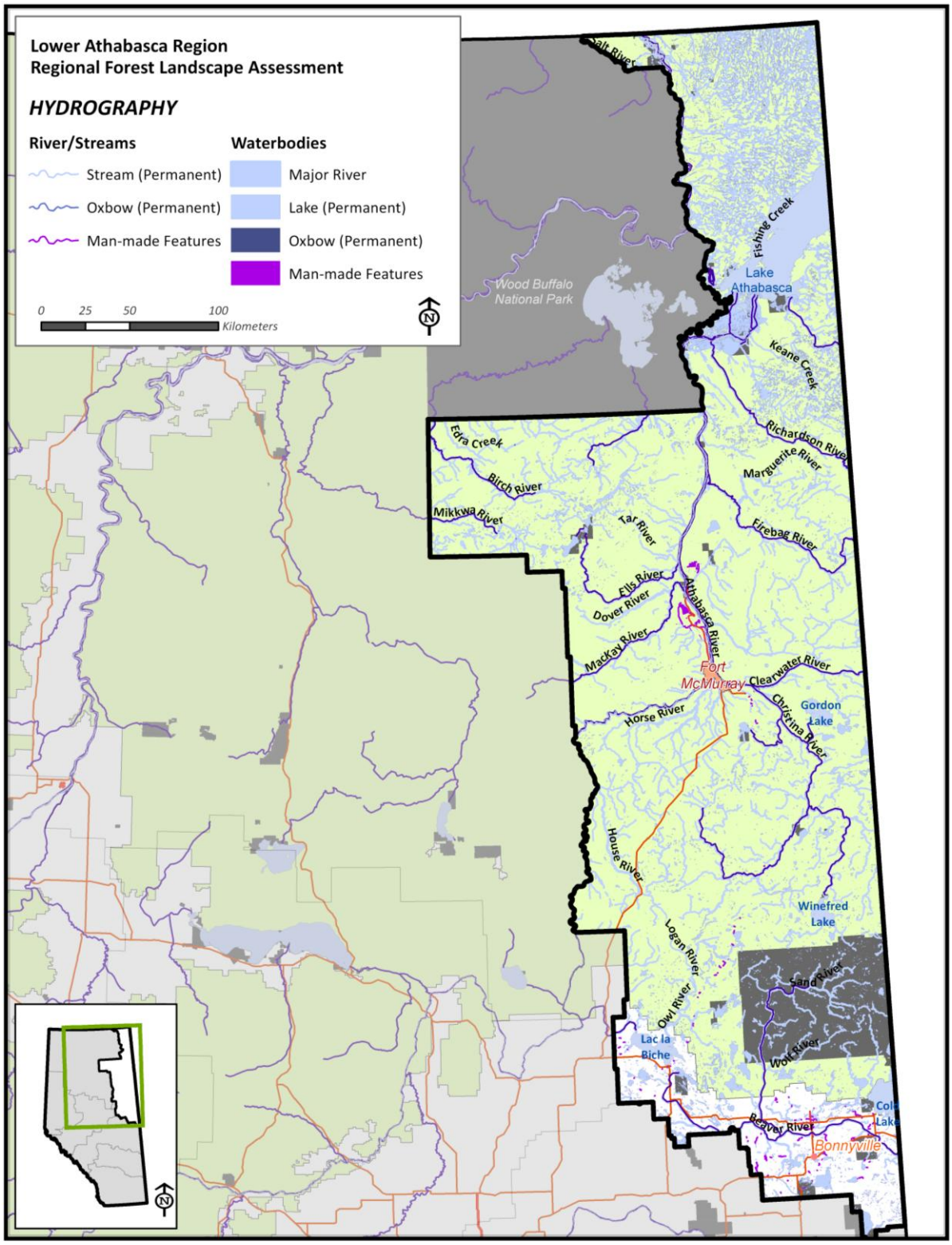


Figure 2-4 Permanent Waterbodies and Rivers

2.3.3 Wetlands

Wetlands are areas typically identified as bogs, fens or marshes and having little or no tree cover. Two sources of identification have identified wetlands in the Region:

- The AVI program (23) identifies wetlands by assigning a moisture regime of 'aquatic' and identifying the type of vegetation cover, which is typically herbaceous grass or forbs (Alberta 2005).
- The base mapping hydrography program (19) identifies wetlands as those areas of low lying terrain which have shallow water most of the year and varying heights of vegetative cover (Alberta 2006b)

The Lower Athabasca region contains approximately 301,400 hectares of wetland (Table 2-6). The majority of identified wetland is located in the northern part of the Region, where Lake Athabasca flows into the Lake Claire complex, and north at the Northwest Territories border west of the Slave River, adjacent to Wood Buffalo National Park.

Table 2-6 Wetland Summary

	Area of Defined Wetland (ha)			
Wetland Classification	**Green Area**	**White Area**	**Federal Lands**	**Total**
AVI				
Herbaceous Forbs/Grasses	107	215	10	331
Hydrography				
Wetlands	282,479	48	18,542	301,069
Total	282,586	263	18,552	301,400

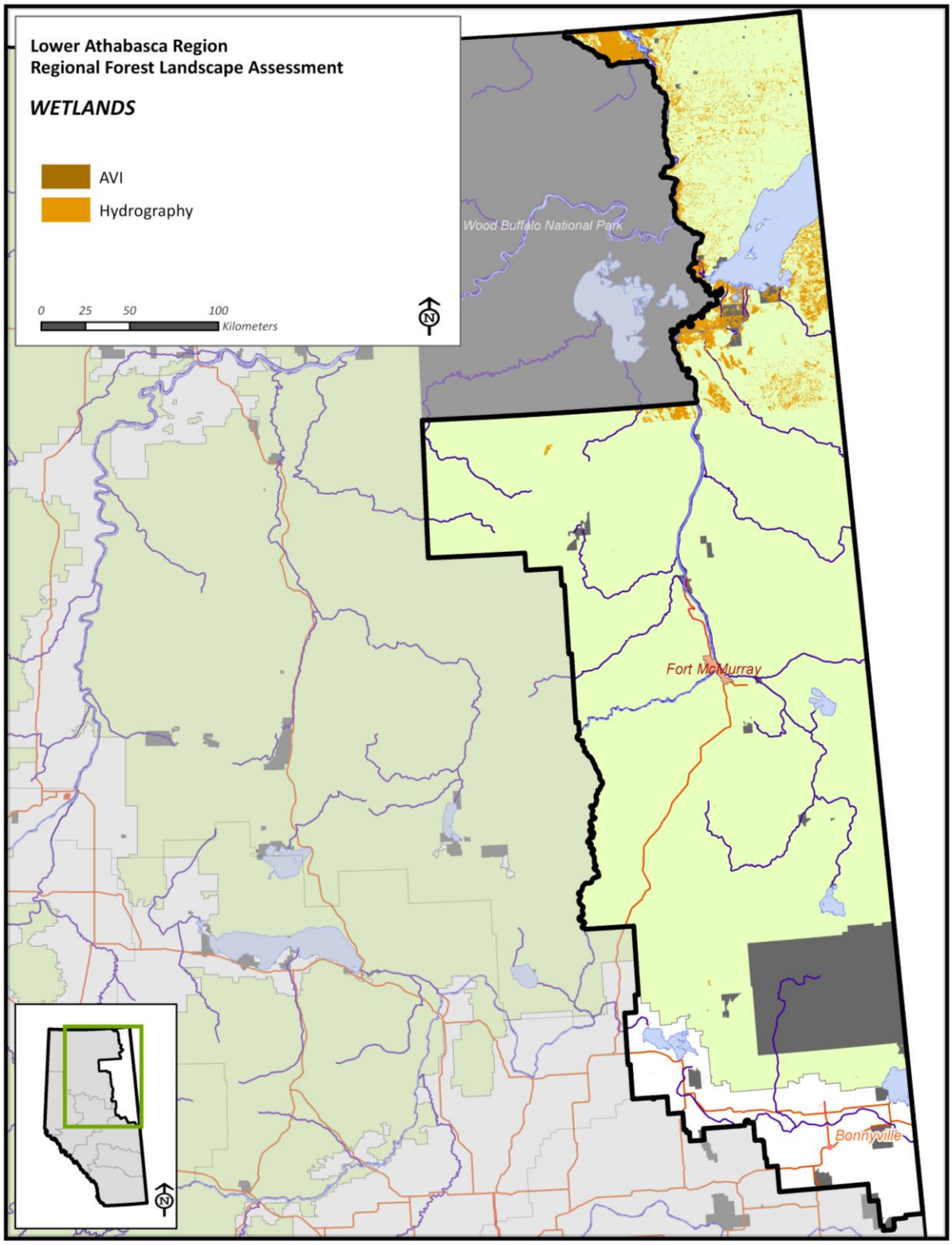


Figure 2-5 Wetlands

2.4 Climate

Alberta has a continental climate which is characterized by a large variation in temperature between summer and winter. A wide range of climatic conditions are present in the Lower Athabasca due to the number of degrees of latitude covered by the Region. Climatic data from 1971 to 2000 summarized by Agriculture Alberta and Environment Canada (21) have resulted in the mapping of general climatic trends over the province.

Figures indicating the daily mean January temperature (°C); daily mean July temperature (°C); length of growing season (defined as the number of days where the daily temperature exceeds 5°C); and mean annual precipitation (mm) appear below as Figure 2-6, Figure 2-7, Figure 2-8 and Figure 2-9 (respectively).

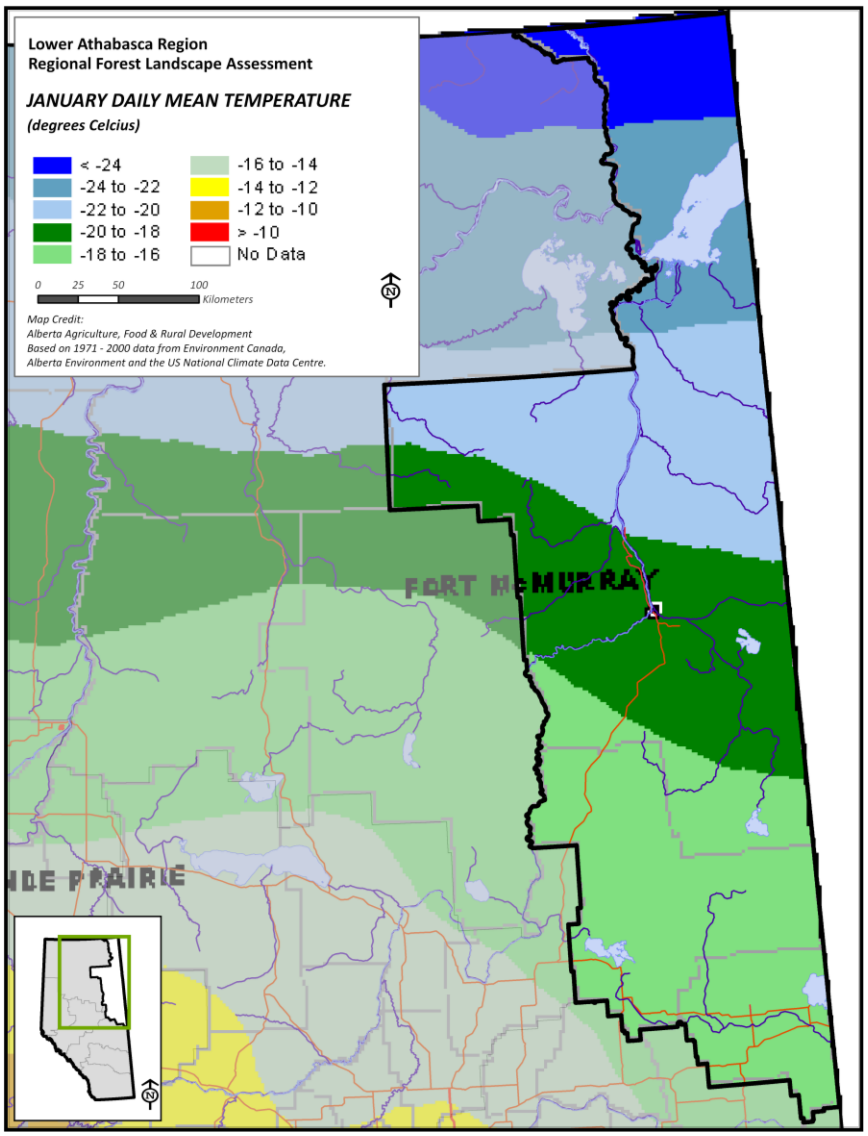


Figure 2-6 Daily Mean January Temperature

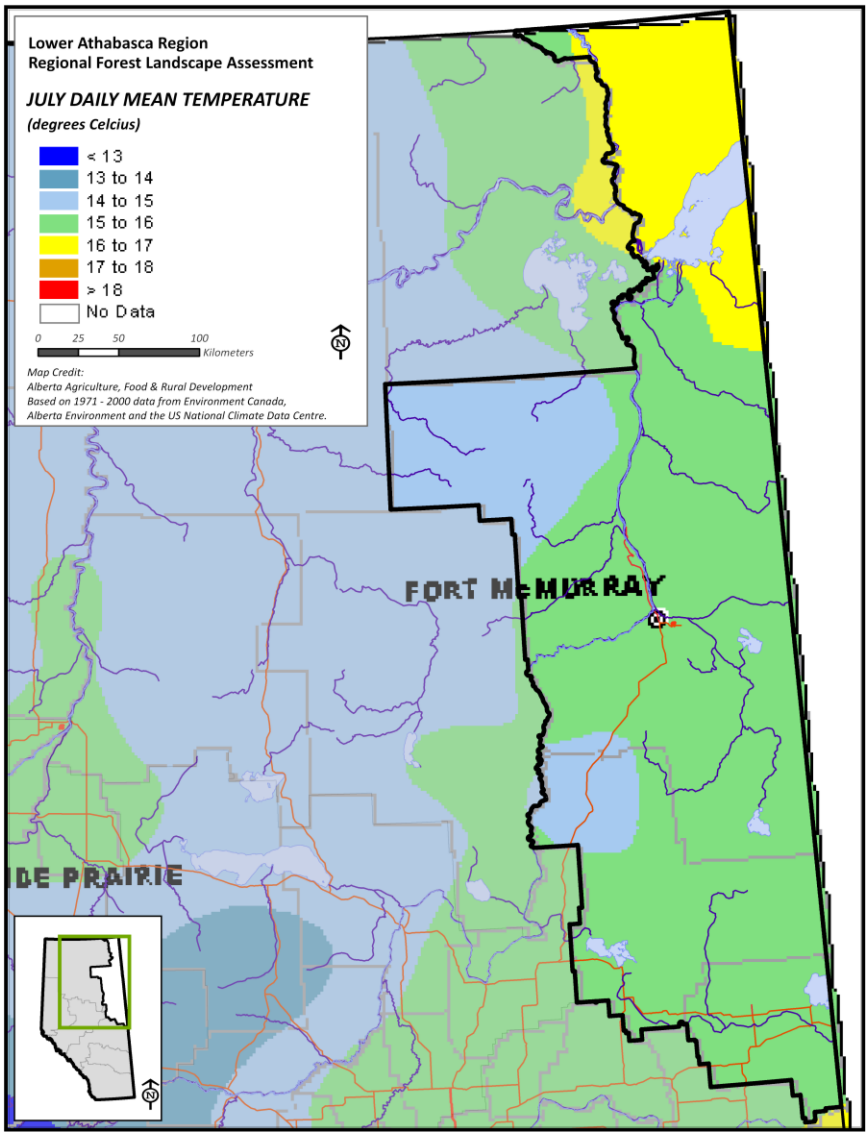


Figure 2-7 Daily Mean July Temperature

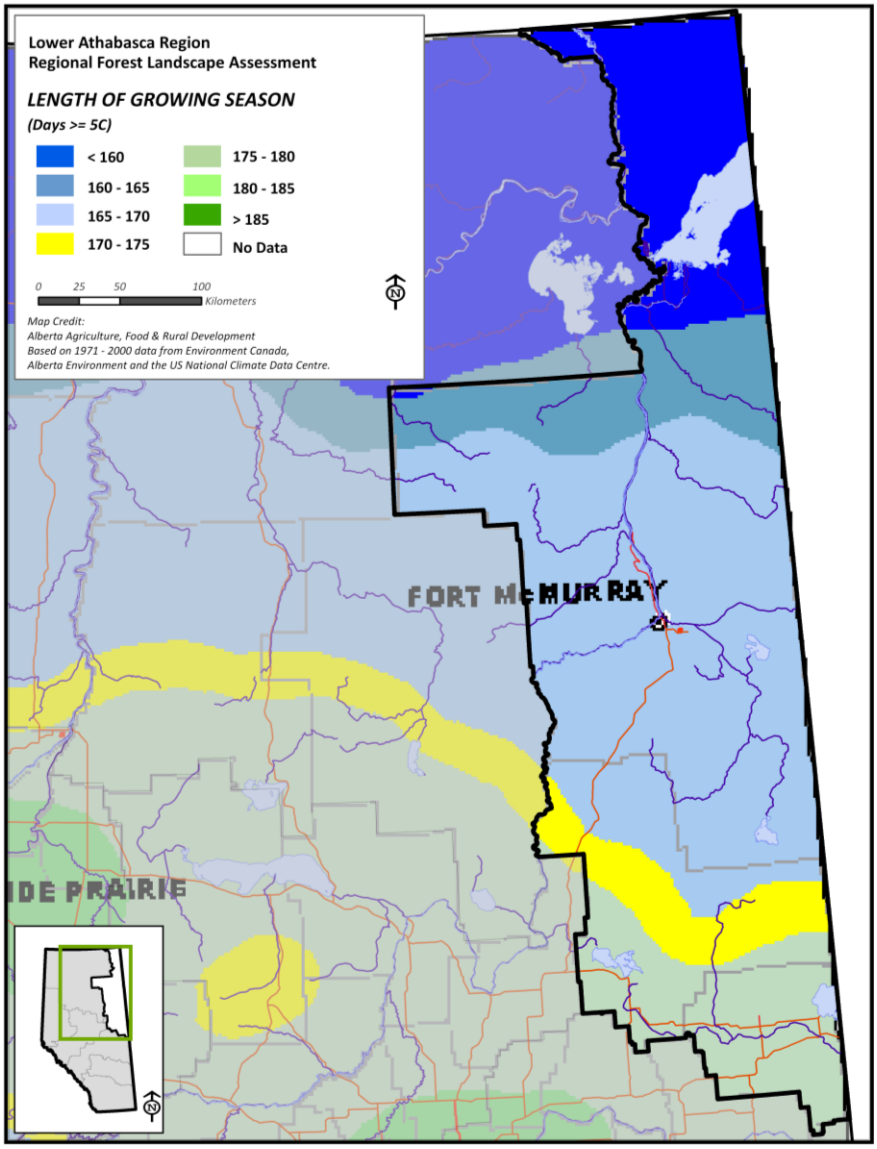


Figure 2-8 Length of Growing Season

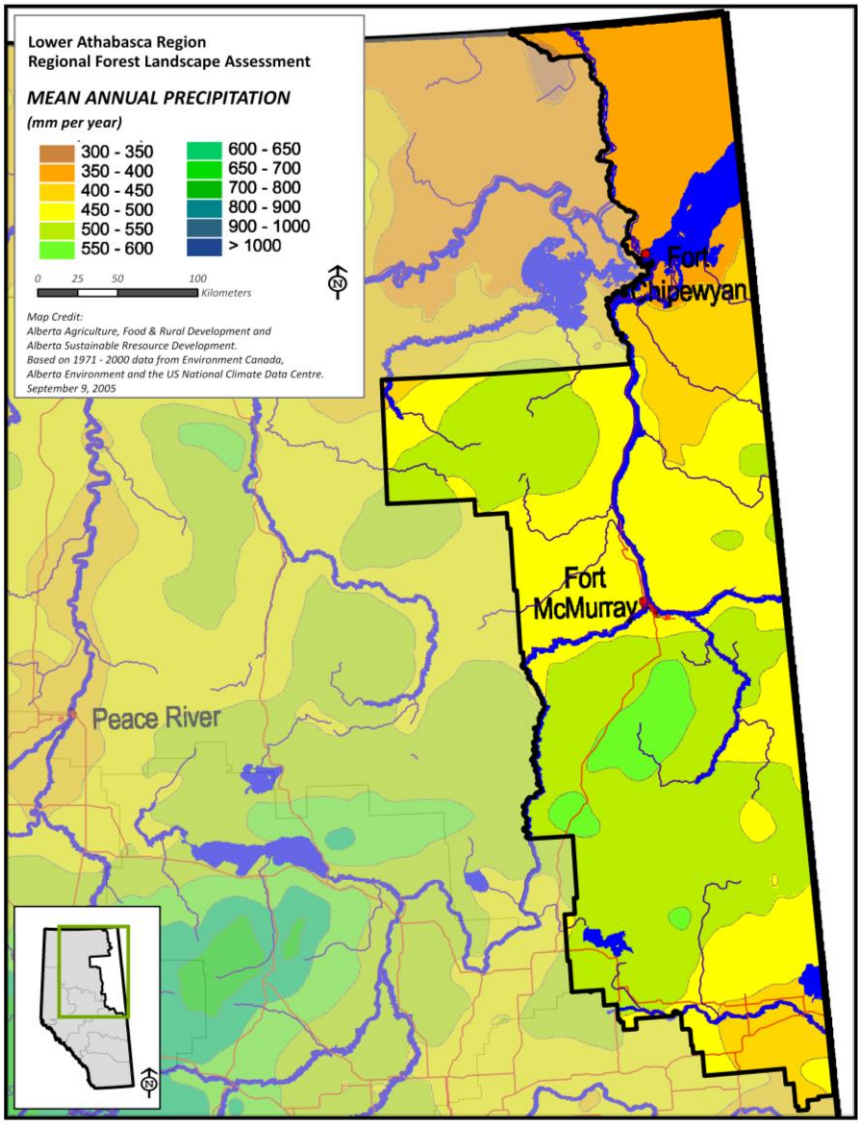


Figure 2-9 Mean Annual Precipitation

The provincial ecological classification identifies the Boreal ecoclimatic province as the dominant climatic presence within the Lower Athabasca Region. In addition to temperature, length of growing season and precipitation shown above, three important factors affecting reforestation success and tree growth have been summarized from the publication Natural Regions and Subregions of Alberta (Natural Regions Committee 2006).

Summer Moisture Index: The summer moisture index (SMI) is a measure of precipitation effectiveness during the growing season. It is calculated by dividing the number of growing degree days over 5°C by the amount of precipitation over the growing season (April through August). A high ratio indicates a greater likelihood that evaporation will exceed precipitation at some time during the growing season. For example, an SMI greater than 4 indicates dry to very dry climatic conditions, an SMI less than 3 indicates moist to wet climatic conditions with no moisture deficits during the growing season. An SMI between 3 and 4 indicates the likelihood of only moderate moisture deficits for short periods of the growing season.

Frost Free Days: The frost-free period is another indicator of temperature regimes that are favourable or unfavourable to plant growth. Factors contributing to short, erratic, frost-free periods are terrain variability and elevation. Rough terrain and higher elevations tend to reflect shorter and more unpredictable frost-free periods, likely due to variations in aspect and cold air drainage from high to low terrain. While general trends and averages are shown in the accompanying figure, the calculations of average frost-free periods are highly unreliable because of year-to-year variations in weather patterns and topographic variability.

Growing Season Precipitation: Growing season precipitation (GSP) is the portion of mean annual precipitation which falls from April to August. Higher proportions of precipitation during the growing season indicate continental climatic influences (where the bulk of the precipitation falls during the summer).

General patterns of summer moisture index, frost-free days and growing season precipitation are displayed in Figure 2-10.

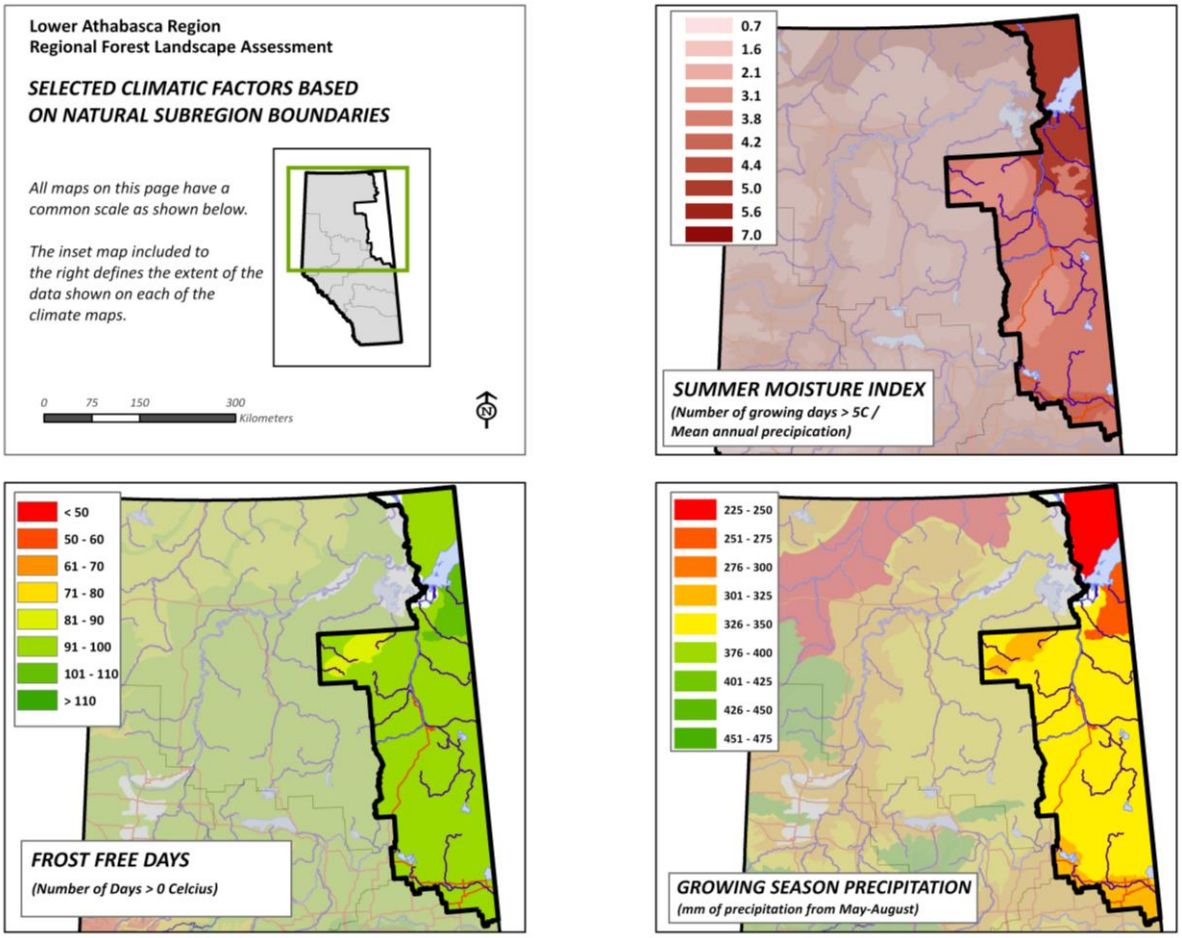


Figure 2-10 Climatic Factors Associated with Natural Subregions

3. Landscape Pattern and Structure

3.1 Source of Data

A review of landscape patterns based on vegetation is only possible where a detailed forest inventory exists. Digital Alberta Vegetation Inventory (AVI) data was compiled by ESRD using industry and Crown sources (23). This compiled data was used for the following assessments of species, stand type, age class, seral stage, patch distribution and interior forest. Approximately 57% of the Lower Athabasca Region has detailed AVI data available. Figure 3-1 indicates the relative coverage of AVI detail across the Lower Athabasca Region and the source of that information. Where the source of the AVI is "Other", this typically will refer to inventories completed by energy companies prior to oil sand mining. All AVI specifications data meet the minimum standard for vegetation classification as described in Alberta (2005).

The available inventory has been compiled over a number of years; hence the age of the inventory information varies across the Region (22). As indicated by Table 3-1, the prevalent age of the AVI appears to be between 0 to 10 years old. Only 9% of the area has an inventory older than 20 years. For the purposes of this report, the inventory data has been updated with known depletions related to harvesting, wildfire and land use disturbances (up to and including 2011), but stand characteristics have not been modified to reflect changes in stand growth (density, height, species composition).

Note that the area identified as "No AVI Available" is largely comprised of FMUs that are not accessible for forest development (A9, A10, A11, A6, A12 and A13). The balance of the non-inventoried area is in the White Area or selected portions of the Green Area where ESRD has no management responsibility (e.g.: Metis communities , First Nations).

Table 3-1 Age of AVI Information

Age of AVI (years)	Area (ha)	Percentage (%)
0 to 5 years	1,898,152	20
5 to 10 years	1,941,974	21
11 - 15 years	513,580	6
16 - 20 years	82,815	1
Greater than 20 years	845,514	9
Sub-total	5,282,034	57
No AVI Available	4,043,733	43
Total	9,325,767	100

For the purposes of this landscape assessment, the classifications of species, forest types, age class and seral stage, only the overstory detail was used and the understory was ignored. It is certainly understood that individual FMA holders may use other business rules for classifying such attributes for their planning and yield estimation, but these overall landscape assessments are based only on the overstory characteristics.

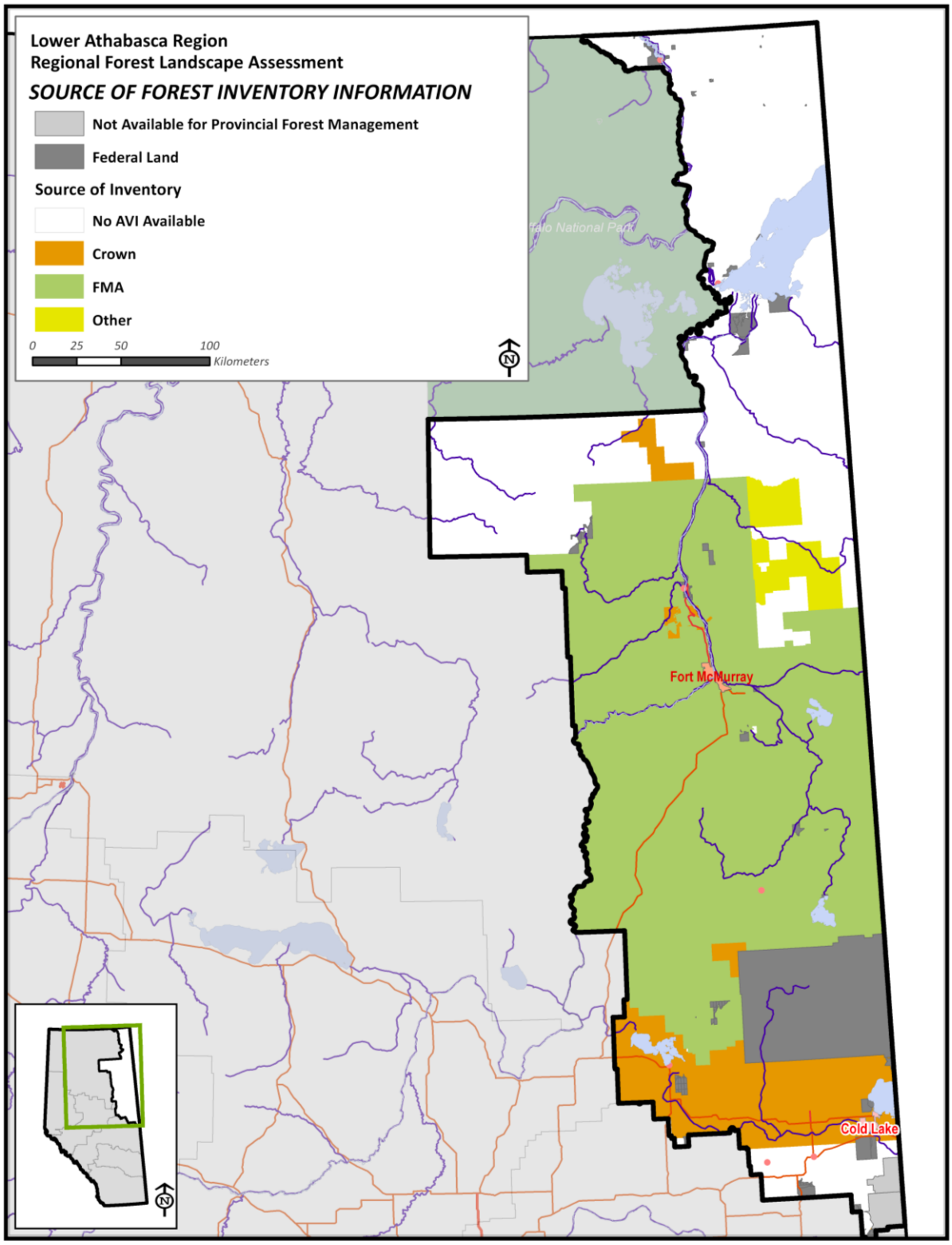


Figure 3-1 Source of AVI Information

3.2 Forest Species

Forest species (23) refers to the general commercial tree species in Alberta and does not include species such as willow or alder as they are typically more shrub-form in Alberta. In this assessment, the selected species was the leading overstory tree species as identified in the forest inventory. Note there are two classes of "undifferentiated" species. The class "Hardwood - undiff" refers to stands that could be aspen or poplar – the differentiation was not possible at the time of the forest inventory interpretation. The class "Pine- undiff" represents areas where lodgepole pine and jack pine are indistinguishable either because of hybridization between the two species, or simply the inability to differentiate tree form on the imagery used for interpretation.

Coniferous species as a group are more prevalent (28%) with black spruce representing the majority of the coniferous distribution. Jack pine, tamarack and white spruce are the next most prevalent with only minor components of balsam fir. Trembling aspen is the most common deciduous species with only minor components of balsam poplar and paper birch.

Black spruce can occur on both upland and lowland areas. Note that there may be large areas of sparse black spruce and larch occurring in wetlands. These areas would typically be classified as "Not Forested" due to the wetland being the dominant feature, despite the presence of black spruce trees.

The category "Undeclared species" refers to regenerating wildfires or harvest areas for which a leading tree species has not yet been established or declared. There is a large amount of such regeneration resulting from significant fires in the past 10 years (see section 4.5).

Table 3-2 Leading Species Distribution

Leading Tree Species Common Name	Latin Name	Area (ha)
Coniferous		
White spruce	*Picea glauca*	208,773
Engelmann spruce	*Picea engelmannii*	7
Black spruce	*Picea mariana*	1,444,294
Pine - undiff	*Pinus sp.*	12,496
Lodgepole pine	*Pinus contorta*	187
Jack pine	*Pinus banksiana*	493,958
Balsam fir	*Abies balsamea*	2,022
Tamarack	*Larix laricina*	406,040
Sub-total: Coniferous		2,567,776
Deciduous		
Hardwood - undiff	*Populus sp.*	121
Trembling aspen	*Populus tremuloides*	984,282
Balsam poplar	*Populus balsamifera*	36,213
Paper birch	*Betula papyrifera*	55,879
Sub-total: Deciduous		1,076,495
Regeneration		
Undeclared species		256,524
Sub-total: Regeneration		256,524
Sub-total Forested Land		3,900,795
Not Forested		1,264,584
No Inventory Data		4,160,389
Total		9,325,767

The general trend for species geographic distribution is evident in Figure 3-2.

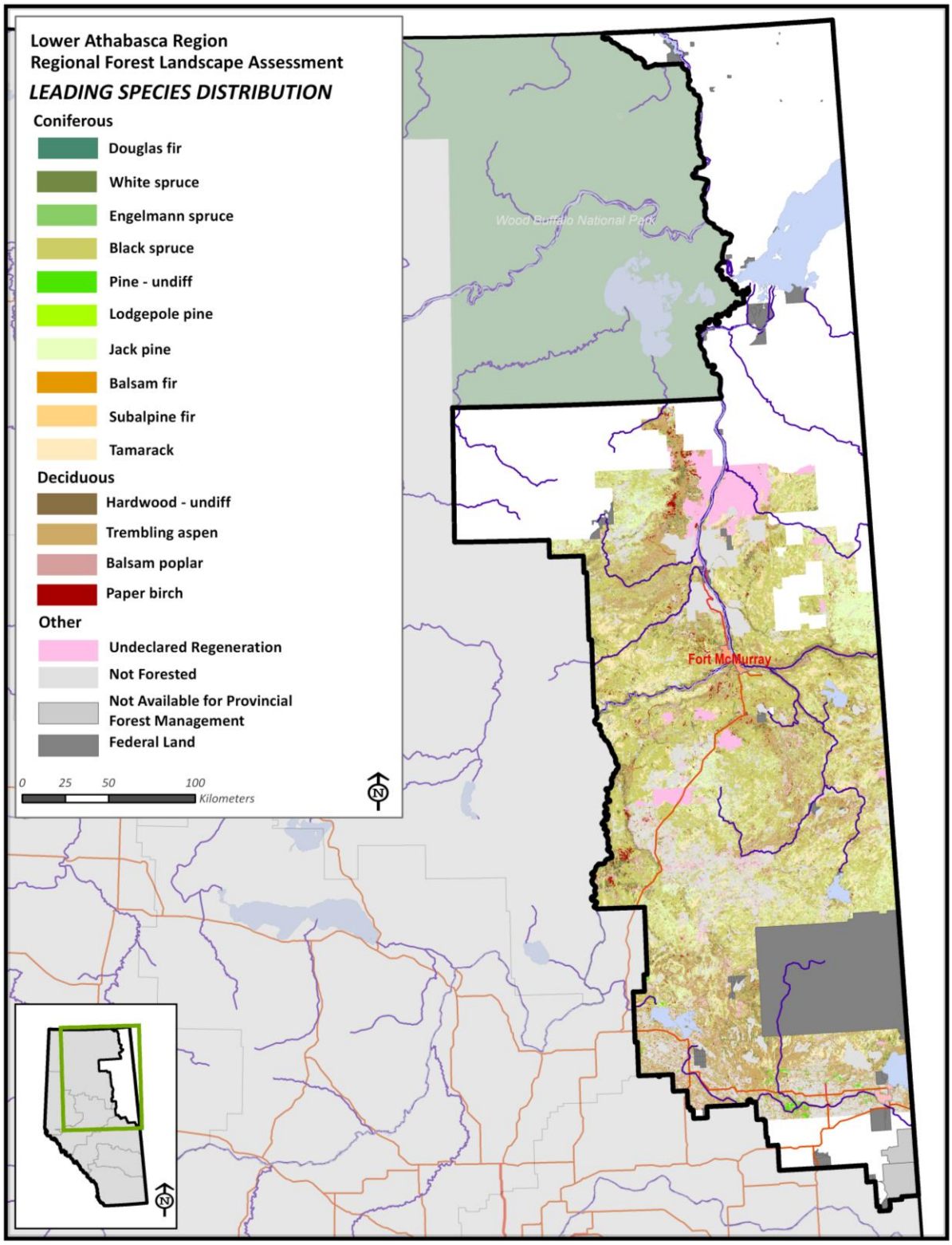


Figure 3-2 Leading Tree Species

3.3 Forest Cover Types

Cover type groupings (23) are based on the provincial strata defined in the yield projection guidelines of the Forest Planning Standard (Alberta 2006). Strata are hierarchical, based first on broad cover group (Deciduous, Deciduous-Coniferous, Coniferous-Deciduous, Coniferous) and then by leading coniferous species (except in the case of pure deciduous). There are 10 primary forest cover types defined in the Planning Standard and the only cover type not represented in the inventoried area of the Lower Athabasca Region is the 'Coniferous, Douglas fir leading" stand type.

The Region is dominated by primarily coniferous stand types (Table 3-3), with 27% of Region covered by spruce and pine forest strata. Pure deciduous stands are significant in the Region (10%). The cover type strata appear to be generally well distributed across the Region.

Figure 3-3 shows the spatial distribution of cover types across the Lower Athabasca Region. The large areas of regeneration are the result of recent wildfires for which a regeneration strata has not yet been established.

Table 3-3 Cover Type Summary

Description	Code	Area (ha)
Forested Land		
Pine pure or leading	C-P	476,121
Black spruce pure or leading	C-Sb	1,840,110
White spruce pure or leading	C-Sw	163,902
Pine/Hardwood	CD-P	31,354
Black spruce/Hardwood	CD-Sb	10,815
White spruce/Hardwood	CD-Sw	46,890
Hardwood/Pine	DC-P	28,344
Hardwood/Spruce	DC-S	77,853
Deciduous	D	968,884
Regeneration (undeclared strata)		256,524
Sub-total		3,900,795
Not Forested		1,264,584
No Inventory Data		4,160,388
Total		9,325,767

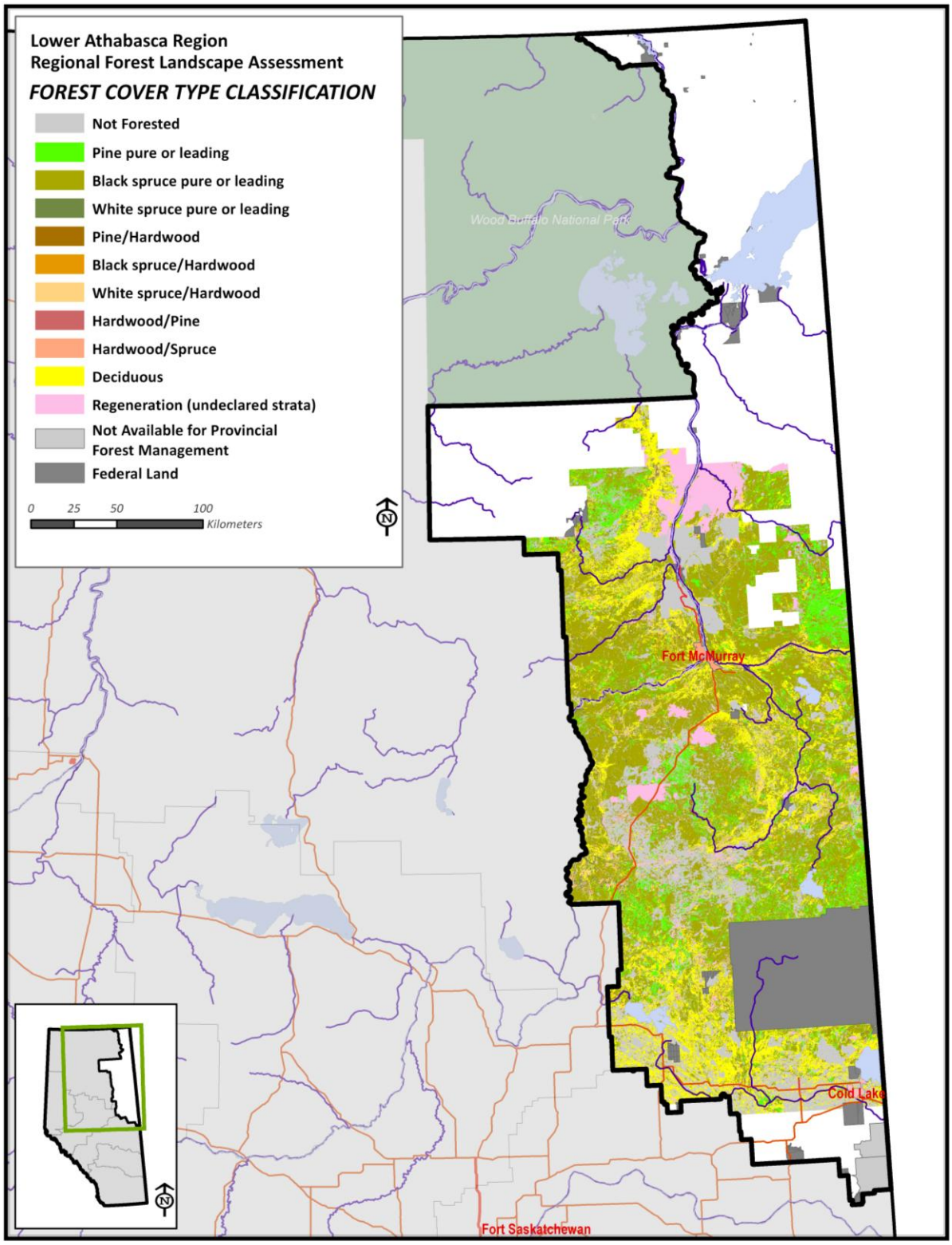


Figure 3-3 Cover Type Distribution

3.4 Forest Age Classes

The age class distribution (23) over the forested landscape of the Region is shown in Table 3-4. The majority of the forest would be considered immature to mature. There is a distinct clumping of age classes around 70 to 90 years of age. These three age groups represent 20% of the Region. The large area in the first 20 years of age are the result not only of timber harvesting, but recent wildfire events.

An overview map of the distribution of age classes appears as Figure 3-5 and a graphical representation appears as Figure 3-4.

Table 3-4 Age Class Distribution

Age Class (years)	Area (ha)
Forested Land	
0 - 9	208,335
10 - 19	116,342
20 - 29	48,460
30 - 39	196,636
40 - 49	61,763
50 - 59	122,840
60 - 69	288,947
70 - 79	782,764
80 - 89	639,366
90 - 99	501,567
100 - 109	282,489
110 - 119	257,690
120 - 129	131,562
130 - 139	118,092
140 - 149	41,626
150 - 159	61,462
160 - 169	17,292
170 - 179	14,617
180 - 189	4,835
190 - 199	2,520
200 +	1,590
Sub-total	3,900,795
Not Forested	1,264,584
No Inventory Data	4,160,389
Total	9,325,767

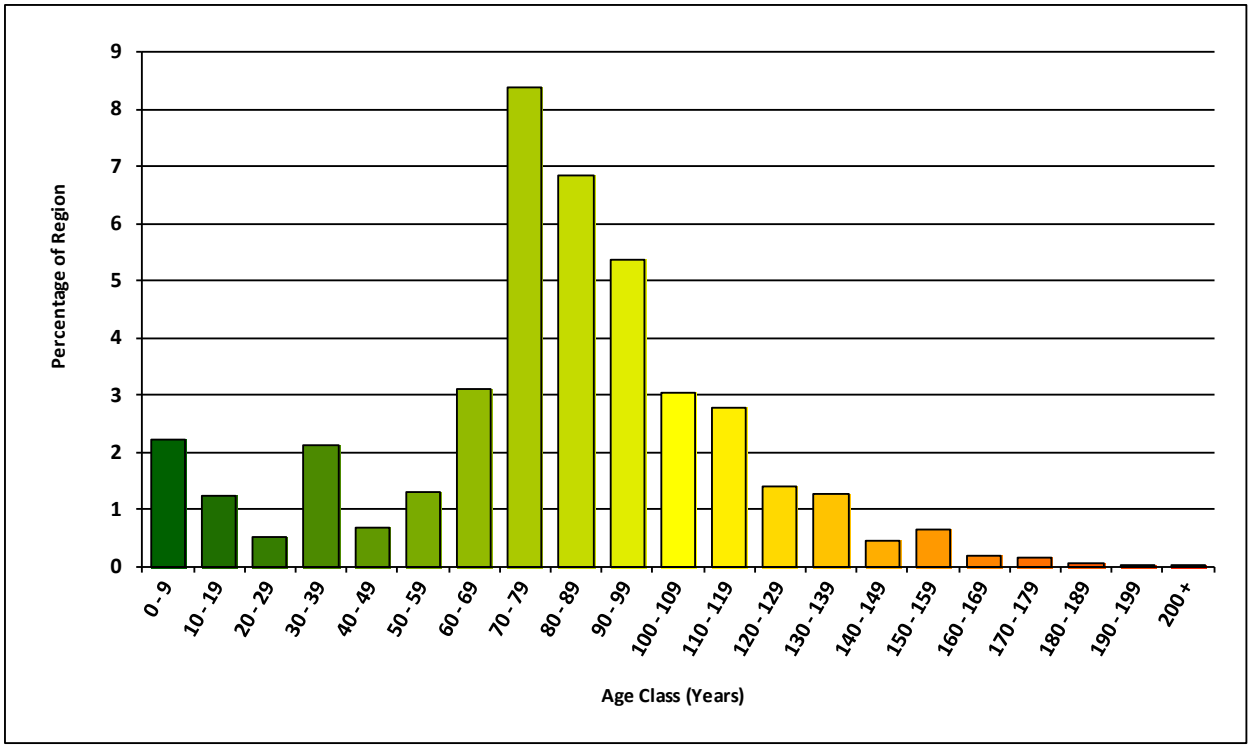


Figure 3-4 Distribution of Age Classes

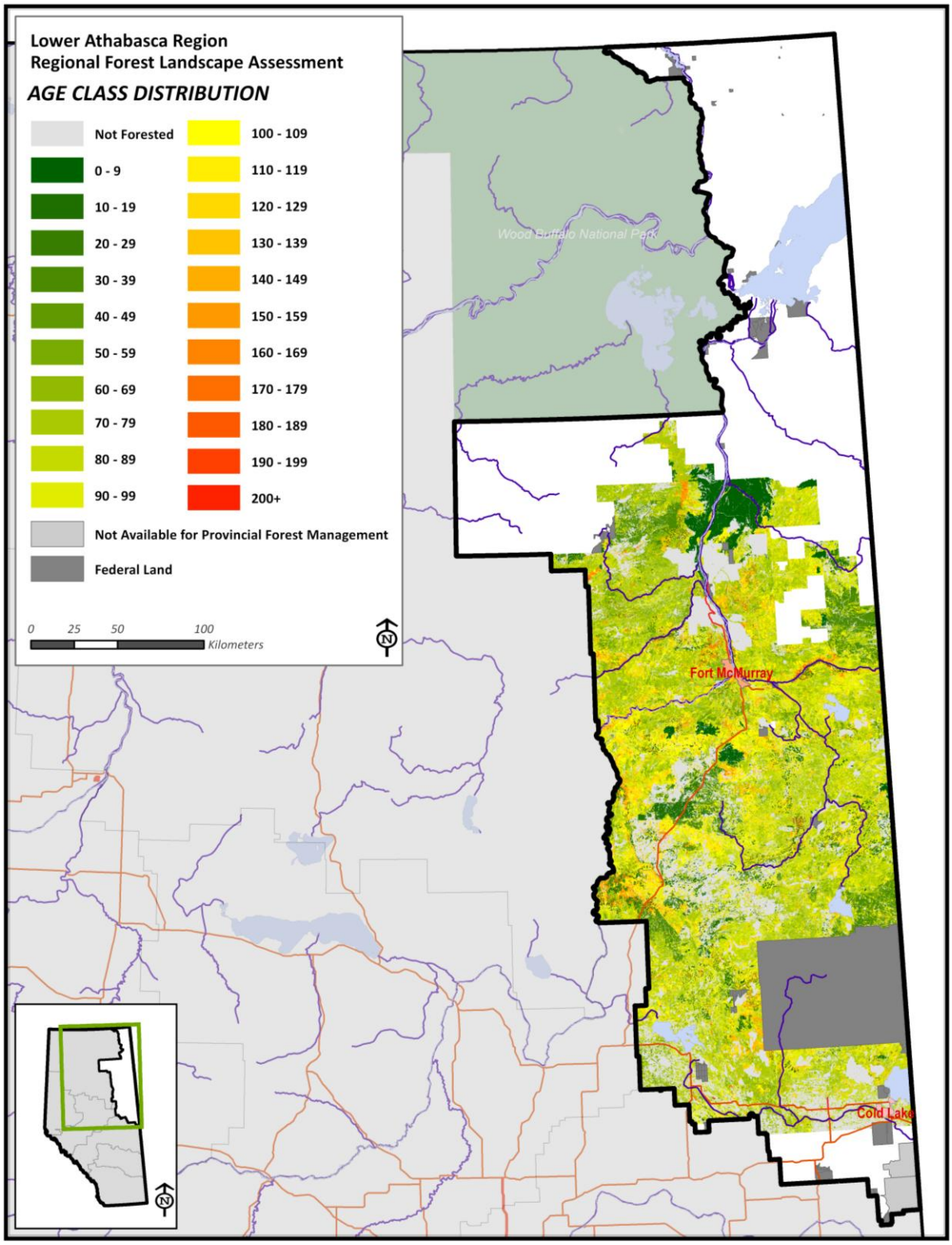


Figure 3-5 Age Class Distribution

3.5 Seral Stages

Seral stages (23) refer to stages in forest succession that are characterized by plant community conditions. For the purposes of this report, seral stages are defined by stand age.

Seral stage classes across the inventoried area of the Lower Athabasca Region are represented mostly by Mature and Immature classes (Table 3-5). The Young class is made up primarily of regenerating harvest areas and wildfires and comprises approximately 3% of the Region. Old and Very Old forest make up approximately 4% of the Region.

Table 3-5 Distribution of Seral Stage

Seral Stage	Definition	Area (ha)
Forested Land		
Young	Stand age < 20 years	324,677
Immature	Stand age 20 to 79 years	1,501,409
Mature	Stand age 80 to 119 years	1,681,112
Old	Stand age 120 to 179 years	384,651
Very Old	Stand age >= 180 years	8,945
Sub-total		3,900,795
Not Forested		1,264,584
No Inventory Data		4,160,389
Total		9,325,767

The spatial distribution of seral stages is shown in Figure 3-6.

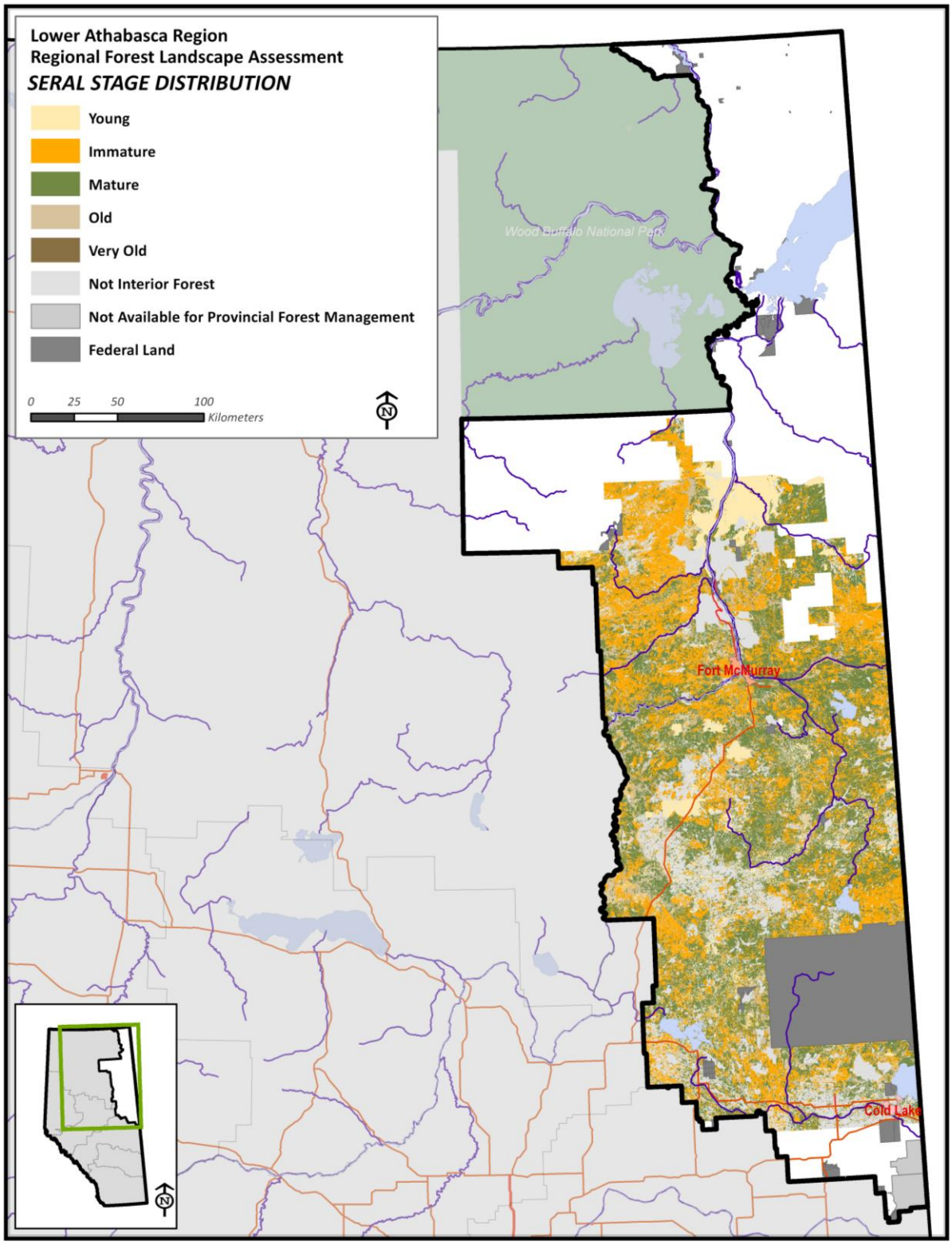


Figure 3-6 Seral Stage

3.6 Forest Patches

3.6.1 Patch Distribution of Young Stands

Patches are forest stands of the same seral stage (23) and not split by any linear feature greater than 8 meters wide. Contiguous patches where the seral stage was classified as "Young" (less than 20 years of age) were classified into 4 patch-size categories. Those results appear as Table 3-6 and Figure 3-7.

Table 3-6 Patch Distribution of Young Seral Stage

Patch Size Class (ha)	Number of Patches	Area (ha)
0 - 20	9,913	48,289
20 - 100	1,850	71,859
100 - 250	171	25,104
250 +	87	183,073

The large area represented by the patch size class of greater than 250 hectares, is primarily due to large fires in the Lower Athabasca Region which occurred within the last 20 years (see Figure 4-7).

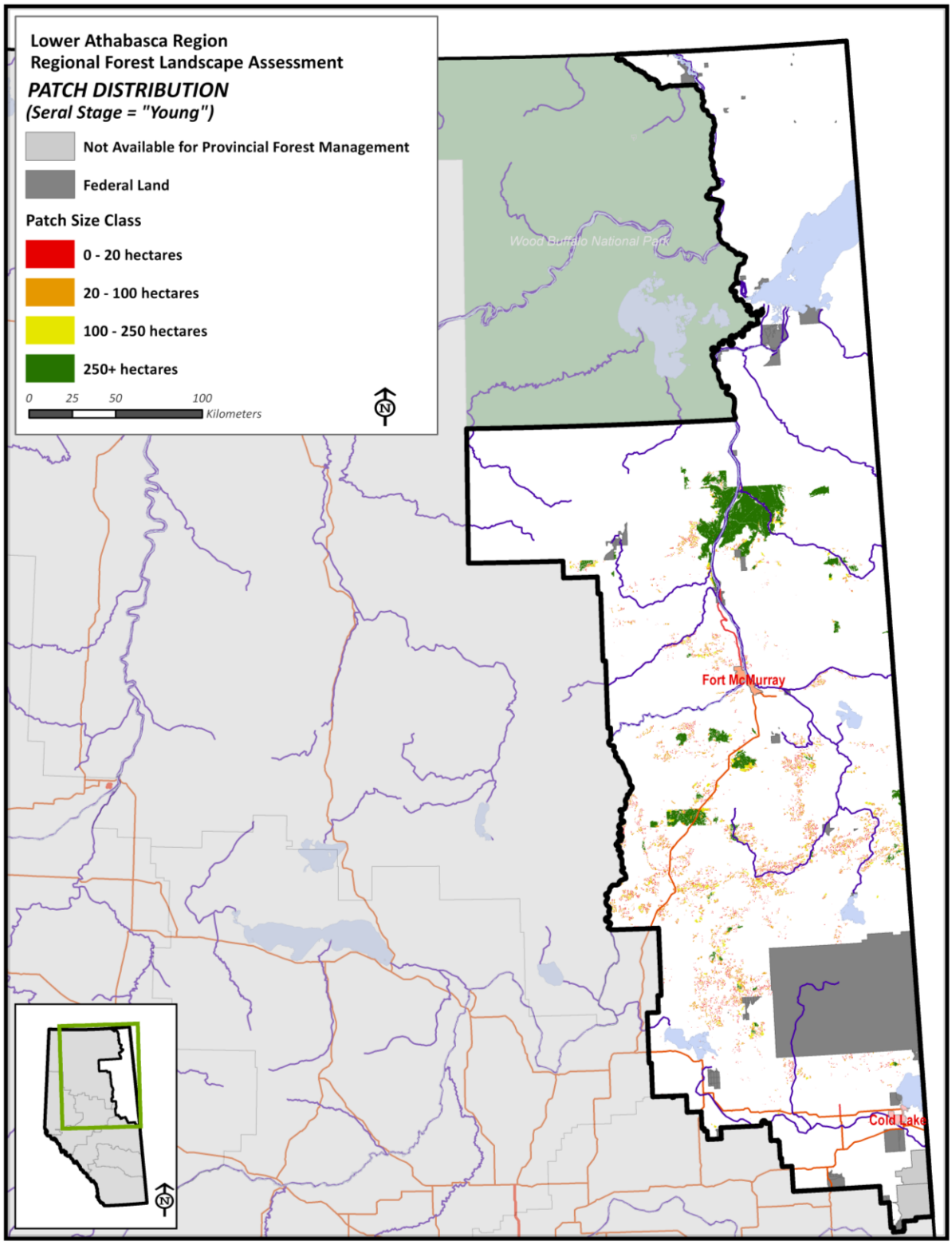


Figure 3-7 Patch Size Distribution of Young Stands

3.6.2 Interior Forest

Interior forest is one of two Forest Management Planning (FMP) reporting requirements that monitors the effect of forest fragmentation and resulting impacts on forest biodiversity. Interior forest is defined as forested areas greater than 100 hectares in size that are located beyond a defined edge-effect buffer zone. The edge-effect buffer zone is applied in two cases:

- along any stand edge which shares a common boundary with a linear disturbance greater than 8 meters in width; or
- stand edge along which the seral stage changes (note that the seral stage definitions used in the interior forest assessment are identical to the definitions presented in Table 3-5)..

The edge-effect buffer zone is calculated as:

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

There is no edge effect applied where adjacent stands are at least mature forest. Using these rules, the resulting interior forest was determined for the Lower Athabasca Region. The area summary is displayed in Table 3-7, and a map of the interior forest locations appears as Figure 3-8.

Table 3-7 Interior Forest by Seral Stage

Seral Stage	Number of Patches greater than 100 ha	Area of Patches > 100 ha (ha)
Young	0	0
Mature	1,934	703,358
Old	326	92,406
Very Old	5	784

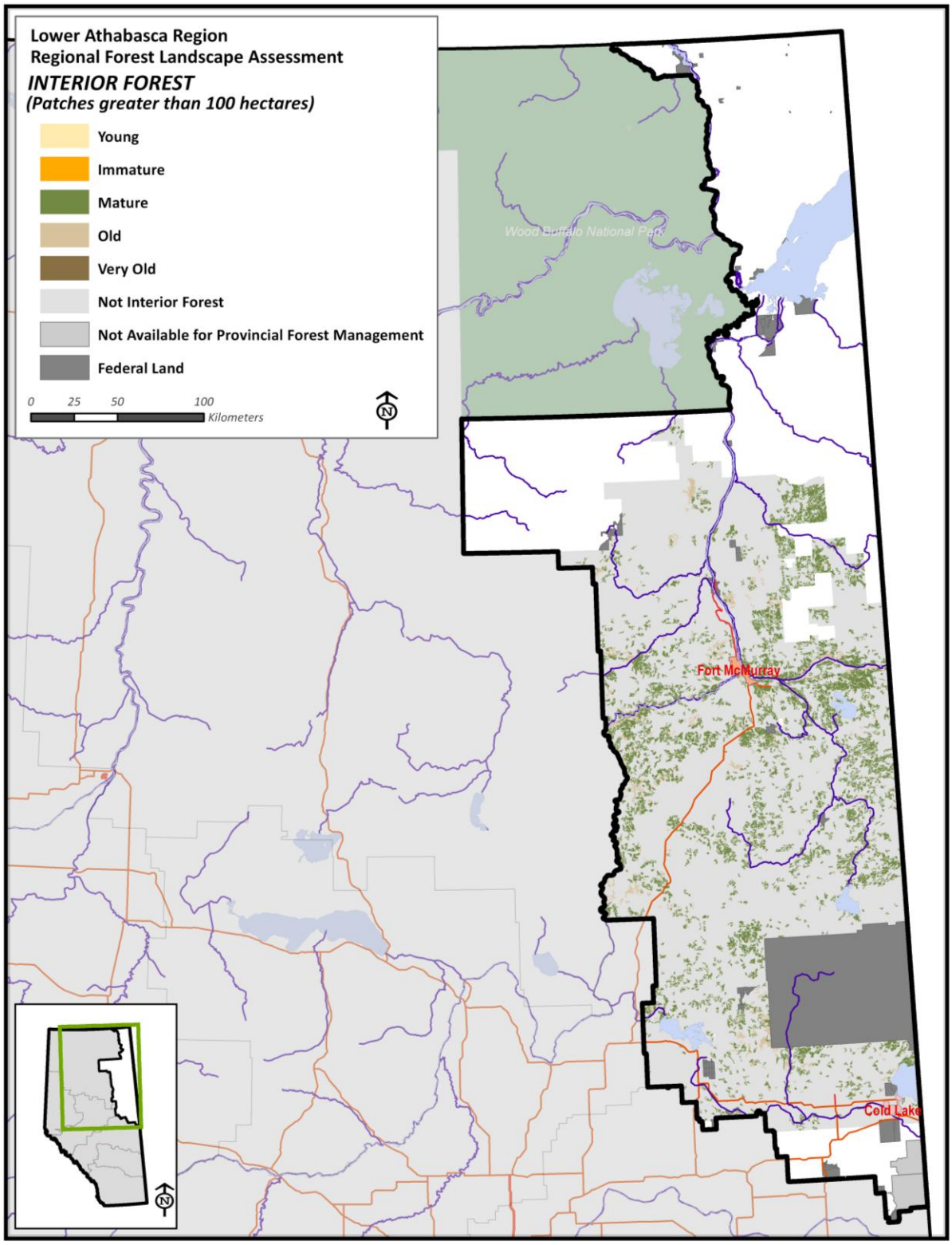


Figure 3-8 Interior Forest by Seral Stage

4. Landscape Disturbance and Succession

4.1 Inherent Disturbance Regime

The natural disturbance regime in the Lower Athabasca consists of wildfire and natural pests, with wildfire being the dominant natural factor shaping the composition and distribution of species (Rowe et al. 1973). Wildfire disturbance is the primary process introducing variability in the forest mosaic (Andison 1999).

The dominant landscape disturbances are now through anthropogenic, or man-caused, events such as increased area taken up by access and settlements as well as development of the forest and energy industries. In addition, regulation and policy to limit the impact of natural disturbances (for example: wildfire control, wildfire prevention and insect suppression programs) have contributed to a landscape shaped primarily by man's activities.

4.2 Insects and Diseases

Insect surveys conducted by ESRD, Forest Management Branch, Forest Health Section indicate that the most prevalent insect pests in this Region are:

- Hardwood defoliators:
    - Large aspen tortrix (*Choristoneura conflicta*);
    - Bruce spanworm (*Operophtera bruceata*);
    - Tent caterpillar (*Malacosoma disstria*);
- Spruce budworm (*Choristoneura fumiferana*).

4.2.1 Hardwood Defoliators

Table 4-1 summarizes the total area of hardwood defoliation as surveyed by ESRD between 1999 and 2011 (inclusive) (25).

The hardwood defoliator agent causing the most damage in this Region is forest tent caterpillar which accounts for 75% of the total area impacted by hardwood defoliators. The majority of the historical infestations are severe. Of the three main defoliator agents, typically only one of the species is the dominant defoliator at a given time.

Other hardwood defoliators (gypsy moth, satin moth, spearmarked black moth, aspen leafroller) are present in the province and potentially in the Lower Athabasca Region, but no surveys have detected any populations worth noting.

Table 4-1 Summary of Hardwood Defoliation Agents

Insect Pest - Hardwood Defoliators		Severity of Impact						Total	
		Light		Moderate		Severe			
Common Name	Latin Name	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
Large aspen tortrix	*Choristoneura conflictana*	155,171	5	480,815	14	208,354	6	844,340	25
Bruce spanworm	*Operophtera bruceata*	510	0	384	0		-	895	0
Forest tent caterpillar	*Malacosoma disstria*	373,176	11	294,766	9	1,863,201	55	2,531,143	75
Total[1]		528,858	16	775,965	23	2,071,555	61	3,376,377	100

[1] Sum of infestation survey records 1999 to 2011 inclusive

Figure 4-1 is an overview of the history of the presence of hardwood defoliator outbreaks impacting forests in the Lower Athabasca Region. As these defoliators tend to occur in cycles, only the last 8 years of infestation are mapped. A detail summary of the most important of these insect species (large aspen tortrix, Bruce spanworm and tent caterpillar) is presented in following sections.

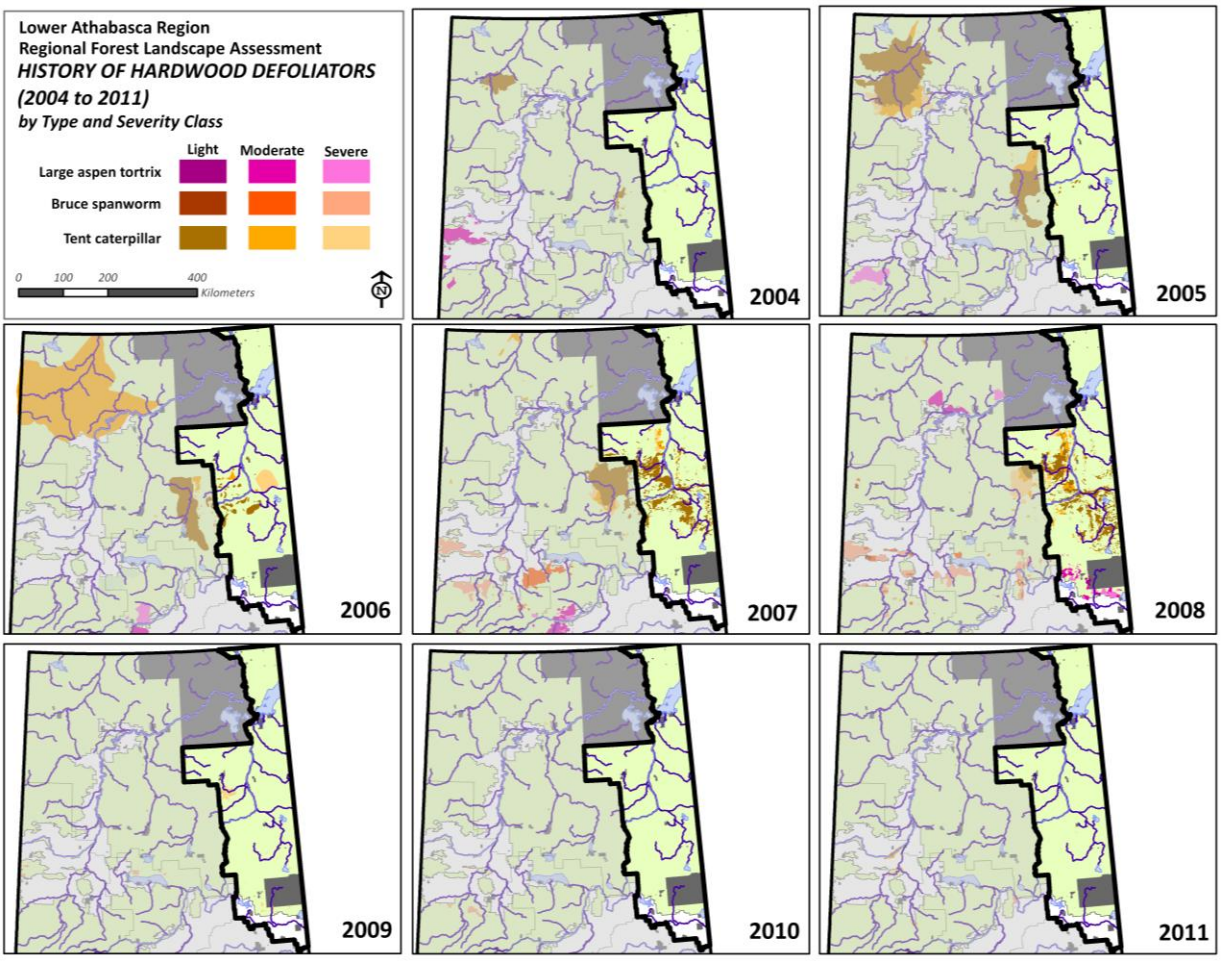


Figure 4-1 History of Hardwood Defoliation Outbreaks (2004-2011)

Large Aspen Tortrix

The large aspen tortrix occurs across Canada and is one of the most serious pests of trembling aspen. Aspen is the preferred host, but the tortrix will also feed on willow, balsam poplar and white birch. Outbreaks may last 3-4 years. Damage is predominantly caused by the later larval stages which may also feed on buds. Massive defoliation can reduce growth increment, but rarely results in tree mortality.

In the past 10 years there have been two infestations of large aspen tortrix. The first population crashed in 2003 and the second in 2008. Small pockets of large aspen tortrix have been surveyed as recently as 2011 so an endemic population is present.

Bruce Spanworm

Bruce spanworm also occurs widely across Canada. Aspen is the principle host, but the spanworm will also feed on willow, balsam poplar, white birch and shrubs such as Saskatoon, currants and wild rose. Historically, outbreaks have not lasted more than 2 years and typically decline very quickly. Hence there seems to be little value in adopting control measures for this pest.

Infestations of Bruce spanworm are sporadic in nature. The most recent infestation occurred over 2007 and 2008 but quickly collapsed. The overall provincial incidence of Bruce spanworm is relatively low, and it's prevalence in the Lower Athabasca Region is also of marginal concern.

Tent Caterpillar

The tent caterpillar occurs across Canada and is considered the most serious defoliator of hardwoods. While aspen is the preferred host, the tent caterpillar will attack almost any hardwood species during outbreaks. Outbreaks generally last 2 to 4 years, and may reoccur every 8-10 years. Infestation cause branch dieback and reduce growth increment. Several years of severe defoliation may cause mortality, particularly where trees may have additional stress factors.

There has been no significant tent caterpillar outbreak since the last major infestation which ran from 2005 to 2008. Incidence of tent caterpillar outbreaks in the Lower Athabasca Region would be considered high, as the Lower Athabasca Region contain over 50% of the provincial area impacted by tent caterpillar in each year from 2007 to 2009. The last infestation collapsed in the Region in 2009 and only a marginal population of insects were surveyed in 2011.

Given the potential greater damage to forest growth caused by tent caterpillar, there have been trials to assess bacterial control mechanisms. No such mechanism has been implemented in an operational setting.

4.2.2 Spruce Budworm

The spruce budworm is the most important defoliator pest of spruce-fir forests in North America. In Alberta, white spruce is the preferred host, but black spruce, tamarack and balsam fir can also be attacked. While attacks are more visible in pure host stands, mixedwood stands are also prone to attack once an infestation is underway. Re-occurrence and length of infestations vary widely. Damage to trees is considerable, as the budworms attack new needle growth as well as buds. After 4-5 years of defoliation, dead tops can appear on trees. Additional years of infestation may result in mortality.

Table 4-2 indicates the summary of historical infestations of spruce budworm in the Lower Athabasca Region (26). The budworm is a prominent pest in this Region. As indicated in Figure 4-2, the budworm appears mainly along the Athabasca River drainage, with large blocks of severe infestation. The most recent infestation noted was in 2011, however, all outbreaks in that year were of moderate severity.

Table 4-2 Summary of Spruce Budworm Presence

Insect Pest - Spruce Budworm		Severity of Impact						Total	
		Light		Moderate		Severe			
Common Name	Latin Name	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
Spruce budworm	*Choristoneura fumeiferana*	21,981	1	632,864	41	898,991	58	1,553,836	100
Total[1]		21,981	1	632,864	41	898,991	58	1,553,836	100

[1] Sum of infestation survey records 1988 to 2011 inclusive

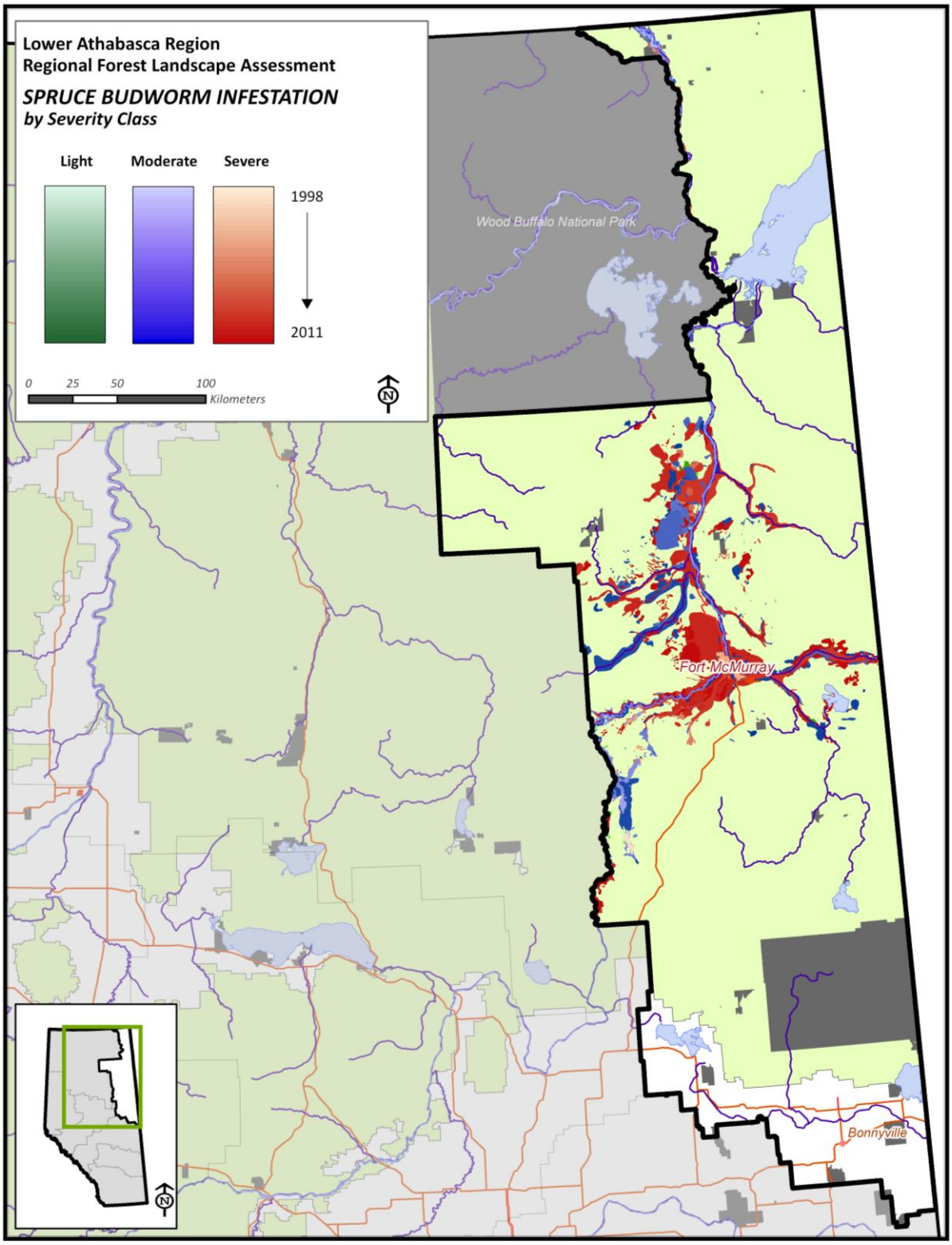


Figure 4-2 History of Spruce Budworm

4.2.3 Mountain Pine Beetle

The mountain pine beetle is the most destructive pest of mature pine forests in North America. Mature and over-mature pine under some sort of stress are the preferred host, but as populations increase, smaller-sized and healthy trees can all be attacked. To date, mountain pine beetle has not been found in the Lower Athabasca region. However if the beetle can successfully utilize jack pine or lodgepole pine-jack pine hybrids, as a host, the Region will be threatened.

4.2.4 Other Forest Health Agents

Other agents such as soil moisture, weather events and other minor insect attacks can impact the health of the forest. ESRD (48) has reported localized drought south of Wood Buffalo National Park, totalling 75,899 hectares. Figure 4-3 shows the areas of extensive damage surveyed in 2011,

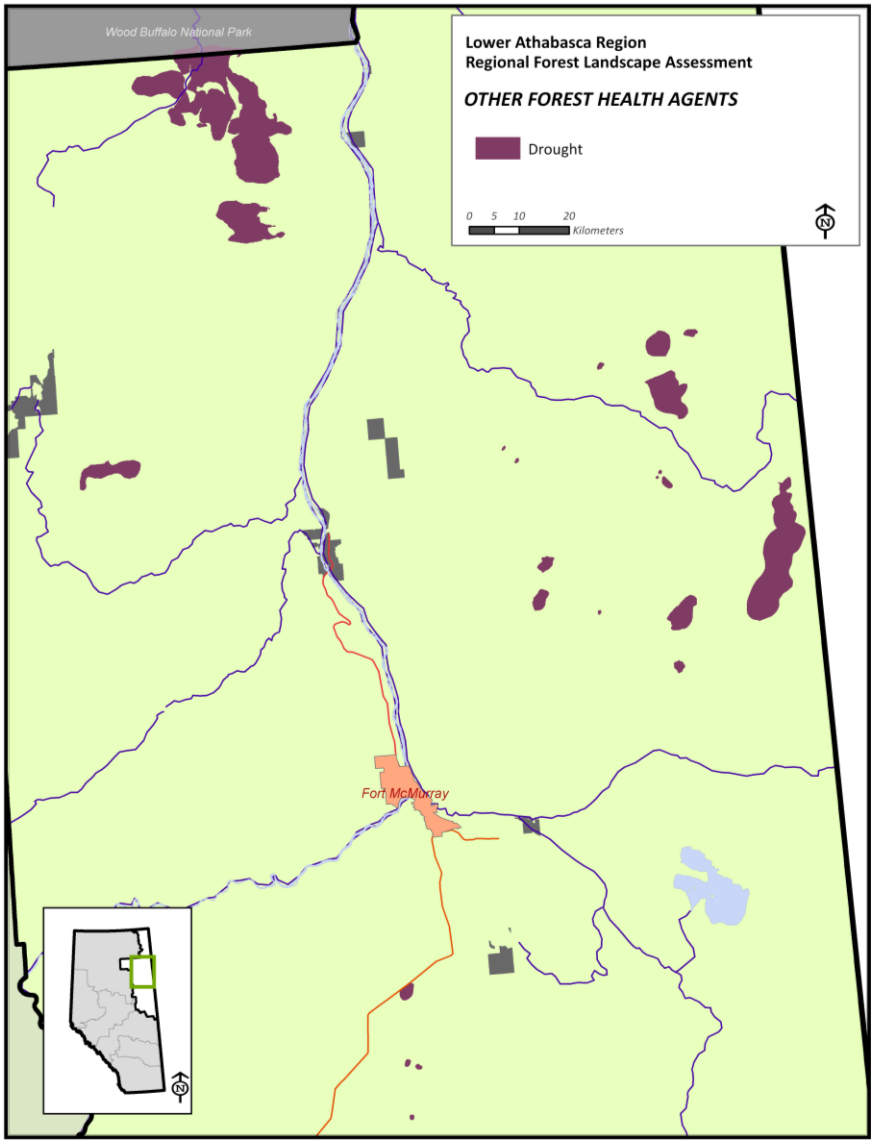


Figure 4-3 Other Forest Health Agents

4.3 Invasive Plant Species

An invasive species has been defined as "a species, subspecies or lower taxon, introduced outside its natural past or present distribution ... whose introduction and/or spread threaten biological diversity" (United Nations Environment Program 1992). Invasive plant species are monitored by Agriculture Alberta as well as Public Lands and Forestry Divisions of Environment and Sustainable Development. Alberta classifies invasive plants into two categories (Alberta 2008a):

Prohibited Noxious	A noxious plant (including seeds) that must be destroyed by the landowner or person who occupies the land. Destroy means to kill all growing parts or to render reproductive mechanisms non-viable.
Noxious	A noxious plant (including seeds) that must be controlled by the landowner or person who occupies the land. Control means that the action may destroy the plant, but at best, must inhibit its growth or spread.

Additionally, plants can be identified as "Nuisance". These have no legislative controls but are identified as potential problem species. The Weed Control Regulations of 2010 also allow municipalities to declare additional plant species as prohibited or noxious and impose the current regulations on those species.

Any areas that receive reclamation activities are potential problem sites for invasive species as commercial seed mixes can contain seeds from noxious plants. There are 1,919 sites of observed invasive species in the Lower Athabasca region (27). At each site, it is possible that multiple invasive species are present. Sample sites are visited by municipal and provincial inspectors on a regular basis. Table 4-3 shows the invasive plants status for the Region by class (prohibited, noxious, nuisance).

No problem weeds were surveyed on only 15% of the sites visited. Fortunately, the occurrence of prohibited noxious plants is very low, with only a single occurrence. Incidences of noxious plants are the highest category at 85% of all observed invasive plants, with the most common problem species being Scentless Chamomile and Perennial Sow Thistle.

Figure 4-4 shows the distribution of invasive plants in the Region. The majority of occurrences are in the Green Area, likely as a result of tighter controls on seed spread in the agricultural areas of the White Area.

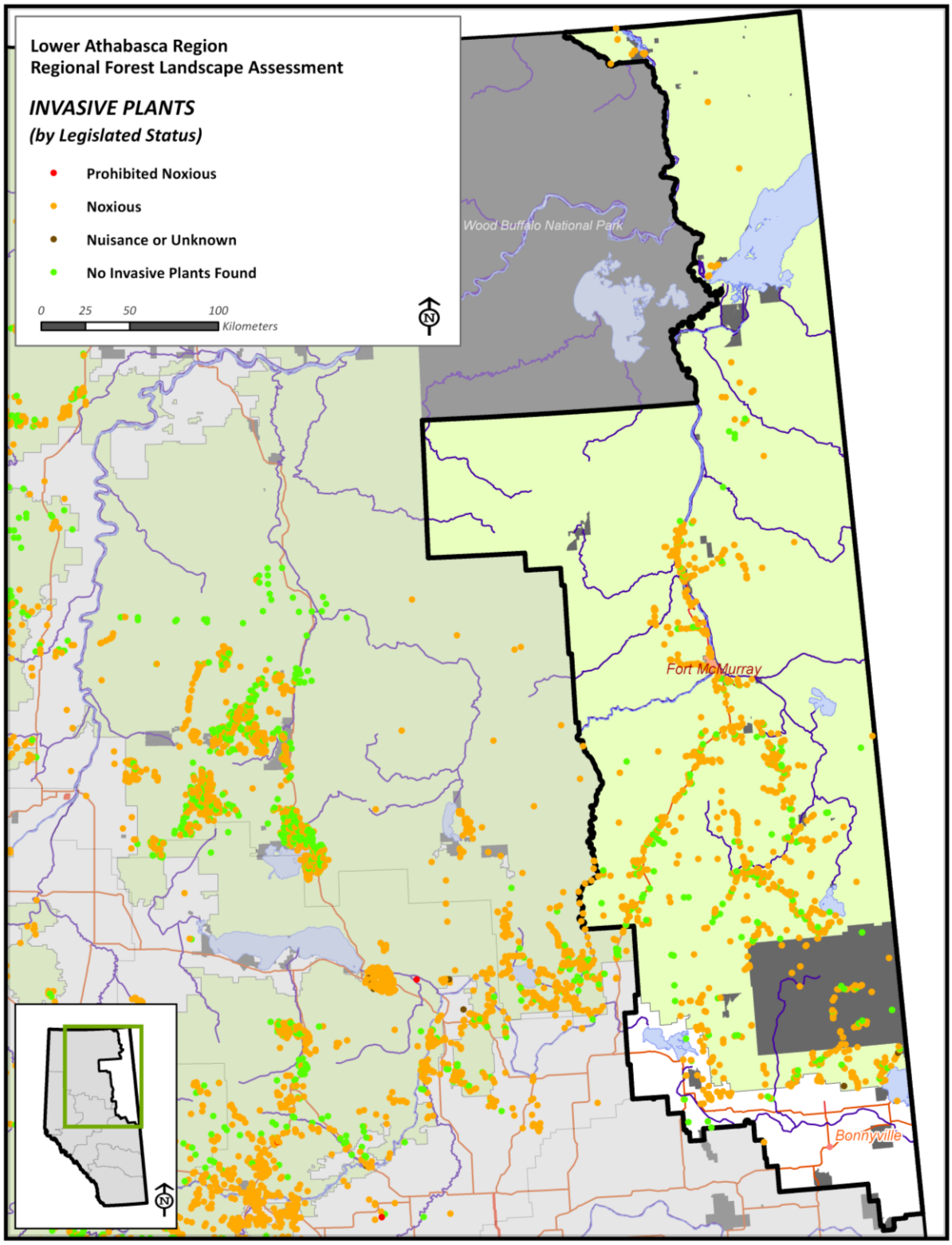


Figure 4-4 Invasive Plant Distribution

Table 4-3 Ranking of Invasive Plant Species

Classification and Weed Name	Incidence of Observed Weeds	Percentage of All Obs. (%)
No Weeds Found		
None	302	15
Sub-total No Weeds Found	302	15
Prohibited Noxious		
Nodding Thistle	1	
Sub-total Prohibited	1	0
Noxious		
Annual Sow Thistle	2	0
Canada Thistle	175	8
Common Tansy	190	9
Oxeye Daisy	30	1
Perennial Sow Thistle	514	25
Scentless Chamomile	823	40
Tall Buttercup	32	2
Toadflax	5	0
White Cockle	6	0
Sub-total Noxious	1777	85
Nuisance/Unknown Status		
Stork's Bill	4	0
Wild Caraway	2	0
Sub-total Nuisance	6	0
Total	2082	100

4.4 Forest Succession

Forest succession is the composition of vegetation communities, on a site, over time. The process of succession results in different structural components (e.g.: density by species, understory composition, snags or other dead materials) at various time periods. Many of these structural components can undergo a somewhat predictable pattern of change as stands age. The discussion of successional factors and patterns presented here are a compilation of information from Boreal Centre (2002), Song (2002), Daishowa-Marubeni (2008). The report compiled by the Boreal Centre includes a considerable list of papers devoted to the subject of succession in the boreal mixedwood.

Moisture regime has the greatest influence on forest succession (Boreal Centre 2002). In the boreal mixedwood of Alberta, moist sites are characterized by stands of black spruce and larch, medium sites by aspen and white spruce and dry sites by pine (Boreal Centre 2002, Daishowa-Marubeni 2008). Succession on moist and dry sites indicate that the original black spruce (moist sites) and pine (dry sites) tend to be generally replaced with the same stand type after fire, though often with some component of aspen. In cases where black spruce occurs as an understory to pine, the trajectory may result in a continued mixed-coniferous stand and not a pure pine stand, particularly in the absence of a fire event.

Following fire, aspen regenerates aggressively on medium sites through root suckering and is virtually always present in regenerating stands (Boreal Centre 2002). The introduction of white spruce on medium sites is more variable for a number of reasons (e.g.: variable seed production on neighbouring seed trees, distance from seed sources). Because of this variability in white spruce regeneration, several stand development pathways are possible on medium sites. Where ever white spruce seed is available along with a suitable seed bed, an even-aged mixed stand of white spruce and aspen can be expected. Because aspen is shade intolerant, it will typically not regenerate under a closed canopy. This leads to the conversion of these mixed stands to pure white spruce in approximately 100 years.

When white spruce seed is available, but the seedbed may not be suitable for quick germination, the stand will initially generate to aspen and spruce will incrementally enter the site. This condition leads to an uneven-aged mixed wood stand which will also eventually become a pure white spruce stand, but over a considerably longer time than under the even-age scenario.

The transition of stands to the mature stage is triggered by closure of the canopy. Self-thinning of the trees begins at this stage, but stand gaps are not yet prominent features. Mature stands tend to have the lowest level of structural diversity (Boreal Centre 2002)

The transition from mature to old stands is gradual. Key changes include canopy breakup and release of understory vegetation, emergence of secondary canopy species and accumulation of snags and downed logs (Stelfox 1995). Overall, structural diversity is highest in old stands and is reflected in high species richness of both plants and animals (Stelfox 1995).

4.5 Wildfire History

Disturbances by wildfire have been tracked and recorded by ESRD since devolution of natural resource management to Alberta in the 1930s (29). The wildfire records summarized in the following tables and figures represent all wildfires, regardless of their origin (lightning or man-caused).

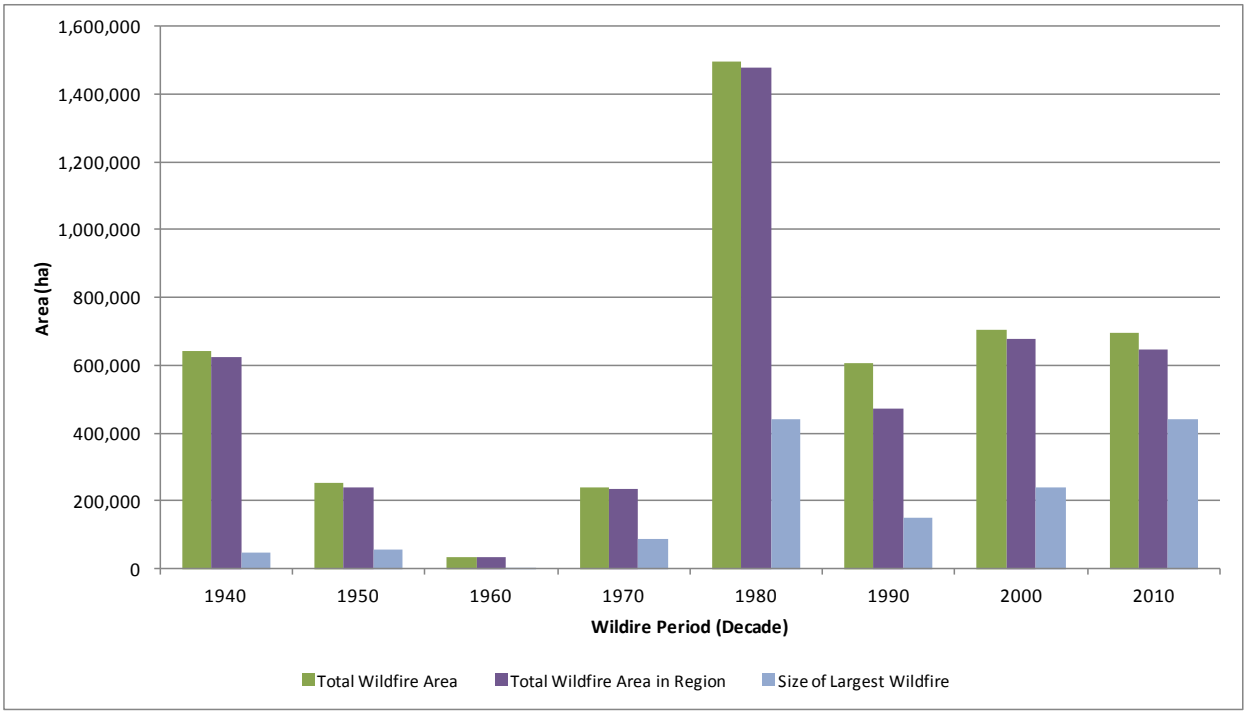
Summary statistics of the Region's wildfire history are reported in Table 4-4. The areas reported in Table 4-4 include only burned area and do not include residual islands that may not have burned during a wildfire event. The reporting period is by decade with the labelled wildfire date representing the start of the decadal period (i.e.: period '1930' represents 1930-1939 inclusive). The number of wildfires by decade is highly variable, as are the total area burned, average wildfire size and size of largest wildfire (Table 4-4, Figure 4-5). However, the median wildfire size is on a clear trend downwards (Figure 4-6). This is likely the result of substantial efforts in the areas of proactive wildfire prevention activities, faster wildfire response and improved wildfire control practices. These factors are also reflected in the drop in percent of the Region burned each decade (Table 4-4).

Table 4-4 Wildfire Statistics by Decade

Wildfire Period	Number of Wildfires	Total Wildfire Area (ha)	Wildfire Area in Lower Athabasca (ha)	Average Wildfiire Size (ha)	Median Wildfire Size (ha)	Size of Maximum Wildfire (ha)	Area Burned as percentage of Region[1] (%)
1940	154	642,712	622,809	4,173	1,143	45,986	7
1950	78	253,682	237,126	3,171	782	55,296	3
1960	43	35,086	35,086	763	371	3,020	0
1970	100	237,885	236,907	2,310	281	86,724	3
1980	56	1,497,587	1,479,889	25,820	965	439,312	17
1990	100	605,001	473,155	5,000	302	151,247	5
2000	355	706,599	677,718	1,835	9	237,671	8
2010[2]	94	694,156	645,816	6,487	11	439,673	7

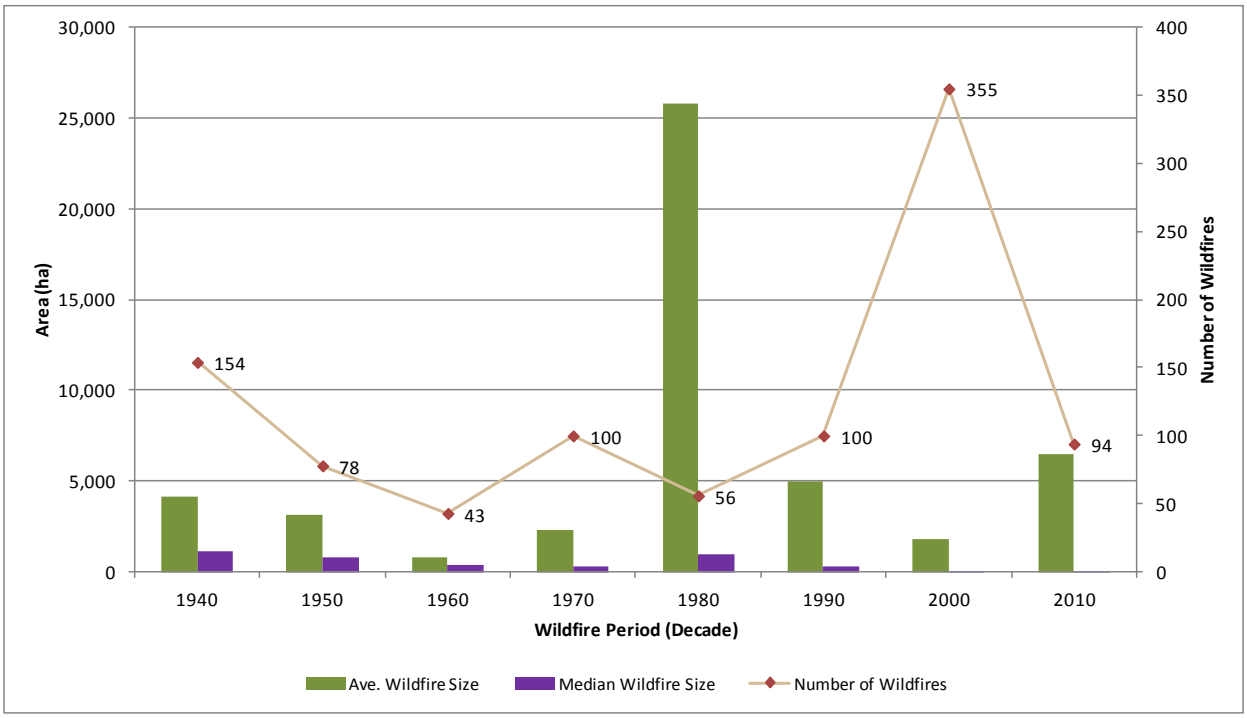
[1] Note that the area used for percent calculation is only the Region's Green and White Area.

[2] The 2010 'decade' includes only 2 years of data.



(NB: The 2010 'decade' includes only 2 years of data)

Figure 4-5 Wildfire Size Statistics by Decade



(NB: The 2010 'decade' includes only 2 years of data)

Figure 4-6 Average and Median Wildfire Size by Decade

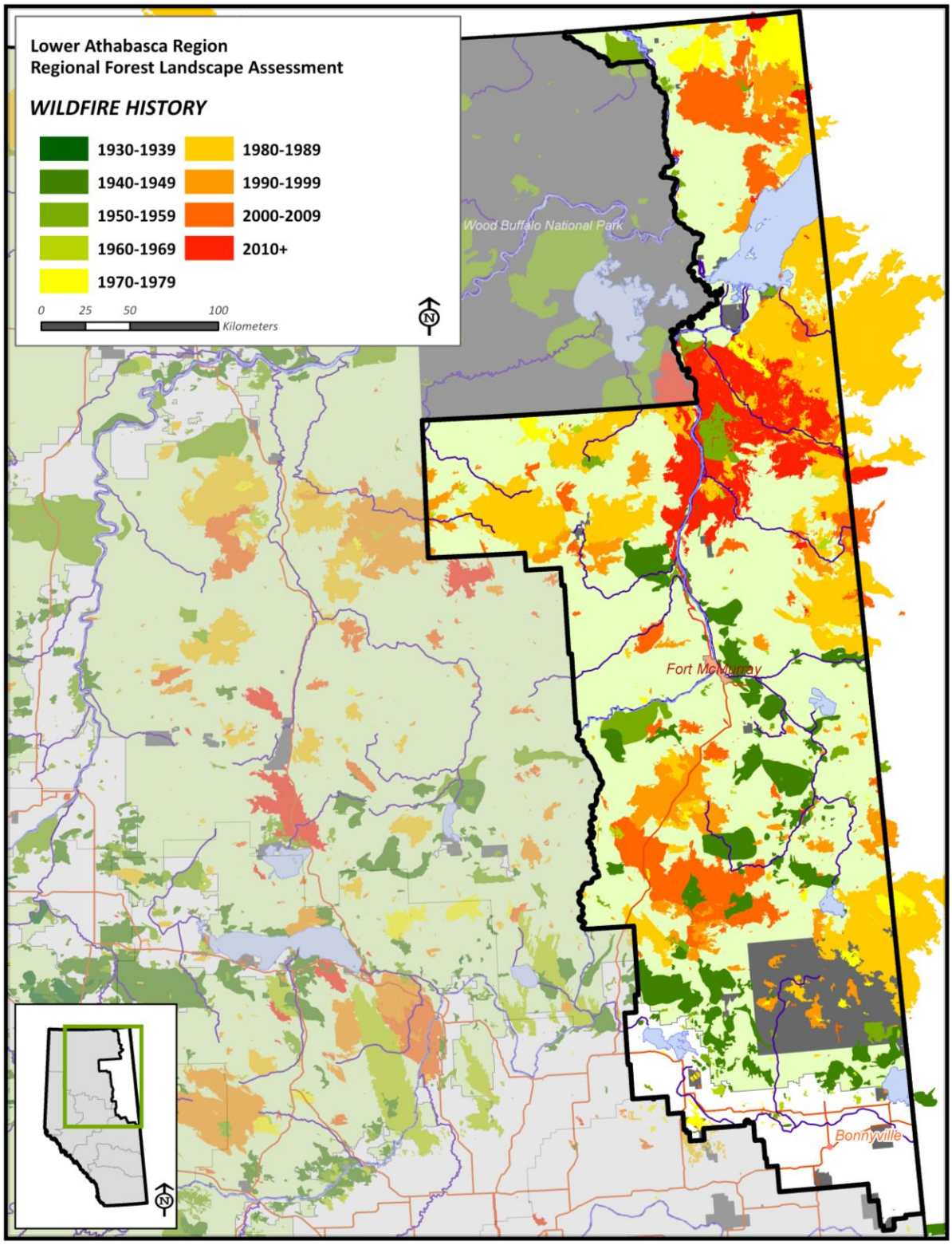


Figure 4-7 Wildfire Distribution by Decade

4.6 Timber Harvesting

Commercial harvesting has been taking place from a number of locations from mid-1970's. Small sawmill operators in the Lac La Biche area and as well, the start-up of Northlands Forest Products in Fort McMurray in 1970. The only Forest Management Agreement in the Region was established in 1991 with ALPAC Forest Products Incorporated who opened a bleached kraft pulp mill near Grassland. A large part of timber harvesting in the Region is the result of salvage operations related to oil sands mining. A summary of the total harvested area and number of harvest areas by decade is displayed in Table 4-5.

Some of the early harvesting in the Region may have been the result of historic species preference (coniferous removed from mixedwood stands or product preference based on tree size (for example, sawlogs versus other products). In many cases, these activities would not result in complete removal of the stand (a clearcut). However, the area summaries presented in Table 4-5 do not account for partial stand removal; rather, they assume complete removal. In that respect, the area summaries may slightly over estimate the area of harvesting. Recent management activities such as green retention or shelterwood operations resulting from the implementation of specific forest management strategies, may also result in partial clearings over full clearcuts.

For the purposes of this report and for spatial mapping, the source data for this metric was spatial harvest area boundaries (31,30) and forest inventory information (23). Harvest area boundaries represent the boundary of a specific harvest activity and carry their associated year of harvest; inventory information (which is stand based, rather than block based) may or may represent a single harvest activity, and in many cases, may not have a year of harvest. In many cases, the harvest activity is evident on the inventory photography, but the actual date of the activity was not traceable.

The information presented in Table 4-5 represents all the known harvest area in the Region based on both harvest boundary and inventory datasets. The number of actual harvest events is difficult to assess as the inventory data (in many cases) does not distinguish individual harvest boundaries. The count provided in Table 4-5 is a best approximation based on the information available.

Table 4-5 Summary of Harvesting by Decade

	Total Harvested Area		Number of Harvest Areas		Average Harvest /Year [1]
Year of Harvest	(ha)	%	Count	%	(ha)
1960-1969	1,229	1	100	1	205
1970-1979	5,847	4	455	5	585
1980-1989	11,974	8	686	7	1,197
1990-1999	52,075	33	2,936	32	5,207
2000-2009	53,516	34	3,057	33	5,352
2010 [2]	361	0	22	0	361
Unknown	32,490	21	1,934	21	
Total	157,491	100	9,190	100	

[1] The Average harvest per year is based on the number of reported years in each decade.

[2] The 2010 decade contains only 1 year of data

The amount of area being harvested annually has been increasing steadily as shown in Table 4-5 and Figure 4-8. A map of the harvested area, by decade, is presented in Figure 4-9.

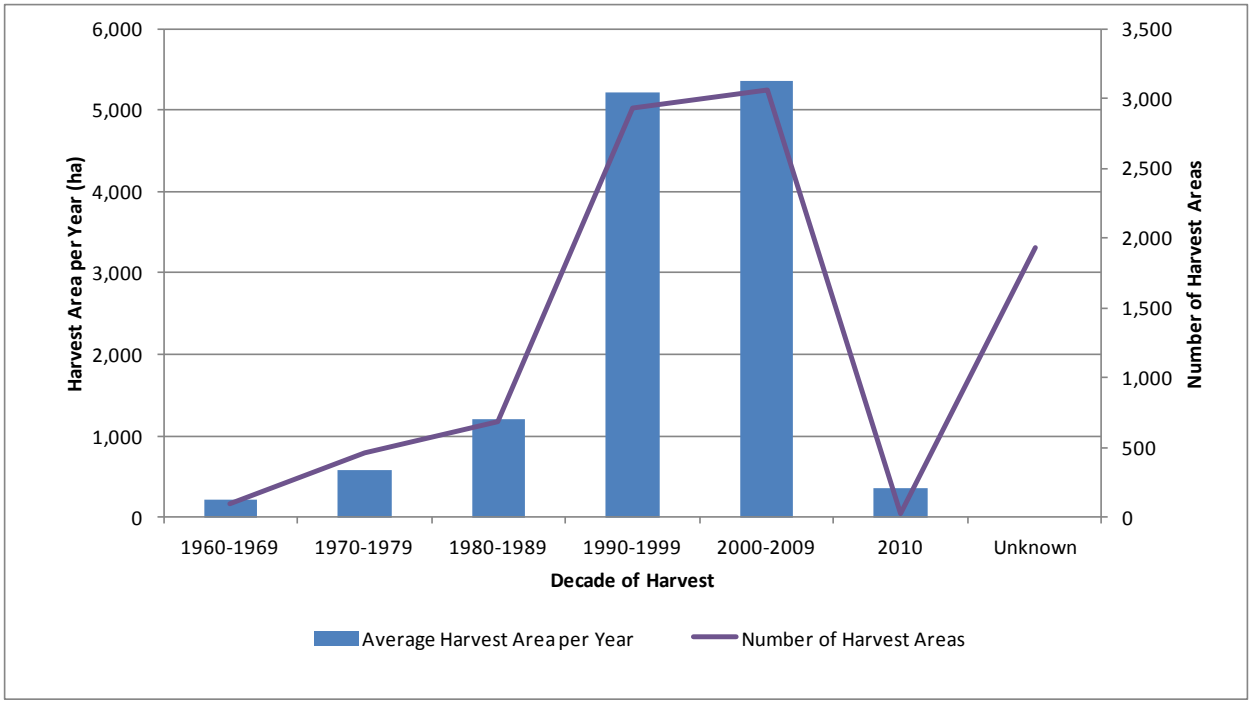


Figure 4-8 Average Annual Area and Count of Harvesting Activity

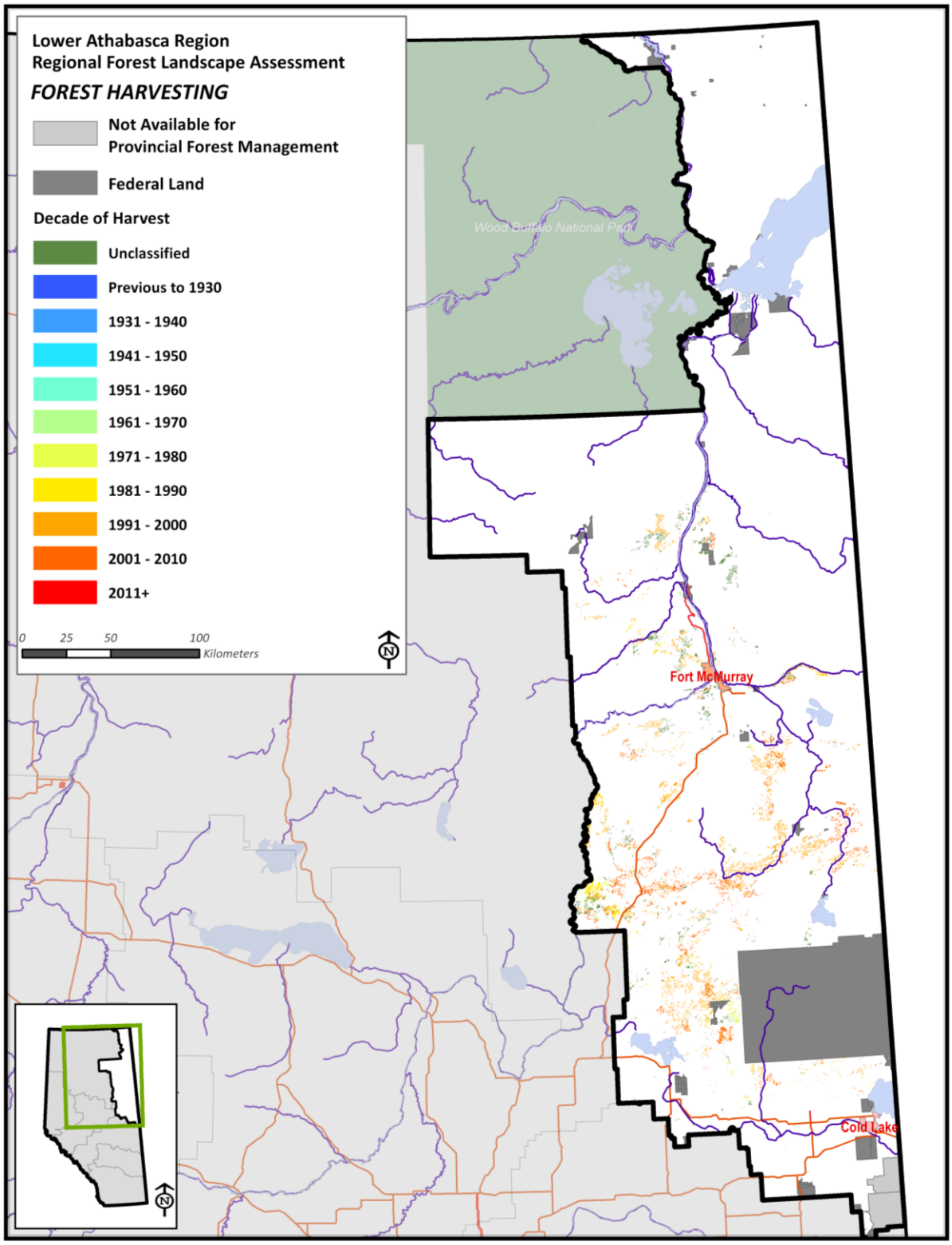


Figure 4-9 Harvest Area by Decade

4.7 Access

The primary road network within the Region would be described as sparse (32). In the Green Area, resource exploration and extraction (e.g.: forestry, conventional oil and gas, oil sands) have been the main drivers of road development.

Figure 4-10 shows the major transportation routes in the Region, including railroad access. In this map, note that only major paved and all-season gravel roads are displayed. The main transportation corridors are:

- Highway 63: this is the main corridor to move goods and services from Edmonton to Fort McMurray.
- Highway 55: runs east/west connecting Cold Lake to Lac La Biche.
- Highway 28: running northeast from Edmonton to Bonnyville.

Table 4-6 summarizes the length of road by road class within each of the Green Area, White Area and Federal lands. At only 225 kilometers, road development on Federal lands is minimal. There is more road development in the White Area (per unit area) and this would be expected primarily due to agricultural activities. Access throughout the Green Area is still quite low when compared to other Regions.

Table 4-6 Length of Road by Class and Location

	Length of Roads (km)			
Road Classification	**Green Area**	**White Area**	**Federal Lands**	**Total**
Major Highway	839	1,244	13	2,097
Secondary Paved Road	244	367	2	613
Gravel Road	1,361	2,224	205	3,790
Winter Road / Unclassified	348		6	354
Total Roads	2,792	3,836	225	6,853
Railway	235	151		386

A map of all road classes is shown in Figure 4-11.

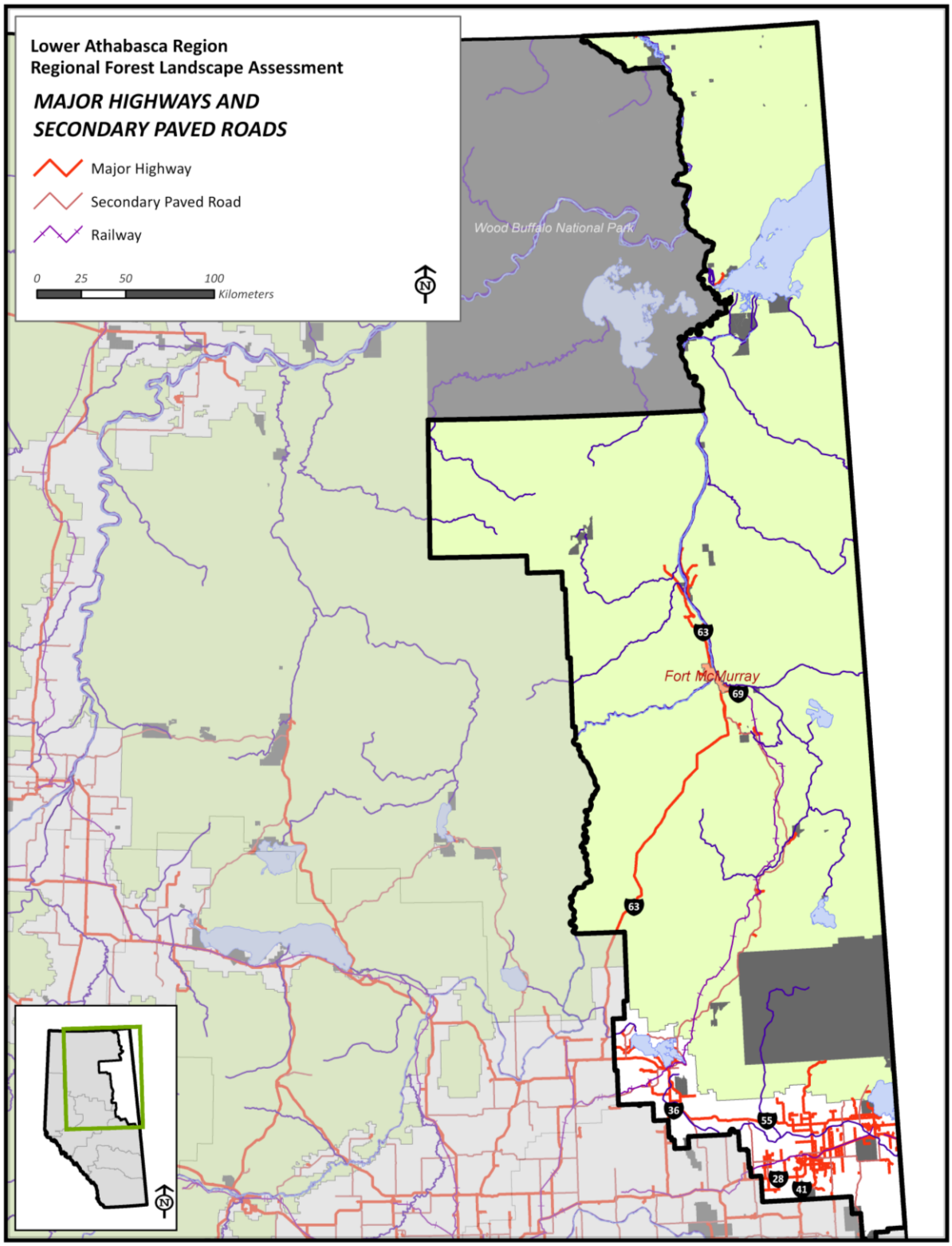


Figure 4-10 Major Transportation Access

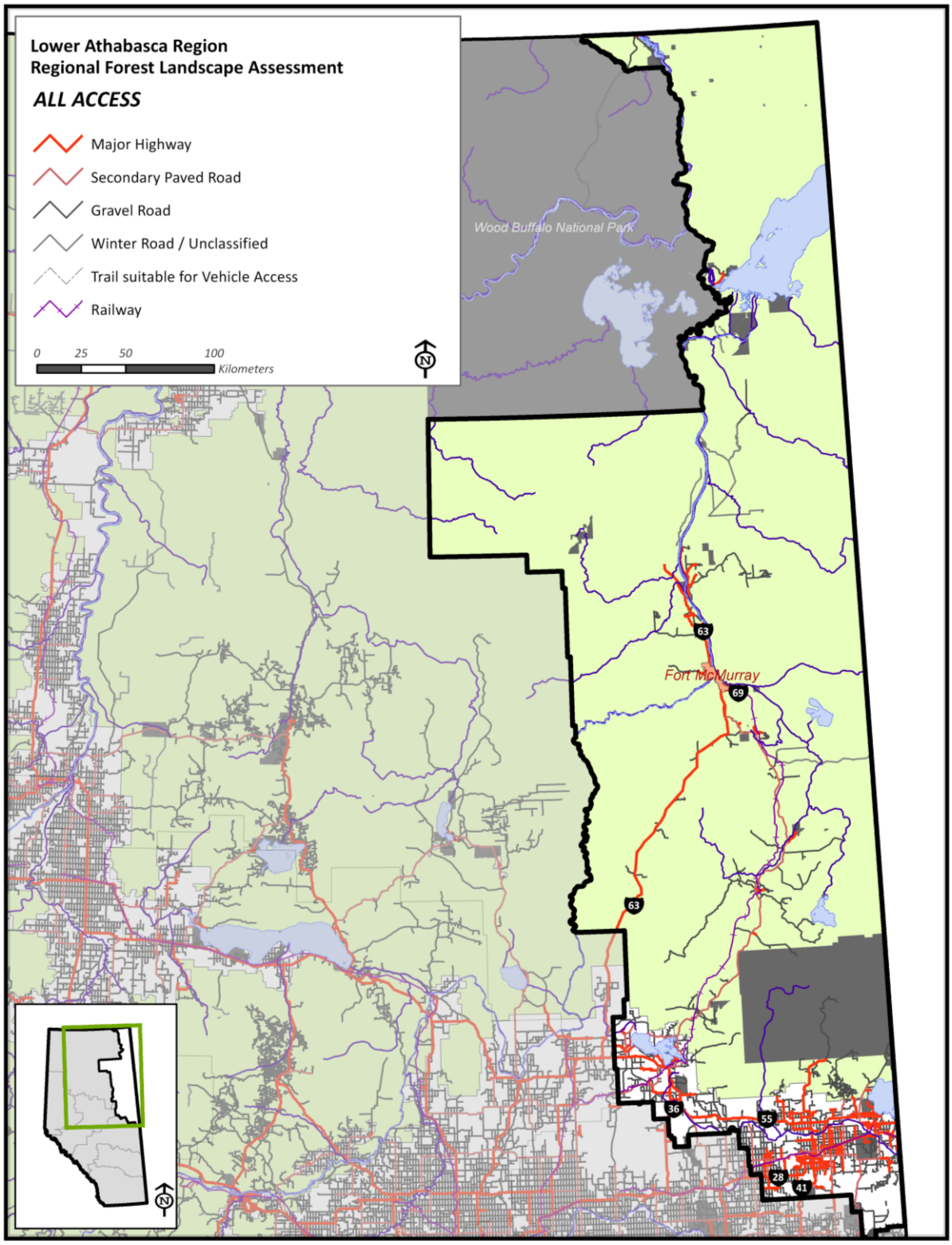


Figure 4-11 All Road Access by Road Class

4.8 Industrial Development

The energy sector accounts for the majority of disposed surface dispositions in this Region (33). As indicated in Table 4-7, the highest percentages of dispositions have been issued to these types: Mineral Surface Lease, License of Occupation and Pipeline Agreement. A License of Occupation typically is for all season road access to specific areas. A Mineral Surface Lease can be issued for a number of energy industry facilities; the most common feature in this Region are oil sand mines as well as conventional oil or gas well sites. Pipelines connect well sites, so naturally there are a high proportion of pipeline dispositions located in the Region.

Table 4-7 Land-use Dispositions

Description	Type	Number of Dispositions	Distribution		Area as Percentage of Region[1] (%)
			Area (ha)	Percentage of All Dispositions (%)	
Easement	EZE	1,429	9,200	4	0
Licence of Occupation	LOC	9,523	62,152	25	1
Mineral Surface Lease	MSL	11,518	147,324	58	2
Pipeline Installation Lease	PIL	640	328	0	0
Pipeline Agreement	PLA	5,672	31,113	12	0
Rural Electrification Agreement	REA	74	215	0	0
Right of Entry Agreement	ROE	51	159	0	0
Vegetation Control Easement	VCE	258	1,721	1	0
Total		29,165	252,213	100	3

[1] Note that the area used for percentage calculation is only the Region's Green and White Area.

Figure 4-12 shows the dense development of well sites and pipelines, most predominantly in the central southern parts of the Region. Despite the dense network, the total area occupied by industrial dispositions is 252,213 hectares or only 3% of the Region's area for which dispositions are allocated. The percent area occupied by disposed land is based *only* on the Green and White Areas of the Region (see section 1.2).

The location of oil sand development is clearly evident in Figure 4-12, just north of Fort McMurray.

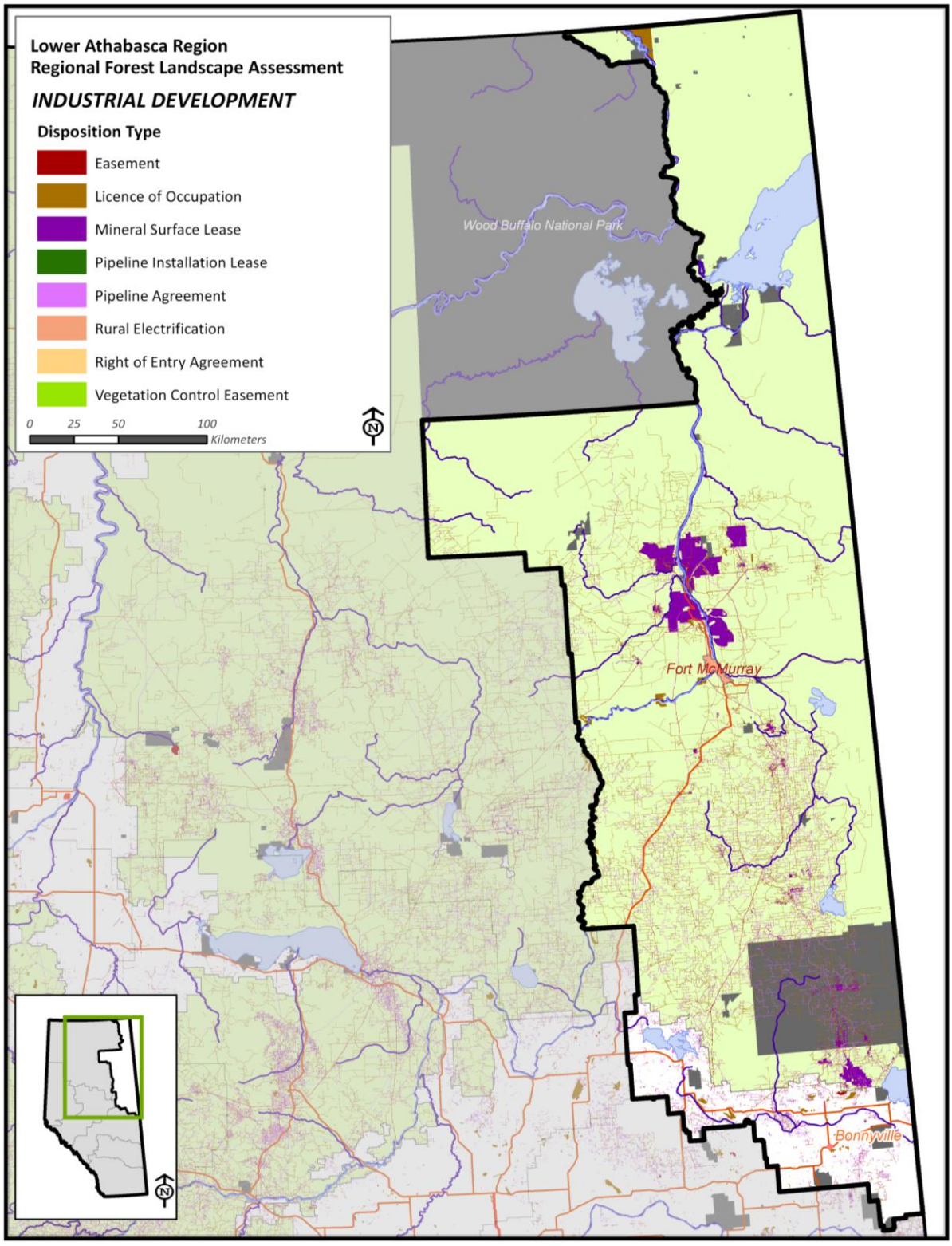


Figure 4-12 Industrial Development under Permit and License

4.9 Monitoring Sites

Permanent monitoring plots have been established throughout the Lower Athabasca Region under a variety of programs. For the purposes of this discussion, 'monitoring programs' are those for which a commitment has been made for ongoing, repeated measurements over time, on a series of established plots. A description of the main types of monitoring systems and programs follows the data summary presented in Table 4-8.

Note that Table 4-8 has values for both the number of installations and the number of plots. A single installation can be comprised of many plots, or it can be a single plot, depending on the type of program under which the plots were established.

In addition, Table 4-8 lists a variety of programs to which the ESRD installations belong. There is no program distinction for either the Alberta Biodiversity Monitoring Institute or Other Agency plots as this information is not available.

Table 4-8 Monitoring Installations

	Green Area		White Area		Federal Lands		Total	
Monitor Plot Classification	No. Installations	No. Plots	No. Installations	No. Plots	No. Installations	No. Plots	No. Installations	No. Plots
ESRD Permanent Sample Plots								
Permanent Sample Plots	37	37					37	37
Reforestation Monitor Plots	49	1,930					49	1,930
Stand Dynamics Plots	20	20					20	20
Other PSP (Special Projects)							0	0
Alberta Biodiversity Monitoring Institute								
ABMI Sample Grid	194	194	20	20	19	19	233	233
Other Agency Permanent Sample Plots								
ISP Registered	309	309	1	1			310	310
Total	609	2,490	21	21	19	19	649	2,530

The distribution of monitoring sites across the Lower Athabasca Region is displayed in Figure 4-13.

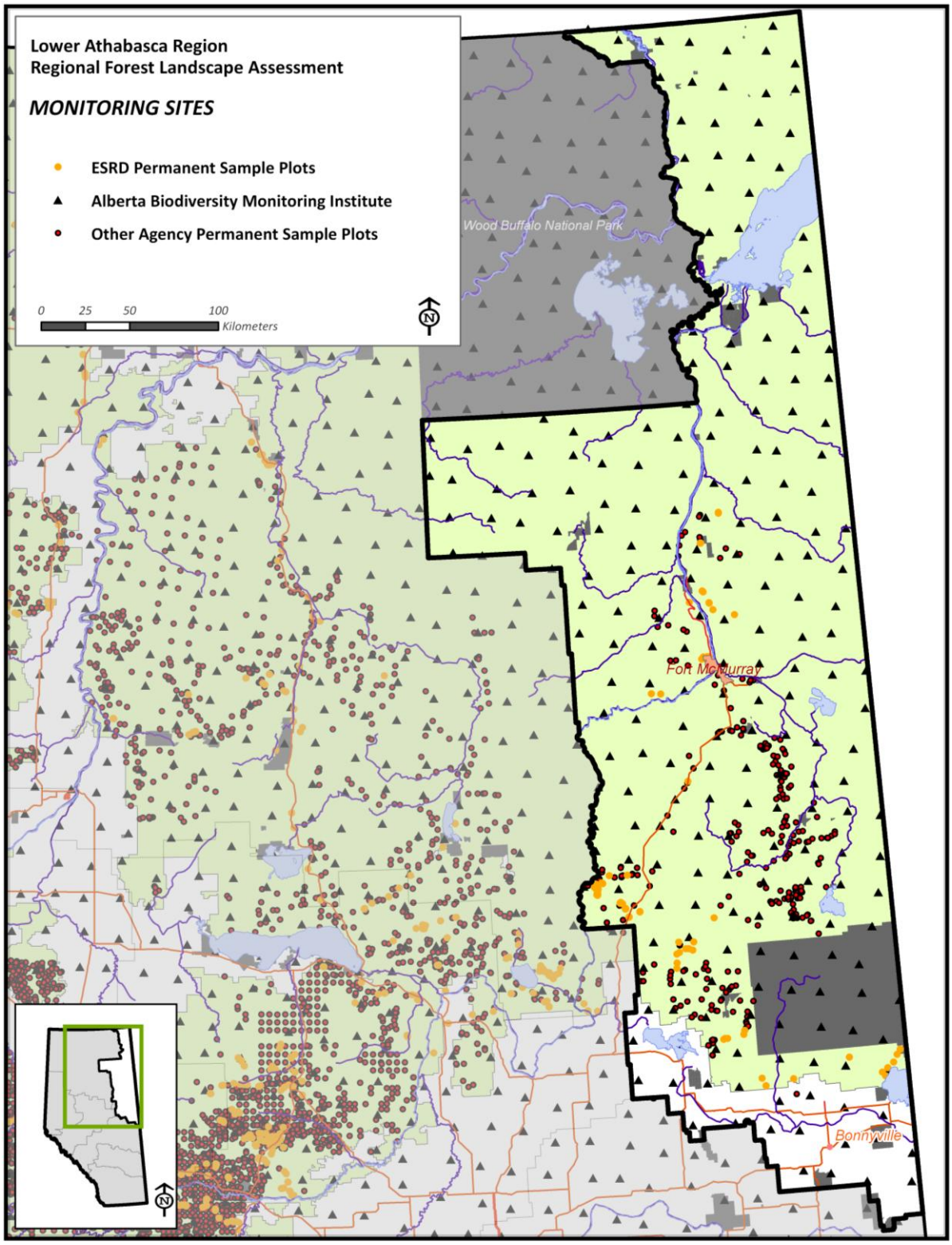


Figure 4-13 Location of Permanent Monitoring Sites

4.9.1 ESRD Permanent Sample Plots

ESRD has been actively managing a variety of programs which involve the use of permanent sample plots (PSP) since the early 1960's (35).

Protection and Registration.

Locations of all installations are registered with the Public Lands, Land Status Automated System (LSAS). Most registrations are designated as Protective Notation (PNT), Consultative Notation (CNT) or Disposition Reservation (DRS). In these cases, any proponent of industrial activity near a PSP must consult with the Department prior to any development to assess potential impact to the sample plot. The Department may give permission for the activity to proceed, but in return it may request compensation to re-establish the plot post-disturbance.

Permanent Monitoring Programs

Permanent Sample Plots	Permanent sample plots have been established since 1960, primarily in mature stand types representative of the most common forests in Alberta. Initially, their purpose was to provide volume estimates for the purpose of yield curve construction. Two sample designs are in place. The initial design involves an installation comprised of four plots. A later design (approximately 1980) revised the PSP installation to be a single plot. The re-measurement cycle for an installation is either 5 or 10 years, depending on stand age.
Reforestation Monitor Plots	Reforestation monitor plots were first established in the early 1980s for the purpose of monitoring the initial stand development (from initial planting to approximately 8-10 years old). An installation is typically made up of 40 plots, distributed over a grid on newly reforested cutblocks. The measurement cycle is annual or bi-annual.
Stand Dynamics Plots	Stand Dynamics plots are similar in nature to the Reforestation Monitor Plots, however their target dynamic is the stand age after the successful establishment of a new forest to the juvenile stand development stage. Re-measurement schedule is approximately 2 years.
Other PSP (Special Projects)	There are a variety of special projects for which additional permanent sample plots have been installed. Some examples are to monitor stand development: (a) in response to mountain pine beetle infestation; (b) following specific wildfire events, or (c) in response to a local or regional forest growth issue (e.g.: spruce budworm, blowdown event).

4.9.2 Alberta Biodiversity Monitoring Institute

The Alberta Biodiversity Monitoring Institute (ABMI) conducts monitoring of more than 2,000 species and habitats to support decision making about biodiversity in the province. The network of plots (36) is based on a 20km by 20km grid, following the protocol for the Canadian National Forest Inventory (NFI) (Canada 2004).

Protection and Registration.

Locations of all installations are predetermined as per the protocol for the NFI. However, the exact plot locations on the ground are not publicly accessible to maintain an unbiased measure of biodiversity and the human footprint across the province (map locations are within 5.5 km of the actual survey location). Locations are not registered with the Public Lands LSAS system as these points do not require protection of any kind.

Monitoring Program

A total of 1,656 plots are located across the province, of which 233 fall in the Lower Athabasca Region. Due to the systematic layout of the plots, they theoretically are distributed across the Region, in the same proportion as the allocation of Green Area, White Area and Federal lands. Locations will be visited once every 5 years, at which time a variety of terrestrial and aquatic surveys are completed.

4.9.3 Other Agency Permanent Sample Plots

Many other agencies establish and monitor sample plots on an ongoing basis. Many FMA holders maintain PSP programs in addition to other forest growth and yield cooperatives (37).

Protection and Registration.

Locations of most permanent sample plots established by other agencies are registered with the Public Lands, Land Status Automated System as Industrial Sample Plots (ISPs). This designation is similar to the Protective or Consultative Notation of the ESRD plots, but applies to non-government holdings. ISP registration alerts other land users that monitoring plots are in place and if disturbed without permission of the owner, compensation may be required.

Monitoring Program

The PSPs in this class are established for a wide variety of purposes. Some compliment the provincial PSP program and are used for the development of local yield curves; others are collaborative installations established by growth and yield cooperatives. Re-measurement schedules depend on the purpose of the installation.

5. Land Use

5.1 Timber Allocations

Annual allowable cut (AAC) levels are calculated by FMU (section 1.4) and are set or approved by Alberta (38). Table 5-1 lists the FMUs located in the Lower Athabasca Region, along with AAC levels prorated by the proportion of the FMU area located inside the Lower Athabasca Region. Prorating AAC levels was done only for the purpose of comparing relative timber allocations between the various Land-use Framework regions. The values presented here represent the proportion of AAC calculated as at the time of publication of this report. For currently approved AAC information, please contact the Government of Alberta.

Table 5-1 only lists FMUs for which AAC levels have been calculated and published. The map presented in Figure 5-1 shows all the FMUs located in the Region, highlighting those which have AAC levels calculated.

Table 5-1 Current AAC Levels Prorated by FMU Area

FMU Name	Managed by	Entire FMU Area (ha)	Portion of FMU located in Lower Athabasca Area (ha)	Portion of FMU located in Lower Athabasca % of FMU	Proportion of Lower Athabasca occupied by FMU % of Lower Athabasca	Annual Allowable Cut (m^3/year) (Prorated to FMU Area) Coniferous	Deciduous	Total
A10	Crown	379,830	379,830	100	4	12,800	0	12,800
A14	FMA	1,178,072	1,102,603	94	12	268,467	209,056	477,523
A15	FMA	1,437,516	1,295,159	90	14	487,110	640,002	1,127,112
A9	Crown	605,145	605,145	100	6	23,298	18,670	41,968
L1	FMA	359,135	359,135	100	4	87,460	177,403	264,863
L11	FMA	1,048,699	1,048,699	100	11	218,548	387,237	605,785
L3	FMA	588,356	376,664	64	4	110,058	62,803	172,860
L8	FMA	126,796	64,216	51	1	20,019	33,300	53,319
S22	FMA	801,696	9,497	1	0	2,156	4,462	6,618
Sub-total		6,525,245	5,240,949		56	1,229,916	1,532,933	2,762,849
No Allowable Harvest Calculated			4,084,819		44	0	0	0
Total			9,325,768		100	1,229,916	1,532,933	2,762,849

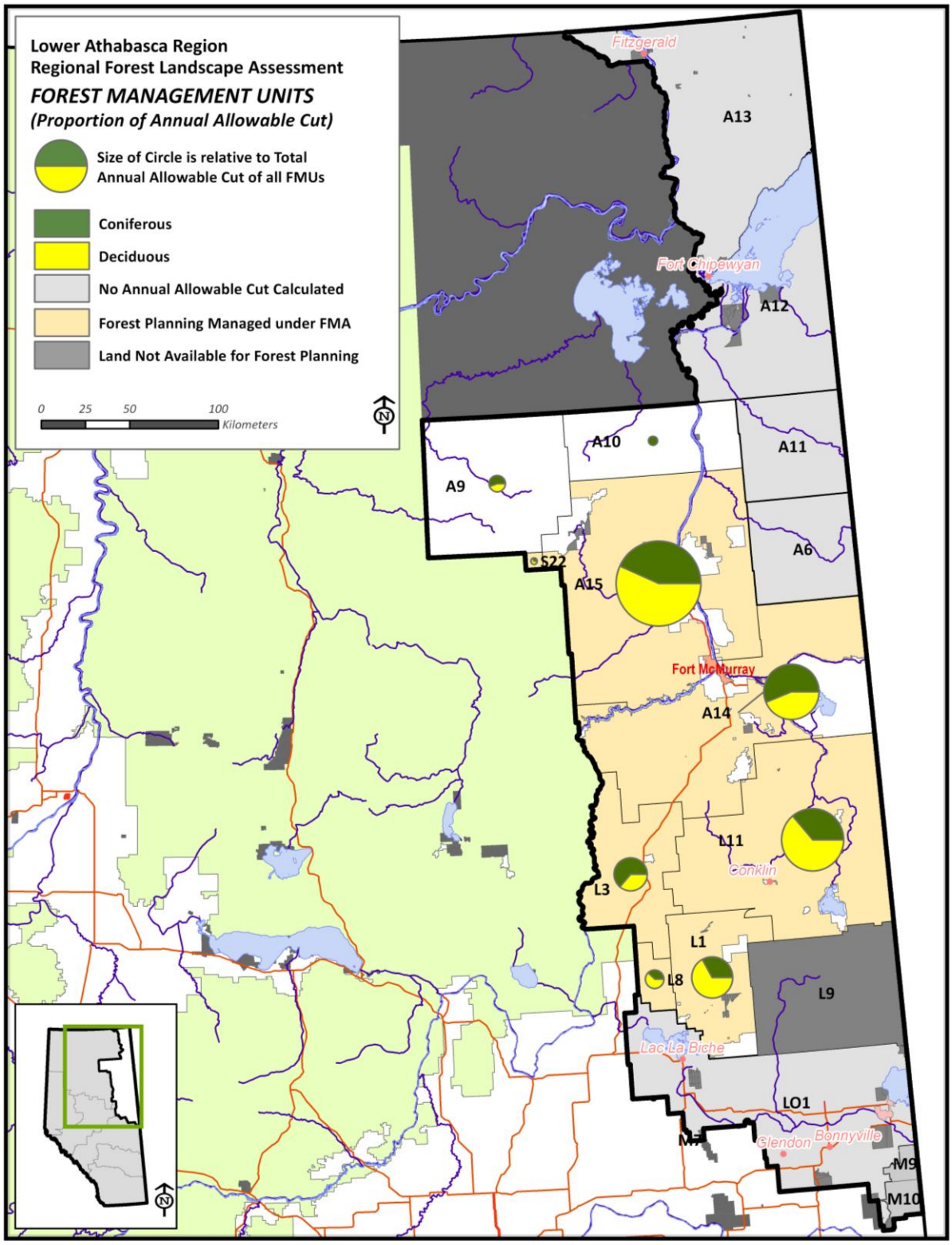


Figure 5-1 FMUs Indicating Prorated AACs

5.2 Trapping

The fur trade in Western Canada is often credited with driving the European occupation of modern day Canada (Foster 2007). Permitting and licensing of trappers was introduced by the Alberta Game Act in 1920 and the establishment of Registered Fur Management Areas (RFMA) for furbearer management came about in the early 1940s. The current Wildlife Act (Alberta 2000) regulates open seasons and areas, methods and reporting requirements. Eight Fur Management Zones are used to establish trapping seasons and quotas for some species (fisher, lynx, otter, and wolverine).

The Lower Athabasca Region is covered by 428 registered fur management areas (or traplines) (39) totalling 8,141,393 hectares or approximately 87% of the Region (Figure 5-2). The average size of an individual trapline is 20,507 hectares, with the largest at 412,217 ha (inside the Cold Lake Air Weapons Range). With the exception of bobcat and badger, all Alberta furbearers can be harvested in the Lower Athabasca Region.

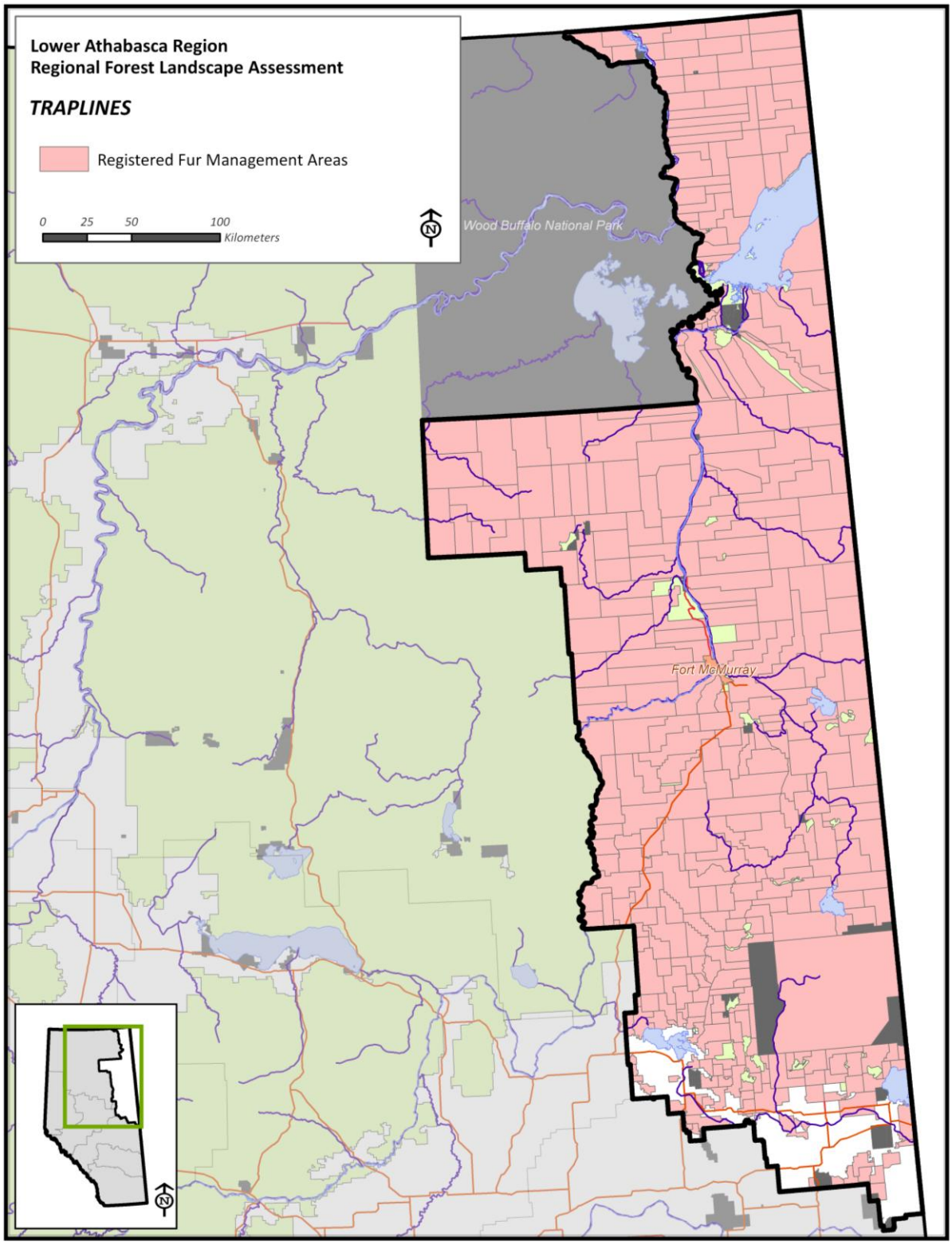


Figure 5-2 Registered Fur Management Areas

5.3 Grazing

Approximately 3.3 million hectares of grazing land is used by livestock producers in Alberta (40). Various levels of grazing permits are issued based on size, type of forage and landscape (41). Table 5-2 describes the types of grazing allocations in Alberta. Table 5-3 summarizes the area by grazing types across the Lower Athabasca Region.

The majority of the grazing dispositions are located in the White Area (Figure 5-3) with only a few allocations stretching into the Green Area.

Table 5-2 Types of Grazing Allocations

Forest Grazing Licence	Long term license (up to 10 years). Renewable. Licensee cannot control public access. Predominantly issued in forested areas where access for other activities (e.g.: recreation, forest harvesting) need to be accommodated.
Grazing Lease	A long term (up to 20 years) authorization to individuals, corporations or associations. Renewable. Access can be controlled with the exception for timber harvesting.
Grazing Permit	Short term permits issues on an annual basis and often on land that is fragmented and perhaps periodically wet.
Provincial Grazing Reserve	Not disposed, these are public areas managed by Public Lands for the purpose of providing summer pasture for farmers and ranchers. Access is not restricted for recreational opportunities. Managed by local associations.

Table 5-3 Grazing Dispositions

Type of Disposition	Code	Number	Area in Region (ha)	Percentage of Grazing (%)	Percentage of Region (%)
Forestry Grazing Licence	FGL	8	1,610	1	0
Grazing Lease	GRL	591	158,404	90	2
Grazing Permit	GRP	68	4,510	3	0
Provincial Grazing Reserve	GRR	1	11,911	7	0
Total		668	176,435	100	2

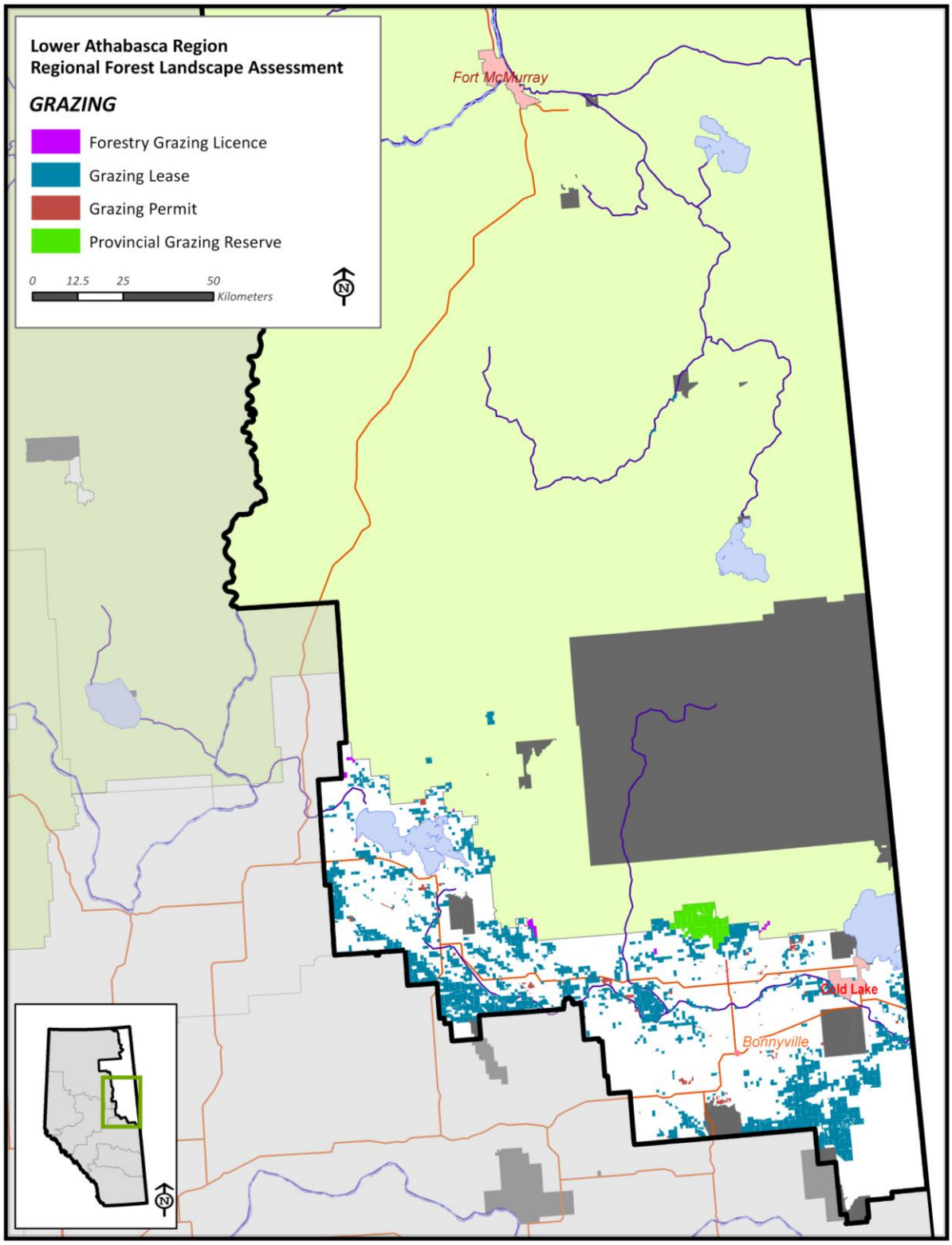


Figure 5-3 Grazing Dispositions

5.4 Guiding and Outfitting

Guides and outfitters are licensed in the province of Alberta and pay annual user fees for their allocations.

In the 1970s, the Alberta government limited bighorn sheep allocations for non-residents to conserve the resource. Up to this time, no restrictions had been placed on big game species. The Professional Outfitters Association of Alberta (POAA) was established in the late 1980's to encourage unity and consensus within the industry. Prior to this a number of organizations had existed. Since 1997, the Alberta Professional Outfitters Society (APOS) has been responsible for managing the outfitting industry on behalf of the government of Alberta.

5.5 Recreation and Tourism

A large number of wildland parks contribute to many eco-tourism opportunities in the Region. Provincial parks such as Sir Winston Churchill at Lac La Biche, and Cold Lake Provincial Park are popular destinations during the summer for camping, fishing and birding. Lakeland Provincial Recreation Area which is adjacent to its similarly named Provincial Park preserves some of the highest quality lakes, beaches and shorelines in Alberta. The area is popular for camping, mountain biking, hiking and canoeing.

Figure 5-4 shows the distribution of public recreation areas across the Region. Facilities run by municipalities, towns or private organizations are not included in the analysis.

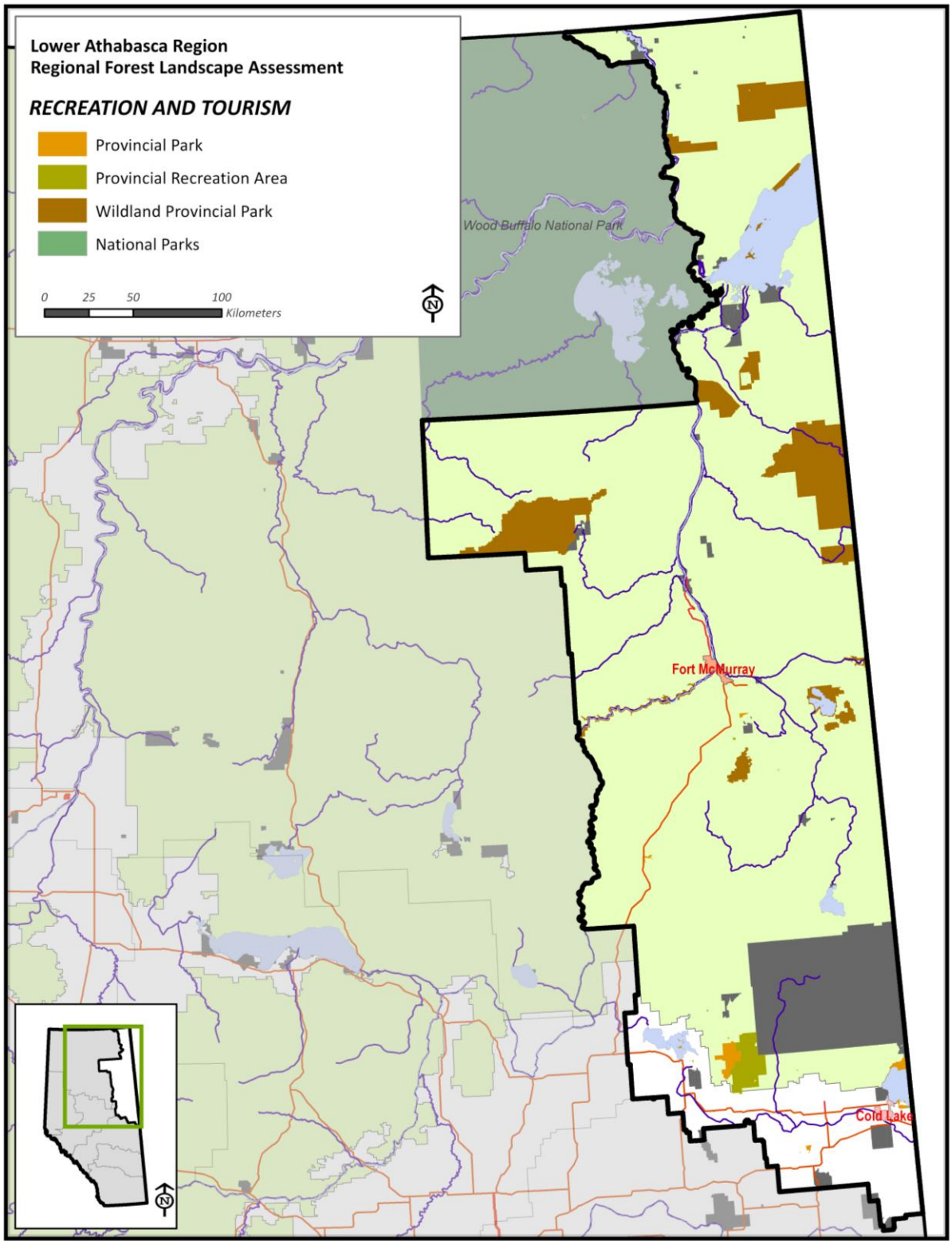


Figure 5-4 Recreation and Tourism Opportunities

5.6 Cultural and Historical Resources

The Listing of Historic Resources (44) identifies lands that contain or are believed to contain historic resources, including primarily archaeological and paleontological sites, Aboriginal traditional use sites of a historic resource nature, and historic structures (Figure 5-5). The listing provides industry and other developers with advance notification of possible historic resource concerns. The listing is constantly being updated as new resources are found and updates are published semi-annually.

Each land parcel in the listing is assigned a Historic Resource Value (HRV) ranging from 1 to 5, reflecting their relative importance:

- HRV 1: includes lands designated as Provincial Historic Resources under the Alberta Historical Resources Act, and may identify World Heritage Sites.
- HRV 2: designated as a Municipal or Registered 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: believed to contain a historic resource

A total of 552,182 hectares (6% of the Region) are identified as having some level of historical or cultural significance. Table 5-4 outlines the area covered as well as percent area of the historical resources in the Region. Approximately 2,070 hectares are listed in the highest category: HRV 1. The significant features within this classification are the Lac La Biche Mission and some specific archaeological sites at Lac La Biche and Fort McKay. Paleontological sites are the most plentiful, occupying 63% of the listing's total area.

Table 5-4 Categories and Relative Importance Value (HRV)

	Relative Importance Ranking (HRV)									
	1		3		4		5		Total	
Category	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Archaeological	1,721	0	1,106	0	16,968	3	151,757	29	171,551	33
Archaeological, Historical		-	156	0		-	1,757	0	1,913	0
Cultural		-		-	14,279	3		-	14,279	3
Cultural, Historical		-		-	32	0		-	32	0
Historical	349	0	330	0	2,381	0		-	3,060	1
Palaeontological		-			1,964	0	329,383	63	331,346	63
Total	2,070	0		0	35,624	7	482,896	92	522,182	100

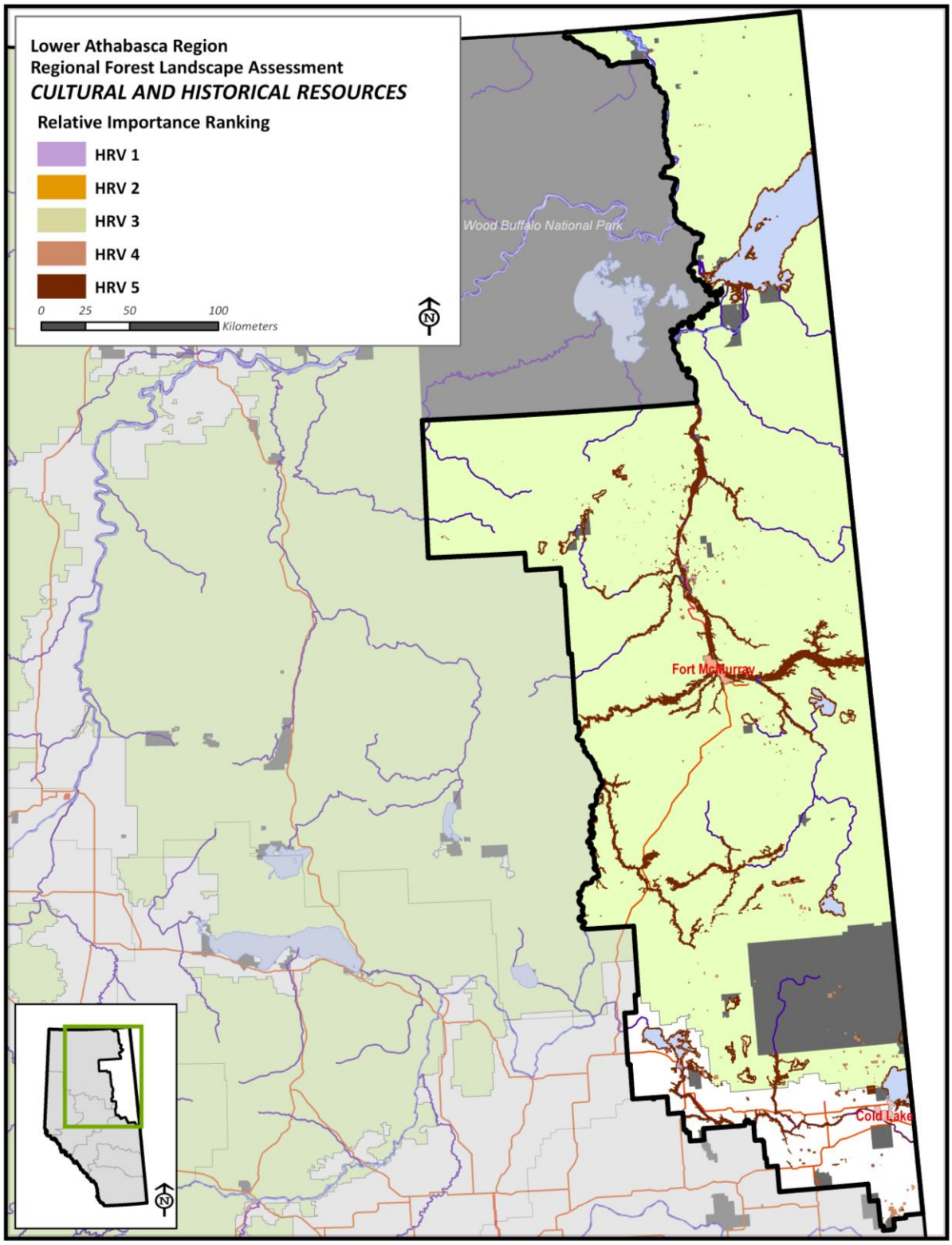


Figure 5-5 Areas of Historic Resource Value

5.7 Visual Resources

No formal inventory of visual resources has been compiled for this Region. Typical high value will occur along travel corridors and near recreational areas.

The region supports a great deal of canoeing routes on rivers such as the Athabasca, Steepbank, Christina, and Firebag; all affording views through the steep-sided river canyons and boreal forests.

5.8 Fish and Wildlife Resources

5.8.1 Management Zones

Fish and Wildlife management and regulation is divided into zones across the province. Table 5-5 outlines the size of each Management zone (45) within the Lower Athabasca region. Figure 5-6 shows the distribution of those districts.

Table 5-5 Fish and Wildlife Districts

Fish and Wildlife District Name	Entire District Area (ha)	Portion of District in Lower Athabasca Area (ha)	Portion of District in Lower Athabasca (%)	Proportion of Lower Athabasca occupied by District (%)
Bonnyville	291,007	286,751	99	3
Cold Lake	914,517	914,517	100	10
Fort McMurray	7,071,387	6,853,561	97	73
Lac La Biche	1,328,292	1,154,292	87	12
Red Earth	2,573,826	9,497	0	0
Smoky Lake	669,021	36,803	6	0
St. Paul	502,552	70,347	14	1
Total	13,350,602	9,325,768		100

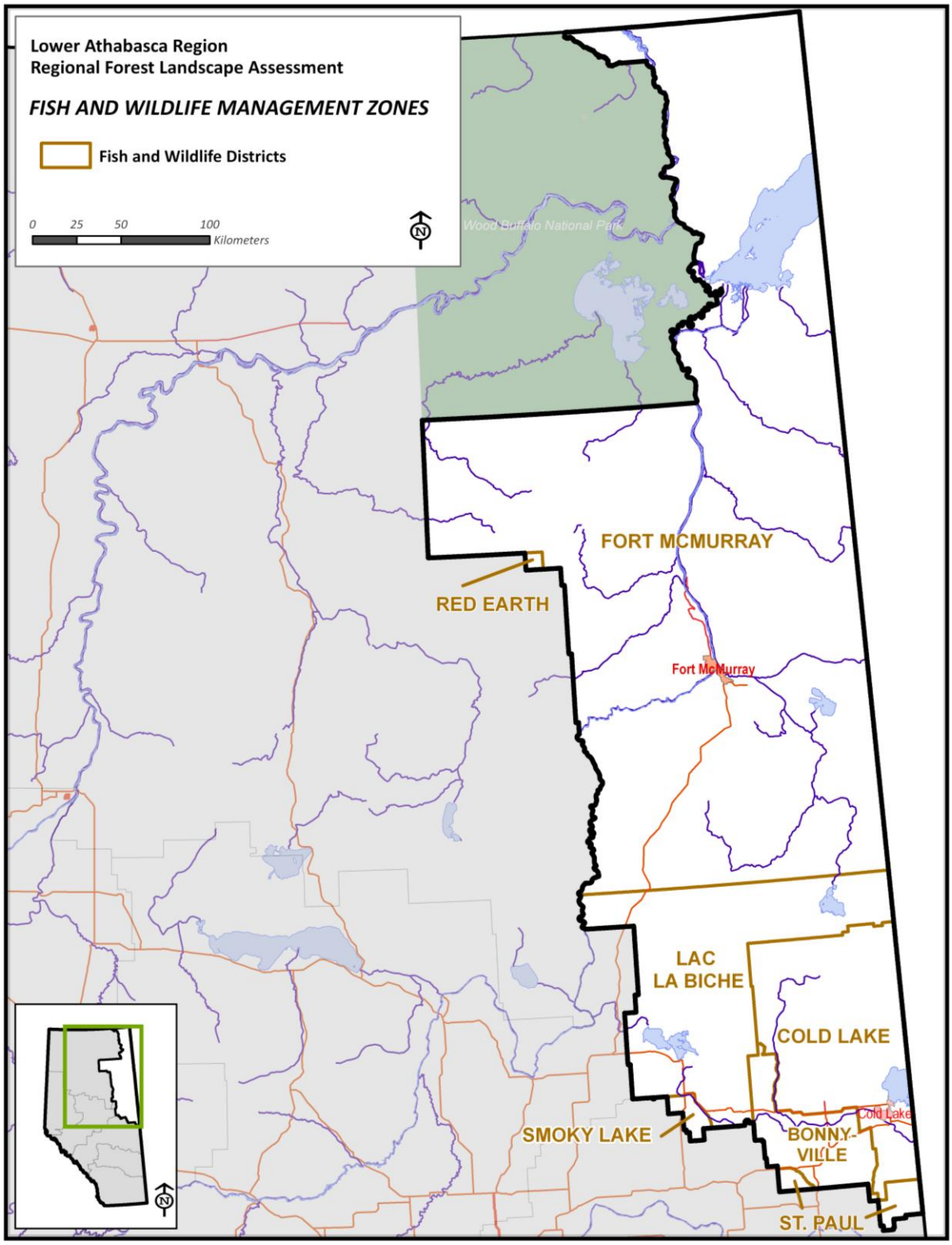


Figure 5-6. Fish and Wildlife Districts

5.8.2 Fisheries

Fish Management Zones (46) are used to determine fisheries health, regulate sport and commercial fishing, and determine fish stocking. There is only one Fish Management Zone in the Lower Athabasca Region. Fish Management Zones are further subdivided into Fish Watershed Units which are based on specific river basins. Sport fishing regulations apply at the Watershed Unit level, or in some cases regulations are site specific to locations (lakes, streams) within a Watershed Unit.

Table 5-6. Fish Management Zones

	Entire Zone	Portion of Zone in Lower Athabasca		Proportion of Lower Athabasca occupied by Zone
Fish Management Zone	Area (ha)	Area (ha)	%	%
Northern Boreal Zone	32,972,500	9,325,768	28	100
Total	32,972,500	9,325,768		100

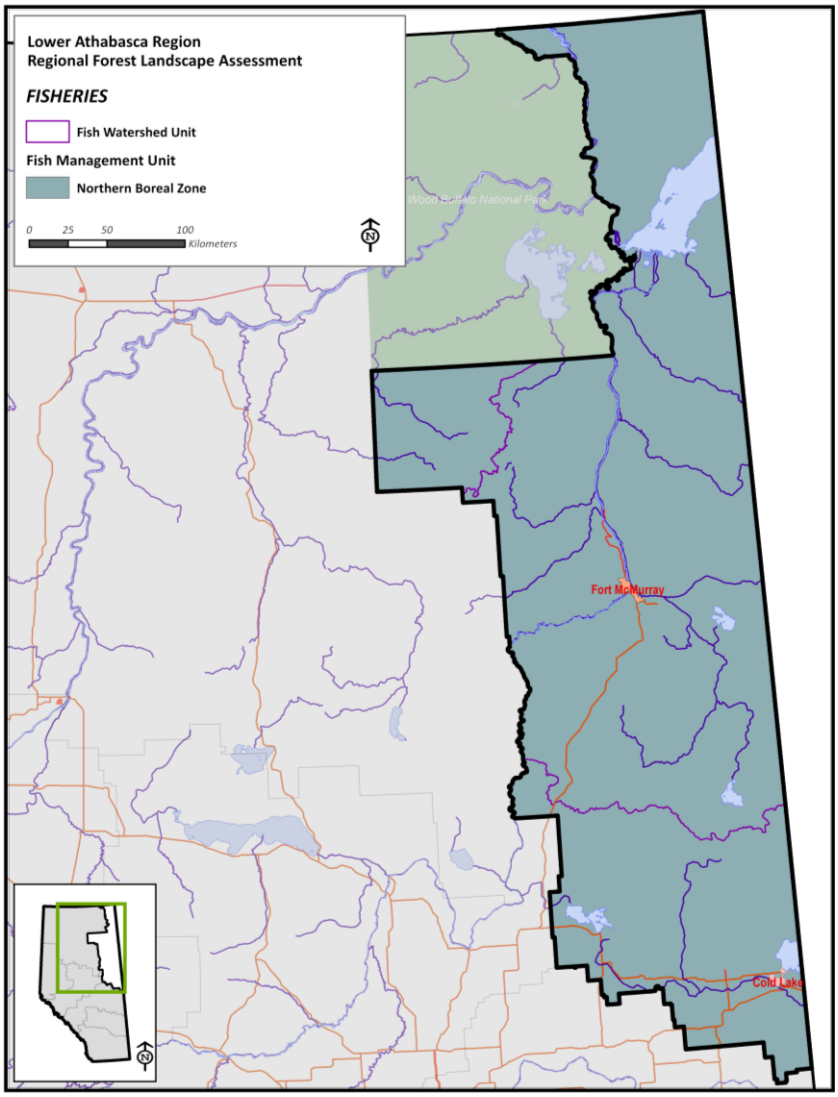


Figure 5-7 Fish Management Units

5.8.3 Wildlife

Wildlife sensitivity zones (Table 5-7 and Figure 5-8) are derived from aerial surveys, historical information, movements of collared animals and specific habitat type requirements. They are used by industrial operators and government departments in operational decision making on Crown land. In addition, these zones provide everyone with the best information currently available on the extent of wildlife sensitivities in Alberta.

The list of species is not exhaustive for the Region but identifies species that ESRD has listed as a concern related to the development of industrial activities. A Landscape Analysis Tool (LAT) has been developed to incorporate the Wildlife Sensitivity zones (47) when planning industrial activity. Reporting from the LAT allows for informed decisions, risk mitigation and adherence to standards.

Table 5-7 Wildlife Sensitivity Zones

Wildlife Species	Area of Wildlife Sensitivity within Alberta (ha)	Portion of Wildlife Sensitivity Zone in Lower Athabasca (ha)[1]	(%)	Proportion of Lower Athabasca occupied by Sensitivity Zone (%)
Caribou sp (*Rangifer tarandus*)	9,749,350	2,070,042	22	21
Piping Plover (*Charadrius melodus*)	154,770	15,891	0	10
Sharp-tailed Grouse (*Pedioecetes phasianellus*)	15,810,566	12,157	0	0
Trumpeter Swan (*Cygnus buccinator*)	538,615	13,527	0	3
Colonial Nesting Birds	46,319	5,711		
- American White Pelican (*Pelecanus erythrorhynchos*)	14,911	2,221		
- Great Blue Heron (*Ardea herodias*)	31,408	3,490		
Sensitive Raptor Range	33,006,540	7,538	0	0
- Peregrine Falcon (*Falco peregrinus*)	13,246	7,538	0	57
Key Wildlife and Biodiversity Zone	4,689,713	790,380	8	17
Special Access Zone	1,763,820	76,236	1	4
Total Area of Lower Athabasca		9,325,767		

[1] Zones overlap each other (see Figure 5-8), so the areas are not additive

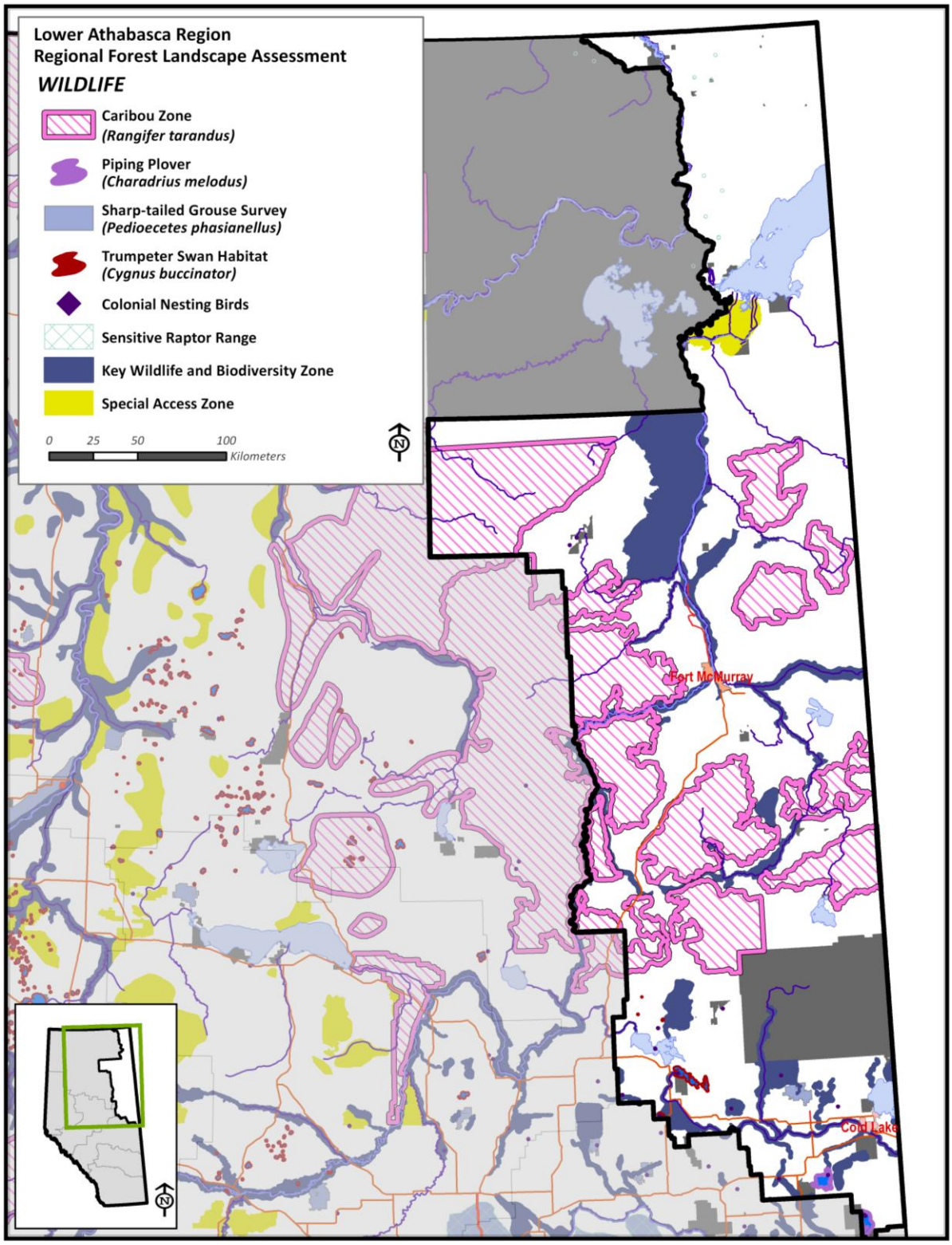


Figure 5-8 Wildlife Sensitivity Zones

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7. Glossary

Glossary	
Term	**Definition**
ABMI	See Alberta Biodiversity Monitoring Institute
AVI	see Alberta Vegetation Inventory
Alberta Biodiversity Monitoring Institute (ABMI)	The ABMI was incorporated in 2007 as a registered not-for-profit member-based organization.. The ABMI measures and provides information on the state of Alberta's biodiversity in order to facilitate the responsible management of the environment.
Alberta Vegetation Inventory (AVI)	AVI is an air-photo based inventory in the province of Alberta. The inventory includes a set of defined specifications for the classification of vegetation as well as specifications for the digital capture of polygon boundaries.
Brunisolic	Very poorly developed soil with a thin topsoil layer. One of three soil orders for forested soils in Canada. Typically developed from sandy parent materials and will often have a slightly acidic or basic pH.
Chernozemic	A productive, well-developed soil with a thick, rich topsoil layer. Typically develop in parent materials ranging from coarse sands to fine-textured silts and clay loams. These soils are found in the grassland and aspen parkland natural regions. The best agricultural land in Alberta is on this soil type.
Cryosolic	Mineral or organic soils that have a permanently frozen layer within one metre of the soil's surface.
ecoclimate	Classification using climate as an ecological factor.
ecoclimatic province	A broad complex of ecoclimatic areas that have similar climatic conditions as reflected by vegetation (Strong 1992).
FMA	see Forest Management Agreement
FMU	see Forest Management Unit
Forest Management Agreement (FMA)	A large, area-based agreement between Alberta and a company, giving the company rights to establish, grow, harvest and removed timber from a defined area of land. An FMA is typically granted for 20 years and are renewable.
Forest Management Unit (FMU)	A forest management unit is a Crown-defined area which is the basis of calculating a sustainable supply of timber. Allowable harvest levels within an FMU are then allocated under the Alberta forest tenure system.
FRAGSTATS	FRAGSTATS is a computer program designed to quantify landscape metrics. Chosen metrics are those typically associated with habitat characteristics (patch size, shape, contiguity, connectivity, etc.). It was developed at the University of Massachusetts, first released for public use in 1995 and currently is published as version 4.0.

Glossary	
Term	**Definition**
Gleysolic	A distinctive soil that results from being saturated with water for long periods of time. This soil is not productive, and is unable to retain nutrients. The water-saturated conditions also reduce the rate of transformation of organic matter which can lead to the build up of organic matter on the surface of mineral Gleysolic soils.
HRV	see Historic Resource Value
Historic Resource Value	An index related to relative importance of historical and cultural features as identified and assigned by Alberta Culture.
National Forest Inventory (NFI)	Canada's National Forest Inventory (NFI) monitors a network of sampling points covering one percent of Canada's land mass on an ongoing basis to provide accurate, timely and consistent information on the state and sustainable development of Canada's forests. This information is shared with collaborators and the public and is used to provide credible information to inform domestic forest policies and positions, and to support science initiatives, and regional, national and international reporting commitments.
NFI	see National Forest Inventory
LAT	see Landscape Analysis Tool
Landscape Analysis Tool	The Landscape Analysis Tool is a web-enabled tool allowing users to plan activities on Alberta land with the purpose of identifying operational constraints which may apply to the activity. The generated report provides provinicial and sensitivity section approval standards and operating conditions that are specific to a proposed activity.
Luvisolic	Soil that has large organic but low humus content. Nutrients are easily washed out of the topsoil and therefore this type of soil is not as productive as the Chernozems soils. Parent materials of Luvisolic soils are typically well supplied with base cations and have loamy or clay domiinated soil textures.
Organic	A soil that is made up of mostly organic, natural material. Usually refers to peat, bog or fen soils. The wetland variants of Organic soils are associated with landscape positions where water accumulates and saturates the soil. Upland versions of these soils are composed of leaf litter and other woody debris.
Permanent Sample Plot (PSP)	A sampling program installed with the express purpose to measure biological metrics on a repeated basis. Such plots are typically revisited on a fixed schedule, depending on the purpose of the programme. In many cases, the plot locations are protected under a provincial disposition, requiring authority from the plot owner for the plot to be accessed or disturbed.
Podzolic	Podzols are forested soils found primarily on sandy parent materials in areas underlain by igneous rocks. Can be prone to cementation of layers within the soil profile. Cemented layers anc form barriers to vertical penetration of tree roots and water, leading to water saturation above the cemented layer.

Glossary	
Term	**Definition**
PSP	See Permanent Sample Plot
Regosolic	Poorly developed soil that has a thin topsoil layer. This soil does not retain nutrients well. Commonly associated with landforms where the land surface is (or has recently been) unstable. Because of the instability, the soils has had little time to develop and hence soil horizons are weakly expressed.
Solonetzic	A typical grassland soil usually found in a subhumid or semiarid climate under grass and shrub vegetation. These typically occur in the same ecozones as Chernozemic soils. Developed primarily from glacial re-working of sedimentary rocks. Typcially the A horizon is depleted of clay which has been deposited in the B horizon.
Seral stage	The series of progressive plant communities that develop during ecological succession from bare ground to the climax stage. A seral stage is defined by species composition and time since stand development.
Vertisolic	Vertisolic soils are found on parent materials high in clay. Lacustrine sediments high in clay were often deposited in the deepest parts of glacial lakes. Vertisolic soils are associated with these flat, level lacustrine surfaces.The mixing of soil material caused by wet/dry cycles (leading to swelling/contraction of the soil layers) is characterisitic of Vertisolic soils. Common throughout the Pairies, but have a limited extent in other regions of Canada.

APPENDIX I Parks and Protected Areas in the Lower Athabasca

Detailed lists of parks and protected features are provided. The registered park/protected area is noted along with any additional areas that are under Crown Reservation and subject to referral if any industrial activity is being planned for the area. Note that some parks/protected features may not be wholly contained in the Lower Athabasca.

Table 7-1 List of Provincial Parks

Provincial Park	Registered Area in Region (ha)	Percentage (%)	Additional PNT/CNT Area (ha)
Cold Lake	5,833	25	55
Crow Lake	790	3	0
Gregoire Lake	706	3	666
Lakeland	14,766	63	0
Moose Lake	734	3	540
Sir Winston Churchill	664	3	0
Total	23,493	100	1,261

Table 7-2 List of Wildland Parks

Wildland Park	Registered Area in Region (ha)	Percentage (%)	Additional PNT/CNT Area (ha)
Birch Mountains Wildland	144,406	26	0
Colin-Cornwall Lakes Wildland	70,238	13	0
Fidler-Greywillow Wildland	7,491	1	0
Gipsy Lake Wildland	35,837	6	0
Grand Rapids Wildland	20,582	4	0
La Butte Creek Wildland	18,221	3	0
Marguerite River Wildland	196,059	35	0
Maybelle River Wildland	15,073	3	0
Richardson River Dunes Wildland	31,230	6	0
Stony Mountain Wildland	13,945	3	0
Whitemud Falls Wildland	3,838	1	0
Total	556,918	100	0

Table 7-3 List of Provincial Recreation Areas

Provincial Recreation Area	Registered Area in Region (ha)	Percentage (%)	Additional PNT/CNT Area (ha)
Beaver Lake	92	0	0
Elinor Lake			440
English Bay	16	0	0
Engstrom Lake	58	0	0
Franchere Bay	19	0	0
French Bay	448	1	0
Hangingstone	15	0	0
Jackson Lake Trail Staging	64	0	0
Lakeland	44,745	98	0
Marie Lake			45
Maqua Lake	191	0	0
Moose Lake			3,035
Muriel Lake	8	0	139
Wolf Lake	37	0	0
Total	45,695	100	3,659

Table 7-4 List of Natural Areas

Natural Area	Registered Area in Region (ha)	Percentage (%)	Additional PNT/CNT Area (ha)
Beaver Lake			1,258
Frog Lake Heronry			44
Garner Orchid Fen	165	28	0
Gregoire Lake			51
Helina Area			130
La Saline	414	72	30
Lac La Biche			62
Lac La Biche Islands			183
Moose Lake Islands			188
Old Canoe Island			825
Total	578	100	2,771

Table 7-5 List of Ecological Reserves

Ecological Reserve	Registered Area in Region (ha)	Percentage (%)	Additional PNT/CNT Area (ha)
Athabasca Dunes	3,848	67	51,522
Crow Lake	980		0
Egg Island	2		0
Whitemud Falls	889	16	0
Total	5,718	100	51,522

Table 7-6 List of Special Management Zones

Special Management Zone Buffer	Registered Area in Region (ha)	Percentage (%)	Additional PNT/CNT Area (ha)
Lakeland	0	0	17,782
Total			17,782

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