HIGH CONSERVATION VALUE FOREST ASSESSMENT

Spray Lake Sawmills (1980) Ltd.
Forest Management Agreement and B9 Quota Area

Prepared for:

Spray Lake Sawmills (1980) Ltd.
Cochrane, Alberta

Prepared by:

John L. Kansas, *M.Sc., P.Biol.*
HAB-TECH Environmental Ltd.

Jason Mogilefsky, B.Sc., RPF
Spray Lake Sawmills

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EXECUTIVE SUMMARY

This report presents results of an assessment for the presence of High Conservation Value (HCV) attributes and forests on the Spray Lake Sawmills (SLS) Forest Management Agreement area (FMA) and B9 Quota land tenure. The assessment is a component of Principle 9, required for Forest Stewardship Council (FSC®) forest management certification. The High Conservation Value Forest (HCVF) concept focuses on environmental, social, and cultural values that make a particular forest area outstandingly significant. The assessment framework is organized as a table with 6 categories, which form the definition of a HCVF. Each Category includes a series of Key, Definitive and Guidance questions designed to help identify HCVF values and thresholds for HCVF designation. Identification of the high conservation values facilitates management decisions that are consistent with maintaining or enhancing the values.

A HCVF possesses one or more of the following attributes:

Category 1: Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g., endemism, endangered species, refugia);

Category 2: Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance;

Category 3: Forest areas that are in or contain rare, threatened or endangered ecosystems;

Category 4**:** Forest areas that provide basic services of nature in critical situations (e.g., watershed protection, erosion control);

Category 5**:** Forest areas fundamental to meeting basic needs of local communities (e.g., subsistence, health); and,

Category 6**:** Forest areas critical to local communities, traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

The assessment for the presence of HCV attributes is to be appropriate to the scale and intensity of forest management. HCVFs and attributes were identified at various scales. Because HCVs are environmental, ecological, and social in nature, they do not necessarily follow administrative boundaries. In general, the forest manager's responsibility is limited to the scope of certification or the area over which the manager has control (i.e. FMA/B9 Quota).

This assessment was completed in accordance with approaches outlined in the Forest Stewardship Council Canada Working Group – National Boreal Standard (FSC 2004). Technical aspects of the assessment were guided in large part by the World Wildlife Fund Canada High Conservation Value Forest Support Document – Draft (WWF – Canada 2005).

A summary of the HCVs and HCVF groups identified in this assessment, organized at the species, habitat/community, and landscape levels of scale, are presented in the Table below. The table summarizes the HCV categories and attributes selected and provides ecological scale and links to Key Questions from the National Boreal Standard (FSC 2004).

HCVF Group #:	**1**	**Ecological Scale:**	Species Level
Category:	1	**Key Question:**	1 & 4
HCVF attribute:	Species at Risk – vertebrates / Focal Species		
HCV(s):	Grizzly Bear		
HCVF Group #:	**2**	**Ecological Scale:**	Species Level
Category:	1	**Key Question:**	1 & 4
HCVF attribute:	Species at Risk – vertebrates / Focal Species		
HCV(s):	Bull Trout	Westslope Cutthroat Trout	
HCVF Group #:	**3**	**Ecological Scale:**	Species Level
Category:	1	**Key Question:**	1 & 4
HCVF attribute:	Provincially Listed Species at Risk – vertebrates / Focal Species		
HCV(s):	Northern Goshawk	Black-backed Woodpecker	Brown Creeper
	Sandhill Crane	Pileated Woodpecker	Canada Lynx
	Barred Owl	Great Gray Owl	Long -toed Salamander
	Columbia Spotted Frog		
HCVF Group #:	**4**	**Ecological Scale:**	Species Level
Category:	1	**Key Question:**	4
HCVF attribute:	Focal Species		
HCV(s):	Western Tanager	Fisher	Ovenbird
	Marten	Moose	Elk
	Rusty Blackbird		

HCVF Group #:	**5**	**Ecological Scale:**	Species Level
Category:	1	**Key Question:**	1
HCVF attribute:	Rare Plant Species – vascular and non vascular plants		
HCV(s):	*Anastrophyllum michauxii*	*Homalothecium nevadense*	*Bacidia hegetschweileri*
	Buellia turgescens	*Chaenotheca stemonea*	*Silene involucrate*
	Ephebe lanata	*Aster maccallae*	*Stellaria umbellate*
	Arnica amplexicaulis	*Aster eatonii*	*Ribes laxiflorum*
	Splachnum vasculosum	*Anaptyychia setifera*	*Chaenotheca chrysocephala*
	Calicium trabinellum	*Chaenotheca trichialis*	*Cladonia bacilliformis*
	Cyphelium inquinans	*Leptogium tenuissimum*	*Mycocalicium subtile*
HCVF Group #:	**6**	**Ecological Scale:**	Species Level / Community
Category:	1	**Key Question:**	1 & 5
HCVF attribute:	Species at Risk – vascular plants (trees) / Outlier Tree Species		
HCV(s):	Whitebark Pine (*Pinus albicaulis)*	Limber Pine (*Pinus flexilis)*	
HCVF Group #:	**7**	**Ecological Scale:**	Community / Habitat Level
Category:	1	**Key Question:**	5
HCVF attribute:	Outlier Tree Species		
HCV(s):	Black Spruce *Picea mariana*	Tamarack *Larix laricina*	White Birch *Betula papyrifera*
	Interior Douglas Fir *Pseudotsuga menziesii* var. *glauca*		
HCVF Group #:	**8**	**Ecological Scale:**	Community / Habitat Level
Category:	3	**Key Question:**	8
HCVF attribute:	Rare Ecological Plant Communities (globally ranked)		
HCV(s):	Lodgepole pine/red-osier dogwood woodland	Lodgepole pine/white meadowsweet forest	Aspen-subalpine fir-Engelmann spruce/clasping-leaved twisted stalk forest
	Douglas fir/angelica spp. Forest	Whitebark pine-Engelmann Spruce / white mountain avens(*not expected to be impacted by forestry)	Limber pine scree woodland (*not expected to be impacted by forestry)

HCVF Group #:	**9**	**Ecological Scale:**	Community / Habitat Level
Category:	3	**Key Question:**	11
HCVF attribute:	Unique and Diverse habitats /Plant Communities		
HCV(s):	Mixedwood forest in riparian settings	Shallow marshes and beaver pond complexes	Deciduous mixedwood and pure deciduous cover types >110 years old
	Late seral and old growth conifer > 170 years old	Upland Grasslands	
HCVF Group #:	**10**	**Ecological Scale:**	Community / Habitat Level
Category:	4	**Key Question:**	16
HCVF attribute:	Critical Impact on Fisheries		
HCV(s):	Important stream reaches identified by AESRD as pure Westslope Cutthroat Trout population sites and known Bull Trout spawning sites.		
HCVF Group #:	**11**	**Ecological Scale:**	Community / Habitat Level
Category:	6	**Key Question:**	18
HCVF attribute:	Traditional Cultural Identity		
HCV(s):	Known and identified site-specific unique and historical resource values, recorded with Alberta Culture and Community Spirit (ACCS), are considered HCVs. Site specific values brought forward by First Nations will also be considered HCVs.		
HCVF Group #:	**12**	**Ecological Scale:**	Landscape Level
Category:	1 and 4	**Key Question:**	3 & 16
HCVF attribute:	Significant Concentrations of Biodiversity Values / Critical Impact on Fisheries		
HCV(s):	The Highwood River watershed portion of the FMA designated as a Nationally Significant ESA		
	The Red Deer River watershed portion of the FMA designated as a Nationally Significant ESA		
HCVF Group #:	**13**	**Ecological Scale:**	Landscape Level
Category:	3	**Key Question:**	7 & 10
HCVF attribute:	Large Landscape Level Forest (50,000 – 200,000 ha)		
HCV(s):	Block 1	Block 2	

HCVF Group #:	**14**	**Ecological Scale:**	Landscape Level
Category:	3	**Key Question:**	7 & 10
HCVF attribute:	Remnant Landscape Level Forest (>5,000 < 50,000 ha)		
HCV(s):	Remnant #8	Remnant #12	
HCVF Group #:	**15**	**Ecological Scale:**	Landscape Level
Category:	4	**Key Question:**	13
HCVF attribute:	Significant Ecological Service		
HCV(s):	The Elbow River main stem and its adjacent alluvial aquifer		
HCVF Group #:	**16**	**Ecological Scale:**	Landscape Level
Category:	1	**Key Question:** 6	13
HCVF attribute:	Designated Conservation Areas		
HCV(s):	Don Getty Wildland Provincial Park, Elbow Sheep Wildland Provincial Park, Bluerock Wildland Provincial Park, Bow Valley Provincial Park, Plateau Mountain Ecological Reserve, Sheep River Provincial Park, Macabee Creek Natural Area, Bragg Creek Provincial Park, Bragg Creek Natural Area, Moose Mountain, OH Ranch Heritage Rangeland, Provincial Recreation Areas located within the FMA boundary, and IRP Zone 1 Prime Protection.		

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1.0 INTRODUCTION

Spray Lake Sawmills (SLS) is in the process of making application for Forest Management Certification of its Forest Management Agreement (FMA) area and B9 Quota land tenures under the Forest Stewardship Council (FSC®). One component of FSC® certification is the completion of an assessment to *…"determine the presence of attributes consistent with High Conservation Value Forests….appropriate to the scale and intensity of forest management"* (FSC 2004). HAB-TECH Environmental Ltd. was commissioned by SLS to complete the assessment related to biodiversity, landscape ecology, and species at risk aspects of HCVFs (Categories 1-3). SLS completed the assessment of areas related to watershed protection, areas fundamental to meeting basic needs of local communities, and areas significant to traditional cultural identity (Categories 4-6). The assessment was completed using approaches consistent with those outlined in the Forest Stewardship Council Canada Working Group – National Boreal Standard (FSC 2004).

The objectives of this assessment are as follows:

- identify candidate High Conservation Value Forests (HCVF) and attributes based on a regional, national, and global information review;
- assess candidates to determine if they meet the FSC® definition of a HCVF attribute;
- map the locations and document the size of HCVF attributes, where possible;
- recommend management strategies that maintain and/or enhance the HCVF attributes (consistent with the precautionary approach);
- recommend monitoring (including adaptive management framework) strategies to assess the effectiveness of management strategies; and
- present the HCVF assessment to the SLS Public Advisory Committee and a broader group of public stakeholders for input on HCVF values and management strategies.

2.0 APPROACH

The concept of High Conservation Value Forests (HCVFs) focuses on environmental, social, or cultural values that make a forest area ***outstandingly significant***. The key to the concept of HCVFs is the identification of High Conservation Values (HCVs) or attributes through an assessment process that takes into account the scale and intensity of forest management (FSC 2004). Principle 9 and Appendix 5 (*High Conservation Value Forest National Framework*) of the FSC National Boreal Standard (FSC 2004) detail the requirements for the assessment. Principle 9 states:

"Management activities in High Conservation Value Forests shall maintain or enhance the attributes which define such forests. Decisions regarding High Conservation Value Forests shall always be considered in the context of a precautionary approach."

The HCVF assessment includes: 1) identification (and mapping, where appropriate) of High Conservation values and forests; 2) development of management strategies to maintain and enhance High Conservation values and forests; and 3) preparation of a monitoring plan to assess the effectiveness of the measures employed to maintain or enhance High Conservation values and forests.

Stakeholders and other interested parties are provided an opportunity, through a publicized and open consultative process, to participate in the identification of HCVs and HCVFs within the context of the *National Framework*. Participation in the development of management objectives that protect those identified values is also a component.

Note that identification of a HCV or HCVF does not automatically infer that the attribute or area must be placed within a protected area defined by legislation, regulation, or land use policy designed to control human activity. Rather, the focus is on maintaining or enhancing the value and making management decisions consistent with this focus. As part of the adaptive management process, the HCVF assessment, management objectives and monitoring strategies will be reviewed and updated on a periodic basis to incorporate new information related to improved scientific knowledge, changing social values, or changes to government policy and regulations. In that sense, the HCVF assessment is an ongoing process and is consistent with the concept of continuous improvement.

As noted above, The *High Conservation Value Forest National Framework* document (Appendix 5 of the FSC National Boreal Standard) was used as the primary guidance tool for identifying HCVFs. The framework is organized as a table covering 6 categories derived from the FSC® definition of a HCVF, which is a forest that holds one or more of the following attributes:

Category 1: Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g., endemism, endangered species, refugia);

Category 2: Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance;

Category 3: Forest areas that are in or contain rare, threatened or endangered ecosystems;

Category 4: Forest areas that provide basic services of nature in critical situation (e.g. watershed protection, erosion control);

Category 5: Forest areas fundamental to meeting the basic needs of local communities (e.g. subsistence, health); and

Category 6: Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

Each category comprises a series of ***Key*** questions aimed at identifying whether or not the forest management area contains any of the values described in the category. Negative answers to these questions mean that the forest does not include HCVs. Positive answers lead to further investigation and additional, more detailed questions. ***Definitive*** and ***Guidance*** questions are structured with Yes/No answers and are designed to determine whether the evidence supports a HCVF designation. A positive response to a *Definitive* question means that the attributes under consideration are HCVs. A negative response to a *Definitive* question leads to the *Guidance* questions. Several positive responses to *Guidance* questions indicate the potential for reaching a threshold for HCV designation.

The framework is not meant to be a prescriptive approach. The process of interpreting the 6 categories leads to the development of evidence and rationale to support HCV designation and the thresholds considered in decision making. A summary of the 19 *Key* questions by Category is presented in Table 1, along with the follow-up *Definitive* and *Guidance* questions associated with each category.

A secondary guidance document consulted for the assessment was the *World Wildlife Fund High Conservation Value Forest Support Document (WWF and The Nature Conservancy 2005).* This document provides technical/ecological support for practitioners completing an HCVF assessment using Appendix 5 of the FSC National Boreal Standard (FSC 2004). It offers scientific guidance for practitioners making decisions on such matters as identifying thresholds for when a value becomes a "high conservation value" or what proportion of the distribution of a value is the most "critical and/or outstanding".

Table 1. Categories, Key questions, and Definitive and Guidance questions for the HCVF Assessment

Key Question	Definitive Question	Guidance Questions
Category 1 – Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values.		
Question 1 - Does the forest contain species at risk or potential habitat of species at risk as listed by international, national or territorial/provincial authorities?	Are any of the rare, threatened or endangered species in the forest a species representative of habitat types naturally occurring in the management unit?	Are any of the rare, threatened or endangered species in the forest a focal species?
		Are there any ecological or taxonomic groups of rare species that would together constitute a HCV?
		Do any of the identified rare, threatened or endangered species (individually or concentration of species) have a demonstrated sensitivity to forest operations?
		Does the forest contain critical habitat for any individual species or concentration of species identified in the above questions?
Question 2 - Does the forest contain a globally, nationally or regionally significant concentration of endemic species?	Does the forest include or lie within a globally significant centre of endemism?	Is there a concentration of endemic species in the forest that includes a focal species?
	Is there a concentration of endemic species in the forest that includes species representative of habitat types naturally occurring in the management unit?	Are there any ecological or taxonomic groups of endemic species or sub-species that would together constitute a globally or nationally significant concentration?
		Do any of the identified endemic species have a demonstrated sensitivity to forest operations?
		Does the forest contain critical habitat of species identified in the above questions?
Question 3 - Does the forest include critical habitat containing globally, nationally or regionally significant seasonal concentration of species?	Is there an IBA (Important Bird Area) in the forest?	What proportion of the global, national or regional population uses the wildlife concentration area?
		How protected are similar wildlife concentration areas within the region?
		Is it a wildlife concentration area for more than one species?
		Are there any landscape features or habitat characteristics that tend to correlate with significant temporal concentrations of species?
Question 4 - Does the forest contain critical habitat for regionally significant species?	Is the regionally significant species in significant decline as a result of forest management?	Is the population of regionally significant species locally at risk?
		Does the forest contain limiting habitat for regionally significant species?
		Are there any ecological or taxonomic groups of species or sub-species that would together constitute a regionally significant concentration?

Table 1. Categories, Key questions, and Definitive and Guidance questions for the HCVF Assessment (continued)

Key Question	Definitive Question	Guidance Questions
Question 5 - Does the forest support concentrations of species at the edge of their natural ranges or outlier populations?	Are there naturally occurring outlier populations of commercial tree species?	Are any of the range edge or outlier species a focal species?
	Are any of the range edge or outlier species a species representative of habitat types naturally occurring in the management unit?	Are there any ecological or taxonomic groups of range edge and/or outlier species/sub-species that would together constitute a globally, nationally or regionally significant concentration?
		Are the species potentially negatively impacted by forest management?
		Is there a population of edge of range and /or outlier species?
Question 6 - Does the forest lie within, adjacent to, or contain a conservation area: *a) designated by an international authority;* *b)legally designated or proposed by relevant federal/provincial/ territorial legislative body; or* *c) identified in regional land use plans or conservation plan?*	Are the values for which the conservation area has been identified consistent with the assessment of HCVs in this framework?	Do permitted uses in the conservation area include industrial activities?
		Are there forest areas important to connect conservation areas in order to maintain the values for which the conservation areas were identified?
		Are there forest areas important to buffer conservation areas in order to maintain the values for which the conservation areas were identified?
Category 2 - Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.		
Question 7 - Does the forest constitute or form part of a globally, nationally or regionally significant forest landscape that includes populations of most native species and sufficient habitat such that there is a high likelihood of long-term species persistence?	Are there forest landscapes unfragmented by permanent infrastructure and of a size (depending on scale) to maintain viable populations of most species?	Is the level of dissection and perforation in large unfragmented forest landscapes below levels that will permit the persistence of most native species?

Table 1. Categories, Key questions, and Definitive and Guidance questions for the HCVF Assessment (continued)

Key Question	Definitive Question	Guidance Questions
Category 3 - Forest areas that are in or contain rare, threatened or endangered ecosystems.		
Question 8 - Does the forest contain naturally rare ecosystem types?	Are there ecosystems that have been officially classified as being rare, threatened or endangered by a relevant national or international organization?	Is a significant amount of the global extent of these ecosystems present in the country and/or ecoregion?
		Are these ecosystems heavily modified?
		Are these ecosystems potentially negatively impacted by forest management?
Question 9 - Are there ecosystem types within the forest or ecoregion that have significantly declined?		Is there forest within an ecoregion with little remaining original forest type?
		Have these ecosystems significantly declined?
		Is there a significant proportion of the declining ecosystem type within the management unit in comparison to the broader ecoregion?
		Does potential vegetation mapping identify areas within the management unit that can support the declining ecosystem type?
		How well is each ecosystem effectively secured by the protected area network and the national/regional legislation?
Question 10 - Are large landscape level forests (i.e., large unfragmented forests) rare or absent in the forest or ecoregion?		Are large remnant patches (thousands of hectares) the best examples of intact forest for their community and landform types?
		Do the largest remnant forest patches include a significant proportion of climax species (i.e., not dominated by pioneer species)?
		Do the largest remnant forest patches include a significant proportion of late seral stands?
		Do the largest remnant forest patches include a significant proportion of structural features such as woody debris and standing dead trees (i.e., structurally complex)?
		Do the largest remnant forest patches include known populations of significant species (species representative of habitat types naturally occurring in the management unit, focal) and/or suitable habitat to maintain short-term persistence (i.e., 25- 50 years) of significant species?

Table 1. Categories, Key questions, and Definitive and Guidance questions for the HCVF Assessment (continued)

Key Question	Definitive Question	Guidance Questions
Question 11 - Are there nationally /regionally significant diverse or unique forest ecosystems?		Are there important and/or unique geological areas that strongly influence vegetation cover?
		Are there important and/or unique microclimatic conditions that strongly influence vegetation cover (e.g., high rainfall, protected valleys)?
		Do these ecosystems possess any exceptional characteristics (including exceptional species richness, critical species, etc.)?
Category 4 – Forest areas that provide basic services of nature in critical situations.		
Question 12 – Does the forest provide a significant source of drinking water?	Is there a sole available and accessible source of drinking water?	Are there watershed or catchment management studies that identify significant recharge areas that have a high likelihood of affecting drinking water supplies?
Question 13 – Are there forests that provide a significant ecological service in mediating flooding and /or drought, controlling stream flow regulation, and water quality?	Are there high risk areas for flooding or drought?	Are there particular forest areas (i.e., a critical subwatershed) that potentially affect a significant or major portion of the water flow (e.g., 75% of water in a larger watershed is funneled through a specific catchment area or river channel)?
		Does the forest occur within a sub-watershed that is critically important to the overall catchment basin?
		Are there particular forest areas (i.e., a critical subwatershed) that potentially affect water supplies for other services such as reservoirs, irrigation, river recharge or hydroelectric schemes?
Question 14 – Are there forests critical to erosion control?	Are there forest areas where the degree of slope carries high risk of erosion, landslides and avalanches?	Are there soil and geology site types that are particularly prone to erosion and terrain instability?
		Is the spatial extent of erosion-prone or unstable terrain such that the forest is at high risk (also of cumulative impacts)?
Question 15 - Are there forests that provide a critical barrier to destructive fire (in areas where fire is not a common natural agent of disturbance)?	***Not relevant to forest ecosystems in Canada.***	

Table 1. Categories, Key questions, and Definitive and Guidance questions for the HCVF Assessment (concluded).

Key Question	Definitive Question	Guidance Questions
Question 16 - Are there forest landscapes (or regional landscapes) that have a critical impact on agriculture or fisheries?		Are there agricultural or fisheries production areas in the forest that are potentially severely negatively affected by changes in wind and microclimate and microhabitat?
Category 5 – Forest Areas fundamental to meeting basic needs of local communities.		
Question 17 - Are there local communities? (This should include both people living inside the forest area and those living adjacent to it as well as any group that regularly visits the forest.) Is anyone within the community making use of the forest for basic needs/ livelihoods (consider food, medicine, fodder, fuel, building and craft materials, water, income)?		Is this the sole source of the value(s) for the local communities?
		Is there a significant impact to the local communities as a result of a reduced supply of these values?
		Are there values that, although they may be a small proportion of the basic needs, are nevertheless critical?
Category 6 - Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).		
Question 18 - Is the traditional cultural identity of the local community particularly tied to a specific forest area?	Do the communities consider that the forest is culturally significant?	Will changes to the forest potentially cause an irreversible change to the culture?
		Is the particular forest in question more valuable than other forests?
Question 19 - Is there a significant overlap of values (ecological and/or cultural) that individually did not meet HCV thresholds, but collectively constitute HCVs?		Are there several overlapping conservation values?
		Do the overlapping values represent multiple themes (e.g., species distribution, significant habitat, concentration area, relatively unfragmented landscape)?
		Are the overlapping values within, adjacent to, or in close proximity to an identified HCV or existing conservation area?
		Are the overlapping values adjacent or in close proximity to an existing protected area or candidate for permanent protection?
		Do the overlapping values provide an option to meet protected areas representation requirements (i.e., overlap an under-represented landscape as assessed using a protected areas gap analysis)?

3.0 OVERVIEW OF THE SPRAY LAKE SAWMILLS FMA

3.1 Forest Management Area (FMA)

SLS received an FMA on September 5, 2001. It is the southern-most FMA in Alberta, encompassing approximately 2,866 km^2 (286,631 ha) of the southern east slopes of Alberta's Rocky Mountains (Figure 1). The FMA extends in a narrow band from Sundre in the north to the southern end of Kananaskis Country encompassing portions of Forest Management Units B10 and B9B. SLS also retains a timber quota in the Eastern portion of B9 (50,816 ha). Total area of the gross landbase is 3374km^2 (337,447 ha). Of this, approximately 2232 km^2 (223,152 ha) is available for timber harvesting.

The lands encompassed by the FMA have a long-standing history of timber harvesting, which includes Spray Lake Sawmills activity dating back to 1943. More recently, SLS operated as a quota holder within the B7, B8 and B6 Forest Management Units under Forest Management Plans (FMPs) prepared by the Government of Alberta. The boundaries of the units changed as part of the FMA establishment and the units were re-numbered to reflect the administrative changes. The FMA area was established "to provide for a perpetual sustained yield of timber for such operations…". In addition to committing a supply of timber to SLS, the FMA defines timber commitments to other parties. These commitments are defined in Paragraph 8(2) of the FMA. Included is a commitment of 15,000m^3 of deciduous timber annually to Sundre Forest Products Ltd. and commitments of 180,500m^3 of coniferous timber and 2,500m^3 of deciduous timber in each five-year cut control period to the Community Timber Use program (CTU). A further 50,000m^3 of coniferous timber was available to the CTU program for the period of May 1, 2001 to April 30, 2006. A Detailed Forest Management Plan (DFMP) was approved in July 2007. The DFMP guides forest harvest plans and operations and provides for a sustained yield of timber while recognizing other social and ecological values.

3.2 Location and Regional Ecology

The FMA occurs in the Rocky Mountain front ranges and foothills of Alberta, Canada. There are two distinct portions of the FMA, which are separated by the Bow River valley (Figure 1). The South FMA occurs west of Calgary and south of the Bow River. It is nested within the eastern portion of Kananaskis Country and occupies 1,624-km^2. The North FMA is located north of the Bow River and the Stoney Indian Reserve, between Canmore and Cochrane and east of Banff National Park. The size of the North FMA is 1,730-km^2.

In a North American context the northern portion of the FMA occurs primarily in the Western Alberta Upland terrestrial ecoregion (Ricketts et al. 1999) with a small component to the west occurring in the Alberta Mountain Forests ecoregion. Approximately 2/3^{rds} of the southern portion of the FMA occurs within the mountains of

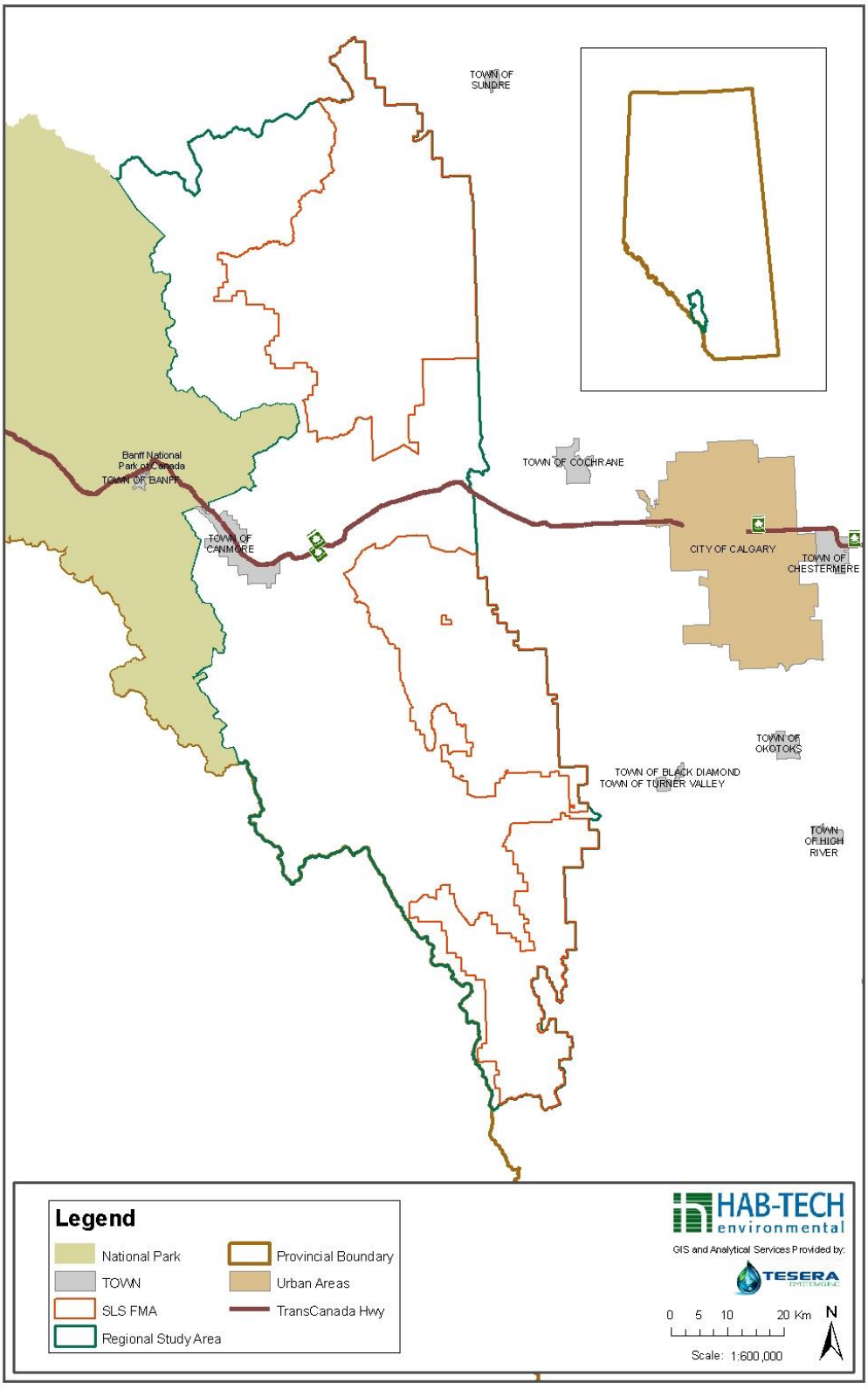

Figure 1. Location of the Spray Lake Sawmills FMA/ B9 Quota areas

the North Central Rockies Forest ecoregion and the remaining 1/3rd is in the foothills of the Western Alberta Upland ecoregion (Ricketts et al. 1999) in the north FMA.

Figure 2 shows the distribution and abundance of Alberta Natural Subregions (Natural Regions Committee 2006) in the Spray Lake Sawmills FMA. Two Natural Regions dominate the FMA land area – Rocky Mountain Natural Region (58.8%) and Foothills Natural Region (41.2%). The southern portion of the FMA occupies approximately 1,638-km^2 and is located entirely within the Rocky Mountain Natural Region. The Rocky Mountain natural region in the South FMA includes three natural subregions: Subalpine, Alpine, and Montane occupying 57.1%, 1.3%, and 41.6% of the South FMA respectively. Two natural regions are represented in the North FMA: Foothills with 1,385-km^2 (80% of the North FMA) and Rocky Mountains with 346-km^2 (20%). The Foothills natural region includes two natural subregions, Upper Foothills (43.5%) and Lower Foothills (36.5%). The Rocky Mountain natural region also includes two subregions, Montane (14%) and Subalpine (6%). The North FMA occurs at generally lower elevations than the South FMA.

3.3 Landforms and Soils

3.3.1 Rocky Mountain Natural Region

The higher elevation subalpine and alpine portions of the FMA are characterized by moderate to steeply sloping moraine, talus and bedrock as the dominant landforms. Typical soils in the Subalpine subregion include brunisols and luvisols with thin, acidic litter layers. Soil development in the Alpine subregion is poor reflecting low biological activity and frequent disturbance (cold and wind). The Montane subregion occupies lower elevation portions of major river valley bottoms and lower slopes. These areas support warmer, drier winters and greater biological activity and soil development. Landforms in the Montane subregion of the FMA are characterized by rolling/undulating moraine with slopes generally <30%. Typical soils in the Montane are Gray Luvisols and Eutric Brunisols.

3.3.2 Foothills Natural Region

Topography in this region is variable ranging from sharp, bedrock controlled ridges near the mountains (upper foothills) to rolling and undulating terrain in the lower elevation portions (lower foothills) (Natural Regions Committee 2006). Bedrock overlain by medium-textured glacial till is the dominant landform in the foothills portion of the FMA. Terrain is inclined and ridged in the upper foothills and more rolling/ridged in the lower foothills. Soils in the upper foothills are generally Brunisolic Gray Luvisols with thin, acidic litter layers. Gleysols and organic soils occur in lower slope seepage areas and in valley bottoms. Lower elevation portions of the foothills are primarily Orthic Gray Luvisols.

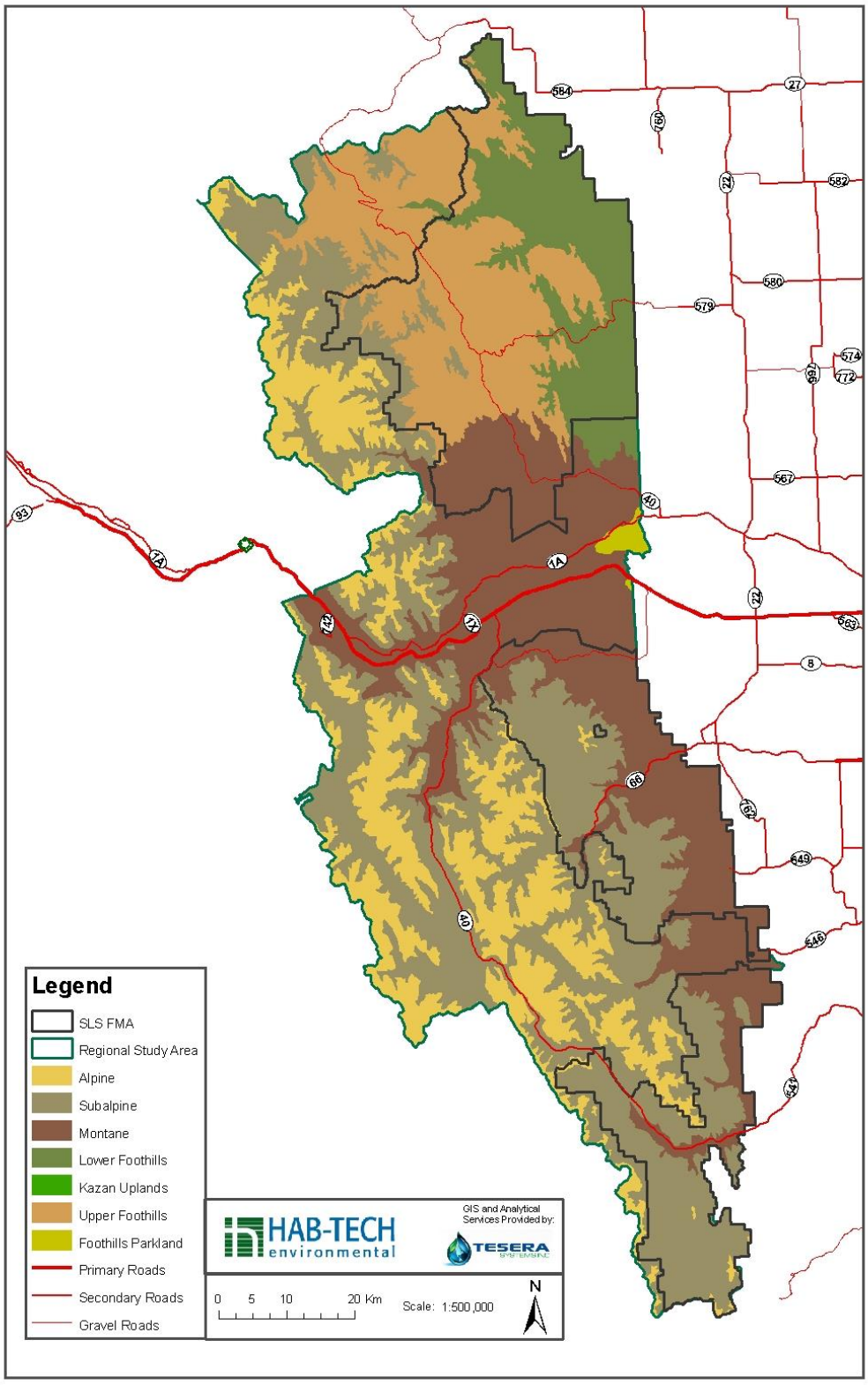

Figure 2. Natural Subregions of the Spray Lake Sawmills FMA and region

3.4 Vegetation Cover

Figure 3 illustrates the distribution and abundance of broad vegetation cover types in the southern and northern portions of the FMA respectively.

3.4.1 FMA South

A total of 28 vegetation cover types were identified in the South FMA (Figure 3). Coniferous forest is the most common physiognomic cover type comprising 73.3% of the South FMA. Lodgepole Pine forest and White x Engelmann Spruce forest are well distributed through the area, and are the most common coniferous forest cover types occupying 53.9% and 19.0% of the total area, respectively. The greatest diversity of vegetation cover types occurs in the eastern portion of the South FMA (Figure 3). In this area, a combination of low elevation, warmer climate, and natural/anthropogenic disturbances has resulted in a heterogeneous landscape with relatively small patches of different land cover types.

Deciduous forest (mainly aspen) and graminoid meadows occupy 6.3% and 5.0% of South FMA, while pine- and spruce-dominated mixedwood forests represent 3.3% of the area. Past timber harvest comprises 5.4% of the area and is dominated by relatively recent, graminoid and low shrub dominated clearcuts. Barren natural land cover occupies 2.7% of the South FMA and is located mainly in the Moose Mountain area and along major river valleys. The other 10 physiognomic cover types (anthropogenic, cropland, aspen dominated mixedwood forest, forb meadow, natural shrubland, rangeland clearings, reclaimed areas, treed bog, waterbodies and improved pasture) occupy the remaining 5.0% and are concentrated mainly in the eastern section of the South FMA.

3.4.2 FMA North

A total of 29 vegetation cover types were mapped in the North FMA (Figure 3). The most common broad vegetation cover type is coniferous forest occupying 58.6% of the North FMA. Within the coniferous forest type, Lodgepole Pine-dominated stands (47.0% of North FMA) are the most common. Coniferous dominated mixedwood forest occurs on 8.4% of the North FMA and Lodgepole Pine-Aspen and White Spruce-Aspen mixedwood forests are the most common cover types in this class. Approximately 11.5% of the North FMA is occupied by lands associated with timber harvest. This cover type is dominated by recent (graminoid) harvest areas. Natural shrubland occupies 7.3% of the North FMA. Deciduous forest covers 4.8% of the North FMA and includes Aspen (4.7%), Balsam Poplar (0.1%), and White Birch (<0.01%). Deciduous dominated mixedwood forest occupies 5.2% of the North FMA. The remaining 11 cover types occupy 7.3% of the North FMA with cultivated areas and graminoid meadows the most common.

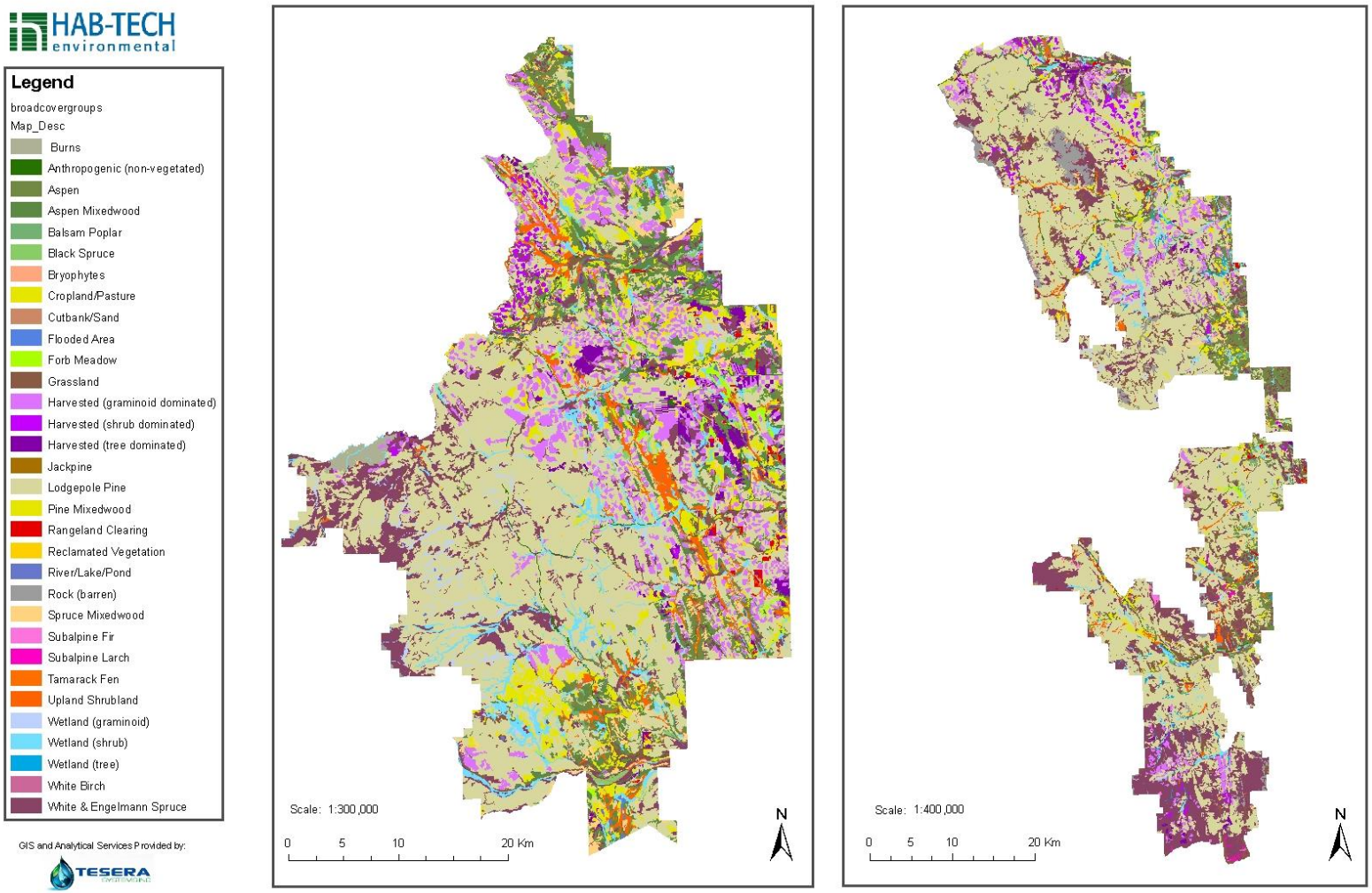

Figure 3. Vegetation cover in the SLS North FMA/ B9 Quota (left) and South FMA (right)

3.4.3 Vegetation Supply Comparison - North and South FMA

The main differences in the relative supply of vegetation/land cover types between the North and South portions of the FMA are:

- rock barren habitat above tree line is more common in the South FMA;
- timber harvest areas are approximately three times more common in the North FMA;
- mixedwood forest are significantly (>5x) more common in the North FMA than in the South FMA – particularly for deciduous mixedwood forest;
- tracts of black spruce that can be mapped occur in the North FMA but not in the South FMA;
- cropland is much more common in the South FMA;
- shrubby meadows are significantly (5x) more common in the North FMA; and
- wetlands are significantly (6x) more common in the North than in the South FMA.

The majority of these differences are due to the lower elevations that occur in the North FMA.

3.5 Land Uses

A wide variety of land uses occur in the FMA. The major industrial land use in addition to forestry is petroleum development. Forest harvest areas occupy approximately 9.3% of the FMA. Livestock grazing allotments occupy almost all of the FMA with the exception of high elevation western portions. Non-industrial land use in the southern portion of the FMA is dominated by recreation and tourism. The FMA is recognized for its diversity of recreational uses in part resulting from its high scenic and natural values as well as proximity to Calgary and many smaller communities located along the eastern boundary. Kananaskis Country and the associated Forest Land Use Zone, is recognized as a major outdoor recreation area in the province, with a wide variety of recreation and tourism activities occurring within or near the FMA. Non-motorized recreation activities are most prevalent in the southern portion of the FMA within Kananaskis. Motorized recreational activities, including random camping, are common across the FMA and are managed in part through four additional Public Land Use Zones and access management plans. Commercial trail riding businesses and trail user groups are common. A detailed description of activities is included under Category 5 below.

SLS (2006) reported average *open* motorized road density for cut compartments in the North FMA of 0.62 km/km^2 and for the South FMA 0.12 km/km^2. The average *total* motorized road density for compartments in the North FMA was 0.85 km/km^2 and 0.40 km/km^2 for the South FMA. Linear densities for cutline/trail features were considerably higher than for roads, ranging from a low of 1.32 km/km^2 to a high of 3.16 km/km^2. The average density of cutlines/trails was 2.56 km/km^2 in the North FMA and 1.89 km/km^2 in the South FMA.

4.0 ASSESSMENT

4.1 Category 1: Forest Areas Containing Globally, Regionally or Nationally Significant Concentrations of Biodiversity Values.

4.1.1 Key Question 1

Does the forest contain species at risk or potential habitat of species at risk as listed by international, national or territorial/provincial authorities?

Definitive Question
Are any of the rare, threatened or endangered species in the forest a species representative of habitat types naturally occurring in the management unit?

A number of species at risk are known to occur in and make use of naturally occurring habitat in the FMA. A list of vertebrate species at risk (73 total, excluding fish) and their status in the FMA, based on international/global, national, and provincial ranking bodies, is presented in Table 2. Status and abundance definitions are found in Appendix 1. Table 3 has a list of plant species (vascular and non-vascular) confirmed to occur in the FMA, and their status from ANHIC (now known as Alberta Conservation Information Management System – ACIMS) records from 1962 to 2010. Table 4 provides an additional list of vascular plants that were not recorded by ACIMS from 1962 to 2010, but have potential to occur based on known distribution and habitat preferences. Table 4 was compiled from a review of master rare plants species lists for the natural regions associated with the FMA/ B9, with corresponding typical habitat associations.

Guidance Questions
Are any of the rare, threatened or endangered species in the forest a focal species?
Are there any ecological or taxonomic groups of rare species that would together constitute a HCV?
Do any of the identified rare, threatened or endangered species (individually or concentration of species) have a demonstrated sensitivity to forest operations?
Does the forest contain critical habitat for any individual species or concentration of species identified in the above questions?

Table 2. Status of species at risk with known or potential occurrence in the SLS FMA

Common Name	Genus/Species	Status	Abundance	Provincial		National	
				General Status 2005	Alberta Wildlife Act	COSEWIC	SARA
Trumpeter Swan	*Cygnus buccinator*	M	U	At Risk	Special Concern	Not at Risk	
Northern Leopard Frog	*Rana pipiens*	R	R	At Risk	Threatened	Special Concern	Schedule 1
Peregrine Falcon	*Falco peregrinus*	M	S	At Risk	Threatened	Special Concern	
West Slope Cutthroat Trout	*Oncorynchus clarkii lewisi*	R	S	At Risk	Threatened	Threatened	Schedule 1
American Badger	*Taxidea taxus*	R	S	May be at Risk	Data Deficient	Not at Risk	
Wolverine	*Gulo gulo*	R	S	May be at Risk	Data Deficient	Special Concern	Schedule 3
Grizzly Bear	*Ursus arctos*	R	U	May be at Risk	Threatened	Special Concern	Schedule 3
Red Knot	*Calidris canutus*	M	S	May be at Risk		Endangered	Schedule 1
Long-tailed Weasel	*Mustela frenata*	R	U	May be at Risk		Not at Risk	
Short-eared Owl	*Asio flammeus*	S	S	May be at Risk		Special Concern	Schedule 3
Bull Trout	*Salvelinus confluentus*	R	U	Sensitive	Threatened	Threatened	
Prairie Falcon	*Falco mexicanus*	S	S	Sensitive	Special Concern	Not at Risk	
Long-toed Salamander	*Ambystoma macrodactylum*	R	C	Sensitive	Special Concern	Not at Risk	
Harlequin Duck	*Histrionicus histrionicus*	S	U	Sensitive	Special Concern		
White-winged Scoter	*Melanitta fusca*	M	U	Sensitive	Special Concern		
Western Grebe	*Aechmophorus occidentalis*	M	S	Sensitive	Threatened		
Barred Owl	*Strix varia*	R	U	Sensitive	Special Concern		
Black-throated Green Warbler	*Dendroica virens*	S	S	Sensitive	Special Concern		
Forster's Tern	*Sterna forsteri*	M	U	Sensitive		Data Deficient	
American White Pelican	*Pelecanus erythrorhynchos*	M	S	Sensitive		Not at Risk	
Bald Eagle	*Haliaeetus leucocephalus*	S	S	Sensitive		Not at Risk	

Northern Harrier	*Circus cyaneus*	S	U	Sensitive		Not at Risk	
Northern Goshawk	*Accipiter gentilis*	R	U	Sensitive		Not at Risk	
Golden Eagle	*Aquila chrysaetos*	R	U	Sensitive		Not at Risk	
Caspian Tern	*Sterna caspia*	M	S	Sensitive		Not at Risk	
Black Tern	*Chlidonias niger*	S	U	Sensitive		Not at Risk	
Northern Hawk Owl	*Surnia ulula*	R	S	Sensitive		Not at Risk	
Great Gray Owl	*Strix nebulosa*	R	U	Sensitive		Not at Risk	
Columbia Spotted Frog	*Rana luteiventris*	R	U	Sensitive		Not at Risk	
Rusty Blackbird	*Euphagus carolinus*	W	U	Sensitive		Special Concern	Schedule 1
Horned Grebe	*Podiceps auritus*	S	S	Sensitive		Special Concern	
Western Toad	*Bufo boreas*	R	C	Sensitive		Special Concern	
Common Nighthawk	*Chordeiles minor*	S	U	Sensitive		Threatened	Schedule 1
Sprague's Pipit	*Anthus spragueii*	S	S	Sensitive		Threatened	Schedule 1
Canada Warbler	*Wilsonia canadensis*	S	R	Sensitive		Threatened	Schedule 1
Northern Pintail	*Anas acuta*	S	U	Sensitive			
Green-winged Teal	*Anas crecca*	S	C	Sensitive			
Lesser Scaup	*Aythya affinis*	S	C	Sensitive			
Sharp-tailed Grouse	*Tympanuchus phasianellus*	R	S	Sensitive			
Pied-billed Grebe	*Podilymbus podiceps*	S	U	Sensitive			
American Bittern	*Botaurus lentigenosis*	S	S	Sensitive			
Great Blue Heron	*Ardea herodias*	S	U	Sensitive			
Osprey	*Pandion haliaetus*	S	U	Sensitive			
Broad-winged Hawk	*Buteo platypterus*	M	S	Sensitive			
Swainson's Hawk	*Buteo swainsoni*	S	S	Sensitive			
Sora	*Porzan carolina*	S	C	Sensitive			
Sandhill Crane	*Grus canadensis*	S	S	Sensitive			
Upland Sandpiper	*Bartramia longicauda*	S	S	Sensitive			

Purple Martin				Sensitive			
Northern Pygmy-Owl	*Glaucidium gnoma*	R	U	Sensitive			
Black-backed Woodpecker	*Picoides arcticus*	R	S	Sensitive			
Pileated Woodpecker	*Dryocopus pileatus*	R	U	Sensitive			
Least Flycatcher	*Empidonax minimus*	S	C	Sensitive			
Eastern Phoebe	*Sayornis phoebe*	S	U	Sensitive			
Eastern Kingbird	*Tyrannus tyrannus*	S	U	Sensitive			
Clark's Nutcracker	*Nucifraga columbiana*	R	U	Sensitive			
Barn Swallow	*Hirundo rustica*	S	C	Sensitive			
Brown Creeper	*Certhia americana*	R	S	Sensitive			
Cape May Warbler	*Dendroica carulescens*	S	R	Sensitive			
Bay-breasted Warbler	*Dendroica castanea*	S	R	Sensitive			
Common Yellowthroat	*Geothlypis trichas*	S	C	Sensitive			
Western Tanager	*Piranga ludoviciana*	S	U	Sensitive			
Brewer's Sparrow	*Spizella breweri*	S	S	Sensitive			
Bobolink	*Dolichonyx oryzivorus*	S	S	Sensitive			
Baltimore Oriole	*Icterus galbula*	S	U	Sensitive			
Silver-haired Bat	*Lasionycteris noctivagans*	S	C	Sensitive			
Hoary Bat	*Lasiuris cinereus*	S	U	Sensitive			
Water Vole	*Microtus richardsoni*	R	U	Sensitive			
Fisher	*Martes pennanti*	R	S	Sensitive			
Canada Lynx	*Lynx canadensis*	R	U	Sensitive			
Bobcat	*Lynx rufus*	R	S	Sensitive			
Wandering Garter Snake	*Thamnophis elegans*	R	S	Sensitive			
Red-sided Garter Snake	*Thamnophis sirtalis*	R	S	Sensitive			
Yellow Rail	*Coturnicops noveboracensis*	S	R	Undetermined		Special Concern	Schedule 1
Olive-sided Flycatcher	*Contopus cooperi*	S	U			Threatened	Schedule 1

Table 3. Occurrences of rare plant species in the SLS FMA – 1962 to 2010 (Source ACIMS)

Scientific Name	Rank		Survey Site	Site Description	Habitat
	Provincial	Global			
Mosses and Liverworts					
Anastrophyllum michauxii	S1	G4	McLean Creek	Moist shaded humus.	
Amblyodon dealbatus	S2	G3G5	Fisher Creek	P. tremuloides-P.glauca upland area. D. crassicostatus dom. aquatic, with calcareous rich fen mat incld R. pseudopunctatum M., flotoeriana A. palustre D. revolvens pH=8.2 cond=350uS	Fen/Bog
Aulacomnium androgynum	S2	G5	Fisher Creek	with Populus tremuloides-Picea glauca upland areas. D. crassicostatis dominant aquatic, with calcareous rich fen mat surrounding lake; mesic mature forest with many rotting logs	Fen/Bog
Brachythecium nelsonii	S2	G?	Elbow Ranger Station	on Sphagnum hummock near water line in carr area of wetland community; 4500 ft.	Fen/Bog
Brachythecium nelsonii	S2	G?	McLean Creek	side wet hummock, under Betula glandulosa, with grasses, Artemesia, Achillea, Arctostaphylos uva-ursa and Aster	Wet shrub
Brachythecium plumosum	S2	G5	Rocky Mountains	on calcareous and non-calcareous rock cliffs and boulders beside stream in Pinus contorta-Picea engelmannii-Abies lasiocarpa forest	Lithic
Brachythecium plumosum	S2	G5	Dry Creek	Picea/(Pinus)/(Abies)-Vaccinium scoparium; soil Brunisol; well drained	Conifer Forest
Brachythecium plumosum	S2	G5	Plateau Mountain	Larix/(Picea)/(Abies)-Vaccinium scoparium; soil Brunisol; well drained	Larch Forest
Bryum algovicum	S2	G4G45	McLean Creek	shaded dwarf willow and birch, hummocky area; wet bank of spring	Wet shrub
Bryum algovicum	S2	G4G45	Elbow River	near spring in exposed outcrop of Blairmore Foundation (sandstone), southern exposure, White spruce type	Lithic/Spirng
Bryum algovicum	S2	G4G45	Highwood River Road	spruce-aspen woods; wet soil on limestone rock	Lithic
Bryum algovicum	S2	G4G45	McLean Creek	at base of shrub, in aspen stand on slope; growing on woody soil	Deciduous forest
Bryum turbinatum	SU	G5	Elbow Ranger Station		
Campylium polygamum	S3	G5	Elbow Ranger Station	in wetland community; on humus at base of mature aspen; 4500 ft.	Wetland
Campylium polygamum	S3	G5	McLean Creek	growing with Abietinella abietinella in shale region on W side of creek, shaded by white spruce; on dead wood	Coniferous forest
Campylium polygamum	S3	G5	Elbow River	along N edge of river, ravine type habitat, localized bedrock exposures (Blairmore Formation: SS-shale), White Spruce river site; dry, sandy soil; 4700 ft.	Lithic
Campylium polygamum	S3	G5	Waiparous Creek	dense mature white spruce-feather moss woods, gentle N-facing slope; humus	Coniferous forest
Cirriphyllum cirrosum	S2	G5?	Kananaskis Area	on soil and rock of calcareous escarpment. Pseudotsuga-Abies lasiocarpa scattered on ledges. T. abietinum-Hylocomium-T. tortuosa-O. jamesianum-Barbula abundant	Lithic
Cirriphyllum cirrosum	S2	G5?	Moose Mountain	springy place, 60 degree east-facing talus slope; 7890 ft.	Spring/Seep
Cirriphyllum cirrosum	S2	G5?	Sibbald Flat	steep, shaded, seeping, north-facing limestone outcrop	Spring/Seep
Cirriphyllum cirrosum	S2	G5?	Canyon Creek	beside rivulet; on wet rocks	Lithic/Spring
Coscinodon calyptratus	S2	G3G5	Stony Creek	dry, south facing Populus tremuloides-Pseudotsuga menziesii-Picea glauca forest along seasonal stream with small waterfalls	Stream
Coscinodon calyptratus	S2	G3G5	Cat Creek	exposed conglomerate boulder, 40 deg. SW-facing grassy slope; crevices; 5250 ft.	Lithic
Coscinodon calyptratus	S2	G3G5	Highwood River	sandstone outcrop	Lithic
Coscinodon calyptratus	S2	G3G5	Macabee Creek	sandstone outcrop, S-facing ridge; sandstone rock	Lithic
Coscinodon calyptratus	S2	G3G5	Sibbald Creek	conglomerate outcrops, steep slope; on conglomerate	Lithic
Cynodontium tenellum	S2S3	G3G5Q	McLean Creek	open area in poplar-willow stand; on dry exposed limestone rock	Lithic
Desmatodon leucostoma	S2	G2G4	Cat Creek	steep north-facing limestone exposure; soil; 5300 ft.	Lithic
Dichelyma falcatum	S1	G4G5	McLean Creek	spring in shaded area of N-facing side of hill, partially covered by alder & willows; 4950 ft.	Spring/Seep
Dicranella crispa	S2	G3G5	Rocky Mountains	steep outcropping; on soil on rock	Lithic
Dicranella subulata	S2S3	G5?	Cat Creek	thin soil on slaty rock; 5300 ft.	Lithic
Dicranella subulata	S2S3	G5?	Elbow River	ravine type habitat, localized bedrock exp. (Blairmore Formation: SS-shale), White spruce river site type, periodic inundation; dry, sandy soil	Lithic
Dicranum tauricum	S1S2	G4	Elbow Falls Ranger Station	south facing slope, average angle 40 degrees, some lodgepole pine; on soil on dead branch; 4600 ft.	Coniferous forest-Steep
Didymodon subandreaeoides	S2	GU	Kananaskis Area	on soil & rock of calcareous escarpment; Pseudotsuga-Abies lasiocarpa scattered on ledges. T. abietinum-Hylocomium-T. tortuosa-O. jamesianum-Barbula abundant	Lithic
Didymodon fallax	S2	G5	McLean Creek	under Betula glandulosa, el.; on moist hummocks with grasses	Wet shrub
Drepanocladus crassicostatus	S2	G3G5	Fisher Creek	mat surrounding northern-most of two small hidden lakes	Wet meadow
Drepanocladus brevifolius	S1	GNRQ	Waiparous Creek	upper surface of boulder in stream, wet, open	Lithic/stream
Grimmia donniana	S2	G4G5	Threepoint Creek	sandstone talus, S-facing slope; crevices; 7000 ft.	Lithic
Grimmia donniana	S2	G4G5	Wilkinson Creek	by creek; acidic boulder	Lithic/stream
Grimmia montana	S2	G5?	Threepoint Creek	in steep sided canyon; crevices in boulder; 5300 ft.	Lithic
Grimmia torquata	S2	G3G5	Wilkinson Creek	steep north-facing rock wall beside creek; limestone rock; 5700 ft.	Lithic/stream
Gymnostomum aeruginosum	S2S3	G5	Stony Creek	dry slope, Populus tremuloides-Pseudotsuga menziesii-Picea glauca forest along seasonal stream with small waterfalls.	Stream
Gymnostomum aeruginosum	S2S3	G5	Elbow River	near spring in exposed sandstone outcrop, southern exposure; dry, calcareous soil; 4700 ft.	Lithic/spring
Homalothecium nevadense	S1	G4	Stony Creek	spruce-feathermoss; well drained	Coniferous forest
Homalothecium nevadense	S1	G4	Wilkinson Creek	steep N-facing rock wall beside creek; humus on rock face; 5700 ft.	Lithic/stream
Homalothecium nevadense	S1	G4	Cat Creek	steep N-facing limestone exposure; humus; 5300 ft.	Lithic
Homalothecium nevadense	S1	G4	Rocky Mountains	steep outcropping; soil on rock	Lithic
Homalothecium nevadense	S1	G4	Stony Creek	limestone outcrop, pine-spruce woods; cracks.	Lithic/Forest

Table 3. Occurrences of rare plant species in the SLS FMA – 1962 to 2010 (Source ACIMS)

Jaffueliobryum raui	S1	G4?	Elbow Falls	under picnis table; rock	Lithic
Limprichtia cossonii	SU	GU	Quirk Creek	wet meadow surrounded by white spuce	Wet meadow
Limprichtia cossonii	SU	GU	Little Elbow River	depression between hummocks, bog birch carr margin of rich fen	Fen/Bog
Limprichtia cossonii	SU	GU	Baril Creek	boggy area in white spruce woods	Fen/Bog
Limprichtia cossonii	SU	GU	Waiparous Creek	spruce.	Coniferous Forest
Limprichtia cossonii	SU	GU	Waiparous Creek	beside backwater of creek; wet soil	Stream
Orthotrichum affine	SU	G3G5	McLean Creek	NE side in white spruce stand; on old spruce; 4700 ft.	Coniferous Forest
Orthotrichum affine	SU	G3G5	Waiparous Creek	open white spruce woods with Arctostaphylos uva-ursi, Potentilla fruticosa & Juniperus communis, level gravel flat.	Coniferous Forest
Philonotis marchica	S1	G5	Fisher Creek		
Philonotis marchica	S1	G5	Waiparous Creek	inclined water-logged bog birch carr	Fen/Bog
Riccardia chamedryfolia	S?	G?	SW of Elbow Ranger Station	Rotton log, Picea glauca woods. With Lepidozia reptans, Lophozia porphyroluca, Lophocolea heteophylla, Lophozia ventricosa.	Coniferous Forest
Scouleria aquatica	S2	G4	Wilkinson Creek	north-facing outcrop; 6100 ft.	Lithic
Scouleria aquatica	S2	G4	McLean Creek	extracted from Tomenthypnum nitens, in willow fen, pH 5.9; 4800 ft.	Fen/Bog
Splachnum sphaericum	S2	G3G5	Fisher Creek	Foothills of E slopes of Rcky Mtns with Poputrem-Piceglau upland areas. Drepcras dominant aquatic, withcalcareous rich fen mat surrounding lake,mesic,mature forest with many rotting logs	Fen/Bog
Splachnum vasculosum	S2	G3G5	Raspberry Ridge Lookout Road	edge of spruce-pine-fir woods; cow dung	Coniferous Forest
Tayloria acuminata	SU	G3G5	Raspberry Ridge	soil in crevice, E-facing limestone outcrop	Lithic
Lichens					
Anaptychia setifera	S2	G3G4	Stony Creek	white spruce-Douglar fir-aspen/twinflower/feathermoss; on Picea glauca; Aspect: 346 deg, Slope: 8 deg.	Mixedwood Forest
Bacidia hegetschweileri	S1	G2G4	Highwood River	Populus balsamifera - Picea glauca woods. Populus x tricocarpa	Mixedwood Forest
Baeomyces rufus	S2	G5?	Jumping Pound Creek	sandstone outcrop, mature Picea glauca stands	Lithic/Forest
Bryonora castanea	S1	G3G5	Ford Creek	Pinus contorta woods, W-facing slope; conglomerate outcrop, on moss	Lithic/Forest
Bryoria simplicior	S2S3	G?	Fir Creek	S-facing slope with Populus tremuloides; Pseudotsuga menziesii and Pinus flexilis on lignum of prostrate log,	Mixedwood Forest
Bryoria trichodes	SU	G3G5	Cat Creek	on Picea glauca twigs	Coniferous Forest
Buellia turgescens	S1	G?	Jumping Pound Road	white spruce-lodgepole pine/feathermoss; on white spruce lignum; Aspect: 306 deg., Slope: 7 deg.	Coniferous Forest
Chaenotheca chrysocephala	S2	G?	Sibbald Creek	wet Picea glauca woods, on base of P. glauca.	Coniferous Forest
Ramalina intermedia	S1	G?	Jumping Pound Creek	sandstone outcrop, mature Picea glauca stand	Lithic/Forest
Calicium trabinellum	S2	G3G4	Sibbald Creek	wet Picea glauca woods, on lignum of P. glauca stump.	Coniferous Forest
Calicium trabinellum	S2	G3G4	Raspberry Ridge	wet Picea glauca woods, on old, decorticated stump at edge of a bog.	Coniferous Forest
Chaenotheca stemonea	S1	G?	Sibbald Creek	wet Picea glauca woods, on lignum of Picea glauca stump.	Coniferous Forest
Chaenotheca trichialis	S2	G?	Sibbald Creek	wet Picea glauca woods, on lignum of P. glauca stump.	Coniferous Forest
Chaenotheca xyloxena	S1	G?	Pasque Mountain	on alpine heath; on old decorticated stump of Picea engelmannii.	Alpine
Cladonia bacilliformis	S2S3	G3G4	Baril Creek	rotten log; Picea glauca wood	Coniferous Forest
Cladonia bacilliformis	S2S3	G3G4	Stony Creek	white spruce-Douglas Fir-aspen/twinflower/feathermoss; on rotting wood	Mixedwood Forest
Cladonia humilis	S1	G5?	Little Elbow River	hummocks, bog birch-willow carr	Fen/Bog
Cladonia ramulosa	S1	G5?	Waiparous Creek	humus, Picea glauce woods beside bog birch carr	Fen/Bog
Cyphelium inquinans	S2	G?	Sibbald Flats	In Pinus contorta-Picea glauca woods.; on Pinus contorta	Coniferous Forest
Endocarpon pusillum	S2	G?	Mount Head	steep slope with limestone outcrops; on crevice in limestone	Lithic/Forest
Ephebe lanata	S1	G5	Ford Creek	Pinus contorta woods, on conglomerate outcrops on mosses	Lithic/Forest
Lecidella anomaloides	S1	G?	Highwood River	exposed summit of mountain, rock	Lithic/Alpine
Lepraria incana	S2	G?	Stony Creek	exposed summit of mountain, rock	Lithic/Alpine
Leptogium furfuraceum	S2	G?	Chiniki Lake	conglomerate outcrop, on conglomerate	Lithic
Leptogium hirsutum	S1?	G?	Chiniki Lake	conglomerate outcrop, on conglomerate	Lithic
Leptogium tenuissimum	S2	G?	Waiparous Creek	well-rotted spruce log, nearly mature white spruce woods.	Coniferous Forest
Lopadium pezizoideum	S1	G?	Cat Creek	on mosses, steep limestone exposure.	Lithic
Melanelia subelegantula	S2	G?	Stony Creek	white spruce-Douglas fir-aspen/twinflower/feathermoss; on white spruce; Aspect: 346 deg.; Slope: 8 degrees; Site D001	Mixedwood Forest
Micarea assimilata	S2	G?	Plateau Mountain	subalpine larch/grouseberry; on soil; Aspect: 174 deg., Slope: 2 degrees; Site A022	Larch Forest
Mycocalicium subtile	S2	G?	Sibbald Creek	wet Picea glauca woods, on lignum of Picea glauca stump.	Coniferous Forest
Phaeophyscia nigricans	S2	G4	Cat Creek	on conglomerate boulder in E side tributary	Lithic/Stream
Phaeophyscia sciastra	S2	G4	Paddy's Flat Recreational Area	river flat area with forest of Picea glauca, Pinus contorta, Populus tremuloides, P. balsamifera, Betula papyrifera/Salix bebbiana, Sheperdia canadensis, sandstone outcrops in area	Stream
Psora nipponica	S2	G?	Ford Creek	Pinus contorta woods, on conglomerate outcrops.	Lithic/Forest
Psora tuckermanii	S2	G5	Brag Creek	steep south-facing sandstone outcrop.	Lithic
Rhizocarpon concentricum	S1	G?	Jumping Pound Creek	Sandstone outcrop, mature Picea glauca stand, NE facing slope.	Lithic/Forest
Umbilicaria americana	S2	G?	Cat Creek	face of fine grained sandstone cliff	Lithic
Umbilicaria americana	S2	G?	Cat Creek	on fine-grained sandstone outcrop, in shade of Pseudotsuga menziesii, steep south-facing slope.	Lithic/Forest
Verrucaria hydrela	S1	G?	Ford Creek	on rocks in running water of stream	Lithic/Stream
Xylographa parallela	S2	G?	Raspberry Ridge		Alpine

Table 3. Occurrences of rare plant species in the SLS FMA – 1962 to 2010 (Source ACIMS)

Vascular Plants					
Agoseris lackschewitzii	S2	G4	Jumpingpound Creek		
Antennaria corymbosa	S1	G5	Barrier Lake	In soil pocket on bedrock	Lithic
Arabis lemmonii	S2	G5	Cataract Creek	Open alpine slope.	Alpine
Arnica longifolia	S2	G5	Kananaskis Country	between rocks & boulders above bank of creek	Lithic/Stream
Carex adusta	S1	G5	Plateau Mountain	alpine meadow , above timberline	Alpine
Carex tincta	S1	G4G5	Moose Dome Creek		
Castilleja cusickii	S2S3	G4G5	Moose Dome Creek	understory of partially closed canopy of pine-spruce-fir on a flattened calcareous ridge top and upper slopes; Picea engl, Abies lasi, Pinus cont, Juni comm, Shep cana, Arct uva, Elym inno, Pleu schr	Ridge top
Draba porsildii	S2	G3G4	Moose Mountain	talus, saddle.	Talus
Epilobium lactiflorum	S2	G5	Jumpingpound Creek		
Erigeron radicatus	S2	G3	Jumpingpound Creek		
Erigeron radicatus	S2	G3	Moose Dome Creek	fine-textured shattered limestone exposures; level or shallow slopes; with Dryas octopetala community with Carex rupestris and/or Kobresia myosuroides; exposed rock varied between 40-75% of ground surface	Lithic
Lesquerella arctica var purshii	S2	G4TNR	Canyon Creek	Gravel outwash flat of Canyon Creek	Stream
Listera convallarioides	S2	G5	Sibbald Flat	boggy wood by beaver dam	Pond
Papaver radicatum ssp kluanense	S2	G5T3T4	Moose Mountain	Talus	Talus
Parnassia parviflora	S2	G4	Meadow Creek	On boggy patch.	Fen/Bog
Pellaea gastonyi	S1	G2G3	Kananaskis Forest Experimental Station	exposed SW-facing limestone cliff in crevices & ledges under scattered Pseudotsuga menziesii w/ few Juniperus horizontalis, Potentilla fruticosa.	Lithic/Forest
Pellaea gastonyi	S1	G2G3	Mount Head	steep slope with limestone outcrops, on soil in crevices	Lithic
Penstemon fruticosus var scouleri	S2	G4T4	Wilkinson Creek	road cut	Anthropogenic
Pinus albicaulis	S2	G4	Highwood River		Whitebark Pine Forest
Pinus albicaulis	S2	G4	Highwood River		Whitebark Pine Forest
Pinus albicaulis	S2	G4	Highwood River		Whitebark Pine Forest
Pinus albicaulis	S2	G4	Highwood River		Whitebark Pine Forest
Pinus flexilis	S2	G5	Highwood River	Limber pine scree slope	Limber Pine Forest
Pinus flexilis	S2	G5	Highwood River		Limber Pine Forest
Pinus flexilis	S2	G5	Ghost River		Limber Pine Forest
Pinus flexilis	S2	G5	Jumpingpound Creek		Limber Pine Forest
Pinus flexilis	S2	G5	Highwood River		Limber Pine Forest
Pinus flexilis	S2	G5	Sullivan Creek		Limber Pine Forest
Pinus flexilis	S2	G5	Highwood River		Limber Pine Forest
Potentilla hookeriana	S2		Elbow Falls	rock crevices by the falls	Lithic/Stream
Primula egaliksensis	S2	G4	Red Deer River	in small wet muskeg; open area in spruce trees is 20 m across; on the river flat.	Fen/Bog
Ranunculus glaberrimus	S2	G5	Cataract Creek	open mountain meadow	Alpine
Ranunculus glaberrimus	S2	G5	McLean Creek	in open aspen-grassland in McLean Creek OHV area	Deciduous Forest
Silene involucrata	S1S2	G5	Moose Mountain	pine-spruce forest	Coniferous Forest
Trichophorum pumilum	S2	G5	Lusk Creek	Hillside flush wet; calcareous soil.	Spring/Seep

Table 4. Rare vascular plant species with potential to occur in the SLS FMA

Scientific Name	Common Name	Rank		Habitat Affiliation	Habitat Type
		Provincial	Global		
Amaranthus californicus	Californian amaranth	S1S2	G4	lake shores, waste ground, roadsides	Lake
Arnica amplexicauls	Stem-clasping arnica	S2	G4G5	moist montane woods	Forest-moist
Arnica longifolia	Long-leaved arnica	S2	G5	Open rocky subalpine slopes	Lithic Slope
Arnica louiseana	Rock arnica	S1S3	G3	Alpine slopes and ledges	Alpine
Arnica parryi	Nodding arnica	S2	G5	Open montane woods	Forest -open
Aster eatonii (Symphyotrichum eatonii)	Eaton's aster	S2	G5	Moist montane woodland, stream banks	Forest-stream
Aster x maccallae		S1S2	GNA	Moist woods	Forest-moist
Crepis atrabarba	Hawk'sbeard	S2	G5	Dry, open mountain slopes	Forest-dry-open
Erigeron lackschewitzii	Front range fleabane	SU	G3	Dry, open mountain slopes	Forest-dry-open
Erigeron ochroleucus var. scribneri	Yellow alpine fleabane; Buff fleabane	S1?	G5T5	Dry, open mountain slopes	Forest-dry-open
Erigeron pallens (E. purpuratus)	pale alpine fleabane	S2	G4	Rocky alpine slopes	Alpine-Lithic
Erigeron trifidus	trifid-leaved fleabane	S3?	G2G3Q	Alpine slopes	Alpine
Saussurea americana	American saw-wort	S1	Gr	Moist meadows, moist open slopes	Meadow /Open forest
Townsendia exscapa	Low townsendia	S2	G5	Dry hillsides and prairies	Grassland
Arabis lemmonii	Lemmon's rock cress	S2	G5	Alpine slopes	Alpine
Braya humilis (ssp. Maccallae or Porsildii)???		S1	G5T2T3Q	Moist to dry open woods, banks, gravel bars to alpine elevations	Forest-variable
Draba macounii	Macoun's whitlow-grass	S2	G3G4	Alpine slopes	Alpine-
Draba paysonii var. treleasii	whitlow-grass	S2?	G5T4T5	Alpine scree	Alpine-Talus
Draba porsildii	Porsild's whitlow-grass	S1S2	G3G4	Moist banks and turfy slopes at alpine elevations	Alpine
Draba ventosa	whitlow-grass	S2	G3	Alpine scree	Alpine-Talus
Lesquerella arctica var. purshii	northern bladderpod	S2	G4TNR	Sandy slopes and ridges to alpine elevations	Alpine-Talus
Rorippa curvipes	Yellow cress	SU	G5	Moist ground	
Rorippa curvipes var. truncata	blunt-leaved yellow cress	S1S2	G5	Moist ground	
Campanula uniflora	Alpine harebell	S2	G4	Alpine slopes	Alpine
Arenaria longipedunculata	Sandwort	S1	G3G4Q	Moist gravelly areas at higher elevations	Alpine-open
Silene involucrata	alpine bladder catchfly	S1S2	G5	gravelly and turfy alpine slopes	Alpine-open
Stellaria umbellata	Chickweed	S1	G5	moist montane forests	Forest-Moist
Carex crawei	Crawe's sedge	S2	G5	Calcareous meadows	Wet meadow -calcareous
Carex glacialis	Glacier sedge	S2	G5	Alpine slopes	Alpine
Carex illota	small-headed sedge	S1	G4G5	Moist mountain slopes and alpine meadows	Alpine
Carex incurviformis var. incurviformis	Seaside sedge	S2	G4G5T4T5	gravelly alpine areas	Alpine-lithic
Carex lachenalii (Carex bipartita)	Two-parted sedge	S2	G5	Moist alpine slopes and snow beds	Alpine
Carex lacustris	Lakeshore sedge	S2	G5	Marshes and swampy woods	Marsh-swamp
Carex petasata	Pasture sedge	S1S2	G5	Dry grasslands and open woods	Grassland
Carex platylepis	Broad-scaled sedge	S1S2	G4?	Dry open coniferous woods	Open Forest-dry
Carex umbellata	Umbellate sedge	S2	G5	Dry open areas, often sandy	Grassland
Eleocharis engelmannii	Engelmann's spike rush	S1	G4G5Q	wet places	
Woodsia glabella	Smooth woodsia	S1	G5	Moist, shaded, usually calcareous sites; boulders, cliff ledges, crevices	Lithic
Gentiana fremontii	Marsh gentian	S2	G4	moist grassy meadows	Meadow
Lomatogonium rotatum	Marsh felwort	S2S3	G5	wet meadows and saline flats	Wet meadow
Ribes laxiflorum	Mountain current	S2	G5	moist subalpine woods	Forest-subalpine
Hippuris montana	Mountain mare's-tail	S1	G4	mountain streams and mossy banks	Stream
Sisyrinchium septentrionale	Pale blue-eyed grass	S3	G3G4	moist meadows and grassy streambanks	Meadow -Stream
Juncus biglumis	Two-glumed rush	S2	G5	moist alpine areas	Alpine
Juncus parryi	Parry's rush	S2	G4G5	wet meadows and slopes in the mountains	Wet meadow
Epilobium lactiflorum	Willow herb	S2	G5	montane stream banks and moist slopes to alpine elevations	Alpine-stream
Epilobium clavatum	Willow herb	S2	G5	moist alpine slopes	Alpine
Epilobium luteum	Willow herb	S1	G5	moist woods and stream banks in the mountains	Stream
Epilobium saximontanum	Rocky Mountain Willow herb	S1	G5	moist montane and subalpine meadows and stream banks	Meadow -Stream

Table 4. Rare vascular plant species with potential to occur in the SLS FMA (continued)

Botrychium ascendens	Ascending grape fern	S2	G2G3	grassy openings in mountain forests	Grassland
Botrychium boreale	Northern grape fern	SU	GNR	open, grassy subalpine and alpine areas	Grassland
Botrychium hesperium	Western grape fern	SU	G3G4	wooded areas	
Botrychium lanceolatum	lance-leaved grape fern	S2	G5	mountain slopes	
Botrychium pinnatum	Northwestern grape fern	S3	G4?	open, moist to mesic sites in montane, subalpine and alpine	Meadow
Botrychium simplex	Dwarf grape fern	S2	G5	moist meadows and edges of wetlands	Meadow
Platanthera stricta	slender bog orchid	S2	G5	wet meadows and forests	Wet meadow-Forest
Larix occidentalis	Western Larch	S2	G5	upper foothills, montane	
Pinus albicaulis	White-bark pine	S2	G4	timberline belt	Forest-dry open
Pinus flexilis	Limber pine	S2	G5	exposed rocky slopes and hilltops to subalpine elevations	Forest-dry open
Thuja plicata	Western Red Cedar	S1S2	G5	foothills and montane	
Agrostis humilis	Low bent grass	S2	G4	moist alpine areas	Alpine
Alopecurus alpinus	Alpine foxtail	S2?	G5	shores and open woodland	Lakeshore
Festuca minutiflora	Tiny-flowered fescue	S2	G5	alpine tundra and meadows and subalpine openings	Alpine
Glyceria elata	tufted tall manna grass	S2	G4G5	stream edges and wet meadows	Stream-Wet meadow
Poa lettermanii	Letterman's bluegrass	S1	G4	exposed alpine ridges in dry, rocky fellfields	Alpine-lithic
Poa stenantha	bluegrass	S1	G5	open woods at montane elevations	Forest-open
Potamogeton foliosus	Leafy pondweed	S2	G5	shallow, standing water	Marsh-swamp
Primula egaliksensis	Primrose	S2	G4	marshy ground, wet meadows and shores in subalpine and alpine	Wet meadow-marsh
Cryptogramma stelleri	Stellar's rock brake	S2	G5	cool, shaded, calcareous sites, on rock or in springs	lithic-stream
Pellaea glabella	Smooth rock brake	S2	G5	calcareous cliffs and ledges	Lithic
Ranunculus glaberrimus	Early buttercup	S2S3	G5	grasslands and meadows in the prairies	Grassland/Meadow
Potentilla drummondii (P. drummondii ssp. drummondii)	Drummond's cinquefoil	S2	G5	moist meadows in subalpine and alpine areas	Meadow
Potentilla hookeriana	Hooker's cinquefoil	S2	G4	dry, rocky alpine slopes	Alpine-Lithic
Potentilla macounii	Macoun's cinquefoil	S1	G1?	dry, rocky slopes	Alpine-Lithic
Potentilla multisecta	smooth-leaved cinquefoil	S2	GNR	dry alpine slopes	Alpine-Lithic
Potentilla villosa	Hairy cinquefoil	S2	G4	alpine slopes and ridges	Alpine
Salix alaxensis var. alaxensis	Alaska willow	S2S3	G5T4T5	alpine slopes	Alpine
Salix commutata	Changeable willow	S2	G5	subalpine areas	
Salix lanata ssp. calcicola	Wooly willow	S1	G4G5T4	calcareous riverbanks, floodplains and meadows	Meadow
Lithophragma glabrum	Rockstar	S2	G4G5	moist mountain meadows and open woods	Meadow
Saxifraga flagellaris ssp. setigera	Spiderplant	S2	G5T3T5	moist, turfy, limestone slopes and ridges in alpine areas	Alpine
Saxifraga nivalis	Alpine saxifrage	S2?	G4G5	moist alpine slopes, ridges and rock crevices	Alpine-lithic
Pedicularis flammea	Flame-coloured lousewort	S2	G3G5	calcareous alpine meadows	Alpine-calcareous
Pedicularis racemosa	Leafy lousewort	S1	G5	dry, open subalpine slopes	Grassland
Penstemon fruticosus var. scouleri	Shrubby beardtongue	S2	G4T4	dry, rocky slopes and open woods in subalpine and alpine zones	Meadow
Aster engelmannii (Eucephalus engelmannii)	Elegant aster	S3S4	G4G5	open montane woods	Forest-open
Erigeron lanatus	Wooly fleabane	S3	G3G4	Rocky alpine slopes	Alpine-lithic
Senecio megacephalus	Large-flowered ragwort	S3	G4	rocky alpine and subalpine slopes	Alpine-Lithic
Minuartia nuttallii spp. nuttallii	Nuttall's sandwort	S3	G5T4T5	dry open areas to alpine elevations	Alpine
Sedum stenopetalum	Narrow-petaled stonecrop	S3	G4G5	dry rocky slopes	Lithic
Carex capitata	Capitate sedge	S3	G5	boggy, often calcareous areas	Fen/bog-calcareous
Carex hookerana (Carex hookeriana)	Hooker's sedge	S3	G4?	plains, dry banks and open woods	grassland-dry
Carex parryana var. parryana	Parry's sedge	S3	G4T4	moist habitats	
Trichophorum pumilum	Dwarf bulrush	S3	G5	calcareous bogs	Fen/bog-calcareous
Drosera linearis	Narrow-leaved sundew	S3	G4	bogs	Fen/bog
Gentiana glauca	Alpine gentian	S3	G4G5	moist subalpine and alpine banks and ledges	Alpine-lithic
Phacelia hastata	silver-leaved scorpionweed	S3	G5	dry slopes and valleys	Grassland-dry
Schizachyrium scoparium var. scoparium (Schizachyrium scoparium ssp. scoparium)	Little bluestem	S3	G5T5	prairie grassland	Grassland
Claytonia megarhiza	Alpine spring beauty	S3	G4G5	rock crevices and talus at alpine elevations	Alpine-talus
Pyrola grandiflora	Arctic wintergreen	S3	G5	alpine slopes and tundra	Alpine
Parnassia parviflora (P. palustris var. parviflora)	small northern grassof-parnassus	S3	G4	bogs and stream banks	Fen/Bog
Saxifraga ferruginea	Saxifrage	S3	G5	moist alpine banks and ledges	Alpine

4.1.1.1 Vertebrates

Species of International/Global Significance

Two databases were searched to determine if any species occurring in the FMA are currently listed internationally or globally. They were the IUCN Red List, and NatureServe Canada (amalgamated Conservation Data Centre lists). Species 'red-listed' by the IUCN that occur in the FMA include Olive-Sided Flycatcher (near threatened), Rusty Blackbird (vulnerable), Western Toad (near threatened), Bull Trout (vulnerable) and Sprague's Pipit (vulnerable). No G1 (critically imperiled), G2 (imperiled) or G3 (vulnerable) ranked species occur on the NatureServe lists. Westslope cutthroat trout are ranked as G4T3, indicating the species as a whole is secure, but the subspecies is vulnerable. All of the above red-listed species were ranked as G4 (apparently secure) according to NatureServe.

The Olive-sided Flycatcher is not considered to be a suitable HCVF attribute because there is considerable scientific uncertainty as to whether the open habitats created by timber harvest offer suitable habitat for this species (COSEWIC 2007a). Additional region-specific research would be required to resolve this uncertainty. Rusty blackbirds use riparian wetlands and rarely occupy interior forest. Riparian buffer requirements associated with the 2009 Timber Harvest Planning and Operating Ground Rules (OGRs) (SLS and AESRD 2009) used to manage SLS operational activities will mitigate impacts on this species, and it is not considered to be a HCVF attribute under this question. There is little evidence that timber harvest affects the use of habitat by western toad (COSEWIC 2002), therefore it is not considered to be a HCVF attribute. Sprague's Pipit is a grassland-obligate that lies at the western edge of its range in the FMA. Forestry operations are expected to have negligible impacts on this species and it is not considered to be a suitable HCVF attribute.

The Westslope Cutthroat Trout is a sub-species of Cutthroat Trout, a salmonid species native to western North America. The species has evolved to live in cold freshwater environments with clean water and abundant instream cover. They are sensitive to changes in temperature and sediment loads and are viewed as an indicator species of general ecosystem health (COSEWIC 2006). In Alberta, pure Westslope Cutthroat trout are extirpated throughout most of their historic range in the Bow and Oldman drainages of the South Saskatchewan River basin. Existing populations are threatened by over-fishing, population fragmentation, land-use activities that alter or deplete aquatic and riparian habitats, and hybridization with non-native subspecies of Cutthroat Trout and Rainbow Trout. Native populations have been marginalized and are generally found in steep, forested headwater basins (Costello 2006). Maintenance of the genetic purity of the remaining populations is usually due to the presence of a natural barrier to migration (Westslope Cutthroat Trout Recovery Team 2013). Headwater basins typically experience the most extreme seasonal fluctuations in discharge and temperature in a stream network (Schlosser 1995) and therefore there is concern about the long-term viability of these remnant populations.

It can be difficult to visually distinguish pure Westslope Cutthroat Trout from introduced Cutthroat Trout and Rainbow-Cutthroat Trout hybrids. The only way to be certain about identification is by genetic testing. The AESRD has collected DNA from suspected Westslope Cutthroat Trout in Alberta to map pure strains and populations exhibiting low levels of genetic introgression (hybridization) within each watershed. This information has been used to develop a recovery plan for Alberta pure-strain populations (Westslope Cutthroat Trout Recovery Team 2013). Recommendations in the recovery plan include protecting and enhancing habitat, restricting development in areas with critical habitat, installing barriers to protect pure-strain populations, and angler management in critical habitat areas (Westslope Cutthroat Trout Recovery Team 2013).

In summary, the Westslope Cutthroat Trout is a suitable HCVF attribute because: 1) it is at risk nationally and provincially; 2) it has utility as a focal species; 3) important habitat is present in the FMA; and, 4) it is potentially sensitive to forestry operations.

Bull Trout occur in a number of watersheds in the SLS FMA. Bull Trout populations have declined in both distribution and abundance and are considered a *Threatened Species* in Alberta. Bull Trout is the only char species to have occupied all drainages on the eastern slopes of Alberta (Berry 1994, Nelson and Paetz 1992). However, populations have been extirpated in three core areas, with 81% of core areas at risk of extirpation (AESRD and ACA 2009). Bull Trout spawn in small streams and the young inhabit their natal stream, but may move to other waters as they mature. Adult Bull Trout exhibit a variety of adult life history strategies, including: 1) residents that live in the same stream or tributaries in which they were born; 2) fluvial adults that move to larger streams and migrate back to their natal stream to spawn; and, adfluvial adults that migrate to large lakes and return to their native stream to spawn. This variety of life history strategies is important to the stability and persistence of populations, but also complicates restoration and conservation because a diversity of high quality habitats is needed. When individual habitat components are altered, by human or natural events, Bull Trout populations may be negatively impacted (AESRD and ACA 2009).

Bull Trout are viewed as an indicator species for environmental disturbance due to their specific habitat requirements that influence their distribution and abundance. They are sensitive to increased water temperature, poor water quality and low flow conditions. They require stable stream channels, clean spawning and rearing gravel, complex and diverse cover, and unblocked migratory corridors (Fraley and Shepard 1989, AESRD and ACA 2009).

Past and continuing land management activities have degraded stream habitat, especially along larger river systems and stream areas located in valley bottoms, to the point where Bull Trout can no longer survive or reproduce successfully. In many watersheds, remaining Bull Trout are small, resident fish isolated in headwater streams. Factors contributing to declines of Bull Trout populations include: habitat degradation and loss due to land and water management practices; angling pressure, isolation and fragmentation of populations by structural migration barriers; introduction of non-native fishes resulting in competition, predation and hybridization threats; and historical eradication efforts (Fraley and Shepard 1989, Donald and Stelfox 1997, AESRD and ACA 2009, AESRD 2012).

Many of the actions intended to protect other declining salmonids may also benefit Bull Trout. Stream and habitat protection and restoration, reduction of siltation from roads and other erosion sites, proper sizing and installation of stream crossing structures to provide habitat connectivity, and modification of land management practices to improve water quality and temperature are all important.

In summary, the Bull Trout is a suitable HCVF attribute because of its utility as a focal species, the occurrence of important habitat in the FMA, and its potential sensitivity to forestry operations.

Species of National (Canada-wide) Significance

Sixteen (16) species that occur in the FMA are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and/or the Species at Risk Act (SARA), as follows (note that all are listed in Table 2, with the exception of Westslope Cutthroat Trout):

- Red Knot — Endangered/Schedule 1
- Common Nighthawk — Threatened/Schedule 1
- Sprague's Pipit — Threatened/Schedule 1
- Olive-sided Flycatcher — Threatened/Schedule 1
- Canada Warbler — Threatened/Schedule 1
- Westslope Cutthroat Trout — Threatened/Schedule 3
- Rusty Blackbird — Special Concern/Schedule 1
- Yellow Rail — Special Concern/Schedule 1
- Wolverine — Special Concern/Schedule 3
- Grizzly Bear — Special Concern/Schedule 3
- Northern Leopard Frog — Special Concern/Schedule 3
- Short-eared Owl — Special Concern/Schedule 3
- Peregrine Falcon — Special Concern
- Horned Grebe — Special Concern
- Western Toad — Special Concern
- Bull Trout — Threatened/No Schedule

The red knot is a shorebird that breeds in barren areas not subject to timber harvest operations (COSEWIC 2007b). It is not a suitable HCVF attribute. Common nighthawks prefer open habitats such as those provided by timber harvest (COSEWIC 2007c). There is no indication that timber harvest negatively impacts this species and it is not a suitable HCVF attribute. Canada warbler is primarily a boreal forest bird that is at the south-western edge of its range in the FMA. Timber harvest is not a major factor contributing to population declines of this species (COSEWIC 2008). For these reasons, it is not considered to be a suitable HCVF attribute.

Yellow rail is an obligate of sedge marshes and wet riparian grasslands and is at the western edge of its range in the FMA (Alvo and Robert 1999). Its primary habitat is generally not impacted by timber harvesting, as harvesting is excluded in marshes and wet grasslands. Therefore, it was not considered to be a suitable HCVF attribute. Wolverines are very sparsely distributed in the FMA and in the Rocky Mountains occur primarily in the more rugged western main range (Holroyd and VanTighem 1983, Petersen 1997, COSEWIC 2003). Timber harvest does not necessarily exert negative effects on wolverine habitat, although road access and increased trapping pressure could be a negative factor (COSEWIC 2003). Only a small portion of the SLS timber harvest occurs in high-elevation deep snow habitat favored by wolverines. For the above reasons, this species was not identified as a suitable HCVF attribute for the FMA.

The SLS FMA and region offer primary source habitat for grizzly bears (Herrero 2005, AESRD and ACA 2010). Grizzly bears were listed in June of 2010 as threatened in Alberta under the Wildlife Act because of low population levels. The Spray Lake FMA lies within two grizzly bear study areas. The north FMA is found within the Clearwater population unit that supports a density of 5.2-bears/1000 km^2. The southern portion of the FMA occurs within the Livingstone population unit that supports a population density of 11.8-bears/1000 km^2. Garshelis (2005) determined that the grizzly bear population in the Bow River drainage (includes the northern portion of the Livingstone unit) was slightly increasing. Festa-Bianchet (2010) noted that although the population trend in most of Alberta is unknown, it could be inferred that access-mediated mortality is likely leading to grizzly bear population decline in portions of Alberta.

The effects of timber harvest on grizzly bears are mixed with researchers noting generally positive effects on forage availability and use in early-seral cutblocks, yet negative effects relating to increased mortality. Resource selection function modeling by Nielsen et al. (2004a) and Roever et al. (2008a) showed that radio-collared grizzly bears generally selected clearcut (mainly edges) and areas adjacent to roads above and beyond their placement on the landscape. It appears that this selection is highly food-motivated. Nielsen et al. (2004b) assessed the occurrence and fruit production of 13 grizzly bear foods to better understand use of clearcuts by grizzly bears. Ants, horsetail, hedysarum, dandelion, clover and one species of blueberry (*Vaccinium myrtilloides*) had higher frequencies of occurrence in clearcuts than in adjacent upland forest stands. Total fruit production was slightly higher in forested than nearby clearcut stands. The authors found that soil scarification of clearcuts reduced frequency of hedysarum, buffaloberry and ants - all important seasonal grizzly bear foods. The authors also noted that terrain variables including elevation, compound topographic index, and slope aspect index strongly influenced grizzly bear food occurrence. Nielsen et al. (2004a) cautioned that human access (roads/trails) into and adjacent to food-rich clearcuts could result in increased grizzly bear mortality and more than offset positive aspects of forage increases.

Roever et al. (2008b) measured the abundance of 16 grizzly bear foods near roads and examined patterns of road placement to better understand use of roadside habitats by grizzly bears. They found that roadside habitats supported a higher occurrence of herbaceous early-season bear foods including ants, horsetail, dandelion, clover, and graminoids. The authors recommended that roadside clover (*Trifolium* spp.) was highly attractive to grizzly bears and that planting of this nutrient rich forage on roadsides should be banned because of potential bear mortality concerns.

Grizzly bears are often used as a coarse-filter focal or umbrella species for biodiversity conservation (Carroll et al. 2001, Hannon and McCallum 2004). Carnivores with large area requirements are suggested to be umbrella species using the assumption that the area of habitat required to support viable populations will protect sufficient habitat for other species with lesser area requirements (Noss et al. 1996). Carroll et al. (2001) showed that the habitat requirements of grizzly bears overlap significantly with those of wolverines. Hence regional management approaches intended to protect grizzly bear populations should have positive benefit for wolverines.

In summary, the grizzly bear is a suitable HCVF attribute for the SLS FMA because: 1) its potential as a focal species for regional landscape management; 2) the Spray Lake FMA occurs in primary habitat for grizzly bears; and 3) timber harvest has potential for both positive and negative effects on grizzly bear populations.

The northern leopard frog may or may not occur in the FMA currently as the foothills of the Rocky Mountains in southern Alberta represent the far western edge of its historic/current range (Wagner 1997, COSEWIC 2000, Kendall and Prescott 2007). This species is tied very closely to breeding ponds. If it does occur in the FMA, OGR buffer requirements around water bodies and the avoidance of timber harvesting around ponds and wetlands should mitigate impacts to this species. As such, this species was not identified as a suitable HCVF attribute for the Spray Lake FMA. The short-eared owl is at the western edge of its range in the eastern portion of the FMA (Clayton 2000). It requires open areas for foraging and breeding and is not subject to the effects of timber harvest. As such it is not a suitable HCVF attribute for the FMA. Peregrine falcons nest on large riverbanks and may not occur in the FMA based on recent distribution reports (Alberta Peregrine Falcon Recovery Team 2005). Timber harvest is not a limiting factor of peregrine falcon populations and as such, this species is not suitable as a HCVF attribute in the FMA. Horned grebes forage and breed in semi-permanent and permanent ponds, marshes and small lakes. Such areas are excluded from timber harvest and are buffered based on the OGRs. It was not identified as a suitable HCVF attribute for the FMA.

Species of Provincial Significance

All of the globally and nationally listed species discussed above are listed provincially at some level (refer to Table 2). An additional 59 species are listed in Alberta but are not listed nationally or internationally/globally. Of these 59 species, the Western Grebe is listed as *Threatened*; the American badger as *May be at Risk-Data Deficient*; and the Long-tailed weasel as *May be at Risk*. The western grebe is an aquatic species that is not sensitive to forestry operations and is very rare in the FMA. The American badger and long-tailed weasel are edge of range prairie species that are very rare in the FMA and not subject to timber harvest effects. None of the 3 species were identified as suitable HCV attributes for the Spray Lake FMA.

Seven of the 59 species are listed as *Sensitive-Special Concern* and include: The Trumpeter swan, Long-toed salamander; Harlequin duck; White-winged scoter; barred owl; and black-throated green warbler. The remaining 49 species are listed as *Sensitive* under the 2005 Alberta General Status document but are not listed under the Alberta Wildlife Act.

WWF-Canada (2005) advises that species that are considered to be at somewhat lower levels of risk (e.g. Special Concern, Vulnerable, Rare, populations in decline, but not yet formally listed) may also qualify as HCVs. Consideration is given if they: 1) are presently known to be experiencing continuing population decline or range retraction (relative to historical levels); 2) are known to be vulnerable to changes in their habitat conditions caused directly by forestry operations and/or indirectly by its related infrastructure (e.g. roads, increased human access); and/or 3) occur in concentration in a particular habitat or region.

Fifty-three species listed as sensitive under the Provincial 2005 Alberta General Status document are presented in Table 5, with notes referring to whether or not these species meet the 3 qualification criteria listed above. An additional screening criterion was added, indicating whether or not the FMA serves as primary range for the species in a provincial context.

Species that use the FMA as primary range, are vulnerable to forestry, use specific habitats, and have a declining or uncertain population trend were identified as HCVF attributes. These include: northern goshawk; black-backed woodpecker; brown creeper; sandhill crane; pileated woodpecker; Canada lynx; barred owl; great gray owl; long-toed salamander; and Columbia spotted frog.

Table 5. Species listed Provincially as sensitive - 2005 General Status Document

Common name	Genus/Species	Status	Abundance	FMA = Primary Range?	Vulnerable Forestry?	Habitat/Region Specific?	Population/Range Decline?
Northern Goshawk	*Accipiter gentilis*	R	U	YES	YES	YES	YES
Black-backed Woodpecker	*Picoides arcticus*	R	S	YES	YES	YES	YES
Brown Creeper	*Certhia americana*	R	S	YES	YES	YES	YES
Sandhill Crane	*Grus canadensis*	S	S	YES	YES	YES	?
Pileated Woodpecker	*Dryocopus pileatus*	R	U	YES	YES	YES	?
Canada Lynx	*Lynx canadensis*	R	U	YES	YES	YES	?
Barred Owl	*Strix varia*	R	U	YES	YES	YES	?
Great Gray Owl	*Strix nebulosa*	R	U	YES	YES	YES	?
Long-toed Salamander	*Ambystoma macrodactylum*	R	C	YES	YES	YES	?
Columbia Spotted Frog	*Rana luteiventris*	R	U	YES	YES	YES	?
Northern Hawk Owl	*Surnia ulula*	R	S	YES	YES	NO	?
Northern Pygmy-Owl	*Glaucidium gnoma*	R	U	YES	YES	NO	?
Green-winged Teal	*Anas crecca*	S	C	YES	NO	YES	NO
Brewer's Sparrow	*Spizella breweri*	S	S	YES	NO	YES	NO
Harlequin Duck	*Histrionicus histrionicus*	S	U	YES	NO	YES	?
Water Vole	*Microtus richardsoni*	R	U	YES	NO	YES	?
Western Tanager	*Piranga ludoviciana*	S	U	YES	NO	NO	YES
Wandering Garter Snake	*Thamnophis elegans*	R	S	YES	NO	NO	?
Black-throated Green Warbler	*Dendroica virens*	S	S	NO	YES	YES	YES
Cape May Warbler	*Dendroica carulescens*	S	R	NO	YES	YES	NO
Bay-breasted Warbler	*Dendroica castanea*	S	R	NO	YES	YES	NO
Broad-winged Hawk	*Buteo platypterus*	M	S	NO	YES	NO	NO
Fisher	*Martes pennanti*	R	S	NO	YES	NO	NO
Silver-haired Bat	*Lasionycteris noctivagans*	S	C	NO	YES	NO	?
Hoary Bat	*Lasiuris cinereus*	S	U	NO	YES	NO	?
Sharp-tailed Grouse	*Tympanuchus phasianellus*	R	S	NO	NO	YES	YES
Western Grebe	*Aechmophorus occidentalis*	M	S	NO	NO	YES	YES
Great Blue Heron	*Ardea herodias*	S	U	NO	NO	YES	YES
Clark's Nutcracker	*Nucifraga columbiana*	R	U	NO	NO	YES	YES
Common Yellowthroat	*Geothlypis trichas*	S	C	NO	NO	YES	YES
Northern Pintail	*Anas acuta*	S	U	NO	NO	YES	NO
Lesser Scaup	*Aythya affinis*	S	C	NO	NO	YES	NO
Pied-billed Grebe	*Podilymbus podiceps*	S	U	NO	NO	YES	NO
American White Pelican	*Pelecanus erythrorhynchos*	M	S	NO	NO	YES	NO
American Bittern	*Botaurus lentigenosis*	S	S	NO	NO	YES	NO
Northern Harrier	*Circus cyaneus*	S	U	NO	NO	YES	NO
Sora	*Porzan carolina*	S	C	NO	NO	YES	NO
Upland Sandpiper	*Bartramia longicauda*	S	S	NO	NO	YES	NO
Black Tern	*Chlidonias niger*	S	U	NO	NO	YES	NO
Bobolink	*Dolichonyx oryzivorus*	S	S	NO	NO	YES	NO
White-winged Scoter	*Melanitta fusca*	M	U	NO	NO	YES	?
Caspian Tern	*Sterna caspia*	M	S	NO	NO	YES	?
Forster's Tern	*Sterna forsteri*	M	U	NO	NO	YES	?
Least Flycatcher	*Empidonax minimus*	S	C	NO	NO	NO	YES
Eastern Phoebe	*Sayornis phoebe*	S	U	NO	NO	NO	YES
Barn Swallow	*Hirundo rustica*	S	C	NO	NO	NO	YES
Baltimore Oriole	*Icterus galbula*	S	U	NO	NO	NO	YES
Osprey	*Pandion haliaetus*	S	U	NO	NO	NO	NO
Bald Eagle	*Haliaeetus leucocephalus*	S	S	NO	NO	NO	NO
Swainson's Hawk	*Buteo swainsoni*	S	S	NO	NO	NO	NO
Eastern Kingbird	*Tyrannus tyrannus*	S	U	NO	NO	NO	NO
Bobcat	*Lynx rufus*	R	S	NO	NO	NO	NO
Red-sided Garter Snake	*Thamnophis sirtalis*	R	S	NO	NO	NO	?

4.1.1.2 Vascular and Non-Vascular Plants

A search of rare element records from ACIMS shows that 93 rare plant species were recorded in the FMA from 1962 to 2010 (Table 3). This included 34 species of moss, 36 species of lichens and 23 vascular plants. The majority (84 or 90.3%) of the species were found in the Southern FMA. This skewing of records is undoubtedly a result of greater search effort. The majority of rare plants found in the FMA occurred on sites that are avoided by forestry operations. Of the 126 rare plant records 97 (77.0%) were located in habitats avoided by timber harvest, including:

- Lithic (bedrock outcrops) 52
- Streamside 7
- Spring/Seepage 4
- Fen/Bog 12
- Wetland/Wet Shrub/Meadow 6
- Alpine/talus slope 8
- Non-commercial forest 13
- Anthropogenic/disturbed 1

Twenty-nine (29) records (23.0%) were located in forested habitat including: coniferous forest (22); mixedwood forest (5); and deciduous forest (2). It is likely that a significant portion of the rare plant records in forests were located on non-merchantable sites (e.g. steep slopes or within riparian buffers). This data was however, largely unavailable.

No systematic, extensive rare plant searches have been conducted in the FMA to date. As such, there is a strong likelihood that a significant number of rare plants occur in the FMA over and above those found in the ACIMS database. Table 4 provides a list of 104 vascular plants that were not recorded by ACIMS, but have potential to occur on the FMA based on distribution and habitat requirements. Of the 94 species from Table 4 for which habitat affiliations were provided, 85 (90.4%) occur in habitats where logging is avoided or unlikely to occur (e.g. alpine, talus, bedrock crevices, moist and wet meadows, grasslands, open dry forest, lakeshores, stream sides, fens and bogs).

Species of International/Global Significance

Global ranks from the ACIMS tracking lists were searched to determine if any species occurring in the FMA are currently internationally or globally listed. A total of 7 species in combined Tables 3 and 4 were ranked as either: G1 (critically imperiled); G2 (imperiled); and/or G3 (rare and local). These species and their habitat affiliations include:

- *Erigeron radicatus* G3 Alpine - lithic
- *Pellaea gastony* G2G3 Lithic-bedrock crevices
- *Arnica louiseana* G3 Alpine slopes and ledges
- *Erigeron lackschewitzii* G3 Dry, open mountain slopes
- *Draba ventosa* G3 Alpine scree
- *Botrichyum ascendens* G2G3 Grasslands

- *Potentilla macounii* G1? Dry, rocky slopes

None of the above rare plant species occur in habitats subject to commercial forestry. As such, none were identified as HCV attributes.

Species of National Significance

COSEWIC species lists for vascular plants, moss, and lichens were reviewed to identify those listed as endangered, threatened, or of special concern. None of the plants on the above lists occur in the FMA.

Species of Provincial Significance

Tables 3 and 4 provide 'S-rankings' for the plant species known or with potential to occur in the FMA. A total of 167 species are currently ranked provincially as S1 (especially vulnerable to extirpation) and/or S2 (vulnerable to extirpation). Of the 51 species ranked as S1 or S1S2, 9 occur in habitats that are potentially affected by timber harvest. These include:

- *Anastrophyllum michauxii* S1
- *Homalothecium nevadense* S1
- *Bacidia hegetschweileri* S1
- *Buellia turgescens* S1
- *Chaenotheca stemonea* S1
- *Silene involucrata* S1/S2
- *Ephebe lanata* S1
- *Aster maccallae* S1S2
- *Stellaria umbellata* S1

Of the 116 species ranked as S2 or S2S3, 12 occur in habitats that are potentially affected by timber harvest. These include:

- *Arnica amplexicaulis* S2
- *Aster eatonii* S2
- *Ribes laxiflorum* S2
- *Splachnum vasculosum* S2
- *Anaptyychia setifera* S2
- *Chaenotheca chrysocephala* S2
- *Calicium trabinellum* S2
- *Chaenotheca trichialis* S2
- *Cladonia bacilliformis* S2S3
- *Cyphelium inquinans* S2
- *Leptogium tenuissimum* S2
- *Mycocalicium subtile* S2

The 21 provincially ranked plant species at risk listed above are recommended as High Conservation Value attributes because of their potential sensitivity to timber harvest.

Both whitebark pine (*Pinus albicaulis*) and limber pine (*Pinus flexilis*) have been declared endangered under the *Alberta Wildlife Act* and have S1 (especially vulnerable to extirpation) or S2 (vulnerable to extirpation) rankings in ACIMS. A search of the Forest Inventory (AVI) for the FMA identified 1 stand (16 ha) in the far South FMA that has a minor component of whitebark pine (C17La6Fa2Se1Pa1). The stand is located in the passive land base. Limber pine was not identified on the FMA through an AVI search. These species are in decline from white pine blister rust, fire suppression that has influenced successional patterns, and threat from mountain pine beetle. Habitat modification as a result of climate change may represent a long-term threat. While widespread on the C05 Forest Management Unit to the south, presence on the FMA/B9 is largely unknown.

As shade-intolerant, early seral species, both whitebark and limber pine often colonize environments exposed by avalanche, glacial retreat, or fire. They can play an important role in watershed protection by binding soil and facilitating the return of vegetation to exposed mountain landscapes following disturbance. They are ecologically important in providing shelter and food for wildlife in exposed landscapes. Climax stands of whitebark may persist for 500-1000 years. Forest operations on the FMA are expected to have minimal impacts on these species due to their associated habitats (e.g. dry rocky sites, high elevation alpine and subalpine areas). Whitebark pine is at greater risk to forest management impacts because it is a lower subalpine generalist occurring in mixed species merchantable stands. Limber pine is at less risk because it is a tree line specialist (L. Barnhardt, email comments to Authors, August 28, 2010). However, no harvesting is permitted for either species if they are encountered. Provincial recovery plans are currently being developed for both species.

Whitebark pine relies entirely on the Clark's nutcracker for seed dispersal due to indehiscent cones, even after fire. Limber pine is less reliant on the Clark's nutcracker for dispersal, as the cones open naturally as well. The seeds are an important seasonal food source for grizzly bears. These relationships have implications for consideration as high conservation values under other areas of the Assessment, such as Key Question 3 below. No formal conservation reserves for limber and whitebark pine have been established to date and none are expected on the FMA, however, future conservations reserves (e.g. implications for Key Question 6) may be an outcome of the recovery plan process to address gene conservation (L. Barnhardt, email comments to Authors, August 28, 2010).

Rare trees with ranges that suggest a *potential* to occur in the FMA include western larch and western red cedar (Kershaw et al. 2001). Western larch has scattered representatives in areas that were formerly harvested near Kananaskis. Western red cedar can be found in the Crowsnest area in merchantable stands and in the vicinity of cut blocks (L. Barnhardt, email comments to Authors, August 28, 2010). These trees were not identified as leading species in an AVI search for the FMA. SLS does not considered these trees to be commercial species. Due to their limited distribution in the vicinity of the FMA, these 2 species are unlikely to be found in predominantly mature pine/ spruce harvest areas and have not been considered for

HCV designation at this time. This decision will be re-evaluated if they are identified in future updates to the AVI (implications for mapping) or found in the field.

In summary, forest operations are expected to have minimal impacts on whitebark and limber pine due to their scattered distribution on the FMA and their habitat associations (e.g. dry rocky sites, alpine, subalpine). However, both whitebark and limber pine have been identified as HCVF values due to their endangered status, potential to occur on the FMA, and 'No Harvest' management strategy.

4.1.2 Key Question 2

Does the forest contain a globally, nationally or regionally significant concentration of endemic species?

Definitive Questions
Does the forest include or lie within a globally significant centre of endemism?
Is there a concentration of endemic species in the forest that includes species representative of habitat types naturally occurring in the management unit?

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) defines endemic species as a species native and confined to a certain region, having comparatively restricted distribution. According to Ricketts et al. (1999) there are two North American terrestrial ecoregions encompassing the Spray Lake FMA. Most of the northern portion of the FMA lies in the Alberta/British Columbia Foothills Forests and the southern portion in the North Central Rockies Forest. Neither of these ecoregions classify as globally significant centers of endemism based on Ricketts et al.'s (1999) 50,000 km^2 threshold for identifying restricted range species. The Alberta/British Columbia Foothills Forests ecoregion supports no endemic birds, mammals, butterflies, reptiles, amphibians, snails, or tiger beetles. Two vascular plant species were considered to be endemic. The North Central Rockies Forest ecoregion supported no endemic birds, butterflies, reptiles, or tiger beetles. This ecoregion does support 1 endemic mammal species, 1 endemic amphibian, 2 fish species (Westslope Cutthroat Trout and Bull Trout), 10 snails and 36 endemic vascular plants. Most vascular plants were likely found in Waterton Lakes National Park, a hot-bed of plant endemism. The ecoregions considered to be globally significant centers of endemism by Ricketts et al (1999) in a North America wide context generally supported from 99 to 290+ total endemic species, whereas the two ecoregions in the Spray Lake FMA support from 1 (foothills) to 49 (mountains) total endemic species.

The Spray Lake FMA does not support a concentration of endemic species from a regional perspective. Timoney (1998) identified 26 plant species as being endemic in an Environmentally Significant Areas (ESA) inventory for the Rocky Mountain Natural Region of Alberta. The Conservation Biology Institute (CBI 2007) mapped high conservation value and endangered forests in the Alberta Foothills and noted that…"*Species richness and*

endemism were not easily discernible and minimally important for this region and therefore not considered".

In summary, the Spray Lake FMA lands do not contain a globally, nationally or regionally significant concentration of endemic species and no HCVFs have been identified from this perspective.

4.1.3 Key Question 3

Does the forest include critical habitat containing globally, nationally or regionally significant seasonal concentrations of species (e.g., concentrations of wildlife in breeding sites, wintering sites, migratory routes or corridors)?

Definitive Question
Is there an IBA (Important Bird Area) in the forest?

There are 48 Important Bird Areas recognized and mapped in Alberta (IBA Canada 2004-2010). The vast majority of IBAs in Alberta occur in the east-central portion of the province in the grassland and parkland. No IBAs occur in the mountains and foothills, where the SLS FMA is located. No RAMSAR wetlands occur in or near the FMA (Wetlands International 2007). There are no globally recognized concentrations of species in the FMA.

Guidance Questions
What proportion of the global, national or regional population uses the wildlife concentration area?
How protected are similar wildlife concentration areas within the region?
Is it a wildlife concentration area for more than one species?
Are there any landscape features or habitat characteristics that tend to correlate with significant temporal concentrations of species?

Fiera Consulting (2009) classified and mapped Environmentally Significant Areas (ESA) in Alberta. ESAs were classed as internationally (globally), nationally, or provincially (regionally) significant. Three patches of the FMA were classified as being Nationally significant (Figure 4). They included: 1) the southwestern portion of the South FMA within the Highwood River watershed of Kananaskis Country; 2) the Red Deer River valley transecting the northern portion of the North FMA; and 3) a block of high elevation land at the headwaters of the North Burnt Timber Creek.

The Highwood River watershed ESA represents the northern tip of a large (398,552 ha) ESA (#2) that extends south to Waterton National Park. The rationale for recognizing this ESA is seven-fold:

1. contains 253 elements of conservation concern;
2. contains 16 rare or unique landforms (all from southern Alberta);
3. contains habitat for focal species;
4. contains important wildlife habitat;
5. contains riparian areas including headwater streams, intact riparian areas along 6 major rivers;
6. contains large natural areas; and
7. contains sites of recognized significance.

The Highwood River watershed ESA also corresponds to one of the largest contiguous blocks of land in the FMA that is unfragmented by permanent infrastructure. This area is also primary and seasonally important range for the Livingstone grizzly bear population unit (Herrero 2005, Foothills Research Institute – Phase 6 Deliverables). The Livingstone population unit contains approximately 10% of the provincial grizzly bear population and is a secure source of recruitment for regional grizzly bear populations.

In summary, the Highwood River watershed portion of the FMA designated as a nationally significant ESA warrants HCVF status because of its high level ESA ranking and the relatively secure seasonal concentration of grizzly bears which account for a large proportion of the provincial grizzly population.

Both portions of the North FMA that are classified as nationally significant occur at the southern end of a very large (943,828 ha) ESA (#20) that extends north to the Brazeau/Cardinal River confluence area. The Red Deer River portion of this ESA transects the FMA from east to west. The Red Deer River valley represents a natural travel corridor for numerous species of wildlife, as well as a wintering area for ungulate populations and spawning area for a number of fish species. The North Burnt Timber headwaters occur at high elevations and are not subject to timber harvest (i.e. are dominated by passive landbase). This area is included as an HCVF as part of regionally significant large landscape-level forest 2-HCVF (Figure 7).

In summary, the Red Deer River portion of the nationally significant ESA in the north FMA is selected as a High Conservation Value Forest because of its national ESA status, wintering concentration of ungulates, and role as a major east to west wildlife movement corridor through the FMA.

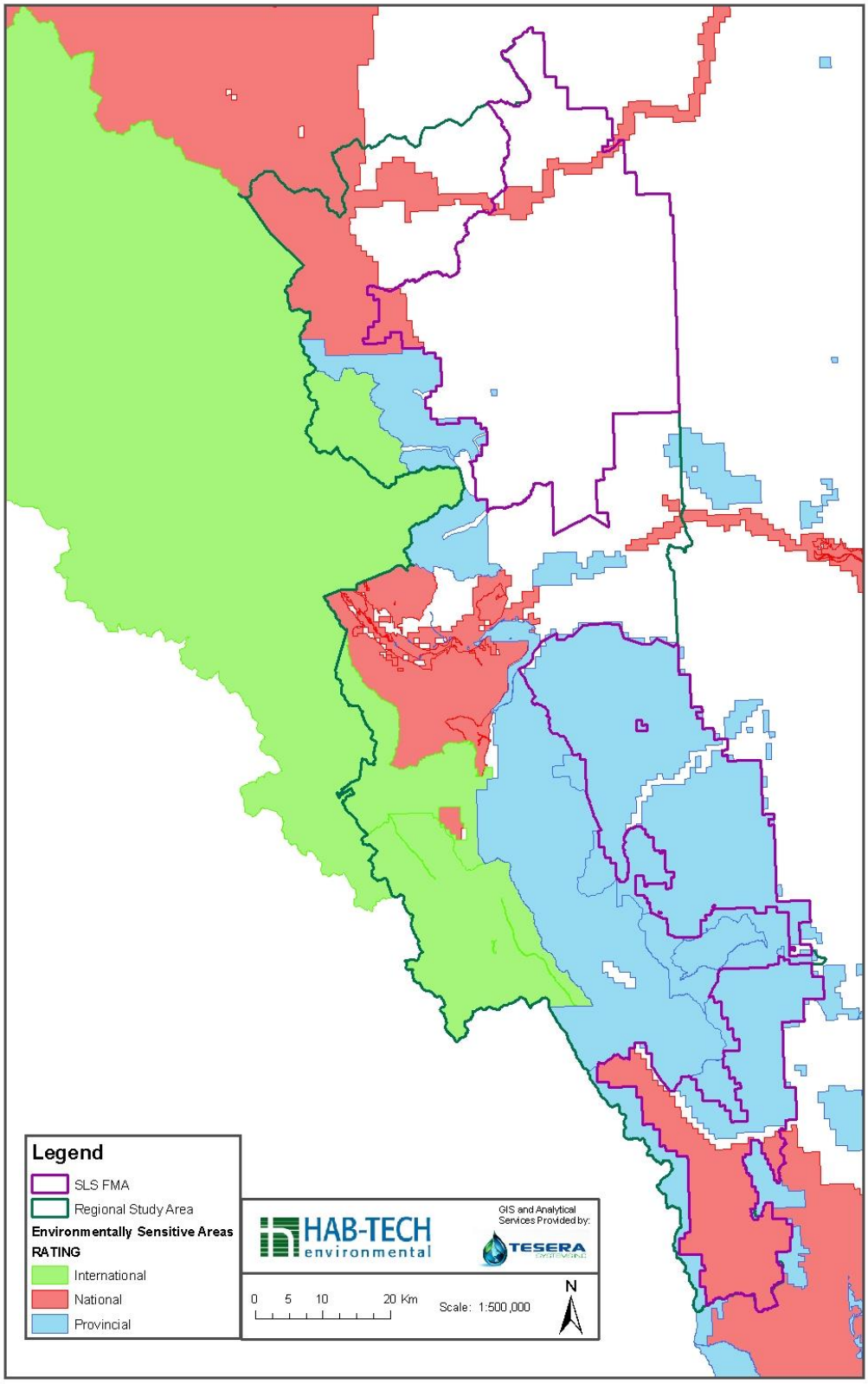

Figure 4. Environmentally Significant Areas in the SLS FMA and region

4.1.4 Key Question 4

Does the forest contain critical habitat for regionally significant species (e.g. species representative of habitat types naturally occurring in the management unit, focal species, species declining regionally)?

Definitive Question
Is the regionally significant species in significant decline as a result of forest management?

At this point in time, the direct surface footprint of timber harvest occupies approximately 9.3% of the FMA with a maximum of 19.9% in any given cut compartment (mean = 8.2%; range = 0.5% to 19.9%). Although it is unlikely that existing levels of timber harvest have resulted in a significant decline in regionally significant species, the full suite of monitoring necessary to document this assertion has not been conducted.

Guidance Questions
Is the population of regionally significant species locally at risk? Does the forest contain limiting habitat for regionally significant species? Are there any ecological or taxonomic groups of species or sub-species that would together constitute a regionally significant concentration?

WWF Canada (2005) recommended the following approach for selecting a group of regionally significant species for which habitat protection would ensure meeting the objectives of this HCVF category and question.

1. Develop a set of ecological criteria to help identify regionally significant species in the FMA. Attributes of the collective list of species in the table should reflect:
    a. All major habitat and forest seral stages occurring in the region, and
    b. A sample of species:
        i. Whose populations have declined or increased significantly from estimated baseline conditions
        ii. That are resource limited (e.g. cavity nesters)
        iii. That are process limited (e.g. dependent on natural disturbances such as fire)
        iv. That are dispersal limited (e.g. plants, amphibians, reptiles, some invertebrates)
        v. That are area limited (e.g. wide-ranging species, those requiring large blocks of continuous forest cover).

2. Assess and map critical habitat for the range of focal species selected.

A total of 12 regionally significant species use the FMA as primary range and are considered to be sensitive to the effects of timber harvest (Table 5). These species include: northern goshawk; black-backed woodpecker; brown creeper; sandhill crane; pileated woodpecker; Canada lynx; barred owl; great gray owl; long-toed salamander; Columbia spotted frog; northern pygmy owl; and northern hawk owl.

The Bull Trout, Westslope Cutthroat Trout, and grizzly bear are three globally and nationally significant species (HCV attributes identified under Key Question 1) that can be added to the list above due to their potential sensitivity to the effects of timber harvest and associated road access. This list of 15 species represents a starting point from which to build a matrix designed to select a full complement of regionally significant focal species.

A group of regionally significant species along with their primary habitat affiliations are presented in Table 6. Rationale for species selection, based on particular aspects of their biology that make them potentially vulnerable to the effects of timber harvest, is provided.

Table 6. Regionally significant species and habitat associations for the SLS FMA

	Forested Habitat			**Interspersed Non-Forest Habitat**		
	Conifer Dominated	*Mixedwood*	*Deciduous Dominated*	*Grasslands*	*Wetlands*	*Aquatic*
Mature/Old Growth	Northern Goshawk Brown Creeper	Barred Owl Fisher	Pileated Woodpecker Ovenbird	Elk Grizzly Bear	**Bogs/Fens** Sandhill Crane Great Gray Owl	**River** Bull Trout West Slope Cutthroat Trout
Mid Successional	Marten	Western Tanager	Ovenbird		**Marsh** Long-toed salamander	**Lake**
Early Successional	Black-backed Woodpecker Canada Lynx		Moose		**Riparian Sedge/Willow** Moose Columbia Spotted Frog	**Beaver Pond** Rusty Blackbird

Additional characteristics of each regionally significant species presented in Table 6, that make them suitable individually and collectively as focal species to represent critical habitat on the FMA, are listed below.

Bull Trout	Focal species for access management Potentially sensitive to forestry Process and Mortality limited (inter-breeding)
West Slope Cutthroat Trout	Focal species for access management Potentially sensitive to forestry Process and Mortality limited (inter-breeding)
Grizzly Bear	Requires large areas with low open road densities Limited by mortality
Northern Goshawk	Focal species for old growth conifer/mixedwood Sensitive to forestry activities Sensitive to habitat fragmentation Declining populations in Alberta Area limited
Black-backed Woodpecker	Focal species for post-fire habitats Sensitive to salvage logging Process limited (requires fire)
Brown Creeper	Focal species for old growth coniferous forest Sensitive to forestry activities Sensitive to habitat fragmentation Declining populations in Alberta Spruce forest specialist/readily monitored Area limited
Sandhill Crane	Focal species for open muskegs habitats Potentially sensitive to disturbance from forestry Resource limited (open muskeg)
Pileated Woodpecker	Focal species for old deciduous mixedwood Resource limited (nesting cavities)
Canada Lynx	Focal species for early succession conifer habitats Potentially declining Readily monitored Process limited (requires adequate hare populations)
Barred Owl	Focal species for riparian old growth mixedwood Sensitive to forestry activities Sensitive to habitat fragmentation Readily monitored Resource limited (nesting cavities)

Great Gray Owl	Forages in open areas/breeds in old growth forest Requires juxtaposition of foraging/breeding habitat
Long-toed Salamander	Focal species for bog/fen wetlands Requires old forest near breeding habitat Resource limited (wetlands/old growth)
Columbia Spotted Frog	Focal species for subalpine wetlands/riparian Process limited (subalpine hydrology)
Western Tanager	Focal species for pine/pine-dominated mixedwood Somewhat area limited
Fisher	Focal species for old growth riparian mixedwood Fur species in region Needs old snags for breeding
Ovenbird	Focal species for deciduous forest Sensitive to habitat fragmentation and disturbance Readily monitored Area limited (interior deciduous forest)
Marten	Focal species for old spruce/lodgepole pine forest Primary fur harvest species in the region Readily monitored
Moose	Focal species for riparian shrubland Important to hunters Readily monitored Mortality limited
Elk	Focal species for subalpine/montane grassland Process (fire) and mortality limited
Rusty Blackbird	Focal species for forest wetlands Process limited (beaver activity/hydrology)

Maps of high and very high quality habitat for most of the species listed above are found in the 2006 SLS DFMP. These habitat areas are important for retaining population viability of the species listed above. The term "critical habitat" is not used here in the same spirit as for the Federal Species at Risk Act. Critical habitat for the purposes of this High Conservation Value Forest assessment is high and very high quality habitat that is required for long-term population viability. Without adequate levels of high and very high quality habitat, the growth and population viability of these species would be limited.

In summary, 20 regionally significant focal species were selected as HCVF attributes. They serve as focal species representative of the range of habitat types and seral stages. Thirteen of these species have already been selected as HCVF attributes. The additional 7 species (western tanager, fisher, ovenbird, marten, moose, elk and rusty blackbird) were chosen because they are focal species with specific habitat requirements, sensitivities, and importance to the regional public.

Note that while the northern pygmy owl and northern hawk owl are listed in Table 5 as vulnerable to forestry with primary range on the FMA, they were not identified as HCV attributes because they are not highly habitat specific.

4.1.5 Key Question 5

Does the forest support concentrations of species at the edge of their natural ranges or outlier populations

This question addresses genetic level biodiversity and species which are represented by populations that may be vulnerable to extirpation or may be compromised in their ability to adapt. The species may not be rare or at risk at a broader scale, and in fact, may be very common (e.g. national scale). Edge of range species can be important ecologically for the following reasons:

- being on the edge of range, these populations have less support from source populations to buffer impacts;
- they can host more genetic variation which provides range expansion capabilities and more resilience to landscape change; and
- outlier populations serve as the 'seed source' for range expansion under appropriate conditions.

Definitive Questions

Are there naturally-occurring outlier populations of commercial tree species?

Are any of the range edge or outlier species representative of habitat types naturally occurring in the management unit?

Black spruce shows evidence for western genotypes with peripheral and outlier populations around the Canmore corridor. Tamarack has disjointed or peripheral populations south of Caroline through the Sundre area (L. Barnhardt, email comments to Authors, August 28, 2010). Both species can be found in the North FMA in transition from the Boreal Forest and are approaching the southwest limit of their range in Alberta. Stands are often found in poorly drained organic sites or in narrow bands around peatlands. Both species are post fire pioneers and most often form pure, even aged stands. They may also be found together in mixed stands. Tamarack is very shade intolerant and generally does not establish under its own shade. In the

absence of disturbance (i.e. fire), the more shade tolerant black spruce often succeeds tamarack on the poor wet sites noted above. Closed stands of black spruce usually become uneven aged when black spruce layering fills the gaps created by breakup of the overstory after 100 years. Black spruce may eventually be succeeded by balsam fir in the absence of disturbance. Both species have been removed from the timber supply analysis (removed from active landbase and annual allowable cut calculation) and are not considered commercial species by SLS. Poorly drained sites associated with these species are generally avoided during harvest operations.

White birch is a shade intolerant, short lived pioneer species that grows in limited clumps with spruce and aspen. It is common on the North FMA, but uncommon on the south FMA and is approaching the southwest limit of its range in Alberta. The trees generally show poor growth and form characteristics. The bulk of regeneration becomes established during the first growing season after disturbance, from seeds that fell the previous fall and winter. White birch will also reproduce from stump sprouts. Mortality is heavy throughout the life of white birch stands, with individual trees expressing dominance early in life. When growing in mixture with spruce or spruce-fir, birch often retains a position in the stand by invading openings created by wind or declining conifer, and the stands do not go toward pure spruce climax. SLS does not use white birch in its commercial operations, however, it may be found in mixed deciduous stands allocated to other commercial users (note that the deciduous allocation has not been utilized to date on the FMA). White birch is likely sought after for firewood by local residents.

Interior Douglas fir is approaching its northeast range in Alberta on the FMA. A search of the AVI for the FMA identified 1 stand (10 ha) with a component of Douglas fir (B18Se6Fd4), with 80% of the stand located in the passive land base. North of the Porcupine Hills, populations tend to be associated with isolated mountain corridors and there is evidence for high among population adaptive genetic variation (L. Barnhardt, email comments to Authors, August 28, 2010). Douglas fir has adapted to survive disturbance from fire by showing rapid growth, longevity (e.g. 400 years), and thick corky bark on its lower bole and main roots, combined with a capacity to form adventitious roots. While Douglas fir can withstand some shade at the seedling stage, in the absence of fire or other major disturbance, it will gradually be replaced by more shade tolerant spruce and subalpine fir. Douglas fir is generally more prevalent in the Montane regions of the Province. Scattered trees are generally left for residual structure and other resource values (e.g. wildlife, aesthetics), thus providing seed trees for regeneration. Stands with considerable volume may be considered for harvest and are addressed in the OGRs.

The locations of black spruce, tamarack, white birch, and Douglas fir stands on the FMA/B9 are shown in Figures 5a (North FMA) and 5b (South FMA). Note that Figure 5b also includes the single stand with the whitebark pine component discussed under Key Question 1. As shown in the figures, the AVI has identified very few rare trees or outlier populations in the South FMA . Douglas fir appears to be more concentrated at higher elevations to the west near Canmore. Black spruce and tamarack are more common north east of highway 579 and in the B9 Quota area.

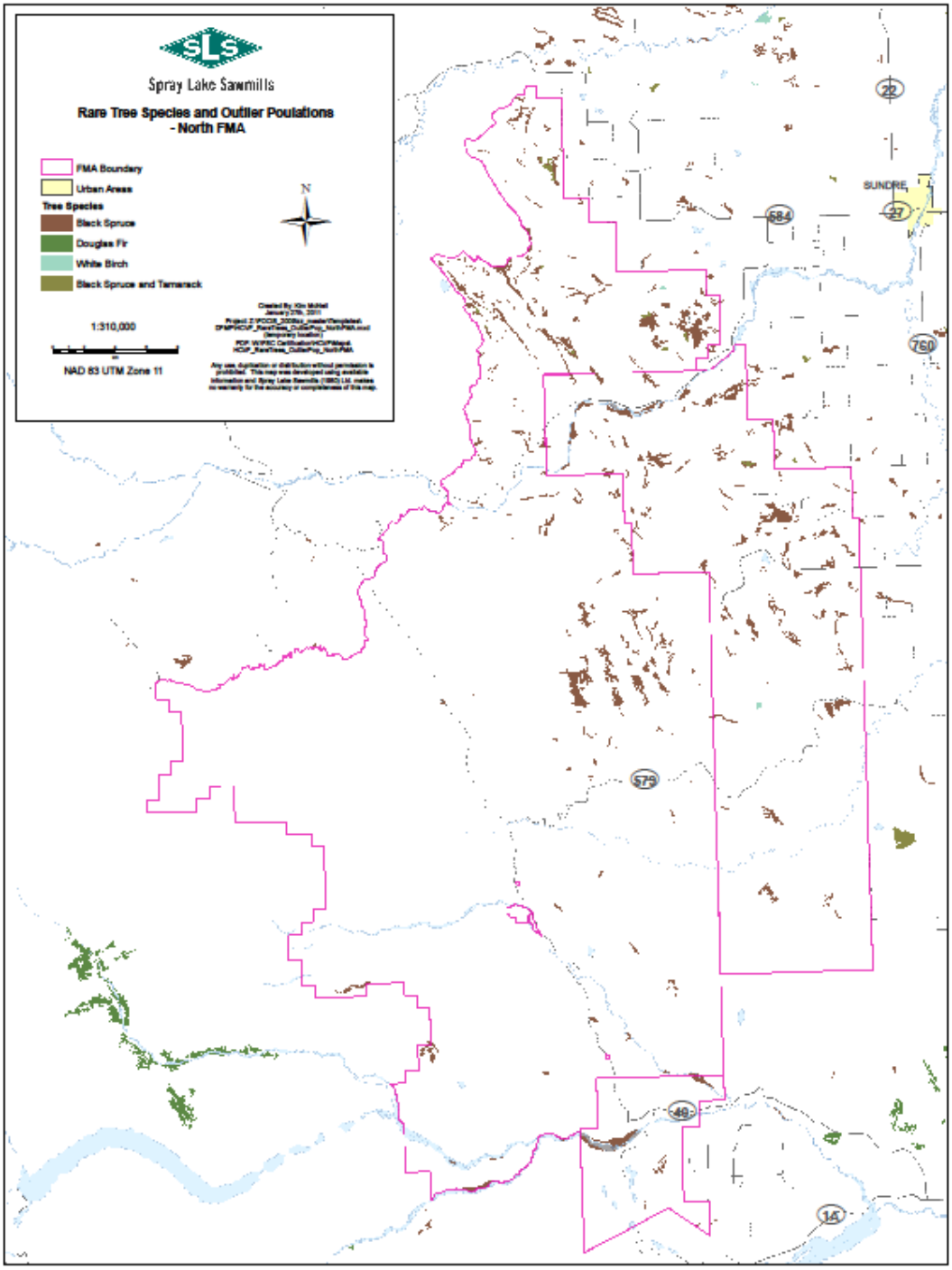

Figure 5a. Rare tree species and outlier populations on the North FMA/B9 Quota

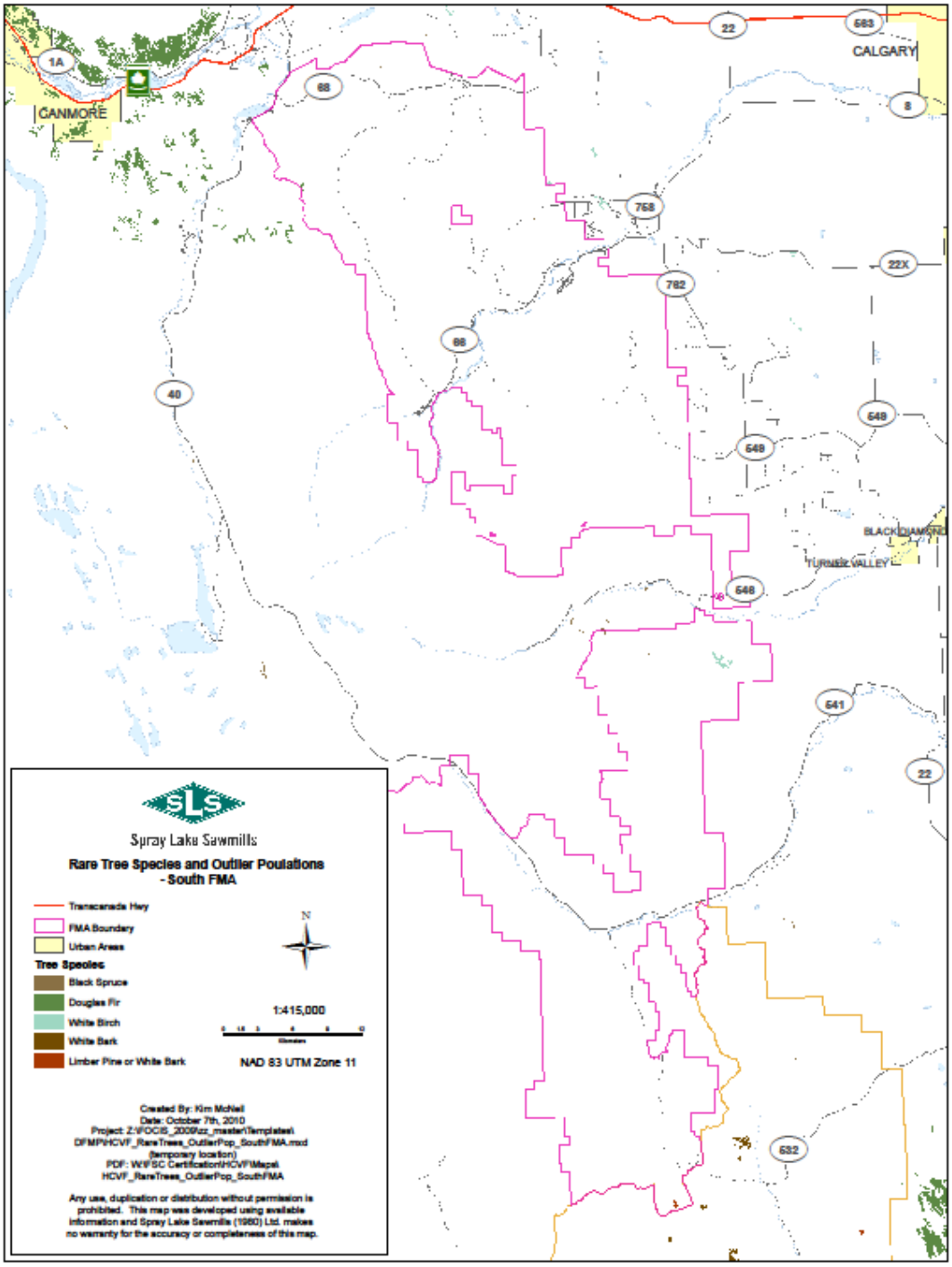

Figure 5b. Rare tree species and outlier populations on the South FMA

In summary, the tree species noted above are generally considered '*non commercial species'* for SLS management activities and are not actively targeted for harvest. However, they have been identified as HCVF values due to *potential* impacts from forestry activities (e.g. harvest in road right of ways, firewood cutting, significant volume of Douglas fir in a harvest block, etc.).

There are several edge of range wildlife species that occur in the SLS FMA that are representative of habitat types that naturally occur in the FMA. Refer to the discussion below.

Guidance Questions

Are any of the range edge or outlier species a focal species?

Are there any ecological or taxonomic groups of range edge and/or outlier species/sub-species that would together constitute a globally, nationally or regionally-significant concentration?

Are the species potentially negatively impacted by forest management?

WWF-Canada (2005) recommends that populations that should qualify as range edge under this indicator include those that:

- represent the outermost 100 km of the known continuous range area;
- represent relatively narrow, linear extensions of the main range area (e.g. along riparian corridors); and
- are reproductively disjunct or isolated from the main range area (the distance between such qualifying populations and the main range area will vary with the species dispersal ability).

The approach noted above was used to determine which of the 73 listed species (Table 2), known to occur or with potential to occur in the FMA, are at the edge of range or 'outliers'. Of the 73 species, 40 (54.8%) are considered to use the FMA as primary range, 21 (28.8%) are edge species, and 12 (16.4%) are disjunct or extra-limited occurrences. The majority of edge species are at the western edge of their range, being prairie or parkland specialists. Examples include: American badger; Swainson's hawk; long-tailed weasel; upland sandpiper; prairie falcon; great blue heron; sharp-tailed grouse; red-sided garter snake; bobolink; Baltimore oriole; and the bobcat. These "prairie -edge' species are affiliated more with the southern portion of the FMA. Edge species occurring in the northern portion of the FMA are boreal species such as bay-breasted warbler, Cape May warbler, black-throated green warbler, rusty blackbird, broad-winged hawk, Eastern phoebe, and yellow rail.

Only 1 of the edge species (rusty blackbird) is considered a focal species. The status of populations of this species in the FMA is uncertain. Too little is known of the actual population status of the edge species listed above to consider them as globally, nationally or regionally significant concentrations of edge species. Wildlife inventory stratified by habitat type and various distances from FMA edge inventory is recommended in order to determine

population status of edge species. The same recommendation holds for plant species for which even less is known of population status and distribution.

Both Bull Trout and Westslope Cutthroat Trout qualify as range edge species using the WWF-Canada (2005) criteria. The Westslope Cutthroat Trout and Bull Trout have been designated as HCV attributes under Key Question 1.

In summary, a significant number of species in the FMA are edge species primarily due to the narrow shape and spatial juxtaposition of the FMA with respect to adjacent ecoregions. Notwithstanding this high number of potential edge species, too little is known concerning their population status and habitat use to delineate concentrations of edge species as HCVF attributes.

4.1.6 Key Question 6

Does the forest lie within, adjacent to, or contain a conservation area: a) designated by an international authority; b) legally designated or proposed by a relevant federal/provincial/territorial legislative body; or c) identified in regional land use plans or conservation plans?

The location of a number of areas immediately adjacent to or in the vicinity of the FMA that have various levels of environmental protection is shown in Figures 6a and 6b. Protected area classifications include Wildland Provincial Parks, Provincial Parks, Ecological Reserves, Wilderness Areas, Natural Areas, Heritage Rangeland, Indian Reserves, and Banff National Park. All protected areas are provincially designated, with the exception of Banff National Park to the west.

Tenure boundary negotiations for the FMA, completed in 2001, addressed adjacent protected areas particularly for the former B10 Forest Management Unit (Kananaskis Country). Don Getty Wildland Park, Blue Rock Wildland Park and the Sheep River Provincial Park were added to the extensive system of East Slopes protected areas as a result. In the case of the Blue Rock/Sheep River sites, buffers to the parks were also addressed at that time.

Protected areas are much more common adjacent to the southern portion of the FMA than in the northern portion (Figure 6a). The vast majority of protected areas occur in the high elevation subalpine and alpine natural subregions west of the FMA.

Protected areas that directly abut or are adjacent to the southern portion of the FMA include (Figure 6a):

- Don Getty Wildland Provincial Park
- Elbow Sheep Wildland Provincial Park
- Bluerock Wildland Provincial Park
- Bow Valley Provincial Park
- Plateau Mountain Ecological Reserve

- Sheep River Provincial Park
- Macabee Creek Natural Area
- Bragg Creek Provincial Park
- Bragg Creek Natural Area
- OH Ranch Heritage Rangeland

Only one protected area (Don Getty Wildland Provincial Park) directly abuts the North FMA (Figure 6a).

The Morley Indian Reserve (Stoney Nakoda Nation) directly abuts the North and South FMA. Although not a formally protected area, these lands receive less intensive industrial and recreational land use than adjacent lands and occur largely within the ecologically important Montane Natural Subregion. The large protected land blocks of Banff National Park and the Ghost River Wilderness Area occurs within 10 to 20 km of the southwestern boundary of the North FMA (Figure 6a). Spray Valley Provincial Park, Bow Valley Wildland Provincial Park and Banff National Park also occur within 20 km of the northwestern boundary of the South FMA.

There are approximately 51 Provincial Recreation Areas (PRAs) scattered across or within close proximity to the FMA/B9. They are managed by Alberta Tourism, Parks, and Recreation (TPR) with outdoor recreation as the primary objective. Some PRAs are undeveloped, while others are intensely developed. PRAs play a role in the management of adjacent crown lands and waters by serving as staging areas, access points to lakes and rivers, and by localizing the impact of development. All PRAa within the FMA boundary have been removed from the active landbase (Figure 6b).

The Eastern Slopes Policy (established in 1977 and revised in 1984) established regional zones including Zone 1 Prime Protection. The intent of the Prime Protection Zone is to preserve environmentally sensitive terrain and valuable ecological and aesthetic resources (e.g. rugged mountain scenery), as well as portions of watersheds producing most of the streamflow. Subregional Integrated Resource Plans (IRP) established the Zone 1 boundaries to meet objectives compatible with the intent of the Zone. Timber harvest is excluded in Zone 1, with the rare occurrence of management activities such as wildlife habitat improvement, fire control, or sanitation cutting to protect adjacent zones. Zone 1 Prime Protection areas on the FMA have been removed from the active land base (Figure 6b).

Definitive Question

Are the values for which the conservation area has been identified consistent with the assessment of HCVs in this framework?

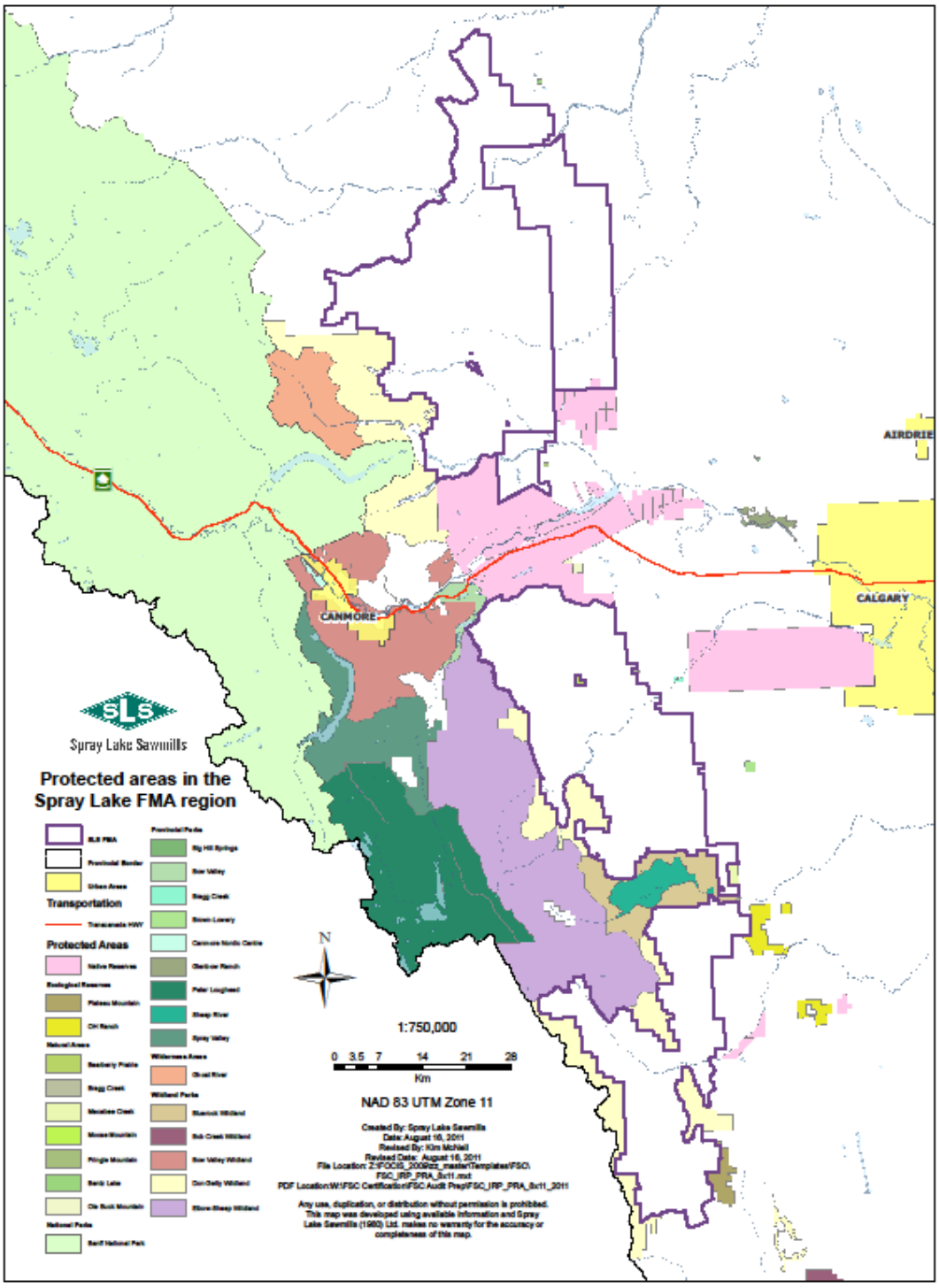

Figure 6a. Protected areas in the SLS FMA region

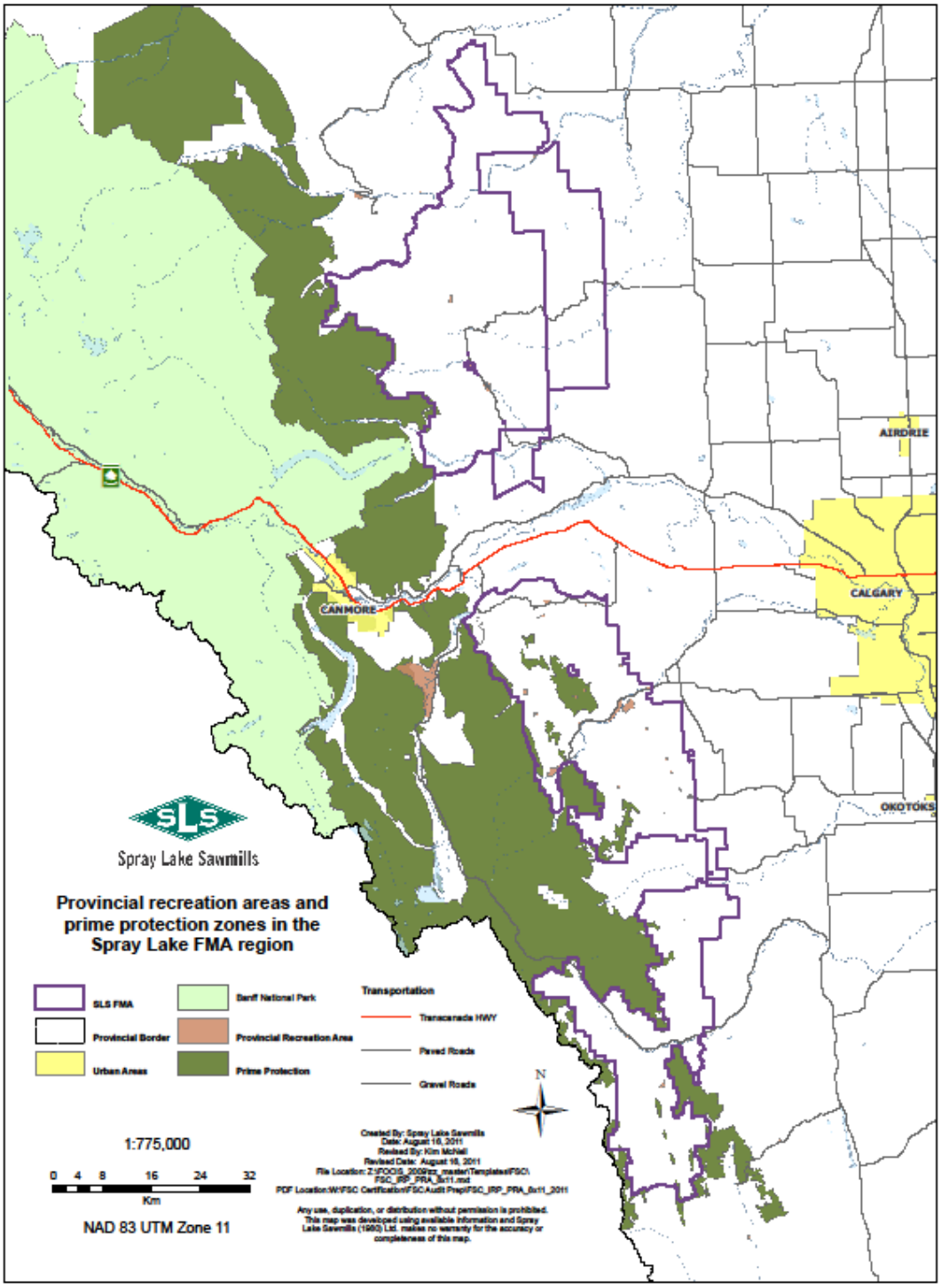

Figure 6b. Zone 1 Prime Protection and PRAs within and adjacent to the SLS FMA

Ecological Reserves, Wildland Provincial Parks, Provincial Parks, Natural Areas, and Heritage Rangelands all offer a degree of environmental protection consistent with the goals of High Conservation Value Forests. The intent of each classification type and activities that are generally permitted within these designated lands (AB TPR 2011) are listed below.

Ecological Reserves

- Ecological reserves contain representative, rare and fragile landscapes, plants, animals and geological features.
- The primary intent of this class is strict preservation of natural ecosystems, habitats and features, and associated biodiversity.
- Ecological reserves serve as outdoor laboratories and classrooms for scientific studies related to the natural environment.
- Public access to ecological reserves is by foot only; public roads 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.

Wildland Provincial Parks

- Wildland parks are large, undeveloped natural landscapes that retain their primeval character.
- Trails and primitive backcountry campsites are provided in some wildland parks to minimize visitor impacts on natural heritage values.
- Some wildland parks provide significant opportunities for eco-tourism and adventure activities such as backpacking, backcountry camping, wildlife viewing, mountain climbing and trail riding.
- Designated trails for off-highway vehicle riding and snowmobiling are provided in some wildland parks.

Provincial Parks

- Provincial parks protect both natural and cultural landscapes and features.
- They are distinguished from wildland parks by their greater range of outdoor recreation facilities, the extent of road access, and the interpretive and educational programs and facilities that are available to visitors.
- Outdoor recreation activities that promote appreciation of a park's natural heritage and cultural features are encouraged.
- Provincial parks offer a variety of outdoor recreation opportunities and support facilities.
- Interpretive and educational programs that enhance visitor understanding and appreciation of, and respect for, Alberta's natural heritage (without damaging natural values) are offered in some provincial parks; these programs serve visitors of diverse interests, ages, physical capabilities and outdoor skills.
- Automobile access is typically provided to staging areas and support facilities.

Natural Areas

- Natural areas include 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 in this class.
- Most natural areas have no facilities and in those that do, facilities are minimal and consist mainly of parking areas and trails.

Heritage Rangeland

- Heritage Rangelands preserve and protect natural features that are representative of Alberta's prairies, and grazing is used to maintain the grassland ecology.
- Heritage rangelands ensure ongoing protection while continuing the traditional grazing approach that has preserved the grasslands for many years.
- Recreational use of heritage rangelands must be compatible with preservation of natural values and grazing management. Limited opportunities for outdoor recreation may be provided.

Guidance Questions

Do permitted uses in the conservation area include industrial activities?

Are there forest areas important to connect conservation areas in order to maintain the values for which the conservation areas were identified?

Are there forest areas important to buffer conservation areas in order to maintain the values for which the conservation areas were identified?

Industrial activities are generally absent from the protected areas that surround the SLS FMA. A small percentage of lands added to the parks and protected areas network since 1995 includes existing commitments to petroleum and natural gas interests.

The existing protected areas that occur immediately adjacent to the FMA both support and connect natural subregion features affiliated with the Rocky Mountain Natural Region in the FMA. In a provincial context the Alpine, Subalpine and Montane Natural Subregions are adequately protected and Level 1 Special Areas theme protection targets, established by the Provincial government, have been achieved. The different segments of the Don Getty Wildland Provincial Park provide supporting 'source' areas for biodiversity associated with upper subalpine habitats in the western portion of both the North and South FMA. The Elbow-Sheep Wildland Provincial Park serves the same purpose for the South FMA at slightly higher elevations. The Bluerock Wildland Provincial Park and embedded Sheep River Provincial Park provide especially important connecting function for the Montane Natural Subregion, that lies on the east side of the South FMA. Smaller protected areas lying on the east side of the South FMA (Bragg Creek Provincial Park, Macabee Creek Natural Area, Plateau Mountain Ecological Reserve) also provide important support functions since less

protected area occurs at lower elevations to the east, where the Rocky Mountain Forest Reserve (i.e. Green Zone) meets the agricultural/ development zone (i.e. White Zone).

In summary, the Ecological Reserves, Wildland Provincial Parks, Provincial Parks, Natural Areas, Heritage Rangeland, Provincial Recreation Areas (having minimal development), and Zone 1 Prime Protection Areas that are in or adjacent to the FMA boundary provide important supporting an connecting functions to the Subalpine and Montane habitats in the FMA. In addition, their legal designation or IRP zoning make them suitable for HCVF designation.

Provincial targets for protected area representation in the Lower and Upper Foothills subregions have not been achieved to date across the Province. This relates to the North FMA and highlights the importance of identifying and managing the largest remnant areas of Lower and Upper Foothills in the North FMA for biodiversity.

4.2 Category 2/3: Forest Areas Containing Globally, Regionally or Nationally Significant Large Landscape Level Forests Contained within or Containing the Management Unit, where Viable Populations of Most, if not all, Naturally Occurring Species Exist in Natural Patterns of Distribution and Abundance.

4.2.1 Key Question 7 and 10

Does the forest constitute or form part of a globally, regionally or nationally significant forest landscape that includes populations of most native species and sufficient habitat such that there is a high likelihood of long-term species persistence?

Are large landscape level forests (i.e. large unfragmented forests) rare or absent in the forest or ecoregion?

This section of the report covers 2 related questions concerning large landscape level forest occurrence and quality. The analyses used to address Question 7 (Category 2) and Question 10 (Category 3) are similar, so they were included here for ease of presentation.

The approach recommended by WWF-Canada (2005) was used to delineate and assess large landscape-level forests in and adjacent to the FMA. The steps listed below were taken to complete the analysis.

- All permanent roads, power lines and pipelines occurring in the FMA and a larger regional area were classified and mapped using Alberta government human features data.
- The permanent features were buffered by 100 meters and overlain onto the FMA and greater region.
- All contiguous forest patches lacking permanent features resulting from the overlay were isolated and their size measured.

- Patches unfragmented by permanent features were classified as follows:
    - greater than 500,000 ha = Globally significant;
    - 200,000 ha to 500,000 ha = Nationally significant;
    - 50,000 ha to 200,000 ha = Regionally significant; and
    - 5,000 ha to 50,000 ha = Remnant forest patches.
- All unfragmented patches of forest >5,000 ha and less than 50,000 ha were characterized as follows:
    - proportion of Natural Subregions;
    - proportions of vegetation cover types;
    - proportions of old growth forest;
    - density of non-permanent human features (cutlines, truck trails);
    - footprint (ha) of non-permanent human features including cutblocks; and
    - Percentage of forest patch containing cutblocks.

Definitive Question

Are there forest landscapes unfragmented by permanent infrastructure and of a size to maintain viable populations of most species?

There are currently a significant number of landscape-level forest patches unfragmented by permanent human features in the FMA and larger region. Open motorized road densities in the FMA are generally low ranging from a low of 0.01 km/km^2 in the Sullivan Creek compartment to a high of 1.1 km/km^2 for the Coal Camp Creek compartment (SLS 2006). The average open motorized road density for compartments in the North FMA is 0.62 km/km^2 and 0.12 km/km^2 for the South FMA. Total (open + closed) motorized road densities range from a low of 0.26 km/km^2 in the Sullivan Creek compartment to a high of 1.1 km/km^2 for the Coal Camp Creek compartment. The average total motorized road density for compartments in the North FMA is 0.85 km/km^2 and 0.40 km/km^2 for the South FMA. These densities are within the range of 0.6 km/km^2 which is generally accepted as the road density threshold for grizzly bears. Ripley et al. (2005) found weak but significant relationships between road density and percentage of sub-basin harvested and Bull Trout occurrence in the Kakwa River watershed in Alberta; however, an alternate modeling approach presented in the same publication found both positive and negative relationships between road density and Bull Trout abundance. Ripley et al. (2005) noted a 0.4 km/km^2 road density relates to a 50% decrease in the probability of finding a Bull Trout and a 0.8 km/km^2 density relates to an 80% decrease in the probability, when compared to a control area with no roads. Harvesting 20% of the sub-basin resulted in a 50% decrease in probability of finding a Bull Trout and harvesting 35% resulted in an 80% decrease in the probability. Although significant, the relatively weak relationships would have large confidence intervals which are not defined by Ripley et al. (2005). The most important predictor of Bull Trout occurrence potentially related to forestry roads is the presence of sediment in the substrate of fish bearing streams. In the case of McLean Creek, ATV use of trails and seismic lines along with cattle grazing may have led to a slightly lower water quality index as compared to other streams rather than the forestry operations themselves. SLS forestry operations are guided by Operating Ground Rules and best management practices designed to protect water courses from sediment delivery.

Guidance Questions

Do the unfragmented forest landscapes include suitable habitat for native species or more natural forests in terms of structure and function?

Is the level of dissection and perforation in large, unfragmented forest landscapes below levels that will permit the persistence of most native species?

Are large remnant patches (thousands of hectares) the best examples of intact forest for their community and landform types?

Do the largest remnant forest patches include a significant proportion of climax species (i.e. not dominated by pioneer species)?

Do the largest remnant forest patches include a significant proportion of late seral stands?

Do the largest remnant forest patches include a significant proportion of structural features such as woody debris and standing dead trees (i.e. structurally complex)?

Do the largest remnant forest patches include known populations of significant species (i.e. species representative of habitat types naturally occurring in the management unit, focal) and/or suitable habitat to maintain short-term persistence (i.e. 25-50 years) of significant species?

Regionally Significant Large Landscape-Level Forests

The overlay of permanent features resulted in the identification of two regionally significant (50,000 ha to 200,000 ha) large landscape level forest blocks (Figure 7). The largest block is 178,867 ha and occurs in and adjacent to the South FMA. This block is the green hatched area classified as 1-HCVF in the map legend of Figure 7. The portion of this forest block in the FMA (66,369 ha) is found along the higher elevation western boundary. It is supported to the west by unfragmented subalpine and alpine lands associated with the Elbow-Sheep, Don Getty, and Bluerock Wildland Provincial Parks. The land area of this unfragmented block outside of the FMA is 112,498 ha.

The next largest regionally significant large landscape-level forest is 161,319 ha in size and occurs in and adjacent to the North FMA. This block is the red hatched area classified as 2-HCVF in the map legend of Figure 7. The portion of this forest block that occurs in the FMA is 44,400 ha and is found along the higher elevation western boundary of the FMA in the upper North Burnt Timber and Waiparous Creek valleys. It occupies primarily Upper Foothills, Montane and Subalpine lands. It is supported to the west by unfragmented Subalpine, Alpine, and to a lesser extent Montane lands associated with the Don Getty Wildland Provincial Park and the Ghost River Wilderness Area. The land area of this unfragmented block outside of the FMA is 116,919 ha.

The remaining map polygons in Figure 7 that are numbered 3 to 24 are areas of land without permanent features that did not meet the 50,000 ha minimum threshold for regionally significant large landscape level forests. The grey areas in Figure 7 are patches of land without permanent features that did not meet the 5,000 ha minimum size for remnant landscape level forests.

Both of these regionally significant forest landscapes are free from permanent road infrastructure and human habitation. They represent core security areas for large mammals such as grizzly bear, elk, bighorn sheep, cougar, wolves, and lynx. They are also large enough to support minimum area requirements for populations of most smaller-bodied species in the FMA and immediate vicinity. These forests include large amounts of 3 of the 4 dominant Natural Subregions in the FMA, including Subalpine, Upper Foothills, and Montane. The only Natural Subregion not well represented by these two landscape level forests is the Lower Foothills.

In summary, two regionally significant large, landscape level forests are selected as High Conservation Value Forests, as shown in Figure 7.

Remnant Landscape-Level Forests

Remnant landscape level forests are land areas without permanent human use features that do not meet the size requirements of a regionally significant large landscape level forest but are >5,000 ha and have potential to:
• provide the only remaining habitat for some forest species on a local or regional scale;
• serve as important source areas for recolonization of species; and
• serve as representative areas, informally within a landscape, or formally within a protected areas network. (WWF-Canada 2005).

A total of 15 remnant forest patches less than 50,000 ha but greater than 5,000 ha in size were mapped in the FMA. Eight were delineated in the North FMA and 7 were delineated in the South FMA (Figure 8). A description of each of these remnant forest blocks, according to size, natural region, broad vegetation cover type composition, linear feature density (not including permanent roads, powerlines and pipelines), non-permanent footprint (ha), % of forest harvested, and % early to late seral forest is presented in Table 7.

Identification of remnant landscape level forest patches for HCVF designation from the list of 15 possibilities was guided by the following primary factors:

- high proportion of low elevation Upper Foothills, Lower Foothills and/or Montane forest;
- a human footprint (including cutblocks) of <5% (WWF Canada 2005);
- relatively low linear feature density; and
- a relatively high proportion of deciduous and mixedwood forest.

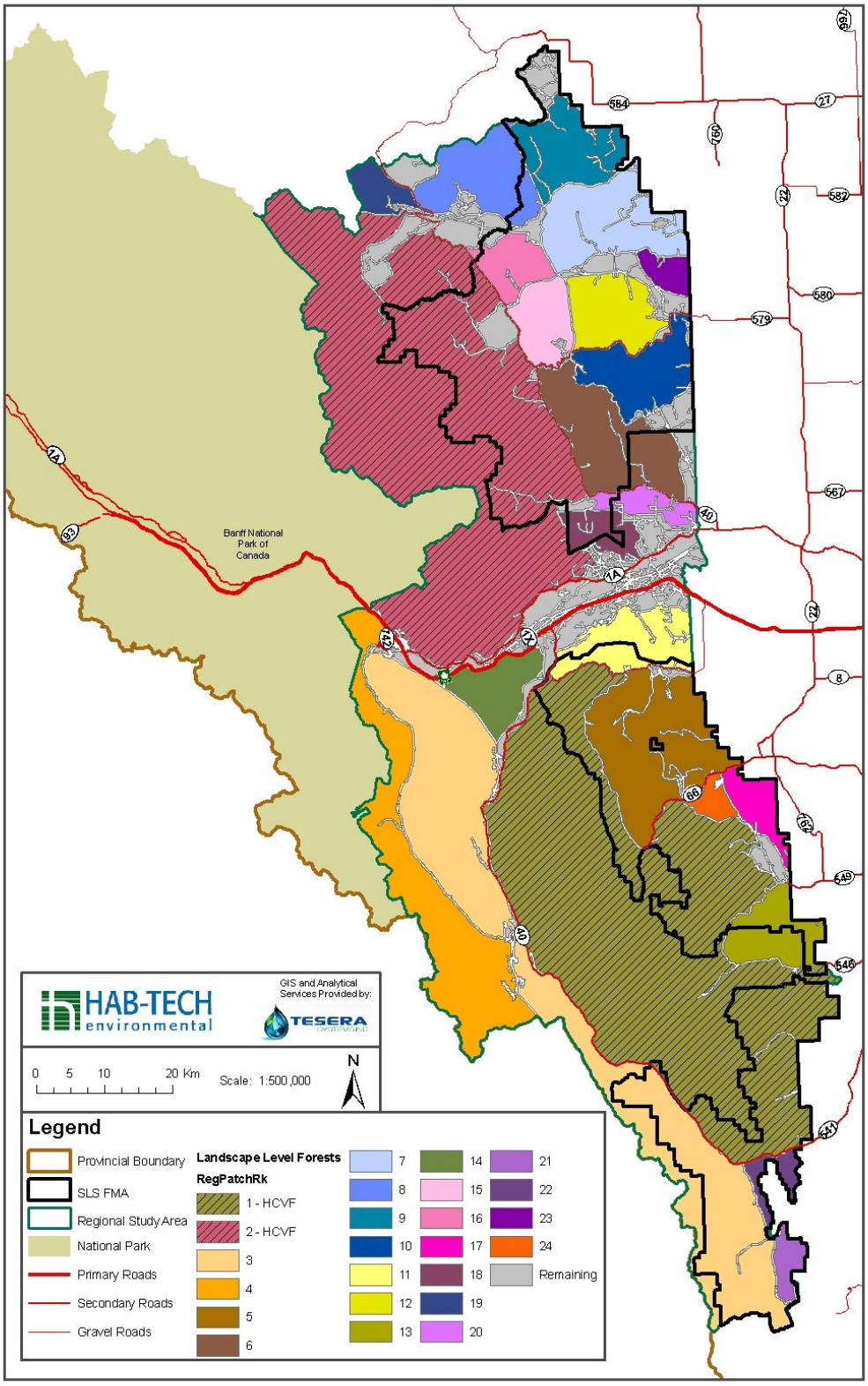

Figure 7. Regionally significant large landscape level forests in the SLS FMA and region

Based on the above criteria, remnant landscape level forest #12 in the North FMA and # 8 in the South FMA were identified as HCVFs.

Remnant #12 is 15,242 ha and supports a mix of Upper Foothills, Montane and Lower Foothills subregions. It has a low footprint and linear feature density. Remnant # 8 is 28,245 ha and supports a high proportion of Montane forest with very low linear feature density and human footprint. Both remnant forests have relatively large proportions of deciduous and mixedwood forests, which are rare in the FMA and are subject to reduced area on the landscape due to natural succession to shade tolerant conifers and the absence of wildfire that supports establishment of pioneer species (SLS 2006).

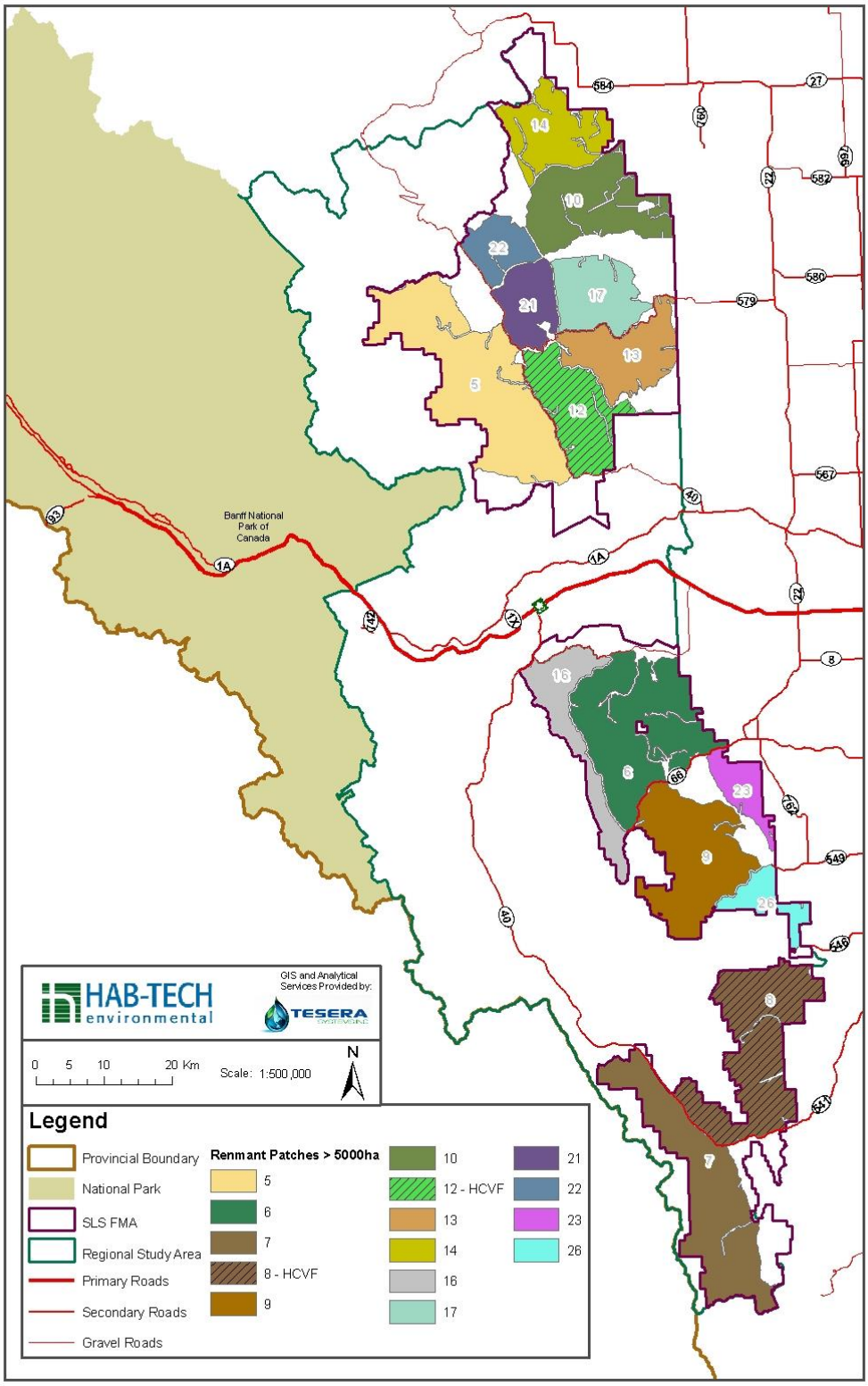

Figure 8. Remnant landscape level forests in the SLS FMA

Table 7. Ecological and land use characteristics of remnant landscape level forests in the SLS FMA

Remnant #	Area (ha)	Portion of FMA	Natural Subregion %					Linear Feature Density (km/km^2)	Footprint (%)	% Cutblock	% Old Growth Forest	% Deciduous		% Wetland
			Alpine	*Subalpine*	*Upper Foothills*	*Lower Foothills*	*Montane*					*Pure*	*Mixed*	
5	38,587	North	0.1	24.0	50.9	0.0	25.1	2.9	3.0	2.3	7.7	1.8	7.5	8.5
6	30,778	South	1.0	52.0	0.0	0.0	46.9	2.0	8.3	6.8	0.9	3.0	2.7	0.9
7	30,069	South	2.8	92.4	0.0	0.0	4.8	3.4	6.4	5.7	1.1	0.8	1.4	2.9
8	**28,245**	**South**	**0.6**	**57.9**	**0.0**	**0.0**	**41.5**	**1.4**	**1.4**	**0.4**	**3.3**	**9.2**	**4.1**	**1.6**
9	24,263	South	0.0	66.0	0.0	0.0	34.0	2.1	6.2	5.7	1.1	2.5	1.8	4.9
10	19,495	North	0.0	0.0	10.4	89.4	0.0	4.3	24.4	18.5	7.0	5.0	27.5	6.2
12	**15,242**	**North**	**0.0**	**0.0**	**53.3**	**12.2**	**34.5**	**2.9**	**3.1**	**1.9**	**4.0**	**7.9**	**12.5**	**5.6**
13	14,097	North	0.0	0.0	21.7	78.3	0.0	2.9	19.8	16.6	5.7	6.9	11.4	3.3
14	13,993	North	0.0	0.0	34.8	65.2	0.0	3.5	19.3	17.7	25.7	10.1	21.7	3.0
16	13,284	South	2.9	67.9	0.0	0.0	29.2	1.2	4.9	4.6	0.6	0.3	1.5	0.2
17	12,440	North	0.0	0.0	69.9	30.1	0.0	3.5	25.2	20.2	3.9	1.5	8.7	9.8
21	8,837	North	0.0	0.0	99.1	0.9	0.0	3.3	11.8	10.8	4.3	0.1	2.5	5.8
22	6,984	North	0.0	0.0	92.2	7.8	0.0	2.9	14.5	13.7	6.1	0.4	6.6	1.2
23	5,987	South	0.0	0.0	0.0	0.0	100.0	4.1	17.9	15.3	2.1	17.4	6.6	6.1
26	5,632	South	0.0	0.0	0.0	0.0	100.0	2.2	0.8	0.2	6.6	45.9	9.8	3.7

4.3 Category 3: Forest Areas that are in or Contain Rare, Threatened or Endangered Ecosystems.

4.3.1 Key Question 8

Does the forest contain naturally rare ecosystem types?

Maintenance of an ecologically appropriate supply of native vegetation and habitat is a cornerstone of conservation biology and is generally considered to be the primary management tool for the protection of biological diversity (Meffe and Carroll 1994). Native habitats considered to be in short supply (rare) in a regional context are considered to be more significant than abundant habitats in the context of preserving landscape diversity and the plant and animal species that these landscapes support (Noss 1993; Council on Environmental Quality 1993; Noss and Cooperrider 1994). Rare, unique or sensitive biological communities are the most vulnerable elements of biological diversity (Salwasser and Pfister 1994) and are most likely to support rare plant species and communities (Packer and Bradley 1984).

Definitive Question

Are there ecosystems that have been officially classified as being rare, threatened or endangered by a relevant national or international organization?

The ACIMS data was reviewed to determine if any rare plant (ecological) communities are classified as globally rare (Allen, 2010). A total of 34 communities were ranked as G2 and/or G3 (Appendix 2). All but 1 of these communities occurs in the Rocky Mountain Natural Region. The single community ranked globally that occurs in the Foothills Natural Region is the Silverberry Riparian Shrubland community.

The Conservation International (2010) website was reviewed for biodiversity hotspots and areas of conservation concern. None are located in Canada. Various maps provided by the World Wildlife Fund, in conjunction with Terrestrial Ecosystems of North America (Ricketts et al. 1999) were also reviewed. No internationally ranked ecosystems occur in the vicinity of the FMA.

Guidance Questions

Is a significant amount of the global extent of these ecosystems present in the country and/or ecoregion?

Are these ecosystems heavily modified?

Are these ecosystems potentially negatively impacted by forest management?

Of the 34 rare ecological communities recorded in the ACIMS data that have potential to occur in the FMA, 21 are non-forest communities (grasslands, herbaceous, dwarf shurbland

etc.) and are at low risk to impacts from forestry operations. No HCVF designations were made from this group of 21. Of the 13 forest communities ranked globally, 9 are non-commercial forest types or occur in sites not accessible to forestry (e.g. high subalpine, riparian areas).

Four globally ranked forested plant communities have potential to be harvested and were identified as HCVFs:

- **Lodgepole pine/red-osier dogwood woodland (S2?/G2/G3)**
- **Lodgepole pine/white meadowsweet forest (S2S3/G3G4)**
- **Aspen-subalpine fir-Engelmann spruce/clasping-leaved twisted stalk forest (S1S2/G2/G3)**
- **Douglas fir/angelica spp. Forest (S1/S2/G2?)**

Two additional forested plant communities were included as HCVFs due to their global ranking, important biodiversity component, and the Provincial endangered status of limber and whitebark pine. Forest operations are expected to have minimal impacts due to the habitat locations (e.g. dry rocky sites, alpine, subalpine) associated with these communities. However, there is *potential* for whitebark and limber pine communities to be found in the lower supbalpine where harvesting may occur.

- **Whitebark pine-Engelmann Spruce / white mountain avens woodland (S1/G2G3)**
- **Limber pine scree woodland**

The presence and/or locations of these community types have not been verified in the FMA. This knowledge gap is addressed in the management and monitoring strategies (Section 5.0).

4.3.2 Key Question 9

Are there ecosystem types within the forest or ecoregion that have significantly declined?

Guidance Questions

Is the forest within an ecoregion with little remaining original forest type?

Have these ecosystems significantly declined (>50% loss)?

Is there a significant proportion of the declining ecosystem type within the management unit in comparison to the broader ecoregion?

Does potential vegetation mapping identify areas within the management unit that can support the declining ecosystem type (e.g., regeneration potential)?

How well is each ecosystem secured by the protected area network and the national/regional legislation?

At this point in time, timber harvest has affected approximately 9.3% of the FMA, with a maximum of 19.9% in any given cut compartment (mean = 8.2%; range = 0.5% to 19.9%). Timber harvest focuses on softwood tree species including lodgepole pine and White x Engelmann spruce. Harvest tends to occur in large homogenous patches of these coniferous forest types and avoids rare and uncommon vegetation communities that occur in riparian areas, wetlands, steep slopes, seepage areas and high elevation upper subalpine habitats.

Characteristic native vegetation cover and communities are not declining in the region, with the possible exception of a decline in deciduous and mixedwood forests due to fire suppression and natural vegetation succession. Pure deciduous and deciduous mixedwood forest >110 years are rare in the FMA. Projection modeling shows that natural vegetation succession in the absence of fire will lead to a significant decline in deciduous and mixedwood forest cover types at from 50 to 100 years (Kansas and Collister 2004). High quality habitat supply for mixedwood dependent wildlife species also declined markedly at this time period.

The Rocky Mountain Natural Region of Alberta is one of the most protected ecoregions in the province. The Alpine and Sub-alpine sub-regions of the Rocky Mountain Natural Region are well represented within the parks and protected areas network. All of the Level 1 and Level 2 natural history themes are represented, as are many of the known special features. In addition, all of the Level 1 natural history theme targets have been met for the Montane subregion (AB TPR 2011).

Protection targets have not been completely achieved for the Foothills Natural Region. Five Level 1 and 38 Level 2 natural history themes have been identified for the Lower Foothills. With the exception of mineral wetlands, all of the Level 1 themes are well represented in the parks and protected areas network. Level 2 themes are also well represented. Overall, 24.6% of the Level 1 targets have been achieved to date in the Lower Foothills and 77.6% have been achieved in the Upper Foothills (AB TPR 2011). It is estimated that achieving Level 1 targets will incorporate about 80% of the Level 2 and 3 themes.

No additional HCVFs or attributes have been identified under this question.

4.3.3 Key Question 11

Are there nationally/regionally significant diverse or unique forest ecosystems?

Guidance Questions
Are there important and/or unique geological areas that strongly influence vegetation cover?
Are there important and/or unique microclimatic conditions that strongly influence vegetation cover?
Do these ecosystems possess any exceptional characteristics?

This question is closely related to Key Question 8 *(Are there ecosystems that have been officially classified as being rare, threatened or endangered by a relevant national or international organization?).*

The difference between this question and Question 8 is the scale of the assessment and the introduction of the aspect of diversity. The response to Question 8 addressed international and national scale features from a rarity perspective. The following response to Question 11 addresses regionally unique and/or rare ecosystems and the potential for their selection as HCVF attributes.

Regional Ecosystem Uniqueness/Rarity

The level of uniqueness of ecosystems in the Spray Lake FMA was assessed at 2 scales. The first is the Ecosection, which is an area of land delineated based on recurring patterns of slope, landform, soil and vegetation. It is a form of enduring landscape feature (Kavanagh and Iacobelli 1995). The second is the Wildlife Habitat Unit (WHU), which is a recurring combination of vegetation cover, elevation, aspect, stand age, and moisture regime.

Rare Ecosections

SLS (2006) mapped 75 ecosections in the South FMA and 53 ecosections in the North FMA. The ecosections in each portion of the FMA were rank-ordered by area and classified into five percentiles (20% each) representing levels of rarity (rare, scarce, uncommon, common, and abundant). Rare and scarce ecosections comprised 0.5% and 3.2% of the South FMA, respectively. The locations of rare ecosections in the South portion of the FMA are mapped in Figure 9. Rare and scarce ecosections are found mainly along riparian areas of rivers and streams in the eastern section of the South FMA. Rare ecosections occur on a wide range of landforms including fluvial (4), colluvial (3), bedrock (2), hummocky moraine (2), morainal slopes (2), glaciofluvial (1) and anthropogenic (1). Vegetation cover of rare ecosections is also variable and includes riparian shrub, grassland, mixedwood forest, deciduous forest, and non vegetated areas.

Rare and scarce ecosections occupy 0.6% and 2.4% of the North FMA, respectively and range in area from 55 ha to 255 ha for rare ecosections, and 268 ha to 658 ha for scarce ecosections. The locations of rare ecosections in the North FMA are mapped in Figure 9. The 10 rarest ecosections occur on a wide range of landforms including moraine (3), fluvial (2), glaciofluvial (1), colluvial (2), lacustrine (1), and bedrock (1). Vegetation cover for these 10 ecosections is variable and includes lodgepole pine forest, aspen forest, deciduous shrub, xeric grassland, and mixedwood forest. Three of the rare forested ecosections occur on very steep slopes.

Rare Wildlife Habitat Units (WHU)

SLS (2006) mapped 200 WHUs in the South FMA. WHUs were rank-ordered by land area and classified into five percentiles (20% each) representing five levels of rarity (rare, scarce,

uncommon, common, and abundant). Rare and scarce habitat types comprise 0.1% and 0.8% of the South FMA, respectively.

The locations of rare WHUs in the South FMA are mapped in Figure 10. As was the case for rare ecosections, rare habitat types were mainly found along the riparian zones of rivers and streams in the eastern section of the FMA, where mixedwood and aspen forests are more prevalent. Of the 40 WHUs ranked as rare in the south FMA, the most typical vegetation types were subalpine fir forest (13), aspen forest (6), balsam poplar forest (5), spruce mixedwood forest (4), pine mixedwood forest (4), subalpine larch forest (3), aspen mixedwood forest (1), shrub meadow (1), and lodgepole pine forest (1). Thirty eight of the 40 rare WHUs were forest cover types with the majority of area in the young seral (50%) and old growth (37%) stages. Mid-seral forest types were abundant.

SLS (2006) mapped 934 WHUs in the North FMA. Again, these were classified into five rarity classes (rare, scarce, uncommon, common, abundant) based on area using five percentiles (20% each). Rare WHUs were all less than 5.0 ha in size and comprised 0.21% of the North FMA. Mapped locations are shown in Figure 10. Scarce and uncommon WHUs had areas between 5.0 ha and 14.2 ha, and between 14.2 ha and 38.8 ha, respectively. Scarce habitats occupy 0.95% and uncommon habitats occupy 2.7% of the North FMA. The 187 WHUs classified as rare occupy the following types of sites: 1.8-ha bryophyte cover type on flat upper foothills (1); a 1.4 ha cultivated cover type (1); anthropogenic cover types including human settlement and industrial facilities (3); barren-natural cover types (3); clearcuts/selective cuts (20); coniferous dominated mixedwood forest cover types (23); and coniferous forest types (83). Deciduous forest and deciduous dominated mixedwood forest characterize 29 (15 and 14, respectively) of the 187 rare types.

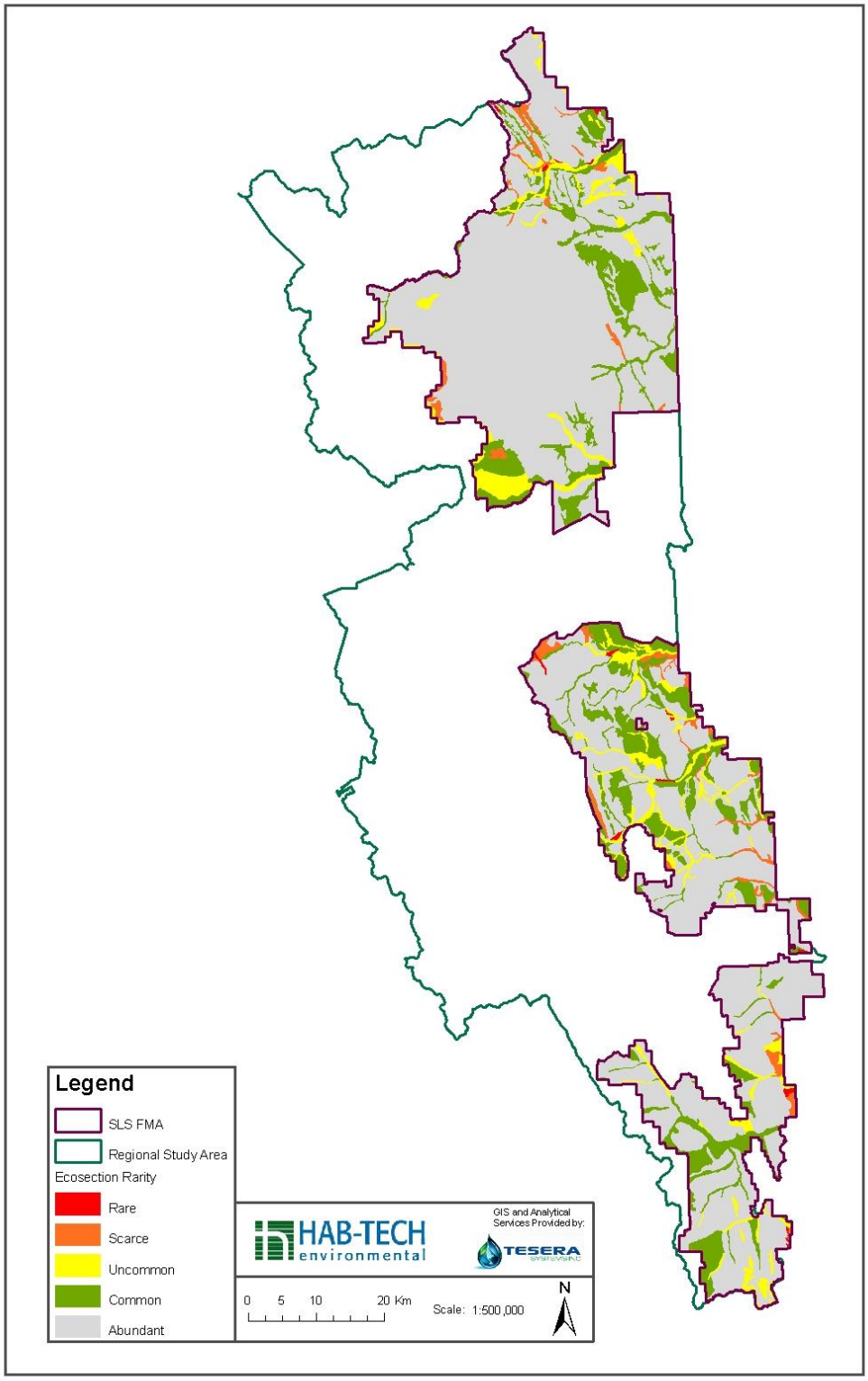

Figure 9. Location of rare (red/orange) ecosections in the SLS FMA/ B9 Quota

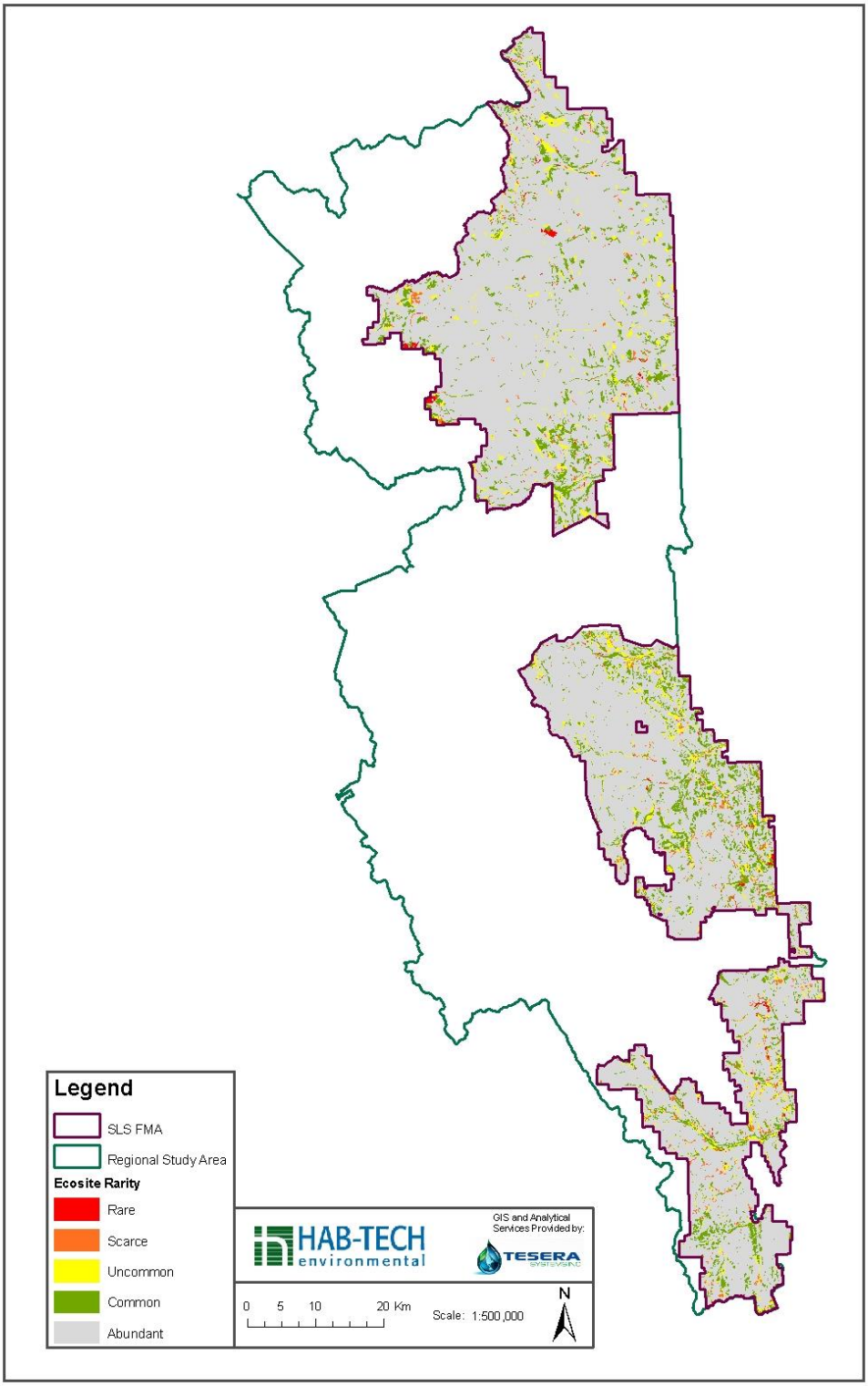

Figure 10. Location of rare (red/orange) WHUs in the SLS FMA/ B9 Quota

Regional Ecosystem Diversity

Plant Species Richness

A fundamental principle of conservation biology is to protect sites that support high levels of local *species richness*, referring to the number of organisms present in an area (Council on Environmental Quality 1993, Noss 1990). Ecosystems that support a high level of diversity of plant species tend to be structurally diverse and productive (Meffe and Carroll 1994). These areas in turn support a wide variety and abundance of insect and animal forms.

SLS (2006) used data from over 1700 vegetation sampling plots to describe the floristic and structural diversity of habitats in the South FMA. Similar plot data is not available for the North FMA. WHUs in the South FMA were ranked and divided into five equal sized diversity classes based on the mean number of species found in sampling plots. Twenty four percent of the South FMA was rated as high (18.9%) or very high (5.5%) for plant species diversity, 35% was ranked as moderately diverse, and the remaining 40% of the area was rated as having low (29.8%) to very low (10.1%) diversity.

WHUs with very high plant species diversity averaged from 28 to 37 vascular plant species per sampling plot. Of the 21 WHUs with the highest plant diversity, 10 were mixedwood forests, including 4 pine dominated mixedwood types, 3 spruce dominated mixedwood types, and 2 deciduous dominated mixedwood types. Five deciduous forest WHUs were ranked as having very high plant species diversity. Four of these were balsam poplar forests and 1 was an aspen forest. Two moderately sloping (15 – 45%) upland shrub meadows and 1 steep slope shrub meadow type were ranked as having very high plant species diversity. Other WHUs with very high plant diversity were NE facing subalpine larch forest, treed wetlands between 1600 m and 1900 m elevation, upper subalpine fir forest with a NE aspect, and grasslands between 1600 m and 2200 m elevation with NE aspects.

Although there are some ecological differences between the North and South portions of the FMA, it is likely that similar patterns of plant species richness occur between the 2 areas, certainly at the vegetation cover type level.

Structural Vegetation Diversity

The structural complexity of plant communities is positively correlated with the diversity of animal life using the community (Meffe and Carroll 1994). The more complex the structure of the plant community the more potential habitat niches are available for wildlife use (e.g. reproduction, forage, movement). Collister and Kansas (2003) used the Shannon-Wiener structural diversity coefficients from the 1700 + vegetation sampling plots completed in the South FMA. Diversity coefficients were calculated and grouped into 5 classes. Higher values represented areas with more and denser layers of vegetation. Again, this work was only completed for the South FMA, but as per plant species diversity, the information can be extrapolated to habitat types in the North FMA.

Only 8.3% of the South FMA was rated as having very high structural diversity. WHUs in this class included pine and spruce dominated mixedwood forest and aspen and balsam poplar forest. Upper subalpine spruce and Engelmann spruce forest on gentle and SW facing slopes also received high ratings for structural diversity. Other habitat types with high ratings for structural diversity include treed clearcuts on SW and NE facing slopes, and treed wetlands at elevations less than 1600 m.

Multi-SAR Occurrence

Kansas and Collister (2005) identified WHUs that provided high quality habitat for the largest number of vertebrate species at risk (SAR). This work was done for the Sundre Forest Products FMA, adjacent to the North boundary of the SLS FMA/B9, which supports very similar topography and vegetation. Using a list of 58 vertebrate SAR, they determined that lakes and ponds, flooded areas (beaver ponds), riparian mixedwood forests, and old growth conifer forests were the WHUs that supported the largest number of species at risk with high or very high quality habitat. This pattern of SAR concentration is likely to occur in the SLS FMA as well. Multi – species habitat suitability ratings for the FMA are shown in Figures 11a (North FMA/ B9 Quota) and 11b (South FMA).

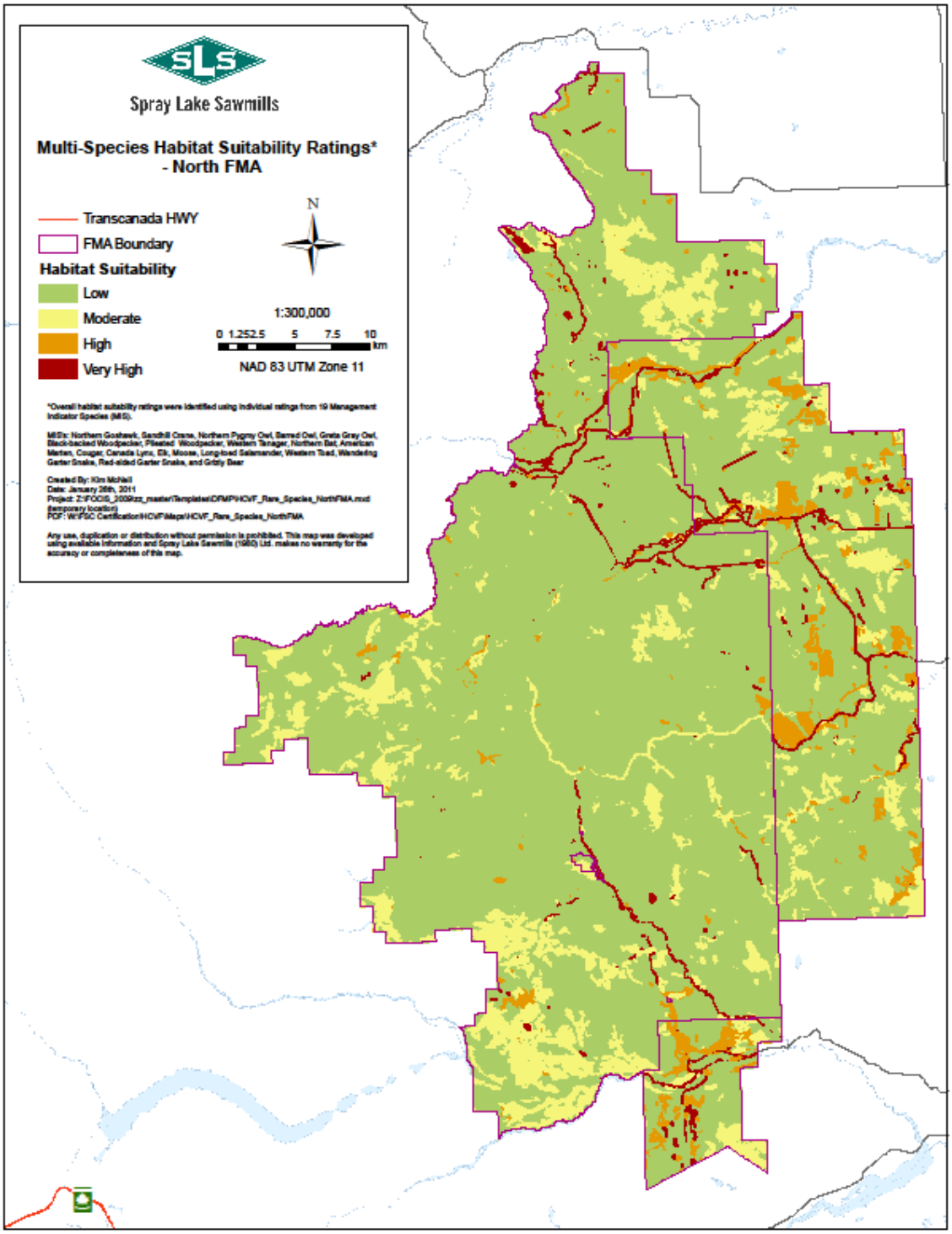

Figure 11a. Multi –species habitat suitability ratings for the North FMA/ B9 Quota

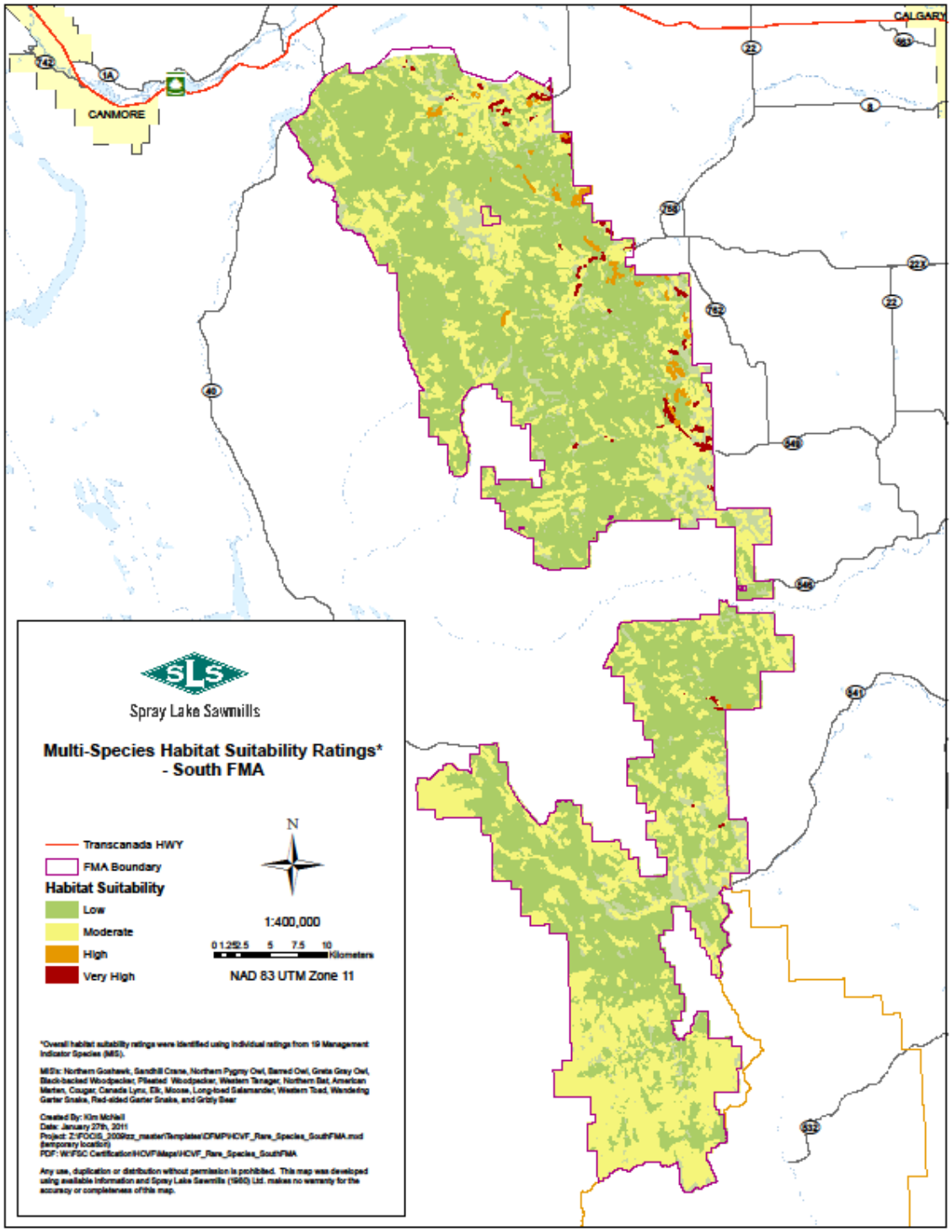

Figure 11b. Multi –species habitat suitability ratings for the South FMA

Synthesis of Regional Uniqueness and Diversity

Upon review of the rare ecosections and WHU analysis, plant species richness data, structural vegetation diversity data, and multi species at risk occurrence data, the following habitats were identified as High Conservation Value Forests because of their regional uniqueness/rarity and their floristic, structural and vertebrate species at risk diversity.

- ***Mixedwood forests in riparian settings*** **-** particularly those with balsam poplar and white spruce. These are rare vegetation cover types that are diverse botanically and structurally and are productive as habitat for vertebrate species at risk and rare plants.

- ***Shallow marshes and beaver pond complexes*** - are rare in the FMA and are high quality habitat for a number of bird and herpetile species at risk.

- ***Deciduous mixedwood and pure deciduous forest cover types >110 years old*** **-** are of limited supply in the FMA and are subject to loss due to natural succession in a fire suppressed system. These are highly diverse, botanically and structurally, and are productive wildlife habitat sources.

- ***Late seral and old growth conifer forests >170 years old*** **-** are high quality habitat for a number of listed wildlife species including Marten, Northern Goshawk, Pileated Woodpecker, Northern Pygmy Owl, Barred Owl, Bay-breasted Warbler, Black-throated Green Warbler, Cape May Warbler, and Lynx.

- ***Upland Grasslands*** **-** are essential habitat for elk and mule deer, which are key species for large carnivores. This habitat is of limited and diminishing supply due to encroachment of shade tolerant conifers as a result of the absence of fire.

The 5 unique and diverse habitats are shown in Figures 12a (North FMA/ B9 Quota) and 12b (South FMA). Note that current HCVF mapping depicts the entire AVI polygon for the mixedwood forests in riparian settings. Focus for HCVF management is on the 10-50m area immediately adjacent to the watercourse channel bank and is often characterized by imperfect drainage. HCVF mapping will be refined (e.g. Lidar technology) with the next AVI update.

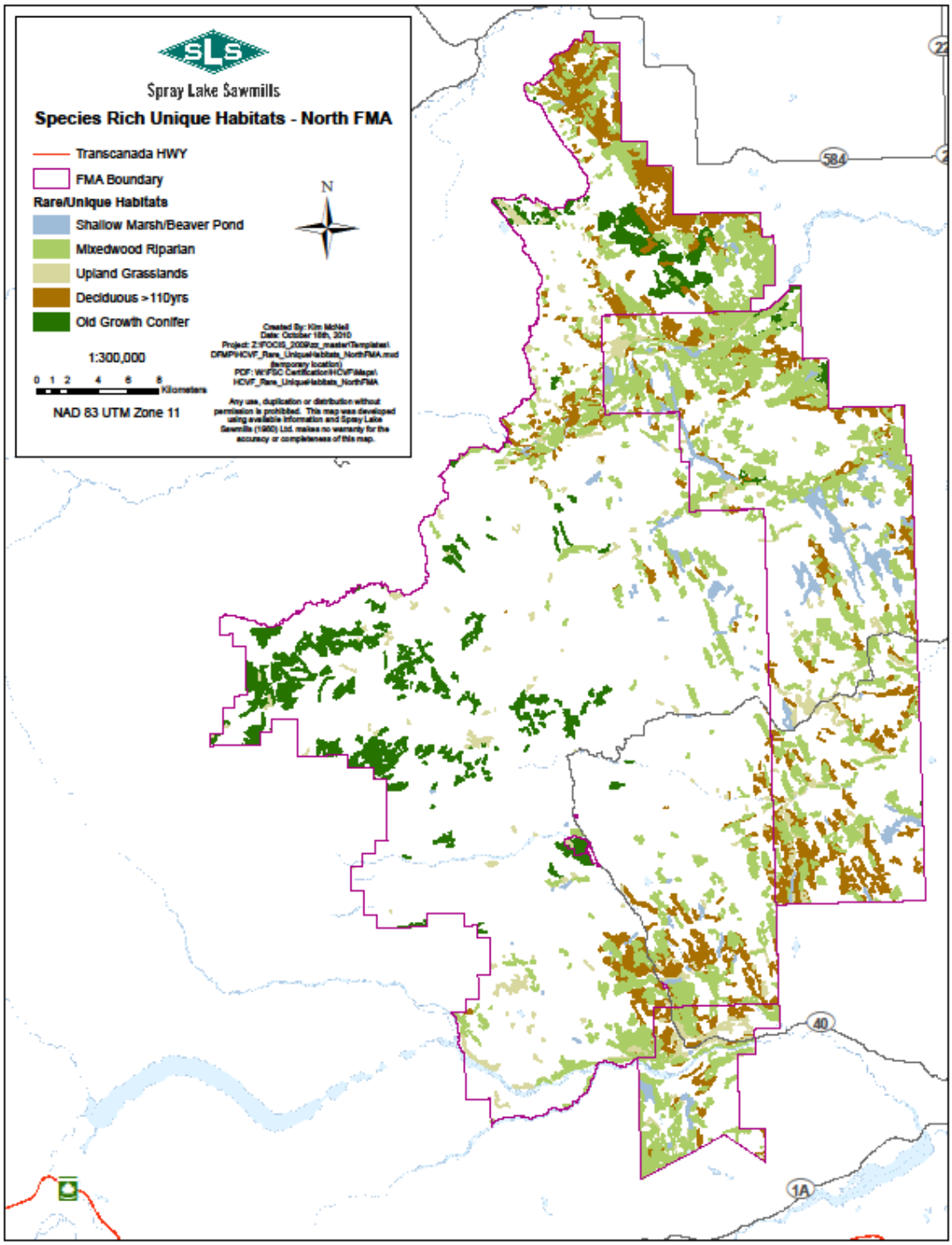

Figure 12a. Unique and diverse habitats in the North FMA/ B9 Quota

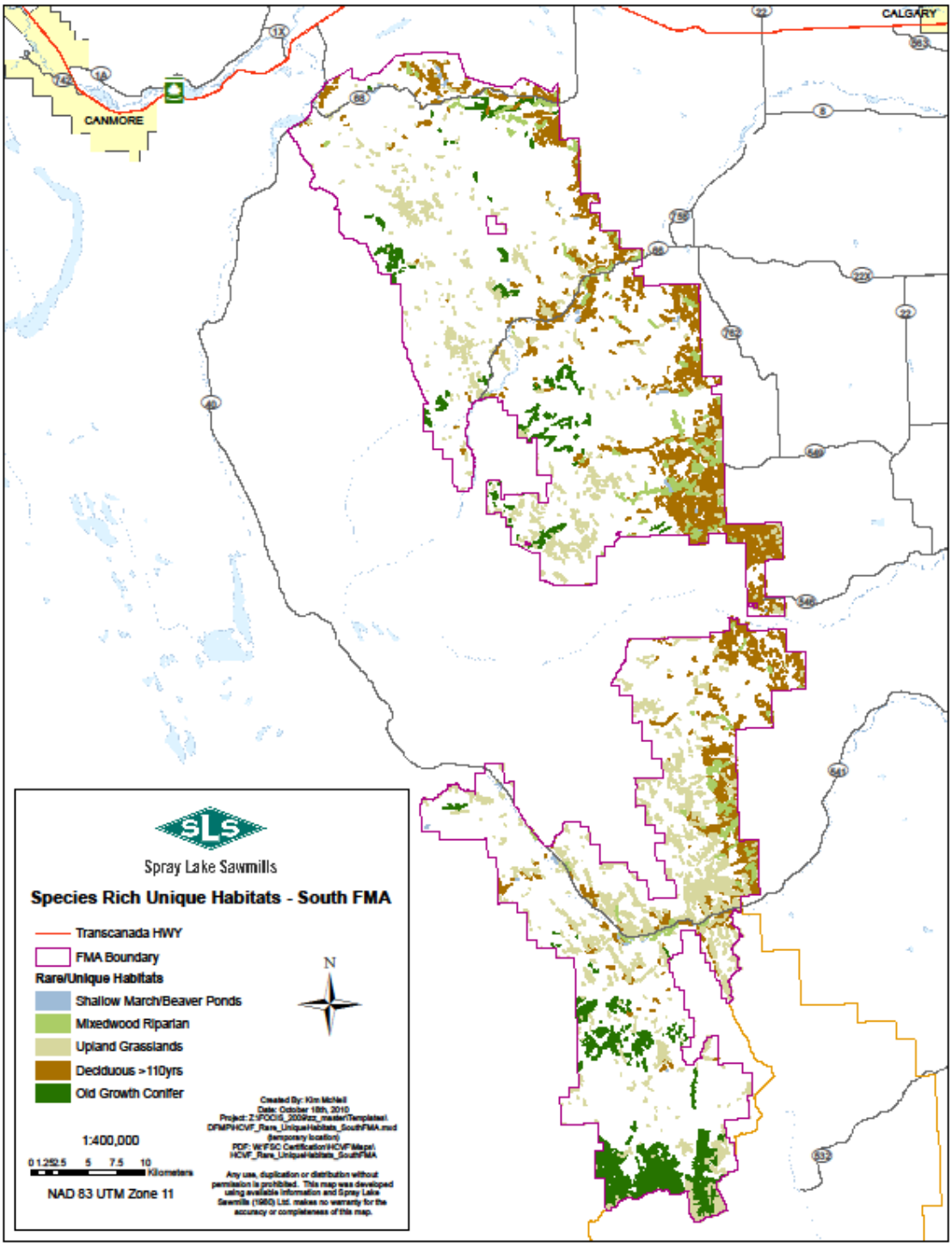

Figure 12b. Unique and diverse habitats in the South FMA

4.4 Category 4: Forest Areas that Provide Basic Services of Nature in Critical Situations (e.g. Watershed Protection, Erosion Control).

4.4.1 Key Question 12

Does the forest provide a significant source of drinking water?

Forest managers must determine whether or not incorrect actions or management could cause serious cumulative or ***catastrophic*** impacts to basic services provided by the forest, such as drinking water. Areas are considered a HCVF where potential negative impacts on human communities from forest management activities are ***so significant that they lead to significant loss of productivity or sickness and death, with no alternate sources of drinking water***.

Definitive Question Is there a sole available and accessible source of drinking water?

The importance of protecting Alberta watersheds has been recognized for over 100 years. This is indicated by legislation and policy documents with a focus on watershed management, including: the Federal Dominion Forest Reserves Act (1906); establishment of the Green and White Areas (1948); formal establishment of the Rocky Mountains Forest Reserve (1964); the Eastern Slopes Policy (1977 and revised in 1984); Alberta's Water For Life Strategy (2009); and the implementation of the South Saskatchewan Regional Plan (2014).

The FMA falls within the Red Deer and Bow River basins, 2 of Alberta's 10 major river basins. The location of the FMA/B9 Quota in relation to these watersheds is presented in Figure 13. The Red Deer River flows through the FMA/ B9 Quota area southwest of Sundre. The lower half of the North FMA and B9 quota areas are located in the Bow River basin. The Bow River parallels Highway 1 and splits the FMA west of Cochrane, although the main stem and riparian area is not included within the FMA Boundary. The South FMA lies entirely within the Bow River basin.

The headwaters of these two rivers originate from the snowpack and glacial ice of the Rocky Mountains on the east side of the continental divide, primarily outside of the FMA. Both rivers originate in Banff National Park, then flow through the foothills and onto the prairie. The Bow River meets the Oldman River east of Taber in southeastern Alberta and forms the South Saskatchewan River. The confluence of the Red Deer River and South Saskatchewan

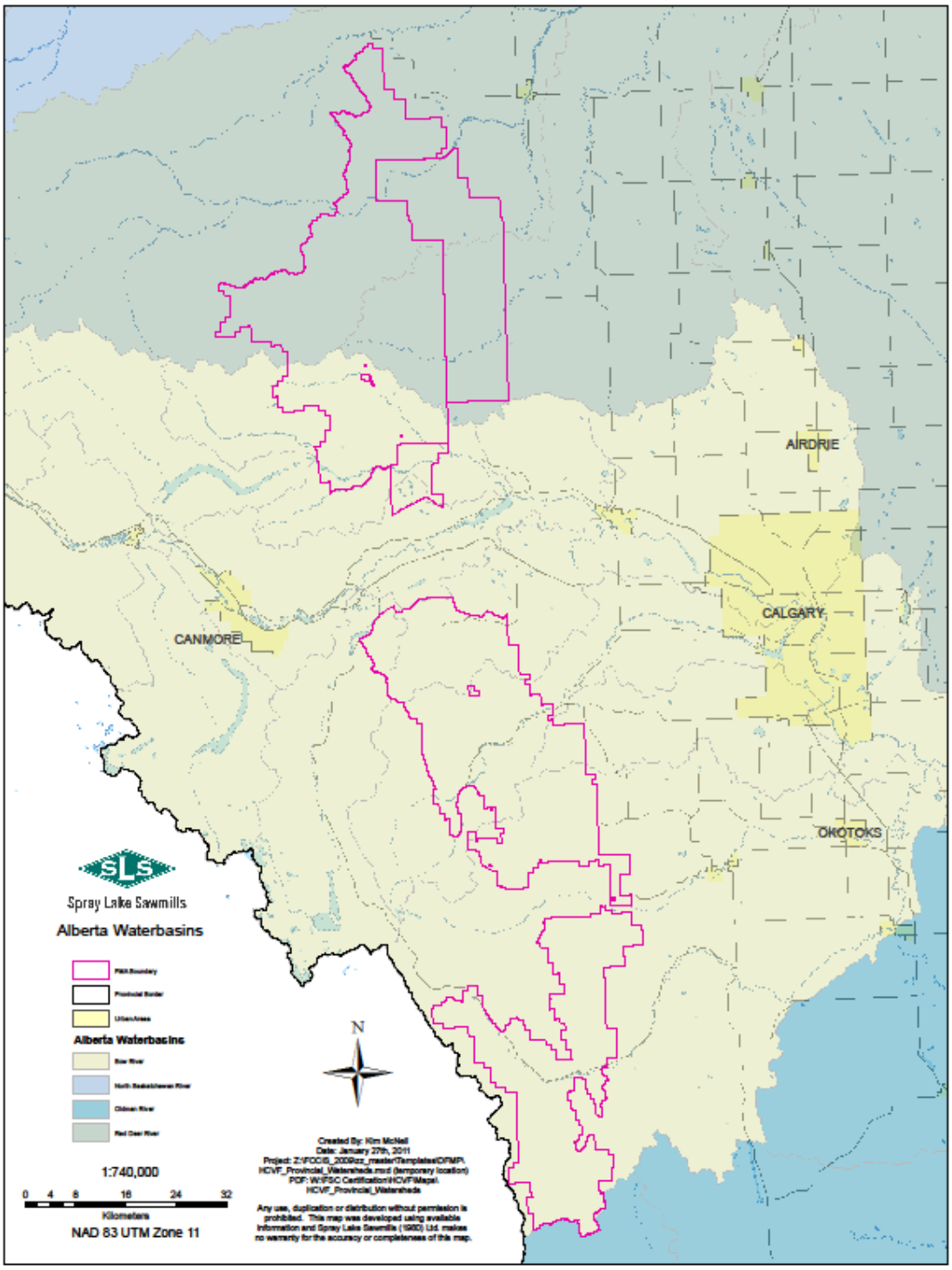

Figure 13. SLS FMA /B9 Quota in relation to major Alberta river basins

River is approximately 8 km east of the Saskatchewan border, near the village of Empress. The South Saskatchewan River is a tributary of the Nelson River system that eventually flows into the Hudson Bay.

The rivers are considered snowmelt rivers, with the majority of water supplied by precipitation falling as snow and accumulating in the high elevation peaks of the Rocky Mountains. A series of peak flows occur during the spring and summer, related to progressive melting of snowpacks at high elevations. Water flow declines over the late summer, fall, and winter. Snow and glacial melt provide water recharge during late summer and fall. Peak flows generally occur during June, with minimum flows in January (BRBC 2005). Many fresh water springs, intermittent, and permanent streams, as well as major sub-basin rivers provide water to the main stems of the Bow and Red Deer Rivers along the foothills.

The Bow River Basin as it relates to the FMA/B9

The Bow River flows for 645 km with a drainage basin of approximately 25,000 km^2, which is approximately 23% of the entire drainage area of the South Saskatchewan River (Golder Associates Ltd. 2003). The River drops 2,600 meters in elevation from the headwaters to the mouth. The FMA encompasses approximately 2,040 km^2 or 8% of the area within the Bow River Basin, including 3 major sub-basin rivers: the Ghost (including Waiparous Creek); the Elbow; and the Highwood River (including the Sheep River). The Bow River is the largest tributary of the South Saskatchewan River, contributing approximately 43% of the average annual combined flow (Bow River Water Quality Council 1994).

The Bow River basin is the most highly populated river basin in Alberta, having approximately 1,367,575 people (as of 2011, Bow River Basin Council data). The City of Calgary, with approximately 1,096,833 people (Statistics Canada 2011), is the largest urban centre and represents over 80% of the population in the watershed. The river upstream of Banff is relatively unchanged, however the natural flows downstream are highly altered due to hydro electric dams, water withdrawals, diversions, irrigation canals, and wastewater discharges (BRBC 2005). Approximately 40% of the basin's total annual natural flows are altered, making the Bow River the most regulated river in Alberta (Clipperton et al. 2003).

The City of Calgary is the largest municipal user of water in the Bow River Basin. It stores drinking water from the Bow and Elbow Rivers in the Bearspaw and Glenmore reservoirs, respectively. Calgary supplies the communities of Airdrie and Chestermere, while the majority of communities upstream of Calgary use groundwater as a domestic supply. Exceptions include Canmore, which draws water from the Spray Lakes Reservoir and the community of Cochrane, which draws water from the Bow River. A combination of surface water, groundwater, and irrigation works supplies water to communities downstream of Calgary (Bow River Basin Water Council 1998).

Once the Bow River flows past the boundary of Banff National Park, it continues through Canmore, Exshaw, and Kananaskis Country to the vicinity of the FMA boundary, located near the confluence of the Kananaskis River and the Bow River. The major watershed sub-basins

associated with the Bow River are shown in Figure 14, and are described below in relation to segments (or reaches) along the Bow River.

The Bow River flows through the Stoney Reserve No. 142 and the community of Morley, passes through Cochrane and heads towards the Bearspaw Dam upstream of Calgary. Major tributaries feeding this section of the Bow River within or adjacent to the FMA include the Kananaskis River and Jumpingpound Creek south of Highway 1, and the Ghost River and Waiparous Creek north of Highway 1. Cochrane and Morley withdraw water from the Bow River and the Village of Waiparous utilizes ground water. The town of Cochrane pipes waste water to the Calgary treatment plant at Bonnybrook (BRBC 2005).

Approximately 675 km^2 or 15% of the FMA falls within the sub-watershed (i.e. area draining into the Bow River from the Banff National Park boundary to the Bearspaw Dam). Outside of Banff National Park, are Kananaskis Country provincial parks and mixed-use areas including: forestry, oil and gas development, grazing, and motorized and non-motorized recreation.

The reach of the Bow River from the Bearspaw Dam to the Western Irrigation District Weir, (approximately 23 km) marks the beginning of major water withdrawals. The Bow is fed from the southwest by the Elbow River sub-basin. The Elbow River originates at Elbow Lake in Kananaskis Country and flows approximately 108 km to the Glenmore Reservoir, then 11 km further to the confluence of the Bow River. Approximately half of Calgary's water supply is drawn from the Glenmore Reservoir on the Elbow River, while the other half is drawn from the Bearspaw Reservoir on the Bow River. Waste water from Calgary and surrounding communities (Cochrane, Airdrie, Chestermere, Tsuu T'ina Reserve) is discharged to the Bow River downstream of this reach.

The upper reaches of the Elbow River west of Bragg Creek are considered to have a healthy riparian zone and excellent water quality (ERWP 2008). Significant tributaries to the Elbow River include Bragg, Canyon, Lott, Quirk, and McLean Creeks. Water for the Tsuu T'ina Nation (Sarcee No. 145), the community of Bragg Creek, and rural residential communities along the Elbow River comes from the Elbow River, its tributaries, and from groundwater and private wells. Wastewater from these communities is generally released to septic fields or sewage lagoons. The Elbow River basin itself is approximately 1,235 km^2 with over 60% of the area within Kananaskis Country and 30% of the SLS FMA overlapping the drainage area.

Recreation is a particularly prevalent land use in the sub-basin, including the McLean Creek Off Highway Vehicle Forest Land Use Zone (FLUZ) and a dense network of hiking and mountain biking trails. East of Bragg Creek, rural residential development and agriculture likely present the highest threat to water quality as stream side buffers are often not used. Oil and gas activity also have potential impacts (BRBC 2005, ERWP 2008).

The Bow River reach from the Western Irrigation District (WID) Weir to the confluence of the Highwood River flows through the City of Calgary. Urban development has had a negative impact on the quality of the riparian zone and water, with this section receiving the wastewater discharge from Calgary's 2 waste water treatment plants as well as the majority of the stormwater out flow. Communities including Strathmore, Standard, Langdon, Gleichen,

and Rockyford fill their municipal reservoirs from the WID canal system during the irrigation season. This reach also marks the beginning of substantial water allocations for irrigation for surrounding areas east of Calgary (BRBC 2005).

Fish Creek, originating in Kananaskis Country, is the major tributary to the Bow River in this reach. The upper half of the Fish Creek sub-basin has commercial land uses including oil and gas development, grazing, recreation, and forestry activity within the FMA. The lower half of Fish Creek receives run-off and stormwater from Calgary. A major feature on the lower half of the stream is Fish Creek Provincial Park, located within the Calgary city limits.

The Highwood River is the main tributary to the Bow River in the reach between the WID Weir and the Carseland Weir to the east. This river originates in the Highwood Range of the Rocky Mountains and joins the Bow River approximately 8 km east of Calgary. The Sheep River is the most significant tributary of the Highwood River, joining east of Okotoks. There are no communities adjacent to the Bow River in this section of the watershed. Several communities are located in the Highwood River sub-basin, including Black Diamond, Turner Valley, Longview, Eden Valley Reserve No. 216, High River, and Okotoks. These communities access ground water by local wells or from the Sheep River (e.g. Okotoks) and sewage effluent is discharged to the Highwood or Sheep Rivers (BRBC 2005).

The major human influence on the Highwood River is the Highwood Diversion near High River, which has been in place for over 100 years (BRBC 2005). With the exception of the diversion, flows are considered to be unchanged from the natural condition and inputs to the Bow River somewhat mitigate the impacts of upstream dams on the Bow River (Golder Associates Ltd. 2003). The major land use in the lower reaches of the river is ranching, which has been active for over 100 years.

Approximately thirty-seven percent of the Spray Lake Sawmills regional assessment area is currently comprised of formally protected areas, including Wildland Provincial Parks (WPP) and Provincial Parks (PP) (Don Getty WPP, Elbow-Sheep WPP, Bluerock WPP, Sheep River PP), which occur immediately adjacent to and functionally within the FMA (Kansas and Mogilefsky 2013). The boreal region, Operating Ground Rule, stream protection practices are also among the most stringent in North America (Lee P, Smyth C, Boutin S. 2004).

More than 188 km^2 of currently protected lands were former timber quota lands, voluntarily contributed by SLS to the Crown for the purpose of protecting lower elevation Foothills landscapes. Protected areas are abundant in the FMA and region for the Alpine, Subalpine and Montane subregions. Within the Forest Management Agreement boundary, approximately 28% of the area is not available for harvest. Most of this area has been set aside for prime protection, wetland and riparian stream buffers and steep slopes that are off limits to forestry (Kansas and Mogilefsky 2013).

Spray Lake Sawmills (SLS) has been operating in the Bow River watershed since it acquired the Eau Claire Lumber Company timber quota in 1953. Back in those days, SLS operated near Spray Lake reservoir above the current day Town of Canmore (Munns, L. 1995). Over time, through the development of Alberta Government, Integrated Resource Plans and the adoption

of landscape level, formally protected areas, the designated mixed use forestry areas have been reallocated to the generally low risk, lower elevation, mixed use forests zones.

The Bow River State of the Watershed Sub-Basin Water Quality Snapshot (2010 BRBC) and the Calgary Watershed Report, A Summary of Surface Water Quality in the Bow and Elbow Watersheds, 2010-2012

In 2010, the Bow River Basin Council (BRBC), a multi-stakeholder, charitable organization dedicated to conducting activities for the improvement and protection of the waters of the Bow River Basin, completed the Bow River Basin State of the Watershed Summary Report.

The City of Calgary Water Resources Department also monitors surface water quality from a sampling network of thirty stations established on rivers, streams and reservoirs in the Calgary region. The key objective of the watershed monitoring program is to provide sound data to support informed decisions on immediate water operations for which future technologies and/or source water protection strategies can be developed, and as an essential component in an integrative approach for basin-wide watershed management (City of Calgary 2013).

From 1998 to present, the City of Calgary has been conducting water quality sampling along the Elbow and Bow Rivers as well as some of the major tributary streams. Four sites, including the Elbow River above Cobble Flats, McLean Creek near Mouth and Prairie Creek near Mouth and the Elbow River above Bragg Creek are located within the FMA. An additional site, Bragg Creek at Mouth is adjacent downstream of the FMA.

A Bow River tributary site, located on the Ghost River near Benchlands is located adjacent and downstream of the FMA. In total, the City has been collecting data from 6 sites representative of the mixed-use Spray Lake Sawmills FMA.

The following table has been adapted from the 2010 BRBC State of the Basin Report and City of Calgary water quality reports, from 2010 through 2012. The BRBC report provides a range of values or ratings to illustrate and report on the condition of each indicator from *Natural* to *Good* to *Fair* to *Cautionary*.

The definitions for the ratings are as follows: *Natural*- conditions considered to be in a natural state; *Good*- cumulative impacts are considered to be minimal and the indicator is in a desired state; *Fair*- conditions are shifting away from a desired state; *Cautionary*- an undesired state and conditions are not desirable. The City of Calgary uses a similar criteria of *excellent*-natural and close to pristine; *Good*- desirable; *fair*-minor departures from natural or desirable; *marginal*-often departed from natural or desirable and frequently threatened and impaired; and *poor* usually departs from natural or desirable and are almost always threatened and impaired.

Table 8 Bow sub-basin water quality snapshot for FMA regional assessment area (adapted from BRBC 2010 and City of Calgary 2010-2012 water quality sampling)

Sub-basin	City of Calgary Rating	Indicator	BRBC Rating	Identified Risks	Points located within FMA Area
Upper Bow	NA	All indicators measured including river flow, surface water quality, riparian assessment, and aquatic plants	Natural and desired state	Growing tourism and recreation use, including sewage, solid waste and demand for potable water	No FMA area. Headwater areas are formally protected
Kananaskis River	NA	River flow	Natural to cautionary (hydro operations) all other indicators reported as Natural	Protection of source waters, effects of hydro-generation, mountain pine beetle, recreation	Yes & Peter Lougheed, Bow, Spray Valley and Elbow Sheep Provincial Parks
Ghost River (Benchlands)	Overall indicator score of natural to desired state	All indicators measured	Natural or in a desired state	Protection of source waters, and managing the impacts from increased tourism and recreation	Yes & the Don Getty Wildland Provincial Park, and the Ghost River Wilderness Area
Seebe to Bearspaw	NA	All categories	Natural or in a desired state except for nitrogen and riparian assessment, not in a desired state	Growth of municipal development and off-road recreational use	Yes
Jumping Pound Creek	Overall indicator score of natural to desired state	All categories	Natural	Protection of source waters, and managing the impacts from increased tourism, recreation and suburban development	Yes and adjacent
Bragg Creek at Mouth*	Occasionally threatened and impaired sometimes departing from natural or desirable: total suspended solids, total phosphorus, dissolved phosphorus, total nitrogen, & *E. coli*		NA	Agriculture, forestry, recreation, rural residential development	Adjacent downstream
Elbow River above Bragg Creek*	Rarely departs from natural and desirable	All measured categories	NA	None reported	Yes
Prairie Creek***	Rarely departs from natural and desirable	All measured categories	NA	None reported	Yes
McLean Creek near Mouth***	Rarely departs from natural and desirable	All measured categories	NA	Recreation, agriculture, forestry	Yes
Elbow River above Cobble Flats***	Rarely departs from natural and desirable	All measured categories	NA	None reported	Yes & Elbow Sheep & Peter Lougheed Provincial Parks
Calgary Downstream Below Policeman's Flats	Occasionally threatened and impaired sometimes departing from natural or desirable from total phosphorous, total nitrogen aluminum, metals & *E. Coli*	All measured categories	NA	Wastewater treatment	No

*Annual monthly samples collected since 1998 ** Annual monthly June-October samples collected since 1998 *** Annual monthly May-October samples collected since 1998

For the Bow River reaches downstream of the City of Calgary, the City of Calgary's water quality monitoring work indicates water quality index values steadily deteriorate. The degradation to water quality is as a consequence of increasing concentrations of nutrients (phosphorus and nitrogen), total suspended solids, total organic carbon, aluminum and *E. coli* bacteria. Water quality in the lower reaches of the Bow River has been impacted appreciably from effluent discharges from the three, City of Calgary wastewater treatment plants (City of Calgary 2013).

Wildfire is likely the biggest threat to maintaining excellent water quality (Water Research Foundation 2014). From a forest protection and ecological standpoint, creating new age classes is paramount to promoting a healthy forest and watershed. In January of 2013, SLS completed an Evaluation of the Pre-industrial Forest Condition Report. The evaluation demonstrates that the Bow forests age class distribution are out of balance with the pre-industrial forest baseline.

This problem is not unique to Alberta and ironically is the case for almost all unmanaged forests, including parks and forest preserves in North America (Water Research Foundation 2014). The age class imbalance is by and large resulting from successful fire suppression efforts. Large areas, of disproportionate old forest, containing significant levels of dead and dying trees are creating the potential to be dangerous wildfire fuel. As fuel levels accumulate on the landscape, they can be very challenging to firefighters during a wildfire event. Wildfires become intensely hot, making them very difficult to suppress and damaging to soils and wildlife habitat releasing a multitude of contaminates into the watershed (Water Research Foundation 2014).

The Red Deer River Basin as it relates to the FMA

The Red Deer River has a length of 724 km and a drainage area of almost 50,000 km^2, forming the largest sub-basin of the South Saskatchewan River (RDRWA 2009). The upper Red Deer River crosses the FMA/B9 quota area southwest of Sundre, with approximately 1,331 km^2 or 3% of the basin included in the FMA (Figure 13). The 3 major sub-basins associated with the FMA/B9 (James, Little Red Deer, and Panther) are shown in Figure 14. The reaches of the Red Deer River transecting the FMA/ B9 have been designated as a HCVF due to the nationally significant ESA (refer to Category 1, Key Question 3).

Population estimates indicate over 267,000 people living in the Red Deer River watershed. Approximately 69% of the population lives in urban settings with the remaining 31% in rural areas. The City of Red Deer is the largest urban area in the watershed with a population of approximately 90,564 people. The Town of Sundre, located east of the North FMA, has approximately 2,610 residents (Statistics Canada 2011).

The 3 main sub-basins (Panther, James, and Little Red Deer River) and their associated tributaries on the FMA were found to have good water quality (RDRWA 2009). The Panther River itself is located northwest of the FMA boundary, with Burnt Timber Creek being a major tributary located within the FMA. The area of this sub-basin associated with the FMA

is 227 km^2. No communities or waste water treatment plants are identified within the sub-watershed. Tourism, recreation, forestry, oil and gas development, and grazing are the primary land uses.

The James River is located north of the FMA boundary in the headwaters of the Red Deer River. The area of this sub-basin overlapping the FMA/ B9 is 604 km^2. The sub-basin includes the town of Sundre and the Hamlet of Bearberry. The Hamlet of James River Bridge and the Summer Village of Burnstick Lake are also located in the sub-basin, but are not impacted by the FMA/B9. Sundre has a water treatment facility, with current water supplies coming from ground water that is treated with chlorine due to the influence of the alluvial aquifer. Significant tributaries within the FMA/B9 include Williams Creek and tributaries associated with Bearberry Creek.

The Little Red Deer River is located south of Gleniffer Lake Reservoir and east of the upper reaches of the Red Deer River. Communities in the sub-watershed include the Towns of Bowden, Carstairs, and Olds, the Village of Cremona, and numerous hamlets including Bergen, Bottrel, Dogpound, Eagle Hill, Elkton, Garrington, Harmattan, Madden, Mound, Shantz, Water Valley, Westerdale, and Westward Ho. Significant tributaries within the FMA/B9 include the Little Red Deer River, Atkinson Creek, Dogpound Creek, Fallen Timber Creek, Grease Creek, and Harold Creek. The area of this sub-basin overlapping the FMA is approximately 500 km^2.

In summary, there are multiple sources of drinking water across the FMA in the many water source areas, streams, rivers and scattered lakes. However, there is no sole available and accessible source of drinking water. Furthermore, the majority of the land in regional recharge areas that provide drinking water are in formally protected areas and given that approximately 70% of the FMA is not located in snow dominated watersheds, there are no significant sources of drinking water on the FMA.

Guidance Questions

Are there watershed or catchment management studies that identify significant recharge areas that have a high likelihood of affecting drinking water supplies?

Recharge areas represent the portion of precipitation or runoff that percolates into the ground and eventually reaches an aquifer or water-bearing zone under the ground surface. Recharge zones are often found in high elevation zones (Alberta Environment Website 2010) outside of the FMA.

Each year there is significant groundwater recharge in Alberta (approximately 15 to 30 billion m^3), with approximately 1% of recharge being withdrawn by the hydrocarbon sector, agriculture, commercial and industrial users, and municipal users (AWRI, 2011). In addition to human use, groundwater provides important baseflow contribution to streams and rivers in Alberta, regulating water quantity and quality (MacDonald *et al.* 2014). SLS harvest or mill operations do not divert, store, or use water.

Groundwater recharge in mountain watersheds can occur from one or a combination of sources: direct infiltration and transport through faults and fractures in the high-elevation areas, through near-surface and subsurface runoff from high-elevation areas to infiltrate at basin-filled margins along mountain fronts, and by runoff infiltrating along ephemeral channels that occur within the watershed (Wilson and Guan, 2004). Extensive analysis and data are required to estimate groundwater recharge zones and volumes in mountain environments (Smerdon *et al.* 2009; Waterline, 2013). Therefore, it is important to consider the conceptual understanding of key hydrologic processes affected by timber harvest and useful indicators of potential risk to groundwater recharge.

In general, forest harvesting has been found to result in a temporary increase in groundwater recharge as a function of water table rise, primarily attributed to reduced interception and evapotranspiration from the loss of forest cover (Smerdon *et al.* 2009; Winkler *et al.* 2010). A review of empirical studies in snow-dominated watersheds demonstrates that low flows and shallow groundwater recharge either increases or does not change as a result of forest harvest (Pike and Scherer, 2003).

Higher water tables following harvesting could be a source of baseflow to most streams in the low flow season (Pike and Scherer, 2003). Recent work suggests that an earlier onset of snowmelt from harvest has the potential to reduce late-season streamflow in small (<5 km^2) (snow dominated) watersheds (Winkler, 2014).

However, areas of groundwater recharge include small depressions in the landscape and temporary or ephemeral wetlands, which collect rainwater and snowmelt and release a proportion of this accumulated water into the groundwater aquifer (van der Kamp and Hayashi 1998, Hayashi et al. 2003).

Groundwater flows in the subsurface and eventually emerges as discharge into springs, streams, wetlands, and other surface water bodies. This process can take from days to many years, depending on the scale of the aquifer system and its hydrogeological properties (Alberta Environment Website 2010). Recharge or discharge areas often indicate where the groundwater table is close to the surface (i.e. freshwater springs) and where soils are generally more permeable. These areas can be at greater risk of becoming negatively impacted by forestry, agriculture, industrial activity or development (RDRWA 2009).

Groundwater assessments (HCL 2004) indicate that in general, most of the area south of the Red Deer River is a recharge area, while most of the area north of the Red Deer River is a discharge area. The James River sub-watershed has about equal portions of groundwater discharge and recharge areas (HCL 2000a, 2004). A complex mosaic (HCL 2000a, 2002, 2005) of discharge and recharge areas are located within the Little Red Deer River sub-watershed. The headwaters of the Little Red Deer River, Beaverdam Creek (not on FMA), and the Dogpound Creek are generally groundwater recharge areas. The middle and lower reaches of the Little Red Deer River are primarily discharge areas.

The RDRWA (2009) report indicated that approximately 27 freshwater springs were identified in the Panther River sub-watershed, with nearly half located within the confluence of the Burnt Timber Creek and Red Deer River. In addition, the Little Red Deer River has approximately 75 freshwater springs, of which most are located in the southern area of the

sub-watershed near the Hamlet of Water Valley in the vicinity of Silver Creek, Grease Creek, Lower Dogpound Creek and the Little Red Deer River (RDRWA 2009).

Analysis of groundwater recharge zones requires datasets that are not normally available in mountain regions and it is likely that timber harvest will simply result in temporally higher groundwater recharge based on current hydrologic knowledge.

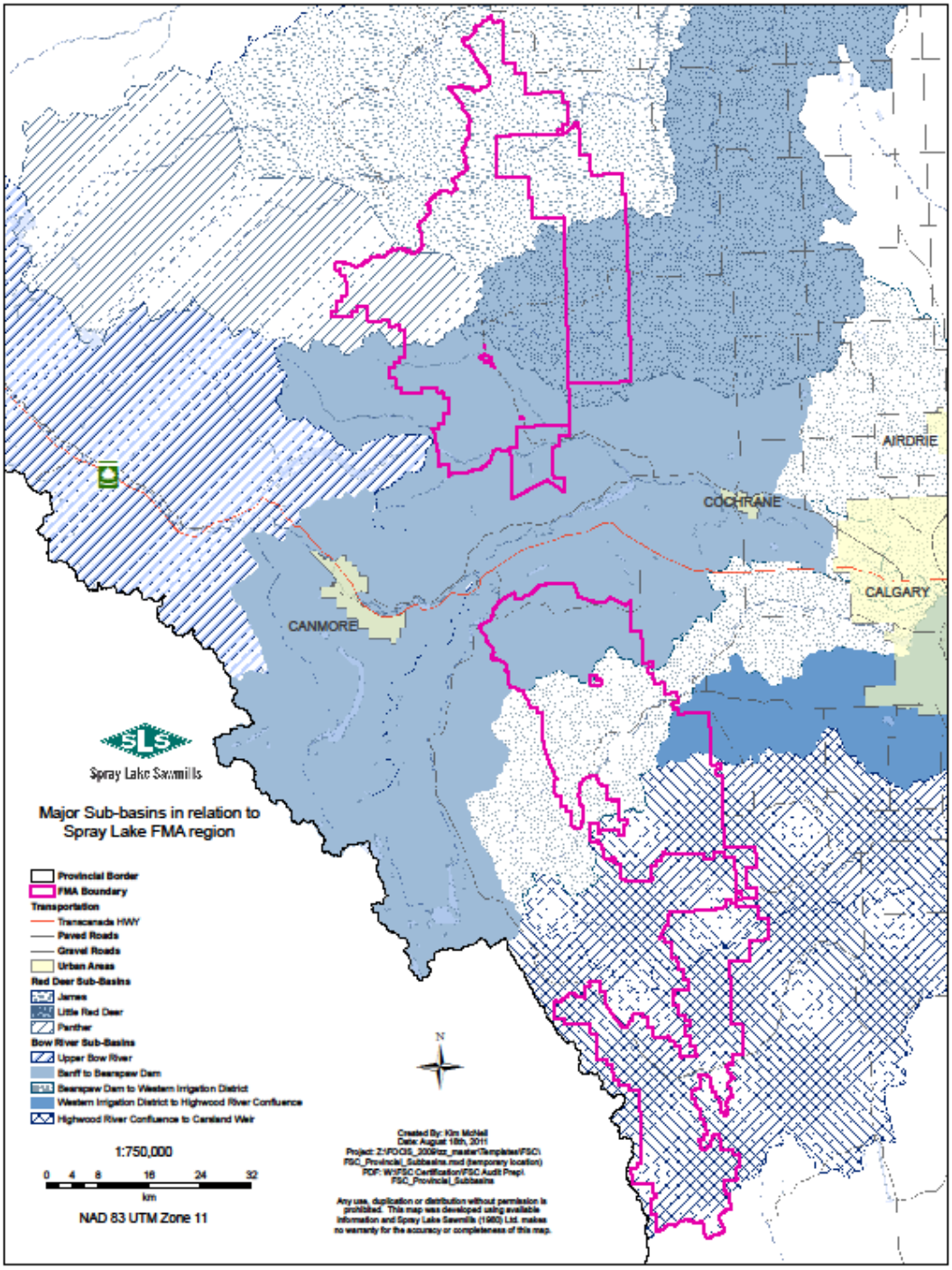

Figure 14. Major sub-basins of the Red Deer and Bow rivers associated with the FMA/ B9 Quota area

Potential Impacts of Forest Management Activities and Measures to Mitigate Impacts

SLS harvest and mill operations do not divert, store, or use water. In general, the greatest risk of impacts to water quality associated with forest management activities are related to skid trails, road construction and stream crossing installations. Skid trails are rarely used, as generally, the terrain is not steep and trees sizes are small. Even though roads are typically 100% reclaimed within 3 years, soil exposed for road building increases potential for erosion and the transport of sediment to streams (Mogilefsky and Denney 2013). Ditch lines can result in concentration of flows, with associated erosion and sedimentation in streams if ditchwater is allowed to enter streams. Improper installation of stream crossings has negative impacts to water quality and poor road maintenance can lead to problems over time.

The 2006 DFMP was developed in alignment with higher order planning documents such as the Eastern Slopes Policy and Integrated Resource Management Plans. SLS activities around watercourses are subject to the Federal Fisheries Act and the Federal Navigable Waters Protection Act. At the Provincial level, activities are guided by the Water Act, Code of Practice for Water Course Crossings, the Alberta Forest Planning Standard, and the OGRs. Spray Lake Sawmills' Boreal Region stream protection buffers are among the largest in North America (P. Lee, et al. 2003).

Buffers for lakes, rivers, and streams (e.g. 100 m buffers on permanent lakes, 60 m buffers on large permanent rivers and streams), using base data supplied by AESRD, were removed from the net (or active) land base during the timber supply analysis for the DFMP. These areas are not included in the spatial harvest sequence (SHS) or calculations for the allowable annual harvest.

The OGRs provide day to day guidance on stream classification and the associated buffer widths required for site specific lower order streams. The requirements for erosion control measures are indicated for roads and crossings. In addition, the Operating Ground Rules (OGRs) specify the amount of permitted soil disturbance on each harvest area, the distance required between watercourses and road surfaces, log decks, bared areas, and fuel tanks, etc.

Annual Operating Plans (AOP), including road and crossing locations, require approval from AESRD staff. Road construction is minimized by using existing access or coordinating with other resource users when possible. The number of stream crossings is minimized where possible. Operations are monitored regularly by SLS field staff and inspections are completed by AESRD field officers. Road inspections are completed annually to identify problem areas and to schedule required maintenance. AOP roads and borrow pits are reclaimed once silviculture activities are complete. This involves removing crossing structures, decompacting/ re-contouring slopes, and re-vegetating road and crossing locations. Training is provided annually to contract staff performing harvest activities and road construction to ensure proper techniques are being implemented.

Wetlands provide critical ecosystem services such as ground water recharge and discharge, flood damage reduction, shoreline stabilization, sediment trapping, and nutrient retention and removal. Wetlands also provide important habitat for many wildlife species. Wetlands of various sizes are scattered throughout the FMA and are often associated with small lakes, grassy areas, and river and stream systems. These aquatic systems also serve as important

travel corridors and feeding areas for wildlife. Wetlands are protected and not removed or filled with forestry operations. Forestry operations are conducted in compliance with the September 2013, Alberta Wetlands Policy.

SLS completed aquatic monitoring studies in the McLean Creek area on 12 streams between 1997 and 2007 to assist in the development of ecosystem based harvest plans and to develop a framework to allow the identification and evaluation of changes in aquatic resources over time. Wicklum and Scrimgeour (1997) completed work on Etherington Creek, Lost Creek, Wilkinson Creek, Cataract Creek, McPhail Creek, and Baril Creek. Townsend (2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008) completed monitoring on 6 additional streams (Fish Creek, Fisher Creek, McLean Creek, Quirk Creek, Silvester Creek, and Prairie Creek,) between 2000 and 2007. To meet the overall objectives, biological diversity of benthic macroinvertebrates; presence or absence of sport fish; stream habitat measurements; stream classification and temporal patterns in selected physicochemical characteristics of surface water data were collected, analyzed, and compared where appropriate. Statistical significant differences were not identified when comparing the streams associated with logging and the controls (G. Townsend, personal communication, August, 2010).

Climate Change and Future Considerations

A number of studies have documented hydrological changes in snow dominated regions, including earlier snowmelt onset as a result of warmer winter and spring air temperatures (Cayan *et al.* 2001; Mote *et al.* 2005; Stewart *et al.* 2004; Stewart 2009; Clow 2010). Stream flow in rivers along the eastern slopes of the Rocky Mountains has been declining over the last century (Rood *et al.* 2005; St. Jacques *et al.* 2010). The reduction of late season stream flow as a result of decreased glacial runoff has also been observed (Marshall *et al.* 2011).

Snow accumulation in the Rocky Mountains is expected to decline with continued atmospheric warming (Beniston *et al*. 2003; Lapp *et al.* 2005; Larson *et al.* 2011; MacDonald *et al*. 2011; MacDonald *et al.* 2012) as the proportion of rain to snow increases, altering the timing and magnitude of snowmelt contributions to streamflow in mountain regions (Barnett *et al.* 2005). An earlier spring snowmelt onset is likely to advance peak streamflow earlier in the year (Stewart 2009). Shifts in the timing of snowmelt runoff can result in lower late-season streamflow (Huntington and Niswonger, 2012).

The effect of climate change on hydrology is likely to be compounded by enhanced landscape disturbance due to wildfire and pest outbreaks (Flannigan *et al.* 2005), significantly affecting water supply from snow-dominated regions. Climate change has resulted in warmer temperatures, less moisture, longer fire seasons, and drier fuels. The total average annual forest area consumed by wildfires has significantly increased over the last thirty years and is expected to continue as a result of climate change (Water Research Foundation 2014).

Wildfires can cause complex changes in soil characteristics that pollute water with sediments, nutrients, and heavy metals. In some instances the negative impacts on water may persist for several decades or longer and also may extend far downstream resulting in long-term issues for drinking water supplies (Water Research Foundation 2014).

These types of scenarios are concerns for the Elbow River watershed, in part because the City of Calgary relies on clean water from the forest reserve.

Alberta has experienced rapid population growth over the past decade. The population of Calgary grew by approximately 12.6% from 2006 to 2011 (Statistics Canada 2011). The City of Calgary population is projected to increase to 1,273,800 when the census is taken in 2017, and to 1,370,500 when the census is taken in 2022 (City of Calgary 2013). Population growth and associated development will continue to place demands on water supply in both the Bow, Elbow and Red Deer River watersheds.

In summary, all streams, rivers, lakes, wetlands, and riparian areas on the FMA are considered high value resources and receive special management consideration and protection. There is no sole source of drinking water and no specific recharge areas on the FMA/B9 have been identified that have a high likelihood of affecting drinking water. Therefore no HCVF designation was made under this question.

4.4.2 Key Question 13

Are there forests that provide a significant ecological service in mediating flooding and or drought, controlling stream flow regulation, and water quality?

Forests play a critical role in maintaining water quantity and quality. HCVF designation is considered where a potential breakdown of this service has ***catastrophic*** impacts or cannot be replaced.

Definitive Questions
Are there high risk areas for flooding or drought?

Flooding is a natural occurrence in all streams and lakes in Alberta, with the largest floods occurring as a result of combined snowmelt runoff and heavy rainfall events. High flows are most likely to occur in May or June (Alberta Environment Website 2010). Benefits of natural flooding include flushing sediment and plant material, redistributing sediment and nutrients, depositing coarse woody debris for fish habitat, creating new channels and undercut banks, and recharging alluvial aquifers. Negative impacts include changes to fish habitat, debris flows from landslips, hardship to communities along floodplains, property damage, lower quality drinking water with increased treatment costs, and in severe cases, loss of life.

In the Bow River Basin, the Ghost Lake, Bearspaw, and Glenmore Reservoirs mitigate flooding effects to some degree for downstream communities, including the City of Calgary, by controlling flows downstream of the reservoirs. Glennifer Lake provides a similar function for the City of Red Deer and surrounding areas. Reservoirs and dams are not capable of removing all risk of flooding during times of major storm events. Small lakes and wetlands across the FMA help to filter water and reduce flood impacts.

Forest management activities at the stand and watershed level may impact water quantity in several ways. Minor, increased water yield may result from forest harvesting and may be beneficial if there are extreme water supply issues and a high demand on water (e.g., for fish habitat, drinking water or irrigation). Risk to flooding issues and peak flow increases are associated with snow dominated watersheds having sub basins less than 100 km^2, that have ECA's greater than 20%. (Buttle 2011)

At the stand scale, for instance, harvesting in high elevation forests reduces canopy interception of snow leading to more snow accumulation for smaller opening sizes up to several tree heights wide (e.g., Golding and Swanson, 1986), potentially increasing the amount of water available to recharge groundwater, surface runoff, and stream flow. Conversely, large clearings greater than 20 tree heights in width may actually accumulate less snow than an adjacent forest stand (Golding and Swanson, 1986) due to the effects of increased wind speeds on snow redistribution and sublimation. Water yields may therefore be maximized in high elevation forests, when harvesting occurs in a large number of small cutblocks (e.g., Swanson et al., 1986) than vice versa; however, the relationship between snow accumulation with opening size will inevitably change between study areas depending on local factors such as wind patterns.

Harvesting may accelerate spring melting (in high elevation forests), particularly by removing the shading capacity of the canopy. Removing the forest canopy decreases transpiration and the amount of precipitation intercepted by trees prior to reaching the ground. Less precipitation remains stored in the litter layer, and there is a potential for an elevated water table (Redding et al. 2008; Teti 2010).

Watershed scale effects of forest disturbance can be difficult to quantify due to natural variations in climate, soils, and topography. Theoretically, a watershed (compartment) divided equally between a north and south facing aspect will have a very different runoff regime to a catchment/compartment with no dominant aspect. Topographically, the greatest impact is often associated with harvesting at high elevations (SLS 2006). Harvesting at high elevations increases the potential for synchronized runoff (larger spring freshet) from different elevations, since a larger snowpack higher up (due to harvesting) melts out earlier and closer to the time of snowmelt from lower elevations (e.g., Whitaker et al., 2002). Conversely, earlier melt of low-elevation snowpack due to lower-elevation harvesting may not contribute to the main melt event later in the season (snowmelt desynchronization). The increase in water yield and peak flows combined with the duration of these flows most likely impacts channel processes and sediment movement through associated floodplains.

Year-to-year climate variability also impacts on snowmelt synchronization; a cool early-spring followed by a sudden warming shows the potential for the greatest peak-flow increases (e.g. Whitaker et al. 2002), since there may then be greater melt synchronization between elevations, and the hydrograph rises rapidly from base flow to the annual peak without the occurrence of secondary peaks on the rising limb. Only approximately 30% of the SLS, FMA is located in snow dominated watersheds, all which maintain ECA's less than 20%.

Smith and Redding (2012) summarize the main controls on runoff generation dynamics in snowmelt-dominated montane (north of SLS FMA) and boreal plain catchments. Table 9 below outlines many of these controls, arranged to indicate areas of the watershed where theoretically forest harvesting may disproportionately increase water availability and peak flows (floods).

Table 9 Catchment characteristics likely to enhance negative hydrological impacts associated with snow dominated watersheds (adapted from Smith and Redding 2012)

Variable	Hydrologically higher-risk areas for forest harvesting
Harvesting area	Peak flows and water yields likely increase in watershed areas with greater harvesting due to greater water availability (typically associated with watersheds less than 100 km^2 having an ECA greater than 30%)
Elevation	Harvesting at higher elevations is likely to lead to earlier melt and greater synchronization with melt from lower lying snowpacks
Aspect	Harvesting on south facing (upper) slopes may also lead to earlier melt and greater synchorinzation with melt from lower lying snowpacks
Slopes	Steep slopes may result in: i) higher peak flows due to a more flashy response of streamwater delivery (rates of gravity-led lateral flow transfer increase); and ii) greater mass wasting and slope failures due to increased pore water pressure through higher precipitation inputs
Cutblock Sizes	A greater number of smaller cutblocks likely maximize snow retention and meltwater relative to large, windswept cutblocks
Wetland Areas	Less extent of wetlands areas represent less storage of runoff, less attenuation and the potential for faster runoff delivery
Soil characteristics	Smaller soil depths or finer-grained soil material (e.g. clays) reduce the amount of soil water percolation and the storage volume for soil moisture, enhancing potential flashy runoff through surface overland flows than through subsurface soils or groundwater
Bedrock characteristics	Similarly, less permeable bedrock is likely to enhance lateral movement of percolated water and the rate of eventual water delivery to surface streams
Road Network	A greater density of impervious surfaces enhances the efficiency of drainage network by intersecting slower-moving subsurface flows and conveying more rapid surface runoff delivery
Culverts	Areas of non-existent/less culverts are not able to transmit flows away from the roads and into the subsurface soils
Stream Density	Higher stream densities alter flowpaths, runoff rates and potential peak flows
Karst hydrology	Harvesting may interrupt natural hydrological pathways in karst areas (e.g., point infiltration locations or outlet springs) leading to changes in water table levels of karst aquifers and water quality (note that attenuation/filtration of contaminants in karst aquifers is often less effective than in other geological aquifer types; IAH 2013)

ECA Simulation

Hydrologic recovery is predicated on forestry research that leaf area index (LAI) explains 85-96% of the variation in above ground net primary production of forests in the western US. Net primary production coincides with evapotranspiration relationships that equate to hydrologic recovery. LAI is influenced largely by water and nutrient availability. SLS based its current hydrologic disturbance evaluation on an analysis called ECA-AB (Watertight Solutions 2009).

This approach is based on the timing of a tree's maximum current growth increment. The literature has shown that maximum growth coincides with maximum LAI at a particular time in a trees lifecycle. Other factors, including tree species and site variability, create multiple growth curves that create net primary production variability across the landscape. ECA or equivalent clear-cut area is used as an index of disturbance for the watershed (Watertight Solutions 2009).

The process of hydrologic recovery occurs annually. This process initiates after reforestation. As an example, if 1 hectare of land was reforested 15 years ago, the hectare of land is functioning at approximately 50% of the full hydrologic level, assuming maximum LAI is achieved at 30 years. As previously mentioned, there are different growth curves that result in varying ECA ages potentially applied across the FMA (Watertight Solutions 2009).

During evaluation of the Preferred Forest Management Strategy and the spatial harvest sequence (SHS) for the 2006 DFMP, the Equivalent Clearcut Area (ECA) model ("ECA-Alberta") written by Dr. Uldis Silins, a forest hydrologist with the University of Alberta, was used to predict the cumulative effects from forest harvesting, and the potential change in water yield and the associated rate of hydrologic recovery over time. As stated above, ECA is an area based representation of the 'hydrologically effective disturbance' area that either new or recovering disturbances represent on the landscape. This can be described as the absolute area in hectares or the percent of total area for the planning unit (SLS 2006).

The relationship between tree height and crown closure can also be used to estimate percent recovery for fully stocked stands. Fully stocked stands that reach a crown closure of 50-70% can expect a recovery of 90% once the trees are more than 9 meters tall. Yield curves used to prepare the DFMP indicate that the average age of stands meeting this criteria are approximately 50 years. A regeneration lag of 5 years was assumed, for a total of 55 years (SLS 2006).

Ten Planning compartments on the FMA, shown in Figure 15, were simulated over a 200 year horizon. The projected range in maximum ECA was from 18.4 to 29.5% over the 200 year horizon. The first 25 years of the plan indicated a much lower range of ECA's from 8.2 to 19.2% (SLS 2006). Maximum ECA was maintained below 30% of the area in each compartment, which is a common upper limit used for management plans in Canada. Maximum ECA for the first 25 years of the plan is maintained below 20% disturbance, which is the threshold recommended by the World Wildlife Fund-Canada (2005). SLS's harvest levels are expected to have minor impacts on water yield and are within the normal natural range of variation.

Water yield projections were based on long term average climatic conditions for the region to separate out large variations associated with annual precipitation, which in turn affects annual stream flow. This facilitated the examination of changes in water yield produced solely from disturbance and recovery over time, and allowed separation of the changes associated with variability in climate (SLS 2006).

Representative hydrometric and annual precipitation data was assembled. Variations in the mean annual precipitation and stream flow were identified between the areas north and south of the Bow River. Values are generally lower (less precipitation and less flow) north of the Bow River. Therefore, long term average regional precipitation and water yields were calculated separately for each portion of the FMA (i.e. north and south of the Bow River). Annual water yield increases (percent increase over baseline averages and absolute increases in mm/yr) were projected for the 200 year planning horizon in the 10 FMA compartments (SLS 2006).

Water yield projections generally reflected differences in ECA percent among the compartments, however, projected water yield increases were greater in the north compartments, ranging from 8.2 to 12.2% above baseline over 200 years and 4.7 to 11.3% for the first 25 years of the plan. In comparison, the projected water yield increases in the south area were considerably lower, ranging from 3.1 to 4.1 % over the 200 year horizon and 1.6 to 2.7% in the first 25 years of the plan (SLS 2006).

Larger percent yield increases in the north compartments (an area with lower precipitation and water yield) were attributed to the increased role of evapotranspiration in this region. While water yield (mm) increases on a unit area basis were still generally lower in the south compartments, these stream flow increases per unit area ECA are generally higher, reflecting higher precipitation and runoff. Overall, projections for the increase in water yields were all less than the 15% threshold used by AESRD over the 200 year planning horizon (SLS 2006), representing the volume that can be added to a unit hydrograph without significantly affecting peak flows. To ensure the forest is harvested sustainably, SLS is required to write a new Detailed Forest Management Plan every 10 years which includes completing a new watershed ECA assessment. To increase accuracy of the model, updated forest inventory data along with an updated spatial harvest sequence will be used.

In other studies quantifying the effects of forest harvesting on peak flows, a paired-watershed approach is often used to detect changes in water yield and peak flows within a harvested (test) catchment relative to a neighboring non-harvested (baseline) catchment, before and after the harvesting takes place. In smaller research catchments where harvesting large watershed proportions is more attainable, large (>50%) and statistically-significant increases in water-yield and peak flows due to harvesting have often been detected using this approach. Examples include studies the Rocky Mountain Foothills (e.g., Burton, 1997), although the magnitude of changes depends on the method of frequency analysis conducted (see Alila et al., 2009 for an alternative approach).

Summary

In large watersheds greater than 200 km^2, a statistically significant relationship between level of harvest and the effect on peak flows is more unlikely (e.g., Duncan 1986; Stork et al. 1995, Thomas and Megahan 1998). This is due to a number of factors including the increased influence of subsurface flow on delivery of runoff to streams in large watersheds, natural decreases in variability in peak discharge with increasing drainage area, and the effects of runoff occurring at different rates with a greater distribution of aspects and elevations in a large watershed.

Only studies in small, (less than 100 $km^{2)}$ mountainous watersheds (having ECA's greater than 20%) have shown changes in peak flow to occur as a result of timber harvest (Green and Alila, 2012). There have been no studies assessing the effects of scale on peak flows in the eastern slopes of the Rocky Mountains. However, the natural variability in peak flow has been shown to decrease as a function of larger watershed area (Dodov and Foufoula-Georgiou, 2005). Therefore, as spatial scales increase the effect of harvest on peak flow is likely reduced.

Contrary to popular belief, forests have only a limited influence on major downstream flooding, especially large-scale events. It is correct that on a local scale forests and forest soils are capable of reducing runoff, generally as the result of enhanced infiltration and storage capacities. But this holds true only for small-scale rainfall events, which are not responsible for severe flooding in downstream areas. During a major rainfall event (like those that result in massive flooding), especially after prolonged periods of preceding rainfall, the forest soil becomes saturated and water no longer filters into the soil but instead runs off along the soil surface (City of Calgary, 2014 & UNAFO, 2005).

In terms of the watershed scale for the FMA region, the upper Elbow River basin above the Hamlet of Bragg Creek is approximately 780 km^2 and the upper Bow basin above Calgary including Banff National Park and Kannanskis Country represent approximately 9,220 km^2. The main watershed boundary sub basins on the FMA/B9 are presented in Figure 16, showing third order watersheds on the FMA/B9 that range in size from 58 to 285 km^2. Given SLS's forest management plan is designed to maintain ECA's less than 20%; that approximately 70% of the area harvested is outside of snow dominated watersheds; and that most of the FMA, sub basins are greater than 100 Km^2, the risks to influence flooding or drought are extremely low.

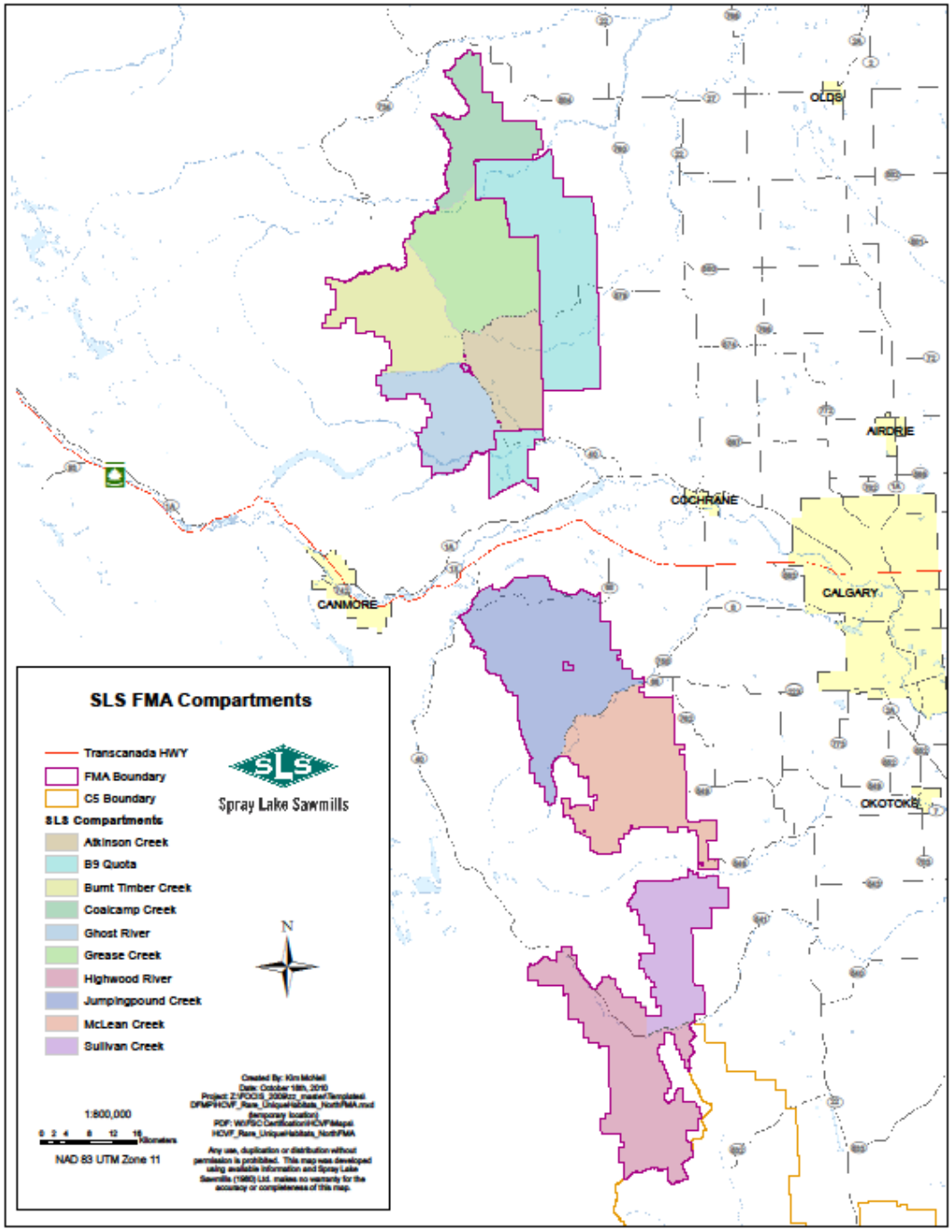

Figure 15. Planning compartments used for the ECA model (source 2006 DFMP)

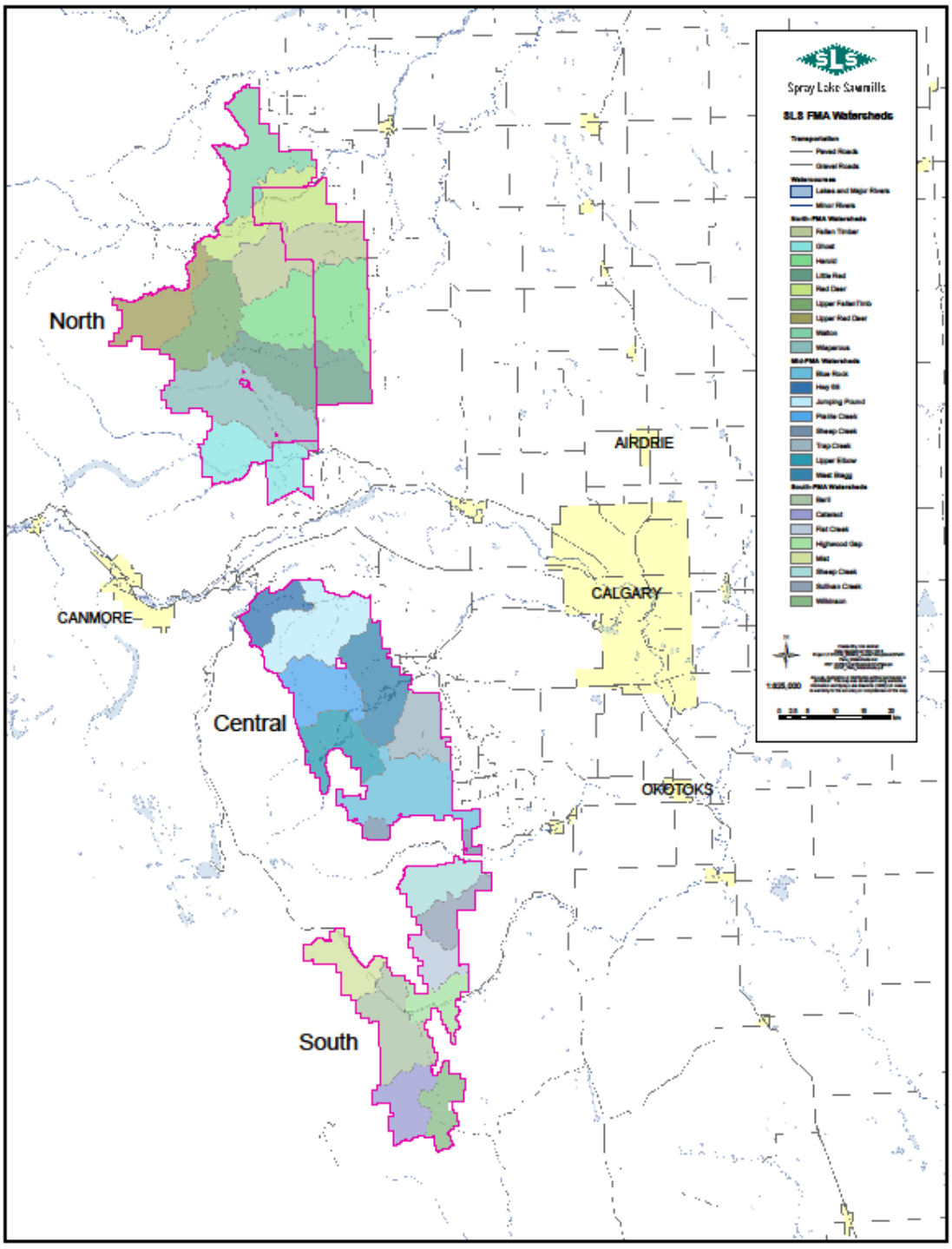

Figure 16. FMA/ B9 Quota area watersheds (source 2006 DFMP)

Guidance Questions

Are there particular forest areas that potentially affect a significant or major portion of the water flow (e.g. 75% of water in a larger watershed is funneled through a specific catchment area or river channel)?

Does the forest occur within a sub-watershed that is critically important to the overall catchment basin?

Are there particular forest areas (i.e. a critical subwatershed) that potentially affect water supplies for services such as reservoirs, irrigation, river recharge, or hydroelectric schemes?

Due to the long and narrow geographic extent of the FMA boundary (from Sundre in the north to the southern end of Kananaskis Country), there are no specific forest areas that affect a major portion of water flow to a significant watershed (e.g. equal to 75%). There are many ephemeral, intermittent, and small permanent streams networking across the forest, which contribute to larger order streams (e.g. large permanent streams) that feed the major sub-basin rivers.

As described under Key Question 12, reservoirs for water storage, diversions, and multiple hydroelectric schemes are present in the Bow and Red Deer River basins downstream of the FMA. No significant impoundments, diversions, or infrastructure is located on the FMA itself.

Snow melt from the high elevation forests provides the recharge for rivers that supply irrigation on the prairies to the east. In the absence of irrigation, the agriculture industry in Alberta would be severely hampered or non-existent. Again, the intent of the question is not to designate all water features as an HCV. Protected areas, the provincial Operating Ground Rules and existing policy and legislation are in place to protect these values. Most all of the water serving to recharge streams and rivers in the late summer originates from snow melt in the formally protected areas found in the Alpine forests and above tree line areas outside of the FMA.

The Elbow River is significant in that it supplies 45-50% of the drinking water for the City of Calgary, stored in the Glenmore Reservoir, and it's sub-basin is only $1/25^{th}$ the size of the entire Bow River basin. The river is naturally braided, with a number of channels separated by transitory gravel bars or islands (ERWP 2008). Braided rivers are subject to rapid and unpredictable abandonment of channel segments (Dunne and Leopold 1978), with this characteristic displayed regularly in the Elbow riparian area.

The Elbow River alluvial aquifer, presented in Figure 17, refers to the gravel and sand deposited by recent or historic river processes, usually located under, and on at least one side of the river. It is very permeable and hydraulically connected to the river. Groundwater from the alluvial aquifer flows into the river during periods of low river

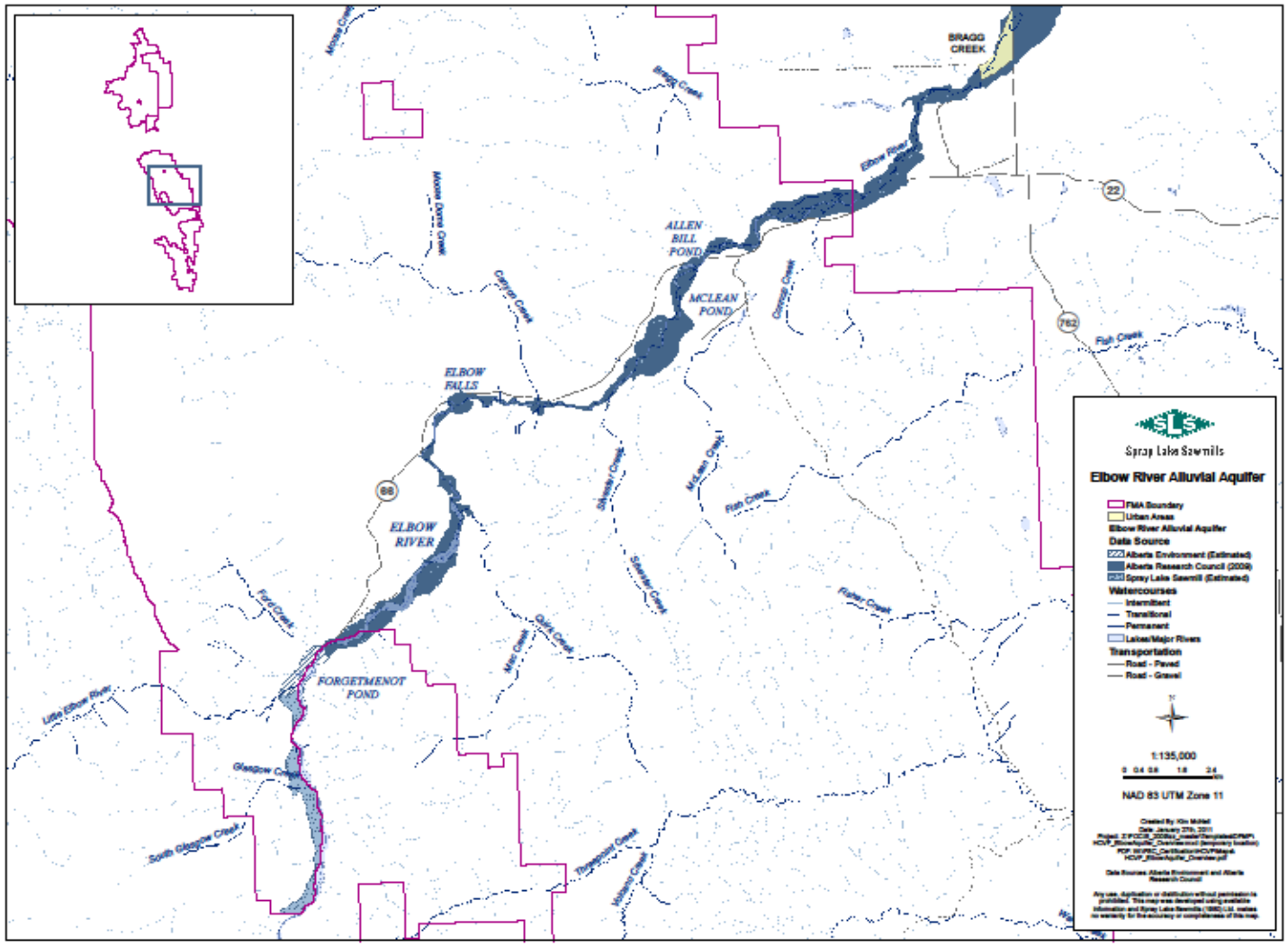

Figure 17. Elbow River alluvial aquifer

flow and river water flows into the aquifer during times of high river flow. Groundwater flow often moves sub-parallel to the river. The interconnectedness of the river and aquifer has only recently been recognized, with the groundwater and surface water being considered a single resource. Therefore, land use on the aquifer has the potential to directly impact water quality (Ryan 2008, ERWP 2008).

The Hamlet of Bragg Creek is located along the south banks of the Elbow River and has historically been impacted by flooding. Before 2013, the 1932 flood was the largest on record (estimated at 726 m^3/second as compared to the average of 31 m^3/second during normal spring runoff), resulting in the destruction of several buildings including the post office and the death of one resident. Following the 1963 flood, an artificial levee was constructed on the south bank of the river to protect the Bragg Creek Trading Post. In addition, a dike has been constructed upstream of the Elgin Drive bridge on Bragg Creek. Other notable flood years include 1967 and 1990 and a flood in 2005 that resulted in a voluntary evacuation order, washouts on Bracken Road, and highway closures including a road block of the Elbow River bridge and a closure of highway 66 in Kananaskis. (City of Calgary 2004, Dixon 2006, Sephton 2005-2010). In 2013, Bragg Creek flooded again, with an estimated streamflow of approximately 959 m^3 per second, the largest on record. The flooding of 2013, caused substantial damage to homes and infrastructure.

Bragg Creek has been under a water boil advisory for over 20 years, with wells in the aquifer showing the presence of coliforms (ERWP 2008). As the community has been without a sewage treatment plant, coliform bacteria contamination is likely caused from residential septic effluent leaching through the alluvial aquifer into the ground water. The MD of Rocky View has recently undertaken potable water and waster water treatment initiatives. At the time of completing the 3rd version of this report, most all of the rural residential communities in and around Bragg Creek are not connected to a sewage treatment facility.

A detailed literature review of studies globally suggests an ECA of less than 20% will likely result in minimal change in peak streamflow (Buttle & Guillemette *et al*. 2005). For the first 25 years of the plan, SLS's projected water yield increases ranged from 4.7% to 11.3% for the north FMA and ranged from 1.6% to 2.7% in the south FMA (SLS 2006).

In summary, while the Elbow River is a large watershed (i.e. >200 km^2) and predicted ECA's are low, impacts from forestry are expected to be insignificant. The Elbow River main stem and its adjacent alluvial aquifer is considered a High Conservation Value attribute due to the significance of the water supply for the City of Calgary (e.g. 45-50%) and the history of floods with potential negative impacts to the Hamlet of Bragg Creek. Maximum ECA disturbance levels in the McLean and Jumpingpound compartments, associated with the Elbow River, are projected to be only 12% for the first 25 years of the DFMP (SLS 2006).

4.4.3 Key Question 14

Are there forests critical to erosion control?

A HCVF designation is considered where a forest is critical to soil, terrain, or snow stability, and where there is increased risk of erosion, sedimentation, landslides or avalanches.

Definitive Questions
Are there forest areas where the degree of slope carries high risk of erosion, landslides and avalanches?

There are steep alpine slopes within the FMA that have avalanche chutes and the potential for landslides however, harvest activity is avoided on steep Alpine slopes. SLS uses ground based mechanical harvesting methods that are restricted by operability limits on steep slopes (i.e. safety concerns). Sustained slopes greater than 45% were removed from the net land base during development of the DFMP. Slopes greater than 45% are typically excluded from harvesting and left for stand retention. Terrain stability analysis prior to logging is not a requirement in the Province of Alberta and the risk of landslides, avalanches, and excessive erosion as a result of forest harvesting activities is considered low.

The climate in the foothills west of Calgary is dry and windy. Snow accumulations are limited to some degree by frequent Chinook winds through the winter months. Human dwellings in the vicinity of harvest operations are restricted to trapper's cabins and seasonal camps, with no communities located below steep slopes where logging could occur. The risk of loss of life or damage to property or infrastructure from landslides or avalanches is very low.

Guidance Questions
Are there soil and geology site types that are particularly prone to erosion and terrain instability?
Is the spatial extent of erosion –prone or unstable terrain such that the forest is at high risk (also of cumulative impacts)?

Areas on the FMA with soil and geology types that are prone to erosion and instability are generally localized and site specific. Lidar technology and wet areas mapping have improved operational planning prior to harvest activity. These areas are addressed at the operational level and are often buffered or removed from the harvest areas. After operating for over 70 years in the region, SLS has not caused or been associated with a landslide or avalanche event. Negative impacts and risks associated with harvesting activities is considered low.

No HCVF designation has been established under Key Question 14.

4.4.4 Key Question 15

Are there forests that provide a critical barrier to destructive fire?

This question is deemed not relevant to forest ecosystems in Canada (see Appendix 5 in FSC Canada National Boreal Standard, Version 3.0).

4.4.5 Key Question 16

Are there forest landscapes (or regional landscapes) that have a critical impact on agriculture or fisheries?

This attribute refers to forests that mediate wind and microclimates at an ecoregion scale, and which affect agriculture or fisheries production.

Guidance Questions
Are there agriculture or fisheries production areas in the forest that are potentially severely negatively affected by changes in wind and microclimate and microhabitat (i.e. woody debris from riparian vegetation)?

The FMA and B9 Quota areas lie within Alberta's Green Area, which is 1 of 2 major land designations established in 1948. Land use in the Green Area is for forest management planning and protection of important watersheds. The FMA also lies within the Rocky Mountain Forest Reserve, established for the conservation of forests and other vegetation and the maintenance of conditions favourable to an optimum water supply. Therefore, lands within the FMA and B9 Quota are not available for agricultural development (i.e.cultivation), with the exception of cattle grazing. The B9 Quota area has grazing leases and the FMA has approximately 80 overlapping grazing allotments. Both land uses have coexisted for many years. As previously described, agricultural development in the White Zone (designated for agriculture and settlement) to the east of the FMA is dependent on the Rocky Mountains and Foothills for irrigation water. Forest management activities are expected to have little or no impacts to agriculture. There are no commercial fisheries or production facilities on the FMA.

Riparian forests play an important role in maintaining fisheries by providing overhead cover habitat value and also shade that reduces water temperatures, particularly in summer. Root systems enhance bank stability which reduces sediment input and maintains undercut banks that provide important salmonid habitat. They also act as a filter, reducing sediment and nutrient inputs to watercourses. Microhabitat diversity and cover is improved through the recruitment of coarse woody debris from stream side trees. Riparian forests are addressed by the OGRs and Indicator 6.3.17 of the FSC Boreal Standard, which require reserves around water bodies to prevent forest harvesting from resulting in significant, negative effects on water quality and fish habitat. Spray Lake Sawmills Boreal Region stream protection buffers are among the largest in North America (P.Lee, et al. 2003).

Rivers and streams on the FMA and B9 Quota are fast moving cold–water aquatic habitats suitable for fish species including mountain whitefish (*Prosopium williamsoni*- Girard), Brook Trout (*Salvelinus fontinalis* - Mitchill), Brown Trout (*Salmo trutta* - Linnaeus), Bull Trout (*Salvelinus confluentus* - Suckley), Rainbow Trout (*Oncorhynchus mykiss* - Walbaum), Cutthroat Trout (*Oncorhynchus clarki* - Richardson) and Burbot (*Lota lota* - Linnaeus). In general, streams originating along the eastern slopes of the Rocky Mountains tend to exhibit low temperature, high dissolved oxygen content, and a pH close to neutral. Most of the rivers and streams on the FMA are able to support salmonid life cycles (SLS 2006).

While all watercourses on the FMA are considered important, the Highwood and Sheep Rivers are instrumental in supporting the Bow River rainbow trout and a world class recreational sport fishery. The Highwood River basin (which includes the Sheep River) provides more than 75% of the spawning and nursery habitat for the lower Bow River's Rainbow Trout population (BRBC 2005). Bull and Cutthroat Trout spawn in the tributaries and upper reaches, and have to compete with introduced Rainbow and Brook trout (BRBC 2005). Mountain Whitefish are quite abundant in the larger watercourses in the FMA.

As described under Key Question 1, the Westslope Cutthroat Trout has been listed as a threatened species and has been listed on Schedule 1 of SARA. A recovery plan has been prepared that outlines steps to be taken over the next five years to promote the recovery of the species (Westslope Cutthroat Trout Recovery Team 2013). Remaining populations have survived due to their isolation from downstream fish populations and most of that isolation (e.g., waterfalls) pre-dates settlement. Initial genetic analysis indicates that a degree of genetic independence among pure populations is present and appears to be concentrated at the individual stream level, rather than among major watersheds. Population work is ongoing with regards to barrier surveys, upstream limits of distribution, and abundance and size structures of populations (AESRD 2010). The Recovery Plan contains a map of the estimated extent of the pure strain Westslope Cutthroat Trout, based on genetic testing conducted between 2005 and 2009 (Figure 4 in Westslope Cutthroat Trout Recovery Team 2013). There are several streams on the FMA with the potential to contain Cutthroat with genetic purity values greater than or equal to 0.99 (green locations on Figure 18); these systems are of significant conservation value. SLS, a member of the Recovery Team, will continue to work with AESRD as new information becomes available and will implement recommendations included in the Recovery Plan.

AESRD has also produced a map of Bull Trout spawning areas for sampling completed between 1947 and 2009 (Figure 19). These spawning reaches are also considered significant conservation values.

In summary, the Sheep River is largely surrounded by protected areas in the vicinity of the FMA. Note that the Highwood River and Red Deer River riparian areas within the nationally significant ESA have been designated as HCVF under Key Question 3. The Westslope Cutthroat Trout and Bull Trout have been designated as HCV attributes under Key Question 1. Stream reaches identified by AESRD with genetic purity values greater than or equal to 0.99 for Westslope Cutthroat Trout (Figure 18) are considered HCVF attributes. Bull Trout spawning reaches identified by AESRD (Figure 19) are also considered HCVF attributes.

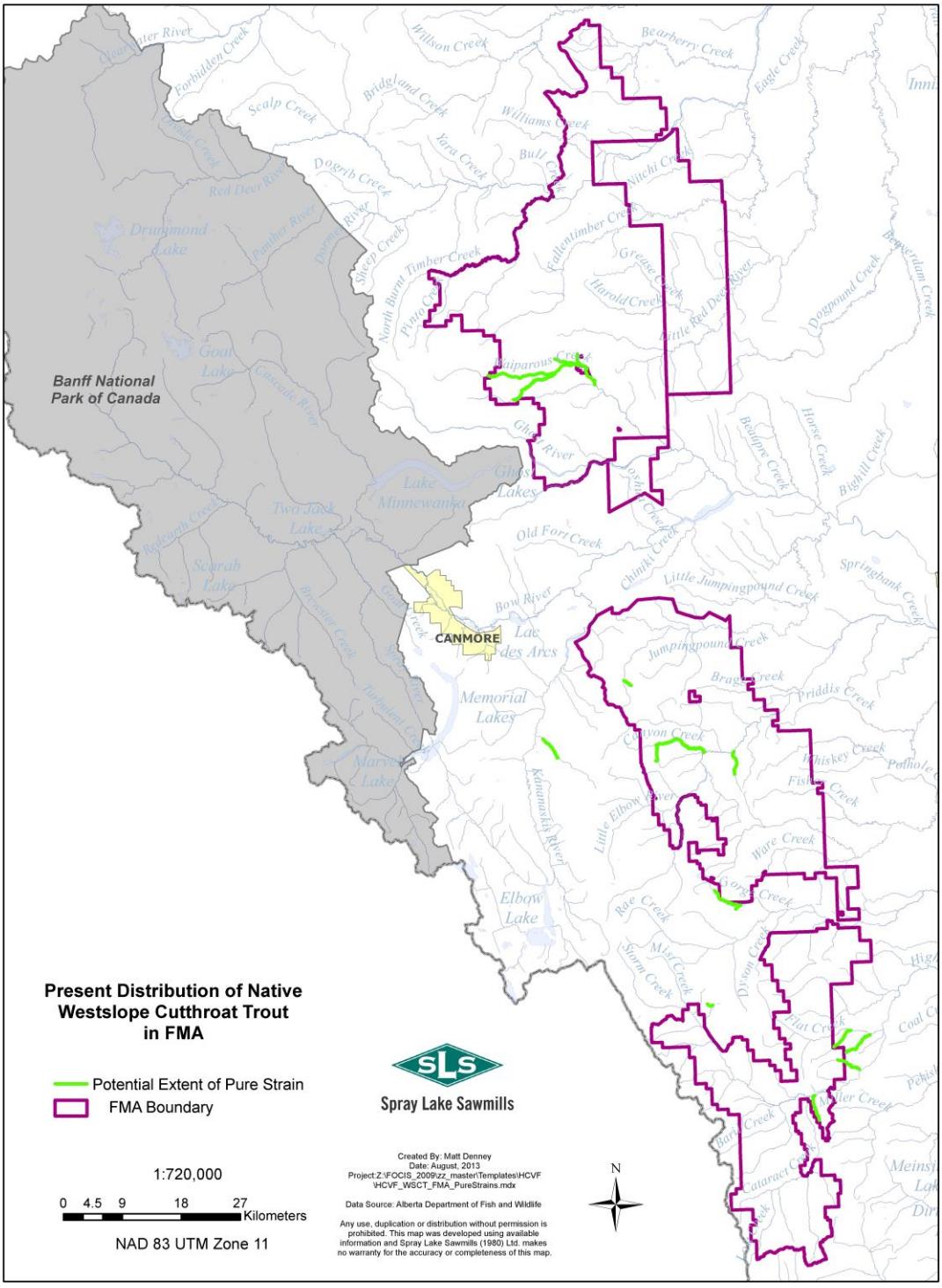

Figure 18. Westslope Cutthroat Trout sampling locations and genetic purity values (source AESRD)

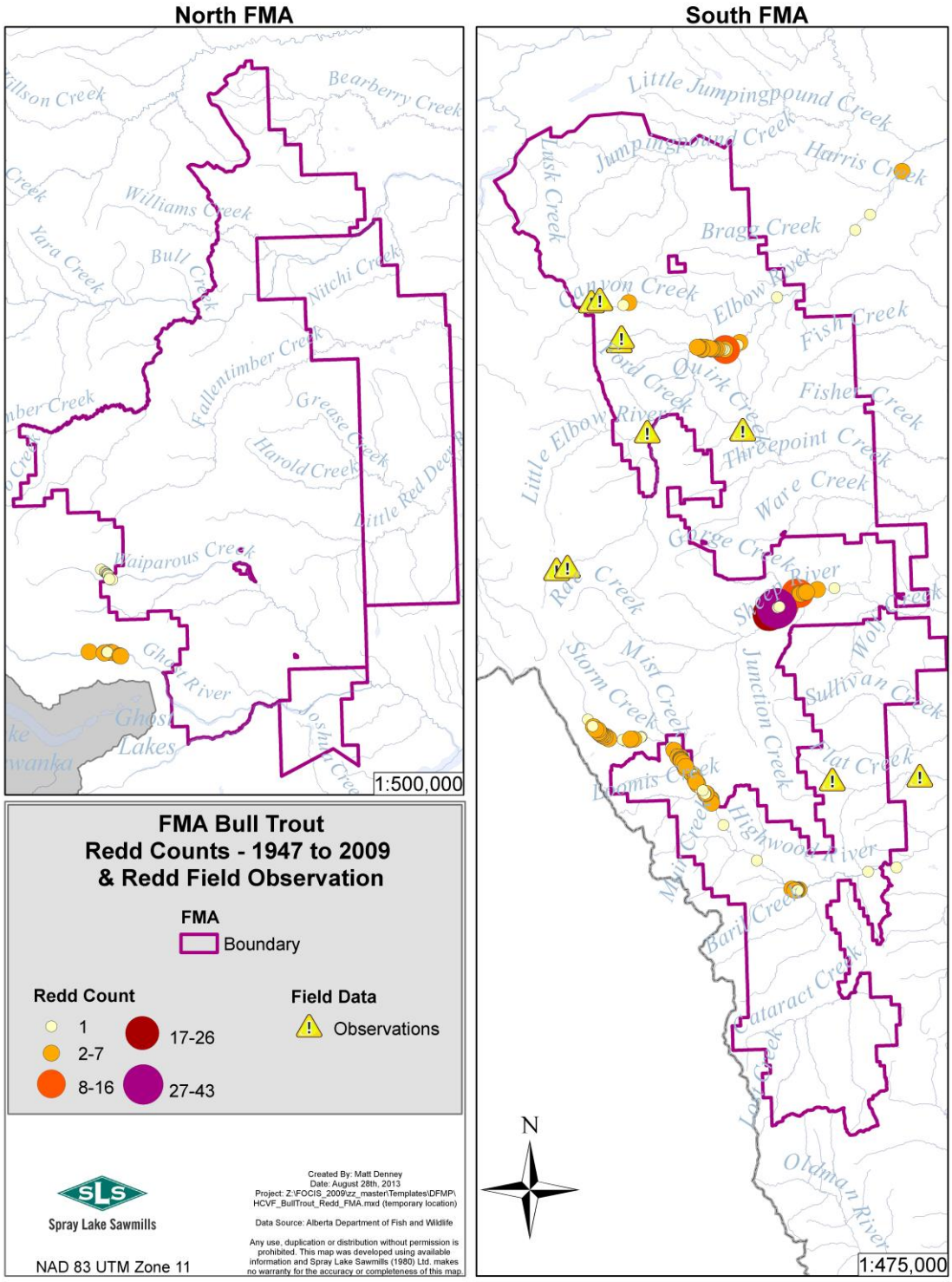

Figure 19. Bull Trout spawning (Redd) locations (source AESRD)

4.5 Category 5: Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health).

4.5.1 Key Question 17

Are there local communities (including people living inside the forest area and those adjacent to it as well as any group that regularly visits the forest)? Is anyone within the community making use of the forest for basic needs/ livelihoods?

In the context of the FSC National Boreal Standard, ***Local*** is defined as: people who permanently reside within commuting distance by car or boat from the management unit, or where they are part of a First Nation whose lands and territories contain or are contained within the management unit; or any human community that is adjacent to the forest being audited for certification. A distinction is made between use of the forest by individuals (i.e. trap lines) and where use is ***fundamental*** for local ***communities. Basic needs*** and ***livelihoods*** refer to food, medicine, fodder, fuel, building and craft materials, water, and income (i.e. subsistence and health).

For example, a community that derives a large part of its protein from hunting and fishing in forests where there is no alternative (e.g. supermarket) and acceptable source of meat or fish, the forests would constitute a HCVF. Another forest, where people hunted largely for recreational purposes (even if they did eat their catch) and where they were not dependent upon hunting, would not constitute a HCVF (ProForest 2003).

It is reasonable to state that the SLS FMA and B9 Quota areas fulfill some needs for local and adjacent communities. The *Guidance Questions* help to assess whether the forest area meets fundamental or basic needs for local communities.

Guidance Questions

Is this the sole source of the value(s) for the local communities?

Is there a significant impact to the communities as a result of a reduced supply of these values?

Are there values that, although they may be a small proportion of the basic needs, are nevertheless critical?

The FMA plays a significant role in the culture of the 5 First Nations and other indigenous communities in proximity to the forest (see Key Question 18 for the list of First Nations). Aboriginal people routinely use the forest for hunting, fishing, berry picking, and domestic fuel wood cutting. Benefits are derived from food and medicinal plant gathering, materials for crafts, as well as the use of sites that have cultural or spiritual significance. Many of the registered trap lines are held by First Nations people. SLS is unaware of any specific areas that supply *fundamental* needs for First Nations people relying on the forest for *subsistence*.

SLS is a local family owned business that has been active in the area since 1943 and employs approximately 165 employees at the Sawmill in Cochrane and with the Top Spray division. In addition, approximately 75 people are employed in woodlands contract operations. Tree planters (40-80) are employed each year, planting approximately 2 million seedlings annually. The allowable annual harvest level for conifer on the FMA and B9 Quota for SLS is 281,900m^3. Sundre Forest Products Ltd. has a deciduous commitment from the FMA of 15,000m^3 annually (SLS 2006).

As per the FMA document, the primary use of the forest management area is "for establishing, growing, harvesting and removing timber". Recognizing and managing for other resource values and uses is carried out as part of this planning process. The DFMP was prepared in alignment with the Kananaskis Country Sub-Regional IRP, the Nordegg-Red Deer River Sub-Regional IRP, and the Ghost River Sub-Regional IRP to address issues and resource values identified for the FMA area. A public involvement process was completed for the McLean Creek and Etherington Creek harvest areas, with a list of issues and values presented in the DFMP Terms of Reference and included in the approved Preliminary Forest Management Plan (PFMP), completed after the FMA was established in 2001. Finally, input received from the public involvement process for the 2006 DFMP was assessed to finalize a list of issues and values. This updated list formed the basis for the development of the objectives and strategies contained in the DFMP (SLS 2006).

The Community Timber Program (current as of DFMP completion) includes 5 small Quota holders (converted from commercial timber permit holders after the 2004 submission of the DFMP) in the B9 area north of Highway 1, one Community Timber Permit holder (Ted Dietrich) and one Commercial Timber Licence (Bell Pole Quota also known as Stella - Jones) in the South FMA (B10 FMU), as well as the "Open" category (Permits and TM66 program) administered by AESRD, which includes public firewood cutting. A fixed volume of 36,100m^3 coniferous and 500m^3 deciduous is available annually to the Community Timber Program under the terms of the FMA. Fixed volumes were sequenced in the DFMP as part of the SHS and reflect the average wood profile for the FMA/Quota area. The Ghost and Dogpound areas are the initial focus areas for the program. It is expected that the timber harvest operations in the Community Timber Program will follow the SLS OGRs (SLS 2006).

SLS supports the income of other local businesses by selling lumber to secondary manufacturers, logs to hydro pole producers, and logs to local log home builders. SLS purchases industrial salvage from oil and gas and utility developments. SLS purchases minor volumes of logs from local private land owners (e.g. fence line clearing, etc.), which supplements income.

Ranching and cattle grazing is a prominent activity with a long history in the area and is recognized in key documents such as the Eastern Slopes Policy. As described under Key Question 16, The B9 Quota area has grazing leases and the FMA has approximately 80 overlapping grazing allotments. Both land uses have coexisted for many years, with local ranchers and SLS entering into jointly developed Grazing and Timber Agreements to mitigate the impacts of the overlapping activities.

The FMA has 23 overlapping Registered Fur Management Areas (RFMA or trap lines). Trappers are notified when SLS harvest activities are planned for their trap line areas, with the intent to hold discussions to identify mitigation strategies to reduce impacts from harvesting. The Alberta Trappers Association administers a compensation program for specific situations where Trapper income is impacted directly by forestry. Trapping is no longer considered a subsistence activity on the FMA.

Oil and gas development and exploration is a key land use activity in the area, creating significant employment. The industry is less active on the FMA / B9 quota area than in northern parts of the Province. Companies include Direct Energy, Suncor, Shell, Husky Oil, Imperial Oil, Taqa North, and Devon Energy, etc. Fortis Alberta, an electrical distribution company, supplies power lines to industrial facilities. Companies withdraw lands from the FMA/ B9 area through an application process administered by the Energy Resources Conservation Board (ERCB) and the Public Lands Division of AESRD. Land withdrawals include well sites (i.e. MSL), pipeline right of ways (i.e. PLA), road right of ways (i.e. LOC), and utility right of ways (i.e. EZE). On average, land withdrawals have ranged from 40-70 ha per year from 2001 through to 2008, with only 6 ha removed in 2009/2010. Seismic programs for exploration are not considered land withdrawals. While there is significant impact from historical programs (i.e. thousands of kilometers), no significant new programs have been completed in recent years and heli-portable techniques are used to reduce impacts.

Recreation and tourism is a major land use activity on the FMA throughout the year. The FMA is recognized for its high scenic and natural values and is a popular destination for day trips due to good road access and the low cost of travel to the area from Calgary and surrounding communities. Kananaskis Country, overlapping the South FMA, is one of the most heavily used outdoor recreation areas in the Province. The FMA has approximately 60 Provincial Recreation Areas (PRAs) within or adjacent to the FMA. These sites are 1 of 8 classes of protected area in the province and form a significant component of the range of outdoor recreation activities in the Calgary region. PRAs are often located along streams and rivers, which are central points for activities. The recreation activity provides economic benefits for *gateway* communities including Sundre, Canmore, Cochrane, Bragg Creek, Turner Valley, Black Diamond, and Longview. There is potential for the development of tourism facilities and services in these communities due to the restrictions of new development within Kananaskis Country. Many small businesses in the local communities rely on tourism for income generation. The PRAs and adjacent parks and protected areas were selected as HCVFs under Category 1, Key Question 6.

Activities across the FMA include: camping; OHV or off highway motor vehicle use (including 4*4 trucks, motor bikes, ATVs including commercial tour operators, and snowmobiles); mountain biking; hiking; climbing; caving; skiing (cross country, heli); snowshoeing; water sports (canoeing, kayaking, rafting); golf in adjacent communities; fishing; hunting; horseback trail riding (including commercial tour operators); helicopter tours; outdoor photography (including commercial businesses); bird watching; and other wildlife viewing. There are approximately 100 guide or outfitting businesses operating in the area. Commercial filming projects, including feature films, are shot in the area. There are

several leases for youth camps and special events such as mountain bike, running races, and cross country ski events are staged in the area (Alberta TPR 2008). The area has over 3.5 million visitors annually with day use accounting for 80% of the use (Park User Statistics Report 2003/2004).

The North FMA includes the Ghost-Waiparous area (approximately 1,500 km^2) and the associated Ghost FLUZ. The area has been popular for OHV use since the 1960s and activity increased significantly after 1978 due to the establishment of Kananaskis Country to the south and the associated limitations to OHV use in that area. Seismic lines and roads associated with oil and gas exploration as well as old logging trails made the area particularly appealing for this activity. The Ghost River Sub-Regional IRP (1988) directed the establishment of an access management plan. The IRP stated that OHV use is a legitimate activity and highly valued by many users. However, there were concerns regarding impacts to terrain, vegetation, water quality, and wildlife from OHV use and random camping. The Don Getty Wildland Provincial Park was established in 2001, with no OHV use permitted in the park. Public consultation was initiated in 2002 and 2003 for the Ghost – Waiparous Operational Access Management Plan (GAMP 2005).

Recreation pressure in the Ghost- Waiparous area has increased with population growth. Telephone surveys completed during the public consultation indicated a range of 91,000 to 96,000 unique users annually in the area. Repeat use suggests a much higher potential. Retail sales of OHVs in Canada increased approximately 350% from 1995-2005, with Alberta showing the highest sales in the country on a per-capita basis as of 2005 (GAMP 2005). This sector of the recreation industry has become an important economic contributor.

The GAMP was approved in 2005 and the associated Ghost FLUZ was established in 2006. The four primary objectives of the access management plan include ensuring public safety, ensuring sustainability of the natural resources, minimizing conflicts between recreational OHV users and other users, and providing a range of opportunities for summer and winter recreational use. The public involvement process completed for the access management plan indicated support for a balanced access plan that provided clear guidelines and regulations for access (GAMP 2005).

As indicated in the DFMP (SLS 2006), there are six developed campgrounds and approximately 170 km of recognized trails in the Ghost area for summer and winter OHV use. The area has approximately 341 camping units (Waiparous 56; North Ghost 173; Fallen Timber 62; Burnt Timber 30; North Ghost Group Camp 20) and extensive random camping.

The South FMA is located within the Kananaskis Country FLUZ (2,083 Km^2), established in 1979 to prevent conflicts between motorized and non-motorized recreational activities. There are 3 imbedded land use zones within Kananaskis Country designated for OHV use. The McLean Creek OHV FLUZ was established in 1998 and is 202 Km^2. The Sibbald Snow Vehicle FLUZ is 97 Km^2 and was established in 1979. The Cataract Creek Snow Vehicle FLUZ is 503 km^2 and was established in 1979. OHV use outside of these zones within Kananaskis Country is prohibited, with the exceptions of snow vehicle use on the Powder Face and Elbow Loop trails during designated winter periods. Motorized access restrictions

are common throughout the Kananaskis FLUZ, with many gated roads and posted signs. For example, Highway 66 has a seasonal closure from December 1st to May 15th for winter wildlife habitat protection. Others roads have seasonal closures for wildlife and public safety reasons (e.g. Gorge Creek and Moose Mountain). Users are encouraged to know the rules prior to entering the forest.

West Bragg Creek is a popular Kananaskis Country trailhead, located approximately 9 km west of the Hamlet of Bragg Creek in the Elbow River Watershed. There are currently 43 km of designated cross country ski trails, a hiking trail (Fullerton Loop), and 1 all season trail (Tom Snow). The Greater Bragg Creek Trails Association (GBCTA) in partnership with Alberta TPR has developed a Draft All Season Trail Plan for West Bragg Creek, Kananaskis Country (2010) to accommodate a wide variety of non-motorized users in all seasons. Many of the existing trails use old logging roads or seismic lines in sheltered areas due to lower snowfall and Chinook winds. The plan addresses environmental impacts from summer use in wet areas. As well, GBCTA members have been involved in reviewing the community based FireSmart initiative that overlaps the trail plan area and involves the creation of firebreaks within a 10 km radius of Bragg Creek. The GBCTA recently completed a consultation process with local stakeholders (e.g. SLS, grazing allotment holders, local FireSmart Committee, etc.).

The Elbow Valley is one of the busiest areas in Kananaskis Country, with almost 500,000 visitors annually. There are approximately 700 km of designated trails in the east part of Kananaskis Country. Large-scale tourism developments are restricted within the FLUZ boundary, but Alberta TPR has identified 3 potential small scale development nodes near the PRAs at Lusk Creek, Sibbald Lake, and Elbow Falls (Alberta TPR 2008). As indicated in DFMP (SLS 2006), there are approximately 1035 camping units (Jumpingpound 154; Elbow 660; Highwood 221) and 1070 day use sites (Jumpingpound 95; Elbow 490; Highwood 485). As a result, existing roads and visitor facilities are important tourism resources. Alberta TPR works in cooperation with AESRD to identify future potential recreation sites, based on demand and feasibility, which may be designated as PRAs after public consultation, and approval to proceed with development.

Alberta has one of the highest rates of RV ownership in North America, with 18% of households owning an RV and over three quarters of the overnight trips done using RVs. In 2007, more than $380 million was spent on camping trip expenditures and approximately $700 million is spent annually on RV purchases. While the overall supply of campsites is adequate, areas such as Kananaskis are perceived to be difficult to get into due to the lack of serviced campsites required to meet the needs of RV campers. Investment is required in provincial and National parks to meet the needs of this growing industry, and to retain the business within Alberta (The Praxis Group 2009).

A Visual Sensitivity Assessment was completed during development of the DFMP to minimize impacts to aesthetic resources. The assessment incorporated input from the public consultation process and from Alberta TPR and AESRD. The FMA/B9 area was stratified and rated into areas of high, medium, and low visual sensitivity. Rating factors included the location, surroundings, and existing condition of landscapes. Visual perception was

addressed, including the distance between the viewer and feature, the angle of view, and visual screening. Social sensitivity was also considered, involving the number of visitors to an area, the length of stay, and the level of concern for particular areas. The visual sensitivity rating for the FMA/ B9 area is presented in Figure 20, and is used when designing harvest plans to lessen the impacts on visual resources.

SLS recognizes the importance of the large range of ecological, social, and economic values derived from the FMA/ B9 multiple use area, independent of HCVF designation. The critical water resource was described in Category 4. Adjacent communities (i.e. from Sundre to south of Long View), including local First Nations communities rely on the forest for income and quality of life. The forest supports local small business activities and tourism related jobs are dependent on the recreation resource. Outdoor recreation is a *way of life* in Kananaskis, Provincial Recreation Sites are scattered across the FMA/B9, and Forest Land Use Zones (e.g. Kananaskis, McClean Creek, Ghost River, etc.) are heavily used (AESRD 2011). Many jobs in the energy and forestry sectors are dependent on resource extraction. Grazing areas are critical to historic ranching interests.

There are various mechanisms in place to manage and integrate the multiple uses to ensure a sustainable supply of values. These include collaborative planning, timing of activities, and designing harvest areas with good visual management practices. Where possible, opportunities to maximize benefits to other land users are explored (e.g. upgrading or adding new trails, cooperating with the oil and gas industry on road use, enhancing range land, etc.) SLS is in the implementation phase of the DFMP, which was completed with a public consultation component and is highly regulated and monitored. Day to day operations are guided by the OGRs, which require prescriptions for unique values. The DFMP and the HCVF processes follow the adaptive management approach and are re-evaluated at regular intervals. Higher level planning exercises such as the Alberta Land Use Framework will have future implications for the FMA/ B9. FSC® Principles 1 through 8 also address many of the values related to Key Question 17. In addition, SLS participates in ongoing consultation with community initiatives (e.g. FireSmart planning, GBCTA, etc.).

An effort was made to avoid using a *broad-brush* approach with HCVF designation and to focus in on areas of outstanding significance. Use of the forest for basic needs is not exclusive to the FMA / B9, and no specific areas were considered critical in this regard. No HCVF has been identified under Key Question 17. Lack of a HCVF designation does not diminish the importance of values examined under this question, and they will continue to be managed going forward.

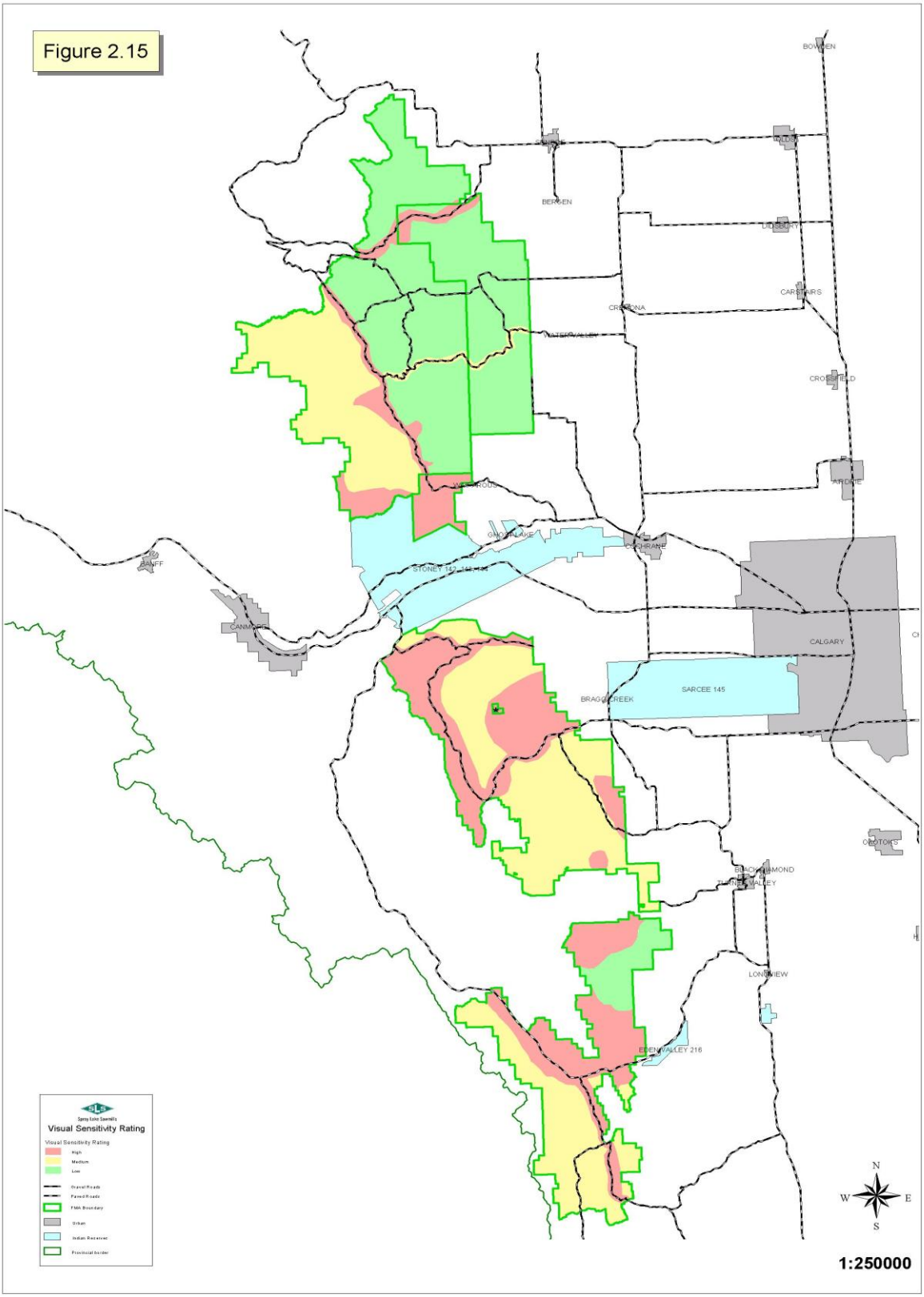

Figure 20. Visual sensitivity rating for the FMA/ B9 Quota (source 2006 DFMP)

4.6 Category 6: Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

4.6.1 Key Question 18

Is the traditional cultural identity of the local community particularly tied to a specific forest area?

In the context of the Standard, a ***Local*** community refers to the definition provided under Category 5, Key Question 17. It is reasonable to state that local communities consider the SLS FMA and B9 Quota areas to have significance to cultural identity (i.e. names for landscape features; stories about the forest; sacred or religious sites; historical associations; and amenity or aesthetic value). All identified values must be addressed and many will be dealt with under other Principles. To have HCVF designation, the value or forest area must be ***critical*** to the culture.

Guidance Questions

Will changes to the forest potentially cause an irreversible change to the culture?

Is the particular forest in question more valuable than other forests?

As described under Key Question 17, SLS completed a public involvement process during development of the DFMP to identify issues and values from the members of local communities. Objectives and strategies were prepared to address key subject areas, including natural and aesthetic values, for which the FMA is known. Historical resources were also addressed through this process. Public involvement is an ongoing process, with periodic meetings with a local Public Advisory Group and annual First Nation consultation regarding the GDP and AOP.

As noted previously, the FMA was established in 2001 with special areas in mind. Through negotiations with AESRD, the FMA boundary locations were selected with the creation of the Don Getty, Blue Rock, and Sheep River Wildland Provincial Parks. Forest operations have co-existed with recreation and tourism, ranching, and oil and gas development for many years. Changes to the forest as a result of SLS activities in the future will not have critical or irreversible negative impacts to the local culture. Traditional cultural identity is not known to be tied to a specific area in the forest. First nation values will be addressed as they are brought forward or identified. Area within the FMA is considered to have similar values and forest resources when compared to forested areas north and south of the FMA/ B9.

SLS recognizes the traditional interests of First Nations located adjacent to and within the vicinity of the FMA. AESRD provides direction to SLS on the requirements for First Nation

Consultation through use of the Government's Area of Interest Map and the Provincial First Nations Consultation Guidelines (Government of Alberta 2007). SLS completed a First Nation Consultation process during the development of the DFMP and continues to engage the following groups:

- Blood Tribe 148 (Treaty 7);
- Piikani Nation 147 (Treaty 7);
- Siksika Nation 146 (Treaty 7);
- Stoney Bands 142,143,144 (Treaty 7); and
- Tsuu T'ina Nation 145 (Treaty 7)

SLS has a First Nation's representative on the local Public Advisory Committee (PAC). At this time, SLS does not have data or access to a traditional land use study for the FMA or B9 Quota area. GDP and AOP reviews are completed in an effort to identify traditional resources and values, so that steps can be taken to mitigate impacts from forestry operations. SLS has initiated discussions with First Nations to work towards an Agreement to outline the future working relationship, as part of FSC® Principle 3.

During preparation of the DFMP, a GIS based Historical Resource Predictive Model was developed for the FMA by Golder Associates. The purpose of the model is to predict where there is a high potential for historical resources and to identify potential conflicts with forestry operations and archaeological sites where inventory data is absent. The model highlights the location of all previously recorded archaeological sites within the FMA and stratifies the landbase into high, moderate and low potential for unidentified sites (Figure 21).

The model included 217 pre-contact archaeological sites that are now contained in the Alberta Culture and Community Spirit (ACCS) historical resource database. Sites include pre-contact campsites dating over 10,000 years and bison kill and processing areas. As well, there are a number of culturally significant sites such as medicine wheels and grave sites.

A number of independent environmental parameters were examined to create the model, including proximity to streams and rivers, mountain tops, mountain passes, and ridge shadows. Slope, aspect, and resource availability (e.g. access to flora, fauna, water, workable stone) were also considered. Cultural variables included the location of known historical trails and passes. The predictive value of these criteria and the variations within each were given weights and ranks based on established archaeological principals.

Planned harvest blocks that fall within areas modeled as having a high potential for historical resources must have a Historical Resource Impact Assessment (HRIA) completed prior to road construction, harvesting, or scarification. Examinations include pedestrian traverse, visual examination of existing soil exposures, and judgmental shovel testing by qualified archaeological consultants. Experience gained in the field can be used to validate the predictive model.

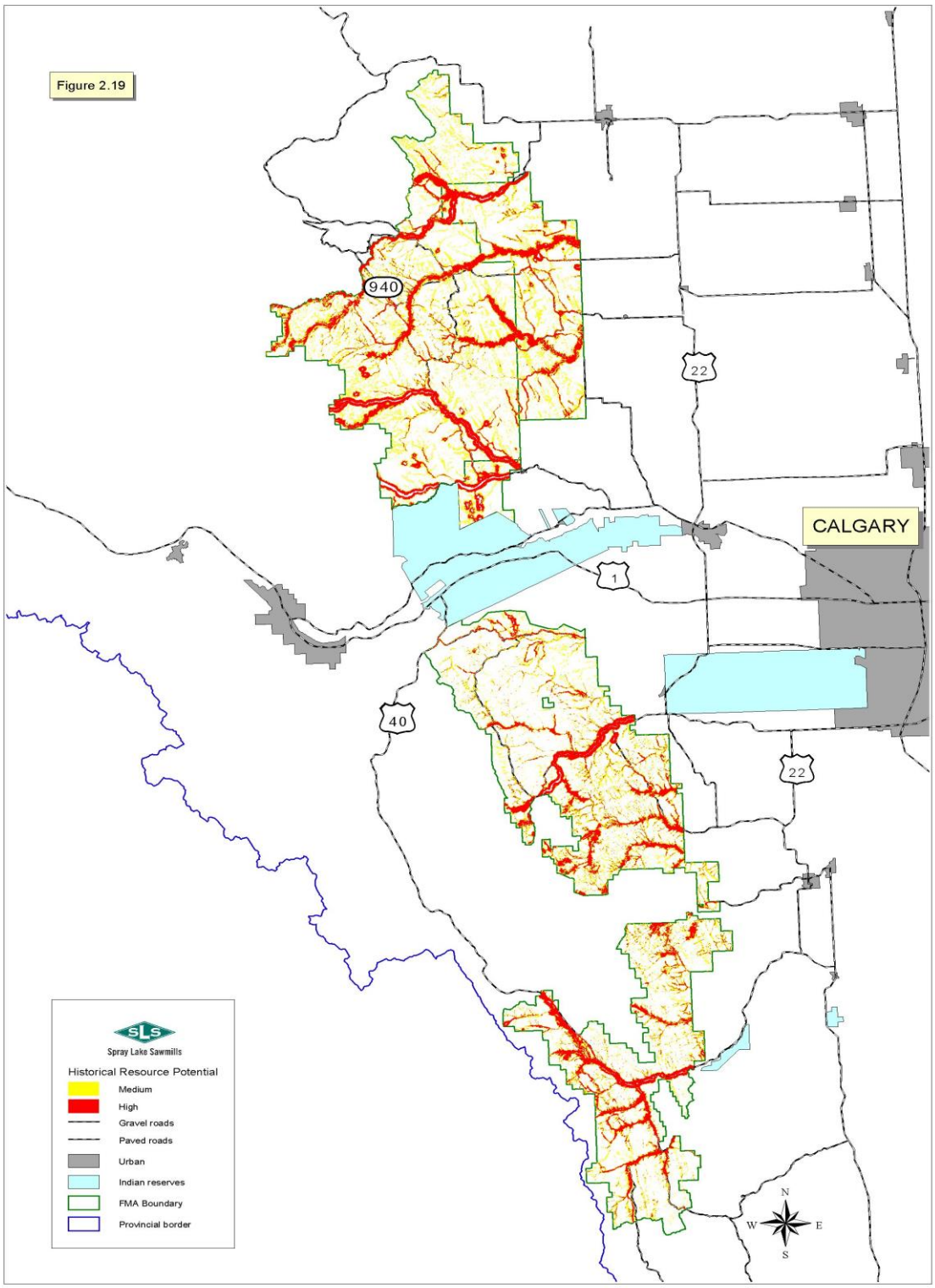

Figure 21. Historical resources predictive model (source 2006 DFMP)

Strategies are developed and implemented to mitigate impacts from forestry for any new sites identified through field work. Should sites be identified through chance discovery in areas modeled as having low or moderate potential, the site must be recorded and reviewed for further potential. ACCS must also be notified. SLS completes this work to maintain compliance with the Historical Resources Act. New sites are maintained in an internal GIS layer and are used for planning purposes. The sites are not made public by SLS due to their sensitive nature.

In Summary, known and identified site specific unique and/or historical resource values (recorded with ACCS) are considered HCVs. Site specific values brought forward by First Nations will also be considered HCVs.

4.6.2 Key Question 19

Is there a significant overlap of values (ecological and/or cultural) that individually do not meet HCV thresholds, but collectively constitute HCVs?

Individual values that do not meet the threshold for ***critical*** and /or ***outstanding*** may collectively meet the threshold. Consideration of several spatially overlapping values is important for optimizing conservation management.

Guidance Questions

Are there several overlapping conservation values?

Do the overlapping values represent multiple themes (e.g. species distribution, significant habitat, concentration area, relatively unfragmented landscape)?

Are the overlapping values within, adjacent to, or in close proximity to an identified HCV or existing conservation area?

Are the overlapping values adjacent or in close proximity to an existing protected area or candidate for permanent protection?

Do the overlapping values provide an option to meet protected areas representation requirements (i.e. overlap an under-represented landscape as assessed using a protected areas gap analysis)?

The approach taken by SLS to identify HCVs and forests addresses 3 levels of ecosystem hierarchy: landscape; habitat/community; and species.

Landscape-Scale

Landscape level values will be addressed by HCVF recognition and cooperative management of 2 environmentally significant areas (ESA), 2 regionally significant large landscape level forests, 2 remnant large landscape level forests, Zone 1 prime protection areas within the FMA, and the extensive protected areas network in the vicinity of the FMA / B9. Most of the parks and protected areas occur to the west of the FMA/B9 in the Subalpine and Alpine Natural Subregions, where timber harvest is less prevalent. SLS recognizes these areas as important reservoirs of biodiversity and will work cooperatively with the Alberta government to address access management, corridor management, and sharing of data and information that promotes ecosystem management. The 2 remnant landscape-level HCVFs identified by SLS provide enhanced management opportunities for lower elevation habitats in the Montane, Lower Foothills and Upper Foothills ecological regions. Important water values are addressed from the landscape level (e.g. Elbow River alluvial aquifer) down to the site level for individual rivers and streams.

Habitat/Community Scale

Habitat level values will be addressed by the identification and management of 4 globally ranked forested plant communities, outlier tree populations, and 5 species rich and unique habitat types, as well as the critical water resource associated with individual rivers and streams. These HCVFs occur only within the FMA and values associated with some groups (e.g. Group 9, unique/ diverse plant communities) are distributed largely within the lower elevation portions of the FMA to the east. SLS will mitigate impacts or enhance these habitat-level HCVFs by a combination of avoidance, access management, and timber harvest approaches that mimic natural disturbance regimes.

Species Scale

A total of 20 vertebrate wildlife species, including species at risk and focal species, were selected as HCVs (refer to Section 5.0, HCVF Groups 1-4). Management prescriptions in the DFMP and AOPs will be designed with a coarse filter approach to maintain suitable levels of high quality habitat for these species over the planning horizon. Site level prescriptions will be implemented to address species at risk, if they are observed. This will in turn accommodate long-term population viability. The 20 species-level HCVs were chosen to reflect a full range of habitat types and seral stages (Category 1, Key Question 4, Table 6), which has wide distribution across the FMA and large overlap with HCVFs at the landscape and community scales.

In summary, the range of HCVs and HCVFs selected at different spatial scales provides significant spatial overlap of values for the majority of the FMA/B9, which will optimize conservation management. No new HCVFs were identified under this question.

5.0 HCVF MANAGEMENT AND MONITORING STRATEGIES

SLS is committed to the implementation of the management and monitoring strategies identified in the High Conservation Value Forest assessment. SLS's HCVF management strategies and effectiveness monitoring program will be ongoing and long-term to include regular corporate review and an adaptive management response process. SLS has formed an HCVF management review team that will annually assess HCVF monitoring results and is responsible for making responsive changes to management strategies, Operating Ground Rules (along with AESRD) and or corporate policy, when it is evident that current management strategies are ineffective in meeting the HCVF objectives. As indicated in FSC principal 8.2.5, SLS's efforts will be focused on maintaining, enhancing and monitoring terrestrial HCVF focal species habitat. SLS will continue to participate with and rely on the Alberta Environment and Sustainable Resource Development, Fish and Wildlife Division for monitoring individual species on the FMA.

HCVF Group #:	**1**	**Ecological Scale:**	Species Level
Category:	1	**Key Question:**	1 & 4
HCVF attribute:	Species at Risk – vertebrates / Focal Species		
HCV(s):	Grizzly Bear		

Objectives:

The HCVF group 1 objectives are to maintain or enhance HCVF attributes in support of Grizzly Bear recovery on the FMA. The HCVF management strategies are designed to promote the maintenance and recovery of grizzly bear populations within and surrounding the FMA.

Management Strategies:

• The Alberta Grizzly Bear Recovery Plan guides management of grizzly bear which was officially declared as a threatened species under the Wildlife Act in June 2010.
• Implement recovery plan recommendations through the implementation of Operating Ground Rules, including targeting open road densities at or below 0.6 km/ km^2 in core habitat and 1.2 km/km^2 in secondary habitat.
• Annually review and update the Operating Ground Rules to ensure compliance with the Alberta Grizzly Bear Recovery Plan recommendations.
• Pursue joint Road Use Agreements with energy sector companies and other forest users to reduce the overall access footprint.
• Use temporary access roads for timber harvesting. Access that is no longer required for operations will be promptly reclaimed as per the applicable Operating Ground Rules and the SLS Road Use and Reclamation Plan.
• Incorporate existing plans, zones, other resource values (e.g. fish, wildlife, recreation and other commercial interests) and consultation with government authorities regarding access.
• Work with the AESRD to identify sensitive grizzly bear areas (e.g. known denning and seasonal foraging 'hotspots') in access planning, to minimize road densities and to develop operational strategies for incorporation into the OGRs.

Effectiveness Monitoring Strategies:

•Monitor and evaluate Foothills Research Institute bear density data compared with 2005 and 2006 DNA hair-snag survey estimates every 10 years or as soon as the data is available. The north FMA is found within the Clearwater population unit that supports a density of 5.2-bears/1000 km^2 (survey completed in 2005). The southern portion of the FMA occurs within the Livingstone population unit that supports a population density of 11.8-bears/1000 km^2 (survey completed in 2006).
•Assess and report open route road densities, every 5 years on the FMA to monitor SLS road densities compared to the Alberta Grizzly Bear Recovery Plan targets of 0.6 km/ km2 in core habitat and 1.2 km/km2 in secondary habitat.
• Annually assess and report the total km's of road constructed compared to the total km's of road reclaimed on the FMA.

HCVF Group #:	**2**	**Ecological Scale:**	Species Level
Category:	1	**Key Question:**	1
HCVF attribute:	Species at Risk – Vertebrates / Focal Species		
HCV(s):	Bull Trout	Westslope Cutthroat Trout	

Objectives:

The HCVF group 2 objectives are to maintain or enhance known Bull Trout spawning reaches and known pure Westslope Cutthroat Trout stream reaches, identified by the AESRD, in support of the maintenance and recovery of Bull Trout and pure strain Westslope Cutthroat Trout within and surrounding the FMA. The management strategies have been developed to: 1) protect Bull Trout and Westslope Cutthroat Trout from potential adverse impacts from forest management activities; and 2) maintain or enhance known Bull Trout spawning reaches and known pure strain Cutthroat Trout stream reaches identified by the AESRD within the FMA.

Management Strategies:

• Participate on the Provincial Recovery Team for Westslope Cutthroat Trout and implement recommendations from the final recovery plan.
• Implement recommendations from the evaluation of the current set of government approved Timber Harvest Planning and Operational Ground Rules and the Water Act Code of Practice For Water Crossings, as outlined in the Alberta Westslope Cutthroat Trout Recovery Plan 2012-2017.
• Map pure Westslope Cutthroat Trout stream reaches classified as Core populations, as Class A Watercourses, once refined and made available by the AESRD.
• Identify and map known Bull Trout spawning areas and pure Westslope Cutthroat Trout reaches in cooperation with the AESRD and communicate the location of these HCV's with planning, operational staff and contractors to ensure forest operations do not negatively impact the HCV's.
• Use the forest hydrology ECA model (DFMP Chapter 2.18) data to regulate timber harvesting and assess potential increases in water yield.
• Participate in the local Watershed Planning and Advisory Council (Bow River Basin Council - BRBC) as part of Alberta's Water for Life strategy.
• Coordinate forest management operations with the Alberta Environment and Sustainable Resource Development Fish and Wildlife, and Forestry Divisions and the Department of Fisheries and Oceans.
• Plan forest management operations to meet or exceed all federal and provincial laws, rules and regulations including the Fisheries Act and Species at Risk Act.

Effectiveness Monitoring Strategies:

• Annually compare the actual area of timber harvest with the projected ECA's to ensure potential increases in water yield are within the projected normal, natural range of variation and in compliance with provincial regulations.
•Review and evaluate future provincial AESRD Fish and Wildlife population and habitat monitoring data and effectiveness of mitigation and restoration monitoring data, representing the FMA regional assessments area.
•Report FMA, regional assessment area provincial AESRD Fish and Wildlife recovery data every 5 years or as it becomes available in the 5 year stewardship report.

HCVF Group #:	**3**	**Ecological Scale:**	Species Level
Category:	1	**Key Question:**	1 & 4
HCVF attribute:	Provincially Listed Species at Risk – vertebrates / Focal Species		
HCV(s):	Northern Goshawk	Black-backed Woodpecker	Brown Creeper
	Sandhill Crane	Pileated Woodpecker	Canada Lynx
	Barred Owl	Great Gray Owl	Long -toed Salamander
	Columbia Spotted Frog		

Objectives:

The HCVF group 3 objectives are to maintain or enhance provincially listed Species at Risk habitats within and surrounding the FMA. The HCVF management strategy objectives are to protect provincially listed Species At Risk from potential adverse impacts from forestry operations and maintain or enhance Species At Risk indicator species habitat on the FMA as modeled in the DFMP.

Management Strategies:

- Conduct Species at Risk identification training and record and report Species at Risk to the AESRD.
- Develop a point source tracking system (GIS based) for sightings and nest locations.
- For old growth adapted and cavity nesting birds including Northern Goshawk, Brown Creeper, Pileated Woodpecker, Barred Owl, and Great Gray Owl the following management strategies will be implemented:
  - Retain single trees, small clumps and large clumps representative of the pre-harvest stand well distributed across the block. Retain all deciduous and understory conifers to the fullest extent possible.
  - Manage timber harvest to sustain old forest levels consistent with DFMP projections.
  - Move deficit old forest levels, within 25% of the mean pre-industrial forest condition estimates overtime.
  - Retain pre-harvest stand coarse woody debris, well distributed across the block to increase in-block foraging opportunities.
  - Retain as many natural snags as safety permits. In the absence of natural or safe snags, top 1 to 3 green or dead trees per ha 3-5m tall and greater than 20 cm DBH as safety permits for nesting and foraging.
- For Long-toed Salamander and Columbia Spotted Frog:
  - Avoid watercourses and wetlands as per Operating Ground Rule riparian buffers.
- For Black-backed Woodpecker:
  - Coordinate with the AESRD to document and map areas of significant mountain pine beetle mortality (e.g. Provincial Level 2 and 3 treatment areas);
  - Retain sufficiently large patches of standing dead tress (e.g. grey attack, snags) during salvage, where possible, in scattered areas to act as source areas.
- For Canada Lynx:
  - Maintain a mosaic of successional forest stages;
  - Retain stand retention to promote cross-block movement;
  - Avoid pre-commercial thinning in regenerating stands to promote stocking density for snowshoe hare habitat.
- For Sandhill Crane:
  - Avoid extensive bogs and fens and other wetlands as per the Operating Ground Rules.

Effectiveness Monitoring Strategies:
• Monitor land area supply of high and very high quality habitat at DFMP renewal periods, based on DFMP baselines and TSA projections, for focal species taking into account timber harvest and natural succession. High quality habitat levels will be maintained within the natural range of variability moving toward PIC levels. • Complete pre-harvest surveys for Species at Risk based on field training, record and report all sightings to the AESRD. • Update forest seral age classes by natural Subregion every 10 years and compare with 2012 benchmarks to ensure deficit old forest levels, are moving within 25% of the mean pre-industrial forest condition estimates overtime.

HCVF Group #:	**4**	**Ecological Scale:**	Species Level
Category:	1	**Key Question:**	4
HCVF attribute:	Focal/Indicator Species		
HCV(s):	Western Tanager	Fisher	Ovenbird
	Marten	Moose	Elk
	Rusty Blackbird		
Objectives:			
The HCVF group 4 objectives are to maintain or enhance indicator species habitat within and surrounding the FMA. The HCVF management strategy objectives are to protect indicator species from potential adverse impacts from forestry operations and maintain or enhance indicator species habitat within the FMA as modeled in the DFMP.			
Management Strategies:			
• For Moose and Elk: - Maintain a mosaic of successional forest stages; - Utilize stand retention strategies to promote cross-block movement; - Implement access management and control as per grizzly bear recommendations. • For Marten and Fisher: - Retain as many natural snags as safety permits. In the absence of natural or safe snags, top 1 to 3 green or dead trees per ha greater than 3-5 m tall and greater than 20 cm DBH as safety permits. - Retain residual forest patches within harvest blocks to serve as security habitat for marten (e.g. corridors connected to larger forest patches) and as a seed source for native plant ingress; - Move deficit old forest levels, within 25% of mean pre-industrial forest condition estimates over time. • For Ovenbird: - Maintain a supply of deciduous forest patches of greater than 10 ha and preferably up to 100 ha; - Work with the AESRD to manage the deciduous land-base to maintain deciduous forest (e.g. reduce loss to succession), especially in the eastern portion of the FMA. • For Western Tanager: - No specific management strategies are proposed – not particularly susceptible to habitat fragmentation.			

• For Rusty Blackbird: - Avoid watercourses, wetlands, and beaver pond complexes as per the Operating Ground Rules; - Forest planners/biologists to assess and report sightings during block layout – avoid sites spatially or temporally (as per training, field assessment, and reporting procedures to be developed).
Effectiveness Monitoring Strategies:
• Monitor land area supply of indicator species habitat at DFMP renewal periods, based on DFMP baselines and TSA projections, for focal species taking into account timber harvest and natural succession. High quality habitat levels will be maintained within the natural range of variability moving toward PIC levels.

HCVF Group #:	**5**	**Ecological Scale:**	Species Level
Category:	1	**Key Question:**	1
HCVF attribute:	Species at Risk – vascular and non vascular plants		
HCV(s):	*Anastrophyllum michauxii*	*Homalothecium nevadense*	*Bacidia hegetschweileri*
	Buellia turgescens	*Chaenotheca stemonea*	*Silene involucrate*
	Ephebe lanata	*Aster maccallae*	*Stellaria umbellate*
	Arnica amplexicaulis	*Aster eatonii*	*Ribes laxiflorum*
	Splachnum vasculosum	*Anaptyychia setifera*	*Chaenotheca chrysocephala*
	Calicium trabinellum	*Chaenotheca trichialis*	*Cladonia bacilliformis*
	Cyphelium inquinans	*Leptogium tenuissimum*	*Mycocalicium subtile*
Objectives:			
The HCVF group 5 objectives are to maintain or enhance vascular and non vascular plant Species At Risk within the FMA. The HCVF management strategy objectives are to protect vascular and non vascular plant Species At Risk from potential adverse impacts from forestry operations and maintain or enhance vascular and non vascular plant Species At Risk within the FMA.			
Management Strategies:			
• Conduct training program for identification of these plant species and record and report them to the AESRD. • Avoid known locations of these species. • Avoid timber harvest operations in wetlands, riparian areas, beaver complexes, groundwater seepage areas, and rocky outcrops as per the Operating Ground Rules.			
Effectiveness Monitoring Strategies:			
• Monitor records related to the location and status of plant species at risk (ACIMS) and update the list associated with the FMA/B9 on an annual basis. • If rare plants are identified, they will be recorded in the SAR database. A rare plant specialist will be retained if necessary to verify plant identification. SLS will record and map identified sites found during pre-harvest planning.			

HCVF Group #:	6	Ecological Scale:	Species Level / Community
Category:	1	Key Question:	1 & 5
HCVF attribute:	Species at Risk – vascular plants (trees) / Outlier Tree Species		
HCV(s):	Whitebark Pine (*Pinus albicaulis)*	Limber Pine (*Pinus flexilis)*	

Objectives:

The HCVF group 6 objectives are to ensure forestry operations avoid the harvesting of Whitebark and Limber pine on the FMA.

Management Strategies:

• A search of the Forest Inventory (AVI) for the FMA identified 1 stand (16 ha) in the southern FMA containing a minor component of whitebark pine (C17La6Fa2Se1Pa1). The stand is located in the *passive* land base. Limber pine was not identified on the FMA through an AVI search.
• **No harvesting** is permitted for either species.
• Staff and contractors are trained in identification of these species and trees will be flagged for protection where found. SLS will notify the AESRD if these species are encountered.
• In stands containing whitebark pine and or limber pine, Provincial Recovery Plan recommendations will be adopted.
• Operating Ground Rules (section 7.7.3.9 and 7.7.3.10) will be implemented and updated as required.

Effectiveness Monitoring Strategies:

• Review the new forest inventory data (due prior to 2018) for the presence of whitebark and limber pine.
• Annually document any stand level occurrences and actions taken for conservation of these species.

HCVF Group #:	7	Ecological Scale:	Community / Habitat Level
Category:	1	Key Question:	5
HCVF attribute:	Outlier Tree Species		
HCV(s):	Black Spruce *Picea mariana*	Tamarack *Larix laricina*	White Birch *Betula papyrifera*
	Interior Douglas Fir *Pseudotsuga menziesii* var. *glauca*		

Objective:

The HCVF group 7 objective is to ensure that tree species at the edge of their current ranges are not harvested within the FMA.

Management Strategies:

• For black spruce and tamarack:
  - Both species are generally considered '*non commercial species'* for SLS activities and stands identified in the AVI have been removed from the active landbase and are not included in AAC calculations;
  - Where these stands are found on upland sites, harvesting will be avoided.
• For white birch:
  - White birch is generally considered a '*non commercial species'* for SLS activities and harvesting will be avoided, where possible;

- White birch will be retained on site for structure and retention.

• For Douglas fir:
- A search of the Alberta Vegetation Inventory for the FMA identified 1 stand (10 ha) with a component of Douglas fir (B18Se6Fd4), with 80% of the stand located in the *passive* land base.
- To the fullest extent possible, SLS will retain Douglas fir trees encountered with its forestry operations.

Effectiveness Monitoring Strategies:

• Review the updated forest inventory (due prior to 2018) for the presence of these species to establish a baseline.

HCVF Group #:	**8**	**Ecological Scale:**	Community / Habitat Level
Category:	3	**Key Question:**	8
HCVF attribute:	Rare Ecological Plant Communities		
HCV(s):	Lodgepole pine/red-osier dogwood woodland	Lodgepole pine/white meadowsweet forest	Aspen-subalpine fir-Engelmann spruce/clasping-leaved twisted stalk forest
	Douglas fir/angelica spp. Forest	Whitebark pine-Engelmann Spruce / white mountain avens woodland *(not expected to be impacted by forestry operations due to habitat location)	Limber pine scree woodland *(not expected to be impacted by forestry operations due to habitat location)

Objective:

The HCVF group 8 objective is to ensure the persistence of rarely occurring plant communities within the FMA.

Management Strategies:

• These are plant communities that have been recorded in Natural Subregions (ACIMS) associated with the FMA and have the potential to occur on the FMA. No known locations have been identified on the FMA to date.
• Conduct rare plant communities identification and training and record rare plant community locations.
• Known locations of rare plant communities will be avoided.

Effectiveness Monitoring Strategies:

The occurrence of these plant communities in the FMA have not been confirmed. SLS commits to protection of any known occurrences of these HCVF plant communities. Where possible these community types will be incorporated into the passive landbase or in retention patches within harvest areas.
• Monitor records in ACIMS for known locations and update the list associated with the FMA/B9 on an annual basis.
• Annually document any occurrences within harvest blocks and report in the 5 year stewardship report.

HCVF Group #:	**9**	**Ecological Scale:**	Community / Habitat Level
Category:	3	**Key Question:**	11
HCVF attribute:	Unique and Diverse Habitats/Plant Communities		
HCV(s):	Mixedwood forest in riparian settings	Shallow marshes and beaver pond complexes	Deciduous mixedwood and pure deciduous forest cover types >110 years old
	Late seral and old growth conifer forest > 170 years old	Upland Grasslands	

Objective:

The HCVF group 9 objective is to ensure the persistence of unique habitats within the FMA.

Management Strategies:

• For mixedwood forests in riparian settings:
- The majority of these habitats/stands are addressed through riparian buffer requirements in OGRs (e.g. harvest exclusion);
- Use selective timber harvest in larger riparian settings that emulates natural disturbance gap formation processes.

(* Note – current HCVF mapping depicts the entire AVI polygon for this plant community. Focus for HCVF management is on the 10-50m area immediately adjacent to the watercourse channel bank and is often characterized by imperfect drainage. HCVF mapping to be refined using Lidar technology at a future date e.g. DFMP renewal).

• For shallow marshes and beaver pond complexes:
- Riparian buffer requirements in OGRs will address these habitats (e.g. avoidance).

• For Upland Grasslands:
- These are often found on inoperable slopes steeper than 45% and are generally excluded from timber harvest activities due to the absence of trees.

• For late seral and old growth conifer forests:
- Move deficit old forest levels, within 25% of mean pre-industrial forest condition estimates over time.
- Retain single trees, small clumps and large clumps representative of the pre-harvest stand well distributed across the block. Retain all deciduous and understory conifers to the fullest extent possible.
- Manage timber harvest to sustain old forest levels consistent with DFMP projections.
- Retain pre-harvest stand coarse woody debris well distributed across the block to increase in-block foraging opportunities.
- Retain as many natural snags as safety permits. In the absence of natural or safe snags, top 1 to 3 green or dead trees per ha 3-5m tall and greater than 20 cm DBH as safety permits for nesting and foraging.
- Forest planners/biologists to inventory for stick and cavity nest sites during block layout – avoid sites spatially or temporally (as per training, field assessment, and reporting procedures to be developed).

• For late seral mixedwoods and deciduous forest:
- Maintain a supply of deciduous and mixed deciduous forest patches of greater than 10 ha and preferably up to 100 ha;
- Work with the AESRD to manage the deciduous landbase to maintain deciduous forest (e.g. reduce loss to succession), especially in the eastern portion of the FMA;
- Maintain supply of old deciduous dominated forests within range of natural variability.

- Move deficit old forest levels, within 25% of mean pre-industrial forest condition estimates over time.
- As per recommendations in the Protected Areas Gap Analysis (Kansas and Mogilefsky 2013) current passive landbase areas will be designed to meet specific ecological objectives and serve as permanent reserves. Portions of the passive and active landbase will be designed with stakeholders to contribute to a protected area network beyond the management unit to fill identified protected area gaps. This approach will be designed to increase the connectivity of unique habitat types within the FMA.

Effectiveness Monitoring Strategies:

• Update forest seral age classes by natural Subregion every 10 years and compare to 2012 benchmarks to ensure deficit old forest levels, are moving within 25% of the mean pre-industrial forest condition estimates over time.

HCVF Group #:	**10**	**Ecological Scale:**	Community / Habitat Level
Category:	4	**Key Question:**	16
HCVF attribute:	Critical Impact on Fisheries		
HCV(s):	Important stream reaches identified by the AESRD containing pure Westslope Cutthroat trout and Bull Trout spawning sites.		

Objectives:

The HCVF group 10 objectives are to maintain or enhance known Bull Trout spawning reaches and known pure Westslope Cutthroat Trout stream reaches identified by the AESRD in support of the maintenance and recovery of Bull Trout and pure strain Westslope Cutthroat Trout within and surrounding the FMA. The management strategies have been developed to protect Bull Trout and Westslope Cutthroat trout from potential adverse impacts from forest management operations and to maintain or enhance known Bull Trout spawning reaches and known pure strain cutthroat trout stream reaches identified by the AESRD within the FMA.

Management Strategies:

• Participate on the Provincial Recovery Team for Westslope Cutthroat Trout and implement recommendations from the final recovery plan.
• Implement recommendations from the evaluation of the current set of government approved Timber Harvest Planning and Operational Ground Rules and The Water Act Code of Practice For Water Crossings, as outlined in the Alberta Westslope Cutthroat Trout Recovery Plan 2012-2017.
• Map pure Westslope Cutthroat Trout streams reaches classified as Core populations, as Class A Watercourses, once refined and made available by the AESRD.
• Coordinate forest management operations with the Alberta Environment and Sustainable Resource Development Fish and Wildlife and Forestry Divisions and the Department of Fisheries and Oceans.
• Plan forest management operations to meet or exceed all federal and provincial laws, rules and regulations including the Fisheries Act and Species at Risk Act.
• Identify and map known Bull Trout spawning areas and pure Cutthroat Trout reaches in cooperation with the AESRD and communicate the location of these HCV's with planning, operational staff and contractors to ensure forest operations do not negatively impact the HCV's.
• Use the forest hydrology ECA model (DFMP Chapter 2.18) data to assess potential increases in water yield.
• Participate in the local Watershed Planning and Advisory Council (Bow River Basin Council - BRBC) as part of Alberta's Water for Life strategy.
• Review new information, research and plans produced by watershed stewardship groups, universities and the government for applicability to forestry operations.

Effectiveness Monitoring Strategies:
• Annually compare actual area of timber harvest with projected ECA to ensure potential increases in water yield are within the projected normal, natural range of variation and in compliance with provincial regulations. • Review and evaluate future provincial AESRD Fish and Wildlife population and habitat monitoring data and effectiveness of mitigation and restoration monitoring data, representing the FMA regional assessment area. • Report FMA and regional assessment area provincial AESRD Fish and Wildlife recovery data every 5 years or as it becomes available in the 5 year stewardship report.

HCVF Group #:	**11**	**Ecological Scale:**	Community / Habitat Level
Category:	6	**Key Question:**	18
HCVF attribute:	Traditional Cultural Identity		
HCV(s):	Known and identified site specific, unique and historical resource values, recorded with Alberta Culture and Community Spirit (ACCS), are considered HCVs. Site specific values brought forward by First Nations will also be considered HCVs.		
Objective:			
The HCVF group 11 objective is the protection of Traditional Cultural Areas.			
Management Strategies:			
• Request First Nation's input on values and information based on completed Traditional Use Studies through the consultation process. • Request public input in regards to unique values through the annual open house and collaborative planning workshops consultations. • Implement the Historical Resource Predictive Model results for the FMA as per the DFMP. • Complete Historical Resource Impact Assessments for Final Harvest Plans using qualified archaeological consultants. • Record unique finds during harvest block layout /operations and consult with AESRD, as required. • Consult with local First Nations when traditional or First Nations' related historical resources values are identified in the field to mitigate impacts of forest management activities. • Incorporate site-specific values brought forward or the results of completed traditional use studies by First Nations in operational plans. • Use harvest buffers or deletions as per recommendations from archaeologists or through consultation with First Nations or the general public.			
Effectiveness Monitoring Strategies:			
• Report finds to ACCS for the Provincial database and incorporate known historical sites and unique values into the SLS GIS system. • Report the number of FMA cultural sites encountered and protected in the 5 year stewardship report.			

HCVF Group #:	**12**	**Ecological Scale:**	Landscape Level
Category:	1 & 4	**Key Question:**	3 & 16
HCVF attribute:	Significant Concentrations of Biodiversity Values / Critical Impact on Fisheries		
HCV(s):	The Highwood River watershed portion of the FMA designated as a Nationally Significant ESA		
	The Red Deer River watershed portion of the FMA designated as a Nationally Significant ESA		

Objectives:

The HCVF group 12 objectives are to maintain or enhance HCVF attributes located within the Highwood River watershed and Red Deer River watershed, both Nationally Significant ESA's within the FMA. The HCVF management strategy objectives are to protect HCVF attributes from potential adverse impacts from forestry operations and maintain or enhance ESA habitats within the FMA as modeled in the DFMP.

Management Strategies:

• The Highwood River ESA was selected as it contains: habitat for focal species; important wildlife habitat; riparian areas including headwater streams; intact riparian areas along major rivers; and, large natural areas.

• For the Highwood River ESA:

- Approximately 1600 ha east of Cataract Creek and south of the Highwood River (TWP 16, Ranges 4 and 5) to the east FMA boundary has been subjectively added to the passive landbase by SLS.
- SLS does not anticipate completing crossing installations on the Highwood River.
- Follow and implement all management strategies for grizzly bear as per HCV group #1.
- Follow and implement all management strategies for watercourses and critical fisheries impacts as per HCV group #10.
- Follow the applicable Operating Ground Rules and associated guidelines (e.g. Resource Road Planning Guidelines and the Stream Crossing Guidelines).

• The Red Deer River ESA was selected as the Red Deer River valley represents a natural travel corridor for numerous species of wildlife as well as a wintering area for ungulate populations and spawning area for a number of fish species. Biodiversity and Fisheries values will largely be addressed by OGR riparian area buffers associated with this class C watercourse.

• For the Red Deer River ESA:

- SLS does not anticipate completing crossing installations on the Red Deer River.
- Implement all management strategies for grizzly bear as per HCV group #1.
- Implement all management strategies for watercourses and critical fisheries impacts as per HCV group #10.
- Follow the applicable Operating Ground Rules and associated guidelines (e.g. Resource Road Planning Guidelines and the Stream Crossing Guidelines).
- Implement all management strategies for bull/cutthroat trout, species at risk, and focal species (HCV groups 2, 3 and 4).
- Work with interested parties to evaluate potential protected areas candidates within the Upper and Lower Foothills subregions.
- Defer harvest in the Red Deer River ESA Upper and Lower Foothills subregions pending protected area evaluation.

Effectiveness Monitoring Strategies:

• Follow monitoring strategies as per HCV groups 2, 3 and 4 for the FMA portion of the Highwood River ESA.

• Report protected area evaluations once available.

• Annually verify that no harvest is occurring within the Red Deer River ESA Upper and Lower Foothills subregions.

HCVF Group #:	**13**	**Ecological Scale:**	Landscape Level
Category:	3	**Key Question:**	7 & 10
HCVF attribute:	Large Landscape Level Forest (50,000 – 200,000 ha)		
HCV(s):	Block 1	Block 2	
Objectives:			
The HCVF group 13 objectives are to maintain core forest attributes over time. The HCVF management strategy objectives are to maintain or enhance Large Landscape Level Forest habitats within the FMA.			
Management Strategies:			
• Maintain low road densities consistent with the provincial grizzly bear guidelines. • Within the FMA, portions of each Large Landscape Level Forest, access management and control measures such as gates or physical barricades will be used to control access. • Maintain open route densities at or below current levels. • Assess and map habitat suitability for focal or indicator species (e.g. grizzly bear, marten,) and set targets for habitat maintenance over time (to be completed as part of DFMP renewal process). • Move deficit old forest levels, within 25% of mean pre-industrial forest condition estimates over time. • As per the Protected Areas Gap Analysis (Kansas and Mogilefsky 2013) work with interested parties to evaluate potential protected area candidates within the passive landbase within the Upper and Lower Foothills subregions. Current passive landbase areas will be designed to meet specific ecological objectives and serve as permanent reserves. Portions of the passive and active landbase will be designed with stakeholders to contribute to a protected area network beyond the management unit to fill identified protected area gaps. This approach will be designed to increase the connectivity of Large Landscape Level forest attributes within the FMA.			
Effectiveness Monitoring Strategies:			
• Assess and report open route road densities, every 5 years to monitor SLS road densities compared to the Alberta Grizzly Bear Recovery Plan targets of 0.6 km/ km^2 in core habitat and 1.2 km/km^2 in secondary habitat. • Annually assess and report access control, road reclamation and construction activities to minimize linear disturbance impacts. • Update forest seral age classes by natural Subregion every 10 years and compare to 2012 benchmarks to ensure deficit old forest levels, are moving within 25% of the mean pre-industrial forest condition estimates overtime. • Report protected area evaluations once available. • Update wildlife habitat suitability for focal species at 10 year intervals in conjunction with DFMP renewal.			

HCVF Group #:	**14**	**Ecological Scale:**	Landscape Level
Category:	3	**Key Question:**	7 & 10
HCVF attribute:	Remnant Landscape Level Forest (>5,000 < 50,000 ha)		
HCV(s):	Remnant #8	Remnant #12	
Objective:			
The HCVF group 14 objective is to maintain core forest attributes overtime. The HCVF management strategy objectives are to maintain or enhance Remnant			

Landscape Level Forest habitats within the FMA.
Management Strategies:
• Maintain low road densities consistent with the provincial grizzly bear guidelines. • Within the FMA, portions of each Remnant Landscape Level Forest, access management and control measures such as gates or physical barricades will be used to control access. • Move deficit old forest levels, within 25% of mean pre-industrial forest condition estimates over time. • Maintain deciduous and mixed deciduous forest cover over the long term, using mixedwood management strategies such as aspen retention.
Effectiveness Monitoring Strategies:
•Assess and report open route road densities, every 5 years to monitor road densities compared to The Alberta Grizzly Bear Recovery Plan targets of 0.6 km/ km^2 in core habitat and 1.2 km/km^2 in secondary habitat. • Annually assess and report access control, road reclamation and construction activities to minimize linear disturbance impacts. • Update forest seral age classes by Natural Subregion every 10 years and compare to 2012 benchmarks to ensure deficit old forest levels, are moving within 25% of the mean pre-industrial forest condition estimates overtime. • Update wildlife habitat suitability for focal species at 10 year intervals in conjunction with DFMP renewal.

HCVF Group #:	**15**	**Ecological Scale:**	Landscape Level
Category:	4	**Key Question:**	13
HCVF attribute:	Significant Ecological Service		
HCV(s):	The Elbow River main stem and its adjacent alluvial aquifer		
Objective:			
The HCVF group 15 objective is to ensure SLS operations do not negatively impact the water quantity and quality of the Elbow River.			
Management Strategies:			
• Follow the DFMP spatial harvest sequence for alignment with ECA water yield projections to ensure potential increases in water yield are within the normal, natural range of variation and in compliance with provincial regulations. • Adhere to Operating Ground Rules (Sections 6 and 11) and associated guidelines (e.g. Resource Road Planning Guidelines and the Stream Crossing Guidelines) . The Operating Ground Rules are designed to: minimize the potential for sedimentation; prevent soil and logging debris and deleterious substances from entering water courses and; maintain aquatic and terrestrial habitat. • Review new information, research and plans produced by watershed stewardship groups (e.g. Elbow River Watershed Partnership), universities and the government for applicability to forestry operations.			
Effectiveness Monitoring Strategies:			
• Annually compare the actual area of timber harvest with the projected ECA's to ensure potential increases in water yield are within the projected normal, natural range of variation and in compliance with provincial regulations. • The AESRD and SLS to annually inspect harvest and road reclamation operations to monitor Operating Ground Rules and planning guideline compliance.			

HCVF Group #:	**16**	**Ecological Scale:**	Landscape Level
Category:	1	**Key Question:** 6	13
HCVF attribute:	Designated Conservation Areas		
HCV(s):	Don Getty Wildland Provincial Park, Elbow Sheep Wildland Provincial Park, Bluerock Wildland Provincial Park, Bow Valley Provincial Park, Plateau Mountain Ecological Reserve , Sheep River Provincial Park, Macabee Creek Natural Area, Bragg Creek Provincial Park, Bragg Creek Natural Area, Moose Mountain, OH Ranch Heritage Rangeland, Provincial Recreation Areas located within the FMA boundary, IRP Zone 1 Prime Protection (passive landbase).		
Objective:			
The HCVF group 16 objective is to ensure SLS forestry operations do not encroach upon or negatively impact designated conservation areas.			
Management Strategies:			
• The majority of the lands described under this group are managed by the Alberta Tourism Parks and Recreation division, and have site specific management policies or management plans independent of SLS operations. • Identify park, natural area, recreation area, and IRP zone 1 boundaries when locating adjacent harvest blocks or any other forest management operations.			
Effectiveness Monitoring Strategies:			
• Annually ensure forestry operations do not encroach upon existing conservation areas.			

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APPENDIX 1

Status and Abundance Definitions

STATUS AND ABUNDANCE CODES

Status

S summer resident, migrates out of study area for the winter

W winter resident, present only during late fall, winter and early spring

R permanent resident, present year-round although not necessarily active during winter

M migrant, passes through area during spring and/or fall, not normally resident at any time of the year

T transient, expected to occur only in passing, not normally resident at any time of the year

Abundance

C common, detected whenever suitable habitat is investigated during an appropriate season

U uncommon, detected often, but not always, whenever suitable habitat is investigated during an appropriate season

S scarce, detected occasionally, but not usually, even when suitable habitat is investigated during an appropriate season

R rare, unexpected but could occur in any given year, would not generally be considered a regular component of the study area fauna

APPENDIX 2

Rare [Ecological] Plant Communities with Potential to Occur in the Spray Lakes FMA

Scientific Name	Common Name	Rank	Class
Abies bifolia - Picea engelmannii / Luzula hitchcockii woodland	subalpine fir – Engelmann spruce / smooth wood-rush woodland	S1S2 G5	Forest/ Woodland
Abies bifolia - Picea engelmannii / Oplopanax horridus	subalpine fir – Engelmann spruce / devil's-club	SNR G3	Forest/ Woodland
***Abies bifolia - Picea engelmannii / Streptopus amplexifolius - Luzula hitchcockii* woodland**	**subalpine fir – Engelmann spruce / clasping-leaved twisted-stalk – smooth wood rush woodland**	**S2S3 G2G3**	**Forest/ Woodland**
Abies bifolia - Picea engelmannii / Vaccinium scoparium / Xerophyllum tenax forest	subalpine fir – Engelmann spruce / grouseberry / beargrass forest	S1 G4G5	Forest/ Woodland
***Abies bifolia - Picea engelmannii / Valeriana sitchensis* woodland**	**subalpine fir – Engelmann spruce / mountain valerian woodland**	**S2? G2?**	**Forest/ Woodland**
Abies bifolia – Pinus albicaulis – Picea engelmannii / Empetrum Nigrum	subalpine fir – whitebark pine - Engelmann spruce /crowberry	S2	Forest/ Woodland
Abies bifolia – Pinus albicaulis / Xerophyllum tenax	subalpine fir – whitebark pine / beargrass	S1S2	Forest/ Woodland
Abies bifolia – Pinus flexilis – Populus tremuloides / Thalictrum Venulosum	subalpine fir - limber pine - aspen / veiny meadow rue	S2?	Forest/ Woodland
***Amelanchier alnifolia / Pseudoroegneria spicata* shrubland**	**saskatoon / bluebunch wheat grass shrubland**	**S2S3 G3G4Q**	**Shrubland**
Aquilegia flavescens - Senecio Megacephalus	**yellow columbine – large flowered ragwort**	**SNR G2G3**	**Sparsely Vegetated**
***Arctostaphylos uva-ursi / Pseudoroegneria spicata* dwarf Shrubland**	**common bearberry /bluebunch wheat grass dwarf shrubland**	**S2S3 G2G3**	**Dwarf Shrubland**
Arctostaphylos uva-ursi / Solidago Multiradiata	**common bearberry / alpine goldenrod**	**SNR G2G3**	**Dwarf Shrubland**
Arenaria capillaris / Polytrichum Piliferum	**linear leaved sandwort /awned hair-cap moss**	**SNR G2G3**	**Herbaceous**
Artemisia norvegica – Mertensia paniculata – Leymus innovatus	mountain sagewort – tall lungwort - hairy wild rye	S1	Herbaceous
Artemisia tridentata ssp. *vaseyana - Amelanchier alnifolia*	big sagebrush – Saskatoon slope community	S1	Shrub Herbaceous
Artemisia tridentata ssp. *vaseyana – Rhamnus alnifolia*	big sagebrush – alderleaved buckthorn	S1	Shrub Herbaceous
Aristida purpurea grassland	red three-awn grassland	S1	Herbaceous
Athyrium alpestre* var *americanum - Cryptogramma acrostichoides	**alpine spleenwort – parsley fern**	**SNR G2G3**	**Sparsely Vegetated**
Betula occidentalis - Amelanchier alnifolia / Artemisia campestris - Elymus lanceolatus (Agropyron dasystachyum)	water birch - saskatoon /plains wormwood - northern wheat grass	S1	Shrubland
***Betula occidentalis* montane Shrubland**	**water birch montane shrubland**	**S1S2 G3G4**	**Shrubland**
Betula papyrifera / Betula occidentalis / Arctostaphylos uvaursi	white birch / water birch /common bearberry	S1	Forest/ Woodland
***Bromus marginatus - Pseudoroegneria spicata* grassland**	**large mountain brome -bluebunch wheatgrass grassland**	**S1S2 G2?**	**Herbaceous**
***Carex albonigra - Myosotis alpestris* herbaceous vegetation**	**black-and-white sedge -alpine forget-me-not herbaceous vegetation**	**S2S3 G2G3**	**Herbaceous**
Carex limosa / Sphagnum jensenii	mud sedge / pendantbranch peat moss	S1	Herbaceous
Crataegus chrysocarpa / Heracleum lanatum - Urtica dioica - Viola canadensis	round-leaved hawthorn /cow parsnip – common nettle - western Canada violet	S1S2	Shrubland
Cymbella pusilla - Mastogloia smithii - Nitzschia palea	diatom ponds	S1S3	Aquatic
Dryas integrifolia – Carex rupestris	white mountain avens - rock sedge	S1	Dwarf Shrubland
Dryas octopetala - Polygonum Viviparum	**white mountain avens - alpine bistort**	**S1S2 G3?**	**Dwarf Shrubland**
***Elaeagnus commutata* riparian Shrubland**	**silverberry riparian shrubland**	**SU G2Q**	**Shrubland**
Elymus lanceolatus - Artemisia dracunculus - Artemisia frigida	northern wheat grass -dragonwort - pasture sagewort	S1	Herbaceous
Elymus lanceolatus - Artemisia Frigid	northern wheat grass -pasture sagewort	S2S3	Herbaceous
Elymus lanceolatus - Elymus Trachycaulus	northern wheat grass -slender wheat grass	S1	Herbaceous
Elymus lanceolatus - Stipa comata	northern wheat grass - needleand-thread	S2	Herbaceous
Elymus trachycaulus - Koeleria Macrantha	slender wheat grass – June grass	SU	Herbaceous
Festuca altaica - Deschampsia Caespitose	northern rough fescue -tufted hair grass	S1	Herbaceous
Festuca altaica - Leymus innovatus (Elymus innovatus)	northern rough fescue -hairy wild rye	S1	Herbaceous
Festuca campestris - Deschampsia Caespitose	mountain rough fescue -tufted hair grass	S1	Herbaceous
Festuca campestris - Leymus innovatus (Elymus innovatus	mountain rough fescue -hairy wild rye	S2S3	Herbaceous
Festuca campestris - Pseudoroegneria spicata grassland	mountain rough fescue -bluebunch wheat grass grassland	S1S2 G4	Herbaceous
Festuca campestris - Stipa curtiseta	mountain rough fescue -western porcupine grass	S2S3	Herbaceous
Festuca idahoensis - Pseudoroegneria spicata grassland	Idaho fescue – bluebunch wheat grass grassland	S1S2 G4	Herbaceous
Isoetes bolanderi aquatic community	Bolander's quillwort aquatic community	S1	Aquatic

Juncus drummondii – Carex saxatilis – Ranunculus nivalis	Drummond's rush – rockyground sedge – snow buttercup	S1?	Herbaceous
Juncus filiformis / Sphagnum spp.	thread rush / peat moss	S1S2	Herbaceous
***Juncus parryi / Sibbaldia procumbens* snowbed community**	**Parry's rush / sibbaldia snowbed community**	**S1S2 G3G4**	**Herbaceous**
Koeleria macrantha – Artemisia frigida – Linum lewisii	June grass – pasture sagewort - wild blue flax	S2S3	Herbaceous
Larix lyallii / Luzula hitchcockii	subalpine larch / smooth wood rush	S2?	Forest/ Woodland
***Larix lyallii / Vaccinium membranaceum / Luzula hitchcockii* woodland**	**subalpine larch / tall bilberry / smooth woodrush woodland**	**S2 G2G3**	**Forest/ Woodland**
Larix occidentalis / Rubus parviflorus	western larch /thimbleberry	S1	Forest/ Woodland
***Menziesia ferruginea / Xerophyllum tenax* shrubland**	**false azalea / bear-grass shrubland**	**S1S2 G3G4**	**Shrubland**
Pascopyrum smithii - Pyrrocoma Uniflora	western wheat grass - oneflowered ironplant	S1	Sparsely Vegetated
Penstemon ellipticus talus barren	creeping beardtongue talus barren	S1?	Sparsely Vegetated
***Phacelia hastata - (Penstemon ellipticus)* scree slope sparse vegetation**	**silver-leaved scorpionweed-(creeping beardtongue) scree slope sparse vegetation**	**S2S3 G2G3**	**Sparsely Vegetated**
Phyllodoce glanduliflora / Sibbaldia Procumbens	**yellow heather / sibbaldia**	**SNR G2G3**	**Dwarf Shrubland**
Picea engelmannii - Abies bifolia / Dryas octopetala	Engelmann spruce -subalpine fir / white mountain avens	S2S3	Forest/ Woodland
Picea engelmannii – Abies bifolia / Salix planifolia / Hylocomium Splendens	Engelmann spruce -subalpine fir / flat-leaved willow / stair-step moss	S1?	Forest/ Woodland
Picea engelmannii – Abies bifolia / Salix vestita / Cassiope tetragona	Engelmann spruce -subalpine fir / rock willow / white mountain-heather	S2	Forest/ Woodland
Picea engelmannii / Leymus Innovates	Engelmann spruce / hairy wild rye	S2	Forest/ Woodland
Picea engelmannii / Salix Drummondiana	Engelmann spruce /Drummond's willow	S1?	Forest/ Woodland
Picea engelmannii / Salix vestita	Engelmann spruce / rock willow	S2?	Forest/ Woodland
Picea glauca / Abietinella abietina	white spruce / fern moss	S2S3	Forest/ Woodland
Picea glauca / Betula pumila - Salix bebbiana / Carex eburnea	white spruce / dwarf birch -beaked willow / bristleleaved sedge	S1?	Forest/ Woodland
Picea glauca / Rosa acicularis / Abietinella abietina	white spruce / prickly rose /fern moss	S1	Forest/ Woodland
Picea glauca / Shepherdia canadensis / Abietinella abietina	white spruce / Canada buffaloberry / fern moss	S2	Forest/ Woodland
Pinus albicaulis - Abies bifolia / Luzula hitchcockii - Vaccinium Myrtillus	whitebark pine – subalpine fir / smooth wood rush - low bilberry	S1S2	Forest/ Woodland
***Pinus albicaulis – Picea engelmannii / Dryas octopetala* woodland**	**whitebark pine -Engelmann spruce / white mountain avens woodland**	**S1 G2G3**	**Forest/ Woodland**
Pinus albicaulis – Pinus contorta / Juniperus communis – Leymus innovatus – Linnaea borealis	whitebark pine – lodgepole pine / ground juniper – hairy wild rye	S2S3	Forest/ Woodland
Pinus albicaulis / Juniperus communis – Arctostaphylos uva-ursi	whitebark pine / ground juniper - common bearberry	S2S3	Forest/ Woodland
***Pinus contorta / Cornus stolonifera* Woodland**	**lodgepole pine / red-osier dogwood woodland**	**S2? G2G3**	**Forest/ Woodland**
Pinus contorta / Ledum groenlandicum / Vaccinium scoparium / Pleurozium schreberi	lodgepole pine / common Labrador tea / grouseberry / Schreber's moss	S1?	Forest/ Woodland
***Pinus contorta / Spiraea betulifolia* Forest**	**lodgepole pine / white meadowsweet forest**	**S2S3 G3G4**	**Forest/ Woodland**
Pinus flexilis - Pseudotsuga menziesii / Juniperus spp. */ Arctostaphylos uva-ursi*	limber pine - Douglas-fir /juniper species / common bearberry	S2	Forest/ Woodland
Pinus flexilis / Arctostaphylos uva ursi - Juniperus horizontalis	limber pine / common bearberry - creeping juniper	S2S3	Forest/ Woodland
Pinus flexilis / Arctostaphylos uvaursi Woodland	limber pine / common bearberry woodland	S2 G4	Forest/ Woodland
***Pinus flexilis* scree woodland**	**Limber pine scree woodland**	**S1S2 G3Q**	**Forest/ Woodland**
Populus angustifolia / Cornus Stolonifera	narrow-leaf cottonwood / redosier dogwood	S2S3 G4	Forest/ Woodland
Populus balsamifera - P. tremuloides / Alopecurus alpinus - Calamagrostis Canadensis	balsam poplar - aspen /alpine foxtail - bluejoint	S1S2	Forest/ Woodland
***Populus balsamifera ssp. trichocarpa - (Populus tremuloides) / Heracleum lanatum* forest**	**black cottonwood - (aspen)/ cow parsnip forest**	**S2 G2**	**Forest/ Woodland**
***Populus balsamifera ssp. trichocarpa - Picea engelmannii / Cornus stolonifera* forest**	**black cottonwood -Engelmann spruce / redosier dogwood forest**	**S1S2 G2G3**	**Forest/ Woodland**
***Populus balsamifera ssp. trichocarpa - Picea engelmannii / Equisetum arvense* forest**	**black cottonwood -Engelmann spruce / common horsetail forest**	**S1S2 G2?**	**Forest/ Woodland**
***Populus balsamifera ssp. trichocarpa / Calamagrostis canadensis* forest**	**black cottonwood - conifer/ bluejoint forest**	**S1S2 G2?**	**Forest/ Woodland**

Populus tremuloides - Abies bifolia - Picea engelmannii / Streptopus amplexifolius **forest**	**aspen - subalpine fir -Engelmann spruce / clasping-leaved twistedstalk forest**	**S1S2 G2G3**	**Forest/ Woodland**
Populus tremuloides - Amelanchier alnifolia **avalanche chute shrubland**	**aspen – Saskatoon avalanche chute shrubland**	**S1S2 G3?**	**Shrubland**
Populus tremuloides / Leymus innovatus – Aster conspicuus avalanche community	aspen / hairy wild rye - showy aster avalanche community	S2	Forest/ Woodland
Populus tremuloides / Menziesia Ferruginea	aspen / false azalea	S1	Forest/ Woodland
Populus tremuloides / Rubus Parviflorus	aspen / thimbleberry	S2	Forest/ Woodland
Populus tremuloides / Rubus parviflorus / Aralia nudicaulis	aspen / thimbleberry / wild sarsaparilla	S2S3	Forest/ Woodland
Potentilla fruticosa / Festuca campestris - Danthonia intermedia	shrubby cinquefoil /mountain rough fescue – intermediate oat grass	S2S3	Shrub Herbaceous
Pseudoroegneria spicata - Carex Obtusata	bluebunch wheat grass -blunt sedge	S1	Herbaceous
Pseudoroegneria spicata – Leymus innovatus – Aster conspicuus	bluebunch wheat grass -hairy wild rye - showy aster	S1	Herbaceous
Pseudoroegneria spicata grassland	bluebunch wheat grass grassland	S1	Herbaceous
Pseudotsuga menziesii - Pinus flexilis / Juniperus communis / Festuca campestris	Douglas-fir - limber pine /ground juniper / mountain rough fescue	S2S3	Forest/ Woodland
Pseudotsuga menziesii / Angelica **spp. Forest**	**Douglas-fir / angelica spp. Forest**	**S1S2 G2?**	**Forest/ Woodland**
Salix bebbiana / Cornus stolonifera	beaked willow / red-osier dogwood	S3?	Shrubland
Salix bebbiana / Rubus idaeus / Geranium richardsonii	beaked willow / wild red raspberry / wild white geranium	S2	Shrubland
Salix drummondiana / Scirpus microcarpus – Calamagrostis canadensis	Drummond's willow / smallfruited bulrush – bluejoint	S1	Shrubland
Salix drummondiana / Thalictrum Venulosum	Drummond's willow / veiny meadow rue	S1	Shrubland
Saxifraga bronchialis **scree slope sparse vegetation**	**spotted saxifrage scree slope sparse vegetation**	**S2S3 G3?**	**Sparsely Vegetated**
Saxifraga mertensiana **cliff Vegetation**	**Merten's saxifrage cliff vegetation**	**SNR G2G3**	**Herbaceous**
Stipa columbiana - Lupinus sericeus **herbaceous vegetation**	**Columbia needle grass - silky perennial lupine herbaceous vegetation**	**S2S3 G2G3**	**Herbaceous**
Stipa richardsonii – Koeleria macrantha – Antennaria parvifolia	Richardson's needle grass - June grass - small-leaved Everlasting	S2S3	Herbaceous
Vaccinium (myrtillus, scoparium) / Luzula hitchcockii	**low bilberry, grouseberry /smooth wood rush**	**SNR G2G3**	**Dwarf Shrubland**
Vaccinium membranaceum / Xerophyllum tenax	**tall bilberry / bear-grass**	**SU G3?**	***Vaccinium membranaceum***
Xerophyllum tenax herbaceous Vegetation	bear-grass herbaceous vegetation	Herbaceous	*Xerophyllum tenax*

**** Bolded Plant Communities are Globally Ranked**