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PROTECTED AREA REPRESENTATION GAP ANALYSIS
Blue Rock/Sheep River Fine Scale Assessment

Spray Lake Sawmills FMA/B9 Areas

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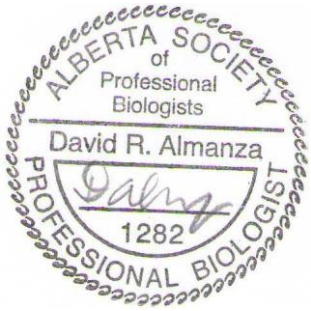

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EXECUTIVE SUMMARY

Spray Lake Sawmills (SLS) retained the services of Birdseye Environmental Ltd. (Birdseye) in May 2016 to conduct an ecological assessment of the Bluerock Sheep River Provincial Parks. The overall purpose of this project was designed to compare site level and sub regional biogeoclimatic conditions in the Sheep River/Blue Rock Provincial Park (currently mapped as being mainly in the Montane Natural Subregion) with Lower Foothills sub regional conditions in the Waiparous Creek, Burnt Timber Creek and Sundre areas.

Thirty-seven percent of the Spray Lake 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. 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. Approximately 329 km^2 of protected lands also occur along the Sheep River and Bow River valleys in what is now mapped as the Montane Natural Subregion (Natural Regions Committee 2006).

Protected areas are abundant in the FMA and region for the Alpine, Subalpine and Montane Subregions. Both Provincial and 12% SLS targets for these three subregions have been met or exceeded. In 2006, the Natural Regions Committee revised the classification of the Bluerock Sheep River Provincial Parks as Montane (was previously mapped as Lower Foothills). This revision created the current deficit of protected areas within Upper and Lower Foothills. The gap in protected lands in the FMA accounts for 66.4 km^2 and 71.7 km^2 respectively (Kansas and Mogilefsky 2013).

Field aspects of the study focused on standardized sampling and comparisons of breeding songbirds and vegetation composition within three common forest cover types (aspen, lodgepole pine and white spruce) sharing the same age, aspect and elevations between local study areas (LSA) located in areas south and north of the Bow River. Field inventories were completed in June 2016 and consisted of Breeding Songbird Point Counts and Plot Level Botanical Surveys completed at identical sites. The desktop component of the study consisted of review and analysis of available sub-regional biogeoclimatic data including vegetation cover, climate, surficial geology, prevailing winds, and topography (slope, aspect and elevation).

A total of 18 sites were surveyed in Lower Foothills and 19 in the Bluerock Sheep River Provincial Parks (Montane). Sample sizes ranged from 5 to 7 per forest cover type. A total of 46 indicated pairs (IP) including 20 different breeding songbird species were detected in Lower Foothills north of the Bow River compared to 62 IP from 25 species in the Bluerock Sheep River Provincial Parks (south of the Bow River). For both LSAs, American robin, golden-crowned kinglet, chipping sparrow, yellow-rumped warbler and red-breasted nuthatch were among the ten most commonly occurring species. Notable discrepancies among the most frequently observed species were white throated sparrow and Lincoln's sparrow which were frequently recorded in the Lower Foothills and less frequently recorded in the Bluerock Sheep River Provincial Parks. Swainson's thrush and Dark-eyed junco were among the most frequently recorded in the Bluerock Sheep River Provincial Parks, but these species were not frequently recorded in Lower Foothills. White throated sparrow, Lincoln's sparrow, Swainson's thrush and dark-eyed junco are commonly occurring species which are not representative of either LSA.
The 37 sites were revisited (after bird surveys) to sample forest stand and understory characteristics. A total of 83 plant species were recorded in Lower Foothills compared to 100

species in the Bluerock Sheep River Provincial Parks. Within Lower Foothills, plant species richness (57 species) was greatest within aspen forest. Lodgepole pine and white spruce forests had 44 and 33 species, respectively. Conversely, 65 plant species were recorded in white spruce forests in the Bluerock Sheep River Provincial Parks. Aspen forests and lodgepole pine forests had total species richness values of 52 and 50, respectively in Lower Foothills.

Results from the field surveys were mixed, however the results generally trend toward functional similarity between the Bluerock Sheep River Provincial Parks and the Lower Foothills Natural Subregion lands north of the Bow River. The desktop analysis also suggests functional similarities between the Bluerock Sheep River Provincial Parks and Lower Foothills Natural Subregions including mean slope and aspect values, climate statistics and surficial geology.

Notwithstanding some notable functional similarities between the Bluerock Sheep River Provincial Parks and Lower Foothills project areas, our assessment indicates that the Bluerock Sheep River Provincial Parks contain biophysical elements that in our opinion deserve closer consideration of a hybrid classification of Montane and Lower Foothills Natural Subregions. We provide some alternative approaches to correct the current deficit of protected areas within Upper and Lower Foothills including prioritizing biological "hotspots" associated with deciduous and riparian forests and designating passive landbase as protected areas.

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1.0 INTRODUCTION

In June of 2016, Spray Lake Sawmills (SLS) commissioned Birdseye Environmental Ltd. (Birdseye) to complete a fine scale biogeoclimatic assessment of the Sheep River/Blue Rock Provincial Park. This assessment was designed to compare biogeoclimatic conditions in the Sheep River/Blue Rock Provincial Park (currently mapped as being mainly in the Montane Natural Subregion) with Lower Foothills subregion biogeoclimatic conditions in the Waiparous Creek, Burnt Timber Creek and Sundre areas (Figure 1).

Field aspects of the study focused on standardized sampling and comparisons of breeding songbirds and vegetation composition within three common forest cover types (aspen, lodgepole pine and white spruce) sharing similar age, aspect and elevations between local study areas (LSA) located in areas south and north of the Bow River.

The desktop component of the study consisted of review and analysis of available biogeoclimatic data including vegetation cover, climate, surficial geology, prevailing winds, and topography (slope, aspect and elevation).

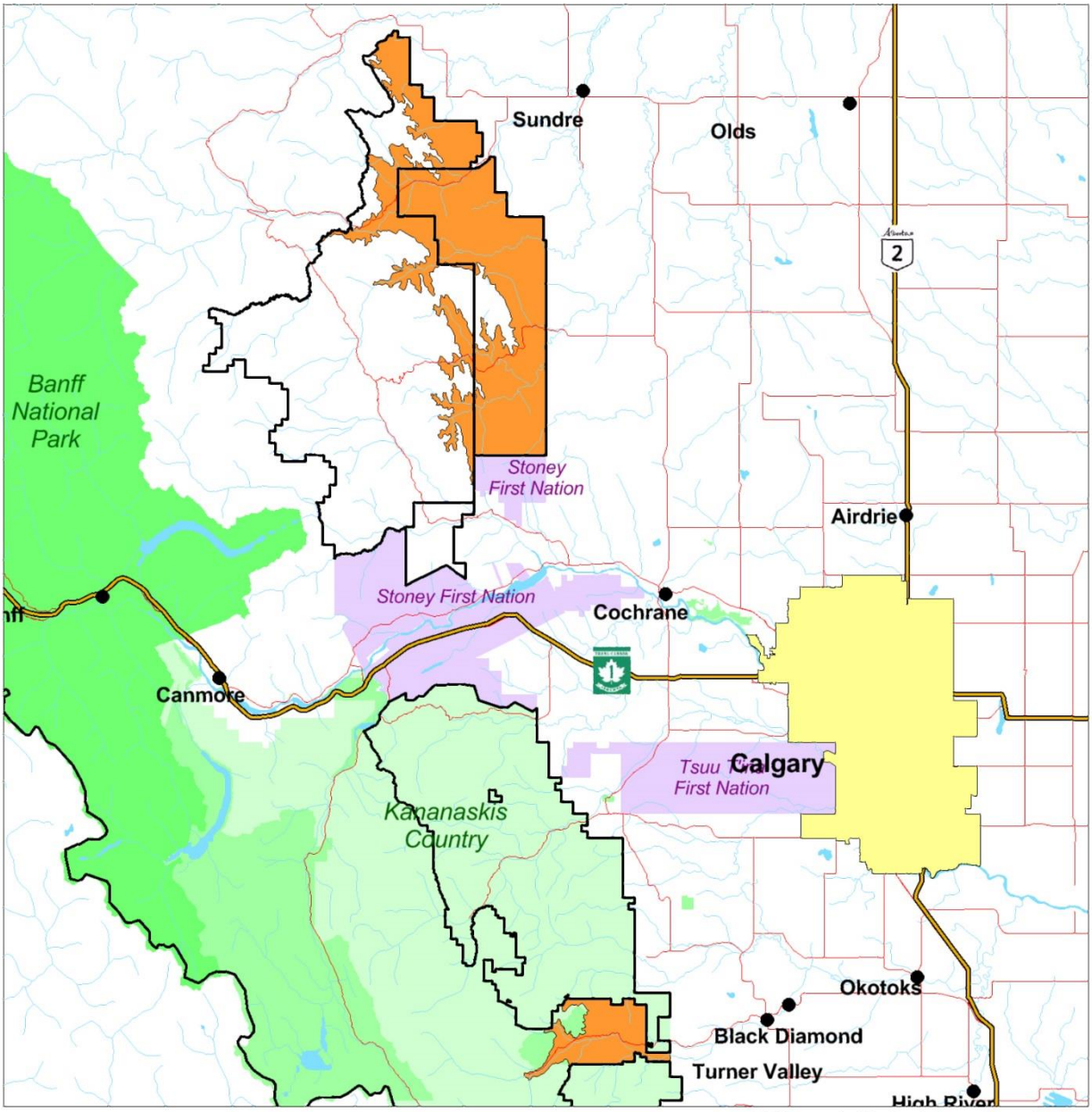
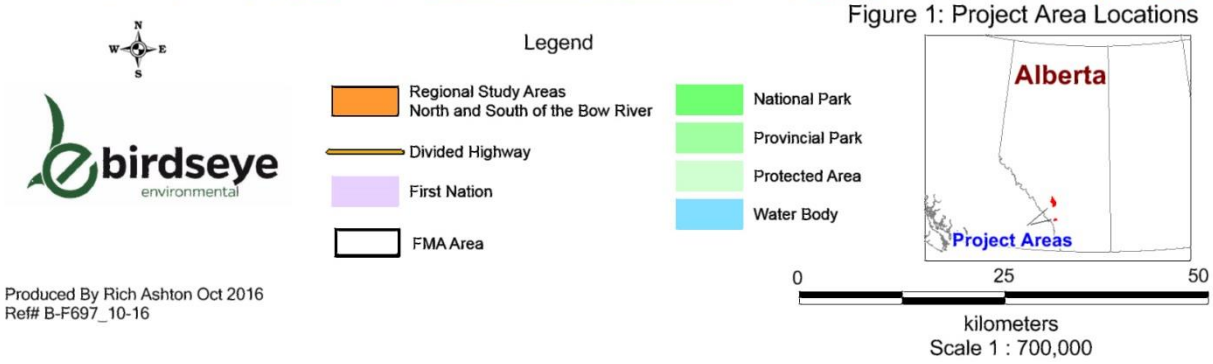


Figure 1: Project Area Locations



birdseye environmental

Produced By Rich Ashton Oct 2016
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2.0 PROJECT BACKGROUND AND OBJECTIVES

2.1 Protected Area Gaps

This report is a follow-up to a July 2013 Protected Area Gap analysis (Kansas and Mogilefsky 2013) completed for the SLS Forest Management Area (FMA)/B9 Quota, as required for Forest Stewardship Council (FSC) certification. The analysis followed standard approaches for representation gap analysis used by the Secretariat for the Convention on Biological Diversity (CBD) and the World Wildlife Fund. The approach compared the distribution of key biodiversity areas with the distribution of protected areas as a means of finding where important elements of biodiversity (i.e. habitat, ecosystems) remained unprotected or under-protected. Alberta Natural Subregions were used as a coarse-filter surrogate for landscape, community and species-level biodiversity in the SLS FMA/B9 Quota area. Compared to a provincial target of 5%, SLS has voluntarily adopted a 12% protection level proportionate to the occurrence of these Subregions in the FMA.

The Spray Lake FMA comprises portions of five Natural Subregions - Montane, Lower Foothills, Upper Foothills, Subalpine and Alpine. Lower elevation lands in the Montane and Lower Foothills Subregions support disproportionately higher levels of vegetation composition, structure and vertebrate wildlife diversity than do the Upper Foothills, Subalpine and Alpine natural regions (Collister and Kansas 2003; Kansas and Kelly 2011). Furthering protection of low elevation habitats and particularly deciduous and mixedwood forests in the FMA was identified as a primary goal of the gap analysis.

Thirty-seven percent of the Spray Lake 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. 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. Approximately 329 km^2 of protected lands also occur along the Sheep River and Bow River valleys in what is now mapped as the Montane Natural Subregion (Natural Regions Committee 2006). Industrial activity does not occur in the provincial parks or wildland provincial parks. Although backcountry recreation is common, these areas are wilderness in nature and offer a level of protection commensurate with Level II of the IUCN classification of protected areas management (IUCN 1994; Dudley and Parish 2006).

Protected areas are abundant in the FMA and region for the Alpine, Subalpine and Montane Subregions. Both Provincial and 12% SLS targets for these three subregions have been met or exceeded. Accepting the 2006 Natural Subregion mapping revisions, and not including the passive land base as apparent protected areas, there remains a gap in protected Lower and Upper Foothills lands in the Spray FMA of 66.4 km^2 and 71.7 km^2 respectively (Kansas and Mogilefsky 2013).

The 2013 gap analysis identified three potential sources for filling Lower Foothills protection gaps in the SLS FMA. These sources have been explored as follows:

1. **Potential source:** The Red Deer River ESA, for formal protection. The Red Deer River portion of nationally significant ESA #20 occurs in the northern portion of the FMA and crosses mainly Lower Foothills lands, with some Upper Foothills. This ESA (or portions thereof) offered strong potential as a protected areas candidate for Foothills habitats

in the FMA. SLS collaborated with interested parties and stakeholders through a formal protection process.

Progress: SLS solicited input from numerous Environmental Non-Governmental Organizations (ENGO) including: The Alberta Wilderness Association, Canadian Parks and Wilderness Society, The Red Deer River Naturalists, and Nature Alberta. SLS heard back from a small group of interested stakeholders including Nature Alberta. Several areas were identified by Nature Alberta, primarily in the passive landbase. These areas warrant further review and will be incorporated into a finer scale passive landbase assessment. Formal protection of the Red Deer River ESA is no longer being explored by Spray Lake Sawmills.

2. **Potential Source**: The passive landbase areas in the FMA designed to meet specific ecological objectives and serve as permanent reserves. The intent is to design portions of the passive and active landbase (with stakeholder input) to contribute to a protected area network beyond the management unit.

   Progress: SLS met with interested stakeholders including the Bow River Basin Council, the Elbow River Watershed Partnership, and the Ghost Watershed Alliance Society. Stakeholders mapped several areas for consideration, primarily located within the passive landbase.

   Stakeholder mapped areas and passive landscape areas will be assessed for suitability to fill gaps. The passive landbase currently has approximately 107 km^2 of Lower Foothills subregion land and 173 km^2 of Upper Foothills subregion land. Selected reserve areas will be identified in the 2018 Forest Management Plan.

3. **Potential Source:** South Saskatchewan Regional Planning Candidate Conservation Management Areas having ecological integrity serving as formal or informal protected areas.

   Progress: The South Saskatchewan Regional Plan was approved by Cabinet on July 23, 2014, and became effective on September 1, 2014. A total of 560 ha were removed from the FMA for protected area designation; however no Foothills subregion areas were added.

2.2 Special Case of the Sheep River/Bluerock Protected Area

SLS participated in the Special Places 2000 Provincial Coordinating committee and fully supported the establishment of The Sheep River Provincial Park and adjacent Bluerock Wildland Provincial Park. The Special Places 2000 committee was the result of the World Wildlife Fund Canada's Endangered Spaces Campaign launched in 1989. The purpose of this campaign was to create protected area networks to maintain biological diversity in Canada.

In 1996, GAIA Environmental Inc. (GAIA) completed a Gap analysis of the Foothills Natural Region for the World Wildlife Fund Canada to be used by the Alberta Special Places Committee, for the purpose of filling ecological gaps in the Foothills Natural Region. That gap analysis (GAIA 1996) focused specifically on identifying gaps within the Foothills Natural Region of Alberta including lands within the SLS timber quota areas. Specific study objectives of the GAIA report included:…."*an assessment of representation of ecological diversity in the Foothills Natural Region, through a gap analysis of enduring features; an evaluation of the*

adequacy of enduring feature representation; and the development of recommendations regarding candidate site boundaries and sizes, and their adequacy in securing long-term conservation of biological diversity in the Foothills Natural Region."

After GAIA reviewed the entire Alberta Foothills Natural Region, including the location of the existing SLS FMA, 14 areas were recommended for formal protection. The Sheep River area, located within the SLS timber quota, was the only area identified meeting the study objectives that was located near the FMA.

Prior to park establishment in 2001, the Sheep River Provincial Park and the Bluerock Wildland Provincial Park were identified in the Provincial Integrated Resource Plan (IRP) as "permanent timber land base". The GAIA report identified 5,045 hectares (50.4 km^2) of land in the former Sheep River Wildlife Sanctuary as a candidate to be included into a regulated protected area. The report also recommended that the boundaries of this candidate area be expanded to include adjacent upland areas. As the Special Places 2000 committee worked toward identifying a regulated protected area candidate, 18,889 hectares (189 km^2) of SLS timber quota areas were voluntarily contributed by SLS and incorporated in to the Sheep River Provincial Park and adjacent Bluerock Wildland Provincial Park. The additional hectares were protected to provide a logical topographic boundary for the parks. In 2001, Ed Kulcsar, representing SLS, received a plaque in recognition from the Minister of Environmental Protection of Alberta for participation and contribution to the provincial protected areas network.

Designation of the Sheep River and Bluerock areas as protected was achieved with the understanding that these two areas were representative of Foothills Natural Region landscapes. In 2006, the government of Alberta changed the ecological classification of approximately 114 km^2 of the Sheep River Provincial Park and Bluerock, Wildland Provincial Parks (originally classified as Foothills Natural Region) to Montane (Natural Regions Committee 2006). Prior to the change in classification, the Spray Lake FMA had a surplus of Foothills Natural region in Protected Areas. Due to the classification change, the FMA area now has a surplus of Montane Natural Region and a deficit of Foothills Natural Region in protected areas.

These protected areas were established to assist in fulfilling Foothills Natural Region protected area targets, but since that time, these two parks were classified almost entirely as being within the Montane Subregion. As recognized by GAIA (1996), and confirmed by Collister and Kansas (2003), the Sheep River/Bluerock area (regardless of Subregion designation) is a hot-spot of ecological diversity, because of the occurrence of lower elevation deciduous, mixedwood and riparian forest cover types (Collister and Kansas 2003). No other portion of the SLS FMA region offers an equivalent combination of ecological diversity, lack of industrial development, and limits to motorized vehicles as does the Sheep/Bluerock protected area. The Conservation Biology Institute (2007) singled out the Sheep River Provincial Park/Bluerock Wildland Park block as being one of only two protected areas larger than 10,000 ha in the Foothills of Alberta and northeast British Columbia. The other was Bearhole Lake Provincial Park (~18,000 ha) which occurs in the province of British Columbia.

2.3 Project Objectives and Approach

Prior to the 2006 change in status of Natural Subregions in the Sheep/Bluerock area, protected areas in the Lower Foothills of the Spray Lake FMA met the 12% protection goal of Special Places 2000. Current Natural Regions/Subregions mapping (Natural Regions Committee 2006) leaves a shortage of Lower Foothills protection and an overage of Montane protection in the context of the Spray Lake FMA.

Given that GAIA (1996) and previous versions of Ecoregions mapping (Strong and Leggat 1981) and Natural Regions/Subregions (Alberta Environmental Protection 1998) classified the Sheep River/Bluerock area as Lower Foothills, the possibility exists that for the purposes of protected area gap analysis, this area is functionally similar to Lower Foothills. The purpose of this assessment is to assess biogeoclimatic differences or similarities between lands currently mapped as Montane in the Sheep/Bluerock area and those lands mapped as Lower Foothills in the portion of the Spray Lake FMA that lies north of the Bow River. A multiple lines of evidence approach is used to test the working hypothesis that there is no functional difference between the elements of biological diversity/importance between these two areas. Biogeoclimatic elements compared include climate, topography (slope, aspect and elevation), surfical geology, vegetation cover, breeding songbird diversity and vascular plant species diversity.

3.0 NATURAL REGION AND SUBREGION DESCRIPTIONS

In 2006 the Natural Regions Committee recognized six distinct Natural Regions in Alberta. These include the Rocky Mountain, Foothills, Grassland, Parkland, Boreal Forest and Canadian Shield Natural Regions. These regions are typically established geographically depending on vegetation, soils and physiographic features. The interacting effects of climate, wind, topography and geology also help distinguish these regions. The degree to which climate, physiography, vegetation and soils define a particular Natural Region depends on its geographic location. Soils and climate tend to be most important characteristics in the southeastern plains while elevation, topography and vegetation are most important along the foothills and mountains (Natural Regions Committee 2006). Table 1 (below) outlines the Natural Regions and Sub-regions in Alberta.

Table 1. Natural Regions and Subregions of Alberta

Natural Region	Natural Subregion
Rocky Mountain	Alpine
	Subalpine
	Montane
Foothills	Upper Foothills
	Lower Foothills
Grassland	Dry Mixedgrass
	Mixedgrass
	Northern Fescue
	Foothills Fescue
Parkland	Foothills Parkland
	Central Parkland
	Peace River Parkland
Boreal Forest	Dry Mixedwood
	Central Mixedwood
	Lower Boreal Highlands
	Upper Boreal Highlands
	Athabasca Plain
	Peace-Athabasca Delta
	Northern Mixedwood
	Boreal Subarctic
Canadian Shield	Kazan Upland

Below we provide a general characterization of the Rocky Mountain and Foothills Natural Regions that characterize the Spray Lake FMA, with specific emphasis on the *Montane* and *Lower Foothills* Natural Subregions. Figure 2 illustrates the Natural subregion occurrence in each RSA.

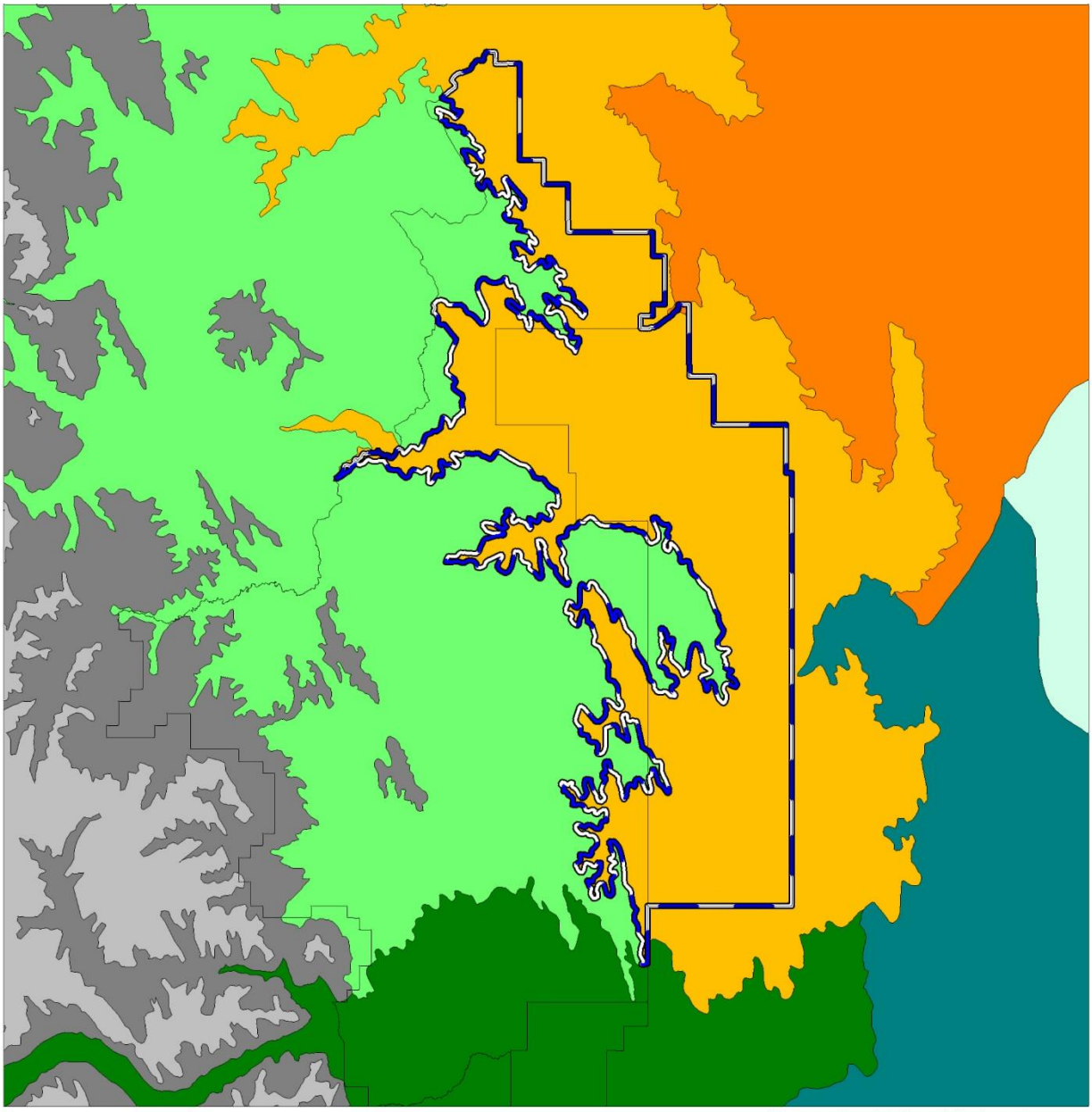

Figure 2a. Natural Subregions - North of the Bow River Regional Study Area

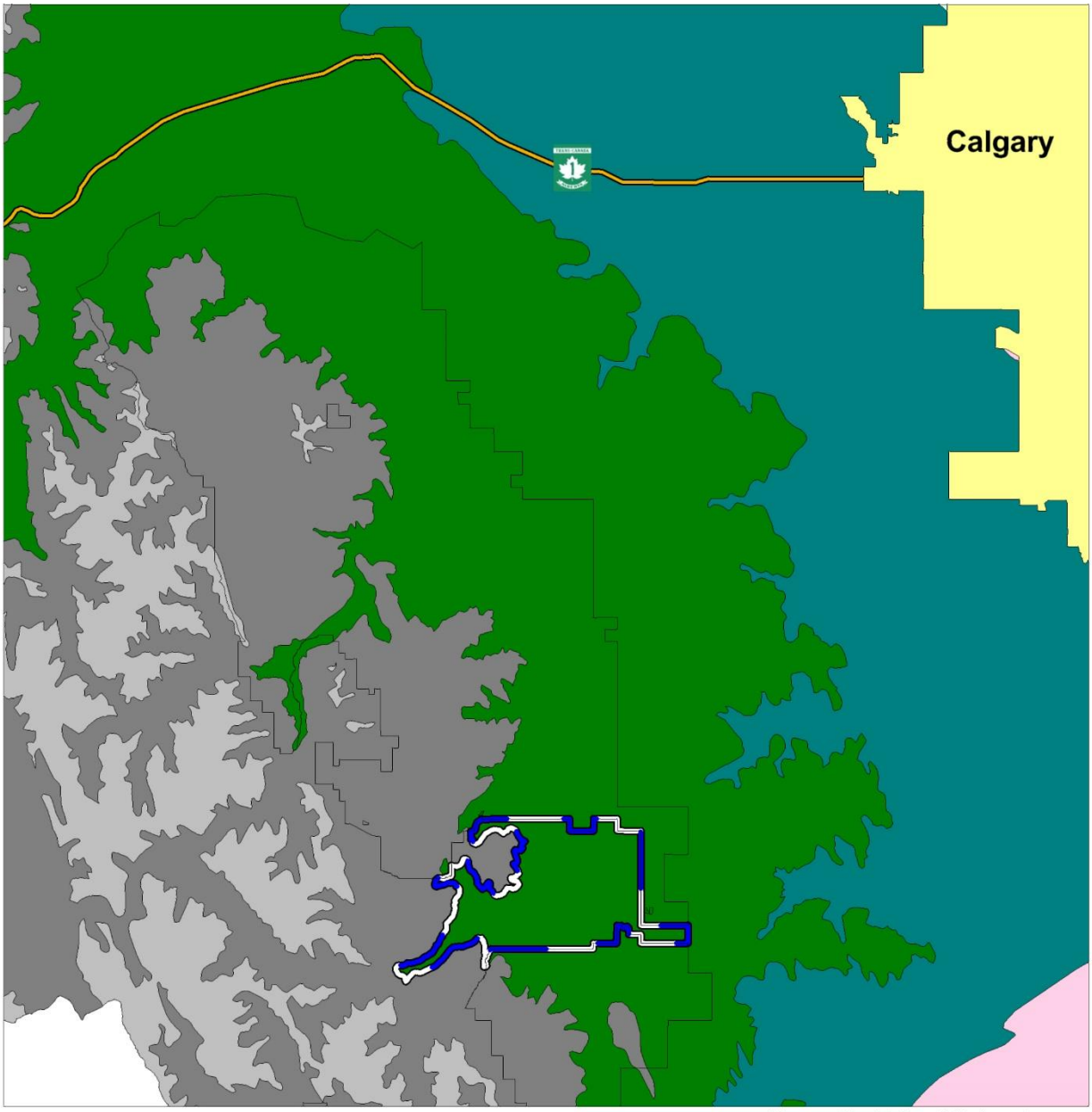

Figure 2b. Natural Subregions - South of the Bow River Regional Study Area

Legend

Natural Subregions

- Alpine
- Subalpine
- Montane
- Upper Foothills
- Lower Foothills
- Dry Mixedwood
- Foothills Parkland
- Foothills Fescue
- Central Parkland

- Regional Study Area
- Divided Highways
- FMA Area

0 12.5 25

kilometers

Scale 1 : 350,000

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3.1 Rocky Mountain Natural Region

The Rocky Mountain Natural Region is sub divided into three distinct subregions including Alpine, Subalpine and Montane. The Rocky Mountain Natural Region has the largest elevation variations of all natural regions (range of from 825 meters to 3600 meters). Slope angles are less pronounced in the Subalpine and Montane subregions compared to the Alpine.

Climate

Of any region in Alberta, the Rocky Mountain Natural Region has on average the coolest summers, shortest growing season, highest mean annual precipitation and snowiest winters. Climates are generally highly variable considering the lower elevation Montane subregion has less precipitation than the Alpine and Subalpine Natural Subregions, and has milder winters than most other Natural Subregions.

Vegetation

The vegetation cover of Subregions within this natural region are effected strongly by climate, elevation, aspect and geological substrate. Complex vegetation and soil types within the Rocky Mountain Natural Region reflect this influence. The Montane Natural Subregion is composed of grasslands, deciduous and coniferous forests on southerly and westerly aspects. Coniferous forests dominate northerly aspects particularly at higher elevations.

Topography, Geology and Soils

Alpine and Subalpine sub regions share similar bedrock characteristics including Paleozoic and Mesozoic aged stone. Often these bedrock materials are exposed along steep slopes. Bedrock exposures within the montane subregion are composed of glacial till deposits, fluvial deposits along river valleys, and occasionally highly calcareous wind deposited materials. Cretaceous and Tertiary sedimentary rocks underlie the Montane Natural Subregion.

Soil regimes are vastly different between subregions of this natural region. Soil development is limiting within alpine and to a lesser extent subalpine areas. The soils of the Montane Natural Subregion are characterized generally by Chernozemic soils under grasslands and Luvisols under coniferous stands.

Hydrology

Glaciers, lakes and rivers account for about 4% of the Alpine Natural Subregion; rivers and small lakes account for 2-3% of the Subalpine and Montane Natural Subregions.

Wildlife Habitats and Populations

Due to the diverse composition of elevations and habitat types, the Rocky Mountain Natural Region supports a relatively diverse assemblage of wildlife. This is particularly true at lower elevations of the natural region (Montane). The Montane Natural Subregion has a number of unique habitats and wildlife species assemblages. The most unique habitats contain some component of Douglas fir, limber pine, mixedwoods and riparian areas.

3.1.1 Montane Natural Subregion

The Montane Natural Subregion occurs in several areas of Alberta including along the Front Ranges of the Rocky Mountains from just north of the Bow Valley to the Alberta–Montana border and the Cypress Hills in southeastern Alberta.

South of the Bow River, this subregion consolidates with the Foothills Fescue and Foothills Parkland Natural Subregions. This consolidation is in part contributed to by similar climates, vegetation and soils along these interfaces. In areas north of the Bow River the Montane subregion borders the Upper and Lower Foothills Natural Subregions. This is the driest and warmest of the three Natural Subregions in the Rocky Mountain Natural Region, and regional and local climatic influences produce a highly diverse array of plant communities and soil types that change rapidly over very short distances.

Climate

The Montane subregion generally has mild summers with high precipitation and warm winters with frequent Chinook wind events. Variable topography, slope angle and slope aspects produce unique microclimates on north-east and south-west facing slopes.

Vegetation

Well defined vegetation patterns result from topographically based microclimates. Plant species distribution patterns in the Montane, along with significant regional variations in landscapes, suggest a division into three districts defined by topography and latitude:

- southern foothills and plains district;
- southern and central mountain valley district (Sheep River and Bluerock Provincial Parks), and;
- northern mountain valley district.

The southern foothills and plains district includes lower-elevation areas along the Front Ranges, mainly south of the Bow River Corridor. Vegetation common to rocky ridgetops and upper slopes in the south-central foothills and plains district may include limber pine, Douglas fir, ground juniper, bearberry and mountain rough fescue. Lower elevations may include grasslands dominated by bluebunch wheatgrass, mountain rough fescue and sedge. Open forest canopies are usually comprised of lodgepole pine, Douglas fir, aspen, and white spruce either as pure or mixed stands. Common understory composition includes bearberry, Canada buffaloberry, hairy wild rye, pine reed grass and forbs. Moister sites support Douglas fir, aspen, lodgepole pine and white spruce stands.

Lodgepole pine forests dominate high elevations however mixedwood and Douglas fir forests may also occur particularly in the southern foothills and southern and central mountain valley districts. White spruce and Engelmann spruce hybridize, and subalpine fir is occasional. Green alder, white meadowsweet, a variety of forbs and feathermosses are typical understory species.

Topography, Geology and Soils

Soils are generally medium to fine textured Brunisols and Luvisols, with some Chernozems occurring at the lowest elevations. The wettest sites contain poorly drained Organic and Gleysolic soils. The Montane subregion is composed of non-marine Cretaceous sandstones,

siltstones and shales. Surficial materials in the foothills are mainly medium textured, weakly calcareous tills. River valleys can be fluvial and glaciofluvial sands and gravels which often form undulating terraces on valley bottoms. Till and colluvial deposits of variable textures occur on lower slopes.

Hydrology

Approximately three percent of the Montane Natural Subregion is occupied by water. Wetlands are rare but fens and marshes do occupy approximately two percent of the total area.

Land Uses

The Montane Natural Subregion provides important wildlife habitat, recreational opportunities and livestock grazing. Urban development is also occurring at a rapid pace in some areas. Timber harvesting, mining and ranching occurs throughout the Natural Subregion. Three main transportation corridors (the Yellowhead, Trans- Canada and Crowsnest highways) occupy valley bottoms in this sub region.

4.2 Foothills Natural Region

The Foothills Natural Region includes the Lower and Upper Foothills Natural Subregions. This natural region occurs along the east side of the Rocky Mountains from the Bow River to south of Grande Prairie. Included within this natural region are the Swan Hills, Pelican Mountain and Saddle Hills north of Grande Prairie.

Topography ranges from sharp ridges near the mountains to rolling and undulating terrain in the north and east. Elevation ranges from 700 m in the north to 1700 m in the south. Mixed forests of aspen, lodgepole pine, white spruce and balsam poplar occur on Gray Luvisolic soils at lower elevations while Lodgepole pine forests with less diverse understories and well developed feathermoss layers on Brunisolic Gray Luvisols are typical of higher elevations.

Climate

The upper and lower foothills receive relatively high annual precipitation. Only the Alpine and Subalpine Natural Subregions are wetter. Average July precipitation is higher in the Lower and Upper Foothills Natural Subregions than in any others. The Lower Foothills Natural Subregion generally has warmer summers and colder winters than the Upper Foothills Natural Subregion. The growing season is longer and total precipitation is lower especially in the winter months.

Vegetation

Upland forests within the Lower Foothills Natural Subregion are typically deciduous or mixedwood with aspen, balsam poplar, white birch, lodgepole pine, white spruce and black spruce. Wetlands are mainly vegetated by stunted black spruce and tamarack or shrub-graminoid communities. The transition between the Lower and Upper Foothills Natural Subregions is well defined with a change of deciduous or deciduous dominated forests to conifer-dominated forests.

Topography, Geology and Soils

Medium textured glacial tills overlay sandstone and mudstone bedrock strata within the Foothills Natural Region. Colluvial and residual deposits occur with steep slopes and exposed bedrock while fluvial materials line stream systems. Low elevation soils are mainly Orthic Gray Luvisols particularly in upland areas. Brunisolic Gray Luvisols occur at higher elevations. Seepage is common in lower slope positions leading to Gleysols and Organic (mainly Mesisolic) soils.

Hydrology

Less than 1 percent of the Foothills Natural Region is covered with water. Wetlands do occur in the Foothills Natural Region but they are less common in the Upper Foothills.

Wildlife Habitat

Variable topography, surface hydrology and groundwater creates high habitat diversity in this subregion. The transitional position of the Foothills Natural Region contributes to a relatively high diversity of animal species. Highly diverse wildlife communities overlap areas of moist deciduous forests, mainly in the eastern and southern parts of the Lower Foothills Natural Subregion. Localized areas of lush deciduous growth are of special significance for songbird and mammal diversity. These areas are usually located in sloping or valley bottom areas receiving higher precipitation and/or nutrient-rich groundwater discharge. Slumping on unstable slopes further contributes to habitat diversity. Wetlands and lakes provide additional habitat diversity. In the south and east portions of the Natural Region, wetland habitats are more diverse and richer in species diversity.

4.2.1 Lower Foothills Natural Subregion

The Lower Foothills Natural Subregion is located between the Bow River Valley and Grande Prairie. The Swan Hills, Pelican Mountains and Saddle Hills are also classified as lower foothills. Elevation ranges from 700 to 800 m in the north and east to over 1500 m in the south and west. A transition between cold, dry continental climates and milder, moister Cordilleran climates is present in the Lower Foothills. Compared to the Upper Foothills, a decrease in both annual and winter precipitation and an increase in growing degree-days are common in the lower foothills. This subregion occurs at the westernmost extent of the Interior Plains where undulating till-covered landscapes are present.

Climate

Precipitation in the Lower Foothills is higher than adjacent Natural Subregions. Moisture levels are able to support lodgepole pine as pure stands or as mixedwood stands. High mesic areas overlapping groundwater supports productive and species-rich forests. Compared to the Upper Foothills, the Lower Foothills Natural Subregion has a longer growing season and less winter precipitation.

Vegetation

The Lower Foothills Natural Subregion is considered to support the most diverse forests in Alberta. Aspen, balsam poplar, white birch, lodgepole pine, black spruce, white spruce, balsam fir and tamarack grow as pure stands or mixedwoods. Generally, deciduous stands

are more common at lower elevations, shrubby grasslands occur on the driest sites and fens occur on low, wet sites.

The lower boundary of the Lower Foothills Natural Subregion is marked by the occurrence of lodgepole pine stands on sites of average moisture and nutrient status. The upper boundary of the Lower Foothills Natural Subregion is typically identified by the restriction of pure deciduous stands to mainly southerly and westerly aspects. The diverse array of sites created by changes in latitude, elevation, and aspect and parent material creates a correspondingly high diversity in both community types and species composition.

North of the North Saskatchewan River, mesic forest stands have a greater abundance of black spruce and common Labrador tea. On the driest sites, bearberry, common juniper and hairy wild rye form open communities. Slightly moister sites typically support pure or mixed aspen, lodgepole pine and white spruce stands with an understory of bearberry and hairy wild rye. Mesic sites also support pure or mixed stands of these tree species, but are more species rich. Nutrient-poor mesic to very moist sites have an overstory of lodgepole pine and black spruce (the latter dominant on wetter areas), and a species-poor understory dominated by feathermosses with variable cover of common Labrador tea, bog cranberry, and common blueberry. Black and white spruce occur in pure or mixed stands and tamarack as a tertiary canopy species. The wettest areas may contain shrubby or sedge fens.

Geology and Geomorphology

The Lower Foothills Natural Subregion is characterized by undulating to strongly rolling dissected plateaus. Southern areas are dominated with sandstones and siltstones of Tertiary origin while the north has cretaceous sandstones. Medium textured calcareous glacial till comprise the surficial materials on sloped lands. Textures change to gravels at higher elevations. Bedrock exposures can occur in the steep landscapes.

Water and Wetlands

Excluding the Brazeau Reservoir, significant standing water is limiting within the Lower Foothills Natural Sub region. Hydrology in the form of major streams or river do occur. Seepage areas replace wetlands in areas of significant slope. On more level terrain, wetlands are present and can account for 15 to 40 percent of the landscape. Wetlands are dominated with fens and bogs.

Soils

Orthic Gray Luvisolic and Brunisolic subgroups make up the majority of soil types in this sub region. Most upland soils in these materials are well to imperfectly drained. Poorly drained sites often contain Gleysolic soils while fen areas are mainly Mesisols.

Land Uses

The Lower Foothills subregion is highly developed by industrial and agricultural activities. Uses range from timber harvest, coal mining, ranching, farming and oil and gas. Much of these activities are constrained to lower elevations however oil and gas activity has left a network of legacy seismic lines which the public utilize for recreational purposes.

4.0 SPECIES-LEVEL BIODIVERSITY COMPARISON OF THE LOWER FOOTHILLS AND MONTANE NATURAL SUBREGIONS

4.1 Methods

Two local study areas (LSA) were selected between which songbird and plant species diversity metrics were compared. The LSA south of the Bow River (SOB LSA) included areas currently mapped as Montane within the Sheep River/Bluerock Provincial Park and Wildland Provincial Park (Figure 4). The LSA north of the Bow River (NOB) included the Ghost River and Sundre areas classified as Lower Foothills (Figure 3). These LSAs are herein referred to as SOB LSA and NOB LSA and occurred within similar ranges of elevation. Sampling was stratified by forest cover type including pure stands of lodgepole pine, trembling aspen and white spruce. Identical locations were surveyed for the breeding songbird and vegetation field programs. Handheld Garmin GPS units were used to navigate between sites. Flagging ribbon was placed in the middle of each plot.

In addition to a general results summary, the Shannon-Wiener Diversity index was used to quantify the level of diversity among species for both the breeding songbird and vegetation surveys. Species richness (S) is a measure of the number of species occurring in a given habitat. However the evenness of distribution of those species among all habitats will not affect the richness and as a result true diversity for each habitat is unknown if only simple richness is assessed. For example, a forest cover type with one American robin and one yellow-rumped warbler compared with another with one American robin and ten yellow-rumped warbler will have the same species richness but different species evenness. A mathematical approach for incorporating the evenness of diversity of species distribution can be achieved using the Shannon-Wiener Diversity Index (H) and an evenness coefficient. The Shannon Wiener calculation is detailed below:

$$H = \sum_{i=1}^{s} - (P_i * \ln P_i)$$

where:

H = the Shannon diversity index
Pi = fraction of the entire population made up of species i
S = numbers of species encountered
∑ = sum from species 1 to species S

Evenness (E) is then calculated using (H) and the natural logarithm of (S). Evenness values will range from 0-1 where variation in species decreases as values near 1 (complete evenness).

$$E = H/\ln (S)$$

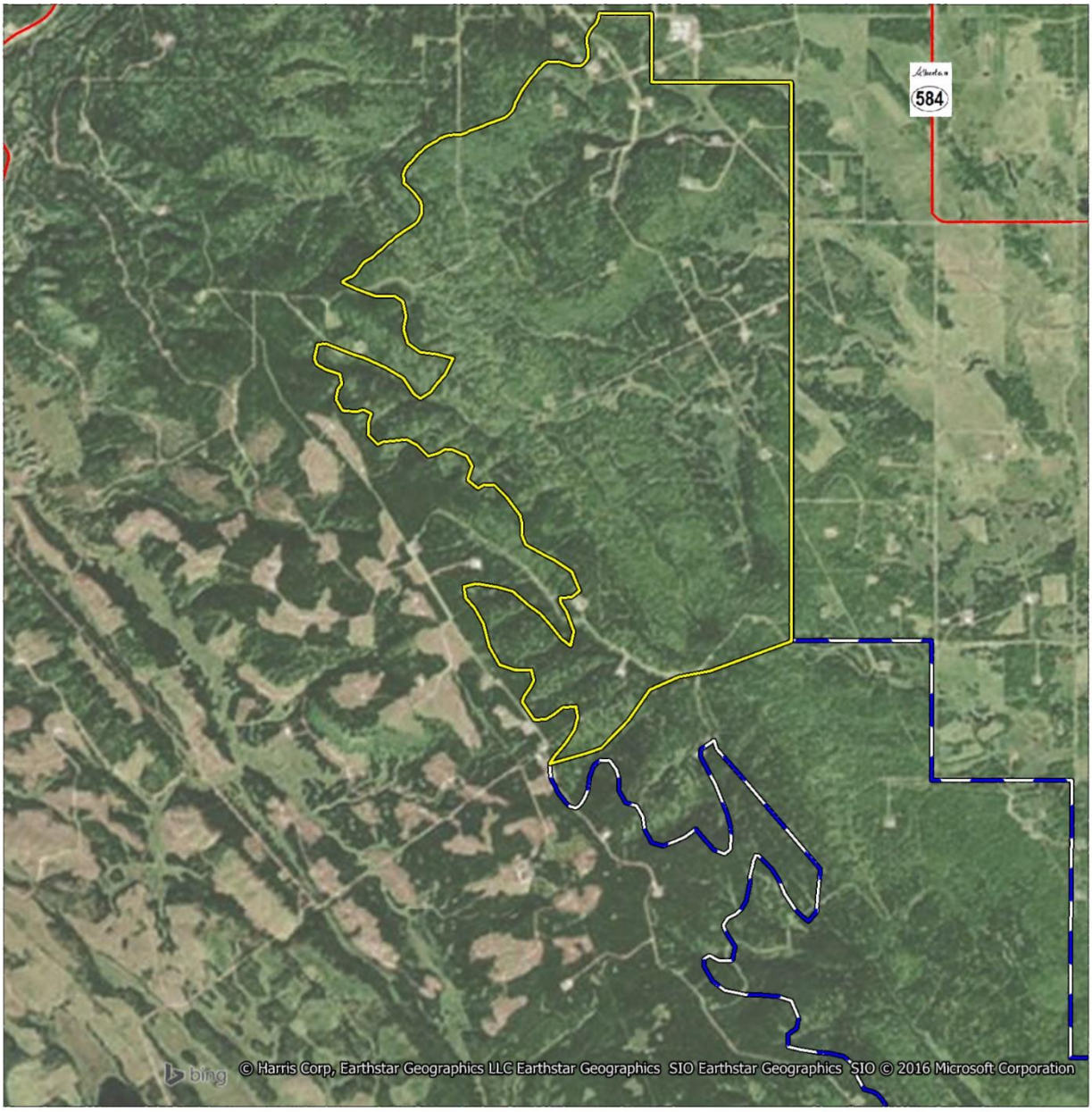
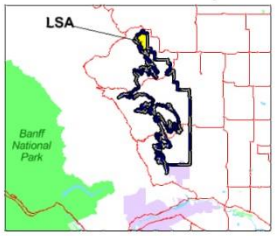


Figure 3. North of the Bow Local Study Area

birdseye environmental

Legend

- North of the Bow Regional Study Area (RSA)
- North of the Bow Local Study Area (LSA)
- Provincial Highway



0 1 2
kilometers
Scale 1 : 60,000

Produced By Rich Ashton Oct 2016
Ref# B-F697_10-16

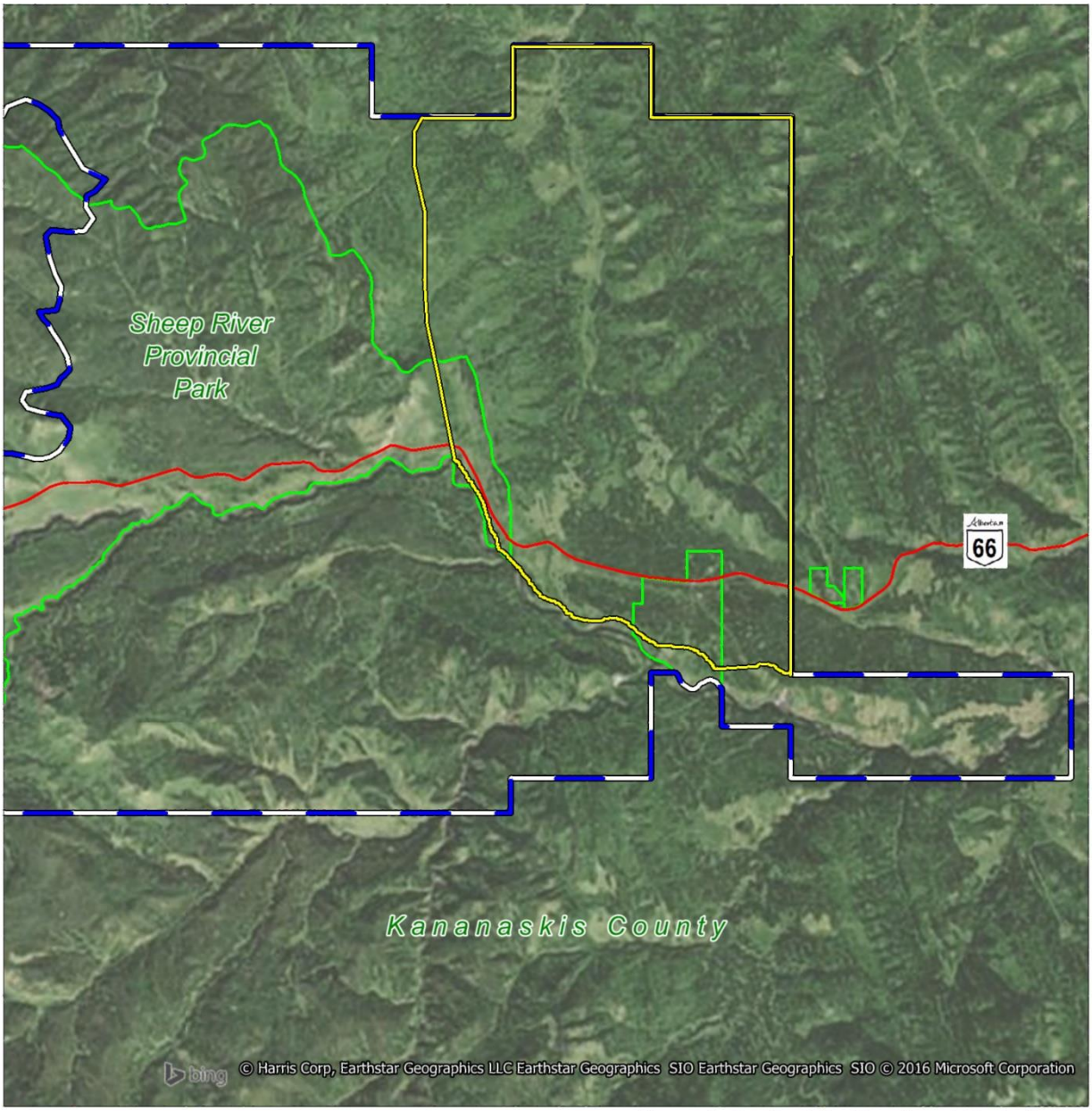


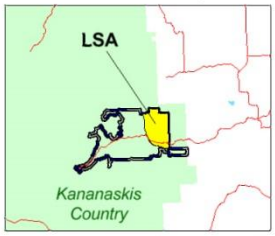
Figure 4. South of the Bow Local Study Area

birdseye environmental

Produced By Rich Ashton Oct 2016
Ref# B-F697_10-16

Legend

- North of the Bow Regional Study Area (RSA)
- North of the Bow Local Study Area (LSA)
- Provincial Highway
- Provincial Park



0 1 2
kilometers
Scale 1 : 60,000

4.1.1 Breeding Songbird Surveys

A breeding songbird survey was undertaken to document both the diversity and abundance of breeding songbirds within the LSAs. Auditory point counts (PCs) were established within representative habitat types. PCs were located a minimum distance of 100m from any anthropogenic feature. PCs were surveyed between approximately 04:00 and 09:00 hours. Each PC consisted of a 2-minute calming period followed by a 5-minute detection period. Surveys were completed under low wind conditions with no significant precipitation. All birds seen and heard within the 100m radius plot were recorded to species. Species detected outside of the survey plot were also recorded. Simple weather data (temperature, sky condition, wind) were recorded at the beginning and end of each transect. Birding data was summarized by three broad forest cover types including aspen forest, lodgepole pine forest and white spruce forest.

4.1.2 Vegetation Composition Surveys

Each site was located using a handheld GPS. A 10x10m square plot was marked using a measuring tape. All observed layers including trees, shrubs, herbaceous and moss/lichen were identified in each plot to the closest estimated cover percentage. A cover estimate was then assigned to each plant species in the plot, by layer. Specific plot variables such as tree species, tree dbh, tree height, canopy composition and canopy closure were estimated at each plot. Additional information collected included:

- moisture and nutrient regime;
- slope;
- aspect; and,
- elevation.

A small soil pit was excavated immediately outside plot centre in order to obtain information on soil texture and horizon depths. Upon completion of the survey, the soil pit was filled in and re-covered with the vegetation that was removed. Representative photos at each plot location were captured which detailed each cardinal direction, ground cover and canopy.

4.2 Results

4.2.1 Breeding Songbird Surveys

The breeding songbird point-count surveys were completed to obtain comparative information relating to breeding avifauna between Montane and Lower Foothills LSAs. Information gathered included presence/absence, relative abundance and detection of species at risk. The breeding songbird call survey was completed between June 21st and 30th, 2016.

A total of 18 sites were surveyed in the NOB LSA and 19 in the SOB LSA (Figures 5 and 6). Sample sizes ranged from 5 to 7 per forest cover type. A total of 46 indicated pairs (IP) including 20 different songbird species were detected in the NOB LSA compared to 62 IP from 25 species in the SOB LSA. The ten most abundant species in each LSA are presented in Tables 2 and 3. For both LSAs, American robin, golden-crowned kinglet, chipping sparrow, yellow-rumped warbler and red-breasted nuthatch were among the ten most commonly occurring species. Notable discrepancies among the most frequently observed species were

white throated sparrow and Lincoln's sparrow which were frequently recorded in the NOB LSA and less frequently recorded in the SOB LSA. Swainson's thrush and Dark-eyed junco were among the most frequently recorded in the SOB LSA, but these species were not frequently recorded in the NOB LSA. White throated sparrow, Lincoln's sparrow, Swainson's thrush and dark-eyed junco are commonly occurring species which are not representative of either RSA.

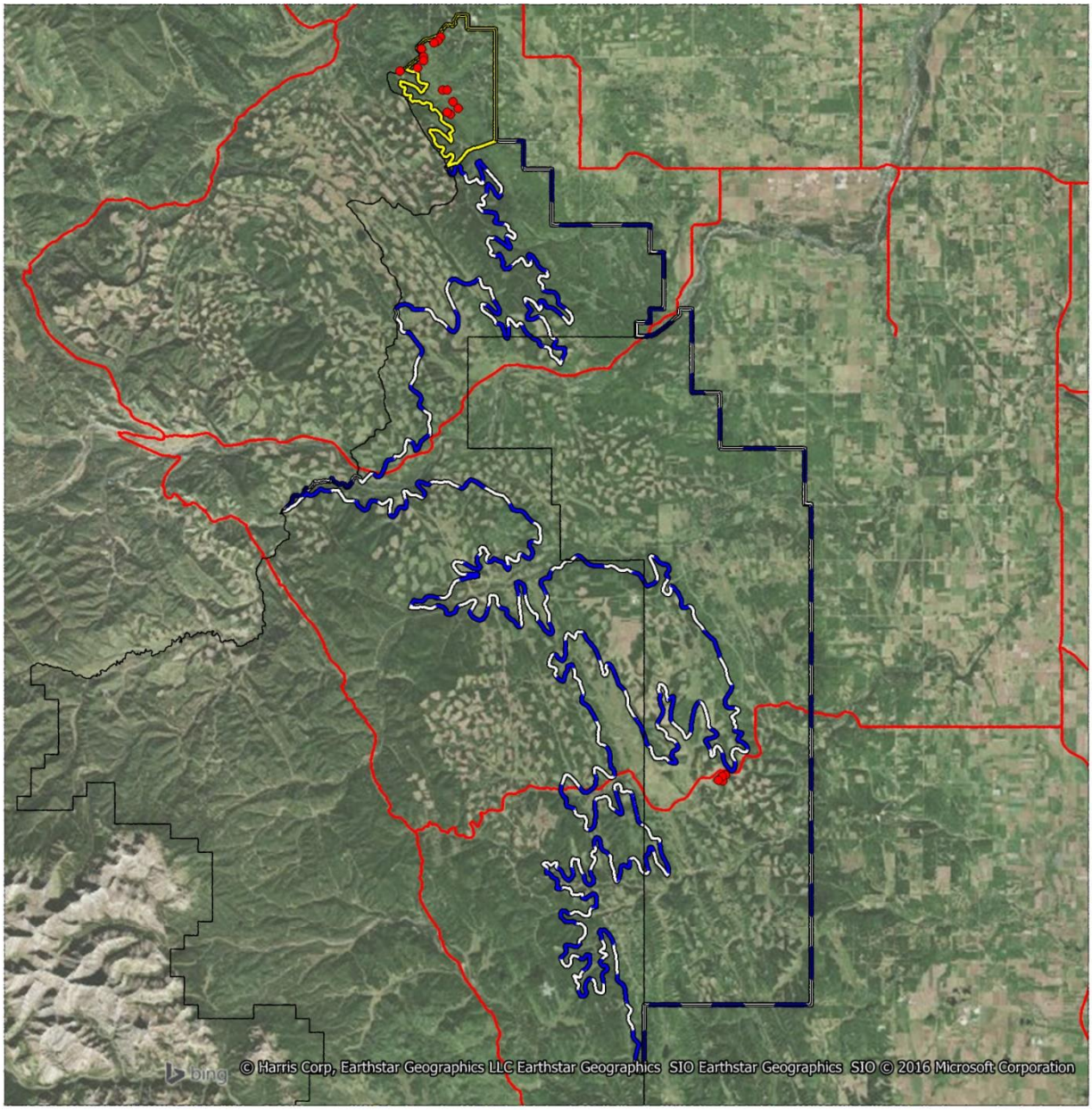


Figure 5. Survey Plot Locations of the Project Area - North of the Bow Regional Study Area

N
W E
S

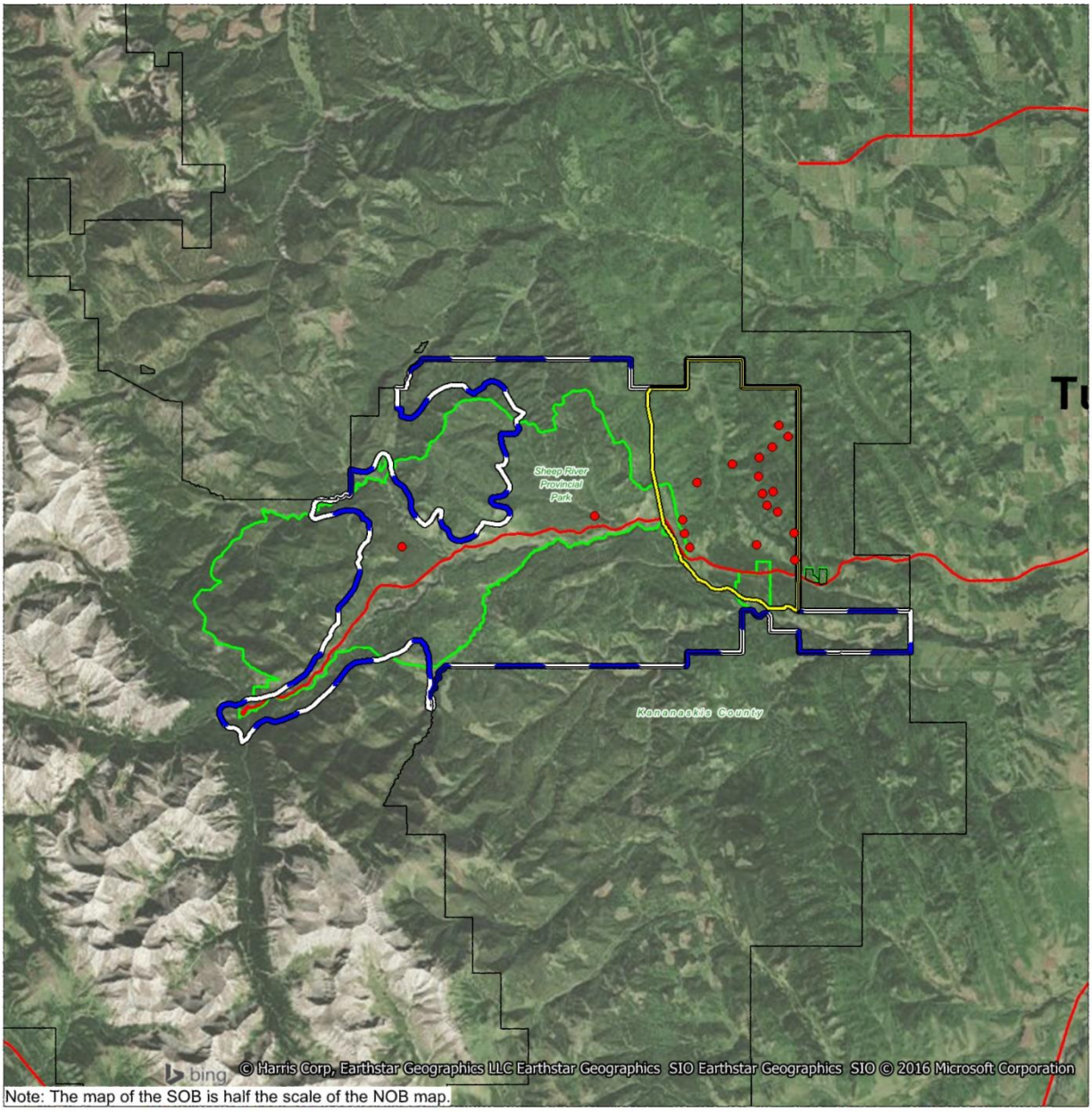
birdseye environmental

Legend

- Survey Location
- North of the Bow Regional Study Area
- North of the Bow Local Study Area
- Provincial Highway
- FMA Area

0 5 10
kilometers
Scale 1 : 300,000

Produced By Rich Ashton Oct 2016
Ref# B-F697_10-16



Note: The map of the SOB is half the scale of the NOB map.

Figure 6. Survey Plot Locations of the Project Area - South of the Bow Regional Study Area

Legend

- Survey Location
- South of the Bow Regional Study Area
- South of the Bow Local Study Area
- Provincial Highway
- Provincial Park
- FMA Area

0 2.5 5

kilometers

Scale 1 : 150,000

Produced By Rich Ashton Oct 2016
Ref# B-F697_10-16

Table 2. Bird Species Detected During the Breeding Songbird Surveys - North of the Bow River

Alphabetical Order			Descending Abundance	
Common Name	**Scientific Name**	**Pairs**	**Common Name**	**Pairs**
American Robin	*Turdus migratorius*	2	**White-throated Sparrow**	**9**
Black-capped Chickadee	*Poecile atricapillus*	1	**Lincoln's Sparrow**	**5**
Chipping Sparrow	*Spizella passerina*	2	**Red-breasted Nuthatch**	**4**
Dark-eyed Junco	*Junco hyemalis*	1	**Ruby-crowned Kinglet**	**3**
Fox Sparrow	*Passerella iliaca*	1	**American Robin**	**2**
Golden-crowned Kinglet	*Regulus satrapa*	2	**Chipping Sparrow**	**2**
Gray Jay	*Perisoreus canadensis*	2	**Golden-crowned Kinglet**	**2**
House Wren	*Troglodytes aedon*	1	**Gray Jay**	**2**
Least flycatcher*	*Empidonax minimus*	2	**Least flycatcher**	**2**
Lincoln's Sparrow	*Melospiza lincolnii*	5	**MacGillivray's Warbler**	**2**
MacGillivray's Warbler	*Oporornis tolmiei*	2	**Varied Thrush**	**2**
Red-breasted Nuthatch	*Sitta canadensis*	4	**Warbling Vireo**	**2**
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	1	**Yellow-rumped Warbler**	**2**
Ruby-crowned Kinglet	*Regulus calendula*	3	Black-capped Chickadee	1
Sandhill Crane	*Grus canadensis*	1	Dark-eyed Junco	1
Swainson's Thrush	*Catharus ustulatus*	1	Fox Sparrow	1
Varied Thrush	*Ixoreus naevius*	2	House Wren	1
Warbling Vireo	*Vireo gilvus*	2	Rose-breasted Grosbeak	1
White-throated Sparrow	*Zonotrichia albicollis*	9	Sandhill Crane	1
Yellow-rumped Warbler	*Dendroica coronata*	2	Swainson's Thrush	1

**Vertebrate Species at Risk*

Table 3. Bird Species Detected During the Breeding Songbird Surveys - South of the Bow River

Alphabetical Order			Descending Abundance	
Common Name	**Scientific Name**	**Pairs**	**Common Name**	**Pairs**
American Robin	*Turdus migratorius*	10	**American Robin**	**10**
Black-capped Chickadee	*Poecile atricapillus*	5	**Swainson's Thrush**	**8**
Brown Creeper	*Certhia americana*	1	**Black-capped Chickadee**	**5**
Clay-colored Sparrow	*Spizella pallida*	1	**Dark-eyed Junco**	**4**
Cedar Waxwing	*Bombycilla cedrorum*	2	**House Wren**	**4**
Chipping Sparrow	*Spizella passerina*	3	**Chipping Sparrow**	**3**
Dark-eyed Junco	*Junco hyemalis*	4	**Red-breasted Nuthatch**	**3**
Euopean Starling	*Sturnus vulgaris*	2	**Cedar Waxwing**	**2**
Golden-crowned Kinglet	*Regulus satrapa*	2	**Euopean Starling**	**2**
House Wren	*Troglodytes aedon*	4	**Golden-crowned Kinglet**	**2**
Lincoln's Sparrow	*Melospiza lincolnii*	1	**Olive-sided Flycatcher**	**2**
MacGillivray's Warbler	*Oporornis tolmiei*	1	**Orange-crowned Warbler**	**2**
Olive-sided Flycatcher*	*Contopus cooperi*	2	**Wilson's Warbler**	**2**
Orange-crowned Warbler	*Vermivora celata*	2	**Yellow-rumped Warbler**	**2**
Pine Siskin	*Carduelis pinus*	1	Brown Creeper	1
Purple Finch	*Carpodacus purpureus*	1	Clay-colored Sparrow	1
Red-breasted Nuthatch	*Sitta canadensis*	3	Lincoln's Sparrow	1
Ruby-crowned Kinglet	*Regulus calendula*	1	MacGillivray's Warbler	1
Swainson's Thrush	*Catharus ustulatus*	8	Pine Siskin	1
Townsends Solitaire	*Myadestes townsendi*	1	Purple Finch	1
Warbling Vireo	*Vireo gilvus*	1	Ruby-crowned Kinglet	1
Western Kingbird	*Tyrannus verticalis*	1	Townsends Solitaire	1
White-throated Sparrow	*Zonotrichia albicollis*	1	Warbling Vireo	1
Wilson's Warbler	*Wilsonia pusilla*	2	Western Kingbird	1
Yellow-rumped Warbler	*Dendroica coronata*	2	White-throated Sparrow	1

**Vertebrate Species at Risk*

Tables 4 and 5 summarize the mean number of indicated pairs per species by vegetation cover type for samples north and south of the Bow River, respectively. In general, the higher the mean number of indicated pairs, the more important a forest cover type is to a particular species. Variability in sample size (although relatively low) should be kept in mind when comparing results across AVI polygons. With the exception of lodgepole pine forests, mean indicated pairs were greater within all forest cover types in the SOB LSA. Overall mean indicated pairs were also greater in the SOB LSA compared to the NOB LSA (Tables 4 and 5).

Table 4. Mean Pairs of Breeding Songbirds Detected by Forest Cover Type - North of the Bow River

Species	Total	Forest Cover Type and Sample Size		
		Aw	Pl	Sw
	18	7	6	5
	Mean Pairs			
American Robin	0.11	0.14	0.00	0.20
Black-capped Chickadee	0.06	0.00	0.17	0.00
Brown Creeper	0.00	0.00	0.00	0.00
Clay-colored Sparrow	0.00	0.00	0.00	0.00
Cedar Waxwing	0.00	0.00	0.00	0.00
Chipping Sparrow	0.11	0.00	0.33	0.00
Dark-eyed Junco	0.06	0.14	0.00	0.00
Euopean Starling	0.00	0.00	0.00	0.00
Fox Sparrow	0.06	0.14	0.00	0.00
Golden-crowned Kinglet	0.11	0.00	0.00	0.40
Gray Jay	0.11	0.00	0.00	0.40
House Wren	0.06	0.14	0.00	0.00
Least flycatcher	0.11	0.29	0.00	0.00
Lincoln's Sparrow	0.28	0.57	0.17	0.00
MacGillivray's Warbler	0.11	0.14	0.17	0.00
Olive-sided Flycatcher	0.00	0.00	0.00	0.00
Orange-crowned Warbler	0.00	0.00	0.00	0.00
Pine Siskin	0.00	0.00	0.00	0.00
Purple Finch	0.00	0.00	0.00	0.00
Red-breasted Nuthatch	0.22	0.14	0.33	0.20
Rose-breasted Grosbeak	0.06	0.00	0.17	0.00
Ruby-crowned Kinglet	0.17	0.00	0.00	0.60
Sandhill Crane	0.06	0.00	0.17	0.00
Swainson's Thrush	0.06	0.00	0.00	0.20
Townsends Solitaire	0.00	0.00	0.00	0.00
Varied Thrush	0.11	0.00	0.00	0.40
Warbling Vireo	0.11	0.29	0.00	0.00
Western Kingbird	0.00	0.00	0.00	0.00
White-throated Sparrow	0.50	0.86	0.50	0.00
Wilson's Warbler	0.00	0.00	0.00	0.00
Yellow-rumped Warbler	0.11	0.00	0.33	0.00
TOTAL	**2.56**	**2.86**	**2.33**	**2.40**

Table 5. Mean Pairs of Breeding Songbirds Detected by Forest Cover Type - South of the Bow River

Species	Total	Forest Cover Type and Sample Size		
		Aw	Pl	Sw
	19	6	6	7
	Mean Pairs			
American Robin	0.53	0.83	0.33	0.43
Black-capped Chickadee	0.26	0.17	0.33	0.29
Brown Creeper	0.05	0.00	0.00	0.14
Clay-colored Sparrow	0.05	0.17	0.00	0.00
Cedar Waxwing	0.11	0.00	0.00	0.29
Chipping Sparrow	0.16	0.00	0.17	0.29
Dark-eyed Junco	0.21	0.50	0.00	0.14
Euopean Starling	0.11	0.33	0.00	0.00
Fox Sparrow	0.00	0.00	0.00	0.00
Golden-crowned Kinglet	0.11	0.00	0.00	0.29
Gray Jay	0.00	0.00	0.00	0.00
House Wren	0.21	0.67	0.00	0.00
Least flycatcher	0.00	0.00	0.00	0.00
Lincoln's Sparrow	0.05	0.17	0.00	0.00
MacGillivray's Warbler	0.05	0.17	0.00	0.00
Olive-sided Flycatcher	0.11	0.33	0.00	0.00
Orange-crowned Warbler	0.11	0.00	0.00	0.29
Pine Siskin	0.05	0.00	0.00	0.14
Purple Finch	0.05	0.17	0.00	0.00
Red-breasted Nuthatch	0.16	0.17	0.17	0.14
Rose-breasted Grosbeak	0.00	0.00	0.00	0.00
Ruby-crowned Kinglet	0.05	0.17	0.00	0.00
Sandhill Crane	0.00	0.00	0.00	0.00
Swainson's Thrush	0.42	0.33	0.17	0.71
Townsends Solitaire	0.05	0.17	0.00	0.00
Varied Thrush	0.00	0.00	0.00	0.00
Warbling Vireo	0.05	0.17	0.00	0.00
Western Kingbird	0.05	0.17	0.00	0.00
White-throated Sparrow	0.05	0.17	0.00	0.00
Wilson's Warbler	0.11	0.33	0.00	0.00
Yellow-rumped Warbler	0.11	0.00	0.33	0.00
TOTAL	**3.26**	**5.17**	**1.50**	**3.14**

Total species richness within the NOB LSA was 20 species compared to 25 species in the SOB LSA. Mean indicated pairs across all cover types were higher in the SOB LSA accounting for a total of 3.26 compared to 2.56 found in the NOB LSA. Shannon-Wiener values were also higher in the SOB LSA (2.92) compared to the NOB LSA (2.76). Evenness values were similar among both study areas amounting to 0.92 and 0.91 in the NOB LSA and SOB LSA respectively. As these evenness values are close to 1, we assume that our diversity of recorded species are close to the theoretical maximum diversity of breeding songbirds.

Aspen forest supported the highest species richness among all forest cover types within both study areas. Species richness within aspen forest was highest within the SOB LSA (n=18). Lodgepole pine forests (n=9) were more species rich in the NOB LSA while white spruce forest were richer in the SOB LSA (n=11) (Table 6).

Table 6. Songbird Diversity Indices by Study Area and Forest Cover Type

Forest Cover Type	N	Diversity Indices				Decreasing Richness		Decreasing Pairs		Decreasing S-W		Decreasing Evenness	
		Species Richness	Mean # of Pairs	Shannon-Wiener Diversity	Evenness	Forest Cover Type	Species Richness	Forest Cover Type	Mean # of Pairs	Forest Cover Type	Shannon-Wiener Diversity	Forest Cover Type	Evenness
North of the Bow River													
Aw	7	10	2.86	2.04	0.89	Aw	10	Aw	2.86	Aw	2.04	PL	0.96
PL	6	9	2.33	2.11	0.96	PL	9	SW	2.4	PL	2.11	SW	0.96
SW	5	7	2.40	1.86	0.96	SW	7	PL	2.33	SW	1.86	Aw	0.89
South of the Bow River													
Aw	6	18	5.17	2.71	0.94	Aw	18	Aw	5.17	Aw	2.71	PL	0.97
PL	6	6	1.50	1.74	0.97	SW	11	SW	3.14	SW	2.26	Aw	0.94
SW	7	11	3.14	2.26	0.94	PL	6	PL	1.5	PL	1.74	SW	0.94
TOTAL													
NOB	18	20	2.56	2.76	0.92	SOB	25	SOB	3.26	SOB	2.92	NOB	0.92
SOB	19	25	3.26	2.92	0.91	NOB	18	NOB	2.56	NOB	2.76	SOB	0.91

The mean number of indicated pairs across all forest cover types ranged from 2.33 to 2.86 in the NOB LSA (Table 6) compared to 1.50 to 5.17 in the SOB LSA. Mean indicated pairs were highest within aspen forests across both study areas amounting to 5.17 (SOB LSA) and 2.86 (NOB LSA). This is consistent with reporting by Collister and Kansas (2003) and Kansas and Kelly (2011). Mean indicated pairs were lowest within lodgepole pine forests, particularly in the SOB LSA. Shannon-Wiener diversity indices were highest within lodgepole pine forests in the NOB LSA (2.11) and aspen forests in the SOB LSA (2.71). White spruce forests in the NOB LSA (1.86) and lodgepole pine forests in the SOB LSA (1.74) recorded the lowest Shannon-Wiener values, indicating relatively lower songbird diversity in these habitat types. Evenness values were consistent across all forest cover types with the exception of aspen forest in the NOB LSA (0.89). Evenness values ranged from 0.94 to 0.97 across all other forest cover types.

Brown creeper, least flycatcher and olive-sided flycatcher were the only species at risk detected during the breeding songbird program. Brown creeper and least flycatcher are currently designated as *sensitive* in Alberta and have no federal designation. Olive-sided flycatcher is currently listed as *may be at risk* provincially and *threatened* by COSEWIC.

Incidental and Distant Observations

Distant observations of brown creeper and pileated woodpecker were recorded during the breeding songbird survey. Both observations occurred in the NOB LSA as single occurrences. Brown creeper and pileated woodpecker are both listed provincially as *sensitive*.

4.2.2 Vegetation Site Characteristics

4.2.2.1 South of the Bow River vs. North of the Bow River Regional Study Areas

The 37 sites were revisited (after bird surveys) to sample forest stand and understory characteristics (sample locations in Figures 5 and 6). A total of 83 plant species were recorded in the NOB LSA compared to 100 species in the SOB LSA (Tables 7 and 8).

Within the NOB LSA, plant species richness (57 species) was greatest within aspen forest, again consistent with findings from Collister and Kansas (2003) for the entire SLS FMA. Lodgepole pine and white spruce forests had 44 and 33 species, respectively. Conversely, 65 plant species were recorded in white spruce forests in the SOB LSA. Aspen forests and lodgepole pine forests had total species richness values of 52 and 50, respectively in the NOB LSA (Table 11).

Shannon-Weiner Diversity indices for vegetation cover types showed similar trends as for species richness values in the NOB LSA. Shannon-Weiner values for aspen forest, lodgepole pine forests and white spruce forests were calculated at 3.84, 3.61 and 3.35 respectively. Evenness values calculated for these indices concluded highly diverse habitats as values scored between 0.95 and 0.96 (Table 11).

A similar trend in decreasing values of Shannon-Weiner values were found in the SOB LSA. White spruce forest has a Shannon-Weiner index of 3.94 while aspen forest and lodgepole pine forest accounted for 3.76 and 3.70 respectively (Table 11). Evenness values were identical at 0.95 across all forest cover types. Shannon-Weiner and Evenness values do not show a significant difference between forest cover types

Table 11. Plant Diversity Indices by Study Area and Forest Cover Type

Forest Cover Type	N	Diversity Indices			Decreasing Richness		Decreasing S-W		Decreasing Evenness	
		Species Richness	Shannon-Wiener Diversity	Evenness	Forest Cover Type	Species Richness	Forest Cover Type	Shannon-Wiener Diversity	Forest Cover Type	Evenness
North of the Bow River										
Aw	7	57	3.84	0.95	Aw	57	Aw	3.84	Sw	0.96
PL	6	44	3.61	0.95	PL	44	PL	3.61	Aw	0.95
Sw	5	33	3.35	0.96	Sw	33	Sw	3.35	PL	0.95
South of the Bow River										
Aw	6	52	3.76	0.95	Sw	65	Sw	3.94	Aw	0.95
PL	6	50	3.70	0.95	Aw	52	Aw	3.76	Sw	0.95
Sw	7	65	3.94	0.95	PL	50	PL	3.70	PL	0.95
TOTAL										
NOB	18	83	4.11	0.93	SOB	100	SOB	4.25	NOB	0.93
SOB	19	100	4.25	0.92	NOB	83	NOB	4.11	SOB	0.92

4.3 Comparative Statistical Analyses

The purpose of this section of the report was to test for the presence or absence of statistically significant differences (between NOB and SOB study area samples) for songbird and plant species richness.

4.3.1 T Test

The NOB and SOB songbird and vegetation data were compared between study areas using T tests. The three forest cover types were tested for significant differences in the mean number of breeding songbird pairs. Using a 95% confidence interval, P values less than 5% determined where significant differences were detected among forest cover types. Results of the statistical analysis is detailed below and presented in Tables 12 and 13.

4.3.1.1 Breeding Songbirds

Our test results indicate a significant difference in the mean number of breeding songbird pairs between aspen forests within each study area (P = 0.01). This P value concludes that on average, mean pairs of breeding songbirds are greater within SOB LSA aspen forests compared to aspen forests found in the NOB LSA.

Our test results indicate no significant difference between lodgepole pine forests and white spruce forests among LSAs. P values for lodgepole pine forest and white spruce forests were 0.20 and 0.60 respectively.

Table 12. T Test Results of Breeding Songbird Data by Local Study Area and Forest Cover Type

Statistics	Aw (Equal Variance)		Pl (Equal Variance)		Sw (Equal Variance)	
	NOB	SOB	NOB	SOB	NOB	SOB
Mean	5.17	2.86	1.50	2.33	3.14	2.40
Variance	1.37	2.14	1.90	0.27	2.14	10.80
Observations	6.00	7.00	6.00	6.00	7.00	5.00
Pooled Variance	1.79		1.08		5.61	
Hypothesized Mean Difference	0.00		0.00		0.00	
df	11.00		10.00		10.00	
t Stat	3.10		-1.39		0.54	
P(T<=t) one-tail	0.01		0.10		0.30	
t Critical one-tail	1.80		1.81		1.81	
P(T<=t) two-tail	0.01		0.20		0.60	
t Critical two-tail	2.20		2.23		2.23	

4.3.1.2 Vegetation Site Characteristics

Our test results indicate no significant difference in plant species richness between aspen forests and lodgepole pine forests between LSAs. P values for aspen forest and lodgepole pine forests equaled 0.75 and 0.67 respectively. A significant difference of data between white spruce forests within each study area (P = 0.01) was found. The P value of 0.01 concludes that there was a greater plant species richness in white spruce forest plots in the NOB LSA than in the SOB plots.

Table 13. T Test Results of Vegetation Data by Local Study Area and Forest Cover Type

Statistics	Aw (Equal Variance)		Pl (Equal Variance)		Sw (Equal Variance)	
	NOB	SOB	NOB	SOB	NOB	SOB
Mean	23.00	23.86	18.83	17.67	20.14	13.00
Variance	26.80	19.14	26.57	15.07	16.48	14.50
Observations	6.00	7.00	6.00	6.00	7.00	5.00
Pooled Variance	22.62		20.82		15.69	
Hypothesized Mean Difference	0.00		0.00		0.00	
df	11.00		10.00		10.00	
t Stat	-0.32		0.44		3.08	
P(T<=t) one-tail	0.38		0.33		0.01	
t Critical one-tail	1.80		1.81		1.81	
P(T<=t) two-tail	0.75		0.67		0.01	
t Critical two-tail	2.20		2.23		2.23	

4.3.2 Coefficients of Similarity

We compiled a list of the species that occur in each of the three forest cover types. Using these species composition data we determined if each forest cover type was similar in terms of species composition between the SOB LSA and NOB LSA. We have chosen a binary coefficient to measure similarity using presence/absence data among our breeding songbird and vegetation data. We used the Jaccard index of similarity for the purposes of our study.

The Jaccard index is described as follows:

$$S_j = \frac{a}{a+b+c}$$

where:

Sj = Jaccard's similarity coefficient

a, b, c = As defined below in a presence-absence matrix

The basic data for calculating binary coefficients is a 2x2 table:

SOB		NOB	
		# of species present	# of species absent
	# of species present	a	b
	# of species absent	c	d

where:

a = Number of species in sample A and sample B
b = Number of species in sample B but not in sample A
c = Number of species in sample A but not in sample B
d = Number of species absent
S values will range between 0 (completely dissimilar) and 1 (identical).

4.3.2.1 Breeding Songbirds

Aspen Forest

Breeding songbird composition similarity between aspen forests is calculated as follows.

SOB		NOB	
		# of species present	# of species absent
	# of species present	8	10
	# of species absent	2	0

As a result we have Sj = 8/8+10+2 which gives us a similarity index of **0.40.**

Lodgepole Pine Forest

Breeding songbird composition similarity between lodgepole pine forests is calculated as follows.

SOB		NOB	
		# of species present	# of species absent
	# of species present	4	2
	# of species absent	5	0

As a result we have Sj = 4/4+2+5 which gives us a similarity index of **0.36.**

White Spruce Forest

Breeding songbird composition similarity between white spruce forests is calculated as follows.

SOB		NOB	
		# of species present	# of species absent
	# of species present	4	7
	# of species absent	3	0

As a result we have Sj = 4/4+7+3 which gives us a similarity index of **0.29.**

NOB versus SOB (Total Samples)

Breeding songbird composition similarity across all forest cover types is calculated as follows.

SOB		NOB	
		# of species present	# of species absent
	# of species present	14	11
	# of species absent	6	0

As a result we have Sj = 14/14+11+6 which gives us a similarity index of **0.45.**

4.3.2.2 Vegetation

Aspen Forest

Plant species composition similarity between aspen forests is calculated as follows.

SOB		NOB	
		# of species present	# of species absent
	# of species present	33	19
	# of species absent	24	0

As a result we have Sj = 33/33+19+24 which gives us a similarity index of **0.43.**
Lodgepole Pine Forest

Plant species composition similarity between lodgepole pine forests is calculated as follows.

SOB		NOB	
		# of species present	# of species absent
	# of species present	24	26
	# of species absent	22	0

As a result we have Sj = 24/24+26+22 which gives us a similarity index of **0.33.**

White Spruce Forest

Plant species composition similarity between white spruce forests is calculated as follows.

SOB		NOB	
		# of species present	# of species absent
	# of species present	22	43
	# of species absent	11	0

As a result we have Sj = 22/22+43+11 which gives us a similarity index of **0.29.**

NOB versus SOB

Plant species composition similarity across all forest types is calculated as follows.

SOB		NOB	
		# of species present	# of species absent
	# of species present	56	43
	# of species absent	27	0

As a result we have Sj = 56/56+43+27 which gives us a similarity index of **0.44.**

Similarity indices across all forest cover types and for each LSA indicates that there is low to moderate similarity between breeding songbird and vegetation species composition between areas north and south of the Bow River. Despite its wide application in ecological studies, the Jaccard idex, when computed for sample data, can perform poorly as a measure of similarity between diverse assemblages that include a substantial fraction of rare species (Wolda 1981; Colwell & Coddington 1994; Plotkin & Muller-Landau 2002). Our study focused largely on homogenous forest cover types where rare species are not particularly predicted to be encountered or have elevated potential for occurrence. As a result a substantial fraction of rare species was not predicted to occur.

5.0 BIOGEOCLIMATIC COMPARISON OF THE LOWER FOOTHILLS AND MONTANE NATURAL SUB REGIONS

5.1 Climate

Mean climate statistics were collected and summarized for TWN 019 Range 04 W5 (SOB RSA) and TWN 033 Range 07 W5 (NOB RSA). Monthly mean minimum temperatures, mean maximum temperatures and mean overall temperatures were sampled between the years of 2006 to 2015 (Table 12). Mean precipitation was also summarized for these townships. Data was collected from Alberta Agriculture and Forestry (http://agriculture.alberta.ca/acis/alberta-weather-data-viewer.jsp).

Table 14. Mean Climate Statistics for the Regional Study Areas - 2006 to 2015

Month	Climate Statistics								
	Mean Minimum Temp (C°)		Mean Maximum Temp (C°)		Average Temperature (C°)		Diff (C°)	Mean Precip. (mm)	
	SOB	NOB	SOB	NOB	SOB	NOB		SOB	NOB
Jan	-11.66	-14.12	-0.48	-1.17	-6.07	-7.65	1.58	20.91	14.85
Feb	-12.97	-15.05	-0.69	-0.94	-6.83	-8.00	1.17	18.98	12.94
March	-8.79	-10.07	3.23	3.51	-2.78	-3.28	0.50	36.02	17.58
April	-4.81	-4.74	7.60	8.81	1.39	2.03	0.64	54.64	40.98
May	-0.09	0.20	13.09	14.28	6.50	7.24	0.74	91.13	76.33
June	3.54	4.60	15.89	17.65	9.71	11.13	1.41	120.84	121.88
July	6.84	7.66	20.90	21.81	13.87	14.73	0.86	54.71	78.10
Aug	5.54	6.26	19.67	20.43	12.61	13.35	0.74	70.74	72.15
Sept	2.38	2.33	16.18	17.41	9.28	9.87	0.59	58.26	52.12
Oct	-2.19	-3.12	9.69	10.21	3.75	3.54	0.20	37.98	23.97
Nov	-8.76	-10.67	1.82	1.39	-3.47	-4.64	1.17	31.98	18.27
Dec	-13.25	-15.71	-2.55	-4.07	-7.90	-9.89	1.99	21.39	17.04

Mean minimum temperatures are cooler in the NOB RSA between the months of January and April and from October to December. Spring and summer months (May to September) are cooler in the SOB LSA. Mean maximum temperatures are warmer in the NOB RSA between the months of March and November while the winter months of January, February and December are warmer in the SOB LSA. Generally the SOB LSA is on average month to month warmer throughout the year where mean monthly temperature differentials range between 0.20°C (October) to 1.99°C (December). Mean precipitation is either greater or similar in the SOB LSA compared to the NOB RSA with the exception of the months of July and August where mean precipitation is greater in the NOB RSA.

Compared to Table 14, month to month statistics provided within the natural regions descriptions (2006) vary for minimum mean temperatures and are generally equal for mean maximum and mean overall temperatures. Compared to the natural regions committee

(2006), precipitation values within Table 14 are generally lower during winter months, higher to variable during spring and summer periods and highly variable during fall months.

5.2 Topography

Aspect

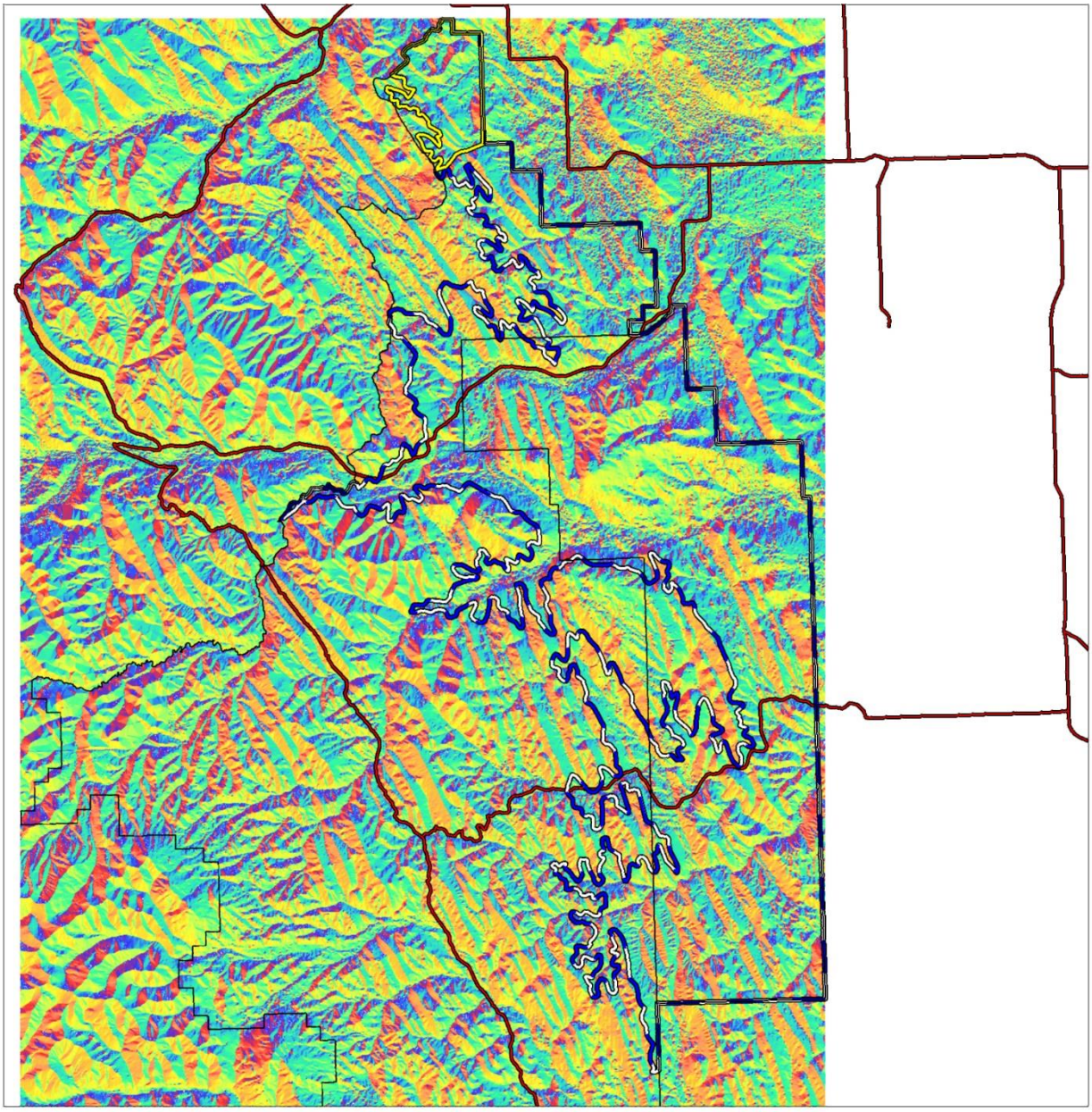
Aspect was divided into the eight cardinal and sub cardinal directions. Generally, north, north east and east facing slopes dominate both RSAs. Slightly greater area percentages of southerly aspects occur in the SOB RSA. Notable discrepancies in aspect between the RSAs occur with percent cover of southeast (>SOB), northeast and north (>NOB) facing slopes (Table 15) (Figures 7 and 8). Rank order statistics using a Mann U Whitney Test was performed for the percent cover of each aspect class within each RSA. Results indicate no significant difference in the proportion of aspect classes between RSAs.

Table 15. Aspect Summary of the Regional Study Areas

Aspect Class and Range		Regional Study Area (%)	
Class	Range (Degrees)	North of the Bow	South of the Bow
North	337.5 - 22.5	12.16%	9.21%
Northeast	22.5 - 67.5	21.35%	15.77%
East	67.5 - 112.5	17.52%	17.68%
Southeast	112.5 - 157.5	11.48%	15.14%
South	157.5 - 202.5	10.02%	11.41%
Southwest	202.5 - 247.5	10.19%	11.38%
West	247.5 - 292.5	9.62%	10.82%
Northwest	292.5 - 337.5	7.67%	8.60%

Slope

Slopes were classed based upon the guidelines within the British Columbia Ministry of Environment *Describing Ecosystems in the Field 1990*. Slope classes included Level 0 – 0.5%), Nearly Level (0.5 – 2.5%), Very Gentle Slopes (2.5 – 5%), Gentle Slopes (6 – 10%), Moderate Slopes (10 – 15%), Strong Slopes (15 – 30%), Very Strong Slopes (30 – 45%), Extreme Slopes (45 – 70%), Steep Slopes (70 – 100%) and Very Steep Slopes (>100%) (Table 16). Slopes are generally greater in the SOB RSA particularly between strong and very strong slopes or 15 to 45%. This slope bracket account for approximately 56% of the total area of the SOB RSA. In comparison, slopes most common in the NOB RSA were slightly less steep at slopes ranging from 6 to 30%, accounting for approximately 58% of the total area. Slope in the NOB RSA averages 14.3% compared to an average slope of 12.2% in the NOB LSA. Level to very gentle slopes were also more common in the NOB RSA (35%) compared to the SOB RSA (22%) (Figures 9 and 10). Rank order statistics using a Mann U Whitney Test was performed for the percent cover of each slope class within each RSA. Results indicate no significant difference in the proportion of slope classes between RSAs.



Compass Direction

- North
- Northeast
- East
- Souteast
- South
- Southwest
- West
- Northwest

Legend

- North of the Bow Regional Study Area
- North of the Bow Local Study Area
- Provincial Highway
- FMA Area

0 5 10
kilometers
Scale 1 : 300,000

Figure 7. Topographical Aspects of the Project Area - North of the Bow RSA

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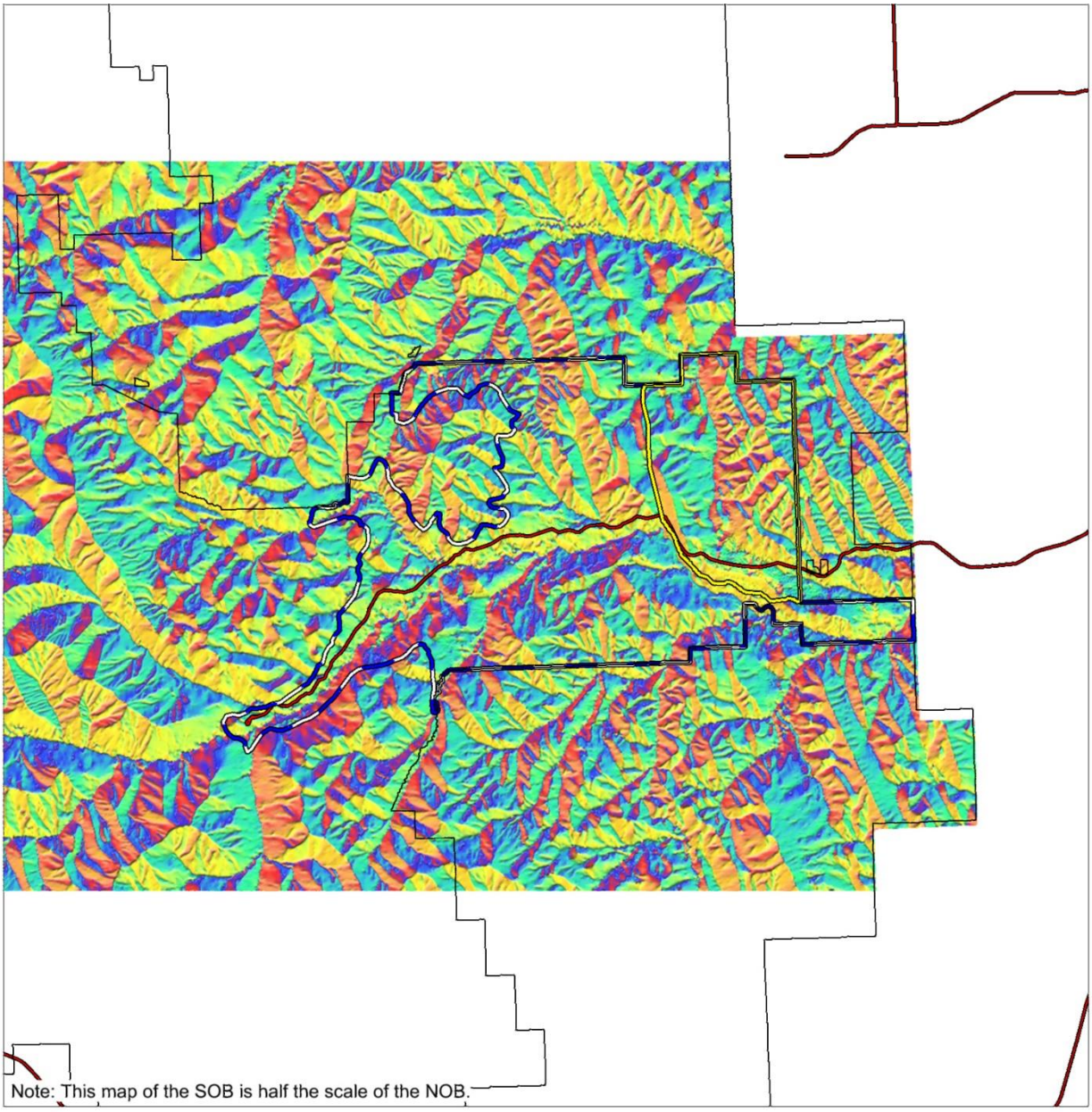

Figure 8. Topographical Aspects of the Project Area - South of the Bow RSA

Legend

- North of the Bow Regional Study Area
- North of the Bow Local Study Area
- Provincial Highway
- FMA Area

0 2.5 5

kilometers

Scale 1 : 150,000

Compass Direction

- North
- Northeast
- East
- Souteast
- South
- Southwest
- West
- Northwest

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Table 16. Mann U Whitney Rank Order Statistic Results

	NOB	SOB
Aspect	Sum of ranks: 67	Sum of ranks: 69
	Mean of ranks: 3.9	Mean of ranks: 4.1
	U-value: 31	U-value: 33
	U Critical: 13	
	Ustat: 31	
	Accept Null Hypothesis: No Significant Difference	

	NOB	SOB
Slope	Sum of ranks: 108	Sum of ranks: 102
	Mean of ranks: 10.8	Mean of ranks: 10.2
	U-value: 53	U-value: 47
	U Critical: 23	
	Ustat: 47	
	Accept Null Hypothesis: No Significant Difference	

Table 17. Slope Summary of the Regional Study Areas

Slope Class and Range		Regional Study Area			
		North of the Bow		South of the Bow	
Class*	Range	Area (ha)	Percentage	Area (ha)	Percentage
Level	0 - 0.5%	1043.65	1.65	31.51	0.31
Nearly Level	0.5 - 2.5%	10052.45	15.88	350.07	3.46
Very Gentle Slopes	2.5 - 5%	11166.40	17.64	573.57	5.67
Gentle Slopes	6 - 10%	13515.11	21.35	1342.25	13.26
Moderate Slopes	10 - 15%	9536.83	15.06	1312.06	12.97
Strong Slopes	15 - 30%	13523.01	21.36	3645.10	36.02
Very Strong Slopes	30 - 45%	3460.66	5.47	1980.72	19.57
Extreme Slopes	45 - 70%	973.21	1.54	796.05	7.87
Steep Slopes	70 - 100%	42.02	0.07	85.62	0.85
Very Steep Slopes	>100%	0.25	0.00	2.97	0.03

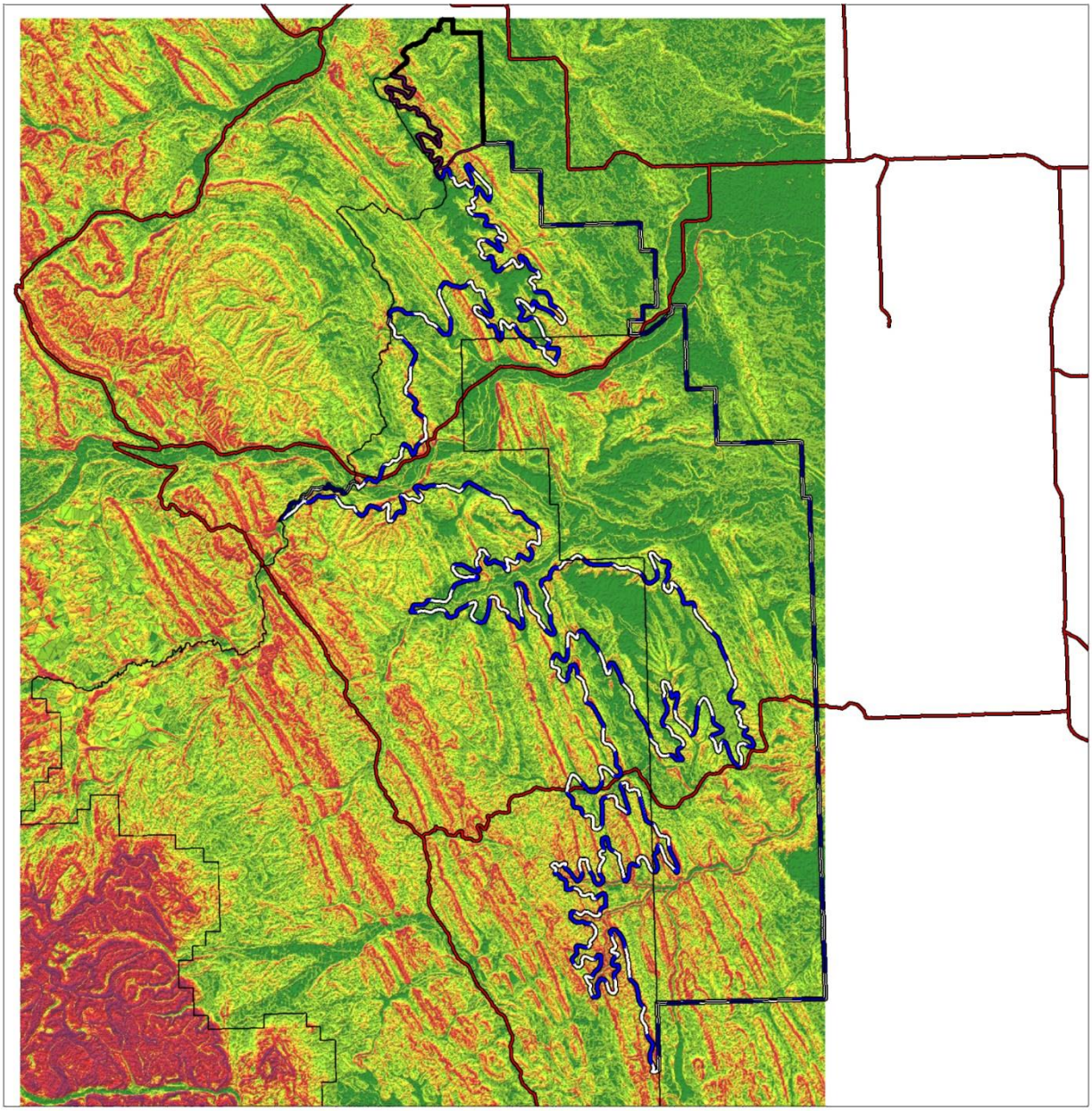

Figure 9. Slope angle of the Project Area - North of the Bow RSA

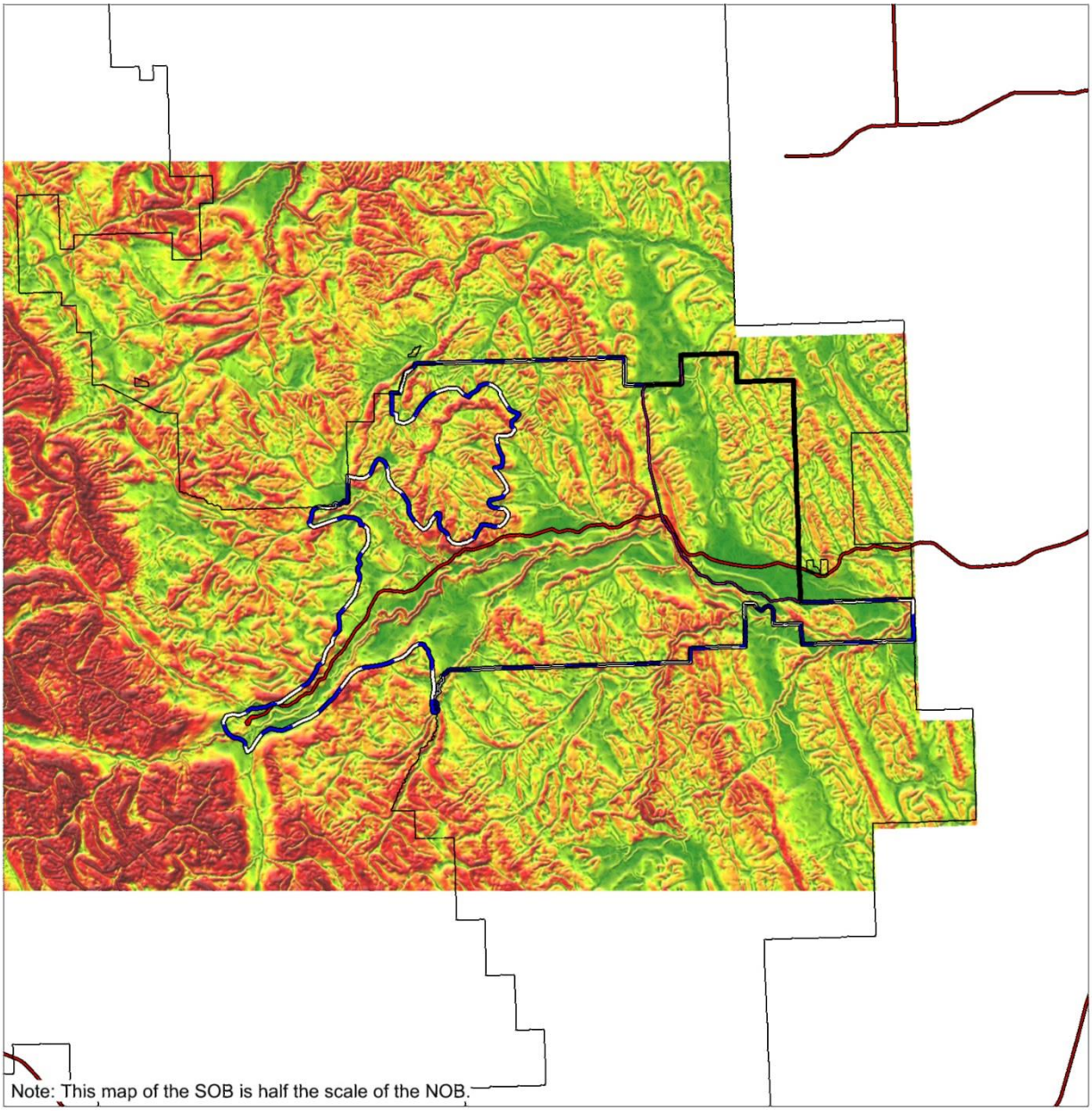

Figure 10. Slope angle of the Project Area - South of the Bow RSA

Elevation

The Natural Regions Committee (2006) reports a mean elevation for the Montane Natural Subregion of 1400m (range 825-1850 meters) while in the Lower Foothills Natural Subregion a mean elevation of 950 meters (range 650-1625 meters) is reported.

Elevation was grouped into ten equal classes and compared between each RSA (Table 18). Classes C, D, and E (1200 to 1500 meters) dominate the NOB RSA accounting for 98% of the total area. The SOB RSA is dominated (92%) by elevations ranging from 1400 to 1700 meters (Classes E-G). Class D or elevations between 1300 to 1400 meters account for 63% of the NOB RSA. The SOB RSA is dominated with elevations ranging from 1500 to 1600 meters. This elevation class is poorly represented in the NOB RSA (1%). Elevation classes are illustrated within Figures 11 and 12.

Table 18. Elevation Summary of the Regional Study Areas

Elevation Class and Range		Regional Study Area			
		North of the Bow		South of the Bow	
Class	Range (meters)	Area (ha)	Percentage	Area (ha)	Percentage
A	1000 - 1100 (MIN)	0.00	0.00	0.00	0.00
B	1100 - 1200	78.57	0.12	0.00	0.00
C	1200 - 1300	14016.06	22.14	0.00	0.00
D	1300 - 1400	40169.36	63.45	469.03	4.63
E	1400 - 1500	8318.64	13.14	2831.44	27.98
F	1500 - 1600	718.01	1.13	4307.48	42.56
G	1600 - 1700	12.96	0.02	2208.79	21.83
H	1700 - 1800	0.00	0.00	277.00	2.74
I	1800 - 1900	0.00	0.00	26.19	0.26
J	1900 - 2000 (MAX)	0.00	0.00	0.00	0.00

5.3 Surficial Geology

Surficial geology was summarized within both RSAs using data from McGregor et al. (1981) (Figures 13 and 14). Surficial deposits and landforms within these areas include colluvial fluvial, glaciofluvial, lacustrine, morainal, organics and residuum (Table 19). Surficial geology within each RSA is dominated by morainal and consolidated morainal deposits. These deposits account for approximately 77% and 60% of the total area within the NOB and SOB RSAs respectively. Relatively higher amounts of land area is covered by glaciofluvial deposits in the SOB RSA. Deposits comprised exclusively of colluvial or colluvial dominated materials are absent in the NOB RSA. These deposits account for 9% and 12% of the SOB RSA. Conversely, lacustrine or lacustrine dominated deposits are absent in the SOB RSA. These account for 1% (lacustrine), 4% (lacustrine and morainal) and 2% (lacustrine and organics) of the NOB RSA (Table 18). The Natural Regions Committee (2006) do not report organic parent materials within the Montane Natural Subregion and confirm the dominance of morainal till deposits within both Natural Subregions.

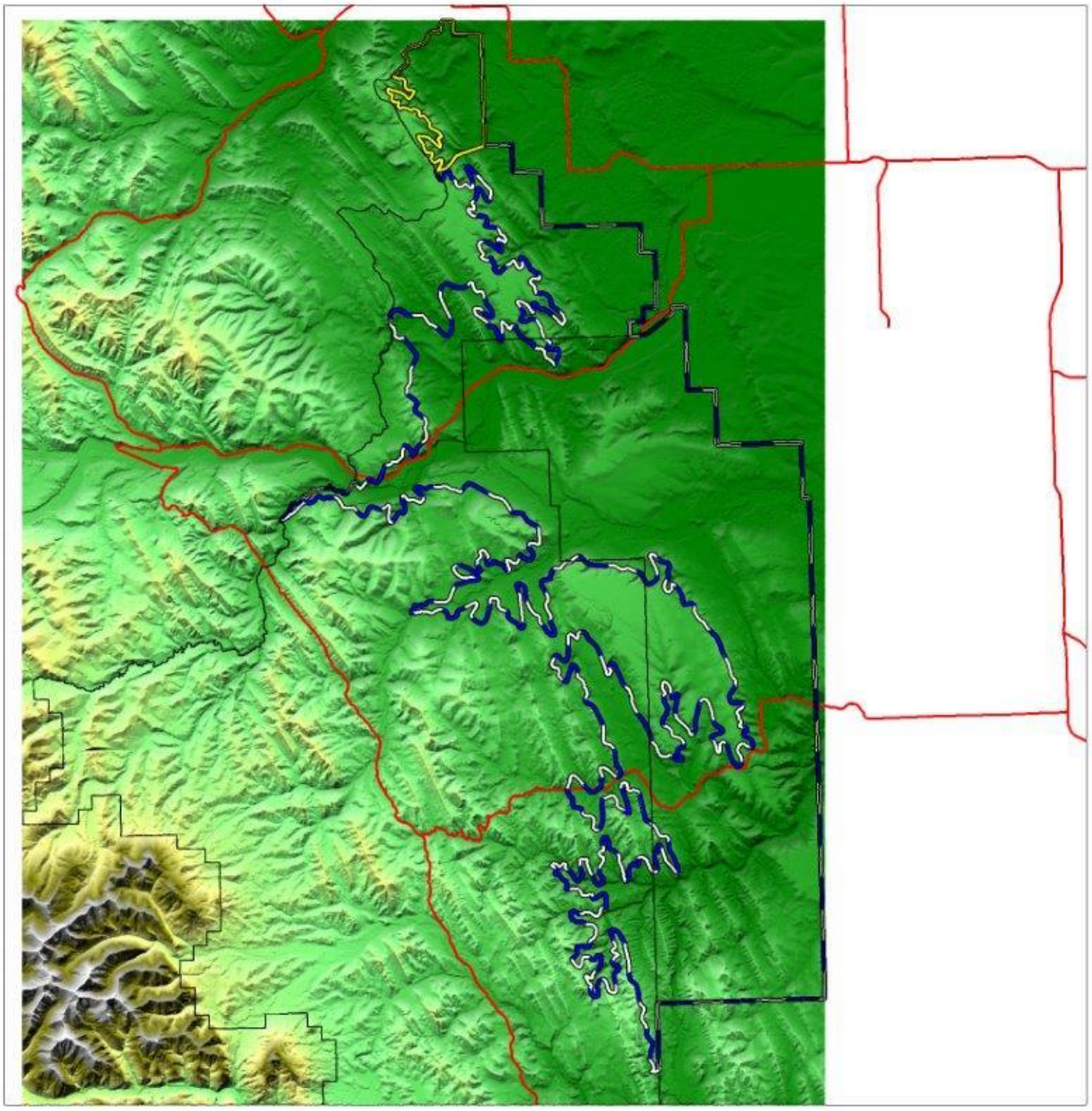

Figure 11. Elevation -
North of the Bow River Regional Study Area

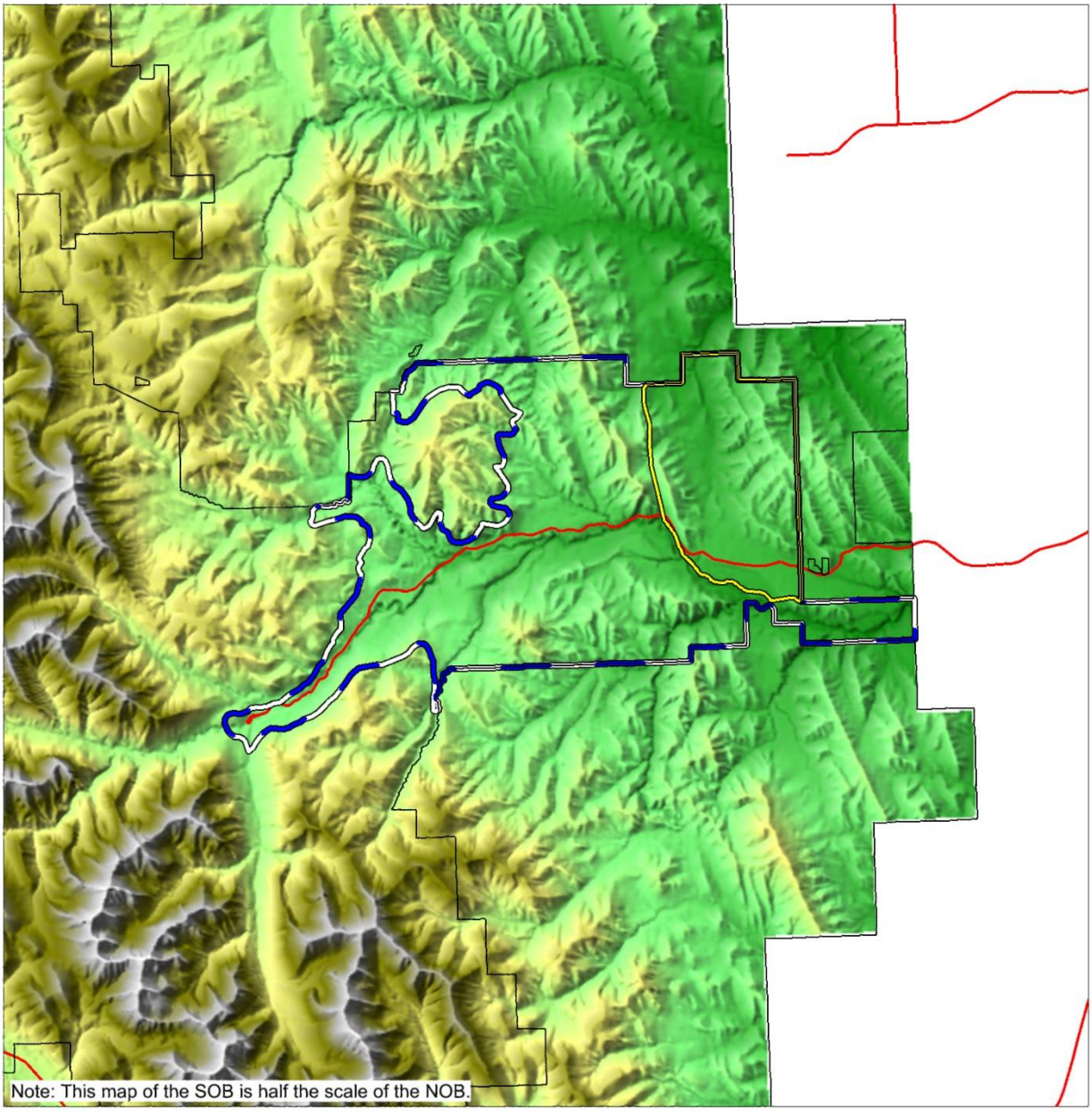

Figure 12. Elevation -
South of the Bow River Regional Study Area

Table 19. Surficial Geology Summary of the Regional Study Areas

Surficial Geology	Regional Study Area			
	North of the Bow		South of the Bow	
	Area (ha)	Percentage	Area (ha)	Percentage
Colluvial			877.01	8.67
Colluvial & Morainal			1,259.27	12.45
Fluvial	6,296.60	9.96	969.17	9.58
Fluvial & Lacustrine	0.73	0.00		
Fluvial & Organics	490.51	0.78		
Glaciofluvial	1,493.29	2.36	822.88	8.14
Hummocky Morainal			93.80	0.93
Lacustrine	827.64	1.31		
Lacustrine & Morainal	2,278.19	3.60		
Lacustrine & Organics	1,416.48	2.24		
Morainal	29,874.85	47.23	2,631.26	26.02
Morainal & Colluvial	3,996.42	6.32	3,444.73	34.06
Morainal & Fluvial			16.21	0.16
Morainal & Glaciofluvial	106.97	0.17		
Morainal & Organics	1,706.27	2.70		
Morainal & Residuum	9,193.38	14.54		
Organics	4,873.95	7.71		
Residuum & Colluvial	54.97	0.09		
N/A	639.45	1.01		

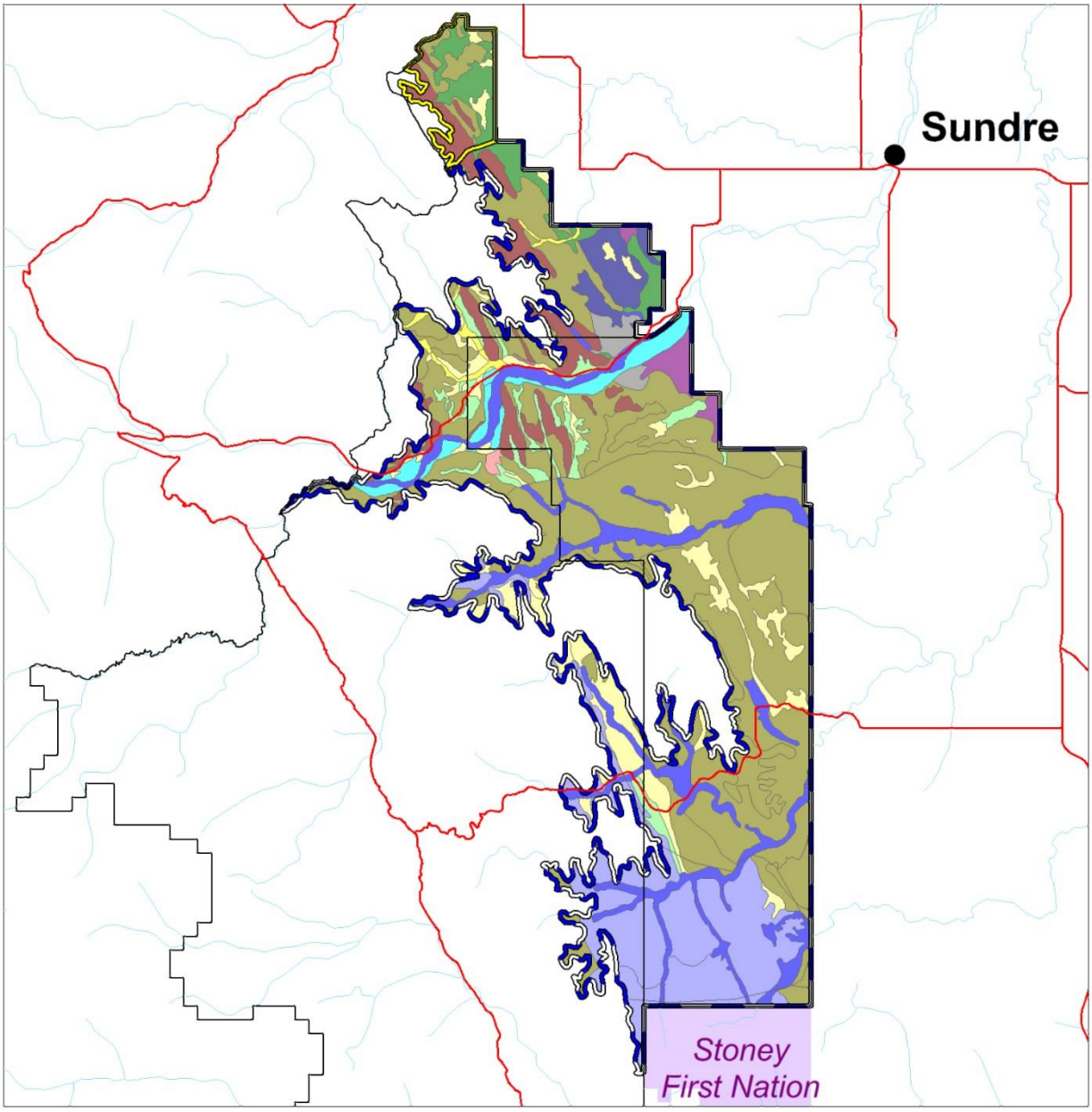

Figure 13. Surficial Geology -
North of the Bow River Regional Study Area

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Parent Material
- Bedrock
- Colluvial
- Fluvial
- Fluvial & Lacustrine
- Fluvial & Organics
- Glaciofluvial
- Lacustrine
- Lacustrine & Morainal
- Lacustrine & Organics
- Morainal
- Morainal & Colluvial
- Morainal & Fluvial
- Morainal & Glaciofluvial
- Morainal & Organics
- Morainal & Residuum
- Organics
- Organics & Morainal
- Residuum & Colluvial
- N/A

Legend
- North of the Bow RSA
- North of the Bow LSA
- Provincial Highway
- Waterway
- FMA Area

0 5 10
kilometers
Scale 1 : 300,000

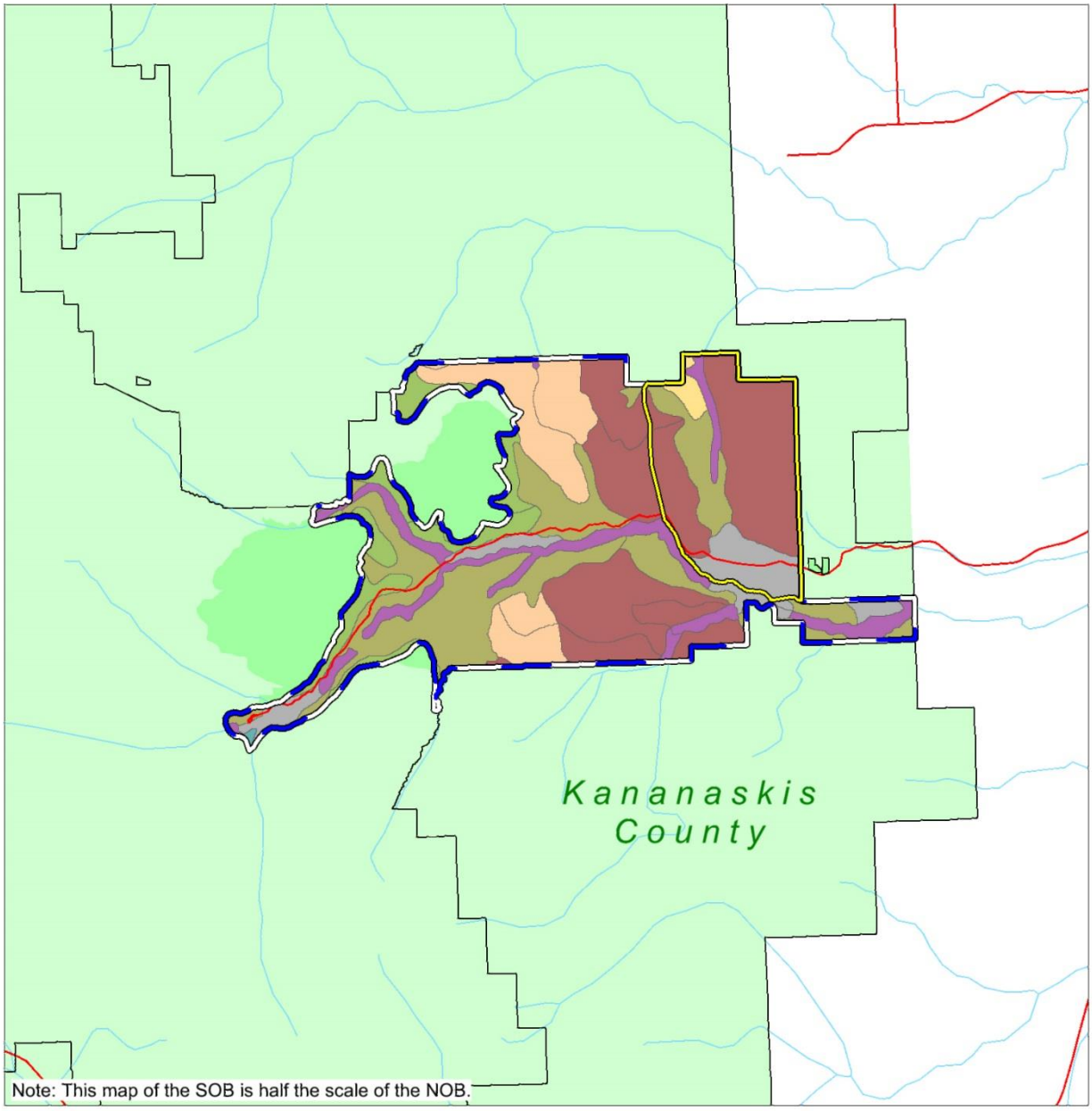

Figure 14. Surficial Geology - South of the Bow Regional Study Area

Parent Material
- Colluvial
- Colluvial & Morainal
- Fluvial
- Glaciofluvial
- Hummocky Morainal
- Morainal
- Morainal & Colluvial
- Morainal & Fluvial

Legend
- South of the Bow RSA
- South of the Bow LSA
- Provincial Highway
- Waterway
- Provincial Park
- Protected Area
- FMA Area

0 2.5 5
kilometers
Scale 1 : 150,000

birdseye environmental

Produced By Rich Ashton Oct 2016
Ref# B-F697_10-16

5.4 Prevailing Winds

Prevailing wind data was generated for south west Alberta including the two RSAs http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag7019. Wind data is presented in annual quarters and by nine wind speed classes (Figure 15).

In the months of December, January and February wind direction and speed is similar between both study areas. Winds appear to originate from the west and prevail at 16 to 18 km/hour. Wind speeds are slightly weaker in the NOB RSA prevailing at 14 to 16 km/hour during this time of year. Wind speed and direction appear to have slight differences between the two RSAs between the months of March, April and May. Generally, historical data suggests a westerly dominated wind at speeds of 18 to 20 km/hour in the regional area of the SOB RSA compared to northwest winds at 14 to 18 km/hour in a northwest direction in the NOB RSA regional area. Wind direction (south/southwest) are similar between the RSAs during June, July and August. During this time frame winds speeds range between 14 to 16 km/hour in the SOB RSA compared to 12 to 14 km/hour in the NOB RSA.

Winds are nearly identical between both study areas between the months of September, October and November where prevailing direction and speed are north/northwest ranging between 18 to 20 km/hour. A slight discrepancy in this trend may exist for the NOB RSA. Historical wind data displays an overlap of slightly weaker winds (16 to 18 km/hour).

5.5 Vegetation Cover

A total of 24 broad land cover types were classified and mapped in the two RSAs (Figures 16 and 17). Both RSAs are dominated by similar vegetation cover types. The SOB RSA is dominated by lodgepole pine forest (40%), aspen forest (25%), white spruce forest (11%), and pine mixedwood forests (9%). These four vegetated cover types account for approximately 85% of the SOB RSA. The NOB RSA is dominated by lodgepole pine forest (27%), aspen/aspen mixedwood forests (19%), white spruce forest (8%) and pine mixedwood forests (7%) (Table 19). These four vegetated cover types account for 61% of the NOB RSA. Total area covered by grasslands amounted to 6% and 2% within the SOB RSA and NOB RSA respectively. Shrub meadows are more prominent within the NOB RSA comprising 6% of land area compared to 1% within the SOB RSA. Various forms of wetlands including flooded, treed wetland, wet graminoid and shrub wetland are notably more prominent in the NOB RSA compared to the SOB RSA accounting for 6% and 2% of total area respectively (Table 20). Black spruce forest does not occur in the SOB RSA but comprises 1.96% (1235 ha) of the NOB. The Natural Regions Committee (2006) report an approximate 2% coverage of land area by wetland habitat types in the Montane Natural Subregion compared to 20% in the Lower Foothills Natural Subregion.

Human influenced land cover types including anthropogenic-industrial, graminoid clearcuts, rangeland clearing, cropland/pasture and shrub-sapling clearcuts are significantly more prominent in the NOB RSA. These land cover types account for 15% of the NOB RSA compared to only 1% in the SOB RSA. These figures are not surprising given the level of protection in provincially regulated parks. It is likely that a large portion of the clearcut areas in the NOB RSA were originally lodgepole pine forest, hence the 27% proportion of lodgepole pine forest in the NOB is probably and underestimate.

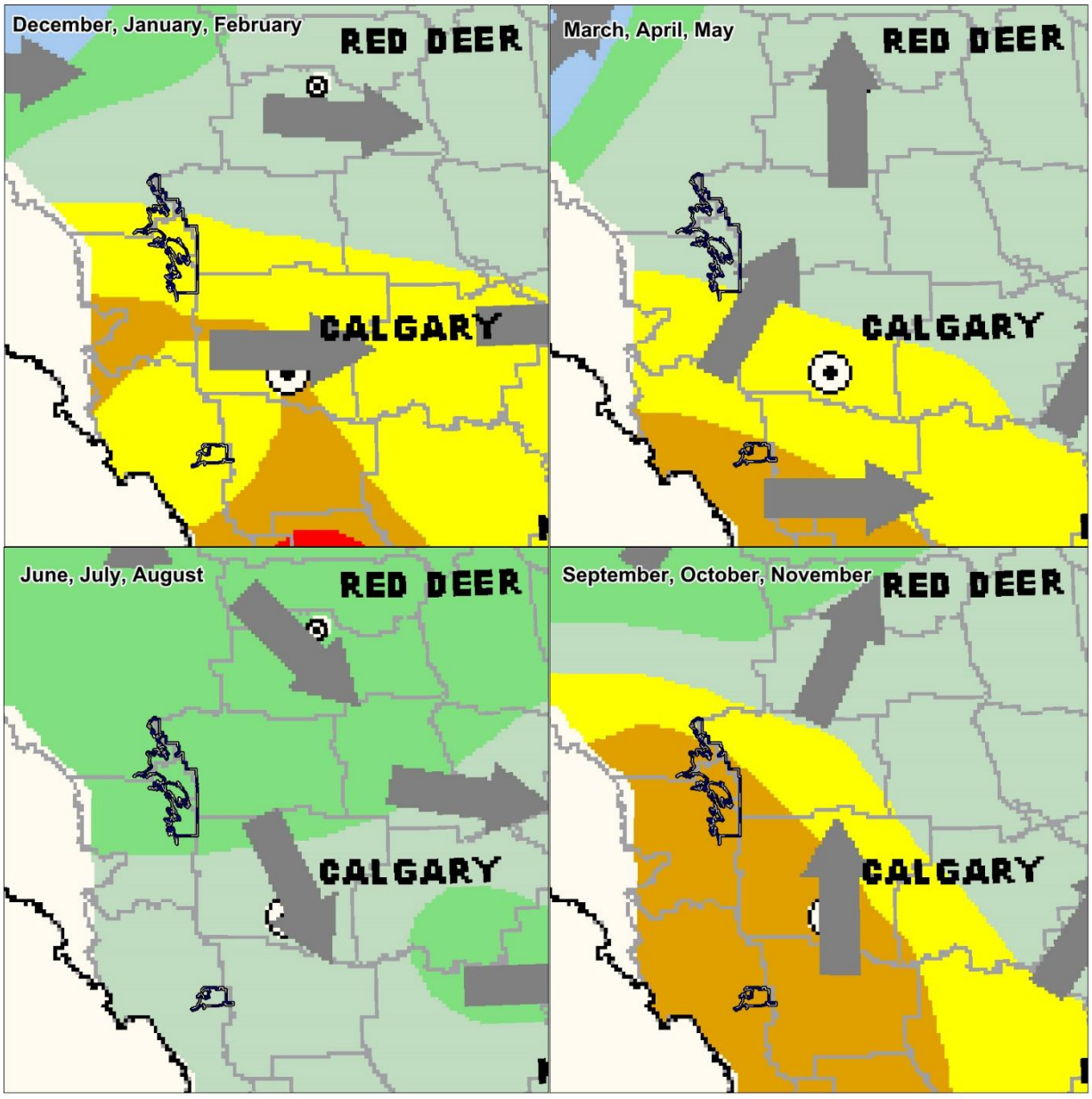

Figure 15. Wind Trends of the Regional Study Areas

Legend

Wind speed (km/h)

- < 8
- 8 to 10
- 10 to 12
- 12 to 14
- 14 to 16
- 16 to 18
- 18 to 20
- > 20
- No Data

Prevailing Wind Driection

Rural Municipal Boundaries

Regional Study Areas
North and South of the Bow River

birdseye environmental

Produced By Rich Ashton Oct 2016
Ref# B-F697_10-16

0 50 100
kilometers
Scale 1 : 2.5 million

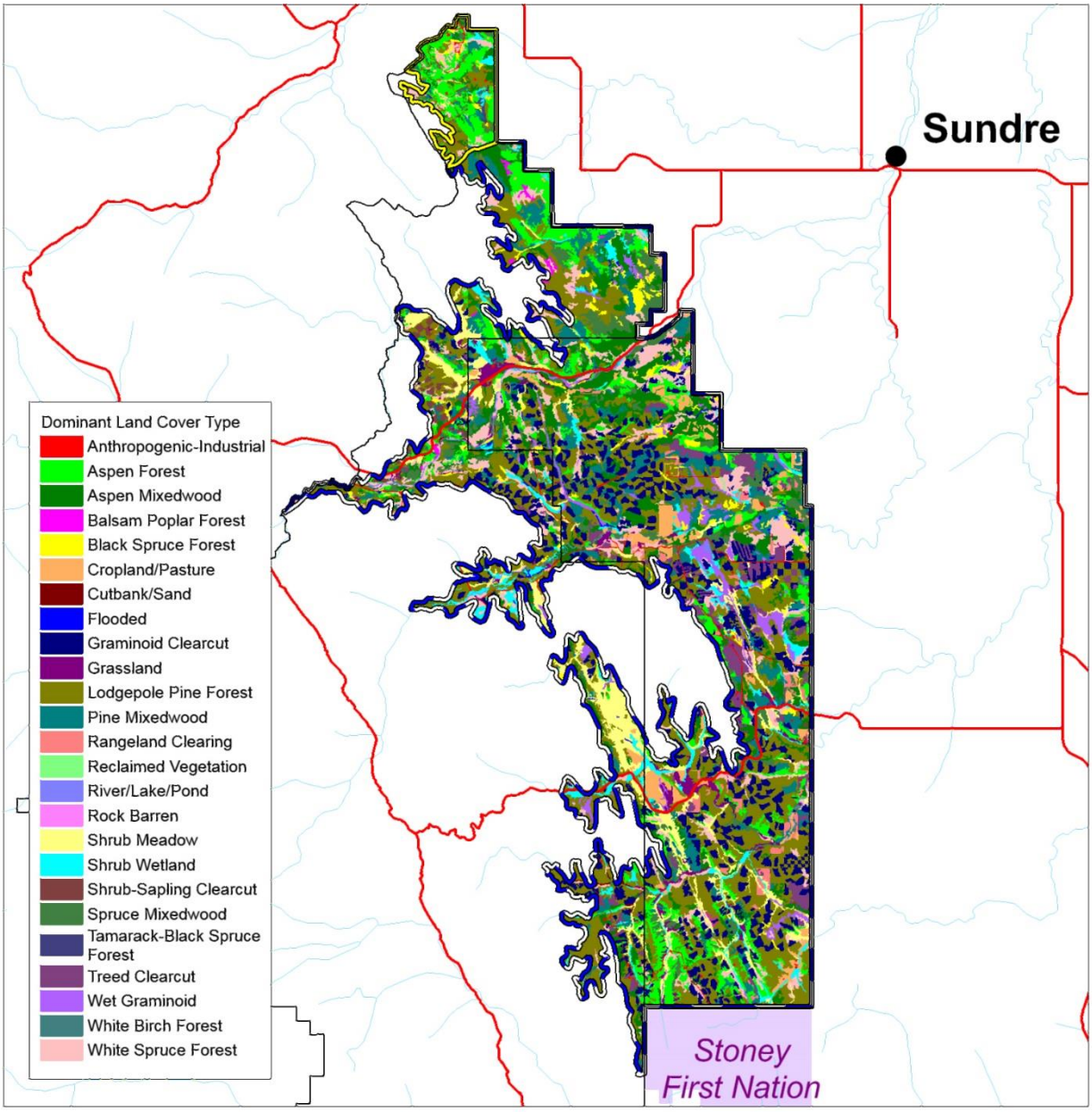

Figure 16. Distribution of Dominant Land Cover Types - North of the Bow River Regional Study Area

birdseye environmental

Legend
- North of the Bow RSA
- North of the Bow LSA
- Provincial Highway
- Waterway
- FMA Area

0 5 10
kilometers
Scale 1 : 300,000

Produced By Rich Ashton Oct 2016
Ref# B-F697_10-16

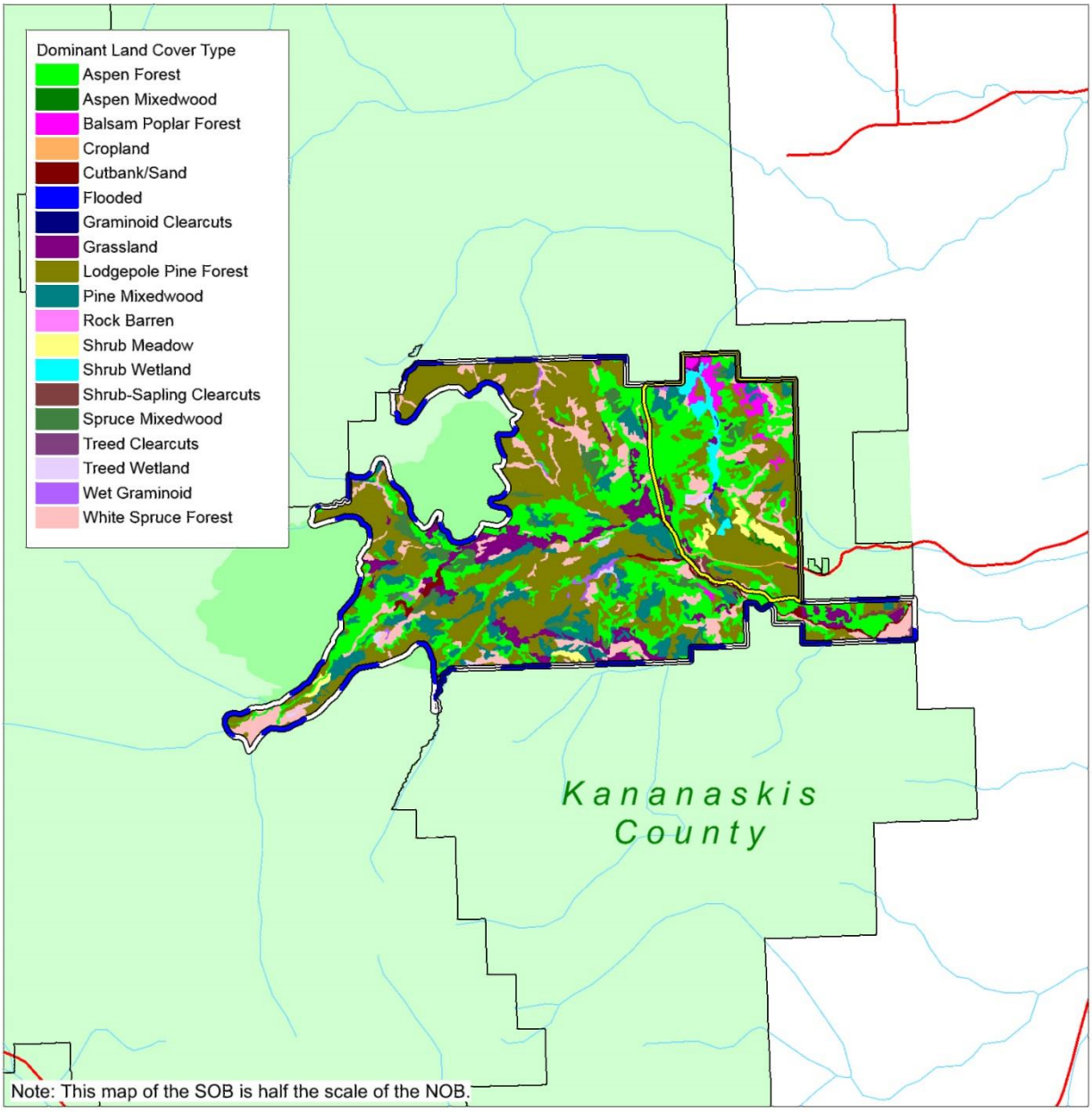

Figure 17. Distribution of Dominant Land Cover Types - South of the Bow River Regional Study Area

birdseye environmental

Produced By Rich Ashton Oct 2016
Ref# B-F697_10-16

Legend
South of the Bow RSA
South of the Bow LSA
Provincial Highway
Waterway
Provincial Park
Protected Area
FMA Area

0 2.5 5
kilometers
Scale 1 : 150,000

Table 20. Broad Land Cover Types by Regional Study Area

Broad Land Cover Type	SOB Area (ha)	SOB Supply (%)	NOB Area (ha)	NOB Supply (%)
Anthropogenic-Industrial	0.00	0.00	657.79	1.04
Rock Barren	0.60	0.01	5.95	0.01
Graminoid Clearcuts	3.92	0.04	6200.23	9.85
Rangeland Clearing	0.00	0.00	567.91	0.90
Flooded	4.60	0.05	131.11	0.21
Treed Clearcuts	6.91	0.07	1884.24	2.99
Aspen Mixedwood	11.12	0.11	6185.09	9.82
Cropland/Pasture	17.87	0.18	1656.68	2.63
Shrub-Sapling Clearcuts	36.48	0.36	266.88	0.42
Treed Wetland	53.22	0.52	0.00	0.00
Wet Graminoid	55.57	0.55	1304.31	2.07
Cutbank/Sand	95.80	0.94	71.66	0.11
Shrub Wetland	121.15	1.19	2192.32	3.48
Shrub Meadow	128.74	1.27	3600.96	5.72
White Birch Forest	0.00	0.00	14.02	0.01
Black Spruce Forest	0.00	0.00	1235.05	1.96
Tamarack-Black Spruce Forest	0.00	0.00	29.06	0.05
Balsam Poplar Forest	158.43	1.27	162.54	0.26
Spruce Mixedwood	277.94	2.74	3317.56	5.27
Grassland	574.28	5.66	1043.58	1.67
Pine Mixedwood	929.50	9.17	4717.03	7.49
White Spruce Forest	1054.56	10.50	4890.72	7.77
Aspen Forest	2539.64	25.04	6009.74	9.55
Lodgepole Pine Forest	4073.59	40.15	16819.93	26.71
Total	**10143.92**	**100.00**	**62964.36**	**100.00**

7.0 CONCLUSIONS

Our approach to the ecological characterization of the Bluerock Sheep River Area consisted of several comparative analyses. While our assessment included fine scale inventories of breeding songbird and vegetative assemblages, we also investigated similarities between biogeoclimatic characteristics of the Bluerock Sheep River area and a typical Lower Foothills area. Typical characteristics that were compared across Montane and Lower Foothills Natural Subregions included climate, topography, elevation, surficial geology, prevailing winds and percent cover of occurring land cover types.

Notwithstanding inherent similarities between the SOB and the NOB, our assessment indicates that the SOB currently contains unique variables which in our opinion deserve closer consideration of a hybrid classification of Montane and Lower Foothills Natural Subregions. Table 21 presents a matrix of characteristics typical of Montane Natural Subregions and how they compare between the SOB and NOB.

Table 21. Typical Characteristics of Montane Natural Regions Relative to the SOB and NOB

Typical Montane Characteristics	Study Area		Similar?	South of the Bow Trend
	SOB	NOB		
Unique Habitats and Wildlife Species Assemblages (LSA)	No	No	Similar	Trending to Lower Foothills
Complex Vegetation Patterns (LSA)	No	No	Similar	Trending to Lower Foothills
Presence of Limber Pine (LSA)	No	No	Similar	Trending to Lower Foothills
Presence of Douglas Fir (LSA)	No	No	Similar	Trending to Lower Foothills
Presence of Engelmann Spruce (LSA)	No	No	Similar	Trending to Lower Foothills
Rare Occurrences of Black Spruce	Yes	No	Dissimilar	Trending to Montane
Absence of Significant Wetland Coverage	Yes	No	Dissimilar	Trending to Montane
Prevailing Seasonal Wind Direction	Yes	Yes	Similar	No Trend
Prevailing Seasonal Wind Speeds	Yes	No	Dissimilar	Trending to Montane
Morainal and Glaciofluvial Deposits Dominate Parent Materials	Yes	Yes	Similar	No Trend
Organic Soils Absent	Yes	No	Dissimilar	Trending to Montane
Mean Elevation of 1400 m	Yes	No	Dissimilar	Trending to Montane
South-West Aspects Dominate	Yes	Not Significantly Different	Similar	No Trend
Relatively Steep Slope	Yes	Not Significantly Different	Similar	No Trend
Mild summers, a summer-high precipitation pattern and warm winters	Yes	Yes	Similar	No Trend

Our results indicate that there are significant inconsistencies in terms of the Bluerock-Sheep having typical Montane characteristics. In spite of these inconsistencies, there are several attributes within the SOB that indicate Montane Natural Subregion status including: rare occurrence of black spruce forests; rare occurrence of wetland habitats; prevailing wind speeds; relatively high mean elevation; and, the absence of organic soils. Distinct dissimilarities between the Bluerock Sheep River area and a typical Montane ecosystem may be due to transitional areas of adjacent Foothills Fescue and Foothills Parkland Natural Subregions, which have similar climates, vegetation and soils along the boundary.

In our opinion, the Bluerock Sheep River area does not fit the classic or typical characteristics of Montane Natural Subregion. While it does not fully support characteristics of typical Lower Foothills Natural Subregions, the Bluerock-Sheep area is functionally similar. A key element shared by each of the RSAs is the relatively high proportion of deciduous and mixedwood forest cover and associated high levels of floral and faunal species richness.

8.0 PROTECTED AREA NEXT STEPS

Our assessment demonstrates an incomplete suite of key diagnostic attributes common to Montane Natural Subregion in the Bluerock Sheep area. This includes the absence of Douglas fir and Limber pine. Several key indicators are present that hint to a Lower Foothills setting, indicating a transitional status. A key aspect of each of the RSAs is the presence of relatively high proportion of deciduous and mixedwood forest types that all contain high plant and songbird species richness.

The High Conservation Value Forest Assessment (Kansas and Mogilefsky 2013a) and Section 3.3 of the Protected Area Representation Gap Analysis (Kansas and Mogilefsky 2013b) identified lower elevation lands, including those in both the Lower Foothills and Montane subregions, as biodiversity 'hotspots'. Upper Foothills lands do not tend to be as diverse as Lower Foothills and Montane lands because of the relative scarcity of deciduous and mixedwood forests, riparian forests, and marsh wetlands (Natural Regions Committee 2006). From a biodiversity richness perspective, Upper Foothill habitats are more similar to subalpine habitats than they are to the Lower Foothills or Montane. Regardless of whether the Bluerock Sheep area is Montane or Lower Foothills it does possess a varied deciduous, mixedwood and riparian forest assemblage with high species richness. This same kind of species richness occurs in deciduous and mixedwood forests north of the Bow in the Lower Foothills subregion.

8.1 Prioritizing Biological Hotspots

Prioritizing large expanses of low elevation lands as protected areas is historically proving difficult from a timber management perspective. To facilitate a protected areas approach and to prioritize the most highly ecologically sensitive lands we propose an alternative approach to filling the current land area gap which currently exists. Our studies, including Kansas and Mogilefsky 2013a and Kansas and Mogilefsky 2013 b conclude the following habitat types/ecosystems are the most biologically diverse and may serve as surrogates to fill gaps in protected land areas:

- Riparian stream buffers;
- Wetlands;
- Deciduous forests;
- Areas of steep slope; and,
- Mixed wood Forests.

Prioritized ecological hotspots will be identified using newly available (2016) High Resolution Microstand Forest Inventory System. Ideally these areas can be merged if occurrences are juxtaposed in a manner which allows for an expanded network or landscape matrix. Using the High Resolution Microstand Forest Inventory System, we can create a protected areas map which delineates biological hotspot areas within Foothills areas.

8.2 Designate Passive Landbase as Protected Areas

Significant land area including those possessing highly ecological integrity (i.e. biodiversity hotspots) are currently protected from timber harvest. Examples of Passive Landbase which are currently protected include:

- Areas of steep slope;
- Wetlands; and
- Riparian buffers.

The Forest Stewardship Council (FSC) boreal standard recommends that typical riparian reserves or buffers should not be considered as protected areas. We argue that riparian areas including wetlands specifically may serve as suitable protected areas for the following reasons:

- Maintaining the ecological integrity of potentially the greatest areas of biological diversity including species listed as at risk (provincially and federally);
- Riparian reserves provide internal linkages between adjacent areas of high biological integrity at a local level.
- Riparian reserves may also provide transboundary opportunities to link areas at a regional level.

SLS will assess the role of the Lower Foothills passive landbase for areas serving as apparent reserves. The degree of retention, patch size and the forest types will be described for these areas. The suitable passive landbase reserve areas will then be incorporated into the development of the 2018 Detailed Forest Management Plan.

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