Valemount & Area
Environmental Background Report

Prepared to provide background information to support the development of the Valemount and Area Integrated Land Use Development Plan

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FOREWORD

The area surrounding the Village of Valemount is poised for significant change. Although the landscape of the area has already been altered by settlement, major infrastructure corridors and natural resource extraction activities, it seems very likely that major resort developments will significantly increase the population and ecological "footprint" of the community in the next two decades.

The purpose of this paper is two-fold: first, to identify and discuss the existing environmental information knowledge base for the area – specifically, known sensitive and environmentally important species, lands, waters, and ecological parameters for the region; second, recognizing that the area is likely to see significant population and settlement growth in the near future, the paper makes recommendations on appropriate actions for the Village, Regional District, and Provincial governments to consider in order to help preserve important environmental attributes in the area.

This paper has been prepared by Ministry of Sustainable Resource Management (MSRM) staff as a technical background paper to support the completion and preparation of the Valemount and Area Integrated Land Use Development Plan. MSRM is appreciative of the support of Ministry of Water, Land, and Air Protection Environmental Stewardship staff that have reviewed and commented on this paper.

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[1] Canoe Mountain as viewed from Highway 5 south of Valemount

Table of Contents

List of Figures

List of Tables

Graphs

List of Appendices

1. PURPOSE & BACKGROUND

The Valemount area is a region of beautiful scenery, significant natural resources, and recreational amenities. It is also an area on the brink of significant potential growth and expansion. Two major resort proposals are currently in the planning stages. If built to full capacity these would nearly double the population of the area. The land area surrounding Valemount already supports significant winter recreational use. As the area becomes increasingly recognized and developed as a four-season resort area, the recreational and commercial use of mid and backcountry areas will also increase. Given the probable growth of the Valemount area and all the resulting subsequent pressures of increased land demand and settlement infrastructure on the valley floor, and the increased public and commercial use of mid and backcountry areas, there is an urgent need to examine probable growth-related impacts and to develop appropriate planning responses.

As the Village of Valemount has attempted to diversify its economic base, it has become clear that the Village's economy is directly tied to the use and management of the Crown lands surrounding the Village. Likewise, the demands and use of Crown land and resources in the region are directly impacted by the growth and development activities of the Village and its residents. Recognizing this interdependency and the need for a strategic and integrative approach to land and resource management in the region, the Village, Regional District of Fraser-Fort George, Ministry of Sustainable Resource Management (MSRM), and Land and Water British Columbia (LWBC), agreed to undertake a Valemount and Area Integrated Land Use Development Plan (VILUDP) for the area. These four agencies, representing the three levels of government in British Columbia, are the major agencies responsible for determining, managing, and regulating land use in the area. The major objectives of the VILUDP are to examine and determine the most appropriate actions to undertake in order to manage growth-related impacts, and to ensure that land and resource use in the area reflects the Village's development aspirations. In order to effectively implement the final VILUDP; the four partner agencies will incorporate the recommendations of the final VILUDP into their own separate formal land and resource planning processes.

This paper has been prepared to help inform the preparation and completion of the VILUDP. It will also be used by MSRM and LWBC respectively in their Sustainable Resource Management Planning and Crown Land Plan planning processes.

Planning for the integration of many different resource values is important in order to establish a balance for all concerned. Maintaining the integrity of the landscape and protecting those values that attracted users in the first place is part of that balance. Therefore the first step of any such planning process should be to identify the unique and important resource values that exist on the landscape, and then to identify, establish, and rationalize any conservation and management strategies that should be put in place to maintain those values through time. This, then, is the purpose of this document.

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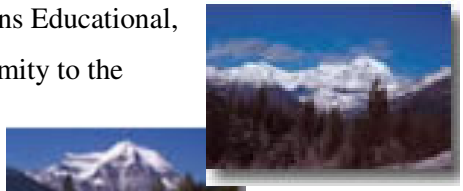
[2] Canoe reach of Kinbasket Lake as seen from the top of Canoe Mt. Photo as pictured at http://www.bbexpo.com/BC/gallery4.htm

[3] Canoe Mt. as seen from Valemount Photo as pictured at http://www.bbexpo.com/BC/gallery4.htm

2. INTRODUCTION

[4]The Village of Valemount and surrounding area has been identified as having high values for a multitude of resources. Both Mount Robson Provincial Park and Jasper National Park are part of the Canadian Rocky Mountains World Heritage Site as declared by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and are in close proximity to the Valemount area. This results in high use of the area by recreationists and highway travellers, creating increasing pressures on the land base. The Village of Valemount, Regional District of Fraser-Fort George, Land and Water BC, and the Ministry of Sustainable Resource Management, in partnership, have identified the need to do strategic level planning to create certainty on the land base for economic development opportunities and protection of existing resources.



Valemount Integrated Land Use Development Planning (ILUDP) area, henceforth referred to as the planning area, consists of eight Landscape Units (LU's) located around the Village of Valemount. The Village of Valemount is located on Highway 5 just southwest of the junction with Highway 16 and Tete Jaune Cache, and 34 kilometres from Mount Robson. The Village lies within the Rocky Mountain Trench, at the convergence of three river valleys: the Camp-Albreda Valley, the Canoe River Valley, and the McLennan-Fraser River Valley. The planning area is bordered by Mt. Robson Provincial Park on the East and Wells Gray Provincial Park on the West. Jackman Flats, Mount Terry Fox, Rearguard Falls, and Foster Arm Provincial Parks are within the boundaries of the plan area (Prov. BC IAMC, 1999).

The planning area is unique in that it includes areas of both the Fraser and Columbia River basin catchments, and encompasses habitat that creates somewhat unique fish and wildlife occurrences. The southern portion of the planning area is situated around the northern third of the Kinbasket Reservoir, which is part of the Columbia River watershed. The Fraser River watershed upstream of Kiwa Creek and Small River are in the northern portion of the planning area.

Within the Valemount ILUD plan area there are seven different biogeoclimatic zones, each having unique vegetation related to climate (temperature and precipitation), nutrient cycling, and soil properties. From valley bottoms to mountain tops, the forested zones are within the Sub-Boreal Spruce (SBSdh), Interior Cedar Hemlock (ICH mm, ICHvk, ICHvk1, and ICH wk1), and the Engelmann Spruce Subalpine Fir

[4] Pictures of Mount Robson courtesy of Mount Robson Provincial Park Photo Gallery at: http://wlapwww.gov.bc.ca/bcparks/explore/parkpgs/mtrobson.htm

(ESSFmm1 and ESSFwc2) biogeoclimatic zones. There are vast areas of un-forested Alpine Tundra (AT) resulting from the presence of the Rocky Mountains, Cariboo Mountains, and Monashee Mountains within the plan boundaries. Within the Alpine Tundra, there are numerous ice fields, icefalls, glaciers, and alpine meadows.

The Robson Valley Land and Resource Management Plan (LRMP) was signed off for approval by the provincial government in the spring of 1999. LRMPs were intended to provide broad direction for the sustainable use of Crown land and resources and designate new provincial parks as part of the Protected Area Strategy. The VILUDP study area encompasses a series of Resource Management Zones (RMZ's) as designated by the Robson Valley LRMP (see Figure 1), that are afforded different resource management emphasis as described below (Prov. BC IAMC, 1999).

> General RMZ's are designated where one use is not to be emphasized over another. The area is to be managed for a wide array of resource values, such as wildlife, recreation, and timber. General use RMZ's within the study area include; Upper Canoe / Premier Range, and the Upper Canoe / Premier Range - Tete Creek sub-zone.
>
> Settlement and Agriculture RMZ's include agriculture and settlement area in the main valley floor of the Rocky Mountain Trench.
>
> Resource Development Emphasis RMZ's areas are identified for intensive development of resources such as timber and minerals. Areas include; West Kinbasket, East Kinbasket, and East Kinbasket – Selwyn sub-zone.
>
> Special Management Zone's (SMZ's) are areas for which the conservation of one or more values are a priority. The intent at the time was that water quality, fish and wildlife habitat, recreation, and scenery protection were given priority in SMZ's. The community watershed for Valemount is included in this category as well as the Rocky Mountain Trench and the Rocky Mountain Trench – Tete Creek sub-zone

Because the LRMP dealt with a very large land base, it does not provide enough detail on strategies to protect landscape level biodiversity. The next planning process introduced by government to deal with Crown land management was Landscape Unit Planning (LUP). The Forest Practices Code of British

Columbia Act (FPC) provided the framework for landscape-level biodiversity management through the Biodiversity Guidebook and the Landscape Unit Planning Guide.

Valemount Integrated Land Use Development Planning (ILUDP) area consists of eight Landscape Units (LU's) located around the Village of Valemount. The Village of Valemount is located on Highway 5, just southwest of the junction with Highway 16 and Tete Jaune Cache, and 34 kilometres from Mount Robson. The eight LU's within the planning area are Kiwa-Tete, Canoe, South Trench, West Kinbasket, Dawson, East Kinbasket, Hugh Allen, and Foster as shown in Figure 2. Since Landscape Units and Resource Management Units were created through different processes and for different reasons, their boundaries do not match. Landscape Units are based on biological features and most of the provincial government's resource information database is oriented to LU's. Therefore LU's are the major reference unit for this report.

3. FISH & WILDLIFE SPECIES IN THE AREA

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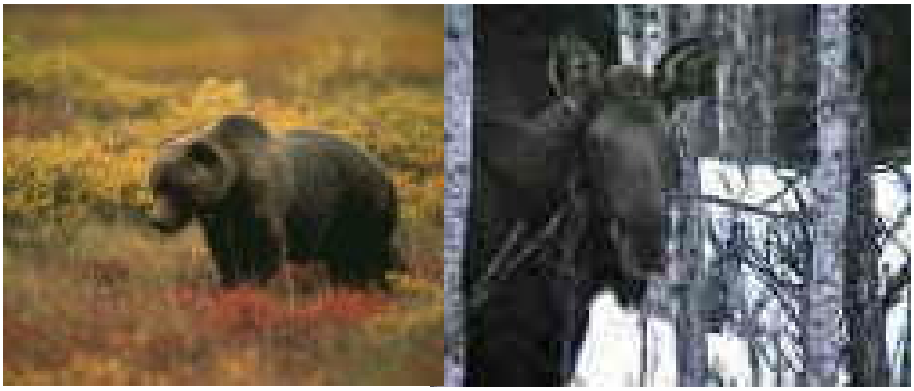


3.1 FISH AND WILDLIFE OVERVIEW

One of the main biodiversity goals identified in the Robson Valley LRMP was the maintenance and, where applicable, the enhancement of wildlife and wildlife habitat (Robson Valley Land and Resource Management Plan (Prov. BC IAMC, 1999). In order to accomplish this goal, one of the identified strategies included species inventories and critical habitat assessment within the Robson Valley. Species inventories are needed to identify both regionally and provincially significant species in order to adequately account for their needs within the overall planning process. Specifically, within the planning area, the Robson Valley LRMP suggested strategies that would address quality and quantity of browse,

[5] Grizzly bear as seen at Kinbasket Lake, "Moose Looking" photos courtesy of Yellowhead Motel website: http://www.yellowheadmotel.com/English/index.html

riparian habitats, and guidelines for critical habitat attributes where ungulate winter range is identified (Prov. BC IAMC, 1999). While fish and wildlife values are becoming more recognized and programs such as Forest Renewal BC, the Mica Fisheries Compensation Program (MFCP), and the Columbia Basin Fish and Wildlife Compensation Program (CBFWCP) have provided a means of collecting important species information, it has only been in recent years that comprehensive species inventory and habitat classification work has been carried out in the planning area.

Species at risk or of concern in the Robson Valley Forest District as identified through the BC Conservation Data Centre (CDC), and regionally important species in the planning area, are located in Table 1 (MWLAP and SRM, 2003). The ranking for each species is based on a scientific standard and is applied by scientists, specialists, and experts throughout the Province (Vennesland, Harcombe, Cannings, & Darling, 2002). The level of threat to a species determines it as any of three colour-coded rankings; red, blue or yellow. As outlined by the Canadian Conservation Data Centre, these colour codes are defined by one or more of five threat ratings: extirpated, endangered, threatened, vulnerable, or non-threatened (MWLAP and SRM, 2003). Red-listed species include those that have been determined as endangered, threatened, extirpated, or at risk of such designation. Extirpated species are no longer located in BC but may be found elsewhere. Endangered species face impending extirpation or extinction, and threatened species are those considered likely to become endangered if there is no change in what is limiting the species. Blue-listed species are those considered under no immediate threat but are vulnerable. Vulnerable species are at risk because of characteristics that make them sensitive to disturbance. Yellow-listed species include any species not designated as red or blue-listed. These species are non-threatened or subject to no immediate risks. Those yellow-listed species included in Table 1 are species that are considered regionally important. This designation is given to species that have very specific habitat requirements or are of higher concern for management purposes. They have been chosen based on their sensitivity to human interactions as determined by their Provincial colour ranking, and their importance to the people of the region.

Regionally important species, as well as those red and blue-listed species threatened by forest practices, are identified under the Forest Practices Code (FPC) as “Identified Wildlife” and are afforded special management guidelines in order to protect critical habitat and habitat threatened by forest harvesting (Ministry of Forests [MOF] and MELP, 1999; Vennesland *et al.*, 2002). Protection for these species can be achieved through both Wildlife Habitat Management Areas (WHMA’s) designated under the Land Act and reserves called Wildlife Habitat Areas (WHA’s) established through the FPC.

Table 1: Major Species and Conservation Status

Scientific Name	Common Name	Provincial List
Fish		
Acipenser transmontanus	White Sturgeon	Red
Oncorhynchus clarki lewisi	Cutthroat Trout	Blue
Salvelinus confluentus	Bull Trout	Blue
Oncorhynchus nerka	Kokanee	Yellow
Oncorhynchus tshawystcha	Chinook Salmon	Yellow
Oncorhynchus mykiss	Rainbow Trout – Yellow fin (phenotype)	Yellow
Birds		
Botarus lentiginosus	American Bittern	Blue
Ardea herodias heodias	Great Blue Heron	Blue
Numenius americanus	Long-billed Curlew	Blue
Accipiter gentiles	Northern Goshawk	Yellow
Haliaeetus leucocephalus	Bald Eagle	Yellow
Mammals		
Rangifer tarandus	Caribou (southern population)	Red
Martes pennanti	Fisher	Red
Myotis septentrionalis	Northern Long-eared Myotis	Blue
Ursus arctos	Grizzly Bear	Blue
Gulo gulo luscus	Wolverine, *luscus* subspecies	Blue
Oreamnos americanus	Mountain Goat	Yellow
Alces alces	Moose	Yellow
Odocoileus hemionus	Mule Deer	Yellow
Odocoileus virginianus	White-tailed Deer	Yellow
Puma concolor	Cougar	Yellow
Lynx canadensis	Lynx	Yellow
Ursus americanus	Black Bear	Yellow

Red = Endangered, Threatened, or Extirpated
Blue = Vulnerable and sensitive to disturbance
Yellow = Non-threatened
* Yellow-listed species that have been included in this list are considered regionally important.

3.2 Fisheries

The rivers and streams surrounding the Valemount area support many regionally important populations of fish species. Red-listed White Sturgeon (*Acipenser transmontanus*) are known to exist within the Fraser River drainage. A small but relatively stable sub-population inhabits the upper reaches of the Fraser River, although the true extent of its range is unknown (Pers. Comm. Ray Pillipow). Blue-listed species such as Bull trout (*Salvelinus confluentus*) and Cutthroat trout (*Oncorhynchus clarki lewisi*) populate many of the surrounding watersheds (Fisheries and Oceans Canada, 2003). The McLennan River and its tributaries boast the farthest migrating Chinook salmon (*Oncorhynchus tshawystcha*[6]) population in interior BC (FISH Wizard, 2003; Per. Comm. With Ray Pillipow). Camp Creek is also an important water-body in the area as it hosts the largest population of Kokanee

(*Oncorhynchus nerka*[7]) spawners in the Canoe Reach of Kinbasket Reservoir (Bray, 2001). Notably, Camp Creek is known to support a population of yellow fin rainbow trout (*Oncorhynchus mykiss*), a phenotype of the popular sport fish, which is considered unique by fisheries biologists and is considered a candidate for protection through a Wildlife Habitat Area under the Identified Wildlife Management Strategy (Per. Comm. Ray Pillipow). In order to manage for these species, especially those sensitive to disturbance, recommendations for the expansion of the riparian reserve and management zones along specific water-bodies have been suggested by numerous studies as discussed later in this document.

3.3 Resident and Migratory Birds:

Resident and migratory birds contribute to the local level of biological and ecological diversity. The Rocky Mountain Trench is a major north/south flyway for migratory birds. A study conducted in 1993 for BC Hydro recorded 204 different bird species within the Robson Valley (Leung & Simpson, 1993). In 1997, Westworth Associates recorded 72 species within the Canoe River / Camp Creek drainage area. It was noted in the study that uncommon species and species that use the area for migration would most likely be underrepresented or un-tallied – thus providing a lower species numbers count then is actually

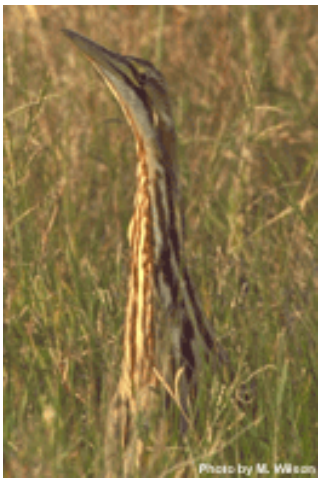
[6] Chinook Salmon battling upstream during spawning migration; courtesy http://www.tnccalifornia.org/news/newsletters/newsletter_spring_2001.asp

[7] Kokanee spawners from http://www.kootenay-country.com

present. Diversity of bird species was noted to be highest in deciduous riparian and aspen-dominated, mixed-wood habitats, and at its lowest in pine and alpine tundra habitats (Leung & Simpson, 1993; Westworth, 1997).

To date, the Conservation Data Centre (CDC) reports that there are three blue-listed species with some level of occurrence within the Robson Valley Forest District: The Great Blue Heron (*Ardea herodia herodia*[8]), American Bittern (*Botaurus lentiginosus*[9]), and Long-billed Curlew (*Numenius americanus*) (MWLAP and MSRM, 2003). Of the three blue-listed species, the Great Blue Heron and the American bittern are most likely to be found utilizing the habitats within the planning area.

The Long-billed Curlew has been noted as occurring within the Robson Valley but recorded sightings have been in the McBride area (MWALP & MSRM, 2003), beyond the boundaries of the current planning area.



Both blue-listed species considered within the planning area, the Great Blue Heron and the American Bittern, depend on marshes, sloughs, and swamps and marshy lakes for either foraging or breeding needs (Fraser, Harper, Cannings & Cooper, 1999). The Great Blue Heron is known to nest in undisturbed mature woodlands near foraging habitat and the most common nesting tree reported for interior populations is the black cottonwood (70%) with Douglas fir being the most commonly used conifer. The American Bittern is slightly more dependent on riparian habitats as it breeds in areas that are wet, densely vegetated, and have abundant forage. American bittern nests are usually well concealed within cattails and bulrush, but occasionally can be found in dry fields or marshes. These species are sensitive to disturbance and pollution and are somewhat threatened by loss of habitat where wetlands are being degraded (Fraser *et al,* 1999).

The Northern Goshawk (*Accipiter gentiles*[10]) has been identified as a species of management concern in the Robson Valley. Northern Goshawks require large areas of old-growth and mature coniferous or mixed coniferous forests

[8] Great Blue Heron as pictured at bcadventure.com (http://www.bcadventure.com/adventure/wilderness/birds/grblue.htm)
[9] American Bittern as pictured at borealforest.org (http://www.bcadventure.com/adventure/wilderness/birds/grblue.htm)

[10] Northern Goshawk as pictured at bcadventure.com (http://www.bcadventure.com/adventure/wilderness/birds/goshawk.htm)

(Ministry of Environment , Lands, and Parks [MELP], 1998). They build nests up to 1.5 m wide in the canopy of large trees in nesting territories that may encompass large areas of old-growth forest. Goshawks will use the same nesting territory for years, alternating between as many as eight nests. Foraging takes place in the surrounding open under-story, forest edges, and riparian areas (MELP, 1998; Westworth, 1997).

[11]The Bald Eagle (*Haliaeetus leucocephalus*), which has been identified by the CDC as a potential management concern in the Robson Valley, is another species whose habitat requirements need to be considered during the planning process. Bald eagles nest in coniferous and occasionally in deciduous or mixed-wood forests near lakes, wetlands, and rivers (Westworth, 1997). During Kokanee spawning surveys done in October of 2000, up to 32 bald eagles along Camp Creek were observed (Bray, 2000). Although no nesting sites have been recorded, large numbers observed during Kokanee spawning in Camp Creek (Bray, 2000) and Chinook salmon spawning in the McLennan River suggest at least a migratory population utilizing the planning area.

3.4 Wildlife

Location of the headwaters of the Fraser River and confined by the Rocky Mountains to the North, the Cariboo Mountains to the West and the Monashee mountains to the South, the Robson Valley is a diverse mixture of habitats and wildlife species (MOF, 2003). Rare and common furbearers and ungulates inhabit the different habitats that can be found within the planning area. Red and blue-listed species include Caribou, Fisher, Grizzly Bear, Wolverine, and the Northern long-eared myotis (MWALP & MSRM, 2003). Yellow-listed species that are considered of management interest in the area include Mountain Goat, moose, white-tailed, and Mule Deer (MOF, 1997).

3.4.1 Mountain Caribou (southern population): *Rangifer tarandus*

Mountain Caribou, an ecotype of Woodland Caribou, are found in the planning area and are considered rare and endangered within the province of British Columbia (MWALP & MSRM, 2003). They have been given special status and management considerations through both provincial and federal legislation. Provincially, Fish and Wildlife Habitat Protection staff developed the "Omineca Region Mountain

[11] Bald Eagle as pictured at bcadventure.com

Caribou Management Zone Strategy of 1990 (Ritchie, 2003). The new federal *Species at Risk Act* (SARA), passed in December of 2002, requires the development and publishing of "A Strategy for the Recovery of Mountain Caribou in British Columbia" (Ritchie, 2003).

Mountain Caribou are sensitive to habitat fragmentation and disturbance, and require large undisturbed areas to survive harsh winter conditions (Ritchie, 2003). Studies have located Caribou utilizing higher elevation areas in winter months, and selected areas have been given the designation of ungulate winter range under the FPC. Caribou prefer high-elevation habitat[12] as they seek security from predators. Large areas are used throughout the year, usually with higher elevations being sought out in the winter and summer, and lower elevations[13] primarily used during the spring and fall (Ritchie, 2003).

The Ministry of Water, Land and Air Protection (MWLAP), formerly the Ministry of Environment , Lands, and Parks, is in the process of identifying and delineating areas of critical ungulate winter range (UWR) throughout the province, including areas within the planning area (Per. Comm. Chris Ritchie, 2003). While UWR and Caribou high or medium value habitat is often referred to in different terms, the processes to designate these are the same. The UWR's that are proposed for Caribou in the planning area can be viewed in Fig. 3. The largest is located along the old Robson Valley Forest district and planning area boundary to the South of Valemount, and encompasses the headwaters of the Canoe River and western side of the Camp Creek drainage (Ritchie, 2003). There are also three areas delineated as proposed UWR at the southern extent of the planning area, located around the Foster Creek drainage and overlapping the Foster Arm Park (Ritchie, 2003).

The objectives to be achieved through UWR designation and identification of caribou medium habitat include maintenance of lichen producing forests, and limiting impacts to Caribou from predators andhuman activities (Ritchie, 2003). In order to accomplish the intent of this management strategy, the

(http://www.bcadventure.com/adventure/wilderness/birds/baldeagl.htm)

[12] Mountain Caribou in alpine tundra courtesy of Peace Williston Fish and Wildlife Compensation Program

[13] Mountain Caribou in old seral pine forest courtesy of Peace Williston Fish and Wildlife Compensation Program

Province prohibits harvesting in Caribou high UWR and imposes restrictions on harvesting of forests in areas identified as Caribou medium habitat. It can also be important to limit the access granted to the public to these areas through road deactivation and managed recreational and industrial access, so that the animals are not stressed by human contact. Strategies such as these limit the opportunity for competing species and predators to become established in areas through human-made roads and trails, and are a key factor in reducing predator impact on Caribou.

Management of Caribou requires a landscape-level approach. Resource use outside critical habitat identified as UWR can still have negative impacts due to the interconnectedness of the landscape. For example, logging blocks identified within the side valleys and low elevation areas adjacent to the UWR will convert mature stands into early seral forest, which will in turn improve the habitat suitability for moose. Improved moose habitat may correlate with increased moose populations, which would increase the number of wolves present. Increased wolf presence equals increased predation risk to Caribou (Ritchie, 2003). With this in mind, habitat protection measures will be considered using a landscape approach within the planning area and the Robson Valley area as a whole.

3.4.2 Fisher: *Martes pennati*[14]

The Fisher is a medium-sized furbearing carnivore that was considered on the blue list in 1999 (Anonymous, 2002; Cannings, Ramsay, Fraser & Fraker, 1999) and has been downgraded to red-listed status since 2002 (MWALP & MSRM, 2003). This change in classification may be a result of a declining population, or studies conducted in South Central British Columbia and other areas making available better information to judge the population numbers. However, fewer than 3000 are estimated to exist in the Province (MWALP & MSRM, 2003). Greater understanding of this species management needs is required for application of proper stewardship practices.

Studies conducted in South Central British Columbia have determined that Fisher should be considered habitat specialists due to their penchant for fulfilling the majority of their life requirements in late successional coniferous forests (Cannings *et al*, 1999; Weir, 1995). The flooding of Kinbasket reservoir,

[14] Fisher photo: copywrite Erwin and Peggy Bauer www.agpix.com/epbauer

and specifically the flooding of the lower Canoe drainage, may have contributed to the rarity of this species within the ILUD area when large areas of riparian habitat were submerged. This mammal is considered vulnerable to habitat loss due to industrial activities including: land-use changes, logging, hydroelectric expansion, and trapping (Cannings *et al*, 1999). Specific habitat needs have been identified as low-elevation riparian systems with older forest characteristics and available home ranges up to 30km^2 with large diameter trees, movement corridors and continuous forest cover. This species will avoid areas that do not provide overhead cover, and in British Columbia studies have shown that riparian cottonwoods are especially important as they may become quite large and contain large cavities appropriate for denning. The prevailing opinion of professionals is that protecting riparian zones is very important for management and stewardship of this species (Cannings *et al*, 1999).

3.4.3 Northern Long-eared Myotis: *Myotis septentrionalis*

The Northern Long-eared Myotis is a blue-listed bat species that although considered widely distributed, has population numbers that are sparse and population trends that are unknown (Cannings *et al*, 1999). This species is associated with both boreal forests and the wet forests of the ICH BEC zone in British Columbia. They are known to nest in buildings and under the bark of trees, emerging at dusk to hunt above small ponds and forest clearings for a variety of invertebrate species. In fall this species is known to move to hibernacula, up to 56 kilometres away, where they hibernate alone or in small groups and where mating will occur (Cannings *et al*, 1999).

Not much is known about this bat and research is needed into all aspects of its life requirements. Research suggests that this is a species dependent on areas of mature forest and is most likely threatened by forest harvesting (Cannings *et al*, 1999). More information is required on the contributing factors and occurrence of hibernacula disturbance. Old wildlife trees are required for day roosts and nursery colonies, and proximity to foraging areas may be an important success factor. Like many species, the protection of riparian habitats and the attributes that they provide may be an important step for managing aspects of this species life history (Cannings *et al*, 1999).

3.4.4 Grizzly Bear: *Ursus arctos* & Black Bear: *Ursus americanus*

Both species of bear, Grizzly and Black Bear, occur within the planning area. While Black Bears are common across the landscape and under no immediate threat, Grizzly Bear are recognized by the CDC as a blue-listed species threatened by the loss of habitat associated with human development (Cannings *et al,*

1999). Because of their nature, Grizzly Bears are sensitive to the encroachment of human development and the fragmentation of their habitats. Fragmentation can result in increased mortality due to direct human interaction and the segregation of individuals from their breeding populations.[15]

Reliant on large home ranges that consist of the right combination of alpine, subalpine mountain forest and lower elevation areas, resource managers need to be aware of practices that may hinder Grizzly Bears from reaching habitats during the appropriate season (Cannings *et al*, 1999).

Interconnectedness and habitat suitability are extremely important when overseeing the placement of new developments in consideration of Grizzly Bear needs for survival. Spring feeding areas on south- facing avalanche slopes, summer alpine refuge, and high-elevation winter denning areas should all be available. The associated corridors and migration routes that link these individual habitat types should remain intact to ensure individuals are not displaced from critical areas of their home ranges.

The Robson Valley LRMP identifies high Grizzly Bear habitat as occurring in many watersheds within the ILUDP area. On the east and west side of Kinbasket reservoir: Foster, Howard, Bulldog, Blackman, and lower Hugh Allan Creeks have high Grizzly Bear values. In the South Trench area: Tete Creek, McLennan, and Swiftcurrent River, and the Mount Robson corridor are identified as high value. The Canoe watershed is identified as having high values in all the forested valleys, except for Camp Creek.

While higher elevation areas may be protected through current land use constraints, it is the important lower elevation and seasonal habitats that remain at risk. Two of the specific strategies identified in the Robson Valley LRMP to reduce the risk to these important habitats is the placement of 100m reserves adjacent to important south-facing avalanche chutes, and enhanced access management (Prov. BC IAMC, 1999). It is through access management that fragmentation is most likely to be mitigated and in some cases avoided, ensuring that individuals are not displaced from key foraging areas.

[15] Grizzly Sow and Cubs photo courtesy of Peace Williston Fish and Wildlife Compensation Program

3.4.5 Wolverine: *Gulo gulo luscus*[16]

Wolverines are wide-ranging carnivores that lead a solitary existence for most of their lives, and are currently considered a blue-listed species in British Columbia (Cannings *et al*, 1999). Most of the published literature regarding this species indicates that individuals will avoid human-made corridors such as highways and right-of-ways And, as a result, these corridors will act as barriers to natural wolverine movement (Cannings *et al*, 1999; Austin, Herrero & Paquet, 1999). Breeding females seem to prefer road-less, undeveloped drainages, as this is the only habitat in which they have been found (Columbia Mtn Institute of Applied Ecology, 2003; Cannings *et al*, 1999).

A wide-ranging species, wolverine and its movements have been known to exceed 30 km in a day, and males tend to have larger home ranges then do females (Cannings *et al*, 1999). While geographic features such as rivers and mountains are no more of a barrier to this species than to any other, selection of travel corridors is most likely greatly dependent on cover (Cannings *et al*, 1999; Austin *et al*, 1999). A study done by Brusnyk in 1997 revealed that use of coniferous riparian habitat by wolverine was high, and this observation fits with what facts are known about this species.

3.4.6 Mountain Goat: *Oreamnos americanus*

[17]

Mountain Goats are not considered a threatened species across the Province of British Columbia. However, this is a regionally important species and its sensitivity to disturbance has required certain

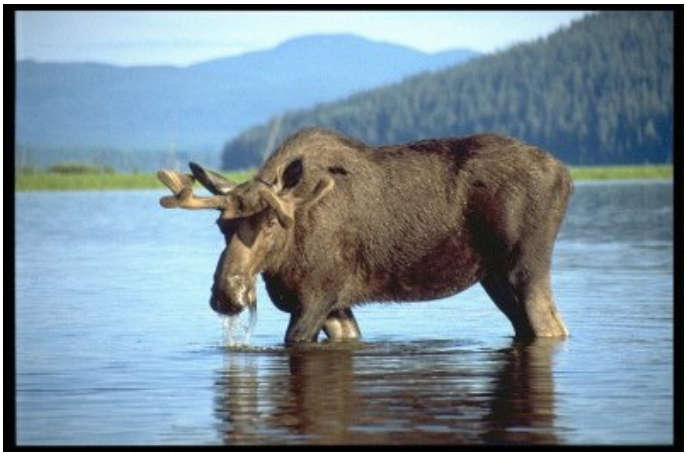
[16] Wolverine photo from http://www.bcadventure.com/adventure/wilderness/animals/wolverine.htm

[17] Mountain Goat photos courtesy Peace Williston Fish and Wildlife Compensation Program
Mountain Goat and kid at mineral lick courtesy of Yellowhead Motel website: http://www.yellowheadmotel.com/English/index.html

management guidelines. Populations of Mountain Goats exist in the East Kinbasket, Hugh Allan, and West Kinbasket Landscape Units. The planning area is subject to a number of different recreational activities including heli-skiing and snowmobiling. Both of these activities are considered extremely disruptive, as Mountain Goats are sensitive to human disturbance. This sensitivity, as well as the need for specific habitat requirements for winter cover, makes this a regionally important species. These specific habitats include older age-class forests located just below the alpine (MOF and MELP, 1997). Mountain Goats will attempt to avoid areas with deep snow - generally any depth greater than 50 cm - and in the interior this means that many goats move from their alpine or sub-alpine meadows to higher elevation forested lands (MOF and MELP, 1997).

In the planning area, Mountain Goat populations of various sizes are known to occur in high elevation areas in the Kiwa, Camp, Kimmel, and Gold Creek areas. The LRMP has also identified populations in the Mt. Thompson, Mt. Blackman, and the Canoe Mountain areas. Ptarmigan, Yellowjacket, Bulldog, Dave Henry, and Swift Creek all have some Mountain Goat use.

The combined attributes of thermal cover and reduced snow depth provided by forested, south facing slopes make such habitats extremely valuable. Other important habitat for this species is escape terrain, including steep rocky cliffs and bluffs. Ideally, kidding areas will be located in terrain treacherous to predators and having food and water nearby (MOF and MELP, 1997). The Robson Valley LRMP has identified enhanced protection and management strategies in order to reduce the risk to these habitats by increased access and disturbance.



3.4.7 Moose: *Alces alces*

Yellow-listed species within the ILUDP area suffer no immediate threats to population numbers; however, regional interest in these species for wildlife viewing and hunting has led to specific management strategies for these species. Moose[18] are one of three yellow-listed ungulate species that are considered important within the Valemount ILUDP area. Moose are only limited in the area by availability of good winter foraging habitat. Recently disturbed areas, meadows, bogs, and marshy areas all provide browse that is considered ideal by this species. Isolated

[18] Bull Moose as pictured at **www.snowfarmers.com/slidesummer/ Moose.jpg**

from all other influences, moose would find ideal habitat throughout the valleys of the Fraser, McLennan and lower Canoe Rivers; however, predation, development, and direct mortality caused by humans does affect moose populations.

Recent disturbance by humans of previously unmanaged stands provides foraging areas for moose, but this disturbance also increases the likelihood of human/moose encounters and mortality. Increased access to areas for logging has developed an extensive road network in the area, which in turn has put hunting pressure on the species. Hunters now have increasingly easy access to habitats previously considered remote and unreachable.

In the winter, moose require lower elevation habitats that provide adequate forage for survival. Unfortunately the majority of suitable habitats within the plan area are located in the valley bottom along the river drainages where settlement has been extensive. The major human transportation corridors that have been built through the valley present migration challenges to this species, as the probability of mortality increases when these corridors separate important habitats.

Low elevation[19], riparian, and open meadow-type habitats need to be considered in conjunction with other species' requirements during the planning phase of development. When overlapping habitat requirements and migration paths are identified, managers can use the information to plan the integration of human development and habitat values.

3.4.8 White-tailed Deer *Odocoileus virginianus* & Mule Deer *Odocoileus hemionus*

Both White-tailed and Mule Deer exist within the planning area and are considered significant as game species. Neither species' populations are currently considered threatened by human disturbance, but it has been recognized that the availability of winter foraging range is a limiting factor for both species (Ritchie, 2003). The Robson Valley LRMP outlines strategies to identify and protect critical winter range within the Robson Valley, as well as to minimize the damage to preferred forage species while maintaining adequate levels of mature and early seral stages across the landscape (Prov. BC IAMC, 1999).

[19] Bull Moose as pictured at **www.valemount.com/ramakada/ photos.htm**

The Ministry of Water, Land and Air Protection is also working to identify areas of winter range for deer through the same legislation as that for classification of Caribou winter range. Once established they will have legal designation on Provincial forest land[20] (Ritchie & Safford, 2003). Currently, there is one candidate Mule Deer UWR identified within the planning area. This UWR is located upslope of the Highway 5 and Highway 16 intersection at Tete Jaune Cache, just south of the Lost Lake recreational area. The area was identified as important for Mule Deer through a study conducted by the Columbia Basin Fish and Wildlife Program (Safford, 2002). Fig. 3: Caribou and Mule Deer UWR within the Planning Area, identifies the location of this candidate UWR.

3.4.9 Cougar: *Puma concolor* & Lynx: *Lynx canadensis*

Feline species known to inhabit the area include both the Cougar and Lynx. Both are relatively solitary creatures, preferring to avoid humans and keep to their respective habitats, although when populations become high they have been known to disperse into more settled areas.

The Cougar prefers montane habitats and will venture into the subalpine depending on food availability. They usually den in a cave or tight crevice between rocks, roaming within their territory and hunting their prey of choice - deer (Fisher, Pattie and Hartson, 2000). Solitary creatures except during mating and when mothers are raising kits, these beautiful animals are rarely seen and appear extremely adaptable. The effects of human development have seemingly little affect on their survivability, with the exception of direct human-caused mortality.

The Lynx is another example of a solitary feline, reliant simply on its ability to find food and adapt to new resource pressures. The Lynx prefers the habitat provided by northern coniferous forests. The availability of fallen logs and dense thickets are desired habitat components (Fisher, Pattie and Hartson,

[20] Doe and fawn as pictured at bcadventure.com
http://www.bcadventure.com/adventure/wilderness/animals/deer.htm

2000). This species relies heavily on the population of Snowshoe Hare, and as a result have been known to follow the "boom and bust" cycle associated with hare populations. Mothers only share their den until the kits are mature enough to venture out on their own. Adult contact within this species is strictly related to mating.

3.5 Summary

When considering all the species that inhabit the planning area, the literature suggests that the protection of old seral and riparian habitats is extremely important for a variety of species at different levels of resource use. Because the tree species and other vegetation produced in riparian habitats can grow larger, denser, and older due to increased moisture and nutrient levels, their value is of extreme importance. As well, riparian areas - as a consequent of their very nature - follow water bodies across the landscape. This in turn provides connectivity from high elevations to valley bottoms and along valley floors. All or some of these attributes are required by most of the previously identified species; hence managing for these areas would provide a significant portion of the required resources for species across the landscape.

4. ENVIRONMENTALLY IMPORTANT AND SENSITIVE AREAS

4.1 Land Designations for Important Wildlife and Fish Habitat areas

As outlined in the fish and wildlife overview, there are a number of different species and associated habitats within the Robson Valley and within the Valemount ILUD planning area. While some species seem to be able to adapt quickly to human activity and landscape changes, and therefore are of less concern to wildlife managers, other species have been identified as requiring special management action. For example, there are species whose habitat requirements are so specialized, and whose habitats have become so rare, that special attention must be given to identifying these specific habitats. Once these areas have been identified resource managers can work towards affording them some form of protection to ensure their endurance, and ensuring that their usefulness is not diminished through degradation of surrounding areas (i.e. that there remains a corridor or connection between specialized habitats and the more common habitat areas).

There are a number of different habitat areas identified as important for wildlife and fish species within the planning area (see Fig. 4). Under the Land Act, protection of environmental or physical biological

features found on Crown Land can be afforded protection through identification of a land reserve or designated area where only uses compatible with the biophysical characteristics of the lands are permitted. The current Robson Valley Crown Land Plan (CLP) was completed in 1985 and updated in 1992. The CLP defines and identifies: five Wildlife Habitat Management Area's (WHMA's), two identified Wildlife Habitat Emphasis Areas (WHE's), seven Recreation Conservation Management Area's (RCMA's), and numerous Natural Environment Areas (NEA's) along important fish production streams within the valley (see Figure 4). Other important habitat areas identified in the planning area include: four proposed Ungulate Winter Range (UWR) areas, Jackman Flats Provincial Park, the Starratt Wildlife Sanctuary, Wells Grey Provincial Park, Mount Robson Provincial Park, and Foster Arm Provincial Park. Each of these land classifications is important to wildlife and fish species for the specific reasons discussed in this document.

[21]

As part of the Robson Valley Reserve Land Plan Project in 1992, WHMA's were identified on Crown land within the Robson Valley and each was subject to inventory procedures and a resulting management plan. WHMA's are areas that maintain habitat in its natural state to provide options for managing regionally important wildlife and fisheries habitats (SEE ME, 1993). WHE's are identified and function to alert people of areas significant for wildlife. RCMA's are lands that were set aside as potential future parks, recreation areas, and for the management of heritage areas. NEA's are sensitive areas that were

[21] Looking west at the Cariboo Mountains from Starratt Wildlife Sanctuary as pictured at http://www.valemount.com/ramakada/photos.htm

identified in order to monitor and assess activities proposed for these areas. A range of activities may be carried out, including selective logging, as long as the integrity of the area is not compromised. Where NEA's have been identified on streams with high fish values there is a requirement of wind-firm green belts as a buffer to any activity. UWR designations are the responsibility of the Ministry of Water, Land and Air Protection, and biologists are currently in the process of identifying and delineating these areas under the auspices of the FPC.

In 1993-1994, the Mica Wildlife Compensation Program and the Wildlife Branch of Ministry of Environment Lands and Parks jointly sponsored "The Robson Valley Wildlife Enhancement Plan Development Project" (WEPDP), to identify high quality wildlife habitat areas that exist on private land within the Robson Valley (SEE ME, 1994). Although the information generated provided managers with knowledge regarding important habitat areas, the provincial government did not follow through with the purchase of any of the identified lands. Currently these areas remain privately owned and therefore beyond current management legislation.

4.2 Key Wildlife Habitat Areas

As discussed in detail later in this section, the VILUD planning area contains a number of different habitat areas identified as important, primarily for ungulate species. The habitat most likely to be a limiting factor for ungulates is winter foraging range. Moose and deer are unable to thrive at elevations greater than 1000 m in the winter, as the snow-pack limits the ability to move quickly and locate adequate food supplies. Caribou species do not have this constraint and rely heavily on high elevation, older forests in winter months for protection against predators and a sufficient food source.

There are four Caribou UWR's currently proposed for the plan area, the largest of which encompasses a considerable portion of the Canoe River, including its headwaters. The area extends from the outer boundary of the planning region to the area around Albreda (Ritchie, 2003). The remaining three UWR proposed areas are located in the Foster Landscape Unit. They are all located within proximity of Foster Arm Provincial Park; one almost completely overlapping the park boundaries.

Deer and Moose winter range in the Camp – Albreda valley is considered to occur only at lower elevations along the highway corridor (Spencer Environmental Management Services Ltd., 2002). A WHE has been identified along Camp Creek and the associated valley bottom where deer wintering range occurs (Spencer Environmental Management Services Ltd., 2002).

The Canoe River meanders through a flat area at the base of Canoe Mountain, periodically flooding and disturbing the surrounding vegetation and creating a dynamic system ideal for ungulate species and their predators. This area has been described as important for wildlife and wildlife movement (Norecol, 1992; Spencer Environmental Management Services Ltd., 2002; Thompson Forest Management and Forestscape Consulting Ltd., 2002).

There are a number of different wildlife features within this area, most of which are captured within existing WHMA or WHE designations. WHMA 7390 is located along the Canoe River and encompasses an area of semi-bog, riparian grassland, with little forested area (SEE MEc 1993). White-tailed Deer utilize this area and doe with fawn have been known to make use of the southern portion of the area that abuts a bench of pine-forested land. It is also considered good Moose winter habitat and Black Bear utilize the land along the Canoe for forage in the summer and fall (SEE ME, 1993). Located at the base of Canoe Mt. along the reservoir, is a WHE that encompasses an area known as East Ponds where Moose and Deer are known to travel for fresh water (Thompson Forest Management et.al, 2002). There is a deer rutting and calving site near the northeast end of the reservoir. A wolf den has been reported in close proximity to WHMA 7390 as well. Other records have also stated that Grizzly Bear can occasionally be seen from the Forest Service Road along the sides of the reservoir and in the avalanche tracts of the mountains that slope down towards Kinbasket Lake (Thompson Forest Management et al, 2002).

North of the lower Canoe River, the McLennan River flows into the town of Valemount, joins with Swift Creek, and then proceeds to drain north into the Fraser River. This river is important, as mentioned previously, because of its contribution to the sustainability of the furthest travelled spawning population of interior Chinook Salmon. During spawning season carcasses act to attract many different wildlife species, and those that are not consumed enrich the surrounding lands with nitrogen and other nutrients. Black Bears are suspected of utilizing this food source during the fall, and many other species would potentially benefit. Eagles, Coyotes, Marten, and other opportunistic omnivores may take advantage of this food source.

Located north of Valemount and just south of Jackman Flats is the second WHMA that provides wildlife habitat features. WHMA 883 is 256 ha and covers a variety of habitat types that support a diverse number of species (SEE MEd, 1993). The area consists of low level river channels, old oxbow meadows, and esker uplands. Large mammals known to use this area are Mule and White-tailed Deer, Moose, Elk, Black Bear, and Cougar. The mixture of riparian and forested uplands makes this area attractive to many

species for forage and it is considered a "winter range on which animals from surrounding areas depend" (SEE MEd, 1993). Private land that abuts this WHMA was identified as a candidate for purchase by BC Hydro in 1994 under the Robson Valley Wildlife Enhancement Plan Development Project because of its unique habitat features (SEE ME, 1994), but this suggestion has never been acted upon. The parcel of private land extends north of WHMA 883, encompassing a portion of Lower Hogan Creek, several sections of marsh and swampland, and stops just below the southern boundary of Jackman Flats Provincial Park. Great Blue Heron have been sighted in the area in spring and fall, and the area is considered one of the most-used moose habitat areas within the Robson Valley (SEE ME, 1994).

At the confluence of Tete Creek and the McLennan and Fraser Rivers is the third WHMA with important wildlife attributes. WHMA 3155 is 120 ha surrounding a complex arrangement of islands, deltas, marshlands and forested uplands (SEE MEa, 1993). A valuable White Spruce riparian area exists in a backwater of the Fraser River within this area (Leung and Simpson, 1993). Believed to contain high habitat diversity, including an ungulate migratory corridor and winter range, this WHMA provides much more than just protection of salmon habitat. Great Blue Heron have been noted as utilizing this area for nesting and Bald Eagle use is extremely high during the salmon spawning season (SEE MEa, 1993).

It is believed that wildlife, including ungulates, bear and other mammal species utilize WHMA 3155 as a component for movement from the Upper Fraser River wetlands, or the uplands of the Mount Robson area, to the lower elevation Fraser and McLennan Rivers (SEE MEa, 1993). Dispersal, migration, forage, and any other number of reasons can influence animals to move from one area to another, and habitat as supplied by this WHMA is critical. The large trees located on the islands and along the river banks provide important habitat requirements for many species sensitive to cold temperatures and deep snow pack, and the quality browse that is available attracts ungulate species to the area (SEE MEa, 1993).

4.3 Key Fish Habitat Areas

There are specific requirements of fish species that must be met in order to fulfil certain life stages. From spawning gravels which can be very limiting, to the ideal habitat sought by adults, fish species can depend on a variety of different habitat types throughout their life span. For example, Kokanee will return to spawn in their brood stream in the fall, laying thousands of eggs into a redd constructed of gravels that will allow aeration and survival of their young. Temperature is extremely important in determining the emergence timing, and once hatched the young will require rearing habitat that will protect them from predators and provide enough food so that they will remain healthy and competitive

once they reach open water. Universal for most fish species, these requirements are dependant on factors that extend beyond the banks or the wetted edge of streams.

Riparian vegetation is extremely important for maintaining the quality and quantity of fish habitat that is available. Roots strengthen banks and help reduce or prevent erosion. Leaves support insects and these, in turn, provide fish species with food. Fragments from the vegetation also provide a food source for fish species, while enriching the water with organic matter. Shade from the branches and leaves protect the water, keeping it cool, and once they have died, these structures fall into the water and provide complexity to the aquatic environment. Overall, it is important to have diverse vegetation and associated structures in order to provide fish species with all the requirements needed to utilize a water body. Suggested protection of riparian vegetation in the planning area will benefit all species known to utilize these systems, including: Bull trout, Yellow-fin Rainbow Trout and the sports fish occurring in the reservoir.[22]

The McLennan River, Swift Creek, and Fraser River are all known important fish-bearing streams and have associated NEA designation. There are known Chinook Salmon spawning areas within these water bodies and popular public viewing areas include a recreation site on the Fraser River by Tete Jaune Cache and on Swift Creek in George Hicks Regional Park, adjacent to the Village of Valemount. The observation platform in George Hicks Regional Park is maintained by the village of Valemount and is operated for public education and viewing of spawning Chinook Salmon. The Crown land around the spawning grounds at Tete Jaune Cache has been identified for protection under WHMA designation.

There are two WHMA's with significant fisheries values that have been identified within the Tete Jaune Cache area. WHMA 3155, is located at the confluence of the McLennan and Fraser Rivers where the largest Chinook salmon spawning grounds in the Upper Fraser River have been identified (SEE MEa, 1993), and the other, WHMA 6012, is located downstream of Tete Jaune Cache on the south side of the river near an old side channel (SEE MEb, 1993). The downstream side channel is very important for salmon populations as it provides critical habitat for young migrating salmon seeking refuge from high water and access to rearing habitat in the spring before starting their long journey to the ocean.

The largest spawning population of Kokanee within the Canoe Reach of Kinbasket Reservoir is known to spawn within Camp Creek, and are considered a regionally important population. Resource managers should be aware of the key spawning areas for this species. There is a natural fish barrier 13 km upstream

on Camp Creek and this is the extent of the range for this species. Where Camp Creek connects with Canoe River and continues to flow into Kinbasket Reservoir, there are a number of areas considered important to fish. There is NEA designation on public lands along Camp Creek and Canoe River, as identified in the existing Robson Valley Crown Land Plan, however it is felt at this time that increasing the riparian buffer width would provide greater protection for this system.

Within the planning area there are a number of fish species that are considered important for the local area and these species need to be examined, and known occurrences of important habitat needs to be recorded. Substrate, water body size, and the riparian elements that influence stream productivity must be considered when determining suitability of a stream section for fulfilling life stages of these fish species. Riparian health is an important contributing factor in the health of fish populations. As riparian health is degraded by development activities, sensitive fish species are put under stress.
[23]

4.4 Riparian Buffers

Riparian areas occur next to the banks of streams, lakes, and wetlands, and include both the area dominated by continuous high moisture content and the adjacent upland vegetation that is influenced by the moisture. Plant diversity and structural complexity resulting from the proximity to water provide many different habitats in a relatively small area. Riparian areas are also highly productive for wildlife as a result of the plant communities and water associated with them. (Stevens, Backhouse, & Eriksson, 1995). Most of British Columbia's amphibians spend some part of their life cycle in riparian habitats.

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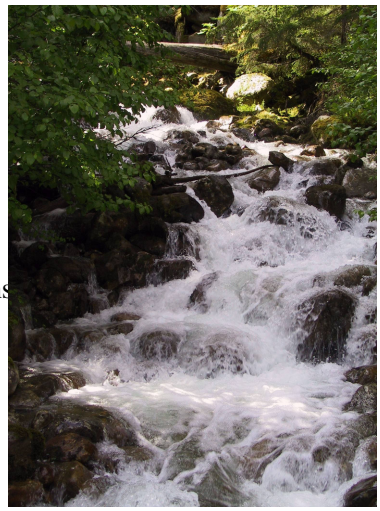
[22] Chinook Salmon spawning in McLennan River courtesy of Yellowhead Motel website: http://www.yellowheadmotel.com/English/index.html
[23] Swift Creek Backwater channel as pictured at http://www.yellowheadmotel.com/English/scenery.htm

Riparian areas frequently contain the highest number of plant and animal species found in forests, and provide critical habitats, home ranges, and travel corridors for wildlife. Biologically diverse, these areas maintain ecological linkages throughout the forest landscape, connecting hillsides to streams and upper headwaters to lower valley bottoms. There are no other landscape features within the natural forest that provide the natural linkages of riparian areas. (Province of BC, 1995).



Within the plan area, the riparian areas of the Columbia River system are very different than the riparian areas of the systems in the Fraser River watershed. The flooding of McNaughton Lake to create Kinbasket reservoir removed most of the riparian habitat in the planning area that is part of the Columbia basin catchments. There is very little true riparian habitat[24] along the reservoir itself due to significant water level fluctuations as the reservoir level varies for the purpose of generating hydroelectric power. The tributaries that run into the reservoir all have narrow channels and deeply incised slopes, limiting their value as habitat to very narrow strips. Such limitations make what riparian habitat is left in the Columbia River catchment and surrounding area that much more valuable. The Canoe River and Camp Creek systems do have valuable floodplain habitat where mature coniferous and mature mixed forest still exist (Norecol, 1992).

The McLennan River drainage (part of the Fraser River catchment) flows through the Valemount Valley and supports a relatively large riparian area that is unique within the plan area. It is a convenient avenue for movement providing access to the Fraser, a passage between habitats, and a source of refuge and sustenance at different times of the year. A NEA has been designated along the length of the McLennan River where the land remains in Crown ownership. Due to the rarity of this habitat, additional protection is desirable (Leung and Simpson, 1993).Under the FPC, varying degrees of protection are afforded to riparian areas based on stream classification dependent on the width of the water body and the presence or absence of fish. The Riparian Management Area Guidebook outlines the standards for riparian protection, identifying two levels of protection based on the stream classification. A Riparian Reserve Zone (RRZ) shall be placed adjacent to the stream channel where the channel width is greater than 1.5m, absence of fish has not been confirmed by an appropriate inventory, or where the stream is considered part of a Community watershed. The width of the RRZ is dependent on the width of the water body and harvesting shall not be permitted in the RRZ. In addition to the RRZ, all streams shall have a Riparian

Management Zone, regardless of channel width or presence of fish. Only the width of the Riparian Management Zone is determined by the channel width. Some constraints to harvesting shall be applied within the Riparian Management Zone. Where both a RRZ and a Riparian Management Zone exist they are considered a Riparian Management Area (RMA).

Table 2 and 3 refer to FPC classification of streams. Determined by the width of the stream and the presence and absence of fish as follows: S1 is a fish-bearing stream greater than 20 m wide; S2 is fish-bearing and less than 20 metres wide, but greater than 5 metres wide; S3 is fish bearing and less than 5 metres wide, but greater than 1.5 metres wide; S4 is fish bearing but less than 1.5 metres wide; S5 is non-fish-bearing and greater than 3 metres wide; while and S6 stream is non-fish bearing and less than 3 metres wide.

[24] One of many small tributaries that flows into the valley bottom of the plan area – heavy cobble, steep terrain and incised slopes.

Table 2 Classified Streams in the Fraser River Watershed area of the ILUDP Area

Waterbody	**Classification Under the FPC**	**FPC RRZ width**	**FPC RMZ width**	**FPC Total RMA width**	**LRMP Recommended[2]**	**Other Studies*,[5,7]**
Fraser River	S1	0	100	100	50 RRZ and 50 RMZ	Norecol-b 1992[1] Leung and Simpson 1993[4]
Kiwa Ck	S1	50	20	70	None	
Tete Ck	S1	50	20	70	None	Norecol-b 1992[1] Leung and Simpson 1993[4]
McLennan River	S1	50	20	70	60 RRZ and 20 RMA	Norecol 1992-b 1992[1] Leung and Simpson 1993[4] Westworth Assoc- a&b, 1997[6&8] Spencer Env, 2002
Hogan Creek	S3[z]	20	20	40		Westworth Assoc- a&b, 1997[6&8] Spencer Env, 2002
Teepee Creek	S2	30	20	50		Westworth Assoc- a&b, 1997[6&8] Spencer Env, 2002
Crooked Creek	S3[z]	20	20	40		Westworth Assoc- a&b, 1997[6&8] Spencer Env, 2002
Swift Ck **Community watershed**	S1	50	20	70	none[3]	Norecol-b 1992[1]

- **Other studies noted here have suggested that the current protection of riparian areas under the FPC is not adequate for species other than fish and as such have encouraged the expansion of this protection. Exact recommendations may not have been stated.**
- [z] – classification was calculated using Trim II digital information. Once additional information is forthcoming, this will be confirmed or altered.

Table. 3 Classified Streams of the Columbia River Watershed within the ILUDP Area

Waterbody	**Classification under the FPC**	**FPC RRZ width**	**FPC RMZ width**	**FPC Total RMA width**	**LRMP Recommended[2] & 3**	**Other Studies[+,1,7]**
Canoe River	S1	50	20	70	same	Leung and Simpson, 1993[4] Westworth Assoc.-c 1997[5] Westworth Assoc-a 1997[6] Spencer Environmental, 2002[9]
Camp Ck	S1	50	20	70	Same**	Leung and Simpson, 1993[4] Westworth Assoc.-c 1997[5] Westworth Assoc-a 1997[6]
Gold Ck	S3	20	20	40	None	Westworth Assoc.-c 1997[5] Westworth Assoc-a 1997[6]
Kimmel Ck	S2	30	20	50	None	Westworth Assoc.-c 1997[5] Westworth Assoc-a 1997[6]
Zillmer Ck	S2	30	20	50	None	Westworth Assoc.-c 1997[5] Westworth Assoc-a 1997[6]
Packsaddle Ck	S1*				None	Westworth Assoc-c 1997[5] Westworth Assoc-b 1997[6]
Dave Henry Ck	S2*	30	20	50	None	
Yellowjacket Ck	S2*	30	20	50	None	
Bulldog Ck	S2	30	20	50	None	
Ptarmigan Ck	S1*	50	20	70	None	
Hugh Allan Ck	S1	50	20	70	None	Westworth Assoc-b 1997[8]
Blackman Ck	S2	30	20	50	None	Westworth Assoc-b 1997[8]
Iroquois Ck	S5	0	30	30	None	
East Iroquois Ck	S5	0	30	30	None	
Foster Ck	S1	50	20	70	None	

+ Other studies noted here have suggested that the current protection of riparian areas under the FPC is not adequate for species other than fish and as such have encouraged the expansion of this protection. Exact recommendations may not have been stated.

***** Stream classification calculated from inventory cards done by Aquatic Resources Limited, 1992.

****A portion of the riparian zone on Camp Creek is already at risk due to the proximity of Highway 5, railroad line, and transmission corridors for natural gas and electricity.**

FPC-designated Riparian classifications are implemented on Crown land only. On private land, the regulatory protection of riparian areas comes from the Regional District. Development permits are one tool available to local governments, which can place restrictions on location of development for the protection of riparian area habitat. The Federal Department of Fisheries and Oceans, affords protection to riparian areas through Section 35 of the federal Fisheries Act. This section does not provide the same detail as the FPC but prohibits the harmful alteration, disruption, or destruction of fish habitat unless authorized by the Minister.

Other studies and planning documents may have identified additional protection to be given to water bodies or increased riparian buffers for connectivity reasons as noted in Table 2 and 3 with rationale provided in Appendix 4

The Rocky Mountain Trench is a major north-south flyway for migrating birds, including waterfowl, other aquatic birds, raptors, and songbirds. Riparian areas and wetlands play a major part in the success of migratory birds reaching their breeding grounds as they provide "migratory connectivity" between breeding and non-breeding areas (Webster, Marra, Haig, Bensch and Holmes, 2002). As well as facilitating migration, riparian habitats are used by some species for breeding and the late summer moulting period (Norecol, 1992). Both the blue-listed Great Blue Heron and American Bittern have been observed in riparian areas within the boundaries of the planning area ((MWLAP and MSRM, 2003).

Leung and Simpson (1993) identified in their study that wetlands, riparian habitats, and mature mixed deciduous or old-growth forest provided habitat for the greatest number of bird species in the Robson Valley. They also identified that these habitats have a restricted distribution and occurrence and are the habitats most threatened by human activities. They recommend that lowland riparian and old-growth forests need protection in the Robson Valley because of their rarity and the value of the habitats they provide for a wide range of species, and specifically identify Cottonwood and Spruce as species that should be protected wherever possible.

The valley bottoms of both the Fraser and Columbia rivers have been altered by land clearing, logging, and agricultural use of the area. These areas provide suitable habitat for a variety of birds of prey including Bald Eagle, Osprey (*Pandion haliaetus*), American Kestrel (*Falco sparverius*), and a wide variety of hawks and owls. (Norecol, 1992).

Domestic Water Use

In British Columbia all water is owned by the Crown. The two pieces of legislation that impact domestic water users include; the Water Act which provides authority for permission or rights to use surface water through licensing or approval documents obtained through Land and Water British Columbia Inc (LWBC) and the Drinking Water Protection Act which provides for safe water used for human consumption, food preparation or sanitation.

In the planning area, there are a large number of licenses issued for either domestic, irrigation, or waterworks purposes (See Figure 5: Points of Diversion within the Planning Area). Licences can also be issued for purposes including: industrial, power, conservation, mining, stock watering and land improvement. A water licence holder is granted rights to take a specific quantity of water from a stream for a designated purpose, on a specified parcel of land, at the time of year designated that water may be diverted and used.

 [25]

Because of the large number of surface water users in the area, the provisions of the Drinking Water Protection Act also has an impact on land use practices. In Part 4 of the Drinking Water Protection Act, contamination of drinking water or tampering with any part of a domestic water system is prohibited and there are requirements to report threats to drinking water; provisions for hazard abatement and prevention orders, and powers are given to a drinking water officer to prevent or remediate any drinking water health hazard.

Land management and resource use activities may impact on water users, water quality or quantity, and land or structures located in or near streams. Resource extraction may occur within a watershed creating a downstream impact on water licensees. Because of these possible impacts, recommendations coming out of the Robson Valley LRMP identified a strategy to provide additional protection to stream banks above what may result from the FPC. The LRMP strategy is to establish a minimum 20-metre reserve zone (RRZ) and 30-metre machine-free management zones on the main creek upstream of known domestic water intakes (Table 4, Fig. 5). This provides protection greater than for S2 classified streams because of the larger machine-free zone. The Drinking Water Protection Act was brought into legislation since the sign-off of the LRMP, and while it has the same intentions as the LRMP recommendations, it is not as prescriptive. It does take precedence over the LRMP.

[25] Independent power producer located west of Valemount courtesy of the Ministry of Sustainable Resource Management.

4.6 Jackman Flats Provincial Park[26]

Located approximately 10 Km north of Valemount along Highway 5, Jackman Flats is a beautiful and unique ecosystem. Representative of the dry, xeric site series of the SBS dh biogeoclimatic sub-one, the area consists of sand dunes across a relatively open landscape with a mixed array of plant species. Low moisture and nutrient levels in the sandy soil make Jackman Flats an extremely harsh environment for many plant species, and as a result only the most hardy can survive in this area. There are two communities of plants that are found nowhere in British Columbia except within Jackman Flats and these have been identified as red-listed – rare and endangered – by the British Columbia CDC (MWLAP and MSRM, 2003; Park Finder, 2003). In sharp contrast to the desert like conditions of the sand dunes, swamp communities can also be found here, making this area extremely rich in biodiversity (MWLAP and MSRM, 2003; Park Finder, 2003).

Although not considered the most suitable wildlife habitat, the park is home to mammals such as Moose, Deer, Coyote, and Marten. Grizzly Bear have been historically present in the area as well. It is also recognized that the park serves as an important wintering range for ungulate species. The park is also a good place for people to bird watch and approximately 40 species of birds have been identified in the park.

4.7 Robert W. Starratt Wildlife Sanctuary: (also known as Cranberry Marsh)[27]

Starratt Marsh is located immediately adjacent to the southern boundary of the Village (approximately 1.6 km from the centre of Valemount) along Highway 5 South. It was originally designated as a wildlife sanctuary in 1969 when the area was recognized for its wildlife habitat value. With the loss of high value riparian wetlands occurring with the creation of the Mica Dam, this area was designated to mitigate the loss of waterfowl habitat. In the early 1980's Ducks Unlimited Canada completed extensive enhancement works within the marsh, including dyking and creating two areas where water levels could be controlled (Mol, 1992).

Habitat assessment of the marsh was conducted in 1992 by Norecol Environmental Consultants Ltd. Norecol provided some clarity on utilization of the marsh by species identified as red or blue-listed and/or important to

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[26] Pictures of Sand Dunes and lichen flats courtesy of Jackman Flats Provincial Park Photo Gallery at http://wlapwww.gov.bc.ca/bcparks/explore/parkpgs/jackman.htm

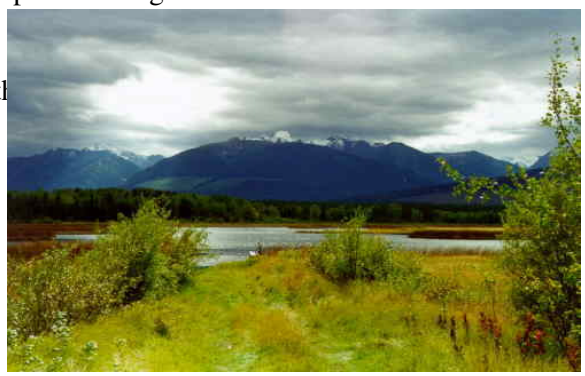
[27] Photo 1: Looking east towards the Rocky Mountains from Cranberry Marsh; Photo 2: Wildlife viewing tower in Cranberry Marsh
Pictures courtesy of http://www.yellowheadhighway.com/2001/june%2028/june28b.htm

the area. Through identification and assessment of habitat within the marsh and personal communications with local residents, the field team from Norecol were able to identify the utility of the marsh to various bird and wildlife species.

Today, this remnant of a flat-bottomed lake provides refuge to a large number of migratory and resident birds as well as providing habitat for locally important ungulate species. While there has not been an extensive record of wildlife presence and use within the marsh, it is an area that has been noted to provide habitat for a number of different species (Mol, 1992; Norecol-a, 1992). The area attracts naturalists, bird watchers and lovers of nature with its simple beauty and trail systems. At least 96 bird species have been observed within the marsh according to Mol's report in 1992, and the list is neither complete nor completely accurate because there were no formal records kept and all observations are incidental or taken from local bird watchers (Norecol-a, 1992; Mol, 1992). While there are many bat species that could potentially inhabit the area, actual utilization of the marsh by bat species is unknown.

has been identified as existing in the area of Valemount and as a blue-listed species, identification and protection of potential habitat is important. The Starratt Marsh produces an abundant food supply from spring to early fall (insects) and the mixed forest that borders the marsh provides opportunity for roosts in hollow trees and cavities (Norecol-a, 1992). Also of significance is the presence of two blue-listed species in the marsh; the Great Blue Heron and the American Bittern (Norecol-a, 1992). Anecdotal evidence places both species within the marsh, and the Great Blue Heron has been recorded by Ducks Unlimited Canada. The wetland complex would support feeding habits of both species and the American Bittern may even breed within the marsh.

Ungulate species including Moose, White-tailed, and Mule Deer, occur within the area and utilize the marsh and its surrounding areas (Norecol, 1992). Moose are known to frequent the south side of Cranberry Marsh and the mixed forest provides suitable habitat for all three ungulate species. Large mammals such as Black Bears and Coyotes are common in the planning area and are expected to utilize the marsh[28]. Black Bears probably utilize the south and west sections of the uplands around the marsh and Coyotes were believed to range extensively throughout the marsh and its surrounding area (Norecol, 1992). Many furbearers common within the Province can also be found within the marsh, including: Ermine, Long-tailed weasel,



[28] Starratt Wildlife Sanctuary aka Cranberry Marsh looking East to the Rocky Mountains Photo as pictured at http://www.valemount.com/ramakada/photos.htm

Muskrat, Beaver, Chipmunk, Porcupine, Red Squirrel and various rodents (Norecol, 1992).

4.8 Other Protected Areas of Interest in and Adjacent to the Study Area

The uniqueness of the Rocky Mountain Trench geography and its ecosystems promotes an environment rich with rare and significant ecological features; subsequently, the Robson Valley is home to many parks and protected areas. Within the planning area are four Provincial Parks; Jackman Flats, Mt. Terry Fox, Rearguard Falls, and Foster Arm. Due to its unique ecological values, Jackman Flats has been discussed in greater detail than Mt. Terry Fox, Rearguard Falls, or Foster Arm. The planning area spans the Rocky Mountain Trench between two of the Province's better-known Provincial parks. Adjacent to the northeast and southwest boundaries of the planning area are Mount Robson Provincial Park and Wells Grey Provincial Park, respectively.

Mt. Terry Fox was created in September of 1981 in memory of Terry Fox and serves as a memorial and scenic attraction. Rearguard Falls is a relatively small park located on the south side of Highway 16, just before Mount Robson Provincial Park. This small park consists of a scenic trail that leads to a viewing platform. In late summer and early fall visitors can view Chinook Salmon at the end of their 1,200 km trek from the Pacific Ocean as they encounter the virtually unsurpassable barrier of Rearguard Falls. Foster Arm is also a relatively small park that is located at the southern end of the study area, and has been protected due to the occurrence of Western White Pine. The entire park is classified as high Caribou habitat, with a proposed UWR overlapping the majority of its area. It is considered to be good Grizzly habitat, with the western side classified as high and the eastern side classified as moderate for population density. Foster Arm Provincial Park has fisheries values limited to the lakeshore of Kinbasket reservoir due to its terrain and the limited number of small creeks (Prov. BC IAMC, 1999).

Mount Robson Provincial Park is the second-oldest park in British Columbia and was established in 1913. Currently, forty-two species of mammals, four amphibians, one reptile and one hundred and eighty-two species of birds have been recorded in the park. From its valley bottoms to the top of the highest peak in the Canadian Rocky Mountains, Mount Robson Provincial Park provides a full representation of landscape diversity., and is part of the Canadian Rocky Mountains World Heritage Site. Swiftcurrent River was recently added to Mount Robson Provincial Park and is located along the western boundary of the park, north of Tete Jaune Cache. The majority of the Swiftcurrent River drainage has been identified as sensitive for Mountain Goats. Ungulate winter range for Deer, Moose, and Elk is known to occur at the mouth of the Swiftcurrent River and along the

Fraser River, and the same area is known to be summer range for bears. Grizzly Bear habitat in forested regions is considered high, while alpine areas have been rated low for Grizzly Bear densities (Prov. BC IAMC, 1999).

Wells Grey Provincial Park was established in 1939 and has had several lands added to it since that time. Extinct volcanoes, mineral springs, glaciers, and waterfalls are only a few of the many natural attractions that can be found in the park. Excellent examples of dense forest and wildlife species abound throughout the park and its many different habitats.

Finally, it must be recognized that the parks and species inhabiting them can be significantly influenced by activity outside of the parks' boundaries. Therefore for gateway communities such as Valemount, it is critically important that there be open and ongoing discussion between the Village and parks staff regarding park management issues.

4.9 Mount Robson Ecosystem Management Planning and Mountain Pine Beetle.

A Mount Robson Provincial Park Ecosystem Management Plan (2000) recommended that the following three inter-related ecosystem management issues needed to be addressed: seral stage distribution, Mountain Pine Beetle hazard, and fire hazard. 1913-1915 fires created an even-aged forest over a significant area within the main valley and travel corridor through the park. Effective fire suppression has maintained this distribution. Since 1996 it has been well documented that these forests are currently susceptible, and will increase in susceptibility to Mountain Pine Beetle. The Mountain Pine Beetle has been active in or adjacent to the park since 1997 and the infestation continues to grow. A fire management strategy was developed which divided the affected area into three management zones: Suppression Zone, Prescription Zone and Natural Zone. In 2000 a prescribed fire planning process was undertaken to address the three inter-related issues identified above within the Prescription Management Zone. A detailed burn prescription was developed. Over the past four years fire weather indices were in prescription, but lack of funding and/or availability of resources has precluded the implementation of the burn plan.

5. WILDLIFE MOVEMENT IN THE STUDY AREA

5.1 Wildlife Movement Corridors: Connectivity, Urban Development and Resource Extraction

Human beings affect the natural flows of nature. Forestry, agriculture, and settlement-related development radically change the natural state of the landscape. Historically, the designation of conservation and reserve areas has been applied to landscapes; however human modification continues to contribute to an overall loss and fragmentation of natural ecosystems and habitats.

Habitat fragmentation isolates populations adversely affecting species, especially those at greater risk to extinction because of their small numbers. As these populations disappear from the land there is a reduction in biological diversity (Rosenberg, Noon & Meslow, 1997; Dawson, 1997; Wilcove, 1986). Sustaining linkages between habitats allows organisms to disperse and move across the landscape, effectively revitalizing and maintaining genetic complexity within populations. Connectivity across the landscape is essential for ecological systems to remain healthy, alive and functioning (Dawson, 1997).

Ecologists recognize that there exists interconnectedness between populations of species, and that some of these species require linkages between habitats for fulfilment of life requisites (Dawson, 1997). Corridors are important components of landscape structure. Usually remnants of naturally occurring vegetation, these 'corridors of green' link contiguous patches of undisturbed habitat and facilitate the movement of individuals or their genes (Dawson, 1997). Forage, seasonal habitat, mating, and dispersal are all reasons for wildlife species to move throughout the landscape and from habitat to habitat. Each of these is a necessity that, if not provided within a single habitat, must be accessed through some form of movement or migration.

Protecting the existence of natural corridors has been suggested to promote ecological processes and to benefit both regional and local biodiversity (Rosenberg *et al*, 1997). The importance of reserve patches for the persistence of organisms is recognized by many, and the equally important concept of interconnected landscapes and biodiversity is becoming increasingly accepted by managers (Dawson, 1997; Rosenberg *et al*, 1997). Multiple reserves connected by corridors can offer regional solutions to protecting many different species (Dawson, 1997; Wilcove, 1986). Studies on the importance of landscape connectivity repeatedly conclude that isolation of small populations will certainly lead to reduced fertility and survivability of species (Dawson, 1997; Rosenberg *et al*, 1997). Where small habitat islands have maintained linkages to large tracts of forested land, studies have shown that inhabitants are more likely to persist (Dawson, 1997; Rosenberg *et al*, 1997).

Much of the forested lands within the study area have been impacted by some form of human use – settlement; agricultural, or forestry activities, and recreational use. As resource extraction activity continues, new developments (e.g. Canoe Mountain Resort) are built and the population of the area increases, increased landscape alteration will occur. As noted above, corridors of undisturbed vegetation situated in landscapes that have been modified by humans provide a path for the movement of organisms. The likelihood of use increases as the degree of modification and natural habitat destruction increases in the surrounding landscape. In order to avoid fragmentation and possible extinction of species it is important for land managers to include corridor design in their landscape level planning (Rosenberg *et al*, 1997; Wilcove, 1986). Recognition of natural movement patterns, and plan development with understanding of local species may alleviate some threats to biodiversity, especially those posed by isolation. Conscious effort must be given to preventing the loss of biodiversity, especially in those instances where opportunity exists to be proactive, planning alterations rather than salvaging the remnants of development (Dawson, 1997; Rosenberg *et* al, 1997; Wilcove, 1986).

The importance of identifying and protecting wildlife movement corridors in landscapes subject to rapid settlement expansion or other forms of landscape change has been increasingly recognized. For example, the communities of Jasper, Banff, and Canmore Alberta are all currently attempting to identify, protect and manage wildlife corridors in areas within or adjacent to the communities. Given that Valemount is on the verge of significant potential growth, the Village can learn from the experiences of these communities.

Currently, it would seem that the most recognized and used science on designing and protecting wildlife movement corridors near urban areas is the work completed by the Bow Corridor Ecosystem Advisory Group (BCEAG). In 1998, as part of an effort to ensure the viability of a system of wildlife corridors in the Bow Valley, BCEAG developed and issued a set of science-based guidelines for the design and assessment of wildlife corridors and habitat patches. The BCEAG guidelines set out minimum acceptable design standards regarding corridor width, slope, hiding cover and other critical design specifications for achieving functional wildlife corridors. The BCEAG guidelines published in 1998 were approved by the Town of Canmore, the Municipal District of Bighorn, Banff National Park, Alberta Environmental Protection, and Alberta Agriculture, Food & Rural Development. The Town of Canmore subsequently incorporated the BCEAG guidelines into the Town of Canmore Municipal Development Plan.

A key element of the BCEAG design guidelines is the determination of the width of individual corridors based on a combination of factors including the major species intended to use the corridors, corridor length, nature of the terrain and whether the corridor is intended to be a primary or secondary movement corridor. Major elements of the BCEAG design guidelines are summarized in the table below.

Table 5: BCEAG Summary *(taken from Jacob Herrero Environmental Consulting, September 2000)*

Wildlife Corridor	• provides connectivity among habitat patches, requires hiding cover
1. Primary or multi-species corridor	• used by a variety of species including wary carnivore species (e.g. wolves) • connects regional habitat areas and populations • must meet the security (i.e. the hiding cover) and thermal needs of many species • minimum width : 350 metres (assumes flat ground with open areas)
2. Secondary corridor	• more appropriate for smaller or adaptable species (e.g. pine marten and elk). • may contain low impact features (e.g. trails) • should provide sufficient hiding cover (e.g. forest) for security • minimum width: 250 metres (assumes flat ground with open areas)
Habitat Patch	• areas of land with specified habitat functions linked by wildlife corridors
1. Local habitat patch	• intended to meet the rest, food and water needs of an animal for a short period, while enroute to a larger, regional habitat patch • needs to provide sufficient habitat for resting and feeding free from human disturbance • minimum size: 4.5 square km
2. Regional habitat patch	• larger areas that meet a wider spectrum of habitat requirements such as feeding, breeding, birthing, thermal regulation, security, and resting • minimum size : 10 square km

While the Valemount valley is obviously ecologically different from the Alberta sites previously mentioned; it is also clear that it is highly likely that Valemount will face many of the same wildlife movement issues with which the communities of Banff and Canmore are dealing. It seems prudent therefore to consider how wildlife movement corridors could be identified and protected at this point in Valemount's development. A recommended option is therefore presented in the next section of this paper.

5.2 Identified Wildlife Movement within the Study Area – Potential Wildlife Corridors

Four major transportation corridors currently run through the planning area: Highway 5, the Canadian National Rail line, and the pipeline and powerlines with their respective right-of-ways. These corridors bisect the area and effectively divide the west and the east sides of the valley. While each of these divisions poses varying degrees of disruption for individual species, they cannot always be considered barriers to migration. Ribbons of disturbance can effectively separate home ranges of certain species too timid, small, or sensitive to cross wide-open and dangerous stretches. However, there are some species that find such structures and openings to be no barrier at all, and will in fact utilize them to facilitate movement and migration. Such species include Moose, Deer, Wolves, Coyotes, Cougars, and Black Bear. However, utilization of these corridors increases opportunity for human interaction and thus the chance of mortality. Vehicle, train, hunter, trapper, and of course human-conflict mortalities become more prevalent when species become adapted to utilizing human-made corridors bringing them into closer contact with human populations.

Steep terrain and constrained valleys can force animals to cross from one side of the valley to the other in search of lower elevations and flatter ground while they move from one habitat to another. Consequently, the probability of vehicle/animal collisions would increase as more animals cross the highway. Vehicle collision data have been collected within the planning area along Highway 5, specifically from just south of Tete Jaune Cache to Chappell Creek, south of Dominion and Allan Creeks (see Fig. 4, Graph 1, and Table 6). Analysis of vehicle collisions over a ten-year period demonstrated a pattern of collision mortality that corresponded with one of two theories: site-specific movement corridors induced by terrain pressures, or where the highway spans a corridor between critical habitats or resources (Spencer Environmental Management Services Ltd., 2002).

Vehicle collision data indicate that there are three major species that experience high collision mortalities in the study area: Moose, Deer, and Bear. There were also reports of Lynx, Cougar, Coyote, Porcupine and Wolf mortalities, although numbers were very low and sporadic throughout the ten years evaluated. Trends for these other species could be attributed to a number of reasons, including: population densities, less likely, or less frequent and more cautious crossing behaviour, size of the animal, or less diligent reporting when collisions occur. Visibility while travelling on the road way, such as brush height and density in the right of way, whether the road is straight or on a corner, presence of hills creating blind spots, as well as the damage to vehicles, all play a factor in vehicle collisions and reporting.

Where trends were determined, it was important to evaluate the possible reasons for crossing areas and the number of species mortalities that were reported. Graph 1 outlines the total reported animal mortalities per

kilometre and Table 6 reports the total mortalities by species for each year examined. High collision areas shown on Figure 4, include the following:

Between km 87 and 90 – Dominion Creek to Allan Creek
Between km 94 and 95 – near Clemina Creek
Between km 100 and 106 – where the valley narrows
Between km 117 and 134 – Camp Creek Access Road to Valemount
At km 137 – near Blackman Road
Between km 142 and 144 – near Jackman Flats

Table 6: Animal – Vehicle Collisions per year Between the CN Overpass and Chappell Creek on Highway 5 from 1999-2000 (Spencer Report, 2001)

Year	Bear	*Lynx	Cougar	Coyote	Deer	Moose	Porcupine	Wolf	Grand Total
1991	1	0	0	0	6	5	0	0	12
1992	3	0	0	0	11	4	5	0	23
1993	6	1	1	0	9	15	0	0	32
1994	0	0	0	3	15	26	0	1	45
1995	3	0	0	0	5	16	0	1	25
1996	3	0	0	0	12	8	0	0	23
1997	1	0	0	0	15	5	1	0	22
1998	0	0	0	0	17	9	0	0	26
1999	6	0	0	0	16	21	0	1	44
2000	1	0	0	0	18	10	0	0	29
Grand Total	24	1	1	3	124	119	6	3	281
Average/yr	2.4	0.1	0.1	0.3	12.4	11.9	0.6	0.3	28.1
Percent of Total	8.5	0.4	0.4	1.1	44.1	42.3	2.1	1.1	100.0

* Reported as a Bobcat, but likely a misidentification of a Lynx.

In consideration of known habitat features, terrain pressures, and the local knowledge of movement, many of the identified corridors seem logical from an ecological or biological perspective. High collision areas, such as those between Km's 87-90 and 94-95, correspond with mountain passes accessed via stream channels (Spencer Environmental Management Services Ltd., 2002). It was noted in the Spencer Environmental Management

Services Ltd report (2002) that the collision areas at the southern end of the highway (Km's 81-99) may correspond with a regional corridor that moves animals from the upper North Thompson River into the Dominion Creek drainage. Between Km 100 and 106, the valley narrows and steep terrain constraints most likely influence animals to move from one side of the valley to the other. Animals travelling these passes may need to cross the highway in order to avoid sections of steep channels or in order to access forage that is available along the valley bottom. The northern end of the Camp Creek – Albreda River valley contains sedge meadows at Albreda Lake that may attract ungulates (Spencer Environmental Management Services Ltd., 2002). There are also sections along this stretch of highway that have been identified as important Mule Deer wintering range (Ritchie, 2003).

Similarly, between Km's 142 and 144, Mt. Terry Fox of the Selwyn Range is adjacent the highway and the resulting steep terrain may be causing animals to move across the highway to the west side. Along the northwest slope of Mt. Terry Fox, between Km 144 and the Fraser River, a bench provides easy and direct access to the Fraser River Valley from the McLennan Valley. The reported high number of bear kills along this section may represent bears seeking forage at lower elevations, including seasonally available food sources (Spencer Environmental Management Services Ltd., 2002).

The long stretch between Km 117 and 134 encompasses the town of Valemount and all its associated rural and industrial areas. Human development within the area is at its highest and so there may be an increased probability of vehicle collisions (Spencer Environmental Management Services Ltd., 2002). It is interesting to note that this stretch reported 103 collision mortalities, while the section between Km 100 and 106 only had 28 mortality reports. Along this stretch of highway, there are a number of factors that may affect the movements of animals. The area around Km 117 represents some habitat that would make good forage and winter habitat for ungulates (pine flats and power line access). Between Km's 122 and 126 there are swamp and herbaceous areas associated with Cranberry Lake and Starratt Marsh that could provide good ungulate forage. The major development in the area is located between Km's 125 and 130, including the actual town of Valemount and the Slocan mill site. Beyond the town site, an increased number of collisions reported between Km's 130 and 134 may be representative of animals attempting to avoid the town site by using the valley edge when travelling north/south (Spencer Environmental Management Services Ltd., 2002). There is a variety of reasons that could explain the higher mortality rate within this stretch of highway. Additional studies should be considered to attempt to confirm the actual reasons for these mortalities.

Reports prepared for Ministry of Environment , Lands, and Parks identified private lands along the McLennan River and Blackman Road that are well used by animals. These lands are interspersed with Crown land

identified and designated as important wildlife habitat. This information would appear to support the suggestion of movement corridors at Km 137 and Km's 142-144, as the location of these sites along Highway 5 coincide with Blackman Road and Jackman Flats respectively. This identified section of highway has movement limiting terrain on the eastern side and animals may be crossing the highway for both foraging opportunities and ease of travel along the valley (Spencer Environmental Management Services Ltd., 2002).

6.0 MAINTAINING LANDSCAPE LEVEL BIODIVERSITY

6.1 Importance of Biodiversity

Biodiversity, or biological diversity, refers to the number, variety, and variability of all living organisms. This includes species diversity, genetic diversity, and ecosystem diversity. It is about quantity and quality across multiple organisms and within species of organisms. It is about the species themselves and the habitats that they live in. Managing habitats for biodiversity means maintaining the native diversity of genes, species, populations, habitats, and ecosystems. (Province of BC). Our economy relies on biodiversity since it provides renewable economic resources and ecosystem services, medical and scientific benefits, and is priceless in terms of cultural and aesthetic values. (Warman, L. and L. Lucas, 2002).

Biodiversity concepts that need to be dealt with concurrently at the landscape level for natural resource management purposes include: natural disturbance ecology, spatial patterns, connectivity, riparian areas and wetlands, interior habitats and edge effects, and seral stages across landscapes.

The approach used to maintain biodiversity in the managed forests of British Columbia is that of maintaining habitat patterns and attributes that mimic natural disturbances. This means managing for the resemblance to the size, shape, location and content of a variety of habitats that would occur in an unmanaged situation. The principle being that most species would be better able to use these attributes to maintain their existence. Given the great variety of plant and animal species in British Columbia, it is not possible to manage for all species individually so resource managers look for habitat attributes that are shared by as many species as possible or for the most vulnerable species and manage for those.

In the unmanaged forest (i.e. without intervention by humans) wildfires, insect outbreaks, diseases, avalanches, and windthrow shape the structure and pattern of habitats across the landscape. The field of landscape ecology integrates natural disturbance regimes and their effects on the distribution of ecological types across a landscape,

the dispersal and movement of plant and animal species, and the flow of energy and nutrients (Parminter, J. and P. Daigle, 1997). Human intervention in our forests affects biodiversity by changing the natural disturbances for economic uses. These changes include: the structure and composition of individual stands or treatment units; the distribution of treatment units through space and time; and processes such as predation, dispersal, and migration that sustain plant and animal communities.

Threats to biodiversity in the Valemount planning area are mainly caused by habitat fragmentation and exotic species introduction. To mitigate our practices on the landscape and at the stand level, managing for biodiversity involves the following approaches: managing landscapes to reflect historic ecosystem patterns, retaining networks of older forests and special habitats, and maintaining important habitat attributes in individual stands.

Resource management for biodiversity is easier to implement and see at the stand level. Legislation is in place in the FPC to protect the three habitat features that are most important at the stand level. these include: large, live, old conifer and deciduous trees, as well as snags and dying trees preserved as wildlife trees or wildlife tree patches, and down wood, or coarse woody debris. (Klenner, W. and L. Kremsater). These three features support foraging, nesting, cover, perch sites, and growing sites for many plants and micro-organisms.

6.2 Landscape Level Biodiversity

Because we continue to learn new information about the impacts of our actions on the landscape, we must alter our management practices to incorporate this information the best way possible. We inherit a history of land use that we need to work with to reach our goals, since past land use practices have not mimicked what naturally would have occurred in the absence of human intervention. The result is vastly different attributes, size, and shape of forested patches, the age and species composition of remaining forests, and the connections between the remaining forests. To sustain biodiversity at the landscape level, the idea is to maintain a network of representative ecosystems and special habitats that would provide habitat for the majority of species. The Protected Area Strategy and Provincial Parks are in place to protect special habitats; as are Wildlife Management Areas, Sensitive Areas, Ungulate Winter Range, Ecological Reserves, and other designations. Other reserve zones such as Old-growth Management Areas (OGMA's) will also serve as larger patches of habitat for old-growth dependant species. Most of these areas are large enough to support some individuals of many species but may not be large enough to support entire populations of all species. In addition, many animals have home ranges or practice migration during different seasons of the year. Riparian buffer strips play a role in allowing many species to live within or travel through undisturbed areas.

In order to mitigate effects to timber supply from various constraints on the landscape, a maximum 4% short-term timber supply impact is current policy under the FPC. Where possible, different constraints to timber supply such as visual quality objectives, Ungulate Winter Range, riparian buffers, and old-growth management areas are layered over top of each other to reduce impacts on timber access

Forest Harvesting generally increases the amount of young forest and decreases the amount of older forest, because commercial forest rotations are generally shorter than natural disturbance return periods. The more that managed forests diverge from natural disturbance regimes, the greater the risk of loss of biodiversity.

The most recent information on natural disturbance ecology in the planning area comes from DeLong, 2002. This work identifies that in the Moist Trench, there are stand replacement disturbance events with a 150-year cycle for SBS and 300 for the ESSF. In the absence of stand replacement disturbance, stands are affected by damaging agents such as Mountain Pine Beetle (*Dendroctonus ponderosae*), Spruce Beetle (*Dendroctonus rufipennis*) Western Balsam Bark Beetle (*Dryocoetes confuses*), Tomentosus root disease (*Inonotus tomentosus*), and Armillaria root disease (*Armillaria ostoyae*). . Fire control over the past 40-50 years has likely slowed the natural disturbance rate in this area (DeLong, 2002). This has increased the amount of old forest in remote areas where harvesting has not occurred and has reduced young forests established by fire. Currently, disturbance rates associated with harvesting are higher than those previously associated with wildfire, especially at higher elevations. This pattern, combined with the concentration of harvesting older forest has likely resulted in an overall decrease in older stands and reduced seral stages across the landscape.

DeLong further goes on to note that connectivity between old forest patches should be managed for since there was always a fair degree of connectivity of old forest in the natural landscape, especially at higher elevations.

6.3 Maintaining Biodiversity in the Valemount ILUDP Area

To maintain biodiversity in the planning area, landscape level attributes and features need to be studied. Old-growth Management Areas (OGMA's) and wildlife corridors are the elements this planning process identifies to meet this need. A Forest Ecosystem Network (FEN) is a contiguous network of representative old-growth and mature forests delineated in a managed landscape. This includes both OGMA's and wildlife corridors.

To delineate wildlife corridors, the most recent information on connectivity and wildlife corridor widths was reviewed. The general acceptance is that corridor width is dependant on the species and that placement along

natural features that ease movement will garner the most frequent use. In the Valemount planning area, the mountain ranges that exist create distinctive corridors of travel for different species. Valley bottoms that get less snowfall are critical for movement by ungulate species except Caribou. Furbearers do not like open areas as a general rule and will avoid travelling across them. They are very dependant on leave areas with interior forest conditions. (i.e. un-impacted by light and climate from outside influences). Amphibian species and bird species are highly reliant on access to water and as such, concentrate in riparian areas.

To delineate OGMA's a combination of information was used. Taking the recent work done on natural disturbance regimes by DeLong 2002, the biogeoclimatic sub-zones and variants for all eight of the landscape units in the planning area were combined. This allowed flexibility to meet target areas of old growth across a larger landscape than using individual landscape units would allow. This flexibility also enabled placement of OGMA's to better meet biological needs and processes. The process for ranking biodiversity emphasis options is outlined in the FPC Biodiversity Guidebook, which provides a risk assessment based on the value of the biodiversity features and the impact of different activities on the existing value within a geographic area. The Landscape Unit Planning Guide sets out the rules and hierarchy for placement of OGMA's and other biodiversity tools across the landscape.

Of the eight Landscape Units included in the planning area, Hugh Allan and South Trench are identified as having intermediate biodiversity emphasis, and the remaining units have low biodiversity. The low biodiversity emphasis option is used for areas where other social and economic demands are the primary management objectives. This option will provide habitat for a wide range of native species, but the pattern of natural biodiversity will be significantly altered, and the risk of some native species being unable to survive in the area will be relatively high. Intermediate biodiversity will provide more natural levels of biodiversity and a reduced risk of eliminating native species from the area (Province of British Columbia, 1995). Given the biodiversity emphasis option, data sets were prepared to determine forest biodiversity targets in each landscape unit.

The approach to developing objectives for old-growth retention is through the establishment of OGMA's and associated landscape unit objectives that will ensure retention and/or recruitment of old-growth structure over time. The rules for landscape unit planning are; 1) old-growth representation must be calculated at the variant level only, 2) the impact of the biodiversity objectives will result in an overall timber supply impact no greater than outlined in the FPC Timber Supply Analysis, 1996, 3) old-growth targets must be met using the non-contributing lands base first, 3i) where targets cannot be met entirely in the non-contributing land base, consider partially constrained areas, 3ii) in intermediate and high biodiversity emphasis landscape units, establish OGMA's to the full target determined by the analysis. Where a shortfall exists, develop a recruitment strategy,

3iii) in low emphasis landscape units, only 1/3 of the OGMA target will be established unless it can be met using the non-contributing land base., 3iv) the criteria to capture interior forest conditions and rare old forest ecosystems must be met to the limit set by the variant-level representation rule (MOF & MELP, 1999).

When reviewing landscape units to determine placement of OGMA's the entire unit was examined for available old timber types. Then three major criteria were assessed.

The first criteria used for placement is biological. Does the identified OGMA exhibit old-growth characteristics? What is the proximity to other biologically significant features such as water bodies, avalanche tracts, swamps, important spawning, or winter range? What is the existing wildlife use? Are there studies done to determine habitat capability, suitability and probability? Is the area large enough to provide interior forest conditions, and are there unacceptable levels of edge effect relative to the size and placement of the proposed OGMA? What is the position of the area in relation to the landscape? Is there connectivity across the landscape in terms of riparian areas, and protected areas and parks? Is there connectivity between elevation? There should be connectivity from mountain top, to valley bottom, back up to mountain top where possible. Is the proposed area likely to be maintained in an undisturbed condition for a foreseeable period of time?

The second criterion used was that of operational considerations. Where are areas already constrained for other values such as riparian buffers, UWR, visual quality objectives, community watersheds? Are there areas that contain constraints for green-up, soil steepness, or high soil disturbance hazards? Are these areas biologically appropriate for OGMA placement? Where are proposed areas in relation to road locations and what conflicts might occur in future? From current Forest Development Plans (FDP), where are proposed, approved or information blocks located? What other tenures are on the area? Are there licensed water users, recreation tenures, trapping concerns?

And thirdly, the other criteria considered when looking at OGMA placement were: Are there significant recreational values in the area? Would OGMA placement create or remove conflict for recreational users? What type of wildlife habitat would be maintained or protected with the placement, and lastly, are there unique biological features that could be afforded additional protection by placement of OGMAs adjacent to the feature?

7. CONCLUSIONS & RECOMMENDATIONS

7.1 Presentation Summary

The information reviewed and discussed within this report indicates that the Valemount planning area includes several important areas from an environmental and habitat perspective. It is also clear from the information reviewed that it is important to recognize the linkages and connections between these specialized habitat "patches" and the larger landscape in terms of animal movements.

As noted in this report, the various riparian areas within the planning area serve not only very important ecological and specialized habitat roles, but also serve as natural corridors for animal movement throughout the planning area. The importance of the planning area should also be recognized in terms of its location between two of the larger blocks of parks and protected areas in the Province – the Mt. Robson/Jasper National Park system to the East of the planning area and the Cariboo Mountains/Wells Gray/Bowron Lakes Park system to the West.

It is also recognized that the Valemount area is being actively considered for significant resort developments. Developments such as the Canoe Mountain Resort and the resulting increase in population and related business operations will have a significant impact on the landscape in the area. As noted in this report the experience of other rapidly growing communities (and/or communities located in environmentally sensitive areas) have indicated the importance of identifying, protecting, and managing environmentally sensitive and important lands and waterways. It is also clear from the experience of Jasper, Banff, and Canmore that it is important to recognize and include wildlife movement corridors in urban and regional planning.

Finally, although the land base of the planning area is made up of both private and publicly owned lands; and falls under the jurisdiction of a variety of agencies within three levels of government, from an ecological perspective it is one large, interrelated landscape that would benefit from being managed as such.

7.2 A Recommended Environmentally Important Lands Network

Within the context of the above issues, MSRM staff has examined key habitat areas, riparian areas, candidate areas for potential Old-growth Management Areas, and wildlife movement patterns within the study area. Based on the need to protect both key habitat areas and maintain landscape connectivity, MSRM staff recommends the creation of an environmental landscape network as shown in Figure 6. The network shown in

Figure 6 is comprised of a variety of individual land designations, which in combination create a significant potential wildlife movement corridor through the middle of the study area. This proposed environmental land network also provides a landscape linkage between Mt. Robson and Wells Gray Provincial Parks. MSRM staff feels that this proposed pattern best protects the environmentally important and sensitive land and water areas in the plan area. However, identifying and designating such lands is only one half of the equation; maintaining the ecological attributes of those lands over the long term is also essential. Therefore MSRM staff recommends that the lands identified within Figure 6 be kept in as natural a state as possible. Therefore resource development activity and the creation of built structures within these areas should be minimized and only allowed if they will not have any negative ecological impact. Finally, although small portions of appropriately placed recreational trails may be appropriate within some of these areas, every attempt should be made to limit further landscape alterations of this environmental land network in order to maximize its potential as a permanent primary wildlife movement corridor.

All of the areas identified in Figure 6 for environmental designation are Crown lands. The areas in Figure 6 that are coloured yellow are privately owned lands. As noted throughout this report, some private lands in the study area, especially those containing riparian areas, include environmentally important lands. For these private owned lands it will be important to work with landowners to try and maintain the ecological integrity of these environmentally sensitive and important lands wherever possible.

7.3 Recommendations from Partner Agencies:

While it is important to examine and strategically plan for the VILUDP area as a single landscape entity, in reality the three levels of government have various legal and regulatory authorities and responsibilities to manage the land and resource use in the planning area. Therefore, in order to effectively achieve and maintain the environmental land pattern proposed in Figure 6, the following recommendations for action are made to each of the four VILVDP partner agencies:

Village of Valemount

(Note : the following recommendations are for demonstration and discussion purposes only – actual final recommendations will be developed in partnership with Village staff.)

1. That the Village review and consider formally endorsing the concept of attempting to maintain the integrity and ecological functioning of the environmental land pattern shown in Figure 6.

2. That the Village use this report to identify environmentally sensitive and important lands within the Village boundary or immediately adjacent to the Village boundary, and ensure that the Village's planning and development processes recognize the environmental importance of these lands and waterbodies.

3. That for new developments adjacent to riparian areas within the Village boundary, that the Village consider maintaining development setbacks similar to the Regional District setback requirements (see next section).

4. That the Village consider implementing development control by-laws on new developments on, or adjacent to, lands and waterbodies identified as environmentally important or significant in this report.

Regional District of Fraser Fort George

Staff from the Regional District of Fraser Fort George (RDFFG) worked with MSRM staff in preparing this report. The following recommendations will be considered by RDFFG staff and the RDFFG Board as part of the Official Community Plan update for the planning area.

5. For privately owned lands within the study area that include, or are adjacent to, riparian areas the RDFFG will consider implementing development permit requirements. A permit requirement for any proposed development within the identified development permit area will involve an environmental assessment of the proposed development. The following Development Permit areas along watercourses are as follows (these have not been approved by RD Board or taken to the Public for input.)
    - Fraser River - 100m (Tete Jaune Cache area only)
    - Mclennan River - 60m
    - Tete Creek - 60m
    - Swift Creek - 50m
    - Canoe River - 50m
    - Camp Creek - 50m

Note: other identified environmentally sensitive areas on Crown land ie. WHMAs, will be identified within the OCP as Environmentally Sensitive Areas.

Ministry of Sustainable Resource Management

That MSRM uses its authority and powers through Landscape Unit Objectives and Sustainable Resource Management Planning to implement the landscape pattern and function shown in Figure 6 (on Crown lands within the plan area) through the following actions.

6. Formal recognition and protection of the environmental attributes of the identified Wildlife Habitat Management Areas, Wildlife Habitat Emphasis Areas; Natural Environment Areas and Recreation Conservation Management Areas within a MSRM SRMP for the area.

7. Identification and designation of the Riparian Buffer zones as shown in the following table in a MSRM SRMP for the area:

Recommended Riparian Buffer widths for Wildlife Movement Corridor within the VILUDP area

Waterbody	Riparian wildlife corridor (m)	Riparian Management Zone (m)	Total Wildlife corridor width (m)
Fraser River	0	100	100
Kiwa Creek	60	40	100
Tete Creek	50	20	70
McLennan River	60	40	100
Hogan Creek	60	40	100
Teepee Creek	50	20	70
Crooked Creek	50	20	70
Swift Creek	60	40	100
Spittal Creek	50	20	70
Canoe River	60	40	100
Camp Creek	60	40	100**
Packsaddle Creek	60	40	100
Gold Creek	20	20	40[1]
Kimmel Creek	30	20	50[1]
Zillmer Creek	30	20	50[1]
Yellowjacket Creek	60	40	100
Bulldog Creek	30	20	50[1]
Ptarmigan Creek	60	40	100
Hugh Allan Creek	60	40	100
Blackman Creek	30	20	50[1]
Iroquois Creek	10	30	40
East Iroquois Creek	10	30	40
Foster Creek	50	20	70[1]

1- The widths for these corridors have been defaulted to the FPC riparian management areas. If increased consumptive land uses occur in these watersheds, this should be reviewed and revised if necessary.

****A portion of the riparian zone on Camp Creek is already at risk due to the proximity of Highway 5, railroad line, and transmission corridors for natural gas and electricity. In this situation the wildlife corridor should abut Highway 5 on the one side.**

8. Through SRMP and Landscape Unit Objectives management of land use and resource development activities within, and adjacent to, environmentally important lands, habitat areas, and riparian buffers in order to ensure protection of their ecological functions.

9. Use of the proposed OGMA placements shown in Figure 5 for stakeholder and public consultations. Wherever possible use of OGMA placement to gain secondary benefits such as connectivity or visual landscape management benefits. After stakeholder and public consultations, formalization of final OGMA placements through a SRMP and Landscape Unit Order.

Land & Water BC

(Note : the following recommendations are for demonstration and discussion purposes only – actual final recommendations will be developed in partnership with LWBC staff.)

10. LWBC should consider incorporating the recommended environmental land use designations shown in Figure 5 into an updated Crown Land Plan for the area.

11. LWBC should consider the recommendations of this report in future decisions regarding Crown land sales and tenure granting in the area.

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APPENDIX I

ROBSON VALLEY CROWN LAND PLAN

APPENDIX II

DOMESTIC WATER USERS DETAILED INFORMATION

TPOD_BC_	TPOD_BC_ID	FCODE	TPOD_TAG	WRMAP_REF	STRM_NAME
29610	8	EA83010000	PD76801	83D/NW(14-a) MM (PD76801)	Packsaddle Creek
29611	9	EA83010000	PD74739	83D/NW(14-b) JJ (PD74739)	Packsaddle Creek
29612	10	EA83010000	PD73035	83D/NW(14-b) GG (PD73035)	Packsaddle Creek
29613	11	EA83010000	PD75128	83D/NW(14-b) KK (PD75128)	Packsaddle Creek
29614	12	EA83010000	PD36557	83D/NW(14-b) L (PD36557)	McKirdy Creek
29615	13	EA83010000	PD36555	83D/NW(14-b) J (PD36555)	Snowcourse Creek
29617	15	EA83010000	PD66995	83D/NW(14-b) Z (PD66995)	McKirdy Creek
29619	17	EA83010000	PD73367	83D/NW(14-b) HH (PD73367)	McKirdy Creek
29620	18	EA83010000	PD36461	83.D.084.2 P (PD36461)	McKirdy Creek
29621	19	EA83010000	PD76798	83.D.084.4 K (PD76798)	Swift Creek
29622	20	EA83010000	PD61507	83D/NW(14-b) V (PD61507)	McKirdy Creek
29623	21	EA83010000	PD61506	83D/NW(14-b) T (PD61506)	McKirdy Creek
29624	22	EA83010000	PD36559	83D/NW(14-b) R (PD36559)	McKirdy Creek
29625	23	EA83010000	PD36458	83.D.084.2 Q (PD36458)	McKirdy Creek
29626	24	EA83010000	PD36459	83.D.084.2 R (PD36459)	McKirdy Creek
29627	25	EA83010000	PD36457	83.D.084.2 S (PD36457)	Tapli Creek
29628	26	EA83010000	PD36574	83E/SW(3-b) D (PD36574)	Cochrane Creek
29629	27	EA83010000	PD36573	83E/SW(3-b) C (PD36573)	Carr Spring
29630	28	EA83010000	PD36454	83.D.084.2 H (PD36454)	Selkirk Creek
29631	29	EA83010000	PD36453	83.D.084.2 J (PD36453)	Selkirk Creek
29632	30	EA83010000	PD36452	83.D.084.2 K (PD36452)	Selkirk Creek
29633	31	EA83010000	PD36451	83.D.084.2 L (PD36451)	Selkirk Creek
29634	32	EA83010000	PD36450	83.D.084.2 M (PD36450)	Selkirk Creek
29635	33	EA83010000	PD36456	83.D.084.2 N (PD36456)	Selkirk Creek
29636	34	EA83010000	PD69079	83.D.084.2 Z (PD69079)	Selkirk Creek
29637	35	EA83010000	PD36575	83E/SW(3-b) B (PD36575)	Fraser River
29638	36	EA83010000	PD36432	83.D.074.4 D (PD36432)	Canoe River
29639	37	EA83010000	PD36477	83.D.084.4 A (PD36477)	Dyson Brook
29640	38	EA83010000	PD36430	83.D.074.4 B (PD36430)	Camp Creek
29641	39	EA83010000	PD36431	83.D.074.4 C (PD36431)	Camp Creek
29642	40	EA83010000	PD36429	83.D.074.4 A (PD36429)	Little Cranberry Lake
29643	41	EA83010000	PD76799	83.D.084.4 L (PD76799)	Swift Creek
29644	42	EA83010000	PD36449	83.D.084.2 G (PD36449)	Cranberry Lake

29645	43	EA83010000	PD36448	83.D.084.2 F (PD36448)	Cranberry Lake
29646	44	EA83010000	PD36463	83.D.084.2 U (PD36463)	Swift Creek
29647	45	EA83010000	PD64978	83.D.084.2 X (PD64978)	Robson Pond
29648	46	EA83010000	PD66746	83E/SW(3-c) H (PD66746)	Nystrom Spring
29649	47	EA83010000	PD63656	83.D.084.4 G (PD63656)	Crooked Creek
29650	48	EA83010000	PD62384	83E/SW(3-c) G (PD62384)	O'Donaghue Spring
29651	49	EA83010000	PD36447	83.D.084.2 E (PD36447)	Cranberry Lake
29652	50	EA83010000	PD36444	83.D.084.2 C (PD36444)	Swift Creek
29653	51	EA83010000	PD36439	83.D.084.2 B (PD36439)	Swift Creek
29654	52	EA83010000	PD36438	83.D.084.2 A (PD36438)	Swift Creek
29655	53	EA83010000	PD36571	83E/SW(3-c) A (PD36571)	Norlander Spring
29656	54	EA83010000	PD65482	83.D.084.2 Y (PD65482)	Cranberry Creek
29657	55	EA83010000	PD36445	83.D.084.2 D (PD36445)	Cranberry Creek
29658	56	EA83010000	PD70677	83.D.084.2 AA (PD70677)	Swift Creek
29659	57	EA83010000	PD36474	83.D.084.4 C (PD36474)	Crooked Creek
29660	58	EA83010000	PD36476	83.D.084.4 E (PD36476)	Crooked Creek
29661	59	EA83010000	PD36462	83.D.084.2 T (PD36462)	Swift Creek
29662	60	EA83010000	PD73729	83.D.084.4 J (PD73729)	Crooked Creek
29663	61	EA83010000	PD36473	83.D.084.4 F (PD36473)	Crooked Creek
29664	62	EA83010000	PD77684	83E/SW(3-c) (PD77684)	Carmen Spring
29665	63	EA83010000	PD36472	83.D.084.4 D (PD36472)	Crooked Creek
29666	64	EA83010000	PD36471	83.D.084.3 H (PD36471)	Crooked Creek
29667	65	EA83010000	PD36470	83.D.084.3 G (PD36470)	Fitzgerald Brook
29668	66	EA83010000	PD70676	83.D.084.1 H (PD70676)	McLennan River
29669	67	EA83010000	PD36469	83.D.084.3 F (PD36469)	Fitzgerald Brook
29670	68	EA83010000	PD36434	83.D.084.1 A (PD36434)	MacMillan Creek
29671	69	EA83010000	PD36468	83.D.084.3 E (PD36468)	Bebel Brook
29672	70	EA83010000	PD36467	83.D.084.3 D (PD36467)	Teepee Creek
29673	71	EA83010000	PD36512	83.D.094.3 A (PD36512)	Cinnamon Spring
29674	72	EA83010000	PD70327	83.D.084.1 G (PD70327)	Jack Adams Swamp
29675	73	EA83010000	PD36435	83.D.084.1 B (PD36435)	Starratt Spring
29676	74	EA83010000	PD36441	83.D.084.1 E (PD36441)	West Cranberry Creek
29677	75	EA83010000	PD75912	83.D.084.3 L (PD75912)	Teepee Creek
29678	76	EA83010000	PD75069	83E/SW(3-c) J (PD75069)	ZZ Creek (75068)
29679	77	EA83010000	PD36466	83.D.084.3 B (PD36466)	Teepee Creek
29680	78	EA83010000	PD71431	83.D.084.1 K (PD71431)	Zorn Spring
29681	79	EA83010000	PD36506	83.D.094.1 D (PD36506)	Hogan Creek
29682	80	EA83010000	PD36436	83.D.084.1 D (PD36436)	Leagh Creek

29683	81	EA83010000	PD36437	83.D.084.1 C (PD36437)	Leagh Creek
29684	82	EA83010000	PD75639	83.D.084.3 K (PD75639)	Hogan Creek
29685	83	EA83010000	PD36465	83.D.084.3 A (PD36465)	Hogan Creek
29686	84	EA83010000	PD73674	83.D.084.3 J (PD73674)	Hogan Creek
29687	85	EA83010000	PD36464	83.D.084.3 C (PD36464)	Hogan Creek
29688	86	EA83010000	PD70679	83.D.084.1 J (PD70679)	Caruso Spring
29689	87	EA83010000	PD36508	83.D.094.1 B (PD36508)	Pooli Brook
29690	88	EA83010000	PD36509	83.D.094.1 C (PD36509)	Hordeae Swamp
29691	89	EA83010000	PD36507	83.D.094.1 A (PD36507)	Little Jackman Creek
29692	90	EA83010000	PD61653	83.D.084.1 F (PD61653)	Hystad Creek
29693	91	EA83010000	PD76795	83.D.084.1 L (PD76795)	Hystad Creek
29694	92	EA83010000	PD36510	83.D.094.1 E (PD36510)	Hordeae Creek
29695	93	EA83010000	PD36481	83.D.093.4 Q (PD36481)	Bragg Swamp
29696	94	EA83010000	PD36502	83.D.093.4 AA (PD36502)	Fraser River
29697	95	EA83010000	PD36489	83.D.093.4 Y (PD36489)	L'Estrange Creek
29698	96	EA83010000	PD36480	83.D.093.4 R (PD36480)	Mahoney Spring
29699	97	EA83010000	PD62804	83.D.093.4 BB (PD62804)	Lido Creek
29700	98	EA83010000	PD36487	83.D.093.4 Z (PD36487)	L'Estrange Creek
29701	99	EA83010000	PD36483	83.D.093.4 X (PD36483)	L'Estrange Creek
29702	100	EA83010000	PD36488	83.D.093.4 U (PD36488)	L'Estrange Creek
29703	101	EA83010000	PD36485	83.D.093.4 N (PD36485)	L'Estrange Creek
29704	102	EA83010000	PD36484	83.D.093.4 W (PD36484)	L'Estrange Creek
29705	103	EA83010000	PD36501	83.D.093.4 T (PD36501)	Black Bear Spring
29706	104	EA83010000	PD36486	83.D.093.4 V (PD36486)	L'Estrange Creek
29707	105	EA83010000	PD36503	83.D.093.4 A (PD36503)	L'Heureux Creek
29708	106	EA83010000	PD36504	83.D.093.4 K (PD36504)	L'Heureux Creek
29709	107	EA83010000	PD36491	83.D.093.4 C (PD36491)	Goslin Creek
29710	108	EA83010000	PD36492	83.D.093.4 B (PD36492)	Goslin Creek
29711	109	EA83010000	PD36494	83.D.093.4 D (PD36494)	Goslin Creek
29712	110	EA83010000	PD36495	83.D.093.4 E (PD36495)	Goslin Creek
29713	111	EA83010000	PD36496	83.D.093.4 F (PD36496)	Goslin Creek
29714	112	EA83010000	PD36497	83.D.093.4 G (PD36497)	Goslin Creek
29715	113	EA83010000	PD36498	83.D.093.4 H (PD36498)	Goslin Creek
29716	114	EA83010000	PD36499	83.D.093.4 J (PD36499)	Goslin Creek
29717	115	EA83010000	PD36500	83.D.093.4 L (PD36500)	Beck Spring
29718	116	EA83010000	PD36482	83.D.093.4 S (PD36482)	Otis Spring
29719	117	EA83010000	PD36505	83.D.093.4 M (PD36505)	Goslin Creek
29720	118	EA83010000	PD76312	83.D.093.2 A (PD76312)	ZZ Creek (76310)

29721	119	EA83010000	PD65226	83.D.093.4 CC (PD65226)	Fraser River
29722	120	EA83010000	PD76313	83.D.093.2 B (PD76313)	ZZ Creek (76311)
29723	121	EA83010000	PD69636	83.E.003 V (PD69636)	Spittal Creek
29724	122	EA83010000	PD70989	83.E.003 W (PD70989)	Serbia Spring
29725	123	EA83010000	PD36479	83.D.093.3 B (PD36479)	Bowman Creek
29726	124	EA83010000	PD73384	83.E.003 X (PD73384)	ZZ Spring (73383)
29727	125	EA83010000	PD36565	83D/NW(13-h) U (PD36565)	Tete Creek
29728	126	EA83010000	PD44066	83.E.003 Q (PD44066)	Spittal Creek
29729	127	EA83010000	PD36478	83.D.093.3 A (PD36478)	Spittal Creek
29730	128	EA83010000	PD64558	83.E.003 U (PD64558)	Leona Creek
29731	129	EA83010000	PD44078	83.E.003 K (PD44078)	Leona Creek
29732	130	EA83010000	PD44081	83.E.003 N (PD44081)	Leona Creek
29733	131	EA83010000	PD61047	83.E.003 R (PD61047)	Eustis Creek
29734	132	EA83010000	PD61046	83.E.003 J (PD61046)	Eustis Creek
29736	134	EA83010000	PD44070	83.E.003 G (PD44070)	Eustis Creek
29737	135	EA83010000	PD61608	83.E.003 T (PD61608)	Rosbar Spring
29738	136	EA83010000	PD44086	83.E.003 L (PD44086)	Sandy Creek
29739	137	EA83010000	PD73915	83.E.003 Y (PD73915)	Eustis Creek
29740	138	EA83010000	PD75479	83.E.003 Z (PD75479)	Pandora Spring
29741	139	EA83010000	PD44084	83.E.003 H (PD44084)	Sandy Creek
29742	140	EA83010000	PD44069	83.E.003 A (PD44069)	Davis Spring
29744	142	EA83010000	PD44072	83.E.003 D (PD44072)	Kiwa Creek
29745	143	EA83010000	PD44075	83.E.003 C (PD44075)	Kiwa Creek
29746	144	EA83010000	PD44087	83.E.003 M (PD44087)	Nearguard Creek
29747	145	EA83010000	PD44210	83.E.002 K (PD44210)	Small Creek
29748	146	EA83010000	PD62373	83.E.002 MM (PD62373)	Small Creek
29749	147	EA83010000	PD77334	83.E.002 (PD77334)	Small Spring
29750	148	EA83010000	PD44209	83.E.002 J (PD44209)	Fister Creek
29751	149	EA83010000	PD44208	83.E.002 H (PD44208)	North Fister Creek
29755	153	EA83010000	PD44211	83.E.002 JJ (PD44211)	Tindill Creek
29756	154	EA83010000	PD71589	83.E.002 NN (PD71589)	Tindill Creek

APPENDIX III

FIGURE 6

APPENDIX IV

LITERATURE PROVIDING INFORMATION FOR WILDLIFE CORRIDORS WITHIN THE FRASER AND COLUMBIA WATERSHEDS

Literature providing information for wildlife movement corridors for Fraser River watersheds

1-Norecol-b, 1992 does not make specific width recommendations. It identifies the unique riparian habitats and values that exist along these water bodies, and makes recommendations to preserve the areas for corridors or reserves.

2-Overall Biodiversity Goal from the LRMP is to establish Forest Ecosystem Networks (FENs) where appropriate during landscape unit planning. FEN designs should maintain continuity/linkages between: critical wildlife habitat, protected areas, travel corridors, various landscapes (alpine, early seral, mature forests, old-growth, etc.) and where possible incorporate inoperable and/or unmerchantable forested areas. From the Overall Environment Goal for water quality, the LRMP states that there should be established windfirm Riparian Management Areas along watercourses and prevent encroachment on the floodplains through appropriate development setbacks and covenants.

3-In the LRMP there is no specific direction provided for the community watershed in terms of additional protection. Swift Creek falls under the requirements of the Forest Practices Code Act of BC. More broadly, the recommendations for all domestic water use is to establish a minimum 20-metre reserve zone and 30-metre machine-free zone on the main creek upstream of known domestic water intakes. Side tributaries are to be assessed during operational planning and in consultation with the volunteer domestic water liaison committee. (Unable to confirm if this committee exists)

4- Leung and Simpson identify the rarity of riparian habitats in the Robson Valley and the value to bird species provided by these habitats. They further recommend protection of Cottonwood and Spruce wherever possible.

6-Westworth Associates Environmental Ltd-a & b, 1997: Sighted 81% of Moose in survey in the SBSdh and 75% of total within 500 metres of the Canoe River or Camp Creek. Also recommend protection of S4- S6 streams of 40 m. or 10m. beyond ravine edges, whichever is greater. Cites Thomas *et al.* (1979) to define hiding cover as the amount of cover that hides 90% of an animal from human view at a distance of 61 m or less. Also cites Bloomfield (1979) as suggesting a width of at least 400 m of forest habitat to provide protective cover for Woodland Caribou along travel routes.

7-Proulx, 1998: For wildlife corridors, recommends widths from 20m for Black Bear to 100 plus m. for American Marten, Cougar, and ungulates. He further states that the effect of width on corridor utilization depends on vegetation, proximity of connected habitats, the time of year, the species of interest, and the surrounding vegetation and activity outside the corridor. His experience with wildlife corridors is that most corridors should consist of riparian habitats of mature and old forest stands representative of the locally harvested stands. The objective of movement corridors is to provide a continuum of sufficient cover for larger animals to allow security of movement from one habitat type to another.

8- Spencer Environmental Management Services Ltd., 2002

Literature that provides information for wildlife movement corridors for Columbia watershed

1-Norecol-b, 1992 does not make specific width recommendations. It identifies the unique riparian habitats and values that exist along these water bodies, and makes recommendations to preserve the areas for corridors or reserves.

2-Overall Biodiversity Goal from the LRMP is to establish Forest Ecosystem Networks (FENs) where appropriate during landscape unit planning. FEN designs should maintain continuity/linkages between: critical wildlife habitat, protected areas, travel corridors, various landscapes (alpine, early seral, mature forests, old-growth, etc.), and where possible incorporate inoperable and/or unmerchantable forested areas. From the Overall Environment Goal for water quality, the LRMP states that there should be established windfirm Riparian Management Areas along watercourses and prevent encroachment on the floodplains through appropriate development setbacks and covenants.

3-In the LRMP: the recommendations for all domestic water use is to establish a minimum 20-metre reserve zone and 30-metre machine-free zone on the main creek upstream of known domestic water intakes. Side tributaries are to be assessed during operational planning and in consultation with the volunteer domestic water liaison committee. (Unable to confirm if this committee exists)

4- Leung and Simpson: identify the rarity of riparian habitats in the Robson Valley and the value to bird species these habitats provide. They further recommend protection of Cottonwood and Spruce wherever possible.

5-Westworth Associates Environmental Ltd.-c, 1999: raises specific concerns about future development in the Canoe River watershed that will occur along the low gradient floodplains. These areas provide important rearing habitat, holding areas, and potential spawning grounds.

6-Westworth Associates Environmental Ltd-a & b, 1997: Sighted 81% of Moose in survey in the SBSdh and 75% of total within 500 metres of the Canoe River or Camp Creek. Also recommend protection of S4- S6 beyond ravine edges, whichever is greater. In winter tracking surveys, they found 14 species in the Camp/Canoe watersheds. In identifying these species, it has been shown that the species in this study area used a variety of habitat classes, which emphasizes the importance of maintaining a range of forest stand types across the landscape. It is suggested that the old-growth forest requirements of Fisher and Marten can only be met by following the recommended seral stage distributions for intermediate to high biodiversity emphasis for the BEC sub-zones in the Canoe River/Camp Creek watershed. Connectivity between stands of suitable habitat is essential for many carnivores, and can be ensured by maintaining late successional forest linkages within Forest Ecosystem Networks. Cites Thomas *et al.* (1979) to define hiding cover as the amount of cover that hides 90% of an animal from human view at a distance of 61 m or less. Also cites Bloomfield (1979) as suggesting a width of at least 400 m of forest habitat to provide protective cover for Woodland Caribou along travel routes.

Records of incidental observations of ungulates obtained from CMH Heli-skiing suggest that Mountain Goats are present in the Canoe River/Camp Creek watershed at larger numbers than previous surveys have identified.
7-Proulx, 1998: For wildlife corridors, recommends widths from 20m for Black Bear to 100 plus m. for American Marten, Cougar, and ungulates. He further states that the effect of width on corridor utilization depends on vegetation, proximity of connected habitats, the time of year, the species of interest, and the surrounding vegetation and activity outside the corridor. His experience with wildlife corridors is that most corridors should consist of riparian habitats of mature and old forest stands representative of the locally harvested stands. The objective of movement corridors is to provide a continuum of sufficient cover for larger animals to allow security of movement from one habitat type to another.
8-Westworth Associates Environmental Ltd-b, 1997: Inventory found Harlequin Ducks in Spruce wetland habitat and in the main stem of lower Hugh Allan Creek. In a study conducted by Crowley, 1993, Harlequin Ducks were found nesting in small first-order tributaries near timberline, which would not be afforded any riparian protection under the FPC. Harlequin Ducks may be sensitive to activities that cause siltation and human disturbance while breeding. Mineral licks for Mountain Goats were identified in four separate locations along the Hugh Allan main stem.
9-Spencer Environmental Management Services Ltd., 2002: Specific studies found Lynx, Moose, Deer, and Bear use along Camp Creek and the lower Canoe River.