WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

Updated 2012

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1.0 INTRODUCTION

The Bow Valley is located in southwestern Alberta along the Bow River and extends over an approximate 120 km distance to include the communities of Lake Louise, Banff, Harvie Heights, Canmore, Exshaw, Seebe and Kananaskis Village. The valley is located within the Montane subregion of the Rocky Mountain Natural Region and is bordered by steep sub-alpine and alpine slopes on either side. The low elevation valley bottom supports a diversity of wildlife species and serves as a vital linkage corridor for large mammals between the Kananaskis Valley, Banff National Park and areas to the north (Paquet 1993; Paquet *et al.*, 1994; Gibeau 2000; Callaghan 2002). The cumulative effect of human activity and development footprint has resulted in habitat loss and alteration, increased sensory disturbance to wildlife and an overall increase in habitat fragmentation and alienation (Alberta Tourism, Parks and Recreation [ATPR] 2010a). Wildlife corridors and habitat patches in the Bow Valley are necessary to preserve functional wildlife habitat, to allow daily and seasonal wildlife movement to avoid genetically isolated wildlife populations and to reduce human-wildlife conflicts.

The Bow Corridor Ecosystem Advisory Group (BCEAG) was established in 1995 and prepared the *Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley* in 1998 to protect corridors and habitat patches in light of the rapid population growth associated with residential, commercial, industrial and recreational expansion in the town of Canmore and surrounding area. This document was revised in 1999 (BCEAG 1999). The document identified guidelines for land managers to be applied as a consistent approach to development applications as well as standards for wildlife corridor and habitat patch design. The area of interest was the southern segment of the Bow Valley that extends from Harvie Heights to Seebe (Figure 1). A provision of the document was continued review, adjustment and modification to the guidelines and standards as new information became available.

The BCEAG contracted TERA Environmental Consultants (TERA) to review the 1999 BCEAG document. This report provides the results of the review that was conducted to ensure the guidelines are still relevant based on current scientific information and to update the document as needed. This task was completed in 2010. The report was subsequently reviewed by the BCEAG members including respective Councils in 2011 and 2012, and any changes have been incorporated.

The following report represents the end-product and provides an updated version of the 1999 *Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley* (BCEAG 1999). Much of the original information is still relevant and remains the same, although revisions have been made and additional information is provided. The results of a literature search conducted as part of the review are provided in Appendix A.

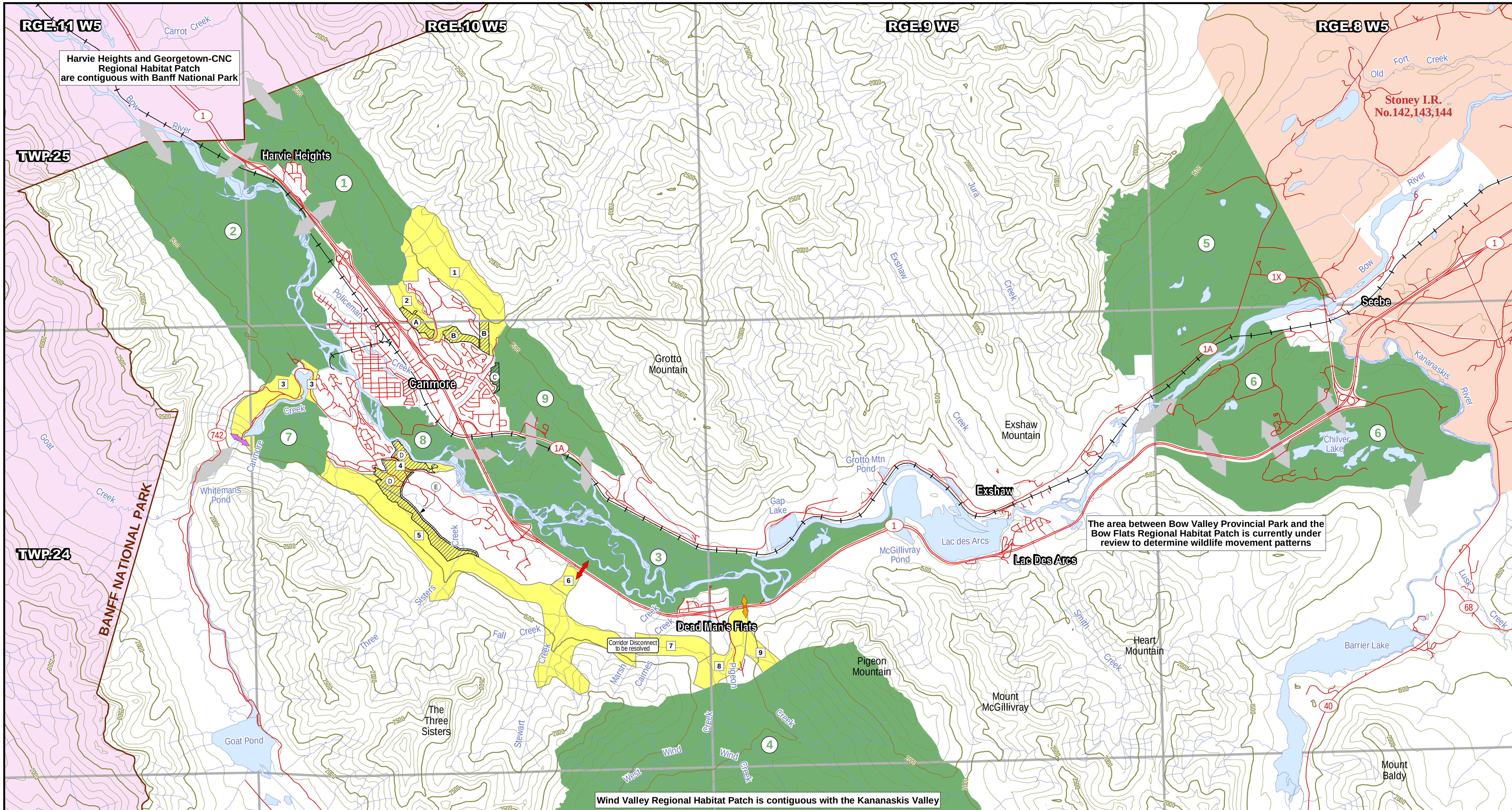
1.1 Purpose

The purpose of this document is to identify the current wildlife corridors and habitat patches in the Bow Valley and to provide land management agencies with guidelines for assessing development applications that have the potential to impact adjacent wildlife corridors and habitat patches. The objective is for land management agencies to apply a consistent approach based on current information that will ensure the viability of wildlife corridors and habitat patches in the Bow Valley (see Figure 1). This document provides the following:

- guidelines that identify a consistent set of ground rules for land management agencies to apply when dealing with new development applications and human use activities within and adjacent to wildlife corridors and habitat patches;

- standards for wildlife corridor and habitat patch design including size, topography, cover and vegetation characteristics; and

- guidelines and best practices for proposed and existing developments and activities that will identify compatible uses within and adjacent to wildlife corridors and habitat patches, as well as measures to lessen their impacts on the viability of wildlife corridors and habitat patches.



Road
Rail
Hydrography
Banff National Park
First Nation Reserve

Wildlife Underpass
- Wind Valley
- Stewart Creek

Wildlife Crossing Structure
- Rundle Canal

Regional Habitat Patch
1. Harvie Heights
2. Georgetown - CNC
3. Bow Flats
4. Wind Valley
5. Yamnuska
6. Bow Valley Provincial Park

CNC - Canmore Nordic Centre

Local Habitat Patch
7. Quarry Lake
8. South Canmore
9. Indian Flats

Wildlife Corridor
1. Upper Silvertip
2. Lower Silvertip
3. Georgetown - Quarry Lake
4. Tipple
5. Three Sisters Along Valley
6. Stewart Creek
7. Wind Valley
8. Dead Man's Flats
9. Pigeon

Conceptual Wildlife Corridor

Conservation Easements
- A Palliser
- B Eagle Terrace
- C Canyon Ridge
- D 2003 Easement
- E 35m Easement

Prepared by: ASRD, Southern Rockies Area, RIU-Calgary.

SCALE
0 1 2 3 4
Kilometres

Government of Alberta

FIGURE 1
WILDLIFE CORRIDORS AND HABITAT PATCHES

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011

2.0 DEVELOPMENT PROPOSALS

The *Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley* present "guidelines" that are intended to provide consistent common ground rules for decision making for all jurisdictions that adopt them. As such, they are not legally binding unless they are adopted under specific legislation. In addition, these guidelines will not apply to projects that have existing commitments and approvals prior to 1999 from any of the land management jurisdictions.

If a proposed development is located within or adjacent to a wildlife corridor or habitat patch, then these guidelines would be applied. The proponent should be required to follow these guidelines to ensure the value and function of the wildlife corridor or habitat patch is not compromised by their proposed development. An application will not be approved if these guidelines cannot be met.

If a proposed development is not located within or adjacent to a wildlife corridor or habitat patch, then these guidelines do not apply.

Other projects that are specifically exempt from these guidelines include the following:

- projects for which approvals have been previously granted by the Natural Resources Conservation Board (NRCB) prior to July 1999 (*e.g.*, Three Sisters Mountain Village);
- projects that conform to an already approved area structure plan, area redevelopment plan, master plan, land use bylaw or subdivision approval issued prior to July 1999;
- projects that have existing valid development permits issued prior to July 1999;
- existing developments that have valid surface leases or existing letters of intent from the provincial government issued prior to July 1999; and
- existing developments on private land with permits issued prior to July 1999.

3.0 DEFINITIONS

The definitions provided in the *Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley* (BCEAG 1999) were reviewed and a few were modified. The definitions are provided in Table 1. The numbers within the definitions include the following:

- minimum area of a regional habitat patch is 10 km²;
- minimum area of a local habitat patch is 4.5 km² with a minimum width of 1.2 km; and
- a development is considered "adjacent" if it is within 175 m of a primary wildlife corridor, within 125 m of a secondary wildlife corridor, or within 250 m of a local habitat patch.

These numbers were based on wildlife movement data collected in Banff National Park, wolf use of the Bow Valley area, cougar use of urban environments in California, grizzly bear use related to vegetation cover and land area in Banff National Park and general conservation biology theory (BCEAG 1999).

The BCEAG (1999) definitions originally identified primary wildlife corridors as those intended for use by wildlife more wary of human activities (*i.e.*, large carnivores), while secondary wildlife corridors would be used by smaller species or those more habituated to human activities (*i.e.*, elk). Wildlife monitoring data of wildlife corridors has since shown that large carnivores (*i.e.*, grizzly bears, wolves, cougars) will use both types of corridors (Golder Associates Ltd. 2002). Carnivore use of narrower, secondary wildlife corridors, however, creates undesirable public safety concerns since these wildlife corridors are often located between areas of human development that receive a high level of public recreational use. As a result, all wildlife corridors should strive to meet the minimum criteria for a multi-species corridor. Table 1 provides an update of the definitions based on a review of the scientific literature and wildlife monitoring data collected in the Bow Valley.

TABLE 1

DEFINITIONS

Term[1]	Definition
Wildlife Corridor *(modified)*	An area of land designed and managed to maintain connectivity between habitat patches. The primary function of a wildlife corridor is to facilitate safe movement of wildlife in the Bow Valley. A distinction can be made between wildlife corridors that extend along the length of the Bow Valley (Along Valley Corridors) and wildlife corridors that cross the Bow Valley (Across Valley Corridors). A second distinction can be made between wildlife corridors and conceptual wildlife corridors. These are identified on Figure 1. Wildlife corridors have formal defined boundaries, while conceptual wildlife corridors represent areas of wildlife movement that have not had formal boundaries identified.
Multi-species Wildlife Corridor *(modified)*	All wildlife corridors should be designed and managed as multi-species. Multi-species wildlife corridors accommodate the movement of large and small carnivores as well as ungulates). All wildlife corridors should provide security to facilitate movement between habitat patches as well they may also provide thermal cover and foraging areas.
Secondary Wildlife Corridor *(modified)*	These are wildlife corridors that do not meet the minimum requirements of a multi-species corridor, such as length and width, though they still provide some corridor function (*i.e.*, connectivity and linkages to larger habitat patches). Secondary wildlife corridors have been constrained by existing developments, physical landscape features or other human related infrastructure that act as barriers to movement.
Habitat Patch *(same)*	Habitat patches are areas of land linked together by wildlife corridors. Habitat patches are generally large in area and meet a wider spectrum of habitat requirements (*e.g.,* feeding, breeding, thermal regulation, security, resting) for wildlife in the Bow Valley. Habitat patches are classified as either regional or local based on their size.
Regional Habitat Patch *(same)*	Regional habitat patches are large enough (>10 km²) to contain adequate resources to sustain large carnivores for short periods of time. A regional habitat patch can accommodate the seasonal range of elk, deer or moose (e.g., Wind Valley or the benches of the Fairholme Range in Banff National Park). In the Bow Valley, regional habitat patches are generally incorporated within a protected area. Wildlife corridors and local habitat patches provide connections to the regional habitat patches.

Local Habitat Patch *(same)*	A local habitat patch is meant to meet the food, rest and water needs of an animal for a short period while negotiating a corridor network toward a larger, regional habitat patch at its end. Much of the difference between a local habitat patch and a wildlife corridor depends on shape. Habitat patches need to provide sufficient habitat in their interior for an animal to rest or feed with security from human disturbance. Based on minimum security areas defined for female grizzly bears (Gibeau *et al*., 1996), minimal habitat patch size is 4.5 km^2 with a minimum width of 1.2 km. Narrower blocks of land merely become wildlife corridors.
Adjacent *(modified)*	The area surrounding a wildlife corridor or habitat patch that serves to buffer the effects of human activity along wildlife corridor and habitat patch edges.
Adjacent to Wildlife Corridor *(same)*	Adjacent areas are within 175 m from the edge of a wildlife corridor boundary.
Adjacent to Habitat Patch *(same)*	Adjacent areas are within 250 m from the edge of either a regional or local habitat patch.

1. Indicates if a definition has been modified from the definitions presented in the *Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley* (BCEAG 1999).

4.0 DESIGN STANDARDS

The *Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley* (BCEAG 1999) identified minimum standards for the design of wildlife corridors and habitat patches that considered corridor length and width, habitat patch size, topography and hiding cover. The standards were based on information available at the time related to conservation biology (*i.e.*, wildlife corridors and core security areas), as well as wildlife studies conducted primarily in Banff National Park. The minimum design standards provided in the BCEAG (1999) document are presented in Table 2. A review of current literature and more recent wildlife monitoring data within the Bow Valley since 1999 was undertaken to ensure the relevancy of the minimum design standards in Table 2, as well as the relationships between wildlife corridor and/or habitat patch dimensions and the various design criteria. The results of the review did not find information to suggest that the minimum design standards need to be modified.

The concept of maintaining multi-species wildlife movement corridors along the north and south side of the Bow Valley, as well as across the valley to link habitat patches is still the primary goal of the guidelines. Regional planning must consider the need for a multiple wildlife corridor network since it is better suited to accommodate a variety of wildlife movement options, will enhance species abundance and diversity by providing increased biophysical diversity among wildlife corridors and will address uncontrollable natural/man-made disturbances that may render corridors or portions of corridors dysfunctional (*i.e.* forest fire).

TABLE 2

MINIMUM DESIGN STANDARDS FOR WILDLIFE CORRIDORS AND LOCAL HABITAT PATCHES

Design Standard	Multi-Species Wildlife Corridor	Local Habitat Patch
Width / Area	350 m	$4.5\ km^2$
Length / Area	1 km	
Topography	Flat	Flat
Vegetation Cover	>40%	>40%
Area to Perimeter Ratio	n/a	0.45

4.1 Wildlife Corridors - Width and Length

Standards related to widths of wildlife corridors in the Bow Valley initially began with the Three Sister Resorts application that recommended secondary wildlife corridors be a minimum of 183 m wide, while primary corridors be a minimum of 350 m wide (Three Sisters Resorts 1991). The approach used to develop these widths was based on Thomas (1979) (see Herrero and Jevons 2000). The NRCB also recommended in their Decision Report for the Three Sisters Resort application that primary wildlife corridors should not be narrower than 350 m except in unusual circumstances. The Decision Report further stated that the widths and locations of wildlife corridors should be reviewed in consideration of all wildlife that use them (NRCB 1992).

The wildlife corridor widths presented in the BCEAG (1999) document used these minimum dimensions as a starting point for wildlife corridor design and were based on current information at the time related to conservation biology and available wildlife research in the Bow Valley.

As a general principle, corridors should have linear edges especially along human development nodes and avoid peninsulas, doglegs, and cul-de-sacs that have the potential to trap animals or direct them out of the corridor and into development areas where conflict with humans may result.

A review of specific research that quantifies the relationship between wildlife corridor width and effectiveness as a movement corridor was found to be limited. In general, common principles of corridor design related to width include the following:

- the larger the species, the wider the corridor will need to be to facilitate movement and provide potential habitat (Bentrup 2008);
- as the length of the corridor increases, so should the width (Bentrup 2008);
- a corridor will generally need to be wider in landscapes that provide limited habitat or that are dominated by human use (Bentrup 2008);
- corridors that need to function for decades should be wider. Some functions that require significant time include dispersal for slow-moving organisms, gene flow and changes to range distribution due to climate change (Bentrup 2008); and
- a measure of corridor width may be influenced by wildlife response to disturbances. Research related to avoidance by wildlife to disturbance is highly variable for different species. For grizzly bear, the effect of a large disturbance may extend for greater than 2 km (Gibeau *et al.*, 2002). Wolves and wolverine may be affected by disturbances for distances greater than 900 m (Alexander 2001 and Austin 1998). More tolerant species, such as elk and coyote, may show little avoidance of human disturbances.

The results of the literature review did not find information to suggest that the minimum corridor width of 350 m is inadequate. Deer, elk, cougar, bighorn sheep, black bear, grizzly bear and coyote have been recorded within the Three Sisters Along Valley Corridor and the relative abundance of these species did not decrease over a monitoring period of 2005 to 2007 (Jacques Whitford AXYS Limited 2008c).

4.2 Habitat Patch Area

Within the Bow Valley, a regional habitat patch should be large enough (>10 km^2 or 1,000 ha) to contain adequate resources to sustain large carnivores for short periods of time and/or encompass the seasonal range of elk, deer or moose. A local habitat patch should be 4.5 km^2 (450 ha) or greater with a minimum width of 1.2 km to provide sufficient habitat in their interior for an animal to rest or feed with security from human disturbance. These parameters from the BCEAG (1999) document were based on the concept of core security areas specific to grizzly bears.

Similar to the width/length of wildlife corridors, specific research related to effective habitat patch size is limited. Relevant information related to patch size includes the following:

- as a general guideline, Kennedy *et al.*, (2003) suggests that land use planners should strive to protect and maintain habitat patches larger than 55 ha, though not enough is known about the critical minimum habitat size that is needed to maintain species diversity and species composition. The recommended minimum patch sizes will vary depending on species. Given the lack of minimum patch size requirements of species, it is recommended that land use planners work with natural resource agencies and local biologists to identify suitable habitat patches and their size;
- the edge to area ratio of a habitat patch is affected by the shape of the patch. A more convoluted, irregular or linear patch will have a higher proportion of edge and favour edge-tolerant species over interior species (Kennedy *et al.* 2003) hence patches with a low edge to area ratio would be preferred. The 1999 BCEAG document recommended a minimum area to perimeter ratio for local habitat patches of 0.45 (or perimeter to area equivalent of 2.2); and
- Beier *et al.*, (2007) suggests that land use planners should strive to maintain and protect habitat patches greater than 55 ha. The goal should be to maintain larger parcels greater than 2,500 ha to protect more area-sensitive species.

Information specific to grizzly bears includes the following:

- the concept of security areas for grizzly bears was developed based on areas where female grizzly bears can forage for 24 to 48 hours secure from human disturbance. Secure areas are defined by areas greater than 500 m away from human activity and are contiguous areas greater than 9 km^2 (Gibeau *et al.*, 2001);
- the recommended core area for grizzly bear recovery in the North Cascades of British Columbia is greater than 10 ha in size (North Cascades Grizzly Bear Recovery Team 2001);

- large, roadless areas greater than 1,000 ha are preferred for grizzly bear habitat security (British Columbia Ministry of Water, Land and Air Protection 2004); and
- the recommended minimum size of a Grizzly Bear Core Area in Alberta is 2,400 km^2 which is based on the size of four female grizzly bear home ranges (*i.e.*, 600 km^2) (Alberta Sustainable Resource Development [ASRD] 2008).

4.3 Slope

Slope is a common assessment variable in wildlife research studies in the Bow Valley and elsewhere. As such, there is adequate information to suggest that most wildlife avoid slopes greater than 25 degrees (with the exception of bighorn sheep, mountain goats and to a lesser degree cougars). While most species can use steeper slopes, there is a clear preference to avoid steep slopes particularly on north facing aspects. Information relevant to slope is listed below.

- Alexander (2001) found that in winter, wolf, coyote, wolverine, elk, deer and moose selected for flatter areas (less than 10 degree slopes), and lynx and cougar selected for 10 to 20 degree slopes.
- Studies in the Bow Valley indicate that flatter areas are preferred by most wildlife species including deer, elk, coyote and wolf (Callaghan and Jevons 2001, 2004, Duke 2001, Jacques Whitford AXYS Limited 2008b,c, Jacques Whitford Limited 2005b, ATPR 2011b).
- Areas of steeper terrain limit movement and/or are avoided by deer and elk, while terrain is not a limiting factor for cougar and coyote movement (Jacques Whitford AXYS Limited 2008b,c).
- Grizzly bears were found to prefer slopes of less than 25 degrees (Alberta Parks 2006).
- Percy (2006a,b) found that the majority of cougar and wolf locations occurred on slopes of 25 degrees or less.
- Wolves typically select low elevations, shallow slopes, southwest aspects and open forests (Paquet 1993, Duke 2001, Callaghan 2002, Whittington *et al.*, 2005, Hebblewhite and Merrill 2008, Webb 2009).
- During winter, movements of cougar, bobcat and lynx on the south side of the valley where snowpack is greater were found to occur on lower elevation slopes when compared to the north or south-facing side of the valley (ATPR 2010a,b).
- Compared to other species, cougars were found to use higher elevations and steeper slopes. Ninety-five percent of cougar movements occurred on slopes less than 30.1 degrees, while 95% of the movements of the other species occurred on slopes below 25 degrees *(i.e.*, wolf 21.3 degrees; lynx 23.4 degrees; bobcat 14.4 degrees) (ATPR 2010a).
- A modeling exercise for the habitat preferences of cougars, wolves and lynx that compared topographic and vegetative features used by each species to features within 500 m found that carnivores selected for low elevations, especially on northern aspects. Cougars selected areas with steeper slopes on southern aspects and slightly avoided steep slopes on northern aspects. Wolves selected for low to moderate slopes and strongly avoided steep slopes (ATPR 2010a).
- Bighorn sheep favour slopes between 20 to 40 degrees (Alexander 2001). Jacques Whitford Limited (2005b) observed sheep using all slope classes but favouring slopes greater than 25 degrees.

4.4 Hiding Cover

Specific research that quantifies the optimal amount of hiding cover within a wildlife corridor or habitat patch is limited. In the BCEAG (1999) document, the baseline optimal average vegetative hiding cover for wildlife corridors and local habitat patches is greater than 40%. Vegetative hiding cover less than 40% will require larger wildlife corridor widths and local habitat patch sizes. This optimal amount was based on several unpublished studies from wildlife surveys in Banff National Park, as well as information on security cover requirements for grizzly bears (BCEAG 1999).

Recent studies in the Bow Valley have found that wolves and cougars prefer areas with more hiding cover, while elk use more open areas (Callaghan 2002, Callaghan and Jevons 2004, Jacques Whitford Limited 2005a). Duke (2001) found that as distance to cover increased, wolf and cougar use decreased.

Species-specific habitat requirements, particularly for carnivores (grizzly and black bears, wolf, lynx, wolverine, fisher) and mule deer support the importance of hiding cover (Interagency Grizzly Bear Committee 2004).

5.0 STEP-WISE APPROACH

The following provides a summary of the step-wise approach to determine the shape, width and size of wildlife corridors and habitat patches as presented in the BCEAG (1999) document. This approach is still considered applicable and provides numbers that can be applied by land-use managers and developers. The variables presented interact together to create an acceptable wildlife corridor and/or habitat patch. If a proposed development is located within or adjacent to a wildlife corridor or habitat patch, the following approach must be completed. The steps are shown with additional detail on Figures 2 to 5. An example calculation using the step-wise approach is provided in Appendix B.

Step 1: Shape or Area (Figure 2)

- if the proposed development will change the shape of a wildlife corridor or the area of a habitat patch then adjustments to the development plan are required.

Step 2: Length and Width of Wildlife Corridors (Figure 3)

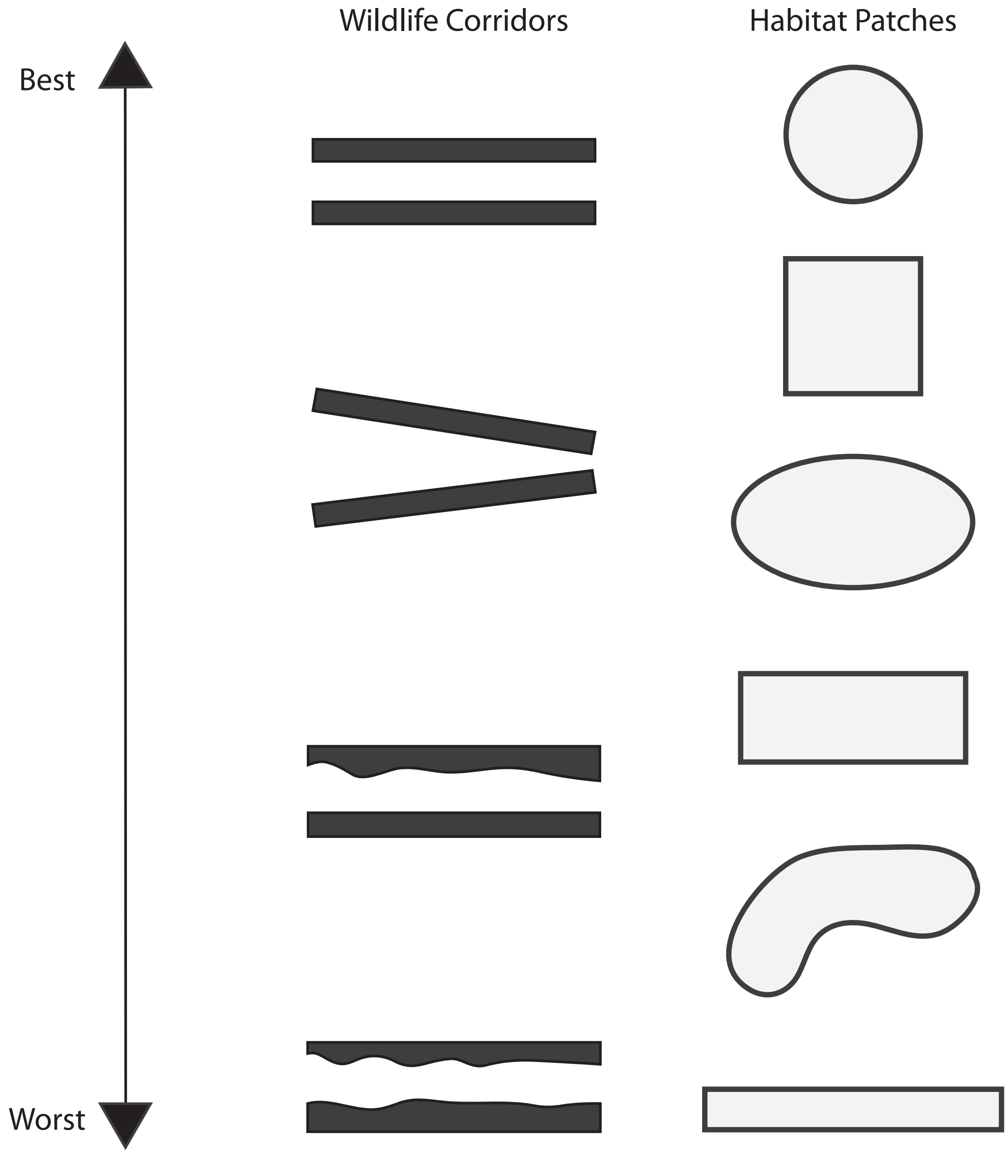
- if a wildlife corridor is greater than 1 km in length, then increase the corridor width.

Step 3: Topography (Figure 4)

- if a ridge, ravine or bench is located between the proposed development and the wildlife corridor or habitat patch and can be considered to effectively buffer the wildlife corridor or habitat patch from noise and light, then no adjustments are necessary to the development plan.
- if a wildlife corridor or habitat patch is located above the proposed development, then an increase in the width of the wildlife corridor and/or an increase in the size of the habitat patch will be necessary.
- if flat topography is located between the development and the wildlife corridor or habitat patch, then ensure the vegetation hiding cover within the wildlife corridor and habitat patch is appropriate (see Figure 5).

Step 4: Vegetation Hiding Cover (Figure 5)

- if the vegetation hiding cover within a wildlife corridor or habitat patch is greater then 40%, than no adjustments related to hiding cover are required.
- if the vegetation hiding cover within a wildlife corridor or habitat patch is less than 40%, than widen the wildlife corridor and increase the size of the habitat patch.



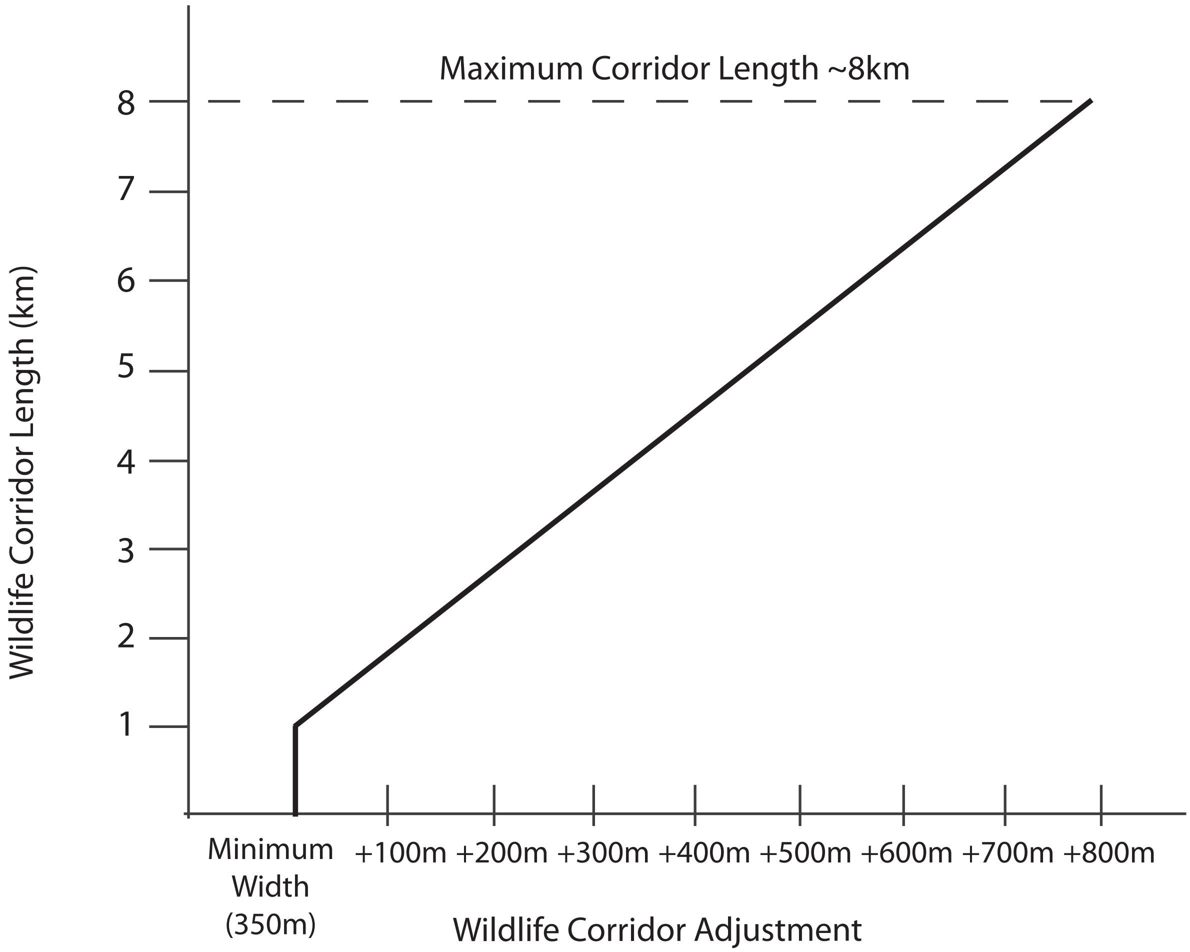
Detail:
Human development along the edge of a wildlife corridor or local habitat patch should form as straight an edge as possible. Peninsulas, doglegs and cul-de-sacs have the potential to trap wildlife or direct them into developed areas where conflict with humans may result. Square or circular shapes are prefered over long, narrow and odd shapes since light, noise and smell will penetrate more of the interior and increase the area of impact. For local habitat patches, the minimum area is 4.5 km^2 to reduce edge effects. Smaller areas will lack sufficient interior habitat to meet the food, rest and water needs of an animal for a short period of time.

Method: GIS analysis can be used to calculate the length/width of a wildlife corridor and the ratio of surface area to perimeter of a habitat patch.

Step 1: Shape

Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley

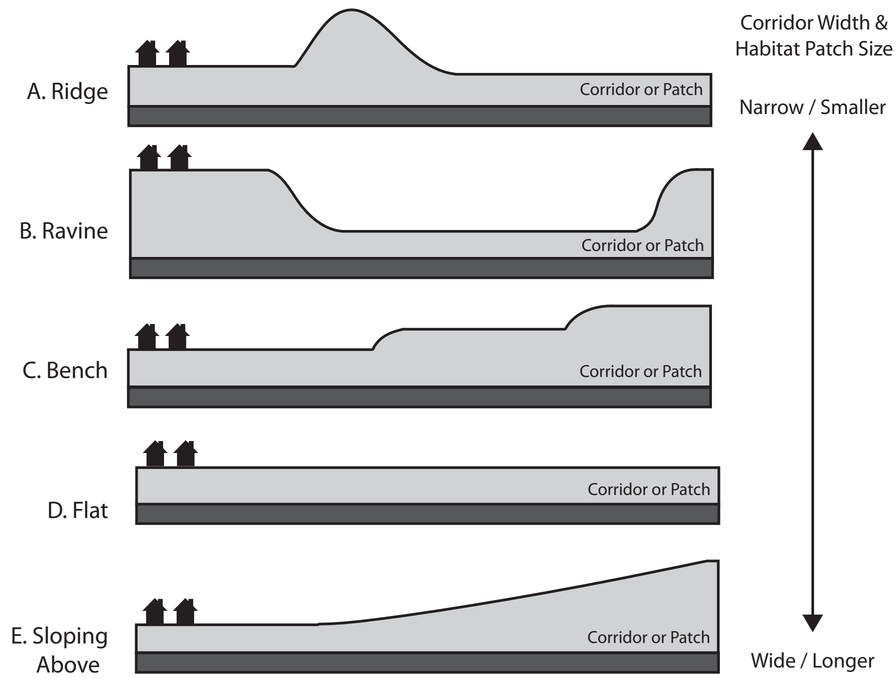
2011	Figure 2

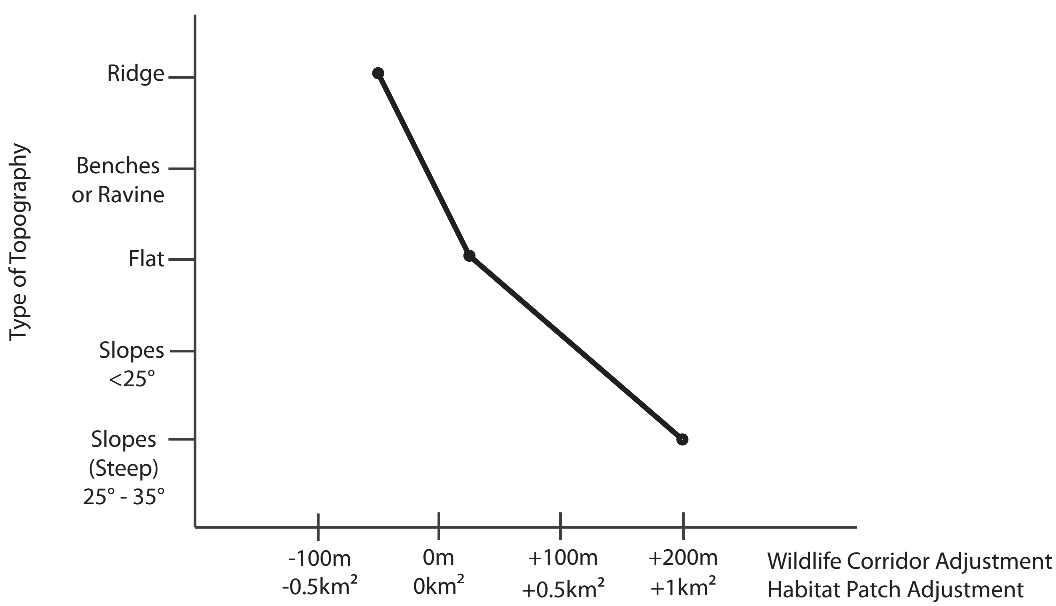


Detail:
Wildlife corridor length and width are interrelated. Longer corridors require a greater width. Long corridors have the potential to expose wildlife to unfavourable conditions for longer periods of time, as well as increase the potential for an animal to leave the corridor and come into conflict with humans. Given the time required to travel a longer corridor, adequate food, water and security are necessary. This can be achieved by increasing the width of the corridor. The maximum allowable distance between two regional habitat patches is 8 km. Unless sufficient corridor width (1.25 km) can be accommodated along its length, a network or shorter, narrower corridors linking local habitat patches is necessary.

Method: GIS analysis can be used to calculate the length/width of a wildlife corridor, and the ratio of surface area to perimeter of a habitat patch.

Step 2: Length / Width of Wildlife Corridors





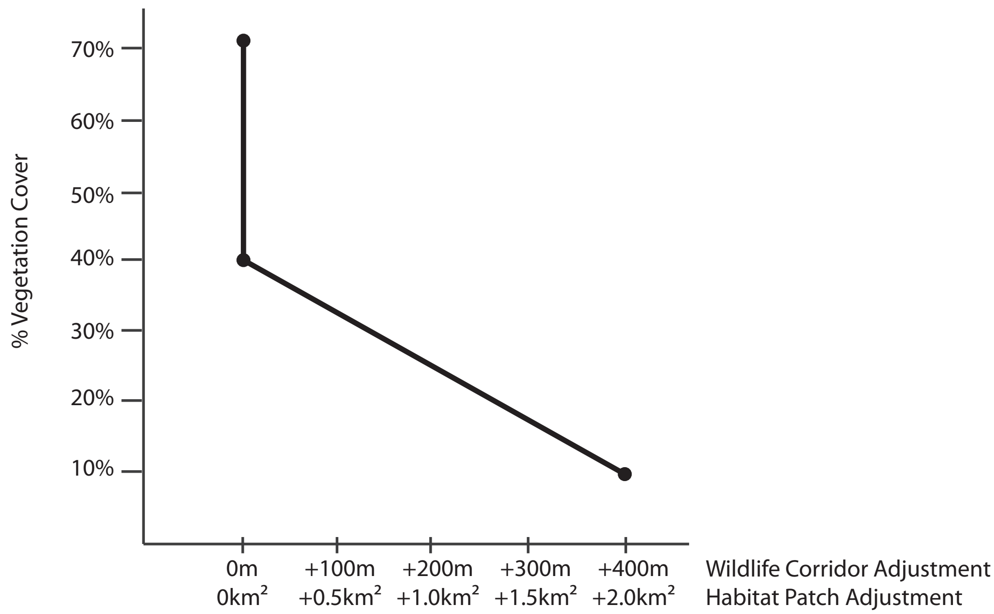
Detail:
Landscape features such as ridges, ravines, benches, flat terrain and slopes will influence wildlife use of a wildlife corridor or habitat patch. A ridge, ravine or bench can insulate a wildlife corridor or habitat patch from human disturbance (noise, light and smell). As such, these wildlife corridors and habitat patches may not require larger widths or more dense vegetation cover. A ridge, ravine or bench can be defined as such if it attenuates noise and light from an adjacent source by 60%. Topography that slopes up and away from human development will allow noise, light and smell to permeate deeper into the wildlife corridor or habitat patch. As a result, these wildlife corridors and habitat patches require larger widths and vegetation cover. Wildlife also avoid slopes greater than 25 degrees. Wildlife corridors and habitat patches with steep slopes require larger widths with more level terrain.

Method: 1:50,000 digital elevation model (DEM) or LiDar can be used to determine the slope. Field validation is required.

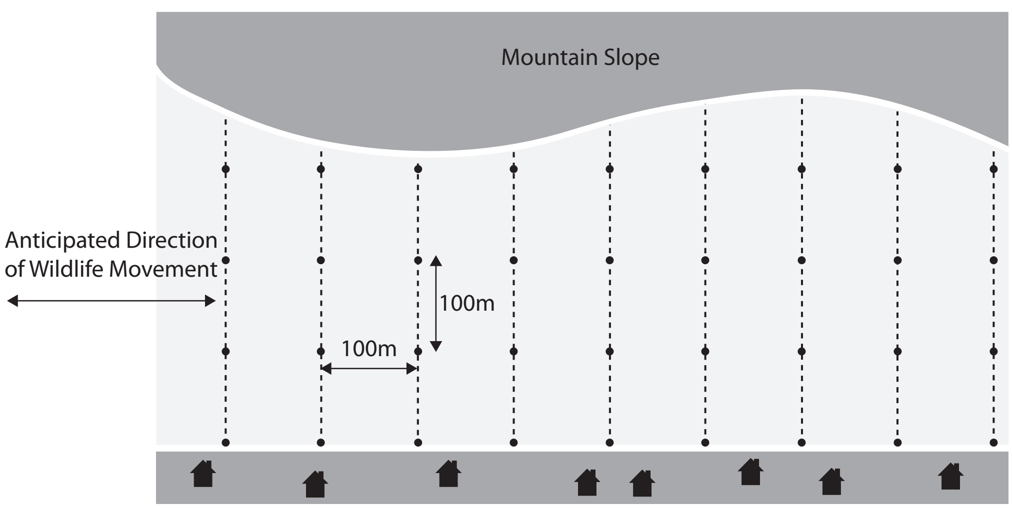
Step 3: Topography

Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley

2011	Figure 4



Detail
Vegetation is used as thermal and hiding/security cover for wildlife and acts as a buffer to human activity. The baseline optimal average vegetation hiding cover for wildlife corridors and local habitat patches is greater than 40%. Less hiding cover will require larger corridor widths and local habitat patch sizes.



Method: A narrow board or cloth 2.5 m high and 30 cm wide is subdivided into vertical rows that are 25 cm high and 30 cm wide. The board or cloth is placed vertically at the point to be sampled. From 15 m away, the percent obscured for each row is recorded from the observer's standing position. The method is repeated four times at each site, once in each direction of the four cardinal points of the compass. Rough vegetative cover maps for a wildlife corridor can be prepared by sampling vegetation cover within a $100m^2$ grid (see diagram above).

Step 4: Vegetation Hiding Cover

6.0 WILDLIFE CORRIDORS AND HABITAT PATCHES IN THE BOW VALLEY

Over the years, various research reports and assessments have applied different names to the wildlife corridors and habitat patches in the Bow Valley. In addition, some of their locations and boundaries have been modified. Figure 1 shows the recommended name designations that should be used by land managers, developers, researchers and consultants. Table 3 provides a brief summary of the evolution of wildlife corridors and habitat patch boundaries in the Bow Valley.

TABLE 3

HISTORY OF WILDLIFE CORRIDORS AND HABITAT PATCHES IN THE BOW VALLEY

Year	Information	References
1992	Wildlife corridors were mapped in the Bow Valley using the best available information at the time.	Report The Preservation of Wildlife Populations in the Bow Valley, Alberta (Banff National Park 1992).
1994/1995	In 1994, the Technical Subcommittee for the Bow Valley Wildlife Corridor Task Force created a map showing existing and recommended wildlife movement corridors. The map was revised in 1995. The map represents a compilation of data from numerous sources and the best judgement of subcommittee members. The map identified the locations and boundaries of the minimum size and number of corridors that would be required to maintain wildlife movements around and through Canmore.	Report Wildlife in the Bow River Valley, Alberta (Wildlife Corridor Technical Committee May 1994). Map Existing (1995) and Recommended Future Minimum Wildlife Movement Corridors (Wildlife Corridor Technical Committee May 1995).
1998/1999	In 1998, the BCEAG reviewed some of the wildlife corridors and habitat patches based on best professional judgement, wildlife use data, wildlife-vehicle collision mortality data and consideration of the remaining contiguous natural lands.	Report Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley, Revised July 1999 (BCEAG 1999). Map Wildlife Habitat Patches and Requirements for Connecting Movement Corridors in the Bow Valley 1998 (wildlife corridors revised June 1999).
2002	Modifications to wildlife corridors within and adjacent to the Three Sisters Mountain Village property were recommended.	Report Assessment of Wildlife Corridors within DC Site 1, DC Site 3 and District "R" (Golder Associates Ltd. 2002).
2002	A study was conducted to identify the Wind Valley and Dead Man's Flats wildlife corridors.	Report Part 1: Regional Wildlife Corridor Study, Wind Valley to Dead Man's Flats, Part I, Wildlife Corridor Delineation (Wildlife and Company 2002). Part II: Regional Wildlife Corridor Study, Wind Valley to Dead Man's Flats, Part II, Wildlife Corridor Delineation (Anonymous 2002).
2011	This report. Provides an update to the BCEAG (1999) document. Name designations are formally applied to the wildlife corridors and habitat patches to ensure consistency.	Report Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley, Updated 2011. Map Figure 1: Wildlife Corridors and Habitat Patches.

Figure 1 identifies the wildlife corridors and habitat patches as a result of this review. Revisions have been made to the boundaries of some of the wildlife corridors and habitat patches since the original 1999 document (BCEAG 1999). Some of the revisions are due to land use decisions made since 1999 by the responsible management agencies, while others are based on the results of this review (the maps in Appendices C and E identify any changes to the wildlife corridor and habitat patch boundaries).

In 1999, several areas were still under review with decisions yet to be made on wildlife corridor or habitat patch delineation (Areas 1-4; see BCEAG 1999). Resolution of outstanding issues in Area 3 (east of

Silvertip) and Area 4 (Wind Valley) allowed for the mapping of a habitat patch west of Silvertip and wildlife corridors in the Wind Valley area (Figure 1). Current wildlife tracking in the Bow Valley has also permitted the preliminary mapping of wildlife corridors in Area 4 (between Bow Valley Provincial Park and Lac des Arc) and Area 1 (above Grassi Lakes).

Substantial changes have been made to the original Three Sisters Along Valley Wildlife Corridor. This wildlife corridor is now wider than the original wildlife corridor in the area between Three Sisters Creek and the Quarry Lake Local Habitat Patch. Additionally, one of the three original cross-valley wildlife corridors on the Three Sisters Resorts Property was eliminated (Three Sisters Creek wildlife corridor) and the two remaining wildlife corridors were widened (Stewart Creek and Tipple wildlife corridors). These revisions were the result of negotiations between Three Sisters Resorts, the Town of Canmore and ASRD and were influenced by the construction of the mid-point interchange. A two year field study conducted between 1998 and 2000 in the Wind Valley area (Area 4 of the 1999 BCEAG Guidelines) in association with Three Sisters Resorts, BHB Canmore, and Banff Mountain Gate Resort Association, provided empirical data to identify the Wind Valley, Dead Man's Flats and Pigeon wildlife corridors (Wildlife and Company 2002 and Anon. 2002).

The initial boundaries of the habitat patches were general boundaries that were drawn to delineate large patches of undeveloped forest cover known to be used by ungulates and carnivores. The habitat patch boundaries were not drawn with the intent of being interpreted as surveyed boundaries. Over time, it became apparent that if development proposals deemed to be "adjacent" to wildlife corridors or habitat patches are expected to apply these guidelines, then the exact location of the wildlife corridor or habitat patch boundary needs to be clearly delineated. As a result, a careful examination of the 1999 boundaries was undertaken as part of this review and slight modifications to wildlife corridor and habitat patch boundaries were made (see Figure 1 and Appendices C and E). In many cases, minor revisions were made to align boundaries with major geographic features (*e.g.*, rivers, tree-line), legal boundaries or property lines. Wildlife monitoring data was also used to adjust boundaries of wildlife corridors and habitat patches where warranted.

Tables 4 and 5 provide a summary of information for the wildlife corridors and habitat patches in the Bow Valley. Data sheets and maps that provide a greater level of detail on the wildlife corridors and habitat patches are provided in Appendices C to F.

TABLE 4

WILDLIFE CORRIDORS IN THE BOW VALLEY[1]

No.[2]	Wildlife Corridor	Area		Length of All Linear Features[3] (km)	Linear Density of All Linear Features (km/km²)	Linear Density of Designated Trails (km/km²)	Linear Density of Non-Designated Trails[4] (km/km²)	Existing Development Footprint[5]	
		(km²)	(ha)					(ha)	%
1	Upper Silvertip	2.63	263	18.5	7.0	3.1	3.9	0	0
2	Lower Silvertip	0.78	78	10.1	12.9	3.1	9.1	0	0
3	Georgetown-Quarry Lake	1.13	113	15.2	13.5	4.1	3.8	0.2	0.2
4	Tipple	0.68	68	8.1	11.9	3.2	5.1	0	0
5	Three Sisters Along Valley	5.23	523	38.4	7.3	0.8	6.5	0.8	0.2
6	Stewart Creek	0.22	22	1.7	7.7	0	2.3	0	0
7	Wind Valley	0.74	74	5.5	7.4	0	5.3	0	0
8/9	Dead Man's Flats / Pigeon	1.23	123	6.7	5.4	0.3	3.6	0.4	0.3

1. Measurements are approximate and based on digital data provided by ATPR (2011a). See Appendix D for more detail.
2. Numbers correspond to Figure 1.
3. Linear features include designated trails, non-designated trails, roads and other linear corridors (powerlines, pipelines, seismic lines, railway).
4. Information on non-designated trails is incomplete and requires field validation.
5. Includes obvious buildings and paved areas (*i.e.*, parking lots) based on 2009 aerial photography. Does not include golf course fairways.

No.[2]	Wildlife Corridor	Area		Golf Course	
		(km²)	(ha)	(ha)	%
1	Upper Silvertip	2.63	263	11.72	4.5
2	Lower Silvertip	0.78	78	6.52	8.3
3	Georgetown-Quarry Lake	1.13	113	0	0
4	Tipple	0.68	68	0	0
5	Three Sisters Along Valley	5.23	523	50.24	9.6
6	Stewart Creek	0.22	22	1.45	6.5
7	Wind Valley	0.74	74	0	0
8/9	Dead Man's Flats / Pigeon	1.23	123	0	0

TABLE 5. HABITAT PATCHES IN THE BOW VALLEY[1]

No. [2]	Habitat Patch	Area (km²)	Area (ha)	Length of Linear Features[3] (km)	Linear Density of All Linear Features (km/km²)	Linear Density of Designated Trails (km/km²)	Linear Density of Non-Designated Trails[4] (km/km²)	Existing Development Footprint[5] (ha)	Existing Development Footprint[5] %
Regional									
1	Harvie Heights	7.96	796	44.7	5.6	1.3	3.9	1.3	0.2
2	Georgetown - Canmore Nordic Center	14.28	1,428	117.1	8.2	6.8	0.7	2.0	0.1
3	Bow Flats	11.55	1,155	15.2	1.3	0	0.1	2.6	0.2
4	Wind Valley	45.75	4,575	46.3	1.0	0.5	0.3	0	0
5	Yamnuska	17.62	1,762	70.7	4.0	0.2	2.4	35.1	2.0
6	Bow Valley Provincial Park	17.49	1,749	100.4	5.7	1.0	2.6	42.2	2.4
Local									
7	Quarry Lake	1.90	190	18.4	9.7	2.7	5.7	0	0
8	South Canmore	1.82	182	12.3	6.8	0.7	4.6	4.8	2.6
9	Indian Flats	4.32	432	45.3	10.5	2.5	6.9	6.4	1.5

1. Measurements are approximate and based on digital data provided by ATPR (2011a). See Appendix F more detail.
2. Numbers correspond to Figure 1.
3. Linear features include designated trails, non-designated trails, roads and other linear corridors (powerlines, pipelines, seismic lines, railway).
4. Information on non-designated trails is incomplete and requires field validation.
5. Includes obvious buildings and paved areas (*i.e.*, parking lots) based on 2009 aerial photography. Does not include golf course fairways.

No.[2]	Wildlife Corridor	Area (km²)	Area (ha)	Golf Course (ha)	Golf Course %
1	Harvie Heights	7.96	796	0	0
2	Georgetown - CNC	14.28	1428	18.36	1.29
3	Bow Flats	11.55	1155	0	0
4	Wind Valley	45.75	4575	0	0
5	Yamnuska	17.62	1762	63.38	3.6
6	Bow Valley Provincial Park	17.49	1749	0	0
7	Quarry Lake	1.9	190	0	0
8	South Canmore	1.82	182	0	0

7.0 LAND USE MANAGEMENT

Given the development pressures in the Bow Valley, the management of activity within and adjacent to wildlife corridors and habitat patches is critical to maintaining their function. In order to preserve wildlife habitat, to allow wildlife movement and to reduce human-wildlife conflicts, restrictions on the type and amount of development and recreational activity permitted within and adjacent to wildlife corridors and habitat patches are necessary. The following presents acceptable activities and best practices for wildlife corridors and habitat patches. These are presented as general guidelines and their application must consider the site-specific conditions associated with each wildlife corridor and habitat patch.

7.1 Acceptable Activities within Wildlife Corridors and Habitat Patches

Land use activities that are considered acceptable within wildlife corridors and habitat patches are presented below.

<u>Wildlife Corridors</u>

- scientific research (must be deemed appropriate for the area);
- designated, non-motorized recreational trails that cross perpendicular (to the extent feasible) to the direction of the wildlife corridor should only be permitted;
- linear service corridors that cross and are perpendicular to wildlife corridors (*e.g.*, powerlines, roads, pipelines);
- vegetation management for fire, disease and weed control. These activities should not reduce the optimal average vegetative hiding cover to 40% or less; and
- wildlife habitat management activities designed to encourage or discourage wildlife use of site-specific areas (*e.g.*, prescribed fire, enhance habitat by planting forage species and limiting human access or attractant management such as the removal of Canada buffaloberry to reduce bear-human encounters).

<u>Habitat Patches</u>

- Scientific research (must be deemed appropriate for the area).
- Designated, non-motorized recreational trails.
- Linear service corridors that cross habitat patches (*e.g.*, powerlines, roads, pipelines).
- Vegetation management for fire, disease and weed control. These activities should not reduce the optimal average vegetative hiding cover to 40% or less.
- Wildlife habitat management activities designed to encourage or discourage wildlife use of site-specific areas (*e.g.*, enhance habitat by planting forage species and limiting human access and/or remove species such as Canada buffalo-berry to reduce bear-human encounters). This activity will be dependent on the location of the habitat patch. For example, removal of Canada buffaloberry may be an acceptable measure in habitat patches in close proximity to human development (*e.g.*, South Canmore) and less acceptable in other habitat patches (*e.g.*, Wind Valley).

7.1.1 Best Practices within Wildlife Corridors and Habitat Patches

Recommended best practices within wildlife corridors and habitat patches are listed below and are intended to provide land management agencies with common ground rules related to existing and proposed land use activities and measures to reduce potential impacts.

<u>Linear Density</u>

- Within wildlife corridors, coordinate perpendicular crossings such that they are spaced at not less than 1 km intervals.

- Group linear corridors (*i.e.*, powerlines, roads, trails) together where possible to reduce the number of crossings.
- Trails that are located and travel length-wise within the interior of a wildlife corridor should be re-located either outside of the wildlife corridor or to the edge of the wildlife corridor. Generally, trails that travel the length of a wildlife corridor are not recommended.
- Spur trails off designated trails should be eliminated.
- Research and develop a linear trail density threshold. Trail density within wildlife corridors and habitat patches should not exceed the linear trail density threshold. In wildlife corridors and habitat patches where the linear density already exceeds the threshold (typically as a result of multiple non-designated trails), consideration should be given to trail closures or the creation of a designated trail with less impact that replaces multiple non-designated trails (see also Section 10: Recommendations).

<u>Development Footprints in Habitat Patches</u>

- The minimum local habitat patch size of 4.5 km^2 should be maintained. New development within any of the local habitat patches will not be permitted since all habitat patches are currently less than 4.5 km^2 (see Table 5).
- New developments with regional habitat patches will only be considered if such development is consistent with existing policy and legislation and does not reduce the area of secure habitat to below 10 km^2.

<u>Recreational Trail Protocol</u>

- Implement seasonal and temporal trail closures as necessary for public safety reasons or when wildlife are most sensitive to human disturbance (*e.g.*, early spring when bears are emerging from their dens and/or fall rut for ungulates).
- Users should be required to remain on designated trails.
- Dogs must be kept on a leash at all times, unless within a designated off-leash area.
- Amenities such as benches, tables, garbage receptacles and lights should not permitted.
- Encourage safe practices to reduce wildlife-human encounters.

<u>Creation of New Trails</u>

This document recognizes the previous work of BCEAG in addressing the issue of human use within wildlife corridors and habitat patches, as well as earlier trail recommendations in the following reports: *Guidelines for Human Use within Wildlife Corridors and Habitat Patches in the Bow Valley* (BCEAG 1999) and *Recommendations of the Recreational Opportunities Working Group* (BCEAG 2002).

Until such time that an accurate inventory has been gathered on non-designated trails, new designated trails can be created only if they replace more than one non-designated trail in order to reduce the overall density of trails. Their design should also consider the following:

- avoidance of high wildlife use and movement areas;
- avoidance of sensitive environmental features (*e.g.*, seeps, mineral licks, rare plant communities);
- measures to increase line-of-sight (avoid hidden corners) to minimize surprise encounters with potentially harmful wildlife;
- selection of direct routes between locations (to discourage creation of short-cuts); and
- ways to direct human use away from a wildlife corridor or habitat patch, or if necessary, take the most direct route across a wildlife corridor or habitat patch.

<u>Educational Signage</u>

- Install signs on trails that bisect wildlife corridors to outline the purpose and importance of wildlife corridors and any restrictions that may apply.

- Install signs on trails entering habitat patches to outline the importance of the habitat patch and to alert users to stay on designated trails and any other restrictions that may apply.

Maintain Hiding Cover

- Ensure that adequate hiding cover for wildlife is available (*i.e.*, minimum 40% cover) in wildlife corridors and habitat patches by planting trees as required.
- Vegetation management for fire, disease or weed control should only be permitted in multi-species wildlife corridors as long as the average vegetative hiding cover remains greater than 40%. Vegetation management should only be permitted in secondary wildlife corridors if done for the purposes of reducing wildlife-human conflicts.

7.2 Acceptable Activities adjacent to Wildlife Corridors and Habitat Patches

As noted earlier, "adjacency" is defined in terms of a distance within 175 m from a multi-species wildlife corridor and 250 m from a Regional or Local habitat patch. Land use activities adjacent to wildlife corridors and habitat patches have the potential to compromise the value of these areas and need to be considered.

Considerable development within the defined “adjacency” area has already taken place relative to many of the wildlife corridors and habitat patches. Additionally, Section 2.0 identifies projects that are exempt from these guidelines since they were already in various stages of planning or had approvals prior to July 1999. These projects should still strive to follow the basic principles in these guidelines as much as possible. New land use activities that are considered acceptable adjacent to wildlife corridors and habitat patches should include those that are less intrusive (*i.e.*, recreational trails and golf courses).

7.2.1 Best Practices adjacent to Wildlife Corridors and Habitat Patches

Recommended best practices adjacent to wildlife corridors and habitat patches are listed below and are intended to provide land management agencies with common ground rules related to existing and proposed land use activities that are located adjacent to these areas. New developments adjacent to wildlife corridors or habitat patches will be required to complete an environmental assessment as required by the appropriate regulatory agency (see Section 9.0).

New land use activities should follow a gradient of less intrusive to more intrusive relative to distance from the wildlife corridor or habitat patch. For example, beginning with a golf course nearest to a wildlife corridor or habitat patch, then moving to a recreational trail, large acreage lots, light industrial development (*i.e.,* warehouse), low density housing, hotel development, followed by high density housing.

Recommended Land Use Setbacks / Buffers

BCEAG (1999) recommended setback distances from the edge of a wildlife corridor or a habitat patch. Following this review, it is recommended that these setbacks continue to be used. They are:

- 20 m buffer - Residential (*i.e.*, single family to four unit residential complex).

- 40 m buffer - Local Commercial Activity (*i.e.*, businesses that serve the local neighbourhood with limited traffic).

The 20 m or 40 m buffer should be measured from the wildlife corridor or habitat patch boundary to the nearest "active" area of the property development (*e.g.,* building, parking lot, loading/unloading area, patio, entrance/exit to property). It is recommended that the buffer be left in a natural state, although dependent on the location of the wildlife corridor or habitat patch, measures to discourage wildlife use of site-specific areas (*e.g.*, remove attractants such as Canada buffaloberry to reduce bear-human encounters) may be necessary. Fuel reduction (*i.e.*, forest thinning) will be permitted within the buffer.

Lighting, Traffic and Landscaping

- Street and outdoor residential lighting should be designed or screened to prevent illumination into a wildlife corridor or habitat patch.
- High human activity centres (*e.g.*, parking lots, playgrounds) should be located away from the edge a wildlife corridor or habitat patch.
- Reduce vehicle traffic speeds with speed bumps, curves and other traffic calming devices.
- Trail head parking lots should be located in an area that encourages the use of designated trails.
- Implement strategies to reduce/eliminate wildlife attractants (*i.e.*, remove berry producing bushes such as Canada buffaloberry, bird-feeders, ornamental fruit trees, etc).
- Landscaping should not include plant species known to be attractants to wildlife.
- Retention or the planting of trees, if necessary, in order to provide screening between the development and the wildlife corridor or habitat patch.
- Activities should follow a gradient of less intrusive to more intrusive relative to distance from the wildlife corridor or habitat patch, as noted above (*e.g.*, a local road should be placed adjacent to a wildlife corridor rather than a high density residential community).

8.0 HABITAT PATCH - EVALUATION SUMMARY

An evaluation of the habitat patches was conducted. Information on the habitat patches is summarized in Table 5 in Section 6 and greater detail (*i.e.*, maps and patch-specific data sheets) are provided in Appendices E and F. Based on the evaluation, a summary of recommendations is provided in Table 6.

TABLE 6

SUMMARY OF HABITAT PATCH EVALUATION

Habitat Patch	Summary and Key Recommendations
Regional	
Harvie Heights	• Based on an approximate calculation of linear density, the Harvie Heights Regional Habitat Patch has the highest density of non-designated recreational trails compared to the other Regional Habitat Patches. It has a low level of human development (*i.e.,* 0.2%) compared to the other Regional Habitat Patches. • The linear density of non-designated recreational trails (3.9 km/km²) is greater than the linear density of designated recreational trails (1.3 km/km²). Evaluate the location and suitability of non-designated and designated recreational trails in an effort to address this imbalance. • Residents of Harvie Heights make use of non-designated trails within the habitat patch in all seasons and use the area for dog-walking. Residents may not know which trail is designated versus non-designated. Implement an educational signage program to emphasize the intent and importance of the area as a habitat patch, to provide information on which trails are/are not designated and to remind users to leash dogs.
Georgetown - Canmore Nordic Center	• Based on an approximate calculation of linear density, the Georgetown-CNC Regional Habitat Patch has the highest density of designated recreational trails compared to the other Regional Habitat Patches. These trails are associated with the Canmore Nordic Centre. • Given the number of existing trails that are used year-round, it is recommended that there be no net increase in trail density. • Any development or modifications within the CNC facility zone will be done in accordance with the most current Canmore Nordic Provincial Park Management Plan. • The south side of the Bow River valley within this habitat patch should remain as an area with minimal activity to facilitate wildlife movement to/from Banff National Park. • Very limited data collection related to wildlife and human use has been conducted within this habitat patch. Evaluate the need for a data collection program.
Bow Flats	• Currently does not have any designated recreational trails. The linear density of non-designated recreational trails is low. • The valley bottom captured in the Bow Flats Regional Habitat Patch is fragmented by several branches of the Bow River, however, it provides high quality habitat for wildlife and specifically accommodates east-west movement. • Given that both the Stewart Creek and Dead Man's Flats wildlife underpasses connect to this habitat patch, it serves as an important area to facilitate wildlife movement through the corridor network. • Designated recreational trails are not recommended within this habitat patch.
Wind Valley	• Currently very low levels of trails and human development. • Maintain low level of linear density. • Very limited data collection related to wildlife and human use has been conducted within this habitat patch. Evaluate the need for such a data collection program.

Habitat Patch	Summary and Key Recommendations
Yamnuska	• Has the second highest level of existing development footprint (*i.e.*, 2.0 km/km²) compared to other Regional Habitat Patches. • The linear density of non-designated recreational trails (2.4 km/km²) is greater than the linear density of designated recreational trails (0.2 km/km²). Evaluate the location and suitability of non-designated and designated recreational trails in an effort to address this imbalance. • Before any new development or expansion of existing development is approved, studies on wildlife and human use within this habitat patch are recommended.
Bow Valley Provincial Park	• Has the highest level of human development (2.4%) compared to the other Regional Habitat Patches. Human activity is seasonally high during the summer months (campgrounds, YMCA Camp, Rafter Six Ranch, Visitor Centre). • The linear density of non-designated recreational trails (2.6 km/km²) is greater than the linear density of designated recreational trails (1.0 km/km²). Evaluate the location and suitability of non-designated and designated recreational trails in an effort to address this imbalance. • Habitat patch provides important habitat for elk as they move south into the Kananaskis Valley along the west side of Barrier Lake. • Before any new development or expansion of existing development is approved, studies on wildlife and human use within this habitat patch are recommended. • Investigate wildlife movement across the TransCanada Highway and evaluate the need and possible methods to facilitate movement across the highway.
Local	
Quarry Lake	• Has a high level of human use given proximity to the dog off-lease area. • The linear density of non-designated recreational trails (5.7 km/km²) is greater than the linear density of designated recreational trails (2.7 km/km²). Evaluate the location and suitability of non-designated and designated recreational trails in an effort to address this imbalance. • Enforce off-leash bylaws for dogs. • Improve educational signage in the area to inform users of the purpose and importance of the habitat patch, to stay on designated trails and to keep dogs on-leash when outside of the off-leash area.
South Canmore	• The linear density of non-designated recreational trails (4.6 km/km²) is greater than the linear density of designated recreational trails (0.7 km/km²). Evaluate the location and suitability of non-designated and designated recreational trails in an effort to address this imbalance. • Wildlife do not appear to be using the Tipple wildlife corridor as intended given the level of development and human activity within and adjacent to this corridor. This information and level of human activity within and adjacent to the South Canmore Local Habitat Patch suggests wildlife use of the Tipple wildlife corridor and habitat patch are compromised. • In order to preserve the intended function of the habitat patch, new dispositions (eg leases, licenses of occupation) and expansions to existing dispositions should not be permitted within the South Canmore Local Habitat Patch. • A review of non-designated recreational trails should be conducted to determine which trails should be closed and how the network of non-designated trails can be replaced by a designated trail that accommodates the purpose of the habitat patch (i.e., the designated trail should be designed and located in a location that is less intrusive to wildlife).
Indian Flats	• This Local Habitat Patch has the highest density of linear features compared to other Local Habitat Patches. The linear density of non-designated recreational trails (6.9 km/km²) is greater than the linear density of designated recreational trails (2.5 km/km²). Evaluate the location and suitability of non-designated and designated recreational trails in an effort to address this imbalance.

9.0 DEVELOPMENT APPROVAL REQUIREMENTS

A development proposal must comply with the regulations and recommendations of the appropriate regulatory agency. The wildlife corridors and habitat patches shown on Figure 1 are located within the town of Canmore boundary or the Municipal District of Bighorn (No. 8). Additionally, many of the wildlife corridors and habitat patches are located within Provincial Parks (Bow Valley, Bow Valley Wildland, Spray Valley, Canmore Nordic Centre), or overlap into Banff National Park. Regardless of location, if a proposed development is located within or adjacent to a wildlife corridor or habitat patch, then the BCEAG guidelines apply. The proponent is required to follow these guidelines.

The protection of wildlife corridors and habitat patches is an important land use planning consideration in the Bow Valley. The Town of Canmore requires an Environmental Impact Statement (EIS) by development proposals within or adjacent to a wildlife corridor or habitat patch (note: wildlife corridors and habitat patches are referred to as Environmentally Sensitive Areas within the Town of Canmore Municipal Development Plan). An Environmental Impact Assessment (EIA) may be warranted based on the review of the EIS. Construction Management Plans that outline specific environmental protection measures are also required for the Town of Canmore for new large-scale multi-unit developments, large subdivisions and recreational developments that are located within or adjacent to wildlife corridors and habitat patches. Specific land use districts, conservation easements and other implementation tools may be used to ensure protection of these areas. Similarly, the MD of Bighorn requires a Development Impact Assessment (DIA) for sub-divisions and large development proposals within or adjacent to a wildlife corridor or habitat patch, and has wildlife related policies as part of their Land Use bylaw.

In summary, the following should be required if a development proposal is located within or adjacent to a wildlife corridor or habitat patch:

- a detailed map that identifies the development footprint in relation to the existing wildlife corridor or habitat patch;
- implementation of the step-wise approach to determine and map the shape, width and size of any wildlife corridor and/or habitat patch according to design standards in this report in relation to a proposed development (see Section 5.0 and Figures 2 to 5);
- an EIS and if warranted, an EIA (Town of Canmore);
- a Construction Management Plan (Town of Canmore);
- DIA (MD of Bighorn); and
- a Wildlife / Human interaction Prevention Plan (WHIPP) if requested by ASRD.

Report EIAs or DIAs may also require the design and implementation of monitoring programs to collect baseline data, to assess potential impacts and to evaluate the effectiveness of mitigation measures. The scope and duration of data collection and monitoring will be in accordance with the conditions applied by the regulatory authority. Generally, a year of baseline data, followed by three years of monitoring post-development is required. In the event any issues and/or negative impacts to wildlife use and/or habitat function are identified, the developer must address the issue accordingly and additional monitoring may be warranted. The appropriate regulatory agency (ASRD, ATPR, Town of Canmore, MD of Bighorn) should review and approve the design of the monitoring program and the methods to be implemented for data collection and monitoring.

10.0 RECOMMENDATIONS

Recommendations for both the developer and land management agencies are provided below.

- When a BCEAG member is processing a statutory plan amendment, Land Use Bylaw amendment or disposition amendment that may affect a wildlife corridor or habitat patch boundary, the member shall circulate the amendment to BCEAG for comment as part of the standard public or internal referral process.

- Review the boundaries of regional and local habitat patches and revise as necessary.

- Research and data collection related to wildlife and human-use in the Bow Valley, whether it is collected by a proponent for a development application, for academic research or government-supported research, should be collected in a manner that allows for comparison over time as well as for comparison between wildlife corridors and habitat patches. This will allow for the development of a consistent evaluation process to assess the value and function of the wildlife corridor or habitat patch. It is recommended that a general sampling protocol and/or suggested methodologies be developed such that the data collection and monitoring techniques that are implemented are similar and the data can be easily compared and interpreted. Common sampling techniques and sources of information include the following: winter transect surveys, wildlife snow-tracking, remote wildlife camera monitoring, analysis of available GPS-collar data; trail monitoring (for both wildlife and humans) with passive infrared counters.

- Process and analyze the existing raw data already collected in the Bow Valley related to human use, increase the research-effort related to human-use within wildlife corridors and habitat patches (*i.e.*, trail counters) and investigate and develop definitions for low versus high human-use levels.

- Conduct an inventory of both designated and non-designated recreational trails within wildlife corridors and habitat patches. Provide these in a GIS format. Develop a protocol to determine a trail density threshold for habitat patches.

- Use Resource Selection Function (RSF) analysis for target species (*i.e.*, grizzly bears, cougars, elk, etc) to identify habitats with the highest probability of use. This information can also be used to evaluate current wildlife corridors and habitat patches based on the minimum design standards (*i.e.*, length/width, slope, hiding cover). RSF models have been prepared for selected species in the Bow Valley (Chetkiewicz and Boyce, 2009, Chetkiewicz *et al.*, 2006, Herrero 2005). It is suggested that the RSF model that is developed and/or used, should be the same to allow for consistency and comparison.

- Investigate new techniques in modelling (*i.e.*, graph theory, step selection functions, least cost path analysis).

- The results of wildlife and human use studies within the Bow Valley and the associated digital data should be organized into a common database. The database should be managed by a group designated by the BCEAG. Data should be made available for future project planning and evaluation purposes.

- Programs such as Bow Valley WildSmart and the Kananaskis Trails Committee should be supported and continue to operate to promote public education and manage trail designation, design and use.

11.0 REPORT REFERENCES

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APPENDIX A
LITERATURE REVIEW

APPENDIX A

LITERATURE REVIEW

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Alberta Parks. 2006. Discussion Paper - Wildlife Use of topography in Corridors. Draft. Prepared by Alberta Parks, Canmore, Alberta. May 2006. 4pp.	• Studied how topography influences grizzly travel and habitat use using radio-telemetry data. • Grizzlies use relatively gentle slopes and rarely use slopes over 25 degrees. Grizzlies use slopes over 25 degrees more in the pre-berry season than in the berry season. • Bears around Canmore used slopes > 25 degrees only 5.9% of the time during the pre-berry season and only 1.9% of the time during berry season. Bears at Lake Louise used slopes >25 degrees only 2.4% of the time during pre-berry season and 2.7% of the time during berry season.
Alberta Sustainable Resource Development. 2008. Alberta Grizzly Bear Recovery Plan 2008-2013. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 15. Edmonton, Alberta. 68 pp.	• Suggested that to limit human caused mortality open route (route without restrictions on motorized vehicle use) densities should be at or below 0.6 km/km^2 in high quality grizzly bear habitat. • Open route densities should be at or below 1.2 km/km^2 in all remaining grizzly bear range.
Alberta Tourism, Parks and Recreation. 2010a. Eastern Bow Valley Wildlife Corridor Study Five-Year Report: An Analysis of Winter Tracking and Monitoring 2004-2009. January 2010. 37 pp.	• Cougars used higher elevations and steeper slopes when compared to other species. Ninety-five percent of cougar movements occurred on slopes of less that 30.1° while 95% of movements of other species occurred on slopes below 25°. • Cougars selected areas far from large water bodies and avoided grasslands relative to closed coniferous forest. • Lynx selected low elevations, northern aspects, and avoided grasslands relative to closed coniferous forest. • Wolves selected for low to moderate slopes and strongly avoided steep slopes. • Wolves selected open coniferous forest, grasslands, and deciduous forest relative to closed coniferous forests. • Some species exhibited strong season trends towards the use of underpasses and some showed strong increases or decreases in underpass use over time.
Alberta Tourism, Parks and Recreation. 2010b. Eastern Bow Valley Wildlife Corridor Study An Analysis of Winter Tracking and Monitoring Summary Report. November 24, 2010. 34 pp.	• Movement of many wildlife species are confined to narrow valley bottoms by cliffs, rugged topography, and deeper snow in winter. These valley bottoms contain several obstructive features to animals (rivers, water bodies, highways, residential areas and mines). • Cougars selected lower elevations and steeper slopes on southern aspects which are areas favoured by deer with lower snow depths. • Wolves selected low elevations, moderate slopes, southwest aspects and open forests.
Alberta Tourism, Parks and Recreation. 2011. Eastern Bow Valley Wildlife Corridor Study Wildlife Camera Study Summary Report. January 19, 2011. 33 pp.	• Most species selected areas of low or low to moderate elevations and low to moderate slopes. • Cougars preferred sites with higher sheep presence and therefore used areas of higher elevations on south facing aspects.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Alexander, S. 2001. A spatial analysis of road fragmentation and linkage zones for multi-species in the Canadian Rocky Mountains: A Winter Ecology Study. PhD Thesis, Univ. of Calgary 35 2pp.	• Across temporal scales wolves did not select consistently for any single aspect class. Flat aspects were selected consistently by wolves at all spatial scales. • Wolf tracks were observed more than expected on slope angles of 0-10 degrees. Wolves selected for areas 0-100 m from roads. • Lynx tracks were observed at spatial and temporal scales more than expected on aspects North, Northeast, East and Northwest. Lynx selected for areas between 0-100 m from roads, with moderate variance across temporal scales and low variance across spatial scales. This does not support the road avoidance hypothesis. Lynx selected for slopes of 20-30 degrees. • Cougar track density was greater than expected on South, West and Northwest aspects across temporal scales (*i.e.*, at the landscape scale). Spatially, cougar showed a preference for West and Northwest aspects and slopes of 0-20 degrees. • Wolverine track density was greater than expected on Southeast and Southwest aspects. Areas between 0-100 (only on low traffic volume roads) and 900-1,000 metres were used more than expected. Wolverine selected slopes of 0-10 degrees more often than expected. • Elk track density was greater than expected on West and Northwest aspects at temporal scales. Spatially, no consistent selection could be inferred for elk by aspect classes. Elk showed a preference for areas between 0-100 metres from roads. Slopes 0-10 degrees were used more often than expected by elk. • Moose selected for East, South, Northwest and Flat aspects. Areas between 0 and 100 m were used more often than expected by moose. Slopes from 0-10 degrees were used more than expected by moose. • Sheep were found more often than expected on Southwest aspects. Sheep track density was greater than expected in regions between 0-100 m from roads. Tracks of sheep showed higher than expected density on slopes between 20-40 degrees. • Species clustered in their selection of slopes and no selection occurred above 30 degrees. Species that selected for 0-1 0 degree slopes include marten, moose, elk, deer, wolverine, wolf and coyote. Squirrel spanned slopes 0-20 degrees. Cougar and lynx selected only 10-20 degree slopes. Hare, weasel and sheep selected slopes of 20-30 degrees.
Alexander S., D. Duke and P. Paquet. 2002. Modeling carnivore habitat-use, travel patterns and human activity around the Town of Canmore, Alberta. Prepared for the Wilburforce Foundation. 50pp.	• Developed an interactive and repeatable process for identifying wildlife corridors that combines ecological, sociological, and economic information and encourages interactions by scientists, land managers, urban planners and developers. The resulting GIS-based model can be revisited and rerun with varying inputs, updates with new information, and used to assess countless land-planning scenarios. Regulatory agencies, parks, town managers, developers, and private landowners can use the information to track and improve decision-making when considering activities and landscape modifications that may influence established wildlife movements. The modeling process outlined probable movement patterns of wolves and cougar that travel through the Bow Valley. • Models highlighted the importance of montane valley bottom for wolf and cougar movements. • Models that include future developments show considerable lateral change in modeled wolf and cougar pathways, which results in an increase in elevation and a greater energy costs. • Future land development around Canmore might adversely affect wildlife movements both locally and regionally. Modifications to current development plans are necessary to ensure continued security of wildlife movement through the Bow Valley.
Anonymous. 2002a. Part I: Regional Wildlife Corridor Study, Wind Valley to Dead Man's Flats, Wildlife Corridor Delineation.	• Wildlife data was used to delineate the Wind Valley and Dead Man's Flats wildlife corridors.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Anonymous. 2002b. Part II: Regional Wildlife Corridor Study, Wind Valley to Dead Man's Flats, Wildlife Corridor Delineation.	• Identify science-based corridor alignments that include the majority of existing movement patterns of the species, especially carnivores. • Corridor alignments avoid steep slopes and other topographical features that could create physical barriers. • Alignments attempt to avoid foreseeable future development and the TCH. • Alignments attempt to avoid situations of human/wildlife conflicts and the pinching of corridors between possible future developments.
Austin, M. 1998. Wolverine winter travel routes and response to transportation corridors in Kicking Horse Pass between Yoho and Banff National Parks. Master's Thesis. Faculty of Environmental Design, University of Calgary. 40 pp.	• Investigated the influence of transportation corridors on wolverine movements through snow-tracking. • Analysis of movements within the study area showed avoidance of areas within 100 m of the Trans-Canada Highway and preference for areas >1100 m from the highway. • Wolverine movements were documented on ski trails with wolverines appearing to favour travelling on the packed snow for ease of movement. • Roads should be avoided where possible in wolverine habitat, especially in important movement corridors such as low elevation passes. • Where a road is necessary, designers should seek to maintain as narrow a right-of-way as is practical (<50m) in order to reduce the impact on wolverines.
Banff National Park Proposal. 1992. The preservation of wildlife populations in the Bow Valley, Alberta. January 1992. 26pp.	• Width of corridor and network of connecting corridors are important to allow for unimpeded movement of wildlife. • The Benchlands between Harvie Heights and Cougar Creek and the Wind Valley-Pigeon Mountain area are important multispecies migration corridors. • Wildlife tend to circumvent developed areas by travelling higher up slope.
Beier, P. and R. Noss. 1998. Do habitat corridors provide connectivity? Conservation Biology, 12:1241–1252.	• A review of studies that empirically address whether corridors enhance or diminish the population viability of species in habitat patches connected by corridors. • Experiments using demographic parameters as dependent variables (even if unreplicated) can demonstrate the demographic effects of particular corridors in particular landscapes. Such studies should measure demographic traits before and after treatment in both the treated area (corridor created or destroyed) and an untreated area (habitat patches isolated from one another). This approach is superior to observing the demographic conditions in various landscapes because of the tendency for corridor presence to be correlated with other variables, such as patch size, that can confound the analysis. • Observations of movements by naturally dispersing animals in fragmented landscapes can demonstrate the conservation value of corridors more convincingly than controlled experiments on animal movement. Such field observations relate directly to the type of animals (*e.g.*, dispersing juveniles of target species) and the real landscapes that are the subject of decisions about corridor preservation. • Fewer than half of the 32 studies reviewed provided persuasive data regarding the utility of corridors; other studies were inconclusive, largely due to design flaws. The evidence from well-designed studies suggests that corridors are valuable conservation tools.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Beier, P., D. Majka and J. Jenness. 2007. Conceptual steps for designing corridors. Website: http://www.corridordesign.org.	• Present a logical series of steps and guidelines for the corridor planning process. • Land use planners should strive to maintain and protect habitat patches greater than 55 ha. The goal should be to maintain larger parcels greater than 2,500 ha to protect more area-sensitive species. • Land-use planners should strive to conserve at least 20% up to 50% of the total landscape for wildlife habitat, where possible. The conservation of greater proportions of habitat (such as a minimum of 60%) may be needed to sustain long-term populations of area-sensitive species and rare species. • To avoid the negative effects of edges on habitats, land use planners should consider establishing buffer zones up to at least 230 m to 300 m from the periphery of edges. • Land-use planners should plan for riparian buffer strips that are a minimum of 25 m in width to provide for nutrient and pollutant removal; a minimum of 30 m to provide temperature and microclimate regulation and sediment removal; a minimum of 50 m to provide detrital input and bank stabilization; and over 100 m to provide for wildlife habitat functions. To provide water quality and wildlife protection, buffers of at least 100 m are recommended. • Land use planners should strive to reduce the distances between habitat patches and to optimize the natural connectivity of the landscape. This may be done by: establishing habitat corridors that connect previously isolated patches; maintaining the natural, structural conditions within the landscape; or by setting aside stepping stone patches. Simultaneously, land use planners should minimize the connectivity of artificial habitats like clear-cuts, agricultural fields, and roadsides.
Beier, P., D. Majka, S. Newell and E. Garding. 2008a. Best management practices for wildlife corridors. Website: http://www.corridordesign.org.	• The authors present a summary of BMPs, including the following: • Integrate the Linkage Design into local land use plans. Specifically, use zoning and other tools to retain open space and natural habitat and discourage urbanization of natural areas in the Linkage Design. • Where development is permitted within the linkage design, encourage small building footprints on large (> 40 acre) parcels with a minimal road network. • Integrate this Linkage Design into county general plans, and conservation plans of governments and non-government organizations. • Combine habitat conservation with compatible public goals such as recreation and protection of water quality. • Each strand of the linkage design must be broad (typically 1-2 km for most of its length) to allow a designated trail system without compromising the usefulness of the linkage for wildlife.
Beier, P., D. Majka and W. Spencer. 2008. Forks in the road: choices in procedures for designing wildland linkages. Conservation Biology, 22(4):836–851.	• Summarize 16 choices and assumptions that arise in designing linkages to facilitate movement or gene flow of focal species between two or more pre-defined wildland blocks. • Recommend designing linkages to serve multiple (rather than one) focal species likely to serve as a collective umbrella for all native species and ecological processes, explicitly acknowledging untested assumptions, and using uncertainty analysis to illustrate potential effects of model uncertainty. Such uncertainty is best displayed to stakeholders as maps of modeled linkages under different assumptions. • Recommend modeling corridor dwellers (species that require more than one generation to move their genes between wildland blocks) differently from passage species (for which an individual can move between wildland blocks within a few weeks).
Bélisle, M. 2005. Measuring landscape connectivity: the challenge of behavioral landscape ecology. Ecology, 86(8):1988–1995.	• Discussion on functional connectivity and the role of behavioural ecology. • Landscape ecologists should be proactive and approach behavioural ecologists to improve models. • By quantifying functional connectivity within a stronger behavioural ecology theoretical framework, landscape ecologists will certainly reduce the likelihood of obtaining equivocal results that may have negative implications not only for their science, but also for biological conservation.
Bennett, A. 2003. Linkages in the landscape: the role of corridors and connectivity in wildlife conservation. IUCN, Gland, Switzerland and Cambridge, UK. 254 pp.	• Provides a general overview with background discussion and examples. • Chapter 9: "Case Studies of Linkages in Land-use Planning and Conservation" describes "linkages for the conservation of large mammals".

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. Gen. Tech. Rep. SRS-109. Asheville, NC: Department of agriculture, forest Service, Southern Research Station. 110 pp.	• Provides illustrated design guidelines for conservation buffers, synthesized and developed from a review of over 1,400 research publications. • Each guideline describes a specific way that a vegetative buffer can be applied to protect soil, improve air and water quality, enhance fish and wildlife habitat, produce economic products, provide recreation opportunities, or beautify the landscape. These science-based guidelines are presented as easy-to-understand rules-of-thumb for facilitating the planning and designing of conservation buffers in rural and urban landscapes. (www.bufferguidelines.net).
Bierwagen, B. 2005. Predicting ecological connectivity in urbanizing landscapes. Environment and Planning B: Planning and Design, 32:763 -776.	• Investigated how urban form can be used to predict ecological connectivity and assist in prioritizing urban landscapes for conservation activities and risk management. Examines the value of qualitative and quantitative descriptions of urban morphology as predictors of ecological connectivity by comparing sixty-six cities in the USA. • Qualitative categories are not adequate for describing ecological connectivity; multivariate descriptions are much better predictors. • The dominance of area as a differentiating variable led to the development of a new urban connectivity index using a combination of urban area and population size. This metric, based on readily available aspatial data, explains 78% of variation in ecological connectivity.
Bierwagen, B. 2007. Connectivity in urbanizing landscapes: the importance of habitat configuration, urban area size, and dispersal. Urban Ecosystems, 10:29–42.	• Investigated how urbanization interacts with the initial amount and aggregation of habitat to change dispersal potential, restoration potential, and the risk of spatially extensive disturbances. • The relationship between habitat loss and connectivity loss is non-linear and subject to interactions between the spatial patterns of habitat distribution, urban morphology, and dispersal capabilities. • While the results clearly show that more aggregated or continuous habitats are more vulnerable to connectivity loss, this approach can also be used to identify landscapes where restoring connectivity will be particularly effective, for example through placement of stepping stone habitats.
Bow Corridor Ecosystem Advisory Group (BCEAG). 2002. Recommendations of the Recreational Opportunities Working Group. 12 pp.	• Provides recommendations regarding: community education and participation; research and monitoring; physical impacts; and enforcement. • Also provides trail-specific recommendations for locations around Canmore.
British Columbia Ministry of Water, Land and Air Protection. 2004. Identified wildlife management strategy accounts and measures for managing identified wildlife. Northern Interior Forest Region.	• Summarizes the status, life history, distribution and habitats of Identified Wildlife, and outlines specific guidelines for management of their habitats. • Road development objectives should include provisions that maximize the net amount, quality, and seasonal representation of Grizzly Bear habitat that is >500 m from an open road (*i.e.*, roads that receive any motorized use from 1 April to 31 October). Larger roadless areas (*e.g.*, >1000 ha) are preferred. • For Wolverine, retain suitable movement and dispersal corridors. Habitat connectivity within and between watersheds is very important for successful daily movements, foraging, and dispersal of wolverines. Connectivity of valley bottom habitats is important, specifically along watercourses. These corridors should be dominated by older forests. Large connectivity corridors should be maintained between refugia where human disturbance is prevalent.
Callaghan, C. and S. Everett. 2004. Use of the Fairholme Benchlands Wildlife Movement Corridor by carnivores and ungulates winter 2003/04. Report prepared for Parks Canada, Banff National Park Warden Service, Alberta Community Development, Parks and Protected Areas, and Alberta Sustainable Resource Development, Canmore. Canadian Institute for Conservation Biology. 20 pp.	• Fairholme Benchlands Corridor provides conditions conducive to traveling for wolves and cougars and functions well as a movement corridor. • Low use rate by ungulates which may be caused by intense human and domestic dog activity and housing developments. • Corridors may help prevent local patch extinctions by providing connections among patches in the habitat matrix.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Callaghan, C. and S. Everett. 2007. Wildlife use of the Rundle Forebay G8 Wildlife Crossing Structure January 2004 - December 2006. Prepared for Alberta Conservation Association. Canadian Institute for Conservation Biology. Canmore, Alberta. 24 pp.	• The goal of the project was to monitor the effectiveness of the wildlife crossing structure over the Rundle Forebay. The wildlife crossing structure was constructed during fall 2003 for the Kananaskis Environmental Legacy as part of a strategy to improve wildlife connectivity throughout the area to the west and east of the Forebay. The monitoring project focused on the movements of large ungulates and large to medium size carnivores and data was collected from January 1, 2004 to December 31, 2006. • Grizzly bear, lynx and wolf were not detected in the monitoring program. • Recommend that measures be instituted to reduce human and domestic dog use of the crossing structure (enforce off-leash bylaws, consider closure to area during certain hours).
Callaghan, C. and S. Jevons. 2001. A Multi-species Habitat Use Model for the Canmore Benchlands Wildlife Movement Corridor. Prepared for Alberta Environment, Natural Resources Service, Canmore. Canadian institute for Conservation Biology. Canmore, Alberta. 34 pp.	• Identified wildlife use of the Canmore Benchlands corridor and developed predictive habitat use models using multiple logistic regression analyses, digital data on landscape and anthropogenic characteristics, snow-tracking data and transect data. • Coyotes and deer selected for lower elevations and slopes and used habitats closer to development. • Where a road is necessary, designers should seek to maintain as narrow a right-of-way as is practical in order to reduce the impact on wolverines selected for lower elevations and slopes and use habitats closer to development. • Elk showed preference for habitat closer to human infrastructure. • Marten showed preference for hiding cover due to greater rate of prey capture than in open habitats. • Area with high species diversity tended to be in areas adjacent to developments in areas of low elevation and slope. Lower diversity was found in developments, pockets of rugged terrain and open, wind-exposed areas.
Callaghan, C. and S. Jevons. 2004. Use of the Canmore Benchlands Wildlife Movement Corridor by Carnivores and Ungulates. Report prepared for Alberta Community Development, Parks and Protected areas, and Alberta Sustainable Resource Development, Canmore. 40 pp.	• Identified wildlife use of the Canmore Benchlands corridor and developed predictive habitat use models using multiple logistic regression analyses, digital data on landscape and anthropogenic characteristics, and transect, snow tracking and radio-telemetry data. • Wolves preferred habitats with greater hiding cover. Preference was indicated for higher elevation and areas closer to trails but avoided areas with highest levels of human use. • Cougar preferred habitat with greater hiding cover and were associated with areas of high probability of finding sheep. Preference for areas with lower density of access/human use. • Deer showed preference for areas closer to trails and less rugged habitat. • Elk tended to use habitats with less hiding cover, habitat with lower density of trails and habitat farther away from access/trails. They also preferred areas closer to development, higher elevations and steeper slopes.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Callaghan, C. 2002. The ecology of grey wolf (*Canis lupus*) habitat use, survival and persistence in the Central Rocky Mountains, Canada. Ph.D. thesis, Department of Zoology, University of Guelph. 211 pp.	• Modeled combined effects of topography and anthropogenic activity on habitat use, survival and population viability based on winter snow tracking data, digital data on habitat characteristics and multiple regression analysis. • Wolves in all four packs studies indicated a preference for significantly lower elevations and slopes, less rugged habitat, higher quality prey habitat, and habitat closer to trails and high use roads than expected based on availability within their home range. • Results show wolves prefer lower elevations, likely resulting from reduced habitat availability due to snow depth at higher elevations and proximity to prey (elk) in fall and winter, whose wintering grounds exist in low elevation areas. • Results suggest that wolves are attracted to roads and trails during winter. Human activities that modify snow compaction, including cross-country skiing, snowmobiling and ploughing roads, may influence winter movements of wolves by providing efficient travel routes. Wolves tended to change their direction of travel to use compacted roads and trails as well as rivers. • Wolves were negatively associated with terrain ruggedness, indicating an avoidance of highly variable habitat. • Wolves tended to travel through vegetation that provided greater hiding cover capability, such as closed coniferous forest. • Placement of roads in areas of high winter wolf activity does not deter wolves from using habitat near roads but increases probability of wolf mortality from automobile collisions and exposure of wolves to human hunters in non-protected areas. • The behavioural response of wolves to linear features they encounter was found to be influenced by the magnitude and timing of human activity on the linear features. Linear features may at times be physical or psychological impediments to wolf movement and, at other times, be used by wolves for efficient travel through a snowy environment. It was found that crossing success rate was similar for roads, rivers and trails. The frequency of traffic affected road-crossing success.
Carroll, C., R. Noss, P. Paquet, and N. Schumaker. 2003. Use of population viability analysis and reserve selection algorithms in regional conservation plans. Ecological Applications, 13:1773–1789.	• A regional conservation plan for mammalian carnivores in the Rocky Mountain region using both a reserve selection algorithm (SITES) and a spatially explicit population model (PATCH). • Although it is unlikely that planning for focal species requirements alone will capture all facets of biodiversity, when used in combination with other planning foci, it may help to forestall the effects of loss of connectivity on a larger group of threatened species and ecosystems.
Carroll, C. 2006. Linking connectivity to viability: insights from spatially explicit population models of large carnivores. Chapter 15 in Connectivity Conservation (Crooks K.R. and M. Sanjayan, eds), pp. 369–389. Cambridge University Press, Cambridge.	• Provides an overview of spatially explicit population models (SEPMs) with examples from studies in British Columbia and Alberta. • There are several different ways to model connectivity. Choosing between these models depends on what level of model complexity provides better guidance in a particular planning context. • For wide-ranging species in medium contrast landscapes, a simple connectivity metric such as patch isolation is unlikely to substitute for SEPM-based mechanistic and context-specific predictions of the probability of functional connectivity and persistence in a patch.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Chetkiewicz, C. and M. Boyce. 2009. Use of resource selection functions to identify conservation corridors. Journal of applied Ecology, 46:(5):1036-1047.	• Resource selection functions (RSFs) and least-cost path (LCP) analyses are used for the purpose of corridor planning for grizzly bear and cougar. Used RSFs developed from Global Positioning System telemetry data to predict the seasonal distribution of grizzly bears and cougars. Applied LCP analyses to identify potential corridors in two fragmented montane landscapes: Canmore and Crowsnest Pass, Alberta. • Grizzly bear habitat selection in both areas correlated positively with greenness in all seasons and soil wetness and proximity to water in the summer when both variables were associated with bear forage. During spring, grizzly bear occurrence in Canmore inversely correlated with road density. • For cougars, habitat selection varied by region. It correlated negatively with road density in Canmore during non-winter and correlated positively with terrain ruggedness in Crowsnest Pass. Cougar occurrence during the non-winter season in Canmore positively correlated with greenness. • For each species, seasonal RSFs were used to develop a cost surface for LCP analyses to identify potential corridor locations in each study area. Overlaying the paths for the two species highlighted where the landscape could support corridors for both species and potential highway crossing zones. The telemetry data supported some of these modelled crossings. • Maps of probability of occurrence and least-cost pathways for cougars and grizzlies around Canmore are provided.
Chetkiewicz, C., C. St. Clair and M. Boyce. 2006. Corridors for conservation: integrating pattern and process. Annual Review of Ecology Evolution and Systematics, 37:317–342.	• Shows how resource selection functions can be used to describe habitat suitability with continuous and multivariable metrics and review methods by which animal movement can be quantified, analyzed, and modeled. • Resource selection functions describe habitat selection patterns in a continuous and multivariate way, and movement patterns can be quantified to examine movement behaviour across the landscape. • Processes of habitat selection and movement can be integrated with landscape features using a variety of approaches. These tools offer new ways to design, implement, and study corridors as landscape linkages.
Chruszcz, B., A. Clevenger, K. Gunson, and M. Gibeau. 2003. Relationships among grizzly bears, highways, and habitat in the Banff-Bow Valley, Alberta, Canada. Can. J. Zool. 81: 1378–1391.	• Examined the relationships among roads, grizzly bears and their habitat in a protected area with low road density but dominated by a major transportation corridor and highway system. Examined grizzly bears' spatial response to roads, road-crossing behaviour, crossing-location attributes and habitat and temporal patterns of cross-road movements. • Grizzly bears used areas close to roads more than expected, particularly roads with low traffic volume. Habituated bears were closer to roads than wary bears. Males were closer to low-volume roads than females but crossed roads less than females during the berry season. Bears were more likely to cross low-volume roads than high-volume roads and were more likely to cross at points with higher habitat rankings. In addition, bears were more likely to cross high-volume roads when moving from areas with low habitat values to areas with high habitat values. Efforts to prevent loss of habitat connectivity across highways should involve maintenance of high-quality grizzly bear habitat adjacent to roads and should address the effects of traffic volume on the road-crossing decisions of grizzly bears.
Clevenger, A. and J. Wierzchowski. 2006. Maintaining and restoring connectivity in landscapes fragmented by roads. Chapter 20 in Connectivity Conservation (Crooks K.R. and M. Sanjayan, eds), pp. 502–535. Cambridge University Press, Cambridge.	• Overview of the effects of roads, types of mitigation and the measurement of the impacts to wildlife travel. Summarizes models used for the design and placement of crossing structures, with examples from the Bow Valley. • Expert-literature-based models outperformed expert-opinion-based models. However, both model types can be useful to managers. • Regional-scale movement models and local-scale habitat suitability models showed reasonably good fit with the empirical data and are useful for identifying locations of important bottlenecks or fracture zones at a regional scale.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Crooks, K. 2002. Relative sensitivities of mammalian carnivores to habitat fragmentation. Conservation Biology, 16(2):488–502.	• Examined the effects of habitat fragmentation on the distribution and abundance of mammalian carnivores in coastal southern California and tested the prediction that responses to fragmentation varied with the body size of carnivore species. • Fragment area and isolation were the two strongest landscape descriptors of predator distribution and abundance. Six species were sensitive to fragmentation, generally disappearing as habitat patches became smaller and more isolated; three species were enhanced by fragmentation, with increased abundance in highly fragmented sites; and two species were tolerant of fragmentation, with little to no effect of landscape variables on their distribution and abundance. • Within urban habitat fragments, the carnivore visitation rate increased at sites with more exotic cover and closer to the urban edge, a pattern driven largely by the increased abundance of fragmentation-enhanced carnivores at edge sites. • Many of the isolated habitat remnants in urban southern California are likely too small and too isolated to permanently support any resident lion populations. Consequently, mountain lions or other large, apex predators may not be the most effective indicator species with which to evaluate the degree of functional landscape-level connectivity in moderately to highly fragmented landscapes.
Dickson, B., J. Jenness and P. Beier. 2005. Influence of vegetation, topography and roads on cougar movement in southern California. Journal of Wildlife Management, 69: 264 - 276.	• Examined the movements of 10 female and 7 male cougars at 15-min intervals during 44 nocturnal periods of hunting or traveling in the Santa Ana Mountain Range of southern California. • Riparian vegetation ranked highest in a compositional analysis of vegetation types selected during movement; grassland, woodland and urbanized sites were least selected. • Cougars spent a disproportionate amount of time in highly ranked vegetation types, and traveled slowest through riparian habitats and fastest through human-dominated areas. • Hunting or traveling individuals consistently used travel paths that were less rugged than their general surroundings. Traveling cougars avoided 2-lane paved roads, but dirt roads may have facilitated movement. • Results indicate that riparian vegetation, and other vegetation types that provide horizontal cover, are desirable features in such corridors, that dirt roads should not impede cougar use of corridors, and that corridors should lie along routes with relatively gentle topography.
Donelon, S. 2004. The influence of human use on fine scale, spatial and temporal patterns of grizzly bear in the Bow Valley of Alberta. Unpublished Master's thesis, Royal Roads University. Victoria, British Columbia, Canada.	• Examined the fine-scale spatial and temporal relationships between grizzly bears and trails and developed sites, in two separate areas in the Bow Valley. • Bears in the Canmore area selected areas near trails more than expected. • Bears in the Lake Louise area selected areas near trails less than expected. • Bears used areas less than expected when human use of trails approached one event per hour. • The results highlight the need to understand site-specific bear behaviour.
Duke, D. 2001. Wildlife use of corridors in the central Canadian Rockies: Multivariate Use of Habitat Characteristics and Trends in Corridor Use. M.Sc. thesis, University of Alberta, Edmonton. 115 pp.	• Provides evidence that a reduction in structures and activity can promote wolf use of a wildlife corridor. • The results also suggest that habitat/movement models can be used to identify travel linkages and determine levels of human activity that impede wildlife movements. This process provides an approach for identification and restoration of wildlife movement corridors.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Duke, D., M. Hebblewhite, P. Paquet, C. Callaghan, and M. Percy. 2001. Restoring a large carnivore corridor in Banff National Park. Pages 261–275 in D. S. Maehr, R. F. Noss, and J. L. Larkin, editors. Large mammal restoration: ecological and sociological challenges in the 21st century. Island Press, Washington, D.C., USA.	• Examined habitat characteristics and wildlife movements through corridors in the Bow Valley based on analysis of data from winter snow tracking sequences and GIS mapping. • Wolf travel routes were not randomly used (P<0.10) for the following habitat characteristics: slope, distance to cover, distance to trails and distance to human disturbance. Travel routes were located randomly for corridor width and relative prey abundance. • As slope increased, wolf use decreased. Wolves used flat and gentle slopes (0-10 degrees) more than their availability and avoided use of steep slopes. • As distance to cover increased, wolf use decreased. Wolves showed weak preference for areas 0 to 25m from cover and weak avoidance of areas >25m from cover. • Wolves used areas <500m from trails more than their availability and avoided areas >500m from trails. Wolves showed a particularly strong preference for areas <50m from trails. • Wolves used areas between 50m and 500m from human disturbance more than their availability and avoided areas <50m and >500m from human disturbance. • Wolves showed a weak avoidance for areas of low relative prey abundance and used areas with moderate and high relative prey abundance more than their availability. • Wolf use of corridor width was variable across corridor width classes. • Cougar travel routes were not randomly used for the following habitat characteristics: slope, distance to cover and distance to human disturbance. Cougar travel routes were located randomly for corridor width, distance to trails, and relative prey abundance. • Cougars used moderate (1-5 degree to 20-30 degree) slopes more than their availability and used flat and very steep slopes less than their availability. • As distance to cover increased, cougar used decreased. Cougars used areas <10m from cover more than their availability and areas >10m from cover less than their availability. • Cougars used areas <500m from trails more than their availability and areas >500m from trails less than their availability. Cougars showed a particularly strong preference for areas <50m from trails. • Cougars used areas between 50m and 500m from human disturbance more than their availability and areas <50m and areas >500m less than their availability. • Cougars used areas with moderate prey abundance more than their availability and areas of low and high relative prey abundance less than their availability. • Cougars used corridor widths of <1,000m more than their availability and corridor widths >100m less than their availability.
Ferrari, J., T. Lookingbill and M. Neel. 2007. Two measures of landscape-graph connectivity: assessment across gradients in area and configuration. Landscape Ecology, 22:1315–1323.	• This study investigates two metrics that measure different influences on connectivity. The first metric, graph diameter, has been advocated as a useful measure of habitat configuration. A second area-based metric is proposed that combines information on the amount of connected habitat and the amount of habitat in the largest patch. • The results identify critical connectivity thresholds as a function of the level of fragmentation and a parallel is drawn between the behaviour of graph theory metrics and those of percolation theory. The combination of the two metrics provides a means for targeting sites most at risk of suffering low potential connectivity as a result of habitat fragmentation.
Gibeau, M. and S. Stevens. 2005. Grizzly bear response to human development. Chapter 11 in Herrero, S. editor. 2005. Final Report of the Eastern Slopes Grizzly Bear Project. pp 182 - 192.	• Provides a summary of the complex nature of the responses of grizzlies to human development in the Eastern Slopes of Alberta.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Gibeau, M., Herrero, S., McLellan, B. and J. Woods. 2001. Managing for grizzly bear security areas in Banff National Park and the Central Canadian Rocky Mountains. Ursus, 12: 121-130.	• Developed a predictive GIS-based model of adult female grizzly bear security areas in the Central Canadian Rocky Mountains. • Of the land surface area of the Banff, Yoho, and Kootenay National Parks, 48% is unsuitable for grizzly bears, primarily because it is composed of rock and ice. • An average of 69% of the land within grizzly bear home ranges was secure using our sample of 28 radio-collared adult females.
Gibeau, M., A. Clevenger, S. Herrero, and J. Wierzchowski. 2002. Grizzly bear response to human development and activities in the Bow River Watershed, Alberta, Canada. Biological Conservation, 103:227–236.	• Documented the degree of grizzly bear response to various human developments as a function of multiple interacting variables based on observed median distances to roads, trails and development features in a landscape where human presence is widespread. • Female grizzly bears remained further than males from paved roads regardless of habitat quality or time of day. • Males were found closer to paved roads when within or adjacent to high quality habitat and during the period of least human activity. • Bears were found closer to trails during the human inactive period within high quality habitat and further from trails when distant to high quality habitat. • Female bears were found further away than males in relation to vehicles and traffic noise, yet found closer than males to human settlement and places where people may be encountered. • Adult female grizzly bears were influenced most by human activities and development. • The median distance to human high use features during the human active period was 1259 m for male bears, and 894 m for female bears. Distances were greater for the Trans-Canada Highway (1626 m and 2185 m for male and female bears, respectively).
Golder Associates Ltd. 2002. Assessment of wildlife corridors within DC Site 1, DC Site 3 and District R. Submitted to: Three Sisters Resorts inc/United inc. and town of Canmore. 55 pp.	• A desktop study of existing corridors within and adjacent to the Three Sisters Mountain property in Canmore and examination of alternatives. • Tracks of cougars and bears were more common at higher elevations and slopes and away from human activity. • Tracks of deer, elk and wolves tended to be evenly distributed across slopes less than 25 degrees. • Bears and cougars used slopes greater than 25 degrees. • The abundance of ungulate and wolf tracks appeared to be inversely related to elevation.
Haddad, N. and J. Tewksbury. 2006. Impacts of corridors on populations and communities. Chapter 16 in Connectivity Conservation (Crooks K.R. and M. Sanjayan, eds), pp. 390–415. Cambridge University Press, Cambridge	• Focuses on the creation and maintenance of habitat corridors. Provides a review of corridor effects on populations and communities, and forecasts future directions that link theory, model systems and management. • Concludes that empirical studies would be aided by insights from analytical, demographic, and individual-based models that help to focus research on specific life-history characteristics and life-cycle stages that link corridor effects to population dynamics.
Hebblewhite, M. and E.H. Merrill. 2007. Multiscale wolf predation risk for elk: does migration reduce risk. Oecologia, 152: 377-387.	• Highest predation risk exposure to elk was during migration as elk moved through low elevation valley bottoms and was associated with a high frequency of death from wolves. • Since wolves avoided areas near high human activity, fine scale selection by resident elk of areas near high human activity reduced their predation exposure to only 15% higher than migrants.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Hebblewhite, M. and E. Merrill. 2008. Modeling wildlife-human relationships for social species with mixed-effects resource selection models. Journal of Applied Ecology, 45: 834-844.	• Illustrate the application of mixed-effects RSF models using a case study of resource selection by individual wolves living in packs as a function of human activity. • In areas of low human activity, wolf resource selection was independent of proximity to humans. • As human activity increased, wolves displayed a functional response selecting areas closer to human activity. With increasing human activity, however, wolves displayed spatio-temporal avoidance of human activity during daylight. • Accounting for the hierarchical social structure of wolves clearly showed that the response of wolves to human disturbance was strongly correlated, but different, within packs, and that the correlation was strongest during winter and weakest during summer. • Wolves strongly avoided steeper slopes and strongly selected for areas close to "hard" edges. • Wolves selected burned and alpine areas during summer but selected burns less and avoided alpine completely in the winter. • Open conifer and cut-blocks were selected during summer but were equally avoided during winter.
Hess, G. and R. Fischer. 2001. Communicating clearly about conservation corridors. Landscape and Urban Planning, 55:195–208.	• A review of the terminology regarding conservation corridors. Includes general corridor design guidelines. • Proper design and management of a corridor depends critically on a clear and explicit statement of its intended functions. Suggestions on how to do this are provided.
Herrero, J. and S. Jevons. 2000. Assessing the design and functionality of wildlife movement corridors in the Southern Canmore Region.	• Used the existing government guidelines and standards as the basis for assessing the design and functionality of the wildlife corridors and habitat patches designated in the Southern Canmore Region. • The primary Multi-Species Wildlife Corridor through the Southern Canmore Region fails to meet the minimum standards for a functional, viable corridor as set by BCEAG. This failure has the potential to severely impair the movement of wildlife in the Bow Valley between the Kananaskis Valley, Banff National Park and beyond, and could have adverse effects on the regional populations of wide-ranging, wary species such as wolf, grizzly bear, wolverine and lynx.
Holroyd, P. 2008. Towards Acceptable Change: A thresholds approach to manage cumulative effects of land use change in the Southern Foothills. Masters Thesis, Faculty of Environmental Design, University of Calgary. 166 pp.	• Three components of environmental and socioeconomic value were identified: fescue grassland, grizzly bears, and water. Candidate thresholds for the valued components were identified through a literature review and interviews with key informants. • Thresholds could be set for minimum corridor widths and minimum distance between habitat patches, although no literature with specific values for grizzly bear habitat conservation was found. • Recommendations for threshold-based management of cumulative effects are provided, considering regulatory and land management processes in Alberta.
Jacques Whitford Limited. 2003. 1997-2002 wildlife monitoring report for the Silvertip Residential Development Canmore, Alberta. 42 pp.	• Wildlife monitoring initiatives are required to assess the effectiveness of mitigation measures in reducing wildlife sensory disturbance and wildlife-human conflicts that may lead to wildlife mortality.
Jacques Whitford Limited. 2005a. Three Sisters Mountain Village Wildlife Monitoring Program 2000-2004 Results. Draft Report to Three Sisters Mountain Village Ltd. March 29, 2005. 99pp.	• A wildlife monitoring program to determine wildlife use, movement patterns, and functionality of the existing Three Sisters Mountain Village wildlife corridor using a systematic sample design based on linear transects. Included summer and winter track counts, pellet-group counts and winter backtracking. • Cougar abundance did not differ significantly relative to different slope classes. Cougar tracks were detected on a range of slopes including those classed as moderate (5-14 degrees) and high (>25 degrees). • No clear patterns in wolf abundance relative to different slope classes were detected. In all study years except 2003/2004, wolf tracks occurred at roughly equal densities in areas within different slope classes. During winter 2003/2004, wolf tracks were found at the highest densities within areas with slopes ranging from 5-14 degrees and were not found on slopes greater than 15 degrees. • In most years, data analysis revealed that bear abundance was higher in gentle to moderately sloping terrain (5-14 degree slope) but in 2001 bears were more abundant on steeper slopes (>25 degrees).

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Jacques Whitford Limited. 2005b. Three Sisters Mountain Village Wildlife Monitoring Program 2000-2004 Report. Draft Report to Three Sisters Mountain Village Ltd. May 13, 2005. 117pp + appendix.	• A wildlife monitoring program to determine wildlife use, movement patterns, and functionality of the existing Three Sisters Mountain Village wildlife corridor using a systematic sample design based on linear transects. Included summer and winter track counts, pellet-group counts and winter backtracking. • Deer used terrain of various slopes in proportion to its availability. • Elk used terrain in higher slope classes less and gently sloping terrain more than expected. • Bears used moderate slope classes (5-14 degrees and 15-24 degrees) more than expected and terrain in low (0-4 degrees) and high (>25 degrees) slope classes less than expected. During all summers, bears used terrain in all slope classes but used terrain with slopes between 5-14 degrees the most, and terrain with slopes greater than 25 degrees the least. • Cougars used gently sloping terrain (slopes of 0-4 degrees and 5-14 degrees) more than steeply sloping terrain (slopes of 15-24 degrees and >25 degrees), though use of terrain in all slope classes was observed. • Wolves tended to use terrain of various slopes in proportion to its availability, however, wolves used terrain in the lowers slope classes (0-4 degrees and 5-14 degrees) the most and were rarely observed using terrain with slopes greater than 25 degrees. • During summer, bighorn sheep were observed using terrain in all slope classes yet tended to use terrain with slopes greater than 25 degrees the least.
Jacques Whitford AXYS Limited. 2008a. Wildlife Monitoring Program 2003-2006 Summary Report. Prepared for Stone Creek Properties Inc. and submitted to Alberta Sustainable Resource Development, July 2008.	• Wildlife data collection included winter track counts, winter backtracking and pellet group transects. Human activity was recorded through observations of foot, bicycle, vehicle, snowmobile, ATV and horse tracks. Domestic dog tracks were also recorded. Track count and pellet group transects focused on Silvertip.
Jacques Whitford AXYS Limited. 2008b. Silvertip Wildlife Monitoring Program 2006-2007 Interim Report. Prepared for Stone Creek Properties Inc. and submitted to Alberta Sustainable Resource Development, July 2008.	• A continuation of the data collection listed above. • Flatter areas were preferred by most wildlife species including deer, elk, coyote and wolf. Areas of steeper terrain limit movement and/or are avoided by deer and elk, while terrain is not a limiting factor for cougar and coyote movement.

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Jacques Whitford Limited. 2005b. Three Sisters Mountain Village Wildlife Monitoring Program 2000-2004 Report. Draft Report to Three Sisters Mountain Village Ltd. May 13, 2005. 117pp + appendix.	• A wildlife monitoring program to determine wildlife use, movement patterns, and functionality of the existing Three Sisters Mountain Village wildlife corridor using a systematic sample design based on linear transects. Included summer and winter track counts, pellet-group counts and winter backtracking. • Deer used terrain of various slopes in proportion to its availability. • Elk used terrain in higher slope classes less and gently sloping terrain more than expected. • Bears used moderate slope classes (5-14 degrees and 15-24 degrees) more than expected and terrain in low (0-4 degrees) and high (>25 degrees) slope classes less than expected. During all summers, bears used terrain in all slope classes but used terrain with slopes between 5-14 degrees the most, and terrain with slopes greater than 25 degrees the least. • Cougars used gently sloping terrain (slopes of 0-4 degrees and 5-14 degrees) more than steeply sloping terrain (slopes of 15-24 degrees and >25 degrees), though use of terrain in all slope classes was observed. • Wolves tended to use terrain of various slopes in proportion to its availability, however, wolves used terrain in the lowers slope classes (0-4 degrees and 5-14 degrees) the most and were rarely observed using terrain with slopes greater than 25 degrees. • During summer, bighorn sheep were observed using terrain in all slope classes yet tended to use terrain with slopes greater than 25 degrees the least.
Jacques Whitford AXYS Limited. 2008a. Wildlife Monitoring Program 2003-2006 Summary Report. Prepared for Stone Creek Properties Inc. and submitted to Alberta Sustainable Resource Development, July 2008.	• Wildlife data collection included winter track counts, winter backtracking and pellet group transects. Human activity was recorded through observations of foot, bicycle, vehicle, snowmobile, ATV and horse tracks. Domestic dog tracks were also recorded. Track count and pellet group transects focused on Silvertip.
Jacques Whitford AXYS Limited. 2008b. Silvertip Wildlife Monitoring Program 2006-2007 Interim Report. Prepared for Stone Creek Properties Inc. and submitted to Alberta Sustainable Resource Development, July 2008.	• A continuation of the data collection listed above. • Flatter areas were preferred by most wildlife species including deer, elk, coyote and wolf. Areas of steeper terrain limit movement and/or are avoided by deer and elk, while terrain is not a limiting factor for cougar and coyote movement.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Jacques Whitford AXYS Limited. 2008c. Three Sisters Mountain Village Wildlife Monitoring Program 2005-2007 update Report. Prepared for Three Sisters Mountain Village ULC. March 2008.	• A wildlife monitoring program to determine wildlife distribution, wildlife movement and functionality of the existing Three Sisters Mountain Village wildlife corridor using a systematic sample design based on linear transects. Included summer and winter track counts, pellet-group counts, winter backtracking and analysis of slope effects on species movement. • In 2005 and 2006, deer were observed in all slope classes between 0-24.99 degrees but were detected less than expected in areas with slopes greater than 25 degrees. During 2007, deer were found in slope class 15-24.99 more than expected. Data suggests steep terrain may limit deer movement. • In summer, elk seemed to use habitats with low slopes and tended to avoid terrain with higher slopes. In summer 2005-2007, elk were found in gently sloping terrain more than expected, however in 2006 elk were detected in areas where slope was >15 degrees less than expected. In winter, elk used terrain with slopes between 0-4 degrees more than expected and terrain with slopes of 15-24 and >25 degrees less than expected. • In winter, cougars used terrain with slopes between 5-14 degrees significantly less than expected but used terrain in all other slope classes in proportion to availability. During summers 2006 and 2007, cougars were observed using variable terrain in all slope classes, which may indicate that terrain does not limit cougar movements. • During summer, wolves used terrain proportion to its availability although wolf presence was more prominent in the 0-5 degree slope class. • Coyotes appear to use all slope classes equally, indicating that terrain is likely not limiting coyote movements. During winter, coyotes used terrain with slopes between 5-14 degrees significantly less than expected but used terrain in all other slope classes in proportion to availability. • Enhancement sites (man-made meadows within the wildlife corridor network designed to create/enhance foraging opportunities for ungulates) were used by elk more than other land use regions in 2006. In winter 2007 deer used the enhancement sites more than other land use regions.
Jevons, S. and C. Callaghan. 2001. Assessment of Wildlife Movement Around the Rundle Forbay in Canmore, Alberta. Prepared for Alberta Community Development, Alberta Sustainable Resource Development, Canmore, Alberta.	• Monitored wildlife movement in the area of the Rundle Forebay. Most of the wildlife tracked used habitat on the north end of the Forebay and a narrow strip of vegetation between Spray Road and Rundleview subdivision to travel between the Quarry Lakes area and Banff National Park. On occasion, some animals used the pedestrian bridge at the south end of the Forebay to access habitat on the other side of the Forebay. • The report recommended four placement options for the wildlife crossing structure on the north segment of the Forebay. The proposed locations were based on the pattern of wildlife activity observed on both sides of the Rundle Forebay. Due to engineering design limitations and budget restrictions, the actual location chosen was not among those recommended in this report.
Kadoya, T. 2008. Assessing functional connectivity using empirical data. Population Ecology, 51:5–15	• A review of recent connectivity research. • Summarizes the current use of connectivity concepts in terms of both meta-population and landscape ecology, and presents recently developed promising techniques in spatial ecology, such as graph theory, pattern-oriented modeling, and state–space modeling, which will help to improve assessment of species-centered or functional connectivity based on empirical data.
Kamenka, L. 1998. Rundle Forbay and Spray Forbay area: wildlife tracking summary for the winter months of 1994 to 1998. Prepared for the Town of Canmore by Three Sisters Resorts, Canmore, Alberta. 48 pp.	• Studied wildlife movement in the area and recorded wildlife use of the pedestrian bridge.
Karlsson, J., M. Eriksson and O. Liberg, 2007. At what distance do wolves move away from an approaching human? Canadian Journal of Zoology, 85(11): 1193–1197.	• Assessed the distance at which radio-collared wolves move away from an approaching human, also called the flight initiation distance (FID), and how FID is affected by wind speed and wind direction. • Wolves moved away when the approaching human was between 17 and 310 m away. FID was negatively correlated with wind speed and had a mean value of 106 m. One hour after having been roused by the approaching human, wolves had moved a median distance of 1.2 km.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Kennedy, C., J. Wilkinson, J. Balch. 2003. Conservation thresholds for land use planners. Washington, DC: Environmental Law Institute. 55 pp.	• A survey of existing scientific literature to determine whether a body of knowledge has emerged within the scientific community relevant and applicable to national land use decision-making, specifically pertaining to biological conservation thresholds. Conducted a literature search of the major ecological, conservation and land use journals. • The literature suggests that, depending on the species or habitat in question, minimum critical patches range from as little as 0.0004 ha (based on the needs of certain invertebrates) up to 220,000 ha (based on the needs of certain mammals) to sustain target species or communities. This wide range reveals that a generic "minimum" critical patch size or habitat requirement does not exist; thresholds are entirely dependent on the target species in question. • Minimum habitat requirements for birds ranged from one hectare up to 2,500 ha with the majority (75 %) of the values found within the literature to be under 50 ha. Minimum patch size required by mammals ranges from one hectare to 10 hectares for small mammals and up to 220,000 ha for large-bodied or wide-ranging mammals (*e.g.,* bears, cougars). • No matter how small habitat patches may be, they still have ecological and/or aesthetic values, whether providing habitat for small organisms like amphibians or insects; providing green space for recreational activities; helping moderate temperature and provide shade in urban areas; or decreasing run-off from streets, pavements, and other impermeable surfaces. • When making land use planning decisions, practitioners should consider the contribution of patches to the overall landscape structure and how well the location of any given patch relates or links to other patches. • To minimize edge effects at the local scale and facilitate the movement of species between a patch and the surrounding matrix, land-use planners should mimic naturally occurring edges and provide gradual thinning of vegetation (*e.g.,* smaller shrubs grading into larger shrubs and taller trees at the edge of a wooded patch) rather than an abrupt transition from vegetated to denuded areas.
Kindlmann P. and F. Burel. 2008. Connectivity measures: a review. Landscape Ecol. 23:879–890.	• A review of various definitions of landscape connectivity, their mathematical connotations, and conclusions and suggestions for future research. • Models should incorporate more realistic movement behaviour to determine which aspects of behaviour have a large effect on landscape connectivity. • Modeling movement behaviours within heterogeneous landscapes could build a bridge between experimental studies and management decisions. • Different landscapes may have different degrees of connectivity for the same species, and the same landscape may have different degrees of connectivity for different species or even for the same species at different times. Landscape connectivity also changes with the choice of measures. • More functional connectivity measures need to be developed to reflect broad categories of organisms and their biological traits. A major challenge in connectivity research is to develop functional connectivity measures that incorporate both species-specific movement behaviour and landscape structure, and that are relatively simple to calculate.
Leeson, B.F. and P. Kamenka. 2008. A proposal for completion of the Three Sisters Along Valley Wildlife Corridor in the east end of the Three Sisters Mountains Village Property, Canmore Alberta. Prepared for Three Sisters Mountain Village ULC. Canmore, Alberta. 38pp.	• Identified areas of wildlife use, trails, and conducted a literature review. • In 2008, there were fewer records of grizzly bears present along a section of powerline that had been brushed/cleared in 2006 and 2007 which eliminated most of the Canada buffaloberry. • Cougars are not limited by slope steepness in their range choices. • There is widespread evidence that elk, bighorn sheep and bears are and have been using slopes substantially in excess of 25 degrees in the east end of the Bow Valley. Trails provide a travel route between important habitats that are substantially lower than 25 degrees in gradient for much of their length, even though the slope of the topography calculated from a general topographic map would inform otherwise. They avoid cliff bands and patches of heavy downfall. Steep slopes that can't be avoided are negotiated on a traverse that lowers the grade. • Elk, bighorn sheep, mule deer, bears and cougars were found to utilize the steep meadows over the back of Wind Ridge, many of which are on slopes steeper than 35 degrees, and some exceed 40 degrees.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Matisziw, T. and T. Murray. 2009. Connectivity change in habitat networks. Landscape Ecology, 24:89–100.	• Eight different habitat configurations were compared and impacts to patch connectivity were explored under various patch loss scenarios. • The analysis demonstrated that connectivity vulnerability is strongly dependent on the spatial distribution of patches within a network, with some network configurations proving to be less vulnerable than others. • The developed framework is equally applicable to evaluating the effects of linkage loss between patches as well as on patch/or linkage acquisition on connectivity.
Mercer, G., G. Carrow and J. Deagle. 2000. Assessing Wildlife Movement and human Use in the Three Valley Confluence. 1999 Progress Report. Jasper National Park. March 2000. 40pp + appendix.	• A preliminary sampling of wildlife movement and human use in the Three Valley Confluence in 1999 using remote cameras. • Slopes at sites with ungulate use were significantly less than at sites without ungulate use. There was no difference in slope at sites with and without carnivore detections. • Data showed a relationship between increasing human use and decreasing carnivore use with the number of carnivore detections decreasing by 42% from low (less than 100 people per month) to high (greater than 1,000 people per month) human use areas. Peak detections of wildlife occurred outside of peak periods of human use.
McLellan, B.N. and F.W. Hovey. 2001. Habitats selected by grizzly bears in a multiple-use landscape. Journal of Wildlife Management, 65:92-99.	• Season was a significant factor influencing habitats and elevations selected by grizzly bears. • Riparian and avalanche chutes had relatively high mean use. • Riparian habitats were selected over other habitats during spring. • Open forest burns (conifers <10m, 5-30% canopy cover due to early succession after wildfire) were selected over other habitats in summer. • In autumn, riparian areas were selected followed by forest and open forest. • Regenerating cut-blocks and rock outcrops were consistently selected less than other habitats.
Miistakis Institute for the Rockies. 2000. Golf Courses and Wildlife; A Literature Review–Assessing the Current State of Knowledge of Golf Course Compatibility for Selected Wildlife. Prepared for Alberta Environment.	• Examined the state of scientific knowledge regarding the suitability of golf courses for wildlife habitat and movement corridors. • Golf courses may affect wildlife by altering habitat, increasing human presence, displacing individuals, shifting movement corridors, and contributing to direct or indirect mortality. • Impacts differ depending on the wildlife species in question, the context, the amount of habitat alteration, and the level of human presence. • Golf courses provide very few long-term benefits to wildlife. Wildlife species that are sensitive to human presence will be particularly affected. • Golf courses may also increase the risk of human-wildlife conflict.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Morrison, S. and W. Boyce. 2009. Conserving connectivity: some lessons from mountain lions in Southern California. Conservation Biology, 23: 275–285	• Examines a case study from southern California that combines monitoring of radio-collared mountain lions with an assessment of land-protection efforts to illustrate lessons learned while attempting to maintain ecological connectivity in a rapidly urbanizing landscape. • Effective land-use plans and policies that incorporate conservation principles are needed to support the retention of landscape permeability. Lessons from this study have broad application, especially as a precautionary tale for places where such extensive and intensive development has not yet occurred. • *Get Specific*: Ranking corridors by their ecological importance is a critical and preferably early step. • *Be Realistic:* Connectivity planning based solely on ecological considerations can lead to visions that may be science-based, but in their ambition they may be divorced from implementation reality. • *Diversify the Tools:* Conservationists must deploy other strategies to help achieve connectivity goals, such as land-use regulations and incentives for compatible uses. • *Couple the Blueprint to Implementation Mechanisms:* Since authority over land-use is often local, coordination across jurisdictions is required to ensure that regional connectivity needs are informing, and being supported by, local planning efforts. Such coordination is one of many necessary components of an effective implementation strategy. Other components include engagement by scientists, collaboration among stakeholders, participation of landowners, effective regulatory and incentives structures, reliable funding, legal frameworks, and indefatigable advocacy.
Morrison, S. and M. Reynolds. 2006. Where to draw the line: integrating feasibility into connectivity planning. Chapter 21 in Connectivity Conservation (Crooks K.R. and M. Sanjayan, eds), pp. 536–554. Cambridge University Press, Cambridge.	• Focuses on landscape fragmentation by irrevocable human land-use impacts. • Discussion of trade-offs; examples from California.
Naylor, L., M. Wisdom and R. Anthony. 2009. Behavioral responses of North American elk to recreational activity. Journal of Wildlife Management, 73(3):328–338.	• Measured responses of elk to recreational disturbance (all-terrain vehicle riding, mountain biking, hiking, and horseback riding) in northeast Oregon. • Results demonstrated that activities of elk can be substantially affected by off-road recreation. • Elk travel time increased in response to all 4 disturbances and was highest in mornings. Elk travel time was highest during ATV exposure, followed by exposure to mountain biking, hiking, and horseback riding. Elk feeding time decreased during ATV exposure and resting time decreased during mountain biking and hiking disturbance.
Noss, R. 2003. A checklist for wildlands network designs. Conservation Biology, 17(5):1270–1275.	• A thorough set of guidelines for the ranking and delineation of conservation corridors.
Paquet, P., J. Wierczhowski and C. Callaghan. 1996. Summary report of the effects of human activity on gray wolves in the Bow River Valley, Banff National Park, Alberta. Prepared for Parks Canada, Banff, Alberta.	• An overview of the effects of humans on wolves in the Bow Valley. • Wolves showed avoidance of roads within 400 m. • Very low disturbance (<100 people/month) did not have a significant influence on wolves. • 100-1,000 people/month cause wolves to be dislocated from sub-optimal habitats. • Higher levels of disturbance caused partial or complete abandonment of preferred habitats. • Wolves use human made trails and roads during periods of moderately deep snow cover. • Wolves use powerline corridors, railways and roads as travel corridors.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Percy, M. 2003. Spatio-temporal movement and road crossing patterns of wolves, black bears and grizzly bears in the Bow River valley of Banff National Park. M.Sc Thesis. University of Alberta. 127 pp.	• Monitored the daily movement patterns of radio-collared wolves, black bears and grizzly bears in the Bow Valley of Banff National Park between 1998 and 2001 to determine when they travel through wildlife corridors, areas of high human-use, and across roads. • Temporal displacement from habitat may be occurring as a result of human activity. To increase habitat effectiveness for large carnivores during crepuscular and night hours, human activity outside the footprints of town sites, campgrounds and outlying commercial accommodation areas should be limited to daylight hours. • Off-trail recreational activity should be discouraged to ensure that diurnal wildlife movements are not interrupted by spatially unpredictable human disturbance. Within a management context, casual and organised (*i.e*., eco-tourist groups) be limited to using existing trails for both summer and winter activities (*e.g.*, hiking and snowshoeing).
Preisler, H., A. Ager and M. Wisdom. 2006. Statistical methods for analysing responses of wildlife to human disturbance. Journal of Applied Ecology, 43:164-172.	• Tested methods for studying wildlife responses to off-road recreation with the use of new technologies that allow frequent and accurate monitoring of human–wildlife interactions. • Elk appeared to respond at relatively long distances (>1,000 m) to ATVs, and the estimated probability of flight appeared to be higher when elk were closer to the ATV routes, even when the distance to an ATV was large.
Rogala, J.K. 2008. The response of wolves, grizzly bears, and elk to human activity on trails and roads. MSc Thesis, University of Calgary. 62 pp.	• Grizzly bears did not select any areas <800 m from trails. • A threshold of 400m is suggested at which wolf response changes from avoidance to attraction with increasing trail and road activity.
Rothley K, and C. Rae. 2005. Working backwards to more forwards: graph-based connectivity metrics for reserve network selection. Environ. Model. Assess. 10(2):107–113.	• An application of graph theory for rating wildlife corridors and habitat patches using Whistler, B.C. as an example. • Explores the trade-offs between maintaining connectivity and minimizing the total area of a protected area network. Rather than focusing on a single organism, a multi-species approach was used. Trade-off curves were examined for organisms with varying dispersal abilities. Trade-off curves were generated using a graph-based metric to determine the importance of individual patches for maintaining connectivity.
Rowland, M., M. J. Wisdom, B. K. Johnson, and J. G. Kie. 2000. Elk distribution and modeling in relation to roads. Journal of Wildlife Management, 64:672–684.	• Elk selected areas away from open roads in both spring and summer. • As elk were further removed from road related humane activities, other factors such as amount and quality of forage more strongly influenced elk distribution. • Management of roads and related human activity should remain an important consideration during spring and summer.
Saura, S. and J. Torné. 2009. Conefor Sensinode 2.2: a software package for quantifying the importance of habitat patches for landscape connectivity. Environmental Modelling and Software, 24: 135–139.	• Describes the new Conefor Sensinode 2.2 (CS22) software, which quantifies the importance of habitat patches for maintaining or improving functional landscape connectivity and is conceived as a tool for decision-making support in landscape planning and habitat conservation. • CS22 is based on graph structures, which have been suggested to possess the greatest benefit to effort ratio for conservation problems regarding landscape connectivity. CS22 includes new connectivity metrics based on the habitat availability concept, which considers a patch itself as a space where connectivity occurs, integrating in a single measure the connected habitat area existing within the patches with the area made available by the connections between different habitat patches. These new metrics have been shown to present improved properties compared to other existing metrics and are particularly suited to the identification of critical landscape elements for connectivity.
Shepherd, B., and J. Whittington 2006. Response of wolves to corridor restoration and human use management. Ecology and Society, 11(2): 1. [online] Website: http://www.ecologyandsociety.org/vol11/iss2/art1/	• Examined how corridor restoration through a golf course changes the distribution of wolves and their prey in Jasper National Park, Alberta. Recorded wolf paths in the snow both within the corridor and in the surrounding landscape before and after a corridor was restored. • Prior to restoration, wolves traveled around the golf course and used the mountainside to connect valley-bottom habitat. Conversely, elk densities were highest in the golf course. After restoration, wolves shifted most of their movement to the golf course corridor, whereas elk dispersed along the corridor and mountainside. When traveling through the study area, wolves selected for areas with high prey abundance, low elevations, and low levels of human activity. Corridor restoration increased the area of high quality habitat available to wolves and increased their access to elk and deer at low elevations. The results corroborate other studies suggesting that wolves and elk quickly adapt to landscape changes and that corridor restoration can improve habitat quality and reduce habitat fragmentation.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Stankowich, T. 2008. Ungulate flight responses to human disturbance: A review and meta-analysis. Biological Conservation, 141: 2159–2173.	• Conducted a comprehensive review of studies measuring escape responses (*e.g.*, flight initiation distance, distance moved) to experimental harassment by humans and vehicles, and meta-analyses aimed at predictive questions about the impact of human disturbance on ungulate behaviour under an optimization framework. • Ungulates pay attention to approaching humans' behaviour, have greater perceptions of risk when disturbed in open habitats, and females or groups with young offspring show greater flight responses than adult groups. • Increased group size and the presence of hunting showed weak but positive heterogeneous effects on flight behaviour both between and within species. • Humans on foot were more evocative than other stimuli (vehicles, noises). • Populations in areas with higher levels of human traffic showed reduced wariness but a lack of alternative sites to move to may explain some of this effect. • Hunted populations showed significantly greater flight responses than non-hunted populations.
Taylor, A., and R. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13:951–963.	• Examined the responses of bison, mule deer and pronghorn to hikers and mountain bikers at Antelope Island State Park, Utah, by comparing alert distance, flight distance, and distance moved. • All three species exhibited a 70% probability of flushing from on-trail recreationists within 100 m from trails. • Mule deer showed a 96% probability of flushing within 100 m of recreationists located off trails; their probability of flushing did not drop to 70% until perpendicular distance reached 390 m.
Tewksbury, J., D. Levey, N. Haddad, S. Sargent, J. Orrock, A. Welden, B. Danielson, Brinkerhoff, J., Damschen, E., and P. Townsend. 2002. Corridors affect plants, animals, and their interactions in fragmented landscapes. Proceedings of the National academy of Sciences of the United States of America, 99:12923–12926.	• Explores how corridors not only increase the exchange of animals between patches, but also facilitate two key plant-animal interactions: pollination and seed dispersal. • Results support the importance of creating/maintaining corridors over, for example, the expansion of existing protected areas. • Results show that the beneficial effects of corridors extend beyond the area they add, and suggest that increased plant and animal movement through corridors will have positive impacts on plant populations and community interactions in fragmented landscapes.
Thebegre, J. 2002. Scale-dependent selection of resource characteristics and landscape pattern by female grizzly bears in the Eastern Slopes of the Canadian Rockies. Ph.D. Dissertation, University of Calgary. 181 pp.	• Studied the influences of scale and pattern on resource selection by female grizzly bears in the eastern slopes of the Bow River watershed as determined using comparison of radio telemetry data and digital data of resource characteristics. • Both habituated and wary bears selected for close proximity to edge and water. Exception was for wary bears in the pre-berry season. • Bears avoided rock/soil in both berry and pre-berry seasons and favoured avalanche paths in the pre-berry season. • Habituated females exhibited marginal selection for shrub fields and steep slopes. • Wary females selected graminoid meadows and low elevation. • Bears shifted from neutral use of elevation in the pre-berry season to use of low elevation in the berry season. • For every 100 m moved away from human activity the likelihood of presence by a habituated bear decreased by 2-18% compared to wary bears. Wary bears in the berry season, regardless of cubs, selected far distance to human access in core areas of their ranges. Wary bears with cubs-of-the-year also avoided human access in the pre-berry season. • Attraction for steep slope was particularly strong for females with cubs-of-the-year in core areas of their home ranges during the berry season. In periphery areas of their home ranges, selection was for flat slopes, particularly during the pre-berry season for wary females and in the berry season for wary females with cubs-of-the-year. • Management Implications: Human activity should avoid edge environments by >60m, riparian areas, avalanche paths (during spring) and grasslands. Human activity may be more appropriate in large homogenous areas of conifer or rocky outcrops.

REFERENCE	DESCRIPTION AND SUMMARY OF KEY RESULTS
Theobald, D. 2006. Exploring the functional connectivity of landscapes using landscape networks. Chapter 17 in Connectivity Conservation (Crooks K.R. and M. Sanjayan, eds), pp. 416–443. Cambridge University Press, Cambridge.	• A review of the basics for estimating effective distance in GIS and use in graph-theoretic-based models. • Introduces a refinement to standard methods called Landscape Networks (LN), which provide a new way of measuring connectivity, and also provide a means to examine directly the degree to which changes in a population are due to habitat loss or fragmentation.
Tracey, J. 2006. Individual-based modeling as a tool for conserving connectivity. Chapter 14 in Connectivity Conservation (Crooks K.R. and M. Sanjayan, eds), pp. 343–368. Cambridge University Press, Cambridge.	• Summarizes how individual-based movement simulations can be used to assess functional connectivity, and provides an example study of carnivore movement in southern California.
Verboom, J. and R. Pouwels. 2004. Ecological functioning of ecological networks: a species perspective. Chapter 4 in Ecological Networks and Greenways: Concept, Design, Implementation. (Jongman, R. and G. Pungetti eds.), pp. 56–72. Cambridge, UK. Cambridge University Press.	• Describes a simple step-by-step method for assessing functional ecological networks by using meta-population theory in terms of network sustainability for species.
Whittington, J., C.C. St. Clair, and G. Mercer. 2004. Path tortuosity and the permeability of roads and trails to wolf movement. Ecology and Society, 9(1): 4.	• Where human activity degrades habitat quality lower tortuosity (path complexity) may be expected. • Tortuosity of wolf paths increased near predation sites which are associated with high quality wolf habitat. • Tortuosity of wolf paths also increased in areas with high trail and road density; however, wolves were more willing to cross low-use trails and roads than high-use roads.
Whittington, J., St Clair, C. and G. Mercer. (2005) Spatial responses of wolves to roads and trails in mountain valleys. Ecological Applications, 15: 543–553.	• Recorded the movements of two wolf packs for two winters by following their tracks in the snow and simultaneously recording positions with a hand-held global positioning system. Uses matched case-controlled logistic regression to compare habitat covariates of wolf paths (cases) to multiple paired random locations (controls). • Both packs selected low elevations, shallow slopes, and southwest aspects. They selected areas within 25 m of roads, trails, and the railway line and more strongly selected low-use roads and trails compared to high-use roads and trails. One pack strongly avoided distances between 26 and 200 m of high-use trails; otherwise, the wolves weakly selected or avoided this distance class. Both packs avoided areas of high road and trail density. • Roads and trails have a cumulative effect on wolf movement and that management of trails, in addition to roads, may be needed to retain high-quality habitat for wolves, particularly in known movement corridors.
Whittington, J. and A. Forshner. 2009. An analysis of wildlife snow tracking, winter transect, and highway underpass data in the Eastern Bow Valley. Unpublished Report, Canmore Alberta. 24 pp.	• Cougars selected areas with steeper slopes on southern aspects and slightly avoided steep slopes on northern aspects. • Wolves selected for low to moderate slopes and strongly avoided steep slopes. • Cougars and lynx avoided grasslands relative to closed coniferous forest. • Wolves selected open coniferous forests, grasslands, and deciduous forest relative to closed coniferous forest.
Wisdom, M., A. Ager, H. Preisler, N. Cimon and B. Johnson. 2004. Effects of off-road recreation on mule deer and elk. In: Transactions of the 69th North American Wildlife and Natural Resources Conference: 531-550.	• Initiated a manipulative landscape experiment to measure effects of off-road recreation on mule deer and elk. • The probability of flight for elk from hikers declined rapidly at a distance of 500 m. • Elk flight response was >750 m for horseback riders and >1,500 m from mountain bike and ATV riders. • Deer flight response was similar for all activities (hiking, biking, horseback and ATV), and decreased rapidly at distances >500 m.

APPENDIX B
EXAMPLE CALCULATION USING THE STEPWISE APPROACH

Example for Corridor Width (Adapted from BCEAG 1999)

Scenario

Land above and immediately adjacent to a proposed development is a wildlife corridor. if the developer builds to full capacity only a 700 m wide area of land will remain between the houses and slopes which are greater than 25°. Half of the 700 m wide area is mature forest that averages 40% hiding cover value while the other half is open forest slopes that average 25% hiding cover value. the wildlife corridor will constrict to 700 m for a 2 km length, connecting two large areas of critical winter habitat for deer and elk (*i.e.*, regional habitat patches).

Forty percent of the wildlife corridor is a flat bench that sits above and below two 200 m long, 20° slopes that comprise the remaining 60% of the wildlife corridor. The developer plans to restrictions on human access into the wildlife corridor using fencing and signs. The developer has adjusted the proposal to meet the specified land use setback from the wildlife corridor boundary.

Based on these guidelines, is the wildlife corridor wide enough (*i.e.*, 350 m wide)?

Explanation of Calculation

1) Determine the *Starting Point Value*. The starting point value for the width of a wildlife corridor is 350 m.

2) Calculate the effect of to*pography*. Since there are two types of topography in the area (bench and slope), calculate the values for these separately and then multiply each by the respective percentage area of land they cover in the corridor (*i.e.* 40% and 60% or 0.40 and 0.60). Step 3 gives values of -50 m for bench and +100 m for 20% slope. Since the bench only occupies 40% of the corridor area, its area modified value is -50 m x 0.4 = -20 m. Similarly, areas of 20% slope only occupy 60% of the corridor, so the area modified value is +100 m x 0.6 = +60 m.

3) Calculate the effect of *Vegetation* (hiding cover). Since there are two classes of vegetative hiding cover (40% vegetative hiding cover and 25% vegetative hiding cover), calculate the values for these separately and then multiply each by the respective percentage area of land they cover in the corridor. in this case, each vegetative hiding cover class occupies half of the total corridor area. Each value is then multiplied by 50% or 0.50. Step 4 gives values of 0 m for 40% vegetative hiding cover and +150 m for 25% vegetative hiding cover. Since the 40% vegetative hiding cover class occupies half of the corridor area, its area modified value is 0 m x 0.5 = 0 m. the area modified value for the 25% vegetative hiding cover class is +150 m x 0.5 = +75 m.

4) Determine the *maximum addition* and *maximum subtraction* values. of the three addition values (+100 m for corridor length (see Figure 3), +60 m for the effects of topography and +75 m for the effects of hiding cover), the +100 m for corridor length is the largest and will be used as the maximum addition value in the final calculation. There is only one subtraction value (-20 m for the area of bench), so this is used as the value of maximum subtraction in the final calculation.

5) Calculate the adjusted corridor width. The starting point value for width of a primary corridor is 350 m. the maximum addition to this width is 100 m. the maximum subtraction is -20 m. therefore, the required corridor width is:

- (Primary corridor width) + (Max. addition) + (Max. subtraction) = (Min. width)
- 350 m + 100 m - 20 m = 430 m wide

The proposed 700 m alignment is more than adequate given the constraints of the local landscape and vegetation inside corridor boundaries. Excess width could be used to buffer against unexpected human use inside the corridor.

SAMPLE CALCULATION

	Calculated Value	
Starting Width	350 m	
Corridor Length = 2 km	+100 m	
Topography - 40% bench - 60% 20° Slope	0.40 (-50 m)	-20 m
	0.60 (100 m)	+60 m
Vegetation - half 40% cover - half 25% cover	0.50 (0)	0 m
	0.50 (150)	+75 m

APPENDIX C
WILDLIFE CORRIDOR MAPS

Wildlife Corridor
Georgetown-Quarry Lake
Three Sisters along Valley
Tipple
Stewart Creek
Lower Silvertip
Upper Silvertip
Wind Valley
Dead Man's Flats / Pigeon

MAP C-1

WILDLIFE CORRIDORS

GEORGETOWN - QUARRY LAKE

WILDLIFE CORRIDOR AND HABITAT PATCH QUIDELINES FOR THE BOW VALLEY

2011

- Wildlife Corridors
- Habitat Patchs
- Roads
- Recognized Recreation Trails
- Hydrographic Features
- Transmission Lines

SCALE

0 100 200 300 400 500 600

Metres

NAD_1983_UTM_Zone_11N

Imagery: 2008 Color Ortho - 1metre accuracy

NOTE: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch, provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

<u>Revisions to Wildlife Corridor Boundary Since 2003</u>

- Recent tracking data used to revise wildlife corridor boundary to more accurately reflect wildlife movement around the Rundle Forbay.
- Removed portions of steep slopes above Grassi Lakes that restrict wildlife movement options.

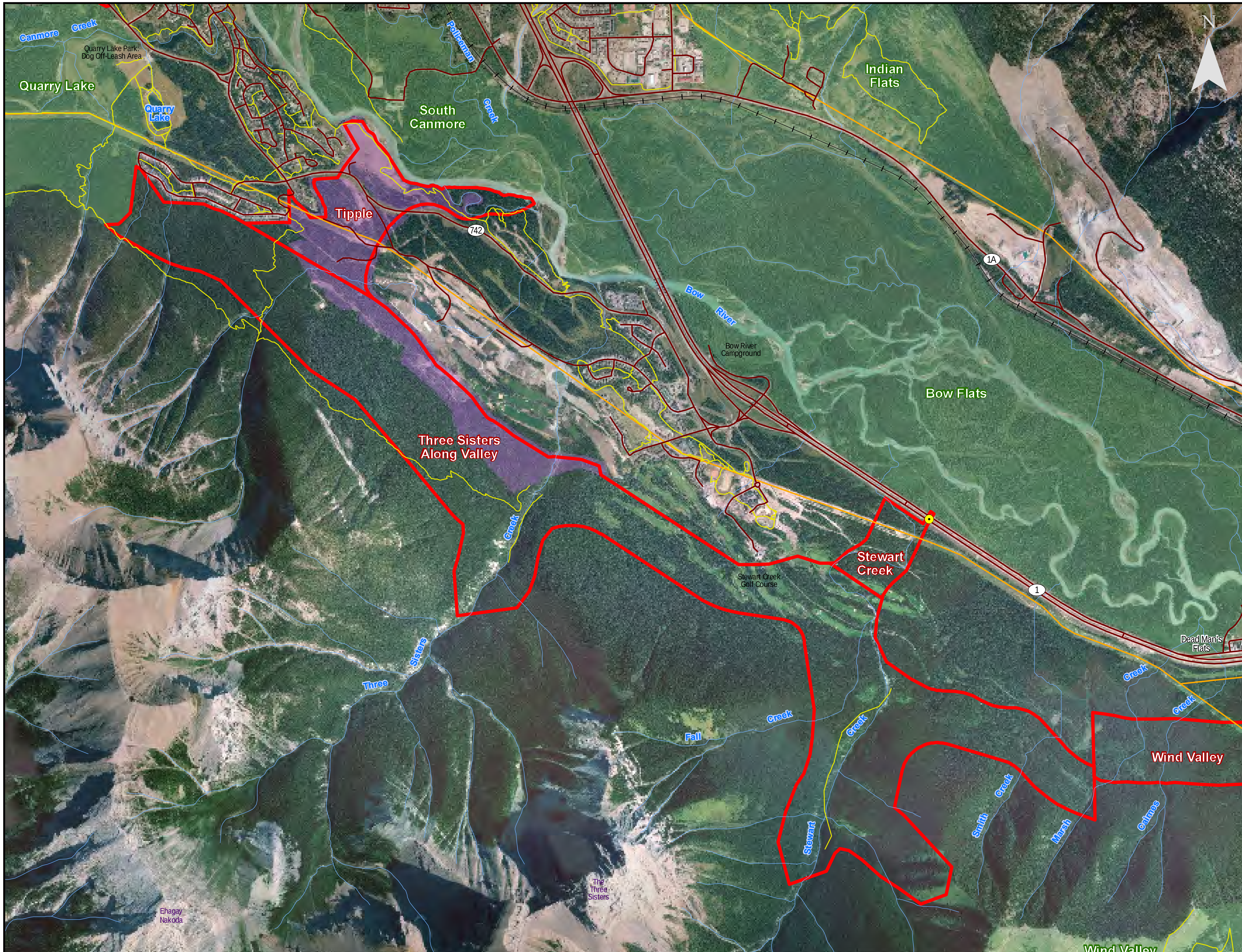
(All Locations Approximate)

Base data provided by Spatial Data Warehouse Ltd.
Data provided by Alberta Tourism, Parks and Recreation

Prepared by: ASRD, Southern Rockies Area, RIU-Calgary.

Government of Alberta

PROJECT: U:\workspace\Landuse\BCEAG\2012\ProjectFiles\TeraMapC1_RvsdJan2012_utm11.mxd
PLOT: U:\workspace\Landuse\BCEAG\2012\PlotFiles\TeraMapC1_RvsdJan2012_utm11.pdf



MAP C-2
WILDLIFE CORRIDORS

- THREE SISTERS ALONG VALLEY
- TIPPLE
- STEWART CREEK

WILDLIFE CORRIDOR AND HABITAT PATCH QUIDELINES FOR THE BOW VALLEY

2011

Wildlife Corridors

Habitat Patchs

Conservation Easements

Roads

Recognized Recreation Trails

Hydrographic Features

Transmission Lines

Railways

Stewart Creek Wildlife Underpass

SCALE

0 200 400 600 800 1,000 1,200

Metres

NAD_1983_UTM_Zone_11N

Imagery: 2008 Color Ortho - 1metre accuracy

NOTE: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch, provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revisions to Wildlife Corridor Boundary Since 2003

- Overlap of the Three Sisters Along Valley with the Wind Valley wildlife corridor removed. The boundary ends at Section line between Sections 11&12 Twp.24 Rge.10 W5M.

(All Locations Approximate)

Base data provided by Spatial Data Warehouse Ltd.
Data provided by Alberta Tourism, Parks and Recreation

Prepared by: ASRD, Southern Rockies Area, RIU-Calgary.

Government of Alberta

MAP C-3

WILDLIFE CORRIDORS

- LOWER SILVERTIP
- UPPER SILVERTIP

WILDLIFE CORRIDOR AND HABITAT PATCH QUIDELINES FOR THE BOW VALLEY

2011

Wildlife Corridors

Habitat Patchs

Conservation Easements

Roads

Recognized Recreation Trails

Hydrographic Features

Transmission Lines

Railways

SCALE

0 100 200 300 400 500 600 700

Metres

NAD_1983_UTM_Zone_11N

Imagery: 2008 Color Ortho - 1metre accuracy

NOTE: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch, provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revisions to Wildlife Corridor Boundary Since 2003

- Wildlife corridor boundaries stop at Habitat Patch boundary.
- Lower Silvertip wildlife corridor boundary adjusted to exclude small portion of the Eagle Terrace subdivision.
- Northwest portion of Upper Silvertip wildlife corridor extended slightly upslope to include area of high wildlife use based on recent wildlife tracking data.

(All Locations Approximate)

Base data provided by Spatial Data Warehouse Ltd.
Data provided by Alberta Tourism, Parks and Recreation

Prepared by: ASRD, Southern Rockies Area, RIU-Calgary.

Government of Alberta

PROJECT: U:\workspace\Landuse\BCEAG\2012\ProjectFiles\TeraMapC3_RvsdJan2012_utm11.mxd
PLOT: U:\workspace\Landuse\BCEAG\2012\PlotFiles\TeraMapC3_RvsdJan2012_utm11.pdf

MAP C-4

WILDLIFE CORRIDORS

- WIND VALLEY
- DEAD MAN'S FLATS
- PIGEON

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011

Wildlife Corridor

Habitat Patch

Designated Recreational Trail

Existing Road

Existing Railway

Existing Transmission Line

Stewart Creek Wildlife Underpass

Note: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10 m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revision to Wildlife Corridor Boundary Since 2003

- Adjusted so that the wildlife corridor boundary (Pigeon and Dead Man's Flats) ends at the Wind Valley Habitat Patch.

(All Locations Approximate)

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011a.
Aerial Imagery from September 2009.

SCALE: 1: 15,000

0 200 400 M

tera ENVIRONMENTAL CONSULTANTS

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Wind Valley_Dead Mans Flats_Pigeon_REV02

APPENDIX D
WILDLIFE CORRIDOR DATA SHEETS

Wildlife Corridor	Map Reference in appendix C
Georgetown-Quarry Lake	Map C-1
Three Sisters along Valley	Map C-2
Tipple	Map C-2
Stewart Creek	Map C-2
Lower Silvertip	Map C-3
Upper Silvertip	Map C-3
Wind Valley	Map C-4
Dead Man's Flats / Pigeon	Map C-4

Explanation of Land Cover Types Used on Data Sheets

Shadow	Shadow.
Water	Lakes, reservoirs, rivers, streams.
Rock	Bedrock, rubble, talus.
Exposed Land	River sediments, exposed soils, pond or lake sediments, reservoir margins, beaches, landings, road surfaces, mudflat sediments, cutbanks, moraines, gravel pits, tailings, railway surfaces, buildings and parking or other non-vegetated surfaces.
Developed	Land that is predominantly built-up or developed and vegetation associated with these land covers. this includes road surfaces, railway surfaces, buildings and paved surfaces, urban areas and industrial sites.
Shrub tall	At least 20% ground cover which is at least one-third shrub; average shrub height greater than or equal to 2 m. Moist to wet erect tall shrub > 40 cm forming more than 25% of the vegetated cover, consisting mainly of dwarf birch, willow and / or alder. Remaining cover consists of graminoids, lichen and may contain < 10% prostrate dwarf shrubs and bare soil.
Wetland/Shrub	Land with a water table near/at/above soil surface for enough time to promote wetland or aquatic processes; the majority of vegetation is tall, low or a mixture of tall and low shrub.
Herb	Vascular plant without woody stem (grasses, crops, forbs, graminoids); minimum of 20% ground cover or one-third of total vegetation must be herb.
Grassland	Native Grass: Predominantly native grasses and other herbaceous vegetation may include some shrubland cover. Land used for range or native unimproved pasture may appear in this class. Comments: alpine meadows fall into this class.
Coniferous Dense	Greater than 60% crown closure; coniferous trees are 75% or more of total basal area.
Coniferous Open	26-60% crown closure; coniferous trees are 75% or more of total basal area.
Broadleaf Dense	Greater than 60% crown closure; broadleaf trees are 75% or more of total basal area
Mixedwood Dense	Greater than 60% crown closure; neither coniferous nor broadleaf tree account for 75% or more of total basal area.
Pasture	Grassland, shrubland, grazed areas.

Based on 2000 Landsat 5 and 7 ortho-images (Government of Canada 2009).

GEORGETOWN QUARRY LAKE - WILDLIFE CORRIDOR

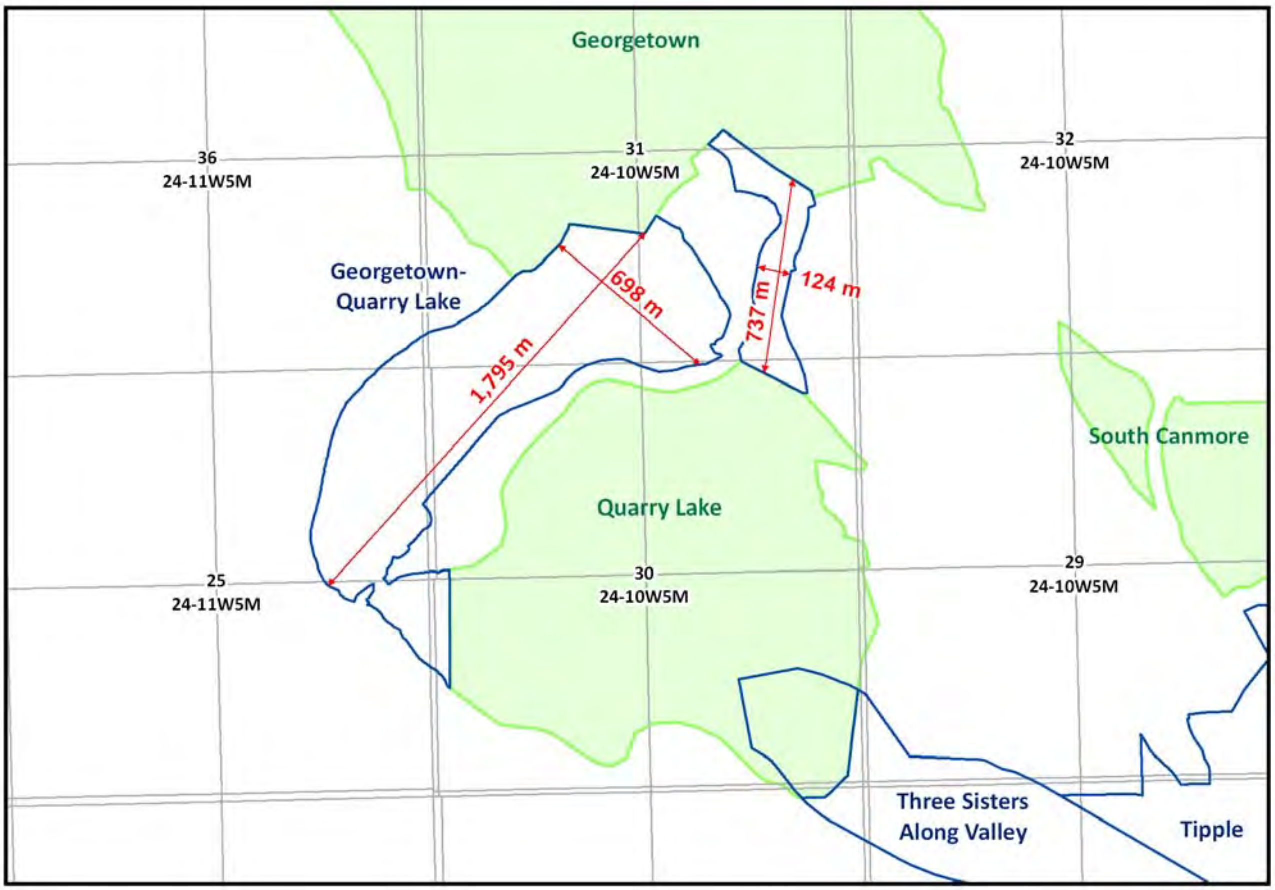
(see Map C-1) (All measurements are approximate)

Within and/or Habitat Patch/ Wildlife Corridor Linked to:	• links Georgetown-CNC and Quarry Lake habitat patches
Land Use Within (General Description)	• includes Hwy. 742

Source: air photo imagery (September 2009 imagery) and wildlife corridor boundaries from ATPR (2011a).

Corridor Dimensions - Georgetown Quarry Lake Portion A	
Length	1,795 m
Width	698 m
Area	94.1 ha (0.94 km^2)

Corridor Dimensions - Georgetown Quarry Lake Portion B	
Length	737 m
Width	124 m
Area	14.1 ha (0.14 km^2)



Note: all measurements (terrain, land cover, anthropogenic footprint, dimensions) are approximate and do not include the blue-shaded area.
Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management (Portions A + B)	**Area (ha)**	**Percent (%)**
Provincial Protected	72.1	66.7
Provincial Unprotected	8.7	8.0
Private	11.3	10.5
Private (Conservation Easements)	0	0
Municipal	0.3	0.3
Other (transportation corridors, waterways)	15.8	14.5

Source: Government of Alberta, 2009.

Terrain within Wildlife Corridor (Portions A+B)	**Area (ha)**	**Percent (%)**
Slope 0-25 degrees	104.5	96.0
Slope > 25 degrees	3.7	4.0

Source: DEM data from ATPR (2011a).

Land Cover (Portions A+B)	**Area (ha)**	**Percent (%)**
Coniferous Dense	59.7	55.3
Shrub Tall	19.2	17.0
Developed	14.7	13.6
Grassland	6.2	5.4
Herb	5.0	4.4
Rock	2.6	2.3
Water	0.5	0.4
Shadow	0.3	0.2

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint within Wildlife Corridor		
Linear Feature	Designated Recreational Trails	4.6 km
	Non-Designated Recreational Trails	4.3 km
	Vehicular roads (paved and gravel)	3.1 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	2.7 km
	Total Length	14.7 km
	Linear Density	13.6 km/km²
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential).	0.2 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

List of Wildlife / Human Use Research Conducted within and adjacent to Wildlife Corridor (refer to reference list in Appendix A)
• Jevons and Callaghan (2001): Winter backtracking was conducted to determine wildlife movement around the Rundle Forbay during the winter of 1999/2000. Results summarize and are consistent with a study by Kamenka (1998). The study area concentrated on the areas adjacent to the Rundle Forbay.

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	48.1	44.5
		2	52.1	48.1
		3	7.8	7.2
		4	0.2	0.2
		5	0	0
	Summer (June 16 - Aug. 10)	1	0	0
		2	0	0
		3	20.1	18.6
		4	88.1	81.4
	Fall (Aug. 11 to Nov. 7)	1	16.9	15.6
		2	5.8	5.4
		3	6.2	5.7
		4	9.1	8.4
		5	4.8	4.4
		6	4.2	3.9
		7	9.5	8.8
		8	42.2	39.0
		9	9.4	8.8
Cougar	Non-Winter (April 16 to Nov. 14)	1	0	0
		2	19.4	17.9
		3	65.3	60.3
		4	22.2	20.5
		5	1.2	1.3
	Winter (Nov. 15 to April 15)	1	0	0
		2	1.2	1.2
		3	0.7	0.6
		4	2.3	2.1
		5	61.6	56.9
		6	42.4	39.2

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

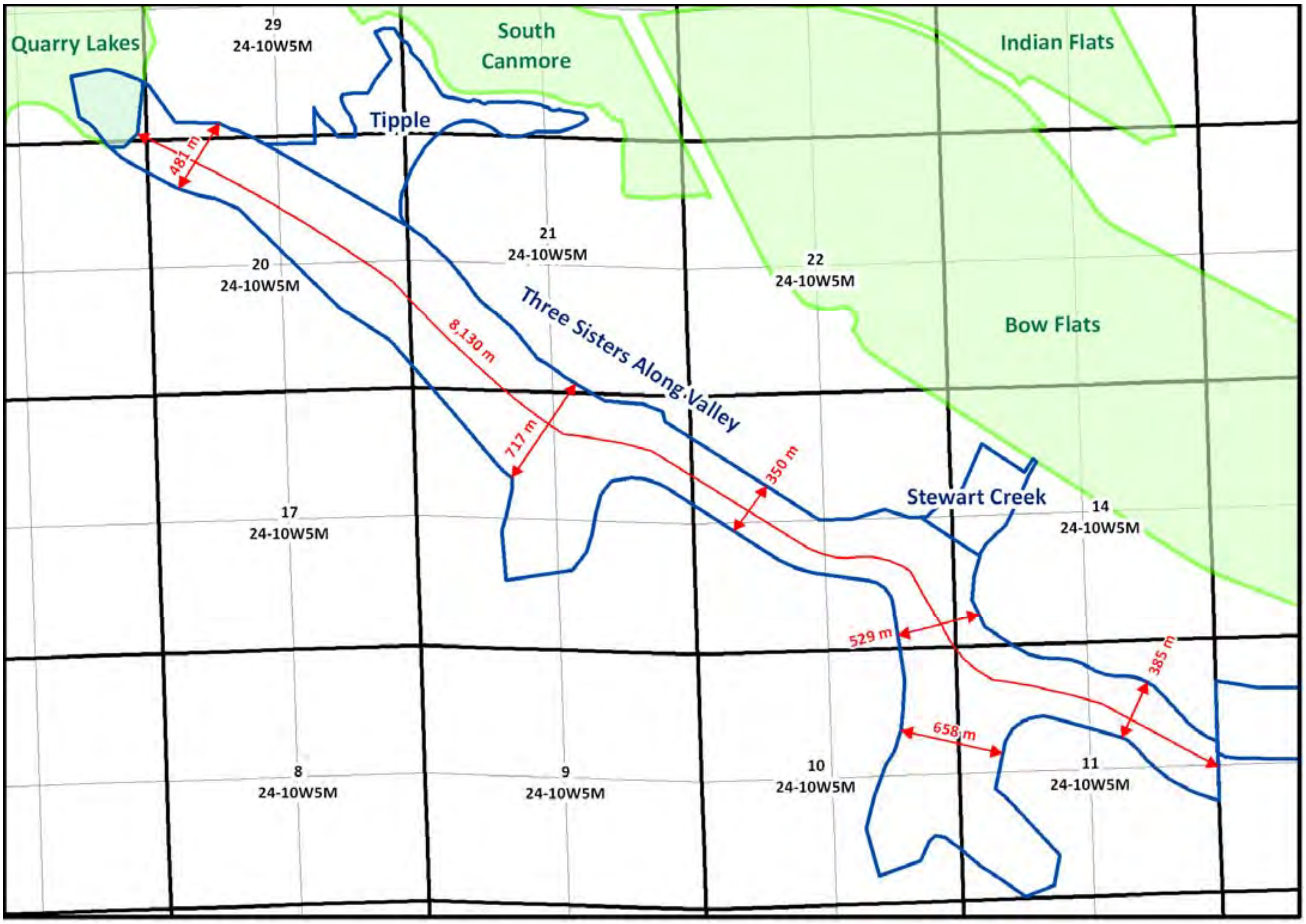
THREE SISTERS ALONG VALLEY- WILDLIFE CORRIDOR

(see Map C-2) (All measurements are approximate)

Within and/or Habitat Patch/ Wildlife Corridor Linked to:	• linked to Tipple, Stewart Creek and Wind Valley wildlife corridors • linked via the above wildlife corridors to Wind Valley Regional habitat patch, Bow Flats Regional habitat patch, South Canmore Local habitat patch and Quarry Lake Local habitat patch.
Land Use Within (General Description)	• includes fairways of Stewart Creek golf course

Source: air photo imagery (September 2009 imagery) and wildlife corridor boundaries from ATPR (2011a).

Corridor Dimensions - Three Sisters Along Valley	
Length	8,130 m
Width	350 m to 717 m
Area	522.8 ha (5.23 km^2)



Note: all measurements (terrain, land cover, anthropogenic footprint, dimensions) are approximate and do not include the blue-shaded area.
Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	371.7	71.1
Provincial Unprotected	27.7	5.3
Private	69.1	13.2
Private (Conservation Easements)	44.8	8.6
Municipal	0.0	0.0
Other (transportation corridors, waterways)	9.5	1.8

Source: Government of Alberta, 2009.

Terrain within Wildlife Corridor	Area (ha)	Percent (%)
Slope 0-25 degrees	401.5	77.0
Slope > 25 degrees	120.7	23.0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	475.4	90.9
Shadow (unable to measure)	13.1	2.5
Shrub Tall	11.2	2.1
Broadleaf Dense	9.5	1.8
Exposed Land	8.3	1.6
Grassland	3.7	0.7
Herb	1.1	0.2
Rock	0.4	0.1

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint within Wildlife Corridor		
Linear Feature	Designated Recreational Trails	4.2 km
	Non-Designated Recreational Trails	34.2 km
	Vehicular roads (paved and gravel) (m)	0
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	0
	Total Length	38.4 km
	Linear Density	7.3 km/km²
Non-Linear Feature	Anthropogenic Disturbance Golf Course (includes buildings, paved areas and obvious disturbances with no habitat potential).	0.8 ha 50.2 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	28.1	5.4
		2	237.4	45.4
		3	223.8	42.8
		4	27.9	5.3
		5	4.5	0.9
	Summer (June 16 - Aug. 10)	1	0	0
		2	1.0	0.2
		3	192.4	36.8
		4	329.4	63.0
	Fall (Aug. 11 to Nov. 7)	1	0	0
		2	0.1	0
		3	0	0
		4	1.0	0.2
		5	8.5	1.6
		6	6.8	1.3
		7	17.1	3.3
		8	311.0	59.5
		9	178.3	34.1
Cougar	Non-Winter (April 16 to Nov. 14)	1	0	0
		2	54.6	10.4
		3	252.5	48.3
		4	112.7	21.6
		5	103.0	19.7
	Winter (Nov. 15 to April 15)	1	0	0
		2	3.8	0.7
		3	12.1	2.3
		4	40.6	7.8
		5	437.8	83.7
		6	28.5	5.5

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

List of Wildlife / Human Use Research Conducted within and adjacent to Wildlife Corridor (refer to reference list in Appendix A)
• Golder Associates Ltd. (2002): desktop review to assess wildlife corridors on TSR property using data from previous reports. Assessed only a portion of the west half of the corridor. • Jacques Whitford Limited (2005a): Summer and winter track counts, spring and fall pellet group counts, winter backtracking. The study area included the entire wildlife corridor. Winter backtracking extended outside the corridor into adjacent areas. • Jacques Whitford AXYS Limited (2008c): Winter track counts, summer track pad counts, spring pellet group counts, winter backtracking (2005 to 2007). Used the same transects as previous Jacques Whitford Limited study (2005a, 2005b). The study area included the entire wildlife corridor. Winter backtracking extended outside the corridor into adjacent areas • Leeson and Kamenka (2008): Mapped wildlife use and reviewed wildlife use data from previous studies. (April to November 2008). The study area is concentrated on the junction between the west end of the Wind Valley wildlife corridor and the east end of the Three Sisters Along Valley wildlife corridor

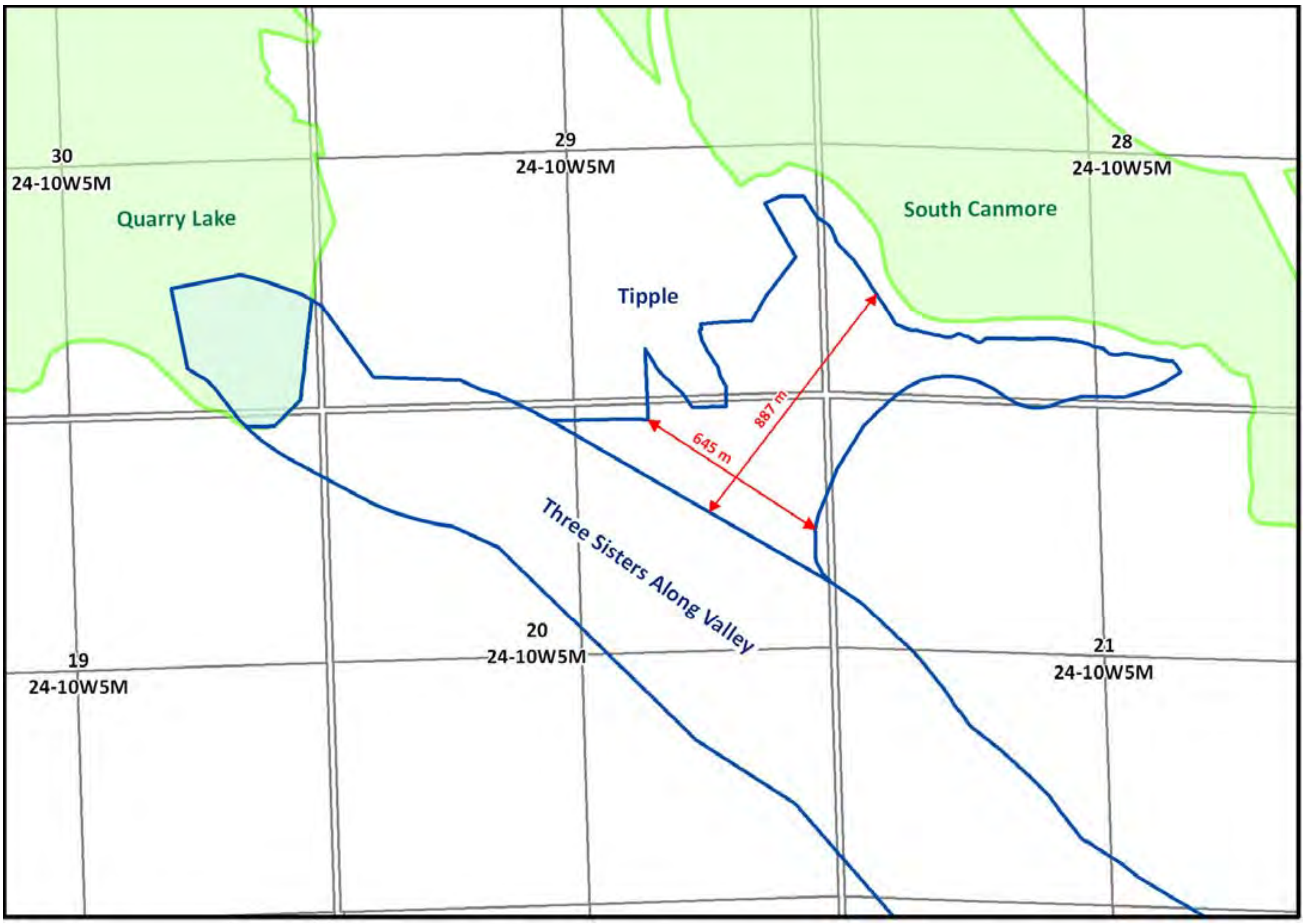
TIPPLE -WILDLIFE CORRIDOR

(see Map C-2) (All measurements are approximate)

Within and/or Habitat Patch/ Wildlife Corridor Linked to:	• links to South Canmore Local Habitat Patch and Three Sisters Along Valley wildlife corridor. • provides across valley movement.
Land Use Within (General Description)	• powerline corridor • Three Sisters Parkway

Source: air photo imagery (September 2009 imagery) and wildlife corridor boundaries from ATPR (2011a).

Corridor Dimensions - Tipple	
Length	887 m
Width	645 m
Area	68.31 ha (0.68 km²)



Note: all measurements (terrain, land cover, anthropogenic footprint, dimensions) are approximate.
Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	3.7	5.4
Provincial Unprotected	1.1	1.6
Private	3.4	5.0
Private (Conservation Easements)	53.5	78.3
Municipal	0.0	0.0
Other (transportation corridors, waterways)	6.6	9.7

Source: Government of Alberta, 2009.

Terrain within Wildlife Corridor	Area (ha)	Percent (%)
Slope 0-25 degrees	68.31	100
Slope > 25 degrees	0	0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	42.0	61.4
Rock	12.3	18.0
Developed	9.8	14.3
Herb	2.3	3.4
Shrub Tall	1.4	2.1
Shadow (unable to measure)	0.5	0.7

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint within Wildlife Corridor		
Linear Feature	Designated Recreational Trails	2.2 km
	Non-Designated Recreational Trails	3.5 km
	Vehicular roads (paved and gravel)	1.5 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	0.9 km
	Total Length	8.1 km
	Linear Density	11.9 km/km²
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential).	0 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank**[2]	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	49.2	72.0
		2	18.9	27.7
		3	0.2	0.2
		4	0	0
		5	0	0
	Summer (June 16 - Aug. 10)	1	0	0
		2	0	0
		3	7.1	10.5
		4	61.1	89.5
	Fall (Aug. 11 to Nov. 7)	1	24.6	36.0
		2	6.8	10.0
		3	5.3	7.8
		4	5.4	8.0
		5	1.4	2.1
		6	0.4	0.6
		7	2.4	3.5
		8	13.7	20.0
		9	8.2	12.0
Cougar	Non-Winter (April 16 to Nov. 14)	1	0	0
		2	35.8	52.4
		3	31.4	46.0
		4	1.1	1.6
		5	0	0
	Winter (Nov. 15 to April 15)	1	0	0
		2	1.1	1.6
		3	0.1	0.1
		4	0.4	0.5
		5	25.9	38.0
		6	40.8	59.8

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes:

1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

List of Wildlife / Human Use Research Conducted within and adjacent to Wildlife Corridor (refer to reference list in Appendix A)
• Jacques Whitford Limited (2005a): Summer and winter track counts, spring and fall pellet group counts, winter backtracking (2000 to winter 2004/2005). The study area included the Three Sisters Along Valley corridor and winter backtracking extended outside the corridor into adjacent areas, including the Tipple wildlife corridor.
• Jacques Whitford AXYS Limited (2008c): Winter track counts, summer track pad counts, spring pellet group counts, winter backtracking (2005 to 2007). Used the same transects as previous Jacques Whitford Limited study (2005a, 2005b). The study area included the Three Sisters Along Valley corridor and winter backtracking extended outside the corridor into adjacent areas, including the Tipple wildlife corridor.

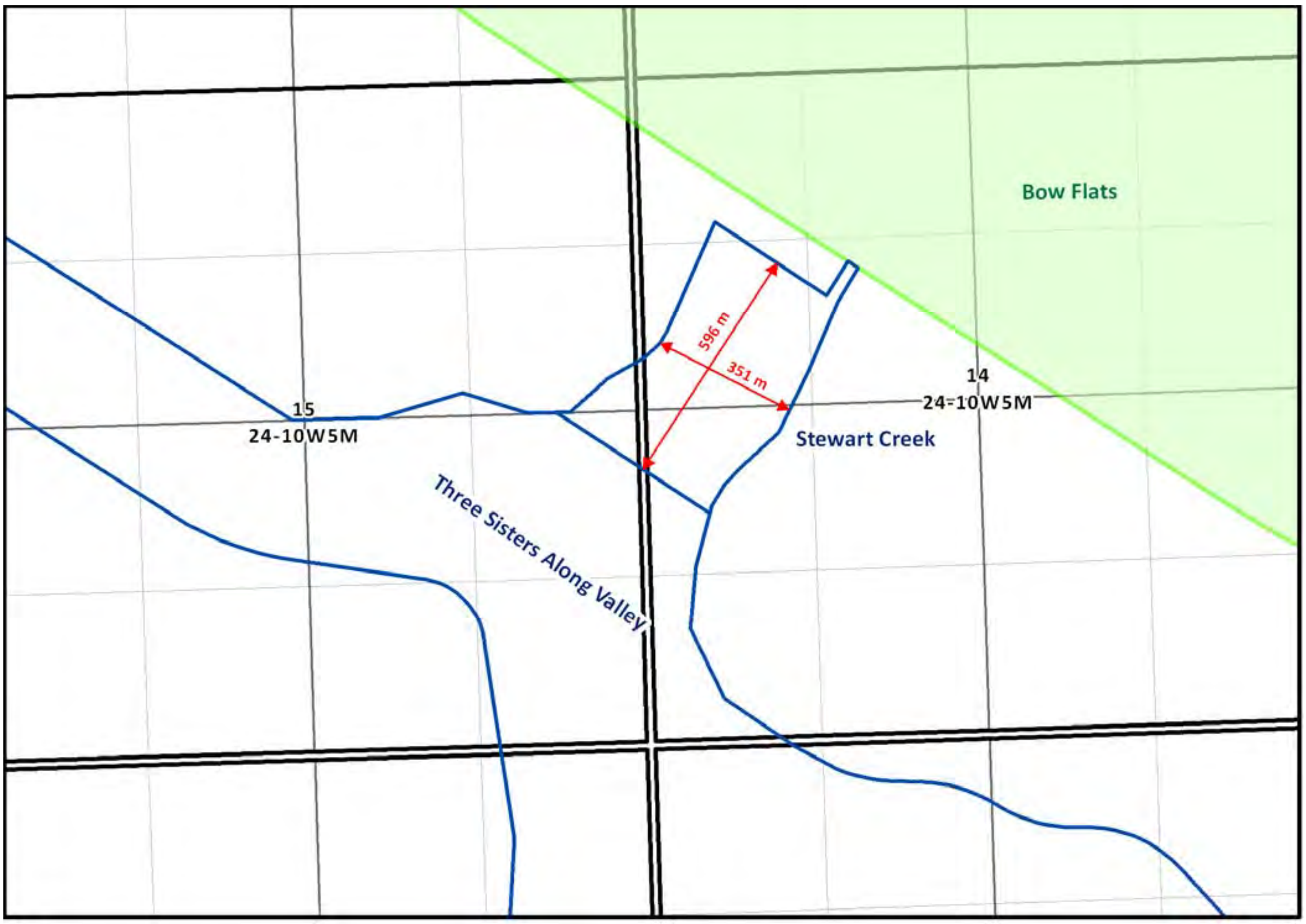
STEWART CREEK- WILDLIFE CORRIDOR

(see Map C-2) (All measurements are approximate)

Within and/or Habitat Patch/ Wildlife Corridor Linked to:	• linked to Bow Flats Regional Habitat Patch • provides across valley movement
Land Use Within (General Description)	• wildlife underpass beneath Hwy. 1 • includes powerline corridor

Source: air photo imagery (September 2009 imagery) and wildlife corridor boundaries from ATPR (2011a).

Corridor Dimensions - Stewart Creek	
Length	596 m
Width	351 m
Area	22.31 ha (0.22 km^2)



Note: all measurements (terrain, land cover, anthropogenic footprint, dimensions) are approximate and do not include the blue-shaded area.
Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	0.0	0.0
Provincial Unprotected	6.9	31.0
Private	13.9	62.4
Private (Conservation Easement)	0	0
Municipal	0.2	1.1
Other (transportation corridors, waterways)	1.2	5.4

Source: Government of Alberta, 2009.

Terrain within Wildlife Corridor	Area (ha)	Percent (%)
Slope 0-25 degrees	22.3	100
Slope > 25 degrees	0	0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	20.8	93.1
Broadleaf Dense	0.9	3.9
Herb	0.4	1.6
Developed	0.2	1.0
Rock	0.1	0.3
Exposed Land	0	0.2

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint within Wildlife Corridor		
Linear Feature	Designated Recreational Trails	0
	Non-Designated Recreational Trails	0.5 km
	Vehicular roads (paved and gravel) (m)	0.4 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	0.8 km
	Total Length	1.7 km
	Linear Density	7.7 km/km²
Non-Linear Feature	Anthropogenic Disturbance Golf Course (includes buildings, paved areas and obvious disturbances with no habitat potential).	0 ha 1.4 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	21.3	95.4
		2	1.0	4.6
		3	0	0
		4	0	0
		5	0	0
	Summer (June 16 - Aug. 10)	1	0	0
		2	0	0
		3	0	0
		4	22.3	100
	Fall (Aug. 11 to Nov. 7)	1	12.6	56.4
		2	5.3	23.6
		3	1.6	7.2
		4	0.3	1.5
		5	0	0
		6	0	0
		7	0.1	0.4
		8	1.1	5.0
		9	1.3	5.8
Cougar	Non-Winter (April 16 to Nov. 14)	1	0	0
		2	0.1	0.7
		3	13.5	60.4
		4	8.0	35.7
		5	0.7	3.2
	Winter (Nov. 15 to April 15)	1	0	0
		2	0	0
		3	0	0
		4	0	0
		5	1.9	8.6
		6	20.4	91.4

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

List of Wildlife / Human Use Research Conducted within and adjacent to Wildlife Corridor (refer to reference list in Appendix A)
• ATPR (2010a): conducted transect monitoring and winter backtracking for the Eastern Bow Valley Corridor between November 2004 and March 2009. • Jacques Whitford Limited (2005a): conducted summer and winter track counts, spring and fall pellet group counts, winter backtracking (2000 to winter 2004/2005). The study area included the Three Sisters Along Valley wildlife corridor. Winter backtracking extended outside the corridor into adjacent areas. • Jacques Whitford AXYS Limited (2008c): conducted winter track counts, summer track pad counts, spring pellet group counts, winter backtracking (2005 to 2007). Used the same transects as previous Jacques Whitford Limited study (2005a, 2005b). The study area included the Three Sisters Along Valley wildlife corridor. Winter backtracking extended outside the corridor into adjacent areas.

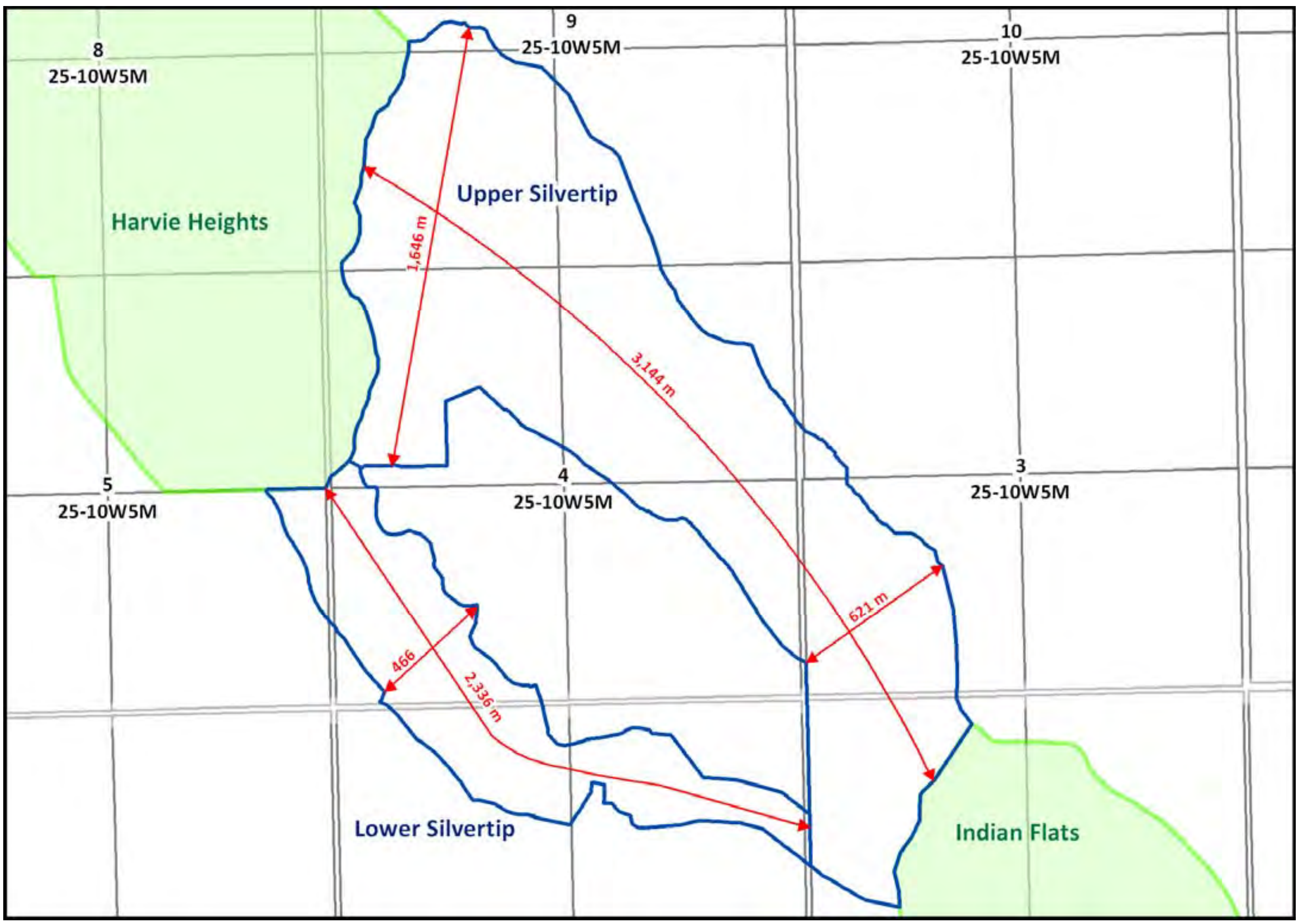
LOWER SILVERTIP - WILDLIFE CORRIDOR

(see Map C-3) (All measurements are approximate)

Within and/or Habitat Patch/ Wildlife Corridor Linked to:	• links Harvie Heights Regional and Indian Flats Local habitat patches
Land Use Within (General Description)	• includes fairways of Silvertip Golf Course

Source: air photo imagery (September 2009 imagery) and wildlife corridor boundaries from ATPR (2011a).

Corridor Dimensions - Lower Silvertip	
Length	2,336 m
Width	466 m
Area	78.26 ha (0.78 km²)



Note: all measurements (terrain, land cover, anthropogenic footprint, dimensions) are approximate and do not include the blue-shaded area.
Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	3.5	4.5
Provincial Unprotected	0.0	0.0
Private	18.4	23.5
Private (Conservation Easement)	33.9	43.5
Municipal	19.8	25.3
Other (transportation corridors, waterways)	2.5	3.2

Source: Government of Alberta, 2009.

Terrain within Wildlife Corridor	Area (ha)	Percent (%)
Slope 0-25 degrees	78.1	100
Slope > 25 degrees	0	0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	21.8	27.9
Herb	19.6	25.0
Grassland	18.9	24.2
Shrub Tall	10.3	13.1
Developed	5.2	6.6
Exposed Land	1.9	2.4
Rock	0.6	0.8

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint within Wildlife Corridor		
Linear Feature	Designated Recreational Trails	2.4 km
	Non-Designated Recreational Trails	7.1 km
	Vehicular roads (paved and gravel)	0.6 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	0 km
	Total Length	10.1 km
	Linear Density	12.9 km/km²
Non-Linear Feature	Anthropogenic Disturbance Golf Course (includes buildings, paved areas and obvious disturbances with no habitat potential).	0 ha 6.5 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	78.1	100
		2	0	0
		3	0	0
		4	0	0
		5	0	0
	Summer (June 16 - Aug. 10)	1	26.3	33.7
		2	16.6	21.2
		3	30.2	38.7
		4	5.0	6.4
	Fall (Aug. 11 to Nov. 7)	1	23.1	29.6
		2	8.6	11.0
		3	15.3	19.6
		4	17.7	22.6
		5	10.6	13.6
		6	1.8	2.3
		7	0.6	0.7
		8	0.5	0.7
		9	0	0
Cougar	Non-Winter (April 16 to Nov. 14)	1	0.1	0.1
		2	74.8	95.5
		3	3.4	4.3
		4	0	0
		5	0	0
	Winter (Nov. 15 to April 15)	1	0.8	1.0
		2	38.0	48.6
		3	8.3	10.6
		4	4.8	6.1
		5	16.4	20.9
		6	10.0	12.8

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes:

1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

List of Wildlife / Human Use Research Conducted within and adjacent to Wildlife Corridor (refer to reference list in Appendix A)
• Callaghan and Jevons (2001): conducted winter track counts along transects and winter backtracking (winter 1999/2000). The study includes the slopes of the Fairholme range and the Benchlands habitat patch • Callaghan and Everett (2004): conducted winter track counts along transects, winter backtracking. GPS collar locations from one cougar (winter 2003/2004). Same study area and transects as Callaghan and Jevons (2001, 2004) plus an extended study area and two more transects in Banff National Park. • Callaghan and Jevons (2004): conducted winter track counts along transects; winter backtracking, GPS collar locations from one cougar (December 1999 to April 2003). Study area covers the same area and transects as Callaghan and Jevons 2001 • Jacques Whitford Limited (2003, 2005b): Winter backtracking, pellet-count transects, incidental observations, bird point counts, existing vegetation data. Human activity was recorded through observations of foot, bicycle, vehicle, snowmobile, ATV and horse tracks. Domestic dog tracks were also recorded. Data from the studies covers: 1992 to 2002; 1999 to 2005). The study area is located primarily on the Silvertip development and wildlife corridors (Lower and Upper), though backtracking extends into adjacent areas and pellet counts were conducted in the SE corner of the Benchlands habitat patch. Limited data related specifically to the Benchlands habitat patch • Jacques Whitford AXYS Limited (2008a, 2008b): Winter backtracking, pellet-count transects, incidental observations, bird point counts, existing vegetation data. Human activity was recorded through observations of foot, bicycle, vehicle, snowmobile, ATV and horse tracks. Domestic dog tracks were also recorded. Data from the studies covers: 2003-2006; 2006-2007). The study area is located primarily on the Silvertip development and wildlife corridors (Lower and Upper).

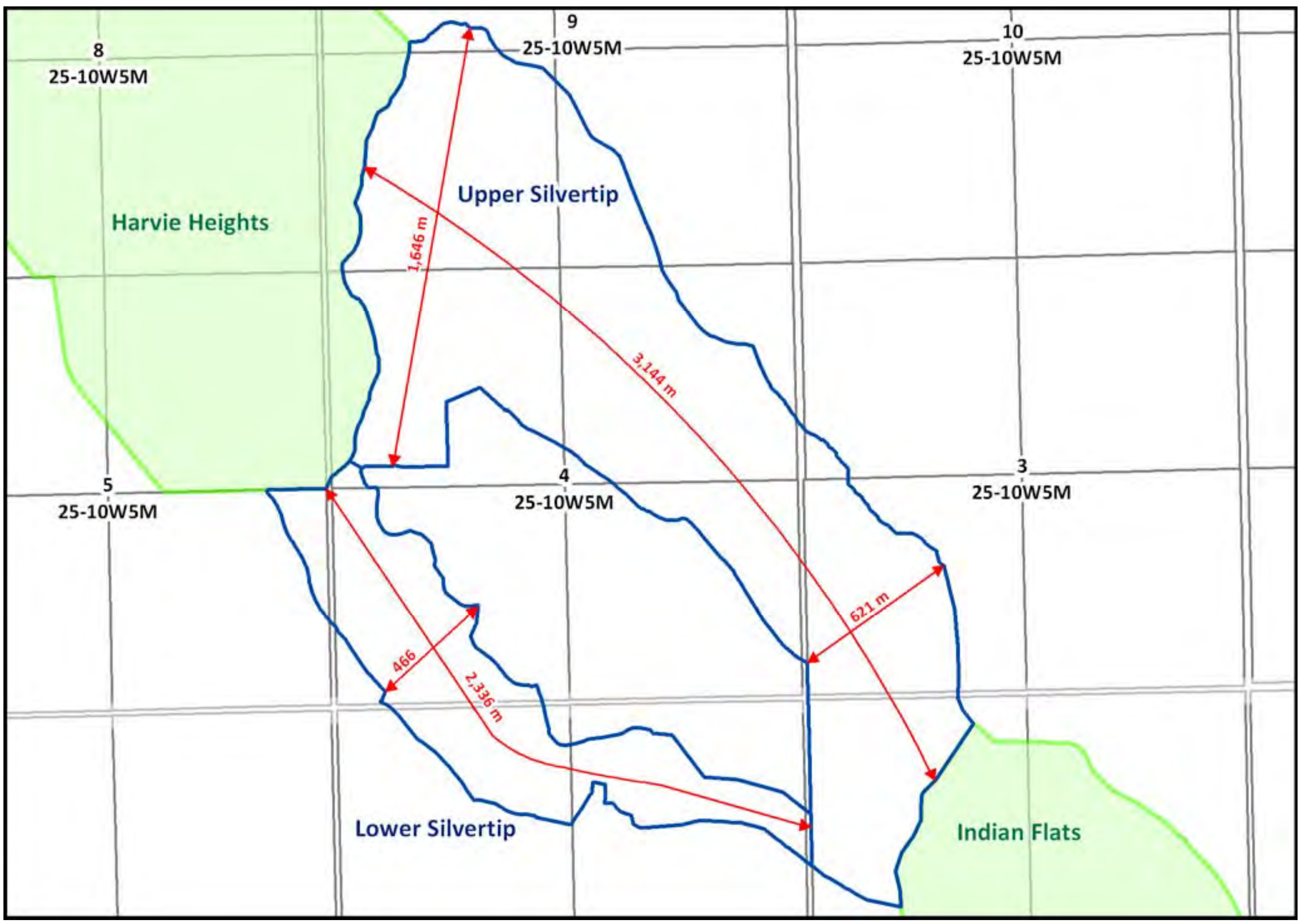
UPPER SILVERTIP - WILDLIFE CORRIDOR

(see Map C-3) (All measurements are approximate)

Within and/or Habitat Patch/ Wildlife Corridor Linked to:	• links Benchlands and Indian Flats local habitat patches
Land Use Within (General Description)	• includes fairways of Silvertip Golf Course

Source: air photo imagery (September 2009 imagery) and wildlife corridor boundaries from ATPR (2011a).

Corridor Dimensions - Upper Silvertip	
Length	3,144 m
Width	621 m to 1,646 m
Area	262.81 ha (2.63 km^2)



Note: all measurements (terrain, land cover, anthropogenic footprint, dimensions) are approximate and do not include the blue-shaded area.

Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	188.1	71.5
Provincial Unprotected	4.4	1.7
Private	11.8	4.5
Private (Conservation Easement)	13.7	5.2
Municipal	0.0	0.0
Other (transportation corridors, waterways)	45	17.1

Source: Government of Alberta, 2009.

Terrain within Wildlife Corridor	Area (ha)	Percent (%)
Slope 0-25 degrees	249.3	95.0
Slope > 25 degrees	13.2	5.0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	148.0	56.3
Herb	47.9	18.2
Shrub Tall	44.5	16.9
Exposed Land	10.2	3.9
Grassland	10.0	3.8
Rock	1.8	0.7
Developed	0.4	0.2
Shadow	0.1	0

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint within Wildlife Corridor		
Linear Feature	Designated Recreational Trails	8.2 km
	Non-Designated Recreational Trails	10.3 km
	Vehicular roads (paved and gravel)	0 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	0 km
	Total Length	18.5 km
	Linear Density	7.0 km/km²
Non-Linear Feature	Anthropogenic Disturbance* Golf Course * (includes buildings, paved areas and obvious disturbances with no habitat potential).	0 ha 11.7 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	235.4	89.6
		2	27.2	10.4
		3	0.1	0
		4	0	0
		5	0	0
	Summer (June 16 - Aug. 10)	1	0	0
		2	0	0
		3	74.9	28.5
		4	187.9	71.5
	Fall (Aug. 11 to Nov. 7)	1	136.7	52.0
		2	59.7	22.7
		3	29.9	11.4
		4	4.4	1.7
		5	13.2	5.0
		6	10.2	3.9
		7	4.3	1.6
		8	2.4	0.9
		9	2.0	0.8
Cougar	Non-Winter (April 16 to Nov. 14)	1	0	0
		2	12.8	4.9
		3	97.7	37.2
		4	69.6	26.5
		5	82.7	31.5
	Winter (Nov. 15 to April 15)	1	0	0
		2	0	0
		3	0	0
		4	0	0
		5	0.8	0.3
		6	262.0	99.7

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

List of Wildlife / Human Use Research Conducted within and adjacent to Wildlife Corridor (refer to reference list in Appendix A)
• Callaghan and Jevons (2001): conducted winter track counts along transects and winter backtracking (winter 1999/2000). The study includes the slopes of the Fairholme range and the Benchlands habitat patch • Callaghan and Everett (2004): conducted winter track counts along transects, winter backtracking. GPS collar locations from one cougar (winter 2003/2004). Same study area and transects as Callaghan and Jevons (2001, 2004) plus an extended study area and two more transects in Banff National Park. • Callaghan and Jevons (2004): conducted winter track counts along transects; winter backtracking, GPS collar locations from one cougar (December 1999 to April 2003). Study area covers the same area and transects as Callaghan and Jevons 2001 • Jacques Whitford Limited (2003, 2005a): Winter backtracking, pellet-count transects, incidental observations, bird point counts, existing vegetation data. Human activity was recorded through observations of foot, bicycle, vehicle, snowmobile, ATV and horse tracks. Domestic dog tracks were also recorded. Data from the studies covers: 1992 to 2002; 1999 to 2004). The study area is located primarily on the Silvertip development and wildlife corridors (Lower and Upper), though backtracking extends into adjacent areas and pellet counts were conducted in the SE corner of the Benchlands habitat patch. Limited data related specifically to the Benchlands habitat patch • Jacques Whitford AXYS Limited (2008a, 2008b): Winter backtracking, pellet-count transects, incidental observations, bird point counts, existing vegetation data. Human activity was recorded through observations of foot, bicycle, vehicle, snowmobile, ATV and horse tracks. Domestic dog tracks were also recorded. Data from the studies covers: 2003-2006; 2006-2007). The study area is located primarily on the Silvertip development and wildlife corridors (Lower and Upper).

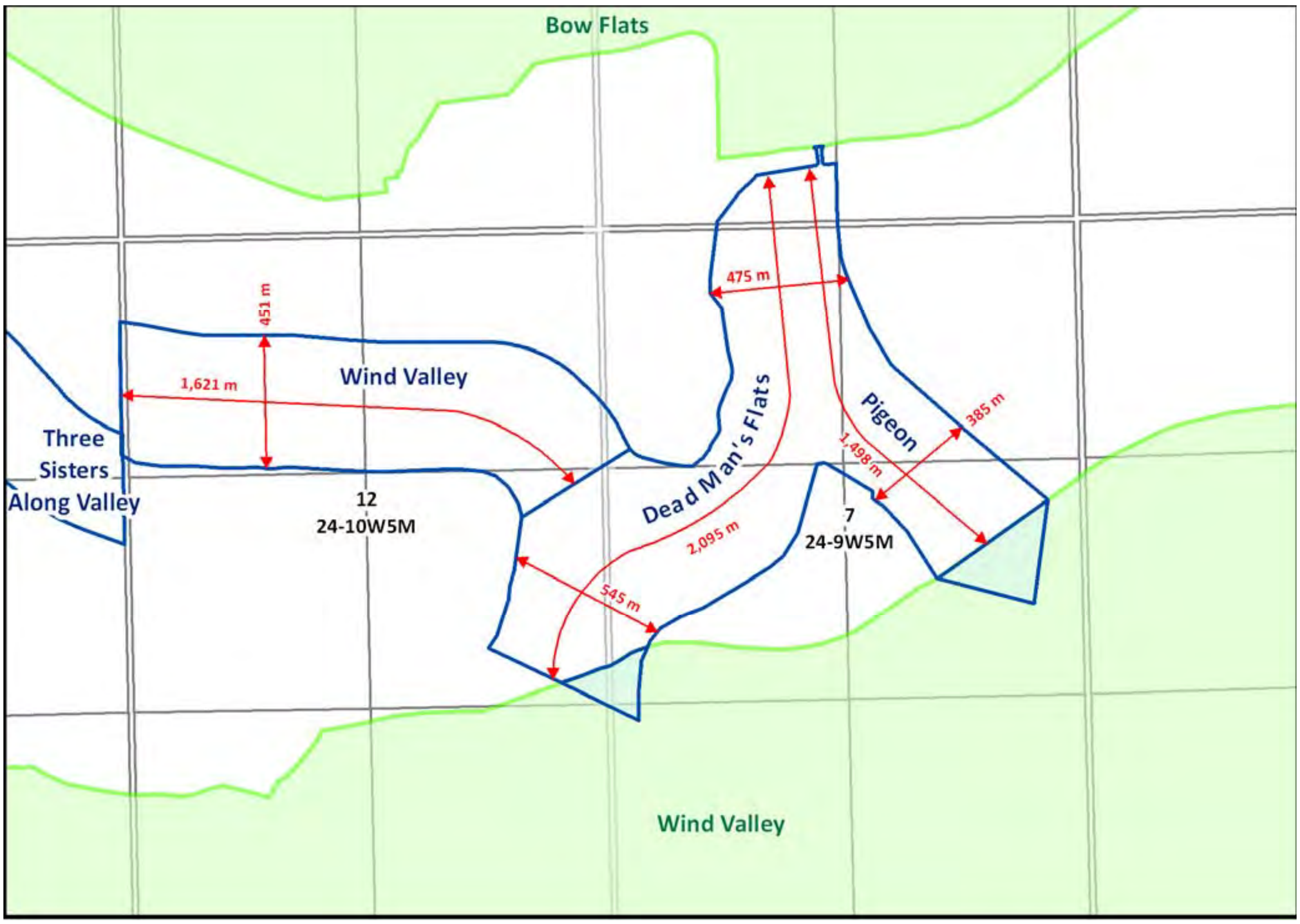
WIND VALLEY - WILDLIFE CORRIDOR

(see Map C-4) (All measurements are approximate)

Within and/or Habitat Patch/ Wildlife Corridor Linked to:	• links to Wind Valley Regional Habitat Patch • linked to Three Sisters Along Valley and Dead Man's Flats Wildlife Corridors
Land Use Within (General Description)	• includes powerline corridor

Source: air photo imagery (September 2009 imagery) and wildlife corridor boundaries from ATPR (2011a).

Corridor Dimensions - Wind Valley	
Length	1,621 m
Width	451 m
Area	73.98 ha (0.74 km²)



Note: all measurements (terrain, land cover, anthropogenic footprint, dimensions) are approximate and do not include the blue-shaded area.

Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	4.6	6.2
Provincial Unprotected	1.0	1.4

Private	67.0	90.6
Private (Conservation Easement)	0.0	0.0
Municipal	0.0	0.0
Other (transportation corridors, waterways)	1.4	1.9

Source: Government of Alberta, 2009.

Terrain within Wildlife Corridor	**Area (ha)**	**Percent (%)**
Slope > 25 degrees	6.2	8.42
Slope < 25 degrees	67.7	91.47

Source: DEM data from ATPR (2011a).

Land Cover	**Area (ha)**	**Percent (%)**
Coniferous Dense	71.1	96.1
Shrub Tall	2.9	3.9

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint within Wildlife Corridor		
Linear Feature	Designated Recreational Trails	0
	Non-Designated Recreational Trails	3.9 km
	Vehicular roads (paved and gravel) (m)	0.8 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	0.8 km
	Total Length	5.5 km
	Linear Density	7.4 km/km²
Non-Linear Feature	Anthropogenic Disturbance* Golf Course *(includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	0 ha 0 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank**[2]	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	30.3	41
		2	27.6	37.3
		3	14.8	20
		4	1.3	1.8
		5	0	0
	Summer (June 16 - Aug. 10)	1	0	0
		2	0	0
		3	21.3	28.7
		4	52.7	71.3
	Fall (Aug. 11 to Nov. 7)	1	3.8	5.1
		2	16.2	21.9
		3	5.2	7
		4	3.1	4.2
		5	1.1	1.5
		6	0.2	0.3
		7	0.6	0.8
		8	19.8	26.7
		9	24.1	32.5
Cougar	Non-Winter (April 16 to Nov. 14)	1	0	0
		2	0.6	0.8
		3	25.0	33.8
		4	32.1	43.4
		5	16.2	21.9
	Winter (Nov. 15 to April 15)	1	0	0
		2	0.2	0.2
		3	0.1	0.2
		4	0.9	1.2
		5	43.4	58.7
		6	29.4	39.7

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes:

1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

List of Wildlife / Human Use Research Conducted within and adjacent to Wildlife Corridor (refer to reference list in Appendix A)
• Used pellet counts, summer track pad counts, winter track counts, winter backtracking and highway mortality data to identify wildlife movement areas. Data were collected between 1998 and 2000. Study area covers the Wind Valley Corridor (Anon. 2002b). • Leeson and Kamenka 2008: Mapped wildlife use and reviewed wildlife use data from previous studies (April to November 2008). The study area is concentrated on the junction between the west end of the Wind Valley Wildlife Corridor and the east end of the Three Sisters Wildlife Corridor. • Wind Valley Wildlife Corridor Committee 2002: Used pellet counts, summer track pad counts, winter track counts, winter backtracking, and highway mortality data to identify wildlife movement areas (1998 and 2000). Study area covers the Wind Valley Corridor.

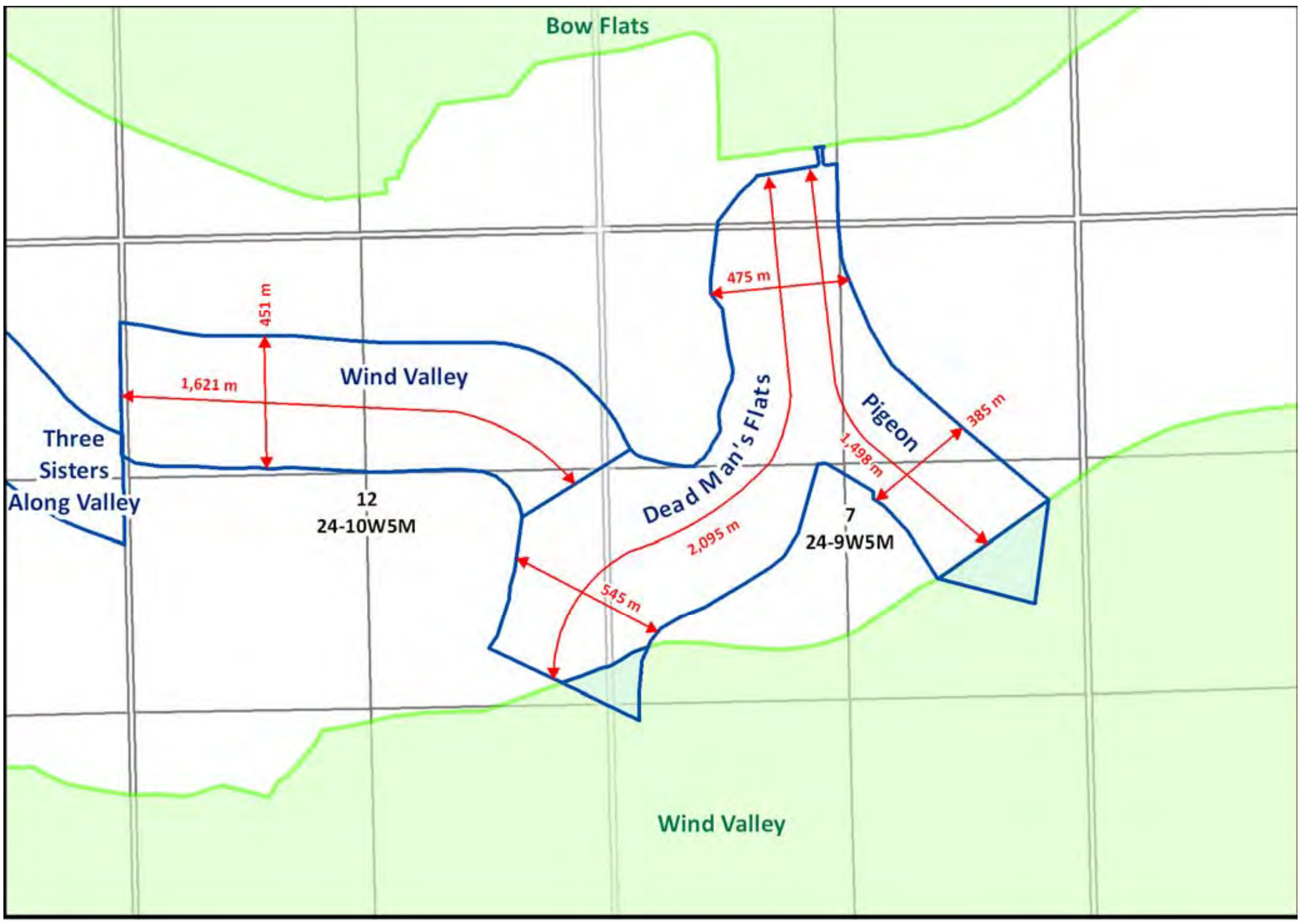
DEAD MAN'S FLATS / PIGEON - WILDLIFE CORRIDOR

(see Map C-4) (All measurements are approximate)

Within and/or Habitat Patch/ Wildlife Corridor Linked to:	• links Wind Valley Regional Habitat Patch and Bow Flats Regional Habitat Patch
Land Use Within (General Description)	• wildlife underpass beneath Hwy. 1 • includes powerline corridor and access road

Source: air photo imagery (September 2009 imagery) and wildlife corridor boundaries from ATPR (2011a).

Corridor Dimensions - Dead Man's Flats	
Length	1,498 m to 2,095 m
Width	385 m to 545 m
Area	123 ha (1.23 km^2)



Note: all measurements (terrain, land cover, anthropogenic footprint, dimensions) are approximate and do not include the blue-shaded area.

Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	31.59	25.7
Provincial Unprotected	51.21	41.6
Private	34.2	27.8
Private (Conservation easement)	0.0	0.0
Municipal	0.0	0.0
Other (transportation corridors, waterways)	6.1	5.0

Source: Government of Alberta, 2009.

Terrain within Wildlife Corridor	Area (ha)	Percent (%)
Slope 0-25 degrees	122.2	99.0
Slope > 25 degrees	0.9	1.0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	112.4	91.2
Shrub Tall	7.4	6.0
Grassland	1.9	1.6
Coniferous Open	1.2	1.0
Developed	0.2	0.1
Rock	0.1	0.1

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint within Wildlife Corridor		
Linear Feature	Designated Recreational Trails	0.4 km
	Non-Designated Recreational Trails	4.4 km
	Vehicular roads (paved and gravel)	0.7 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	1.2 km
	Total Length	6.7 km
	Linear Density	5.4 km/km²
Non-Linear Feature	Anthropogenic Disturbance*	0.4 ha
	Golf Course	0 ha
	*(includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	122.7	99.6
		2	0.4	0.4
		3	0	0
		4	0	0
		5	0	0
	Summer (June 16 - Aug. 10)	1	0	0
		2	0	0
		3	61.3	49.8
		4	61.8	50.2
	Fall (Aug. 11 to Nov. 7)	1	49.8	40.5
		2	37.2	30.2
		3	19.6	15.9
		4	10.8	8.8
		5	3.6	2.9
		6	0.9	0.7
		7	0.5	0.4
		8	0.6	0.5
		9	0.1	0.1
Cougar	Non-Winter (April 16 to Nov. 14)	1	0	0
		2	1.9	1.6
		3	12.9	10.5
		4	43.1	35.0
		5	65.2	53.0
	Winter (Nov. 15 to April 15)	1	0	0
		2	0	0
		3	0	0
		4	0.3	0.2
		5	1.7	1.3
		6	121.2	98.4

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

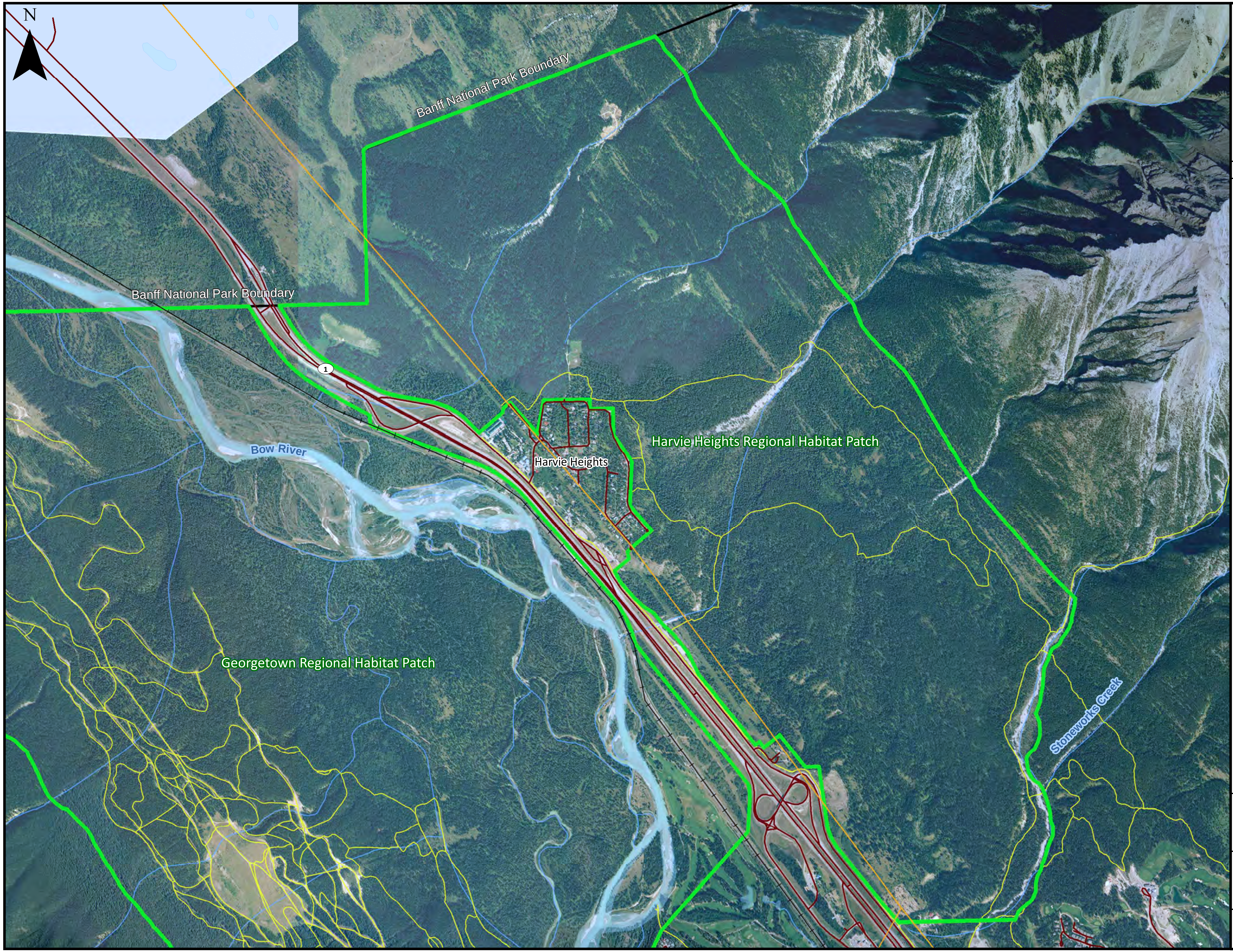
2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

List of Wildlife / Human Use Research Conducted within and adjacent to Habitat Patch
• ATPR (2010a): conducted transect monitoring and winter backtracking for the Eastern Bow Valley Corridor between November 2004 and March 2009.

APPENDIX E

HABITAT PATCH MAPS

	Habitat Patch
Regional	Harvie Heights
	Georgetown - Canmore nordic Center
	Bow Flats
	Wind Valley
	Yamnuska
	Bow Valley Provincial Park
Local	Quarry Lake
	South Canmore
	Indian Flats



MAP E-1

HARVIE HEIGHTS REGIONAL HABITAT PATCH

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011

Habitat Patch Boundary

Designated Recreational Trail

Existing Road

Existing Railway

Existing Transmission Line

Note: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10 m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revisions to Habitat Patch Boundary Since 2003

- The Benchlands Local Habitat Patch has been joined with the Harvie Heights Regional Habitat Patch to form a larger Harvie Heights Regional Habitat Patch.
- The upper habitat patch boundary moved upslope based on recent wildlife tracking that indicated extensive use.
- Lower habitat patch boundary better aligned with TransCanada Highway and private land around Harvie Heights.
- The southeast habitat patch boundary moved east to align with Stoneworks Creek.
- The northwest habitat patch boundary aligned with Banff National Park.

(All Locations Approximate)

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011a.
Aerial Imagery from September 2009.

SCALE: 1: 18,000

0 100 200 300 M

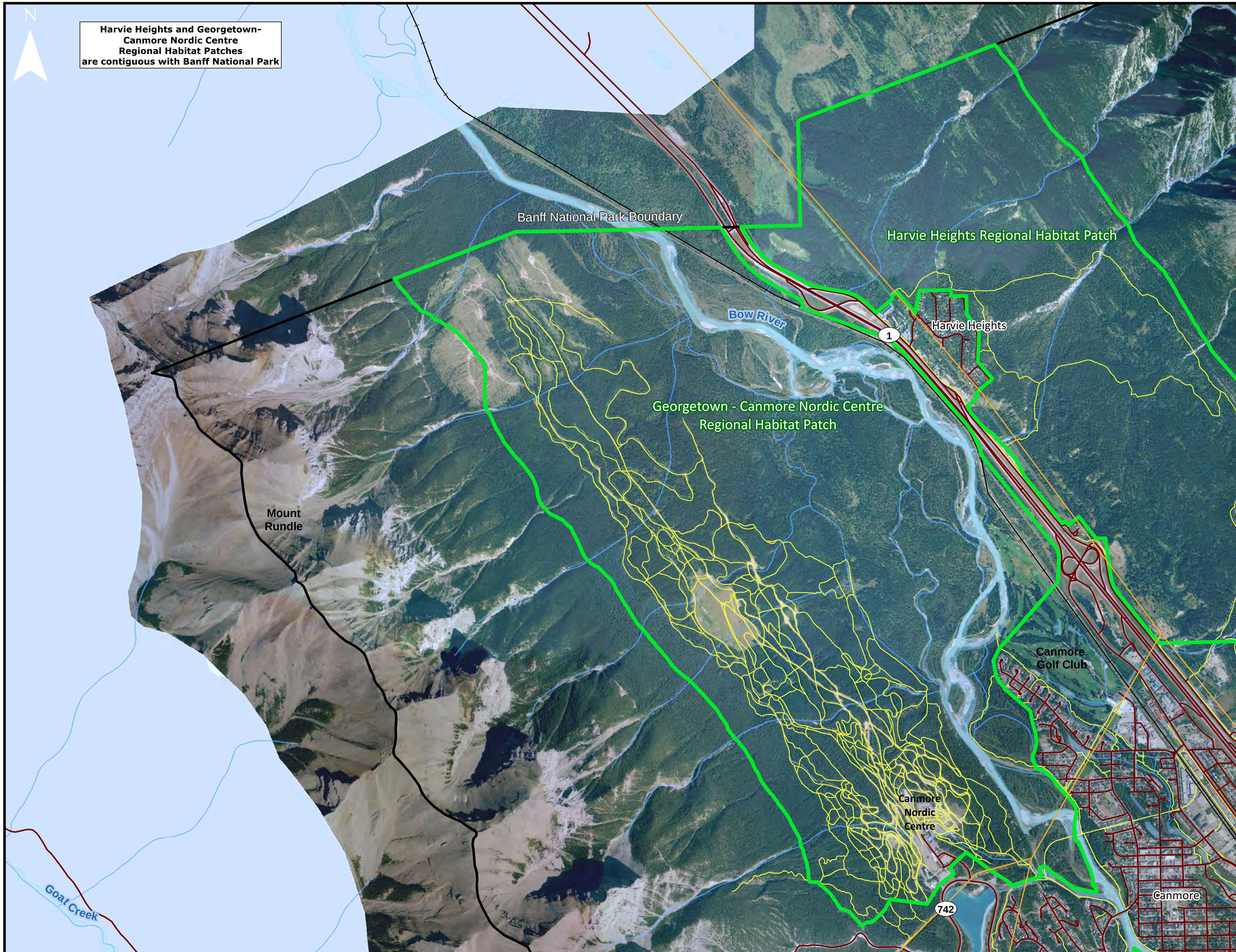
tera ENVIRONMENTAL CONSULTANTS

MAP E2

GEORGETOWN - CANMORE NORDIC CENTRE REGIONAL HABITAT PATCH

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011



Habitat Patch Boundary

Designated Recreational Trail

Existing Road

Existing Railway

Existing Transmission Line

Note: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10 m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revisions to Habitat Patch Boundary Since 2003

- North boundary aligned with Banff National Park
- The northeast boundary aligned with the TransCanada Highway and railway.
- East boundary aligned better with Larch subdivision.
- Boundary moved east as far as transmission line bordering the Rundleview subdivision on west side and now includes island with train bridge.

(All Locations Approximate)

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011a.
Aerial Imagery from September 2009.

SCALE: 1: 27,000

0 200 400 600 M

tera ENVIRONMENTAL CONSULTANTS

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

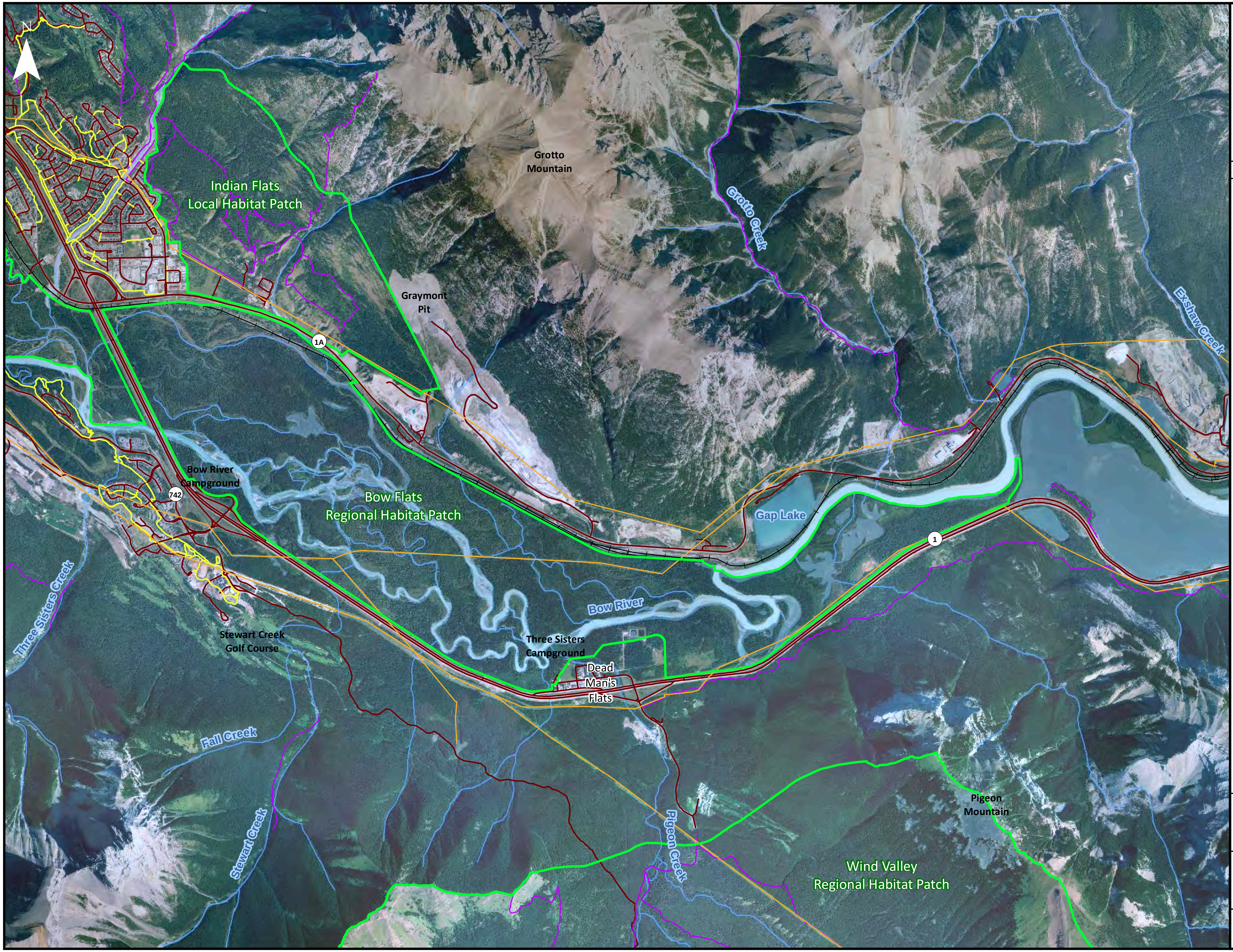
Georgetown Regional Habitat Patch REV02

MAP E-3

BOW FLATS REGIONAL HABITAT PATCH

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011



- Habitat Patch Boundary
- Designated Recreational Trail
- Existing Road
- Existing Railway
- Existing Transmission Line

Note: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10 m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revisions to Habitat Patch Boundary Since 2003

- Leased parcel at west end along Hwy 1A now included in the habitat patch.
- Adjustments made to habitat patch boundary around Dead Man's Flats to better reflect recent land use decisions by MD of Bighorn.
- Adjusted to align better with the TransCanada Highway.

(All Locations Approximate)

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011a.
Aerial Imagery from September 2009.

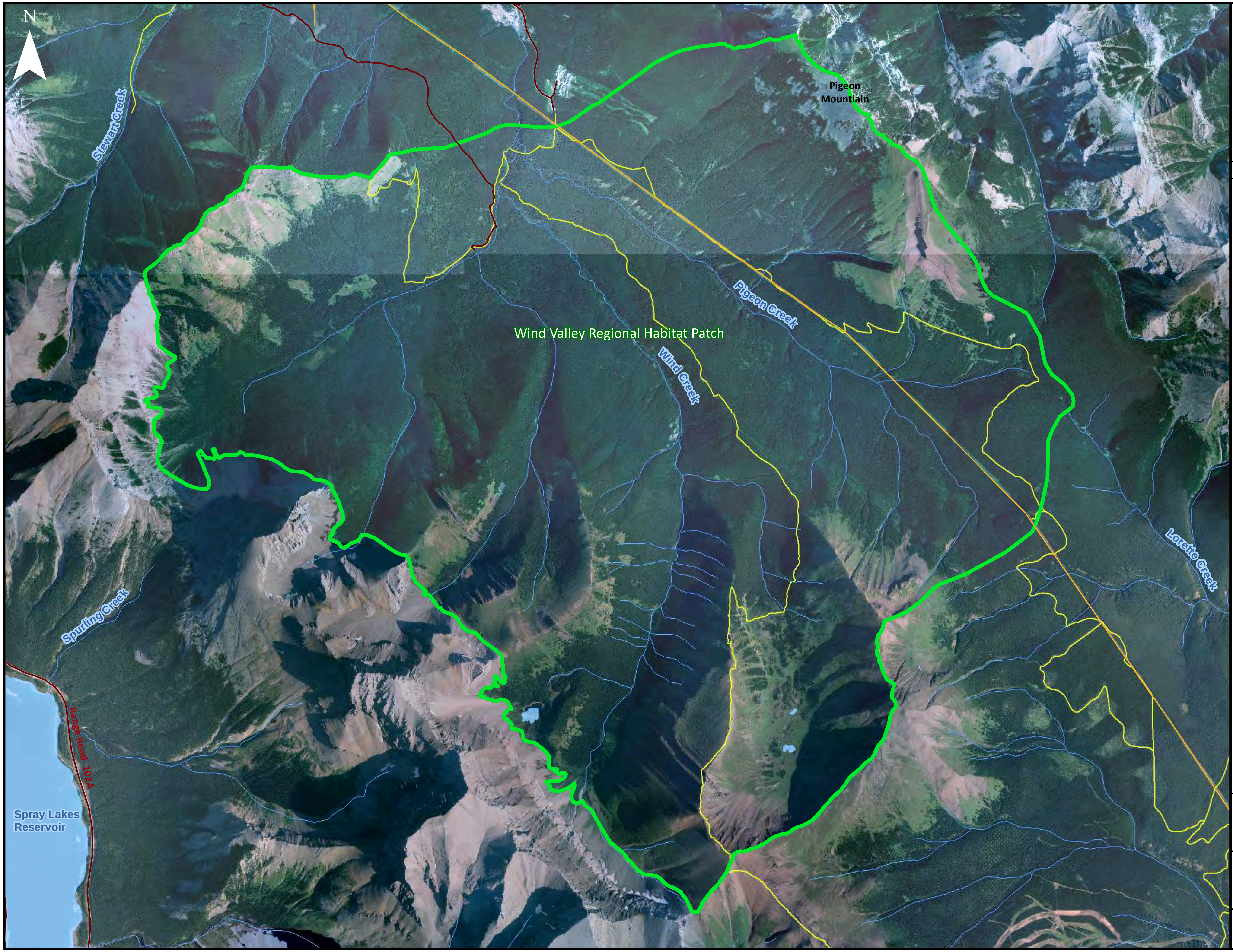
SCALE: 1: 35,000

0 200 400 600 M

tera ENVIRONMENTAL CONSULTANTS

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Bow Flats Regional Habitat Patch REV02



MAP E-4

WIND VALLEY REGIONAL HABITAT PATCH

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011

- Habitat Patch Boundary
- Designated Recreational Trail
- Existing Road
- Existing Transmission Line

Note: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10 m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revisions to Habitat Patch Boundary Since 2003

- Expanded southward to include all of Wind Valley.
- Boundary adjusted to approximate tree-line and ridgeline.

(All Locations Approximate)

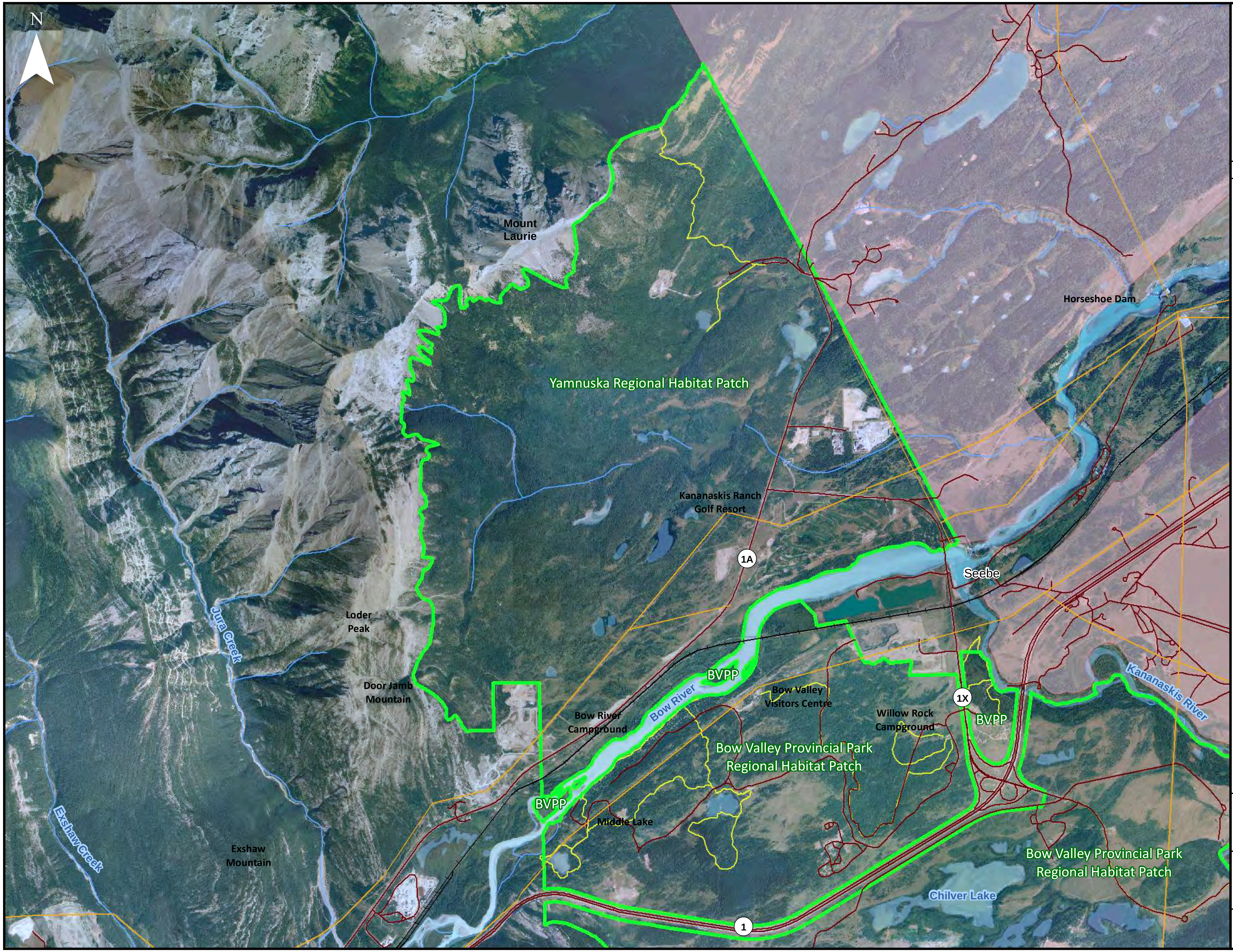
Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011a.
Aerial Imagery from September 2009.

SCALE: 1: 35,000

0 250 500 750 M

tera ENVIRONMENTAL CONSULTANTS

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.



MAP E-5

YAMNUSKA REGIONAL HABITAT PATCH

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011

- Habitat Patch Boundary
- Designated Recreational Trail
- Existing Road
- Existing Railway
- Existing Transmission Line
- First Nation Reserve

BVPP Identifies small islands that belong to the Bow Valley Provincial Park (BVPP) Regional Habitat Patch.

Note: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10 m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revisions to Habitat Patch Boundary Since 2003

- Slight expansion eastward and northward to better approximate tree-line.
- Modified to exclude Thomas Cooke Landfill.
- Expanded in southeast corner to follow north bank of the Bow River to the First Nation Reserve.

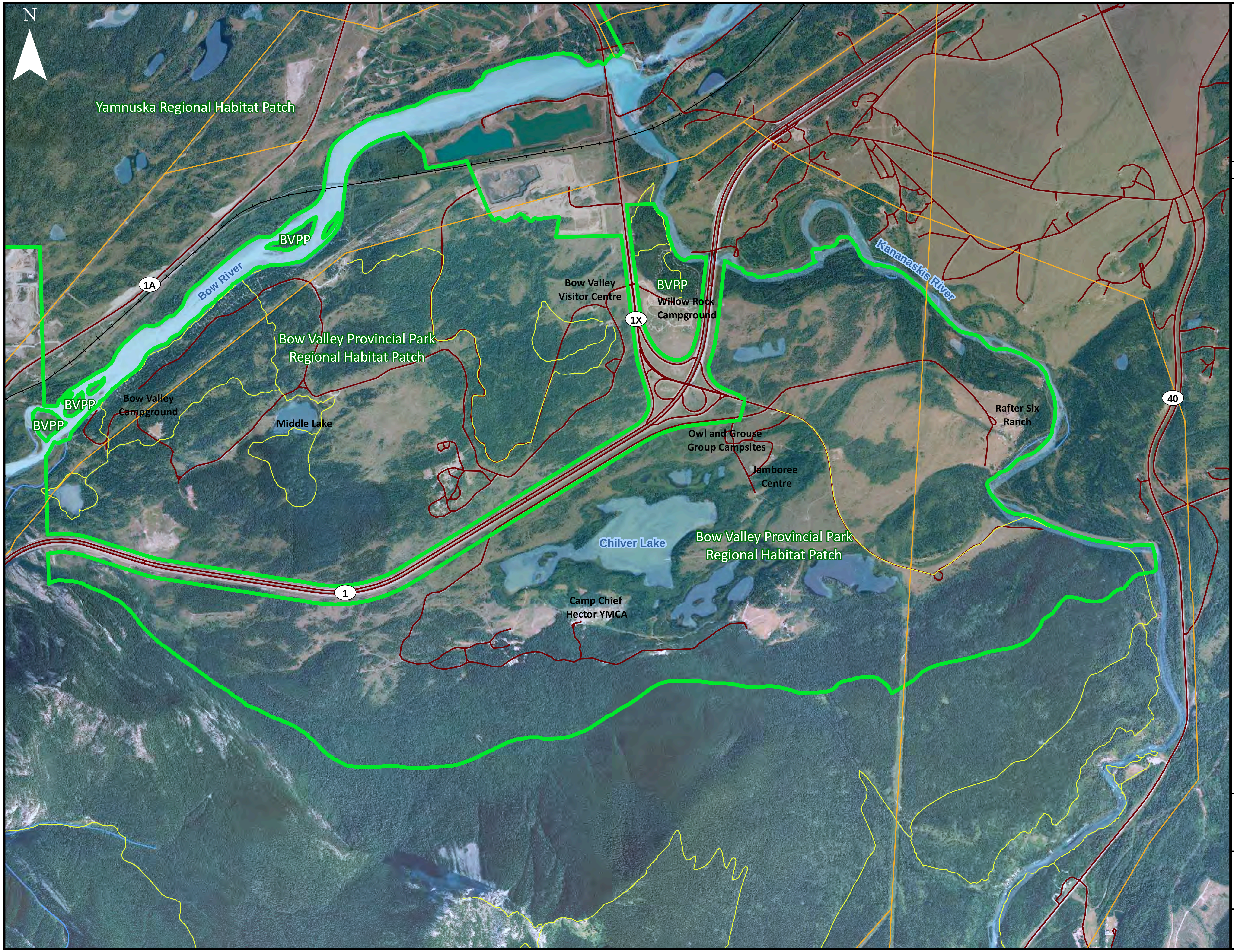
(All Locations Approximate)

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011a.
Aerial Imagery from September 2009.

SCALE: 1: 32,000

0 300 600 900 M

tera ENVIRONMENTAL CONSULTANTS



MAP E-6

BOW VALLEY PROVINCIAL PARK REGIONAL HABITAT PATCH

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011

- Habitat Patch Boundary
- Designated Recreational Trail
- Existing Road
- Existing Railway
- Existing Transmission Line

BVPP Identifies small islands that belong to the Bow Valley Provincial Park (BVPP) Regional Habitat Patch.

Revisions to Habitat Patch Boundary Since 2003

- Expanded eastward to align better with the Kananaskis River.
- Habitat patch boundary moved slightly to align better with Bow Valley Provincial Park boundary.

(All Locations Approximate)

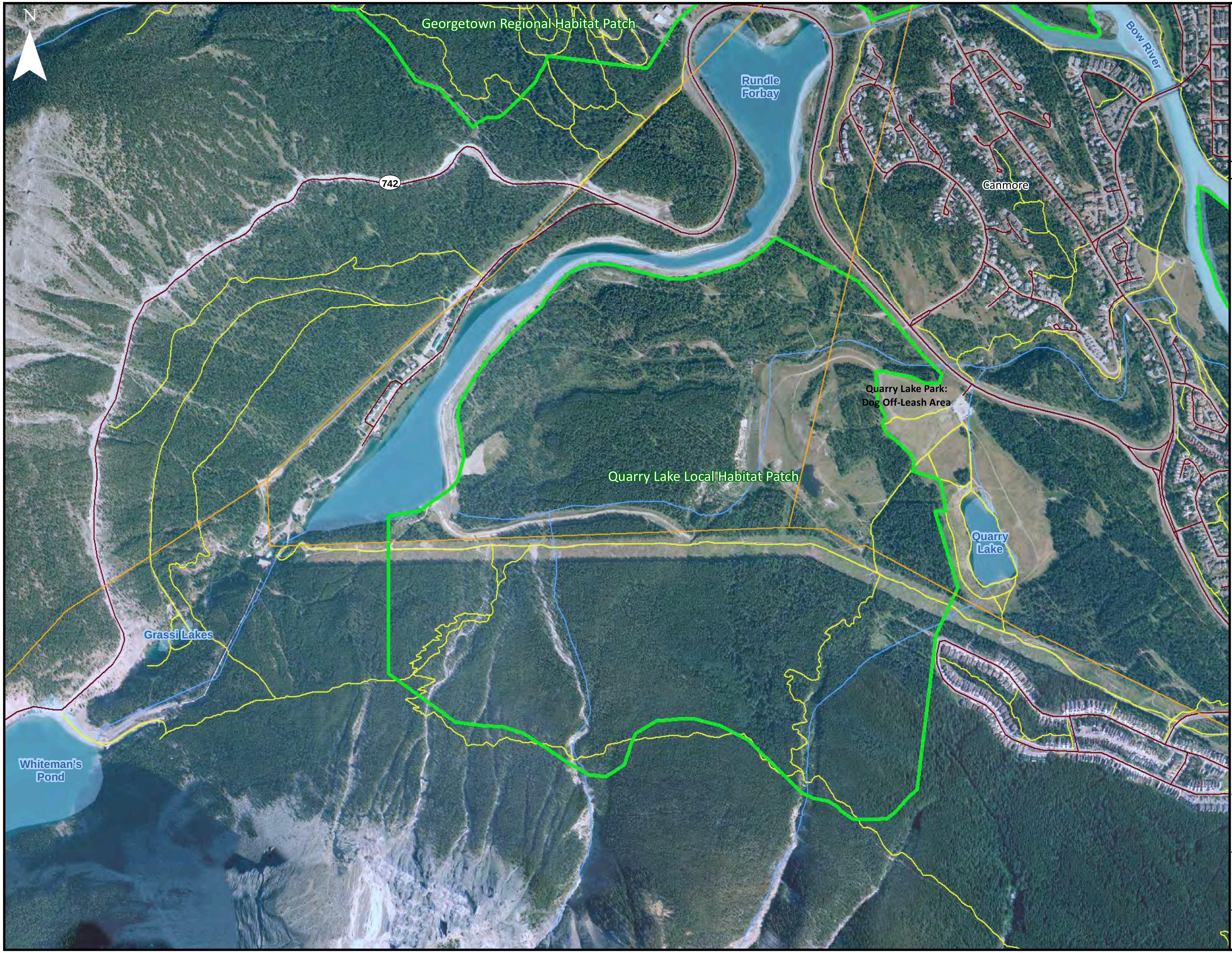
Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011a.
Aerial Imagery from September 2009.

SCALE: 1: 23,000

0 200 400 600 M

tera ENVIRONMENTAL CONSULTANTS

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.



MAP E-7

QUARRY LAKE LOCAL HABITAT PATCH

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011

Habitat Patch Boundary

Designated Recreational Trail

Existing Roads

Existing Transmission Line

Note: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10 m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revisions to Habitat Patch Boundary Since 2003

- Expanded upslope and to the east to include patches of forest cover used by wildlife.
- Aligned better with the dog off-leash area which is excluded from the habitat patch.

(All Locations Approximate)

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011a.
Aerial Imagery from September 2009.

SCALE: 1: 10,000

0 100 200 M

tera ENVIRONMENTAL CONSULTANTS

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Quarry Lakes Local Habitat Patch REV02

MAP E-8

SOUTH CANMORE LOCAL HABITAT PATCH

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011

- Habitat Patch Boundary
- Designated Recreational Trail
- Existing Road
- Existing Railway
- Existing Transmission Line

Note: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10 m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revisions to Habitat Patch Boundary Since 2003

- Millenium Park excluded.
- Island to west of Millenium Park included.
- Adjusted to align with TransCanada Highway, railway and north bank of Bow River.
- Excludes developed portion in northwest corner.

(All Locations Approximate)

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011a.
Aerial Imagery from September 2009.

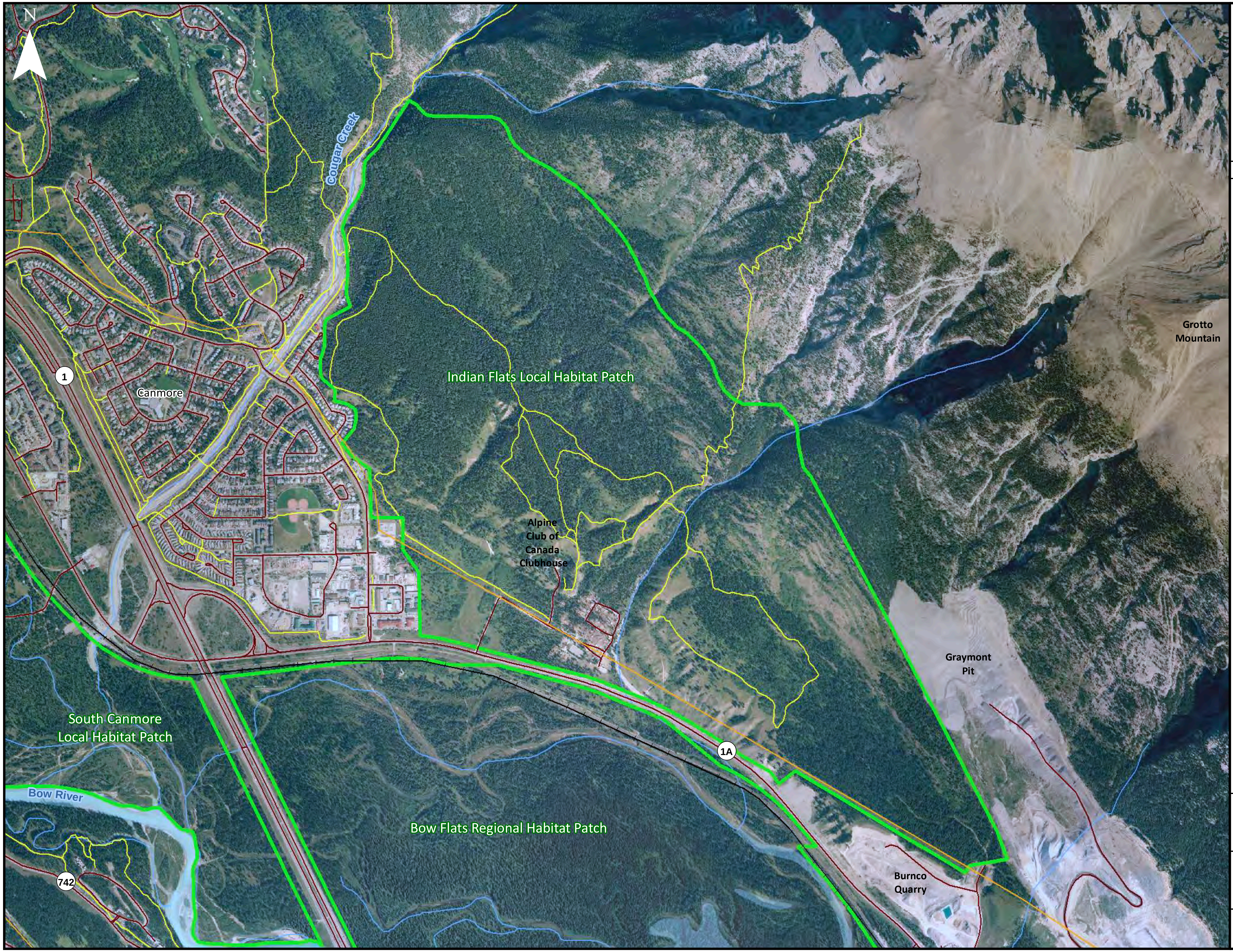
SCALE: 1: 12,000

0 100 200 300 M

tera ENVIRONMENTAL CONSULTANTS

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

South Canmore Local Habitat Patch REV02



MAP E-9

INDIAN FLATS LOCAL HABITAT PATCH

WILDLIFE CORRIDOR AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011

- Habitat Patch Boundary
- Designated Recreational Trail
- Existing Road
- Existing Railway
- Existing Transmission Line

Note: Where the boundary of a wildlife corridor or habitat patch follows a waterbody, the location of the boundary should be interpreted as being 10 m from the bank of the waterbody to the benefit of the wildlife corridor or habitat patch provided that this placement does not result in a reduction in the size of the wildlife corridor or habitat patch.

Revisions to Habitat Patch Boundary Since 2003

- West boundary of habitat patch aligned with private land along Elk Run industrial area.
- South boundary of habitat patch better aligned with Hwy 1A and transmission line.
- Includes patch of forest cover at east end between the Lafarge Quarry and Baymag Pit.

(All Locations Approximate)

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011a.
Aerial Imagery from September 2009.

SCALE: 1: 15,000

0 100 200 300 M

ENVIRONMENTAL CONSULTANTS

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Indian Flats Local Habitat Patch REV02

APPENDIX F
HABITAT PATCH DATA SHEETS

Habitat Patch		Map Reference in appendix E
Regional	Harvie Heights	E-1
	Georgetown - Canmore Nordic Center	E-2
	Bow Flats	E-3
	Wind Valley	E-4
	Yamnuska	E-5
	Bow Valley Provincial Park	E-6
Local	Quarry Lake	E-7
	South Canmore	E-8
	Indian Flats	E-9

Habitat Patch - Explanation of Land Cover Types Used on Data Sheets

Shadow	Shadow.
Water	Lakes, reservoirs, rivers, streams.
Rock	Bedrock, rubble, talus.
Exposed Land	River sediments, exposed soils, pond or lake sediments, reservoir margins, beaches, landings, road surfaces, mudflat sediments, cutbanks, moraines, gravel pits, tailings, railway surfaces, buildings and parking or other non-vegetated surfaces.
Developed	Land that is predominantly built-up or developed and vegetation associated with these land covers. this includes road surfaces, railway surfaces, buildings and paved surfaces, urban areas and industrial sites.
Shrub tall	At least 20% ground cover which is at least one-third shrub; average shrub height greater than or equal to 2 m. Moist to wet erect tall shrub > 40 cm forming more than 25% of the vegetated cover, consisting mainly of dwarf birch, willow and / or alder. Remaining cover consists of graminoids, lichen and may contain < 10% prostrate dwarf shrubs and bare soil.
Wetland/Shrub	Land with a water table near/at/above soil surface for enough time to promote wetland or aquatic processes; the majority of vegetation is tall, low or a mixture of tall and low shrub.
Herb	Vascular plant without woody stem (grasses, crops, forbs, graminoids); minimum of 20% ground cover or one-third of total vegetation must be herb.
Grassland	Native Grass: Predominantly native grasses and other herbaceous vegetation may include some shrubland cover. Land used for range or native unimproved pasture may appear in this class. Comments: alpine meadows fall into this class.
Coniferous Dense	Greater than 60% crown closure; coniferous trees are 75% or more of total basal area.
Coniferous Open	26-60% crown closure; coniferous trees are 75% or more of total basal area.
Broadleaf Dense	Greater than 60% crown closure; broadleaf trees are 75% or more of total basal area
Mixedwood Dense	Greater than 60% crown closure; neither coniferous nor broadleaf tree account for 75% or more of total basal area.
Pasture	Grassland, shrubland, grazed areas.

Based on 2000 Landsat 5 and 7 ortho-images (Government of Canada 2009).

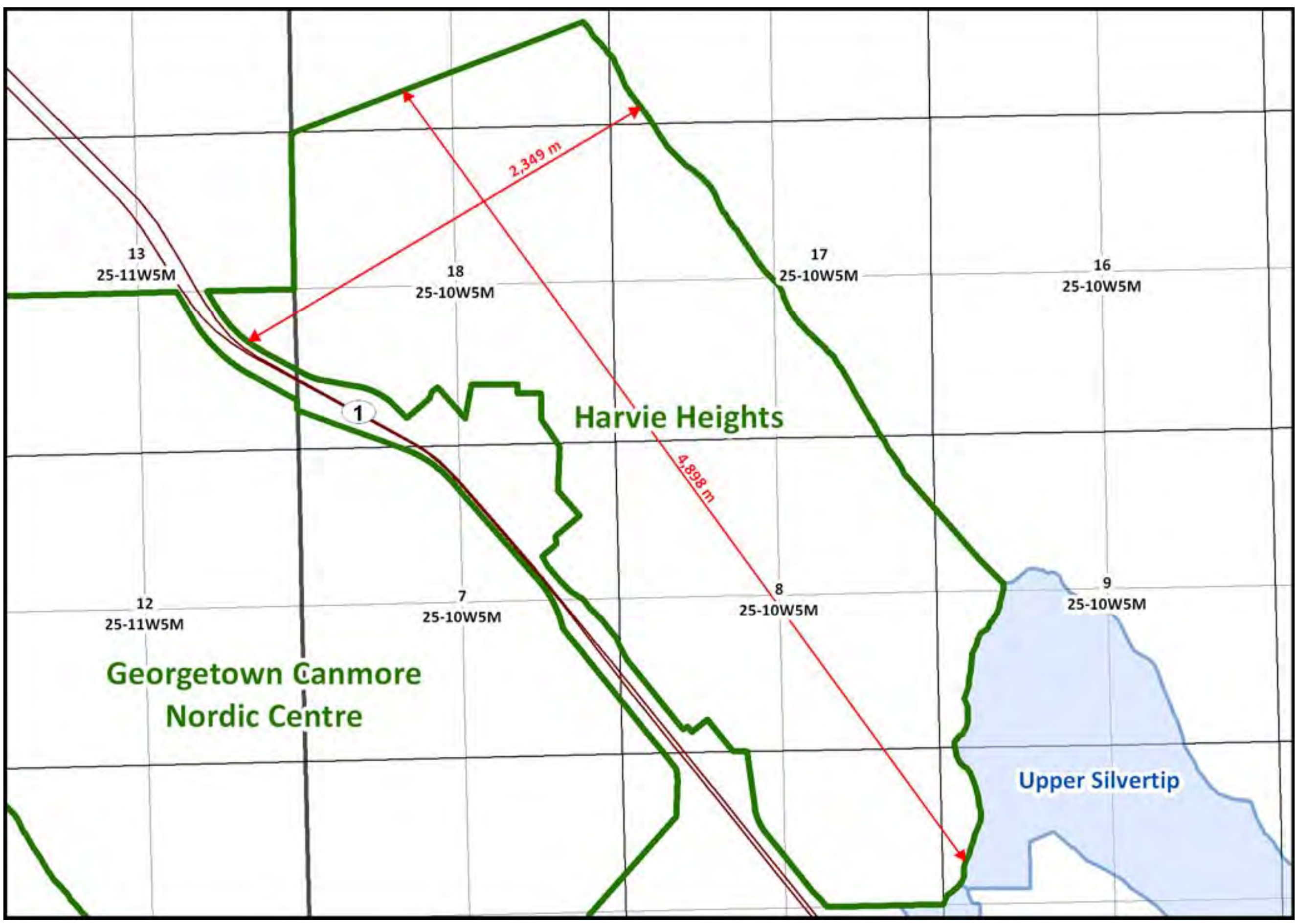
HARVIE HEIGHTS - REGIONAL HABITAT PATCH

(see Map E-1) (All measurements are approximate)

Linked to Wildlife Corridor:	• Harvie Heights • Georgetown - Harvie Heights
Land Use Within (General Description)	• rundle rock quarry and associated access road. • approximately 4.1 km of powerline corridor • west half is currently located within Banff National Park.

Source: air photo imagery (September 2009 imagery) and habitat patch boundaries from ATPR (2011a).

Habitat Patch Dimensions - Harvie Heights	
Area	796 ha or 7.96 km^2
Perimeter	14,711 m
Area to Perimeter Ratio (km^2/km)	0.54



Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management[1]	Area (ha)	Percent (%)
Provincial Protected	658.45	82.7
Provincial Unprotected (Public Lands)	66.95	8.4
Private	44.0	5.5
Municipal	0.4	0.1
Other (transportation corridors, waterways)	26.4	3.3

Source: Government of Alberta, 2009.

Terrain	Area (ha)	Percent (%)
Slope 0-25 degrees	788.0	99.0
Slope >25 degrees	7.2	1.0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	680.3	85.5
Shrub Tall	70.9	8.9
Grassland	27.0	3.4
Developed	10.0	1.3
Herb	6.6	0.8
Exposed Land	1.3	0.2

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint		
Linear Feature	Designated Recreational Trails	10.2 km
	Non-Designated Recreational Trails	31.3 km
	Vehicular roads (paved and gravel)	0 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	3.2 km
	Total Length	44.7 km
	Linear Density	5.6 km/km^2
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	1.3 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	793.9	99.7
		2	2.2	0.3
		3	0	0
		4	0	0
		5	0	0
	Summer (June 16 - Aug. 10)	1	0	0
		2	4.9	0.6
		3	318.9	40.1
		4	472.3	59.3
	Fall (Aug. 11 to Nov. 7)	1	468.5	58.9
		2	224.1	28.1
		3	77.2	9.7
		4	20.2	2.5
		5	3.8	0.5
		6	0.9	0.1
		7	0.8	0.1
		8	0.7	0.1
		9	0	0
Cougar	Non-Winter (April 16 to Nov. 14)	1	0.2	0
		2	25.1	3.1
		3	215.4	27.1
		4	331.7	41.7
		5	223.8	28.1
	Winter (Nov. 15 to April 15)	1	0	0
		2	0.3	0
		3	0.1	0
		4	0.7	0.1
		5	13.3	1.7
		6	781.7	98.2

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes:

1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

Revisions to Habitat Patch Boundary Since 2003

- The Benchlands Local Habitat Patch has been joined with the Harvie Heights Regional Habitat Patch to form a larger Harvie Heights Regional habitat Patch.
- The upper habitat patch boundary moved upslope based on recent wildlife tracking that indicated extensive use.
- The lower habitat patch boundary was better aligned with the TransCanada highway and private land around Harvie Heights.
- The southeast habitat patch boundary moved east to and align with Stoneworks Creek.
- The northwest habitat patch boundary was aligned with Bannf National Park.

List of Wildlife / Human Use Research Conducted within and adjacent to Habitat Patch
(refer to reference list in Appendix A)

- Callaghan and Jevons (2001): conducted winter track counts along transects; winter backtracking (1999/2000). Study area covers the Fairholme Range and primarily the central and east portion of the habitat patch.
- Callaghan and Everett (2004): conducted winter track counts along transects, winter backtracking, GPS collar locations from one cougar (2003/2004). Same study area and transects as Callaghan and Jevons (2001, 2004) plus an extended study area and two more transects in Banff National Park. Note that ASRD and ATPR continued these winter track counts and backtracking until 2009
- Callaghan and Jevons (2004): conducted winter track counts along transects; winter backtracking, GPS collar locations from one cougar (December 1999 to April 2003). Study area covers the same area and transects as Callaghan and Jevons (2001).
- Jacques Whitford Limited (2003, 2005b): Winter track counts, winter backtracking, pellet group transects. Human activity was recorded through observations of foot, bicycle, vehicle, snowmobile, ATV and horse tracks. Domestic dog tracks were also recorded. Backtracking concentrated on the Silvertip wildlife corridors and did not necessarily extend into the Harvie Heights habitat patch.
- Jacques Whitford AXYS Limited (2008a, 2008b): Winter track counts; winter backtracking; pellet group transects. Human activity was recorded through observations of foot, bicycle, vehicle, snowmobile, ATV and horse tracks. Domestic dog tracks were also recorded. Track count and pellet group transects focused on Silvertip and data collection only included portions of the Harvie Heights habitat patch.

Summary of Findings of Relevance to Habitat Patch

- Compared to Indian Flats, the Upper and Lower Silvertip wildlife corridors and the area in-between (Silvertip Central), the area around the Harvie Heights habitat patch (outside Silvertip) had low levels of activity by humans and dogs (Jacques Whitford AXYS Limited 2008a, 2008b).
- Overall, when compared to Indian Flats, the Upper and Lower Silvertip wildlife corridors and the area in-between (Silvertip Central), the area around the Harvie Heights habitat patch (outside Silvertip) had lower densities of deer and elk, but higher densities of cougar and wolves (Jacques Whitford AXYS Limited 2008a, 2008b)
- The primary linear feature within the habitat patch is the powerline corridor. Recreational use of the western portion of the habitat patch adjacent to Banff National Park is considered to be low. As a result, cougars and wolves were detected more frequently than other areas with higher levels of human activity.
- Based on an approximate calculation of linear density (see Table 5), the Harvie Heights Regional Habitat Patch has the highest density of non-designated recreational trails compared to the other Regional Habitat patches. It has a low level of human development (*i.e.*, 0.2%) compared to the other Regional Habitat Patches
- The linear density of non-designated recreational trails (3.9 km/km^2) is greater than the linear density of designated recreational trails (1.3 km/km^2).

Notes and Recommendations

- Residents of Harvie Heights make use of non-designated trails within the habitat patch in all seasons and use the area for dog-walking. Residents may not know which trail is designated versus non-designated. Implement an educational signage program to emphasize the importance and purpose of the area as a habitat patch, information on which trails are/aren't designated and a reminder to leash dogs
- Evaluate the location and suitability of the non-designated and designated recreational trails in an effort to address the imbalance between their length.

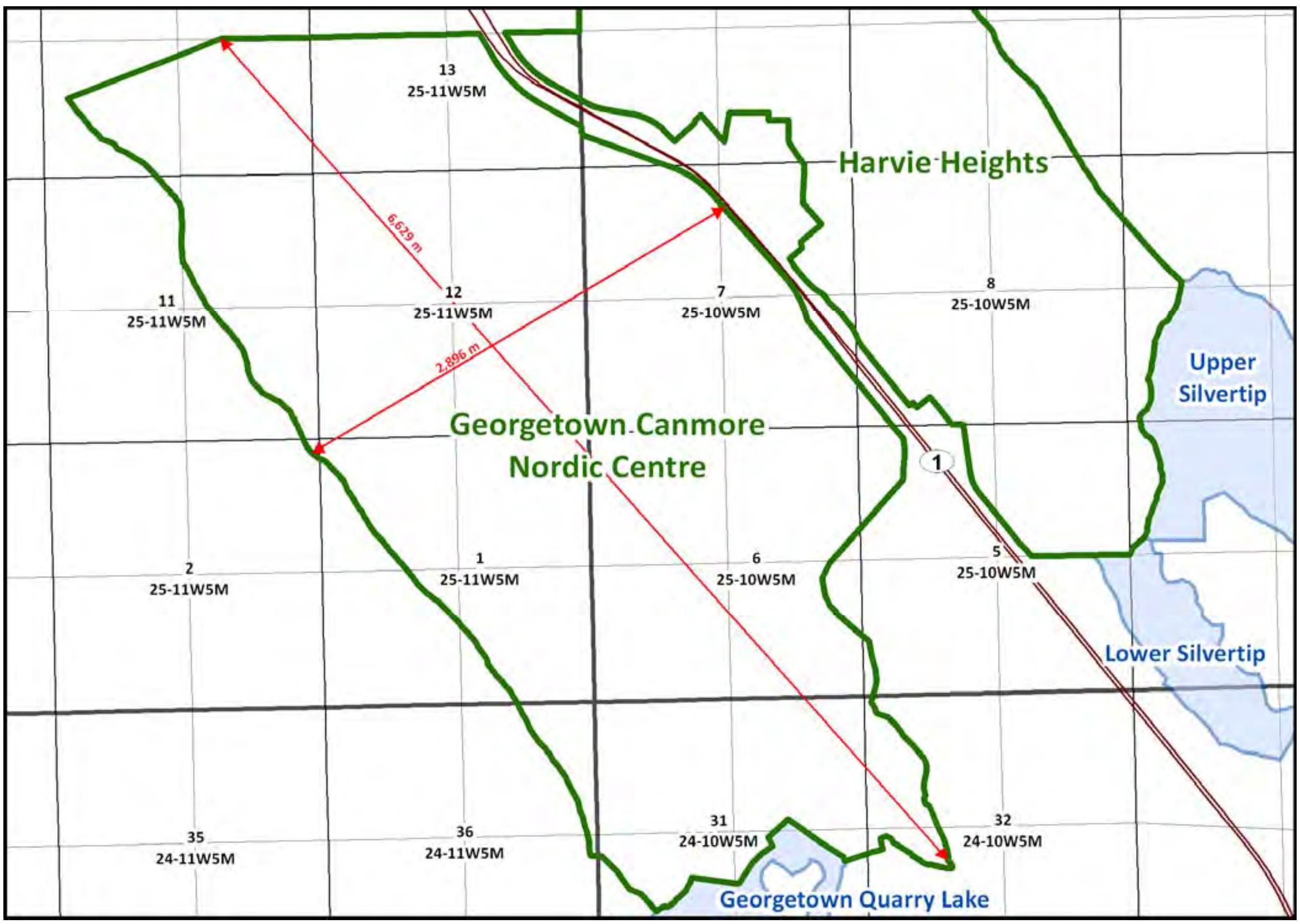
GEORGETOWN - CANMORE NORDIC CENTRE - REGIONAL HABITAT PATCH

(see Map E-2) (All measurements are approximate)

Linked to Wildlife Corridor:	• CNC West • Georgetown-Harvie Heights
Land Use Within (General Description)	• CPR tracks on north boundary • West tip within Banff National Park, remainder in CNC Provincial Park

Source: air photo imagery (September 2009 imagery) and habitat patch boundaries from ATPR (2011a).

Habitat Patch Dimensions - Georgetown CNC	
Area	1,428 ha or 14.3 km^2
Perimeter	18,000 m
Area to Perimeter Ratio (km^2/km)	0.79



Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	1,165.53	81.6
Provincial Unprotected (Public Land)	34.87	2.4
Private	104.5	7.3
Municipal	0.9	0.1
Other (transportation corridors, waterways)	122.3	8.6

Source: Government of Alberta, 2009.

Terrain	Area (ha)	Percent (%)
Slope 0-25 degrees	1,421.6	99.6
Slope >25 degrees	4.9	0.4

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	1,185.1	83.0
Grassland	103.1	7.2
Shrub Tall	57.9	4.1
Rock	38.8	2.7
Exposed Land	19.2	1.3
Herb	15.7	1.1
Developed	4.4	0.3
Coniferous Open	1.9	0.1
Shadow (unable to measure)	1.2	0.1
Water	0.8	0.1

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint		
Linear Feature	Designated Recreational Trails	97.7 km
	Non-Designated Recreational Trails	10.3 km
	Vehicular roads (paved and gravel)	0.6 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	8.5 km
	Total Length	117.1 km
	Linear Density	8.2 km/km^2
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	2.0 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	1,293.9	90.6
		2	124.9	8.7
		3	8.3	0.6
		4	0.2	0
		5	0.7	0.1
	Summer (June 16 - Aug. 10)	1	2.7	0.2
		2	21.6	1.5
		3	774.7	54.3
		4	629.0	44.0
	Fall (Aug. 11 to Nov. 7)	1	506.6	35.5
		2	435.1	30.5
		3	219.7	15.4
		4	86.1	6.0
		5	35.8	2.5
		6	9.0	0.6
		7	11.2	0.8
		8	104.8	7.3
		9	19.6	1.4
Cougar	Non-Winter (April 16 to Nov. 14)	1	0	0
		2	92.9	6.5
		3	413.8	29.0
		4	389.2	27.2
		5	532.2	37.3
	Winter (Nov. 15 to April 15)	1	2.1	0.2
		2	53.6	3.8
		3	14.8	1.0
		4	79.1	5.5
		5	270.3	18.9
		6	1,008.2	70.6

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

Revisions to Habitat Patch Boundary Since 2003
• North boundary aligned with Banff National Park. • The northeast boundary aligned aligned with the TransCanada highway and railway. • East boundary aligned better with the Larch subdivision. • Boundary moved east as far as the transmission line bordering the Rundleview subdivision on west side and now includes island with train bridge.
List of Wildlife / Human Use Research Conducted within and adjacent to Habitat Patch (refer to reference list in Appendix A)
• Monitoring of transects in the area to the east and opportunistic data from grizzly bear radio and GPS collars, however, no formal wildlife monitoring data within the habitat patch.
Summary of Findings of Relevance to Habitat Patch
• Based on an approximate calculation of linear density (see Table 5), the Georgetown-CNC Regional habitat patch has the highest density of designated recreational trails associated with the Canmore Nordic Centre.
Notes and Recommendations
• Given the number of existing trails that are used year-round, the addition of new trails is not recommended. The south side of the Bow River valley within this habitat patch should remain as an area with minimal activity (*i.e.*, currently free of trails) to facilitate wildlife movement to/from Banff National Park.

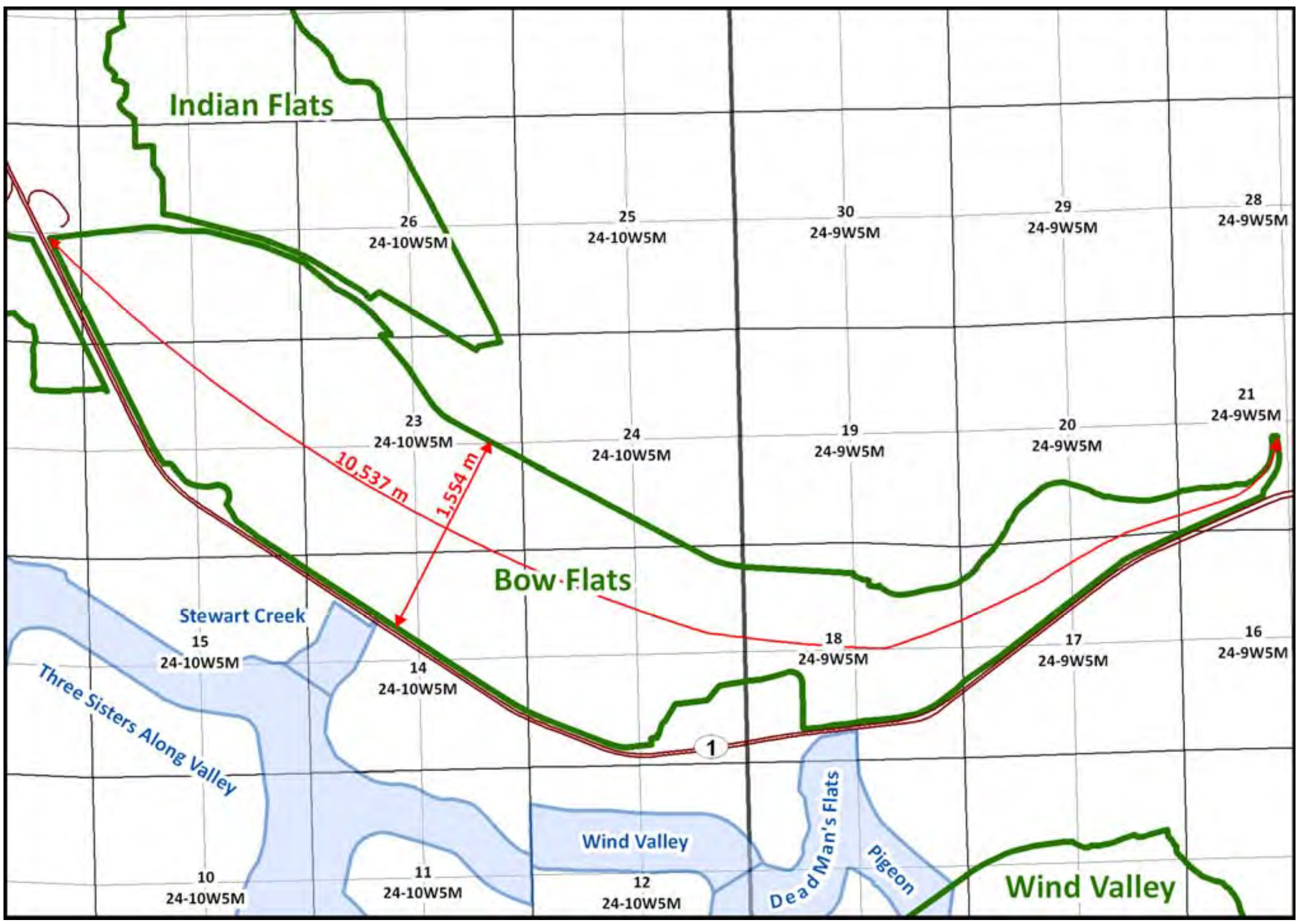
BOW FLATS - REGIONAL HABITAT PATCH

(see Map E-3) (All measurements are approximate)

Linked to Wildlife Corridor:	• Dead Man's Flats • Indian-Bow Flats (West and East) • Stewart Creek • South Canmore-Bow Flats
Land Use Within (General Description)	• Bisected by the Bow River • Sewage Treatment Plant • Bow River Campground • At the edge of the Three Sisters Campground

Source: air photo imagery (September 2009 imagery) and habitat patch boundaries from ATPR (2011a).

Habitat Patch Dimensions - Bow Flats	
Area	1,155 ha or 11.55 km^2
Perimeter	23,355.7 m
Area/Perimeter Ratio (km^2/km)	0.49



Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	835.6	72.3
Provincial Unprotected (Public Lands)	72.3	6.3
Private	12.0	1.0
Municipal	33.6	2.9
Other (transportation corridor, waterways)	201.6	17.5

Source: Government of Alberta, 2009.

Terrain	Area (ha)	Percent (%)
Slope 0-25 degrees	1,153.4	100
Slope >25 degrees	0.3	0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	898.0	77.7
Shrub Tall	87.6	7.6
Broadleaf Dense	44.9	3.9
Herb	34.6	3.0
Developed	29.8	2.6
Rock	24.3	2.1
Grassland	9.1	0.8
Water	8.5	0.7
Wetland Shrub	6.7	0.6
Shadow (unable to measure)	6.3	0.5
Exposed Land	5.3	0.5

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint		
Linear Feature	Designated Recreational Trails	0
	Non-Designated Recreational Trails	0.6 km
	Vehicular roads (paved and gravel)	0.3 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	14.3 km
	Total Length	15.2 km
	Linear Density	1.3 km/km^2
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	2.6 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	1,154.3	99.9
		2	0.8	0.1
		3	0	0
		4	0	0
		5	0	0
	Summer (June 16 - Aug. 10)	1	2.0	0.2
		2	19.1	1.7
		3	148.3	12.8
		4	985.6	85.3
	Fall (Aug. 11 to Nov. 7)	1	486.3	42.1
		2	277.9	24.1
		3	194.4	16.8
		4	102.2	8.8
		5	42.9	3.7
		6	10.2	0.9
		7	7.9	0.7
		8	18.7	1.6
		9	14.5	1.3
Cougar	Non-Winter (April 16 to Nov. 14)	1	0	0
		2	61.2	5.3
		3	441.1	38.2
		4	441.1	38.2
		5	211.7	18.3
	Winter (Nov. 15 to April 15)	1	0	0
		2	100.5	8.7
		3	0	0
		4	0.1	0
		5	10.2	0.9
		6	1,044.3	90.4

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

Revisions to Habitat Patch Boundary Since 2003

- Leased parcel at west end along Hwy 1A now included in habitat patch.
- Adjustments made to habitat patch boundary around Dead Man's Flats to better reflect recent land use decisions by MD of Bighorn.
- Adjusted to align better with the TransCanada Hiighway.

List of Wildlife / Human Use Research Conducted within and adjacent to Habitat Patch
(refer to reference list in Appendix A)

- ATPR (2010a,b and 2011b) conducted transect monitoring, winter backtracking and a wildlife camera study for the Eastern Bow Valley Corridor between November 2004 and March 2009.

Summary of Findings of Relevance to Habitat Patch

- ATPR (2010a,b) identified the area between Hwy. 1 and Hwy 1A as the most *very* high and *high* quality habitat in the study area (which includes the Bow Flats habitat patch). Resource selection maps presented in the ATPR (2010a,b) report shows the Bow Flats habitat patch as having high to very high probability of occurrence for cougar, low probability for wolves and low to high probability for lynx.
- There are two-pinch points to wildlife movement near the south boundary of the habitat patch: between Dead Man's Flats and the Bow River (through the Three Sisters Campground), and 1.5 km west of Dead Man's Flats where the Bow River is very close to the wildlife fence (ATPR 2010a,b).
- The high concentration of carnivore movements between the Bow River and Dead Man's Flats suggests east-west connectivity in this area is important. Movement in this direction within the Bow Flats habitat patch needs to be maintained since there is a low number of documented wildlife crossings of the Bow River and carnivore use of the north-south Dead Man's Flats underpass appears limited (ATPR 2010a,b)
- Currently does not have any designated recreational trails. The linear density of non-designated recreational trails is very low (see Table 5)
- Highest RSF (greater probability of occupancy) for grizzly bear - summer compared to other habitat patches.

Notes and Recommendations

- The valley bottom captured in the Bow Flats habitat patch is fragmented by several branches of the Bow River, however, it provides high quality habitat for wildlife and specifically accommodates east-west movement.
- Given that both the Stewart Creek and Dead Man's Flats wildlife underpasses connect to this habitat patch, it serves as an important area to facilitate wildlife movement through the corridor network.
- Designated recreational trails are not recommended within this habitat patch.

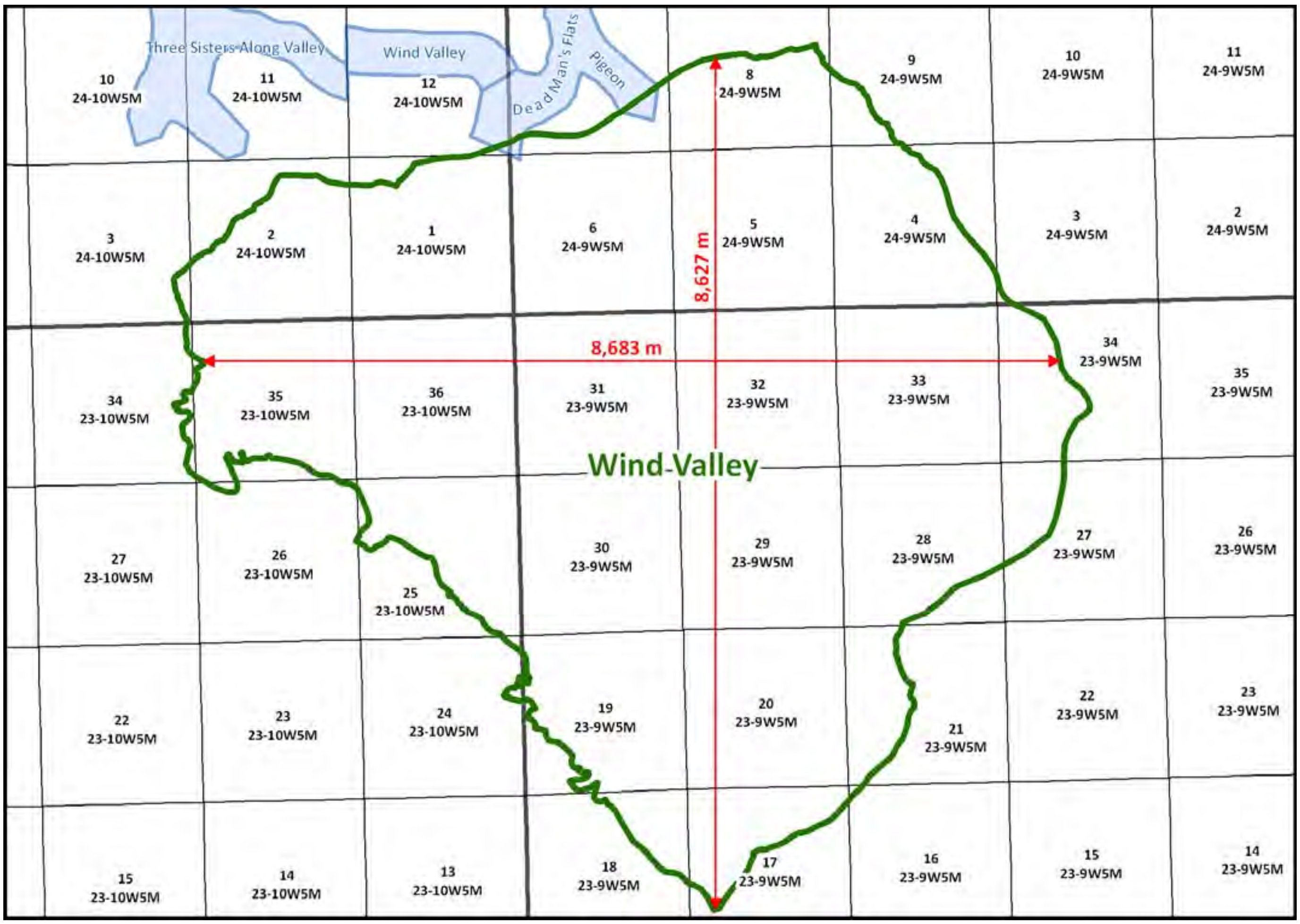
WIND VALLEY - REGIONAL HABITAT PATCH

(see Map E-4) (All measurements are approximate)

Linked to Wildlife Corridor:	• Wind Valley and Pigeon

Source: air photo imagery (September 2009 imagery) and habitat patch boundaries from ATPR (2011a).

Habitat Patch Dimensions - Wind Valley	
Area	4,575 ha or 45.8 km^2
Perimeter	32,505 m
Area to Perimeter Ratio (km^2/km)	1.40



Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	Not calculated	
Provincial Unprotected (Public Land)		
Private		
Municipal		
Other (transportation corridors, waterways)		

Source: Government of Alberta, 2009.

Terrain	Area (ha)	Percent (%)
Slope 0-25 degrees	Not calculated	
Slope >25 degrees		

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	2,924.9	63.9
Shadow (unable to measure)	406.2	8.9
Grassland	345.9	7.6
Shrub Tall	324.7	7.1
Rock	289.7	6.3
Herb	281.7	6.2
Broadleaf Dense	1.6	0
Exposed Land	0.5	0

Source: Government of Canada 2009.

Anthropogenic Footprint		
Linear Feature	Designated Recreational Trails	23.9 km
	Non-Designated Recreational Trails	14.7 km
	Vehicular roads (paved and gravel)	1.4 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	6.3 km
	Total Length	46.3 km
	Linear Density	1.0 km/km^2
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	0 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	incomplete	
		2		
		3		
		4		
		5		
	Summer (June 16 - Aug. 10)	1	96.9	2.1
		2	382.7	8.4
		3	3,462.2	75.7
		4	633.5	13.8
	Fall (Aug. 11 to Nov. 7)	1	257.4	5.6
		2	121.6	2.6
		3	49.7	1.1
		4	62.3	1.4
		5	101.7	2.2
		6	94.3	2.1
		7	275.1	6.0
		8	2,058.4	45.0
		9	1,554.9	34.0
Cougar	Non-Winter (April 16 to Nov. 14)	1	73.5	1.6
		2	625.6	13.7
		3	711.2	15.6
		4	1,272.0	27.8
		5	1,889.8	41.3
	Winter (Nov. 15 to April 15)	1	681.8	14.9
		2	1,457.0	31.9
		3	553.7	12.1
		4	1,318.8	28.8
		5	119.8	2.6
		6	444.1	9.7

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

Revisions to Habitat Patch Boundary Since 2003
• Expanded southward to include all of Wind Valley. • Boundary adjusted to approximate tree-line and ridgeline.
List of Wildlife / Human Use Research Conducted within and adjacent to Habitat Patch (refer to reference list in Appendix A)
• Wolf tracking by the Central Rockies Wolf Project and ATPR (unpublished data).
Summary of Findings of Relevance to Habitat Patch
• Currently very low levels of trails and human development (see Table 5) • Highest RSF (greater probability of occupancy) for grizzly bear fall and cougar non-winter compared to other habitat patches.
Notes and Recommendations
• Very little existing information on wildlife and human use within the habitat patch. Review the need for research in this area. • Maintain low level of linear density.

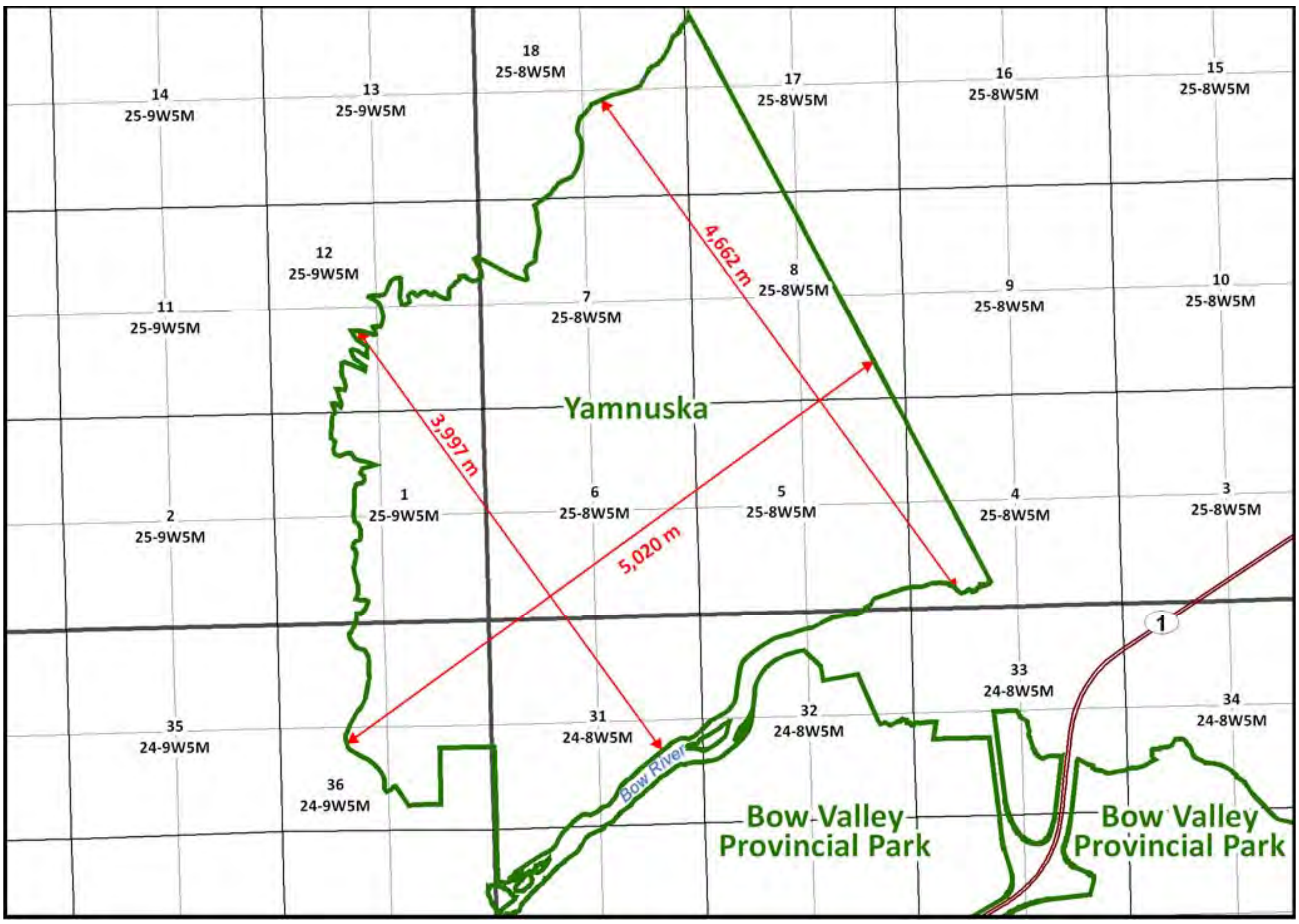
YAMNUSKA - REGIONAL HABITAT PATCH

(see Map E-5) (All measurements are approximate)

Linked to Wildlife Corridor:	• Yamnuska-Lac Des Arcs • BVPP (East, Centre and West)
Land Use Within (General Description)	• Hwy. 1A bisects patch; Kananaskis Ranch Golf Resort; Bow Valley Campground; Willow Rock Campground; several public day use sites (Whitefish, Many Springs, Elk Flats, Middle Lake) for picnicking, fishing, interpretive walks; as well as Park Administration Building.

Source: air photo imagery (September 2009 imagery) and habitat patch boundaries from ATPR (2011a).

Habitat Patch Dimensions - Yamnuska	
Area	1,762 ha or 17.6 km^2
Perimeter	22,741 m
Area to Perimeter Ratio (km^2/km)	0.77



Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	1,300.7	73.8
Provincial Unprotected (Public Land)	338.8	19.2
Private	48.9	2.8
Municipal	0.0	0.0
Other (transportation corridors, waterways)	73.3	4.2

Source: Government of Alberta, 2009.

Terrain	Area (ha)	Percent (%)
Slope 0-25 degrees	1,639.1	93.0
Slope >25 degrees	120.5	7.0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Broadleaf Dense	502.2	28.5
Coniferous Dense	483.5	27.4
Herb	332.9	18.9
Shrub Tall	143.0	8.1
Grassland	100.8	5.7
Wetland Shrub	89.2	5.1
Developed	39.9	2.3
Rock	33.1	1.9
Pasture	23.9	1.3
Water	9.6	0.5
Exposed Land	3.0	0.2
Shadow (unable to measure)	0.5	0

Source: Government of Canada 2009.

Anthropogenic Footprint		
Linear Feature	Designated Recreational Trails	3.2 km
	Non-Designated Recreational Trails	42.9 km
	Vehicular roads (paved and gravel)	10.0 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	14.6 km
	Total Length	70.7 km
	Linear Density	4.0 km/km^2
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	35.1 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	1,526.7	86.7
		2	139.1	7.9
		3	78.5	4.4
		4	12.7	0.7
		5	4.7	0.3
	Summer (June 16 - Aug. 10)	1	106.7	6.0
		2	240.7	13.7
		3	790.5	44.9
		4	623.9	35.4
	Fall (Aug. 11 to Nov. 7)	1	423.9	24.1
		2	366.1	20.8
		3	349.9	19.9
		4	238.5	13.5
		5	148.9	8.4
		6	61.9	3.5
		7	80.2	4.6
		8	71.3	4.0
		9	21.0	1.2
Cougar	Non-Winter (April 16 to Nov. 14)	1	12.3	0.7
		2	632.0	35.9
		3	613.9	34.8
		4	272.7	15.5
		5	230.9	13.1
	Winter (Nov. 15 to April 15)	1	0.2	0
		2	30.6	1.8
		3	42.9	2.4
		4	91.9	5.2
		5	470.5	26.7
		6	1,125.6	63.9

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

Revisions to Habitat Patch Boundary Since 2003
• Slight expansion eastward and northward to better approximate tree-line. • Modified to exclude Thomas Cooke Landfill . • Expanded in southeast corner to follow north bank of the Bow River up to the First Nation Reserve.
List of Wildlife / Human Use Research Conducted within and adjacent to Habitat Patch (refer to reference list in Appendix A)
• None
Summary of Findings of Relevance to Habitat Patch
• High level of existing development footprint compared to other Regional Habitat Patches (see Table 5). • The linear density of non-designated recreational trails (2.4 km/km²) is greater than the linear density of designated recreational trails (0.2 km/km²).
Notes and Recommendations
• Maintain low level of linear density. Evaluate the location and suitability of the non-designated and designated recreational trails in an effort to address the imbalance between their length. • conduct wildlife research to gather information on wildlife use within the habitat patch.

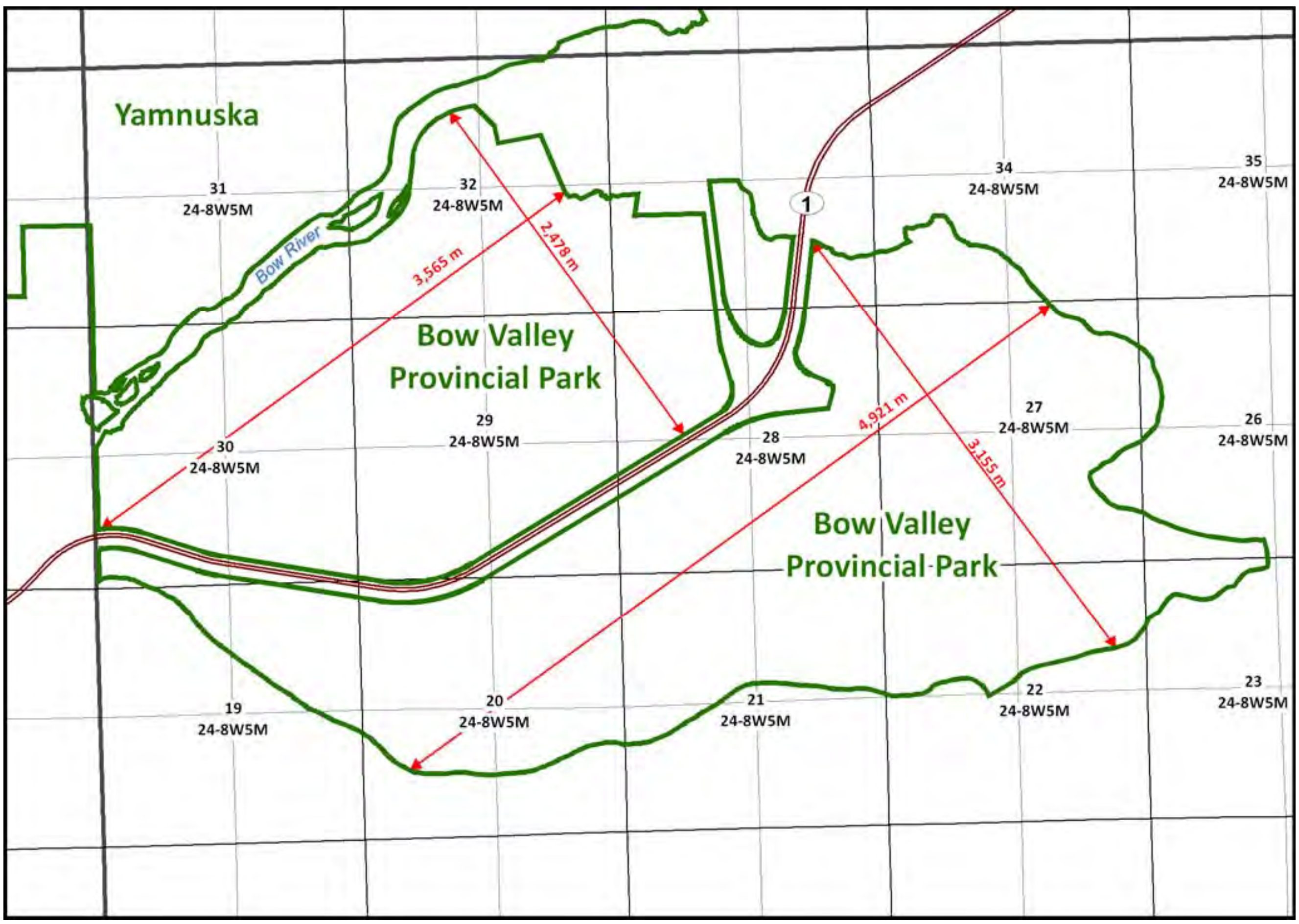
BOW VALLEY PROVINCIAL PARK - REGIONAL HABITAT PATCH

(see Map E-6) (All measurements are approximate)

Linked to Wildlife Corridor:	• n/a
Land Use Within (General Description)	• Camp Chief Hector YMCA, Rafter Six Resort Ranch, Jamboree Centre, Owl and Grouse Group Campsites

Source: air photo imagery (September 2009 imagery) and habitat patch boundaries from ATPR (2011a).

Habitat Patch Dimensions - BVPP	
Area	1,749 ha or 17.5 km^2
Perimeter	33,523 m
Area to Perimeter Ratio (km^2/km)	0.52



Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	1,604.5	91.7
Provincial Unprotected (Public Land)	39.8	2.3
Private	53.6	3.1
Municipal	0.0	0.0
Other (transportation corridors, waterways)	51.5	2.9

Source: Government of Alberta, 2009.

Terrain	Area (ha)	Percent (%)
Slope 0-25 degrees	1,733.9	99.0
Slope >25 degrees	13.4	1.0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	958.1	54.8
Wetland Shrub	204.0	11.7
Broadleaf Dense	143.1	8.2
Grassland	132.6	7.6
Pasture	89.3	5.1
Herb	83.6	4.8
Developed	63.7	3.6
Rock	47.2	2.7
Shrub Tall	20.2	1.2
Mixedwood Dense	4.9	0.3
Shadow (unable to measure)	1.5	0.1
Water	1.1	0.1

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint		
Linear Feature	Designated Recreational Trails	18.1 km
	Non-Designated Recreational Trails	46.1 km
	Vehicular roads (paved and gravel)	26.5 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	9.7 km
	Total Length	100.4 km
	Linear Density	5.7 km/km^2
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	42.2 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank**[2]	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	1,596.2	91.2
		2	118.2	6.8
		3	25.8	1.5
		4	7.8	0.4
		5	1.2	0.1
	Summer (June 16 - Aug. 10)	1	48.4	2.8
		2	206.4	11.8
		3	751.4	42.9
		4	743.2	42.5
	Fall (Aug. 11 to Nov. 7)	1	243.1	13.9
		2	392.2	22.4
		3	473.2	27.1
		4	247.4	14.1
		5	92.0	5.3
		6	31.6	1.8
		7	29.9	1.7
		8	87.0	5.0
		9	153.0	8.7
Cougar	Non-Winter (April 16 to Nov. 14)	1	213.7	12.2
		2	1,081.2	61.8
		3	307.5	17.6
		4	126.8	7.2
		5	20.2	1.2
	Winter (Nov. 15 to April 15)	1	0.1	0
		2	59.6	3.4
		3	9.9	0.6
		4	79.8	4.5
		5	293.3	16.8
		6	1,306.7	74.7

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

Revisions to Habitat Patch Boundary Since 2003
• Expanded eastward to align better with Kananaskis River. • Habitat patch boundary moved slightly to align better with Bow Valley Provincial Park.
List of Wildlife / Human Use Research Conducted within and adjacent to Habitat Patch (refer to reference list in Appendix A)
• No studies within this area have been completed.
Summary of Findings of Relevance to Habitat Patch
• Has the highest level of human development (*i.e.*, 2.4%) compared to the other Regional Habitat Patches. Human activity is seasonally high during the summer months (campgrounds, YMCA Camp, Rafter Six Ranch, Visitor Centre). • The linear density of non-designated recreational trails (2.6 km/km²) is greater than the linear density of designated recreational trails (1.0 km/km²). • The Rafter Six Ranch Resort Area Structure Plan was recently amended in 2010 to include a new free-standing hotel with 112 units.
Notes and Recommendations
• Habitat patch provides important habitat for elk as they move south into the Kananaskis Valley along the west side of Barrier Lake. • Before any new development or expansion of existing development is approved, studies on wildlife and human use within this habitat patch are recommended • Investigate wildlife movement across the TransCanada highway and evaluate the need to facilitate movement with an underpass.

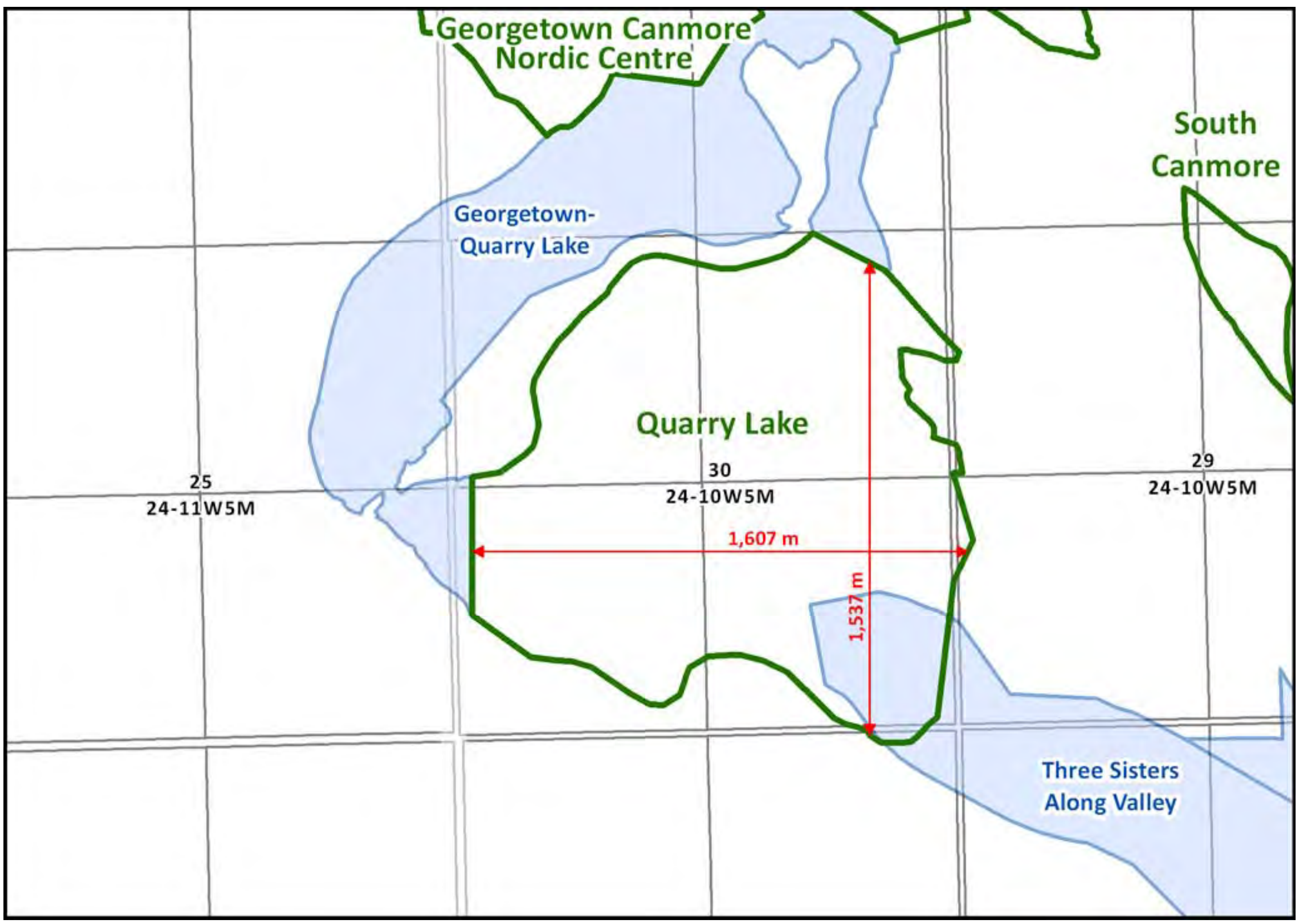
QUARRY LAKE - LOCAL HABITAT PATCH

(see Map E-7) (All measurements are approximate)

Linked to Wildlife Corridor:	• Linked to George-town-Quarry Lake and Three Sisters Along Valley wildlife corridors.
Land Use Within (General Description)	• Includes powerline corridor; dog-off leash area extends into habitat patch.

Source: air photo imagery (September 2009 imagery) and habitat patch boundaries from ATPR (2011a).

Habitat Patch Dimensions - Quarry Lake	
Area	189.75 ha or 1.9 km^2
Perimeter	6,016 m
Area to Perimeter Ratio (km^2/km)	0.32



Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	80.9	42.6
Provincial Unprotected	7.9	4.1
Private	41.3	21.8
Municipal	57.2	30.2
Other (transportation corridors, waterways)	2.5	1.3

Source: Government of Alberta, 2009.

Terrain	Area (ha)	Percent (%)
Slope 0-25 degrees	173.2	91.0
Slope >25 degrees	16.4	9.0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	138.1	72.8
Grassland	23.1	12.2
Shrub Tall	20.7	10.9
Herb	5.1	2.7
Rock	1.9	1.0
Shadow (unable to measure)	0.6	0.3
Developed	0.1	0.1
Water	0.1	0.0

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint		
Linear Feature	Designated Recreational Trails	5.1 km
	Non-Designated Recreational Trails	10.9 km
	Vehicular roads (paved and gravel)	0
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	2.4 km
	Total Length	18.4 km
	Linear Density	9.7 km/km^2
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	0

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	78.6	41.4
		2	77.3	40.8
		3	33.0	17.4
		4	0.8	0.4
		5	0	0
	Summer (June 16 - Aug. 10)	1	0	0
		2	1.1	0.6
		3	47.7	25.1
		4	141.0	74.3
	Fall (Aug. 11 to Nov. 7)	1	24.9	13.1
		2	6.3	3.3
		3	7.4	3.9
		4	10.6	5.6
		5	13.0	6.9
		6	7.5	4.0
		7	17.7	9.3
		8	78.7	41.5
		9	23.6	12.4
Cougar	Non-Winter (April 16 to Nov. 14)	1	3.2	1.7
		2	61.5	32.4
		3	86.4	45.5
		4	37.1	19.6
		5	1.6	0.8
	Winter (Nov. 15 to April 15)	1	0	0
		2	2.0	1.1
		3	5.9	3.1
		4	7.3	3.8
		5	155.4	81.9
		6	19.2	10.1

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes:

1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

Revisions to Habitat Patch Boundary Since 2003
• Expanded upslope and to the east to include patches of forest cover used by wildlife. • Aligned better with off-leash dog area which is excluded from the habitat patch.
List of Wildlife / Human Use Research Conducted within and adjacent to Habitat Patch (refer to reference list in Appendix A)
• Jevons and Callaghan (2001): Winter backtracking was conducted to determine wildlife movement around the Rundle Forbay during the winter of 1999/2000. Results summarize and are consistent with a study by Kamenka (1998). The study area concentrated on the area adjacent to the Rundle Forbay. • Although a study specific to human use was not conducted, Kamenka (1998) and Jevons and Callaghan (2001) noted an increase of human use and an increase in dog use. The Town of Canmore created an off-leash dog park in 1999 near Quarry Lake. Although the intention was to stay within the designated boundary of the off-lease area, there was evidence that that the entire area around the Rundle Forbay is used as an off-leash area (Jevons and Callaghan 2001) • Kamenka (1988) noted that current wildlife movements may become a concern if large carnivores are forced to travel through residential communities to the north to navigate around the Forbay. A wildlife crossing structure was suggested to divert carnivores away from this area. • Jevons and Callaghan (2001) noted that the Rundle Forbay acts as a filter for wildlife movement. Species sensitive to human activity, such as cougars and wolves, may have difficulty navigating around the Forbay • A 25 m wide wildlife crossing structure was built in 2003 across the Rundle Forbay to facilitate wildlife movement. Callaghan and Everett (2007) noted that most of the medium to large mammal species used the crossing (lynx, wolf and grizzly bear were not detected in their study). .
Summary of Findings of Relevance to Habitat Patch
• Has a high level of human use given proximity to the dog off-lease area. • The linear density of non-designated recreational trails (5.7 km/km²) is greater than the linear density of designated recreational trails (2.7 km/km²). • Callaghan and Everett (2007) noted human use and unleased dogs using the Forbay crossing.
Notes and Recommendations
• Enforce off-leash bylaws for dogs. • Improve educational signage in the area to inform users of the purpose and importance of the habitat patch, to stay on designated trails and to keep dogs on-leash when outside the off-leash area • Evaluate the location and suitability of the non-designated and designated recreational trails in an effort to address the imbalance between their length.

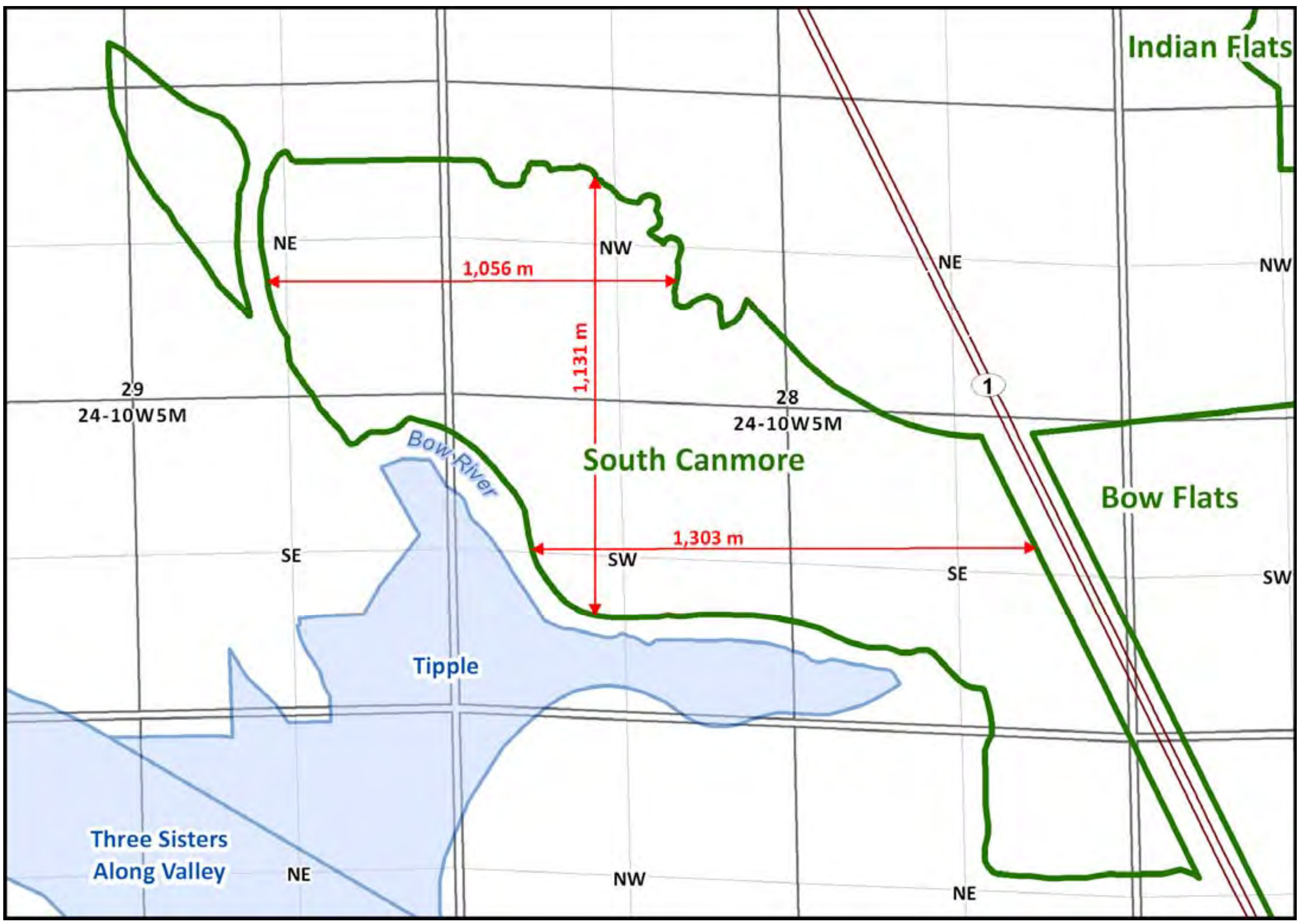
SOUTH CANMORE - LOCAL HABITAT PATCH

(see Map E-8) (All measurements are approximate)

Linked to Wildlife Corridor:	• Tipple
Land Use Within (General Description)	• Wastewater treatment plant • Horse barns, dog walking

Source: air photo imagery (September 2009 imagery) and habitat patch boundaries from ATPR (2011a).

Habitat Patch Dimensions - South Canmore	
Area	182.2 ha or 1.82 km^2
Perimeter	9,287.8 m
Area to Perimeter Ratio (km^2/km)	0.19



Source: wildlife corridor and habitat patch boundaries provided by ATPR (2011a).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	94.8	52.1
Provincial Unprotected (Public Land)	66.0	36.2
Private	8.5	4.7
Municipal	0.0	0.0
Other (transportation corridor, waterways)	12.7	7.0

Source: Government of Alberta, 2009.

Terrain	Area (ha)	Percent (%)
Slope 0-25 degrees	182	100
Slope >25 degrees	0	0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	116.5	63.9
Developed	31.9	17.5
Shrub Tall	14.5	8.0
Herb	10.8	5.9
Grassland	7.1	3.9
Exposed Land	0.2	0.1
Rock	1.3	0.7
Water	0.1	0.03

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint		
Linear Feature	Designated Recreational Trails	1.3 km
	Non-Designated Recreational Trails	8.4 km
	Vehicular roads (paved and gravel)	1.5 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	1.1 km
	Total Length	12.3 km
	Linear Density	6.8 km/km^2
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	4.8 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	182	100
		2	0	0
		3	0	0
		4	0	0
		5	0	0
	Summer (June 16 - Aug. 10)	1	2.2	1.2
		2	12.1	6.6
		3	61.2	33.6
		4	107	58.6
	Fall (Aug. 11 to Nov. 7)	1	54	29.6
		2	55.5	30.4
		3	39.5	21.7
		4	14.8	8.1
		5	6	3.3
		6	2.1	1.1
		7	2.3	1.3
		8	4.0	2.2
		9	4.2	2.3
Cougar	Non-Winter (April 16 to Nov. 14)	1	0.2	0.1
		2	96.5	52.9
		3	85.1	46.6
		4	0.7	0.4
		5	0	0
	Winter (Nov. 15 to April 15)	1	2.2	1.2
		2	36.3	19.9
		3	14.2	7.8
		4	9.2	5.0
		5	46.3	25.4
		6	74.2	40.7

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes:

1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

Revisions to Habitat Patch Boundary Since 2003
• Millenium Park excluded from habitat patch. • Island to the west of Millenium Park included. • Adjusted to align with TransCanada highway and railway, and the north bank of the Bow River • Excludes developed portion in the northwest corner.
List of Wildlife / Human Use Research Conducted within and adjacent to Habitat Patch (refer to reference list in Appendix A)
• Jacques Whitford AXYS Limited (2008c): Winter track counts, summer track pad counts, spring pellet group counts, winter backtracking (2005 to 2007). The study area included the Three Sisters Along Valley corridor and winter backtracking extended outside the corridor into adjacent areas, including the Tipple wildlife corridor that links to the South Canmore habitat patch.
Summary of Findings of Relevance to Habitat Patch
• Jacques Whitford AXYS Limited (2008c) found that although deer and elk used the Tipple wildlife corridor, use by carnivores was low. The Tipple wildlife corridor appears to be the portion of the corridor network that is the least functional given the level of human activity within and adjacent to the corridor (Jacques Whitford AXYS Limited 2008c).
Notes and Recommendations
• The linear density of non-designated recreational trails (4.6 km/km^2) is greater than the linear density of designated recreational trails (0.7 km/km^2). • Wildlife do not appear to be using the Tipple wildlife corridor as intended given the level of development and human activity within and adjacent to this corridor. This information and level of human activity within and adjacent to the South Canmore habitat patch suggests wildlife use of the Tipple wildlife corridor and habitat patch are compromised. • In order to preserve the intended function of the habitat patch, new dispositions and expansions to existing dispositions should not be permitted within the South Canmore habitat patch. • A review of non-designated recreational trails should be conducted to determine which trails should be closed and how the network of non-designated trails can be replaced by a designated trail that accommodates the purpose of the habitat patch (*i.e.*, the designated trail should be designed and located in a location that is less intrusive to wildlife).

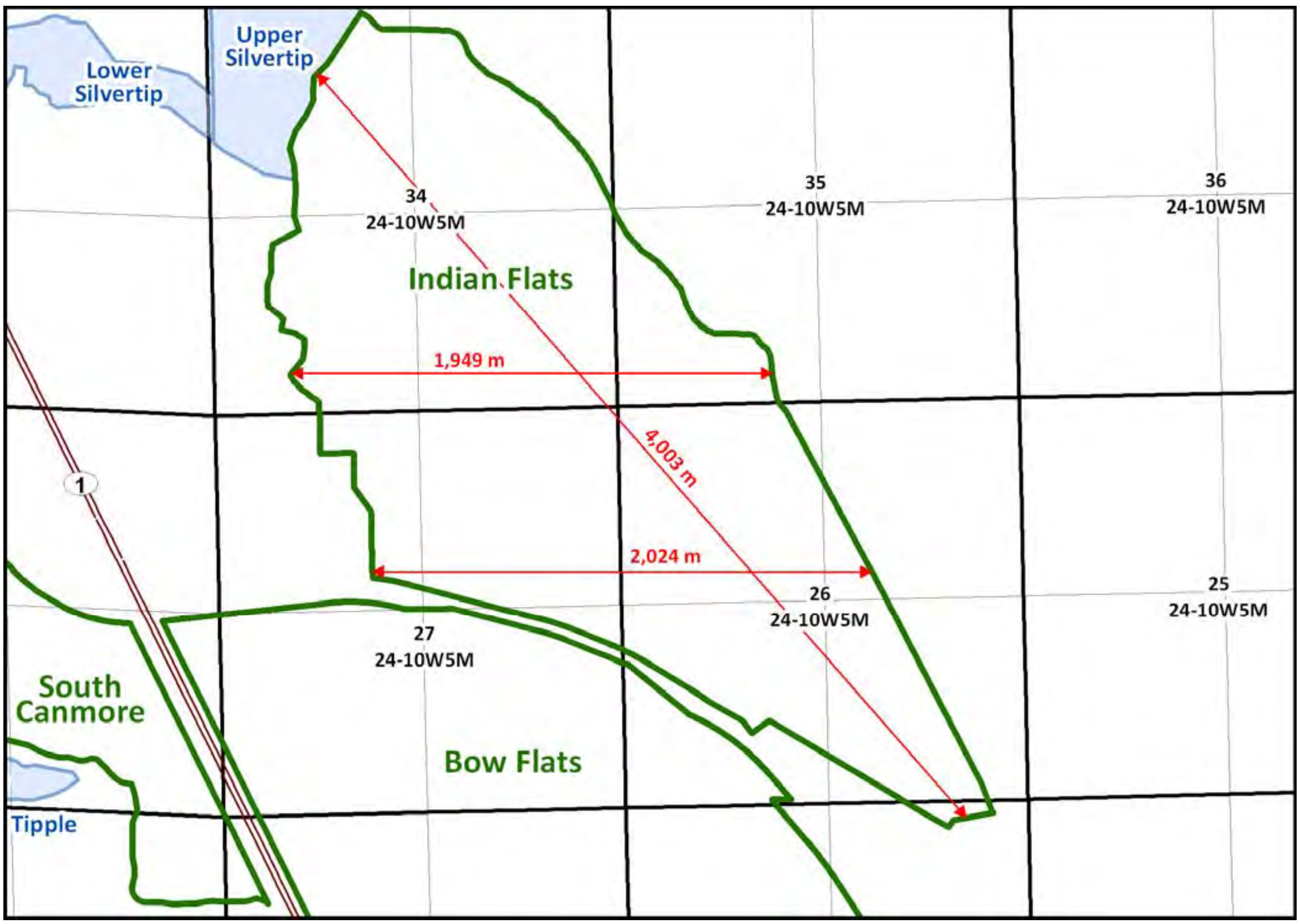
INDIAN FLATS - LOCAL HABITAT PATCH

(see Map E-9) (All measurements are approximate)

Linked to Wildlife Corridor:	• Upper Silvertip and Lower Silvertip
Land Use Within (General Description)	• Includes powerline corridor; Alpine Clubhouse of Canada clubhouse and Hostel; Municipal horse stables/barns.

Source: air photo imagery (September 2009 imagery) and habitat patch boundaries from ATPR (2011a).

Habitat Patch Dimensions - Indian Flats	
Area	431.51 ha or 4.32 km^2
Perimeter	9,996 m
Area to Perimeter Ratio (km^2/km)	0.43



Source: wildlife corridor and habitat patch boundaries provided by ATPR (2010b).

Land Ownership / Management	Area (ha)	Percent (%)
Provincial Protected	160.9	37.3
Provincial Unprotected (Public Lands)	256.4	59.4
Private	0.0	0.0
Municipal	9.4	2.2
Other (transportation corridors, waterways)	4.7	1.1

Source: Government of Alberta, 2009.

Terrain	Area (ha)	Percent (%)
Slope 0-25 degrees	416.7	97.0
Slope >25 degrees	14.3	3.0

Source: DEM data from ATPR (2011a).

Land Cover	Area (ha)	Percent (%)
Coniferous Dense	226.8	52.6
Shrub Tall	74.8	17.3
Herb	63.5	14.7
Grassland	57.0	13.2
Developed	5.8	1.4
Rock	2.8	0.7
Shadow (unable to measure)	0.8	0.2

Source: Government of Canada. 2009. Note data is based on 2000 Landsat 5 and 7 ortho-images.

Anthropogenic Footprint		
Linear Feature	Designated Recreational Trails	10.7 km
	Non-Designated Recreational Trails	29.9 km
	Vehicular roads (paved and gravel)	1.7 km
	Rights-of-Way (powerlines, pipelines, seismic lines, railway)	3.0 km
	Total Length	45.3 km
	Linear Density	10.5 km/km^2
Non-Linear Feature	Anthropogenic Disturbance (includes buildings, paved areas and obvious disturbances with no habitat potential. Does not include golf course fairways).	6.4 ha

Source: trail data provided by ATPR (2011a)(designated and non-designated trails), as well as air photo interpretation (September 2009 imagery)(powerlines, railway, highways, roads, anthropogenic disturbance).

Note: only designated recreational trails are shown on the maps (ATPR 2011a).

Resource Selection Function[1]				
Species	**Season**	**Rank[2]**	**Area (ha)**	**Percent (%)**
Grizzly Bear	Spring (April 30 – June 15)	1	412.2	95.5
		2	19.3	4.5
		3	0	0
		4	0	0
		5	0	0
	Summer (June 16 - Aug. 10)	1	0	0
		2	0	0
		3	159.0	36.8
		4	272.4	63.1
	Fall (Aug. 11 to Nov. 7)	1	233.2	54.1
		2	123.6	28.6
		3	40.4	9.4
		4	26.5	6.1
		5	6.2	1.4
		6	0.8	0.2
		7	0.6	0.1
		8	0.2	0.1
		9	0	0
Cougar	Non-Winter (April 16 to Nov. 14)	1	0.2	0.0
		2	29.9	6.9
		3	179.9	41.7
		4	135.2	31.3
		5	86.4	20.0
	Winter (Nov. 15 to April 15)	1	0	0
		2	0	0
		3	0	0
		4	0.4	0.1
		5	5.2	1.2
		6	425.8	98.7

Source: Chetkiewicz *et al.*, 2006; Chetkiewicz and Boyce, 2009.

Notes: 1 RSF is the statistical model defined to be proportional to the probability of use of a resource unit. Applying the RSF in a geographic information system (GIS) identifies areas likely to support occupancy (*i.e.*, allow us to identify habitats that are more likely to support grizzly bear and cougar use). This data provides a snapshot of the probability of occupancy and does not address variables such as human use on trails and development that has occurred after 2004.

2. The higher ranks indicate the animal is predicted to be more likely to occur. Note: this is not equivalent to habitat quality. The ranking across seasons and species are not directly comparable. Each season ranking is based on a different model and no two models are the same.

Revisions to Habitat Patch Boundary Since 2003

- West boundary of habitat patch aligned with private land boundary along Elk Run Industrial area.
- South boundary of habitat patch better aligned with Hwy 1A and transmission line.
- Includes patch of forest cover at east end between the two quarries.

List of Wildlife / Human Use Research Conducted within and adjacent to Habitat Patch
(refer to reference list in Appendix A)

- Callaghan and Jevons (2001): conducted winter track counts along transects; winter backtracking (1999/2000). Study area covers the Indian Flats habitat patch.
- Callaghan and Everett (2004): conducted winter track counts along transects, winter backtracking, GPS collar locations from one cougar (2003/2004). Study area covers the Indian Flats habitat patch. Same study area and transects as Callaghan and Jevons (2001, 2004) plus an extended study area and two more transects in Banff National Park. Note that ASRD and ATPR continued these winter track counts and backtracking until 2009.
- Callaghan and Jevons (2004): conducted winter track counts along transects; winter backtracking, GPS collar locations from one cougar (December 1999 to April 2003). Study area covers the Indian Flats habitat patch (same area and transects as Callaghan and Jevons 2001).
- Jacques Whitford Limited (2005b): Winter track counts along transects, winter backtracking, pellet group transects. Human activity was recorded through observations of foot, bicycle, vehicle, snowmobile, ATV and horse tracks. Domestic dog tracks were also recorded (1999 to 2005). Track counts include the Indian Flats habitat patch. Pellet group transects did not include the Indian Flats habitat patch. Backtracking concentrated on the Silvertip wildlife corridor and areas immediately adjacent, and only included areas on the far NW edge of the Indian Flats habitat patch.
- Jacques Whitford AXYS Limited (2008a, 2008b): Winter track counts along transects; winter backtracking; pellet group transects. Human activity was recorded through observations of foot, bicycle, vehicle, snowmobile, ATV and horse tracks. Domestic dog tracks were also recorded (2003 - 2006; 2006-2007). Track counts include the Indian Flats habitat patch. Pellet group transects did not include the Indian Flats habitat patch. Backtracking concentrated on the Silvertip wildlife corridor and areas immediately adjacent, and only included areas on the far NW edge of the Indian Flats habitat patch.

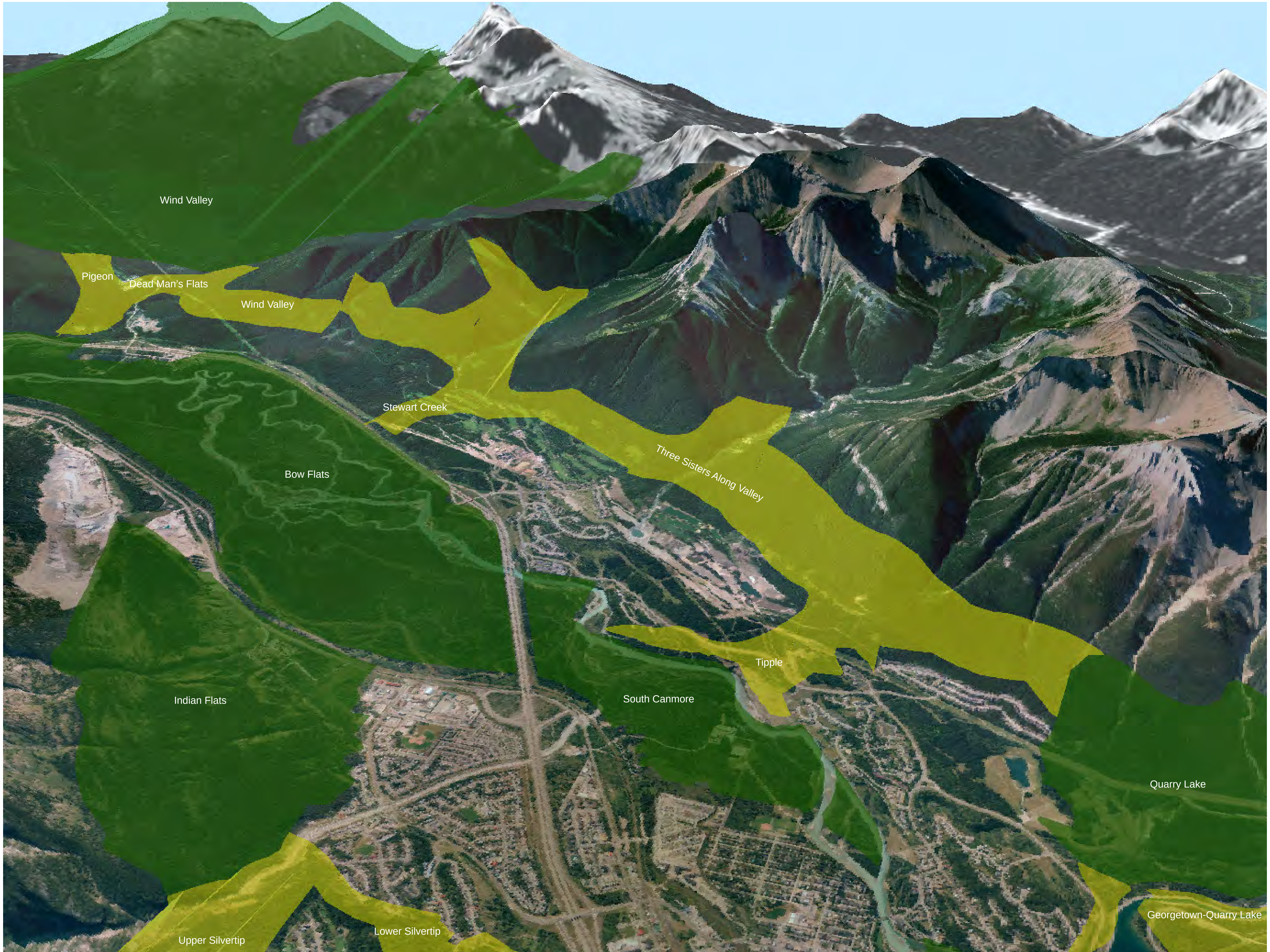
Summary of Findings of Relevance to Habitat Patch

- Cougar tracks were most frequently encountered in the Indian Flats habitat patch compared to the Upper and Lower Silvertip wildlife corridors and areas outside of Silvertip. Wolf tracks were not observed. The relative abundance of deer and elk was lower in the Indian Flats habitat patch likely due to lower habitat suitability related to steep and rugged terrain, however, this habitat supported higher encounters of bighorn sheep (Jacques Whitford AXYS Limited 2008a, 2008b).
- Jacques Whitford AXYS Limited (2008b) found domestic dog tracks were encountered most frequently in Silvertip (central), followed by Indian Flats habitat patch, the Upper and Lower Silvertip wildlife corridors and areas outside of Silvertip. Human activity within Indian Flats habitat patch was also considered to be intermediate.
- Callaghan and Jevons (2004) reported few crossings of Cougar Creek (located on the northwest boundary of the Indian Flats habitat patch) by carnivores and ungulates. Factors that may limit wildlife crossing of the creek include the high level of human activity, development on either side of the creek, open habitat and rocky bed and steep banks of the creek. Cougar and wolf crossings typically occurred farther upstream away from human development.
- Although wildlife monitoring indicates use of the patch by all species (deer, elk, cougar, wolf, bighorn sheep), the most commonly encountered species were cougar and bighorn sheep. Wolves were noted using Indian Flats with a notable peak in observed abundance in 2002-2003 (Jacques Whitford AXYS Limited 2008a)
- Highest RSF (greater probability of occupancy) for cougar winter compared to other habitat patches.

Notes and Recommendations

- This Local Habitat Patch has the highest density of linear features compared to other Local Habitat Patches. The linear density of non-designated recreational trails (6.9 km/km^2) is greater than the linear density of designated recreational trails (2.5 km/km^2).
- A review of non-designated recreational trails should be conducted to determine which trails should be closed and how the network of non-designated trails can be replaced by a designated trail that supports the purpose of the habitat patch (i.e., the designated trail should be designed and located in a location that is less intrusive to wildlife).

APPENDIX G
3D VIEW MAPS



MAP G-1

VIEW SOUTHEAST

WILDLIFE CORRIDORS AND HABITAT PATCH GUIDELINES FOR THE BOW VALLEY

2011

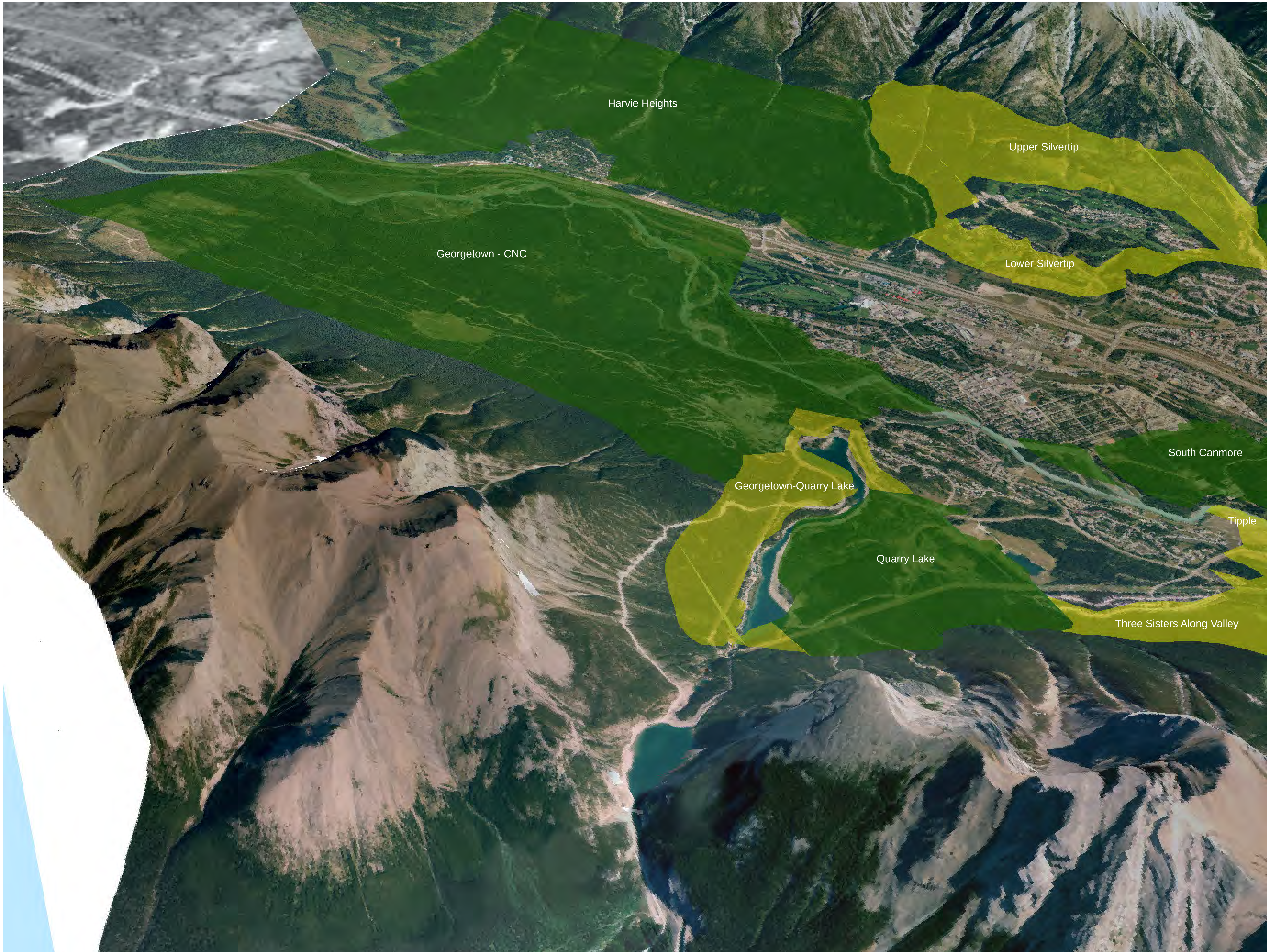
Wildlife Corridor

Habitat Patch

(All Locations Approximate)

tera ENVIRONMENTAL CONSULTANTS

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2011.
Aerial Imagery from September 2009.



MAP G-2

VIEW NORTH

WILDLIFE CORRIDORS AND HABITAT PATCH GUILDELINES FOR THE BOW VALLEY

2011

Wildlife Corridor

Habitat Patch

(All Locations Approximate)

tera ENVIRONMENTAL CONSULTANTS

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2010.
Aerial Imagery from September 2009.

MAP G-3

VIEW WEST

WILDLIFE CORRIDORS AND HABITAT PATCH GUILDELINES FOR THE BOW VALLEY

2011

Habitat Patch

(All Locations Approximate)

tera ENVIRONMENTAL CONSULTANTS

Source:
Data for this map provided by Alberta Tourism, Parks and Recreation 2010.
Aerial Imagery from September 2009.