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Connecting the Upper Columbia Valley III:
Habitat Criteria and Conditions

Prepared for:

Columbia Wetlands Stewardship Partners

Prepared by:

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1 Introduction

This report represents the third phase of an ongoing habitat linkage process in the Upper Columbia Valley designed to facilitate the conservation of species at risk and those of local conservation concern.

Phase I of the process examined land use planning between Fairmont Hot Springs and Edgewater, BC (Adams and Robinson 2009). A mosaic of municipalities was identified, including numerous land use planning jurisdictions:

- Incorporated municipalities
  - District of Invermere
  - Village of Radium Hot Springs
  - Village of Canal Flats

- Regional District of East Kootenay under with three separate Official Community Plans
  - Fairmont Hot Springs
  - Lake Windermere
  - Steamboat / Jubilee
  - plus areas not under any planning guidance

- First Nations
  - Akisq'nuk First Nation
  - Shuswap Indian Band

- Environment Canada
  - Kootenay National Park (Parks Canada Agency)
  - Columbia National Wildlife Area

- Province of British Columbia
  - Columbia Wetlands Wildlife Management Area
  - Dry Gulch Provincial Park
  - James Chabot Provincial Park

Phase II (Adams 2010) identified "key areas of concern or 'pinch points' where topography, development and jurisdiction act alone or in combination to disrupt fish and wildlife movement." Concentrating on species inhabiting the Rocky Mountain Trench (below 1100 m elevation) and large-scale movements, the report's objective was to identify areas of concern and where the jurisdictions of Phase I and other key landowners and stakeholders ought to focus attention to maintain options for fish and wildlife movements in the Upper Columbia.

The objective of Phase III, this report, is to focus on finer scale details of focal species and a smaller area of interest: Dry Gulch (roughly Stoddart Creek at the northern limit of the Shuswap Reserve) to Edgewater and east of the Columbia River mainstem). Stand-level habitat criteria for focal species are summarized and current conditions are explored.

2 Habitat Criteria

Eight species were identified as potential focal species (Table 1). These were based on conservation concerns and covering the suite of habitat types identified previously (Adams and Robinson 2009). Reliable habitat suitability mapping is not available for Northern Goshawk, though publication of stand-level habitat guidelines are imminent (K. Stuart-Smith, Tembec pers. comm.). For now, goshawk has been omitted, but may be a suitable focal species in the future.

Forest stand age class (Figure 1) and leading species (Figure 2) were mapped for the area using BC provincial Vegetation Resources Inventory (VRI) data. These maps provide information on habitat conditions within specific corridors (see Section 0) as well as general overview of the study area. Species-specific habitat suitability / capability mapping was used where available.

Table 1: Potential focal species for habitat linkage planning the Upper Columbia Valley. For a full outline of species, see Table 4 in Adams and Robinson (2009).

Common Name	Scientific Name	COSEWIC	CDC	CF Prior.[1]
Grassland / Open Forest				
Bighorn Sheep	*Ovis canadensis canadensis*	not assessed	Blue	3
Closed forest				
Flammulated Owl	*Otus flammeolus*	Special Concern	Blue	2
Generalist				
Common Nighthawk	*Chordeiles minor*	Threatened	Yellow	2
Wide Ranging Carnivore				
Northern Goshawk	*Accipiter gentilis*	not assessed	Yellow	3
Wolverine	*Gulo gulo luscus*	Special Concern	Blue	2
Grey Wolf	*Canis lupus*	Not at Risk	Yellow	3
American Badger	*Taxidea taxus jeffersonii*	Endangered	Red	1
Grizzly Bear	*Ursus arctos*	Special Concern	Blue	2

[1] BC provincial Conservation Framework priority. Lower value indicates higher conservation concern on a scale of 1-6.

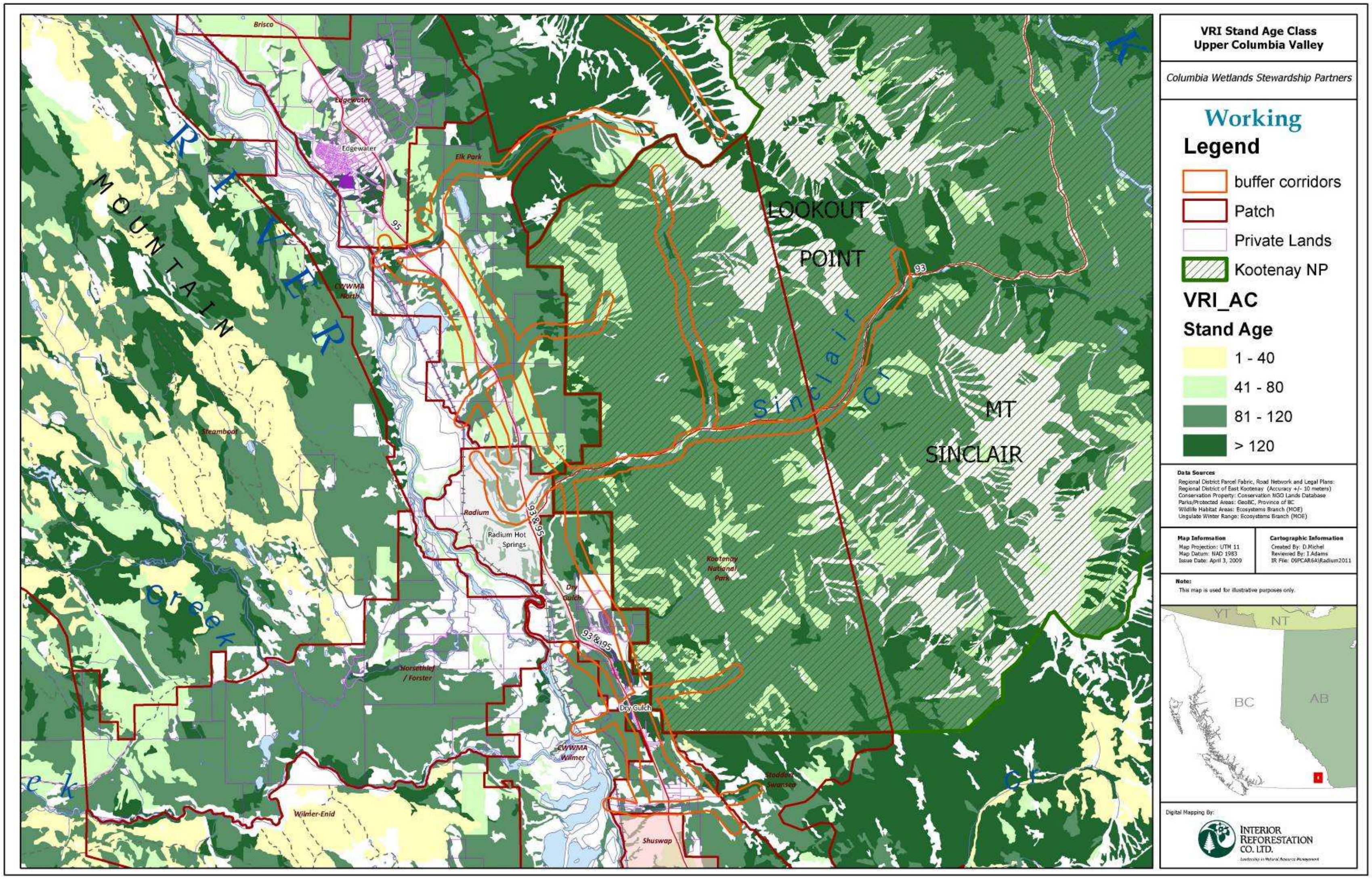


Figure 1: Age class groupings of forest stands in the Upper Columbia Valley, BC. White polygons are classified as 'non-forested.' Data source: BC Vegetation Resources Inventory.

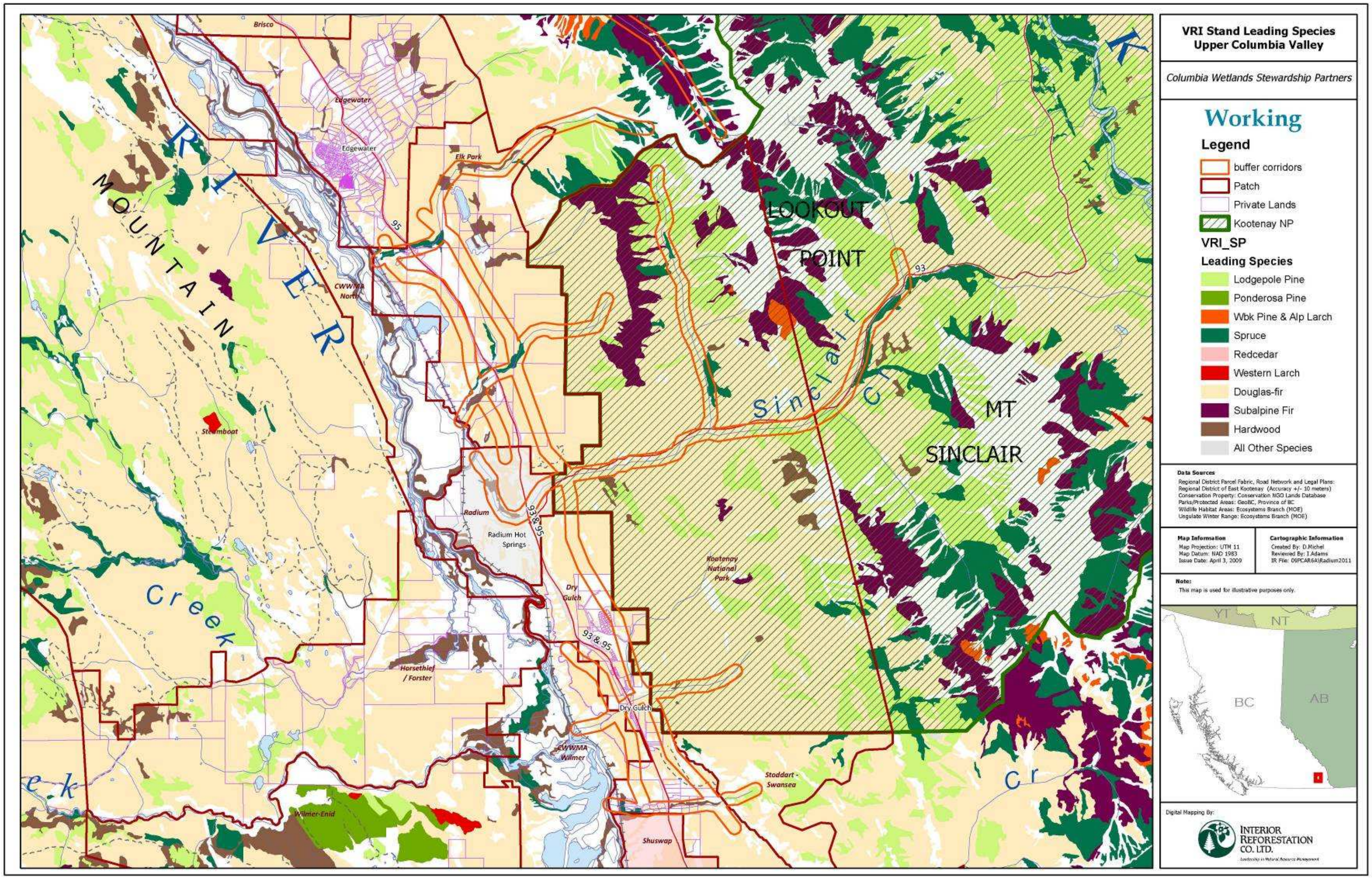


Figure 2: Leading species (most common tree species in stand) groupings of forest stands in the Upper Columbia Valley, BC. White polygons are classified as 'non-forested.' Data source: BC Vegetation Resources Inventory.

2.1 Rocky Mountain Bighorn Sheep

- Well studied at Radium Hot Springs (Dibb 2007; Tremblay 2001; Stelfox 1990; Stelfox et al. 1985).
- Dibb (2007) summarizes bighorn sheep habitat needs as “presence or proximity of steep, rugged terrain, relatively arid conditions, and open habitat with good visibility such as alpine areas, grasslands and shrub-steppes”.
- Presence of quality forage is also important. Winter diet consists mainly of bunchgrasses, such as wheatgrasses (*Agropyron* spp.), fescues (*Festuca* spp.), bluegrasses (*Poa* spp.), needle grasses (*Stipa* spp.), and various forbs and shrubs (Davidson 1994).
- However, Shackleton et al. (1999) conclude that bighorns consume grasses, forbs and shrubs roughly in proportion to their availability.

Connectivity

- Movement patterns are well documented (Dibb 2007; Tremblay 2001).
- Bighorn sheep are very traditional in their movements, consistently following the same routes.
- Recommend to follow Dibb work (Figure 3) as it is most recent and more comprehensive.

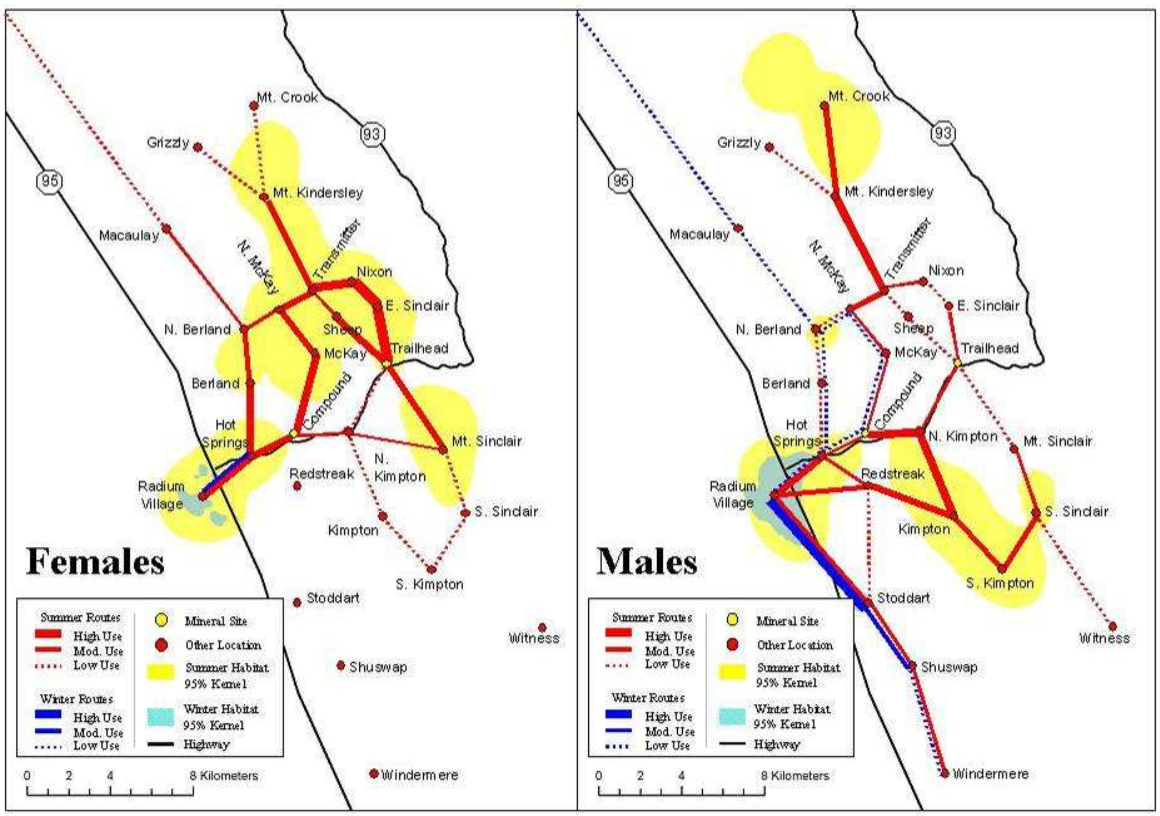


Figure 3: Movement patterns of female and male Rocky Mountain bighorn sheep for the Radium Hot Springs band. Source: Dibb (2007).

2.2 Flammulated Owl

- Habitat criteria are not well understood.
- A habitat suitability model was identified as a critical knowledge gap by Cooper et al. (2005), but has never been completed (T. Antifeau, BC Ministry of Natural Resource Operations pers. comm.). A summary of provincial VRI parameters consistent with known nesting sites in the East Kootenay may be available (T. Antifeau pers. comm.).
- Reliant on Pileated Woodpecker and Northern Flicker cavities for nesting.
- Habitat associations are thought to be mosaic of old seral Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) or ponderosa pine (*Pinus ponderosa*) forests: "multi-age class stands with multiple canopy layers, including a veteran tree component for nesting and roosting." (BC Ministry of Water, Land and Air Protection 2004.).
- Presence of bunchgrasses may also be an important habitat consideration; likely an indication of seral stage and canopy openness (COSEWIC 2001).
- WHA is located east of Windermere Loop Rd. at the south end of the Stoddart – Swansea block, south of the focus area for this report.
- Limited inventory work has been completed north of the Swansea WHA. Flammulated Owls are known from Kootenay National Park (at the hot springs and McKay Compound, L. Halverson, Parks Canada (ret'd), pers. comm.) and as far north as Brisco (Ferguson 2004).
- They likely occur where suitable habitat exists in low- to mid-elevation forests along the entire east side of the Trench from the USA border north to at least Brisco.

<u>Connectivity</u>

- Willingness of individual Flammulated Owls to cross patches of non-preferred habitat is poorly discussed.
- Once on breeding territories they maintain home ranges of roughly 2 to 4 ha (BC Ministry of Water, Land and Air Protection 2004).
- They also display strong site fidelity to breeding territories (Reynolds and Linkhart 1992).
- However, as a migratory owl, they must cross non-preferred habitats to access breeding territories, so they have the ability to expand locally within the breeding area to occupy suitable unoccupied habitat, if numbers warrant. Other factors may leave apparently suitable habitat unoccupied.
- As bird capable of flight, the importance of maintaining corridors of suitable nesting habitat is of uncertain importance unless future research shows Flammulated Owls are reluctant to cross non-preferred habitat types.
- At this time it is perhaps more important to ensure sufficient high quality home ranges and nesting territories are available to maintain a regional (i.e. East Kootenay) population.
- Cooper et al. (2005) provide detailed prescriptions for maintaining and enhancing Flammulated Owl habitat.

2.3 Common Nighthawk

- Very little information is available on Common Nighthawk nesting habitat or other requirements.
- COSEWIC (2007) listing (Threatened) based on population declines likely resulting from reduction in food resources of nighthawks and other aerial insectivores. Habitat availability declines resulting from fire suppression and other factors are also cited as possible reasons.
- Declines in aerial insectivores are greatest in eastern North America, though are more widespread for Common Nighthawk, including BC (Nebel et al. 2010).
- Cited habitat requirements include open habitats; mixed and coniferous forests & pine stands. Fairly adaptable to human activity and have been found nesting on flat gravel roofs (COSEWIC 2007).
- Brigham (1989) noted preference for natural sites in the Okanagan.

- At a microsite-level for nests, they may prefer open sites, possibly for long sight-lines (T. Kinley, Sylvan Consulting, pers. comm.).

Connectivity
- As a highly mobile aerial species that are often viewed in urban areas, nighthawks are not likely limited or hindered by fragmentation.
- However, as a ground nesting species, they are susceptible to human disturbances (e.g. off-road activities).
- As long as suitable nesting habitat exists (which is currently poorly understood for the BC Interior) as well as an available food supply, few management actions with respect to connectivity are known for this species at this time.

2.4 Wolverine

- Primarily a mid- to high-elevation species that will occasionally cross larger valley-bottoms, including the Upper Columbia Valley.
- Habitat associations for British Columbia recently outlined by Krebs et al. (2007) include:
  - Males are associated with moose winter range, mid-elevation forested valley bottoms and avalanche terrain;
  - Moose are known to winter in the Columbia Wetlands WMA and adjacent valleys (Poole and Stuart-Smith 2006);
  - Female associations are more complex and include: alpine and avalanche terrain, hoary marmot and Columbian ground squirrel presence in the summer; and
  - Both males and females are negatively associated with human disturbance in the form of roads, winter recreation (including heli-skiing activity).

Connectivity
- Likely to occasionally cross the Upper Columbia Valley between the Rocky and Purcell Mountains. However, these movements are considered rare (Lofroth and Krebs 2007).
- Individuals (especially males) may follow prey sources in the more isolated areas of the Columbia wetlands, but these areas are unlikely to form part of individuals' home range (E. Lofroth, BC Ministry of Environment, pers. comm.).
- Key importance is to maintain undeveloped habitat patches between mid-slope forests (roughly approximated by the MS – ESSF biogeoclimatic zone boundary) and the Columbia River Wetlands WMA on both sides of the Columbia River.
- Best options are probably north of at least Edgewater and likely Brisco.
- North-South movements of wolverine are most likely to take place at higher elevations in both Rocky and Purcell Mountains. Highway 93 likely presents a barrier to north-south wolverine movements within Kootenay National Park, but is beyond the scope of this study.
- Planning for wolverine is very difficult. Maintaining low development densities along Highway 95 north of Edgewater is likely the best option, but anticipated increased traffic volumes may preclude the best land-use planning and conservation initiatives.
- In many respects, wolverines are ecologically comparable to grizzly bears (large home ranges, avoiding human disturbance). Providing movement options for grizzly bears will likely also accommodate wolverine to a certain extent.

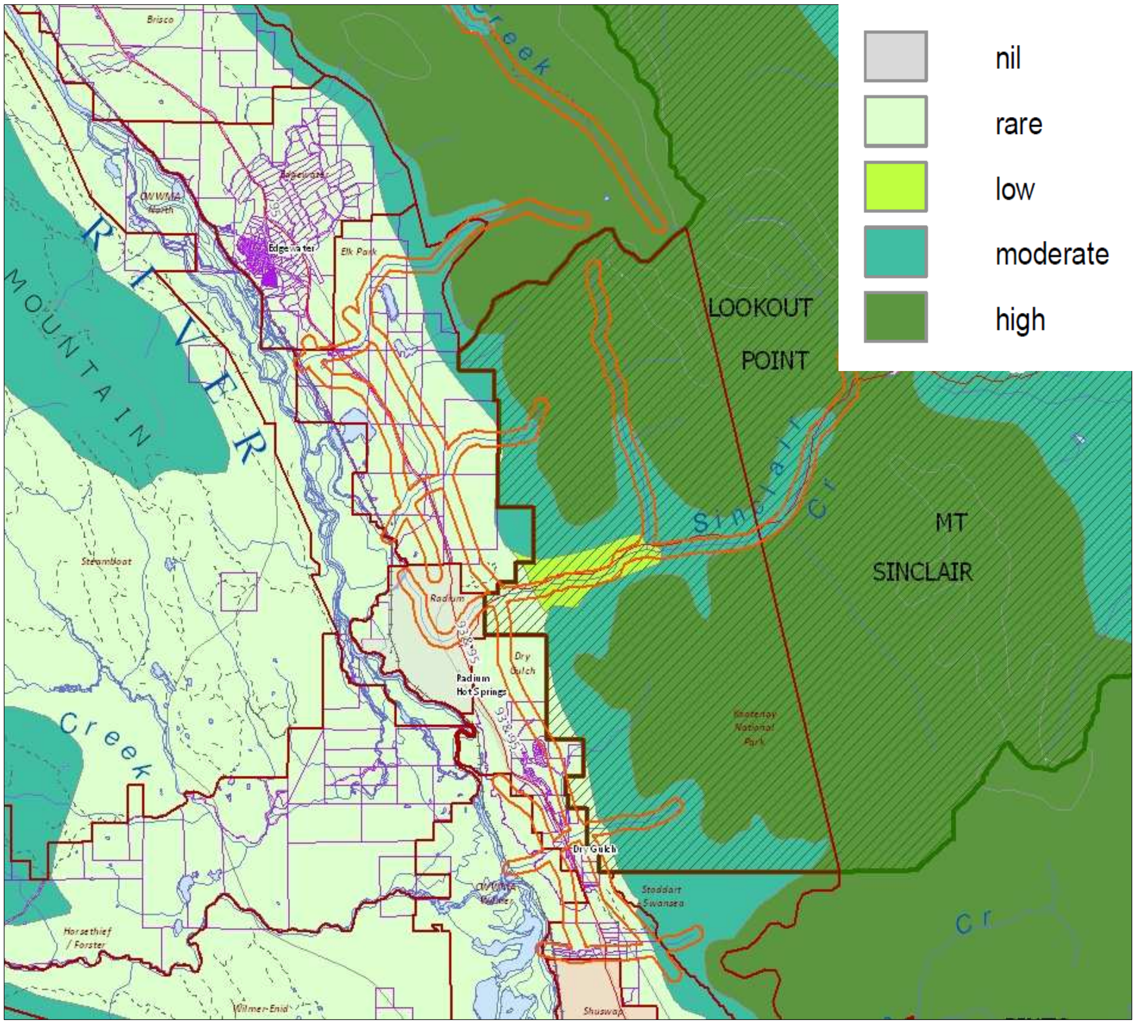


Figure 4: Wolverine habitat quality rankings (largely based on biogeoclimatic subzone boundaries, i.e. elevation) for the Upper Columbia Valley centred on the Stoddart Ck to Kindersley Ck study area. See Figure 6 for corridors outlined in orange. Source: Lofroth and Krebs (2007).

2.5 Grizzly Bear

- Key habitat features include river valley riparian zones, avalanche chutes and fire-generated berry patches – primarily huckleberry (*Vaccinium membranaceum*) and buffaloberry (*Shepherdia canadensis*), are also important and more widespread (McLellan and Hovey 2001).
- Otherwise occur in a broad range of habitats and elevation
- Tend to avoid human habitation and high traffic roads or else habituate to human presence usually resulting in increased mortality (Gibeau et al. 2002).
- For mapping habitat Nielson et al. (2010) recommend modelling habitat based on known food resource distribution and seasonal diets that also incorporate regional patterns of mortality risk. This method may yield better results but is likely much more difficult / costly to construct.
- Nielson et al. (2006) also recommend a habitat model that includes spatial predictions of survival. Basic occupancy may include sink habitats (usually related to high human activity) counter-productive to overall conservation.

- Key habitat parameters[2] used by Apps et al. (2007) to model grizzly bear habitat include:
  - Elevation, slope, site productivity (site series), stand structure and vegetation classes, riparian features, security (as distance to human activity / roads).

Connectivity
- Corridors suitable to grizzly bears should deflect movements around communities such as Edgewater, Radium and Dry Gulch.
- Low elevation provisions for grizzly bear movements should be north of Edgewater where cross-Trench bottom movements can facilitate exchange between Rocky and Purcell mountains.

2.6 Badger

- An updated badger habitat suitability model is being developed by Parks Canada. This model is not yet available, so data presented here (Figure 5) are based on earlier work (Apps et al. 2002).
- Soils with positive associations include: glaciolactustrine and glaciofluvial parent materials, brunisols and regosols, soils with sandy loam textures and open range, agricultural habitats and linear disturbances (Apps et al. 2002)
- Prey availability is also important – primarily Columbian ground squirrels in East Kootenay.
- Connectivity habitat in Upper Columbia is primarily a north-south concern as badgers are mostly limited to lower elevations in the Trench.
- However they will move upslope, primarily along roaded corridors) to higher elevations and utilize early seral forest stands with abundant prey sources (T. Kinley, Sylvan Consulting, pers. comm.).

Connectivity
- The Lake Windermere OCP maps a badger movement corridor as a Development Permit Area. This jurisdiction is further south than the focus area for this phase of the project (Dry Gulch / Stoddart Creek north to Edgewater); see Figure 4 in Adams (2010).
- Main concern is north-south movement.
- Developments stretching from wetlands to mountain side present a key challenge (T. Kinley pers. comm.).

[2] Detailed model parameters used by Apps et al. (2007) are provided in that report as an appendix.

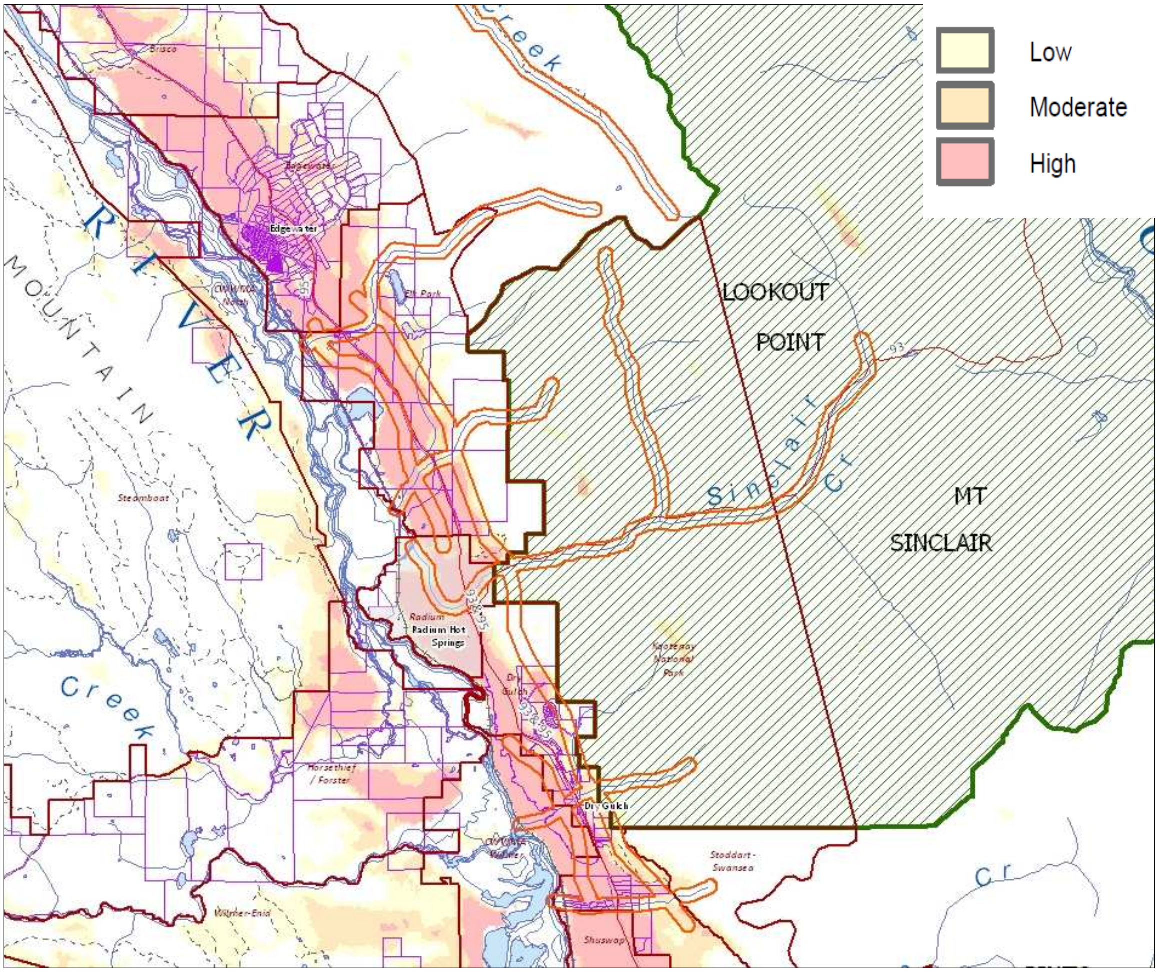


Figure 5: Badger habitat capability in the Upper Columbia Valley, centred on the Stoddart Ck to Kindersley Ck study area. See Figure 6 for corridors outlined in orange. Source based on Apps et al. (2002).

2.7 Grey Wolf

- Most work is from Rocky Mountain eastern slopes in Banff and Jasper National Parks.
- From Banff National Park (Hebblewhite & Merrill 2008):
  - Avoid steep slopes, selected use of hard edge, areas supporting higher ungulate forage;
  - Response at wolf-pack level: and
    - Variable response depending on where wolf pack is located;
    - Far from high human activity – response was random to human activity;
  - When forced to be close to high human activity – avoided daytime with resulting creation of 'attractive sinks' where wolves select areas close to humans for food reasons, but suffer higher mortality (usually shot) as a result.

- From Jasper National Park (Whittington et al. 2005):
  - Select areas with low elevation, flatter slopes and southwest aspects;
  - Use linear corridors as travel routes (see Callaghan 2002);
  - Opportunistically selected areas <25 m from road, trails, railway, especially low-use features, vs high use; but most movements occurred in forests, meadows, along waterways;

- Avoid areas of high road and trail density (>1.0 km / km^2); and
- Winter vs summer seasonality of movements – much more constrained in winter.

- Apps et al. (2007:24) summarize wolf habitat attributes as "relatively low elevation, flat terrain and proximity to both water and roads; security cover provided by closed coniferous forests may also be important".
- Key parameters used by Apps et al. (2007) include:
  - Elevation, slope, site productivity (site series), ungulate winter range, security (as distance to human activity / roads).

Connectivity

- Highly mobile species able to cross a wide variety of habitat conditions.
- As a species moderately tolerant of human activity, especially rural conditions, maintaining movement options is as much about where managers *do not* want wolves (i.e. keeping wolves away from areas of moderate to high human activity) as opposed to identifying corridor possibilities.
- Models developed by Apps et al. (2007) could be updated (if necessary) and applied to the Upper Columbia study area.

2.8 Note on Focal Species

Wildlife corridors are usually delineated and managed for target species. They can be single-species or for a suite of species that utilize the habitats within the corridor. The species indentified here are either listed species at risk or key local species.

The focus of this process has been on low elevation (below 1100m) lands within the Rocky Mountain Trench (Adams and Robinson 2009). Thus species such as wolverine, wolf and grizzly bear which are frequent wildlife corridor focal species has been greatly reduced. Maintaining broad scale opportunities for these species to move between the Rocky and Purcell Mountains is important for these populations, but unlikely to occur within the current study area between Stoddart and Kindersley Creeks (but see Section 3.2 Dry Gulch corridor below).

Birds are the most common species at risk in the East Kootenays. However, most listed avian species in the East Kootenay have habitat quality and quantity issues rather than connectivity issues: habitat loss rather than habitat fragmentation (see Fahrig 2003). Basic presence of corridors is not necessarily a suitable conservation tool to assist bird species, even forest birds that are hesitant to cross non-preferred habitat types (Hannon and Schmiegelow 2002; Grubb and Doherty 1999; Desrochers and Hannon 1997).

The two bird species discussed here, Flammulated Owl and Common Nighthawk have conservation concerns, but their threats are not necessarily relieved by habitat connectivity, especially for nighthawks. Flammulated Owl threats are habitat-related (Cooper et al. 2005; COSEWIC 2001), but maintaining a connected network of preferred habitat types that links nesting territories is not necessarily a benefit to the species. Recovery actions that may include habitat protection and enhancement should be investigated and pursued, but these species do not make good focal species for a regional habitat connectivity network.

Listed amphibians and turtles have been discussed previously during this planning process (Adams and Robinson 2009; Adams 2010). These species have limited terrestrial mobility so land-based corridor planning is of uncertain use. Note however, that, like birds, these species have significant habitat quality and quantity issues, but they are more insular in nature so connectivity of isolated populations or habitats is much more difficult and not necessarily required. Area-based conservation initiatives for these species may be more beneficial. These methods would ensure habitat patches are large enough to maintain species within them (Hager 1998).

Of the species discussed here, only badger and bighorn sheep have the most significant habitat connectivity issues at low elevations in the Upper Columbia Valley and future efforts should concentrate on these species. As typically grassland / open forest species, habitat restoration activities targeting these species should benefit numerous other species at risk (to varying degrees) in the East Kootenay (e.g. Long-billed curlew, Common Nighthawk, Lewis' Woodpecker, Sharp-tailed Grouse).

Although very high in public awareness, elk and deer (*Odocoileus* spp.) were not considered as focal species because of their very broad habitat preferences, particularly around human developments. Managed habitat corridors are generally not required to facilitate their movements.

3 Corridors

The narrow width of the Rocky Mountain Trench limits north-south movement options in the Upper Columbia Valley near Radium Hot Springs. Particularly east of the Columbia River mainstem, valley bottom habitats are very limited between the wetlands and the steep west slopes of the Rocky Mountains. Corridor options are limited by terrain and current or proposed development.

Sections 3.1 through 3.12 outline twelve corridors between Stoddart Creek and Edgewater (Table 2, Figure 6; Figure 7). Points are provided for each corridor outlining:

- land ownership;
- age class groupings found in each corridor (Figure 1);
- leading forest stand species in each age class (Figure 2);
- the functionality of the corridor consisting of what focal species may utilize it and how useful the corridor may be, either based on its condition, location or other features;
- major impediments - key barriers that may limit the corridor's function;
- Other comments where necessary; and
- Aerial imagery captured from Google Earth© with corridor and private land layers. Most Google Earth images are credited to Parks Canada 2007 orthophotos. Note scale (lower left corner) and orientation (north arrow in upper right corner) change significantly for each corridor. Images are presented here for basic overview of where the corridor is. More detailed examination of these areas is highly recommended within Google Earth[3].

These corridors were primarily identified by Tremblay (2001) but some have also been identified elsewhere (Dibb 2007; Adams 2010). Their graphical representation here (Figure 6) is meant for discussion purposes only. The layer mapped in Figure 6 was generated by either following creeks or approximating previously identified corridors (e.g. upper and lower benchland corridors) by hand within ESRI's ArcMap© software. These hand-drawn lines were then arbitrarily buffered 150 m on either side (total width = 300 m) throughout. This simplistic step is useful for the purposes of identifying habitat types and impediments within the corridor, but should not be taken as definitive boundaries of proposed corridors. Widths should not be fixed at any distance; the 300 m width used here is entirely arbitrary and not based on previous precedence. Locating many corridors in valley bottoms following creeks is not necessarily the optimal location. In some cases, species may prefer to move up and down valleys above the valley bottom. Stands at low to mid-elevations on warm-side slopes (typically west- and south-facing) tend to be more open and easier to move through than valley bottoms along the creek (if present). When more detailed exanimation of corridor location takes place, many may be moved upslope. Example corridors include: Upper Sinclair, McKay, Kindersley and upper portions of McCauley, Geddes and Dry Gulch (T. Kinley pers. comm.).

[3] KMZ files that will project in Google Earth of the buffered corridor, study area block areas and RDEK's private land layer are provided as appendices to this report.

Other corridors may exist as well. For example, larger animals may traverse the ridge south of Mt. Berland between the main Columbia valley Trench and McKay Creek in Kootenay National Park (T. Kinley pers. comm.). A possible corridor for this area is outlined on (Figure 7) as well as sections on Upper Sinclair (Section 3.10) and McKay Ck (Section 3.11).

The environmental habitat values schedule from the Radium Hot Springs OCP (section 3.4) is included here because Radium represents a major impediment to north-south movements. Kootenay National Park abuts Radium along the Sinclair Creek valley, but terrain is much more rugged through Kootenay National Park than the relatively flat benchlands that characterize the townsite. Bighorn sheep easily move through the Radium townsite and the village should be considered semi-permeable to badgers.

There are no unimpeded north-south corridors through Radium Hot Springs for badgers. However, there are areas, mostly associated with The Springs golf course, that may facilitate their movement. Recent habitat restoration projects in the Redstreak campground to The Springs golf course have greatly improved open forest habitat conditions in this area.

Table 2: Corridors in the Upper Columbia that occur within the Stoddart Creek to Kindersley Creek study area. Although not a target species here, elk are cited here as a target species because they were prominent in work by Tremblay (2001) in identifying corridors in the Radium area.

Corridor	Source	Orientation	Species
Stoddart	Tremblay 2001	east-west	elk, badger?
Dry Gulch	Tremblay 2001 Adams 2010	east-west	badger,
Lower Sinclair	Tremblay 2001 Dibb 2007	east-west	sheep, badger
Village of Radium Hot Springs	Radium Hot Springs OCP	north-south east-west	permeable for: sheep, badger exclude: grizzly, wolf.
Geddes	Tremblay 2001	east-west	elk, badger
McCauley	Tremblay 2001	east-west	elk, badger
Upper Benchland	Tremblay 2001 Dibb 2007	north-south	badger, elk, sheep, grizzly bear? wolf?
Lower Benchland North	Tremblay 2001	north-south	badger, elk, sheep
Lower Benchland South	Tremblay 2001	north-south	badger, elk, sheep
Upper Sinclair	Tremblay 2001 Dibb 2007	east-west	sheep, wolf, grizzly, wolverine?
McKay	Tremblay 2001	north-south	grizzly, wolf, wolverine?
Kindersley	Tremblay 2001	north-south	grizzly, elk, wolf, wolverine?

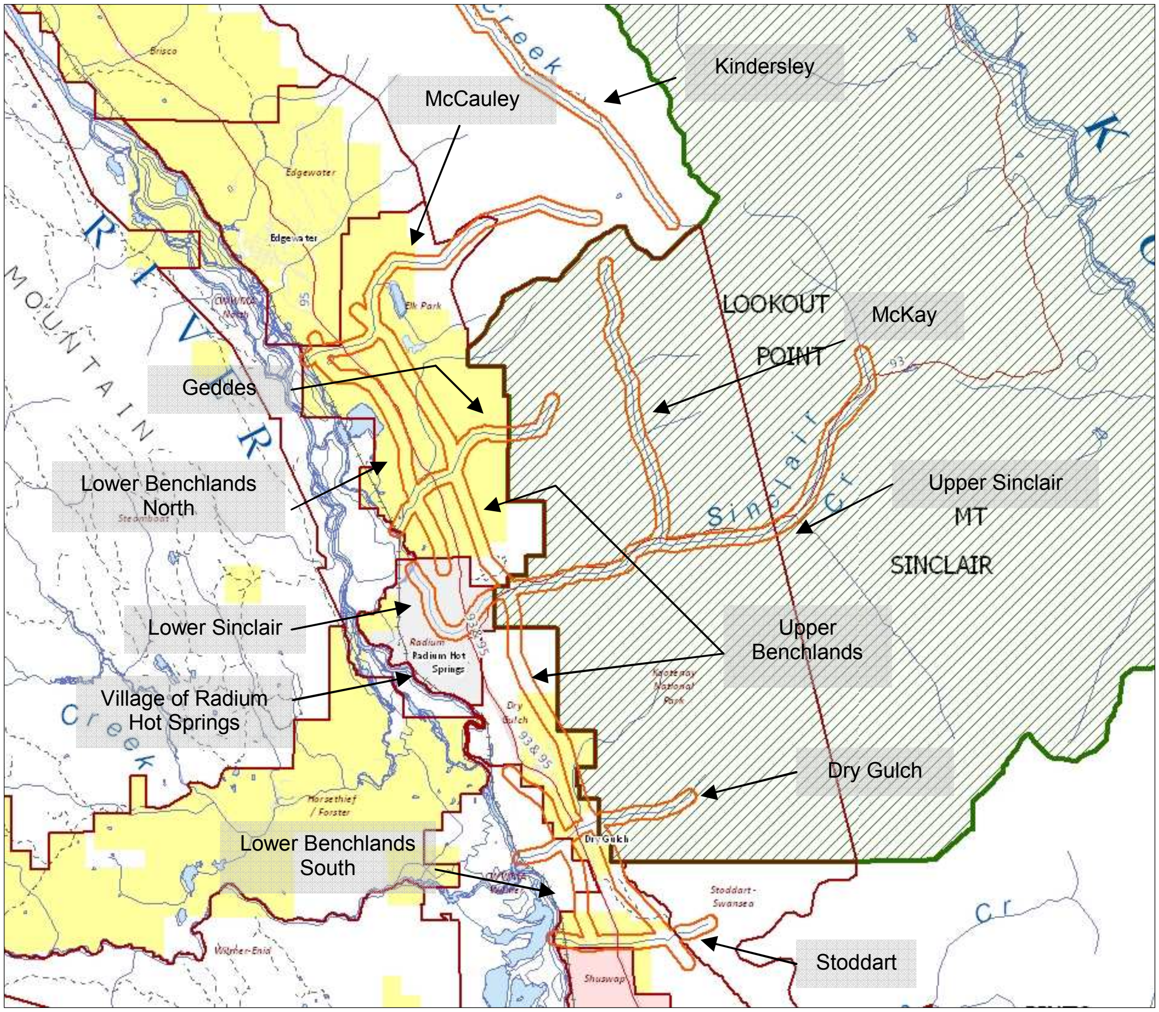


Figure 6: Location of conceptual corridors (outlined in orange) as 300 m width buffers following creeks (except Upper Benchland corridor which approximates Tremblay 2001). Yellow areas are private land.

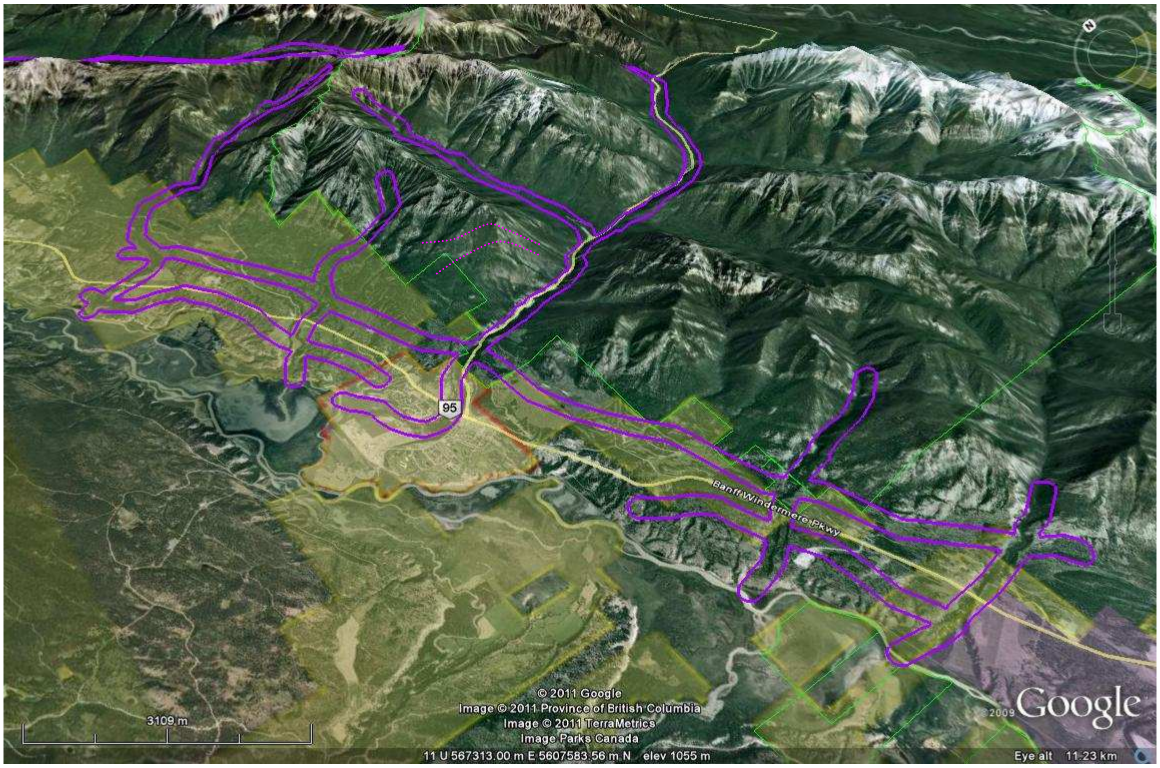
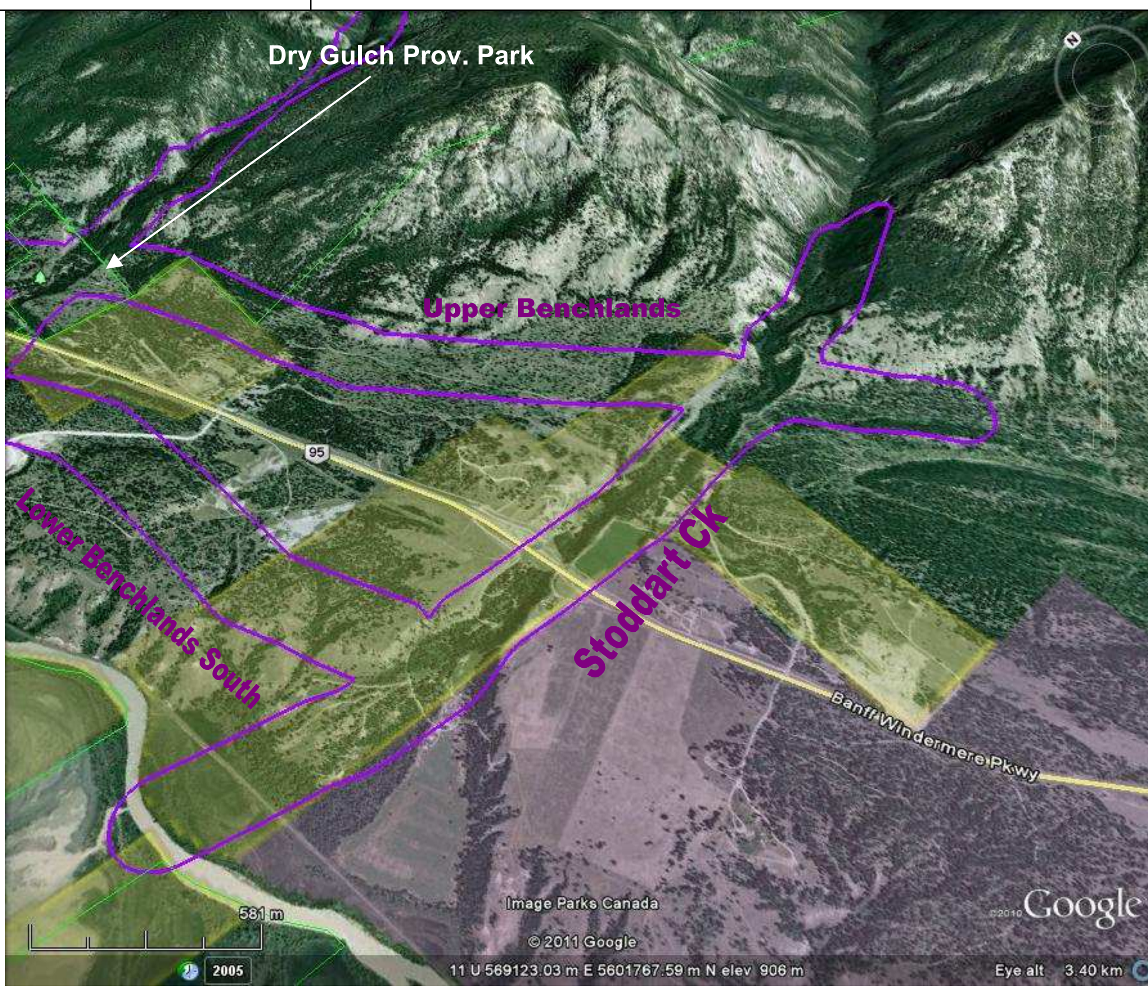


Figure 7: Overview of conceptual corridors in Upper Columbia Valley. Corridors outlined in purple / dashed pink; private land is shaded yellow; Shuswap Indian Reserve in lower right corner is shaded pink; Village of Radium Hot Springs is bounded by orange (by Hwy 95 marker) and shaded slightly lighter than surrounding private land. Green lines outline protected areas. Background image source: Google Earth. Note north arrow in upper right and scale in lower left.

3.1 Stoddart

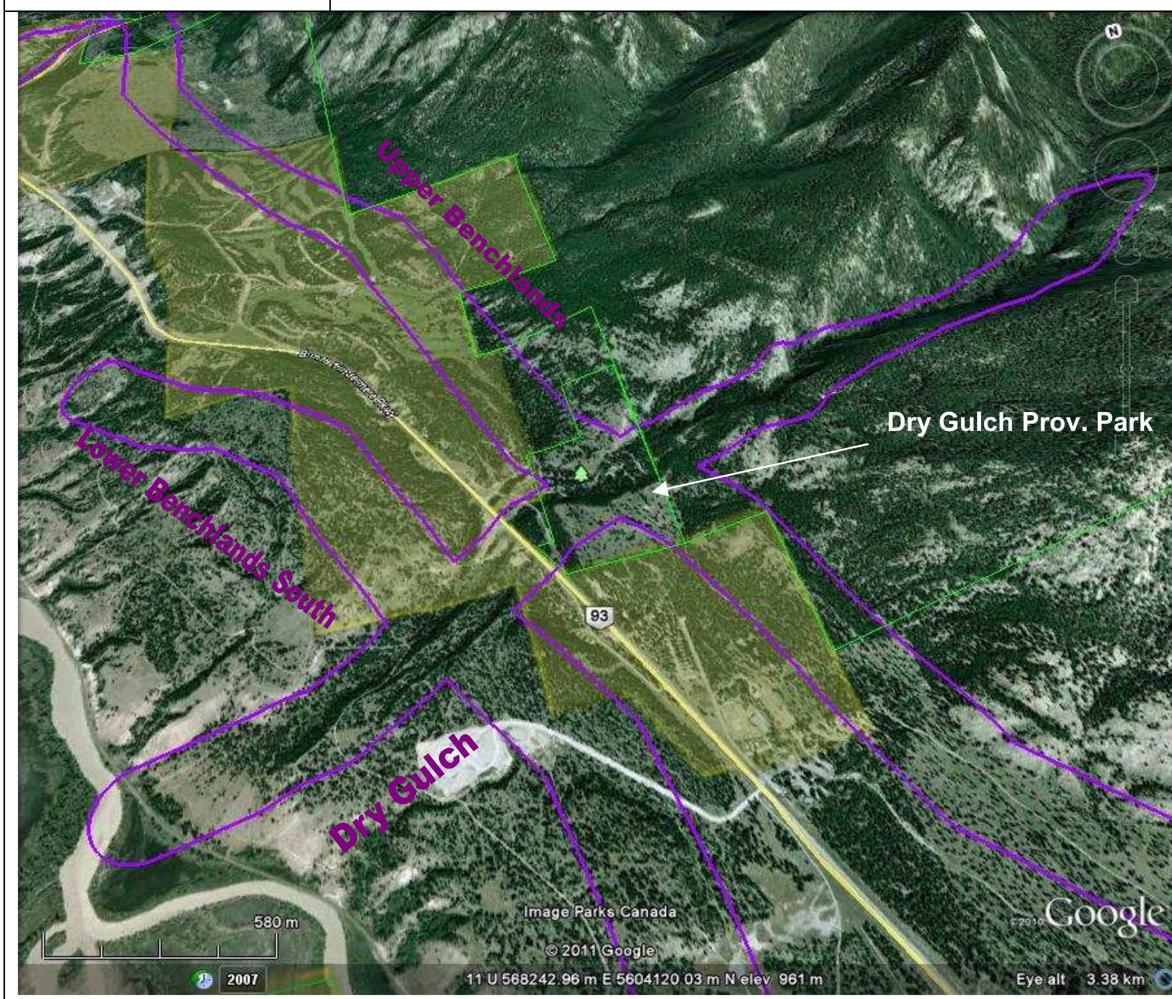
Land ownership	• private in lower reaches, crossing numerous small lots crown at higher elevations
Age Class	• where forested, mostly mature
Leading tree species	• primarily Douglas-fir, some hardwood at lower elevations, lodgepole pine higher up
Functionality as wildlife corridor	• most values are east of Hwy 93/95
Major Impediments	• multiple private land ownership will complicate restoration options west of the highway
Comments	• important connectivity to Shuswap Reserve lands to south (pink shade in image below)



Note: Corridors outlined in purple; private land is shaded yellow; Shuswap Indian Reserve is shaded pink, green lines outline protected areas. Background image source: Google Earth with north arrow in upper right and scale in lower left.

3.2 Dry Gulch

Land ownership	• National Park, Provincial Park, private, crown (WMA)
Age Class (see	• Primarily mature, some old stands in Dry Gulch Prov. Park
Leading tree species	• almost entirely Douglas-fir; some grasslands on south-facing slopes
Functionality as wildlife corridor	• Likely good for badger. Ability to function for other species is unknown
Major Impediments	• Development along Hwy 93/95 • very steep in some locations
Comments	• A narrow steep corridor through significant development that crosses a high traffic-volume highway. • However development is relatively concentrated to Hwy 93/95 corridor and this corridor offers the shortest distance between current protected areas (Columbia Wetlands WMA to Prov / National Parks)



Note: Corridors outlined in purple; private land is shaded yellow; green lines outline protected areas. Background image source: Google Earth with north arrow in upper right and scale in lower left.

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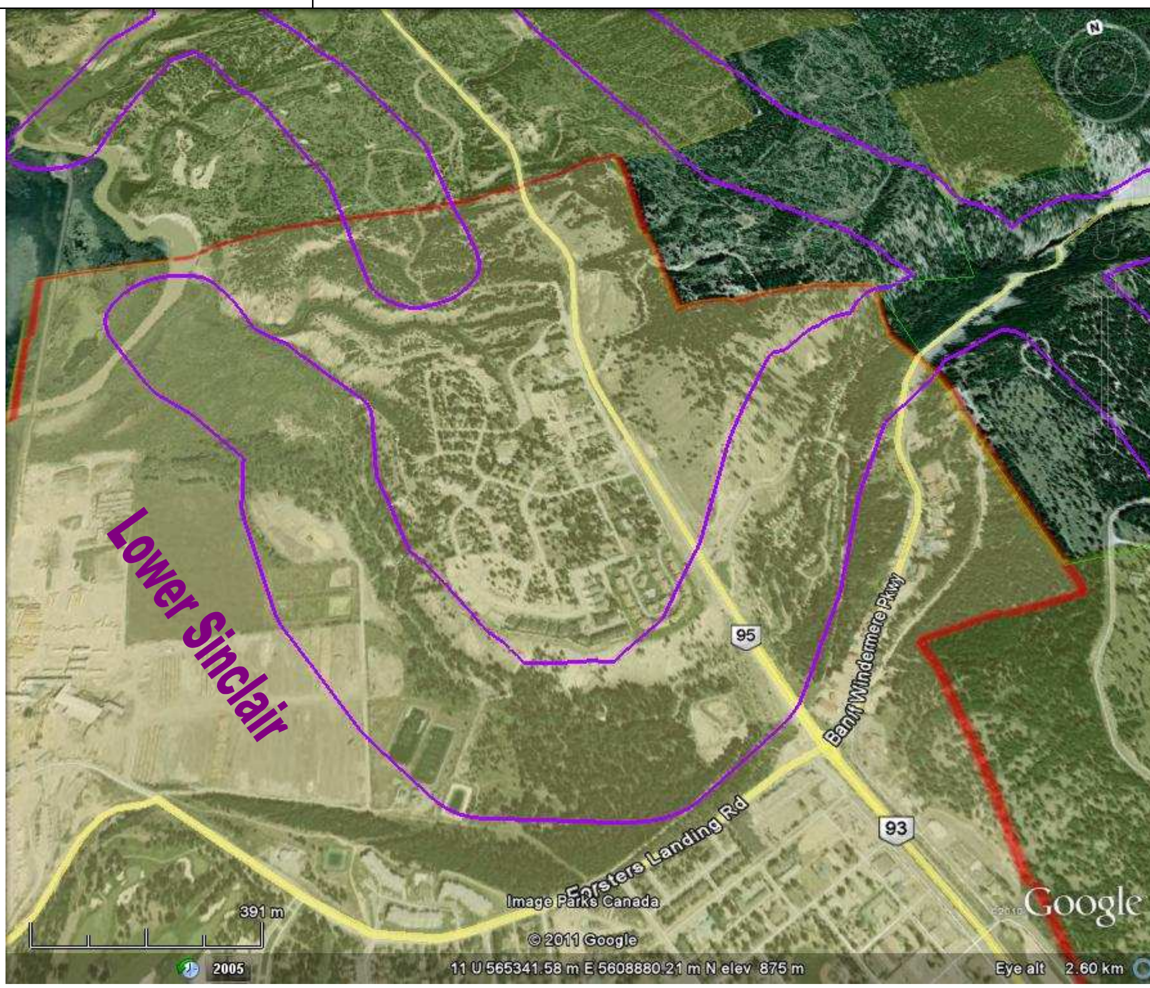
3.3 Lower Sinclair

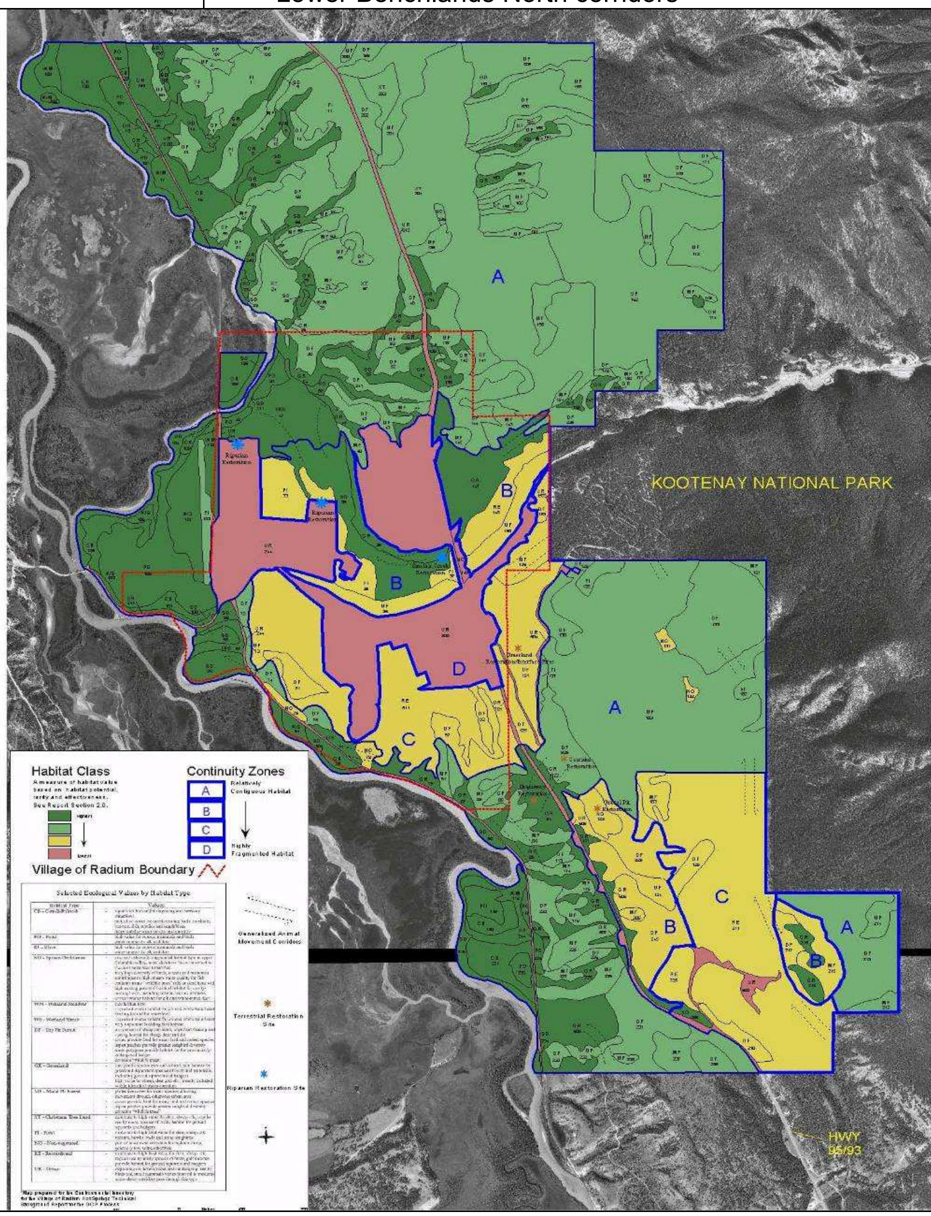
Land ownership	• private land within Village or Radium
Age Class	• where forested, mostly mature
Leading tree species	• Douglas-fir through most of Radium townsite; some hardwood near wetlands
Functionality as wildlife corridor	• through townsite, very limited functionality except for sheep; likely semi-permeable to badger
Major Impediments	• urban setting through townsite
Comments	• important to retain as much as possible of remaining functional habitat • In image below, Village or Radium Hot Springs outlined in orange



Note: Corridors outlined in purple; private land is shaded yellow; green lines outline protected areas; Village of Radium Hot Springs is bounded by red and shaded slightly lighter than surrounding private land. Background image source: Google Earth with north arrow in upper right and scale in lower left.

3.4 Village of Radium Hot Springs

Land ownership	• private land within Village or Radium
Age Class	• variable
Leading tree species	• Douglas-fir through most of Radium townsite; some hardwood near wetlands
Functionality as wildlife corridor	• through townsite, very limited functionality except for sheep; likely semi-permeable to badger, though potential mortality sink
Major Impediments	• urban setting through townsite
Comments	• important to retain as much as possible of remaining functional habitat • OCP Environmental habitat value ratings map • includes Lower Sinclair and parts of Upper Benchlands and Lower Benchlands North corridors



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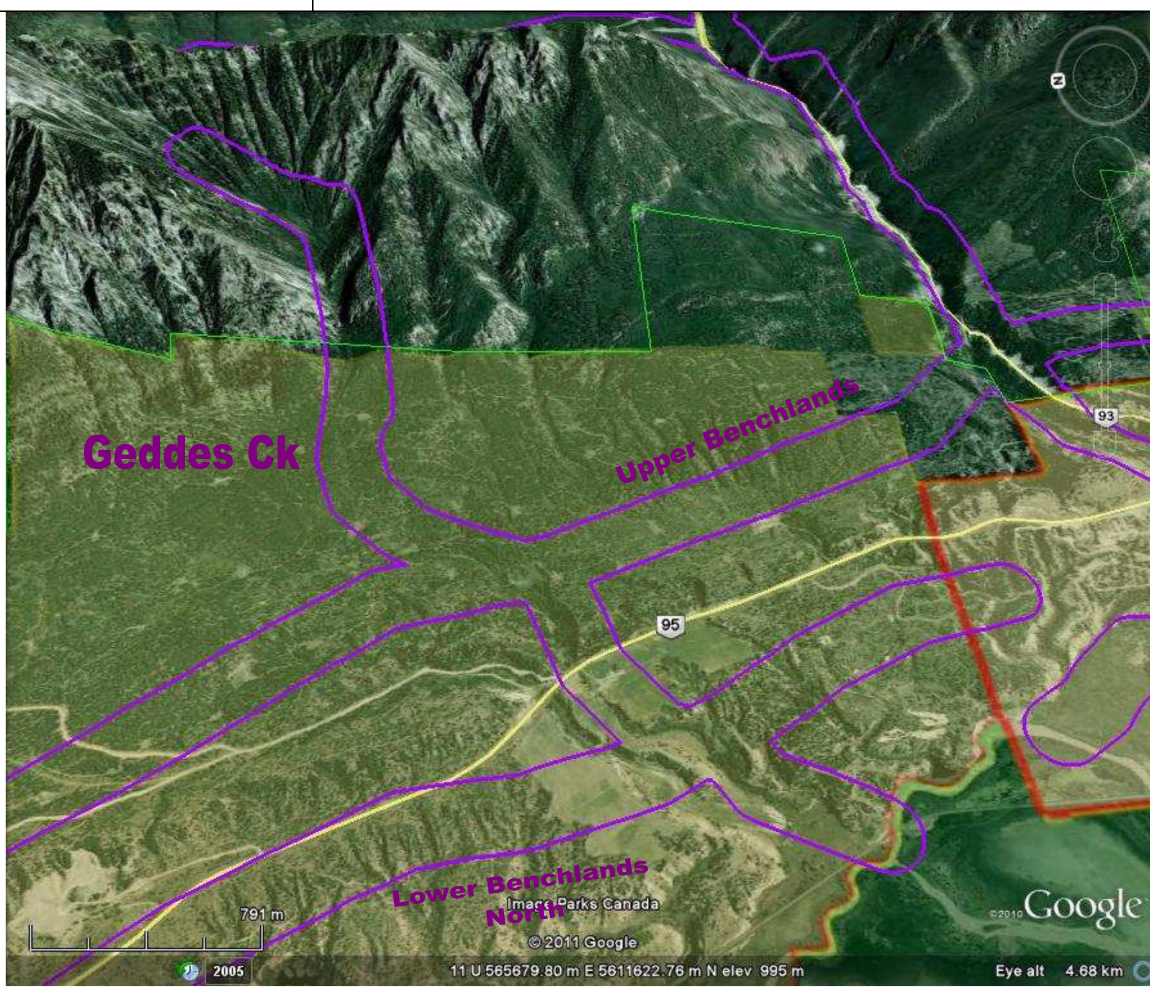
3.5 Geddes

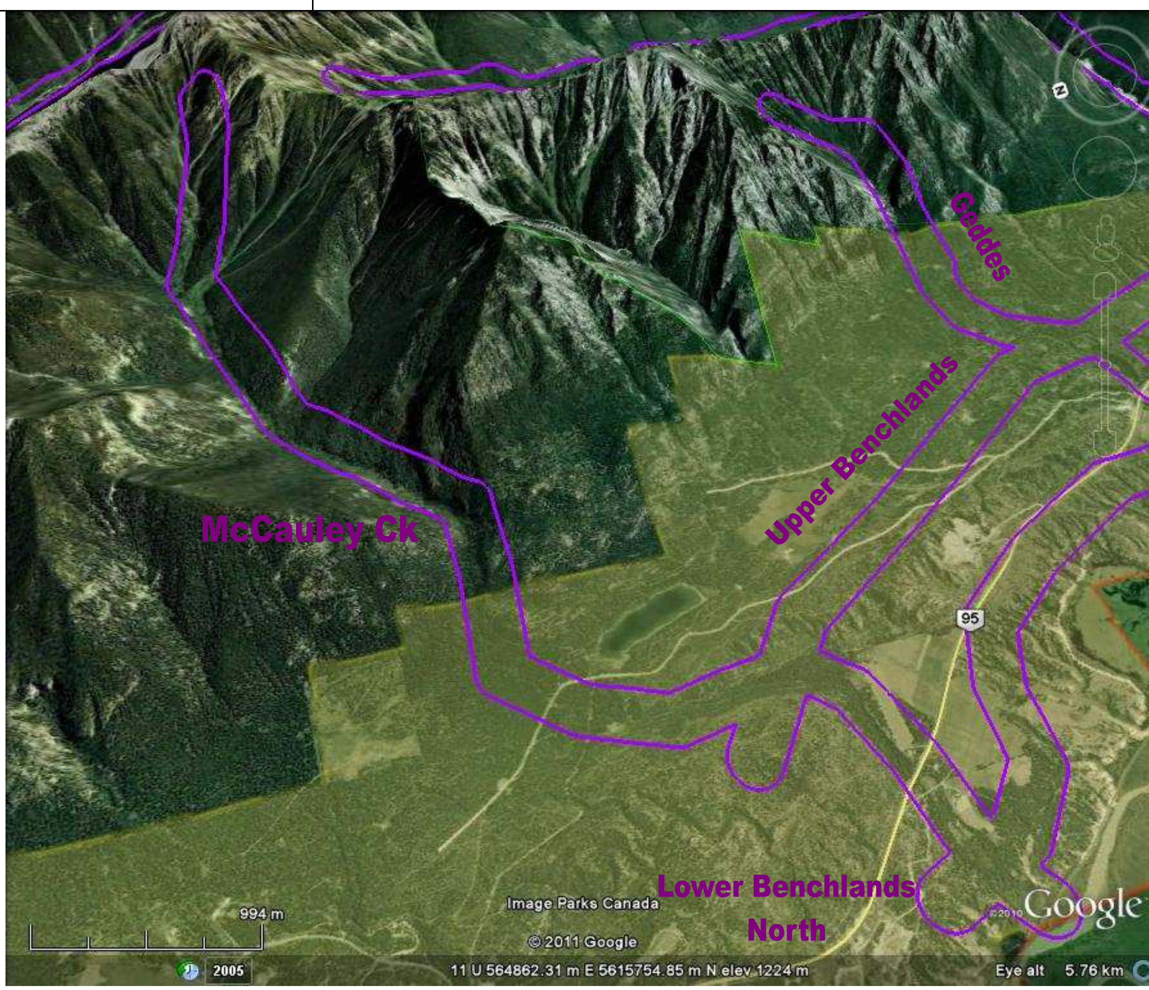
Land ownership	• private (large Elk Park Ranch parcels); headwaters in KNP
Age Class	• mostly mature
Leading tree species	• mostly Douglas-fir; spruce stand just east of Hwy 95; hardwood stand between Hwy 95 and wetlands
Functionality as wildlife corridor	• good opportunities east of Hwy 95, if ownership is cooperative
Major Impediments	• Hwy 95 crossing • Ranch development at Hwy 95 crossing
Comments	• relatively short corridor between wetlands and KNP. • development along 95 likely restricts movements • too close to Radium and Edgewater to manage as grizzly bear or wolf corridor



Note: Corridors outlined in purple; private land is shaded yellow; green lines outline protected areas; Village of Radium Hot Springs is bounded by orange and shaded slightly lighter than surrounding private land. Background image source: Google Earth with north arrow in upper right and scale in lower left.

3.6 McCauley

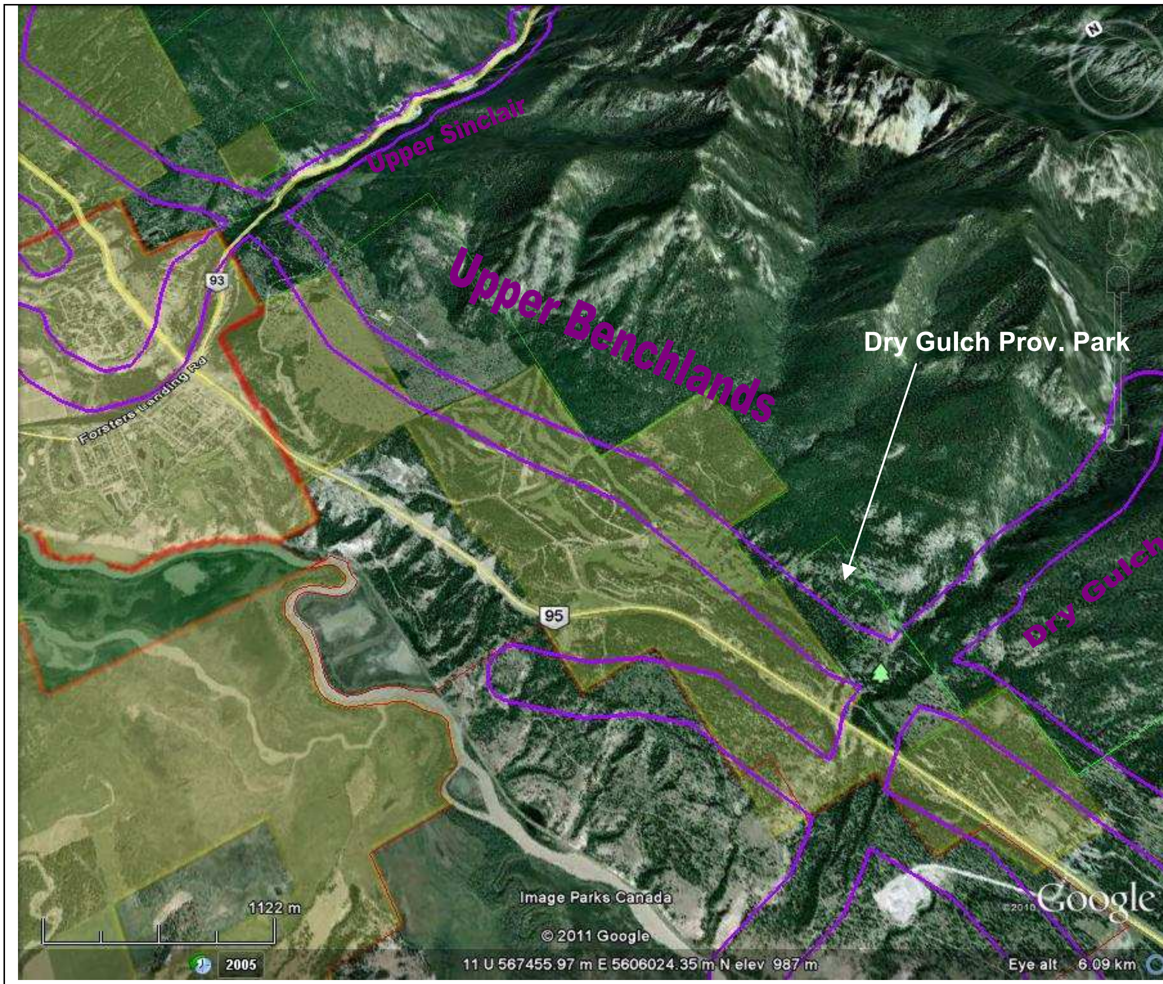
Land ownership	• private (large Elk Park Ranch parcels) at lower elevations; crown land higher up
Age Class	• mosaic
Leading tree species	• Douglas-fir; some hardwood and spruce stands in middle reaches; spruce and lodgepole pine stands at higher elevations
Functionality as wildlife corridor	• good opportunities east of Hwy 95, if ownership is cooperative
Major Impediments	• Hwy 95 crossing; • lower reaches are into "suburban" Edgewater
Comments	• similar to Geddes corridor, but longer. • Geddes corridor does not cross into Kootenay National Park



Note: Corridors outlined in purple; private land is shaded yellow; green lines outline protected areas. Background image source: Google Earth with north arrow in upper right and scale in lower left.

3.7 Upper Benchlands

Land ownership	• north of Radium – predominantly private (large Elk Ranch parcels) • crosses KNP around Hot Springs pools • south of Radium / Redstreak campground is crown land until Radium Resort • Numerous small private land holdings between Radium Resort and Dry Gulch Provincial Park • south of Dry Gulch Prov. Park, mostly crown land, except for Juniper Heights
Age Class	• broad mosaic
Leading tree species	• predominantly Douglas-fir
Functionality as wildlife corridor	• In places, highly functional but major impediments exist • Includes habitat restoration areas in Redstreak / Dry Gulch areas
Major Impediments	• Highway 93 and Hot Springs developments within KNP • Radium Resort golf course and surrounding housing • Dry Gulch developments • Juniper Heights
Comments	• long, primary north-south corridor in the area • ability to function as corridor along entire length is doubtful • in map below, Radium boundary is in orange



Note: Corridors outlined in purple; private land is shaded yellow; green lines outline protected areas; Village of Radium Hot Springs is bounded by orange and shaded slightly lighter than surrounding private land. Background image source: Google Earth with north arrow in upper right and scale in lower left.

3.8 Lower Benchlands North

Land ownership	between Edgewater and Radium – entirely private (predominantly Elk Ranch parcels, including proposed 'village' site)
Age Class	• broad mosaic
Leading tree species	• predominantly Douglas-fir
Functionality as wildlife corridor	• likely key for badger
Major Impediments	• Poor connectivity to the north – into Edgewater community • Developments (existing and proposed) within Elk Park Ranch • Canfor mill • Radium Hot Springs townsite • Highway 95
Comments	•

Note: Corridors outlined in purple; private land is shaded yellow; green lines outline protected areas; Village of Radium Hot Springs is bounded by orange and shaded slightly lighter than surrounding private land. Background image source: Google Earth with north arrow in upper right and scale in lower left.

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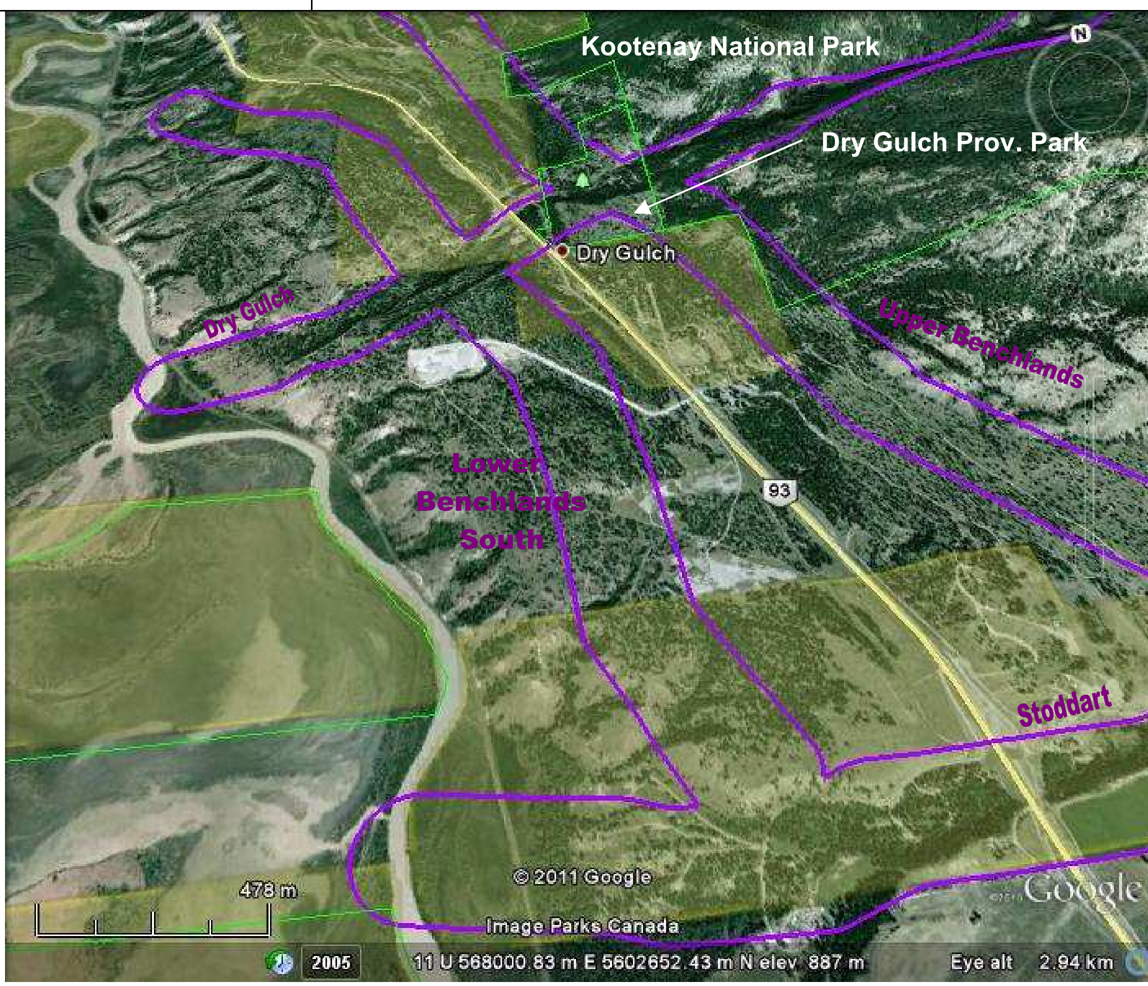
3.9 Lower Benchlands South

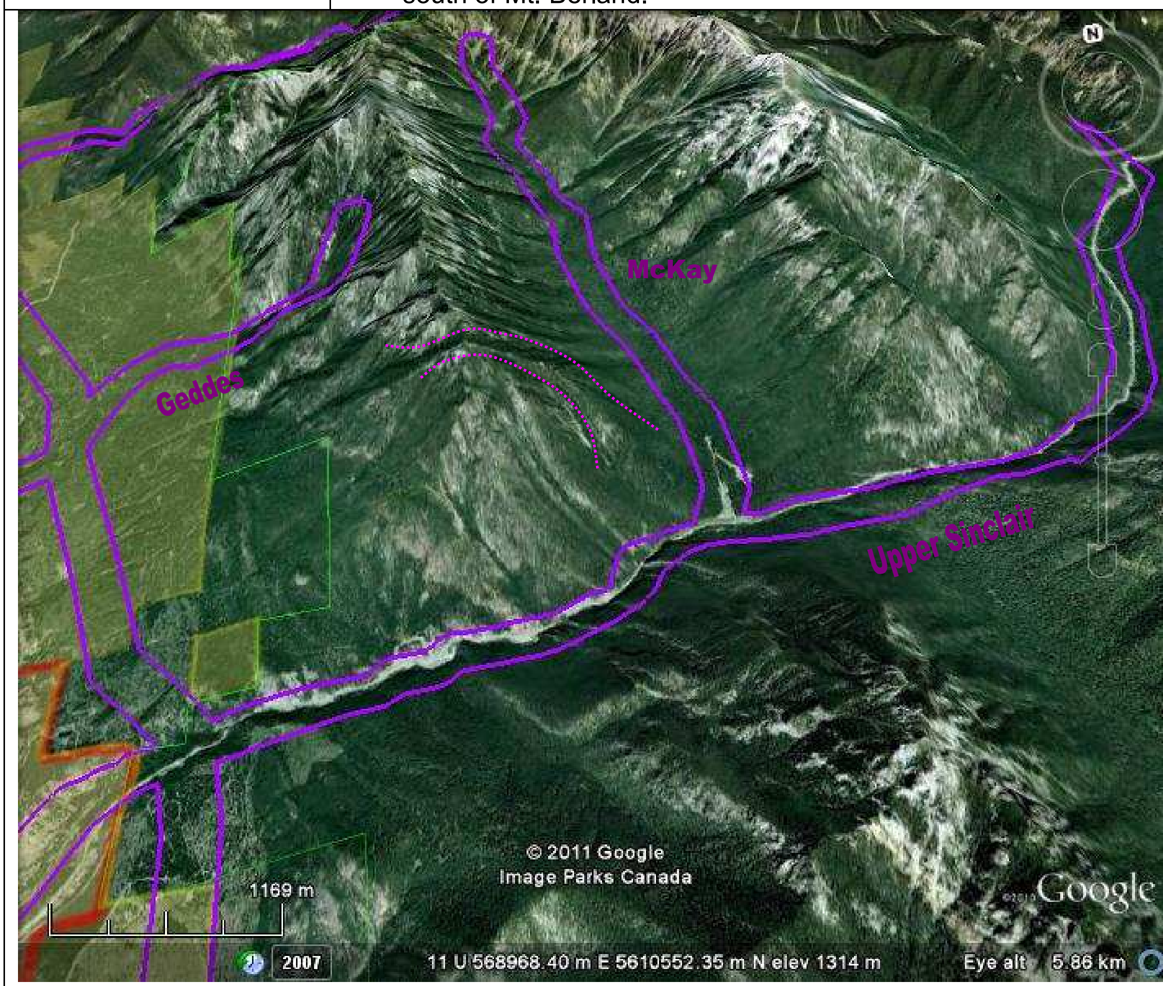
Land ownership	• mix of private land (mostly small parcels) and crown land; also some Columbia Wetlands WMA
Age Class	• mix of open grasslands and mature forest
Leading tree species	• Douglas-fir
Functionality as wildlife corridor	• likely some key areas for badger connectivity
Major Impediments	• south of Radium, either steep terrain down to wetlands or along Hwy 93/95 • at times very narrow width between Hwy 93/95 and steep drop to wetlands
Comments	• key connectivity to Shuswap Reserve lands to the south; provides link to Dry Gulch and into KNP, if highway crossing is facilitated



Note: Corridors outlined in purple; private land is shaded yellow; green lines outline protected areas; Village of Radium Hot Springs is bounded by orange and shaded slightly lighter than surrounding private land. Background image source: Google Earth with north arrow in upper right and scale in lower left.

3.10 Upper Sinclair

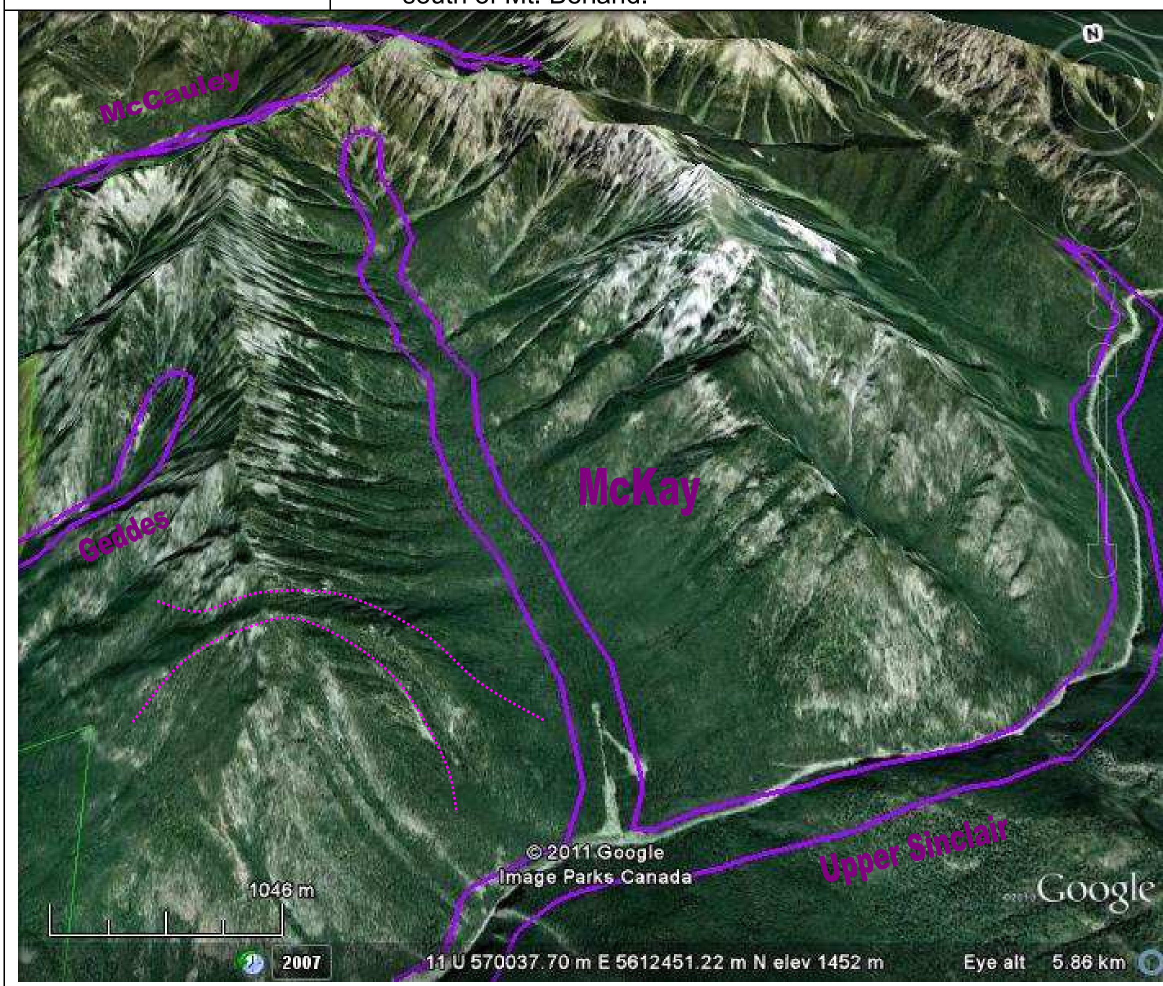
Land ownership	• National Park
Age Class	• mostly mature, some old stands, some unforested stands where creek is close to Hwy 93
Leading tree species	• Douglas-fir at lower elevations; some lodgepole pine and spruce at higher elevations
Functionality as wildlife corridor	• often steep-walled valley, function compromised by highway and traffic volume • bottle-neck at western boundary: canyon and development
Major Impediments	• strongly limited by highway traffic; includes relatively high industrial truck volumes (log and ore hauling)
Comments	• important linkage between Upper Columbia and Kootenay valleys • Dashed pink line corridor is a potential linkage over the ridge south of Mt. Berland.



Note: Corridors outlined in purple; private land is shaded yellow; green lines outline protected areas; Village of Radium Hot Springs is bounded by orange and shaded slightly lighter than surrounding private land. Background image source: Google Earth with north arrow in upper right and scale in lower left.

3.11 McKay

Land ownership	• entirely within KNP
Age Class	• mostly mature, some old stands
Leading tree species	• Douglas-fir; some spruce and lodgepole pine stands at higher elevations
Functionality as wildlife corridor	• suitable for wolf, grizzly and wolverine • connectivity from McKay headwaters into McCaughley, Kindersley and Sinclair Creeks is uncertain.
Major Impediments	• McKay compound and Hwy 93 at lower end of creek and confluence with Sinclair Creek. • Salt storage at Parks Canada McKay compound may act as attractant to ungulates (T. Kinley pers. comm.).
Comments	• likely low importance for wildlife in Upper Columbia • probably acts more as refuge for wolf, grizzly and maybe wolverine (at higher elevation). • Dashed pink line corridor is a potential linkage over the ridge south of Mt. Berland.



Note: Corridors outlined in purple; green lines outline protected areas. Background image source: Google Earth with north arrow in upper right and scale in lower left.

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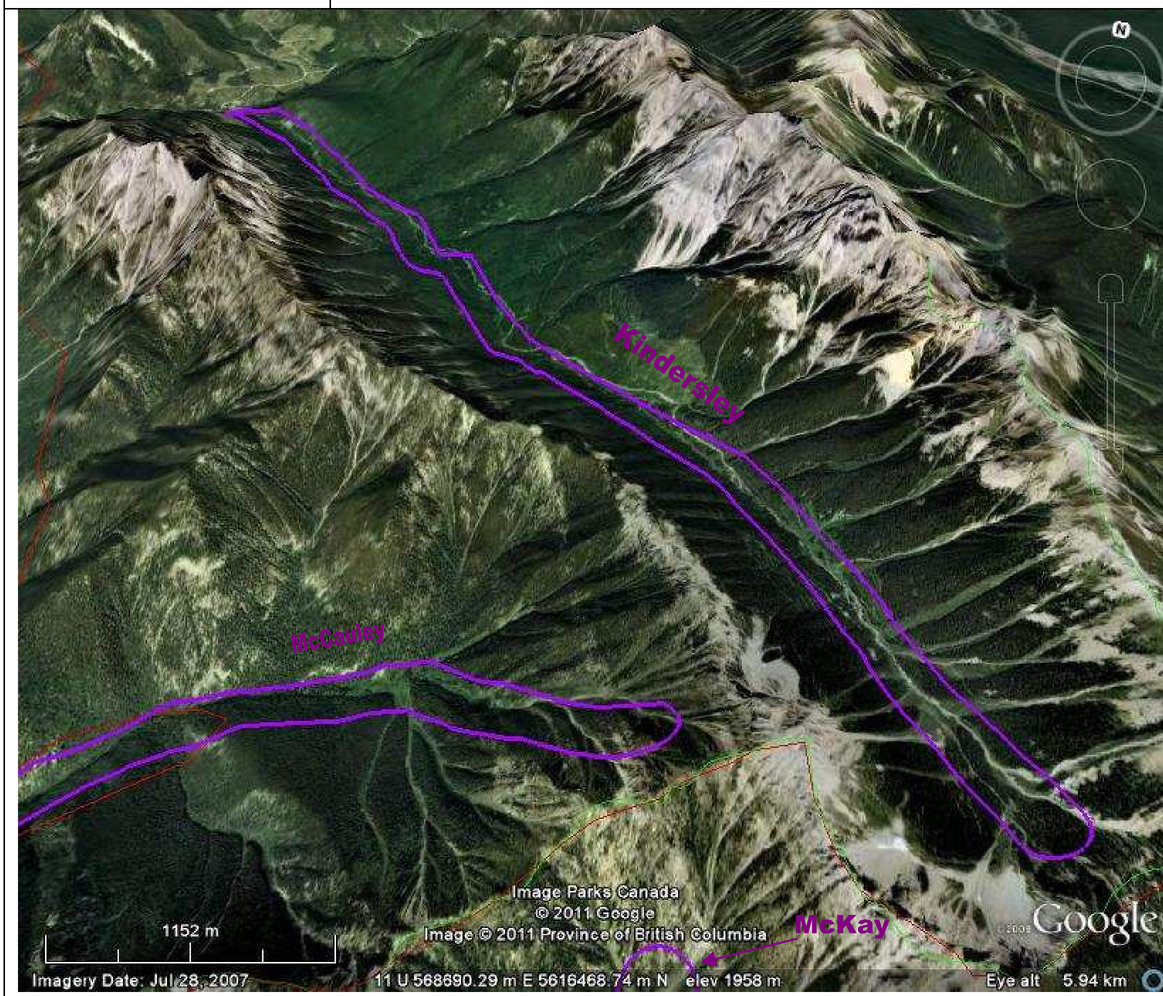
3.12 Kindersley

This creek is outside current patch boundaries for this project, but was identified by Tremblay (2001) as a key corridor, especially for grizzly bear.

Land ownership	• provincial crown land
Age Class	• mostly old and mature in headwaters – need to check on current forestry activity
Leading tree species	• spruce, sub-alpine fir
Functionality as wildlife corridor	• likely very good for grizzly bear, good connectivity into KNP (upper Sinclair Creek)
Major Impediments	• few – forestry developments
Comments	• key grizzly corridor to access Trench bottom north of Edgewater



Note: Corridors outlined in purple; green lines outline protected areas. Background image source: Google Earth with north arrow in upper right and scale in lower left.

3.13 Corridor Rankings

This report has outlined numerous corridors proposed or identified for the east side of the Upper Columbia Valley between Stoddart Creek and Edgewater. Table 3 ranks these corridors according to capability, suitability and management priority.

Table 3: Proposed rankings for wildlife corridors in the Upper Columbia Valley between Stoddart Creek and Edgewater. *Capability* is defined as "an assessment based on of natural conditions, assuming minimal development or human disturbances." *Suitability* is defined as "an assessment based on current conditions and limitations." *Management Priority* represents the recommended prioritization of management actions / land acquisitions to maintain or enhance corridor function.

Corridor	Capability Ranking	Suitability Ranking	Management Priority
Stoddart	Moderate	Low	Low
Dry Gulch	Moderate	Moderate	High
Lower Sinclair	High	Low	Moderate
Village of Radium Hot Springs	Moderate	Low	Moderate
Geddes	Low	Low	Low
McCauley	Moderate	Moderate	Low
Upper Benchlands	High	Moderate	High
Lower Benchlands North	High	Moderate	Moderate
Lower Benchlands South	High	Moderate	High
Upper Sinclair	High	Moderate	Moderate
McKay	Low	Moderate	Low
Kindersley	Moderate	High	Low

4 Applicability of Upper Columbia to other Corridor Mapping Processes.

The situation in the Upper Columbia valley does not require data- and model-intensive processes used in corridor and connectivity initiatives elsewhere (e.g. *Corridor Design*, see also Beier et al. 2008; D'Eon et al. 2002). This planning initiative is relatively simple in comparison to more complex situations in highly developed areas where small, isolated patches of often degraded habitats are attempted to be linked through a network of corridors.

In the Upper Columbia, there are several advantages to the current conservation situation which makes undertaking a full-fledged corridor planning exercise unnecessary (Table 4). The 'pinch-points' where linkages are required are known (see Adams 2010) and surrounding landscapes are relatively intact. Populations of large mammals (carnivores and ungulates) are perceived to be "healthy". Most conservation concerns surround species and habitats in the Trench (below 1100 m), thus the focus of this ongoing planning effort.

However, if a more scientifically robust method is desired for planning purposes, the process followed by Apps et al. (2007) for large carnivore planning in the Crowsnest Pass / Highway 3 area is recommended as providing the best value for a limited budget. The models are likely readily available and many of the parameters used for that process are directly applicable to the Upper Columbia. The shortcoming of this method is that it is single-species based, but this may not matter as much in the Upper Columbia.

A main objective of Apps et al. (2007) was to identify key north-south crossing areas for Highway 3; linkages between the Elk Valley to the north and upper Flathead to the south. In the Upper Columbia, between Canal Flats and Edgewater, there are limited options for east-west linkages across the Rocky Mountain Trench. Application of the suitability-based modeling approach of Apps et al. (2007) would identify areas within those linkages that are not suitable habitat – targets for restoration or conservation land purchases. North of Edgewater, the Apps et al. (2007) approach is more consistent with the original objective: identification of key crossing areas and more applicable to species such as grizzly bear, wolf and wolverine.

More conservation concern surrounds north-south movements within the trench. The two focal species identified here are badger and bighorn sheep. There is likely sufficient information for both species to proceed with planning. Completion of the updated habitat model for badger should be a priority, as is obtaining the digital layers of bighorn sheep corridors identified by Dibb (2007). Having these two sources available as digital overlays is essential to planning for these listed species.

Table 4: Advantages and challenges facing habitat linkage planning in the Upper Columbia Valley.

Advantages	Challenges

• Small study area, largely surrounded by intact ecosystems
• Straight-forward conservation concerns:
  o ongoing development
  o inconsistent planning across numerous jurisdictions
  o in-growth and encroachment of grassland and open forest Trench habitats
• Surrounding populations of typical focal species (large mammals) are generally "healthy".
• Terrain constrains development; containing sprawl within definable limits.
• Though limited, existing options are obvious.
• Land conservation organizations actively prioritizing acquisition targets.
	• Limited budget
	• Most listed Species at Risk in the study area are not well suited to habitat linkage planning, i.e. fragmentation is not major threat to most locally listed species.
	• Within 'developable' area (i.e. Trench bottom), development is wide-spread along a north-south axis
	  o limited East-West movement options
	• High property values limit capacity of land conservation organizations.

5 Closure

Interior Reforestation Co. Ltd. trusts that this report satisfied your present requirements. Should you have any comments, please contact us at your convenience.

Interior Reforestation Co. Ltd.

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7 Appendices

7.1 VRI Maps

Accompanying PDF and ESRI shape files:

- Age class
- Leading Species

7.2 Conceptual buffer corridors

Accompanying KMZ (Google Earth projection) and ESRI shape files.

7.3 Study Area Blocks

Accompanying KMZ (Google Earth projection) and ESRI shape files.

7.4 RDEK Private Land Layer

Accompanying KMZ (Google Earth projection) and ESRI shape files. Note the KMZ file does not split private land into individual parcels. It breaks up contiguous blocks of private land which are separated by crown land. These divisions within the KMZ file ***do not*** represent any legal ownership or lot line boundaries.