REPORT

Environmental Impact Statement: Smith Creek Area Structure Plan

Submitted to:

Town of Canmore
902 - 7th Avenue
Canmore, AB

On behalf of:

Three Sisters Mountain Village Properties Ltd.

Submitted by:

Golder Associates Ltd.
2800, 700-2nd Street SW, Calgary, Alberta, T2P 2W2, Canada

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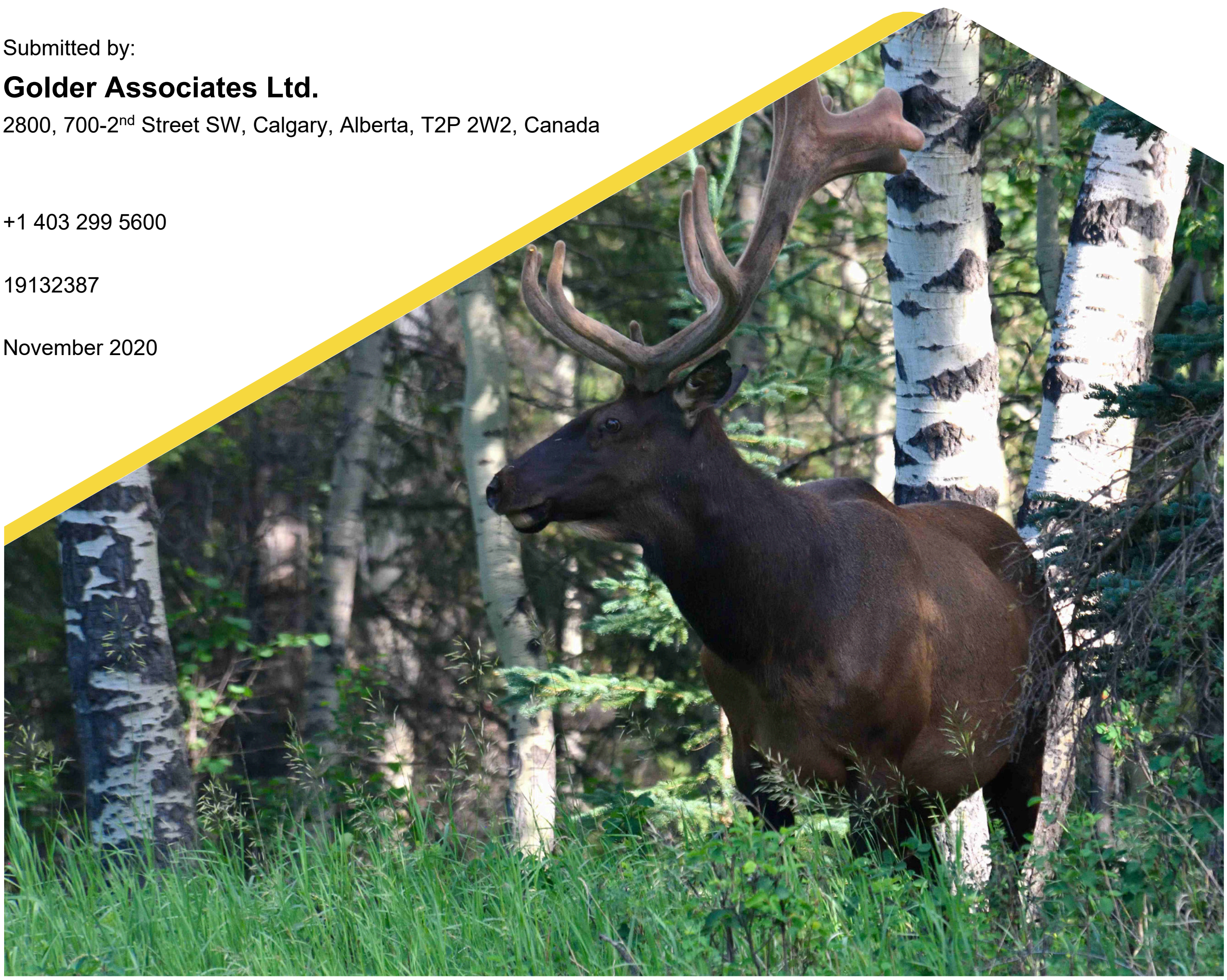
19132387

November 2020



Distribution List

1 Electronic Copy - Town of Canmore

1 Electronic Copy - QuantumPlace Developments Ltd.

1 Electronic Copy - Golder Associates Ltd.

Executive Summary

Introduction and Background

The Three Sisters Mountain Village (TSMV) property is located within the eastern boundary of the Town of Canmore (the Town). Development approval for TSMV property was granted by the Natural Resources Conservation Board (NRCB) through Decision Report #9103 released in 1992. The approval included developments such as golf courses, residential neighbourhoods and supporting commercial infrastructure. However, the Town of Canmore has planning authority regarding the “detailed timing and specific land uses and population densities” of the TSMV property. Development of TSMV properties thus far has generally progressed in stages from west to east and several residential and limited commercial areas have been developed.

The Smith Creek Area Structure Plan (ASP) (the Project) includes TSMV properties formerly known as Sites 7, 8 and 9, and the lands currently occupied by Thunderstone Quarries Ltd. On behalf of the current TSMV owners, Three Sisters Mountain Village Properties Ltd. (TSMVPL), QuantumPlace Developments Ltd. (QPD) is working to develop the Project, which will serve a local population and includes homes, a commercial component, a flex commercial-industrial district, open space, and a multi-modal transportation network. The overall ASP area comprises approximately 154 hectares (380 acres) of land. The Smith Creek ASP is being prepared pursuant to a collaborative ASP process between the Town and TSMVPL which began in 2015.

Purpose and Scope of the Environmental Impact Statement

The purpose of this Environmental Impact Statement (EIS) is to provide enough information about the potential environmental impacts of the Smith Creek ASP, and the proposed actions to mitigate adverse impacts, for Council to make an informed decision about the Project. The EIS was prepared to meet a Terms of Reference (TOR) issued by the Town after being reviewed by third-party reviewer hired by the Town to review the EIS. The goal of this EIS is to:

- outline existing conditions and identify significant natural and ecological features present in the vicinity of the Project
- determine the nature and scale of the potential impacts generated by the proposed Project prior to mitigation
- provide recommendations to avoid or otherwise mitigate these impacts
- identify residual impacts and their significance after implementation of proposed mitigation.

Following the TOR, valued environmental components (VECs) covering elements of biodiversity and the physical and social environments were assessed in the EIS. Specifically, VECs assessed included wildlife, vegetation, aquatic ecology, surface and bedrock geology, soils and terrain, surface and groundwater, air, noise, visual resources, historic resources, and land and resource use.

Because stakeholders were especially concerned about Project impacts on wildlife, particularly wildlife movement and negative human-wildlife interactions, the level of assessment for wildlife was greater than for other VECs. The focus on wildlife VECs is also reflected in the TOR for the EIS, which identifies several wildlife-specific analyses that must be included in the EIS.

Alternatives and Modifications

As required by the Town's EIS policy, alternatives and modifications to the Project and other design elements were considered to limit or remove impacts, prior to TSMV developing the final Project design proposed in the ASP. The alternatives analysis and consultation about alternatives with stakeholders, including the Town, residents, local environmental organizations, recreational enthusiasts, and community services representatives, was led by TSMV and considered a wide range of factors including environmental, social and economic.

The addition of residential, commercial, and light industrial development can induce changes to (i) the availability of native vegetation (i.e., habitat); (ii) wildlife use in designated wildlife corridors adjacent to the Smith Creek ASP (Along Valley, Stewart Creek Across Valley, and Pigeon Mountain Across Valley corridors); and (iii) human-wildlife conflict that result from increases in human-wildlife interactions.

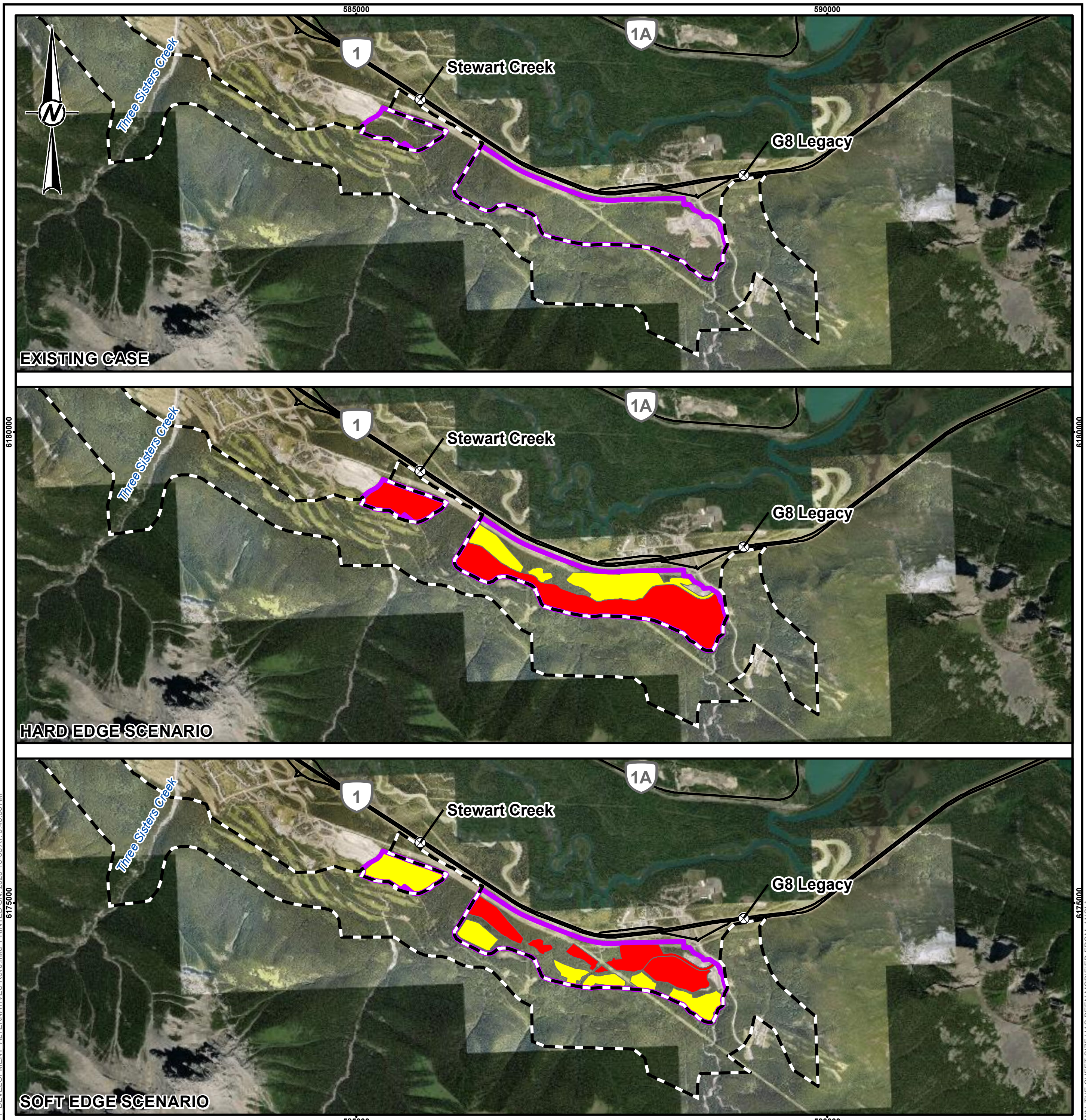
Two conceptual development scenarios were developed in consultation with the Town and the third-party reviewer (Figure E-1):

- **Hard edge scenario (development as a deterrent)** – Higher density development closer to wildlife corridors and lower density developments in the remainder of the ASP area. This scenario uses higher density development adjacent to wildlife corridors to reduce the potential for animals to enter the development and interact negatively with humans.
- **Soft edge scenario** – Higher density development in the northern part of the ASP area, lower density development along the southern edge. This scenario represents a typical soft edge development designed to increase the effective width of adjacent wildlife corridors.

Trade-offs between sensory disturbance in the wildlife corridor (i.e., reduced probability of selection) and negative human-wildlife interactions (i.e., whether developed areas are selected) for the two scenarios were evaluated for grizzly bears and wolves using resource selection function (RSF) models. Grizzly bears and wolves were selected for this analysis in consultation with the Town and the third-party reviewer. Grizzly bears were selected because they do not strongly avoid development and are a primary species of concern with respect to negative human-wildlife interactions, whereas wolves were selected because they are one of the most sensitive species to human development and are expected to be the species for which movement within wildlife corridors will be most strongly affected by a zone of influence around new development.

For grizzly bears, the effects of the two development scenarios changed predicted habitat selection patterns within the proposed Project ASP, but the development scenarios did not substantially change habitat selection patterns in the adjacent wildlife corridors (Figure E-2). Both scenarios increased the likelihood of negative human-bear interactions, but the magnitude of change induced by the soft edge scenario was predicted to be larger. A physical barrier, such as a fence that excludes wildlife from developed areas, is the most effective means of avoiding the increased risk of negative human-wildlife interactions, relative to existing conditions.

For wolves, the two development scenarios differed little in their effects on predicted wolf use within the Project ASP and both scenarios resulted reduced probability of selection within the wildlife corridors and habitat that was somewhat avoided under existing conditions was predicted to become strongly avoided habitat (Figure E-3). This effect was somewhat stronger in the hard edge scenario (Figure E-3).



LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- WILDLIFE CORRIDOR
- PROJECT BOUNDARY

PROJECT FOOTPRINT DENSITY

- HIGH DENSITY
- LOW DENSITY

0 1,000 2,000

1:60,000 METRES

REFERENCE(S)

1. IMAGERY COPYRIGHT © 20170115 ESRI AND ITS LICENSORS. SOURCE: TOWN OF CANMORE. USED UNDER LICENSE, ALL RIGHTS RESERVED.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	10/8/2020
DESIGNED	SM
PREPARED	AK/DA
REVIEWED	SM
APPROVED	KK

TITLE

CONCEPTUAL DEVELOPMENT ALTERNATIVES

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	E-1

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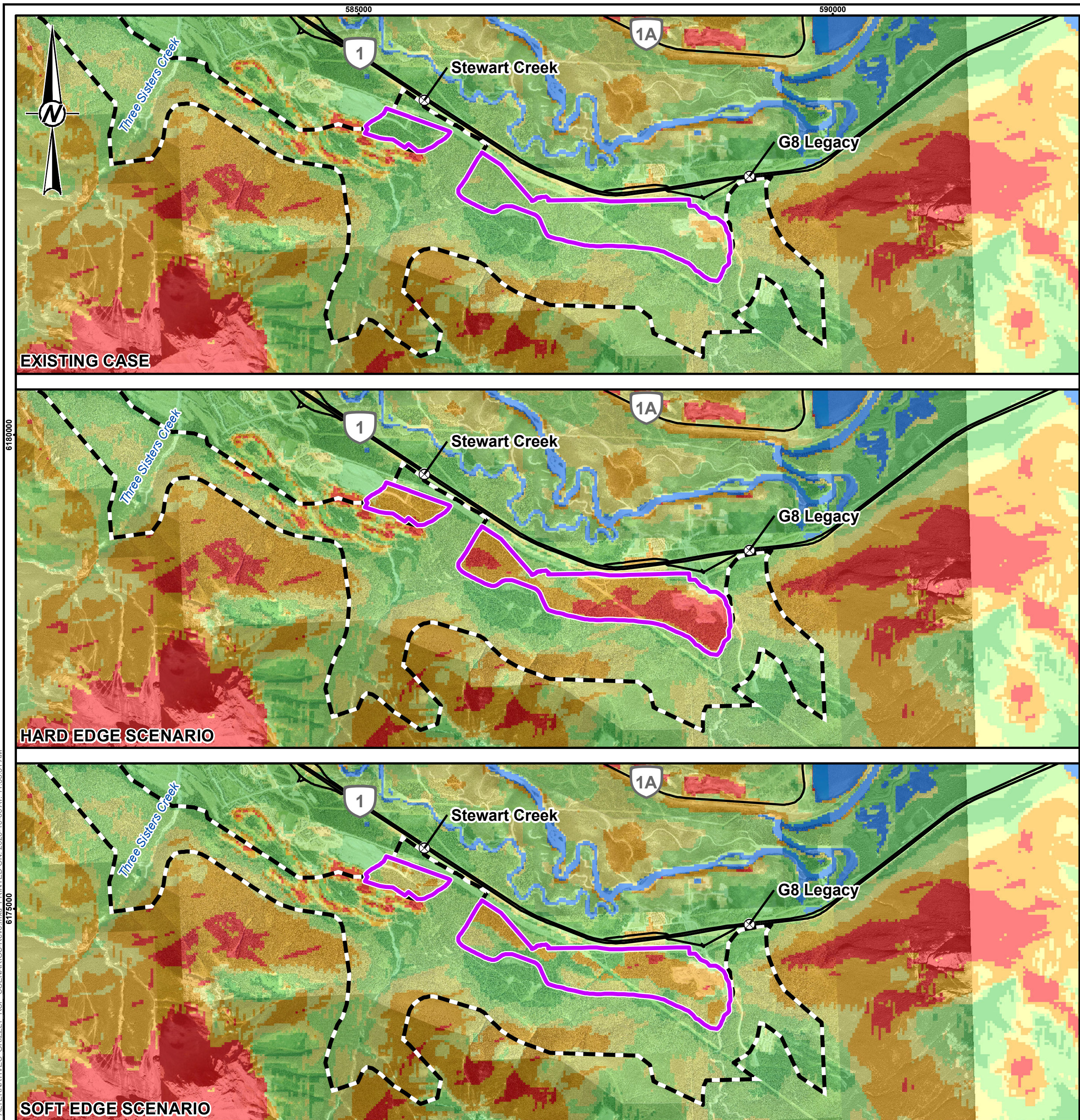

LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 1,000 2,000

1:60,000 METRES

REFERENCE(S)
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2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

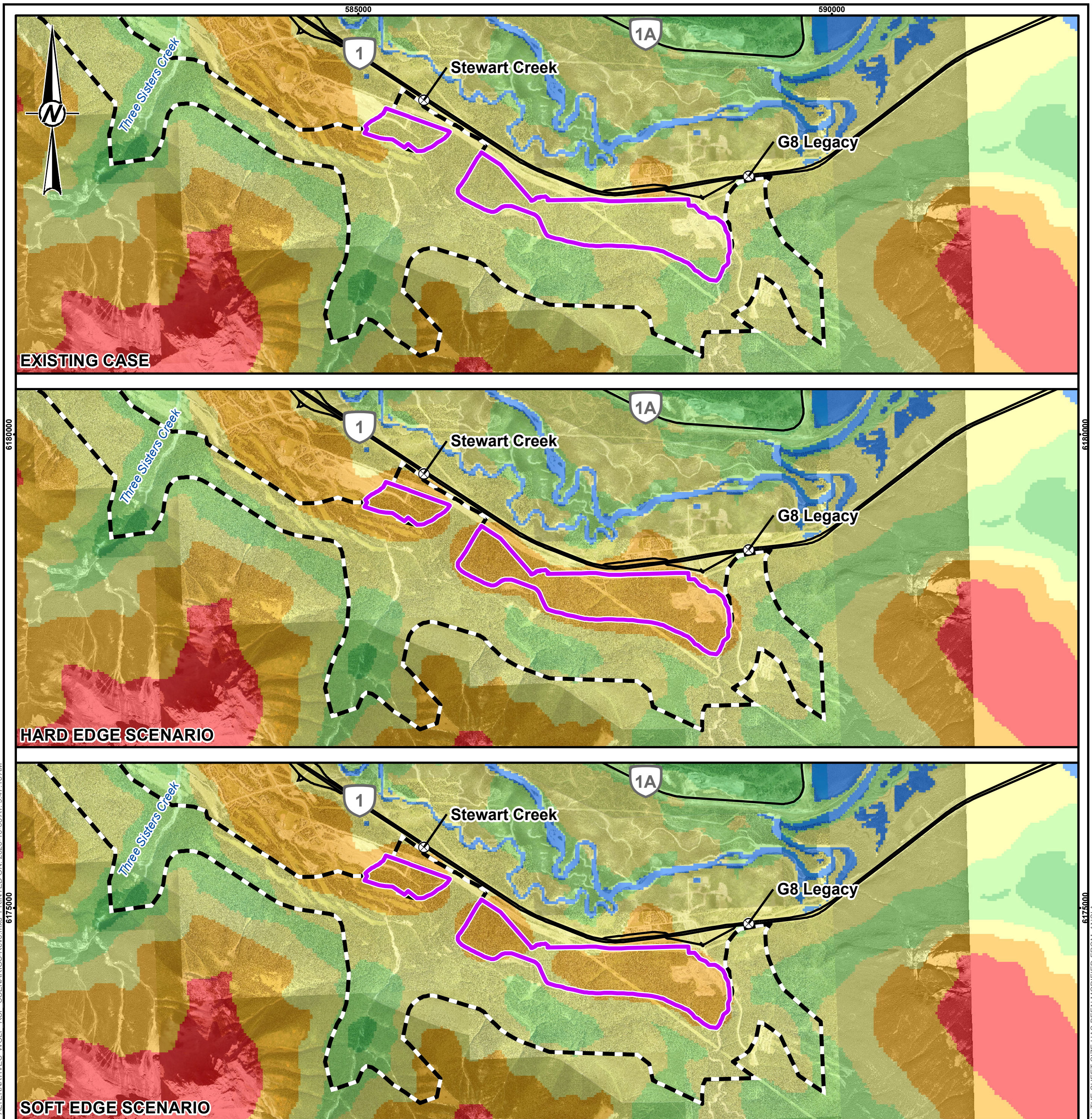
CONSULTANT
GOLDER

YYYY-MM-DD	10/6/2020
DESIGNED	KK
PREPARED	DA/AK
REVIEWED	SM
APPROVED	KK

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE
SUMMER GRIZZLY BEAR RESOURCE SELECTION UNDER DIFFERENT DEVELOPMENT SCENARIOS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	E-2



LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 1,000 2,000

1:60,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	10/8/2020
DESIGNED	KK
PREPARED	DA/AK
REVIEWED	SM
APPROVED	KK

TITLE

WINTER WOLF RESOURCE SELECTION UNDER DIFFERENT DEVELOPMENT SCENARIOS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	E-3

Based on the scenario analysis, Golder provided the following key recommendations and observations:

- When comparing the soft edge and hard edge scenarios, the modelling results indicate that the small, incremental benefits of lower density development for reducing sensory disturbance to wolves in wildlife corridors are outweighed by the higher potential for negative human-wildlife interactions in developed areas for grizzly bears.
- If a physical barrier like a wildlife fence is put in place between people and wildlife corridors, lower density development can be placed next to wildlife corridors. In this case, the advantages of reduced sensory disturbance associated with lower density development can be achieved for species like wolves without increasing the risk of negative human-wildlife interactions for species like grizzly bears.
- Recreational activities such as off-leash dog use, hiking trails, cross country skiing, and mountain biking were proposed as possible activities that could occur within open spaces or recreation zones in the Project ASP. If the Project includes recreational activities in open spaces adjacent to the wildlife corridor, the modelling results and current conflict data support the requirement for a physical barrier to mitigate potential effects on wildlife.

Proposed Smith Creek Area Structure Plan

The proposed Smith Creek ASP defines a policy framework to inform development and guide future planning and development decision within the ASP area. The project boundaries (Figure E-4) include all or portion of:

- the area previously designed as the Stewart Creek Across Valley Corridor and exchanged for a new Across Valley corridor as part of the final TSMV wildlife corridor approval by the province
- Site 7, 8 and 9
- a parcel of land owned by Thunderstone quarry limited partnership Ltd. that currently contains an active rock quarrying operation

During the development of the Smith Creek ASP land use concept, QuantumPlace worked collaboratively with the Town and stakeholders to propose a cohesive land use concept and set of policies to shape the development of the Project to support the economy and social sustainability of Canmore as a whole. The discussions with the Town were focused on providing a central road through the ASP area to efficiently deliver transit and road access while being cognisant of topography and the desire to integrate development into the natural environment. For the Smith Creek Land Use Concept to change, the planning and engineering priorities established during the collaborative discussion for Smith Creek would have to change for an alternative development concept to have Administrative support from the Town of Canmore. Consultation about appropriate mitigation to protect the environment was also a major part of the ASP process.

Smith Creek is envisioned to become an established community in Three Sisters Mountain Village for residents living and working in Canmore. Smith Creek will serve Canmore by providing a variety of housing options and amenities with all the conveniences and services needed for daily living. Smith Creek will strengthen Canmore’s position as highly desirable place to live, work, play and raise a family. The proposed Smith Creek ASP is designed so that future developments support the Town’s vision to be socially diverse, economically active and environmentally sustainable.

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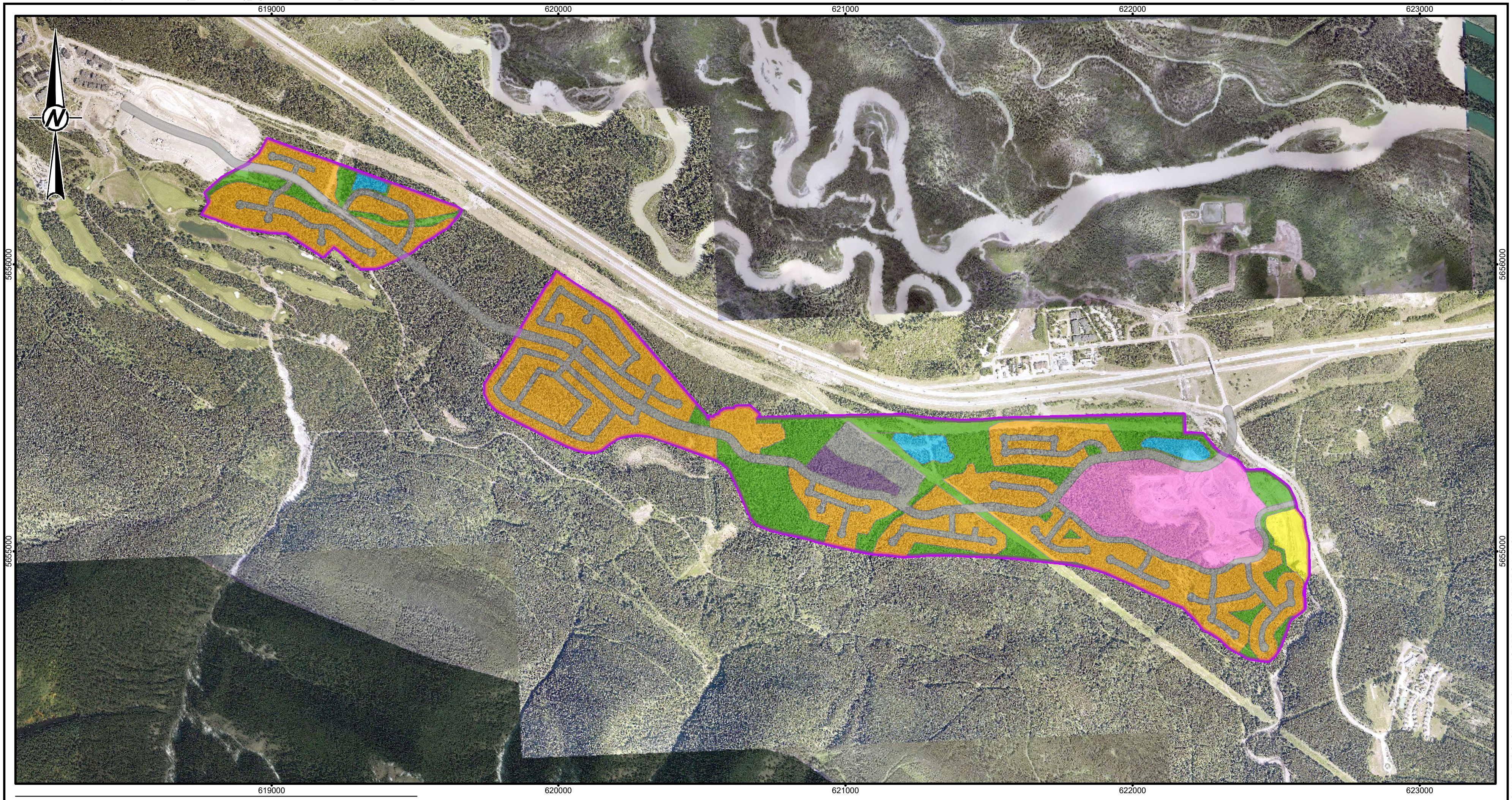

LEGEND

PROJECT BOUNDARY

PROJECT FOOTPRINT

COMMERICIAL

GREEN AREA

POND

RESIDENTIAL AREA

ROAD

SEDIMENT RETENTION AREA

SCHOOL

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-06
DESIGNED	KK
PREPARED	AK/DA
REVIEWED	SM
APPROVED	KK

TITLE

SMITH CREEK ASP LAND USE CONCEPT

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	E-4

Assessment Methods

The assessment considered three primary spatial scales:

- The Project Study Area (ASP area), which encompasses the 154 ha where the ASP land use concept's green spaces and built-up areas will occur.
- A Local Study Area (LSA) that encompasses 1,570 ha and includes the Project ASP, Stewart Creek ASP, Three Sisters Village ASP and adjacent wildlife corridors.
- A Regional Study Area (RSA) that encompasses 23,878 ha within the Bow River watershed between the east boundary of Banff National Park and Exshaw.

The temporal boundaries of the assessment extend from the late 1800s to 2055. This broad timeframe is considered so that the cumulative effects of previous, existing and future developments and disturbances can be assessed together. This cumulative effects assessment provides context to help define the importance of the incremental effects from the Project to VECs.

The assessment first describes existing conditions for each VEC to provide a baseline against which residual effects of the Project could be measured. Existing conditions represent conditions in the Bow Valley during 2016-2018 and are the outcome of past and present developments, human activities, and natural factors. Next, residual effects of the Project are predicted for each VEC. Residual effects are the incremental effects that the Project adds to existing cumulative effects, and are predicted using five sequential steps:

1) Identify environmental risks by assessing potential effects of the Project without application of mitigation.
2) Summarize relevant legislation that is in place to constrain potential adverse effects and outlines requirements requires that certain mitigation is applied.
3) Present mitigation measures to which QPD (on behalf of TSMV) has committed to as part of the ASP. Commitments include mitigation to comply with relevant legislation and additional mitigation to address important environmental risks identified in Step 1.
4) Predict and characterize residual effects after the application of mitigation:
    a) Describe assessment criteria, including context, direction, magnitude, geographic extent, duration, frequency, reversibility and probability of effects.
    b) Use weight of available evidence and professional judgement to determine environmental consequence (Table E-1) using logical reasoning. A high environmental consequence was associated with a serious risk[1], which is equivalent to a significant adverse effect. A precautionary approach was applied, such that adverse effects were overestimated where uncertainty was present.

[1] Using wildlife as an example, a serious risk would be any factor that puts the viability of a population inhabiting the RSA at risk. For instance, the loss of connectivity among habitat patches in the RSA or creation of a population sink for a particular wildlife species in the RSA through increased negative human wildlife interactions would constitute a serious risk.

Table E-1 Environmental Consequence Rating for Effects Assessment

Environmental Consequence	Definition
Positive	The Project results in a net benefit relative to existing conditions
Negligible	No detectible adverse change is expected relative to existing conditions
Low	Detectible adverse effect that does not compromise the integrity or function of the resource or population. The magnitude of change is small and is not expected to result in a serious risk to the resource or population, nor is it expected to contribute to a serious risk already present under existing conditions.
Moderate	Detectible adverse effect that does not compromise the integrity or function of the resource or population. The magnitude of change is medium or large but is not expected to result in a serious risk to the resource or population, nor is it expected to contribute to a serious risk already present under existing conditions.
High[(a)]	Effect is expected to pose a serious risk to the resource or population, or will contribute to a serious risk already present under existing conditions.

a) A high environmental consequence is equivalent to a significant adverse effect (CEAA 2015).

Finally, a cumulative effects assessment was completed for VECs for which Project related residual effects were predicted to have an environmental consequence greater than negligible. Cumulative effects were assessed at the RSA scale by adding the Project and other reasonably foreseeable development (RFDs) to the existing condition to predict a future outcome for VECs. RFDs considered in the assessment included developments such as Three Sisters ASP, Dead Man's Flats ASP, Silvertip Village and Silvertip Residential ASP, Upper Benchlands Residential, Peaks Landing, Three Sisters Gateway Commercial District, and various trail extension projects.

Biodiversity

The assessment's heavy focus on wildlife VECs meant that a substantial amount of quantitative data was considered in the assessment, including data from remote cameras, field studies, telemetry data from collared wildlife, empirical models of wildlife habitat selection including the influence of human use, and records of negative human wildlife interactions were combined with a review of literature, opinion of local wildlife experts, and information provided by the Town and Province to provide the foundation for the wildlife effects assessment. Other biodiversity features (e.g., vegetation, fish) were assessed using data from field studies and/or a review of literature and other available information sources.

Human use

An analysis of human use impacts on wildlife populations and habitats was required by the TOR and was central to evaluating the effects of the Project and cumulative effects on wildlife. Human use on recreational trails in the Bow Valley is high and has been increasing over time. Negative human-wildlife interactions have also increased over time in the Bow Valley and are highest in places where wildlife habitat overlaps with or occurs adjacent to human development. Undesignated trails are more common than designated trails in wildlife corridors in the RSA (i.e., 57.7 kilometres [km] of designated trail and 83.9 km of undesignated trail). Unsanctioned trail use in wildlife corridors is common because many residents and visitors appear to be unaware of the restrictions that apply in designated corridors (e.g., seasonal trail closures and prohibitions on undesignated trial use and off-leash dog use).

Within the LSA, human use (walkers and hikers) was highest in the corridors adjacent to the ASP and other approved wildlife corridors, while people on bikes were most common in the wildlife corridors west of the Project (i.e., not in the corridor area adjacent to the Project). Off-leash dogs were more commonly detected in corridors and other areas of the LSA other than the Project area. Greater human use in the corridors adjacent to the Project is associated with distance from urban developments. Most people accessing wildlife corridors, do so from adjacent development where they live or park their cars, as evidenced by a strong relationship between the amount of human use detected at a camera location and the distance of the camera from the nearest urban development. Cameras detected humans more frequently than wildlife in wildlife corridors, even though the rate of human detection decreases with increasing distance from the Town.

Grizzly bears

Grizzly bears are provincially listed as ‘Threatened’. They have a slow population growth; therefore, it takes more time for populations to recover after declines. The RSA is considered a population sink for grizzly bears under existing conditions because bears are exposed to high mortality rates. A serious risk is present in the RSA under existing conditions. With the addition of the Project, the following residual effects are expected for grizzly bears:

- A loss of 141.2 ha currently selected habitat is predicted within the ASP area due to development of the Project and installation of a wildlife exclusion fence. Habitat selection within the adjacent corridors was predicted to change slightly (a loss of 5 ha of selected habitat and a loss of 1 ha of used as available habitat). The loss of habitat will have a negative impact on habitat availability, but limiting grizzly bear access to the area within the fence will likely be beneficial for the grizzly bear population overlapping the RSA because the ASP area represents an ecological trap under existing conditions (i.e., the Project is predicted to have a positive outcome of reducing human-grizzly bear conflict). FireSmart measures implemented by the Town, the MD of Bighorn, and the Province could provide high quality habitat for grizzly bears away from zones of higher negative human-bear interactions, which could result in a net benefit to grizzly bears.
- Human use on undesignated trails is expected to decrease because of Project mitigation (e.g., education, wildlife fencing), which should positively influence bear use of wildlife corridors. The probability of grizzly bear selection in wildlife corridors adjacent to the Project is predicted to change little because of the Project, even if human use on designated trails increases.
- Fencing around the ASP area is predicted to substantially reduce the risk of negative human-bear interactions inside the ASP area. The risk of negative human-bear interactions is also predicted to decrease in adjacent wildlife corridors if people use recreational amenities envisioned for the Project. Effects of the Project are likely to be positive (i.e., reduction of negative human-bear interactions in the LSA). Overall outcomes for the grizzly bear population may be neutral at the RSA scale because of greater numbers of people in the RSA because of the Project.
- There is some uncertainty about predictions regarding grizzly bear use of wildlife corridors and negative human-bear interactions in wildlife corridors because these will depend on how people access the wildlife corridor and on the good behaviour of people in wildlife corridors. To be precautionary, the residual effects of the Project for these two effects pathways are predicted to be neutral relative to existing conditions.

- Environmental consequence of residual effects of the Project on grizzly bears are predicted to be low for loss of selected habitat, negligible for use of corridors, and, to be precautionary in the face of uncertainty, negligible for negative interactions between grizzly bears and people. Consequently, the Project is not expected to contribute to the serious risk identified for grizzly bears under existing conditions, and may have a net benefit because the serious risk identified under existing conditions is driven by negative human-bear encounters and bear mortality and mitigations associated with the Project could reduce these adverse effects relative to existing conditions.

Cumulative effects of the Project and other RFDs are expected to result in a high environmental consequence because these developments and activities contribute to an existing serious risk. The most important change is the increase in negative human-bear interactions, which increases grizzly bear mortality risk in the RSA. The contribution of the Project to these cumulative effects is predicted to be neutral or positive because of wildlife fencing and associated mitigations.

Cougars

The main source of cougar mortality (hunting) is managed to achieve a stable population in the RSA. Cougar densities within and surrounding the RSA are among the highest in the province. Therefore, the cougar population overlapping the RSA is likely self-sustaining and ecologically effective. With the addition of the Project, the following residual effects are expected for cougars:

- A predicted loss of 39.9 hectares (ha) of selected and 104.4 ha of used as available habitat, resulting in a small negative effect for cougars in the Project area. The adjacent corridor was predicted to gain 118.1 ha of selected habitat.
- The probability of selection is predicted to be higher for cougars in wildlife corridors adjacent to the Project after the development occurs, presumably because prey density is higher near development and in more open habitats (greater forest edge). However, it is uncertain whether prey density will continue to be relatively high near development after the construction of the fence. Applying a precautionary approach, the Project is predicted to have a neutral (versus positive) effect on cougar use of corridors.
- Fencing around the ASP area is predicted to substantially reduce the probability of negative human-cougar interactions inside the ASP area. The risk of negative human-cougar interactions is also predicted to decrease in the adjacent wildlife corridors if people use the recreational amenities envisioned for the Project and stay on designated trails in wildlife corridors. There is some uncertainty about whether this benefit will be achieved because it would depend on how people access the wildlife corridor and on the good behaviour of people in wildlife corridors. To be precautionary, the Project is predicted to have a neutral (versus positive) effect on human-cougar interactions.
- Environmental consequence of residual effects of the Project on cougars are predicted to be low (loss of habitat) to negligible (use of corridors and negative human-cougar interactions). Cougars are expected to remain self-sustaining and ecologically effective in the RSA as the Project is not expected to introduce a serious risk to the regional population.

Cumulative effects of the Project and other RFDs are expected to result in a low environmental consequence.

Wolves

Under existing conditions, it is uncertain if wolves are self-sustaining and ecologically effective due to the limited use of wildlife corridors and habitat patches and the unknown level of stability of the regional wolf population. Using a precautionary approach, a serious risk is identified under existing conditions. With the addition of the Project, the following residual effects are expected for wolves:

- No loss of selected habitat and a loss of 6.2 ha of used as available habitat within the Project area because of the development and exclusion fence. The change represents a small negative effect for wolves in the RSA.
- A predicted incremental decline in habitat quality in wildlife corridors (loss of 16 ha of used as available habitat and increase of 77.1 ha of strongly avoided) that could negatively influence wolf use in these areas.
- Wildlife fencing is predicted to have a positive effect by reducing the potential for wolf habituation and human-wolf interactions in the ASP area. Similarly, the potential for human-wolf encounters in wildlife corridors adjacent to the Project is predicted to decrease if people use recreational amenities envisioned for the Project. The Project is expected to have a neutral effect on human-wolf interactions because human-wolf interactions have not been a substantial concern in the Bow Valley under existing conditions.
- Overall, the small adverse effects of the Project are not predicted to change how wolf populations use or move through the RSA and are not predicted to contribute adversely to the potential serious risk identified for wolves under existing conditions. Environmental consequence of residual effects of the Project is predicted to be low (loss of habitat, use of corridors) to negligible (negative human-wolf interactions).

Cumulative effects of the Project and other RFDs are expected to result in a high environmental consequence because changes contribute to an existing serious risk for wolves in the RSA.

Elk

Elk in the RSA are not considered sensitive to the effects of habitat loss and sensory disturbance because they regularly use human-modified habitats and are highly habituated to humans. Elk may be self-sustaining in the RSA under existing conditions, but their natural ecological interactions have been substantially diminished. A serious risk is identified for elk under existing conditions because they do not function in their natural ecological role and therefore are not considered ecologically effective. With the addition of the Project, the following residual effects are expected for elk:

- A net loss of 133.2 ha of selected and 20.4 ha of used as available habitat in the Project area resulting in a small negative effect for elk.
- An increase of 96.6 ha of selected habitat in wildlife corridors. Elk use in the corridors may increase because the increased proximity of corridors to human residences should reduce the habitat suitability for predators, and the fence will exclude elk from the ASP area. However, exclusion from the ASP area could potentially increase the risk of predation on elk by preventing escape from the wildlife corridors into urban areas that create a refuge from predators. Owing to this uncertainty, the Project is predicted to have a neutral (versus positive) effect on elk use of the wildlife corridors.
- The wildlife fence will reduce the potential for negative human-elk interactions within the ASP area, but elk may concentrate elsewhere in Canmore, possibly increasing the potential for negative interactions between people and elk in these areas. Owing to this uncertainty, the Project is predicted to have a neutral (versus positive) effect on negative human-elk interactions.

- Environmental consequence of residual effects of the Project on elk is predicted to be low (loss of habitat) to negligible (use of corridors and negative human-elk interactions). The addition of the Project is not predicted to affect the self-sustaining status of elk population in the RSA because suitable habitats remain available and well distributed across the RSA. The neutral effects of human-elk interactions should not contribute to further habituation of elk in the RSA and therefore the Project is not expected to contribute to the existing serious risk.

The environmental consequence of cumulative effects of the Project and other RFDs is somewhat uncertain. A high environmental consequence would continue to be present if elk continue to concentrate their use in anthropogenic habitats in Canmore, and thus contribute to the serious risk under existing conditions. This is the most likely outcome. However, environmental consequence could be reduced to moderate or low if elk redistribute themselves outside of Canmore and improve their contribution to ecological function.

Other Wildlife

Other wildlife species, including species at risk and non-listed species, may also be affected by the Project through direct mortality (from clearing of vegetation, construction activities, and vehicle strikes) and loss of habitat quantity and quality. Some species may reduce their use of approved wildlife corridors, but this pathway is applicable only to medium and large bodied mammals for which wildlife corridors have been designated. With the addition of the Project the following residual effects are expected:

- Negligible to small magnitude of effects because of mortality. The application of timing restrictions on clearing vegetation and minimizing disturbance to wetlands largely avoids mortality of songbirds, water birds and wetland associated birds, raptors, bats, and breeding amphibians. Some mortality could occur for small mammals, large and medium bodied mammals, reptiles, and amphibians that exploit terrestrial habitats.
- Negligible to small magnitude of effects are predicted because of changes to habitat quantity and quality. Effects will be largest for species associated with coniferous forest habitats. Limited effects are predicted for most species at risk, particularly for those with no suitable habitat in the ASP area, those associated with wetlands or open water habitats, and those whose occurrence in the LSA is not documented or unlikely.
- Negligible or small magnitude effects are predicted because of reduced use of wildlife corridors. Effects on large and medium bodied mammals will depend on the species' response to human activity and are likely to be similar to those previously described for grizzly bears, cougars, wolves, and elk.
- Environmental consequence of residual effects of the Project on species at risk and other non-listed species are predicted to be low to negligible:
  - Residual effects from changes in wildlife mortality risk are predicted to have a negligible environmental consequence for most taxonomic groups (e.g., large to medium bodied mammals, bats, birds). A low environmental consequence is predicted for smaller species that occupy anthropogenic habitats (e.g., amphibians, reptiles, rodents and other small mammals).
  - Residual effects from changes to habitat quantity and quality for species not known to occur in the ASP area are predicted to have a neutral effect, and therefore a negligible environmental consequence. Regarding species that may occur in the ASP area, the magnitude of habitat change is considered small relative to the broader availability of habitats in the RSA and therefore the environmental consequence is predicted as low.
  - Like the assessment of grizzly bears, cougars, wolves and elk, environmental consequence of changes to wildlife corridor use is predicted to be negligible to low.

Vegetation

Native terrestrial vegetation communities are reasonably resilient to changes in quantity and quality owing to their broad distribution in the RSA and beyond. Deciduous stands are an exception because they are relatively uncommon both at the local and regional scale; however, tree species that make up this vegetation community type are found across the RSA. Further, there are no known occurrences of provincially or federally-listed plants or tracked and watched plant communities within the ASP area. ESAs in the ASP area include old growth Douglas fir, wetland and riparian areas, which are sensitive to loss and degradation.

With the addition of the Project, the following residual effects are expected for vegetation:

- Small magnitude of effects because of changes to the quantity and quality of native vegetation communities:
  - Removal of a maximum 107 ha of native terrestrial vegetation communities within the ASP area and an increase in weeds within the ASP area.
  - Removal of ESAs with a maximum loss of 2.25 ha of old growth Douglas fir, 0.1 ha of wetlands and 0.5 ha of riparian area in the ASP area, and potential changes to wetland and riparian community composition and structure from the proliferation of weeds.
- The environmental consequence of residual effects of the Project on native terrestrial vegetation communities and ESAs is predicted to be low.

The cumulative effects of the Project and other RFDs are expected to result in a low environmental consequence for native terrestrial vegetation communities and ESAs.

Aquatic Ecology

It is unlikely that any of the creeks within the Smith Creek ASP has suitable fish habitat due to seasonal and intermittent flows, steep gradients and lack of suitable habitat for spawning or overwintering; therefore, fish are unlikely to be present in these creeks. However, downstream effects on fish populations from sediment and erosion and contamination could occur in the Bow River.

With the addition of the Project, the following residual effects are expected for fish populations, including species at risk:

- Negligible (i.e., non-measurable) reduction in fish survival and reproductive success from effects of sediment releases, stormwater runoff, and spills/contamination due to the implementation of mitigation measures, industry standard best management practices, and implementation of management plans:
  - Although there may be small changes in suspended sediment concentrations, or changes to water quality from spills/contamination, these changes are expected to be minimized or avoided through the effective application of mitigation measures, such that effects on fish populations are negligible.
  - Any watercourse crossing construction will follow standard best management practices and applicable regulatory guidelines (i.e., Measures to Protect Fish and Fish Habitat and Alberta Code of Practice).
  - Stormwater runoff will be managed according to the Stormwater Management Plan (to be developed following ASP approval).
- The environmental consequence of residual effects of the Project on fish, including species at risk, are predicted to be negligible.

As the environmental consequence of Project effects on fish populations in the Bow River, including fish species at risk, is rated as negligible, the Project is not expected to contribute to cumulative effects for this VEC in the RSA.

Physical and Social Components

Residual effects of the Project on VECs of the physical environment, including surface and bedrock geology, soils and terrain, surface water, groundwater, air, and noise are of low environmental consequence. The Project is predicted to have detectible effects, but the magnitude of change is predicted to be small. The predicted changes do not compromise the integrity or function of the affected resources and are not expected to result in a serious risk. Key mitigation includes complying with legal requirements and good practice guidelines such as the Alberta *Water Act*, *Alberta Ambient Air Quality Objectives and Guidelines*, Canmore's *Undermining Review Regulation AR34/2020,* and Canmore's *Noise Control Bylaw*, and conducting soil salvage and reclamation, and applying erosion and sedimentation controls.

Residual effects of the Project on VECs of the social environment are of negligible environmental consequence (historic resources, land and resource use) or low environmental consequence (visual resources). Key mitigation includes complying with legal requirements and good practice guidelines such as the *Historical Resources Act,* Canmore's *Land Use Bylaw* and policies related to architectural and landscaping controls, and Canmore's *Municipal Development Plan*.

Uncertainty, Monitoring, and Adaptive Management

Uncertainty regarding the assessment of Project effects for wildlife was reduced by using site-specific empirical data, empirically derived habitat models, and scientific literature from similar ecosystems and conditions to those found near Canmore. When combined with precautionary assumptions that are likely to overestimate potential adverse effects, the available evidence indicates that the effects caused by the Project are unlikely to be worse than predicted in this EIS, provided the recommended mitigation is fully applied..

Although the available data provides substantial support for the predictions made in this assessment, some uncertainty was identified, especially with respect to ecological thresholds that may exist but have not been detected, and the response of current and future citizens of Canmore to education, signs, fencing, and enforcement. Uncertainty about how elk will redistribute themselves on the landscape after fencing is constructed is also present. Uncertainty for other VECs was low and attributable mostly to uncertainty in the precise footprint location and footprint area.

To address uncertainty, the following monitoring and follow-up actions are recommended for the Project:

- Perform pre-construction surveys to locate sensitive wildlife features, such as nests, if construction timing overlaps with sensitive periods for wildlife (e.g., migratory bird nesting).
- A qualified professional will undertake the final design of the wildlife fence, including design at creek crossings, fence ends, and other aspects and evaluate the design to confirm that it is consistent with the principles described in the EIS.

- Initiate the wildlife fence construction ahead of Project development. Monitoring will occur as development proceeds and providing opportunities for adaptive management[2] as development progresses closer to the wildlife fence and wildlife corridors.
- The Town and the Province should undertake an education and enforcement campaign over the first five years that the fence is in place to maximize efficacy of fencing and education in achieving compliance with trail use, off-leash dog use, and seasonal closure regulations within wildlife corridors.
- Develop and implement an adaptive wildlife monitoring plan in accordance with the principles identified in the EIS. The plan should evaluate the efficacy of the fence for excluding large mammals from the ASP area and improving compliance with existing regulations in wildlife corridors. The plan should be designed to monitor changes in use of wildlife corridors by people, off-leash dogs, and large mammals, and changes in negative human-wildlife interactions. The plan will monitor the efficacy of the underpass for facilitating movement for multiple wildlife species.
- Comply with the requirements of the Alberta Wetland Policy.
- Monitor weeds using a program similar to that implemented by the Town of Canmore. Disturbed areas should be monitored for up to five years after development and sprayed as required when new weed infestations are documented, and afterwards on public spaces by the Town, until inspection and acceptance of the Final Acceptance Certificate.
- Maintain and monitor sediment and erosion controls identified in the Erosion and Sediment Control Plan as described in the Engineering Design & Construction Guidelines.
- Runoff monitoring conducted by Alberta Environment and Parks at established stations on the Bow River, downstream from the Project.
- Conduct environmental monitoring and inspection of construction activities to confirm compliance with the *Construction Management Guidelines* and the site-specific *Construction Management Plan.*
- As required, prepare an Undermining Report compliant with the Canmore *Undermining Review Regulation AR34/2020.*
- Develop a Master Drainage Plan to be submitted as a supporting study for the ASP application.
- Once final development footprints are defined (i.e., the subdivision stage), submit a Statement of Justification and Historic Resource Application to Alberta Culture, Multiculturalism and the Status of Women (ACMSW). Obtain updated *Historical Resources Act* requirements for any features that have the potential to be affected by the Project and comply with requirements.

[2] Adaptive management is a tool for decision making in the face of uncertainty that is comprised of four iterative steps: act, measure, evaluate, and adapt. In the case of the Project, actions represent the phased development (i.e., fencing first), measurement and evaluation are undertaken through monitoring, and adaptations may be undertaken if monitoring indicates that they are required.

Conclusion

Through the application of mitigation, the Project is not predicted to contribute to any of the serious risks identified for wildlife under existing conditions, nor is it predicted to create or contribute to the serious risks for other VECs. Key mitigation identified include wildlife fencing, education, off-leash dog parks, and other outdoor recreation opportunities. The wildlife assessment highlights the critical importance of wildlife fencing as a mitigation measure to avoid negative human-wildlife interactions and the corresponding serious risk these changes would pose for many species.

Cumulative effects of previous and existing developments have resulted in high environmental consequences for some wildlife under existing conditions. Other reasonably foreseeable developments combined with an expected overall increase in the number of people accessing and living in Canmore are predicted to intensify these adverse effects, even in the absence of the Project. The Project is predicted to have mixed contributions to cumulative effects, but in general the contributions of the Project are expected to be low provided mitigation recommended in this EIS is appropriately applied.

The EIS predicts that the application of mitigation will reduce the environment consequence of Project effects. In particular, the EIS highlights how the residual effects of the Project are mainly predicted to range from negligible to low. Although there will be a negative impact on grizzly bear habitat availability, limiting grizzly bear access to the area within the fence will likely be beneficial for the population overlapping the RSA because the ASP area represents an ecological trap under existing conditions (i.e., the fence creates a positive outcome by reducing human-grizzly bear conflict). The following environmental benefits were also identified for the Project:

- By combining wildlife fencing with public awareness (e.g., signs) and alternative options for recreation (i.e., off-leash dog parks and designated trails), a substantial reduction in human use of undesignated trails in approved wildlife corridors is predicted, relative to existing conditions. Measures implemented by TSMV should improve public compliance with the Bow Valley Protected Areas Management Plan because many residents and visitors appear to be unaware of the restrictions that apply in designated corridors (e.g., seasonal trail closures and prohibitions on off-leash dog use).
- Changes in negative human-bear, human-cougar, human-wolf, and human-elk interactions were predicted to be positive inside the ASP area but were considered neutral at the RSA scale owing to uncertainty about the level of negative interaction that could occur in adjacent wildlife corridors after development (i.e., outside the fence).

For these conclusions to be maintained, mitigation and adaptive management strategies identified in the EIS, including monitoring, must be fully and effectively implemented.

ACRONYM LIST

Abbreviation	Definition
2004 Resort Centre ASP	2004 Resort Centre Area Structure Plan
AAAQO	Alberta Ambient Air Quality Objectives
AB	Alberta
ACIMS	Alberta Conservation Information Management System
ACMSW	Alberta Culture, Multiculturalism and the Status of Women (formerly Alberta Culture and Tourism)
ACT	Alberta Culture and Tourism
AENV	Alberta Environment
AEP	Alberta Environment and Parks
AER	Alberta Energy Regulator
am	*ante meridiem*
ANPC	Alberta Native Plant Council
ASIC	Alberta Soil Information Centre
ASP	Area Structure Plan
ASP area	Project Study Area
ASRD	Alberta Sustainable Resource Development
AVI	Alberta Vegetation Inventory
BACI	before after control impact
BC	British Columbia
BCEAG	Bow Corridor Ecosystem Advisory Group
CAAQS	Canadian Ambient Air Quality Standards
CAMBA	Canmore and Area Mountain Bike Association
CCC	Construction Completion Certificate
CCME	*Canadian Environmental Quality Guidelines*
CEA	cumulative effect assessment
CEAA	Canadian Environmental Assessment Agency
CESCC	*General Status of Species in Canada*
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CP	Canadian Pacific
DC	Direct Control District
Delta	Delta Environmental Management Group Ltd.
Directive 038	Alberta Energy Regulator (AER) Directive 038: Noise Control
ECCC	Environment and Climate Change Canada
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPEA	Environmental Protection and Enhancement Act

Abbreviation	Definition
ERCB	Energy Resources Conservation Board
ESAs	environmentally sensitive areas
ESRD	Alberta Environment and Sustainable Resource Development
FAC	Final Acceptance Certificate
FMA	Fedirchuk McCullough & Associates Ltd.
FWMIS	Fisheries and Wildlife Management Information System
GNR	Globally Not Ranked
Golder	Golder Associates Ltd.
GPS	global positioning system
HRIA	Historic Resource Impact Assessment
HRV	Historic Resource Value
HUMR	Human Use Management Review
Leq	equivalent sound level
LFH	organic soil horizon
LID	low impact development
LSA	Local Study Area
MD	Municipal District
MDP	Municipal Development Plan
MMM	MMM Group Limited
MOU	memorandum of understanding
MSES	Management and Solutions in Environmental Science
NRCB	Natural Resources Conservation Board
pg.	page
pm	*post meridiem*
QPD	QuantumPlace Developments Ltd.
RAP	Restricted Activity Period
RFDs	reasonably foreseeable developments
RSA	Regional Study Area
RSF	resource selection function
S3	vulnerable
SARA	*Species at Risk Act*
SNR	Species Not Ranked
Stantec	Stantec Consulting Inc.
SU	unrankable
the Project	Smith Creek Area Structure Plan
the Town	Town of Canmore
TOR	Terms of Reference

Abbreviation	Definition
TPR	Third-Party Review
TSMV	Three Sisters Mountain Village
TSMVPL	Three Sisters Mountain Village Properties Ltd.
TSP	Total Suspended Particulate
UMA	UMA Engineering Ltd.
UTM NAD	Universal Transverse Mercator North American Datum
VECs	valued environmental components
vs.	versus
WHIPP	Wildlife Human Interface Prevention Plan
WMU	Wildlife Management Unit
WWHR	What We Heard Report

UNIT AND SYMBOL LIST

Abbreviation	Definition
%	percentage
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
°	degrees
°C	degrees Celsius
dBA	A-weighted decibel
ha	hectare
km	kilometre
km^2	square kilometre
m	metre
masl	metres above sea level
min	minute
$\mu g/m^3$	micrograms per cubic meter
NO_2	Nitrogen Dioxide
SO_2	Sulphur Dioxide
$PM_{2.5}$	Particulate Matter with a mean aerodynamic diameter less than 2.5 microns (μm)
L_{eq}	energy equivalent sound levels
$L_{eq,day}$	average energy equivalent sound levels over the daytime period
$L_{eq,night}$	average energy equivalent sound levels over the nighttime period

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FIGURES

APPENDICES

1.0 INTRODUCTION

Three Sisters Mountain Village (TSMV) property is located within the eastern boundary of the Town of Canmore (the Town). Development approval for the TSMV property was granted by the Natural Resources Conservation Board (NRCB) through Decision Report #9103 released in 1992 (NRCB 1992). The approval included developments such as golf courses, residential neighbourhoods and supporting commercial infrastructure. As outlined in Condition #4 of the 1992 NRCB Decision, the Town has planning authority regarding the "detailed timing and specific land uses and population densities" of TSMV property. Through the Settlement Agreement and the Town's master zoning bylaw Direct Control District (DC)1-98 within Land Use Bylaw 22-2010, the Town provided for a total of 5,457 residential, resort accommodation, and timeshare units, and up to 306 hectares (ha) of developable area across TSMV lands. Development of TSMV properties thus far has generally progressed in stages from west to east and several residential and limited commercial areas (Mountaineers Village I) have been developed.

The Smith Creek Area Structure Plan (ASP) (the Project) includes TSMV properties formerly known as Sites 7, 8 and 9, and the lands currently occupied by Thunderstone Quarries Ltd (Figure 1). On behalf of the current TSMV owners, Three Sisters Mountain Village Properties Ltd. (TSMVPL) and QuantumPlace Developments Ltd. (QPD) is working to develop the Project, which will serve a local population and includes homes, a commercial component, a flex commercial-industrial district, open space, and a multi-modal transportation network. The overall ASP area comprises approximately 154 hectares (380 acres) of land. The Smith Creek ASP is being prepared pursuant to a collaborative ASP process between the Town and TSMVPL which began in 2015.

The policies developed for the Project will guide future development and planning processes to better reflect the Town's 2016 Municipal Development Plan (MDP), which was amended in 2018 (Town of Canmore 2016), and current planning practice for community and resort design. Although the existing 2004 Resort Centre ASP is being replaced, the proposed Project remains aligned with the intent of the 1992 NRCB decision and is envisioned as the core activity hub for the entire Three Sisters Mountain Village community. The new proposal is therefore generally consistent with the overall vision of the 2004 Resort Centre ASP. The guiding principles of the ASP have been updated to include considerations related to inclusivity, safety, sense of place, design and economy.

The Town's MDP requires that an Environmental Impact Statement (EIS) be prepared and submitted as part of the Project application. Golder Associates Ltd. (Golder) was retained by QPD to prepare the EIS for the Project.

This introduction familiarizes the reader with background information and the scope of the EIS by:

- identifying the objectives of the Project
- defining the purpose and scope of the EIS
- describing the role of stakeholder engagement undertaken to inform the design of the Project and the mitigation identified in this EIS
- outlining the structure of the EIS and providing a concordance table with the TOR developed by the Town

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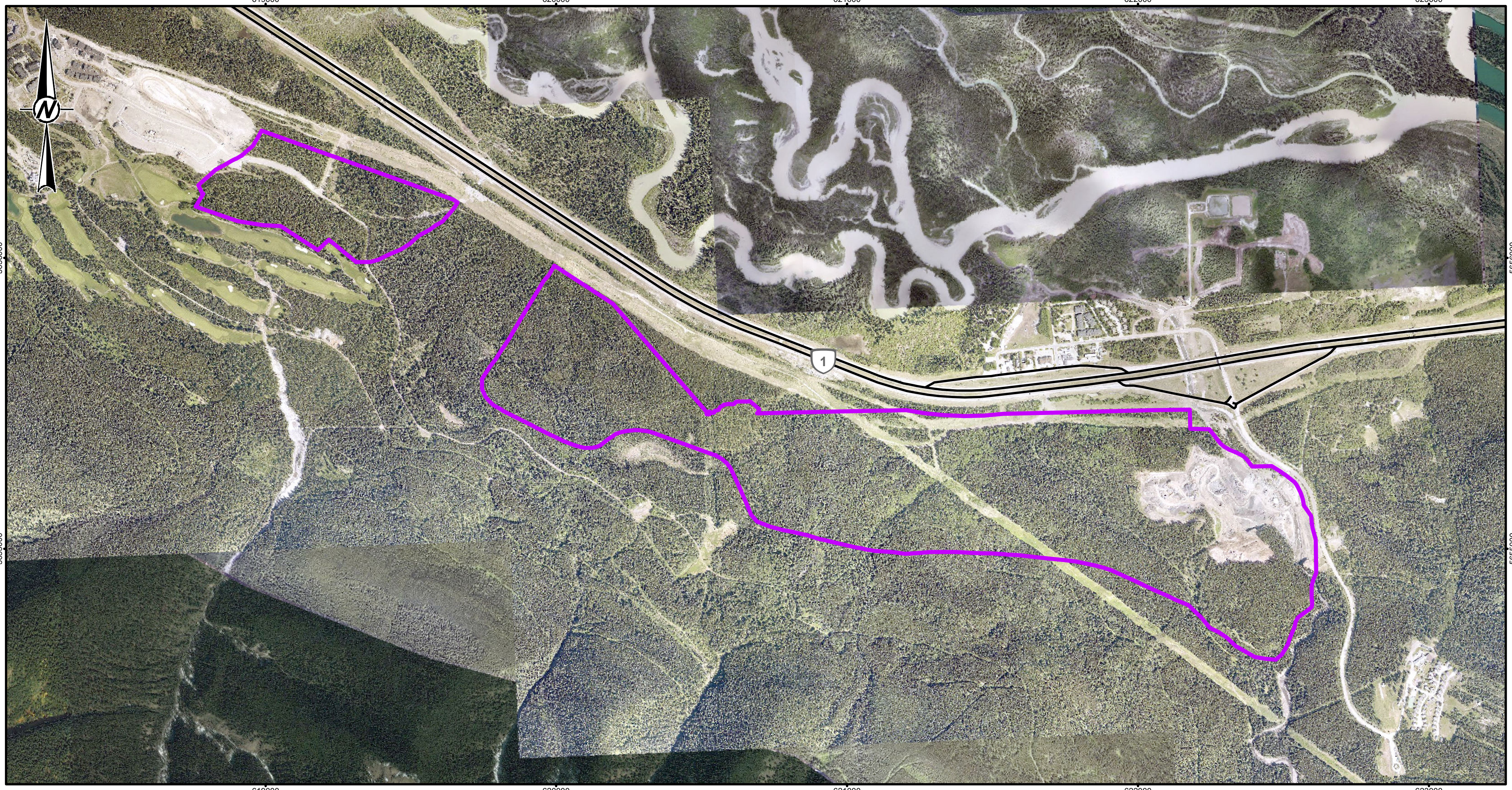

LEGEND

PRIMARY HIGHWAY

PROJECT BOUNDARY

0 500 1,000

1:20,000 METRES

REFERENCE(S)

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DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT
GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE
SMITH CREEK AREA STRUCTURE PLAN BOUNDARY

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	1

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1.1 Development Context

In 1992, the Natural Resources Conservation Board (NRCB) approved TSMV's application to construct a "Recreational and Tourism development". The NRCB Decision provided certainty that the development would move forward, but the details to be determined in the planning process. In broad strokes, the decision outlined the following key elements:

- A resort component with hotels, service commercial, residential home for permanent residents.
- An opportunity for economic diversification through a business park.
- The resort included residential components supporting the year-round vibrancy of the resort.
- The resort would also include space for recreation and attract year-round amenity.
- The area now referred to as Smith Creek, would serve a local population and include homes and a commercial component.
- Stewart Creek would include residential and a commercial component.
- The development would include a spectrum of housing with an emphasis on market entry and employee housing.

Although not part of the NRCB decision, Thunderstone Quarries Canmore Ltd. is an active rundle rock quarry operation located immediately south of the Dead Man's Flats interchange and is included as part of the Smith Creek ASP area. The quarry has been in operation under various corporate entities since 1960. Thunderstone Quarries will require reclamation prior to redevelopment. It is anticipated that the reclamation and redevelopment will occur when the resource is extracted and is anticipated to occur within the next 15-20 years.

The designation of wildlife corridors was a requirement resulting from the NRCB decision (NRCB 1992) and under the jurisdiction of the Province. In 2020, Three Sisters Mountain Village working with the Province of Alberta, received approval for the Smith Creek wildlife corridor, satisfying the NRCB requirement to dedicate wildlife corridors. According to the Provincial approval letter (AEP 2020, page 6) dated February 2020, "*The corridor will be designed to facilitate the safe passage of wildlife in order to enable ecological processes, such as movement, foraging, etc., at levels reflecting persistent over generations and sustainable human-wildlife interactions. Finally, the intent is that additional management approaches are not needed outside of the delineated corridors including additional buffers, setbacks or layering of uses, and that the proposed corridor stands on its own for land requirements."* The corridor proposal considered feedback from the Town and stakeholders gained through consultation during the Smith Creek collaborative ASP process (Section 1.4 Stakeholder Engagement).

The Smith Creek wildlife corridor is divided into three components (Figure 2). The first component amends and adds to the previously approved Along Valley Corridor, creating a connection between the previously approved Along Valley Corridor and the Wind Valley Habitat Patch (Figure 2). This proposed primary wildlife corridor increases the overall width of the existing approved corridor in Sites 7/8, which is the portion of TSMV lands where an approved wildlife corridor has been in place since 1998 and for which no additional corridor delineation is required prior to development. This segment of the corridor also extends the approved Along Valley Corridor by approximately 1.5 kilometres (km) through Site 9 (Figure 2). The overall width of the corridor within Sites 7/8 has been increased from the approved Along Valley Corridor, making this corridor segment much wider (i.e., >500 metres [m]). The Smith Creek extension of the Along Valley Corridor would extend through Site 9 and complete the primary wildlife corridor with respect to connecting to the Wind Valley Habitat Patch.

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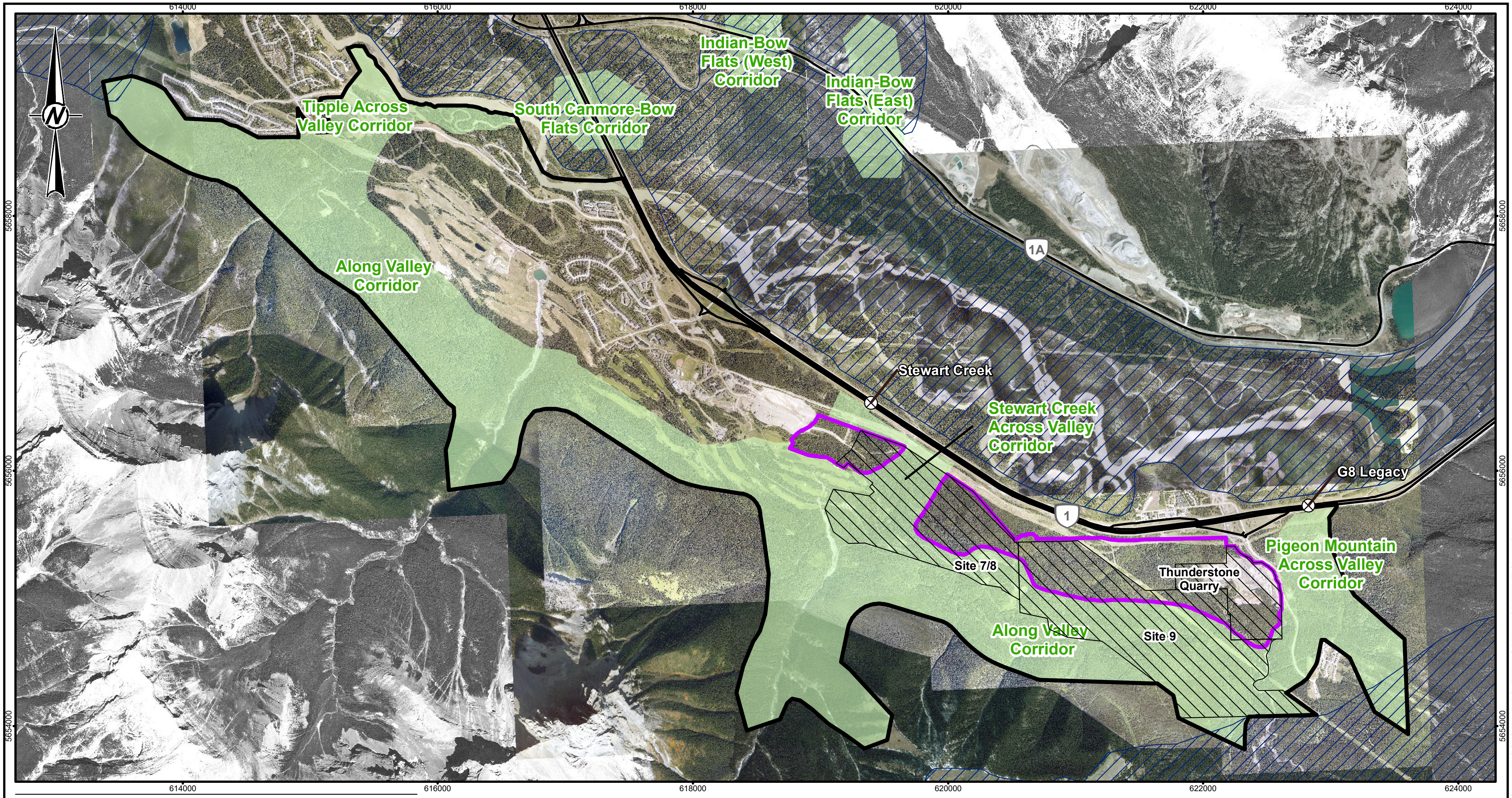

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED WILDLIFE CORRIDOR
- HABITAT PATCH
- LOCAL STUDY AREA
- PROJECT BOUNDARY
- SITE BOUNDARY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

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2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-06
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE

APPROVED WILDLIFE CORRIDORS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

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The second component proposed an optional realignment of the Stewart Creek Across Valley Corridor (Figure 2). The existing Stewart Creek Across Valley Corridor was formally designated by the Province in 1998 and amended in 2014. The optional realignment involves a recommendation of moving the Stewart Creek Across Valley Corridor approximately 300 m to the east and centering the corridor on the location of a new wildlife crossing under the TransCanada Highway. The alignment was altered based on discussions with the Town of Canmore regarding potential steep creek hazards identified by the Town, drainage grade separation of the Parkway, wildlife movement, and public input.

The existing wildlife crossing structure near Stewart Creek will be retained and would be linked to the western edge of the Optional Stewart Creek Across Valley Corridor (Figure 2). Once relocated, the portion of the existing Stewart Creek Across Valley Corridor located on TSMV property would be rescinded and become developable land without restrictions. Additionally, TSMV will be implementing mitigation to improve the effectiveness of the Stewart Creek Across Valley Corridor over the previously approved across valley corridor.

The third component of the Smith Creek corridor proposal was the Pigeon Mountain Across Valley Corridor. The proposed Pigeon Mountain Across Valley Corridor is primarily located outside of TSMV lands but is considered beneficial to create a connection from the Wind Valley Habitat Patch to the Bow Flats Habitat Patch via the G8 Legacy Underpass (Figure 2). A portion of the proposed Pigeon Mountain Across Valley Corridor is found on Site 9 (Figure 2).

1.2 Smith Creek Area Structure Plan Objectives[3]

The objective of the Smith Creek ASP is to define a policy framework to inform development and guide future planning and development decision within the Plan Area. The project boundaries include all or portion of:

- the area previously designed as the Stewart Creek Across Valley Corridor and exchanged for a new Across Valley corridor as part of the corridor approval by the province
- site 7, 8 and 9
- a parcel of land owned by Thunderstone quarry limited partnership Ltd which currently contains as active rock quarrying operation

During the development of the Smith Creek ASP land use concept, QuantumPlace worked collaboratively with the Town and stakeholders to propose a cohesive land use concept and set of policies to shape the development of the project to support the economy and social sustainability of Canmore as a whole. The discussions with the Town were focused on providing a central spine road at the central to the Plan Area to efficiently deliver transit and road access while being cognisant of undulating topography and the need for slope adaptive development to inform planning and development decisions. The result was a planning and development policy framework that created the plan proposed within the ASP today. It is important to note, that for the Smith Creek Land Use Concept to change, the planning and engineering priorities established during the collaborative discussion for Smith Creek would have to change for an alternative development concept to have Administrative support from the Town of Canmore. Consultation about appropriate mitigation to protect the environment was also a major part of the ASP process.

[3] Objectives may be modified as the ASP review progresses.

Smith Creek is envisioned to become an established community in Three Sisters Mountain Village for residents living and working in Canmore. Smith Creek will serve Canmore by providing a variety of housing options and amenities with all the conveniences and services needed for daily living. Smith Creek will strengthen Canmore's position as highly desirable place to live, work, play and raise a family.

The following principles are meant to guide the Smith Creek Area Structure Plan (ASP) direction and subsequent development. Smith Creek ASP will ensure that future developments support the Town's vision to be socially diverse, economically active and environmentally sustainable.

Inclusive

Smith Creek is an inclusive and interconnected community. Anchored by its mountain surroundings, Smith Creek prioritizes residential development that would accommodate various housing types and modes of travel. Smith Creek offers aesthetically engaging, diverse residential housing opportunities for a variety household types and tenures. Smith Creek is connected to surrounding areas via a network of complete streets that provide the opportunity to travel by a variety of modes throughout the community.

Resilience

Smith Creek is a safe and resilient community responsibly balancing the requirement of both the built and natural environments. Safe development around areas potentially impacted steep creek considerations and implementing FireSmart measures will be core to this development. Communities will be respectful of wildlife and the surrounding environment by implementing the proactive measures outlined in the Environmental Impact Statement (EIS) and through the Town's work with other levels of government and the multi-stakeholder committee on Wildlife Co-Existence.

Wildfire, steep creek and undermining will also continue to be addressed by:

- considering how community design contributes to safety by creating lively and active places that respect the environment and establish systems that are adaptable in response to the impacts of climate change
- implementing the recommendations from the EIS
- continuing to implement FireSmart approaches
- mitigating steep creek hazards by accounting for climate change to protect proposed and existing developments

Sense of Place

Smith Creek will be a close-knit community with residents putting down roots, and taking advantage of the gathering spaces, multi-use trails and other activity-oriented amenities integrated into the community's fabric. Smith Creek will be a highly desirable place to live, work and raise a family. Smith Creek will create a built environment which offers a distinct sense of place by considering the building form, orientation and relationship to the surrounding context so that a physical and social connection to the town would be clear.

Design

Smith Creek will employ appropriate practices in neighbourhood design for the setting and location. Smith Creek ASP encourages variety in design and considering green buildings and slope adaptive guidelines and practices, while keeping consistent with Canmore's authentic mountain character.

Economy

Smith Creek will be economically viable, vibrant, and will contribute positively to the town. Its commercial centre will be a hub for new local commercial/light industrial development that assists in the diversification of Canmore's economy. The development provides a beneficial mix of light industrial, office and retail infrastructure, maximizing opportunities to work towards the stability of long-term municipal finances through the building of a complete community.

1.3 Purpose and Scope of the Smith Creek EIS

The Town approved and updated the MDP in 2016, which was subsequently amended in 2018. The MDP is the principal long-range planning document used by the Town to guide development. The associated EIS policy was also approved by Council in 2016. Based on these policies, a TOR entitled "Terms of Reference: Environmental Impact Statement (EIS) for Smith Creek Area Structure Plan, Canmore, Alberta (September 5, 2018)" was prepared by the Town (Appendix A). This EIS has been prepared to meet the requirements outlined in the approved TOR and the EIS Policy.

The purpose of this EIS is to provide the information necessary for Council to make an informed decision about the application for the Project. Specifically, the goal of this EIS is to identify the potential environmental impacts of the proposed developments and to identify mitigations that can be used to avoid or minimize negative impacts or build on positive impacts.

As defined in the towns EIS policies, Golder's role is to evaluate the proposed development projected by:

- outline existing conditions and identify significant natural and ecological features
- determine the nature and scale of the potential effects generated by the proposed Project prior to mitigation
- provide recommendations to avoid or mitigate these effects
- identify residual effects and their significance after implementation of proposed mitigation
- recommend further studies or monitoring if necessary

Residual effects will be placed in context of cumulative effects of existing, approved, and future developments in the Bow Valley. The EIS will also recommend further studies and/or monitoring to be undertaken to address uncertainty in the prediction of residual effects or in the overall conclusions of the assessment. Because of the importance of environmentally sensitive areas (ESAs) in the Town's MDP, potential effects on ESAs are an important focus in this EIS.

1.4 Stakeholder Engagement

TSMV has been conducting stakeholder engagement on the Smith Creek and Three Sisters Village (previously Three Sisters Resort) since 2015. The community engagement process was coordinated to help articulate a clear direction that resonates with TSMV, the community and Town of Canmore Council and Administration. It creates a forum for greater understanding of the purpose of an ASP and how it informs future development. It also allows TSMV to hear input from many voices in a safe and productive environment.

To date, engagement has informed various ASP concepts that the TSMV Team has iteratively developed with Town Administration. Stakeholders consulted have included residents of Hubman Landing, representatives from local environmental groups, seniors, recreational enthusiasts, community services representatives, and Canmore residents.

Engagement has included:

- the establishment of Community Advisory Groups
- a series of information booths at community events (e.g., Mountain Market, Elevation Place, local grocery stores)
- presentations to active community groups (e.g., seniors, Rotary, Bow Valley Builders & Developers Association)
- meetings with wildlife and environmental stakeholder groups
- open House events open to the public featuring TSMV and third-party experts

Following TSMV's 2017 Resort Centre ASP amendment submission, TSMV heard from the community that it needs to better articulate the vision for its developable land, which represents 80% (percent) of the remaining developable land in Canmore. As TSMV enters this new Area Structure Plan (ASP) process, it has worked to make the vision clear for TSMV as a whole, of which Three Sisters Village ASP, the approved Stewart Creek ASP and the Smith Creek ASP are a part.

Once the Terms of Reference (TOR) was approved by the Town of Canmore Council on October 2, 2018, TSMV initiated a community engagement plan to seek broad input on the Draft Vision and Principles. Through ASP Phase 2 Community Engagement, the following themes emerged:

- 19% affordability (66 comments)
- 15% wildlife (51 comments)
- 15% mobility (50 comments)
- 14% commercial (49 comments)

Residents were most concerned about affordability—this is a notable community issue in Canmore. Those who raised this issue suggested it could be alleviated by providing a range of property types and Perpetually Affordable Housing alternatives.

When discussing “Sense of Place,” wildlife was the largest concern. The community wants to make sure that development mitigates the impact on wildlife; the corridor adjacent to Smith Creek was the main concern. Residents want a functional corridor backed by independent science-based review that is provincially approved. The Province finalized the Smith Creek corridor boundaries to the south and east of the Smith Creek ASP area on February 26, 2020 (AEP 2020). The need for more education regarding human use—off-leash dogs, recreational activities—was also noted, as was further mitigation opportunities (e.g., no mountain ash, buffer zones needed, fencing).

Beyond these core themes, comments concentrated on:

- 6% community spaces (21 comments)
- 6% undermining (20 comments)
- 2% aesthetics (6 comments)
- 2% natural disaster mitigations (6 comments)

There was a long list of general statements (21%/72 comments), unrelated to the primary themes:

- position on Project: in favour, opposed, mixed feelings, more clarity needed
- no more grading
- tax implications
- suggestions for further outreach

TSMV is committed to transparency and continues to share information about Project progress through the following approaches:

- timely updates to Canmore Council members during Committee of the Whole meetings
- coordinated regular meetings with Town of Canmore's Planning and Development Department and Communications Department
- updates through local media/newspapers
- refreshed navigation and content on TSMV's website to reflect a clearer vision for TSMV
- new website content, including expert blog posts and updates about the Project (e.g., information about the EIS process)
- updates on TSMV's webpages
- regular community email newsletter updates to over 1,000 subscribers

TSMV continues to create opportunities for all community members to be heard during each step of the ASP process.

Table 1 provides a summary of environmental concerns identified during stakeholder engagement up to August 2019. An updated summary table will be submitted in the What We Heard Report (WWHR) with the ASP and associated documents.

Table 1: Summary of Environmental Concerns Identified during Stakeholder Engagement

Topic	Public Engagement Questions/Comments	TSMV Response/Outcome
Fencing	Why has the recommendation changed – hard vs soft edges?	Soft edges have created additional human-wildlife conflict challenges. Refer to Section 5.6.4 (Wildlife Fencing) of EIS
	Who will pay for and maintain the fence in the long term?	TSMV will pay for the installation of the fence and the operation and maintenance of the fence will be paid for as determined through the ASP process with the Town and as part of a collaborative effort with Alberta Transportation Refer to Section 5.6.4 (Wildlife Fencing) of EIS
	Will corridors be functional and maintain connectivity?	Yes. Refer to Section 5.3.6 (Existing Conditions - Elk), Section 5.6.4 (Wildlife Fencing), Section 5.7.2.2 (Use of Approved Corridors – Grizzly Bears), Section 5.7.3.2 (Use of Approved Corridors – Cougars), Section 5.7.4.2 (Use of Approved Corridors – Wolves), and Section 5.7.5.2 (Use of Approved Corridors – Elk) of the EIS
	Where has a fence been successful?	(Brief summary response) Refer to Section 5.6.4 (Wildlife Fencing) of EIS
	There were some groups and individuals that wanted no development as the only strategy for wildlife preservation.	The NRCB Decision in 1992 permits development in the Smith Creek ASP. Consequently, the landowner has a legal right to develop the land. The discussion should now focus on ensuring that the development that goes forward maintains a balance between social, environmental considerations, economic feasibility and the technical requirements of the Town. Refer to Section 1.1 (Existing Resort Centre ASP and Current Land Status)
Wildlife Corridor Design	Corridor is not wide enough.	The wildlife corridor is, on average, more than 600 meters wide, exceeding the NRCB requirement of a minimum of 350 meters for primary wildlife corridors. The Province is the approving authority for wildlife corridors in Three Sisters Mountain Village. Refer to Section 1.3 (Purpose and Scope of the Smith Creek EIS – Wildlife Corridors) Section 5.2.2 (Wildlife Movement in Wildlife Corridors) and Section 5.3.6 (Existing Conditions - Elk) of EIS
	Corridor too sloped.	The wildlife movement corridor adjacent to the Smith Creek ASP area is approved by the Province and corridor width or slopes are not being contemplated as part of the ASP application. What is being contemplated, is how development may impact the ability for wildlife to move through the corridor. With regards to slope, while particular species show preference for flatter terrain, wildlife movement does occur on steep slopes. There is no published basis for the designation of slopes greater than 25 degrees as ineffective for wildlife movement. Approximately 80% of the corridor occurs on slopes less than 25 degrees. Refer to Section 5.2.2 (Wildlife Movement in Wildlife Corridors) and Section 5.3.6 (Existing Conditions - Elk) of EIS
	Corridor does not provide for connectivity.	The approval authority for wildlife corridors rests with the Province of Alberta and evaluation of the location and design of wildlife corridors is not part of the scope of the EIS. Refer to Section 1.3 (Purpose and Scope of the Smith Creek EIS – Wildlife Corridors)

Table 1: Summary of Environmental Concerns Identified during Stakeholder Engagement

Topic	Public Engagement Questions/Comments	TSMV Response/Outcome
Wildlife Corridor Design (continued)	Habitat enhancement to enhance corridor functionality.	Habitat enhancement initiatives are discussed in Golder's wildlife corridor report (Golder 2012) and are proposed within this EIS as a potential mitigation. However, it is also recognized in the EIS that efforts to enhance habitat in the corridor are within Provincial jurisdiction rather than the developer's. Refer to Section 5.6.2 Quantity and Quality of Wildlife Habitat within the ASP area).
Impacts to Wildlife and Wildlife Corridor	Human use in wildlife corridor associated with population growth.	The effects of increased human use within the adjacent wildlife corridors on grizzly bears, cougars, wolves and elk were modelled in the EIS. Refer to Section 5.3.2 (Existing Conditions – Human Use), Section 5.7.1 (Predicted Project Effects – Human Use), Section 5.7.2.2 (Use of Approved Corridors – Grizzly Bears), 5.7.3.2 (Use of Approved Corridors – Cougars), 5.7.4.2 (Use of Approved Corridors – Wolves), and 5.7.5.2 (Use of Approved Corridors – Elk) in the EIS Refer also to Appendix B (Wildlife Modelling Methods), Section 2.3 (Human Use of Recreational Trails)
	Fear of increased mortality on local roads and highways.	The intent of the wildlife fence is to exclude large mammals from developed areas, which should avoid mortalities on local roads associated with the Smith Creek ASP. The eastern side of the fence will connect to the existing fence located along the Trans-Canada Highway (Figure 43) and is not expected to increase wildlife interactions with the Three Sisters Parkway or the Trans-Canada Highway.
Data and Research Methods	Data skewed by developer and project biologist.	As practicing professionals, the project biologists have an ethical responsibility to ensure that the data used to inform the EIS and the Wildlife Corridor report (Golder 2012) is objective. The data that has been collected by TSMV has used the same data collection methods as the Province and the Town. These data are also categorized using the same techniques and shared between the three entities. Refer to Section 4 (Assessment Methods), Section 5.2 (Wildlife – Methods), and Appendix B (Wildlife Modelling Methods) of the EIS
	Data should be publicly available.	Much of the data is already publicly available, and publication of the Smith Creek ASP EIS will add to those data available. Refer to Section 4 (Assessment Methods), Section 5.2 (Wildlife – Methods), and Appendix B (Wildlife Modelling Methods) of the EIS
	Cumulative impact assessment required.	A cumulative impact assessment was completed as part of the Smith Creek ASP EIS. Refer to Section 4.5 (Assessment methods – Cumulative Effects) and Section 5.9 (Wildlife – Cumulative Effects)
	Not enough evidence to support the fence.	The Smith Creek ASP EIS details the rationale for the wildlife fence and highlights research and experience supporting the fence. Refer to Section 1.4 (Stakeholder Engagement – Wildlife Fencing), Section 2.2 (Alternatives and Modifications – Analysis) Section 2.3 (Alternatives and Modifications – Development Recommendations) and Section 5.6.4 (Mitigation – Wildlife Fencing) of the EIS

Table 1: Summary of Environmental Concerns Identified during Stakeholder Engagement

Topic	Public Engagement Questions/Comments	TSMV Response/Outcome
Data and Research Methods (continued)	Need to monitor corridor and fence after implementation.	The EIS requires that the Province, the Town and the developer collaborate on a monitoring program for the wildlife corridor during the implementation of the fence and the build out of Smith Creek ASP. Refer to Section 5.8 (Uncertainty and Monitoring) of EIS
General Development	Opposed to any development.	The NRCB Decision in 1992 permits development in the Smith Creek ASP. Consequently, the landowner has a legal right to develop the land. The discussion should now focus on ensuring that the development that goes forward maintains a balance between social and environmental considerations, economic feasibility, and the technical requirements of the Town. Refer to Section 1.1 (Existing Resort Centre ASP and Current Land Status)
	Town or Province to buy back land.	The area was previously a site of a private coal mining operation. In 1994, TSMV transferred 1,330 acres of sensitive land to the Province in the Wind Valley and Wind Ridge area. Another land transfer in 1994 saw TSMV transfer another 525 acres in the Wind Valley to the Province. Since 1994, TSMV has given 925 ha of land to the Province for the purpose of wildlife corridor designations or in other land exchanges.
	No development on undermining.	TSMV areas with undermining impacts will be carefully mitigated in accordance with the Canmore Undermining Review Regulation AR34/2020. Refer to Section 6.1 (Surface and Bedrock Geology, Soils and Terrain) of the EIS.
	Provide grocery store and community garden.	Because the ASP is a high-level planning document that provides a framework for future development, the specific types of uses and amenities provided in the Smith Creek ASP will be determined at a future planning stage. However, within Three Sister Mountain Village there are many different ASP's some of which are already approved and a grocery store within the commercial area of the Stewart Creek community has always been contemplated. This will provide for residents of Smith Creek an easy destination for people to do their shopping. There are also many different public community spaces that could accommodate a local community garden. Refer to Section 3.1 (Policy Areas and Development Concept) and Figure 6 of the EIS.
	High quality rather than generic development.	All development in the Smith Creek ASP will be subject to a set of architectural guidelines to ensure that development is consistent with the authentic look and feel of Canmore. Refer to Section 7.1 (Visual Resources) of the EIS
Cumulative Impacts	Cumulative impacts of all development in Bow Valley should be considered in the decision-making process.	A cumulative impacts assessment was completed as part of the EIS. Refer to Section 4.5 (Assessment Methods - Cumulative Effects)

Table 1: Summary of Environmental Concerns Identified during Stakeholder Engagement

Topic	Public Engagement Questions/Comments	TSMV Response/Outcome
Wildlife Mitigation Strategy	Fence will not be effective.	Experience with fencing elsewhere in the Rockies (i.e., along the Trans-Canada Highway and the Lake Louise Campground), as well as in Jackson, Wyoming, suggests that wildlife fencing will be an effective mitigation provided it is implemented as part of a comprehensive wildlife mitigation strategy. The fence will not be effective unless it is implemented in conjunction with strong attractant management and education initiatives as well as recreational amenities within the developed area to provide people with an alternative to recreating in the wildlife corridor. Refer to Section 5.6.4 (Wildlife Fencing) of the EIS
	Who will pay for the fence? Who will maintain it?	TSMV will pay for the installation of the fence and the operation and maintenance of the fence will be paid for as determined through the ASP process with the Town, and in a collaboration effort with Alberta Transportation. The boundaries of the land use concept "districts" are considered conceptual. The ASP concept may be adjusted due to on site conditions as planning applications get into greater detail throughout the development process as long as it is still in keeping with the ASP. An ASP amendment would be required if there was a complete change to the concept for example significant expansion (full blocks) of the Village Core into a residential area or Expansion of the Innovation District into a residential area. Refer to Section 5.6.4 (Wildlife Fencing) of EIS
	Seeing wildlife in town is an important part of the Canmore lifestyle.	Wildlife entering the developed area can result in negative human-wildlife interactions that not only pose safety risks to humans, but also can result in negative impacts on the wildlife populations. The use of wildlife fencing to exclude wildlife from developed areas is consistent with recommendations from the Bow Valley *Human-Wildlife Coexistence Report* (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018) Refer to Section 5.4.4 (Environmental Risks – Increased Negative Human-Wildlife Interactions) and Section 5.6.4 (Wildlife Fencing) of the EIS.
	More education surrounding appropriate use in wildlife corridors.	The Smith Creek EIS recommends educational initiatives as part of the comprehensive wildlife mitigation strategy. Refer to Section 5.6.3 (Wildlife Use of Approved Corridors and Negative Human-Wildlife Interactions) and Section 5.8 (Uncertainty and Monitoring) of the EIS.
	Greater enforcement for wildlife corridors.	Enforcement of appropriate uses in the wildlife corridor is an initiative that is within the jurisdiction of the Province.
	Stop running dogs in wildlife corridors.	In accordance with the Smith Creek, the ASP proposes off-leash dog parks within the developed area as well as a network of multi-use and mountain bike trail trails to deter people from recreating in the wildlife corridor. Refer to Section 7.3.4 (Land and Resource Use - Mitigation) of the EIS

Table 1: Summary of Environmental Concerns Identified during Stakeholder Engagement

Topic	Public Engagement Questions/Comments	TSMV Response/Outcome
Density and Population Increase	Exceed environmental carrying capacity of the Bow Valley.	The EIA completed as part of the NRCB Decision in 1992 considered the implications of an increased population in the Bow Valley, particularly for wildlife. Cumulative effects of the current Smith Creek ASP were assessed in the current EIS. Refer to Cumulative Effects sections for each Valued Component
	Loss of small town feel.	The proposed development is intended to remain consistent with the look and feel that is authentic to the anticipated and planned growth of Canmore. Refer to Section 7.1 (Visual Resources) in the EIS
	No clear cuts	While it would be advantageous to both developer and residents if trees could be maintained this is not always possible. Terrain modifications are required in order to conform to community engineering requirements, provide a variety of housing choice to residents, construct efficiently to maintain affordability. In Smith Creek, there are policies to limit the amount of terrain modification required but construction will still require clearing of areas. Revegetation of areas is done through landscaping after construction and is done in alignment with Town of Canmore Land Use Bylaw. Refer to Section 5.15 (Vegetation - Mitigation) of the EIS
Open House Content	Maps are hard to understand.	The maps shown at the open house were accompanied by captions and descriptions to provide additional context. The Smith Creek Project Team and project biologists were also available at the session to answer questions. The boards displayed at the open house are available on tsmv.ca and the Project Team is more than willing to answer any follow-up questions, please email info@tsmv.ca.

EIA = Environmental Impact Assessment.

Wildlife Fencing

Wildlife fencing was one of several key mitigations identified by Golder during initial discussions with the TSMV Team and the Town about alternatives and modifications to the Project to limit or remove effects (Section 2). Fencing as a proposed mitigation was also an important part of stakeholder engagement. Because of the substantial stakeholder engagement regarding wildlife fencing undertaken by the TSMV Team during 2015-2018, the reasons for including wildlife fencing as a mitigation for the Project and the engagement undertaken to address this important but contentious mitigation is summarized herein.

Negative human-wildlife interactions represent interactions between people and wildlife that span a continuum ranging from mild interactions (e.g., observing wildlife in a place where they are not welcome) to severe interactions (e.g., an attack on a person or a pet). From the perspective of wildlife populations, the problem with negative human-wildlife interactions at any point in the continuum arises when wildlife managers need to apply aversive conditioning or remove wildlife to protect people. Wildlife fencing can be a part of the solution to this problem.

Wildlife fencing strategies are not new; for example, the approved 2004 Resort Centre and approved Stewart Creek ASPs both recommended forms of fencing or a review of fencing, as a potentially effective mitigation to lower the effects of development and human use on how wildlife use the corridors. Parks Canada has long recognized the need to separate wildlife and people in the mountain parks and has used a variety of fencing types to provide necessary separation. Examples include the Sulphur Mountain wildlife corridor fence, Trans-Canada Highway fencing, permanent and temporary electric fencing at the Lake Louise campground and the lodges at the Lake Louise Ski Hill. The towns of Banff and Jasper have fenced school yards to reduce potential for negative interactions with elk and other large mammals. Recent collaborative work undertaken by the Town of Canmore, the Town of Banff and the Government of Alberta through the Bow Valley Human Wildlife Coexistence Roundtable’s Human-Wildlife Coexistence Technical Working Group, identifies wildlife fencing as a key mitigation strategy for reducing mortality on Bow Valley highways (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018). Although the group did not explicitly recommend fencing for residential and commercial developments in the Bow Valley, it did conclude that wildlife in developed areas cause public safety concerns, that separation between people and wildlife is important, and that the key recommendations of the report were developed to “increase cooperation across agencies, enable areas and time for wildlife to be undisturbed, remove attractants from areas where we do not want wildlife and create a degree of separation of wildlife from public areas using strategies such as highway fencing to exclude wildlife from developed areas” (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018, pg. 50).

Different types of fencing and partial fencing were considered as possible solutions for the Project to exclude wildlife from developed areas used by humans; these are discussed in Section 5.6.4. Ultimately, a 2.5 m high page wire fence with a buried apron, like those found on the Trans-Canada Highway, was identified as part of the solution to mitigate the existing approved scenario (2004 Resort Centre ASP) and its effects as well as the likely effects of the proposed Project on wildlife. Although fencing in the form proposed in this EIS has not previously been applied to residential developments in the Bow Valley, it is commonly used to reduce wildlife mortality on highways (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018), and has been applied to residential developments elsewhere. For example, in Jackson, Wyoming, wildlife fencing and supplemental feeding are used as mitigation to reduce human-wildlife conflict associated with bison and elk.

Given the importance of wildlife fencing as a mitigation strategy identified in this EIS to address human-wildlife conflict and concerns raised by some Canmore residents as part of previous ASP processes, specific engagement with external wildlife managers was sought regarding wildlife fencing. The Town convened a meeting of wildlife managers from Banff National Park and the Province in April 2016 to discuss the efficacy of wildlife fencing as a mitigation strategy for the TSMV developments. Attendees were:

- David Gummer and Eric Knight from Parks Canada
- Jay Honeyman from Alberta Fish & Wildlife
- Brett Boukall from AEP
- Tracy Woitenko, Alaric Fish, Lisa Guest, and Lori Rissling-Wynn from the Town
- Martin Jalkotzy and Cornel Yarmoloy from Golder
- Jessica Karpat, Kent MacDougall, and Jenn Giesbrecht from the TSMV Team

The focus of the meeting was to discuss negative human-wildlife interactions in the Bow Valley, determine whether wildlife fencing is a viable mitigation option for future development in TSMV, and, if so, to discuss potential challenges and configuration options. Fence construction, fence ends, swing gates, jump-outs, and electromats were discussed.

Permeable fencing was not considered effective due to the high level of enforcement that is required to manage human crossing and because permeable fencing does not prevent wildlife from accessing developed areas. On the other hand, wildlife exclusion fence similar to the fencing used on the Trans-Canada Highway was identified as a potentially effective mitigation tool if the fence fully enclosed development.

Information regarding fencing was presented as part of the community conversations and at open houses in 2017 to address some of the long-standing concerns within the community about wildlife fencing. The latest design features and suggestions on conceptual alignment recommended by some attendees have been incorporated into this EIS.

1.5 Document Structure and Concordance Table

Following these introductory materials, this EIS is structured as follows:

- Section 2 provides an evaluation of alternative design scenarios and lists design recommendations provided by Golder to the TSMV Team to limit effects on valued environmental components (VECs).
- Section 3 presents an overview of the proposed Project.
- Section 4 outlines the assessment methods.
- Section 5 presents the impact statements for biodiversity VECs (wildlife, vegetation, aquatic ecology).
- Section 6 presents the impact statements for physical VECs (surface and bedrock geology, soils and terrain, surface and groundwater, air, noise).
- Section 7 presents the impact statements for social VECs (visual resources, historic resources, land and resource use).

- Section 8 provides a summary of environmental consequences (before and after mitigation) as well as the commitments related to mitigation, compensation, studies and monitoring that will be required of TSMV should the ASP be approved by Council and development proceeds to the next stage of the planning process. These commitments are relied upon by Golder when estimating the environmental effects of the Project.
- Section 9 lists the scientific literature and other information sources used during the development of this EIS.

The structure of the EIS is intended to provide all the information required by the TOR (Appendix A) in a logical and efficient order. The TOR concordance table identifies all key requirements outlined within the TOR and identifies the section in this EIS where the information can be found (Table 2).

Table 2: Concordance Table

Terms of Reference Section	Terms of Reference Requirement	Section(s) in the Environmental Impact Statement
3.0	Relevant sections of guidelines applied in the EIS ▪ Municipal Development Plan Bylaw 2016-03, Town of Canmore (2016) ▪ South Saskatchewan Regional Plan 2014-2014: An Alberta Land-use Framework Integrated Plan. Alberta Government ▪ Town of Canmore. Human Use Management Review. Consultation Summary, Final Recommendation and Implementation Plans (2015) ▪ Recommendations for Trails and Management of Recreational Use for the Town of Canmore: South Canmore and West Palliser (2012) ▪ Town of Canmore Wildfire Mitigation Strategy Review. Montane Forest Management Ltd. (2018) ▪ Town of Canmore Noise Bylaw (1997) ▪ AE Guidelines for Storm Water Management for Province of Alberta (1999) ▪ Town of Canmore Construction Management Plan Guidelines rev-03-2018 ▪ Engineering Design and Construction Guidelines (2010) ▪ Stepping Back from the Water: A Beneficial Management Practices Guide for New Development Near Water Bodies in Alberta's Settled Region (AESRD 2012)	▪ 1.0, 7.1.4, 7.3.3 ▪ 5.5, 5.23, 6.2.4, 7.3.3 ▪ 5.2.1, 5.7.1 ▪ 2.3 ▪ 5.6.2 ▪ 6.4.5 ▪ 6.2.5 ▪ 5.5, 5.14, 5.23 6.2.4, 6.3.4, 7.2.4 ▪ 5.24, 6.2.4, 6.2.5
3.0	The EIS should consider *"Human-Wildlife Coexistence – Recommendations for Improving Human-Wildlife Coexistence in the Bow Valley" (2018)*	1.4, 2.2.1, 5.3.5, 5.3.6, 5.6.4, 5.7.1, 5.7.5, 5.8
3.0	The scientific principles included in the following documents will be considered in the EIS wildlife assessment: ▪ *BCEAG Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley (2012)* ▪ *BCEAG Wildlife and Human Use Monitoring Recommendations for the Bow Valley (Banff National Park to Seebe) (2001)* ▪ *BCEAG Guidelines for Human Use within Wildlife Corridors and Habitat Patches in the Bow Valley (Banff National Park to Seebe) (1999)*	▪ 2.2, 5.3.1, ▪ 5.8 ▪ 5.3.1, 5.3.2
3.0, 4.6a	A description of existing environmental conditions and existing developments/footprints (e.g., Stewart Creek, Thunderstone Quarry, transmission lines) within the Local Study Area (LSA) and as required, within the Regional Study Area (RSA). The LSA should include the proposed Smith Creek ASP, as well as approved development lands in the TSMV (Stewart Creek ASP, Three Sisters Village ASP), and adjacent wildlife movement corridors.	5.3, 5.12, 5.21, 5.24, 6.1.2, 6.2.2, 6.3.2, 6.4.2, 7.1.2, 7.2.2, 7.3.1, 8.0
2.0, 3.0	In the LSA, describe the cumulative environmental impacts from the Project in combination with baseline effects.	1.3, 5.3, 5.7, 5.9, 5.18, 6.1.2, 6.1.8, 6.2.2, 6.2.8, 6.3.8, 6.4.9, 7.1.8, 7.2.8, 7.3.7

Table 2: Concordance Table

Terms of Reference Section	Terms of Reference Requirement	Section(s) in the Environmental Impact Statement
3.0	A discussion of the potential effects of climate change on the Project and on VECs will be provided.	5.3.6, 5.9.2.1, 5.9.2.4, 5.9.3.1, 5.9.3.4, 5.9.4.1, 5.9.5.1, 5.18, 5.27, 6.2.8, 6.3.8
3.0	Evaluate alternate development scenarios, including development layouts, to reduce environmental and social (human use and public safety) effects from the Project.	2.0
3.0	Provide summary tables that address environmental consequences, mitigation and monitoring during both the construction and build-out phases. The tables should include the following headings: Environmental and Social Disciplines; Pre-Mitigated Impact Consequences; Proposed Mitigation; Post-Mitigated (i.e., residual) Impact Consequences); Proposed Monitoring and Future studies.	8.0 (Table 50)
3.0	Provide summary tables of all commitments related to mitigation, compensation, studies, and monitoring in the EIS.	8.0 (Table 50)
3.0	Include a table of commitments that will need to be met by the developer, under municipal, provincial and federal legislation when more detailed, site-specific plans for development in the ASPs are completed. i.e., construction outside of sensitive wildlife windows, protection of environmentally sensitive areas, requirements under the federal *Fisheries Act* and *Species at Risk Act*, and *Alberta Water Act* and Wetland Policy.	8.0 (Table 50)
3.0	Pre-construction baseline surveys will be conducted for fish, amphibians, reptiles, and wetland should be identified.	5.6.1, 8.0 (Table 50)
4.1a	Describe the development context for the Project, including previous approvals and ASPs.	1.1
4.1b	Map the Project in relation to existing conditions within the Project, Local and Regional Study Areas.	Figure 11, Figure 12, Figure 13, Figure 59, Figure 62, and Figure 64
4.1c	Provide an overview of the Canmore municipal planning policy context.	3.1
4.2a	Summarize Project details from the ASP. Describe conceptual layout, development nodes, densities and units and temporal development schedule. Include a detailed description of Project-associated infrastructure i.e., road systems and utilities including municipal water, storm water, waste water (e.g., sanitary water) and waste management.	3.0
4.2b	Provide a land use map that includes and accounts for density of people, buildings, and infrastructure in the Project Area.	Figure 6
4.2c	Estimate the maximum number of people and traffic for each phase.	3.0
4.3a	Identify the approach used to consult with the public to identify their concerns about the Project, how the issues have been addressed, and where information to address the concerns is presented in the EIS.	1.4
4.4a – i	Project Study Area boundary should include all the residential, resort and supporting commercial structures, and recreational uses and infrastructure within the ASP.	4.1
4.4a-ii	Local Study Area should include the proposed Project, as well as approved development lands in the TSMV (Stewart Creek ASP, Three Sisters Village ASP) and adjacent movement corridors.	4.1

Table 2: Concordance Table

Terms of Reference Section	Terms of Reference Requirement	Section(s) in the Environmental Impact Statement
4.4a – iii 3.0	Regional Study Area boundary for Environmental Consequences of residual effects of the Project should include future developments whose impacts overlap with those of the Project. The Regional Study Area needs to be meaningfully sized to properly reflect the effects of the proposed Project. Within the RSA, describe the Baseline conditions, the Project effects, and the Cumulative Environmental Impacts from probable projects that could occur in the next five years and would impact the same environmental resources as those affected by the Project.	4.1
4.4a-iv	The Project, Local and Regional Study Areas are illustrated on Maps A and B.	4.1, Figure 11, Figure 12
4.4b	Temporal boundaries should extend from the time of project approval to full build-out of the facilities, including the construction and build-out phases (e.g., 5 to 20 years).	4.1
4.5	The level of assessment detail for each VEC will reflect the potential effects from the Project. More detailed assessments should be provided for those VECs for which potential effects are greater.	4.3
4.6a	A description of existing environmental conditions with the Local Study Area and, as required, within the Regional Study Area.	5.3, 5.12, 5.21, 6.1.2, 6.2.2, 6.3.2, 6.4.2, 7.1.2, 7.2.2, 7.3.1
4.6b	A literature review of relevant studies, including background environmental effects studies, and the most current monitoring data from remote cameras, telemetry from collared wildlife, and wildlife-human interactions, and the effects of wildlife enhancement and fire reduction sites.	5.3, 5.6.2, 5.15
3.0, 4.6c	Conduct field programs where data gaps exist in baseline conditions. Based on discussion with the third-party reviewer, the additional site-specific field surveys should include rare plant surveys; and wildlife corridor surveys for constraints and sites for mitigation to improve functionality.	4.0, 5.0, 5.2
4.6d	Discuss effects from the existing developments/footprints, including existing mitigation.	5.3, 5.12, 5.6.4, 5.21, 6.1.2, 6.2.2, 6.3.2, 6.4.2, 7.1.2, 7.2.2, 7.3.1
3.0, 4.7	For each VEC, identify federal or provincial requirements or restrictions relevant to the VEC, and how the proposal will meet the intent of legislative requirements.	5.5, 5.14, 5.23, 6.1.4, 6.2.4, 6.2.5, 6.3.4, 6.4.5, 7.1.4, 7.2.4, 7.3.3
4.8a	Identify the benefits of the Project	8.1
4.8b	Evaluate how the Project has been designed to address environmental sensitivities or constraints.	3.4
4.8c	Outline alternatives and modifications to the Project to limit or remove environmental impacts. Where feasible reduce existing effects from the currently developed TSMV lands. Discuss how the Project has addressed concerns of the public.	2.2, 2.3, 3.4, 8.0 (Table 50)
4.8d	Identify anticipated impacts from activities of future residents associated with the Project on VECs.	5.7, 5.16, 5.25, 6.1.3, 6.1.6, 6.2.3, 6.2.5, 6.2.6, 6.3.6, 6.4.7, 7.1.6, 7.2.6, 7.3.5
4.8e	Identify cumulative impacts from the Project and the existing conditions, on VECs.	5.9, 5.18, 6.1.8, 6.2.8, 6.3.8, 6.4.9, 7.1.8, 7.2.8, 7.3.7
4.8f	Address impacts from both the construction and build-out phases of the Project.	5.7, 5.16, 5.25, 6.1.3, 6.1.6, 6.2.6, 6.3.6, 6.4.7, 7.1.6, 7.2.6, 7.3.5
2.0, 4.8g-i	Identify the pre-mitigated nature and scale of environmental risks and the significance of the residual (or post-mitigated) effects from the Project, and the Environmental Consequence of the residual effects (positive, negligible, low, moderate and high).	5.7, 5.16, 5.25, 6.1.6, 6.2.6, 6.3.6, 6.4.7, 7.1.6, 7.2.6, 7.3.5

Table 2: Concordance Table

Terms of Reference Section	Terms of Reference Requirement	Section(s) in the Environmental Impact Statement
4.8g-ii	Significance terms to be used in defining the impacts will include: 1. Context 2. Direction 3. Magnitude 4. Frequency 5. Duration 6. Reversibility 7. Geographic Extent 8. Probability	4.3
2.0, 4.8h-i	Define Mitigation and Environmental Management Plans: Provide recommendations on how to avoid, reduce or mitigate negative effects, and build on positive effects from the Project.	5.6, 5.15, 6.1.5, 6.2.5, 6.3.5, 6.4.6, 7.1.5, 7.2.5, 7.3.4
2.0, 4.8h-ii	Define Mitigation and Environmental Management Plans: Provide specific recommendations on how to mitigate long-term human use effects.	5.6, 5.15, 6.1.5, 6.2.5, 6.3.5, 6.4.6, 7.1.5, 7.2.5, 7.3.4
4.8h-iii	Where applicable, provide more detailed environmental management plans for effects on wildlife, habitat and the wildlife movement corridors, and to reduce human-wildlife interactions.	5.6
4.8h-iv	Discuss regional and cooperative efforts that have been initiated, or participated in, by the Developer to address regional environmental issues.	5.6, 5.15, 6.1.5, 6.2.5, 6.3.5, 6.4.6, 7.1.5, 7.2.5, 7.3.4
4.8i	Identify and describe the uncertainty of the data, models, mitigation and projected effects, and the confidence in the predictions of residual impacts. Identify how uncertainty has been managed in the EIS.	5.8, 5.17, 5.26, 6.1.7, 6.2.7, 6.3.7, 6.4.7, 7.1.7, 7.2.7, 7.3.6
2.0, 3.0, 4.9a	Conduct a meaningful cumulative effect assessment (CEA) within the RSA that includes proposed and probable projects that could occur in the next 5 years and impact the same environmental resources (e.g., grizzly bears, elk, groundwater) as those affected by the Project.	5.9, 5.18, 6.1.8, 6.2.8, 6.3.8, 6.4.9, 7.1.8
4.9b	In the broader CEA, include residual impacts from the Project with an Environmental Consequence greater than negligible.	5.9, 5.18, 6.1.8, 6.2.8, 6.3.8, 6.4.9, 7.1.8
4.9c	Issues that may need to be addressed in the cumulative effects assessment include: i. Incremental effects on the wildlife movement corridors ii. Increased human-wildlife interactions iii. Increased traffic on wildlife mortality	5.4.5, Table 23, 5.7, 5.7.6, 5.9
2.0, 4.10a-i	Identify potential monitoring programs, for the Project. The programs need to have linkage to potential thresholds defined for effects (e.g., water quality objectives, air quality objectives).	5.6, 5.8, 5.15, 6.1.5, 6.2.5, 6.3.5, 6.4.6, 7.1.5, 7.2.5
2.0, 4.10a-ii	Identify whether additional environmental studies are required.	5.6, 5.15, 6.1.5, 6.2.5, 6.3.5, 6.4.6, 7.1.5, 7.2.5
4.10b	Identify and participate in comprehensive valley-wide regional monitoring programs, involving and funded by all stakeholders, to monitor the status and mortality of wildlife populations, and to determine the effectiveness (i.e., functionality, connectivity) of wildlife movement corridors near the TSMV lands.	5.6
4.10c	Provide all data from monitoring programs and future studies to the Town of Canmore or regional bodies assisting in the management of wildlife in the Bow Valley.	5.6, 5.8
4.11a	Specific analyses to be completed: Environmental impacts due to undermining, including effects on ground and surface water.	6.1, 6.2, 6.2.2, 6.2.6

Table 2: Concordance Table

Terms of Reference Section	Terms of Reference Requirement	Section(s) in the Environmental Impact Statement
4.11b-i	Specific analyses to be completed: Related to Wildlife Use meaningful and well justified Alternative Development Scenarios that will lead to the selection of development plans that will have acceptable impacts on wildlife. Scenario assessments could reflect a range in development densities and layouts, and hence different development footprints, different numbers of people who could reside in the development, and different pressures on wildlife from increased human use of wildlife corridors, from increased traffic and from indirect effects of noise and light.	2.0
4.11b-ii	Specific analyses to be completed: Related to Wildlife Assess Project effects on proposed and existing wildlife corridor movement patterns related to change in habitat use and increased human use. Use validated habitat selection models (e.g., resource selection functions developed and validated using telemetry data collected in the RSA). Use approaches that recognize existing movement constraints and propose mitigations to improve those constraints. Include the Along Valley, Steward Creek Across Valley, and proposed Smith Creek Along wildlife corridors in the analysis.	5.1
4.11b-iii	Specific analyses to be completed: Related to Wildlife Identify impacts from the wildfire mitigation strategy that will be required for development, including changes to vegetation, habitat and effects on wildlife.	5.6.2, 5.15
4.11b-iv	Specific analyses to be completed: Related to Wildlife Evaluate the mitigation used to reduce effects on wildlife, including fencing, if this is proposed to manage Project effects.	5.6, 5.6.4, 5.7
4.11b-v	Specific analyses to be completed: Related to Wildlife Address human-use impacts on wildlife populations (e.g., corridor functionality, vehicle collisions), as well as the potential effects on human safety from wildlife conflicts.	5.6, 5.7
4.11b-vi	Specific analyses to be completed: Related to Wildlife Update the *2004 Wildlife Human Interface Prevention Plan* (previously prepared in 2004 for the TSMV) to reflect current legislation, and potential wildlife – human effects, and mitigation and monitoring required for the Project.	N/A[(a)]

a) As discussed during a March 25, 2019 meeting between the Town of Canmore (the Town), Management and Solutions in Environmental Science (MSES) and QuantumPlace Developments (QPD) it was agreed that the Wildlife Human Interface Prevention Plan (WHIPP) is a provincially approved document and that it should be handled separately from the EIS and Third-Party Review (TPR).

ASP = Area Structure Plan; LSA = Local Study Area; N/A = not applicable; QPD = QuantumPlace Developments; RSA = Regional Study Area; TOR = Terms of Reference; TPR (Third Party Reviewer); TSMV = Three Sisters Mountain Village; VEC = valued environmental component; WHIPP = Wildlife Human Interface Prevention Plan.

2.0 ALTERNATIVES AND MODIFICATIONS

2.1 Approach

Alternatives and modifications to the conceptual design for the Project were presented to QPD prior to finalizing the proposed Project design described in Section 3. The alternatives analysis and consultation about alternatives was led by QPD and considered a wide range of factors including environmental, social, legal, and economic. Golder provided input into the environmental component of the alternatives considered by QPD and this section describes that input. Input was iterative, and Golder provided feedback on various conceptual options by making recommendations that would help reduce the potential impact of the Project on VECs.

Like other aspects of this EIS, exploring alternatives focused on wildlife, especially on identifying design principles that could reduce negative human-wildlife interactions and limit sensory disturbance in approved wildlife corridors. The question asked in the alternatives analysis is: “how does wildlife selection of habitat within designated wildlife corridors change (e.g., through changes in sensory disturbance) and how are negative human-wildlife interactions altered as a result of different development configurations inside the Project Boundary?” This section focuses on describing the potential outcomes of some conceptual alternative scenarios for the distribution of unit densities and development areas but does not include the Three Sisters Parkway. These concepts were developed and analyzed by Golder and then presented to QPD. The purpose of the conceptual scenarios was to help QPD and TSMV understand the implications of different land use concept design alternatives and their impact on wildlife to inform their ultimate land use concept proposal. Additional mitigation was recommended based on Golder’s assessment of the final proposed design, and this mitigation is presented in sections addressing each VEC (Sections 5, 6 and 7).

Available information about how wildlife responds to existing developments and mitigation in the Bow Valley, along with available scientific literature, formed the basis of the alternatives analysis. The information used to inform this analysis is the same as the concept used to inform the impact assessment for wildlife presented in Section 5.1. General concepts are summarized here, and readers interested in more detail about the literature and data supporting these concepts will find it in Section 5.1 and Appendix B.

A fundamental consideration of the alternatives analysis was that the NRCB had already been approved development of TSMV lands in 1992. As outlined in the ASP, approximately 840-1,730 units could be developed in the Smith Creek ASP, and this final number will depend on the number of units developed elsewhere on TSMV properties. Consequently, the alternatives analysis did not consider a no development option.

2.2 Analysis

The Project proposes to add residential, commercial and light industrial districts within the ASP area (Section 3). The amount, density, and spatial arrangement of the proposed development has the potential to affect wildlife use in the adjacent wildlife corridors through sensory disturbance, and human-wildlife conflict by increasing the potential for interactions between humans and wildlife in the ASP area. Human use within wildlife corridors also has the potential to affect wildlife use of the corridor, but the amount of human use in the corridor is expected to be driven more by the number of people in the development and the likelihood that they recreate in the corridors, and less as a function of different development footprint designs. The alternatives analysis therefore evaluated the spatial configuration and density of different conceptual development footprint options on wildlife use of corridors and negative human-wildlife interactions.

Because no development will occur in the approved wildlife corridors adjacent to the ASP area, sensory disturbance is the mechanism by which variation in the ASP footprint design could alter wildlife habitat selection within the approved wildlife corridors. The degree to which sensory disturbance from development might change the probability of wildlife selection within the approved wildlife corridors is a function of many variables including:

- amount of sensory disturbance entering the corridor; that is, how noisy, how much light, how many strong smells
- the distance of the nearest human structures from the edge of the corridor
- species of wildlife because different species react to human developments to varying degrees
- the degree of habituation that individuals of a species exhibit because of prior experience

Several different mitigation measures can be used to reduce sensory disturbance, including changing development footprint design and reducing development density. Some design options, however, can have unintended consequences. For example, both Golder (2002) and BCEAG (2012) incorporated an outdated recommendation that development areas adjacent to corridors should include as much open space as possible. That is, golf courses and recreation areas are preferred over acreage lots, which in turn are preferred over higher density housing. The intention of this “soft edge” approach is to increase the effective width of the adjacent wildlife corridor by reducing the effects of sensory disturbance on wildlife travelling within corridors, thereby increasing the probability that the corridor would be used. This approach is based on the assumptions that wildlife would strongly avoid all forms of human development and that human development would exert a large zone of influence that adversely affects probability of selection; assumptions that have since proven false for species like cougars, grizzly bears, and elk (Appendix B).

Because assumptions about large mammal responses to development were inaccurate, one of the unintended consequences of looking for ways to reduce sensory disturbance using “soft edges” is that these open space and park-like habitats can increase the risk of negative human-wildlife interactions. Negative human-wildlife interactions have increased substantially in large open spaces that are found immediately adjacent to residential developments in Canmore during the last decade (Town of Canmore 2015a), with strong adverse outcomes for some species (Section 5.1).

The analysis undertaken in this section uses two different conceptual development scenarios to investigate trade-offs between sensory disturbance and negative human-wildlife interactions adjacent to the Smith Creek Corridor. The conceptual scenarios are presented in Figure 3, and were developed in consultation with the Town and the Town’s third-party reviewer as follows:

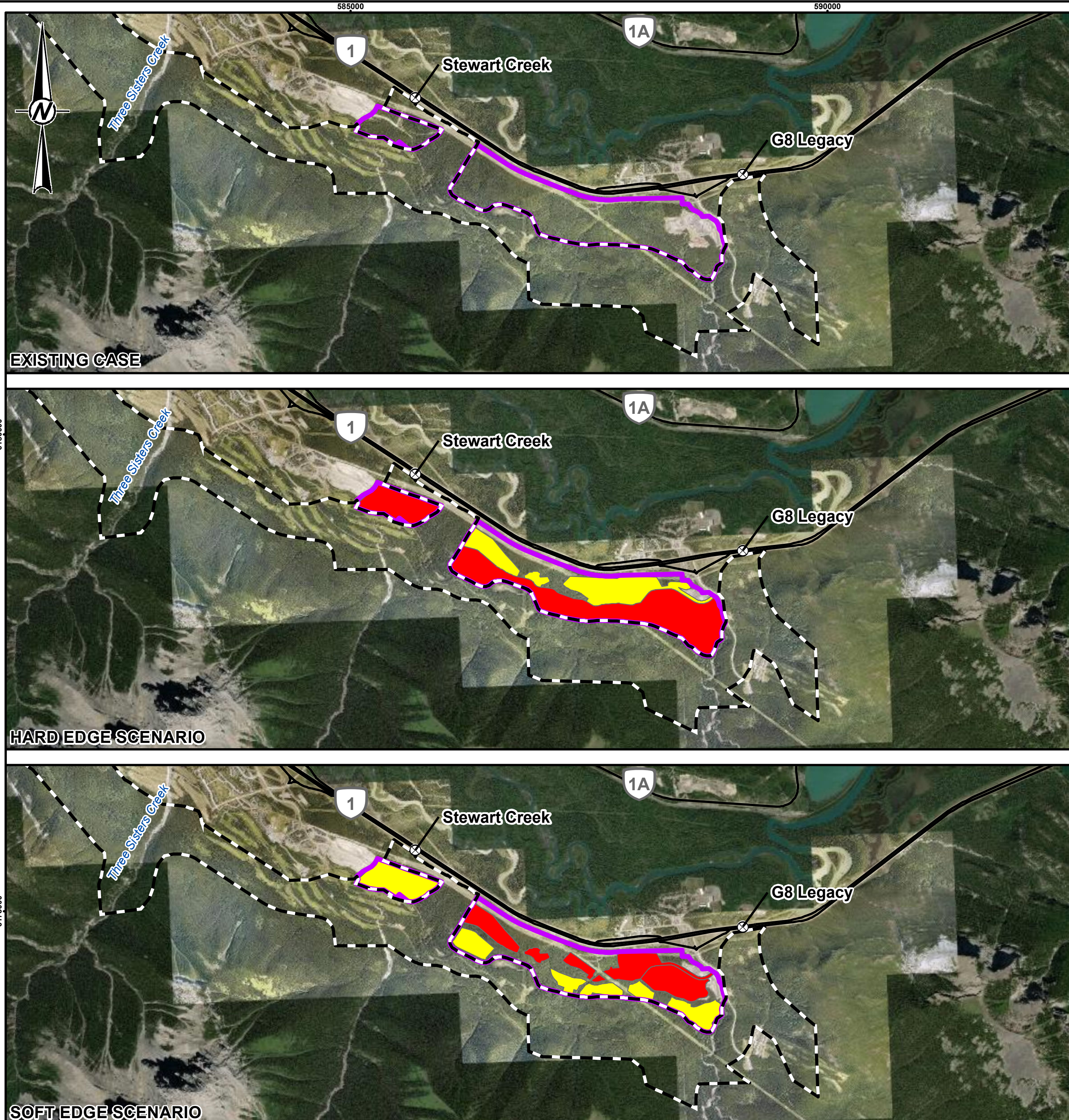
- **Hard edge scenario (development as a deterrent)** – Higher density development closer to wildlife corridors with lower density developments in the remainder of the ASP area. This scenario represents an alternative to the soft edge approach and uses higher density development adjacent to wildlife corridors to reduce the potential for animals to enter the development and interact negatively with humans.
- **Soft edge scenario** – Higher density development in the northern part of the ASP area, and lower density development (i.e., 2 to 8 units per acre) occurring only within four pods located on the abandoned golf course and otherwise maintaining recreational zones on the abandoned golf course lands. This scenario represents a typical soft edge development designed to increase the effective width of wildlife corridors.

The scenarios were evaluated (Sections 2.2.1 and 2.2.2) without the application of mitigation and therefore are meant only to compare the two approaches to development. The alignment and location of the proposed Three Sisters Parkway through the Stewart Creek Across Valley Corridor was a fixed element and was not subject to change as part of the analysis of alternatives. As such, the Parkway was not included as a feature in the assessment of alternatives. The Parkway alignment was an element that underwent significant discussion during the collaborative process to establish the Smith Creek land use concept. The Town wanted to see a balance of priorities in the design of the alignment. This included locating the road alignment centrally within Smith Creek to ensure efficient access to future residential developments, elimination of any potential duplication of road right-of-ways, ensuring future transit coverage, and ultimately making sure that the road could be designed not to exceed safe vertical and horizontal alignments.

Trade-offs between sensory disturbance in the wildlife corridor (i.e., reduced probability of selection) and negative human-wildlife interactions (i.e., whether or not developed areas are selected) for the different scenarios were evaluated for grizzly bears and wolves using resource selection function (RSF) models derived from empirical data collected in the Bow Valley (Section 5.2.3 and Appendix B).

Grizzly bears and wolves were the species selected for this analysis in consultation with the Town and the third-party reviewer. Grizzly bears are a species of concern in terms of both movement and negative human-wildlife interactions in the Bow Valley (Section 5.3.3) and are most likely to be adversely affected by a “soft edge” scenario. Wolves are a species for which sensory disturbance from human development creates a strong zone of influence and are therefore most likely to be adversely affected by a “hard edge” scenario (Appendix B).

The RSF models provide a spatially explicit quantification of the responses of grizzly bears and wolves inhabiting the Bow Valley to several environmental variables including human development (Appendix B). Because the zones of influence estimated from the RSF models are derived from responses exhibited by animals collared in the Bow Valley, they will more accurately represent site-specific responses to development than literature values obtained from places with less development (Knopff et al. 2014). Integrating the conceptual development scenarios into the models results in a quantitative prediction of how grizzly bears and wolves will respond to different development scenarios. This permits a quantitative evaluation of the change in the probability of grizzly bear and wolf selection within the ASP area and in approved wildlife corridors adjacent to the Project because of each conceptual development scenario. As a result, the model predicts how different types of development affect the likelihood of use/selection in the adjacent wildlife corridor by wildlife.



LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- WILDLIFE CORRIDOR
- PROJECT BOUNDARY

PROJECT FOOTPRINT DENSITY

- HIGH DENSITY
- LOW DENSITY

0 1,000 2,000

1:60,000 METRES

REFERENCE(S)

1. IMAGERY COPYRIGHT © 20170115 ESRI AND ITS LICENSORS. SOURCE: TOWN OF CANMORE. USED UNDER LICENSE, ALL RIGHTS RESERVED.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT
GOLDER

YYYY-MM-DD	10/5/2020
DESIGNED	SM
PREPARED	AK/DA
REVIEWED	SM
APPROVED	KK

TITLE
CONCEPTUAL DEVELOPMENT ALTERNATIVES

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	3

Detailed methods used to derive RSF models are presented in Appendix B and summarized in Section 5.2.3. Five categories of habitat selection were created to help understand how wildlife selection changes with the addition of development. Model categories for each species should be interpreted as follows:

- Selected – observed proportion of independent telemetry locations in this category are greater than the proportion that would be expected if habitats are used as available.
- Used as available – observed proportion of independent telemetry locations in this category are at or near the proportion that would be expected if habitats are used as available.
- Somewhat avoided – observed proportion of independent telemetry locations in this category are below the proportion that would be expected if habitats are used as available.
- Strongly avoided – observed proportion of independent telemetry locations in this category are much less than the proportion that would be expected if habitats are used as available.
- Rarely used – observed proportion of independent telemetry locations in this category are near zero.

In general, habitats that are selected and used as available are considered suitable habitats whereas somewhat avoided, strongly avoided and rarely used habitats are, by definition, avoided and therefore of lower suitability. When interpreting changes in habitat selection, negative effects are inferred when models predicted a loss of selected and used as available habitats and a commensurate gain in somewhat avoided, strongly avoided and rarely used habitats.

2.2.1 Grizzly Bears

Results of the scenario analysis for grizzly bears are quantified as changes to habitat selection both within the ASP area (Table 3, Figure 4) and within the adjacent wildlife corridors (Table 4, Figure 4).

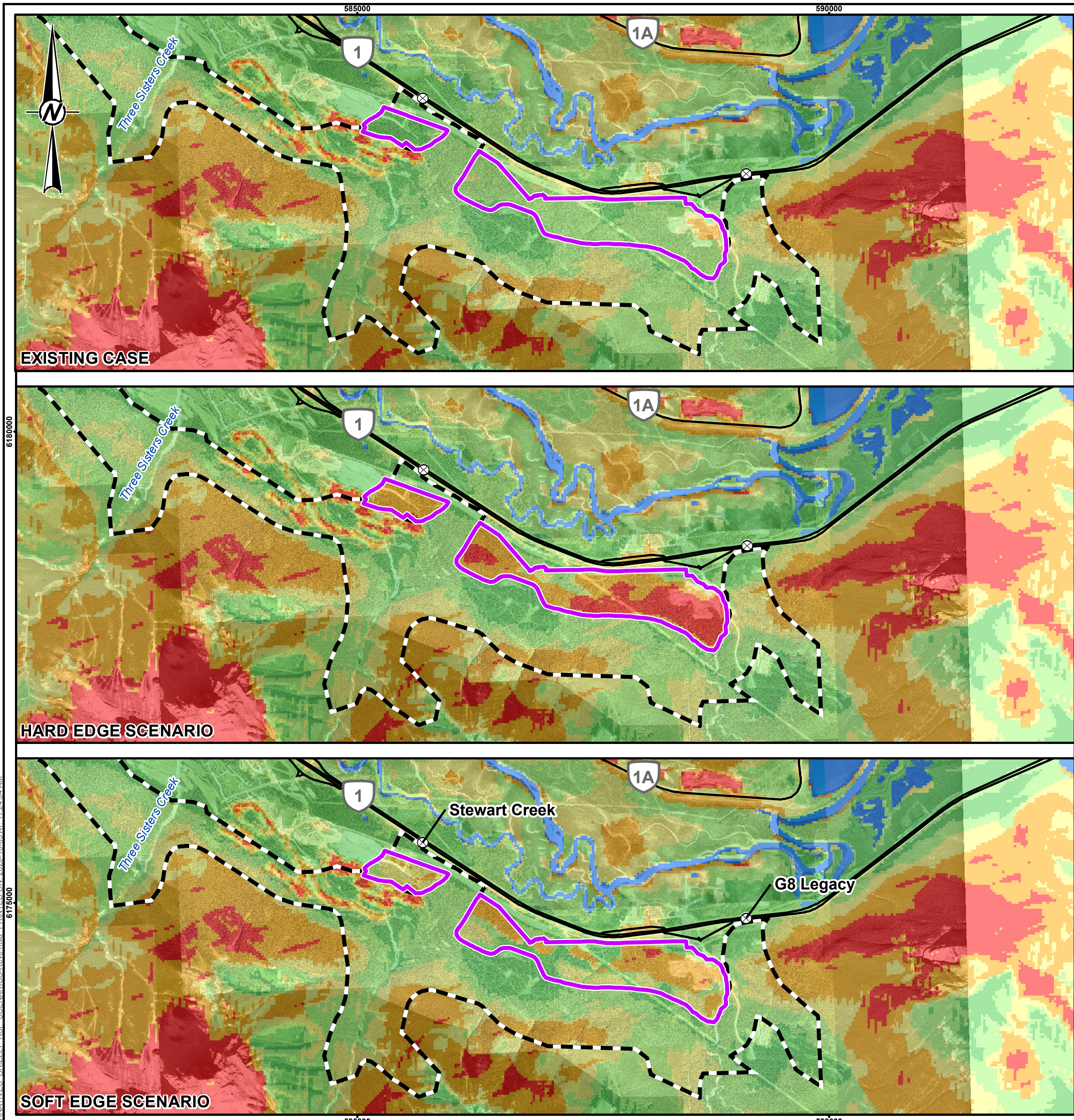
Table 3: Change in Habitat Classes for Grizzly Bears in the Area Structure Plan Area as a Result of Different Conceptual Development Scenarios

Habitat Class	Existing Conditions [ha]	Soft Edge Scenario (Change[(a)]) (ha)	Hard Edge Scenario (Change[(a)]) (ha)
Selected	32.6	27.3 (-5.3)	2.9 (-29.7)
Used as available	108.6	28.5 (-80.1)	10.3 (-98.3)
Somewhat avoided	7.0	42.1 (35.1)	10.3 (3.3)
Strongly avoided	5.5	53.0 (47.5)	74.2 (68.7)
Rarely used	0.0	2.8 (2.8)	55.9 (55.9)

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Change calculated by subtracting the existing conditions value from the scenario value. Negative effects are inferred when models predicted a loss of selected and used as available habitats or a gain in somewhat avoided, strongly avoided and rarely used habitats.

ha = hectares.



LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 1,000 2,000

1:60,000 METRES

REFERENCE(S)
1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT	PROJECT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.	SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	10/5/2020
DESIGNED	KK
PREPARED	DA/AK
REVIEWED	SM
APPROVED	KK

TITLE

SUMMARY GRIZZLY BEAR RESOURCE SELECTION UNDER DIFFERENT DEVELOPMENT SCENARIOS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	4

Table 4: Change in Habitat Classes for Grizzly Bears in Approved Wildlife Corridors Adjacent to the Project as a Result of Different Conceptual Development Scenarios

Habitat Class	Existing Conditions (ha)	Soft Edge Scenario (Change[(a)]) (ha)	Hard Edge Scenario (Change[(a)]) (ha)
Selected	116.1	117.5 (1.4)	110.3 (-5.9)
Used as available	234.9	230.7 (-4.2)	229.1 (-5.8)
Somewhat avoided	140.2	133.8 (-6.4)	139.3 (-0.8)
Strongly avoided	68.0	75.2 (7.2)	78.2 (10.2)
Rarely used	7.9	9.8 (1.9)	10.2 (2.4)

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Change calculated by subtracting the existing conditions value from the scenario value. Negative effects are inferred when models predicted a loss of selected and used as available habitats or a gain in somewhat avoided, strongly avoided and rarely used habitats.

ha = hectares.

Under existing conditions, the ASP area is predicted to be selected or used as available by grizzly bears during summer (Table 3, Figure 4). Similarly, the adjacent wildlife corridors consist primarily of land that is either selected or used as available with only 13.4% of the corridors consisting of habitat that is strongly avoided or rarely used (Table 4). Under existing conditions, negative human-bear interactions may occur throughout the Smith Creek ASP as well as the adjacent approved wildlife corridor. However, based on AEP data (Honeyman 2019, pers. comm.; Bow Valley Human-Wildlife Coexistence Round Table 2018), negative human-bear interactions are currently rated as low in the ASP area, although the ranking increases to high northwest of the Project ASP and closer to existing developments in Canmore (Section 5.3.3).

Neither scenario results in substantial changes in the probability of habitat selection in the approved wildlife corridors adjacent to the Project (Table 4, Figure 4). This reflects the adaptability of grizzly bears in the Bow Valley, which commonly select habitat immediately adjacent to development, including high density developments (Appendix B). Grizzly bear habitat selection is positively correlated with forest edges which are associated with openings in forest canopy where food resources for grizzly bears may be higher (Section 2.2.1 in Appendix B). Therefore, developments that create forest edge may increase the selection of nearby habitats by Grizzly Bears. In other words, the zone of influence is small because grizzly bears in the Bow Valley are habituated to anthropogenic disturbance (Donelon 2004). Although the type of development in the ASP footprint makes little difference in the likelihood that grizzly bears will use the corridor, the two scenarios have very different implications for human-bear conflict.

The soft edge scenario, which assumes higher density development in the northern part of the proposed Smith Creek ASP, and lower density development along the southern edge of the ASP, reduces the total area of habitat that is selected or used as available by grizzly bears, but the reduction is less than under the hard edge scenario (Table 3). Approximately 36% of the ASP area remains classified as either selected or used as available in this scenario (Table 3). Within the proposed developed area, the northern developed portions of the ASP area are less likely to be used by grizzly bears (Figure 4).

Development consistent with a soft edge scenario would result in negative human-bear interactions along the full length of the interface between the development pods and grizzly bear habitat because areas with a greater probability of selection are interspersed with development. Negative interactions are predicted to be highest in the most westerly portions of the ASP that are bordered by wildlife corridors on two sides (Figure 4).

The hard edge scenario, which assumes higher density development closer to wildlife corridors (i.e., hard edge) reduces the area of ASP habitat that is selected by grizzly bears by 29.7% relative to existing conditions (Table 3). Most of the ASP area in this scenario (91%) is classified as habitats that are somewhat avoided, strongly avoided or rarely used (Table 3). Negative human-bear interactions are expected along the western edge of the ASP area where development borders selected habitats within the Stewart Creek Across Valley Corridor (Figure 4). Within the ASP area, habitats that remain selected or used as available are spatially separated from wildlife corridors, which presumably decreases the probability of human-bear interactions in the development, relative to a soft edge scenario. The degree to which the spatial arrangement of building forms (for example, apartments or townhomes) within the development will deter grizzly bears from accessing the remaining areas of suitable habitat in the ASP area (Figure 4) is uncertain.

Negative human-bear interactions under the soft edge scenario are more likely than under the hard edge scenario because of the increased probability of grizzly bear selection within and adjacent to development. Selected habitat between developed areas of the ASP may draw bears into habitat where the probability of negative human-bear interactions will be high.

In summary, the effects of the two development scenarios changed the predicted extent of selected and used as available habitat for grizzly bears within the proposed ASP area, but the development scenarios did not change habitat selection patterns in the adjacent wildlife corridors. Both development scenarios increased the likelihood of negative human-bear interactions, but the magnitude of change induced by the soft edge scenario is predicted to be larger. Although the hard edge scenario likely reduces the probability of human-bear interactions, relative to a soft edge, the effectiveness of placing higher density building forms at the development edge to deter animals from entering the development is uncertain. In both cases, a physical barrier such as a fence that excludes wildlife from developed areas is the only means of avoiding the increased risk of negative human-bear interactions, relative to existing conditions.

2.2.2 Wolves

Results of the scenario analysis for wolves are quantified as changes to habitat selection both within the ASP area (Table 5, Figure 5) and within the adjacent wildlife corridors (Table 6, Figure 5).

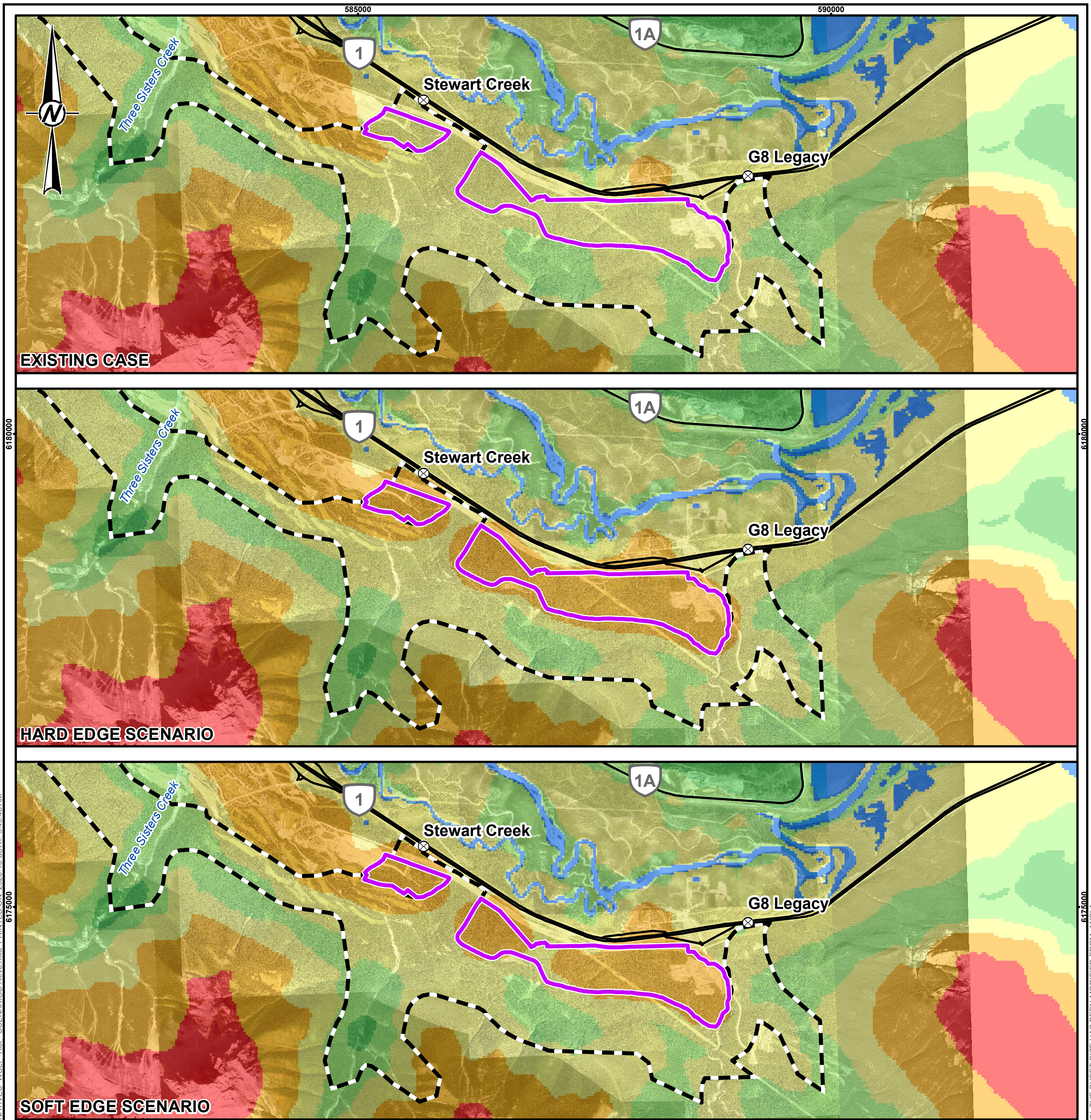
Table 5: Change in Habitat Classes for Wolves in the Area Structure Plan Area as a Result of Different Conceptual Development Scenarios

Habitat Class	Existing Conditions [ha]	Soft Edge Scenario (Change[(a)]) (ha)	Hard Edge Scenario (Change[(a)]) (ha)
Selected	0.0	0.0 (0.0)	0.0 (0.0)
Used as available	6.2	0.0 (-6.2)	0.0 (-6.2)
Somewhat avoided	146.2	12.1 (-134.1)	0.0 (-146.2)
Strongly avoided	1.3	141.6 (140.3)	153.7 (152.4)
Rarely used	0.0	0.0 (0.0)	0.0 (0.0)

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Change calculated by subtracting the existing conditions value from the scenario value. Negative effects are inferred when models predicted a loss of selected and used as available habitats or a gain in somewhat avoided, strongly avoided and rarely used habitats.

ha = hectares.



LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 1,000 2,000

1:60,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	10/8/2020
DESIGNED	KK
PREPARED	DA/AK
REVIEWED	SM
APPROVED	KK

TITLE
WINTER WOLF RESOURCE SELECTION UNDER DIFFERENT DEVELOPMENT SCENARIOS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	5

Table 6: Change in Habitat Classes for Wolves in Approved Wildlife Corridors Adjacent to the Project as a Result of Different Conceptual Development Scenarios

Habitat Class	Existing Conditions (ha)	Soft Edge Scenario (Change[a]) (ha)	Hard Edge Scenario (Change[a]) (ha)
Selected	8.5	8.5 (0.0)	8.5 (0.0)
Used as available	185.9	158.9 (-27.0)	150.9 (-35.0)
Somewhat avoided	342.3	325.2 (-17.1)	304.8 (-37.5)
Strongly avoided	30.3	74.4 (44.1)	102.9 (72.6)
Rarely used	0.0	0.0 (0.0)	0.0 (0.0)

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Change calculated by subtracting the existing conditions value from the scenario value. Negative effects are inferred when models predicted a loss of selected and used as available habitats or a gain in somewhat avoided, strongly avoided and rarely used habitats.

ha = hectares.

Wolf habitat on the south side of the Bow Valley generally has a lower probability of selection during winter when compared to habitat on south facing slopes at moderate elevations on the north side of the Bow Valley (e.g., Benchlands; Appendix B). In this context, under existing conditions, wolf habitat in the Project ASP as well as the adjoining wildlife corridor is largely comprised of habitats avoided by wolves during winter (96 and 65.7%, respectively; Table 5 and Table 6, Figure 5).

Both scenarios result in a complete loss of used as available habitat (6.2 ha) in the ASP area. Habitat that was classified as being somewhat avoided by wolves in the base case (146.2 ha) generally became strongly avoided in the soft edge scenario (i.e., a decrease of 134.1 ha of somewhat avoided habitat with a corresponding increase of 140.3 ha of strongly avoided habitat). This pattern was very similar in the hard edge scenario although there was a slightly stronger effect (i.e., a decrease of 146.2 ha of somewhat avoided habitat with a corresponding increase of 152.4 ha of strongly avoided habitat) (Table 5, Figure 5).

Both scenarios also have similar effects on the probability of use in adjacent wildlife corridors (Table 6, Figure 5). Neither scenario affects the small proportion of habitat (8.5 ha) selected by wolves within corridors. The hard edge scenario, however, results in a slightly larger loss of used as available habitat than the soft edge scenario (a loss of 35.0 ha versus 27.0 ha, respectively, Table 6). Corridor habitat that was strongly avoided under existing conditions increased by 44.1 ha under the soft edge scenario and by 72.6 ha in the hard edge scenario.

In summary, the two development scenarios differed little in their effects on predicted wolf use within the Project ASP; the entire area becomes uniformly avoided. Both scenarios resulted in patterns of selection within the wildlife corridors that show a reduction in probability of use relative to existing conditions although the reduction is somewhat greater in the hard edge scenario.

2.3 Development Recommendations

Based on the concepts presented in Section 2.2 and using information about ESAs provided in the existing conditions section for vegetation (Section 5.12), Golder provided QPD with recommendations for development footprint designs that would limit effects on the environment, especially for wildlife. The relative importance of these recommendations for determining the likely conclusions of the EIS was discussed with QPD, so that they could consider these potential outcomes along with other factors affecting development, such as physical constraints (e.g., undermining, steep creek hazards), sustainable community design, and economic feasibility. All of these factors were integrated by QPD when making decisions about the final land use concept to propose to the Town in the proposed ASP and submit to Golder for assessment as the Project in this EIS.

The recommendations are as follows:

- To the extent possible, select development footprint alternatives that avoid effects on ESAs, such as wetlands and riparian areas.
- Concentrating development at higher density closer to existing disturbances (e.g., the Trans Canada Highway, Thunderstone quarry) will benefit both species like grizzly bears that exhibit higher potential for negative interactions with people in lower density developments, and species like wolves for which the zone of influence from higher density development can extend into adjacent wildlife corridors. Concentrating development closer to the north end of the ASP area (i.e., a soft edge) will only be effective if wildlife fencing is used (see next bullets). Golder notes that this recommendation was largely achieved through the Provincial corridor designation process for Smith Creek, which concentrated the approved development area adjacent to the Trans Canada Highway and in the area currently occupied by Thunderstone quarry.
- When comparing the soft edge and hard edge scenarios, the modelling results indicate that the small, incremental benefits of lower density development for reducing sensory disturbance to wolves in wildlife corridors are outweighed by the higher potential for negative human-wildlife interactions in developed areas for grizzly bears.
- If a physical barrier like a wildlife fence is put in place between people and wildlife corridors, lower density development can be placed next to wildlife corridors. In this case, the advantages of reduced sensory disturbance associated with lower density development can be achieved for species like wolves without increasing the risk of negative human-wildlife interactions for species like grizzly bears. Maximum advantage can be achieved by maintaining residential developments farther away from the corridor edge, provided attractants are removed from open habitats inside the fence. Commercial operations like hotels and spa uses do not carry the same implications because their use patterns tend to be concentrated in the developed areas. However, the advantage of reduced sensory disturbance associated with developing further from the corridor edge will be small for many species for which human developments create a weak zone of influence, such as grizzly bears.
- Recreational activities such as off leash dog use and trails for hiking have been proposed as possible activities that could occur within open spaces or recreation zones in the Project and should consider the recommendations in planning documents such as Recommendations for Trails and Management of Recreational Use for the Town of Canmore: South Canmore and West Palliser (TERA 2012) and Open Space and Trails Plan (2015b), where appropriate.
- Because animals like grizzly bears show strong selection for open areas within developments, these areas could become hotspots for negative human-wildlife interactions. Human recreational activities could also spill over into the wildlife corridor. If the development footprint includes recreational activities in open spaces adjacent to the wildlife corridor, the RSF scenario modelling and current conflict data (refer to Section 5) support the requirement for a physical barrier to mitigate potential effects on wildlife. To the extent possible, a physical barrier should separate open spaces designated for recreation from wildlife movement corridors.

3.0 PROJECT DESCRIPTION

The Smith Creek ASP has been initially submitted to the Town of Canmore in 2017 and was amended with the 2020 submission of the Smith Creek ASP. In 2020, Three Sisters Mountain Village working with the Province of Alberta, has dedicated the final piece of lands for wildlife corridor movement, satisfying the NRCB requirement to dedicate wildlife corridors. The remaining developable lands in Smith Creek is approximately 154 ha.

After considering regulatory and technical requirements, existing approvals, market conditions, stakeholder input and recommendations provided by Golder to reduce potential effects on VECs, QPD prepared a project design to meet the requirement of an ASP. The Conceptual Policy Map for the proposed ASP which was accepted in-principal by Town Administration for the purpose of EIS modelling. The Project, which is a based on the conceptual policy map contained within the ASP and focuses on providing a residential neighbourhood with a mix of residential built forms (single-detached, semi-detached, townhomes, stacked townhomes and apartments) and emphasises a multi-modal transportation network (transit, bicycling, walking).

The ASP incorporates a Flex Commercial and Industrial District at the entry of the neighbourhood offering retail and commercial services for resident's daily needs. Offices and light industrial uses are also located in this area to support the diversification of Canmore's economy and increase the land base for new industrial and business opportunities.

The ASP outlines specific policies on both the intended use of the policy areas and how development will be shaped by the constraints and location of the community. Figure 6 and Figure 7 present a general schematic of the different Project areas (e.g., commercial, green areas, residential areas) and alignment of the Three Sisters Parkway. This project description should be used in conjunction with an examination of the ASP policies and how these policies will shape future planning and development approval processes. These policies include directions on:

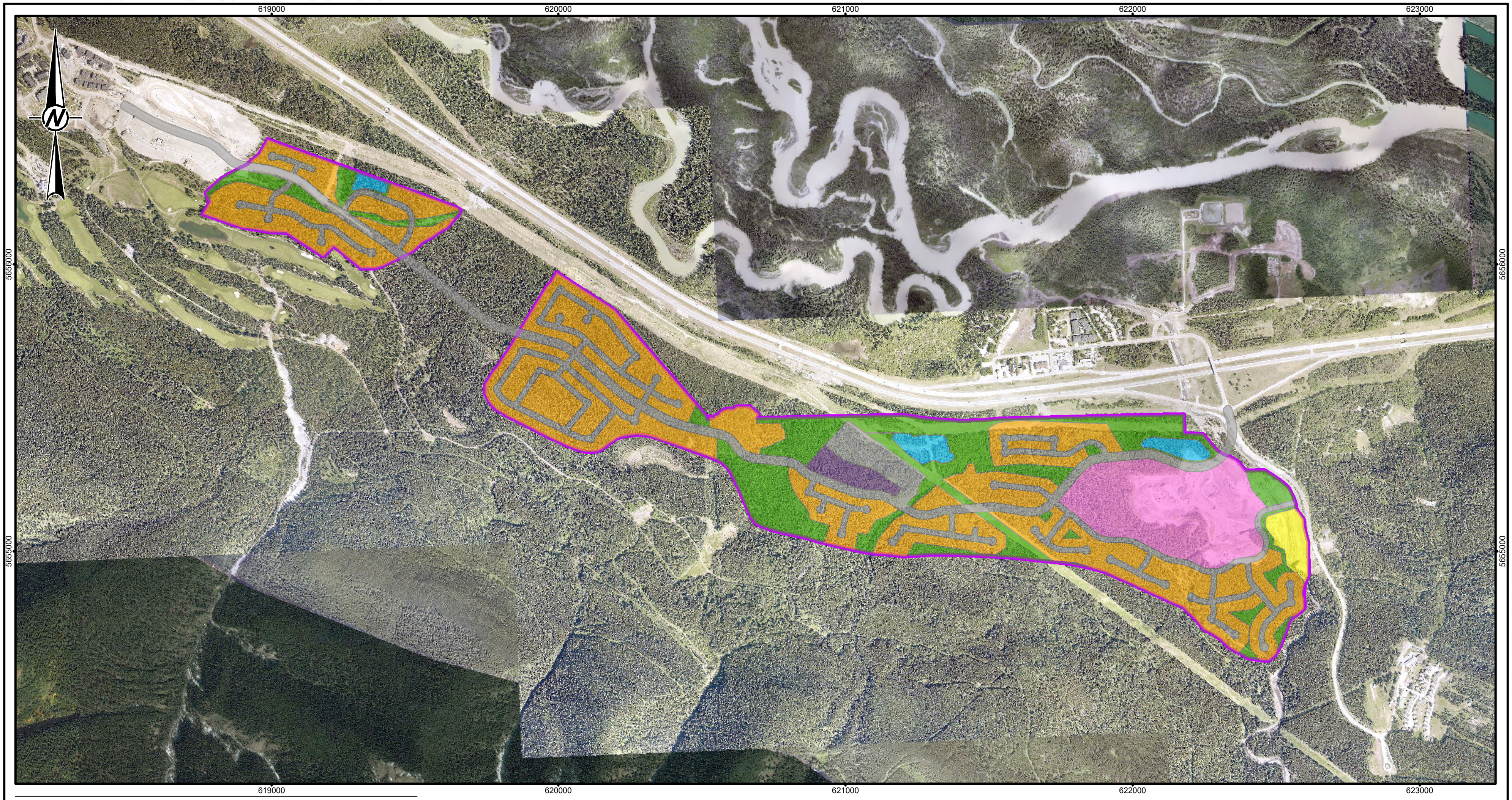
- land use, potential building forms and high-level direction on urban design outcomes
- mobility and the emphasis of walking, biking and transit
- sustainable design principles
- recreation and how to manage human use within the adjacent wildlife corridors

This section presents details of the Project that are relevant to this EIS. As noted in Section 1.3, the details of the Project at the ASP stage are conceptual and the precise location of development footprints, roads, and trails will not be defined until later planning stages (e.g., conceptual scheme, land use, subdivision and development permit). The timing of development has not been established and will be determined in consultation with the Town. However, it is anticipated that development will follow a phased approach (Table 7, Figure 8). The final design of each policy area will be determined through the conceptual scheme, land use, subdivision and development application processes. The planning rationale for the development concept described in this section and assessed as part of this EIS is presented in the ASP and the supporting documents and is not repeated in detail within this EIS.

The Parkway, when triggered by emergency access requirements, would be constructed to connect the phases allowing emergency access only. The entrances will be gated and the surface of the emergency connection will likely remain a gravel surface until development can be accommodated. This is similar to how access is currently gated at the Parkway ends today. Fence end details (see Section 5.6.4) would be designed in detail at Conceptual Scheme.

The ASP proposes 840-1,730 dwelling units with a potential population of 2,200- 4,500 people. According to the ASP’s residential policy, 70% of the dwelling units will be low density in form of single-detached, semi-detached, and townhomes and the other 30% would include medium density housing in the form of townhouses, stacked townhouses and apartments.

PATH: I:\2019\19132387\Mapping\Products\Working_Report_Figures\Rev0\19132387_SC_FIG006_ASP_FOOTPRINT-Rev0.mxd PRINTED ON: 2020-10-05 AT: 11:44:39 AM



LEGEND

PROJECT BOUNDARY

PROJECT FOOTPRINT

- COMMERICIAL
- GREEN AREA
- POND
- RESIDENTIAL AREA
- ROAD
- SEDIMENT RETENTION AREA
- SCHOOL

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK/DA
REVIEWED	SM
APPROVED	KK

TITLE

SMITH CREEK AREA STRUCTURE PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	6

Figure 7: Smith Creek Land Use Concept Plan (Image provided by QPD)

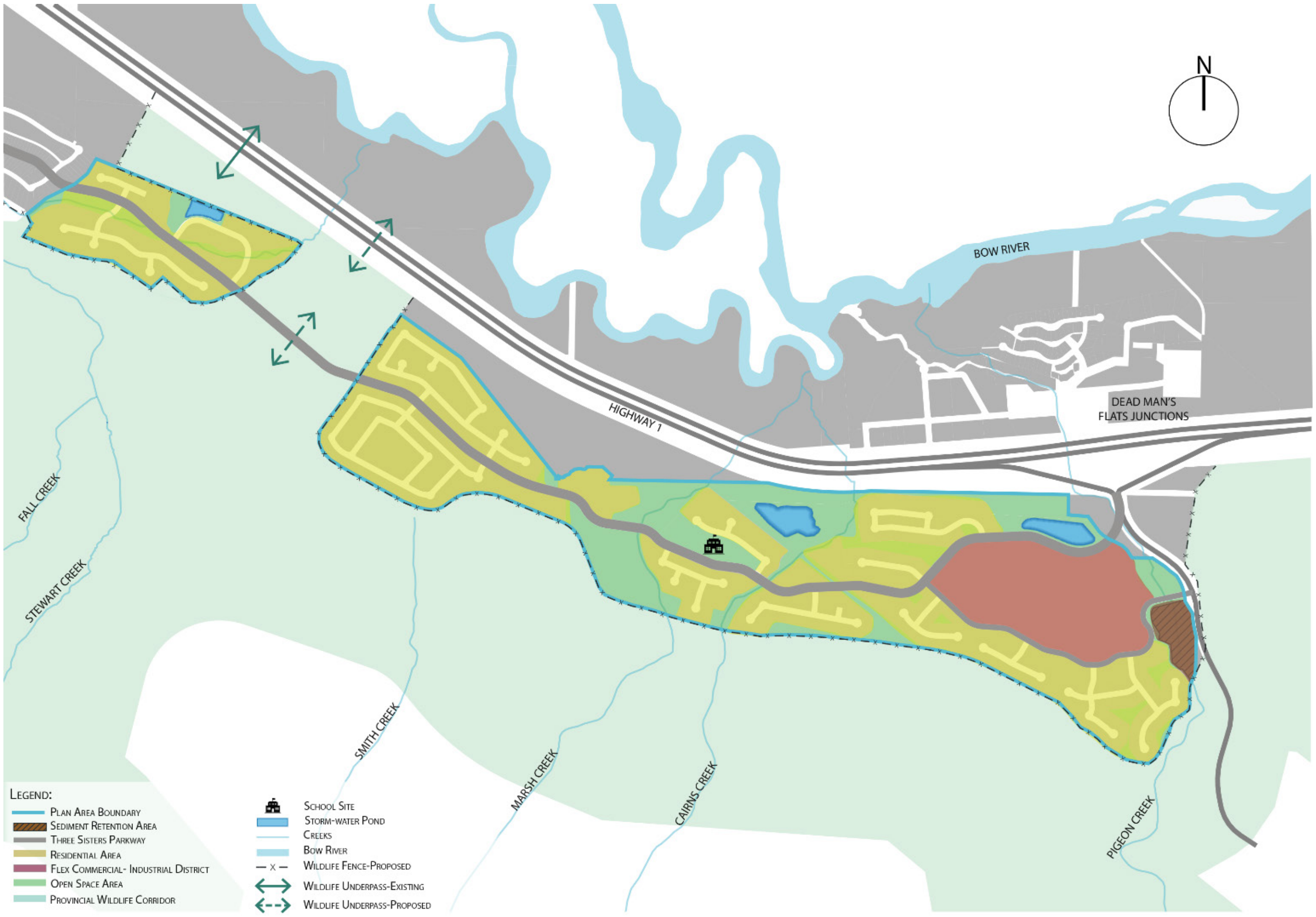


Figure 8: Smith Creek Development Phase (Image provided by QPD)

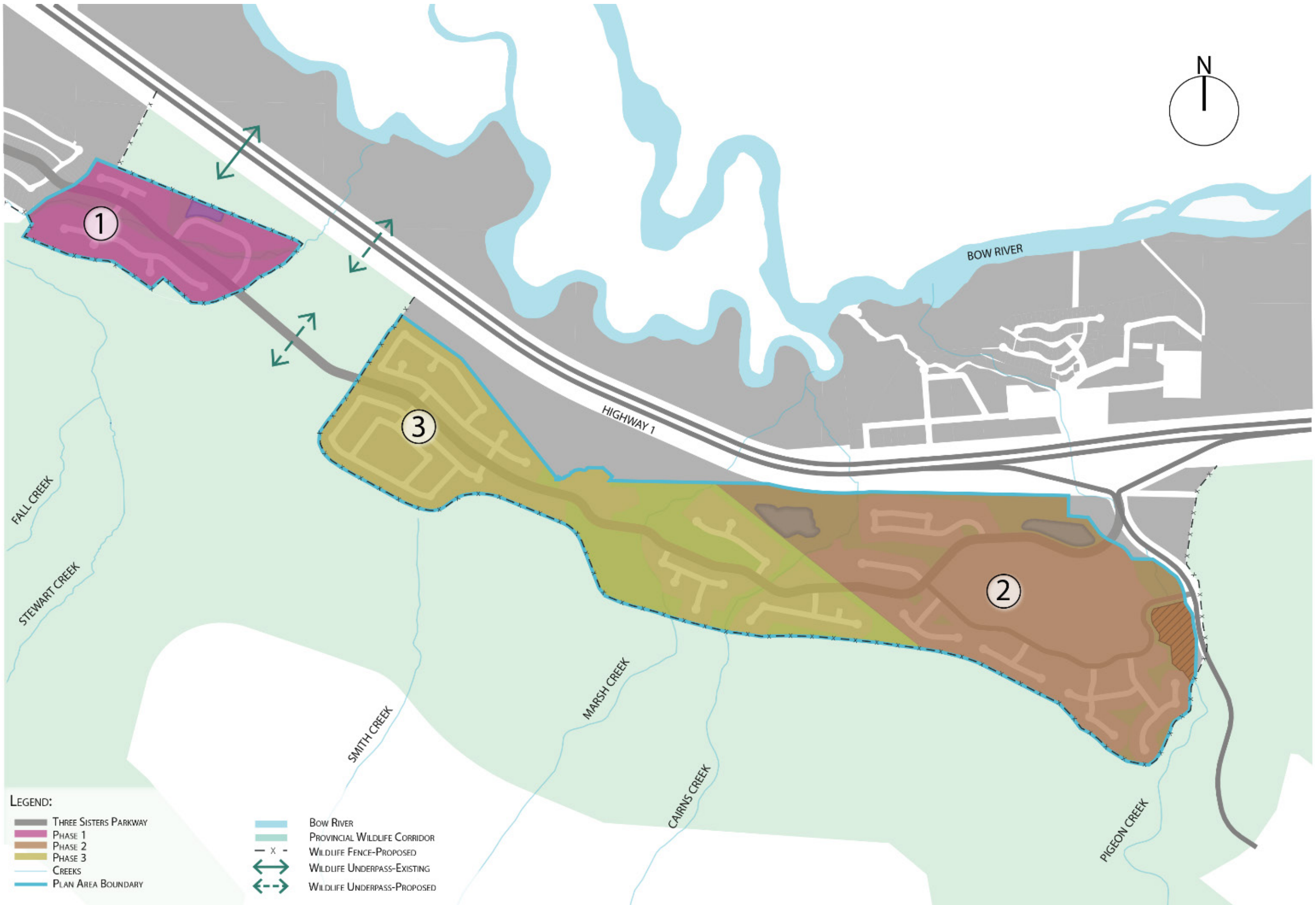


Table 7: Estimated population range and approximate average floor to area ratio for each phase of development.

Phase	Estimated Population Range	Approximate Average Floor to Area Ratio
1	400 - 825	0.5
2	750 - 1,525	0.5
3	1,050 - 2,150	0.75
Total	2200 – 4,500	

Note: Estimated numbers based on estimated unit typology predictions and occupancy at 100%. All unit types, even those that are not typically counted within a census population, are included.

In the Concept Plan, the placement of low and medium density residential areas is deliberately deferred to Conceptual Scheme / Land Use Redesignation in alignment with the policies regarding slope adaptive development. This allows development forms to be selected when the analysis of topography and grades are being reviewed. This will allow for a balance to be achieved between the technical requirements to meet engineering guidelines while also striving to meet the objectives of Canmore's Municipal Development Plan (i.e., compact development, walkable and transit accessible communities). As a result of the analysis at Conceptual Scheme, low density areas will be located in areas that require building types to be more responsive to the terrain (steeper slopes). Medium density areas are generally located on flatter slopes while balancing the need to also locate density in close proximity to transit stops, on parcels with good pedestrian access to the Three Sisters Parkway or in close proximity to commercial and mixed-use areas.

3.1 Open Space and Trails

Three Sisters Mountain Village within its neighbourhoods of Three Sisters Village, Stewart Creek and Smith Creek Smith Creek will have a large network of open space connected by an extensive multi-user trail and pathway system (Figure 9). The entire parks and open space system, trails and pathways are intended to accommodate different types of users, a variety of skill levels and align to Canmore's Open Space and Trail Plan as well as the Recreation Master Plan. As with all developments that need to undergo subdivision, the *Municipal Government Act* requires that developments contribute up to 10% of land as park. In addition, unstable slopes, gullies, streams, ravines can be contributed to Environmental Reserve. This open space is available to the public – town wide. Plans for Three Sisters Village ASP have identified approximately 40% of the ASP will be dedicated to some form of open space, including a Resort Recreation Amenity Area. This large contribution toward open space is in recognition of the resort, its central location within Three Sisters Mountain Village and the population expected to live and work in this area.

Smith Creek contributes to the open space and trail system connecting to Three Sisters Village, Stewart Creek and into the Dead Mans Flats area and beyond to offer all residents of Canmore additional choice for recreation outside of the corridor. Specifically, Smith Creek's open space system (Figure 10) will focus on recreational mountain bike trails and multi-user pathways and dog parks. Potential for a mountain bike jump park, or pump track and other similar amenities could be options for Smith Creek if administration buy-in to those types of uses. Within the residential areas, Parklettes will provide more active amenities like playgrounds and areas to congregate. A school site may be used for sports fields and when provincial funding permits, a K-12 school.

Figure 9: Smith Creek Multi-modal Transportation (Image provided by QPD)

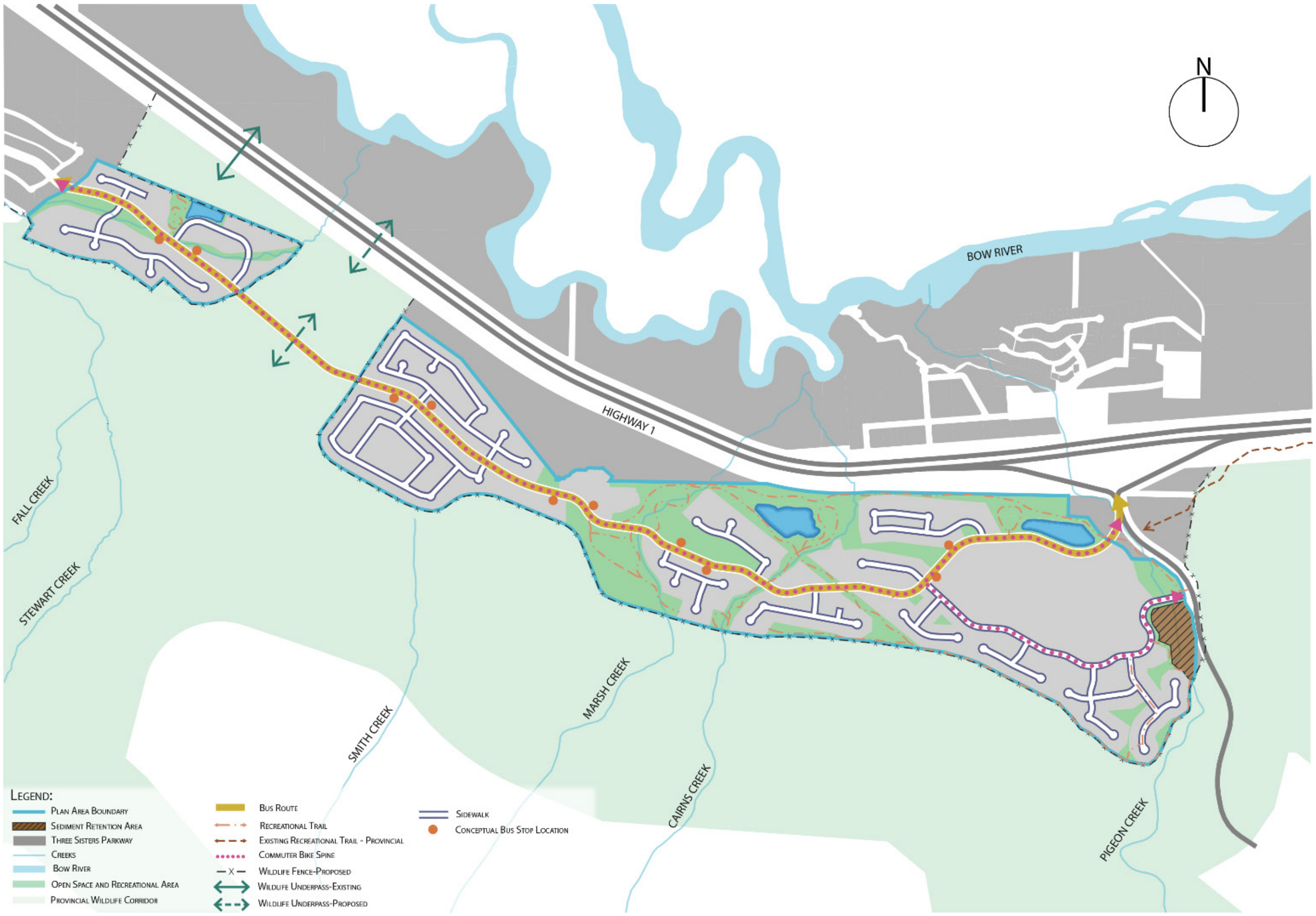
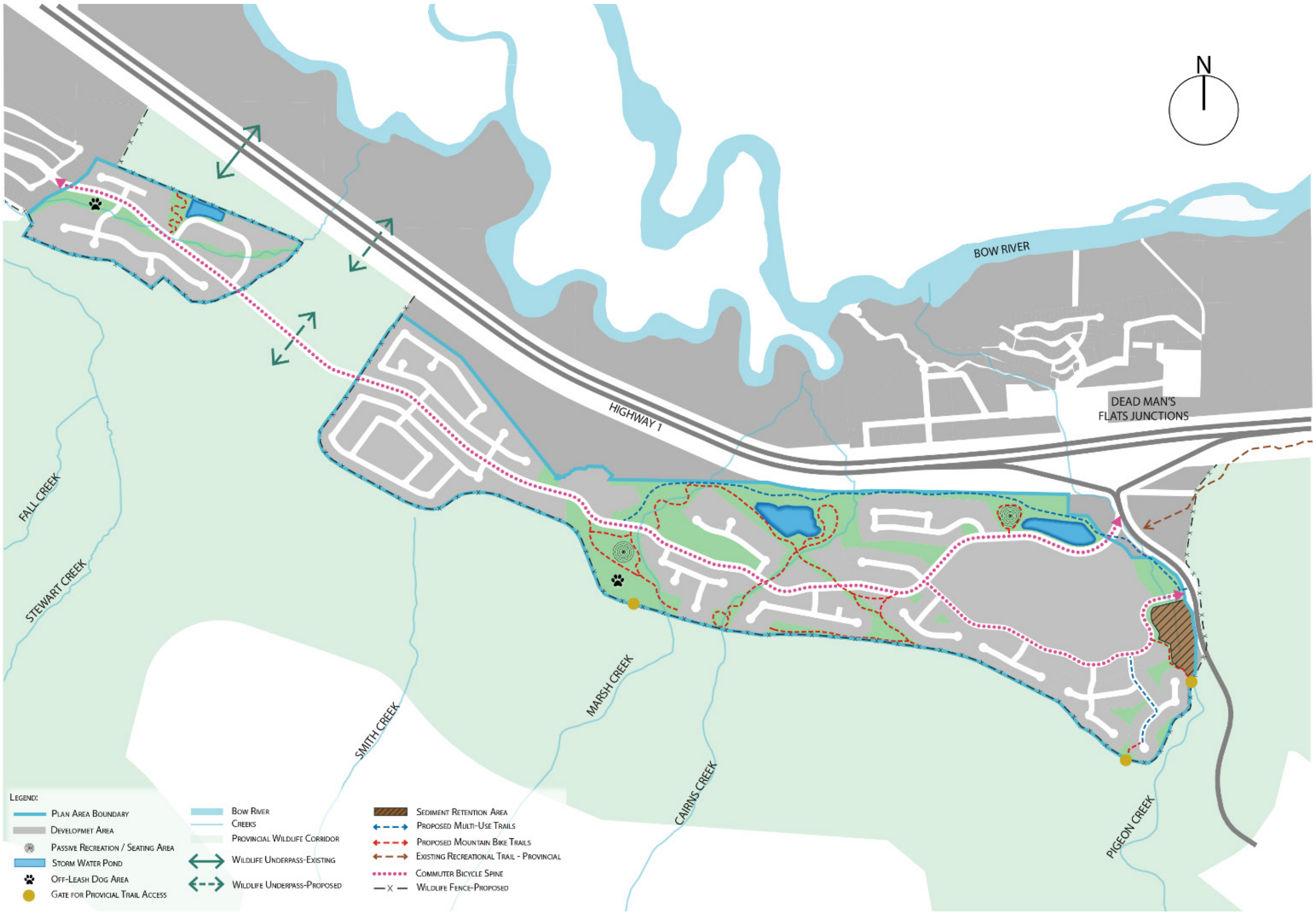


Figure 10: Smith Creek Open Spaces (Image provided by QPD)



3.2 Transportation and Utility Services

Traffic counts were collected along the Three Sisters Parkway in in the summer of 2019 over two weekends: a regular summer weekend and the August long weekend. While volumes were higher over the long weekend, the traffic analysis is being completed on the 'typical' summer weekend, with the Friday PM Peak and the Saturday Peak hour representing the analysis horizons. Counts were collected between 9am and 9pm and all volumes identified are for two way traffic. On the 'typical' summer Friday, volumes along the Three Sisters Parkway currently range from approximately 5000 – 8000 vehicles per (12 hour) day. On a weekday the peak hour is approximately from 4-5 pm. PM Peak hour volumes represent approximately 10% of the 12 hour daily traffic, with peak hour volumes ranging between 400 and 800 vehicles per hour. The Saturday volumes are similar to the Friday volumes, but the peak occurs earlier in the day.

Trip generation for the overall development area was completed on a 2040 horizon, which is the estimated full build out of the study area. The Project is anticipated to add between 10,000 – 30,000 vehicles per day on a weekday to the Parkway, based on current estimates. When combined with background growth to the network, this translates to weekday PM Peak hour volumes along the Parkway that range between 1,200 – 3,000 vehicles per hour (two way traffic). Table 7 provides estimated population ranges, and therefore an approximation of increased traffic volumes, for each of the three development phases. For example, the initial phase of development (Phase 1) is expected to add –400-825 people whereas Phase 2 is anticipated to add 750-1,525 people to the Project. The population in the ASP area will increase as each phase is completed along with an associated increase in vehicles and traffic.

The analysis on the Saturday horizon identified a slightly higher daily traffic total than the Friday estimate (between 10,000 and 35,000 vehicles per day). However, Saturday traffic is more dispersed during the day and the peak hour is less intense than the Friday PM Peak (between 500 and 2,000 vehicles per hour). Based on ongoing discussions with the Town of Canmore, an analysis horizon may also evaluate a 15% additional peak against the highest peak hour. This is to represent a more significant summer weekend holiday day. Detailed analysis on the impact of the development on the street, multimodal and transit network will be included in the Traffic Impact Assessment supporting the Area Structure Plan submission.

The proposed Smith Creek development will require municipal services for water, sanitary and storm. Water servicing for the development will be provided by connecting to the existing Town of Canmore water distribution system at both the eastern end of the existing Stewart Creek development and directly south of Dead Man's Flats. These water connections will be supplemented by pressure reducing valves, booster pumps, and a reservoir to provide adequate supply to the proposed population and to address the undulating topography of the site. Sanitary servicing for the development will be provided by using gravity sanitary mains to direct flow to a number of on-site pump stations. The pump stations will use pressurized pipe to convey the sewage flows to the existing Town of Canmore sanitary sewer system located within Stewart Creek. Stormwater management will be provided by three on site stormwater facilities which will generally be located adjacent to the Trans Canada Highway. These stormwater facilities will control the amount of stormwater discharge to suitable release rates and provide the treatment necessary to discharge the flow into the existing drainage courses. Engineering drawings related to development are refined as development phases move forward. Further detail will be provided at Conceptual Scheme and again at Subdivision.

4.0 ASSESSMENT METHODS

This section provides the general methods applied to assess each VEC. Specifically, it:

- presents the spatial and temporal boundaries applied in this EIS (Section 4.1)
- describes the approach used to define and assess existing conditions (Section 4.2)
- identifies the methods used to predict and characterize potential Project effects before the application of mitigation (i.e., environmental risks) and residual Project effects after application of mitigation (Section 4.3)
- outlines the approach used to address uncertainty and identify monitoring requirements (Section 4.4)
- defines the methods applied to assess the cumulative effects of existing conditions, the addition of the Project, and the addition of other reasonably foreseeable developments (RFDs) to the Bow Valley in the vicinity of Canmore (Section 4.5)

Where required, additional methods used to quantify or describe effects for each VEC are presented in their respective sections.

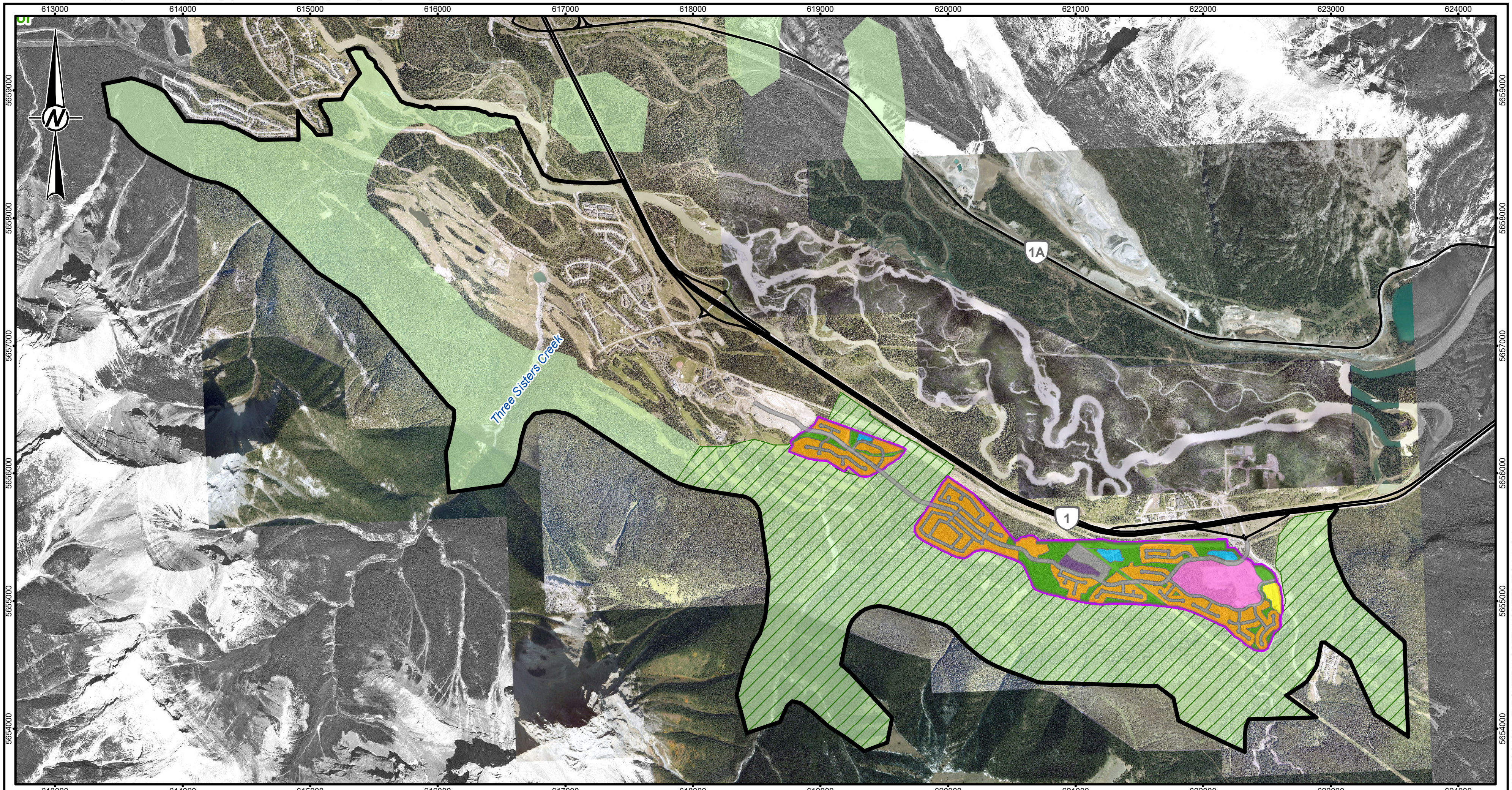
4.1 Spatial and Temporal Boundaries

Assessment boundaries are used to set the spatial and temporal limits of the EIS. The boundaries are defined to capture the areas and times in which the Project is expected to interact with VECs. Spatial and temporal boundaries are also intended to capture past, present, and reasonably foreseeable effects that might interact cumulatively with the incremental effects of the Project.

As defined in the TOR (Appendix A), the assessment considered three primary spatial scales:

- The Project Study Area (ASP area), which encompasses the ASP land use concept's 154 ha of built-up areas corresponding to the Project development (Figure 11).
- A Local Study Area (LSA) that encompasses 1,570 ha and includes the Project ASP, Stewart Creek ASP, Three Sisters Village ASP and adjacent wildlife corridors (Figure 11).
- A Regional Study Area (RSA) that encompasses 23,878 ha within the Bow River watershed between the east boundary of Banff National Park and Exshaw (Figure 12).

Within these three primary spatial boundaries, the assessment considered various scales, as appropriate to the VEC and potential issue of concern. For example, the wildlife assessment considered the boundaries of wildlife corridors in the LSA for certain analyses and throughout the RSA for others. The largest effects of the Project were anticipated to be in the ASP area and the wildlife corridors immediately adjacent to the ASP area. Therefore, in addition to summarizing effects in the ASP area, the corridor area immediately adjacent to the ASP area was assessed separately from other parts of the LSA for certain analyses to better understand Project effects on wildlife corridors (Figure 11).



LEGEND

- PRIMARY HIGHWAY
- ADJACENT WILDLIFE CORRIDOR
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROJECT FOOTPRINT

- COMMERICIAL
- GREEN AREA
- POND
- RESIDENTIAL AREA
- ROAD
- SEDIMENT RETENTION AREA
- SCHOOL

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

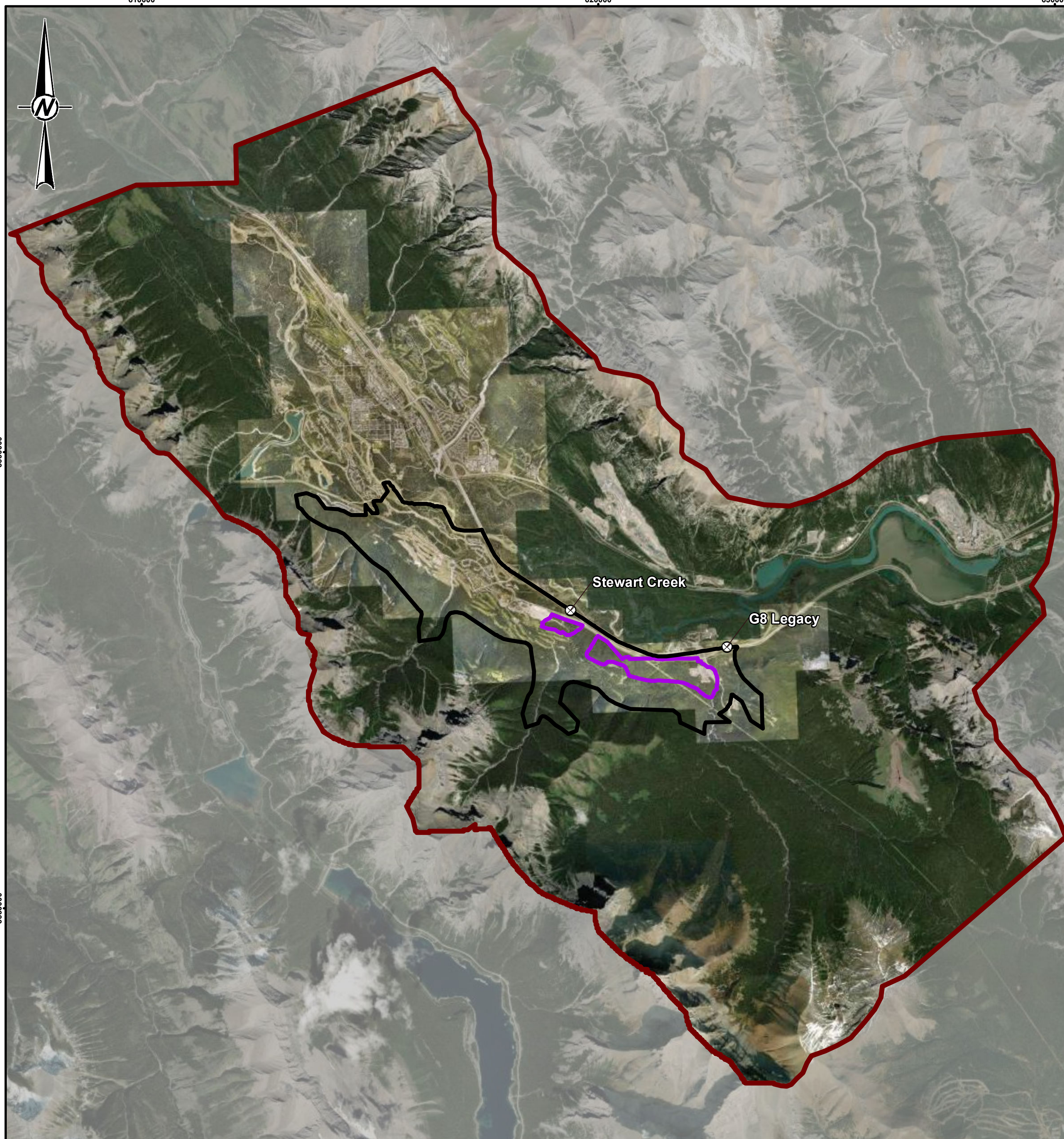
CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE
ASP AREA AND LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	11



LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PROJECT BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

0 2,000 4,000

1:125,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, JANUARY 2017.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE
REGIONAL STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	JE/DA
REVIEWED	SM
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	12

For most VECs, the assessment focused spatially on effects inside the ASP area. Some indirect effects of the Project, such as those associated with FireSmart activities, noise associated with construction or operations, or human use outside of developed areas, may extend beyond the ASP area into adjacent wildlife corridors and other parts of the LSA and possibly beyond the LSA and into the RSA. These effects are considered according to their likely spatial extent and interaction with VECs.

The RSA boundaries were selected using political and ecological boundaries and for consistency with past studies (e.g., JWA 2005; Golder 2013, 2017). The Banff National Park boundary constitutes the western edge of the RSA, and the heights of land paralleling the Bow River were used for the north and south boundaries (Figure 12). The east boundary is the community of Exshaw (Figure 12) The RSA includes major developments, landscape boundaries, wildlife corridors and wildlife habitat patches at a scale relevant to assessing the effects of the Project and, where appropriate, the cumulative effects of the interaction of the Project with other developments (Figure 12). Specifically, development and human use present environmental challenges within the RSA not faced to the same degree outside of its boundaries, and unique management solutions may be required within the RSA.

The temporal boundaries of the assessment are broad and cumulative effects extending back in time as far as the late 1800s and as far forward as 2055 are considered to provide context to help define the importance of the incremental effects from the Project to VECs. The residual effects assessment focuses on changes caused by the Project between existing conditions (i.e., 2018), the initiation of construction of Smith Creek Phase 1 within five years of ASP approval, and through to full build out of the entire Smith Creek ASP development, which is predicted to be 20 to 30 years into the future (i.e., 2045 to 2055). The assessment identifies potential environmental effects associated with both construction and operations of the Project. Construction includes short-term effects associated with equipment and workers on site, whereas operations extend over the life of the Project, which will occur over many decades, and is considered permanent for the purposes of this assessment.

4.2 Existing Conditions

Existing conditions are described for each VEC to provide a baseline against which residual effects of the Project could be measured. Existing conditions represent conditions in the Bow Valley during 2016-2018[4] and are the outcome of past and present developments, human activities, and natural factors. Therefore, the description of existing conditions provides information about the cumulative effects of previous and existing developments and other factors acting on each VEC prior to the addition of the Project or other RFDs. Existing conditions are described within the spatial boundaries defined for the EIS.

Smith Creek ASP Area and Local Study Area

Existing conditions are presented for each VEC within the ASP area and LSA. Particularly sensitive natural features, hazards, or constraints within the ASP area or adjacent to it in the LSA are identified for each VEC.

The Project occurs in an area that was previously affected by open pit and underground coal mining and currently has an open pit mine in the eastern portion (i.e., Thunderstone). However, most of the area is currently forested with a network of old roads and trails across it. Additional information about existing conditions in the ASP area relevant to each VEC was obtained primarily using available information from previous and ongoing studies. Information was also collected during reconnaissance surveys undertaken in 2015 and 2016 by Golder, including confirming the location of wetlands, riparian areas, and other ESAs. Additional information was gathered through rare plant and wildlife corridor surveys undertaken in 2018 by Golder.

[4] Not all data sources were up to date as of 2018. Most existing conditions data represent a period between 2016 and 2018, but older information was sometimes used if it was the most recent available (e.g., electrofishing surveys, historic resources).

Regional Study Area

The level of detail used to describe existing conditions in the RSA varies among VECs. More detail is provided for VECs for which past and present developments and activities have had strong adverse cumulative effects under existing conditions. Consequently, substantially more information is presented to describe existing conditions for wildlife at the RSA scale than for other VECs. General information about existing conditions in the RSA that was used to inform the existing conditions assessment for all VECs is presented in the following paragraphs.

The RSA is a wide, low-elevation valley that is part of the Bow River watershed, which supplies water to much of southern Alberta, including the City of Calgary. Topographically diverse conditions produce a diverse assemblage of wildlife and vegetation. At lower elevations, coniferous forests are dominant, with some grasslands and mixed-wood forests on south- and west-facing aspects and in valley bottoms. At moderate elevations, the montane subregion features differing aspects, slope positions and wind exposures that result in highly variable microclimates, and changes in soil and vegetation assemblages at small spatial scales (Natural Regions Committee 2006).

Substantial portions of the RSA have been designated as protected areas due to the ecological importance and natural beauty of the area. These protected areas include Bow Valley Wildland Provincial Park, Don Getty Wildland Provincial Park, Canmore Nordic Centre Provincial Park, Bow Valley Provincial Park, and Spray Valley Provincial Park. The total protected area in the RSA as of 2019 was 17,326 ha or 73%.

Approximately one third of the lands outside of protected areas in the RSA have been developed. Major developments in the RSA include the Trans-Canada Highway, which is fenced in places to reduce vehicle-wildlife collisions, the Canadian Pacific Railway, several cement plants and quarries, the Town of Canmore, and the communities of Exshaw, Deadman’s Flats, Lac Des Arcs, and Harvie Heights.

After many decades as a small coal mining town, Canmore has more recently maintained a strong economic focus on tourism and recreation. Residential, commercial, and resort development in Canmore has continued to grow since the 1988 Olympics. In addition to construction of new golf courses, hotels, and other infrastructure, Canmore’s population more than doubled between 1993 and 2016, increasing from 6,621 to 13,992 permanent residents. The population count increases to over 17,000 when non-permanent second homeowners are included (Statistics Canada 2019; Town of Canmore 2014).

Overall, human development in the RSA has been substantial along the valley bottom, particularly in the Town of Canmore and in Dead Mans Flats. Human development can negatively affect the ecological function of landscapes, and development interests are not always compatible with maintaining viable ecosystems (Hilty et al. 2006). For example, roads and buildings reduce habitat quality for many wildlife species and can impede movement (Fahrig and Merriam 1985; Huck et al. 2010). Negative environmental effects often increase when effects from several different sources act cumulatively.

To provide a better understanding of the cumulative effects of development in the Bow Valley, existing disturbance areas within the RSA were calculated using disturbance layers developed by Golder (2013) and updated in 2016 (Table 8). Disturbance area associated with linear features is defined using average widths for each linear feature in the study area as estimated from available imagery. This approach likely overestimates the actual extent of linear disturbance in many cases. Disturbance data indicate that approximately 11% of the RSA has been altered by development (Table 8). Development within the RSA is not evenly distributed but is generally concentrated in the valley bottom (Figure 13, Figure 14). Urban development is the single greatest form of disturbance, followed closely by transportation infrastructure (including highways, rail lines, and roads within urban developments), and golf courses (Table 8).

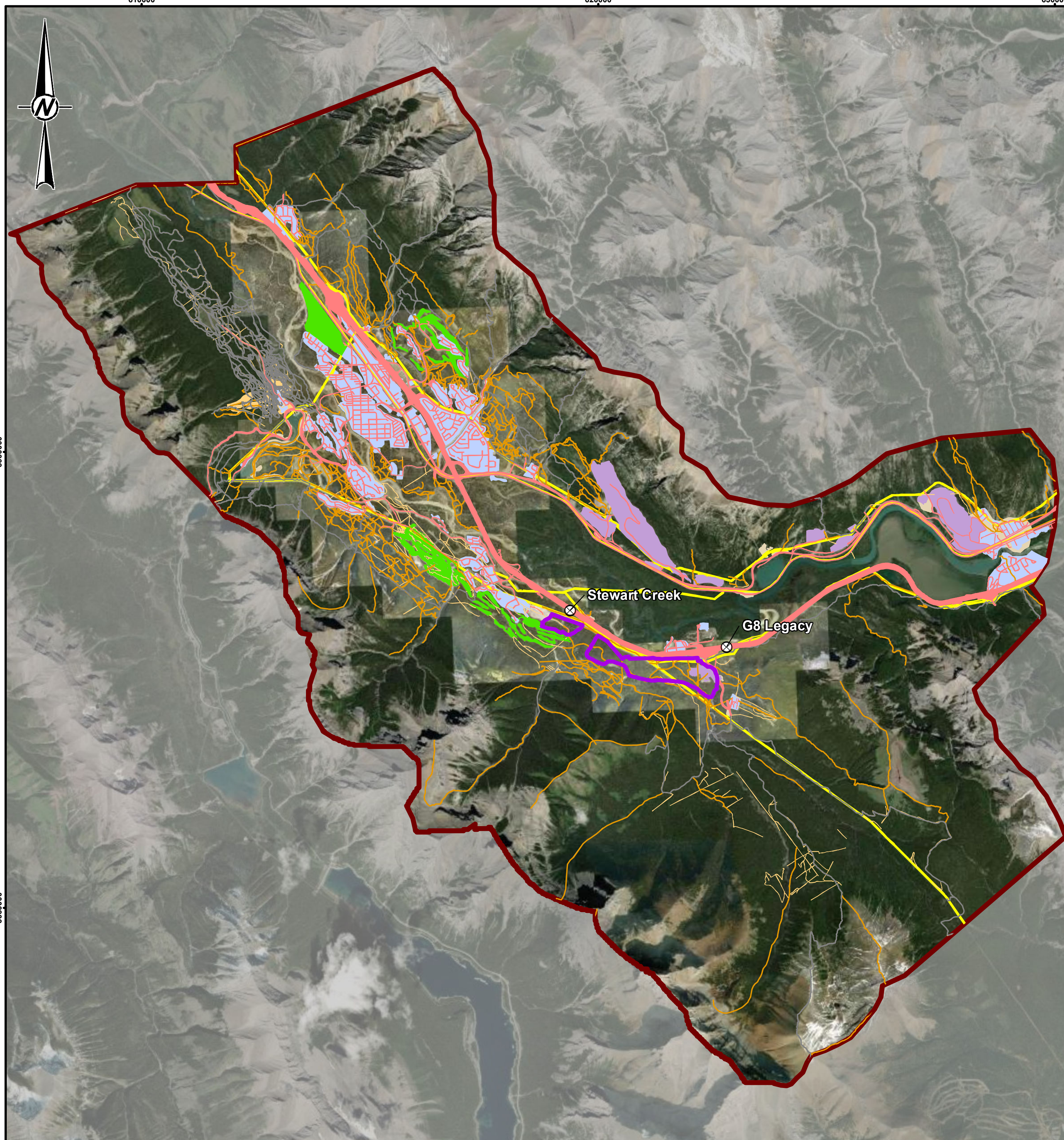
Table 8: Amount of Anthropogenic Disturbance in the Regional Study Area by Disturbance Type Under Existing Conditions

Disturbance type	Area (ha)	Percent of Regional Study Area
Golf Course[(a)]	312.2	1.3%
Industrial	281.4	1.2%
Non vegetated	56.9	0.2%
Other Trails	373.6	1.6%
Pipeline/Transmission Line	302.8	1.3%
Transportation	657.4	2.8%
Urban Development	685.9	2.9%
Unknown	1.5	<0.1%
Anthropogenic Water Impoundments	2.7	<0.1%
Total disturbance	**2674.47**	**11.2%**

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Includes anthropogenic grasslands associated with the approved 2004 Resort Centre ASP that are not an active golf course.

ha= hectares



LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PROJECT BOUNDARY
- REGIONAL STUDY AREA

DISTURBANCE

- DESIGNATED TRAIL
- UNDESIGNATED TRAIL
- GOLF COURSE
- INDUSTRIAL
- NON VEGETATED
- OTHER TRAIL
- PIPELINE / TRANSMISSION LINE
- TRANSPORTATION
- URBAN DEVELOPMENT

0 2,000 4,000

1:125,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, JANUARY 2017.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE

EXISTING DISTURBANCE IN THE REGIONAL STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	JE/DA
REVIEWED	SM
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	13

25mm

Figure 14: Aerial Image of the Bow Valley (2012)

4.3 Project Effects

Residual effects of the Project are the incremental effects that the Project adds to existing cumulative effects, after mitigation has been applied. Residual effects were predicted for each VEC using four sequential steps:

1) Identify environmental risks by assessing potential effects of the Project without application of mitigation.

2) Summarize relevant legislation that is in place to constrain potential adverse effects and outlines requirements that certain mitigation is applied.

3) Present mitigation measures to which TSMV has committed to implementing. Commitments include mitigation to comply with relevant legislation and additional mitigation to address important environmental risks identified in Step 1.

4) Predict and characterize residual effects after the application of mitigation.

Details for each step are described in the following sections.

Environmental Risks

The effects assessment first considers the environmental risks of the Project by evaluating implementation of the Project description (Section 3.0) without additional mitigation for each VEC. Potential interactions between the Project and each VEC were identified based on literature review and documented evidence from previous similar developments in Canmore.

The unmitigated risks of the Project were characterized using the following assessment criteria based on *Canadian Environmental Assessment Act* principles (CEAA 2012a) and guidance provided in the TOR (Appendix A):

- **Context** – Describes the sensitivity of a VEC to changes caused by the Project. For example, important context for wildlife VECs includes the ecological adaptability and resilience of the VEC[5]. Cumulative effects of previous and existing developments also provided important context for the sensitivity of a VEC to additional changes caused by the Project (e.g., how close was a wildlife VEC to its resilience and adaptability limits before the Project is implemented).
- **Direction** – Incremental contribution of the Project were defined as positive (net benefit to VEC), neutral (no measurable change to VEC), or negative effect (net loss to VEC).
- **Magnitude** – Effect size or severity measured in specific terms (e.g., ha of habitat lost, number of mortality events, amount of change in flow regime), or using an ordinal scale (e.g., small, medium, large) defined for each VEC when specific measurements cannot be made.
- **Geographic Extent** – Spatial scale where effect occurs were defined as site specific (confined to the ASP area), local (confined to the LSA), or regional (extending to the RSA).
- **Duration –** Length of time effect was defined as short-term (during construction only) or long-term (during operations.
- **Frequency –** Number of events measured in specific terms (e.g., once, annually, weekly, daily, continuous).
- **Reversibility –** Whether the effect could be reversed after the Project or activity ceases.
- **Probability** – Whether the effect was unlikely (less than [<] 10% chance), possible (10%-80% chance), or likely (greater than [>] 80% chance).

For each environmental risk (e.g., loss of habitat quantity and quality, reduced wildlife use in corridors), the assessment criteria were considered together to obtain an environmental consequence for each VEC (Table 9). A key term in Table 9 is "serious risk", because this defines a high environmental consequence, which represents a significant adverse effect. The precise definition of serious risk depends on the VEC being evaluated and is described in each residual effects section for which an environmental consequence greater than negligible was identified.

[5] Adaptable wildlife species are those that can change their behaviour, physiology, or population characteristics (e.g., reproduction rate) in response to a disturbance such that the integrity of the population is maintained. For example, certain wildlife populations can accommodate loss of some individuals without a change in overall population status or trajectory (known as compensatory mortality), or can adjust their physiology or behaviour to accommodate disturbance. Adaptable species can accommodate substantial disturbance and sometimes thrive in highly modified environments, whereas species with low adaptability can accommodate little or no disturbance. Resilience is a concept that is distinct from, yet closely related to, adaptability. Biological populations often have inertia and will continue to function after disturbance up to the point where the disturbance becomes severe and long enough that the population undergoes a fundamental change. Adaptability influences the duration and magnitude of effect required for this to happen, whereas resilience defines the ability of a species or ecosystem to recover or bounce back from disturbance. Highly resilient wildlife species have the potential to recover quickly from disturbance (e.g., after reclamation is achieved or a mortality source is removed), whereas species with low resilience will recover more slowly or may not recover at all.

Using wildlife as an example, a serious risk would be any factor that put the viability of the portion of a wildlife species population inhabiting the RSA at risk (i.e., causes or contributes to a declining population trajectory that is not predicted to recover or stabilize without substantial immigration). For instance, the loss of connectivity among habitat patches in the RSA or creation of a population sink for a wildlife species in the RSA through increased negative human-wildlife interactions would constitute a serious risk. Weight of available evidence (i.e., data and scientific literature) was evaluated using professional judgement to determine environmental consequence and the determination is described using logical reasoning for each VEC.

Table 9: Environmental Consequence Rating for Effects Assessment

Environmental Consequence	Definition
Positive	The Project results in a net benefit relative to existing conditions.
Negligible	No detectible adverse change is expected relative to existing conditions.
Low	Detectible adverse effect that does not compromise the integrity or function of the resource or population. The magnitude of change is small and is not expected to result in a serious risk to the resource or population, nor is it expected to contribute to a serious risk already present under existing conditions.
Moderate	Detectible adverse effect that does not compromise the integrity or function of the resource or population. The magnitude of change is medium or large but is not expected to result in a serious risk to the resource or population, nor is it expected to contribute to a serious risk already present under existing conditions.
High[a]	Effect is expected to pose a serious risk to the resource or population, or will contribute to a serious risk already present under existing conditions.

a) A high environmental consequence is equivalent to a significant adverse effect (CEAA 2015).

The environmental risks section identifies key issues requiring mitigation. Positive outcomes or small effects with negligible or low environmental consequences may not require mitigation, whereas moderate or high environmental consequences would require additional mitigation.

The residual effects assessment provides a realistic evaluation of likely Project outcomes because relevant legislation and mitigation can reduce or eliminate potential environmental risks identified for each VEC and can substantially change predicted environmental consequence. Although the pre-mitigation assessment presented in the environmental risks section for each VEC is useful for identifying risk associated with an unmitigated project, the environmental consequences predicted do not reflect realistic scenarios for the Project because legal requirements set by provincial and federal governments combined with mitigation committed to by TSMV will change the effects of the Project on each VEC.

Relevant Legislation

Relevant federal or provincial requirements or restrictions that are defined in existing legislation and will result in a reduction in residual effects are identified for each VEC.

Mitigation

Mitigations were developed by Golder, the TSMV Team, and feedback from stakeholders, the Town, and the third-party reviewer hired by the Town to review this EIS. The iterative design process included consideration by the TSMV Team and the Town of the information about alternative development scenarios presented in Section 2. The TSMV Team considered results from previous assessments and studies, and integrated those learnings into the Project design. Therefore, most mitigation integrated into the design of the Project is included prior to assessing the unmitigated environmental risks of the Project (e.g., layout of pods defining development types and designations, distribution of green space). Other mitigations identified as important at the design phase (e.g., wildlife fencing) are excluded from the assessment of environmental risks and included in the characterization and assessment of residual effects (see below).

After mitigation had been integrated into the design, additional mitigation was identified for each VEC, as appropriate, to eliminate or reduce environmental risks associated with the Project, as identified through the assessment of unmitigated effects. Mitigation is discussed extensively as part of the consultation undertaken for the proposed Project and outcomes from consultation are also considered when identifying mitigation. Where mitigation is used to meet federal or provincial legislative requirements, this is stated in the assessment text for each VEC.

At this conceptual stage of development planning (i.e., ASP), detailed design for some mitigation remains unavailable (e.g., exact position and size of off leash dog parks; exact location of wildlife fencing; education materials). Assumptions about the type of mitigation used are made for the purposes of this EIS. Failure of the final design to meet these assumptions would require re-assessment of the conclusions provided in this EIS. Mitigation for which uncertainty is present and for which assumptions must be met in the final design is described in the uncertainty and monitoring section for each VEC. To address uncertainty, an adaptive management approach will be applied whereby monitoring will be used to evaluate the effectiveness of mitigation. Where required, mitigation measures are adjusted according to the findings of monitoring.

Predict and Characterize Residual Effects

Residual effects of the Project are those that are predicted to persist after successful implementation of all mitigation that is either legally required or has been committed to as part of the ASP. Residual effects, where identified, are characterized using the same assessment criteria described above for the unmitigated environmental risks of the Project. The unmitigated and mitigated (i.e., residual) environmental consequences can therefore be directly compared for each VEC to understand the importance of implementing mitigation.

4.4 Uncertainty and Monitoring

Scientific inference is associated with uncertainty, and prediction confidence depends on the level of uncertainty and the way it is addressed. Primary factors that have the potential to affect confidence in the predictions made in the EIS include:

- availability and accuracy of data to describe existing conditions
- accuracy of ecosystem maps
- accuracy of models
- level of understanding of population viability and ecological resilience

- level of understanding of the strength of Project-environment interactions in terms of the effects they are likely to have on each VEC
- level of certainty associated with the effectiveness of proposed mitigation
- level of understanding of the cumulative drivers of environmental change and associated effects on VECs.

Uncertainty in the EIS is managed by:

- incorporating historical data and relevant studies conducted in the RSA
- using relevant published literature to help make predictions
- validating models
- overestimating rather than underestimating potential effects where uncertainty is high (i.e., a precautionary assessment)
- specifying assumptions about mitigation for which final designs are not available and recommending follow up actions to confirm consistency of final design within this EIS
- recommending monitoring and adaptive management where substantial uncertainty remained or where the consequences of being wrong about a predicted residual effect are substantial (e.g., potential for a high environmental consequence).

The precautionary approach used when preparing this assessment means that predicted adverse effects identified within this report are predicted to be greater than the effects that are likely to be observed when the Project is built. For example, the development footprints used to define developed areas for the Project overestimated the likely total disturbance to address uncertainty about exactly where development will be located and what will remain as green space. In all cases, policy presented in the Smith Creek ASP indicates a smaller total development footprint than is assumed for this assessment. For example, within a given District the developed footprint will be smaller than the overall size of the District because typically lots are not fully developed, and green space remains after development. Similarly, where a range of units or populations is presented in the ASP, this assessment evaluated the maximum values in all cases.

4.5 Cumulative Effects

Cumulative effects are defined for the purposes of this EIS as the sum of all natural and human-induced influences on each VEC in the RSA from a condition prior to development of the Town (i.e., 1800s) until full build out of the Project, which is expected to take 20 to 30 years (i.e., complete development by 2045 to 2055). A cumulative effects assessment is only completed for VECs for which Project related residual effects are predicted to have an environmental consequence greater than negligible (Table 10). These were discussed with the third party reviewer in advance and agreed upon. Cumulative effects may be important for VECs for which the Project has positive or negligible effects, but the Project will not make them worse, and therefore they are not considered in this EIS.

Cumulative effects were assessed at the RSA scale. Both quantitative and qualitative approaches were used to conduct the cumulative effects assessment, depending on the availability of data for each VEC.

Cumulative effects are primarily generated by the interactions of previous and existing developments and activities, and the largest portion of the cumulative effect is described in the existing conditions section for each VEC. Existing disturbance and activities associated with human development in the RSA that are considered in the cumulative effects assessment are presented in Figure 13 and includes:

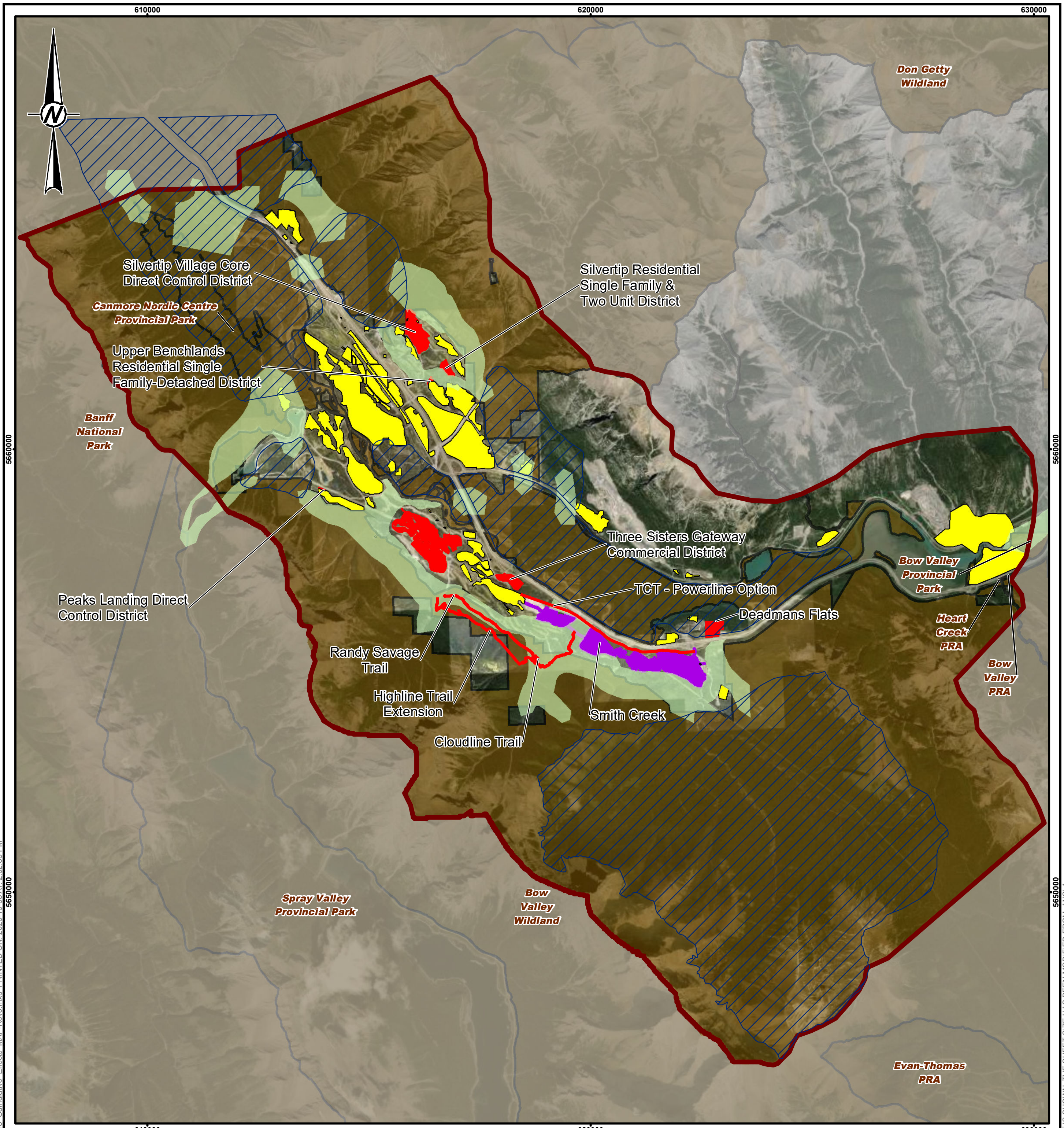
- Trans-Canada Highway and other secondary highways and roads in the RSA and associated existing traffic
- Canadian Pacific Railway
- urban developments: Canmore, Harvey Heights, Deadman's Flats, Banff Gate Mountain Resort, Lac des Arcs, Exshaw
- industrial developments: Baymag, Lafarge, Thunderstone Quarry, Graymont
- designated and undesignated trails and patterns of human use on these trails in the RSA

A cumulative effects assessment is achieved by adding the Project and other RFDs to the existing condition to predict a future outcome for VECs in the RSA, assuming all RFDs are implemented. In consultation with the Town, the following criteria are applied to identify RFDs (Welsh 2019, Pers. comm.):

- the development overlaps spatially with the RSA
- the development must be reasonably foreseeable (i.e., proposal submitted to the Town in the last five years). Older proposals with no action for more than 5 years or ideas for projects that have not been formally proposed are excluded
- there is sufficient information about the development to support a cumulative effects assessment (e.g., a footprint or a detailed description of the project is available)

In addition to the Project, other RFDs that are included quantitatively in the cumulative effects assessment are (Figure 15):

- Three Sisters Village ASP
- Dead Man's Flats ASP
- Silvertip Village and Silvertip Residential Project ASP
- Upper Benchlands Residential Project
- Peaks Landing Project
- Three Sisters Gateway Commercial District Project
- Highline Trail Extension Project
- Cloudline Trail Project
- TransCanada Trail Powerline Option
- Randy Savage Trail Project



LEGEND

- CUMULATIVE EFFECTS TRAIL
- BASE CASE BUILT UP AREA
- CUMULATIVE EFFECTS BUILT UP AREA
- APPROVED WILDLIFE CORRIDOR
- HABITAT PATCH
- PARK / PROTECTED AREA
- PROJECT CASE BUILT UP AREA
- REGIONAL STUDY AREA

0 2,000 4,000

1:125,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, JANUARY 2017.
2. PROJECT FOOTPRINTS FOR CUMULATIVE EFFECTS CASE PROVIDED BY TOWN OF CANMORE, PLANNING AND DEVELOPMENT. MAY 31, 2019
3. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE
CUMULATIVE EFFECTS BUILT UP AREAS IN THE REGIONAL STUDY AREA

CONSULTANT
GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	15

Future projects or activities that are considered qualitatively or using projections include:

- Spring Creek Area Redevelopment Plan (addition of housing density and increase in human population)
- Teepee Town Area Redevelopment Plan (addition of housing density and increase in human population)
- population growth within the RSA
- climate change

The existing disturbance in the RSA, the ASP area, and footprints of RFDs for which data are available are presented in Table 10. When all RFDs are considered, the amount of urban development in the RSA will increase by 201.9 ha (30.7%) relative to existing conditions. If all RFDs are built, this will mean that the proportion of the RSA affected by disturbance will increase from 11.2% under existing conditions to approximately 12.0% with the addition of future cumulative developments. Given that approximately 73% of the RSA is park or protected area, opportunities for additional development in the Bow Valley beyond those defined for the cumulative effects assessment are limited.

The significance of cumulative effects for each VEC is identified by determining if the combined effects of previous, existing, and future projects in the Bow Valley would cause a serious risk (i.e., high environmental consequence) to the VEC. The contribution of the Project to any significant adverse cumulative effects identified is described.

Table 10: Existing and Future Anthropogenic Disturbance in the Regional Study Area by Disturbance Type

Disturbance Type	Disturbance Amount (ha)			
	Existing Disturbance	Smith Creek ASP	Reasonably Foreseeable Developments	Total Future Disturbance
Golf Course [(a)]	312.2	0.0	-45.4	266.7
Industrial	281.4	7.6	0.0	289.0
non vegetated	56.9	0.0	0.0	56.9
Other Trails	373.6	-3.8	-4.9	364.8
Pipeline/Transmission Line	302.8	-5.1	-3.0	294.8
Transportation	657.4	34.6	-3.9	688.2
Unknown	1.5	0.0	0.0	1.5
Urban Development	685.9	67.8	143.1	896.8
Water Impoundment - Anthropogenic	2.7	5.7	-0.3	8.1
Total disturbance	**2,674.4**	**106.8**	**85.6**	**2,866.9**

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
a) Includes anthropogenic grasslands associated with the 2004 Resort Centre ASP that are not an active golf course.
ASP = Area Structure Plan; ha = hectares.

5.0 BIODIVERSITY

Biodiversity refers to all the variety of life on Earth including the communities that they form and the habitats in which they exist. From the perspective of this Project and this assessment, the biodiversity VEC is made up of the wildlife, vegetation and aquatic VECs. As such, biodiversity within each VEC and the effects of the Project on it is discussed individually and includes species at risk, species assemblages and rare communities. For example, the wildlife VEC includes potential effects of the Project on federally-listed species at risk under the *Species at Risk Act* and the Committee for Endangered Wildlife in Canada (COSEWIC), the wildlife corridor Environmentally Sensitive Areas (ESAs) and predator prey relationships, and vegetation VECs include wetland ESAs and federally and provincially listed rare plants. The overall effects of the Project on the biodiversity VEC are summarized at the end of this section.

5.1 Wildlife Valued Ecosystem Component

The wildlife VEC is a primary focus of this EIS. To identify appropriate mitigation for wildlife generally, the wildlife section identifies existing conditions, potential effects prior to mitigation, and residual effects after mitigation for a range of wildlife species and important habitat features present or potentially present in the ASP area. For example, considering potential effects of the Project on avian species at risk and migratory birds permitted identification of important mitigation, such as clearing vegetation outside of the breeding period or conducting nesting surveys to avoid mortality and comply with the federal *Species at Risk Act* and *Migratory Birds Convention Act*.

The residual and cumulative effects assessments were undertaken for grizzly bears, cougars, wolves, and elk, which were selected as indicator species based on their varied responses to development and in the case of grizzly bears, their provincial status as ‘Threatened’ (Section 5.3.1; AEP 2018). Using these species as indicators permits an evaluation of the key issues of habitat loss, potential changes in use of provincially approved wildlife corridors, potential negative human-wildlife interactions and predator-prey relationships within the RSA. Some information about black bears is also included in the grizzly bear section because of similarities of the environmental risks faced by both species and in the mitigation used to address environmental risks. Human recreational use of natural areas is also a major focus of the wildlife impact assessment because of the potential for human use to influence wildlife habitat use or result in negative human-wildlife interactions.

5.2 Wildlife Methods

The wildlife impact assessment follows the general assessment methods outlined in Section 4. This section presents additional details about specific analyses and approaches used to complete the wildlife impact statement.

5.2.1 Camera Data

Motion-sensitive remote cameras were deployed on TSMV lands and in adjacent wildlife corridors by Chinook Co. Environmental Ltd. during 2009-2014, and Corvidae Environmental Consulting Inc. during 2015-2016. Cameras were deployed to quantify wildlife and human use within TSMV lands and adjacent wildlife corridors.

The camera deployment area consisted of portions of TSMV lands slated for future development, the Stewart Creek Golf Course, the designated wildlife corridor system, the portion of TSMV properties known as the proposed Smith Creek ASP and provincial lands on Wind Ridge. The deployment area extended from the Trans-Canada Highway, at its northern boundary, to the southern edge of the approved Along Valley Corridor, except east of Stewart Creek where the deployment area extended south past the approved Along Valley Corridor to include Wind Ridge. The deployment area was bounded to the west by the Peaks of Grassi subdivision and extended east to the Wind Valley.

The deployment area was stratified into 300 m x 300 m grid cells to achieve representative coverage of the entire area. Monitoring occurred throughout the grid during 2009-2016 and more cameras were deployed east of Stewart Creek from 2010 to 2012 and 2015 to 2016.

Random sample site points were generated within each 300 m x 300 m grid cell. Cameras were deployed on the nearest trail to the random location, including faint game trails, heavily used game trails, designated and undesignated human recreation trails, and active and inactive access / mine roads. Cameras were rotated to a new random site approximately every three to four weeks. Initially, the program generated new random locations that were restricted from occurring within 50 m of a previous sampling location in each grid cell, but over the years this rule had to be relaxed because of the high number of sampling locations within each grid cell. Camera equipment included Reconyx PC 85 (colour), PC 75 (monochrome), and HC600 (colour) models.

Cameras could not be deployed at random locations falling within open habitat without a suitable tree for attachment of the camera. Where trees were present, cameras were attached to a suitable tree with a minimum 6-inch diameter to prevent false image triggers due to wind shaking the tree. Cameras were mounted at approximately chest height and tilted slightly down, at a 45° angle to the trail, to maximize the amount of time a subject could be detected. Cameras were locked to the tree to deter theft. A global positioning system (GPS) unit was used to record the location of the camera.

Cameras specifically targeted detections of mammals coyote-sized or larger. Smaller animals could have passed undetected. Cameras were deployed to achieve a similar field of view at each deployment location to limit variation in detection probability among sites. Camera sensors were set on high and the cameras took three pictures if the motion-sensitive sensor was triggered.

Reconyx cameras use compact flash and microSD memory cards that can be changed in the field. Memory cards were downloaded onto a computer, and the images were reviewed by researchers and data associated with each image was recorded on data sheets (Table 11). The data for each image was then entered and stored in Microsoft Excel.

Table 11: Summary of Information Collected From Images

Heading	Description
Observer	The researcher who transcribed the images from memory card to database.
Sample Site	The UTM NAD 83 coordinates for the sample site.
Data	The date the camera was deployed.
Time	The time the camera was deployed.
Days Operating	The number of days the camera was deployed.
Event	The type of event; options were human (including dogs) or wildlife.
Species	Either the wildlife species or the type of human recreation use.
Young	Whether there is a young-of-year or yearling in the image.
Number	Number of humans or wildlife in the image.

UTM NAD = Universal Transverse Mercator North American Datum.

The following protocols were used when reviewing images:

- If a subject was in a series of images continuously, without a break, no matter how long, this was entered as only one event.
- If a subject enters and exits the frame a series of times, and it can be determined that it is the same subject, then it is entered as one event. This rule resets every two hours.

During 2009-2016, 1,336 locations were monitored by Chinook Co. Environmental Ltd. and Corvidae in the deployment area. Data from an additional 26 locations monitored by the Town and AEP as part of a Human Use Management Review (HUMR) program were also incorporated into the analyses. Sampling at these 1,362 locations totaled 42,559 camera monitoring days (Table 12).

Most deployment area units presented in Table 12 were primarily forested. Exceptions were the Stewart Creek Golf Course and anthropogenic grasslands. These areas were sampled by deploying cameras in patches of forested habitat, but open areas were not sampled.

Table 12: Camera Analysis Categories and Sample Sizes

Trail Type	Deployment Area Unit [a]					Total
	ASP Area	Adjacent Wildlife Corridor	Other Corridors within LSA	Other LSA	Other (outside of LSA but within RSA)	
Designated	0 / 0	2 / 360	9 / 542	0 / 0	8 / 826	19 / 1728
Undesignated	20 / 613	97 / 3437	47 / 1801	13 / 391	22 / 956	199 / 7198
Other[b]	150 / 4809	383 / 11575	201 / 5564	177 / 4778	233 / 6907	1144 / 33632
Total	**170 / 5421**	**482 / 15372**	**257 / 7907**	**190 / 5169**	**263 / 8690**	**1362 / 42559**

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
a) Results presented as number of camera locations / number of camera days.
b) Other is any location that does not fall on a trail that has been mapped as designated or undesignated.
ASP Area = Project Study Area Boundary; LSA = Local Study Area; RSA = Regional Study Area.

Camera data were analyzed using the number of photographs of individuals from a category of interest, such as humans, off leash dogs, or grizzly bears, divided by the number of days monitored for each camera deployment. This yields a detection rate expressed as photos/camera/day. Comparisons were made using these data among various spatial categories, such as deployment area unit and trail type. The distance between each camera location and the nearest urban development was also calculated in a Global Information System to permit investigation of the influence proximity to urban development had on detection rates. Temporal and seasonal patterns of detection over a 24-hour period were investigated using the time-stamp on photographs from all cameras for carnivores, and from HUMR cameras for humans. Because random locations sampled different locations with variable numbers of cameras deployed on designated, undesignated, and other trail types among years, inter-annual comparisons were not undertaken.

Variation in detectability among species and locations can affect the interpretation of comparisons using detection rates from camera data (Burton et al. 2015). Variation in detectability was not explicitly tested in this study, but constant detectability was considered a reasonable assumption for the following reasons:

- The random design of the study incorporated a variety of habitats, including faint game trails through the forested matrix, thereby avoiding bias associated with deploying cameras on a single trial type (Harmsen et al. 2010).
- The relatively small size of the study area (i.e., within the home range of target species like elk, cougars, wolves, and grizzly bears), meant that behavioural and ecological processes were similar throughout the sampled area, avoiding bias associated with behavioural or ecological variation among sites (Burton et al. 2015).
- Camera locations were not baited and were moved regularly, avoiding potential problems associated with increasing visitation rates to camera locations over time (Sollmann et al. 2013).
- Consistent deployment methods, camera specifications, camera settings, and consistent large body size of target species (e.g., people, elk, grizzly bears) avoids several potential sources of inconsistent detection (Wellington et al. 2014; Burton et. al. 2015).

A key exception to this assumption was present for open habitats. Species selecting open habitats, such as elk and grizzly bears (Appendix B), may be underrepresented by camera data in places with substantial open areas. Comparisons among deployment area units must therefore consider this potential bias.

5.2.2 Wildlife Movement in Wildlife Corridors

Wildlife movement route surveys were conducted in 2018 to address the Terms of Reference requirements to assess the effects of the Project on existing and predicted wildlife movement patterns related to change in habitat use and increased human use (Appendix D). The primary objective was to identify existing constraints to wildlife movement and potential sites for mitigation to improve corridor functionality regarding wildlife movement in designated provincial corridors.

Potential mitigations based on the results of these surveys could include removal of obstacles such as downed trees, or dense vegetation to facilitate ease of movement, vegetation clearing to improve forage potential away from potential development areas, and identification of unofficial human recreation trails that could be modified to reduce human use and facilitate wildlife movement. Surveys were conducted within the Tipple Creek Across Valley Corridor, the Stewart Creek Along Valley Corridor, the Steward Creek Across Valley Corridor, and Smith Creek ASP area and the portion of the Along Valley wildlife corridor adjacent to the ASP area.

Surveys consisted of two types of transects: pre-set transects and game meander transects. Pre-set transects targeted areas with high potential to be used by animals such as elk, grizzly bear, cougar, and wolf and features that could be modified to improve movement potential (e.g., dense vegetation, thick deadfall). Survey transects were designed to turn at close to right angles approximately every 700 m, to increase the number of times the transects crossed the direction of potential animals' movement (i.e., primarily southeast to northwest animal movement). Game trails that had no obvious human use but clear sign of wildlife use (e.g., tracks, scat) and were relatively continuous were selected for game meanders transects. Game meanders were surveyed because of their existing known use by wildlife, thus providing a benchmark for corridor characteristics that currently allow wildlife passage in approved wildlife corridors.

Data collected along transects included changes in movement class (Table 13), the occurrence of wildlife or human trails, and any microfeature that could present a barrier to movement such as cliffs or water bodies.

Table 13: Potential Characteristics of the Movement Class

Movement Class of Terrain	Potential Characteristics of the Movement Class[a]				
	Pace[b]	Obstacles (e.g., dense vegetation, deadfall, cliff)	Deviations from the Transect or Game Trail Meander (i.e., around obstacles) (m)	Slope (%)	Examples
Easy	Easy and fast hiking (e.g., 15 to 30 min for 1 km is possible).	Few obstacles (e.g., >50 m between obstacles). Movement through, over, or under is relatively easy.	<10 m deviation perpendicular to the transect, and/or >30 m between deviations.	Gentle (e.g., mainly ≤6° (10.5%), short sections might be steeper than 6° or 10.5%). Does not impede movement.	Open grassland, open forest, recreational trails, roads, flat ground.
Moderate	Slow hiking (e.g., >30 to 45 min for 1 km is possible).	Occasional obstacles (e.g., one every 20 m). Slow movement through, over, or under.	Occasional deviations of <10 m perpendicular to the transect, and/or one deviation approximately every 25 to 50 m. e.g., Approximately 2-3 deviations / 30 m.	Slope slows movement (e.g., long sections of slope ≥6° or 10.5%, short sections of slope ≥ 25° or 46.6%).	Dense grassland, moderately dense shrubland, moderately dense forest, moderate deadfall, steep side slope.
Difficult	Slow; might require climbing, scrambling, or weaving in the general direction of the transect (e.g., >45 min for 1 km is likely).	Frequent obstacles (e.g., one every 5-10 m or less). Slow movement through, over, or under.	Continually climbing through, over or under obstacles or deviating from the transect.	Slope makes movement difficult (e.g., long sections of slope ≥25° or 46.6%, steeper for short sections).	Dense shrubland, dense forest, heavy deadfall, scrambling up steep embankments.
Impassable	A stretch of transect that cannot safely be travelled by the observers.	No safe movement possible through, over, or under obstacles, only around is an option. Take waypoints before and after the obstacle, and write "I" for movement class.	Deviation of >5 m perpendicular to the transect that results in a long detour (e.g., one deviation that lasts for a 25 m stretch of transect).	Slope renders safe movement impossible.	Heavy deadfall, cliff, or waterbody >5 m wide and/or over a span of ≥25 m.

a) Not all characteristics within a movement class were required to be present to qualify for a given classification.

b) An easy walking pace on flat open ground covers about 1 km in 15 minutes. Data collection slowed movement, such that terrain movement class was classified according to the speed that was "possible" as opposed to the speed of survey progression.

>= greater than; <= less than; ≥ = greater than or equal to; ≤ = less than or equal to; m = metre; min = minute; km = kilometre;% = percentage; ° = degrees.

Habitat parameters were collected in a representative location both when beginning a new transect segment, and when there was a change in movement class. Parameters included understory density, estimated visibility (m), canopy cover, downed woody material 60 cm above the ground, and movement enhancement potential. Notes were recorded regarding whether the movement classification was related to slope, deadfall, or other factors. Photographs of the understory density were taken to the north and east of each waypoint.

Wildlife trails were recorded in two categories: trails and wildlife use areas. Transects would sometimes cross through an area covered with a dense network of wildlife trails. These stretches were recorded as wildlife use areas with a waypoint either every 50 m or when the transect intersected a high use trail within the trail network. For both wildlife trails and wildlife use areas the movement class, trail type (i.e., low, moderate, or high use), trail direction (i.e., upslope, downslope, both), enhancement potential, and obvious human usage were recorded. For wildlife use areas these data represent most trails in the trail network (e.g., most wildlife trails were low use). Moderate and high use wildlife trails were photographed in both directions. Representative photographs of low use trails in different habitats were also taken.

5.2.3 Resource Selection Functions

Changes in habitat selection from existing conditions as a result of the Project and the Project plus other RFDs were estimated using RSFs developed for grizzly bears, cougars, wolves, and elk using telemetry data collected from animals collared in the Bow Valley (Appendix B). The Foothills Research Institute has also developed RSFs for grizzly bears that could be applied using their GBTools program. These models were considered, but models derived from bears in the Bow Valley were selected because:

1) bears in the Bow Valley may respond differently to disturbance variables than bears occupying habitats with less disturbance and human use[6]

2) models available in GBTools did not include a variable for urban development; therefore, responses of grizzly bears to the addition of the Project could not be evaluated, except through changes in landcover and the addition of roads

The RSA was divided into raster cells of 25 m x 25 m and the RSF for each species outputs a value that indicates the relative probability of selection for each cell. Models were validated using five discrete habitat selection categories and validation indicated that all models interpreted at the category level had excellent predictive abilities (Appendix B). Model categories for each species were interpreted as follows:

- **Selected** – observed proportion of independent telemetry locations in this category are greater than the proportion that would be expected if habitats are used as available.
- **Used as available** – observed proportion of independent telemetry locations in this category are at or near the proportion that would be expected if habitats are used as available.
- **Somewhat avoided** – observed proportion of independent telemetry locations in this category are below the proportion that would be expected if habitats are used as available.
- **Strongly avoided** – observed proportion of independent telemetry locations in this category are much less than the proportion that would be expected if habitats are used as available.
- **Rarely used –** observed proportion of independent telemetry locations in this category are near zero.

[6] This phenomenon is known as a functional response in habitat selection. Some animals decrease avoidance of anthropogenic features as those features become more prevalent on a landscape. As noted by Knopff et al. 2014 “failure to account for potential functional responses could lead to overestimation of negative effects of development for adaptable large carnivores”.

Three spatially explicit model outputs were created using the RSFs for each species at the RSA scale[7].

- **Existing Conditions** – The models used to describe existing conditions were run using habitat and human disturbance layers representing the conditions currently present in the Bow Valley.
- **Project Effects** – The models developed to inform the Project effects assessment incorporated habitat and human disturbance layers representing existing conditions within the proposed Project footprint stamped in.
- **Cumulative Effects** – The models developed to inform the cumulative effects assessment incorporated habitat and human disturbance layers representing existing conditions with the Project footprint and all RFDs stamped in (Section 4.5, Table 9).

A comparison of the existing conditions model outputs to the Project effects or cumulative effects model outputs permitted quantification of changes in animal selection and habitat conditions. Existing conditions and residual effects were evaluated within the ASP area, approved wildlife corridors within the LSA, and the remaining largely developed areas within the LSA. Cumulative effects were evaluated at the RSA scale and included an evaluation of cumulative changes in grizzly bear, cougar, wolf, and elk habitat selection within the entire wildlife corridor network around Canmore.

The RSFs can be interpreted as representing habitat quality, which is a traditional interpretation of this kind of model (Manly et al. 2002). Using this interpretation, habitat quality and the contribution to the number of animals the landscape can support is proportionally highest in selected habitats and habitats used as available. Avoided habitats contribute less, and rarely used habitats may contribute little or nothing to the number of animals the landscape can support. Because wildlife occurrence is proportional to the probability of selection (Lele et al. 2013), the potential for encountering animals also increases as habitat quality increases, and risk of negative interactions between people and wildlife increases in higher quality habitats (Takahata et al. 2014).

More recently, RSFs have been used for corridor identification and movement modelling. In these cases, RSFs are interpreted as a resistance layer (Chetkiewicz et al. 2006; Chetkiewicz and Boyce 2009; Abrahms et al. 2016). The assumption typically made when using RSFs in this way is that the poorest quality habitat on the landscape will inhibit wildlife movement (i.e., high resistance), whereas the highest quality habitat facilitates its movement (i.e., low resistance) (Chetkiewicz and Boyce 2009; Abrahms et al. 2016). Therefore, increases in probability of selection can also be interpreted as reducing resistance and increasing the likelihood of movement through a given area on the landscape.

When applying RSFs to corridor definition with the goal of achieving connectivity for dispersing animals or during long-distance movements, behavioural state can be considered in model development (Elliot et al. 2014; Zeller et al. 2014; Abrahms et al. 2016). Behaviour during long-distance dispersal is frequently different from behaviour during other behavioural states such as foraging or resting. Dispersers or animals moving long distances sometimes take greater risks than animals involved in other behaviours and animals sometimes display opposite selection patterns during movement. For example, cougars normally avoid grassland habitats, but individuals moving long distances will sometimes select them (Zeller et al. 2014). Similarly, African wild dogs strongly avoid roads when all behavioural states are considered together but select for them during movement (Abrahms et al. 2016), and avoidance of roads and human development by lions declines dramatically during dispersal (Elliot et al. 2014).

[7] RSF models were run at scales larger than the RSA to account for edge effects (Appendix B) and subsequently clipped to the RSA for analysis.

Although resistance surfaces derived using RSF developed using data from dispersing individuals[8] or from long-distance movements of resident animals may be useful for defining the location of corridors for protection (Abrahms et al. 2016), defining the location or function of movement corridors is not part of the scope of this EIS (Section 1.3, Appendix A). Instead, the task implied for this EIS by the TOR is to consider changes in animal behaviour and selection for habitats in wildlife corridors adjacent to the ASP area that are approved by the Province (Section 1.3).

The RSF models used in this EIS incorporate multiple behavioural states, which is appropriate for answering questions about how the Project could affect wildlife use in approved wildlife corridors. The models consider the breadth of behavioural states exhibited by grizzly bears, cougars, wolves, and elk in the Bow Valley, acknowledging that corridors in the Bow Valley may be used both for occasional dispersal by animals traveling to other destinations, for short inter-patch movement for resident animals, and as habitat that contributes to population viability. Using probability of selection for all behavioural states combined also provides a better understanding of where animals are most likely to occur on the landscape and permits an improved understanding of the potential for negative human-wildlife conflict.

Human use of trails could reduce wildlife use of high-quality habitats and increase landscape resistance for movement (Ladle et al. 2016). Trail density is considered during RSF development (Appendix B) and appears in the top models for grizzly bears (positively associated with trail density), cougars (negatively associated with trail density), and wolves (negatively associated with trail density). Trail density is considered for elk but does not explain sufficient variation in elk habitat selection to be included in the top model (Appendix B). Because data about the intensity of human use on trails is not available concurrent with the telemetry data collected for the grizzly bears, cougars, wolves and elk in the Bow Valley, intensity of human use cannot be included as a candidate variable in the RSF models. In Kananaskis Country, fine scale patterns of human use (i.e., average daily number of humans and vehicles on trails and roads) are found to affect grizzly bear habitat selection at the local scale (Hojnowski 2017).

Human use of recreational trails in the Bow Valley has increased substantially since the RSFs were estimated (J. Herrero, unpublished data), and is predicted to increase further as a result of the Project and other RFDs and activities in the RSA (Section 5.9.1). Noting that site-specific data are not available to parameterize the strength of the response of wildlife to increased human use of trails in the Bow Valley[9], spatially explicit scenarios were run based on literature-based assumptions about potential reductions in probability of selection as a function of increased human use (Appendix B).

Scenarios were run for grizzly bears, cougars, and wolves, both to describe existing conditions and to predict residual and cumulative effects. Trail use scenarios were not evaluated for elk because increased human use on trails was not anticipated to change probability of selection by elk in wildlife corridors. Elk in the Bow Valley are habituated to people, spend much of their time near and within development (Appendix B), and need to be aggressively chased to achieve displacement (Kloppers et al. 2005).

[8] Telemetry data from dispersing animals was not available for this EIS; only resident animals were collared.

[9] Human use data on trails and GPS collar data were not collected at the same time. Therefore RSFs could not be developed using amount of use on trails as a predictor variable in candidate sets (Appendix B).

5.2.4 Environmental Consequence

The TOR for the EIS requires that the residual effects of the Project be identified, along with their significance (Appendix A). As described in Section 4.3, residual effects for each VEC are assigned an environmental consequence. A high environmental consequence, which can be considered a significant effect, is assigned if serious risk is identified. The definition of a serious risk varies among VECs and this section provides the methods used to identify whether or not a serious risk is present for wildlife under existing conditions or would be expected as a result of the Project, or the Project plus other RFDs.

Defining a serious risk for wildlife was accomplished using the concept of self-sustaining and ecologically effective populations. Self-sustaining wildlife populations are populations that will be maintained into the future with a low risk of extirpation[10]. Self-sustaining populations are healthy and viable populations, which are by definition robust and capable of withstanding environmental change and accommodating random population processes (Reed et al. 2003). Maintaining viable populations is a conservation target frequently applied by conservation biologists and resource managers (Fahrig 2001; Nicholson et al. 2006; Ruggiero et al. 1994; With and Crist 1995).

Achieving viable populations may not be sufficient to meet conservation objectives for assemblages of wildlife species that might interact with the species being assessed (Soulé et al. 2005). For highly interactive wildlife species that have strong effects on ecosystem structure and function, such as grizzly bears (Gailus 2010), cougars (Ripple and Beschta 2006, 2008), or wolves and elk (Hebblewhite et al. 2005a), the concept of ecologically effective populations is also applied. An ecologically effective population differs from a self-sustaining population if the number of individuals needed to maintain ecological function is greater than the number required to maintain a viable population, or if the behaviour of animals in a viable population of a highly interactive species is altered so that they no longer perform important ecological functions.

The potential for a serious risk is evaluated for grizzly bears, cougars, wolves, and elk by considering the cumulative effects of previous and existing disturbance on a) the amount of habitat in the RSA, b) habitat connectivity, and c) mortality, and combining this with the predicted residual effects of the Project and the effects of the Project and other RFDs. Although residual effects of the Project are characterized, the significance of the Project in isolation is not evaluated for wildlife because effects of a single project infrequently cause serious risk on their own (McCold and Saulsbury 1996).

A serious risk is identified for grizzly bears, cougars, wolves, or elk if the evidence indicated that:

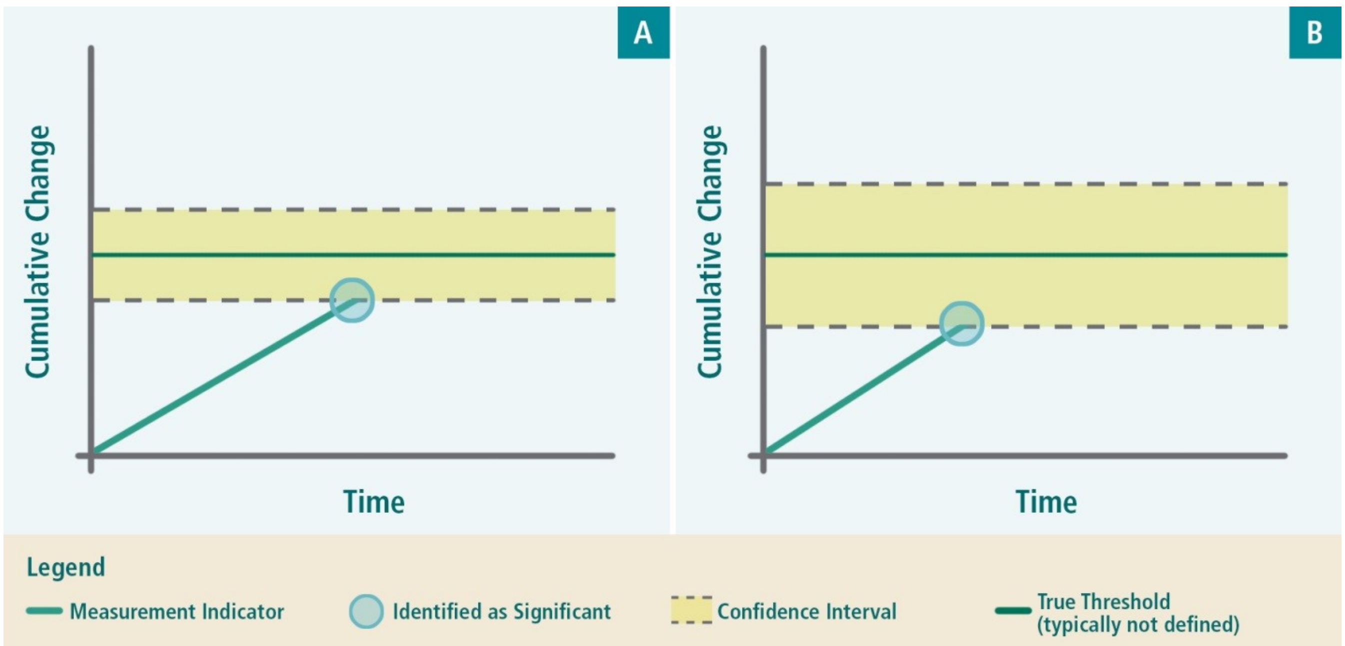
- the abundance of the species in the RSA, whether an open or closed population, is on a declining trajectory that is not predicted to recover or stabilize, or an ecological trap and a population sink is present at the scale of the RSA;
- connectivity through the RSA for the species declines to a level at which population viability for the species in the RSA or in surrounding areas may be adversely affected; or
- the species has lost important ecological function in the RSA, regardless of their self-sustaining status, such that the loss in function might trigger ecological changes that result in degraded or simplified ecosystems (Soulé et al. 2003).

[10] Extirpation occurs when a species becomes locally extinct. In the context of the Project, a species would be considered extirpated if it no longer occupied the regional study area.

Determining whether a wildlife population is self-sustaining and ecologically effective cannot be accomplished without a cumulative effects assessment and all aspects of the wildlife assessment consider cumulative effects, (including the description of existing conditions). The potential contribution of the Project to the cumulative effect is described using the residual effects characterization.

Uncertainty about whether a serious risk is present is identified and discussed. Where uncertainty is high, the assessment applied a precautionary approach[11] and identified a serious risk (equivalent to a high environmental consequence or significant effect) earlier on a continuum or cumulative change (Figure 16) than where confidence is higher (Figure 16). Serious risks identified because of high uncertainty are clearly recognized as such, and additional follow-up actions to reduce uncertainty are recommended.

Figure 16: Conceptual Schematic Showing Effect of Uncertainty on Significance Determination



Note: Where confidence is higher, a serious risk is identified closer to the unknown true threshold (A), but serious risk is identified farther from the unknown true threshold when confidence is lower (B).

[11] As described in Section 4.4, the precautionary approach used when preparing this assessment means that predicted adverse effects identified within this report are predicted to be greater than the effects that are likely to be observed when the Project is built. For example, if there was a high level of uncertainty about whether certain effects would result in a serious risk to a VEC, the assessment conservatively assigned a high risk to avoid an underestimation of effects.

5.3 Wildlife Existing Conditions

5.3.1 Species Present, Habitat Features, and ESAs

Wildlife surveys do not always capture all species present; therefore, both species that are confirmed within the ASP area and those that are present in the Bow Valley and may occasionally overlap with the Project are identified so that appropriate mitigation could be considered in this assessment. In total, 258 species of mammals, birds, amphibians, and reptiles have been confirmed or are potentially present within or near the ASP area (Appendix C). Mammals known to be present or potentially present include at least 16 species of carnivores, six species of ungulates, seven bat species, and 42 species of other small mammals. One hundred and seventy-nine (179) species of birds are identified, along with six species of amphibians and two species of reptiles. Many of these species only occasionally use land within the Project.

Of the 258 species identified, 58 are provincial and/or federal species at risk. Provincially listed species include 44 listed as 'Sensitive', eight listed as 'May Be At Risk' and three listed as 'At Risk' (Appendix C). Federally listed species include 10 listed as 'Special Concern', four listed as 'Threatened', and three listed as 'Endangered'. Of the federally-listed species or species listed provincially as 'May Be At Risk' or higher, only two are known to frequently use habitat within the ASP area:

- Grizzly bears regularly use habitats near the Project and several studies have recorded their presence in and around TSMV land (UMA Engineering Ltd. [UMA] 1991a; JWA 2005; Leeson and Kamenka 2008; Golder 2013). The northwest population of grizzly bears, including those in the Canmore region, are federally-listed as 'Special Concern' (COSEWIC 2012a; Government of Canada 2019). This status designation indicates that the population has biological characteristics that make it particularly sensitive to human activities. The species is provincially-listed as 'Threatened' (AEP 2018) and is addressed in detail as one of the indicator species selected for this assessment.
- Western toads have been observed in the Smith Creek ASP area and have been known to breed in some of the wetlands and riparian habitat near the Project, particularly in the Carex Meadows (Figure 62, wetland 9N, JWA 2008, Golder 2013). Western toads are federally-listed as a species of 'Special Concern' (COSEWIC 2012b; Government of Canada 2019), listed under Schedule 1 of the Species at Risk Act in 2005, and provincially-listed as 'Sensitive' (AEP 2018). Mitigation to avoid effects on breeding habitat for western toads is presented in Section 5.6.
- Long-toed salamander habitat at a wetland commonly known as Carex Meadows in the Project area (Figure 62, wetland 9N; JWA 2005, JWA 2008, Golder 2013).
- A movement route for bighorn sheep that extends from Wind Ridge, through the southeastern branch of the existing Along Valley Corridor, through the currently designated Stewart Creek Across Valley Corridor and to the TransCanada Highway, including at the existing Stewart Creek Underpass (Golder 2013).
- Mineral licks for bighorn sheep along Stewart Creek within and near the Stewart Creek Golf Course and in proximity to the Stewart Creek Underpass at the TransCanada Highway (Leeson 2008, pers. comm., Garrow 2012, pers. comm., Corvidae 2014 [Figure depicting sheep Mineral Lick Sites, page 7]). Based on field checks conducted in August 2014 (Corvidae 2014), old sheep tracks were located at the traditional mineral lick on the Stewart Creek Golf Course and fresh tracks were documented at the new mineral lick near the TransCanada Highway. The mineral lick on the Stewart Creek Golf Course was artificially supplemented for many years. Once supplementation was discontinued, use by sheep declined.

Wildlife habitat present in the Project Boundary has been substantially modified by human activity in the past. The Project area was affected by open pit and underground mining but it is now largely forested. Under existing conditions, the Project area contains utility corridors, roads, and a large number of undesignated hiking and biking trails, some of which are subject to high levels of human use (Section 5.3.2). Nevertheless, important habitat features and ESAs for wildlife are still present within or adjacent to the Project Boundary, as follows:

- the Along Valley Corridor (Figure 2)
- the Stewart Creek Across Valley Corridor (Figure 2)
- Pigeon Mountain Across Valley Corridor (Figure 2)
- breeding habitat for western toads in wetlands and riparian habitats
- nesting habitat for birds associated with forested habitat, meadows, and wetlands
- portions of the ASP area and surrounding areas are used as elk calving grounds in spring (Wildlife & Company 1998a,b; Delta 1991a)

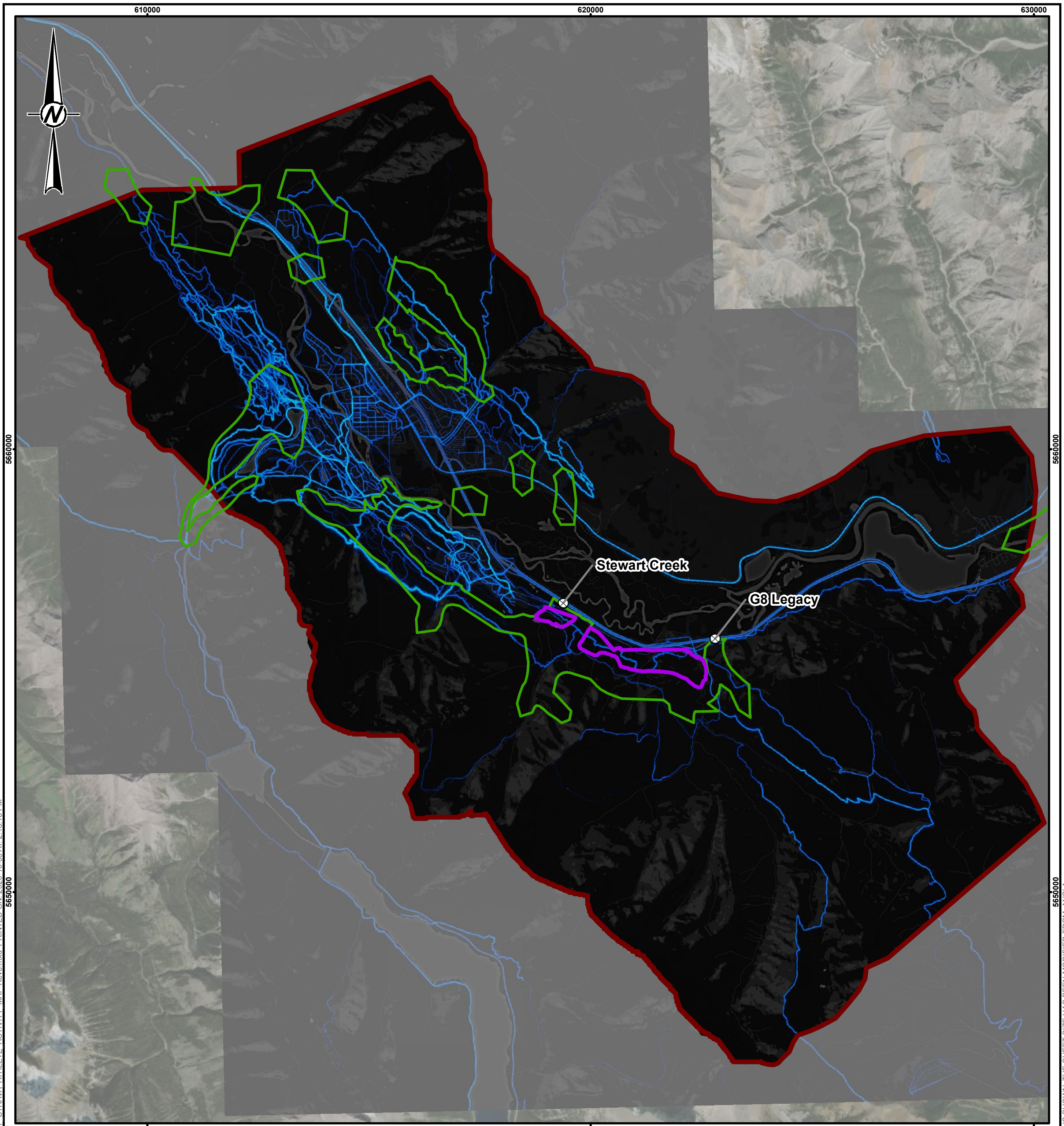
The Smith Creek Corridor, Along Valley Corridor and the Pigeon Mountain and Stewart Creek Across Valley Corridors are part of a broader network of wildlife corridors and habitat patches, which are ESAs designed to maintain viable wildlife populations in the RSA. In the 1990's a number of habitat patches were identified and set aside to provide for the needs of a variety of wildlife species (BCEAG 1999). These habitat patches are linked to one another with designated wildlife movement corridors (BCEAG 2012).

Wildlife corridors are especially important for large mammals, for which many habitat patches in the Bow Valley are too small to meet all of an individual animal's requirements and population viability depends on connectivity among patches (Weaver et al. 1996; BCEAG 1999). Connectivity across the Trans-Canada Highway is also important for large mammals (Merrill 2005) but has been strongly constrained by cumulative effects of development in the valley bottom (Golder 2013). The network of corridors and highway crossing structures in the Bow Valley was established to help mitigate adverse cumulative effects on wildlife connectivity.

5.3.2 Human Use - Existing Conditions

Negative human-wildlife interactions have been increasing under existing conditions in the Bow Valley, predominantly in places where wildlife habitat overlaps with or occurs adjacent to human development (BCEAG 1999, Town of Canmore 2015a). Increasing negative interactions between people and animals in all of its forms relates, at least in part, to increasing development and human use in the Bow Valley. Based on 10 years of trail monitoring in the Bow Valley, using trail counters deployed during 2003-2012, J. Herrero (unpublished data) estimates that human use is increasing near Canmore at a rate of approximately 6% per year. Human use is common on trails throughout the RSA, including on designated and undesignated trails in wildlife corridors, as indicated by data collected by Strava[12] (Figure 17).

[12] Strava is a social network for athletes where members can upload spatial data associated with their workouts online. The data are therefore biased to the sub-portion of the population that uses Strava, mostly runners and cyclists. Strava's website can be accessed at https://www.strava.com



LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- STRAVA IDENTIFIED TRAILS[1]
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- REGIONAL STUDY AREA

0 2,000 4,000

1:125,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, JANUARY 2017.
2. STRAVA IDENTIFIED TRAILS OBTAINED JANUARY 2017 FROM STRAVA HEAT MAP.
3. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

NOTE(S)

1. BRIGHTER COLOUR DENOTES HIGHER USE OF TRAIL.

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE

STRAVA ATHLETE ACTIVITY MAP

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	17

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Much of the human use within existing corridors that increases potential for negative human-wildlife interactions is contrary to existing regulations. For example, human use in wildlife corridors is only permitted on designated trails (Government of Alberta 2002). However, undesignated trails are more common than designated trails in wildlife corridors in the RSA (i.e., 57.7 km of designated trail and 83.9 km of undesignated trail)[13], and trails often radiate out from the backyards of residences adjacent to corridors (Figure 13).

The Bow Valley Protected Areas Management Plan applies special designation to some wildlife corridors in the RSA. For example, the Along Valley Corridor is designated a P4 wildlife corridor, which means that most trails are closed between December 1 and June 15 (Government of Alberta 2002). Analysis of remote camera data showed that this corridor was used by people year-round, with use increasing rapidly during April and May, remaining relatively high until August and then declining during winter. The period of higher use during April and May overlaps with the closure period.

Similarly, off-leash dog use is not permitted in wildlife corridors, but commonly occurs in wildlife corridors and habitat patches in the RSA (Golder 2013). Such use could be one of the most important factors adversely affecting wildlife use of corridors and habitat patches in the Bow Valley (Young et al 2011).

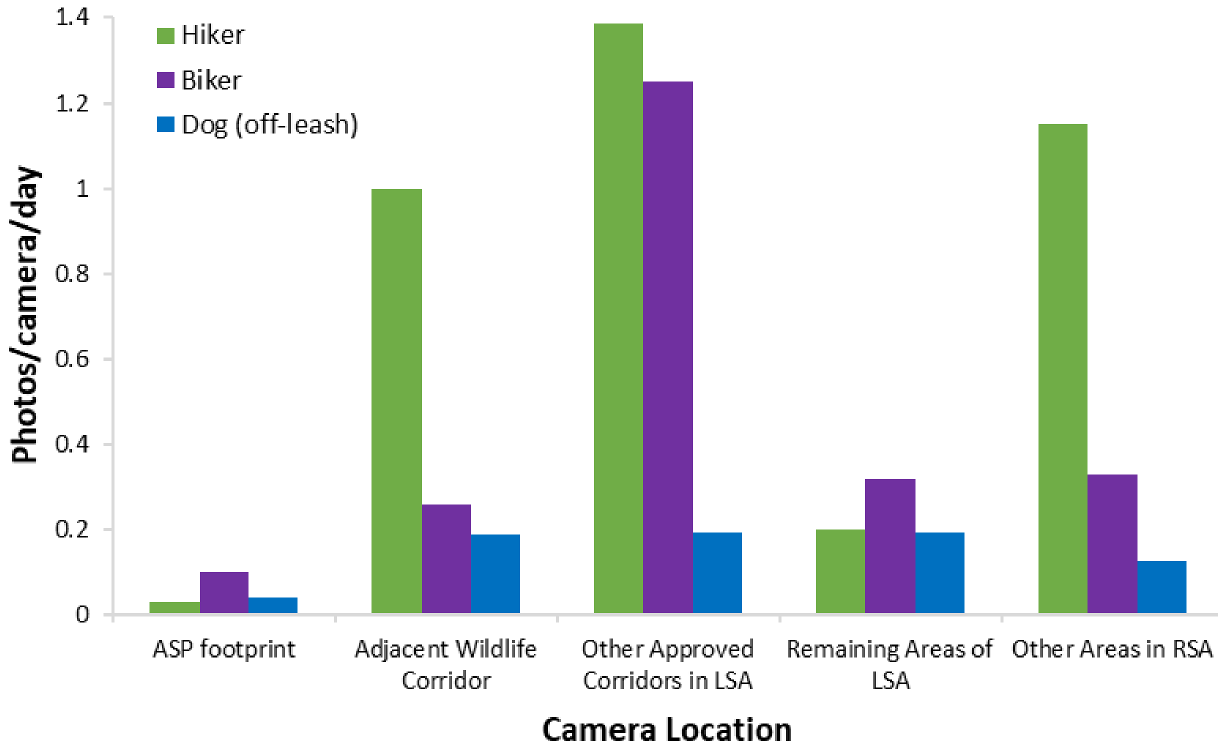
Within the LSA, human use (walkers and hikers) was highest in the corridors adjacent to the ASP and other approved wildlife corridors, while people on bikes were most common in the wildlife corridors west of the Project (i.e., not in the corridor area adjacent to the Project, Figure 18). Off-leash dogs were more commonly detected in corridors and other areas of the LSA other than the Project area (Figure 18).

Greater human use in the corridors adjacent to the Project is linked to how far away corridors are from urban developments. Most people accessing wildlife corridors, do so from adjacent development where they live or park their cars, as evidenced by a strong relationship between the amount of human use detected at a camera location and the distance of the camera from the nearest urban development (Figure 19).

Cameras detected humans more frequently than wildlife in wildlife corridors, even though the rate of human detection decreases with increasing distance from the Town. Cameras deployed within the Tipple Across Valley and Along Valley Corridors adjacent to the ASP area detected humans (including humans with their dogs) twice as often as wildlife (66% vs. 34%, respectively), and cameras deployed in the Along Valley Corridor and TSMV lands outside the LSA recorded humans slightly more frequently than wildlife (55% vs. 45%).

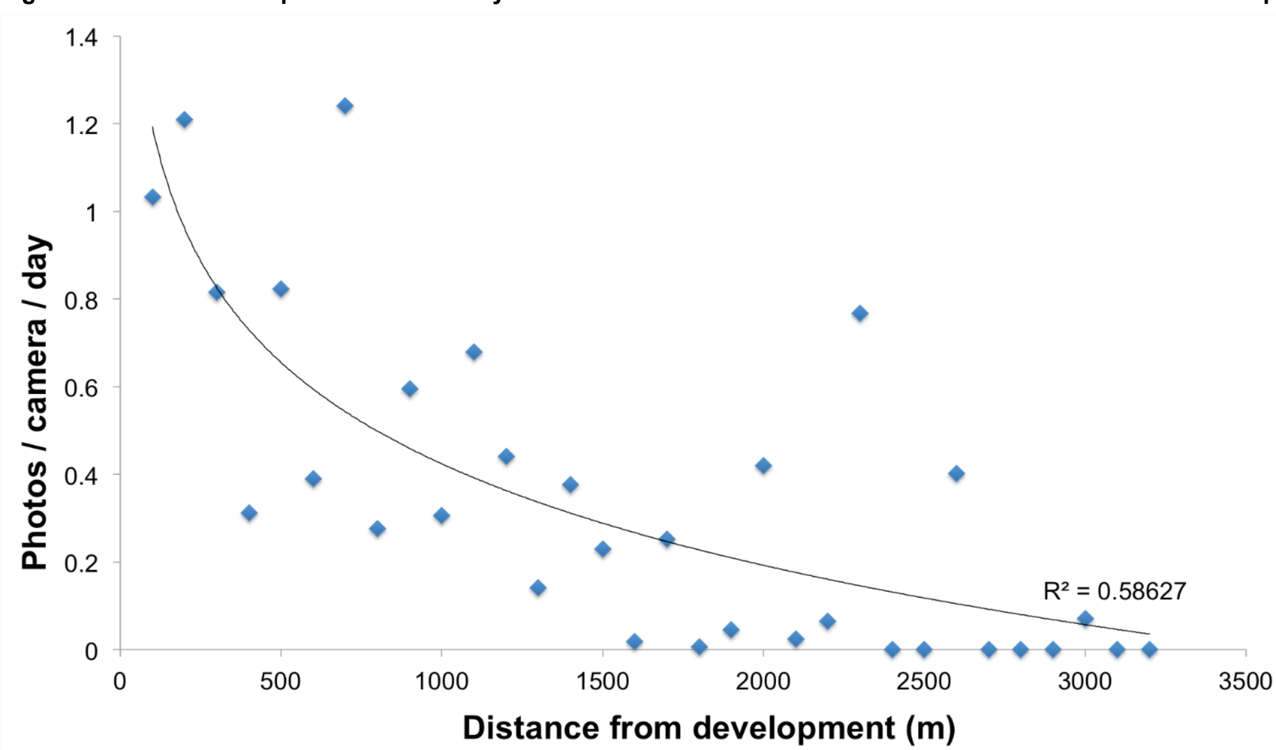
[13] Undesignated trails may be under-represented because not all of them have been mapped and new trails are created each year, often by individuals who do not know they are building trails in wildlife corridors (Derwortz 2015).

Figure 18: Hikers, Bikers, and Off Leash Dogs in and Around the Local Study Area



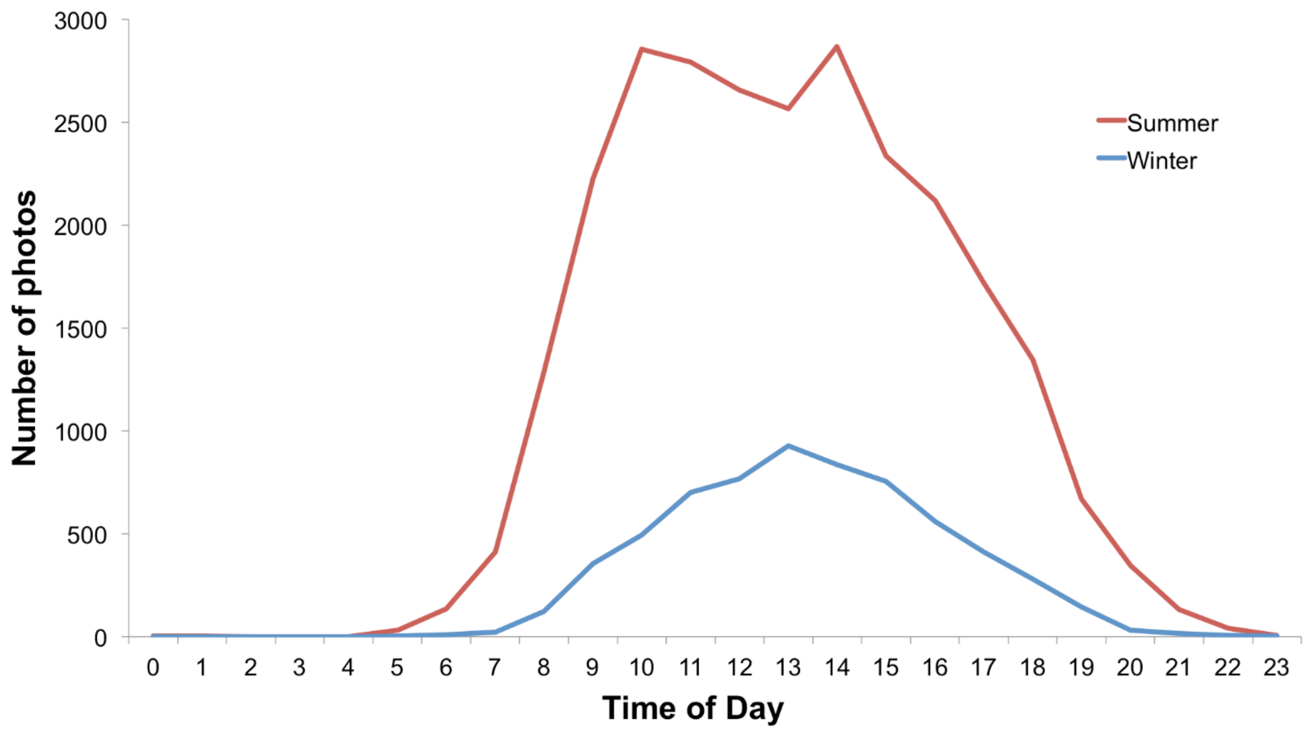
ASP = Area Structure Plan; LSA = Local Study Area; RSA = Regional Study Area.

Figure 19: Relationship Between Intensity of Human Use at Camera Locations and Distance to Urban Development



Human use varies substantially by season and time of day (Figure 20). The lack of human use of natural habitats at night means that the potential for negative human-wildlife interactions in wildlife corridors is restricted to daylight hours. Human use is lowest in winter, which is the same period that wildlife use is most concentrated in the valley bottom (Appendix B) and is therefore the period during which use of low elevation wildlife corridors is most important. This seasonal pattern applies to cougars, wolves and elk (Appendix B); however, grizzly bear use of the valley bottom is highest in summer (Appendix B).

Figure 20: Temporal and Seasonal Patterns of Human Activity



Rates of human use at camera locations on designated trails within wildlife corridors exceeds rates of human use on undesignated trails (Table 14). However, the linear distance of designated trails in wildlife corridors is small (Table 14), and the diffused nature of human use on a larger linear network of undesignated trails and use of areas where neither designated nor undesignated trails are defined, means that the majority of all human use in wildlife corridors under existing conditions occurs away from designated trails (Table 14, Figure 21 and Figure 22).

Table 14: Human Use of Designated and Undesignated Trails in Wildlife Corridors

Trail Type	Corridor Adjacent to ASP[(a)]		Other Corridors in LSA	
	Photos/Camera/Day	Linear Distance (km)	Photos/Camera/Day	Linear Distance (km)
Designated	1.327	1.79	2.611	4.37
Undesignated	0.012	25.90	0.056	27.11
Other	0.011	undefined	0.012	undefined

LSA = Local Study Area; km = kilometre.

Note: Adjacent corridors refer to the Stewart Creek Across Valley Corridor, Pigeon Mountain Across Valley Corridor, and portions of the Along Valley Corridor as illustrated in Figure 11.

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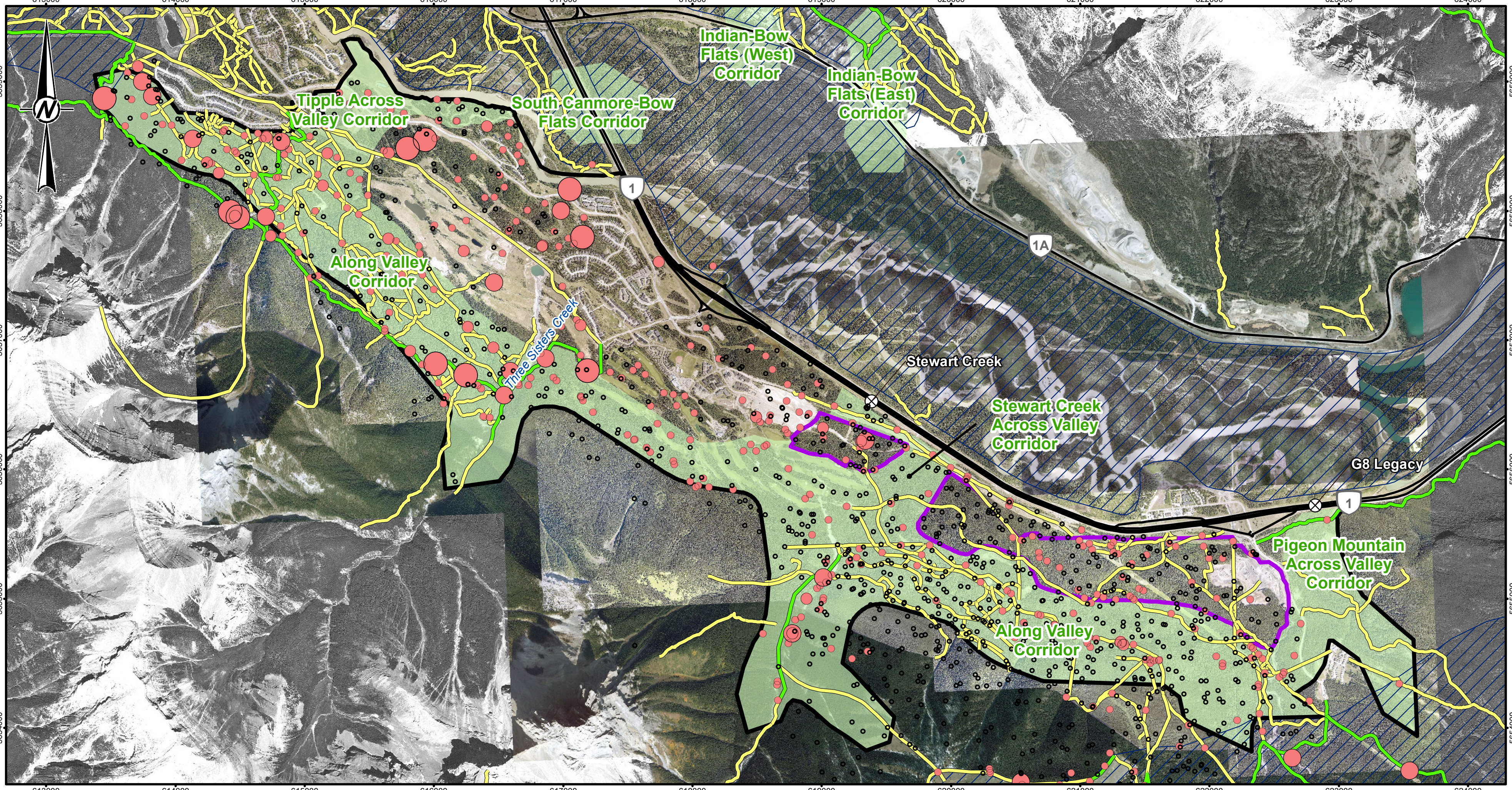

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- DESIGNATED TRAIL
- UNDESIGNATED TRAIL
- PRIMARY HIGHWAY
- APPROVED WILDLIFE CORRIDOR
- HABITAT PATCH
- LOCAL STUDY AREA
- PROJECT BOUNDARY

MEAN NUMBER OF INDIVIDUALS PHOTOGRAPHED PER DAY[1]

- 0.00
- 0.011 - 2.818
- 2.818 - 6.742
- 6.742 - 13.786
- 13.786 - 33.908

0 800 1,600

1:45,000 METRES

NOTE(S)

1. DATA INTERALS CATERGORIZED USING JENKS METHOD FOR NATURAL BREAKS

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. REMOTE CAMERA DATA (2013 - 2016) OBTAINED FROM AEP, AUGUST 2016. USED UNDER LICENCE.
3. TRAILS OBTAINED FROM ALBERTA PARKS AND PROTECTED AREAS, 2011. ADDITIONAL TRAILS DIGITIZED 2016.
4. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE

HUMAN USE RECORDED ON REMOTE CAMERAS IN AND AROUND THE LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
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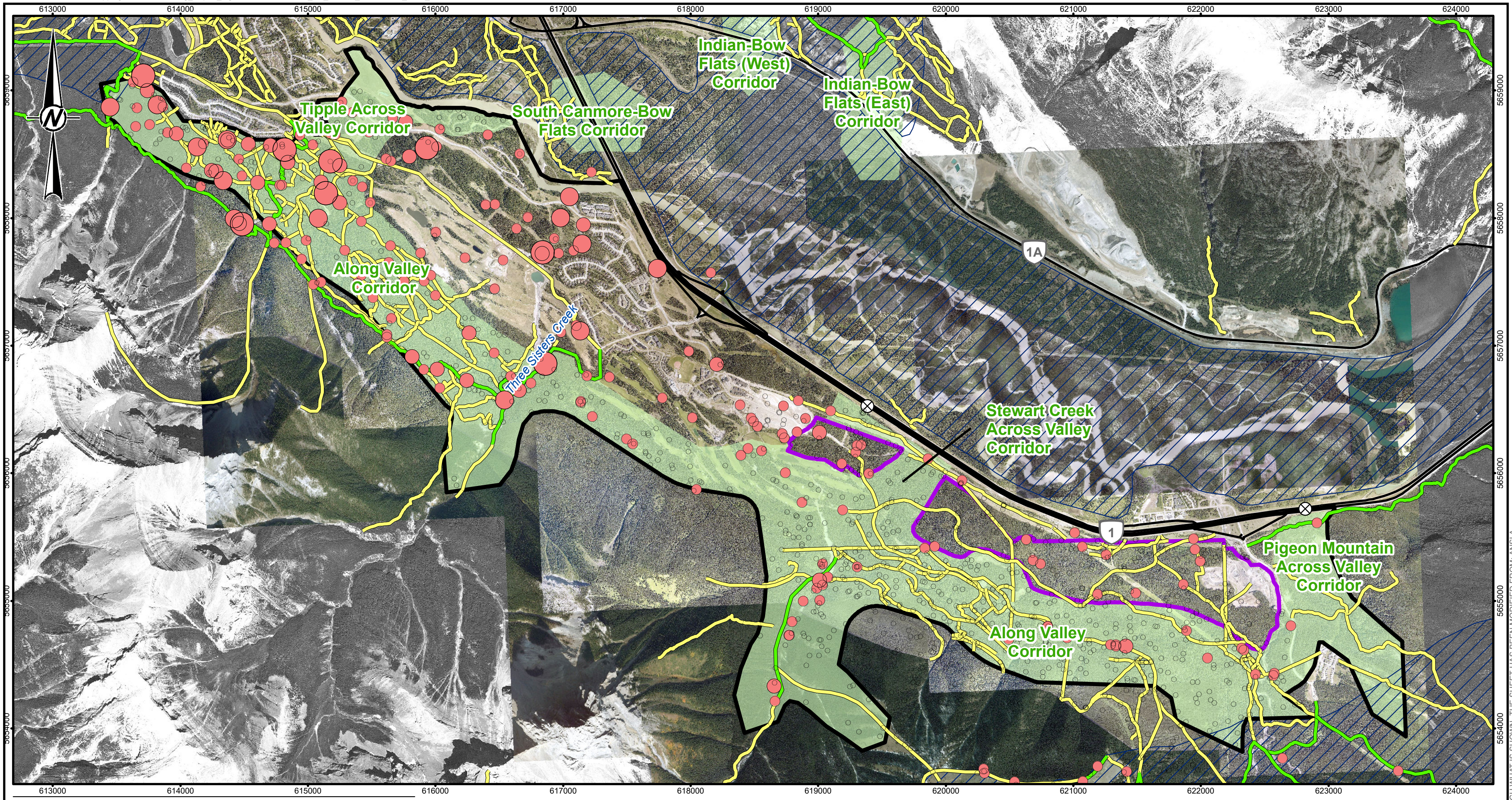


LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- DESIGNATED TRAIL
- UNDESIGNATED TRAIL
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

MEAN NUMBER OF INDIVIDUALS PHOTOGRAPHED PER DAY[1]

- 0.000
- 0.005 - 0.458
- 0.458 - 1.006
- 1.006 - 1.878
- 1.878 - 3.365

0 800 1,600

1:45,000 METRES

NOTE(S)

1. DATA INTERVALS CATERGORIZED USING JENKS METHOD FOR NATURAL BREAKS

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. REMOTE CAMERA DATA (2013 - 2016) OBTAINED FROM AEP, AUGUST 2016. USED UNDER LICENCE.
3. TRAILS OBTAINED FROM ALBERTA PARKS AND PROTECTED AREAS, 2011. ADDITIONAL TRAILS DIGITIZED 2016.
4. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE

OFF-LEASH DOG USE RECORDED ON REMOTE CAMERAS IN AND AROUND THE LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	22

25mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

5.3.3 Grizzly Bears – Existing Conditions

The Bow Valley, including the communities of Canmore, Banff and Lake Louise, represents one of the most intensely developed and heavily accessed landscapes in North America where a grizzly bear population persists (Chruszcz et al. 2003). The RSA intersects with two provincial Bear Management Areas, including Bear Management Areas 5 (Livingstone) and 4 (Clearwater). The LSA overlaps with the Livingstone Bear Management Area. The Livingstone area had a population estimate of 89.9 bears (95% confidence interval = 75-116 bears) in 2006 while the Clearwater area had population estimate of 45 bears (95% confidence interval = 41-52 bears) in 2005 (ASRD and ACA 2010; AEP 2016). Updated population estimates are unavailable, though work to re-estimate grizzly bear populations in the Livingstone and Clearwater areas were initiated in 2016 and 2018, respectively (Government of Alberta 2019a; fRI Research 2019).

Habitat quality in the Bow Valley around Canmore is high for grizzly bears during summer (Chetkiewicz and Boyce 2009), and grizzly bears commonly access it (Gibeau et al. 2002a; Chruszcz et al. 2003; Appendix B, Figure B-2). Under existing conditions, grizzly bears use a wide variety of habitats throughout the RSA at virtually all elevations, slopes, and aspects to meet their life requisites (Chetkiewicz and Boyce 2009). Grizzly bears make use of the RSA on both sides of the Trans-Canada Highway based on radio telemetry data and use wildlife corridors and other undeveloped or less developed portions of the landscape to move between habitat patches. During summer (June 16 to August 10), grizzly bears spend most of their time at lower elevations (Appendix B); this is when movement is potentially affected by development in the valley bottom. During the non-summer season (August 11 to November, and April to June 15) bears spend most of their time at higher elevations (Chetkiewicz and Boyce 2009).

Highways and towns, like those present in the RSA, can isolate grizzly bear populations in some cases (Mace et al. 1999; Proctor et al. 2005). Least cost path analysis conducted for grizzly bears near Canmore indicates that preferred movement routes occur upslope from currently designated wildlife corridors and away from development, indicating that substantial space is available for east-west movement through the Bow Valley for grizzly bears under existing conditions (Chetkiewicz and Boyce 2009). The Trans-Canada Highway and associated fencing reduce north-south connectivity in the RSA, but wildlife crossing structures help to mitigate this risk (Clevenger et al. 2009). Collared bears from which telemetry data were collected near Canmore all crossed the Trans-Canada Highway (Appendix B, Figure B-2). Except for underpasses, most of the areas designated as wildlife corridors in the Bow Valley function as extensions of habitat patches and are intensely used by grizzly bears (Appendix B, Figure B-5).

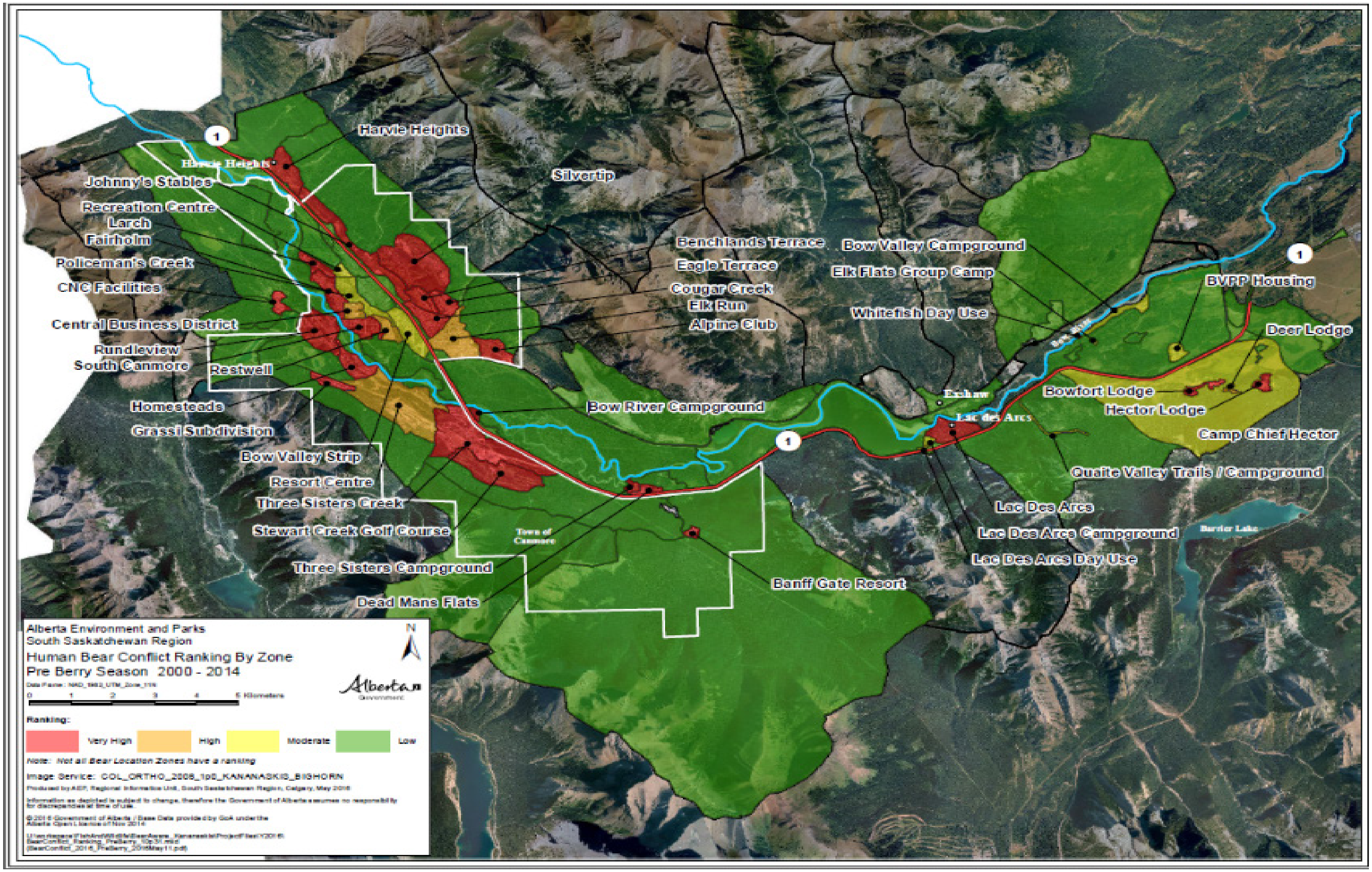
Although high quality habitat is abundant, and movement and habitat connectivity has been maintained in the Bow Valley under existing conditions, a serious risk is present for grizzly bears because of mortality. One of the consequences of habitats with a high probability of grizzly bear selection near towns, roads, and other places where human use is high is that an ecological trap can occur. An ecological trap is present when attractive habitats cause animals to come to an area, but higher mortality risk in that area means that the use of the habitat results in a net loss for the population. Because grizzly bears can adapt to human presence and frequently use habitats near development (Roever et al. 2008, 2010; Stewart et al. 2012; Elfstrom et al. 2012; Labree et al. 2014; McKay et al. 2014, Lamb et al. 2020), ecological traps for this species are increasingly reported in the literature (Lamb et al. 2016, Lamb et al. 2020), including near Canmore, which has been identified as one of the places with the highest mortality risk for grizzly bears in western Alberta (Nielsen et al. 2004).

Garbage management and many other aspects of minimising negative human-wildlife interactions are better in Canmore than some other places in North America where people and bears co-exist. The *Wildlife Attractant Bylaw* (Bylaw 2017-10, Town of Canmore 2017a) specifies restrictions on wildlife attractants (i.e., any substance that could be reasonably expected to attract dangerous wildlife). In particular, *Bylaw 2017-10* prohibits residents from allowing fruit to accumulate on trees, shrubs, or on the ground; however, this remains a problem in some areas (Figure 23). Because habitats within or adjacent to development are attractive to bears, places like Peaks of Grassi, the Homesteads, Rundleview, Cougar Creek, and Silvertip where housing developments occur adjacent to wildlife corridors or habitat patches are hotspots for negative human-bear interactions (Figure 24).

Figure 23: A Black Bear Eats Apples in a Back Yard in Cougar Creek

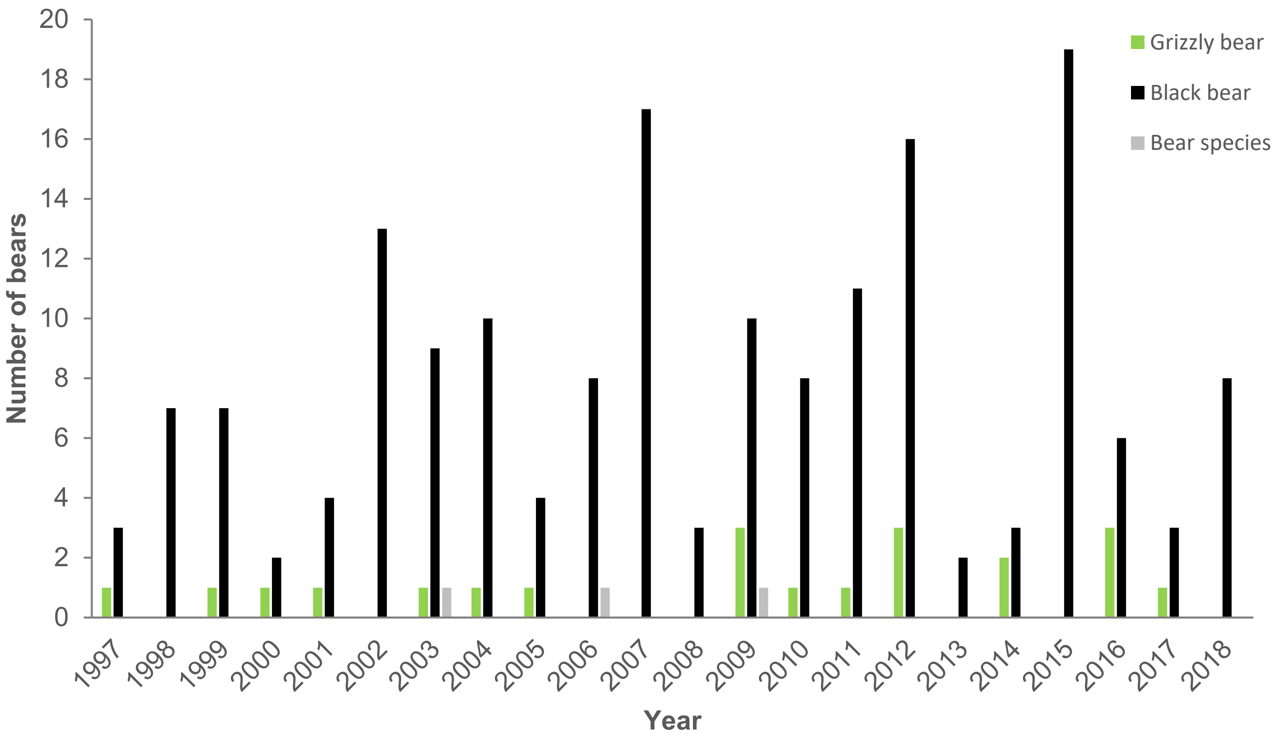
Note: Photo courtesy Jay Honeyman, AEP.

Figure 24: Spatial Depiction of Negative Human-Bear Interaction Data in the Bow Valley



Tolerance for negative interactions between bears and people in the Bow Valley is low (Jorgenson 2012, pers. comm.) and bears in Canmore are often hazed, translocated, or killed if they spend time near residential developments, or are involved in aggressive interactions with people. Most grizzly bear mortality in the Bow Valley is human-caused, with bears dying as a result of vehicle or train strikes or removed as problem animals (Nielsen et al. 2004; Garshelis et al. 2005). During 1997-2018, 21 grizzly bears, 173 black bears, and three bears of unknown species were killed or translocated in the immediate vicinity of Canmore (from the Banff East Gate to the Kananaskis River), averaging approximately nine bears per year (Figure 25). Bears that are relocated do not always survive, and those that do may return over distances of hundreds of kilometers to the original location of the negative interaction or may cause additional negative interactions elsewhere (Linnell et al. 1997). Between 1997 and 2018, most grizzly bear removals in the Bow Valley were from translocations (n=13, 62%) while road mortalities (n=4) were the most common source of mortality (AEP, unpublished data). Grizzly bear mortalities were also recorded as a result of rail collisions (n=3) and management destruction (n=1) (AEP, unpublished data).

Figure 25: Annual Bear Removals in the Bow Valley Between 1997 and 2018



Delayed age of first reproduction, long inter-birth intervals, and small litter sizes mean that grizzly bears have a limited capacity to compensate for human-caused mortality, especially mortality of adult females (ASRD and ACA 2010). Consequently, where human-caused mortality of bears occurs, it presents a notable conservation challenge for grizzlies in Alberta (Nielsen et al. 2004). High mortality rates near Canmore have led scientists and government wildlife managers to conclude that the Bow Valley represent an ecological trap for grizzly bears (Benn and Herrero 2002; Hebblewhite et al. 2003; Nielsen et al. 2004; Nielsen et al. 2006; Sawaya et al. 2012; Webb 2013, pers. comm.; Boukall 2016, pers. comm.). Sawaya et al. (2012) succinctly conclude that, although additional confirmatory analyses would be helpful, their results “show concordance with previous research suggesting that the Bow Valley may act as an attractive sink for grizzly bears in the Central Canadian Rocky Mountains”.

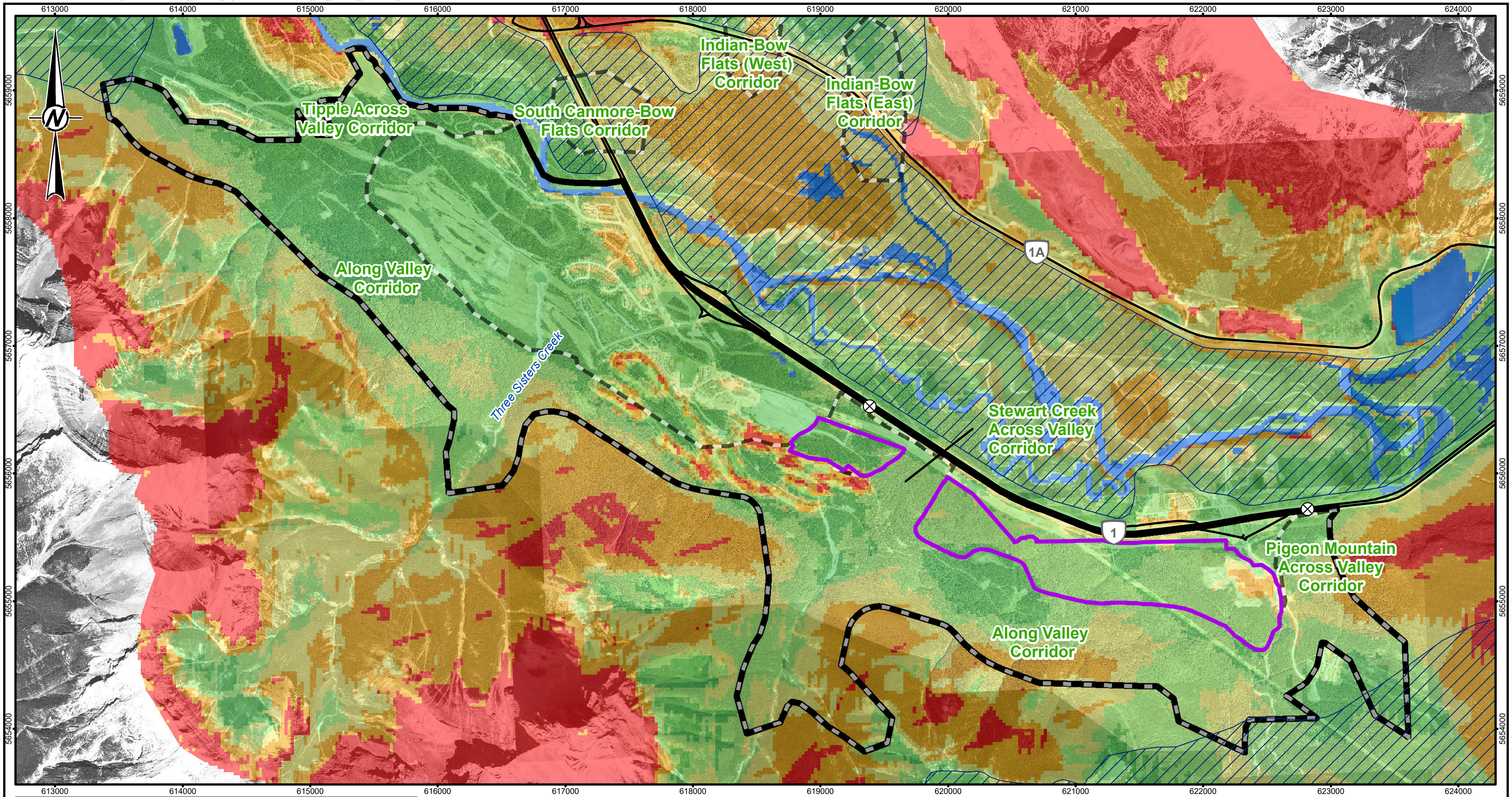
Within the ASP area, summer grizzly bear habitat under existing conditions consists primarily of those that are selected or used as available (Table 15, Figure 26 and Figure 27). However, these habitats are also heavily used by people under existing conditions (Section 5.3.2) and the Stewart Creek Golf Course at the northwest end of the Project ASP is in an area identified by AEP as having very high human-bear conflicts (Figure 24).

Although habitat conditions in the ASP area are selected by grizzly bears during summer, the probability that winter dens are present is near zero. Studies of grizzly bear denning habitat in the Central Rockies ecosystem around Banff and Canmore show that grizzly bears den in upper subalpine habitat, where they excavate dens on steep slopes, most often choosing slopes between 30° and 38° (Vroom et al. 1980). Grizzlies also select locations where heavy snowfall will provide good insulating cover for the den (Vroom et al. 1980). More recent work in the northern Rocky Mountains of Alberta yielded similar findings (Pigeon et al. 2014), with bears selecting high elevation habitats with steep slopes and consistent snowpack for denning. Because the ASP area consists of flat low elevation habitat where deep snow does not accumulate during winter, denning habitat for grizzly bears is not present.

Table 15: Grizzly Bear Habitat Within the Local Study Area Under Existing Conditions With and Without Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)				With Estimated Effects of Increased Human Use on Trails (ha)			
	ASP Area (ha)	Adjacent Wildlife Corridor (ha)	Other Approved Corridors (ha)	Remaining Largely Developed Areas (ha)	ASP Area (ha)	Adjacent Wildlife Corridor (ha)	Other Approved Corridors (ha)	Remaining Largely Developed Areas (ha)
Selected	32.6	116.1	162.1	309.7	23.4	98.2	145.3	303.3
Used as available	108.6	234.9	134.2	92.1	111.0	228.7	125.2	95.9
Somewhat avoided	7.0	140.2	65.3	48.3	13.1	155.3	88.8	50.9
Strongly avoided	5.5	68.0	13.8	14.2	6.0	76.1	15.9	14.1
Rarely used	0.0	7.9	0.9	3.3	0.0	8.7	0.9	3.5
Waterbody[(a)]	0.0	0.0	0.4	5.4	0.0	0.0	0.4	5.4
Total	**153.7**	**567.0**	**376.5**	**472.9**	**153.7**	**567.0**	**376.5**	**472.9**

Notes:
Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
Habitat suitability is not assigned to waterbodies.
ASP Area = Project Study Area Boundary; ha = hectare; <= less than.



LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

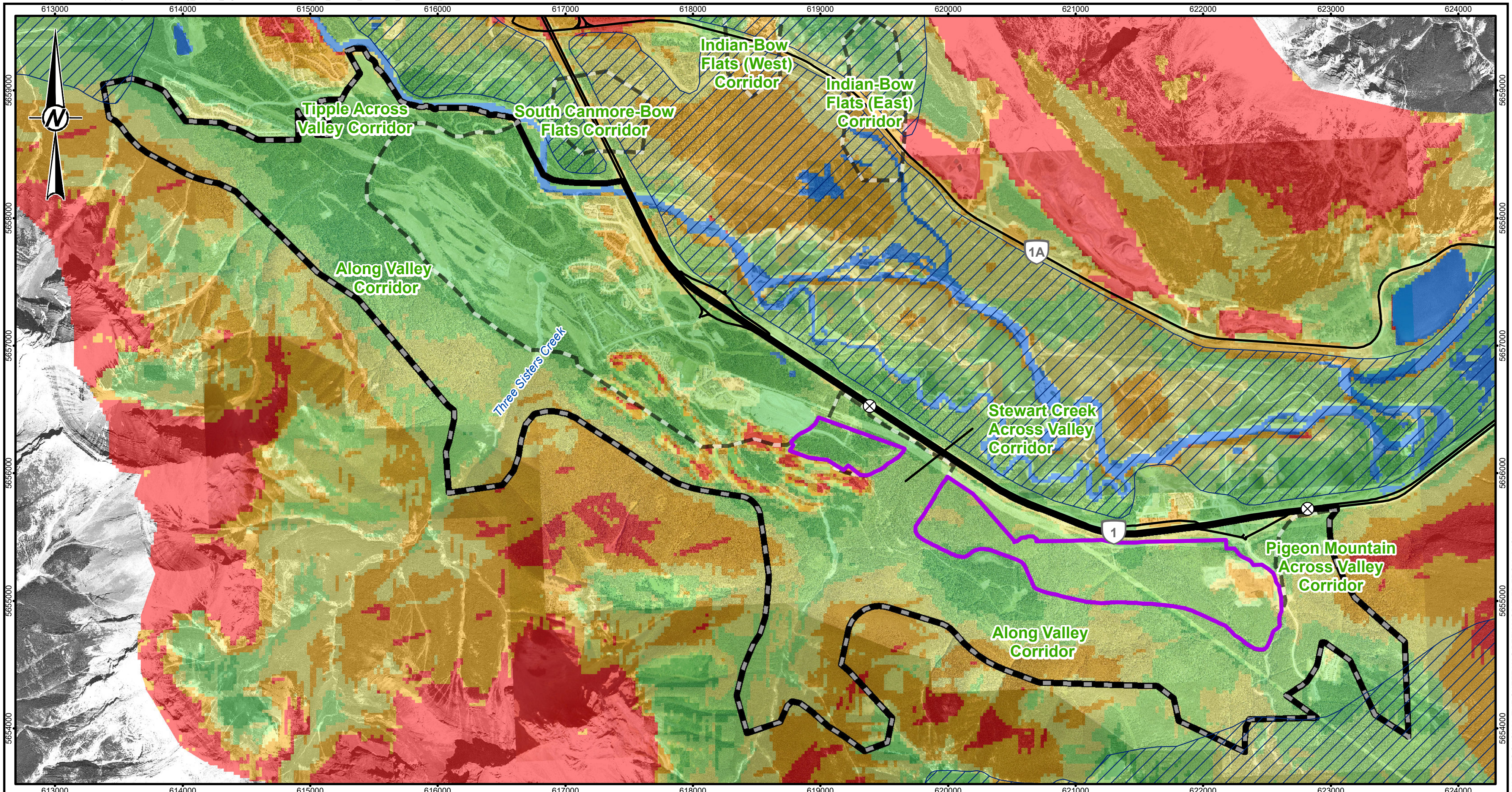
TITLE

SUMMER GRIZZLY BEAR RESOURCE SELECTION – EXISTING CONDITIONS WITHOUT ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	26

25mm

PATH: I:\2019\19132387\Mapping\Products\Working_Report_Figures\Rev0\19132387_SC_FIG027_GRIZZLY_EXISTING_TRAIL-Rev0.mxd PRINTED ON: 2020-10-05 AT: 2:40:47 PM



LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT
GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE
SUMMER GRIZZLY BEAR RESOURCE SELECTION – EXISTING CONDITIONS WITH ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	27

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

25mm

Wildlife corridors adjacent to the ASP area within the LSA consist primarily of habitat that is selected or used as available by grizzly bears during summer (Table 15). As demonstrated in Appendix B (Figure B-10), there is a strong positive relationship between the probability of selection class and the proportion of grizzly bear steps overlapping with each habitat class. This relationship indicates that the RSF is a good reflection of grizzly bear movement and that selected habitat is especially important for movement (i.e., resistance is very low relative to other classes). High human use does not strongly affect grizzly bear selection in the Bow Valley, and bears sometimes select habitats, such as the Canmore Nordic Centre, that have high trail density (Appendix B) and are subject to very high levels of human use (Figure 17). In both the RSF without estimated effects of increased human use on trails and the RSF with the estimated effects of increased human use on trails, habitats that are strongly avoided or rarely used and may create higher resistance to grizzly bear movement are uncommon in the approved wildlife corridor, i.e., up to 15% of the corridor adjacent to the Project ASP and 10.8% of all approved corridors in the LSA (Table 15). Grizzly bears can adapt to temporal patterns of human use (Boyce et al. 2010, Lamb et al. 2020), and therefore reductions in probability of selection associated with human use of trails identified in Table 15 are likely present only during the day when human use on trails occurs (Section 5.3.2).

Habitat that is used as available or selected by grizzly bears extends upslope from the Project boundary upslope into the adjacent corridor (Figure 26 and Figure 27). Habitats south of the approved Along Valley Corridor adjacent to the ASP area were identified by Chetkiewicz and Boyce (2009) as a multi-season movement route for grizzly bears.

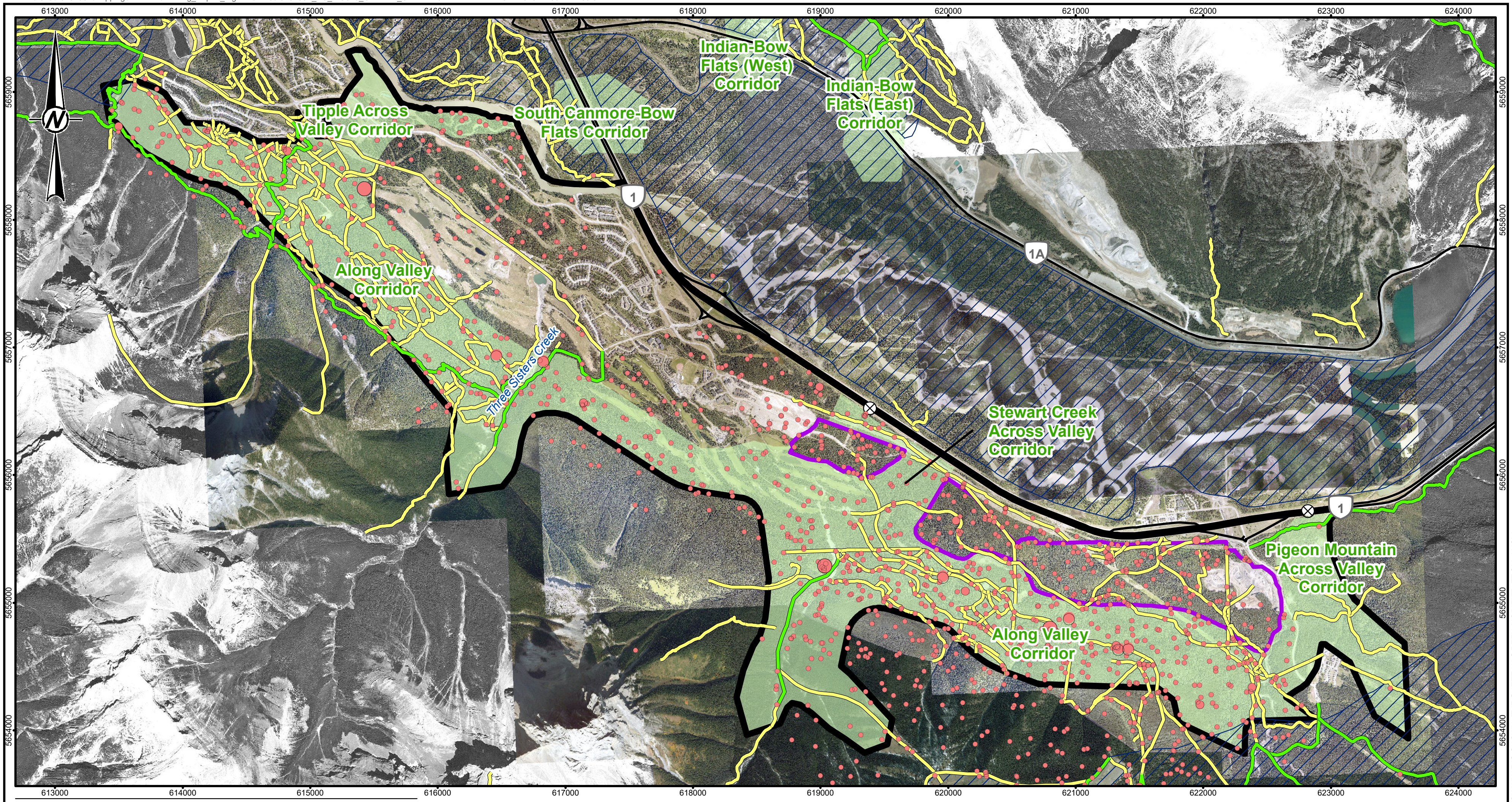
Grizzly bears were detected by remote cameras within the ASP area (0.0095 detections/camera/day, Figure 28), they were detected by cameras placed in adjacent wildlife corridors (0.0013 detections/camera/day near the Project boundary).

Grizzly bears were detected most frequently at cameras deployed on designated trails (0.0053 detections/camera/day), followed by undesignated trails (0.0019 detections/camera/day), and were less commonly detected at cameras deployed on other trails (0.0006 detections/camera/day). However, because designated trails are not common in the wildlife corridors, most grizzly bear occurrences were recorded on undesignated or other trail types (Figure 28). Cameras were not placed south of the approved Along Valley Corridor where Chetkiewicz and Boyce (2009) identified a multi-season movement route for grizzly bears.

Grizzly bears were detected by cameras throughout the day and night, with peaks at 7:00 am and 6:00 pm. Peak grizzly bear detections were at the margins of where human use was highest, but grizzly bears and people showed overlap in patterns of temporal use. Black bears showed even greater overlap with people, with most detections recorded between 1:00 pm and 8:00 pm.

Although this section focuses on grizzly bears, black bears are also a potential source of conflict with people and are commonly removed from the Bow Valley for this reason (Figure 24). Black bears were detected throughout the LSA (Figure 29) including the Project area and the portion of the Along Valley Corridor immediately adjacent to the Project boundary. Black bears were frequently detected at cameras located in the Along Valley Corridor southeast of Three Sisters Creek (Figure 29). Black bears also were detected in the Tipple Across Valley Corridor, Stewart Creek Across Valley Corridor, and Pigeon Mountain Across Valley Corridor including at cameras near the wildlife crossing structures at the Trans-Canada Highway (Figure 29).

PATH: I:\2019\19132387\Mapping\Products\Working_Report_Figures\Rev0\19132387_SC_FIG028_GRIZZLY_CAM-Rev0.mxd PRINTED ON: 2020-11-06 AT: 1:39:31 PM



LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- DESIGNATED TRAIL
- UNDESIGNATED TRAIL
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

MEAN NUMBER OF INDIVIDUALS PHOTOGRAPHED PER DAY[1]

- 0 - 0.025
- 0.025 - 0.050
- 0.050 - 0.075
- 0.075 - 0.100
- 0.100 - 0.200
- 0.200 - 0.300
- 0.300 - 0.414

0 800 1,600

1:45,000 METRES

NOTE(S)

1. DATA INTERALS CATERGORIZED USING JENKS METHOD FOR NATURAL BREAKS

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. REMOTE CAMERA DATA (2013 - 2016) OBTAINED FROM AEP, AUGUST 2016. USED UNDER LICENCE.
3. TRAILS OBTAINED FROM ALBERTA PARKS AND PROTECTED AREAS, 2011. ADDITIONAL TRAILS DIGITIZED 2016.
4. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

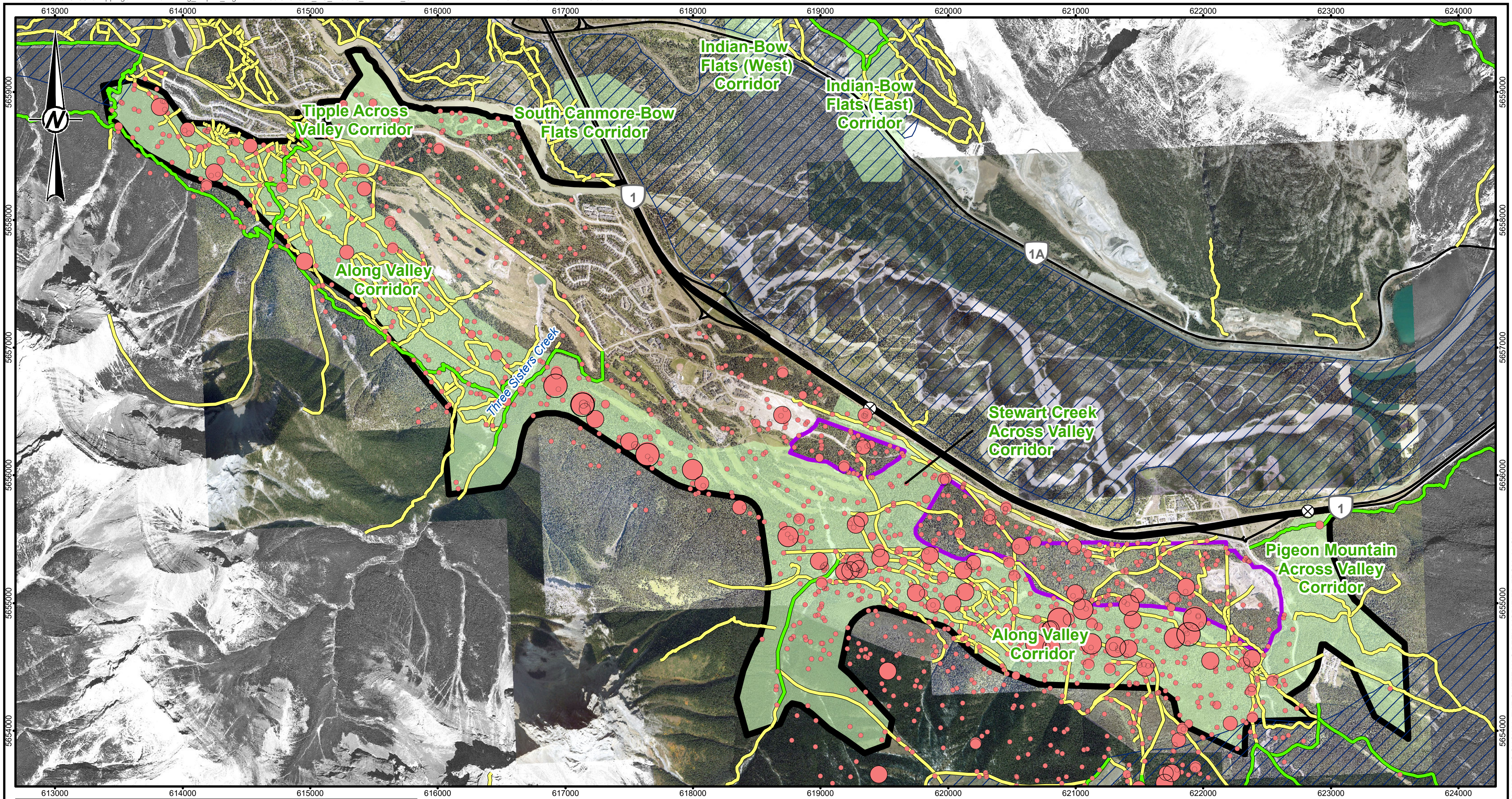
GOLDER

YYYY-MM-DD	2020-11-06
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE

GRIZZLY BEARS RECORDED ON REMOTE CAMERAS IN AND AROUND LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	28



LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- DESIGNATED TRAIL
- UNDESIGNATED TRAIL
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

MEAN NUMBER OF INDIVIDUALS PHOTOGRAPHED PER DAY[1]

- 0 - 0.025
- 0.025 - 0.050
- 0.050 - 0.075
- 0.075 - 0.100
- 0.100 - 0.200
- 0.200 - 0.300
- 0.300 - 0.414

0 800 1,600

1:45,000 METRES

NOTE(S)
1. DATA INTERALS CATERGORIZED USING JENKS METHOD FOR NATURAL BREAKS

REFERENCE(S)
1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. REMOTE CAMERA DATA (2013 - 2016) OBTAINED FROM AEP, AUGUST 2016. USED UNDER LICENCE.
3. TRAILS OBTAINED FROM ALBERTA PARKS AND PROTECTED AREAS, 2011. ADDITIONAL TRAILS DIGITIZED 2016.
4. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-11-06
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE
BLACK BEARS RECORDED ON REMOTE CAMERAS IN AND AROUND LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	29

25mm

In summary, the combined effects of past and present developments and activities in the Bow Valley (e.g., Trans-Canada Highway and other roads, vehicle traffic, railway, industrial development and mining, urban development, growing human population, and trails) have influenced the existing conditions for grizzly bear habitat quantity and quality, corridor use and movement and risk of negative interactions with humans. Despite these changes, high quality habitat is abundant, and movement and habitat connectivity has been maintained in the Bow Valley under existing conditions. However, habitats with a high probability of grizzly bear selection near towns, roads, and other places where human use is high present an ecological trap because these habitats are associated with a high risk of mortality. Considering the grizzly bear's conservation status and population size in Bear Management Area 5 (75-116 bears [2006 estimate]), each individual mortality is of concern. Accordingly, a serious risk is present for grizzly bears under existing conditions in the RSA because of mortality.

5.3.4 Cougars - Existing Conditions

Cougars are ecosystem generalists capable of occupying diverse habitats provided enough prey and cover are present. Deer, elk and bighorn sheep, all important prey for cougars, are present in suitable habitats throughout the RSA. Cougars using the RSA are part of a broader regional population occupying the eastern slopes of the Rocky Mountains from the U.S. border to northwestern Alberta.

Although the size and trend of the cougar population in the RSA have not been rigorously measured, cougars are common. Cougars were the most frequently tracked carnivore during winter backtracking studies undertaken by the Province in 2002 (Regional Wildlife Corridor Study 2002). Detections in the vicinity of TSMV were obtained at a rate of 0.005/camera/day, including photos of females with kittens. At broader regional scales, cougar populations have been increasing and expanding their range since the late 1970s (Ross and Jalkotzy 1992; Knopff et al. 2013). Human caused mortality, especially from hunting and trapping, is the most important mortality source for cougar populations in Alberta (Knopff et al. 2010; ESRD 2012; Government of Alberta 2019b). The RSA overlaps with Cougar Management Area 6 where incidental cougar mortalities (from accidental trapping, landowners, problem wildlife, and other sources) have ranged from 0 to 3 recorded mortalities per year between 2014 and 2018 (Government of Alberta 2019b). Cougar density in Cougar Management Area 6 was estimated at approximately 35 cougars/1,000 square kilometres (km^2) in 2012 (ESRD 2012). Because cougar harvest is managed to achieve stable populations in the RSA and cougar densities in the vicinity of the RSA are among the highest in the Province (ESRD 2012), self-sustaining and ecologically effective populations are likely present.

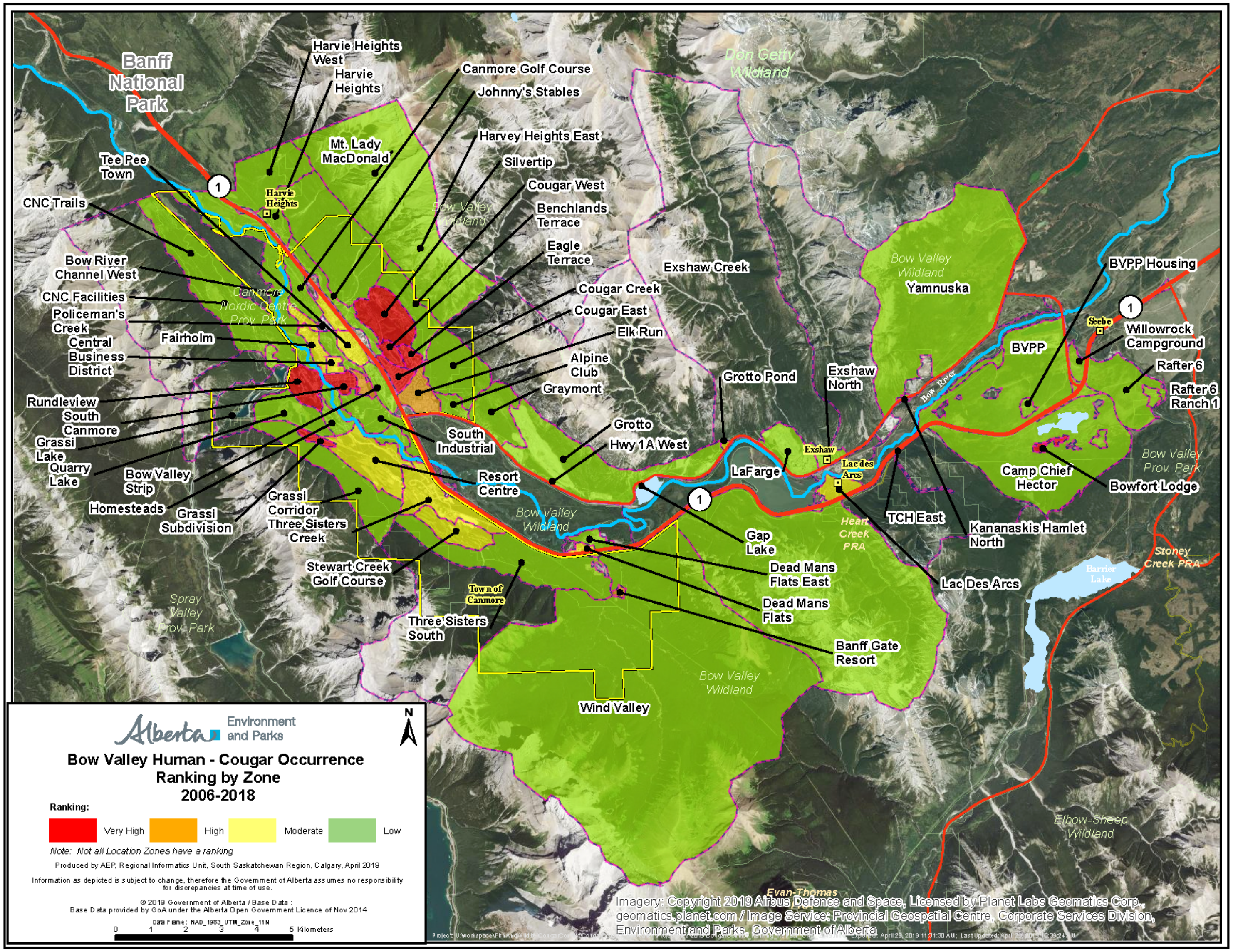
Connectivity between habitat patches for cougars either through corridors or in otherwise undeveloped land, does not appear to be constrained in the RSA. Both the G8 and the Stewart Creek Underpasses are used regularly by cougars; between 2008 and 2012, cougars were recorded using the Stewart Creek Underpass 134 times and the G8 Underpass 49 times. Cougars have also been recorded regularly on winter snow tracking transects and during remote camera surveys on both sides of the valley (Lee et al. 2010; Golder 2013).

Least cost path analysis conducted for cougars near Canmore indicates that preferred movement routes occur upslope from currently designated wildlife corridors and away from development, indicating that substantial space is available for east-west movement through the Bow Valley for cougars under existing conditions (Chetkiewicz and Boyce 2009). Except for underpasses, most of the areas designated as wildlife corridors in the Bow Valley function as extensions of habitat patches and are heavily used by cougars (Appendix B, Figure B-5).

Carnivores that are tolerant of human activity, such as cougars, are also commonly found close to development in habitat patches and movement corridors in the Bow Valley. Cougars can adapt to anthropogenic landscape change (Knopff et al. 2014). Although probability of cougar selection declines within developed areas in the Bow Valley, it increases immediately adjacent to them (Appendix B). Cougar habitat selection is closely linked to prey availability, and selection for places closer to development is likely a result of strong selection by some prey species (e.g., elk) for urban development in the Bow Valley (Section 5.3.6).

Although cougars make use of natural prey near humans, cougar proximity to human development represents a safety risk for humans and their pets. Cougar attacks on people are rare but do occur, often with tragic outcomes (Beier 1991; Conrad 1992). In 2001, a cross-country skier was killed by an adult male cougar on a heavily used ski trail in Banff National Park. More frequently, pets, particularly dogs, are killed and consumed by cougars that use the interface between wildlife habitat and residential areas. This kind of conflict can result in low tolerance for cougars, with potential adverse implications for cougar conservation (Knopff et al. 2016). The ASP area is in an area with a low risk of cougar conflict, based on documented cougar occurrences between 2006 and 2018 (Figure 30).

Figure 30: Spatial Depiction of Cougar Conflict Rankings in the Bow Valley



Within the ASP area, RSF modelling identifies cougar winter habitat under existing conditions that consists primarily of habitats that are selected or used as available (Table 16, Figure 31 and Figure 32).

Wildlife corridors adjacent to the ASP area consist primarily of habitat that is used as available by cougars (Table 16, Figure 31 and Figure 32). High human use on trails may decrease probability of selection somewhat for cougars, primarily by transforming selected habitat into habitat used as available, with some increase in the amount of habitat that is somewhat avoided (Table 16). As described in Appendix B (Figure B-11), both used as available and selected habitats should be interpreted as maintaining equally low resistance for cougar movements. The current selection pattern in wildlife corridors suggests that habitat connectivity is maintained for cougars under existing conditions.

Substantial habitat that is used as available by cougars during winter extends upslope into and beyond the approved Along Valley Corridor (Figure 31 and Figure 32) and is contiguous with Spray Lakes Provincial Park to the south. Habitats south of the approved Along Valley Corridor adjacent to the ASP area were identified by Chetkiewicz and Boyce (2009) as a multi-season movement route for cougars.

Table 16: Cougar Habitat Within the Local Study Area Under Existing Conditions With and Without Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)				With Estimated Effects of Increased Human Use on Trails (ha)			
	ASP Area (ha)	Adjacent Wildlife Corridor (ha)	Other Approved Corridors (ha)	Remaining Largely Developed Areas (ha)	ASP Area (ha)	Adjacent Wildlife Corridor (ha)	Other Approved Corridors (ha)	Remaining Largely Developed Areas (ha)
Selected	34.9	83.2	62.7	133.0	28.6	61.0	41.5	130.6
Used as available	104.4	322.5	237.3	138.2	110.2	323.8	233.9	140.2
Somewhat avoided	6.8	104.2	62.4	83.4	7.0	124.8	86.9	83.5
Strongly avoided	7.5	38.8	13.7	97.7	7.8	39.2	13.8	98.1
Rarely used	0.0	18.2	0.0	15.2	0.0	18.2	0.0	15.2
Waterbody[(a)]	0.0	0.0	0.4	5.4	0.0	0.0	0.4	5.4
Total	**153.7**	**567.0**	**376.5**	**472.9**	**153.7**	**567.0**	**376.5**	**472.9**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

ASP Area = Project Study Area Boundary; ha = hectare; <= less than.

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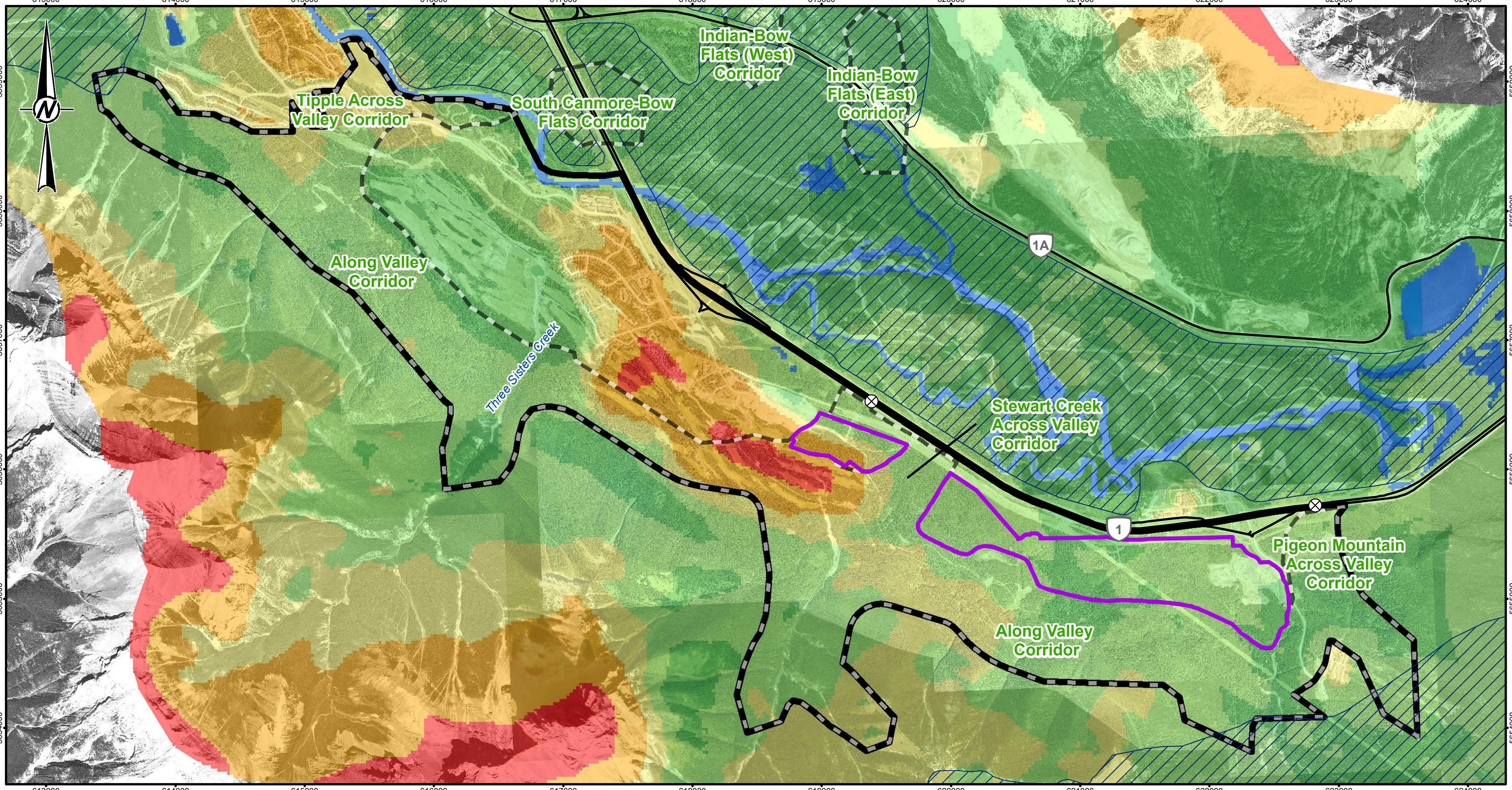


LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600
1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	10/5/2020
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

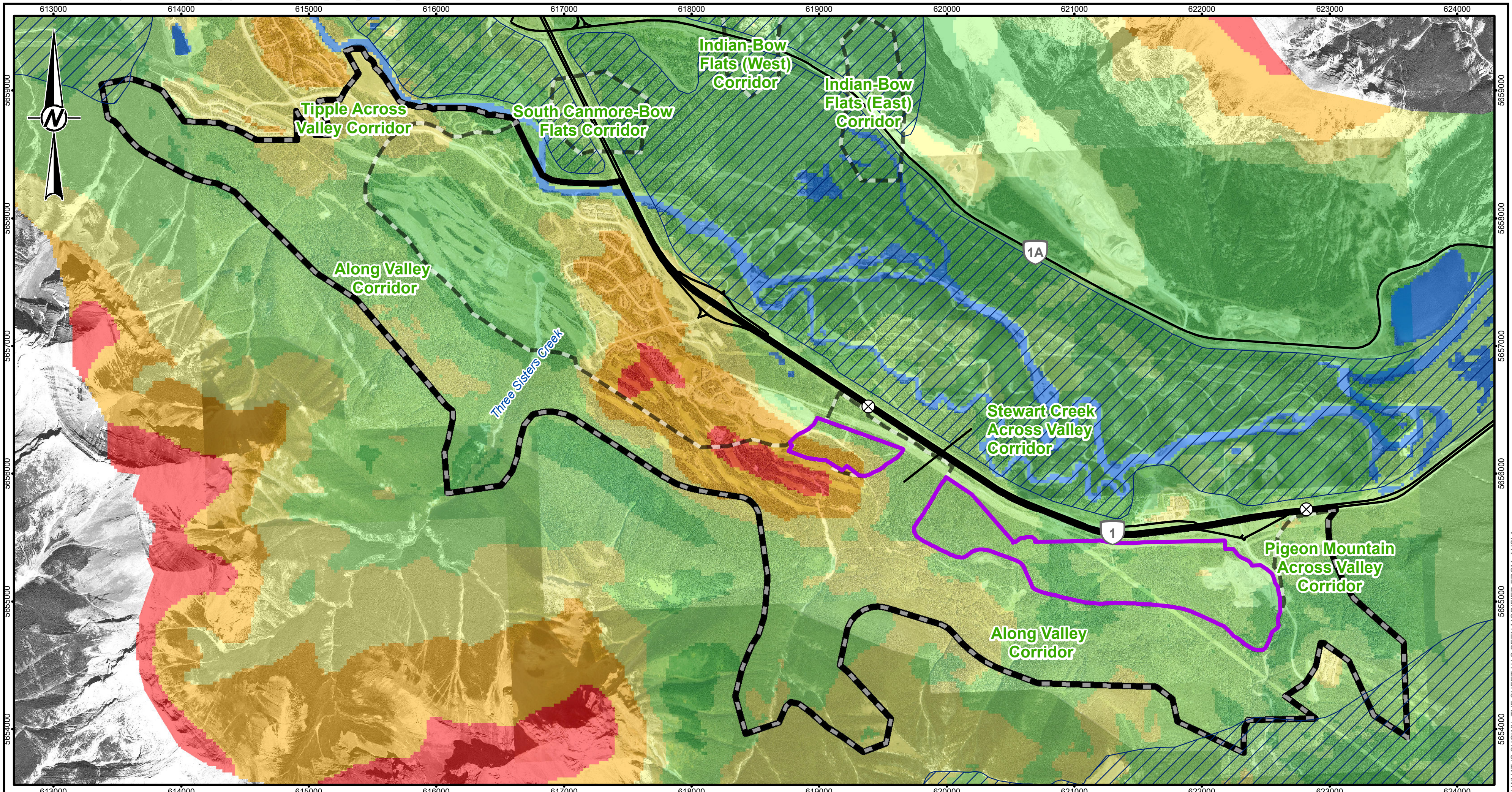
TITLE
WINTER COUGAR RESOURCE SELECTION – EXISTING CONDITIONS WITHOUT ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	31

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

25mm 0

PATH: I:\2019\19132387\Mapping\Products\Working_Report_Figures\Rev0\19132387_SC_FIG032_COUGAR_EXISTING_TRAIL-Rev0.mxd PRINTED ON: 2020-10-05 AT: 2:55:25 PM



LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	10/5/2020
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE
WINTER COUGAR RESOURCE SELECTION – EXISTING CONDITIONS WITH ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	32

As depicted in Figure 33, cougars were detected by remote cameras within the ASP area (0.0031 detections/camera/day) and in adjacent wildlife corridors within the LSA (0.0005 detections/camera/day). Throughout the camera deployment area, cougars were detected most frequently at cameras deployed on designated trails (0.0069 detections/camera/day), followed closely by undesignated trails (0.0057 detections/camera/day) and other deployment areas (0.0048 detections/camera/day). Cameras were not placed south of the approved Along Valley Corridor where Chetkiewicz and Boyce (2009) identified a multi-season movement route for cougars.

Cougars were detected by cameras throughout the day and night, with peaks in the late afternoon and overnight and the lowest number of detections between 6:00 am and 3:00 pm. Cougar detections overlapped substantially with periods of high human use in the afternoon and early evening, especially during summer.

In summary, the combined effects of past and present developments and activities in the Bow Valley (e.g., Trans-Canada Highway and other roads, vehicle traffic, railway, industrial development and mining, urban development, growing human population, and trails) have influence the existing conditions for cougar habitat quantity and quality, corridor use and movement and risk of negative interactions with humans. Despite these changes, a large proportion of the LSA, including the ASP area and wildlife corridors, consist of habitats that are either selected or used as available. Available information suggests that cougar movement and habitat connectivity has been maintained in the Bow Valley, as evidenced by habitat selection patterns in wildlife corridors and information gathered at wildlife underpasses. With increased development in and around Canmore, and a growing human population, the potential for cougar conflict has increased over time; however, this change has not been linked to an increased incidence of human-cougar conflict. Considering the cougar’s conservation status, their density in Cougar Management Area 6, regional cougar management practices and existing habitat conditions, cougars in the RSA are considered self-sustaining and ecologically effective under existing conditions.

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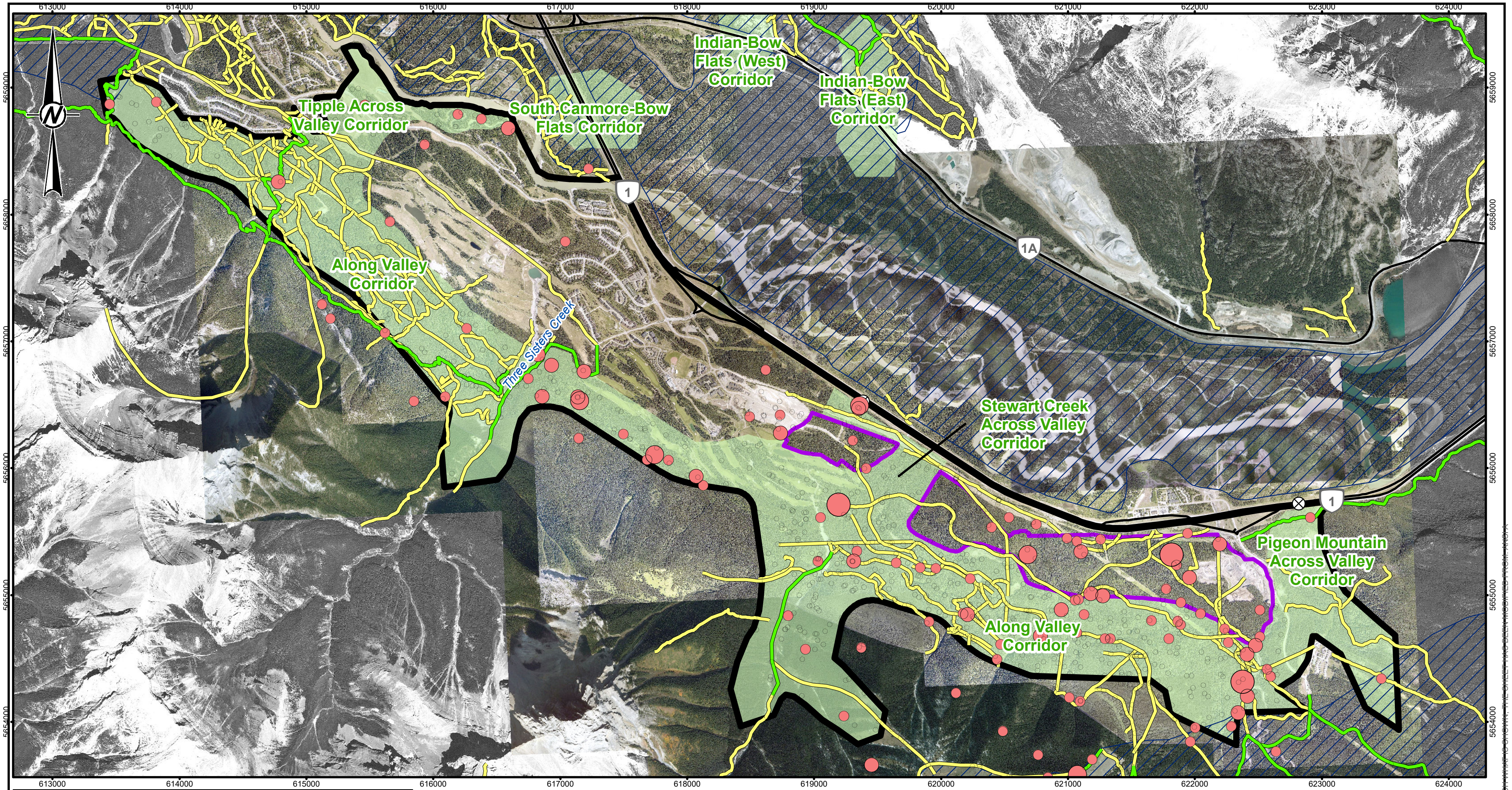

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- DESIGNATED TRAIL
- UNDESIGNATED TRAIL
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

MEAN NUMBER OF INDIVIDUALS PHOTOGRAPHED PER DAY[1]

- 0.000
- 0.003 - 0.055
- 0.055 - 0.105
- 0.105 - 0.214
- 0.214 - 0.789

0 800 1,600

1:45,000 METRES

NOTE(S)

1. DATA INTERVALS CATERGORIZED USING JENKS METHOD FOR NATURAL BREAKS

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. REMOTE CAMERA DATA (2013 - 2016) OBTAINED FROM AEP, AUGUST 2016. USED UNDER LICENCE.
3. TRAILS OBTAINED FROM ALBERTA PARKS AND PROTECTED AREAS, 2011. ADDITIONAL TRAILS DIGITIZED 2016.
4. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE

COUGARS RECORDED ON REMOTE CAMERAS IN AND AROUND THE LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	33

25mm

5.3.5 Wolves - Existing Conditions

Wolves maintain an important ecological role as top predators and are capable of structuring ecosystems through trophic cascades (Fortin et al. 2005; Hebblewhite et al. 2005a). In addition to their ecological value, wolves have substantial consumptive value within Alberta's hunting and trapping communities (Webb 2009). Although wolf conservation is often controversial, wolves are frequently used as flagship species for conservation efforts (Musiani et al. 2005). Large home ranges, sensitivity to human development, and substantial political and ecological importance make wolves a prime candidate for use as an indicator species, particularly in the Bow Valley (Callaghan 2002).

Wolves are ecosystem generalists capable of occupying almost any habitat where enough prey are available, and humans are willing to tolerate wolf presence (Paquet and Carbyn 2003; Oakleaf et al. 2006). Habitat use is strongly affected by abundance and distribution of primary prey, typically ungulates, and wolf occupancy in the northern Rocky Mountains of the U.S. correlated positively with elk density (Oakleaf et al. 2006). Wolves often select conifer or mixed forest (Mladenoff et al. 1995; Paquet and Carbyn 2003), but also select cut blocks and natural openings under certain circumstances (Hebblewhite and Merrill 2008; Houle et al. 2010). Areas closer to edges between forest and clearcuts or natural meadows and areas with higher ungulate forage biomass might provide the best opportunity to find prey where sufficient cover also is available to facilitate hunting (Hebblewhite and Merrill 2008; Houle et al. 2010).

In mountainous areas, wolf home range placement, habitat selection and travel routes are influenced by topographic complexity, especially during winter when wolves tend to select low elevations, flat or shallow slopes and south aspects, presumably because those areas accumulate less snow and maintain the highest prey abundance (Alexander 2001; Duke 2001; Callaghan 2002; Paquet and Carbyn 2003; Whittington et al. 2005). When travelling between valleys in mountainous terrain, wolves are most likely to use low elevation mountain passes (Callaghan 2002). Wolves in Banff National Park were mainly found at elevations below 1,850 m, but during summer, wolves tracked the vertical migration of elk to high elevations and open areas (Paquet 1993). However, even in summer, wolves tend to avoid steeper slopes (Hebblewhite and Merrill 2008).

Despite a strong preference for low elevation and shallow slopes where such habitats are available, wolves can and do use steep slopes when gentle terrain is unavailable. For example, in the Kicking Horse Valley west of Lake Louise around the village of Field, wolves selected for steeper slopes when traveling (Duke 2001), presumably because the valley is narrow and shallow slopes were unusable due to high levels of human development (i.e., the village of Field and the Trans-Canada Highway). Similarly, in Jasper National Park, wolves successfully used higher elevations and steeper slopes to move around places of high human activity to access fragmented habitat patches in the valley bottom (Shepherd and Whittington 2006). When a corridor was implemented on the valley bottom, wolves used the mountainside less frequently, indicating that lower elevations were preferred, if available, but that alternate routes are possible (Shepherd and Whittington 2006).

Wolves are sensitive to human disturbance in many places. In North America[14], wolves are typically absent from areas with dense human populations or intense agriculture and are prone to extirpation in areas with high livestock density (Alberta Forestry, Lands, and Wildlife 1991; Oakleaf et al. 2006; Mladenoff et al. 1995; Paquet and Carbyn 2003). Human development can have a profound effect on wolf habitat selection and may be one of the most important determinants of wolf travel routes (Duke 2001; Hebblewhite and Merrill 2008).

---

[14] But see Chapron et al. 2015 for new information from Europe that indicates wolves may be more adaptable to human presence than previously believed

In the Bow Valley, for instance, wolves might have been excluded from prime habitat east of the town of Banff by the town itself (Paquet 1993), creating an artificial predator-free zone. The effect of anthropogenic linear features (e.g., roads) on wolves has been well-studied, and linear features are thought to have an especially important influence on movement and habitat selection. Wolves near Jasper, Alberta selected areas with lower road and trail density (i.e., <1 km/km^2) and both kinds of linear features fragmented habitat and degraded habitat quality (Whittington et al. 2005). Ninety percent of wolf locations occurred where road density was less than 1.3 km/km^2 and trail density was less than 2.9 km/km^2 (Whittington et al. 2005). In the Rocky Mountains, wolves are thought to persist only at road densities below 0.60 to 0.70 km/km^2 (Paquet and Carbyn 2003).

However, the physical presence of roads does not necessarily reduce wolf habitat quality. Rather, human-caused mortality and disturbance near roads might be the primary influence of roads on wolves. Thus, human activity that accompanies development must be considered when evaluating habitat suitability for wolves. Indeed, wolves frequently used anthropogenic linear features at night in Banff and Yoho National Parks when human activity is low, presumably to take advantage of an easy travel route (Callaghan 2002), and wolves might regularly exploit linear features to facilitate travel and hunting efficiency where human use of such features is low (James and Stewart-Smith 2000).

As is typical in mountainous regions, low elevation montane habitats like those found at low elevation in the RSA, are used primarily by wolves in winter when their ungulate prey congregates on low elevation winter range (Section 5.3.6). The winter RSF developed for wolves indicates that wolves select intermediate elevations, especially on south facing slopes (Appendix B). Wolves avoided non-vegetated habitats, built up areas, areas with high trail densities and golf courses. In addition to a strong preference for south facing slopes, wolves selected for forest edge, herbaceous vegetation and areas with more shrubs. Habitats on the south side of the Bow Valley tend to be less strongly selected than the south facing slopes on the north side. Most of the selected habitat for wolves during winter in the RSA occurs in wildlife corridors and habitat patches on the north side of the river.

Corridors and habitat patches in the Bow Valley may only be partially effective for wolves under existing conditions. Lee et al. (2010) noted a decreasing trend in wolf use over time in high quality habitats north of Canmore, with minimal use of the Benchlands area after 2002-2003, except in the far west end next to Banff National Park. Similarly, Golder (2013) concluded that rare use by wolves of the approved Along Valley Corridor, Tipple Across Valley Corridor and Stewart Creek Across Valley Corridor (Figure 37 in Golder 2013) was most likely a result of high human use. No wolves were documented using the G8 or Stewart Creek wildlife underpasses during 2007 to 2012, but wolves were known to cross the Trans-Canada Highway using the Stewart Creek Underpass prior to 2007 (Clevenger et al. 2002, 2007).

The stability of the regional wolf population is not known, but wolf packs overlapping the Bow Valley are subjected to a variety of mortality sources, including being hit on highways and by trains, harvest, and, more recently, being killed in response to negative human-wolf interactions (Small 2016). To be precautionary, a serious risk is identified for wolves under existing conditions in the RSA because of uncertainty about pack stability and very low levels of use reported in wildlife corridors and habitat patches (Lee et al. 2010; Golder 2013).

Wolf habitat in the ASP area and in adjacent wildlife corridors is primarily avoided under existing conditions (Table 17, Figure 34 and Figure 35). This is not surprising in the context of generally reduced probability of selection south of the Bow River relative to the Benchlands north of the Bow River. Human use on designated and undesignated trails reduced the probability of selection (Table 17). Habitats that are strongly avoided may create higher resistance to wolf movement and would be slightly more common in the wildlife corridors adjacent to the ASP area under increased human use (i.e., 5.3% versus 7.6% of the adjacent corridor, Table 17).

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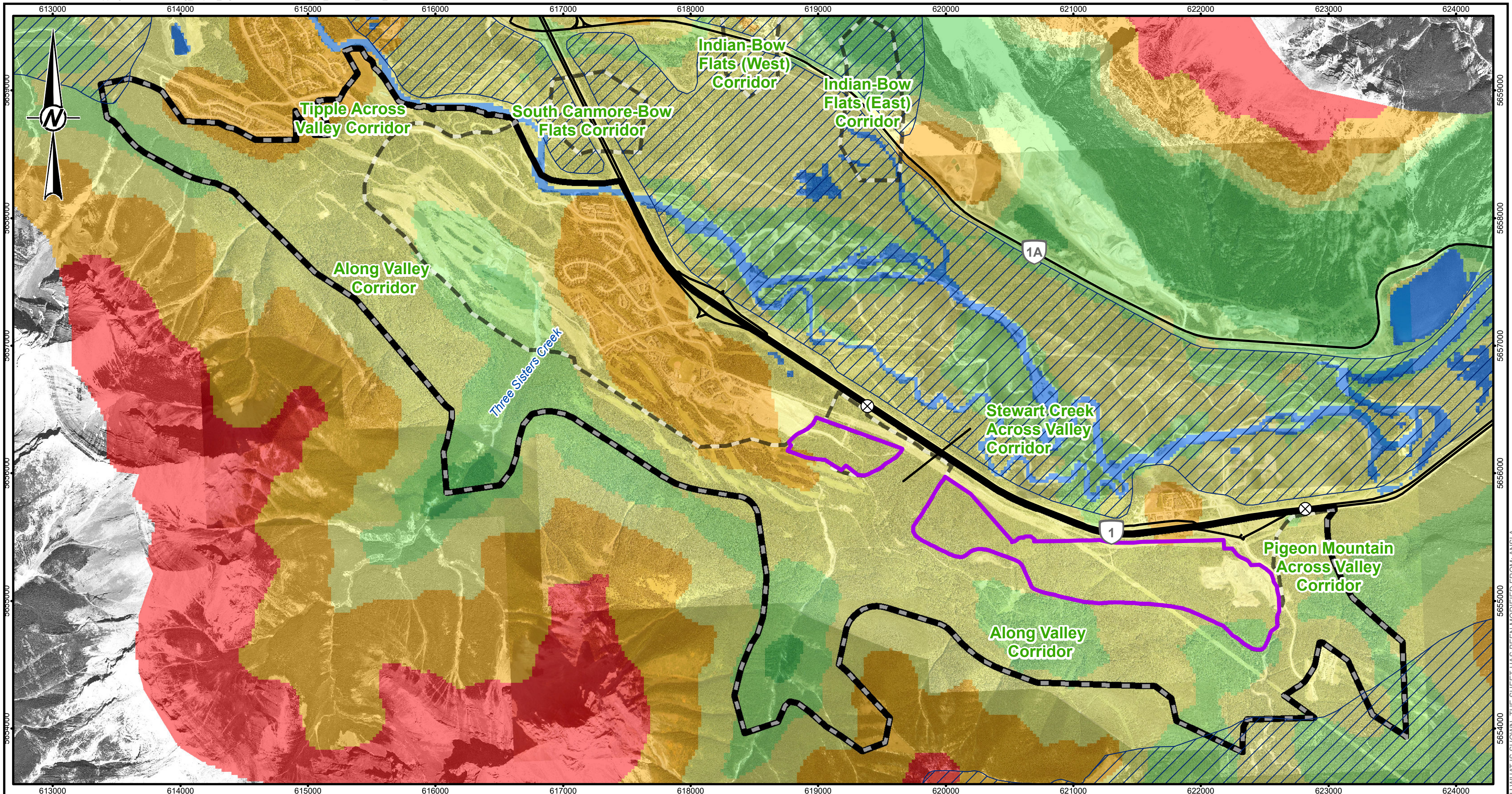

LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	10/5/2020
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE
WINTER WOLF RESOURCE SELECTION – EXISTING CONDITIONS WITHOUT ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	34

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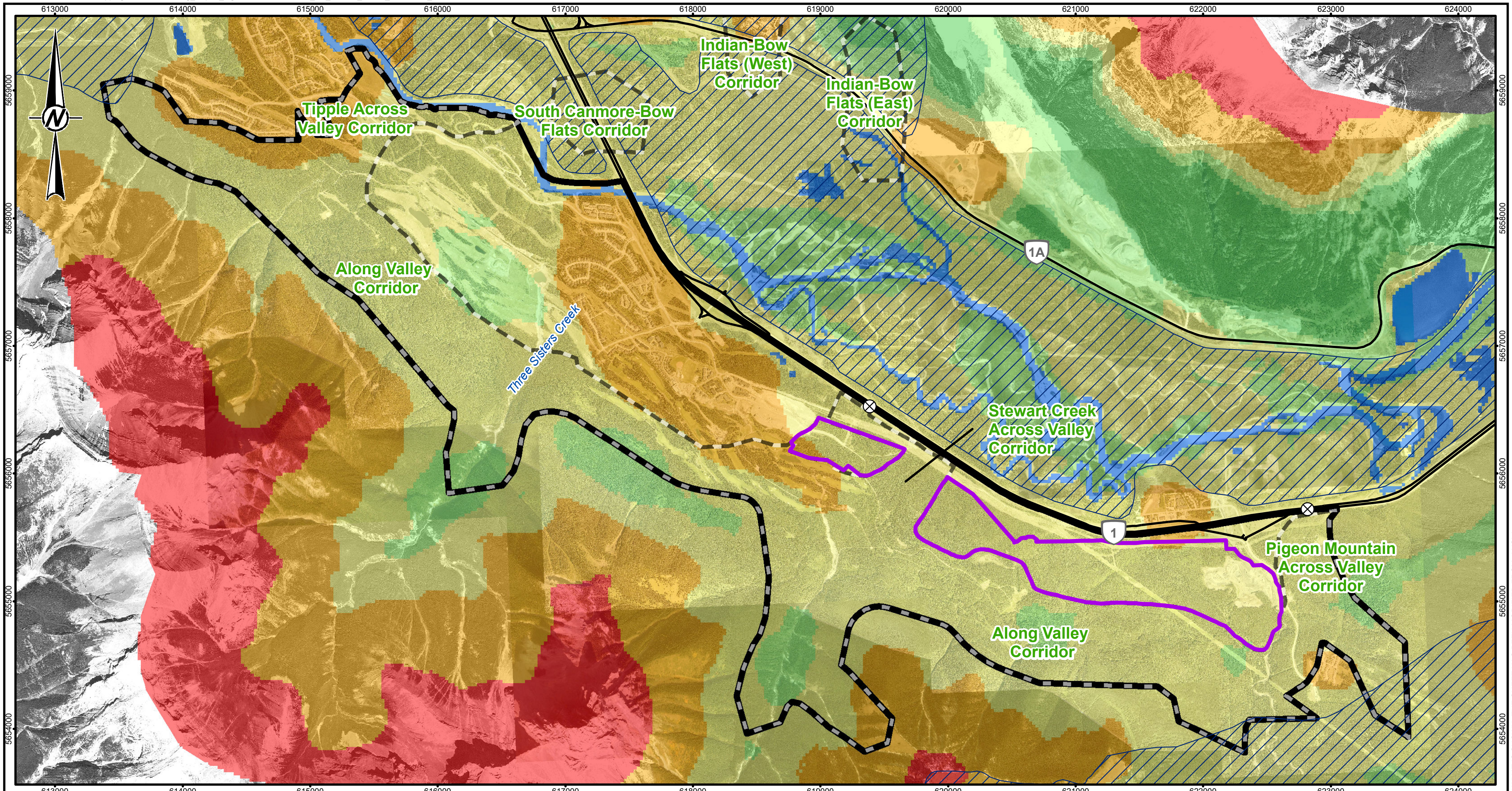

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	10/5/2020
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REVIEWED	SM
APPROVED	KK

TITLE

WINTER WOLF RESOURCE SELECTION – EXISTING CONDITIONS WITH ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	35

Table 17: Wolf Habitat Within the Local Study Area Under Existing Conditions With and Without Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)				With Estimated Effects of Increased Human Use on Trails (ha)			
	ASP Area (ha)	Adjacent Wildlife Corridor (ha)	Other Approved Corridors (ha)	Remaining Largely Developed Areas (ha)	ASP Area (ha)	Adjacent Wildlife Corridor (ha)	Other Approved Corridors (ha)	Remaining Largely Developed Areas (ha)
Selected	0.0	8.5	8.3	8.1	0.0	0.0	0.0	0.0
Used as available	6.2	185.9	106.9	63.3	0.1	46.3	23.5	44.1
Somewhat avoided	146.2	342.3	233.4	216.9	149.2	477.8	304.7	230.9
Strongly avoided	1.3	30.3	27.6	179.3	4.4	42.8	47.9	192.5
Rarely used	0.0	0.0	0.0	0.0	0	0.0	0	0.0
Waterbody[(a)]	0.0	0.0	0.4	5.4	0	0.0	0.41	5.4
Total	**153.7**	**567.0**	**376.5**	**472.9**	**153.7**	**567.0**	**376.5**	**472.9**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

ASP Area = Project Study Area Boundary; ha = hectare; <= less than.

Wolves can adapt to temporal patterns of human use (Hebblewhite and Merrill 2008), and therefore reductions in probability of selection associated with human use of trails identified in Table 17 are likely present only during the day when human use on trails occurs (Section 5.3.2). Remote camera data indicate that wolves are primarily active during the crepuscular periods in the early morning and later in the evening, a temporal pattern opposite to human use on the trails (Figure 36). In addition, 94% of photographs of wolves collected at remote cameras were obtained in winter (i.e., 15 November to 15 April) when human use is at its lowest (Figure 36).

Although wolf use has declined in wildlife corridors in the Bow Valley over time (Lee et al. 2010; Golder 2013), more recent available data (Figure 36) suggest that wolf use of wildlife corridors on the south side of the Bow Valley may have increased since the Golder (2013) review was completed (i.e., during 2013-2016). For example, wolves were detected in the Along Valley Corridor and adjacent TSMV lands several times in 2016, including near the ASP area (Figure 36).

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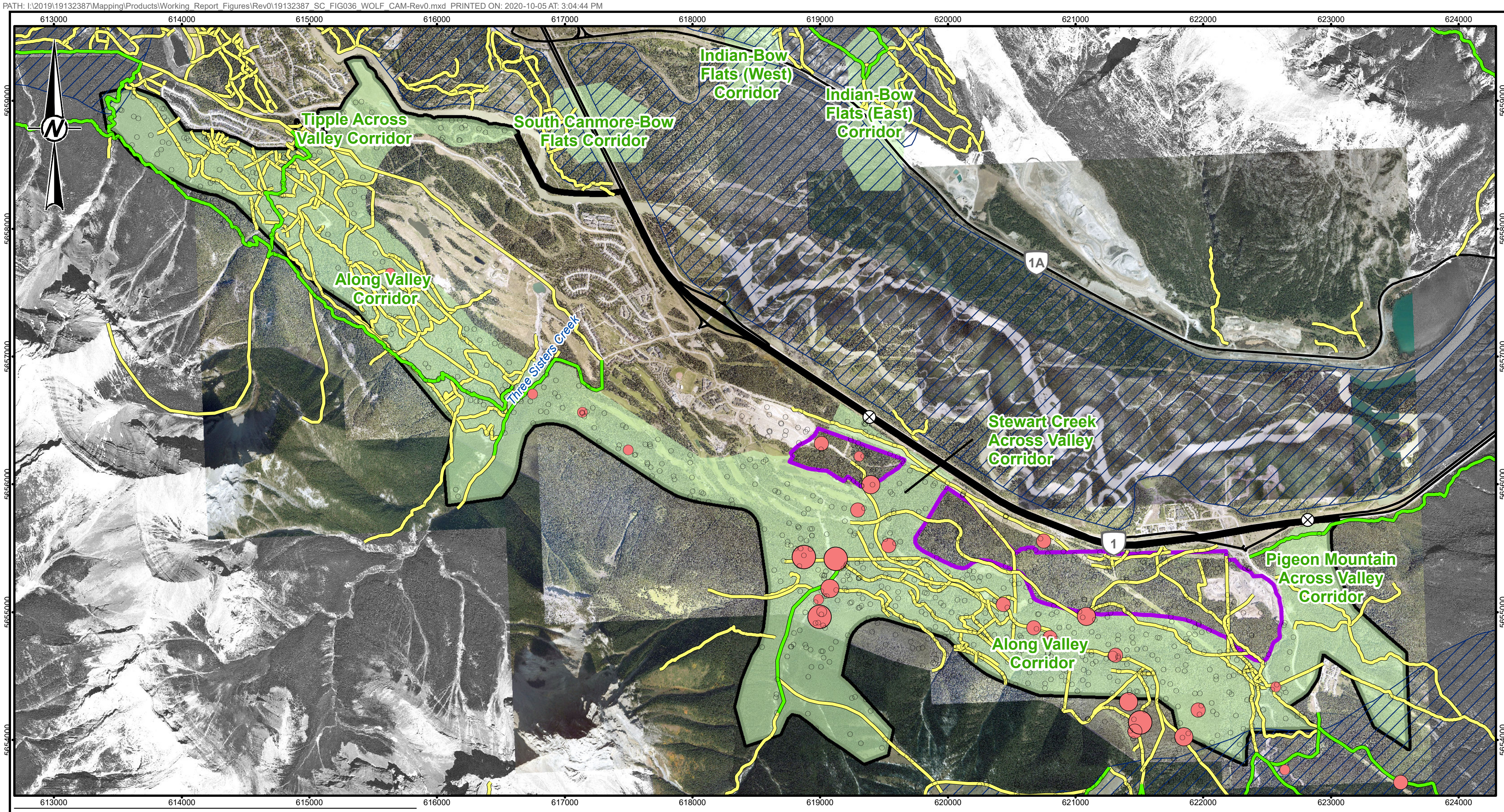


LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- DESIGNATED TRAIL
- UNDESIGNATED TRAIL
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

MEAN NUMBER OF INDIVIDUALS PHOTOGRAPHED PER DAY[1]

- 0.000
- 0.0025 - 0.020
- 0.020 - 0.048
- 0.048 - 0.103
- 0.103 - 0.202

0 800 1,600

1:45,000 METRES

NOTE(S)

1. DATA INTERALS CATERGORIZED USING JENKS METHOD FOR NATURAL BREAKS

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. REMOTE CAMERA DATA (2013 - 2016) OBTAINED FROM AEP, AUGUST 2016. USED UNDER LICENCE.
3. TRAILS OBTAINED FROM ALBERTA PARKS AND PROTECTED AREAS, 2011. ADDITIONAL TRAILS DIGITIZED 2016.
4. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE

WOLVES RECORDED ON REMOTE CAMERAS IN AND AROUND THE LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	36

25mm

Increased use of wildlife corridors by wolves in the vicinity of TSMV in 2015 and 2016 coincided with Parks Canada having to kill two wolves from the Bow Valley Pack in the summer of 2016 because the animals exhibited bold behaviours around people (Fletcher 2016; Small 2016). As a result, Parks Canada created a wildlife messaging campaign in 2017 to communicate with park visitors, residents and businesses (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018). The goal of the messaging campaign is to provide consistent and coordinated communications throughout the Bow Valley (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018).

Although the wolves observed in the vicinity of TSMV in 2015 and 2016 were not likely members of the Bow Valley Pack, other packs in Kananaskis Country and the Bow Valley are frequently in contact with humans and associated infrastructure, and therefore also have the potential to habituate to people.

Large carnivores, including wolves, can be highly adaptable in human dominated landscapes (Chapron et al. 2015). Habituation of wolves to people in the Bow Valley may be increasing in response to higher levels of human use or to greater contact with human food sources. In January 2017, wolf activity was reported between Stewart Creek and the Nordic Centre, including wolves in the Peaks of Grassi and Larch neighbourhoods, close to and around houses (Ellis 2017). Jay Honeyman, a wildlife conflict specialist with AEP, indicated that wolves were probably following elk into the Town, and that this posed a risk to wolves and could create a public safety hazard (Ellis 2017). Habituation is a double-edged sword. Although it may eliminate the serious risk identified for Bow Valley wolves under existing conditions because of low levels of movement and limited use of available habitat, it also exposes wolves to higher levels of negative interactions with people and possibly to higher mortality.

In summary, the combined effects of past and present developments and activities in the Bow Valley (e.g., Trans-Canada Highway and other roads, vehicle traffic, railway, industrial development and mining, urban development, growing human population, and trails) have negatively influenced the existing conditions for wolf habitat quantity and quality, corridor use and movement and risk of negative interactions with humans. Given that wolves exhibit a relatively strong avoidance of humans and human disturbance (Appendix B), the pattern of development and human use in the RSA has likely altered wolf habitat use, distribution and abundance in the RSA over time. Under existing conditions, few wolves use habitat patches and wildlife corridors south of the Bow River and no wolves were documented using the G8 or Stewart Creek wildlife underpasses during 2007 to 2012. To be precautionary, a serious risk is identified for wolves under existing conditions in the RSA because of uncertainty about pack stability and negative trends in their use of wildlife corridors and habitat patches.

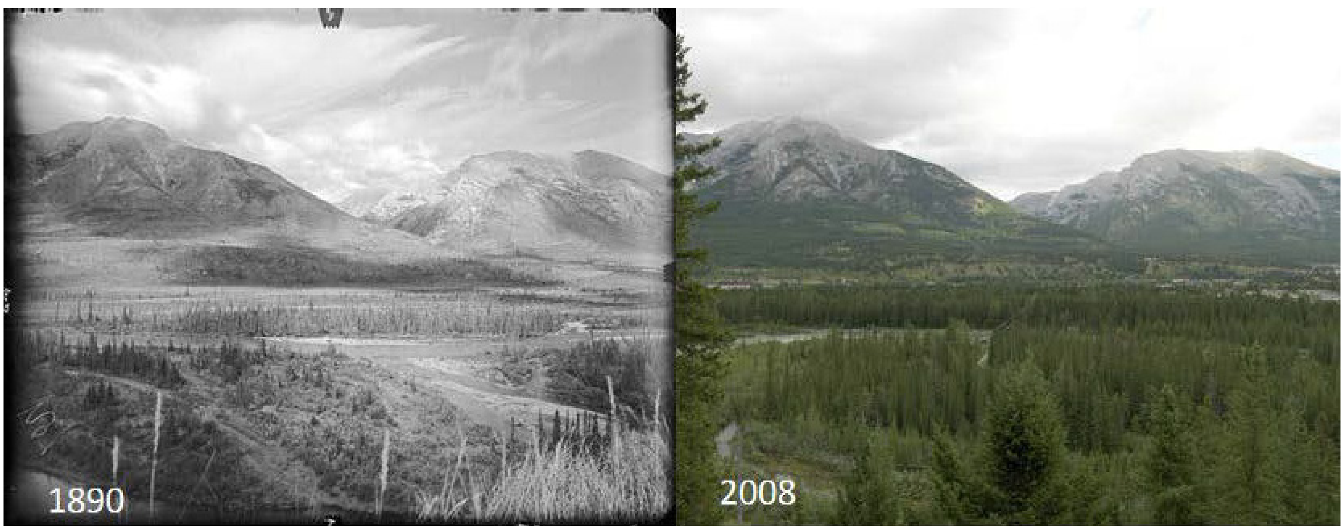
5.3.6 Elk - Existing Conditions

Elk occur in a range of habitats throughout the RSA in different seasons. Elevation, slope, and aspect are linked to precipitation, snow accumulation and plant phylogeny, and thus have a substantial influence on elk habitat selection (Hohler 2004; Hebblewhite et al. 2008). Higher elevations can be used year-round, though lower elevations often are preferred, especially during winter (Boyce 1991; Skovlin et al. 2002; Boyce et al. 2003; Serrouya et al. 2000). Elk move upslope during summer, influenced primarily by forage availability as plant growth initiates at progressively higher elevations through the spring and summer (Hebblewhite et al. 2008).

Elk generally prefer gentle slopes (Johnson et al. 2000), although preference for slope can vary with season, year and among sexes (Hohler 2004). In less human-affected ecosystems where wolves are present, elk may select higher elevations and steeper slopes (Mao et al. 2005), presumably because elk encounter wolves more frequently in valley bottoms, i.e., places with gentle slopes and low elevation (Hebblewhite et al. 2005a). However, in the RSA, elk tend to be concentrated in the valley bottom in and around the Town (Appendix B, Figure B4), where forage is present and the risk of predation is lower (Appendix B, Sections 2.2.2 and 2.2.3; Edwards 2013).

Anthropogenic grasslands are not a natural habitat feature but are nevertheless identified as important for elk in the Bow Valley because they provide optimal conditions for elk where forage quality is high and predation risk is low (Frair et al. 2005). Another reason that anthropogenic grasslands are important for elk in the Bow Valley is because grassland habitats are not common in other parts of the Bow Valley. Forest cover and the availability of grassland habitat in the Bow Valley has varied historically based on fire occurrence. There have been no recent large fires in the RSA, and vegetation in the area is currently dominated by forest cover. As illustrated in Figure 37, in 1890 the valley had much less tree cover and more grassland area because of wildfires. Forest encroachment and reduction of open habitats in similar ecosystems has been well documented in Alberta (e.g., Rhemtulla et al. 2002; Widenmaier and Strong 2010). The concentration of elk activity within and immediately adjacent to Canmore (Appendix B; Edwards 2013) is consistent with the findings of previous studies of elk habitat selection use near the town of Banff (McKenzie 2001; Hebblewhite et al. 2005a,b; Kloppers et al. 2005).

Figure 37: Photographs Demonstrating Substantial Increase in the Amount of Forested Habitat in the Bow Valley Between 1890 and 2008



Source: Mountain Legacy, School of Environmental Studies 2013.

The habituation of elk to human activity and developments in the Bow Valley, as well as clear evidence of elk use throughout wildlife corridors and developed areas (Edwards 2013), means that landscape connectivity for elk in the RSA remains high under existing conditions.

Elk in the Bow Valley are so habituated to people that they only respond by moving away if people approach within 20 to 50 m and do not move far without strong provocation including starter pistols, screamers, cracker shells, and actively chasing the elk by running after them (Kloppers et al. 2005). Habituated elk can pose a human safety risk when they concentrate in urban areas, including school yards, as elk are known to do in Canmore (Figure 38). Fire suppression, and the increasingly forested landscape that results (Rhemtulla 1999), may have intensified negative human-elk interactions in the Bow Valley under existing conditions because grassland habitats are concentrated near development, and are less abundant elsewhere than they were historically.

The Town of Canmore plans to erect a wildlife fence around Centennial Park, where herds of 80 or more elk are periodically observed, to exclude elk from the area (Town of Canmore 2019a). The use of wildlife fencing is consistent with recommendations from the Bow Valley *Human-Wildlife Coexistence Report* (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018), and other urban green spaces may be fenced in the future (Town of Canmore 2019a).

The concentration of elk in areas where wolves are scarce, such as near Canmore, results in an overall reduction in mortality risk and an increased rate of calf recruitment (Hebblewhite et al. 2005b). This effect is so strong that elk in Canmore do not exhibit seasonal shifts in habitat use; instead they remain in Canmore and access anthropogenic landscapes year-round and maintain unusually small home ranges and high population density (Edwards 2013).

Another detrimental effect of the high concentrations of elk in and around Canmore is higher rates and intensities of parasitic infections among the resident elk population because of frequent and repeated use of small numbers of foraging sites and day beds (Edwards 2013).

Figure 38: Elk in a School Yard in Canmore

Note: Photo Courtesy Jay Honeyman, AEP

The RSA mainly intersects Wildlife Management Unit (WMU) 410 but also overlaps with the northern portion of WMU 408. Based on available information, the elk population in WMU 410 is considered stable or increasing under existing conditions (Boukall 2019, pers. comm.), whereas limited harvest success over the past few years suggests that elk in WMU 408 are declining under existing conditions (Boukall 2019, pers. comm.). The most recent aerial surveys for the RSA are from 2015 and 2016 (Boukall 2019, pers. comm.) when minimum counts were 240 and 243 elk, respectively (Chapman 2017, pers. comm.). When correcting for visibility and other factors affecting minimum counts, the population of elk is probably between 300 and 400 animals (Chapman 2017, pers. comm.). Elk in the RSA are likely self-sustaining; however, there is some uncertainty associated with this prediction.

Although elk may be self-sustaining in the RSA under existing conditions, their natural ecological interactions have been substantially diminished, predation risk is near zero for elk living in Canmore, and parasite loads in elk are higher because elk are concentrated in small areas of intense use (Edwards 2013). Consequently, a serious risk is identified for elk in the RSA under existing conditions because they do not function in their natural ecological role and are not considered ecologically effective.

The concentration of elk activity in proximity to golf courses (e.g., Stewart Creek Golf Course) and other human developments occurs during all seasons and is apparent from remote camera data (Figure 39), elk telemetry data (Appendix B, Figure B4), and wildlife movement surveys (Appendix D). Elk were detected by remote cameras within the ASP area (0.002 detections/camera/day) and in wildlife corridors (0.0009 detections/camera/day) adjacent to the Smith Creek ASP. Remote camera data shows that elk were detected at cameras deployed on designated trails (0.182 detections/camera/day) more often than undesignated trails (0.110 detections/camera/day) or other areas (0.139 detections/camera/day).

Patterns of elk habitat selection in the ASP area and adjacent wildlife corridors are clearly expressed through the numerical and graphical output of the RSF model built using elk telemetry collar data (Appendix B). The RSF model expresses the preference of elk for built-up areas (i.e., elk in the Bow Valley near Canmore prefer to be closer to human developments; Figure 39 and Figure 40), as well as forest edge, herbaceous vegetation, and golf courses, while avoiding dense conifer and shrub habitats (Appendix B). Within the ASP area, 86.7% of habitat is predicted by RSF modelling to be selected by elk (Table 18; Figure 40). Habitat in wildlife corridors adjacent to the ASP area is approximately 43% selected and 48% used as available by elk (Table 18), and elk use wildlife corridors regularly (Figure 39). As described in Appendix B (Figure B-12), the relationship between the probability of selection class and the proportion of elk steps overlapping with each habitat class indicates that the RSF is a good overall reflection of elk movement and that the selected class is especially important for movement (i.e., resistance is very low relative to other classes).

Table 18: Elk Habitat in the Local Study Area Under Existing Conditions

Habitat Class	ASP Area (ha)	Adjacent Wildlife Corridor (ha)	Other Approved Corridors (ha)	Remaining Largely Developed Areas (ha)
Selected	133.2	245.4	195.1	467.6
Used as available	20.4	270.5	180.9	0.0
Somewhat avoided	0	45.8	0.1	0.0
Strongly avoided	0	5.4	0.0	0.0
Rarely used	0	0.0	0.0	0.0
Waterbody[a]	0	0.0	0.4	5.4
Total	**153.7**	**567.0**	**376.5**	**472.9**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

ASP Area = Project Study Area Boundary; ha = hectares; <= less than.

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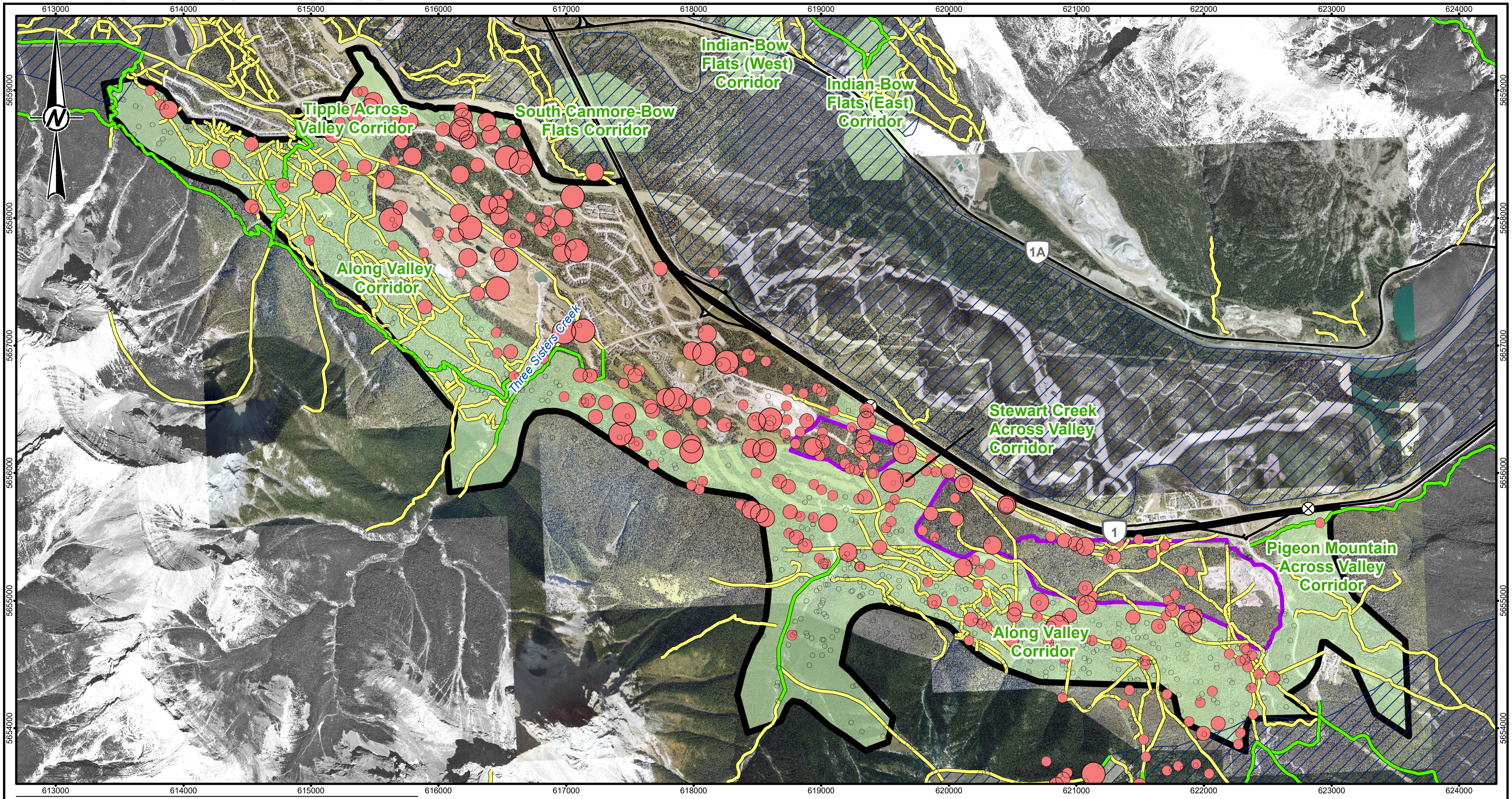

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- DESIGNATED TRAIL
- UNDESIGNATED TRAIL
- PRIMARY HIGHWAY
- HABITAT PATCH
- 35 m CONSERVATION EASEMENT
- PROJECT BOUNDARY
- LOCAL STUDY AREA

MEAN NUMBER OF INDIVIDUALS PHOTOGRAPHED PER DAY[1]

- 0.000
- 0.108 - 0.367
- 0.367 - 0.731
- 0.731 - 1.345
- 1.345 - 3.632

0 800 1,600

1:45,000 METRES

NOTE(S)

1. DATA INTERVALS CATERGORIZED USING JENKS METHOD FOR NATURAL BREAKS

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. REMOTE CAMERA DATA (2013 - 2016) OBTAINED FROM AEP, AUGUST 2016. USED UNDER LICENCE.
3. TRAILS OBTAINED FROM ALBERTA PARKS AND PROTECTED AREAS, 2011. ADDITIONAL TRAILS DIGITIZED 2016.
4. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-08
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE

ELK RECORDED ON REMOTE CAMERAS IN AND AROUND THE LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	39

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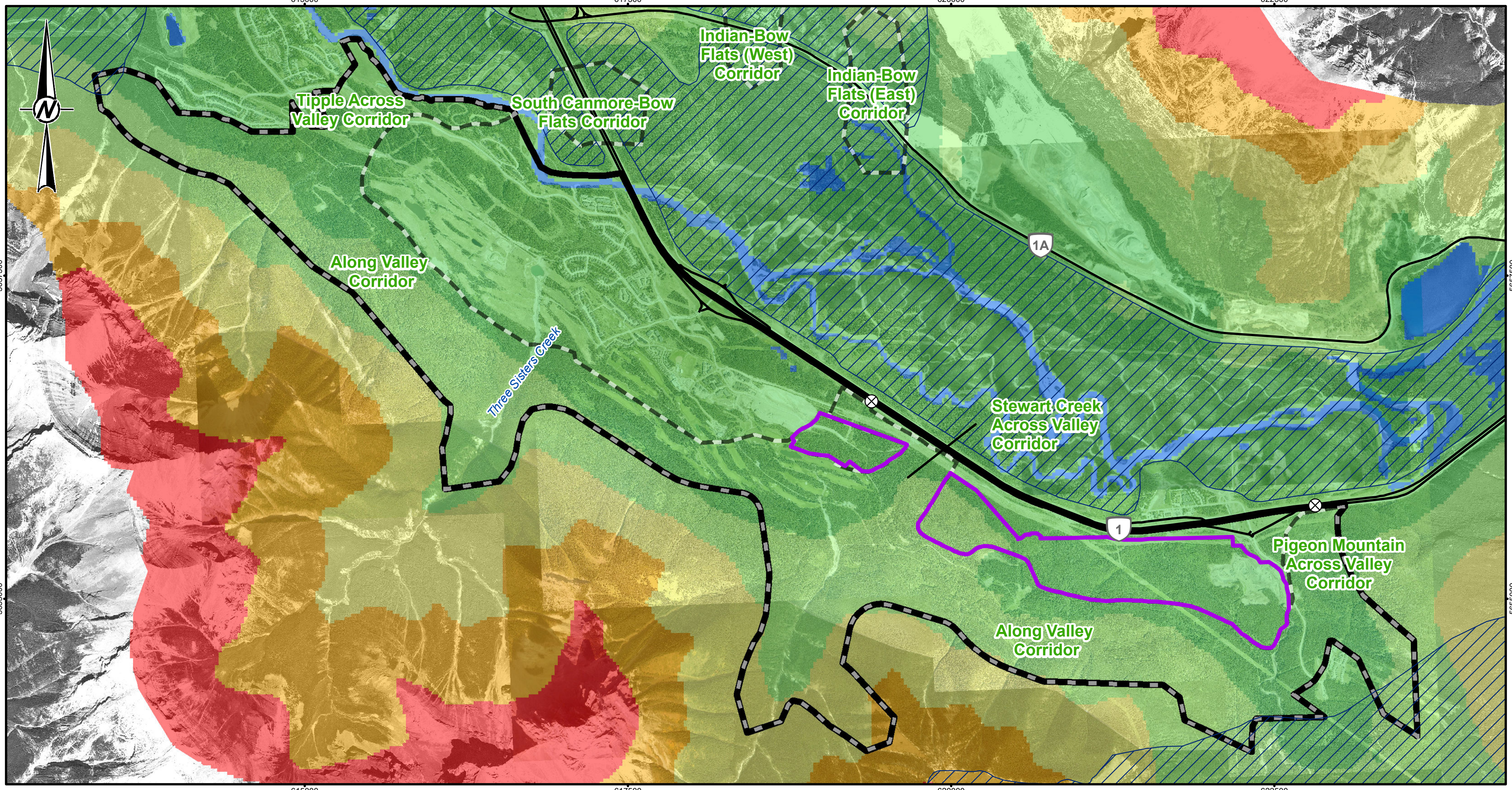

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE

WINTER ELK RESOURCE SELECTION – EXISTING CONDITIONS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	40

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Wildlife movement surveys in wildlife corridors within the LSA and surrounding other TSMV lands predominantly recorded signs of elk movement. A total of 19.02 km of transects and game meanders were surveyed, and 3.21 km of wildlife use areas were identified, all of which consisted of a dense network of elk trails and tracks. These areas typically occurred within easy movement classes at lower elevations adjacent to the Stewart Creek Golf Course or close to the Bow River (Appendix D). Two-thirds of all transects were considered easy terrain (8.05 km) compared to moderate (3.30 km) or difficult terrain (1.67 km). Game meanders (5.86 km) were within easy terrain, with trails moving along benches or around dense deadfall. However, when wildlife trails split into multiple moderate trails, across slope trails were typically selected to achieve target game meander length, which potentially reduced the likelihood of game meanders traveling up or down steeper slopes that would be classified as moderate or difficult movement class.

Elk trails recorded included 8.4 trails/km in difficult terrain, 18.2 trails/km in moderate terrain, and 13.6 trails/km in easy terrain. Easy movement terrain generally occurred in lower elevations and gentler slopes. Elk moved in all directions in these areas, with an equal number of upslope (n=79) and across slope (n=79) trails, as well as moderate (n=75) and low use (n=76) trails. Moderate movement class occurred in areas with steeper slopes or areas of moderate deadfall. The number of high (n=13) and moderate (n=16) trails were similar and they mostly travelled across slope (n=30) compared to upslope (n=19). Difficult terrain generally encompassed heavy blow-down areas or steep terrain with heavy deadfall. There were similar number of trail use levels (high = 4; moderate = 6, low = 3) as well as direction of trails (upslope = 5; across slope = 7). No areas encountered were considered impassible for wildlife. Twenty-three percent of all trails were also identified as having obvious signs of high human use.

In summary, the combined effects of past and present developments and activities in the Bow Valley (e.g., Trans-Canada Highway and other roads, vehicle traffic, railway, industrial development and mining, urban development, growing human population, trails, fire suppression and climate change) have influenced the existing conditions for elk habitat quantity and quality, corridor use and movement and risk of negative interactions with humans. In particular, the absence of large fires in the RSA is linked to a decline in the availability of natural grasslands. Despite these changes, there is abundant elk habitat in the LSA with large amounts of selected habitat within the ASP area and wildlife corridors. Available information on elk population estimates and trends in WMUs that overlap the RSA suggests that the regional elk population is likely self-sustaining under existing conditions. However, the cumulative effects of development in the Bow Valley have altered elk behaviour and condition in the region (i.e., they concentrate in urban areas, pose a safety risk to humans, have substantially diminished interactions with predators, and have higher parasite loads). Elk do not function in their natural ecological role and are not considered ecologically effective; therefore, a serious risk is identified for elk in the RSA under existing conditions.

5.4 Wildlife Environmental Risks

The following categories of environmental risks for wildlife are identified for the Project:

- wildlife mortality caused by site clearing and construction activities
- reduced quantity and quality of wildlife habitat within the ASP area caused by construction and operations
- reduction in wildlife use of approved wildlife corridors adjacent to the ASP area
- increased negative human-wildlife interactions

Specific risks associated with each risk category are discussed in the following sections.

5.4.1 Wildlife Mortality Caused by Site Clearing and Construction

Construction activities, particularly site clearing and vehicle activity, have the potential to cause direct mortality to wildlife. Wildlife most at risk of mortality during construction include those with limited mobility or those that remain still in response to danger, such as young animals, small mammals, birds, and amphibians. In some cases, in addition to potential adverse effects on local individuals and populations, such mortality contravenes federal or provincial legislation (Section 5.5). Adult large mammals are generally expected to avoid construction activities, except in rare circumstances where mobility might be limited, such as the case of black bears that are in their dens.

5.4.2 Reduced Quantity and Quality of Wildlife Habitat within the ASP Area

Habitats that provide value for wildlife under existing conditions will be removed and replaced with buildings, roads, recreation areas, and other components of the Project. Some habitats that will be removed within the ASP area have already been modified by humans, such as the Thunderstone Quarry and right-of-ways. Increased human use around the development could lead to additional habitat loss outside the Project footprint if unsanctioned trails are created, including in wildlife corridors (Section 5.3.2).

Noise associated with construction may exceed that associated with the completed Project and may result in greater disturbance and displacement of wildlife that use habitat near active construction sites. This type of disturbance may also extend beyond the ASP area where construction occurs near the boundary. For species such as elk that select habitats near developed areas, active construction may temporarily decrease probability of selection below values expected once construction is complete (i.e., during operations).

Areas of natural habitat or anthropogenic open spaces within the ASP area will retain some value for wildlife, particularly those that adapt well to people, but overall reductions in habitat quality and biodiversity in these habitats are likely because of high levels of human use.

An important mitigation to reduce the effect of the Project on negative wildlife human interactions and human use of adjacent wildlife corridors is wildlife fencing, which will provide a hard edge that physically separates wildlife habitat from human development (Section 5.6.4). Application of fencing as a mitigation will exclude large mammals from areas of natural habitat or anthropogenic open spaces within the Project Boundary, resulting in a complete loss of access to habitat that otherwise might be used. Other species of wildlife, such as birds, amphibians, and small mammals will continue to be able to access habitats inside the fence, such as wetlands.

Licks currently used by bighorn sheep are located along the Trans-Canada Highway both west of the Stewart Creek Underpass as well immediately adjacent to it. Movement routes from Wind Ridge to these areas have been delineated by camera monitoring data (Figure 54 in Golder 2013) and local knowledge (Kamenka 2008, pers. comm.; Leeson 2008, pers. comm., Corvidae 2014). Access to the licks created in the vicinity of the highway should not be prevented by the erection of wildlife fencing, although the fence will alter the route bighorn sheep would have to take to access the Stewart Creek underpass. Whether or not bighorn sheep will continue to access the area along the TransCanada Highway and the underpass to access minerals after implementation of the Project is uncertain.

5.4.3 Reduction in Wildlife Use of Approved Corridors

The Project has the potential to change patterns of wildlife use within approved wildlife corridors adjacent to the Project. If the Project described in Section 3.0 is completed (without mitigation), these changes could adversely affect wildlife use in corridors adjacent to the ASP area.

Sensory disturbance associated with the Project may result in a zone of influence that will extend away from the Project and into wildlife corridors, reducing the probability of selection for wildlife that tend to avoid human disturbance. Sensory disturbance for wildlife will occur due to noise, light, smells, and the sight of human activity that are associated with construction of the Project, and the presence of the residential, commercial and light industrial development (Section 3.0).

The risk from sensory disturbance associated with the Project footprint is different from the risk from sensory disturbance associated with human use. Human use is currently not restricted to developed areas, and commonly occurs within wildlife corridors under existing conditions. Therefore, the risk from sensory disturbance associated with increased use by recreating humans and their pets is diffused throughout the landscape and will be most strongly associated with designated and undesignated trails. Recreational use of wildlife habitat, wildlife corridors, and wildlife crossing structures is already prevalent near the Project footprint (Section 5.3.2) and studies show that this kind of use can reduce the probability of use for many wildlife species (Banks and Bryant 2007; Clevenger and Waltho 2000; George and Crooks 2006; Gibeau et al. 2002a; Reed and Merenlender 2008; Rogala et al. 2011; Roloff et al. 2001; Whittington et al. 2005).

Sensory disturbance and increased human recreational use pose particularly important risks within the Stewart Creek Across Valley Corridor. The alignment of the Stewart Creek Corridor is relatively narrow and would be bound on both sides by development. This is distinct from the Along Valley Corridor, which is wider at its narrowest point south of the Project Boundary and is unbounded on its southern edge.

If the Project is approved, development of the Project is expected to introduce new residents and visitors to Canmore (Section 3.0). Taken as a whole and without application of appropriate mitigation, substantial increases in human use, off-leash dog use, and associated unsanctioned trail proliferation in wildlife corridors adjacent to the ASP area is expected.

5.4.4 Increased Negative Human-Wildlife Interactions

As outlined in Section 5.3.3, negative human-wildlife interactions have been increasing in the Bow Valley and have contributed to a population sink for grizzly bears. Soft edges associated with existing human developments leave wildlife free to move into areas used by humans, and animals regularly do so under existing conditions. Humans also are frequently found in wildlife corridors. The resulting mix of wildlife and people, especially along or at the interface between wildlife habitat and human development, has driven increasing negative human-wildlife interactions (Section 5.3.3 and Section 5.3.4). If the Project developments described in Section 3.0 are completed without mitigation, similar levels of negative interactions can reasonably be expected adjacent to wildlife corridors.

Without adequate mitigation, wildlife are expected to enter Project developments and high levels of negative interactions similar to what is observed under existing conditions in other Canmore neighbourhoods adjacent to wildlife corridors and habitat patches are predicted. Wildlife entry into human developments would be especially likely in green spaces left between developed areas of the ASP (Section 3).

Without mitigation, increased traffic volumes within the Project area and along connecting roadways (e.g., Three Sisters Parkway, Trans-Canada Highway) associated with Project construction and operation have the potential to increase wildlife mortality due to collisions with vehicles. The Trans-Canada Highway is currently fenced along portions south of the Bow River (i.e., north of the Project area) to reduce the risk of vehicle-wildlife collisions but is unfenced north of the Bow River (i.e., northwest of the Project area). The unfenced portion of the Trans-Canada from where it crosses the Bow River to Canmore was classified as experiencing a very high (80-100 percentile) incidence of wildlife-vehicle collisions (Lee et al. 2012). Most of the detected collisions in that study involved ungulates (95%), black bears (4%) and cougars (1%) (Lee et al 2012). In subsequent sections (e.g., Section 5.7 and 5.9), wildlife-traffic collisions are discussed within the broader context of negative human-wildlife interactions.

New Canmore residents and visitors present within and adjacent to the Project, will want to walk, mountain bike, run their dogs, and otherwise use natural habitats in the vicinity of the Project. Without the application of appropriate mitigation, available data suggests that these residents will use areas adjacent to development, including wildlife corridors, for these activities. Activity will likely occur both on and off designated trails within wildlife corridors and additional illegal trail building should be expected without adequate mitigation. Such use is likely to substantially increase negative human-wildlife interactions in and around the Project and would pose a serious risk without adequate mitigation. The Stewart Creek Across Valley Corridor will also have development on both sides, which has potential to exacerbate negative human-wildlife interactions.

5.4.5 Unmitigated Risks

The unmitigated risks of the Project are characterized below for each wildlife VEC and other species at risk.

5.4.5.1 Grizzly Bears

Grizzly bears are considered very sensitive to Project effects. They are provincially listed as ‘Threatened’ (AEP 2018) and they are a long-lived species with relatively low recruitment rate, resulting in a slow recovery potential from population declines (ARSD and ACA 2010). Further, the Bow Valley is considered an ecological trap for grizzly bears (Benn and Herrero 2002; Hebblewhite et al. 2003; Nielsen et al., 2004; Nielsen et al. 2006; Sawaya et al. 2012; Webb 2013, pers. comm.; Boukall 2016, pers. comm.). Attractive habitat and food sources (e.g., fruit trees) within Canmore results in potential negative human-bear interactions and the hazing, translocation, and/or mortality of grizzly bears. Although high quality habitat is abundant, and movement and habitat connectivity has been maintained in the Bow Valley, a serious risk is present for grizzly bears under existing conditions because of human conflict and grizzly bear mortality.

Habitat loss from construction of the Project is anticipated to result in a minimum loss of 8 ha of selected habitat within the ASP area (Section 5.7.2.2). Grizzly bears generally avoid high density development areas, resulting in increases of 4.3 ha for somewhat avoided habitat and 69 ha for strongly avoided habitat within the ASP area. Remaining selected (25 ha) and used as available (7 ha) habitat within the ASP area are located in recreational areas and lower density developments where human activity will also be high. Although habitat loss occurs within the ASP area, the RSF predicts an increase in selected habitat in the adjacent wildlife corridors under both human use scenarios. Grizzly bears select for areas of forest edge which is associated with preferred food resources, and the ASP area creates additional edge in the LSA (Section 5.7.2.2). Without mitigation, human and off-leash dog use in wildlife corridors within the LSA is also anticipated to increase, similar to areas surrounding the Canmore Nordic Centre, which could result in increased human-bear conflicts in the adjacent wildlife corridors.

Without mitigation, an increase in traffic volume associated with the Project during construction and operations may increase the number of bear-vehicle collisions in the LSA and along local roads and highways, particularly along highways without wildlife fencing. An increase in the number of bear-vehicle collisions would decrease bear survival in the RSA and would contribute to the serious risk present under existing conditions.

If poor garbage and food management occurs within the Project, bears would likely become food conditioned, habituated to people, and select habitat that is also highly used by people and pets both within the ASP area and elsewhere in the LSA. This could result in potentially fatal human-bear encounters for bears, humans, and/or pets. The added mortality source from human-bear conflicts would decrease bear survival in the RSA and contribute measurably to the serious risk already present under existing conditions.

Without mitigation, the Project will reduce selected and used as available habitat in the ASP area and will increase grizzly bear mortality in an area that is already an ecological trap, resulting in a high environmental consequence associated with negative human-wildlife interactions (Table 19). The most important contribution of the Project to a high environmental consequence is the increase in bear mortality from human-bear conflict, which will amplify the existing negative effects of the regional population's main limiting factor.

Table 19: Unmitigated Risks of the Project on Grizzly Bear

Context	The RSA is already considered a population sink; provincially listed as 'Threatened'; slow population growth therefore slower for populations to recover after declines.		
Effect Category	**Impact Criterion**	**Description**	**Environmental Consequence**
Quantity and Quality of Wildlife Habitat	Direction	Negative	Moderate
	Magnitude	Low – Habitat loss from site clearing and project development coupled with the tendency of grizzly bears to avoid high density developments is predicted to result in a minimum loss of 8 ha of selected habitat in the ASP, but increased forest edge will result in a net increase of 15 ha of selected habitat in the LSA. Additional habitat loss could occur if unsanctioned trails are constructed.	
	Geographic Extent	ASP area – clearing for Project infrastructure Local – effects of sensory disturbance Regional – effects associated with increased human use	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Likely	
Wildlife Use of Approved Corridors	Direction	Negative	Moderate
	Magnitude	Small: grizzly bears in the RSA currently retain probability of selection despite high human use and trail density in some areas. Under the scenario with human use of trails, less than 1 ha of selected habitats may be reduced in quality as a result of human use and sensory disturbances.	
	Geographic Extent	Local – effects from sensory disturbance Regional – effects from increased human use	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Likely	

Table 19: Unmitigated Risks of the Project on Grizzly Bear

Context	The RSA is already considered a population sink; provincially listed as 'Threatened'; slow population growth therefore slower for populations to recover after declines.		
Effect Category	**Impact Criterion**	**Description**	**Environmental Consequence**
Negative Human-Wildlife Interactions	Direction	Negative	High
	Magnitude	Large – potential for poor garbage and food management coupled with remaining selected as available habitats within the ASP area located within recreational areas and lower density developments will result in habituated, food conditioned, aggressive bears. Bear-vehicle collisions may increase on local roads and highways. Bear mortalities will increase measurably. The risk of humans and pet fatality will increase because of increased bear conflicts.	
	Geographic Extent	Regional – given the large territory size of grizzly bears, the increased risk of human bear-conflict (including with habituated and/or food conditioned bears) will extend to the RSA	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Likely	

ASP area = Project Study Area Boundary; RSA = Regional Study Area.

5.4.5.2 Cougars

The cougar population within and in proximity to the RSA is thought to be stable, self-sustaining, and ecologically functional (Regional Wildlife Corridor Study 2002; ESRD 2012). They are ecosystem generalists and can occupy a wide range of habitats when sufficient cover and prey populations are present. Prey species include deer, elk, and bighorn sheep, all of which occur within the RSA. Cougars are tolerant of humans and can adapt to anthropogenic activities and developments (Knopff et al. 2014). Cougars heavily use most areas within wildlife corridors in the Bow Valley currently (Appendix B, Figure B-5). While cougar habitat selection declines within developed areas, it increases immediately adjacent to them (Appendix B), likely in response to prey availability (Section 5.3.6). Available information suggests that cougar in the RSA are resilient to changes in habitat availability, habitat distribution and human use.

Under the scenario with no increased human use of trails, the Project is predicted to result in a net loss of 27.0 ha of selected habitat in the Project area, a gain of 118.1 ha within adjacent wildlife corridors, and a gain of 13.6 ha in other areas of the LSA. The Project will also cause a net loss of 110.9 ha of used as available habitat in the LSA, including losses of 65.9 ha, 29.9 ha , and 15.2 ha in the Project area, adjacent wildlife corridors and other areas of the LSA, respectively. The amount of somewhat avoided and strongly avoided habitats will increase with most of that located within the ASP area.

Within the LSA, the probability of cougar selection in adjacent wildlife corridors will increase, suggesting a potential increase in corridor use by cougars following Project construction. Limited effects on cougar habitat connectivity and animal movement are predicted in the wildlife corridors.

Some selected and used as available habitats will remain in the ASP area, primarily within areas designated for recreational use, which will also have high human and pet use. The increase in selected habitat in wildlife corridors is predicted to occur in proximity to the ASP area, an area that will also likely have more human and off leash dog recreational activities. This increased selected habitat within wildlife corridors in proximity to the ASP area is likely in response to the predicted increase in elk population within the ASP area (see elk section below). Without mitigation, these shifts in habitat selection could create a high potential for negative human-cougar interactions, with potentially fatal outcomes for humans, pets, and/or cougars. On a regional scale, negative human-cougar interactions can lead to low tolerance for cougars and potentially create challenges for conservation efforts.

Without mitigation, an increase in traffic volume associated with the Project during construction and operations may increase the number of cougar-vehicle collisions in the LSA and along local roads and highways, particularly those areas without wildlife fencing. The added mortality from cougar-vehicle collisions would decrease cougar survival in the RSA and may contribute to the high environmental consequence.

Without mitigation, the environmental consequence of the Project on cougars is anticipated to be high overall (Table 20). The most important contribution of the Project to adverse effects is the increase in human-cougar conflict, which will increase the risk to public safety and increase the potential for cougar mortality. Reduced human tolerance to cougars in the region, caused by increased human-cougar conflict, could introduce a serious risk to the cougar population.

Table 20: Unmitigated Risks of the Project on Cougar

Context	The main source of cougar mortality (hunting) is managed to achieve stable populations in the RSA. Cougar densities within and surrounding the RSA are among the highest in the Province (ESRD 2012). Therefore, the cougar population is likely self-sustaining and ecologically effective.		
Effect Category	**Environmental Criterion**	**Description**	**Environmental Consequence**
Quantity and Quality of Wildlife Habitat	Direction	Negative	Low
	Magnitude	Project area: loss of 34.9 ha of selected and 104.4 ha used as available habitat due to fencing relative to existing. Adjacent corridor: increase of 118.1 ha selected habitat	
	Geographic Extent	ASP area – clearing for Project infrastructure Local – effects of sensory disturbance Regional – effects associated with increased human use	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Likely	

Table 20: Unmitigated Risks of the Project on Cougar

Context	The main source of cougar mortality (hunting) is managed to achieve stable populations in the RSA. Cougar densities within and surrounding the RSA are among the highest in the Province (ESRD 2012). Therefore, the cougar population is likely self-sustaining and ecologically effective.		
Effect Category	**Environmental Criterion**	**Description**	**Environmental Consequence**
Wildlife Use of Approved Corridors	Direction	Negative[(a)]	Low
	Magnitude	Small – the RSF predicts an increase of 118.1 ha of selected habitat in adjacent corridor although some loss is possible if unsanctioned trails are developed. Change in habitat suitability and human use are not predicted to influence cougar habitat connectivity or movement.	
	Geographic Extent	Local – effects from sensory disturbance Regional – effects from increased human use	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Likely	
Negative Human-Wildlife Interactions	Direction	Negative	High
	Magnitude	Large: increase in human-cougar conflict leading to negative outcomes for cougars because habitats that are selected or used as available by cougars are also anticipated to be heavily used by humans and off-leash dogs (recreation, corridors near developments).	
	Geographic Extent	Local – human, off leash dog, and cougar use of corridors in proximity to development Regional – lower tolerance to cougars and increase conservation challenges	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Likely	

a) Although an increase in the amount of selected habitat is predicted for cougars in wildlife corridors (positive effect), there are potential negative effects associated with increased human use including sensory disturbance and habitat loss associated with unsanctioned trail development. To be precautionary, the effect in wildlife corridors is characterized as negative.

ASP area = Project Study Area Boundary; RSA = Regional Study Area.

5.4.5.3 Wolves

Wolves are ecosystem generalists, able to occupy a range of habitats given sufficient prey populations and the tolerance of local human communities (Paquet and Carbyn 2003; Oakleaf et al. 2006). Habitat use is strongly affected by prey abundance and distribution, with wolf occupancy in the northern Rocky Mountains correlating positively with elk density (Oakleaf et al. 2006). Wolves are generally sensitive to and avoid human disturbance, and human development may be one of the most important determinants of wolf travel routes (Duke 2001; Hebblewhite and Merrill 2008). Wolves will often avoid anthropogenic linear features such as roads except for during times of low human activity (James and Stuart-Smith 2000; Callaghan 2002). Wolves are somewhat resilient to changes in survival because they have a relatively high reproductive rate and are capable of rapid population growth if the availability of prey is high (Peterson et al. 1998).

Most of the wolf's selected habitat in the RSA occurs in wildlife corridors and habitat patches on the north side of the Bow River. Current corridors and habitat patches in the Bow Valley may be only partially effective, with Lee et al. (2010) noting a decreasing trend in wolf use in high quality habitat north of Canmore. Golder (2013) documented rare wolf use of the Tipple Across Valley, Along Valley, and Stewart Creek Across Valley corridors. This is thought to be related to high human use in these areas. Accordingly, it is uncertain whether the regional wolf population is self-sustaining and ecologically effective under existing conditions. Using a precautionary approach, a serious risk is identified for wolves within the RSA because the stability of the regional wolf population is unknown and there is limited documented use of wildlife corridors and habitat patches.

Predicted wolf habitat losses include 6.2 ha of used as available habitat in the ASP area; there is no selected habitat in the ASP area under existing conditions. In the adjacent corridor, under the scenario with human use of trails, there was an increase of 77.1 ha of strongly avoided habitat. Within the LSA, the scenario that considered human use of trails predicted 9.3 ha of selected habitat was unaffected although these was a conversion of 18.1 ha of used as available and 292.9 ha of somewhat avoided habitat into strongly avoided habitat. The change may be greater if the increased presence of humans is associated with unsanctioned trail building. The change in habitat quantity may have limited effect on the regional population given the paucity of wolf occurrence records south of the Bow River. Nonetheless, an increase in the amount of strongly avoided habitat in the LSA contributes to an incremental decline in ecological conditions for wolves in a portion of the RSA that already has poor suitability, which is likely attributable to existing levels of human use and development. As described above, this change adds to the already limited use of wildlife corridors and habitat patches south of the Bow River.

In the absence of mitigation, an increase in traffic volume associated with the Project during construction and operations may increase the number of wolf-vehicle collisions in the LSA and along local roads and highways, particularly those areas without wildlife fencing. The added mortality from wolf-vehicle collisions would decrease wolf survival in the RSA and contributes to a high environmental consequence.

Of the four wildlife VECs assessed, wolves demonstrate the strongest avoidance of human infrastructure in the RSA. Human-wolf conflict has not been a large concern in the Bow Valley historically; however, this may be changing (Section 5.3.5) as wolves have been observed more frequently near development and food habituation resulted in two wolves being destroyed in Banff National Park in 2016.

Habituation of wolves, although novel in the Bow Valley, has occurred elsewhere and negative human-wolf interactions are a result. Wolves become habituated when they use human food sources (e.g., garbage, livestock) and lose their fear of humans (Linnell et al. 2002). Some wolves without access to human food may also become increasingly bold because of repeated interactions with human that do not result in negative experiences for wolves (McNay 2002; Smith and Stahler 2003). Even though negative human-wolf interactions have been increasing in recent years in North America, there are only two recorded fatalities attributed to wolves behaving in a predatory manner in North America since 1950 (Linnell and Alleau 2016). One of those fatalities occurred in northern Saskatchewan in 2005. This incident appears to have been a predatory attack by a healthy but food-conditioned and habituated wolf (Geist 2007). Another similar attack occurred in the same area of northern Saskatchewan in 2016, although in that case the human that was attacked survived. However, seven habituated wolves in the area were destroyed after the attack. Where predatory attacks by wolves on humans do occur, most of these attacks are from wolves that have been habituated (Linnell et al. 2002). Problems resulting from habituated and food-conditioned wolves have been increasing in recent years in North America (Fritts et al. 2003); Linnell and Alleau 2016). Given the recent trends in the Bow Valley, the issue of wolf habituation and potential human-wolf conflict need to be considered for the Project.

Due to recent wolf activities within the Bow Valley, there is a potential for wolf habituation and an increase in negative human-wolf interactions. Consequences of wolf habituation or food conditioning would be high, as they present a mortality risk to humans, pets, and wolves, where wolves may be killed as a precautionary measure or after an attack. Accordingly, humans may lose tolerance for the presence of wolves following negative human-wolf interactions, which could increase conservation challenges in the region. Given the existing patterns of wolf use in wildlife corridors and habitat patches south of the Bow River, an increase in human-wolf conflict is considered possible. In 2019, a wolf attacked campers in their tent in the Bow Valley near Banff.

Unmitigated effects of the Project on wolves is predicted to be high because the Project would contribute incrementally to a serious risk already present under existing conditions, especially for habitat loss and movement, but also possibly with respect to negative human-wildlife interactions (Table 21). Additive sources of mortality caused by the removal of wolves implicated in negative human-wolf interactions or killed in traffic collisions would represent the most important Project effects given that the stability of the regional wolf population is not well understood.

Table 21: Unmitigated Risks of the Project on Wolves

Context	It is uncertain if wolves are self-sustaining and ecologically effective due to the limited use of wildlife corridors and habitat patches and the unknown level of stability of the regional wolf population. Using a precautionary approach, a serious risk is identified under existing conditions.		
Effect Category	**Environmental Criterion**	**Description**	**Environmental Consequence**
Quantity and Quality of Wildlife Habitat	Direction	Negative	High
	Magnitude	Small: Project area: No loss of selected habitat, and 6.2 ha of used as available habitat will be lost; Adjacent Corridor: 16.0 ha of used as available habitat lost and increase of 77.1 ha of strongly avoided habitat, contributing to an ongoing decline of ecological conditions for wolves in the region. Effects of habitat loss may be limited given the pattern of wolf detections in the LSA.	
	Geographic Extent	ASP area – clearing for Project infrastructure Local – effects of sensory disturbance Regional – effects associated with increased human use	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Likely	
Wildlife Use of Approved Corridors	Direction	Negative	High
	Magnitude	Small: loss of 12 ha of used as available habitat in wildlife corridors. Reduced habitat quality where human use increase.	
	Geographic Extent	Local – effects from sensory disturbance Regional – effects from increased human use	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Possible	

Table 21: Unmitigated Risks of the Project on Wolves

<table>
<tr><th>Context</th><td colspan="3">It is uncertain if wolves are self-sustaining and ecologically effective due to the limited use of wildlife corridors and habitat patches and the unknown level of stability of the regional wolf population. Using a precautionary approach, a serious risk is identified under existing conditions.</td></tr>
<tr><th>Effect Category</th><th>Environmental Criterion</th><th>Description</th><th>Environmental Consequence</th></tr>
<tr><td rowspan="7">Negative Human-Wildlife Interactions</td><td>Direction</td><td>Negative</td><td rowspan="7">High</td></tr>
<tr><td>Magnitude</td><td>Large: increased risk of food condition or habituation if garbage management is inadequate. Change could lead to increased risk of human-wolf conflict, including predatory attacks on humans and/or pets, and the destruction of wolves following conflict incidents. Increased risk of mortality from traffic collisions on local roads and highways.</td></tr>
<tr><td>Geographic Extent</td><td>Local – interactions with humans resulting in habituation and/or food conditioning; increased human use.
Regional – human-wolf conflict involving habituated or food conditioned wolves; lower tolerance to wolves and increased conservation challenges.</td></tr>
<tr><td>Duration</td><td>Long-term</td></tr>
<tr><td>Frequency</td><td>Continuous</td></tr>
<tr><td>Reversibility</td><td>Irreversible</td></tr>
<tr><td>Probability</td><td>Possible</td></tr>
</table>

ASP area = Project Study Area Boundary; LSA = Local Study Area.

5.4.5.4 Elk

The overall population trend for elk in the RSA is uncertain because elk in WMU 408 are likely declining under existing conditions (Boukall 2019, pers. comm.) but elk in WMU 410 are considered stable or increasing under existing conditions (Boukall 2019, pers. comm.). The RSA overlaps mostly with WMU 410. Landscape connectivity for elk is high within the RSA (Edwards 2013). Elk tend to be concentrated in the valley bottom as well as within Canmore (Appendix B, Figure B4) and frequently use wildlife corridors (Edwards 2013). Historical fire suppression within the Bow Valley has resulted in grasslands being uncommon and typically located within and near developed areas in the valley bottom. While much of these grasslands are anthropogenic, they still provide optimal habitat conditions with high quality forage with lower density of predators (Frair et al. 2005). This concentration of elk near anthropogenic developments where predators like wolves are scarce results in an overall decrease in mortality risk and increase in calf recruitment (Hebblewhite et al. 2005b). Due to high quality forage and minimal predators, the elk remain within and in proximity to anthropogenic landscapes year-round rather than conducting seasonal shifts (Edwards 2013). High densities of resident elk remaining in a small area results in higher rates and intensities of parasitic infections (Edwards 2013).

Although elk may be self-sustaining in the RSA under existing conditions, their natural ecological interactions have been substantially diminished (Section 5.3.6). A serious risk is identified for elk in the RSA under existing conditions because they do not function in their natural ecological role and are not considered ecologically effective. Despite the identification of a serious risk, elk in the RSA are not considered sensitive to the effects of habitat loss and sensory disturbance because they regularly use human-modified habitats and are highly habituated to humans (Section 5.3.6). Elk in the RSA are most sensitive to changes that would further reduce their ecological effectiveness (i.e., increased habituation). Such changes can pose a human safety risk when elk concentrate in urban areas where people are active, such as playgrounds, which commonly occurs in Canmore.

RSF models predict that elk habitat selection within the ASP area will remain largely unchanged with the application of the Project, although the amount of selected habitat will increase by approximately 15 ha and 5.7 ha will be converted to an anthropogenic waterbody. The amount of selected habitat within the wildlife corridors adjacent to the ASP is expected to increase by 97 ha with the addition of the Project relative to existing conditions. No habitat alteration is expected elsewhere in the LSA. Some areas of the LSA may be avoided temporarily during construction when humans and heavy equipment create more pronounced sensory disturbance. After construction, the changes to habitat quantity and quality are considered neutral because they are unlikely to result in measurable change to elk distribution or abundance in the LSA.

Elk use of wildlife corridor is unlikely to change because of the Project. The probability of elk selection is predicted to increase in some areas of the adjacent wildlife corridors near the ASP area (i.e., an increase of 96.6 ha of selected habitat). Overall, this change is predicted to have a neutral effect on elk use, distribution, and abundance within the wildlife corridors of the LSA.

Without mitigation, an increase in traffic volume associated with the Project during construction and operations may increase the number of elk-vehicle collisions in the LSA and along local roads and highways, particularly those areas without wildlife fencing. The added mortality from elk-vehicle collisions would decrease elk survival in the RSA and contribute to a high environmental consequence.

Under existing conditions, the ASP area is predicted to be selected by elk (Section 5.3.6) and there is an existing risk of human-elk conflict within or near the ASP area. Although the probability of elk presence is not expected to change substantially following Project development (i.e., an increase of 14.8 ha of selected habitat), the addition of residents and visitors will increase the probability of human-elk encounters in the LSA, which in turn will increase the chance for negative encounters. In addition, the Project could create conditions that encourage further habitation of elk (e.g., people feeding elk, landscaping with fruit trees and other palatable browse species). Without any mitigation, the Project could contribute incrementally to a decline in elk population’s ecological effectiveness by encouraging behaviours that are not typically associated with the species’ natural ecological role. Although this change may be small, it would add to a serious risk already present under existing conditions, and therefore constitute a high environmental consequence.

Unmitigated effects of the Project are anticipated to have a high environmental consequence for elk (Table 22) because of an incremental contribution to the population’s declining ecological effectiveness.

Table 22: Unmitigated Risks of the Project on Elk

Context	Elk in the RSA are not considered sensitive to the effects of habitat loss and sensory disturbance because they regularly use human-modified habitats and are highly habituated to humans. Elk may be self-sustaining in the RSA under existing conditions, but their natural ecological interactions have been substantially diminished. A serious risk is identified for elk under existing conditions because they do not function in their natural ecological role and are not considered ecologically effective.		
Effect Category	**Environmental Criterion**	**Description**	**Environmental Consequence**
Quantity and Quality of Wildlife Habitat	Direction	Neutral	Negligible
	Magnitude	Small: Conversion of 5.7 ha of selected habitat to an anthropogenic waterbody in the ASP area but an increase in the probability of selection over 96.6 ha elsewhere in the LSA.	
	Geographic Extent	ASP area – loss of habitat due to clearing and construction. Local – changes in habitat suitability associated with increased human use	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Likely	
Wildlife Use of Approved Corridors	Direction	Neutral	Negligible
	Magnitude	Small: conversion of 96.6 ha of used as available and avoided habitat to selected habitat within adjacent wildlife corridors.	
	Geographic Extent	Local	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Likely	
Negative Human-Wildlife Interactions	Direction	Neutral	High
	Magnitude	Small: increase in the risk of further elk habituation, and increased probability for negative human-elk encounters by adding more people in areas used by elk. Project adds incrementally to the serious risk present under existing conditions: elk are already habituated, and negative human-elk interactions are already of concern. Increased risk of mortality from traffic collisions on local roads and highways.	
	Geographic Extent	Local	
	Duration	Long-term	
	Frequency	Continuous	
	Reversibility	Irreversible	
	Probability	Possible	

ASP area = Project Study Area Boundary; RSA = Regional Study Area; LSA = Local Study Area.

5.4.5.5 Other Species/Species at Risk

Other non-VEC wildlife species may be affected by the Project, including some species at risk. Without mitigation, environmental risks would involve:

- Direct mortality of individuals, specifically from clearing of vegetation, construction activities, and vehicle strikes. These effects are most likely to occur in species that have limited mobility or whose danger response is to remain still, including young animals, small mammals, birds and amphibians.
- Loss of habitat quantity and quality.
- Reduction in wildlife use of approved wildlife corridors. This pathway is applicable to medium and large bodied mammals for which wildlife corridors have been designated.

Large and medium bodied mammals

Within the large and medium bodied mammals, three species at risk are identified as potentially present in the RSA (Appendix C):

- Canada lynx (*Lynx canadensis*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Between 2009 and 2016, only two Canada lynx detections were recorded by remote cameras near the LSA. Both detections were in coniferous forest. The presence of lynx in the ASP area is considered unlikely. Loss of coniferous forest in the ASP area would represent a loss of potential lynx habitat; however, the amount of habitat change is considered small relative to the availability of these forested habitats elsewhere in the RSA. Given that lynx was not detected in wildlife corridors inside the LSA, it is unlikely that Project development activities adjacent to corridors will influence their use by lynx. Lynx are unlikely to be affected by direct mortality events because they are a highly mobile. Individuals should be able to avoid interacting with vehicles and machinery during construction, and residential traffic during operations.
- Fisher (*Martes pennanti*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Between 2009 and 2016 no fishers were detected by remote cameras despite the high monitoring effort (Section 5.2.1). Fisher are unlikely to occur in the LSA or the ASP area. Accordingly, loss of potential habitat (forested areas), changes in wildlife corridor use, and increased risk of vehicle collisions are unlikely to affect fisher.
- Wolverine (*Gulo gulo*) – provincially listed as 'May be At Risk' (AEP 2018) and federally listed as 'Special Concern' on *Species at Risk Act* (SARA) Schedule 1 (Government of Canada 2019). Between 2009 and 2016 no wolverine were detected by remote cameras despite the high monitoring effort (Section 5.2.1). Further, wolverine are considered sensitive to anthropogenic disturbance and avoid areas used by humans (COSEWIC 2014). Wolverine are unlikely to occur in the LSA or the ASP area. Accordingly, loss of potential habitat (forested areas), changes in wildlife corridor use, and increased risk of vehicle collisions are unlikely to affect wolverine.

Available information suggests that the Project will have neutral effects on Canada lynx, fisher, and wolverine. Even without mitigation, the Project effects are expected to have a negligible environmental consequence for these species (Table 23). Other non-listed carnivores and ungulates that occupy that LSA could be affected by the Project. There would be a measurable loss of habitat, which would be most important for species associated with treed land cover types, in particular closed pine stands. Use of wildlife corridors could decline measurably, particularly for species that tend to avoid humans. Overall, changes to habitat availability and corridor use are predicted to be small in magnitude, and similar to those previously described for grizzly bears, cougars, wolves and elk. Lastly, this species group has limited vulnerability to direct mortality sources owing to their high mobility. Environmental consequence is predicted to be low (Table 23).

Table 23: Unmitigated Risks of the Project on Other Wildlife Species and Species at Risk

Large and Medium Bodied Mammals			
Context	Large and medium bodied mammals have large home ranges/territories and generally have lower reproductive output. This group is sensitive to the effects of habitat fragmentation and changes in survival. Three carnivore species at risk are included within this group.		
Effect Category	**Environmental Criterion**	**Description**	**Environmental Consequence**
Habitat Loss, Reduced use of Wildlife Corridors and Wildlife Mortality	Direction	negative/neutral	Negligible - Canada lynx, fisher, and wolverine Low – other non-listed species occurring in the LSA
	Magnitude	**Species at risk** – ASP area and adjacent areas in LSA are unlikely occupied so effects are neutral. **Non-listed species** – measurable loss of habitat and measurable reduction in wildlife corridor use. No measurable change in mortality risk. Magnitude is considered small.	
	Geographic Extent	Local	
	Duration	Long-term	
	Frequency	Once – clearing for Project infrastructure Continuous – sensory disturbance, risk of vehicle collisions	
	Reversibility	Irreversible	
	Probability	Likely	
Small Mammals and Bats			
Context	Most small mammal species have relatively small home-ranges and a high reproductive capability, meaning that populations can recover quickly from losses. Three bat species at risk may occur in the ASP area and are most sensitive to mortality events and loss of overwintering habitat.		
Effect Category	**Environmental Criterion**	**Description**	**Environmental Consequence**
Habitat Loss and Wildlife Mortality	Direction	Negative	Moderate (bat species at risk) Low (other small mammals)
	Magnitude	**Bats (species at risk)** – measurable loss in roosting and foraging habitat. Mortality of individuals during the maternity roosting period, resulting in a measurable decline in survival and reproductive output. Magnitude of change considered medium. **Other small mammals (not at risk)**: measurable loss in habitat availability representing a small magnitude of change within the RSA. Incremental increase in mortality risk during vegetation clearing and construction, particularly for species that burrow. Incremental increase in mortality risk as a result of vehicle collisions. Magnitude of change considered small.	
	Geographic Extent	ASP area	
	Duration	Short-term (mortality from vegetation clearing, construction) and long-term (habitat loss and vehicle collisions)	
	Frequency	Once – clearing for Project infrastructure Continuous – risk of vehicle collisions	
	Reversibility	Irreversible	
	Probability	Likely	

Table 23: Unmitigated Risks of the Project on Other Wildlife Species and Species at Risk

<table>
<tr><th colspan="4">Birds</th></tr>
<tr><th>Context</th><td colspan="3">Mortality during the breeding season represents a large energetic loss as well as decrease in recruitment. Many songbird species have experienced declining population trends. Taxonomic group includes 15 species at risk that could occur in the ASP area, including songbirds, raptors, and a woodpecker.</td></tr>
<tr><th>Effect Category</th><th>Environmental Criterion</th><th>Description</th><th>Environmental Consequence</th></tr>
<tr><td rowspan="7">Habitat Loss and Wildlife Mortality</td><td>Direction</td><td>Negative</td><td rowspan="7">High</td></tr>
<tr><td>Magnitude</td><td>Large – direct loss of active nests during clearing activities. Sensory disturbances could cause adults to abandon their nests, forcing them to rebuild late in the breeding season or resulting in loss of eggs or chicks. Changes lead to a measurable reduction in survival and reproductive output. Small but measurable reduction in amount of breeding habitat, particularly for species associated with coniferous stands.</td></tr>
<tr><td>Geographic Extent</td><td>ASP area.</td></tr>
<tr><td>Duration</td><td>Short-term</td></tr>
<tr><td>Frequency</td><td>Once – clearing for Project infrastructure</td></tr>
<tr><td>Reversibility</td><td>Irreversible</td></tr>
<tr><td>Probability</td><td>Likely</td></tr>
<tr><th colspan="4">Amphibians</th></tr>
<tr><th>Context</th><td colspan="3">Population status of many amphibian species within the RSA are unknown. Critically important habitat can be threatened when breeding waterbodies are destroyed, drained, or disturbed. Certain species (e.g., western toad) may also aggregate seasonally while on land, making them vulnerable to mass vehicle-strike mortality or mortality from earthworks</td></tr>
<tr><th>Effect Category</th><th>Environmental Criterion</th><th>Description</th><th>Environmental Consequence</th></tr>
<tr><td rowspan="7">Habitat Loss and Wildlife Mortality</td><td>Direction</td><td>Negative</td><td rowspan="7">Moderate</td></tr>
<tr><td>Magnitude</td><td>Medium – risk of loss for wetlands within the Project footprint. Without mitigation known breeding ponds for western toad could be notably degraded through sedimentation or change in local watershed regimes, resulting in further loss of breeding habitat. These changes could also affect breeding habitat of other amphibian species. During terrestrial life phase amphibians, particularly western toad, may experience mass mortality from construction activities and vehicle strikes</td></tr>
<tr><td>Geographic Extent</td><td>Project footprint</td></tr>
<tr><td>Duration</td><td>Short-term (vegetation clearing) and long-term (vehicle collisions)</td></tr>
<tr><td>Frequency</td><td>Once – clearing for Project infrastructure
Continuous – risk of vehicle strikes</td></tr>
<tr><td>Reversibility</td><td>Irreversible</td></tr>
<tr><td>Probability</td><td>Likely</td></tr>
</table>

Table 23: Unmitigated Risks of the Project on Other Wildlife Species and Species at Risk

Reptiles			
Context	Two garter snake species are known from the region, both are provincially listed as 'Sensitive'. Snakes have a relatively high reproductive output. Garter snakes are habitat generalists and can tolerate low to moderate levels of human disturbance, indicating some adaptability to habitat loss. Are very sensitive to loss of hibernacula and populations near busy roads are vulnerable to road mortalities.		
Effects Category	**Environmental Criterion**	**Description**	**Environmental Consequence**
Loss of habitat and wildlife mortality	Direction	Negative	Moderate
	Magnitude	Medium to large – magnitude of change is dependent on whether hibernaculum is affected, in which case a large measurable decline in the local population would result. Project is expected to cause a small, incremental decrease in habitat quantity; however, suitable habitat would remain widespread across the region.	
	Geographic Extent	ASP area	
	Duration	Short-term (vegetation clearing) and long-term (vehicle collisions)	
	Frequency	Once – clearing for Project infrastructure Continuous – risk of vehicle strikes	
	Reversibility	Irreversible	
	Probability	Likely	

ASP area = Project Study Area Boundary; LSA = Local Study Area.

Small mammals and bats

Seven small mammal species at risk are identified as potentially present in the RSA (Appendix C):

- **long-tailed weasel** (*Mustela frenata*) - provincially listed as 'May be At Risk' (AEP 2018) but holds no federal status. Ecology of the species not well understood (Hornbeck and Soprovich 2013) but is believed to be an ecotonal species inhabiting areas in proximity to free-standing water (Gamble 1982). Provincial distribution coincides mainly with the black soil zone, with some occurrences in the brown and grey soil zones and at the edge of the Rocky Mountains range (Proulx and Drescher 1993). Species occurs in semi-urban areas, rural and agricultural areas, grasslands, parklands, the foothills of the Rocky Mountains, and montane forests (Smith 1993). It has been trapped near a reservoir in southwestern Alberta, including in a riparian zone, native pasture, dense non-native grassland at the edge of heavily grazed pasture, and in native grassland/shrub with a mixture of agronomic species (Hornbeck and Soprovich 2013). Long-tailed weasel is unlikely to occur in the ASP area.

- **hoary bat** (*Lasiurus cinereus*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Long-distant migrant present in summer only (WCS 2018). Roosts in the foliage of deciduous and coniferous trees and forages in open areas along forest edges (WCS 2018). Hoary bat occurrence in ASP area has not been determined but possible because it is within the species' range.

- **little brown myotis** (*Myotis lucifugus*) – provincially listed as 'May be At Risk' (AEP 2018) and federally listed as 'Endangered' on SARA schedule 1 (Government of Canada 2019). Roosts in trees of mature forest and man-made structures; forages in open habitats such as ponds, roads, open canopy forests; and overwinters in caves, abandoned mines, wells and tunnels (ECCC 2018a). Species is limited by mortality from white-nose syndrome (ECCC 2018a). Little brown myotis occurrence in ASP area has not been determined but possible because it is within the species' range.
- **northern long-eared myotis** (*Myotis septentrionalis*) – provincially listed as 'May be At Risk' (AEP 2018) and federally listed as 'Endangered' on SARA schedule 1 (Government of Canada 2019). Roosts in trees of mature forest and less commonly in man-made structures; forages within forests and along forest edges; and overwinters in in caves, abandoned mines, wells and tunnels (ECCC 2018a). Species is limited by mortality from white-nose syndrome (ECCC 2018a). Northern long-eared myotis occurrence in ASP area undetermined but possible because it is within the species' range.
- **silver-haired bat** (*Lasionycteris noctivagans*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Roosting occurs in decaying, large diameter trees, mostly deciduous trees. Forages above wetlands, high in canopy and along forest edges (WCS 2018). Silver-haired bat occurrence in ASP area is unlikely.
- **wandering shrew** / **vagrant shrew** (*Sorex vagrans*) – provincially listed as 'May be At Risk' (AEP 2018) but holds no federal status. Species is extremely rare, with the population including an estimate of fewer than 100 breeding individuals (AEP 2018). Species is known from only seven verified records in the West Castle area (AEP 2018). Wandering shrew is unlikely to occur in the ASP area.
- **water vole** (*Microtus richardsoni*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Prefers subalpine and alpine meadows close to water (Cassola 2016). Water vole is unlikely to occur in the ASP area.

For species at risk that could occur in the LSA or in the ASP area (i.e., hoary bat, little brown myotis, and northern long-eared myotis), mortality of females and young is likely to occur if vegetation clearing occurs in summer. In addition to the loss of roosting habitat, some loss of foraging habitat will likely occur. There are no known overwintering sites in the LSA. Additive sources of mortality during the breeding period are considered particularly detrimental to the survival and reproductive output of populations in the RSA. Without mitigation, potential effects from the Project would have a moderate environmental consequence for listed bat species (Table 22).

The Project will affect other non-listed small mammals (i.e., rodents, hares, and bats) with measurable losses of habitat and an incremental increase in mortality risk within the ASP area. Mortality risk will be highest during Project construction, and for species that burrow underground (i.e., are more likely to be disturbed, injured or killed during earthworks). The higher level of traffic associated with residents and visitors during operation will increase mortality risk for small mammals. The risk during operations will be highest for species that are active at night and those that regularly occur in anthropogenic habitats. Although losses of habitat and increased mortality are expected to be measurable, these changes will have limited effects on regional populations because the proportion of habitat loss in the RSA is expected to be small and small mammals can recover quickly from mortality events due to their high reproductive output. Without mitigation, potential effects from the Project would have a low environmental consequence for non-listed small mammal species (Table 23).

Birds

Thirty-seven (37) bird species at risk have been identified as potentially occurring in the RSA (Appendix C). These include:

- Eight species that are unlikely to occur in the ASP area owing to their association with open water or wetlands (i.e., ducks, swans, grebes, herons, terns, and rusty blackbird [*Euphagus carolinus*]). Wetland habitat occurs within the ASP area and may provide habitat for these species.
- Fourteen (14) species that are uncommonly found in the Canmore area or are considered uncommon breeders in the region, including golden eagle (*Aquila chrysaetos*), northern goshawk (*Accipiter gentilis*), sandhill crane (*Grus canadensis*), barred owl (*Strix varia*), great gray owl (*Strix nebulosa*), northern pygmy-owl (*Glaucidium gnoma*), black swift (*Cypseloides niger),* black-backed woodpecker (*Picoides arcticus*), American kestrel (*Falco sparverius*), peregrine falcon (*Falco peregrinus anatum),* prairie falcon (*Falco mexicanus*), eastern phoebe (*Sayornis phoebe*), olive-sided flycatcher (*Contopus cooperi*), and evening grosbeak (*Coccothraustes vespertinus*). These species are unlikely to occur in the ASP area and are therefore not expected to be affected by Project activities.
- Two raptor species that commonly breed in the Canmore area:
  - Bald eagle (*Haliaeetus leucocephalus*) – provincially listed as 'Sensitive' (AEP 2018) and considered 'Not at Risk' by COSEWIC (Government of Canada 2019). Associated with large lakes and ponds, rivers, and open areas and nests in large trees bordering watercourses and waterbodies (Fisher and Acorn 1998). Habitat in ASP area is inadequate to support regular bald eagle occurrence.
  - Osprey (*Pandion haliaetus*) – provincially listed as 'Sensitive' but holds no federal status. Occurs near lakes and slow-flowing rivers and streams and nests in treetops, utility poles and transmission towers (Fisher and Acorn 1998). Habitat in ASP area is inadequate to support regular osprey occurrence.
- Twelve (12) passerine species that commonly breed in the Canmore area:
  - Alder flycatcher (*Empidonax alnorum*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Occurs along edges of wet areas in willows and birch thickets, muskeg edges and in streamside vegetation (Fisher and Corn 1998). There is limited suitable habitat in the ASP area to support species occurrence.
  - Eastern kingbird (*Tyrannus tyrannus*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Occurs in open areas with willow and birch, agricultural areas, and riparian areas. Presence in ASP area is not confirmed but suitable habitat exists.
  - Least flycatcher (*Empidonax minimus*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Occurs in aspen forests and alder and willow thickets (Fisher and Acorn 1998). Presence in ASP area is not confirmed but suitable habitat exists.
  - Western wood-pewee (*Contopus sordidulus*) – provincially listed as 'May be At Risk' (AEP 2018) but holds no federal status. Occurs in open woodlands, deciduous forest, ponderosa pine forest, and riparian forest (Fisher and Acorn 1998). Presence in ASP area not confirmed but suitable habitat exists.

  - Clark's nutcracker (*Nucifraga columbiana*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Occurs in open coniferous forest, open mixed-wood forest, scenic overlooks, krummholz forest, and townsites (Fisher and Acorn 1998) and is dependent on pines and Douglas fir for their seeds as sources of food (Tomback 1998). Presence in ASP area has not been confirmed but suitable habitat exists.
  - Bank swallow (*Riparia riparia*) – provincially listed as 'Sensitive' (AEP 2018) and federally listed as 'Threatened on SARA Schedule 1 (Government of Canada 2019). Occurs along steep banks, lakeshores, and open areas (Fisher and Acorn 1998). Bank swallows are colonial nesting birds that nest in burrows of earthen banks (Fisher and Acorn 1998). It is unknown whether there is suitable habitat in the ASP area to support regular bank swallow occurrence.
  - Barn swallow (*Hirundo rustica*) – provincially listed as 'Sensitive' (AEP 2018) and federally listed as 'Threatened on SARA Schedule 1 (Government of Canada 2019). Occurs near rivers, lakes and marshes and is commonly associated with man-made structures such as bridges, culverts and buildings (Fisher and Acorn 1998). Habitat in ASP area unlikely to support regular barn swallow occurrence.
  - Brown creeper (*Certhia americana*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Primarily associated with coniferous forests, including spruce, pine and fir forests (Fisher and Acorn 1998). Habitat present in ASP area and presence of brown creeper is possible.
  - Common yellowthroat (*Geothlypis trichas*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Occurs in wetter habitats such as cattail marshes, riparian willow and alder clumps, sedge wetlands and beaver ponds (Fisher and Acorn 1998). There is limited suitable habitat in the ASP area.
  - Brewer's sparrow (*Spizella breweri*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Prefers meadows containing thickets of willow and dwarf birch (FAN 2007). There is limited suitable habitat in the ASP area to support species occurrence.
  - Western tanager (*Piranga ludoviciana*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Occurs in mature coniferous forest, mature mixed-wood forest, and aspen woodlands (Fisher and Acorn 1998). Habitat is present in ASP area and the presence of western tanager is possible.
  - Baltimore oriole (*Icterus galbula*) – provincially listed as 'Sensitive' (AEP 2018) but holds no federal status. Occurs in deciduous forest, riparian forest, and mixed-wood forest (Fisher and Acorn 1998). Habitat is present in ASP area and the presence of Baltimore oriole is possible.
- One woodpecker species, pileated woodpecker (*Dryocopus pileatus*), that commonly breeds in the Canmore area. Listed provincially as 'Sensitive' and holds no federal status. Occurs in mature coniferous forest and mature mixed-wood forest, with a preference for dead and dying trees (Fisher and Acorn 1998). Habitat present in ASP area and presence of pileated woodpecker is likely.

Bird species at risk and other non-listed birds that occupy that LSA and ASP area could be affected by the Project. The most important effect would be the destruction of active nests during site clearing and construction. Further, sensory disturbance (e.g., noise, human presence) during the nesting period could incite adults to abandon their nests, forcing them to rebuild late in the breeding season or resulting in loss of eggs or chicks. Together, these effects would cause measurable changes in bird survival and reproductive success. Species at risk are particularly vulnerable to changes in survival and reproduction because their populations have already suffered declines. The Project is likely to cause measurable losses of nesting habitat for species that occupy the ASP area, in particular for species associated with coniferous forest stands such as closed pine spruce stands).

The magnitude of change to habitat quantity and quality is likely to be small, relative to the availability of these same habitats in the RSA; however, the magnitude of change to survival and reproduction would be high. Given the sensitivity of birds to mortality events during the nesting period and the likely occurrence of species at risk, the environmental consequence without mitigation is predicted to be high (Table 23).

Amphibians

Four amphibian species at risk are known from the RSA, including:

- Columbia spotted frog (*Rana luteiventris*) – listed provincially as ‘Sensitive’ (AEP 2018) but holds no federal status. Associated with permanent water sources, including slow moving streams, rivers, marshes, springs, pools and the margins of small lakes, typically with abundant aquatic vegetation (James 1998). Limited habitat available in the ASP area.
- Western toad (*Anaxyrus boreas*) – provincially listed as ‘Sensitive’ (AEP 2018) and listed as ‘Special Concern’ on SARA Schedule 1 (Government of Canada 2019). Uses a variety of aquatic and terrestrial habitats. Western toad breed in wetlands, including shallow sandy margins of lakes, ponds, streams, river deltas, river backwaters, river estuaries, and geothermal springs (COSEWIC 2012b). Adults disperse to other wetlands or terrestrial habitats following breeding, and toads overwinter underground in spaces created by small mammals (COSEWIC 2012b). Presence of western toad has been confirmed in the LSA and ASP area.
- Long-toed salamander (*Ambystoma–macrodactylum*) - listed provincially as ‘Sensitive’ (AEP 2018) but holds no federal status. Breeding habitat includes lakes and ponds, often in large and shallow lakes with boggy edges and abundant aquatic vegetation (Graham and Powell 1999). Long-toed salamander habitat is present in the Project area, at a wetland commonly known as Carex Meadows (Figure 62, wetland 9N).
- Tiger salamander (*Ambystoma mavortium*) – holds no provincial status but is listed as ‘Special Concern’ by COSEWIC (Government of Canada 2019). Occurs in a variety of open habitats with key habitat features being sandy or crumbly soils surrounding semi-permanent to permanent waterbodies without predatory fish (COSEWIC 2012c). Over-winter in burrows it creates or uses those of small mammals (COSEWIC 2012c). Occurrence is unknown; there is limited habitat available in the ASP area.

A minimum of 0.1 ha of wetlands will be directly removed (Table 43), which could represent the potential loss of amphibian breeding habitat. Without mitigation, known breeding ponds for western toad could be notably degraded through sedimentation or through changes in local watershed regimes, resulting in further loss of breeding habitat. These changes could also affect breeding habitat of other amphibian species. During their terrestrial life phase some amphibians, particularly western toad, may experience mass mortality from construction activities and vehicle strikes. These effects are difficult to quantify because the location of terrestrial overwintering sites (i.e., hibernacula) are not known. Without mitigation, the changes described correspond to a medium magnitude of effects, and a moderate environmental consequence is predicted (Table 23).

Reptiles

Two reptile species at risk have been recorded in the RSA, including:

- Red-sided garter snake (*Thamnophis sirtalis*) - listed provincially as 'Sensitive' (AEP 2018) but holds no federal status. During the active season, red garter snakes are habitat generalists occupying forests, shrublands, wetlands, fields and rocky areas (CHS 2017a). Red-sided garter snake overwinter in large groups within hibernacula. Hibernacula are located underground below the frost line, including tree roots, shale cliffs, rock piles, animal burrows, rock outcrops, pits, fissures, crevices, sinkholes, and anthropogenic structures (CHS 2017a; Takats 2002). Hibernacula are limiting on the landscape. Location of potential hibernacula in the LSA are not known and presence of red-sided garter snake is uncertain.
- Wandering garter snake (*Thamnophis elegans*) - listed provincially as 'Sensitive' (AEP 2018) but holds no federal status. The species is a habitat generalist occupying lowlands, rocky hillsides, grasslands, woodlands, forest clearings and wetlands as well as near streams, rivers and ponds (CHS 2017b). It typically occurs in areas with vegetation. In winter, hibernacula include mammal burrows, rock crevices, talus slopes and anthropogenic structures (CHS 2017b). Location of potential hibernacula in the LSA are not known and presence of wandering garter snake is uncertain.

Because snakes overwinter communally in large groups, they are vulnerable to mass mortality events if hibernacula are destroyed or disturbed (e.g., flooding or freezing) (CHS 2017a). Earthworks associated with construction could disturb hibernacula if these activities occur during the denning period. The likelihood of this disturbance is uncertain because the presence and location of hibernacula in the LSA are not known, and earthworks are unlikely to occur under frozen ground conditions.

Garter snakes are sensitive to road mortality, in particular during the period of emergence and dispersal from hibernacula when snakes move over longer distances and are more likely to cross roads (CHS 2017a). Populations with hibernacula near busy roads are particularly sensitive to road mortality because large numbers of individuals are likely to cross high risk areas. The occurrence of hibernacula within or in proximity to the ASP area is not known.

Garter snakes are habitat generalists and are therefore considered somewhat adaptable to habitat loss. Furthermore, both red garter snake and wandering garter snake are able to persist in areas with low to moderate human disturbance (CHS 2017a, b). Loss of potential habitat would represent a small magnitude change relative to the availability of habitat in the RSA.

Project effects could cause a medium to large magnitude of change in the snake population, depending on whether or not a hibernaculum is affected. Without mitigation, potential effects from the Project would have a moderate environmental consequence for reptiles (Table 23).

5.5 Wildlife Relevant Legislation and Guidelines

Federal legislation and guidelines intended to protect wildlife and that are relevant to the Project include:

- the *Migratory Birds Convention Act*, which prohibits mortality of migratory birds or damaging their nests or eggs
- the *Species at Risk Act* (SARA), which prohibits killing, harming, or harassing species listed on Schedule 1, damaging or destroying the residence (e.g., nest or den) of individuals of a species listed as endangered or threatened, and damaging critical habitat as defined in a recovery plan

Provincial legislation and guidelines intended to protect wildlife and that are relevant to the Project include:

- the *Wildlife Act*, under which protective measures for wildlife may be established
- the *Alberta Wetland Policy*, which promotes the conservation, restoration and protection of Alberta's wetlands to sustain the benefits they provide to the environment, society and economy
- the *Alberta Wetland Mitigation Directive*, which provides guidelines to limit adverse effects on wetlands and details wetland replacement requirements when permanent disturbance cannot be avoided.
- the *South Saskatchewan Regional Plan*, which provides high level guidance regarding biodiversity in the South Saskatchewan River basin
- the 1992 NRCB Three Sisters decision, which has specific requirements for wildlife associated with development on TSMV property (e.g., wildlife corridors)
- the 2015 Three Sisters Mountain Village Construction Management Guidelines, which provides guidelines related to the protection of the environment including wildlife and wildlife habitat
- the 2020 Alberta Environment and Parks Decision on TSMV's Smith Creek Wildlife Corridor Application
- the Town of Canmore Construction Management Plan (CMP) Guidelines (*rev-03-2018*), which provides guidance to developers and builders for the preparation of a CMP
- Stepping Back from the Water: A Beneficial Management Practices Guide for New Development Near Water Bodies in Alberta's Settled Region (AESRD 2012)

5.6 Wildlife Mitigation

Mitigation measures to avoid or reduce effects associated with each category of environmental risk identified for the Project are recommended in this section. As part of TSMV's overall mitigation strategy, monitoring and adaptive management will be applied to address areas of uncertainty and confirm the efficacy of specific mitigation measures. Environmental management plans will be developed prior to Conceptual Scheme approval.

5.6.1 Wildlife Mortality Caused by Site Clearing and Construction

Mitigation measures to avoid or reduce direct mortality during site clearing and construction include:

- Avoiding clearing during potential mortality periods, such as the migratory bird nesting period, where possible (the Project is within Environment and Climate Change Canada's migratory bird nesting zone A4, but is close to zone A3, which, to be precautionary, suggests a Restricted Activity Period of April 11 to August 23 [ECCC 2018b]). Nests sweep surveys should be conducted prior to any clearing activity scheduled between March 1 and April 30 to help protect active owl nests (ESRD 2013), as required by the Alberta *Wildlife Act* (Government of Alberta 2000a, b).

- Conducting a pre-construction survey to identify the location of any sensitive wildlife features (e.g., active nest sites, dens, hibernacula) if site clearing occurs during the Restricted Activity Period for migratory birds or within other critical time periods defined in the *Master Schedule of Standards and Conditions* (Government of Alberta 2018a). In addition, pre-construction surveys will specifically target amphibians and reptiles to document the occurrence of species at risk and sensitive features such as breeding ponds or hibernacula. If sensitive features are detected, implement appropriate measures to reduce potential effects (e.g., delay construction until migratory bird nesting is complete).
- Keeping all construction equipment out of wetlands and riparian areas. Follow up work to confirm that wetlands have been appropriately avoided in compliance with the Alberta Wetland Policy should occur at the subdivision stage.
- Implementing erosion and siltation control measures as stated in Section 5.15 in the vicinity of wetlands and riparian areas.
- Traffic control measures (e.g., speed limits below 50 kilometres per hour) to reduce the risk of vehicle collisions with wildlife.
- Continued implementation of *TSMV Construction Management Guidelines* (March 20, 2015 Version 2.5).

Some small mammal mortality may occur during construction, but large mammals are generally expected to avoid construction activities and lower vehicular speed limits can reduce mortality rates for these animals (Found and Boyce 2011; Neumann et al. 2012). Mortality of particularly susceptible wildlife such as nesting birds and denning bears will be avoided by clearing at appropriate times or by conducting pre-clearing surveys, and subsequently avoiding active nests and dens. Timing restrictions applied to avoid disturbing active migratory bird nests also benefit tree roosting bats. Specifically, the Restricted Activity Period (RAP) of April 11 to August 23 coincides with the bat maternity roosting period, meaning that Project activities will be planned to avoid disturbing female bats and their young during the most sensitive time.

Amphibian mortality will be predominantly avoided by avoiding development in wetlands or riparian areas, to the extent feasible, and keeping construction equipment out of these areas. Western toads have a terrestrial life phase in which they will be vulnerable to effects by construction activities outside of wetlands (ECCC 2016), and some mortality may be unavoidable. However, given that most earthworks and digging will coincide with the frost-free period, there will be limited temporal overlap between the western toad hibernation period, which reduces the likelihood that Project activities will disturb toads when they are most vulnerable (i.e., during hibernating). Silt fencing may be used to discourage or prevent toad dispersal from breeding ponds into active construction areas. Should development occur in wetlands, the requirements of SARA and the Alberta Wetland Policy must be met, and losses compensated for.

The mitigation measures identified in this section, with a strong focus on avoidance, represent application of due diligence to meet requirements of the *Migratory Birds Convention Act*, SARA and the Alberta *Wildlife Act*.

Because of uncertainty about development footprint location at the ASP stage, follow up work to confirm that wetlands have been appropriately avoided or compensated for in compliance with the Alberta Wetland Policy should occur at the subdivision stage. Similarly, follow up work in the form of pre-clearing surveys will be required for any vegetation clearing activities that are proposed during the migratory bird nesting window; clearing must be delayed if nesting birds are detected.

5.6.2 Quantity and Quality of Wildlife Habitat within the ASP Area

The 1992 NRCB approval accepted that wildlife habitat loss would occur as the result of the development of TSMV. The NRCB also recognized that there were opportunities to avoid developing on particularly sensitive wildlife habitats and to limit other kinds of effects on ESAs. Mitigation measures to avoid or reduce adverse effects of the Project on wildlife habitat quantity and quality include:

- restricting construction schedule to daylight hours to facilitate wildlife use of adjacent habitats, especially adjacent to wildlife corridors or habitat patches at dawn, dusk and overnight
- delineating the designated construction zone boundary and instructing construction personnel to stay within the boundary
- training for employees and contractors to confirm personal awareness of key issues for wildlife and stewardship responsibility while working in the area (e.g., identify opportunities to limit noise and other forms of sensory disturbance)
- avoiding wetlands and riparian areas within the ASP, where possible, through the creation of green space designations and compensating for wetland loss were avoidance is not possible (Sections 3.0 and 5.15)
- continued implementation of *TSMV Construction Management Guidelines* (March 20, 2015 Version 2.5)

Lighting will be in accordance with Town bylaw 2018-22 (Section 2.10). The negative effects of lighting may be reduced through the following mitigations measures:

- use of shielded directional lighting to reduce sensory disturbance effects on wildlife and to limit sky glow (aka light pollution)
- where possible, vegetation is left intact around Project infrastructure to act as a natural screen so that light only affects targeted area
- keep lighting to the minimum required to confirm safety
- illuminate areas only when they are in use (e.g., place timers or motion sensors on lights)
- use of temporary lighting to support construction activities or other short-term tasks (e.g., truck mounted job lights use to illuminate work areas)
- illuminate exterior signs from the top
- use lowest possible light levels to achieve objectives such as safety, security, access, wayfinding, identification and aesthetics

Although outside the scope of the developer’s direct influence, a mitigation measure that could be considered by the Town, the Municipal District (MD) of Bighorn, and the Province is off-site wildlife habitat improvements. Habitat improvements can also be associated with wildfire control efforts (e.g., clearing forested areas to create fire breaks) in wildlife corridors and other habitats adjacent to the ASP area. For example, clearing that creates early seral habitats would help compensate for adverse effects of habitat loss to these habitats within the ASP area, and simultaneously meet FireSmart objectives (e.g., Town of Canmore 2018). Modelling that simulated habitat enhancements consistent with these objectives in the Along Valley Corridor identified increased habitat suitability for grizzly bears, wolves, cougars, and elk (Golder 2012). This approach has been supported by the province in recent wildlife corridor decisions (AEP 2020).

5.6.3 Wildlife Use of Approved Corridors and Negative Human-Wildlife Interactions

Mitigation measures to avoid or limit adverse effects of the Project on the efficacy of wildlife corridors adjacent to the ASP area and on the potential for increased negative human-wildlife interactions overlap substantially and include:

- Erecting wildlife fencing along the perimeter of the ASP area and around other TSMV developments with public access points only at provincially designated trails through the wildlife corridors to limit the potential for ungulates and carnivores to enter developed areas and reduce trail proliferation and off-leash dog use in wildlife corridors (Section 5.6.4). Fencing will also include access to the corridor at utility maintenance access points, or other rights or way.
- Using gates with signs at the entrance to wildlife corridors to improve user awareness of wildlife corridors and present maps of designated trails through the corridors. TSMV has a memorandum of understanding (MOU) with the Canmore and Area Mountain Bike Association (CAMBA), which outlines a framework for the development, construction and maintenance of mountain bike trails on TSMV property (CAMBA and TSMV 2018). Short-term objectives of the MOU include installing signage and discouraging unsanctioned trail building and use.
- Reduce the negative effects of lighting in accordance with Town bylaw 2018-22 (Section 2.10) (Construction: Developer and Builder).
- Designing residential lots immediately adjacent to wildlife corridors to incorporate outdoor spaces with minimal exterior lighting (see previous section regarding lighting mitigations) to reduce sensory disturbance in the corridors (only effective with a fence, otherwise could encourage wildlife to enter development).
- Minimize wildlife attractants in accordance with Town Bylaws 2017-10 (Wildlife Attractant Bylaw) and 2016-11 (Recyclables and Waste Disposal Bylaw) to limit potential negative human-wildlife interactions, including:
  - animal attractants such as berry-producing shrubs (e.g., buffaloberry), and understory and/or overstorey vegetation will be cleared in certain areas to reduce potential for human-bear interaction, where possible
  - on-site landscaping will be completed using only non-palatable plant species
  - no fruit trees, gardens, or outside composting
  - all garbage collection containers must be bear-proof
  - barbeques be stored in a secure location when not in use
  - no bird feeders
- Planning a trail system inside the ASP area that will provide users with an enjoyable and effective alternative to use of trails in the corridor while connecting to existing provincially designated trails, where appropriate, through the corridor. Through it's MOU with CAMBA, TSMV has agreed to establishing a process by which CAMBA and its selected partners (e.g., Canmore Trail Alliance) can maintain and adjust an integrated trail system that contributes to a vibrant, active Canmore (CAMBA and TSMV 2018).
- Providing educational materials to encourage responsible use of wildlife corridors and minimize negative human-wildlife interactions. The educational strategies will be developed at later stages development.

- Provide off-leash areas for dogs as appropriate and approved by the Town of Canmore as Municipal Reserve inside the ASP area to provide an opportunity for safe off-leash dog recreation and reducing the need for people to find inappropriate places to run their dogs (i.e., outside of the fence in wildlife corridors and habitat patches).
- Connecting trail systems to the Three Sisters Village ASP area, where 40% of the ASP will be dedicated to some form of open space, including a Resort Recreation Amenity Area and off leash dog areas. These recreation areas are substantial relative to typical developments (where 10% open space is common) and are therefore expected to provide substantial opportunities for people living in TSMV to recreate and walk their dogs in places other than wildlife corridors.
- Provide alternate mineral lick locations for bighorn sheep using anthropogenic mineral sources if sheep use of existing licks near Highway 1 is reduced following Project development. If required, alternative anthropogenic mineral lick locations would be identified in consultation with the Province of Alberta and placed in locations to maximize successful access by bighorn sheep and minimize risk of predation to bighorn sheep.

The separation between people and ungulates and carnivores in developed areas is important for wildlife conservation and TSMV/QPD were involved in the Human Use Round Table Committee and work with Biosphere in pursuit of these objectives. Attractant management is central for achieving this separation. Wildlife will not enter developed areas unless there is a benefit for them doing so, such as food acquisition or predator avoidance. However, there have been many approaches tried in Canmore to achieve this separation, including but not limited to attractant management, education, enforcement, and aversive conditioning; none has worked sufficiently well to prevent negative human-wildlife interactions from contributing to the population sink identified for grizzly bears (Section 5.3.3). For this reason, wildlife fencing is proposed as an additional required mitigation and is discussed in more detail in the following section.

5.6.4 Wildlife Fencing

One of the most important mitigation actions proposed to reduce the risk of negative human-wildlife interactions and the risk of reduced use of approved corridors by wildlife is wildlife fencing. Fencing to separate wildlife and people has been used for centuries and is increasingly used around the world (Hayward and Kerley 2009). As outlined in Somers and Hayward (2012), fencing allows fragmented habitats to be used by wildlife when they may not be used otherwise, and fences can conserve wildlife in an otherwise human-dominated landscape. The use of wildlife fencing is consistent with recommendations from the Bow Valley *Human-Wildlife Coexistence Report* (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018), which encourages the use of fencing to exclude wildlife from developed areas.

Many conservation biologists agree that appropriately designed and well-maintained fences can be a fundamental conservation tool (Pfeifer et al. 2014; Woodroffe et al. 2014a,b). Even within remote wilderness of National Parks, wildlife fences can play an important role in separating wildlife from places where they might come into conflict with people. For example, as part of Parks Canada’s Banff National Park Bison reintroduction program, Parks Canada designed a 1,200 km^2 reintroduction zone which would keep reintroduced bison away from places where they might come into conflict with people. The boundaries of the reintroduction zone consist of natural mountain ridges along with stretches of wildlife fencing designed to prevent bison crossing while allowing other wildlife passage (Parks Canada 2016, 2019).

The importance of fencing as part of a conservation strategy for large carnivores has been strongly advocated by some. Packer et al. (2013) surveyed contrasting management practices with African lion densities and population trajectories at 42 sites in 11 countries. They found that lion populations in fenced reserves were on average at 80% of their potential densities while lions in unfenced reserves were only at 50% of their potential densities. In addition, the unfenced reserves required management budgets that were four times the budgets of fenced reserves, yet almost half of the lion populations in unfenced reserves were predicted to disappear within 20 to 40 years. Higher lion mortality on unfenced reserves is related to conflict with people in surrounding communities. In the opinion of Packer et al. (2013), human development in larger wildlife dominated ecosystems may need to be fenced as enclaves to conserve large carnivores. Similarly, a recent global survey of negative human-bear interactions conducted by Can et al. (2014, pg. 501) concluded that, within the toolbox of available mitigation, "*the peer-reviewed literature indicates a heavy reliance on education and physical barriers for conflict mitigation".*

But there is debate about the efficacy of large-scale wildlife fencing, and this type of fencing clearly fails to meet conservation objectives in some cases (Woodroffe et al. 2014a). Many of the failures are due to major changes in landscape connectivity caused by long fences or heavily fenced landscapes, where wildlife populations can become isolated (Woodroffe et al. 2014a). Connectivity problems associated with large scale fencing in North America have been mitigated in many places, including in the Bow Valley, by using crossing structures (Clevenger et al. 2009).

By contrast, fencing used to enclose relatively small areas of intense conflict, such as human settlements, may achieve important conservation benefits while avoiding the potential negative ramifications of large-scale wildlife fencing (Woodroffe et al. 2014a; Kuijper et al. 2017). In this context, fencing is frequently recommended as part of a broader suite of tools use to limit negative interactions with people and achieve conservation objectives, especially for carnivores (Treves and Karanth 2003; Stone et al. 2008; Can et al. 2014; Takahata et al. 2014; Knopff et al. 2016; Kuijper et al. 2017).

In North America, fencing is sometimes used in this way to separate residential developments from areas intended for wildlife. For example, in Jackson, Wyoming, an approximately 3 km page wire fence between the town and National Elk refuge has helped to contribute to low levels of negative human-wildlife interactions (Figure 41). The fence was a mitigation put in place several decades ago (Figure 42 and Figure 43). Without the wildlife fence, refuge staff feel there would be a notable increase in negative interactions (Dippel 2016, pers. comm.). In a recent email to Yellowstone2Yukon (Y2Y), Alyson Courtemanch, a wildlife biologist with the Wyoming Department of Game and Fish living in Jackson, stated that '*without the fence we could have thousands of elk on the highway or in downtown Jackson during the winter creating enormous human safety (and elk safety) issues"*.

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LEGEND

WILDLIFE FENCE LINE

0 250 500

1:12,500 METRES

REFERENCE(S)

1. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	10/5/2020
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE
LOCATION OF A WILDLIFE FENCE BETWEEN THE TOWN AND THE NATIONAL ELK WILDLIFE REFUGE IN JACKSON, WYOMING

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	41

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

25mm

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Figure 42: Jackson Wildlife Fence Along Edge of Residential Neighbourhood (Fence Circled in Red)

Figure 43: Jackson Wildlife Fence Along Edge of Residential Neighbourhood (Wildlife Fence is Located Adjacent to the Property Line, Circled in Red)

Closer to Canmore, the tenting area in Parks Canada's Lake Louise campground is also entirely fenced, in this case using electric fencing, to separate campers from grizzly bears (Parks Canada 2013). The base and Whitehorn lodges at the Lake Louise Ski Resort are similarly fenced during the summer months. Fencing is also used to separate wildlife from vehicles on the Trans-Canada Highway and Highway 93S in Kootenay National Park. Fencing on highways is considered a major benefit to wildlife populations because, in combination with crossing structures, wildlife suffer substantially lower mortality rates on fenced highways (Clevenger et al. 2009; Jarvie 2017). To address public safety concerns, the Town of Canmore will, in fall 2019, erect a wildlife fence around Centennial Park where herds of 80 or more elk are periodically observed (Town of Canmore 2019a). Other urban green spaces may also be fenced in the future (Town of Canmore 2019a). The Town considered wildlife hazing as an alternative solution, but it was considered very costly, largely ineffective and potentially dangerous when done an urban environment (Town of Canmore 2019a). Wildlife fencing was deemed most effective at reducing human-wildlife conflict by preventing wildlife from accessing attractants within developed areas. Incursions through wildlife fencing are rare, and wildlife mortality of carnivores and ungulates declines substantially where fencing has been introduced. In a recent study focusing on the Bow Valley, Gilhooly et al. (2019 pg. 2) indicate that "*road mitigation has unambiguous net benefits for people and wildlife … particularly for mitigation that consists of exclusion fending (to prevent animals from accessing the road)* …".

Wildlife fencing can take several forms and different types of fencing were initially considered for the Project. The first type is a standard fence that does not restrict wildlife movement but is a boundary that marks the edge of a wildlife corridor. An example of this type is the chain link fence used to demarcate the edge of the Sulphur Corridor from the Middle Springs subdivision in Banff (Bow Valley Naturalists 2010). The corridor is closed to people and signage on the fence indicates that trespassers were subject to prosecution. The purpose of the fence was to reduce human intrusion in the wildlife corridor without constraining wildlife movement. Heavy fines enforced by Parks Canada were also applied so that humans respect the boundary between the community and wildlife corridors.

The second type of wildlife fence is similar, but in this case the fence is designed to restrict the movement of elk but not that of carnivores. This type of fencing has been erected on either side of the wildlife corridor on the golf course on the Jasper Park Lodge lease in Jasper National Park (Shepherd and Whittington 2006). Although deer move back and forth across the barrier, elk for the most part cannot. Wolves could travel back and forth across the fence but to a great degree have not, possibly because prey (e.g., elk) are less available inside the fence. Voluntary trail closures have reduced human use in the corridor, resulting in a corridor that is used by wolves and elk.

Both wildlife fence types could achieve the goal of reducing human use in a wildlife corridor, one of the two key issues that currently exists in the wildlife corridors around the ASP area. However, neither fully addresses negative human-wildlife interactions within the ASP area, which is another major risk for large mammals, particularly bears. Given the serious risk identified for grizzly bears in the Bow Valley (Section 5.3.3), the reduction in negative human-wildlife interactions are of paramount importance when considering mitigation for the potential effects of the proposed Projects on wildlife. Therefore, the first two fencing options discussed above are not considered any further.

A third wildlife fence option that was considered and ultimately selected as a recommended mitigation measure for the Project is a page wire fence, approximately 2.5 m high, with a buried apron similar to those found along the Trans-Canada Highway and in Jackson, Wyoming. A high-tension wire at the top will be used to reduce the effects of tree fall on the fence.

The page wire fence was chosen because it can address both primary wildlife issues that currently exist in the Bow Valley, i.e., wildlife incursion into developed areas and inappropriate human use in wildlife corridors. The fence will substantially reduce or eliminate the ability of mammals larger than a coyote to enter the development from the wildlife corridor. As an example, fencing along the Trans-Canada Highway in Banff National Park reduced vehicle-ungulate collisions by 80% (Clevenger et al. 2001). Although fencing will keep most wildlife from entering developed areas, reducing attractants within the human development area remains important so that wildlife are less likely to attempt to breach the barrier.

The wildlife fence will easily accommodate human access to wildlife corridors on designated trails using walk-through swing gates. The design allows human and bike access but does not permit wildlife passage. Examples of successful deployment of such points can be found in numerous places along the Trans-Canada Highway in the Bow Valley (e.g., Redearth Trail head access point) and on the enclosed portion of the Lake Louise Ski Hill to allow access to the Pipestone Trail system in the summer. Larger locked swing gates will also be incorporated into the fence at intervals to permit wildlife to be removed from the developed area should they get in. Experience in Banff National Park and AEP suggest swing gates are more effective than jump-outs for this purpose (Honeyman 2016, pers. comm.; Gummer 2016, pers. comm.; Boukall 2016, pers. comm.). Jump outs may also be included, depending on the final design.

To achieve the greatest overall efficacy, the wildlife fence should fully encompass the Smith Creek ASP and join with existing fences such as those along the Trans-Canada Highway and other developments in the LSA. (Figure 44). The portion of the proposed Three Sisters Parkway that passes through the Stewart Creek Across Valley Corridor should be fenced along the north and south sides of the right of way to guide wildlife through the planned wildlife underpasses (Figure 44). Fencing in this manner will also reduce the amount of human activity in the corridor and thereby increase the corridor's effectiveness for wildlife movement. A single transportation access point through the Stewart Creek Across Valley Corridor linking vehicles, pedestrians, and cyclists to developments in the Project area will be constructed and a wildlife crossing structure will be constructed under the Three Sisters Parkway. The existing underpass (Stewart Creek Underpass) and planned underpasses (Three Sisters Parkway and the Trans-Canada Highway) will permit the movement of wildlife as well as the passage of water from the corridor system towards the Bow River. The fencing will maximize retention of habitat by installing the fence in phases (refer to phases shown in Figure 8) so that not all habitat is lost at once. The phased fencing approach also eliminates the potential need to remove attractants from inside the larger fenced area if the entire ASP area was fenced at once.

In general, application of fencing as mitigation will exclude large mammals from areas of natural habitat or anthropogenic open spaces within the ASP area, resulting in a complete loss of access to habitat that otherwise might be used and funnelling these animals into provincially designated wildlife corridors. Adjacent to the Project, fencing will maintain movement through the corridors. There is potential for elk to concentrate elsewhere in Canmore, potentially creating negative interactions between elk and people (Section 5.7.5.3). Other species of wildlife, such as birds, amphibians, and small mammals will continue to be able to access habitats inside the fence.

Final design of the fence, including design at creek crossings, fence ends, underpasses, human access points and other aspects will be undertaken after ASP approval and should include the design principles outlined here. Fence location may be altered to account for future corridor alignment associated with TSMV development in Smith Creek, or for other reasons as development is defined in more detail prior to sub-division. Final fence design will include input and guidance from regional experts. A qualified wildlife biologist should evaluate the final design of the wildlife fence to confirm that it is consistent with the fence described in this section.

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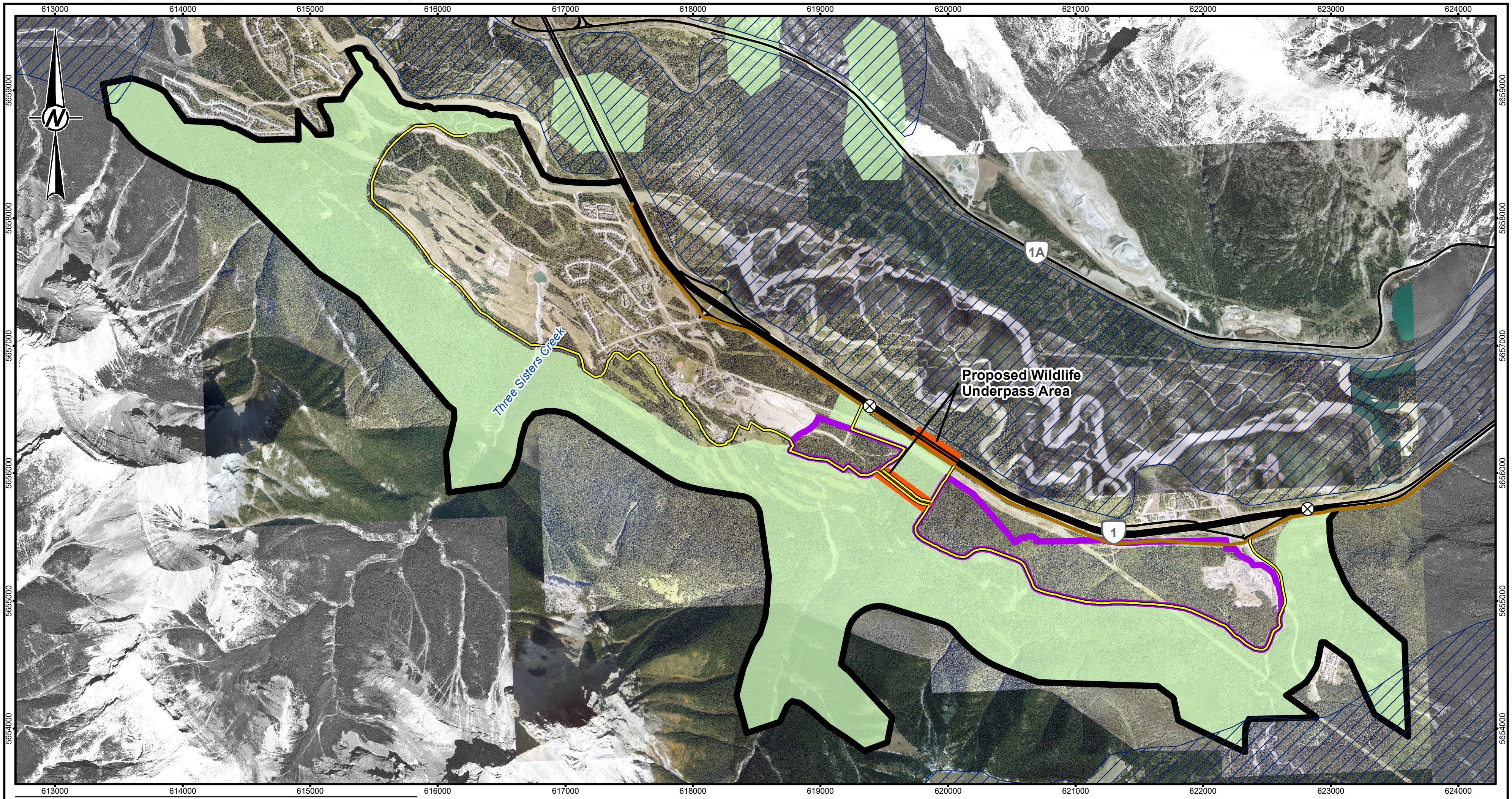

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PROPOSED FENCE
- EXISTING FENCE
- PRIMARY HIGHWAY
- HABITAT PATCH
- PROPOSED WILDLIFE UNDERPASS AREA
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE

PROPOSED LOCATION OF WILDLIFE FENCE FOR THE PROJECT

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	44

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5.7 Wildlife Predicted Project Effects

This section predicts residual effects of the Project for grizzly bears, cougars, wolves, elk, and other species at risk, assuming the mitigation measures recommended in Section 5.6 are implemented.

Based on the mitigation identified in Section 5.6 and the fact that the probability of grizzly bear dens occurring in the ASP area is near zero (Section 5.3.3), construction of the Project is not expected to cause increased mortality for grizzly bears, cougars, wolves or elk. Therefore, the Project effects assessment on these VECs focuses on evaluating the importance of the residual effect of the Project for habitat quantity and quality, use of wildlife corridors adjacent to the Project, and negative wildlife human interactions. The assessment of residual effects for other species at risk identified in Section 5.7.6 include an evaluation of mortality risk.

Because of the importance of human use in influencing habitat quantity and quality, use of wildlife corridors adjacent to the Project, negative wildlife human interactions, and wildlife mortality risk, predicted changes in human use are presented prior to assessing effects of the Project on each wildlife species.

5.7.1 Human Use – Wildlife Predicted Project Effects

Mitigation identified to address the potential for human use to increase in wildlife corridors includes:

- a wildlife fence with a wildlife crossing structure on the Three Sisters Parkway to separate human traffic from wildlife in the Stewart Creek Across valley Corridor
- a trail network inside the ASP area that permits access only through signed gates onto designated trails through wildlife corridors
- education
- opportunities for off-leash dog use inside the ASP area

From the perspective of human use in wildlife corridors, the intent of the proposed mitigation is to manage human use in wildlife corridors by providing people with an opportunity to recreate and run their dogs inside the fence and to help them follow existing regulations within wildlife corridors, such as using only designated trails. The efficacy of this mitigation will depend on how people respond to its implementation and is therefore uncertain. However, available evidence suggests that this suite of mitigations will most likely be successful, as described in the following paragraphs.

The efficacy of a wildlife fence for directing human access can be seen along the fenced portions of the Trans-Canada Highway, where people rarely go over the fence to access trails and vehicles tend to pull out at designated trailheads. Compare this with Highway 40, which is unfenced, where people park vehicles at many locations in the ditch or on the side of the road to access various trails. East of Canmore along the Trans-Canada Highway, people park vehicles at a variety of locations on the side of the highway, like Heart Creek or McGillvray Pond.

Human use in wildlife corridors has been successfully limited in some parts of the RSA using education programs. For example, trail closures in the Benchlands were reinforced by education campaigns and resulted in more than 10-fold reductions in human use (Lee et al. 2010). By combining the fencing mitigation with education, similar or better success is expected within the corridors near the Project area. This expectation is further supported by a survey undertaken in 2014 as part of the Town’s Human Use Management Review program. When residents of Canmore were asked “what would it take for you to not recreate in wildlife corridors or habitat patches?”, they consistently answered that more signage, alternative trails for recreation, and better education would be most effective (Town of Canmore 2015c).

During their review of Golder (2013), Management and Solutions in Environmental Science (MSES) concurred with Golder "*that the fencing could indeed reduce wildlife – human interactions in the corridor*" (MSES 2013). In MSES's view, this reduction could be achieved not only through the physical separation between wildlife and people, but also as a result of the increased awareness of people who enter the wildlife corridor through designated gates equipped with educational signs.

By combining wildlife fencing with alternative options for recreation, especially off-leash dog parks and designated trails that are fun to use, the potential effects of increased human use in the wildlife corridor are predicted to be substantially reduced relative to building the Project without recommended mitigation. Developing the Project with a wildlife fence and educational signs is predicted to result in a substantial reduction in human use of undesignated trails in adjacent wildlife corridors relative to developing the Project without that mitigation.

With the application of wildlife fencing, a trail network that connects to designated trails and is fun to use, and off-leash dog opportunities included in the ASP area, effects of the Project on human use in wildlife corridors may result in positive outcomes for wildlife when compared to existing conditions. The corridors adjacent to the Project experience human use under existing conditions that is contrary to existing regulations, including high use by off leash dogs and substantial use of undesignated trails (Section 5.3.2). Fencing and provision of off-leash dog areas inside the fence is predicted to reduce the amount of off-leash dog use in corridors relative to existing conditions by providing alternatives and direction.

Education and developing trails that are fun to use within the ASP area are predicted to reduce use of undesignated trails in the corridors, particularly the areas of the corridor adjacent to the ASP. Thoughtful trail construction has proven successful elsewhere in the Bow Valley. For example, the "Long Road to Ruin" Trail in the Canmore Nordic Center has resulted in the abandonment of almost all non-sanctioned trails in the immediate vicinity of the constructed trail (Dickison 2017, pers. comm.).

Because the number of new people likely to occur in the ASP area as a result of the Project and increased concentration of existing users on designated trails because of the fence and improved education, use of designated trails in wildlife corridors adjacent to the ASP area could more than double from existing conditions, although the amount of increase is uncertain.

As pointed out by MSES (2013), there is uncertainty about whether or not a fence will result in a reduction of off-leash dog use and undesignated trail use relative to existing conditions because the benefit will depend on whether people are accessing the corridor through the ASP area, or if they are coming from elsewhere. If people are accessing through the ASP area, they will be exposed to the fence and associated educational signs about uses that are permitted in the wildlife corridor. Camera data indicate that many recreational activities do begin within TSMV property under existing conditions.

Addressing human use within wildlife corridors is a problem that is broader than this Project (Town of Canmore 2015c). The Province and the Town will need to provide enforcement and will likely need to work together with agencies like WildSmart and other local organizations to help with developing educational materials for people entering corridors from outside of the ASP area. The Human-Wildlife Coexistence report (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018) identified 'people compliance' as one of six areas for improving human-wildlife coexistence in the Bow Valley and the key strategies included increased capacity for enforcement.

5.7.2 Grizzly Bears – Predicted Project Effects

5.7.2.1 *Grizzly Bears Predicted Project Effects (with Mitigation) Habitat Quantity and Quality*

An important mitigation to reduce the effect of the Project on negative wildlife human interactions and human use of adjacent wildlife corridors is wildlife fencing, which physically separates wildlife habitat from human development (Sections 2.0 and 5.6.4). Application of fencing as a mitigation will exclude large mammals from areas of natural habitat or anthropogenic open spaces within the ASP area, resulting in a complete loss of access to habitat that otherwise might be used. Other species of wildlife, such as birds, amphibians, and small mammals will continue to be able to access habitats inside the fence.

Habitat quality in the LSA is predicted to increase for grizzly bear following development of the Project. Grizzly bear habitat selection is positively correlated with trail density and forest edge, both of which are associated with openings in forest canopy where food resources for grizzly bears may be higher (Section 2.2.1 in Appendix B). Within the ASP area, there is a loss of 8 ha of selected habitat but an increase of 15 ha of selected habitat in the adjacent wildlife corridor and an increase of approximately 7 ha of selected habitat in the remainder of the LSA (Table 24, Figure 45). The net change is an increase of approximately 15 ha of selected habitat within the LSA. The scenario with increased human use on trails results in a similar increasing trend of grizzly bear habitat in the LSA (42 ha increase in selected habitat), with the majority of increase in selected habitat (25 ha) occurring in the adjacent wildlife corridor (Table 24, Figure 46).

Development of the Project with a wildlife fence surrounding the developments should substantially reduce future grizzly bear use of the area. Fencing will increase the amount of grizzly bear habitat loss by removing access to the remaining 24.6 ha of selected habitat and 7 ha of used as available habitat in the ASP area, under the scenario without increased human use of trails (Table 24). Under the scenario with increased human use of trails, fencing would remove access to the remaining 22.8 ha of selected habitat and 8.5 ha of used as available habitat in the ASP area (Table 24). Additional selected and used as available habitat could be lost in the Stewart Creek Across Valley wildlife corridor depending on the final alignment of the fence and the Three Sisters Parkway. Because the ASP area represents an ecological trap where grizzly bear selection and negative human interactions are both higher under existing conditions (Figure 26 and Figure 27), loss of access to the area will be beneficial or neutral for the grizzly bear population overlapping the RSA (Lamb et al. 2016).

FireSmart measures implemented by the Town, the MD of Bighorn, and the Province that reduce forest cover and increase early seral habitats in wildlife corridors adjacent to the ASP area and other TSMV lands would provide high quality habitat for grizzly bears away from zones of higher negative human-bear interactions. Well planned implementation of FireSmart could results in a net benefit to grizzly bears (Golder 2012).

Table 24: Predicted Grizzly Bear Habitat in the Local Study Area with the Addition of the Project With and Without Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)												With Estimated Effects of Increased Human Use on Trails (ha)											
	ASP Area (ha)			Adjacent Wildlife Corridor (ha)			Other Approved Corridors (ha)			Remaining Largely Developed Areas (ha)			ASP Area (ha)			Adjacent Wildlife Corridor (ha)			Other Approved Corridors (ha)			Remaining Largely Developed Areas (ha)		
	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project
Selected	32.6	24.6	-8.0	116.1	130.9	14.7	162.0	162.0	0.0	309.7	317.0	7.3	23.4	22.8	-0.6	98.2	123.1	25.0	145.3	155.6	10.3	303.3	311.0	7.7
Used as available	108.6	6.9	-101.7	234.9	214.8	-20.1	134.1	134.1	0.0	92.1	88.5	-3.6	111.0	8.5	-102.5	228.7	206.5	-22.2	125.2	121.5	-3.7	95.9	90.0	-5.9
Somewhat avoided	7.0	11.3	4.3	140.2	135.3	-4.9	65.3	65.3	0.0	48.3	44.5	-3.8	13.1	10.0	-3.1	155.3	147.9	-7.4	88.8	82.0	-6.8	50.9	48.9	-2.0
Strongly avoided	5.5	74.3	68.8	68.0	77.3	9.4	13.8	13.8	0.0	14.2	14.3	0.1	6.0	66.8	60.8	76.1	80.6	4.5	15.9	15.9	0.0	14.1	14.3	0.2
Rarely used	0.0	30.9	30.9	7.9	8.8	0.9	0.9	0.9	0.0	3.3	3.3	0.0	0.0	39.8	39.8	8.7	8.8	0.1	0.9	1.1	0.2	3.5	3.5	0.0
Waterbody[(a)]	0.0	5.7	5.7	0.0	0.0	0.0	0.4	0.4	0.0	5.3	5.4	0.0	0.0	5.7	5.7	0.0	0.0	0.0	0.4	0.4	0.0	5.3	5.4	0.0

a) Habitat suitability is not assigned to waterbodies.
ASP area = Project Study Area Boundary; ha – hectare; <= less than.

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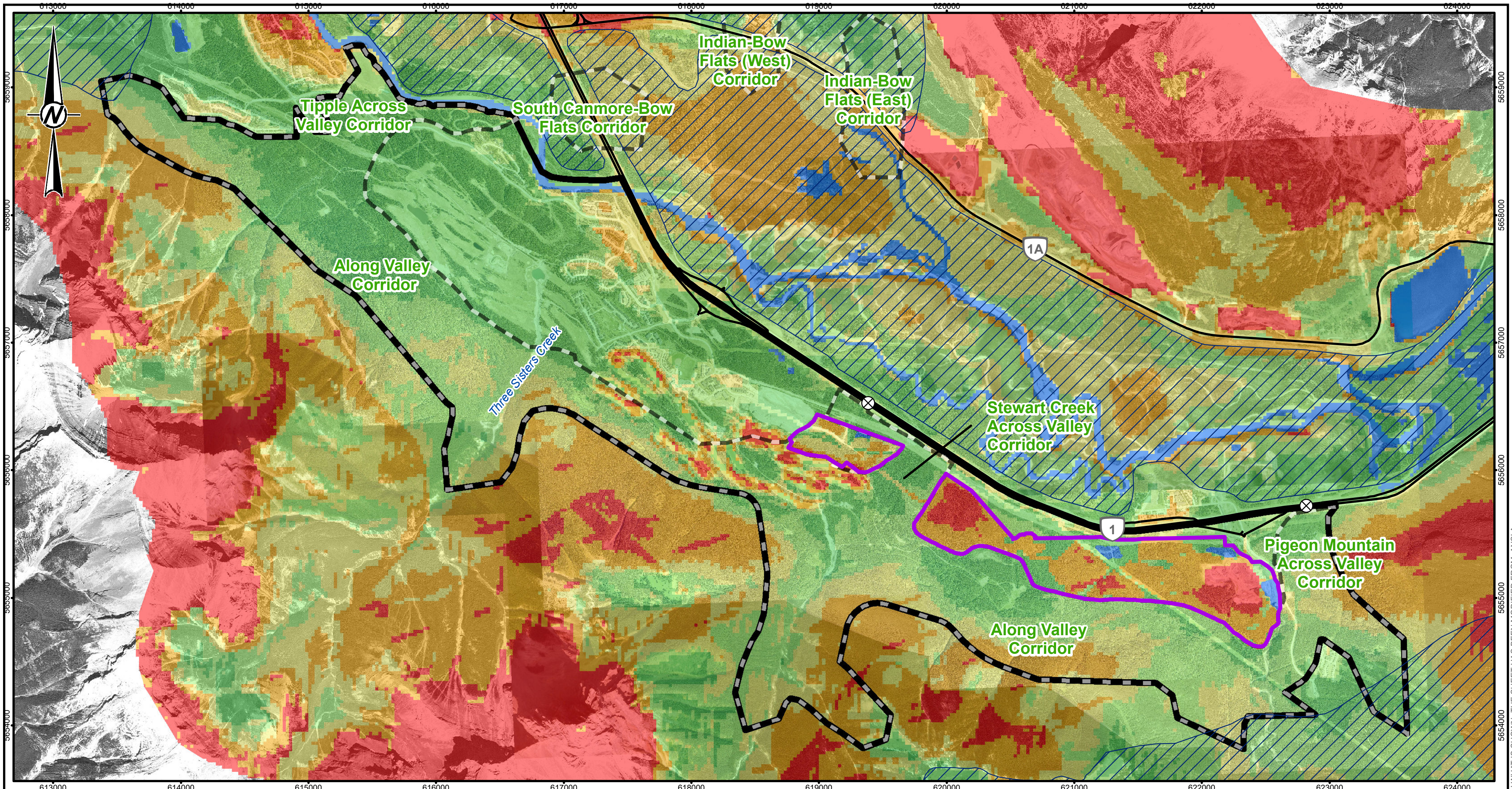

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE

PREDICTED SUMMER GRIZZLY BEAR RESOURCE SELECTION – PROJECT EFFECTS WITHOUT ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	45

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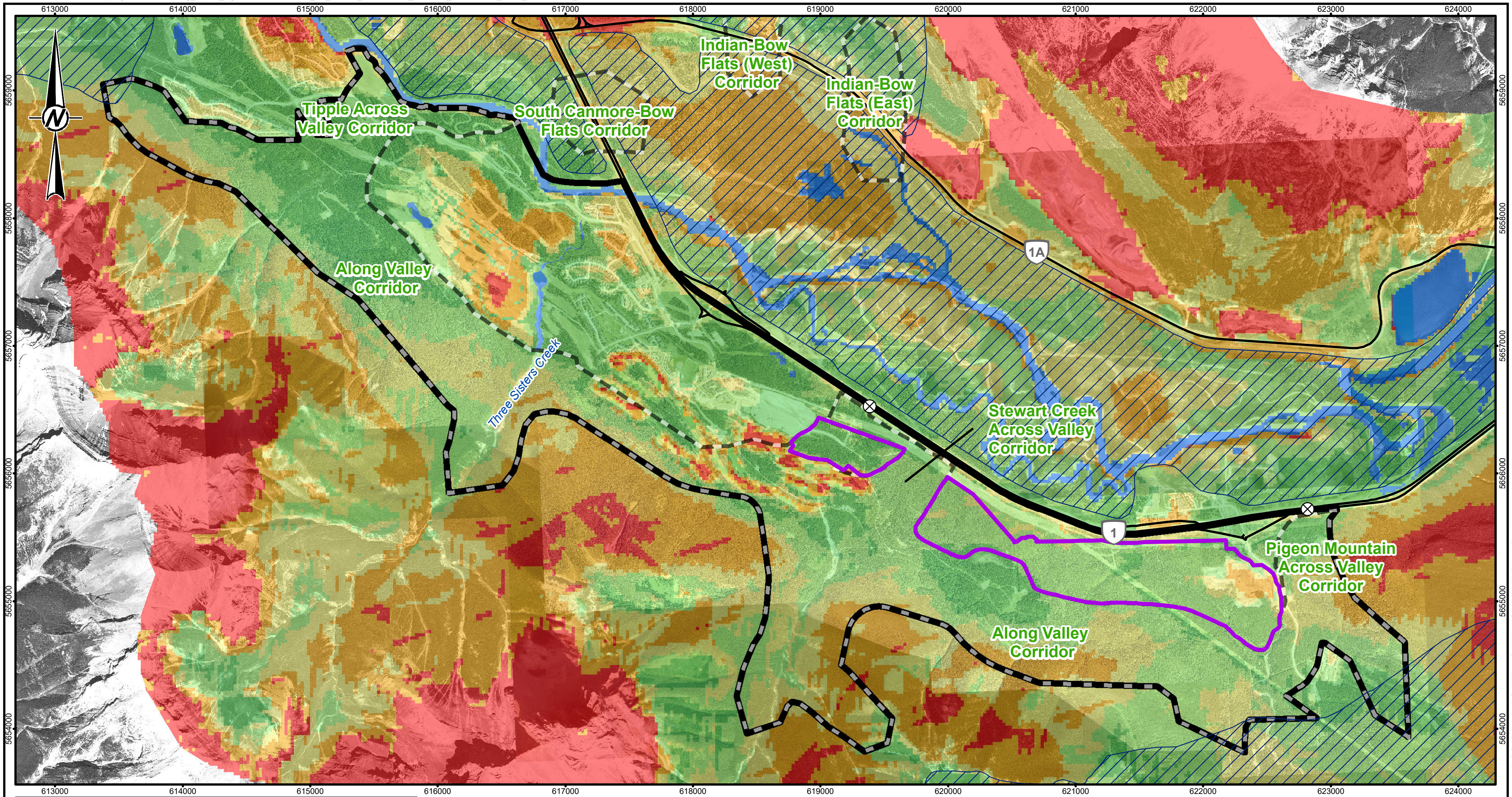

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE

PREDICTED SUMMER GRIZZLY BEAR RESOURCE SELECTION – PROJECT EFFECTS WITH ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	46

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

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5.7.2.2 Grizzly Bears Predicted Project Effects (with Mitigation) Use of Approved Corridors

Under existing conditions, grizzly bears in the RSA retain probability of selection for some places where human use and trail density are also high, such as the Canmore Nordic Centre and in the vicinity of the Project. Probability of grizzly bear selection is therefore expected to remain relatively high in wildlife corridors adjacent to the ASP area, even if human use in the corridor increases (Gibeau et al. 2002b). Probability of grizzly bear selection predicted by RSF output in approved corridors increases by approximately 15 ha, likely as a result of the forest edge created by the addition of the Project on the landscape (Table 24, Figure 45). The wildlife corridors adjacent to the Project contain substantial easy movement terrain and many trails that could be used by wildlife (Appendix D). Grizzly bears are expected to continue using these trails for movement after development of the Project.

The wildlife fence is predicted to eliminate access by grizzly bears to the ASP area, which could increase grizzly bear use of adjacent wildlife corridors when combined with the predicted increase in probability of selection. There is some uncertainty about whether the small predicted benefit for bears in approved corridors will be achieved because it would depend on how people access the wildlife corridor and on the good behaviour of people in wildlife corridors (Section 5.7.1). Consequently, to be precautionary, the residual effects of the Project are predicted to be neutral relative to existing conditions. However, relative to a similar but unfenced development the effects of the Project are predicted to be positive.

5.7.2.3 Grizzly Bears Predicted Project Effects (with Mitigation) Negative Human-Wildlife Interactions

Under current conditions, the ASP area is heavily used by people (Section 5.3.2) and the grizzly bear RSF identifies a high probability of selection (Section 5.3.3). Negative human-bear interactions are high in the northwest portion of the Project footprint during the pre-berry season (Figure 24), indicating the likely presence of an ecological trap. Negative human-bear interactions are low in the remainder of the Project footprint (Figure 24).

As outlined in Section 5.6.3, TSMV will continue to implement the Wildlife Human Interface Prevention Plan (WHIPP); however, the mitigation commitments outlined in this EIS go beyond the provisions of the WHIPP. For example, fencing the ASP area, as identified in Section 5.6.4, is predicted to substantially reduce the number of negative human-bear interactions inside the Project footprint. Therefore, effects of the Project are predicted to have a positive outcome by reducing negative human-bear interactions within the Project.

In wildlife corridors adjacent to the ASP area, the number of negative human-bear interactions is also predicted to decrease from existing conditions if people use recreational amenities envisioned for the Project Amendment, such as the off-leash dog park and trail system, and stay on designated trails when traveling through the wildlife corridor. There is some uncertainty about whether this benefit will be achieved because it would depend on how people access the wildlife corridor and on the good behaviour of people in wildlife corridors (Section 5.7.1). An increase in negative human-bear interactions is possible in wildlife corridors adjacent to the ASP area if the new residents and visitors associated with the Project do not respect regulations in wildlife corridors, including ignoring direction provided on signs at entry points. There is potential for bears (grizzly bears and black bears) to be displaced to other areas in the region (e.g., Canmore) resulting in a spatial shift in human-bear interactions.

To be precautionary, the residual effects of the Project resulting from changes to negative human-bear interactions are predicted to be neutral relative to existing conditions because of uncertainty about the level of negative interaction in adjacent wildlife corridors after development. However, relative to a similar but unfenced development the effects of the Project are predicted to be overwhelmingly positive.

5.7.2.4 Grizzly Bears Predicted Project Effects (with Mitigation) Environmental Consequence

The effects described in Sections 5.1.6.2.1 to 5.1.6.2.3 are classified according to the impact criteria used to inform the determination of environmental consequence and are summarized in Table 25. Residual changes in habitat quantity and quality, use of approved wildlife corridors adjacent to the ASP area, and negative human bear interactions associated with the Project are predicted to have moderate to negligible (i.e., neutral) outcomes from grizzly bears (Table 25). The Project is not predicted to change negative human-bear interactions in the LSA. Consequently, the Project is not expected to contribute adversely to the serious risk identified for grizzly bears under existing conditions, which is associated with human conflict and grizzly bear mortality (Section 5.3.3).

Table 25: Residual Effects Summary for Grizzly Bears

Context	The RSA is already considered a population sink; provincially listed as 'Threatened'; slow population growth therefore slower for populations to recover after declines.			
Effect Category	**Impact Criterion**	**Description**	**Prediction Confidence**	**Environmental Consequence**
Habitat Quantity and Quality	Direction	Negative	High – the direction of change is expected to be negative for grizzly bears because of an overall loss of selected habitat.	Low
	Magnitude	Small - removal of 8 ha of selected habitat[a] (<1% of available in RSA). Fence restricts access to all habitat in ASP area, resulting in a minimum loss of 33 ha of selected habitat in the LSA. Additional selected habitat could be lost in the Stewart Creek Across Valley wildlife corridor depending on the final alignment of the fence and the Three Sisters Parkway.	High – development will reduce habitat quality and fencing will exclude access to remaining selected habitats. These habitats represent a relatively small portion of available habitat at the RSA scale.	
	Geographic extent	ASP area – fence excluding from habitat Local - minor changes in adjacent wildlife corridors	High – RSF models, scientific literature, camera data, and conflict data for the Bow Valley all indicate that habitat will be lost in the footprint and that the zone of influence from development is small for grizzly bears.	
	Duration	Long-term	High – development will be present for many decades.	
	Frequency	Once - when the wildlife fence is constructed.	High – construction of the fence will immediately eliminate access by grizzly bears to select habitats in the ASP area.	
	Reversibility	Irreversible	High – development, including the exclusion fence, will be present for many decades	
	Probability	Likely	High – if development proceeds with a fence, bears will be excluded from primary sink habitats that act as an ecological trap.	

Table 25: Residual Effects Summary for Grizzly Bears

Context	The RSA is already considered a population sink; provincially listed as 'Threatened'; slow population growth therefore slower for populations to recover after declines.			
Effect Category	**Impact Criterion**	**Description**	**Prediction Confidence**	**Environmental Consequence**
Use of Approved Wildlife Corridor	Direction	Neutral	Moderate – the outcome of the Project has a potential to be positive relative to existing conditions.	Negligible
	Magnitude	Small – <1 ha loss of selected habitat in the ASP area and a 25 ha increase in selected habitat in the adjacent wildlife corridor under scenario with increased human use[b]. Additional selected habitat could be lost in the Stewart Creek Across Valley wildlife corridor depending on the final alignment of the fence and the Three Sisters Parkway.	High – RSF models validate well, available evidence suggests grizzly bears respond weakly to human use.	
	Geographic extent	Local - Immediately adjacent to the ASP area	High – human use is highest close to development and zone of influence from development is small for grizzly bears.	
	Duration	Long-term	High – development will be present for many decades.	
	Frequency	Once – construction of fence and signage Continuous – human use by local residents and visitors	Moderate – Changes within wildlife corridors will occur over time as people are added, but the largest positive change will be associated with application of the fence and this change will occur rapidly with fence construction.	
	Reversibility	Reversible	Moderate – Human use of corridor (main disturbance source) can change depending on educational outreach, enforcement, and alternative recreational options	
	Probability	Likely	High – Changes in the corridor are likely, to be small, and will most likely be neutral or positive.	

Table 25: Residual Effects Summary for Grizzly Bears

Context	The RSA is already considered a population sink; provincially listed as 'Threatened'; slow population growth therefore slower for populations to recover after declines.			
Effect Category	**Impact Criterion**	**Description**	**Prediction Confidence**	**Environmental Consequence**
Negative Human-Wildlife Interactions	Direction	Neutral	Moderate – Changes within wildlife corridors will occur over time as people are added, but the largest positive change will be associated with application of the fence and this change will occur rapidly with fence construction.	Negligible
	Magnitude	Small - No change from existing conditions	Moderate – outcome could be positive.	
	Geographic extent	Local - adjacent wildlife corridors	High – the primary benefit will be within the fenced ASP area. Additional possible benefits from increased good behaviour of people in the wildlife corridor	
	Duration	Long-term	High – development will be present for many decades.	
	Frequency	Once – the largest change is when the fence is constructed Continuous – behaviour of people in the wildlife corridor	Moderate/High – high confidence that fence will eliminate access by grizzly bears to areas heavily used by people in the ASP area. Moderate confidence that the combination of educational signs, maps of designated trails and wildlife corridor entrance points, off-leash dog park, and enjoyable recreation trails inside the ASP area will decrease human and off-lease dog use of undesignated trails within wildlife corridors.	
	Reversibility	Irreversible – wildlife fence Reversible – human behaviour	High - development, including the exclusion fence, will be present for many decades. Human use of corridor can change depending on educational outreach, enforcement, and alternative recreational options.	
	Probability	Likely	High – A neutral or better outcome is expected based on available evidence.	

a) Most conservative estimate of habitat loss, associated with the scenario without increased human use.

b) Most conservative estimate of habitat loss, associated with the scenario with increased human use.

ASP area = Project Study Area Boundary; RSA = Regional Study Area; LSA = Local Study Area; RSF = resource selection functions.

5.7.3 Cougars – Predicted Project Effects

5.7.3.1 Cougars Predicted Project Effects (with Mitigation) Habitat Quantity and Quality

Habitat quality for cougars within the Project area is predicted to shift from habitats consisting primarily of those that are selected or used as available to habitats that are primarily avoided because of the Project (Table 26). Some areas of habitat that are selected or used as available under existing conditions are predicted to remain, especially in open areas designated for recreation (Figure 47 and Figure 48). Development of the Project with a wildlife fence surrounding the developments will virtually eliminate any future cougar use of the area.

Relative to existing conditions, fencing will result in a loss of 7.9 ha of selected habitat (Table 26) in the Project area which represents <1% of the habitat class in the RSA. A small amount of additional habitat between the Project and the Trans-Canada highway may also be lost depending on the final alignment of the proposed fence. This will result in a small adverse effect on cougar habitat availability in the RSA. However, this is offset by a larger increase in the amount of selected habitat (a gain of 118.1 ha) that is predicted in the adjacent wildlife corridor (Table 26, Figure 47 and Figure 48). Selected habitat in other areas of the LSA's wildlife corridors was predicted to increase in area by 17.3 ha in the scenario assuming increase trail use by people (Table 26). An increase in probability of selection is predicted because cougars select habitats on the edges of developed areas where prey are abundant (Appendix B). Whether or not prey will increase on the edge of development with a fence is uncertain, so the model may overestimate the positive change in cougar selection in the wildlife corridor. Overall, to be precautionary, the outcome of changes in habitat quantity and quality are predicted to negatively affect cougars.

FireSmart measures implemented by the Town, the MD of Bighorn, and the Province that reduce forest cover and increase early seral habitats in wildlife corridors adjacent to the Project Boundary and the Project Boundary would improve habitat conditions for cougars in the wildlife corridors. Well planned implementation of FireSmart could result in a net benefit to cougars (Golder 2012, pg. 88-94).

Overall, the outcome of changes in habitat quantity and quality are predicted to negatively affect cougars within the Project footprint, but positively affect cougars in the corridors adjacent to the project and in the larger LSA.

5.7.3.2 Cougars Predicted Project Effects (with Mitigation) Use of Approved Corridors

Zones of influence vary by species and disturbance type and also by the amount of exposure animals have to people (Rogala et al. 2011). For example, cougars tend to avoid human activity landscapes where such activity is rare but avoid it substantially less or not at all in places where human disturbance is prevalent (Knopff et al. 2014). Cougars are also capable of adjusting their behaviour temporally to use landscapes closer to human development during times when people are less active (Knopff et al. 2014).

In the RSA, cougars select habitats that are closer to development, presumably because prey density is highest there (Section 5.3.6). As a result of this selection pattern, probability of selection is predicted to be higher for cougars in wildlife corridors adjacent to the Project after the development occurs (Table 26, Figure 47 and Figure 48). Wildlife corridors adjacent to the Project contain substantial easy movement terrain and many trails demonstrating high use by wildlife (Appendix D). Cougars are expected to continue using these trails for movement and may increase use of these trails if prey density increases in the wildlife corridors.

As identified in Section 5.3.6, whether prey density will increase near development after a fence is constructed is uncertain. Therefore, an increase in probability of selection, and associated increased potential for movement, may not occur in the wildlife corridors adjacent to the Project. Moreover, the potential improvement in probability of selection within wildlife corridors as a result of lower human use on undesignated trails is small (Table 26). Consequently, to be precautionary, the Project is predicted to have a neutral effect on cougar use of the wildlife corridors.

FireSmart measures implemented by the Town, the MD of Bighorn, and the Province that reduce forest cover and increase early seral habitats in wildlife corridors adjacent to the ASP area and other TSMV lands outside the LSA would improve habitat conditions for cougars in the wildlife corridors. Well planned implementation of FireSmart could result in a net benefit to cougars (Golder 2012).

Table 26: Predicted Cougar Habitat in the Local Study Area with the Addition of the Project With and Without Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)												With Estimated Effects of Increased Human Use on Trails (ha)											
	ASP Area (ha)			Adjacent Wildlife Corridor (ha)			Other Approved Corridors (ha)			Remaining Largely Developed Areas (ha)			ASP Area (ha)			Adjacent Wildlife Corridor (ha)			Other Approved Corridors (ha)			Remaining Largely Developed Areas (ha)		
	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project
Selected	34.9	7.9	-27.0	83.2	201.3	118.1	62.7	62.8	0.1	133.0	146.7	13.7	28.6	7.2	-21.5	61.0	188.0	127.1	41.5	58.8	17.3	130.6	141.2	10.6
Used as available	104.4	38.6	-65.8	322.5	292.6	-29.9	237.3	237.3	0.0	138.2	123.1	-15.2	110.2	37.5	-72.7	323.8	305.3	-18.5	233.9	231.5	-2.4	140.2	127.3	-13.0
Somewhat avoided	6.8	85.4	78.5	104.2	18.4	-85.9	62.4	62.3	-0.1	83.4	84.3	0.9	7.0	81.7	74.7	124.8	19.0	-105.8	86.9	72.0	-14.9	83.5	85.1	1.6
Strongly avoided	7.5	15.0	7.5	38.8	37.5	-1.3	13.7	13.7	0.0	97.7	98.3	0.6	7.8	20.6	12.7	39.2	37.5	-1.7	13.8	13.8	0.0	98.1	98.8	0.8
Rarely used	0.0	1.1	1.1	18.2	17.2	-1.0	0.0	0.0	0.0	15.2	15.2	0.0	0.0	1.1	1.1	18.2	17.2	-1.0	0.0	0.0	0.0	15.2	15.2	0.0
Waterbody[(a)]	0.0	5.7	5.7	0.0	0.0	0.0	0.4	0.4	0.0	5.4	5.4	0.0	0.0	5.7	5.7	0.0	0.0	0.0	0.4	0.4	0.0	5.4	5.4	0.0

a) Habitat suitability is not assigned to waterbodies.
ASP area = Project Study Area Boundary; ha – hectare; <= less than.

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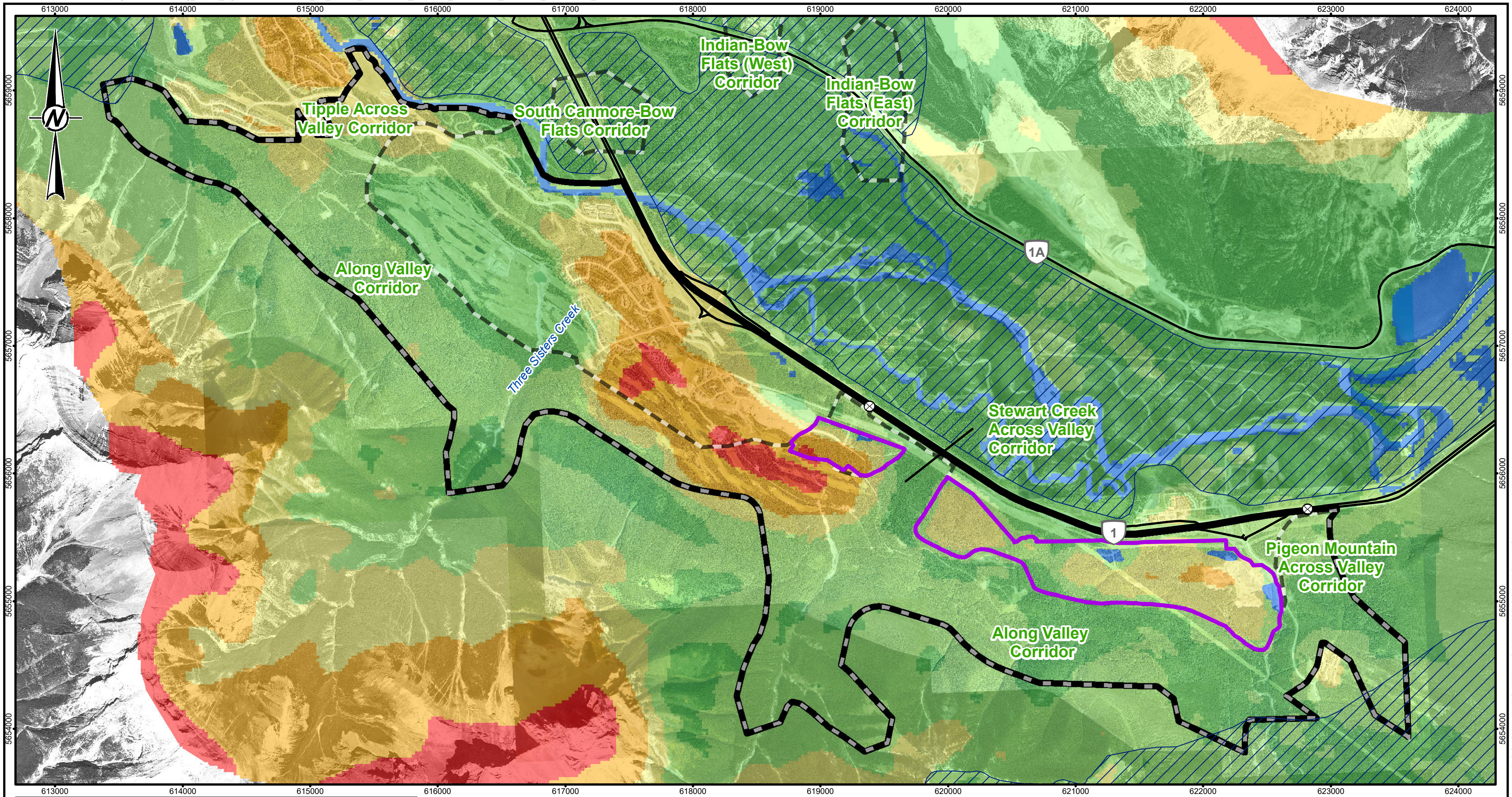

LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE
PREDICTED WINTER COUGAR RESOURCE SELECTION – PROJECT EFFECTS WITHOUT ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	47

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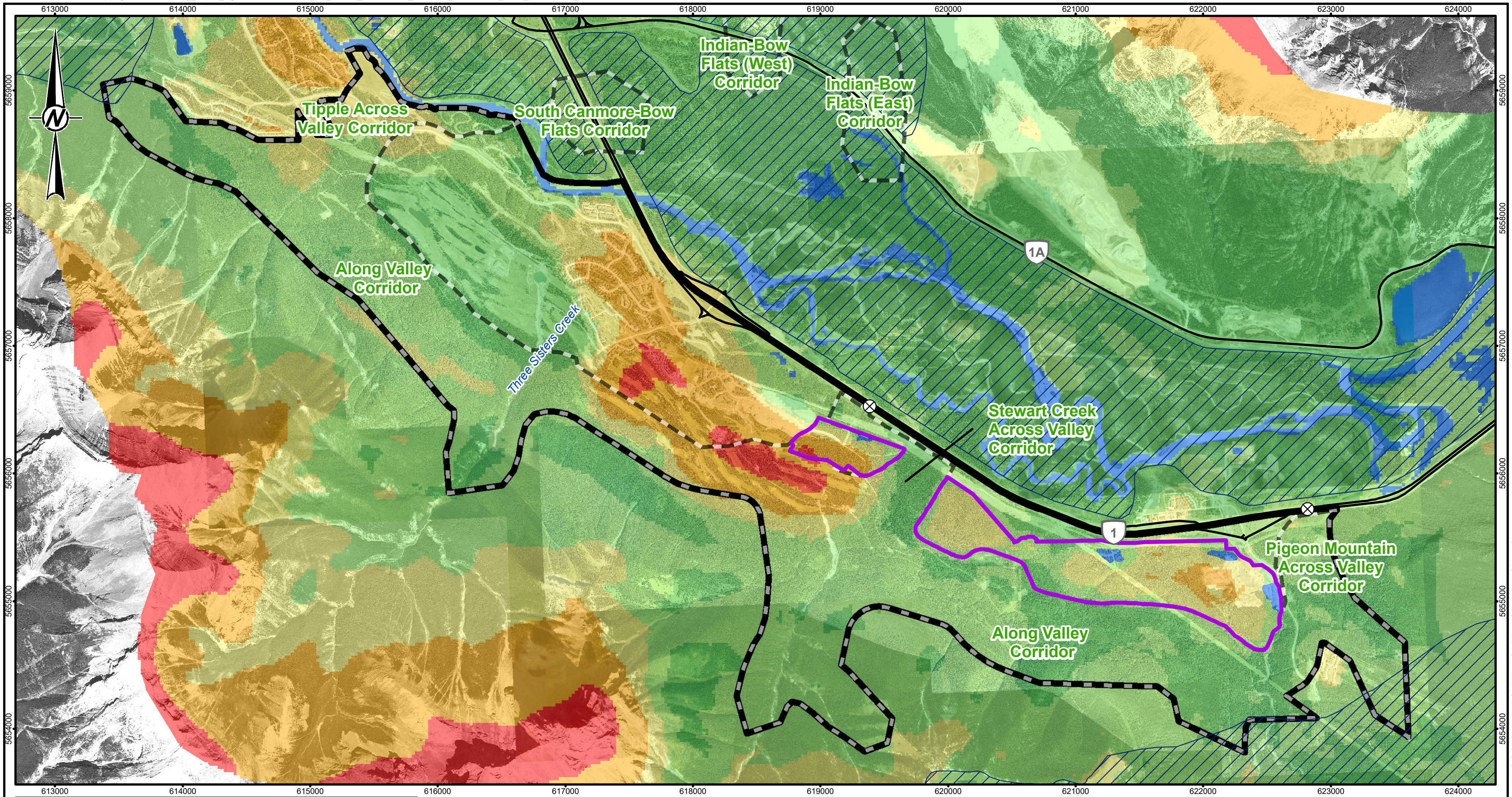

LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE
PREDICTED WINTER COUGAR RESOURCE SELECTION – PROJECT EFFECTS WITH ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	48

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

25mm

5.7.3.3 Cougars Predicted Project Effects (with Mitigation) Negative Human-Wildlife Interactions

Under existing conditions, the area within the Project Boundary is used by people (Section 5.7.1) and the cougar RSF modelling predicts a high probability of selection (Section 5.7.3). Therefore, there is the potential for negative human-cougar interactions in the Project Boundary under existing conditions. After the Project is developed, areas of habitat selected by cougars will be present in areas designated for recreation (Figure 43), resulting in a high potential for negative human-cougar interactions.

As outlined in Section 5.6, TSMV will continue to implement the WHIPP; however, the mitigation commitments outlined in this EIS go beyond the provisions of the WHIPP. Fencing the ASP area, as identified in Section 5.6.4, is predicted to reduce the potential for negative human-cougar interactions inside the ASP area. In wildlife corridors adjacent to the Project footprint, the risk of negative human-cougar interactions is predicted to be neutral relative to existing conditions if people use recreational amenities envisioned for the Project, such as the off leash dog park and trail system, and stay on designated trails when traveling through the wildlife corridor. The risk of dogs being attacked by cougars is predicted to decline with the use of off leash dog parks inside the fence. However, there is some uncertainty about whether this benefit will be achieved because it would depend on how people access the wildlife corridor and on the good behavior of people in wildlife corridors (Section 5.7.1).

Fencing will decrease the potential for negative human-cougar interactions inside the Project area. Increased use of designated trails outside the wildlife fence in the adjacent corridors is predicted to have a neutral effect on human-cougar interactions, although this effect may be negative if people do not stay on designated trails. The overall residual effects of the Project in terms of changes to negative human-cougar interactions are predicted to be neutral relative to existing conditions because the decline in negative interactions inside the Project Boundary and the potential increase in negative interactions in wildlife corridors are predicted to balance each other. Although there is some uncertainty related to human behaviour in wildlife corridors, the use of wildlife corridors by people, off-leash dogs, large mammals, and changes in negative human-wildlife interactions will be monitored. Mitigation will be adjusted as appropriate within an adaptive management framework to avoid or minimize adverse effects of the Project on corridor function and negative human-wildlife interactions (Section 5.6). Without the implementation of the wildlife fence, the effects of the Project on human-cougar interactions are predicted to be strongly negative.

5.7.3.4 Cougars Predicted Project Effects (with Mitigation) Environmental Consequence

The impacts described in Sections 5.7.3.1 to 5.7.3.3 according to the impact criteria used to inform the determination of environmental consequence are summarized in Table 27. Residual changes in habitat quantity and quality in the Project area predicted to have small adverse effects. Residual changes in the use of approved wildlife corridors adjacent to the Project Boundary are predicted to be neutral because cougars are unlikely to be affected by increased human use on designated trails, and there is uncertainty about whether prey density will increase in proximity to development with a fence. The overall residual effects of the Project in terms of changes to negative human-cougar interactions are predicted to have neutral outcomes for cougars relative to existing conditions because the decline in negative interactions inside the Project Boundary may be countered by a potential increase in negative interactions in wildlife corridors. Consequently, the Project is not expected to change the self-sustaining and ecologically effective status of the cougar population identified in the RSA under existing conditions, and the environmental consequence is predicted to remain low.

Table 27: Residual Effects Summary for Cougars

<table>
<tr><th>Context</th><td colspan="4">The main source of cougar mortality (hunting) is managed to achieve stable populations in the RSA. Cougar densities within and surrounding the RSA are among the highest in the Province (ESRD 2012). Therefore, the cougar population is likely self-sustaining and ecologically effective.</td></tr>
<tr><th>Effect Category</th><th>Impact Criterion</th><th>Description</th><th>Prediction Confidence</th><th>Environmental Consequence</th></tr>
<tr><td rowspan="7">Habitat Quantity and Quality</td><td>Direction</td><td>Negative - Project area
Positive - Adjacent Corridor and LSA</td><td>High - the direction of change is expected to be negative for cougars in the Project footprint because of a loss of selected habitat. The direction of change is positive in the corridors and LSA.</td><td rowspan="7">Low</td></tr>
<tr><td>Magnitude</td><td>Project area: loss of 34.9 ha of selected and 104.4 ha used as available habitat due to fencing relative to existing.
Adjacent corridor: increase of 118.1 ha selected habitat</td><td>High – in Project area development will reduce habitat quality and fencing will exclude access to remaining selected habitats. These habitats represent a relatively small portion of available habitat at the RSA scale.</td></tr>
<tr><td>Geographic extent</td><td>ASP area – exclusion via fencing
Local - changes in adjacent wildlife corridors</td><td>High – RSF models, scientific literature, camera data, and conflict data the Bow Valley all indicate that the zone of influence from development is small for cougars. If changes in selection occur in habitats adjunct to development, the change is generally positive (Appendix B).</td></tr>
<tr><td>Duration</td><td>Long-term</td><td>High – development will be present for many decades.</td></tr>
<tr><td>Frequency</td><td>Once – construction of the wildlife fence.</td><td>High – construction of the fence will immediately restrict access by cougars to selected habitats in the Project Boundary.</td></tr>
<tr><td>Reversibility</td><td>Irreversible</td><td>High - development will be present for many decades.</td></tr>
<tr><td>Probability</td><td>Possible</td><td>Moderate – if development proceeds with a fence, cougars should be excluded from remaining selected habitat within the ASP area, but some uncertainty is present</td></tr>
<tr><td rowspan="2">Use of Approved Wildlife Corridor</td><td>Direction</td><td>Neutral</td><td>Moderate – the outcome of the Project has a potential to be positive relative to existing conditions.</td><td rowspan="2"></td></tr>
<tr><td>Magnitude</td><td>Small - the RSF predicts an increase of 118.1 ha of selected habitat in adjacent corridor.</td><td>Low – RSF models validate well, but do not consider potential effects of a fence on prey abundance adjacent to development.</td></tr>
</table>

Table 27: Residual Effects Summary for Cougars

Context	The main source of cougar mortality (hunting) is managed to achieve stable populations in the RSA. Cougar densities within and surrounding the RSA are among the highest in the Province (ESRD 2012). Therefore, the cougar population is likely self-sustaining and ecologically effective.			
Effect Category	**Impact Criterion**	**Description**	**Prediction Confidence**	**Environmental Consequence**
Use of Approved Wildlife Corridor	Geographic extent	Local	High – human use is highest close to development and zone of influence from development is small for cougars.	Negligible
	Duration	Long-term	High – development will be present for many decades.	
	Frequency	Continuous - change will occur incrementally over time as the Project is built	Moderate – Changes within wildlife corridors will occur over time as people are added, but the largest change will be associated with application of the fence and this change will occur rapidly with fence construction.	
	Reversibility	Irreversible	High – development will be present for many decades.	
	Probability	Likely	High – Neutral or positive effects are expected, based on available evidence.	
Negative Human-Wildlife Interactions	Direction	Neutral	Moderate – the outcome of the Project will be positive relative to existing conditions inside the Project and may be negative outside. Effects are predicted to balance each other and be net neutral. Mitigation effectiveness will be monitored and adaptively managed.	Negligible
	Magnitude	No change from existing conditions	Moderate – the outcome of the Project will be positive relative to existing conditions inside the western portion of the Project Boundary and may be negative outside. Effects are predicted to balance each other and be net neutral. Mitigation effectiveness will be monitored and adaptively managed.	
	Geographic extent	Local	High – the primary benefit will be within the fenced Project Boundary.	
	Duration	Long-term	High – development will be present for many decades.	
	Frequency	Once – construction of wildlife fence	High – construction of the fence will restrict access by cougars to selected habitats that are also heavily used by people in the Project Boundary.	
	Reversibility	Irreversible – wildlife fencing Reversible – human behaviour	High - development, including the exclusion fence, will be present for many decades. Human use of corridor can change depending on educational outreach, enforcement, and alternative recreational options	
	Probability	Likely	High – A neutral of better outcome is expected based on available evidence.	

a) Represents the most conservative estimate of loss, calculated using the total availability of habitats under the scenario with increased human use.

ASP area = Project Study Area Boundary; RSA = Regional Study Area; LSA = Local Study Area; RSF = resource selection function.

5.7.4 Wolves – Predicted Project Effects

5.7.4.1 Wolves Predicted Project Effects (with Mitigation) Habitat Quantity and Quality

Habitat quality declines incrementally for wolves within the ASP area and adjacent wildlife corridor with implementation of the Project, and the majority of these areas are predicted to be avoided by wolves with or without taking into account the effects of trail use by humans (Table 28, Figure 49 and Figure 50). Within the other approved corridors, no change in selection patterns was predicted when human use of trails was not considered, but habitat quality declined when human use of trails was considered (Table 28). These patterns were predicted because wolves avoid human development and activity (Appendix B). Within the full LSA, habitat quality declined with implementation of the Project, largely due to somewhat avoided habitat being converted to strongly avoided habitat (Table 28). In the scenario that did not consider increased human use of trails, the 24.9 ha of selected habitat under existing conditions was unaffected in the LSA; however 34.7 ha of used as available and 209.7 of somewhat avoided habitat were converted to strongly avoided habitats. Similar patterns were observed in the scenario that considered human use of trails: the 9.3 ha of selected habitat was unaffected although these was a conversion of 18.1 ha of used as available and 292.9 ha of somewhat avoided habitat into strongly avoided habitat.

Development of the Project with a wildlife fence surrounding the development is intended to eliminate any future wolf use of the ASP area. Fencing will increase the amount of wolf habitat loss by removing access to the remaining 6.2 ha of used as available habitat in the ASP area, under the scenario without increased human use of trails (Table 28). No selected habitat was predicted to occur in the ASP under either scenario (with or without human use of trails). A small amount of habitat between the Project and the Trans-Canada highway may also be lost depending on the final alignment of the proposed fence. The overall effect of the fence would be neutral under increased human use of trails because no selected habitats occur within the ASP area under existing conditions (Table 28).

The change in habitat quantity may have limited effect on the regional population given the paucity of wolf occurrence records south of the Bow River. Although some wolf habitat will be lost, deer and elk will also be excluded from the area. Elk and deer will likely be displaced elsewhere in the Bow Valley, potentially increasing the value of those habitats for wolves. The loss of access to the Project area will be neutral for the wolf population overlapping the RSA.

Table 28: Predicted Wolf Habitat in the Local Study Area with the Addition of the Project With and Without Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)												With Estimated Effects of Increased Human Use on Trails (ha)											
	ASP Area (ha)			Adjacent Wildlife Corridor (ha)			Other Approved Corridors (ha)			Remaining Largely Developed Areas (ha)			ASP Area (ha)			Adjacent Wildlife Corridor (ha)			Other Approved Corridors (ha)			Remaining Largely Developed Areas (ha)		
	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project
Selected	0.0	0.0	0.0	8.5	8.5	0.0	8.3	8.3	0.0	8.1	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.9	0.0	7.4	7.4
Used as available	6.2	0.0	-6.2	185.9	157.4	-28.5	106.9	106.9	0.0	63.3	63.3	0.0	0.1	0.0	-0.1	46.3	30.3	-16.0	23.5	15.2	-8.3	44.1	50.5	6.4
Somewhat avoided	146.2	1.0	-145.2	342.3	311.6	-30.6	233.4	233.4	0.0	216.9	183.0	-33.9	149.2	0.1	-149.0	477.9	416.8	-61.1	304.7	280.3	-24.3	230.9	171.5	-59.4
Strongly avoided	1.3	147.0	145.8	30.3	89.4	59.1	27.6	27.6	0.0	179.3	213.1	33.9	4.4	147.9	143.5	42.9	120.0	77.1	47.9	78.7	30.7	192.5	238.2	45.7
Rarely used	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0
Waterbody[(a)]	0.0	5.7	5.7	0.0	0.0	0.0	0.4	0.4	0.0	5.4	5.4	0.0	0	5.7	5.7	0.0	0.0	0.0	0.4	0.4	0.0	5.4	5.4	0.0

a) Habitat suitability is not assigned to waterbodies.
ASP = Area Structure Plan; ha = hectares.

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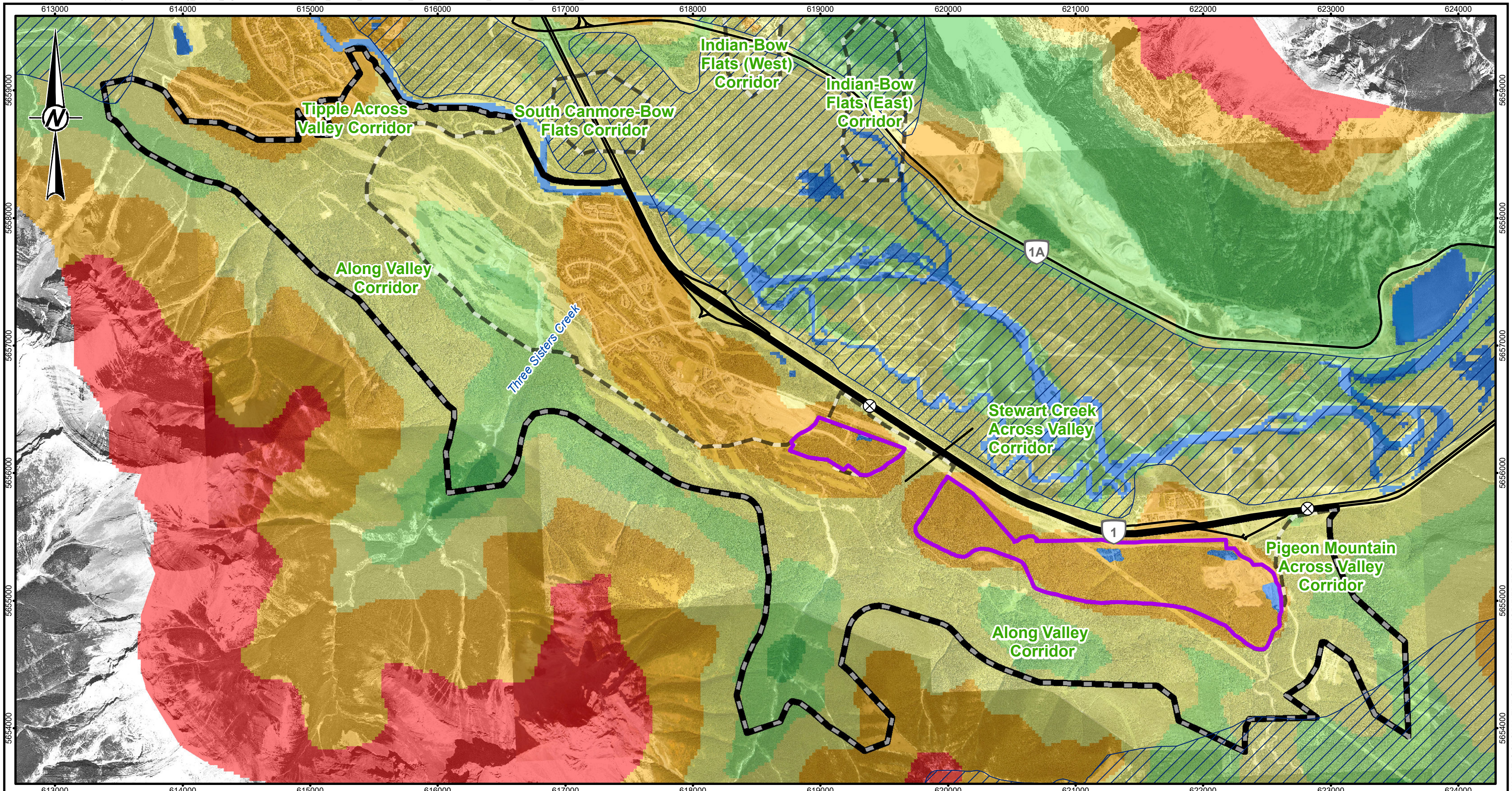

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600
1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT
GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE
PREDICTED WINTER WOLF RESOURCE SELECTION – PROJECT EFFECTS WITHOUT ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	49

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
25mm
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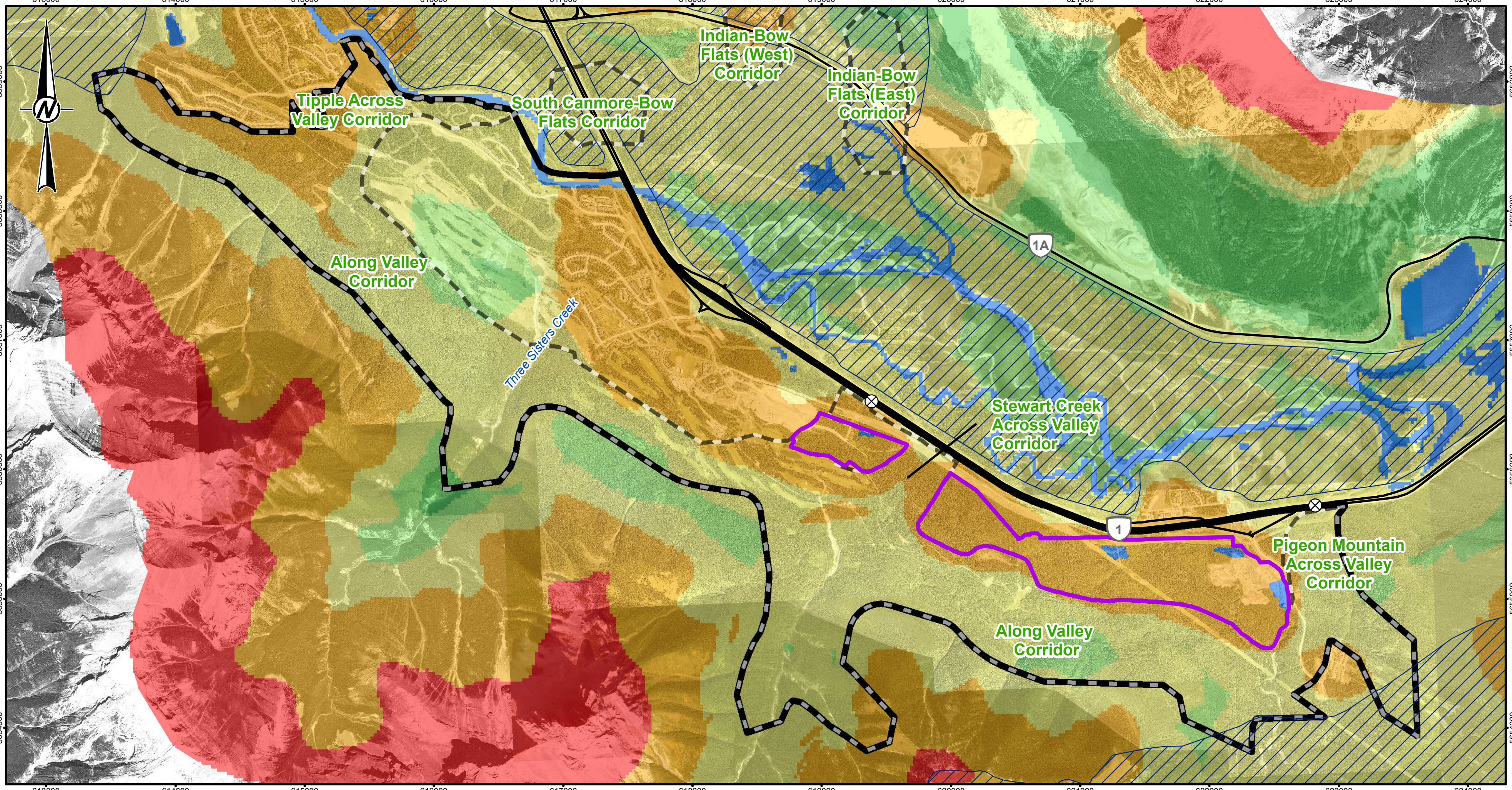

LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE

PREDICTED WINTER WOLF RESOURCE SELECTION – PROJECT EFFECTS WITH ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	50

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

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5.7.4.2 Wolves Predicted Project Effects (with Mitigation) Use of Approved Corridors

Under existing conditions, wolves in the RSA are predicted to retain a high probability of selection on the north side of the Bow Valley, whereas the south side of the valley has a greater proportion of avoided habitat. With the addition of the Project, most of the wildlife corridors in the LSA remain habitat that is avoided by wolves in winter (Figure 49 and Figure 50). Using the habitat model that assumed increased human use on trails, there was a predicted loss of 24.3 ha of used as available habitat, a gain of 1.9 ha of selected habitat, a decrease of 85.4 ha somewhat avoided habitat, and an increase of 107.8 ha of avoided habitat.

The Project is predicted to result in a further reduction in habitat quality within approved wildlife corridors on the south side of the Bow Valley. Most of the habitat in the Along Valley Corridor remains somewhat avoided after construction of the Project (Table 28). The Stewart Creek Across Valley Corridor between the western and eastern portions of the Project area is predicted to go from mostly somewhat avoided to primarily strongly avoided due to the Project. This is due to a zone of influence from development on either side of the corridor.

Wolves were not recorded using the Stewart Creek Underpass during 2007 to 2012, most likely because of high levels of human use (Section 5.3.5). Consequently, the change in probability of selection within this corridor may make little difference in the number of successful wolf movements through it. Without a combination of fencing, a wildlife crossing structure associated with the Three Sisters Parkway, and a single elevated access route for all human crossings of the corridor within the Project area, wolves may continue to avoid use the Stewart Creek underpass. However, with fencing, a wildlife crossing structure, elimination of human use within this corridor as well as site design principles associated with any development proposals directly adjacent to the wildlife corridor to minimize sensory disturbance (e.g., placement of residential buildings immediately adjacent to the corridor will be located in the furthest position possible from the corridor, rear yards will minimize exterior lighting and native vegetation will be maintained along the wildfire corridor interface) may improve conditions sufficiently to increase probability of use by wolves. Although possible, this improvement is highly uncertain and the overall precautionary conclusion of the EIS is that the effect of the Project on wolf use of wildlife corridors will be negative (Table 29), though the magnitude of this negative effect will be small in the context of no current use by wolves of the underpass under existing conditions.

The Pigeon Across Valley Corridor east of the Project Boundary is predicted to remain somewhat avoided by wolves after implementation of the Project (Figure 49 and Figure 50). The Along Valley Corridor adjacent to the Project contains substantial easy movement terrain and many trails demonstrating high use by wildlife (Appendix D). Wolves are expected to continue using these trails for movement at rates similar to those observed under existing conditions (i.e., very low).

Predicted changes in habitat selection do not account for the effects of fencing on wildlife use of adjacent corridors because fenced developments were not present in the Bow Valley when models were developed and responses to such developments could not be measured. As described in Section 5.7.1, by combining wildlife fencing with alternative options for recreation, especially off-leash dog parks, the potential effects of increased human use in the wildlife corridor are predicted to be reduced relative to building the Project without a fence.

Although fencing is a key mitigation that should minimize impacts of the Project on wolf use of wildlife corridors, large potential zones of influence around designated trails (Appendix B) mean that wolf probability of selection is still predicted to decline using the model with estimated effects of increased human use on trails, even if people remain on designated trails (Table 28). Effects to wolf use in corridors are therefore predicted to be negative (Table 29), although this conclusion is associated with some uncertainty and conditions for wolf use in wildlife corridors have the potential to improve relative to existing conditions if human use in wildlife corridors becomes less dispersed and wolves do not respond as negatively to human use on designated trails as the model predicts.

FireSmart measures implemented by the Town, the MD of Bighorn, and the Province that reduce forest cover and increase early seral habitats in wildlife corridors adjacent to the ASP area and TSMV lands outside the LSA would improve habitat conditions for wolves in wildlife corridors (Golder 2012). Improvement for wolves is likely strongly linked to increased use of early seral habitats by ungulate prey (Section 5.7.5).

Although the Project is predicted to contribute adversely to the serious risk and high environmental consequence identified for wolves under existing conditions (Section 5.3.5), the contribution to a high environmental consequence is likely small because wolves stopped using the Stewart Creek Underpass in 2006 and were not recorded using the Stewart Creek Underpass during 2007-2012 (Section 5.3.5). With the additional mitigations associated with the Project, there is the potential that wolves could begin using the Stewart Creek Cross Valley Corridor again.

5.7.4.3 Wolves Predicted Project Effects (with Mitigation) Negative Human-Wildlife Interactions

Based on the radio telemetry data and the winter RSF modelling of the RSA, wolves demonstrate the strongest avoidance of human infrastructure (e.g., built up areas, areas with high trail densities and gold courses) among the four wildlife VECs assessed. Given this avoidance of urban development and areas of high human use, negative human-wolf interactions have not been a substantial concern in the Bow Valley. However, as described in Section 5.3.5, this may be changing. Wolves in the Bow Valley are being observed more often by people in and around development and negative human-wolf interactions are occurring in neighbouring Banff National Park. Two wolves were destroyed there in 2016 as a result of food habituation. In January 2017, wolves were observed in and around developments in the south side of Canmore, contrary to the predictions of the RSF model.

As outlined in Section 5.6.3, TSMV will continue to implement the WHIPP; however, the mitigation commitments outlined in this EIS go beyond the provisions of the WHIPP. Wildlife fencing is predicted to have a positive effect on reducing the potential for wolf habituation. Development of the Project with a wildlife fence surrounding developments will eliminate or substantially reduce future wolf use of the area, limiting potential for habituation. Similarly, the potential for human-wolf encounters in wildlife corridors adjacent to the fenced Project is predicted to decrease from existing conditions if people use recreational amenities envisioned for the Project, such as the off-leash dog park and trail system and stay on designated trails when traveling through the wildlife corridor. There is some uncertainty about whether this benefit will be achieved because it would depend on how people access the wildlife corridor and on the good behaviour of people in wildlife corridors (Section 5.7.1). An increase in the number of encounters between wolves and people is possible in wildlife corridors adjacent to the ASP area if the new residents and visitors associated with the Project do not respect regulations in wildlife corridors, including ignoring direction provided on signs at entry points.

The residual effects of the Project in terms of changes to negative human-wolf interactions are predicted to be neutral relative to existing conditions.

5.7.4.4 Wolves Predicted Project Effects (with Mitigation) Environmental Consequence

Table 29 summarizes the impacts described in Sections 5.7.4.1 to 5.7.4.3 according to the impact criteria used to inform the determination of environmental consequence. Residual changes in habitat quantity and quality are predicted to have negative outcomes while negative human-wildlife interactions associated with the Project are predicted to have neutral outcomes for wolves. With the application of wildlife fencing, an effective trail network that connects to designated trails and is fun to use, and off-leash dog opportunities included in the Project ASP area, effects of the Project on the Along Valley wildlife corridor is predicted to be negative, but small. Effects from sensory disturbance associated with development on either side of the Stewart Creek Across Valley corridor are predicted to reduce much of the corridor from somewhat avoided to strongly avoided habitat, and this may create an impediment for wolf movement. Although the Project is predicted to contribute adversely to the serious risk and high environmental consequence identified for wolves under existing conditions (Section 5.3.5), the contribution to a high environmental consequence is likely small because wolves stopped using the Stewart Creek Underpass in 2006 and were not recorded using the Stewart Creek Underpass during 2007-2012 (Section 5.2.5). With the additional mitigations associated with the Project, there is the potential that wolves could begin using the Stewart Creek Cross Valley Corridor again.

Table 29: Residual Effects Summary for Wolves

Context	Under existing conditions, it is uncertain if wolves are self-sustaining and ecologically effective due to the limited use of wildlife corridors and habitat patches and the unknown level of stability of the regional wolf population. Using a precautionary approach, a serious risk is identified under existing conditions.			
Effect Category	**Impact Criterion**	**Description**	**Prediction Confidence**	**Environmental Consequence**
Habitat Quantity and Quality	Direction	Negative	High – Habitat lost within the Project area was primarily avoided under existing conditions.	Low
	Magnitude	Small: Project area: No loss of selected habitat, and 6.2 ha of used as available habitat will be lost Adjacent Corridor: 16.0 ha of used as available habitat lost and increase of 77.1 ha of strongly avoided habitat.	High – habitat quality is low relative to the north side of the Bow valley; fencing will exclude access to habitat that was used as available or somewhat avoided.	
	Geographic extent	Local	High – RSF modelling indicate that the zone of influence extends effects of habitat loss beyond the Project footprint.	
	Duration	Long-term	High – development will be present for many decades.	
	Frequency	Change will occur once, when the wildlife fence is constructed.	High – construction of the fence will immediately eliminate access by wolves to habitat in the Project Boundary.	
	Reversibility	Irreversible	High – development will be present for many decades.	
	Probability	Likely	High – with development proceeding with a fence, wolves will be excluded from within the Project Boundary.	

Table 29: Residual Effects Summary for Wolves

Context	Under existing conditions, it is uncertain if wolves are self-sustaining and ecologically effective due to the limited use of wildlife corridors and habitat patches and the unknown level of stability of the regional wolf population. Using a precautionary approach, a serious risk is identified under existing conditions.			
Effect Category	**Impact Criterion**	**Description**	**Prediction Confidence**	**Environmental Consequence**
Use of Approved Wildlife Corridor	Direction	Negative	Moderate – the outcome of the Project has a potential to be neutral or even positive relative to existing conditions with predicted reductions in dispersed human use.	Low
	Magnitude	Small – loss of 14 ha of used as available habitat and gain of 2 ha of selected habitat. Most change occurs in the Tipple Across Valley Corridor where no wolves were detected on cameras from 2009 to 2016.	Moderate – Evidence from the Benchlands study and the HUMR report suggests that with education and signage, people will respect the changes to trail use in the wildlife corridors. Evidence from fencing in Banff National Park demonstrates fencing is effective in managing human access.	
Use of Approved Wildlife Corridor	Geographic extent	Local	High – human use is highest close to development and effects from zone of influence are well documented in the literature.	
	Duration	Long-term	High – development will be present for many decades.	
	Frequency	Continuous - change will occur incrementally over time as the Project is built	Moderate – changes within wildlife corridors will occur over time as development proceeds and the population grows, but the largest positive change will be associated with application of the fence and this change will occur rapidly with fence construction.	
	Reversibility	Irreversible	High – development will be present for many decades.	
	Probability	Likely	High – Predictions based on RSF models that validated very well.	
Negative Human-Wildlife Interactions	Direction	Neutral	Moderate – effect of fence on reducing wolf habituation may be positive, but there is some uncertainty related to human behaviour in wildlife corridors.	
	Magnitude	No change from existing conditions	Moderate – outcome could be positive.	
	Geographic extent	ASP area – local, within wildlife corridors adjacent to ASP area	High – the primary benefit will be within the fenced ASP area, greater predictability of human use on designated trails will reduce the likelihood of encounters elsewhere in the wildlife corridors.	
	Duration	Long-term	High – development and wildlife fencing will be present for many decades.	

Table 29: Residual Effects Summary for Wolves

Context	Under existing conditions, it is uncertain if wolves are self-sustaining and ecologically effective due to the limited use of wildlife corridors and habitat patches and the unknown level of stability of the regional wolf population. Using a precautionary approach, a serious risk is identified under existing conditions.			
Effect Category	**Impact Criterion**	**Description**	**Prediction Confidence**	**Environmental Consequence**
Negative Human-Wildlife Interactions	Frequency	Once - the largest change when the wildlife fence is constructed Continuous – human behaviour within wildlife corridors adjacent to the ASP area	High – construction of the fence will eliminate access by wolves to habitats that are also heavily used by people in the ASP area. Moderate – a combination of educational signs, maps of designated trails and wildlife corridor entrance points, off-leash dog park, and enjoyable recreation trails inside the ASP area will decrease human and off-lease dog use of undesignated trails within wildlife corridors adjacent to ASP area.	Negligible
	Reversibility	Irreversible – wildlife fence Reversible – human behaviour	High - development, including the exclusion fence, will be present for many decades. Human use of corridor can change depending on educational outreach, enforcement, and alternative recreational options.	
	Probability	Likely	High – A neutral or better outcome is expected based on available evidence.	

ASP area = Project Study Area Boundary; RSA = Regional Study Area; LSA = Local Study Area; RSF = resource selection function.

5.7.5 Elk – Predicted Project Effects

5.7.5.1 Elk Predicted Project Effects (with Mitigation) Habitat Quantity and Quality

Habitat quality in the LSA is predicted to increase for elk following development of the Project. Within the ASP area there is a predicted conversion of 5.7 ha of selected or used as available habitat to an anthropogenic waterbody and an increase of 14.8 ha of selected habitat. There is also a predicted increase of 96.6 ha of selected habitat in adjacent wildlife corridors (Table 30, Figure 51). The net change is an increase of 96.7 ha of selected habitat within the LSA almost all of which is located in the ASP and the wildlife corridors adjacent to the ASP; minimal change was predicted in other approved corridors or remaining areas of the LSA (Table 30, Figure 51). Although probability of selection remains high because anthropogenic landscapes have low predation risk, forage quantity will decline, especially because landscaping will be undertaken using plants that are not palatable for wildlife, including elk (Section 5.6.3).

Fencing will make habitat in the ASP area more difficult for elk to access, resulting in the loss of 154 ha of habitat that is selected (133.2 ha) or used as available (20.4 ha) under existing conditions. A small amount of additional habitat between the Project and the Trans-Canada highway may also be lost depending on the final alignment of the proposed fence. Accounting for the 96.6 ha of improved habitat quality in the adjacent wildlife corridors, the net loss due to the ASP will total 57.4 ha of selected and used as available habitat (Table 30), which is about 3.8% of selected and used as available habitat available in the LSA under existing conditions. Effects of the Project on elk habitat quantity and quality are therefore considered negative, with a loss of 154 ha of habitat within the ASP area.

Table 30: Predicted Elk Habitat in the Local Study Area with the Addition of the Project

Habitat Class	ASP Area			Adjacent Wildlife Corridor			Other Approved Corridors			Remaining LSA		
	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project	Existing Conditions	Amount Remaining	Change from Project
Selected	133.2	148.0	14.8	245.4	341.9	96.6	195.1	195.2	0.1	467.6	467.6	0.0
Used as available	20.4	0.0	-20.4	270.5	185.5	-85.0	180.9	180.8	-0.1	0.0	0.0	0.0
Somewhat avoided	0.0	0.0	0.0	45.8	36.9	-8.9	0.1	0.1	0.0	0.0	0.0	0.0
Strongly avoided	0.0	0.0	0.0	5.4	2.7	-2.7	0.0	0.0	0.0	0.0	0.0	0.0
Rarely used	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waterbody[(a)]	0.0	5.7	5.7	0.0	0.0	0.0	0.4	0.4	0.0	5.4	5.4	0.0

a) Habitat suitability is not assigned to waterbodies.

ASP area = Project Study Area Boundary; <= less than.

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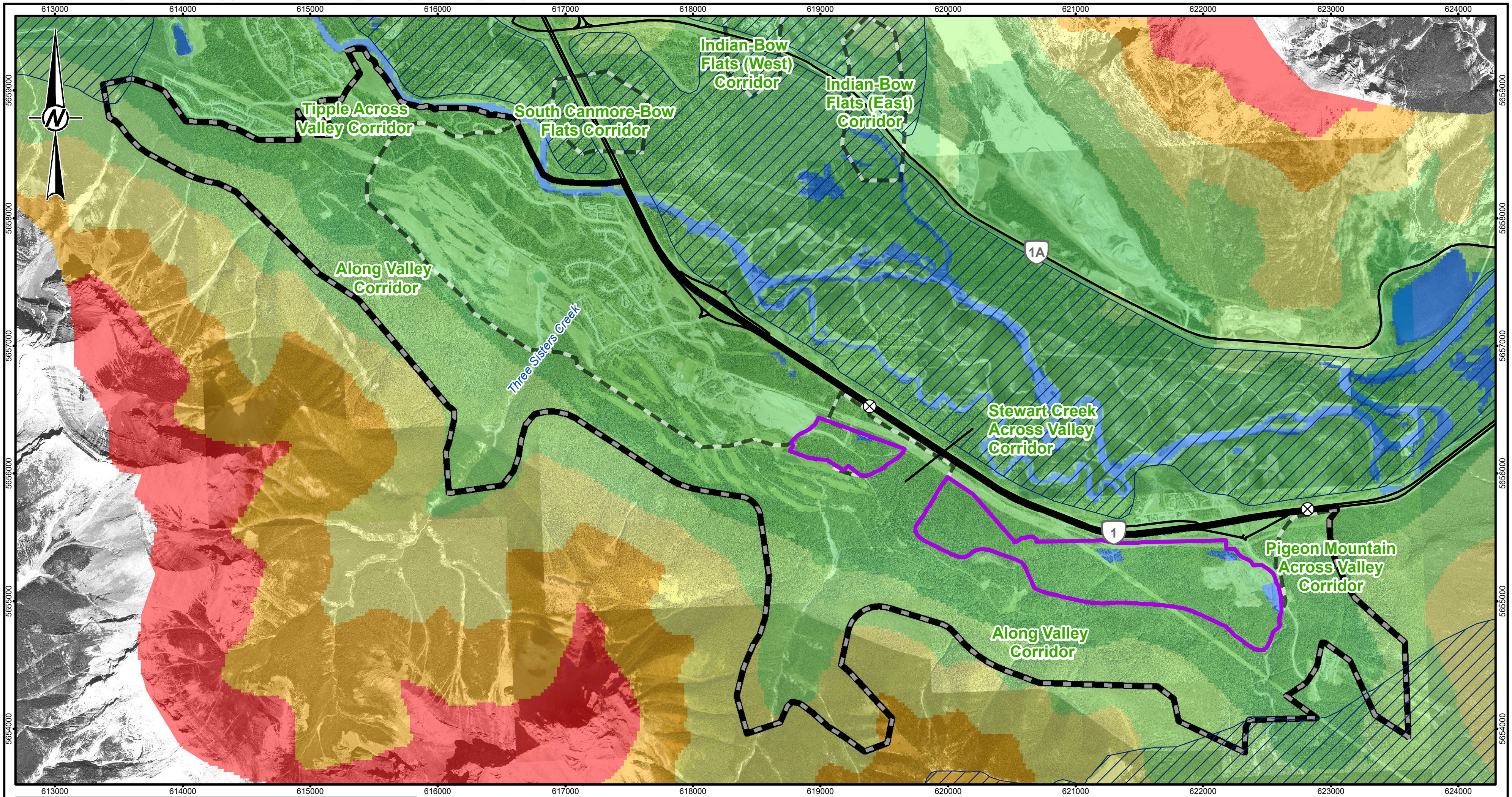

LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

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1:45,000 METRES

REFERENCE(S)

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2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

TITLE
PREDICTED WINTER ELK RESOURCE SELECTION – PROJECT EFFECTS

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	51

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5.7.5.2 Elk Predicted Project Effects (with Mitigation) Use of Approved Corridors

Elk habitat in wildlife corridors adjacent to the ASP area will increase in quality following the development of the Project (Table 30,Figure 51). An increase of 96.6 ha of selected habitat is predicted in wildlife corridors adjacent to the ASP area (Table 30). This change is expected because of the increased proximity of corridors to human residences, which will reduce the suitability of habitat for predators (Section 5.7.4.2). The predicted decrease of human use on undesignated trails and increased human use on designated trails (Section 5.7.1) will likely not affect elk, which are habituated to people.

The wildlife fence is predicted to eliminate access by elk to the ASP area, which could increase elk use of adjacent wildlife corridors when combined with the predicted increase in probability of selection. The fence also has potential to increase the risk of predation on elk by preventing escape from the wildlife corridor into urban areas that create a refuge from predators (Edwards 2013, Appendix B). Therefore, the increase in probability of selection predicted within the corridors by the RSF may not occur.

If elk use of wildlife corridors does increase, it could result in positive ecological outcomes. As described in Section 5.3.6, the concentration of elk in areas where wolves are scarce results in an overall reduction in mortality risk and an increased rate of calf recruitment (Hebblewhite et al. 2005b). This effect is so strong that elk remain in Canmore year-round where they access anthropogenic landscapes and maintain unusually small home ranges and high population density (Edwards 2013). High concentrations of elk in and around Canmore results in higher rates and intensities of parasitic infections because of frequent and repeated use of small numbers of foraging sites and day beds (Edwards 2013). The dispersal of elk to natural habitats (i.e., wildlife corridors) and their increased exposure to predators would be considered a positive effect because the ecological function of the elk population would improve.

FireSmart measures implemented by the Town, the MD of Bighorn, and the Province that reduce forest cover and increase early seral habitats in the wildlife corridors and south of the wildlife corridors, would help to compensate for the loss of anthropogenic grasslands, such as the unfinished golf course (Golder 2012). Increasing early seral habitats will bring conditions in the corridors closer to historical conditions that were likely more prevalent prior to active fire suppression (Figure 37).

Based on the weight of available evidence, elk use of corridors adjacent to the Project is not expected to change because elk are largely habituated in the RSA, corridors consist of selected and used as available habitats after Project development, and camera and telemetry data demonstrate elk use within wildlife corridors and developed areas under existing conditions. Elk are expected to continue using these trails for movement. The effect of the Project on elk use of wildlife corridors is therefore considered neutral.

5.7.5.3 Elk Predicted Project Effects (with Mitigation) Negative Human-Wildlife Interactions

Implementation of the Project is not predicted to result in a change in negative interactions between people and elk. As outlined in Section 5.6.3, TSMV will continue to implement the WHIPP; however, the mitigation commitments outlined in this EIS go beyond the provisions of the WHIPP. The potential for negative human-elk interactions within the ASP area will be reduced by building a fence, but elk may concentrate elsewhere in Canmore, potentially increasing the potential for negative interactions between people and elk in these different areas of Canmore.

Negative interactions with elk are already an issue of concern under existing conditions, both within TSMV lands and in other Canmore neighbourhoods. As described in Section 5.3.6, the habituation of elk in the RSA resulted in the identification of a serious risk under existing conditions because they do not function in their natural ecological role and are not considered ecologically effective.

Jay Honeyman, a wildlife conflict specialist with AEP, has indicated that elk in Canmore are problematic for public safety, and therefore elk are often herded away from playfields and playgrounds (Ellis 2017). According to Honeyman, keeping elk in wildlife corridors and habitat patches, and away from Canmore, is the most desirable outcome (Ellis 2017). To address public safety concerns, the Town of Canmore intends to install a wildlife fence around Centennial Park to exclude elk from the area (Town of Canmore 2019a). Other urban green spaces may also be fenced in the future (Town of Canmore 2019a).

The wildlife fence will be effective at reducing negative human-elk interactions within the ASP area and other developed areas of the LSA, but will not address similar problems elsewhere in Canmore, and could exacerbate them. In this context, habitat improvements in wildlife corridors and habitat patches are important mitigation. Reducing forest cover associated with FireSmart measures implemented by the Town, the MD of Bighorn, and the Province will increase early seral habitats in the wildlife corridors and increase the likelihood that elk use these areas. Larger cleared areas will result in greater benefits for elk (Golder 2012) and could help to reduce negative human-elk interactions by providing elk with alternative habitats. These measures, in combination with other wildlife exclusion fencing initiatives implemented by the Town, should reduce the risk of displacing negative human-elk interactions to other areas of Canmore.

Changes in negative human-elk interactions are predicted to be neutral as a result of the Project because the benefits of wildlife fencing around the ASP area could be offset by an increased risk of negative human-elk interactions elsewhere in Canmore. However, there is substantial uncertainty regarding how elk distribution in Canmore may change due to the wildlife fence. Managing human-wildlife conflict in Canmore and in the broader Bow Valley is a shared responsibility that requires collaboration among various levels of government, residents, and visitors (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018; Town of Canmore 2019b). The degree to which elk shift to other parts of Canmore may depend substantially on:

- the scope and effectiveness of human-wildlife coexistence measures implemented in Canmore (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018)
- whether or not the Town, the MD of Bighorn, and the Province implement habitat improvements in wildlife corridors and habitat patches, as recommended as part of mitigation identified in this EIS (Section 5.6.2)

5.7.5.4 Elk Predicted Project Effects (with Mitigation) Environmental Consequence

Effects described in Sections 5.7.5.1 to 5.7.5.3 according to the impact criteria are used to inform the determination of environmental consequence (Table 31). Development of the Project will affect the attractiveness of habitat in the ASP area for elk, but fencing will limit elk from accessing it and result in a negative effect. Changes in use of the wildlife corridors and negative human-elk interactions are predicted to be neutral for elk because of the Project.

The addition of the Project to existing cumulative effects is not predicted to affect the self-sustaining status of the elk population in the RSA because suitable habitats remain available and well distributed across the RSA. A serious risk for elk is identified under existing conditions because the regional population is not considered ecologically effective. The neutral effects of human-elk interactions should not contribute to further habituation of elk in the RSA and therefore the Project is not expected to contribute to the existing serious risk. However, there is uncertainty in this prediction because of the intense use by elk of anthropogenic habitats within TSMV. A moderate to low level of uncertainty is also present with respect to potential construction of habitat enhancements in habitat patches and wildlife corridors. If these are constructed in association with the Project, a positive outcome is possible for elk. In this case, an improvement in the ecological function of the elk population could be possible because elk would be more exposed to their natural predators.

Table 31: Residual Effects Summary for Elk

<table>
<tr><th>Context</th><td colspan="4">Elk in the RSA are not considered sensitive to the effects of habitat loss and sensory disturbance because they regularly use human-modified habitats and are highly habituated to humans. Elk may be self-sustaining in the RSA under existing conditions, but their natural ecological interactions have been substantially diminished. A serious risk is identified for elk under existing conditions because they do not function in their natural ecological role and are not considered ecologically effective.</td></tr>
<tr><th>Effect Category</th><th>Impact Criterion</th><th>Description</th><th>Prediction Confidence</th><th>Environmental Consequence</th></tr>
<tr><td rowspan="7">Habitat Quantity and Quality</td><td>Direction</td><td>Negative</td><td>High – forage quality will be reduced; fencing will make selected habitat in the Project ASP unavailable to elk.</td><td rowspan="7">Low</td></tr>
<tr><td>Magnitude</td><td>Small – with mitigation (fence surrounding the ASP) a net loss of 57 ha of selected and used as available in the LSA.</td><td>High – forage quality will be reduced; fencing will make selected habitat in the Project ASP unavailable to elk.</td></tr>
<tr><td>Geographic extent</td><td>Within the Project Boundary, with minor changes in adjacent wildlife corridors</td><td>High – RSF modelling predicts small changes in habitat quality in wildlife corridors. The loss of selected habitat due to the fence will be localized in the Project ASP.</td></tr>
<tr><td>Duration</td><td>Permanent</td><td>High – development will be present for many decades.</td></tr>
<tr><td>Frequency</td><td>Change will occur when the wildlife fence is constructed.</td><td>High – construction of the fence will immediately alter access by elk to selected habitats in the Project Boundary.</td></tr>
<tr><td>Reversibility</td><td>Irreversible</td><td>High – development will be present for many decades.</td></tr>
<tr><td>Probability</td><td>Possible</td><td>Low- substantial uncertainty is present about whether elk will enter the ASP area through the gap in the fence</td></tr>
<tr><td rowspan="4">Use of Approved Wildlife Corridor</td><td>Direction</td><td>Neutral</td><td>Moderate – uncertainty is present about how the fence will alter predation risk in the wildlife corridor.</td><td rowspan="4">Negligible</td></tr>
<tr><td>Magnitude</td><td>Small - Predicted increase of 96.6 ha of selected habitat in adjacent wildlife corridors.</td><td>Low/Moderate – RSF models validate well, available evidence demonstrate elk in the Bow Valley respond positively to human development, but elk response to potential changes in predation risk associated with the fence are uncertain.</td></tr>
<tr><td>Geographic extent</td><td>Immediately adjacent to the Project Boundary</td><td>Moderate – RSF modelling predicts small changes in habitat quality in wildlife corridors.</td></tr>
<tr><td>Duration</td><td>Long-term</td><td>High – development will be present for many decades</td></tr>
</table>

Table 31: Residual Effects Summary for Elk

Context	Elk in the RSA are not considered sensitive to the effects of habitat loss and sensory disturbance because they regularly use human-modified habitats and are highly habituated to humans. Elk may be self-sustaining in the RSA under existing conditions, but their natural ecological interactions have been substantially diminished. A serious risk is identified for elk under existing conditions because they do not function in their natural ecological role and are not considered ecologically effective.			
Effect Category	**Impact Criterion**	**Description**	**Prediction Confidence**	**Environmental Consequence**
Use of Approved Wildlife Corridor (continued)	Frequency	Change will occur when the wildlife fence is constructed.	High – construction of the fence will immediately alter access by elk to selected habitats in the Project ASP and may change how elk use adjacent wildlife corridors.	
	Reversibility	Irreversible	High – development will be present for many decades.	
	Probability	Possible	Moderate – changes in the corridor are likely to be small.	
Negative Human-Wildlife Interactions	Direction	Neutral	Low – the outcome of the Project is predicted to be positive within the ASP area, and there is uncertainty about how elk distribution will change in Canmore because of the fence and uncertainty about whether elk may enter the ASP area through the gap in the fence.	Negligible
	Magnitude	Small – positive effect in the ASP area, but potential for redistribution of negative interactions to other parts of Canmore is possible.	Low – there is uncertainty about how elk distribution will change in Canmore because of the fence and uncertainty about whether elk may enter the ASP area through the gap in the fence.	
	Geographic extent	ASP area – positive effects of exclusion Regional – potential for redistribution of negative interactions	Moderate – negative human-elk interactions could change throughout Canmore. There is uncertainty about how elk distribution will change in Canmore because of the fence.	
	Duration	Permanent	High – development will be present for many decades	
	Frequency	Once – the largest change will occur when the wildlife fence is constructed	High – change in elk behaviour will be primarily associated with construction of the fence, which will occur only once.	
	Reversibility	Irreversible	High – development will be present for many decades	
	Probability	Likely	Moderate – available evidence supports the conclusion, but uncertainty is present.	

ASP area = Project Study Area Boundary; RSA = Regional Study Area; LSA = Local Study Area; RSF = resource selection function.

5.7.6 Other Species and Species at Risk

Wildlife Mortality

The application of timing restrictions and other mitigation measures outlined in Section 5.6 will largely avoid negative effects of increased mortality for species at risk and other non-listed wildlife species during site clearing, construction, and operations. Predicted residual effects are as follows:

- **Direction**: negative
- **Magnitude**: negligible:
  - Mortality of songbirds avoided by restricting clearing during the Restricted Activity Period. Mortality of water birds and wetland associated birds largely limited by avoiding riparian areas and minimizing wetland disturbance, to the extent possible.
  - Mortality of raptors avoided by restricting clearing during the Restricted Activity Period.
  - Mortality of bats avoided by restricting clearing during the Restricted Activity Period; no loss of known hibernacula; no removal of existing infrastructure that could serve as bat roosts.
  - Mortality of amphibians largely limited by avoiding riparian areas and minimizing wetland disturbance, to the extent possible. Some individuals could be lost when occupying terrestrial habitats.
  - Mortality of large to medium bodied mammals is avoided by installing a wildlife fence that will exclude these animals from developed areas of the LSA.
  - Incremental increase in small mammal mortality on roadways; however, the extent is not possible to quantify. The most sensitive species (e.g., long-tailed weasel) are not likely to occupy the Project footprint.
  - Incremental increase in reptile mortality on roadways; however, the extent is not possible to quantify. Mortality in hibernacula is highly uncertain because there are no know locations in the Project footprint.
- **Geographic Extent**: local – restricted to the ASP area and areas in proximity to the footprint
- **Duration**: short-term (effects of site clearing and construction); long-term (effects of vehicle-wildlife collisions)
- **Frequency**: once (effects from clearing and construction); continuous (effects from vehicle collisions)
- **Reversibility**: reversible
- **Probability**: possible

Residual effects from changes in wildlife mortality risk are predicted to have a negligible environmental consequence large to medium bodied mammals. A low environmental consequence is predicted for smaller species that may occupy anthropogenic habitats (e.g., birds, bats, amphibians, rodents and other small mammals, reptiles) because they will not be excluded from the ASP by the fence. As a result, they will be exposed to a small change in mortality risk, even after mitigation.

Loss of Habitat Quantity and Quality

Species at risk and other non-listed wildlife species may be affected by changes to habitat quantity and quality. Predicted residual effects are as follows:

- **Direction**: negative
- **Magnitude**: negligible:
  - 90.0 ha loss of coniferous forest cover
  - 3.2 ha loss of mixed-wood forest cover
  - 5.9 ha loss of deciduous forest cover
  - 0.1 ha loss of wetlands
- **Geographic Extent**: ASP area (vegetation clearing); local (loss due to sensory disturbance)
- **Duration**: long-term
- **Frequency**: once (effects from clearing and construction); continuous (effects from sensory disturbance)
- **Reversibility**: irreversible
- **Probability**: likely

Residual effects from changes in wildlife habitat quantity and quality are predicted to have limited effects on most species at risk, particularly for those with no suitable habitat in the ASP area, those associated with riparian areas or open water habitats, and those whose occurrence in the LSA is not documented or unlikely (Section 5.3.1). For these species, changes to habitat quantity and quality are predicted to have a neutral effect, and therefore a negligible environmental consequence.

Regarding species that may occur in the ASP area, the magnitude of habitat change is considered small relative to the broader availability of habitats in the RSA. The magnitude of effects will be largest for species associated with coniferous forest habitats; however, coniferous stands are common and widespread in the LSA and RSA. Environmental consequence is predicted as low.

Use of Wildlife Corridors

Species at risk and other non-listed wildlife species may change their use of wildlife corridors. In the case of bighorn sheep, use of the corridor is to access minerals at the Stewart Creek Underpass. If access to this anthropogenic mineral source was detected through monitoring, other anthropogenic mineral sources could be deployed to mitigate any potential adverse effect (Section 5.6.3). No other adverse effects to bighorn sheep movement are predicted. Predicted residual effects are as follows:

- **Direction**: negative
- **Magnitude**: negligible
- **Geographic Extent**: local
- **Duration**: long-term

- **Frequency**: continuous
- **Reversibility**: irreversible
- **Probability**: likely

Environmental consequence of changes to wildlife corridor use are predicted to be negligible.

5.8 Wildlife Uncertainty and Monitoring

Uncertainty

Site-specific empirical data, empirically derived RSF models, and scientific literature are used to understand existing conditions and to predict the potential effects of the Project on wildlife. When combined with precautionary assumptions[15] that are likely to overestimate potential adverse effects of the Project, the available evidence indicates that the effects caused by the Project will not be worse than predicted in this assessment. Factors increasing certainty in the conclusions of the wildlife assessment include:

- Conceptual development footprints identified for the ASP overestimate the total area that will ultimately be developed and the maximum number of units associated with the Project was used to predict effects.
  - For instance, some of the districts included in the conceptual land use plan may not be fully developed or entirely cleared of native vegetation but the entire boundaries of these districts were assumed to be disturbed for the purposes of the assessment.
- RSF models used for the assessment validate very well (Appendix B), indicating that they have an excellent ability to predict spatial patterns of selection by wildlife and changes in probability of selection because of zones of influence associated with the Project.
- Models incorporating intensity of trail use by people and zones of influence based on flight initiation distance[16] were evaluated. These models quantified the potential effects of wildlife use of corridors under scenarios that explored changes in human use on designated and undesignated trails.
- Ten years of camera data, including 1,362 locations and 42,558 camera monitoring days, were available and analyzed to provide an understanding of seasonal, diel and spatial patterns of wildlife and human use in wildlife corridors and TSMV lands.
- Mitigation such as clearing outside of the migratory bird nesting window are effective for limiting or avoiding wildlife mortality.
- The type of wildlife fencing proposed to maintain separation between wildlife and people to limit negative human-wildlife interactions within the ASP area has proven to be highly effective for controlling wildlife entry (Clevenger et al. 2009). Further, fencing will exclude larger animals from areas where vehicle traffic can increase the risk of collisions causing injury or mortality.

[15] As described in Section 4.4, the precautionary approach used when preparing this assessment means that predicted adverse effects identified within this report are predicted to be greater than the effects that are likely to be observed when the Project is built. For example, if there was a high level of uncertainty about whether certain effects would result in a serious risk to a VEC, the assessment conservatively assigned a high risk to avoid an underestimation of effects.

[16] Flight initiation distance is a metric that indicates the distance within which wildlife may respond to a disturbance (e.g., being approached by a human) by moving away from the source of the disturbance.

- Information collected as part to the Human Use Management Review (Town of Canmore 2015c) indicates that better delineation of wildlife corridor boundaries and education would result in people changing their behaviour to recreate less in wildlife corridors.
- Wildlife conflict data were available from AEP, including maps of the distribution of human-wildlife conflict risk. These data were used in the analysis and improved the understanding of how the Project could interact with areas of known human-wildlife conflict.
- Expert opinion of wildlife managers in the Bow Valley was used to inform predictions and analysis.

Although the available data provides substantial support for the predictions made in this assessment, some uncertainty remains. As described in more detail below, monitoring and adaptive management approaches can mitigate this uncertainty. Residual uncertainty is associated with the following:

- Ecological thresholds may exist beyond which changes are non-linear or exhibit surprising outcomes that cannot easily be predicted from existing data (Kelly et al. 2014).
- Human behaviour is challenging to predict and predictions about future human use of wildlife corridors depend on current and future citizens of Canmore responding positively to education, signs, fencing, and enforcement such that they comply with existing regulations in wildlife corridors. Positive outcomes will depend also on ongoing collaboration among various levels of government to address education and enforcement needs and improving regulations, such as those related to wildlife attractants.
- Potential changes in negative human-wildlife interactions elsewhere in developed areas of the Bow Valley because of the Project remain uncertain, especially for elk.

The consequences of being wrong about the potential effects of the Project or the efficacy of mitigation could be substantial for wildlife in the Bow Valley. If the Project is to proceed without the proposed mitigation, or if proposed mitigation is less effective than predicted, the Project has the potential to contribute to a high environmental consequence for wildlife.

For example, if mitigation proves unsuccessful, the increase in residents and visitors associated with the Project (traffic studies indicating potentially more than 10,000, Section 3.0) would exacerbate the serious risk already present for grizzly bears under existing conditions. Levels of negative human-bear interactions higher than those currently observed in Peaks of Grassi are predicted in the ASP area without fencing and associated mitigation.

Similarly, if fencing and associated mitigation proves ineffective for achieving human behaviour that follows existing regulations in wildlife corridors, the currently high levels of undesignated trail and off-leash dog use in wildlife corridors adjacent to the Project could increase dramatically because of the Project. This increase could contribute to the serious risk to wolf movement already present in the RSA under existing conditions.

Where consequences associated with uncertainty are potentially high for wildlife, as they are in the case of new developments in the Bow Valley, monitoring and adaptive management should be applied (MSES 2013, Foley et al. 2015). Consequently, a monitoring program is recommended in conjunction with a phased approach to developing the Project to facilitate adaptive management.

Adaptive management is a tool for decision making in the face of uncertainty (Williams 2011) and, after identifying appropriate actions and making predictions about their outcomes, is comprised of four iterative steps: act, measure, evaluate, and adapt. In the case of the Project, actions represent the phased development, measurement and evaluation are undertaken through monitoring, and adaptations may be undertaken if monitoring indicates that they are required. These concepts are discussed in turn in the following sections.

Phased Development

Phased development of the Project should be undertaken in a manner that facilitates adaptive management in response to monitoring. For instance, development should begin by constructing the wildlife fence (Figure 44), as proposed in Section 5.6.4, prior to occupancy of the first building. Early construction of the fence will permit evaluation of the efficacy of the fence for 1) excluding large mammals from the ASP area, and 2) improving compliance with existing regulations in wildlife corridors. An education and enforcement campaign undertaken by TSMV, the Town and the Province over the first 5 years that the fence is in place is recommended to maximize efficacy of fencing and education in achieving compliance with trail use, off-leash dog use, and seasonal closure regulations within wildlife corridors. A coordinated approach implemented by authorities such as the Town and/or Province and supported by TSMV may be most effective. This is especially important for existing residents, who may be using wildlife corridors inappropriately because they are unaware of legal requirements or the location of corridor boundaries (Town of Canmore 2015c; Derworiz 2015). Other examples of adaptive management may include modifying the location or number of access points to the corridor or reconfiguring lighting design.

Prior to developing within 200 m from the corridor boundary results of the monitoring should be examined to determine if any adaptive management mechanisms (e.g., different lighting, noise attenuation, additional enforcement, changing trails and access points, and adjusting elements of final fence design [see Section 5.6.4]) are required. Note that the 200 m zone is not intended to stop the development of this area, but rather this is the zone in which the previously described mitigations (e.g., changes to lighting, noise attenuation, fence design) would be adjusted if required. This approach to development will permit monitoring to occur in the wildlife corridor as development moves from north to south, providing opportunities for adaptive management. Recent decision about wildlife corridors in the Bow Valley (AEP 2020) outlines that wildlife corridors have been designated such that “additional management approaches are not needed outside of the delineated corridors including additional buffers, setbacks of layering of uses”. Consequently, adaptive management does not include substantive changes to the arrangement of development types within the ASP which were assumed to be fixed for the purposes of this EIS.

Monitoring

The primary issues of concern with respect to uncertainty relate to changes in human and wildlife use of wildlife corridors and negative human-wildlife interactions in those corridors. Consequently, a monitoring program will be developed to evaluate these uncertainties and provide opportunities for adaptive management.

The EIS made several predictions with respect to the effectiveness of the fence and other mitigations which can be treated as hypotheses that can be tested as part of a wildlife monitoring program. For example, wildlife fencing (Sections 5.6.3 and 5.6.4) was predicted to prevent most large mammals from entering the Project and provide controlled access points where people may enter the corridor network on designated trails, utility maintenance access points, or other rights or way. Similarly, education, signage and off leash dog parks inside the fence were predicted to reduce negative human-wildlife interactions through reduced use of undesignated trails in wildlife corridors and reduced off-leash dog use in wildlife corridors (relative to implementing the Project without these mitigations). The combined suite of all mitigation proposed for the Project was predicted to result in wildlife movement that is maintained within wildlife corridors for grizzly bears, cougars, wolves, and elk. Examples of hypotheses that could be evaluated, possibly using an array of wildlife cameras or other methods, include:

- fewer large mammals will be detected within the ASP area than outside it (e.g., in the wildlife corridor) following fence construction[17]

[17] Elk could be a good species to examine when testing this hypothesis because elk currently congregate in developed areas and are much less commonly detected in wildlife corridors (See Section 5.3.6).

- the percentage of people using designated trails relative to undesignated trails will increase
- the number of negative human-wildlife interactions[18] will decrease inside the fence
- the relative percentage of leashed dogs in wildlife corridors will increase and off-leash dog use will be concentrated in designated off-leash dog parks on TSMV property inside the wildlife fence
- wildlife (e.g., grizzly bears, cougars, wolves, and elk) will continue to use the wildlife corridors adjacent to the ASP boundary at rates like those detected prior to the Project[19]

Because of the high environmental consequences already present in the RSA for some species under existing conditions and because of broader regional implications of changes in human use and negative human-wildlife interactions in the future, considerable collaboration among stakeholders, including financial collaboration and sharing resources, will be required to manage human use in wildlife corridors and limit negative human-wildlife interactions in the Bow Valley. Consequently, monitoring for the Project should be integrated with broader regional monitoring programs, where these are being undertaken. Wildlife monitoring plans have been developed and implemented in the Bow Valley for decades and any new monitoring plan should consider the recommendations and learnings from previous plans (e.g., BCEAG 2001, Bow Valley Human-Wildlife Coexistence Technical Working Group 2018). This section recommends an approach to developing the monitoring program and identifies some of the key considerations that should be accounted for.

In particular, the adaptive monitoring for the Project should be integrated with, and implemented as part of, TSMV's participation in a broader working group that may include TSMV, the Town, the Province, and possibly other organizations. One example of such a group is the Human-Wildlife Coexistence Technical Working Group which was tasked by the Bow Valley Human-Wildlife Coexistence Roundtable to address the current state of human-wildlife coexistence within the Bow Valley. The Roundtable was recommended by the Province as part of the Smith Creek Corridor Decision (AEP 2020). The EIS has not identified specific metrics, targets, and thresholds for the wildlife monitoring program. These details, along with a decision-making structure and a mechanism for dispute resolution should be established as part of the broader working group such that the resulting monitoring program adequately addresses key questions, identifies acceptable thresholds, metrics, and targets, and can respond effectively when adaptive management is required. The monitoring program will include methods, predictions, metrics, targets, and thresholds and will be developed prior to the first Conceptual Scheme approval in the ASP area. Where appropriate, the monitoring program should involve collaboration with other regional or cooperative monitoring efforts such as the wildlife camera program run by AEP.

The program should consider the following:

- A before after control impact (BACI) design may be appropriate to isolate the effects of the Project.
- Remote cameras may be the appropriate data collection tool to monitor use of wildlife corridors by people, off-leash dogs, and large mammals. The reasons for using remote cameras are a) substantial remote camera data are available for TSMV between 2009 and 2016 (existing conditions), and b) data collection by the Town and the Province for the Human Use Management Review has been collected using remote cameras to monitor human and wildlife use of wildlife corridors and habitat patches in the RSA. Integration with the Human Use Management Review study is recommended.

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[18] Monitoring negative human-wildlife interactions is a responsibility of the Province, to which negative interactions are reported.

[19] Great care must be taken to account for confounding factors when evaluating this hypothesis. For example, regional declines in species abundance may result in a reduction in wildlife detections unrelated to the efficacy of mitigation implemented for the Project. Consideration should be given to control sites or other means of addressing possible confounding factors.

- Fixed camera locations should be considered to facilitate detecting trends in use over time. The potential need to collect additional baseline data from fixed locations should be evaluated.
- Some cameras should specifically target monitoring bighorn sheep use of existing licks to address uncertainty about ongoing bighorn sheep use of these important habitat features.
- Statistical power should be considered when defining sampling effort.
- The design should account for possible confounding factors that could affect the interpretation of results.
- AEP currently collects information about negative human-wildlife interactions. The adequacy of this information to test predictions of this EIS should be considered, and additional data collection approaches identified, if required.
- Data and results of monitoring will be compiled annually and provided to other member agencies of the Human-Wildlife Coexistence Technical Working Group.

Adaptation

As indicated by the name “adaptive management”, provisions need to be in place so that the Project can be adjusted, if required. Specifically, the identification of metrics, targets and thresholds (as described above) will allow for the evaluation of performance against expected outcomes. Adaptation is not always necessary, and if monitoring indicates that the predictions of this EIS are met, no adaptation would be required. On the other hand, if monitoring identifies important deviations[20] from the predictions of the EIS (e.g., targets not met or thresholds exceeded), then adaptation should be explored if the Project is identified as the cause of the deviation.

The adaptation applied would depend on the type and cause of the deviation from EIS predictions and may need to be applied to the developer, the Town, or the Province, depending on the situation. Potential adaptations include:

- updating educational materials
- implementing or increasing habitat improvements within wildlife corridors or habitat patches
- increasing enforcement
- opening new trails or consolidating existing trails to create a more desirable trail
- adapting the recreation opportunities offered on Town or TSMV owned land
- closing trails or adjusting when trails can be accessed within wildlife corridors (e.g., closure during winter or at night time, or other seasonal closures)
- adjusting fence design
- examining timed or guided entry into the corridors
- other solutions as deemed appropriate to address the identified concern

[20] Important deviations would be findings contrary to the predictions of this EIS. An example could be if human use on undesignated trails increased after implementation of the fence, enforcement, and education, which would be contrary to the prediction of this EIS.

Monitoring needs to continue to evaluate success and the potential need for adjustments. Monitoring should cease when uncertainty about the effects of the Project and associated mitigation has been resolved. The decision to stop monitoring could be made at any time with the approval of the Province, and TSMV's contribution would continue no longer than the issuance of a Final Acceptance Certificate (FAC). The Province may choose to continue monitoring at their discretion, but the developer's responsibility would end after the Project is completed at full buildout and the developer has incorporated any adaptations that may be required.

5.9 Wildlife Cumulative Effects

5.9.1 Human Use – Wildlife Cumulative Effects

Human use on trails in the RSA has been rising at a rate of 6% annually (J. Herrero, unpublished data). With or without the Project or other RFDs, human use on designated and undesignated trails in the RSA, including those in wildlife corridors is predicted to increase. A 6% annual increase translates to a doubling in human use every 12 years. Whether such a high rate of increase would continue is uncertain. However, the combined effect of the Project, other reasonably foreseeable urban developments, population growth in other towns in the RSA, and growth of the city of Calgary could result in doubling the number of people residing in the RSA and more than tripling the number recreating in the RSA by 2055. Estimates from the Town's Utility Plan indicate that the Town could achieve a population of 34,000 at full build out (Town of Canmore 2017b). This increase in population and human use in the RSA is predicted to lead to decreased habitat effectiveness for many wildlife species and increased negative human-wildlife interactions over time. Both legal and illegal use of wildlife corridors would likely more than double, unless something is done to change patterns of human use relative to those observed under existing conditions. Temporal and seasonal patterns of human use are not expected to change dramatically and most use in 2055 will likely continue to be during the day and in summer. However, new cold weather activities, such as fat biking, may contribute to increasing human use during winter relative to existing conditions.

5.9.2 Grizzly Bears – Cumulative Effects

5.9.2.1 Grizzly Bears Cumulative Effects Habitat Quantity and Quality

During summer, substantial habitat that is selected or used as available remain in the RSA for grizzly bears after cumulative effects have been accounted for (Table 32, Figure 52 and Figure 53). Using the model without estimated effects of increased human use on trails, total reductions represent less than 1% of the selected habitat in the RSA under existing conditions. The model with estimated effects of increased human use on trails predicts a 2.0% decline in selected habitat at the RSA scale (Table 32).

As described in Section 5.7.2, fencing associated with the Project, means that 141.2 ha of currently selected or used as available habitat within the ASP area will become unavailable to grizzly bears. These habitats represent an ecological trap and their removal is predicted to benefit grizzly bears relative to existing conditions.

The resulting habitat conditions integrate the combined effects of previous and existing developments in the RSA (e.g., Trans-Canada highway, railway, industrial development and mining, urban development, growing human population, and trails [Section 5.3.3]) in addition to the Project and other RFDs. The effects of climate change were not quantified.

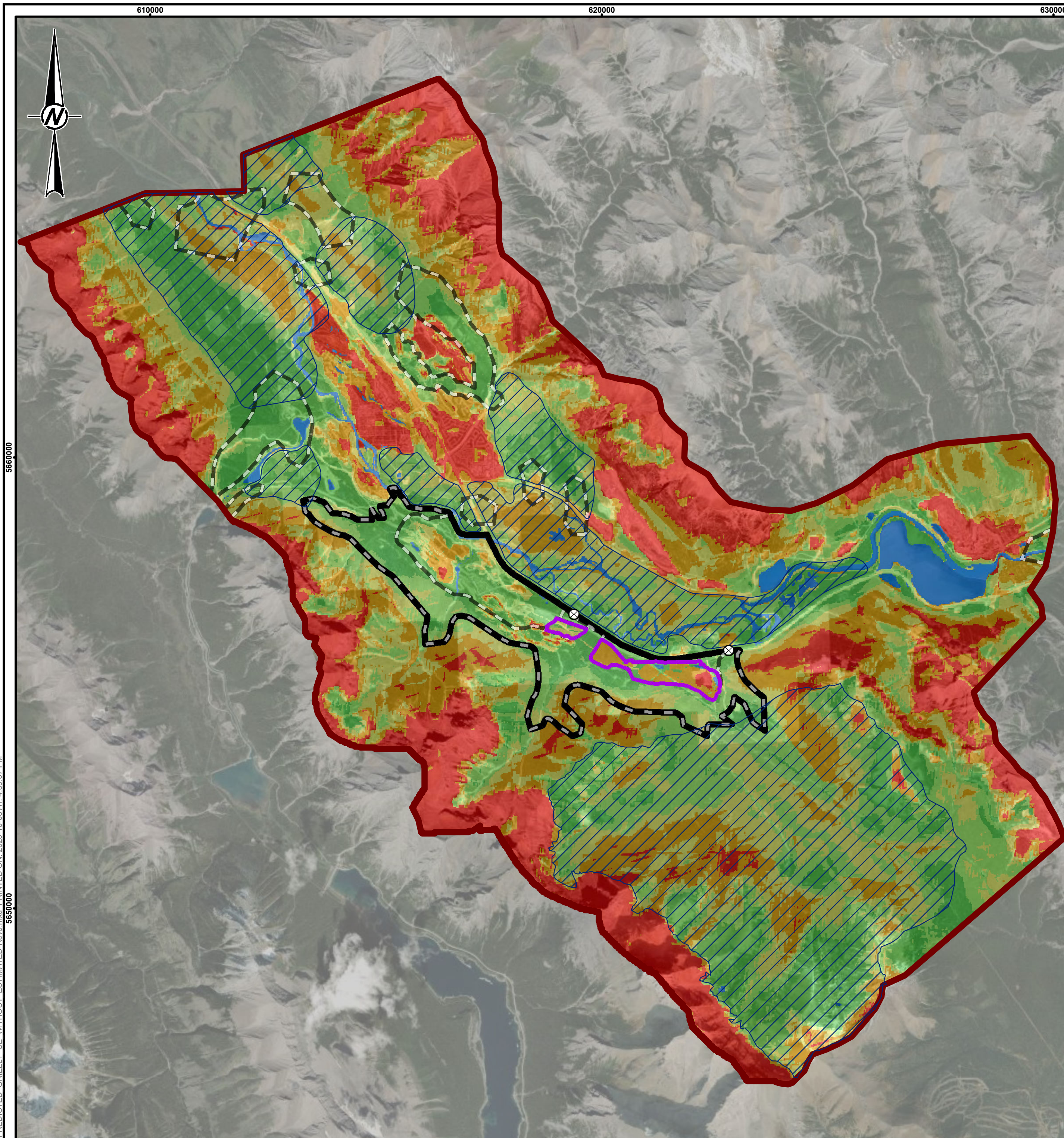
Table 32: Predicted Grizzly Bear Habitat in the Regional Study Area with the Addition of the Project and Other Reasonably Foreseeable Developments With and Without Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)			With Estimated Effects of Increased Human Use on Trails (ha)		
	Existing Conditions	Amount Remaining	Change from the Project and RFDs	Existing Conditions	Amount Remaining	Change from the Project and RFDs
Selected	3900.9	3887.5	-13.4	3639.2	3567.6	-71.6
Used as available	4975.4	4836.6	-138.8	4916.7	4749.4	-167.4
Somewhat avoided	4656.5	4647.6	-8.9	4795.2	4797.7	2.4
Strongly avoided	4720.5	4824.7	104.3	4870.1	5022.3	152.2
Rarely used	5009.0	5055.2	46.2	5041.1	5114.6	73.6
Waterbody[(a)]	616.0	626.7	10.7	616.0	626.7	10.7

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

RFDs = reasonably foreseeable developments; ha = hectare.



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LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- HABITAT PATCH
- REGIONAL STUDY AREA
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 2,000 4,000

1:125,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, JANUARY 2017.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE
PREDICTED SUMMER GRIZZLY BEAR RESOURCE SELECTION – CUMULATIVE EFFECTS WITHOUT ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	52

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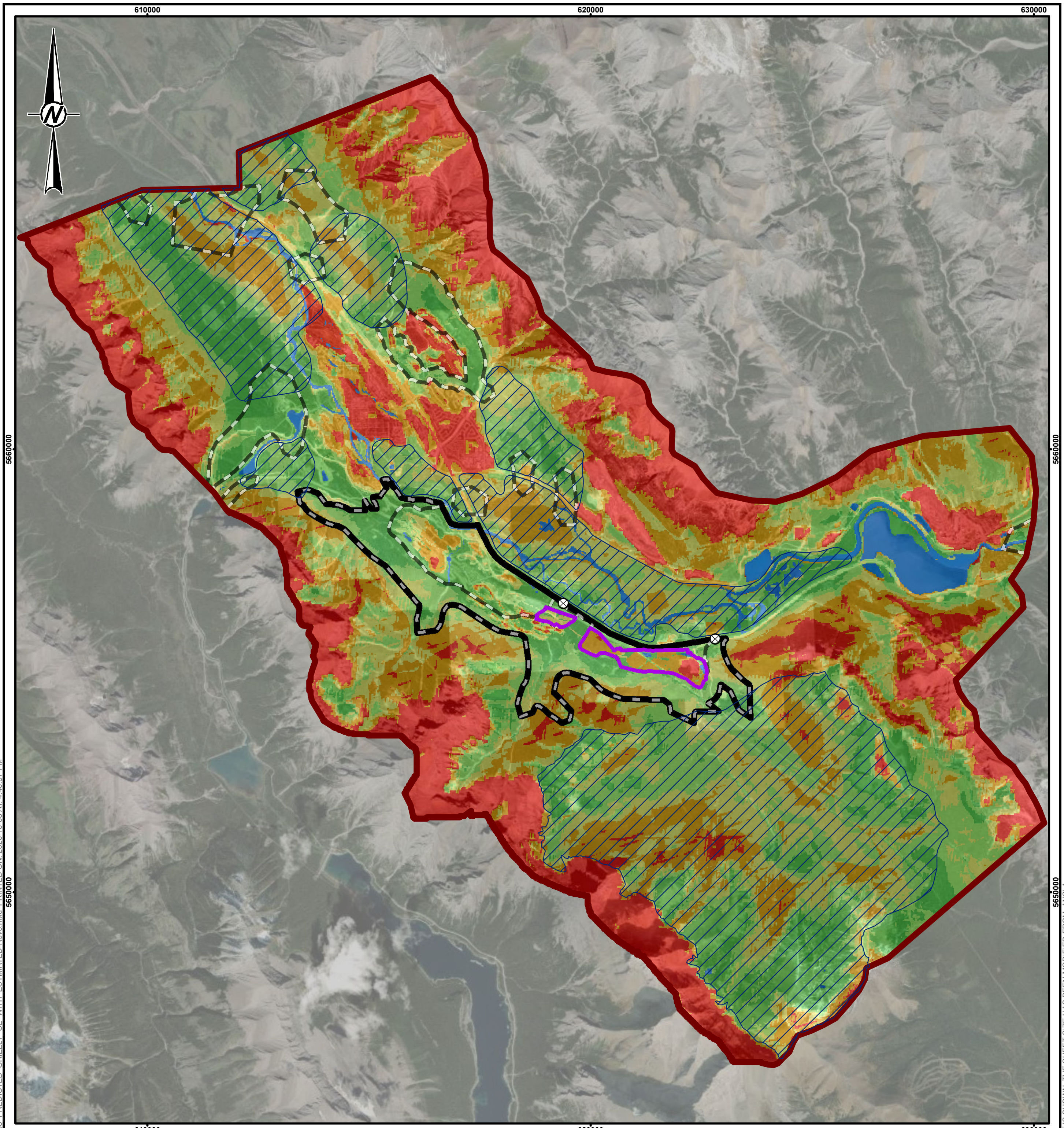

LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- HABITAT PATCH
- REGIONAL STUDY AREA
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 2,000 4,000

1:125,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, JANUARY 2017.
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PREDICTED SUMMER GRIZZLY BEAR RESOURCE SELECTION – CUMULATIVE EFFECTS WITH ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	53

Potential effects from climate change in the RSA include an increased risk of forest fires and insect infestations, which would reduce the quality and availability of forested habitats. One prediction for forest fires in Canada indicates the potential for a 74% to 118% increase in average burn area by the end of this century (Flannigan et al. 2005). FireSmart measures implemented by the Town and province may decrease these effects, to a certain extent. Historically, climatic conditions were more conducive to keeping insect populations under control (Carroll et al. 2004) but with milder winters, insect outbreaks are more likely. Stands dominated by old growth pine are considered most vulnerable to the effects of insect infestations (Carroll et al. 2004; Taylor and Carroll 2003).

Climate change could also induce treeline migration into higher elevations (Harsh et al. 2009), which could encroach alpine ecosystems (Dirnbök et al. 2011). The extent of this change is uncertain because some studies have shown that other factors, such as grazing, soil properties, microsite availability, and species' dispersal and recruitment behaviour, can limit elevational shifts of treeline in alpine systems (Klasner and Fagre 2002; Dullinger et al. 2004; Davis and Gedalof 2018). Overall, effects on grizzly bear habitat quantity and quality will be negative if all RFDs described in Section 4.5 are undertaken. The magnitude of change predicted is small relative to the availability of selected and used as available habitats in the RSA. Further, most RFDs in the RSA are expansions of existing urban development, which means that new developments will be created in proximity to areas already disturbed and occupied by humans. Additional effects could occur as a result of climate-induced changes, but these are difficult to predict. Reduced forest cover could benefit grizzly bears if that is an outcome of climate change.

5.9.2.2 Grizzly Bears Cumulative Effects Use of approved corridors

As mentioned in Section 5.9.2.1, previous and existing developments in the RSA have influenced the quality and quantity of habitats in the RSA. These same cumulative changes have also influence regional habitat connectivity for grizzly bears. Although grizzlies are using wildlife corridors and other undeveloped lands to move between habitat patches under current conditions (Section 5.3.3), the Trans-Canada Highway and associated fencing limits across valley movement. During six years of monitoring between 1999-2002 and 2004-2007, no grizzly bears were documented using either the Stewart Creek Underpass or the G8 Legacy Underpass across the Trans-Canada Highway (Clevenger et al. 2002, 2007). However, grizzly bears were documented using both corridors in 2009 and 2012 (ESRD, unpublished data). Moreover, collared bears are known to cross the Trans-Canada Highway at underpasses linked by existing wildlife corridors (Appendix B, Figure B2), although across valley movement through underpasses was much less common than along valley movement (Figure 31 in Golder 2013).

Fencing along the portion of the proposed Three Sisters Parkway that passes through the Stewart Creek Across Valley Corridor will guide wildlife through the planned wildlife underpasses (Section 5.6.4, Figure 44). Fencing will reduce human activity in the corridor and increase the corridor's effectiveness for wildlife movement. The existing Stewart Creek Underpass and planned underpasses (Three Sisters Parkway and the Trans-Canada Highway) will facilitate the movement of bears through this corridor.

As demonstrated in Appendix B (Figure B-10), there is a strong positive relationship between the probability of selection class and the proportion of grizzly bear steps overlapping with each habitat class. This relationship indicates that the RSF is a good reflection of grizzly bear movement and that selected habitat is especially important for movement (i.e., resistance is very low relative to other classes). Using estimates from the RSF model with increased human use on trails, habitat classes in the wildlife corridors consist primarily of habitats that are selected (31%) or used as available (31%) by grizzly bears under existing conditions (Table 33). This pattern of selection changes little when all RFDs are added using models with or without estimated effects of increased human use on trails (Table 33). A similar pattern is observed at the scale of the entire RSA, where a 2.0% decline in selected habitat is predicted (Section 5.9.2.1, Table 32). These predictions are mostly explained by the nature of RFDs included in the analysis (i.e., mainly expansions of existing developments), the spatial arrangement of RFDs relative to wildlife corridors (i.e., limited overlap with existing corridors [Figure 15]) and grizzly bear response to development in the Bow Valley (i.e., a relatively small zone of influence around development [100 m]). In fact, the amount of selected habitat and used as available habitat in wildlife corridors is predicted to increase under both human use scenarios (Table 37) because grizzly bear habitat selection is positively correlated with trail density and forest edge, both of which are associated with openings in forest canopy where food resources for grizzly bears may be higher (Section 2.2.1 in Appendix B). Therefore, grizzly bear movements through the RSA are expected to be maintained.

Table 33: Predicted Grizzly Bear Habitat in Wildlife Corridors in the RSA with the Addition of the Project and Other Reasonably Foreseeable Developments With and Without the Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)			With Estimated Effects of Increased Human Use on Trails (ha)		
	Existing Conditions	Amount Remaining	Change from the Project and RFDs	Existing Conditions	Amount Remaining	Change from the Project and RFDs
Selected	712.8	789.4	76.5	635.7	704.5	68.8
Used as available	716.2	696.7	-19.4	721.5	715.0	-6.5
Somewhat avoided	463.1	419.2	-44.0	500.0	448.2	-51.8
Strongly avoided	211.8	200.9	-11.0	243.1	233.6	-9.5
Rarely used	24.0	21.8	-2.2	27.6	26.7	-1.0
Waterbody[(a)]	33.9	33.9	0.0	33.9	33.9	0.0

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

RFDs = reasonably foreseeable developments; ha = hectares.

5.9.2.3 Grizzly Bears Cumulative Effects Negative human-wildlife interactions

Because habitats that are selected by grizzly bears continue to be present in the RSA and human use is predicted to more than double (Section 5.9.1), negative human-bear interactions are predicted to increase. Between 1997 and 2018, 21 grizzly bears were removed from the Bow Valley (AEP, unpublished data). The majority were the of translocations (n=13) while the remainder were mortality events on roads (n=4), rail (n=3) or the result of management destruction (n=1).

The degree to which negative human-bear interactions will increase is uncertain, but assuming negative interactions increases linearly with the amount of human use, they could more than double. If bears adjust their behaviour to use wildlife corridors mostly at night because of substantially higher human use (e.g., Boyce et al. 2010, Lamb et al. 2020), negative human-bear interactions may not increase linearly with the amount of human use.

As described in Section 5.7.2, the Bow Valley is already considered an ecological trap under existing conditions due to high levels of mortality. Many RFDs, including the Project, overlap with areas of very high human-bear conflict (Figure 15 and Figure 24), suggesting a high potential for increased negative interactions between bears and humans. Although the Project will minimize its contribution to these cumulative effects by using wildlife exclusion fencing, this may not be the case for all planned developments. Any increase in mortality resulting from increased human-bear interactions will contribute to the existing serious risk for grizzly bears.

5.9.2.4 Grizzly Bears Cumulative Effects Environmental Consequence

Grizzly bears using the RSA are part of a broader regional population that use Kananaskis Country to the south as well as Banff National Park to the west and provincial lands such as Don Getty Wildland Park to the North. At this landscape scale extending beyond the RSA, the population trend may be stable under existing conditions (Garshelis et al. 2005). Grizzly bear populations in southwestern Alberta appear to be doing well (Morehouse and Boyce 2016). However, a serious risk is identified under existing conditions for grizzly bears in the RSA because habitats in the vicinity of Canmore represent an ecological trap (Section 5.3.3).

The combined effects of the Project, other RFDs and climate change are predicted to contribute adversely to the serious risk present under existing conditions. Habitats with a high probability of selection remain after the Project and other RFDs have been added to the effect already present under existing conditions. At the same time, human use and the potential for negative human-bear interactions is predicted to increase, likely intensifying the effects of the ecological trap.

The contribution of the Project to the cumulative increase in risk of negative human-bear interactions is predicted to be neutral or moderate. Within the ASP area, fencing is predicted to result in a positive outcome by reducing negative human-bear interactions from the high levels identified under existing conditions (Figure 24). Fencing associated with the Three Sisters Mountain Village ASP will also encompass the Smith Creek development, which collectively range from low (in eastern parts of TSMV property) to very high (in western parts of TSMV property) human-bear conflict ranking under existing conditions (Figure 24), and fencing this development is predicted to have a positive outcome.

Grizzly bear movement is expected to be maintained at the regional scale because habitat classes in the wildlife corridors consist primarily of habitats that are selected or used as available by grizzly bears, and this changes little when all RFDs are added (Section 5.9.2.2). The contribution of the Project will likely result in a positive outcome for wildlife corridors adjacent to these developments relative to a future condition without fences and educational signs. This conclusion is uncertain because it depends on whether people are exposed to signs and fencing as they access the corridor through the Smith Creek ASP and on the good behaviour of people once they are inside the corridor. The former is likely for many users given the spatial configuration of the Project development (Figure 52), and the latter is also likely based on the feedback from Canmore residents on surveys undertaken as part of the HUMR program (Town of Canmore 2015c). Other factors that may affect the outcomes include the level of enforcement that may be applied by the Province, and the effectiveness of education programs beyond signage.

The most important change predicted under the cumulative effects scenario is the increase in negative human-bear interaction, which increases grizzly bear mortality risk in the RSA. The environmental consequence of RFDs and other future activities is expected to be high because these developments and activities contribute to an existing serious risk.

5.9.3 Cougars – Cumulative Effects

5.9.3.1 Cougars Cumulative Effects Habitat Quantity and Quality

The RSF modelling predicts similar losses of selected habitat in the RSA because of the Project and other RFDs, using models with or without estimated effects of increased human use on trails (Table 34). The model with increased human use on trails predicts the largest loss of selected cougar habitat with a reduction of 243.6 ha (5.0% change of this habitat class in the RSA).

Most RFDs in the RSA are expansions of existing urban development, which means that new developments will be created in proximity to areas already disturbed and occupied by humans. As a result, the distribution of selected and used as available habitats changes very little in the RSA (Figure 54 and Figure 55).

The resulting habitat conditions integrate the combined effects of previous and existing developments in the RSA (Section 5.3.4) in addition to the Project and other RFDs; however, the effects of climate change were not quantified. Although cougars are habitat generalists, they tend to avoid open or non-vegetated habitats (ESRD 2012; Appendix B). Accordingly, climate-induced changes to forested habitats could negatively affect habitat availability in the future. As explained in the grizzly bear assessment (Section 5.9.2.1), the increased frequency of forest fires and insect outbreaks could reduce the quantity and quality of cougar habitat in the RSA.

Overall, effects on cougar habitat quantity and quality will be negative if all RFDs described in Section 4.5 are undertaken. The magnitude of change predicted is unlikely to be sufficiently large to compromise the sustainability and function of the regional cougar population.

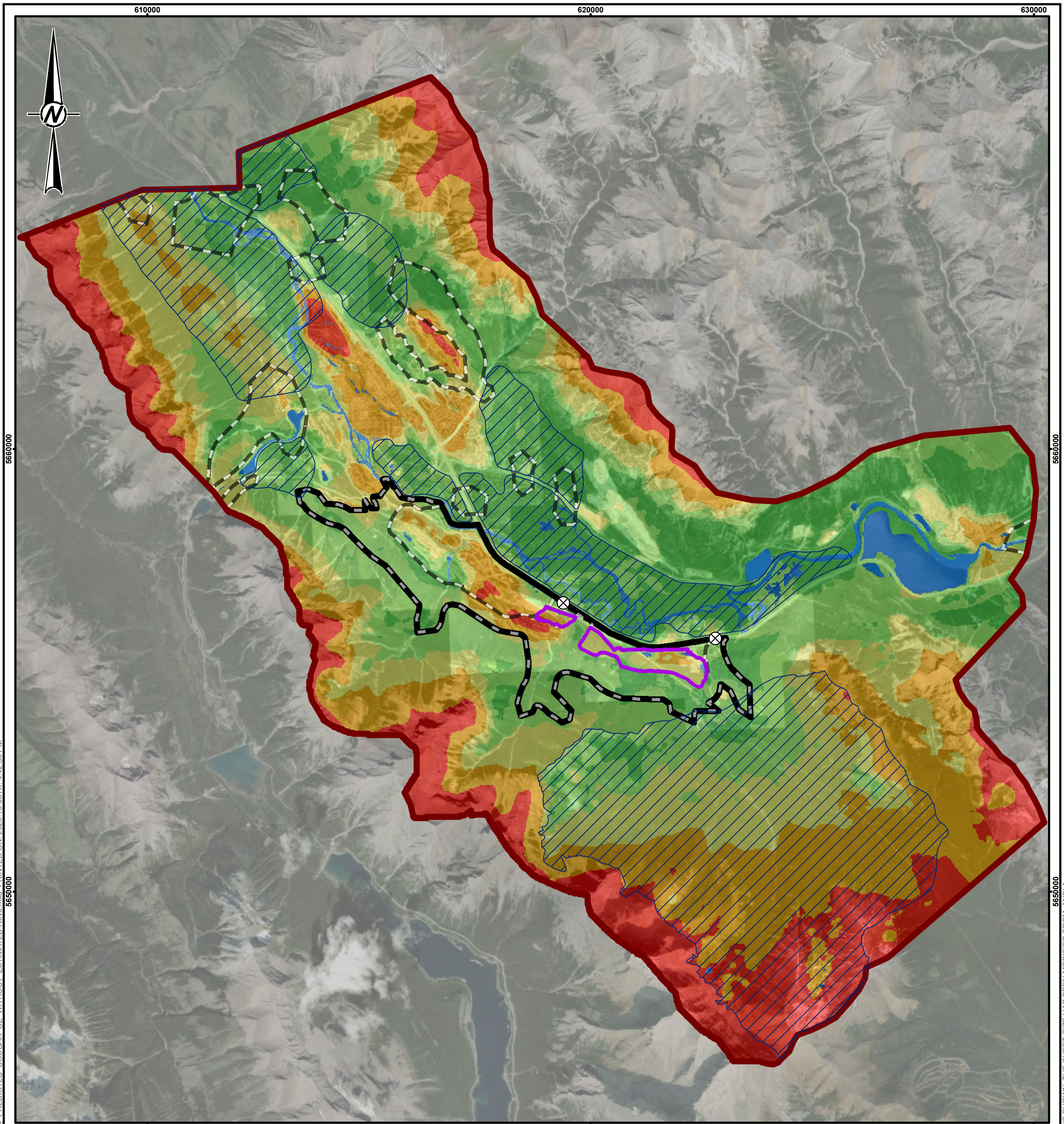
Table 34: Predicted Cougar Habitat in the Regional Study Area with the Addition of the Project and Other Reasonably Foreseeable Developments With and Without the Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)			With Estimated Effects of Increased Human Use on Trails (ha)		
	Existing Conditions	Amount Remaining	Change from the Project and RFDs	Existing Conditions	Amount Remaining	Change from the Project and RFDs
Selected	5072.6	4841.3	-231.4	4831.2	4587.7	-243.6
Used as available	5315.8	5457.4	141.6	5347.4	5446.8	99.4
Somewhat avoided	4731.7	4674.1	-57.6	4858.2	4808.7	-49.4
Strongly avoided	4920.8	5032.2	111.3	4985.7	5139.4	153.7
Rarely used	3221.2	3246.5	25.3	3239.8	3269.0	29.2
Waterbody[(a)]	616.0	626.7	10.7	616.0	626.7	10.7

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

RFDs = reasonably foreseeable developments; ha = hectares.



LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- HABITAT PATCH
- REGIONAL STUDY AREA
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 2,000 4,000

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REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, JANUARY 2017.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE
PREDICTED WINTER COUGAR RESOURCE SELECTION – CUMULATIVE EFFECTS WITHOUT ESTIMATED EFFECTS OF INCREASED HUMAN USE ON TRAILS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
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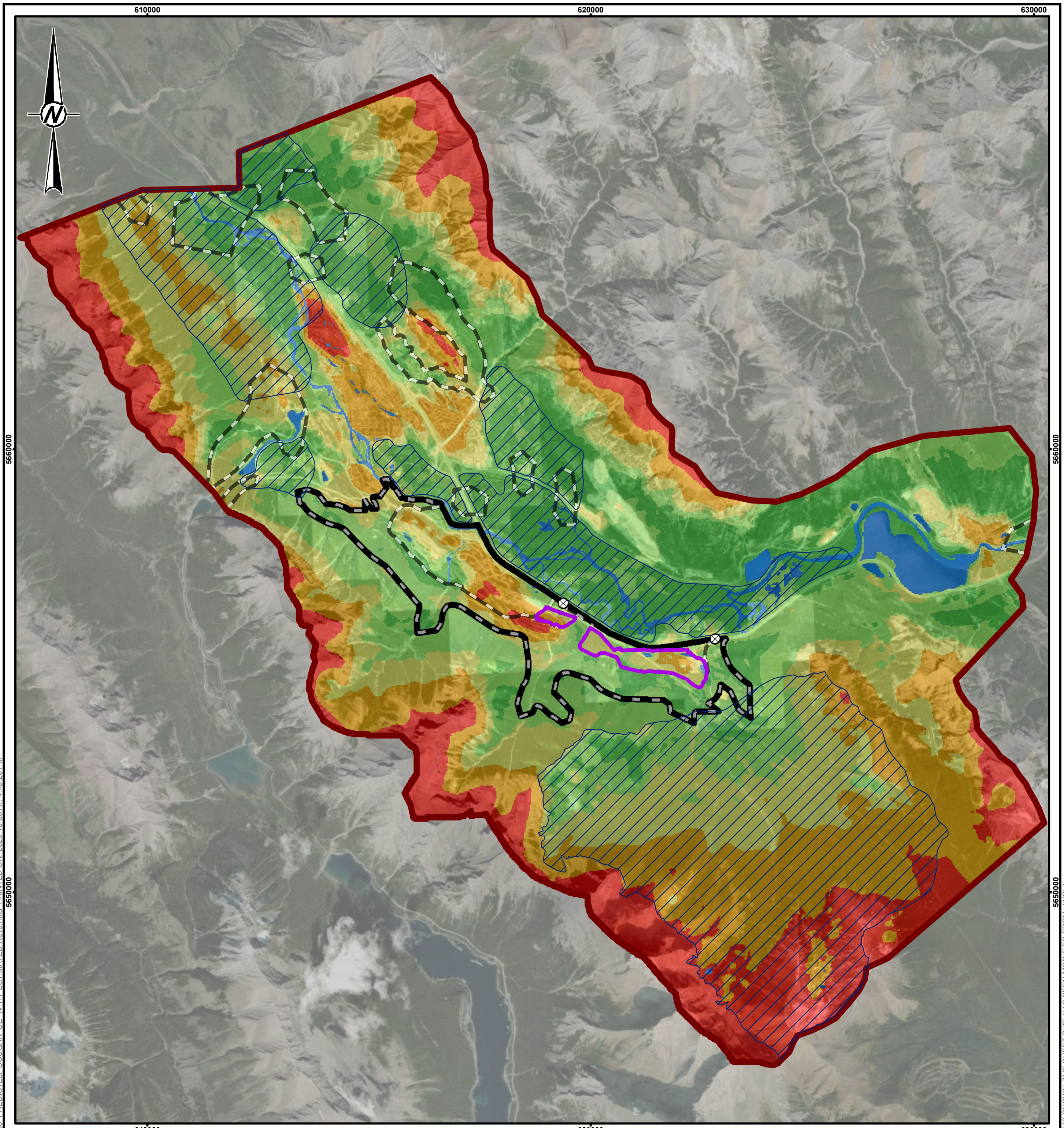

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
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- REGIONAL STUDY AREA
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

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5.9.3.2 Cougars Cumulative Effects Use of Approved Corridors

With the addition of the Project and other RFDs, cougar habitat quality in regional wildlife corridors is predicted to increase under the scenarios with and without increased human use on trails (Table 35). The model with no change in human use on trails predicts a 40.2 ha (5.5%) increase of selected habitat in regional wildlife corridors and the model with increased human use on trails predicts a 57.7 ha (9.0) increase in selected habitat in regional wildlife corridors (Table 35).

As described in Appendix B (Figure B-11), there is a positive relationship between the probability of selection class and the proportion of cougar steps overlapping with each habitat class. This relationship indicates that both used as available and selected habitats should be interpreted as maintaining equally low resistance for cougar movements in the RSA. Given the predicted changes in habitat selection patterns in wildlife corridors, the incremental changes induced by the Project and RFDs could have localized effects on cougar movement, but overall regional movements should be maintained. These predictions are supported by cougar behaviour, namely that they are commonly found close to development in habitat patches and movement corridors in the Bow Valley and can adapt to anthropogenic landscape change (Knopff et al. 2014). The contribution of the Project to these effects is expected to be negligible because the Project increases the amount of selected habitat in wildlife corridors adjacent to the footprint (Section 5.7.3.2).

Table 35: Predicted Cougar Habitat in Wildlife Corridors in the Regional Study Ara with the Addition of the Project and Other Reasonably Foreseeable Developments With and Without the Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)			With Estimated Effects of Increased Human Use on Trails (ha)		
	Existing Conditions	Amount Remaining	Change from the Project and RFDs	Existing Conditions	Amount Remaining	Change from the Project and RFDs
Selected	725.4	765.6	40.2	644.2	701.9	57.7
Used as available	910.0	905.8	-4.2	912.7	904.7	-7.9
Somewhat avoided	392.5	349.2	-43.4	458.3	392.3	-66.1
Strongly avoided	78.6	84.8	6.2	91.3	106.5	15.1
Rarely used	21.4	22.6	1.2	21.4	22.6	1.2
Waterbody[(a)]	33.9	33.9	0.0	33.9	33.9	0.0

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

RFDs = reasonably foreseeable developments; ha = hectares.

5.9.3.3 Cougars Cumulative Effects Negative Human-Wildlife Interactions

Because habitats that are selected by cougars continue to be present and human use is predicted to more than double (Section 5.9.1), the risk of negative human-cougar interactions is predicted to increase substantially. This change would be most pronounced in proximity to new urban developments where the likelihood of human-cougar interaction would increase. If cougars adjust their behaviour to use wildlife corridors and other habitats near human development mostly at night because of substantially higher human use (e.g., Knopff et al. 2014), negative human-cougar interactions may not increase linearly with the amount of human use.

Overall, the effects of human-cougar interactions are predicted to be negative if all RFDs described in Section 4.5 are undertaken. Effects on the regional cougar population are difficult to predict because they will depend in part on mitigation implemented by proponents of RFDs and on the behaviour of people in the Bow Valley. Both are uncertain.

5.9.3.4 Cougars Cumulative Effects Environmental Consequence

Cougar densities within and surrounding the RSA are among the highest in the Province (ESRD 2012). Available evidence suggests that the cougar population in the RSA is self-sustaining and ecologically effective under existing conditions (Section 5.3.4).

Habitat quantity and quality and habitat connectivity for cougars in the RSA are expected to decline incrementally with development of the Project, other RFDs, and climate change. Changes in habitat quality, quantity, or connectivity are not expected to be large enough to affect cougar viability in the region; therefore, these changes are not predicted to alter the self-sustaining ecologically effective status of cougars in the RSA.

The risk of negative human-cougar interactions is predicted to increase substantially as a result of increases in human use expected in the RSA by 2055. This may pose a risk to cougars, depending on how people respond to the real or perceived risk presented by cougars (Knopff et al. 2016). Available data indicate relatively low numbers of annual cougar mortalities from incidental human-caused mortalities (i.e., unrelated to legal harvest), ranging from 0 to 3 mortalities per year between 2014 and 2018 in Cougar Management Area 6 (Government of Alberta 2019b). Prior to this, provincial mortality trends between 1971 and 2011 show an increase in cougar incidental cougar mortality from accidental trapping (ESRD 2012); however, this has not been a mortality source recorded in the RSA in recent years (Government of Alberta 2019b). Whether or not changes in negative human-cougar interactions as a result of increased human use will pose a serious risk to cougars in the RSA is uncertain. However, fencing associated with the Project mean that the Project will not contribute to changing the risk of negative human-cougar interactions. Using a precautionary approach, a small decrease in cougar survival is predicted for the RSA under future conditions. Given the robust condition of the regional cougar population, the change is unlikely to alter the population’s self-sustaining and ecological effectiveness.

The environmental consequence of the Project and other RFDs is predicted to be low.

5.9.4 Wolves – Cumulative Effects

5.9.4.1 Wolves Cumulative Effects Habitat Quantity and Quality

Using the model with no increased human use on trails, winter selected habitat for wolves decrease by 26.4 ha (1.1%) in the RSA (Table 36, Figure 56). The same model also predicts a loss of 295.8 ha (8.3%) of used as available habitat in the RSA (Table 36).

The effects of increased trail human use on wolf habitat selection are particularly evident for wolves. During winter, areas that are selected are reduced by 384.5 ha (26.9%) in the RSA using the model with estimated effects of increased human use on trails (Table 36, Figure 57). There is also a predicted loss of 460.8 ha (15.8%) of used as available habitat in the RSA (Table 36). These changes correspond to a 19.5% increase in strongly avoided habitats in the region. As described in the Section 5.3.5, under existing conditions, most habitat selected by wolves is on the north side of the RSA on mid-elevation south-facing benches. The effects of RFDs and increased trail use on wolf habitat selection are particularly evident north of the Bow River (Figure 57), and in particular near the Silvertip Village development in the northeastern portion of the RSA.

The resulting habitat conditions integrate the combined effects of previous and existing developments in the RSA (e.g., Trans-Canada highway, railway, industrial development and mining, urban development, growing human population, and trails [Section 5.3.5]) in addition to the Project and other RFDs. The effects of climate change were not quantified.

Wolves in the RSA tend to use low elevation montane habitats in winter when their ungulate prey congregates on low elevation winter range. Wolves select intermediate elevations, especially on south facing slopes, and avoid non-vegetated habitats, built up areas, areas with high trail densities and golf courses. Wolves in the RSA also select for forest edge, herbaceous vegetation and areas with more shrubs. Accordingly, climate-induced changes to forested habitats could negatively affect habitat availability in the future, as explained in the grizzly bear and cougar assessments (Sections 5.9.2 and 5.9.3). The degree to which these changes will affect wolf habitat use and distribution in the RSA is uncertain because wolves exhibit highly variable habitat selection patterns and are likely to respond more strongly to changes in prey availability and distribution.

Effects on wolf habitat quantity and quality will be negative if all RFDs described in Section 4.5 are undertaken. Using predictions from the model with increased human use on trails, the magnitude of change to habitat quantity and quality is considered large. Although uncertain, changes induced by climate change could exacerbate these effects depending on how prey respond to climate-induced effects. Positive effects of climate change are possible if ungulate densities increase. The Project will make a very small contribution to these cumulative effects.

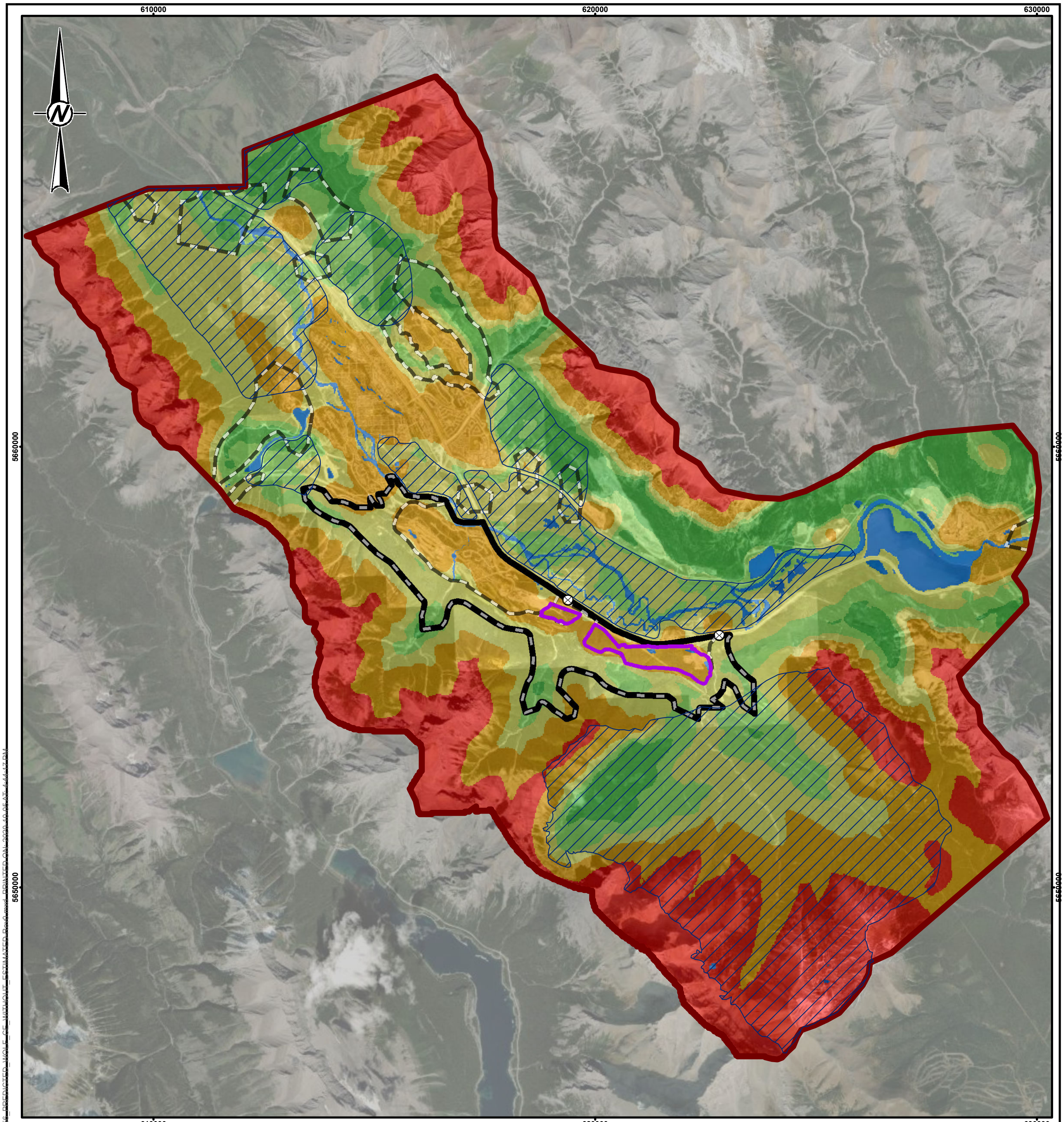
Table 36: Predicted Wolf Habitat in the Regional Study Area with the Addition of the Project and Other Reasonably Foreseeable Developments With and Without Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)			With Estimated Effects of Increased Human Use on Trails (ha)		
	Existing Conditions	Amount Remaining	Change from the Project and RFDs	Existing Conditions	Amount Remaining	Change from the Project and RFDs
Selected	2,453.8	2,427.3	-26.4	1,430.6	1,046.2	-384.5
Used as available	3,546.3	3,250.5	-295.8	2,921.7	2,460.9	-460.8
Somewhat avoided	6,042.0	5,793.9	-248.1	7,118.1	6,691.7	-426.4
Strongly avoided	5,660.6	6,219.6	559.0	6,147.9	7,347.1	1,199.2
Rarely used	5,559.6	5,560.2	0.6	5,643.9	5,705.6	61.7
Waterbody[(a)]	616.0	626.7	10.7	616.0	626.7	10.7

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

RFDs = reasonably foreseeable developments; ha = hectares.



LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- HABITAT PATCH
- REGIONAL STUDY AREA
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 2,000 4,000

1:125,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, JANUARY 2017.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

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CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
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REVIEWED	SM
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
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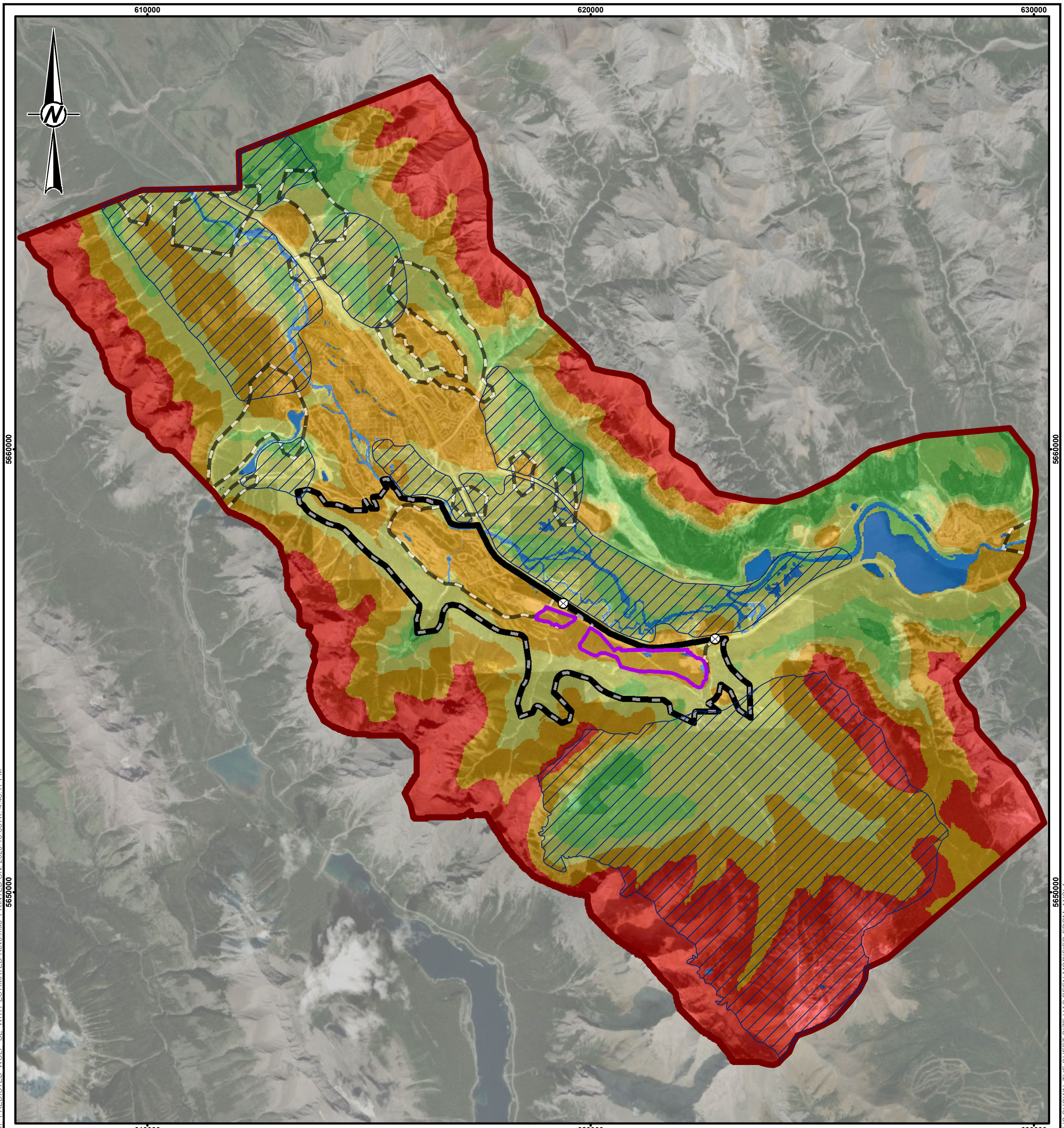

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

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REFERENCE(S)

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2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

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PROJECT
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CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
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PREPARED	AK
REVIEWED	SM
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
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5.9.4.2 Wolves Cumulative Effects Use of approved corridors

Wolf habitat quality within wildlife corridors in the RSA is predicted to decline in the cumulative effects case. As is the case with overall habitat quality, the effects of trail use by humans is particularly evident.

Using the model with increased human use on trails (i.e., the most conservative prediction), selected habitat is expected to decline by 42.2 ha (69.1%) in wildlife corridors (Table 37, Figure 57). Used as available habitat within corridors are predicted to decline by 239.1 ha (49.6%) in the RSA. The loss of selected habitats occurs mainly in the Silvertip, Harvey Heights, and Indian-Bow Flats East corridors. Most changes are therefore expected north of the Bow River. Some changes are also expected south of the Bow River, with losses of used as available habitat in the Along Valley and Georgetown-Grassi Lakes corridors. Under existing conditions in relatively poorer habitat on the south side of the valley, the Along Valley Corridor, Tipple Across Valley Corridor and Stewart Creek Across Valley Corridor were used only rarely by wolves (Section 5.3.5).

If wolves do not avoid trails to the degree modelled (Appendix B), then the change in selected and used as available habitats are comparatively smaller with reductions of 8.1 ha (2.7%) and 125.3 ha (17.1%) in selected and used as available habitats, respectively (Table 37).

Overall, the cumulative effects on wolf corridor use is predicted to be negative if all RFDs described in Section 4.5 are undertaken. Changes to local and regional wolf movement patterns are possible as a result of reduced connectivity among patches of selected habitat. In particular, connectivity between selected habitat in the northeastern portion of the RSA and the northwestern portion of the RSA (Figure 57) is expected to decline from existing conditions (Figure 34). These changes could reduce connectivity to suitable wolf habitats beyond the RSA, in Banff National Park.

Table 37: Predicted Wolf Habitat in wildlife corridors in the Regional Study Area with the Addition of the Project and Other Reasonably Foreseeable Developments With and Without the Estimated Effects of Increased Human Use On Trails

Habitat Class	Without Estimated Effects of Increased Human Use on Trails (ha)			With Estimated Effects of Increased Human Use on Trails (ha)		
	Existing Conditions	Amount Remaining	Change from the Project and RFDs	Existing Conditions	Amount Remaining	Change from the Project and RFDs
Selected	296.3	288.2	-8.1	61.1	18.9	-42.2
Used as available	732.5	607.2	-125.3	482.1	243.0	-239.1
Somewhat avoided	932.5	973.0	40.5	1,333.2	1,346.0	12.8
Strongly avoided	166.7	259.6	92.9	251.6	520.1	268.5
Rarely used	0.0	0.0	0.0	0.0	0.0	0.0
Waterbody[a]	33.9	33.9	0.0	33.9	33.9	0.0

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

RFDs = reasonably foreseeable developments; ha = hectares.

5.9.4.3 Wolves Cumulative Effects Negative Human-Wildlife Interactions

Because wolves have shown a strong avoidance of urban development and areas of high human use in the Bow Valley in the past, negative human-wolf interactions have not been an issue in the Bow Valley until recently. However, wolves in the Bow Valley are being seen more often in and around development and negative human-wolf interactions may become more common place. The cumulative effects of increased trail use in the RSA could increase the likelihood that wolves become more habituated to humans with the potential to increase the likelihood of negative human-wolf encounters. The magnitude of change will depend in part on how humans respond to wolves and their willingness to tolerate wolf presence (Paquet and Carbyn 2003).

Fencing associated with the Project should reduce the likelihood of wolf habituation adjacent to those developments because dispersed human use within adjacent corridors should decrease. If wolves adjust their behaviour to use wildlife corridors and other habitats near human development mostly at night because of substantially higher human use (e.g., Hebblewhite and Merrill 2008), the likelihood of habituation and associated human-wolf interactions may not increase at the same rate as the amount of human use. In these cases, habitats in the RSA are unlikely to become an ecological trap for wolves with the addition of the Project and other RFDs. However, if the increased presence of humans leads to more human-wolf interactions that result in wolf mortality the RSA could potentially become an ecological trap for wolves, similar to that described for grizzly bears.

5.9.4.4 Wolves Cumulative Effects Environmental Consequence

Wolves using the RSA are members of packs that use Kananaskis Country to the south, Banff National Park to the west and potentially provincial lands such as Don Getty Wildland Park to the north, as well as lone wolves that are not affiliated with packs. The stability of the population at this landscape scale is not known under existing conditions. To be precautionary, given the extent of development and associated human use in the RSA, low wolf use of the RSA is identified as a serious risk under existing conditions (Section 5.3.3).

The combined effects of the Project and other RFDs and activities are predicted to contribute adversely to the serious risk already present under existing conditions. Habitats that are selected or used as available by wolves in the RSA, particularly on the north side of the RSA, will be further reduced and connectivity among habitat patches will decline. This is especially true if wolves continue to avoid trails in the future as modelled (Appendix B). Under these conditions, pack use in the RSA may decline to near zero. However, dispersing wolves are likely to continue to travel through the RSA because dispersing wolves take greater risks and use habitats that are otherwise not preferred (e.g., Hinton et al. 2016).

The contribution of the Project to the prediction of low pack use of the RSA is small because most of the change from cumulative effects is predicted on the north side of the Bow Valley and because fencing is predicted to lead to small reductions in probability of selection in wildlife corridors adjacent to ASP area (Section 5.7.4.2). This conclusion depends on whether people are exposed to signs and fencing as they access the corridor along the ASP area and on the good behaviour of people once they are inside the corridor. The former is likely for many users given the spatial configuration of the two developments, and the latter is also likely based on the feedback from Canmore residents on surveys undertaken as part of the HUMR program (Town of Canmore 2015c).

The very low use of the RSA predicted for wolves from RSF models is associated with uncertainty. Wolf habituation, which until recently has not been an issue in the RSA, appears to be increasing. Habituation has the potential to increase connectivity for wolves in the RSA and also increase the amount of time wolves spend in suitable habitats. However, increased habituation also has the potential to affect human safety in and around Canmore and ultimately, wolves could be removed, similar to the removal of two wolves from the Bow Valley pack in Banff National Park in 2016. Removal of wolves in the RSA as a result of human safety concerns could put additional pressure on the regional wolf population. The contribution of the Project to the cumulative increase in risk of increasing wolf habituation and associated human-wolf interactions is predicted to be neutral because of fencing.

The environmental consequence of cumulative effects in the RSA are predicted to be high because changes contribute to an existing serious risk.

5.9.5 Elk – Cumulative Effects

5.9.5.1 Elk Cumulative Effects Habitat Quantity and Quality

With the addition of the Project and other RFDs the elk RSF model predicts a 141.0 ha (2.4%) increase in selected habitat in the RSA relative to existing conditions (Table 38; Figure 58). However, with the addition of wildlife fencing proposed for the Project, habitat that is selected inside the fence under existing conditions (133 ha) would become unavailable for elk representing a net 8.0 ha decline of selected habitat available with the RSA with the addition of cumulative effects. If the Three Sisters ASP is also fenced as planned the decline of selected habitat will be greater.

Habitat conditions summarized in Table 38 integrate the combined effects of previous and existing developments and activities in the RSA in addition to the Project and other RFDs. However, the future effects of climate change were not quantified. Warmer and wetter conditions may promote the transition of natural grasslands to more forested cover but climate change resulting in a drier climate could promote grassland expansion into areas that formerly supported trees and shrubs dependent on moister soils (Gayton 2013). Climate change may also induce treeline migration into higher elevations (Harsh et al. 2009), which could influence montane and alpine grasslands (Dirnbök et al. 2011). Given that elk tend to concentrate in valley bottoms (Appendix B), changes occurring at higher elevation will likely have limited influence on elk habitat quantity and quality. As mentioned in Section 5.3.6, ongoing fire suppression to protect to protect private and public property and infrastructure will further enable woody encroachment of grassland habitats. On the other hand, FireSmart measures implemented by the Town, the MD of Bighorn, and the Province include reducing forest cover. These measures will increase early seral habitats in the RSA, which should increase the likelihood that elk use these areas and result in a benefit for elk. If climate change is associated with increased fire frequency, elk may benefit from greater availability of grassland habitat.

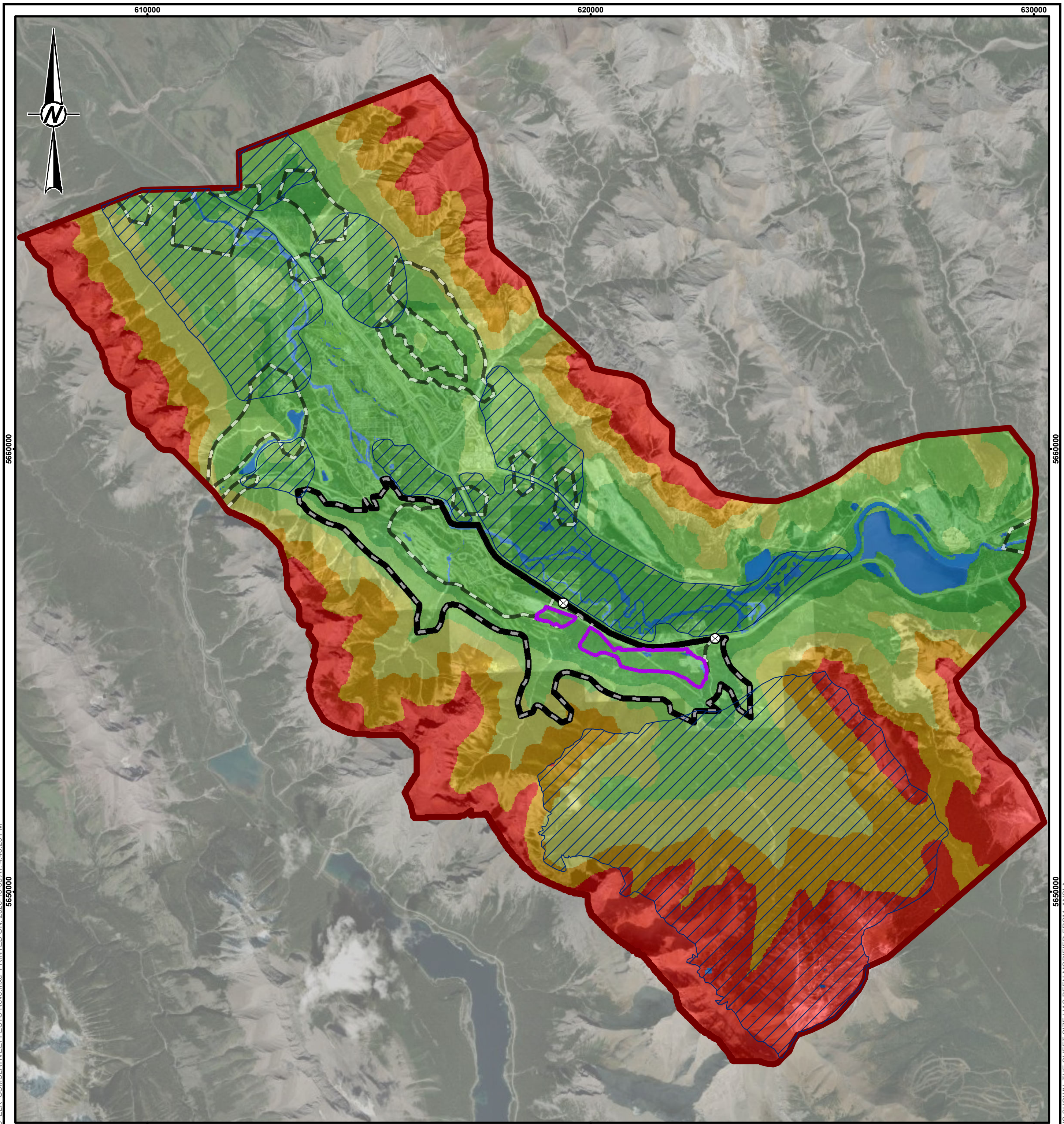
Table 38: Predicted Elk Habitat in the Regional Study Area with the Addition of the Project and Other Reasonably Foreseeable Developments

Habitat Class	Area (ha)		
	Existing Conditions	Amount Remaining	Change from the Project and RFDs
Selected	5,902.1	6,043.1	141.0
Used as available	4,680.7	4,617.5	-63.1
Somewhat avoided	3,742.2	3,721.0	-21.2
Strongly avoided	3,909.1	3,859.9	-49.2
Rarely used	5,028.2	5,010.0	-18.3
Waterbody[(a)]	616.0	626.7	10.7

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

RFDs = reasonably foreseeable developments; ha = hectares.



LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- HABITAT PATCH
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

PROBABILITY OF SELECTION

- SELECTED
- USED AS AVAILABLE
- SOMEWHAT AVOIDED
- STRONGLY AVOIDED
- RARELY USED
- WATERBODY

0 2,000 4,000

1:125,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, JANUARY 2017.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE
PREDICTED WINTER ELK RESOURCE SELECTION – CUMULATIVE EFFECTS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	AK
REVIEWED	SM
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	58

5.9.5.2 Elk Cumulative Effects Use of Approved Corridors

The addition of the Project and other RFDs are predicted to increase probability of selection for elk in wildlife corridors in the RSA because increased proximity of developments will reduce predation risk (Section 5.7.5). The RSF model predicts a 115.1 ha (10.6%) increase in selected elk habitat in wildlife corridors in the RSA due to the Project and other RFDs (Table 39). As described in Appendix B (Figure B-12), the relationship between the probability of selection class and the proportion of elk steps overlapping with each habitat class indicates that the RSF is a good overall reflection of elk movement and that the selected class is especially important for movement (i.e., resistance is very low relative to other classes). Based on the predicted changes to elk selection patterns (Table 39), wildlife corridors in the RSA should continue to provide habitat connectivity.

Although the RSF model predicts an increase in probability of elk selections adjacent to development because of reduced predation risk, the implementation of wildlife fencing has the potential to eliminate this benefit by preventing elk from escaping from wildlife corridors into the adjacent development. This change only applies to corridors where fencing is proposed. Probability of selection for elk in other corridors in the RSA where development will expand, such as those adjacent to Silvertip, is predicted to increase.

Habituation of elk to human activity and developments in the Bow Valley, telemetry and camera data showing elk use throughout wildlife corridors and developed areas, and a potential net increase in probability of selection in the regional corridor network for elk means that landscape connectivity for elk in the Bow Valley is likely to remain high after addition of the Project and other RFDs.

Table 39: Predicted Elk Habitat in Wildlife Corridors in the Regional Study Area with the Addition of the Project and Other Reasonably Foreseeable Developments

Habitat Class	Area (ha)		
	Existing Conditions	Amount Remaining	Change from the Project and RFDs
Selected	1,082.3	1,197.4	115.1
Used as available	956.0	855.2	-100.8
Somewhat avoided	84.3	72.7	-11.6
Strongly avoided	5.4	2.7	-2.7
Rarely used	0.0	0.0	0.0
Waterbody[(a)]	33.9	33.9	0.0

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) Habitat suitability is not assigned to waterbodies.

RFDs = reasonably foreseeable developments; ha = hectares.

5.9.5.3 Elk Cumulative Effects Negative Human-Wildlife Interactions

As discussed in Section 5.7.5, implementation of the wildlife fence associated with the Project has the potential to shift negative human-elk interactions into other parts of Canmore. If this occurs, elk are particularly likely to concentrate in other developed areas where forage is abundant, such as golf courses, the edges of roads, and schoolyards. Other RFDs will likely attract elk, which could result in additional negative interactions with people near these developments. If habitat enhancements are implemented in wildlife corridors and habitat patches, a decline in negative human-elk interactions may result because elk will have high-quality forage resources available outside of Canmore.

5.9.5.4 Elk Cumulative Effects Environmental Consequence

Changes to elk habitat connectivity are not expected as a result of cumulative effects in the Bow Valley, and negative human-elk interactions may decline with implementation of habitat enhancements in wildlife corridors and habitat patches. The primarily adverse effect to elk in the RSA when the cumulative effects of existing and reasonably foreseeable projects and activities are combined is habitat loss associated with fencing for the Project and the Three Sisters ASP. Although fencing may adversely affect elk in this manner, it is a key mitigation required to prevent substantial contributions from the Project to high environmental consequences present in the Bow Valley for grizzly bears under existing conditions and to reduce human-wildlife interactions more broadly.

Edwards (2013, pg 44) concluded that "*propositions to construct wildlife exclusion fencing around the perimeter of the Three Sisters development could have catastrophic effects on the local elk by eliminating a significant portion of the core home range and restricting lateral movement between the Bow River and heavily grazed terrain at Three Sisters*". This assessment identified an increase of 2.4% (141 ha) of selected habitat in the RSA for elk, although this will be reduced by fencing around the Project. Most of the habitat selected by elk in the RSA will be present after RFDs are built, and changes do not affect high-quality winter range in the west Wind Valley discussed below, the resulting effects are not expected to affect the self-sustaining status of elk in the Bow Valley identified under existing conditions.

Elk habituation and use of anthropogenic landscapes within the Project was one of the greatest concerns raised by the NRCB (1992). The high density of elk and deer taking advantage of high-quality anthropogenic foraging opportunities and reduced predation risk could also attract habituated predators into areas used heavily by people. Elk habituation and intense use of anthropogenic habitats to obtain forage and avoid predation also means that areas identified as high-quality winter range, such as the West Wind Valley (Alberta Parks 2015), are less frequently used by elk than they were in the 1980s (NRCB 1992), and were not selected by GPS collared elk during winter (Appendix B). Fencing at the Project could increase elk use of naturally occurring high-quality habitats in the West Wind Valley where elk are exposed to their natural predators without putting people at risk (Ellis 2017). On the other hand, if elk congregate in other parts of Town as a result of fencing, the likelihood of negative interactions between elk and people and between people and predators that are attracted to the elk could increase in these areas (Section 5.9.4.4).

Edwards (2013) identified another important consequence of the concentrations of elk in Canmore. Higher rates and intensities of parasitic infections were recorded in urban elk because of heavy repeated use of a relatively small amount of habitat in and around Canmore. Removing artificial refuges from predation could improve ecological function of elk at the local scale of the Smith Creek ASP by making them less prone to parasitic infection and more available to their predators (Hebblewhite et al. 2005b).

Overall, the addition of the Project and other RFDs are not expected to contribute adversely to the diminished ecological efficacy of elk in the Bow Valley identified under existing conditions. Wildlife fences at the Project combined with habitat enhancements in wildlife corridors and habitat patches have the potential to increase use of habitat patches and wildlife corridors by elk (Bow Valley Human-Wildlife Coexistence Technical Working Group 2018, but there is uncertainty about how elk will redistribute themselves after fencing is applied. Possible environmental consequences as a result of cumulative effects include maintaining the high environmental consequence identified under existing conditions if elk continue to concentrate their use in anthropogenic habitats in Canmore, or reducing the environmental consequence to moderate or low if elk redistribute themselves outside of Canmore and improve their contribution to ecosystem function.

5.10 Vegetation Valued Ecosystem Component

The vegetation assessment focused on the following elements:

- vegetation communities
- ESAs
- rare plants
- tracked and watched plant communities
- weeds

5.11 Vegetation Methods

The vegetation impact assessment follows the general assessment methods outlined in Section 4. This section presents additional details about specific analyses and approaches used to complete the vegetation impact statement.

5.11.1 Vegetation Communities

A vegetation community map was developed by Golder using methods developed for the environmental impact assessment in support of the NRCB application (Delta 1991b, c). This map was developed using 1995 AVI data obtained from Alberta Sustainable Resource Development (ASRD, now AEP) and then verified using air photo interpretation and field data collected during the summer of 2008.

A total of 153 vegetation surveys were conducted within Three Sisters Mountain Village properties between July 2 and August 7, 2008. These surveys included rare plant and ecosystem surveys where site characteristics were documented (e.g., moisture and nutrient regimes, slope, aspect, species, strata and percent cover).

Maps were updated in 2016 using high-resolution imagery to define new disturbance boundaries and confirm land cover type classification.

Although other methodologies are available for developing vegetation community maps (e.g., remote-sensed classification), the approach used here relies heavily on site-specific detail (i.e., field survey data and field delineated polygons). Consequently, there is a high degree of confidence in the vegetation community mapping presented here.

5.11.2 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are areas of land established for the protection of sensitive natural features and ecologic functions and diversity, primarily for the protection of wildlife and waterbodies (Town of Canmore 2016). The Town's MDP requires that lands identified as ESAs should be conserved or protected. The NRCB (1992) also required that ESAs be considered in the development of the Project. The NRCB included old growth stands of Douglas fir (*Pseudotsuga menziesii*) and subalpine fir (*Abies lasiocarpa*), wetlands and riparian areas as ESAs. As part of the Canmore MDP, the Town has also identified riparian and wetlands as ESAs within the municipality.

ESAs were identified and mapped based on vegetation field surveys (2008, 2012, 2015, and 2018), Alberta Vegetation Inventory (AVI) data and a review of air-photo imagery. Field surveys included:

- 153 vegetation surveys conducted within the ASP area between July 2 and August 7, 2008 and additional surveys focussed on delineating wetland and riparian ESA boundaries on September 4 and 5, 2008 (Appendix B in Golder 2013).
- Additional data collected in 2012, 2015 and 2018 to update ESA boundaries within the ASP area.
- Rare plant surveys conducted on August 8, 9 and 10, 2018 (described below).

Old Growth Douglas Fir

The Montane Natural subregion is one of the most diverse subregions in Canada, and dominant coniferous tree species form or are associated with old-growth forests. The inland Rocky Mountain Douglas fir is found sporadically throughout Alberta's mountain valleys and foothills in the Montane Natural subregion (Natural Regions Committee 2006). It is the largest tree species in Alberta, growing up to 3 feet in diameter and rising up to 150 feet tall (HeRMIS 2020). Douglas fir trees have strong wood that resists rotting, and were historically used for railroad ties and bridges in Kananaskis Country (Alberta Environment 1999).

ESA surveys conducted within the ASP boundary on September 4 and 5, 2008 and October 8, 2015 documented old growth Douglas fir forest patches (Figure 58). Stand ages in the ASP area were estimated using AVI data. Douglas fir stand age class is divided as: early (0-19 years), young (20-59 years), mature (60-140 years) and old growth (>150 years) (British Columbia Ministry of Forests and Range, and British Columbia Ministry of Environment 2010).

Wetlands

Wetlands are ecosystems containing soils that are saturated with moisture either permanently or seasonally (Aber et al. 2012; National Wetlands Working Group 1988), and are further characterized by the presence of water adapted vegetation. The areas within and surrounding the ASP area are typical of mountain landscapes with steep elevational gradients, varied bedrock type and groundwater chemistry across relatively short distances (Lemly and Cooper 2011). In continental climate regions, deep winter snow cover accumulates at high elevation. During the spring and summer, snowmelt recharges groundwater aquifers and contribute to the formation of array of wetlands and riparian areas (Cooper 1990; Cooper and Andrus 1994; Clausen et al. 2006; Winter et al. 1998).

Peatlands are wetlands where there is an accumulation of organic matter that is at least 40 cm thick and include bogs and fens. Peatlands form in mountain valleys, in basins, or on slopes and are typically supported by groundwater input (Lemly and Cooper 2011). Because of the variation in chemical content and landform, the diversity of plants within Rocky Mountain wetlands is highly variable. These areas are of particular importance within the region, because they contribute substantially to regional biodiversity of both plants and animals (Chadde et al. 1998). Additionally, fens function as regionally important habitat islands for rare plant and animal species that are otherwise limited to colder environments in boreal and arctic regions (Cooper 1996).

Surveys were conducted to document wetlands areas within the ASP boundaries on 4 and 5 September 2008. Natural wetlands were characterized and delineated according to the Stewart and Kantrud (1971) wetland classification, the Canadian Wetland Classification System, Second Edition (National Wetlands Working Group 1997), and the United States Army Corps of Engineers Wetland Delineation Manual (US ACE 1987). Each potential wetland site was searched for water-adapted vegetation, wet soils, and primary or strong secondary indicators of wetland hydrology. The presence and persistence of wetlands within the Project area were verified on 13 and 14 September 2012.

Riparian Areas

Riparian habitat is a transition zone between aquatic and terrestrial ecosystems (Austin et al. 2008; Charron and Johnson 2006). Riparian habitat is defined as areas adjacent to rivers and lakes, or ephemeral, intermittent, or perennial streams that differ from surrounding uplands in plant and animal diversity and productivity (Environment Canada 2013). Generally, riparian ecosystems are found in areas where watercourses at least occasionally cause flooding beyond their channel allowing for the establishment and growth of diverse and flood-tolerant vegetation (Bradley and Smith 1986). These areas are structurally complex, transitioning from zones of higher to lower moisture (Mitsch and Gosselink 1993). Riparian areas were surveyed in conjunction with wetlands surveys on 4 and 5 September 2008.

Watercourse drainages in the LSA were mapped using Altalis (2015) and field-verified data. The datasets were merged, and a 10 m buffer was applied to all watercourses except the Bow River and waterbodies where a 30 m buffer was applied (Castelle and Johnson 2000; Castelle et al. 1994; Environment Canada 2013). The buffers were applied to provide a rough estimate of the areal extent of riparian area within the LSA and the ASP. The actual boundary of riparian habitat adjacent to Stewart and Pigeon creeks, as well as ephemeral creeks such as Smith, Marsh and Cairnes creeks, will be determined at the land use and subdivision application stage using methods described in 'Stepping Back from the Water" (AEP 2012).

5.11.3 Rare Plants

A rare plant is defined as any native vascular or non-vascular (i.e., lichens and bryophytes) plant species that, because of its biological characteristics, exists in low numbers or in very restricted areas (ANPC 2012). Plant rarity is determined by three factors: geographic range, habitat specificity and local population size (Drury 1974; Rabinowitz 1981). For example, some rare plant species may have a widely dispersed distribution but are usually only found in small numbers. Other rare plant species require specific habitat conditions that are geographically uncommon. Thus, the range of some rare species is restricted to so few localities that they are considered rare even though they occur in large numbers at each locality.

Prior to the field program, a desktop review was undertaken to identify any listed plant species occurrences historically observed within the ASP area (ACIMS 2017a) and select areas exhibiting high potential for listed plants (e.g., uncommon landscape features, transitional habitats, wetlands, previous listed plant observations) for visitation during the field surveys.

Both the Alberta and Canadian governments identify listed plant species. For the purposes of this report, listed plants are defined as meeting one or more of the following criteria:

- listed as 'Special Concern', 'Threatened', or 'Endangered' within the *Species at Risk Act* (SARA) Public Registry (Government of Canada 2019)
- assessed as 'Special Concern', 'Threatened', or 'Endangered' by COSEWIC (Government of Canada 2019)
- provincially listed as 'At risk', 'May be at risk', or 'Sensitive' within the *Wild Species 2015: General Status of Species in Canada* Report (CESCC 2016)
- provincially listed by the Alberta Conservation Information Management System (ACIMS) on the Tracking or Watched Lists (ACIMS 2017b).

Tracked and watched plant communities in Alberta are represented by those species listed on the ACIMS tracking and watch lists (Allen 2014; ACIMS 2017b). The tracking lists include species of high priority because they are rare or there is a conservation concern (Kemper 2009). Species on the watch lists are taxa that are not currently considered as having high conservation concern, but there is some information that they may become rare should there be significant alterations to habitat or population (ACIMS 2017b).

The ACIMS tracking and watch lists denote nine ranks of rarity for rare plants where the species are evaluated and ranked on their status both globally and provincially (Golder 2013 Appendix D). Ranking is generally based on the number of known population occurrences in the province. In some cases, species have not been assessed at a provincial level, or global level, and have been classified as "unranked" for the purposes of reporting. These species are different than those ranked "SNR" (species not ranked) or "GNR" (globally not ranked)" (Unranked—National or subnational conservation status not yet assessed) or "GNR" (Unranked – Global conservation rank not yet assessed) which are formally recognized by ranking bodies, such as ACIMS, but have not yet been ranked or are under review.

Scientific names and common names presented in this report follow those used by the Alberta Conservation Information Management System (ACIMS 2018).

Listed rare plant field surveys were conducted on August 8, 9 and 10, 2018 to document listed plants observed in the ASP area (Appendix E). Systematic random floristic meanders of varying lengths were undertaken throughout the ASP area, exploring representative habitats. Nine detailed 20 m x 20 m plots were investigated within areas deemed to exhibit high potential for listed plant occurrences. General site characters were recorded at each of these detailed plot locations, including dominant vascular plant species by strata (e.g., trees, shrubs, forbs and graminoids), soil moisture and nutrient regime and a GPS coordinate. When listed plants were observed, additional data were collected including microhabitat characteristics, population size and distribution. Field surveys investigated listed vascular plants only; non-vascular plant and lichen species were not recorded as agreed to by the third-party reviewer during the Project kick-off meeting. The rationale for this decision was based on no known occurrences of federally listed non-vascular plants within the ASP area and only a single occurrence within the RSA (refer to Section 5.12).

Collection of plant samples was limited to specimens that could not be identified in the field and only when local populations could withstand sampling following guidance in Henderson (2009), the Alberta Native Plant Council (ANPC 2012) and Penny and Klinkenberg (2018).

5.11.4 Tracked and Watched Plant Communities

In addition to species-level rankings, ACIMS develops tracking lists of plant community elements that are considered high priority because they are rare or special in some way (Allen 2014; ACIMS 2017b). The ACIMS database was queried to identify any tracked or watched plant communities in the ASP area.

5.11.5 Weed Species

The definition of a weed is limited to those plants listed in the *Alberta Weed Control Act* (Government of Alberta 2010). Weeds listed in the *Alberta Weed Control Act* are invasive, aggressive and difficult to manage (Government of Alberta 2010). They may displace native plants or change native plant communities and may also cause economic damage to private and public lands.

The Town has a comprehensive weed control program and monitors locations and spread of invasive plant species. The Town database was queried to identify invasive plant species with confirmed occurrences in Canmore.

5.11.6 Environmental Consequence

As described in Section 4.3, residual effects for each VEC are assigned an environmental consequence. A high environmental consequence, which can be considered a significant effect, is assigned if serious risk is identified. The definition of a serious risk varies among VECs and this section provides the methods used to identify whether or not a serious risk is present for vegetation under existing conditions or would be expected as a result of the Project, or the Project plus other RFDs.

Serious risk for vegetation is defined in a similar manner to wildlife, using the concept of self-sustaining and ecologically effective communities (Section 5.2.4). Self-sustaining vegetation communities are those that will be maintained into the future with a low risk of extirpation. Self-sustaining vegetation communities are healthy and viable communities, which are by definition robust and capable of withstanding environmental change and accommodating stochastic processes. An ecologically effective community differs from a self-sustaining community if the distribution, connectivity, or relative quality of the system needed to maintain ecological function is greater than that required to maintain a viable community. A community is ecologically effective when it is able to perform its ecological functions (e.g., provide habitat for species at risk, nutrient cycling, water purification or stormwater retention).

A serious risk is identified for vegetation when:

- a vegetation community is no longer self-sustaining at the scale of the RSA (i.e., the community is on a declining trajectory that is not predicted to recover or stabilize)
- a vegetation community has lost important ecological function in the RSA, regardless of their self-sustaining status, such that the loss in function might trigger ecological changes that result in degraded or simplified ecosystems (Soulé et al. 2003)

5.12 Vegetation Existing Conditions

Vegetation Communities and Land Cover Types

Vegetation communities in the LSA are part of the montane ecoregion of the Rocky Mountain Natural Region (Archibald et al. 1996). The LSA consists mainly of treed land cover types, which cover 1,114 ha (71%) of the LSA (Table 40, Figure 59). Within treed land cover types, closed pine vegetation communities are the most prominent (695 ha or 44% of the LSA). Tree cover in the LSA is dominated by coniferous species (Figure 60); however, smaller patches of deciduous and mixed-wood cover are also present. Other land cover types in the LSA include non-native vegetation (i.e., anthropogenic grasslands) (10%), anthropogenic disturbances (16%), open vegetation (2%), wetlands and water (1%), bare ground (less than 1%), and anthropogenic water impoundments (less than 1%) (Table 40).

Ten land cover types occur within the ASP area (Table 40). Native vegetation in the ASP area includes treed areas, open vegetation (Figure 61), and wetland areas (Table 40). Treed areas account for 123.4 ha (80%) of the ASP area, most of which is closed pine forest (Table 40). Wetlands and Douglas fir are ESAs and are described in more detail in section devoted to ESAs below. Although native vegetation is present, large areas of disturbance and anthropogenic land cover types are also found throughout the ASP area, where habitat has previously been heavily disturbed by an active rundle rock quarry operation. Anthropogenic disturbances total 27.8 ha (18%) of the ASP area, including Thunderstone Quarries Ltd., pipelines/ transmission lines, and trails.

Table 40: Land Cover Types Within the Local Study Area

Land Cover Types	Area (ha)				
	ASP Area	Adjacent Wildlife Corridors	Other Wildlife Corridors	Remaining Areas of the LSA	LSA Total
Treed					
Closed Douglas fir	2.74	1.96	0.00	2.32	7.03
Closed Pine	74.43	269.82	232.84	117.89	694.98
Closed Spruce	16.42	84.45	39.99	37.42	178.29
Deciduous	8.95	19.09	7.00	7.14	42.18
Mixed-wood	4.46	14.48	5.82	4.54	29.31
Open Douglas fir	0.00	0.03	0.00	0.00	0.03
Open Pine	7.34	16.26	8.60	2.88	35.07
Open Spruce	9.04	71.31	21.62	24.93	126.90
treed total	*123.37*	*477.41*	*315.88*	*197.13*	*1,113.78*
Open Vegetation					
Shrub Meadow	0.00	0.66	0.27	0.29	1.22
Grassland	2.34	14.88	4.69	6.18	28.08
open vegetation total	*2.34*	*15.54*	*4.95*	*6.47*	*29.30*
Non-Native Vegetation					
Non-Native Grassland	0.00	28.46	22.54	103.43	154.43
non-native vegetation total	*0.00*	*28.46*	*22.54*	*103.43*	*154.43*
Wetlands and Water					
Wetlands	0.19	3.80	0.00	2.44	6.43
River	0.00	0.00	0.00	4.48	4.48
wetlands total	*0.19*	*3.80*	*0.00*	*6.93*	*10.92*
Anthropogenic Water Impoundments					
Anthropogenic Water Impoundments	0.00	0.27	0.00	2.46	2.73
anthropogenic water impoundments total	*0.00*	*0.27*	*0.00*	*2.46*	*2.73*
Bare Ground					
Rock	0.00	0.40	1.13	2.73	4.26
Sand	0.00	0.00	2.55	2.29	4.84
bare ground total	*0.00*	*0.40*	*3.69*	*5.01*	*9.10*
Disturbance					
Disturbance	27.76	41.14	29.44	151.47	249.81
disturbance total	*27.76*	*41.14*	*29.44*	*151.47*	*249.81*
Total	**153.65**	**567.02**	**376.50**	**472.90**	**1,570.07**

Note: The sum of column values may not equal the total due to rounding.
ASP area = Project Study Area Boundary; LSA = Local Study Area; ha = hectares.

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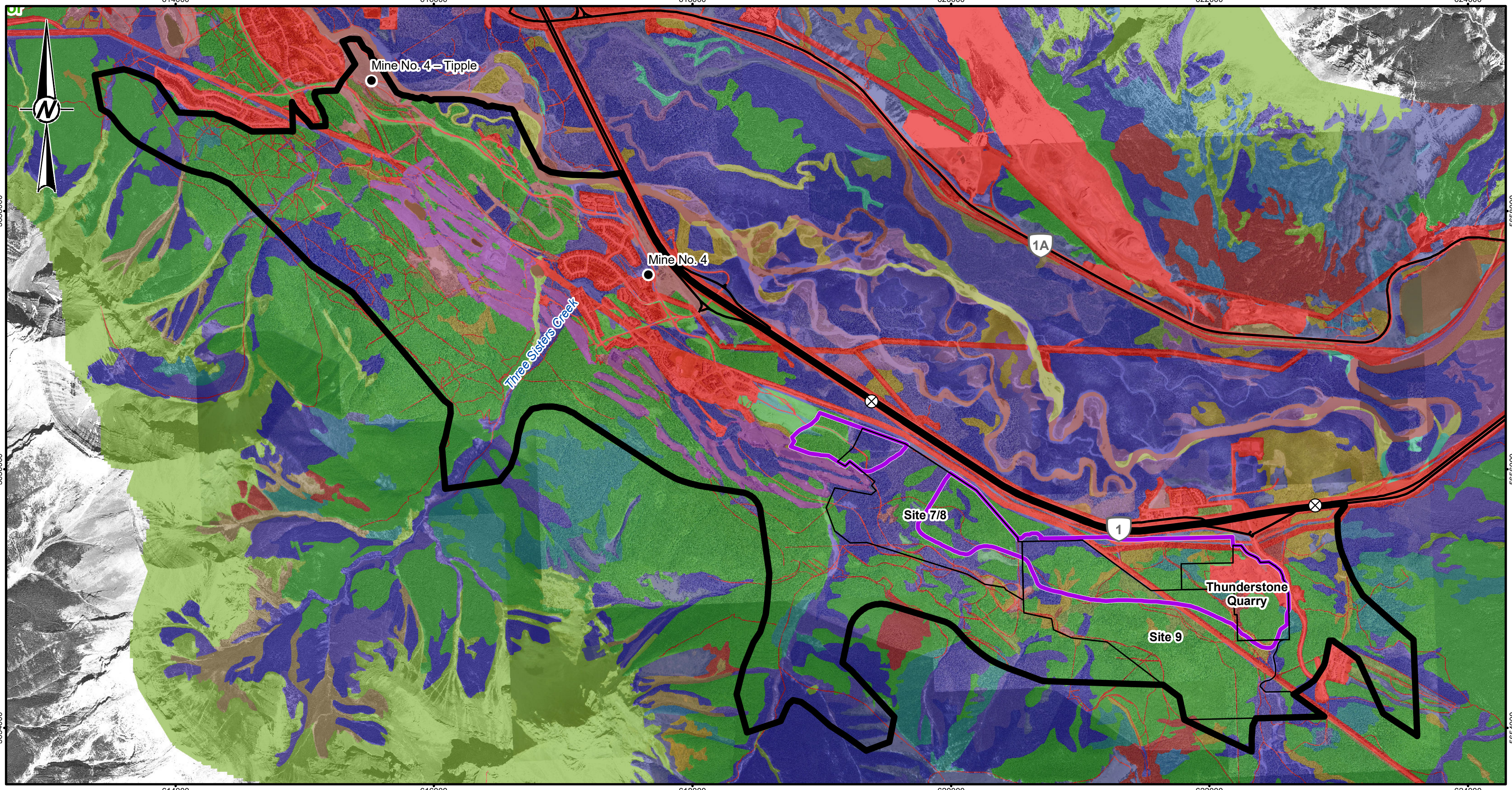

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- MINE LOCATION
- PROJECT BOUNDARY
- LOCAL STUDY AREA
- SITE BOUNDARY
- PRIMARY HIGHWAY

BASE CASE LANDCOVER

- CLOSED DOUGLAS FIR
- CLOSED PINE
- CLOSED SPRUCE
- DECIDUOUS
- DISTURBANCE
- FLOODED
- GRASSLAND MEADOW
- LAKE
- MIXEDWOOD
- NON-NATIVE GRASSLAND MEADOW
- NON-NATIVE GRASSLAND MEADOW GOLF COURSE
- OPEN DOUGLAS FIR
- OPEN PINE
- OPEN SPRUCE
- RIVER
- ROCK
- SAND
- SHRUB MEADOW
- WATER IMPOUNDMENT - ANTHROPOGENIC
- WETLAND
- WETLANDS (SHRUBBY) MEADOW
- MARSH
- WETLANDS MEADOW

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT
SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT
GOLDER

YYYY-MM-DD	2020-10-07
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE
LAND COVER TYPES WITHIN THE LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	59

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25mm

Figure 60: Spruce (foreground) and Pine (background) Stands Typical of the Local Study Area

Figure 61: Grassland Meadow within the ASP

Environmentally Sensitive Areas

Vegetation ESAs in the LSA are illustrated in Figure 62. Based on field surveys (2008, 2012, 2015, and 2018) and a review of existing information, Old growth Douglas fir, wetland, and riparian areas are present in the ASP area.

Douglas fir

Old growth Douglas fir forest patches were documented within the ASP boundary during field surveys on September 4 and 5, 2008, and October 8, 2015 (Figure 62). Stand ages were estimated using AVI data. Douglas fir stand age class is divided as: early (0-19 years), young (20-59 years), mature (60-140 years) and old growth (>150 years) (British Columbia Ministry of Forests and Range, and British Columbia Ministry of Environment 2010). Field surveys estimated approximately 2.78 ha of old growth Douglas fir on the east side of the Project area, within and adjacent to the Thunderstone Quarry lands. These stands were estimated to be 230 years old; and their locations are illustrated in Figure 63. More recent imagery and land cover layers show that some of the old growth patches have been reduced, especially in areas that overlap the Thunderstone Quarry lands.

Wetlands

The LSA contains approximately 6.4 ha of wetlands (Table 40). Based on these field surveys and vegetation community mapping, there are portions of three natural wetlands (7n, 9N, and 10N) present in the ASP area (Figure 63) accounting for 0.2 ha of the ASP area (Table 40).

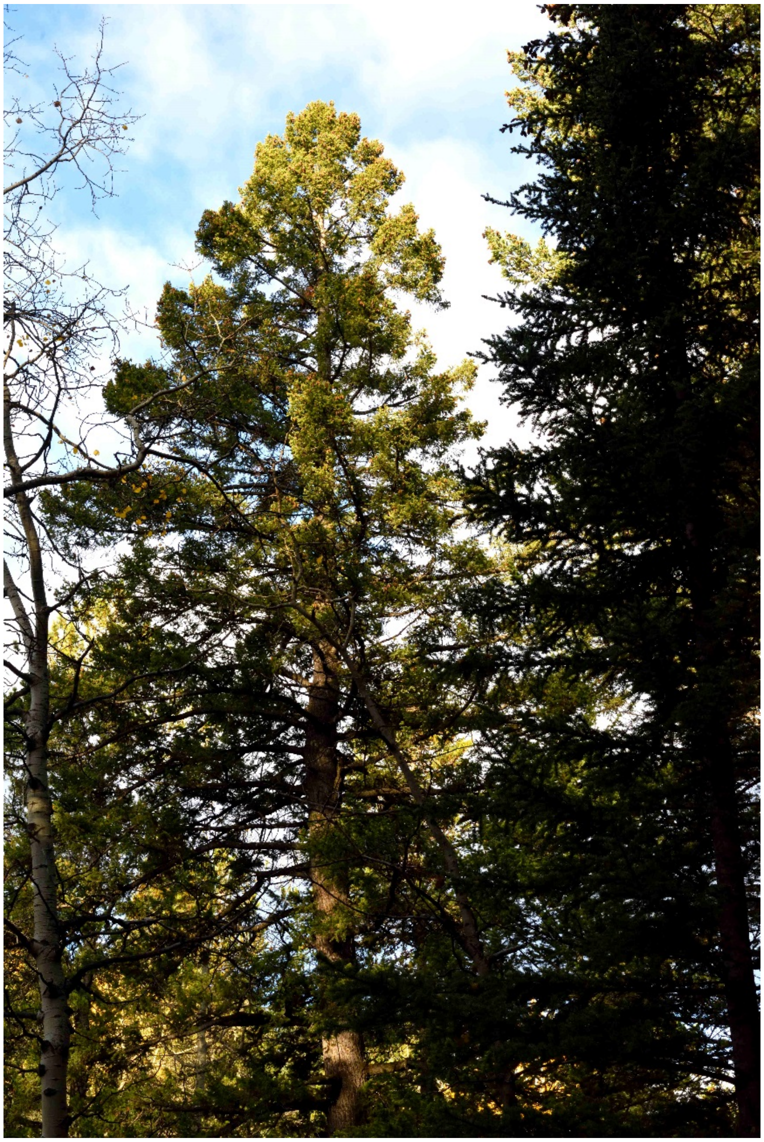
Riparian Areas

The LSA contains approximately 34.7 ha of riparian areas, of which 6.3 ha are in the ASP area (Figure 63). This riparian buffer was heavily scoured during the 2013 flood event and the banks were reinforced by the municipality to channelize the flood.

Rare Plants

Two federally listed vascular species, whitebark pine (*Pinus albicaulis*) and limber pine (*Pinus flexilis*) are known to occur in the vicinity of the ASP area, where elevations and conditions are appropriate. Whitebark pine is federally listed as Endangered by SARA and COSEWIC, provincially listed as Endangered by the *Alberta Wildlife Act*, and is on the ACIMS Tracking list (Government of Canada 2019; ACIMS 2018). Limber pine is federally listed as Endangered by COSEWIC, provincially listed as Endangered by the *Alberta Wildlife Act*, and is on the ACIMS Tracking list (Government of Canada 2019; ACIMS 2018).

Figure 62: Old growth Douglas Fir in Thunderstone Quarry Lands



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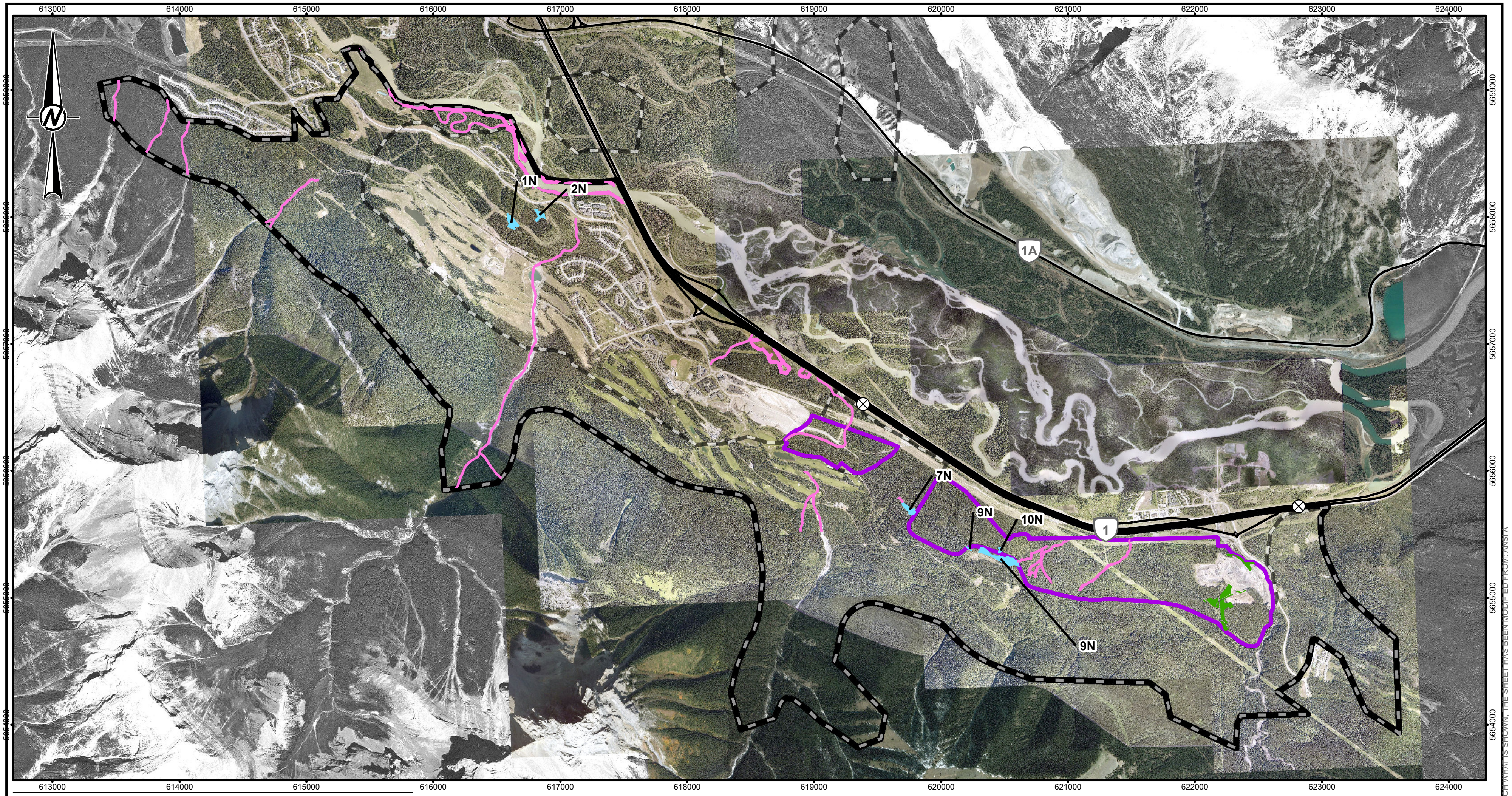

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

ENVIRONMENTALLY SENSITIVE AREAS

- OLD GROWTH
- RIPARIAN AREA
- WETLAND

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE

VEGETATION ENVIRONMENTALLY SENSITIVE AREAS IN THE LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	63

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A total of six listed vascular plant species have been documented in the ASP, with several occurrences of most of these species. There are no known occurrences of vascular plants within the ASP boundary that are considered At Risk (CESCC 2016). Based on habitat, drainage patterns and hydrology appear to be the primary factor that supports habitats for the rare vascular species observed within the ASP, and these areas, typically wetlands and riparian areas, are identified as having high rare plant potential. Additionally, soil chemistry, including pH, salts, and nutrient uptake, plays a role in the presence of these species. None of these species has been documented in the RSA outside of the ASP boundary (ACIMS 2016).

- Crawe's sedge (*Carex crawei*): provincially listed as S3 (vulnerable)
- blister sedge (*Carex vesicaria*): provincially listed as S1
- mountain lady's slipper (*Cypripedium montanum*): provincially listed as S2
- Alaska bog orchid (*Piperia unalascensis*): provincially listed as S2
- mountain currant (*Ribes laxiflorum*): provincially listed as S2
- western larch (*Larix occidentalis*): provincially listed as S2

Listed plant surveys conducted in August 2018 did not identify any federally or provincially listed vascular plant species within the ASP area (Appendix E). Despite extensive searching, the historic occurrence of western larch was not observed. Similarly, whitebark pine was not observed in the ASP area and its presence is considered unlikely because whitebark pine is largely restricted to higher elevations (approximately 1,950 to 2,250 metres above sea level [masl]). Vascular plants recorded during 2018 surveys are listed in Appendix E.

There are no known occurrences of federally listed non-vascular plants within the ASP area that would require avoidance measures, however uncertainty is present because targeted field surveys for non-vascular plants were not undertaken. There are eight provincially listed bryophyte species with the potential to be within the ASP based on the ACIMS database (2016), however, the actual occurrence may be anywhere within the ACIMS occurrence polygon, and may not be within the ASP boundary. These occurrences were documented in 1928 and 1965. All eight species appear on the ACIMS tracked list (ACIMS 2016), four of which are listed as *Sensitive* on the *Wild Species 2015: General Status of Species in Canada* Report (CESCC 2016). There are no known occurrences of non-vascular plants within the ASP boundary that are considered At Risk (ASRD 2010).

- short-tooth hump moss (*Amblyodon dealbatus*): provincially listed as S3
- moss (*Bryum lonchocaulon*): provincially listed as S1S2
- narrow-leaved Chinese phoenix moss (*Fissidens gradifrons*): provincially listed as S2S3
- moss (*Homalothecium nevadense*): provincially listed as S1S2
- moss (*Hygroamblystegium tenax):* provincially listed as S1S2
- moss (*Jungermannia rubra*): provincially listed as SU (unrankable)
- moss (*Limprichtia cossonii*): provincially listed as SU (unrankable)
- large-fruited splachnum moss (*Splachnum vasculosum*): provincially listed as S1S2

Within the RSA, there is one reported occurrence of Porsild's Bryum (*Bryum porsildii*) (ACIMS 2017a). Porsild's Bryum is listed federally as Threatened by the COSEWIC, is listed in Schedule 1 of SARA (Government of Canada 2019) and is provincially listed as S2/S3 (ACIMS 2017a). Porsild's Bryum is associated with western mountain ranges, preferring sites that are constantly moist with seepage or splash during the growing season, along with complete desiccation (i.e., drying out due to water freezing) during the winter season. This moss grows in cracks and cliffs of calcareous conglomerate rock, limestone, basalt, sandstone, and shale and is very unlikely to occur in the ASP area.

Tracked and Watched Plant Communities

The ACIMS database was queried and there are no documented tracked or watched communities within the ASP area.

Weed Species

The noxious weed species documented within the town boundaries are listed in Table 41. Some of these species are only found, or were originally found, within the TSMV area (e.g., blueweed). It is believed that these species were brought in during movement of spoils and equipment (Guest 2013, pers. comm.).

Table 41: Invasive Plant Species Documented within the Town of Canmore

Scientific Name	Common Name
Arctium lappa	great burdock
Campanula rapunculoides	garden bluebell
Chrysanthemum leucanthemum	ox-eye daisy
Cirsium arvense	Canada thistle
Clematis tangutica	yellow clematis
Echium vulgare	Blueweed
Hieracium aurantiacum	orange hawkweed
Hieracium caespitosum	meadow hawkweed
Linaria vulgaris	common toadflax
Matricaria perforata	scentless chamomile
Ranunculus acris	tall buttercup
Silene latifolia	bladder campion
Sonchus arvensis	perennial sow-thistle
Tanacetum vulgare	common tansy
Verbascum Thapsus	common mullein

Note: Data provided by the Town of Canmore.

5.13 Vegetation Environmental Risks

Four primary environmental risks have been identified for Vegetation:

1) Construction and operation of the Project may result in the disturbance and removal of areas of native vegetation and ESAs because of clearing. Listed plant species (especially non-vascular plants) can be difficult to detect, even when targeted surveys are undertaken. Overall potential risks to listed plant species are therefore also considered by evaluating risk to native vegetation and ESAs.

2) Operation of the Project may increase accidental damage of native vegetation and ESAs associated with recreational use of the area.

3) Construction and operations of the Project may result in a reduction of vegetation quality through changes to hydrology, dust deposition and the introduction of contaminants (e.g., spills):

   a. Project activities that alter wetlands or riparian areas, may alter local water flows and drainage patterns. Changes in drainage patterns can strongly influence plant species composition, community structure, and biological diversity (Vale et al. 2015). These changes in water levels will affect soil moisture and may result in localized effects on vegetation habitat quality.

   b. Accidental spills or leaks of hydrocarbons (e.g., gasoline and diesel fuel) could occur during equipment operation, maintenance, fueling, or fuel storage during clearing, construction, and operation, resulting in local contamination of vegetation and soil.

   c. Dust will be generated as a result of clearing and construction activities, which may result in changes to vegetation. Dust that falls directly on plants can have a physical effect by smothering plant leaves or blocking stomata openings (Farmer 1993). Crusts forming on leaves can reduce net photosynthesis (Brandt and Rhoades 1973). After many cycles of crusting, the annual growth rate of plants can be reduced or cease and crusting can lead to death.

4) Construction and operation of the Project may result in the introduction of weed species, which can out compete native plant species and reduce biodiversity within native plant communities and ESAs. Project activities including the movement of machinery or equipment from and to the site, ground disturbance and vegetation clearing could introduce invasive plants to or add to existing infestations within the study area. Bare soil, where reclamation has not been initiated or is unsuccessful, is susceptible to encroachment by invasive plant species.

As described in Section 5.12, there are no known occurrences of provincially or federally-listed plants with legal protection (i.e., avoidance requirements) or tracked and watched plant communities within the ASP area and therefore effects on species at risk (including rare plants and tracked and watched plant communities) are not anticipated. The VECs assessed are native vegetation communities and ESAs. A summary of pre-mitigation effects and environmental consequences for native vegetation communities and ESAs are presented in Table 42.

Table 42: Potential Project Effects for Vegetation Before the Application of Mitigation Measures

Native Vegetation Communities			
Context	Native terrestrial vegetation communities are reasonably resilient to changes in quantity and quality owing to their broad distribution in the RSA and beyond, providing opportunities for recolonization and recovery of structure and function.		
Effect Category	**Impact Criterion**	**Description**	**Environmental Consequence**
Change in native vegetation quantity due to site clearing, accidental damage	Direction	Negative	Moderate
	Magnitude	Medium change: terrestrial vegetation removal due to site clearing for the Project will result in a minimum loss of 107 ha of native vegetation within the ASP area. Increased human presence in the ASP area could encourage dispersed use of green space and conservation areas, including additional loss of vegetation if unsanctioned trails are created.	
	Geographic extent	Project footprint – Clearing for Project infrastructure Regional – Losses associated with human use	
	Duration	Long-term	
	Frequency	Once – Clearing for Project infrastructure Continuous - Losses associated with human use	
	Reversibility	Irreversible	
	Probability	Likely	
Change in native vegetation quality due to changes in hydrology, dust deposition and the introduction of contaminants or invasive species	Direction	Negative	Moderate
	Magnitude	Moderate change: reduced quality of vegetation and change in community composition in the LSA	
	Geographic extent	Local	
	Duration	Short-term – Dust deposition during construction Long-term – Reduced quality due to changes in hydrology, introduction of contaminants or invasive species	
	Frequency	Continuous – Proliferation of invasive weeds Daily – Dust deposition Periodic – Introduction of contaminants	
	Reversibility	Reversible – Dust deposition during construction removed by rain and wind. New annual growth would be free of dust from previous year. Irreversible – Reduced quality due to changes in hydrology, introduction of contaminants or invasive species	
	Probability	Likely – Dust deposition, introduction of invasive species Possible – Reduced quality due to changes in hydrology, introduction of contaminants	

Table 42: Potential Project Effects for Vegetation Before the Application of Mitigation Measures

Environmentally Sensitive Areas			
Context	Old growth Douglas fir, wetlands and riparian areas are sensitive to changes in quantity because they are naturally uncommon on the landscape. Wetlands and riparian areas are particularly sensitive to invasive species, and changes in species composition can affect local wetland community composition and structure.		
Effect Category	**Impact Criterion**	**Description**	**Environmental Consequence**
Change in ESA quantity due to site clearing, accidental damage	Direction	Negative	Moderate
	Magnitude	Wetlands and Riparian areas: Medium change: minimum loss of 0.1 ha of wetlands and 0.5 ha of riparian areas. Increased human presence in the ASP area could encourage dispersed use of green space and conservation areas, including additional loss of ESAs, particularly in riparian areas, if unsanctioned trails are created. Old growth Douglas fir: Medium change: maximum loss of 2.25 ha of old growth Douglas fir[a]. Increased human presence in the ASP area could encourage dispersed use of green space and conservation areas, including additional loss of ESAs if unsanctioned trails are created.	
	Geographic extent	Project footprint – Clearing for Project infrastructure Regional – Losses associated with human use	
	Duration	Long-term	
	Frequency	Once – Clearing for Project infrastructure Continuous - Losses associated with human use	
	Reversibility	Irreversible	
	Probability	Likely – Loss and degradation Unlikely – Direct removal of riparian areas	
Change in ESA quality due to changes in hydrology, dust deposition and the introduction of contaminants or invasive species	Direction	Negative	Moderate
	Magnitude	Medium change: reduced quality of ESAs and change in community composition and structure of ESA areas in the LSA	
	Geographic extent	Local	
	Duration	Short-term – Dust deposition during construction Long-term – Reduced quality due to changes in hydrology, introduction of contaminants or invasive species	
	Frequency	Continuous – Proliferation of invasive weeds Daily – Dust deposition Periodic – introduction of contaminants Once – Changes induced by altered hydrology	
	Reversibility	Reversible – Dust deposition during construction removed by rain and wind. New annual growth would be free of dust from previous year. Irreversible – Reduced quality due to changes in hydrology, introduction of contaminants or invasive species	
	Probability	Likely – Dust deposition, introduction of invasive species Possible – Reduced quality due to changes in hydrology, introduction of contaminants	

a) This value for amount of old growth Douglas fir removed is based on surveys from 2008 and 2015; more recent land cover shows less old growth Douglas fir was available prior to project.

ESAs = Ecologically Sensitive Areas; RSA = Regional Study Area; LSA = Local Study Area.

5.14 Vegetation Relevant Legislation

Federal legislation and guidelines intended to protect vegetation include:

- *Species at Risk Act*, prohibits killing or harming species listed on Schedule 1, or damaging critical habitat as defined in a recovery plan.

Provincial legislation and guidelines intended to protect vegetation include:

- *Alberta Wetland Policy*, promotes the conservation, restoration and protection of Alberta's wetlands to sustain the benefits they provide to the environment, society and economy.
- *Alberta Wetland Mitigation Directive*, provides guidelines to limit adverse effects on wetlands and details wetland replacement requirements when permanent disturbance cannot be avoided.
- *Water Act,* promotes the conservation and management of water resources within Alberta.
- *Stepping Back from the Water*, provides guidelines for determining appropriate setbacks and riparian buffer areas for developments near wetlands, waterbodies, and watercourses.
- *Alberta Weed Act*, identifies and regulates weeds through control measures.
- *Wildlife Act*, under which protective measures for wildlife and plants may be established.
- The 2015 Three Sisters Mountain Village Construction Management Guidelines (TSMV 2015), which provides guidelines related to the protection of the environment including vegetation.
- Canmore Municipal Development Plan, Bylaw 2016-03

5.15 Vegetation Mitigation

Mitigation measures to avoid or reduce effects associated with each category of environmental risk identified for the Projects are recommended in this section.

Disturbance and Removal of Native Vegetation

The following mitigation measures will be implemented to reduce the potential damage or loss of native vegetation and ESAs (i.e., Old Growth Douglas fir, wetlands and riparian areas) during construction and operations of the Project:

- Follow the Canmore Municipal Development Plan (Bylaw 2016-03, Section 4.2) regarding the conservation and protection of ESAs.
- At the design stage, apply a 20 m setback to avoid land areas around the stream and creek. Damage and/or disturbance to ESAs will be avoided, where possible, through the creation of green space designations around natural wetlands.
- Old growth Douglas fir, wetlands and riparian areas will be avoided, to the extent possible, during subdivision design.
- Where loss to wetlands cannot be avoided, they will be compensated for according to the requirements of the Alberta Wetland Policy.

- Pre-construction surveys will be conducted for rare plants including non-vascular plants and lichens, and wetlands
- A site-specific Construction Management Plan will be prepared to include environmental protection measures including, but not limited to vegetation and ESA protection, and monitoring measures, and reclamation and revegetation plans.
- Prior to construction, all on-site contractors will be briefed on the proper procedures and activities to limit environmental effects, as per the TSMV Construction Management Guidelines (TSMV 2015).
- Work limits will be marked so that operations will remain within the clearing boundaries to limit damage to vegetation and soil.
- Boundaries for wetlands and riparian areas will be clearly delineated and avoided during construction so that no clearing will take place beyond the development footprint, unless approved for wildlife and vegetation habitat improvement, or wildfire control purposes.
- Workers and vehicles will be restricted to the designated work area of the development site and will not be permitted to access other parts of the property without written authorization from TSMV.
- Areas that are temporarily disturbed during construction will be progressively reclaimed with native species where feasible. *Flowering Landscapes of TSMV* (Stantec 2004a) and the *Woody Plants of TSMV* (Stantec 2004b) and Town bylaws will be used as a guide for post-construction planting.

Accidental Damage of Native Vegetation Associated with Recreational Use

- Canmore residents and visitors will want to walk, mountain bike, run their dogs and otherwise use natural habitats within and adjacent to the ASP because of the Project. Although these activities have the potential of damaging vegetation and increasing soil erosion, mountain biking may have the highest potential to affect native vegetation, rare plants, and ESAs (i.e., wetlands and riparian areas). The following mitigation measures will be implemented to reduce the likelihood of native vegetation being impacted through increased human use of green spaces areas within and adjacent to the ASP area:
  - Planning a trail system inside the ASP area that will provide users with an enjoyable and effective link between different components of the Project and limit trail proliferation and potential damage to native vegetation. TSMV has a memorandum of understanding with CAMBA, which outlines a framework for the development, construction and maintenance of mountain bike trails on TSMV property (CAMBA and TSMV 2018). Short-term objectives of the MOU include:
    - establishing a process by which CAMBA and its selected partners (e.g., Canmore Trail Alliance) can maintain and adjust an integrated trail system that contributes to a vibrant, active Canmore
    - installing signage and discouraging unsanctioned trail use and building
  - Apply guidelines in the TSMV Vegetation Management Handbook (Stantec 2005), specifically maintenance standards for residual and planted vegetation such as plant health care programs and tree protection plans.

Reduction of Vegetation Habitat Quality

The following mitigation measures will be implemented to limit the potential for reduced vegetation habitat quality, including rare plant habitat, and ESAs (i.e., Old growth Douglas fir, wetlands and riparian areas) during construction and operations of the Project:

- maintaining established drainage patterns, and vegetation habitat quality, through the implementation of the Master Drainage Plan
- adhere to the Engineering Design & Construction Guidelines
- develop and implement an Erosion and Sediment Control Plan as described in the Engineering design & Construction Guidelines (Construction; part of the construction plan; Developer)
- follow applicable Town bylaws relate to herbicides, pesticides, and fertilizers
- implement dust control measures during construction

Introduction of Weed Species

Mitigation measures to reduce the potential establishment of weed species including those recommended by the Town are as follows:

- Guideline in the *TSMV Vegetation Management Handbook* (Stantec 2005).
- A site-specific Construction Management Plan will be prepared to include environmental protection measures including pesticide and herbicide control.
- All equipment will be steam or pressure washed to remove dirt and vegetative debris before entering the work site.
- Limit use of introduced soils from outside the Bow Valley where feasible and use soil and seed mixtures certified as being free from noxious weeds.
- Native soil stockpiles must be sprayed regularly to kill any weed growth.
- Disturbed soil must be seeded or planted within three days to prevent invasive plants from establishing. Over seeding with approved seed mixtures should be conducted in seed areas that have not germinated.
- If herbicide application is required, spot application techniques will be used in lieu of broad-scale herbicide application.
- Turf establishment and maintenance shall follow the Town's *Construction and Landscaping Standards and Land Use Bylaw and approved permits*, including preparing the site for the Construction Completion Certificate followed by the standard warranty/maintenance period leading up to the FAC.
- Disturbed areas should be monitored for up to five years after development and sprayed as required when new weed infestations are documented, and afterwards on public spaces by the Town, until inspection and acceptance of the FAC.

5.16 Vegetation Predicted Project Effects (with Mitigation)

This section predicts the residual effects for the environmental risks of the Project (i.e., removal of native vegetation, accidental damage associated with recreational use of the area, reduction in vegetation habitat quality and the introduction of weeds) identified in Section 5.13 assuming the mitigation measures recommended in Section 5.15 are implemented. There are no known occurrences of provincially or federally listed plants with legal protection (i.e., avoidance requirements) or tracked and watched plant communities in the ASP area and therefore rare plants and tracked and watched plant communities are not anticipated. As such, no residual effects are expected for plant species at risk. Residual effects are assessed for native vegetation communities and ESAs.

Native Vegetation Communities

Terrestrial vegetation removal due to site clearing for the Project will result in the loss of a maximum of 106 ha of treed land cover types (Table 43). The Project footprint also overlaps with less than 1 ha of open vegetation, less than 1 ha of wetland, and 21 ha of existing disturbance (Table 43). The ASP footprint presented in this EIS is conceptual and overestimates the actual amount of vegetation disturbance. Design of final development pods within the ASP area will occur at the subdivision application stage. During construction, vegetation will be cleared to accommodate houses, roads, pedestrian trails and associated infrastructure, and new water features.

Table 43: Change in Land Cover Types Within the Local Study Area

Land Cover Types	Area (ha)		
	Existing Conditions	Change due to the Project	Amount Remaining
Treed			
Closed Douglas fir	7.03	-2.45	4.58
Closed Pine	694.98	-67.50	627.48
Closed Spruce	178.29	-10.99	167.30
Deciduous	42.18	-5.87	36.31
Mixed-wood	29.31	-3.22	26.09
Open Douglas fir	0.03	0.00	0.03
Open Pine	35.07	-6.78	28.29
Open Spruce	126.90	-9.02	117.88
treed total	*1,113.78*	*-105.83*	*1,007.95*
Open Vegetation			
Shrub Meadow	1.22	0.00	1.22
Grassland	28.08	-0.91	27.17
open vegetation total	*29.30*	*-0.91*	*28.39*
Non-Native Vegetation			
Non-Native Grassland	154.43	0.00	154.43
non-native vegetation total	*154.43*	*0.00*	*154.43*
Wetlands and Water			
Wetlands	6.43	-0.10	6.33
River	4.48	0.00	4.48
wetlands and water total	*10.92*	*-0.10*	*10.82*
Anthropogenic Water Impoundments			
Anthropogenic Water Impoundments	2.73	0.00	2.73
anthropogenic water impoundments total	*2.73*	*0.00*	*2.73*

Table 43: Change in Land Cover Types Within the Local Study Area

Land Cover Types	Area (ha)		
	Existing Conditions	Change due to the Project	Amount Remaining
Bare Ground			
Rock	4.26	0.00	4.26
Sand	4.84	0.00	4.84
bare ground total	*9.10*	*0.00*	*9.10*
Disturbance			
Disturbance	249.8	106.8	356.7
disturbance total	*249.8*	*106.8*	*356.7*

Note: The sum of column values may not equal the total due to rounding.
ha = hectares

Most native terrestrial vegetation clearing will be associated with closed pine stands (67.5 ha) but will also include small losses of closed Douglas fir (including 2.25 ha of old growth Douglas fir stand documented in 2008 surveys), closed spruce, deciduous, mixed-wood, open pine and open spruce stands. Native terrestrial vegetation communities have a broad distribution in the RSA and beyond and therefore high potential for recolonization in disturbed areas. Deciduous stands are an exception because they are relatively uncommon both at the local and regional scale; however, species that make up this vegetation community type are found across the RSA and will not be disproportionally affected by the Project (Golder 2013).

The design of the Project will include designation of parks and trails for recreationalists, which aim to reduce the dispersed use of green space and conservation areas within and outside the ASP area. With the implementation of mitigation measures, expected effects on native terrestrial vegetation from recreational use will not increase from baseline conditions.

With the application of mitigation measures specified in Section 5.15, changes to terrestrial vegetation because of alteration in hydrology, dust and the introduction of contaminants are not anticipated.

Because of the invasive nature of weeds, even when mitigation measures have been implemented, weeds have been a consistent problem in past developments within the Town. Therefore, even once mitigation measures have been effectively implemented, the development of the Project is anticipated to increase potential for weed species within the ASP area.

With the application of the mitigation outlined in Section 5.15, predicted effects of the Project on native vegetation, excluding ESAs, are:

- **Direction**: negative
- **Magnitude**: expected to result in a small change with the removal of 106 ha of treed vegetation communities and 1 ha of grassland vegetation communities within the ASP area and an increase in weeds within the ASP boundaries
- **Geographic Extent:** restricted primarily to the ASP area; however, weeds have the potential to proliferate locally within open areas of the ASP area
- **Duration**: long-term

- **Frequency**: expected to occur once for vegetation clearing; however, weed proliferation could occur continually
- **Reversibility**: irreversible
- **Probability**: certain for most terrestrial vegetation communities within the ASP area; probable increase in weed species

Although the effects of tree clearing and the introduction of weed species associated with the Project on native vegetation communities are anticipated to be permanent, they do not pose a risk to terrestrial vegetation communities regionally; therefore, the environmental consequence of the Project on terrestrial vegetation communities is rated as low.

Potential changes are also possible for ESAs (Table 43), and these are specifically discussed in the following section.

Environmentally Sensitive Areas

ESAs could be affected by clearing and disturbance associated with development, a reduction in habitat quality through changes to hydrology, dust deposition and the introduction of contaminants (i.e., spills) and reduced biodiversity through the introduction of weed species. Wetlands and riparian areas are sensitive to losses because they are naturally uncommon on the landscape. In addition, wetlands and riparian areas are particularly sensitive to invasive species, which can induce changes in species composition and affect community composition, structure, and function. Residual effects for each of the ESAs (i.e., Old growth Douglas fir, wetlands and riparian areas) are assessed individually below.

Old Growth Douglas Fir

Old growth Douglas fir comprises approximately 2.7 ha within the ASP Boundary, as documented in the 2008 and 2015 surveys. Most of this area will be disturbed but, to the extent possible, clearing old growth Douglas fir will be avoided during subdivision planning as recommended in the NRCB Decision (NRCB 1992, p. 10-31). With the application of mitigation measures specified in Section 5.15, changes to old growth Douglas fir habitat because of alteration in hydrology, dust and the introduction of contaminants are not anticipated.

Weeds have the potential to alter old growth forest condition, particularly in smaller patches where the edge-to-interior ratio is higher (Honnay et al. 2002). Even with the application of weed control mitigation measures, the projects have the potential of increasing presence of weed species, which may affect the condition of old growth Douglas fir forests within the Project area through the increase of edge-to-interior ratios.

The design of the Project will include designation of parks and trails for recreationalists, which aim to reduce the dispersed use of green space and conservation areas within and outside the Project Boundary. With the implementation of mitigation measures, expected effects to old growth Douglas fir from recreational use will not increase from baseline conditions.

With the application of the mitigation outlined in Section 5.15, including the avoidance of old growth Douglas fir stands, where possible, predicted effects of the Project on old growth Douglas fir stands are primarily associated with the introduction of weeds within the Smith Creek ASP and are:

- **Direction**: negative

- **Magnitude**: expected to result in small change with a maximum loss of 2.25 ha of remaining old growth Douglas fir stands, and potential changes from the proliferation of weeds
- **Geographic Extent**: local (i.e., restricted to the ASP area)
- **Duration**: long-term
- **Frequency**: ESA loss will occur only once during construction; however, weed proliferation could occur continually
- **Reversibility**: irreversible
- **Probability**: probable for ESA area loss; to the extent possible, old growth Douglas fir clearing will be avoided during subdivision planning within the Project Boundary but some clearing may occur

Consistent with the NRCB Decision Report (NRCB 1992, p. 10-31), old growth Douglas fir will be avoided during subdivision planning, where possible. Although the Project has the potential to increase weed species within the Project Boundary, and remove or reduce the condition of Douglas fir stands locally, it does not pose a risk to the old growth Douglas fir within the RSA; therefore, the environmental consequence of the Project on this ESA is rated as low.

Wetlands and Riparian Areas

Wetlands are present within the ASP area. Placement of development areas has considered and avoided wetlands to the extent possible. A maximum loss of 0.1 ha of wetlands and 0.5 ha of riparian areas in the ASP is predicted (Table 43).

The ASP area presented in this EIS is conceptual and overestimates the actual amount of vegetation disturbance. During final development design, the small loss of wetland may be avoided. If wetlands cannot be avoided, then under the *Alberta Water Act*, an approval must be obtained before undertaking any construction activity in a wetland. A construction activity includes, but is not limited to, disturbing, altering, infilling or draining a wetland. The *Wetland Mitigation Directive* (under the Alberta Wetlands Policy) (AEP 2015) outlines the wetland mitigation process that AEP follows when making approval decisions for developments that may affect wetlands. Where wetlands cannot be avoided, an application to AEP will be required for approval to cause permanent adverse effects. There will be a requirement to provide compensation to a Wetland Replacement Agent (e.g., Southern Alberta Land Trust, Ducks Unlimited Canada) for permanent adverse effects on any wetland.

Changes in drainage patterns due to grading and contouring could locally alter hydrology and result in additional changes to the vegetation community composition and structure of wetlands and riparian areas; however, the development and implementation of a Master Drainage Plan including a stormwater management plan is predicted to limit these effects. With the application of mitigation measures specified in those plans, wetlands and riparian areas are not anticipated to be impacted by dust and the introduction of contaminants.

Wetlands and riparian areas can be particularly sensitive to invasive species, and changes in species composition can affect local wetland community composition and structure (Zedler and Kercher 2004). Species such as common toadflax (*Linaria vulgaris*), Canada thistle (*Cirsium arvense*) and perennial sow-thistle (*Sonchus arvensis*) have been reported within wetland ecosystems, are known within the Town, and may affect wetlands and riparian areas that are retained within ASP area.

The design of the Project will include designation of parks and trails for recreationists, which aim to reduce the dispersed use of green space and conservation areas outside the ASP area. With the implementation of mitigation measures, expected effects on wetlands and riparian areas from recreational use will not increase from baseline conditions.

With the application of the mitigation outlined in Section 5.15, including avoidance of natural wetlands and riparian areas and compensation for any affected wetlands, predicted effects of the Project on wetlands and riparian areas are primarily associated with the introduction of weeds within the Smith Creek ASP and are:

- **Direction**: negative
- **Magnitude**: expected to result in small change with a maximum loss of 0.1 ha of wetlands and 0.5 ha of riparian areas, and potential changes to wetland and riparian community composition and structure from the proliferation of weeds
- **Geographic Extent**: local (i.e., restricted to the ASP area)
- **Duration**: long-term
- **Frequency**: ESA loss will occur only once during construction; however, weed proliferation could occur continually
- **Reversibility**: irreversible
- **Probability**: likely for ESA area loss; possible for increase in weed species

Although the increase in weed species may result in changes to wetland and riparian community composition, implementation of weed control measures is predicted to limit these effects. The Project may affect these ESAs within the ASP area but does not pose a risk to ESAs regionally. The environmental consequence to these ESAs is rated as low.

5.17 Vegetation Uncertainty and Monitoring

There is substantial certainty associated with vegetation community mapping. Vegetation surveys conducted within the ASP area were used to map and characterize the vegetation (Section 5.11), and subsequent field programs were completed to delineate, characterize and verify wetland and riparian areas.

The amount of old growth Douglas Fir within the LSA and RSA is unknown because age data are not available. Therefore, an assessment of the proportion of old growth Douglas Fir in the LSA or RSA represented by the ASP area was not possible.

Weeds are currently an important issue for the Town and the Town has a weed control program that involves locating, spraying and monitoring infestations. Because the *Alberta Weed Act* requires that provincially listed weeds are controlled, the Town must address this issue. Similar monitoring approaches as have been used elsewhere in the Town should be applied for the Project.

Uncertainty associated with vegetation communities, wetlands, and rare plants will be considered when planning follow-up programs and pre-construction surveys.

5.18 Vegetation Cumulative Effects

Native vegetation communities

The environmental consequence of the Project on native vegetation communities is rated as low. The Project in combination with other RFDs (i.e., residential and commercial developments in the Bow Valley) will result in the loss of native vegetation communities. Effects are likely to result from:

- vegetation clearing directly removing native vegetation communities
- increased presence of people who may choose to recreate on undesignated trails near new residential developments, or who may expand undesignated trail networks in the Bow Valley
- introduction of weed species or increased proliferation of weed species, which reduces the quality of native vegetation communities

Climate change may add to the effects of native vegetation loss in the RSA, although the direction and magnitude of climate change effects are uncertain because many scenarios are possible (Deser et al. 2010; Walther 2010; Dawson et al. 2011). Climate change resulting in a drier climate could promote grassland expansion into areas that formerly supported trees and shrubs dependent on moister soils (Gayton 2013). The risk of insect infestations in the RSA may also increase owing to changes in management practices over the past century (e.g., fire suppression) and climate change. Such outbreaks would affect treed land cover types, and particularly stands dominated by old growth pine (Carroll et al. 2004; Taylor and Carroll 2003). Continued fire suppression in the RSA could also promote tree encroachment into open ecosystems, such as grasslands.

Together, the Project and other RFDs are expected to result in the loss of 191 ha of native terrestrial vegetation communities, representing a 1.3% change within the RSA (Table 44). The largest change will occur within closed pine forest with a loss of approximately 110 ha (2.2% of available in the RSA). Rare plant species and tracked and watched plant communities represent the most sensitive features of vegetation communities; however, given uncertainties around their local distribution, it is not known how these features will be affected by RFDs. Provincial guidance emphasises avoidance of sensitive features and application of measures to limit negative effects. This assessment therefore assumes that proponents of RFDs will implement best management practices to avoid and limit effects on rare plant species and tracked and watched plant communities.

Taking into account existing conditions described in Section 5.12 and future projects or activities, the cumulative effects caused by site clearing, the introduction of weed species, and climate change are expected to pose a low risk to terrestrial vegetation communities within the RSA. Therefore, the cumulative effects are expected to result in a low environmental consequence.

Table 44: Cumulative Change in Land Cover Types Within the Regional Study Area

Land Cover Types	Area (ha)		
	Existing Conditions	Change due to the Project and RFDs	Amount Remaining
Treed			
Closed Alpine Fir	54.03	0.00	54.03
Closed Douglas Fir	661.24	-8.41	652.82
Closed Pine	5,087.45	-109.56	4,977.88
Closed Spruce	4,806.65	-21.91	4,784.74
Deciduous	424.60	-19.56	405.04
Mixed-wood	133.78	-3.86	129.92
Open Alpine Fir	31.00	0.00	31.00
Open Alpine Larch	5.08	0.00	5.08
Open Douglas Fir	348.71	0.00	348.71
Open Pine	333.47	-7.67	325.81
Open Spruce	1,904.64	-13.71	1,890.93
treed total	*13,790.65*	*-184.68*	*13,605.97*
Open Vegetation			
Shrub Meadow	283.74	0.00	283.74
Grassland	954.32	-5.89	948.43
open vegetation total	*1,238.06*	*-5.89*	*1,232.18*
Non-Native Vegetation			
Non-Native Grassland	203.19	-41.48	161.71
non-native vegetation total	*203.19*	*-41.48*	*161.71*
Wetlands and Water			
Wetlands	476.14	-1.83	474.31
River	218.55	0.00	218.55
Flooded Area	21.76	0.00	21.76
Lake	79.80	0.00	79.80
wetlands and water total	*796.25*	*-1.83*	*794.42*
Anthropogenic Water Impoundments			
Anthropogenic Water Impoundments	2.73	-0.27	2.46
anthropogenic water impoundments total	*2.73*	*-0.27*	*2.46*
Bare Ground			
Rock	5,239.61	0.00	5,239.61
Sand	139.29	0.00	139.29
bare ground total	*5,378.91*	*0.00*	*5,378.91*
Disturbance			
Disturbance	2,468.47	233.88	2,702.35
disturbance total	*2,468.47*	*233.88*	*2,702.35*

Note: The sum of column values may not equal the total due to rounding.
RFDs = reasonable foreseeable developments; ha = hectares.

Environmentally Sensitive Areas

The environmental consequence on ESAs, specifically wetlands and riparian areas, as a result of site clearing and construction for the Project is rated as low. Similar to the assessment for native vegetation communities, the Project and other RFDs could result in the loss or degradation of ESAs because of vegetation clearing, increased human presence, and increased proliferation of weeds.

The Project and other RFDs are predicted to remove 1.8 ha (0.4% of available in the RSA) of wetlands in the RSA (Table 44). The loss of riparian areas in the RSA from other RFDs is uncertain; however, the Project is predicted to remove 0.5 ha of riparian areas in the RSA. The construction of the Three Sisters ASP on TSMV lands will apply similar mitigation to the Project. Regarding other RFDs, the *Alberta Wetland Mitigation Directive* provides guidelines to limit adverse effects on wetlands and details wetland replacement requirements when permanent disturbance cannot be avoided. Accordingly, RFD effects on wetlands are assumed to be avoided or compensated by wetland replacement.

Wetland availability may be adversely affected by climate change in the RSA. Wetlands are considered one of the ecosystems most sensitive to predicted changes in temperature, and the resultant changes in precipitation and timing and volume of snowmelt (Gayton 2008). Riparian areas may also be adversely affected by potential changes in precipitation, changes in snow accumulations and melt times, and changes in streamflow (Clow 2010). Further, the increased frequency and severity of flooding events could alter the distribution and condition of riparian areas. For example, many riparian areas in the RSA were heavily impacted by flooding in 2013 (i.e., scoured banks, sediment deposition). There is high uncertainty associated with the effects of climate change on riparian area availability, distribution, and condition.

Taking into account existing conditions described in Section 5.12 and future projects or activities, the cumulative effects caused by site clearing and construction and climate change are not expected to alter the overall distribution and condition of wetland and riparian ESAs within the RSA. Therefore, the cumulative effects are expected to result in a low environmental consequence.

5.19 Aquatic Ecology Valued Ecosystem Component

This section presents additional details about the approach used to complete the VEC’s impact statement.

5.20 Aquatic Ecology Methods

The aquatic ecology assessment follows the general assessment methods outlined in Section 4.

Environmental Consequence

A high environmental consequence, which can be considered a significant effect, is assigned if serious risk is identified. The definition of a serious risk varies among VECs and this section provides the methods used to identify whether or not a serious risk is present for fish under existing conditions or would be expected because of the Project, or the Project plus other RFDs.

Serious risk for fish is defined using the concept of self-sustaining and ecologically effective populations, as described in detail for wildlife (Section 5.2.4). Self-sustaining fish populations are populations that will be maintained into the future with a low risk of extirpation. Self-sustaining populations are healthy and viable populations, which are by definition robust and capable of withstanding environmental change and accommodating stochastic population processes (Reed et al. 2003).

Achieving viable populations may not be sufficient to meet conservation objectives for assemblages of fish species that might interact with the species being assessed (Soulé et al. 2005). Accordingly, the concept of ecologically effective populations is also applied. An ecologically effective population differs from a self-sustaining population if the number of individuals needed to maintain ecological function is greater than the number required to maintain a viable population, or if the behaviour of animals in a viable population of a highly interactive species is altered so that they no longer perform important ecological functions. As an example, if the introduction of an impermeable barrier impedes a fish population's ability to migrate upstream and provide a seasonally important prey source for other species, its ecological function would be lost.

A serious risk is identified for fish if the evidence indicated that:

- The abundance of the species in the RSA, whether an open or closed population, is on a declining trajectory that is not predicted to recover or stabilize, or an ecological trap and a population sink is present at the scale of the RSA.
- Connectivity through the RSA for the species declines to a level at which population viability for the species in the RSA or in surrounding areas may be adversely affected.
- The species has lost important ecological function in the RSA, regardless of their self-sustaining status, such that the loss in function might trigger ecological changes that result in degraded or simplified ecosystems.

5.21 Aquatic Ecology Existing Conditions

The Bow River is the main watercourse in the RSA. Dominant sport fish species in the Bow River in this region include mountain whitefish (*Prosopium williamsoni*) and brown trout (*Salmo trutta*) (Thompson 1977; R.L. & L. 1995), as well brook trout (*Salvelinus fontinalis*), longnose sucker (*Catostomus catostomus*), and white sucker (*Catostomus commersoni*) (Bow River Water Quality Council 1994). Additional sport fish species that may be present include westslope cutthroat trout (*Oncorhynchus clarki lewisii*), bull trout (*Salvelinus confluentus*), lake trout (*Salvelinus namaycush*), burbot (*Lota lota*) and rainbow trout (*Oncorhynchus mykiss*) (UMA 1991a; Banff-Bow Valley Study 1995, 1996; Froese and Pauly 2019). Non-native species introduced from stocking the Bow River system include brown trout, rainbow trout, and brook trout (Banff-Bow Valley Study 1995, 1996).

Additional non-sport and forage fish species found in the Bow River in this region include mountain sucker (*Catostomus platyrhynchus*), lake chub (*Couesius plumbeus*), longnose dace (*Rhinichthys cataractae*) and brook stickleback (*Culaea inconstans*) (Nelson and Paetz 1992; Banff-Bow Valley Study 1995, 1996; Froese and Pauly 2019).

Fish species at risk in the region include:

- bull trout – provincially listed as 'At Risk' (AEP 2018) and the Saskatchewan - Nelson Rivers populations federally assessed as "Threatened" by COSEWIC (Government of Canada 2019)
- westslope cutthroat trout – native populations of westslope cutthroat trout are provincially listed as 'At Risk' (AEP 2018) and the Saskatchewan - Nelson Rivers populations are federally listed as 'Threatened' by COSEWIC and on SARA Schedule 1 (Government of Canada 2019). The presence of native westslope cutthroat trout populations in the RSA is uncertain, but possible (ASRD and ACA 2006; Fisheries and Oceans Canada 2014)
- lake trout – provincially listed as 'Sensitive' (AEP 2018) but hold no federal status. Although lake trout are present in lakes within the Bow Valley, they are not present within the Bow River in this region

Bull trout is a coldwater species found in lakes, streams and rivers from sea level to mountainous areas. Its habitat has been described by the U.S. Fish and Wildlife Service as “cold, clean, complex and connected.” (Fisheries and Oceans Canada 2019a). In streams, they are typically located in pools or backwater areas, instead of fast-moving riffles and rapids. Their primary food source is bottom fauna, mostly insects and other fish. Bull trout spawning occurs in the fall, from late September to October, in water temperatures below 9°C (Nelson and Paetz 1992). Preferred spawning depths in streams are up to 1 m (Ford et al. 1995). Small, cold-water tributaries with groundwater upwelling also provide important spawning areas for bull trout as the eggs require a constant temperature throughout the winter during their incubation period. The eggs hatch in April (Nelson and Paetz 1992).

Westslope cutthroat trout are found in lakes and streams along both the east and west slopes of the Rocky Mountains. Habitat requirements include cool, well oxygenated water with large pools and slow velocity areas for rearing, and gravel substrate for spawning. Spawning generally takes place in small natal streams in redds on bottoms of fine gravel (Fisheries and Oceans 2016). Westslope cutthroat trout spawn in late spring/early summer (May through June) when the water temperature reaches approximately 10°C (Nelson and Paetz 1992) at water depths of 20 to 50 cm (Fisheries and Oceans 2016). Their eggs and alevins remain in the spawning gravels until the fry emerge in early July to late August. Their young remain in the gravel for about a week and then disperse to slower-moving waters with cover, commonly to the stream margins and off channel habitat.

Five permanent or ephemeral creeks flow through the Project ASP. Prominent permanent creeks include Stewart and Pigeon creeks, both of which drain into the Bow River. Stewart Creek flows along the western edge of the Project ASP (UMA 1991a). Pigeon Creek flows along the eastern edge of the Project Boundary and passes through the Thunderstone Quarry property. Smith, Marsh, and Cairnes creeks are intermittent watercourses that cross the Project area.

Fish habitat information for Stewart Creek was collected by UMA in 1990; the upper and lower portions were considered ephemeral. The channel consisted primarily of swift, broken runs and wide shallow riffle habitat. Substrate was 90% boulder and rock (UMA 1991b). Riparian vegetation consisted of 80% grass and shrub, with no instream vegetation present at the time of the survey. Instream cover was provided by boulder and minor amounts of undercut banks. The creek banks were considered to be mainly unstable.

Electrofishing surveys were conducted in 500 m of Stewart Creek in August 1991; no fish were captured (UMA 1991c). After the site inspections conducted on Stewart Creek, it was determined that there is limited fish habitat potential due to the following habitat attributes:

- frequent high gradients
- low pool to riffle ratio
- lack of spawning substrate
- low winter flows, lack of overwintering pools
- lack of pools of sufficient size and depth for adult fish
- ephemeral flows

No fish or fish habitat studies were found for Pigeon Creek and there are no fish capture records documented in the Fisheries and Wildlife Management Information System (FWMIS; AEP 2016). Habitat mapping for Pigeon Creek is not available; however, a set of falls is present a short distance upstream from the Thunderstone Quarry boundary which is likely a substantial barrier to upstream fish movements. Fish may be present downstream from the falls. Similar fish habitat conclusions from Stewart Creek are likely applicable to Pigeon Creek; especially given the extensive and significant manmade reconstruction after the 2013 floods.

No habitat information is available for Smith, Marsh or Cairnes creeks. Cairnes Creek was considered by UMA for field work; however no work was conducted due to the lack of surface flow and a visible channel (UMA 1991c).

The current conditions of aquatic ecology resources in the LSA have been influenced by previous and existing developments and activities. The banks of the creeks that flow through the Project ASP and their associated riparian areas were heavily scoured during the 2013 flood event and the banks were reinforced by the municipality to channelize the flood. The flood event also resulted in sediment deposition.

5.22 Aquatic Ecology Environmental Risks

The Project may affect fish and fish habitat through construction of watercourse crossings on Smith Creek and other tributaries and through sediment loading or contaminant inputs to the Bow River from construction activities and stormwater runoff.

It is unlikely that any of the creeks within the ASP has suitable fish habitat due to seasonal and intermittent flows, steep gradients and lack of suitable habitat for spawning or overwintering (UMA 1991c). However, downstream effects on the Bow River could occur. The use and operation of equipment and vehicles during in-stream activities and storm water runoff from the proposed development can result in sedimentation or contamination of watercourses during construction which can affect surface water quality, and riparian habitat. Increases in suspended sediment concentrations can cause physiological effects to fish ranging from minor physiological stress to mortality. The severity of effects depends on a combination of: concentration; size, shape and chemical composition of sediment particles; and duration of exposure. Depending on the levels of sediment, the introduction of fine sediment downstream to the Bow River can have sub-lethal (e.g., irritation of gill tissue) and lethal (e.g., suffocation of developing embryos) effects on fish (CCME 2008).

Changes to surface water quality from unplanned releases of deleterious substances can affect fish and other aquatic life principally by physical alteration of the habitat available to carry out life processes. Spills during construction and operation that occur in high enough concentrations could contaminate water and cause direct toxicity to fish and aquatic life.

Environmental risks of the Project, therefore, consider changes to the quality and quantity of aquatic habitats, and resulting effects on fish populations in the Bow River (including for species at risk). Changes to aquatic habitat quality or quantity is an indicator for effects on fish species populations. For example, alteration to fish habitat from sedimentation or spills/contaminants can subsequently affect fish populations by reducing survival and reproductive success.

Due to the limited fish habitat potential in any of the creeks within the ASP, sedimentation and contamination effects from in-stream construction activities are unlikely. However, downstream effects in the Bow River may occur, where species at risk such as bull trout and westslope cutthroat trout may be present. However, sediment inputs are likely to be diluted over short distances because of relatively high flow rates. Further, segments of the Bow River within the RSA may be resilient to changes in sediment input owing to its proximity to mountain tributaries, which contribute large volumes of turbid water and floating debris during the spring melt. The Bow River is sensitive to the effects of contamination. Without the application of mitigation, measurable increases in turbidity and sediment inputs to the five creek that run through the ASP and the Bow River may occur. However, these inputs are likely to be localized and short-term in nature, during the period of construction.

Without the implementation of mitigation, there is also the potential for an incremental, localized reduction in fish habitat quality in the Bow River from sediment and contamination effects from stormwater runoff associated with the Project. These effects on habitat quality may occur periodically (i.e., during freshet or higher rainfall events) over the period of operations.

Changes to aquatic habitat could affect fish populations by causing reduced survival and reproductive success for species at risk, in particular for individuals occupying habitats in the Bow River. Without the application of mitigation, predicted effects of the Project on fish populations, including bull trout and westslope cutthroat trout, are:

- **Direction**: negative
- **Magnitude**: expected to cause a small but measurable reduction in fish survival and reproductive success resulting from sub-lethal effects of fine sediment introduction to the Bow River or from spills/contaminants
- **Geographic Extent**: may extend beyond the ASP boundary
- **Duration**: short-term sedimentation effects and spills related to construction activities; long-term for sedimentation effects related to changes in stormwater runoff and contamination events
- **Frequency**: continuous for effects related to construction activities; periodic for effects related to stormwater runoff
- **Reversibility**: reversible (effects from construction activities) and irreversible (changes to stormwater runoff)
- **Probability**: possible

The environmental consequence of Project effects on bull trout and westslope cutthroat trout is predicted to be low without the application of mitigation.

5.23 Aquatic Ecology Relevant Legislation

Federal legislation and guidelines intended to protect aquatic life and water quality include:

- *Fisheries Act*
- Fisheries and Oceans Canada's *Measures to Protect Fish and Fish Habitat* (Fisheries and Oceans Canada 2019b)
- *Species at Risk Act*
- *Canadian Environmental Quality Guidelines* (CCME 2014)

Provincial legislation and guidelines intended to protect aquatic life and water quality include:

- *Water Act*; promotes the conservation and management of water resources within Alberta
- *Environmental Protection and Enhancement Act*
- *Environmental Quality Guidelines for Alberta Surface Waters* (Government of Alberta 2018b)
- *Code of Practice for Watercourse Crossings*
- *Code of Practice for Outfall Structure on Water Bodies*
- *Code of Practice for Pesticides*
- *South Saskatchewan Regional Plan* 2014-2024 (Government of Alberta 2018c)
- *Approved Water Management Plan for the South Saskatchewan River Basin* (Alberta Environment 2006)
- the 2015 Three Sisters Mountain Village Construction Management Guidelines (TSMV 2015), which provides guidelines related to the protection of the environment including the protection of streams and water courses, and water quality

5.24 Aquatic Ecology Mitigation

The potential effects and mitigation measures outlined in this section are related to those outlined in the Surface and Groundwater Section (Section 6.2.5) and are addressed in the Stormwater Management Strategies document that has been developed for the site (MMM 2016). A detailed Master Drainage Plan will be prepared in accordance to the *Stormwater Management Guidelines for the Province of Alberta* (CH2M Gore & Storrie Ltd. 1999) and the Town *Engineering, Design and Construction Guidelines* (Town of Canmore 2010).

To mitigate effects, management practices presented in the Construction Management Guidelines (TSMV 2015) will be applied to all construction activities, and development activities will adhere to federal and provincial legislation and guidelines. Mitigation measures to reduce effects from the operation of equipment and vehicles and sedimentation to watercourses and riparian areas include:

- clearly delineating the designated boundary for construction
- maintaining or restoring riparian vegetation
- locating staging areas at least 20 m away from all permanent watercourse streambanks (Town of Canmore 2012)
- complying with regulatory timing windows for working in or near rivers or streams that have the potential to connect with viable fish bearing waterbodies (i.e., Bow River). The Bow River is a Class C waterbody with a Restricted Activity Period from September 1 to April 30 (AEP 2006)
- performing pre-construction fish and fish habitat surveys at proposed watercourse crossing locations
- isolating the streambed as much as possible during in-stream activities
- minimizing the time and extent of equipment and vehicles operating in the riparian zones and/or on watercourse banks
- conducting environmental monitoring during in-stream activities in fish-bearing watercourses

- developing and implementing an erosion and sediment control plan, with particular attention to the stabilization of watercourse streambanks and prevention of siltation. The plan will be prepared in accordance with the Town's *Construction Management Plan Guidelines* and *Engineering, Design and Construction Guidelines* (Town of Canmore 2010) and will consider adaptive management approaches
- scheduling work during the driest times of the year to limit erosion and sedimentation
- suspending all construction activities during wet conditions (e.g., heavy rainfall and run-off events), when necessary to limit erosion and sedimentation
- maintaining and monitoring all sediment and erosion controls

Mitigation measures to reduce effects on the aquatic environment through contamination will include:

- restricting residential use of fertilizers and chemicals, and washing of vehicle according to applicable Town bylaws
- apply, store and dispose of residential chemicals (e.g., pesticides, herbicides) according to applicable Town bylaws (Construction and operation)
- developing and implementing a Spill Response Plan for watercourse crossing construction (may form part of the Construction Management Plan that will be provided to the Town)
- maintaining all machinery used for in-stream activities in clean condition and free of fluid leaks to prevent any deleterious substances from entering the water
- washing, refuelling, and servicing machinery at least 30 m from the banks of any watercourse

Adaptive management approaches will be a key component of the mitigation and best management practices that will be applied during construction and operation to minimize or avoid adverse effects on fish and aquatic habitat.

5.25 Aquatic Ecology Predicted Project Effects (with Mitigation)

As described in Section 5.22, due to the limited fish habitat potential in any of the creeks within the ASP, sedimentation and contamination effects from in-stream construction activities are unlikely. However, downstream effects in the Bow River may occur, where species at risk such as bull trout and westslope cutthroat trout may be present.

Changes to aquatic habitat quality and quantity from the release of sediment during instream construction and from stormwater runoff are expected to be minor due to the effective implementation of mitigation, use of appropriate construction methods, and adherence to best management practices (e.g., Alberta Code of Practice for Watercourse Crossings and Fisheries and Oceans Canada's Measures to Protect Fish and Fish Habitat) and other related industry guidance, and the Erosion and Sediment Control and Stormwater Management plans (to be submitted as a supporting study for the ASP application). Any effects to habitat quality and quantity from in-stream construction would be localized and short-term during the period of construction. Effects to habitat quality and quantity in the Bow River from sediment associated with stormwater runoff would be longer-term (during operations) but would be managed according to the Master Drainage Plan.

Similarly, mitigation practices and industry standard best management practices will be implemented to reduce the likelihood and extent of spills associated with construction and operation of the Project. Implementation of the Spill Response Plan is expected to reduce the likelihood, extent and severity of spills of fuel or other hazardous materials during Project construction and operations.

Changes to aquatic habitat could affect fish populations by causing reduced survival and reproductive success for species at risk, in particular for individuals occupying habitats in the Bow River. With the application of mitigation outlined in Section 5.24, predicted Project effects on fish populations, including bull trout and westslope cutthroat trout, are:

- **Direction**: negative
- **Magnitude**: expected to result in negligible (i.e., non-measurable) reduction in fish survival and reproductive success from effects of sediment releases, stormwater runoff, and spills/contamination due to the implementation of mitigation measures, industry standard best management practices, and implementation of management plans
- **Geographic Extent**: may extend beyond the ASP boundary
- **Duration**: short-term for sedimentation and spills associated with construction activities, but possibly long-term for potential surface water runoff and contaminants during operations
- **Frequency**: continuous during the construction period; periodic for stormwater runoff and contamination events during operations
- **Reversibility**: reversible (effects from construction activities) and irreversible (changes from stormwater runoff)
- **Probability**: possible

With the application of effective mitigation, the environmental consequence of these residual effects on bull trout and westslope cutthroat trout is predicted to be negligible.

5.26 Aquatic Ecology Uncertainty and Monitoring

Although it is unlikely that any creeks within the ASP Boundary have suitable fish habitat for spawning or over wintering due to seasonal and intermittent flows, steep gradients and lack of suitable habitat (UMA 1991d), site conditions including water flows, water quality, and presence of fish or fish habitat should be verified for the creeks intersecting the ASP boundary that might be impacted by the Project. No fish or fish habitat studies were found for Pigeon Creek and there are no fish capture records documented in FWMIS (AEP 2016).

Although uncertainty exists around the precise location and area within the ASP area, appropriate setbacks from watercourses will be implemented during final subdivision planning. An environmental monitor will be on-site for in-stream watercourse crossing construction activities in fish-bearing watercourses. Mitigation and best practices identified for surface water are standard for construction activities and are expected to have a high probability of success.

Water quality monitoring on the Bow River is conducted by AEP downstream of TSMV.

5.27 Aquatic Ecology Cumulative Effects

The cumulative effects caused by site clearing and construction may result in a detectable adverse effect in water quality, but the effect is not predicted to result in serious risk to fish populations within the RSA. For example, there may be short term increases in sediment loads due to high precipitation events but these are not predicted to have long term effects on fish populations in the RSA. The environmental consequence of Project effects on fish populations in the Bow River, including fish species at risk, is rated as negligible; therefore, the Project is not expected to contribute to cumulative effects for this VEC in the RSA.

Climate change is predicted to adversely affect the aquatic ecology in the RSA, although the magnitude of climate change effects is uncertain. The Town of Canmore's (2016) Climate Change Adaptation Background Report and Resilience Plan lists increased river flooding, increased sediment loading (turbidity), increased water temperatures, and changes to stream flow timing and volume as climate-related effects that may adversely affect aquatic ecology in the Bow Valley Corridor.

5.28 Biodiversity Summary

The Project EIS identified several opportunities to apply mitigation to avoid serious risk to important biodiversity features in the Bow Valley. This section summarizes the results of the biodiversity assessment.

5.28.1 Wildlife

Grizzly bears

Grizzly bears are provincially listed as 'Threatened'. They have a slow population growth; therefore, it takes more time for populations to recover after declines. The RSA is considered a population sink for grizzly bears under existing conditions because bears are exposed to high mortality rates. A serious risk is present in the RSA under existing conditions. With the addition of the Project, the following residual effects are expected for grizzly bears:

- A loss of 141.2 ha currently selected habitat is predicted within the ASP area due to development of the Project and installation of a wildlife exclusion fence. Habitat selection within the adjacent corridors was predicted to change slightly (a loss of 5 ha of selected habitat and a loss of 1 ha of used as available habitat). The loss of habitat will have a negative impact on habitat availability, but limiting grizzly bear access to the area within the fence will likely be beneficial for the grizzly bear population overlapping the RSA because the ASP area represents an ecological trap under existing conditions (i.e., the Project is predicted to have a positive outcome of reducing human-grizzly bear conflict). FireSmart measures implemented by the Town, the MD of Bighorn, and the Province could provide high quality habitat for grizzly bears away from zones of higher negative human-bear interactions, which could result in a net benefit to grizzly bears.
- Human use on undesignated trails is expected to decrease because of Project mitigation (e.g., education, wildlife fencing), which should positively influence bear use of wildlife corridors. The probability of grizzly bears selection in wildlife corridors adjacent to the Project is predicted to change little because of the Project, even if human use on designated trails increases.
- Fencing the ASP area is predicted to substantially reduce the risk of negative human-bear interactions inside the Project footprint. The risk of negative human-bear interactions is also predicted to decrease in adjacent wildlife corridors if people use recreational amenities envisioned for the Project. Effects of the Project are likely to be positive (i.e., reduction of negative human-bear interactions in the LSA). Overall outcomes for the grizzly bear population may be neutral at the RSA scale because of greater numbers of people in the RSA because of the Project.
- There is some uncertainty about predictions regarding grizzly bear use of wildlife corridors and negative human-bear interactions in wildlife corridors because these will depend on how people access the wildlife corridor and on the good behaviour of people in wildlife corridors. To be precautionary, the residual effects of the Project for these two effects pathways are predicted to be neutral relative to existing conditions.

- Environmental consequence of residual effects of the Project on grizzly bears are predicted to be moderately adverse for loss of selected habitat, negligible for use of corridors, and, to be precautionary in the face of uncertainty, negligible for negative interactions between grizzly bears and people. Consequently, the Project is not expected to contribute to the serious risk identified for grizzly bears under existing conditions, and may have a net benefit because the serious risk identified under existing conditions is driven by negative human-bear encounters and bear mortality and mitigations associated with the Project could reduce these adverse effects relative to existing conditions.

Cumulative effects of the Project and other RFDs are expected to result in a high environmental consequence because these developments and activities contribute to an existing serious risk. The most important change is the increase in negative human-bear interactions, which increases grizzly bear mortality risk in the RSA. The contribution of the Project to these cumulative effects is predicted to be neutral or positive because of wildlife fencing and associated mitigations.

Cougars

The main source of cougar mortality (hunting) is managed to achieve a stable population in the RSA. Cougar densities within and surrounding the RSA are among the highest in the province. Therefore, the cougar population overlapping the RSA is likely self-sustaining and ecologically effective. With the addition of the Project, the following residual effects are expected for cougars:

- A predicted loss of 39.9 ha of selected and 104.4 ha of used as available habitat, resulting in a small negative effect for cougars in the Project area. The adjacent corridor was predicted to gain 118.1 ha of selected habitat.
- The probability of selection is predicted to be higher for cougars in wildlife corridors adjacent to the Project after the development occurs, presumably because prey density is higher near development. However, it is uncertain whether prey density will continue to be relatively high near development after the construction of the fence. Applying a precautionary approach, the Project is predicted to have a neutral (versus positive) effect on cougar use of corridors.
- Fencing the ASP area is predicted to substantially reduce the probability of negative human-cougar interactions inside the ASP area. The risk of negative human-cougar interactions is also predicted to decrease in the adjacent wildlife corridors if people use the recreational amenities envisioned for the Project and stay on designated trails in wildlife corridors. There is some uncertainty about whether this benefit will be achieved because it would depend on how people access the wildlife corridor and on the good behaviour of people in wildlife corridors. To be precautionary, the Project is predicted to have a neutral (versus positive) effect on human-cougar interactions.
- Environmental consequence of residual effects of the Project on cougars are predicted to be low (loss of habitat) to negligible (use of corridors and negative human-cougar interactions). Cougars are expected to remain self-sustaining and ecologically effective in the RSA as the Project is not expected to introduce a serious risk to the regional population.

Cumulative effects of the Project and other RFDs are expected to result in a low environmental consequence.

Wolves

Under existing conditions, it is uncertain if wolves are self-sustaining and ecologically effective due to the limited use of wildlife corridors and habitat patches and the unknown level of stability of the regional wolf population. Using a precautionary approach, a serious risk is identified under existing conditions. With the addition of the Project, the following residual effects are expected for wolves:

- No loss of selected habitat and a loss of 6.2 ha of used as available habitat within the Project area because of the development and exclusion fence. The change represents a small negative effect for wolves in the RSA.
- A predicted incremental decline in habitat quality in wildlife corridors (loss of 16 ha of used as available habitat and gain of 77.1 ha of strongly avoided) that could negatively influence wolf use in these areas.
- Wildlife fencing is predicted to have a positive effect by reducing the potential for wolf habituation and human-wolf interactions in the ASP area. Similarly, the potential for human-wolf encounters in wildlife corridors adjacent to the Project is predicted to decrease if people use recreational amenities envisioned for the Project. The Project is expected to have a neutral effect on human-wolf interactions because human-wolf interactions have not been a substantial concern in the Bow Valley under existing conditions.
- Overall, the small adverse effects of the Project are not predicted to change how wolf populations use or move through the RSA and are not predicted to contribute adversely to the potential serious risk identified for wolves under existing conditions. Environmental consequence of residual effects of the Project is predicted to be low (loss of habitat, use of corridors) to negligible (negative human-wolf interactions).

Cumulative effects of the Project and other RFDs are expected to result in a high environmental consequence because changes contribute to an existing serious risk for wolves in the RSA.

Elk

Elk in the RSA are not considered sensitive to the effects of habitat loss and sensory disturbance because they regularly use human-modified habitats and are highly habituated to humans. Elk may be self-sustaining in the RSA under existing conditions, but their natural ecological interactions have been substantially diminished. A serious risk is identified for elk under existing conditions because they do not function in their natural ecological role and therefore are not considered ecologically effective. With the addition of the Project, the following residual effects are expected for elk:

- A net loss of 133.2 ha of selected and 20.4 ha of used as available habitat in the Project area resulting in a small negative effect for elk.
- An increase of 96.6 ha of selected habitat in wildlife corridors. Elk use in the corridors may increase because the increased proximity of corridors to human residences should reduce the habitat suitability for predators, and the fence will exclude elk from the ASP area. However, exclusion from the ASP area could potentially increase the risk of predation on elk by preventing escape from the wildlife corridors into urban areas that create a refuge from predators. Owing to this uncertainty, the Project is predicted to have a neutral (versus positive) effect on elk use of the wildlife corridors.
- The wildlife fence will reduce the potential for negative human-elk interactions within the ASP area, but elk may concentrate elsewhere in Canmore, possibly increasing the potential for negative interactions between people and elk in these areas. Owing to this uncertainty, the Project is predicted to have a neutral (versus positive) effect on negative human-elk interactions.

- Environmental consequence of residual effects of the Project on elk is predicted to be low (loss of habitat) to negligible (use of corridors and negative human-elk interactions). The addition of the Project is not predicted to affect the self-sustaining status of elk population in the RSA because suitable habitats remain available and well distributed across the RSA. The neutral effects of human-elk interactions should not contribute to further habituation of elk in the RSA and therefore the Project is not expected to contribute to the existing serious risk.

The environmental consequence of cumulative effects of the Project and other RFDs is somewhat uncertain. A high environmental consequence would continue to be present if elk continue to concentrate their use in anthropogenic habitats in Canmore, and thus contribute to the serious risk under existing conditions. This is the most likely outcome. However, environmental consequence could be reduced to moderate or low if elk redistribute themselves outside of Canmore and improve their contribution to ecosystem function.

Other Wildlife

Other wildlife species, including species at risk and non-listed species, may also be affected by the Project through direct mortality (from clearing of vegetation, construction activities, and vehicle strikes) and loss of habitat quantity and quality. Some species may reduce their use of approved wildlife corridors, but this pathway is applicable only to medium and large bodied mammals for which wildlife corridors have been designated. With the addition of the Project the following residual effects are expected:

- Negligible to small magnitude of effects because of mortality. The application of timing restrictions on clearing vegetation and minimizing disturbance to wetlands largely avoids mortality of songbirds, water birds and wetland associated birds, raptors, bats, and breeding amphibians. Some mortality could occur for small mammals, large and medium bodied mammals, reptiles, and amphibians that exploit terrestrial habitats.
- Negligible to small magnitude of effects are predicted because of changes to habitat quantity and quality. Effects will be largest for species associated with coniferous forest habitats. Limited effects are predicted for most species at risk, particularly for those with no suitable habitat in the ASP area, those associated with wetlands or open water habitats, and those whose occurrence in the LSA is not documented or unlikely.
- Negligible or small magnitude effects are predicted because of reduced use of wildlife corridors. Effects on large and medium bodied mammals will depend on the species' response to human activity and will be similar to those previously described for grizzly bears, cougars, wolves, and elk.
- Environmental consequence of residual effects of the Project on species at risk and other non-listed species are predicted to be low to negligible:
  - Residual effects from changes in wildlife mortality risk are predicted to have a negligible environmental consequence for most taxonomic groups (e.g., large to medium bodied mammals, bats, birds). A low environmental consequence is predicted for smaller species that occupy anthropogenic habitats (e.g., amphibians, reptiles, rodents and other small mammals).
  - Residual effects from changes to habitat quantity and quality for species not known to occur in the ASP area are predicted to have a neutral effect, and therefore a negligible environmental consequence. Regarding species that may occur in the ASP area, the magnitude of habitat change is considered small relative to the broader availability of habitats in the RSA and therefore the environmental consequence is predicted as low.
  - Similar to the assessment of grizzly bears, cougars, wolves and elk, environmental consequence of changes to wildlife corridor use is predicted to be negligible to low.

5.28.2 Vegetation

Native terrestrial vegetation communities are reasonably resilient to changes in quantity and quality owing to their broad distribution in the RSA and beyond. Deciduous stands are an exception because they are relatively uncommon both at the local and regional scale; however, tree species that make up this vegetation community type are found across the RSA. Further, there are no known occurrences of provincially or federally-listed plants or tracked and watched plant communities within the ASP area. ESAs in the ASP area include old growth Douglas fir, wetland and riparian areas, which are sensitive to loss and degradation.

With the addition of the Project, the following residual effects are expected for vegetation:

- Small magnitude of effects because of changes to the quantity and quality of native vegetation communities:
  - Removal of a maximum 107 ha of native terrestrial vegetation communities within the ASP area and an increase in weeds within the ASP area.
  - Removal of ESAs with a maximum loss of 2.25 ha of old growth Douglas fir, 0.1 ha of wetlands and 0.5 ha of riparian area in the ASP, and potential changes to wetland and riparian community composition and structure from the proliferation of weeds.
- The environmental consequence of residual effects of the Project on native terrestrial vegetation communities and ESAs is predicted to be low.

The cumulative effects of the Project and other RFDs are expected to result in a low environmental consequence for native terrestrial vegetation communities and ESAs.

5.28.3 Aquatic Ecology

It is unlikely that any of the creeks within the Smith Creek ASP has suitable fish habitat due to seasonal and intermittent flows, steep gradients and lack of suitable habitat for spawning or overwintering; therefore, fish are unlikely to be present in these creeks. However, downstream effects on fish populations from sediment and erosion and contamination could occur in the Bow River.

With the addition of the Project, the following residual effects are expected for fish populations, including species at risk:

- Negligible (i.e., non-measurable) reduction in fish survival and reproductive success from effects of sediment releases, stormwater runoff, and spills/contamination due to the implementation of mitigation measures, industry standard best management practices, and implementation of management plans:
  - Although there may be small changes in suspended sediment concentrations, or changes to water quality from spills/contamination, these changes are expected to be minimized or avoided through the effective application of mitigation measures, such that effects on fish populations are negligible.
  - Any watercourse crossing construction will follow standard best management practices and applicable regulatory guidelines (i.e., Measures to Protect Fish and Fish Habitat and Alberta Code of Practice).
  - Stormwater runoff will be managed according to the Stormwater Management Plan (to be developed following ASP approval).
- The environmental consequence of residual effects of the Project on fish, including species at risk, are predicted to be negligible.

As the environmental consequence of Project effects on fish populations in the Bow River, including fish species at risk, is rated as negligible, the Project is not expected to contribute to cumulative effects for this VEC in the RSA.

6.0 PHYSICAL COMPONENTS

6.1 Surface and Bedrock Geology, Soils and Terrain

6.1.1 Surface and Bedrock Geology, Soils and Terrain Methods

The surface and bedrock geology, soils and terrain assessment follows the general assessment methods outlined in Section 4. This section presents additional details about the approach used to complete the VEC's impact statement.

Environmental Consequence

A high environmental consequence, which can be considered a significant effect, is assigned if serious risk is identified. The definition of a serious risk varies among VECs and this section provides the methods used to identify whether or not a serious risk is present for surface and bedrock geology, soils and terrain under existing conditions or would be expected because of the Project, or the Project plus other RFDs.

Serious risk for surface and bedrock geology, soils and terrain is identified when road or building construction creates a high likelihood of landslides.

6.1.2 Surface and Bedrock Geology, Soils and Terrain Existing Conditions

The Project is located in the front ranges of the southern Rocky Mountains physiographic region on the south side of the Bow River (Pettapiece 1986, *in* Paquet and Carbyn 2003). The general topography of the area consists of broad-terraced, fluvial deposits along the Bow River surrounded by steep ridged and gullied bedrock-dominated mountains (UMA 1991e) (Figure 64). Elevations within the Project Boundary range from approximately 1,300 metres above sea level (masl) to 1,550 masl.

Bedrock geology in the region is dominated by siltstones, limestone, shales, sandstones and coal, which were deposited during the Lower Mesozoic-Lower Cretaceous periods (Hamilton et al. 1999). Specifically, the ASP area is underlain by the Kootenay Formation, the Fernie Group and the Sulphur Mountain Formation (Alberta Geological Survey Map 232A 1998).

Topographic relief varies within the Project with approximately 47% of the area consisting of gentle slopes (0% to 9%) and approximately 42% consisting of moderate slopes (12% to 44%) (Figure 62). Strong and steep slopes (over 45%) occupy approximately 1% and are predominantly associated with rock outcrops and colluvial deposits. Aspects within the Project are predominantly north (338-23°) accounting for 30%, with an additional 27% for northeasterly (23 - 68°), 12% for northwesterly (293-338°) and 10% for east (68-113°). Southerly (113 - 248°) facing slopes cover 15% of the ASP boundary while westerly (248 – 293°) facing slopes account for 7%. Flat areas where aspect was not assigned, including water bodies, accounts for <1% of the Project.

Surficial materials in the ASP area are predominantly glacial tills, flood plain deposits, alluvial fans and cones, and weathered bedrock (NRCB 1992). Gently undulating to moderately inclined glacial till deposits are present on lower slopes and colluvial deposits of variable thickness are present on the steeper topography (O'Leary and Bradshaw.1988). Drainage sources from the mountains have transported extensive quantities of materials that have been deposited in the form of alluvial fans and cones over bedrock (UMA 1991e).

Soils in the Project Boundary are largely Orthic Eutric Brunisols derived from moderately fine textured (sand clay loam, clay loam and silty clay loam) till, with Orthic Regosols located within the braided channel on the north side of Highway 1 (ASIC 2013). Soils across the ASP are well drained (ASIC 2013).

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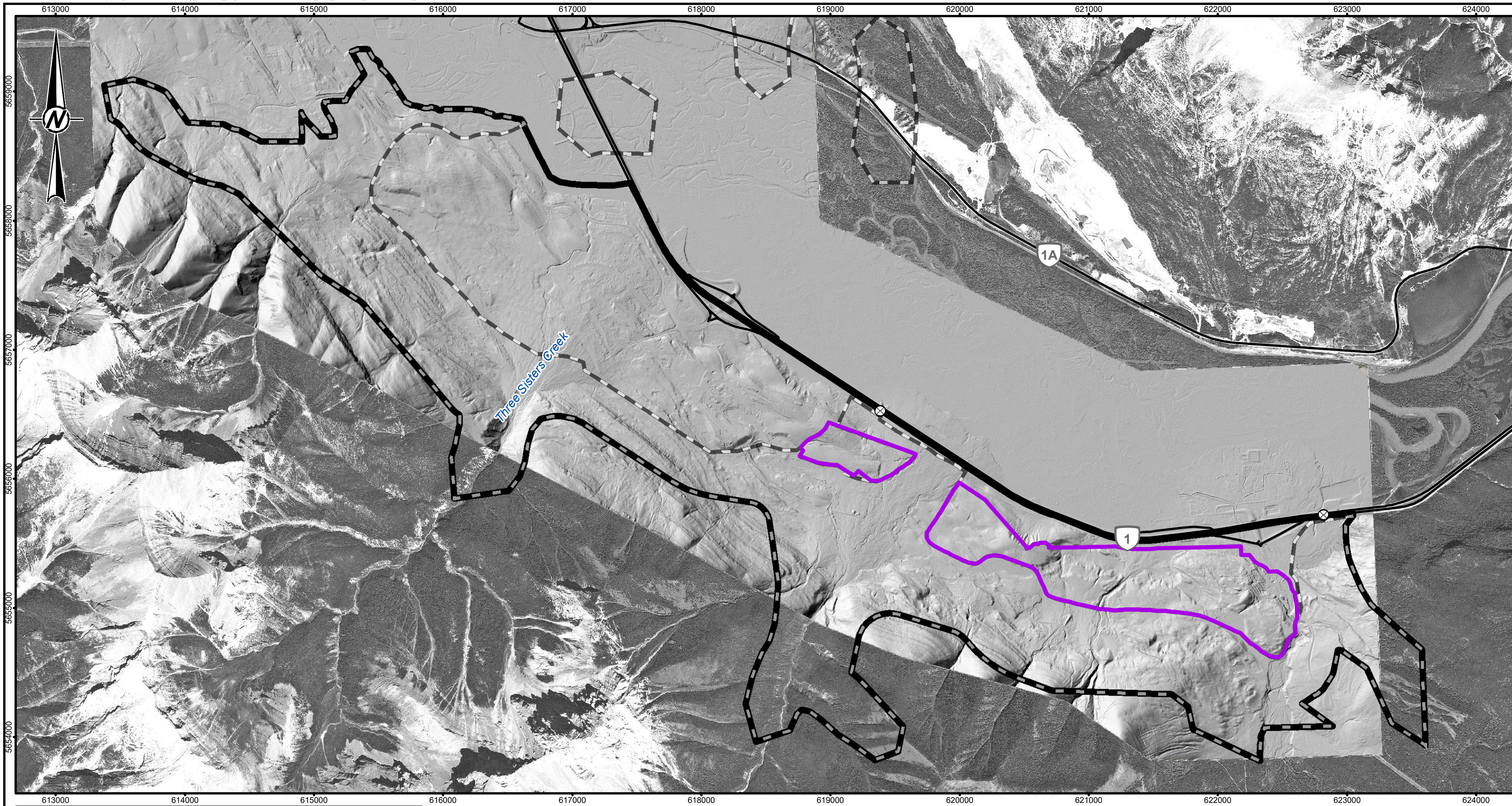

LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- APPROVED WILDLIFE CORRIDOR
- PROJECT BOUNDARY
- LOCAL STUDY AREA

0 800 1,600

1:45,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, 2017. BACKGROUND IMAGERY OBTAINED FROM UMA ENGINEERING, 2003.
2. WILDLIFE CORRIDOR OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS, 2020.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LTD.

PROJECT

SMITH CREEK ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-05
DESIGNED	KK
PREPARED	DA
REVIEWED	SM
APPROVED	KK

TITLE

HILL SHADED TERRAIN MODEL OF THE PROJECT AREA

PROJECT NO.	CONTROL	REV.	FIGURE
19132387	2000	0	64

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25mm

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There are only two areas in Site 7/8 that are affected by recorded mine workings: a small prospect mine in the Wilson Seam and deep mine workings associated with the No. 4 Mine (Golder 2008) during the middle of the 20th Century. Additionally, the currently-active Thunderstone Quarry is located at the eastern end of the Project area.

The LSA contains one contaminated site, known as the Tipple Mine site. The site owner has carried out remediation activities to contain the contamination (CEAA 2012b) and monitoring and reporting to the Alberta Government is ongoing. This site is located outside the ASP area, within the Stewart Creek Wildlife Corridor. Phase 1 environmental site assessments were previously completed on TSMV lands in the LSA. Of relevance to soil and terrain, Stantec (2004c) identified low environmental risk for:

- debris (e.g., scrap metal empty cans, barrels)
- surficial coal deposits, which are present both naturally and because of mining activities
- mining related activities (e.g., mine shafts, excavations) - the mine site has been issued a reclamation certificate by Alberta Environment

The assessments did not identify risks related to soil or water contamination and no further environmental investigations were recommended (Stantec 2004c).

Existing conditions for soils and terrain are the result of cumulative change induced by previous and existing developments and activities. Previous mining activities including underground and surface excavations to extract coal from the 1890s through to 1979 (ERCB 2013) have influenced soils and terrain in the LSA, in particular terrain stability because of undermining effects.

6.1.3 Surface and Bedrock Geology, Soils and Terrain Environmental Risks

Four potential environmental risks have been identified for surface and bedrock geology, soils and terrain:

- Ground disturbance during vegetation clearing, construction, and contouring and grading may result in increased erosion and/or loss of soil, soil compaction, change in soil moisture regime, soil admixing or mass movement.
- Accidental spills of contaminants such as fuels, hydraulic fluids, oils and coolants from the coal undermining operation or Project activities could introduce soil contamination, reducing soil quality.
- Human use during operations may decrease soil quality, particularly though the creation of new undesignated trails, or through activities associated with the coal undermining operation which can result in soil compaction and/or erosion.
- Reduced terrain stability over old mine workings areas of low strength of coal seams, and a variation in the amount of coal removed and the number of seams mined (NRCB 1992).

Environmental risks identified pertain to soils and terrain. Although previous undermining effects (e.g., coal mining activities) may have influence existing conditions for surface and bedrock geology, the interaction of Project activities and undermining effects are more likely to manifest as changes to terrain stability than to the geological properties of the ASP area. Environmental risks to surface and bedrock geology are therefore neutral, resulting in a negligible environmental consequence.

Native soil types found in the ASP area are common and sensitivity to erosion varied from low to high depending on soils type and slope. Eutric Brunisols have high erosion risk on slopes greater than 10%, moderate between 5-10%, and low <5% (generally friable/ loose sandy soils) when the vegetation, LFH (organic soil horizon)/duff layer is removed.

Without the application of mitigation, predicted effects of the Project on soils and terrain because of soil erosion, loss of topsoil and soil compaction are:

- **Direction**: negative
- **Magnitude**: expected to result in medium magnitude of change due to a loss 107 ha of native soil with ASP boundary, a measurable increase in soil erosion, a measurable loss of topsoil volume, a measurable reduction in soil quality associated with compaction/rutting/admixing, deleterious changes in soil moisture regime and increased risk of soil contamination due to accidental spills, leaks, and an incremental decrease in terrain stability
- **Geographic Extent:** local for effects related to construction activity; regional for effects associated with human use and creation of undesignated trails (soil compaction, erosion risk)
- **Duration**: short-term for most effects (i.e., those associated with construction activities), long-term for operational effects associated with human use, native soil loss and degradation in soil quality
- **Frequency**: once for loss of native soils; continuous for effects related to human use and degradation in soil quality
- **Reversibility**: irreversible (loss of native soils, degradation in soil quality, soil compaction); reversible (erosion during construction)
- **Probability**: likely

The environmental consequence of Project effects on soils and terrain is predicted to be moderate without the application of mitigation.

6.1.4 Surface and Bedrock Geology, Soils and Terrain Relevant Legislation

- Canmore Undermining Review Regulation, Alta Reg 34/2020
- Environmental Protection & Enhancement Act: Conservation and Reclamation Regulation, Alta Reg 115/93

6.1.5 Surface and Bedrock Geology, Soils and Terrain Mitigation

Measures to mitigate the potential environmental impact on soils and terrain include:

- Prior to construction, all on-site contractors will be briefed by TSMV on the proper procedures and activities to limit environmental effects, as described in the *Construction Management Guidelines* (TSMV 2015).
- Implement the steep creek hazard mitigation plan as appropriate as per the Steep Creek Hazard Report approved at ASP.
- Construction management will include environmental protection measures including erosion control, vegetation protection and environmental mitigation and monitoring measures (e.g., Canmore Engineering Design and Construction Guidelines).
- Salvaging and storing surface soil for post-construction site reclamation.
- Prioritize the use of local soils, such as stored soils salvaged from other areas in Canmore, to improve reclamation success. Salvaged soils from the Bow Valley will be used preferentially over soils from outside the Bow Valley.

- Protecting topsoil stockpiles by prompt revegetation by either seeding with native grasses for long-term storage or applying herbicides for weeds.
- Restricting construction activities and heavy machinery to designated work spaces.
- Clearly delineating areas designated for terrain modification by survey stakes and flagging.
- Developing and implementing erosion and sediment control plans that will include, but not be limited to installing silt fencing around the perimeter of cleared areas, promptly revegetating or covering areas of exposed mineral soils and suspending all earthwork activities during and following heavy rainfall, including short events and high storm runoff.
- Comply with the Construction Management Guidelines (TSMV 2015) and the Construction Management Plan (listed above).
- The proposed wildlife fence (refer to Section 5.6.4) and educational signs is predicted to result in a substantial reduction in human use of, and creation of, undesignated trails in adjacent wildlife corridors. Fewer undesignated trails will reduce soil compaction and erosion.

Mitigation measures to address surface stability related to undermining can vary and must be identified on a case-by-case basis. Development of undermined land within the designated area defined by the "*Canmore Undermining Review Regulation AR34/2020* (the Regulation)". The Regulation requires that the developer retain an Undermining Engineer to produce an Undermining Report for each development that is submitted to the Minister and that recommended mitigation has been implemented. The Undermining Report also is required to be reviewed by a second engineer that is independent of the Undermining Engineer (and the Undermining Engineer's firm). Both the Undermining Engineer and the Review Engineer are required to sign certificates that identify the land as suitable for the intended use.

The regulation also provides an exemption to the Town with respect to their duties under the *Municipal Governance Act*. Section 3 of the Regulation states:

> *3(1) Part 17 of the Act and the Subdivision and Development Regulation (AR43/2002) do not apply with respect to undermining and related conditions in designated land.*
>
> *(2) Canmore and Canmore's agents have no responsibility, duty or obligation to consider undermining and related conditions in designated land with respect to the subdivision, development or any other land use planning function of Canmore under Part 17 of the Act and the Subdivision and Development Regulation (AR43/2002), including, without restricting the generality of the foregoing, with respect to enforcement, maintenance or inspection of undermining and related conditions in designated land.*

6.1.6 Surface and Bedrock Geology, Soils and Terrain Predicted Project Effects (with Mitigation)

As described in Section 6.1.3, coarse-textured soils (Eutric Brunisols) are considered common but sensitive to erosion effects, while terrain stability is considered moderately sensitive to terrain modifications.

With the application of mitigation outlined in Section 6.1.5, predicted Project effects on terrain and soils are:

- **Direction**: negative
- **Magnitude**: expected to result in small magnitude of change due to a loss of 107 ha of native soil. After considering the application of industry-standard best management practices and Conservation & Reclamation regulations under the Environmental Protection and Enhancement Act (EPEA) mitigations for soil conservation, a negligible increase in soil erosion, negligible losses of topsoil volume, negligible loss of soil quality (associated with compaction/rutting and incremental increase in contamination risk [accidental spills]), and a negligible decrease in terrain stability is predicted
- **Geographic Extent:** local for effects related to construction activity; regional for effects associated with human use (i.e., creation of undesignated trails)
- **Duration**: short-term for most effects (i.e., those associated with construction activities), long-term for effects associated with human use (e.g., proliferation and use of undesignated trails resulting in compaction and erosion), native soil loss and degradation in soil quality
- **Frequency**: once for loss of native soils; continuous for effects related to human use
- **Reversibility**: irreversible (loss of native soils); reversible (erosion during construction, soil compaction)
- **Probability**: likely (loss of native soils), possible (erosion, reduced soil quality), and unlikely (loss of topsoil and soil compaction)

The environmental consequence of residual Project effects on soils and terrain is predicted to be low. As described in Section 6.1.3, the environmental consequence of Project effects on surface and bedrock geology is negligible.

6.1.7 Surface and Bedrock Geology, Soils and Terrain Uncertainty and Monitoring

Uncertainty exists around the precise footprint location and footprint area. However, the assessment is conservative because it overestimated disturbance. Mitigation and best practices defined are standard for this type of project and are expected to have a high probability of success. During construction, monitoring will be conducted by TSMV site engineers to confirm compliance with the TSMV Construction Management Guidelines (2015).

6.1.8 Surface and Bedrock Geology, Soils and Terrain Cumulative Effects

The environmental consequence to surface and bedrock geology is rated as negligible therefore, the Project is not expected to contribute to cumulative effects for this VEC in the RSA.

The environmental consequence of residual Project effects on soils and terrain is rated as low. The Project in combination with other RFDs (i.e., residential and commercial developments in the Bow Valley) could result in soil erosion, loss of topsoil (direct loss of native soils), soil compaction, and changes to terrain stability. These effects are likely to result from site clearing and construction activities, but would be mitigated through soil conservation best management practices. The potential for soil contamination also exists during construction activities; however, these are localized and mitigated through environmental best management practices and application of spill-response plans at the construction stage.

Together, the Project and other RFDs are predicted to result in the loss of native soils. Based on the location and spatial extent of RFDs, the most important contributions to cumulative effects are likely to come from the Three Sisters Village ASP and the Silvertip Village and Silvertip Residential Project. Climate change may affect soil organic matter content and composition over time due to changes in the moisture/temperature regimes in mountainous environments which are sensitive to land use and climate change.

Similar mitigation as described for the Project will be applied to the Three Sister Village ASP, and presumably similar best practices will be applied to other RFDs in the RSA. Cumulative effects on soils and terrain are expected to be equal to or less than that experienced in similar developments in the RSA. Taking into account existing conditions described in Section 6.1.2 and future projects or activities, the cumulative effects on soils and terrain are expected to result in a low environmental consequence.

6.2 Surface and Groundwater

6.2.1 Surface and Groundwater Methods

The surface and groundwater assessment follows the general assessment methods outlined in Section 4. This section presents additional details about the approach used to complete the VEC's impact statement.

Environmental Consequence

A high environmental consequence, which can be considered a significant effect, is assigned if serious risk is identified. The definition of a serious risk varies among VECs and this section provides the methods used to identify whether or not a serious risk is present for surface and groundwater under existing conditions or would be expected because of the Project, or the Project plus other RFDs.

Serious risk for surface and groundwater is identified when Project effects are predicted to cause sustained exceedances of applicable water quality guidelines (Government of Alberta 2018b).

6.2.2 Surface and Groundwater Existing Conditions

Canmore is located within the third reach of the Bow River watershed, which has a catchment area of about 26,000 km^2 from the Rocky Mountains to the South Saskatchewan River. The Project is drained by five creeks including Stewart and Pigeon creeks (UMA 1991a). The Bow River parallels the Project's north property edge for approximately 4 km. However, it is separated from the Project by the Trans-Canada Highway (Figure 1).

The ASP area and its upstream catchment is primarily north facing with slopes ranging from 0% to over 45%. The area inside the ASP area have high infiltration capacity as well as high groundwater flows (Stantec 2005).

There are large upslope off-site natural sub-catchments that affect the development of the downstream areas. The catchments of creeks on the Project area have their origins in the high mountainous region south of the Project (UMA 1991a,c).

The groundwater conditions throughout the general area of the Three Sisters development are highly variable depending on location and the nature of the local soil and bedrock. Typically, the groundwater level is within the bedrock, though local perched groundwater conditions within the overburden may be encountered during spring run-off and periods of wet weather.

The flow direction of the groundwater can be generally estimated from the surface topography within the Bow River Valley. The land surface within the valley slopes gently towards the northwest. Therefore, the flow within the surficial aquifer is predominately in a northwest direction towards the Bow River. Seasonal changes caused by spring rainfall and snowmelt runoff from the Rocky Mountains may occur with the highest levels expected in June and July.

The groundwater conditions are mainly influenced by the Benchlands Aquifer system. These aquifers are mainly comprised of poorly sorted glacial deposits of sand, gravel and clay. As such, permeability is high in the region. Most of the aquifers of significance are surficial and unconfined. This means that there is a lot of interaction between the surface and groundwater systems. As such, the groundwater chemistry of the region is often similar to that of the Bow River. Typically, the groundwater is a calcium-magnesium-bicarbonate-sulphate type and the water quality mostly falls within Drinking Water Guidelines (Government of Alberta 2012).

Groundwater flows in the ASP have been affected by undermining. Groundwater can flow between and along mines relatively easily, and the surface deposits are largely gravel, which is well drained. Due to the lateral extent of the mines and the interconnections between them, there is very little opportunity for perched water tables. Groundwater flows south to north towards the river, but the exact flow paths have not been mapped in detail. Surficial gravels provide a high level of drainage without taking into account the additional potential drainage conduits through the mines.

Although more detailed hydrological data are available from the Province, this more detailed scale of mapping is not required for effects assessment at the ASP stage. Any area that is proposed for development that is affected by undermining will be mitigated in accordance with the Town Policies and provincial regulations.

6.2.3 Surface and Groundwater Environmental Risks

Six potential environmental risks are identified for surface and groundwater:

- Increased stormwater runoff from proposed development areas may change watercourse geomorphology as a result of increased erosion and sedimentation.
- Increased erosion and sedimentation may reduce surface and groundwater quality.
- High groundwater flow episodes may affect structures in susceptible zones.
- Spills during construction activity may contaminate groundwater or surface water.
- Grout or mortar (i.e., paste) material used to mitigate undermined areas may locally impede groundwater flow.
- Activities of residents, such as the use of chemicals products like herbicides, pesticides and fertilizers, could negatively affect surface and groundwater quality during operations.

Surface Water

During construction, vegetation removal and grading of the site will occur, exposing the subsoil to weathering. As a result, there is a potential for erosion and sedimentation (e.g., suspended sediment) increases during storm events which may affect surface water quality. Surface water quality may also be affected by the release of contaminants; for example, during construction, there is an increased possibility of gasoline or motor oil spills to occur in the ASP area. During operations, surface water quality could be affected by the use of herbicides, pesticides or other chemical products used by residents.

Without the application of mitigation, predicted effects of the Project on surface water because of increased stormwater runoff, increased erosion and sedimentation, and spills are:

- **Direction**: negative
- **Magnitude**: expected to result in medium magnitude of change with a measurable increase in suspended sediments in surface waters (e.g., watercourses, wetlands) corresponding to a minimum loss of 107 ha of native soils in the ASP; and periodic exceedances of applicable water quality guidelines following spill incidents or application of herbicides/pesticides
- **Geographic Extent:** local; confined largely to the ASP area but extending beyond as surface water drains to the Bow River
- **Duration**: short-term (increased erosion and sedimentation, spills during construction) and long-term (stormwater runoff effects and contamination, changes to watercourse geomorphology)
- **Frequency**: continuous (effects related to construction activities, changes to watercourse geomorphology) and periodic (stormwater runoff, contamination)
- **Reversibility**: reversible (increased erosion and sedimentation, spills during construction) and irreversible (contamination from runoff, changes to watercourse geomorphology)
- **Probability**: likely (erosion and sedimentation); possible (stormwater runoff effects, changes to watercourse geomorphology and contamination)

The environmental consequence of effects on surface water is expected to be moderate.

Groundwater

During construction, the main groundwater quality concern is the increased possibility of contaminant spills such as gasoline or motor oil occurring in the ASP area. Such spills can have a negative effect if the contaminant seeps into the groundwater. During operations, the use of pesticides, herbicides or other chemical products may also introduce contaminants to groundwater.

Aquifers in the RSA are mainly comprised of poorly sorted glacial deposits of sand, gravel and clay. Regionally and locally, most of the aquifers of significance are surficial and unconfined, meaning that permeability is high in the region. The groundwater levels in the valleys of the RSA tend to be fairly close to surface (Toop and de la Cruz 2002) and there is a lot of interaction between the surface and groundwater systems. Groundwater quantity and quality can therefore be affected by surface water systems. Groundwater quantity and quality are considered sensitive to contamination events (e.g., spills) and changes in surface water quantity (e.g., runoff events) owing to high levels of interactions between the systems.

Groundwater quantity and flow patterns may be altered at a local scale due to the removal and/or modification of native vegetation and the construction of buildings and infrastructure including the use of cement-based grout or mortar (i.e., paste) to mitigate localized undermined areas. The creation of non-permeable surfaces through paste application could create perched water tables. However, because the surface deposits are largely gravel (i.e., well drained), ground water can flow between and along mines relatively easily. The lateral extent of the mines and the interconnections between them means that there is very little opportunity for perched water tables. Groundwater in the LSA is therefore not considered sensitive to localized changes in permeability.

Without the application of mitigation, predicted effects of the Project on groundwater because of increased stormwater runoff, increased erosion and sedimentation, high groundwater events, spills or non-permeable surfaces are:

- **Direction**: negative
- **Magnitude**: expected to result in a medium magnitude of change with a measurable reduction in groundwater quality as a result of erosion and sedimentation associated with a minimum loss of 107 ha of native soils in the ASP; a measurable increase in the frequency of high groundwater events and associated flood damage; a measurable reduction in groundwater quality as a result contamination events; and local perched water tables as a result of paste injection
- **Geographic Extent:** local; confined largely to the ASP area with an end point for some flows at the Bow River (aquifer flow is toward the Bow River)
- **Duration**: short-term (increased erosion and sedimentation) and long-term (stormwater runoff effects, contamination, non-permeable surfaces)
- **Frequency**: continuous (effects related to construction activities, non-permeable surfaces) and periodic (stormwater runoff, contamination effects)
- **Reversibility**: reversible (increased erosion and sedimentation) and irreversible (contamination, non-permeable surfaces)
- **Probability**: likely (erosion and sedimentation) and possible (increased stormwater runoff, contamination, non-permeable surfaces)

The environmental consequence of effects on groundwater is expected to be moderate without the application of mitigation.

6.2.4 Surface and Groundwater Relevant Legislation

- *Water Act*
- *Public Lands Act*
- *Fisheries Act*
- Fisheries and Oceans Canada's *Measures to Protect Fish and Fish Habitat* (Fisheries and Oceans Canada 2019b)
- *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems* – (Government of Alberta 2012)
- *Code of Practice for Watercourse Crossings Alberta* – Government of Alberta 2019c
- *Stormwater Management Guidelines for the Province of Alberta* (CH2M Gore & Storrie Ltd. 1999)
- *Canmore Stormwater Master Plan* (Town of Canmore 2005)
- *Engineering Design and Construction Guidelines for the Town* (Town of Canmore 2010)
- *South Saskatchewan Regional Plan* 2014-2024 (Government of Alberta 2018c)

- *Approved Water Management Plan for the South Saskatchewan River Basin* (Alberta Environment 2006)
- the 2015 Three Sisters Mountain Village Construction Management Guidelines, which provides guidelines related to the protection of the environment including the protection of streams and water courses and water quality

6.2.5 Surface and Groundwater Mitigation

Erosion and Sedimentation

The Storm Water Management Strategies Report (MMM 2016) predicts potential stormwater discharge and preliminary estimates of runoff that must be stored on site. The number and type of storage facilities, such as ponds and wetlands, would be determined by the development site plans after approval of the ASP. Details of the ponds and wetlands design and water management will be provided in a Master Drainage Plan prepared in accordance to the *Stormwater Management Guidelines for the Province of Alberta* (CH2M Gore & Storrie Ltd. 1999) and the Town *Engineering, Design and Construction Guidelines* (Town of Canmore 2010). The Master Drainage Plan will be submitted as a supporting study for the ASP application.

Erosion and sediment control plans will be prepared, implemented, and enforced to limit sediment input into the creeks, wetlands, storm ponds, bioswales, and bioretention areas during the construction phases of the Project as detailed in the Construction Management Guidelines (TSMV 2015). The Town *Construction Management Plan Guidelines* and *Engineering, Design and Construction Guidelines* (Town of Canmore 2010) will also be incorporated. The following plans will be produced prior to construction:

- a Construction Management Plan, consistent with *Construction Management Plan Guidelines* from the Town of Canmore, will be developed following ASP approval and will include environmental protection measures including, but not limited to erosion and sediment control, vegetation protection, pesticide and herbicide control, environmental mitigation and monitoring measures, and reclamation and revegetation plans including but not limited to:
  - maintaining native vegetation where feasible
  - maintaining buffer strips of existing native vegetation around natural aquatic systems
  - implementing erosion and sediment control plans
- Construction Management Guidelines (TSMV 2015) including but not limited to:
  - prior to construction, all on-site contractors will be briefed by TSMV on the proper procedures and activities to limit environmental effects
  - reclaiming disturbed areas as soon as construction works permit, following ground disturbance
  - applying temporary erosion protection measures if the reclamation of a disturbed area is to be delayed by more than a week
  - applying hydroseed to any topsoil stockpiled for more than six months, and straw crimping, mulch, netting or hydroseeding to any topsoil stockpiled for thirty days or more or during wet conditions
  - applying erosion controls immediately after clearing an area in wet conditions and within 72 hours of work completion during dry conditions
  - applying dust control measures using water only, if required

- ensuring that no direct discharge of sumps and equipment rinse water is released to surface water
- conducting all in-stream work in accordance with the *Water Act*, *Public Lands Act* and *Fisheries Act*, outside of the AEP Restricted Activity Periods
- conducting environmental monitoring and inspection of all construction activities to confirm compliance with the Construction Management Guidelines (TSMV 2015) and a site-specific Construction Management Plan

Adaptive management approaches will be a key component of the mitigation and best management practices that will be applied during construction and operation to minimize or avoid adverse effects due to sedimentation and erosion.

Surface and Groundwater Quality and Quantity

The following mitigation measures will be implemented to reduce the potential for contaminant spills:

- prior to construction, all on-site contractors will be briefed by TSMV on the proper procedures and activities to limit environmental effects, as per the Construction Management Guidelines (TSMV 2015)
- use of fertilizers, herbicides, pesticides, and other chemicals should follow applicable Town bylaws
- develop and apply the Construction Management Plan
- apply the Engineering Design & Construction Guidelines
- develop and implement an Erosion and Sediment Control Plan as described in the Engineering Design & Construction Guidelines. A qualified Engineer retained by the developer/builder, must monitor sediment and erosion controls)
- develop and implement a Spill Response Plan (may form part of the Construction Management Plan that will be provided to the Town) will be developed and implemented for spills of vehicle fluids or other potential contaminants during in-stream construction.
- machinery used for in-stream activities will be maintained in clean condition and free of fluid leaks to prevent any deleterious substances from entering the water
- washing, refuelling, and servicing machinery will be conducted at least 30 m from the banks of any watercourse
- Comply with the Alberta Wetland Policy

Mitigation measures to reduce effects of contamination introduced by residents during operation will include:

- restricting residential use of fertilizers and chemicals, and washing of vehicle
- integrating all chemical use (i.e., pesticides, herbicides) into an approved Integrated Pest Management Plan

Adaptive management approaches will be a key component of the mitigation and best management practices that will be applied during construction and operation to minimize or avoid adverse effects on surface water and groundwater.

Groundwater quantity and flow patterns may be altered at a local scale due to the removal and/or modification of native vegetation and the construction of buildings and infrastructure including the use of cement-based grout or mortar (i.e., paste) to mitigate localized undermined areas. Any area that is proposed for development that is affected by undermining will be mitigated in accordance with provincial regulations. Given the well-drained gravels that generally sit on top of the sedimentary rock in the Project area the lateral extent of the mines and the interconnections between them and the small area of the features being filled with paste relative to the watershed, local perched water are an unlikely outcome of paste injection.

Paste injection is done in areas with voids at shallow depths above typical groundwater elevations in TSMV. Paste also rarely goes all the way to the top of the void so there is still room for water flow above the paste infill, where such flows occur. The catchment area which drains water in and out of the Three Sisters Creek aquifer zone is much larger than the Project area, and no effects on regional groundwater patterns are anticipated.

Master Drainage Plan

A Master Drainage Plan will be submitted as a supporting study for the ASP application and will be consistent with the Town Engineering, Design and Construction Guidelines (Town of Canmore 2010) and *Stormwater Management Guidelines for the Province of Alberta* (CH2M Gore & Storrie Ltd. 1999). The Master Drainage Plan for the Project, will use concepts of BMPs and low impact development (LID) to limit effects of the proposed development on receiving watercourses, to the extent practical, under the Town's engineering requirements. Mitigating measures to meet or exceed the above noted criteria in the current guidelines will be described in the Master Drainage Plan. All applicable provincial and municipal guidelines for stormwater treatment and discharge will be met.

6.2.6 Surface and Groundwater Predicted Project Effects (with Mitigation)

Surface Water

With the application of mitigation outlined in Section 6.2.5, predicted Project effects on surface water are:

- **Direction**: negative
- **Magnitude**: expected to result in a small change, similar or less than other developments in Canmore, including:
  - incremental increase in suspended sediments in surface waters (e.g., watercourses, wetlands) associated with a maximum loss of 107ha of native soils in the ASP
  - no measurable change in watercourse geomorphology
  - very low risk of water quality guideline exceedances because of a spill incident
- **Geographic Extent**: local; confined largely to the ASP area but extends beyond the Project as surface water drains to the Bow River
- **Duration**: short-term (increased erosion and sedimentation from in-stream construction) and long-term (stormwater runoff and associated contamination)
- **Frequency**: continuous (effects related to in-stream construction activities) and periodic (stormwater runoff and associated contamination effects)
- **Reversibility**: reversible (increased erosion and sedimentation from in-stream construction) and irreversible (stormwater runoff and associated contamination)
- **Probability**: possible

The environmental consequence of residual effects on surface water is expected to be low.

Groundwater

As described in Section 6.2.3, groundwater is considered sensitive to changes in surface water quantity and quality owing to the high level of interaction between surface and groundwater systems.

With the addition of the Project, grout or mortar (i.e., paste) material may be used to mitigate localized undermined areas. These measures could impede local groundwater flow. At the ASP stage, the exact location and need for these mitigation measures are not defined; however, TSMV intends to apply any required undermining mitigation measures in accordance with all applicable Town Policies and provincial regulations. Portions of the plan area are undermined from previous coal mining operations. Any area that is proposed for development that is affected by undermining will be addressed in accordance with Provincial Regulations AR34/2020 as amended from time to time and AR112/97. Guidelines have been developed and approved under AR34/2020, and are currently established with Ministerial Order MSD:004/20 approving the “2020 Guidelines to Evaluate Proposed Development Over Designated Undermined Lands in the Town of Canmore, Alberta” to be used as of April 1, 2020.

Given the well-drained gravels that generally sit on top of the sedimentary rock in the Project area, the lateral extent of the mines and the interconnections between them and the small area of the features likely being filled with paste relative to the watershed, local perched water are an unlikely outcome of paste injection. Paste injection is typically done in areas with voids at shallow depths above typical groundwater elevations in TSMV. Paste also rarely goes all the way to the top of the void so there is still room for water flow above the paste infill, where such flows occur. The catchment area, which drains water in and out of the Three Sisters Creek aquifer zone, is much larger than the Project area. Pursuant to the 1992 NRCB Decision Report #9103 (NRCB 1992), TSMV will not withdraw groundwater from the mines. Based on the available information, no effects on regional groundwater patterns are anticipated.

With the application of mitigation outlined in Section 6.2.5, predicted Project effects on groundwater are:

- **Direction**: negative
- **Magnitude**: expected to result in a small change, similar or less than other developments in Canmore, including:
  - incremental reduction in groundwater quality because of erosion and sedimentation associated with a minimum loss of 107 ha of native soils in the ASP
  - no measurable increase in the frequency of high groundwater events and associated flood damage
  - a very low risk of groundwater contamination from spill incidents
  - no measurable change groundwater quantity or flow patters because of possible changes to permeability
- **Geographic Extent:** local; confined largely to the ASP area with an end point for some flows at the Bow River (aquifer flow is toward the Bow River)
- **Magnitude**: short-term (increased erosion and sedimentation)
- **Duration**: long-term (stormwater runoff effects, contamination, non-permeable surfaces)
- **Geographic Extent:** continuous (effects related to construction activities, non-permeable surfaces)
- **Frequency**: periodic (stormwater runoff, contamination effects)

- **Reversibility**: reversible (increased erosion and sedimentation) and irreversible (contamination, non-permeable surfaces)
- **Probability**: possible (erosion and sedimentation) and unlikely (increased stormwater runoff, contamination, non-permeable surfaces)

The environmental consequence of residual effects on groundwater is expected to be low.

6.2.7 Surface and Groundwater Uncertainty and Monitoring

Environmental monitoring will be conducted during in-stream activities in fish-bearing watercourses.

TSMV will also conduct environmental monitoring and inspection of all construction activities to confirm compliance with the Construction Management Guidelines (TSMV 2015), the Town's guidelines and a site-specific Construction Management Plan.

Water quality monitoring on the Bow River is conducted by AEP downstream of the Project.

6.2.8 Surface and Groundwater Cumulative Effects

The environmental consequence of Project effects on surface water and groundwater is rated as low. The Project in combination with other RFDs (i.e., residential and commercial developments in the Bow Valley) will result in changes to land cover from site clearing and construction activities, which will remove 192 ha of native soils in the RSA, which may increase suspended sediments in surface waters (e.g., watercourses, wetlands) and reduce groundwater quality. Federal legislation (i.e., *Fisheries Act*) and provincial codes of practice will similarly apply to all developments in or near aquatic habitats. Mitigation and best management practices as outlined in Section 6.2.5 are industry standard and have shown to be effective in avoiding or minimizing adverse effects from erosion and sedimentation and contamination events on surface water or groundwater.

There may be short-term increases in sediment loads due to high precipitation events, but these are not predicted to have long-term effects on surface and groundwater quality in the RSA. Effects are expected around new residential and commercial developments during the construction period when surface runoff and erosion are more likely to occur. These effects are expected to be localized and temporary, and proven mitigation measures are available to limit their effects.

Climate change may change hydrological patterns in the RSA. For example, there is the potential that warmer winters and earlier snowmelt will combine to produce higher winter flows in streams and rivers, and that smaller snowpacks and loss of glacier ice will combine to produce lower summer flows. Warmer summers may increase evaporation of surface water and contribute to reduced summer water availability in the future despite more precipitation in some places. The Project and other RFDs are not expected to contribute to these effects. Project effects to hydrology in the Bow River would be small (non-measurable), localized and short-term and managed under the Master Drainage Plan. Climate change may also change groundwater resources in the RSA, with conditions potentially becoming wetter or dryer than existing conditions. However there remain uncertainties on the impact of climate change in relation to groundwater impact projections.

Taking into account existing conditions described in Section 6.2.2, industry standard mitigation and best management practices and future projects or activities, the cumulative effects on surface and groundwater are expected to result in a low environmental consequence.

6.3 Air

6.3.1 Air Methods

The air assessment follows the general assessment methods outlined in Section 4. This section presents additional details about the approach used to complete the VEC's impact statement.

Environmental Consequence

A high environmental consequence, which can be considered a significant effect, is assigned if serious risk is identified. The definition of a serious risk varies among VECs and this section provides the methods used to identify whether or not a serious risk is present for air quality under existing conditions or would be expected because of the Project, or the Project plus other RFDs.

Serious risk for air quality is identified when Project effects are predicted to cause sustained exceedances of Alberta Ambient Air Quality Objectives and Guidelines (Government of Alberta 2019d).

6.3.2 Air Existing Conditions

The Bow Valley's ambient air quality levels are generally below Alberta's Ambient Air Quality Objectives (Government of Alberta 2019d). Concentrations of small respirable particulate levels are generally low and below the 24-hour Canadian Ambient Air Quality Standards (CCME 2014). Ambient air quality in the Bow Valley is influenced primarily by forest fires, industrial activity (e.g., Lafarge, Graymont, Baymag), natural wind-blown dust, vehicle exhaust and smoke from recreational fires.

While the existing and proposed developments are for the most part non-industrial, air quality at TSMV is also influenced by local and regional emission sources (UMA 1991d), including:

- natural gas combustion emissions from residential and commercial heating
- residential wood combustion from fireplaces and wood stoves
- vehicular emissions from local and highway traffic
- fugitive dust emissions from local and highway traffic

The most representative ambient air quality monitoring data in the ASP area is undertaken near the Lafarge Exshaw site. The Lafarge site currently operates an air quality monitoring program as a condition of the approval and to monitor the long-term air quality in the airshed. Metrics are measured against the Alberta Ambient Air Quality Objectives (AAAQOs, AEP 2019c). There are four continuous monitoring stations on the site. The Lagoon station is designed to carry out the monitoring program objectives and can thus be considered representative of the ambient concentrations from natural sources, nearby sources and unidentified, possibly distant sources. The remaining three stations are designed to assess the effectiveness of the fugitive dust control procedures in place at the Lafarge Project site. Data are available in the form of annual reports (Air Quality 2019).

The ambient concentrations for each of the compounds monitored at the Lagoon Station over the most recently year of publicly available monitoring data (May 2018 to April 2019) are presented in Table 45. The public Lafarge Exshaw data are published in monthly reports and have been summarized here as annual averages. Wildfire smoke present in August 2018 was a considerable determinant in the results of the particulate data analysis, therefor the particulate data have been presented with and without the influence of the wildfire smoke.

Table 45: Ambient Concentration of Criteria Air Compounds from the Lagoon Station, Lafarge Exshaw site

Compound	AAAQO / CAAQS[(a)] ($\mu g/m^3$)	Annual Average Concentration ($\mu g/m^3$)	Annual Average Concentration Without Wildfire Influence ($\mu g/m^3$)
Nitrogen Dioxide, NO_2	45 [a]	12.8	—
Sulphur Dioxide, SO_2	20 [a]	2.3	—
Particulate Matter with a mean aerodynamic diameter less than 2.5 microns (µm), $PM_{2.5}$	10 [b]	9.7	6.4
Total Suspended Particulate, TSP	60 [a]	34.7	31.0

Source: Air Quality 2019

a) CAAQS – Canadian Ambient Air Quality Standards.

AAAQOs = Alberta Ambient Air Quality Objectives; $\mu g/m^3$ = micrograms per cubic meter.

6.3.3 Air Environmental Risks

The Project will result in a temporary reduction in air quality during construction due to vehicles and construction activity and subsequent incremental increases in local emissions with natural gas combustion emissions from residential and commercial heating and vehicular emissions from local traffic during Project operations.

Under existing conditions, the RSA's ambient air quality levels are generally below Alberta's Ambient Air Quality Objectives (Government of Alberta 2019d). Regional air quality levels are therefore considered resilient to small changes in emissions associated with residential/commercial developments (i.e., dust, vehicular emissions, and emissions from residential or commercial heating).

Without the application of mitigation, predicted effects of the Project on air quality because of increased emissions are:

- **Direction**: negative
- **Magnitude**: expected to result in a medium magnitude of change with a measurable decrease in air quality associated with increased emissions of NO_2, SO_2, particulate matter, and total suspended particulate matter; and a moderate to high risk of exceeding Alberta Ambient Air Quality Guidelines during construction activities (particularly for dustfall and fine particulate matter)
- **Geographic Extent:** regional
- **Duration**: short-term (dust emissions) and long-term (vehicular exhaust, combustion-based heat sources)
- **Frequency**: continuous
- **Reversibility**: reversible (dust emissions) and irreversible (vehicular exhaust, combustion-based heat sources)
- **Probability**: likely

The environmental consequence of Project effects is expected to be moderate without the application of mitigation.

6.3.4 Air Relevant Legislation

- Alberta Ambient Air Quality Objectives and Guidelines – Government of Alberta 2019d
- Environmental Protection and Enhancement Act – Government of Alberta 2013a
- The 2015 Three Sisters Mountain Village Construction Management Guidelines, which provides guidelines related to the protection of the environment including air quality (TSMV 2015)

6.3.5 Air Mitigation

During construction TSMV will:

- Run equipment with valid emissions controls as per Federal regulations
- allow vehicles and machinery to run only when in use
- Develop and implement an Erosion and Sediment Control Plan as described in the Engineering Design & Construction Guidelines that includes dust control during construction
- provide fugitive dust control during construction – early paving and sweeping combined with watering on site roadways will be considered

During operations TSMV will design residential and recreational elements to encourage residents to use non-vehicular transportation and the trail network within the ASP area to access other portions of TSMV and Canmore.

6.3.6 Air Predicted Project Effects (with Mitigation)

As described in Section 6.3.3, regional air quality levels are considered relatively resilient to small changes in emissions associated with residential/commercial developments. With the application of mitigation outlined in Section 6.3.5, predicted Project effects on air quality are:

- **Direction**: negative
- **Magnitude**: expected to result in a small magnitude of change, similar to other urban zones in the Canmore area, including:
  - incremental decrease in air quality associated with increased emissions of NO_2, SO_2, particulate matter, and total suspended particulates
  - very low risk of contributing to exceedances of Alberta Ambient Air Quality Objectives and Guidelines
- **Geographic Extent:** local
- **Duration**: short-term (dust emissions) and long-term (vehicular exhaust, combustion-based heat sources)
- **Frequency**: continuous
- **Reversibility**: reversible (dust emissions) and irreversible (vehicular exhaust, combustion-based heat sources)
- **Probability**: likely

The environmental consequence of residual Project effects is expected to be low.

6.3.7 Air Uncertainty and Monitoring

There are no public air quality monitoring stations present in Canmore, but intermittent monitoring programs, the most recent from September and October of 2012 (Government of Alberta 2013b), indicate that particulate concentrations in the Bow Valley near the site are consistently low and well within the Alberta Ambient Air Quality Objectives and Guidelines. A single, temporary excursion above the relevant guidance for 24-hour $PM_{2.5}$ was observed during this monitoring campaign (Government of Alberta 2013b). The proposed residential development does not warrant additional monitoring in the area because the changes to air quality are predicted to be local, and low level, and typical of residential developments elsewhere in Alberta.

6.3.8 Air Cumulative Effects

The environmental consequence of residual Project effects is rated as low. The Project in combination with other RFDs (i.e., residential and commercial developments in the Bow Valley) may decrease air quality through increased emissions of NO_2, SO_2, particulate matter, and total suspended particulates. Effects are likely to result from vehicle and construction activity during the construction of RFDs, and from increases in natural gas combustion emissions from residential and commercial heating, and vehicular emissions from local traffic during the operation of RFDs. The Project contributions to these changes would be small.

Climate change may increase the frequency of forest fires in an around the RSA, which would periodically reduce air quality in the RSA. The Project and other RFDs are not expected to contribute to these effects.

At the RSA scale, existing ambient air quality levels are generally below Alberta's Ambient Air Quality Objectives (AENV 2001; Government of Alberta 2019d). Concentrations of small respirable particulate levels are generally low and below the 24-hour Canada-wide standard. The Project and other RFDs are expected to implement similar mitigation measures and adhere to best practices to limit changes to local and regional air quality. Accordingly, future projects or activities present a small risk of exceeding Alberta's Ambient Air Quality Objectives. The environmental consequence of cumulative effects on quality is expected to be low.

6.4 Noise

6.4.1 Noise Methods

The noise assessment follows the general assessment methods outlined in Section 4. This section presents additional details about the approach used to complete the VEC's impact statement.

Environmental Consequence

A high environmental consequence, which can be considered a significant effect, is assigned if serious risk is identified. The definition of a serious risk varies among VECs and this section provides the methods used to identify whether or not a serious risk is present for noise under existing conditions or would be expected because of the Project, or the Project plus other RFDs.

Serious risk for noise is identified when Project effects are predicted to contravene the Town's Noise Control Bylaw (Town of Canmore 1997).

6.4.2 Noise Existing Conditions

Existing noise levels within the ASP area, LSA, and RSA are generally dominated by the contribution from:

- natural sources, such as wind, birds, insects, and flowing water
- general human activities within the Town, along hiking trails, and in the backcountry
- vehicular traffic on Highway 1, Highway 1A, and smaller local roads

- train traffic on the Canadian Pacific (CP) rail line
- industrial activity (e.g., Lafarge, Graymont, Baymag)

Alberta Energy Regulator (AER) *Directive 038: Noise Control* (AER 2007) is the regulation applicable to environmental noise from oil and gas facilities in Alberta. *Directive 038* provides a desktop method for estimating ambient noise levels based on time of day, population density, and proximity to transportation infrastructure. Although *Directive 038* does not apply to the Project (i.e., the Project is not an oil and gas facility regulated by the AER), the Project EIS made use of the *Directive 038* method to estimate existing noise levels within the ASP area, LSA, and RSA.

Existing noise levels for various locations within the ASP area, LSA, and RSA are presented in Table 46. In accordance with *Directive 038* and for consistency with the Canmore Noise Control Bylaw, existing noise levels are presented for the daytime period (defined as 7 am to 10 pm) and for the nighttime period (defined as 10 pm to 7 am). Existing noise levels are presented in the form of energy equivalent sound levels (L_{eq}), expressed in A-weighted decibels (dBA). The L_{eq} noise level represents the average noise level over a specified period of time (e.g., the daytime period: $L_{eq,day}$). Noise levels expressed in dBA have been scaled to reflect the frequency sensitivity of the human auditory system.

Table 46: Existing Noise Levels at Locations in the Area Structure Plan Footprint, the Local Study Area, and the Regional Study Area

Location Description	Existing Noise Level [dBA]	
	Daytime[(a)] [$L_{eq,day}$]	Nighttime[(b)] [$L_{eq,night}$]
Sparsely populated[(c)] areas more than 500 m from the CP rail line, Highway 1, Highway 1A, and other busy roads	45	35
Sparsely populated[(c)] areas between 30 m and 500 m of the CP rail line, Highway 1, Highway 1A, or other busy roads	50	40
Sparsely populated[(c)] areas within 30 m of the CP rail line, Highway 1, Highway 1A, or other busy roads	55	45
Moderately populated[(d)] areas more than 500 m from the CP rail line, Highway 1, Highway 1A, and other busy roads	48	38
Moderately populated[(d)] areas between 30 m and 500 m of the CP rail line, Highway 1, Highway 1A, or other busy roads	53	43
Moderately populated[(d)] areas within 30 m of the CP rail line, Highway 1, Highway 1A, or other busy roads	58	48
Heavily populated[(e)] areas more than 500 m from the CP rail line, Highway 1, Highway 1A, and other busy roads	51	41
Heavily populated[(e)] areas between 30 m and 500 m of the CP rail line, Highway 1, Highway 1A, or other busy roads	56	46
Heavily populated[(e)] areas within 30 m of the CP rail line, Highway 1, Highway 1A, or other busy roads	61	51
Areas in close proximity to existing industrial sites	≤85[(f)]	≤85[(g)]

a) Daytime is defined as 7 am to 10 pm, in accordance with *Directive 038* (AER 2007) and for consistency with the Canmore Noise Control Bylaw (Canmore 1997).
b) Nighttime is defined as 10 pm to 7 am, in accordance with *Directive 038* (AER 2007) and for consistency with the Canmore Noise Control Bylaw (Canmore 1997).
c) Sparsely populated refers to an area with fewer than nine dwellings per quarter section, in accordance with *Directive 038* (AER 2007).
d) Moderately populated refers to an area with nine to 160 dwellings per quarter section, in accordance with *Directive 038* (AER 2007).
e) Heavily populated refers to an area with more than 160 dwellings per quarter section, in accordance with *Directive 038* (AER 2007).
f) During the daytime period, noise levels as low as 45 dBA or as high as 85 dBA may be observed at the fence line or boundary of remote industrial facilities.
g) During the nighttime period, noise levels as a low as 35 dBA or as high as 85 dBA may be observed at the fence line or boundary of remote industrial facilities.

≤ = less than or equal to; dBA – A-weighted decibel; Leq = equivalent sound level; CP = Canadian Pacific.

6.4.3 Noise Environmental Risks

Construction

Use of heavy machinery during Project construction will increase noise levels at receptors. Because noise levels attenuate with distance, increases will be greatest at receptors located in the ASP area and LSA (i.e., close to the heavy machinery) but noise level increases may also extend into some parts of the RSA.

Mobile equipment required to support Project construction may include dozers, graders, and trucks. Stationary equipment required to support Project construction may include generators, rock crushers, cranes, and pile drivers.

The operation of engine-driven equipment will result in near-continuous emission of noise across a wide range of frequencies (i.e., broadband noise). The majority of noise will be emitted from the engine exhaust, although the air intake, cooling fans, and engine casing also emit broadband noise.

Mobile equipment will likely make use of standard back-up alarms. Back-up alarms are an important safety feature on active construction sites. Back-up alarms use a tonal signal that emits noise in a very narrow frequency band (typically centred on 1 kilohertz). Tonal signals are effective at cutting through background noise and capturing attention but, as a result, tonal back-up alarms can be particularly disturbing to nearby receptors.

Pile drivers typically function by dropping a heavy impact hammer on a stationary pile. This type of activity emits noise that is impulsive rather than continuous (i.e., short bursts of loud noise). Because of its impulsive character, noise from pile drivers can be particularly disturbing to nearby receptors. In particular, it is often more difficult for human and wildlife receptors to become habituated to impulsive noise sources that continuous noise sources.

Operations

During Project operations, new dwellings and commercial facilities will become active in areas that were previously uninhabited. Use of these new dwellings and commercial facilities by local residents and visitors will increase noise levels in the ASP area and LSA. Noise level increases associated with Project operation are unlikely to extend into the RSA.

Noise sources associated with Project operations will likely include vehicular traffic on new local roads, as well as general noise sources associated with residential neighbourhoods (e.g., human voices, recorded music, lawnmowers and other small tools, dogs barking, children playing).

6.4.4 Noise Predicted Project Effects (without Mitigation)

The acoustic environment is considered sensitive to change in noise levels given the Project’s proximity to human receptors and designated wildlife corridors. Without the application of mitigation, predicted effects of the Project are:

- **Direction**: negative, because noise levels will increase
- **Magnitude**: medium to large magnitude during construction because noise levels will increase beyond existing conditions in the LSA and could contravene the Town’s bylaws if these are not considered during construction planning; small magnitude during operations because noise levels will increase measurably but are unlikely to increase beyond existing conditions currently found elsewhere in the LSA (e.g., within existing residential areas)

- **Geographic Extent**: regional during construction because increased noise levels may extend into the RSA; local for operations
- **Duration**: short-term in duration for construction activities; long-term for residential/commercial noise during operations
- **Frequency**: periodic for construction because construction shifts are unlikely to span 24 hours per day, and seven days a week; continuous for operations because the ASP area will be continuously inhabited
- **Reversibility**: reversible for construction activities; permanent for noise associated with operations
- **Probability**: likely for both construction and operations, because noise levels are certain to increase because of Project activities

The environmental consequence of Project effects is expected to be moderate to high without the application of mitigation; however, a high environmental consequence would occur only if there is a contravention of the Town's Noise Control Bylaw (Town of Canmore 1997).

6.4.5 Noise Relevant Legislation

- *Bylaw 11-97. A Bylaw of the Town of Canmore in the Province of Alberta for the Purpose of Prohibiting, Eliminating or Abating Noise* (Town of Canmore 1997).

6.4.6 Noise Mitigation

During Project construction TSMV will:

- Restrict construction activities to the *"hours during which construction noise is permitted"* by the Canmore Noise Control Bylaw: 7 am to 10 pm, Monday to Saturday (Town of Canmore 1997) or as applied for in an exemption to Sunday activities from time to time.

During Project operations TSMV will design residential and recreational elements to encourage local residents and visitors to use non-vehicular transportation and the trail network within the ASP area to access other portions of the TSMV and Canmore. Local residents and visitors to the ASP area will be required to abide by the Canmore Noise Control Bylaw.

6.4.7 Noise Predicted Project Effects (with Mitigation)

With the application of the mitigation outlined in Section 6.4.6, predicted Project effects on noise levels are classified as follows.

- **Direction**: negative in direction because noise levels will increase
- **Magnitude**: medium magnitude for construction activities because noise levels will increase beyond existing conditions in the LSA; small in magnitude for operations because noise levels will increase measurably but will not increase beyond existing conditions currently found elsewhere in the LSA (e.g., within existing residential areas)
- **Geographic Extent**: regional in extent for construction activities because increased noise levels may extend into the RSA; local during operations because increased noise levels will likely be confined to the LSA
- **Duration:** short-term in duration for construction activities; long-term for residential/commercial noise during operations

- **Frequency**: periodic in frequency for construction because construction will be mainly limited to daytime hours; continuous for operations because the ASP area will be continuously inhabited
- **Reversibility**: reversible for construction activities; permanent for residential/commercial noise during operations
- **Probability**: likely for both construction and operations because noise levels are certain to increase because of Project activities

The environmental consequence of residual Project effects is expected to be low.

6.4.8 Noise Uncertainty and Monitoring

Project construction and operations will be complex and highly variable. There will be seasonal and daily variations in the size and location of the construction fleet. Similarly, there will be seasonal and daily variations in the location and intensity of activities undertaken by residents and visitors during Project operations. This variation makes it challenging to predict the specific noise levels that may be experienced by a particular receptor on any given day. Notwithstanding this uncertainty, the overall prediction confidence for the assessment of Project effects on noise levels is high. In other words, although there is uncertainty and variability in the specific noise levels that may be experienced by a given receptor, there is a high degree of confidence in the residual effects classification for noise levels.

As discussed in Section 6.4.7, the environmental consequence of the residual Project effects is expected to be low. Consequently, noise monitoring is not recommended during Project construction or operations.

6.4.9 Noise Cumulative Effects

The environmental consequence of residual Project effects is rated as low. The Project in combination with other RFDs (i.e., residential and commercial developments in the Bow Valley) and general population growth in the RSA will increase noise levels in the region. The Project is expected to contribute locally to these changes.

The cumulative effects on noise levels, both present and future, are anticipated to be detectable and adverse due to the increase in development in the RSA. In most instances, the largest magnitude of change will occur over temporary periods during the construction of new developments, and these effects are expected to be localized. In general, the changes are not predicted to alter the overall noise environment or general existing noise levels in the RSA, with mitigation and by following direction in the Canmore Noise Control Bylaw 11-97. Environmental consequence of cumulative effects is therefore predicted to be low.

7.0 SOCIAL COMPONENTS

7.1 Visual Resources

7.1.1 Visual Resources Methods

The visual resources assessment follows the general assessment methods outlined in Section 4. This section presents additional details about the approach used to complete the VEC's impact statement.

Environmental Consequence

A high environmental consequence, which can be considered a significant effect, is assigned if serious risk is identified. The definition of a serious risk varies among VECs and this section provides the methods used to identify whether or not a serious risk is present for visual resources under existing conditions or would be expected because of the Project, or the Project plus other RFDs.

Serious risk for visual resources is identified when Project effects are predicted to cause a fundamental change in the overall visual character or general existing visual conditions in the RSA.

7.1.2 Visual Resources Existing Conditions

The regional visual resources of the Bow Valley are considered an important factor for both the tourism industry and those that reside in the area. The Bow Valley is a key destination for people seeking the opportunity to experience the mountain vistas of the region and large areas of native vegetation communities that extend the length of the valley at lower elevations.

Within the Project Boundary, high quality visual resources include Stewart Creek, mature forest stands, and views of surrounding mountain peaks, including the Three Sisters. Low quality visual resources in the area include mining scars, old haul roads, power line infrastructure and the Thunderstone Quarry.

7.1.3 Visual Resources Environmental Risks

Two main potential environmental risks are identified for visual resources:

- poor integration of architectural and landscaping designs resulting in dissonance of form and materials with the surrounding environment
- obstructions or reduced viewshed quality for high quality visual resources (e.g., mountain peaks and vistas) from various locations within the RSA

The importance of visual resources for the tourism industry and residents indicates that visual resources are sensitive to change. Without the application of mitigation, predicted effects of the Project on visual resources are:

- **Direction**: negative
- **Magnitude**: are expected to result in a measurable reduction in the visibility or quality of key visual resources (mountain peaks and vistas) from various vantage points in the RSA; localized reduction of visual resource quality, including native vegetation communities
- **Geographic Extent**: regional
- **Duration**: long-term
- **Frequency**: continuous

- **Reversibility**: irreversible
- **Probability**: likely

The environmental consequence of potential Project effects is expected to be moderate without the application of mitigation.

7.1.4 Visual Resources Relevant Legislation

- *Canmore Municipal Development Plan* (Town of Canmore 2020a)
- *Canmore Land Use Bylaw 2018-22*, Section 4: Commercial Land Use Districts, Section 11: Community Architectural and Urban Design Standards, and Section 14: Direct Control Districts (Town of Canmore 2020b)
- *Construction Management Plan* (TSMV 2015)
- *TSMV Flowering Landscape* (Stantec 2004a)

7.1.5 Visual Resources Mitigation

To reduce potential adverse effects on visual resources from the Trans-Canada Highway during site planning and construction, TSMV will:

- adhere to the Town *Revised Land Use Bylaw* (2018-22) and associated Town policies and guidelines (e.g., Municipal Development Plan – Bylaw 2018-27; Town of Canmore 2020a) with respect to architectural and landscaping considerations as a minimum to confirm that buildings achieve a harmony of form and materials with the surrounding environment and are framed by natural landscaping
- adhere to the Visual Impacts management policies (Section 4.5) outlined in the ASP
- retain native vegetation where possible surrounding the wetlands and the riparian areas, and limit the amount of vegetation removal required
- complete landscaping within the development using natural vegetation features and native plant species where feasible, in keeping with the TSMV Flowering Landscape (Stantec 2004a) and Woody Plants of TSMV (Stantec 2004b) as per Town bylaws
- dispose of debris and slash as per the Construction Management Plan (TSMV 2015) to maintain aesthetic quality of the site
- rehabilitate existing disturbances during reclamation of Project related disturbances, where possible

During operations, TSMV will:

- apply architectural standards and designs as per Town bylaws (e.g., *Revised Land Use Bylaw 2018-22*, MDP Bylaw 2016-03)
- avoid obstruction of key viewsheds where possible according to Town bylaws (e.g., MDP Bylaw 2018-27)
- apply appropriate downcast exterior lighting as per Town bylaws

7.1.6 Visual Resources Predicted Project Effects (with Mitigation)

Section 10.1.11 of the Town's Municipal Development Plan (MDP; Bylaw 2018-27) indicates that architectural and landscaping controls will be required so that buildings achieve harmony of form and materials with the surrounding environment, especially to limit adverse effects on the viewshed from the Trans-Canada Highway. If buildings associated with the Project are constructed in a manner that is consistent with the Town's MDP, there is little risk that visual resources could be adversely affected.

The Project will not impede views of high-quality visual resources such as mountain peaks and vistas. The proposed development within Project will be visible to recreational area users from higher elevations on the surrounding mountains and from portions of the Smith Dorrien / Spray Trail, Three Sisters Parkway and George Biggy Sr. Road. Portions of the development will also be visible from the Trans-Canada Highway. The Project adds development of lower intensity uses, such as recreational amenities, low and medium density housing forms, and a flexible district containing commercial, light industrial and institutional uses.

The importance of visual resources for the tourism industry and residents indicates that visual resources are sensitive to change. However, removing the Thunderstone Quarry and development of iconic buildings within the ASP may be viewed by some as a positive visual outcome.

With the application of mitigation outlined in Section 7.1.5, predicted Project effects on visual resources are:

- **Direction**: negative
- **Magnitude**: expected to have very little risk of degrading the quality of high-value visual resources in the RSA; the Project footprint adds 127.6 ha of new built up area (Section 5.16, Table 42), representing small changes at the scale of the RSA
- **Geographic Extent**: regional
- **Duration**: long-term
- **Frequency**: continuous
- **Reversibility**: irreversible
- **Probability**: likely

The environmental consequence of residual Project effects is expected to be low.

7.1.7 Visual Resources Uncertainty and Monitoring

Uncertainty exists about the specific footprint and structure design within the development areas at the ASP stage but building type and height within different policy areas is defined. Controls and restrictions with respect to architectural standards will be developed at the subdivision phase. No additional monitoring or study is recommended.

7.1.8 Visual Resources Cumulative Effects

The environmental consequence of residual Project effects on visual resources is rated as low. The Project will contribute to cumulative effects on visual resources together with existing developments, RFDs, and population growth in the RSA.

The combined effects of present and future cumulative effects on visual resources are anticipated to be detectable and adverse due to the increase in development in the RSA. The addition of the Project and other RFDs represent increases the proportion of disturbance in the RSA from 11.2% under existing conditions to 12.0% under the cumulative effects scenario (Section 4.5).

Changes to visual resources are not predicted to change the overall visual character or general existing visual conditions in the RSA, with mitigation and by following direction in the Municipal Development Plan. In particular, cumulative effects are expected to have very little risk of degrading the quality of high-value visual resources in the RSA (i.e., mountain peaks and vistas). The environmental consequence of cumulative effects on visual resources in the RSA is therefore predicted to be low.

7.2 Historic Resources

The following is a summary of the historic resource concerns associated with the Project. The background information used for this summary includes a search of the historic resource inventory files maintained by the Historic Resources Management Branch of Alberta Culture, Multiculturalism and the Status of Women (ACMSW), discussion with Barry Newton (Regional Regulator at ACMSW), and a review of the 1990 Historic Resource Impact Assessment (HRIA) conducted by Fedirchuk McCullough & Associates Ltd. (FMA 1991).

7.2.1 Historic Resources Methods

The historic resources assessment follows the general assessment methods outlined in Section 4. This section presents additional details about the approach used to complete the VEC's impact statement.

Environmental Consequence

A high environmental consequence, which can be considered a significant effect, is assigned if serious risk is identified. The definition of a serious risk varies among VECs and this section provides the methods used to identify whether, or not, a serious risk is present for historic resources under existing conditions or would be expected because of the Project, or the Project plus other RFDs.

Serious risk for historic resources is identified when Project effects are predicted to cause the destruction of palaeontological sites, archaeological sites, or historic features.

7.2.2 Historic Resources Existing Conditions

In 1990, on behalf of TSMV, FMA conducted an HRIA of the entire TSMV property. The results of the HRIA indicated that the area is rich in historic resources. Some historic resources may already have been mitigated during previous development at the Resort Centre (e.g., the unfinished golf course). Other resources on TSMV properties, such as the Canmore Mines Lamphouse, have been identified for permanent protection.

Existing conditions for historical resources are based on a search of the historic resource inventory files maintained by the Historic Resources Management Branch of ACMSW, discussion with Barry Newton (Regional Regulator at ACMSW), and a review of the 1990 HRIA conducted by FMA (FMA 1991). The field investigations undertaken to inform the HRIA already done on the entire TSMV property provided useful information for describing existing conditions.

The HRIA conducted in 1990 considered the potential effects on palaeontological and archaeological sites as well as historic features situated on the TSMV properties. No palaeontological sites were identified within the TSMV property (FMA 1991). However, the HRIA did identify 10 previously unknown prehistoric archaeological sites and 122 historic period features associated with coal mining infrastructure. The types of historic period features recorded include building/building remains, mine entrances, subsidence features, airshafts, sawmills, middens, transportation features, water diversions and cairns.

Based on a comparison of the historic period features map (FMA 1991 and the Project area), 21 historic features are present within, or immediately adjacent to, the ASP area (Table 47) and all 21 are related to mining. Eight of the prehistoric archeological sites are present within, or immediately adjacent to, the ASP area.

Table 47: Historic Period Features and Prehistoric Archaeological Sites Identified in or Immediately Adjacent to the Project Boundary

Time Period	Type of Feature	Relationship of Feature to Project ASP	*Historic Resources Act Requirements* (Alberta Culture and Multiculturalism 1992)
Historic	A13 Pumphouse	in close proximity to the southern boundary Site 7/8	Avoidance
Historic	B12 Mine Entrance	in close proximity to the southwest boundary Site 7/8	detailed recording and documentation
Historic	B15 Mine Entrance	in close proximity to the west boundary Site 7/8	detailed recording and documentation
Historic	B16 Mine entrance	within boundary Site 7/8	detailed recording and documentation
Historic	B17 Mine entrance	within boundary Site 7/8	detailed recording and documentation
Historic	B18 Mine entrance	within boundary Site 7/ 8	detailed recording and documentation
Historic	B19 Mine Entrance	within boundary Site 7/ 8	detailed recording and documentation
Historic	B20 Mine Entrance	in close proximity to the southern boundary Site 7/8	detailed recording and documentation
Historic	B21 Mine Entrance	within boundary Site 9	detailed recording and documentation
Historic	B22 Mine Entrance	within boundary Site 9	detailed recording and documentation
Historic	B23 Mine Entrance	within boundary Site 9	detailed recording and documentation
Historic	B24 Mine Entrance	in close proximity to the southern boundary Site 7/8	detailed recording and documentation
Historic	B25 Mine Entrance	in close proximity to the southern boundary Site 7/8	detailed recording and documentation
Historic	B26 Mine Entrance	within boundary Site 7/8	detailed recording and documentation
Historic	E01 Sawmill	within boundary Site 9	detailed recording and documentation
Historic	G04 Railroad Bed	within boundary Site 7/8	detailed recording and documentation
Historic	H07 Pipe	within boundary Site 7/8	detailed recording and documentation
Historic	H08 Wooden Box (driven nail)	in close proximity to the southern boundary Site 7/8	detailed recording and documentation
Historic	H09 Sled	in close proximity to the southern boundary Site 7/8	Avoidance
Historic	I01 Stewart Creek Dam	South of the boundary Site 7/8	detailed recording and documentation
Historic	J02 Boulder Cairn	in close proximity to the southern boundary Site 7/8	detailed recording and documentation
Prehistoric	Borden Number: EgPt 18	within boundary Site 9	Mitigation is required should the site be impacted
Prehistoric	Borden Number: EgPt 19	within boundary Site 9	No further work

Table 47: Historic Period Features and Prehistoric Archaeological Sites Identified in or Immediately Adjacent to the Project Boundary

Time Period	Type of Feature	Relationship of Feature to Project ASP	*Historic Resources Act Requirements* (Alberta Culture and Multiculturalism 1992)
Prehistoric	Borden Number: EgPt 20	within boundary Site 9	further testing may be necessary should the site be impacted
Prehistoric	Borden Number: EgPt 21	within boundary Site 9	avoidance of this site is required
Prehistoric	Borden Number: EgPt 22	within boundary Site 9	avoidance of this site is required
Prehistoric	Borden Number: EgPt 23	within boundary Site 9	no further work recommended
Prehistoric	Borden Number: EgPt 24	within boundary Site 9	avoidance of this site is required
Prehistoric	Borden Number: EgPt 25	within boundary Site 9	avoidance of this site is required

a) Based on the quality of the historic feature map from the 1990 HRIA report, historic features are included here if they appeared to be close to or within the boundaries of ASP area.

ASP area = Project Study Area Boundary

7.2.3 Historic Resources Environmental Risks

Historic resources (i.e., palaeontological, prehistoric and archaeological sites and historic period features) are non-renewable resources, which are highly vulnerable to alteration, destruction or damage due to development activity. Potential impacts may occur whenever the ground surface is disturbed, because these features tend to be located either at or directly below the ground surface.

With regard to the Project, there are no concerns for impacts to palaeontological sites. However, there is one historic period feature and six prehistoric archaeological sites that may be situated within the Project Boundary that have *Historical Resources Act* requirements associated with them (Table 47).

Adverse effects on historic and prehistoric resources are expected during both Project construction and operations. During construction, some historic and prehistoric features may be removed or otherwise affected. During operations, the addition of new residences in the area may result in greater use of the areas beyond the ASP area, which may result in an increase in unofficial trail development, and therefore potential damage to historic and prehistoric resources.

Without the application of mitigation, predicted effects of the Project on historic and prehistoric resources are:

- **Direction**: Negative
- **Magnitude**: expected to result in the loss of historic or prehistoric period features due to site clearing and damage to historic or prehistoric period features if unsanctioned trails are created. Magnitude of change is considered medium to large.
- **Geographic Extent:** mostly restricted to the Project footprint (clearing for Project infrastructure) but loss or damage associated with human use could be regional
- **Duration**: short-term (loss/damage associated with site clearing and construction) and long-term (effects of human use)
- **Frequency**: expected to occur once for site clearing and construction activities, but effects of human use will be continuous

- **Reversibility**: irreversible
- **Probability**: likely (loss/damage associated with site clearing and construction) and possible (effects of human use)

The environmental consequence of Project effects is expected to be high without implementation of mitigation.

7.2.4 Historic Resources Relevant Legislation and Guidelines

- 1992 *Historical Resources Act*
- Alberta Culture and Multiculturalism 1992; Files 90-065, 90-CR013 (2), 50-THR-9054, and 6392-002-00-02
- The 2015 Three Sisters Mountain Village Construction Management Guidelines, which provides guidelines related to the protection of cultural and historic resources

7.2.5 Historic Resources Mitigation

The Project area and other TSMV properties are considered rich in historic resources, prompting ACMSW (formerly Alberta Culture and Tourism [ACT]) to issue a letter outlining the *Historical Resource Act* requirements associated with the proposed development area (Alberta Culture and Multiculturalism 1992; Files 90-065, 90-CR013 (2), 50-THR-9054, and 6392-002-00-02). This letter, issued in 1992, is considered here as an appropriate guideline for mitigation measures that may be required for the development of the ASP, if there is potential overlap between the ASP area and historic resources (Table 48).

Table 48: Potential *Historical Resources Act* Requirements for Historic Features within the Project Development Area

Type of Feature	Relationship of Feature to ASP Area [(a)]	*Historical Resources Act* Requirements (Alberta Culture and Multiculturalism 1992)	*Listing of Historic Resources, September 2016 Edition (ACT)*
H09 Sled	in close proximity to the southern boundary Site 7/8	Avoidance	n/a
EgPt-18	within boundary Site 9	Mitigation is required should the site be impacted	HRV 4 requires avoidance or further work
EgPt 20	within boundary Site 9	Further testing may be necessary should the site be impacted	HRV 0 indicating no further work
EgPt 21	within boundary Site 9	Avoidance	HRV 4 requires avoidance or further work
EgPt 22	within boundary Site 9	Avoidance	HRV 4 requires avoidance or further work
EgPt 24	within boundary Site 9	Avoidance	HRV 4 requires avoidance or further work
EgPt 25	within boundary Site 9	Avoidance	HRV 4 requires avoidance or further work

a) Locations are approximated based on results of 1990 HRIA (FMA 1991: 92).
ASP area = Project Study Area Boundary, HRV = Historic Resource Value.

Anticipated mitigation measures include:

- avoidance of historic period feature H09 (sled)
- conducting detailed recording and documentation of all historic period features related to mining
- avoidance or further testing of sites EgPt-20, 21, 22, 24 and 25
- avoidance or mitigation of site EgPt-18
- fencing constructed as a mitigation for wildlife is expected to reduce proliferation of undesignated trails and access to historical resources

Three Sisters Mountain Village Properties Limited will submit a Statement of Justification and Historic Resource Application to ACMSW to obtain updated *Historical Resources Act* requirements for any features that have the potential to be affected by the Project. This will be done at future planning stages (i.e., subdivision stage) once final development footprints are known. Such planning is not required at ASP stage when detailed development footprints have not been finalized. Three Sisters Mountain Village will comply with the requirements of the *Historical Resources Act*.

7.2.6 Historic Resources Predicted Project Effects (with Mitigation)

Predicted adverse residual impacts to historic resources are expected during both Project construction and operations. During construction, some historic resources may be removed or otherwise affected. However, because mitigation defined by ACMSW will be applied, no significant loss of historic resources is anticipated. During operations, the addition of new residences in the area may result in greater use of the areas beyond the Project footprint, which may result in an increase in unofficial trail development, and therefore potential damage to historic resources. Such impacts are expected to be of low magnitude and local in extent and fencing as a mitigation for wildlife is expected to reduce proliferation of undesignated trails. With the implementation of mitigation measures and the granting of *Historical Resources Act* approval for the Project area, the predicted adverse environmental consequences to historic resources as a result of Project are expected to be negligible overall.

As described in Section 7.2.3, historic resources are highly vulnerable to alteration, destruction or damage. With the application of mitigation outlined in Section 7.2.5, predicted Project effects on historic resources are:

- **Direction**: negative
- **Magnitude**: expected to result in a small risk of damage to historic period features, particularly if unsanctioned trails are created
- **Geographic Extent:** mostly restricted to the Project footprint (clearing for Project infrastructure) but loss or damage associated with human use could be regional
- **Duration**: short-term (loss/damage associated with site clearing and construction) and long-term (effects of human use)
- **Frequency**: expected to occur once for site clearing and construction activities, but effects of human use will be continuous
- **Reversibility**: irreversible
- **Probability**: unlikely

The environmental consequence of residual Project effects is expected to be negligible.

7.2.7 Historic Resources Uncertainty and Monitoring

Once Project footprints have been defined (i.e., subdivision stage), TSMV will follow any requirements defined by ACMSW.

7.2.8 Historic Resources Cumulative Effects

A cumulative effects assessment was not completed for Historic Resources because the Project related residual effects were predicted to be negligible. Cumulative effects may be important for VECs for which the Project has positive or negligible effects, but the Project will not make them worse; therefore cumulative effects on Historic Resources are not considered in this EIS.

7.3 Land and Resource Use

7.3.1 Land and Resource Use Existing Conditions

The Project is located at the eastern edge of the Town within the growth boundary, adjacent to Stewart Creek Golf & Country Club and south of the Trans-Canada Highway. The Project occurs in an area that was previously affected by open pit and underground coal mining and currently has an open pit mine in the eastern portion (i.e., Thunderstone). The majority of the area is currently forested with a network of old roads and trails across it with a small portion taken up by wetlands. Wetlands are considered Environmentally Sensitive Areas and are discussed in detail in Section 5.11.2.

Table 49 presents the existing disturbance types within the ASP area. The ASP area is used primarily for industrial use (12.8 ha), followed by disturbance due to pipelines/transmission lines (10.5 ha). Trails make up a small part of the ASP area (4.4 ha) and are used for recreational purposes (e.g., hiking, biking off-leash dog walking). Occurrence of human and off-leash dog use is highest in the corridors adjacent to the ASP area, and other approved wildlife corridors, while people on bikes were most common in the wildlife corridors west of the Project (i.e., not in the corridor area adjacent to the Project, Figure 18). Off-leash dogs were more commonly detected in corridors and other areas of the LSA other than the Project area (Figure 18). Human use varies throughout the time of day and season, occurring more often in the summer and only during daylight hours (Figure 20). Outside of industrial use and pipeline/transmission lines, a minimal amount of the ASP area is used for other resource use such as transportation (0.1 ha) (Table 49).

Table 49: Existing Disturbances Types in the Area Structure Plan Area

Disturbance Type	Area (ha)
Industrial	12.8
Pipeline/Transmission Line	10.5
Other Trails	4.4
Transportation	0.1
Total	**27.8**

ASP area = Project Study Area Boundary; ha = hectares.

7.3.2 Land and Resource Use Environmental Risks

During Project construction and operation, recreational activities (e.g., hiking, biking, off-leash dog walking) in the ASP area will be disrupted due to the removal of existing designated and undesignated trails for development. Thunderstone Quarry will have been reclaimed by the time of full build out of the entire Smith Creek ASP development.

Without the application of mitigation, predicted effects of the Project on land and resource use are:

- **Direction**: negative
- **Magnitude**: expected to result in low magnitude of change in recreational land use in the ASP area
- **Geographic Extent:** site-specific
- **Duration**: short-term
- **Frequency**: continuous
- **Reversibility**: irreversible
- **Probability**: likely

The environmental consequence of the Project effects is expected to be low without the application of mitigation.

7.3.3 Land and Resource Use Relevant Legislation

Provincial and local legislation intended to protect land and resource use and that are relevant to the Project include:

- proposed *Smith Creek Area Structure Plan* (2020)
- *South Saskatchewan Regional Plan* 2014-2024 (Government of Alberta 2018c)
- Town of Canmore's Revised *Land Use Bylaw 2018-22* (Town of Canmore 2020b)
- Town of Canmore's *Municipal Development Plan* 2018-27 (Town of Canmore 2020a)

7.3.4 Land and Resource Use Mitigation

Anticipated mitigation measures include:

Construction

- Adhere to relevant land use plans and bylaws.
- Reach agreements with non-renewable resource users (i.e., pipeline/transmission owners) in the ASP area, where applicable.
- Additional mitigation is not required as residents and visitors have alternative outdoor recreational spaces outside of the ASP area to partake in recreational activities (e.g., hiking, biking, off-leash dog walking,). These include five parks and three off-leash dog parks in the Town and numerous hiking trails within the Town's boundaries (Town of Canmore no date; Banff and Beyond 2019).

Operation

- Adhere to relevant land use plans and bylaws.
- Reach agreements with non-renewable resource users (i.e., pipeline/transmission owners) in the ASP area, where applicable.
- As part of Project design, open space areas will be integrated throughout Smith Creek and integrate a network of green spaces, woodlands, parks, drainage courses, wetlands and other natural areas.
- Open Space Areas will accommodate an interconnected system of trails within the ASP area which interconnects the developed areas throughout Smith Creek and provides connections to the regional trail systems.
- Development will continue to be restricted on environmentally sensitive areas (i.e., wetlands) and will continue to be restricted through the designation of such areas as Environmental Reserve or creditable Municipal Reserve.
- Open space will be multi-functional and act as zones of recreation and leisure and should contain amenities such as a school, picnic areas, washrooms, trail heads and where feasible, sports fields.
- A mix of amenities such as off-leash dog parks, playgrounds, and a feature recreational amenity will be provided via Municipal Reserve or via a title transferred to the Town with a covenant ensuring the recreational use of the land in perpetuity.
- Off-leash dog areas will be centrally located and clustered with other recreational amenities.
- Off-leash dog parks will be completely enclosed and should be designed to prevent conflict between off-leash dogs and other recreational users.

7.3.5 Land and Resource Use Predicted Project Effects (with Mitigation)

The Project will clear 107 ha of land in the amendment area of natural vegetation (Refer to Table 43 in Section 5.16 for details). Project construction will build dwelling units (including single-detached, semi-detached, townhouses, stacked townhouses and apartments), roads, pedestrian trails and associated infrastructure. During Project operation, recreational use of the ASP area can resume due to Project design features, albeit in smaller designated open spaces.

With the application of mitigation outlined Section 7.3.4, predicted Project effects are land and resource use are:

- **Direction:** neutral – while recreational activities will be disrupted during Project construction activities (i.e., clearing, infrastructure construction), recreational users have numerous alternative areas within and outside of the Town to engage in these activities. During operations, while recreational users have less overall land in the ASP area to resume their recreational activities, they will have more recreational options due to the Project (i.e., a Open Space Areas, designation of parks and trails, permitted off-leash dog areas)
- **Magnitude**: small
- **Geographic Extent:** site-specific
- **Duration**: long-term

- **Frequency**: continuous
- **Reversibility**: irreversible
- **Probability**: likely

The environmental consequence of residual Project effects is expected to be negligible.

7.3.6 Land and Resource Use Uncertainty and Monitoring

Although uncertainty exists around the precise footprint location, data on existing human use (i.e., hikers, bikers, off-leash dogs) in the LSA is extensive. While development detail of the Smith Creek Area Structure Plan is currently in the conceptual stage, designation of open space and trails are defined throughout the land use concept and in the Open Space Areas which have recreational amenities. No additional monitoring or study is required.

7.3.7 Land and Resource Use Cumulative Effects

A cumulative effects assessment was not completed for Land and Resource Use because the Project related residual effects are predicted to be negligible. Cumulative effects may be important for VECs for which the Project has positive or negligible effects, but the Project will not make them worse; therefore, cumulative effects on Land and Resource Use are not considered in this EIS.

8.0 PROJECT SUMMARY

This EIS provides the information necessary for Council to make an informed decision about the application for the new Smith Creek ASP. Specifically, the EIS:

- outlined existing conditions and identified significant natural and ecological features
- determined the nature and scale of the potential effects generated by the proposed Project prior to mitigation
- provided recommendations to avoid or mitigate these effects
- identified residual effects and their significance after implementation of proposed mitigation

The EIS demonstrated that the application of mitigation would reduce the environment consequence of Project effects. In particular, the EIS highlighted how most residual effects of the Project are predicted to range from negligible to low (Table 50), meaning that either:

- no detectible adverse change is expected relative to existing conditions; or
- some detectible adverse effects are expected but these do not compromise the integrity or function of the resource or population. In these cases, the magnitude of change is small and is not expected to result in a serious risk to the affected resource or population, nor is it expected to contribute to a serious risk already present under existing conditions.

Table 50: Project Summary

VEC/Other Wildlife Species	Serious Risk[a] Identified Under Existing Conditions	Pre-mitigation Environmental Consequence	Proposed Mitigation [b]	Post-mitigated Environmental Consequence
Grizzly bear	Yes	High	▪ Avoid clearing where feasible during the migratory bird nesting season (April 11 to August 23); if clearing is required during this period perform nest sweep (Pre-construction: Developer and Builder) ▪ Conduct nest sweeps if clearing occurs between March 1 and April 30 to protect active owl nests in accordance with the Alberta *Wildlife Act* (Pre-construction: Developer and Builder) ▪ Conduct pre-construction surveys to locate sensitive wildlife features (e.g., active nest sites, dens, hibernacula), and surveys targeting amphibians and reptiles (Pre-construction: Developer and Builder ▪ Comply with requirements of the Alberta Wetland Policy (At subdivision: Developer) ▪ Keep construction equipment out of wetlands and riparian areas (Construction: Developer and Builder) without proper erosion and sediment control measures in place and in accordance with Alberta Wetland Policy ▪ Develop and implement an Erosion and Sediment Control Plan as described in the Engineering Design & Construction Guidelines (Construction: Developer) ▪ Implement the *TSMV Construction Management Guidelines* (Construction; Developer and Builder) ▪ Restrict construction activities according to Town bylaw 1997-11 (0700 to 2200 hrs Monday to Saturday; no construction noise on Sundays) (Construction: Developer and Builder) ▪ Awareness training for employees and contractors to confirm personal awareness of key issues for wildlife and stewardship responsibility while working in the area (e.g., identify opportunities to limit noise and other forms of sensory disturbance) (Construction: Developer and Builder)Final design of the wildlife fence, including design at creek crossings, fence ends, and other aspects will be undertaken at subdivision construction approval and should include the design principles outlined in the EIS. A qualified professional should evaluate the final design of the wildlife fence to confirm that it is consistent with the fence described in the EIS. (Developer) ▪ Implement a phased development approach, including completing the wildlife fence construction prior to occupancy of first subdivision. (Developer) ▪ Final fence design will include input and guidance from regional experts (Pre-construction; Developer) ▪ Evaluate the efficacy of the fence for 1) excluding large mammals from the ASP area, and 2) improving compliance with existing regulations in wildlife corridors. Responsibility: Developer to evaluate the efficacy of the fence against these two metrics. TSMV's contribution to monitoring would continue no longer than the issuance of construction completion certificate for surface works of final phase. ▪ Monitor the efficacy of the underpass for facilitating movement for multiple wildlife species (Developer) ▪ Recommend an education and enforcement campaign developed through the Human-Wildlife Coexistence Technical Working Group. Education and enforcement will serve to maximize efficacy of fencing and education in achieving compliance with trail use, off-leash dog use, and seasonal closure regulations within wildlife corridors (Enforcement: Town and Province; Education: Developer, Town, Province) ▪ Participate in the Human-Wildlife Coexistence Technical Working Group to develop and implement an adaptive wildlife monitoring plan. (Responsibility: Developer) ▪ Erect a page wire wildlife fence around the ASP area and adjacent TSMV developments (as defined in this EIS) with access points restricted to designated trails or utility maintenance access points or other right of ways (Construction: Developer) ▪ Install gates with signs at the public entrances of wildlife corridors to inform users of expected behaviour (Construction: Developer) ▪ Minimize wildlife attractants in accordance with Town Bylaws 2017-10 (Wildlife Attractant Bylaw) and 2016-11 (Recyclables and Waste Disposal Bylaw) (Construction: Developer and Builder) ▪ Reduce the negative effects of lighting in accordance with Town bylaw 2018-22 (Section 2.10) (Construction: Developer and Builder). ▪ Plan trail systems inside the ASP area and connect it to existing designated trails where appropriate. TSMV has a memorandum of understanding (MOU) with the Canmore and Area Mountain Bike Association (CAMBA), which outlines a framework for the development, construction and maintenance of mountain bike trails on TSMV property (CAMBA and TSMV 2018). Short-term objectives of the MOU include installing signage and discouraging unsanctioned trail use and building (Pre-Construction: Developer) ▪ Provide off-leash areas for dogs as appropriate and approved by the Town of Canmore as Municipal Reserve inside the ASP area (Construction: Developer and Builder)	Low
Cougar	No	High		Low
Wolf	Yes	High		Low
Elk	Yes	High		Low
Listed large to medium bodied mammals	No	Negligible		Negligible
Non-listed large to medium bodied mammals	No	Low		Low
Listed bat species	No	Moderate		Low
Non-listed small mammals	No	Low		Low
Birds	No	High		Low
Amphibians	No	Moderate		Low
Reptiles	No	Moderate		Low
Native vegetation communities	No	Moderate	▪ Comply with requirements of the Alberta Wetland Policy (Developer at Conceptual Scheme and subdivision)	Low

Table 50: Project Summary

VEC/Other Wildlife Species	Serious Risk[(a)] Identified Under Existing Conditions	Pre-mitigation Environmental Consequence	Proposed Mitigation [(b)]	Post-mitigated Environmental Consequence
Environmentally sensitive areas	No	Moderate	■ Implement the Master Drainage Plan (Developer) ■ Awareness training for employees and contractors to confirm personal awareness of key issues for environmentally sensitive areas and stewardship responsibility while working in the area (e.g., identify opportunities to avoid disturbances) (Construction: Builders and Developers) ■ Restrict workers and vehicles to designated work areas and will not be permitted to access other parts of the property without written authorization from TSMV (Construction: Builders and Developers) ■ Progressively reclaim areas of temporary disturbance with native species (Post-construction: Developer and Builders) ■ Apply guidelines from Flowering Landscapes of TSMV (Stantec 2004a) and the Woody Plants of TSMV (Stantec 2004b) where feasible and in compliance with any Town of Canmore requirements ■ Plan trail system inside the ASP area to encourage use of trails (Pre-construction: Developer) ■ Apply guidelines from Town bylaws for vegetation maintenance standards for residual and planted vegetation such as plant health care programs and tree protection plans (Construction/Operation; Developer and Builders) ■ Implement the Master Drainage Plan (Construction; Developer) ■ Develop and implement an Erosion and Sediment Control Plan as described in the Engineering Design & Construction Guidelines (Construction: Developer and Builder) ■ Follow applicable Town bylaws related to herbicides, pesticides, fertilizers, and other chemicals (Construction: Developer and Builder; Operation: Town) ■ Limit use of introduced soils from outside the Bow Valley where feasible and use soil and seed mixtures certified as being free of noxious weeds (Construction: Developer and Builder) ■ Spray native soil stockpiles with herbicide as needed to kill weed growth (Construction/Operation: Developer and Builder) ■ Seed or plant disturbed soils using Town of Canmore guidelines or Bylaws and over seed with approved seed mixes in seeded areas that have not germinated (Construction: Developer and Builder) ■ Use spot application techniques for herbicides per Town of Canmore Bylaw and Weed Control Bylaw, when required (Construction/Post-Construction: Developer and Builder) ■ Follow the Town's *Construction and Landscaping Standards and Land Use Bylaw and approved permits*, including preparing the site for a Construction Completion Certificate followed by the standard warranty/maintenance period leading up to the Final Acceptance Certificate (Construction/Operation: Developer and Builder) ■ Monitor disturbed areas in ASP after development; spray herbicides as required when new weed infestations are documented per Town of Canmore Weed Control Bylaw. (Operation/Monitoring: Developer until FAC. Town of Canmore after FAC)	Low
Fish, including species at risk	No	Low	■ Implement the *TSMV Master Drainage Plan: TSV* ASP (WSP 2020) (Construction: Developer and Town) ■ Implement the *Construction Management Guidelines* (TSMV 2015) (Construction: Developer) ■ Develop and implement a Spill Response Plan (may form part of the Construction Management Plan that will be provided to the Town) (Construction: part of the construction plan, Contractor) ■ Develop and implement an Erosion and Sediment Control Plan as described in the Engineering Design & Construction Guidelines (Construction; part of the construction plan; Developer) ■ Develop and implement a Storm Water Management Plan in alignment with the Master Drainage Plan in accordance with the Town *Engineering, Design and Construction Guidelines* (Town of Canmore 2010) and *Stormwater Management Guidelines for the Province of Alberta* (CH2M Gore & Storie Ltd. 1999) as updated from time to time (Construction; Developer). ■ Clearly delineate boundary of construction zone (Construction; part of the construction plan; Developer or Builder) ■ Maintain or restore riparian vegetation (Construction: Developer and Builder)" ■ Locate staging areas at least 20 m from permanent watercourse streambanks (Construction; Developer and Builders) ■ Adhere to timing windows when working in or near rivers and streams that connect with fish bearing waterbodies (i.e., Bow River); the Restricted Activity Period for the Bow River is September 1 to April 30 (Construction; Developers and Builders) ■ Conduct environmental monitoring during in-stream activities in fish-bearing watercourses (Construction; Developer) ■ Conduct pre-construction surveys for fish and fish habitat in affected watercourses (Pre-construction; Developer) ■ Isolate streambeds as much as possible during in-stream activities (Construction; Developer) ■ Limit the time and extent of equipment and vehicles operating in riparian zones or watercourse banks (Construction; Developer and Builders) ■ Suspend construction activities during wet conditions (heavy rainfall and run-off events) (Construction; Developer and Builders) ■ Maintain all machinery used for in-stream activities in clean condition and free of fluid leaks to prevent any deleterious substances from entering the water (Construction; Developer, Builder and Contractors) ■ Wash, refuel, and service machinery at least 30 m from the banks of any watercourse (Construction; Developer and Builders) ■ Use of fertilizers, herbicides, pesticides, and other chemicals should follow applicable Town bylaws (Construction: Developer and Builder; Operation: Town) ■ Washing of vehicles should follow applicable Town Bylaw (Operation: Town) ■ Runoff monitoring conducted by AEP at established stations on the Bow River, downstream from the Project (Operation/Monitoring; AEP)	Negligible

Table 50: Project Summary

<table>
<tr><th>VEC/Other Wildlife Species</th><th>Serious Risk[a] Identified Under Existing Conditions</th><th>Pre-mitigation Environmental Consequence</th><th>Proposed Mitigation [b]</th><th>Post-mitigated Environmental Consequence</th></tr>
<tr><td>Surface and bedrock geology, soils and terrain</td><td>No</td><td>Moderate</td><td>■ Inform staff and contractors of proper procedures to follow to limit environmental effects (Construction; Developer and Builders)
■ Apply the Construction Management Guidelines (TSMV 2015) (Construction; Developer and Builders)
■ Develop and apply the Construction Management Plan (Developer and Builder)
■ Apply the Engineering Design & Construction Guidelines (Developer and Builder)
■ Develop and implement an Erosion and Sediment Control Plan as described in the Engineering Design & Construction Guidelines (Construction; part of the construction plan; Developer)
■ Salvage and store surface soil for site reclamation (Construction; Developer and Builders)
■ Enable the use of stored soils salvaged from Canmore area to improve reclamation success (Construction; Town of Canmore)
■ Protect topsoil stockpiles with prompt revegetation or erosion control measures (Construction; Developer and Builders)
■ Delineate areas designated for terrain modification (Construction; Developer and Builders)
■ Develop and implement erosion and sediment control plan (e.g., silt fencing around perimeter of cleared areas, promptly revegetating or covering areas of exposed mineral soils, suspending all earthwork activities during and following heavy rainfall) (Construction; Developer and Builders)
■ Comply with Canmore Undermining Review Regulation AR34/2020 (Pre-construction; Developer and Builders)</td><td>Low</td></tr>
<tr><td>Surface water</td><td>No</td><td>Moderate</td><td rowspan="2">■ Inform staff and contractors of proper procedures to follow to limit environmental effects (Construction; Developers and Builders)
■ Apply Construction Management Guidelines (TSMV 2015) (Construction: Developers and Builders; Environmental Monitoring: Province; Inspection: Town)
■ Use of fertilizers, herbicides, pesticides, and other chemicals should follow applicable Town bylaws (Construction; Developers and Builders; Operations: Town bylaws)
■ Develop and apply the Construction Management Plan (Construction: Developers and Builders; Environmental Monitoring: Province; Inspection: Town)
■ Apply the Engineering Design & Construction Guidelines (Construction; Developers and Builders)
■ Develop and implement a Spill Response Plan (may form part of the Construction Management Plan that will be provided to the Town) (Construction: Contractor)
■ Develop and implement an Erosion and Sediment Control Plan as described in the Engineering Design & Construction Guidelines (Construction; Developers and Builders. A qualified Engineer retained by the developer/builder, must monitor sediment and erosion controls)
■ Maintain native vegetation where feasible (Construction: Developers and Builders)
■ Comply with requirements of the Alberta Wetland Policy with respect to native vegetation around aquatic systems (At subdivision: Developer)
■ Reclaim disturbed areas as soon as possible (Construction: Developers and Builders)
■ No direct discharge of sumps and equipment rinse water released to surface water (Construction: Developers and Builders)
■ Conduct all in-stream works in accordance with the Water Act, Public Lands Act and Fisheries Act outside of the AEP Restricted Activity Periods (Construction: Developers and Builders)
■ Areas affected by undermining will be mitigated according to provincial regulations (Construction: Developers and Builders)
■ Apply the Master Drainage Plan (Construction: Developers and Builders)
■ Develop and implement a Storm Water Management Plan in accordance with the Town Engineering, Design and Construction Guidelines (Town of Canmore 2010), Stormwater Management Guidelines for the Province of Alberta and the Master Drainage Plan submitted at ASP (CH2M Gore & Storie Ltd. 1999) (Construction: Developers).
■ Water quality monitoring conducted by AEP on the Bow River, downstream from the Project (Operations/Monitoring: AEP)</td><td>Low</td></tr>
<tr><td>Groundwater</td><td>No</td><td>Moderate</td><td>Low</td></tr>
<tr><td>Air</td><td>No</td><td>Moderate</td><td>■ Run equipment with valid emissions and noise controls as per Federal regulations (Construction: Developer and Builder)
■ Vehicles and machinery run only when in use (Construction: Developer and Builder)
■ Develop and implement an Erosion and Sediment Control Plan as described in the Engineering Design & Construction Guidelines that includes dust control during construction. Consider early paving and sweeping combined with water or chemical suppressants on site roadways. (Construction; part of the construction plan; Developer)
■ Design trail network within ASP area to access other portions of TSMV and Canmore to encourage non-vehicular transportation where feasible (Pre-construction (Conceptual Scheme): TSMV)</td><td>Low</td></tr>
<tr><td>Noise</td><td>No</td><td>Moderate to High</td><td>■ Adhere to Canmore Noise Control Bylaw 11-97 (Canmore 1997) (Construction: Developer and Builder: Town responsible for enforcing their Bylaws)</td><td>Low</td></tr>
<tr><td>Visual resources</td><td>No</td><td>Moderate</td><td>■ Adhere to the Town Land Use Bylaw (2018-22) and associated Town policies and guidelines (e.g., Municipal Development Plan - Bylaw 2016-03) with respect to architectural and landscaping considerations as a minimum to confirm that buildings achieve a harmony of form and materials with the surrounding environment and are framed by natural landscaping, including the potential effects of the Project on views from the Trans-Canada Highway (Construction: Developer)
■ Retain native vegetation where feasible, use natural vegetation features and native plant species in keeping with the TSMV Flowering Landscape (Stantec 2004a) and Woody Plants of TSMV (Stantec 2004b) as per Town bylaws (Construction: Developer)
■ Dispose of debris and slash as per the Construction Management Plan (TSMV 2015) to maintain aesthetic quality of the site (Construction: Developer)
■ Where possible, rehabilitate existing disturbances during Project reclamation (Operation/Reclamation: Developer)
■ Apply appropriate downcast exterior lighting as per Town Land Use Bylaws (Construction: Developer)</td><td>Low</td></tr>
</table>

Table 50: Project Summary

VEC/Other Wildlife Species	Serious Risk[a] Identified Under Existing Conditions	Pre-mitigation Environmental Consequence	Proposed Mitigation [b]	Post-mitigated Environmental Consequence
Historic resources	No	High	■ Comply with requirements of the *Historical Resources Act* (Pre-construction/Construction: Developer). Province ensures compliance with Provincial regulations.	Negligible
Land and resource use	No	Low	■ Adhere to relevant land use plans and bylaws (Construction/Operation: Developer) ■ As part of Project design, a Public Open Space District and Resort Recreation District will be created (Pre-construction: Developer) ■ Open spaces and trails will be set aside in the ASP area, consisting of municipal reserve lands and private open spaces. Multi-use and recreational trails will strategically link development areas to the open space areas (Operation: Developer). ■ Development will continue to mitigate or avoid environmentally sensitive areas where feasible, and will continue to be restricted through the designation of such areas as Environmental Reserve or creditable Municipal Reserve (Operation: Developer) ■ Provide off-leash areas for dogs as appropriate and approved by the Town of Canmore as Municipal Reserve inside the ASP area (Construction: Developer and Builder)	Negligible

(a) The precise definition of serious risk depends on the VEC being evaluated and is described in the VECs methods section when an environmental consequence greater than negligible was identified. Using wildlife as an example, a serious risk would be any factor that put the viability of the portion of a wildlife population inhabiting the RSA at risk (i.e., caused or contributed to a declining population trajectory that is not predicted to recover or stabilize without substantial immigration).

(b) Detailed description of mitigation measures for each VEC are provided in Sections 5, 6, and 7. Environmental monitoring programs will be developed prior to Conceptual Scheme approval.

the Town = Town of Canmore; Province = Province of Alberta; ACMSW = Alberta Culture, Multiculturalism and the Status of Women; AEP = Alberta Environment and Parks; ASP = Area Structure Plan; EIS = Environmental Impact Statement; ESAs = environmentally sensitive areas; TSMV = Three Sisters Mountain Village; VEC = valued environmental component.

8.1 Anticipated Benefits of the Project

The application of mitigation associated with the Project has the potential to improve environmental outcomes relative to existing conditions. The EIS identified the following environmental benefits of Project:

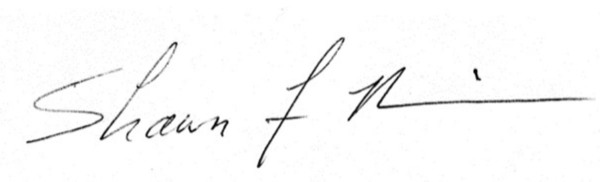
- By combining wildlife fencing with public awareness (e.g., signs) and alternative options for recreation (i.e., off-leash dog parks and designated trails), a substantial reduction in human use of undesignated trails in approved wildlife corridors is predicted, relative to existing conditions. Measures implemented by TSMV should improve public compliance with the Bow Valley Protected Areas Management Plan (Government of Alberta 2002) because many residents and visitors appear to be unaware of the restrictions that apply in designated corridors (e.g., seasonal trail closures and prohibitions on off-leash dog use).
- Changes in negative human-bear, human-cougar, human-wolf, and human-elk interactions were predicted to be neutral relative to existing conditions. Identifying the effect direction as neutral as opposed to positive represents a precautionary approach, which was applied to address uncertainty about the level of negative interaction that could occur in adjacent wildlife corridors after development (i.e., outside the fence) or as a result of some animals getting inside the fence.
- The exclusion of grizzly bears from the ASP area, which represents an ecological trap where grizzly bear selection and negative human interactions are both higher under existing conditions, will be beneficial or neutral for the grizzly bear population overlapping the RSA. Grizzly bear habitat selection is positively correlated with trail density and forest edge, both of which are associated with openings in forest canopy where food resources for grizzly bears may be higher. Development of the Project with a wildlife fence surrounding the developments should substantially reduce future grizzly bear use of the area.
- The exclusion of elk from developed areas of the LSA could have benefits for the population relative to existing conditions if elk increase their use of designated wildlife corridors. Effects related to changes in elk use of wildlife corridors were conservatively assigned a neutral direction to address uncertainty associated with this prediction. Habitat models predicted an increase in the probability of habitat selection within corridors; however, the fence has the potential to increase the risk of predation on elk by preventing escape from the wildlife corridors into urban areas (i.e., a predation refuge). As a result, there is a possibility that habitat model predictions may not occur. The dispersal of elk to natural habitats (i.e., wildlife corridors) and their increased exposure to predators would be considered a positive effect because the ecological function of the elk population would improve, and the rates and intensities of parasitic infections could decline.

Social and economics benefits of the Project are outside the scope of this EIS; however, these will be identified and evaluated in the Socio-Economic Impact Assessment and Municipal Fiscal Impact Assessment for the Project and will be submitted as part of the ASP and associated documents.

For EIS predictions to hold, mitigation identified in this EIS must be fully and effectively implemented. Cases where there was some uncertainty about the efficacy of mitigation such that the Project could contribute to a serious risk if mitigation was unsuccessful were recognized as such, and additional follow-up actions to reduce uncertainty were recommended (Table 50). Following recommended approaches to address uncertainty using adaptive management will improve the ability to adjust mitigations, if necessary, to achieve desired outcomes for VECs.

Signature Page

Golder Associates Ltd.



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https://golderassociates.sharepoint.com/sites/117267/project files/6 deliverables/smith creek eis/02_eis/smith creek_eis_draft_master_nov2020.docx

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APPENDIX A

Final Terms of Reference: Environmental Impact Statement (EIS) for Smith Creek Area Structure Plan, Canmore, Alberta (Sept 5, 2018)

FINAL Terms of Reference

Environmental Impact Statement (EIS) for Smith Creek Area Structure Plan, Canmore, Alberta (Sept 5, 2018)

1.0 Overview

1.1 Environmental Impact Statement Terms of Reference Context

Under the *NRCB Act*, Three Sister's Golf Resorts Inc. applied for approval to develop a recreational and tourism project within the Town of Canmore. An Environmental Impact Assessment (EIA) was prepared and submitted to the NRCB. In 1992, the NRCB released a Decision Report #9103, which provided conditional approval to Three Sisters to develop a four-season resort with accompanying residential development in the Bow Valley that included multiple golf courses, recreational use areas, residential neighborhoods, and supporting commercial infrastructure. Since 1992, development within the Three Sisters Mountain Village (TSMV) has proceeded in stages and the Three Sisters property has changed ownership several times. The most recent application for development has been for the Three Sisters Village Area Structure Plan (ASP) that replaced the previously approved 2004 Resort Centre ASP.

The current owners, Three Sisters Mountain Village Properties Ltd. (TSMVPL) has undertaken the development on 1036 ha of land located within the eastern boundary of the Town of Canmore and within a wide, low-elevation valley that is part of the Bow River Watershed. At lower elevations, coniferous forests dominant the landscape, with some grasslands and mixed wood forests on south- and west-facing aspects and in the valley bottoms. Several creeks flow in a northeastern direction across the TSMV property to the Bow River), including Pigeon, Cairnes, Marsh, Smith, Stewart and Three Sisters creeks. The TSMV property extends south from the TransCanada Highway to roughly 1 km up the lower slopes of the Three Sisters, Mount Lawrence Grassi peaks, and Wind Ridge between the existing developed areas at Deadman Flats and Thunderstone Quarry, to the existing Peaks of Grassi neighborhood. The Along Valley Wildlife Movement corridor runs along the southwest edge of the TSMV lands, and two corridors run perpendicularly in a northeast direction including Tipple Across Valley and the Stewart Creek Corridor (see Map A).

TSMVPL is proposing a new Smith Creek Area Structure Plan (ASP) that includes those parts of the TSMV lands known as Sites 7, 8 and 9 and the adjacent Thunderstone Quarry. An ASP has not been previously approved for the Smith Creek area. The current landowners of Three Sisters are proposing an ASP for the Smith Creek area that will support a mix of residential, commercial, light industrial and recreational uses.

The new Smith Creek ASP will be called “the Project” in this Terms of Reference (TOR).

1.2 Requirements for EIS

The Town of Canmore’s Municipal Development Plan (2016) requires that an Environmental Impact Statement (EIS) be prepared for a new or amending ASP application. The general contents expected in an EIS submitted as part of an ASP are outlined in the Town’s EIS Policy. The Town is responsible for preparing a Terms of Reference (ToR) that considers the EIS Policy and sets the specific requirements for what must be included in the EIS. The Town will hire a qualified, independent third-party reviewer to help prepare the ToR and review the EIS (see Section 5 for the role of the third-party reviewer).

The 1992 NCRB approval had two conditions that remain relevant for the currently proposed Smith Creek ASP, including:

- Condition #14 of the NRCB Decision requires Three Sisters to “incorporate into its detailed design, provision for wildlife movement corridors in an “as undeveloped state as possible”, and prepare a wildlife aversion conditioning plan, both satisfactory to Alberta Forestry, Lands and Wildlife”.
    - In lieu of a wildlife aversion conditioning plan, Three Sisters has prepared a Wildlife Human Interaction Prevention Plan that was approved by the Province in 2004. Some wildlife corridors have been designated, but a wildlife corridor designation has not been completed at the eastern end of the Three Sisters property within the Smith Creek area. The approval authority for wildlife corridors rests with the Province of Alberta and evaluation of the location and design of wildlife corridors is not part of the scope of the EIS.
    - Although the wildlife corridor designation is under the jurisdiction of the Province, development adjacent to the corridors is within the scope of approval by the Town of Canmore as directed within the Town’s Municipal Development Plan,and identifying the effects and mitigation of the Project on adjacent wildlife corridors is part of the scope of the EIS.

- As outlined in Condition #4 of the NRCB Decision, the Town of Canmore has planning authority regarding the “detailed timing and the specific land uses and population densities” of the Three Sisters lands.

2.0 Purpose of the EIS

The purpose of the EIS is to provide sufficient information to Council to make an informed decision on the proposed Smith Creek ASP. The EIS will outline existing conditions, identify significant natural and ecological features, determine the nature and scale of the potential impacts generated by the proposed Project prior to mitigation, provide recommendations to avoid or mitigate these impacts, and identify residual impacts and their significance after implementation of proposed mitigation. The EIS will also recommend further studies and/or monitoring to be undertaken through the course of implementation, and discuss cumulative effects in reference to existing, approved and future developments in the area.

3.0 Scope Definition

In accordance with Section 18.2.12 of the Town of Canmore Municipal Development Plan an EIS is required to be prepared for new or amending ASP applications. The application is for the proposed Smith Creek ASP.

The EIS for the Project will identify Federal and Provincial legislation and guidelines relevant to the Project and describe how the Project has considered guidelines and meets legislative requirements.

In addition, relevant sections of the following guidelines apply in the design and development of the Project and/or for the Environmental Impact Statement (EIS):

- Municipal Development Plan Bylaw 2016-03, Town of Canmore (2016)
- South Saskatchewan Regional Plan 2014-2014: An Alberta Land-use Framework Integrated Plan. Alberta Government
- Town of Canmore. Human Use Management Review. Consultation Summary, Final Recommendation and Implementation Plans (2015)
- Recommendations for Trails and Management of Recreational Use for The Town of Canmore: South Canmore and West Palliser (2012)
- Town of Canmore Wildlife Mitigation Strategy Review. Montane Forest Management Ltd. (2018)
- Town of Canmore Noise Bylaw (1997)
- AE Guidelines for Storm Water Management for Province of Alberta (1999)
- Contractor Health and Safety Guidelines, Responsibilities and Sign off - Town of Canmore (2017)
- Engineering Design and Construction Guidelines (2010)

The EIS should consider "Human-Wildlife Coexistence – Recommendations for Improving Human-Wildlife Coexistence in the Bow Valley" (2018).

While the TSMV is exempt from these guidelines, the Bow Corridor Ecosystem Advisory Group (BCEAG) Guidelines contain useful information for the EIS. Therefore, the scientific principles included in the following documents will be considered in the EIS wildlife assessment:

- BCEAG Wildlife Corridor and Habitat Patch Guidelines for the Bow Valley (2012)
- BCEAG Wildlife and Human Use Monitoring Recommendations for the Bow Valley (Banff National Park to Seebe) (2001)
- BCEAG Guidelines for Human Use within Wildlife Corridors and Habitat Patches in the Bow Valley (Banff National Park to Seebee) (1999)

Extensive bodies of literature and studies exist for the TSMV lands, some of which arise from previous approvals or proposals. The applicability of these reports will be evaluated during the preparation of the EIS. Biophysical information was originally compiled in support of the NRCB Decision Report Application #9103 for the property. Since that time, many studies and monitoring programs have been conducted, including those by Chinook Co., Golder Associates Ltd. (Golder), university researchers, and Alberta Environment and Sustainable Resource Development (ESRD) and its predecessors. The accumulated data, models, and interpretations along with the most recent scientific field studies, research, and thought will form the basis of the EIS.

In addition, site specific field data will be collected to fill baseline environmental information gaps required to complete the EIS. Based on discussion with the third-party reviewer, additional site-specific field surveys should include:

- Rare plant surveys
- Wildlife corridor surveys, including identification of any existing constraints to movement and potential sites for mitigation to improve functionality.

Other site-specific pre-condition field surveys will become conditions of the development and will be defined in commitment tables as discussed below.

Hence, the EIS will be based on an understanding of available and newly collected information on environmental resources within the Project area, surrounding environments and identified linkages to the proposed project. Where there is significant or extensive reliance on previously unpublished reports, the relevant sections referred to should be incorporated into the EIS for ease of readability and comprehension.

The Study Areas to be used in the EIS, including the Project, Local and Regional Study Areas are outlined in Section 4.4. The EIS should be structured to:

- Within the Local Study Area, describe the Baseline or existing environmental conditions and existing developments/footprints (e.g. Stewart Creek, Thunderstone Quarry, transmission lines), and then describe the Cumulative Environmental Impacts from the Project in combination with Baseline effects (see Sections 4.6 and 4.8). The Local Study Area should include the proposed Smith Creek ASP, as well as approved development lands in the TSMV (Stewart Creek ASP, Three Sister Village ASP), and adjacent wildlife movement corridors (see Map A and Section 4.4). A discussion of the potential effects of climate change on the Project and on VECs will be provided.
- Within the Regional Study Area (see Section 4.4), describe the Baseline conditions, the Project effects, and the Cumulative Environmental Impacts from probable projects that could occur in the next five years and would impact the same environmental resources as those affected by the Project (see Section 4.9).
- Evaluate alternate development scenarios, including development layouts, to reduce environmental and social (human use and public safety) effects from the Project.
- Provide Summary Tables that address environmental consequences, mitigation and monitoring during both the construction and build-out phases. The tables should include the following column headings:
    - Environmental and Social Disciplines
    - Pre-Mitigated Impact Consequences
    - Proposed Mitigation
    - Post-Mitigated (i.e., residual) Impact Consequences
    - Proposed Monitoring and Future Studies
- Provide clear, comprehensive summary tables of all commitments related to mitigation, compensation, studies and monitoring in the EIS.
    - Include a table of commitments that will need to be met by the Developer, under Municipal, Provincial and Federal legislation when more detailed, site-specific plans for development in the ASPs are completed. These should include commitments such as construction outside of sensitive

wildlife windows, protection of environmentally sensitive areas, requirements under the Federal Fisheries Act and Species at Risk Act, and Alberta Water Act and Wetland Policy. Pre-construction baseline surveys will be conducted for fish, amphibians, reptiles, and wetland should be identified.

- These commitments should be incorporated into future decision conditions and obligations as appropriate. The tables may be attached to subsequent subdivision applications, land use designations and development permits.

4.0 EIS Report Deliverables

The EIS report will contain all information required by this Terms of Reference. The EIS will provide the following information.

4.1 Proposal Overview

a. Describe the development context for the Project, including previous approvals and ASPs.
b. Map the Project in relation to existing conditions within the Project, Local and Regional Study Areas.
c. Provide an overview of the Canmore municipal planning policy context.

4.2 Description of the Project

a. Summarize details of the proposed Project from the ASP. Describe conceptual layout, development nodes, densities and units and temporal development schedule so that the EIS can present a robust and complete analysis of the direct and indirect effects from the proposed ASP. Include a detailed description of the infrastructure associated with the Project, including road systems and utilities including municipal water, storm water, waste water (e.g., sanitary water) and waste management.
b. Provide a land use map that includes and accounts for density of people, buildings, and infrastructure in the Project Area.
c. To account for the specific and separate set of impacts associated with the construction phase and build-out phases of the project, estimate the maximum number of people and traffic for each phase.

4.3 Public Consultation and Approach Used to Address Concerns Raised

a. Identify the approach used to consult with the public to identify their concerns about the Project, how the issues have been addressed, and where information to address the concerns is presented in the EIS.

4.4 Spatial and Temporal Boundaries of Study Areas

a. Three spatial study areas will be addressed in the EIS:
    i. Project Study Area boundary should include all the residential, resort and supporting commercial structures, and recreational uses and infrastructure within the ASP.
    ii. The Local Study Area should include the proposed Smith Creek ASP, as well as approved development lands in the TSMV (Stewart Creek ASP, Three Sister Village ASP), and adjacent wildlife movement corridors.
    iii. Regional Study Area boundary for Environmental Consequences of residual effects from the Project, should include future developments

whose impacts overlap with those of the Project. The Regional Study Area needs to be meaningfully sized to properly reflect the effects of the proposed Project.

iv. The Project, Local and Regional Study Areas are illustrated on Maps A and B.

b. Temporal Boundaries should extend from the time of project approval to full build-out of the facilities, including the construction and build-out phases (e.g. 5 to 20 years).

4.5 Valued Environmental Components

a. Valued Environmental Components (VECs) are any part of the environment that is considered important by the proponent, public, scientists or government involved in the assessment process. Importance may be determined based on cultural values or scientific concern. Several key features of the environment should be selected as VECs for this assessment.
b. The level of assessment detail for each VEC will reflect the potential effects from the Project. More detailed assessments should be provided for those VECs for which potential effects are greater.

4.6 Baseline Conditions

a. A description of existing environmental conditions within the Local Study Area, and, as required, within the Regional Study Area, including:
    i. Air Quality and Noise
    ii. Surface and Bedrock Geology
    iii. Groundwater Quantity and Quality
    iv. Surface Water Quantity and Quality
    v. Soil and Terrain, including hazards and constraints for development (e.g., slope, undermining)
    vi. Terrestrial and Aquatic Vegetation, including wetlands
    vii. Wildlife including populations, habitat and movement corridor functionality and connectivity, and interactions with people. The wildlife assessment must include an assessment of human use and public safety.
    viii. Aquatic Ecology including fish populations and habitats
    ix. Biodiversity including unique and special status species and communities, and significant natural and ecological features
    x. Historical Resources
    xi. Visual Resources
    xii. Land and Resource Use
    xiii. Existing Human Use
b. A literature review of relevant studies, including background environmental effects studies, and the most current monitoring data from remote cameras, telemetry from collared wildlife, and wildlife-human interactions, and the effects of wildlife enhancement and fire reduction sites.
c. Conduct field programs where data gaps exist in baseline conditions. Based on discussion with the third-party reviewer, the additional site-specific field surveys should include rare plant surveys; and wildlife corridor surveys for constraints and sites for mitigation to improve functionality.
d. Discuss effects from the existing developments/footprints, including existing mitigation.

4.7 Legislative Requirements

For each VEC, identify Federal or Provincial requirements or restrictions relevant to the VEC, and how the proposal will meet the intent of legislative requirements.

4.8 Project Environmental Impact Assessment

a. Identify the benefits of the Project.
b. Evaluate how the Project has been designed to address environmental sensitivities or constraints.
c. Outline alternatives and modifications to the Project to limit or remove environmental impacts. Where feasible reduce existing effects from the currently developed TSMV lands. Discuss how the Project has addressed concerns of the public.
d. Identify anticipated impacts from activities of future residents associated with the Project on VECs.
e. Identify cumulative impacts from the Project and the existing conditions, on VECs.
f. Address impacts from both the construction and build-out phases of the Project.
g. Define the significance of impacts:
    i. Identify the pre-mitigated nature and scale of environmental risks and the significance of the residual (or post-mitigated) effects from the Project, and the Environmental Consequence of the residual effects (positive, negligible, low, moderate and high).
    ii. Significance terms to be used in defining the impacts will include:
        1. Context: refers to the current and future sensitivity and resilience of the VECs to changes caused by the Project. Consideration of context draws heavily on the description of existing conditions of the VEC, which reflect cumulative effects of other projects and activities, and of natural and human-caused trends in the conditions of the VEC;
        2. Direction: positive, neutral or negative;
        3. Magnitude: size or severity of the effect;
        4. Frequency: how often the effect occurs;
        5. Duration: length of time the effect persists;
        6. Reversibility: whether the effect on the VEC can be reversed once the Project or activity causing disturbance ceases;
        7. Geographic Extent: spatial extent of the effect; and
        8. Probability: likelihood of effect
h. Define Mitigation and Environmental Management Plans:
    i. Provide recommendations on how to avoid, reduce or mitigate negative effects, and build on positive effects from the Project.
    ii. Provide specific recommendations on how to mitigate long-term human use effects.
    iii. Where applicable, provide more detailed environmental management plans for effects on wildlife, habitat and the wildlife movement corridors, and to reduce human-wildlife interactions.
    iv. Discuss regional and cooperative efforts that have been initiated, or participated in, by the Developer to address regional environmental issues.

i. Identify Uncertainty of Effects:

i. Identify and describe the uncertainty of the data, models, mitigation and projected effects, and hence the confidence in the predictions of residual impacts. Identify how uncertainty has been managed in the EIS.

4.9 Cumulative Environmental Assessment

a. Conduct a meaningful cumulative effect assessment (CEA) within the Regional Study Area that includes proposed and probable projects that could occur in the next 5 years and impact the same environmental resources (e.g., grizzly bears, elk, groundwater) as those affected by the Project.
b. In the broader CEA, include residual impacts from the Project with an Environmental Consequence greater than negligible.
c. CEAs for projects can be variable depending on the existing and future developments near the Project area. Issues that may need to be addressed in the CEA include:
    i. Incremental effects on the wildlife movement corridors,
    ii. Increased human-wildlife interactions, and
    iii. Increased traffic on wildlife mortality.

4.10 Monitoring Programs and Future Studies

a. Local Monitoring Program and Future Study Recommendations
    i. Monitoring programs are required both to verify the predicted impacts, and to track uncertain effects of the Project. Identify potential monitoring programs, for the Project. The programs need to have linkage to potential thresholds defined for effects (e.g., water quality objectives, air quality objectives).
    ii. Identify whether additional environmental studies are required.
b. Regional Monitoring Program
    i. Monitoring programs are required to assess regional cumulative effects. Identify and participate in comprehensive valley-wide regional monitoring programs, involving and funded by all stakeholders, to monitor the status and mortality of wildlife populations, and to determine the effectiveness (i.e., functionality, connectivity) of wildlife movement corridors near the TSMV lands.
c. Provide all data from monitoring programs and future studies to the Town of Canmore or regional bodies assisting in the management of wildlife in the Bow Valley.

4.11 Specific Analyses To Be Completed

a. Environmental impacts due to undermining, including effects on ground and surface water.
b. Related to Wildlife:
    i. Use meaningful and well justified Alternative Development Scenarios that will lead to the selection of development plans that will have acceptable impacts on wildlife. Scenario assessments could reflect a range in development densities and layouts, and hence different development footprints, different numbers of people who could reside in the development, and different pressures on wildlife from increased human use of wildlife corridors, from increased traffic and from indirect effects of noise and light.
    ii. Assess the effects of the Project on proposed and existing wildlife corridor movement patterns related to change in habitat use and

increased human use. Use validated habitat selection models (e.g., resource selection functions developed and validated using telemetry data collected in the RSA). Use approaches that recognize existing movement constraints and propose mitigations to improve those constraints. Include the Along Valley, Steward Creek Across Valley, and proposed Smith Creek Along Valley wildlife corridors in the analysis.

iii. Identify impacts from the wildfire mitigation strategy that will be required for development, including changes to vegetation, habitat and effects on wildlife.

iv. Evaluate the mitigation used to reduce effects on wildlife, including fencing, if this is proposed to manage Project effects.

v. Address human-use impacts on wildlife populations (e.g. corridor functionality, vehicle collisions), as well as the potential effects on human safety from wildlife conflicts.

vi. Update the Wildlife Human Interface Prevention Plan (previously prepared in 2004 for the TSMV) to reflect current legislation, and potential wildlife – human effects, and mitigation and monitoring required for the Project.

5.0 Preparation of ToR and Review of EIS

The Town of Canmore EIS Policy requires that this EIS Terms of Reference and the resulting EIS are reviewed by an independent qualified third-party consultant who reports directly to the Town and that this reviewer be involved from the beginning of the EIS process.

The Town and its third-party reviewer will work with the Developer and their consultant to achieve a mutual understanding of the information that must be included in the EIS. The third-party reviewer will have access to a draft version of the EIS to provide comments and recommendations. As questions arise or incremental work is produced by the Town or its consultant, or the Developer and its consultant's, this information will be provided in a timely manner to the other parties.

The EIS must be submitted and reviewed by the Town's third-party reviewer prior to the First Reading of the Project ASP by Council. The third-party review will answer three main questions, as follows:

- Does the EIS include the required information, as outlined in this ToR? If any information is missing the third-party reviewer will identify the deficiency.
- Does the EIS follow agreed upon methods and analysis, as outlined in this ToR?
- Does the third-party reviewer agree with the assessment of un-mitigated risks, the mitigation identified, and the assessment of residual effects?

The third-party reviewer will assess whether that the EIS meets the requirements of the Town's EIS policy. The reviewer will identify gaps in the EIS, and provide recommendations on additional, mitigation, monitoring, or future studies required. The third-party reviewer will also complete further work on the EIS as required by the Town of Canmore.

Both the third-party reviewer and the Developer's EIS consultant will respond to any additional questions, provide clarification, and address any requirements that the Town of Canmore requests because of the EIS and its review.

The Town may also refer the EIS to other agencies or committees for circulation, including but not limited to the Government of Alberta and Canmore's Environmental Advisory Review Committee (EARC).

APPENDIX B

Modelling Methods

REPORT

Appendix B

Modelling Methods

Submitted to:

Town of Canmore
902 - 7th Avenue
Canmore, AB

Submitted by:

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Distribution List

1 Electronic Copy - Town of Canmore

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TABLES

FIGURES

1.0 INTRODUCTION

This appendix presents the methods employed to develop and validate models that were used to help describe existing conditions and predict effects of the Project and other reasonably foreseeable developments on grizzly bears, wolves, elk, and cougars. This appendix presents the methods and results of a Resource Selection Function (RSF) developed from telemetry data for all four species. The RSF is important for understanding how animals select habitats and is a key information source for understanding the potential for negative human-wildlife interactions.

2.0 RESOURCE SELECTION FUNCTIONS

An RSF uses empirical data to provide an unbiased estimate of relative probability of selection by an organism (Manly et al. 2002). Key benefits of RSFs are that they use spatial data collected from wildlife to provide quantitative (as opposed to qualitative) habitat models, they are easily implemented using standard statistical techniques, and information theory can be used for model selection or inference (Manly et al. 2002, Burnham and Anderson 2002). For these reasons, RSFs are increasingly used to assess wildlife habitat relationships (Johnson et al. 2004; Lemaitre and Villard 2005; Psyllakis and Gillingham 2009; Richardson et al. 2005; Sawyer et al. 2006).

Models were developed for four large mammals: grizzly bears, wolves, elk, and cougars. These species were chosen because:

- discussions with the Town of Canmore (the Town) and their consultants indicated that these species would adequately address the primary concerns associated with the proposed development, which include changes in the way wildlife use approved wildlife corridors and changes in negative human-wildlife interactions;
- as charismatic megafauna, these species maintain a notable socio-political profile and are among the species for which the greatest concern is voiced by the conservation community in the Bow Valley;
- these species are among those most prevalently considered by previous researchers in the Bow Valley (NRCB 1992, BCEAG 1999, Herrero and Jevons 2000, Jacques Whitford AXYS 2008, Chetkiewicz and Boyce 2009, Alberta Tourism Parks and Recreation 2010, Golder 2012, Golder 2013), so that the results of this study will be comparable to previous work; and
- telemetry data were available in the Bow Valley for these four species to permit developing empirical models of habitat selection.

The resource selection functions for grizzly bears, wolves, elk, and cougars presented in this section are the same as those presented in Golder 2012. Importantly, however, the application of the models differs from previous applications because models were run using landscape variables updated to reflect conditions in 2016 (e.g., to incorporate new development and new trails) and were run using footprints provided for the Project to predict future conditions.

One of the most substantial changes from the application of the RSF models by Golder (2013) and the application of those same models for this EIS is the treatment of the unfinished golf course on the Resort Centre. This area was assigned to a golf course class by Golder (2013). However, the unfinished golf course is not managed or used like other golf courses in Canmore, and the designation was changed from one of “golf course greens, tees, and fairways” (Golder 2013) to anthropogenic grassland (the herbaceous grassland code) for application of the models to all analyses undertaken as part of the EIS prepared for the Project. This adjustment resulted in substantial changes in predicted probability of selection for grizzly bears, wolves, and cougars on the abandoned golf course; it resulted in very little change in probability of selection for elk. This change did not affect the underlying models described in the following sections and the change was deliberately made to more accurately reflect the ecological conditions and types of human use that occur on the abandoned golf course.

2.1 Methods

2.1.1 Modelling Approach

The used-available approach described by Manly et al. (2002) was employed to develop the RSFs used for this EIS. In this design, used sites are compared to random samples of available locations generated in a Geographical Information System [GIS] environment using logistic regression. Because available samples are not the same as unused locations, predictive output yields a relative as opposed to absolute probability of selection (Manly et al. 2002). Thus, although the model cannot indicate the actual probability that a particular landscape will be selected by an animal, it does describe how much more or less likely a particular habitat patch may be selected than a neighbouring patch, or one across the valley (Pearce and Boyce 2006).

Although sample contamination (i.e., the potential for randomly generated available points also to be used points) has been raised as a potential problem in used-available designs and some authors discourage their application as a result (Keating and Cherry 2004), recent analyses confirm that contamination is generally insufficient to significantly bias RSF output for used-available designs (Johnson et al. 2006). More importantly, Johnson et al. (2006) show how to avoid the contamination issue completely by using the logistic regression model to estimate coefficients for the exponential discriminant function. From this function, the selection ratio for any particular values of predictor covariates is obtained, reinforcing the validity of applying a used-available approach to RSF estimation.

To develop a used-available RSF model depicting relative probability of selection across a landscape, coefficients estimated for each habitat variable using logistic regression are inserted into the following log-linear selection model proposed by Manly et al. (2002):

$$w(x) = \exp(\beta_1 x_1 + \ldots \beta_n x_n)$$

where $w(\mathbf{x})$ represents the relative probability of selection of a habitat by a species, β_n represent regression coefficients estimated from the logistic regression model and x_n represent values for the n^{th} habitat variable in a given patch. RSF values were generated for each pixel in a raster landscape using this equation (Manly et al. 2002, Nielsen et al. 2004, Chetkiewicz and Boyce 2009).

2.1.2 Season

To produce conservative estimates of selection within wildlife corridors, RSF models were developed for each indicator species during the season when that species has been shown to be most restricted to low elevation habitat and shallow slopes. Wildlife movements are more likely to be impeded by development in the valley bottom during these periods. For grizzly bears in the Bow Valley, this occurs during summer (16 June to 10 August), after bears leave denning habitat at high elevation and move down to the valley bottom and before they move back upslope to access berry crops and alpine vegetation in fall (Chetkiewicz and Boyce 2009). Bears are presumably attracted to lower elevations during summer to forage on abundant green vegetation and also to prey on ungulate young. Habitat suitability models for bears were therefore developed for summer using cut-off dates (16 June to 10 August) defined by Chetkiewicz and Boyce 2009.

Habitat use by elk, wolves, and cougars, on the other hand, is most restricted to valley bottoms during winter when snow and ice at higher elevations cause these animals to congregate at lower elevations and on south facing slopes where snow depth is lower (Alexander 2001, Duke 2001, Callaghan 2002, Paquet and Carbyn 2003, Hohler 2004, Whittington et al. 2005, Alexander et al. 2006, Chetkiewicz and Boyce 2009). Thus, habitat suitability models for these species were developed for winter. For the purposes of this study, winter was defined as 15 November to 15 April, again following Chetkiewicz and Boyce (2009).

2.1.3 Spatial Data

Three types of spatial data are required to estimate an RSF:

- locations used by wildlife;
- a random sample of locations across the landscape; and
- spatially explicit depictions of habitat features that can be linked to the used and available location data.

Scale is an important consideration for RSF model development (Boyce 2006), and the scale of interest in this study was the Bow Valley. The area over which spatial data were obtained for RSF modelling was that part of the Bow Valley beginning near the Town of Banff and stretching south-east to where the Bow River flows out of the Rocky Mountains approximately 20 km east of Canmore (Figure B-1).

2.1.3.1 Telemetry Data

Use locations for grizzly bears, wolves, elk, cougars, were generated using either Very High Frequency (VHF) or Global Positioning System (GPS) wildlife telemetry collars deployed on a sample of animals from each species in the Bow Valley. Use and availability data were drawn from the polygons shown in Figures B-2 to B-5 to confirm that this scale was reflected in RSF models. Although individual animals used to estimate the RSFs for this study often traveled out of the Bow Valley, these data were not used in RSF modeling, ensuring that habitat suitability models reflect wildlife habitat use patterns only when animals are present in the Bow Valley.

Grizzly bear data came from five individuals (three males and two females) collared during 2000-2008 with Televilt-Simplex collars programmed to acquire a fix either every 1 or 2 hours, yielding 2,913 locations (Figure B-2). The number of locations for each bear were 30, 590, 405, 1264, and 624. A total of 797 wolf use locations were obtained during winter from 22 VHF collared wolves during 1988-2003 (Figure B-3). Number of locations for individual wolves varied between 1 and 142. Elk locations were obtained during winter from 11 animals collared with VHF collars during 2000-2003 (189 locations) and 4 GPS collared animals wearing Telonics (Messa, Arizona) collars during 2009 (9,874 locations; Figure B-4). GPS collared elk yielded 1385, 3381, 3583, and 1525 locations each. Cougar location data were derived from 5 individuals collared with Televilt-Simplex GPS radiocollars (Lindesberg, Sweden) programmed to obtain a fix either every 1 or 4 hours during 2000-2004. A total of 2,285 cougar locations were obtained during winter (Figure B-5) and these were distributed fairly evenly among individuals (536, 640, 720, 194 and 195 locations each).

Telemetry data for individual animals were pooled to develop population-level models. This is the simplest approach to RSF estimation and was chosen because it suited the available data and could be easily applied and interpreted. Alternate approaches include mixed-effects models, and models estimated for each individual animal in the sample and subsequently taking the mean coefficient value to obtain a population model (Gillies et al. 2006, Fieberg et al. 2010). Pooling data from different animals means that individuals contributing more location data to the model will have greater influence on population level coefficient values.

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LEGEND

- TOWNS AND HAMLETS
- TRANS CANADA HIGHWAY
- RSF MODELING EXTENT

DRAFT

0 5,000 10,000

1:300,000 METRES

REFERENCE(S)

1.SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

QUANTUMPLACE DEVELOPMENTS LTD.

CONSULTANT

GOLDER

YYYY-MM-DD	2019-07-04
DESIGNED	KK
PREPARED	JE
REVIEWED	
APPROVED	

PROJECT

THREE SISTERS MOUNTAIN VILLAGE ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE

RSF MODELLING EXTENT

PROJECT NO.	CONTROL	REV.	FIGURE
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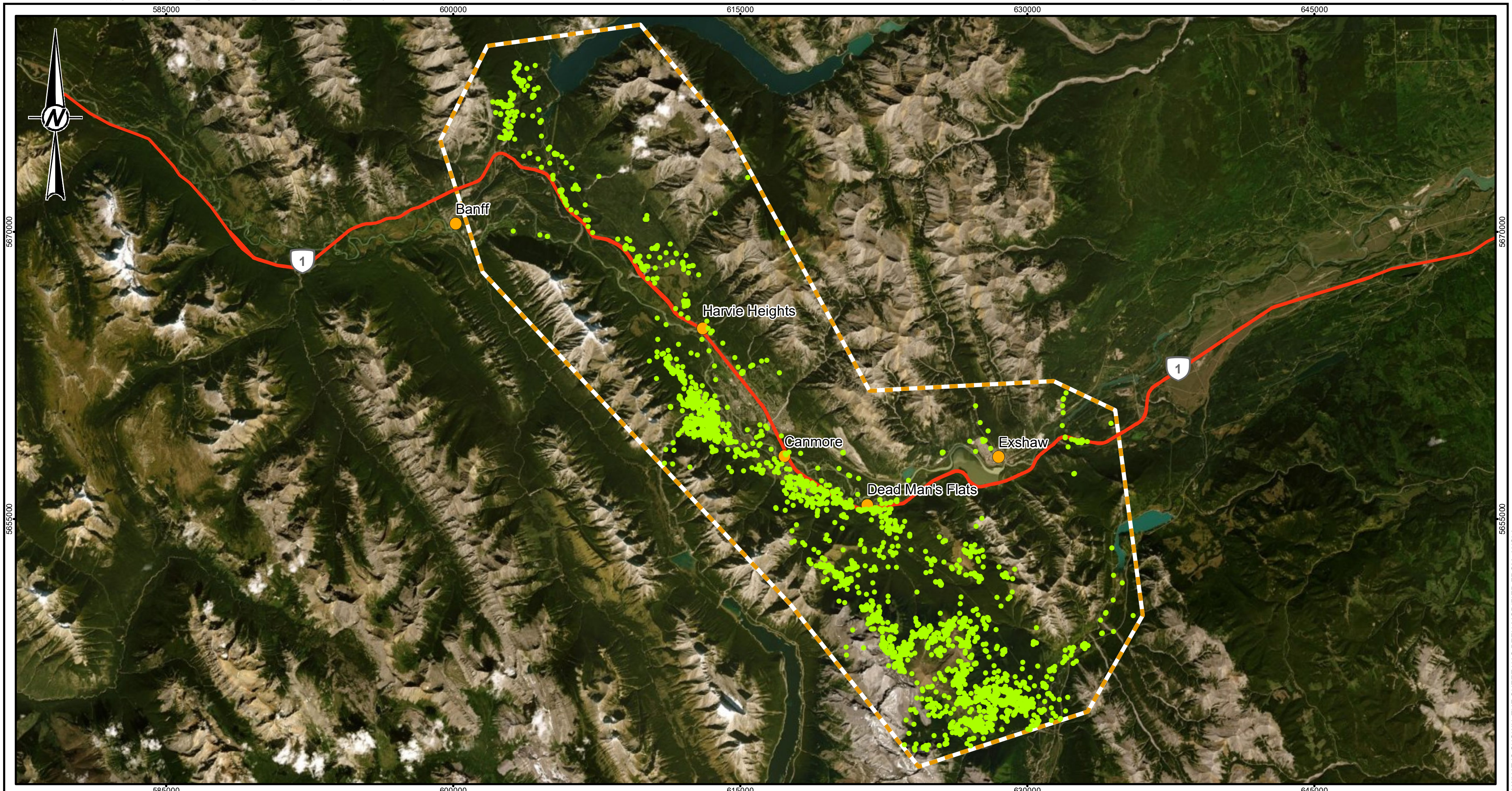

LEGEND

- TELEMETRY LOCATION
- TOWNS AND HAMLETS
- TRANS CANADA HIGHWAY
- AVAILABILITY EXTENT

DRAFT

0 5,000 10,000

1:300,000 METRES

REFERENCE(S)

1.SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

QUANTUMPLACE DEVELOPMENTS LTD.

PROJECT

THREE SISTERS MOUNTAIN VILLAGE ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2019-07-04
DESIGNED	KK
PREPARED	JE
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TITLE

GRIZZLY BEAR TELEMETRY LOCATION DATA

PROJECT NO.	CONTROL	REV.	FIGURE
18109757	2000	A	B-2

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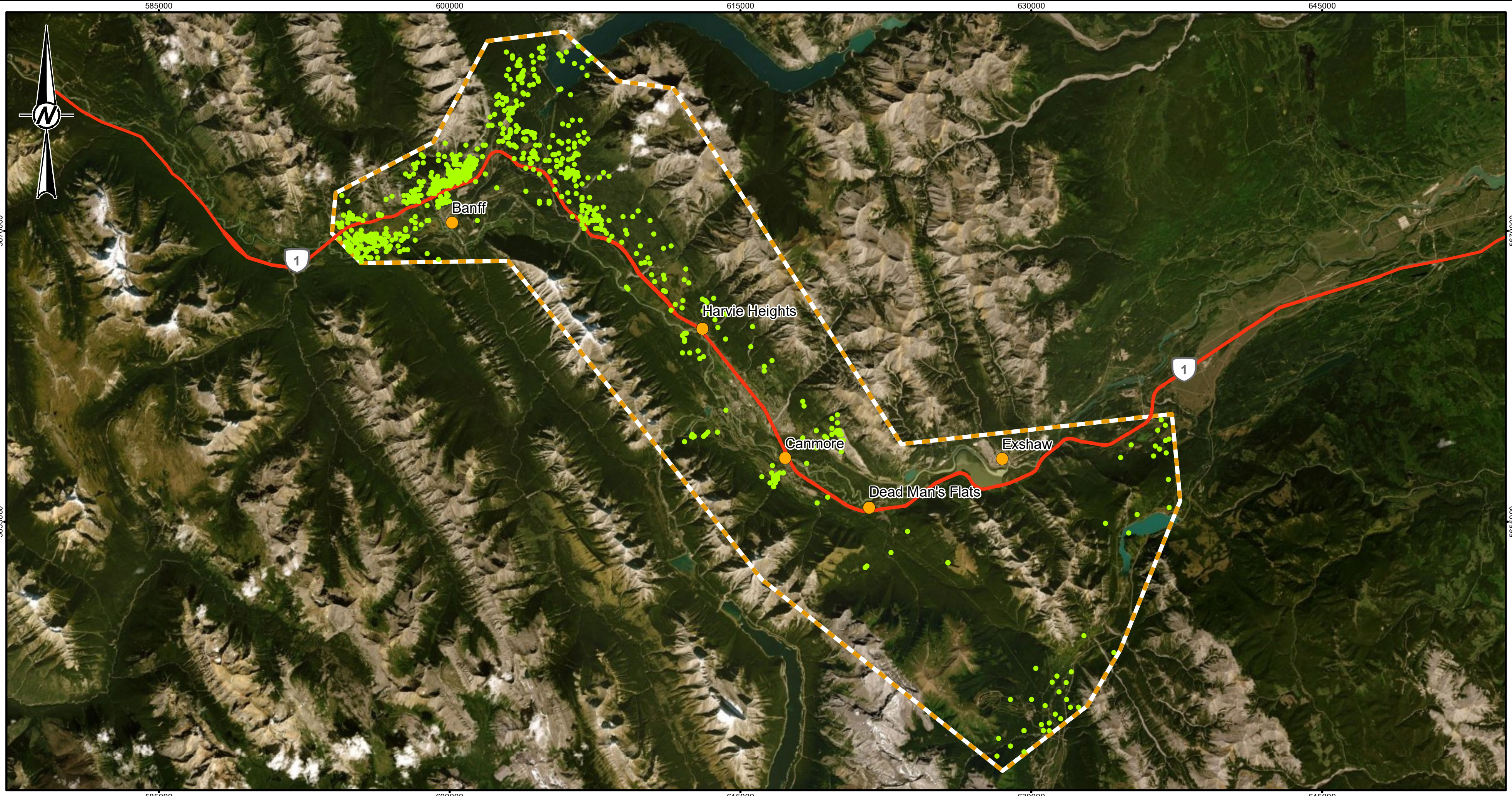

LEGEND

- TOWNS AND HAMLETS
- TELEMETRY LOCATION
- TRANS CANADA HIGHWAY
- AVAILABILITY EXTENT

DRAFT

0 5,000 10,000

1:300,000 METRES

REFERENCE(S)

1.SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

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PROJECT

THREE SISTERS MOUNTAIN VILLAGE ASP ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT

GOLDER

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PREPARED	JE
REVIEWED	
APPROVED	

TITLE

WOLF TELEMETRY LOCATION DATA

PROJECT NO.	CONTROL	REV.	FIGURE
18109757	2000	A	B-3

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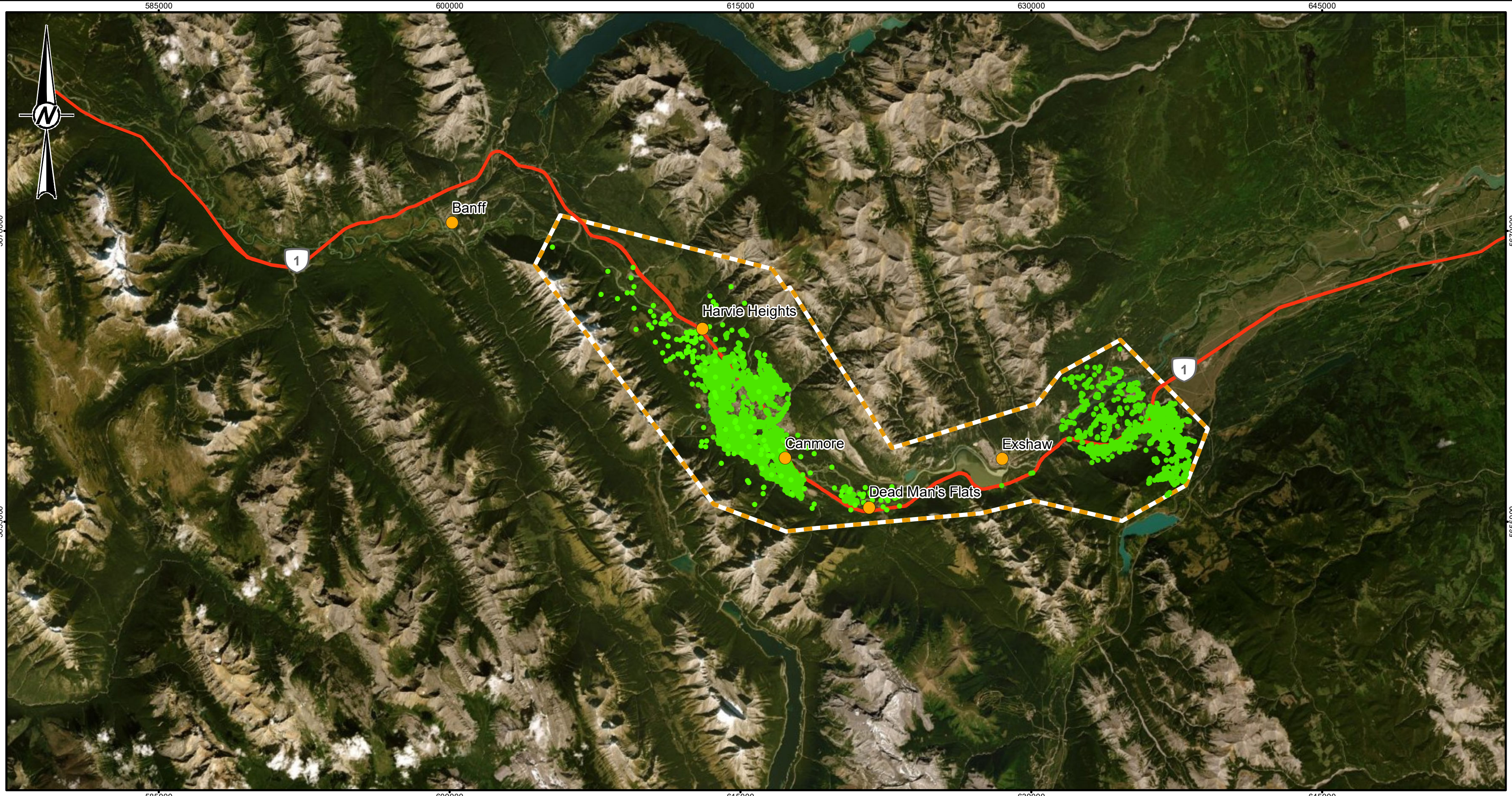

LEGEND

- TOWNS AND HAMLETS
- TELEMETRY LOCATION
- TRANS CANADA HIGHWAY
- AVAILABILITY EXTENT

DRAFT

0 5,000 10,000

1:300,000 METRES

REFERENCE(S)

1.SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
QUANTUMPLACE DEVELOPMENTS LTD.

CONSULTANT

GOLDER

YYYY-MM-DD	2019-07-04
DESIGNED	KK
PREPARED	JE
REVIEWED	
APPROVED	

PROJECT
THREE SISTERS MOUNTAIN VILLAGE ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE
ELK TELEMETRY LOCATION DATA

PROJECT NO.	CONTROL	REV.	FIGURE
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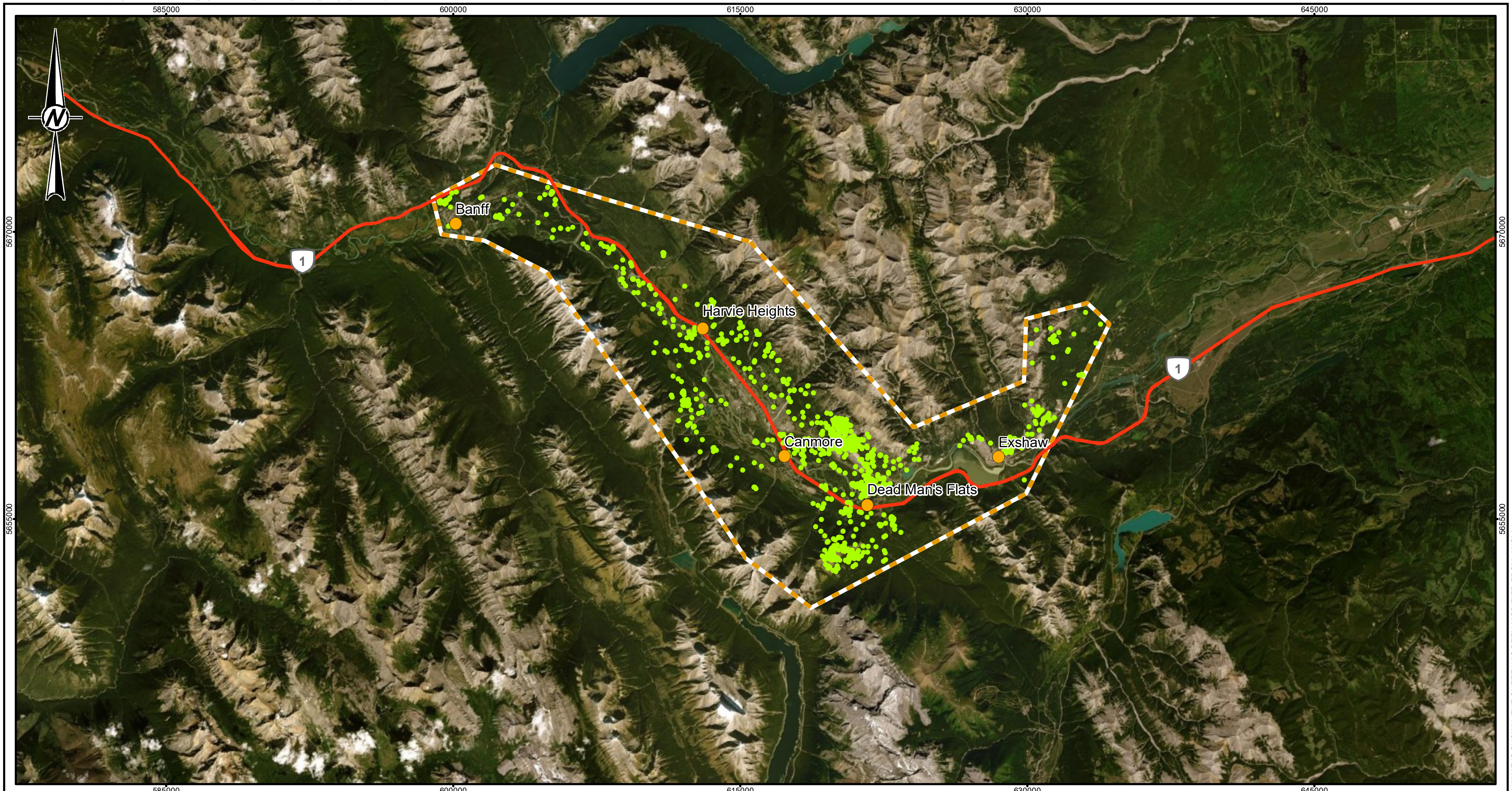

LEGEND

- TOWNS AND HAMLETS
- TELEMETRY LOCATION
- TRANS CANADA HIGHWAY
- AVAILABILITY EXTENT

DRAFT

0 5,000 10,000

1:300,000 METRES

REFERENCE(S)

1.SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT

QUANTUMPLACE DEVELOPMENTS LTD.

CONSULTANT

GOLDER

YYYY-MM-DD	2019-07-04
DESIGNED	KK
PREPARED	JE
REVIEWED	
APPROVED	

PROJECT

THREE SISTERS MOUNTAIN VILLAGE ASP ENVIRONMENTAL IMPACT STATEMENT

TITLE

COUGAR TELEMETRY LOCATION DATA

PROJECT NO.	CONTROL	REV.	FIGURE
18109757	2000	A	B-5

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Although random effects models can account for this potential problem and might improve model fit (Gillies et al. 2006), problems with specifying correlation structure (Fieberg et al. 2010) and challenges associated with interpreting the output of random effects models were deemed to outweigh the potential benefits of their application. In addition, small sample sizes for some animals meant that they would have more influence on the models than the amount of data (i.e., <30 locations) could justify (Fieberg et al. 2010). Combining coefficients from models developed for each individual animal to obtain population-level coefficients for RSFs has recently been advocated as an alternative, but this approach also was not appropriate because of small numbers of locations obtained for some collared animals (Fieberg et al. 2010).

2.1.3.2 Availability Data

Availability data were sampled to characterize the landscape using a random point generator in ArcGIS (version 9.3.1). Points were generated at a sampling intensity of five random locations per square kilometre (km^2) following Nielsen et al. (2004) and Chetkiewicz and Boyce (2009). For all species, random locations to characterize the available landscape were generated only within the polygons delineating use locations within the Bow Valley (Figures B-2 to B-5).

All grizzly bears used in this analysis crossed the Trans-Canada Highway, suggesting that the preponderance of grizzly bear locations on the south side of the Bow Valley is driven by high-quality landscape characteristics and not because bears were unable to move across the valley, justifying incorporating the less-frequently used north side of the valley as habitat available to bears (Figure B-2).

2.1.3.3 Habitat Layers

Used and available locations were intersected with habitat layers developed in a GIS environment to accommodate RSF estimation. All spatial analyses were conducted using ArcGIS version 9.3.1 and the pixel size for all vegetation, terrain, and human use layers was 25 m x 25 m.

Vegetation classification was derived from the Canadian Forest Service's Earth Observation for Sustainable Development of Forest (EOSD) land cover classification (SAFORAH, website). Some EOSD classes were collapsed into ecologically similar categories prior to analysis (Table B-1). Where EOSD classified habitat as Shadow, Cloud, or No Data, visual interpretation of high resolution satellite imagery was used to reclassify pixels to the appropriate habitat class. Most unclassified habitat occurred high on the mountains surrounding the Bow Valley where satellite imagery indicated it could be reclassified as rock/rubble or dense conifer. Edges between forests and other habitat types also can be important habitats for some wildlife species and a forest edge layer was created using a buffer 1 pixel wide on either side of the coniferous, broadleaf and mixed wood forest types (total width = 50 m). The landscape also was divided into alpine, subalpine, or montane vegetation communities using the provincial natural regions and sub-regions data; each generalized vegetation community category encompassed several habitat types.

Human development (e.g., buildings, golf courses, mines) also were digitized based on visual interpretation of high-resolution satellite imagery, and linear disturbance (e.g., roads, trails, and railways) were obtained from the Government of Alberta and Banff National Park. Polygons of built-up areas and golf courses were stamped onto the EOSD classification as distinct habitat types (Table B-1).

Table B-1: Land Cover, Development, and Terrain Classifications used for Resource Selection Function Modelling

Classification for Modelling	EOSD Classification	Description
N/A (reclassified)	no data	No data – unknown reason
N/A (reclassified)	cloud	No data – image obscured by cloud cover
N/A (reclassified)	shadow	No data – image obscured by shadow
water	water	Lakes, reservoirs, rivers, or streams
nonveg	snow/ice	includes glacier, snow, or ice
nonveg	rock/rubble	Bedrock, rubble, talus, blockfield, rubbley mine spoils, or lava beds
nonveg	exposed land	River sediments, exposed soils, pond or lake sediments, reservoir margins, beaches, landings, burned areas, road surfaces, mudflat sediments, cutbanks, moraines, gravel pits, tailings, or other non-vegetated surfaces
shrub	shrub tall	At least 20% ground cover which is at least one-third shrub; average shrub height greater than or equal to 2 m
wet_shrub	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	herb	Vascular plant without woody stem (grasses, crops, forbs, gramminoids); minimum of 20% ground cover or one-third of total vegetation must be herb
conif_dens	coniferous dense	Greater than 60% crown closure; coniferous trees are 75% or more of total basal area
conif_open	coniferous open	26-60% crown closure; coniferous trees are 75% or more of total basal area
br_leaf	broadleaf dense	Greater than 60% crown closure; broadleaf trees are 75% or more of total basal area
mixwood	mixed wood dense	Greater than 60% crown closure; neither coniferous nor broadleaf tree account for 75% or more of total basal area
montane	N/A	Occurring in the Montane subregion of the Rocky Mountain Natural Region (NRC 2006)
forest_edge	N/A	50m edge adjacent to coniferous, broadleaf and mixed wood forest polygons
greeness	N/A	Greenness calculated using tasseled cap transformation from thematic images
builtup	N/A	Buildings, parking lots, or other anthropogenic structures
dist_builtup	N/A	Distance to nearest building, parking lot, or other anthropogenic structure
golf	N/A	Golf course greens, tees, and fairways
dens_roads	N/A	Density of roads (km/km^2)
dens_trails	N/A	Density of trails (km/km^2)
dens_tchwy	N/A	Density of Trans-Canada Highway (km/km^2)
dist_trails	N/A	Distance to nearest trail
slope_perc	N/A	Slope (percent) calculated for each pixel using a DEM
slope2	N/A	Squared value of slope (percent) calculated for each pixel using a DEM
elev	N/A	Elevation in meters calculated using a DEM
elev2	N/A	Squared value of elevation in meters calculated using a DEM
TRI	N/A	Terrain ruggedness index was obtained from the DEM using the TRI.aml script in ArcGIS
cti	N/A	Compound topographic index calculated using ArcGIS
south_slope	N/A	South facing (157.5° – 202.5°) calculated from DEM
elevnonveg	N/A	Interaction multiplying elev x nonveg

Note: _150, _300, or _600 were applied to each classification variable where a moving window was used to calculate a proportion or density.
n/a = not applicable; % = percentage; m = metres; ° = degrees; EOSD = Earth Observation for Sustainable Development of Forest.

In addition to data on vegetation cover and human use, GIS layers depicting terrain features also were obtained. Elevation, slope, and a terrain ruggedness index (TRI) were calculated using a Digital Elevation Model (DEM). The TRI was obtained from the DEM using the TRI.aml script in ArcGIS, which conforms to the approach described by Riley et al. (1999). Each pixel in the GIS also was assigned a binary value identifying it as south facing (157.5° – 202.5°) or not, again using the DEM. Greeness was calculated using a tasseled cap transformation from thematic imagery (Franklin et al. 2001).

Although snow might be an important determinant of wildlife habitat suitability during winter, snow depth can vary dramatically both spatially and temporally during winter and these fine-scale data were unavailable. However, south-facing slopes and elevation may account for some of the variation in snow depth.

Animals can select for landscape features at different spatial scales (i.e., moving window sizes; Gaucherel et al. 2010). Proportions of each EOSD habitat classification, linear classification, habitat classifications stamped into the EOSD, or classifications derived from these were calculated within three moving windows classes: 150 m, 300 m, and 600 m to test for responses at different spatial scales. Similarly, 300 m and 600 m moving windows were used to calculate density of linear features (km/km^2). Larger moving windows will tend to smooth RSF probability surfaces because adjacent cells necessarily have similar properties.

For species where location data were obtained primarily or exclusively using GPS collars (e.g., grizzly bears, elk, and cougars), the scale of moving window used in model development was selected based on the best performing univariate model, or was assigned based on biological expectation. For VHF collared wolves, on the other hand, only the 600 m diameter size was used in RSF model development because of location bias associated with VHF telemetry (see next section for additional information). Surfaces depicting the shortest straight-line distance from a pixel to the nearest built-up habitat or to roads or trails also were calculated and evaluated as potential drivers of wildlife habitat selection.

Because wildlife telemetry data were obtained over long periods of time (i.e., 1988-2009, depending on species), accounting for landscape changes caused by human development during that period and intersecting telemetry data with appropriate spatial layers was important. Wildlife location data were integrated with land cover layers depicting development prior to and after 2004, depending on the date associated with the telemetry location. Data were unavailable to make finer temporal divisions.

The pre-2004 snapshot was associated with data primarily obtained from 2001 and the post-2004 snapshot was associated with data primarily obtained from 2008. Not all data sources regarding disturbance and other landscape change were available at yearly intervals, which was the reason for describing the snapshots as pre-2004 and post-2004. The original EOSD data are from 2001. The pre-2004 and post-2004 land cover data align well with most of the data from each species (Table B-2).

Table B-2: Intersection Between Land Cover Data and Telemetry Data

Land cover year	Data Intersected During RSF Development
Pre-2004 (most data from 2001)	▪ Grizzly bear GPS data (2000-2004) ▪ Wolf VHF data (1988-2003) ▪ Cougar GPS data (2000-2004) ▪ Elk VHF data (2000-2003)
Post 2004 (most data from 2008)	▪ Elk GPS data (2009) ▪ Grizzly bear GPS data (2008)

RSF = Resource Selection Function; GPS = Global Positioning System; VHF = Very High Frequency

This approach accounted least well for wolves, for which some telemetry data were collected in the late 1980s and early 1990s. Because most wolf locations occur west of Canmore where new development over the last two decades has been less pronounced, the introduced bias was expected to be minimal. All RSF surfaces used to predict probability of selection for the purpose of preparing environmental impact statements were estimated by applying models estimated from appropriate temporal information to more up-to-date development and land cover surfaces (e.g., 2016 for existing conditions and predicted cases with the Project and with all future projects for the Project case and cumulative effects assessments, respectively).

2.1.3.4 Wildlife Telemetry Collar Bias

Wildlife location data collected using VHF telemetry is often associated with uncertainty regarding the precise location of an animal because of triangulation error (White and Garrott 1990, Gilsdorf et al. 2008). Data on wolf habitat use were exclusively obtained using VHF telemetry and were subject to this form of error. To account for location uncertainty, wolf points were intersected only with GIS layers calculated using a moving window 600 m in diameter. Although some elk data also were derived using VHF collars, the vast majority (>95%) were generated using GPS telemetry, and a similar restriction to the 600 m moving window size for elk RSF development was deemed unnecessary.

Another bias associated with VHF telemetry locations is that these data are generally collected during daylight hours and so do not represent habitat selection throughout the diel cycle. The only species this form of bias substantially affects is wolves, but considering this potential bias is important because wolves have demonstrated a tendency to reduce avoidance of anthropogenic features at night (Hebblewhite and Merrill 2008). Consequently, any avoidance of anthropogenic features by wolves might be over-emphasised using daytime VHF telemetry.

Location data obtained using GPS collars are generally much more accurate than those obtained from VHF telemetry and precision after the United States government stopped scrambling GPS signals in 2000 has increased dramatically. Moreover, GPS collars collect data throughout the diel cycle, avoiding temporal bias. GPS telemetry is not perfect, however, and bias can be introduced where vegetation or terrain interfere with fix acquisition, causing fix locations to occur less frequently in some habitats than others. This bias has important implications for habitat models, including RSFs, because it can cause selection coefficients to be underestimated in habitats where the probability of successfully obtaining a fix is lower (D’Eon et al. 2002, Frair et al. 2004). For GPS collars with high fix success, this form of bias is not a concern (Frair et al. 2004, Hebblewhite et al. 2007). However, for collars with low fix success such as the Televilt Simplex collars used on grizzly bears and cougars in this study (see Chetkiewicz and Boyce 2009 for additional detail on collar performance), correction for habitat bias is necessary (Hebblewhite et al. 2007). Correction was accomplished by using the inverse of the probability of fix as a sample weight for used locations in the logistic regression model applied to estimate grizzly bear and cougar RSFs (available locations all received a sample weight of 1; Frair et al. 2004). To identify the probability of obtaining a fix where each cougar or grizzly bear location was recorded, a P_{FIX} layer developed by Hebblewhite et al. (2007) for Televilt Simplex collars in the region around the Bow Corridor was applied to the landscape at the pixel level in the GIS and intersected with cougar and grizzly bear GPS data.

2.1.4 Model Selection

A critical step towards developing effective RSF models is to identify variables that might drive habitat selection for a particular species. Well-informed model construction is an integral part of using information theory for model selection (Burnham and Anderson 2002). Identifying appropriate habitat drivers for a species improves predictive capacity, serving to reduce the incidence of spurious relationships in models (Anderson et al. 2001). Spurious relationships are those which are biologically irrelevant and arise due to chance; their inclusion in habitat models can impede conservation when land-management decisions are made based on false wildlife-habitat relationships.

A review of the scientific literature was performed to identify variables that should be tested as possible drivers of selection for grizzly bears, cougars, wolves and elk (Golder 2012 pg. 25-33). Particular attention was paid to reviewing the literature regarding the influence of slope, elevation and human development on habitat use by each indicator species because steep slopes, high elevation and areas with substantial development are all features that have been prominently identified as potential barriers to wildlife movement in the Bow Valley. Variable identification and the structure of candidate models was based on this review.

In some cases, studies may contradict each other in terms of the strength or direction of a particular wildlife-habitat relationship. Where this occurs, it highlights the complexity and scale-, site- and season-specific nature of wildlife-habitat relationships (Nielsen et al. 2004, Boyce 2006, Ciarniello et al. 2007*a*, 2007*b*), and does not preclude incorporating such variables into candidate models. Such variables were therefore incorporated into the candidate set to evaluate their strength and direction for animals inhabiting the Bow Valley.

Candidate models were developed for grizzly bears (Table B-3) in summer, and elk (Table B-4), wolves (Table B-5), and cougars (Table B-6) during winter. Candidate models incorporated different combinations of variables thought to drive the habitat-selection patterns of the particular species for which the model was developed. Each model represents a hypothesis about the drivers of habitat selection for each species in the Bow Valley.

Because shallow slopes, substantial hiding cover (e.g., forest), and low anthropogenic development have been proposed as important characteristics of functional corridors in the Bow Valley (BCEAG 1999), a model including this combination of variables was considered in the candidate set for each species. To avoid multicollinearity, variables correlated at $|r| > 0.7$ were not used in the same model (Tabachnick and Fidell 2001, Chetkiewicz and Boyce 2009, Webb et al. 2008). Importantly, slope and elevation were always highly and positively correlated ($r > 0.7$) in the Bow Valley. These two variables were therefore always considered in separate candidate models.

Each candidate model was fit using logistic regression and ranked using the small sample size correction for Akaike's Information Criterion (AIC_c; Akaike 1973, Burnham and Anderson 2002). Model selection criterion from the AIC family were used because of their comparative advantage when ranking models that describe complex systems, such as ecosystems (Hurvich and Tsai 1989). The small sample corrected form of AIC (AIC_c) converges on AIC as sample size becomes large. Consequently, it provides an improved model selection criterion for small sample sizes and is comparable to AIC for larger sample sizes, indicating that AIC_c can be universally applied for model selection regardless of sample size.

Table B-3: Candidate Models Tested for Grizzly Bears

Model	Variables
1	greenness elev tri builtup_150 elevnonveg_600 south_slope_600 dens_trails_600 forest_edge_600 herb_600 golf_150 shrub_600 dist_builtup montane
2	greenness elev builtup_150 elevnonveg_600 south_slope_600 dens_trails_600 forest_edge_600 herb_600 golf_150 shrub_600 dist_builtup montane
3	slope_perc slope2 greenness builtup_300 elevnonveg_600 south_slope_600 dens_trails_600 forest_edge_600 herb_600 golf_150 shrub_600 dens_roads_600 dist_builtup
4	greenness elev elev2 builtup_300 dens_trails_600 forest_edge_600 herb_600 golf_150 shrub_600 dens_roads_600 dist_builtup
5	builtup_150 forest_edge_300 dens_trails_300 dens_roads_600 dist_builtup south_slope_600 elev elev2 shrub_150 conif_dens_600 nonveg_300 herb_600 golf_600
6	greenness cti elev elev2 builtup_600 nonveg_600 south_slope_600 dens_trails_600 herb_600 shrub_600
7	elev elev2 builtup_600 nonveg_600 south_slope_600 dens_trails_600 forest_edge_600 herb_600 golf_600 shrub_600
8	slope_perc slope2 builtup_600 nonveg_600 south_slope_600 dens_trails_600 forest_edge_600 herb_600 golf_600 shrub_600
9	conif_dens_300 conif_open_150 golf_600 herb_300 nonveg_150 shrub_150 forest_edge_300 greenness
10	elev elev2 greenness forest_edge_300 south_slope_600 elevnonveg_150
11	slope_perc nonveg_600 conif_open_600 builtup_600 conif_dens_600 dens_trails_600 dens_tchwy_600 dens_roads_600
12	conif_dens_300 herb_600 nonveg_300 shrub_150 wet_shrub_300 forest_edge_300
13	elev elev2 greenness forest_edge_300 south_slope_600
14	conif_dens_300 herb_600 nonveg_300 shrub_150 forest_edge_300
15	elev elev2 greenness forest_edge_300
16	herb_600 nonveg_300 shrub_150 forest_edge_300 montane subalpine
17	herb_600 nonveg_300 shrub_150 forest_edge_300
18	cti greenness dens_roads_300 conif_dens_600 herb_150 shrub_300 nonveg_150 elev
19	dens_roads_600 dens_rail_600 dens_tchwy_600 dens_trails_300 dist_trails builtup_600 golf_300
20	dens_tchwy_600 dens_trails_300 dist_trails builtup_600 golf_300

Note:Variables are defined Table B-1.

Table B-4: Candidate Models Tested for Wolves

Model	Variables
1	elev elev2 builtup_600 nonveg_600 south_slope_600 dens_trails_600 forest_edge_600 herb_600 golf_600 shrub_600
2	elev elev2 builtup_600 south_slope_600 dens_trails_600 forest_edge_600 herb_600 shrub_600
3	slope_perc slope2 builtup_600 nonveg_600 south_slope_600 dens_trails_600 forest_edge_600 elev herb_600 golf_600 shrub_600
4	builtup_600 nonveg_600 south_slope_600 dens_trails_600 forest_edge_600 elev herb_600 golf_600 shrub_600
5	builtup_600 nonveg_600 south_slope_600 dens_trails_600 forest_edge_600 elev
6	elev elev2
7	nonveg_600 south_slope_600 forest_edge_600 elev herb_600 golf_600 shrub_600
8	builtup_600 conif_dens_600 golf_600 herb_600 nonveg_600 south_slope_600 dens_tchwy_600 dens_roads_600 dens_trails_600 forest_edge_600 slope_perc
9	builtup_600 nonveg_600 south_slope_600 dens_tchwy_600 dens_trails_600 forest_edge_600 slope_perc
10	slope_perc nonveg_600 conif_open_600 builtup_600 conif_dens_600 dens_trails_600 dens_tchwy_600 dens_roads_600
11	builtup_600 south_slope_600 slope_perc
12	builtup_600 nonveg_600 south_slope_600 dens_tchwy_600 dens_trails_600 forest_edge_600
13	nonveg_600 dens_tchwy_600 dens_trails_600 forest_edge_600 slope_perc
14	elev
15	conif_dens_600 conif_open_600 herb_600 shrub_600 nonveg_600 wet_shrub_600 forest_edge_600
16	conif_open_600 herb_600 shrub_600 nonveg_600 forest_edge_600
17	slope_perc slope2
18	slope_perc
19	herb_600 nonveg_600 forest_edge_600
20	builtup_600 golf_600 dens_roads_600 dens_trails_600 dens_tchwy_600 dens_rail_600
21	builtup_600 dens_roads_600 dens_tchwy_600
22	builtup_600 dens_tchwy_600

Note:Variables are defined Table B-1.

Table B-5: Candidate Models Tested for Elk

Model	Variables
1	conif_dens_600 shrub_600 forest_edge_600 golf_600 herb_150 elev elev2 dist_builtup south_slope_600
2	conif_dens_600 shrub_600 forest_edge_600 golf_600 herb_150 elev dist_builtup south_slope_600
3	golf_600 herb_150 elev dist_builtup south_slope_600
4	conif_dens_600 shrub_600 forest_edge_600 golf_600 herb_150 elev elev2 dist_builtup
5	conif_dens_600 shrub_600 forest_edge_600 golf_600 herb_150 elev dist_builtup
6	shrub_600 forest_edge_600 golf_600 herb_150 elev elev2 dist_builtup
7	slope_perc nonveg_600 conif_open_600 builtup_600 conif_dens_600 dens_trails_600 dens_tchwy_600 dens_roads_600
8	conif_dens_600 shrub_600 forest_edge_600 herb_150 elev elev2 south_slope_600
9	herb_150 elev elev2 south_slope_600
10	builtup_600 golf_600 dens_roads_600 dens_trails_600 dens_tchwy_600 dens_rail_600
11	elev elev2
12	elev
13	slope_perc slope2
14	builtup_150 golf_600 dist_builtup
15	slope_perc
16	builtup_600 dens_roads_600 dens_tchwy_600
17	conif_dens_600 conif_open_600 herb_150 shrub_600 nonveg_600 wet_shrub_300 forest_edge_600
18	builtup_600 dens_tchwy_600
19	conif_open_600 herb_150 shrub_600 nonveg_600 forest_edge_600
20	herb_150 nonveg_600 forest_edge_600

Note:Variables are defined Table B-1.

Table B-6: Candidate Models Tested for Cougars

Model	Variables
1	builtup_150 forest_edge_300 dens_trails_300 dens_roads_600 dist_builtup south_slope_600 elev elev2 shrub_150 conif_dens_600 nonveg_300 herb_600 golf_600
2	builtup_150 forest_edge_300 dens_trails_300 dens_roads_600 dist_builtup south_slope_600 elev elev2 nonveg_300 herb_600 golf_600
3	builtup_150 forest_edge_300 dens_trails_300 dens_roads_600 dist_builtup south_slope_600 slope_perc slope2 shrub_150 conif_dens_600 nonveg_300 herb_600 golf_600
4	builtup_150 conif_dens_300 conif_open_600 golf_600 herb_600 shrub_150 wet_shrub_300 elev elev2 south_slope_600 dens_trails_300 dens_tchwy_600 forest_edge_300
5	builtup_150 conif_dens_300 golf_600 herb_600 nonveg_150 shrub_150 wet_shrub_300 elev elev2 south_slope_600 dens_trails_300 forest_edge_300
6	builtup_150 forest_edge_300 dens_trails_300 south_slope_600 elev elev2 shrub_150 conif_dens_600 nonveg_300 herb_600 golf_600
7	forest_edge_300 dens_trails_300 south_slope_600 elev elev2 shrub_150 nonveg_300 herb_600
8	builtup_150 nonveg_300 elev elev2 south_slope_600
9	elev elev2 south_slope_600
10	elev elev2
11	conif_dens_300 herb_600 nonveg_300 shrub_150 wet_shrub_300 forest_edge_300
12	conif_dens_300 herb_600 nonveg_300 shrub_150 forest_edge_300
13	elev
14	herb_600 nonveg_300 shrub_150 forest_edge_300
15	slope_perc nonveg_150 conif_open_300 conif_dens_300 builtup_150 dens_roads_600 dens_tchwy_600 dens_trails_600
16	slope_perc slope2
17	slope_perc
18	builtup_150 golf_600 dens_tchwy_600 dens_trails_600

Note:Variables are defined Table B-1.

2.1.5 Model Validation

2.1.5.1 K-Fold Validation

Prior to application, models were evaluated for predictive reliability in a process referred to as model validation (Marcot et al. 1983). Validation was conducted on the best RSF model (identified from the candidate set using AICc) for each indicator species to evaluate model reliability. When employing a used-available sampling scheme, as in this study, traditional logistic regression diagnostic approaches such as Receiver Operating Characteristics (ROC) curves or goodness-of-fit tests are inappropriate (Boyce et al. 2002, Johnson et al. 2006). Therefore, a cross-validation approach using *k*-fold partitioning (as recommended by Boyce et al. 2002) was applied to RSF models for each indicator species. This approach iteratively withholds a partition of the used data (the number of partitions = *k*), parameterizes the model using the remaining data, and predicts probability of selection for the withheld data (Fielding and Bell 1997, Boyce et al. 2002, Johnson et al. 2006). All models developed in this study were evaluated using *k* = 5. A good model is one where the withheld used locations fall more often in habitat patches that are predicted to be high suitability by a model parameterized with the remaining data.

To assess model fit, the RSF probability surface for each species was predicted at the appropriate availability extent (Figures B-2 to B-5) and binned into 5 equal-area RSF score categories for each of the 5 validation sets. The average number of withheld locations in each bin (across all 5 validations) was then correlated with bin rank using a Spearman Rank Correlation (Boyce et al. 2002) and observed number of locations in each bin were compared to expected values derived from a utilization function (Johnson et al. 2006) to quantify predictive ability. Models that predict well will have a high positive Spearman Rank Correlation score (R_s; Boyce et al. 2002), and, when used locations are compared with expected, a model that is proportional to the probability of use will exhibit a regression slope "different from 0, but not different from 1, and intercept of 0, and a high R^2 value with nonsignificant χ^2 goodness-of-fit value" (Johnson et al. 2006 pp. 352).

Model categories for each species should be interpreted as follows:

- **Selected** – observed proportion of independent telemetry locations were greater than the proportion that would be expected if habitats were used as available.
- **Used as available** – observed proportion of independent telemetry locations were at or near the proportion that would be expected if habitats were used as available.
- **Somewhat avoided** – observed proportion of independent telemetry locations were below the proportion that would be expected if habitats were used as available.
- **Strongly avoided** – observed proportion of independent telemetry locations were much less than the proportion that would be expected if habitats were used as available.
- **Rarely Used** – observed proportion of independent telemetry locations are near zero.

2.1.5.2 Validation for Selection during Movement

The RSFs developed for this assessment used all locations, regardless of behavioural state (e.g., resting versus moving). Using the inverse of the probability of selection derived from these RSFs to define resistance to movement will not always provide an accurate reflection of wildlife movement (Abrahms et al. 2016). To examine the ability of the RSFs developed for this assessment to reflect selection during movement, the relationship between RSF values and steps between consecutive telemetry locations was analyzed. This relationship may take one of three forms, as follows:

1) Probability of selection derived from the full suite of animal behavior (i.e., all point data) is positively correlated with movement steps – this relationship indicates that the RSF can be used to understand both movement and habitat selection (e.g., Chetkiewicz et al. 2006; Chetkiewicz and Boyce 2009; Fattebert et al. 2015).

2) Probability of selection derived from the full suite of animal behavior (i.e., all point data) is independent of the location of movement steps such that movement steps occur equally in all RSF classes – this relationship represents an RSF that would serve as a poor movement model.

3) Probability of selection derived from the full suite of animal behavior (i.e., all point data) is negatively correlated with movement steps – this form has been reported in the literature and indicates that the RSF provides a very poor reflection of movement potential, where selection patterns during movement are the opposite of selection patterns during other behavioral states (e.g., Abrahms et al. 2016).

GPS telemetry data used to examine these relationships are available for grizzly bears, cougars and elk. Wolf VHF telemetry data are not suitable for this kind of analysis[1]. Therefore, this analysis was conducted for grizzly bears, cougars and elk.

Straight line movement steps of ≥500 m, ≥1,000 m and ≥5,000 m between consecutive elk, cougar and grizzly bear GPS collar relocation points were intersected with the RSF output for each species for the period when the GPS data were collected. The linear distance of each RSF category passed through by each step was obtained. The RSF outputs were categorized and interpreted according to the 5 classes (i.e., selected, used as available, somewhat avoided, strongly avoided, rarely used).

2.2 Results

2.2.1 Grizzly Bears

The most parsimonious model for predicting relative probability of grizzly bear selection in the Bow Valley during summer contained variables for terrain features, anthropogenic landscape features, and vegetation (Table B-7). Grizzly bears selected locations with high greenness, higher elevations, areas with high trail density, forest edge, herbaceous vegetation, and montane vegetation communities (Table B-8). Grizzly bears avoided rugged terrain, developed areas, non-vegetated areas at high elevation, south slopes, golf courses, and habitats dominated by shrubs (Table B-8).

Slope was tested as a candidate variable but was not included in the most parsimonious model. Although grizzly bears tended to avoid areas consisting of the steepest slopes (e.g., mountain tops) telemetry data indicate that bears used areas with slopes up to 34.5˚ during summer. The BCEAG guidelines model which included slope, hiding cover, and anthropogenic development variables ranked 11th of 20 candidate models (w_i = 0.00).

Although alpine meadows provided highly selected habitat, especially at the head of Wind Valley, most of the best grizzly bear habitat during summer was in the valley bottom, a result also reported by Chetkiewicz and Boyce (2009). Presumably, grizzly bear selection for greenness and a preference for habitats closer to trails reflect selection for the food resources with which these variables were correlated (e.g., Roever et al. 2008). In the case of trails, edge habitats may contain higher volumes of bear foods like *Shepherdia*, which may be attractive enough to override negative zone of influence from people using the trail networks in places where trail density is high (e.g., the Canmore Nordic Centre Provincial Park).

Model validation indicated that the most parsimonious summer grizzly bear RSF provided an extremely good fit to the data and exhibited excellent predictive capacity (Rs = 1, R2 = 0.99, Slope = 0.94, Intercept = 0.01, P(χ2) >0.1; Figure B-6).

The poorest habitats for grizzly bears in the Bow Valley during summer consisted primarily of exposed rock at high elevation. Strong avoidance of golf courses by grizzly bears may be related to ongoing aversive conditioning programs implemented by the Province in the Bow Valley, and not necessarily because golf courses represent inherently poor habitat for bears. Grizzly bears that entered areas of high human use, such as golf courses, were hazed using rubber bullets, bangers and aggressive dogs. Aversive conditioning of collared bears such as those used for RSF development was perhaps more consistently applied than aversive conditioning of other bears because collared animals were easily monitored (Honeyman 2008). Of the bears monitored by the Province and used in model development, two received no aversive conditioning and two received extensive aversive conditioning (J. Jorgensen, ESRD, personal communication). The fifth bear used for model development was collared in Banff National Park, and it was unclear whether it was subjected to aversive conditioning (J. Jorgensen ESRD, personal communication).

[1] Wolf and elk VHF data are also not suitable for developing other kinds of movement models because of the long time interval between points (commonly days).

Table B-7: Top-ranked Logistic Regression Models for Relative Probability of Grizzly Bear Habitat Use in the Bow Valley During Winter

Rank	Variables [a]	LL	K	AIC_c	ΔAIC_c	w_i
1	greenness elev tri builtup_150 elevnonveg_600 south_slope_600 dens_trails_600 forest_edge_600 herb_600 golf_150 shrub_600 dist_builtup montane	-3,051	13	6,127	0.0	1.0
2	greenness elev builtup_150 elevnonveg_600 south_slope_600 dens_trails_600 forest_edge_600 herb_600 golf_150 shrub_600 dist_builtup montane	-3,121	12	6,267	139.9	0.0
3	slope_perc slope2 greenness builtup_300 elevnonveg_600 south_slope_600 dens_trails_600 forest_edge_600 herb_600 golf_150 shrub_600 dens_roads_600 dist_builtup	-3,129	13	6,283	156.1	0.0
4	greenness elev elev2 builtup_300 dens_trails_600 forest_edge_600 herb_600 golf_150 shrub_600 dens_roads_600 dist_builtup	-3,137	11	6,296	168.6	0.0
5	builtup_150 forest_edge_300 dens_trails_300 dens_roads_600 dist_builtup south_slope_600 elev elev2 shrub_150 conif_dens_600 nonveg_300 herb_600 golf_600	-3,207	12	6,437	310.0	0.0

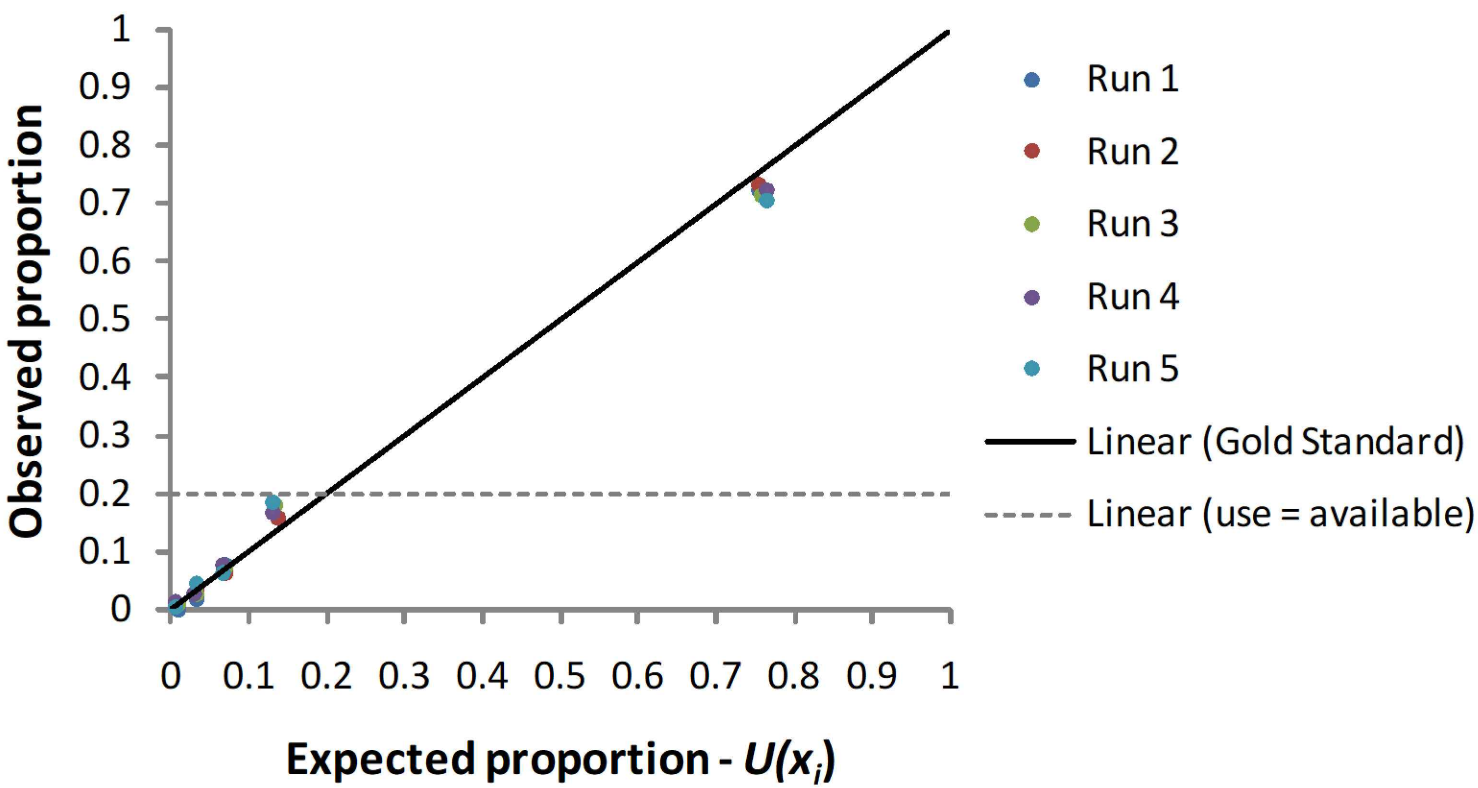
a) Numbers following variable names indicate the moving window size used.

Note: Models are shown in order of decreasing rank. Log-likelihood (LL), number of estimated parameters (*K*), small sample size corrected Akaike's Information Criterion (AIC_c), AIC difference (ΔAIC_c), and AIC weight (w_i) are displayed for each of the top 5 models considered in the candidate set. Variables are defined in Table B-1.

Table B-8: Coefficients for the Highest Ranked Logistic Regression Model used to Predict Relative Probability of Grizzly Bear Habitat Use in the Bow Valley During Summer

Variable	Coefficient
Greenness	0.0598720
elev	0.0029652
TRI	-0.0312045
builtup_150	-0.9917101
elev*nonveg_600	-0.0006170
south_slope_600	-0.6676020
dens_trails_600	0.2813665
forest_edge_600	2.5757000
herb_600	1.9769270
golf_150	-6.5657650
shrub_600	-1.8038040
dist_builtup	0.0000848
montane	0.8545787

Note: Variables are defined Table B-1.



CLIENT QUANTUMPLACE DEVELOPMENTS LTD.	PROJECT THREE SISTERS MOUNTAIN VILLAGE ASP ENVIRONMENTAL IMPACT ASSESSMENT

CONSULTANT		
GOLDER	YYYY-MM-DD	2020-05-19
	DESIGNED	MG
	PREPARED	AM
	REVIEWED	KK
	APPROVED	SM

TITLE
GRIZZLY BEAR K-FOLD CROSS-VALIDATION

PROJECT NO.	CONTROL	REV.	FIGURE
18109757	2000-HM-0001	0	6

2.2.2 Wolves

The most parsimonious model for predicting relative probability of wolf selection in the Bow Valley during winter contained variables for terrain features, anthropogenic landscape features, and vegetation (Table B-9). Wolves exhibited a non-linear (quadratic) response to elevation (i.e., a squared term was included in the model). This indicates that wolves generally avoided valley bottoms and selected intermediate elevations, especially on south facing slopes (Table B-10). Wolves avoided non-vegetated habitats, built up areas, areas with high trail density, and golf courses (Table B-10). In addition to a strong preference for south facing slopes, wolves selected for forest edge, herbaceous vegetation, and areas with more shrubs (Table B-10). Models including slope as a covariate explained less of the overall variation in habitat use than did models including elevation. Although wolves tended to remain in valley bottoms where slopes are gentle, telemetry data indicate that wolves used areas with slopes up to 32.5˚. These results are generally consistent with previous findings regarding wolf habitat selection in the Alberta Rockies (Alexander 2001, Duke 2001, Callaghan 2002, Paquet and Carbyn 2003, Whittington et al. 2005). A primary difference is that a non-linear relationship with elevation was tested during model selection and that it proved important (i.e., it was retained in the top model). The BCEAG guidelines model which included slope, hiding cover, and anthropogenic development variables ranked 10th of 22 candidate models (w_i = 0.00).

The poorest quality habitat for wolves in the Bow Valley during winter consisted primarily of exposed rock at high elevation, while the best habitat included south facing slopes at moderate elevations; these were especially prominent on the north side of the Bow Valley (e.g., the benches north of Canmore and west of the town of Banff). Model validation indicated that the top wolf RSF generated in this analysis provided an extremely good fit to the data and exhibited excellent predictive capacity (R_s = 1, R^2 = 0.95, Slope = 0.97, Intercept = 0.01, $P(\chi^2)$ >0.1; Figure B-7).

Table B-9: Top-ranked Logistic Regression Models for Relative Probability of Wolf Habitat use in the Bow Valley During Winter

Rank	Variables (a)	LL	K	AIC_c	ΔAIC_c	w_i
1	elev elev2 builtup_600 nonveg_600 south_slope_600 dens_trails_600 forest_ edge_600 herb_600 golf_600 shrub_600	-1433	10	2886	0.0	0.7
2	elev elev2 builtup_600 south_slope_600 dens_trails_600 forest_edge_600 herb _600 shrub_600	-1436	8	2888	1.8	0.3
3	slope slope2 builtup_600 nonveg_600 south_slope_600 dens_trails_600 forest_ edge_600 elev herb_600 golf_600 shrub_600	-1506	10	3033	147.1	0.0
4	builtup_600 nonveg_600 south_slope_600 dens_trails_600 forest_edge_ 600 elev herb_600 golf_600 shrub_600	-1518	9	3053	167.2	0.0
5	builtup_600 nonveg_600 south_slope_600 dens_trails_600 forest_edge_ 600 elev	-1543	6	3098	211.5	0.0

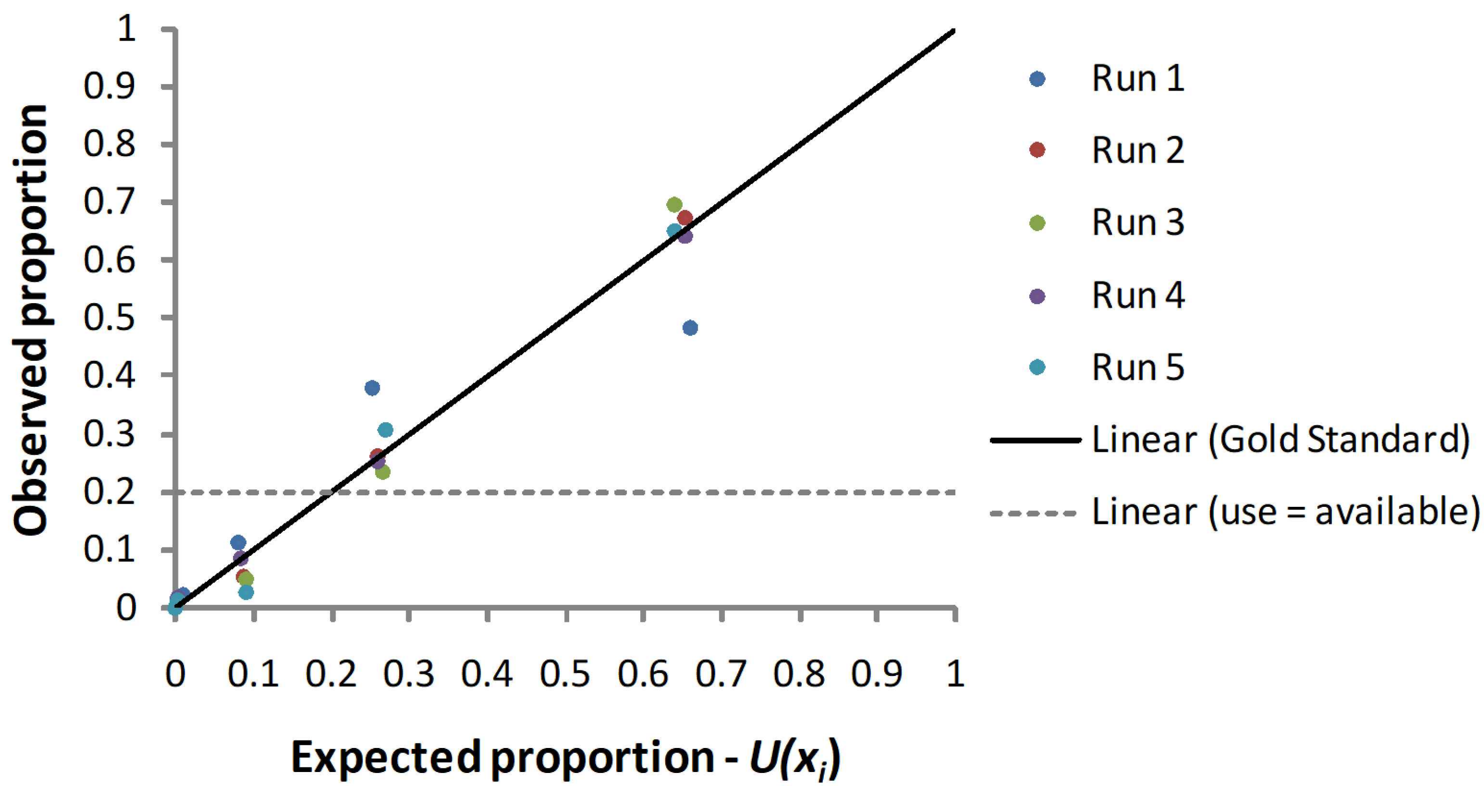
a) Numbers following variable names indicate the moving window size used.

Note: Models are shown in order of decreasing rank. Log-likelihood (LL), number of estimated parameters (*K*), small sample size corrected Akaike's Information Criterion (AIC_c), AIC difference (ΔAIC_c), and AIC weight (w_i) are displayed for each of the top 5 models considered in the candidate set. Variables are defined in Table B-1.

Table B-10: Coefficients for the Highest Ranked Logistic Regression Model used to Predict Relative Probability of Wolf Habitat Use in the Bow Valley During Winter

Variable	Coefficient
elev	0.088387
elev2	-0.000030
builtup_600	-7.021987
nonveg_600	-0.146696
south_slope_600	1.538460
dens_trails_600	-0.200368
forest_edge_600	0.670858
herb_600	1.033150
golf_600	-4.090004
shrub_600	1.32248

Note: Variables are defined in Table B-1.



CLIENT	PROJECT
QUANTUMPLACE DEVELOPMENTS LTD.	THREE SISTERS MOUNTAIN VILLAGE ASP ENVIRONMENTAL IMPACT ASSESSMENT

CONSULTANT		
GOLDER	YYYY-MM-DD	2020-05-19
	DESIGNED	MG
	PREPARED	AM
	REVIEWED	KK
	APPROVED	SM

TITLE
WOLF K-FOLD CROSS-VALIDATION

PROJECT NO.	CONTROL	REV.	FIGURE
18109757	2000-HM-0002	0	7

2.2.3 Elk

The most parsimonious model for predicting relative probability of elk selection in the Bow Valley during winter contained variables for terrain features, anthropogenic landscape features, and vegetation (Table B-11). Like wolves, elk exhibited a non-linear (quadratic) response to elevation. In addition to a preference for built-up areas (i.e., elk in the Bow Valley near Canmore prefer to be closer to human developments), elk selected for forest edge, herbaceous vegetation, and golf courses (Table B-12). Surprisingly, elk avoided south facing slopes, but this appears to be a function of the extensive use of built up areas in the Town of Canmore, especially on the south side of town (i.e., north aspect). Elk also avoided dense conifer and shrub habitats. These results, particularly selection for built-up areas and golf courses, are consistent with previous studies of elk habitat use near the town of Banff and may be a function of built-up areas providing protection from predation in addition to good quality forage (McKenzie 2001, Kloppers et al. 2005).

Models including slope as a covariate explained less of the overall variation in habitat use than did models including elevation. Although elk tended to remain in the valley bottoms during winter, telemetry data indicate that elk used areas with slopes up to 34.5˚. The BCEAG guidelines model which included slope, hiding cover, and anthropogenic development variables ranked 7th of 20 candidate models (w_i = 0.00).

The poorest quality habitat for elk in the Bow Valley during winter included snow covered mountaintops consisting of broken rock and little vegetative cover. The best habitat for elk was found on the valley floor, especially around developed areas and golf courses, the same places avoided by wolves and cougars, which are important predators of elk. Model validation indicated that the top elk RSF generated in this analysis provided an extremely good fit to the data and exhibited excellent predictive capacity (R_s = 1, R^2 = 0.99, Slope = 0.94, Intercept = 0.01, $P(\chi^2)$ >0.1; Figure B-8).

Table B-11: Top-ranked Logistic Regression Models for Relative Probability of Elk Habitat Use in the Bow Valley During Winter

Rank	Variables (a)	LL	K	AIC_c	ΔAIC_c	w_i
1	conif_dens_600 shrub_600 forest_edge_600 golf_600 herb_150 elev elev2 dist_builtup south_slope_600	-2895	9	5808	0.0	1.0
2	conif_dens_600 shrub_600 forest_edge_600 golf_600 herb_150 elev dist_builtup south_slope_600	-2915	8	5845	37.7	0.0
3	golf_600 herb_150 elev dist_builtup south_slope_600	-2964	5	5937	129.7	0.0
4	conif_dens_600 shrub_600 forest_edge_600 golf_600 herb_150 elev elev2 dist_builtup	-2991	8	5998	190.3	0.0
5	conif_dens_600 shrub_600 forest_edge_600 golf_600 herb_150 elev dist_builtup	-2998	7	6010	202.8	0.0

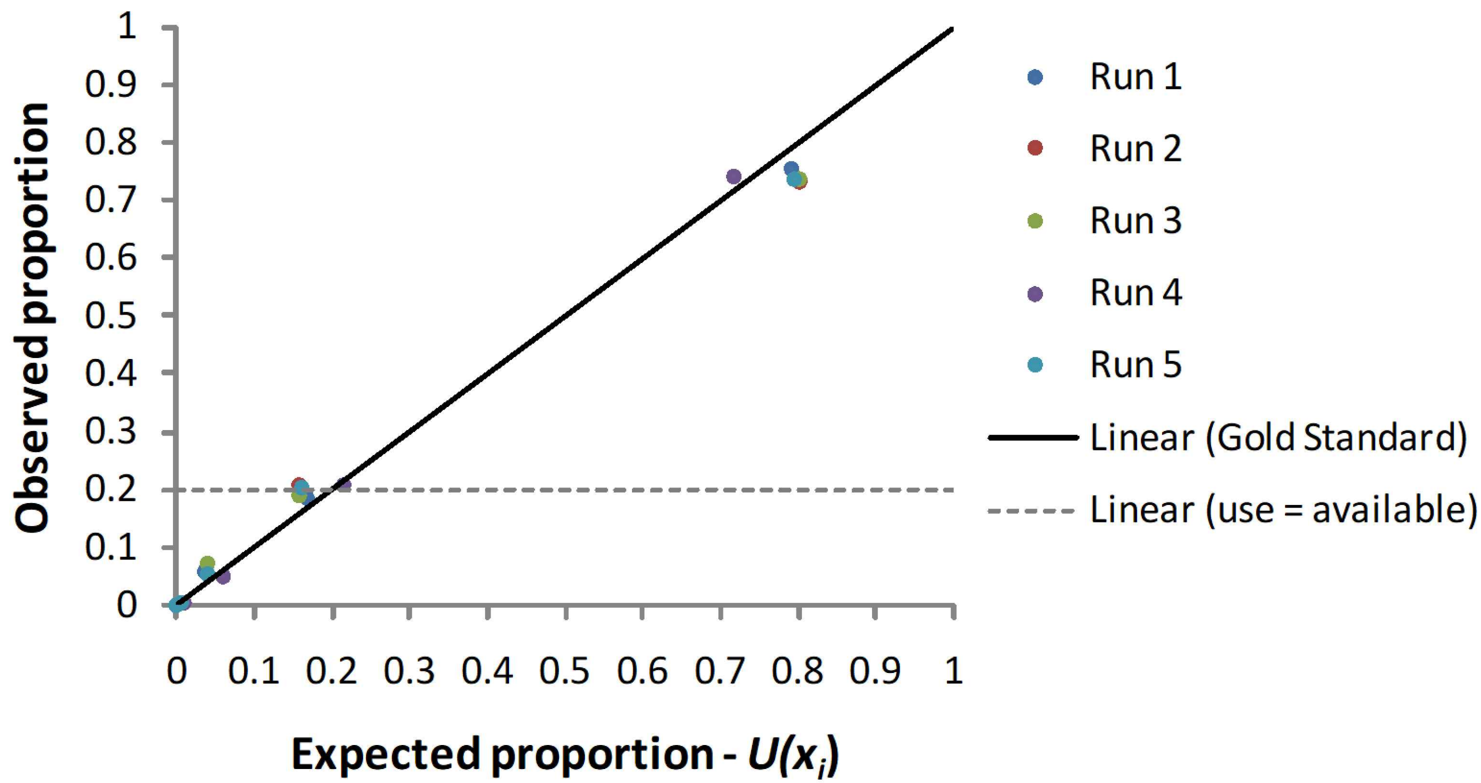
(a) Numbers following variable names indicate the moving window size used.

Note: Models are shown in order of decreasing rank. Log-likelihood (LL), number of estimated parameters (K), small sample size corrected Akaike's Information Criterion (AIC_c), AIC difference (ΔAIC_c), and AIC weight (w_i) are displayed for each of the top 5 models considered in the candidate set. Variables are defined Table B-1.

Table B-12: Coefficients for the Highest Ranked Logistic Regression Model used to Predict Relative Probability of Elk Habitat use in the Bow Valley during Winter

Variable	Coefficient
conif_dense_600	-1.176067
shrub_600	-2.687693
forest_edge_600	1.73134
golf_600	4.113394
herb_150	1.041379
elev	0.0550596
elev2	-0.0000215
dist_builtup	-0.0008968
south_slope_600	-4.455782

Note: Variables are defined in Table B-1.



CLIENT
QUANTUMPLACE DEVELOPMENTS LTD.

PROJECT
THREE SISTERS MOUNTAIN VILLAGE ASP ENVIRONMENTAL IMPACT ASSESSMENT

CONSULTANT
GOLDER

YYYY-MM-DD	2020-05-19
DESIGNED	MG
PREPARED	AM
REVIEWED	KK
APPROVED	SM

TITLE
ELK K-FOLD CROSS-VALIDATION

PROJECT NO.	CONTROL	REV.	FIGURE
18109757	2000-HM-0003	0	8

2.2.4 Cougars

The most parsimonious model for predicting relative probability of cougar selection in the Bow Valley during winter contained variables for terrain features, anthropogenic landscape features, and vegetation (Table B-13). As with wolves and elk, cougars exhibited a non-linear (quadratic) response to elevation during winter. Like wolves, cougars showed a particular affinity for intermediate elevation south facing slopes. Cougars avoided non-vegetated habitats, built up areas, areas with high trail density, areas with high road density, and golf courses (Table B-14).

Presumably because prey species (e.g., elk) selected built-up areas, cougars preferred to be closer to these areas, even though the coefficient for built-up areas was negative. This indicates that, all else being equal, cougars are more likely to use the areas around urban developments but are less likely to enter them. Cougars also selected forest edge, herbaceous vegetation, dense conifer forest, and areas with more shrubs (Table B-14).

Models including slope as a covariate explained less of the overall variation in habitat use than did models including elevation. Like wolves and elk, cougars during winter tended to avoid higher elevations that correlated with steep slopes. However, telemetry data indicate that cougar used areas with slopes up to 32˚. The BCEAG guidelines model which included slope, hiding cover, and anthropogenic development variables ranked 15th of 18 candidate models (w_i = 0.00).

The Bow Valley contains habitat with a relatively high probability of selection by cougars within a regional context, especially during winter (Chetkiewicz and Boyce 2009). The habitat with the lowest probability of selection by cougars in the Bow Valley during winter consisted of rocky peaks at high elevation, intensely developed areas (i.e., the core of the town of Canmore), and golf courses. Preferred cougar habitat extended to higher elevations than for either wolves or elk. Like wolves, the best winter habitats for cougars were found on the south-facing benches on the north side of the Bow Valley, likely because snow depth is lower and more prey are available in these habitats during winter.

Residential developments outside of Canmore's core did not necessarily cause probability of cougar selection to decline to low levels. In fact, RSF scores indicated that some smaller residential developments surrounded by forest (e.g., developments on Lawrence Grassi Ridge and Wilson Way on the south side of Canmore) consisted of habitat with moderate to high probability of selection by cougars. Model validation indicated that the top cougar RSF generated in this analysis provided an extremely good fit to the data and exhibited excellent predictive capacity (R_s = 1, R^2 = 0.99, Slope = 1, Intercept = 0, $P(\chi^2)$ >0.1; Figure B-9.

Table B-13: Top-ranked Logistic Regression Models for Relative Probability of Cougar Habitat Use in the Bow Valley During Winter

Rank	Variables [a]	LL	K	AIC_c	ΔAIC_c	w_i
1	builtup_150 forest_edge_300 dens_trails_300 dens_roads_600 dist_builtup south_slope_600 elev elev2 shrub_150 conif_dens_600 nonveg_300 herb_600 golf_ 600	-1902	13	3830	0.0	1.0
2	builtup_150 forest_edge_300 dens_trails_300 dens_roads_600 dist_builtup south_slope_600 elev elev2 nonveg_300 herb_600 golf_600	-1908	11	3839	9.2	0.0
3	builtup_150 forest_edge_300 dens_trails_300 dens_roads_600 dist_builtup south_slope_600 slope_perc slope2 shrub_150 conif_dens_600 nonveg_300 herb_600 golf_ 600	-1928	13	3882	52.0	0.0
4	builtup_150 conif_dens_300 conif_open_600 golf_600 herb_ 600 shrub_150 wet_shrub_300 elev elev2 south_slope_600 dens_trails_300 dens_tchwy_600 fores t_edge_300	-2015	13	4056	226.2	0.0
5	builtup_150 conif_dens_300 golf_600 herb_600 nonveg_150 shrub_150 wet_shrub_300 elev elev2 south_slope_600 dens_trails_300 forest_edge_300	-2026	12	4077	247.3	0.0

[a] Numbers following variable names indicate the moving window size used.

Note: Models are shown in order of decreasing rank. Log-likelihood (LL), number of estimated parameters (*K*), small sample size corrected Akaike's Information Criterion (AIC_c), AIC difference (ΔAIC_c), and AIC weight (w_i) are displayed for each of the top 5 models considered in the candidate set. Variables are defined in Table B-1.

Table B-14: Coefficients for the Highest Ranked Logistic Regression Model used to Predict Relative Probability of Cougar Habitat Use in the Bow Valley During Winter

Variable	Coefficient
builtup_150	-1.281421
forest_edge_300	0.2907269
dens_trails_300	-0.1273898
dens_roads_600	-0.1737865
dist_builtup	-0.0006896
south_slope_600	1.394376
elev	0.0077137
elev2	-2.90E-06
shrub_150	0.8890654
conif_dense_600	0.9852458
nonveg_300	-0.3634998
herb_600	4.427354
golf_600	-12.5119

Note:Variables are defined Table B-1.

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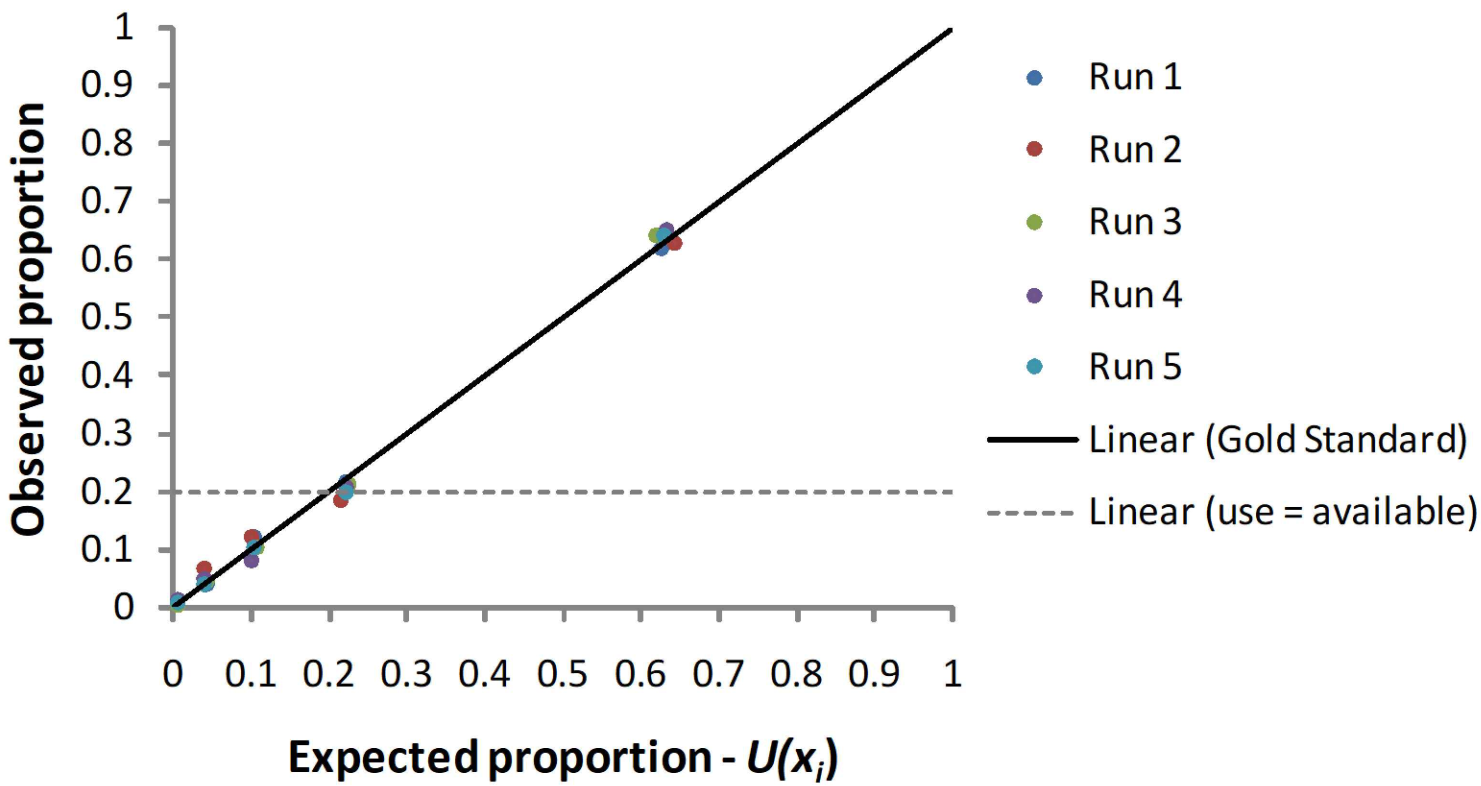

CLIENT QUANTUMPLACE DEVELOPMENTS LTD.	PROJECT THREE SISTERS MOUNTAIN VILLAGE ASP ENVIRONMENTAL IMPACT ASSESSMENT

CONSULTANT: GOLDER

YYYY-MM-DD	2020-05-19
DESIGNED	MG
PREPARED	AM
REVIEWED	KK
APPROVED	SM

TITLE
COUGAR K-FOLD CROSS-VALIDATION

PROJECT NO.	CONTROL	REV.	FIGURE
18109757	2000-HM-0004	0	9

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25 mm

2.3 Human Use of Recreational Trails

One factor that could both reduce access of animals to high quality habitats and increase landscape resistance for movement is human use on trails. Trail density was considered during model selection and appeared in the top RSF models for grizzly bears (positively associated with trail density), cougars (negatively associated with trail density), and wolves (negatively associated with trail density). Trails were not retained in the top model for elk.

Human use of recreational trails in the Bow Valley has increased substantially since the RSFs were estimated, and is predicted to increase further as a result of the Project and other reasonably foreseeable developments and activities in the RSA. Animals may respond differently to trails with more or less human use, and human use may therefore influence probability of selection (Ladle et al. 2016). Because data about the intensity of human use on trails were not available concurrent with the telemetry data collected for the grizzly bears, cougars, wolves and elk in the Bow Valley, intensity of use could not be included as a candidate variable in the RSF models.

During initial consultation about the Resort Centre ASP amendment EIS, the Town and their consultants recommended undertaking spatially explicit analyses to investigate the potential ramifications of changes in human use of recreational trails for wildlife. Because data were not available to parameterize the zone of influence or strength of the response of wildlife to increased human use of trails in the Bow Valley, spatially explicit scenarios were created using assumptions about potential derived from and inferences from available data about how animals respond to human disturbance in the Bow Valley.

Assumptions about the zone of influence of human use of trails relied on information about flight initiation distance (FID). In their review of Golder (2013), MSES (2013) identified the concept of flight initiation distance (FID), which is a metric that informs the distance within which wildlife may respond by moving away. This concept was applied by MSES to an evaluation of changes in effective corridor width using the simplified assumption that people will remain within the developed area and not in the corridor. However, human use is currently not restricted to developed areas, and commonly occurs within wildlife corridors under existing conditions. Trails were therefore used as the origin for the FID, and the total zone of influence was obtained by applying the FID to either side of the trail.

The FID used to define the zone of influence and the disturbance coefficient applied to each model for grizzly bears, wolves, and cougars under existing and future scenarios are presented in Table B-15. Disturbance coefficients associated with trails were not applied to elk because increased human use of trails was not anticipated to change the probability of selection by elk in wildlife corridors. Elk in the Bow Valley are habituated to people, spend much of their time near and within development (Appendix B), and need to be aggressively chased to achieve displacement (Kloppers et al. 2005).

Different disturbance coefficients were applied under existing and future scenarios (Table B-15) to represent changes in intensity of human use (i.e., potential doubling). Disturbance coefficients were applied within the zone of influence identified from the literature. Disturbance coefficients most likely decline with distance away from the disturbance, but evidence to describe the shape of this relationship to was not identified for grizzly bears, wolves, and cougars. Consequently, a precautionary assumption that the coefficient applied evenly to the entire zone of influence was used.

Table B-15: Grizzly Bear, Wolf, and Cougar Flight Initiation Distance and Disturbance Coefficient for Designated and Undesignated Trails

Species	Flight Initiation Distance (m)	Disturbance Coefficient			
		Existing Conditions		Future Conditions	
		Designated Trails	Undesignated Trails	Designated Trails	Undesignated Trails
Grizzly bear	100	0.85	0.9	0.8	0.85
Wolf	400	0.6	0.75	0.4	0.65
Cougar	50	0.8	0.85	0.75	0.8

Although FID can be estimated directly from the literature, the disturbance coefficient is an interpretation or “best guess” based on an understanding of how the RSF for each species works and on the evidence for stronger or weaker responses by different species. Evidence and rationale used to select the FID and disturbance coefficient information presented in Table B-15 is described in the following sections. Because the application of fencing and signage is expected to reduce human use on undesignated trails in wildlife corridors adjacent to the Resort Centre ASP amendment boundary and Smith Creek ASP boundary (EIS for the 2017 Resort Centre ASP Amendment, Section 5.6.1), the undesignated trail disturbance coefficient was not applied to undesignated trails in these corridors for future conditions (i.e., residual effects assessment and cumulative effects assessment).

Grizzly bears

Grizzly bears in the Bow Valley avoid high density development (e.g., downtown Canmore), but select areas near lower density urban developments with adjacent natural habitats (e.g., near Peaks of Grassi or Silvertip). The RSF model showed that grizzly bears in the Bow Valley tend to select areas with high trail density and areas close to forest edges (Section 2.2.1). This is likely due to grizzly bear selection for the high quality forage that is often available in early successional habitat, such as the edges of trails (e.g., Roever et al. 2008). The attraction of the available forage in edge habitat is sufficient to override the negative zone of influence that arises from people using the trail networks in places where trail density and human use is high (e.g., the Canmore Nordic Centre Provincial Park). However, to be precautionary, a zone of influence was applied to represent human presence as aversive stimulus.

A review of the literature undertaken by Fortin et al. (2016) found that brown bears fled at distances from 100 m to 400 m when directly approached by hikers, but bears that were not approached directly tolerated distances <100 m. Grizzly bears in the Bow Valley are selecting areas where human use is high, and in general people will not be directly approaching grizzly bears; therefore, a FID of <100 m may be appropriate. However, to be precautionary, a FID of 100 m was selected (Table B-15). Disturbance coefficients applied for grizzly bears were relatively weak because grizzly bears in the Bow Valley do not exhibit strong responses to high levels of human use.

Wolves

Habitat suitability modelling shows that wolves avoid anthropogenic developments and trails in the Bow Valley (Section 2.2.2). This avoidance appears to be influenced by the intensity of human use. For example, Rogala et al. (2011) found that trails with high human use were more strongly avoided by wolves than roads in the National Parks. In some cases, wolves may be able to adapt to human disturbance, and as a general rule, wolves will be more active near people when humans occupy habitats that are attractive to wolves (Paquet and Carbyn 2003; Hebblewhite and Merrill 2008). Flexibility in wolf habitat selection may permit wolves to access areas with greater human development than is sometimes considered possible (Mech 2006). In Banff and Yoho National Parks, wolves frequently used anthropogenic linear features at night when human activity is low, presumably to take advantage of an easy travel route (Callaghan 2002). Wolves may regularly exploit linear features to facilitate travel and hunting efficiency where human use of such features is low (James and Stuart-Smith 2000). Nevertheless, where human use is extremely high, wolves will stop using otherwise suitable habitat. In the Bow Valley, wolves changed their habitat use patterns when human activity in an area exceeded 100 people/month and stopped using areas entirely when human visitation exceeded 10,000 people/month, regardless of habitat suitability (Paquet and Carbyn 2003).

Little research has been done on FIDs for wolves. However, in Scandinavia, Karlsson et al. (2007) found that wolves moved away when humans approached between 17 and 310 m away, and at an average distance of 106 m over 34 encounters. To be precautionary given the paucity of available information and the known sensitivity of wolves to human activity, a FID of 400 m was assigned (Table B-15). Higher disturbance coefficients were also applied for wolves than were applied for either grizzly bears or cougars because wolves responded more strongly to trails than either of the other species (Section 2.1.4).

Cougars

Cougars are tolerant of human activity, adaptable to anthropogenic landscape change (Knopff et al. 2014) and are commonly found in habitat patches and movement corridors in the Bow Valley, including near developed areas (Golder 2013). Presumably because prey species (e.g., elk) select built-up areas, RSF modelling showed that cougars are likely to use the areas around urban developments but are less likely to enter them because of the associated risk (Section 2.2.4).

Cougars do not always move away from people and can have short flight initiation distances in developed landscapes. In one study in New Mexico, cougars moved away from researchers 66% of the time when approached within 2 to 50 m but remained where they were (25%) or exhibited an aggressive response (9%) on other occasions (Sweanor et al. 2005). Therefore, a FID of 50 m was selected for cougars and disturbance coefficients were weaker than for wolves (Table B-15).

2.4 Resource Selection Functions and Movement

The telemetry data used to generate the RSF models presented here include multiple behavioral states. The telemetry locations could represent movement, foraging, resting, and all other behaviors exhibited by each collared animal. The models deliberately consider the breadth of behavioral states exhibited by grizzly bears, cougars, wolves, and elk in the Bow Valley, acknowledging that corridors, areas proposed for development, and habitat patches in the Bow Valley may all be used for occasional by animals traveling to other destinations, for short inter-patch movement for resident animals, and as important habitat that contributes to population viability. Using probability of selection for all behavioral states combined provides a better understanding of where animals are most likely to occur on the landscape, permitting an improved understanding of potential habitat loss as a result of development and providing the foundation for interpreting the potential for negative human-wildlife conflict (i.e., identifying places where human use is high and wildlife also have a high probability of selection).

The inverse of the RSF output can be used to define a resistance layer for movement analyses (Chetkiewicz and Boyce 2009). However, as concluded by Abrahms et al. (2016 pg. 9): "*resource selection within an animal's home range may be a suitable proxy for movement preference during dispersal for some species (Fattebert et al. 2015), though researchers and conservation practitioners should be aware this is not always the case and failure to recognize this distinction may have important consequences for preserving landscape connectivity*." To evaluate the potential interpretation of the RSF as a resistance layer, the relationship between RSF values and steps between consecutive telemetry locations was analyzed. This relationship may take one of three forms, as follows:

1) Probability of selection derived from the full suite of animal behavior (i.e., all point data) is positively correlated with movement steps. This relationship indicates that the RSF can be used to understand both movement and habitat selection (e.g., Chetkiewicz et al. 2006; Chetkiewicz and Boyce 2009; Fattebert et al. 2015).
2) Probability of selection derived from the full suite of animal behavior (i.e., all point data) is independent of the location of movement steps such that movement steps occur equally in all RSF classes. This relationship represents an RSF that would serve as a poor movement model.
3) Probability of selection derived from the full suite of animal behavior (i.e., all point data) is negatively correlated with movement steps. This relationship has been reported in the literature and indicates that the RSF provides a very poor reflection of movement potential, where selection patterns during movement are the opposite of selection patterns during other behavioral sates (e.g., Abrahms et al. 2016).

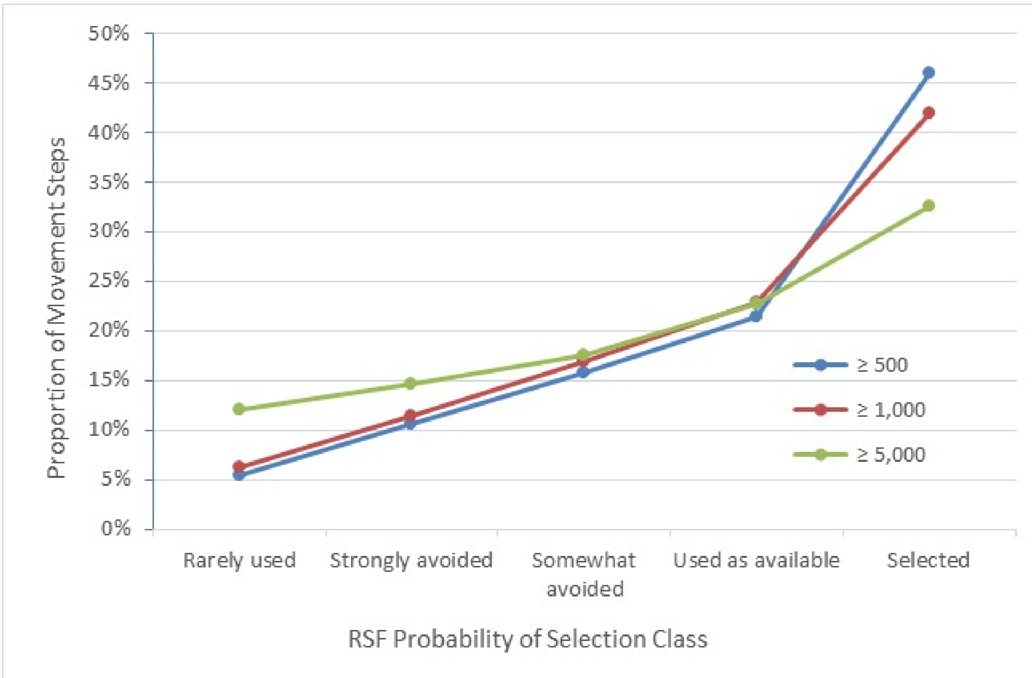
GPS telemetry data used to examine these relationships are available for elk, grizzly bears, and cougars. Wolf VHF telemetry data are not suitable for this kind of analysis[2].

Straight line movement steps of ≥500 m, ≥1,000 m and ≥5,000 m between consecutive cougar, grizzly bear, and elk GPS collar relocation points were intersected with the RSF output for each species for the period when the GPS data were collected. The RSF outputs were categorized and interpreted according to the 5 classes used in the RSF model (i.e., selected, used as available, somewhat avoided, strongly avoided, rarely used). The linear distance of each RSF category passed through by each step was obtained.

In the case of grizzly bears, a strong positive relationship was identified between probability of selection class and the proportion of grizzly bear steps overlapping with each class (Figure B-10). This relationship indicates that the RSF is a good reflection of grizzly bear movement and that the selected class is especially important for movement (i.e., resistance is very low relative to other classes). Although the relationship flattens somewhat at steps ≥5,000 m, it remains consistently positive (Figure B-10).

[2] Wolf and elk VHF data are also not suitable for developing other kinds of movement models because of the long time interval between points (commonly days).

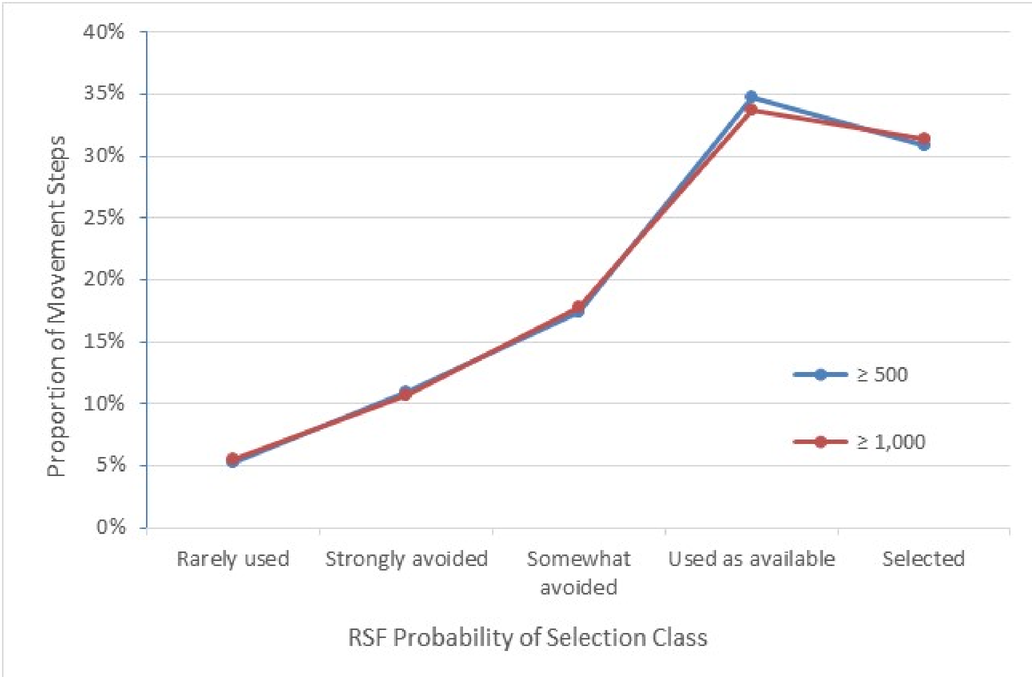
Figure B-10: Interaction Between Grizzly Bear Movement Steps and Probability of Selection Class from the Grizzly Bear RSF



Analysis of the available cougar GPS telemetry collar data also shows that there is a positive relationship between habitat selected during all behavioural states and habitat selected during movement. The relationship between proportion of movement paths ≥500 m, ≥1,000 m that intersect habitat classes with an increasing relative probability of cougar habitat selection is generally positive. However, this relationship breaks down in the top two habitat classes (i.e., used as available and selected; Figure B-11). Both habitat classes are important for movement, but cannot be interpreted precisely in the manner predicted in the RSF. Instead, both used as available and selected habitats should be interpreted as maintaining equally low resistance for cougar movements. Unlike grizzly bears, patterns of movement behavior did not change with cougar step length. No steps of ≥5,000 m were recorded for cougars.

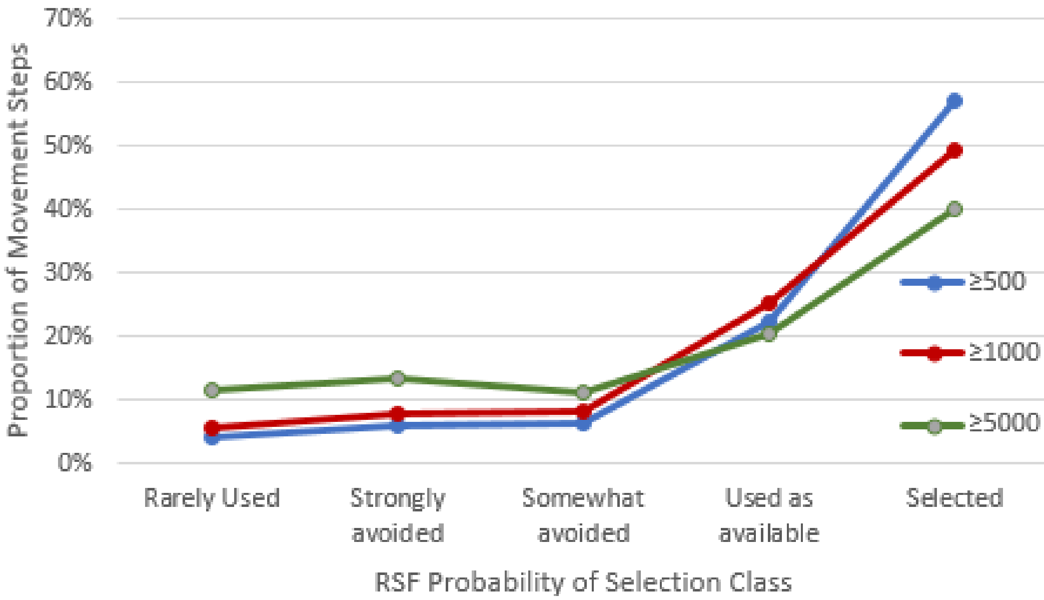
The analysis presented here for cougars and grizzly bears provides strong support for a conclusion that increasing probability of selection can also be interpreted as reducing resistance and increasing the likelihood of movement through a given area on the landscape, although the top 2 habitat classes cannot be distinguished in the case of cougars. The RSF modelling conducted for the EIS can therefore be used to demonstrate potential effects from the Project to wildlife movement through wildlife corridors. This analysis addresses recommendations made by the Town and their consultants that existing telemetry data be used to assess confidence in model predictions to reduce uncertainty.

Figure B-11: Interaction Between Cougar Movement Steps and Probability of Selection Class from the Cougar RSF



In the case of elk, the relationship between probability of selection class and the proportion of elk steps overlapping with each class was generally positive (Figure B-12), but discrimination between avoided and rarely used categories was weak. These three categories can be considered equal in terms of their ability to support elk movement and these categories are increasingly incorporated into straight line steps as the distance of movement steps increases (Figure B-12). This relationship indicates that the RSF is a good overall reflection of elk movement and that the selected class is especially important for movement (i.e., resistance is very low relative to other classes). Just as with grizzly bears, although the relationship flattens somewhat at steps ≥5,000 m, the overall trend remains consistently positive (Figure B-12).

Figure B-12: Interaction Between Elk Movement Steps and Probability of Selection Class from the Elk RSF



Signature Page

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KK/al

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APPENDIX C

Wildlife Species List

Table C-1 Mammal Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[(a)]	Federal Status Under the Species at Risk Act (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[(b)]
Carnivores			
American Marten	*Martes americana*	Secure	Not listed
American Mink	*Mustela vison*	Secure	Not listed
Black bear	*Ursus americanus*	Secure	COSEWIC: Not at Risk
Canada lynx	*Lynx canadensis*	**Sensitive**	COSEWIC: Not at Risk
Cougar	*Puma concolor*	Secure	Not listed
Coyote	*Canis latrans*	Secure	Not listed
Fisher	*Martes pennanti*	**Sensitive**	Not listed
Grey Wolf	*Canis lupus*	Secure	COSEWIC: Not at Risk
Grizzly bear	*Ursus americanus*	**At Risk**	**COSEWIC: Special Concern**
Least Weasel	*Mustela nivalis*	Secure	Not listed
Long-tailed Weasel	*Mustela frenata*	**May Be At Risk**	COSEWIC: Not at Risk
Northern River Otter	*Lutra canadensis*	Secure	Not listed
Red fox	*Vulpes vulpes*	Secure	Not listed
Short-tailed Weasel	*Mustela erminea*	Secure	Not listed
Striped Skunk	*Mephitis mephitis*	Secure	Not listed
Wolverine	*Gulo gulo*	**May Be At Risk**	**COSEWIC: Special Concern; SARA: Schedule 1 Special Concern**
Ungulates			
Bighorn sheep	*Ovis canadensis*	Secure	Not listed
Elk	*Cervus elaphus*	Secure	Not listed
Moose	*Alces alces*	Secure	Not listed
Mountain goat	*Oreamnos americanus*	Secure	Not listed
Mule deer	*Odocoileus hemionus*	Secure	Not listed
White-tailed deer	*Odocoileus virginianus*	Secure	Not listed
Bats			
Big brown bat	*Eptesicus fuscus*	Secure	Not listed
Hoary bat	*Lasiurus cinereus*	**Sensitive**	Not listed
Little brown Myotis	*Myotis lucifugus*	**May Be At Risk**	**COSEWIC: Endangered; SARA: Schedule 1 Endangered**
Long-legged Myotis	*Myotis volans*	Undetermined	Not listed
Northern long-eared Myotis	*Myotis septentrionalis*	**May Be At Risk**	**COSEWIC: Endangered; SARA: Schedule 1 Endangered**
Silver-haired bat	*Lasionycteris noctivagans*	**Sensitive**	Not listed
Western long-eared Myotis	*Myotis evotis*	Secure	Not listed

Table C-1 Mammal Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[a]	Federal Status Under the Species at Risk Act (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[b]
Hares and Rodents			
American beaver	*Castor canadensis*	Secure	Not listed
American pika	*Ochotona princeps*	Secure	Not listed
Bushy-tailed Woodrat	*Neotoma cinerea*	Secure	Not listed
Columbian ground squirrel	*Spermophilus columbianus*	Secure	Not listed
Common muskrat	*Ondatra zibethicus*	Secure	Not listed
Common porcupine	*Erethizon dorsatum*	Secure	Not listed
Deer mouse	*Peromyscus maniculatus*	Secure	Not listed
Dusky shrew	*Sorex monticolus*	Secure	Not listed
Golden-mantled ground-squirrel	*Spermophilus lateralis*	Secure	Not listed
Heather vole	*Phenacomys intermedius*	Secure	Not listed
Hoary marmot	*Marmota caligata*	Secure	Not listed
House mouse	*Mus musculus*	Exotic	Not listed
Least chipmunk	*Eutamias minimus*	Secure	Not listed
Long-tailed vole	*Microtus longicaudus*	Secure	Not listed
Northern bog lemming	*Synaptomys borealis*	Secure	Not listed
Northern flying squirrel	*Glaucomys sabrinus*	Secure	Not listed
Northern water shrew	*Sorex palustris*	Secure	Not listed
Masked shrew	*Sorex cinereus*	Secure	Not listed
Meadow vole	*Microtus pennsylvanicus*	Secure	Not listed
Muskrat	*Ondatra zibethicus*	Secure	Not listed
Pygmy shrew	*Sorex hoyi*	Secure	Not listed
Red squirrel	*Tamiasciurus hudsonicus*	Secure	Not listed
Richardson’s ground squirrel	*Spermophilus richardsonii*	Secure	Not listed
Snowshoe hare	*Lepus americanus*	Secure	Not listed
Southern red-backed vole	*Myodes gapperi*	Secure	Not listed
Wandering shrew /vagrant shrew	*Sorex vagrans*	**May Be At Risk**	Not listed
Water vole	*Microtus richardsoni*	**Sensitive**	Not listed
Western jumping mouse	*Zapus princeps*	Secure	Not listed
Yellow pine chipmunk	*Neotamias minimus*	Secure	Not listed

a) AEP 2018
b) Government of Canada 2019

Table C-2 Bird Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[a]	Federal Status Under the Species at Risk Act and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[b]	Seasonal Distribution
Ducks, Geese and Swans				
American wigeon	*Anas americana*	Secure	Not Listed	Uncommon breeder, spring and fall migrant
Barrow's goldeneye	*Bucephala islandica*	Secure	Not Listed	Common breeder
Blue-winged teal	*Anas discors*	Secure	Not Listed	Uncommon breeder
Bufflehead	*Bucephala albeola*	Secure	Not Listed	Common breeder
Canada goose	*Branta canadensis*	Secure	Not Listed	Common breeder
Common goldeneye	*Bucephala clangula*	Secure	Not Listed	Common breeder
Common merganser	*Mergus merganser*	Secure	Not Listed	Common breeder
Harlequin duck	*Histrionicus histrionicus*	**Sensitive**	**COSEWIC: Special Concern; SARA: Schedule 1 Special Concern**	Uncommon breeder
Hooded merganser	*Lophodytes cucullatus*	Secure	Not Listed	Uncommon breeder
Lesser scaup	*Aythya affinis*	**Sensitive**	Not Listed	Uncommon breeder, spring and fall migrant
Mallard	*Anas platyrhynchos*	Secure	Not Listed	Common breeder
Northern shoveler	*Anas clypeata*	Secure	Not Listed	Uncommon breeder, spring and fall migrant
Redhead	*Aythya americana*	Secure	Not Listed	Uncommon breeder, spring and fall migrant
Ring-necked duck	*Aythya collaris*	Secure	Not Listed	Uncommon breeder, spring and fall migrant
Ruddy duck	*Oxyura jamaicensis*	Secure	Not Listed	Uncommon breeder, spring and fall migrant
Trumpeter swan	*Cygnus buccinator*	**Sensitive**	COSEWIC: Not At Risk	Uncommon breeder and spring and fall migrant
Tundra swan	*Cygnus columbianus*	Secure	COSEWIC: Not At Risk	spring and fall migrant
Grouse				
Ruffed grouse	*Bonasa umbellus*	Secure	Not Listed	Uncommon year round
Spruce grouse	*Falicpennis canadensis*	Secure	Not Listed	Uncommon year round
White-tailed ptarmigan	*Lagopus leucura*	Secure	Not Listed	Uncommon year round

Table C-2 Bird Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[a]	Federal Status Under the Species at Risk Act and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[b]	Seasonal Distribution
Loons and Grebes				
Common loon	*Gavia immer*	Secure	COSEWIC: Not At Risk	Common breeder
Horned grebe	*Podiceps auritus*	**Sensitive**	**COSEWIC: Special Concern; SARA: Schedule 1 Special Concern**	Uncommon breeder, spring and fall migrant
Pacific loon	*Gavia pacifica*	Secure	Not Listed	Uncommon migrant
Pied-billed grebe	*Podilymbus podiceps*	**Sensitive**	Not Listed	Uncommon breeder
Red-necked grebe	*Podiceps grisegena*	Secure	COSEWIC: Not At Risk	Uncommon breeder, spring and fall migrant
Western grebe	*Aechmophorus occidentalis*	**At Risk**	**COSEWIC: Special Concern; SARA: Schedule 1 Special Concern**	Uncommon breeder, spring and fall migrant
Herons				
Great blue heron	*Ardea herodias*	**Sensitive**	Not Listed	Common breeder
Hawks and Eagles				
Bald eagle	*Haliaeetus leucocephalus*	**Sensitive**	COSEWIC: Not At Risk	common breeder
Cooper's hawk	*Accipiter cooperii*	Secure	COSEWIC: Not At Risk	uncommon breeder
Golden eagle	*Aquila chrysaetos*	**Sensitive**	COSEWIC: Not At Risk	Uncommon year round, common spring and fall migrant
Northern goshawk	*Accipiter gentilis*	**Sensitive**	COSEWIC: Not At Risk	uncommon year round
Northern harrier	*Circus cyaneus*	Secure	COSEWIC: Not At Risk	Uncommon breeder
Osprey	*Pandion haliaetus*	**Sensitive**	Not Listed	common breeder
Red-tailed hawk	*Buteo jamaicensis*	Secure	COSEWIC: Not At Risk	common breeder
Rough-legged Hawk	*Buteo lagopus*	Secure	COSEWIC: Not At Risk	Spring and fall migrant
Sharp-shinned hawk	*Accipiter striatus*	Secure	COSEWIC: Not At Risk	Uncommon breeder
Swainson’s hawk	*Buteo swainsoni*	Secure	Not Listed	Uncommon breeder
Cranes, Rails and Coots				
American coot	*Fulica americana*	Secure	COSEWIC: Not At Risk	common breeder
Sandhill crane	*Grus canadensis*	**Sensitive**	Not Listed	uncommon breeder
Virginia rail	*Rallus limicola*	Undetermined	Not Listed	uncommon breeder

Table C-2 Bird Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[a]	Federal Status Under the Species at Risk Act and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[b]	Seasonal Distribution
Shorebirds				
Barid's sandpiper	*Calidris bairdii*	Secure	Not Listed	Spring and fall migrant
Greater yellowlegs	*tringa melanoleuca*	Secure	Not Listed	Spring and fall migrant
Killdeer	*Charadrius vociferus*	Secure	Not Listed	Common breeder
Lesser yellowlegs	*tringa flavipes*	Secure	Not Listed	Spring and fall migrant
Pectoral sandpiper	*Calidris melanotos*	Secure	Not Listed	Spring and fall migrant
Solitary sandpiper	*tringa solitaria*	Secure	Not Listed	Uncommon breeder
Spotted sandpiper	*Actitis macularia*	Secure	Not Listed	Common breeder
Wilson's snipe	*Gallinago delicata*	Secure	Not Listed	Common breeder
Dippers				
American dipper	*Cinclus mexicanus*	Secure	Not Listed	Common year-round
Gulls and Terns				
Black tern	*Chlidonias niger*	**Sensitive**	COSEWIC: Not at Risk	uncommon breeder, spring and fall migrant
Bonaparte's gull	*Chroicocephalus philadelphia*	Secure	Not Listed	spring and fall migrant
California gull	*Larus californicus*	Secure	Not Listed	spring and fall migrant
Herring gull	*Larus argentatus*	Secure	Not Listed	spring and fall migrant
Ring-billed gull	*Larus delawarensis*	Secure	Not Listed	uncommon breeder, spring and fall migrant
Doves and Pigeons				
Mourning dove	*Zenaida macroura*	Secure	Not Listed	uncommon breeder
Rock pigeon	*Columba livia*	Exotic	Not Listed	common year round
Owls				
Barred owl	*Strix varia*	**Sensitive**	Not Listed	uncommon year round
Boreal owl	*Aegolius funereus*	Secure	COSEWIC: Not At Risk	uncommon year round
Great gray owl	*Strix nebulosa*	**Sensitive**	COSEWIC: Not At Risk	uncommon year round
Great horned owl	*Bubo virginianus*	Secure	Not Listed	common year round
Long-eared owl	*Asio otus*	Secure	Not Listed	uncommon breeder
Northern hawk owl	*Surnia ulula*	Secure	COSEWIC: Not At Risk	uncommon year round
Northern pygmy-owl	*Glaucidium gnoma*	**Sensitive**	Not Listed	uncommon year round
Northern saw-whet owl	*Aegolius acadicus*	Secure	Not Listed	common breeder

Table C-2 Bird Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[(a)]	Federal Status Under the Species at Risk Act and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[(b)]	Seasonal Distribution
Nightjars				
Common nighthawk	*Chordeiles minor*	**Sensitive**	**COSEWIC: Special Concern; SARA: Schedule 1 Threatened**	**uncommon breeder**
Swifts				
Black swift	*Cypseloides niger*	Undetermined	**COSEWIC: Endangered**	**uncommon breeder**
Hummingbirds				
Calliope hummingbird	*Stellula calliope*	Secure	Not Listed	common breeder
Rufous hummingbird	*Selasphorus rufus*	Secure	Not Listed	common breeder
Kingfishers				
Belted kingfisher	*Megaceryle alcyon*	Secure	Not Listed	common breeder
Woodpeckers and Allies				
American three-toed woodpecker	*Picoides dorsalis*	Secure	Not Listed	common year round
Black-backed woodpecker	*Picoides arcticus*	**Sensitive**	Not Listed	uncommon year round
Downy woodpecker	*Picoides pubescens*	Secure	Not Listed	common year round
Hairy woodpecker	*Picoides villosus*	Secure	Not Listed	common year round
Northern flicker	*Colaptes auratus*	Secure	Not Listed	common breeder
Pileated woodpecker	*Dryocopus pileatus*	**Sensitive**	Not Listed	common year round
Red-naped sapsucker	*Sphyrapicus nuchalis*	Undetermined	Not Listed	common breeder
Falcons				
American kestrel	*Falco sparverius*	**Sensitive**	Not Listed	uncommon breeder
Merlin	*Falco columbaris*	Secure	COSEWIC: Not At Risk	uncommon year round
Peregrine falcon	*Falco peregrinus anatum*	**At Risk**	**COSEWIC: Special Concern; SARA: Schedule 1 Special Concern**	uncommon breeder, spring and fall migrant
Prairie falcon	*Falco mexicanus*	**Sensitive**	COSEWIC: Not At Risk	uncommon year round

Table C-2 Bird Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[a]	Federal Status Under the Species at Risk Act and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[b]	Seasonal Distribution
Flycatchers				
Alder flycatcher	*Empidonax alnorum*	**Sensitive**	Not Listed	common breeder
Dusky flycatcher	*Empidonax oberholseri*	Secure	Not Listed	common breeder
Eastern kingbird	*Tyrannus tyrannus*	**Sensitive**	Not Listed	common breeder
Eastern phoebe	*Sayornis phoebe*	**Sensitive**	Not Listed	uncommon breeder
Hammond's flycatcher	*Empidonax hammondii*	Secure	Not Listed	uncommon breeder
Least flycatcher	*Empidonax minimus*	**Sensitive**	Not Listed	common breeder
Olive-sided flycatcher	*Contopus cooperi*	**May Be At Risk**	**COSEWIC: Special Concern; SARA: Schedule 1 Threatened**	**uncommon breeder**
Pacific-slope flycatcher	*Empidonax difficilis*	Undetermined	Not Listed	uncommon breeder
Western wood-pewee	*Contopus sordidulus*	**May be at Risk**	Not Listed	common breeder
Willow flycatcher	*Empidonax traillii*	Secure	Not Listed	common breeder
Shrikes and Vireos				
Cassin's vireo	*Vireo cassinii*	Undetermined	Not Listed	common breeder
Northern shrike	*Lanius excubitor*	Secure	Not Listed	spring and fall migrant
Red-eyed vireo	*Vireo olivaceus*	Secure	Not Listed	common breeder
Warbling vireo	*Vireo gilvus*	Secure	Not Listed	common breeder
Jays and Crows				
American crow	*Corvus brachyrhynchos*	Secure	Not Listed	common breeder
Black-billed magpie	*Pica hudsonia*	Secure	Not Listed	common year round
Blue jay	*Cyanocitta cristata*	Secure	Not Listed	uncommon year round
Clark's nutcracker	*Nucifraga columbiana*	**Sensitive**	Not Listed	common year round
Common raven	*Corvus corax*	Secure	Not Listed	common year round
Gray jay	*Perisoreus canadensis*	Secure	Not Listed	common year round
Steller's jay	*Cyanocitta stelleri*	Secure	Not Listed	uncommon year round
Larks and pipits				
American pipit	*Anthus rubescens*	Secure	Not Listed	**common breeder**
Horned lark	*Eremophila alpestris*	Secure	Not Listed	**common breeder**

Table C-2 Bird Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[a]	Federal Status Under the Species at Risk Act and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[b]	Seasonal Distribution
Swallows				
Bank swallow	*Riparia riparia*	**Sensitive**	**COSEWIC: Threatened; SARA: Schedule 1 Threatened**	common breeder
Barn swallow	*Hirundo rustica*	**Sensitive**	**COSEWIC: Threatened; SARA: Schedule 1 Threatened**	common breeder
Cliff Swallow	*Petrochelidon pyrrhonota*	Secure	Not Listed	common breeder
Northern rough-winged swallow	*Stelgidopteryx serripennis*	Secure	Not Listed	common breeder
Tree swallow	*Tachycineta bicolor*	Secure	Not Listed	common breeder
Violet-green swallow	*Tachycineta thalassina*	Secure	Not Listed	common breeder
Chickadees, Nuthatches and Creepers				
Black-capped chickadee	*Poecile atricapillus*	Secure	Not Listed	common year round
Boreal chickadee	*Poecile hudsonicus*	Secure	Not Listed	common year round
Brown creeper	*Certhia americana*	**Sensitive**	Not Listed	common breeder
Mountain chickadee	*Poecile gambeli*	Secure	Not Listed	common year round
Red-breasted nuthatch	*Sitta canadensis*	Secure	Not Listed	common year round
White-breasted nuthatch	*Sitta carolinensis*	Secure	Not Listed	uncommon year round
Wrens and Kinglets				
Golden-crowned kinglet	*Regulus satrapa*	Secure	Not Listed	common breeder
House wren	*Troglodytes aedon*	Secure	Not Listed	common breeder
Marsh wren	*Cistothorus palustris*	Secure	Not Listed	uncommon breeder
Rock wren	*Salpinctes obsoletus*	Secure	Not Listed	uncommon breeder
Ruby-crowned kinglet	*Regulus calendula*	Secure	Not Listed	common breeder
Winter wren	*Troglodytes troglodytes*	Secure	Not Listed	common breeder

Table C-2 Bird Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[a]	Federal Status Under the Species at Risk Act and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[b]	Seasonal Distribution
Thrushes				
American robin	*Turdus migratorius*	Secure	Not Listed	common breeder
Hermit thrush	*Catharus guttatus*	Secure	Not Listed	common breeder
Mountain bluebird	*Sialia currucoides*	Secure	Not Listed	uncommon breeder
Swainson's thrush	*Catharus ustulatus*	Secure	Not Listed	common breeder
Townsend's solitaire	*Myadestes townsendi*	Secure	Not Listed	common breeder
Varied thrush	*Ixoreus naevius*	Secure	Not Listed	common breeder
Veery	*Catharus fuscescens*	Secure	Not Listed	uncommon breeder
Waxwings and Starling				
Bohemian waxwing	*Bombycilla garrulus*	Secure	Not Listed	uncommon breeder, spring and fall migrant
Cedar waxwing	*Bombycilla cedrorum*	Secure	Not Listed	common breeder
European starling	*Sturnus vulgaris*	Exotic	Not Listed	common breeder
Wood-warblers				
American redstart	*Setophaga ruticilla*	Secure	Not Listed	common breeder
Blackpoll warbler	*Dendroica striata*	Secure	Not Listed	uncommon breeder
Common yellowthroat	*Geothlypis trichas*	**Sensitive**	Not Listed	common breeder
Macgillivray's warbler	*Oporornis tolmiei*	Secure	Not Listed	common breeder
Nashville warbler	*Vermivora ruficapilla*	Secure	Not Listed	uncommon breeder
Northern waterthrush	*Seiurus noveboracensis*	Secure	Not Listed	common breeder
Orange-crowned warbler	*Vermivora celata*	Secure	Not Listed	common breeder
Ovenbird	*Seiurus aurocapilla*	Secure	Not Listed	common breeder
Tennessee warbler	*Oreothlypis peregrina*	Secure	Not Listed	common breeder
Townsend's warbler	*Dendroica townsendi*	Secure	Not Listed	common breeder
Wilson's warbler	*Wilsonia pusilla*	Secure	Not Listed	common breeder
Yellow warbler	*Dendroica petechia*	Secure	Not Listed	common breeder
Yellow-rumped warbler	*Dendroica coronata*	Secure	Not Listed	common breeder

Table C-2 Bird Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[a]	Federal Status Under the Species at Risk Act and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[b]	Seasonal Distribution
Towees, Sparrows, Juncos and Longspurs				
American tree sparrow	*Spizella arborea*	Secure	Not Listed	spring and fall migrant
Brewer's sparrow	*Spizella breweri*	**Sensitive**	Not Listed	common breeder
Chipping sparrow	*Spizella passerina*	Secure	Not Listed	common breeder
Clay-colored sparrow	*Spizella pallida*	Secure	Not Listed	common breeder
Dark-eyed junco	*Junco hyemalis*	Secure	Not Listed	common breeder
Fox sparrow	*Passerella iliaca*	Secure	Not Listed	common breeder
Golden-crowned sparrow	*Zonotrichia atricapilla*	Secure	Not Listed	common breeder
Lapland longspur	*Calcarius lapponicus*	Secure	Not Listed	spring and fall migrant
Lincoln's sparrow	*Melospiza lincolnii*	Secure	Not Listed	common breeder
Savannah sparrow	*Passerculus sandwichensis*	Secure	Not Listed	common breeder
Song sparrow	*Melospiza melodia*	Secure	Not Listed	common breeder
Vesper sparrow	*Pooecetes gramineus*	Secure	Not Listed	common breeder
White-crowned sparrow	*Zonotrichia leucophrys*	Secure	Not Listed	common breeder
White-throated sparrow	*Zonotrichia albicollis*	Secure	Not Listed	common breeder
Tanagers, Grosbeaks, Buntings				
Black-headed grosbeak	*Pheucticus melanocephalus*	Secure	Not Listed	uncommon breeder
Lazuli bunting	*Passerina amoena*	Secure	Not Listed	common breeder
Rose-breasted grosbeak	*Pheucticus ludovicianus*	Secure	Not Listed	spring and fall migrant
Snow bunting	*Plectrophenax nivalis*	Secure	Not Listed	spring and fall migrant
Western tanager	*Piranga ludoviciana*	**Sensitive**	Not Listed	common breeder

Table C-2 Bird Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[a]	Federal Status Under the Species at Risk Act and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[b]	Seasonal Distribution
Blackbirds				
Baltimore oriole	*Icterus galbula*	**Sensitive**	Not Listed	uncommon breeder
Brewer's blackbird	*Euphagus cyanocephalus*	Secure	Not Listed	common breeder
Brown-headed cowbird	*Molothrus ater*	Secure	Not Listed	common breeder
Common grackle	*Quiscalus quiscula*	Secure	Not Listed	uncommon breeder
Red-winged blackbird	*Agelaius phoeniceus*	Secure	Not Listed	common breeder
Rusty blackbird	*Euphagus carolinus*	**Sensitive**	**COSEWIC: Special Concern; SARA: Schedule 1 Special Concern**	spring and fall migrant
Finches and Relatives				
American goldfinch	*Spinus tristis*	Secure	Not Listed	not listed
Common redpoll	*Acanthis flammea*	Secure	Not Listed	spring and fall migrant
Evening grosbeak	*Coccothraustes vespertinus*	Secure	**COSEWIC: Special Concern**	uncommon breeder
Gray-crowned rosy-finch	*Leucosticte tephrocotis*	Secure	Not Listed	common breeder
House sparrow	*Passer domesticus*	Exotic	Not Listed	common breeder
Pine grosbeak	*Pinicola enucleator*	Secure	Not Listed	uncommon breeder
Pine siskin	*Spinus pinus*	Secure	Not Listed	common breeder
Purple finch	*Carpodacus purpureus*	Secure	Not Listed	uncommon breeder, spring and fall migrant
Red crossbill	*Loxia curvirostra*	Secure	Not Listed	common breeder
White-winged crossbill	*Loxia leucoptera*	Secure	Not Listed	common breeder

a) AEP 2018
b) Government of Canada 2019

Table C-3 Amphibian and Reptiles Species that May Occur within the Canmore Region

Common Name	Latin Name	General Provincial Status[a]	Federal Status Under the Species at Risk Act (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)[b]
Frogs			
Boreal chorus frog	*Pseudacris maculata*	Secure	Not listed
Columbia spotted frog	*Rana luteiventris*	**Sensitive**	COSEWIC: Not at Risk
Wood frog	*Lithobates sylvatica*	Secure	Not listed
Toads			
Western toad	*Anaxyrus boreas*	**Sensitive**	**COSEWIC: Special Concern; SARA: Schedule 1 Special Concern**
Salamanders			
Long-toed salamander	*Ambystoma macrodactylum*	**Sensitive**	COSEWIC: Not at Risk
Tiger salamander	*Ambystoma mavortium*	Secure	**COSEWIC: Special Concern**
Snakes			
Red-sided garter snake	*Thamnophis sirtalis*	**Sensitive**	Not listed
Wandering garter snake	*Thamnophis elegans*	**Sensitive**	Not listed

a) AEP 2018
b) Government of Canada 2019

APPENDIX D

2018 Wildlife Corridor Survey

TECHNICAL MEMORANDUM

DATE July 9, 2019

Project No. 18109757

TO Jenn Giesbrecht

CC Jessica Karpat, Monica Gunn

FROM Golder Associates Ltd.

EMAIL Krista_Kenyon@golder.com, Martin_Jalkotzy@golder.com

2018 WILDLIFE CORRIDOR SURVEY: WILDLIFE MOVEMENT IN LANDS ADJACENT TO THREE SISTERS MOUNTAIN VILLAGE PROPERTIES

Background

Three Sisters Mountain Village Properties Limited has undertaken the development of 1,036 hectares of land located within the eastern boundary of the Town of Canmore (the Project, Figure 1). Approved and yet to be approved wildlife corridors are south and west of the development lands. The wildlife movement surveys described in this memo were conducted to address requirements in the Environmental Impact Statement Terms of Reference to assess the effects of the Project related to development and increased human use on existing and predicted wildlife movement patterns. The methods used in the surveys were vetted by the Town of Canmore 's (the Town) Third Party Reviewer and the Town.

Transects

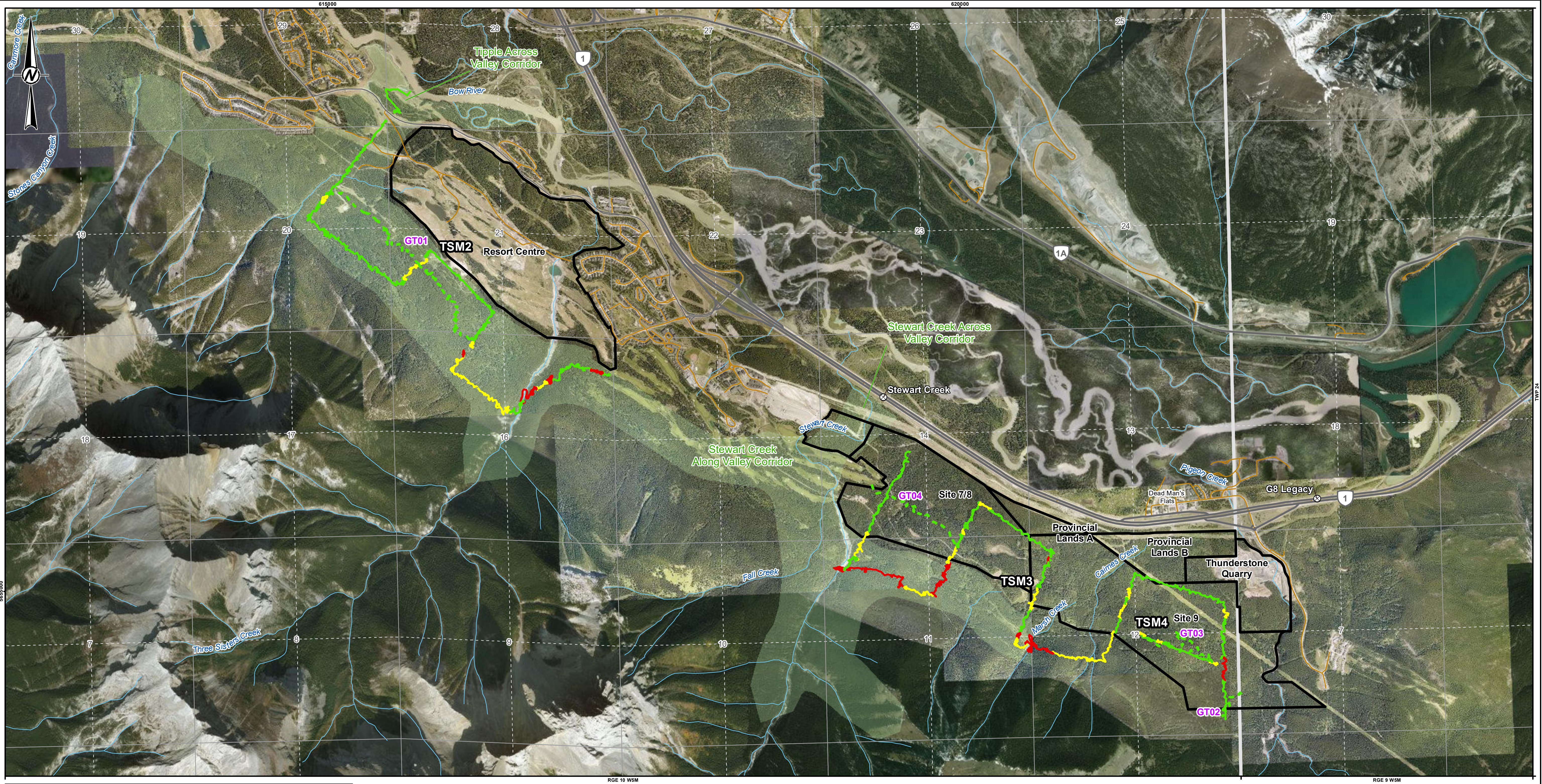
Four transects were designed to capture wildlife movement throughout the study area, but Transect 1 was dropped as redundant, once in the field. Surveyors walked transects 2, 3 and 4 and recorded the data summarized below.

Movement Class

Habitat parameters were collected in a representative location both when beginning a new transect segment, and when there was a change in movement class. Movement classes were defined as easy, moderate or difficult. Parameters included understory density, estimated visibility (m), canopy cover, downed woody material 60 centimetres above the ground, and movement enhancement potential. Notes were recorded regarding whether the movement classification was related to slope, deadfall, or other factors. Photographs of the understory density were taken to the north and east of each waypoint.

Wildlife Trails

Wildlife trails were recorded in two categories: trails and wildlife use areas. Transects would sometimes cross through areas covered with a dense network of wildlife trails. These stretches were recorded as wildlife use areas with a waypoint either every 50 meters or when the transect intersected a high use trail within the trail network. For both wildlife trails and wildlife use areas, the movement class, trail type (low, moderate, or high use), trail direction (upslope, downslope, both), enhancement potential, and obvious human use were recorded. For wildlife use areas these data represented the majority of trails in the trail network (e.g. most wildlife trails were low use). Moderate and high use wildlife trails were photographed in both directions. Representative photographs of low use trails in different habitats were also taken.



LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- APPROVED WILDLIFE CORRIDOR
- PROPERTY BOUNDARY

GAME MEANDER MOVEMENT CLASS

- EASY

SURVEY TRANSECT MOVEMENT CLASS

- EASY
- MODERATE
- DIFFICULT

0 1,000 2,000

1:30,000 METRES

REFERENCE(S)

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2. TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. WILDLIFE CORRIDOR OBTAINED FROM ASRD, MARCH 2010.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE

PROJECT
THREE SISTERS VILLAGE ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT
GOLDER

YYYY-MM-DD	2018-11-29
DESIGNED	KK
PREPARED	HR
REVIEWED	MJ
APPROVED	MJ

TITLE
WILDLIFE CORRIDOR SURVEY
SURVEY TRACK AND GAME MEANDER MOVEMENT CLASS

PROJECT NO.	CONTROL	REV.	FIGURE
18109757	3000	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

Microfeatures

Microfeatures that could present a barrier to movement such as cliffs or water bodies were recorded with a waypoint and a written description.

Game Meanders

Moderate to high use game trails that had no obvious human use were selected for game meanders. All data collected on transects were also collected along game meanders. When game meanders joined a trail obviously used by humans, surveyors would follow the human used trail for as short as distance possible before re-joining a wildlife specific trail. Start and end points where this occurred were recorded as comments.

Results

Transect 1 was dropped as redundant, once in the field and was not surveyed. Wildlife movement surveys were conducted along Transect 2, 3, and a portion of Transect 4 for a total of 13.16 kilometres (km) of transect surveys. Additionally, four game meanders of 0.36 km, 1.1 km, 1.1 km, and 3.3 km were conducted for a total of 5.86 km (Figure 1). This resulted in a combined 19.02 km of surveyed routes.

The surveyed transects covered 8.05 km of terrain classified as easy movement, 3.30 km of moderate movement class, and 1.81 km of difficult movement class. Wildlife trails used in game meanders typically travelled around deadfall or across benches and therefore resulted in easy movement class routes compared to randomly placed transects. Additionally, when wildlife trails split into multiple moderate trails, across slope trails were typically selected to achieve the desired 1.0 km game meander length. This method potentially reduced the likelihood of game meanders traveling up or down steeper slopes that would be classified as moderate or difficult movement class.

Between transects and game meanders a total of 263 wildlife trails were recorded: 110 low use, 97 moderate use, and 55 high use and one undefined use (Figure 2). Of these, 61 trails were identified as having a high likelihood of regular human use. Of the 19.02 km of surveyed routes, a total of 3.21 km of wildlife use areas were recorded along transects and game meanders (Figure 3). These areas typically occurred within easy movement classes at lower elevations adjacent to the golf course or close to the Bow River. In total, five microfeatures were encountered including one river crossing and four small cliffs. No routes were identified as being impassable for wildlife.

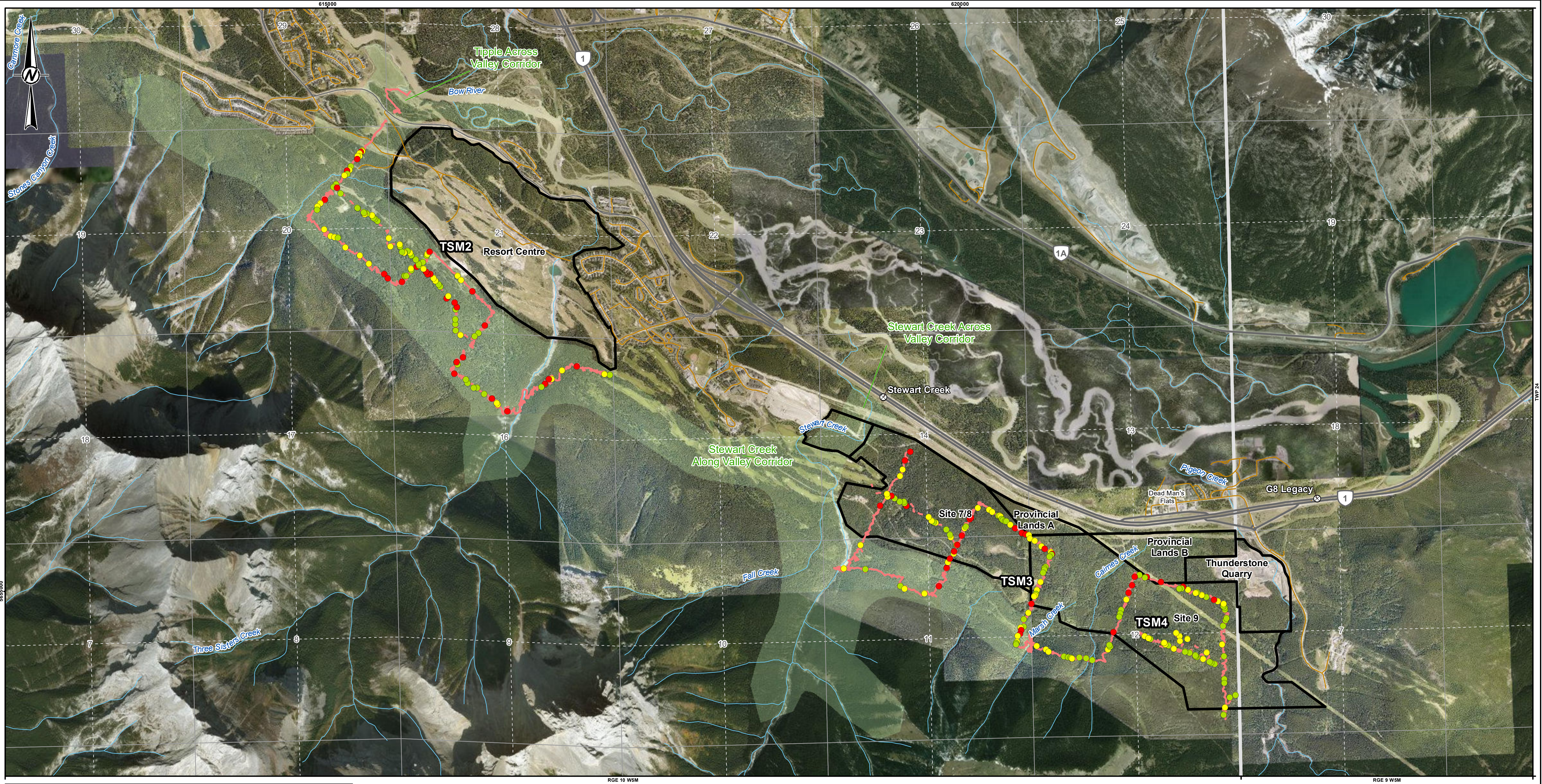
Golder Associates Ltd.

Krista Kenyon, MSc
Wildlife Biologist

Martin Jalkotzy, MEDes, PBiol
Principal, Senior Wildlife Ecologist

KK/MJ/DW/MG/crm/jlb

FILENAME * Lower \p * MERGEFORMAT https://golderassociates.sharepoint.com/sites/34005g/technical work/01. three sisters eis/memos/wildlife memo/2018 tsmv wildlife fieldwork memo.docx



LEGEND

- ⊗ HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- APPROVED WILDLIFE CORRIDOR
- PROPERTY BOUNDARY

WILDLIFE TRAIL CROSSING

- HIGH USE
- MODERATE
- LOW

SURVEY TRACKS

- GAME MEANDER
- SURVEY TRANSECT

0 1,000 2,000
1:30,000 METRES

REFERENCE(S)

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3. WILDLIFE CORRIDOR OBTAINED FROM ASRD, MARCH 2010.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE

PROJECT
THREE SISTERS VILLAGE ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT
GOLDER

YYYY-MM-DD	2018-11-29
DESIGNED	KK
PREPARED	HR
REVIEWED	MJ
APPROVED	MJ

TITLE
WILDLIFE CORRIDOR SURVEY
WILDLIFE TRAILS

PROJECT NO.	CONTROL	REV.	FIGURE
18109757	3000	0	2

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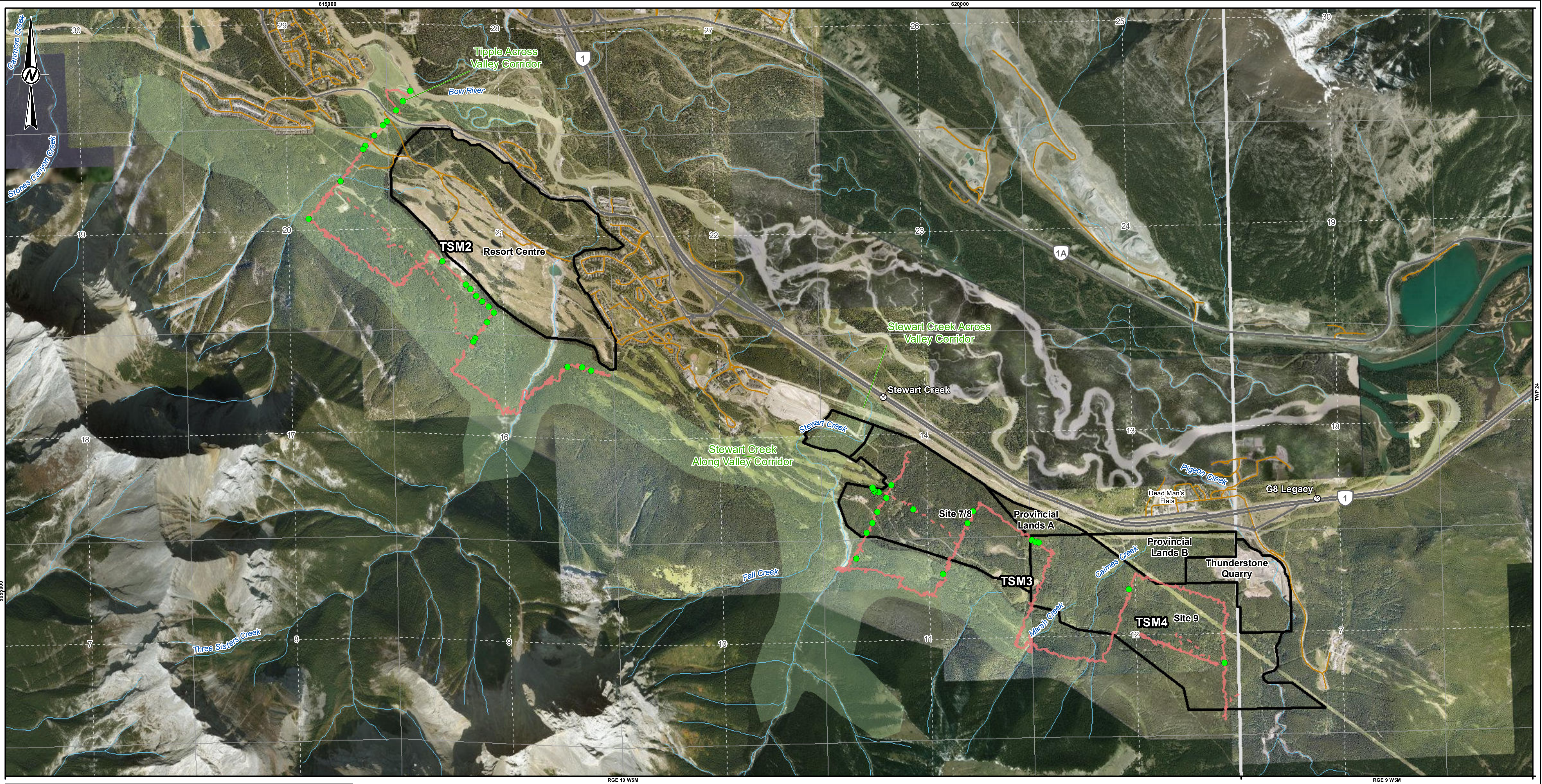
25mm



LEGEND

- HIGHWAY WILDLIFE UNDERPASS
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- APPROVED WILDLIFE CORRIDOR
- PROPERTY BOUNDARY
- WILDLIFE USE AREA

SURVEY TRACKS

- GAME MEANDER
- SURVEY TRANSECT

0 1,000 2,000
1:30,000 METRES

REFERENCE(S)

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3. WILDLIFE CORRIDOR OBTAINED FROM ASRD, MARCH 2010.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
THREE SISTERS MOUNTAIN VILLAGE

PROJECT
THREE SISTERS VILLAGE ENVIRONMENTAL IMPACT STATEMENT

CONSULTANT
GOLDER

YYYY-MM-DD	2018-11-29
DESIGNED	KK
PREPARED	HR
REVIEWED	MJ
APPROVED	MJ

TITLE
WILDLIFE CORRIDOR SURVEY
WILDLIFE USE AREAS

PROJECT NO.	CONTROL	REV.	FIGURE
18109757	3000	0	3

APPENDIX E

2018 Rare Plant Survey

TECHNICAL MEMORANDUM

DATE October 4, 2018 **Project No.** 1784782

TO Jenn Giesbrecht
QuantumPlace Developments

FROM Golder Associates Ltd. **EMAIL** Kate_Walsh@golder.com, Martin_Jalkotzy@golder.com

THREE SISTERS AREA STRUCTURE PLAN LISTED VASCULAR PLANT SURVEY EIS/ 1784782

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Three Sisters Mountain Village (TSMV) to complete listed vascular plant surveys for the Three Sisters Area Structure Plan (ASP) in parts of the TSMV lands known as the Resort Centre and Sites 7, 8 and 9 and adjacent lands (e.g., Thunderstone Quarry) near Canmore, Alberta (the Study Area; Figure 1).

Both the Alberta and Canadian governments identify listed plant species. For the purposes of this memo listed plants are defined as meeting one or more of the following criteria:

- listed as 'Special Concern', 'Threatened', or 'Endangered' within the *Species at Risk Act* (SARA) Public Registry (Government of Canada 2018);
- assessed as 'Special Concern', 'Threatened', or 'Endangered' by COSEWIC (Government of Canada 2018);
- legally designated as Endangered or Threatened under Alberta's *Wildlife Act* (Government of Alberta 1997); and/or
- provincially listed by the Alberta Conservation Information Management System (ACIMS) on the Tracking or Watched Lists (ACIMS 2017a).

Methods

Desktop Review

Prior to the field program, a desktop review was undertaken to identify any listed plant species occurrences historically observed within the Study Area (ACIMS 2017b) and select areas exhibiting high potential for listed plants (e.g., uncommon landscape features, transitional habitats, wetlands, previous listed plant observations) for visitation during the field surveys.

Scientific names and common names presented in this report follow those used by ACIMS (2018).

Field Survey

Listed plant field surveys were conducted on August 8, 9 and 10, 2018 to document listed plants observed in the Study Area. Systematic random floristic meanders of varying lengths were undertaken throughout the Study Area, exploring representative habitats. Additional detailed 20 m x 20 m plots were investigated within areas deemed to exhibit high potential for listed plant occurrences. General site characters were recorded at each of these detailed plot locations, including dominant vascular plant species by strata (e.g., trees, shrubs, forbs and graminoids), soil moisture and nutrient regime and a global positioning system (GPS) coordinate. When listed plants were observed, additional data were collected including microhabitat characteristics, population size and distribution. Field surveys investigated listed vascular plants only; non-vascular plant and lichen species were not recorded.

Collection of plant samples was limited to specimens that could not be identified in the field and only when local populations could withstand sampling following guidance in Henderson (2009), the Alberta Native Plant Council (ANPC; 2012) and Penny and Klinkenberg (2018).

Incidental observations of other biological (e.g., wildlife, weeds), archaeological or terrain features of importance were also recorded in conjunction with vegetation surveys. These observations were marked with a GPS location, documented with representative photographs and notes describing the observation.

2.0 RESULTS

Desktop Review

Two federally listed species, whitebark pine (*Pinus albicaulis*) and limber pine (*Pinus flexilis*) are known to occur in the vicinity of the Project Area, where elevations and conditions are appropriate. Whitebark pine is federally listed as Endangered by SARA and COSEWIC, provincially listed as Endangered by the Alberta *Wildlife Act*, and is on the ACIMS Tracking list (Government of Canada 2018, ACIMS 2018). Limber pine is federally listed as Endangered by COSEWIC, provincially listed as Endangered by the Alberta *Wildlife Act*, and is on the ACIMS Tracking list (Government of Canada 2018, ACIMS 2018).

An occurrence of western larch (*Larix occidentalis*) was historically observed within the study area in 1978 (Figure 1; ACIMS 2017b). Western larch is provincially listed as S2 (imperiled) and is on the ACIMS Tracking list (ACIMS 2018). Field survey effort was targeted within this part of the Study Area to locate this historical observation.

Field Survey

Listed plant surveys conducted between August 8 and 10, 2018 did not identify any federally or provincially listed vascular plant species within the Study Area. Despite extensive searching, the historic occurrence of western larch was not observed. A full list of vascular plant species observed during the survey is provided in Appendix A, and detailed plot locations within the Project Area are shown in Figure 1.

Two western toads (*Anaxyrus boreas*) were incidentally observed on August 8, 2018 in a wetland at survey location TSM001 (619686/5655763/11U; Figures 1 and 2). Western toads are federally listed as Special Concern by SARA and COSEWIC, and provincially classified as Sensitive (Government of Canada 2018, Alberta Environment and Parks [AEP] 2018).

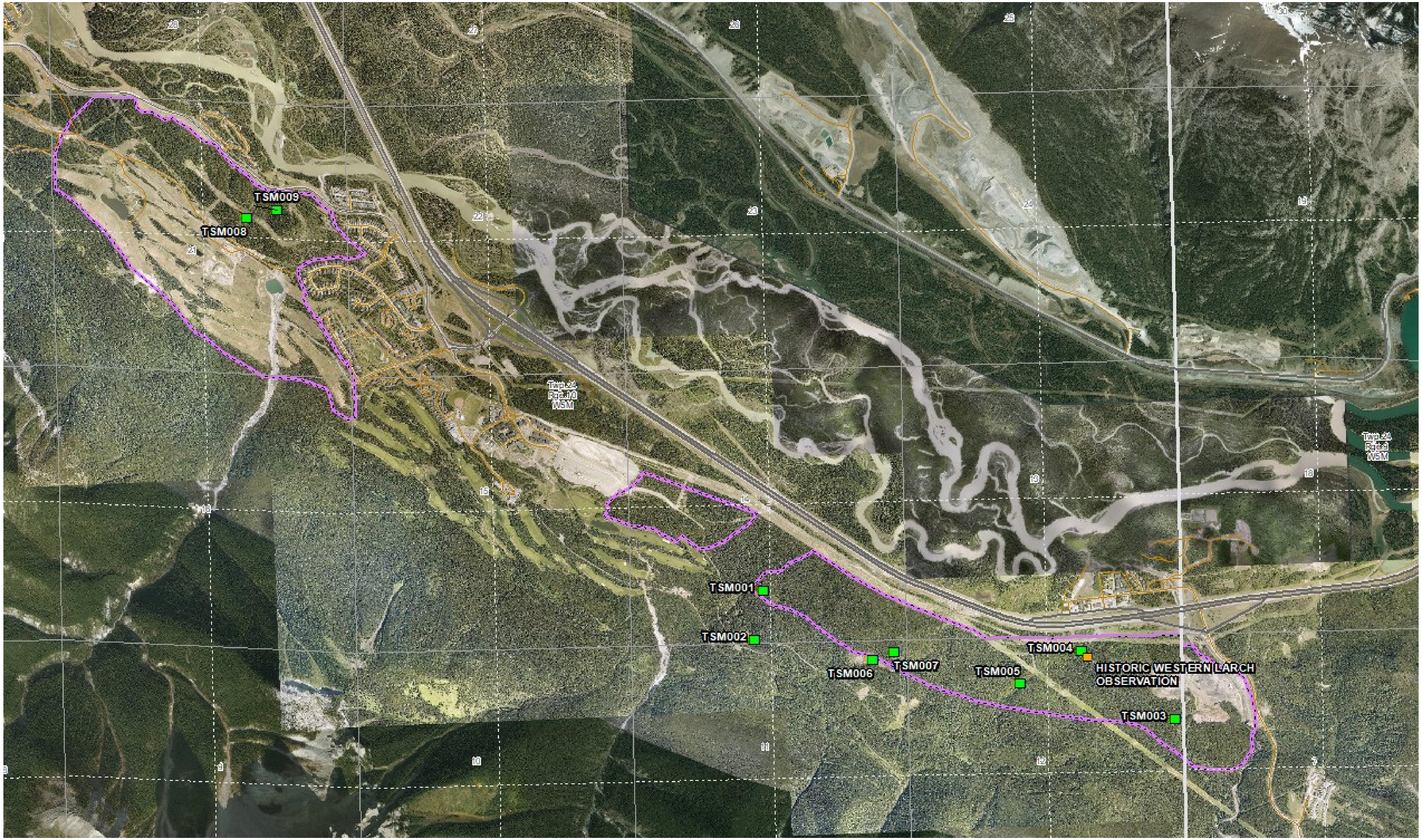

Figure 1: August 2018 Listed Plant Survey Locations

Figure 2: Western Toad observed at survey location TSW001 on August 8, 2018.

3.0 RECOMMENDATIONS AND MITIGATIONS

No listed vascular plants were observed during the survey. A listed plant survey can only confirm the presence of listed species on a site at the time of the survey and cannot discount the potential existence of listed plants on site during other seasons.

Surveys for listed plant species are recommended at least twice over the growing season (ANPC 2012, Penny and Klinkenberg 2010) to capture plant species which mature and flower at different times (e.g., early and late blooming species). Exact timing of the surveys depends on the length of the growing season of the survey area, and specific conditions of the site for the given year. In past years, Golder has successfully completed listed plant surveys at the beginning of August to capture late-blooming species. The timing of this survey likely prevented accurate identification of any early blooming species. It is recommended that an early season survey is completed to better characterize early-blooming listed plants species within the survey area.

4.0 CLOSURE

Golder trusts this technical memorandum meets the expectation of the client. Please contact the undersigned should you require any further clarification about the information presented in this memo.

Golder Associates Ltd.

Kate Walsh, BSc, AIT
Vegetation/Reclamation Ecologist

Martin Jalkotzy, MEDes, PBiol
Principal, Senior Wildlife Ecologist

KM/MJ/rd

https://golderassociates.sharepoint.com/sites/34005g/technical work/01. three sisters eis/memos/2018 tsv rare plant memo.docx

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APPENDIX A

Plant Species List

Table A-1: Vascular Plant Species Observed in the Study Area

Common Name	Scientific Name	ACIMS RANK (2018)
alpine bistort	*Bistorta vivipara*	S5
alpine hedysarum	*Hedysarum alpinum*	S5
alsike clover	*Trifolium hybridum*	SNA
Arctic aster	*Eurybia sibirica*	S5
arrow-leaved coltsfoot	*Petasites frigidus* var. *sagittatus*	S5
aspen	*Populus tremuloides*	S5
balsam fir	*Abies balsamea*	S5
balsam poplar	*Populus balsamifera*	S5
Barclays willow	*Salix barclayi*	S3
bishops-cap	*Mitella nuda*	S5
bluejoint	*Calamagrostis canadensis*	S5
bog muhly	*Muhlenbergia glomerata*	S4
bracted honeysuckle	*Lonicera involucrata* var. *involucrata*	S5
bristly black currant	*Ribes lacustre*	S5
buck-bean	*Menyanthes trifoliata*	S5
buckbrush	*Symphoricarpos occidentalis*	S5
bunchberry	*Cornus canadensis*	S5
Canada buffaloberry	*Shepherdia canadensis*	S5
clasping-leaved twisted-stalk	*Streptopus amplexifolius*	S5
common bearberry	*Arctostaphylos uva-ursi*	S5
common butterwort	*Pinguicula vulgaris*	S4
common fireweed	*Chamerion angustifolium*	S5
common horsetail	*Equisetum arvense*	S5
common Labrador tea	*Rhododendron groenlandicum*	S5
common pink wintergreen	*Pyrola asarifolia*	S5
common red paintbrush	*Castilleja miniata*	S5
common yarrow	*Achillea millefolium*	S5
cream-colored vetchling	*Lathyrus ochroleucus*	S5
cut-leaved anemone	*Anemone multifida*	S5
dark-scaled sedge	*Carex atrosquama*	S4
dewberry	*Rubus pubescens*	S5
Douglas-fir	*Pseudotsuga menziesii*	S5

Table A-1: Vascular Plant Species Observed in the Study Area

Common Name	Scientific Name	ACIMS RANK (2018)
drooping wood-reed	*Cinna latifolia*	S4
Drummonds willow	*Salix drummondiana*	S4
dwarf birch	*Betula pumila*	S5
dwarf scouring-rush	*Equisetum scirpoides*	S5
early blue violet	*Viola adunca*	S5
elephants-head	*Pedicularis groenlandica*	S5
elk sedge	*Carex garberi*	S3
fairybells	*Prosartes trachycarpa*	S5
false Solomons-seal	*Maianthemum racemosum*	S5
few-flowered spike-rush	*Eleocharis quinqueflora*	S3
flat-leaved willow	*Salix planifolia*	S5
fowl manna grass	*Glyceria striata*	S5?
fragile bladder fern	*Cystopteris fragilis*	S5
golden sedge	*Carex aurea*	S5
green sedge	*Carex viridula*	S4
ground juniper	*Juniperus communis*	S5
hair-like sedge	*Carex capillaris*	S5
hairy wild rye	*Leymus innovatus*	S5
hairy-fruited sedge	*Carex lasiocarpa*	S4
heart-leaved arnica	*Arnica cordifolia*	S5
hoary willow	*Salix candida*	S4
inland sedge	*Carex interior*	S4
Kalms lobelia	*Lobelia kalmii*	S3
knotted rush	*Juncus nodosus*	S5
lesser rattlesnake plantain	*Goodyera repens*	S5
Lindleys aster	*Symphyotrichum ciliolatum*	S5
lodgepole pine	*Pinus contorta*	S5
low sedge	*Carex duriuscula*	S5
low-bush cranberry	*Viburnum edule*	S5
marsh aster	*Symphyotrichum boreale*	S5
meadow horsetail	*Equisetum pratense*	S5
myrtle-leaved willow	*Salix myrtillifolia*	S5

Table A-1: Vascular Plant Species Observed in the Study Area

Common Name	Scientific Name	ACIMS RANK (2018)
northern bastard toadflax	*Geocaulon lividum*	S5
northern bedstraw	*Galium boreale*	S5
northern bog sedge	*Carex gynocrates*	S5
northern grass-of-parnassus	*Parnassia palustris*	S5
palmate-leaved coltsfoot	*Petasites frigidus* var. *palmatus*	S5
prickly rose	*Rosa acicularis*	S5
red and white baneberry	*Actaea rubra*	S5
red clover	*Trifolium pratense*	SNA
red fescue	*Festuca rubra*	S5
red-osier dogwood	*Cornus stolonifera*	S5
rough hair grass	*Agrostis scabra*	S5
saskatoon	*Amelanchier alnifolia*	S5
seaside arrow-grass	*Triglochin maritima*	S5
short-capsuled willow	*Salix brachycarpa*	S3
showy aster	*Eurybia conspicua*	S5
showy locoweed	*Oxytropis splendens*	S5
shrubby cinquefoil	*Dasiphora fruticosa* ssp. *floribunda*	S5
silverberry	*Elaeagnus commutata*	S5
slender arrow-grass	*Triglochin palustris*	S5
slender wheat grass	*Elymus trachycaulus* ssp. *trachycaulus*	S5
small bottle sedge	*Carex utriculata*	S5
small wood anemone	*Anemone parviflora*	S5
snowberry	*Symphoricarpos albus*	S5
spreading sweet cicely	*Osmorhiza depauperata*	S5
star-flowered Solomons-seal	*Maianthemum stellatum*	S5
sticky false asphodel	*Triantha glutinosa*	S5
swamp horsetail	*Equisetum fluviatile*	S5
sweet-scented bedstraw	*Galium triflorum*	S5
tall larkspur	*Delphinium glaucum*	S5
tall northern green orchid	*Platanthera aquilonis*	S4
twinflower	*Linnaea borealis*	S5
two-seeded sedge	*Carex disperma*	S5

Table A-1: Vascular Plant Species Observed in the Study Area

Common Name	Scientific Name	ACIMS RANK (2018)
variegated horsetail	*Equisetum variegatum*	S5
velvet-fruited willow	*Salix maccalliana*	S4
water sedge	*Carex aquatilis*	S5
western Canada violet	*Viola canadensis*	S5
western meadow rue	*Thalictrum occidentale*	S5
western wood lily	*Lilium philadelphicum*	S5
white meadowsweet	*Spiraea betulifolia*	S5
white spruce	*Picea glauca*	S5
wild lily-of-the-valley	*Maianthemum canadense*	S5
wild strawberry	*Fragaria virginiana*	S5
wild vetch	*Vicia americana*	S5
wire rush	*Juncus balticus*	S5
woolly everlasting	*Antennaria lanata*	S5
yellow sweet-clover	*Melilotus officinalis*	SNA

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