652000 654000 656000 658000 660000 662000 664000 666000

5526000 5524000 5522000 5520000 5518000 5516000 5514000

Musil Road
Lower Elk Valley Road
Grave Lake
Harriet Lake
Grave Creek Road
Grave Creek
Elk River
Dazel Creek
43
Harmer Creek
West Alexander Creek
Alexander Creek
Holley Road
SPARWOOD

Crown Mountain Coking Coal Project

Figure 15.4-22
High-Quality Mountain Goat Year-round Habitat in Relation to the Project Footprint and Noise Contours

LEGEND

- High-Quality Mountain Goat Year-round Habitat
- Continuous Project Related Noise - 45 dBA Contours
- Continuous Project Related Noise - 55 dBA Contours
- Offsite Peak Noise Levels From Blasting >108 dB
- Project Footprint
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- British Columbia/Alberta Border

0 1 2
Kilometres

N W E S

Scale 1:50,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
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Table 15.4-25: Area of Sensory Disturbance outside the Project Footprint and Overlapping with High-Quality Bighorn Sheep and Mountain Goat Habitat

Season	Zone of Influence Area (ha)	Area (ha) of High-Quality Habitat Affected Outside Footprint	Area Affected as Proportion of High-Quality Habitat in Terrestrial LSA
Continuous Project-related noise ≥ 55 dBA (daytime threshold)			
Bighorn Sheep	242	70	1.1%
Mountain Goat		43	1.9%
Continuous Project-related noise ≥ 45 dBA (nighttime threshold)			
Bighorn Sheep	1,118	338	5.5%
Mountain Goat		190	8.2%
Peak noise ≥ 108 dB from blasting			
Bighorn Sheep	1,955	266	4.3%
Mountain Goat		88	3.8%

Blasting will be intermittent. The 1,500 m zone of influence peak from blasting (peak noise ≥ 108 dB) does not overlap with the Erickson Ridge top where the availability of high-quality habitat for bighorn sheep and mountain goat is greatest (Figure 15.4-21 and Figure 15.4-22).

Once the Operations phase is complete, noise will substantially decrease and noise from blasting will cease. Noise during Reclamation and Closure will be from decommissioning and removal of infrastructure and reclamation activities.

The residual effect to bighorn sheep and mountain goat from sensory disturbance is characterized as follows:

- Duration: *Long-term*, as sensory disturbance will continue through to the end of Operations and to a lesser extent during Reclamation and Closure
- Magnitude: *Low to moderate*, up to 5.5% and 8.2% of high-quality habitat for bighorn sheep and mountain goat for continuous Project-related noise and 4.3% and 3.8% of high-quality habitat for peak noise from blasting will be affected in the Terrestrial LSA.
- Geographic Extent: *Local*, as the effect of habitat loss will be outside the Project footprint and within the Terrestrial LSA.
- Frequency: *Continuous,* though at varying levels until the end of Operations, peaking at Year 10 of Operations. Noise from blasting will be intermittent.
- Reversibility: *Reversible long-term*, the effect of noise will decline substantially at the end of Operations and continue at lower levels during Reclamation and Closure.
- Context: *High* for bighorn sheep, as they have relatively low sensitivity to noise and may be able to adapt to certain levels of noise generated by the Project. *Low* for mountain goats, as they have relatively high sensitivity to noise and may not be able to adapt to certain levels of noise generated by the Project.

Disruption to Movement

Movements of both bighorn sheep and mountain goat in the Elk Valley generally follow north-south high elevation mountain ranges and ridges but also include low elevation crossings. The main movement corridor in the Terrestrial LSA is the corridor that connects Erickson Ridge to Sheep Mountain (through Grave Creek Canyon). This corridor intersects with the access road. The access road will be upgraded and will have higher levels of daily traffic relative to existing conditions. Bighorn sheep and mountain goat were recorded along Grave Creek Road in both summer and winter. In general, roads represent a semi-permeable barrier, provided that no physical barriers are created during road upgrade or unbroken snowbanks created from snow clearing. The predicted traffic level of 140 vehicles per day is unlikely to affect crossing success, especially with speed reductions in areas known to have frequent wildlife (e.g., Grave Creek Canyon) and that wildlife have the right-of-way.

When the Project is at its largest extent and prior to any large areas of reclamation (around Year 10 of Operations), the mine site footprint will occupy a large portion of West Alexander Creek valley and will be a nearly impermeable barrier. The upper slopes of the west side of the valley will remain intact, but may be degraded by sensory disturbance and use for connectivity between daily or seasonal habitats may be reduced.

Along the conveyor, underpasses will be created by elevating the conveyor to at least 2.4 m above ground (or higher where terrain can be used to create more clearance) at intervals of two per 1,000 m. Both bighorn sheep and mountain goat are unlikely to be present in the conveyor area, given the habitats available.

The utility corridor is primarily composed of the powerline and the buried gas line. Suitable habitat will be present beneath the powerline after construction. The powerline may not be a barrier to movement on its own but since it parallels the road, it may be avoided due to proximity and function as a semi-permeable barrier in combination with the road.

The residual effect to bighorn sheep and mountain goat from disruption to movement is characterized as follows:

- Duration: *Long-term*, as some effects will continue to the end of Reclamation and Closure.
- Magnitude: *Moderate*, given the semi-permeable nature of the linear infrastructure.
- Geographic Extent: *Local*, as the effect will extend outside the Project footprint and within the Terrestrial LSA.
- Frequency: *Continuous,* as the effect will continue through Operations to Reclamation and Closure.
- Reversibility: *Reversible long-term*, the effect will decline substantially at the end of Operations and continue at lower levels during Reclamation and Closure.
- Context: *High* for bighorn sheep as they have low sensitivity and high resilience to human activities. *Low* for mountain goat as they have high sensitivity to human activities.

Increased Mortality Risk

Pathways of increased risk of mortality for bighorn sheep and mountain goat (described in Section 15.4.3.2.3) that are unlikely to be fully mitigated are collisions with Project-related traffic on access or mine roads and increased hunter access post-closure.

Even with the traffic control mitigation measures described in Section 15.4.3.3.4, vehicle collisions with bighorn sheep and mountain goat may still occur. The number is expected to be small. Wildlife sightings and wildlife-vehicle collisions will be recorded and monitored. Further mitigation measures will be implemented to further minimize the risk of collision, if required.

The Project will involve loading of 120 trains per year. Trains will not be travelling at high speeds within the rail loadout, and train-wildlife collisions in this area are unlikely. There will be an incremental increase in rail traffic on the main rail lines as a result of the Project (one additional train every three days on average) where the risk of wildlife-train collisions is higher. The extent to which the Project will contribute to an incremental increase in bighorn sheep or mountain goat mortalities from train collisions is unknown.

The upgraded Grave Creek Road will remain open post-closure and may provide increased access to hunters. The current condition of the road is rough, though is currently accessed by 4x4 vehicles, snowmobiles, and all-terrain vehicles. Access up from Grave Creek Road to the mine site will be open to the public. The road to the explosives factory will decommissioned and reclaimed. A change in access by hunters and leading to increased hunting of bighorn sheep and mountain goat is difficult to predict, but an incremental increase is assumed.

The residual effect to bighorn sheep and mountain goat from increased mortality risk is characterized as follows:

- Duration: *Long-term*, as some effects will continue to the end of Reclamation and Closure.
- Magnitude: *Low*, as bighorn sheep and mountain goat mortalities as a result of the Project are expected to be uncommon.
- Geographic Extent: *Discrete*, as the effect will be within the Project footprint.
- Frequency: *Intermittent,* as bighorn sheep and mountain goat mortalities may be at sporadic intervals (if any) during any phase of the Project.
- Reversibility: *Reversible long-term*, as the potential for increased mortality risk will end after Reclamation and Closure.
- Context: *High*, as any bighorn sheep and mountain goat mortalities as a result of the Project are expected to be small relative to other sources of mortality.

Determination of Significance

The latest population estimate for the Elk Valley East Population Management Unit (PMU) is 515 to 770 bighorn sheep, corresponding to an average density of 16 bighorn sheep/ km^2 on winter ranges. The population is considered stable. The Sheep Mountain and Erickson Ridge subpopulation (which extends outside the Terrestrial LSA) has a relatively stable population trend (Poole et al., 2018). The Project will result in loss of a relatively small amount of year-round high-quality habitat, though none of which has been mapped as bighorn sheep winter range (Poole et al., 2018). Sensory disturbance has the potential to displace bighorn sheep in high-quality annual habitat, though it does not overlap with mapped winter range. Post-closure, the reclaimed mine landscape will provide abundant forage for bighorn sheep.

Mountain goat population trends indicate a stable to decreasing trend in southern B.C. Mountain goat surveys in 2005 estimated 1,005 goats in the Elk Valley, with a corresponding density of 1.69 goats per km^2. The mountain goat population within the Terrestrial LSA is not known. The Project will result in the loss of a relatively small amount of year-round high-quality habitat. Sensory disturbance has the potential

to displace mountain goat in high-quality habitat on the east side of Erickson Ridge. Post-closure, the steep pit faces may provide additional escape terrain for goats.

Based on the characterization of the residual effects and local and regional bighorn sheep and mountain goat population levels, the Project would not limit the ability of bighorn sheep and mountain goat to persist and maintain self-sustaining populations in the Terrestrial LSA. The residual effects of habitat loss and degradation, sensory disturbance, disruption to movement, and increased mortality on bighorn sheep and mountain goat arising from the Project during all phases are therefore considered not significant.

Likelihood and Confidence

Effects that are determined to be not significant do not require a characterization of likelihood.

There is a good understanding of bighorn sheep and mountain goat ecology, their habitat availability and distribution, known occurrences, and abundance in the Terrestrial LSA. The confidence in the determination of the significance determination for residual effects to bighorn sheep and mountain goat is high.

15.4.3.4.5 Summary of Residual Effects Assessment

Residual effects and the selected mitigation measures, characterization criteria, likelihood, significance determination, and confidence are summarized in Table 15.4-26. There are no significant residual effects to ungulate VCs anticipated as a result of the Project.

15.4.4 Cumulative Effects Assessment

Cumulative environmental effects are the result of Project residual environmental effects interacting with the effects of other past, present, and reasonably foreseeable future projects or activities to produce a combined/overlapping effect. The objective of the cumulative effects assessment is to consider overlapping effects for all residual adverse effects, not only those predicted to be significant (EAO, 2013). The assessment of cumulative effects on ungulate VCs requires that:

- The Project results in a residual adverse environmental effect on the ungulate VC;
- A residual Project effect interacts cumulatively with effects from other projects or activities (i.e., an effect of the Project overlaps spatially and temporally with those of other projects or activities that have been or will be carried out);
- The other projects or activities have been or will be carried out and are not hypothetical; and
- The cumulative effect is likely to occur.

Further information regarding the cumulative effects assessment methodology is provided in Chapter 5, Section 5.3.5.4.

An assessment of cumulative effects is required for ungulate VCs due to the possibility that potential Project residual effects on ungulate VCs may remain after implementation of proposed mitigation measures. Habitat loss and degradation, sensory disturbance, disruption to movement, and increased mortality risk were found to have residual (though not significant) Project effects for moose, elk, bighorn sheep, and mountain goat.

Table 15.4-26: Summary of Residual Effects on Ungulate VCs

Valued Component	Residual Effect	Project Phases	Mitigation Measures	Summary of Residual Effects Characterization	Significance (Significant, Not Significant)	Likelihood (High, Moderate, Low)	Confidence (High, Moderate, Low)
Moose	Habitat Loss and Degradation	• Construction and Pre-Production • Operations	• Minimization through Project design • Delay clearing until needed • Erosion and sediment control • Air quality and dust management • Progressive reclamation	Duration: Long-term and permanent Magnitude: Moderate Geographic Extent: Discrete Frequency: Continuous Reversibility: Reversible long-term Context: Neutral	Not Significant	Not Applicable	High
Moose	Sensory Disturbance	• Construction and Pre-Production • Operations • Reclamation and Closure	• Noise and Vibration Management Plan • Lighting management • Management of vehicle traffic and site access	Duration: Long-term Magnitude: Low to Moderate Geographic Extent: Local Frequency: Continuous Reversibility: Reversible long-term Context: Neutral			
Moose	Disruption to Movement	• Construction and Pre-Production • Operations • Reclamation and Closure	• Wildlife education • Limited new roads • Conveyor elevated to create underpasses • Progressive reclamation • Management of vehicle traffic and site access • Gaps in snowbanks	Duration: Long-term Magnitude: Moderate Geographic Extent: Local Frequency: Continuous Reversibility: Reversible long-term Context: Neutral			

Valued Component	Residual Effect	Project Phases	Mitigation Measures	Summary of Residual Effects Characterization	Significance (Significant, Not Significant)	Likelihood (High, Moderate, Low)	Confidence (High, Moderate, Low)
Moose	Increased Mortality Risk	• Construction and Pre-Production • Operations • Reclamation and Closure • Post-Closure	• Wildlife education • Management of vehicle traffic and site access • Prevent wildlife entrapment • Clear area before blasting and avalanche control • Minimize attractants • Manage chemical hazards	Duration: Long-term Magnitude: Low Geographic Extent: Discrete Frequency: Intermittent Reversibility: Reversible long-term Context: High			
Elk	Habitat Loss and Degradation	• Construction and Pre-Production • Operations	• Minimization through Project design • Delay clearing until needed • Erosion and sediment control • Air quality and dust management • Progressive reclamation	Duration: Long-term and permanent Magnitude: Moderate Geographic Extent: Discrete Frequency: Continuous Reversibility: Reversible long-term Context: High	Not Significant	Not Applicable	High
Elk	Sensory Disturbance	• Construction and Pre-Production • Operations • Reclamation and Closure	• Noise and Vibration Management Plan • Lighting management • Management of vehicle traffic and site access	Duration: Long-term Magnitude: Low to Moderate Geographic Extent: Local Frequency: Continuous Reversibility: Reversible long-term Context: High			

Valued Component	Residual Effect	Project Phases	Mitigation Measures	Summary of Residual Effects Characterization	Significance (Significant, Not Significant)	Likelihood (High, Moderate, Low)	Confidence (High, Moderate, Low)
Elk	Disruption to Movement	• Construction and Pre-Production • Operations • Reclamation and Closure	• Wildlife education • Limited new roads • Conveyor elevated to create underpasses • Progressive reclamation • Management of vehicle traffic and site access • Gaps in snowbanks	Duration: Long-term Magnitude: Moderate Geographic Extent: Local Frequency: Continuous Reversibility: Reversible long-term Context: High			
Elk	Increased Mortality Risk	• Construction and Pre-Production • Operations • Reclamation and Closure • Post-Closure	• Wildlife education • Management of vehicle traffic and site access • Prevent wildlife entrapment • Clear area before blasting and avalanche control • Minimize attractants • Manage chemical hazards	Duration: Long-term Magnitude: Low Geographic Extent: Discrete Frequency: Intermittent Reversibility: Reversible long-term Context: High			
Bighorn Sheep and Mountain Goat	Habitat Loss and Degradation	• Construction and Pre-Production • Operations	• Minimization through Project design • Delay clearing until needed • Erosion and sediment control • Air quality and dust management • Progressive reclamation	Duration: Long-term and permanent Magnitude: Low Geographic Extent: Discrete Frequency: Continuous Reversibility: Reversible long-term Context: Low	Not Significant	Not Applicable	High

Valued Component	Residual Effect	Project Phases	Mitigation Measures	Summary of Residual Effects Characterization	Significance (Significant, Not Significant)	Likelihood (High, Moderate, Low)	Confidence (High, Moderate, Low)
Bighorn Sheep and Mountain Goat	Sensory Disturbance	• Construction and Pre-Production • Operations • Reclamation and Closure	• Noise and Vibration Management Plan • Lighting management • Management of vehicle traffic and site access	Duration: Long-term Magnitude: Low to Moderate Geographic Extent: Local Frequency: Continuous Reversibility: Reversible long-term Context: High (bighorn sheep) and low (mountain goat)			
Bighorn Sheep and Mountain Goat	Disruption to Movement	• Construction and Pre-Production • Operations • Reclamation and Closure	• Wildlife education • Limited new roads • Conveyor elevated to create underpasses • Progressive reclamation • Management of vehicle traffic and site access • Gaps in snowbanks	Duration: Long-term Magnitude: Moderate Geographic Extent: Local Frequency: Continuous Reversibility: Reversible long-term Context: High (bighorn sheep) and low (mountain goat)			
Bighorn Sheep and Mountain Goat	Increased Mortality Risk	• Construction and Pre-Production • Operations • Reclamation and Closure • Post-Closure	• Wildlife education • Management of vehicle traffic and site access • Prevent wildlife entrapment • Clear area before blasting and avalanche control • Minimize attractants • Manage chemical hazards	Duration: Long-term Magnitude: Low Geographic Extent: Discrete Frequency: Intermittent Reversibility: Reversible long-term Context: High context			

15.4.4.1 Assessment Boundaries

15.4.4.1.1 Spatial Boundaries

The assessment of cumulative effects for ungulate VCs was conducted for the Terrestrial RSA, as defined in Section 15.2.3.1. The Terrestrial RSA is approximately 18,760 km^2. It includes all operating and proposed mines within the Elk Valley and several developed areas including the municipal boundaries of Sparwood, Elkford, Cranbrook and Kimberley.

15.4.4.1.2 Temporal Boundaries

The temporal boundaries for the Project include periods of Construction and Pre-Production, Operations, Reclamation and Closure, and Post-Closure, as identified in Section 15.2.3.2.

Temporal cases used in the assessment of cumulative effects includes the following:

1. Base Case – The current status of the VC prior to the start of the Project, including all appropriate past and present projects and/or activities – generally represented by existing conditions;
2. Project Case – Status of the VC with the Project in place, over and above the Base Case – generally represented by the Project effects assessment; and
3. Future Case – The status of the VC as a result of the Project Case in combination with all reasonably foreseeable future projects or activities that could be carried out.

The comparison of the Project Case with the Future Case allows the Project contribution to cumulative effects of all past, present, and reasonably foreseeable future projects or activities to be determined.

15.4.4.1.3 Technical Boundaries

In addition to those presented in Section 15.2.3.4, technical boundaries or constraints imposed on the assessment due to limitations in the ability to predict the cumulative effects of the Project in combination with those of other past, present, or reasonably foreseeable future projects or activities include the following:

- Information on species ranges and population numbers in the region is variable and, in some cases, limited;
- Habitat availability (including habitat suitability, resource selection, and habitat use) was assessed from occupancy and habitat modelling. The models have inherent uncertainty and are an imperfect representation;
- There is limited knowledge of the precise scope and extent of potential effects of past, present, and reasonably foreseeable future projects, aside from the Project. The geographic extents of footprints for these projects are from publicly available sources and their accuracy cannot be guaranteed; and
- There is limited knowledge of species and individual responses to disturbance and the relationship to potential population-level effects is not well understood.

15.4.4.2 Identifying Past, Present, and Reasonably Foreseeable Projects and/or Activities

Descriptions of the past, present, and reasonably foreseeable projects or activities for consideration in the cumulative effects assessment are provided in Chapter 5, Section 5.3.5.3.

Several past, present, and reasonably foreseeable future projects or activities are expected to interact with the ungulate VCs, which may result in a potential for adverse cumulative effects (Table 15.4-27). Maps showing the location of the past, present, and reasonably foreseeable future projects or activities are presented in Figure 5.3-4 to Figure 5.3-6 (Chapter 5).

As noted in Chapter 5, Section 5.3.5.3, the following projects were considered as past, present, or reasonably foreseeable future projects or activities in the cumulative effects assessment but were not included:

- Coal Mountain Phase 2, as the environmental assessment was placed on hold by Teck Coal Limited in 2016;
- Mount Brussil of (Baymag Mine) by Baymag, due to no temporal overlap;
- Barnes Lake Phosphate Exploration Project by Fertoz International Inc., given that the project is in exploration phase and no project has been proposed; and
- Cabin Ridge Coal by Warburton Group is in exploration and no project has been proposed.

15.4.4.3 Mitigation for Cumulative Effects

Cumulative effects can be reduced through minimizing local Project-related effects using the mitigation measures described for the Project (Section 15.4.3.3). It is assumed that other projects in the region will also adopt similar measures.

Addressing cumulative effects often requires regional stakeholder involvement and government-led initiatives to implement effective management plans and monitoring programs. NWP will participate in regional initiatives, where relevant and appropriate, and will adopt new management practices and measures to meet regional planning objectives, where possible.

15.4.4.4 Potential Residual Cumulative Effects

15.4.4.4.1 Assessment Methods

The assessment of potential cumulative effects on ungulate VCs was characterized using a combination of quantitative methods and qualitative discussions. Quantitative methods were used to measure habitat loss and degradation. Qualitative discussions are based on scientific literature, baseline studies, habitat models, and professional judgment and were used to characterize sensory disturbance, disruption to movement, and increased mortality risk.

Habitat loss and degradation was measured by calculating the loss of high-quality habitat within the Terrestrial RSA for the Base Case, the Project Case, and the Future Case. High-quality habitat was defined as areas with high and very high habitat suitability.

The habitat suitability mapping for each species used for the Project Case and Future Case is the same as used for the Base Case. Ecosystems change over time through natural successional processes (e.g., forest regrowth) and natural disturbance regimes (e.g., fire). Habitat suitability for any given wildlife species will therefore also change over time. For the purposes of the assessment of cumulative effects, the assumption is that while ecosystems are dynamic, the general amount and distribution of ecosystems (and therefore suitable habitat for any given wildlife species) in the Terrestrial RSA is approximately the same for the Base, Project, and Future Cases, aside from habitat losses from the reasonably foreseeable

Table 15.4-27: Project-Ungulate VC Interactions Matrix for Potential Cumulative Effects

Past, Present, or Reasonably Foreseeable Future Projects or Activities	Ranking of Potential Cumulative Effect			Justification / Rationale
	Moose	Elk	Bighorn Sheep/ Mountain Goat	
Past or Present Projects and/or Activities that Have Been Carried Out				
Natural Resource Extraction – Mining (past)	I	I	I	Has occurred within the range of ungulate VCs and their habitat though occurs in the past.
Coal Mountain Operations	III	III	III	Currently operating and occurs within the range of ungulate VCs and their habitat.
Elkview Operations	III	III	III	Currently operating and occurs within the range of ungulate VCs and their habitat.
Line Creek Operations	III	III	III	Currently operating and occurs within the range of ungulate VCs and their habitat.
Fording River Operations	III	III	III	Currently operating and occurs within the range of ungulate VCs and their habitat.
Greenhills Operations	III	III	III	Currently operating and occurs within the range of ungulate VCs and their habitat.
Kootenay West Mine	III	III	III	Currently operating and occurs within the range of ungulate VCs and their habitat.
Elkhorn Quarry West (Windermere Mining Operations)	III	III	III	Currently operating and occurs within the range of ungulate VCs and their habitat.
Marten Phosphate Project	III	III	III	Currently operating and occurs within the range of ungulate VCs and their habitat.
Energy - Elko Dam	III	III	I	Currently operating and occurs within the range of moose and elk and their habitat.
Koocanusa Reservoir	III	III	I	Currently operating and occurs within the range of moose and elk and their habitat.
Forestry	III	III	II	Currently operating and occurs within the range of ungulate VCs and their habitat.

Past, Present, or Reasonably Foreseeable Future Projects or Activities	Ranking of Potential Cumulative Effect			Justification / Rationale
	Moose	Elk	Bighorn Sheep/ Mountain Goat	
Energy - Pipelines	II	II	II	Currently operating and occurs within the range of ungulate VCs and their habitat.
Energy - Electrical Transmission	II	II	II	Currently operating and occurs within the range of ungulate VCs and their habitat.
Transportation	II	II	II	Habitat loss and increased mortality risk
Recreation and Tourism	I	I	I	Currently operating and occurs within the range of ungulate VCs and their habitat, though adverse effects are expected to be minimal or absent.
Commercial, Residential, and Industrial Use	III	III	I	Currently operating and occurs within the range of moose and elk and their habitat.
Parks and Protected Areas	I	I	I	Currently operating and occurs within the range of ungulate VCs and their habitat, though adverse effects are expected to be minimal or absent.
Agriculture	II	II	II	Currently operating and occurs within the range of moose and elk and their habitat. Not all effects are adverse.
Natural Processes or Events	I	I	I	Magnitude of effect on ungulate VCs likely very small.
Reasonably Foreseeable Future Projects and/or Activities That Will Be Carried Out				
Michel Coal Project	III	III	III	Occurs within the range of moose and elk and their habitat.
Grassy Mountain Coal Project	III	III	III	Occurs within the range of ungulate VCs and their habitat.
Tent Mountain Mine	III	III	III	Occurs within the range of ungulate VCs and their habitat.
Fording River Extension Project	III	III	III	Occurs within the range of ungulate VCs and their habitat.
Bingay Main Project	III	III	III	Occurs within the range of ungulate VCs and their habitat.
Elan Hard Coking Coal Project	III	III	III	Occurs within the range of ungulate VCs and their habitat.
Climate Change	II	II	II	May affect habitat availability of all ungulate VCs

Past, Present, or Reasonably Foreseeable Future Projects or Activities	Ranking of Potential Cumulative Effect			Justification / Rationale
	Moose	Elk	Bighorn Sheep/ Mountain Goat	
Natural Processes or Events	I	I	I	Magnitude of effect on ungulate VCs likely very small.

Notes (after EAO, 2013):
I – Residual Project effects do not act cumulatively with those of other past, present, or reasonably foreseeable future projects and/or activities. Not carried forward in the assessment.
II – Residual Project effects act cumulatively with those of other past, present, or reasonably foreseeable future projects and/or activities, but are unlikely to result in significant cumulative effects; or residual Project effects act cumulatively with existing significant cumulative effects but the Project will not measurably contribute to these cumulative effects on the VC. Carried forward in the assessment.
III – Residual Project effects act cumulatively with those of other past, present, or reasonably foreseeable future projects and/or activities, and may result in significant cumulative effects; or residual Project effects act cumulatively with existing significant cumulative effects and the Project may measurably contribute to adverse changes in the state of the VC. Carried forward in the assessment.

future projects and activities that are included in the Future Case. Reasonably foreseeable future projects and activities were assumed to result in complete removal of suitable wildlife habitat. This is a conservative approach as some activities will not result in complete loss of habitat (e.g., cutblocks provide food resources for some species) and some physical disturbance footprints are restored over time (e.g., mine reclamation).

For sensory disturbance, ground vibration from rail was not expected to have a significant impact on wildlife (see Chapter 7) and vibration from blasting greater than the threshold level of 10 mm/s is not expected to extend beyond the pits. For the remaining types of sensory disturbance, the effect of noise extends greater distances than the effect of dust, light, and human presence. The focus of the assessment of residual cumulative effects of sensory disturbance is therefore on noise.

For the assessment of Project effects of noise, a quantitative approach was used. A fully quantitative approach could not be used for the cumulative effects of sensory disturbance because of the difficulty in assigning zones of influence or avoidance to all reasonably foreseeable future projects or activities when design details are not available. A qualitative approach was therefore used.

Road density was used as an index of the degree to which the risk of mortality to ungulate VCs from vehicle collisions may change. The estimate of Future Case road density includes reasonably foreseeable future projects and activities as well as simulated forestry, fire, and insect outbreak (see Appendix 13-E for details).

The EV-CEMF is used to assess historic, current, and potential future conditions of selected VCs and to provide a framework that supports decisions related to the mitigation and management of these VCs in the Elk Valley. There are four VCs addressed in the EV-CEMF, one of which is bighorn sheep. The background and approached to the EV-CEMF and to bighorn sheep specifically are described in Elk Valley Cumulative Effects Management Framework Working Group (2018) and Poole et al. (2018). The approach and methodology used in the EV-CEMF was used to further characterize cumulative effects of the Project on bighorn sheep. Scenario analysis was conducted using ALCES Online to evaluate a range of potential future landscape scenarios in the Elk Valley and to assess the change in indicators specifically developed for bighorn sheep. Three future development scenarios were simulated:

- Scenario 1 - Project Case: This scenario uses the Project footprint and sequence of development over the life of mine;
- Scenario 2 - Project Case with Cumulative Effects Scenario: The same allocations and assumptions described in Scenario 1 were carried forward, and all reasonably foreseeable future projects and activities (those listed in Section 15.4.4.2) were added to represent the cumulative foreseeable development within the Elk Valley; and
- Scenario 3 - Project Case with Cumulative Effects and Natural Disturbance Scenario: This scenario builds off Scenario 2, while also simulating fire and insect outbreak natural disturbances.

Indicators are rolled into a hazard rating or index. Hazard is the deviation of the current amount from the range of expected amounts that would have occurred historically through natural variation. The hazard rating for the three scenarios can be compared to current conditions to quantify potential cumulative effects to bighorn sheep. A detailed description of the approach, methodology, and assumptions is provided in MacHydro (2021; included as Appendix 13-F).

15.4.4.4.2 Moose

Many present and future projects and activities occur within the distributional range of moose and in suitable habitat. The residual effects of habitat loss and degradation, sensory disturbance, disruption to movement, and increased mortality risk could potentially have a cumulative effect on moose.

Characterization of Residual Cumulative Effects

Habitat Loss and Degradation

Most present and reasonably foreseeable future projects and activities occur within the range of moose and in potentially suitable habitat and thus involve habitat loss or alteration of moose habitat (Figure 15.4-23 and Figure 15.4-24). The Base Case incorporates the cumulative loss or alteration of moose habitat as a result of past and present projects and was the basis for the assessment of the Project Case. For the Future Case that includes both the Project and all reasonably foreseeable future projects and activities, approximately 5.6% of fall-winter habitat and 5.1% of spring-summer high-quality moose habitat are predicted to be lost within the Terrestrial RSA (Table 15.4-28). The Project is predicted to contribute 0.06% of that loss in fall-winter, and 0.11% in spring-summer.

The effects of habitat loss and alteration due to forestry is a more complicated prediction. Logging can increase habitat quality for moose by removing overstory cover and creating early seral habitats that provide higher levels of forage than mature stands (described previously in Section 15.4.2.1.1). Conversely, the removal of old and mature coniferous forest cover from logging can be detrimental for moose, as forests provide security cover from predation, access to browse (i.e., reduced snow depths and forage), and shelter from the elements. Given the potential combination of beneficial and detrimental effects on moose, the effect of forestry on moose is assumed to be neutral.

Table 15.4-28: Change in High-Quality Moose Habitat for the Base Case, the Project Case, and the Future Case in the Terrestrial RSA

VC	Season	Amount (ha) of High-Quality Habitat (Change from Base Case in Brackets)			Change as Proportion of Terrestrial RSA	
		Base Case	Project Case	Future Case	Base Case to Project Case	Base Case to Future Case
Moose	Fall-Winter	270,249	270,101 (-149)	255,058 (-15,192)	-0.06%	-5.6%
Moose	Spring-Summer	963,825	962,784 (-1,041)	914,898 (-48,927)	-0.11%	-5.1%

The residual cumulative effect to moose from habitat loss and degradation arising from the effects of the Project in combination with those of all other past, present, and reasonably foreseeable future projects and activities is characterized as follows:

- Duration: *Long-term and permanent*, as some lost habitat will be restored prior to the end of the Post-Closure phase and the remainder not restored until forest is established after the Post-Closure phase.
- Magnitude: *Moderate*, there will be an overall 5.6% loss of high-quality moose habitat in spring-summer and 5.1% loss of high-quality moose habitat in fall-winter in the Terrestrial RSA due to the development of the Project and all reasonably foreseeable future projects and activities.

Crown Mountain Coking Coal Project

Figure 15.4-23
High-Quality Moose Fall-Winter Habitat and Reasonably Foreseeable Future Projects and Activities in the Terrestrial Regional Study Area

LEGEND

- High-Quality Moose Fall-Winter Habitat
- Reasonably Foreseeable Future Projects and Activities
- Terrestrial Regional Study Area
- Terrestrial Local Study Area
- Crown Mountain Coking Coal Project
- Highway
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- National Park
- British Columbia/Alberta Border

0 15 30
Kilometres

Scale 1:700,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
Imagery Provided By ESRI.

Map Created By: LMM
Map Checked By: HEB
Map Coordinate System: NAD 1983 UTM Zone 11N

NWP Coal Canada Ltd

Project: 12-6231
Status: FINAL
Date: 2022-01-18

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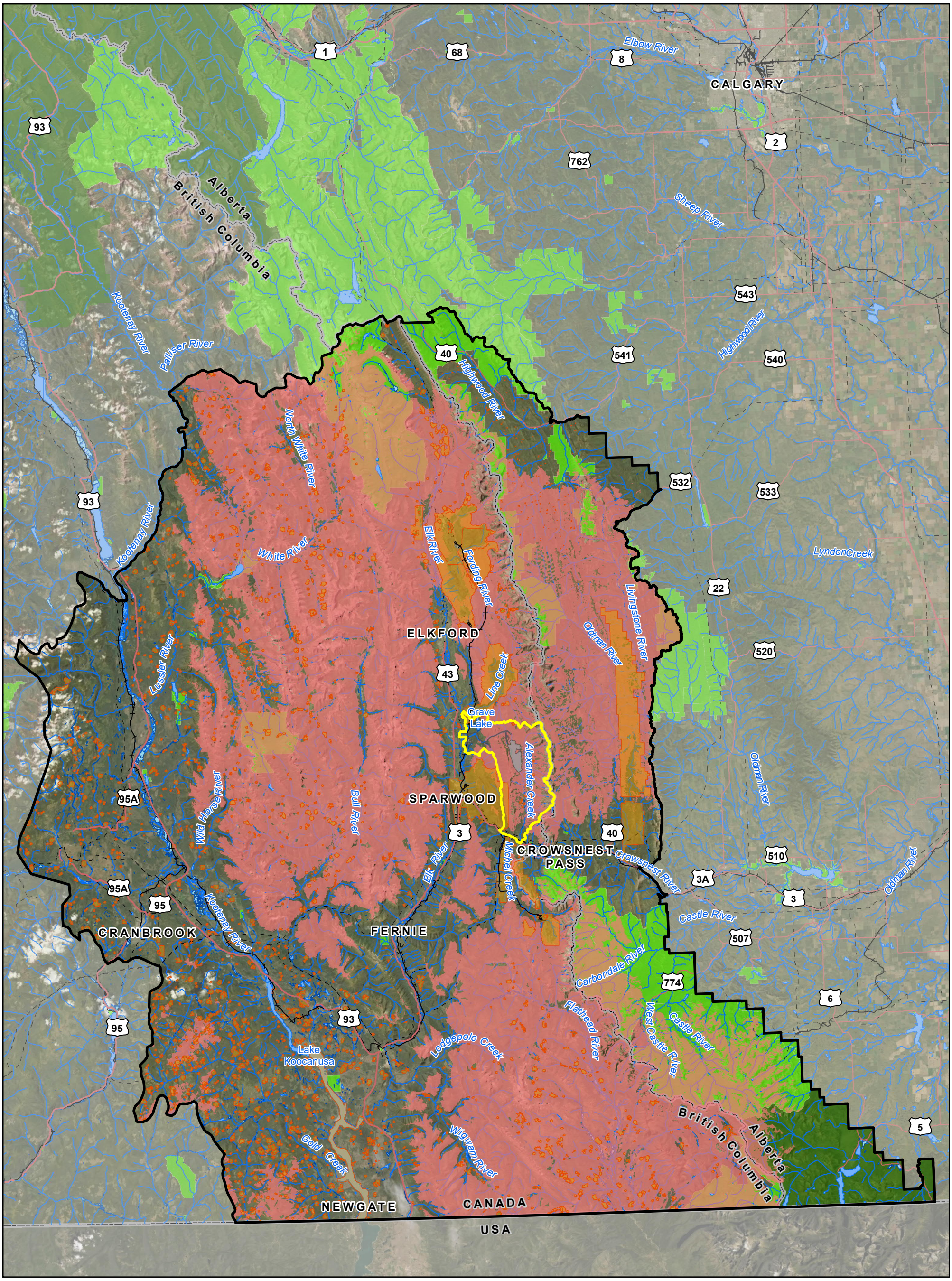

Crown Mountain Coking Coal Project

Figure 15.4-24
High-Quality Moose Spring-Summer Habitat and Reasonably Foreseeable Future Projects and Activities in the Terrestrial Regional Study Area

LEGEND

- High-Quality Moose Spring-Summer Habitat
- Reasonably Foreseeable Future Projects and Activities
- Terrestrial Regional Study Area
- Terrestrial Local Study Area
- Crown Mountain Coking Coal Project
- Highway
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- National Park
- British Columbia/Alberta Border

0 15 30
Kilometres

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Scale 1:700,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
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Project: 12-6231
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The Project contribution to these losses is expected to be a 0.06% loss of high-quality moose habitat in fall-winter and 0.11% loss of high-quality moose habitat in spring-summer in the Terrestrial RSA.

- Geographic Extent: *Regional*, as the effect of habitat loss of the Future Case will be in the Terrestrial RSA.
- Frequency: *Continuous*, the effect of habitat loss and degradation is expected to be continuous until lost habitat is restored.
- Reversibility: *Reversible long-term*, the effect of habitat loss is anticipated to be reversed, though not fully for many years after Post-Closure.
- Context: *Neutral*, moose present within the Terrestrial RSA will be able to utilize alternate areas and thus have a degree of resiliency, though are sensitive to loss of habitat at the landscape scale.

Sensory Disturbance

Many present and reasonably foreseeable future projects and activities generate noise, vibration, light, and dust which may affect suitable moose habitat. A quantitative approach could not be used for the cumulative effects of sensory disturbance because of the difficulty in assigning zones of influence or avoidance to all reasonably foreseeable future projects and activities when design details (and resulting noise, vibration, light, and dust) of those other projects or activities are not available. All reasonably foreseeable future projects and activities included in the Future Case are either new coal mines or coal mine expansions. The effect of sensory disturbance is highly dependent on the distribution of moose habitat, project activities, and on topography and land cover; however, it may be reasonable to use the results of the Crown Mountain Coking Coal Project-level sensory disturbance analysis for moose (Section 15.4.3.4.2) as an indication of the amount of moose habitat that may be affected by noise from other reasonably foreseeable future projects or activities. The Project-level sensory disturbance analysis for moose found that the area potentially affected by continuous noise outside the Project footprint is up to 87% of the amount of high-quality moose habitat in fall-winter and up to 76% of high-quality spring-summer habitat within the Project footprint. If these proportional estimates are applied to the proportional loss of high-quality habitat for the Future Case (presented in the previous section in Table 15.4-28), then roughly 3 to 5% of high-quality moose habitat in both fall-winter and spring-summer will be affected by sensory disturbance outside of the project footprints. This may be an overestimate as sensory disturbance is not generated continuously from all portions of any given project area and not all projects are likely to be generating noise in overlapping time periods.

The residual cumulative effect to moose from sensory disturbance arising from the effects of the Project in combination with those of other past, present, and reasonably foreseeable future projects or activities is characterized as follows:

- Duration: *Long-term*, as sensory disturbance will continue through to the end of the Operations phases of both the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Magnitude: *Low*, as up to 5% of high-quality habitat will be affected in the Terrestrial RSA.
- Geographic Extent: *Regional*, as the effect of sensory disturbance will be within the Terrestrial RSA.
- Frequency: *Continuous,* though at varying levels till the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.

- Reversibility: *Reversible long-term*, the effect of noise will decline substantially at the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Context: *Neutral*, moose have neutral sensitivity and resilience to disruption noise and may be able to adapt to certain levels of noise.

Disruption to Movement

Many present and reasonably foreseeable future projects and activities create impermeable barriers (e.g., pits and dumps at mines) or semi-permeable barriers (e.g., roads and other linear features) for wildlife. While each of the existing and reasonably foreseeable future projects and activities may block movements to varying degrees, they are geographically separated from the Crown Mountain Coking Coal Project such that additive barriers with the Project are limited (Figure 15.4-23 and Figure 15.4-24).

The residual cumulative effect to moose from disruption to movement arising from the effects of the Project in combination with those of other past, present, and reasonably foreseeable future projects or activities is characterized as follows:

- Duration: *Long-term*, as disruption to movement will continue through to the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Magnitude: *Low*, given the geographic distribution of current and reasonably foreseeable future projects and activities.
- Geographic Extent: *Regional*, as disruption to movement is limited to within the Terrestrial RSA.
- Frequency: *Continuous,* as the effect will continue through to the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Reversibility: *Reversible long-term*, the effect will decline substantially at the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Context: *Neutral*, moose have neutral sensitivity and resilience to disruption to movement and may be able to adapt to altered movement corridors.

Increased Mortality Risk

The effect of the Project on increased risk of moose mortality may combine with those of other reasonably foreseeable future projects and activities to produce a cumulative increase in mortality risk. The main pathways are from increased vehicle traffic resulting in increased moose-vehicle collisions and increased hunter access. The change in road density between the Base Case and Future Case can be used as an index that reflects the degree to which the risk of mortality may change. Road density for the Base Case is 1.7 km/km^2 and estimated to be 1.4 km/km^2 in the Future Case, a decline of 18%.

The residual cumulative effect to moose from increased mortality risk arising from the effects of the Project in combination with those of other past, present, and reasonably foreseeable future projects or activities is characterized as follows:

- Duration: *Long-term*, as some effects will continue to the end of Reclamation and Closure.
- Magnitude: *Negligible*, as mountain goat and bighorn sheep mortalities from vehicle collisions and hunter access are expected to decline due to a decline in road density in the Terrestrial RSA.

- Geographic Extent: *Discrete*, as the effect will be within the footprint of the Project as well as those of other past, present, and reasonably foreseeable future projects or activities.
- Frequency: *Intermittent*, as moose mortalities may be at sporadic intervals during any phase of the Project or other projects or activities.
- Reversibility: *Reversible long-term*, as the potential for increased mortality risk will end after Reclamation and Closure.
- Context: *High*, as any moose mortalities as a result of the Project are expected to be small relative to other sources of mortality.

Determination of Significance

There are approximately 4,000 to 7,000 moose in the East Kootenay region with a stable regional population trend (Government of B.C., 2017). Based on the characterization of the residual cumulative effects and regional moose population levels, the Project in combination with reasonably foreseeable future projects and activities would not limit the ability of moose to persist and maintain self-sustaining populations in the Terrestrial RSA, including within Alberta and the federal Dominion Coal Block Parcels 73 and 82. The residual cumulative effects of habitat loss and degradation, sensory disturbance, disruption to movement, and increased mortality risk on moose arising from the Project in combination with other past, present, and reasonably foreseeable future projects and activities during all phases are therefore considered not significant.

Likelihood and Confidence

Effects that are determined to be not significant do not require a characterization of likelihood.

There is a good understanding of moose ecology, their habitat availability and distribution, known occurrences, and abundance in the Terrestrial RSA. The confidence in the determination of the significance of residual cumulative effects to moose is therefore high.

15.4.4.4.3 Elk

Many present and future projects and activities occur within the distributional range of elk and in suitable habitat. The residual effects of habitat loss and degradation, sensory disturbance, disruption to movement, and increased mortality risk could potentially have a cumulative effect on elk.

Characterization of Residual Cumulative Effects

Habitat Loss and Degradation

Most present and reasonably foreseeable future projects and activities occur within the range of elk and in potentially suitable habitat and thus may result in habitat loss or alteration of elk habitat (Figure 15.4-25 and Figure 15.4-26). The Base Case incorporates the cumulative loss or alteration of elk habitat as a result of past and present projects and was the basis for the assessment of the Project Case. For the Future Case that includes both the Project and all reasonably foreseeable future projects and activities, approximately 8.2% of fall-winter habitat and 6.1% of spring-summer high-quality elk habitat are predicted to be lost within the Terrestrial RSA (Table 15.4-29). The Project is predicted to contribute 0.10% of that loss in fall-winter, and 0.02% in spring-summer.

Crown Mountain Coking Coal Project

Figure 15.4-25
High-Quality Elk Fall-Winter Habitat and Reasonably Foreseeable Future Projects and Activities in the Terrestrial Regional Study Area

LEGEND

- High-Quality Elk Fall-Winter Habitat
- Reasonably Foreseeable Future Projects and Activities
- Terrestrial Regional Study Area
- Terrestrial Local Study Area
- Crown Mountain Coking Coal Project
- Highway
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- National Park
- British Columbia/Alberta Border

0 15 30
Kilometres

Scale 1:700,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
Imagery Provided By ESRI.

Map Created By: LMM
Map Checked By: HEB
Map Coordinate System: NAD 1983 UTM Zone 11N

NWP Coal Canada Ltd

Project: 12-6231
Status: FINAL
Date: 2022-01-18

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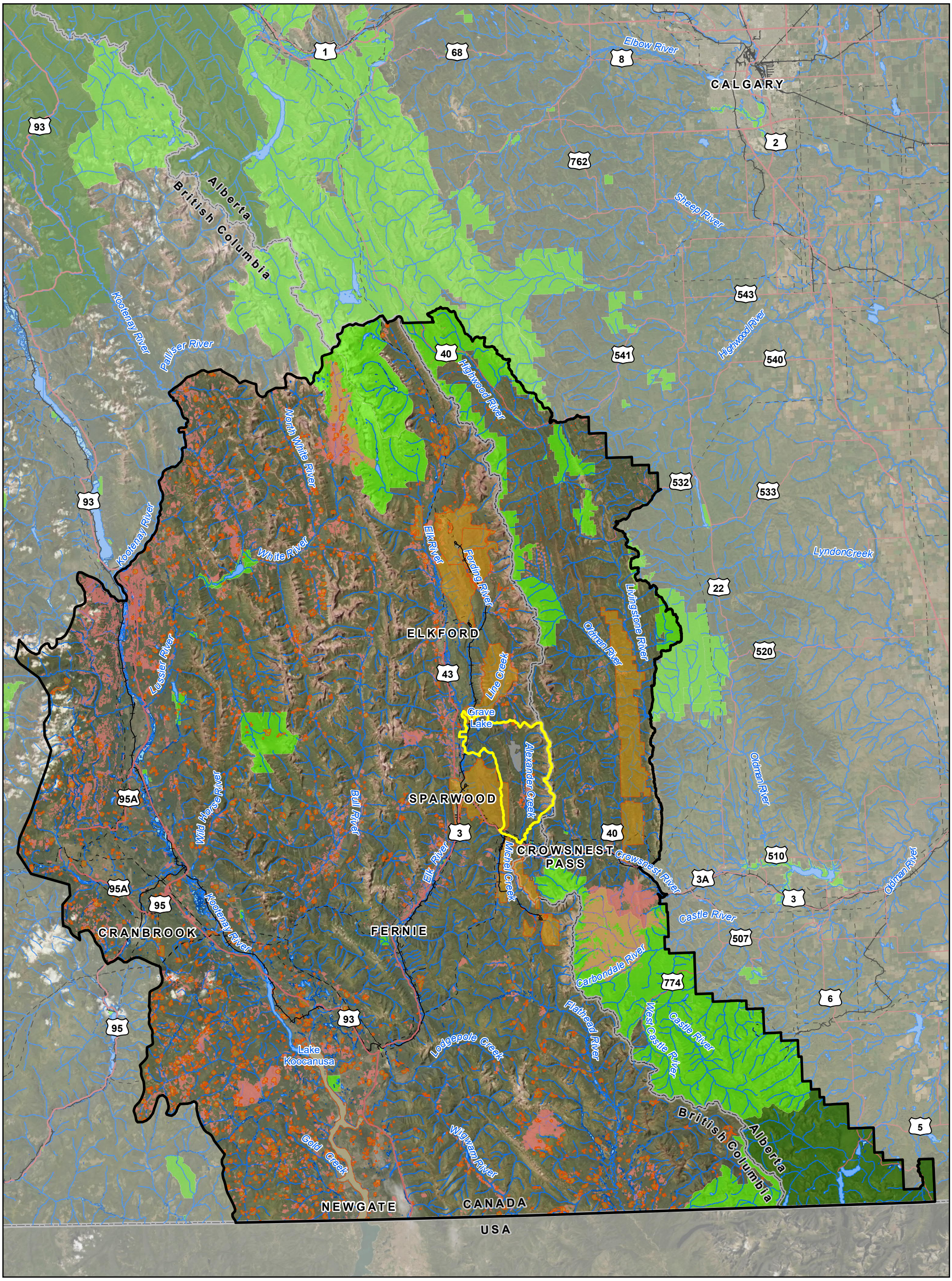

Crown Mountain Coking Coal Project

Figure 15.4-26
High-Quality Elk Spring-Summer Habitat and Reasonably Foreseeable Future Projects and Activities in the Terrestrial Regional Study Area

LEGEND

- High-Quality Elk Spring-Summer Habitat
- Reasonably Foreseeable Future Projects and Activities
- Terrestrial Regional Study Area
- Terrestrial Local Study Area
- Crown Mountain Coking Coal Project
- Highway
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- National Park
- British Columbia/Alberta Border

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Scale 1:700,000

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The effects of habitat loss and alteration due to forestry is a more complicated prediction. Logging can increase habitat quality for elk by removing overstory cover and creating early seral habitats that provide higher levels of forage than mature stands (described previously in Section 15.4.2.1.2). Conversely, the removal of old and mature coniferous forest cover from logging can be detrimental for elk, as forests provide security cover from predation, access to browse (i.e., reduced snow depths and forage), and shelter from the elements. Given the potential combination of beneficial and detrimental effects on elk, the effect of forestry on elk is assumed to be neutral.

Table 15.4-29: Change in High-Quality Elk Habitat for the Base Case, the Project Case, and the Future Case in the Terrestrial RSA

VC	Season	Amount (ha) of High-Quality Habitat (Change from Base Case in Brackets)			Change as Proportion of Terrestrial RSA	
		Base Case	Project Case	Future Case	Base Case to Project Case	Base Case to Future Case
Elk	Fall-Winter	182,849	182,659 (-191)	167,936 (-14,914)	-0.10%	-8.2%
Elk	Spring-Summer	133,329	133,306 (-23)	125,208 (-8,121)	-0.02%	-6.1%

The residual cumulative effect to elk from habitat loss and degradation arising from the effects of the Project in combination with those of all other past, present, and reasonably foreseeable future projects and activities is characterized as follows:

- Duration: *Long-term and permanent*, as some lost habitat will be restored prior to the end of the Post-Closure phase and the remainder not restored until forest is established after the Post-Closure phase.
- Magnitude: *Moderate*, there will be an overall 8.2% loss of high-quality elk habitat in spring-summer and 6.1% loss of high-quality elk habitat in fall-winter in the Terrestrial RSA due to the development of the Project and all reasonably foreseeable future projects and activities. The Project contribution to these losses is expected to be a 0.1% loss of high-quality elk habitat in fall-winter and 0.02% loss of high-quality elk habitat in spring-summer in the Terrestrial RSA.
- Geographic Extent: *Regional*, as the effect of habitat loss of the Future Case will be in the Terrestrial RSA.
- Frequency: *Continuous*, the effect of habitat loss and degradation is expected to be continuous until lost habitat is restored.
- Reversibility: *Reversible long-term*, the effect of habitat loss is anticipated to be reversed, though not fully for many years after Post-Closure.
- Context: *High*, elk present within the Terrestrial RSA will be able to utilize alternate areas and have low sensitivity and high resilience to human activities.

Sensory Disturbance

Many present and reasonably foreseeable future projects and activities generate noise, vibration, light, and dust which may affect suitable elk habitat. A quantitative approach could not be used for the cumulative effects of sensory disturbance because of the difficulty in assigning zones of influence or avoidance to all reasonably foreseeable future projects and activities when design details (and resulting noise, vibration, light, and dust) of those other projects or activities are not available. All reasonably foreseeable future projects and activities included in the Future Case are either new coal mines or coal

mine expansions. The effect of sensory disturbance is highly dependent on the distribution of elk habitat, project activities, and on topography and land cover; however, it may be reasonable to use the results of the Crown Mountain Coking Coal Project-level sensory disturbance analysis for elk (Section 15.4.3.4.3) as an indication of the amount of elk habitat that may be affected by noise from other reasonably foreseeable future projects or activities. The Project-level sensory disturbance analysis for elk found that the area potentially affected by continuous noise outside the Project footprint is up to 35% of the amount of high-quality elk habitat in fall-winter and up to 96% of high-quality spring-summer habitat within the Project footprint. If these proportional estimates are applied to the proportional loss of high-quality habitat for the Future Case (presented in the previous section in Table 15.4-29), then roughly <1% of high-quality elk habitat in both fall-winter and spring-summer will be affected by sensory disturbance outside of the project footprints. This may be an overestimate, as sensory disturbance is not generated continuously from all portions of any given project area, and not all projects are likely to be generating noise in overlapping time periods.

The residual cumulative effect to elk from sensory disturbance arising from the effects of the Project in combination with those of other past, present, and reasonably foreseeable future projects or activities is characterized as follows:

- Duration: *Long-term*, as sensory disturbance will continue through to the end of the Operations phases of both the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Magnitude: *Low*, as less than 1% of high-quality habitat will be affected in the Terrestrial RSA.
- Geographic Extent: *Regional*, as the effect of sensory disturbance will be within the Terrestrial RSA.
- Frequency: *Continuous,* though at varying levels till the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Reversibility: *Reversible long-term*, the effect of noise will decline substantially at the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Context: *High*, elk have low sensitivity and high resilience to human activities.

Disruption to Movement

Many present and reasonably foreseeable future projects and activities create impermeable barriers (e.g., pits and dumps at mines) or semi-permeable barriers (e.g., roads and other linear features) for wildlife. While each of the existing and reasonably foreseeable future projects and activities may block movements to varying degrees, they are geographically separated from the Crown Mountain Coking Coal Project such that additive barriers with the Project are limited (Figure 15.4-25 and Figure 15.4-26).

The residual cumulative effect to elk from disruption to movement arising from the effects of the Project in combination with those of other past, present, and reasonably foreseeable future projects or activities is characterized as follows:

- Duration: *Long-term*, as disruption to movement will continue through to the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.

- Magnitude: *Low*, given the geographic distribution of current and reasonably foreseeable future projects and activities.
- Geographic Extent: *Regional*, as disruption to movement is limited to within the Terrestrial RSA.
- Frequency: *Continuous,* as the effect will continue through to the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Reversibility: *Reversible long-term*, the effect will decline substantially at the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Context: *High*, elk have low sensitivity and high resilience to human activities.

Increased Mortality Risk

The effect of the Project on increased risk of elk mortality may combine with those of other reasonably foreseeable future projects and activities to produce a cumulative increase in mortality risk. The main pathways are from increased vehicle traffic resulting in increased elk-vehicle collisions and increased hunter access. The change in road density between the Base Case and Future Case can be used as an index that reflects the degree to which the risk of mortality may change. Road density for the Base Case is 1.7 km/km^2 and estimated to be 1.4 km/km^2 in the Future Case, a decline of 18%.

The residual cumulative effect to elk from increased mortality risk arising from the effects of the Project in combination with those of other past, present, and reasonably foreseeable future projects or activities is characterized as follows:

- Duration: *Long-term*, as some effects will continue to the end of Reclamation and Closure.
- Magnitude: *Negligible*, as elk mortalities from vehicle collisions and hunter access are expected to decline due to a decline in road density in the Terrestrial RSA.
- Geographic Extent: *Discrete*, as the effect will be within the footprint of the Project as well as those of other past, present and reasonably foreseeable future projects or activities.
- Frequency: *Intermittent*, as elk mortalities may be at sporadic intervals during any phase of the Project or other projects or activities.
- Reversibility: *Reversible long-term*, as the potential for increased mortality risk will end after Reclamation and Closure.
- Context: *High*, as any elk mortalities as a result of the Project are expected to be small relative to other sources of mortality.

Determination of Significance

There are approximately 15,000 to 24,000 elk in the East Kootenay region with a stable regional population trend (Government of B.C., 2017). Based on the characterization of the residual cumulative effects and regional elk population levels, the Project in combination with reasonably foreseeable future projects and activities would not limit the ability of elk to persist and maintain self-sustaining populations in the Terrestrial RSA, including within Alberta and the federal Dominion Coal Block Parcels 73 and 82. The residual cumulative effects of habitat loss and degradation, sensory disturbance, disruption to movement, and increased mortality risk on elk arising from the Project in combination with other past, present, and reasonably foreseeable future projects and activities during all phases are therefore considered not significant.

Likelihood and Confidence

Effects that are determined to be not significant do not require a characterization of likelihood.

There is a good understanding of elk ecology, their habitat availability and distribution, known occurrences, and abundance in the Terrestrial RSA. The confidence in the determination of the significance of residual cumulative effects to elk is therefore high.

15.4.4.4.4 Bighorn Sheep and Mountain Goat

Many present and future projects and activities occur within the distributional range of bighorn sheep and mountain goat and within their suitable habitat. The residual effects of habitat loss and degradation, sensory disturbance, disruption to movement, and increased mortality risk could potentially have a cumulative effect on bighorn sheep and mountain goat.

Characterization of Residual Cumulative Effects

Habitat Loss and Degradation

Several present and reasonably foreseeable future projects and activities occur within the range of bighorn sheep and mountain goat and in potentially suitable habitat and thus involve habitat loss or alteration of bighorn sheep (Figure 15.4-27) and mountain goat (Figure 15.4-28) habitats. The Base Case incorporates the cumulative loss or alteration of bighorn sheep and mountain goat habitat as a result of past and present projects and was the basis for the assessment of the Project Case. For the Future Case that includes both the Project and all reasonably foreseeable future projects and activities, approximately 2.7% of year-round high-quality bighorn sheep habitat is predicted to be lost within the Terrestrial RSA (Table 15.4-30). The Project is predicted to contribute 0.05% of that loss. Approximately 1.7% of year-round high-quality mountain goat habitat is predicted to be lost within the Terrestrial RSA (Table 15.4-30). The Project is predicted to contribute 0.03% of that loss.

Table 15.4-30: Change in High-Quality Bighorn Sheep and Mountain Habitat for the Base Case, the Project Case, and the Future Case in the Terrestrial RSA

VC	Season	Amount (ha) of High-Quality Habitat (Change from Base Case)			Change as Proportion of RSA	
		Base Case	Project Case	Future Case	Base Case to Project Case	Base Case to Future Case
Bighorn Sheep	Year-round	395,554	395,352 (-202)	384,815 (-10,739)	-0.05%	-2.7%
Mountain Goat	Year-round	147,320	147,269 (-50)	144,757 (-2,563)	-0.03%	-1.7%

The residual cumulative effect to bighorn sheep and mountain goat from habitat loss and degradation arising from the effects of the Project in combination with those of all other past, present, and reasonably foreseeable future projects and activities is characterized as follows:

- Duration: *Long-term*, as some lost habitat will be restored prior to the end of the Post-Closure phase.

Crown Mountain Coking Coal Project

Figure 15.4-27
High-Quality Bighorn Sheep Year-round Habitat and Reasonably Foreseeable Future Projects and Activities in the Terrestrial Regional Study Area

LEGEND

- High-Quality Bighorn Sheep Year-round Habitat
- Reasonably Foreseeable Future Projects and Activities
- Terrestrial Regional Study Area
- Terrestrial Local Study Area
- Crown Mountain Coking Coal Project
- Highway
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Provincial Park/Protected Area
- National Park
- British Columbia/Alberta Border

0 15 30
Kilometres

N W E S

Scale 1:700,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
Imagery Provided By ESRI.

Map Created By: LMM
Map Checked By: HEB
Map Coordinate System: NAD 1983 UTM Zone 11N

NWP Coal Canada Ltd

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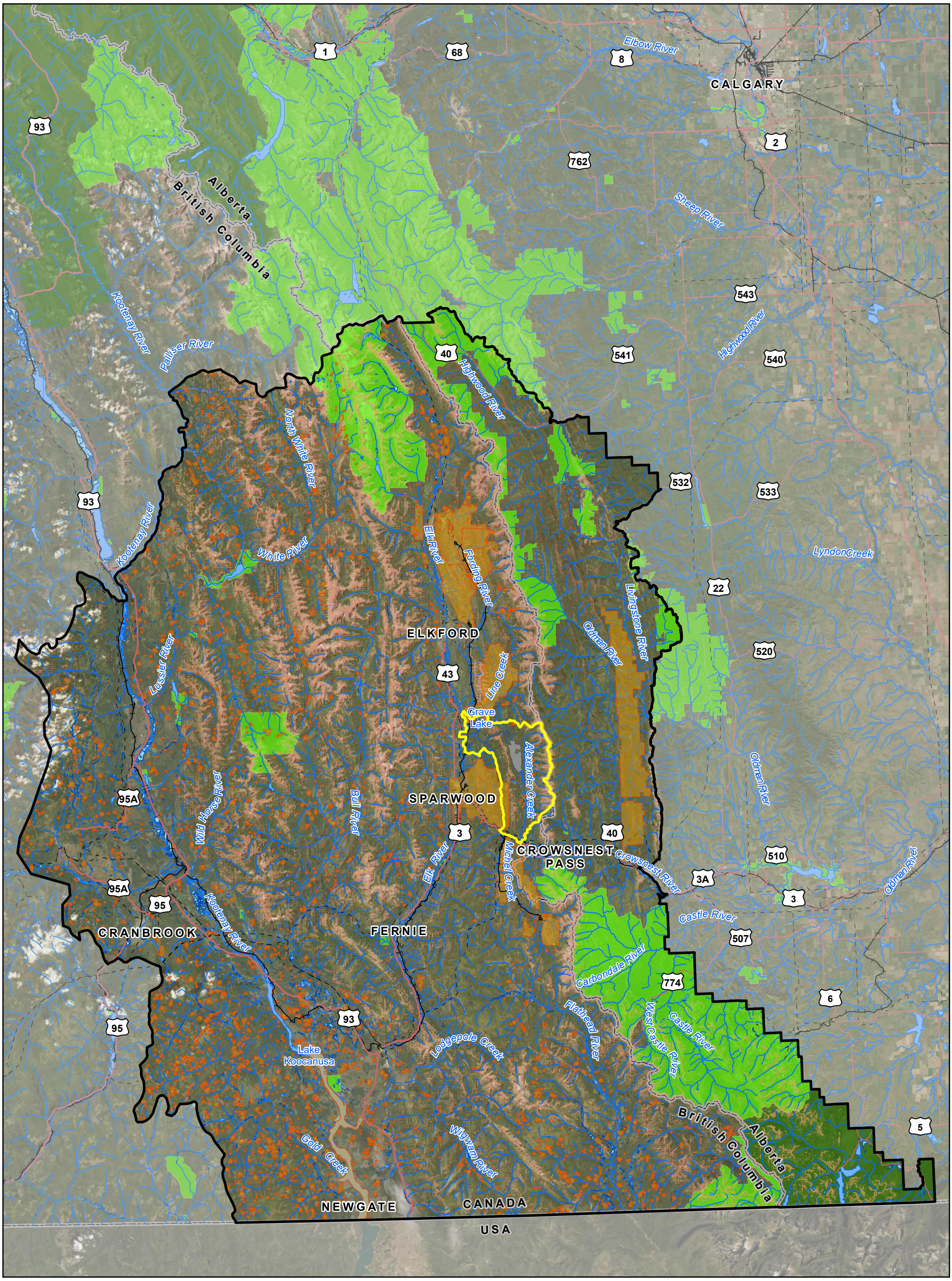

Crown Mountain Coking Coal Project

Figure 15.4-28
High-Quality Mountain Goat Year-round Habitat and Reasonably Foreseeable Future Projects and Activities in the Terrestrial Regional Study Area

LEGEND

- High-Quality Mountain Goat Year-round Habitat
- Reasonably Foreseeable Future Projects and Activities
- Terrestrial Regional Study Area
- Terrestrial Local Study Area
- Crown Mountain Coking Coal Project
- Highway
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- National Park
- British Columbia/Alberta Border

0 15 30
Kilometres

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Scale 1:700,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
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Date: 2022-01-18

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- Magnitude: *Low*, there will be a 2.7% loss of high-quality year-round bighorn sheep habitat and a 1.7% loss of high-quality year-round mountain goat habitat in the Terrestrial RSA due to the development of the Project and all reasonably foreseeable future projects and activities. The Project contribution to these losses is expected to be a 0.05% loss of high-quality year-round bighorn sheep habitat and a 0.03% loss of high-quality year-round mountain goat habitat in the Terrestrial RSA.
- Geographic Extent: *Regional*, as the effect of habitat loss of the Future Case will be in the Terrestrial RSA.
- Frequency: *Continuous*, the effect of habitat loss and degradation is expected to be continuous until lost habitat is restored.
- Reversibility: *Reversible long-term*, the effect of habitat loss is anticipated to be reversed, though not fully for many years after Post-Closure.
- Context: *Low*, as habitat for bighorn sheep and mountain goat is highly specific.

Sensory Disturbance

Many present and reasonably foreseeable future projects and activities generate noise, vibration, light, and dust which may affect suitable bighorn sheep and mountain goat habitat. A quantitative approach could not be used for the cumulative effects of sensory disturbance because of the difficulty in assigning zones of influence or avoidance to all reasonably foreseeable future projects and activities when design details (and resulting noise, vibration, light, and dust) of those other projects or activities are not available. All reasonably foreseeable future projects and activities included in the Future Case are either new coal mines or coal mine expansions. The effect of sensory disturbance is highly dependent on the distribution of bighorn sheep and mountain goat habitat, project activities, and on topography and land cover; however, it may be reasonable to use the results of the Crown Mountain Coking Coal Project-level sensory disturbance analysis for bighorn sheep and mountain goat (Section 15.4.3.4.4) as an indication of the amount of habitat that may be affected by noise from other reasonably foreseeable future projects or activities. The Project-level sensory disturbance analysis for bighorn sheep and mountain goat found that the area potentially affected by continuous noise outside the Project footprint is up to 167% of the amount of high-quality bighorn sheep habitat and 380% of the mountain goat habitat within the Project footprint. If these proportional estimates are applied to the proportional loss of high-quality habitat for the Future Case (presented in the previous section in Terrestrial RSA (Table 15.4-30), then roughly 4.5% and 6.6% of high-quality bighorn sheep and mountain goat habitat, respectively, will be affected by sensory disturbance outside of the project footprints. This may be an overestimate as sensory disturbance is not generated continuously from all portions of any given project area and furthermore, not all projects are likely to be generating noise in overlapping time periods. Furthermore, bighorn sheep and mountain goat habitat is patchily distributed and not present in proximity to some of the future projects or activities.

The residual cumulative effect to bighorn sheep and mountain goat from sensory disturbance is arising from the effects of the Project in combination with those of other past, present, and reasonably foreseeable future projects or activities characterized as follows:

- Duration: *Long-term*, as sensory disturbance will continue through to the end of the Operations phases of both the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Magnitude: *Low to moderate*, as 3.5 to 6.6% of high-quality habitat will be affected in the Terrestrial RSA.

- Geographic Extent: *Regional*, as the effect of sensory disturbance will be within the Terrestrial RSA.
- Frequency: *Continuous,* though at varying levels till the end of Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Reversibility: *Reversible long-term*, the effect of noise will decline substantially at the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Context: *High* for bighorn sheep as they have relatively low sensitivity to noise and may be able to adapt to certain levels of noise. *Low* for mountain goats as they have relatively high sensitivity to noise and may not be able to adapt to certain levels of noise.

Disruption to Movement

Many present and reasonably foreseeable future projects and activities create impermeable barriers (e.g., pits and dumps at mines) or semi-permeable barriers (e.g., roads and other linear features) for wildlife. While each of the existing and reasonably foreseeable future projects and activities may block movements to varying degrees, they are geographically separated from the Crown Mountain Coking Coal Project such that additive barriers with the Project are limited (Figure 15.4-27 and Figure 15.4-28).

The residual cumulative effect to bighorn sheep and mountain goat from disruption to movement arising from the effects of the Project in combination with those of other past, present, and reasonably foreseeable future projects or activities is characterized as follows:

- Duration: *Long-term*, as disruption to movement will continue through to the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Magnitude: *Low*, given the geographic distribution of current and reasonably foreseeable future projects and activities.
- Geographic Extent: *Regional*, as disruption to movement is limited to within the Terrestrial RSA.
- Frequency: *Continuous,* as the effect will continue through to the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Reversibility: *Reversible long-term*, the effect will decline substantially at the end of the Operations phases of the Crown Mountain Coking Coal Project and those of other reasonably foreseeable future projects and activities.
- Context: *High* for bighorn sheep as they have low sensitivity and high resilience to human activities. *Low* for mountain goat as they have high sensitivity to human activities.

Increased Mortality Risk

The effect of the Project on increased risk of bighorn sheep and mountain goat mortality may combine with those of other reasonably foreseeable future projects and activities to produce a cumulative increase in mortality risk. The main pathways are from increased vehicle traffic resulting in increased vehicle collisions and increased hunter access. The change in road density between the Base Case and Future Case can be used as an index that reflects the degree to which the risk of mortality may change. Road density for the Base Case is 1.7 km/km^2 and estimated to be 1.4 km/km^2 in the Future Case, a decline of 18%.

The residual cumulative effect to bighorn sheep and mountain goat from increased mortality risk arising from the effects of the Project in combination with those of other past, present, and reasonably foreseeable future projects or activities is characterized as follows:

- Duration: *Long-term*, as some effects will continue to the end of Reclamation and Closure.
- Magnitude: *Negligible*, as moose mortalities from vehicle collisions and hunter access are expected to decline due to a decline in road density in the Terrestrial RSA.
- Geographic Extent: *Discrete*, as the effect will be within the footprint of the Project as well as those of other past, present, and reasonably foreseeable future projects or activities.
- Frequency: *Intermittent*, as bighorn sheep and mountain goat mortalities may be at sporadic intervals during any phase of the Project or other projects or activities.
- Reversibility: *Reversible long-term*, as the potential for increased mortality risk will end after Reclamation and Closure.
- Context: *High*, as any bighorn sheep and mountain goat mortalities as a result of the Project are expected to be small relative to other sources of mortality.

Bighorn Sheep EV-CEMF Analysis

The amount of bighorn sheep winter range habitat (rank 3 and 4) was selected as the best indicator to evaluate the overall condition of bighorn sheep populations. Winter range habitat is considered essential for bighorn sheep population persistence during winter, and habitat ranks 3 and 4 are the most highly selected types.

The bighorn sheep that overlap with the Crown Mountain Coking Coal Project are members of the Erickson-Sheep Mountain sub-population. The hazard rating for the Erickson-Sheep Mountain sub-population for the current conditions is very-low, meaning little change in the total amount of rank 3 and 4 winter range habitat from historic conditions. For the prospective assessments, the Crown Mountain Coking Coal Project does not overlap with mapped rank 3 and 4 winter range habitat. Furthermore, no other reasonably foreseeable future project or activity overlaps with rank 3 and 4 winter range habitat for the Erickson-Sheep Mountain sub-population. Hazard indices for all scenarios therefore remain at very low hazard.

Not all bighorn sheep sub-populations have the same trend in hazard indices as the Erickson-Sheep Mountain population for the prospective assessments. The nearby Fording sub-population (which does not overlap with the Project and therefore has no potential for cumulative effects with the Crown Mountain Coking Coal Project) is predicted to move from high to very-high hazard for the cumulative effect scenarios 2 and 3 (reasonably foreseeable future projects plus natural disturbance).

A detailed description of the results is provided in MacHydro (2021; included as Appendix 13-F).

Determination of Significance

There are approximately 2,200 to 2,600 bighorn sheep in the East Kootenay region (Demarchi et al., 2000; Poole et al., 2016) and an estimated 515 to 770 individuals in the Elk Valley East Population Management Unit with a stable population trend (Poole et al., 2018; Poole and Ayotte, 2019). Mountain goat population trends indicate a stable to decreasing trend in southern B.C. (MGMT, 2010), and surveys completed in the Elk Valley in 2005 estimated 1,005 individuals (Poole and Klafki, 2005). Based on the characterization of the residual cumulative effects and regional bighorn sheep and mountain goat population levels, the

Project in combination with reasonably foreseeable future projects and activities would not limit the ability of bighorn sheep and mountain goat to persist and maintain self-sustaining populations in the Terrestrial RSA, including within Alberta and the federal Dominion Coal Block Parcels 73 and 82. The residual cumulative effects of habitat loss and degradation, sensory disturbance, disruption to movement, and increased mortality risk on bighorn sheep and mountain goat arising from the Project in combination with other past, present, and reasonably foreseeable future projects and activities during all phases are therefore considered not significant.

Likelihood and Confidence

Effects that are determined to be not significant do not require a characterization of likelihood.

There is a good understanding of bighorn sheep and mountain goat ecology, their habitat availability and distribution, known occurrences, and abundance in the Terrestrial RSA. The confidence in the determination of the significance of residual cumulative effects to bighorn sheep and mountain goat is therefore high.

15.4.4.5 Summary of Cumulative Effects Assessment

Residual cumulative effects and the selected mitigation measures, characterization criteria, significance determination, likelihood, and confidence for ungulate VCs are summarized in Table 15.4-31.

15.4.5 Follow-up Strategy

A follow-up program is used to verify environmental effects predictions or to verify the effectiveness of mitigation measures where there is uncertainty (i.e., low to moderate confidence). Where environmental effects exceed those predicted under the effects assessment, or mitigation measures prove to be ineffective, alternative strategies are developed to adaptively manage the Project's effects on wildlife VCs.

Two mitigation measures were identified as having uncertainty in their effectiveness: the overland conveyor underpasses and traffic-related mitigations at Grave Creek Canyon. Along the conveyor, underpasses will be created by elevating the conveyor to at least 2.4 m above ground (or higher where terrain can be used to create more clearance) at intervals of two per 1,000 m. Use of the conveyor underpasses and habitats adjacent to the conveyor will be dependent on the sensitivity of ungulate VCs to the physical presence of the conveyor and the noise that is generated. A program will be developed to monitor ungulate and other wildlife use of underpasses and areas immediately adjacent, using remote wildlife cameras.

A north-south corridor that connects Erickson Ridge to Sheep Mountain through Grave Creek Canyon is known to occur. Measures to mitigate the effects of increased traffic volume along Grave Creek Road on the frequency of crossing by wildlife will be implemented; however, there is uncertainty on their effectiveness. A program will be developed to monitor ungulate and other wildlife movement across Grave Creek Road at Grave Creek Canyon and in areas immediately adjacent (for comparison) using remote wildlife cameras, similar to the program for the overland conveyor.

Table 15.4-31: Summary of Cumulative Effects on Ungulate VCs

Valued Component	Residual Cumulative Effect	Mitigation Measures	Summary of Cumulative Residual Effects Characterization	Significance (Significant, Not Significant)	Confidence (High, Moderate, Low)
Moose	Habitat Loss and Degradation	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term and permanent Magnitude: Moderate Geographic Extent: Regional Frequency: Continuous Reversibility: Reversible long-term Context: Neutral	Not Significant	High
Moose	Sensory Disturbance	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term Magnitude: Low Geographic Extent: Regional Frequency: Continuous Reversibility: Reversible long-term Context: Neutral		
Moose	Disruption to Movement	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term Magnitude: Low Geographic Extent: Regional Frequency: Continuous Reversibility: Reversible long-term Context: Neutral		
Moose	Increased Mortality Risk	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term Magnitude: Negligible Geographic Extent: Discrete Frequency: Intermittent Reversibility: Reversible long-term Context: High		

Valued Component	Residual Cumulative Effect	Mitigation Measures	Summary of Cumulative Residual Effects Characterization	Significance (Significant, Not Significant)	Confidence (High, Moderate, Low)
Elk	Habitat Loss and Degradation	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term and permanent Magnitude: Moderate Geographic Extent: Regional Frequency: Continuous Reversibility: reversible long-term Context: High	Not Significant	High
Elk	Sensory Disturbance	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term Magnitude: Low Geographic Extent: Regional Frequency: Continuous Reversibility: Reversible long-term Context: High		
Elk	Disruption to Movement	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term Magnitude: Low Geographic Extent: Regional Frequency: Continuous Reversibility: Reversible long-term Context: High		
Elk	Increased Mortality Risk	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term Magnitude: Negligible Geographic Extent: Discrete Frequency: Intermittent Reversibility: Reversible long-term Context: High		

Valued Component	Residual Cumulative Effect	Mitigation Measures	Summary of Cumulative Residual Effects Characterization	Significance (Significant, Not Significant)	Confidence (High, Moderate, Low)
Bighorn Sheep And Mountain Goat	Habitat Loss and Degradation	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term Magnitude: Low Geographic Extent: Regional Frequency: Continuous Reversibility: Reversible long-term Context: Low	Not Significant	High
Bighorn Sheep And Mountain Goat	Sensory Disturbance	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term Magnitude: Low to moderate Geographic Extent: Regional Frequency: Continuous Reversibility: Reversible long-term Context: High (bighorn sheep), low (mountain goat)		
Bighorn Sheep And Mountain Goat	Disruption to Movement	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term Magnitude: Low Geographic Extent: Regional Frequency: Continuous Reversibility: Reversible long-term Context: High (bighorn sheep), low (mountain goat)		
Bighorn Sheep And Mountain Goat	Increased Mortality Risk	• Minimizing local Project-related effects • Participate in regional initiatives where relevant and appropriate and adoption of new management practices and measures to meet regional planning objectives where possible	Duration: Long-term Magnitude: Negligible Geographic Extent: Discrete Frequency: Intermittent Reversibility: Reversible long-term Context: High		

Other wildlife monitoring outlined in the Wildlife Management and Monitoring Plan (Chapter 33, Section 33.4.1.13) to support the verification of mitigation measures and effects predictions relating to ungulates VCs will include:

- Monitoring of footprint and habitat losses/gains to track and compare the planned footprint with the actual footprint and to track ecological restoration;
- Recording and reporting on wildlife mortality, incidents, accidents, or near misses; and
- Monitoring of species occurrence at the local level by Project personnel documenting incidental observations of wildlife (i.e., wildlife sighting and incidents).

15.4.6 Summary and Conclusions

Moose, elk, bighorn sheep, and mountain goat (bighorn sheep and mountain goat considered as one VC) were selected as ungulate VCs. The potential effects of the Project on ungulate VCs were determined to be habitat loss and degradation, sensory disturbance, disruption to movement, and increased mortality risk. The effect of potential contaminants of concern on ungulates was included in the Human and Ecological Health Assessment (Chapter 22). Various mitigation measures will avoid or minimize potential effects to ungulate VCs, though potential residual effects may remain. These residual effects were determined to be not significant. The residual cumulative effects of habitat loss and degradation, sensory disturbance, disruption to movement, and increased mortality risk on ungulate VCs arising from the Project in combination with other past, present, and reasonably foreseeable future projects and activities were considered not significant. The confidence in the determination of significance was considered high. Follow-up monitoring for ungulate VCs will include monitoring wildlife movement across Grave Creek Road at Grave Creek Canyon, monitoring of use of the overland conveyor wildlife underpasses, and footprint and facility monitoring.

15.5 Carnivore Community

15.5.1 Introduction

Five carnivore species are identified as VCs under the provincial AIR (EAO, 2018). There are seventeen species belonging to the order Carnivora that occur within the Terrestrial RSA: grizzly bear (*Ursus arctos*), black bear (*Ursus americanus*), grey wolf (*Canis lupus*), coyote (*Canis latrans*), cougar (*Puma concolor*), Canada lynx (*Lynx canadensis*), bobcat (*Lynx rufus*), wolverine (*Gulo gulo*), American badger (*Taxidea taxus*), American marten (*Martes americana*), red fox (*Vulpes vulpes*), ermine (*Mustela erminea*), mink (*Neovison vison*), long-tailed weasel (*Mustela frenata*), river otter (*Lontra canadensis*), and striped skunk (*Mephitis mephitis*). Fisher (*Martes pennanti*) also exist in low populations across B.C.; however, fisher have likely been extirpated from the southern Rocky Mountain ranges, including the Terrestrial RSA (Weir, 2003). The carnivore community effects assessment focuses on species at risk, species with large space requirements, demonstrated sensitivities to disturbance, and species of social, cultural, and economic importance (Section 15.2.1; Table 15.2-2). The selected VCs belong to three families within the Order Carnivora: Ursidae (bears), Mustelidae (weasels), and Felidae (cats). The specific carnivore VC species are as follows:

- Grizzly bear;
- Wolverine;
- American badger;
- American marten; and

- Canada lynx.

These species were selected to capture carnivore VCs identified in the AIR (EAO, 2018) and form the foundation by which potential effects on the carnivore community are evaluated.

Carnivores are important for ecosystem health and function, regulating prey population numbers and distribution through carnivory (Ripple et al., 2014). Due to their large space requirements and naturally low population densities and reproductive rates, carnivores are sensitive to landscape change resulting in habitat loss (including loss of prey), habitat fragmentation (i.e., loss of connectivity), and mortality (Carroll et al., 2001; Ripple et al., 2014). Given that carnivores' distributional patterns can be strong indicators of functioning ecosystems and regional-scale population processes, their conservation management is a priority in the Rocky Mountain region (Carroll et al., 2001).

15.5.1.1 Regulatory and Policy Considerations

Applicable provincial and federal legislation, guidelines, standards, and BMPs related to the protection of wildlife and wildlife habitat in general are summarized in Section 15.1.1. Provided below are regulatory and policy considerations specific to carnivore VCs.

15.5.1.1.1 Grizzly Bear

The grizzly bear is federally a species of Special Concern under the *Species at Risk Act* (SARA; 2002; COSEWIC, 2012a; Government of Canada, 2018), and vulnerable to extirpation or extinction in B.C. (i.e., Blue-listed; Provincial Conservation Status: S3; B.C. CDC, 2005a). As a species of Special Concern, grizzly bears have the potential to become threatened or endangered as a result of a combination of biological characteristics and identified external threats (Environment Canada, 2007a). Factors contributing to grizzly bear vulnerability include small population sizes, habitat loss and degradation, direct mortality (e.g., road mortality, illegal hunting), and indirect mortality (i.e., population fragmentation, loss of gene flow; B.C. CDC, 2005a, COSEWIC, 2012a; Government of Canada, 2018). Grizzly bears are an apex omnivore and are important to ecosystem function (Peek et al., 2003; Lamb et al., 2016). As grizzly bears require large tracts of habitat to maintain population viability, the species is a good indicator of biodiversity and their protection can benefit numerous other species such as wolverine and Canada lynx (Peek et al., 2003).

Grizzly bears are managed as big game under the B.C. *Wildlife Act* (1996); however, as of 2018, there is a permanent ban on grizzly bear hunting in B.C. Grizzly bears are protected under the *Forest and Range Practices Act* (FRPA; 2002), which on Crown land enables the designation of Wildlife Habitat Areas (WHAs) and associated management practices (General Wildlife Measures) to protect important grizzly bear habitats as specified in the Accounts and Measures for Managing Identified Wildlife (British Columbia Ministry of Water, Lands, and Air Protection [MWLAP], 2004). Recommended guidelines for the management of grizzly bear populations and their habitat that are relevant to the Project are summarized in Table 15.5-1. Currently, the threat level of the South Rockies GBPU is considered high, with transportation and service corridors, and resource use (hunting and logging) being the primary threats (Morgan et al., 2020). The Kootenay Boundary Land Use Plan (KBLUP) provides management guidelines on conserving grizzly bear habitat and populations and minimizing bear-human interactions (Kootenay Inter-Agency Management Committee (KIAMC), 1997). Specific management objectives of the KBLUP pertaining to grizzly bear and relevant to the Project are described in Table 15.5-2.

Table 15.5-1: Recommended Guidelines for Grizzly Bear Management in B.C.[13]

Management Objective	Recommendation
Habitat Management	• Maintain or restore grizzly bear foraging opportunities and habitat effectiveness across the landscape and over time • Determine current and future forage values and habitat effectiveness of planning area • Consider management of early seral stages to recover habitat effectiveness where developments reduce the effectiveness of habitat within a landscape, where forest succession is reducing foraging values, or where restoration is an objective, • Manage landscapes for steady levels of early seral habitat to avoid "booming" and "busting" forage supply • Lower conifer stocking levels to provide grizzly bear forage • In Natural Disturbance Types (NDTs) 1-3, retain 50% of the largest pieces of coarse woody debris in decay classes 1-2 for summer foraging on ants • Do not use broadcast vegetation management methods in capable watersheds, except where stand establishment is the objective and these methods are required • Do not use sheep, domestic goats, or cattle for vegetation management in occupied grizzly bear habitat to reduce conflict • Conduct controlled burning to improve berry production • Plan for extended rotations to recover mature and old-growth characteristics (open canopies, higher understorey forage) • Implement thinning/pruning to maintain open stands and reopen closed canopies to recover productive shrub understories, considering uneven spacing to maximize forage benefit
Mitigate Threats: Disturbance Management	• Remove ballast from roads across avalanche chutes. Remove bridges when permanently deactivating roads. • Promote one-side development (i.e., road construction and harvesting on one side of a valley at a time) • Revegetate temporary access, roads, and landings with non-forage species to minimize mortality risk of bears • Minimize the impact of open roads on grizzly bears • Schedule forestry activities to avoid displacing bears from preferred habitat during periods of seasonal use • Provide windfirm visual screening along roads to provide security (i.e., do not conduct vegetation management or stand tending adjacent to roads) • Consider establishing zones where range permits will be gradually removed and no new permits issued to reduce direct and indirect conflicts with grizzly bears • Maintain "attractant" free main and fly-in camps, ensuring adequate food storage and garbage management

[13] Adapted from BC Accounts and Measures for Managing Identified Wildlife: Grizzly Bear (Gyug et al., 2004). Retrieved from http://www.env.gov.bc.ca/wld/frpa/iwms/documents/Accounts_and_Measures_South.pdf

Table 15.5-2: Recommended Guidelines for Grizzly Bear Management from the Kootenay Boundary Land Use Plan Applicable to the Project[14]

Operational Guidelines	Recommendations
Interim Direction	• Focus on grizzly bear management should be relative to avalanche chutes, access requirements, and site-specific identification of feeding and denning habitat sites
Access Management	• Specific direction for access management within and around critical grizzly bear habitat includes: o Emphasizing a concentration of resource development and active roads to small portions of a drainage at any one time, in contrast to concurrent dispersed development activities o Where necessary, roads for other resource activities will be regulated through specific permitting conditions identified through an enhanced referral o Avoiding roads, where possible, in high-elevation post-wildfire shrubfields, riparian habitat, seepage areas and avalanche slopes o Identifying specific measures through resource development plans that result in effective permanent or seasonal closures, such reclaiming road designed for short-term access to cutting and/or mineral exploration areas and designing main haul roads to incorporate effective physical road closures at impassable barriers, such as river crossings. o The priority for access management planning and activities will be where priority grizzly bear habitat overlaps with regional connectivity corridors.
Attractant Management	• Locations for new sanitary landfills should avoid Conservation Management Areas, or if not possible, there should be a waste management plan/permit which must include plans to minimize attractants for Grizzly Bears. • Existing landfills in Conservation Management Areas should be reviewed by BCE staff, and where necessary, a management plan developed to minimize attraction to the area. If landfills occur in key bear habitat and there is a history of problem bears, they should be closed or modified as bear-proof. • All work camps in bear habitat should incinerate garbage at least daily, or provide bear-proof garbage containers. These requirements should be included in all permits for activities involving the establishment of camps. All Ministry of Forests, B.C. Parks and private campsites should eliminate waste disposal containers and require users to independently store and remove their waste from the site.

B.C. Grizzly Bear Conservation Strategy (1995)

The B.C. Grizzly Bear Conservation Strategy (MELP, 1995) provides guidance to maintain viable grizzly bear populations throughout the province. As part of the strategy, grizzly bear distribution throughout the province was divided into 56 Grizzly Bear Population Units (GBPUs) that delineate individual populations. The delineation of GBPUs was based on physical features that act as boundaries to grizzly bear movement. The Project is located within the South Rockies GBPU, which includes the WMUs 4-21 to 4-24. Currently, the threat level of the South Rockies GBPU is considered high, with transportation and service corridors, and resource use (hunting and logging) being the primary threats (Morgan et al., 2020). The goals and objectives of this strategy focus on three major issues (MELP, 1995):

[14] Adapted from the Kootenay/Boundary Land Use Plan Implementation Strategy (KIAMC, 1997). Retrieved from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/kootenayboundary-region/kootenayboundary-rlup/kootenayboundary_rlup_implementation_strategy.pdf

1. Loss and alienation of grizzly bear habitat;
2. Human interactions; and
3. International considerations.

Elk Valley Cumulative Effects Management Framework

The Grizzly bear Cumulative Effects Assessment considers effects to the Elk Valley populations of grizzly bears with four measurement indicators: availability of four key habitat types (avalanche chutes and alpine, huckleberry [*Vaccinium membranaceum*], and soopalallie [*Sheperdia canadensis*] habitat, early seral forest, and riparian habitat), discounted for human settlements and road density; habitat connectivity; human-caused mortality; and population trend (Mowat et al., 2018). Key recommendations to maintain and enhance grizzly bear populations and their habitat are identified in three levels of management responses: operational, tactical, and strategic (Table 15.5-3; Mowat et al., 2018). Recommendations focus on implementing mitigation measures to reduce human impacts on grizzly bear habitat and food availability, improving and implementing policies, and directing management of land and/or natural resources.

Table 15.5-3: Recommendations for Grizzly Bear Management from the Elk Valley Cumulative Effects Management Framework

Objective	Recommendation
Enhance Grizzly Bear Habitat Availability and Quality	• Implement road deactivation and management plan, with potential AMA amendments using CEMF • Consider amending private land regulations with respect to grizzly bear habitat requirements • Develop and implement mitigation options to reduce mortality on Highway 3 based on existing research • Apply prescribed burns in specific areas for encouraging berry growth • Monitor and control water quality on and off private industry sites • Encourage the application of best management practices (i.e., retention of existing forest, setting back forest ingrowth, reclamation using native forbs of high values) • Coordinate approaches for managing timber harvest and fire to preserve existing high value old forest and foraging habitat
Research and Monitoring	• Focus research on identifying wildlife migration routes, updated population estimates, and habitat mapping/condition every three to four years • Evaluate the effectiveness of existing Old Growth Management Areas (OGMAs) • Identify old forest retention and mature forest recruitment opportunities
Minimize Disturbance	• Manage attractants to reduce human-bear conflict • Coordinate access management between companies and sectors to ensure shared access and maintenance of resource roads, reducing the increase of road networks and ensuring existing roads are managed properly in terms of their influence on VCs • Minimize riparian disturbance • Apply landscape level fuel breaks to help protect old growth stands from wildfire

15.5.1.1.2 Wolverine

The wolverine is federally a species of Special Concern under the *Species at Risk Act* (COSEWIC, 2014; SARA, 2018) and vulnerable to extirpation or extinction in B.C. (i.e., Blue-listed; Provincial Conservation Status: S3; B.C. CDC, 2019a). The species is of Special Concern due to small population sizes, habitat loss and degradation, road mortality, and persecution (i.e., illegal killing; COSEWIC, 2014). Wolverine habitat has become increasingly fragmented due to industrial activity (especially in the southern portion of their range), increased motorized access and resulting increases in harvest pressure and loss of ungulate prey (COSEWIC, 2014). The species is sensitive to human disturbance and requires large areas to maintain viable populations (COSEWIC, 2014). Wolverines are thus considered a good indicator species of ecosystem health, due to their dependence on large, connected, and intact ecosystems (Carroll et al., 2001; COSEWIC, 2014). There is existing concern for wolverine populations in B.C. due to range contractions, habitat loss (including loss of prey) and fragmentation, loss of connectivity, and historical overharvest (Weir, 2004; Ruggiero et al., 2007; Mowat et al., 2020a).

Wolverines are managed as Class 2 furbearers under the B.C. Fur Management Program and as a big game species under the B.C. *Wildlife Act* (1996; FLNRORD, 2020). Trapping of wolverine in the Kootenay region is closed for 2020 to 2022 (FLNRORD, 2020), in response to recommendations that harvest rates be reduced throughout southern B.C. and AB to prompt population recovery (Mowat et al., 2020a). Wolverines are included as Identified Wildlife under the provincial FRPA (2002). Recommended guidelines for the management of wolverine populations and their habitat that are relevant to the Project are summarized in Table 15.5-4.

Table 15.5-4: Recommended Guidelines for Wolverine Management in B.C.[15]

Management Objective	Recommendation
Habitat Management	• Creation/maintenance of refugia at the landscape spatial scale (using suitable portions of watersheds and areas protected from trapping) • Maintain seasonal foraging areas by providing appropriate structural stages that support their primary prey near adequate thermal and security cover • Maintain secure, undisturbed denning sites near reliable food sources • Maintain adequate movement corridors within and between watersheds, especially along valley bottoms and watercourses • Maintain dispersal corridors dominated by older forests between refugia where human disturbance is prevalent
Mitigate Threats: Disturbance Management	• Incorporate the arrangement and timing of forest development in strategic level plans to allow wolverines to avoid operational areas • Minimize industrial disturbance • Minimize recreational disturbance, especially near maternal denning areas • Minimize road access with careful road planning and deactivation • Prevent logging near identified avalanche chutes

[15] Adapted from BC Accounts and Measures for Managing Identified Wildlife: Wolverine (Weir, 2004). Retrieved from http://www.env.gov.bc.ca/wld/frpa/iwms/documents/Mammals/m_wolverine.pdf

15.5.1.1.3 American Badger

American badgers in B.C. are of the *jeffersonii* subspecies (COSEWIC, 2012b; B.C. Badger Recovery Team, 2016). Within this subspecies there are two distinct populations, the Western Population (in the Thompson/Okanagan) and the Eastern Population (in the East Kootenay Region; COSEWIC, 2012b). American badgers (*Taxidea taxus jeffersonii* subspecies) are federally Endangered under the *Species at Risk Act* (SARA, 2002; COSEWIC, 2012b) and at risk of extinction in B.C. (i.e., Red-Listed; Provincial Conservation Status: S1; B.C. CDC, 2015a). The subspecies is considered at risk due to small population sizes, habitat loss and degradation (including loss of prey), road mortality, and persecution (i.e., illegal killing; COSEWIC, 2012b). American badgers have an important functional role in grassland ecology, influencing a wide range of soil functions that benefit grassland vegetation when they excavate and occupy their burrows (Eldridge, 2004; 2009; Eldridge and Whitford, 2008). Providing sufficient habitat (including prey) and reducing mortality from motor-vehicle collisions are the keys to maintaining American badger populations in the province (*Jeffersonii* Badger Recovery Team, 2008; Weir and Almuedo, 2010; COSEWIC, 2012b).

American badgers are protected under the FRPA (2002; B.C. MOE, 2019a). WHAs for American badgers are generally 2 to 100 ha, protecting a concentration of burrows, prey species, or suitable soil. The stated objectives of WHAs for American badgers are to (Weir and Almuedo, 2010):

1. Maintain important habitat features including suitable soils and prey;
2. Control forest encroachment and ingrowth; and
3. Protect existing burrow complexes from machine disturbance and degradation and minimize disturbance of American badgers during the breeding season.

There are a total of 791 ha of land within 7 WHAs that have been established specifically for American badger in the Terrestrial RSA, which are all located within the Rocky Mountain Trench. The Wildlife Habitat Decision Aid (WHDA) for American badgers outlines the habitat features required by the species, current habitat protection measures, and management considerations for landscape level forest harvesting and range practices (Weir and Almuedo, 2010). Management considerations for American badger that are relevant to the Project and this assessment include:

1. Maintaining a close distribution (e.g., <1 km) between patches of suitable habitat for prey to support dispersal;
2. In areas with suitable soils (i.e., silty, fine sandy or loamy soils), forest harvesting would benefit American badger and prey habitat characteristics by reducing tree cover and promoting forb productivity of a site for at least 20 years;
3. Regenerating cutblocks may be colonized by American badgers and their prey if open areas are maintained; and
4. Areas of open forests and grasslands with suitable soils for burrowing may be increased by reducing forest in-growth and encroachment (target in late-seral open forests: 20 stems per hectare, ≤15% canopy closure; target in mid-seral open forests: <75 stems per hectare; Weir and Almuedo, 2010).

As part of the American Badger Mitigation and Habitat Restoration Plan for the Trans Mountain Pipeline Expansion, Environment and Climate Change Canada (ECCC) provided a summary of biophysical attributes of draft critical habitat for American badger within its range (Environment Canada, 2014a, 2014b; Trans Mountain Pipeline ULC, 2017). Biophysical attributes important for American badgers include: soil types

that allow for digging; non-forested areas (e.g., grasslands, pasture, open-forested areas and recently cleared or burned areas) that support small-mammal prey (primarily Columbian ground squirrels); and continuous corridors not impeded by anthropogenic barriers (e.g., major roadways without safe passage features or large developed areas) facilitating American badger movement (e.g., dispersal to new concentrations of prey, finding mates; Environment Canada, 2014a, 2014b; Trans Mountain Pipeline ULC, 2017).

Recovery Strategy for the American Badger in British Columbia (2016)

The Province of B.C. has developed a Recovery Strategy (2016) to address the threats facing American badgers and BMPs for enhancing American badger prey populations (Hoodicoff, 2005; B.C. Badger Recovery Team, 2016). Recommendations include habitat protection through installment of underpasses during road construction in areas of high American badger occurrence, reducing attractants for American badgers and their prey near roads (e.g., forage grasses), restoration of grasslands and open forests, and reducing habitat fragmentation (B.C. Badger Recovery Team, 2016). Objectives and recommendations to maintain American badger populations and their habitat that are relevant to the Project are summarized in Table 15.5-5 (B.C. Badger Recovery Team, 2016).

Table 15.5-5: Recommended Guidelines for American Badger Management in B.C.[16]

Management Objective	Recommendation
Protect American badgers and their habitat.	• Encourage installment of suitable underpasses during road construction in areas of high American badger occurrence • Identify key highway crossing locations, either from movement data or high number of road mortality incidents, to target priority locations for underpasses • Reduce attractants for American badgers and their prey near roads • Promote private land stewardship for American badgers, their habitat, and prey, particularly in areas well away from major roads and highways • Provide scientific support for grassland and open forest restoration in accordance with strategic range management objectives and values • Establish and approve WHAs for American badgers, especially in forest districts with low areas of current approved habitat • Work with road maintenance contractors to identify all American badger road mortalities and map to highlight key problem locations and identify high-risk areas where mitigation would be most useful • Regularly test American badger tissues (as available) for rodenticide exposure
More accurately estimate American badger abundance.	• Develop a reliable, cost-effective, and repeatable method for estimating American badger abundance at a regional level • Continue to solicit and collect American badger sightings, including road mortalities and fresh burrow diggings
Better understand prey ecology, history, and distribution.	• Better understand current and historic prey distribution, especially for Columbian ground squirrels • Better understand impacts of invasive plants on prey abundance and distribution

[16] Objectives and strategies are taken directly from the Recovery Strategy for the Badger in British Columbia (B.C. Badger Recovery Team, 2016).

Management Objective	Recommendation
Better understand distribution of preferred soil associations.	• Support work to update and complete soils mapping
Improve understanding of genetic structure of American badgers.	• Encourage and cooperate with neighbouring jurisdictions to undertake American badger conservation work, including genetics, movement, and survival • Complete population viability analysis for American badgers • Cooperate with researchers to improve conservation genetics knowledge of American badgers throughout their provincial distribution, making available samples wherever possible (priority regions: Nicola, Elk Valley, Boundary)
Improve knowledge of American badger distribution and abundance in poorly documented regions.	• Conduct inventories in regions where American badger abundance and distribution are poorly documented (priority: Nicola, Elk Valley, Boundary)
Increase public awareness and appreciation of American badgers in B.C.	• Work with private landowners, land managers, and other government officials to create awareness of American badgers, their habitat, and threats

15.5.1.1.4 American Marten

The American marten is not listed under the *Species at Risk Act* and is provincially widespread, abundant, and secure in B.C. (i.e., Yellow-Listed; Provincial Conservation Status: S5; B.C. CDC, 2019a). American martens are managed as Class 1 furbearers under B.C.s Fur Management Program and are economically one of the most important furbearers in B.C. (FLNRORD, 2020). Trapping of American marten in the Terrestrial RSA and Terrestrial LSA is conducted from November 1 to February 15. Given the species' economic importance and dependency on late successional, structurally complex forest stands, American marten are considered a good indicator species for old and mature forests (Hatler et al., 2003). Although the species is widespread across most of Canada and into contiguous United States, habitat loss and over-exploitation have contributed to population declines (Krohn, 2012). Recommended guidelines for the management of American marten populations and their habitat relevant to the Project are summarized in Table 15.5-6.

Table 15.5-6: Recommended Guidelines for American Marten Management in B.C.[17]

Management Objective	Recommendation
Habitat Management	• Identify/maintain habitat connectivity • Include maintenance of forested corridors in forestry cutting plans • Identify valuable marten habitat and adjust cutblock boundaries to best protect habitat • Preserve "wildlife tree patches" and coarse woody debris as much as possible • Provide brush and debris piles within or near forest areas to supplement valuable habitat features

[17] Adapted from Furbearer Management Guidelines for Marten (*Martes americana*) in BC (Hatler et al., 2003). Retrieved from https://www2.gov.bc.ca/assets/gov/sports-recreation-arts-and-culture/outdoor-recreation/fishing-and-hunting/hunting/trapping/marten.pdf

Management Objective	Recommendation
Harvest Management	• Encourage trappers to provide harvest information to provide better occurrence locations/population data for habitat managers
Mitigate Threats: Disturbance Management	• Minimize logging and silviculture activities in known marten habitat • Encourage forest managers to use selective logging practices and minimize cutblock sizes • Minimize industrial disturbance • Minimize recreational disturbance

15.5.1.1.5 Canada Lynx

Canada lynx are not listed under the *Species at Risk Act* (COSEWIC, 2001; Government of Canada, 2011) and are provincially widespread, abundant, and secure in B.C. (i.e., Yellow-Listed; Provincial Conservation Status: S5; B.C. CDC, 1995a). Canada lynx are managed as Class 2 furbearers under B.C.'s *Fur Management Program* and as a big game species under the *B.C. Wildlife Act* (1996; FLNRORD, 2020). The Province maintains short seasons for both activities within the Terrestrial RSA (trapping - November 15 to February 15; hunting- November 15 to December 31). Within the contiguous U.S.A, Canada lynx are Threatened under the *Endangered Species Act* and legal harvest is restricted (Ruediger et al. 2000; United States Fish and Wildlife Service, 2017). Canada lynx are important indicators of ecosystem health, as their regulation of snowshoe hare (*Lepus americanus*) populations influences vegetation community structure and diversity and trophic dynamics (Krebs et al., 2014). Recommended guidelines for the management of Canada lynx populations and their habitat relevant to the Project are outlined in Table 15.5-7.

Table 15.5-7: Recommended Guidelines for Canada Lynx Management in B.C.[18]

Management Objective	Specific Recommendation
Habitat Management	Identify/maintain habitat connectivity
	Encourage trappers/hunters to provide harvest locations and sightings to provide better occurrence information/inventory data for habitat managers
	Minimize forest fire suppression in remote areas
	Remove over-mature shrubs to encourage new growth that benefits prey species
Mitigate Threats: Disturbance Management	Minimize impacts from livestock grazing through guidelines/regulations
	Recommend alternate logging practices (e.g., selective logging, minimize cutblock size)
	Minimize silvicultural practices (e.g., extensive thinning, herbicide use)
	Minimize industrial disturbance
	Minimize recreational disturbance
	Reduce the development of roads

15.5.2 Existing Conditions

This section describes the existing conditions of carnivore VCs in the Terrestrial LSA, Terrestrial RSA, and Grizzly Bear RSA to enable potential effects of the Project on carnivores to be assessed.

[18] Adapted from Furbearer Management Guidelines for Canada lynx (*Lynx canadensis*) in BC (Hatler & Beal, 2003). Retrieved from https://www2.gov.bc.ca/assets/gov/sports-recreation-arts-and-culture/outdoor-recreation/fishing-and-hunting/hunting/trapping/lynx.pdf

15.5.2.1 Existing Regional and Local Information

Existing local and regional data for carnivores were compiled by conducting a desktop assessment of background information for ecology and habitat requirements, regional occurrence and abundance, and regional and local connectivity in the Project study areas (i.e., the Project footprint, the Terrestrial LSA, and the Terrestrial RSA). Data and information sources included:

- Canadian Species at Risk Public Registry (Government of Canada, 2019);
- B.C. Conservation Data Centre iMap and Species and Ecosystems Explorer (B.C. CDC, n.d.a.; n.d.b.);
- Scientific literature and government reports;
- Research from local non-governmental organizations (NGOs); and
- Other baseline studies for projects in the region.

15.5.2.1.1 Grizzly Bear

Ecology and Habitat Requirements

Grizzly bears in the interior of B.C. and the Grizzly Bear RSA tend to utilize a wide variety of ecosystem types during their active season (April to November). These ecosystem types range from forested valley bottoms to avalanche chutes and alpine meadows and include early seral forests, old and mature forests, grasslands, riparian, and wetland habitats (Gyug et al., 2004; Turney and Roberts, 2004; Proctor et al., 2017). Den habitats are typically located on north or northeasterly sloped high elevation areas with deep snow and dry, stable soil that remains frozen over the winter (Gyug et al., 2004; Ciarniello et al., 2005; Pigeon et al., 2014).

As opportunistic omnivores, grizzly bears consume a wide variety of plant material (e.g., berries, forbs, roots, and graminoids), invertebrates, fish, and mammals (Hamer and Herrero, 1987a; McLellan and Hovey, 1995; Gyug et al., 2004). The bulk of grizzly bear diet in southern interior B.C. is comprised primarily of vegetative matter (McLellan and Hovey, 1995). Grizzly bears have a high nutritional demand in preparation for reproduction and hibernation (Lopez-Alfaro et al., 2013). Generally, grizzly bears forage in areas of open canopy, partial forest, or older forests with many tree gaps due to the higher vegetation productivity (Gyug et al., 2004; Proctor et al., 2015; Mowat et al., 2020b). The numerous gaps or dying canopies within old growth and mature forests support fruit-bearing shrubs and herbaceous plants that provide valuable forage for grizzly bears (Gyug et al., 2004). Avalanche chutes and alpine areas provide high-value food resources in addition to providing denning areas (Gyug et al., 2004; Proctor et al., 2017). Old burns and logged areas at subalpine elevations can also provide important berry foraging habitat (Proctor et al., 2015). Riparian areas provide numerous important food resources and movement corridors (McLellan and Hovey, 2001; Northern Cascades Grizzly Bear Recovery Team [NCGBRT], 2004; South Rockies Grizzly Bear Project [SRGBP], 2019). Habitats providing thermoregulation, rest, and security tend to be within closed canopy forests (e.g., old and mature forests) near high quality foraging areas (Gyug et al., 2004). Of biogeoclimatic (BGC) zones found within the Grizzly Bear RSA, the MSdw subzone provides early-season herbaceous vegetation important for grizzly bear forage (MacKillop et al., 2018). The ESSFdk1 subzone also supports later spring herbaceous vegetation important for foraging, especially in avalanche run-out zones and riparian habitats (MacKillop et al., 2018).

Two pre- and post-berry resource selection function (RSF) models were developed for grizzly bear to support the Fording River EA (Apps and McLellan, 2008; Teck Coal Limited, 2014). GPS and very high

frequency (VHF) telemetry data were collected in the lower Elk and upper Flathead River drainages from 133 collared grizzly bears between 1978 and 2007 (Apps and McLellan, 2008; Teck Coal Limited, 2014). Both models suggested grizzly bears select for areas with limited human access and presence, often along steep, rugged terrain (Apps and McLellan, 2008; Teck Coal Limited, 2014). Grizzly bears selected for low elevation riparian habitats in early spring, likely due to increased forage and ungulate prey availability. The model results showed that grizzly bears selected for open forb/shrub and open forest/shrub habitats, particularly in the pre-berry season and tended to avoid mature forests in both seasons (Apps and McLellan, 2008; Teck Coal Limited, 2014).

Habitat suitability index (HSI) models (pre-berry and post-berry) were developed for grizzly bear to support the EA for the Baldy Ridge Extension Project (Teck Coal Limited, 2015b). Results from the models predicted high-quality grizzly bear habitats were located in rugged mid-elevation valleys northwest of Elkford and Fernie. There were also a few patches located between the Fording River and Line Creek operations, east of Elkview Operations and south of Highway 3, consistent with grizzly bear movement research indicating high connectivity probability across Highway 3, near Alexander Creek (Apps et al., 2007; Proctor et al., 2017). The post-berry season HSI predicted high-quality grizzly bear habitat along Erickson Ridge. The highest quality grizzly bear habitats in the post-berry season were predicted in the Harmer Valley north of Elkview Operations, along the southern part of Erickson Ridge and on Sparwood Ridge (Teck Coal Limited, 2015b).

Mining, forestry, road, agriculture, and urban and recreational developments have resulted in habitat loss and degradation for grizzly bear in the Grizzly Bear RSA (McLellan and Hovey, 2001; Mowat et al., 2020b; Proctor et al., 2015). Loss of habitat due human disturbance in the Grizzly Bear RSA has been most pronounced at low elevations (McLellan and Hovey, 2001; Proctor et al., 2015). The Highway 3 transportation corridor in particular has resulted in considerable habitat loss and fragmentation for grizzly bear (Mowat et al., 2020b).

Forestry cutblocks and forestry roads in the region have progressively moved upslope to higher elevations and into high quality grizzly bear habitat (Gyug et al., 2004; Golder Associates Ltd., 2015; Kortello et al., 2019). Increased road access increases the risk of human-caused mortality (i.e., vehicle strikes, hunter kills, illegal kills) and reduces habitat suitability through displacement or loss of resources (Apps et al., 2013; Proctor et al., 2018; Proctor et al., 2020). Cutblocks may benefit grizzly bears by increasing early seral conditions that provide important food values for bears (e.g., berry producing shrubs, herbaceous growth and ungulates; McLellan and Hovey, 2001; Nielsen et al., 2004; Apps and McLellan, 2008; Kearney et al., 2019). Harvested areas are often planted or seeding with conifers, and while habitat use may increase for the first 15 to 20 years post harvest, this can ultimately lead to relatively lower quality habitat (Kearney et al., 2019). Older regenerated coniferous forests are often associated with increased closed canopies and reduced vegetation (e.g., berry) production (Kearney et al., 2019; Larsen et al., 2019). Soil disturbance and site preparation with heavy machinery, associated with forest harvesting, can often disturb berry productivity in clear-cuts and alter forest structure (e.g., increase in dense conifer stands; Gyug et al., 2004; Kearney et al., 2019; Larsen et al., 2019). Such a reduction in berry foraging values reduces grizzly bear habitat availability (Gyug, et al., 2004; Kearney et al., 2019). In addition, timber harvesting near high value habitats such as avalanches and subalpine meadows can reduce grizzly bear habitat quality and use (Gyug et al., 2004). Altogether, forestry practices have most likely resulted in a loss of grizzly bear habitat availability in the Grizzly Bear RSA.

Grizzly bears may access reclaimed mines to forage on vegetation and prey on ungulates (Cristescu et al., 2011); however, mine reclamation areas generally do not support high value forage used by grizzly bears (Teck Coal Limited, 2014; Mowat et al., 2018). Further, mining activities often alter avalanche chute and alpine grassland availability, resulting in diminished habitat values for grizzly bear (Teck Coal Limited, 2015a; Mowat et al., 2018). Mine reclamation practices can reduce forage conditions for grizzly bear for 40 years post reclamation (Teck Coal Limited, 2014).

Many habitats remain highly productive foraging sites for grizzly bear for 35 to 70 years post fire (McLellan and Hovey, 2001; Gyug et al., 2004). Fire suppression activities introduced after the 1980s promoted a shift in forest composition to more dense, mature forests (Gray and Blackwell, 2005), which may have reduced grizzly bear habitat availability. Fire suppression practices can reduce forage habitat for grizzly bears by reducing the quality and quantity of important limiting berry patches that are mediated by fire (Hamer and Herrero, 1987b; Hamer, 1996; Nielson et al., 2004).

Regional Occurrence and Abundance

Within the Grizzly Bear RSA, grizzly bear occurrence is negatively associated with both human access (i.e., road density) and development (Apps et al., 2004; Mowat et al., 2018). Food resources are often in short seasonal supply and patchily distributed (McLellan and Hovey, 2001; Nielsen et al., 2010; McLellan, 2015). Nutritional demands are exceptionally high given the costs of reproduction and hibernation (Weaver et al., 1996; McLellan and Hovey, 2001; McLellan, 2011; Pigeon et al., 2014). As a result, grizzly bears adopt a seasonal movement pattern that follows quality food sources as they become locally abundant (McLellan and Hovey, 2001; Gyug et al., 2004; Turney and Roberts, 2004; Lopez-Alfaro et al., 2013).

During early spring, grizzly bears seek out emerging herbaceous vegetation in riparian habitats, avalanche chutes, and alpine slopes (McLellan and Hovey, 1995; Mowat and Ramcharita, 1999; McLellan and Hovey, 2001; NCGBRT, 2004; MacKillop et al., 2018; SRGBP, 2019). As spring progresses, grizzly bears forage on a wide variety of nutritious plants such as horsetails (*Equisetum arvense*), dandelion (*Taraxicum officinale*), cow parsnip (*Heracleum maximum*), and graminoids (e.g., grasses, rushes, and sedges; Gyug, et al., 2004; McLellan and Hovey, 2001). During summer, grizzly bears move to riparian forests and productive low elevation, young forests to feed on berries (Zager et al., 1983). From early summer until fall, grizzly bears in the Kootenay region rely on black huckleberry and soopolallie as their primary energy-rich food resources (McLellan and Hovey, 1995, Munro et al., 2006; McLellan, 2011; McLellan, 2015). In the fall, grizzly bears tend to move to higher elevations before hibernation, foraging on berries, hedysarum (*Hedysarum sulphurescens*) roots, and young ungulates (Gyug et al., 2004; McLellan and Hovey, 2001; SRGBP, 2019).

In the interior mountains of B.C., the average male grizzly bear home range size is 804 km^2. Males generally overlap with several female home ranges that average 222 km^2 (Ciarniello et al., 2001; Gyug et al., 2004; Stenhouse et al., 2005; Ciarniello et al., 2007). Female grizzly bears tend to disperse shorter distances than males (from 14 to 40 km^2, respectively) and take several years to establish a home range (McLellan and Hovey, 2001; Proctor et al., 2004).

B.C. currently supports an estimated 14,378 grizzly bears (Lamb et al., 2020). This estimate compares closely to the 2013 estimate of approximately 14,000 individuals (Mowat et al., 2013). Within the Grizzly Bear RSA (South Rockies GBPU) there is an estimated 239 grizzly bears, corresponding to a population

density of approximately 2.9 individuals /100 km^2 (Lamb et al., 2020). Current population density estimates in southeast B.C. are considerably lower than during the 1980s, when grizzly bear population density was approximately 6.4 individuals /100 km^2 (McLellan, 1989).

In the Elk Valley, grizzly bear population density is negatively associated with both human disturbance areas and road density (Mowat et al., 2020b). Grizzly bear mortality has been shown to be influenced greater by road density than by distance to road and human access-human population centres (Proctor et al., 2015). Grizzly bear population density is greater in habitats with greater berry production and lower in habitats with increased human presence and roads (Mowat et al., 2020b). The Elk Valley has the highest human-caused (e.g., hunter harvest, vehicle strikes) grizzly bear mortality rate in the province (Mowat et al., 2020b). The grizzly bear mortality rate is triple that of bears from the rest of the SRGPU, with exceeding policy thresholds of 1.8 % of the female population and 6% of the total population in the last decade (Mowat et al., 2020b). The grizzly bear population north of Highway 3 within the Elk, Bull, and White River valleys declined by 40% between 2006 and 2013, indicating a doubling of mortality rate between those years (Mowat and Lamb, 2016). Population fluctuations were attributed to poor huckleberry production as a result of unusually dry conditions, increased human-caused mortality, and low recruitment (Lamb et al., 2016; Mowat and Lamb, 2016).

The estimated density of grizzly bear in the Elk Valley is 2.9 individuals /100 km^2 (Lamb et al., 2020). Based on this assumption, the Terrestrial LSA (241 km^2) can support approximately 7 grizzly bears.

Regional and Local Connectivity

Grizzly bear landscape connectivity in the Grizzly Bear RSA has been reduced substantially by habitat fragmentation and degradation from roads, railways, and associated human settlements (Proctor et al., 2005; 2012). Roads, urban settlements, and development projects can reduce the connectivity of grizzly bear through mortality and landscape changes that result in a reduction in the quality and amount of habitat (Proctor et al., 2012; Lamb et al., 2020). Within the Elk Valley, the associated effects of the Highway 3 corridor have resulted in a loss of gene flow between grizzly bear populations (Apps et al., 2007; Proctor et al., 2012; 2015; Mowat et al., 2020b). Dispersal is particularly limited among females, with potential deleterious consequences for population viability and long-term persistence (Proctor et al., 2004; 2012; 2015; Mowat et al., 2020b). A road density threshold of 0.6 km/km^2 is the established maximum value that should not be exceeded to maintain grizzly bear habitat values (including security and movement; Proctor et al., 2018). The majority of sub-basin watersheds in the central and southern portions of the Elk Valley exceed a road density of 1.2 km/km^2 (Mowat et al., 2018). Besides roads, other developments that likely act as landscape barriers or impede movement by grizzly bear include mining and reclamation activities and urban centres (Proctor et al., 2005; 2012; Teck Coal Limited, 2014; Lamb et al., 2016).

Important habitats for grizzly bear connectivity include riparian areas and old and mature forest (NCGBRT, 2004; SRGBP, 2019). The Terrestrial LSA has been identified almost entirely as core grizzly bear habitat and a key linkage area for maintaining grizzly bear connectivity (Proctor et al., 2015; Mowat et al., 2018). Studies of grizzly bear in the Grizzly Bear RSA have identified several areas in the Terrestrial RSA that maintain connectivity between populations (Apps et al., 2007; Teck Coal Limited, 2014; 2015b; Proctor et al., 2015; Mowat et al., 2018). Some of these are within the Terrestrial LSA, including:

- A north-south corridor along the Alexander River and West Alexander;
- A north-south corridor across Highway 3 between Michel Creek and Erickson Creek; and

- A north-south corridor across Highway 3 between Michel Creek and Alexander Creek.

Additional corridors for grizzly bear in the Grizzly Bear RSA include:

- Fernie to Morrissey corridor between the valleys of Morrissey Creek and the east slopes of the Lizard Range;
- Lizard Basin to South Elk Valley Linkage;
- A west-east corridor across the Continental Divide (Ptolemy Pass, Tent Mountain Pass, Deadman Pass, Racehorse Pass);
- A west-east corridor across the Elk Valley to the Hartley Drainage; and
- Connection of Hosmer/Marten/Sparwood Ridges to McCool and Ladner Creeks and Hartley Pass, and further north to Sulphur Creek and Hornaday Pass.

Transboundary Considerations

Grizzly bears are highly mobile animals with markedly large home ranges and a distribution that includes contiguous portions of AB and Montana (COSEWIC, 2012a). It is therefore highly likely that individuals exhibit seasonal or regular transboundary movements within the Grizzly Bear RSA. Known or anticipated movement corridors along the Continental Divide within the Terrestrial LSA include riparian and alpine habitats within the Crowsnest, Deadman, and Racehorse passes (Apps et al., 2007).

Loss of connectivity for grizzly bear is extensive across the Canada-U.S.A. transborder largely due to habitat fragmentation from development (roads and settlements), human-caused mortalities, and low recruitment (Proctor et al., 2012; Lamb et al., 2016). Transboundary immigration is necessary for population viability and long-term persistence (Proctor et al., 2012). Grizzly bear populations in the southern Rocky Mountains of B.C. and AB connect populations further south, into Montana (Mowat et al., 2020b). Transboundary movements by grizzly bear from the southern Canadian Rocky Mountain population to Montana are particularly important due to the unoccupied areas to the east and west of the distribution (Proctor et al., 2012; Mowat et al., 2020b).

15.5.2.1.2 Wolverine

Ecology and Habitat Requirements

Wolverines are habitat generalists with exceptionally large home ranges, and as such use a wide variety of ecosystems, but are often associated with high elevation montane areas (Weir, 2004; Sawaya and Clevenger, 2014). As an obligate carnivore, habitat selection by wolverines is primarily driven by prey and carrion distributions (Banci and Harestad, 1990; Krebs et al., 2007; Kortello et al., 2019). Wolverine habitat is defined by the distribution and abundance of food resources (prey/carrion) and suitable habitat for denning and rearing kits (Krebs and Lewis, 2000). Wolverine habitat must have an adequate year-round supply of food, mainly consisting of smaller prey such as rodents and hares during summer, and the carcasses of large ungulates during winter (Krebs and Lewis, 2000). Wolverines are highly susceptible to fluctuations in food availability during winter (i.e., the availability of ungulate carcasses), which is likely the greatest limiting factor determining wolverine habitat use (Weaver et al., 1996; Lofroth and Krebs, 2007). Den habitats are typically associated with the ESSF in areas where snow cover persists into April, under snow-covered rocks, piles of logs, and avalanche debris, or within snow tunnels (Magoun and Copeland, 1998; Krebs and Lewis, 2000; Inman et al., 2012).

Wolverines predominately use mature and old growth forests; however, they will frequently use a wide variety of other of structural stages (Weir, 2004; Krebs et al., 2007; Lofroth and Krebs, 2007). Open habitats in alpine and subalpine zones are strongly selected for in summer, and forested habitat, particularly in the ESSF, are selected for year-round (Krebs et al., 2007; Lofroth and Krebs, 2007; Teck Coal Limited, 2011). High snow cover provides thermoregulation and security for denning (Copeland et al., 2010). Additionally, continuous snow cover may be utilized for food caching from late fall through to the spring to reduce competition with other scavengers when food is scarce (Inman et al., 2012). Avalanche chute habitats are used year-round largely due to the availability of prey (e.g., winter avalanche kills of larger mammals, small mammals, and young ungulates during summer; Krebs and Lewis, 2000; Krebs et al., 2007; Lofroth and Krebs, 2007).

An HSI model was developed for wolverine to support the EA for the Fording River Operations Swift Project (Teck Coal Limited, 2014). The model was based on professional opinion and a historical information review due to the lack of local and regional data. Results from the model predicted high quality habitat to include rugged high elevation habitat on the west side of the Terrestrial RSA as well as some patches east of the Terrestrial RSA and south of Highway 3 (Teck Coal Limited, 2014). Low suitable habitat was associated with roads, towns and agriculture in valley bottoms including Highway 43 between Elkford and Sparwood and Highway 3 surrounding Fernie (Teck Coal Limited, 2014).

Mining, forestry, road, and urban and recreational developments have resulted in habitat loss and degradation for wolverine in the Terrestrial RSA (Weir, 2004; Fisher et al., 2013; Kortello et al., 2019; Mowat et al., 2020a). Forestry practices have resulted in mid-elevation deforestation in the ESSF, which has reduced the quality and amount of wolverine habitat (Golder Associates Ltd., 2015; Kortello et al., 2019). Forestry practices tend to target old and mature forest stands, which removes required cover for wolverine and tends to reduce prey availability (Ritchie and Sullivan, 1989; Fisher et al., 2013; Scrafford et al., 2017). Conversely, in some cases cutblocks can provide wolverines with increased hunting and scavenging opportunities and roads are used for movement (Fisher and Wilkinson, 2005; Copeland et al., 2007; Scrafford et al., 2017). In general, wolverines tend to avoid recently logged areas, areas with high road density and human activity, which results in habitat displacement (Krebs et al., 2007; Kortello et al., 2019; Mowat et al., 2020a). In addition, timber harvesting near high value habitats such as avalanches and subalpine meadows can reduce wolverine habitat quality and use (Weir, 2004).

Similarly, coal mining activities in the Terrestrial RSA have generally resulted in deforestation of mid elevational forests that are preferred by wolverine (Krebs et al., 2007; Bowman et al., 2010; Teck Coal Limited, 2011; Fisher et al., 2013). Further, mining activities often alter avalanche chute availability, resulting in diminished habitat values for wolverine (Teck Coal Limited, 2015a).

Portions of winter habitat for wolverine have been degraded or lost due to recreational activities in the Terrestrial RSA (Krebs et al., 2007; Larson et al. 2016; Heinemeyer et al., 2019). Wolverines are particularly sensitive to ground and sensory disturbances in the alpine and ESSF during winter from avalanche control, helicopter activity, roads, and off-highway vehicles (Weir, 2004; Heinemeyer et al., 2010; Heinemeyer et al., 2019; Mowat et al., 2020a). Such disturbances may cause destruction of dens or disturbance to denning females that are deep within snowpack (Magoun and Copeland 1998; Krebs et al., 2007; Heinemeyer et al., 2019).

Regional Occurrence and Abundance

Within the Terrestrial RSA, wolverine occurrence is negatively associated with human access and development (Krebs et al., 2007; Fisher et al., 2013; Kortello et al., 2019). Wolverine occurrence tends to be greatest in the cooler, montane to subalpine forested ecosystems, high elevation alpine zones, avalanche zones, and areas where persistent snow cover is present throughout the spring (Apps et al., 2007; Mowat et al., 2020a). Wolverine occurrence is generally greater in the northern portions of the Columbia, Selkirk, and Purcell mountain ranges (Kortello and Hausleitner, 2014; Clevenger et al., 2016).

In B.C., female wolverines tend to use higher elevations than males throughout the year; however, both sexes often shift to lower elevation habits during winter (Krebs and Lewis, 2000; Krebs et al., 2007; Inman et al., 2012). Variation of occurrence is mostly driven by prey and carrion distributions in the winter, as well as denning habitat locations and human disturbance (Kortello et al., 2019; Krebs et al., 2007). Male wolverine habitat selection has been found to be most associated with food availability (e.g., moose winter ranges), valley bottom forests, and avalanche terrain (Krebs et al., 2007). Female habitat selection is often associated with areas of low human disturbance (e.g., recreation, roads) and predation risk, as well as alpine and avalanche regions that provide prey (e.g., Columbian ground squirrel) throughout the summer (Krebs et al., 2007). Wolverine home ranges are exceptionally large and highly variable, ranging from 230 to 1,580 km^2 for males and 50 to 400 km^2 for females (Hornocker and Hash, 1981; Krebs et al., 2007). Male wolverine home ranges generally overlap with one or more females, while female home ranges do not tend to overlap (Krebs and Lewis, 2000).

There is little known about wolverine population sizes in B.C. (COSEWIC, 2014). Wolverines exist at naturally low population densities and tend to exhibit low juvenile survivorship (Weir, 2004). Wolverines in high quality habitat have been shown to exhibit densities of 0.6 wolverines/100 km^2 in B.C. (Lofroth and Krebs, 2007). In the southeast Kootenay region, wolverine density averages 0.2 wolverines/100 km^2 (Mowat et al., 2020a). Wolverine abundance and density is reduced in areas with greater anthropogenic development (e.g., forestry, oil and gas and mineral exploration) and human disturbance (e.g., outdoor recreation; Fisher et al., 2013; Krebs et al., 2007). Due to their low reproductive potential and large spatial requirements, wolverines are considered to have low resilience in the Elk Valley region (Apps et al., 2007).

Regional and Local Connectivity

Wolverine landscape connectivity in the Terrestrial RSA has been reduced substantially by habitat fragmentation and degradation from roads, railways, and associated human developments (Apps et al., 2007; Fisher et al., 2013; Sawaya et al., 2019; Balkenhol et al., 2020). Roads, urban settlements, and development projects can reduce the connectivity of wolverine through mortality and landscape changes that result in a reduction in the quality and amount of habitat (Fisher et al., 2013; COSEWIC, 2014; Krebs et al., 2014). Within the Elk Valley, the associated effects of the Highway 3 have resulted in loss of connectivity for wolverine (Apps et al., 2007). Similar to grizzly bear, wolverine dispersal across major highways is particularly limited among females, leading to further losses of gene flow between populations (Sawaya et al., 2019). Genetic research on wolverine has shown that loss of connectivity is greatest at southern extent of wolverine distribution in B.C., which includes the Terrestrial RSA (Kyle and Strobeck, 2002; Cegelski et al., 2006). Low genetic connectivity has also been noted between the south Purcell population and other populations in southeastern B.C. (Clevenger et al., 2016). Besides roads, other developments that likely act as landscape barriers or impede movement by wolverine include

recreational and urban developments and mining and forestry practices (Fisher et al., 2013; Sawaya et al., 2019).

Important habitats for wolverine connectivity include riparian areas, low-elevation mountain passes, and old and mature forest (Weir, 2004). Elevational diversity is also important for movement throughout their range as it provides a variety of abundant seasonal food sources (Inman et al., 2012; Weir, 2004). Consistent spring snowpack is another influential landscape feature that contributes to gene flow in wolverines (Schwartz et al., 2009). Studies of wolverine have identified several key corridors in the Terrestrial RSA that maintain connectivity between populations (Apps et al., 2007; Teck Coal Limited, 2014; Mowat et al., 2020a). Some of these are within the Terrestrial LSA, including:

- A north-south corridor that connects Alexander Creek and Michel Creek.

Additional corridor areas in the Terrestrial RSA include:

- A west-east corridor along the Continental Divide both north and south of the Crowsnest Highway;
- A west-east corridor north of Fernie that links the Three Sisters- Hartley Pass- Lladner Creek and Fernie-Hosmer Ridge complex; and
- A west-east corridor south of Fernie linking the Lizard Range to the Morrissey and upper Flathead drainage.

Transboundary Considerations

Wolverines are highly mobile and wide-ranging animals with exceptionally large home ranges and a distribution that includes contiguous portions of AB and Montana (COSEWIC, 2014). It is therefore highly likely that individuals exhibit seasonal or regular transboundary movements within the Terrestrial RSA. Known or anticipated movement corridors to AB along the Continental Divide including the Crowsnest, Deadman, and Racehorse passes (Apps et al., 2007). B.C. contains extensive areas of spring snow cover that connect to snow-covered areas in northwestern Montana (McKelvey et al., 2011). The Kootenay region has been identified as a potential corridor for wolverine movements into the U.S.A. (Singleton, 2002; Schwartz et al., 2009; McKelvey et al., 2011). Such transboundary movements are important for the population viability and long-term persistence of wolverine populations in southeastern B.C. and contiguous U.S.A. (Krebs et al., 2004; Kortello and Hausleitner, 2014).

15.5.2.1.3 American Badger

Ecology and Habitat Requirements

In B.C., habitat use by American badgers is primarily related to prey availability and soil characteristics (Apps et al., 2002; *Jeffersonii* Badger Recovery Team, 2008). Suitable habitats for American badgers generally correspond with dry, grassy low elevation valley bottoms with deep friable soils (Weir et al., 2003). Since American badgers are obligate carnivores, suitable habitat is comprised of a combination of sufficient prey and landscapes that facilitate prey capture and denning (i.e., soil characteristics suitable for burrowing) rather than specific vegetative landcover classes (Weir et al., 2003; Mitchell and Hebblewhite, 2011; COSEWIC, 2012b). The primary prey of American badgers in the region are Columbian ground squirrels (*Urocitellus columbianus*), with alternative prey including northern pocket gophers (*Thomomys talpoides segregatus*), voles, mice, insects, birds, amphibians, and reptiles (Messick, 1987; Newhouse and Kinley, 2000; *Jeffersonii* Badger Recovery Team, 2008). Optimal habitat for American

badgers is in close proximity to large prey colonies (i.e., Columbian ground squirrel colonies; Adams and Kinley, 2004; Weir and Almuedo, 2010). Parent material conducive for excavating burrows by American badgers includes well-drained coherent soils that maintain structure when excavated (e.g., glaciofluvial and glaciolacustrine parent materials, silts to fine sand with low coarse material content; Apps et al., 2002; Weir et al., 2003; Hoodicoff and Packham, 2007; Duquette, 2008). American badgers inhabit grassland and open forest ecosystems as well as open and/or roaded areas within forested ecosystems (Apps et al., 2002; Hoodicoff, 2003; Jannett et al., 2007; Weir and Almuedo, 2010). American badger habitat in the East Kootenay region is patchy (COSEWIC, 2012b).

An HSI model was developed for American badger to support the EA for the Baldy Ridge Extension Project (Teck Coal Limited, 2015a). Results from the model predicted that high quality American badger habitat would occur in valley bottoms, grasslands, and human development right-of ways (Teck Coal Limited, 2015a). High quality habitat was also predicted to include low elevation habitat, including open and semi-open forests habitats between the Elk River, Harmer Creek, and along the Michel Creek and Highway 3 corridor (Teck Coal Limited, 2015a).

Historical fire regimes would have benefited American badgers and prey in the Terrestrial RSA by maintaining a mosaic of open habitats with deep, friable soils (Teck Coal Limited, 2014). Increased fire suppression activities in the Elk Valley after the 1950s have resulted in forest in-growth and encroachment which have created dense, closed canopy forests in many stands (MacKillop et al., 2018). Forest in-growth (i.e., the infill of open forest with greater density of trees and corresponding canopy closure) and forest encroachment (i.e., the establishment of trees, shrubs and woody vegetation in grasslands) in the Rocky Mountain Trench has resulted in considerable historic loss of open forest and grassland habitats (MOF, 1999; Gayton, 2001; Turner and Krannitz, 2001; Scobie, 2002; Wikeem and Wikeem, 2004). American badgers are generally unable to exploit closed canopy forests as these areas are unsuitable for principal prey (Weir et al., 2003; Kinley and Newhouse, 2008). American badgers will inhabit forested areas when early seral habitats adjacent to forest corridors support prey populations (Weir et al., 2003; Kinley and Newhouse, 2008). Although forest cutblocks may temporarily benefit American badger by providing openings in the canopy, this early seral habitat is only useable if it contains suitable prey (Rahme et al., 1995; Kinley, 2009). Logging also has the potential to alter drainage patterns, possibly resulting in soil erosion that inhibits badgers from using the area for habitat (Rahme et al., 1995).

Providing there is sufficient prey available, American badgers can inhabit human-modified habitats and (unless persecuted) are generally tolerant of human presence (Weir et al., 2004; *Jeffersonii* Badger Recovery Team, 2008; COSEWIC, 2012b). American badgers use roadsides because these habitats offer friable soils for burrowing and quality forage (grass) that their prey are attracted to (Weir et al., 2004; COSEWIC, 2012b; Klafki, 2014). Roads facilitate movements and cut banks expose soil deposits that are readily used for burrowing (COSEWIC, 2012b; Klafki, 2014). Since American badgers frequently use roadsides for denning and foraging, it increases the vehicle collision morality risk to individuals when roads are built in their habitat.

Within the Elk Valley, American badgers are known to utilize landscapes impacted by mining, including clearings adjacent to process facilities and coarse-coal reject dumps where soils have low to moderate coarse fragments with friable textures (Teck Coal Limited, 2014). Mines also have the potential to create loss of habitat and prey availability for American badgers, and reduce movement corridors (*Jeffersonii* Badger Recovery Team, 2008). In addition, soil compaction from mining activities may limit the burrowing

abilities of American badger and prey (Trans Mountain Pipeline ULC, 2017*).* During the 1960s, reclamation practices on coal mining operations emphasized planting of agronomic grasses and legumes to rapidly establish plant cover and to compensate for adverse effects on wildlife (Lowenberger, 1973). Reclaimed mining areas in the baseline therefore are primarily represented by agronomic grasslands (Teck Coal Limited, 2014). Such mining reclamation practices in the Elk Valley can produced patches of grassland habitat that may be used by American badgers and prey (Teck Coal Limited, 2014). Despite these reclamation efforts, many previously occupied grasslands sites remain vacant post mine reclamation, and are considered degraded habitat (*Jeffersonii* Badger Recovery Team, 2008; Teck Coal Limited, 2014).

Regional Occurrence and Abundance

Within the East Kootenay, American badger are primarily distributed in open habitats at dry, grassy lower elevations with deep friable soils for burrowing (Newhouse and Kinley, 2000; Apps et al., 2002; Weir et al., 2003; Kinley, 2009). Although American badgers are most commonly associated with low elevations in valley bottoms where there is grassland and open forested habitat, they can be found up to and including alpine elevations and in a variety of forested and unforested ecosystems (B.C. Badger Recovery Team, 2016).

American badger home-range sizes vary based largely on prey availability, but can also vary based on age classes, seasons, geographic area, and habitat features (Minta, 1993; Newhouse and Kinley, 2000; Hoodicoff, 2003; Hoodicoff et al., 2009). In B.C., males home range size is from 33 to 64 km^2, and female home range size is from 16 to 18 km^2 (COSEWIC, 2012b). Within their home ranges, American badgers often make use of hundreds of burrows and many are re-used (Weir et al., 2003). Whereas female home ranges are limited by food availability, male home ranges are thought to be limited by density of females (Minta 1993; Goodrich and Buskirk 1998).

There are an estimated 250 to 405 mature American badgers of the sub-species *Taxidea taxus jeffersonii,* which occur in south-central (*Jeffersonii* West) and southeastern B.C. (COSEWIC, 2012b*; Jeffersonii* East; B.C. Badger Recovery Team, 2016). Although there is limited historical population data in B.C. for American badgers, historical trapping records between 1919 and 1977 infer a likely long-term decline (*Jeffersonii* Badger Recovery Team, 2008). In addition, there have been lower reported female and juvenile captures in certain regions, as well as less anecdotal American badger sightings in B.C. over the last two decades (*Jeffersonii* Badger Recovery Team, 2008). The East Kootenay American badger population (*Jeffersonii* East) is comprised of an estimated 100 to 160 mature individuals (COSEWIC, 2012b; B.C. Badger Recovery Team, 2016). The *Jeffersonii* East population are likely overall stable with declines in certain areas (COSEWIC, 2012b). Collisions with vehicles is the leading cause of mortality for American badger in the East Kootenay (Kinley and Newhouse, 2008; B.C. Badger Recovery Team, 2016).

Regional and Local Connectivity

The Western American badger population (in the Thompson/Okanagan) and the Eastern American badger population (in the East Kootenay Region), are separated by extensive unsuitable habitat in the Selkirk and Monashee Mountains and wet, closed-canopy forests of Western Redcedar (*Thuja plicata*) and Western Hemlock (*Tsuga heterophylla*; Ethier et al., 2012; B.C. Badger Recovery Team, 2016). The Elk Valley lies within the Eastern population, which extends from the U.S.A. border at Grasmere, B.C., up to Golden, B.C. (Kinley et al., 2014). This region presents high resistance landscapes (i.e., is generally impermeable/not able to support the species or its prey; Zeller et al., 2012) and is thus limits gene movement between

populations (COSEWIC, 2012b). American badger in the Elk Valley are most likely more closely related to the *taxus* subspecies due to low elevation mountain ranges across the B.C.-AB border (e.g., Crowsnest pass) and movement capabilities of the species (Kyle et al., 2004; Ethier et al., 2012; B.C. Badger Recovery Team, 2016). There is limited connectivity between the Rocky Mountain Trench and Elk Valley (COSEWIC, 2012b; B.C. Badger Recovery Strategy, 2016). As data are limited in this region on American badgers, further studies are required to identify potential movement corridors in the Terrestrial LSA and Terrestrial RSA. Movement corridors in the East Kootenay region mostly occur within dry grassland valley bottoms, fields, and open-canopied forests (*Jeffersonii* Badger Recovery Team, 2008).

Transboundary Considerations

American badgers are wide ranging animals with known populations existing in AB and Montana. Populations of the subspecies *taxus* in southern AB and north-central Montana showed high levels of genetic variation, indicating high gene flow (Kyle et al., 2004). In addition, there is evidence of gene flow in the *jeffersonii* East subpopulation between the East Kootenay population and northwestern Montana populations, showing the importance of transboundary considerations in conservation management (Kyle et al., 2004). Although *taxidea* and *jeffersonii* subpopulations are connected further south by populations in the U.S.A., movement between the two through this area is very unlikely due to unsuitable habitat as well as geographic barriers like the Bitterroot Mountain range and the Okanagan Highlands (Washington Wildlife Habitat Connectivity Working Group, 2010; COSEWIC, 2012b). Translocations have occurred across the Canada-U.S.A. border, and American badgers in the East Kootenay region and in northwest Montana are believed to exist as one population (Kyle et al., 2004).

15.5.2.1.4 American Marten

Ecology and Habitat Requirements

Within B.C., optimal habitats for American marten can be characterized as coniferous forests dominated by spruce and fir with large amounts of coarse woody debris (CWD) that support abundant prey populations (Buskirk and Ruggerio, 1994; Lyon et al., 1994; Mowat, 2006). Within B.C., American marten habitats range in elevation from valley bottoms up to the limit of continuous tree cover (Government of B.C., 1994). American marten tend to avoid dry (xeric) forests and select for wetter (mesic) ecosystems, likely due to the higher primary productivity and greater abundance of prey (e.g., voles) these ecosystems provide (Koehler and Hornocker, 1977; Mowat, 2006).

The species is strongly associated with later seral stages and uneven-aged stands of coniferous or mixed wood forests (Allen, 1982; Buskirk and Ruggerio, 1994; Thompson and Colgan, 1994; Bull, 2000). American martens are considered an old-growth dependent species, and forest structure can be more important to American marten than stand age (Lofroth, 1993; Buskirk and Ruggerio, 1994). Structural complexity provides American marten with hunting and denning habitat, as well as thermal and security cover (Buskirk and Powell, 1994; Buskirk and Ruggiero, 1994; Payer and Harrison, 2003). Complex structures include large diameter CWD, hollows in decaying logs, stumps, squirrel middens, and cavities in large diameter snags (i.e., wildlife trees) created by vertebrates such as red squirrels (*Tamiasciurus hudsonicus*) and cavity nesting birds (e.g., Pileated Woodpecker (*Dryocpus pileatus*); Buskirk, 1984; Spencer, 1987). Winter is the most limiting season for American marten due to reduced prey availability and increased costs of thermoregulation and movement in deep snow (Government of B.C., 1994; RISC, 1999b). During winter, American marten are particularly reliant on CWD in the understory and large diameter snags as

these features provide thermal and security cover and/or access to subnivean sites used for hunting prey (Buskirk and Ruggerio, 1994; Government of B.C., 1994; Hatler et al., 2003).

American marten prefer closed-canopy forests and often avoid open forests and habitats with limited cover including young seral stages, grasslands, brushlands, shrublands, and alpine ecosystems (Spencer et al., 1983; Lofroth amd Banci, 1991; Buskirk and Ruggiero, 1994). Landscapes that have more than 25% non-forest cover result in almost a complete absence of American marten (Hargis et al., 2001). Riparian areas offering adequate structure are used for foraging, resting, and dispersal; however, lake and wetland habitats are generally avoided (Lofroth, 1993; Government of B.C., 1994).

Resource selection probability function models were developed for American marten to support the EA for the Baldy Ridge Extension Project (Teck Coal Limited, 2015b. The results of the model showed that American marten select for high elevation mature and old growth forests dominated by spruce and subalpine fir. Selected habitats also included scattered grasses and low shrubs in the understory (Teck Coal Limited, 2015a).

Although large-scale fires would have reduced the availability of habitat for American marten, small-scale fires may have created prey habitat, snags and coarse woody debris that would have benefitted the species (Koehler and Hornocker, 1977). Fire suppression activities introduced after the 1980s promoted a shift in forest composition to denser, mature forests (Gray and Blackwell, 2005). Fire suppression likely increased habitat availability for American marten by increasing the accumulation of CWD and wildlife trees required by American marten for hunting and denning (Payer and Harrison, 2003). Fire suppression may also have decreased habitat quality in mid-seral stands by reducing understory growth required by American marten prey populations (Binkley et al., 2007).

Forestry tends to target old and mature stands that are preferred by American marten, resulting in reduced habitat quality and patch connectivity (Soutiere, 1979; Ritchie and Sullivan, 1989; Thompson, 1994). In addition, American marten tend to avoid recently logged areas, areas with high road density causing habitat displacement (Robitaille and Aubry, 2000; Tigner et al., 2015). It may take 15 to 40 years of regeneration for a cutblock to become suitable habitat for American marten (Soutiere, 1979; Thompson, 1994). Overall, forestry practices have most likely resulted in a loss of habitat for American marten in the Terrestrial RSA.

Similarly, coal mining activities in the Terrestrial RSA have generally resulted in considerable landscape changes including deforestation of mid elevational forests that are preferred by American marten (Teck Coal Limited, 2014; Teck Coal Limited, 2015a). Mined landscapes are predominantly sparsely vegetated with low structural complexity, resulting in a loss of habitat quality for American marten (Teck Coal Limited, 2015a). Mining reclamation areas are primarily represented by agronomic grasslands that are not suitable for American marten, and reclaimed sites may take over 30 years to achieve the structural complexity required by the species (Teck Coal Limited, 2015a).

Regional Occurrence and Abundance

American marten are widely distributed across most of B.C., often in late-successional coniferous forest habitats (Mowat, 2006). Regionally, American marten are often broadly distributed in mid-elevational, mature and old growth spruce and subalpine fir dominated forests in the ESSF zone (Lofroth, 1993; Hatler

et al., 2003; Teck Coal Limited, 2015a). Late-successional forest stands with >30% canopy closure may have increased values for American marten during winter (Koehler et al., 1975; Government of B.C., 1994). In the southern interior of B.C., American marten occur primarily in high elevation habitats, particularly in the ESSF Biogeoclimatic zone (Hatler et al., 2003; Teck Coal Limited, 2015a). Higher elevation zones with dependable snowpack may be favoured within a home range due to increased prey availability in subnivean spaces and reduced competition with other predators (Buskirk and Powell, 1994). At broad spatial scales American marten occurrence is determined by areas of forest fragmentation whereas at finer spatial scales occurrences are more influenced by the presence of late seral forest conditions (Wasserman, 2008).

American marten home ranges vary considerably among geographic areas, between sexes, and according to prey abundance and habitat type (Buskirk and McDonald, 1989; Buskirk and Ruggiero, 1994; Buskirk and Zielinski, 1997). Adult male home ranges are often larger (i.e., from 1.8 km^2 to 28.6 km^2) than female home ranges (0.6 km^2 to 9.8 km^2), with limited overlap (Hawley and Newby, 1957; Stordeur, 1986; B.C. CDC, 1994c). In interior B.C., home ranges for males were found to be 5.25 km^2 on average, and 3.16 km^2 on average for females (Lofroth, 1993). American martens are not known to change their home ranges seasonally; however, their movements may become more concentrated on the highest quality portions of their ranges during winter when resources are less abundant (Buskirk and Ruggiero, 1994; Wasserman et al. 2010). Juveniles are known to disperse more 40 km to establish their home range (B.C. CDC, 1994c Broquet et al., 2006). Home range boundaries often border open meadows and burns, due to avoidance of high contrast edges and areas without overhead cover (Hawley and Newby, 1957; Wasserman, 2008).

American martens have relatively low population density compared to other mammals and exhibit density-dependent population growth (Buskirk and Ruggiero, 1994; Fryxell et al., 1999). Low prey abundance can lead to a decrease in American marten population density, reduced number of young, and increased dispersal resulting in lower population abundance (Thompson and Colgan, 1987). American marten density was estimated 0.33 animals/km^2 in the Selkirk Mountains (Mowat and Paetkau, 2002). American marten abundances can be expected to be impacted by habitat quality and quantity (including prey availability), trapping activities, and habitat connectivity (Buskirk and Ruggiero, 1994; Weaver, 2001).

Regional and Local Connectivity

American martens are sensitive to forest fragmentation, which causes discontinuity of high-quality habitat and reduces population gene flow (Wasserman et al., 2010; Cushman et al., 2011; Wasserman et al., 2013). Although connectivity of American marten habitat is naturally fragmented by unsuitable habitats such as grasslands, wetlands, and open deciduous forests, the encroachment of development (e.g., mines, logging, roads) into forested areas has likely caused additional disruption of habitat linkages (Wasserman et al., 2010; Teck Coal Limited, 2015a). Human activities have the potential to reduce landscape connectivity for American marten in the Terrestrial RSA through mortality and landscape changes, resulting in a reduction in the quality and amount of habitat (Cushman et al., 2011; Cushman and Wasserman, 2017).

Landscape features that best facilitate dispersal of American marten populations include intermediate elevation, late successional areas throughout the ESSF zone, and riparian areas (Government of B.C., 1994; Wasserman et al., 2010; Teck Coal Limited, 2015a). Gene flow for American martens is found to be largely

influenced by elevation in the Purcell, Selkirk, and Cabinet mountains, with low resistance gene flow occurring around 1500 m (Wasserman et al., 2010).

Studies have identified several areas in the Terrestrial RSA that may maintain connectivity between populations of American marten (Teck Coal Limited, 2014; 2015a). Some of these are within the Terrestrial LSA, including:

- A north-south corridor that connects Alexander Creek and Michel Creek; and
- A north-south corridor linking Michel Creek and Erickson Creek.

Additional connectivity areas in the Terrestrial RSA include:

- A west-east corridor connecting Hosmer-Marten-Sparwood Ridge complex to McCool and Ladner Creeks;
- A west-east corridor north of Hosmer connecting the Hartley Drainage; and
- A west-east corridor south of Fernie, linking the valleys of Morrissey Creek and the east slopes of the Lizard Range.

Transboundary Considerations

American marten are mobile animals with high dispersal capacity (Broquet et al., 2006). It is therefore highly likely that individuals regularly disperse across the AB border. Likely dispersal corridors along the Continental Divide include contiguous old and mature mid-elevational forest patches within the Crowsnest, Deadman, and Racehorse passes.

15.5.2.1.5 Canada Lynx

Ecology and Habitat Requirements

Canada lynx inhabit a broad range of forested habitats in B.C. where their primary prey (snowshoe hare [*Lepus americanus*]) are most abundant (Koehler and Aubry, 1994; Poole, 1994; Poole et al., 1996; Aubry et al., 2000; Apps et al., 2007; Government of B.C., n.d.). Optimal habitats for Canada lynx within B.C. include early successional forests that follow wildfires and forest harvesting, high elevation riparian thickets, and both deciduous and older coniferous forests that support thick undergrowth (Litvaitis et al., 1985; Aubry et al., 2000; Hatler and Beal, 2005; Government of B.C., n.d.).

Canada lynx use a variety of landscapes and forest structures that provide the required resources to meet life requisites (i.e., prey-capture, security and thermal cover, travel habitat, and denning sites (Koehler, 1990; Koehler and Brittell, 1990; Hatler and Beal, 2003)). Dense, early seral forests and shrub thickets are often selected for by Canada lynx as these habitats provide important browsing for snowshoe hare (Koehler, 1990; Mowat et al., 2000). Quality habitats tend to include mid-successional forests (20-40 years old) that have regenerated with high vegetative cover after lower intensity burns (Thompson et al., 1989; Aubry et al., 2000). Old and mature forest stands with dense understory are used for security, thermal cover, resting/denning, and movement between suitable hunting habitats (Koehler, 1990; Koehler and Brittell, 1990; Aubry et al., 2000; Mowat and Slough, 2003). Canada lynx tend to avoid open areas including grasslands, sparse forest, and forest openings greater than 100 m wide (Koehler and Aubry, 1994; Government of B.C., n.d.).

In southeastern B.C., Canada lynx typically select mid-elevation and moderate to gentle slopes (<40%) within home ranges (Koehler, 1990; Koehler and Aubry, 1994; Apps, 2000;). Habitat components important for Canada lynx in the Terrestrial LSA include travel habitat (e.g., Alexander River, Deadman Pass), denning sites, security and thermal cover habitat, and security habitat (Apps, 2000; Aubry et al., 2000).

Resource selection probability function models were developed for Canada lynx and snowshoe hare to support the EA for the Baldy Ridge Extension Project (Teck Coal Limited, 2014). The results showed that Canada lynx selected for habitats with a greater than 60% probability of being selected by snowshoe hare (Teck Coal Limited, 2014). Both species were found to select for habitats characterized by mid-elevation coniferous forests, gentle slopes, and cool aspects (Teck Coal Limited, 2014). The results showed that both species selected for regenerating cutblocks and avoided open areas including grasslands and mine lands (Teck Coal Limited, 2014). In the Elk Valley, a Canada lynx HSI model showed that Canada lynx habitat is patchily distributed, occurring primarily along major ridge complexes and higher elevation valleys (Apps, 2007).

Landscape disturbances such as logging and fire can increase habitat quality for Canada lynx by removing overstory cover and creating early seral habitats that provide higher levels of forage for prey (Hodges, 2000; Nagorsen, 2005; Apps, 2007). Conversely, the removal of forest cover from logging can diminish landscape level habitat quality for Canada lynx by reducing/removing thermal and security cover, as well as breeding and denning habitat (Hodges, 2000; Nagorsen, 2005; Apps, 2007). Vegetation structure is the most important factor determining the security or thermal value of a given habitat for Canada lynx (Fuller and Heisey, 1986; Government of B.C., n.d.). Loss of forest cover is generally considered the highest threat to southwestern Canada lynx populations, along with expansion of competing predator distributions and increasing human presence (Weaver, 1993; Koehler and Aubry 1994).

Natural fires would have promoted the establishment of forest patches of varying ages, resulting in a mosaic of forest habitats that would have benefited lynx (e.g., old and mature forests for denning, and early successional forests for prey; Koehler, 1990). During the 1980s, habitat availability may have declined for Canada lynx as a result of fire suppression activities that reduced early successional forests (Hodges, 2000).

Coal mining is often associated with mid-elevation deforestation, resulting in a loss of quality Canada lynx habitat (Teck Coal Limited, 2014; 2015a). Current mining reclamation practices provide unfavourable conditions for snowshoe hare 40 years post-reclamation as they typically are dominated by sparse conifers with limited understory (Teck Coal Limited, 2014; 2015a).

Regional Occurrence and Abundance

Within southeastern B.C., Canada lynx typically select mid-elevation and moderate to gentle slopes (<40%) within home ranges; however, habitat selection varies seasonally (Koehler, 1990; Koehler and Aubry, 1994; Apps, 2000). During summer, Canada lynx tend to use higher elevation riparian habitats, early seral forests, and dense shrub thickets (Koehler, 1990; Apps, 2000; Squires et al., 2010). During winter, individuals exhibit shorter daily movements and smaller home ranges (Apps, 2000). Higher elevations have greater snow depths that may restrict lynx movements and/or increase expended energy (Murray and Boutin, 1991; Apps, 2000). In mountainous terrain, Canada lynx tend to use lower elevations, old and

mature coniferous forests, and gentler slopes (Fuller and Heisey, 1986; Koehler, 1990; Apps, 2000; Squires et al., 2010).

Canada lynx home ranges vary in size depending on geographic area, habitat features, sex and age classes, seasons and primary-prey abundance (Slough and Mowat, 1996; Apps et al., 1999; Apps, 2000; Hatler and Beal, 2005; Vashon et al., 2008). Canada lynx home ranges in southern B.C. tend to be larger (e.g., 200 km^2; Apps et al., 1999) than northern population home ranges due to relatively lower snowshoe hare abundances (Koehler, 1990; Apps et al., 1999; Aubry et al., 2000; Vashon et al., 2008). Female home ranges tend to be smaller than male home ranges, with extensive spatial overlap between sexes (Koehler and Aubry, 1994; Apps et al., 1999; Vashon et al., 2008). Major roads in the Terrestrial RSA including Highway 3 and 43 may act as boundaries that constrain the spatial distribution of Canada lynx home ranges (Apps et al., 2007; Clevenger et al., 2010).

The abundance of snowshoe hares is the primary limiting factor for Canada lynx populations (B.C. CDC, 1995a). At cyclic low hare densities, Canada lynx occur at densities of approximately 2 to 3 animals per 100 km^2 in northern parts of their distributional range, with densities increasing 3 to 4 fold at high population levels (Koehler, 1990; Hatler and Beal, 2003). Population densities of Canada lynx are lower and more patchily distributed in southeastern B.C., and population viability may be more dependent on immigration (Apps et al., 2000; Schwartz et al. 2002; Apps et al., 2007). Although there is limited data on Canada lynx population trends in the Terrestrial RSA, a minimum population density from hair snagging found 0.74 Canada lynx per 100 km^2 in the Elk Valley (Apps et al., 2007). Population density is presumably higher as the density represents a minimum count and is not a derived estimate that accounts for detection error (Apps et al. 2007).

Regional and Local Connectivity

Canada lynx movements typically parallel the north to south orientation of the southern Canadian Rockies, which provide a valuable corridor to populations within the US (Apps et al., 2007). As habitat for Canada lynx is patchily distributed in the southern Canadian Rockies, species population viability is likely highly dependent on immigration and habitat connectivity (Apps et al., 2007). High-quality habitat within the Elk Valley is patchy in distribution, likely resulting in low densities of Canada lynx at a regional scale (Apps et al., 1999). The population within the Elk Valley is likely reliant on immigration from neighbouring populations (Apps et al., 1999; McKelvey, et al., 2000; Apps et al., 2007).

Human activities have the potential to alter the connectivity of Canada lynx in the Terrestrial RSA through mortality and landscape changes resulting in a reduction in the quality and amount of habitat. Increasing linear features generally fragment habitats used by Canada lynx (Apps et al., 2007). Road density and length increased in the Terrestrial RSA between 1950 and 2020. Roads can impact Canada lynx connectivity by increasing mortality risk and disturbance (Apps et al., 2007). Increasing road density can increase Canada lynx mortality through increased vehicle collisions and higher harvest pressure facilitated by increased access to quality habitats (Kramer-Schadt et al., 2004; Apps et al., 2007; Bayne et al., 2008a). In addition, major roads in the Elk Valley (e.g., Highway 3 and 43) may often form boundaries of Canada lynx home ranges resulting in habitat fragmentation and a loss of connectivity (Apps et al., 2007; Clevenger et al., 2010). Other human disturbances (e.g., mining, reclamation activities, urban development) create higher resistance landscapes and reduce Canada lynx population connectivity and gene flow (Apps, 2000; Teck Coal Limited, 2014).

Connectivity habitats for Canada lynx are generally linear and wooded, including riparian habitats and deciduous and coniferous forests that are greater than 2 m in height (Apps et al., 1999; Mowat and Slough, 2003; Government of B.C., n.d.). Likely or known movement corridors for Canada lynx in the Terrestrial RSA include the major tributaries of the Elk River including the Alexander-Michel Creek linkage (Apps et al., 2007; Teck Coal Limited, 2015b; Lee et al., 2019).

Studies of Canada lynx have identified several key corridors in the Terrestrial RSA that maintain connectivity between populations (Apps et al., 2007; Teck Coal Limited, 2015a). Some of these are within the Terrestrial LSA, including:

- A north-south corridor that connects the Alexander Creek to the Michel Creek; and
- A north-south corridor linking Michel Creek and Erickson Creek.

Additional connectivity areas in the Terrestrial RSA include:

- A west-east corridor connecting the Hosmer-Marten-Sparwood Ridge complex to McCool and Ladner Creeks across Highway 3;
- A west-east corridor south of Hosmer connecting the Hartley Drainage to Hosmer and Fernie Ridges
- A west-east corridor linking the valleys of Morrissey Creek and the east slopes of the Lizard Range; and
- A west-east corridor across the Continental Divide (Racehorse Pass and Deadman Pass north of Highway #3, and Tent Mountain and Ptolemy Passes south of Highway 3).

Transboundary Considerations

Canada lynx are highly mobile animals with relatively large home ranges and known populations existing in AB and Montana. It is therefore highly likely that individuals exhibit seasonal or regular transboundary movements. Known or anticipated movement corridors include riparian and forested habitats in the Rocky Mountain Ranges including the Crowsnest, Deadman, and Racehorse passes.

The contiguous northwestern Montana and Idaho population unit is thought to support 200 to 300 resident Canada lynx, as habitats are naturally patchy and fragmented due to topography, elevation, and aspect constraints (U.S. Fish and Wildlife Service, 2017). Maintaining transboundary connectivity is important for the persistence of Canada lynx, as populations that exist adjacent to Canadian provinces may function as peripheral subpopulations of the larger metapopulation distributed across Canada and Alaska (McKelvey et al., 2000; U.S. Fish and Wildlife Service, 2017). The Elk Valley Canada lynx population likely acts as a source population to the contiguous US (Apps et al., 1999; McKelvey, et al., 2000; Apps et al., 2007).

15.5.2.2 Baseline Programs

15.5.2.2.1 Summary of Methods

Comprehensive field surveys were conducted in 2014, 2017, 2018, and 2019 to support the Project's baseline studies and the development of the EA. The surveys were completed to obtain information on carnivore occurrence, abundance, distribution, and habitat availability within the Terrestrial LSA (Table 15.5-8). The carnivore community baseline surveys were conducted within the Project footprint and the Terrestrial LSA. Survey methods followed provincial survey standards, where applicable, and were

Table 15.5-8: Baseline Field Survey Effort for Carnivores in the Terrestrial LSA

Survey Type	Survey Dates	Survey Standards	References	Sample Effort	Data Collected
Remote Camera Surveys	February 1 - May 19, 2014 January 31 - May 2, 2015	Wildlife Camera Metadata Protocol (RISC, 2019)	• Quinn and Klafki, 2015 • Des Rosiers-Ste. Marie, 2019	8,198 sampling nights across 42 camera stations	Presence/non-detection
Ground Transects	January 1, 2017 - September 13, 2019 February 6 - 10, 2014 February 24 - 28, 2014 March 27 - 28, 2014 February 13 - 16, 2015 February 23 - 25, 2015 March 7 - 9, 2015 March 17, 2015 March 30 - 31, 2015 July 9 - 10, 2019 July 15 - 19, 2019 July 28, 2014	Inventory Methods for Medium-Sized Territorial Carnivores: coyote, red fox, lynx, bobcat, fisher, & badger (RISC, 1999c)	Quinn and Klafki, 2015	557.21 km total surveyed	Presence/non-detection
Badger Burrow Surveys	August 1, 2014 July 3 - 4, 2018 July 9 - 10, 2019 July 15 –19, 2019	Inventory Methods of Medium-Sized Terrestrial Carnivores: coyote, red fox, lynx, bobcat, wolverine, fisher & badger (RISC, 1999c)	• Klafki, 2014 • Hausleitner and Lowey, 2018	250.46 km of transects surveyed	Presence/non-detection
Hair Snagging Surveys	February 1 – May 19, 2014 January 31 – May 2, 2015	Inventory Methods of Medium-Sized Terrestrial Carnivores: coyote, red fox, lynx, bobcat, wolverine, fisher & badger (RISC, 1999c)	Quinn and Klafki, 2015	5 baited stations	Presence/non-detection; Genetic (hair) samples

conducted during the spring, summer, fall, and winter to capture seasonal variability in habitat selection and distribution (RISC, 1999b; Brennan et al., 2019). Surveys were established to include representative habitat types, while focusing effort on areas where carnivores (and their prey) would be expected to be found if present, including trails, roads, and other linear landscape features that facilitate animal movements (RISC, 1999b; Mackenzie et al., 2002; Kelly et al., 2012; Quinn and Klafki, 2015; Chow, 2019; RISC, 2019).

The carnivore surveys completed as part of the baseline program included the following survey types:

- Remote camera surveys;
- Ground transects;
- Badger burrow surveys; and
- Hair-snagging surveys.

A summary of the carnivore community baseline program surveys is outlined in Table 15.5-8 and survey locations are shown in Figure 15.5-1, Figure 15.5-2, and Figure 15.5-3. For additional details on the carnivore community baseline survey methods, refer to Appendix 15-B. Other data used in the assessment included GPS collaring of grizzly bear and remote camera data from the surrounding Terrestrial RSA (Apps and Lamb, 2019; Chow, 2019; Table 15.5-9; Figure 15.5-4; Appendix 15-B). Winter transect data were used to provide estimates of carnivore relative abundance. Track observations were converted to frequency of tracks/km-day to rank habitat use (Quinn and Klafki, 2015). This (relative abundance) was derived by dividing the number of tracks observed by the distance surveyed (km) and by the number of days since last snowfall for each respective BEC subzone.

The assessment of grizzly bear included data obtained from a collaborative research program that seeks to understand behavioural responses by grizzly bears against a suite of factors pertaining to habitat and human influence (Apps and Lamb, 2019; Appendix 15-D). Grizzly bears were captured through localized ground trapping using cable-snares, culvert traps, free-range darting, as well as through helicopter searching and aerial darting (Apps and Lamb, 2019). GPS collars were deployed on a total of 75 grizzly bears (99 times) between 2003 and 2019, with a variable interval of location fixes (Apps and Lamb, 2019; Table 15.5-9). The majority of location fixes occurred every 6 hours, with some occurring at 2, 4, 13 hour, or daily intervals. In the Crowsnest Highway (including lower Elk Valley and Crowsnest Pass), 32 GPS radio collars (Lotek 4000/4400M) were placed on adult grizzlies (15M, 17F) 37 times between 2003 and 2010 at location fixes occurring every 1 or 2 hours. Between 2015 and 2018, GPS radio collars (Followit or Vectronic) were deployed on 43 grizzlies (22M, 21F) 62 times within the Elk Valley. Winter den sites for grizzly bears were also determined from GPS location data during November to April. Den site locations were inferred based on clustering of GPS location data during the expected denning period (Apps and Lamb, 2019).

Table 15.5-9: Supplementary Baseline Program Surveys Conducted in the Terrestrial RSA

Survey Type	Survey Dates	References	Sample Effort	Data Collected
RSA Camera Surveys	June 9, 2016 - December 19, 2018	Chow, 2019 (FLNRORD)	80 camera stations over 5 years	Presence/ non-detection
Grizzly Bear GPS Collaring	2003-2008	Apps and Lamb, 2019	75 grizzly bears collared (99 collaring events)	GPS locations recorded at 6 hour intervals

Crown Mountain Coking Coal Project

Figure 15.5-1
Remote Camera Survey Locations

LEGEND

- Remote Camera
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

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Scale 1:85,000

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Crown Mountain Coking Coal Project

Figure 15.5-2
Ground Transect Survey Locations

LEGEND

Ground Transects
- 2014
- 2015
- 2019
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

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Crown Mountain Coking Coal Project

Figure 15.5-3
Non-Invasive DNA Sampling Station Locations

LEGEND

- Baited Stations
- 10x10 km grid
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

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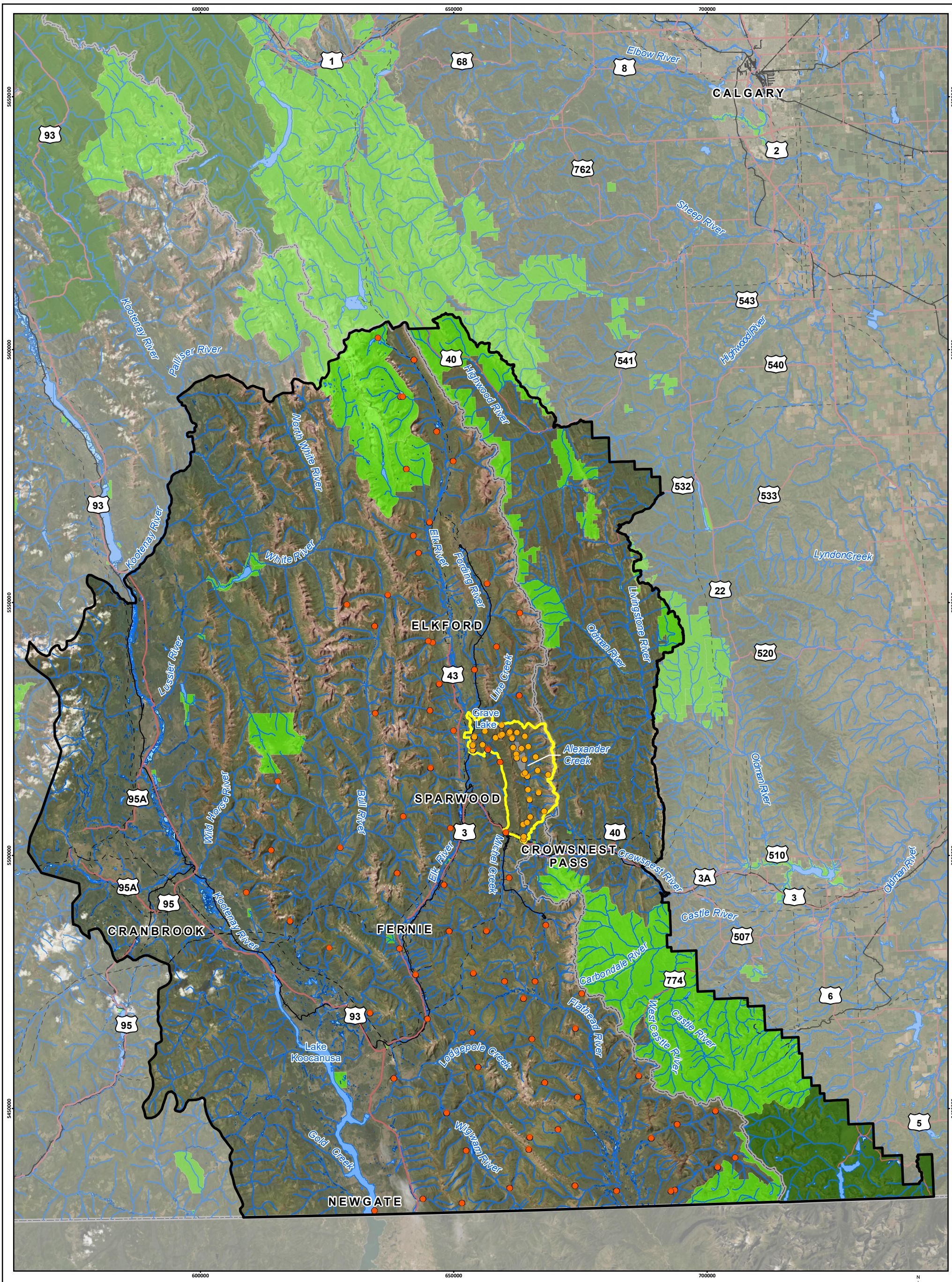

Crown Mountain Coking Coal Project

Figure 15.5-4
Remote Camera Stations Established in the Terrestrial RSA (Chow, 2019)

LEGEND

Camera Stations
- Keefer Ecological Services
- FLNRORD
- Terrestrial Regional Study Area
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- National Park
- British Columbia/Alberta Border

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15.5.2.2.2 Results

Grizzly Bear

Baseline surveys showed that grizzly bears were broadly distributed in the Terrestrial LSA, occurring along Alexander, Grave, and Harmer Creek drainages and transboundary mountain passes (Figure 15.5-5). The majority of grizzly bear detections were located within the MSdw, but also occurred in the ESSFdk1 and ESSFdkw zones (Table 15.5-10).

Table 15.5-10: Grizzly Bear Detections in BGC Zones within the Terrestrial LSA

BGC Zone	Grizzly Bear
MSdw	40
ESSFdkw	6
ESSFdk1	16

Survey efforts resulted in a total of 55 unique detections/locations of grizzly bear across the Terrestrial LSA (Table 15.5-11). Remote camera detections in the Terrestrial LSA found a total grizzly bear relative abundance estimate of 0.007 detections per sampling night. Grizzly bears were recorded on seven occasions during ground transects in the Terrestrial LSA (Quinn and Klafki, 2015; Table 15.5-11). An additional two incidental sightings of grizzly bear were recorded during baseline surveys, which are not included in the results table. Grizzly bear were incidentally observed on the avalanche chutes directly west of Crown Mountain and below Gaff peak during July 2019. In addition, a grizzly bear den was incidentally observed in the avalanche chute directly west of Crown Mountain during July 2018. Baseline surveys showed evidence of breeding females throughout the Terrestrial LSA.

Table 15.5-11: Grizzly Bear Detections within the Terrestrial LSA

Survey Method	Grizzly Bear
Remote Cameras	55
Ground Transects	7

Wolverine

Baseline surveys showed that wolverine detections were broadly distributed in the Terrestrial LSA, occurring along the Alexander, Grave, and Harmer Creek drainages and transboundary mountain passes (Table 15.5-11). The majority of wolverine detections were located within the MSdw, followed by the ESSFdk1 and ESSFdkw zones (Table 15.5-12).

Table 15.5-12: Wolverine Detections in BGC Zones within the Terrestrial LSA

BGC Zone	Wolverine Detections
MSdw	47
ESSFdkw	3
ESSFdk1	31

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Figure 15.5-5
Grizzly Bear Observations within the Terrestrial LSA (2014-2019)

LEGEND

- Winter Transect
- Winter Camera
- Summer Transect
- Summer Camera
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

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Remote camera survey efforts resulted in a total of 19 unique detections/locations of wolverine in the Terrestrial LSA (Table 15.5-13; Figure 15.5-6) for a total wolverine relative abundance estimate of 0.005 detections per sampling night. Wolverines were recorded on 28 occasions during ground transects in the Terrestrial LSA (Quinn and Klafki, 2015; Table 15.5-13; Figure 15.5-6).

Wolverine tracks were detected in all three BEC zones, with no substantial difference between detection in different zones. No wolverine tracks were detected west of Erickson Ridge or lower Grave Lake area but were detected on transects (and incidentally observed) across the eastern portion of the Terrestrial LSA including the upper Grave Creek, Crown Mountain, Alexander Creek, Racehorse Pass, and Deadman Pass areas. The relative abundance estimates of wolverine during 2014 and 2015 transect surveys was 0.044 tracks/km-day and 0.059 tracks/km-day, respectively (Quinn and Klafki, 2015). One wolverine bed was encountered, from which a scat sample was collected for DNA analysis. Wolverine hair was collected from both a natural rub tree as well as from one of the non-invasive sampling sites (Quinn and Klafki, 2015).

Table 15.5-13: Wolverine Detections within the Terrestrial LSA

Survey Method	Wolverine
Remote Cameras	19
Ground Transects	28

Quinn and Klafki (2015) concluded that there was a minimum of 2 wolverine in the Terrestrial LSA, including 1 male and 1 female, based on unique pelage markings visible in remote cameras and genetic analysis.

American Badger

Baseline surveys showed that American badger were broadly distributed in the Terrestrial LSA (Figure 15.5-7). The area south of Grave Lake corresponds to the area with the highest concentration of observed Columbian ground squirrel colonies (Figure 15.5-8). Active or recently-used American badger burrows were only documented in the northwest portion of the Terrestrial LSA, to the south and southeast of Grave Lake (Figure 15.5-9). Inactive American badger burrows were mostly found within the MSdw zone, but also occurred in the ESSFdkw and ESSFdk1 zones (Table 15.5-14). Active burrows were only detected in the MSdw zone.

Table 15.5-14: American Badger Detections in BGC Zones within the Terrestrial LSA

BGC Zone	American Badger Inactive Burrows	American Badger Active Burrows
MSdw	65	10
ESSFdkw	4	0
ESSFdk1	4	0

Detection/non-detection transect survey efforts resulted in a total of 73 unique detections/locations of American badger burrows in the Terrestrial LSA (Table 15.5-15). In addition, survey efforts resulted in a total of 439 detections (a minimum of 20 m apart) of Columbian ground squirrel and 30 detections of northern pocket gopher (Table 15.5-15).

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Figure 15.5-6
Wolverine Observations within the Terrestrial LSA (2014-2019)

LEGEND

- Winter Transect
- Winter Camera
- Summer Camera
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

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Figure 15.5-7
American Badger Observations within the Terrestrial LSA (2014-2019)

LEGEND

Active Burrows
- 2014
- 2018

Inactive Burrows
- 2014
- 2018

- Badger Mortality
- Terrestrial Local Study Area
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

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