



Chapter 14 - Vegetation Assessment

Crown Mountain Coking Coal Project
Application for an Environmental Assessment Certificate /
Environmental Impact Statement

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- Appendix 14-D. Whitebark Pine Distribution, Health and Critical Habitat Assessment

14. Vegetation Assessment

14.1 Introduction

Vegetation is an important component of functioning terrestrial and aquatic ecosystems and is an important resource for wildlife, the public, and Indigenous communities. Vegetation species and communities, particularly those that are considered sensitive or vulnerable to extinction, can be affected by human activities, including industry, farming, forestry, urban development, construction of linear features (e.g., pipelines, roads/highways), and resource development. Given the complex relationships between vegetation, wildlife, and human activities, representative vegetation species and communities that demonstrate sensitivities to disturbance were identified as receptor valued components (VCs) for the Project in the Application Information Requirements (AIR; Environmental Assessment Office [EAO], 2018). These include:

- Listed and sensitive plant communities and species (herein referred to as listed plant communities and species);
- Limber pine (*Pinus flexilis*);
- Whitebark pine (*Pinus albicaulis*); and
- Culturally significant plants and ecosystems (assessed in Chapters 23 to 31).

In addition, federally listed species at risk were identified as a VC in the Guidelines for the Preparation of an Environmental Impact Statement for the Crown Mountain Coking Coal Project (EIS Guidelines; Canadian Environmental Assessment Agency, 2015).

An understanding of the potential effects to the aforementioned vegetation VCs with respect to the Project is critical to the Project design, engineering, operations, and assessment and mitigation of potential environmental effects. Vegetation VCs have linkages with other VCs; these effects are primarily assessed in the following chapters:

- Chapter 6: Atmospheric Environment Assessment;
- Chapter 8: Soil and Terrain Assessment;
- Chapter 9: Groundwater Assessment;
- Chapter 11: Surface Water Quality Assessment;
- Chapter 13: Landscapes and Ecosystems Assessment;

- Chapter 15: Wildlife and Wildlife Habitat Assessment; and
- Indigenous Communities discussed in Chapters 23 through 31.

14.2 Regulatory and Policy Setting

Applicable provincial and federal legislation related to the protection of listed plant communities and species, whitebark pine, limber pine are summarized in Table 14.2-1. Relevant guidelines, including standards and best management practices, are summarized in Table 14.2-2.

Table 14.2-1: Regulatory Considerations Relevant to Listed and Sensitive Plant Communities and Species, Whitebark Pine, and Limber Pine

Legislation Name	Year	Description
Federal		
Species at Risk Act	2002	Protects listed plant species (including whitebark pine and limber pine) in Canada from decline or disappearance. Aids in the recovery of species that are extirpated, threatened, or endangered, resulting from anthropogenic activities, and to manage species of special concern.
Canadian Environmental Assessment Act	2012	Provides the legal basis for the federal environmental assessment process. As of August 28, 2019, the Canadian Environmental Assessment Act, 2012 has been repealed and replaced by the Impact Assessment Act (2019); however, this Project remains under the 2012 legislation.
Provincial		
Forest and Range Practices Act	2002	Outlines how all forest and range practices and resource-based activities are to be conducted on Crown land in British Columbia (B.C.), while ensuring the protection of plants, wildlife, and ecosystems.
Environmental Management Act	2003	Regulates industrial and municipal waste discharge, hazardous waste, pollution, and contaminated sites remediation. The Environmental Management Act (EMA) enables the use of permits, regulations, and codes of practice to authorize discharges to the environment.
Environmental Assessment Act	2002; 2018	Provides a framework for the process of reviewing major projects and assessing their potential environmental impacts. As of December 16, 2019, the 2002 Act has been repealed and replaced by the Environmental Assessment Act (2018). On May 3, 2023, the Project was transitioned to the EAA (2018) through a Transition Order under Section 78(7) of the 2018 Act.
Mines Act	1996	In combination with the accompanying Health, Safety and Reclamation Code for Mines, this Act provides a foundation for the protection of the land and watercourses by minimizing the environmental risks associated with mining activities, in addition to providing reclamation requirements for disturbed areas.

Legislation Name	Year	Description
Land Act	1996	The primary legislation through which the government conveys land to the public for community, industrial, and business use. The Act allows the granting of land and the issuance of Crown land tenure in the form of leases, licenses, permits and rights-of-way. Sustainable management of Crown land and natural resources is guided in part by the Land Act and associated Land Use Objectives Regulation, in addition to land use plans, which work to protect species at risk and their habitats within certain regions.
Forest and Range Practices Act and Invasive Plants Regulation	2004	Identifies species of invasive plants in B.C.
Weed Control Act and Weed Control Regulation	1996; 1985	Sets out requirements for land occupiers to control noxious weed species and provides the province legislation to plan, implement, and enforce a weed control program. The regulation outlines plant species designated as noxious weeds in B.C.
Seeds Act	1985	Regulates seed sold, imported, and exported in Canada and their associated grade, also requires that seed in Canada is free of prohibited noxious weeds and ensures that standards of purity are met.

Table 14.2-2: Guidelines Relevant to Listed and Sensitive Plant Communities and Species, Whitebark Pine, and Limber Pine and their Habitats

Guideline Name	Year	Description
Federal		
Recovery Strategy for the Whitebark Pine (<i>Pinus albicaulis</i>) in Canada [Proposed]	2017	Outlines the threats to this species, particularly an invasive fungus, and provides strategies to counteract harm and facilitate population recovery.
Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Assessment and Status Report on the Whitebark Pine (<i>Pinus albicaulis</i>) in Canada	2010	Outlines the status of the population in Canada, threats, particularly an invasive fungus, that face this species and provides strategies to counteract harm and facilitate population recovery.
COSEWIC Assessment and Status Report on the Limber Pine (<i>Pinus flexilis</i>) in Canada (2014)	2014	Outlines the status of the population in Canada, threats, particularly an invasive fungus, that face this species and provides strategies to counteract harm and facilitate population recovery.
An Invasive Alien Species Strategy for Canada	2004	National strategy to protect Canada's native biodiversity and domesticated plants from invasive species.
Provincial		
Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development	2014	Outlines the planning and site development phases of building with environmental objectives and the aim of balancing urbanization with the protection of the environment.

Guideline Name	Year	Description
Health, Safety and Reclamation Code for Mines in British Columbia	2021	Provides a foundation for the protection of terrestrial landscapes and ecosystems through requirements that minimize environmental risks associated with mining activities, in addition to providing reclamation requirements for disturbed areas.
Invasive Species Strategy for British Columbia (2018 - 2022)	2017	Provides a strategic framework for improved terrestrial and aquatic invasive species management in B.C.
Best Practices for Managing Invasive Plants Along Roadsides: A Pocket Guide for British Columbia's Maintenance Contractors	2019	The Ministry of Transportation and Infrastructure (MOTI) has developed invasive plant best practices for roadside maintenance operations. If applied, these best practices can limit the introduction and spread of invasive to terrestrial ecosystems along roads.

14.3 Scope of the Assessment

14.3.1 Valued Components and Measurement Indicators

Three vegetation species or groups were identified as receptor VCs for the Project in the provincial AIR (EAO, 2018): listed plant communities and species; whitebark pine; and limber pine. The list of vegetation receptor VCs assessed does not differ from the Project AIR (EAO, 2018). Measurement indicators for listed plant communities and species, whitebark pine, and limber pine are summarized in Table 14.3-1. Rationale for the selection of the three vegetation VCs for inclusion in the Application/Environmental Impact Statement (EIS) is presented in Sections 14.3.1.1 to 14.3.1.3. The fourth vegetation VC identified in the AIR (EAO, 2018), culturally significant plants and ecosystems, is assessed in the context of Indigenous communities in Chapters 23 to 31.

Table 14.3-1: Measurement Indicators and Effects Pathways for Vegetation VCs

Valued Component	Measurement Indicators	Effects Pathways
Listed and Sensitive Plant Communities and Species	<ul style="list-style-type: none"> Community abundance and distribution relative to baseline (e.g., amount of community present, distribution of, structure, connectivity of the community, patch size); Community changes measured through species richness, sensitive/rare species, and presence of invasive species; Habitat availability and distribution relative to baseline (e.g., changes to the available habitat and distribution of habitat for this species); and Known occurrence and abundance (e.g., changes to the number of documented occurrences relative to baseline, changes to individual populations). 	VCs or VC groups identified as effects pathways for listed plant communities and species include: <ul style="list-style-type: none"> Soil quality and quantity; and Air quality.

Valued Component	Measurement Indicators	Effects Pathways
Whitebark Pine	<ul style="list-style-type: none"> Habitat availability and distribution relative to baseline (e.g., changes to the available habitat and distribution of habitat for this species); Known occurrence and abundance (e.g., changes to the number of documented occurrences relative to baseline, changes to individual populations); and Whitebark pine health (e.g., presence of blister rust). 	VCs or VC groups identified as effects pathways for whitebark pine include: <ul style="list-style-type: none"> Soil quality and quantity; Terrain; Surface water quality; and Air quality.
Limber Pine	<ul style="list-style-type: none"> Habitat availability and distribution relative to baseline (e.g., changes to the available habitat and distribution of habitat for this species); and Known occurrence and abundance (e.g., changes to the number of documented occurrences relative to baseline, changes to individual populations). 	VCs or VC groups identified as effects pathways for limber pine include: <ul style="list-style-type: none"> Soil quality and quantity; Terrain; Surface water quality; and Air quality.

14.3.1.1 Listed and Sensitive Plant Communities and Species

Listed and sensitive plant communities and species are identified as a VC given the threats as a result of habitat loss, invasive species encroachment, and changes in disturbance regimes. Several plant species and ecosystems, which are provincially Red- or Blue-listed (i.e., at greatest risk of risk of being lost or of special concern [Section 14.3.3.3; Province of British Columbia [B.C.], 2021]), have the potential to occur within the Project footprint and the Landscapes and Ecosystems Local Study Area (LSA). Within the East Kootenay region, key habitat types for listed plant communities and species are typically non-forested ecosystems as they make up a smaller portion of the landscape and as such are more likely to contain sensitive species or ecosystems due to their uncommon habitat attributes (e.g., ENV [n.d.]; Grasslands Conservation Council of British Columbia, [2017]).

Listed plant communities and species are considered to have scientific, ecological, social, cultural and historical importance.

14.3.1.2 Limber Pine

Limber pine is considered a VC as it is currently provincially Blue-listed (Environment and Climate Change Canada [ECCC], 2017; B.C. Conservation Data Centre [B.C. CDC], 2013) and recommended for listing as Endangered by the Committee on the Status of Endangered Wildlife in Canada (Committee on the Status of Endangered Wildlife in Canada [COSEWIC], 2014), although it does not have legal protection under the federal Species at Risk Act (SARA). The seeds of limber pine provide important food for a variety of mammal species, including bears and birds, and the trees provide shelter for wildlife (COSEWIC, 2014). As such, limber pine is considered a keystone species (COSEWIC, 2014). Like whitebark pine, limber pine is threatened by white pine blister rust (B.C. CDC, 2013) and due to this species' lack of potential for rescue, delayed age of maturity, low dispersal rate, and reliance on dispersal agents, it is considered at high risk of extirpation in Canada (COSEWIC, 2014).

Limber pine is considered to have scientific, ecological, social, cultural and historical importance.

14.3.1.3 Whitebark Pine

Whitebark pine is a VC given its current status as federally listed as Endangered under Schedule 1 of the federal SARA. In addition, in B.C., whitebark pine is Blue-listed, a classification which includes any Indigenous species or subspecies considered to be imperiled or of special concern, or vulnerable to extirpation or extinction (ECCC, 2017; B.C. CDC, 2020). Whitebark pine’s lack of potential for rescue, delayed age of maturity, low dispersal rate, and reliance on dispersal agents all contribute to the species being at high risk of extirpation in Canada (COSEWIC, 2010). Whitebark pine is at risk primarily due to white pine blister rust, which has killed and infected a large proportion of all five-needled pines in North America since its introduction from Asia in the early twentieth century; however, mountain pine beetle (*Dendroctonus ponderosae*), altered fire regimes, and climate change are also contributing to respective population decline.

Whitebark pine is considered to have scientific, ecological, social, cultural and historical importance.

14.3.2 Indigenous and Stakeholder Information

NWP engaged with Indigenous groups and conducted consultation with public stakeholders and government agencies. A summary of all consultation and engagement activities undertaken to date is presented in Chapter 4. A summary of consultation feedback specific to the vegetation VCs is presented in Table 14.3-2. Feedback received was considered in the assessment of effects to whitebark pine and associated mitigation measures.

Table 14.3-2: Summary of Consultation Feedback on Vegetation VCs

Topic	Feedback Received*:				Consultation Feedback	Feedback Source	Response or Actions Identified
	IG	G	P/S	O			
Whitebark pine recovery strategy		✓			The recovery strategy for whitebark pine was released in draft form in 2017 and identifies the methods for defining critical habitat. ECCC suggests that this strategy is taken into consideration for the Project.	Comment received from ECCC during the October 15, 2015 Working Group meeting.	The draft whitebark pine recovery strategy was considered in the assessment of effects to whitebark pine and associated mitigation measures.

Note:

* IG = Indigenous Group (group specified in feedback source); G = Government (provincial or federal agencies); P/S = Public/Stakeholder (Interest group, local government, tenure and license holders, members of the public); O = Other

14.3.3 Assessment Boundaries

14.3.3.1 Spatial Boundaries

Three spatial boundaries were considered in the assessment of effects to vegetation VCs: the Project footprint, the Landscapes and Ecosystems Local Study Area (LSA), and the Landscapes and Ecosystems

Regional Study Area (RSA). As detailed in Chapter 5, Table 5.3-2, the spatial boundaries for the vegetation VCs have changed from the study areas presented in the AIR. A discussion on the spatial boundaries used in the assessment is provided below.

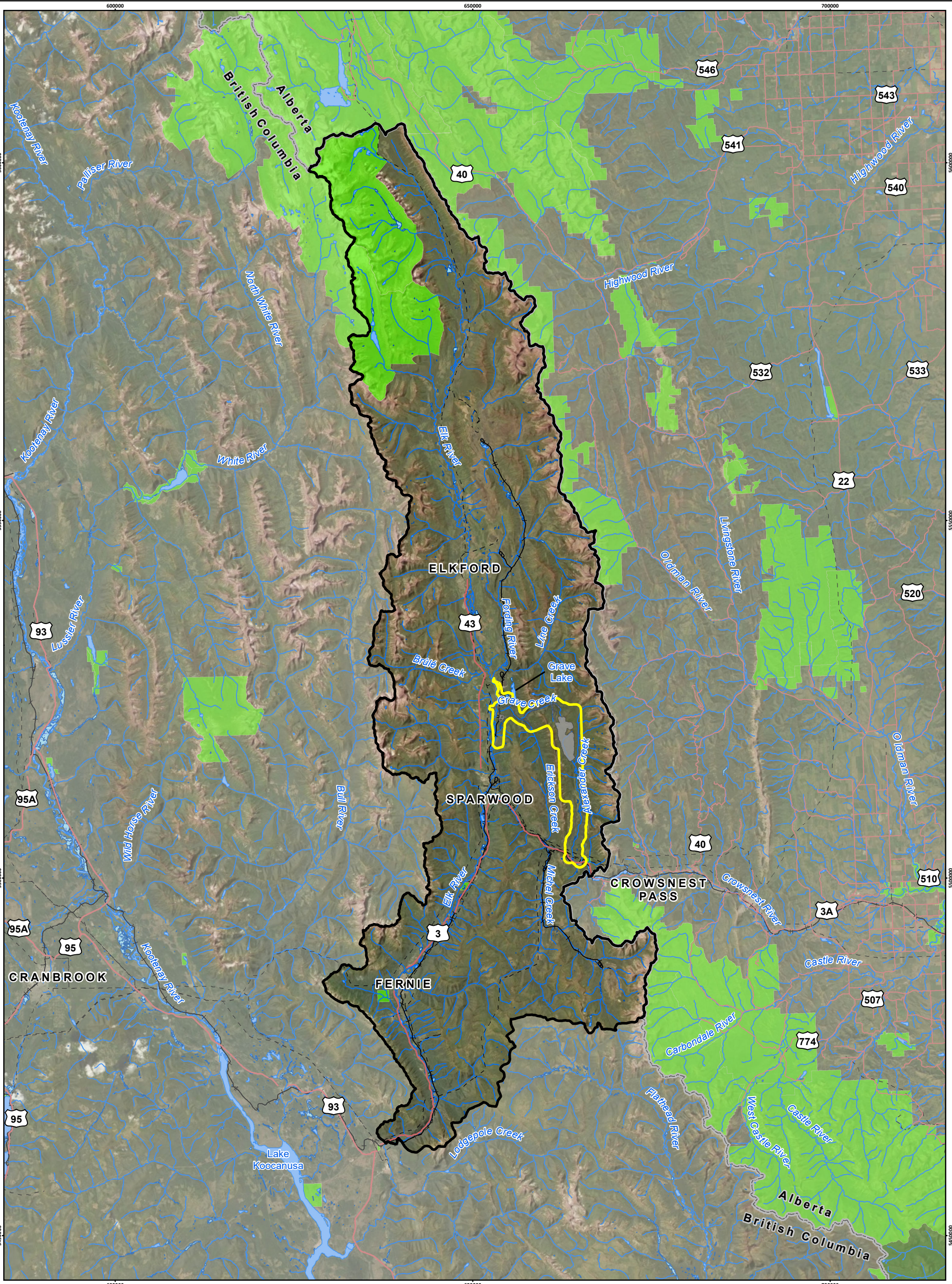
The Project footprint is the area of physical disturbance associated with the Project and encompasses all anticipated Project components, both temporary and permanent, covering approximately 13 square kilometres (km²) or 1,283 hectares (ha; Figure 14.3-1). The centre of the Project is positioned approximately 12 km northeast of the District of Sparwood and approximately 5 km west of the provincial boundary between B.C. and Alberta. The Project footprint is the area of physical disturbance associated with the Project and consists of the proposed surface extraction areas (three pits - north pit, east pit, and south pit); mine rock management areas; mine infrastructure and support facilities, including the plant area (raw coal stockpile area and processing plant); clean coal transportation route; rail loadout facility and rail siding; and ancillary facilities (i.e., water supply, power supply, natural gas supply, water, sewage treatment, fuel storage and explosives storage). All watersheds in the Project footprint are located on the western side of the Continental Divide. The Project footprint is located within portions of the Grave Creek and Alexander Creek watersheds. The majority of the Project footprint is located within the Alexander Creek watershed, while the access roads leading to the mine are generally located within the Grave Creek watershed.

The Landscapes and Ecosystems LSA is 12,886 ha and represents a 1 km buffer around the Project coal licences and the transportation corridor (Figure 14.3-1). The Landscapes and Ecosystems LSA was developed in consultation with the B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). The Landscapes and Ecosystems LSA can be thought of as the “zone of influence” of the Project on vegetation VCs including listed plant communities and species, limber pine, and whitebark pine.

The Landscapes and Ecosystems RSA mainly coincides with the assessment area used by the Elk Valley Cumulative Effects Management Framework (EV-CEMF; Province of B.C., 2021a) and includes important landscape features known to facilitate wildlife movement (e.g., the Elk River drainage), including mountain passes on the Continental Divide such as Deadman and Racehorse Passes. It also includes all operating and proposed mines within the Elk Valley, and several developed areas, including the municipal boundaries of Sparwood, Elkford, and Fernie. The Landscapes and Ecosystems RSA is the main study area for conducting the cumulative effects assessment on vegetation VCs.

14.3.3.2 Temporal Boundaries

Temporal boundaries include the time periods during which the Project is anticipated to result in potential effects on VCs (EAO, 2013). The temporal boundaries considered in the assessment include the temporal limits of the Project in terms of its Construction and Pre-Production, Operations, Reclamation and Closure, and Post-Closure phases. The temporal boundaries of the Project used in the effects assessment include the timing of Project phases and activities as outlined in Table 14.3-3. Additional details on the Project phases and activities are provided in Chapter 3.

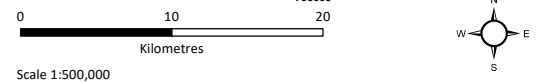


Crown Mountain Coking Coal Project

Figure 14.3-1
Landscapes and Ecosystems Local and Regional Study Areas

LEGEND

- Landscapes and Ecosystems Regional Study Area
- Landscapes and Ecosystems Local Study Area
- Project Footprint
- Highway
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- National Park
- British Columbia/Alberta Border



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

Map Created By: RB
Map Checked By: BH
Map Coordinate System: NAD 1983 UTM Zone 11N



Project: 12-6231
Status: FINAL
Date: 2022-01-11

Table 14.3-3: Temporal Boundaries for the Vegetation Effects Assessment

Phase	Project Year	Length of Phase (Years)
Construction and Pre-Production	1 – 2	2
Operations	3 - 17	15
Reclamation and Closure	18 – 19	2
Post-Closure	20 – 34	15

14.3.3.3 Administrative Boundaries

Administrative boundaries refer to the limitations imposed on the assessment by political, economic, or social constraints and includes consideration of various policy frameworks, guidelines, standards, and legislation that applies to a VC. The Project falls within the resource management area boundaries of the FLNRORD Rocky Mountain District in Kootenay Region 4 of the Regional District of East Kootenay (RDEK). Within the RDEK, Crown land is subject to the Kootenay Boundary Land and Resource Management Plan (KBLUP; Kootenay Inter-Agency Management Committee, 1997), which is subdivided into four land use designation categories identified as Resource Management Zones (RMZ). The Project occurs in the Cranbrook RMZ.

Administrative boundaries may also include the legislative, regulatory, and/or policy frameworks as well as regional land management plans that apply to the VC. Implementation of the provincial Weed Control Act, Weed Control Regulation, and the Forest and Range Practices Act are applicable to the Project.

Provincial Conservation Status Ranking

In B.C., the B.C. Conservation Data Centre (B.C. CDC) assigns conservation status ranks to plant species and ecological communities that have the potential of being lost (Province of B.C., 2021a). In addition to the B.C. CDC conservation ranks, NatureServe also assigns a conservation status of species and ecosystems in B.C. (Province of B.C., 2021a). The conservation rank indicates the commonness, rarity, and vulnerability of plants and ecological communities by assigning a species or ecosystem as Red-, Blue-, or Yellow-listed (Table 14.3-4; Table 14.3-5). The categorization of the conservation status ranks sets conservation priorities and also helps to identify species and ecosystems considered as endangered or threatened in B.C. (Province of B.C., 2021a).

Table 14.3-4: Provincial Conservation Status Ranks

Rank	B.C. CDC Definition	NatureServe Subnational Conservation Ranks
Red-listed	Ecological communities, native species and subspecies in B.C. that are at the greatest risk of being lost (i.e., extirpated, endangered, or threatened)	Plants: SX, SH, S1, S1S2, S2, S2?, S1S3 Ecological Communities: SX, SH, S1, S1S2, S2
Blue-listed	Ecological communities, native species and subspecies in B.C. that are of special concern.	Plants and Ecological Communities: S2S3, S2S4, S3, S3?
Yellow-listed	Ecological communities and native species in B.C. that are at the least risk of being lost.	Plants and Ecological Communities: S3S4, S3S5, S4, S4S5, S5
Special Concern	Particularly sensitive to human activities or natural events but not endangered or threatened	-

Table 14.3-5: NatureServe Subnational Ranks and Modifiers

Rank	Definition
SX	Presumed extirpated
SH	Historical (species) / possibly extirpated (ecological communities)
S1	Critically imperiled
S2	Imperiled
S2?	Imperiled but Inexact or Uncertain
S1S2	Critically imperiled/Imperiled
S3	Special concern, vulnerable to extirpation or extinction
S3?	Special concern but Inexact or Uncertain
S2S3	Imperiled/Special concern
S4	Apparently secure, with some cause for concern
S3S4	Special concern / Apparently secure
U	Unrankable

Federal Species at Risk Ranking

The federal SARA (2002) provides legislative protection to specific listed species and their critical habitat in Schedule 1 of the Act. Species are recommended to be designated on Schedule 1 by COSEWIC. As per Section 34(1) of SARA (2002), species aside from fish and migratory birds (i.e., those included under the Migratory Bird Convention Act [1994]) are only protected under SARA (2002) if they occur on federal lands. In addition to individual protection for listed species, the habitat and residences of listed species are also protected if formally designated as critical habitat.

The SARA (2002) contains general prohibitions against species listed as Endangered, Threatened, or Extirpated in Schedule 1 of the Act (Table 14.3-6). Key management measures to provide SARA-listed species include critical habitat and recovery strategies. Critical habitat represents the habitat necessary for the recovery and survival of a species listed in Schedule 1 of the Act. A recovery strategy outlines the strategies to stop or reverse the decline of a species and identifies critical habitat (Environment Canada, 2007).

Table 14.3-6: Species at Risk Act (2002) Listing Definition (SARA, 2002)

Rank	Definition
Endangered	Species that faces imminent extirpation or extinction
Threatened	Species that is likely to become endangered if no action is done to reverse factors leading to its extirpation or extinction
Extirpated	Species that no longer exists in the wild in Canada but may exist elsewhere in the wild outside of Canada

Land Management Plans

The Project is located within the Regional District of East Kootenay and contains areas of Crown land subject to the KBLUP (Kootenay Inter-Agency Management Committee, 1997). Approximately 7.5 million ha of land are included within the KBLUP, which is subdivided into four RMZs. The land use designations

indicate the general land and resource management intent for the area and comparative emphasis of conservation-oriented land uses to development-oriented land uses. The Project license is within the Cranbrook RMZ. Management objectives of the KBLUP pertaining to listed plant communities and species, whitebark pine, and limber pine are described in Table 14.3-7.

Table 14.3-7: Regional Management Objectives from the Kootenay Boundary Land Use Plan: Implementation Strategy as they pertain to Vegetation VCs

Vegetation-related Resource	Management Objectives
Ecosystem Health - General	<ul style="list-style-type: none"> • Maintain healthy, functioning ecosystems that are essential to the diversity, abundance, distribution and life histories of fish, wildlife, vegetation and water resources • Protect, conserve, and reduce risks to rare, threatened and endangered terrestrial and aquatic species • Maintain the quality, integrity and connectivity of grassland habitats so as to support the associated Red- and Blue-listed species • Maintain wildland attributes necessary for ecosystem health through coordinated access planning for resource development and associated activities
Ecosystem Health - Terrestrial	<ul style="list-style-type: none"> • Maintain the regional diversity and a suitable abundance of native terrestrial species of plants and animals, and the ecosystems upon which they depend

14.3.3.4 Technical Boundaries

Technical boundaries represent constraints imposed on the assessment due to limitations in the ability to predict the effects of the Project (EAO, 2013). Existing information used to evaluate effects to vegetation VCs includes baseline data collection, the Terrestrial Ecosystem Mapping (TEM), aerial imagery, provincial Vegetation Resource Inventory (VRI) data, and predictive habitat modelling. Species-, population- and community-specific responses to changes in environmental conditions are inherently complex and vary over space and time. As such, where data was found to be insufficient for the quantification of impacts to a vegetation VC, the VC and associated potential effects were characterized qualitatively.

14.3.3.4.1 Limber Pine

Currently, no standard distribution delineation method exists for limber pine and as such, the potential distribution of limber pine was evaluated through the use of the TEM polygons which were known to contain whitebark pine, whitebark pine critical habitat surveys conducted in 2018, and VRI data. Uncertainties of models and predictive habitat mapping for limber pine are inherent due to the accuracy of data and parameters selected to determine potential habitat conditions for selected vegetation VCs. Potential limber pine habitat was determined through the selection of biogeoclimatic (BGC) unit, elevation, geology, and VRI data. Areas selected as potential limber pine habitat may not provide or contain suitable habitat for limber pine.

14.3.3.4.2 Whitebark Pine

In terms of additional technical boundaries specific to whitebark pine, although the field surveys are often developed based on replicates of studies across multiple survey locations, there are typically no repeated measures at each survey location over time. The results of field surveys provide a “snapshot” of the

existing conditions and do not address change over time. Unless demonstrable evidence exists from other resources, the assessment of potential effects of the Project would assume that the results are generally within the range of natural variation and are stable under existing conditions. Given that a complete inventory of all whitebark pine is not necessarily feasible during early phases of development, field surveys are conducted for a sample of the population. Where occupancy is addressed as present or absent, the potential habitat area determined through this assessment may over-represent the actual area occupied by whitebark pine as any level of presence may be considered “occupied” habitat.

Additionally, not all areas mapped as potential habitat for whitebark pine within the Project TEM (Keefer Ecological Services [KES], 2020a; Appendix 13-A) are represented in polygons attributed to a single site series. For example, an ecosystem polygon may be dominated by an unrelated upland site series; however, co-dominant or sub-dominant proportions of the delineated polygon area may be attributed to whitebark pine habitat related site series, and therefore may be misrepresented if evaluating based strictly on the full extent of the mapped polygon. The total area of overlap with whitebark pine habitat was interpolated by multiplying the total polygon area by the estimated proportion attributed to whitebark pine habitat site series. Although this method is reasonable for the quantification of potential effects associated with the Project, it may not accurately reflect the precise location and delineated extent of all areas of impact. Site-specific mitigation planning should be based on refined mapping conducted during the detailed design stage of development.

14.4 Regional and Local Overview

The Project is located in the Elk Valley within the front ranges of the southern Rocky Mountains in south-eastern B.C. The Elk Valley stretches more than 180 km from the mouth of the Elk River at Lake Kococanus in the south, north to its headwaters in Elk Lakes Provincial Park near the Continental Divide along the B.C.-Alberta border (Elk Valley Cumulative Effects Management Framework Working Group [EV-CEMF Working Group, 2018; George et al., 1987). The Elk Valley forms part of the Continental Ranges of the Rocky Mountains. Elevations in the Landscapes and Ecosystems LSA range from 1,170 metres above sea level (m asl) along the Elk River west of Grave Lake up to above 2,700 m asl along the Continental Divide at the northeast corner of the Landscapes and Ecosystems LSA. Erickson Ridge (2,480 m asl) is a major north-south limestone ridgeline from the Kootenay Group within the Landscapes and Ecosystems LSA that separates the Project from Teck Coal Ltd.’s (Teck) Elkview Operations to the southwest. Immediately north of Erickson Ridge, across the east-west flowing Grave Creek is Sheep Mountain (2,460 m asl), of the same geologic origin. Sheep Mountain parallels Grave Lake as its western shore and is connected via a north-south ridgeline to Mount Salter (2,530 m asl) immediately south of the east-west Line Creek valley.

Current land uses within the Landscapes and Ecosystems LSA and Landscapes and Ecosystems RSA include: residential; recreational (e.g., hunting, all-terrain vehicle [ATV] trails, fishing, hiking, etc.); exploration; resource; industrial; transportation; rangeland; agriculture; and forestry. Forestry, agriculture, and mining in the East Kootenay region have been ongoing for well over a century, with coal being the dominant resource extracted in the area. Fire suppression is practiced in the Elk Valley and there have not been any large fires in the last several years (Tourism Fernie, 2020; B.C. Wildfire Service, 2020). Controlled burning projects have been carried out to improve wildlife habitat and increase available forage in the Elk Valley, funded through the Fish and Wildlife Compensation Program (e.g., FLNRORD, 2020). Additional information on past and present land uses is provided in Chapter 1, Section 1.3.2.

Ktunaxa Nation knowledge holders recognize the importance of vegetation for human use and as habitat for other living things (Teck, 2015, as cited in EV-CEMF Working Group, 2018). The Elk Valley has abundant and diverse vegetation resources, although human land-uses are prevalent on the landscape and many habitats have been modified (EV-CEMF Working Group, 2018). Historical and current mining, forestry, and agricultural activities in the Elk Valley have resulted in removal, fragmentation, and intensive modification of terrestrial ecosystems. Other sources of vegetation impacts in the Elk Valley include development of local municipalities, off-road vehicle use, intensive grazing (both by wildlife and livestock), loss of natural fire patterns, introduction of invasive plant species, natural and anthropogenic air emissions, and climate change.

14.5 Existing Conditions

In this section, information from baseline surveys, the TEM, and predictive habitat modelling is used to describe ecosystems within and surrounding the Project footprint, Landscapes and Ecosystems LSA, Terrestrial LSA, and Landscapes and Ecosystems RSA and to identify, explain, and evaluate potential Project impacts on vegetation VCs.

14.5.1 Existing Regional and Local Information

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

- Canadian Species at Risk Public Registry;
- British Columbia Conservation Data Centre iMap and Species and Ecosystems Explorer;
- Scientific literature and government reports;
- Research from local non-governmental organizations (NGOs); and
- Other baseline studies for projects in the region.

14.5.1.1 Listed and Sensitive Plant Communities and Species

14.5.1.1.1 Habitat Availability and Distribution

Non-forested ecosystems, such as grasslands and wetlands, make up a small portion of the provincial landscape and are more likely to contain rare species or ecosystems due to their uncommon habitat attributes (British Columbia Ministry of Environment and Climate Change Strategy, n.d.; GCC, 2017). Changes in listed plant communities and species can result from changes in disturbance regimes. Historical plant communities were heavily governed by natural disturbances along with geography, topography, and environmental conditions (Averill et al., 1994). Human disruptions to natural disturbance regimes have implications for species compositions and biodiversity (Averill et al., 1994).

Frequent, mixed severity fires in the Elk Valley historically maintained open forests and grasslands, consuming surface litter, reducing biological soil crusts, and releasing nutrients (MacKillop et al., 2018). In the Elk Valley, the last large fire event that created open grasslands and open forest occurred in the 1930s (Casselmann, 1998; McCauley, 2000); modern fire suppression activities now reduce the frequency and size of fires. Fire suppression activities have resulted in a greater abundance of young forests, reducing the occurrence of non-forested structural stages where many listed plants occur (Demarchi et al., 2000; Kirby

and Campbell, 1999; Mountain Goat Management Team, 2010; and Poole and Ayotte, 2019). Longer fire intervals in the region have resulted in considerable changes in vegetation composition in all biogeoclimatic zones that support grasslands and savannahs (Gayton et al., 1995), and resulted in a greater abundance of young forests (Kirby and Campbell, 1999).

Settlement throughout the 1900s in the Elk Valley rapidly changed ecosystems in valley bottoms along the Elk River. Agriculture and ranching developments resulted in new grassland areas for grazing and cropping (VAST Resource Solutions Inc., 2014; Szkorupa and Mowat, 2010). Changes on the landscape permanently removed natural ecosystems and introduced non-native crop species and invasive plants. The invasion of non-native species reduces the abundance of native species making up listed ecosystems (Adams et al., 2016). In the Elk Valley, an estimated 4% of grasslands have been permanently modified due to settlement activities and agricultural development (Chapter 13, Section 13.5.1.2). Open-pit mining has removed approximately 30% of the high elevation grasslands in the Elk Valley between 1950 and 2016 through physical removal and permanent modification (Golder Associates, 2015; Poole and Stuart-Smith, 2006; Poole et al., 2018; Poole and Ayotte, 2019; Smyth, 2014). Research on associations between coal bearing geology and grasslands or the at-risk communities is limited (Poole et al., 2018).

Invasive species threaten the diversity of native plant communities, and can cause rapid and lasting change to the landscape due to their competitive traits (Invasive Species Council of B.C. [ISCBC], 2017). Increased disturbance from agricultural grazing, industry, recreation, and other human activities in the East Kootenay region has led to increased competition from invasive species in sensitive plant communities, with anthropogenic activities acting as a vector to spread seed, and as a source of soil disturbance that creates conditions ideal for invasive plant establishment (Moorehead et al., 2011). Fire suppression activities can also influence invasive plant spread through incidental dispersal of invasive species via vehicles, machinery, and foot traffic. Common invasive species in the East Kootenay include non-native hawkweeds, knapweeds, sulphur cinquefoil (*Potentilla recta*), non-native annual bromes, and common St. John's-wort (*Hypericum perforatum*) (East Kootenay Invasive Species Council, 2020). Introduced agronomic grass species such as smooth brome (*Bromus inermis*), timothy (*Phleum pratense*), Kentucky bluegrass (*Poa pratensis*), and Canada bluegrass (*Poa compressa*) may also invade grasslands (MacKillop et al., 2018). Rare species in a community contribute to community resilience against invasive species invasion (Lyons and Schwartz, 2001). The decline of rare and listed plant species may further facilitate the invasion of non-native plant species.

Habitat availability for listed plant communities and species is heavily tied to non-forested ecosystems condition, such as wetlands and grasslands (Chapter 13). Permanent habitat loss and fragmentation for listed plant communities and species in the Elk Valley has resulted from industrial and urban development over the past century. The extent of mined areas in the Elk Valley has removed land and potential habitat for listed plant communities and species and high elevation grassland communities whose habitat is linked to coal deposits (MacKillop et al., 2018). Habitat connected to riparian or wetland zones has also been lost due to urban and agricultural development. Habitat removal is likely to have affected mid-bench flood ecosystems along the Elk River such as the balsam poplar – spruces/red-osier dogwood (*Populus balsamifera* – *Picea* spp./*Cornus sericea*) mid-bench flood ecosystem listed by the B.C. CDC and documented in the Landscapes and Ecosystems RSA (Golder Associates, 2015). The development of cropping and long-term overgrazing of pasture and rangeland can also permanently modify or remove grassland ecosystems.

The Red-listed Gg12 rough fescue - (bluebunch wheatgrass) - yarrow - clad lichens association, located with the LSA and RSA, (*Festuca campestris* - (*Pseudoroegneria spicata*) - *Achillea borealis* – *Cladonia* spp.) is known to have been impacted by ungulate overgrazing (MacKillop et al., 2018) and may be permanently modified in some areas (B.C. CDC., n.d.b; Suding and Hobbs, 2009). Sites in good condition are highly limited and subject to grazing pressure by ungulates and domestic livestock (MacKillop et al., 2018). It is likely that alfalfa fields, irrigated crops and hay fields are encouraging year-round ungulate use in low elevation agricultural clearings and winter range grasslands (Phillips and Szkorupa, 2011).

14.5.1.1.2 Known Occurrence and Abundance

Historical occurrence and abundance of rare and listed plant communities and species are not well documented in the Elk Valley, and presents a data gap in the existing information. Prior to the establishment of the B.C. CDC in 1988, rare plant inventory and documentation were carried out largely by academic institutions, and work across the East Kootenay region was limited. Listed plants including Drummond's milk-vetch (*Astragalus drummondii*), ground plum (*Astragalus crassicaarpus*), and Parry's townsendia (*Townsendia parryi*), have been documented in previous field surveys for environmental assessments conducted for projects in the Landscapes and Ecosystems RSA (Golder Associates, 2015; Teck, 2011). Project-specific baseline field surveys and desktop assessments were conducted to inform existing conditions of listed and sensitive plant communities and species in the local area (see Sections 14.5.2.1.2 and 14.5.2.2.2 for more information).

As of May 2021, the B.C. CDC has documented historical observations of 39 listed plants and 11 listed plant communities in the Landscape and Ecosystems RSA (B.C. CDC, 2021a) based on a query of the B.C. Species and Ecosystems Explorer using the following search criteria:

- Vascular Plants OR Ecosystem Realm-Groups: All;
- B.C. Conservation Status: Red (Extirpated, Endangered, or Threatened) or Blue (Special Concern);
- SARA Schedule 1 Status: True;
- Area Of Interest: User Defined Polygon; and
- BGC Zone, Subzone, Variant, Phase: ESSFdk1, ESSFdkp, ESSFdkw, IDFun, MSdk1

Of the 39 listed plants documented by the B.C. CDC in the Landscapes and Ecosystems RSA, 14 historical detections are Red-listed vascular plant species and 25 historical detections are Blue-listed vascular plant species. Historical observations of listed plant ecological communities by the B.C. CDC include 5 Red-listed and 6 Blue-listed ecological communities (Appendix 14-A). Limber pine and whitebark pine are both considered Endangered by COSEWIC with whitebark pine additionally being listed as Threatened under SARA (2002).

Within the Landscapes and Ecosystems LSA, 8 Red-listed and 15 Blue-listed plants have been documented by B.C. CDC along with 10 ecological communities that have the potential to occur based on the above search criteria. Five of these ecological communities were grasslands, three were wetlands, one was a flood ecosystem, and one was an alpine ecosystem. Through Project-specific wetland ecosystem surveys, 11 provincially-listed wetland ecosystems and 3 non-wetland group ecosystems occur in the Terrestrial LSA (Chapter 13, Section 13.5.2.2.6). Several wetlands in the northwestern portion of this study area were found to contain site associations currently ranked by the B.C. CDC, many of which are marshes (see Chapter 13, Section 13.5.2.2.6 for more information).

14.5.1.1.3 Transboundary Considerations

The Southern Rocky Mountain Trench and the Columbia Basin are considered a “hotspot” and a centre of rarity in the province for plants (Douglas et al., 1994). Plant communities of similar composition and structure to those found in the Landscapes and Ecosystems LSA occur in neighbouring areas in Alberta and Montana (Baker et al., 2020; Montana Natural Heritage Program [MNHP], 2017). The Rocky Mountain Natural Region of Alberta adjacent to the Elk Valley contains several environmentally significant areas of international, national, provincial, and regional significance (Downing and Pettapiece, 2006). Grasslands are abundant in Alberta’s eastern slopes as compared to those within the Landscapes and Ecosystems LSA (Baker et al., 2020).

Red-listed plants with the potential to occur in the Landscapes and Ecosystems LSA are either secure, or vulnerable (NatureServe S3 ranking) in Alberta due to restricted range, often occurring more abundantly such as Parry’s townsendia. Cusick’s paintbrush (*Castilleja cusickii*) is considered vulnerable and a watch list species in Alberta (Alberta Conservation Information Management System [ACIMS], 2018) and is listed as Unknown in B.C. (B.C. CDC, n.d.a). None of the Red-listed species with the potential to occur in the Landscapes and Ecosystems LSA or Landscapes and Ecosystems RSA appear as a species of concern in Montana (MNHP, 2020). Given the Project’s distance from Alberta (5 km) and Montana (85 km), no transboundary effects are anticipated as a result of the Project.

14.5.1.2 Limber Pine

14.5.1.2.1 Habitat Availability and Distribution

Regionally, high-quality limber pine habitat includes warm aspects at mid-elevation, over shallow calcareous soils, talus slopes, dolomitic carbonate rock, sandstone, and limestone outcrops (Achuff et al., 2002; COSEWIC, 2014; KES, 2020b; Piggot and Moody, 2013; Timoney, 1999; Appendix 14-C). Limber pine habitat availability and distribution have been affected by human activities, fire suppression, and industrial activity in the Elk Valley (COSEWIC, 2014). According to MacKillop et al. (2018), limber pine habitat occurs within the MSdw, ESSFdkw, and ESSFdk1 subzones within the vicinity of the Project. Limber pine is an early successional species that prefers open canopy conditions and reduced competition (Coop and Schoettle, 2009; COSEWIC, 2014; Rebertus et al., 1991; Webster and Johnston, 2000). Generally speaking, ideal conditions for limber pine can be characterized as a mosaic of successional stages across the landscape, generated by infrequent, stand replacing fires (Arno, 2001). Within this context, limber pine stands are known to persist in the complete absence of fire (Rebertus et al., 1991; Veblen, 1986). Burned areas serve as preferred limber pine seed-catching sites by Clark’s Nutcracker (*Nucifraga columbiana*) (Alberta Environment and Parks, 2020; Lanner and Vanderwall, 1980). Fire-return intervals in limber pine habitats are highly variable, occurring from 2 to 30 years in some sites to several hundred years in upper elevations (Wright and Bailey, 1982; Coop et al., 2010, Coop and Shoettle, 2009; Rebertus et al., 1991; Veblen, 1986). Fire suppression activities lead to increased competition through successional replacement by shade-tolerant species and the potential for increased fire severity beyond what is beneficial to limber pine (COSEWIC, 2014).

Open-pit mining unavoidably causes large scale surface level disturbances (Chadwick et al., 2013). The total coal mining footprint, including reclaimed areas, has more than quadrupled in the Elk Valley since the 1950s, from 25 km² to 143 km² (EV-CEMF Working Group, 2018). Given that limber pine frequently

occurs over limestone, the species is unlikely to be abundant in association with coal-bearing geology; however, occasional individual losses may have occurred in the East Kootenay region.

14.5.1.2.2 Known Occurrence and Abundance

Disease arising from white pine blister rust is the greatest factor impacting limber pine occurrence and abundance (COSEWIC, 2014). Data gaps exist regarding known limber pine occurrences in the Elk Valley, and the location of local sub-populations (COSEWIC, 2014; Piggot and Moody, 2013) and as such, Project-specific baseline field surveys and predictive habitat modelling were used to evaluate potential limber pine occurrence and abundance in the area within and surrounding the Project (see Sections 14.5.2.1.3 and 14.5.2.2.3 for more information). Incidental harvest of limber pine on rocky outcrops and on steep slopes in the region is uncommon; however, it is likely limber pine at lower elevations were removed by logging (Piggot and Moody, 2013).

The EV-CEMF analysis of imagery showed that the cumulative change in human disturbance on the Elk River watershed between 1950 and 2014 increased more than 850% (EV-CEMF Working Group, 2018). The incidental harvest and removal of mature limber pine limits capacity for seedling recruitment and natural regeneration (Government of Alberta, 2014; Piggot and Moody, 2013; ECCC, 2017; Moody et al., 2018). Natural regeneration of limber pine is often low because of the species' poor competitive ability and tendency to be outcompeted before reaching sexual maturity (Scholette, 2004). Limber pine has been observed within the Elk Valley at Phillips Pass, on Mount Broadwood, and near Corbin (B.C. CDC, 2021b). Historic limber pine occurrences in the Elk Valley are poorly documented and the impacts of development on limber pine occurrences are difficult to infer (COSEWIC, 2014).

14.5.1.2.3 Health

White pine blister rust is the primary cause of limber pine population decline (B.C. CDC, 2020; COSEWIC, 2014; Smith et al., 2011, 2013). The infection rates of white pine blister rust are poorly known in limber pine within B.C. and population monitoring of limber pine health has been minimal (Piggot and Moody, 2013). Limber pine mortality rates are highest in the southern and northern portions of their Canadian and American distribution, respectively (Smith et al., 2013). Young trees are most susceptible to the blister rust, where seedlings and saplings are usually killed within one to three years of infection (COSEWIC, 2014).

Records of limber pine mortality due to mountain pine beetle (*Dendroctonus ponderosae*) have been minimal (COSEWIC, 2014; Smith et al., 2013). Blister rust interacts with mountain pine beetle and infected trees are likely more susceptible to beetle infestations (Schwandt et al., 2010). Mountain pine beetle is present in the Elk Valley (Cullingham et al., 2011; Goyette et al., 2019), and has the potential to occur in the Landscapes and Ecosystems LSA and Landscapes and Ecosystems RSA. There is a potential for climatic warming to contribute to greater mountain pine beetle populations, which may impact the health and abundance of limber pine (COSEWIC, 2014).

14.5.1.2.4 Transboundary Considerations

Limber pine naturally occurs in western North America (Langor, 2007). To the south of the Landscapes and Ecosystems RSA, limber pine has been observed in the Flathead Valley on the MacDonald Range and in abundant populations to the east of the Landscapes and Ecosystems RSA in the Crowsnest Pass, Alberta (Alberta Whitebark and Limber Pine Recovery Team [AWLPRT], 2014a, B.C. CDC, 2021b). Undocumented

populations likely occur in the Flathead valley between B.C. and Montana (Piggot and Moody, 2013). Dispersal of limber pine seed by Clark's Nutcracker can extend up to 33 km which may extend seed dispersal between populations in Alberta, B.C. and Montana (Lorenz et al., 2011) and across provincial and federal boundaries. High rates of blister rust infections occur in southwest Alberta, which has resulted in increased mortality and reduced seed availability (COSEWIC, 2014; Peters and Visscher, 2019). White pine blister rust has the potential to disperse across provincial and national borders, as spores can disperse as far as 1,000 km in large wind events (Frank et al., 2008).

14.5.1.3 Whitebark Pine

14.5.1.3.1 Habitat Availability and Distribution

Whitebark pine is noted as occurring in BGC units in the Landscapes and Ecosystems LSA and Landscapes and Ecosystems RSA at high elevations including the ESSFwm1, ESSFwmw, ESSFdk1, ESSFdk2, and ESSFdkw (Lea, 1984; MacKillop et al., 2018; Parish, 1948). High-quality whitebark pine habitat in the region consists of high elevation (i.e., above 1,750 m asl) open-canopy conditions with well- to rapidly-drained soils that are coarse-textured, rocky, and shallow over bedrock (ECCC, 2017). Human activities including fire suppression and mining have resulted in a reduction in whitebark pine habitat availability and distribution (COSEWIC, 2010).

Historical fire regimes have varied across the Landscapes and Ecosystems RSA, resulting in a mosaic of even-aged stands (MacKillop et al., 2018). Under natural fire regimes, mixed-severity fires would burn through stands, removing competition and providing a receptive seedbed, which would allow whitebark pine to thrive, with the last large-scale fire event in the Elk Valley occurring in the 1930s (Casselmann, 1998; MacKillop et al., 2018; McCauley, 2000; AWLPRT, 2014b). Following this, fire suppression practices resulted in shade-tolerant species such as subalpine fir dominating in areas that would previously have been dominated by whitebark pine (Association of B.C. Forest Professionals, 2005; Perkins, 2015). Increased stand density due to increased numbers of more shade tolerant trees can cause conditions unfavourable for whitebark pine to establish and persist (Sala et al., 2001).

Open-pit coal mining activities in the Elk Valley have resulted in a reduction of habitat availability and distribution of whitebark pine. The open-pit mining processes unavoidably cause a large-scale surface disturbance (Chadwick et al., 2013). Excavations remove the subalpine forest areas where whitebark pine may occur, resulting in a loss of available habitat during the life of a mine. Whitebark pine typically regenerates following disturbance; however, regeneration is limited by specific niche requirements that may not be emulated successfully in the mine reclamation process (Gelderman et al., 2016). For example, reclamation of forested sites at Fording River utilized lodgepole pine, Engelmann spruce, and subalpine fir at stocking rates of 1,000 to 1,800 stems per ha (Teck, 2008). Such shade-tolerant species inhibit whitebark pine seedling growth (Arno and Hoff, 1989; Perkins, 2015).

14.5.1.3.2 Known Occurrence and Abundance

Disease arising from white pine blister rust is currently the greatest factor impacting whitebark pine occurrence and abundance in the Elk Valley (Section 14.5.1.3.3). Other key factors influencing whitebark pine occurrence and abundance in the region include timber harvesting and mining activities (ECCC, 2017, Moody et al., 2018).

Timber harvesting occurs infrequently within high elevation whitebark pine forests. Despite this, more than 5,000 cubed metres (m³) of whitebark pine have been logged in the Elk Valley since 2016, predominantly on private forest land (Province of B.C., 2021b). Through the EV-CEMF, an analysis of imagery showed that the cumulative change in human disturbance on the landscape between 1950 and 2014 increased by more than 850% (EV-CEMF, 2018). Through EV-CEMF data (EV-CEMF Working Group, 2018), analysis of disturbance layers showed that between 2005 and 2020, timber harvesting on private land disturbed 3,176 ha of forest, constituting a 1.74% increase in disturbance due to high elevation cutblocks. Since 1950, the total coal mining footprint, including reclaimed areas, has more than quadrupled in the Elk Valley, from 25 km² to 143 km² (EV-CEMF Working Group, 2018). Mining and logging activities that result in the removal of healthy seed sources from mature whitebark pine reduce or remove the capability for seedling recruitment and natural regeneration (Leirfallom et al., 2015). Whitebark pine is a slow-growing species and does not produce cones until 30-50 years of age, with no sizable cone crops until 60-80 years, resulting in a low reproductive capacity (COSEWIC, 2010).

14.5.1.3.3 Health

White pine blister rust is the primary threat to the population of whitebark pine (COSEWIC, 2010). The average estimated infection rate for whitebark pine in the region is 52%, with an estimated annual increase of 3% (Smith et al., 2013). The regeneration of whitebark pine is disproportionately affected by white pine blister rust as most seedlings die within three years of becoming infected and developing cankers (Hoff and Hagle, 1990). Although the rate of mortality within the Elk Valley has not been previously estimated, mortality of whitebark pine due to white pine blister rust in was estimated to be approximately 5% per year in Waterton Lakes National Park¹, located approximately 80 km southeast of the Project (Langor, 2007), the highest rate of infection and loss relative to other locations in Alberta. Finally, stands that have high infection rates of white pine blister rust have been found to be at higher risk of seed predation, further reducing the ability of populations to regenerate through direct loss of genetic material (McKinney and Tomback, 2007).

Mountain pine beetle is a natural disturbance agent of the Canadian Rocky Mountains and has co-existed with whitebark pine for millennia, occurring throughout much of whitebark pine's Canadian range (Brunelle et al., 2008; COSEWIC, 2010; ECCC, 2017). With climatic changes and less severe winters, warmer summers, and longer growing seasons, mountain pine beetle infestation rates in mixed and pure whitebark pine stands at high elevations have increased (Canadian Forest Service Publications, 2008; Gibson et al., 2008). Mountain pine beetle is present in the Elk Valley (Cullingham et al., 2011; Goyette et al., 2019), and has the potential to occur in the Landscapes and Ecosystems LSA and Landscapes and Ecosystems RSA. At this time, local data are not available beyond that gathered for the Project baseline whitebark pine health assessment, for which mountain pine beetle damage to whitebark pine was surveyed but not found (COSEWIC, 2010); however, climatic warming has the potential to contribute to greater mountain pine beetle populations, which may impact the health and abundance of whitebark pine (COSEWIC, 2010).

14.5.1.3.4 Transboundary Considerations

Whitebark pine occurs in both neighbouring Alberta and Montana in habitats that are similar to that encountered in the Landscapes and Ecosystems LSA and Landscapes and Ecosystems RSA. Some of the

¹ Waterton Lakes National Park is located approximately 90 km southeast from the Project.

highest levels of blister rust infestations have been documented directly adjacent to B.C. in the Waterton region, approximately 90 km southeast of Crown Mountain on the east slope of the Rocky Mountains (Smith et al., 2013). White pine blister rust has the potential to spread to and from transboundary areas, as spores can disperse as far as 1,000 km in large wind events (Frank et al., 2008). The high incidence of disease and mortality in these stands also has implications for natural regeneration, as these stands no longer provide a healthy seed source to the surrounding area. Clark's Nutcracker plays an important role in seed dispersal, dispersing seeds up to a maximum of 36 km away from the seed source (Lorenz et al., 2011), which could include forests in Alberta and Montana. Given the exceptional dispersal distances of white pine blister rust spores and Clark's Nutcracker, there is potential for Project impacts to whitebark pine to occur in the adjacent jurisdictions of Alberta and Montana or on federal lands located in B.C. and Alberta (refer to Chapter 1, Section 1.3.3 for a description of federal lands near the Project).

14.5.2 Baseline Programs

14.5.2.1 Methods

14.5.2.1.1 Terrestrial Ecosystem Surveys and Mapping

Through the use of TEM, a landscape is stratified into map polygons based on ecological features including climate, vegetation, physiography, surficial material, bedrock geology, and soil (Province of B.C., 1998). TEM is based on the provincial biogeoclimatic ecosystem classification (BEC) system, which was developed in B.C. to classify and manage sites based on ecosystem features. The TEM stratifies a landscape into map polygons based on ecological features including climate, vegetation, physiography, surficial material, bedrock geology, and soil (Province of B.C., 1998). TEM involves more detailed information than predictive ecosystem mapping (PEM) as it requires direct air-photo interpretation and field surveys of ecosystem attributes to verify ecosystem identification and boundaries (Province of B.C., 1998). The map products of TEM offer valuable information for various uses, such as forest management, wildlife capability and suitability mapping, and potential rare species mapping (Province of B.C., 1998).

The Project TEM (Appendix 13-A) was used to map and quantify the occurrence of potential habitat for listed plant communities and species, whitebark pine, and limber pine in the Landscapes and Ecosystems LSA. The provincial VRI data were utilized to aid in determining structural stage in the Project TEM and for further refining the mature and old forest mapping within the Landscapes and Ecosystems LSA. TEM was utilized to map and characterize ecosystems within the Landscapes and Ecosystems LSA. TEM field sampling was conducted in 2014, 2018, and 2019 and included the completion of 217 field plots (97 ground plots and 120 visual plots; see Figure 14.5-1). Field sampling targeted one inspection per 100 ha at a ratio of 1:3 ground to visual plots. Additional details of the approach to TEM are provided in Chapter 13 and Appendix 13-A.

The TEM completed for the Project used the new BEC guide for the East Kootenay (MacKillop et al., 2018). Revisions associated with the new BEC guide resulted in alterations to BGC units and corresponding site series from those listed in the B.C. CDC reports. As such, the at-risk communities identified under B.C. CDC as potentially occurring within the Landscapes and Ecosystems LSA do not directly correspond to the revised site series. In response, the at-risk ecological communities identified by B.C. CDC and the BGC units under which they fall were cross-referenced with the MacKillop et al. (2018) guide to identify which site series from the revised guide have the potential of containing these at-risk communities.



Crown Mountain Coking Coal Project

LEGEND

- TEM Field Plot
- Landscapes and Ecosystems 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

0 2 4
Kilometres

Scale 1:85,000

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 Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

Map Created By: RB
Map Checked By: BH
Map Coordinate System: NAD 1983 UTM Zone 11N

Figure 14.5-1
Terrestrial Ecosystem Mapping Field Plots in the Landscapes and Ecosystems LSA



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Surveys of vascular plants, ecological communities of management concern, and sensitive ecosystems were carried out during the TEM field surveys. The presence of invasive species was also noted during TEM field surveys. Following the publication of the new East Kootenay BEC (MacKillop et al., 2018), BGC mapping changes were examined and refined classification of non-forested ecosystems were attributed, where possible.

14.5.2.1.2 Listed and Sensitive Plant Communities and Species

The existing conditions of listed plant communities and species within the Landscapes and Ecosystems LSA and the Project footprint were characterized by the following approaches:

- Desktop assessment of B.C. CDC to determine potential listed plant communities and species within the selected study areas;
- TEM surveys and mapping; and
- Project-specific baseline field surveys.

Desktop Assessment

Prior to conducting field surveys, listed vascular plant species with the potential to occur in the Landscapes and Ecosystems LSA were identified through a review of the B.C. CDC database (B.C. CDC, 2014). Listed and at-risk ecological communities were also searched in the B.C. CDC database (B.C. CDC, 2018a). The following queries were used in the B.C. CDC search for vascular plants and ecological communities prior to field surveys for listed plant communities and species:

- Biogeoclimatic zone (e.g., ESSFdk1, ESSFdkp, ESSFdkw, MSdk1, IDFun);
- Conservation status;
- Forest district;
- Ministry of Environment region; and
- Regional district and municipalities.

A re-assessment of rankings for both vascular plants and ecological communities was undertaken by the B.C. CDC in 2018. Several species and ecological communities that were listed at the outset of the Project were no longer considered rare (Blue- or Red-listed) or had their ranking reduced from Red- to Blue-listed. Long-leaved hawkbeard (*Crepis acuminata* subsp. *acuminata*) was added as a Red-listed species, and sheep cinquefoil (*Potentilla ovina*) had its ranking increased from Blue- to Red-listed.

Baseline Field Surveys

Rare plant surveys were conducted to identify plant species and ecosystems provincially listed by the B.C. CDC as Red- or Blue-listed, and those that currently have protection under the federal SARA (2002), or are currently ranked by COSEWIC as Threatened or Endangered (Appendix 14-B). Plant and plant community habitat requirements and aerial imagery (e.g., Google Earth, PEM) was used to select survey locations within the Landscapes and Ecosystems LSA for field surveys. Based on the desktop assessment and information gathered on potentially listed plant communities and species, areas of greater likelihood of occurrence for listed plant communities and species were selected as areas for baseline field surveys. Non-forested areas and wetlands were targeted, as these ecosystems have a higher likelihood to support listed plant communities and species. The occurrence of listed plant communities and species in the Landscapes and Ecosystems LSA was informed by Project-specific sensitive plant and species surveys, the wetland ecosystem assessment, and the Project TEM (Table 14.5-1).

Table 14.5-1: Summary of Baseline Surveys Completed to Inform Existing Conditions of Listed and Sensitive Plant Communities and Species

Survey Completed	Survey Year	Survey Standards	Sample Effort	Data Collected
TEM field surveys	2014, 2018, and 2019	B.C Ministry of Forests and Range and B.C. Ministry of Environment (2010)	Intensity Level 3 ¹	217 plots: site, vegetation and soil data (Chapter 13, Section 13.5.2.2.1)
Listed and sensitive plant communities and species field surveys	2014	Guidelines for Rare Plant Surveys (ANPC, 2012; Penny and Klinkenberg, 2013)	71 plots, with over 50km of meander transects	Site, vegetation and soil data on site visit forms, voucher specimens
Wetland ecosystems surveys	2017, 2018, and 2019	B.C Ministry of Forests and Range and B.C. Ministry of Environment (2010), Poon and Margules (2004), MacDougall and Loo (2002), Macdonald (2004), and Keddy (2010)	36 wetland ecosystems surveyed	Vegetation, soil, landscape position and hydrological connectivity, rare plants, invasive plants, wildlife (Chapter 13, Section 13.5.2.2.6)

Note: ¹Intensity Level 3 denotes a sample was measured for each 30-59 ha, of study areas at a map scale of 1:20,000 (Province of B.C., 1998).

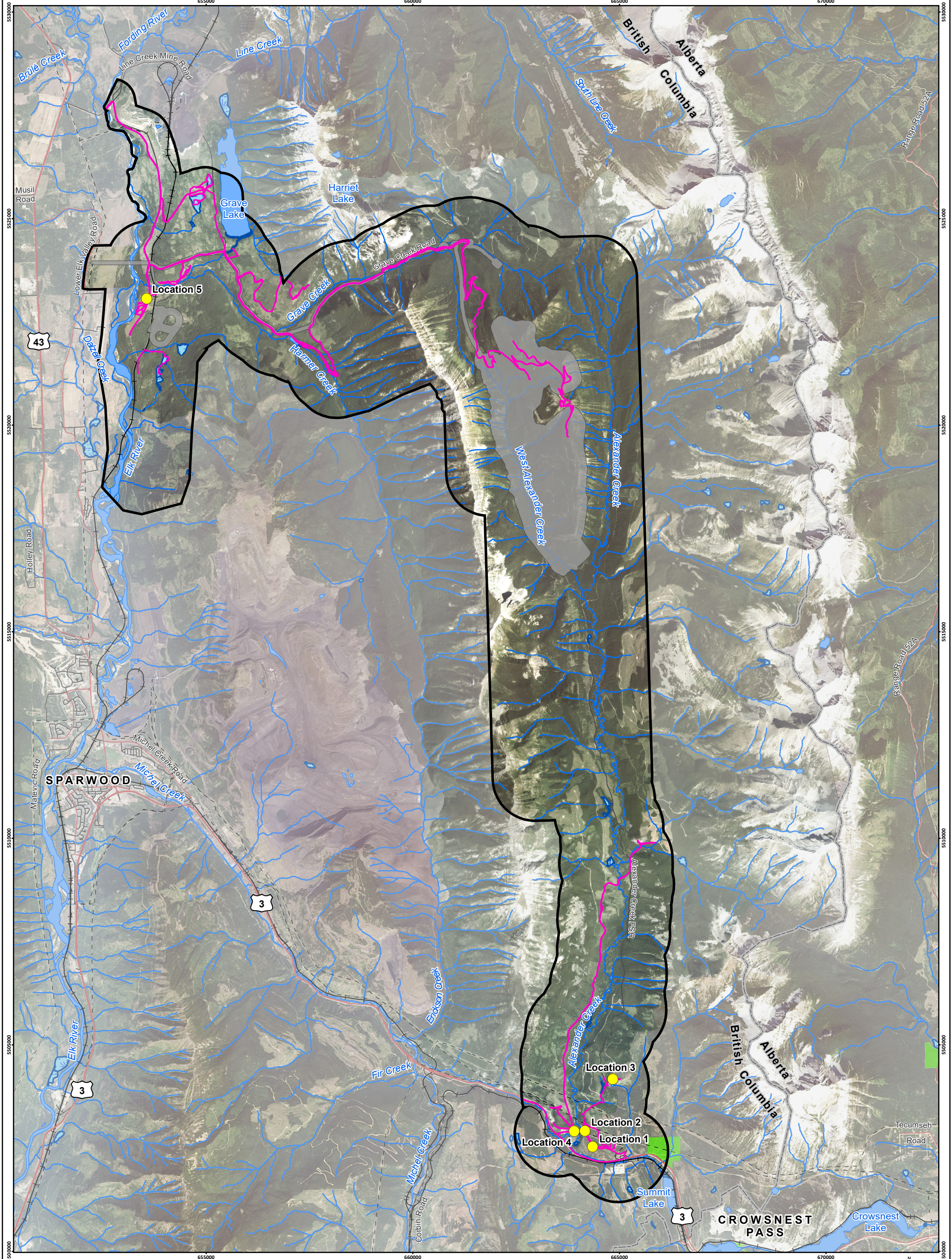
Field surveys were conducted at the onset of flowering, which occurred in May through June 2014 for low to mid-elevation species and in July through August 2014 for high elevation species. A total of 71 sampling plots and 50 km of meander transects were completed in 2014 as part of the listed plant communities and species field surveys (Figure 14.5-2). At each sampling plot, a meander search was conducted, which involved walking through a site and observing all plant species present (Alberta Native Plant Council [ANPC], 2012; Penny and Klinkenberg, 2013). Invasive plants observed at sampling plots and transects were also recorded.

The presence of listed plant communities and species was surveyed in the field during field work for the TEM and listed plant species surveys. Other identified sensitive ecosystems, including riparian, wetlands, grasslands/brushlands and avalanche chutes are reported as individual VCs in Chapter 13.

14.5.2.1.3 Limber Pine

Baseline Field Surveys

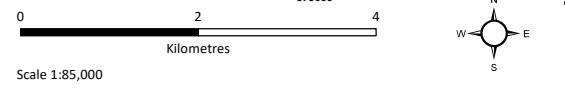
Before 2019, limber pine within the Landscapes and Ecosystems LSA was surveyed during several Project baseline programs including the TEM field surveys, whitebark pine baseline surveys, and listed plant communities and species studies (Table 14.5-2). In addition, during other ground surveys, such the invasive plant sampling (Chapter 13, Appendix 13-C), soil (Chapter 8, Appendix 8-A), and terrain mapping (Chapter 8, Appendix 8-C), the incidental occurrence of limber pine was noted, if present, even though targeted surveys for limber pine were not a specific component of these surveys.



Crown Mountain Coking Coal Project

LEGEND

- Listed Plant Sampling Plot
- Listed Plant Survey Transect
- Landscapes and Ecosystems 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



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 Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).
 Map Created By: RB
 Map Checked By: BH
 Map Coordinate System: NAD 1983 UTM Zone 11N

Figure 14.5-2
 Listed Plant and Plant Community Sampling Locations



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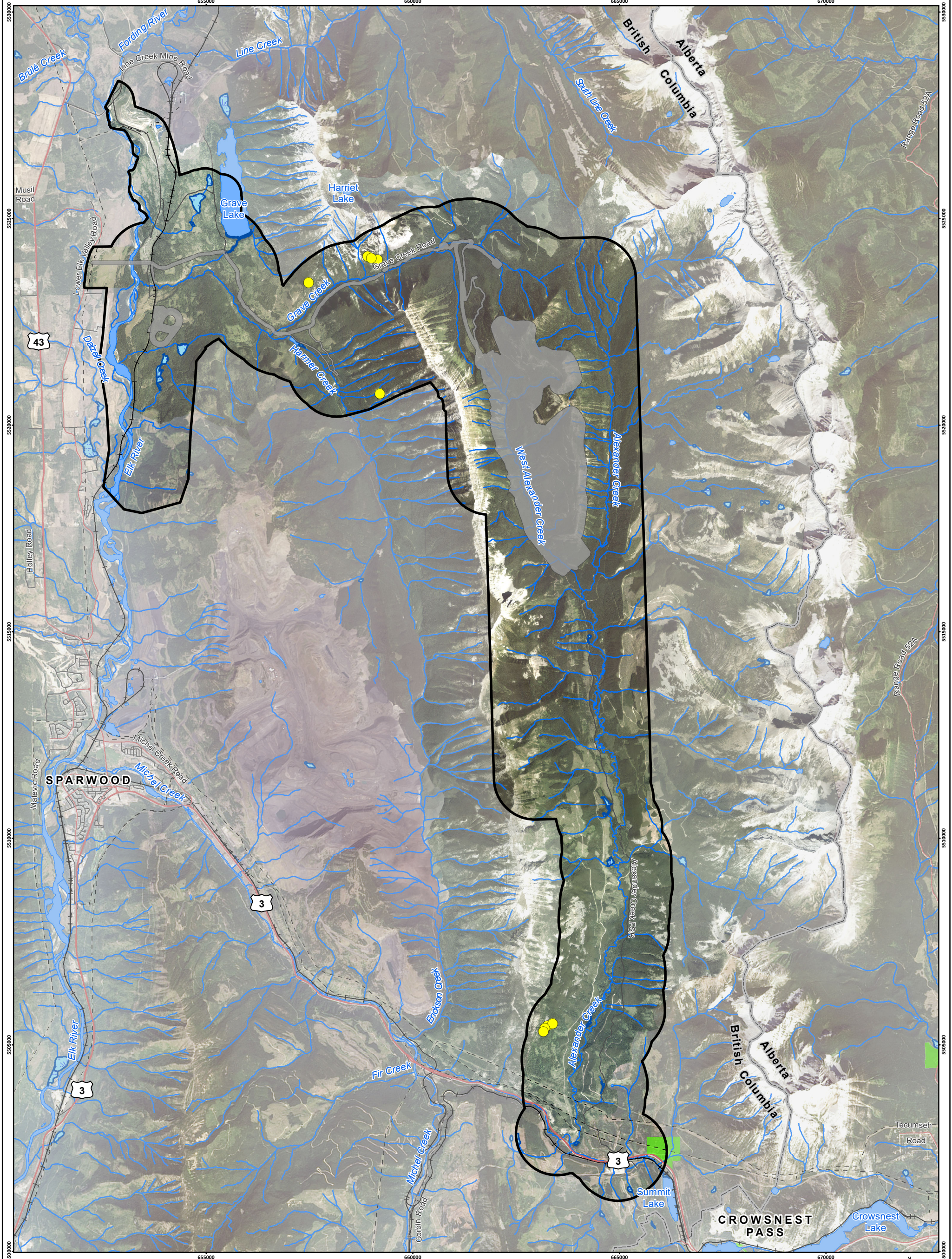
Table 14.5-2: Summary of Baseline Surveys and Modelling Completed to Inform Limber Pine Existing Conditions

Survey Method	Survey Year	Survey Standards	Sample Effort	Data Collected
TEM field surveys	2014 2018 2019	B.C Ministry of Forests and Range and B.C. Ministry of Environment, 2010	217 plots; Intensity Level 3 ¹	Site, vegetation and soil data
Listed and sensitive plant communities and species field surveys	2014	Guidelines for Rare Plant Surveys (ANPC, 2012; Penny and Klinkenberg, 2013)	71 plots, with over 50 km of meander transects	Site, vegetation and soil data on site visit forms, voucher specimens
Whitebark pine critical habitat field surveys	2018	Whitebark pine recovery strategy [proposed] (ECCC, 2017)	24 plots/ 84 ha	24-11.28 m fixed-radius plots – reproductive status, substrate evaluation as per criteria 1 of the Whitebark Pine Recovery Strategy
Whitebark pine health assessment (surveyed concurrently with critical habitat)	2018	Whitebark pine recovery strategy [proposed] (ECCC, 2017)	24 plots/ 84 ha	24-11.28 m fixed-radius plots - incidence of blister rust infection on mature stems and seedlings, % canopy kill, presence of mountain pine beetle and cause of mortality
Limber pine habitat field surveys	2019	Guidelines for Rare Plant Surveys (ANPC, 2012; Penny and Klinkenberg, 2013)	Approximately 30 ha sampled in 9 locations	No limber pine documented during surveys

Note: ¹. Intensity Level 3 denotes a sample was measured for each 30-59 ha, of study areas at a map scale of 1:20,000 (EWG, 1998).

Limber pine field surveys were conducted in August 2019 at nine locations in the Landscapes and Ecosystems LSA (KES, n.d., Appendix 14-C). To inform limber pine field surveys, a desktop evaluation was completed to inform possible limber pine locations within the Landscapes and Ecosystems LSA based on BGC unit, elevation, geology and other habitat requirements that had not been observed through TEM surveys. Forest cover data (provincial VRI data), slope and aspect data, and bedrock geology data (B.C. Geological Survey) were examined to determine other possible locations within the Landscapes and Ecosystems LSA where limber pine may be present. Potential limber pine habitat locations were then assessed as part of the limber pine field surveys. As part of the August 2019 limber pine field survey, survey transects were completed at nine locations within the Landscapes and Ecosystems LSA (Figure 14.5-3; Appendix 14-C). Field staff walked transects across the polygons identified as potentially suitable limber pine habitat, and where possible, used vantage points to locate limber pine using binoculars.

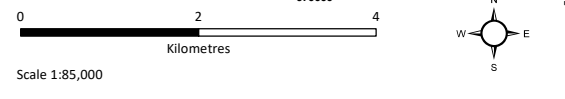
The potential distribution of limber pine in the Landscapes and Ecosystems LSA was also delineated by identifying TEM polygons known to contain whitebark pine based on trees documented as part of TEM field surveys in 2014, critical habitat surveys in 2018 (Section 14.5.2.1.4), and provincial VRI data (Figure 14.5-1). Where there was no VRI data coverage, the TEM polygons were selected if they were predicted to contain limber pine based on BGC unit, elevation, aspect, slope position, and tree cover less than 50%.



Crown Mountain Coking Coal Project

LEGEND

- Limber Pine 2019 Field Surveys
- Landscapes and Ecosystems 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



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 Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).
 Map Created By: RB
 Map Checked By: LKD
 Map Coordinate System: NAD 1983 UTM Zone 11N

Figure 14.5-3
 Limber Pine 2019 Survey Locations within the Landscapes and Ecosystems LSA

Project: 12-6231

Status: FINAL

Date: 2022-01-11

In some cases, TEM polygons were truncated if they extended above 1,900 metres (m) in elevation (the upper elevation limit for limber pine in the Landscapes and Ecosystems LSA). TEM polygons were adjusted to elevation limits in order to provide a better representation of areas where limber pine may be found. Accessible polygons were walked in transects by field staff as part of the August 2019 field survey

Predictive Habitat Modelling

Predictive modeling of potential limber pine habitat in B.C. based on provincial occurrence data was recently developed by Keefer Ecological Services (KES) for FLNRORD (KES, 2020b). The study to map limber pine habitat considered limber pine occurrence, distribution data, and habitat correlates in southeastern B.C. using an occupancy modelling technique and provincial database of plot data collected between 1968 and 2019. Predictive modeling results were examined for the Landscapes and Ecosystems LSA to identify potential limber pine habitat areas previously not identified by the Project TEM and aerial image analysis.

14.5.2.1.4 Whitebark Pine

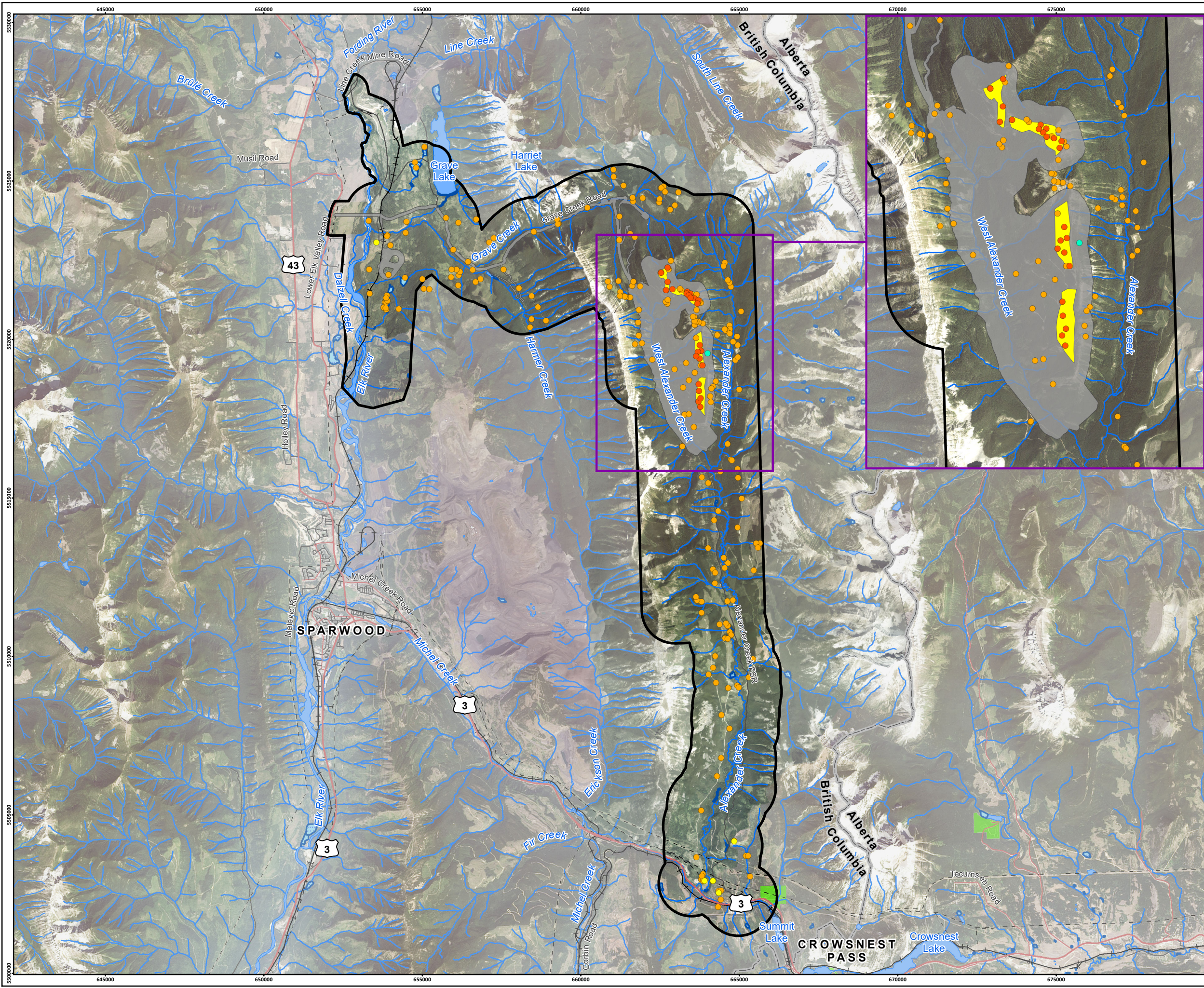
The assessment of baseline conditions for whitebark pine in the Landscapes and Ecosystems LSA was conducted through interpretation of the Project TEM (Chapter 13, Appendix 13-A) and VRI data. Additional supplemental surveys were conducted to characterize the health and density/mensuration of whitebark pine (Appendix 14-D) in select locations to determine the potential occurrence of critical habitat as proposed by ECCC (2017) (Figure 14.5-4).

Habitat

Under the draft Recovery Strategy for the Whitebark Pine (*Pinus albicaulis*) in Canada [Proposed] (ECCC, 2017), whitebark pine habitat is described as high elevation (above 1,750 m asl) sites with open-canopy conditions on well to rapidly drained soils that are coarse-textured, rocky and shallow over bedrock.

The extent of potential habitat for whitebark pine in the Landscapes and Ecosystems LSA was delineated by overlaying confirmed locations of occurrence with the Project TEM polygons (Chapter 13, Appendix 13-A) that generally coincide with the habitat described by ECCC (2017). Confirmed occurrences were detected during preliminary surveys to support development of the Project TEM, listed plant communities and species surveys, whitebark pine critical habitat and health assessment surveys (KES, 2020c, Appendix 14-B), VRI data and incidental observations made during other surveys conducted for the Project. Project TEM polygons overlapping with a confirmed occurrence of whitebark pine were considered to be “potential habitat”. Where occurrences of whitebark pine were not confirmed through field surveys or the VRI but suitable habitat was suspected to occur, such as on Teck Coal Ltd. private land in the southern portion of Alexander Creek, Project TEM polygons were selected if they exhibited similar environmental context as other areas with confirmed occurrences of whitebark pine, including: BGC zone/subzone, elevation, aspect, slope position, and tree cover less than 50%. In some cases, TEM polygons considered to be potential habitat for whitebark pine were truncated to a minimum elevation of 1,800 m asl, the lower elevation limit for confirmed occurrence of whitebark pine in the Landscapes and Ecosystems LSA.

Given that a confirmed occurrence does not necessarily confer occupancy of the entire area polygon area (or even the complete occupancy of any of the site types partitioned within the Project TEM polygon), the potential habitat area determined through this assessment may over-represent the actual area occupied by whitebark pine.

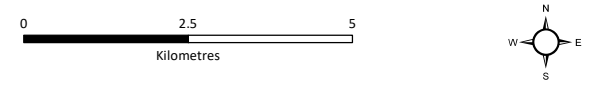


Crown Mountain Coking Coal Project

Figure 14.5-4
Whitebark Pine Sampling Locations

LEGEND

- TEM Listed Plant
- TEM Survey Plots
- Historic Whitebark Pine Occurrences
- Whitebark Pine Critical Habitat Survey Plots
- Whitebark Pine Critical Habitat Study Area
- Landscapes and Ecosystems 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



Scale 1:115,000

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 Landsat 8 (Aug 2018), and GeoBC OrthoImagery (Aug 2016).

Map Created By: RB
Map Checked By: BH
Map Coordinate System: NAD 1983 UTM Zone 11N



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Status: FINAL
Date: 2022-01-11

Critical Habitat

Although whitebark pine habitat may be present, not all occurrences may be critical to the long term viability of whitebark pine in British Columbia or Canada. Critical habitat necessary for the survival and/or recovery of whitebark pine is defined in (ECCC, 2017), which includes habitats necessary for seed dispersal and for recovery and regeneration.

As defined by ECCC (2017), critical habitat for recovery and regeneration of whitebark pine is defined (in part) by proximity to stands of sufficient density and health to support Clark's Nutcracker, the primary means of seed dispersal, although other factors are also important (i.e., absence of overstorey/understorey competition, suitable substrates). Consequently, a supplemental whitebark pine Health and Critical Habitat Assessment was conducted to determine the condition of whitebark pine occurrences in the areas most likely to be considered seed dispersal critical habitat from existing occurrences of whitebark pine in the Project footprint.

Potential critical habitat was based on their likelihood of containing whitebark pine with sufficient basal area and sufficient stature to be of cone-bearing age, in upper slope and ridgetop landscape positions, with relatively open forest canopy. Four polygons were delineated to guide field sampling which were selected to sample a range of tree sizes to determine whether an "image signature" could be established for the threshold basal area (>2 square metres (m²) /ha) of critical habitat. A total of twenty-four 400 m² fixed radius (i.e., an approximate 11 m radius) plots were established with between four and nine plots per assessment polygon.

Plot locations were placed in areas of representative density of relatively healthy whitebark pine for the sampling polygons. At each plot, a general site description was noted and the diameter-at-breast-height (DBH) of all whitebark pine trees was measured to calculate basal area (i.e., cumulative stem area, measured at breast height, per hectare) to determine if whitebark pine density was equal to or greater than 2 m²/ha, the minimum threshold density needed to support Clark's Nutcracker. The health of each tree was also assessed, to determine if trees were infected with white pine blister rust or affected by other factors. Health status was assessed as to whether the tree was infected with white pine blister rust, the percentage of canopy kill, whether mountain pine beetle had impacted the tree, and cause of death, if applicable. The presence of cones was documented and all whitebark pine trees less than 1.3 m in height were recorded as seedlings and tallied but were not factored in the calculation of basal area per plot. The presence of blister rust infection was also noted on seedlings (i.e., trees less than 1.3 m tall).

Critical habitat was determined in whitebark pine sampling polygons based on the criteria outlined in the proposed whitebark pine recovery strategy (ECCC, 2017). Basal area of whitebark pine was calculated based on cone-bearing and/or non-terminally infected whitebark pine trees in sample plots located in areas suspected to meet the definition of seed dispersal critical habitat. Cone-bearing trees were defined as trees that are visibly producing cones and/or trees equal to or greater than 10 centimetres (cm) DBH based on diameter-to-age correlation for trees of cone-bearing age (R. Moody, pers. comm., October 9, 2018). Whitebark pine produces mast cone crops at irregular intervals of 3-5 years; however, little to no cone production is common between mast years (ECCC, 2017). To capture reproductive trees in the inventory that are not producing cones (i.e., not during a mast year), a minimum 10 cm DBH limit was applied. Non-terminally infected trees were defined as trees with less than 45% canopy kill (R. Moody, pers. comm., October 9, 2018). Whitebark pine sampling polygons were identified as seed dispersal critical

habitat if average basal area of whitebark pine equalled or exceeded 2 m²/ha in the polygon, tree cover was less than 50%, and soils were well to rapidly drained, coarse or rocky.

To identify other potential critical habitat, TEM polygons were assessed within the elevational range of whitebark pine throughout the Landscapes and Ecosystems LSA. Polygons were assessed using imagery, VRI data, TEM and other survey field observations and observed characteristics for critical habitat. TEM polygons were predicted to contain critical habitat based on similarities to confirmed (by ground observation) critical habitat polygons using the following attributes: elevation, slope position, aspect, tree cover less than 50%, and two-kilometer distance from confirmed critical habitat criterion (Figure 14.5-4).

14.5.2.2 Results

14.5.2.2.1 Terrestrial Ecosystem Surveys and Mapping

A total of 936 polygons were delineated across 12,886 ha of the Landscapes and Ecosystems LSA, for an average polygon size of 13.8 ha (Chapter 13, Appendix 13-A; Figure 14.5-5; Table 14.5-3). Most polygons delineated occur in the MSdw (n=363), with the lowest number of polygons in the ESSFdkp (n=67). The MSdw occupies the largest area of the Landscapes and Ecosystems LSA, at 6,064 ha. Of the 217 plots completed within the Landscapes and Ecosystems LSA, most of the sampling (89%) occurred in the two BGC units, namely the MSdw and the ESSFdk1. The plot sampling ratio of ground plots to visuals is close to 1:1; a higher proportion of ground plots were established than were planned (1:3). The resulting sample intensity is one plot per 59 ha, which is within the one plot per 30-59 ha range provided in the TEM standard (Province of B.C., 1998). The TEM sampling intensity completed for the Project is suitable for wildlife capability assessments, local resource planning, and habitat enhancement prescriptions.

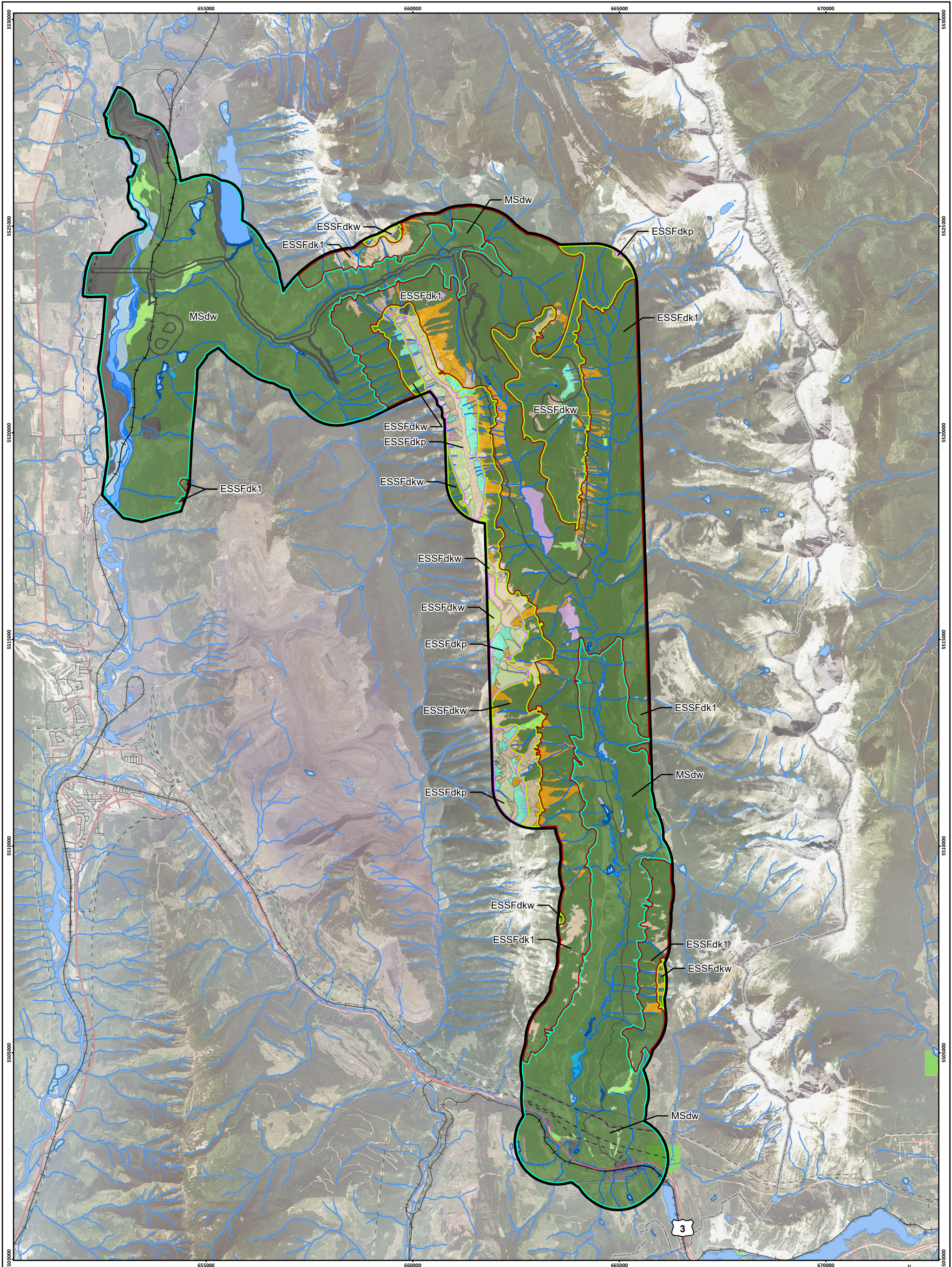
Table 14.5-3: TEM Polygons in the Landscapes and Ecosystems Local Study Area

BGC Unit	Number of Polygons	Total Polygon Area (ha)	Landscapes and Ecosystems LSA Extent (%)	Mean Polygon Area (ha)	Completed Ground Plots	Completed Visual Plots	Total Surveyed Plots
MSdw	363	6,064	47	16.7	60	53	113
ESSFdk1	350	4,704	37	13.4	26	54	80
ESSFdkw	156	1,554	12	10.0	11	13	24
ESSFdkp	67	564	4	8.4	0	0	0
Total	936	12,886	100	13.8	97	120	217

14.5.2.2.2 Listed and Sensitive Plant Communities and Species

Listed and Sensitive Plant Communities and Species

Habitat conditions for listed plant communities and species in the Landscapes and Ecosystems LSA were observed in low elevations areas of the MSdw (below 1,600 m asl) with warm aspect or soil conditions preventing the establishment of trees. Other habitats with elevated potential for listed plant communities and species include wetlands, riparian areas, limestone outcrops, high elevation forests, and ridgetop environments. Historical observations of listed ecological communities within the Landscapes and Ecosystems LSA, the document 10 ecological communities that have the potential to occur (see



Crown Mountain Coking Coal Project

LEGEND

- Biogeoclimatic Ecosystem Group**
- Alpine
 - Anthropogenic
 - Avalanche
 - Disclimax
 - Exposed Soil
 - Floodplain
 - Forest
 - Grassland

- Rock
 - Subalpine
 - Water
 - Wetland
- Biogeoclimatic Zone**
- ESSFdk1
 - ESSFdkp
 - ESSFdkw
 - MSdw

- Landscapes and Ecosystems 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

0 2 4
Kilometres

Scale 1:85,000

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 Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

Map Created By: RB
Map Checked By: BH
Map Coordinate System: NAD 1983 UTM Zone 11N

Figure 14.5-5
Terrestrial Ecosystem Mapping Biogeoclimatic Units of the Landscapes and Ecosystems LSA



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Status: FINAL
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Section 14.4.1.1.2 and Appendix 14-B). Five of these ecological communities were grasslands, three were wetlands, one was a flood ecosystem, and one was an alpine ecosystem.

As part of the baseline field surveys, one Red-listed grassland was observed within the Landscapes and Ecosystems LSA. Gg12 Rough Fescue - (Bluebunch Wheatgrass) - Yarrow - Clad Lichens (*Festuca campestris* - (*Pseudoroegneria spicata*) - *Achillea borealis* – *Cladonia* spp.) was identified through the rare plant field surveys, accounting for 0.21% of the Landscapes and Ecosystems LSA and 0.04% of the Project footprint (Table 14.5-4; Figure 14.5-6). Twelve wetland and two non-wetland ecological communities were identified through the wetland ecosystems baseline surveys, accounting for 0.04% and 0.01% of the Terrestrial LSA, respectively. Information on listed wetland ecosystems is provided in Chapter 13, Section 13.5.2.2.6 and is not presented in this chapter.

Table 14.5-4: Listed Ecological Communities Documented within the Landscapes and Ecosystems LSA and Project Footprint

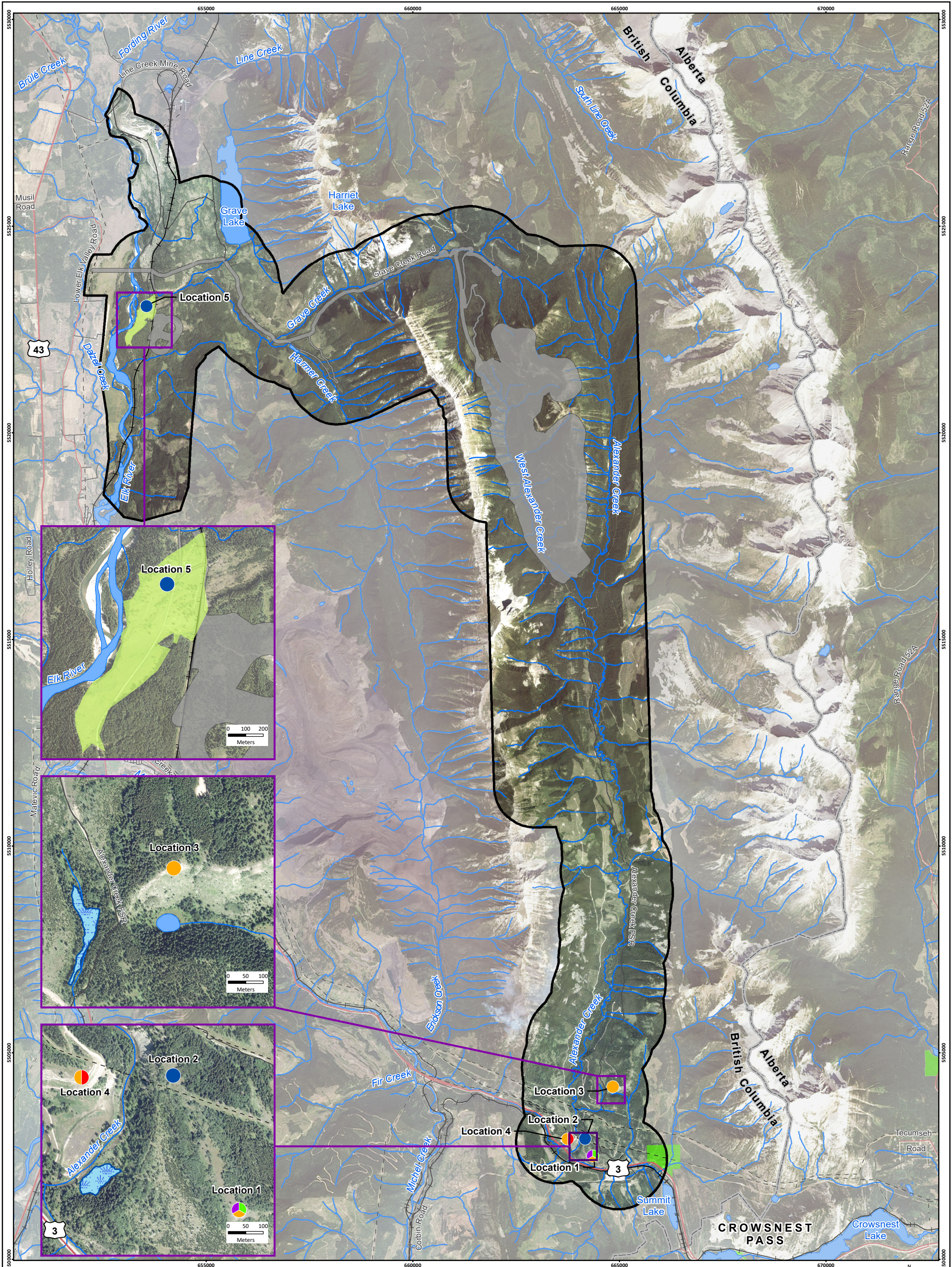
BGC Unit	Class	Ecosystem Name	Provincial Listing	Provincial Status	Structural Stage	Landscapes and Ecosystems LSA Extent (ha)	Landscapes and Ecosystems LSA Extent (%)	Project Footprint Extent (ha)*	Project Footprint Extent (%)
MSdw	Gg12	Rough fescue - (bluebunch wheatgrass) - yarrow - clad lichens association	Red	S1S2	2 (herb-dominated)	26.75	0.21	0.54	0.04

Note: * Total area based on the exclusion of existing and historic road and rail disturbance within the Gg12 ecosystem TEM polygon

The Red-listed Gg12 Rough Fescue - (Bluebunch Wheatgrass) - Yarrow - Clad Lichens (MacKillop et al., 2018) association was observed west of the proposed Project rail loadout and east of the Elk River along Valley Road, spanning approximately 26.75 ha. The Gg12 occurs level and gentle slopes with a gravelly, cemented layer under fine-textured soils (MacKillop et al., 2018). Sites generally occur in the IDfXk, IDfDm2, IDfDk5, and occasionally in the MSdw (MacKillop et al., 2018). Currently, Cusick’s paintbrush is listed as Unknown by the B.C. CDC (B.C. CDC, n.d.a). The Gg12 ecological community occurs in an area fragmented by linear features such as access roads and the Canada Pacific (CP) rail line and may have been disturbed in the past by logging and land clearing and/or livestock grazing.

Within the East Kootenay region, three generalized locations of Gg12 are mapped by the B.C. CDC (B.C. CDC, n.d.b). In the Landscapes and Ecosystems LSA, one generalized location overlaps with the ecological community recorded as part of baseline and a second location approximately 2.12 ha in size occurs approximately 540 m south of the Project footprint (B.C. CDC., n.d.b; Figure 14.5-6). The third mapped location in the East Kootenay occurs on the banks of the Flathead River, north of the B.C.-Alberta border, and is estimated to be approximately 7.19 ha in size (B.C. CDC, n.d.b).

The dominant grass at this site is the non-native Canada bluegrass, indicating the Gg12 ecological community is not in pristine condition and has likely undergone some disturbance. The species composition of this site was diverse with 38 plant species noted. A widespread biological soil crust was



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Figure 14.5-6
Listed Plant and Plant Community Occurrences within the Landscapes and Ecosystems LSA and Project Footprint

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- | | |
|--|--|
| <ul style="list-style-type: none"> Parry's townsendia Cusick's paintbrush Rough Fescue - (Bluebunch Wheatgrass) - Yarrow - Clad Lichens Ecological Landscapes and Ecosystems Local Study | <ul style="list-style-type: none"> Drummond's milk-vetch Ground plum Waxy-leaved beardtongue Project Footprint Highway Arterial/Collector Road Local/Resource Road Railway Transmission Line Watercourse Waterbody Provincial Park/Protected Area British Columbia/Alberta Border |
|--|--|

0 2 4
Kilometres

Scale 1:85,000

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 Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).
Map Created By: PR/RB
Map Checked By: LKD
Map Coordinate System: NAD 1983 UTM Zone 11N

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also noted, a feature of this ecological community as noted in MacKillop et al. (2018). Biological soil crusts typically consist of lichens, bryophytes, algae, cyanobacteria, and microfungi (MacKillop et al., 2018) and protect soils from erosion (wind and water), improves water infiltration to soil, and provides carbon and nitrogen to soil (Rosentreter et al., 2007). The non-native plant species, yellow salsify (*Tragopogon dubius*), was noted to occur within the Gg12 community. Dominant vegetation of the Gg12 ecological community within the Landscapes and Ecosystems LSA included wood rose (*Rosa woodsii*), Rocky Mountain juniper (*Juniperus scopulorum*), few-flowered shootingstar (*Dodecatheon pulchellum*), Canada bluegrass, rough fescue (*Festuca campestris*), northern bedstraw (*Galium boreale*), Idaho fescue (*Festuca idahoensis*), spreading needlegrass (*Achnatherum richardsonii*), field chickweed (*Cerastium arvense*), short-beaked agoseris (*Agoseris glauca*), rosy pussytoes (*Antennaria rosea*), and Sutherland's larkspur (*Delphinium sutherlandii*).

Listed Plant Species and Associated Habitat

The 2018 updated B.C. CDC database search identified 44 plant species, Blue- or Red-listed, with the potential to occur in the Landscapes and Ecosystems LSA (Appendix 14-A).

Baseline field surveys recorded four listed plant species with the Landscapes and Ecosystems LSA (Table 14.5-5; Figure 14.5-6). Whitebark pine and limber pine occurrence are outlined in Section 14.5.2.2.4 and Section 14.4.2.2.3, respectively, and are not included in this total count of listed species. The four plant species recorded within the Landscapes and Ecosystems LSA are currently Red-listed by the B.C. CDC and include ground plum (*Astragalus crassicaarpus*), shining penstemon (*Penstemon nitidus* var. *nitidus*), Parry's townsendia (*Townsendia parryi*), and Drummond's milk-vetch (*Astragalus drummondii*). Of the listed plant species observed during baseline surveys, none are listed as species at risk under the SARA (2002) or are designated at-risk by COSEWIC.

Table 14.5-5: Listed Plant Species Observed within the Landscapes and Ecosystems LSA

Plot ID	Plant Species	Provincial Listing	Provincial Status	Ecosystem Features	Plant Abundance	Comments
Location 1	Ground plum	Red	S1	Steep sloping warm aspect subxeric grasslands in the MSdw: 1,389 m asl	≥ 50 plants (2014); 2 plants (2016)	Threatened by invasive spotted knapweed
	Shining penstemon	Red	S2?		Found in 2 locations within plot	Healthy reproducing population
	Parry's townsendia	Red	S2		5 plants limited to 100 m ²	Threatened by invasive spotted knapweed
Location 2	Cusick's paintbrush	Unknown	SU	Moderate sloping Mesic in the MSdw	Spotty	First occurrence documented in the Elk Valley
Location 3	Shining penstemon	Red	S2?	Steep sloping south-facing subxeric open grassland in the	≥ 20 plants; widespread	-

Plot ID	Plant Species	Provincial Listing	Provincial Status	Ecosystem Features	Plant Abundance	Comments
				MSdw: 1,495 m asl		
Location 4	Drummond's milk-vetch;	Red	S1	Steep sloping south-east facing xeric eroding in the MSdw: 1,370 m asl	1 plant	One of three populations known in B.C. – high risk of extirpation
	Shining penstemon	Red	S2?		≥ 20 plants; widespread	Location threatened by accelerated erosion due to road construction
Location 5	Cusick's paintbrush	Unknown	SU	Flat submesic grassland in the MSdw; 1,190 m asl	Widespread	Population distributed on glacio-fluvial terrace

Prior to 2019, Cusick's paintbrush was Red-listed; however, since 2019, its status has been listed as Unknown (B.C. CDC, n.d.a). The four Red-listed plant species within the Landscapes and Ecosystems LSA were observed in the southern portion of the Landscapes and Ecosystems LSA and not within the Project footprint. Cusick's paintbrush was also observed in the southern portion of the Landscapes and Ecosystems LSA and east of the proposed rail loadout within the Gg12 ecological community west of Valley Road. The observation of Cusick's paintbrush in the southern Landscapes and Ecosystems LSA was the first occurrence of this species documented in the Elk Valley.

Invasive spotted knapweed (*Centaurea stoebe*) was observed near two Red-listed plant occurrences of ground plum and Parry's townsendia (identified as Location 1 on Table 14.5-5) and may affect the restricted abundance of Parry's townsendia at this location as the Parry's townsendia plants observed are established in an area of approximately 100 m². Spotted knapweed is a provincially noxious under the provincial Weed Control Act (1996) and the Forest and Range Practices Act (2002).

14.5.2.2.3 Limber Pine

Baseline Field Surveys

No limber pine was observed in the Landscapes and Ecosystems LSA or the proposed Project footprint. As well, no limber pine was detected in the provincial VRI data. Although limber pine was not observed within the Landscapes and Ecosystems LSA, the potential for this species to occur cannot be ruled out as seed catches or trees may occur and were not observed during the extensive baseline surveys. Limber pine has been documented south of the Landscapes and Ecosystems LSA (Klinkenberg, 2019) in habitats similar to those found within the Landscapes and Ecosystems LSA. As well, calcareous bedrock is widespread within the Landscapes and Ecosystems LSA, with Grave Canyon, both sides of Erickson Ridge, and the east slopes above Alexander Creek having potential for limestone, dolomite or calcareous sandstone occurrences (Grieve and Price, 1987), which may result in conditions favorable to limber pine. Immediately surrounding the Project footprint and areas of planned infrastructure, it is unlikely that limber pine occurs due to the thoroughness of baseline surveys conducted within this area.

The delineation of potential limber pine habitat within the Landscapes and Ecosystems LSA based on BGC unit, elevation, geology, and habitat requirements identified several that could be suitable for limber pine. Accessible potential limber pine habitat areas were assessed in August 2019 and no limber pine was observed.

Predictive Habitat Modelling

The predictive modelling results indicate that limber pine occurrence is strongly determined by dolomitic carbonate, limestone, and calcareous and undivided sedimentary rocks (KES, 2020b). Limber pine were predicted to occur on exposed land at mid elevations with steep slopes and their occurrence was predicted to be negatively associated with both coniferous dense and coniferous open forest and positively associated with shrublands (KES, 2020b). As well, the model indicated a strong positive association of limber pine occurrence with south and southwest aspects and a negative association with solar radiation (KES, 2020b).

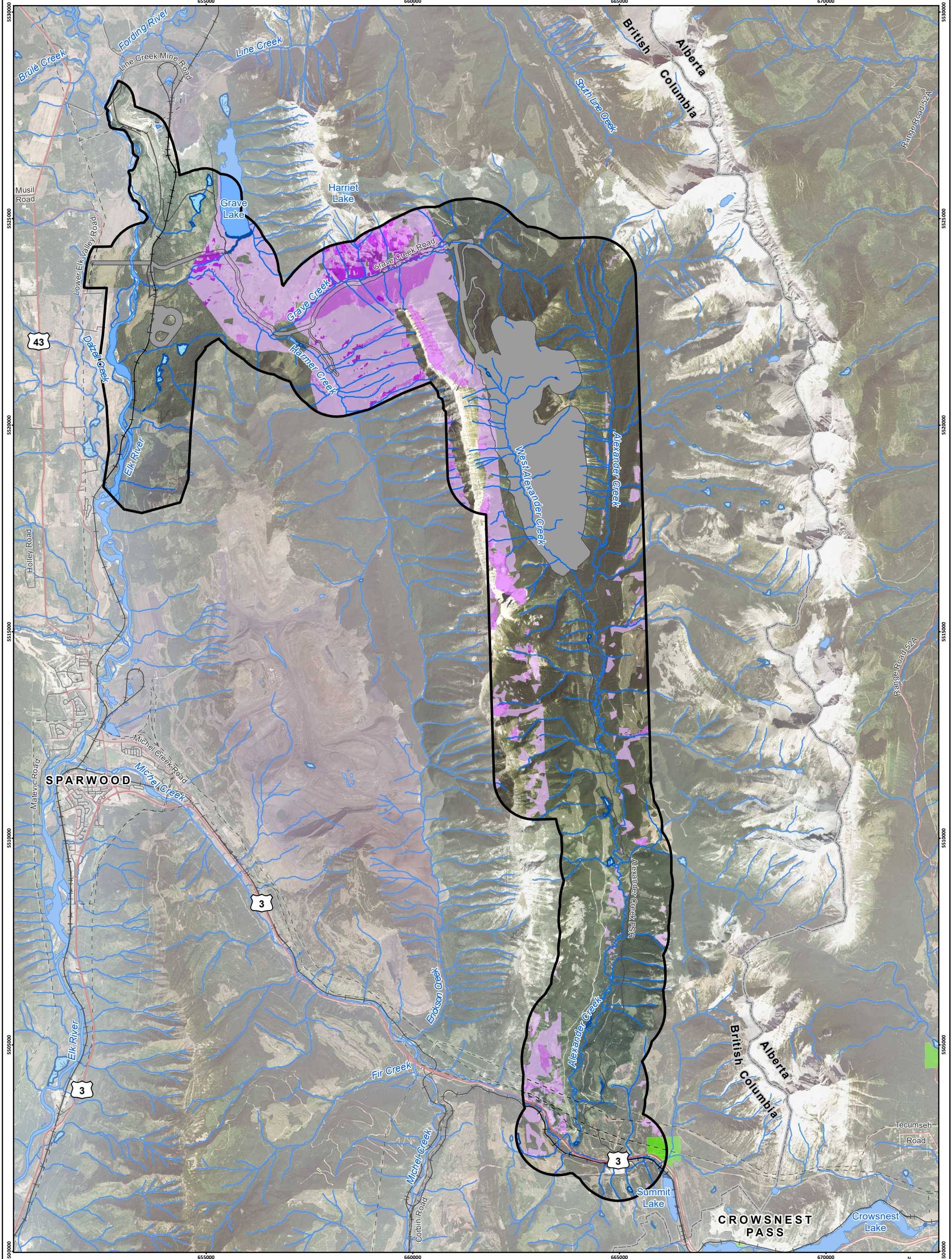
Based on the limber pine predictive habitat modelling, no very high quality potential limber pine habitat was identified in the Project footprint (Table 14.5-6; Figure 14.5-7). Some high quality limber pine habitat is predicted to occur within the Project footprint along the Grave Creek Road corridor, approximately 8.45 ha or 0.66% of the potential limber pine habitat in the Project footprint; however, no limber pine was observed along Grave Creek Road as part of the 2019 limber pine field surveys. Within the Landscapes and Ecosystems LSA, very high quality limber pine habitat has the potential to occur across 18.73 ha or 0.15% of the Landscapes and Ecosystems LSA.

Table 14.5-6: Predictive Limber Pine Habitat in the Project Footprint and Landscapes and Ecosystems LSA

Predictive Habitat Ranking	Amount of Habitat in the Project Footprint		Amount of Habitat in the Landscapes and Ecosystems LSA	
	Area (ha)	Project Footprint Extent (%)	Area (ha)	Landscape and Ecosystem LSA Extent (%)
Very High (0.91 - 1.00)	0	0.00	18.73	0.15
High (0.81 - 0.90)	8.45	0.66	126.04	0.98
Moderate (0.71 - 0.80)	15.57	1.21	537.11	4.17
Low (0.61 - 0.70)	51.02	3.98	2075.48	16.11

Health

Health surveys of limber pine were not completed as part of the limber pine baseline program as no limber pine was found in the Landscapes and Ecosystems LSA and as such, health surveys could not be completed. Although no limber pine was encountered as part of the baseline surveys, whitebark pine health information gathered as part of the whitebark pine health assessments can be used as a surrogate for understanding the health of potential limber pine that occur within the Landscapes and Ecosystems LSA (Section 14.5.2.2.4). An average infection rate of whitebark pine with whitebark pine blister rust was found to be 69% in reproductive whitebark pine, with the infection increasing as tree size increased. Unless resistant to white pine blister rust, any limber pine individuals that may incidentally occur in the Landscapes and Ecosystems LSA are likely to be infected due to the high rates of infection in the whitebark pine population.



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Figure 14.5-7
 Limber Pine Predictive Habitat Modelling of the
 Landscapes and Ecosystems Local Study Area

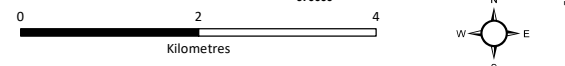
Predictive Habitat Suitability

- Very High
- High
- Moderate
- Low

- Landscapes and Ecosystems 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



Scale 1:85,000

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 Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

Map Created By: RB
 Map Checked By: LKD
 Map Coordinate System: NAD 1983 UTM Zone 11N



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14.5.2.2.4 Whitebark Pine

Whitebark pine was detected within the Project footprint and Landscapes and Ecosystems LSA, from an elevation of approximately 1,800 m asl to the ridge top of Crown Mountain (2,230 m asl) with the bulk of observations located at or above 1,900 m asl (Appendix 14-D). Whitebark pine is also found to the north of Crown Mountain along the ridge that extends from Crown Mountain to the northern edge of the Landscapes and Ecosystems LSA in the upper Grave Creek drainage. Additionally, VRI data indicates that whitebark pine is found just outside the Landscapes and Ecosystems LSA to the east and northeast.

Habitat

Whitebark pine was confirmed via observations in 14 TEM polygons, with an additional 23 TEM polygons predicted to have whitebark pine based on the available VRI data. Together with TEM polygons exhibiting similar habitat characteristics but for which specific observations or VRI data are not available, potential habitat for whitebark pine is predicted to occur in up to 78 TEM polygons in the Landscapes and Ecosystems LSA (out of 936 polygons in total). Considering the relative proportion of site types in each TEM polygon providing potential habitat for whitebark pine (i.e., confirmed or predicted occupancy), whitebark pine is predicted to occur in up to 1,375 ha and 591 ha in the Landscapes and Ecosystems LSA and Project footprint, respectively (Table 14.5-7; Figure 14.5-8). Given that whitebark pine does not necessarily occupy the entire area of each TEM polygon, the total area of whitebark pine habitat likely presents an upper limit of maximum occupancy, offering a precautionary estimate of the extent within the Landscapes and Ecosystems LSA and Project footprint.

Table 14.5-7: Extent of Whitebark Pine Potential Habitat by Site Type

Site Type	Landscapes and Ecosystems LSA		Project Footprint		Proportion of Whitebark Pine Habitat (%)
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)	
101	523.02	4.06	290.05	22.61	55.46
103	334.07	2.59	183.20	14.28	54.84
104	85.78	0.67	53.42	4.16	62.28
102	21.77	0.17	11.91	0.93	54.70
110	54.59	0.42	10.81	0.84	19.81
Af	5.51	0.04	0.49	0.04	8.98
At	47.52	0.37	2.46	0.19	5.17
ES	0.25	0.00	0.25	0.02	100.00
Gb20	29.11	0.23	3.65	0.28	12.55
Ro	60.03	0.47	11.88	0.93	19.79
Rt	27.59	0.21	6.42	0.50	23.29
RZ	10.84	0.08	10.84	0.85	100.00
Sk02	93.30	0.72	0.00	0.00	0.00
Sk10	36.39	0.28	0.00	0.00	0.00
Sk20	9.76	0.08	0.00	0.00	0.00
Vhd	5.46	0.04	0.00	0.00	0.00
Vs	19.37	0.15	0.84	0.07	4.32
Vt	10.68	0.08	4.90	0.38	45.91
Total	1,375.03	10.67	591.14	46.07	42.99



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|---|-------------------------|---------------------------------|
| Potential Whitebark Pine Habitat | Project Footprint | Provincial Park/Protected Area |
| Historic Whitebark Pine Occurrences | Highway | British Columbia/Alberta Border |
| Whitebark Pine Detected | Arterial/Collector Road | Local/Resource Road |
| Whitebark Pine Not Detected | Railway | Transmission Line |
| Contour (100 m) | Watercourse | Waterbody |
| Lower Elevation Limit for Whitebark Pine (1800 m) | Wetland | |
| Landscapes and Ecosystems Local Study Area | | |

Figure 14.5-8
Whitebark Pine Habitat within the Landscapes and Ecosystems LSA

0 2 4
Kilometres

Scale 1:85,000

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 Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

Map Created By: RB
Map Checked By: BH
Map Coordinate System: NAD 1983 UTM Zone 11N



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Critical Habitat

Whitebark pine critical habitat assessments were conducted for a total of 24 survey plots distributed across 4 separate polygon study areas (Figure 14.5-4). A total of 763 individuals were assessed, of which 73 met the size requirements for reproductively mature trees. Of the non-reproductively mature trees and seedlings, 476 (out of 690, or 69%) were considered to be healthy or non-terminally infected with white pine blister rust (Table 14.5-8). Generally, rates of white pine blister rust infection increased with tree size; there were no live trees infected with mountain pine beetle detected.

Table 14.5-8: Whitebark Pine Health Status across the Twenty-Four Fixed-Radius Plots¹

Health Status	Size Class			
	Reproductive	Non-Reproductive	All > 1.3 m Tall	Seedlings
Healthy or Non-Terminally Infected	8% (0-33%)	28% (17-55%)	21% (3-41%)	81% (63-90%)
Terminally Infected or Dead	69% (54-78%)	66% (33-81%)	67% (39-78%)	17% (10-36%)
Other Agent	23% (0-38%)	6% (2-33%)	12 (2-30%)	2% (0-10%)
Total	73	116	189	574

Note:

1. Reproductive trees are those cone-bearing or >10 cm DBH, non-reproductive are >1.3 m tall and <10 cm DBH, seedlings are < 1.3m tall). Terminally Infected or Dead health status are those trees that are terminally infected by white pine blister rust or have died due to the rust, Other Agent are trees unhealthy or dead due to agents other than blister rust; ranges reflect averages for the four assessment polygons.

The calculated basal area of reproducing and/or non-terminally infected whitebark pine in the selected critical habitat study areas ranged from 0.81 m²/ha to 14.43 m²/ha (Table 14.5-9). For those study areas exhibiting a basal area greater than the minimum threshold of 2 m²/ha (i.e., Pa1, Pa3 and Pa4), the average basal area of such seed dispersal critical habitat areas is 10.40 m²/ha. Given this exceedance of the threshold basal area for whitebark pine, there is potential for as much as 332 ha of seed dispersal critical habitat, and 1,004 ha of recovery/regeneration critical habitat in the Landscapes and Ecosystems LSA (Table 14.4-10).

The extent of potential seed dispersal and recovery/regeneration critical habitat in the Landscapes and Ecosystems LSA is depicted in Table 14.5-10. The distribution of whitebark pine and critical habitat is provided in Figure 14.5-9.

Table 14.5-9: Survey Effort for the Whitebark Pine Health and Critical Habitat Field Surveys

Assessment Polygon	Area (ha)	Number of Plots (n)	Number of Trees by Size Class [% Non-Terminally Infected]				Number of Trees Used in Basal Area Calculation (n)	Basal Area (m ² /ha) ⁺	
			Reproductive [*]	Non-Reproductive ^{**}	Seedlings ^{***}	Total		Average ⁺⁺ [Standard Deviation]	Range of Natural Variation
Pa1	13.67	4	13 [8%]	33 [55%]	47 [87%]	93 [65%]	33	14.43 [8.73]	5.70 – 23.16
Pa2	20.88	9	15 [33%]	59 [17%]	139 [63%]	213 [48%]	49	0.81 [0.65]	0.16 – 1.47
Pa3	23.02	6	27 [0%]	3 [33%]	338 [90%]	368 [83%]	23	8.87 [2.16]	6.71 – 11.04
Pa4	27.26	5	18 [0%]	21 [19%]	50 [66%]	89 [42%]	22	9.01 [6.31]	2.70 – 15.32
Total (Polygons with Basal Area ≥2 m ² /ha only)	63.94	15	58 [2%]	57 [40%]	435 [87%]	550 [73%]	78	10.40 [5.98]	4.42 – 16.38
Total (All Polygons)	84.82	24	73 [10%]	116 [28%]	574 [81%]	763 [66%]	127	6.80 [6.66]	0.14 – 13.47

Notes:

*≥1.3 m height, ≥10 cm DBH

**≥1.3 m height, <10 cm DBH

***<1.3 m height

+Basal Area is calculated using the DBH of all reproductive trees, and all non-terminally infected, non-reproductive trees (excluding seedlings)

++Figures in bold exceed critical habitat basal area threshold of 2 m²/ha.

Table 14.5-10: Potential Extent of Whitebark Pine Critical Habitat by Site Type

Site Type	Seed Dispersal Critical Habitat					Recovery/Regeneration Critical Habitat				
	Landscapes and Ecosystems LSA		Project Footprint		Proportion of Seed Dispersal Critical Habitat (%)	Landscapes and Ecosystems LSA		Project Footprint		Proportion of Recovery/Regeneration Critical Habitat (%)
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)		Area (ha)	Proportion (%)	Area (ha)	Proportion (%)	
101	167.14	1.30	167.14	13.03	100.00	371.44	2.88	189.21	14.75	50.94
103	26.61	0.21	26.61	2.07	100.00	290.31	2.25	196.82	15.34	67.79
104	116.59	0.90	116.59	9.09	100.00	55.49	0.43	9.81	0.76	17.68
102	0.49	0.00	0.49	0.04	100.00	13.55	0.11	13.55	1.06	100.00
110	11.14	0.09	11.14	0.87	100.00	32.18	0.25	0.00	0.00	0.00
Af	0.00	0.00	0.00	0.00	-	5.51	0.04	0.49	0.04	8.98
As	0.23	0.00	0.23	0.02	100.00	0.00	0.00	0.00	0.00	-
At	0.94	0.01	0.94	0.07	100.00	38.81	0.30	5.96	0.46	15.36
ES	0.00	0.00	0.00	0.00	-	0.25	0.00	0.25	0.02	100.00
Gb20	0.00	0.00	0.00	0.00	-	16.81	0.13	4.09	0.32	24.33
Ro	3.47	0.03	3.47	0.27	100.00	40.24	0.31	15.22	1.19	37.83
Rc	0.00	0.00	0.00	0.00	-	3.10	0.02	0.00	0.00	0.00
Rt	0.63	0.00	0.63	0.05	100.00	24.06	0.19	9.66	0.75	40.13
RZ	0.43	0.00	0.43	0.03	100.00	11.53	0.09	11.53	0.90	100.00
Sk02	0.00	0.00	0.00	0.00	-	27.57	0.21	0.00	0.00	0.00
Sk10	0.00	0.00	0.00	0.00	-	28.70	0.22	0.00	0.00	0.00
Vhd	0.00	0.00	0.00	0.00	-	7.74	0.06	2.28	0.18	29.44
Vs	0.00	0.00	0.00	0.00	-	19.04	0.15	6.14	0.48	32.27
Vt	0.00	0.00	0.00	0.00	-	14.30	0.11	4.90	0.38	34.29
Xv	4.01	0.03	4.01	0.31	100.00	3.33	0.03	0.00	0.00	0.00
Total	331.68	2.57	331.68	25.85	100.00	1,003.96	7.79	469.91	36.63	46.81



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- | | | |
|---|---------------------------------|---------------------------------|
| Whitebark Pine Critical Habitat | Contour (100 m) | Watercourse |
| Potential Whitebark Pine Recovery/Regeneration Critical | Lower Elevation Limit for | Waterbody |
| Potential Whitebark Pine Seed | Landscapes and Ecosystems Local | Wetland |
| Whitebark Pine Critical Habitat | Project Footprint | Provincial Park/Protected Area |
| Historic Whitebark Pine | Highway | British Columbia/Alberta Border |
| Whitebark Pine Detected | Arterial/Collector Road | |
| Whitebark Pine Not Detected | Local/Resource Road | |
| | Railway | |
| | Transmission Line | |

Figure 14.5-9
Whitebark Pine Critical Habitat within the Landscapes and Ecosystems LSA

0 2 4
Kilometres

Scale 1:85,000

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 Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

Map Created By: RB
Map Checked By: BH
Map Coordinate System: NAD 1983 UTM Zone 11N



Project: 12-6231
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14.6 Project Effects Assessment

14.6.1 Thresholds for Determining Significance of Residual Effects

14.6.1.1 Listed and Sensitive Plant Communities and Species

A significant adverse residual effect on listed plant communities and species is defined as one that results in:

- Direct mortality of an individual listed plant community or species such that the likelihood for long-term survival of the listed plant or ecological community in the East Kootenay region is substantially reduced as a result; or
- Alteration of the terrestrial habitat in which a listed plant community or species occurs in such a way as to cause a substantial decline in the listed plant population or community abundance or distribution that in turn creates a reduction of the listed plant community or species long-term survival in B.C.

No quantitative threshold values or guidelines related to provincially-listed species are currently available in B.C., and as such, the above-listed thresholds have been selected as the thresholds for determining significance of residual effects to listed vegetation species and communities.

14.6.1.2 Limber Pine

A significant adverse residual effect on limber pine is defined as one that results in:

- Direct mortality of an individual limber pine or limber pine stand such that the likelihood for long-term survival of the limber pine population in the East Kootenay is substantially reduced as a result; or
- Alteration of the terrestrial habitat in which limber pine or limber pine stand occurs and results in a substantial decline in abundance or change in distribution such that the limber pine long-term survival in B.C. is reduced.

No quantitative threshold values or guidelines related to provincially-listed species are currently available in B.C., and as such, the above-listed thresholds have been selected as the thresholds for determining significance of residual effects to limber pine. Although designated as Endangered by COSEWIC in 2014, limber pine is not currently listed under the SARA (2002) and no federal critical habitat has been defined for limber pine to date.

14.6.1.3 Whitebark Pine

In its draft recovery strategy for whitebark pine, ECCC (2017) identified that the long term viability of whitebark pine in Canada depends on the conservation of critical habitat, inclusive of both seed dispersal and recovery/regeneration types. Although there is no defined threshold area of each critical habitat type needed to support a viable population of whitebark pine, the loss of area defined as critical habitat as a result of Project activities would be adverse to the condition of whitebark pine. Further, existing populations of whitebark pine require a minimum density of reproductively mature and/or healthy individuals equal to or greater than a cumulative whitebark pine basal area of 2 m²/ha. Project activities resulting in a loss of reproductively mature and/or healthy individuals would also be considered adverse to the condition of whitebark pine.

In consideration of the guidance provided by the draft recovery strategy for whitebark pine (ECCC, 2017), a significant adverse effect to whitebark pine would include:

- Removal of individuals or degradation of habitat conditions to result in a permanent and irreversible net loss of critical habitat (all types combined)²; or
- Permanent and irreversible reduction of whitebark pine density to below the range of natural variation³ or minimum basal area of 2 m²/ha, whichever is greater.

14.6.2 Project Interactions

Project activities and components have the potential to result in adverse effects to vegetation. This assessment focuses only on planned activities within the designed scope of the Project. Effects related to unplanned events (e.g., spills, equipment malfunctions, accidents) are presented in Chapter 21.

Project activities occurring through the Construction and Pre-Production, Operations, Reclamation and Closure, and Post-Closure phases have the potential to affect vegetation VCs. The Project interaction matrix for vegetation VCs is presented by Project phase, component and activity in Table 14.6-1. Specific details on Project activities and components are discussed in Chapter 3.

14.6.3 Potential Effects on Listed and Sensitive Plant Communities and Species

14.6.3.1 Discussion of Potential Effects

The potential effects identified in Table 14.6-1 are discussed in the context of each Project phase (Construction and Pre-Production, Operations, Reclamation and Closure, and Post-Closure) in the following subsections.

Based on the interactions identified in Table 14.6-1, the Project has the potential to affect listed plant communities and species through:

- Direct (physical) loss of a listed plant community or species due to site clearing, grubbing and soil movement/salvage;
- Indirect loss or alteration of a listed plant community or species due site clearing, grubbing and soil movement/salvage;
- Alteration of listed plant community or species vigour due to dust deposition associated with construction and transportation; and
- Alteration of listed plant community or species composition due to invasive plant species introduction and/or encroachment along construction/dismantling areas, transportation/utility corridors, and during soil salvaging and stockpiling activities.

Potential effects on listed plant communities and species as a result of the Project that are carried forward in the discussion of potential effects are summarized below in Table 14.6-2.

² A reduction in seed dispersal critical habitat would be “not significant” where replaced with an equivalent area of suitable recovery/regeneration habitat and sufficient seed dispersal habitat remains to maintain the potential for recovery/regeneration of whitebark pine.

³ The range of natural variation for basal area of whitebark pine is defined as 1 standard deviation from the mean for the respective study area.

Table 14.6-1: Project-Vegetation VC Interaction Matrix and Ranking

Project Phase	Project Component	Description of Activities	Listed Plant Communities and Species	Limber Pine	Whitebark Pine	
Construction and Pre-Production	Transportation	Use of Highway 43, Line Creek Mine Road, Valley Road, and Grave Creek Road by highway transport trucks, light duty vehicles, and crew busses to transport personnel, materials, and consumable items	II	II	I	
	Logging of Merchantable Timber	Merchantable timber will be logged from the infrastructure and pre-production development footprint	I	II	III	
	Clearing and Grubbing	After the merchantable timber has been removed, the remaining vegetation will be cleared and grubbed from the infrastructure and pre-production development footprint	II	II	III	
	Stockpiling Wood Waste	Wood waste will be stockpiled on site and used for reclamation as a source of coarse woody debris	I	I	I	
	Quarry for Construction Materials	Excavation of road bed materials from the North Pit footprint for use on Grave Creek Road	I	I	I	
	Water Management or Water Management Structures		Water management structures to support initial construction activities will be built prior to soil being salvaged from the run of mine (ROM) and plant site	I	I	I
			Interim Sediment Pond will be built prior to the soil removal and stockpiling from the pit access road and initial phase of the North Pit	I	I	I
			Grave Creek Reservoir will be constructed to act as a back-up source of process water	I	I	I
	Soil Salvage	Soil will be salvaged from the footprint of the infrastructure	II	I	II	
	Road Upgrading and Construction		Branch C Road will be widened and upgraded to facilitate construction and mine traffic to plant site area	I	I	I
			Grave Creek Road will be widened to facilitate the clean coal haul	I	II	I
			A new road will be constructed off the Valley Road to access the rail loadout for construction and operation	III	I	I
	Linear Infrastructure		Installation of the powerline	I	I	I

Project Phase	Project Component	Description of Activities	Listed Plant Communities and Species	Limber Pine	Whitebark Pine
		Installation of the natural gas line	I	I	I
	Overland Conveyor	Clearing, grubbing, and construction of overland conveyor from the plant site to Grave Creek Road	I	II	II
	Coal Handling Process Plant Construction	Excavating and pouring of foundation	I	I	I
		Transportation of materials and personnel to site	I	I	I
		Constructing of the Coal Handling Process Plant (CHPP)	I	I	I
		Commissioning of the CHPP	I	I	I
	Workshop / Mine Dry Construction	Excavating and pouring of foundations	I	I	I
		Transportation of materials to site	I	I	I
		Construction of workshop / mine dry	I	I	I
		Equipment wash bay and heavy equipment parking	I	I	I
		Administration, first aid, and mine dry building	I	I	I
		Diesel tank farm	I	I	I
		Warehouse	I	I	I
		Potable water system	I	I	I
		Septic system	I	I	I
		Water supply pipelines from Grave Creek and West Alexander Creek	I	I	I
		Commissioning of the facilities	I	I	I
	Explosives Factory Construction	Construction of the explosives factory	I	I	I
	Rail Loadout Construction	Excavation and preparation of the rail bed	I	I	I
		Excavation and preparation of foundation stockpiling and coal handling systems	I	I	I
		Transportation of materials and personnel to site	II	I	I
		Construction of rail loadout	I	I	I
		Connection to the CP Fording Sub-line	I	I	I

Project Phase	Project Component	Description of Activities	Listed Plant Communities and Species	Limber Pine	Whitebark Pine	
		Commissioning of the rail loadout	I	I	I	
	Labour	Hiring of personnel for the mine, CHPP operations, administration, and coal haul	I	I	I	
		Training of personnel	I	I	I	
	Construction Waste Materials	Collection and transfer to a recycling facility or other approved facility	I	I	I	
Operations	Transportation	Use of Highway 43, Line Creek Mine Road, Valley Road, and Grave Creek Road by highway transport trucks, light duty vehicles, and crew busses to transport personnel, materials, and consumable items	II	I	II	
	Explosives Factory	Ammonium nitrate / emulsion storage facilities which have the ability to load explosive agents into delivery trucks	I	I	I	
		Wash facility to decontaminate the bulk explosive delivery trucks	I	I	I	
		Storage of explosives (detonators and boosters)	I	I	I	
	Fuel Storage	Receiving bulk fuel deliveries	I	I	I	
		On-site storage of fuel	I	I	I	
		Dispensing fuel	I	I	I	
		Transferring fuel to on-site delivery trucks	I	I	I	
	Mine Roads Development	Building roads from material sourced on-site	I	I	I	
	Mining	Progressive clearing		I	I	III
		Removal of unconsolidated material		I	I	II
		Loading, hauling, and stockpiling of soil		I	I	I
		Drilling and loading of blastholes		I	I	I
		Detonating the explosives		I	I	II
		Loading, hauling, and dumping of mine rock		I	I	III
		Loading, hauling, and stockpiling of coal		I	I	II

Project Phase	Project Component	Description of Activities	Listed Plant Communities and Species	Limber Pine	Whitebark Pine	
	Site Water Requirements	Using contact water as the primary process make-up water from Interim Sediment Pond (Year 1 to 5)	I	I	I	
		Using contact water as the primary process make-up water from the North Pit (Year 5 to 15)	I	I	I	
		Backup reservoir in Grave Creek as a secondary source of process make-up water	I	I	I	
	Coal Processing	Run of mine coal sizing	I	I	I	
		Washing coal	I	I	I	
		Mechanical and thermal drying of coal	I	I	I	
		Coal reject disposal (part of loading, hauling, and dumping of mine rock activities)	I	I	I	
		Conveying clean coal	I	I	I	
	Sewage Treatment	Sewage will be treated by a septic system constructed at the plant site which will support the administration, mine dry, and CHPP facilities	I	I	I	
	Main Sediment Pond	Construction of Main Sediment Pond in Year 4	I	I	I	
		Management of the Main Sediment Pond discharge	I	I	I	
	Reclamation	Reclaiming available areas as soon as possible to achieve reclamation objectives	I	I	I	
	Reclamation and Closure	Transportation	Use of Highway 43, Line Creek Mine Road, Valley Road, and Grave Creek Road by highway transport trucks, light duty vehicles, and crew busses to transport personnel, materials, and consumable items	II	I	II
		Dismantling Infrastructure and Buildings	Dismantling of the CHPP, maintenance facilities, administration, and other facilities	I	I	II
Dismantling, salvaging, collecting, and transferring materials to a recycling facility or other approved facility			I	I	I	
Removal of Linear Infrastructure		Removal of the powerline	I	I	I	
		Removal of the natural gas line	I	I	I	

Project Phase	Project Component	Description of Activities	Listed Plant Communities and Species	Limber Pine	Whitebark Pine	
	Reclamation	Reclaiming available areas as soon as possible to achieve reclamation objectives	I	I	II	
	Monitoring	Reclamation monitoring	I	I	I	
		Geotechnical monitoring	I	I	I	
		Aquatic effects monitoring	I	I	I	
	Water Management	Management of the Main Sediment Pond discharge	I	I	I	
Post-Closure	Water Management	Decommissioning the Main Sediment Pond once water quality objectives have been met	I	I	I	
	Road Use	Branch C Road will remain as a permanent access road for future commercial and recreational use	I	I	I	
	Rail Line	The rail line will remain as a permanent feature	I	I	I	
	Monitoring	Reclamation monitoring		I	I	I
		Geotechnical monitoring		I	I	I
		Aquatic effects monitoring		I	I	I

Notes (after EAO, 2013):

I = No or negligible effect (positive or adverse) is anticipated; not carried forward in the assessment

II = Potential adverse effects requiring additional mitigation or substantial positive effects are expected; carried forward in the assessment

III = Key interaction resulting in potential significant adverse effect or significant concern; carried forward in the assessment

Table 14.6-2: Potential Effects on Listed and Sensitive Plant Communities and Species

Potential Effect	Rationale for Selection of Environmental Effect
Change in Listed Plant Community or Species Abundance and Distribution through Site Clearing, Grubbing, and Soil Salvaging	Land clearing, grubbing, and soil salvaging associated with the haul road construction to the rail loadout will result in vegetation and soil removal and the direct physical loss of portions of the Red-listed Gg12 Rough fescue - (bluebunch wheatgrass) - yarrow - clad lichens ecological community. Removal of the ecological community can result in impacts to the geographic distribution of the community and changes in the abundance of the community in the regional and local area.
Change in Listed Plant Community or Species Composition and Structure due to Site Clearing, Grubbing, and Soil Salvaging	The direct loss of the Gg12 ecological community has the potential to result in indirect effects to the remaining ecological community adjacent to the areas of disturbance as a result of Project development. Vegetation removal and soil disturbance (removal and compaction of soils) within the Project footprint may alter the plant community around areas of disturbance, resulting in changes to the plant community composition and structure.
Change in Listed Plant Community and Species Composition from the Introduction and Spread of Invasive Plants	Invasive plant species, as well as introduced agronomic plant species, may be introduced and/or spread during construction activities and site disturbance through soil removal and stockpiling and vegetation removal, altering listed plant community composition and individual listed plant populations. Use of the haul roads within and adjacent to the Project footprint can also spread invasive plants through vehicle and machinery traffic.
Change in Listed Plant Community and Species Vigour through Dust Deposition	Construction and upgrading of the haul road to the rail loadout will result in the generation of dust through site clearing and vegetation removal, movement of soil, and increased vehicle traffic for the transportation of materials and personnel. Dust deposition on vegetation can reduce plant species and plant community vigour, altering composition and habitat value.

14.6.3.1.1 Change in Listed Plant Community and Species Abundance and Distribution through Site Clearing, Grubbing, and Soil Salvaging

The Project is expected to result in the direct loss of 0.54 ha of the Gg12 Rough fescue - (bluebunch wheatgrass) - yarrow - clad lichens ecological community, representing a 0.21% loss of the ecological community within the Landscapes and Ecosystems LSA and a 0.04% loss of the community within the Project footprint (Table 14.5-4). The abundance and distribution of the Gg12 ecological community within the Project footprint is anticipated to be directly affected as a result of site preparation and construction activities. No listed plants or plant populations are located within the Project footprint and as such, no direct losses to listed plants or listed plant populations are anticipated to occur as a result of Project activities.

The potential effects identified in Table 14.6-2 are discussed in the context of each Project phase (Construction and Pre-Production, Operations, Reclamation and Closure, and Post-Closure) in the following subsections.

Construction and Pre-Production

Construction and Pre-Production activities are anticipated to directly remove portions of the Gg12 ecological community. Construction activities include site clearing and grubbing in preparation for road upgrading and construction and the salvaging and stockpiling of soils (Figure 14.6-1). Valley Road, which currently bisects the Gg12 ecological community, will be upgraded and include a turning lane and as such, the road will be expanded into the Gg12 ecological community and result in the loss of 0.54 ha of Gg12. An existing access road which crosses the CP line will be upgraded to allow for the main access to the Project rail loadout. Direct impact to the Gg12 ecological community within the Project footprint may result in changes to the plant community abundance and distribution in the Elk Valley.

To maintain sight lines for vehicle and machinery traffic along Project access roads, taller vegetation in the northern portion of the Gg12 ecological community will cut back. No direct losses to Gg12 are anticipated through the creation of sight lines for the Project.

Operations

No potential adverse effects to the listed plant community and species abundance and distribution are expected to occur during Operations that did not occur during the Construction and Pre-Production phase. Loss of the Gg12 Red-listed ecological community will be experienced during initial site clearing, grubbing, and soil salvaging activities and no additional affects to this ecological community are anticipated during Operations; however, indirect changes or loss of the Gg12 ecological community could occur due to Operations activities that result in adverse effects in the community near the Project footprint. Examples of such changes include dust deposition or the introduction of invasive plant species from Project activities. The extent of these changes (if any) would be identified through follow-up, monitoring, and adaptive management as required.

Reclamation and Closure

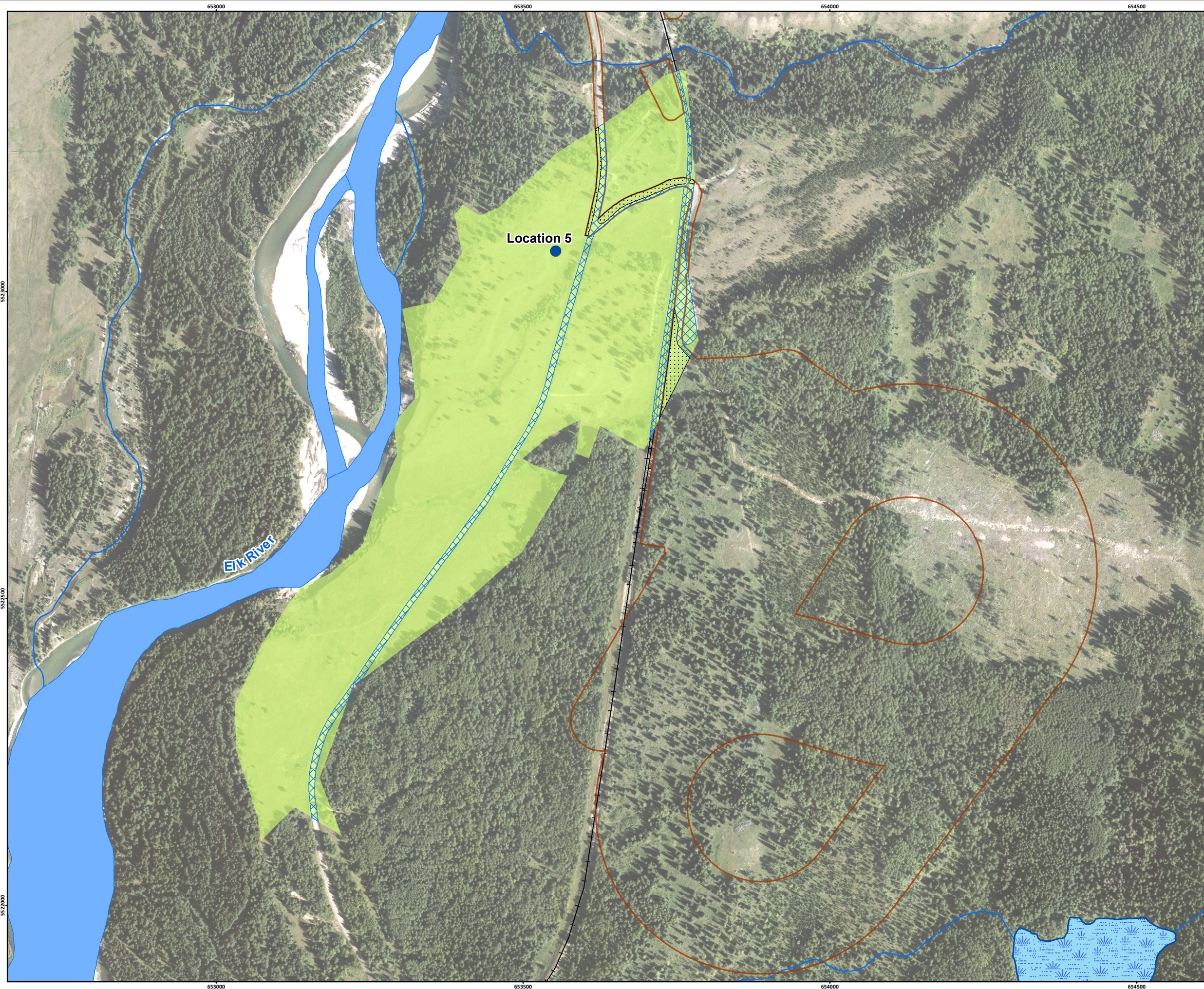
No potential adverse effects to listed plant community and species abundance and distribution are anticipated to occur during Reclamation and Closure. Project access roads, including Valley Road and the road to the rail loadout which bisects the Gg12 ecological community, will remain as a permanent features in the Post-Closure mine environment. Valley Road will remain as a local road as it currently operates.

Post-Closure

No potential adverse effects to listed plant community and species abundance and distribution are anticipated to occur during Post-Closure. Access roads to the rail loadout will remain as a permanent features in the Post-Closure mine environment.

14.6.3.1.2 Change in Listed Plant Community and Species Composition and Structure due to Site Clearing, Grubbing, and Soil Salvaging












The listed plant community, Gg12, which occurs adjacent to proposed linear Project components has the potential to experience alteration of composition and structure as a result of Project activities.

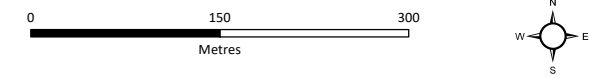


Crown Mountain Coking Coal Project

Figure 14.6-1
Loss of Listed and Sensitive Plant Communities

LEGEND

-  Loss of Listed and Sensitive Plant Community
-  Existing Disturbance
-  Cusick's Paintbrush
-  Rough Fescue - (Bluebunch Wheatgrass) - Yarrow - Clad Lichens Ecological Community
-  Landscapes and Ecosystems Local Study Area
-  Project Footprint
-  Railway
-  Watercourse
-  Waterbody
-  Wetland
-  British Columbia/Alberta Border



Scale 1:6,000

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 Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

Map Created By: RB
Map Checked By: LKD
Map Coordinate System: NAD 1983 UTM Zone 11N



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Composition and structure of the listed plant community can be altered due to changes in vegetation communities and soil structures around areas of direct disturbance. Given the proximity of the Project and Project infrastructure to listed plant populations (e.g., ground plum), no impacts to the composition and structure of listed plant habitat is anticipated.

Construction and Pre-Production

Alteration in soil quality and quantity, and therefore changes to edaphic conditions, during the Construction and Pre-production phase may affect listed plant community and species composition and structure. Soil removal and compaction within the Project footprint through the use of heavy equipment may result indirect effects to soils of the Gg12 ecological community, within an area of influence around the Project footprint, potentially upwards of 50 m from the direct areas of disturbance. Compaction of soils can result in the degradation of soil fertility and reduce a plant community's ability to support plant growth. Soil compaction can also affect water infiltration (Hoorman et al. 2011) and create long recovery times in grassland ecosystems (Krzic et al. 2014). Changes in soils and moisture regime of the Gg12 ecological community may contribute to forest encroachment, a threat that has reduced the Gg12 ecological integrity across its range (B.C. CDC, 2018b).

Another impact to soils within the Construction and Pre-Production phase that may indirectly affect the composition and structure of the Gg12 ecological community is removal or compaction of soils which support a biological soil crust. Soil disturbance within the Project footprint may alter the ecological conditions of Gg12 which support the health of the biological soil crust within the Gg12 community. Removal of vegetation from within the Project footprint may indirectly alter the ecological community outside of the direct area of disturbance and result in higher soil temperatures, increased evaporation, and reduced soil moisture availability (MacKillop et al., 2018). Disturbance associated with vegetation removal and soil conditions can alter the biological crust species composition by reducing moss and lichen cover (MacKillop et al., 2018). Loss of the biological soil crust can lead to increase soil erosion from wind and water, reduction of the carbon and nitrogen contributions to soil, and reduction in soil water infiltration (Rosentreter et al., 2007).

Operations

In the Operations phase, further ground disturbance adjacent to access roads and the rail loadout is not expected to occur. As such, no impacts to listed plants or the listed Gg12 ecological community composition and structure as a result of vegetation and soil removal are expected to occur.

Post-Closure

No potential adverse effects to listed plant community and species composition and structure are anticipated to occur during Post-Closure. Access roads to the rail loadout will remain as a permanent features in the Post-Closure mine environment.

Reclamation and Closure

No potential adverse effects to listed plant community and species composition and structure are anticipated to occur during Reclamation and Closure. Project access roads, including Valley Road and the road to the rail loadout which bisect the Gg12 ecological community, will remain as a permanent features in the Post-Closure mine environment. Valley Road will remain as a local road as it currently operates.

14.6.3.1.3 Change in Listed Plants Community and Species Composition from the Introduction and Spread of Invasive Plants

The listed plant community, Gg12, which occurs adjacent to proposed linear Project components has the potential to experience alteration of composition and structure as a result of Project activities due to the due to the introduction and spread of invasive plant species. Invasive plant surveys conducted along Valley Road (see Chapter 13, Appendix 13-C) identified three invasive plant species designated as a provincially noxious weed, and one invasive plant species designated as nuisance weed, under the provincial Weed Control Act (1996) and the Forest and Range Practices Act (2002).

Construction and Pre-Production

Activities in the Construction and Pre-Production phase create the greatest opportunity for the introduction and spread of invasive and agronomic plant species and result in an increased potential for listed plant populations and listed plant communities to be impacted. In particular, ground disturbance through vegetation and soil removal, use of the access roads, and use of unwashed vehicles and machinery onsite increase the potential for the spread of invasive and agronomic plants. The disturbance and movement of soils adjacent to the Red-listed Gg12 ecological community during site preparation and the upgrading of access roads has the potential to create an opportunity for invasive species establishment as exposed soils create optimal conditions for invasive plants to spread rapidly. Vehicles and machinery can transport invasive plant seeds or plant parts from infested areas beyond the Project footprint. Invasive plants can alter listed plant community composition by outcompeting native vegetation and reducing the abundance of native species that comprise an ecological community (Adams et al., 2016).

Operations

Over the course of the Operations phase, Project activities have the potential to spread and introduce invasive plant species through the use of access roads to/from the rail loadout and the traffic of off-site and unwashed vehicles and machinery on roadways. Invasive plants are commonly found along roads in B.C. and with the proximity of the Gg12 ecological community to the Project footprint, there is a potential for increased spread of invasive plants within this Red-listed plant community.

Reclamation and Closure

No potential adverse effects to listed plant community and species composition and structure are anticipated to occur during Reclamation and Closure. Project access roads, including Valley Road and the road to the rail loadout which bisect the Gg12 ecological community, will remain as a permanent features in the Post-Closure mine environment. Valley Road will remain as a local road as it currently operates.

Post-Closure

No potential adverse effects to listed plant community and species composition and structure are anticipated to occur during Post-Closure. Access roads to the rail loadout will remain as a permanent features in the Post-Closure mine environment.

14.6.3.1.4 Change in Listed Plant and Plant Community Vigour through Dust Deposition

Listed plant communities and species within close proximity to the Project footprint have the potential to experience alteration in vegetation vigour due to dust deposition over the course of Project activities.

Construction and Pre-Production

Activities during the Construction and Pre-Production phase have the potential to adversely affect listed plant community and species vigour due to the generation of dust. Dust generation may occur as a result of the construction and upgrading of access roads, construction of the rail loadout and associated infrastructure, and use of the access roads to transport materials to/from the site. Dust deposition on listed plant communities, such as Gg12 which spans the road upgrading area and occurs adjacent to the rail loadout, may occur and result in reduced vegetation vigour of plants within the Red-listed community, thereby affecting the plant community's ability to sustain and grow within the already disturbed area. Lichens, which commonly comprise soil biological crusts, can accumulate atmospheric contaminants from dust and be very sensitive to changes in air quality (Berryman et al. 2009). As such, dust deposition on the soil crust of the Gg12 ecological community may be negatively affected as a result of construction activities.

Cusick's paintbrush occurs approximately 40 m west of Valley Road, within the Gg12 ecological community (Figure 14.6-1). Currently, this species provincial conservation status is listed as Unknown and was previously Red-Listed. Although this species is not currently federally- or provincially-listed, it is important to understand potential impacts to this species as a result of Project activities as it the current species conservation listing may change. Given the occurrence of the Cusick's paintbrush relative to Valley road, there is potential for this species and its localized population to be impacted by the generation of dust, resulting in decreased vigour and ability of the plant population to sustain within the Gg12 ecological community.

Operations

The generation of dust during Operations is anticipated to occur around the Project footprint as a result of the use of access roads for the transportation of materials and vehicle and machinery traffic to/from the rail loadout. Through the Operations phase, these activities may result in increased dust. As described above, dust deposition can have adverse effects on vegetation during growing season periods, through increased deposition and increased airborne particulate matter, and changes to soil and vegetation chemistry.

Reclamation and Closure

No potential adverse effects to listed plant community and species vigour are anticipated to occur as a result of dust deposition during Reclamation and Closure. Project access roads, including Valley Road and the road to the rail loadout which bisect the Gg12 ecological community, will remain as a permanent features in the Post-Closure mine environment. Valley Road will remain as a local road as it currently operates.

Post-Closure

No potential adverse effects to listed plant community and species vigour are anticipated to occur during Post-Closure. Access roads to the rail loadout will remain as a permanent features in the Post-Closure mine environment.

14.6.3.1.5 Transboundary Effects

The Project is located approximately 5 km west from the B.C.-Alberta border and 85 km north from the Montana in the United States of America (U.S.A.). As discussed in Chapter 1, Section 1.3.3, federal land is not required to facilitate the Project and the Project does not overlap with any federal land. The closest federal lands to the Project, Dominion Coal Block Parcels 73 and 82, are located approximately 20 and 40 km southwest of the Project, respectively. No transboundary effects to listed plants communities or species in Alberta, the U.S.A., or on federal lands are anticipated to occur as a result of the Project, as potential effects on listed plant communities and species as a result of the Project are unlikely to occur outside the Landscapes and Ecosystems LSA.

14.6.3.2 Mitigation Measures

The mitigation measures proposed for listed plant communities and species are based on available best management practices (BMPs), provincial and federal guidance documents, mitigation measures conducted and accepted for similar projects, and professional judgment. The identification and selection of technically and economically feasible mitigation measures followed the mitigation hierarchy approach outlined by the provincial Environmental Mitigation Policy and related Environmental Mitigation Procedures (B.C. Ministry of Environment [B.C. MOE], 2014a, 2014b). Technical and economic constraints dictated the highest level of the mitigation hierarchy that could be achieved for managing each potential effect.

Mitigation measures were identified for each potential effect on listed plant communities and species. For the purposes of this assessment, mitigation measures are defined to include Project design features, procedures, or practices that will reduce or eliminate Project-related effects to listed plant communities and species. Potential Project-related changes to listed plant communities and species will be reduced through design mitigation, regulatory requirements, site reclamation, BMPs, including management plans, monitoring, and adaptive management. Where mitigation measures are considered to be completely effective, potential Project effects to listed plant communities and species are not identified as residual effects.

14.6.3.2.1 Mitigation Measures for Change in Listed Plant Community and Species Abundance and Distribution through Site Clearing, Grubbing, and Soil Salvaging

As a result of Project activities, 0.54 ha of the Gg12 ecological community will be directly lost. No listed plant populations will be directly impacted. The primary measure to mitigate changes to a listed plant community as a result of the Project is avoidance. Where avoidance within the Project footprint is not possible, mitigation measures will be used to reduce additional impacts of the Project on the Gg12 listed plant community, including but not limited to the following measures:

- Project design optimization to use existing access roads and areas of existing disturbance;
- Minimize disturbance and encroachment in the Gg12 ecological community to the extent feasible, by clearing and grubbing only what is required for Construction and Pre-Production activities and development of the Project;
- Conduct pre-construction surveys to delineate “no-work” zones to establish buffers and setbacks around the listed Gg12 community to avoid disturbance, where possible;
- Make site-specific adjustments, where possible, to avoid listed plant communities;

- Implement the Soil Management Plan (Chapter 33, Section 33.4.1.9) to salvage and stockpile soils from wetland areas removed during the Construction phase for future reclamation activities;
- Use the Erosion and Sediment Control Plan (Chapter 33, Section 33.4.1.4) to reduce indirect impacts to adjacent vegetated areas; and
- Provide appropriate training and education for employees and contractors on management plans and how to minimize effects to listed plant communities.

14.6.3.2.2 Mitigation Measures for Change in Listed Plant Community and Species Composition and Structure due to Site Clearing, Grubbing, and Soil Salvaging

Project activities, including site clearing and grubbing, vegetation removal, and soil disturbance (removal and compaction) within the Project footprint as well as use of access and haul roads have the potential to be indirectly affect and alter listed plant community and species composition and structure. Plant community composition and structure may be affected within an area of influence around the Project footprint through the alteration of vegetation and soil structures. Avoidance is the best way to reduce the potential for alternation of listed plant community and species composition and structure. In conjunction with avoidance, specific strategies to control potential indirect effects from Project activities will be implemented to reduce the potential for alteration of composition and structure as a result of ground disturbance and vegetation removal.

The Project design optimizes the use of the existing access roads (e.g., Valley Road and local informal roads) as transportation corridors to/from the rail loadout. Indirect effects of Project development on the listed plant community Gg12 could occur as a result of vegetation removal and soil disturbance. The Gg12 community composition and structure may be indirectly impacted as areas adjacent to the Project footprint experience soil degradation, an increased threat to forest encroachment due to soil and vegetation changes, and alteration of the biological soil crust.

The following mitigation will be implemented to reduce the potential for indirect adverse effects to the listed plant community adjacent to the Project footprint:

- Project design optimization to use existing access roads and areas of existing disturbance;
- Conduct pre-construction surveys to delineate “no-work” zones to establish buffers and setbacks around listed plant populations and the listed plant community to avoid disturbance, where possible;
- Conduct pre-construction surveys to identify exclusion “no-work” zones in areas with biological soil crust and reduce disturbance in these areas, where possible;
- Make site-specific adjustments, where possible, to avoid listed plant populations and listed plant communities, including areas with established biological soil crust;
- Minimize disturbance to listed plant communities and species to the extent feasible, by clearing and grubbing only what is required for Construction and Pre-Production activities and development of the Project;
- Retain vegetated and groundcover where possible to prevent soil erosion and maintain soil temperatures;
- Revegetated disturbed areas with native vegetation soon after disturbance to re-establish vegetative cover;
- Minimize compaction of soils as per the Soil Management Plan (Chapter 33, Section 33.4.1.9);

- Use the Erosion and Sediment Control Plan (Chapter 33, Section 33.4.1.4) to reduce indirect impacts to adjacent vegetated areas;
- Provide appropriate training and education for employees and contractors on management plans and how to minimize effects to listed plant communities and species;
- Complete construction activities during periods of least risk windows to minimize impacts to sensitive periods for terrestrial species as per provincial and federal legislation and the strategies; and
- Monitor select locations within the Gg12 ecological community to determine changes in plant composition and structure over time and evaluate revegetation of disturbed areas adjacent to the Project footprint.

14.6.3.2.3 Mitigation Measures for Change in Listed Plant Community and Species Composition from the Introduction and Spread of Invasive Plants

Project activities, including site clearing and grubbing, vegetation removal, and soil disturbance (removal and compaction) within the Project footprint as well as use of access and haul roads have the potential to be indirectly affect and alter listed plant community and species composition and structure. Plant community composition and structure may be affected within an area of influence around the Project footprint through the introduction and spread of invasive plants. Avoidance is the best way to reduce the potential for alternation of listed plant community and species composition and structure. In conjunction with avoidance, specific strategies to control potential indirect effects from Project activities will be implemented to reduce the potential for invasive species introduction.

Activities in the Construction and Pre-Production and Operations phases can encourage invasive plant establishment and spread through machinery and vehicle use and movement and ground disturbance activities. Implementation of the Vegetation and Ecosystems Management and Monitoring Plan (Chapter 33, Section 33.4.1.11) and specific measures to control and eradicate invasive plants is integral to protecting listed plant communities and species.

Prior to Construction, it is anticipated that a Project-specific management plan for invasive plants will be developed as an operational guide to manage invasive plants within the Project footprint. The plan will be implemented over the course of the Project to control existing and future invasive plant populations. Measures to control existing invasive plant populations and reduce the potential for the introduction of additional invasive plants include:

- Identify and demarcate invasive plant populations around within and adjacent to listed plant communities and species prior construction or on-site activities;
- Establish setback areas, exclusion zones, and “no-work” areas if invasive plant populations are located near areas of disturbance to reduce the spread of invasive plants by machinery and vehicles;
- Remove existing plant populations to prevent the spread to adjacent areas;
- Undertake invasive control activities, including distribution of biocontrol agents, and mechanical and chemical treatments, as necessary;
- Reduce exposure of bare ground during disturbance activities;
- Restore sites with native vegetation species following treatment of invasive infestations;
- Establish an Early Detection and Rapid Response (EDRP) system in accordance with the Government of B.C. guidance (e.g., Inter-Ministry Invasive Species Working Group, 2014) and

monitor for new invasive plants of concern through the follow-up and monitoring programs (see the Vegetation and Ecosystems Management and Monitoring Plan;

- Restrict vehicle and machinery traffic to designated access roads;
- Decontaminate vehicles and machinery leaving work areas;
- Apply contouring and erosion control measures to limit spread of invasive and agronomic species seed and plants;
- Revegetated disturbed areas with native vegetation soon after disturbance to re-establish vegetative cover;
- Provide appropriate training and education for employees and contractors on management plans and how to minimize effects to listed plant communities and species; and
- Monitor disturbed areas and areas where invasive plants were removed to evaluate effectiveness of mitigation and control measures.

Several guidance documents and Best Management Practices for controlling invasive plants will be implemented over the course of the Project. Additional mitigation measures related to invasive species management are provided in the Vegetation and Ecosystems Management and Monitoring Plan (Chapter 33, Section 33.4.1.11).

14.6.3.2.4 Mitigation Measures for Changes in Listed Plant Community and Species Vigour through Dust Deposition

Dust has the potential to be generated through Project activities in Construction and Pre-Production and Operations phases. The Air Quality and Greenhouse Gas Management Plan (Chapter 33, Section 33.4.1.1) will be used over the course of the Project to implement measures to avoid and minimize dust generation and deposition and reduce the potential for effects on listed plant community and species vigour.

Specific mitigation measures to be used to control the generation and deposition of dust and reduce the potential for adverse effects on listed plant communities and species include but are not limited to:

- Project design optimization to reduce travel distances between Project infrastructure components;
- Create exclusion zones around listed plant communities and species, where possible through implementation of the Air Quality and Greenhouse Gas Management Plan;
- Conduct earthmoving activities during Construction in a manner that reduced exposed soils and avoids dust-generating activities during windy periods, where possible;
- Design and construct access roads with the goal of keeping dust levels as low as reasonably achievable, which may include the use of coarser aggregate material on haul roads and/or pavement of high traffic areas;
- Maintain unpaved roads and keep in good repair, including regular road compaction and use of coarse aggregate with low silt content, where possible;
- Apply and use dust suppression measures such as wetting work areas and stockpiles, installing equipment covers, and using dust hoods and shields at the rail loadout;
- Locate soil stockpiles at appropriate locations of listed plant communities and species, and store and shape in a way to allow slope stability and reduce moisture content loss, including establishment of vegetation to reduce exposure to wind and water erosion;
- Implement the Soil Management Plan (Chapter 33, Section 33.4.1.9);

- Enforce low speed limits for vehicular traffic throughout the site, such as along access roads to the rail loadout;
- Decontaminate vehicles and machinery leaving work areas;
- Cover haul trucks using Valley Road and the access road to the rail loadout to reduce deposition of fugitive dust;
- Implement water or dust suppression methods during dry periods to mitigate dust generation in areas including unpaved roads and work areas;
- Provide appropriate training and education for employees and contractors on management plans and how to minimize effects to listed plant communities and species; and
- Monitor and inspect air dust control measures to evaluate effectiveness and functionality and allow for timely maintenance and adjustments as required.

14.6.3.2.5 Summary of Mitigation Measures for Listed and Sensitive Plant Communities and Species

The key mitigation measures proposed to mitigate potential effects to listed plant communities and species are summarized in Table 14.6-3. Anticipated residual effects that will be carried forward in the characterization of residual effects, significance, and likelihood and confidence are outlined in Table 14.6-3.

Mitigation measures proposed to reduce adverse effects to listed plant communities and species are generally accepted, understood, and proven to effectively reduce adverse effects on listed vegetation species and communities. Given that the impacts to a listed plant community cannot be completely avoided, the overall effectiveness of the proposed mitigation to address changes in plant community and species abundance and distribution and composition and structure are rated as moderate. Where mitigation measures do not or may not mitigate all effects or if there is a low level of confidence in their effectiveness, the effect was carried forward for further analysis of residual effects. Mitigation measures that are expected to completely mitigate potential effects with a high level of confidence based on their proven effectiveness elsewhere were classified as having no expected residual effects.

If monitoring indicates that the effectiveness of mitigation measures and reclamation activities is lower than predicted, further mitigation may be required as per adaptive management strategies outlined in the Vegetation and Ecosystems Management and Monitoring Plan (Chapter 33, Section 33.4.1.11).

14.6.3.3 Characterization of Residual Effects

Based on the evaluation of potential Project effects on listed plant communities and species, potential residual effects that may remain after implementation of measures to avoid and minimize adverse effects include:

- Change in listed plant community and species abundance and distribution through site clearing, grubbing, and soil salvaging; and
- Change in listed plant community and species composition and structure due to site clearing, grubbing, and soil salvaging.

Table 14.6-3: Summary of Proposed Mitigation Measures Related to Listed Plant Communities and Species

Potential Effect	Mitigation Measure(s)	Rationale	Applicable Project Phase(s)	Effectiveness	Residual Effect?
Change in Listed Plant Community and Species Abundance and Distribution through Site Clearing, Grubbing, and Soil Salvaging	<ul style="list-style-type: none"> Project design optimization Minimizing disturbance and cleared areas Establish exclusion / "no work" zones and setback buffers Education and training Implementation of the Soil Management Plan Implementation of the Erosion and Sediment Control Plan 	<p>Measures have been selected to reduce direct impacts to the listed ecological community and the size of disturbance as a result of the Project.</p> <p>Effects of Project development on a listed plant community are not expected to be fully mitigated.</p>	Construction and Pre-Production	Moderate	Yes
Change in Listed Plant Community and Species Composition and Structure due to Site Clearing, Grubbing, and Soil Salvaging	<ul style="list-style-type: none"> Project design optimization Establish exclusion / "no work" zones and setback buffers Minimizing disturbance and cleared areas Retain vegetation and groundcover Restore with appropriate native vegetation Adhere to least risk windows Minimize soil compaction Implementation of Soil Management Plan Implementation of Erosion and Sediment Control Plan Implementation of Vegetation and Ecosystems Management and Monitoring Plan Education and training Monitor changes in plant community and areas of revegetation 	<p>Measures allow for the reduction of effects resulting from changes in composition and structure due to vegetation removal and soil disturbance within the Project footprint and area of alternation around the footprint.</p> <p>Effects of vegetation removal and soil disturbance on listed plant community and species composition and structure are not expected to be fully mitigated.</p>	Construction and Pre-Production	Moderate	Yes

Potential Effect	Mitigation Measure(s)	Rationale	Applicable Project Phase(s)	Effectiveness	Residual Effect?
Change in Listed Plant Community and Species Composition and Structure from the Introduction and Spread of Invasive Plants	<ul style="list-style-type: none"> • Implementation an EDPR system • Implementation of the Vegetation and Ecosystems Management and Monitoring Plan • Control, manage, and remove invasive plants on site • Identify and demarcate invasive plant populations • Establish exclusion / "no work" zones and setback buffers • Reduce areas of exposed soils • Restore with appropriate native vegetation • Restrict traffic in known infested areas • Decontaminate vehicles and machinery • Education and training 	<p>Prevention of the introduction and movement of invasive plants on site is important to controlling the effects of invasive plant species on listed plant communities and species. Management strategies proposed contribute to the avoidance and minimization of effects of invasive plants on listed plants and plant communities. Early detection systems can be effective in limiting and preventing the spread of invasive plants.</p> <p>Effects of invasive plants on listed plant communities and species are expected to be effectively mitigated such that a residual effect does not occur.</p>	<ul style="list-style-type: none"> • Construction and Pre-Production • Operations 	High	No
Changes in Listed Plant Community and Species Vigour through Dust Deposition	<ul style="list-style-type: none"> • Project design optimization • Implementation of Air Quality and Greenhouse Gas Management Plan • Implementation of the Vegetation and Ecosystems Management and Monitoring Plan • Implementation of the Soil Management Plan • Exclusion zones • Dust suppression methods • Manage machinery and vehicle speed limits • Vehicle covers and decontamination • Road maintenance 	<p>Dust reduction strategies will reduce dust deposition on listed plant communities and species.</p> <p>Effects of dust on listed plant communities and species are expected to be effectively mitigated such that a residual effect does not occur.</p>	<ul style="list-style-type: none"> • Construction and Pre-Production • Operations 	High	No

Potential Effect	Mitigation Measure(s)	Rationale	Applicable Project Phase(s)	Effectiveness	Residual Effect?
	<ul style="list-style-type: none"> • Manage timing of construction and earthmoving activities • Education and training • Monitor and inspect dust control measures 				

14.6.3.3.1 Assessment Methods

The characterization of residual effects follows methods outlined in Chapter 5, Sections 5.3.4.5. A footprint analysis was used to determine areas of the Project footprint that overlap and interact with listed plant communities and species. The maximum Project footprint extent, including clearing and contingency areas presents the maximum extent of disturbance associated with the Project (as detailed by “Project Footprint” line in Figure 14.6-1). Interaction of documented listed plant communities and species and the Project footprint is considered a direct loss in the Landscapes and Ecosystems LSA.

14.6.3.3.2 Potential Residual Effects Assessment

Change in Listed Plant Community and Species Abundance and Distribution through Site Clearing, Grubbing, and Soil Salvaging

Loss of the Red-listed Gg12 ecological community within the Project footprint represents a residual effect as a result of site clearing and grubbing in preparation for road upgrading and the salvaging and stockpiling of soils. A total of 0.54 ha of the Gg12 ecological community will be permanently lost, representing a 2.02% loss of the ecological community within the Landscapes and Ecosystems LSA. Although effects to the listed Gg12 ecological community will be minimized through Project design (e.g., through the use of existing access roads and disturbance areas within the Gg12 ecological community), it is unlikely the direct impacts to the ecosystem will be completely avoided in the Construction and Pre-Production phase. The areas of Gg12 directly impacted as a result of Project construction and site disturbance occur along existing access roads and in areas of existing disturbance, limiting impacts to Gg12 habitat availability and the abundance and distribution of the ecological community. Habitat availability of the Gg12 ecological community will be slightly reduced due disturbance of 0.54 ha of the ecological community within the Project footprint; however, the extent of direct loss of the Gg12 ecological community is not expected to affect the distribution and abundance of the community in the Landscapes and Ecosystems LSA or the Elk Valley.

No listed plant populations were documented within the Project footprint. Residual adverse effects to listed plant populations are not anticipated as no changes to the habitat availability of listed plant species will occur as a result of Project activities.

Baseline observations of the listed Gg12 community noted this ecological community is currently fragmented due to existing linear infrastructure and has likely undergone disturbance given the presence of non-native species and past disturbance. Baseline studies noted the ecological community is inhabited by non-native species such as Canada bluegrass and yellow salsify. Linear infrastructure that currently bisects the Gg12 community includes Valley Road, the CP rail line, and several informal roads that may have served for land clearing or grazing (Figure 14.6-1). The B.C. Conservation Status Report for Gg12 (B.C. CDC, 2018) attributes the Red-listed conservation status of Gg12 to significant short-and long-term declines, overgrazing, invasive plant invasion, forest encroachment due to fire suppression, fragmentation, and urban and agricultural development. As well, use of all-terrain vehicles has been noted as a threat to the Gg12 ecological integrity (B.C. CDC, 2018). According to MacKillop et al. (2018), the Gg12 community is highly sensitive to disturbance and slow to re-establish.

Mitigation measures proposed are aimed at reducing additional direct impacts to the Gg12 ecological community as a result of Construction and Pre-Production activities. Prior to site disturbance, the Project footprint will be surveyed to confirm presence of Gg12 adjacent to existing access roads and previously disturbed areas (Figure 14.6-1). Where the Red-listed Gg12 ecological community overlaps with the anticipated area of disturbance, areas of Gg12 will be flagged and quantified to establish “no-work”, where possible, and establish potential areas for monitoring and data collection. Given past disturbance and current use of access roads, the presence of Gg12 along existing linear infrastructure may be less than the anticipated area of direct loss identified in the Project effects assessment.

Change in Listed Plant Community and Species Composition and Structure due to Site Clearing, Grubbing, and Soil Salvaging

The indirect alteration of the Red-listed Gg12 ecological community within an area of influence around the Project footprint represents a residual effect as a result due to vegetation removal and soil disturbance within the Project footprint. Vegetation removal and soil disturbance within the Project footprint may indirectly alter the conditions of the Gg12 ecological community adjacent to site disturbance and result in the loss or alteration of the biological soil crust, create conditions conducive to forest encroachment, increase potential for soil erosion, alter the plant species assemblages and community structure, and alter the ecological community’s ability to recover from disturbance. Grasslands, such as the Red-Listed Gg12 ecological community, can be slow to recover from disturbance. As well, grassland ecosystems can be vulnerable to disturbance when their soils are affected (B.C. CDC. 2018).

Biological soil crusts provide a variety of functions, such as supporting water infiltration to soil, protecting soil from erosion, and contributing carbon and nitrogen to soil (Rosentreter et al., 2007). As such, changes to soil conditions, whether through soil and biological crust removal, or compaction of soils within the Gg12 ecological community, may impact the biological crust survival and distribution. MacKillop et al. (2018) note that biological soil crusts are highly sensitive to disturbance and very slow to re-establish. The extent of biological soil crust occurrence within the Landscapes and Ecosystems LSA and Project footprint has not been studied. Therefore, the potential effects of the Project on biological soil crusts was not quantified for the purposes of this assessment.

No residual effects to individual listed plant populations (e.g., Cusick’s paintbrush) as a result of vegetation removal and soil disturbance are expected to occur over the course of the Project.

It is anticipated effects to listed plant community and species composition and structure in regards to invasive plants will be mitigated and will not result in a residual effect.

14.6.3.3.3 Characterization of Residual Effects

The assessment of residual effects on listed plant communities and species involves the consideration and evaluation of specific effects assessment criteria based on the degree (i.e., ‘level’) of potential Project effects. Criteria used to characterize residual effects are defined in Chapter 5, Section 5.3.4.5 and include duration, magnitude, geographic extent, frequency, reversibility, and context.

Change in Listed Plant Community and Species Abundance and Distribution through Site Clearing, Grubbing, and Soil Salvaging

The residual effect associated with the change in listed plant community and species abundance and distribution due to clearing, grubbing, and soil salvaging is characterized as follows:

- Duration: Permanent, as the direct loss of the Red-Listed Gg12 ecological community will occur in Construction and Pre-Production phase within the Project footprint.
- Magnitude: Low, as there will be a 2.02% loss of the ecological community within the Landscapes and Ecosystems LSA.
- Geographic Extent: Discrete, as areas of the Gg12 ecological community that overlap with the Project footprint will be directly impacted and lost.
- Frequency: Once, the direct loss of the Gg12 ecological community within the Project footprint occurs only within the Construction and Pre-Production phase of the Project.
- Reversibility: Irreversible, as the loss of 0.54 ha of Gg12 cannot be reversed.
- Context: Low, the Gg12 grassland community affected by the Project has a low sensitivity and resilience to change as it is anticipated to be slow to recover from disturbance.

Determination of Significance

The residual environmental effect of the Project on a change in listed plant community and species abundance and distribution listed plant community and species abundance and distribution through site clearing, grubbing, and soil salvaging during all Project phases is considered not significant. Project effects to the listed plant community Gg12, a provincially Red-listed ecological community, are limited in extent and discrete in nature, only occur within the Project footprint in which 0.54 ha will be directly affected. The direct impact to the Gg12 ecological community represents a loss of only 2.02% of the ecological community within the Landscapes and Ecosystems LSA. Given that the overlap of the Project with the Gg12 ecological community occurs within areas of previous disturbance (e.g., informal local access roads) and that less Gg12 may actually occur within the Project footprint than the TEM indicates, the loss of 0.54 ha of Gg12 is not anticipated to affect or reduce the community's long-term survival in the East Kootenay. Any indirect effects that could occur the listed Gg12 plant community outside the Project footprint (e.g., from dust deposition, invasive plants) would be determined from follow-up and monitoring, and adaptive management measures to implement corrective actions would be developed as necessary based on that follow-up.

Likelihood and Confidence

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

Confidence considers the reliability of data and analytical methods used in the assessment of effects. The confidence in the characterization of the residual effect to listed plant community and species abundance and distribution from Project development is considered to be moderate. While baseline conditions of the listed plant community Gg12 are well established and understood, uncertainty exists with respect to the extent and distribution of the Gg12 ecological community adjacent to existing areas of disturbance and linear features that currently bisect the community. Available data allows for an understanding of potential effects to the listed plant community; however additional data may support a better understanding of the interactions between the Project and the listed plant community and species VC.

Change in Listed Plant Community and Species Composition and Structure due to Site Clearing, Grubbing, and Soil Salvaging

The residual effect associated with the change in listed plant community and species composition and structure due to vegetation removal and soil disturbance is characterized as follows:

- Duration: Long-term, as the listed Gg12 ecological community and associated biological soil crust may be slow to re-establish if indirectly impacted as a result of site disturbance within the Project footprint.
- Magnitude: Low to Moderate, as changes to the Gg12 composition and structure adjacent to the Project footprint may range from undetectable change at a microclimatic scale that is challenging to quantify to detectable and quantifiable alteration in the plant community composition and structure as a result of disturbance within the Project footprint.
- Geographic Extent: Local, as indirect alteration of the Gg12 ecological community may occur within an area of influence adjacent to and outside of the Project footprint.
- Frequency: Once, the potential alteration and indirect effects caused by vegetation removal and soil disturbance will only occur within the Construction and Pre-Production phase of the Project.
- Reversibility: Reversible Long-Term, as the indirect effects of vegetation removal and soil compaction will cease after the Construction and Pre-Production Phase and areas disturbed will be reclaimed and revegetated should alteration of the ecological community occur outside of the Project footprint.
- Context: Low, the Gg12 community and ecological features, such as the biological soil crust, have a low sensitivity and resilience to change and recovery from disturbance is anticipated to be slow.

Determination of Significance

The residual environmental effect of the Project on a change in listed plant community and species composition and structure due to site clearing, grubbing, and soil salvaging during all Project phases is considered not significant. The indirect alteration of the listed Gg12 ecological community adjacent to the Project footprint is not expected to result in an alteration of habitat that results in a decline in the listed plant community such that the survival of community is reduced. Alteration of the Gg12 community, including the biological soil crust, adjacent to the Project footprint will be monitored over the course of the Construction and Pre-Production to evaluate changes in the community composition and structure. As well, areas that anticipate to have been indirectly affected by Project footprint disturbance will be restored with appropriate native vegetation species and conditions conducive to the re-establishment of biological soil crust.

Likelihood and Confidence

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

Confidence considers the reliability of data and analytical methods used in the assessment of effects. The confidence in the characterization of the residual effect to listed plant community and species composition and structure from vegetation removal and soil disturbance is considered to be moderate. Based on existing disturbance of the Gg12 community and use of existing local access roads for Project development, the extent of Gg12 and biological soil crust adjacent to the proposed Project footprint and existing linear features, the extent of Gg12 community immediately adjacent to existing linear features may be less than anticipated. Available data allows for an understanding of potential effects to the listed

plant community; however additional data may support a better understanding of the interactions between the Project and the listed plant community and species VC.

14.6.3.3.4 Summary of Residual Effects Assessment

Residual effects and the selected mitigation measures, characterization criteria, likelihood, significance determination, and confidence are summarized in Table 14.6-4. There are no significant residual effects to listed plant communities and species anticipated as a result of the Project.

14.6.4 Potential Effects on Limber Pine

14.6.4.1 Discussion of Potential Effects

No adverse effects to limber pine are anticipated as a result of the Project. Although the predictive limber pine habitat modelling indicates the potential for high quality limber pine habitat to potentially occur within the Project footprint (8.45 ha or 0.66%), no limber pine was observed as part of limber pine field surveys (Section 14.5.2.2.3). The predictive habitat modelling indicated the potential for very high (18.73 ha or 0.15%) and high quality (126.04 ha or 0.98%) habitat within the Landscapes and Ecosystems LSA. Of the baseline surveys conducted in the Landscapes and Ecosystems LSA, no limber pine was observed. Within the Landscapes and Ecosystems LSA, it is anticipated that high quality limber pine habitat occurs at higher elevations along the Grave Creek corridor and is not expected to be impacted by Project activities. Limber pine frequency occurs over limestone and as such, there is a low potential for this species to be found in association with coal-bearing geology.

Given the negligible interaction between the Project and predictive high quality limber pine habitat within the Landscapes and Ecosystems LSA, Project-related effects, including the potential effects of contaminants of concern, are not carried forward in the assessment of effects on this VC. Limber pine frequently occurs over limestone and is unlikely to be abundant in association with coal-bearing geology; however, occasional individual losses may have occurred in the East Kootenay. Should individual limber pine species be observed within the Project footprint during the Construction phase of the Project, mitigation measures will follow those outlined for whitebark pine (Section 14.6.5.2).

14.6.5 Potential Effects on Whitebark Pine

14.6.5.1 Discussion of Potential Effects

In the absence of mitigation, Project activities can affect whitebark pine through a direct overlap of the Project footprint with whitebark pine stands and habitat, or due to indirect effects from adjacent or nearby Project activities (Table 14.6-5). Direct effects on whitebark pine can result from removal of individuals and/or habitat (including critical habitat) due to clearing of vegetation and loss of high elevation landforms with suitable substrate and exposure conditions. Indirect effects can result from the deposition of dust, release of deleterious substances, as well as the introduction and/or spread of non-native and invasive plant species that may adversely affect the germination, growth and/or reproduction of existing plants, and associated habitat's potential to support whitebark pine (if not currently occupied).

Table 14.6-4: Summary of Residual Effects on Listed Plant Communities and Species

Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization	Significance (Significant, Not Significant)	Confidence (High, Moderate, Low)
Change in Listed Plant Community and Species Abundance and Distribution through Site Clearing, Grubbing, and Soil Salvaging	Construction and Pre-Production	<ul style="list-style-type: none"> • Project design optimization • Minimizing disturbance and cleared areas • Establish exclusion / “no work” zones and setback buffers • Education and training • Implementation of the Soil Management Plan • Implementation of the Erosion and Sediment Control Plan 	Duration: Permanent Magnitude: Low Geographic Extent: Discrete Frequency: Once Reversibility: Irreversible Context: Low	Not Significant	Moderate
Change in Listed Plant Community and Species Composition and Structure due to Site Clearing, Grubbing, and Soil Salvaging	Construction and Pre-Production	<ul style="list-style-type: none"> • Project design optimization • Establish exclusion / “no work” zones and setback buffers • Minimizing disturbance and cleared areas • Retain vegetation and groundcover • Restore with appropriate native vegetation • Adhere to least risk windows • Minimize soil compaction • Implementation of Soil Management Plan • Implementation of Erosion and Sediment Control Plan • Implementation of the Vegetation and Ecosystems Management and Monitoring Plan • Education and training • Monitor changes in plant community and areas of revegetation 	Duration: Long-term Magnitude: Low to Moderate Geographic Extent: Local Frequency: Once Reversibility: Reversible Long-term Context: Low	Not Significant	Moderate

Table 14.6-5: Potential Effects of Activities on Whitebark Pine

Potential Effect	Rationale for Selection of Environmental Effect
Mortality and/or Loss of Habitat	Where overlapping with the Project footprint, logging, clearing, and grubbing of vegetation, and removal of soil and overburden will necessarily remove individual whitebark pine trees and their associated habitat (including critical habitat) within the Project footprint.
Change in Rates of Germination, Growth, and Reproduction	Deposited sediments or deleterious substances have potential to disrupt plant physiological processes (e.g., evapotranspiration, nutrient uptake), causing reduced reproductive and growth rates of existing vegetation that may result in a loss of whitebark pine individuals. Consequently, erosion and suspension of exposed soils, construction material (e.g., road fill), stockpiled coal and mine waste (e.g., mine rock), or release of deleterious substances due to leaks, spills or the transport, handling and/or use of hazardous materials (e.g., ammonium nitrate) have the potential to affect the reproduction and growth of existing occurrences of whitebark pine.
	Finally, where vehicles and/or equipment arrive to the Project with soil and/or vegetation debris, or such vehicles and/or equipment must contact or be operated in the vicinity of existing occurrences, the Project may cause the introduction and/or spread of non-native and invasive species that may outcompete existing occurrences of whitebark pine.

Further discussion of these potential effects by Project phase is provided in Sections 14.6.5.1.1 and 14.6.5.1.2.

14.6.5.1.1 Mortality and/or Loss of Habitat

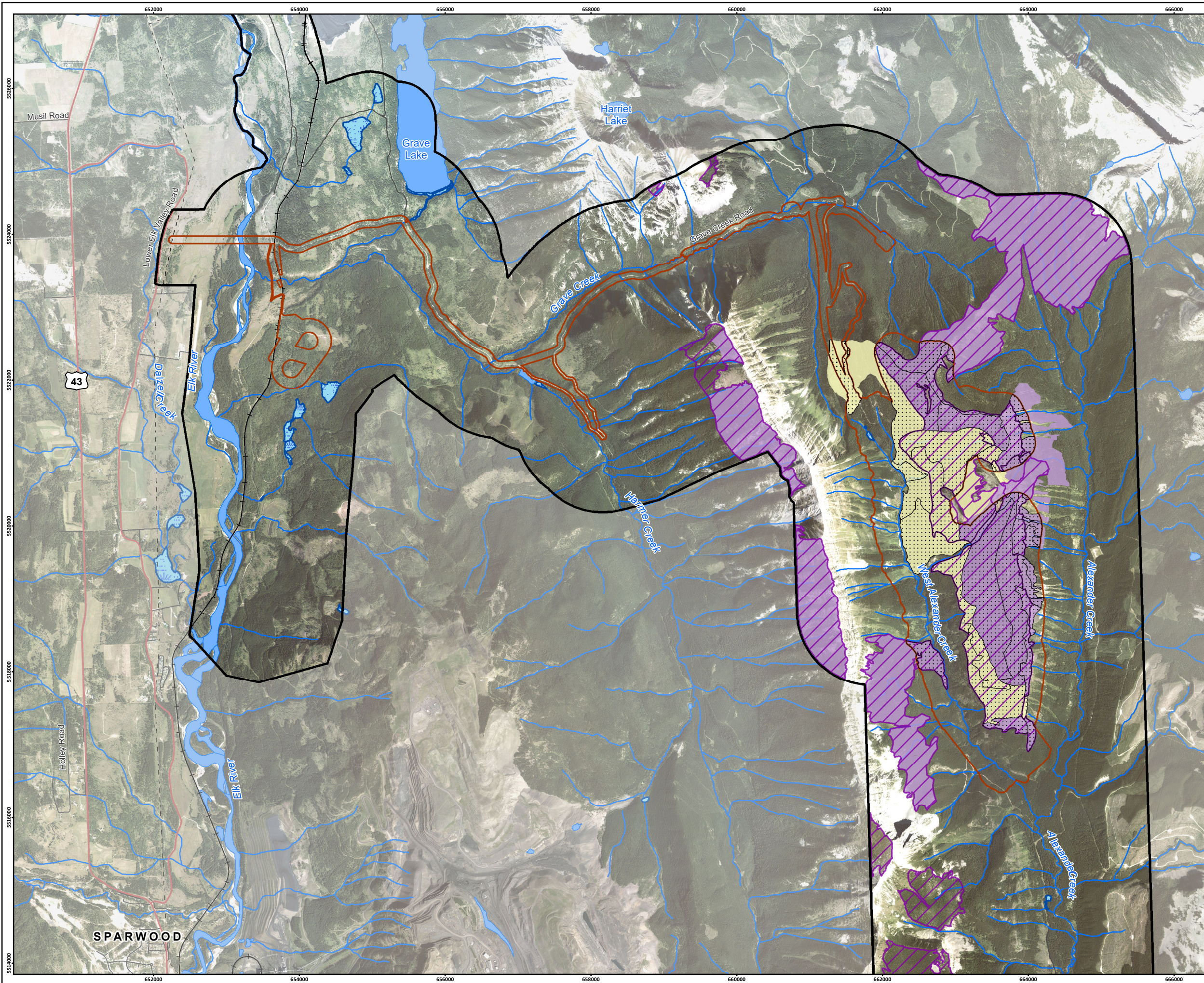
Construction and Pre-Production

Potential effects on the abundance of whitebark pine and its habitat are anticipated in the Construction and Pre-Production phase through direct losses due to logging, clearing and grubbing of vegetation, as well as removal of soil and overburden, mostly located in areas associated with initial development of the pits, mine rock and coal reject disposal areas (Figure 14.6-2). Where there is overlap between the Project footprint and documented areas of whitebark pine, such site preparation activities, the Project has the potential to remove mature cone-bearing (i.e., reproductive) trees, saplings, seedlings, as well as seeds cached by Clark’s Nutcracker.

Additionally, well- to rapidly-drained coarse or rocky soils are preferred by whitebark pine and may be altered during the Construction and Pre-Production phase. Given that such alpine soils are shallow and intermixed with coarse rock, soils may be lost or altered due to incomplete salvage or admixing with other salvaged materials.

Operations

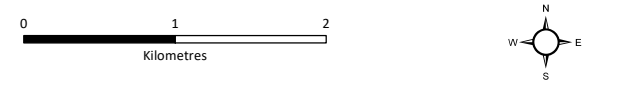
For the same reasons provided for the Construction and Pre-Production phase, the progressive expansion of the pits, mine rock and coal reject disposal areas during the Operations phase has potential to result in mortality of whitebark pine and a loss of habitat.



Crown Mountain Coking Coal Project

Figure 14.6-2
Impacts to Whitebark Pine Habitat and Critical Habitat

- LEGEND**
- Potential Whitebark Pine Habitat Loss
 - Potential Whitebark Pine Habitat
 - Potential Whitebark Pine Recovery/Regeneration Critical Habitat
 - Potential Whitebark Pine Seed Dispersal Critical Habitat
 - Landscapes and Ecosystems Local Study Area
 - Project Footprint
 - Highway
 - Arterial/Collector Road
 - Local/Resource Road
 - Railway
 - Transmission Line
 - Watercourse
 - Waterbody
 - Wetland
 - British Columbia/Alberta Border



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 GeBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
Imagery Provided by GeoBC OrthoImagery (Aug 2016).

Map Created By: RB
Map Checked By: BH
Map Coordinate System: NAD 1983 UTM Zone 11N



Project: 12-6231
Status: FINAL
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Reclamation and Closure

Ecological restoration will be conducted during the Reclamation and Closure phase, during which abiotic conditions (e.g., surface contours, drainage pathways) and early successional trajectories of vegetation communities will be established in accordance with the Ecological Restoration Plan (Chapter 33, Section 33.4.1.3). With successful implementation, the restoration of ecological conditions will reverse (at least in part) the loss of whitebark pine and associated habitat in the Project footprint.

Post-Closure

Potential mortality of whitebark pine and loss of habitat as a result of Project activities are not anticipated during the Post-Closure phase.

14.6.5.1.2 Change in Rates of Germination, Growth, and Reproduction

Construction and Pre-Production

Potential effects to the vigour of whitebark pine (through Project activities potentially affecting rates of germination, growth, and reproduction) are anticipated during the Construction and Pre-Production phase. Operation of vehicles and equipment within the Project footprint, as well as the hauling and use of hazardous materials, have the potential for release of deleterious substances, deposition of dust, and introduction or spread of non-native and invasive species. Deleterious substances and deposited dust have potential to disrupt plant physiological processes (e.g., evapotranspiration, nutrient uptake) that may adversely affect the germination of seeds, growth of existing plants, and reproduction of mature, cone-bearing trees. In particular, baseline studies documented two contaminants of concern (i.e., barium and selenium) with naturally elevated concentrations in the soils of the Landscapes and Ecosystems LSA to be exceeding regulatory guidelines (Chapter 8, Section 8.4.2.2.1). The handling of surface materials (i.e., soils) throughout the Construction and Pre-Production phase has the potential to increase the deposition of dust containing these contaminants of concern on retained occurrences of whitebark pine in the Landscapes and Ecosystems LSA. A search of existing, publicly accessible literature failed to identify that whitebark pine may be adapted to elevated levels of these metals (or any other contaminant of concern). Consequently, it is reasonable to assume that the introduction of such contaminants of concern through deposition of dust has the potential to disrupt physiological processes of whitebark pine similar to other plant species.

As they have evolved outside the context of the local native vegetation communities and typically reproduce or spread at substantially higher rates than local species, non-native or invasive species typically have a competitive advantage over native vegetation. Some non-native and invasive species even release chemicals (e.g., knapweeds) to further restrict the growth of desirable native vegetation. Where such non-native and invasive species become introduced, there is potential for these species to outcompete whitebark pine plants for resources (e.g., water, nutrients, light), resulting in reduced rates of germination, growth, and reproduction. Further, the potential occurrence of naturally exposed substrates in whitebark pine habitat (including recovery/regeneration critical habitat) may pre-dispose these habitats to occupancy of non-native or invasive species.

Although these sources of impact may occur frequently and endure for a prolonged period in some locations, uncertainty in the vegetation response precludes the ability to quantify the extent and magnitude of change in the vigour of whitebark pine.

Operations

For the same reasons provided for the Construction and Pre-Production phase, operation of vehicles and equipment as well as the hauling and use of hazardous materials has potential to result in the deposition of dust, release of deleterious substances, as well as the introduction and/or spread of non-native and invasive species. These potential sources of impact may disrupt plant physiological processes or outcompete whitebark pine, resulting in a reduction in rates of germination, growth, and reproduction.

Reclamation and Closure

For the same reasons provided for the Construction and Pre-Production phase, operation of vehicles and equipment as well as the hauling and use of hazardous materials has potential to result in the deposition of dust, release of deleterious substances, as well as the introduction and/or spread of non-native and invasive species. These potential sources of impact may disrupt plant physiological processes or outcompete whitebark pine, resulting in a reduction in rates of germination, growth, and reproduction.

Post-Closure

Changes to rates of germination, growth, and reproduction of whitebark pine as a result of Project activities are not anticipated during the Post-Closure phase.

14.6.5.1.3 Transboundary Effects

The Project is located approximately 5 km west of the Alberta provincial border, which is downwind and downslope from the Project. The Project is located approximately 85 km north of the international border with the U.S.A. and the State of Montana which is downslope from the Project. Although the Project does not involve the removal of whitebark pine or its habitat in other neighbouring jurisdictions, there is potential for dust and airborne deleterious substances to be dispersed from the Project footprint to whitebark pine occurrences and habitat in the Province of Alberta and the U.S.A., and on federal lands (refer to Chapter 1, Section 1.3.3; Figure 1.3-4). Given the distance between the Project and the respective borders and those federal lands located outside the Elk Valley, potential dust and airborne deleterious substances from the Project are likely to be substantially diluted and dispersed within the greater airshed that overlap with the Project, and are unlikely to be of sufficient magnitude to generate a detectable change in transboundary occurrences of whitebark pine (and its habitat) from existing conditions in these adjacent jurisdictions. Although Clark's Nutcracker can disperse whitebark pine seeds up to a maximum of 36 km, there is an abundance of suitable habitat and existing populations of whitebark pine outside the Landscapes and Ecosystems LSA. Consequently, given the abundance of whitebark pine populations outside of the Landscapes and Ecosystems LSA, the influence of the Project in Alberta and on federal lands is considered to be negligible.

14.6.5.2 Mitigation Measures

The mitigation measures proposed for vegetation VCs are based on available BMPs, guidance documents, mitigation measures conducted for similar projects, and professional judgment. The identification and selection of technically and economically feasible mitigation measures followed the mitigation hierarchy approach outlined by the provincial Environmental Mitigation Policy and related Environmental Mitigation Procedures (B.C. MOE, 2014a, 2014b).

Mitigation measures were identified for each potential effect on whitebark pine. For the purposes of this assessment, mitigation measures are defined to include project design features, procedure, or practice that will reduce or eliminate Project-related effects. Potential Project-related changes to whitebark pine and its habitat will be reduced through design mitigation, regulatory requirements, BMPs, including management plans, monitoring, and adaptive management. Where mitigation measures are considered to be completely effective, potential Project effects to whitebark pine and its habitat are not identified as residual effects.

14.6.5.2.1 Mitigation Measures for Mortality and/or Loss of Habitat

Logging, Clearing, Grubbing, and Soil Salvage

Whitebark pine has the potential to be affected through site preparation activities including the removal of vegetation, soil, and overburden. Where avoidance of whitebark pine within the Project footprint is not possible, additional mitigation measures have been provided to minimize the severity, or geographic or temporal extent of the potential effects. To mitigate the change in abundance of whitebark pine through direct loss of individuals and their habitat within the Project footprint over the course of the Project, the following mitigation measures will be implemented:

- Minimize disturbance and encroachment into whitebark pine habitat, to the smallest extent feasible, by clearing and grubbing only what is required for Construction and Pre-Production activities and development of the Project;
- Implement the Soil Management Plan (Chapter 33, Section 33.4.1.9) to salvage and stockpile soils from whitebark pine habitat removed during the Construction and Pre-Production and Operations phases for future reclamation activities;
- Develop and implement a Whitebark Pine Salvage, Propagation and Restoration Plan as a component of the Ecological Restoration Plan (Chapter 33, Section 33.4.1.3) that consists of the following elements:
 - Inventory of all whitebark pine located within the Project footprint and surrounding 100 m buffer, their respective size/reproductive class and health status;
 - Enhanced mapping (i.e., survey intensity level 2 or greater) for:
 - Seed dispersal critical habitat that will be lost due to construction of the Project;
 - Recovery/regeneration critical habitat with potential to be functionally lost due to loss of the seed dispersal critical habitat (i.e., areas of seed dispersal that are no longer located within 2 km of seed dispersal habitat); and
 - Critical habitat (both types) located within 100 m of the Project footprint that may be subject to impacts due to introduction of weeds, dust and/or spills of deleterious substances;
 - Critical habitat (both types) area is to be replaced at a 1:1 ratio (i.e., area lost : area replaced), which can include improvement of existing areas of marginal condition for whitebark pine, or reclamation/restoration of disturbed areas;
 - A seed and scion collection, testing, and propagation program to identify and enhance whitebark pine's resistance to white pine blister rust in the Landscapes and Ecosystems LSA;
 - Determination of a compensation ratio for replacement of whitebark pine (i.e., the number of trees planted relative to the number removed) that considers:
 - Total number of trees removed;

- Relative efficacy of collection/testing/propagation and revegetation methods using whitebark pine; and
- Rates of self-thinning and background loss of whitebark pine due to white pine blister rust;
- Operational monitoring of retained/adjacent areas of critical habitat (including both seed dispersal and recovery/regeneration types up to 100 m from the Project footprint) for the establishment of weeds, deposition of dust and/or release of deleterious substances to minimize the impact on retained occurrences of whitebark pine, as well as retained areas of recovery/regeneration critical habitat that have potential to support whitebark pine; and
- Monitor reclaimed areas to evaluate effectiveness of the Ecological Restoration Plan (Chapter 33, Section 33.4.1.3) in meeting reclamation goals and objectives.

Information collected as part of follow-up to the management plans (Chapter 33) will be used to inform success of reclamation and compensation strategies and determine, if necessary, the implementation of appropriate adaptive management strategies to achieve replacement of wetland extent and functions.

14.6.5.2.2 Mitigation Measures for Change in Rates of Germination, Growth, and Reproduction

Erosion, Deposition of Dust, and Release of Deleterious Substances

Construction and operational activities have the potential to erode soils and cause deposition of dust and airborne deleterious substances to existing whitebark pine occurrences and habitat downwind from the Project. Deposited sediments or other airborne deleterious substances may interfere with plant physiological processes that affect the germination, growth, and reproduction of whitebark pine. The measures provided in the Air Quality and Greenhouse Gas Management Plan (Chapter 33, Section 33.4.1.1), the Erosion and Sediment Control Plan (Chapter 33, Section 33.4.1.4), the Vegetation and Ecosystems Management and Monitoring Plan (Chapter 33, Section 33.4.1.11), the Soil Management Plan (Chapter 33, Section 33.4.1.9) and the Spill Prevention, Control and Countermeasures Plan (Chapter 33, Section 33.4.1.10) shall be implemented as described therein; the following additional measures shall be included wherever feasible:

- Enforcement of low speed limits for vehicular traffic throughout the site to minimize dust generation from unpaved roads;
- Maintain unpaved roads and keep in good repair, including regular road compaction and use of coarse aggregate with low silt content, where possible;
- Conduct earth moving activities in a manner that reduces exposed soils and avoids dust-generating activities during windy periods, where possible;
- Spray water or other dust suppression methods during dry periods from May to November to mitigate dust generation in areas including unpaved roads and work areas. Water for dust suppression will be withdrawn from the Interim Sediment Pond and Grave Creek Reservoir for the first five years of Operations, and then supplemented from the North Pit sumps for the remainder of the mine life;
- Locate soil stockpiles at appropriate locations far from retained occurrences of whitebark pine, and store and shape in a way to allow slope stability, including establishment of vegetation to reduce exposure to wind erosion;
- Use progressive reclamation and re-vegetation throughout the mine life to minimize wind erosion potential and reduce the Project footprint;

- Provide appropriate training and education for employees and contractors on management plans and how to minimize effects to whitebark pine;
- Monitor and inspect dust control measures are effective and functioning properly, which will allow for timely maintenance and adjustments as required;
- Minimize the extent of disturbance within and adjacent to occurrences of whitebark pine to the smallest extent necessary; and
- Conduct regular inspections of control measures established to address erosion and sedimentation and complete necessary repairs in a timely manner to protect wetland ecosystems.

Introduction and/or Spread of Invasive Species

All mine construction, operation, and reclamation activities requiring ground disturbance and/or removal of vegetation may result in the introduction or spread of non-native and invasive species. Prior to Construction and Pre-Production, it is anticipated that a Project-specific management plan for invasive plants will be developed as an operational guide to manage invasive plants within the Project footprint and be implemented across the Project footprint over the course of the Project to control existing and future invasive plant populations.

Measures to control existing invasive plant populations and reduce the potential for the introduction of additional invasive plants in Construction and Pre-Production, Operations, and Reclamation and Closure include:

- Identify and demarcate invasive plant populations around occurrences of whitebark pine (herein to include recovery/regeneration critical habitat) prior to Construction and Pre-Production;
- Establish setback areas and “no-work” areas if invasive plant populations are located near occurrences of whitebark pine to reduce the spread of invasive plants by machinery and vehicles;
- Remove existing occurrences of non-native and invasive species near occurrences of whitebark pine to prevent the spread to adjacent areas;
- Undertake invasive control activities, including distribution of biocontrol agents, and mechanical and chemical treatments;
- Restore sites with native vegetation species following treatment of invasive species and ground disturbance to establish vegetative cover;
- Provide appropriate training and education for employees and contractors on management plans and how to minimize effects to whitebark pine;
- Restrict vehicle and machinery traffic to designated access roads;
- Apply contouring and erosion control measures to limit spread of invasive and agronomic species seed and plants; and
- Additional mitigation measures related to invasive species management are provided in the Vegetation and Ecosystems Management and Monitoring (Chapter 33, Section 33.4.1.11).

14.6.5.2.3 Summary of Mitigation Measures for Whitebark Pine

The key mitigation measures proposed to mitigate potential effects on whitebark pine are summarized in Table 14.6-6.

Mitigation measures proposed to reduce potential effects to the mortality of and/or loss of habitat for whitebark pine are generally experimental, under ongoing development with little demonstration on

projects of similar context. Consequently, the associated effectiveness of the recommended measures for mitigation of mortality of and/or loss of habitat for whitebark pine is considered to be unknown. Other mitigation measures to reduce the potential effects associated with change in rates of germination, growth, and reproduction due to erosion, deposition of dust and airborne deleterious substances as well as competition with non-native and invasive species are considered to be highly effective. Where mitigation measures do not or may not mitigate all effects or if the effectiveness of mitigation measures is unknown, the effect was carried forward for further analysis of residual effects. Mitigation measures that are expected to completely mitigate potential effects with a high level of confidence based on their proven effectiveness elsewhere were classified as having no expected residual effects.

If monitoring indicates that the effectiveness of mitigation measures and reclamation activities is lower than predicted, further mitigation may be required as per adaptive management strategies outlined in the Vegetation and Ecosystems Management and Monitoring Plan (Chapter 33, Section 33.4.1.11).

As noted in Table 14.6-6, after the application of mitigation measures aimed at reducing environmental effects, there are no residual effects on rates of germination, growth, and reproduction of whitebark pine due to both erosion, deposition of dust and airborne deleterious substances as well as from the introduction and spread of non-native and invasive species. As such, those potential effects are not carried further in the assessment.

No other technically and economically feasible mitigation measures were considered for whitebark pine, and NWP is not aware of potential future technology innovations that could help further mitigate effects.

14.6.5.3 Characterization of Residual Effects, Significance, Likelihood and Confidence

14.6.5.3.1 Assessment Methods

The characterization of residual effects follows methods outlined in Chapter 5, Sections 5.3.4.5. Ecosystem-specific methods used in the assessment of residual effects are detailed below.

A footprint analysis was used to determine areas of the Project footprint that overlap and interact with the estimated extent of whitebark pine in the Landscapes and Ecosystems LSA. The maximum Project footprint extent, including clearing and contingency areas, presents the maximum extent of disturbance associated with the Project (as detailed by "Project footprint" boundary depicted in Figure 14.6-2).

Given the complexity of relationships among species and the abiotic environment, and that not all mechanisms of impact act equally in all locations at all times, characterization of changes in the germination, growth, and reproduction of whitebark pine was conducted qualitatively in consideration of industry best practices and the professional judgment of the authors.

14.6.5.3.2 Potential Residual Effects Assessment

Potential Project-related mortality and/or loss of habitat for whitebark pine was predicted to occur due to clearing of vegetation and salvage of soils in the Project footprint. Although implementation of recommended mitigation measures will reduce the extent of the potential effect, it is unlikely that such measures will be completely effective. Consequently, the Project is predicted to result in a residual effect of mortality and/or habitat loss of whitebark pine.

Table 14.6-6: Summary of Proposed Mitigation Measures Related to Whitebark Pine

Potential Effect	Mitigation Measure(s)	Rationale	Applicable Project Phase(s)	Effectiveness	Residual Effect
Mortality and/or Loss of Habitat	<ul style="list-style-type: none"> Project design optimization Salvage top soils to retain seedbank Implementation of Ecological Restoration Plan, including: <ul style="list-style-type: none"> Complete inventory and mapping of whitebark pine distribution and critical habitat; Replacement of critical habitat; Collection of seeds and scion; and Determination of compensation ratio Operational monitoring of retained critical habitat 	<ul style="list-style-type: none"> Minimization of potential loss of mature, cone-bearing stems Salvage of soil seedbank and suitable substrates for future reclamation Preservation of potentially rust resistant genotypes Replacement of population and habitat lost due to project activities 	<ul style="list-style-type: none"> Construction and Pre-Production Operations 	Unknown	Yes
Change in Rates of Germination, Growth, and Reproduction	<p><u>Erosion, Deposition of Dust and Airborne Deleterious Substances</u></p> <ul style="list-style-type: none"> Implement the Air Quality and Greenhouse Gas Management Plan, the Soil Management Plan, the Erosion and Sediment Control Plan, the Vegetation and Ecosystems Management and Monitoring Plan, and the Spill Prevention, Control and Countermeasures Plan Minimize the extent of disturbance within and adjacent to whitebark pine and habitat Inspect erosion and sediment control measures Education and training Low speed limits Regular road maintenance 	<ul style="list-style-type: none"> Recommended measures will contribute to the minimization of Project effects on the rates of whitebark pine germination growth, and reproduction Effects of erosion, deposition of dust, and airborne deleterious substances on whitebark pine or in its habitat (or critical habitat) are expected to be effectively mitigated such that a residual effect does not occur Effects of invasive plants on the germination, growth, 	<ul style="list-style-type: none"> Construction and Pre-Production Operations Reclamation and Closure 	High	No

Potential Effect	Mitigation Measure(s)	Rationale	Applicable Project Phase(s)	Effectiveness	Residual Effect
	<ul style="list-style-type: none"> Minimize earthworks during windy periods Progressive reclamation and revegetation Dust suppression methods Proper covers/shielding where required Monitor and inspect dust control measures 	and reproduction of whitebark pine are expected to be effectively mitigated such that a residual effect does not occur			
	<p><u>Non-native and Invasive Species</u></p> <ul style="list-style-type: none"> Implementation of the Vegetation and Ecosystems Management and Monitoring Plan Control, manage, and remove invasive plants on site Establish buffers and “no-work” zones where current infestations exist Restore with appropriate native vegetation Education and training Restrict traffic in known infested areas Decontaminate vehicles and machinery 	<ul style="list-style-type: none"> Recommended measures will contribute to the minimization of Project effects on the rates of whitebark pine germination growth, and reproduction due to non-native and invasive species Effects of invasive plants on whitebark pine are expected to be effectively mitigated such that a residual effect does not occur 	<ul style="list-style-type: none"> Construction and Pre-Production Operations Reclamation and Closure 	High	No

With the successful implementation of the recommended mitigation measures, the potential effects erosion, deposition of dust and deleterious substances as well as the introduction and/or spread of non-native and invasive species are anticipated to be completely mitigated. Consequently, there are no residual effects on rates of germination, growth, and reproduction of whitebark pine on rates of germination, growth, and reproduction of whitebark pine due to both erosion, deposition of dust and airborne deleterious substances as well as from the introduction and spread of non-native and invasive species. Therefore, those potential effects are rated not significant and are not carried further in the assessment.

Mortality and/or Loss of Habitat

Vegetation clearing conducted during early site preparation (in particular for areas of the mine pits, mine rock, and coal reject disposal) will necessarily require the clearing of whitebark pine trees that may be present within the Project footprint. Further, stripping and salvage of the soil and surface materials will potentially remove whitebark pine seed caches distributed in or near the Project footprint and will remove appropriate substrates and landforms upon which existing whitebark pine are situated. Generally, the potential effect of the Project on mortality of whitebark pine can be quantified using the extent of occupied habitat within the Project footprint relative to the area in the Landscapes and Ecosystems LSA.

Whitebark pine was confirmed to be present within the Landscapes and Ecosystems LSA, occupying an estimated potential area of 1,375 ha (out of 12,886 ha in the Landscapes and Ecosystems LSA, or 11% of the total area of the LSA), of which the Project footprint overlaps with potentially as much as 591 ha, or 43% of the extent of such habitat in the Landscapes and Ecosystems LSA (Section 14.5.2.2.4). Although the extent of the Project footprint is conservative in nature, buffered to account for uncertainty in the full extent of Project activities, it is not feasible to completely avoid overlap with occurrences of whitebark pine, particularly for the mine pits, mine rock, and coal reject disposal areas (Figure 14.6-2). That stated, the total area of habitat does not reflect the variation in density of whitebark pine or the suitability of habitat because habitat areas are mapped as occupied/suitable, or not. Given the generalized interpretation of habitat for whitebark pine (i.e., occupied/suitable, or not), there is potential that the mapped area provides a liberal estimate of the population of whitebark pine occurring within the Project footprint and the Landscapes and Ecosystems LSA.

Similarly, the representation of loss of critical habitat due to overlap with the Project footprint may not completely reflect the potential effect of the Project. Seed dispersal and recovery/regeneration critical habitat types respectively accounted for 332 ha and 1,004 ha of the Landscapes and Ecosystems LSA, of which the Project footprint overlaps with 100% and 47% of the respective critical habitat areas (Table 14.5-10). The assessment may have underestimated the total extent of recovery/regeneration critical habitat with potential to be affected by the Project. The Project TEM (Chapter 13, Appendix 13-A), upon which the mapping of critical habitat was based, was limited to a distance of only 1 km from the Project footprint; however, recovery/regeneration critical habitat is defined as those areas of suitable characteristics within 2 km from the edge of seed dispersal critical habitat. Given that additional recovery/regeneration critical habitat may exist beyond the Landscapes and Ecosystems LSA, but within 2 km of the mapped areas of critical habitat in the Project footprint, the area of recovery/regeneration critical habitat affected by the Project through loss of the associated seed dispersal habitat may be underrepresented.

For the same reason (i.e., limited extent of Project TEM), there is potential that retained areas of recovery/regeneration critical habitat may be supported from other seed dispersal critical habitat located outside of the Landscapes and Ecosystems LSA (but within the 2 km seed caching distance for Clark's Nutcracker). The functional effect of the loss of seed dispersal critical habitat within the Project footprint is not likely to be realized, as retained recovery/regeneration critical habitat areas would still be accessible to seed caching from other seed dispersal critical habitat areas within 2 km. Consequently, the same mapping limitation may have counteracting influence on the predicted loss of whitebark pine critical habitat, in which it both underestimates and overestimates the potential extent of loss of recovery/regeneration critical habitat.

Finally, the potential effects of the Project on the population of whitebark pine may be further exaggerated when not considering the existing rates of population decline attributed predominantly to white pine blister rust. Although 21% of all mature trees, and 81% of all seedlings assessed during the critical habitat assessment, were found to be healthy or non-terminally infected, the rates of infection and mortality due to white pine blister rust could not be estimated⁴. Without a locally specific rate of infection and mortality due to the primary existing sources of population decline, it is not possible to estimate the net number of trees to be incrementally impacted by the Project outside of existing baseline conditions. In the absence of any other information, assessment of potential Project effects to populations generally assumes populations are stable and are generally represented by the results of the baseline field surveys (i.e., within the range of natural variation). In the case of whitebark pine in Canada, mortality rates have been estimated between 4% and 22% in British Columbia and approximately 5% in Waterton Lakes National Park (WLNP; Langor, 2007). If the estimated rate of mortality from populations in WLNP were applied to the population of whitebark pine found in the Project footprint (a conservatively low estimate for mortality), the Project would have a net potential mortality affecting no more than 20% of the existing population documented at the time of this assessment⁵. Consequently, relying solely on the quantified extent of whitebark pine habitat (i.e., 43% of the Landscapes and Ecosystems LSA) may overestimate the proportion of the population impacted by the Project. If the basal area of whitebark pine is affected by white pine blister rust proportional to the mortality rate (i.e., all tree sizes are affected equally), then the basal area for seed dispersal critical habitat will decrease by at least 80%, generally resulting in a reduction of the basal area below the threshold of 2 m²/ha⁶. On the contrary though, the effects of white pine blister rust may be more pronounced in larger, mature trees (i.e., 21% healthy or non-terminally infected) over younger seedlings (i.e., 81% healthy or non-terminally infected), and therefore the potential effect of mortality is likely to have a greater effect on basal area of whitebark pine. We can assume that conservatively low estimates for existing rates of mortality due to white pine blister rust will reduce the population (and therefore the basal area) of whitebark pine, to lower than sustainable levels in areas of seed dispersal critical habitat. Subsequently, all areas of recovery/regeneration habitat within 2 km would similarly be lost indirectly through the loss of seed dispersal critical habitat (except where supported by an alternate area of seed dispersal critical habitat).

⁴ Rates of change require at least two measurements of population size and status over time.

⁵ At a rate of 5% mortality per year, the proportion of a population lost to white pine blister rust over a period equal to the combined duration of the Construction and Pre-Production, Operations, and the Reclamation and Closure phases is equal to more than 80%.

⁶ The critical habitat assessment identified three assessment areas confirmed to have a basal area of whitebark pine greater than 2 m²/ha. Were these areas to exhibit a loss of 80% of the basal area due to white pine blister rust, all but one would be reduced to below the threshold basal area of 2 m²/ha (i.e., 1.77 m²/ha – 1.80 m²/ha), with the third area remaining marginally greater than the threshold basal area (i.e., approximately 2.89 m²/ha).

These factors highlight that, although whitebark pine occurs prominently in the Project footprint and the Landscapes and Ecosystems LSA, limitations in TEM mapping extent reduce the level of confidence in the predicted potential effect. Further, the presented proportional effect of the Project on whitebark pine (measured by the proportional area of habitat/critical habitat affected) over-estimates the Project's potential effect, as it does not consider the existing rate of mortality due to white pine blister rust (i.e., 4% to 22%). Existing rates of mortality would see the population of whitebark pine decrease to approximately 20% from current/baseline conditions over the subsequent 34 years, regardless of whether the Project were to proceed or not. Consequently, although 43% of potential whitebark pine habitat in the Landscapes and Ecosystems LSA may be affected by the Project, the population would be subjected to a predicted net loss of only 20% due to Project activities, with the remainder due to naturally-occurring disease or mortality.

Regardless, implementation of the recommended mitigation measures will act to reduce the magnitude of potential effects. Although opportunities for discrete avoidance of whitebark pine may be possible, it is unlikely that the majority of the Project footprint's overlap with the extent of whitebark pine can be substantially reduced. Consequently, mortality of whitebark pine and/or the loss of habitat will be largely mitigated through the implementation of whitebark pine related restoration measures identified in the Ecological Restoration Plan (Chapter 33, Section 33.4.1.3). Although still early in development, the methods for salvage, testing, propagation and planting of white pine blister rust-resistant variants of whitebark pine have been improving over time. Although 21% of mature whitebark pine (i.e., greater than 1.3 m height) and 81% of seedlings assessed during the whitebark pine critical habitat assessment were identified as being "Healthy or Non-terminally Infected", this does not mean that these individuals are in fact rust-resistant, but rather that these individuals have not yet succumbed to white pine blister rust but could be resistant. The Ecological Restoration Plan (Chapter 33, Section 33.4.1.3) provides for the use of rust-resistant plants in the restoration of whitebark pine. If the degree of rust resistance in planted individuals is greater than that of the existing population, then it is reasonable that the occurrence of rust resistance in whitebark pine in the Project footprint (and possibly the Landscapes and Ecosystems LSA) will increase through implementation of the restoration program. To minimize losses due to complications in restoration (i.e., there is typically some degree of complication due to site-specific factors), the number of whitebark pine to be planted should exceed the number removed, determined in consideration of the efficacy of whitebark pine salvage, testing for rust resistance, propagation, and planting.

14.6.5.3.3 Characterization of Residual Effects

The residual effect associated with the mortality and/or loss of habitat for whitebark pine is characterized as follows:

- Duration: Permanent, effects from the mortality of whitebark pine and/or loss of habitat (including critical habitat) will extend well beyond the Post-Closure phase until such time that restored populations of whitebark pine achieve reproductive maturity and a minimum basal area of 2 m²/ha.
- Magnitude: Moderate, the Project's potential effect mortality and/or habitat loss for of up to 20% of the whitebark pine population (after white pine blister rust losses) is measurable and detectable, but not likely to reduce the basal area for whitebark pine in seed dispersal critical habitat below the threshold of 2 m²/ha.

- Geographic Extent: Regional, removal of whitebark pine and the associated seed dispersal critical habitat within the Project footprint has potential to result in a functional loss of critical habitat outside of the Landscapes and Ecosystems LSA.
- Frequency: Intermittent, removal of whitebark pine and/or its associated habitat will occur throughout the life of the mine as extraction expands.
- Reversibility: Reversible Long-Term, restored populations of whitebark pine may take at least 60 years to become reproductively mature and self-sustaining; however, the use of rust resistant plants in restoration is likely to have a strong reversibility, particularly as the frequency of rust-resistance increases in the population under natural reproductive conditions.
- Context: Low, whitebark pine has exhibited high rates of loss in other nearby populations (e.g., WLNP; ECCO, 2017) and therefore, until such time that resistance to white pine blister rust is established, is likely to be non-resilient and susceptible to substantial perturbation from other interacting factors.

Determination of Significance

The residual effect of the Project on mortality and/or loss of habitat for whitebark pine is considered not significant. Although the duration of the residual effect will continue well beyond the Post-Closure phase of the Project (i.e., permanent), early research in restoration of whitebark pine has suggested there is potential for favourable restoration outcomes. The use of white pine blister rust resistant plants in restoration is anticipated to further improve the resilience of whitebark pine well beyond the closure of the Project. Regardless of the time required, the residual effect is not considered irreversible (i.e., it is rather reversible, long-term) and, therefore, is considered to be not significant.

Likelihood and Confidence

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

The level of confidence of the significance prediction on mortality of whitebark pine and/or loss of habitat is considered to be low, given uncertainty in the confirmed extent of whitebark pine in the Landscapes and Ecosystems LSA and Project footprint, the background loss of whitebark pine due to white pine blister rust (among other sources of mortality), and the success of whitebark pine restoration programs. Mitigation and follow up measures will improve the level of confidence in this prediction.

14.6.5.3.4 Summary of Residual Effects Assessment

Residual effects for whitebark pine and the selected mitigation measures, characterization criteria, likelihood, significance determination, and confidence are summarized in Table 14.6-7. Significant residual effects to whitebark pine are not anticipated due to mortality and/or loss of habitat from logging, clearing, grubbing and soil salvage during the Construction and Pre-Production, and Operations phases of the Project.

Table 14.6-7: Summary of Residual Effects on Whitebark Pine

Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization	Significance (Significant, Not Significant)	Confidence (High, Moderate, Low)
Mortality and/or Loss of Whitebark Pine Habitat	<ul style="list-style-type: none"> • Construction and Pre-Production • Operations • Reclamation and Closure 	<ul style="list-style-type: none"> • Project design optimization • Salvage topsoil to retain seedbank • Implementation of Ecological Restoration Plan, including: <ul style="list-style-type: none"> ○ Complete inventory and mapping of whitebark pine distribution and critical habitat ○ Replacement of critical habitat ○ Collection of seeds and scion and ○ Determination of compensation ratio • Operational monitoring of retained critical habitat 	Duration: Permanent Magnitude: Moderate Geographic Extent: Regional Frequency: Intermittent Reversibility: Reversible Long-Term Context: Low	Not Significant	Low

14.7 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 vegetation VCs requires that:

- The Project results in a residual adverse environmental effect on vegetation VCs;
- 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.

14.7.1 Overview of Residual Effects

An assessment of cumulative effects is required for vegetation VCs due to the possibility that potential Project residual effects on vegetation VCs may remain after implementation of proposed mitigation measures. For the purposes of the cumulative effects assessment, residual Project effects to be considered include:

- Change in listed plant community and species abundance and distribution through site clearing, grubbing, and soil salvaging;
- Change in listed plant community and species composition and structure due to site clearing, grubbing, and soil salvaging; and
- Change in whitebark pine mortality and/or loss of whitebark pine habitat through site clearing, grubbing, and soil salvaging.

For the assessment of cumulative effects, residual effects for listed plant community and species were combined to evaluate the total potential change in the VC as it relates to changes in abundance, distribution, composition, and structure.

14.7.2 Assessment Boundaries

14.7.2.1 Spatial Boundaries

The assessment of cumulative effects for vegetation VCs was conducted at a regional scale and was confined to the Landscapes and Ecosystems RSA described in Section 14.3.3.1.

14.7.2.2 Temporal Boundaries

The temporal boundaries for the landscapes and ecosystems cumulative effects assessment are the same as those for Project effects, as defined in Section 14.3.3.2.

14.7.2.2.1 Use of Temporal Cases

The temporal cases used in the assessment of cumulative effects are described as follows:

1. Base Case – Describes the current status of the VC prior to the start of the Project, including all appropriate past and present projects and/or activities. The Base Case for vegetation VCs is presented in the existing conditions of the VC assessment chapter, with explicit reference to the fact that the Base Case generally reflects the contributions of past and present projects and/or activities;
2. Project Case – Describes the status of the VC with the Project in place, over and above the Base Case. This is equivalent to the Project effects discussed in Section 14.5; and
3. Future Case – Describes the status of the VC as a result of the Project Case in combination with all reasonably foreseeable future projects and/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 and/or activities to be determined.

14.7.2.3 Administrative Boundaries

No additional administrative boundaries were considered in the cumulative effects assessment beyond those described in Section 14.3.3.3.

14.7.2.4 Technical Boundaries

Data relating to the occurrence of listed plant communities and species, including whitebark pine, obtained from the B.C. CDC are based on historical observations with numerous factors influencing the certainty and currency of the data. Data provided by the B.C. CDC only confirms that the community or species was detected at a specific location at a specific time, and does not mean that the community or species does not also occur elsewhere, or that a previously detected occurrence still exists.

Given that the field surveys used to ground truth vegetation resources were limited to the Landscapes and Ecosystems LSA, and that there are several BGC subzones and variants in the Landscapes and Ecosystems RSA that are not found within the Landscapes and Ecosystems LSA, it is not necessarily technically feasible to extrapolate species occupancy or habitat suitability to the regional scale. In particular, the site types occupied by whitebark pine within the Landscapes and Ecosystems LSA may not necessarily provide suitable habitat for whitebark pine in other locations of the Landscapes and Ecosystems RSA. Consequently, it is not feasible to predict the extent of populations and/or habitat of listed plant communities and species, including whitebark pine, in the Landscapes and Ecosystems RSA.

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

Descriptions of the past, present, and reasonably foreseeable projects and/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 projects or activities are expected to interact with the vegetation VCs, which may result in a potential for adverse cumulative effects (Table 14.7-1). The locations of the past, present, and reasonably foreseeable future projects or activities is presented is

Figure 14.7-1. The Grassy Mountain Coal Project and the Elan Hard Coking Coal Project were not considered to interact with the vegetation VCs and as such are not included in Table 14.7-1.

As noted in Chapter 5, Section 5.3.5.3, the following projects were considered as past, present, or reasonably foreseeable future projects and/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 Ltd. in 2016;
- Mount Brussilof (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.

14.7.4 Identification of Cumulative Effects

14.7.4.1 Listed Plant Communities and Species

The assessment of potential Project-related effects on listed plant communities and species identified the potential for the Project to result in adverse residual effects on the listed Gg12 ecological community, a provincially Red-listed ecological community (B.C. CDC, n.d.b.). As shown in Table 14.7-1, these residual Project effects have the potential to act cumulatively with several past, present, or reasonably foreseeable future projects or activities within the Landscapes and Ecosystems RSA.

The listed Gg12 ecological community has been found to occur sporadically within the Landscapes and Ecosystems RSA. This grassland ecosystem been previously mapped on level to gently sloping terrain or terraces adjacent to rivers at low to mid-elevations. While grassland ecosystems are not typically targeted in forestry planning, their characteristic sparse tree cover and gently sloping terrain may have historically provided suitable staging areas or access routes to adjacent cut blocks for the forestry industry, resulting in adverse effects to the plant communities or soil conditions within these ecosystems.

The terrain and locations in which Gg12 ecological communities has been mapped in the Landscapes and Ecosystems RSA (i.e., level to gently sloping terrain adjacent to rivers and streams) are also conditions commonly used to construct linear transportation features (i.e., rail, roads [e.g., forestry, exploration, private, and local roads], and highways). As a result, these communities have been historically disturbed by construction of roads and railways.

Due to their open, gently sloping topography, Gg12 ecological communities provide ideal grazing opportunities for livestock and wildlife. As a result, these listed ecological communities can be subject to adverse effects of overgrazing from agricultural livestock production and, to a lesser extent, wild ungulate species.

Natural processes may be considered to have a neutral to positive effect on grassland ecosystems, including Gg12 ecological communities. Wildfires benefit grassland ecosystems by removing litter, reducing biological soil crusts that may limit plant growth, and releasing nutrients back into the soil (MacKillop et al., 2018). Fire suppression activities have reduced both the patch size and abundance of grassland ecosystems in the Elk Valley (Demarchi et al., 2000; Mountain Goat Management Team, 2010; Poole and Ayotte, 2019), and the encroachment of young forests into previous grassland ecosystems (Kirby and Campbell, 1999).

Table 14.7-1: Project-Landscapes and Ecosystems VC Interactions Matrix for Potential Cumulative Effects

Past, Present, or Reasonably Foreseeable Future Projects or Activities	Ranking of Potential Cumulative Effect	
	Listed Plant Communities and Species	Whitebark Pine
Past or Present Projects and/or Activities that Have Been Carried Out		
Natural Resource Extraction – Mining (past)	I	I
Coal Mountain Operations	I	I
Elkview Operations	I	I
Line Creek Operations	I	I
Fording River Operations	I	I
Greenhills Operations	I	I
Kootenay West Mine	I	I
Elkhorn Quarry West (Windermere Mining Operations)	I	I
Marten Phosphate Project	I	I
Energy - Elko Dam	I	I
Koocanusa Reservoir	I	I
Forestry	II	I
Energy - Pipelines	I	I
Energy - Electrical Transmission	I	I
Transportation	II	I
Recreation and Tourism	I	I
Commercial, Residential, and Industrial Use	I	I
Parks and Protected Areas	I	I
Agriculture	II	I
Natural Processes or Events	II	I

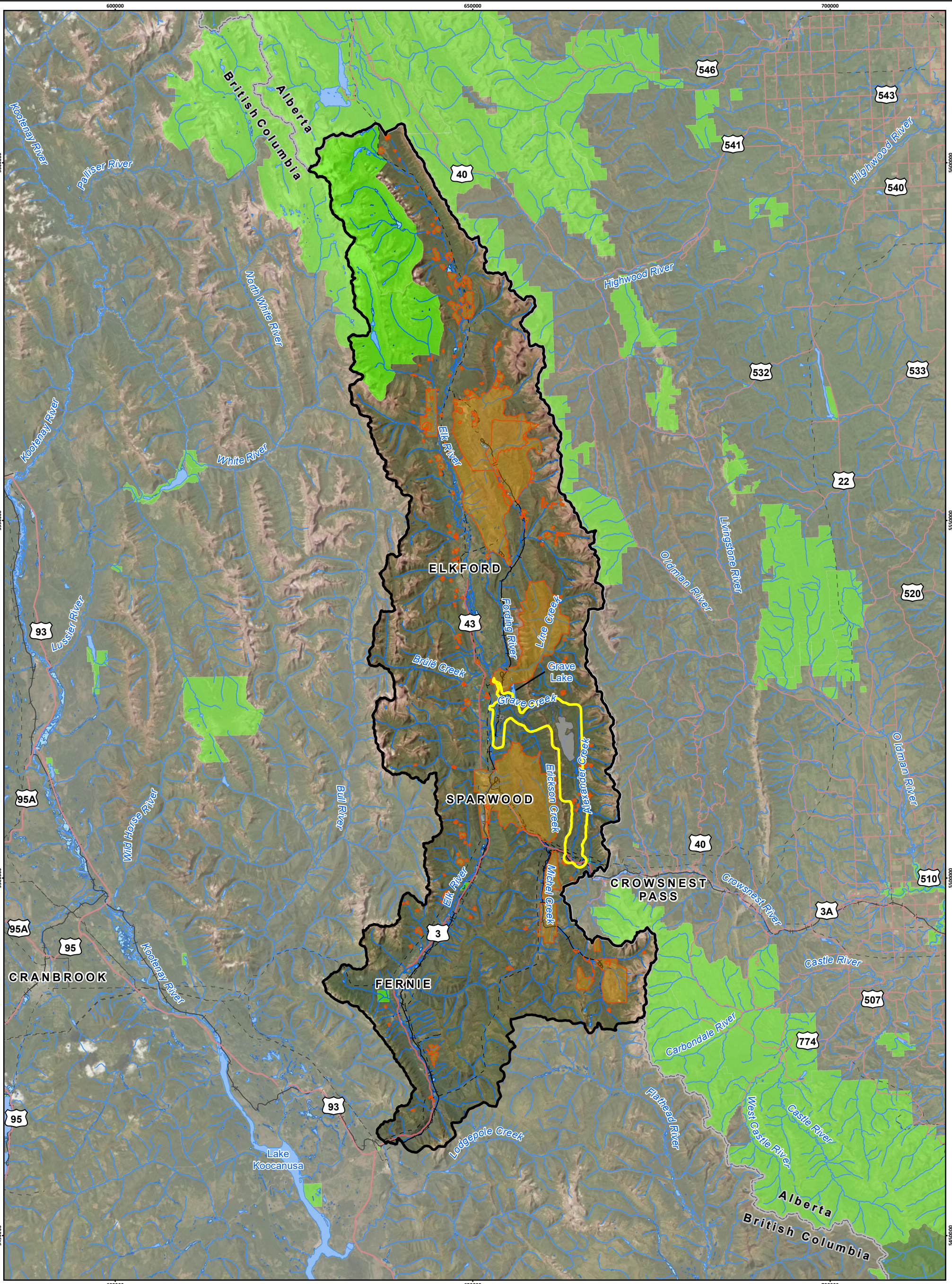
Past, Present, or Reasonably Foreseeable Future Projects or Activities	Ranking of Potential Cumulative Effect	
	Listed Plant Communities and Species	Whitebark Pine
Reasonably Foreseeable Future Projects and/or Activities That Will Be Carried Out		
Michel Coal Project	I	III
Tent Mountain Mine	I	II
Fording River Extension Project	I	III
Bingay Main Project	I	III
Forestry	I	II
Climate Change	II	III
Natural Processes or Events	II	I

Notes:

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.

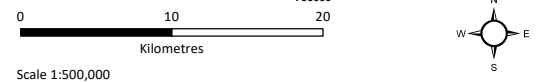
III – Residual Project effects act cumulatively with those of other past, present, or reasonably foreseeable future projects and/or activities, and may result in significant cumulative effects; or residual Project effects act cumulatively with existing significant cumulative effects and the Project may measurably contribute to adverse changes in the state of the VC. Carried forward in the assessment.



Crown Mountain Coking Coal Project

LEGEND

- Reasonably Foreseeable Future Projects and Activities
- Landscapes and Ecosystems Regional Study Area
- Landscapes and Ecosystems 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



Scale 1:500,000

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

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



Project: 12-6231
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Figure 14.7-1
 Reasonably Foreseeable Projects and Activities in the Landscapes and Ecosystems Regional Study Area

Forecasted modelling for the Elk Valley indicates that climate change is likely to result in reduced precipitation falling as snow, higher annual precipitation overall and substantial increase in average annual air temperature (EV-CEMF, 2018). Although regionally specific implications are not available, other studies have indicated that the effects of climate change on montane and alpine grassland ecosystems may result in increased aboveground biomass, and a decrease in overall species richness, due to the resistance of grassland vegetation communities to abrupt alterations in temperature and precipitation (Berauer et al., 2019). While model projections suggest a potential expansion of grassland ecosystems in response to increases in average annual temperature, the magnitude of change in species-specific responses and their interactions influencing the function of grassland ecosystems (including the Gg12 ecological community) cannot be accurately predicted. Given these uncertainties, the potential contribution of climate change to the cumulative effect on changes to the extent, composition and structure of grassland ecosystems cannot be accurately predicted at this time.

14.7.4.2 Whitebark Pine

Given its restricted occurrence to high alpine environments, whitebark pine in the Landscapes and Ecosystems RSA is not likely to have been adversely affected by past or present dams or reservoirs; pipelines, electrical transmission lines, or transportation infrastructure; or commercial, residential or industrial use, or agricultural development. Natural processes may be considered a neutral effect, or potentially a net benefit, to whitebark pine, as either the ecosystems are adapted to such events as forest fire, or that fire enhances opportunities for new habitat. Although past and present recreation facilities (e.g., ski hills) may have potentially resulted in the loss of whitebark pine or its habitat, the extent is likely immaterial given the selective clearing techniques applied and otherwise low impact. Past and present parks and protected areas are unlikely to have had a material effect on whitebark pine, given their intent is to promote conservation and low impact recreational activities. Although historic forestry related impacts are likely to have occurred in the past, and continue to occur in the present, the full extent and severity is not readily quantifiable. Given their location in high alpine environments where conditions are unlikely to provide salvageable timber, the effects of past and present forestry activities on whitebark pine likely to have been immaterial within the Landscapes and Ecosystems RSA. The remainder of the past and present activities potentially affecting whitebark pine are predominantly attributed to mining operations, particularly larger open-pit mines, and mine rock dumps located in high alpine locations, much like that planned for the Project and other reasonably foreseeable future developments. ECCC (2017) characterized the potential threats to whitebark pine, for which anthropogenic threats would be of negligible to low “impact” and negligible to small “scope” relative to the national population. Conversely, ECCC (2017) identified that the greatest potential threats to whitebark pine arise from the spread of white pine blister rust and multiple effects due to climate change.

Mortality rates of whitebark pine due to white pine blister rust have been estimated between 4% and 22% in B.C. and approximately 5% in Waterton Lakes National Park (WLNP; Langor, 2007). At a rate of 5% mortality per year, the proportion of whitebark pine population lost to white pine blister rust over the proposed duration of the Project is equal to more than 80%.

Forecasted modelling for the Elk Valley indicates that climate change is likely to result in reduced precipitation falling as snow, higher annual precipitation overall and substantial increase in average annual air temperature (Mackillop et al. 2018). ECCC (2017) summarized that climate change and severe weather is anticipated to affect whitebark pine through altered and/or shifted habitat as well as increase the severity, duration

and/or frequency of droughts and temperature extremes. Although the potential effects of climate change will adversely affect as much as 70% of the whitebark pine population throughout the entirety of its range in Canada, the full extent cannot be accurately quantified given the uncertainty in the adaptability and resilience of whitebark pine.

14.7.5 Mitigation for Cumulative Effects

The mitigation strategy developed for Project effects is also applicable to the Project's contribution to cumulative effects on vegetation valued components. As described in Sections 14.6.3.2 and 14.6.5.2, mitigation planning involves a combination of Project design features, procedures, and practices aimed at reducing or eliminating Project-related effects to vegetation VCs.

Given that existing (i.e., present) and reasonably foreseeable future developments are generally bound to the same legislative/regulatory frameworks as the Project, it is reasonable to expect that such activities will be subject to similar or analogous mitigation requirements specific to the respective industry. Present and reasonably foreseeable future developments whose construction and operation overlap with the Project are subject to similar states of scientific knowledge regarding the mitigation of environmental effects. Consequently, it is reasonable to assume that potential effects of existing and reasonably foreseeable future developments in the Landscapes and Ecosystems RSA are likely to be mitigated in a manner similar to that proposed for the Project.

For example, other surface mines and resource extraction activities are subject either to project-specific regulatory approvals or standardized practices that require development and implementation of an ecological restoration and reclamation plan. Consequently, it is reasonable to assume that such existing and reasonably foreseeable future mines will minimize the extent of loss of landscapes and ecosystems related VCs through ecological restoration and compensation activities within the Landscapes and Ecosystems RSA.

The potential effects of climate change and white pine blister rust on whitebark pine are anticipated to be partially mitigated through implementation of the proposed federal recovery strategy (ECCC, 2017) and the adopted Alberta Whitebark Pine & Limber Pine Recovery Plan (AWLPRT, 2020). Mitigation strategies implemented through these policy documents, as well as informal recovery planning initiated by the Government of British Columbia, have included supplemental research, propagation and planting outside of commercial/industrial mitigation projects (Province of B.C., 2021b; Alberta Ministry of Agriculture and Forestry, 2021).

14.7.6 Characterization of Residual Cumulative Effects

14.7.6.1 Listed Plant Communities and Species

14.7.6.1.1 Characterization of Residual Cumulative Effects

The assessment of residual cumulative effects on listed plant communities and species involves the consideration and evaluation of specific effects assessment criteria based on the degree (i.e., 'level') of potential Project effects. Similar to the Project effects assessment, the criteria used to characterize residual cumulative effects include duration, magnitude, geographic extent, frequency, reversibility, and context, as defined in Chapter 5, Section 5.3.5.4.5. The residual cumulative effects on listed plant

communities and species are determined based on the same significance thresholds as were established for residual Project effects as outlined in Section 14.6.1.1. For the assessment of cumulative effects, residual effects for listed plant community and species were combined to evaluate the total potential change in the VC as it relates to changes in abundance, distribution, composition, and structure.

Base Case

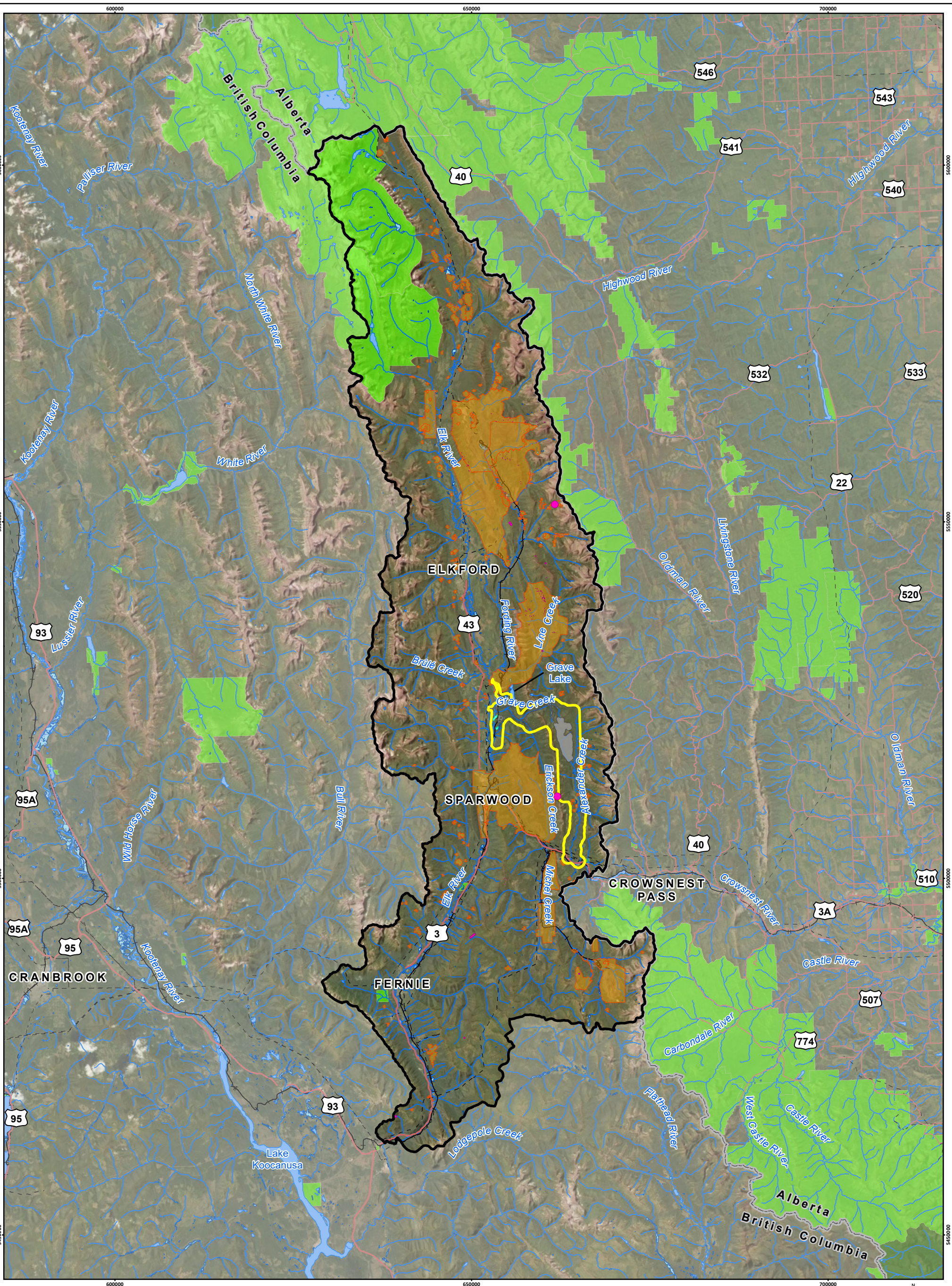
Within the Landscapes and Ecosystems RSA, three generalized locations of Gg12 have been mapped by the B.C. CDC (B.C. CDC, n.d.b). One generalized location overlaps with the dominant Gg12 ecological community that was identified and mapped during the baseline field surveys, a portion of which is intersected by the Landscapes and Ecosystems LSA and Project Footprint. The B.C. CDC estimated the area of Gg12 occupying this site association to be 11.0 ha, while the baseline field survey recorded the extent of the ecological community at approximately 26.75 ha in area. As the area recorded during the baseline survey was larger in extent than that recorded by the B.C. CDC, the field surveyed area was conservatively selected for the assessment of Project-related effects and cumulative effects on this listed ecological community. The B.C. CDC also identified a second generalized location of a Gg12 ecological community within the Landscapes and Ecosystems LSA approximately 540 m south of the Project footprint, comprising a subdominant portion of the site association and occupying an area approximately 2.15 ha in size (B.C. CDC., n.d.b; Figure 14.7-2). The third generalized location in the Landscapes and Ecosystems RSA occurs on the banks of the Flathead River, north of the B.C.-U.S.A. border, in which the Gg12 ecological community is estimated to occupy an area 7.19 ha in size (B.C. CDC, n.d.b). Collectively, Gg12 ecological communities account for approximately 36.09 ha or 0.01% of the Landscapes and Ecosystems RSA.

As previously discussed in Section 14.7.4.1, the identified Gg12 ecological communities within the Landscapes and Ecosystems RSA have been previously affected by several factors, including forestry, development of linear transportation features, recreation and tourism, and agriculture (i.e., livestock grazing). An estimated 1.11 ha or 3.1% of Gg12 ecological communities have been previously affected by forestry activities. Linear transportation features account for an additional 3.74 ha or 10.4% of existing areal disturbance to Gg12 ecological communities within the Landscapes and Ecosystems RSA. Finally, livestock grazing accounts for the largest disturbance to Gg12 ecological communities, accounting for an additional 18.56 ha or 51.4% of existing areal disturbance. Collectively, these past or present activities affect an area of 23.41 ha, or 64.9% of the total area of Gg12 ecological communities within the Landscapes and Ecosystems RSA. This is a conservative estimate, as the calculated areas do not account for overlapping disturbances (i.e., areas previously affected by forestry activities may currently be affected by livestock grazing). Therefore, the actual extent of areas affected by other past or present activities is likely less than the areas calculated above.

Generally speaking, the effects from the aforementioned past and present activities on Gg12 ecological communities are encompassed in the existing (baseline) conditions for listed plant communities and species.

Project Case

The Project footprint overlaps with approximately 0.54 ha of a Gg12 ecological community (Table 14.5-4), which accounts for approximately 1.5% of the total area of Gg12 ecological communities available in the Landscapes and Ecosystems RSA. The Project effects to this ecological community is attributed to land clearing, grubbing, and soil salvaging activities associated with the haul road construction to the rail loadout.



Crown Mountain Coking Coal Project

Figure 14.7-2
Listed and Sensitive Plant Communities in the
Landscapes and Ecosystems Regional Study Area

LEGEND

- | | | |
|---|--|---------------------------------|
| Rough Fescue - (Bluebunch Wheatgrass) - Yarrow - Clad Lichens | Landscapes and Ecosystems Local Study Area | Wetland |
| Whitebark Pine | Crown Mountain Coking Coal Project | Provincial Park/Protected Area |
| Reasonably Foreseeable Future Projects and Activities | Highway | National Park |
| Landscapes and Ecosystems Regional Study Area | Railway | British Columbia/Alberta Border |
| | Transmission Line | |
| | Watercourse | |
| | Waterbody | |

0 10 20
Kilometres

Scale 1:500,000

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

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

NWP Coal Canada Ltd

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The Project also was predicted to result in the indirect change in listed plant community and species composition and structure within an area of influence around the Project footprint as a result of vegetation removal and soil disturbance within the Project footprint. This residual effect is difficult to effectively quantify, as changes to plant community composition and structure adjacent to the Project footprint may range from an undetectable change at a microclimatic scale to a detectable and quantifiable alteration in the plant community composition and structure as a result of disturbance within the Project footprint. As such, the potential cumulative residual Project effect on the composition and structure of listed plant communities and species was combined with the assessment of cumulative residual effects on listed plant communities and species abundance and distribution.

Future Case

An analysis of reasonably foreseeable future projects and/or activities in the Landscapes and Ecosystems RSA did not identify any specific project or activity that intersects with the identified Gg12 ecological communities. Therefore, the Future Case of the cumulative assessment of effects on Gg12 ecological communities is expected to remain consistent with the Project Case.

Natural processes and the effects of climate change are expected to continue to affect Gg12 ecological communities within the Landscapes and Ecosystems RSA in the future; however, based on the forecasted climate modelling for the Elk Valley, and the positive effect that natural processes (specifically fires) can have on grassland ecosystems, the effects of these factors cannot be accurately predicted. Given these uncertainties, the potential contribution of climate change and natural processes to the cumulative effect on changes to the abundance, distribution, composition, and structure of Gg12 ecological communities cannot be accurately predicted at this time.

14.7.6.1.2 Determination of Significance of Residual Cumulative Effects

No other reasonably foreseeable future projects or activities were identified that could interact with the Project to cumulatively contribute to the effects on listed plant communities and species within the Landscapes and Ecosystems RSA. Thus, the maximum potential extent of loss or change in composition and structure of Gg12 ecological communities is expected to be limited to the residual effects of the Project, and the effects resulting from natural processes and climate change, which cannot be accurately predicted at this time.

By extending the threshold of significance to the cumulative effects assessment, the residual effects of the Project acting cumulatively with the other past, present and reasonably foreseeable future developments or activities is not anticipated to pose a risk to the long term viability and persistence of listed plant communities and species in the Landscapes and Ecosystems RSA and, therefore, is not significant. Residual effects are characterized as follows:

- Duration: Permanent, as the direct loss of the Red-Listed Gg12 ecological community will occur in Construction and Pre-Production phase within the Project footprint.
- Magnitude: Moderate, the Project acting cumulatively with past, present and other reasonably foreseeable future developments or activities will result in the loss or alteration of approximately 66.4% of Gg12 ecological communities in the Landscapes and Ecosystems RSA; however, the Project contribution to cumulative effects on Gg12 ecological communities accounts for approximately 1.5% (i.e., 0.54 ha of 36.09 ha) to the existing cumulative effects on Gg12 ecological communities in the Landscapes and Ecosystems RSA.

- Geographic Extent: Discrete, as areas of the Gg12 ecological community that overlap with the Project footprint will be directly impacted and lost.
- Frequency: Once, the direct loss of the Gg12 ecological community within the Project footprint occurs only within the Construction and Pre-Production phase of the Project.
- Reversibility: Irreversible, as the loss of 0.54 ha of Gg12 cannot be reversed.
- Context: Low, the Gg12 grassland communities affected by the Project and past, present or other reasonably foreseeable future developments and/or activities have a low sensitivity and resilience to change as it is anticipated to be slow to recover from disturbance.

In light of the above, and in consideration of planned mitigation for the Project in addition to similar mitigation being assumed for other ongoing projects or activities, the residual cumulative environmental effects of the Project in combination with those of past, present, and reasonably foreseeable future projects or activities on listed plant communities and species, during all phases of the Project, are considered not significant.

14.7.6.1.3 Likelihood and Confidence

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

Confidence considers the reliability of data and analytical methods used in the assessment of effects. The confidence in the characterization of the residual effects to listed plant community and species abundance, distribution, composition, and structure from Project development is considered to be moderate. While baseline conditions of the listed plant community Gg12 are well established and understood, uncertainty exists with respect to the extent and distribution of the Gg12 ecological community adjacent to existing areas of disturbance and linear features that currently bisect the community. Available data allows for an understanding of potential effects to the listed plant community; however, additional data may support a better understanding of the interactions between the Project and the listed plant communities and species VC. Further, while it is reasonably certain that a loss of the Gg12 ecological community will be required, the full extent of loss associated with past, present and reasonably foreseeable future developments and/or activities cannot be accurately predicted with the information available. Consequently, the determination of significance is assessed to have only a moderate level of confidence; however, this level of confidence is reflected in the conservatism included in the predicted area of impact.

14.7.6.2 Whitebark Pine

14.7.6.2.1 Characterization of Residual Cumulative Effects

The assessment of residual cumulative effects on whitebark pine involves the consideration and evaluation of specific effects assessment criteria based on the degree (i.e., 'level') of potential Project effects. Similar to the Project effects assessment, the criteria used to characterize residual cumulative effects include duration, magnitude, geographic extent, frequency, reversibility, and context, as defined in Chapter 5, Section 5.3.4.5. The residual cumulative effects on whitebark pine are determined based on the same significance thresholds as were established for residual Project effects as outlined in Section 14.6.1.3.

Base Case

Whitebark pine has been historically detected throughout the Landscapes and Ecosystems RSA (B.C. CDC, 2020) for which the respective proposed recovery strategy (ECCC, 2017) identifies as much as 236,671 ha, or 67% (i.e., 236,671 ha of 350,919 ha) of the Landscapes and Ecosystems RSA could be considered critical habitat for whitebark pine (Figure 14.7-3). Although the potential critical habitat areas mapped by ECCC (2017) would equal as much as 9,508 ha within the Landscapes and Ecosystems LSA, surveys conducted for the Project refined the potential extent to be far less (i.e., 1,336 ha; Table 14.5-10). Consequently, the estimate of critical habitat in the Landscapes and Ecosystems RSA mapped by ECCC (2017) presents a maximum unverified extent for which the actual extent would be substantially less.

Project Case

Although as much as 1,176 ha of critical habitat proposed by ECCC (2017) is intersected by the Project footprint, Project-specific analysis confirmed that the actual extent will be closer to 802 ha, or less than 1% (i.e., 802 ha of 236,671 ha) of the total extent of potential whitebark pine critical habitat in the Landscapes and Ecosystems RSA.

Future Case

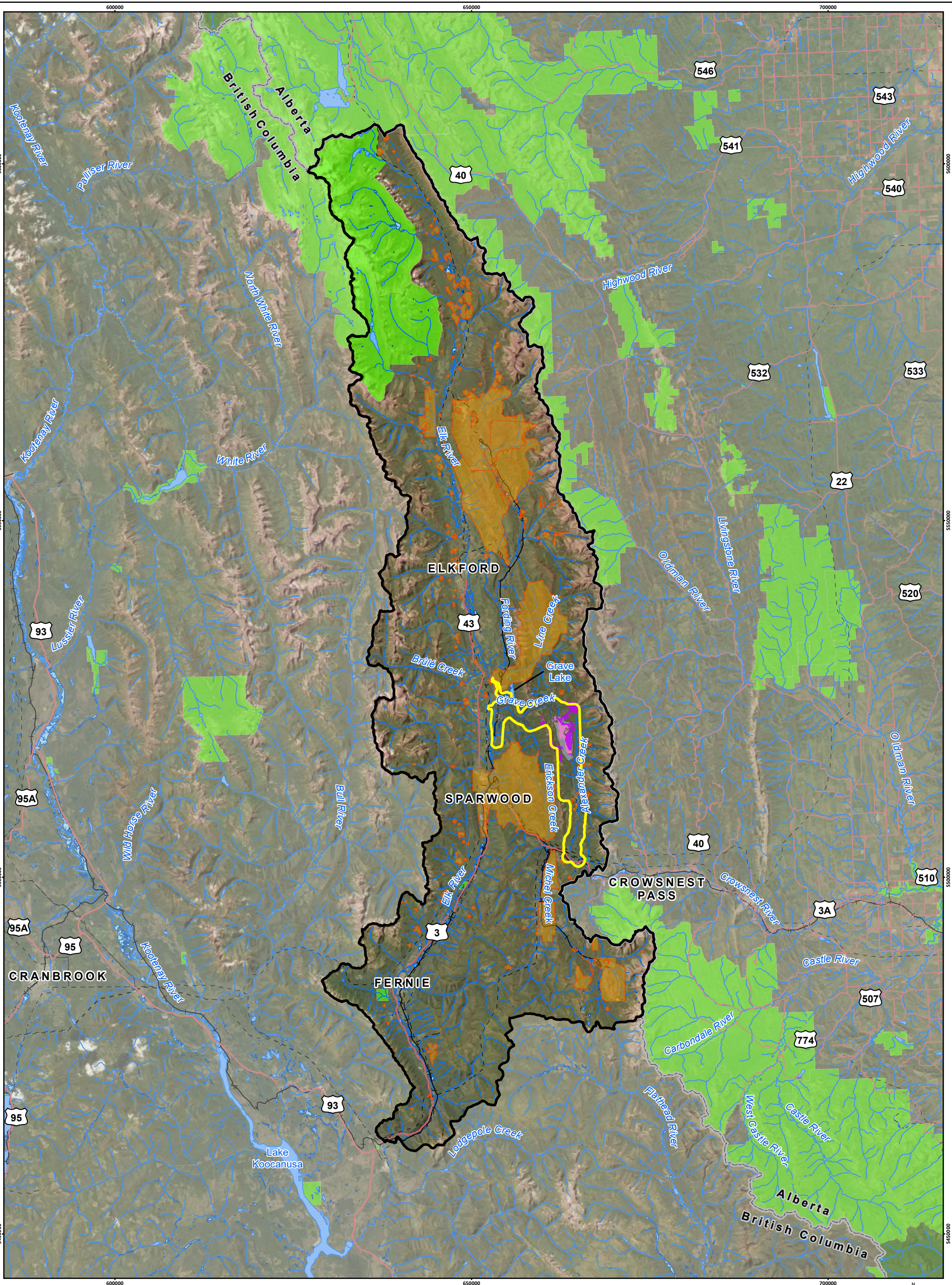
The Project and other reasonably foreseeable future projects or activities directly overlap with approximately 32,984 ha, or approximately 14% (i.e., 32,984 ha of 236,371 ha) of potential whitebark pine critical habitat mapped by ECCC (2017). The Project contributes to approximately 2% of the potential effect on whitebark pine critical habitat (i.e., 591 ha of 32,984 ha), proportional to its contribution to the overall footprint of other reasonably foreseeable future projects or activities (i.e., less than 3%). These extents of overlap between whitebark pine critical habitat and the footprints of reasonably foreseeable future projects or activities does not consider the potential for restoration of populations, or suitable habitat at closure.

Although the extent cannot be spatially quantified, the cumulative effects of other reasonably foreseeable future projects or activities, mortality due to white pine blister rust (i.e., 80% over the duration of the Project⁷), and climate change on the extent of critical habitat for whitebark pine will likely be of materially consequential magnitude.

14.7.6.2.2 Determination of Significance of Residual Cumulative Effects

Regardless of additional mitigation measures being implemented, like the Project, it is unlikely that other reasonably foreseeable future projects or activities can completely avoid the direct loss of whitebark pine (and its critical habitat). The maximum potential extent of cumulative loss or change in composition and structure of whitebark pine critical habitat in the Landscapes and Ecosystems RSA due to the Project in combination with other reasonably foreseeable future projects or activities is estimated to be 32,984 ha or 14% of the area of potential critical habitat available in the Landscapes and Ecosystems RSA, not including the effects of climate change or white pine blister rust. ECCC (2017) identified that both climate change and white pine blister rust had potential to affect up to 100% of the national population, which may be assumed to apply to the Landscapes and Ecosystems RSA.

⁷ The spatial extent of mortality cannot be accurately predicted, as the proportion of individuals affected may not accurately affect the area of critical habitat affected.



Crown Mountain Coking Coal Project

LEGEND

- Potential Whitebark Pine Recovery/Regeneration Critical Habitat
- Potential Whitebark Pine Seed Dispersal Critical Habitat
- Reasonably Foreseeable Future Projects and Activities
- Landscapes and Ecosystems Regional Study Area
- Landscapes and Ecosystems 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 10 20
Kilometres

Scale 1:500,000

Map Drawing Information:
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Imagery Provided By ESRI.
Map Created By: LMM
Map Checked By: LKD
Map Coordinate System: NAD 1983 UTM Zone 11N

Figure 14.7-3
Whitebark Pine Habitat and Critical Habitat in the Landscapes and Ecosystems Regional Study Area



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Although mitigation strategies will support building resilience in whitebark pine populations, it is unlikely that complete restoration will occur such that the extent of whitebark pine will be sustained from existing conditions. Consequently, the net effect of the Project and other reasonably foreseeable future projects or activities interacting cumulatively with natural disturbance and climate change will likely result in a loss or degradation of habitat and a reduction in density to below sustainable population densities. Given the slow generation cycle of whitebark pine (i.e., 60 years to reproductive maturity) and anticipated duration of the effects of climate change, the residual cumulative effect will be permanent and irreversible in the context of the assessment period.

In light of the above, residual cumulative effects are characterized as follows:

- **Duration:** Permanent, effects from the mortality of whitebark pine and/or loss of habitat (including critical habitat) will extend well beyond the Project's Post-Closure phase until such time that restored populations of whitebark pine achieve reproductive maturity and a minimum basal area of 2 m²/ha.
- **Magnitude:** Moderate to High, the Project in combination with other reasonably foreseeable future projects or activities will result in mortality and/or habitat loss of whitebark pine, but not likely of such extent to reduce the net basal area for whitebark pine (after restoration) in seed dispersal critical habitat below the threshold of 2 m²/ha. Climate change and white pine blister rust are anticipated to affect potentially the entire population of whitebark pine.
- **Geographic Extent:** Beyond Regional, although removal of individuals and/or habitat due to the Project in combination with other reasonably foreseeable future projects or activities is confined to the Landscapes and Ecosystems RSA, the effects of climate change and white pine blister rust affect the national population whitebark pine.
- **Frequency:** Continuous, removal of whitebark pine and/or its associated habitat due to all interacting factors (including climate change and white pine blister rust) will occur continuously throughout the duration of the Project.
- **Reversibility:** Reversible Long-Term to Permanent, restored populations of whitebark pine may take at least 60 years to become reproductively mature and self-sustaining; however, the use of rust resistant plants in restoration is likely to have a strong reversibility, particularly as the frequency of rust-resistance increases in the population under natural reproductive conditions. Given the limitations of the alpine environment, it is possible that some areas of critical habitat lost due to climate change will not be replaced.
- **Context:** Low, whitebark pine has exhibited high rates of loss in other nearby populations (e.g., WLNP; ECCO, 2017) and therefore, until such time that resistance to white pine blister rust is established, is likely to be non-resilient and susceptible to substantial perturbation from other interacting factors.

In light of the above, and in consideration of planned mitigation for the Project and other reasonably foreseeable future projects or activities, the residual cumulative environmental effects of the Project in combination with those of past, present, and reasonably foreseeable future projects or activities on whitebark pine, during all phases of the Project, are considered significant; however, the Project contribution to these residual cumulative environmental effects on whitebark pine is estimated at 802 ha, or less than 1% (i.e., 802 ha of 236,671 ha) of the total extent of potential whitebark pine critical habitat in the Landscapes and Ecosystems RSA. In this light, the Project contribution to the residual cumulative environmental effects of the Project in combination with those of past, present, and reasonably

foreseeable future projects or activities on whitebark pine, during all phases of the Project, is considered not significant.

Mitigation measures implemented for the Project would contribute to the body of professional knowledge related to the management, propagation, and restoration of whitebark pine in British Columbia and Canada. Although research in these programs is focussed on a project-specific level, the body of knowledge generated from practical application of these techniques provides foundational knowledge for future scalability in larger conservation initiatives. Absent of this research being conducted in support for reasonably foreseeable future developments (including the Project), an equivalent level of investment would be required from public sources to achieve the same body of knowledge.

14.7.6.2.3 Likelihood and Confidence

Whitebark pine restoration programs associated with mitigation of reasonably foreseeable, future developments will reduce the extent of effects, but are unlikely to be able to completely reverse all losses, at least over the assessment period. Further, the generational period of whitebark pine is sufficiently long to preclude an adaptive response to climate change and white pine blister rust. Consequently, the likelihood of the residual cumulative effect is considered to be high.

The level of confidence of the significance prediction on mortality of whitebark pine and/or loss of habitat is considered to be low, given uncertainty in the confirmed extent of whitebark pine in the Landscapes and Ecosystems RSA, the background loss of whitebark pine due to white pine blister rust (among other sources of mortality), and the success of whitebark pine restoration programs. Mitigation and follow up measures will improve the level of confidence in this prediction.

14.7.7 Summary of Cumulative Effects Assessment

Residual Project effects carried forward to the cumulative effects assessment included:

- Change in listed plant community and species abundance and distribution;
- Change in listed plant community and species composition and structure; and
- Change in whitebark pine mortality and/or loss of whitebark pine habitat.

Given the complexity of potentially interacting projects and activities, and that not all potential effects can be effectively quantified by the extent of the footprint alone, the characterization of changes in composition or structure cannot be feasibly quantified. Consequently, where residual Project effects were predicted to affect the composition or structure of vegetation VCs, these were considered to be approximately proportional to the extent of direct impacts of their footprints. Consequently, the list of potential cumulative effects was reduced to include only those associated with the abundance and distribution of the respective VC.

Using the area of overlap between the identified VCs and the footprints of the Projects, the magnitude of potential cumulative effects was characterized to the extent practical; however, not all potential cumulative effects could be quantified. Where applicable, the anticipated potential effect of climate change and other indirect cumulative effects were described qualitatively. The cumulative effects assessment assumed that potential effects of existing and reasonably foreseeable future projects and activities in the Landscapes and Ecosystems RSA are likely to be mitigated in a manner similar to that proposed for the Project. Consequently, the described extent of cumulative effects (whether qualitative

or quantitative) provides a conservative estimate of the residual effects, as it does not factor the ecological restoration that would occur during the Post-Closure phase of the Project and reasonably foreseeable future projects and activities.

The Project’s respective contribution to the potential cumulative effects was generally found to be proportional to its contribution to the footprint of reasonably foreseeable future projects and activities (Table 14.8-2). There are no residual cumulative effects found to be significant; however, some were characterized to be of moderate or high magnitude, and have some degree of irreversibility.

14.8 Follow-up Strategy

As defined in Canadian Environmental Assessment Act 2012, a follow-up program is used to verify environmental effects predictions or to verify the effectiveness of mitigation measures; general environmental assessment practice is to define a follow-up program where there is uncertainty in the level of confidence (i.e., low to moderate confidence) in the significance predictions or surrounding the effectiveness of mitigation. Where a follow-up program identifies that environmental effects differ from those predicted in the effects assessment, or where mitigation measures prove to be ineffective, alternative strategies are developed to adaptively manage the Project’s effects on the vegetation VCs.

Residual effects and cumulative effects for vegetation VCs for which uncertainty was identified are summarized in Table 14.8-1.

Table 14.8-1: Summary of the Confidence for Residual Project and Cumulative Effects on Vegetation VCs

Valued Component	Residual Effect	Confidence Ranking		Follow-up Program Required
		Project Effects	Cumulative Effects	
Listed and Sensitive Plant Communities and Species	Change in Abundance and Distribution	Moderate	Moderate	Yes
	Change in Composition and Structure	Moderate		
Whitebark Pine	Change in Abundance and Distribution	Moderate	Low	Yes

14.8.1 Proposed Approach to Follow-up

The proposed follow-up program for vegetation VCs is presented in Table 14.8-3.

Species composition and abiotic factors (e.g., dustfall) shall be monitored at permanent fixed survey locations with sufficient frequency and intervals between documentation events to detect material variation affecting vegetation over the implementation period. For example, species composition might be characterized between one and three times per year depending on the duration of the growing season, whereas dustfall rates may be assessed monthly or annually (as a single aggregate sample).

Table 14.8-2: Summary of Cumulative Effects on Vegetation VCs

Residual Cumulative Effect	Mitigation Measures	Summary of Cumulative Residual Effects Characterization	Significance (Significant, Not Significant)	Confidence (High, Moderate, Low)
Change in Listed Plant Community and Species Abundance and Distribution	<ul style="list-style-type: none"> • Project design optimization • Minimizing disturbance and cleared areas • Establish exclusion/ “no work” zones and setback buffers • Education and training • Implementation of the Soil Management Plan • Implementation of the Erosion and Sediment Control Plan 	Duration: Long-term to Permanent Magnitude: Moderate Geographic Extent: Discrete Frequency: Once Reversibility: Irreversible Context: Low	Not Significant	Moderate
Change in whitebark pine mortality and/or loss of whitebark pine habitat	<ul style="list-style-type: none"> • Project design optimization • Salvage topsoil to retain seedbank • Implementation of Ecological Restoration Plan, including: <ul style="list-style-type: none"> ○ Complete inventory and mapping of whitebark pine distribution and critical habitat; ○ Replacement of critical habitat; ○ Collection of seeds and scion; and ○ Determination of compensation ratio; and • Operational monitoring of retained critical habitat 	Duration: Permanent Magnitude: Moderate to High Geographic Extent: Beyond Regional Frequency: Continuous Reversibility: Reversible long-term to Irreversible Context: Low	Not Significant	Low

Table 14.8-3: Follow-up Monitoring Measures and Timing/Duration by Valued Component

Valued Component	Follow-up and Monitoring Measure	Timing (Phase)	Duration (Years)
Listed and Sensitive Plant Communities and Species	Areal extent of known listed plant communities and species overlapping with Project footprint activities	Construction and Pre-Production and Operations phases	Prior to disturbance only
	Areal extent of known listed plant communities and species overlapping with occurrences of weeds and invasive, non-native species as well as the area of implemented control/treatment measures	Construction and Pre-Production and Operations phases	Prior to disturbance, and years 1, 3 and 5 following initial disturbance
	Areal extent of known listed plant communities and species overlapping with spills or releases of deleterious substances including sediment-laden water	Only required where overlapping with reportable spills or releases.	Years 1, 3 and 5 following spill/release event
	Plant species composition as well as the rate of deposition (i.e., mass/year/hectare), particle size analysis and contaminant analysis for dustfall at regular intervals up to 100 m from the edge of clearing from the Project in known areas of listed plant communities and species	Construction and Pre-Production and Operations phases	Prior to disturbance, and years 1, 3 and 5 following initial disturbance
Whitebark Pine	Extent of known whitebark pine populations and critical habitat overlapping with Project footprint activities	Construction and Pre-Production and Operations phases	Prior to disturbance only
	Extent of known whitebark pine populations and critical habitat overlapping with occurrences of weeds and invasive, non-native species as well as the area of implemented control/treatment measures	Construction and Pre-Production and Operations phases	Prior to disturbance, and years 1, 3 and 5 following initial disturbance
	Extent of known whitebark pine populations and critical habitat overlapping with spills or releases of deleterious substances including sediment-laden water	Only required where overlapping with reportable spills or releases.	Years 1, 3 and 5 following spill/release event
	Plant species composition as well as the rate of deposition (i.e., mass/year/hectare), particle size analysis and contaminant analysis for dustfall at regular intervals up to 100 m from the edge of clearing from the Project in known whitebark pine populations and critical habitat	Construction and Pre-Production and Operations phases	Prior to disturbance, and years 1, 3 and 5 following initial disturbance

The follow-up program outlined in the Vegetation and Ecosystems Management and Monitoring Plan (Chapter 33, Section 33.4.1.11) will:

- Describe/quantify (where appropriate) the Project activities conducted over the preceding year including but not limited to the extent of clearing, volume of material mined and type of infrastructure installed;

- Describe the mitigation measures implemented (including their maintenance, alteration and/or removal) over the preceding year;
- Provide the results of monitoring conducted in the preceding year;
- Identify deficiencies in mitigation measures or monitoring protocols as well as their proposed resolution; and
- Verify the accuracy of predictions and conclusions provided in this environmental assessment.

Mitigation and monitoring strategies proposed for the vegetation VCs will be updated over the course of the Project, as appropriate, to maintain consistency with provincial and federal regulatory requirements, best management practices, and scientific methods and research techniques. Throughout the life of the Project, material amendments to mitigation measures and monitoring programs will be carried out in collaboration with Indigenous communities, provincial and federal agencies, and key stakeholders.

14.9 Summary and Conclusions

Vegetation VCs assessed in this chapter included listed plant communities and species, limber pine, and whitebark pine. Potential residual effects on listed plant communities and whitebark pine were predicted to be the result of overlap with the planned Project footprint, resulting in a potential change in the abundance and distribution of these VCs, with the exception of limber pine which is not known to be present in the Project footprint. Predicted residual effects to listed plant communities and species also included potential changes in plant composition and structure as well as changes in listed plant communities or species structure as a result of invasive plants and dust deposition. The project also has the potential to result in indirect effects to vegetation VCs through the introduction and/or spread of weeds and invasive species and the deposition of sediments and dust. These effects are anticipated to be mitigated through standard industry practices.

Despite these potential effects, the Project was not predicted to result in significant environmental effects on any of the vegetation VCs. The Project's Ecological Restoration Plan (Chapter 33, Section 33.4.1.3) will assist in reducing the net effect of the Project on the vegetation VCs; however, not all effects to these VCs can be restored to baseline conditions. For those potential effects that could not be completely mitigated and for which residual Project effects remained after mitigation, their potential to interact with the effects of other past, present, or reasonably foreseeable future projects or activities to result in cumulative effects was considered. In the cumulative effects assessment, the extent of effects to vegetation VCs from past and present projects or activities were considered to be largely encompassed in the existing (baseline) conditions for disturbed land covers and ecosystem types. Reasonably foreseeable future projects and activities were mapped for their incremental contribution to the overlap with vegetation VCs in the Landscapes and Ecosystems RSA. Assuming that the entire mapped area of a VC will be removed or substantially altered within the respective footprints of other projects or activities, changes in the abundance and distribution of applicable VCs were predicted throughout the Landscapes and Ecosystems RSA. Reasonably foreseeable future projects and activities were assumed to be held to the same regulatory requirements as the Project, and therefore are likely to involve the implementation of similar mitigation measures. Residual cumulative effects were predicted for all vegetation VCs; however, there were none considered to be significant, particularly in consideration of the Project's respective modest contribution to those cumulative effects.

Given that there was some uncertainty in several of the mitigation measures, as well as uncertainty in some of the preliminary data and predictive modelling used to predict potential effects and the measures to mitigate them, confidence in the effects predictions was generally considered to be moderate, and therefore follow-up programs are recommended. Follow-up programs will allow for the Project to adaptively manage environmental effects as they arise throughout the phases of the Project.

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