



BC EAO EAC Application – Tenas Project

Section 4.0 Environmental Effects Assessment

Chapter 7 Vegetation Valued Component

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Tenas Project

Section 4.0 Environmental Effects Assessment Chapter 7 Vegetation Valued Component

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Appendix 4.7-A Vegetation and Ecosystems Baseline Report

ABBREVIATIONS AND ACRONYMS

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
AAC	Annual Allowable Cut
AIR	Application Information Requirements
ALR	Agricultural Land Reserve
AQMP	Air Quality Management Plan (S13.0-C2)
ARD	acid rock drainage
BAFAun	Boreal Altai Fescue Alpine Undifferentiated subzone
BC	British Columbia
BC CDC	British Columbia Conservation Data Centre
BC EAO	British Columbia Environmental Assessment Office
BC MAL	British Columbia Ministry of Agriculture and Lands
BC MELP	British Columbia Ministry of Environment, Lands, and Parks
BC MEMLI	British Columbia Ministry of Energy, Mines and Low Carbon Innovation
BC MOE	British Columbia Ministry of Environment
BC MOF	British Columbia Ministry of Forests
BC MOFR	British Columbia Ministry of Forests and Range
BC MFLNRO	British Columbia Ministry of Forests, Lands, and Natural Resource Operations
BC MFLNRORD	British Columbia Ministry of Forests, Lands, and Natural Resource Operations and Rural Development
BGC	Biogeoclimatic
BMP	best management practice
C	Chapter
CEA	cumulative effects assessment
CEAA	Canadian Environmental Assessment Agency
CEPA	<i>Canadian Environmental Protection Act</i> , 2012, SC 2012, c. 19, s. 52 (Government of Canada [GovCan] 2012)
Code	Health, Safety and Reclamation Code for Mines in British Columbia (British Columbia Ministry of Energy, Mines and Low Carbon Innovation [BC MEMLI] 2021)
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPP	Coal Processing Plant
EA	Environmental Assessment
EAC	Environmental Assessment Certificate
ECCC	Environment and Climate Change Canada
eFlora	Electronic Atlas of the Flora of BC
EMP	Explosives Management Plan (S13.0-C6)
EPIC	Environmental Assessment Project Information Centre

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
ESSF	Engelmann spruce subalpine fir zone
ESSFmc	Engelmann spruce subalpine fir zone moist cold subzone
ESSFmcp	Engelmann Spruce-Subalpine Fir moist cold parkland subzone
ESSFmcw	Engelmann spruce subalpine fir zone moist cold subzone woodland variant
FMSCP	Fuel Management and Spill Control Plan (S13.0-C7)
FSR	Forest Service Road
GovBC	Government of British Columbia
GovCan	Government of Canada
IAAC	Impact Assessment Agency of Canada
LRMP	Land and Resource Management Plan
LMH	Land Management Handbook
LSA	Local Study Area
MERP	Mine Emergency Response Plan (S13-C9)
ML	metal leaching
ML/ARDMP	Metal Leaching (ML)/Acid Rock Drainage (ARD) Management Plan (S13.0-C12)
MTCP	Minesite Traffic Control Plan (S13.0-C10)
MWMP	Minesite Water Management Plan (S13.0-C11)
NDT	Natural Disturbance Type
non-PAG	non-potentially acid generating
NWIPC	North West Invasive Plant Council
Oikos	Oikos Ecological Services
OGMAs	Old Growth Management Areas
PAG	potentially acid generating
PEM	Predictive Ecosystem Mapping
POC/COC	Parameters of Concern/Contaminants of Concern
POPC/COPC	Parameters of Potential Concern/Contaminants of Potential Concern
Project	Tenas Project
QA/QC	Quality Assurance and Quality Control
RCP	Reclamation and Closure Plan (S13.0-C15)
RDBN	Regional District of Bulkley-Nechako
RIC	Resources Inventory Committee
RISC	Resources Information Standards Committee
RSA	Regional Study Area
ROM	run-of-mine
ROW	right-of-way
S	Section

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
SARA	<i>Species at Risk Act</i> , SC 2002, c 29 (Government of Canada [GovCan] 2002)
SBS	sub-boreal spruce zone
SBSdk	sub-boreal spruce zone dry cool subzone
SBSmc2	sub-boreal spruce zone moist cold subzone Babine variant
SEPSCP	Surface Erosion Prevention and Sediment Control Plan (S13.0-C17)
SIL	Survey Intensity Level
THLB	Timber Harvesting Land Base
TEM	Terrestrial Ecosystem Mapping
TSA	Timber Supply Area
TK	Traditional Knowledge
VC	Valued Component
VMP	Vegetation Management Plan (S13.0-C18)
VRI	Vegetation Resources Inventory
WHA	Wildlife Habitat Area
WMP	Wildlife Management Plan (S13.0-C21)

UNITS OF MEASURE

Abbreviation	Long form of Abbreviation or Acronym
>	greater than
<	less than
%	percent
ha	hectare
km	kilometre
kV	kilovolt
m	metre
m ³	cubic metres
mg/dm ² -d	milligram per square decimeter per day
µm	micrometre
V	volt

EXECUTIVE SUMMARY

This chapter addresses the potential effects of the Tenas Project (Project) on the Vegetation Valued Component (VC). Vegetation was selected as a VC based on the likelihood of interaction with the Project, its contributing role to biodiversity, ecosystem function, and maintenance of wildlife habitat. Vegetation then contributes to environmental, socio-economic, and cultural values of Indigenous groups, regulators, the public and other stakeholders. Subcomponents and associated indicators under the Vegetation VC are:

- ▶ Old Growth Forest: change in extent and structural stage;
- ▶ Wetlands (including biodiversity, water quantity and quality, and habitat function): change in extent of wetland communities;
- ▶ Listed Ecological Communities: change in extent;
- ▶ Culturally Important Species: change in extent; and
- ▶ Rare Plants and Lichens: change in extent of known occurrences.

Potential Project effects on the Vegetation VC and associated subcomponents include:

- ▶ alteration/loss of vegetation, ecosystems, and wetlands; and
- ▶ deposition of trace metals on plants and soil, which can result in uptake by plants.

The alteration of vegetation is defined as reduced ecosystem function, plant vigour, and/or changes to population extent. The alteration of vegetation may occur due to introduction and/or proliferation of invasive plants, changes in water quality and quantity, edge effects, dust deposition, and soil erosion, deposition, and sedimentation. Alteration of vegetation can lead to the loss of vegetation, ecosystems and/or wetlands. The loss of vegetation is defined as habitat alteration to the extent that it is rendered functionally unable to support vegetation populations or ecosystems. Land clearing and grubbing are anticipated to result in the greatest contribution to loss of vegetation. Trace metals deposition is defined as the deposition of elements on plants and soil at abundances higher than baseline conditions due to Project activities.

The Project will be developed to design-specifications to avoid, minimize, and rehabilitate onsite, potential effects on the Vegetation VC and subcomponents during all Project phases. Project activities have been planned and sequenced to avoid wetlands, watercourses, and sensitive ecosystems to the extent practical, and the Project footprint has been minimized to the extent feasible. Mitigation measures based on industry best management practices (BMP), procedures and proven/accepted mitigation used on other similar projects have been designed and implemented to monitor and maintain the integrity of the Vegetation VC during Project phases.

The Project residual effects on Old Growth Forest, Wetlands, Listed Ecological Communities, Culturally Important Species, and Rare Plants and Lichens are expected to be **Not Significant**. Considering this, the Project effects are not expected to alter the integrity of the Vegetation VC within the Vegetation RSA beyond an acceptable level (i.e., it remains sustainable and is available to contribute to ecological function).

Project-related residual-effects were assessed in terms of their cumulative effect within the RSA based on available information and understanding of other reasonably foreseeable projects and activities. Upon review of projects and activities within the Vegetation RSA (past, present and future), it was determined that cumulative effects are expected to occur but expected to be **Not Significant**. The Level of Confidence for these predictions is Moderate. No additional mitigation is deemed necessary.

1. INTRODUCTION

This chapter presents the identification and assessment of the residual effects of the Tenas Project (Project) and the cumulative effects on the Vegetation Valued Component (VC) in a thorough, rigorous, and concise manner. For this Environmental Assessment Certificate (EAC) Application, the Vegetation VC is represented by five (5) subcomponents:

1. Old Growth Forest;
2. Wetlands;
3. Listed Ecological Communities;
4. Culturally Important Species; and
5. Rare Plants and Lichens.

This assessment is comprised of the following steps:

- ▶ **Regulatory Context:** A description of the applicable legislation, policies, standards, and guidelines pertaining to the protection of the Vegetation VC;
- ▶ **Scope of the Assessment:** A description of the assessment scope including issues scoping, rationale for the selection of the Vegetation VC, subcomponents and indicators, and definitions for the spatial and temporal boundaries of the assessment;
- ▶ **Existing Conditions:** A description of the baseline studies undertaken for the Project, other relevant information, and a description of the Vegetation VC within the defined spatial boundaries;
- ▶ **Assessment of Project-related Effects:** A description of the potential interactions between the Project and the Vegetation VC, potential effects, proposed mitigation measures, an evaluation of potential residual effects that remain following implementation of the proposed mitigation measures, and an assessment of their significance;
- ▶ **Cumulative Effects Assessment (CEA):** The development of additional mitigation measures to avoid, minimize, or control cumulative effects (if/where necessary) and a characterisation of the cumulative effects on the Vegetation VC and their significance considering the residual effects of the Project in combination with the residual effects of past, present, and reasonably foreseeable future projects and activities; and
- ▶ **Follow-up Strategy:** A presentation of monitoring programs to verify assessment predictions and evaluate mitigation effectiveness, and a discussion of adaptive management program(s) to be implemented to address any unexpected Project effects on the Vegetation VC.

2. REGULATORY CONTEXT

This environmental assessment (EA) has considered applicable federal and provincial legislation, regulations, strategies, guidelines, plans, and best management practices (BMPs) relevant to the Vegetation VC, and includes information provided by Indigenous groups. Applicable recommendations in provincial land use plans and designations were also considered.

The Tenas Project Application Information Requirements (AIR) for the Project, approved by the British Columbia Environmental Assessment Office (BC EAO) in 2022, outlines the requirements of the EA for the Vegetation VC to meet the provincial EA requirements under the *Environmental Assessment Act*, SBC 2002, c 43 (Government of British Columbia [GovBC] 2002b) (EAA). The EA for the Vegetation VC follows these guidelines and legislated requirements and is consistent with the requirements of the Project AIR. Legislation specific to the Vegetation VC and descriptions of the data requirements to assess the environmental effects are presented in the following subsections.

2.1 Federal Legislation and Regulations

The Pacific/Yukon region of the Environment and Climate Change Canada (ECCC) administers or shares responsibility for several acts addressing legislation directly or indirectly applicable to the Vegetation VC. Federal legislation, regulations, and policy applicable to the Project and relevant to the Vegetation VC are described in **Table 2.1-1**.

Table 2.1-1: Summary of Federal Legislation, Regulations and Policy Applicable to the Vegetation Valued Component (VC)

Name	Year	Description
<i>Canadian Environmental Protection Act</i> , 1999, SC 1999, c 33 (Government of Canada [GovCan] 1999) (CEPA)	1999	CEPA focuses on protecting environmental and human health by preventing, controlling, and managing pollutants, wastes, and other toxic substances and contributing to sustainable development
Federal Policy on Wetland Conservation (GovCan 1991)	1991	The policy provides goals, guiding principles, and strategies to protect, promote, conserve, and enhance wetlands located on federal lands and waters in Canada, based on scientific evidence and co-operation.
<i>Fisheries Act</i> , 1985, c F-14 (GovCan 1985a)	1985; amended 2019	The Act prohibits harmful alteration, disruption, and destruction of fish habitat, supports restoration of fish habitat and riparian areas, and regulates commercial fisheries and other industry and development, promoting a biodiversity- and ecosystem-based approach.
<i>Seeds Act</i> , RSC 1985, c S-8 (GovCan 1985b)	1985; amended 2019	The Act and Regulations regulate the import, export, and sale of seeds in Canada, and their release into the environment. Seeds must meet established standards of registration, quality, testing, inspection, and labelling.
<i>Species at Risk Act</i> , SC 2002, c 29 (GovCan 2002) (SARA)	2002; amended 2019	SARA protects species listed on Schedule 1 as Extirpated, Endangered, and Threatened, and affords species listed as Special Concern the benefits of management planning. Species included in Schedule 1 are established by the federal Cabinet and are based on recommendations by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and consultation with government, Indigenous groups, and the public. SARA focuses on establishing and

Name	Year	Description
		implementing plans to protect listed species and their critical habitat, reduce threats, and foster recovery. A recovery strategy has been proposed for whitebark pine (<i>Pinus albicaulis</i>) (Environment Canada 2017), a SARA-listed vegetation species that has the potential to occur in the vicinity of the Project. SARA-listed vegetation species are further described in 7.4.2.5.

2.2 Provincial Legislation and Regulations

The British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development (BC MFLNRORD) is responsible for managing vegetation within the region containing the Project. The study areas for the Vegetation VC are located within the Regional District of Bulkley-Nechako (RDBN). Provincial legislation, regulations, and policy applicable to the Project and relevant to the Vegetation VC are described in **Table 2.2-1**.

Table 2.2-1: Summary of Provincial Legislation, Regulations and Policy Applicable to the Vegetation Valued Component (VC)

Name	Year	Description
<i>Agricultural Land Commission Act</i> , SBC 2002, c 36 (Government of British Columbia [GovBC] 2002a)	2002	The Act sets the legislative framework for the establishment and administration of the agricultural land preservation program. The associated Agricultural Land Reserve Use Regulation BC Reg 30/2019 (GovBC 2019a) permitted land uses within the Agricultural Land Reserve (ALR), and the Agricultural Land Reserve General Regulation, BC Reg 30/2019 sets out the required application procedures for alternative (i.e., non-farm) land uses.
<i>Ecological Reserve Act</i> , RSBC 1996, c 103 (GovBC 1996a)	1996	The Act provides for the establishment and administration of ecological reserves, which may be created to protect and preserve species at risk and their habitats (BC Parks 2019). No ecological reserves as delineated by the Government of BC (2019) exist within the Study Areas for the Vegetation Valued Component (VC).
<i>Environmental Assessment Act</i> , SBC 2002, c 43 (GovBC 2002b) (EAA)	2002	The Act provides a mechanism for the Province of British Columbia (BC) to review all major projects proposed in the province to assess for any potentially adverse environmental, economic, social, heritage, or health effects. This Project requires an assessment of potential adverse environmental effects under the Reviewable Projects Regulations, BC Reg 370/02 (GovBC 2002b), of the Act as the Project exceeds the production capacity of 250,000 tonnes per year.
<i>Environmental Management Act</i> , SBC 2003, c 53 (GovBC 2003a) (EMA)	2003	The EMA regulates pollution, hazardous waste, contaminated site remediation, and the discharge of municipal and industrial waste to the environment while ensuring the protection of human health and the environment. The Contaminated Sites Regulations, BC Reg. 161/2020 (GovBC 2020) of the Act provide quantitative standards to

Name	Year	Description
		define site contamination and to evaluate reclamation success.
<i>Forest and Range Practices Act</i> , SBC 2002, c 69 (GovBC 2002c)	2002	The Act outlines standards and requirements for how forest and range practices and natural resource activities should be conducted on Crown land in BC in a manner that safeguards protection of natural resources, including vegetation. The Act regulates forest clearing and applies protection to old growth forests and riparian areas. It also manages ecosystems as wildlife habitat through the Identified Wildlife Management Strategy.
<i>Integrated Pest Management Act</i> , SBC 2003, c 58 (GovBC 2003b)	2003	The Act and associated regulations legislate the sale and use of pesticides in BC to reduce reliance on and use of pesticides. From a vegetation perspective, the Act regulates the use of herbicides to control weeds and invasive plants.
Invasive Plants Regulation, BC Reg 18/2004 (GovBC 2004a)	2002	The Regulation is a provision to section 47 the <i>Forest and Range Practices Act</i> , SBC 2002, c 69 (GovBC 2002c), preventing the introduction or spread of invasive plants. This regulation specifies vegetation species recognized as invasive plants in BC.
<i>Mines Act</i> , RSBC 1996, c 293 (GovBC 1996b)	1996	The Act describes how mines in BC are to be operated, including administration, permitting, acquisition, delegation of power, inspection, health and safety, penalties, abandonment, and enforcement. The British Columbia Ministry of Energy, Mines and Low Carbon Innovation (BC MEMLI) requires completion of a vegetation assessment and development of an environmental management and reclamation plan to support the mitigation, decommissioning and closure of a Project.
<i>Riparian Areas Protection Act</i> , SBC 1997, c 21 (GovBC 1997)	1997 (updated 2016)	The Act regulates approval of work in and around watercourses including provision of directives relating to the protection and enhancement of riparian areas.
Riparian Areas Regulation, BC Reg 178/2019 (GovBC 2019c)	2019	The Regulation aims to protect riparian areas from development, thus preserving riparian heath, features, and functions.
<i>Water Sustainability Act</i> , SBC 2014, c 15 (GovBC 2014a)	2014	The Act manages the licensing, diversion, and use of water resources in BC. This includes regulation of changes made in and around watercourses, and provision of directives to protect water quantity, water quality, and aquatic ecosystems.
<i>Weed Control Act</i> , RSBC 1996, c 487 (GovBC 1996c)	1996	The Act establishes the duty to control designated noxious weeds growing on any occupied land in BC.
Weed Control Regulation, BC Reg 66/85 (GovBC 1985)	1985	The Regulation specifies provincial and regional noxious weeds and provides instruction on controlling their introduction and spread.
<i>Wildlife Act</i> , RSBC 1996, c 488 (GovBC 1996d)	1996 (updated 2019)	The Act provides for conservation of specific ecosystems and ecosystem components that provide habitat for wildlife species.

2.3 Strategies, Guidelines, Plans, and Best Management Practices (BMPs)

Other strategies, guidelines, plans, and BMPs are also applicable to the Vegetation VC (**Table 2.3-1**). These documents were considered when identifying the potential effects of the Project, developing appropriate mitigation measures, and characterising residual and cumulative effects.

Table 2.3-1: Summary of Strategies, Guidelines, Plans and Best Management Practices (BMPs) Applicable to the Vegetation Valued Component (VC)

Name	Year	Description
British Columbia Conservation Framework: Conservation Priorities for Species and Ecosystems (British Columbia Ministry of Environment [BC MOE] 2009)	2009	A science-based framework designed to prioritize species and ecosystems for conservation, select effective conservation actions, and coordinate management actions. Results can be used to advise conservation programs for a variety of stakeholders and organizations.
Canadian Biodiversity Strategy (Environment Canada 1995)	1995	The three (3) objectives of the strategy are the conservation of biodiversity, the sustainable use of biological resources, and the fair and equitable sharing of the benefits that result from the use of genetic resources.
A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, BC – Interim Guidance (British Columbia Ministry of Forests, Lands and Natural Resource Operations [BC MFLNRO] 2014a)	2014	These guidelines provide direction for considering and mitigating threats to wildlife and wildlife habitat in the North Area (i.e., Peace, Omineca, and Skeena regions) during industrial activities.
Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia: Section 4 (Government of British Columbia [GovBC] 2014b)	2014	The purpose of these guidelines is to provide province-wide direction for maintaining environmentally valuable resource during urban and rural land development in British Columbia (BC). Environmentally valuable resources include species, features, or environmentally valuable resource locations that enhance the biodiversity of an area; these may include common or rare species or habitats.
Environmental Assessment Best Practice Guide for Wildlife at Risk in Canada (Environment Canada 2004)	2004	This best practice guide for considering plant and wildlife species at risk in environmental assessment provides best practice guidelines, key sources of information, policy commitments and laws and a discussion of the implications of the federal <i>Species at Risk Act</i> , SC 2002, c 29 (GovCan 2002) (SARA).
Handbook for Mineral and Coal Exploration in British Columbia (British Columbia Ministry of Energy, Mines and Petroleum Resources [BC MEMPR] & BC MOE 2008)	2008	This handbook compiles existing knowledge and recommended management practices for coal exploration and mining, including practices for water management and reclamation.
Health, Safety and Reclamation Code for Mines in British Columbia (British Columbia Ministry of Energy, Mines and Low Carbon Innovation [BC MEMLI] 2021) (Code)	2021	This Code guides mining operations to minimize associated risks to human and environmental health and safety and provide standards for reclamation. The Code focuses on mine operation and personnel. Reclamation standards include land use, revegetation, watercourse, and monitoring specifications.

Name	Year	Description
Identified Wildlife Management Strategy – Accounts and Measures for Managing Identified Wildlife: Northern Interior Forest Region (British Columbia Ministry of Water, Land and Air Protection [BC MWLAP] 2004a)	2004	The strategy summarize the status, life history, distribution, and habitat requirements of identified species and plant communities; they also outline specific guidelines for habitat conservation and management.
Identified Wildlife Management Strategy – Procedures for Managing Identified Wildlife (BC MWLAP 2004b)	2004	The procedures describe the procedures for establishing, modifying, and rescinding a Wildlife Habitat Area (WHA), and for implementing strategic and landscape level planning recommendations.
Interim Assessment Protocol for Old Growth Forest in British Columbia (GovBC 2017)	2017	This report outlines the protocol for two (2) types of assessments of old growth forest objectives in BC: old, and old and mature forest retention, and incursions into Old Growth Management Areas (OGMAs).
North West Invasive Plant Council (NWIPC)	n/a	The Project is located within the Bulkley Invasive Plant Management Area of the NWIPC. The NWIPC provides support and co-ordination for invasive plant management, including providing a shared invasive plant inventory and a list of target invasive plants, spreading awareness about invasive plants, and assessing and treating new and existing invasive plant infestations.
Order Establishing Provincial Non-Spatial Old Growth Objectives (GovBC 2004b)	2004	This order identifies the age and amount of old growth forest (in percent) to be maintained in various natural disturbance types, biogeoclimatic zones, and landscape units to maintain target biodiversity values, and subsequently the amount available for timber harvesting.
Policy for Mitigating Impacts on Environmental Values (BC MOE 2014)	2014	This policy provides guidance to decisions concerning environmental mitigation measures. It incorporates environmental, social, and economic values, encourages use of the best available data and data sharing, and provides a recommended mitigation hierarchy and mitigation process and plan.
Protecting Vulnerable Species: A Five-Year Plan for Species at Risk in BC (GovBC 2014c)	2014	A five (5)-year plan to manage and protect species at risk in BC while balancing economic, environmental, and community values. This plan outlines five (5) main goals of the plan and recommends strategic action items to achieve these goals.
Standard for Terrestrial Ecosystem Mapping in British Columbia (Resources Inventory Committee [RIC] 1998)	1998	This document outlines established standards for ecosystem unit characterization, symbology, sampling, mapping procedures, interpretation, and legends.
Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia. Wetland Stewardship Partnership (GovBC 2009).	2009	This document provides recommended practices on wetland protection and conservation to land managers and land users, with the goal of maintained or increased wetland quality and quantity. The document includes specific guidelines for various sectors, including mining

2.4 Land Use Plans

The Project Area is located within lands governed by the Bulkley Land and Resource Management Plan (LRMP) (GovBC 1998) and overlap with two (2) Landscape Units: Telkwa and the Bulkley Valley. Land use planning objectives within the Telkwa Landscape Unit and the Bulkley Valley Landscape Unit are governed by the Telkwa Land Use Plan (GovBC 1999) and the Bulkley Valley Sustainable Resource Management Plan (British Columbia Ministry of Agriculture and Lands [BC MAL] 2005), respectively. Together, these plans describe resource management objectives for vegetation, including forest structure and Old Growth Forest, Wetlands, Rare Plants and Lichens, and Listed Ecological Communities. These management goals were considered in the development of mitigation measures described in **5.3.2**.

3. SCOPE OF THE ASSESSMENT

The assessment of the Vegetation VC, including the assessment of Project-related effects and cumulative effects, was conducted according to the methods set out in **Section (S) 3.0 Assessment Methodology** of this **EAC Application**. The assessment boundaries specific to the Vegetation VC are provided in **3.2.4** and the characterisation criteria specific to the Vegetation VC are provided at the start of **5.4**.

The subsection outlines the scope of the assessment, including the rationale for the inclusion of Vegetation as a VC along with its subcomponents, the selection of indicators, and the definition of spatial and temporal boundaries. The assessment is informed by the **Vegetation and Ecosystems Baseline Report (Appendix 4.7-A)**, as well as input from Indigenous groups, the public and government agencies through working groups and comment solicitation, which identified the importance of Vegetation. This assessment is organized into five (5) subcomponents:

1. Old Growth Forest;
2. Wetlands;
3. Listed Ecological Communities;
4. Culturally Important Species; and
5. Rare Plants and Lichens.

3.1 Issues Scoping

TCL has undertaken an engagement and consultation process to support the scoping of issues for the Project. Please refer to **S11.0 Wet'suwet'en Rights and Interests** and **S12.0 Public Consultation** of the **EAC Application** for details on the consultation program. The consultation and engagement process has included technical working groups established with Indigenous groups, government departments, community meetings, one-on-one and small group meetings, regarding key themes of interest and discussion of candidate VCs to represent the themes of interest.

3.2 Rationale for Selection of the Vegetation Valued Component (VC)

The Vegetation VC and associated subcomponents were selected during the pre-Application phase of the Project following the VC selection process set out in **S3.0 Assessment Methodology** of this **EAC Application** and used the methodology provided in the Guideline for Selection of Valued Components and Assessment of Potential Effects (BC EAO 2013). The goal was to focus on relevant issues, concerns, and components of the natural and human environment that may be affected by the Project.

Baseline study findings; conservation status; review of applicable government legislation, policies, and plans; effects assessments for other relevant projects; professional judgement of the Project team; and inputs from working group members, government agencies, Indigenous groups, the public, and other interested parties during consultation were considered and used to inform the selection of VCs and subcomponents.

3.2.1 Valued Component (VC)

Vegetation was selected as a VC based on the likelihood of interaction with the Project, as well as its contributing role to biodiversity, ecosystem function, and maintenance of wildlife habitat. Vegetation also contributes to environmental, socio-economic, and cultural values of Indigenous groups, regulators, the

public and other stakeholders. Vegetation supports (i.e., is input to) and/or is dependent on the assessment of several VCs:

▶ **Dependent on:**

- ▶ **Atmospheric Environment VC (S4.0-Chapter [C] 1)** – Atmospheric environment interacts with vegetation through air quality and dust deposition, which can affect vegetation growth;
- ▶ **Terrain and Soils VC (S1.0-C2)** – Terrain and soils interact with vegetation by contributing to landscape form and function, ecosystem moisture and nutrient regimes, and future land capability. Terrain, soil, and vegetation are, together, key components of reclamation design and reinstatement of equivalent land capability;
- ▶ **Groundwater VC (S4.0-C4)** – Groundwater interacts with vegetation by contributing to site drainage and discharge, moisture regimes, and water chemistry which can alter vegetation, ecosystems, and wetlands;
- ▶ **Surface Water VC (S4.0-C3)** – Surface water interacts with vegetation by contributing to site drainage and discharge and moisture regimes, which influence the persistence of vegetation, ecosystems, and wetlands.

▶ **Supporting:**

- ▶ **Aquatic Resources VC (S4.0-C5)** – Vegetation contributes to ecosystem form and function that support aquatic resources (e.g., wetland and riparian ecosystems);
- ▶ **Avian Species VC (S4.0-C9)** – Vegetation provides habitat for feeding, reproduction, rearing, and/or cover for avian species;
- ▶ **Fish and Fish Habitat VC (S4.0-C6)** – Vegetation contributes to ecosystem form and function that support fish and fish habitat (e.g., wetland and riparian ecosystems);
- ▶ **Heritage Resources VC (S7.0-C1)** – Vegetation contributes to heritage resources, including plants harvested for food, medicine, or other uses;
- ▶ **Human Health VC (S8.0-C1)** – Vegetation has been, and continues to be, harvested for food, and as such, are part of the exposure pathway from environment to vegetation to humans;
- ▶ **Land and Resource Use VC (S6.0-C4)** – Vegetation provides resource values such as timber harvesting, agriculture, and recreation;
- ▶ **Visual Resources VC (S6.0-C2)** – Vegetation contributes to visual quality, and disturbance to vegetation can alter the visual landscape; and
- ▶ **Wildlife VC (S4.0-C8)** – Vegetation provides habitat for feeding, reproduction, rearing, and/or cover for wildlife.

3.2.2 Subcomponents

Subcomponents have been selected to focus the Vegetation VC assessment on key themes of interest identified through consultation, and reviews of other information. These ecologically important and/or relevant vegetation species, communities, and habitats are expected to reflect Project effects on the Vegetation VC. Subcomponents of the Vegetation VC are:

- ▶ Old Growth Forest,
- ▶ Wetlands,
- ▶ Listed Ecological Communities,
- ▶ Culturally Important Species, and
- ▶ Rare Plants and Lichens.

Table 3.2-1: Summary of Rationale for Selection of Vegetation Valued Component (VC) and Subcomponents and Their Linkages

Subcomponent	Rationale for Inclusion	Source of Information	VC Linkages	
Old Growth Forest	▪ Potential for Project interaction ▪ Provincial management concern ▪ Habitat for wildlife species ▪ Cultural importance ▪ Contributes to biodiversity, soil building processes, nutrient cycling, productivity, and carbon storage ▪ Historically addressed for previous projects with similar conditions	▪ Land and resource management plans ▪ Sustainable resource management plans ▪ Land use plans ▪ Non-spatial Old Growth Order ▪ Issues scoping	Dependent on: ▪ Atmospheric Environment ▪ Terrain and Soils ▪ Surface Water ▪ Groundwater	Supporting: ▪ Wildlife ▪ Avian Species ▪ Visual Resources ▪ Land and Resource Use ▪ Heritage Resources
Wetlands	▪ Potential for Project interaction ▪ Provincial management concern ▪ Habitat for rare plants, Listed Ecological Communities, and wildlife species ▪ Cultural importance ▪ Contributes to biodiversity, maintenance of hydrologic cycles, nutrient cycling, water quality, and carbon storage ▪ Sensitive to disturbance ▪ Historically addressed for previous projects with similar conditions	▪ BC Conservation Data Centre ▪ Provincial <i>Forest and Range Practices Act</i>, SBC 2002, c 69 (Government of British Columbia [GovBC] 2002) ▪ Issues scoping	Dependent on: ▪ Atmospheric Environment ▪ Terrain and Soils ▪ Surface Water ▪ Groundwater	Supporting: ▪ Aquatic Resources ▪ Fish and Fish Habitat ▪ Wildlife ▪ Avian Species ▪ Visual Resources ▪ Land and Resource Use ▪ Heritage Resources ▪ Human Health
Listed Ecological Communities	▪ Potential for Project interaction ▪ Provincial management concern ▪ Habitat for wildlife species ▪ Contributes to biodiversity ▪ Historically addressed for previous projects with similar conditions	▪ BC Conservation Data Centre ▪ Issues scoping	Dependent on: ▪ Atmospheric Environment ▪ Terrain and Soils ▪ Surface Water ▪ Groundwater	Supporting: ▪ Wildlife ▪ Avian Species ▪ Land and Resource Use
Culturally Important Species	▪ Potential for Project interaction ▪ Valued by Indigenous groups and local communities ▪ Habitat and food for wildlife species ▪ Historically addressed for previous projects with similar conditions	▪ Issues scoping	Dependent on: ▪ Atmospheric Environment ▪ Terrain and Soils ▪ Surface Water ▪ Groundwater	Supporting: ▪ Land and Resource Use ▪ Heritage Resources ▪ Human Health

Subcomponent	Rationale for Inclusion	Source of Information	VC Linkages	
Rare Plants and Lichens	▪ Potential for Project interaction ▪ Provincial management concern ▪ Federal management concern ▪ Contributes to biodiversity ▪ Historically addressed for previous projects with similar conditions	▪ BC Conservation Data Centre ▪ Federal <i>Species at Risk Act</i>, SC 2002, c 29 (Government of Canada [GovCan] (SARA) ▪ Issues scoping	Dependent on: ▪ Atmospheric Environment ▪ Terrain and Soils ▪ Surface Water ▪ Groundwater	n/a

Notes: BC=British Columbia; n/a=not applicable; Project=Tenas Project; VC=Valued Component

3.2.3 Indicators

Indicators are quantitative or qualitative parameters used to describe existing VC or VC subcomponent conditions and trends, and to evaluate potential Project effects on the VC and cumulative effects. VC Indicators used in the assessment of the Vegetation VC are summarized **Table 3.2-2**.

Table 3.2-2: Indicators for Vegetation Valued Component (VC) and Subcomponents

Indicator	Rationale for Selection
Old Growth Forest	
Change in extent	Project activities have the potential to reduce the extent of Old Growth Forest on the landscape.
Change in structural stage	The Project has the potential to change forest structure on the landscape.
Wetlands	
Change in extent of wetland communities	The Project has the potential to reduce the extent of Wetlands on the landscape. Change in extent is considered a proxy for change in Wetland biodiversity, hydrology, water quality and habitat function.
Listed Ecological Communities	
Change in extent	The Project has the potential to alter the extent of Listed Ecological Communities on the landscape.
Culturally Important Species	
Change in extent	The Project has the potential to alter the extent of Culturally Important Species on the landscape.
Rare Plants and Lichens	
Change in extent of known occurrences	The Project has the potential to alter the extent of rare plant and lichen occurrences on the landscape.

Notes: Project=Tenas Project

3.2.4 Assessment Boundaries

The spatial and temporal boundaries encompass the area within, and times during which, the Project is expected to interact with the Vegetation VC. The administrative and technical boundaries represent any constraints that may be placed on the EA due to political, social, and economic realities (i.e., administrative boundaries), or limitations in predicting or measuring changes (i.e., technical boundaries).

This subsection identifies the spatial, temporal, and technical boundaries for the analysis of potential effects on the Vegetation VC.

3.2.4.1 Spatial Boundaries

The spatial boundaries delineated for the Vegetation VC are described in **Table 3.2-3** shown in **Figure 3.2-1**. The Project footprint is the area within the Project Area in which ground will be disturbed and Project activities will occur. The Project Area is the area within which the Project will be constructed and operated, including the Minesite and access routes. Both the Project footprint and Project Area are described in detail in **S3.0-C1 Assessment Methodology** of the **EAC Application**. The Project Area differs from that described in the AIR due to design refinements during the assessment. The Project Area is a conservative estimate of the area of direct disturbance effects on the Vegetation VC within this assessment.

The Vegetation Local Study Area (LSA) is 3,331 hectares (ha) in size and has been delineated to capture direct effects and most of the indirect effects likely to occur on the Vegetation VC and subcomponents. The Vegetation LSA used within this assessment was formed as a buffer around an early version of Project features. As such, it is larger in locations where there has been a reduction in the Project Area resulting from design refinements during the assessment process. This is expected to result in an overestimate of Project-related effects encompassed within the Vegetation LSA.

Considerations used to establish the spatial boundaries of the Vegetation LSA include distances typical of microclimatic edge effects and dust deposition. Changes in microclimate resulting from forest edges (e.g., gradients of light intensity, temperature, wind, humidity) typically range from 25 metres (m) to greater than 240 m, depending on aspect and presence of shrubby vegetation at the forest-edge boundary (Chen 1991, Bannerman 1998, Kremsater and Bunnell 1999).

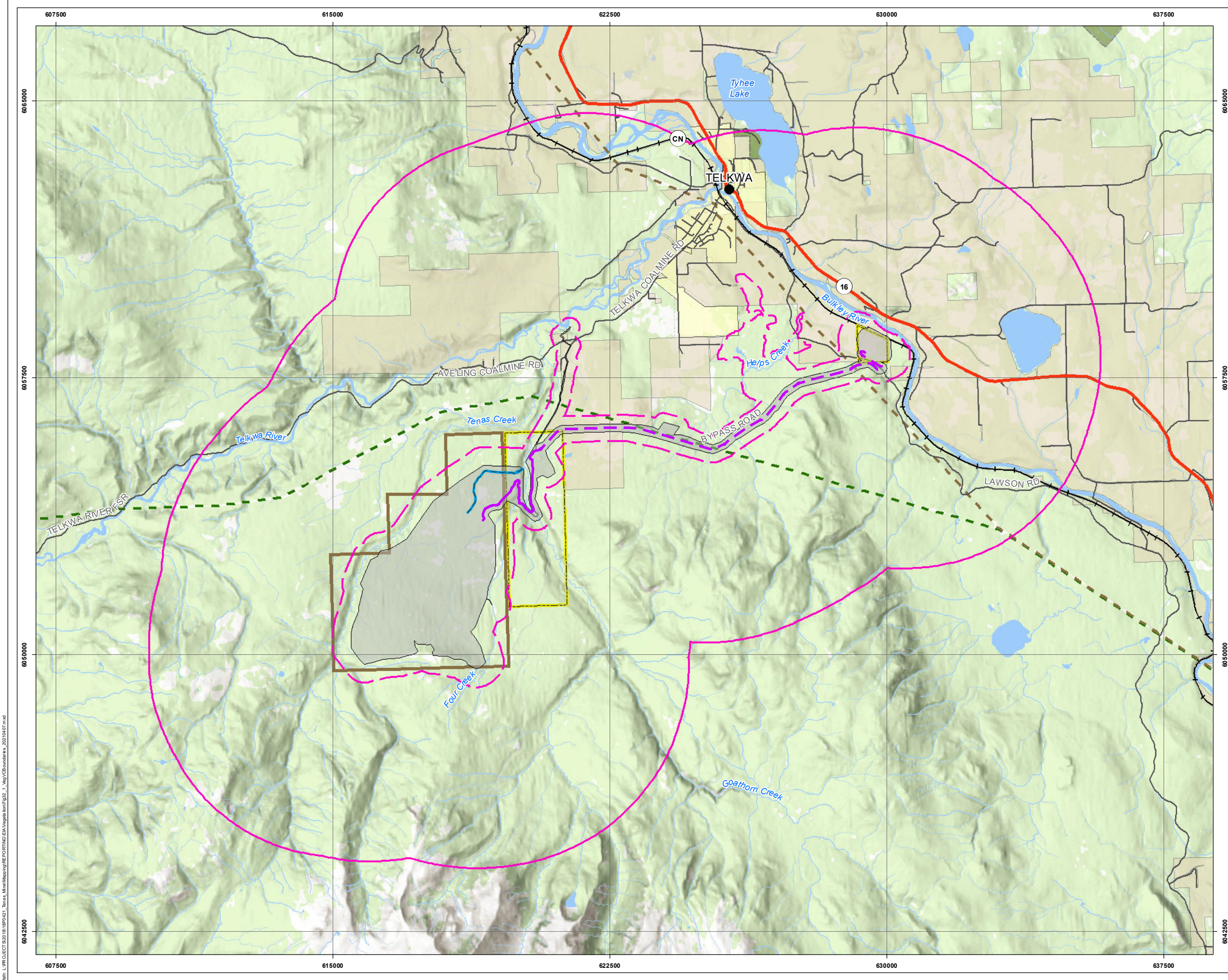
Dust also has variable deposition distance, depending on particle size and weather conditions. Studies have shown that more than 80 percent (%) of the dust generated by vehicle movements is greater in size than 10 micrometre (μm) and concentrations decrease within 30.5 m of a roadway (Golder Associates Ltd. 2010); however, particles of all sizes will travel further (i.e., over 100 m) in high winds. Regardless of particle size, in open conditions 70 to 75% of dust has been observed to be deposited in the first 10 m, 93% deposited within 30 m, and approximately 97% deposited within 125 m from the road edge (Walker and Everett 1987).

The Vegetation Regional Study Area (RSA) is 35,726 ha in size and has been delineated to capture all indirect effects of the Project and provide context for the type, distribution, extent, and prevalence of plant species and ecosystems in the region, as it includes all of the Biogeoclimatic (BGC) subzones and variants and related ecosystems that may be affected by the Project. The Vegetation RSA also represents the area where the direct and indirect influence of other land uses, and activities could interact with Project-specific effects with resulting cumulative effects on the Vegetation VC.

The Vegetation RSA also corresponds with the CEA Area within which Project-related residual effects may interact with other land uses and activities (i.e., past, present, and reasonably foreseeable future).

Table 3.2-3: Spatial Assessment Boundary Definitions for Vegetation Valued Component (VC)

Spatial Boundary	Description of Study Area
Project Area	Maximum disturbance area within which the Tenas Project (Project) will be constructed and operated
Local Study Area (LSA)	Tenas Project (Project) footprint plus: ▪ 250 metre (m) buffer on gravel quarries and linear infrastructure (except the Rail Loop), Minesite and Mine Infrastructure Complex (MIC) (i.e., roads, powerlines, utility distribution network); ▪ a 500 m buffer around all other infrastructure (e.g., Rail Infrastructure, Explosive Facility and Explosive Magazine, open pit); and ▪ A large wetland complex located downgradient from the Project was also included within the Vegetation LSA to encompass potential indirect effects on wetlands downgradient (Figure 3.2-1).
Regional Study Area (RSA)	The Project Area with a minimum of a 5 kilometre (km) buffer (Figure 3.2-1).



Tenas Project

Assessment boundaries for the Vegetation Valued Component

Legend

● City/Town

— Rail Line

— Highway

— Tenas Access Corridor

— Road

— 138 kV Transmission Line

— 500 kV Transmission Line

— Discharge Path

— Watercourse

Waterbody

Park or Protected Area

Municipal Area

Telkwa Coal Limited Private Property

Tenas Coal Licenses

General Private Property

Project Area

Vegetation Local Study Area

Vegetation Regional Study Area

Notes

1. All mapped features are approximate and should be used for discussion purposes only.

2. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2021

- Basedata: Government of British Columbia

- Basemap: World Topo Map

N

1:100,000

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Kilometres

NAD 1983 UTM Zone 9N

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ALLEGIANCE COAL

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3.2.4.2 Temporal Boundaries

As described in **S3.0** of the **EAC Application**, the temporal boundaries for the assessment of Project-related effects on the Vegetation VC encompass the time periods during which the Project is expected to interact with vegetation.

These include the Construction, Operation, Decommissioning and Reclamation, and Post-closure phases (**Table 3.2-4**).

Table 3.2-4: Temporal Boundaries for the Tenas Project

Phase	Year	Duration (years)	Description of Activities
Construction	-0.5 to 0	1.5	Site clearing, soil salvage, open pit development, building construction, service and haul road development, Rail Infrastructure construction, bridge construction and development of onsite utilities and services. Development of mine rock, and overburden storage piles, stockpiling of reclamation material such as soil, overburden and other materials suitable for reclamation. Development of water management systems and management ponds for storage of potentially acid generating (PAG) materials.
Operation	1 to 21	21	Development of the open pit through drilling, blasting, loading, and hauling functions. Development of mine rock, and overburden storage piles, stockpiling of reclamation material such as soil, overburden, and other materials suitable for reclamation. Development of water management systems and management ponds for PAG storage. Conducting coal processing, stockpiling of raw coal prior to processing, and stockpiling of processed coal prior to shipping. Progressive reclamation will be accomplished during operation including, where available, reclamation activities such as sloping, topsoil placement and revegetation.
Decommissioning and Reclamation	22 to 25	4	Tear-down of infrastructure onsite plus reclamation activities, including sloping of storage piles, backfill materials, and placement of reclamation materials including growth media, overburden and non-PAG rock for management pond covers and revegetating surfaces that are planned to be reclaimed.
Post-closure	26 to 50	10	Active: This involves the filling of the open pit with water, monitoring of vegetation growth and water quality for both groundwater and surface water and wildlife. Control and sedimentation ponds may still be needed for settling of total suspended solid levels. The management ponds are left as dry land reclamation except for portions that will be left as open water.
		15	Passive: This stage is when the control and sedimentation ponds are no longer required for settling of total suspended solid (TSS) levels and the management ponds are left as dry land reclamation except for portions that will be left as open water. Telkwa Coal Limited (TCL) is now simply monitoring the site.

3.2.4.3 Administrative Boundaries

The Vegetation LSA and RSA (collectively the Study Areas) are both situated within the RDBN, the Bulkley Timber Supply Area (TSA), and the Skeena Stikine Natural Resource District of the Skeena Natural Resource Region, within which forest resources are managed by the BC MFLNRORD.

The Vegetation Study Areas are located within the jurisdiction of the Bulkley LRMP. Within the Bulkley LRMP, the eastern extents of the Vegetation Study Areas are located within the Bulkley Valley Landscape Unit, and the western extents of the Vegetation Study Areas are located within the Telkwa Landscape Unit (**Figure 3.2 1**).

Landscape Units are assigned a biodiversity emphasis, which provides a target for biodiversity conservation related to old growth retention (see **Table 3.2-5**). These targets are used in implementing non-spatial old growth forest retention objectives within the Landscape Units based on BGC subzones and variants and their associated natural disturbance types (British Columbia Ministry of Forests [BC MOF] 1995). Both the Bulkley Valley and Telkwa Landscape Units have an intermediate biodiversity emphasis option, where biodiversity conservation and timber production are equally valued (BC MOF 1995). Old growth retention targets in relation to Landscape Units and their biodiversity emphasis and BGC subzones/variants and their natural disturbance types are described in **Table 3.2-5**. No legal or non-legal Old Growth Management Areas (OGMAs) are present within either the Vegetation LSA or the Vegetation RSA.

Table 3.2-5: Non-spatial Old Growth Forest Retention Targets Within Planning Units Located Within the Vegetation Regional Study Area (RSA)

Planning Area	Landscape Unit Name	Biodiversity Emphasis	Natural Disturbance Type ¹	Biogeoclimatic Ecosystem Classification Subzone/Variant ²	Retention Target (%)
Bulkley LRMP	Bulkley Valley Landscape Unit	Intermediate	NDT2	ESSFmc	>9
			NDT3	SBSdk	>11
				SBSmc2	
	Telkwa Landscape Unit	Intermediate	NDT2	ESSFmc	>9
				ESSFmcw	
			NDT3	SBSdk	>11
				SBSmc2	

Source: Government of British Columbia (GovBC) 2004b

Notes: >=greater than; %=percent; LRMP=Land and Resource Management Plan

1 NDT2=Ecosystems with infrequent stand-initiating events; NDT3=Ecosystems with frequent stand-initiating events.

2 ESSFmc=Engelmann spruce subalpine fir zone moist cold subzone, ESSFmcw=Engelmann spruce subalpine fir zone moist cold subzone woodland variant, SBSdk=sub-boreal spruce zone dry cool subzone, SBSmc2=sub-boreal spruce zone moist cold subzone Babine variant

3.2.4.4 Technical Boundaries

The Vegetation RSA overlaps portions of two (2) BGC zones (Engelmann spruce subalpine fir zone [ESSF], sub-boreal spruce zone [SBS]), and four (4) BGC subzones/variants (Engelmann spruce subalpine fir zone moist cold subzone [ESSFmc], Engelmann spruce subalpine fir zone moist cold subzone woodland variant [ESSFmcw], sub-boreal spruce zone dry cool subzone [SBSdk], sub-boreal spruce zone moist cold subzone Babine variant [SBSmc2]). Knowledge of vegetation, ecosystems, and wetlands within the Vegetation RSA is based on targeted field surveys, available ecosystem mapping products, and the professional judgement of the EA team. Ecosystem mapping within the Vegetation RSA consists of a compilation of the following products presented in order of precedence:

- ▶ Project-specific Terrestrial Ecosystem Mapping (TEM) completed within the Vegetation LSA at a 1:5,000 scale and a Survey Intensity Level (SIL) 1/2 within the open pit area and Rail Loadout, and a 1:10,000 scale at SIL 2 for the haul road (Ardea Biological Consulting 2020);
- ▶ Historic TEM completed for previous mine proposals at this site (Oikos Ecological Services [Oikos] TEM), completed at a 1:15,000 scale with a SIL 3. This historic TEM was updated to reflect current conditions (Oikos Ecological Services 1999, Ardea Biological Consulting 2020); and
- ▶ Existing Predictive Ecosystem Mapping (PEM) from the Bulkley TSA (Timberline Natural Resource Group Ltd. 2010), updated to reflect current conditions (Ardea Biological Consulting 2020).

4. EXISTING CONDITIONS

The information in this subsection establishes the context for the assessment of effects on the Vegetation VC, including regulatory context, Traditional Knowledge (TK), and baseline studies undertaken for the Project.

4.1 Background Information and Studies

4.1.1 Traditional Knowledge (TK)

The purpose of this subsection is to demonstrate awareness of TK and describe how it influenced the assessment. The Vegetation RSA overlaps with the traditional territory of the Wet'suwet'en. The Project falls within Wet'suwet'en traditional territories: the Minesite is within Cas'Yex House territory, and the Rail Loop and Rail Loadout are within Kwen Bea Yex House territory (Crossroads Cultural Resource Management (Crossroads) 2021).

TK related to the Vegetation VC was obtained through a review of publicly available information as well as the **Cultural Use Study (CUS)**. The **CUS** is found in **Appendix 7.1-B of 7.0 Heritage Effects Assessment** of the **EAC Application**. The **CUS** compiled a baseline inventory of cultural heritage resources pertaining to Wet'suwet'en communities by examining pre-existing cultural, social, historic, and economic data. (Crossroads Cultural Resource Management (Crossroads) 2021). That study and other available sources of TK were reviewed for information relating to plants and plant communities. Through the information outlined in the **CUS** and other documents, there is a recognition of the value of the natural environment that is intrinsic to how the Wet'suwet'en view the land and how it is used:

“The Wet'suwet'en continue to maintain a substantial connection to their hereditary lands by way of Yintah. For the Wet'suwet'en, Yintah is a central factor in their culture; it is the physical and spiritual connection that everything has to their territories... [Yintah is] a concept in which all environmental components - from plants and animals to waterways and mountains - are all interconnected and linked with the human world” (Crossroads 2021).

Plants historically and currently provide important food, medicinal, spiritual, ceremonial, and functional requirements for the Wet'suwet'en. Gathering plants was an important part of the traditional seasonal round related to the use of the land, with gathering places for those plants considered part of a house territory to be managed. Culturally important species were included as a subcomponent of the Vegetation VC (described further below), and were selected following a review of several documents including:

- ▶ Gitksan Traditional Medicine: Herbs and Healing (Johnson and Anderson 1988);
- ▶ Plants, Land and People, A Study of Wet'suwet'en Ethnobotany (Gottesfeld 1993);
- ▶ Wet'suwet'en Ethnobotany: Traditional Plant Uses (Gottesfeld 1994);
- ▶ The Role of Plant Foods in Traditional Wet'suwet'en Nutrition (Johnson 1995);
- ▶ Health, Wholeness, and the Land: Gitksan Traditional Plant Use and Healing (Johnson 1997); and,
- ▶ Gitksan Medicinal Plants - Cultural Choice and Efficacy (Johnson 2006).

4.1.2 Scientific and Other Information

The assessment considered various sources of scientific and other information, and its applicability to the Project. The desktop review included an examination of available published and unpublished scientific data, TK, and local knowledge applicable to ecosystems and vegetation within the Project region. Baseline information from previous EAs conducted near the Project were also reviewed and assessed for use for this Project. The online resources outlined in **Table 4.1-1** were used to characterise vegetation, ecosystems, and wetlands within the Vegetation RSA, including Listed Ecological Communities and Rare Plants and Lichens.

Table 4.1-1: Data Sources Used to Identify Available Information for Tenas Project

Title	Content
BC Conservation Data Centre (BC CDC) (BC CDC 2020a)	Provides status reports and designations for Rare Plant and Lichen Species and Listed Ecological Communities in British Columbia (BC).
Canadian Impact Assessment Registry and the Canadian Environmental Assessment Archive (Canadian Environmental Assessment Agency [CEAA] 2018, Impact Assessment Agency of Canada [IAAC] 2019)	Provides status and available documents for projects undergoing an environmental assessment with the IAAC. Projects initiated but suspended or completed prior to 2016 are in the archive.
EcoCat: The Ecological Reports Catalogue (British Columbia Ministry of Environment [BC MOE] 2018)	Map application and catalogue to identify available ecological reports completed in BC.
Electronic Atlas of the Flora of British Columbia (eFlora) (Klinkenberg 2018)	Provides descriptions and distribution maps of plants, bryophytes, lichens, algae, fungi, and slime molds of BC.
Environmental Assessment Project Information Centre (EPIC) (BC EAO 2019)	Provides status and available documents for projects undergoing an environmental assessment (EA) with the BC EAO.
iMap Mapping Application (Government of British Columbia [GovBC] 2019b)	Provides locations of historic occurrences of listed plants and lichens in BC.
Species at Risk Public Registry (Environment and Climate Change Canada [ECCC] 2018)	Provides status reports and designations for at risk plants species in BC.

Several historic proposed coal mining projects in the vicinity of the Project have prepared EA documents since 1983. A summary of the reports prepared that contain vegetation and ecosystem information is outlined **Table 4.1-2**.

Table 4.1-2: Summary of Previous Environmental Reports in the Vicinity of the Tenas Project

Study Name	Study Content
Telkwa Project Stage I Application (Crows Nest Resources Limited and Read Environmental and Planning Associates Ltd. 1983)	General forest cover and ecosystem information and mapping provided for the proposed project area to describe the area in 1983. No other vegetation information was included.
Telkwa Project Vegetation - Forestry -Wildlife (TAESCO Consultants Ltd. 1984)	Stage II report prepared in 1984 to provide ecosystem mapping, forest capability and potential rare plants and plant

Study Name	Study Content
	communities within the Project Area. A 1:20,000 paper ecosystem map (12,958 hectare [ha]) that covered the existing Tenas Project (Project) Area was provided to the standard of the day, with 64 plots completed. Plants identified as potentially rare, and a rare plant community were identified within the Project Area.
Telkwa Coal Project Application for a Project Approval Certificate (Manalta Coal Ltd. 1997)	Initial project application in 1997 that summarized the TAESCO (1984) for the area. No new vegetation or ecosystem data was collected or provided in this report.
Telkwa Coal Terrestrial Ecosystems, Volume 1: Inventory (Oikos Ecological Services [Oikos] 1999)	Report outlining methods and results for Terrestrial Ecosystem Mapping (TEM), Agricultural Land Capability mapping, Forest Capability mapping, rare plant surveys, rare and sensitive ecosystems mapping, and sampling of vegetation for trace metals analysis from 1999.

Additional sources of information related to specific assessments and studies completed during the baseline program are outlined within the appropriate sections below.

4.1.3 Baseline Studies

Project-specific vegetation baseline investigations were conducted by Ardea Biological Consulting (Smithers, BC) from 2017 to 2019 under the oversight and coordination of Laurence Turney, R.P.Bio. to characterise the baseline conditions of vegetation, ecosystems, and wetlands within the Vegetation RSA (2020). TEM was led by Adrian DeGroot, R.P.Bio. (Drosera Ecological Consulting, Smithers, BC) and Irene Ronalds, R.P.Bio. (Irene Ronalds Ecological Consulting Ltd., Smithers, BC), TEM Quality Assurance and Quality Control (QA/QC) assessments were carried out by qualified independent professional Claudia Houwers, R.P.Bio. (Houwers Ecological Consulting). Adrian DeGroot additionally led invasive plant surveys and rare plant surveys, with Lis Rach (TerraNiche Environmental Solutions, Smithers, BC) leading wetland function sampling.

A summary of these studies is provided in **Table 4.1-3**. Methodological details (including total number of field assessment plots and survey intensity levels), survey parameters and assumptions, and comprehensive data summaries/findings are presented in the Project-specific **Vegetation and Ecosystems Baseline Report (Appendix 4.7-A)**.

Table 4.1-3: Summary of Desktop and Field Studies Related to the Vegetation Valued Component (VC)

Study Name	Study Purpose, Duration and Spatial Boundaries
Terrestrial Ecosystem Mapping (TEM)	- Completion of Project-specific TEM to characterise terrestrial and wetland ecosystems, identification and mapping of Old Growth Forest and Listed Ecological Communities - Completed within the Vegetation LSA at a 1:5,000 scale and a Survey Intensity Level (SIL) 1/2 within the open pit area and Rail Loadout, and a 1:10,000 scale at SIL 2 for the haul road. - Undertaken 2017 to 2019 within the Vegetation LSA
Ecosystem Mapping Updates	Desktop updates to existing ecosystem mapping projects historically completed within the Vegetation Regional Study Area (RSA) to characterise terrestrial and wetland ecosystems, identification and mapping of Old Growth Forest and Listed Ecological Communities

Study Name	Study Purpose, Duration and Spatial Boundaries
	○ 1:20,000 scale TEM (Oikos Ecological Services [Oikos] TEM) for the Manalta Coal Ltd. Telkwa Coal Project (Oikos 1999) ○ Predictive Ecosystem Mapping (PEM) completed by Timberline Natural Resources Group Ltd. for the Bulkley Timber Supply Area (TSA) (Bulkley PEM) (Timberline Natural Resource Group Ltd. 2010) ▪ Undertaken 2017 to 2019 within the Vegetation RSA in areas outside of the Project-specific TEM
Listed Plant and Lichen Surveys	▪ Field surveys for plant and lichen species listed by the BC Conservation Data Centre (BC CDC), Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or protected under <i>Species at Risk Act</i>, SC 2002, c 29 (Government of Canada [GovCan] 2002) (<i>SARA</i>) ▪ Undertaken 2017-2019 within the Vegetation Local Study Area (LSA)
Wetland Function Assessments	▪ Field characterisation of baseline wetland function at targeted wetlands ▪ Undertaken 2017 to 2019 within the Vegetation LSA
Timber Volume Assessments	▪ Desktop estimation of potential timber volume within the Vegetation RSA ▪ Undertaken within the Vegetation RSA
Invasive Plant Surveys	▪ Field identification and mapping of invasive plant species ▪ Undertaken 2017-2019 within the Vegetation LSA
Trace Metals Monitoring	▪ Sampling of selected plants for trace metals concentrations was undertaken. Sample species were selected based on potential consumption by humans and/or wildlife, as well as frequency of occurrence in sufficient quantity to produce at least a single sample. In total, sampling included 23 plant species in 20 genera. ▪ Undertaken 2017 to 2019 within the Vegetation LSA

Assessments, surveys, and mapping were all conducted in accordance with accepted standards and guidebooks including:

- ▶ A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region (Banner et al. 1993);
- ▶ Field Guide Supplement to the Identification of High Elevation ESSF Woodland Subzones and Site Units of the Bulkley Timber Supply Area: Supplement No. 2 to Land Management Handbook No. 26 (Trowbridge and Banner 2002);
- ▶ Field Guide to Identification and Interpretation of Hardwood-Dominated Ecosystems in the SBSdk and ICHmc2 of the Prince Rupert Forest Region: Supplement No. 1 to Land Management Handbook No. 26 (Williams et al. 2001);
- ▶ Field Manual for Describing Terrestrial Ecosystems (British Columbia Ministry of Forests and Range [BC MOFR] and British Columbia Ministry of Environment [BC MOE] 2010);
- ▶ Protocol for Accuracy Assessment of Ecosystem Maps (Meidinger 2003);
- ▶ Protocols for Rare Plant Surveys (Penny and Klinkenberg 2018);
- ▶ Standard for Terrestrial Ecosystem Mapping (TEM - Digital Data Capture in British Columbia, Version 3.0 (Resources Inventory Committee [RIC] 2000);
- ▶ Standard for Terrestrial Ecosystem Mapping in British Columbia (RIC 1998);
- ▶ Wetlands of British Columbia: A Guide to Identification (MacKenzie and Moran 2004); and
- ▶ Wetland Ecological Functions Assessment: An Overview of Approaches (Hanson et al. 2008).

Ecosystem mapping within the Vegetation RSA was compiled from a combination of three (3) mapping sources, each with their own methodologies, scales, and associated limitations. Project-specific TEM was completed at 1:5,000 and 1:10,000 scales within an historic version of the Vegetation LSA, allowing for more detailed ecosystem identification, delineation and characterisation (**Appendix 4.7-A**). 1:20,000 Oikos TEM and PEM within the remainder of the Vegetation RSA were mapped at a smaller scale; as with all smaller scale mapping products, this may result in generalization of some features and lower detection of smaller, isolated ecosystems.

4.2 Description of Existing Conditions

The Project is in northwest BC near the Village of Telkwa, southwest of the confluence of the Telkwa and Bulkley rivers and situated within the Skeena River Watershed. The Vegetation RSA includes the Village of Telkwa and part of Tyhee Lake, Round Lake, the lower slopes of Hunter Basin, and the lowest reaches of Pine Creek (**Figure 3.2-1**).

This subsection provides a description of existing conditions (i.e., conditions prior to interaction with the Project), based on TK, scientific and other information, and baseline studies undertaken for the Project.

Most of the Project Area lies within the SBSdk and the SBSmc2 BGC subzones. A small portion of the Project Area overlaps the ESSFmc BGC subzone. The SBSdk occurs at lower elevations and valley bottoms and transitions into the SBSmc2 and then into the ESSFmc as elevation increases (Banner et al. 1993).

Coniferous forests are the major ecosystem type found within the BGC subzones within both the Vegetation LSA and the Vegetation RSA, making up over 78% of the Vegetation LSA and 80% of the Vegetation RSA (**Appendix 4.7-A**). These forested ecosystems have experienced various levels of historic disturbance associated road development and commercial forestry (i.e., cutblocks and access roads). At the north and western extent of the Vegetation RSA, anthropogenic disturbance is prevalent, including rural residences, agricultural land uses (i.e., hay land, pasture, and rangeland), the Village of Telkwa, part of the Town of Smithers, and overlap with the Highway 16 corridor.

Baseline reporting summarized vegetation within the Vegetation RSA by mine features (i.e., Minesite), linear features (i.e., TAC and powerline and substation), rail features (i.e., Rail Infrastructure), and the Helps Creek wetland complex.

- ▶ The Minesite area is located almost entirely within the SBSmc2, with only minor portions located in the SBSdk and ESSFmc. Past forestry activities have influenced the surrounding landscape, creating a mosaic of regenerating coniferous forest (in a shrub or pole/sapling structural stage) interspersed with remnant patches of mature and Old Growth Forest. Smaller areas of deciduous forest, mixed forest, shrub habitat, and wetland habitat (predominantly small, forested bogs) are scattered throughout;
- ▶ The TAC and powerline and substation areas are located primarily within the SBSdk. These linear features cross a variety of habitat types, including cultivated fields and pastures; coniferous, deciduous, and mixed forest habitats (ranging from pole/sapling to mature and Old Growth Forest); tall/low shrub habitats; floodplain ecosystems (particularly along Goathorn Creek and the Telkwa River); and wetland habitats (predominantly small marshes and swamps). Anthropogenic disturbance is relatively prominent, including agricultural development, rural residences, transmission lines, natural gas pipelines, and various access roads and trails;
- ▶ The Rail Infrastructure area is located adjacent to the Bulkley River within the SBSdk. Rural/farmland activities have influenced the surrounding landscape, creating a patchy distribution

of young to mature forests scattered amongst cultivated fields and pastures. The forested areas tend to contain dry or mesic ecosystems, although upland and floodplain deciduous forests are present; and

- ▶ The Helps Wetland Complex is a large wetland complex located to the north of the TAC that receives water from Helps Creek drainage to the south, as well as from a small lake/wetland complex to the north before draining through Helps Creek to the Bulkley River northwest of the rail infrastructure area. This complex consists of forested bog wetlands, with willow sedge fens, swamp forests and small open water areas. This wetland complex is surrounded by and has been influenced by pastures and cultivated lands to the east, as well as historic forest harvesting to the south and west.

Refer to **Appendix 4.7-A** for further details regarding vegetation within the Vegetation study areas.

4.2.1 Old Growth Forest

Typically characterised by advanced structural complexity resulting from canopy gaps and a diversity of vegetation growth forms, Old Growth Forest is considered valuable for several reasons including maintenance of biodiversity and provision of wildlife habitat (Spies 2004, Hilbert and Wiensczyk 2007). In BC, the age that qualifies a stand to be considered Old Growth Forest depends on the Natural Disturbance Type (NDT) associated with its BGC zone. Within the Vegetation RSA, the minimum age requirements vary between 140 and 250 years (BC MOF 1995). These minimum age requirements are correlated with the structural stage classes “7”, “7a” and “7b”, which represent stands of old age forest with complex structure, patchy shrub and herb understories, and diverse assemblages of species (British Columbia Ministry of Forests and Range [BC MOFR] and British Columbia Ministry of Environment [BC MOE] 2010). It must be noted that even if a forest stand meets the age requirements to be considered Old Growth Forest, it may not display the ecological attributes of an Old Growth Forest (DeLong et al. 2004). As such, all forest stands meeting old growth age thresholds within this assessment are conservatively considered to be potential Old Growth Forest.

In total, 5,352.6 ha of Old Growth Forest was mapped within the Vegetation RSA, and 640.6 ha of Old Growth Forest was mapped within the Vegetation LSA (**Table 4.2-1**, **Figure 4.2 1**). Most of the Old Growth Forest is located at the southern extent of the Vegetation RSA. Old Growth Forest predominantly occurs to the southwest of the LSA as patches of hybrid white spruce-dominated ecosystems in the SBSmc2 interspersed by existing cutblocks, as well as associated with the Tenas Creek Valley and its tributaries (**Figure 4.2-1**).

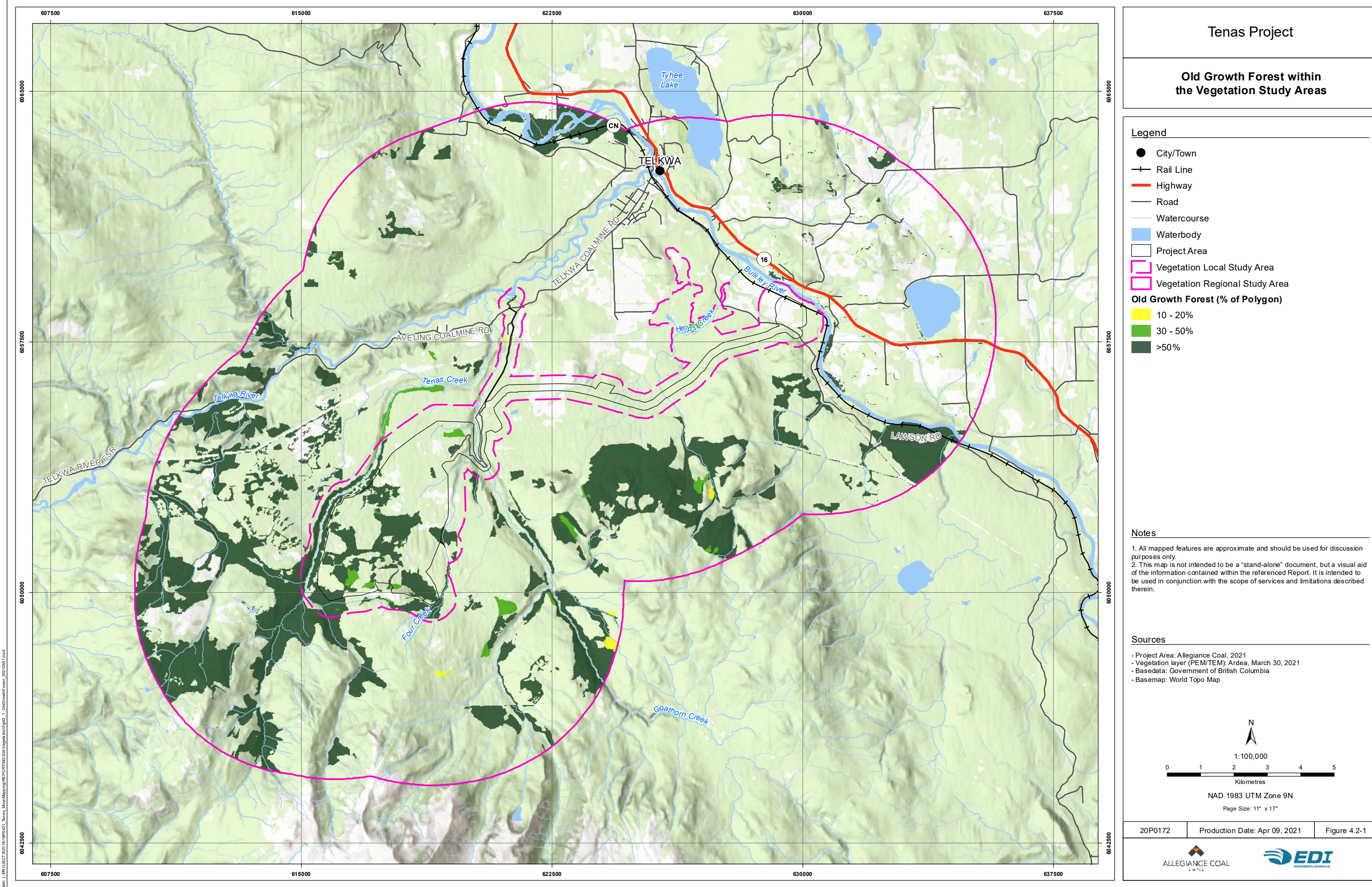
Table 4.2-1: Old Growth Forest within the Vegetation Study Areas

BGC Subzone	Site Series	Map Code	Ecosystem Name	Area in Vegetation LSA (ha)	Area in Vegetation RSA (ha)
SBSdk	00	SD	hybrid white spruce - devil's club (lacustrine/morainal)	0.2	22.2
	01	SP	hybrid white spruce - spirea - purple peavine	1.8	556.2
	02	LJ	lodgepole pine - juniper - ricegrass	-	11.4
	03	LC	lodgepole pine - feathermoss - <i>Cladina</i>	-	30.4
	05	SF	hybrid white spruce - spirea - feathermoss	-	12.8
	06	ST	hybrid white spruce - twinberry - coltsfoot	-	266

BGC Subzone	Site Series	Map Code	Ecosystem Name	Area in Vegetation LSA (ha)	Area in Vegetation RSA (ha)
	07	SH	hybrid white spruce - horsetail	-	59.2
	07a	SH	hybrid white spruce - horsetail (freely drained)	0.4	0.4
	08	CD	black cottonwood - dogwood - prickly rose	-	77.3
	10	SS	black spruce - soft-leaved sedge - <i>Sphagnum</i>	5.3	17.7
Total SBSdk				7.7	1,053.5
SBSmc2	01	SB	hybrid white spruce - huckleberry	12.1	1,161.3
	01a	SB	hybrid white spruce - huckleberry (mesic , fine-textured)	289.5	291.6
	01c	SB	hybrid white spruce - huckleberry (submesic)	17.5	17.5
	02	PH	lodgepole pine - huckleberry - <i>Cladonia</i>	0.2	20.7
	03	BM	black spruce/lodgepole pine - feathermoss	0.5	0.7
	05	TC	hybrid white spruce - twinberry - coltsfoot	15.7	317.4
	06	SO	hybrid white spruce - oak fern	153.9	460.8
	07	BF	hybrid white spruce - scrub birch - feathermoss	9.7	10.8
	09	SD	hybrid white spruce - devil's club	7.2	412.8
	09a	SD	hybrid white spruce - devil's club (fluvial)	11.0	11
	09b	SD	hybrid white spruce - devil's club (lacustrine/morainal)	47.4	47.5
	10	SH	hybrid white spruce - horsetail	2.0	234.8
	10a	SH	hybrid white spruce - horsetail (fluvial)	18.1	18.1
	10b	SH	hybrid white spruce - horsetail (lacustrine/morainal)	46.6	46.6
	12	SS	black spruce/hybrid white spruce - scrub birch - sedge	-	9.5
	Wb05	Wb05	black spruce - water sedge - peatmoss	1.6	1.6
Total SBSmc2				632.9	3,062.5
ESSFmc	01	FB	subalpine fir - huckleberry - leafy liverwort	-	606.4
	02	LC	subalpine fir/lodgepole pine - juniper - <i>Cladonia</i>	-	17.2
	03	FC	subalpine fir - huckleberry - crowberry	-	6
	04	HH	subalpine fir - huckleberry - heron's-bill	-	48.1
	05	FT	subalpine fir - huckleberry - thimbleberry	-	2.5
	06	FO	subalpine fir - oak fern - heron's-bill	-	182.2
	07	FD	subalpine fir - devil's club - lady fern	-	43.6
	08	FV	subalpine fir - valerian - sickle moss	-	9.7
	09	HG	subalpine fir - horsetail - glow moss	-	0.2
	10	FH	subalpine fir - horsetail - leafy moss	-	46.2

BGC Subzone	Site Series	Map Code	Ecosystem Name	Area in Vegetation LSA (ha)	Area in Vegetation RSA (ha)
Total ESSFmc				-	962.1
ESSFmcw	01	FL	subalpine fir - huckleberry - leafy liverwort - heron's bill	-	194.8
	02	FC	subalpine fir (whitebark pine/lodgepole pine) - huckleberry - crowberry - lichen	-	11.6
	03	FJ	subalpine fir (whitebark pine/lodgepole pine) - huckleberry - juniper - lichen	-	9
	04	FV	subalpine fir - valerian - leafy moss	-	47.6
	05	FG	subalpine fir - mixed shrub - glow moss	-	11.4
ESSFmcw Total				-	274.4
Total Area of Old Growth Forest (ha)				640.6	5,352.6

Notes: -=not applicable; BGC=Biogeoclimatic; ESSFmc=Engelmann spruce subalpine fir zone moist cold subzone; ESSFmcw=Engelmann spruce subalpine fir zone moist cold subzone woodland variant; ha=hectare; LSA=Local Study Area; RSA=Regional Study Area; SBSdk=sub-boreal spruce zone dry cool subzone; SBSmc2= sub-boreal spruce zone moist cold subzone Babine variant



Tenas Project

Old Growth Forest within the Vegetation Study Areas

Legend

● City/Town

—+— Rail Line

— Highway

— Road

— Watercourse

Waterbody

Project Area

Vegetation Local Study Area

Vegetation Regional Study Area

Old Growth Forest (% of Polygon)

10 - 20%

30 - 50%

>50%

Notes

1. All mapped features are approximate and should be used for discussion purposes only.

2. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2021

- Vegetation layer (PEM/TEM): Ardea, March 30, 2021

- Basedata: Government of British Columbia

- Basemap: World Topo Map

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Figure 4.2-1

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4.2.2 Wetlands

Wetland ecosystems were identified within the ecosystem mapping in accordance with classifications outlined in Banner et al. (1993), Williams et al. (2001), and MacKenzie and Moran (2004). Wetland ecosystems were mapped in 2,011.1 ha (5.6%) of the Vegetation RSA, and 405.6 ha (10.2%) of the Vegetation LSA (**Table 4.2-2, Figure 4.2-2**). Within both the LSA and RSA, most of wetland ecosystems were swamps, followed by bogs and fens (**Table 4.2-2**).

Terrestrial and wetland ecosystem classifications sometimes overlap in their classifications of the same community, with some of the forested ecosystems in Banner et al. (1993) also classified as wetland ecosystems in Mackenzie and Moran (2004). For example, the Ws07 spruce - common horsetail - leafy mosses swamp wetland ecosystem (MacKenzie and Moran 2004) is a synonymous with several spruce - horsetail site series (e.g., SBSdk/07 and SBSmc2/10) within Banner et al. (1993).

The forested spruce - horsetail site series SBSdk/07 and SBSmc2/10 are split into two (2) discrete phases: freely-drained (fluvial) and poorly-drained (lacustrine/morainal) (Banner et al. 1993). Because the intent of the wetland Ws07 spruce-common horsetail-leafy mosses swamp ecosystem is to describe occurrences with true wetland conditions (i.e., the poorly-drained, lacustrine/morainal phase (MacKenzie and Moran 2004), the Ws07 swamp ecosystem is described only by ecosystems situated on fine-textured soils in the Project-specific TEM (i.e., SBSdk/07b and SBSmc2/10b). In areas outside of the Project-specific TEM (i.e., areas described with updated Oikos TEM or Bulkley PEM), drainage conditions within these spruce-horsetail ecosystems were not always differentiated. As such, all SBSdk/07 and SBSmc2/10 site series in those areas were conservatively classified as the Ws07 wetland. For this reason, the most common wetland ecosystem within the Vegetation RSA is the hybrid spruce-horsetail swamp ecosystem (SBSdk/07(b), SBSmc2/10(b); **Table 4.2-2**).

Within the Vegetation LSA, the majority (56.4%) of the total wetland area is contained within the Helps Creek wetland complex north of the access corridor (**Figure 3.2-1**), which is comprised of a combination of bog, fen and swamp wetland types. Outside of the Helps Creek wetland complex, wetlands in the remaining portions of the Vegetation LSA consist of a variety of wetland types, predominated by forested swamps and bogs. These remaining wetlands are generally small and isolated, ranging from 0.2 to 7.7 ha for all wetland types, and from 0.2 to 1.4 ha for non-forested wetland types such as marshes and open water (**Figure 4.2-2, Table 4.2-2**).

Table 4.2-2: Wetland Ecosystems Within the Vegetation Study Areas

Wetland Class	BGC Subzone	Site Series	Map Code	Wetland Name	Area (ha)	
					Vegetation LSA	Vegetation RSA
Bog	ESSFmc	32	LS	non-forested bog	-	9.8
		00	SS	black spruce/hybrid white spruce - scrub birch - sedge	-	28.4
	SBSdk	09	BS	black spruce - creeping-snowberry - <i>Sphagnum</i>	8.5	8.5
		10	SS	black spruce - soft-leaved sedge - <i>Sphagnum</i>	99.8	136.0
		32	LS	non-forested bog	-	1.2

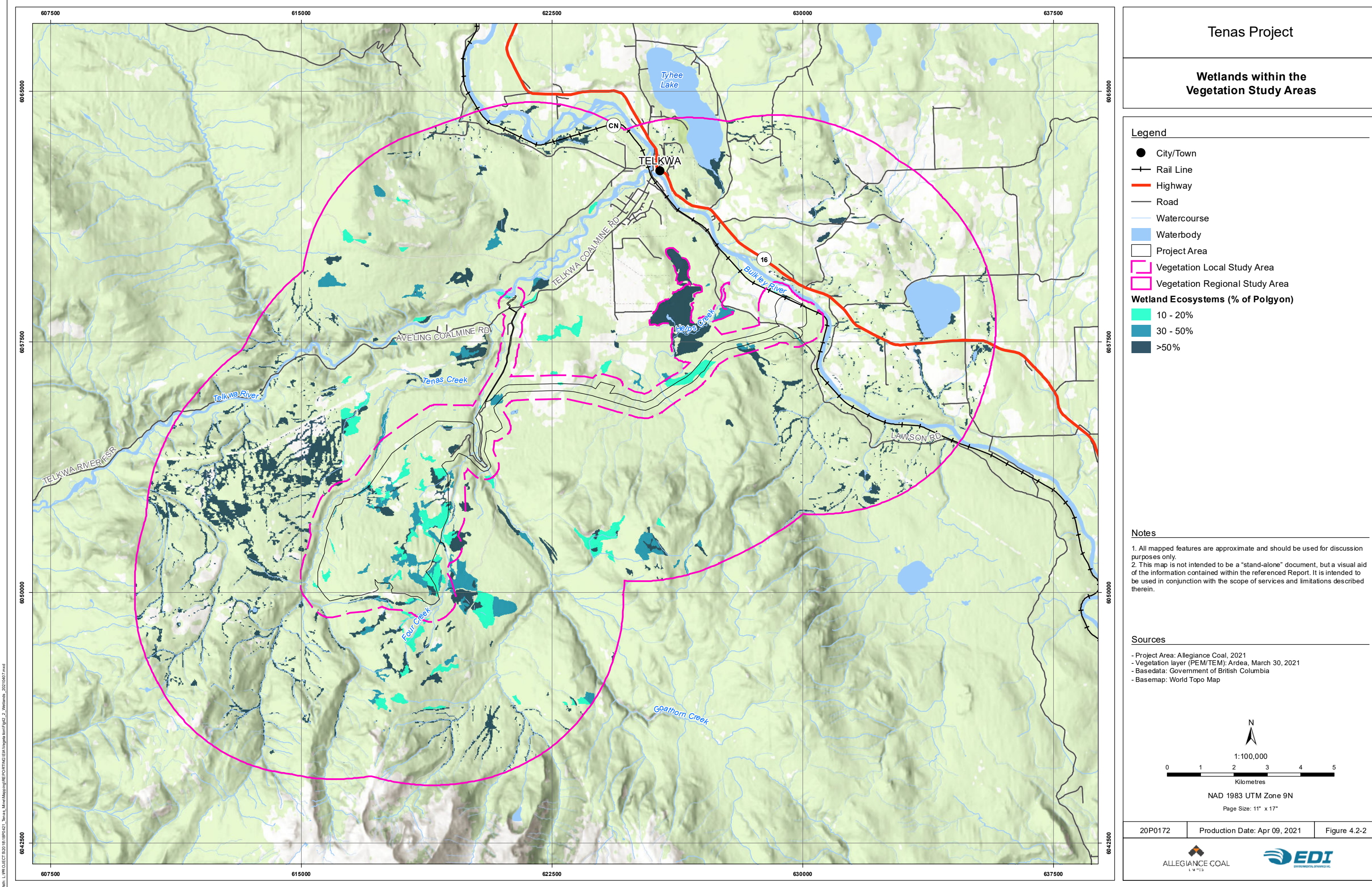
Wetland Class	BGC Subzone	Site Series	Map Code	Wetland Name	Area (ha)	
					Vegetation LSA	Vegetation RSA
	SBSmc2	12	SS	black spruce/hybrid white spruce - scrub birch - sedge	2.6	20.1
		32	LS	non-forested bog	-	0.6
		-	Wb01	black spruce - creeping snowberry - peatmoss	2.8	2.8
		-	Wb05	black spruce - water sedge - peatmoss	9.2	9.2
Total Bog Area					122.9	216.5
Fen	ESSFmc	00	WF	willow - sedge fen		20.4
	SBSdk	00	WF	willow - sedge fen	66.7	107.0
	SBSmc2	00	WF	willow - sedge fen	0.9	1.4
		--	Wf01	water sedge - beaked sedge	1.6	1.6
Total Fen Area					69.2	130.5
Marsh	SBSdk	--	Wm01	beaked sedge - water sedge	2.1	2.1
		--	Wm02	swamp horsetail - beaked sedge	3.9	3.9
		--	Wm05	cattail	0.6	0.6
	SBSmc2	--	Wm02	swamp horsetail - beaked sedge	0.4	0.4
Total Marsh Area					7.1	7.1
Open Water	ESSFmc	00	OW	shallow open water	-	0.3
		00	PD	pond	-	3.1
	ESSFmcw	00	PD	pond	-	1.4
	SBSdk	00	PD	pond	3.2	4.9
		00	OW	shallow open water	1.4	18.9
	SBSmc2	00	OW	shallow open water	0.2	0.5
		00	PD	pond	-	0.5
Total Open Water Area					4.9	29.7
Swamp	ESSFmc	09	HG	subalpine fir - horsetail - glow moss	-	25.0
		10	FH	subalpine fir - horsetail - leafy moss	0.2	182.3
	SBSdk	07	SH	hybrid white spruce - horsetail	51.6	427.8
		07b	SH	hybrid white spruce - horsetail (poorly drained)	5.9	5.9
		--	Ws02	mountain alder - pink spirea - Sitka sedge	0.2	0.2
		--	Ws03	Bebb's willow - bluejoint reedgrass	0.9	1.0
		--	Ws04	Drummond's willow - beaked sedge	0.2	0.2
		10	SH	hybrid white spruce - horsetail	8.8	680.2
	SBSmc2	10b	SH	hybrid white spruce - horsetail - leafy mosses (lacustrine/morainal)	132.5	136.3

Wetland Class	BGC Subzone	Site Series	Map Code	Wetland Name	Area (ha)	
					Vegetation LSA	Vegetation RSA
		--	Ws02	mountain alder - pink spirea - Sitka sedge	0.9	0.9
		--	Ws03	Bebb's willow - bluejoint reedgrass	0.3	0.3
Total Swamp Area					201.5	1,460.3
Undifferentiated	ESSFmc	31	WE	non-forested wetland	-	31.7
	ESSFmcp	00	WL	wetland	-	0.1
	ESSFmcw	31	WE	non-forested wetland	-	8.8
	SBSdk	31	WE	non-forested fen/marsh	-	114.0
	SBSmc2	31	WE	non-forested fen/marsh	-	12.4
Total Undifferentiated Wetland Area					-	167.0
Total Wetland Area					405.6	2,011.1

Notes: --=not applicable; BGC=Biogeoclimatic; ESSFmc=Engelmann spruce subalpine fir zone moist cold subzone; ESSFmcp= Engelmann Spruce Subalpine Fir Unit, Moist Cold Parkland Variant; ESSFmcw=Engelmann spruce subalpine fir zone moist cold subzone woodland variant; ha=hectare; LSA=Local Study Area; RSA=Regional Study Area; SBSdk=sub-boreal spruce zone dry cool subzone; SBSmc2= sub-boreal spruce zone moist cold subzone Babine variant

Wetland function field assessments were completed over seven days from August 1 to 10, 2018 within the Vegetation LSA with the use of a Project-specific wetland functional assessment (**Appendix 4.7-A**).

Most of the wetlands assessed outside of the Helps Creek wetland complex were small (<1 ha), with an average size of 1.1 ha (range 0.1 to 4.8 ha). Wetlands rated with high function scores were primarily marsh or marsh/swamp complexes and made up only 5.2% of the total area assessed. These wetlands showed evidence of use by a variety of wildlife species (e.g., amphibians, waterfowl, mammals), having habitat suitability ratings for a variety of wildlife species of interest and high ratings for hydrologic and biogeochemical functions (**Appendix 4.7-A**). Other complex wetlands such as bog/marsh, bog/swamp and marsh wetland types were rated as moderately-high and made up 7.8% of the total area, while bogs, swamps and open water wetland types were rated as moderate, making up the remaining 87.1% of the wetland area assessed for wetland function.



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4.2.3 Listed Ecological Communities

Listed Ecological Communities are ecosystems listed by BC CDC based on the number and condition of occurrences, distribution, and potential threats from a variety of human activities or natural events. Ecological communities are defined as provincially rare when they are designated on the red list (Extirpated, Endangered, or Threatened status in BC) or the blue list (of Special Concern in BC). The conservation status information provided for Listed Ecological Communities was obtained by using the BC Species and Ecosystems Explorer online search function of the BC CDC (BC CDC 2020).

A total of 1,817.3 ha of listed ecological communities were mapped within the Vegetation RSA, of which 75% (1,367.8 ha) are blue-listed, and 25% (449.2 ha) are red-listed communities (**Table 4.2-3, Figure 4.2-3**). The blue-listed hybrid white spruce-horsetail ecosystem (SBSmc2/10 and 10b, SBSdk/07 and 07b) made up 91% (1,250.4 ha) of the blue-listed ecological community area and 69% of the total listed ecological community area in the Vegetation RSA. This area is a conservative estimate, including both the listed lacustrine/morainal and poorly drained sub-types of this ecosystem and the more common ecosystem as differentiation is not possible within portions of the ecosystem mapping in the Vegetation RSA with coarser resolution.

Other listed communities made up smaller proportions of the Vegetation RSA, including 403.1 ha of the red-listed black cottonwood-spruce-red-osier dogwood ecosystem (SBSdk/08 and Fm02) mapped predominantly along the floodplains of Goathorn Creek and the Telkwa and Bulkley rivers (**Figure 4.2-3**). The other red-listed communities mapped within the Vegetation RSA were the grassland communities saskatoon-slender wheatgrass and bluegrass-slender wheatgrass located along the slopes above Telkwa River (**Table 4.2-3**).

A total of 256.1 ha of blue- and red-listed communities were mapped within the Vegetation LSA. Distribution patterns are similar to that observed within the Vegetation RSA, with a dominance of the blue-listed hybrid white spruce-horsetail ecosystem (SBSmc2/10 and 10b, SBSdk/07 and 07b) combining for a total of 133.8 ha (52% of the total area of Listed Ecological Communities; **Table 4.2-3**). The next most extensive Listed Ecological Community was the red-listed black cottonwood-spruce-red-osier dogwood floodplain ecosystem (SBSdk/08 and Fm02) of which 38.8 ha was mapped, accounting for over 99% the red-listed communities in the Vegetation LSA. This community was found mostly along Goathorn Creek and the Bulkley River in the Rail Infrastructure area (**Figure 4.2-3**).

Table 4.2-3: Listed Ecological Communities Mapped Within the Vegetation Study Areas

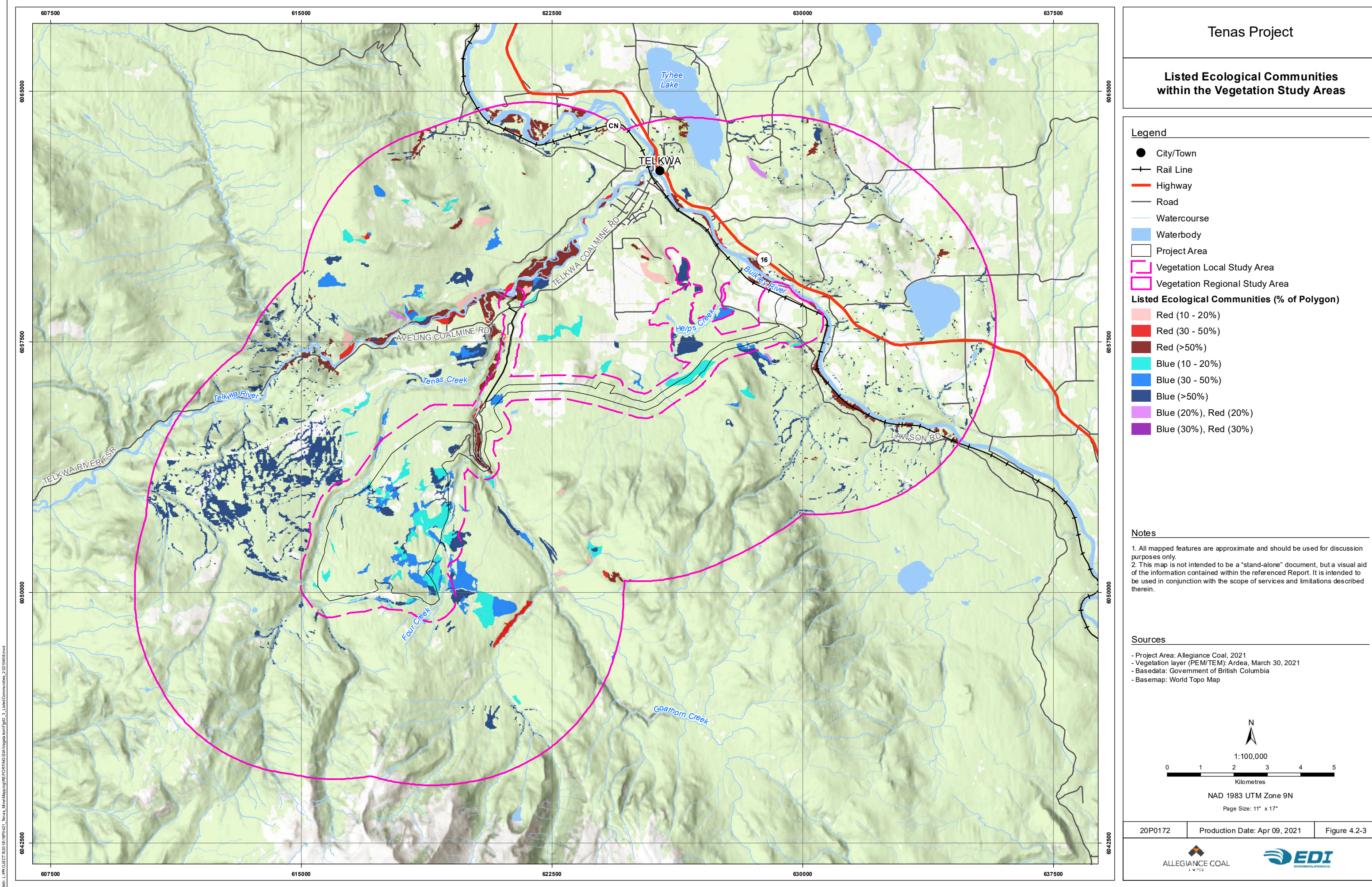
BGC Subzone	Site Series	Map Code	Ecological Community Name	BC List	Area (ha)	
					Vegetation LSA	Vegetation RSA
ESSFmc	81	SW	saskatoon-slender wheatgrass	Red	-	1.2
	82	BW	bluegrass-slender wheatgrass	Red	-	2.0
SBSdk	02	LJ	lodgepole pine-juniper-ricegrass	Blue	0.9	99.9
	07/07b	SH	hybrid white spruce-horsetail	Blue	57.5	433.8
	08	CD	black cottonwood-dogwood-prickly rose	Red ¹	0.4	316.0
	09	BS	black spruce-creeping-snowberry- <i>Sphagnum</i>	Blue	8.5	8.5
	81	SW	saskatoon-slender wheatgrass	Red	0.1	25.8
	82	BW	bluegrass - slender wheatgrass	Red	0.1	4.9

BGC Subzone	Site Series	Map Code	Ecological Community Name	BC List	Area (ha)	
					Vegetation LSA	Vegetation RSA
	n/a	Fm02	black cottonwood - hybrid white spruce / red-osier dogwood	Red ¹	38.4	87.1
	n/a	Wm02	swamp horsetail - beaked sedge	Blue	3.9	3.9
	n/a	Wm05	cattail marsh	Blue	0.6	0.6
	n/a	Ws03	Bebb's willow / bluejoint reedgrass	Blue	0.9	1.0
SBSmc2	10/10b	SH	hybrid white spruce - horsetail	Blue	76.3	816.6
	81	SW	saskatoon - slender wheatgrass	Red	-	8.4
	82	BW	bluegrass - slender wheatgrass	Red	-	3.8
	n/a	Wb01	black spruce - creeping-snowberry - peatmoss	Blue	2.8	2.8
	n/a	Wm02	swamp horsetail - beaked sedge	Blue	0.4	0.4
	n/a	Ws03	Bebb's willow / bluejoint reedgrass	Blue	0.3	0.3
Total Listed Communities Area					256.1	1,817.3

Notes: - =not applicable; BGC=Biogeoclimatic; ESSFmc=Engelmann spruce subalpine fir zone moist cold subzone; ha=hectare; LSA=Local Study Area; RSA=Regional Study Area; SBSdk=sub-boreal spruce zone dry cool subzone; SBSmc2= sub-boreal spruce zone moist cold subzone Babine variant

¹ This community is currently under review, but its last ranking by the BC CDC (2018) identified it as red-listed.

Listed Ecological Communities with the potential to occur within the Vegetation RSA have been correlated with map units and site series identified within ecosystem maps; however, these communities may not necessarily occur within all areas mapped as the corresponding site series. Actual occurrences of Listed Ecological Communities are based on site-specific characteristics that may not have been observed or corroborated with field observations. This assumption is likely to result in a conservative estimation of listed ecological community abundance within the Vegetation RSA.



Tenas Project

Listed Ecological Communities within the Vegetation Study Areas

Legend

- City/Town
- Rail Line
- Highway
- Road
- Watercourse
- Waterbody
- Project Area
- Vegetation Local Study Area
- Vegetation Regional Study Area

Listed Ecological Communities (% of Polygon)

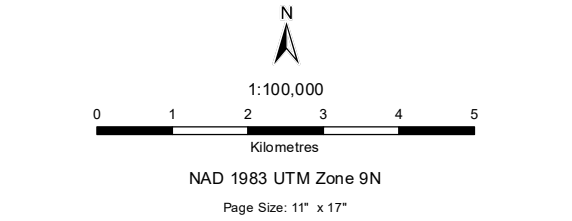
- Red (10 - 20%)
- Red (30 - 50%)
- Red (>50%)
- Blue (10 - 20%)
- Blue (30 - 50%)
- Blue (>50%)
- Blue (20%), Red (20%)
- Blue (30%), Red (30%)

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2021
- Vegetation layer (PEM/TEM): Ardea, March 30, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Map



4.2.4 Culturally Important Species

A subset of Culturally Important Species was selected as described in 4.1.1 and are summarized in **Table 4.2-4**. Ecosystems within the Vegetation RSA with the potential to support these 12 species were identified with the use of the following steps:

- ▶ An initial look-up table containing all unique BGC subzones, site series and structural stages was created from available ecosystem mapping data;
- ▶ Each identified plant species was reviewed within Land Management Handbook (LMH) 26 (Banner et al. 1993) and supplements (Williams et al. 2001, Trowbridge and Banner 2002) or within the wetland classification guidebook (MacKenzie and Moran 2004). Additional information on the distribution of some of the important cultural plants within the subzones was obtained from Beaudry et al. (1999);
- ▶ Ecosystems (e.g., site series, site associations, or map units) were conservatively identified to have the potential to support a selected culturally important plant species if they fulfilled one or more of the following conditions:
 - ▶ The Culturally Important Species had a documented prominence class of 3, 4 or 5 within the ecosystem;
 - ▶ The Culturally Important Species forms part of the ecosystem name;
 - ▶ The Culturally Important Species was observed at an average percent cover of 5% or greater within field plots (i.e., available at a density suitable for harvest);
 - ▶ For Culturally Important Species with generally low abundance in the study area (i.e., buckbean, oval-leaved blueberry), all ecosystems identifying any prominence value were determined to have the potential to support the species;
 - ▶ For BGC subzones and variants without descriptions within LMH 26 or its supplements (i.e., Boreal Altai Fescue Alpine Undifferentiated subzone [BAFAun], Engelmann Spruce-Subalpine Fir moist cold parkland subzone [ESSFmcp]), professional judgement was used to determine whether ecosystems had the potential to support the Culturally Important Species;
- ▶ Once the list of ecosystems with the potential to support Culturally Important Species was identified, a review of the structural stages for each ecosystem was completed with the use of available literature and professional judgement to further refine the list; and
- ▶ A final lookup table was created from the list of ecosystems and structural stages identified to have the potential to support Culturally Important Species.

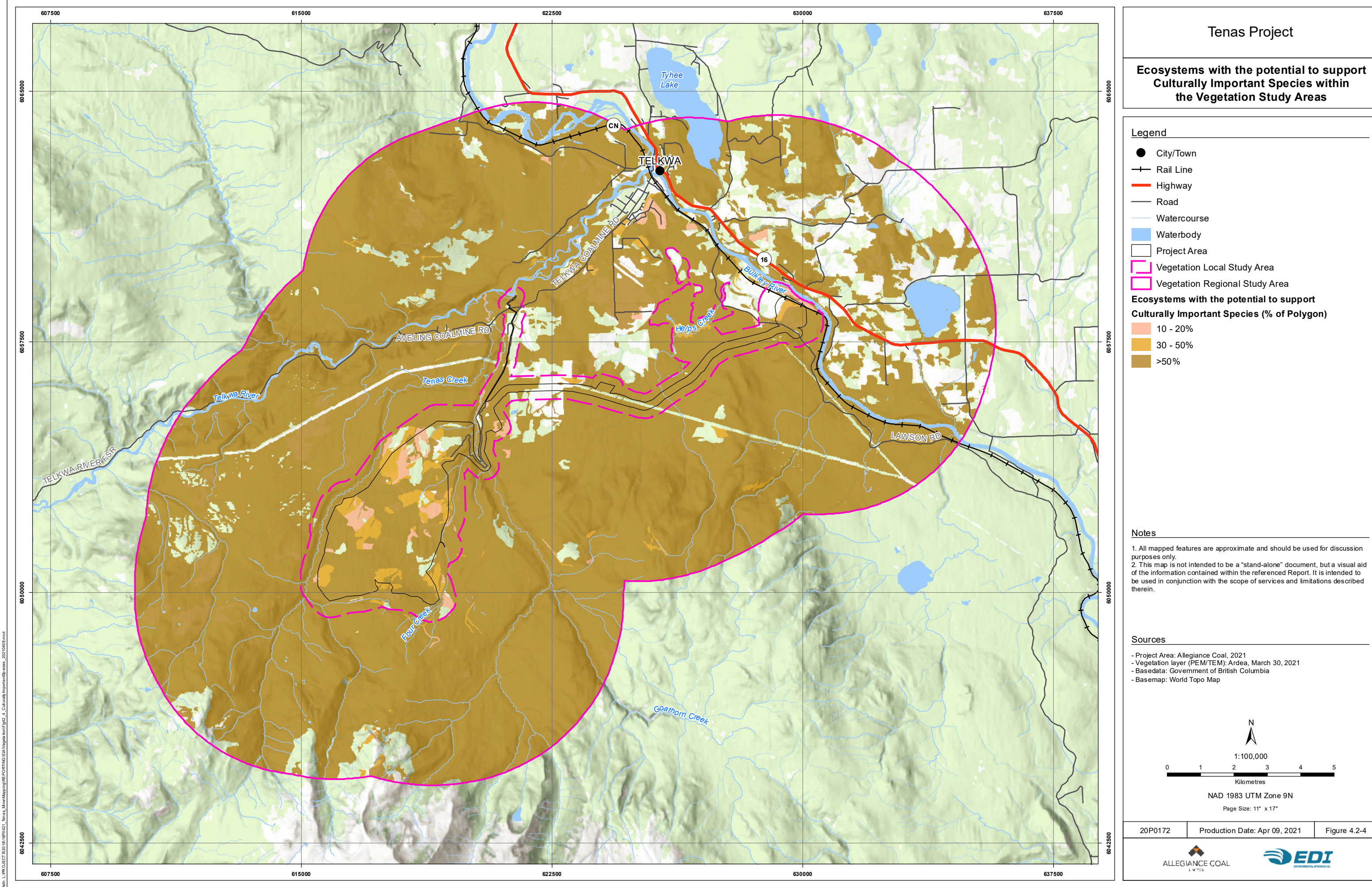
Using the final lookup table, areas with the potential to support culturally important species were identified with the use of available ecosystem mapping, with the assumption that these ecosystems and structural stages represent areas within the Vegetation LSA where Culturally Important Species might be abundant (**Figure 4.2-4**). This analysis was based on assumptions of the plant being relatively easy to find within specific ecosystems and structural stages. These assumptions are based on existing data from various sources, field data collected in this baseline and the professional judgement of the authors based on their work in the region.

Table 4.2-4: Culturally Important Species Selected for Use During the Assessment

Common Name	Scientific Name	Primary Uses
Black huckleberry	<i>Vaccinium membranaceum</i>	Food
Buckbean	<i>Menyanthes trifoliata</i>	Food/Medicinal
Cow parsnip	<i>Heracleum maximum</i>	Medicinal
Devil's club	<i>Oplopanax horridus</i>	Food/Medicinal
Fireweed	<i>Epilobium angustifolium</i>	Food/Medicinal
Highbush cranberry	<i>Viburnum edule</i>	Food
Indian hellebore	<i>Veratrum viride</i>	Medicinal
Kinnickinnick	<i>Arctostaphylos uva-ursi</i>	Food/Medicinal
Oval-leaved blueberry	<i>Vaccinium ovalifolium</i>	Food
Red raspberry	<i>Rubus idaeus</i>	Food
Soopolallie	<i>Shepherdia canadensis</i>	Food/Medicinal
Willows	<i>Salix</i> spp.	Medicinal/Baskets

Within the Vegetation RSA a total of 29,531.4 ha (83%) was identified to support at least one Culturally Important Species, with the areas of individual plant species ranging from 354 ha for Indian hellebore to 11,474 ha for soopolallie. Other species that had large areas where they might be found included black huckleberry (10,535 ha), highbush cranberry (8,763 ha), red raspberry (8,284 ha) and fireweed (8,180 ha). Species such as Indian hellebore and buckbean had limited ranges due to the limited number of ecosystems identified with a high likelihood of supporting the plant species.

The Vegetation LSA had a total of 1,659 ha (42%) of ecosystems with the potential to support at least one (1) Culturally Important Species. The proportion of ecosystems supporting culturally important plant species followed similar patterns to what was observed within the Vegetation RSA, except a lack of higher elevation BGC subzones (e.g., ESSFmc) limited some species such as Indian hellebore and oval-leaved huckleberry.



Tenas Project

Ecosystems with the potential to support Culturally Important Species within the Vegetation Study Areas

Legend

- City/Town
- Rail Line
- Highway
- Road
- Watercourse
- Waterbody
- Project Area
- Vegetation Local Study Area
- Vegetation Regional Study Area

Ecosystems with the potential to support Culturally Important Species (% of Polygon)

- 10 - 20%
- 30 - 50%
- >50%

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2021
- Vegetation layer (PEM/TEM): Ardea, March 30, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Map

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4.2.5 Rare Plants and Lichens

Rare Plants and Lichens are defined as plant and lichen species that are listed by provincial and federal agencies based on their population size, distribution, and potential threats from a variety of human activities or natural events. Plant and lichen species are defined as provincially rare when they are designated on the red list (Extirpated, Endangered, or Threatened status in BC) or the blue list (Special Concern in BC), and federally rare if they are listed as Endangered, Threatened, or Special Concern by COSEWIC or under Schedule 1 of SARA. Conservation status information provided for plant and lichen species was obtained by using the BC Species and Ecosystems Explorer online search function of the BC CDC (BC CDC 2020) and the Species at Risk Public Registry online search function (ECCC 2018).

Two (2) blue-listed species have been historically recorded within the Vegetation RSA: American sweet-flag (*Acorus americanus*) and whitebark pine (*Pinus albicaulis*) (BC CDC 2020b). American sweet-flag is a wetland plant found in open water areas, such as marshes, lakes, and ponds in montane areas of BC (Klinkenberg 2018) and has historically been recorded within the Vegetation RSA at a location on Tyhee Lake (**Figure 4.2-5**).

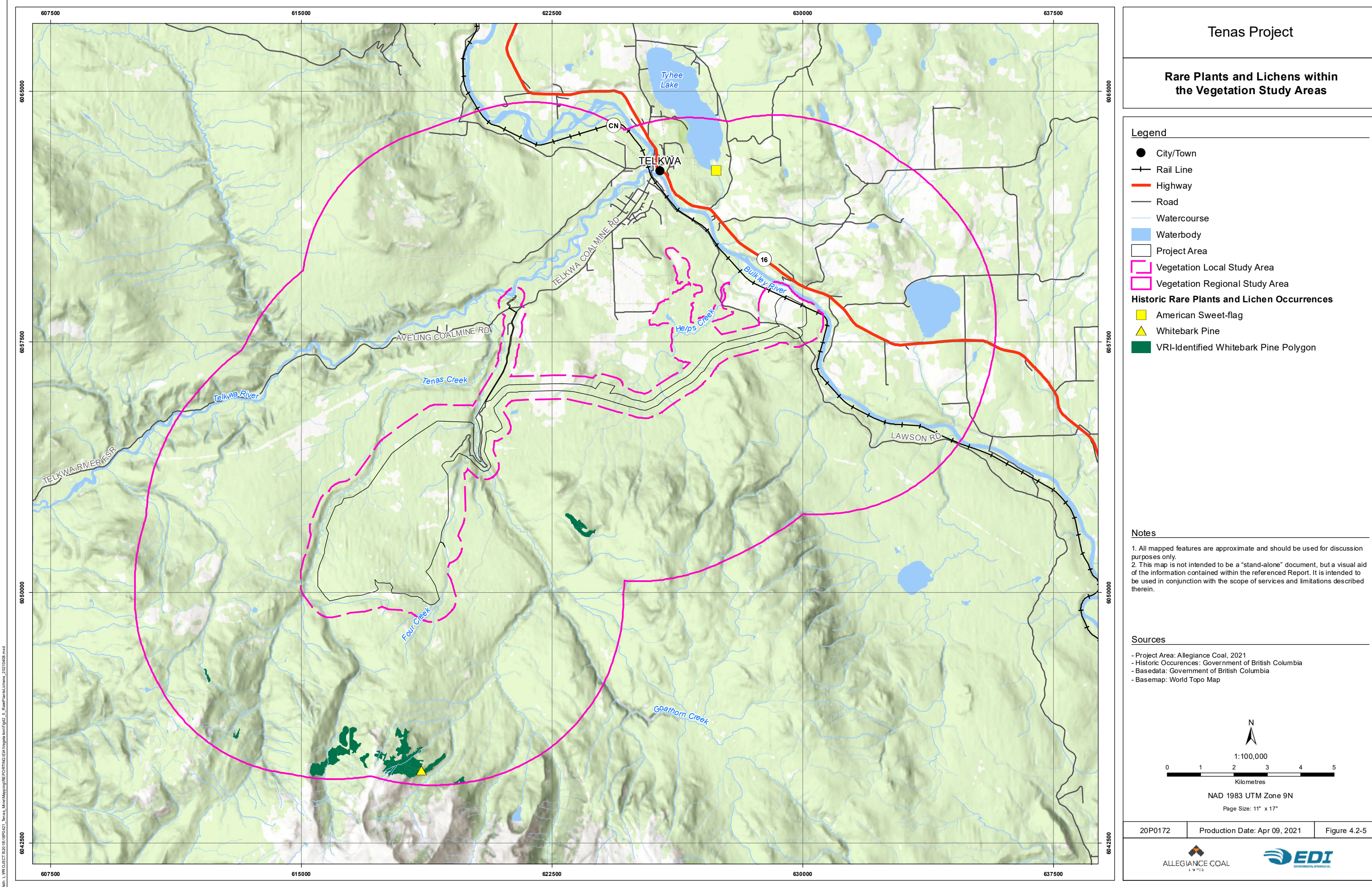
Whitebark pine, a sub-alpine tree species, is also federally listed as Endangered by COSEWIC and on Schedule 1 of SARA (ECCC 2018). Whitebark pine is found on mesic to dry slopes primarily in the ESSF BGC zone in BC (Klinkenberg 2018), and an historic occurrence has been mapped on a subalpine slope in the southern portion of the Vegetation RSA in the Telkwa Mountains near Cabinet Creek.

Additional polygons (24 polygons, 39.4 ha) with the potential to contain whitebark pine were also identified within the Vegetation Resources Inventory (VRI) data at the southern extent of the Vegetation RSA within higher elevation areas in the ESSF (**Figure 4.2-5**). This habitat was not observed to be present within the Vegetation LSA.

No listed lichen species have historically been observed within the Vegetation RSA, nor have any occurrences of listed plant or lichen been historically recorded within the Vegetation LSA.

Field surveys for Rare Plants and Lichens were completed within the Vegetation LSA in accordance with the Protocols for Rare Plant Surveys (Penny and Klinkenberg 2018) and focussed on habitat types considered to have a high potential to support these vegetation elements of concern (e.g., uncommon terrain such as wetlands, south-facing slopes, floodplains, rock outcrops). No occurrences of rare plants or lichens were observed during the vegetation and ecosystems baseline studies within the Vegetation LSA.

Surveys for Rare Plants and Lichens can confirm the presence of rare species but cannot verify their absence (Lancaster 2000). As such, there is potential for unobserved occurrences of Rare Plants or Lichens within the Vegetation LSA.



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4.2.6 Invasive Plants

Invasive plant species were identified within the Vegetation LSA and RSA using existing information sources as well as field surveys. Twenty-one (21) species were identified in the Vegetation LSA and within one (1) kilometre (km) of the Vegetation LSA in the Vegetation RSA using the invasive alien plant database. Field surveys observed ten (10) of those same species and an additional four (4) species, for a total of twenty-five (25) invasive plants occurring within one (1) km of the Vegetation LSA. Invasive plants were observed throughout the LSA, with species such as Canada thistle and Oxeye daisy identified (**Appendix 4.7-A**).

Two (2) invasive plant species of interest, St. John's-wort and Tartarian honeysuckle, were both observed in the Goathorn Creek area. St. John's-wort (*Hypericum perforatum*) is listed as an Early Detection Rapid Response species for the Bulkley Invasive Plant Management area, and Tartarian honeysuckle (*Lonicera tartarica*) had not been detected within the region previously (**Appendix 4.7-A**).

4.2.7 Future Forestry

Future forestry activity within the Vegetation RSA over the course of the lifetime of the Project was estimated for the purposes of the CEA (**6. Cumulative Effects Assessment**). For volume-based tenures, future forestry activity was estimated with the use of Timber Harvesting Land Base (THLB) data obtained from the BC MFLNRORD in April 2020 (McDougall 2020) and TSA-specific base-case forest harvest projections and/or Annual Allowable Cut (AAC) values. Provincial THLB estimates are not applicable for area-based tenures; as such, forestry information was gleaned from other sources (e.g., timber supply analysis reports, management plans). Unless data were available, active, and pending area-based tenures were assumed to be fully harvested throughout the lifetime of the Project (i.e., 52 years, between 2021 and 2073).

The following assumptions underlie these calculations:

- ▶ Where available, annual timber harvest was estimated with the use of TSA-specific base-case harvest projections. Where base-case was not available, AAC was used; and
- ▶ The probability of forestry harvest within any given area is equivalent to all other areas within the same TSA and/or forestry tenure regardless of its spatial location.

5. ASSESSMENT OF PROJECT-RELATED EFFECTS

The information provided within this section includes:

- ▶ identification of potential interactions between the Project and the Vegetation VC;
- ▶ description of potential Project effects on the Vegetation VC;
- ▶ development of mitigation measures to avoid, minimize, rehabilitate onsite, and if required, compensate, or offset the potential effects on the Vegetation VC; and
- ▶ characterisation of Project residual effects and determination of their significance on the Vegetation VC.

5.1 Potential Project-related Interactions with the Vegetation Valued Component (VC)

The intention of this subsection is to focus the assessment on those interactions with potential to adversely affect the Vegetation VC. Potential Project-related interactions with the Vegetation VC were determined by spatial analysis of the extent of Project components and activities in relation to existing conditions related to the Vegetation VC and associated subcomponents as outlined in **4. Existing Conditions**. Each potential interaction is rated using the terms provided in **Table 5.1-1**. Based on this evaluation, potential interactions between the Project and the Vegetation VC were carried forward into the assessment to determine the potential effects of the interaction.

Table 5.1-1: Potential for an Interaction between the Vegetation Valued Component (VC) and the Tenas Project

Term	Definition
No Interaction	Tenas Project (Project) activity will not interact with the Vegetation Valued Component (VC), no adverse effect is expected; no further consideration is warranted.
Interaction	Interaction between the Project activity and the Vegetation VC may have a substantive influence on the short- or long-term integrity of the VC (i.e., measurable, or detectable using the identified indicator). The potential effect(s) of the interaction is considered further in the effects assessment.

Table 5.1-2 provides a summary of potential interactions between Project components or activities and Vegetation VC subcomponents. Interactions expected to result in potential effects on the Vegetation VC are discussed further in **5.2**. Where an interaction is possible, the anticipated potential effect(s) is identified and carried forward in the assessment. Where no interaction between the Project and a subcomponent is anticipated or the interaction is considered minor (i.e., not expected to have a substantive influence on the short- or long-term integrity of the subcomponent as the effect would not be measurable or detectable using the identified Indicator) the interaction is not considered further in the assessment. For these reasons,

Project Activities such as employment and labour (during all Project Phases), maintenance of fuel and lubricant storage facilities, maintenance of administration buildings, operation of the water supply (including wells, storage, and distribution system), and maintenance of the explosives magazine have been excluded from the assessment.

In addition, because Old Growth Forest has been mapped primarily within the western extent of the LSA (**Figure 4.2-1**), interactions between this subcomponent and construction and maintenance of the Bypass road and quarries from the Minesite to the Rail Infrastructure, construction and maintenance of the Rail Infrastructure including Rail Loop and Loadout, maintenance of the permanent bridge over Goathorn Creek, and operation of the solid waste management systems have also been excluded from the assessment.

Table 5.1-2: Interactions between the Vegetation Valued Component (VC) and the Tenas Project

Project Activities	Vegetation Subcomponent				
	Old Growth Forest	Wetlands	Listed Ecological Communities	Culturally Important Species	Rare Plants and Lichens
Construction					
Transportation of equipment, materials, and personnel	X	X	X	X	X
Site clearing (surveying, clearing, grubbing, soil salvaging)	X	X	X	X	X
Construction of Surface Water Management Infrastructure, including channels and ponds (sedimentation, control, management, storage)	X	X	X	X	X
Construction of Bypass Road and quarries from the Minesite to the Rail Infrastructure		X	X	X	X
Improvements to existing private road and Forest Service Roads	X	X	X	X	X
Construction of haul roads and service roads within the Minesite	X	X	X	X	X
Construction of the permanent Goathorn Bridge Crossing over Goathorn Creek	X	X	X	X	X
Construction of the Coal Processing Plant	X	X	X	X	X
Construction of fuel and lubricant storage facilities and distribution network	X	X	X	X	X
Construction of administration buildings (first aid, maintenance, mine dry, warehouse, laboratory, parking, and vehicle wash facilities)	X	X	X	X	X
Construction of a 25 kilovolt (kV) powerline and a 600 volt (V) substation adjacent to the Coal Processing Plant	X	X	X	X	X
Construction of Rail Infrastructure including Rail Loop and Loadout connecting to the existing main Canadian National Railway line		X	X	X	X
Installation of water supply wells, storage, and distribution system	X	X	X	X	X
Construction of the water discharge infrastructure	X	X	X	X	X
Construction of storage piles for overburden, rock separated from coal in Coal Processing Plant, and stockpiles for topsoil and vegetation management	X	X	X	X	X
Construction of material handling systems for Minesite, including run-of-mine coal, processed coal, process rock conveyors, and stockpiles	X	X	X	X	X

Project Activities	Vegetation Subcomponent				
	Old Growth Forest	Wetlands	Listed Ecological Communities	Culturally Important Species	Rare Plants and Lichens
Construction of solid waste management systems including recycling and composting facilities	X	X	X	X	X
Construction of Explosives Magazine (storage building)	X	X	X	X	X
Employment and labour					
Operation					
Mining the open pit (soil salvaging, drilling and blasting, excavation of material, dewatering, loading, hauling, unloading)	X	X	X	X	X
Operation of Surface Water Management Infrastructure including channels and ponds (sedimentation, control, management, storage)	X	X	X	X	X
Maintain and use Bypass Road and quarries from the Minesite to the Rail Infrastructure		X	X	X	X
Maintain improved private and Forest Service Roads	X	X	X	X	X
Maintain haul roads within the Minesite, including service roads	X	X	X	X	X
Maintain permanent bridge over Goathorn Creek		X	X	X	X
Operate Coal Processing Plant	X	X	X	X	X
Maintain fuel and lubricant storage facilities					
Maintain administration buildings (first aid, maintenance, mine dry, warehouse, laboratory, and vehicle wash facilities)					
Maintain 25 kV powerline and a 600 V substation adjacent to the Coal Processing Plant	X	X	X	X	X
Transportation of equipment, materials, and personnel	X	X	X	X	X
Maintain and use Rail Infrastructure including Rail Loop and Loadout connecting to the existing main Canadian National Railway line		X	X	X	X
Operate water supply wells, storage, and distribution system					
Operate the water discharge infrastructure	X	X	X	X	X
Maintain storage piles for overburden, rock separated from coal in Coal Processing Plant, and stockpiles for topsoil and vegetation management	X	X	X	X	X

Project Activities	Vegetation Subcomponent				
	Old Growth Forest	Wetlands	Listed Ecological Communities	Culturally Important Species	Rare Plants and Lichens
Operate material handling systems for Minesite, including run-of-mine coal, processed coal, process rock conveyors, and stockpiles	X	X	X	X	X
Operate solid waste management systems including recycling and composting facilities	X	X	X	X	X
Maintain Explosives Magazine (storage building)					
Progressive reclamation	X	X	X	X	X
Employment and labour					
Decommissioning and Reclamation					
Dismantle and remove mining equipment and facilities (including powerline, Rail Infrastructure)	X	X	X	X	X
Transportation of equipment, materials, and personnel	X	X	X	X	X
Reclamation and closure activities at Minesite	X	X	X	X	X
Reclamation and closure of Bypass Road and haul roads, including quarries	X	X	X	X	X
Reclamation and closure of permanent bridge over Goathorn Creek	X	X	X	X	X
Reclamation and closure of powerlines	X	X	X	X	X
Reclamation and closure of Rail Infrastructure	X	X	X	X	X
Implement post-mining systems and monitoring	X	X	X	X	X
Employment and labour					
Post-closure					
Maintain post-mining systems and ongoing monitoring	X	X	X	X	X
Transportation of equipment, materials, and personnel	X	X	X	X	X
Employment and labour					

Notes:

Interaction (X): Interaction between the Project activity and the VC may have a substantive influence on the short- or long-term integrity of the VC (i.e., measurable or detectable using the identified indicator). The potential effect(s) of the interaction is considered further in the effects assessment.

No interaction (Blank): Project activity will not interact with the VC; no adverse effect is expected; no further consideration is warranted.

5.2 Potential Project-related Effects

Based on the timing and nature of the interactions identified in **Table 5.1-2**, the following effects have the potential to occur:

- ▶ alteration/loss of vegetation, ecosystems, and wetlands; and
- ▶ deposition of trace metals on plants and soil, which can result in uptake by plants.

The alteration of vegetation is defined as reduced ecosystem function, plant vigour, and/or changes to population extent. The alteration of vegetation may occur due to introduction and/or proliferation of invasive plants, changes in water quality and quantity, edge effects, dust deposition, and soil erosion, deposition, and sedimentation. Alteration of vegetation can lead to the loss of vegetation, ecosystems and/or wetlands.

The loss of vegetation is defined as habitat alteration to the extent that it is rendered functionally unable to support vegetation populations or ecosystems. Land clearing and grubbing are anticipated to result in the greatest contribution to loss of vegetation.

Trace metals deposition is defined as the deposition of elements on plants and soil at abundances higher than baseline conditions due to Project activities. These trace metals have the potential to be subsequently taken up by plants through roots and leaves and be accumulated within plant tissue. Trace metals uptake can affect plants by reducing plant health, changing plant abundance and community composition, and potentially changing their nutritional value and toxicity to wildlife (Shaw 1989).

The potential effects are described below as they relate to the phases during which each potential effect is expected to occur. Most of the potential Project-related effects are expected to be similar among all Vegetation VC subcomponents; however, subcomponents expected to be differentially influenced by a particular effect are discussed as appropriate. Mitigation measures for each potential effect are described in **5.3.2**.

5.2.1 Alteration/Loss of Vegetation, Ecosystems, and Wetlands – All Subcomponents

5.2.1.1 Construction Phase

Most of the Project effects are expected to occur during the Construction Phase. Site clearing will occur within the entire Project Area, and soil salvaging, stockpiling, and grading will occur on the Project Area resulting in the direct loss of vegetation, ecosystems, and wetlands. Areas within the Project footprint but outside of the Project Area are not expected to require soil disturbance and topsoil will remain in place (e.g., above-ground water distribution system, water discharge infrastructure, areas within the powerline right-of-way (ROW) where structures are not planned).

Alteration of vegetation, ecosystems, and wetlands may also occur due to indirect effects such as introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition.

Vegetation clearing and soil disturbance during the Construction Phase is expected to create favourable habitat for the introduction and proliferation of invasive plants. Vehicles and construction equipment can inadvertently transport seeds and other invasive plant propagules in tires or the undercarriage to previously unaffected areas. The effects of invasive plants on native vegetation diversity are well documented and recognized as the second greatest threat to listed species after habitat loss (Enserink 1999). Competition with native species can lead to a reduction in the growth and vigour of native species (e.g., Culturally

Important Species, Rare Plants and Lichens), as well as changes in the diversity, structure and function of ecosystems (e.g., Old Growth Forest, Listed Ecological Communities, Wetlands).

Edge effects are expected to extend into areas of native vegetation at the interface of disturbed areas and native ecosystems. Where edge effects are present, vegetation may experience differences in light intensity, temperature, wind, relative humidity, and patterns of snow accumulation and melt relative to undisturbed conditions. This can, in turn, affect plant health and altered natural disturbance regimes (e.g., blowdown) in the short term, and plant population persistence and ecosystem structure and function over the longer term.

Construction may reduce soil infiltration and groundwater recharge, potentially changing the magnitude, timing, and flashiness of surface water and groundwater flows into wetland ecosystems. Construction of surface water management systems (e.g., ditches, ponds) and subsequent diversion of natural drainage patterns can also cause changes in hydrology adjacent to the Project Area and/or downgradient from the Project. Such hydrologic change has the potential to result in the alteration/loss of vegetation, ecosystems, and wetlands by altering local moisture gradients and influencing the persistence of native species and community function. Increased overland surface water flows can also cause soil erosion and mobilize sediment, resulting in sediment deposition on vegetation and ecosystems downgradient. Increased sediment deposition can influence vegetation through physical blockage of photosynthesis and respiration, alteration of nutrient concentrations, and modification of local hydrology.

Water quality has the potential to be influenced by factors such as incidental chemical release to the environment (e.g., hydrocarbons), and the chemical composition of sediment and dust. These substances can alter soil chemistry, be absorbed directly by plants, or be transported downgradient to wetland habitats. Potential effects on vegetation, communities, and wetlands will depend on the type and concentration of the constituent chemicals. For example, increased receipt of nutrients resulting from dust mobilization can be beneficial to vegetation at low to moderate concentrations but can have adverse effects at high concentrations (Adamus et al. 2001). Changes in water quality are expected to affect wetlands and related species, including wetland Listed Ecological Communities and wetland-associated Culturally Important Species and Rare Plants and Lichens.

Dust can be generated by vegetation clearing; soils salvaging/excavation, stockpiling, and grading; wind erosion of exposed soils; and movement of vehicles and equipment. Vegetation growth may be adversely affected by dust through changes in soil pH, microclimate, nutrient availability, radiation absorption, physical blockage of respiration and transpiration, and leaf temperature and chemistry (Farmer 1993). The potential effects of dust deposition will be greatest during dry periods and reduced during wet periods, as precipitation events are expected to wash dust from vegetation.

5.2.1.2 Operation Phase

Direct disturbance to vegetation, ecosystems, and wetlands is expected to be limited during Operation; however, maintenance will occur along the ROW of existing roads, haul roads, Rail Infrastructure, pipelines, and powerlines that will limit the progression of succession and/or limit the height of vegetation. Alteration of remaining vegetation, ecosystems, and wetlands may also occur due to indirect effects such as introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition.

The potential for introduction and proliferation of invasive plants by transport on vehicles and equipment as described in above will continue throughout Operation. Progressive reclamation has the potential to introduce invasive plants if seed used for revegetation is not supplied from a native seed source (Polster 2003).

Edge effects at the interface of disturbed areas and native ecosystems as described above are expected to continue throughout the Operation Phase.

Potential changes in water quantity and quality as described above are expected to continue throughout the Operation Phase. Reduced soil infiltration and groundwater recharge on the Project Area, as well as diversion of natural drainage patterns from surface water management infrastructure (e.g., collection and diversion channels, ponds) can result in the alteration/loss of vegetation, ecosystems, and wetlands by altering local moisture gradients, increasing soil erosion and mobilizing sediment downgradient. These alterations have the potential to reduce vegetation health and community function. In addition to the factors potentially influencing water quality, water quality may be influenced by other factors during the Operation Phase such as acid rock drainage (ARD) and metal leaching (ML) from material storage piles.

In addition to sources of dust described above, the Project Operation Phase may generate additional dust while mining the open pit (i.e., during soil salvage, drilling and blasting, loading, hauling, and unloading); operating the Coal Processing Plant (CPP) and material handling systems for raw coal, coarse and fine rock, and washed product coal; and maintaining material storage piles.

5.2.1.3 Decommissioning and Reclamation Phase

The overall effect on the Vegetation VC during the Decommissioning and Reclamation Phase is expected to be positive as Project activities will be undertaken for the purpose of initiating vegetation regeneration within the Project Area. Direct loss of vegetation, ecosystems and wetlands is not expected during the Decommissioning and Reclamation Phase; however, alteration of remaining vegetation, ecosystems, and wetlands may occur as a result of indirect effects such as introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition.

The potential for introduction and proliferation of invasive plants by transport on vehicles and equipment as described above is expected to continue throughout the Decommissioning and Reclamation Phase.

Edge effects at the interface of disturbed areas and native ecosystems as described above are expected to continue throughout the entire Decommissioning and Reclamation Phase.

Potential changes to water quantity and quality as described above may continue during the Decommissioning and Reclamation Phase. Reduced soil infiltration and groundwater recharge on the Project Area may persist without suitable decompaction of soils, and improper recontouring may result in drainage patterns that alter local moisture gradients, increase soil erosion, and mobilize sediment downgradient, thereby reducing vegetation health and community function.

During the Decommissioning and Reclamation Phase, dust can be generated by soil handling and stockpiling, wind erosion of exposed soils, and vehicles and equipment travelling on roads and within parking lots and staging areas.

5.2.1.4 Post-closure Phase

The overall effect on the Vegetation VC during the Post-closure Phase is expected to be positive as revegetation initiated during the Decommissioning and Reclamation Phase is expected to continue within reclaimed areas. No direct loss of vegetation, ecosystems, or wetlands is expected; however, alteration may occur due to indirect effects such as introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition.

The potential for introduction and proliferation of invasive plants transported on vehicle traffic resulting from maintenance and monitoring crews as described above is expected to continue throughout Post-closure.

Edge effects at the interface of disturbed areas and native ecosystems as described above are expected to continue during the Post-closure Phase, decreasing over time as revegetation and tree growth within the Project Area create a gradual structural transition at forest edges (e.g., a tall shrub or pole/sapling structural stage, approximately 20 years following reclamation).

Potential changes to water quantity and quality as described above have the potential to continue during the Post-closure Phase. Reduced soil infiltration and groundwater recharge on the Project Area may persist without suitable decompaction of soils, and improper recontouring may result in drainage patterns that alter local moisture gradients, increase soil erosion, and mobilize sediment downgradient, thereby reducing vegetation health and community function.

Dust generation may result from occasional vehicle traffic during monitoring and maintenance activities but is expected to be limited.

5.2.2 Trace Metals Deposition – All Subcomponents

5.2.2.1 Construction Phase

During the Construction Phase, trace metals have the potential to be transported and deposited onto vegetation and soil primarily by dust deposition and air emissions. All dust (as described above under alteration/loss of vegetation, ecosystems, and wetlands) has the potential to contain trace metals, but road dust caused by movement of vehicles and equipment is expected to contain the highest concentrations of trace metals originating from oil, grease, hydraulic fluids, fuel additives, wear of vehicle and equipment parts (e.g., brake lining, tires), and road salts. Mobilization of this road dust has the potential to deposit trace metals on plants and soil (Trombulak and Frissell 2000).

Similarly, air emissions from fossil fuel combustion from vehicles and equipment have the potential to disperse trace metals into the ambient air, which can subsequently be deposited onto plants and soil during the Construction Phase. Dust and air emissions are expected to be transported downwind and deposited in response to local atmospheric conditions and particle size. The predominant wind direction within the Vegetation RSA is from the west-southwest to southwest, following the orientation of the Telkwa River Valley (**S4.0-C1 Atmospheric Environment VC of the EAC Application**). Modelling indicates that dustfall deposition will occur up to 800 m from the Project Area (i.e., 0.1 milligram per square decimeter per day [mg/dm²-d]), with the highest deposition expected to occur within 100 m (i.e., >1 mg/dm²-d) (**S4.0-C1 Atmospheric Environment VC of the EAC Application**). Vehicle emissions have been observed to be responsible for alteration of vegetation up to 200 m from the road edge (Forman and Alexander 1998).

5.2.2.2 Operation Phase

Potential trace metals deposition caused by dust and air emissions caused by vehicles and equipment is expected to be highest during the Project Operation Phase. The transport of dust containing metals onto soil and vegetation has the potential to result from drilling and blasting; loading, hauling, and unloading materials; operation of the CPP; and material handling systems for mine rock, processed rock, raw coal, and processed coal, and maintenance of storage piles.

Exposure of mine rock and overburden to weathering can also result in trace metals transport through surface water. ARD can result in increased solubility of trace metals, which can leach from material storage piles and be deposited on plants and soil. The mobilization distance of surface water-borne trace metals is

variable and depends on local hydrology and topography, weather patterns, and preceding dry periods (Hwang et al. 2016). Trace metals have the potential to travel longer distances, leading into receiving waterbodies downgradient. It is therefore expected that the areas with the greatest potential for deposition of trace metals transported by surface water runoff will be within low-lying areas, such as wetlands, within the Vegetation LSA.

5.2.2.3 Decommissioning and Reclamation Phase

Potential trace metals deposition by dust deposition and air emissions caused by vehicles and equipment, as well as surface water transport is expected to continue throughout the Decommissioning and Reclamation Phase, but to a lesser extent related to the reduced traffic.

5.2.2.4 Post-closure Phase

During the Post-closure Phase, the potential exists for trace metals deposition on vegetation and soil by road dust and air emissions originating from occasional vehicle traffic and equipment during monitoring and maintenance activities.

5.3 Mitigation Measures

This subsection describes the mitigation measures to address the potential effects of the Project on the Vegetation VC. The mitigation measures are consistent with mitigation definition provided by the British Columbia Environmental Assessment Office (BC EAO 2013) and encompasses practical means or measures taken to avoid, minimize, rehabilitate onsite, and if required, compensate, or offset the potential adverse effects of a project. The mitigation measures are based on proven and accepted mitigation using standard industry guidelines and BMPs.

TCL has developed incorporated several mitigation measures in the Project's design and/or operational procedures to reduce the magnitude, duration, and extent of effects due to the Project. These Project mitigation measures are outlined in **S1.0 Overview of Project Proponent Description** of the **EAC Application**. Project mitigation measures relevant to minimizing a potential Project-related effect on the Vegetation VC are listed below in **5.3.1** to **5.3.8** with further context as to how each measure is expected to mitigate potential effects on the Vegetation VC.

As not all effects can be addressed through design, additional mitigation measures specific to the Vegetation VC and tailored to Project features are described in **5.3.9** to **5.3.15** and have been incorporated into the various Project management plans such as the **Surface Erosion Protection and Sediment Control Plan (S13.0-C17) (SEPSCP)**, **Vegetation Management Plan (S13.0-C18) (VMP)**, **Reclamation and Closure Plan (S13.0-C15) (RCP)**, **Air Quality Management Plan (S13.0-C2) (AQMP)**, **Minesite Traffic Control Plan (S13.0-C10) (MTCP)**, **Fuel Management and Spill Control Plan (FMSCP) (S13.0-C7) (FMSCP)**, **Mine Emergency Response Plan (S13.0-C9) (MERP)**, **Metal Leaching/Acid Rock Drainage Management Plan (S13.0-C12) (M/ARDMP)**, and the **Minesite Water Management Plan (S13.0-C11) (MWMP)** of the **EAC Application**. Mitigation measures (described below) are based on proven and accepted mitigation used in BC following standard industry guidelines and BMPs such as those listed in **2.3 Strategies, Guidelines, Plans and Best Management Plans**. The management plans provide further guidance to the standard of the day for minimizing alteration/loss of vegetation, ecosystems and wetlands and the deposition of trace metals. The management plans provide direction on sequencing, monitoring and adaptive management to ensure that measures are timely and effective. The mitigation measures are expected to be effective immediately following implementation.

The following measures are commitments that TCL has applied through mine design and to the operating principals through the life cycle of the Project. All mitigation measures for the Vegetation VC are then summarized in **Table 5.3-1**.

5.3.1 Avoid Sensitive Environments

The following apply to sensitive environments:

- ▶ avoid known wetlands and sensitive ecosystems (such as riparian areas); and
- ▶ avoid activities within watercourses.

5.3.2 Limit Project Footprint and Project Area

To limit the Project footprint and Project Area the Project has been designed to:

- ▶ Cluster Project components, including the open pit, stockpiles for run-of-mine (ROM) coal, processed coal and processed rock, CPP, management ponds, and ancillary facilities such as the Maintenance Facility and Administration Building;
- ▶ Align linear Project features (such as powerlines, roads, water distribution) into a common ROW;
- ▶ Place Project features within existing or planned Project component footprints to limit the clearing of vegetation and the salvage of reclamation materials (surface soil, woody debris, and overburden). For example, the Minesite buildings will be built in areas previously cleared by forestry activity;
- ▶ Minimize the length of haul roads, access roads, and rail line where possible. Use or improve existing roads where practical;
- ▶ Utilize a loop design configuration for the rail that requires half the space and subsequent footprint compared to the standard teardrop shape seen at other operating or proposed coal mines in western Canada;
- ▶ Place reclamation material (surface soil and woody debris) stockpiles within development areas such as the open pit and haul roads to avoid disturbance, while overburden is directly placed on Project components for future reclamation activities;
- ▶ Limit the TAC to a single lane width for long distances and utilize existing Forest Service Roads (FSRs) or private roads where appropriate;
- ▶ Backfill approximately 50 percent (%) of non-coal material back into the open pit; and
- ▶ Place processed rock from the CPP within the management ponds versus a separate permanent pile to avoid any potential ARD from this material and reduce Project footprint.

5.3.3 Reclamation Measures

The following reclamation measures have been incorporated into the mine design:

- ▶ Use progressive reclamation techniques to limit the amount of disturbance at any given time by sequencing the open pit and stockpiles to the extent feasible, backfilling of open pit where possible, directly placing reclamation materials, and placing excavated materials on previously disturbed areas;
- ▶ Salvage reclamation materials (surface soil, woody debris, and overburden), for later use in accordance with the **RCP**;

- ▶ Vegetate all temporary surface soil and overburden stockpiles to minimize the potential for erosion and sediment generation, to prevent subsequent potential effects on water quality, and to prevent losses of surface soils;
- ▶ Implement progressive reclamation on embankments, buttresses, backfills, TAC cut and fill slopes, and other Project components to be implemented where possible to minimize fugitive dust emissions and reduce erosion and sediment generation;
- ▶ The reclaimed landscape will be shaped and contoured to achieve variations of slope steepness, slope length, aspect, and form to assist in creating landform diversity suitable for the establishment of varied plant communities and to reduce visual effects;
- ▶ PAG material deposited in the management ponds will be flooded to prevent acid mine drainage but will also be covered with an engineered cover consisting of non-PAG rock, overburden, and surface soils to allow for terrestrial revegetation;
- ▶ Majority of open pit features (e.g., highwalls and footwalls) are covered/resurfaced/recontoured with non-potentially acid generating (non-PAG) rock and overburden; and
- ▶ Revegetate with native plant species appropriate for the target ecosystems, which will include species for merchantable timber, subsistence foods, and ceremonial purposes in consultation with the Wet'suwet'en.

5.3.4 Project Footprint Boundaries

The following apply to Project footprint boundaries:

- ▶ Implement no activity buffers for identified features such as riparian areas and watercourses that were previously documented or by identified by methodologies provided in the related management plans, e.g., **Wildlife Management Plan (S13.0-C21) (WMP)**, **VMP**;
- ▶ Clearly delineate the boundaries of no activity buffer for sensitive features in the proximity of planned disturbances to facilitate avoidance during all phases of the Project, where possible; and
- ▶ Clearly delineate Project footprint boundaries, adhering to construction plans and restricting identified machine use to defined areas within the Project footprint.

5.3.5 Transport Measures

The following mitigation refer to transport measures:

- ▶ Build, maintain, and use the TAC for hauling processed coal to the Rail Infrastructure for the duration of all Project phases after the Construction Phase to minimize traffic on existing, residential roads;
- ▶ Build, maintain, and use the TAC for transport of personnel, goods, and services for the duration of all Project phases after the Construction Phase to minimize traffic on existing, residential roads;
- ▶ Repair and/or replace and/or upgrade existing FSRs or private roads that will be used as part of the TAC;
- ▶ Repair and replace new and existing culverts as required for all Project related transport corridors including the TAC;
- ▶ Design and build a permanent clear span bridge over Goathorn Creek and Helps Creek and its related tributaries to provide vehicular access to the Project that will be controlled by TCL;

- ▶ Use buses and/or vans for employees and contractors as much as practical to reduce the risk of traffic incidents, and to reduce noise and fugitive dust emissions generated by the Project. Bussing options to Witset and/or Houston to be provided (if requested and based on sufficient employees in these locations) to facilitate potential employees accessing employment opportunities with the Project;
- ▶ Use dust suppression agents on the rail cars to reduce fugitive dust emissions;
- ▶ Cover super B-train trucks when hauling processed coal from the CPP to Rail Infrastructure to reduce fugitive dust emissions from trucks;
- ▶ Use water and chemical agents on the TAC to reduce fugitive dust emissions, where and when appropriate; and
- ▶ Use water and chemical agents, as required, on the processed coal and ROM coal stockpiles to reduce fugitive dust emissions resulting from storage and handling.

5.3.6 Forest Management Practices

The following refer to forest management practices:

- ▶ Follow BC MFLNRORD guidelines and requirements for clearing, handling, and hauling any beetle infested wood such as: Guidance on Landscape and Stand-level Structural Retention in Large-scale Mountain Pine Beetle Salvage Operation (BC MFLNRORD 2005), Bark Beetle Management Guidebook (BC MFLNRORD 1995), and Spruce Beetle Management in BC (BC MFLNRORD n.d.);

5.3.7 Blasting Measures

The following mitigation measures apply to blasting:

- ▶ Use best management stemming techniques (e.g., type of material, size consistency, loading method, and thickness) that will minimize effects of noise and fugitive dust from blast patterns and assist in the complete detonation of drill holes to reduce the introduction of nitrogen species into the surrounding rock per the **EMP**; Correctly time blasts to minimize effects of noise, vibration, and fugitive dust from blast patterns;
- ▶ Keep blast patterns small to minimize effects of noise, vibration, and fugitive dust from blast patterns;
- ▶ Monitor actual blast results, and implement improvements as required as per the adaptive management process to reduce effects of noise, vibration, fugitive dust and reduce the introduction of nitrogen species into the surrounding rock; and
- ▶ Use electronic detonators to minimize effects of noise, vibration, and fugitive dust from blast patterns and manage misfires to reduce the introduction of nitrogen species into the surrounding environment.

5.3.8 Management of Metal Leaching/Acid Rock Drainage (ML/ARD)

The following mitigation measures apply to preventing potential ARD:

- ▶ Identify and segregate PAG material while mining the open pit, and place PAG material in management ponds and submerge PAG material under a minimum of 1.0 metre (m) of water within an average of six (6) months after excavation but no longer than 12 months and under at least two (2) m of water once the management pond has met its PAG material storage requirements (North Management Pond is completed first, followed by the East Management

Pond and finally the West Management Pond) to prevent potential ARD and subsequent effects on surface water quality;

- ▶ Place approximately a one (1) to two (2) m layer of non-PAG rock on top of the submerged PAG material below the active water level of the respective management pond, followed by approximately one (1) to three (3) m layer of overburden to create a dry landform above water, followed by an approximately 30 centimetre (cm) layer of reclamation materials (surface soil) to reduce evaporative losses from the management ponds and provide a landscape more similar to pre-Project development;
- ▶ No PAG material will be used in construction of any external piles, pads, roads, embankments, buttresses, or for backfilling the open pit, to prevent potential ARD and subsequent effects on surface water quality;
- ▶ Open pit walls will be covered by non-PAG material to limit oxygen and water ingress into the open pit walls and provide a neutralizing effect on the open pit wall material below;
- ▶ Some of the open pit walls will be flooded with water to further reduce the likelihood of ARD from the covered open pit walls;
- ▶ Establish a material geochemical testing program for future Project exploration drillholes and Operation phase blast holes as part of the blasting program to verify PAG versus non-PAG materials. Maintain a PAG geological model while the open pit is being mined to reflect any changes observed;
- ▶ Maintain a database of geochemical testing results and material placement to avoid the incorrect placement of PAG material and potential ARD with subsequent effects on surface water quality;
- ▶ Establish a material tracking system to document the location and type of material being excavated and hauled to avoid misplacement of material and/or remediate any misplacement that may occur;
- ▶ Controlled open pit wall blasting will be conducted on both the highwall and footwall to limit the amount of damage to the open pit wall to minimize the potential for particle size reduction and provide pathways for water and oxygen to enter the open walls prior to them being covered;
- ▶ Majority of material near the open pit footwall will not be blasted again to minimize the potential of water and oxygen accessing this material;
- ▶ Progressive reclamation will be undertaken to reduce the infiltration of water and oxygen into the open pit walls by placing non-PAG rock and overburden on the open pit walls once mining is completed for an open pit wall section in question and people operating equipment have moved at least 100 m away from proposed backfilling operation. Furthermore, this non-PAG material is expected to provide a permanent high neutralization potential (NP) water source to prevent ARD generation from PAG material present in the open pit walls; and
- ▶ Provide annual reports to British Columbia Ministry of Energy, Mines and Low Carbon Innovation (BC MEMLI) and BC MECCS and designated Indigenous groups summarizing the results of geochemical testing.

The following mitigation measures for minimizing potential ML:

- ▶ Progressive reclamation will be undertaken to reduce the infiltration of water and oxygen into the non-PAG backfills, buttresses, and embankments;
- ▶ Non-PAG rock will be covered with overburden as much as material constraints allow to reduce the infiltration of water and oxygen;

- ▶ Place some non-PAG rock into management ponds that are characterised as PAG because of the mine planning process using a neutralization potential ratio (NPR) value of 2NP (neutralizing potential):1AP (acid potential [AP]) to classify non-PAG material from PAG material versus the geochemistry NPR value of 1.2NP:1AP used for classifying non-PAG material from PAG material; and
- ▶ In the Post-closure Phase, approximately half of non-PAG material will be flooded with water in the open pit to prevent oxygen ingress and further oxidization of this material resulting in a reduction of metal leaching once this occurs.

5.3.9 Project Siting and Construction

- ▶ Project components directly associated with the mine such as the open pit, management ponds, water management structure and Mine Infrastructure will be constructed to design-specifications and follow applicable management plans, regulatory requirements, and BMPs. Project Area/footprint boundaries will be clearly delineated (e.g., with the use of fencing, staking, or flagging and on maps) prior to the Construction Phase; construction will closely adhere to construction plans and schedules. Wetland boundaries, Rare Plant and/or Lichen occurrences, Old Growth Forest, and/or Listed Ecological Communities in the Project footprint will be clearly delineated prior to construction (e.g., with the use of fencing, staking, or flagging, and shown on maps) to facilitate avoidance to the extent practicable; and
- ▶ Appropriate setbacks around riparian and Wetland ecosystems in accordance with recommendations under the *Forest and Range Practices Act*, SBC 2002, c 69 (GovBC 2002c) and associated regulations will be established and maintained where practicable. Temporary workspaces or laydown areas will be sited and constructed within the Project footprint, on previously developed areas, or within Project component footprints.

5.3.10 Vegetation Clearing and Soil Salvage

- ▶ Clearing of vegetation and salvage of surface soils will be restricted to the Project Area/footprint. In areas requiring clearing only, grubbing will be avoided, and the disruption of surface soils minimized; and
- ▶ Surface soil and overburden suitable for reclamation use will be salvaged and stockpiled separately in accordance with the **RCP**; surface groundcover and vegetation matter will be retained to the extent feasible in accordance with the **VMP**. Surface soil and overburden stockpiles will be constructed to design specifications and incorporate erosion control measures; stockpiles will be temporarily revegetated as soon as practical to stabilize exposed surface soils until they are used in the reclamation program.

5.3.11 Invasive Plant Management

- ▶ Equipment and vehicles will arrive at the Project's office in Telkwa clean, and will be inspected for soil materials, overburden, plant material, and seeds to limit the potential for the introduction of invasive plants and noxious weeds. If equipment arrives at the Project office obviously dirty the contractor will be required to clean the equipment at a publicly available wash bay and will need a follow up inspection prior to being allowed within the Project Area. Areas with a high risk for the potential spread of invasive plants and noxious weeds (i.e., within or adjacent to existing infestations) will be avoided to the extent practical; if work must occur in these areas, invasive plants management will be implemented in accordance with the **VMP** before starting work. Gravel, fill, straw matting, or similar materials to be used for erosion control will be inspected to reduce the potential for seeds or propagules of invasive plants and noxious weeds being brought to the Project.

- ▶ Invasive plants and noxious weed occurrences will be addressed as outlined in the **VMP**. Herbicide use will be avoided within 100 m of any known rare plant, rare lichen, or Listed Ecological Community occurrences. Where herbicide use is unavoidable, use will be restricted to direct application instead of broadcast spraying; and
- ▶ Surface soil and overburden which cannot be immediately used for reclamation will be stockpiled. These stockpiles will be vegetated and/or covered as soon as practicable to minimize the potential for proliferation of invasive plants.

5.3.12 Erosion and Sediment Control

- ▶ Sediment and erosion control measures will be implemented in accordance with the **SEPSCP**; and
- ▶ Areas prone to instability and areas in proximity to water bodies and drainages will be further reinforced/stabilized via construction of abutments and permanent erosion controls, if specified. Hydrological connectivity will be maintained by providing unobstructed passage of water in existing drainage channels through fill materials (i.e., using free-span bridges or culverts at waterbody crossings) in accordance with the **MWMP**.

5.3.13 Dust Suppression and Air Emissions

- ▶ Dust generation and subsequent deposition on exposed soils and plants because of Project activities will be limited through dust suppression techniques and implementation of the **AQMP**. The primary approach to reducing road dust re-entrainment within the Project footprint is watering when conditions require. If required alternative and additional approaches include chemical agent application, such as calcium chloride, designed to alter the surface of the roadway, cementing loose material into a hardened surface. Air emissions will be reduced to the extent practical through implementation of the **AQMP** and the **MTCP**.

5.3.14 Spill Prevention and Response

- ▶ Spill prevention and response measures will be implemented during vehicle and equipment travel/operations in accordance with the **FMSCP** and any hazardous materials management will also be implemented in accordance with the **FMSCP**.

5.3.15 Additional Valued Component (VC)-specific Reclamation Measures

- ▶ The Project will be decommissioned and reclaimed to design-specifications to create a safe and stable end-landscape that aligns with end-land use objectives in accordance with the **RCP**. The Decommissioning and Reclamation Phase will closely adhere to reclamation plans and schedules. Reclaimed areas will be re-sloped to approximate pre-Project contours, or stable contours, and revegetated as soon as practicable following sloping and surface soil replacement. Post-Project terrain will be re-contoured and scarified to create terrain diversity, variation in slope steepness, length, aspect, and shape to promote seed retention and establishment of an average of land capability which is not less than the pre-development capability in accordance with the **RCP**; and
- ▶ Surface soils and selected overburden will be directly placed or stockpiled for later use. Once placed as a growth medium it will be decompacted to establish suitable conditions for revegetation by native species. Revegetation will occur as soon as practical to stabilize exposed surface soils in accordance with the **VMP**, **RCP** and the **Soil Management Plan (SMP)** that is **Appendix 13.11-E** of the **RCP**. Areas prone to instability (especially in proximity to watercourses and drainage features) will be identified/flagged prior to reclamation earthworks; if/where reclamation earthworks

must occur in these areas, erosion, and sediment control BMPs will be implemented in accordance with the **SEPSCP** and **CEMP**.

5.3.16 Summary of Mitigation Measures

A summary of the mitigation measures to avoid or reduce potential Project-related adverse effects on the Vegetation VC is provided in **Table 5.3-1**. An indication of whether a residual effect is anticipated for each potential effect following implementation of the listed mitigation measures is provided in the table. Potential effects that are predicted to be residual effects are carried forward in the assessment.

Table 5.3-1: Summary of Potential Effects and Mitigation Measures for the Vegetation Valued Component (VC)

Potential Effect	Contributing Activities within the Project Phase (C, O, D, P)	Proposed Mitigation Measure	Applicable VC Subcomponent	Residual Effect (Yes/No)
Alteration/ loss of vegetation, ecosystems, and wetlands	All Activities (C, O)	- Avoid sensitive environments - Limit Project footprint and Project Area - Reclamation (Refer to RCP) - Project footprint boundaries - Forest management practices - Transport measures - Project siting and construction - Vegetation clearing and soil salvage (Refer to RCP and VMP)	- Old Growth Forest - Wetlands - Listed Ecological Communities - Culturally Important Species - Rare Plants and Lichens	Yes
	All Activities (C, O, D, P)	- Invasive plant management (Refer to VMP) - Erosion and sediment control (Refer to SEPSCP, CEMP and MWMP) - Management of ML/ARD (Refer to ML/ARDMP) - Spill prevention and response (Refer to FMSCP)		Yes
	All Activities (C, O, D)	- Transport measures - Dust suppression and air emissions (Refer to AQMP, MTCP)		Yes
	All Activities (O, D, P)	Additional VC-specific reclamation measures (Refer to RCP , VMP , SEPSCP and CEMP)		Yes
Deposition of Trace Metals on Plants and Soil	All Activities (C, O)	- Avoid sensitive environments - Limit Project footprint and Project Area - Transport measures - Blasting measures - Project siting and construction - Vegetation clearing and soil salvage (Refer to RCP and VMP)	- Old Growth Forest - Wetlands - Listed Ecological Communities - Culturally Important Species - Rare Plants and Lichens	Yes
	All Activities (C, O, D, P)	- Invasive plant management (Refer to VMP) - Erosion and sediment control (Refer to SEPSCP, CEMP and MWMP) - Management of ML/ARD (Refer to ML/ARDMP) - Spill prevention and response (Refer to FMSCP)		Yes

Potential Effect	Contributing Activities within the Project Phase (C, O, D, P)	Proposed Mitigation Measure	Applicable VC Subcomponent	Residual Effect (Yes/No)
	All Activities (C, O, D)	Dust suppression and air emissions (Refer to AQMP, MTCP)		Yes
	All Activities (O, D, P)	Additional VC-specific reclamation measures (Refer to RCP, VMP, SEPSCP and CEMP)		Yes

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure. VC=Valued Component
AQMP=Air Quality Management Plan (S13.0-C2); FMSCP=Fuel Management and Spill Control Plan (S13.0-C7); MERP=Mine Emergency Response Plan (S13.0-C9); ML/ARD=metal leaching/acid rock drainage; ML/ARDMP=Metal Leaching/Acid Rock Drainage Management Plan (S13.0-C12); MTCP=Minesite Traffic Control Plan (S13.0-C10); MWMP=Minesite Water Management Plan (S13.0-C11); RCP=Reclamation and Closure Plan (S13.0-C15); SEPSCP=Surface Erosion Protection and Sediment Control Plan (S13.0-C17); VMP=Vegetation Management Plan (S13.0-C18); VC=Valued Component
See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table.

5.4 Residual Effects and Significance of Residual Effects

This subsection describes the likely residual effects of the Project on Vegetation. Residual effects are effects that remain after the implementation of all mitigation measures and management strategies and are the expected consequences of the Project for the Vegetation VC. The approach to assessing residual Project effects on the Vegetation VC follows the methodology outlined in **S3.0** of the **EAC Application**. For each subcomponent of the Vegetation VC, each residual effect is assessed in the context of the Project activities that will occur within each Project phase. Based on the potential Project-related effects listed in **5.2**, the assessment focuses on Construction, Operation, Decommissioning and Reclamation and Post-closure phases. Residual effects are then characterised based on the combined predicted residual effect for these Phases. The assessment includes a determination of Likelihood, Significance and the Level of Confidence associated with the prediction.

5.4.1 Description of Evaluation Criteria

5.4.1.1 Residual Effects Characteristics

Residual effects on the Vegetation VC subcomponents have been characterised in terms of Magnitude, Geographical Extent, Frequency, Duration, Reversibility, and Context (**Table 5.4-1**). For each subcomponent, guidelines were used to evaluate the Magnitude of each residual effect. These guidelines are based on the ability to detect changes due to Project effects. Quantitative guidelines were used to evaluate the Magnitude for each predicted residual effect and have been defined based on data in EAs for similar approved projects, existing technical knowledge, and professional judgement.

No local, regional, or provincial standards exist against which changes in plant populations and communities can be judged. For each selected subcomponent, guidelines were used to evaluate the Magnitude of each residual effect. These guidelines are based on the ability to detect change due to Project effects (**Table 5.4-1**). Quantitative guidelines were used to evaluate the Magnitude for each predicted residual effect and have been defined based on data in EAs for similar approved projects, existing technical knowledge, and professional judgement.

Scientific research and reviews of ecological thresholds indicate that habitat loss is the primary cause of species decline, and the likelihood of species populations and ecosystems crossing abundance or extinction thresholds increases once habitat is reduced by 30-40% (Andr n 1994, Dykstra 2004, Price et al. 2007). As such, 30% was used as a conservative quantitative boundary between Moderate and High Magnitude characterisations for all Vegetation VC subcomponents except for Rare Plants and Lichens and red-Listed Ecological Communities, as these species and ecosystems are anticipated to be more sensitive (i.e., affected by habitat loss at an earlier stage) (Dykstra 2004).

An accepted guideline for plant collection is that 1 in 20 plants can be collected without damage to a population or its ability to persist (Resources Information Standards Committee [RISC] 2018). Thus, 5% has been used to differentiate Low and Moderate Magnitudes for potential Project effects to blue-listed Rare Plants and Lichens and red-Listed Ecological Communities.

Rigorous and conservative Magnitude characterisations have been employed for red-listed Rare Plants and Lichens, as they are at high risk of extirpation within the province. For red-listed Rare Plants and Lichens, any level of detectable disturbance (>0%) triggers a Moderate Magnitude, and 5% disturbance signifies the quantitative boundary between Moderate and High Magnitudes.

Table 5.4-1: Effect Characteristics Considered When Determining the Significance of Residual Effects on the Vegetation Valued Component (VC)

Residual Effect Characteristic	Definition	Rating
Magnitude	The amount of change in a measurable parameter relative to baseline conditions.	Low <i>Subcomponent – Old Growth Forest</i> - measurable decrease in the spatial extent of Old Growth Forest; less than a 10% loss of old growth within the Vegetation RSA; all original structural stages are present. <i>Subcomponent – Wetlands</i> - measurable decrease in the spatial extent of Wetlands, but less than a 10% loss within the Vegetation RSA; all original wetland classes are present. <i>Subcomponent – Listed Ecological Communities</i> - measurable decrease in the spatial extent of listed communities, but less than a 10% loss within the Vegetation RSA (less than 5% for red-listed communities). <i>Subcomponent – Culturally Important Species</i> - measurable decrease in the spatial extent of ecosystems with the potential to support Culturally Important Species, but less than a 10% loss within the Vegetation RSA. <i>Subcomponent – Rare Plants and Lichens</i> - measurable decrease of less than 5% loss of individuals within a population or occurrences in the Vegetation RSA of a blue-listed species. No measurable decrease of red-listed plants.
		Moderate <i>Subcomponent – Old Growth Forest</i> - measurable decrease in the spatial extent of Old Growth Forest between 10% and 30% loss within the Vegetation RSA; some original structural stages may be absent. <i>Subcomponent – Wetlands</i> - measurable decrease in the spatial extent of Wetlands between 10% and 30% loss within the Vegetation RSA; measurable changes in the diversity of wetland classes; some original wetland classes may be absent. <i>Subcomponent – Listed Ecological Communities</i> - measurable decrease in the spatial extent of listed communities between 10% and 30% loss within the Vegetation RSA (between 5% and 10% for red-listed communities). <i>Subcomponent – Culturally Important Species</i> - measurable decrease in the spatial extent of ecosystems with the potential to support Culturally Important Species between 10% and 30% loss within the Vegetation RSA. <i>Subcomponent – Rare Plants and Lichens</i> - measurable loss varying between 5% and 10% loss of individuals of a species of concern within a population or 5% to 10% loss of all occurrences in the Vegetation RSA for a blue-listed plant; up to 5% loss for any occurrence of a red-listed plant within the Vegetation RSA.
		High <i>Subcomponent – Old Growth Forest</i>

Residual Effect Characteristic	Definition	Rating
		- measurable decrease in the spatial extent of Old Growth Forest equal to or greater than 30% loss within the Vegetation RSA; some original structural stages are absent. <i>Subcomponent – Wetlands</i> - measurable decrease in the spatial extent of Wetlands equal to or greater than 30% loss within the Vegetation RSA; some original wetland classes are absent. <i>Subcomponent – Listed Ecological Communities</i> - measurable decrease in the spatial extent of listed communities equal to or greater than 30% loss within the Vegetation RSA (equal to or greater than 10% for red-listed communities). <i>Subcomponent – Culturally Important Species</i> - measurable decrease in the spatial extent of ecosystems with the potential to support Culturally Important Species equal to or greater than 30% loss within the Vegetation RSA. <i>Subcomponent – Rare Plants and Lichens</i> - measurable loss higher than 10% loss of individuals of a blue-listed plant within a population, or greater than 10% loss of all occurrences within the Vegetation RSA for a blue-listed plant, or greater than 5% loss for any occurrence of a red-listed plant in the Vegetation RSA.
Geographic Extent	The geographic area within which the residual effect is expected to occur.	Project Area: Effect is limited to the Project Area. Local: Effect is limited to the Vegetation LSA. Regional: Effect extends beyond the Vegetation LSA into the Vegetation RSA.
Duration	Length of time over which the residual effect is expected to persist.	Short-term: Less than 2 years (i.e., effect happens during the Construction Phase only). Medium-term: 2 years to 52 years (i.e., effect happens from the Construction Phase through to the end of the Post-closure Phase). Long-term: More than 52 years (i.e., effect extends beyond the Post-closure Phase).
Frequency	How often the residual effect is expected to occur.	Infrequent: Effect occurs several times at sporadic intervals. Frequent: Effect occurs many times on a regular basis. Continuous: Effect occurs continuously.
Reversibility	Whether or not the residual effect can be reversed once the activity causing the residual effect ceases.	Fully Reversible: A residual effect that diminishes to baseline conditions Partially Reversible: A residual effect that partially diminishes to baseline conditions Irreversible: A residual effect that will not diminish to baseline conditions
Context	The extent to which the Vegetation VC has been affected by past and present environmental and socio-economic processes and conditions, its potential sensitivity to the Tenas Project-related residual	Low: Subcomponent has high resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or a lack of historic and ongoing anthropogenic or natural disturbance. No listed species present. Moderate: Subcomponent has moderate resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or an intermediate level of historic or ongoing anthropogenic or natural disturbance with

Residual Effect Characteristic	Definition	Rating
	effect, and its ability to recover from that effect (i.e., resilience)	the capacity to assimilate more change. Presence of blue-listed species High: Subcomponent has weak resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or a high level of historic or ongoing anthropogenic or natural disturbance. Presence of red-listed or SARA-listed species

Notes: %=percent; LSA=Local Study Area; RSA=Regional Study Area; SARA=Species at Risk Act, SC 2002, c 29 (Government of Canada [GovCan] 2002); VC=Valued Component

5.4.1.2 Likelihood

Likelihood refers to the probability that the predicted residual effect will occur while considering that the mitigation will be successful. Likelihood is defined as Likely or Unlikely:

- ▶ **Unlikely:** Low probability of an effect; or
- ▶ **Likely:** Moderate-to-High probability of an effect.

5.4.1.3 Significance Determination

The level of each residual effect has been rated as **Significant** or **Not Significant**, as follows:

Not Significant A residual effect that does not result in a change to the Vegetation VC or subcomponent and does not alter its integrity within the Vegetation RSA beyond an acceptable level (e.g., where it is not sustainable or is unavailable to contribute to ecological function) is considered **Not Significant**.

Significant A residual effect that results in a change in the Vegetation VC or subcomponent that will alter its integrity within the Vegetation RSA beyond an acceptable level (e.g., where it is not sustainable or is unavailable to contribute to ecological function). This is generally defined as high magnitude effects, regional or greater in extent, with a long-term duration and is considered **Significant**.

All residual effects are carried forward to the CEA, regardless of significance.

Limitations of existing data and uncertainty associated with the assessment were also characterised by assigning a Level of Confidence for each residual effect. Level of Confidence was considered in relation to:

- ▶ scientific certainty relative to the quantification of the effect, including the quality and or quantity of data and the understanding of effect mechanisms;
- ▶ scientific certainty relative to the effectiveness of the proposed mitigation; and
- ▶ professional judgment based on prior experience in predicting effects and the known effectiveness of proven mitigation measures.

Confidence estimates allows the decision-maker to evaluate risk associated with the residual effects of the Project. In the determination of confidence, the following is considered:

- ▶ **Low Confidence:** is assigned when the VC, subcomponent and/or Project interaction is not well understood, and/or the mitigation has not been proven effective;
- ▶ **Moderate Confidence:** is assigned where the VC is understood in similar ecosystems and effects have been documented in the larger regional area or in the literature, and/or the mitigation has been proven effective elsewhere; or
- ▶ **High Confidence:** is assigned when the VC, subcomponent, and Project interactions are well understood, and the mitigation has been proven effective.

Based on these criteria, it was determined that an additional risk analysis was not required. Based on these criteria, it was determined that an additional risk analysis was not required.

5.4.2 Old Growth Forest Subcomponent

The definition of Old Growth Forest used within this assessment is provided in **04.2.1**, and is likely to be an overestimate of the area of actual Old Growth Forest as all forest stands meeting age thresholds are conservatively considered to be potential old growth forest regardless of stand structure and composition.

5.4.2.1 Alteration/Loss of Old Growth Forest

The assessment considered the direct effect of loss of Old Growth Forest (i.e., clearing during Construction), and the indirect effect of alteration of Old Growth Forest due to the introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition during Construction, Operation, Decommissioning and Reclamation, and Post-closure phases. Loss of Old Growth Forest during the Project Construction Phase additionally has the potential to affect forest age structure within the Vegetation RSA by reducing the extent of late-seral vegetation communities (see **Table 5.4-2**).

Old Growth Forest comprises 15% (5,352.6 ha) of the Vegetation RSA (**Table 5.4-2**). Direct loss of Old Growth Forest has been mitigated by reducing the size of the Project Area to the extent practicable during Project design; however, Old Growth Forest is still expected to be cleared during the Construction Phase. Up to 363.8 ha (6.8%) of Old Growth Forest within the Vegetation RSA is anticipated to be removed during site clearing.

The most common structural stage within the Vegetation RSA is mature forest, comprising 28% of the RSA (9,890.1 ha). The Project Area has been preferentially located within areas of historic anthropogenic disturbance, including cutblocks, roads, existing ROW, and agricultural lands, resulting in a higher proportion of younger structural stages within the Project Area than within the Vegetation RSA (see **Table 5.4-2**). Consequently, the structural stage expected to be most directly affected by the Project within the Vegetation RSA is the pole/sapling structural stage (631.1 ha; **Table 5.4-2**). Old Growth Forest is expected to be the second-most directly affected structural stage within the Vegetation RSA (363.8 ha; **Table 5.4-2**).

An additional 276.8 ha (5.2%) of Old Growth Forest within the Vegetation RSA may experience indirect Project effects as described in **5.2** of this chapter, including introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition. Mitigation measures outlined in **5.3** are expected to reduce these indirect effects, but not eliminate them entirely. Edge effects, for example, will persist following vegetation clearing. Similarly, invasive plants may still be introduced and/or proliferate, dust is likely to be deposited, and water quality and/or quantity is expected to be affected within remaining areas of Old Growth Forest within the Vegetation RSA due to activities during Construction, Operation, Decommissioning and Reclamation, and Post-closure phases.

Table 5.4-2: Vegetation Structural Stage Changes Expected to Result from the Tenas Project

Structural Stage ¹	Structural Stage Description	Area Within Project Area (ha)	Proportion of Project Area (%)	Area Within Vegetation RSA (ha)	Proportion of Vegetation RSA (%)	Proportion Within the Vegetation RSA Expected to be Cleared during Project Construction (%)	Projected Area Within Vegetation RSA Following Post-closure (ha) ²	Projected Proportion of the Vegetation RSA Following Post-closure (% change) ²
0	Unvegetated	4.5	0.2	1,399.3	3.9	0.3	3,247.8	9.1 (+5.2)
1	Sparse/cryptogam	6.1	0.3	220.4	0.6	2.8	214.3	0.6 (+<0.1)
2	Herb	44.6	2.4	3,854.9	10.8	1.2	3,810.3	10.7 (-0.1)
3	Shrub	341.7	18.4	6,739.1	18.9	5.1	6,397.4	17.9 (-1.0)
4	Pole/sapling	631.1	34.1	2,948.7	8.3	21.4	2,317.6	6.5 (-1.8)
5	Young forest	190.2	10.3	5,320.9	14.9	3.6	5,130.7	14.4 (-0.5)
6	Mature forest	270.9	14.6	9,890.1	27.7	2.7	9,619.2	26.9 (-0.8)
7	Old Growth Forest	363.8	19.6	5,352.6	15.0	6.8	4,988.8	14.0 (-1.0)
Total Area		1,852.9	100.0	35,726.0	100.0	5.2	35,726.0	--

Notes: %=percent; ha=hectare; LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area

¹ Structural stages are further described in (British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment 2010)

² Projected structural stage distributions following the Decommissioning and Reclamation Phase conservatively assume that 100% of the Project Area will be unvegetated, and that structural stages within the Vegetation RSA will not change over the course of the lifetime of the Project. Planned progressive reclamation expected to occur throughout Operation, Decommissioning and Reclamation and Post-closure phases in addition to natural successional processes over the course of 52 years is expected to result in a higher diversity of structural stages on the Project Area and a larger area of forested ecosystems within the Vegetation RSA at the end of the lifetime of the Project.

5.4.2.1.1 *Residual Effects Characterisation*

The residual effects characterisation for alteration/loss of Old Growth Forest is provided in **Table 5.4-3**. Alteration/loss of Old Growth Forest is expected to reduce the prevalence of Old Growth Forest ecosystems within the Vegetation RSA, and potentially alter areas of Old Growth Forest outside of the Project Area due to indirect Project effects.

The Magnitude of the alteration/loss of Old Growth Forest is expected to be Moderate. It is anticipated that up to 12.0% of Old Growth Forest within the Vegetation RSA may be altered or lost due to the Project: 6.8% of Old Growth Forest within the Vegetation RSA will be cleared within the Project Area during the Construction Phase, and an additional 5.2% of Old Growth Forest within the Vegetation RSA may be altered by indirect effects during all Project phases.

The residual effect is expected to be Local in Geographic Extent. While the direct loss of Old Growth Forest is expected to be limited to the Project Area during the Construction Phase, indirect effects to Old Growth Forest are expected to occur within the Vegetation LSA along the margins of the Project Area during all Project phases.

Alteration/loss of Old Growth Forest is expected to occur over the Long-term (>52 years) because of the extended time periods required for Old Growth Forest to regenerate following disturbance. Old Growth Forest is expected to regenerate within reclaimed areas of the Project Area in accordance with Old Growth Forest definitions (e.g., over 140 years in the SBS BGC zone). Forest stands currently classified as mature forests within the Vegetation RSA are also expected to transition to old growth over time (e.g., within 60 years in the SBS and within 170 years within the ESSF), contributing to an increase in the extent of Old Growth Forest within the Vegetation RSA over time.

The Frequency of alteration/loss of Old Growth Forest is expected to be Frequent. While loss of Old Growth Forest as a result of clearing during the Construction Phase will occur once, alteration of Old Growth Forest within the Vegetation RSA by indirect effects is anticipated to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.

The alteration/loss of Old Growth Forest is expected to be Fully Reversible. Progressive and final reclamation will focus on an end land use of forested ecosystems. Undisturbed, such forested ecosystems are expected to follow a successional trajectory towards Old Growth Forest. Thus, Old Growth Forest lost within the Vegetation RSA has the potential to regenerate over time following the end of the Operation Phase. The alteration of Old Growth Forest due to the introduction/spread of invasive plants is expected to be reduced within one (1) year following the end of Decommissioning and Reclamation: the combination of mitigation measures to control existing invasive plant populations and reduced vehicle and equipment traffic is expected to return invasive plant propagule pressure to baseline levels. Similarly, the end of the Decommissioning and Reclamation Phase will result in reduced vehicle and equipment traffic and a subsequent reduction of dust deposition. Existing dust is expected to be naturally washed from vegetation by natural weather events. Edge effects are expected to persist until revegetation and tree growth on the Project Area create a more gradual structural transition along forest edges (e.g., a tall shrub or pole/sapling structural stage, approximately 20 years following the Decommissioning and Reclamation Phase).

The Context of the residual effect of alteration/loss of Old Growth Forest is expected to be Moderate. Old Growth Forest communities are established ecosystems with complex structure, which is expected to confer a moderate resilience to stress, and existing areas of Old Growth Forest within the Vegetation RSA have experienced historic fragmentation and indirect disturbance resulting from cutblocks and forestry roads.

Table 5.4-3: Summary of Effect Characteristics Ratings for Alteration/Loss of the Old Growth Forest Subcomponent

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Moderate	Up to 12.0% of Old Growth Forest within the Vegetation RSA is expected to be altered or lost during all Project Phases.
Geographic Extent	Local	Although loss/alteration of Old Growth Forest is expected to be confined to the Project Area, indirect effects will likely extend beyond the Project Area into the Vegetation LSA.
Duration	Long-term	Forest stands currently classified as mature forests within the Vegetation RSA are expected to transition to old growth within 60 years in the SBS and within 170 years within the ESSF, contributing to the extent of Old Growth Forest within the Vegetation RSA. Old Growth Forest also has the potential to regenerate within reclaimed areas of the Project Area in accordance with Old Growth Forest definitions (e.g., over 140 years in the SBS BGC zone).
Frequency	Frequent	Direct loss of Old Growth Forest on the Project Area will occur during Construction of the Project. Alteration of Old Growth Forest by indirect disturbance (e.g., edge effects, dust deposition) is expected to be Frequent throughout Construction, Operation, and Decommissioning and Reclamation, reducing to Infrequent during Post-closure.
Reversibility	Fully Reversible	Areas of Old Growth Forest removed from the Project Area during Construction may regenerate over the course of ≥ 140 years in the SBS BGC zone. Forest stands within the Vegetation RSA not currently classified as old growth (e.g., mature forests of structural stage 6) are also anticipated to transition into old growth stands over time, additionally contributing to the extent of Old Growth Forest within the Vegetation RSA.
Context	Moderate	While Old Growth Forest communities have a lower resilience to disturbance as a result of their complex structure and the length of time required for a forest to re-establish following disturbance, existing Old Growth Forest within the Vegetation RSA is already fragmented by historic forestry activities.

Notes: $\geq$ =greater than or equal to; %=percent; BGC= Biogeoclimatic; ESSF=Engelmann spruce subalpine fir zone; ha=hectare; LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area; SBS=sub-boreal spruce zone

5.4.2.1.2 Likelihood

The residual effect of alteration/loss of Old Growth Forest is Likely. Old growth forest is present within the Project Area which is expected to be cleared during Construction and indirectly affected during all Project phases.

5.4.2.1.3 Significance Determination

The residual effect of alteration/loss of Old Growth Forest due to the Project is not expected to result in a change in Old Growth Forest that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or is unavailable to contribute to ecological function. The residual effect has been characterised as Moderate in Magnitude, Local in Geographic Extent, and Long-term in Duration; therefore, the residual effect of alteration/loss of vegetation on the Old Growth Forest subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. While the direct effects of clearing are well known, uncertainty exists with respect to the extent and degree of alteration resulting from edge effects, dust deposition, invasive plants, the resiliency of old growth ecosystems to withstand potential Project-related change, and the regeneration of reclaimed areas into forest cover. As with all ecosystem mapping, some uncertainty also exists in relation to the accuracy of the mapping products used to identify Old Growth Forest, and whether forest stands corresponding to provincial old growth definitions exhibit the ecological attributes of an Old Growth Forest (DeLong et al. 2004).

5.4.2.2 Trace Metals Deposition on Old Growth Forest

In consideration of the mitigation outlined in **5.3**, residual low levels of trace metals deposition on Old Growth Forest are expected. The assessment considered the residual trace metals deposition onto Old Growth Forest during all Project phases by dust deposition, air emissions, and surface water runoff.

As described in **5.4.2.1**, Old Growth Forest within the Project Area is expected to be cleared during the Construction Phase. Thus, the majority of residual trace metals deposition is expected to occur within the Vegetation LSA along the edges of the Project Area during the Construction, Operation, and Decommissioning and Reclamation phases due to dust and air emissions primarily associated with roads and areas of active soil disturbance. Trace metals deposition resulting from surface water runoff may occur during the Operation Phase, caused by weathering of overburden and mine rock and subsequent mobilization by surface water to Old Growth Forest downgradient.

This assessment has conservatively assumed equivalent probability within the entire Vegetation LSA of residual trace metals deposition. Given these assumptions, trace metals deposition onto Old Growth Forest may occur within up to 276.8 ha (5.2%) of Old Growth Forest within the Vegetation RSA during all Project phases.

5.4.2.2.1 Residual Effects Characterisation

The residual effects characterisation for trace metals deposition on Old Growth Forest is provided in **Table 5.4-4**. Trace metals deposition on Old Growth Forest is expected to potentially reduce vegetation health and change ecosystem composition and/or plant abundance.

The Magnitude of the deposition of trace metals on Old Growth Forest is expected to be Low. Up to 5.2% of Old Growth Forest within the Vegetation RSA may be affected by trace metals deposition during all Project phases, though the extent of trace metals deposition during the Post-closure Phase is expected to be lessened due to reduced traffic and activity. Areas of Old Growth Forest currently located within the Project Area are expected to be cleared during the initial stages of Construction and are not anticipated to be affected by trace metals deposition.

The Geographic Extent of the residual effect is expected to be Local. Deposition of trace metals on Old Growth Forest is expected to be confined to the Vegetation LSA along the boundaries of roads and adjacent to areas of active soil disturbance.

The deposition of trace metals on Old Growth Forest during all Project phases is expected to have a Long-term (greater than [>] 52 years) Duration because of the extended time periods necessary for trace metals to attenuate in the soil. Timelines for trace metals depletion from the soil vary widely depending on chemistry, from 75 years to over 3,000 years in temperate climates (Kabata-Pendias and Pendias 2001).

The Frequency of the deposition of trace metals on Old Growth Forest is expected to be Frequent. Dust deposition, vehicle emissions, and surface water movement are expected to occur frequently during the

Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.

Deposition of trace metals on Old Growth Forest during all Project phases is expected to be Fully Reversible. Accumulated trace metals deposited on above-ground plant tissues (e.g., stems, leaves, and twigs) is expected to be Fully Reversible within two (2) to five (5) years following the end of the Post-closure Phase by annual leaf drop and weathering, whereas the attenuation of accumulated trace metals within the soil is expected to be reversible over the Long-term.

The Context of the residual effect of trace metals deposition on Old Growth Forest is expected to be Moderate. Old Growth Forest communities are established ecosystems with complex structure, which is expected to confer a moderate resilience to stress, and existing areas of Old Growth Forest within the Vegetation RSA have experienced historic fragmentation and indirect disturbance resulting from cutblocks and forestry roads. In addition, existing naturally elevated levels of trace metals have been identified within surface water and groundwater (relative to generic BC water quality guidelines for freshwater aquatic life) within the Vegetation RSA. See **Appendix 4.1-A Tenas Project 2017 to 2019 Baseline Report** of the **EAC Application**, and **Appendix 4.7-A**. Thus, the potential exists that vegetation may be adapted to naturally elevated trace metals concentrations within the Vegetation RSA.

Table 5.4-4: Summary of Effect Characteristics Ratings for Trace Metals Deposition on the Old Growth Forest Subcomponent

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	Up to 5.2% of Old Growth Forest within the Vegetation RSA may be affected by trace metals deposition during all Project Phases.
Geographic Extent	Local	Trace metals deposition on Old Growth Forest is expected to be confined to the Vegetation LSA.
Duration	Long-term	Trace metals deposition is expected to be Long-term (>52 years) because of the extended time periods that may be necessary for trace metals to attenuate in the soil.
Frequency	Frequent	Activities resulting in trace metals deposition resulting from dust deposition, vehicle emissions, and surface water movement are expected to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.
Reversibility	Fully Reversible	Trace metals deposition on above-ground vegetation structures (e.g., stems, leaves, twigs) is expected to be Fully Reversible by annual leaf drop and weathering, and deposition of trace metals on soil is expected to be reversible over the Long-term.
Context	Moderate	While Old Growth Forest communities have a lower resilience to disturbance due to their complex structure and the length of time required for a forest to re-establish following disturbance, existing Old Growth Forest within the Vegetation RSA is already fragmented by historic forestry activities.

Notes: >=greater than; %=percent; LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area

5.4.2.2.2 *Likelihood*

The residual effect of trace metals deposition on Old Growth Forest is expected to be Likely. Dust, air emissions, and surface water runoff resulting in trace metals deposition on Old Growth Forest has a high potential to occur during the Construction, Operation, and Decommissioning and Reclamation phases.

5.4.2.2.3 *Significance Determination*

The residual effect of trace metals deposition on Old Growth Forest due to the Project is not expected to result in a change in Old Growth Forest that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or unavailable to contribute to ecological function. The residual effect has been characterized as Low in Magnitude, Local in Geographic Extent, and Long-term in Duration; therefore, the residual effect of trace metals deposition on the Old Growth Forest subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. Uncertainty exists with respect to the type and concentration of trace metals that may be deposited, their bioavailability, the responses of individual vegetation species, as well as the responses of old growth communities. As with all ecosystem mapping, some uncertainty also exists in relation to the accuracy of the mapping products used to identify Old Growth Forest, and whether forest stands corresponding to provincial old growth definitions exhibit the ecological attributes of an Old Growth Forest (DeLong et al. 2004).

5.4.3 Wetlands Subcomponent

5.4.3.1 *Alteration/Loss of Wetlands*

Predicted residual effects on wetland extent, structure, and function include the direct effect of loss of Wetlands (i.e., clearing during the Construction Phase), and the indirect effect of alteration of Wetland form and function such as introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition during all Project phases.

Direct loss of Wetlands has been mitigated by reducing the size of the Project Area to the extent practicable during Project design; however, Wetland loss is still expected to occur. Up to 5.6% (112.7 ha) of Wetlands within the Vegetation RSA are anticipated to be removed from the Project Area during Construction (**Table 5.4-5**).

Marshes are expected to be the Wetland class most directly affected by the Project, with 42.3% of mapped marsh ecosystems within the Vegetation RSA expected to be cleared during the Construction Phase. Swamps (7.1%), and bogs (3.0%) are the Wetland classes expected to be the next most directly affected by the Project (**Table 5.4-5**).

Up to 292.9 ha (14.6%) of additional Wetland area within the Vegetation RSA is expected to experience indirect Project effects during all Project phases as described in **5.2 (Table 5.4-5)**. Marshes are expected to be the Wetland class that experiences the most indirect effects resulting from the Project, with an estimated 57.7% (4.1 ha) of mapped marsh ecosystems within the Vegetation RSA expected to experience some indirect effects (**Table 5.4-5**). The next most indirectly affected Wetland classes within the Vegetation RSA include fens (53.0%; 69.2 ha) and bogs (53.8%, 116.5 ha).

Marsh ecosystems within the Vegetation RSA tend to occur in small, isolated depressions and/or as smaller components of larger Wetland complexes (see **4.2.2**). As a result, the detectability of these ecosystems is reliant on mapping scale, and these ecosystems are less likely to be detected at the coarse mapping scales

used within the Vegetation RSA outside of the Vegetation LSA (i.e., 1:10,000 to 1:20,000 scale). Consequently, the relative abundance of marsh Wetlands within the Vegetation LSA in comparison to the larger Vegetation RSA is likely an artifact of baseline mapping methodology, resulting in disproportionate areas of these Wetland types shown as being affected.

Similarly, bog and fen ecosystems within the Helps Creek wetland complex downgradient from the Project form most of these Wetland classes within the Vegetation RSA. Inclusion of the Helps Creek wetland complex as part of the Vegetation LSA has increased the abundance of Bog and Fen ecosystems with the potential to be indirectly affected by the Project.

Table 5.4-5: Disturbance to the Wetland Subcomponent Expected to Result from the Tenas Project

Wetland Class	BGC Subzone	Site Series	Map Code	Common Name	Area of Direct Disturbance within Project Area (ha)	Area of Indirect Disturbance within Vegetation LSA (ha)	Total Area within Vegetation RSA (ha)	Proportion Directly Disturbed within the Vegetation RSA (%)	Proportion Indirectly Disturbed within the Vegetation RSA (%)
Bog	ESSFmc	32	LS	non-forested bog	-	-	9.8	-	-
		00	SS	black spruce/hybrid white spruce - scrub birch - sedge	-	-	28.4	-	-
	SBSdk	09	BS	black spruce - creeping-snowberry - <i>Sphagnum</i>	-	8.5	8.5	-	100.0
		10	SS	black spruce - soft-leaved sedge - <i>Sphagnum</i>	0.1	99.7	136.0	0.1	73.3
		32	LS	non-forested bog	-	-	1.2	-	-
	SBSmc2	12	SS	black spruce/hybrid white spruce - scrub birch - sedge	-	2.6	20.1	-	12.9
		32	LS	non-forested bog	-	-	0.6	-	-
		-	Wb01	black spruce - creeping snowberry - peatmoss	2.7	0.1	2.8	96.4	3.6
		-	Wb05	black spruce - water sedge - peatmoss	3.6	5.6	9.2	39.1	60.9
	Total Bog				6.4	116.5	216.5	3.0	53.8
Fen	ESSFmc	00	WF	willow - sedge fen	-	-	20.4	-	-
	SBSdk	00	WF	willow – sedge fen	-	66.7	107.0	-	62.3
	SBSmc2	00	WF	willow - sedge fen	-	0.9	1.4	-	64.3
		-	Wf01	water sedge - beaked sedge	-	1.6	1.6	-	100.0
	Total Fen				-	69.2	130.5	-	53.0
Marsh	SBSdk	-	Wm01	beaked sedge - water sedge	0.6	1.5	2.1	28.6	71.4
		-	Wm02	swamp horsetail - beaked sedge	2.3	1.6	3.9	59.0	41.0
		-	Wm05	cattail	0.1	0.5	0.6	16.7	83.3
	SBSmc2	-	Wm02	swamp horsetail - beaked sedge	-	0.4	0.4	-	100.0
	Total Marsh				3.0	4.1	7.1	42.3	57.7
Open Water	ESSFmc	00	OW	open water	-	-	0.3	-	-
		00	PD	pond	-	-	3.1	-	-
	ESSFmcw	00	PD	pond	-	-	1.4	-	-
	SBSdk	00	PD	pond	-	3.2	4.9	-	65.3
		00	OW	open water	-	1.4	18.9	-	7.4
	SBSmc2	00	OW	open water	0.1	0.1	0.5	20.0	20.0
		00	PD	pond	-	-	0.5	-	-
	Total Open Water				0.1	4.8	29.7	0.3	16.2
Swamp	ESSFmc	09	HG	subalpine fir - horsetail - glow moss	-	-	25.0	-	-
		10	FH	subalpine fir - horsetail - leafy moss	-	0.2	182.3	-	0.1
	SBSdk	07 ¹	SH	hybrid white spruce - horsetail	-	51.6	427.8	-	12.1
		07b	SH	hybrid white spruce - horsetail (poorly drained)	3.2	2.7	5.9	54.2	45.8
		-	Ws02	mountain alder - pink spirea - Sitka sedge	0.2	0.0	0.2	100.0	0.0
		-	Ws03	Bebb's willow - bluejoint reedgrass	0.4	0.5	1.0	40.0	50.0
		-	Ws04	Drummond's willow - beaked sedge	0.2	0.0	0.2	100.0	0.0
		10 ¹	SH	hybrid white spruce - horsetail	<0.1	8.8	680.2	0.0	1.3
	SBSmc2	10b	SH	hybrid white spruce - horsetail - leafy mosses (lacustrine/morainal)	98.0	34.5	136.3	71.9	25.3

Wetland Class	BGC Subzone	Site Series	Map Code	Common Name	Area of Direct Disturbance within Project Area (ha)	Area of Indirect Disturbance within Vegetation LSA (ha)	Total Area within Vegetation RSA (ha)	Proportion Directly Disturbed within the Vegetation RSA (%)	Proportion Indirectly Disturbed within the Vegetation RSA (%)
		--	Ws02	mountain alder - pink spirea - Sitka sedge	0.9	0.0	0.9	100.0	0.0
		--	Ws03	Bebb's willow - bluejoint reedgrass	0.3	0.0	0.3	100.0	0.0
		Total Swamp			103.2	98.3	1,460.3	7.1	6.7
	Undifferentiated ²	ESSFmc	31	WE	non-forested wetland	-	-	31.7	-
ESSFmcp		00	WL	wetland	-	-	0.1	-	-
ESSFmcw		31	WE	non-forested wetland	-	-	8.8	-	-
SBSdk		31	WE	non-forested fen/marsh	-	-	114.0	-	-
SBSmc2		31	WE	non-forested fen/marsh	-	-	12.4	-	-
Total Undifferentiated				-	-	167.0	-	-	
Grand Total					112.7	292.9	2,011.1	5.6	14.6

Notes: %=percent; BGC=Biogeoclimatic;; ESSFmc=Engelmann spruce subalpine fir zone moist cold subzone; ESSFmcw=Engelmann spruce subalpine fir zone moist cold subzone woodland variant; ha=hectare; LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area SBSdk=sub-boreal spruce zone dry cool subzone; SBSmc2=sub-boreal spruce zone moist cold subzone Babine variant
1 The SBSdk/07 and SBSmc2/10 site series are conservatively classified as the Ws07 wetland in areas of the Vegetation RSA where drainage conditions were not characterised.
2 As a result of reduced map scale and resolution within some parts of the Vegetation RSA, some map units were not differentiated to wetland class.

5.4.3.1.1 *Residual Effects Characterisation*

The residual effects characterisation for alteration/loss of Wetlands is provided in **Table 5.4-6**. Alteration/loss of Wetlands is expected to reduce the prevalence, form and/or function of Wetlands within the Vegetation RSA.

The Magnitude of the alteration/loss of Wetlands is expected to be Moderate. Up to 20.2% of Wetland ecosystems within the Vegetation RSA may be altered or lost due to the Project: 5.6% of Wetlands within the Vegetation RSA will be cleared within the Project Area during Construction, and up to an additional 14.6% of Wetland area within the Vegetation RSA may be altered by indirect effects during all Project Phases. Although marshes, fens and bog ecosystems have been predicted to be notably affected by the Project, this result is likely an artifact of differential mapping scale within the Vegetation LSA and the larger Vegetation RSA, resulting in higher detection of these ecosystems within the Vegetation LSA than the Vegetation RSA.

The residual effect is expected to be Local in Geographic Extent. While direct Wetland loss is expected to be limited to the Project Area during the Construction Phase, indirect effects are expected to occur within the Vegetation LSA during all Project phases.

Alteration/loss of Wetlands is expected to be Medium-term (two (2) years to 52 years). Wetland ecosystems are planned to be created within the Project Area as part of the **RCP**, adding to the extent of Wetland ecosystems within the Vegetation RSA during the Decommissioning and Reclamation Phase and beyond. In addition, once natural drainage patterns are restored following the Operation Phase, the structure and function of Wetlands altered due to indirect Project effects are expected to re-establish over time, reaching similar structure and function to pre-construction conditions by the end of the Post-closure Phase.

The Frequency of alteration/loss of Wetlands is expected to be Frequent. While direct Wetland loss due to clearing will occur over a short time period during the Construction Phase, Wetland alteration by indirect effects is anticipated to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.

The alteration/loss of Wetlands is expected to be Partially Reversible. Direct loss of Wetland area is expected to be Partially Reversible during the Decommissioning and Reclamation Phase through creation of Wetland features as part of the **RCP**. Alterations to Wetland extent, structure and/or function due to indirect Project effects during all Project phases are expected to be Reversible over time once natural hydrologic conditions are restored and edge effects, dust, water quality changes, and invasive plant propagule pressure are reduced at the end of the Decommissioning and Reclamation Phase.

The Context of the residual effect of alteration/loss of Wetlands is expected to be Moderate. Wetlands can exhibit low resilience and high susceptibility to disturbance (MacKenzie and Shaw 2000); however, disturbance is common within the Vegetation RSA, and existing Wetland ecosystems have been historically disturbed by forestry and influenced by surrounding land uses (e.g., cultivation, pasture).

Table 5.4-6: Summary of Effect Characteristics Ratings for the Alteration/Loss of Wetlands Subcomponent

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Moderate	Up to 20.2% of Wetlands within the Vegetation RSA are expected to be altered or lost.
Geographic Extent	Local	Alteration/loss of Wetlands is expected to be restricted to the Vegetation LSA.
Duration	Medium-term	Wetland ecosystems are planned to be created within the Tenas Project (Project) Area as part of the RCP , and once natural drainage patterns are restored during the Decommissioning and Reclamation Phase, the structure and function of Wetlands altered as a result of indirect Project effects are expected to re-establish by the end of the Post-closure Phase (two (2) years to 52 years).
Frequency	Frequent	While direct Wetland loss due to clearing will occur over a short time period during the Construction Phase, Wetland alteration by indirect effects is anticipated to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.
Reversibility	Partially Reversible	Direct loss of Wetland area is expected to be partially reversed during the Decommissioning and Reclamation Phase through creation of Wetland features as part of the RCP . Alterations to Wetland extent, structure and/or function due to indirect effects during all Project Phases are expected to be reversible over time.
Context	Moderate	Wetlands can exhibit low resilience and high susceptibility to disturbance; however, disturbance is common within the Vegetation RSA, and existing Wetland ecosystems have been historically disturbed by forestry and influenced by surrounding land uses (e.g., cultivation, pasture).

Notes: %=percent; LSA=Local Study Area; Project=Tenas Project; RCP=Reclamation and Closure Plan (S13-C15); RSA=Regional Study Area

5.4.3.1.2 Likelihood

The Likelihood of the residual effect of alteration/loss of Wetlands is Likely; there is a high potential for Wetland alteration and loss within the Vegetation RSA due to the Project.

5.4.3.1.3 Significance Determination

The residual effect of alteration/loss due to the Project is not expected to result in a change in the Wetlands subcomponent that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or unavailable to contribute to ecological function. The residual effect has been characterized as Moderate in Magnitude, Local in Geographic Extent, and Medium-term in Duration; therefore, the residual effect of alteration/loss of vegetation on the Wetlands subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. While the direct effects of clearing and grading on Wetland structure and function are well known, uncertainty exists with respect to the extent and degree of alteration resulting from edge effects, dust deposition, changes in water quantity and quality, invasive plants, and the resiliency of Wetland ecosystems within the Vegetation RSA to withstand potential Project-

related change. As with all ecosystem mapping, some uncertainty also exists in relation to the accuracy of the mapping products used to identify Wetland ecosystems.

5.4.3.2 Trace Metals Deposition on Wetlands

In consideration of the mitigation outlined in **5.3**, trace metals deposition onto Wetlands by dust deposition, air emissions, and surface water runoff during all Project phases is predicted to be a residual effect. The majority of residual trace metals deposition is expected to occur along the edges of the Project Area during the Construction, Operation, and Decommissioning and Reclamation phases, primarily associated with roads and areas of active soil disturbance.

Trace metals deposition resulting from surface water runoff may occur during the Operation Phase, caused by weathering of overburden and mine rock and subsequent mobilization by surface water to Wetlands downgradient. It is expected that the area of greatest potential deposition of trace metals transported by surface water runoff will be within low-lying areas of the Vegetation LSA.

This assessment has conservatively assumed equivalent probability of residual trace metals deposition onto Wetlands due to dust, air emissions, and surface water runoff within the Vegetation LSA. Given these assumptions, trace metals deposition onto Wetlands is expected to occur within up to 293 ha (14.6%) of Wetlands within the Vegetation RSA during all Project phases.

5.4.3.2.1 Residual Effects Characterisation

The residual effects characterisation for trace metals deposition on Wetlands is provided in **Table 5.4-7**. Trace metals deposition on Wetlands has the potential to alter Wetland structure and function.

The Magnitude of the deposition of trace metals on Wetlands is expected to be Moderate. Up to 14.6% of Wetland ecosystems within the Vegetation RSA are expected to be affected by trace metals deposition during all Project phases.

The Geographic Extent of the residual effect is expected to be Local. Deposition of trace metals within Wetlands is expected to be confined to the Vegetation LSA along the boundaries of roads, near areas of active soil disturbance, and areas downgradient from the Minesite.

The deposition of trace metals within Wetlands during all Project Phases is expected to be Long-term (>52 years) because of the extended time periods often necessary for trace metals to attenuate in the soil. Timelines for trace metals depletion from the soil vary widely depending on chemistry, from 75 years to over 3,000 years in temperate climates (Kabata-Pendias and Pendias 2001).

The Frequency of the deposition of trace metals on Wetlands is expected to be Frequent. Dust deposition, vehicle emissions, and surface water movement are expected occur frequently throughout the Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.

Deposition of trace metals on Wetlands is expected to be Fully Reversible. Accumulated trace metals deposited on above-ground plant tissues (e.g., stems, leaves, and twigs) are expected to be Fully Reversible within two (2) to five (5) years following the end of the Project Operation Phase by annual leaf drop and weathering, and the attenuation of accumulated trace metals within the soil is expected to be reversible over the Long-term.

The context of the residual effect of trace metals deposition within Wetlands is expected to be Moderate. Wetlands can exhibit low resilience and high susceptibility to disturbance (MacKenzie and Shaw 2000); however, disturbance is common within the Vegetation RSA, existing Wetland ecosystems have been historically disturbed by forestry and influenced by surrounding land uses (e.g., cultivation, pasture). In addition, existing naturally elevated levels of trace metals have been identified within surface water and groundwater (relative to generic BC water quality guidelines for freshwater aquatic life) within the Vegetation RSA (**Appendices 4.1-A, 4.7-A**). Thus, the potential exists that wetland vegetation may be adapted to naturally elevated trace metals concentrations within the Vegetation RSA.

Table 5.4-7: Summary of Effect Characteristics Ratings for Trace Metals Deposition on the Wetlands Subcomponent

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Moderate	Up to 14.6% of Wetland ecosystems within the Vegetation RSA are expected to be affected by trace metals deposition during all Project phases.
Geographic Extent	Local	Trace metals deposition on Wetlands is expected to be confined to the Vegetation LSA.
Duration	Long-term	Trace metals deposition within Wetlands is expected to be Long-term (>52 years) because of the extended time periods often necessary for trace metals to attenuate in the soil.
Frequency	Frequent	Activities resulting in trace metals deposition resulting from dust deposition, vehicle emissions, and surface water movement are expected to occur frequently throughout the Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during Post-closure Phases.
Reversibility	Fully Reversible	Trace metals deposition on above-ground vegetation structures (e.g., stems, leaves, twigs) is expected to be reversible by annual leaf drop and weathering, and deposition of trace metals on soil is expected to be reversible over the Long-term.
Context	Moderate	Wetlands can exhibit low resilience and high susceptibility to disturbance; however, disturbance is common within the Vegetation RSA, existing Wetland ecosystems have been historically disturbed by forestry and influenced by surrounding land uses (e.g., cultivation, pasture), and existing elevated levels of trace metals have been identified within surface water and groundwater within the Vegetation RSA.

Notes: >=greater than; %=percent; LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area

5.4.3.2.2 Likelihood

The residual effect of trace metals deposition within Wetlands is expected to be Likely. Dust, air emissions, and surface water runoff are anticipated to occur during all Project phases, and trace metals are expected to be transported to Wetland ecosystems as a result.

5.4.3.2.3 Significance Determination

The residual effect of trace metals deposition due to the Project is not expected to result in a change in Wetlands that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or

are unavailable to contribute to ecological function. The residual effect has been characterised as Moderate in Magnitude, Local in Geographic Extent, and Long-term in Duration; therefore, the residual effect of trace metals deposition on the Wetlands subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. Uncertainty exists with respect to the type and concentration of trace metals that may be deposited, their bioavailability, and the responses of individual vegetation species, Wetland classes, and Wetland functions. As with all ecosystem mapping, some uncertainty also exists in relation to the accuracy of the mapping products used to identify Wetland ecosystems.

5.4.4 Listed Ecological Communities Subcomponent

The assessment included all ecosystems within the Vegetation RSA with the potential to support Listed Ecological Communities, including early seral ecosystems with the potential to develop into a listed ecological community over time. Ecosystems with the potential to support Listed Ecological Communities are further described in **4.2.3**.

5.4.4.1 Alteration/Loss of Listed Ecological Communities

Alteration/loss of Listed Ecological Communities is expected to be a residual effect because Listed Ecological Communities, which are characterised by a unique composition of native vegetation species that can be challenging to reclaim, are expected to be disturbed by the Project Area. Predicted residual effects include the direct loss of Listed Ecological Community extent (i.e., clearing during the Construction Phase), and the alteration of Listed Ecological Communities resulting from indirect residual effects such as the introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition during all Project phases.

Direct loss of Listed Ecological Communities has been mitigated by reducing the size of the Project Area to the extent practicable during Project design; however, Listed Ecological Communities are likely to be cleared during the Construction Phase. Up to 7.8% (107.1 ha) of blue-Listed Ecological Communities and up to 0.9% (3.8 ha) of red-Listed Ecological Communities within the Vegetation RSA are expected to be cleared from the Project Area during the Construction Phase of the Project (**Table 5.4-8**).

Direct disturbance to red-Listed Ecological Communities is expected to be concentrated within the SBSmc2 within ecosystems with the potential to support the black cottonwood–spruce–red osier dogwood floodplain community (**Table 5.4-8**). Although the ranking of this community is currently under review, its historic placement on the red list has been assumed for this assessment. The blue-listed community expected to experience the most direct disturbance is the hybrid white spruce–horsetail community in the SBSdk and SBSmc2 (**Table 5.4-8**).

Up to 8.0% (145.2 ha) of additional Listed Ecological Communities are expected to experience indirect Project effects as described in **5.2** during all Project phases (**Table 5.4-8**). This area includes 110.0 ha (8.0%) of blue-Listed Ecological Communities, and 35.2 ha (7.8%) of red-Listed Ecological Communities (**Table 5.4-8**).

Table 5.4-8: Disturbance to the Listed Ecological Communities Subcomponent Expected to Result from the Tenas Project

BGC Subzone	Site Series	Map Code	Common Name	BC List ¹	Area of Direct Disturbance within Project Area (ha)	Area of Indirect Disturbance within Vegetation LSA (ha)	Total Area within Vegetation RSA (ha)	Proportion Directly Disturbed within the Vegetation RSA (%)	Proportion Indirectly Disturbed within the Vegetation RSA (%)
ESSFmc	81	SW	saskatoon/slender wheatgrass	Red	-	-	1.2	-	-
	82	BW	Sandberg's bluegrass/slender wheatgrass	Red	-	-	2.0	-	-
SBSdk	08	CD	black cottonwood – spruce – red-osier dogwood	Red ²	3.8	35.0	403.1	1.0	8.7
	-	Fm02							
	81	SW	saskatoon/slender wheatgrass	Red	-	0.1	25.8	-	0.4
	82	BW	Sandberg's bluegrass/slender wheatgrass	Red	-	0.1	4.9	-	2.0
SBSmc2	81	SW	saskatoon/slender wheatgrass	Red	-	-	8.4	-	-
	82	BW	Sandberg's bluegrass/slender wheatgrass	Red	-	-	3.8	-	-
Total Red Listed Ecological Communities					3.8	35.2	449.2	0.9	7.8
SBSdk	02	LJ	lodgepole pine/common juniper/rough-leaved ricegrass	Blue	0.1	0.8	99.9	0.1	0.8
	07/07b	SH	hybrid white spruce - horsetail	Blue	3.2	54.3	433.8	0.7	12.5
	09	BS	black spruce/creeping snowberry/peatmoss	Blue	-	8.5	8.5	-	100.0

BGC Subzone	Site Series	Map Code	Common Name	BC List ¹	Area of Direct Disturbance within Project Area (ha)	Area of Indirect Disturbance within Vegetation LSA (ha)	Total Area within Vegetation RSA (ha)	Proportion Directly Disturbed within the Vegetation RSA (%)	Proportion Indirectly Disturbed within the Vegetation RSA (%)
	-	Wm02	swamp horsetail/beaked sedge	Blue	2.3	1.6	3.9	59.0	41.0
	-	Wm05	cattail marsh	Blue	0.1	0.5	0.6	16.7	83.3
	-	Ws03	Bebb's willow/bluejoint	Blue	0.4	0.5	1.0	40.0	50.0
SBSmc2	10/10b	SH	hybrid white spruce - horsetail	Blue	98.0	43.3	816.6	12.0	5.3
	-	Wb01	black spruce - creeping-snowberry - peatmoss	Blue	2.7	0.1	2.8	96.4	3.6
	-	Wm02	swamp horsetail - beaked sedge	Blue	-	0.4	0.4	-	100.0
	-	Ws03	Bebb's willow / bluejoint reedgrass	Blue	0.3	-	0.3	100.0	-
Total Blue Listed Ecological Communities					107.1	110.0	1,367.8	7.8	8.0
Total Listed Ecological Communities					110.9	145.2	1,817.3	6.1	8.0

Notes: %=percent; BC=British Columbia; BGC= Biogeoclimatic; ESSFmc=Engelmann spruce subalpine fir zone moist cold subzone; ESSFmcw=Engelmann spruce subalpine fir zone moist cold subzone woodland variant; ha=hectare; LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area SBSdk=sub-boreal spruce zone dry cool subzone; SBSmc2=sub-boreal spruce zone moist cold subzone Babine variant

¹ Communities on the red list include those that have been legally designated as Endangered or Threatened under the BC Wildlife Act, are extirpated, or are candidates for such designation. Communities on the blue list include those not immediately Threatened, but of concern because of characteristics that make them particularly sensitive to human activities or natural events (BC Conservation Data Centre [BC CDC] 2020).

² This community is currently under review, but its last ranking by the BC CDC (2018) identified it as red-listed.

5.4.4.1.1 Residual Effects Characterisation

The residual effect characteristic ratings for alteration and loss of Listed Ecological Communities are provided in **Table 5.4-9**. Alteration/loss of Listed Ecological Communities is expected to reduce the extent and/or function of Listed Ecological Communities within the Vegetation RSA.

The Magnitude of alteration/loss of Listed Ecological Communities is expected to be Moderate. While direct disturbance is expected to account for the loss of up to 0.9% of red-Listed Ecological Communities and 7.8% of blue-Listed Ecological Communities within the Vegetation RSA, up to 7.8% of red-listed Ecological Communities and 8.0% of blue-Listed Ecological Communities are expected to experience indirect Project effects. In total, up to 14.1% of Listed Ecological Communities within the Vegetation RSA are expected to be altered or lost. Disturbance to up to 8.7% of red-Listed Ecological Communities is possible.

Alteration/loss of Listed Ecological Communities is expected to be Local in Geographic Extent. Direct effects (i.e., clearing during Construction) are expected to be limited to the Project Area, and indirect effects are expected to be confined to the Vegetation LSA during all Project phases.

The alteration/loss of Listed Ecological Communities is expected to be Long-term (>52 years). As there are no known reliable methods to restore lost Listed Ecological Communities, it is conservatively predicted that all Listed Ecological Communities cleared during the Construction Phase will be lost. Listed Ecological Communities affected indirectly by dust deposition, edges, and changes to water quantity and quality are expected to naturally regenerate and regain lost function over time following the end of the Decommissioning and Reclamation Phase.

The Frequency of alteration/loss of Listed Ecological Communities is expected to be Frequent. Although direct loss of Listed Ecological Communities on the Project Area is expected to occur once during the Construction Phase, indirect effects such as edge effects, dust deposition, and introduction/spread of invasive plants are expected to occur frequently throughout the Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.

The Reversibility of the residual effect of alteration/loss of Listed Ecological Communities is expected to be Partially Reversible. Ecosystems altered by indirect effects are expected to naturally regenerate and regain lost function over time following the end of the Operation Phase; however, loss of Listed Ecological Communities as a result of clearing during the Construction Phase is expected to be irreversible because of a lack of reliable reclamation techniques to recreate these complex ecosystems.

The Context of the residual effect is expected to be High given the unique attributes characteristic of Listed Ecological Communities, their uncommon distribution throughout the province, and their noted conservation value. In addition, Listed Ecological Communities typically exhibit a low resilience to disturbance and cannot be predictably restored following direct disturbance.

Table 5.4-9: Summary of Effect Characteristics Ratings for Alteration/Loss of the Listed Ecological Communities Subcomponent

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Moderate	Up to 14.1% of Listed Ecological Communities within the Vegetation RSA are expected to be altered or lost. Disturbance to up to 8.7% of red-Listed Ecological Communities is possible.
Geographic Extent	Local	Direct effects (i.e., clearing during Construction) are expected to be confined to the Project Area, and indirect effects are expected to be confined to the Vegetation LSA during all Project phases.

Residual Effects Characteristic	Rating	Rationale for Rating
Duration	Long-term	As there are no known reliable methods to restore lost Listed Ecological Communities, it is conservatively predicted that all Listed Ecological Communities cleared during Construction will be lost. Listed Ecological Communities affected indirectly are expected to regain lost function over time following the end of the Decommissioning and Reclamation Phase.
Frequency	Frequent	Although direct loss of Listed Ecological Communities on the Project Area is expected to occur once during the Construction Phase, indirect effects are expected to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.
Reversibility	Partially Reversible	Ecosystems altered by indirect effects are expected to naturally regenerate and regain lost function over time following the end of the Operation Phase; however, loss of Listed Ecological Communities due to clearing during the Construction Phase is expected to be irreversible.
Context	High	The context of the residual effect is expected to be High given the unique attributes characteristic of Listed Ecological Communities, their uncommon distribution throughout the province, and their noted conservation value. In addition, Listed Ecological Communities typically exhibit a low resilience to disturbance and cannot be predictably restored following direct disturbance.

Notes: %=percent; LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area

5.4.4.1.2 Likelihood

Alteration/loss of Listed Ecological Communities is expected to be Likely. The Project has a high potential to result in the alteration/loss of Listed Ecological Communities.

5.4.4.1.3 Significance Determination

The residual effect of alteration/loss due to the Project is not expected to result in a change in Listed Ecological Communities that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or are unavailable to contribute to ecological function. The residual effect has been characterized as Moderate in Magnitude, Local in Geographic Extent, and Long-term in Duration; therefore, the residual effect of alteration/loss of vegetation on the Listed Ecological Communities subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. While the direct effects of clearing and grading on are well known, uncertainty exists with respect to the extent and degree of alteration resulting from edge effects, dust deposition, changes in water quantity and quality, invasive plants, and the resiliency of specific Listed Ecological Communities within the Vegetation RSA to withstand potential Project-related change. As with all ecosystem mapping, some uncertainty also exists in relation to the accuracy of the mapping products used to identify potential Listed Ecological Communities.

5.4.4.2 Trace Metals Deposition on Listed Ecological Communities

In consideration of the mitigation outlined in 5.3, residual low levels of trace metals deposition on Listed Ecological Communities are predicted. The assessment considered residual trace metals deposition onto Listed Ecological Communities during all Project phases by dust deposition, air emissions, and surface water runoff.

As described in **5.4.4.1**, Listed Ecological Communities within the Project Area are expected to be cleared during the Construction Phase. Thus, the majority of residual trace metals deposition within Listed Ecological Communities is expected to occur along the edges of the Project Area during the Construction, Operation, and Decommissioning and Reclamation phases due to dust and air emissions primarily associated with roads and areas of active soil disturbance. Trace metals deposition resulting from surface water runoff may occur during the Operation Phase, caused by weathering of overburden and mine rock and subsequent mobilization by surface water to Listed Ecological Communities downgradient, many of which are wetland communities. It is expected that the area of greatest potential deposition of trace metals transported by surface water runoff will be within low-lying areas of the Vegetation LSA, including listed wetland communities.

This assessment has conservatively assumed equivalent probability of residual trace metals deposition onto Listed Ecological Communities due to dust, air emissions, and surface water runoff within the Vegetation LSA. Given these assumptions, trace metals deposition is expected to occur within up to 145 ha (8.0%) of Listed Ecological Communities within the Vegetation RSA during all Project phases.

5.4.4.2.1 *Residual Effects Characterisation*

The residual effects characterisation for trace metals deposition on Listed Ecological Communities is provided in **Table 5.4-10**. Trace metals deposition on Listed Ecological Communities is expected to have the potential to alter their structure and function.

The Magnitude of the deposition of trace metals on Listed Ecological Communities is expected to be Moderate. Up to 8.0% (145.2 ha) of Listed Ecological Communities within the Vegetation RSA are expected to be affected by trace metals deposition during all Project phases. This includes 7.8% (35.2 ha) of red-Listed Ecological Communities. Listed Ecological Communities currently located within the Project Area are expected to be cleared during the initial stages of the Construction Phase and are not anticipated to be affected by trace metals deposition.

The Geographic Extent of the residual effect is expected to be Local. Deposition of trace metals on Listed Ecological Communities is expected to be confined to the Vegetation LSA along the boundaries of roads, near areas of active soil disturbance, and areas downgradient from the Minesite during all Project phases.

The deposition of trace metals within Listed Ecological Communities is expected to be Long-term (>52 years) because of the extended time periods often necessary for trace metals to attenuate in the soil. Timelines for trace metals depletion from the soil vary widely depending on chemistry and climate, from 75 years to over 3,000 years in temperate climates (Kabata-Pendias and Pendias 2001).

The Frequency of the deposition of trace metals on Listed Ecological Communities is expected to be Frequent. Dust deposition, vehicle emissions, and surface water movement are expected to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.

Deposition of trace metals on Listed Ecological Communities is expected to be Fully Reversible. Accumulated trace metals deposited on above-ground plant tissues (e.g., stems, leaves, and twigs) is expected to be Fully Reversible within two (2) to five (5) years following the end of the Project Operation Phase by annual leaf drop and weathering, and the attenuation of accumulated trace metals within the soil is expected to be reversible over the Long-term.

The Context of the residual effect of trace metals deposition on Listed Ecological Communities is expected to be High given the unique attributes characteristic of Listed Ecological Communities, their uncommon

distribution throughout the province, and their noted conservation value. In addition, Listed Ecological Communities can be ecologically sensitive and exhibit a low resilience to disturbance (BC MOE 2009).

Table 5.4-10: Summary of Effect Characteristics Ratings for Trace Metals Deposition on the Listed Ecological Communities Subcomponent

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Moderate	Up to 8.0% of Listed Ecological Communities within the Vegetation RSA are expected to be affected by trace metals deposition during all Project Phases. This includes 7.8% (35.2 ha) of red-Listed Ecological Communities.
Geographic Extent	Local	Trace metals deposition on Listed Ecological Communities is expected to be confined to the Vegetation LSA during all Project phases.
Duration	Long-term	The deposition of trace metals within Listed Ecological Communities is expected to be Long-term (>52 years) because of the extended time periods often necessary for trace metals to attenuate in the soil.
Frequency	Frequent	Activities resulting in trace metals deposition resulting from dust deposition, vehicle emissions, and surface water movement are expected to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation, and infrequently during Post-closure.
Reversibility	Fully Reversible	Trace metals deposition on above-ground vegetation structures (e.g., stems, leaves, twigs) is expected to be Fully Reversible by annual leaf drop and weathering, and deposition of trace metals on soil is expected to be reversible over the Long-term.
Context	High	Trace metals deposition within Listed Ecological Communities is expected to be High given the unique attributes characteristic of Listed Ecological Communities, their uncommon distribution throughout the province, and their noted conservation value. In addition, Listed Ecological Communities typically exhibit a low resilience to disturbance.

Notes: >=greater than; %=percent; ha=hectare; LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area

5.4.4.2.2 Likelihood

The residual effect of trace metals deposition on Listed Ecological Communities is expected to be Likely. Dust, air emissions, and surface water runoff are anticipated to occur during all Project Phases, and trace metals are expected to have a moderate probability of being transported to Listed Ecological Communities as a result.

5.4.4.2.3 Significance Determination

The residual effect of trace metals deposition as a result of the Project is not expected to result in a change in Listed Ecological Communities that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or unavailable to contribute to ecological function. The residual effect has been characterized as Moderate in Magnitude, Local in Geographic Extent, and Long-term in Duration; therefore, the residual effect of trace metals deposition on the Listed Ecological Communities subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. Uncertainty exists with respect to the type and concentration of trace metals that may be deposited, their bioavailability, and the responses of individual vegetation species and ecosystem structure and function. As with all ecosystem mapping, some uncertainty also exists in relation to the accuracy of the mapping products used to identify Listed Ecological Communities.

5.4.5 Culturally Important Species Subcomponent

The definition of Culturally Important Species used within this assessment, as well as the methodology used to associate these species with ecosystem units, are provided in **0**.

5.4.5.1 Alteration/Loss of Culturally Important Species

Many terrestrial and wetland ecosystem units support Culturally Important Species (see **0**). The assessment considered the direct effect of loss of ecosystems that support Culturally Important Species (i.e., clearing during the Construction Phase), and the indirect effect of alteration of Culturally Important Species as a result of the introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition during all Project phases.

Direct loss of Culturally Important Species has been mitigated by reducing the size of the Project Area to the extent practicable during Project design; however, ecosystems that support Culturally Important Species are expected to be cleared during Construction. Up to 1,378.5 ha (4.7%) of ecosystems supporting Culturally Important Species within the Vegetation RSA is anticipated to be removed during site clearing during the Construction Phase (**Table 5.4-11**). It has been conservatively assumed that all populations of Culturally Important Species will be cleared within the Project Area during Construction and Operation phases; however, progressive reclamation during the Operation Phase is expected to result in the re-establishment of Culturally Important Species within reclaimed areas, particularly those most resilient to disturbance (e.g., fireweed, red raspberry).

This assessment has conservatively assumed equivalent probability of indirect effects within the Vegetation LSA. Given these assumptions, an additional 1,719.2 ha (5.8%) of ecosystems that support Culturally Important Species within the Vegetation RSA may experience indirect Project effects during all Project Phases as described in **5.2**.

Table 5.4-11: Expected Disturbance to Ecosystems with the Potential to Support the Culturally Important Species Subcomponent Resulting from the Tenas Project

BGC Subzone	Site Series	Map Code	Common Name	Structural Stages ¹	Supported Culturally Important Species	Area of Direct Disturbance within Project Area (ha)	Area of Indirect Disturbance within Vegetation LSA (ha)	Total Area within Vegetation RSA (ha)	Proportion Directly Disturbed within the Vegetation RSA (%)	Proportion Indirectly Disturbed within the Vegetation RSA (%)
BAFAun	00	HM	herbaceous meadow	2d	▪ Indian hellebore	-	-	28.6	-	-
BAFAun Total						-	-	28.6	-	-
ESSFmc	00	CB	cutbank	1	▪ red raspberry	-	-	1.7	-	-
	00	SS	black spruce / hybrid white spruce - scrub birch - sedge	3, 3b, 5, 6	▪ willows	-	-	28.4	-	-
	00	WF	willow - sedge fen	4	▪ willows	-	-	0.4	-	-
	01	FB	subalpine fir - huckleberry - leafy liverwort	3,4,5,6,7	▪ black huckleberry ▪ oval-leaved blueberry	-	11.6	2,606.5	-	0.4
	02	LC	subalpine fir / lodgepole pine - juniper - <i>Cladonia</i>	3,5,6,7	▪ soopolallie ▪ kinnickinnick	-	-	71.0	-	-
	03	FC	subalpine fir - huckleberry - crowberry	3,4,5,6,7	▪ black huckleberry	-	6.8	59.6	-	11.4
	04	HH	subalpine fir - huckleberry - heron's-bill	3,5,6,7	▪ black huckleberry	-	0.1	338.5	-	<0.1
	05	FT	subalpine fir - huckleberry - thimbleberry	3,6,7	▪ black huckleberry ▪ oval-leaved blueberry	-	0.1	21.6	-	0.5
	06	FO	subalpine fir - oak fern - heron's-bill	3,4,5,6,7	▪ black huckleberry ▪ oval-leaved blueberry	-	3.5	898.8	-	0.4
	07	FD	subalpine fir - devil's club - lady fern	3,4,5,6,7	▪ devil's club ▪ oval-leaved blueberry	-	0.3	187.9	-	0.2
	08	FV	subalpine fir - valerian - sickle moss	3,4,5,6,7	▪ black huckleberry ▪ oval-leaved blueberry ▪ Indian hellebore	-	<0.1	87.9	-	0.1
	09	HG	subalpine fir - horsetail - glow moss	3, 3b, 5,6,7	▪ oval-leaved blueberry	-	-	25.0	-	-
	10	FH	subalpine fir - horsetail - leafy moss	3,4,5,6,7	▪ oval-leaved blueberry	-	0.2	182.3	-	0.1
	31	WE	non-forested wetland	3a	▪ willows	-	-	31.7	-	-
	32	LS	non-forested bog	3a	▪ willows	-	-	5.2	-	-
	52	SL	Sitka alder - lady fern	3a,3b	▪ devil's club ▪ willows	-	-	18.8	-	-
	82	BW	bluegrass - slender wheatgrass	3a	▪ fireweed	-	-	2.0	-	-
ESSFmc Total						-	22.6	4567.5	-	0.5
ESSFmcp	00	HM	herbaceous meadow	2a	▪ cow parsnip ▪ fireweed ▪ Indian hellebore	-	-	41.5	-	-
	00	WL	wetland	3a	▪ willows	-	-	0.1	-	-
	00	WM	wet meadow	2b	▪ cow parsnip ▪ Indian hellebore	-	-	9.7	-	-
ESSFmcp Total						-	-	51.3	-	-

BGC Subzone	Site Series	Map Code	Common Name	Structural Stages ¹	Supported Culturally Important Species	Area of Direct Disturbance within Project Area (ha)	Area of Indirect Disturbance within Vegetation LSA (ha)	Total Area within Vegetation RSA (ha)	Proportion Directly Disturbed within the Vegetation RSA (%)	Proportion Indirectly Disturbed within the Vegetation RSA (%)
ESSFmcw	00	HM	herbaceous meadow	2a	▪ cow parsnip ▪ fireweed ▪ Indian hellebore	-	-	1.6	-	-
	01	FL	subalpine fir - huckleberry - leafy liverwort - heron's bill	3,4,5,6,7	▪ black huckleberry	-	-	679.0	-	-
	02	FC	subalpine fir (whitebark pine / lodgepole pine) - huckleberry - crowberry - lichen	3,4,5,6,7	▪ black huckleberry	-	-	55.6	-	-
	03	FJ	subalpine fir (whitebark pine / lodgepole pine) - huckleberry - juniper - lichen	4,5,6,7	▪ black huckleberry	-	-	29.8	-	-
	04	FV	subalpine fir - valerian - leafy moss	3,4,5,6,7	▪ black huckleberry ▪ oval-leaved blueberry ▪ Indian hellebore	-	-	184.8	-	-
	05	FG	subalpine fir - mixed shrub - glow moss	4,5,6,7	▪ oval-leaved blueberry	-	-	29.3	-	-
	31	WE	non-forested wetland	3a	▪ willows	-	-	8.8	-	-
ESSFmcw Total						-	-	988.8	-	-
SBSdk	00	CA	cow parsnip - large-leaved avens	2a, 3a	▪ cow parsnip ▪ red raspberry	-	0.2	3.8	-	5.3
	00	CB	cutbank	1	▪ red raspberry	-	0.4	43.8	-	0.9
	00	LA	lake	0	▪ buckbean	-	-	330.8	-	-
	00	OW	shallow open water	0	▪ buckbean	-	1.4	4.9	-	28.6
	00	PD	pond	0	▪ buckbean	-	3.2	18.9	-	16.9
	00	SD	hybrid white spruce - devil's club (lacustrine/morainal)	3,4,5,6,7	▪ black huckleberry ▪ devil's club ▪ highbush cranberry ▪ red raspberry	5.7	19.4	183.3	3.1	10.6
	00	WF	willow - sedge fen	3a,3b	▪ willows	-	37.7	74.3	-	50.7
	01	SP	hybrid white spruce - spirea - purple peavine	1,2,2b,3,3a,3b,4,5,6,7	▪ black huckleberry ▪ soopolallie ▪ highbush cranberry ▪ red raspberry	9.2	119.1	5,733.4	0.2	2.1
	01a	SP	hybrid white spruce - spirea - purple peavine (Fine-textured)	3a,3b,4,5,6	▪ black huckleberry ▪ soopolallie ▪ highbush cranberry ▪ red raspberry	59.7	126.0	219.1	27.2	57.5
	01b	SP	hybrid white spruce - spirea - purple peavine (Coarse-textured)	3a,3b,4,5	▪ black huckleberry ▪ soopolallie ▪ highbush cranberry ▪ red raspberry	27.7	41.5	102.7	27.0	40.4
	02	LJ	lodgepole pine - juniper - ricegrass	3,4,5,6,7	▪ kinnickinnick	0.1	0.8	99.9	0.1	0.8
	03	LC	lodgepole pine - feathermoss - cladina	2,3,3a,3b,4,5,6,7	▪ kinnickinnick	16.6	9.2	1,202.3	1.4	0.8

BGC Subzone	Site Series	Map Code	Common Name	Structural Stages ¹	Supported Culturally Important Species	Area of Direct Disturbance within Project Area (ha)	Area of Indirect Disturbance within Vegetation LSA (ha)	Total Area within Vegetation RSA (ha)	Proportion Directly Disturbed within the Vegetation RSA (%)	Proportion Indirectly Disturbed within the Vegetation RSA (%)
					▪ soopolallie					
	05	SF	hybrid white spruce - spirea - feathermoss	3,5,6,7	▪ soopolallie	0.7	3.3	259.9	0.3	1.3
	06	ST	hybrid white spruce - twinberry - coltsfoot	3,3a,3b,4,5,6,7	▪ devil's club ▪ fireweed ▪ highbush cranberry ▪ red raspberry	98.8	303.1	4,132.0	2.4	7.3
	07	SH	hybrid white spruce - horsetail	3,4,5,6,7	▪ devil's club ▪ willows ▪ fireweed ▪ highbush cranberry ▪ red raspberry	-	51.6	427.8	-	12.1
	07a	SH	hybrid white spruce - horsetail (freely drained/fluvial)	3a,4,5,6,7a	▪ devil's club ▪ willows ▪ fireweed ▪ highbush cranberry ▪ red raspberry	16.3	21.2	40.0	40.8	53.0
	07b	SH	hybrid white spruce - horsetail (poorly drained)	5	▪ devil's club ▪ willows ▪ fireweed ▪ highbush cranberry ▪ red raspberry	3.2	2.7	5.9	54.2	45.8
	08	CD	black cottonwood - dogwood - prickly rose	3,4,5,6,7	▪ cow parsnip ▪ highbush cranberry	-	0.4	316.0	-	0.1
	10	SS	black spruce - creeping-snowberry - <i>Sphagnum</i>	3,3b,4,5,6,7	▪ willows ▪ buckbean	0.1	99.7	136.0	0.1	73.3
	31	WE	non-forested wetland	3b	▪ willows ▪ buckbean	-	-	114.0	-	-
	32	LS	non-forested bog	3a	▪ willows ▪ buckbean	-	-	1.2	-	-
	51	WT	Scouler's willow - thimbleberry	3a,3b,5,6	▪ devil's club ▪ willows ▪ highbush cranberry	6.8	27.8	42.2	16.1	65.9
	52	AN	mountain alder - stinging nettle	3b,4	▪ devil's club ▪ willows	0.1	1.9	28.0	4.3	82.6
	52	SL	Sitka alder - lady fern	3b	▪ devil's club ▪ willows	-	8.5	2.3	-	33.1
	53	AM	mountain alder - mitrewort	5,6	▪ devil's club ▪ cow parsnip ▪ highbush cranberry	5.0	6.7	11.8	42.4	56.8
	82	BW	bluegrass - slender wheatgrass	2b,3a	▪ fireweed	-	0.1	4.9	-	2.0
	Atcv	Atcv	trembling aspen - Canada violet seral association	3a,5,6	▪ willows	49.7	75.1	133.0	37.4	56.5

BGC Subzone	Site Series	Map Code	Common Name	Structural Stages ¹	Supported Culturally Important Species	Area of Direct Disturbance within Project Area (ha)	Area of Indirect Disturbance within Vegetation LSA (ha)	Total Area within Vegetation RSA (ha)	Proportion Directly Disturbed within the Vegetation RSA (%)	Proportion Indirectly Disturbed within the Vegetation RSA (%)
					- fireweed - highbush cranberry - red raspberry					
	Atha	Atha	trembling aspen - hardhack seral association	4,5	willows	1.9	6.6	9.4	20.2	70.2
	Atki	Atki	trembling aspen - kinnikinnick seral association	3b	kinnikinnick	-	-	0.9	-	-
	Atlf	Atlf	trembling aspen - lady fern seral association	5,6	- willows - cow parsnip	0.5	1.4	2.5	20.0	56.0
	Atpw	Atpw	trembling aspen - pink wintergreen seral association	3a,3b,4,5,6	- soopolallie - willows - highbush cranberry	33.5	66.4	107.5	31.2	61.8
	Atss	Atss	trembling aspen - saskatoon - snowberry seral association	3a,4,5	- soopolallie - fireweed - kinnikinnick	4.6	5	17.4	26.4	28.7
	Epdm	Epdm	paper birch - Douglas maple	4,5	- soopolallie - willows - highbush cranberry	1.6	8.5	11.3	14.2	75.2
	FI01	FI01	mountain alder - common horsetail	3a,3b	willows	0.9	7.3	17.7	5.1	41.2
	Fm02	Fm02	black cottonwood / hybrid white spruce - red-osier dogwood	3b,4,5,6	- devil's club - willows - cow parsnip - highbush cranberry - red raspberry	3.8	34.6	87.1	4.4	39.7
	Wm01	Wm01	beaked sedge - water sedge	3a	willows	0.1	-	0.1	100.0	-
	Ws03	Ws03	Bebb's willow - bluejoint reedgrass	3b	willows	0.4	0.5	1.0	40.0	50.0
	Ws04	Ws04	Drummond's willow - beaked sedge	3a	willows	0.2	-	0.2	100.0	-
	Xs	Xs	disclimax shrub	3a	willows	0.3	-	0.3	100.0	-
SBSdk Total						347.3	1,091.5	13,925.5	2.5	7.8
SBSmc2	00	CB	cutbank	1	red raspberry	-	0.3	9.0	-	3.3
	00	OW	shallow open water	0	buckbean	0.1	0.1	0.5	20.0	20.0
	00	PD	pond	0	buckbean	-	-	0.5	-	-
	00	WF	willow - sedge fen	3a,3b	willows	-	0.9	1.2	-	75.0
	01	SB	hybrid white spruce - huckleberry	3,3b,5,6,7	- black huckleberry - soopolallie - red raspberry	0.5	58.6	4,125.4	0.0	1.4
	01a	SB	hybrid white spruce - huckleberry (mesic, fine-textured)	3a,3b,5,6,7a	- black huckleberry - oval-leaved blueberry - red raspberry	357.4	182.7	551.1	64.9	33.2
	01c	SB	hybrid white spruce - huckleberry (submesic)	3a,3b,4,5,6,7a	black huckleberry	71.2	79.8	151.0	47.2	52.8

BGC Subzone	Site Series	Map Code	Common Name	Structural Stages ¹	Supported Culturally Important Species	Area of Direct Disturbance within Project Area (ha)	Area of Indirect Disturbance within Vegetation LSA (ha)	Total Area within Vegetation RSA (ha)	Proportion Directly Disturbed within the Vegetation RSA (%)	Proportion Indirectly Disturbed within the Vegetation RSA (%)
					▪ soopolallie					
	02	PH	lodgepole pine - huckleberry - <i>Cladonia</i>	3,3b,4,5,6,7	▪ black huckleberry ▪ soopolallie	0.3	1.9	106.7	0.3	1.8
	03	BM	black spruce / lodgepole pine - feathermoss	3,3a,3b,4,5,6,7,7a	▪ kinnickinnick	55.0	3.0	66.7	82.5	4.5
	05	TC	hybrid white spruce - twinberry - coltsfoot	3,3a,3b,4,5,6,7,7a	▪ fireweed ▪ highbush cranberry ▪ red raspberry	43.2	31.1	1,361.7	3.2	2.3
	06	SO	hybrid white spruce - oak fern	3,3a,3b,4,5,6,7,7a	▪ devil's club ▪ fireweed ▪ red raspberry	291.7	85.1	1,439.0	20.3	5.9
	07	BF	hybrid white spruce - scrub birch - feathermoss	3,3b,6,7,7a	▪ black huckleberry	14.3	0.4	18.1	79.0	2.2
	09	SD	hybrid white spruce - devil's club	3,6	▪ black huckleberry ▪ devil's club ▪ highbush cranberry ▪ red raspberry	1.0	10.1	982.9	0.1	1.0
	09a	SD	hybrid white spruce - devil's club (fluvial)	6,7a	▪ black huckleberry ▪ devil's club ▪ highbush cranberry	0.8	23.4	24.3	3.3	96.3
	09b	SD	hybrid white spruce - devil's club (lacustrine/morainal)	3b,4,5,6,7a	▪ black huckleberry ▪ devil's club ▪ highbush cranberry ▪ red raspberry	42.4	38.8	82.3	51.5	47.1
	10	SH	hybrid white spruce - horsetail	3,4,5,6,7	▪ devil's club ▪ willows ▪ fireweed ▪ highbush cranberry ▪ red raspberry	<0.1	8.8	680.2	0.0	1.3
	10a	SH	hybrid white spruce - horsetail (fluvial)	3b,4,6,7a	▪ devil's club ▪ willows ▪ fireweed ▪ highbush cranberry ▪ red raspberry	23.4	44.1	68.0	34.4	64.9
	10b	SH	hybrid white spruce - horsetail - leafy mosses (lacustrine/morainal)	3a,3b,4,5,6,7a	▪ devil's club ▪ willows ▪ fireweed ▪ highbush cranberry ▪ red raspberry	98.0	34.5	136.3	71.9	25.3
	12	SS	black spruce / hybrid white spruce - scrub birch - sedge	3b,5,6,7	▪ willows ▪ buckbean	-	2.6	20.1	-	12.9
	31	WE	non-forested bog	3b	▪ willows ▪ buckbean	-	-	12.4	-	-

BGC Subzone	Site Series	Map Code	Common Name	Structural Stages ¹	Supported Culturally Important Species	Area of Direct Disturbance within Project Area (ha)	Area of Indirect Disturbance within Vegetation LSA (ha)	Total Area within Vegetation RSA (ha)	Proportion Directly Disturbed within the Vegetation RSA (%)	Proportion Indirectly Disturbed within the Vegetation RSA (%)
	32	LS	non-forested bog	3a	willows buckbean	-	-	0.6	-	-
	51	WT	Scouler's willow - thimbleberry	3b,4,5,6	devil's club willows highbush cranberry	8.5	2	11.0	77.3	18.2
	52	AN	mountain alder - stinging nettle	3b	devil's club willows	0.8	<0.1	0.8	100.0	<0.1
	52	SL	Sitka alder - lady fern	3,3a,3b	devil's club willows	-	-	73.9	-	-
	82	BW	bluegrass - slender wheatgrass	3,3a	fireweed	-	-	3.8	-	-
	Atcv	Atcv	trembling aspen - Canada violet seral association	5	willows fireweed highbush cranberry red raspberry	1.1	<0.1	1.1	100.0	<0.1
	Atha	Atha	trembling aspen - hardhack seral association	3a,3b,4	willows	17.6	9.5	27.1	64.9	35.1
	FI01	FI01	mountain alder - common horsetail	3b	willows	-	4.4	4.4	-	100.0
	Wb05	Wb05	black spruce - water sedge - peatmoss	3a,3b,7a	buckbean	3.6	5.6	9.2	39.1	60.9
	Ws03	Ws03	Bebb's willow - bluejoint reedgrass	3b	willows	0.3	-	0.3	100.0	<0.1
SBSmc2 Total						1,031.2	627.7	9,969.7	10.3	6.3
Grand Total						1,378.5	1,719.2	29,531.4	4.7	5.8

Notes: %=percent; BAFaun=Boreal Altai Fescue Alpine Undifferentiated subzone; BGC=Biogeoclimatic; ESSFmc=Engelmann spruce subalpine fir zone moist cold subzone, ESSFmcw=Engelmann spruce subalpine fir zone moist cold subzone woodland variant, ha=hectare; LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area; SBSdk=sub-boreal spruce zone dry cool subzone, SBSmc2=sub-boreal spruce zone moist cold subzone Babine variant

¹ Structural stages are further described in (British Columbia Ministry of Forests and Range [BC MOFR] and British Columbia Ministry of Environment [BC MOE] 2010)

5.4.5.1.1 *Residual Effects Characterisation*

The residual effects characterisation for alteration/loss of Culturally Important Species is provided in **Table 5.4-12**. Alteration/loss of Culturally Important Species is expected to reduce the presence of Culturally Important Species within the Vegetation RSA.

The Magnitude of the alteration/loss of Culturally Important Species is expected to be Moderate. Up to 10.5% of ecosystems with the potential to support Culturally Important Species within the Vegetation RSA may be altered or lost due to the Project during all Project phases.

The residual effect is expected to be Local in Geographic Extent. The direct loss of ecosystems with the potential to support Culturally Important Species is expected to be limited to the Project Area during Construction, and indirect effects are expected to be restricted to the Vegetation LSA along the margins of the Project Area during all Project phases.

The Frequency of alteration/loss of Culturally Important Species is expected to be Frequent. While loss of ecosystems with the potential to support Culturally Important Species due to clearing during the Construction Phase is expected to occur once, alteration within the Vegetation RSA by indirect effects is anticipated to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.

The Duration of alteration/loss of Culturally Important Species is expected to be Medium-term (between 2 and 52 years). Culturally Important Species lost due to clearing during Construction are expected to naturally disperse back into the Project Area during progressive reclamation throughout Operation, Decommissioning and Reclamation phases, and the Post-closure Phase. Culturally Important Species altered by indirect effects are expected to regenerate following the end of the Operation Phase.

The alteration/loss of Culturally Important Species is expected to be Reversible. Culturally Important Species lost within the Vegetation RSA have the potential to regenerate over time during progressive reclamation throughout the Operation Phase as well as following the end of the Decommissioning and Reclamation Phase. The alteration of Culturally Important Species due to the introduction/spread of invasive plants is expected to be reduced within one (1) year following the end of the Operation Phase: the combination of mitigation measures to control existing invasive plant populations and reduced vehicle and equipment traffic is expected to return invasive plant propagule pressure to baseline levels. Similarly, the end of the Operation Phase will result in reduced vehicle and equipment traffic and a subsequent reduction of dust deposition. Dust is expected to be naturally washed from vegetation by natural weather events. Edge effects are expected to persist until revegetation and tree growth on the Project Area create a more gradual structural transition at forest edges (e.g., a tall shrub or pole/sapling structural stage, approximately 20 years following reclamation).

The Context of the residual effect of alteration/loss of Culturally Important Species is expected to be Low. Culturally Important Species are common within the Vegetation RSA, occupying a diverse assemblage of ecosystem units on the landscape which has experienced historic fragmentation and indirect disturbance resulting from cutblocks, forestry roads, and agricultural land use. As such, Culturally Important Species within the Vegetation RSA are expected to have a moderate to high resilience to stress.

Table 5.4-12: Summary of Effect Characteristics Ratings for Alteration/Loss of the Culturally Important Species Subcomponent

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Moderate	It is expected that up to 10.5% of ecosystems with the potential to support Culturally Important Species within the Vegetation RSA may be altered or lost during all Project phases.
Geographic Extent	Local	While the direct loss of ecosystems with the potential to support Culturally Important Species is expected to be limited to the Project Area during the Construction Phase, indirect effects are expected to occur within the Vegetation LSA along the margins of the Project Area during all Project phases.
Duration	Medium-term	Culturally Important Species lost due to clearing during the Construction Phase are expected to naturally disperse back into the Project Area during progressive reclamation throughout the Operation Phase as well as during the Decommissioning and Reclamation Phase. Culturally Important Species altered by indirect effects are expected to regenerate following the end of the Operation Phase.
Frequency	Frequent	Loss of ecosystems with the potential to support Culturally Important Species due to clearing during the Construction Phase is expected to occur once; alteration within the Vegetation LSA by indirect effects is anticipated to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase
Reversibility	Fully Reversible	Culturally Important Species altered and/or lost within the Vegetation RSA have the potential to regenerate over time during progressive reclamation throughout the Operation Phase as well as following the end of the Operation Phase.
Context	Low	Culturally Important Species are common within the Vegetation RSA, occupying a diverse assemblage of ecosystem units on the landscape which has experienced historic fragmentation and indirect disturbance resulting from cutblocks, forestry roads, and agricultural land use. As such, Culturally Important Species within the Vegetation RSA are expected to have a moderate to high resilience to stress.

Notes: %=percent; LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area

5.4.5.1.2 Likelihood

The residual effect of alteration/loss of Culturally Important Species is expected to be Likely. Culturally Important Species are common within the Vegetation RSA and there is a high potential for alteration/loss of these species.

5.4.5.1.3 Significance Determination

The residual effect of alteration/loss due to the Project is not expected to result in a change in Culturally Important Species that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or are unavailable to contribute to ecological function. The residual effect has been characterised as Moderate in Magnitude, Local in Geographic Extent, and Medium-term in Duration; therefore, the residual

effect of alteration/loss of vegetation on the Culturally Important Species subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. Uncertainty exists with respect to the extent and degree of alteration resulting from edge effects, dust deposition, changes in water quantity and quality, invasive plants, and the resiliency of Culturally Important Species within the Vegetation RSA to withstand potential Project-related change.

5.4.5.2 Trace Metals Deposition on Culturally Important Species

In consideration of the mitigation outlined in **5.3**, residual low levels of trace metals deposition on Culturally Important Species are predicted. The assessment considered the potential residual trace metals deposition onto Culturally Important Species during all Project phases by dust deposition, air emissions, and surface water runoff.

As described in **5.4.5.1**, Culturally Important Species within the Project Area are expected to be cleared during the Construction Phase. Thus, the majority of residual trace metals deposition is expected to occur along the edges of the Project Area during Construction, Operation, and Decommissioning and Reclamation phases, primarily associated with dust and air emissions from roads and areas of active soil disturbance. Trace metals deposition resulting from surface water runoff may occur during the Operation Phase, caused by weathering of overburden and mine rock and subsequent mobilization by surface water to Culturally Important Species downgradient.

This assessment has assumed equivalent probability within the entire Vegetation LSA for residual trace metals deposition onto Culturally Important Species due to dust, air emissions, and surface water runoff. Given these assumptions, trace metals deposition may occur within up to 1,719.2 ha (5.8%) of ecosystems with the potential to support Culturally Important Species within the Vegetation RSA.

5.4.5.2.1 Residual Effects Characterisation

The residual effects characterisation for trace metals deposition on Culturally Important Species is provided in **Table 5.4-13**. Trace metals deposition on Culturally Important Species is predicted to have the potential to reduce vegetation health and alter plant abundance and population persistence.

The Magnitude of the deposition of trace metals on Culturally Important Species is expected to be Low. Up to 5.8% of ecosystems with the potential to support Culturally Important Species within the Vegetation RSA may be affected by trace metals deposition during all Project phases. Culturally Important Species currently located within the Project Area are expected to be cleared during the initial stages of the Construction Phase and are not anticipated to be affected by trace metals deposition.

The Geographic Extent of the residual effect is expected to be Local. Deposition of trace metals on Culturally Important Species is expected to be confined to the Vegetation LSA along the boundaries of roads and areas of active soil disturbance, as well as areas downgradient from the Minesite during all Project phases.

The deposition of trace metals on Culturally Important Species is expected to be Long-term (>52 years) because of the extended time periods often necessary for trace metals to attenuate in the soil. Timelines for trace metals depletion from the soil vary widely depending on chemistry and climate, from 75 years to over 3,000 years in temperate climates (Kabata-Pendias and Pendias 2001).

The Frequency of the deposition of trace metals on Culturally Important Species is expected to be Frequent. Dust deposition, vehicle emissions, and surface water movement are expected to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.

Deposition of trace metals on Culturally Important Species is expected to be Fully Reversible. Accumulated trace metals deposited on above-ground plant tissues (e.g., stems, leaves, and twigs) is expected to be Fully Reversible within two (2) to five (5) years following the end of the Project Operation Phase by annual leaf drop and weathering, and the attenuation of accumulated trace metals within the soil is expected to be reversible over the Long-term.

The Context of the residual effect of trace metals deposition on Culturally Important Species is expected to be Low. Culturally Important Species are common within the Vegetation RSA, occupying a diverse assemblage of ecosystem units on the landscape which has experienced historic fragmentation and direct and indirect disturbance resulting from cutblocks, forestry roads, and agricultural land use. As such, Culturally Important Species within the Vegetation RSA are expected to have a moderate to high resilience to stress. Some species with cultural importance, including fireweed and red raspberry, exhibit a preference for recent disturbance (Beaudry et al. 1999). Existing naturally elevated levels of trace metals have been identified within surface water and groundwater (relative to generic BC water quality guidelines for freshwater aquatic life) within the Vegetation RSA (**Appendices 4.1-A, 4.7-A**). Thus, the potential exists that vegetation may be adapted to naturally elevated trace metals concentrations within the Vegetation RSA.

Table 5.4-13: Summary of Effect Characteristics Ratings for Trace Metals Deposition on the Culturally Important Species Subcomponent

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	Up to 5.8% of ecosystems with the potential to support Culturally Important Species within the Vegetation RSA may be affected by trace metals deposition during all Project Phases.
Geographic Extent	Local	Deposition of trace metals on Culturally Important Species is expected to be confined to the Vegetation LSA during all Project phases.
Duration	Long-term	The deposition of trace metals on Culturally Important Species is expected to be Long-term (>52 years) because of the extended time periods often necessary for trace metals to attenuate in the soil.
Frequency	Frequent	Dust deposition, vehicle emissions, and surface water movement is expected occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.
Reversibility	Fully Reversible	Trace metals deposition on above-ground vegetation structures (e.g., stems, leaves, twigs) is expected to be reversible by annual leaf drop and weathering, and deposition of trace metals on soil is expected to be reversible over the Long-term.
Context	Low	Culturally Important Species are common within the Vegetation RSA, occupying a diverse assemblage of ecosystem units on the landscape which has experienced historic fragmentation and indirect disturbance resulting from cutblocks, forestry roads, and agricultural land use.

Notes: >=greater than; %=percent; LSA=Local Study Area; RSA=Regional Study Area

5.4.5.2.2 *Likelihood*

The residual effect of trace metals deposition on Culturally Important Species is expected to be Likely. Dust, air emissions, and surface water runoff are anticipated to occur during all Project Phases, and trace metals have a high probability of being deposited on Culturally Important Species as a result.

5.4.5.2.3 *Significance Determination*

The residual effect of trace metals deposition due to the Project is not expected to result in a change in Culturally Important Species that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or are unavailable to contribute to ecological function. The residual effect has been characterized as Low in Magnitude, Local in Geographic Extent, and Long-term in Duration; therefore, the residual effect of trace metals deposition on the Culturally Important Species subcomponent is **Not Significant**.

The Level of Confidence of this prediction is Moderate. Uncertainty exists with respect to the type and concentration of trace metals that may be deposited, their bioavailability, and the responses of individual vegetation species to trace metals.

5.4.6 *Rare Plants and Lichens Subcomponent*

5.4.6.1 *Alteration/Loss of Rare Plants and Lichens*

As detailed in 4.2.5, two (2) blue-listed species have been historically recorded within the Vegetation RSA: American sweet-flag (*Acorus americanus*) and whitebark pine (*Pinus albicaulis*, BC CDC; however, no occurrences of Rare Plants or Lichens have been observed within the Vegetation LSA to date. Further, the subalpine habitat preferred by whitebark pine (e.g., ESSF) is not present in the Vegetation LSA. However, field surveys cannot confirm the absence of Rare Plants or Lichens, and the potential remains for alteration/loss of unobserved rare plants and lichens during Construction. This assessment considers the direct effect of loss of unobserved rare plants and lichens (i.e., clearing during the Construction Phase), and the indirect effect resulting from the introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition during Project phases.

Rare plants typically inhabit specialized habitats that occur infrequently on the landscape (Penny and Klinkenberg 2018), and vegetation communities in the Vegetation RSA have been, and continue to be, exposed to anthropogenic disturbance and fragmentation due to agriculture, forestry, and residential development. Cultivated areas within the Vegetation RSA (2,713.0 ha, 7.7%) have a low potential for Rare Plants and Lichens due to their historic and ongoing disturbance. Upland native vegetation areas within the Vegetation RSA are primarily mesic, zonal sites common within the Vegetation RSA and subsequently considered to have a low to moderate potential for supporting Rare Plants and Lichens. Wetlands within the Vegetation RSA (2,011.1 ha, 5.6%) have a moderate potential to support rare plants and lichens.

5.4.6.1.1 *Residual Effects Characterisation*

The residual effects characterisation for alteration/loss of Rare Plants and Lichens is provided in **Table 5.4-14**. Alteration/loss of Rare Plants and Lichens is expected to potentially reduce the extent and/or abundance of Rare Plants and Lichens within the Vegetation RSA.

The Magnitude of the alteration/loss of Rare Plants and Lichens is expected to be Low. No known occurrences of Rare Plants or Lichens within the Vegetation RSA are anticipated to be affected, but there is potential for unobserved occurrences to be affected during all Project phases.

The residual effect is expected to be Local in Geographic Extent. Potential direct loss of rare plants and lichens is expected to be limited to the Project Area, while indirect effects may occur within the Vegetation LSA during all Project phases.

Alteration/loss of Rare Plants and Lichens is expected to be Long-term (>52 years). Once lost, occurrences of rare plants and/or lichen species are unlikely to regenerate as they often have limited ability for dispersal, poor reproduction and/or recruitment (Schemske et al. 1994, Wamelink et al. 2014).

The Frequency of alteration/loss of Rare Plants and Lichens is expected to be Frequent. While loss of potential occurrences of rare plants and/or lichens caused by clearing during the Construction Phase may occur once, alteration from indirect effects is anticipated to occur frequently throughout Construction, Operation and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.

The Reversibility of the residual effect of alteration/loss of Rare Plants and Lichens is expected to be Partially Reversible. Rare Plants and Lichens typically have specific habitat requirements, are rarely successfully transplanted (Maslovat 2009), and are not likely to return once lost from the Vegetation RSA. However, rare plant and lichen occurrences affected indirectly by dust deposition, edges, and changes to water quantity and quality may naturally regenerate and re-establish over time following the end of the Operation Phase.

The Context of the residual effect of alteration/loss of Rare Plants and Lichens is expected to be Moderate. Rare Plants and Lichens are often highly habitat-specific, with low resiliency to disturbance and habitat loss or degradation (Wamelink et al. 2014). However, no occurrences of Rare Plants and Lichens have been observed in the Vegetation RSA to date.

Table 5.4-14: Summary of Effect Characteristics Ratings for Alteration/Loss of the Rare Plants and Lichens Subcomponent

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	No occurrences of Rare Plants or Lichens within Vegetation RSA are anticipated to be affected, but the potential exists that unobserved occurrences may be affected during all Project Phases.
Geographic Extent	Local	Potential direct loss of Rare Plants and/or Lichens is expected to be limited to the Project Area, indirect effects may occur within the Vegetation LSA during all Project phases
Duration	Long-term	Once lost, occurrences of Rare Plants and/or Lichen species are unlikely to regenerate as they often have limited ability for dispersal, poor reproduction and/or recruitment.
Frequency	Frequent	While loss of potential occurrences of rare plants and lichens due to clearing during Construction will occur once, alteration by indirect effects is anticipated to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.
Reversibility	Partially Reversible	Rare Plants and Lichens typically have specific habitat requirements, are rarely successfully transplanted, and are not likely to return once lost from the Vegetation RSA. However, Rare Plant and Lichen occurrences affected indirectly by effects such as dust deposition, edges, and changes to water quantity and quality are may naturally regenerate over time following the end of the Operation Phase.
Context	Moderate	Rare Plants and Lichens are often highly habitat-specific with low resiliency to disturbance and habitat loss or degradation. However, no

Residual Effects Characteristic	Rating	Rationale for Rating
		occurrences of Rare Plants and Lichens have been observed within the Vegetation RSA to date.

Notes: >=greater than; LSA=Local Study Area; %=percent; Project=Tenas Project; RSA=Regional Study Area

5.4.6.1.2 Likelihood

The residual effect of alteration/loss of Rare Plants and Lichens is expected to be Unlikely. This considers the lack of historical observations and the presence habitats that do not commonly support Rare Plants and Lichens throughout the majority of the Vegetation RSA.

5.4.6.1.3 Significance Determination

The residual effect of alteration/loss due to the Project is not expected to result in a change in Rare Plants and Lichens that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or are unavailable to contribute to ecological function. The residual effect has been characterized as Low in Magnitude, Local in Geographic Extent and Long-term in Duration; therefore, the residual effect of alteration/loss of vegetation on the Rare Plants and Lichens subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. No occurrences of Rare Plants and Lichens have been previously observed within the Vegetation RSA; however, uncertainty exists with respect to whether occurrences are present, and if so, where they are in relation to Project activities. While the direct effects of clearing are well known, additional uncertainty exists with respect to the extent and degree of potential alteration that may result from edge effects, dust deposition, and invasive plants.

5.4.6.2 Trace Metals Deposition on Rare Plants and Lichens

As described in 5.4.6.1, vegetation within the Project Area is expected to be cleared during the Construction Phase. Thus, the majority of residual trace metals deposition is expected to occur along the edges of the Project Area during all Project phases, primarily associated with dust and air emissions from roads and areas of active soil disturbance. Trace metals deposition resulting from surface water runoff may occur during the Operation Phase, caused by weathering of overburden and mine rock and subsequent mobilization by surface water to potential Rare Plant and Lichen occurrences downgradient.

5.4.6.2.1 Residual Effects Characterisation

The residual effects characterisation for trace metals deposition on Rare Plants and Lichens is provided in **Table 5.4-15**. Trace metals deposition on Rare Plants and Lichens may reduce the distribution and/or abundance of Rare Plants and Lichens within the Vegetation RSA.

The Magnitude of trace metals deposition on Rare Plants and Lichens is expected to be Low. No known occurrences of Rare Plants or Lichens within Vegetation RSA are anticipated to be affected, but the potential exists that trace metals may be deposited on unobserved rare plant and lichen occurrences during all Project phases.

The residual effect is expected to be Local in Geographic Extent. Trace metals deposition on Rare Plants and/or Lichens is expected to be limited to the Vegetation LSA along the boundaries of roads and areas of active soil disturbance, as well as areas downgradient from the Minesite during all Project phases.

Trace metals deposition on Rare Plants and Lichens is expected to occur over the Long-term (>52 years) because of the extended time periods often necessary for trace metals to attenuate in the soil. Timelines for trace metals depletion from the soil vary widely depending on chemistry and climate, from 75 years to over 3,000 years in temperate climates (Kabata-Pendias and Pendias 2001).

The Frequency of trace metals deposition is expected to be Frequent. Dust production, air emissions, and surface water movement is expected to occur frequently throughout Construction, Operation, and Decommissioning and Reclamation phases, and be Infrequent throughout the Post-closure Phase.

The Reversibility of trace metals deposition on Rare Plants and Lichens is expected to be Fully Reversible. Accumulated trace metals deposited on above-ground vascular plant tissues (e.g., stems, leaves) is expected to be Fully Reversible within two (2) to five (5) years following the end of the lifetime of the Project by annual leaf drop and weathering. Bryophytes and lichens, on the other hand, do not typically shed tissues during growth and are thus expected to retain higher levels of trace metals on their surface for longer than vascular plants (Conti and Cecchetti 2001). The attenuation of accumulated trace metals within the soil is expected to be reversible over the Long-term.

The Context of trace metals deposition on Rare Plants and Lichens is expected to be Moderate. Rare Plants and Lichens are uncommon in the province (see 4.2.5), exhibit noted conservation value, and often have high habitat specificity and low resilience to disturbance or habitat degradation (Maslovat 2009). However, no occurrences of Rare Plants and Lichens have been observed in the Vegetation RSA to date.

Table 5.4-15: Summary of Effect Characteristics Ratings for Trace Metals Deposition on the Rare Plants and Lichens Subcomponent

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	No known occurrences of Rare Plants or Lichens within Vegetation RSA are anticipated to be affected, but the potential exists that trace metals may be deposited on unobserved Rare Plants or Lichens during all Project phases
Geographic Extent	Local	Trace metals deposition on Rare Plants and Lichens is expected to be limited to the Vegetation LSA during all Project phases
Duration	Long-term	Trace metals deposition on Rare Plants and Lichens is expected to occur over the Long-term (>52 years) because of the extended time periods often necessary for trace metals to attenuate in the soil.
Frequency	Frequent	Dust production, air emissions, and surface water movement is expected to occur frequently during Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.
Reversibility	Fully Reversible	Trace metals deposition on above-ground vascular plant structures (e.g., stems, leaves, twigs) is expected to be reversible by annual leaf drop and weathering; however, this is not anticipated to be as common for bryophyte and lichen species. Deposition of trace metals on soil is expected to be reversible over the Long-term.
Context	Moderate	Rare Plants and Lichens are uncommon in the province (see 4.2.5), exhibit noted conservation value, and often exhibit high habitat specificity, and low resilience to disturbance or habitat degradation. However, no occurrences of Rare Plants and Lichens have been observed within the Vegetation RSA to date.

Notes: >=greater than; LSA=Local Study Area; RSA=Regional Study Area

5.4.6.2.2 *Likelihood*

The residual effect of alteration/loss of Rare Plants and Lichens is expected to be Unlikely, as no occurrences have been historically observed within the Vegetation RSA to date, and the majority of the Project Area consists of habitats that do not commonly support these species.

5.4.6.2.3 *Significance Determination*

The residual effect of trace metals deposition due to the Project is not expected to result in a change in Rare Plants and Lichens that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or unavailable to contribute to ecological function. The residual effect has been characterized as Low in Magnitude, Local in Geographic Extent, and Long-term in Duration; therefore, the residual effect of alteration/loss of vegetation on the Rare Plants and Lichens subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. No occurrences of Rare Plants and Lichens have been previously observed within the Vegetation RSA to date; however, because field surveys cannot confirm the absence of Rare Plants and Lichens, uncertainty exists with respect to whether occurrences are present, and if they are, where they are in relation to Project activities. Uncertainty also exists with respect to the type and concentration of trace metals that may be deposited, their bioavailability, and the responses of individual vegetation species to the trace metals present.

5.5 Summary of Project-related Residual Effects and Significance

The following potential residual effects of the Project were identified as residual effects on the Vegetation VC and all subcomponents (i.e., Old Growth Forest, Wetlands, Listed Ecological Communities, Culturally Important Species, and Rare Plants and Lichens) were identified through the assessment process:

- ▶ alteration/loss of vegetation, ecosystems, and wetlands; and
- ▶ deposition of trace metals on plants and soil, which can result in uptake to plants.

The results of the residual effects characterisations for the Vegetation VC subcomponents are summarized in **Table 5.5-1**. The residual effects of the Project on Old Growth Forest, Wetlands, Listed Ecological Communities, Culturally Important Species, and Rare Plants and Lichens were expected to be **Not Significant**. Considering this, the Project effects are not expected to alter the integrity of the Vegetation VC within the Vegetation RSA beyond an acceptable level (i.e., it remains sustainable and is available to contribute to ecological function); and are expected to be **Not Significant**.

All residual effects, **Significant** or **Not Significant**, are carried forward into the CEA for assessment.

Table 5.5-1: Summary of Residual Effects on the Vegetation Valued Component (VC) Subcomponents

Residual Effect	Contributing Activities within the Project Phases (C, O, D, P)	Proposed Mitigation Measures	Subcomponent	Residual Effects Characterisation								
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Alteration/loss of vegetation, ecosystems, and wetlands	- Site clearing (clearing, grubbing, soil stripping and salvaging) (C) - Transportation of equipment, materials, and personnel (C, O, D, P) - Construction and installation of all Project components (C) - Mining (O) - Operation of surface water management systems, Coal Preparation Plant (O) - Maintenance of roads, bridge, Rail Infrastructure, powerline and substation, water discharge infrastructure, material storage piles, materials handling systems and solid waste management systems (O) - Progressive reclamation of completed mine areas (O) - Dismantling and removal of mining equipment and facilities (including powerline, Rail Infrastructure) (D) - Reclamation and closure of roads, bridge, Powerlines, Rail Infrastructure (D) - Implementation of post-mining systems and monitoring (D) - Maintenance of post-mining systems and ongoing monitoring (P)	- Project siting and construction - Vegetation clearing and soil salvage - Invasive plant management - Erosion and sediment control - Management of ML/ARD - Dust suppression and air emissions - Spill prevention and response - Additional VC-specific reclamation measures	Old Growth Forest	M	LSA	LT	FF	FR	M	L	NS	M
			Wetlands	M	LSA	MT	FF	PR	M	L	NS	M
			Listed Ecological Communities	M	LSA	LT	FF	PR	H	L	NS	M
			Culturally Important Species	M	LSA	MT	FF	FR	L	L	NS	M
			Rare Plants and Lichens	L	LSA	LT	FF	PR	M	U	NS	M
Trace metals deposition	- Site clearing (clearing, grubbing, soil stripping and salvaging) (C) - Transportation of equipment, materials, and personnel (C, O, D, P) - Construction and installation of all Project components (C) - Mining (O) - Operation of surface water management systems, coal preparation plant (O) - Maintenance of roads, bridge, Rail Infrastructure, powerline and substation, water discharge infrastructure, material storage piles, materials handling systems and solid waste management systems (O) - Progressive reclamation of completed mine areas (O) - Dismantling and removal of mining equipment and facilities (including powerline, Rail Infrastructure) (D) - Reclamation and closure of roads, bridge, powerlines, Rail Infrastructure (D) - Implementation of post-mining systems and monitoring (D) - Maintenance of post-mining systems and ongoing monitoring (P)	- Vegetation clearing and soil salvage - Erosion and sediment control - Management of ML/ARD - Dust suppression and air emissions - Spill prevention and response - Additional VC-specific reclamation measures	Old Growth Forest	L	LSA	LT	FF	FR	M	L	NS	M
			Wetlands	M	LSA	LT	FF	FR	M	L	NS	M
			Listed Ecological Communities	M	LSA	LT	FF	FR	H	L	NS	M
			Culturally Important Species	L	LSA	LT	FF	FR	L	L	NS	M
			Rare Plants and Lichens	L	LSA	LT	FF	FR	M	U	NS	M

Notes: C, O, D, P represent Project phases: Construction (C), Operation (O), Decommissioning and Reclamation (D), Post-closure (P)
ML/ARD=metal leaching/acid rock drainage; VC=Valued Component

Magnitude: Low (L), Moderate (M), High (H)
Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA)
Duration: Short-term (ST), Medium-term (MT), Long-term (LT)
Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)
Reversibility: Reversible (FR), Partially Reversible (PR), Irreversible (IR)
Context: Low (L), Moderate (M), High (H)
Likelihood: Likely (L), Unlikely (UL)
Significance: Not-Significant (NS), Significant (S)
Level of Confidence: Low (L), Moderate (M), High (H)

See Table 5.1-2 for list of applicable activities for each listed Project phase, unless otherwise noted in this table.

6. CUMULATIVE EFFECTS ASSESSMENT (CEA)

Cumulative effects are the overall effects on a VC due to the Project's residual effects overlapping both spatially and temporally with those of other projects and activities. This subsection presents an assessment of the cumulative effects on the Vegetation VC.

The environmental effects of past and existing projects and activities are captured in the baseline conditions (i.e., existing environment; see **4. Existing Conditions**). Thus, the Likelihood of cumulative effects due to ongoing and reasonably foreseeable future projects is the focus of this CEA. The approach to determining cumulative effects is described in **3.2**.

As described in **3.2.4**, the spatial boundaries of the CEA for the Vegetation VC are defined as the Vegetation RSA. Projects/activities that are outside of the Vegetation RSA but had potential effects within the Vegetation RSA were also considered. The temporal boundaries within which cumulative effects were considered include past, present, and reasonably foreseeable future activities inclusive of the life of the Project including Construction, Operation, Decommissioning and Reclamation, and Post-closure phases (see **3.2.4.2**).

Baseline conditions represent past and present projects and activities, including existing disturbance. All Projects and activities listed in the Project and Activity Inclusion List (**S3.0 Assessment Methodology**) that are not listed below in **Table 6.1-1** are not considered in the Vegetation CEA as the residual effects of these developments are not anticipated to overlap spatially with the residual effects of the Project and are not in proximity to the Vegetation RSA.

6.1 Potential Cumulative Effects

Cumulative effects resulting from ongoing and future projects are the focus of this CEA. Future projects and activities with likely overlapping residual effects on Vegetation are outlined in **Table 6.1-1**, followed by text that provides supporting rationale.

As outlined in **5.2**, the following Project-related residual effects were considered for their potential to interact cumulatively with the residual effects of reasonably foreseeable projects and activities identified within, or extending into the Vegetation RSA:

- ▶ alteration/loss of vegetation, ecosystems, and wetlands; and
- ▶ deposition of trace metals on plants and soil, which can result in uptake by plants.

Table 6.1-1. Projects Included in the Cumulative Effects Assessment (CEA) For the Vegetation Valued Component (VC) Based on Spatial and Temporal Interaction

Project/Activity Name	Interacts with Project-related effects on the VC as a Past, Present or Future Project/Activity	
	Past and Present	Future
Bulbous Toe	No	Yes
Maple Leaf Cannabis Production Facility	No	Yes
Pacific Northern Gas Looping Pipeline	No	Yes

Project/Activity Name	Interacts with Project-related effects on the VC as a Past, Present or Future Project/Activity	
	Past and Present	Future
Prince George to Terrace Capacitors Project	No	Yes
Telkwa to Smithers Bike Trail	No	Yes
Forestry Activities	Yes	Yes
Recreation Activities	Yes	Yes
Harvesting (including Fishing, Hunting, Trapping, and Outfitting) and Traditional Land Use	Yes	Yes
Urban Development	Yes	Yes
Agriculture Activities	Yes	Yes
Infrastructure Maintenance Activities	Yes	Yes

Notes: Project=Tenas Project; VC=Valued Component

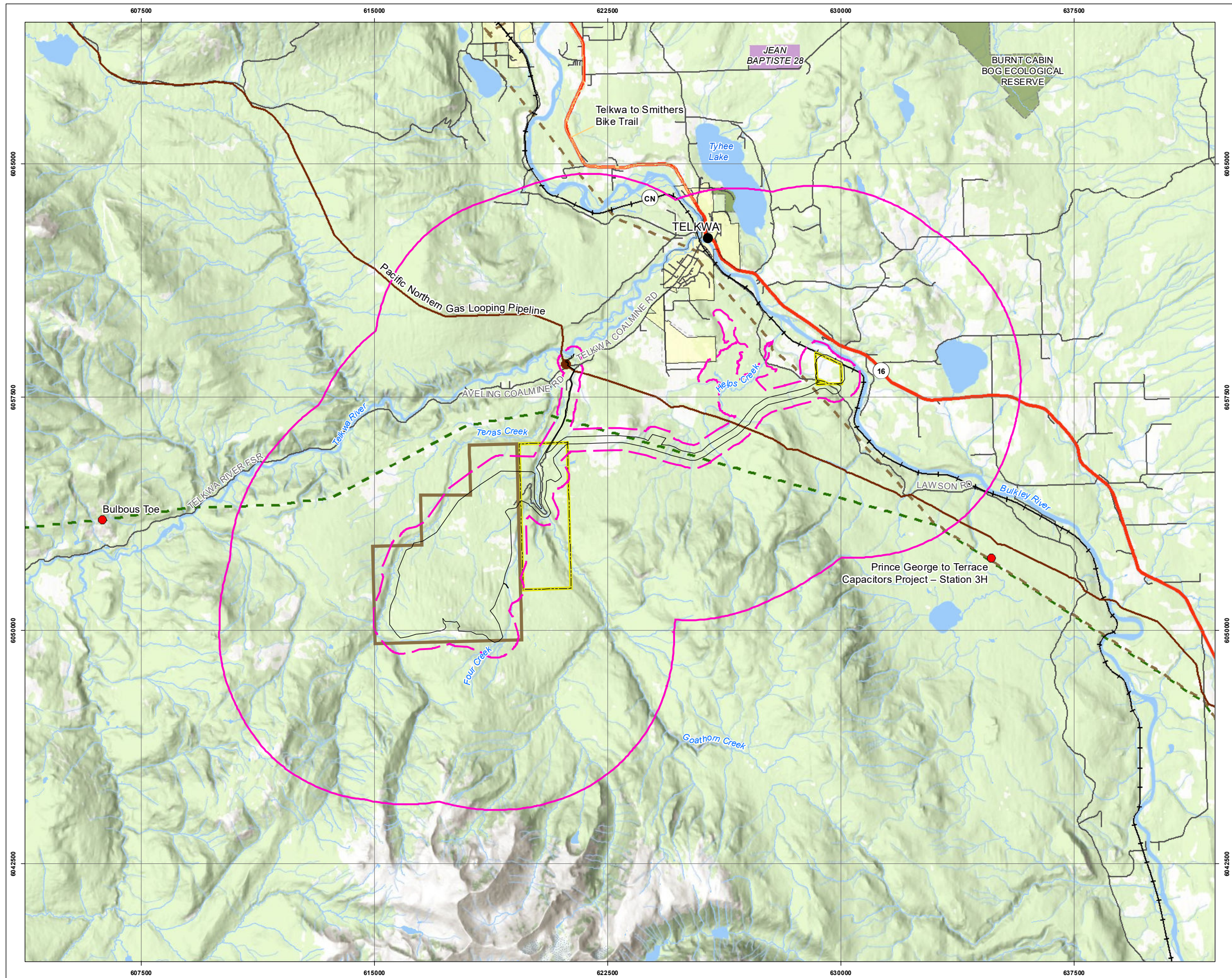
Spatial information is not available for some future projects and most activities. The following projects and activities are expected to have residual effects on the Vegetation VC, within or extending into the Vegetation RSA (**Figure 6.1-1**).

- ▶ **Bulbous Toe:** This slow-moving landslide has a major transmission line traversing it, and as a result one (1) of the towers requires periodic maintenance. Although this tower is located approximately 4 km west of the Vegetation RSA, a portion of the access crosses through the Vegetation RSA from the Village of Telkwa to the east. Vehicle traffic periodically travelling through the Vegetation RSA to perform maintenance at transmission towers and/or on the ROW has the potential to act cumulatively with the Project residual effects as a result of: the introduction and/or proliferation of invasive plants; dust deposition which could alter vegetation ecosystems; and wetlands; and trace metals deposition onto plants and soil within the Vegetation RSA;
- ▶ **Pacific Northern Gas Looping Pipeline:** Pipeline construction is anticipated to result in vegetation clearing along the pipeline ROW and associated workspace, potentially affecting vegetation, ecosystems, and wetlands directly as well as indirectly by means of edge effects, dust deposition, and changes in water quantity and quality. Pipeline construction is also expected to contribute to increased vehicle and equipment traffic, which has the potential to interact cumulatively with the Project residual effects, and result in increased potential for introduction and/or proliferation of invasive plants, dust deposition, and trace metals deposition onto plants and soil within the Vegetation RSA;
- ▶ **Prince George to Terrace Capacitors Project:** One of the proposed capacitor stations (3H) is located outside the Vegetation RSA to the southeast; however, access to this station is proposed to occur within the Vegetation RSA, from the Village of Telkwa to the southeast along Lawson Road. Construction and operation of this capacitor station is expected to contribute to increased vehicle and equipment traffic within the Vegetation RSA, which has the potential to interact cumulatively with the Project residual effects, and result in increased potential for introduction and/or proliferation of invasive plants, dust deposition, and trace metals deposition onto plants and soil within the Vegetation RSA;
- ▶ **Telkwa to Smithers Bike Trail:** This project has been routed predominantly along the Highway 16 ROW, where native vegetation has experienced historic disturbance during highway construction and maintenance. Construction of the bike trail is anticipated to result in limited vegetation clearing

as well as increased vehicle and equipment traffic within the Vegetation RSA. These residual effects have the potential to act cumulatively with the residual effects of the Project, resulting in the introduction and/or proliferation of invasive plants, dust deposition, and trace metals deposition onto plants and soil within the Vegetation RSA;

- ▶ Forestry activities: The Vegetation RSA is located within the Bulkley TSA. It is estimated that 6,977 ha of forest within the Vegetation RSA will be harvested between 2021 and 2073 (4.2.7). This conservative estimate does not account for reforestation or natural forest succession over time, where young and mature forest are expected to transition to mature and Old Growth Forest, respectively, over the course of the Project lifespan (approximately 52 years). In addition, this value overestimates the extent of disturbance, as all future forestry activities are expected to be conducted with consideration of provincial and regional biodiversity and Old Growth Forest management objectives. These forestry activities are expected to contribute to the alteration/loss of vegetation, ecosystems, and wetlands directly through vegetation clearing, and indirectly through increased edge effects, and increased vehicle and equipment traffic that can result in the introduction and/or proliferation of invasive plants, dust deposition, and trace metals deposition onto plants and soil within the Vegetation RSA;
- ▶ Agricultural activities: Agricultural land uses (e.g., cultivation, tame pasture/hay) are present within the Vegetation RSA, in the eastern portion. The current areal extent of agricultural activity within the Vegetation RSA is not expected to change. However, ongoing agricultural activities (e.g., cultivation, seeding, herbicide use) may result in the alteration/loss of vegetation, ecosystems, and wetlands through the introduction/proliferation of invasive plants, translocation of herbicides from surface water and dust movement, and dust deposition that can lead to trace metals deposition on plants and soil within the Vegetation RSA;
- ▶ Harvesting (including fishing, hunting, trapping, and outfitting) and Traditional Land Use: Improved access to the Vegetation RSA may result in increased harvest of traditional plants (e.g., medicinal plants) and vegetation (e.g., berries). This may contribute cumulatively with the residual effects of the Project by reducing the extent of Culturally Important Species and increasing vehicle traffic which could result in the introduction/proliferation of invasive plants and increase dust deposition, which can lead to trace metals deposition on plants and soil within the Vegetation RSA;
- ▶ Recreational activities: Ongoing use of existing recreational trails within the Vegetation RSA may contribute cumulatively with the residual effects of the Project by resulting in the introduction/proliferation of invasive plants. Improved access to the Vegetation RSA due to the Project may also result in increased recreational activities such as off-highway vehicle use. These activities both have the potential to contribute to cumulative alteration/loss of vegetation; and
- ▶ Infrastructure maintenance activities: Existing infrastructure within the Vegetation RSA such as roads, powerlines, and railways are anticipated to require maintenance such as vegetation control for safety and line-of-sight, road grading and gravelling, and other repairs. Such activities have the potential to contribute to the cumulative effects on the Vegetation VC directly through vegetation clearing/control, and indirectly through introduction and/or proliferation of invasive plants, dust deposition, and trace metals deposition onto plants and soil within the Vegetation RSA.

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Tenas Project

Projects included in the Cumulative Effects Assessment for the Vegetation VC

Legend

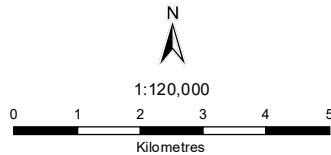
- Project
- Pacific Northern Gas Compressor Site
- City/Town
- Rail Line
- Highway
- Road
- 138 kV Transmission Line
- 500 kV Transmission Line
- Pacific Northern Gas Looping Pipeline
- Watercourse
- Waterbody
- Park or Protected Area
- First Nation Reserve
- Municipal Area
- Telkwa Coal Limited Private Property
- Tenas Coal Licenses
- Project Area
- Vegetation Local Study Area
- Vegetation Regional Study Area

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Map



NAD 1983 UTM Zone 9N

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Production Date: Apr 09, 2021

Figure 6.1-1



Projects and activities not expected to have residual effects that act cumulatively with the residual effects of the Project on the Vegetation VC are:

- ▶ Maple Leaf Cannabis Production Facility: This facility is planned to be sited near the Village of Telkwa on land previously developed as a tree nursery. Because this is a brownfield site with a history of similar use, the facility is not expected to contribute to cumulative effects on the Vegetation VC; and
- ▶ Urban Development: The municipality of Telkwa is located within the Vegetation RSA. Urban development projects, such as road maintenance and construction, municipal works, and industrial construction, often have short-term construction periods localized to areas of existing disturbance and are not likely to contribute to cumulative effects on Vegetation. No new subdivisions or additional development areas are reasonably foreseeable within the village of Telkwa, and all work is anticipated to occur within areas of existing disturbance.

6.2 Additional Mitigation Measures

Additional mitigation measures to those considered in the assessment of Project-related effects (see 5.3) are not considered to be necessary to avoid or minimize the predicted cumulative effects on Vegetation and its subcomponents. It is assumed that the current and future projects and activities have appropriate environmental protection measures in place as required by laws and regulations, and will comply with the goals and objectives of the following documents, as appropriate:

- ▶ Bulkley LRMP and Objectives set by Government (GovBC 1998, Integrated Land Management Bureau 2006);
- ▶ Telkwa Landscape Unit Plan (GovBC 1999);
- ▶ Bulkley Valley Sustainable Resource Management Plan (BC MAL 2005);
- ▶ Order Establishing Provincial Non-Spatial Old Growth Objectives (GovBC 2004b);
- ▶ Biodiversity Guidebook (BC MOF 1995);
- ▶ Landscape Unit Planning Guide (BC MOF and British Columbia Ministry of Environment, Lands, and Parks [BC MELP] 1999);
- ▶ *Forest and Range Practices Act*, SBC 2002, c 69 (GovBC 2002c) and associated regulations; and
- ▶ *Riparian Areas Protection Act*, SBC 1997, c 21 (GovBC 1997) and associated regulations.

Implementation of the BMPs and mitigation strategies within these documents is expected to reduce the potential for cumulative effects on the Vegetation VC.

6.3 Cumulative Effects and Characterisation of Significance by Subcomponent

The interactions between the predicted Project residual effects and the residual effects of other projects and activities (**Table 6.1-1**) were reviewed to determine potential cumulative effects on the Vegetation VC and associated subcomponents.

Cumulative effects on the Vegetation VC and subcomponents have been characterised and assessed in terms of Magnitude, Geographical Extent, Duration, Frequency, Reversibility, Context, Likelihood, Significance, and Level of Confidence of effect. Characterisation criteria and significance definitions for this CEA are consistent with those presented in 5.4.

As quantitative estimates of future forestry were completed (see 4.2.7), cumulative effects on the Old Growth Forest subcomponent were assessed separately. The remaining Vegetation VC subcomponents, Wetlands, Listed Ecological Communities, Culturally Important Species, and Rare Plants and Lichens were considered qualitatively together given a lack of available spatial information available for future projects and activities, as well as the limited extent of the residual effects.

6.3.1 Old Growth Forest Subcomponent

Residual effects on Old Growth Forest resulting from the Project were identified and assessed as **Not Significant** in 5.4. Old Growth Forest is found on lands supporting mature native vegetation. The lands comprising the Vegetation RSA are primarily native but have historically experienced anthropogenic disturbance, including forestry, agriculture, and municipal development.

In addition, natural disturbances such as fires and forest pests have the potential to affect Old Growth Forest within the Vegetation RSA. Based on historical data, limited fires are expected to occur within the Vegetation RSA. Fire is estimated to result in approximately 2,800 cubic metres (m³) of lost timber volume in the Bulkley TSA per year (BC MFLNRO 2014b). Assuming an average harvest volume of 275 m³/ha, this translates to 10.1 ha of forest in the Bulkley TSA, and proportionally 0.5 ha (<0.1%) within the Vegetation RSA.

Similarly, historic data suggests that forest pest infestations are likely to be limited within the Vegetation RSA. In 2019, forestry losses in the Bulkley TSA due to mountain pine beetle (*Dendroctonus ponderosa*) totalled 1,979 ha and <600 ha due to the spruce beetle (*Dendroctonus rufipennis*) (Westfall et al. 2019). This translates proportionally to approximately 93 ha (0.2%) and < 28 ha (<0.1%) in the Vegetation RSA, respectively, per year.

These historic and ongoing disturbances, in combination with the residual effects of the Project and reasonably foreseeable future projects and activities are expected to act cumulatively to affect Old Growth Forest in the Vegetation RSA through alteration/loss of vegetation, ecosystems and wetlands, and trace metals deposition on plants and soil.

Of the proposed projects and activities identified in **Table 6.1-1**, most are expected to occur within existing areas of disturbance (e.g., traffic on existing roads, the Telkwa to Smithers Bike Trail within an existing cleared ROW) and are not anticipated to result in the alteration/loss of Old Growth Forest.

Undisturbed forest stands currently classified as mature forests within the Vegetation RSA are expected to transition to Old Growth Forest over time (e.g., within 60 years in the SBS zone and within 170 years within the ESSF zone). Future forestry harvest is expected to occur within areas of commercially merchantable timber, which is anticipated to include both Old Growth Forest and mature forest (i.e., Structural Stages 6 and 7; **Table 6.1-1**). As such, both forest types are considered for this CEA.

Forestry activity is the largest contributor to alteration/loss of Old Growth Forest within the Vegetation RSA. For this CEA, it is assumed that timber harvesting activity will be evenly distributed across the productive timber land base; as such, the amount of forestry activity over the next 52 years is expected to be relative to the current distribution of old and mature forest in the Vegetation RSA within each Landscape Unit and BGC subzone/variant (**Table 6.1-1**). It is also expected that following harvest, cutblocks will be reforested in accordance with provincial stocking standards (BC MFLNRO 2014b).

Although no OGMA's are present within the Vegetation RSA, target non-spatial objectives for old growth retention have been set within the Telkwa and Bulkley Valley Landscape Units and NDTs (see 7.3.2.4). The intent of these objectives is to identify the amount of old forest that will be maintained to address

biodiversity values across the province and clarify the amount of area available for timber harvesting (GovBC 2004b). **Table 6.3-1** identifies these Landscape Units and the estimated disturbance to Old Growth Forest within them due to the Project and reasonably foreseeable future projects and activities. For the purposes of this CEA, these retention targets have been extrapolated from the Landscape Unit level to the Vegetation RSA.

In total, up to 363.8 ha (6.8%) of Old Growth Forest and up to 634.8 ha (4.2%) of mature and Old Growth Forest within the Vegetation RSA is anticipated to be cleared by the Project during Construction. Future forestry activity is additionally expected to contribute to a loss of up to 6,977.0 ha (45.7%) of mature and Old Growth Forest within the Vegetation RSA, assuming future forestry has an equivalent probability of occurring within any portion of the harvestable land base in the Bulkley TSA. It must be noted that these calculations are conservative in nature, and do not account for reforestation and natural forest succession over time, where young and mature forest are expected to transition to mature and Old Growth Forest, respectively, over the course of the Project lifespan (approximately 52 years). Future forestry is expected to comply with biodiversity and Old Growth Forest management objectives under the Provincial Non-Spatial Old Growth Forest Order (GovBC 2004b), the Bulkley LRMP (GovBC 1998), the Telkwa Landscape Unit Plan (GovBC 1999), and the Bulkley Valley Sustainable Resource Management Plan (BC MAL 2005). As such, for all Landscape Unit/NDT combinations, cumulative disturbance is predicted to be within old growth retention targets.

Table 6.3-1: Projected Timber Harvest Within the Vegetation Regional Study Area (RSA)

Landscape Unit	Natural Disturbance Type ¹	BGC Subzone/Variant ²	Baseline Condition (Past + Present)			Projected Area of Timber Harvest to 2073
			Mature and Old Growth Forest (ha)	Proportion of Vegetation RSA (%)	Proportion of Total Mature and Old Growth Forest in Vegetation RSA (%)	Mature and Old Growth Forest (ha)
Bulkley Valley	NDT2	ESSFmc	595.8	1.7	4.0	279.1
	NDT3	SBSdk	3,526.5	9.9	22.2	1548.9
		SBSmc2	1,221.4	3.4	8.1	565.1
Telkwa	NDT2	ESSFmc	2,592.5	7.3	17.2	1200.0
		ESSFmcw	664.4	1.9	4.4	307.0
	NDT3	SBSdk	2,094.1	5.9	13.9	969.8
		SBSmc2	4,548.0	12.7	30.2	2107.1
Total			15,242.7	42.7	100	6,977.0 ⁴

Source: Government of British Columbia (GovBC)] 2004b

Notes: %=percent; BGC=Biogeoclimatic; ha=hectare; RSA=Regional Study Area

1 NDT2 – Ecosystems with infrequent stand-initiating events; NDT3 – Ecosystems with frequent stand-initiating events.

2 ESSFmc=Engelmann spruce subalpine fir zone moist cold subzone, ESSFmcw=Engelmann spruce subalpine fir zone moist cold subzone woodland variant, SBSdk=sub-boreal spruce zone dry cool subzone, SBSmc2=sub-boreal spruce zone moist cold subzone Babine variant

3 The distribution of reasonably foreseeable forestry is assumed to be relative to the current distribution of mature forest within the Vegetation RSA.

4 This conservative estimate does not take into account reforestation or natural forest succession over time, where young and mature forest are expected to transition to mature and Old Growth Forest, respectively, over the course of the Project lifespan (approximately 52 years). In addition, this value overestimates the extent of disturbance, as all future forestry activities are expected to be conducted with consideration of provincial and regional biodiversity and Old Growth Forest management objectives.

Table 6.3-2: Estimated Project Effect on Old and Mature Forest Within the Vegetation Regional Study Area (RSA)

Landscape Unit	Natural Disturbance Type ¹	BGC Subzone/Variant ²	Old Growth Retention Target (%) ³	Minimum Old Growth (%) ⁴	Minimum Mature + Old Growth (%) ⁴	Total Old Growth Forest Area at Baseline	Total Mature + Old Growth Forest Area at Baseline	Change from Baseline Resulting from the Project			
								Old Growth Forest (ha)	%	Mature + Old Forest (ha)	%
Bulkley Valley	NDT2	ESSFmc	>9	N/A	N/A	268.4	595.8	0	0	0	0
	NDT3	SBSdk	>11	10	N/A	807.4	3,526.5	0	0	-73.4	-2.1
		SBSmc2		10	N/A	632.3	1,221.4	0	0	0	0
Telkwa	NDT2	ESSFmc	>9	9	28	693.7	2,592.5	0	0	0	0
		ESSFmcw		9	28	274.4	664.4	0	0	0	0
	NDT3	SBSdk	>11	11	23	246.1	2,094.1	-0.1	<0.1	-40.0	-1.9
		SBSmc2		11	23	2,430.2	4,548.0	-363.7	-15.0	-521.3	-11.5
Total						5,352.6	15,242.7	-363.8	-6.8	-634.8	-4.2

Source: Government of British Columbia (GovBC) 2004b

Notes: >=greater than; %=percent; BGC=Biogeoclimatic; ha=hectare; RSA=Regional Study Area

1 NDT2 – Ecosystems with infrequent stand-initiating events; NDT3 – Ecosystems with frequent stand-initiating events.

2 ESSFmc = Engelmann spruce subalpine fir zone moist cold subzone, ESSFmcw=Engelmann spruce subalpine fir zone moist cold subzone woodland variant, SBSdk=sub-boreal spruce zone dry cool subzone, SBSmc2=sub-boreal spruce zone moist cold subzone Babine variant

3 From the Order Establishing Provincial Non-Spatial Old Growth Objectives (GovBC 2004b).

4 From the Bulkley Land and Resource Management Plan (LRMP) objectives set by government (Integrated Land Management Bureau 2006).

6.3.1.1 Alteration/Loss of Old Growth Forest

The Magnitude of the alteration/loss of Old Growth Forest is expected to be Moderate. Forestry is common on the landscape and is conservatively estimated to result in disturbance to up to 6,977.0 ha (45.7%) of mature and Old Growth Forest within the Vegetation RSA over the next 52 years. It must be noted that these calculations do not account for reforestation or natural forest succession over time, where young and mature forest are expected to transition to mature and Old Growth Forest, respectively, over the course of the Project lifespan (approximately 52 years). In addition, this value overestimates the extent of disturbance, as all future forestry activities are expected to be conducted with consideration of provincial and regional biodiversity and Old Growth Forest management objectives under the Provincial Non-spatial Old Growth Forest Order (GovBC 2004b), the Bulkley Land and Resource Management Plan (GovBC 1998), the Telkwa Landscape Unit Plan (GovBC 1999), and the Bulkley Valley Sustainable Resource Management Plan (BC MAL 2005). The Project is anticipated to contribute to the disturbance of an additional 634.8 ha (4.2%) of mature and Old Growth Forest in the Vegetation RSA.

The cumulative effect is expected to be Regional in Geographic Extent. Loss and alteration of Old Growth Forest is expected to occur throughout the Vegetation RSA.

The Duration of alteration/loss of Old Growth Forest is expected to occur over the Long-term (>52 years) because of the extended time periods required for Old Growth Forest to regenerate following disturbance and reclamation.

The Frequency of the alteration/loss of Old Growth Forest is expected to be Frequent. While loss due to clearing and forestry practices are anticipated to occur infrequently (i.e., harvest will occur as a one (1)-time event at any one location), alteration of Old Growth Forest within the Vegetation RSA by indirect effects such as introduction/proliferation of invasive plants, edge effects, and dust deposition is expected to occur frequently.

The alteration/loss of Old Growth Forest is expected to be Partially Reversible. Old Growth Forest has the potential to regenerate over time after the source of the disturbance has ceased. Once forest harvest has been completed, cutblocks are expected to regenerate over time. However, permanent features on the landscape (e.g., existing roads, the future Telkwa to Smithers Bike Trail) are not expected to revert to native vegetation and will continue to result in indirect effects to adjacent vegetation (e.g., edge effects, dust deposition, introduction/proliferation of invasive plants).

The Context of the cumulative effect of Old Growth Forest is expected to be Moderate. Existing Old Growth Forest within the Vegetation RSA is dominated by established forested ecosystems, which are expected to confer a moderate resilience to stress; however, existing areas of Old Growth Forest within the Vegetation RSA have experienced historic fragmentation and indirect disturbance resulting from cutblocks, roads, and other development.

The cumulative effect of alteration/loss of Old Growth Forest is Likely. Old Growth Forest within the Vegetation RSA is expected to be affected by both Project construction and other projects and activities, including forestry.

Alteration/loss of Old Growth Forest is not expected to result in a change that will alter its integrity within the Vegetation RSA to the point where it is not sustainable or is unavailable to contribute to ecological function. The cumulative effect has been characterized as Moderate in Magnitude, Regional in Geographic Extent, and Long-term in Duration; therefore, the cumulative effect of alteration/loss on the Old Growth Forest subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. While the direct effects of clearing are well known, uncertainty exists with respect to the extent and degree of alteration resulting from edge effects, dust deposition, invasive plants, the resiliency of old growth ecosystems to withstand change, and the regeneration of reclaimed areas into native vegetation communities.

6.3.1.2 Trace Metals Deposition on Old Growth Forest

Trace metals deposition on Old Growth Forest resulting from air emissions and dust deposition caused by vehicle and train traffic is ongoing on roads, railways, and trails within the Vegetation RSA. Additional residual trace metals deposition is predicted to occur during all phases of the Project due to air emissions and dust deposition caused by construction and operation of the Project, as well as vehicle, train and equipment traffic.

The reasonably foreseeable future projects and activities are expected to result in increased air emissions and dust deposition caused by increased vehicle and equipment traffic during construction and operation, as well as vegetation clearing, grading, and soils handling required for Bulbous Toe maintenance and construction of the Pacific Northern Gas Looping Pipeline and the Telkwa to Smithers Bike Trail. Forestry, agriculture, and other activities are expected to add cumulatively to trace metals deposition within the Vegetation RSA through dust deposition and increased vehicle and equipment traffic.

The Magnitude of the cumulative deposition of trace metals on Old Growth Forest is expected to be Low because it is expected to be confined to the boundaries of roads, near areas of active soil disturbance (e.g., the Minesite, the Pacific Northern Gas Looping Pipeline ROW during the Construction Phase), and areas downgradient from the Minesite.

The Geographic Extent of this cumulative effect is expected to be Regional. Although trace metals deposition is expected to be confined to disturbance edges, past, present, and future projects and activities are scattered throughout the Vegetation RSA.

The Frequency of the cumulative deposition of trace metals on Old Growth Forest is expected to be Frequent. Dust deposition, vehicle emissions, and surface water movement are expected to occur frequently during the Construction, Operation, and Decommissioning and Reclamation phases, and infrequently during the Post-closure Phase.

The Duration of cumulative deposition of trace metals on Old Growth Forest is expected to have a Long-term (> 52 years) Duration because of the time periods necessary for trace metals to attenuate in the soil. Timelines for trace metals depletion from the soil vary widely depending on chemistry, from 75 years to over 3,000 years in temperate climates (Kabata-Pendias and Pendias 2001).

Deposition of trace metals on Old Growth Forest is expected to be Fully Reversible. Accumulated trace metals deposited on above-ground plant tissues (e.g., stems, leaves, and twigs) and the attenuation of accumulated trace metals within the soil is expected to be Fully Reversible over the Long-term (>52 years).

The Context of the cumulative effect of trace metals deposition on Old Growth Forest is expected to be Low. Old Growth Forest within the Vegetation RSA have experienced historic fragmentation and indirect disturbance resulting from cutblocks, roads, and municipal development, with existing naturally elevated levels of trace metals such as iron, copper, aluminum, chromium, and arsenic within surface water and groundwater within the Vegetation RSA (**Appendices 4.1-A, 4.7-A**). Thus, it is possible that vegetation may be adapted to naturally elevated trace metals concentrations within the Vegetation RSA.

The cumulative effect of trace metals deposition on Old Growth Forest is expected to be Likely. Dust, air emissions, and surface water runoff resulting in trace metals deposition on Vegetation is expected to occur within the Vegetation RSA.

The cumulative effect of trace metals deposition on Old Growth Forest is not expected to result in a change that will alter the integrity of the Vegetation VC within the Vegetation RSA to the point where it is not sustainable or unavailable to contribute to ecological function. The cumulative effect has been characterised as Low in Magnitude, Regional in Geographic Extent, and Long-term in Duration; therefore, the cumulative effect of trace metals deposition on the Old Growth Forest subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. Uncertainty exists with respect to the type and concentration of trace metals that may be deposited, their bioavailability, the responses of individual vegetation species, as well as the responses of vegetation species and Old Growth Forest communities.

Table 6.3-3: Summary of Cumulative Effects on Old Growth Forest Subcomponent

Cumulative Effects	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effects Characterisation								
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Alteration/Loss	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the Vegetation RSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.5-1 (C, O, D, P).	M	RSA	LT	FF	PR	M	L	NS	M
Trace Metals Deposition	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the Vegetation RSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.5-1 (C, O, D, P).	L	RSA	LT	FF	FR	L	L	NS	M

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure

Magnitude: Low (L), Moderate (M), High (H)

Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA), Beyond Regional (beyond RSA)

Duration: Short-term (ST), Medium-term (MT), Long-term (LT)

Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)

Reversibility: Fully reversible (FR), Partially reversible (PR), Irreversible (IR)

Context: Low (L), Moderate (M), High (H)

Likelihood: Unlikely (UL), Likely (L)

Significance: Not-Significant (NS), Significant (S)

Level of Confidence: High (H), Moderate (M), Low (L)

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table. Includes all existing and reasonably foreseeable projects as outlined in **Table 6.1-1**.

6.3.2 Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens Subcomponents

Wetlands, Listed Ecological Communities, Culturally Important Species, and Rare Plants and Lichens were considered qualitatively together given a lack of available spatial information available for future projects and activities, as well as a lack of information regarding the extent of their residual effects.

Residual effects on Wetlands resulting from the Project were identified and assessed as **Not Significant** in 5.4. Forestry regulations require licensees to limit activities within wetland areas (e.g., Forest Planning and Practices Regulation, BC Reg 14/2004 [GovBC 2004c]), and it is expected that other future projects and activities will comply with this requirement; however, potential cumulative effects on Wetlands may occur due to overlapping edge effects, changes to water quantity/quality, dust deposition, and/or the introduction/proliferation of invasive plants. However, the cumulative effect on Wetlands is expected to be limited and isolated.

Residual effects on Listed Ecological Communities and Rare Plants and Lichens resulting from the Project were identified and assessed as **Not Significant** in 5.4. Two (2) blue-listed species have been historically recorded within the Vegetation RSA: American sweet-flag (*Acorus americanus*) and whitebark pine (*Pinus albicaulis*, BC CDC 2020b), and the potential exists for other occurrences to be present (see 5.4). Forestry regulations require licensees to limit activities within areas supporting Listed Ecological Communities and Rare Plants and Lichens (e.g., *Forest and Range Practices Act*, SBC 2002, c 69 [GovBC 2002c]). As such, the cumulative effect on Listed Ecological Communities and Rare Plants and Lichens is expected to be limited and isolated.

Many terrestrial and wetland ecosystem units support Culturally Important Species. Residual effects on Culturally Important Species resulting from the Project were identified and assessed as **Not Significant** in 5.4. Contributing projects and activities within the Vegetation RSA are anticipated to have mitigation measures in place to reduce vegetation disturbance, including that Culturally Important Species, to the extent practicable. Culturally Important Species are expected to regenerate within disturbed lands that have been reclaimed (e.g., following pipeline reclamation, upon completion of forestry harvest). As such, the cumulative effect on Culturally Important Species is expected to be limited and isolated.

6.3.2.1 Alteration/Loss of Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens

The Magnitude of the alteration/loss of Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to be Moderate. The majority of past, present and reasonably foreseeable projects and activities are predicted to result in relatively low levels of direct and indirect vegetation disturbance; however, forestry is common on the landscape and is expected to continue to contribute to vegetation disturbance within the Vegetation RSA throughout the foreseeable future.

The cumulative effect is expected to be Regional in Geographic Extent. Loss and alteration of Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens occur throughout the Vegetation RSA.

The Duration of alteration/loss of Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to occur over the Long-term (>52 years) because of the extended time periods required for some ecosystems to regenerate following disturbance and reclamation.

The Frequency of the alteration/loss of Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to be Frequent. While vegetation loss due to clearing

and forestry practices are anticipated to occur infrequently, alteration of Vegetation within the Vegetation RSA by indirect effects such as introduction/proliferation of invasive plants, edge effects, and dust deposition is expected to occur frequently.

The alteration/loss of Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to be Partially Reversible. Most of the vegetation, ecosystems and/or wetlands lost or altered within the Vegetation RSA have the potential to regenerate over time after the source of the disturbance has ceased. This is particularly true for forestry activities; once forest harvest has been completed, the cutblocks are expected to regenerate over time. However, permanent features on the landscape (e.g., existing roads, the future Telkwa to Smithers Bike Trail) are not expected to revert to native vegetation and will continue to result in indirect effects to adjacent vegetation (e.g., edge effects, dust deposition, introduction/proliferation of invasive plants).

The Context of the cumulative effect of alteration/loss of Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to be Moderate. Ecosystems within the Vegetation RSA are dominated by established forested ecosystems, which is expected to confer a moderate resilience to stress; however, existing areas of native vegetation within the Vegetation RSA have experienced historic fragmentation and indirect disturbance resulting from cutblocks, roads, and other development.

The cumulative effect of alteration/loss of Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is Likely. Native vegetation is common within the Vegetation RSA, and this is expected to be affected by both Project construction and other projects and activities.

Alteration/loss of Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is not expected to result in a change in these subcomponents that will alter their integrity within the Vegetation RSA to the point where they are not sustainable or is unavailable to contribute to ecological function. The cumulative effect has been characterised as Moderate in Magnitude, Regional in Geographic Extent, and Medium-term in Duration; therefore, the cumulative effect of alteration/loss of vegetation on Wetlands, Listed Ecological Communities, Culturally Important Species, and Rare Plants and Lichens is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. While the direct effects of clearing are well known, uncertainty exists with respect to the extent and degree of alteration resulting from edge effects, dust deposition, invasive plants, the resiliency of Wetlands, Listed Ecological Communities, Culturally Important Species, and Rare Plants and Lichens to withstand change, and the regeneration of reclaimed areas into native vegetation communities.

6.3.2.2 Trace Metals Deposition on Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens

Trace metals deposition on Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens resulting from air emissions and dust deposition caused by vehicle and train traffic is ongoing on roads, railways, and trails within the Vegetation RSA. Additional residual trace metals deposition is expected to occur during all phases of the Project due to air emissions and dust deposition caused by construction and operation of the Project, as well as vehicle, train, and equipment traffic.

The reasonably foreseeable future projects and activities are expected to result in increased air emissions and dust deposition caused by increased vehicle and equipment traffic during construction and operation, as well as vegetation clearing, grading, and soils handling required for Bulbous Toe maintenance and construction of the Pacific Northern Gas Looping Pipeline and the Telkwa to Smithers Bike Trail. Forestry,

agriculture, and other activities are expected to add cumulatively to trace metals deposition within the Vegetation RSA through dust deposition and increased vehicle and equipment traffic.

The Magnitude of the cumulative deposition of trace metals on Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to be Low because it is expected to be confined to the boundaries of roads, near areas of active soil disturbance (e.g., the Minesite, the Pacific Northern Gas Looping Pipeline ROW during Construction), and areas downgradient from the Minesite.

The Geographic Extent of this cumulative effect is expected to be Regional. Although trace metals deposition is expected to be confined to disturbance edges, past, present, and future projects and activities are scattered throughout the Vegetation RSA.

The Frequency of the cumulative deposition of trace metals on Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to be Frequent. Dust deposition, vehicle emissions, and surface water movement are expected to occur frequently during Construction, Operation, and Decommissioning and Reclamation, and infrequently during Post-closure.

The Duration of cumulative deposition of trace metals on Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to have a Long-term (> 52 years) Duration because of the time periods necessary for trace metals to attenuate in the soil. Timelines for trace metals depletion from the soil vary widely depending on chemistry, from 75 years to over 3,000 years in temperate climates (Kabata-Pendias and Pendias 2001).

Deposition of trace metals on Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to be Fully Reversible. Accumulated trace metals deposited on above-ground plant tissues (e.g., stems, leaves, and twigs) and the attenuation of accumulated trace metals within the soil is expected to be Fully Reversible over the Long-term (>52 years).

The Context of the cumulative effect of trace metals deposition on Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to be Low. Vegetated areas within the Vegetation RSA have experienced historic fragmentation and indirect disturbance resulting from cutblocks, roads, and municipal development, with existing naturally elevated levels of trace metals such as iron, copper, aluminum, chromium, and arsenic within surface water and groundwater within the Vegetation RSA (**Appendices 4.1-A, 4.7-A**). Thus, it is possible that vegetation may be adapted to naturally elevated trace metals concentrations within the Vegetation RSA.

The cumulative effect of trace metals deposition on Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is expected to be Likely. Dust, air emissions, and surface water runoff resulting in trace metals deposition on Vegetation is expected to occur within the Vegetation RSA.

The cumulative effect of trace metals deposition on Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens is not expected to result in a change that will alter the integrity of the Vegetation VC within the Vegetation RSA to the point where it is not sustainable or unavailable to contribute to ecological function. The cumulative effect has been characterised as Low in Magnitude, Regional in Geographic Extent, and Long-term in Duration; therefore, the cumulative effect of trace metals deposition on the Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens subcomponents is expected to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. Uncertainty exists with respect to the type and concentration of trace metals that may be deposited, their bioavailability, responses of individual vegetation species, as well as the responses of vegetation species and communities.

Table 6.3-4: Summary of Cumulative Effects on Wetlands, Listed Ecological Communities, Culturally Important Species and Rare Plants and Lichens Subcomponents

Cumulative Effects	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effects Characterisation								
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Alteration/Loss	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within Vegetation RSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.5-1 (C, O, D, P).	M	RSA	LT	FF	PR	M	L	NS	M
Trace Metals Deposition	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the Vegetation RSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.5-1 (C, O, D, P).	L	RSA	LT	FF	FR	L	L	NS	M

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure

Magnitude: Low (L), Moderate (M), High (H)

Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA), Beyond Regional (beyond RSA)

Duration: Short-term (ST), Medium-term (MT), Long-term (LT)

Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)

Reversibility: Fully reversible (FR), Partially reversible (PR), Irreversible (IR)

Context: Low (L), Moderate (M), High (H)

Likelihood: Unlikely (UL), Likely (L)

Significance: Not-Significant (NS), Significant (S)

Level of Confidence: High (H), Moderate (M), Low (L)

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table. Includes all existing and reasonably foreseeable projects as outlined in **Table 6.1-1**.

6.4 Summary of Cumulative Effects Assessment (CEA)

The following residual effects of the Project on the Vegetation VC were carried forward to the CEA:

- ▶ alteration/loss of vegetation, ecosystems, and wetlands; and
- ▶ deposition of trace metals on plants and soil, which can result in uptake to plants.

As detailed in **6.3**, the residual effects of the Project, in conjunction with the comparable residual effects from past, present, and reasonably foreseeable future projects are not expected to alter the integrity of Old Growth Forest, Wetlands, Listed Ecological Communities, Culturally Important Species, and Rare Plants and Lichens were expected to be **Not Significant**. Considering this, the cumulative effects are not expected to alter the integrity of the Vegetation VC within the Vegetation RSA beyond an acceptable level (i.e., it remains sustainable and is available to contribute to ecological function); and are expected to be **Not Significant**.

Future forestry activities are expected to have the greatest contribution to cumulative effects on the Vegetation VC; however, this is expected to be mitigated with the implementation of existing biodiversity and Old Growth Forest. As Forest management objectives under the Provincial Non-Spatial Old Growth Forest Order (GovBC 2004b), the Bulkley Land and Resource Management Plan (GovBC 1998), the Telkwa Landscape Unit Plan (GovBC 1999), and the Bulkley Valley Sustainable Resource Management Plan (BC MAL 2005). As such, the cumulative effect on Vegetation VC is expected to be **Not Significant** (Table 6.4-1).

Table 6.4-1: Summary of Cumulative Effects on Vegetation Valued Component (VC)

VC Subcomponent	Potential Cumulative Effect	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effect (Yes/No)	Significant (Yes/No)
Old Growth Forest	Alteration/loss of vegetation, ecosystems and wetlands	▪ Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) ▪ Reasonably foreseeable developments within the Vegetation RSA as outlined in Table 6.1-1 (C, O, D, P) ▪ Project-related activities that could interact with the above activities, as outlined in Table 5.5-1 (C, O, D, P).	Yes	No
	Trace metals deposition	▪ Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) ▪ Reasonably Foreseeable developments within the Vegetation RSA as outlined in Table 6.1-1 (C, O, D, P) ▪ Project-related activities that could interact with the above activities, as outlined in Table 5.5-1 (C, O, D, P)	Yes	No
Wetlands, Listed Ecological Communities, Culturally	Alteration/loss of vegetation, ecosystems and wetlands	▪ Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P)	Yes	No

VC Subcomponent	Potential Cumulative Effect	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effect (Yes/No)	Significant (Yes/No)
Important Species, and Rare Plants and Lichens		- Reasonably foreseeable developments within the Vegetation RSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.5-1 (C, O, D, P)		
	Trace metals deposition	- Existing activities including: agriculture, forestry, harvesting, and recreation (C, O, D, P) - Reasonably Foreseeable developments within the Vegetation RSA as outlined in Table 6.1-1 (C, O, D, P) - Project-related activities that could interact with the above activities, as outlined in Table 5.5-1 (C, O, D, P)	Yes	No

Notes: C, O, D, P represent Project phases: (C)onstruction, (O)peration, (D)ecommissioning and Reclamation, (P)ost-closure
RSA=Regional Study Area; VC=Valued Component

See **Table 5.1-2** for list of applicable activities for each listed Project phase, unless otherwise noted in this table. Includes all existing and reasonably foreseeable projects as outlined in **Table 6.1-1**.

7. SUMMARY OF EFFECTS ASSESSMENT FOR VEGETATION VALUED COMPONENT (VC)

The following potential effects to the Vegetation VC and associated subcomponents (i.e., Old Growth Forest, Wetlands, Listed Ecological Communities, Culturally Important Species, and Rare Plants and Lichens) could occur due to interactions with the Project:

- ▶ alteration/loss of vegetation, ecosystems, and wetlands; and
- ▶ deposition of trace metals on plants and soil, which can result in uptake by plants.

Mitigation measures employed during all Project phases will reduce potential effects on the Vegetation VC; however, these effects are not anticipated to be fully mitigated and residual effects are anticipated to result from the Project during Construction, Operation, Decommissioning and Reclamation, and Post-closure phases.

These Project residual effects on Old Growth Forest, Wetlands, Listed Ecological Communities, Culturally Important Species, and Rare Plants and Lichens are expected to be **Not Significant**. Considering this, the Project effects are not expected to alter the integrity of the Vegetation VC within the Vegetation RSA beyond an acceptable level (i.e., it remains sustainable and is available to contribute to ecological function); and are expected to be **Not Significant**.

These Project residual effects were carried forward to the CEA and assessed in relation to their overlap in space and time with the residual effects of other projects and activities. The residual effects of the Project, in conjunction with the comparable residual effects from all past, present, and reasonably foreseeable future projects are not expected to alter the integrity of the Vegetation VC within the Vegetation RSA beyond an acceptable level (i.e., it remains sustainable and is available to contribute to ecological function). Future forestry activities are expected to have the greatest contribution to cumulative effects on the Vegetation VC; however, this is expected to be mitigated with the implementation of existing provincial and regional biodiversity and Old Growth Forest management objectives. As such, the cumulative effect on the Vegetation VC is expected to be **Not Significant**.

8. FOLLOW-UP STRATEGY

Adaptive management is a structured decision-making approach to reduce uncertainty over time via system monitoring. In the present context, the purpose of monitoring and adaptive management is to further quantify and qualify Project effects (if/where necessary), assess the effectiveness of mitigation measures, provide a mechanism for modification and/or adaptation, identify new problems (should they arise), and implement additional mitigation (if/where applicable), including triggers, corrective actions and regulatory implications.

This chapter has characterised residual effects of the Project on the Vegetation VC and cumulative effects as being **Not Significant** with a Moderate Level of Confidence. Targeted monitoring and inspection will be undertaken during Construction to verify that mitigation measures to reduce effects to Vegetation have been appropriately applied, maintained, adapted, and removed, where necessary. Environmental inspectors (onsite monitors) will be present during the Construction Phase to verify compliance and evaluate the success of mitigation measures outlined in 5.3, management plans in S13.0 of the **EAC Application**, and applicable approval conditions.

No Rare Plants or Lichens were observed during baseline vegetation surveys (see 4.2.5); however, should occurrences of Rare Plants or Lichens be identified in within the Vegetation LSA at any point during the lifetime of the Project, these occurrences will be visited by a qualified vegetation ecologist during a biologically appropriate time of year to confirm identification and conservation status, delineate the extent of the occurrence, and develop site-specific mitigation measures to protect the occurrence during all Project Phases.

Project monitoring and adaptive management plans specific to the Vegetation VC include:

- ▶ Vegetation and invasive plants will be routinely monitored throughout the life of the Project in accordance with the **VMP**;
- ▶ Soil monitoring during salvaging and stockpiling activities will be undertaken (**S4.0-C2**);
- ▶ Progressive reclamation and revegetation of disturbed areas will be monitored in accordance with the **RCP**; and
- ▶ Metals monitoring will be employed to understand metals uptake in plants in accordance with the **VMP**.

Monitoring of Parameters of Potential Concern/Contaminants of Potential Concern (POPC/COPC) and Parameters of Concern/Contaminants of Concern (POC/COC) identified for aquatic life, wildlife, terrestrial vegetation, human health, and land uses will be conducted for soils, vegetation, sediment, and surface and groundwater.

Where mitigation measures are not deemed to be successful, adaptive management techniques will be employed. Findings during monitoring, as well as revised BMPs, improved scientific methods, and regulatory changes will be incorporated into the environmental management plans (e.g., **VMP**) to reduce effects during the lifetime of the Project. Key stakeholders, Indigenous groups, and government agencies will be involved in developing mitigation and adaptive management measures where applicable.

In consideration of the findings of the environmental assessment, the proposed management plans and monitoring, and the adaptive management approach, it was deemed that Vegetation VC-specific follow-up programs (i.e., to verify the accuracy of the residual effects and cumulative effects predictions) were not warranted at this time.

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