BC EAO EAC Application – Tenas Project

Section 4.0 Environmental Effects Assessment
Chapter 5 Aquatic Resources Valued Component

May 2022

VERSION 1.0

Submitted to:	BC Environmental Assessment Office
Pursuant to:	*Environmental Assessment Act,* S.B.C. 2002, c.43
Submitted by:	Telkwa Coal Limited Suite 1410 – 409 Granville Street Vancouver, BC V6C 1T2

Tenas Project

Section 4.0 Environmental Effects Assessment
Chapter 5 Aquatic Resources Valued Component

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Abbreviations and Acronymns

Abbreviation or Acronym	Long form of Abbreviation or Acronym
AIR	Application Information Requirements
AQMP	Air Quality Management Plan (S13.0-C2)
ARD	acid rock drainage
BACI	Before-After-Control-Impact
BAT	best available technologies
BC	British Columbia
BC AWQG	British Columbia Approved Water Quality Guidelines
BC CDC	British Columbia Conservation Data Centre
BC EAO	British Columbia Environmental Assessment Office
BC MECCS	British Columbia Ministry of Environment and Climate Change Strategy
BC MEMLI	British Columbia Ministry of Energy, Mines and Low Carbon Innovation
BC MFLNRO	British Columbia Ministry of Forests, Lands, Natural Resource Operations, and Resource Development
BC WWQG	British Columbia Working Water Quality Guidelines
BGC	Biogeoclimatic
Biologica	Biologica Environmental Services Ltd.
BMPs	best management practices
C	Chapter
CABIN	Canadian Aquatic Biomonitoring Network
CEA	cumulative effects assessment
CCME	Canadian Council of Ministers of the Environment
CEMP	Construction Environmental Management Plan (S13.0-C4)
CMSTHP	Chemicals and Materials, Storage, Transfer, and Handling Plan (S13.0-C3)
CPP	Coal Processing Plant
Crossroads	Crossroads Cultural Resource Management
CUS	Cultural Use Study
DFO	Department of Fisheries and Oceans Canada
DMP	Discharge Management Plan (S13.0-C5)
EA	environment assessment
EAA	*Environmental Assessment Act,* SBC 2002, c 43 (Government of British Columbia [GovBC] 2002)
EAC	Environmental Assessment Certificate
ECCC	Environment and Climate Change Canada
EDP	Effluent Discharge Permit
EMA	*Environmental Management Act*, SBC 2003, c. 53 (Government of British Columbia [GovBC] 2003)

Abbreviation or Acronym	Long form of Abbreviation or Acronym
EMP	Explosives Management Plan (S13.0-C6)
EPT	Ephemeroptera, Plecoptera, and Trichoptera
FMSCP	Fuel Management and Spill Control Plan (S13.0-C7)
FSRs	Forest Service Roads
IFA	Instream Flow Assessment
IFM	Instream Flow Methods
GovBC	Government of British Columbia
GovCan	Government of Canada
LSA	Local Study Area
MA/EMA	*Mines Act,* RSBC 1996, c 293, and *Environmental Management Act,* SBC 2003, c 53
MERP	Mine Emergency Response Plan (S13.0-C9)
ML	metal leaching
ML/ARDMP	Metal Leaching (ML)/Acid Rock Drainage (ARD) Management Plan (S13.0-C12)
MWMP	Minesite Water Management Plan (S13.0-C11)
non-PAG	non-potentially acid generating
OW	Office of the Wet’suwet’en
PAG	potentially acid generating
POC/COC	Parameters of Concern/Contaminants of Concern
POPC/COPC	Parameters of Potential Concern/Contaminants of Potential Concern
Project	Tenas Project
RCP	Reclamation and Closure Plan (S13.0-C15)
RGS	Regional Geochemistry Survey
ROM	run-of-mine
RSA	Regional Study Area
S	Section
SBEB	scientifically-based environmental benchmark
SEPSCP	Surface Erosion Prevention and Sediment Control Plan (S13.0-C17)
SPOs	site performance objectives
SSWQO	site-specific water quality objective
TAC	Tenas Access Corridor
TARP	Trigger Action Response Plan
TCL	Telkwa Coal Limited
TK	Traditional Knowledge
TOC	total organic carbon
TSA	Timber Supply Area
TSS	total suspended solids

Abbreviation or Acronym	Long form of Abbreviation or Acronym
VC	Valued Component
VMP	Vegetation Management Plan (S13.0-C1)
WQG	water quality guidelines
WMP	Wildlife Management Plan (S13.0-C21)
WMPRE	Waste Management Plan for Refuse and Emissions (S13.0-C20)

Units of Measure

Abbreviation or Acronym	Long form of Abbreviation or Acronym
<	less than
>	greater than
%	percent
cm	centimetre
chl a	chlorophyll a
cm^2	square centimetres
ha	hectare
km	kilometre
kV	kilovolt
µg chl a/cm^2	micrograms of chlorophyll a per square centimetre
µm	mircrometre
mg/kg	milligram per kilogram
mm	millimetre
V	volt

EXECUTIVE SUMMARY

This chapter addresses the potential effects of the Tenas Project (Project) on the Aquatic Resources Valued Component (VC). Aquatic Resources were selected as a VC based on the likelihood of interaction with the Project and due to the importance of aquatic resources in supporting and indicating aquatic ecosystem health for humans, wildlife, and fish. Because of their short life-cycles, phytoplankton and periphyton are among the first organisms to respond to environmental change, and can exhibit taxon-specific responses to stressors, making them good indicators of prevailing environmental conditions.

Indicators for the Aquatic Resources VC include:

- change in composition, abundance, diversity of periphyton and benthic invertebrates; and
- change in concentrations of Parameters of Potential Concern/Contaminants of Potential Concern (POPC/COPC) or Parameters of Concern/Contaminants of Concern (POC/COC) in sediments relative to toxicological benchmarks.

Potential Project effects on the Aquatic Resources VC include:

- changes in water quality: changes in water quality due to release of sediments, mine contact water, blast residues, and flow alterations;
- changes in sediment quality: changes in sediment quality due to releases of sediments, mine contact water, blast residues, and flow alterations; and
- change in the abundance and community structure of periphyton and benthic invertebrates.

Change in water quality relevant to the Project can be caused by diversions, sediment releases associated with construction activities, and discharges of contact and non-contact water. Sediment quality can be altered by Project activities through changes in the chemistry of sediments. Sediment chemistry can be an indicator of long-term patterns in water quality because sediment particles adsorb water constituents. Potential changes to periphyton and benthic invertebrate abundance and community structure are closely linked to potential changes in surface water quality and sediment quality. Discharges of Minesite contact water into watercourses downstream of the Project have the potential to increase the concentration of water quality parameters that could cause toxicity (either lethal or sub-lethal effects) to periphyton and benthic invertebrates.

The Project will be developed to design-specifications to avoid, minimize, and offset potential effects on the Aquatic Resources VC during all Project phases. Project activities have been planned and sequenced to avoid watercourses and sensitive aquatic habitats 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 Aquatic Resources VC during Project phases.

After mitigations the only predicted residual effect are predicted changes in water quality. Project residual effects on the Aquatic Resources VC are expected to be **Not Significant**. Considering this, the Project effects are not expected to alter the productivity and viability of the Aquatic Resources VC nor their ability to support healthy aquatic ecosystems within the Regional Study Area (RSA).

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 RSA (past, present and reasonably foreseeable future projects), it was determined while there is potential for present and reasonably foreseeable future projects (specifically forestry activities), cumulative effects on the Aquatic Resources VC are rated as **Not Significant**. The Level of Confidence for these predictions is High.

1. INTRODUCTION

The Aquatic Resources Valued Component (VC) examines potential environmental effects of the Project on aquatic resources in watercourses potentially affected by the Tenas Project (Project). Activities associated with the Construction, Operation, Decommissioning and Reclamation, and Post-closure phases of the Project have the potential to affect aquatic resources through changes in water quality and the concentrations of contaminants in sediments that may affect the abundance, diversity, richness, and evenness of benthic invertebrates and periphyton.

This chapter examines potential effects of the Project on sub-basins of the Telkwa River Watershed in which the Project is located (Goathorn Creek, Four Creek, and Tenas Creek), as well as the potentially affected areas of the Telkwa River mainstem and the Bulkley River downstream.

This assessment is comprised of the following subsections:

- **Regulatory Context:** This subsection describes the regulatory framework relevant to the Aquatic Resources VC;
- **Scope of the Assessment:** The VC selection process is described. Following the confirmation of the Aquatic Resources as a VC and indicators for the VC are selected, and assessment boundaries for the analysis are established;
- **Existing Conditions:** A description of the baseline studies undertaken for the Project, other relevant information, and descriptions of the Aquatic Resources VC within the defined spatial boundaries;
- **Assessment of Project-related Effects:** Potential interactions between the Project and the Aquatic Resources VC are identified and evaluated to determine the potential for those interactions to result in adverse effects. Mitigation measures to eliminate, reduce, or control the potential adverse Project effects are outlined. Residual effects are then characterised and their significance determined;
- **Cumulative Effects Assessment (CEA):** Cumulative effects on the Aquatic Resources VC are described, considering the adverse residual effects of the Project in combination with the adverse residual effects of past, present, and reasonably foreseeable future projects, and activities. Additional mitigation measures to eliminate, reduce, or control cumulative effects are outlined. Cumulative effects are then characterised and their significance determined; 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 Aquatic Resources VC.

2. REGULATORY CONTEXT

Provincial and federal regulations and policies relevant to the Aquatic Resources VC are discussed in **Section (S) 4.0-Chapter (C) 3 Surface Water VC**. These regulations and policies are considered in the assessment of the Aquatic Resources VC. In addition, the assessment includes the consideration of the provincial guidelines for periphyton biomass for the protection of aquatic life (BC MECCS 2020) and the federal and working provincial sediment quality guidelines for the protection of aquatic life (BC MECCS 2019, CCME 2019).

The Application Information Requirements (AIR) for the Project, approved by the British Columbia Environmental Assessment Office (BC EAO) in 2022, outlines the requirements of the Aquatic Resources VC effects asssessment to meet provincial environment assessment (EA) requirements under the *Environmental Assessment Act,* SBC 2002, c 43 (Government of British Columbia [GovBC] 2002) (*EAA*).

Water withdrawls for the Project are expected to be subject to the provincial *Water Sustainability Act,* SBC 2014, c 15. (GovBC 2014) via a license for the use of surface or groundwater. The Project is expected to be subject to the federal *Species at Risk Act*, SC 2002, c. 29 (Government of Canada [GovCan] 2002), and *Fisheries Ac*t, RSC, c. F-14 (GovCan 1985) via the future Coal Mining Effluent Regulations which are currently in development (GovCan 2021), as well as the provincial *Environmental Management Act*, SBC 2003, c. 53 (GovBC 2003) (*EMA*); via a Waste Discharge Authorization (permit).

In the British Columbia (BC) provincial jurisdiction, "end-of-pipe" limits for discharge of excess water to the environment may be specified in an Effluent Discharge Permit (EDP) issued by the British Columbia Ministry of Environment and Climate Change Strategy (BC MECCS) under the provincial *EMA,* in addition to established surface Water Quality Guidelines (WQG) for receiving environments. In advance of an EDP, the long-term average BC Approved Water Quality Guidelines (BC AWQG) (BC MECCS 2019) and the BC Working Water Quality Guidelines (BC WWQG) (BC MECCS 2020) for freshwater aquatic life were applied for the evaluation of results from the load balance. Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME WQG) (CCME 2014) are applied for parameters for which there is no BC AWQG or BC WWQG established.

The Coal Mining Effluent Regulations are expected to specify "end-of-pipe" limits for total suspended solids (TSS), nitrate, and selenium for new coal mines. In advance of the regulations, Project-specific end-of-pipe limits have been proposed to meet the in-stream WQG in the receiving environment.

Additional documents and guidelines used to identify and describe applicable provincial and federal legislation, policies, BMPs and guidance documents related to the Aquatic Resources VC include:

- *Canada Water Act*, RSC., 1985, c. C-11 (GovCan 1985a);
- *Fisheries Act,* RSC., 1985, c. F-14 (GovCan 1985b);
- Canadian Environmental Protection Act, SC., 1999, c.33 (GovCan1999);
- *Mines Act,* RSBC 1996. c. 293 (GovBC 1996);
- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (British Columbia Ministry of Environment [BC MOE] 2016);
- Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CCME 2019);
- Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota (CCME 2001);
- British Columbia Approved Water Quality Guidelines (BC MECCS 2019);

- British Columbia Conservation Data Centre (BC Conservation Data Centre [BC CDC] 2021);
- British Columbia Field Sampling Manual (BC MOE 2013);
- Fish and Fish Habitat Protection Policy Statement (DFO 2019); and
- Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (Price et al, 1998).

The following references presented in the AIR were reviewed for applicability, but were determined to not be relevant to the Aquatics Resources VC so were not used:

- Manual of British Columbia Hydrometric Standards (BC MECCS 2018): hydrometric surveying was not conducted for the Aquatic Resources VC. These standards were used in the Surface Water VC (S4.0-C3); and
- *Riparian Areas Protection Act,* SBC 1997 c. 21 (GovBC 1997): this Act applies to industrial developments within municipalities and regional districts in southern BC. The *Water Sustainability Act,* SBC 2014, c 15. (GovBC 2014) is the relevant provinical Act that determines how activiities in and around water must occur.

3. Scope of the Assessment

The assessment of the Aquatic Resources VC, including the assessment of Project-related effects and cumulative effects, was conducted according to the methods set out in **S3.0 Assessment Methodology** of this **Environmental Assessment Certificate (EAC) Application**. The assessment boundaries specific to the Aquatic Resources VC are provided in **3.2.4 Assessment Bondaries** and the characterisation criteria specific to the Aquatic Resources VC are provided at the start of **5.4 Residual Effects and Significance of Residual Effects**.

This subsection outlines the scope of the assessment, including the rationale for the inclusion of Aquatic Resources as a VC, the selection of indicators, and the definition of spatial and temporal boundaries. The assessment is informed by the **Tenas Project 2017 to 2019 Baseline Report (Appendix 4.1-C** of **4.0 Atmospheric Resources VC** of the **EAC Application)**, as well as input from Indigenous groups, the public and government agencies through working groups and comment solicitation, which identified the importance of the Aquatic Resources VC.

3.1 Issues Scoping

Telkwa Coal Limited (TCL) has undertaken an engagement and consultation process to support the scoping of issues for the Project (refer to **S11.0 Wet'suwet'en Rights and Interests Assessment** and **S12.0 Public Consultation** of this **EAC Application** for details). This consultation and engagement process has included technical working groups established with Indigenous groups and 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.

Key themes of interest identified through the consultation and engagement procees, and information review related to Aquatic Resources were:

- design details of proposed infrastructure near waterbodies;
- selenium baseline studies;
- water quality, water quantity, and water use;
- acid rock drainage (ARD) mitigation measures;
- dust mitigation measures; and
- aquatic life and aquatic habitats.

3.2 Rationale for Selection of Aquatic Resources Valued Component (VC)

The Aquatic Resources VC was selected during the pre-application phase of the Project following the VC selection process set out in **S3.0-C1 Assessment Methodology** and using the methodology provided in the Guideline for Selection of Valued Components and Assessment of Potential Effects (BC EAO 2013). The goal was to focus the assessment on relevant issues, concerns, and components of the natural and human environment that may be affected by the Project.

Baseline study findings, review of applicable government legislation and policies, effects assessments for other relevant projects, professional judgement, 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 associated subcomponents (where applicable).

3.2.1 Valued Componnent (VC)

Aquatic Resources was selected as a VC because aquatic organisms are sensitive to the environmental effects of the Project and they are vital in sustaining healthy aquatic ecosystems, and based on the likelihood of interaction with the Project. The assessment of environmental effects on the Aquatic Resources VC provides an indication of potential effects at the population and community levels for periphyton and benthic invertebrates. Many aquatic organisms have known responses to metals, nutrients and suspended sediments typically associated with mining operations. Because of their short life-cycles, phytoplankton and periphyton are among the first organisms to respond to environmental change, and can exhibit taxon-specific responses to stressors, making them good indicators of prevailing environmental conditions. Periphyton community composition is also used as an indicator of biotic integrity and ecosystem health (Hill et al. 2000). Sediment quality has been considered in the assessment as well, and will be an important monitoring component.

The Aquatic Resources VC is based on benthic invertebrates, periphyton, and sediment quality. Aquatic Resources VC support (i.e., are inputs to) and/or are dependent on the assessment of several VCs:

- **Dependent on:**
  - **Atmospheric Environmnent VC (S4.0-C3)** – Atmospheric environment interacts with aquatic environements through air quality and dust deposition, which can affect water quality;
  - **Terrain and Soils VC (S4.0-C2)** – Terrain and soils interact with aquatic environments by contributing to riparian form and function, ecosystem moisture and groundwater inputs to aquatic ecosystems;
  - **Surface Water VC (S4.0-C3)** – Surface water, by its nature, is the primary component of aquatic resources;
  - **Groundwater VC (S4.0-C4)** – There are potential connections between groundwater and surface water, and surface water is a primariy component of aquatic resources;
- **Supporting:**
  - **Fish and Fish Habitat VC (S4-C6)** – Aquatic resources are a major contributor to nutrient cycling in aquatic ecosystems, are important as a food source for fish, and are indicators of environmental change in fish-bearing watercourses and waterbodies;
  - **Vegetation VC (S4.0-C7)** – Aquatic enrvironments are an important component for healthy aquatic and wetland vegetation;.
  - **Avian Species VC (S4.0-C9)** – Waterfowl and other birds depend on water and aquatic environments for portions of their life cycles;
  - **Wildlife VC (S4.0-C8)** – Wildlife waterfowl depend on water and aquatic environments for portions of their life cycles; and
  - **Human Health VC (S8.0-C1)** – Fish living in aquatic environments are harvested for food in Indigenous, recreational, and commercial fisheries. Water quality and aquatic ogranisms can take up and pass on toxins to fish and consquequently to humans.

See **Table 3.2-1** for a summary of rationale for selection of the VC and its linkages.

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

VC	Rationale for Inclusion	Source of Information	VC Linkages	
Aquatic Resources	Aquatic organisms are sensitive to the environmental effects of the Project and they are vital in sustaining healthy aquatic ecosystems. Project activities have the potential to change water quality, sediment quality, and periphyton and benthic invertebrate communities.	▪ *Fisheries Act*, RSC, c. F-14 (Government of Canada [GovCan] 1985) ▪ *Species at Risk Act*, SC 2002, c 29 (GovCan 2002) (*SARA)* ▪ *Water Sustainability Act,* SBC 2014, c. 15 (Government of British Columbia [GovBC] 2014) ▪ Issues scoping	**Dependent on:** ▪ Atmospheric Environmnent ▪ Terrain and Soils ▪ Surface Water ▪ Groundwater	**Supporting:** ▪ Fish and Fish Habitat ▪ Vegetation ▪ Avian Species ▪ Widlife ▪ Human Health

3.2.2 Subcomponents

Aquatic Resources are assessed as a VC without any subcomponents.

3.2.3 Indicators

Indicators are quantitative or qualitative measures that alone, or in combination with other measurable parameters, provide evidence of ecosystem quality, or reliable evidence of the trends or changes in quantity or quality of the environment. **Table 3.2-2** describes the indicators used to quantitatively or qualitatively assess potential Project and cumulative effects on the Aquatic Resources VC.

Table 3.2-2: Indicators for Aquatic Resources Valued Component (VC)

Indicator	Rationale for Selection
Change in composition, abundance, diversity of periphyton and benthic invertebrates	Tenas Project (Project) activities havethe potential to alter the abundance and composition of aquatic organisms in watercourses near and downstream of the Project which may indicate a change in the overall health of the aquatic system.
Change in concentrations of contaminants of potential concern in sediments relative to toxicological benchmarks	Project activities have the potential to alter the levels of contaminants in watercourses near and downstream of the Project which may indicate a change in the overall health of the aquatic system.

3.2.4 Assessment Boundaries

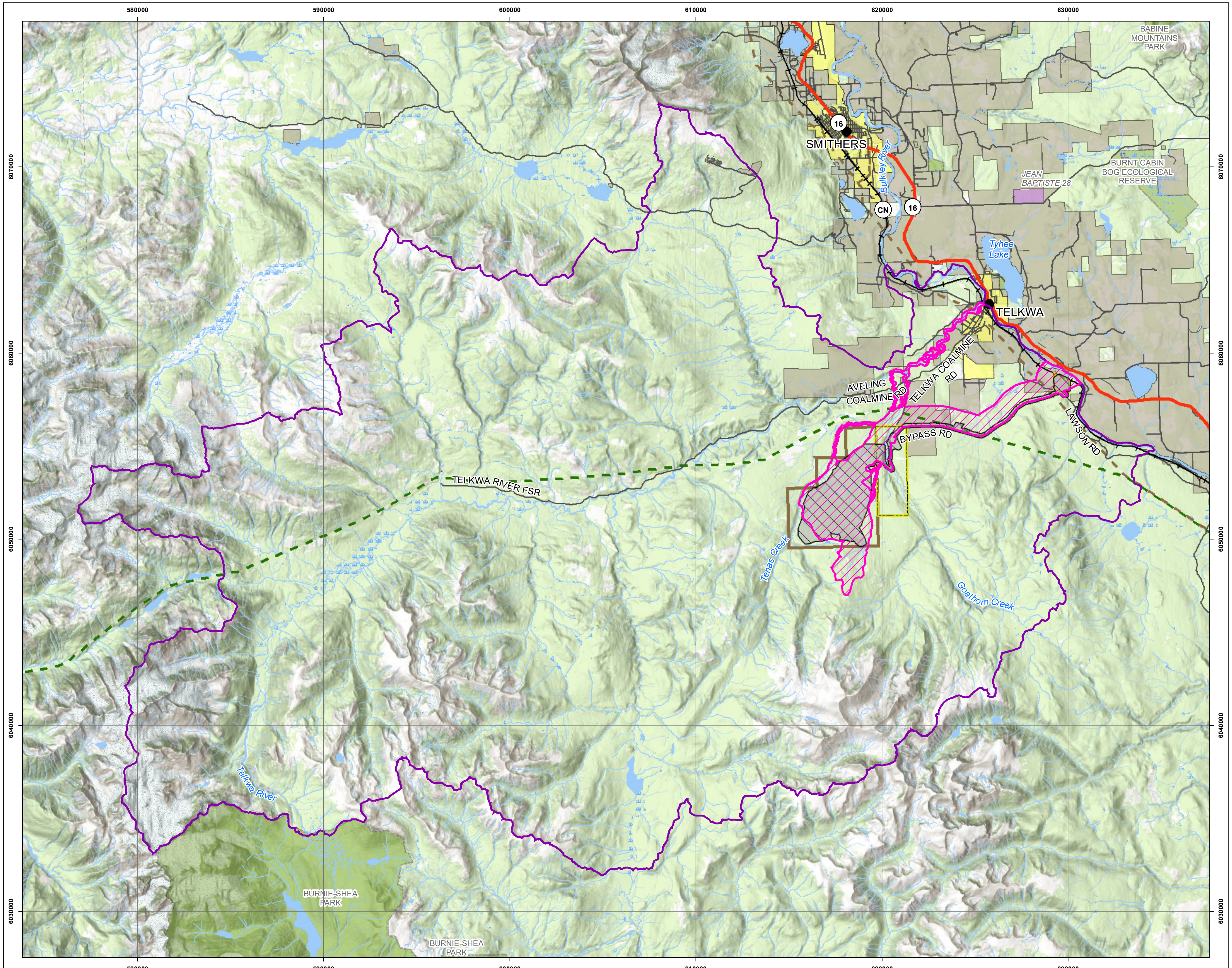
The spatial and temporal boundaries encompass the area within, and times during which, the Project is expected to interact with the Aquatic Resources VC. The administrative and technical boundaries represent any constraints that may be placed on the assessment due to political, social, and economic realities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

3.2.4.1 Spatial Boundaries

The spatial boundaries for the Aquatic Resources VC are described in **Table 3.2-3** and shown on **Figure 3.2-1**. The Local Study Area (LSA) includes instream and riparian areas that are likely to be influenced by Project-related habitat disturbance, water quality effects, flow alteration effects, and sedimentation. The Regional Study Area (RSA) includes those instream and riparian areas in which Project-related effects can potentially interact with effects from other projects. The Aquatic Resources 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 Boundary Definitions for the Aquatic Resources VC

Spatial Boundary	Description of Study Area
Local Study Area (LSA)	Aquatic habitats within the Tenas Project (Project) footprint; areas of Four Creek, Tenas Creek, and Goathorn Creek downstream of the Minesite footprint; and from 100 metre (m) upstream to 300 to1,000 m downstream on watercourses crossed by the proposed haul road.
Regional Study Area (RSA)	Aquatic habitats of the Telkwa River watershed and in tributaries to the Bulkley River crossed by the proposed Bypass Road.



Tenas Project

Aquatic Resources Local and Regional Study Areas

Legend

- Aquatic Resources and Fish and Fish Habitat Local Study Area
- Aquatic Resources and Fish and Fish Habitat Regional Study Area
- City/Town
- Rail Line
- Highway
- Road
- 138 kV Transmission Line
- 500 kV Transmission Line
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- First Nation Reserve
- Municipal Area
- General Private Property
- Tenas Coal Licenses
- Telkwa Coal Limited Private Property
- Project 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, April 21, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Base

N

1:200,000

0 2 4 6 8 10

Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

103260-04	Production Date: Sep 09, 2021	Figure 3.2-1

TELKWA COAL LIMITED

Hemmera An Ausenco Company

3.2.4.2 Temporal Boundaries

As described in **S3.0-C1-3.2** of the **EAC Application**, the temporal boundaries for the assessment of Project-related effects on the Aquatic Resources VC encompass the time periods during which the Project is expected to interact with the Aquatic Resources VC. These include Construction, Operation, Decommissioning and Reclamation, and Post-closure phases. See **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 Project is located in the Bulkley Timber Supply Area (TSA) within the BC MECCS Skeena Regional District. Location within BC MECCS regional districts determines the terms and conditions for *WSA* changes in and about a stream, as well as timing for windows of least risk for instream works. Within the Skeena

Regional District, least risk windows are further refined by their location with specific TSAs, and in the case of the Project, the Bulkley TSA.

3.2.4.4 Technical Boundaries

Technical boundaries refer to the limitations of the assessment imposed by the availability of data and the measurability of an effect. There are no technical boundaries identified for the Aquatic Resources VC.

4. Existing Conditions

The information in this subsection provides a summary of baseline studies completed to characterise existing conditions for the Aquatic Resources VC. It provides the context for the effects assessment for the Aquatic Resources VC, based on Traditional Knowledge (TK), literature reviews, desktop studies, and baseline field surveys undertaken for the Project between 2017 and 2020. Baseline information to support the Aquatic Resources VC is described more fully in **Appendix 4.1-C Tenas Project 2017 to 2019 Baseline Report** of **S4.0-C1 Atmospheric Environment VC** of the **EAC Application** (hereafter referred to as **Appendix 4.1-C**).

4.1 Background Information and Studies

4.1.1 Traditional Knowledge (TK)

The Aquatic Resources LSA and RSA are situated within the Wet'suwet'en Traditional Territory. TK for the Project was obtained through a review of publicly available information as well as the **Cultural Use Study (CUS)** which is presented in **Appendix 7.1-B** of **S7.0-C1 Heritage Resources VC** of the **EAC Application**) which compiled a baseline inventory of cultural heritage resources pertaining to Wet'suwet'en communities by examining pre-existing cultural, social, historic, and economic data.

The recognition of the value of the natural environment, including water, is intrinsic throughout the CUS:

> *"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 (Morris et al. 2006:27; OW 2013a:14) … [*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.* (OW 2011:111)" (Crossroads Cultural Resource Management [Crossroads] 2021)

TK specific to the Aquatic Resources VC (i.e., aquatic organisms) was not reported, but water and fish are important to Wet'sewet'en culture and history, and watercourses potentially affected by the Project contain aquatic organisms that sustain fish species comprising local and regional fisheries:

> *"The health of watersheds and waterways is just as important to Wet'suwet'en culture as the health of dry land. Both land and water are integral to the feast system, which in turn is integral to Wet'suwet'en culture and collective identity (OW 2011:13,110* in Crossroads 2021)*. Given their provision of salmon, some culturally important waterways in the Regional Study Area are the Bulkley and Telkwa Rivers."* (Crossroads 2021)

Potential Project-related effects to water and fish are discussed in **S4.0-C3 Surface Water VC**, **S4.0-C4 Groundwater VC,** and **S4.0-C6 Fish and Fish Habitat VC**.

4.1.2 Scientific and Other Information

Baseline studies began with a literature review of the available information on the freshwater environment in the watercourses potentially affected by the Project. Information sources reviewed included public sources of aquatic resources data and historical reports. See **Table 4.1-1**. Data were reviewed for quality (e.g., technical quality and age of data), relevance (i.e., geographic), and compliance with requirements for EA and for *Mines Act*, RSBC 1996, c. 293 (GovBC 1996) permit applications.

The following information was consulted to support the assessment:

- A Benthic Invertebrate Index of Biological Integrity for Streams in the Bulkley TSA: Field Season 2002 (Bio Logic Consulting 2003);
- A Multimetric Approach to Skeena Region Stream Assessments (Bio Logic Consulting 2005);
- Assessment of Benthic Invertebrate and Juvenile Fish Populations in Goathorn and Tenas Creeks and the Lower Telkwa River, September 1983 (Bustard 1984) **(Appendix 4.5-A)**;
- Telkwa Coal Project Aquatic Resource Assessment. Prepared by D. Bustard and Associates for the Telkwa Coal Project: Smithers, BC. (Bustard 1985) **(Appendix 4.5-B)**;
- Canadian Aquatic Biomonitoring Network (CABIN) database (GovBC n.d. a) including:
  - CABIN - Benthic Invertebrates:
    - Tenas Creek, 2000 and 2006;
    - Goathorn Creek approximately 80 m upstream of Tenas Creek confluence; 2000, 2004, and 2006;
    - Bulkley River at Smithers; 2016;
    - Bulkley River downstream of Smithers; 2007;
- Environmental Monitoring System - Periphyton biomass. (GovBC n.d. b);
- Bulkley River upstream from Smithers Sewage (400434); 1987 to 1992, 2012;
- Bulkley River initial dilution zone at Smithers (400435); 1987 to 1992, 2012;
- Report to Stephen Day BC Research Selenium Results (Frontier Geosciences Inc. 1999);
- Regional Geochemistry Survey (RGS):
  - Till Geochemistry and Clast Lithology Studies of the Bulkley River Valley, West-Central British Columbia (parts of NTS 093L). Geoscience BC 2008-012 (Stumpf 2012); and
  - Quest-West Project Sample Reanalysis. Geoscience BC 2009-05 (Geoscience BC 2009).

4.1.3 Baseline Studies

Baseline studies to support the Aquatic Resources VC were designed to supplement historical data and provide current, robust data for watercourses potentially affected by the Project as well as reference sites in near-field, mid-field, and far-field locations. Study design was based on methods recommended in the Metal Mining Technical Guidance for Environmental Effects Monitoring (Environment Canada [EC] 2012c), in order to obtain baseline data suitable for use in a Before-After-Control-Impact (BACI) monitoring program after mine development.

Baseline programs occurred between 2017 and 2020 and are listed in **Table 4.1 1.** Three (3) types of sampling programs were completed to characterise aquatic habitats and organisms. **Figure 4.1-1** shows locations where surveys were carried out.

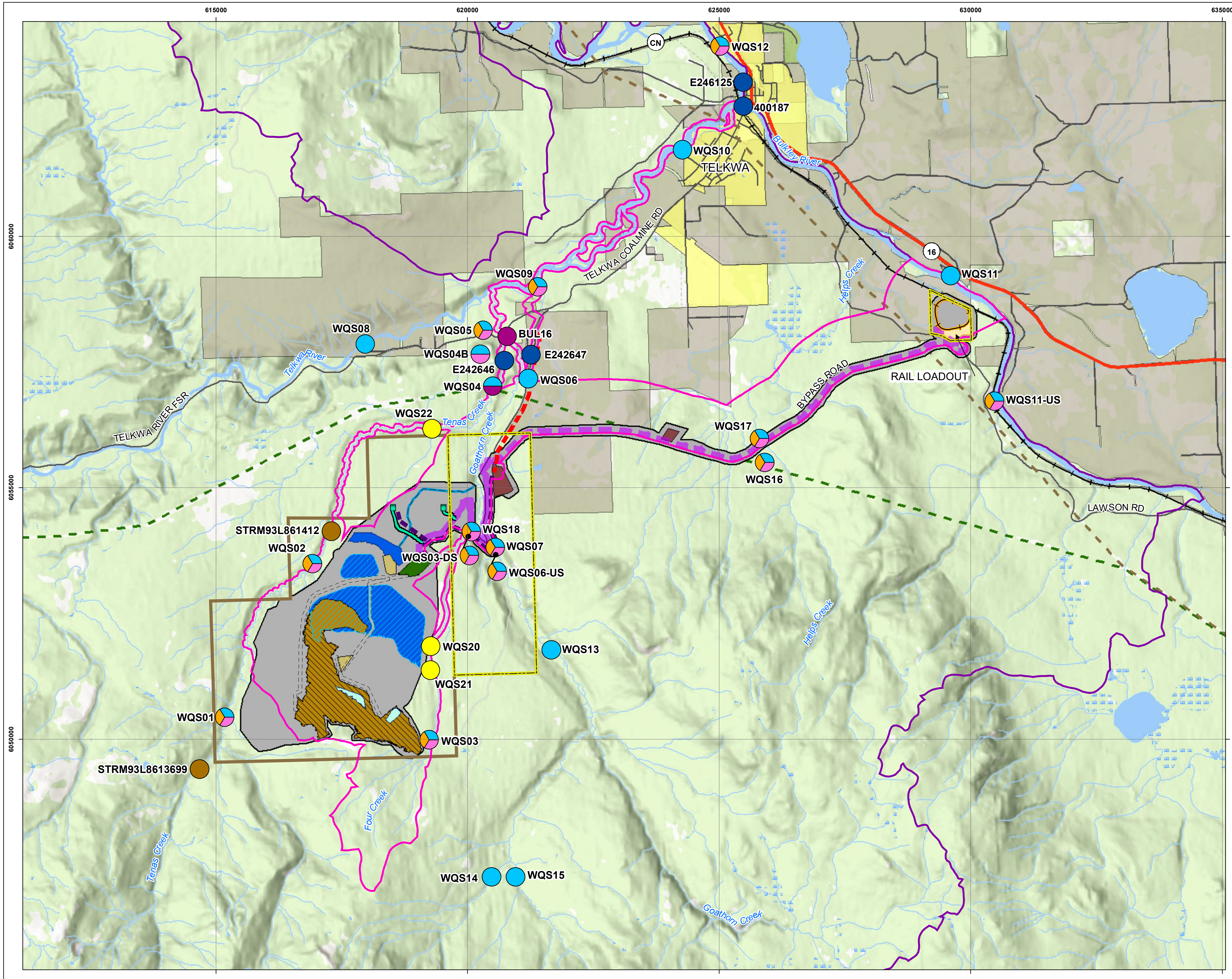
Table 4.1-1: Summary of Baseline Studies for the Aquatic Resources Valued Component (VC)

Study Name	Study Purpose, Timing, and Location
Periphyton Sampling	Periphyton biomass (as chlorophyll a) was sampled from six (6) stream sites in 2017, one (1) new stream site in 2018. In 2019, the seven (7) existing sites, plus seven (7) new sites, were sampled **(Figure 4.1-1) (Appendix 4.1-C** [refer to subsection 10.0 Aquatic Resources]).
Benthic Invertebrate Sampling	Benthic invertebrate sampling was conducted by CABIN-certified field personnel once at each site according to the CABIN protocol (Environment Canada 2012a). Six (6) sites were visited in 2017 and one (1) in 2018. In 2019, the seven (7) existing sites, plus seven (7) new sites, were sampled **(Figure 4.1-1) (Appendix 4.1-C)**.
Sediment Sampling	Sediment samples were collected from 14 sites in the Project Area from 2017 to 2019. Sediment samples were collected from six (6) sites in the Project Area in September 2017. One (1) new site was sampled in September 2018. Sediment samples were collected from existing sites and seven (7) new sites in 2019 **(Figure 4.1-1) (Appendix 4.1-C** [refer to subsection 9.0 Sediment Quality]**)**.

Note: *Appendix 4.1-C=Tenas Project 2017 to 2019 Baseline Report (Appendix 4.1-C of S4.0-C1 of Atmospheric Environment; CABIN=Canadian Aquatic Biomonitoring Network; Valued Component [VC] of the EAC Application)*

4.1.3.1 Methods

A summary of the baseline studies methodologies for the Aquatic Resources VC is provided below. The detailed description of baseline study methods can be found in **Appendix 4.1-C**. Aquatic Resources baseline studies were conducted at all identified sampling locations in either 2017, 2018, or 2019. Sampling locations are shown on **Figure 4.1-1**.



Tenas Project

Aquatic Resources Sampling Locations

Legend

- Aquatic Resource Sample Type
- Water Quality (2017 to 2019)
- Water Quality (Historical)
- Water Quality Prediction Node
- Sediment Quality (2017 / 2018)
- Sediment Quality (Historical)
- Aquatic Resources (2017 / 2018)
- Aquatic Resources (Historical)
- Aquatic Resources and Fish and Fish Habitat Local Study Area
- Aquatic Resources and Fish and Fish Habitat Regional Study Area
- Rail Line
- Highway
- Road
- Watercourse
- Wetland
- Waterbody
- Municipal Area
- General Private Property
- 138 kV Transmission Line
- 500 kV Transmission Line

Project Features

- Existing 25 kV Power Line
- 25 kV Power Line
- Haul Road
- Rail Loop
- Discharge Path
- Tenas Access Corridor
- Backfill Area
- Control and Plant Sedimentation Pond
- Explosive Infrastructure
- Management Pond
- Mine Infrastructure Complex
- Open Pit
- Pit Lake
- Quarry
- Rail Infrastructure
- Topsoil Stockpile
- Tenas Coal Licenses
- Telkwa Coal Limited Private Property
- Project 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.
3. Project line features are for display only.

Sources

- Project Features: Allegiance Coal, April 21, 2021.
- Basedata: Government of British Columbia
- Basemap: World Topo Base

N

1:75,000

0 1 2 3 4 5

Kilometers

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

103260-04	Production Date: Sep 10, 2021	Figure 4.1-1

TELKWA COAL LIMITED

Hemmera An Ausenco Company

Path: S:\Geomatics\Projects\103260\04\mxd\EA\Fig5.2__103260_04_Aquatic_Sampling_Locations_210910.mxd

4.1.3.1.1 Periphyton Sampling

Periphyton biomass (as chlorophyll a) was sampled from six (6) stream sites in 2017 and one (1) stream site in 2018 (**Figure 4.1-1**). Three (3) replicates were collected from randomly selected rocks at each site. Each replicate was a composite of three (3) pooled subsamples scrubbed from an individual rock using a template of known surface area (19.6 square centimetres [cm^2]), a modified toothbrush, syringe, and wash bottle. Three (3) periphyton taxonomy replicates were also collected at six (6) stream sites in 2017 and one (1) site in 2018. Field sampling protocols followed the same protocols as for biomass, with each replicate consisting of a composite of three (3) pooled subsamples. In 2019, periphyton biomass was also collected from eight (8) sites and periphyton taxonomy from 14 sites. Three (3) replicates were collected from each site. While the 2017 and 2018 samples pooled three (3) sub-samples to create one (1) replicate (=58.8 cm^2 per replicate), in 2019 only one (1) sub-sample was collected per replicate (=19.6 cm^2 per replicate).

Taxonomy samples were sent to Biologica Environmental Services Ltd. (Biologica) in Victoria, BC for identification and enumeration.

Chlorophyll a (chl a) concentration was used as an estimate of periphyton biomass (as micrograms of chlorophyll a per square centimetre [µg chl a/cm^2]). Periphyton density was calculated by dividing the total number of cells counted by the area sampled and corrected for subsampling. Taxa not identified to family were included in density estimations, but removed from community composition, richness, and Simpson's Diversity Index calculations.

Periphyton were grouped by genera for richness and Simpson's Diversity Index calculations. Richness and diversity were calculated according to the Metal Mining Technical Guidance for Environmental Effects Monitoring (EC 2012c).

Simpson's diversity can range from 0 (lowest diversity) to 1 (maximum diversity). The use of Simpson's Diversity Index accounts for both the number of taxa present and the relative density of organisms from each taxa (evenness).

4.1.3.1.2 Benthic Invertebrate Sampling

Kick net sampling was conducted by CABIN-certified field personnel once at each site according to the CABIN protocol (EC 2012a). Six (6) sites were visited in 2017 and one in 2018 .In 2019, all seven (7) existing sites, plus seven (7) new sites, were visited. A standard CABIN kick net (400 mircrometre (µm) mesh) was used for sampling. Samples were collected by placing the kick net downstream of the collector with the flat bottom of the net resting on the substrate. The sampler then moved upstream, dragging the net along the bottom of the stream, disturbing the substrate to a depth of 5 to 10 centimetres (cm) using a kicking motion. The sampler zigzagged continuously over the stream bottom for three (3) minutes. The contents of the kick net sample were transferred to a sieve, and sample debris was washed from the net using a wash bottle. Large rocks were scrubbed, rinsed, and removed from the sample. The contents were transferred into clean one (1) litre, pre-labelled plastic jars and preserved to a final concentration of 10 percent (%) buffered formalin. Samples were sent to Biologica for enumeration and identification.

Invertebrates were sorted and identified to the lowest possible taxonomic level (usually genus). Ostracoda, Cladocera, Nematoda, Copepoda, Porifera, Platyhelminthes, and terrestrial organisms were excluded from all analysis following CABIN protocols (EC 2012b). Immature or damaged specimens, as well as specimens not identified to the family level were included in abundance estimations but were excluded from all other calculations. Benthic invertebrate abundance, richness, and Simpson's Diversity indices were calculated for each sample at the family level.

4.1.3.1.3 Sediment Sampling

Sediment samples were replicates. Excess water was drained, and the sample was manually homogenized before being placed into pre-labelled Whirl-Pack bags. Samples were then sealed (no air bubbles) and kept cool in the dark until analyzed by ALS laboratory .

Whole sediment samples from streams were analyzed for pH, particle size, nutrients, and total organic carbon (TOC). Metal analyses were conducted on the less than (<) 63 µm fraction of the sample because this is more bioavailable to benthic organisms and tends to contain greater concentrations of metals and other contaminants than the coarse sediment fraction (BC MOE 2016).

4.1.3.1.4 Instream Flow Methods (IFM)

An instream flow assessment (IFA) was conducted using instream flow methods (IFM) to evaluate the potential for flow-related effects on fish and their habitat in Four Creek. For further details refer to **S4.0-C6-5.2.1.1.6.1 Instream Flow Assessment (IFA)** of the **EAC Application.**

4.2 Description of Existing Conditions

4.2.1 Project Setting

The Project is situated within the transition zone of the Coast Mountains and the Interior Plateau, on a land terrace within the Telkwa River watershed (TCL 2018). The Project is located within the sub-boreal spruce Biogeoclimatic (BGC) zone, which is a montane continental zone characterised by gently rolling plateaus, poorly drained wetland areas, and seasonal extremes of temperature with shorter winters and a longer growing season in comparison to boreal areas. The Project Area is dominated by a nival (snowmelt) driven streamflow regime, with the majority of surface water runoff occurring in the spring and early summer. Following freshet, a typical hydrograph of this region presents a period of late summer/early fall low flows, followed by high intensity precipitation events in the fall, and an annual low flow period in the winter where precipitation is stored in the snowpack and baseflows are predominantly groundwater fed.

Watercourses in the Project vicinity include Tenas Creek and Four Creek, which are tributaries to Goathorn Creek. Goathorn Creek flows north along the eastern edge of the Project boundary and into the Telkwa River, which meets the Bulkley River at the Village of Telkwa. Tenas Creek is located on the western side of the Project, while Goathorn Creek and Four Creek are located on the eastern and southeastern sides of the Project. The Telkwa River is located to the north and flows into the Bulkley River, northeast of the Project (**Figure 4.1-1**).

4.2.2 Periphyton

Periphyton biomass (as chlorophyll a) was higher in the larger rivers than the smaller tributary creeks. The Telkwa River at WQS09 had the highest mean biomass (3.08 µg chl a/cm2) and density (97,000 cells/cm^2), and the periphyton assemblage at this site was dominated by diatoms, primarily Achnanthidium (**Table 4.2-1**). Conversely, biomass and density were much lower in Tenas, Four, Goathorn, and Helps creeks, where mean biomass was less than 0.75 micrograms of chlorophyll a per square centimetre (µg chl a/cm^2), and density was less than 10,000 cells/cm^2 (except WQS01 density in 2017 with 42,500 cells/cm^2). Periphyton biomass and density displayed considerable interannual variability. Periphyton biomass levels remained below the BC guideline of 10 µg chl a/cm^2 and the Bulkley River provisional objective of 5 µg chl a/cm^2.

Periphyton communities at all sites were dominated by either Bacillariophyceae (diatoms) or Cyanophyceae (blue-green algae). Tenas Creek sites were dominated by Cyanophyceae (39% to 99% of the community), which were also abundant in Goathorn Creek (56% to 85%). Bacillariophyceae were a large proportion of the remainder of the periphyton community in both creeks, and were more abundant in 2019. Within Tenas and Goathorn creeks, the Cyanophyceae Heteroleibeinia, Leptolyngbya, Phormidium, and Pseudanabaena were among the dominant genera at each site (**Table 4.2-1**). In 2019, the higher proportion of diatoms was largely attributable to Achnanthidium. While Tenas and Goathorn creeks were generally dominated by Cyanophyceae, the other creeks and rivers were dominated by Bacillariophyceae. Bacillariophyceae were largely represented by Achnanthidium and Fragilaria. Richness and diversity levels were moderate to high, with mean richness ranging from 8 to 23 genera/sample and Simpson's Diversity from 0.19 to 0.85. Samples with low diversity (Simpson's Diversity < 0.5) reflect the dominance of certain taxa at these sites (i.e., one genus comprised greater than (>) 50% of the sample). The Bulkley River had the highest richness (mean range: 16 to 23 genera/sample) and diversity (mean range: 0.81 to 0.85) of all the sampled streams. It should be noted that the area sampled in 2017 and 2018 differed from that in 2019 (**Appendix 4.1-C**), which can affect comparisons of richness and diversity. As such, inter-year comparisons should be limited and interpreted with caution.

The invasive Didymosphenia, also known as rock snot, was identified in Tenas Creek (WQS02), the Telkwa River (WQS08 and WQS09), and the Bulkley River (WQS11-US and WQS12). Therefore, extra precautions were taken to clean equipment and clothing when sampling these waterbodies to ensure it is not spread to other areas.

Table 4.2-1: Dominant Periphyton Taxa; Periphyton Sampling Program 2017 to 2019

Watercourse	Site Number	Year	Class	Genus	Percent
Tenas Creek	WQS01	2017	Cyanophyceae	*Heteroleibeinia*	90
			Cyanophyceae	*Leptolyngbya*	6
			Cyanophyceae	*Pseudanabaena*	3
		2019	Cyanophyceae	*Heteroleibeinia*	25
			Bacillariophyceae	*Ecyonema*	21
			Bacillariophyceae	*Achnanthidium*	14
	WQS02	2017	Cyanophyceae	*Heteroleibeinia*	77
			Cyanophyceae	*Phormidium*	9
			Cyanophyceae	*Leptolyngbya*	9
		2019	Cyanophyceae	*Pseudanabaena*	43
			Cyanophyceae	*Leptolyngbya*	10
			Bacillariophyceae	*Achnanthidium*	7
	WQS04B	2019	Cyanophyceae	*Leptolyngbya*	37
			Cyanophyceae	*Heteroleibeinia*	22
			Cyanophyceae	*Pseudanabaena*	9
Four Creek	WQS03-DS	2019	Bacillariophyceae	*Achnanthidium*	24
			Cyanophyceae	*Leptolyngbya*	19
			Cyanophyceae	*Heteroleibeinia*	15
	WSQ18	2019	Bacillariophyceae	*Achnanthidium*	39
			Bacillariophyceae	*Coconeis*	12

Watercourse	Site Number	Year	Class	Genus	Percent
			Cyanophyceae	*Chamaesiphon*	10
Goathorn Creek	WQS06-US	2019	Bacillariophyceae	*Achnanthidium*	39
			Cyanophyceae	*Heteroleibeinia*	21
			Cyanophyceae	*Leptolyngbya*	13
	WQS07	2019	Cyanophyceae	*Phormidium*	32
			Bacillariophyceae	*Achnanthidium*	18
			Cyanophyceae	*Heteroleibeinia*	16
	WQS05	2017	Cyanophyceae	*Heteroleibeinia*	41
			Cyanophyceae	*Leptolyngbya*	24
			Cyanophyceae	*Tapinothrix*	9
		2019	Cyanophyceae	*Phormidium*	62
			Bacillariophyceae	*Achnanthidium*	14
			Cyanophyceae	*Leptolyngbya*	11
Helps Creek	WQS16	2019	Bacillariophyceae	*Achnanthidium*	49
			Cyanophyceae	*Heteroleibeinia*	30
			Cyanophyceae	*Leptolyngbya*	5
	WQS17	2019	Bacillariophyceae	*Achnanthidium*	51
			Cyanophyceae	*Heteroleibeinia*	20
			Bacillariophyceae	*Coconeis*	8
Telkwa River	WQS08	2017	Bacillariophyceae	*Achnanthidium*	29
			Bacillariophyceae	*Fragilaria*	23
			Cyanophyceae	*Leptolyngbya*	14
		2019	Cyanophyceae	*Phormidium*	25
			Bacillariophyceae	*Achnanthidium*	23
			Cyanophyceae	*Leptolyngbya*	22
	WQS09	2017	Bacillariophyceae	*Achnanthidium*	43
			Bacillariophyceae	*Fragilaria*	36
			Cyanophyceae	*Pseudanabaena*	8
		2019	Bacillariophyceae	*Achnanthidium*	60
			Cyanophyceae	*Leptolyngbya*	11
			Bacillariophyceae	*Diatoma*	7
Bulkley River	WQS11-US	2018	Cyanophyceae	*Chamaesiphon*	22
			Bacillariophyceae	*Achnanthidium*	19
			Cyanophyceae	*Heteroleibeinia*	19
		2019	Bacillariophyceae	*Achnanthidium*	25
			Cyanophyceae	*Phormidium*	22

Watercourse	Site Number	Year	Class	Genus	Percent
			Cyanophyceae	*Leptolyngbya*	15
	WQS12	2017	Bacillariophyceae	*Fragilaria*	25
			Cyanophyceae	*Phormidium*	21
			Bacillariophyceae	*Achnanthidium*	14
		2019	Bacillariophyceae	*Achnanthidium*	25
			Cyanophyceae	*Pseudanabaena*	17
			Cyanophyceae	*Leptolyngbya*	13

4.2.3 Benthic Invertebrates

Benthic invertebrate abundance displayed high temporal and spatial variability, ranging from a mean of 103 to 5,637 organisms/sample. Benthic invertebrate abundances were generally highest in the Bulkley River, and lowest in Four Creek.

Benthic invertebrate communities were dominated by the intolerant to moderately pollution-tolerant taxa, Ephemeroptera (mayflies; 15% to 64% of the community) and Plecoptera (stoneflies; 1% to 48% of the community). Ephmeroptera were largely represented by Baetis, Rithrogena and Drunella, and Plecoptera by Zapada and Taenionema (**Table 4.2-2**). A third intolerant to moderately pollutiontolerant taxon, Trichoptera (caddisflies), was abundant in the lower Bulkley River. Ephemeroptera, Plecoptera, and Trichoptera, collectively termed EPTs, generally made up the majority of the community at most sites (>50%), except lower Tenas Creek at WQS04B in 2000, Helps Creek at WQS17, 2019 samples from the Bulkley River, and the Telkwa River, where there was an abundance of Diptera (true flies), particularly the family Chironomidae (non-biting midges). EPT presence is considered an indicator of good ecosystem health because most taxa are intolerant to moderately tolerant of pollution and poor water quality. Conversely, dipteran species are generally more pollution tolerant.

Benthic invertebrate mean richness ranged from 11 to 25 families/sample. Family richness was generally higher in the larger Telkwa and Bulkley rivers compared to the smaller tributary streams, although Tenas Creek at WQS04B and Goathorn Creek had particularly high family richness. Benthic invertebrate family diversity was high (>0.6 Simpson's diversity), and comparable across sites.

Table 4.2-2: Dominant Benthic Invertebrates; Benthic Invertebrate Sampling Program 2017 to 2019

Watercourse	Site Number	Year	Class	Genus	Percent
Tenas Creek	WQS01	2017	Plecoptera	*Zapada*	27
			Ephemeroptera	*Baetis*	17
			Ephemeroptera	*Rhithrogena*	9
		2019	Ephemeroptera	*Baetis*	10
			Diptera - Chironomidae	*Cricotopus/Orthocladius*	9
			Diptera - Chironomidae	*Tvetenia*	6
	WQS02	2017	Plecoptera	*Zapada*	20

Watercourse	Site Number	Year	Class	Genus	Percent
			Plecoptera	*Taenionema*	14
			Ephemeroptera	*Drunella*	9
		2019	Ephemeroptera	*Baetis*	18
			Plecoptera	*Zapada*	15
			Diptera - Chironomidae	*Cricotopus/Orthocladius*	6
	WQS04B	2000	Plecoptera	*Taenionema*	13
			Diptera - Other	*Pericoma*	8
			Ephemeroptera	*Baetis*	8
		2006	Diptera - Other	*Pericoma*	21
			Ephemeroptera	*Baetis*	13
			Plecoptera	*Zapada*	7
		2019	Ephemeroptera	*Baetis*	25
			Plecoptera	*Zapada*	9
			Ephemeroptera	*Ameletus*	8
Four Creek	WQS03-DS	2019	Plecoptera	*Taenionema*	13
			Plecoptera	*Zapada*	8
			Ephemeroptera	*Baetis*	4
	WQS18	2019	Diptera - Chironomidae	*Pseudodiamesa*	9
			Plecoptera	*Zapada*	5
			Ephemeroptera	*Cinygmula*	5
Goathorn Creek	WQS06-DS	2019	Ephemeroptera	*Baetis*	29
			Plecoptera	*Taenionema*	11
			Ephemeroptera	*Rhithrogena*	11
	WQS07	2019	Ephemeroptera	*Baetis*	31
			Plecoptera	*Taenionema*	14
			Ephemeroptera	*Rhithrogena*	7
	BUL16	2000	Ephemeroptera	*Baetis*	18
			Ephemeroptera	*Rhithrogena*	4
			Ephemeroptera	*Drunella*	4
		2004	Ephemeroptera	*Baetis*	33
			Ephemeroptera	*Rhithrogena*	5
			Ephemeroptera	*Epeorus*	3
		2006	Ephemeroptera	*Baetis*	15
			Ephemeroptera	*Cinygmula*	8
			Acari	*Lebertia*	5

Watercourse	Site Number	Year	Class	Genus	Percent
	WQS05	2017	Ephemeroptera	*Baetis*	40
			Plecoptera	*Taenionema*	9
			Diptera - Other	*Simulium*	8
		2019	Ephemeroptera	*Baetis*	31
			Diptera - Chironomidae	*Cricotopus/Orthocladius*	18
			Ephemeroptera	*Ameletus*	3
Helps Creek	WQS16	2019	Plecoptera	*Sweltsa*	10
			Diptera - Chironomidae	*Tantytarsus*	8
			Ephemeroptera	*Cinygmula*	7
	WQS17	2019	Diptera - Chironomidae	*Tantytarsus*	7
			Ephemeroptera	*Baetis*	6
			Diptera - Chironomidae	*Brillia*	4
Telkwa River	WQS08	2017	Diptera - Chironomidae	*Tvetenia*	22
			Ephemeroptera	*Baetis*	10
			Ephemeroptera	*Drunella*	8
		2019	Diptera - Chironomidae	*Cricotopus/Orthocladius*	33
			Ephemeroptera	*Ameletus*	11
			Lumbriculida	*Stylodrilus*	7
	WQS09	2017	Diptera - Chironomidae	*Cricotopus/Orthocladius*	8
			Ephemeroptera	*Baetis*	7
			Acari	*Lebertia*	6
		2019	Diptera - Chironomidae	*Cricotopus/Orthocladius*	14
			Lumbriculida	*Stylodrilus*	9
			Ephemeroptera	*Rhithrogena*	6
Bulkley River	WQS11-US	2018	Diptera - Chironomidae	*Polypedilum*	9
			Oligochaeta	*Stylodrilus*	8
			Ephemeroptera	*Ameletus*	7
		2019	Diptera - Chironomidae	*Cricotopus/Orthocladius*	13
			Tubificida	*Nais*	13
			Ephemeroptera	*Ameletus*	10
	WQS12	2017	Plecoptera	*Taenionema*	14
			Ephemeroptera	*Rhithrogena*	13
			Ephemeroptera	*Baetis*	6
		2019	Tubificida	*Nais*	17
			Diptera - Chironomidae	*Microtendipes*	5

Watercourse	Site Number	Year	Class	Genus	Percent
			Ephemeroptera	*Ameletus*	5
	BUL01	2016	Ephemeroptera	Baetis	19
			Trichoptera	*Arctopsyche*	12
			Trichoptera	*Hydropsyche*	5
	BUL73	2007	Trichoptera	*Arctopsyche*	8
			Trichoptera	*Hydropsyche*	8
			Plecoptera	*Taenionema*	7

4.2.4 Sediments

Sediments consisted mainly of sand (0.063 to 2.0 millimetre [mm]), that on average made up 40% to 96% of stream sediments, followed by gravel (1% to 37%) and silt (2% to 34%). The highest proportion of fine sediments occurred at the upstream Bulkley River site (WQS11-US), Four Creek, and WQS01 in 2019. Total organic carbon was low, with annual means ranging from 0.07% at WQS08 in 2017 to 2.26% at WQS05 in 2019.

Sediment metal concentrations varied across Project area streams. Several sediment metal concentrations were highest in Goathorn Creek and Helps Creek, which both had elevated cadmium and zinc. Further, Goathorn Creek had high sediment copper, while Helps Creek had high arsenic and lead. Sediment chromium, iron, manganese, and nickel were elevated in Tenas Creek compared to other sampled streams, with higher concentrations typically observed in the upper portion of the creek (WQS01 and WQS02); however, only one sample was collected from WQS04B. Silver concentrations were low (<0.2 milligram per kilogram [mg/kg]), with higher concentrations generally measured in the Telkwa and Bulkley rivers. Selenium concentrations were low in Project area streams with the majority of samples below detection limits (66%, 0.1 to 0.2 mg/kg), and a maximum of 0.31 mg/kg in Goathorn Creek samples from WQS06-US and WQS07. Sediment mercury concentrations were also commonly below the detection limit (65%, 0.005 to 0.05 mg/kg).

Sediment arsenic, iron, manganese, and nickel concentrations appear to be elevated in the Project area as concentrations of these metals at all sites, including upstream of the Project, were above BC lower sediment quality guidelines. Further, iron and manganese concentrations were greater than the BC upper sediment quality guideline in every stream (except iron in Helps Creek), while arsenic concentrations were above the upper guideline in Helps Creek.

Sediment copper concentrations were above the BC lower guideline in Tenas Creek, Goathorn Creek, and the Telkwa River. Sediment cadmium and zinc concentrations in Goathorn Creek and Helps Creek were higher than the BC lower guidelines. Samples from upper Tenas Creek and the upstream Bulkley River site were marginally above the BC lower chromium guideline. Goathorn Creek sediment concentrations were above most sediment quality guidelines, followed by Helps Creek and upper Tenas Creek. All Project Area stream sediment concentrations were below federal and provincial guidelines for lead, mercury, selenium, and silver.

5. Assessment of Project-related Effects

The information provided within this subsection includes:

- identification of potential interactions between the Project and the Aquatic Resources VC;
- description of potential adverse Project effects on the Aquatic Resources VC;
- identification of mitigation measures to eliminate, reduce, or control the potential adverse Project effects on the Aquatic Resources VC; and
- characterisation of Project residual effects on the Aquatic Resources VC.

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

This subsection focuses on the assessment of those interactions with the potential to affect the Aquatic Resources VC. Potential Project-related interactions with the Aquatic Resources VC were determined by evaluating Project components and activities in relation to the Aquatic Resources VC. Project-related interactions and the likelihood of the interaction were determined with spatial analysis of the extent of the Project's potential effects and existing conditions related to the Aquatic Resources VC as outlined in **4. Existing Conditions**. Each potential interaction is rated using the terms provided in **Table 5.1 1**.

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

Term	Definition
No Interaction	Project activity will not interact with the Aquatic Resources Valued Component (VC), no adverse effect is expected; no further consideration is warranted.
Interaction	Interaction between the Project activity and the Aquatic Resources 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 Aquatic Resources VC. Interactions expected to result in potential effects on the Aquatic Resources 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 to determine the effects of the interaction. Where there are no interactions between the Project and the Aquatic Resources VC, or the interaction is considered minor (i.e., not expected to have a substantive influence on the short- or long-term integrity of the VC as the effect would not be measurable or detectable using the identified Indicator), the interaction is not considered further in the assessment.

The Aquatic Resources VC will be primarily influenced by construction of the Minesite and Mine Infrastructure adjacent to water or that requires water diversion or discharges (open pit excavation, Minesite rock storage, water management). Water reporting to Tenas and Four creeks will be diverted through or around the Minesite and back into their channels downstream of the Minesite. Several small, ephemeral tributaries to Tenas Creek will be altered within the Minesite. Potential increases in sedimentation are related to watercourse crossings associated with the proposed haul roads. Sedimentation may also result from runoff from all construction activities within the Minesite.

Interactions of the Project with the Aquatic Resources VC occur during all phases of the Project primarily through water management and the potential for increased sedimentation during Construction Phase activities. These comprise changes in water quality and the potential for contaminants and sediments to be introduced into waterbodies.

Table 5.1-2: Potential for an Interaction between the Aquatic Resources Valued Component (VC) and the Tenas Project

Project Activities	Aquatic Resources
Construction	
Transportation of equipment, materials, and personnel	
Site clearing (surveying, clearing, grubbing, soil salvaging)	X
Construction of Surface Water Management Infrastructure, including channels and ponds (sedimentation, control, management, storage)	X
Construction of Bypass Road and quarries from the Minesite to the Rail Infrastructure	X
Improvements to existing private road and Forest Service Roads	X
Construction of haul roads and service roads within the Minesite	X
Construction of the permanent Goathorn Bridge Crossing over Goathorn Creek	X
Construction of the Coal Processing Plant	X
Construction of fuel and lubricant storage facilities and distribution network	X
Construction of administration buildings (first aid, maintenance, mine dry, warehouse, laboratory, parking, and vehicle wash facilities)	X
Construction of a 25 kilovolt (kV) power line and a 600 volt (V) substation adjacent to the Coal Processing Plant	X
Construction of Rail Infrastructure including Rail Loop and Loadout connecting to the existing main Canadian National Railway line	X
Installation of water supply wells, storage, and distribution system	X
Construction of the water discharge infrastructure	X
Construction of storage piles for overburden, rock separated from coal in Coal Processing Plant, and stockpiles for topsoil and vegetation management	X
Construction of material handling systems for Minesite, including run-of-mine coal, processed coal, process rock conveyors, and stockpiles	
Construction of solid waste management systems including recycling and composting facilities	
Construction of Explosives Magazine (storage building)	
Employment and labour	
Operation	
Mining the open pit (soil salvaging, drilling and blasting, excavation of material, dewatering, loading, hauling, unloading)	X
Operation of Surface Water Management Infrastructure including channels and ponds (sedimentation, control, management, storage)	X

Project Activities	Aquatic Resources
Maintain and use Bypass Road and quarries from the Minesite to the Rail Infrastructure	X
Maintain improved private and Forest Service Roads	
Maintain haul roads within the Minesite, including service roads	
Maintain permanent bridge over Goathorn Creek	
Operate Coal Preparation Plant	
Maintain fuel and lubricant storage facilities	
Maintain administration buildings (first aid, maintenance, mine dry, warehouse, laboratory, and vehicle wash facilities)	
Maintain 25 kV power line and a 600 V substation adjacent to the Coal Processing Plant	
Transportation of equipment, materials, and personnel	
Maintain and use Rail Infrastructure including Rail Loop and Loadout connecting to the existing main Canadian National Railway line	
Operate water supply wells, storage, and distribution system	
Operate the water discharge infrastructure	X
Maintain storage piles for overburden, rock separated from coal in Coal Processing Plant, and stockpiles for topsoil and vegetation management	X
Operate material handling systems for Minesite, including run-of-mine coal, processed coal, process rock conveyors, and stockpiles	X
Operate solid waste management systems including recycling and composting facilities	
Maintain Explosives Magazine (storage building)	
Progressive reclamation	
Employment and labour	
Decommissioning and Reclamation	
Dismantle and remove mining equipment and facilities (including powerline, Rail Infrastructure)	X
Transportation of equipment, materials, and personnel	
Reclamation and closure activities at Minesite	X
Reclamation and closure of Bypass Road and haul roads, including quarries	u
Reclamation and closure of permanent bridge over Goathorn Creek	X
Reclamation and closure of powerlines	

Project Activities	Aquatic Resources
Reclamation and closure of Rail Infrastructure	
Implement post-mining systems and monitoring	X
Employment and labour	
Post-closure	
Maintain post-mining systems and ongoing monitoring	X
Transportation of equipment, materials, and personnel	
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

This subsection considers potential Project-related effects on aquatic resources arising from potential interactions, as identified in **Table 5.1-2**, and in relation to the indicators listed in **Table 3.2-2**.

Three (3) potential effects have been identified to inform the assessment of the effects of the Project on the Aquatic Resources VC:

1. change in water quality due to releases of suspended sediments, Minesite contact water, blast residues, and flow alterations;
2. change in sediment quality due to releases of suspendedsediments, Minesite contact water, blast residues, and flow alterations; and
3. change in the abundance and community structure of periphyton and benthic invertebrates.

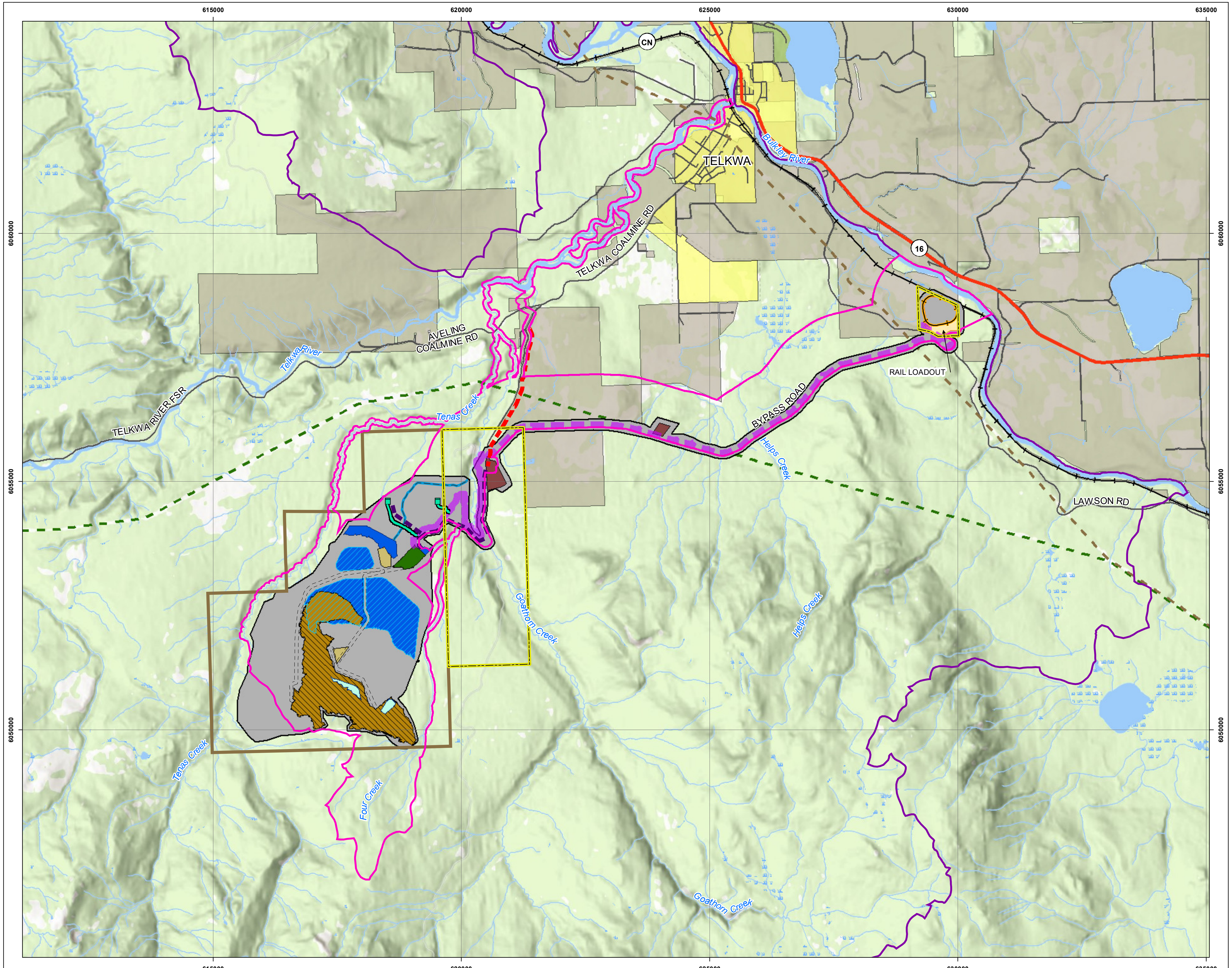
Mitigation measures for the potential effects are described in **5.3**.

5.2.1 Change in Water Quality (All Project Phases)

There is a potential change in water quality due to flow alterations, release of suspended sediments, Minesite contact water, and blast residues. Changes in water quality due to diversions and discharges of contact and non-contact water can cause changes to aquatic environments including altering the conditions for growth of aquatic organisms (eutrophication through increases in nutrients) or lethal and sub-lethal toxic effects on aquatic biota.

During the Construction Phase, several diversion channels will be built to direct non-contact water around the Minesite Infrastructure (**Figure 5.2-1**). These diversions have the potential to reduce base flow contributions to downstream watercourses. The diversions are expected to affect about 8 kilometres (km) of Tenas Creek and about 4.5 km of Four Creek and will be in operation throughout all phases of the Project.

Throughout all stages of the Project, contact water from Minesite components (e.g., open pit, Minesite rock storage) will be collected in diversion and interceptor ditches and will be conveyed into management control ponds before discharge back into Tenas, Four, and Goathorn creeks (**Figure 5.2-1**). The water quality of discharges into Tenas, Four, and Goathorn creeks was modelled using data from the baseline surface water quality program and is discussed in the **S4.0-C3 Surface Water VC.** Discharge locations for Minesite contact water on the creeks are the primary mixing points for contact water from the Minesite and will influence water quality downstream of all Project activities.



Tenas Project

Mine Footprint and Infrastructure

Legend

- Aquatic Resources and Fish and Fish Habitat Local Study Area
- Aquatic Resources and Fish and Fish Habitat Regional Study Area
- Rail Line
- Highway
- Road
- Watercourse
- Wetland
- Waterbody
- Municipal Area
- General Private Property
- 138 kV Transmission Line
- 500 kV Transmission Line

Project Features

- Existing 25 kV Power Line
- 25 kV Power Line
- Haul Road
- Rail Loop
- Discharge Path
- Tenas Access Corridor
- Backfill Area
- Control and Plant Sedimentation Pond
- Explosive Infrastructure
- Management Pond
- Mine Infrastructure Complex
- Open Pit
- Pit Lake
- Quarry
- Rail Infrastructure
- Topsoil Stockpile
- Tenas Coal Licenses
- Telkwa Coal Limited Private Property
- Project 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.
3. Project line features are for display only.

Sources

- Project Features: Allegiance Coal, April 21, 2021.
- Basedata: Government of British Columbia
- Basemap: World Topo Base

N

1:75,000

0 1 2 3 4 5

Kilometers

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

103260-04	Production Date: Sep 09, 2021	Figure 5.2-1

TELKWA COAL LIMITED

Hemmera An Ausenco Company

5.2.2 Change in Sediment Quality (All Project Phases)

The primary potential change to sediment quality from Project activities is a change in the chemistry of sediments. Sediment chemistry can be an indicator of long-term patterns in water quality because sediment particles adsorb water constituents. Fluxes of these constituents are always moving between the water and sediment depending on the environmental conditions.

Water quality changes that may alter the chemistry of sediments in watercourses near and downstream of the Project occur throughout all phases of the Project and may include:

- change in water quality due to discharge of Minesite contact water or accidental introduction of contaminants (e.g., fuels) during the Operation, Decommissioning and Reclamation, and Post-closure phases of the Project; and
- change in surface water quality as a result of erosion and sedimentation, Minesite contact water, residues from blasting, and alterations of flows during any Project phase that leads to a change in particle size distribution of sediments.

5.2.3 Change in Periphyton and Benthic Invertebrates (All Project Phases)

Potential changes in periphyton and bethnic invertebrates may occur during all Project phases.

Potential changes to the abundance and community structure of periphyton and benthic invertebrates are closely linked to potential changes in surface water quality and sediment quality and may occur during all stages of the Project. Discharges of Minesite contact water into Tenas Creek and Goathorn Creek downstream of the Project have the potential to increase the concentration of water quality parameters that could cause toxicity (either lethal or sub-lethal effects) to aquatic biota. Sub-lethal effects from elevated levels of some parameters may include changes in growth, reproduction, physiology, or behavior.

At the community level, elevated concentrations of some metals due to Minesite contact water are associated with decreased periphyton biomass and communities that are dominated by fewer taxa (Hill et al. 2000, Niyogi et al. 2002). Benthic invertebrate communities respond similarly to increased levels of dissolved metals and may experience decreased abundance, density, and richness (Poulton et al. 1995, Clements et al. 2000).

A potential parameter of concern for the Project is selenium because it is commonly associated with coal deposits (Yudovich and Ketris 2006) and has been identified as a concern for other coal projects in BC. Selenium has the potential to bioaccumulate in food webs and is taken up by periphyton through direct interaction with the water column.

Sedimentation or erosion of stream sediments released in Minesite contact water, during Construction Phase activities near water (e.g., watercourse crossings, construction of diversions), blasting, and flow alterations, can either add or remove fine sediments in interstitial spaces between cobble and boulders (Wood and Armitage 1997), which can affect habitat availability and community biomass, density, and composition for aquatic resources (Wood and Armitage 1997, Roy et al. 2003). In extreme cases, large sediment inputs into streams can smother periphyton and benthic invertebrates. In addition, the introduction of by-products from the blasting materials, such as ammonia, can lead to mortality of aquatic biota if blast residues are released in sufficient quantities (Wright and Hopky 1998).

5.3 Mitigation Measures

This subsection describes the mitigation measures to address the potential effects of the Project on the Aquatic Resources VC. The mitigation measures are consistent with the mitigation definition provided by the BC EAO (BC EAO 2013) and encompass practical means or measures taken to avoid, minimize, rehabilitate onsite, and if required, compensate, or offset the potential adverse effects of a project).

Construction Phase activities (site clearing, grubbing, site grading, soil and overburden removal, access roads upgrades, powerline construction, vehicle traffic, etc.) have the potential to release large amounts of sediment to area streams. The effects of erosion and increased sedimentation on aquatic resources is well documented, as are mitigation methods. Codified erosion prevention and sediment control practices are presented in the **Surface Erosion Prevention and Sediment Control Plan (S13.0-C17) (SEPSCP)** and the **Minesite Water Management Plan (S13.0-C11) (MWMP)** for the Project will describe methods to prevent sediment release during construction. All runoff from Minesite construction, site clearing, and other soil and vegetation disturbance and stockpiling activities will report to sediment ponds for detention and settling, prior to release to Tenas and Goathorn Creeks. Sediment ponds will be designed to handle a 1:100 year 24-hour rain event. These practices will help limit discharge of sediment-laden water an maintain TSS levels below permit levels during construction. Provided these mitigation measures are effectively implemented and maintained, minor increases in TSS are predicted to be temporary and no permanent changes in water quality and aquatic resources is expected as a result of increased sediment levels.

Construction of the proposed haul roads has the potential to affect water quality and aquatic resources through clearing of riparian vegetation and bank erosion at stream crossings. Construction or replacement of culverts and construction of pullouts on the roads also have the potential to result in loss or alteration of instream habitat and reduction in water quality. These potential environmental effects will be minimized or avoided through implementation of surface erosion and sediment control measures **(SEPSCP)** and other BMPs (BC MOF 1995, 2002). Road runoff and dust control related to vehicle traffic use will be managed to avoid discharge of sediment and metals to streams (e.g., ditches that allow infiltration of runoff; dust suppression) and details are provided in the **Air Quality Management Plan (S13.0-C2) (AQMP)**.

TCL has 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** and include Project design aspects such as site selection, selection of best available technologies (BAT) to-date for Project infrastructure and mining equipment, and a commitment to progressive reclamation. Project mitigation measures that are relevant to minimizing potential Project-related effect on the Aquatic Resources VC are described in **5.3.1** to **5.3.11** below. As not all effects can be addressed through design, additional mitigation measures specific to the Aquatic Resources VC and tailored to Project features are described in **5.3.12** to **5.3.15** and have been incorporated into the various Project management plans such as the **SEPSCP,** the **Fuel Management and Spill Control Plan (S13.0-C7) (FMSCP),** and the **Mine Emergency Response Plan (S13.0-C9) (MERP)**.

The mitigation measures described below are based on proven and accepted mitigation used in BC following standard industry guidelines and BMPs. The management plans provide further guidance to the standard of the day for minimizing changes to water and sediment quality, and changes in periphyton and bethnic invertebrates. 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. All mitigation measures are summarized in **Table 5.3-1**.

5.3.1 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 pit, stockpiles for run-of-mine (ROM) coal, processed coal and processed rock, Coal Processing Plant (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 components footprints to limit the clearing of vegetation and 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 Tenas Access Corridor (TAC) to a single lane width for long distances and utilize existing Forest Service Roads (FSRs) or private roads where appropriate;
- Backfill approximately 50% 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.

5.3.2 Avoid Sensitive Environments

The Project has been designed to:

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

5.3.3 Reclamation Measures

The following refer to 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, and 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 **Reclamation and Closure Plan (S13.0-C15) (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 feature (e.g., highwalls and footwalls) will be covered/resurfaced/recontoured with non-potentially acid generating (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 identified by methodologies provided in the related management plans e.g., **Construction Environmental Management Plan (S13.0-C4) (CEMP)**, **Wildlife Management Plan (S13.0-C21) (WMP), Vegetation Management Plan (S13.0-C18) (VMP)**;
- Clearly delineate the boundaries of no activity buffers 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 mitigations 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 road;
- 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 sued 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 supression agents on the rail cars to reduce fugitive dust emissions;
- Cover super B-train trucks when hauling processed coal from 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 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 and to reduce the time that patterns need to sleep or wait until they are blasted which reduces the introduction of nitrogen species into the surrounding rock;
- 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.

5.3.7 Seepage Management Measures

The following refer to seepage management measures:

- Use overburden bentonite liners for management ponds to reduce the amount of groundwater seepage and potential effects on surface and groundwater quality ;
- Use liners in the Tenas Control Pond, Wastewater Storage Pond, Soil Treatment Facility, Potable Water Storage Pond, and sedimentation pond at the CPP site to minimize the risk of seepage to groundwater and potential effects on surface water and groundwater quality;
- Monitor seepage, groundwater, and surface water levels, and quality/quantity downstream and upstream of the Project as per the monitoring programs set up in the **MWMP**;
- Establish trigger levels that require the implementation of contingency mitigation measures described in the **Discharge Management Plan (S13.0-C5) (DMP)** to protect surface and groundwater water quality and maintain minimum flow levels downstream of the Project.

5.3.8 Water Capture Measures

The designs of the management ponds, sedimentation ponds, collection and diversion channels, and all other water management structures are documented in **S1.0-1.22 Management Ponds (Tailings Storage Facility) and Control Pond Aspects, Appendix 1.0-G Tenas Project Water Management Technical Design Report**, and the **MWMP**. The following mitigation measures apply to water capture:

- Construct diversion channels, where practical, to prevent non-contact water from entering the Project Area and remain as non-contact water;
- Sedimentation and control ponds will have sufficient storage capacity to allow fine sediments to settle out for 1 in 10-year storm events and will be designed to structurally withstand a 1 in 200-year storm event; total suspended solids (TSS) and/or turbidity will be monitored prior to release;
- Establish flocculent addition systems for sedimentation and/or control ponds that will discharge directly to surface waters to provide additional sedimentation control to reduce potential effects on surface water quality;
- If monitoring indicates, construct wetlands within or downstream of sedimentation and/or control ponds to reduce potential effects on surface water quality;
- Include a control structure on the outflow from the C02 diversion channel south of the East Management Pond to control high flow events discharging into the upstream portion of Four Creek by enabling overflow to the East Management Pond directly in the Post-closure phase or to a channel going into the Tenas Control Pond in the Operation, and Decommissioning and Reclamation phases;
- Maintain sufficient capacity in the Tenas Control Pond to store up to a 1 in 10-year storm event to control discharge;
- Monitor and control water discharges from Tenas Control Pond to a tributary of Goathorn Creek based on downstream water flow rates and water quality to meet in-stream guidelines and flow requirements during the Operation, and Decommissioning and Reclamation phases; and
- Develop the open pit in a manner that will allow it to collect water in the Decommissioning and Reclamation, Post-closure phases to provide additional sedimentation control.

5.3.9 Project Use of Water

The following mitigation measures apply to water use:

- Maximize the use of contact water for Project water needs (i.e., use contact water for process for the CPP and equipment washbays before withdrawing additional water from streams);
- Incorporate a contingency of water supply of 2.5% of Goathorn Creek's mean annual monthly flow which was part of the effects assessment (effect is included in the flow rate of Goathorn Creek downstream of intake location) but this contingency is not incorporated into water cover simulations or the overall Project water balance;
- Use dewatered fine processed rock in the CPP to reduce Project water consumption;
- Direct water from the Maintenance Facility to the CPP to reduce Project water consumption;
- Use process water from the Tenas Control Pond, management ponds, and CPP sedimentation pond for the CPP to limit water consumption;

- Design of the CPP allows for the introduction of additional equipment to be installed within 18 months to further reduce water consumption in the Operation Phase, if required;
- Use process water from the Tenas Control Pond for toilets in the Minesite Administration Building to reduce potable water consumption; and
- Construct engineered covers for the management ponds in the Operation, Decommissioning and Reclamation, and Post-closure phases to limit the consumption of water through evaporation losses.

5.3.10 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 material 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 overburden layer to create a dry landform above water, followed by approximately a 30 centimetre (cm) layer of reclamation materials (surface soil) to reduce evaporative losses from the management ponds and 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 the highwall and footwall to limit the amount of damage to the open pit wall and minimize the potential for partical 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; and
- 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.

The following mitigation measures for minimizing potential metal leaching (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.

5.3.11 Water Quality Monitoring and Reporting Measures

The following refer to surface water quality and monitoring measures:

- Provide results of water quality sampling and quantity monitoring per the **MWMP** via BC MECCS website, as was completed for baseline sampling activities, in addition to annual reporting required as part of regulatory permits. Annual reports regarding *Mines Act,* RSBC 1996, c 293, and *Environmental Management Act,* SBC 2003, c 53 (*MA/EMA)* permits will be sent to Indigenous groups and the public based on final permit conditions.

5.3.12 Diversion and Collection Channels

Water quality for the Project Area watercourseswill be protected in the following ways:

- Diversion and collection channels will be built incorporating erosion protection measures based on the flow and slope of the channel;
- Diversion and collection channels will be sized to safely convey a 1 in 100-year storm event, with erosion protection to withstand 1 in 25-year storm event velocities based on associated catchment areas;
- During the Post-closure Phase, diversion and collection channels to be removed will be stabilized or returned to natural drainages; and
- During the Post-closure Phase, diversion channels that are to remain in perpetuity will be inspected annually to assess maintenance requirements and make sure that performance and diversion design objectives are maintained.

5.3.13 Erosion and Sediment Control

- Sediment and erosion control measures will be implemented in accordance with the **SEPSCP** and **CEMP**; 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 water crossings) in accordance with the **MWMP**.

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 in accordance with the **FMSCP** as well.

5.3.15 Additional Valued Component (VC)-specific Blasting Measures

- Incorporate recommendations from Department of Fisheries and Oceans Canada (DFO) Guidelines for the Use of Explosives in or near Canadian Fisheries Waters (Wright and Hopky 1998) when blasting in or near fish-bearing watercourses. Currently the Project is not planning on any use of explosives near fish bearing watercourses.

5.3.16 Summary of Mitigation Measures

A summary of the mitigation measures to avoid or reduce potential Project-related adverse effects on the Aquatic Resources VC, organized by potential effect and contributing activities within the Project phases, 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.

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

Potential Effect	Contributing Activities within the Project Phases (C, O, D, P)	Proposed Mitigation Measure	Residual Effect (Yes/No)
Changes in Water Quality	All activities (C)	▪ Limit Project footprint and Project Area ▪ Avoid senstive environments ▪ Reclamation measures (Refer to **RCP**) ▪ Project footprint boundaries ▪ Transport measures ▪ Seepage management measures ▪ Water capture measures ▪ Erosion and sediment control (Refer to **CEMP, SEPSCP** and **MWMP**) ▪ Spill prevention and response (Refer to **FMSCP**) ▪ Water quality monitoring and reporting measures	Yes
	Blasting near watercourses (C, D)	▪ Blasting measures (Refer to **EMP**) ▪ Additional VC-specific blasting measures	
	▪ Mining the open pit (O) ▪ Surface water management (O) ▪ Water discharge infrastructure operation (O) ▪ Storage pile maintenance (O) ▪ Opeation of material handling systems for the Minesite (O)	▪ Reclamation measures (Refer to **RCP**) ▪ Project footprint boundaries ▪ Transport measures ▪ Erosion and sediment control (Refer to **CEMP, SEPSCP** and **MWMP**) ▪ Project use of water ▪ Management of ML/ARD (Refer to **ML/ARDMP**) ▪ Spill prevention and response (Refer to **FMSCP**) ▪ Water quality monitoring and reporting measures	
	▪ Dismantling of mining equipment and facilities (D) ▪ Reclamation and post-closure of Minesite (D) ▪ Reclamation and post-closure of Goathorn Creek bridge (D)	▪ Reclamation measures (Refer to **RCP**) ▪ Project footprint boundaries ▪ Erosion and sediment control (Refer to **CEMP, SEPSCP** and **MWMP)** ▪ Spill prevention and response (Refer to **FMSCP**) ▪ Water quality monitoring and reporting measures	
	▪ Implement post-mining systems and monitoring (D) ▪ Maintain post-mining systems and monitoring (P)	▪ Seepage management measures ▪ Water capture measures ▪ Diversion and collection channels ▪ Water quality monitoring and reporting measures	

Potential Effect	Contributing Activities within the Project Phases (C, O, D, P)	Proposed Mitigation Measure	Residual Effect (Yes/No)
Changes in Sediment Quality	All activities (C)	▪ Limit Project footprint and Project Area ▪ Avoid senstive environments ▪ Project footprint boundaries ▪ Reclamation measures (Refer to **RCP**) ▪ Diversion and collection channels ▪ Erosion and sediment control (Refer to **CEMP, SEPSCP** and **MWMP**) ▪ Spill prevention and response (Refer to **FMSCP**) ▪ Water quality monitoring and reporting measures	No
	Blasting near watercourses (C, D)	▪ Blasting measures (refer to **EMP**) ▪ Additional VC-specific blasting measures	
	▪ Mining the open pit (O) ▪ Surface water management (O) ▪ Water discharge infrastructure operation (O) ▪ Storage pile maintenance (O) ▪ Opeation of material handling systems for the Minesite (O)	▪ Diversion and collection channels ▪ Erosion and sediment control (Refer to **SEPSCP** and **MWMP**) ▪ Spill prevention and response (Refer to **FMSCP**) ▪ Water quality monitoring and reporting measures	
	▪ Dismantling of mining equipment and facilities (D) ▪ Reclamation and post-closure of Minesite (D) ▪ Reclamation and post-closure of Goathorn Creek bridge (D)	▪ Reclamation measures (refer to **RCP**) ▪ Project footprint boundaries ▪ Erosion and sediment control (Refer to **CEMP, SEPSCP** and **MWMP**) ▪ Spill prevention and response (Refer to **FMSCP**) ▪ Water quality monitoring and reporting measures	
	▪ Implement post-mining systems and monitoring (D) ▪ Maintain post-mining systems and monitoring (P)	▪ Seepage management measures ▪ Water capture measures ▪ Diversion and collection channels ▪ Water quality monitoring and reporting measures	
Changes in the Abundance and Community Structure of Periphyton and	All activities (C)	▪ Limit Project footprint and Project Area ▪ Avoid senstive environments ▪ Project footprint boundaries ▪ Reclamation measures (Refer to **RCP**) ▪ Diversion and collection channels	No

Potential Effect	Contributing Activities within the Project Phases (C, O, D, P)	Proposed Mitigation Measure	Residual Effect (Yes/No)
Benthic Invertebrates		▪ Erosion and sediment control (Refer to **CEMP, SEPSCP** and **MWMP)** ▪ Spill prevention and response (Refer to **FMSCP**) ▪ Water quality monitoring and reporting measures	
	▪ Mining the open pit (O) ▪ Surface water management (O) ▪ Spillway operation(O) ▪ Storage pile maintenance (O) ▪ Opeation of material handling systems for the Minesite (O)	▪ Diversion and collection channels ▪ Erosion and sediment control (Refer to **CEMP, SEPSCP** and **MWMP)** ▪ Spill prevention and response (Refer to **FMSCP**) ▪ Water quality monitoring and reporting measures	
	▪ Dismantling of mining equipment and facilities (D) ▪ Reclamation and post-closure of Minesite (D) ▪ Reclamation and post-closure of Goathorn Creek bridge (D)	▪ Reclamation measures (refer to **RCP**) ▪ Project footprint boundaries ▪ Erosion and sediment control (Refer to **CEMP, SEPSCP** and **MWMP)** ▪ Spill prevention and response (Refer to **FMSCP**) ▪ Water quality monitoring and reporting measures	
	▪ Implement post-mining systems and monitoring (D) ▪ Maintain post-mining systems and monitoring (P)	▪ Seepage management measures ▪ Water capture measures ▪ Diversion and collection channels ▪ Water quality monitoring and reporting measures	

Notes: *C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecomissioning and Reclamation, (P)ost-closure.*
CEMP=Construction Environmental Management Plan (S13.0-C4); 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); MWMP=Minesite Water Management Plan (S13.0-C11); Project=Tenas Project; RCP=Reclamation and Closure Plan (S13.0-C15); SEPSCP=Surface Erosion Protection and Sediment Control Plan (S13.0-C17); 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 predicted residual effects of the Project on the on the Aquatic Resources VC. 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 Aquatic Resources VC. The approach to assessing residual Project effects on the Aquatic Resources VC follows the methodology outlined in **S3.0 Assessment Methodology** of the **EAC Application**.

Predicted residual effects of the Project related to Aquatic Resources are changes in water quality as some permanent changes in water quality parameters will remain after mitigations. The 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 residual effects during all Project phases (Construction, Operation, Decommissioning and Reclamation, and Post-closure). 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.

Although potential effects on sediment quality and the abundance and community structure of periphyton and benthic invertebrates were identified, residual effects are not anticipated when mitigation and best management practices (BMPs) are in place to avoid accidental introduction of contaminants and achieve site-specific water quality objectives (SSWQO) for Minesite contact water. Therefore, these potential effects are not further characterised and are not carried through to the Significance determination.

5.4.1 Description of Evaluation Criteria

5.4.1.1 Residual Effects Characteristics

Residual effects on the Aquatic Resources VC have been characterised in terms of Magnitude, Geographical Extent, Frequency, Duration, Reversibility, and Context. Definitions for each of the residual effects characteristics is provided in **Table 5.4-1**.

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

Residual Effect Characteristic	Definition	Rating
Magnitude	Size or severity of the residual effect – generally measured in terms of the proportion of the aquatic habitats affected within the LSA, relative to the range of natural variation	**Low** – an effect that is detectable but within the normal variability of baseline conditions **Moderate** – an effect that is measurable and is outside the normal variability of baseline conditions but is within regulatory limits and goals **High** – an effect that is measurable and is outside the normal variability of baseline conditions and exceeds limits set out by regullations
Geographic Extent	Spatial scale over which the residual effect is expected to occur	**Project Area** – effect is limited to the specific locations within which the Project will be constructed and operated **Local** – effects is limited to LSA or portion of LSA **Regional** – effect is limited to portion of RSA or all of the RSA **Beyond Regional** – effect extends beyond RSA.

Residual Effect Characteristic	Definition	Rating
Duration	Length of time over which the residual effect is expected to persist	**Short-term** – occurs for hours or days (e.g., a storm event) **Medium-term** – occurs for up to one (1) year (e.g., during a particular construction activity) **Long-term** – occurs for between one (1) and five (5) years **Permanent** – residual effect lasts in perpetuity
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. Irreversible effects are considered to be permanent.	**Fully reversible** – Effects will diminish to baseline conditions **Partially reversible** – Effects will partially diminish to baseline conditions **Irreversible** – Effects are permanent and will not diminish to baseline conditions
Context	The extent to which the Aquatic Resources VC has been affected by past and present environmental and socio-economic processes and conditions, its potential sensitivity to the Project-related residual effect, and its ability to recover from that effect (i.e., resilience)	**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. **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 the capacity to assimilate more change. **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.

Notes: *LSA=Local Study Area; Project=Tenas Project; RSA=Regional Study Area; 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 Definition

The residual effects classification and associated prediction in changes to the measurement indicators provide the foundation for the determination of Sgnificance. Significance thresholds are defined for identified potential effects. If a threshold for an effect is exceeded, the residual effect is considered significant. All residual effects are carried forward to the CEA, regardless of Significance.

For the Aquatic Resources VC, a Significant adverse residual environmental effect is defined as a Project-related environmental effect that results in:

- a change in water quality or sediment quality parameters that results that alters the integrity of the Aquatic Resources VC beyond an acceptable level, defined as High Magnitude effects, Regional or greater in Extent, with a Long-term Duration, that is Irreversible.

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 allow 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; and
- **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.

5.4.2 Change in Water Quality

5.4.2.1 Residual Effect Characteristics

Changes in stream water quality parameter concentrations were evaluated in relation to guideline values and site performance objectives (SPOs), as well as in context with streams' natural variability observed through baseline monitoring. The assessment of water quality is provided in detail in **S4.0-C3 Surface Water VC)**.

Modelling results show potential exceedances of guidelines and the stream's natural concentrations for total selenium, nitrite, sulphate, and dissolved cadmium. There are no predicted exceedances of SPOs for any water quality parameters. All other parameters are below the limits set out in the guidelines. See **2. Regulatory Context** for applicable regulations and guidelines. **Table 5.4-2** summarizes the occurrence and magnitude of guideline and SPO exceedances in Tenas Creek and Four Creek and the affected area in context with the LSA and RSA. Additional exceedances of guidelines or SPOs are not expected in Goathorn Creek, Telkwa River and Bulkley River beyond those that have occurred historically in baseline data.

Table 5.4-2: Surface Water Quality Affected Areas based on Change in Modelled Parameter Concentration

Stream	Parameters with Exceedances of Guidelines and SPOs*	Comments on Exceedance	Affected Areas as a Percentage of the LSA	Affected Area as a Percentage of the RSA
Tenas Creek	Total Selenium	Guideline is expected to be exceeded by up to 2.0 times the value during the winter months in the Post-closure Phase only in sections of the creek downstream of the management ponds. Long-term modelling results (i.e., Year 2100) are below the guideline. No exceedances of the Tier 1 or Tier 2 SPO values are expected.	11%	1.6%
	Nitrite	Guideline is expected to be exceeded by up to 2.3 times the value during the winter months in the Post-closure Phase only in sections of the creek downstream of the management ponds. Long-term modelling results (i.e. Year 2100) are below the guideline. No exceedances of the SPO value are expected.		
	Sulphate	Guideline is expected to be exceeded by up to 1.2 times the value during the winter months in the Post-closure Phase only in sections of the creek downstream of the management ponds. Long-term modelling results (i.e. Year 2100) are below the guideline.		
Four Creek	Total Selenium	Guideline value is expected to be exceeded by up to 2.9 times the value during the winter months in the Post-closure Phase only in sections of the creek downstream of the management ponds. Long-term modelling results (i.e. Year 2100) are below the guideline. No exceedances of the Tier 1 or Tier 2 SPO values are expected.	3%	0.4%
	Nitrite	Guideline is expected to be exceeded by up to 1.9 times the value during the winter months in the Post-closure Phase only in sections of the creek downstream of the management ponds. Long-term modelling results (i.e. Year 2100) are below the guideline. No exceedances of the SPO value are expected.		
	Sulphate	Guideline is expected to be exceeded by up to 1.2 times the value during the winter months in the Post-closure Phase only in sections of the creek downstream of the management ponds. Long-term modelling results (i.e. Year 2100) are below the guideline.		
	Dissolved Cadmium	Guideline value is expected to be exceeded by up to 1.5 times the value during winter months in the Post-closure Phase only in sections of the creek downstream of the management ponds. Long-term		

Stream	Parameters with Exceedances of Guidelines and SPOs*	Comments on Exceedance	Affected Areas as a Percentage of the LSA	Affected Area as a Percentage of the RSA
		modelling results beyond the Post-closure Phase (i.e. Year 2100) are below the guideline. No exceedances of the SPO value are expected.		
Total Affected Area			**14%**	**2.0%**

Notes: *%=percent; LSA=Local Study Area; RSA=Regional Study Area; SPO=Site Performance Objective*

Two (2) SPOs were developed for total and dissolved selenium, described as a Tier 1 value of 0.008 milligram per litre (mg/L) and a Tier 2 value that is dependent on the sulphate concentrations of the receiving environment. For further information see ***S4.0-C3-3.2.3.1 Water Quality Guidelines (WQG) and Site Performance Objectives (SPOs).***

In total, the Project is expected to affect the water quality parameter concentrations over a catchment area that is equal to 14% of the area in the LSA and 2% of the area in the RSA. The affected area includes the downstream segments of Tenas and Four creeks. The affected area is only expected in the Post-closure Phase during low flow winter months, after seepage from management ponds reaches the downstream segments of each creek. Changes in water quality in Tenas and Four creeks is predicted to be High in Magnitude, Local in Geographical Extent, Short-term in Duration, Infrequent, Partially Reversible, and Moderate in Context. (**Table 5.4-3**).

Table 5.4-3: Summary of Effect Characterictics Rating for Aquatic Resources Valued Component (VC)

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	High	Level for some water quality parameters are predicted to exceed regulatory guidelines and SPOs.
Geographic Extent	Local	Increases in levels of water quality parameters that exceed guidelines will be limited to the parts of the LSA.
Duration	Short term	Measureable changes in one (1) or more water quality parameters are predicted to be above regulatory guidelines and SPOs for greater for brief periods in winter months only during Years 8-17 during the Post-closure Phase of the Project.
Frequency	Infrequent	Measureable changes in one (1) or more water quality parameters are predicted to be above regulatory guidelines and SPOs for brief periods in winter during the Post-closure phase of the Project
Reversibility	Partially Reversible	Changes in water quality parameters will remain through the final phase of the Project.
Context	Moderate	The Context of the residual effect of the change to surface water quality is predicted to be Moderate. Surface water is a valued resource in the region, but it has experienced historic and ongoing effects from agriculture, forestry, mining, and other land uses in the RSA.

Notes: *%=percent; LSA=Local Study Area; Project=Tenas Project; SPO=Site Performance Objective*

5.4.2.2 Likelihood

The residual effect of change to the Aquatic Resources VC as a result of changes in water quality parameter concentration is Unlikely. The modelling did not consider the potential for attenuation of loading through groundwater pathways, which is expected, and which would reduce the amount of change in some parameter concentrations. The modelling results for stream water quality are therefore considered to be conservative.

5.4.2.3 Significance Determination

The residual effect of change to the Aquatic Resources VC due to changes in water quality parameter concentrations is not expected to result in a change that will alter the integrity of the Aquatic Resources VC within the RSA to an unacceptable level (i.e., less than 5% of the RSA is effected). The effect is predicted to be Local in Geographic Extent and Partially Reversible, therefore, the effect is predicted to be **Not Significant**.

The Level of Confidence of this prediction is Moderate. The modelling used to inform the assessment has inherent sources of error based on characterisation of streamflow and geochemical source terms.

5.5 Summary of Project-related Residual Adverse Effects and Significance

Through the assessment process, a change in water quality was identified as a residual effect on the Aquatic Resources VC. The results of the residual effects characterisations is summarized in **Table 5.5 1.**

The residual effects of the Project on the Aquatic Resources VC were expected to be **Not Significant**. Water quality parameters will meet established guidelines for the protection of aquatic life or SPOs developed for the Project except for two (2) water quality parameters during the Post-closure Phase. Residual effects, Significant or Not Significant, are carried forward into the CEA.

Table 5.5-1: Summary of Residual Adverse Effects for Aquatic Resources Valued Component (VC)

Residual Effects	Contributing Activities within the Project Phases (C, O, D, P)	Proposed Mitigation Measures	Residual Effects Characterisation								
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Significance	Likelihood	Level of Confidence
Changes in Water Quality	Maintain post-mining systems and ongoing monitoring (P)	▪ Limit Project footprint and Project Area ▪ Avoid senstive environments ▪ Reclamation measures (Refer to **RCP**) ▪ Project footprint boundaries ▪ Transport measures ▪ Seepage management measures ▪ Erosion and sediment control (Refer to **SEPSCP** and **MWMP**) ▪ Water capture measures ▪ Spill prevention and response (Refer to **FMSCP**) ▪ Water quality monitoring and reporting measures	H	LSA	ST	IF	PR	M	NS	U	M

Notes: *C, O, D, P represent Project phases: (C)onstruction, (O)peration, (D)ecomissioning and Reclamation, (P)ost-closure*
FMSCP=Fuel Management and Spill Control Plan (S13.0-C7); MERP=Mine Emergency Response Plan (S13.0-C9); MWMP=Minesite Water Management Plan (S13.0-C11); Project=Tenas Project; SEPSCP=Surface Erosion Protection and Sediment Control Plan (S13.0-C17)
Magnitude: Low (L), Moderate (M), High (H)
Geographic Extent: Project Area (PA), Local (LSA), Regional (RSA), BR (Beyond RSA)
Duration: Short-term (ST), Medium-term (MT), Long-term (LT), Permanent (PT)
Frequency: Infrequent (IF), Frequent (FF), Continuous (CF)
Reversibility: Fully reversible (FR), Partially reversible (PR), Irreversible (IR)
Context: High (H), Moderate (M), Low (L)
Significance: Not-Significant (NS), Significant (S)
Likelihood: Likely (L), Unlikely (UL)
Level of Confidence: High (H), Moderate (M), or Low (L)
*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 Aquatic Resources VC. The environmental effects of past and present projects are captured in the baseline conditions presented in **4. Existing Conditions**. The focus of the CEA is to determine the likelihood of cumulative effects on the Aquatic Resources VC associated with ongoing and future projects. The spatial boundaries of the CEA for the Aquatic Resources VC refer to the Aquatic Resources RSA described in **3.2.4.1 Spatial Boundaries**. Projects and activities that are outside of the Aquatic Resources RSA but had residual effects that extended into the 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 (**3.2.4.2 Temporal Boundaries**).

6.1 Potential Cumulative Effects

As outlined in **5.4**, changes in water quality due to flow alterations, release of sediments, Minesite contact water, and blast residues was the only Project-related residual effect carried forward to the CEA (see **5.4**).

Baseline conditions represent past and present projects and activities, including all existing disturbance. A summary of the projects and activities identified within and/or predicted to have residual effects extending into the Aquatic Resources RSA is provided in **Table 6.1-1** and shown in **Figure 6.1-1.** It must be noted that other projects and activities listed in the Project and Activity Inclusion List (**S3.0 Assessment Methodology***)* are not considered in the Aquatic Resources CEA as the residual effects of some of these developments are not anticipated to overlap spatially with the residual effects of the Project and are not in proximity to the Aquatic Resources RSA.

Table 6.1-1: Projects Included in the Cumulative Effects Assessment (CEA) with Potential Interactions with Aquatic Resources Residual Effects

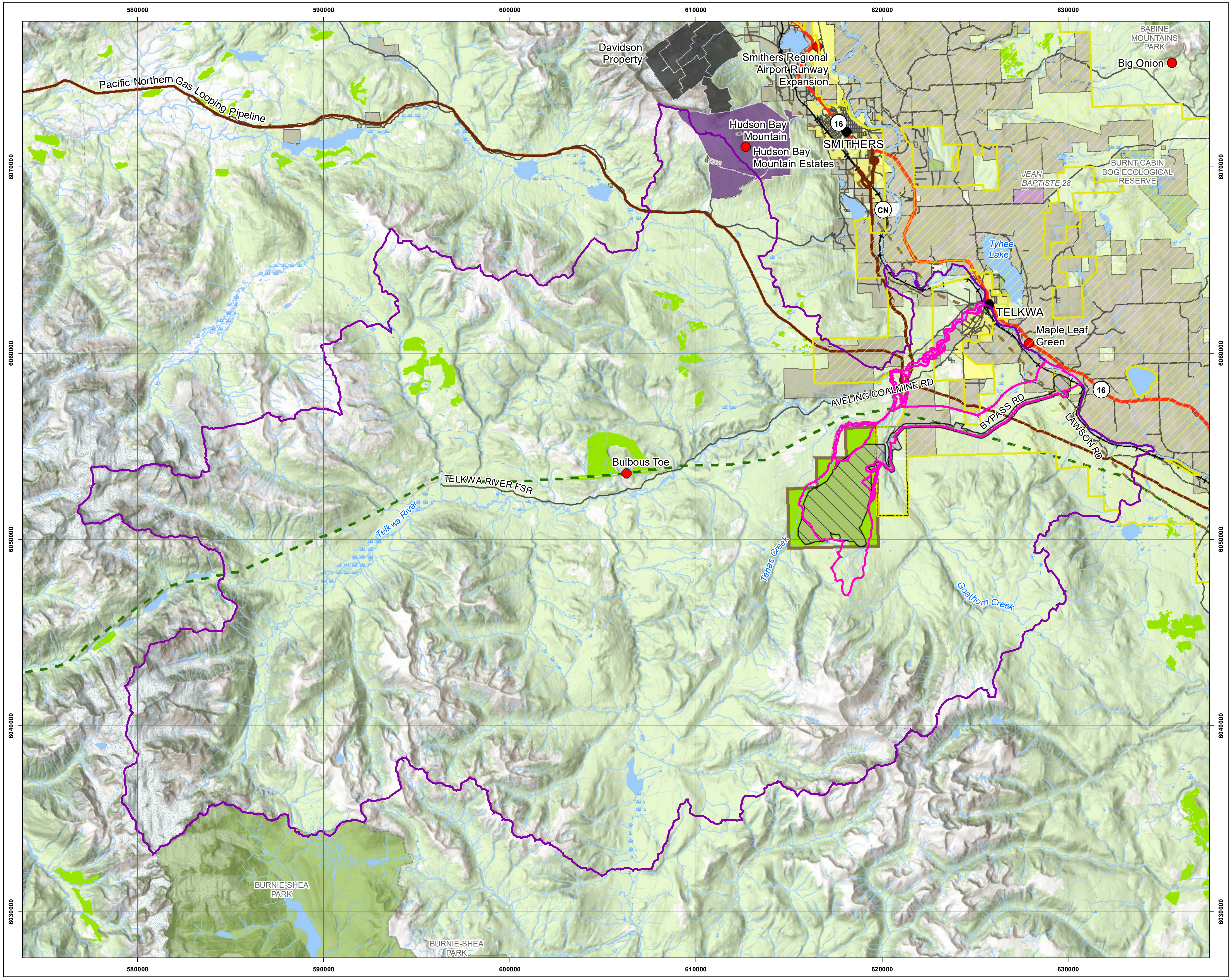
Project/Activity Name	Residual Effect
	Changes in Fish Habitat
Pacific Northern Gas Looping Pipeine	Yes
Telkwa to Smithers Bike Trail	Yes
Forestry Activities	Yes
Agricultural Activities	Yes

Spatial information is not available for some future projects and most activities. The location and level of the residual effects from reasonably foreseeable projects is not known, so the CEA is qualitative. The following projects and activities are expected to have residual effects on the Aquatic Resources VC within or extending into the Aquatic Resources RSA (**Figure 6.1-1**).

- Pacific Northern Gas Looping Pipeline: Pipeline construction is anticipated to require watercourse crossings in portions of the LSA and RSA. Crossings will likely require clearing of riparian vegetation along the pipeline ROW at watercourse crossings and may also necessitate instream works depending on the selection of crossing methods. This has the potential to degrade water quality in the sections of watercourses subject to potential sedimentation associated with Project activities in and around water;

- Telkwa to Smithers Bike Trail: This project has been routed predominantly along the Highway 16 ROW, where vegetation has experienced historic disturbance during highway construction and maintenance. Construction of the bike trail is anticipated to result in limited vegetation clearing which may occur in riparian areas of the Bulkley River within the RSA. The minimal amount of riparian disturbance is not anticipated to cause changes in water quality in these areas;
- Forestry Activities: The Aquatic Resources RSA is located within the Bulkley TSA. It is estimated that 6,977 hectares (ha) of forest within the RSA will be harvested between 2021 and 2073 (see **S4.0-C7 Vegetation VC** of the **EAC Application)**. Future forestry activities are expected to be conducted with consideration of provincial and regional biodiversity and Old Growth Forest management objectives, which include BMPs for operations in and around watercourses. These forestry activities may contribute result in erosion and sedimentation in watercourses within the RSA; and
- Agricultural Activities: Agricultural land uses (e.g., cultivation, tame pasture/hay) are present within the Aquatic Resources RSA, in the eastern portion. The current areal extent of agricultural activity within the RSA is not expected to change. However, ongoing agricultural activities may result in introductions of contaminants into watercourse within the RSA.

.



Tenas Project

Map of Projects and Activities for Cumulative Effects Assessment

Legend

- Project
- City/Town
- Rail Line
- Highway
- Road
- 138 kV Transmission Line
- 500 kV Transmission Line
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- First Nation Reserve
- Municipal Area
- General Private Property
- Tenas Coal Licenses
- Telkwa Coal Limited Private Property
- Project Area
- Aquatics and Fish & Fish Habitat Local Study Area
- Aquatics and Fish & Fish Habitat Regional Study Area
- Coastal GasLink Pipeline Ltd.
- Pacific Northern Gas Ltd.
- Pacific Trail Pipelines Management Inc.
- Telkwa to Smithers Bike Trail
- Hudson Bay Mountain Resort Tenure
- Mining Leases
- Agricultural Land Reserve (ALR)
- Forest Cutblock (Active or Pending)

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, April 21, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Base

N

1:200,000

0 2 4 6 8 10

Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

103260-04	Production Date: Oct 07, 2021	Figure 6.1-1

TELKWA COAL LIMITED

Hemmera An Ausenco Company

6.2 Additional Mitigation Measures

The projects and activities included in the CEA and described in **6.1** all include mitigation measures and requirements determined by their respective jurisdictions and regulatory agencies. Additional mitigation (i.e., that extends beyond the mitigation considered in the assessment of Project-related effects [**5.3 Mitigation Measures**]) is not considered to be necessary to avoid or minimize the predicted cumulative effects on the Aquatic Resources VC.

6.3 Cumulative Effects and Characterisation of Significance

The interactions between the predicted Project residual effects (**5.5**) and the residual effects of other projects and activities (**Table 6.1-1**) were evaluated to characterise potential cumulative effects on the Aquatic Resources VC. The predicted measurable changes in water quality from the Project occur solely within the LSA and are not expected to extend downstream into the Telkwa River; the Telkwa Watershed comprises the RSA. The only activity that is likely to occur within the LSA is forestry. Residual effects from the Project on water quality consist of elevated levels of total selenium, nitrite, sulphate, and dissolved cadmium in areas of Tenas Creek and Four Creek, in portions of the LSA. Effects of forestry on water quality in the RSA are expected to be limited to temporary increases in TSS and are not anticipated to cause further increases in levels of quality parameters.

Cumulative effects on the Aquatic Resources VC have been characterised following a similar framework (i.e., Magnitude, Geographical Extent, Duration, Frequency, Reversibility, Context, Likelihood) used for characterising residual effects and assigning Significance, and Level of Confidence (**5.4.1**). Using this framework, cumulative effects on the Fish Habitat subcomponent are characterised as follows.

Predicted cumulative effects on changes in water quality are predicted to be Low in Magnitude. The only interactions between the Project and other activities are limited to forestry activities within the LSA. The Duration of cumulative degradation of water quality will be Short-term and limited to periods of forestry activities next to water. Mitigations to control sedimentation during Construction Phase activities are expected to be effective at maintaining TSS levels within legislated guidelines; they are expected to return to background levels immediately following cessation of these activities.

Changes in water quality are expected to be Fully Reversible. Increases in TSS are expected to return to background levels immediately upon cessation of activities occurring next to watercourses.

Cumulative changes in water quality due to increases in TSS are expected to be Likely. Activities occurring next to or near water are expected to cause temporary increases in TSS that will return to background immediately following cessation of those activities.

As the cumulative effects resulting from water quality are expected to be Low in Magnitude, confined to the LSA, Short-term in Duration, and Reversible cumulative effects on Aqauatic Resources VC are predicted to be **Not Significant**.The Level of Confidence of this prediction is High. Cumulative changes in water quality are limited to increases in TSS from forestry activities. Forest practices and mitigations to control and eliminate sedimentation are well established and known to be effective at maintaining temporary increases in TSS within provincial guidelines.

Table 6.3-1: Summary of Cumulative Effects on Aquatic Resources Valued Component (VC)

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
Changes in Water Quality	▪ Ongoing projects and activities, including agricultural and forestry activities, and Smithers to Telkwa bike route (**Table 6.1-1**) (C, O, D, P) ▪ Reasonably foreseeable future projects and activities, including agricultural and forestry activities, Smithers to Telkwa bike route, and Pacific Northern Gas Looping Pipeline (**Table 6.1-1**) (C, O, D, P) ▪ Project-related activities as outlined in **Table 5.1-1** (C, O, D, P)	L	LSA	ST	IF	FR	M	U	NS	H

Notes: *C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecomissioning 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), Permanent (PT)
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 effect of the Project on the Aquatic Resources VC was carried forward to the CEA:

- change in water quality.

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 Aquatic Resources and are expected to be **Not Significant.** Considering this, the cumulative effects are not expected to alter the integrity of the Aquatic Resources VC within the Aquatic Resources 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 Aquatic Resources VC; however, this is expected to be mitigated with the implementation of forest management objectives under existing land use plans the Bulkley Land and Resource Management Plan (GovBC 1998), the Telkwa Landscape Unit Plan (GovBC 1999), and the Bulkley Valley Sustainable Resource Management Plan (GovBC 2005). As such, the cumulative effect on the Aquatic Resources VC is expected to be **Not Significant** (see **Table 6.4-1**).

Table 6.4-1: Summary of Cumulative Effects on the Aquatic Resources Valued Component (VC)

VC	Potential Cumulative Effect	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effect (Yes/No)	Significant (Yes/No)
Aquatic Resources	Changes in Water Quality	▪ Ongoing projects and activities, including agricultural and forestry activities, and Smithers to Telkwa bike route (**Table 6.1-1**) (C, O, D, P) ▪ Reasonably foreseeable future projects and activities, including agricultural and forestry activities, Smithers to Telkwa bike route, and Pacific Northern Gas Looping Pipeline (**Table 6.1-1**) (C, O, D, P) ▪ Project-related activities as outlined in **Table 5.1-1** (C, O, D, P)	No	No

Notes: *C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecomissioning and Reclamation, (P)ost-closure*
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 Aquatic Resources Valued Component (VC)

The following potential effects to the Aquatic Resources VC could occur due to interactions with the Project:

- changes in water quality;
- changes in sediment quality; and,
- changes in periphyton and benthic invertebrate diversity.

Mitigation measures employed during all Project phases will reduce potential effects on the Aquatic Resources VC; however, these effects are not anticipated to be fully mitigated and residual effects related to changes water quality are predicted during Project the Post-closure Phase. The Project effects are not expected to alter the integrity of the Aquatic Resources VC in the RSA beyond an acceptable level (i.e., it remains sustainable and is available to contribute to ecological function) and upon characterisation and determination of Likelihood and Significance, the Project residual effect for the Aquatic Resources VC is **Not Significant.** The Level of Confidence for this prediction is Moderate.

Changes in water quality was carried forward to the CEA and assessed in relation to 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 Aquatic Resources VC within the 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 Aquatic Resources VC; however, this is expected to be mitigated with the implementation of existing provincial and regional biodiversity and BMPs. As such, the cumulative effect on the Aquatic Resrouces 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.

8.1 Monitoring

The assessment of the Project on the Aquatic Resources VC has determined residual effects and cumulative effects to be **Not Significant**. Targeted monitoring and inspection will be implemented to verify the accuracy of residual effects and the efficacy of mitigation measures. Two (2) types of monitoring should be implemented:

1. compliance monitoring to document implementation of environmental protection measures; and
2. environmental monitoring to detect alterations in receiving environments (water quality, benthic invertebrate and periphyton abundance/composition/diversity, and sediment quality).

The purpose of compliance monitoring is to confirm that mitigation measures are implemented management plans and best management practices. Compliance monitoring will take place during the construction of the Minesite components and throughout all phases of the Project. At least one (1) experienced supervisor will be onsite during start-up and at critical periods of construction. Information that will be documented during construction will include:

- written and photo-documented sequence of events during the Construction Phase;
- any changes in the design necessary to adapt to unanticipated conditions;
- technical issues that arise during the Construction Phase and how they were addressed;
- confirmation that all offsetting components meet design requirements; and
- confirmation that relevant terms and conditions of the *Fisheries Act*, RSC, c. F-14 (GovCan 1985) authorization are met.

Environmental monitoring will detect alterations to the receiving environment, including changes to water quality, benthic invertebrate and periphyton abundance/composition/diversity, and sediment quality. Additional monitoring if alterations in water quality and aquatic resources are detected. This plan will include provisions for identification of causes of alteration and implementation of additional mitigation measures or adaptive management strategies if effects are identified.

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. Comprehensive descriptions of monitoring for the Aquatic Resources VC will be provided in management plans developed for the Project. Contents of management plans, including monitoring requirements and methods, will be developed with input from the Wet'suwet'en. A list of management plans relevant to the Aquatic Resources VC include:

- AQMP
- Chemicals and Materials, Storage, Transfer, and Handling Plan (S13.0-C3) (CMSTHP);
- CEMP;
- DMP;
- Explosives Management Plan (S13.0-C6) (EMP);
- FMSCP;
- MERP;
- MWMP;
- Metal Leaching (ML)/Acid Rock Drainage (ARD) Management Plan (S13.0-C12) (ML/ARDMP);
- RCP;
- SEPSCP;
- VMP;
- Waste Management Plan for Refuse and Emissions (S13.0-C20) (WMPRE); and
- WMP.

8.2 Follow-up

Where mitigation measures are deemed to be not 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 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.

Considering the findings of the EA, the proposed management plans and monitoring, and the adaptive management approach, it was deemed that a Trigger Action Response Plan (TARP) would be developed to establish and identify objectives and normal operating procedures, monitoring, trigger thresholds, actions to be implemented when thresholds are surpassed, and responses (including further mitigations or offsetting) for water quality and water quantity in streams where changes in base flows and water quality parameters are predicted. Thresholds for water quality will be established through the development of SPOs, and water quantity thresholds will be identified through modelling of critical flow levels for which the viability of fish. Components of monitoring in the TARP will include:

- compliance and biotic response monitoring for permanent flow diversions and discharges from mine water management ponds;
- compliance monitoring to verify that flows are within predicted ranges. This should be done through installation and maintenance of continuous recording flow gauges for measuring instream flows and diversions;
- biotic response monitoring that follows a BACI design, in which “control” sites (i.e., streams without water withdrawal projects) are monitored simultaneously with “impact” sites for a predetermined period both before, during, and after Project implementation; and
- adherence to published and science-based water quality guidelines where possible.

For parameters that do not meet CCME guidelines, SSWQO or a scientifically-based environmental benchmark (SBEB) will be used, per BC MECSS guidance.

9. REFERENCES

Bio Logic Consulting. 2003. A Benthic Invertebrate Index of Biological Integrity for Streams in the Bulkley TSA: Field Season 2002. Available at: https://www.for.gov.bc.ca/hfd/library/fia/2005/FIA2005MR147d.pdf. Accessed January 2022.

Bio Logic Consulting. 2005. A Multimetric Approach to Skeena Region Stream Assessments. Available at: https://www.for.gov.bc.ca/hfd/library/fia/2005/FIA2005MR147d.pdf. Accessed January 2022.

British Columbia Conservation Data Centre. (BC CDC) 2021. BC Species and Ecosystems Explorer. Available at: http://a100.gov.bc.ca/pub/eswp/. Accessed August 2021.

British Columbia Environmental Assessment Office (BC EAO). 2013. Guideline for the Selection of Valued Components and Assessment of Potential Effects. Available at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/environmental-assessments/guidance-documents/eao-guidance-selection-of-valued-components.pdf . Accessed: March 2020.

British Columbia Environmental Assessment Office (BC EAO). 2022. Tenas Project Application Information Requirements. Prepared by Telkwa Coal for the British Columbia Environmental Assessment Office. Vancouver, BC.

British Columbia Ministry of Environment (BC MOE). 2013. British Columbia Field Sampling Manual. Part E. Water and Wastewater Sampling. BC Ministry of Environment.

British Columbia Ministry of Environment (BC MOE). 2016. Water and Air Baseline Monitoring Guidance Document for Mine and Operators. Version 2 – June 2016. Available at: https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/ug_water_and_air_baseline.pdf. Accessed February 2019.

British Columbia Ministry of Environment and Climate Change Strategy (BC MECCS). 2018. Manual of British Columbia Hydrometric Standards, Version 2.0. Ministry of Environment and Climate Change Strategy. Knowledge Management Branch. December 2018. Available at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/man_bc_hydrometric_stand_v2.pdf. Accessed December 2021

British Columbia Ministry of Environment and Climate Change Strategy (BC MECCS). 2019. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Available at: http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-water-quality-guidelines. Accessed February 2019.

British Columbia Ministry of Environment and Climate Change Strategy (BC MECCS). 2020. Working Water Quality Guidelines for British Columbia. British Columbia Ministry of Environment and Climate Change Strategy, Water Protection & Sustainability Branch: Victoria, BC. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf. Accessed February 2019.

British Columbia Ministry of Forests (BC MOF). 2002. Forest road engineering guidebook. For. Prac. Br., B.C. Min. For., Victoria, B.C. Forest Practices Code of British Columbia Guidebook.

Bustard, D. 1984. Assessment of Benthic Invertebrate and Juvenile Fish Populations in Goathorn and Tenas Creeks and the Lower Telkwa River, September 1983.

Bustard, D. 1985. Telkwa Coal Project Aquatic Resource Assessment. Prepared by D. Bustard and Associates for the Telkwa Coal Project: Smithers, BC.

Canadian Council of Ministers of the Environment (CCME). 2001. Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota. Winnipeg, MB. Canadian Council of Ministers of the Environment. http://ceqg-rcqe.ccme.ca.

Canadian Council of Ministers of the Environment (CCME). 2014. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Winnipeg, MB. Canadian Council of Ministers of the Environment. http://ceqg-rcqe.ccme.ca

Canadian Council of Ministers of the Environment (CCME). 2019. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life.http://st-ts.ccme.ca/en/index.html. Accessed: February 2019.

Clements, W. H., D. M. Carlisle, J. M. Lazorchak, and P. C. Johnson. 2000. Heavy metals structure benthic communities in Colorado mountain streams. Ecological Applications 10:626–638.

Crossroads Cultural Resource Management (Crossroads). 2021. Tenas Project: Cultural Use Study. Prepared for Telkwa Coal Ltd.

Department of Fisheries and Oceans Canada (DFO). 2019. Fish and Fish Habitat Protection Policy Statement. Available at: https://www.dfo-mpo.gc.ca/pnw-ppe/policy-politique-eng.html. Accessed August 2020.

Environment Canaada (EC). 2012a. Canadian Aquatic Biomonitoring Network Field Manual for Wadeable Streams. En84-87/2012EPDF.

Environment Canada (EC). 2012b. Canadian Aquatic Biomonitoring Network Laboratory Methods for Processing, Taxonomy, and Quality Control of Benthic Invertebrate Samples. En84-86/2012E-PDF. Water Quality Monitoring and Surveillance Division.

Environment Canada (EC). 2012c. Metal Mining Technical Guidance for Environmental Effects Monitoring. https://www.ec.gc.ca/esee-eem/AEC7C481-D66F-4B9B-BA08-A5DC960CDE5E/COM-1434---Tec-Guide-for-Metal-Mining-Env-Effects-Monitoring_En_02[1].pdf

Environmental Resources Management (ERM). 2020. Telkwa Project Baseline Report: 2017-2020. Prepared for Telkwa Coal Ltd.

Frontier Geosciences Inc. 1999. Selenium Results. Report to Stephen Day BC Research Selenium Results.

Geoscience BC. 2009.Quest-West Project Sample Reanalysis. Geoscience BC 2009-05. Available at: http://cdn.geosciencebc.com/project_data/QUEST-West/Geochemistry/GBC_Report_2009-5/GBC_Report_2009-05.pdf. Accessed January 2022.

Government of British Columbia (GovBC). n.d. a. Canadian Aquatic Biomonitoring Network (CABIN) database. Available at: https://cabin-rcba.ec.gc.ca/cabin/login?culture=en-CA. Accessed January 2022.

Government of British Columbia (GovBC). n.d. b. Environmental Monitoring System - Periphyton biomass. Available at: https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/environmental-monitoring-system. Accessed January 2022.

Government of British Columbia (GovBC). 1995. Riparian management area guidebook. British Columbia Ministry of Forests and British Columbia Ministry of Environment, Lands and Parks, Victoria, BC.

Government of British Columbia (GovBC). 1996. *Mines Act,* RSBC 1996. c. 293. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96293_01. Accessed May 2020.

Government of British Columbia (GovBC). 1997. *Riparian Areas Protection Act,* SBC 1997 c. 21. Available at: https://canlii.ca/t/543lf. Accessed November 2021.

Government of British Columbia (GovBC). 1998. Bulkley Land and Resource Management Plan. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/skeena-region/bulkley-lrmp/bulkley_lrmp.pdf. Accessed January 2022.

Government of British Columbia (GovBC). 1999. Telkwa Landscape Unit Plan. Available at: https://www.for.gov.bc.ca/ftp/dss/external/!publish/web/landscape/Telkwa%20LUPm.DOC. Accessed January 2022.

Government of British Columbia (GovBC). 2002. *Environmental Assessment Act*, SBC 2002, c. 43. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/18051. Accessed May 2021.

Government of British Columbia (GovBC). 2003. *Environmental Management Act*, SBC 2003, c. 53. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/03053_00. Accessed March 2018.

Government of British Columbia (GovBC). 2005. Bulkley Valley Sustainable Resource Management Plan. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/skeena-region/bulkleyvalley-srmp/bulkley_srmp.pdf

Government of British Columbia (GovBC). 2014. *Water Sustainability Act*, SBC 2014, c. 15. Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/14015. Accessed May 2021.

Government of Canada (GovCan). 1985a. *Canada Water Act*. RSC., 1985, c. C-11 Available at: https://laws-lois.justice.gc.ca/eng/acts/c-11/index.html. Accessed May 2021.

Government of Canada (GovCan). 1985b. *Fisheries Act*, RSC, c. F-14. Available at: https://laws-lois.justice.gc.ca/eng/acts/f-14/. Accessed August 2020.

Government of Canada (GovCan). 1999. *Canadian Environmental Protection Act,* SC., 1999, c.33. Available at: https://laws-lois.justice.gc.ca/eng/acts/c-15.31/. Accessed May 2021.

Government of Canada (GovCan). 2002. *Species at Risk Act*, SC 2002, c. 29 (*SARA*). Available at: https://laws.justice.gc.ca/eng/acts/S-15.3/. Accessed July 2019.

Government of Canada (GovCan). 2021. Proposed Coal Mining Effluent Regulations: overview. https://www.canada.ca/en/environment-climate-change/services/managing-pollution/sources-industry/proposed-coal-mining-effluent-regulations.html. Accessed July 2021.

Hill et al. 2000. Use of Periphyton Assemblage Data as an Index of Biotic Integrity March 2000. Journal of the North American Benthological Society 19(1):50-67. DOI:10.2307/1468281. Abstract at: https://www.researchgate.net/publication/235793620_use_of_periphyton_assemblage_data_as_an_index_of_biotic_integrity. Accessed January 2022

Niyogi, D. K., Lewis, W. M., Jr, and McKnight, D. M. (2002). Effects of stress from mine drainage on diversity, biomass, and function of primary producers in mountain streams. Ecosystems 5, 554–567.

Price, W.A. and J.C. Errington. 1998. Guidelines for Metal Leaching and Acid Rock Drainage in British Columbia. Ministry of Energy and Mines. Victoria, BC.

Poulton, B. C., D. P. Monda, D. F. Woodward, M. L. Wildhaber, and W. G. Brumbaugh. 1995. Relations between benthic community structure and metals concentrations in aquatic macroinvertebrates: Clark Fork River, Montana. Journal of Freshwater Ecology 10:277–293. Roy, A.H., Rosemond, A.D., Leigh, D.S., Paul, M.J. and Wallace, J.B. 2003. Habitat-Specific Responses of Stream Insects to Land Cover Disturbance: Biological Consequences and Monitoring Implications. Journal of the North American Benthological Society 22(2): 292-307.

Stumpf 2012. Till Geochemistry and Clast Lithology Studies of the Bulkley River Valley, West-Central British Columbia (parts of NTS 093L). Geoscience BC 2008-012. Available at: http://www.geosciencebc.com/i/project_data/GBC_Report2012-11/GBCR2012-11_Report_rev.pdf. Accessed January 2022.

Telkwa Coal Limited (TCL). 2018 Tenas Project – Project Description. Vancouver, BC.

Hedgmann et al. 1999. Effects Assessment Practitioners' Guide. Prepared for Canadian Environmental Assessment Agency by The Cumulative Effects Assessment Working Group. Water Quality Monitoring and Surveillance Division. Hegmann, G., C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kingsley, W. Ross, H. Spaling, D. Stalker and AXYS Environmental Consulting Ltd. 1999. Available at: https://publications.gc.ca/collections/Collection/En106-44-1999E.pdf. Accessed: December 2019.

Wood, P.J. and Armitage, P.D. 1997. Biological Effects of Fine Sediment in the Lotic Environment. Environmental Management 21(2): 203-217.

Y.E. Yudovich, M.P. Ketris. 2006. Selenium in coal: a review. International Journal of Coal Geology, Volume 67, Issue 1-2, pp. 112-126.