



BC EAO EAC Application - DRAFT

Section 4.0 Environmental Effects Assessment

Chapter 6 Fish and Fish Habitat Valued Component

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Tenas Project

Section 4.0 Environmental Effects Assessment Chapter 6 Fish and Fish Habitat Valued Component

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ABBREVIATIONS AND ACRONYMS

Abbreviation	Long form of Abbreviation
AIR	Application Information Requirements
ALS	ALS Environmental Laboratories
ARD	Acid Rock Drainage
AWS	Area Weighted Suitability
BACI	Before-After-Control-Impact
BC	British Columbia
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 MOE	British Columbia Ministry of Environment
BC MFLNRO	British Columbia Ministry of Forests, Lands, and Natural Resource Operations
BC MFLNRORD	British Columbia Ministry of Forests, Lands, Natural Resource Operations, and Resource Development
BC MWLAP	British Columbia Ministry of Water, Land, and Air Protection
BGC	Biogeoclimatic
BMP	best management practices
C	Chapter
CCME	Canadian Council of Ministers of the Environment
CEA	cumulative effects assessment
CEMP	Construction Environmental Management Plan (S13.0-C4)
CMSTHP	Chemicals and Materials, Storage, Transfer, and Handling Plan (S13.0-C3)
CPP	Coal Processing Plant
CPUE	Catch Per Unit Effort
Crossroads	Crossroads Cultural Resource Management
CUS	Cultural Use Study
DFO	Department of Fisheries and Oceans Canada
DMP	Discharge Management Plan (S13.0-C5)
EA	Environmental Assessment
EAA	<i>Environmental Assessment Act</i> , SBC 2002, c 43 (Government of British Columbia [GovBC] 2002)
EAC	Environmental Assessment Certificate
EFN	environmental flow needs
EFN Policy	Environmental Flow Needs Policy
EMP	Explosives Management Plan (S13.0-C6)

Abbreviation	Long form of Abbreviation
FMSCP	Fuel Management and Spill Control Plan (S13.0-C7)
FSR	Forest Service Road
GovBC	Government of British Columbia
GovCan	Government of Canada
HADD	harmful alteration, disruption, or destruction
HSI	Habitat Suitability Index
ICP-MS	Inductively Coupled Plasma – Mass Spectrometry
IFA	instream flow assessment
IFM	instream flow methods
LSA	Local Study Area
LWD	large woody debris
MAD	mean annual discharge
MERP	Mine Emergency Response Plan (S13.0-C9)
ML/ARD	metal leaching/acid rock drainage
ML/ARDMP	Metal Leaching (ML)Acid Rock Drainage (ARD) Management Plan (S13.0-C12)
MWMP	Minesite Water Management Plan (S13.0-C11)
NCD	Non-classified Drainage
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
PoE	pathways of effects
POPC/COPC	Parameters of Potential Concern/Contaminants of Potential Concern
Project	Tenas Project
RCP	Reclamation and Closure Plan (S13.0-C15)
RIC	Resources Inventory Committee.
RISC	Resource Inventory Standards Committee
ROW	right-of-way
RSA	Regional Study Area
S	Section
SARA	<i>Species at Risk Act</i> , SC 2002, c 29 (Government of Canada [GovCan] 2002)
SC	subcomponent
SEFA	System for Environmental Flow Analysis
SEPSCP	Surface Erosion Prevention and Sediment Control Plan (S13.0-C17)
SPO	site performance objective
SWD	small woody debris

Abbreviation	Long form of Abbreviation
TAC	Tenas Access Corridor
TARP	Trigger Action Response Plan
TCL	Telkwa Coal Limited
TK	Traditional knowledge
TSA	Timber Supply Area
TSS	total suspended solid
US EPA	United States Environmental Protection Agency
VC	Valued Component
VMP	Vegetation Management Plan (S13.0-C18)
WMP	Wildlife Management Plan (S13.0-C21)
WMPRE	Waste Management Plan for Refuse and Emissions (S13.0-C20)
WSA	<i>Water Sustainability Act</i> , SBC 2014, c 15 (Government of British Columbia [GovBC] 2014)
YOY	young-of-year

UNITS OF MEASURE

Abbreviation	Long form of Abbreviation or Acronym
°C	degrees Celsius
<	less than
µg	microgram
µg chl a/cm ²	micrograms of chlorophyll a per square centimetre
%	percent
g	gram
ha	hectare
hrs	hour
Hz	Hertz
kg	kilogram
km	kilometre
km ²	square kilometre
kV	kilovolt
m	metre
m ²	square metre
m ² /m	square metres per metre
m ³ /s	cubic metres per second
mg	milligram

Abbreviation	Long form of Abbreviation or Acronym
mm	millimetre
sec.	second
V	volt
wwt	wet weight

EXECUTIVE SUMMARY

This chapter addresses the potential effects of the Tenas Project (Project) on the Fish and Fish Habitat Valued Component (VC). Fish and Fish Habitat were selected as a VC based on the likelihood of interaction with the Project, the importance of fish to Indigenous communities, as economic and recreational components of fisheries, and as an important indicator of overall aquatic ecosystem health. Subcomponents and associated indicators within the Fish and Fish Habitat VC refer to:

- ▶ Fish: change in fish health, change in fish abundance, change in fish condition; and
- ▶ Fish Habitat: Change in areal extent which is permanently altered, destroyed, or made inaccessible to fish.

Potential effects on the Fish and Fish Habitat VC and associated subcomponents include:

- ▶ change in fish habitat: change in the aerial extent of available fish habitat due to the destruction or alteration of fish habitat, changes in baseflows, degradation of water quality, or creation of barriers to fish passage; and
- ▶ change in fish health: change in the health, abundance, or the condition of fish due to direct impacts, stranding, or degradation of water quality.

The alteration of fish and fish habitat relevant to the Project includes changes in habitat structure and cover, changes in sediment concentrations, changes in water temperature, changes in food and nutrient concentrations, changes in mortality of fish and eggs, changes in contaminant concentrations (water quality), changes in base flows, displacement or stranding of fish and changes in fish migration and access to habitats. Alteration of fish habitats can reduce the productivity of fish habitat and result in lower number of fish or a reduction in fish health. Changes in fish health and mortality can affect the viability of self-sustaining local and regional fish populations.

The Project will be developed to design-specifications to avoid, minimize, and offset potential effects on the Fish and Fish habitat VC and subcomponents 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 Fish and Fish Habitat during Project phases.

The Project residual effects on Fish and Fish Habitat are expected to be **Not Significant**. Considering this, the Project effects are not expected to alter the productivity and viability of the Fish and Fish Habitat VC within the Fish and Fish Habitat Regional Study Area (RSA). With implementation of fish habitat offsetting for harmful alteration, destruction, or disruption of fish habitats (HADDs), a net gain of fish habitat productivity is predicted.

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), and after determining that no additional mitigation measures are expected to be necessary, it was predicted that there is no potential for Project residual effects to interact cumulatively within the RSA. The Level of Confidence for these predictions is High.

1. INTRODUCTION

This chapter presents the identification and assessment of the residual effects of the Tenas Project (Project) and cumulative effects on the Fish and Fish Habitat Valued Component (VC). Activities associated with construction, operation and closure of the Project have the potential to affect the physical structure of fish habitat (including water quality and quantity), and fish health, including fish mortality. This chapter examines potential effects of the Project on sub-basins of the Telkwa River watershed where 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. The Fish and Fish Habitat VC is represented by two (2) subcomponents: Fish Habitat and Fish.

This assessment is comprised of the following subsections:

- ▶ **Regulatory Context:** This subsection describes the regulatory framework relevant to the Fish and Fish Habitat VC;
- ▶ **Scope of the Assessment:** The VC selection process is described. Following the confirmation of the Fish and Fish Habitat as a VC, subcomponents, and indicators for the VC are selected, and assessment boundaries for the analysis are established;
- ▶ **Existing Conditions:** The existing conditions of the subcomponents VC are described;
- ▶ **Assessment of Project-related Effects:** Potential interactions between the Project and the subcomponents 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 subcomponents 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 Fish and Fish Habitat.

2. REGULATORY CONTEXT

This Environmental Assessment Certificate (EAC) Application has considered applicable federal and provincial legislation, regulations, strategies, guidelines, plans, and best management practices (BMPs) relevant to the Fish and Fish Habitat VC, and includes information provided by Indigenous groups.

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 EAC Application for the Fish and Fish Habitat VC to meet the provincial environmental assessment (EA) requirements under the *Environmental Assessment Act* SBC 2002, c 43 (Government of British Columbia [GovBC] 2002) (EAA). The EA for the Fish and Fish Habitat VC follows these guidelines and legislated requirements and is consistent with the requirements of the Project AIR.

Management of fisheries in British Columbia (BC) is shared by the Department of Fisheries and Oceans Canada (DFO) and the British Columbia Ministry of Forests, Lands, Natural Resource Operations, and Resource Development (BC MFLNRORD). DFO is responsible for managing anadromous fish in BC and fish habitat in Canada. BC MFLNRORD is responsible for managing freshwater fish in BC.

2.1 *Fisheries Act*

The federal *Fisheries Act*, 1985. c. F-14 (Government of Canada [GovCan 1985a]) (hereafter referred to as *Fisheries Act*) is the main federal law governing fisheries in Canada, and its purpose is to provide a framework for effectively managing and controlling fisheries, conserving, and protecting fish habitat, and preventing pollution of fish habitat.

Fish habitat, as defined by the *Fisheries Act* is: "... water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas" (subsection 2[1]). Provisions for protecting fish and fish habitat apply to all fish and fish habitat throughout Canada. The provisions for protecting and preventing harm to fish and fish habitat include the following:

- ▶ a prohibition against causing the death of fish, by means other than fishing (Section 34.4);
- ▶ a prohibition against causing the harmful alteration, disruption, or destruction (HADD) of fish habitat (Section 35);
- ▶ a framework of considerations to guide the Minister's decision-making functions (Section 34.1); and
- ▶ ministerial powers to ensure the free passage of fish or the protection of fish or fish habitat with respect to existing obstructions (see 3.4.3).

2.2 *Species at Risk Act*

The *Species at Risk Act*, SC 2002, c. 29 (GovCan 2002) (*SARA*) regulates management of Canadian indigenous species, subspecies, and distinct populations to prevent species from becoming extirpated or extinct; provides for the recovery of endangered or threatened species; and encourages the management of other species to prevent them from becoming at-risk. *SARA* prohibits killing, harming, harassing, capturing, or taking wildlife listed as extirpated, endangered, or threatened (Schedule 1).

SARA prohibits damage to defined residences and designated critical habitat of listed species and applies only on federal land. In some circumstances, federal prohibitions can be applied to other species on private

or provincial Crown land if it is deemed that provincial or voluntary measures do not adequately protect a species and its residence. Specific sections of *SARA* outlining relevant prohibitions are as follows:

- ▶ Section 32 – prohibition against killing, harming, harassing, capturing, or taking an individual of a species listed as extirpated, endangered, or threatened; and
- ▶ Section 33 – prohibition against damaging or destroying the residence of individuals of a species listed as extirpated, endangered, or threatened.

There are no fish species listed on Schedule 1 of the *SARA* present in watercourses potentially affected by the Project, nor are any designated critical habitats present.

2.3 Water Sustainability Act

The BC *Water Sustainability Act*, SBC 2014, c 15 (GovBC 2014) (*WSA*) regulates water rights and use in the province. In BC, changes in and about a stream may be made only with an approval under s. 11 of the *WSA* (formerly s.9 of the *Water Act*) and s. 4 of the *Water Sustainability Regulation*, BC Reg 36/2016 (GovBC 2016), or through a notification, where applicable. An approval is required where the works are more complex in nature (e.g., water diversions, channel relocation/removal), whereas notifications can be used when the works do not involve the diversion of water, the changes are considered low risk, and the effects on the environment are minimal. Temporary use of water (a prescribed quantity for a prescribed use over a prescribed period) in BC or pumping of groundwater is only permitted with approval under s. 10 of the *WSA*. The *WSA* also provides special protection for designated sensitive streams in BC; none of the watercourses potentially affected by the Project are designated sensitive streams under the *WSA*.

2.4 Other Regulatory Guidance

Other relevant acts, policies, and guidelines related to the protection of fish and fish habitat include the following:

- ▶ fish and fish habitat protection policy statement (DFO 2019a);
- ▶ policy for applying measures to offset adverse effects on fish and fish habitat under the *Fisheries Act* (DFO 2019b);
- ▶ *Canadian Navigable Waters Act*, RSC, 1985, c. N-22 (GovCan1985b);
- ▶ Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME 2020);
- ▶ *Mines Act*, RSBC 1996, c 293 (GovBC 1996);
- ▶ *Environmental Management Act*, SBC 2003, c. 53 (GovBC 2003); and
- ▶ Metal Mining Environmental Effect Monitoring Technical Guidance Document (Environment Canada 2011).

2.5 Best Management Practices (BMPs)

BMPs applicable to the Fish and Fish Habitat VC are listed in **Table 2.5-1**. These documents were considered when identifying the potential effects of the Project, developing appropriate mitigation measures, and characterising residual and cumulative effects.

Table 2.5-1: Best Management Practices (BMPs) Applicable to Fish and Fish Habitat Valued Component (VC)

Best Management Practice	Year	Description
Measures to Protect Fish and Fish Habitat (DFO 2019c).	2019	Advice to proponents conducting a project near water, which applies to all project types. Listed measures include: ▪ Project planning ▪ Maintenance of riparian vegetation ▪ Erosion and sediment control ▪ Management of deleterious substances near water ▪ Fish protection ▪ Avoidance of works below the high-water mark
Standards and Best Practices for Instream Works (BC MWLAP 2004)	2004	Provincial standards and recommended BMPs that appropriately address fish populations and habitat protection in the proposal and implementation of instream works in keeping with the <i>Water Sustainability Act</i> , SBC 2014, c. 15 (GovBC 2014) Provides an outline for the planning, design, and construction of all instream works requirements for projects.
Fish-stream Crossing Guidebook (BC MFLNRO et al. 2012).	2012	Provincial standards and recommended BMPs that appropriately address fish populations and habitat protection in the construction of fish-stream crossings as they relate to the <i>Forest and Range Practices Act</i> , SBC 2002, c 69 and the <i>Fisheries Act</i> , 1985. c. F-14 (GovCan 1985a)
Freshwater Intake End-of-pipe Fish Screen Guideline (DFO 1995)	1995	Provides guidance on design and installation of water intake fish screens to protect fish.
Land Development Guidelines for the Protection of Aquatic Habitat (DFO 1993)	1993	Provides guidance to protect fish and fish habitat from the potential effects of land development (including regarding erosion and sediment control).

Notes: BC MFLNRO=British Columbia Ministry of Forests, Lands, and Natural Resource Operations; BC MWLAP=British Columbia; Ministry of Water, Land, and Air Protection; BMP=best management practice; DFO=Department of Fisheries and Oceans Canada; GovBC=Government of British Columbia; GovCan=Government of Canada

3. SCOPE OF THE ASSESSMENT

The Fish and Fish Habitat assessment, including the assessment of Project-related effects and cumulative effects, was conducted according to the methods set out in **Section (S) 3.0 Assessment Methodology** of the EAC Application. The assessment boundaries specific to the Fish and Fish Habitat VC are provided in **0** and the characterisation criteria specific to the Fish and Fish Habitat VC are provided at the start of **5.4**.

This subsection outlines the scope of the assessment, including the rationale for the inclusion of Fish and Fish Habitat as a VC along with its subcomponents, the selection of indicators, and the definitions of boundaries. The assessment is informed by the Fish and Fish Habitat Chapter of the **Tenas Project 2017 to 2019 Baseline Report (Appendix 4.1-C of S4.0-Chapter (C)-1 Atmospheric Environment VC of the EAC Application)** (hereafter referred to as **Appendix 4.1-C**), as well as input from Indigenous groups, the public and government agencies through working groups and comment solicitation, which identified the importance of Fish and Fish Habitat. This assessment is organized into two (2) subcomponents: Fish Habitat and Fish.

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 EAC Application** for details on the consultation program. The 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 candidate VCs to represent the themes.

Key themes of interest identified through the consultation, and reviews of other information related to Fish and Fish Habitat were:

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

3.2 Rationale for Selection of Fish and Fish Habitat Valued Component (VC)

The Fish and Fish Habitat VC and associated subcomponents were selected during the pre-Application phase of the Project following the VC selection process set out in **S3.0-C1 Assessment Methodology** and used the methodology provided in the Guideline for Selection of Valued Components and Assessment of Potential Effects (BC EAO 2013). The goal was to focus 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 Component (VC)

Fish and Fish Habitat was selected as a VC because of potential interactions of the Project with watercourses supporting fish populations. Fish are important for economic, cultural, and recreational reasons. Additionally, fish often have commercial, food, cultural, and ceremonial importance for Indigenous communities (DFO 2019a). As a top predator in the aquatic food chain, fish are important indicators of overall aquatic ecosystem health. The health of the aquatic ecosystem can be maintained by identifying important fish and fish habitat that may be affected by the Project and developing and implementing avoidance and mitigation measures to reduce potential project-related effects on fish and fish habitats.

Watercourses potentially affected by the Project sustain fish species such as Pacific salmon, trout, and char, which comprise and support Indigenous, recreational, and commercial fisheries. Construction, Operations, and Decommissioning and Reclamation phase activities associated with the Project have the potential to interact with fish species and the habitat upon which they depend. Construction will require clearing of riparian vegetation, diversion of flows, creation of a Bypass Road (including culvert and bridge construction over watercourses), disposal of waste rock, and infilling of small order, non-fish-bearing watercourses. Operations will involve ongoing management of water and transport of coal along the proposed Bypass Road to the Rail Infrastructure. Closure will include ongoing management and monitoring of mine water. These activities have the potential to adversely affect the availability and productivity of fish habitat and to cause changes in fish mortality and fish health.

The Fish and Fish Habitat VC has linkages, both dependent and supporting, to other VCs:

► **Dependent On:**

- **Atmospheric Environment VC (S4.0-C1)** – Atmospheric environment interacts with fish habitat through air quality and dust deposition, which can affect water quality;
- **Terrain and Soils VC (S4.0-C2)** – Terrain and soils interact with fish and fish habitat by contributing to riparian form and function, ecosystem moisture and groundwater inputs to aquatic ecosystems. Terrain, soil, and vegetation are, together, key components of reclamation design and reinstatement of riparian function;
- **Surface Water VC (S4.0-C3)** – Surface water sustains aquatic ecosystems. The volume of surface water flows is vital in shaping stream morphology and represents the extent of fish habitat. The quality of surface water (chemical attributes, dissolved oxygen, clarity) is critical in sustaining fish health;
- **Groundwater VC (S4.0-C4)** - Groundwater can supply a substantial proportion of stream flows, depending on the time of year. Groundwater can sustain streams – and thus fish. Groundwater augments 'baseflows' during summer months when rainfall is scarcest and spring snowmelt has run its course. Because it is insulated in the ground, groundwater can regulate stream temperature. Groundwater temperatures are remarkably stable throughout the year, staying close to the average annual air temperature;
- **Aquatic Resources VC (S4.0-C5)** – 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)** - Vegetation contributes to ecosystem form and function that support fish and fish habitat (e.g., wetland and riparian ecosystems);

► **Supporting:**

- **Wildlife VC (S4.0-C8)** – Fish provide food sources for wildlife and riparian areas provide essential habitat for many wildlife species;

- ▶ **Avian Species VC (S4.0-C9)** – Fish provide food sources for some avian species and riparian areas provide essential habitat for many avian species;
- ▶ **Land and Resource Use VC (S6.0-C4)** – Fish provide resource value as food, recreational, and commercial fisheries; and
- ▶ **Human Health VC (S8.0-C1)** – Fish are harvested for food in Indigenous, recreational, and commercial fisheries.

3.2.2 Subcomponents

Subcomponents have been selected to focus the Fish and Fish Habitat VC assessment on key themes of interest identified through consultation, and reviews of other information. The assessment of the Fish and Fish Habitat VC includes the following two (2) subcomponents (SC):

1. Fish Habitat; and
2. Fish.

3.2.2.1 Fish Habitat

Fish habitat was selected as a subcomponent as attributes such as habitat structure, habitat availability, water quality, water quantity, substrate composition, and riparian vegetation are required to sustain fish species populations. These attributes provide the conditions necessary to support healthy and functioning freshwater aquatic ecosystems. Project activities that may interact with the Fish and Fish Habitat VC have the potential to interact with other components of the aquatic ecosystem, such as aquatic plants, insects, and benthic invertebrates. Environmental protection measures to prevent or reduce effects on Fish and Fish Habitat may also mitigate potential environmental effects on other aspects of the aquatic ecosystem.

3.2.2.2 Fish

Fish were selected as a subcomponent as watercourses potentially affected by the Project provide habitat for several fish species that contribute to Indigenous, recreational, and commercial fisheries, including fish that are provincially listed as species of concern. These species include, but are not limited to, Dolly Varden (*Salvelinus malma*), Pacific salmon species (*Oncorhynchus spp.*), and steelhead/rainbow trout (*O. mykiss*). Project activities such as the construction of roads and watercourse crossings have the potential to alter fish habitat through changes in water quality and quantity, and changes in aquatic organism availability.

Project activities have the potential to cause harm to fish through direct injury or by altering water quality and quantity.

Table 3.2-1 summarizes the rationale for inclusion of fish habitat and fish as sub-components, as well as the linkages of the Fish and Fish Habitat VC to other VCs/subcomponents.

Table 3.2-1: Summary of Rationale for Selection of Valued Components (VCs) and Subcomponents and their Linkages

Subcomponent	Rationale for Selection	Source of Information	VC Linkages	
Fish Habitat	- Watercourses potentially affected by the Project provide habitat for several fish species that contribute to Indigenous, recreational, and commercial fisheries; - Project activities have the potential to alter fish habitat through changes in water quality and quantity, and changes in aquatic organism availability; - Sensitive to disturbance; - Cultural importance; and - Historically addressed for previous projects with similar conditions.	<i>Fisheries Act</i>, RSC, c. F-14 (Government of Canada [GovCan] 1985) <i>Species at Risk Act</i>, SC 2002, c 29 (GovCan 2002) (SARA) <i>Water Sustainability Act</i>, SBC 2014, c. 15 (Government of British Columbia [GovBC] 2014) - Issues scoping	Dependent on: - Atmospheric Environment - Terrain and Soils - Surface Water - Groundwater - Aquatic Resources - Vegetation	Supporting: - Wildlife - Avian Species - Land and Resource Use - Human Health
Fish	- Project activities have the potential to cause harm to fish through direct injury or by altering water quality and quantity; - Sensitive to disturbance; - Cultural importance; and - Historically addressed for previous projects with similar conditions.	- Federal Fisheries Act - Federal Species at Risk Act - Provincial Water Sustainability Act - Issues scoping	Dependent: - Surface Water - Groundwater - Aquatic Resources	Supporting: - Land and Resource Use - Human Health

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 Fish and Fish Habitat.

Table 3.2-2: Indicators for Fish and Fish Habitat Subcomponents

Indicator	Rationale for Selection
Fish Subcomponent	
Change in fish health	The Project has the potential to alter fish health and increase mortality rates through a reduction in water quality or through direct contact during construction activities.
Change in fish abundance	The Project has the potential to alter fish abundance through a reduction in fish habitat quantity or quality.
Change in fish condition	The Project has the potential to alter fish condition through a reduction in water quality or habitat quality.
Fish Habitat Subcomponent	
Change in areal extent permanently altered, destroyed, disturbed, or made inaccessible to fish	The Project has the potential to reduce fish habitat productivity through the alteration and/or the destruction of fish habitat, as well as creating barriers to fish passage that makes fish habitat inaccessible to fish.

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 Fish and Fish Habitat VC, respectively. 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

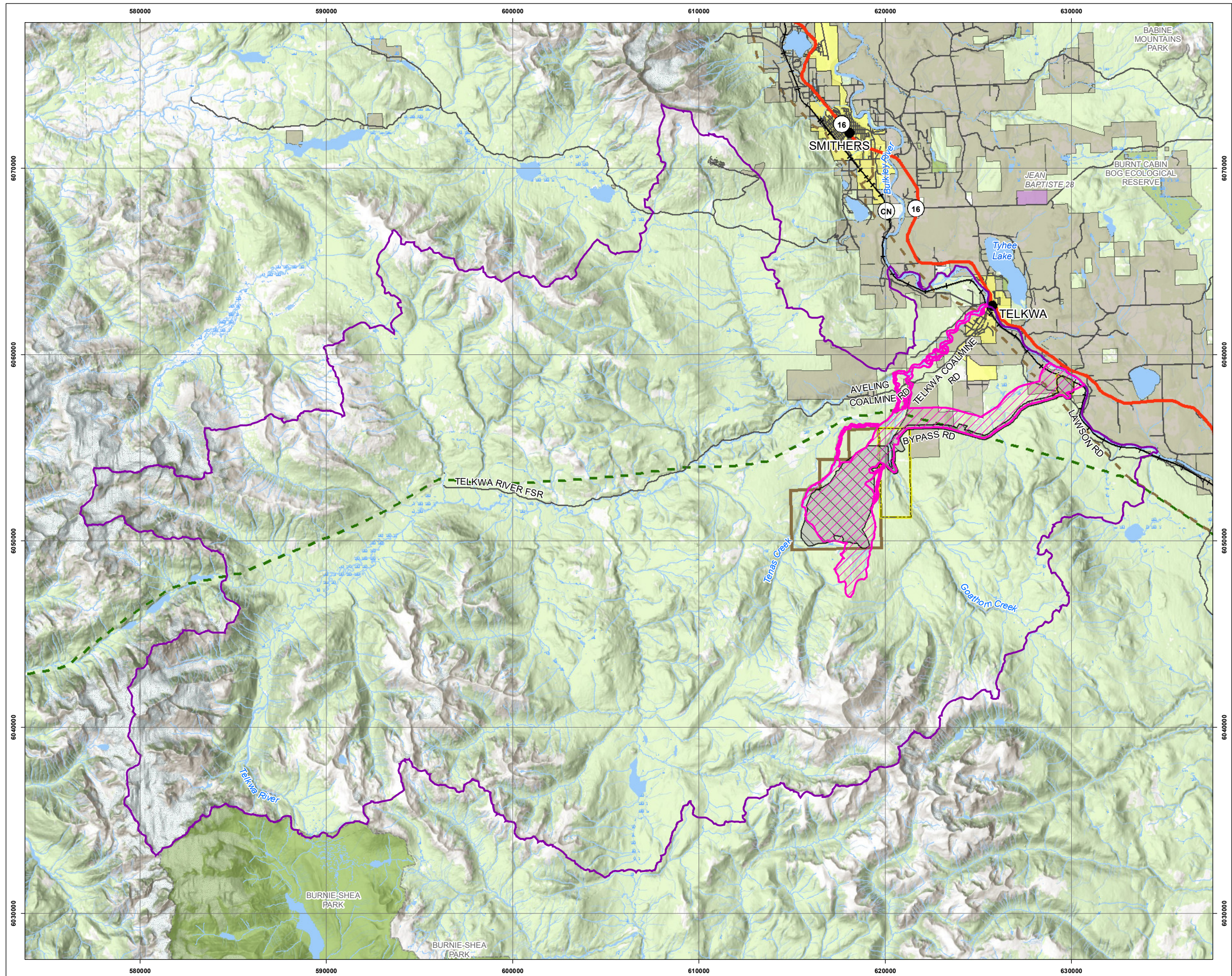
The spatial boundaries delineated for the Fish and Fish Habitat VC are described in **Table 3.2-3** Error! Reference source not found. and shown in **Figure 3.2-1**. The Project Area is where ground-disturbance and Project activities will occur, and within which the Project will be constructed and operated, including the Minesite and access routes. The Project Area is described in detail in **S3.0-3.1 Spatial Boundaries** of the **EAC Application**. The Project Area is a conservative estimate of the area of direct disturbance effects on the Fish and Fish Habitat VC within this assessment.

The Fish and Fish Habitat Study Areas include the Local Study Area (LSA) and the Regional Study Area (RSA). The 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 RSA includes those instream and riparian areas in which Project-related effects may reasonably interact with effects from other projects. The RSA also corresponds with the cumulative effects assessment (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 Fish and Fish Habitat Valued Component (VC)

Spatial Boundary	Description of Study Area
Local Study Area (LSA)	The LSA encompasses fish habitats within the Project footprint; areas of Four Creek, Tenas Creek, and Goathorn Creek downstream of the footprint; and from 100 metres (m) upstream to 300 to 1,000 m downstream on watercourses crossed by the proposed Tenas Access Corridor (TAC).
Regional Study Area (RSA)	The RSA encompasses fish habitats of the Telkwa River Watershed and in tributaries to the Bulkley River crossed by the proposed Bypass Road.

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Tenas Project

Fish and Fish Habitat Local and Regional Study Areas

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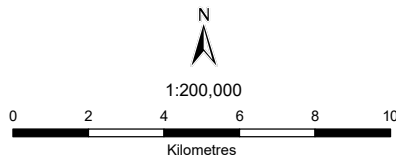
- Fish and Fish Habitat Local Study Area
- Fish and Fish Habitat Regional Study Area
- City/Town
- Rail Line
- Highway
- Road
- 138 kV Transmission Line
- 500 kV Transmission Line
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- First Nation Reserve
- Municipal Area
- General Private Property
- 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



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Production Date: Sep 09, 2021

Figure 3.2-1



3.2.4.2 Temporal Boundaries

Temporal boundaries for the assessment of effects on the Fish and Fish Habitat VC are defined by the Project's Construction, Operation, Decommissioning and Reclamation, and Post-closure phases. The Project phases are summarized as follows (**Table 3.2-4**) and described in detail in **S1.0 Overview of Proposed Project and Proponent Description of the EAC Application**:

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 British Columbia Ministry of Environment and Climate Change Strategy (BC MECCS) Skeena Regional District, and in Management Unit 6-9 in the DFO Skeena (Region 6) Region. 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 – in the case of the Project, the Bulkley TSA. DFO regions and management units determine fisheries-related management objectives specific to watercourses that are located in or flow through or into that division as well as establishing fishing regulations applicable to the region, management unit, and specific watercourses.

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 were no technical boundaries identified for the Fish and Fish Habitat VC.

4. EXISTING CONDITIONS

The information in this subsection provides a summary of baseline studies completed to characterise existing conditions for the Fish and Fish Habitat VC. It provides the context for the effects assessment for the Fish and Fish Habitat 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 Fish and Fish Habitat VC is described more fully in Chapter 11 of **Appendix 4.1-C**.

4.1 Background Information and Studies

4.1.1 Traditional Knowledge (TK)

The Fish and Fish Habitat 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)** presented as **Appendix 7.1-B in S7.0-C1 Heritage Resources VC**, 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 (Crossroads Cultural Resource Management [Crossroads] 2021).

The recognition of the value of the natural environment, including fish, 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 2021)

"...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). Given their provision of salmon, some culturally important waterways in the Regional Study Area are the Bulkley and Telkwa Rivers." (Crossroads 2021)

Fish are important to Wet'suwet'en culture and history:

"Wet'suwet'en life-ways have historically revolved around the summer salmon fishery; during the rest of the year, family groups dispersed to their Houses' resource areas. (Rabnett 2000:i)" (Crossroads 2021).

"Salmon and steelhead were a significant food source for the Wet'suwet'en, and lamprey were often eaten as well (Morris et al. 2006:21). Salmon was of such critical importance to Wet'suwet'en culture, economy, and governance that their return was celebrated each year, and a feast was held marking the first catch (Morin 2016:89-90)." (Crossroads 2021)

"The harvesting, processing, and preserving of fish for the winter food store was an exhaustive activity that involved nearly all members of Wet'suwet'en society." (Crossroads 2021)

“...some anadromous fish harvested by the Wet’suwet’en are: char, chinook, coho, pink, steelhead, and sockeye salmon, as well as bull trout and Pacific Lamprey; and the freshwater species they gather include: burbot, chub, dace, Dolly Varden, kokanee, lake trout, mountain whitefish, northern pike minnow, rainbow trout, sculpin, suckers, and white sturgeon (CSTC 2006; BC MFLNRD 2017; Morin et al. 2006; Morris et al. 2006; OW 2014). Morice sockeye are the largest and most important fish to the Wet’suwet’en in the Bulkley River basin. Wet’suwet’en use various parts of fish. For example, fish meat can be cooked or smoked; dark oolichan grease can be used as a cooking oil, a medicine for hair loss, or to tan moose hides; white oolichan grease can be used as a flavour enhancer and a cleansing medicine; and fish eggs can be eaten as a snack, often alongside seaweed (TERA 2015).” (Crossroads 2021)

“Salmon fisheries are a significant source of trade and subsistence goods for the Wet’suwet’en, and are, thus, vital for their cultural continuity. Traditional fishing laws, established and refined through thousands of years of interaction between the Wet’suwet’en and their physical environment, incorporate conservational values shared by the community. As a result, most restrictions placed over Wet’suwet’en fisheries have been self-enforced (OW 2011:35).” (Crossroads 2021)

4.1.2 Scientific and Other Information

Literature reviews were undertaken to obtain an awareness of existing scientific and other information and identify its applicability to the assessment. Information sources reviewed are included in **Table 4.1-1**. Most information on fish distribution and habitat in the study areas was collected from Habitat Wizard (British Columbia Ministry of Environment [BC MOE] 2018), which compiles information collected from various public reports, including consultant reports, government reports, and permit summary reports. Some reports were available in full text, including aquatic resource assessments conducted by precursors of the project.

Most of the available data were for the mainstems of the larger watercourses potentially affected by the Project – Goathorn Creek, Tenas Creek, Telkwa River, and the Bulkley River– and were collected for the Telkwa coal mine footprint between 1982 and 1998. There was little to no existing information for smaller tributaries to these watercourses.

Table 4.1-1: Information Sources Considered in the Literature Review for Fish and Fish Habitat Valued Component (VC)

Document Name
Bustard, D. 1983. 1982 Investigations of Adult Coho Salmon in the Telkwa River. Smithers, BC: Produced by Dave Bustard and Associates for Crowsnest Resources Ltd. (Appendix 4.6-A).
Bustard, D. 1983. 1982 Investigations of adult pink salmon in the Telkwa River. For READ Environmental & Planning Associates Ltd
Bustard, D. 1984. Assessment of Benthic Invertebrate and Juvenile Fish Populations in Goathorn and Tenas Creeks and the Lower Telkwa River, 1983. (Appendix 4.5-A of S4.0-C5 Aquatic Resources)
Bustard, D. 1985. Telkwa Coal Project Aquatic Resource Assessment. Prepared by D. Bustard and Associates for the Telkwa Coal Project: Smithers, BC (Appendix 4.5-B of S4.0-C5 Aquatic Resources)
Bustard, D. 1998. Telkwa Coal Project Aquatic Resources Inventory. Prepared for Telkwa Coal Ltd. by Dave Bustard & Associates: Smithers, BC.
Crows Nest Resource Ltd. and READ Environmental & Planning Associates Ltd. 1983. Telkwa Project: Stage I Application. For Energy, Mines and Petroleum Resources, Government of British Columbia, Victoria, BC.

Document Name
Triton. 1997. 1996 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 13 (Telkwa River Watershed). Prepared by Triton Environmental Consultants Ltd. for Pacific Inland Resources Ltd. and BC Ministry of Environment, Lands and Parks: Terrace, BC.
British Columbia Ministry of Environment (BC MOE). 2018. HabitatWizard. British Columbia Ministry of Environment and Climate Change Strategy Habitat Wizard website. < http://www.env.gov.bc.ca/habwiz/ >. Accessed 2017, 2018, 2019, 2020.

4.1.3 Baseline Studies

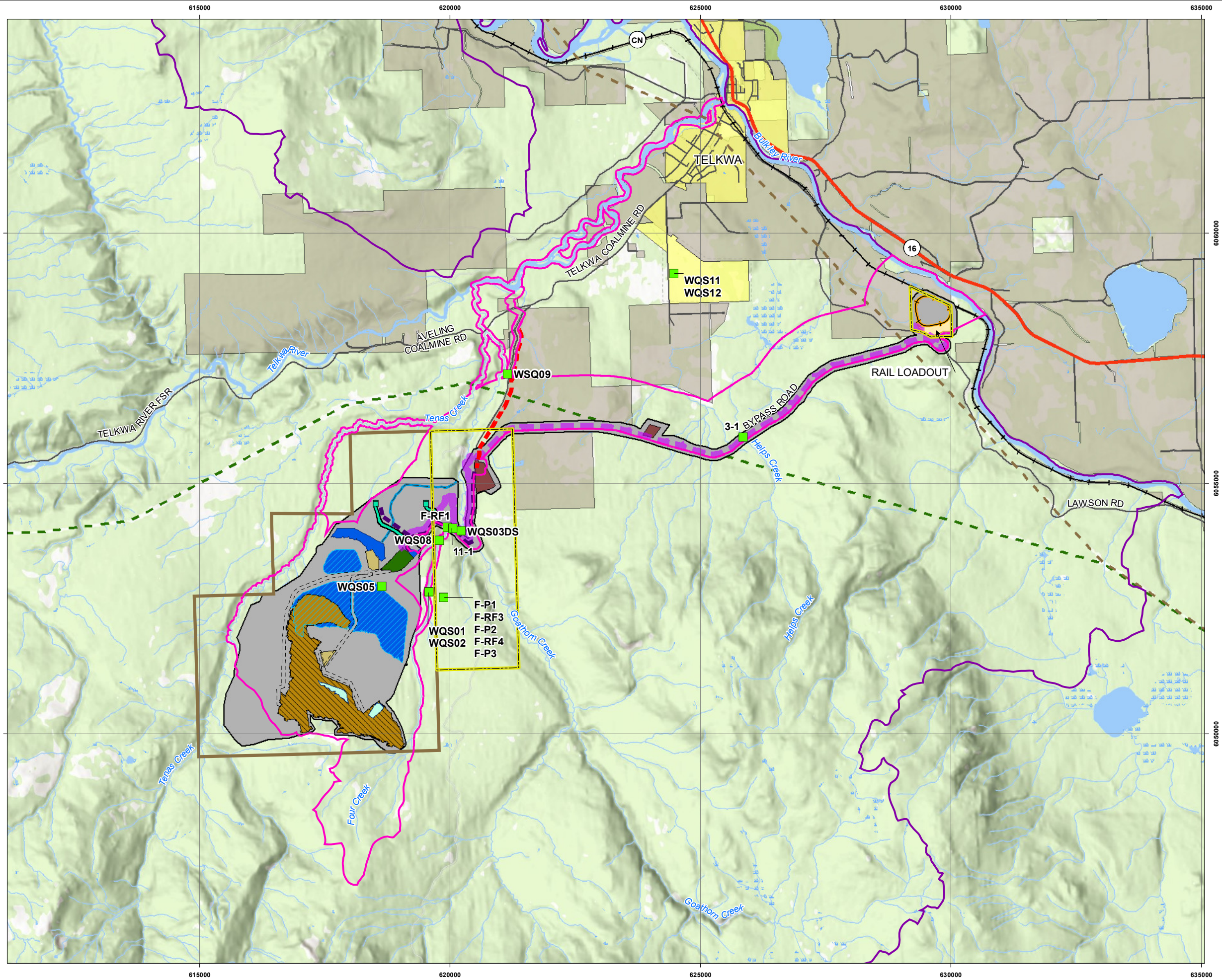
Baseline studies for Fish and Fish Habitat were designed to supplement historical data, provide robust fish and fish habitat data for watercourses potentially affected by the Project and reference sites in near-field, mid-field, and far-field locations. Study design was based on methods recommended in the Environmental Effects Monitoring Technical Guidance Document (Environment Canada 2011), so that baseline data collected would be suitable for use in a Before-After-Control-Impact (BACI) monitoring program after Minesite development.

Baseline studies occurred between 2017 and 2020 and are listed in **Table 4.1-2**. Five (5) distinct fish and fish habitat baseline programs were completed. **Figure 4.1-1** shows locations where each program occurred.

Table 4.1-2: Summary of Baseline Studies Related to Fish and Fish Habitat Valued Component (VC)

Study Name	Study Purpose, Duration and Spatial Boundaries
Fish Habitat Assessments	Assessments were completed to characterise fish habitat in watercourses potentially affected by the Tenas Project (Project). Studies occurred in 2017, 2018, and 2020 in six watercourses: Tenas Creek, Four Creek, Tributary to Four Creek, Goathorn Creek, Telkwa River, and Bulkley River.
Fish Community Sampling	Fish sampling to determine fish presence and species composition was completed in watercourses potentially affected by the Project. Fish sampling occurred in six (6) watercourses in 2017 and 2018: Tenas Creek, Four Creek, Tributary to Four Creek, Goathorn Creek, Telkwa River, and Bulkley River.
Fish Tissue Metals Sampling	Fish tissue metals sampling was completed in watercourses potentially affected by the Project. Fish sampling occurred in four (4) watercourses in 2017 and 2018: Tenas Creek, Goathorn Creek, Telkwa River, and Bulkley River.
Watercourse Crossing Surveys	Fish and fish habitat surveys were completed at 22 watercourse crossings along the proposed Tenas Access Corridor (TAC) in 2018.
Environmental Flow Needs Assessments	Environmental flow needs (EFN) assessments were carried out in Tenas Creek and Four Creek in 2019 and 2020 to inform the assessment of flow-related effects on fish and fish habitat.
Fish Abundance Sampling	Fish abundance sampling was carried out in Four Creek in the summer and fall of 2020 to complement EFN studies.

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Tenas Project

Fish Sampling Locations

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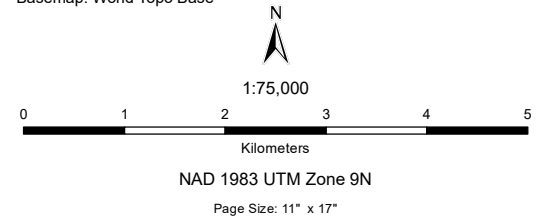
Fish Sampling Location	Project Features
Fish and Fish Habitat Local Study Area	Existing 25 kV Power Line
Fish and Fish Habitat Regional Study Area	25 kV Power Line
Rail Line	Haul Road
Highway	Rail Loop
Road	Discharge Path
Watercourse	Tenas Access Corridor
Wetland	Backfill Area
Waterbody	Control and Plant Sedimentation Pond
Municipal Area	Explosive Infrastructure
General Private Property	Management Pond
138 kV Transmission Line	Mine Infrastructure Complex
500 kV Transmission Line	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



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Production Date: Sep 17, 2021

Figure 4.1-1

TELKWA COAL
LIMITED

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4.1.3.1.1 *Methods*

A summary of the fish and fish habitat baseline studies methodologies is provided below. The detailed description of baseline study methods can be found in **Appendix 4.1-C**. Fish and fish habitat baseline studies were conducted at all identified sampling locations in either 2017, 2018, or 2019.

4.1.3.1.2 *Fish Habitat Assessments*

Stream habitat assessments were conducted at all sites in either 2017 or 2018. At each site, the watercourse was assessed using methods based on the Reconnaissance 1:20,000 Fish and Fish Habitat Inventory Protocol (Resource Inventory Standards Committee [RISC] 2001) and the Reconnaissance 1:20,000 Fish and Fish Habitat Inventory: Site Card Field Guide (Resources Inventory Committee [RIC] 1999).

This protocol involves characterising fish habitat over a 100 metre (m)-long section of watercourse by measuring physical attributes (e.g., channel width, gradient, temperature, and water quality), characterising cover types and substrate (dominant and sub-dominant cover and substrate type, cover abundance, and location), and describing stream morphology. Data and field observations were recorded on the Reconnaissance 1:20,000 Fish and Fish Habitat Inventory Site Card (RIC 1999).

Data collected for each habitat variable were used to evaluate the overall quality of fish habitat. Professional knowledge and expertise were used to rank habitat suitability for each fish life history stage (i.e., spawning, rearing, and over-wintering), and overall habitat quality (categorized as none, marginal, important, or critical).

4.1.3.1.3 *Fish Community Sampling*

Fish sampling at the Project was conducted during October 2017 and June 2018 to determine fish presence, and fish species composition. The study design for fish community sampling followed RISC Fish Collection Methods and Standards (RIC 1997), and the Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures (RISC 2001).

For the determination of fish presence and species composition, electrofishing was conducted over a minimum 100 m stream section using one pass with no stop nets. A systematic sweep was conducted across the entire wetted width from the downstream to the upstream site boundary. Electrofisher voltage (volt [V]), duty cycle (percent [%]), and frequency (Hertz [Hz]) settings remained consistent to the extent practical. Electrofishing in spawning areas during fish spawning activity was avoided to reduce the chance of harming fish and adversely affecting spawning activities.

Salmon spawning surveys were conducted during the 2018 field season. Aerial surveys were performed, followed by ground surveys. Chinook spawning surveys were conducted in August 2018. A one (1)-day aerial survey was completed, followed by point surveys on the ground where the river was safely accessible. These surveys occurred on the Telkwa River as well as on lower Goathorn Creek. Aerial coho spawning surveys took place in October 2018. The ground surveys were then completed in November 2018 and focused on lower Goathorn Creek, from the Coal Mine Road Bridge to the confluence with the Telkwa River.

Fish captured during the 2017 and 2018 baseline programs were sampled for biological data, including fork length, weight, condition, and age. Following capture, fish were identified to species and measured to the nearest 1 millimetre (mm) with a measuring board. Species with a forked tail (e.g., steelhead/rainbow trout) were measured from the nose to the tail notch for fork length. Species without a forked tail (e.g., suckers) were measured from the nose to the end of the tail for total length. Wet weight was collected (to the nearest

0.01 gram [g]). Observations were recorded on the general condition of fish, noting the presence of deformities, erosions, lesions, and tumours, and age (through the collection of scale and fin ray samples from a subsample of fish).

To determine fish age, scales were collected with tweezers below the posterior margin of the dorsal fin on the left side of the sampled fish. For fish that were sacrificed for tissue metal sampling, otoliths were collected as ageing structures. Aging structures from each fish were placed on wax paper and kept in an envelope labeled with the site, date, species, and unique sample number and sent to North/South Consultants Inc. (Winnipeg, Manitoba) for analysis. Age was estimated by counting the number of annuli (yearly rings) on each structure. Scales were attached to plastic fiches and annuli were counted with a microfiche reader. Otoliths were polished and mounted to plastic fiches and annuli were counted under a microscope.

4.1.3.1.4 Fish Tissue Metals Sampling

To collect fish for tissue metal analysis, effort was expended during fish community sampling to collect the required number of fish. Fish health and tissue metal sampling was conducted at receiving and reference sites. Sampling was conducted in October 2017 and June 2018, with the objective being to acquire sexually mature fish for analyses of fecundity. Steelhead/rainbow trout of similar fork length (generally between 90 and 180 mm) were collected for tissue metals analysis at each site. Fish were sacrificed in the field and kept on ice, then dissected in the office at the end of each field day. Each fish was sampled for fork length, body weight, sex, maturity, gonad weight (where possible), liver weight, and age. Fillets were removed from both sides of the fish and dissected to remove skin and bones. All muscle tissues were placed in labelled plastic bags, frozen, and shipped to ALS Environmental Laboratories (ALS) of Vancouver, BC for metals analysis, under proper chain-of-custody protocol.

Once in the laboratory, samples were placed in aluminum weigh boats and weighed to the nearest 0.001 g to provide a total sample weight. Tissue samples were analyzed for metals concentrations according to procedures adapted from United States Environmental Protection Agency (US EPA) (1995). The tissue samples were then placed in a mechanical convection oven at a temperature of 100.3 degrees Celsius (°C) for a period of 24 to 36 hours (hrs). Once the tissue samples were dried, they were weighed in the weigh boat to determine the dry weight of the tissue. Tissue samples were homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis was by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS). Mercury concentrations were analyzed by atomic fluorescence spectrophotometry. Silver concentrations were analyzed in 2017, but not 2018.

4.1.3.1.5 Watercourse Crossing Surveys

A detailed description of methods used to complete watercourse crossing surveys can be found in the **Stream Assessment Report #1** completed for the proposed Tenas Access Corridor (TAC), prepared by DWB Consulting Services Limited (**Appendix 4.6-B**). Field investigations were conducted by a two (2)-person crew outfitted with forest survey and fish sampling equipment. Surveys consisted of fish sampling (electrofishing), channel measurements, instream and bank biophysical characterization, in-situ water quality measurements, and fish barrier identification.

All survey information was recorded on RISC Stream Site Cards. All watercourses were given a stream classification based on definitions in the Riparian Management Area Guidebook (Province of British Columbia 1995).

4.1.3.1.6 Fish Habitat Quality Ratings

For all stream reaches assessed, fish habitat was rated to help determine potential fish use and support the stream classification assigned. Fish habitat values assessed included rearing, spawning, and overwintering habitats with a ranking of nil, poor, moderate or good assigned and a brief rationale provided on site cards. Considerations for downstream and upstream habitats were also described at the reporting stage, which provided information on stream linkages and the type, quality, and quantity of fish habitat potentially available.

For any defaulted or confirmed fish-bearing stream, the assessed fish habitat values were used to assign an overall fish habitat rating (none, marginal, important, or critical) based on criteria provided in the Fish-stream Crossing Guidebook (British Columbia Ministry of Forests, Lands, and Natural Resource Operations [BC MFLNRO] et al. 2012). This information allows for increased choice and direction on appropriate stream crossing structures during road layout and design.

4.1.3.1.7 Determination of Barriers to Fish Passage

If fish were not captured during the initial assessment or if site conditions did not allow sampling to occur (i.e., low flows, dry stream or temperatures below fish permit tolerance), field effort was focused on determining why fish were not present. If a downstream natural barrier was found to support the field findings (as is often the case with small streams), the stream was classified non-fish bearing with a single sample event.

A natural barrier may consist of waterfalls and cascades over bedrock that were assessed as impassable to fish (generally minimum of 1 m vertical height with less than 1.5 m deep pool present below), sustained gradients over 20%, or lost channel definition accompanied by flow infiltration creating an overland barrier. If a fish barrier could not be confirmed and fish habitat was available, the stream was defaulted to fish-bearing and a second season of sampling was recommended.

4.1.3.1.8 Environmental Flow Need (EFN) Assessments

Instream flow data was collected in Tenas and Four creeks during the late-summer and autumn of 2019, and during mid-summer and autumn of 2020. Winter surveys were conducted in late winter of 2021 to evaluate overwintering potential for fish in Four Creek. A detailed description of methods used to undertake Environmental Flow Needs (EFN) assessments can be found in the Tenas Creek and Four Creek Environmental Flow Needs Study (Hemmera 2020). The Environmental Flow Needs Policy (EFN Policy) (BC MFLNRO and BC MOE 2016) was used to quantify the risk levels associated with the proposed construction, operation, and closure of the Project, as per the requirements of the WSA. The EFN Policy is a screening assessment tool that applies to water licenses, approvals, or a project that will result in changes in volume and/or timing of flow within a watercourse. The policy defines EFN as the volume and timing of water flow required for the proper functioning of the aquatic ecosystem of the stream. However, it does not quantify the EFN for a particular watercourse. If the risk level requires quantification of the EFN, a detailed instream flow assessment (IFA) is required.

To assess the effect of the predicted flow reductions in Tenas Creek and Four Creek, stream surveys were completed, and flow and habitat data were collected. The methodology used for this EFN Assessment followed guidance provided in the following documents:

- ▶ Environmental Flow Needs Policy, Ministry of Forests, Lands and Natural Resource Operations, Ministry of Environment (BC MFLNRO 2014);

- ▶ Assessment Methods for Aquatic Habitat and Instream Flow Characteristics in Support of Applications to Dam, Divert, or Extract Water from Streams in British Columbia (Lewis et al. 2004); and
- ▶ Guidelines for the collection and analysis of fish and fish habitat data for the purpose of assessing impacts from small hydropower projects in British Columbia (Hatfield et. al. 2007).

Available fisheries data were assessed, and fish species of concern were identified. Based on the results, spawning and over-wintering habitat are considered potentially limiting habitats for fish species known to utilize Tenas and Four creeks. Habitat/EFN transects were then established in representative areas of each creek containing these limiting habitat units.

4.1.3.1.9 Fish Abundance Sampling

A detailed description of fish abundance sampling methods can be found in the baseline report compiled for the Project (**Appendix 4.1-C Stream Assessment Report #2**). Seven, closed sampling areas were established in the reaches of Four Creek potentially affected by altered flows in 2020. Stop nets were placed across the main channel at the upstream and downstream ends of each section to be sampled to create an effective barrier and retain fish within the sample area. The total length of stream enclosed in each sample area was typically 50 to 100 m, depending on site conditions, such as channel morphology and flow. The nets were secured in place by tying each end to sturdy trees on the streambank and installing rebar posts embedded in the stream substrate. Following installation of the downstream stop net, the field crews walked along the stream bank, where possible, prior to installing the upstream stop net so as not to frighten fish out of the section. To maintain a constant seal between the net and stream channel, lead lines were attached to the bottom of each net and were weighted down using large rocks.

Electrofishing was conducted along the entire length of the enclosed area for a total of two (2), three (3), or four (4) passes depending on fish catch rates. Each pass involved sampling the entire enclosed section in an upstream direction. Rest periods (minimum of 15-minutes) were taken between each successive pass to allow remaining fish to recover. Effort (i.e., the total number of electrofishing seconds) and catch (i.e., the number of each fish species captured) for each pass were recorded on field cards. All fish were retained in holding buckets filled with ambient stream water and released at the site following the last sampling pass and completion of physical data collection.

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 (Telkwa Coal Limited [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 (ERM 2020).

Watercourses in the Project Area include Goathorn Creek, Tenas Creek, Four Creek, and the Telkwa River. Tenas Creek and Four Creek 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 Township of Telkwa. Tenas Creek is located primarily in the western area of the Project Area, while Goathorn Creek and Four Creek are located within the eastern and southeastern portion of the Project Area. The Telkwa River is located to the north of the Project Area and flows into the Bulkley River, northeast of the Project (**Figure 4.1-1**).

4.2.2 Fish Habitat Subcomponent

Detailed descriptions of fish habitat for watercourses potentially affected by the Project are provided in the baseline report compiled for the Project (**Appendix 4.1-C**) and in the aquatic resource baseline studies completed for mine development in the late 1990s (Bustard 1998). The following sections summarize fish habitat in these watercourses.

4.2.2.1 Goathorn Creek

The lower 15 km of Goathorn Creek is accessible to fish from the Telkwa River. During fish studies in the late 1990s, a large debris jam on Goathorn Creek, approximately 500 m upstream from its confluence with Cabinet Creek, marked the upstream limit of fish access from the Telkwa River into the Goathorn Creek mainstem (Bustard 1998). A 5-m high rock falls located in a canyon section of the mainstem approximately 4.5 km further upstream marks the upper limit of fish observations in the Goathorn Creek mainstem.

The fish-bearing sections of Goathorn Creek were divided into four (4) reaches for the purposes of characterizing fish habitat (Bustard 1998) (**Figure 4.2-1**). The four (4) reaches are defined as follows:

- ▶ Reach 1: From the Telkwa River upstream to the confluence with Tenas Creek;
- ▶ Reach 2: From the top of Reach 1 upstream to confluence with Cabinet Creek;
- ▶ Reach 3: From the top of Reach 2 approximately 2.5 kilometres (km) upstream to the beginning of the canyon section of the Goathorn Creek mainstem; and
- ▶ Reach 4: From the top of Reach 3 approximately 2.0 km upstream to the 5 m rock falls that marks the upstream extent of fish presence in the Goathorn Creek mainstem.

The lower two (2) reaches of Goathorn Creek have low gradients (2 to 3%) and a predominantly riffle-pool morphology. Toward the upstream end of Reach 2, morphology changes largely to cascade-pool (Bustard 1998). Downstream of the Tenas Creek confluence there are more patches of gravel and small cobble substrates with deeper pools, whereas upstream of the confluence, bed material is dominated by cobbles and boulders. Streamflow throughout these reaches are generally swift and large woody debris (LWD) is oriented parallel to the banks. Reach 1 provides good spawning habitat for salmon and resident fish as well as good rearing and migration habitat. Over-wintering habitat is moderate, as pools deep enough to support fish throughout the winter are limited and severe ice conditions can occur.

Habitat in the upper reaches of Goathorn Creek is more favorable for trout and char species with isolated pockets of gravel suitable for spawning and accessible tributary streams for rearing. The mainstem provides good, clean, rearing habitat in boulder and cobble substrates for trout and char; however, a highly fluctuating flow regime and channel scour poses a risk for juvenile salmonids, especially during spring freshet (Bustard 1998).

Most smaller tributaries to Goathorn Creek provide poor access for fish and limited potential fish habitat due to a topographic break creating steep drops into the mainstem.

4.2.2.2 Tenas Creek

The Tenas Creek drainage is about one-third the area of the Goathorn Creek watershed. The mainstem is accessible to fish from its mouth at Goathorn Creek for approximately 16.5 km to a 20 m falls (Bustard 1998). For habitat characterisation, the fish-bearing section of the mainstem has been divided into four (4) reaches (**Figure 4.2-1**):

- ▶ Reach 1: From Goathorn Creek approximately 8.0 km upstream; this marks the primary sections of Tenas Creek that provide spawning and rearing habitat for steelhead/rainbow trout;
- ▶ Reach 2: From the top of Reach 1 upstream to the confluence with the east fork of Tenas Creek;
- ▶ Reach 3: From the top of Reach 2 approximately 2.5 km upstream to the upper extent of known fish observations in the Tenas Creek mainstem; and
- ▶ Reach 4: From the top of Reach 3 approximately 1.2 km upstream to the 20 m rock falls that marks the upstream extent of fish presence in the Tenas Creek mainstem.

The length of Tenas Creek potentially affected by the Project is located in Reach 1. The mainstem throughout Reach 1 is primarily confined within a gully with evidence of extensive valley-wall instability. Exposed fine-textured banks are prevalent, particularly on the east bank (Bustard 1998). Most of the tributaries entering Tenas Creek from the east side are small drainages that are not accessible beyond the steep embankment along Tenas Creek (Bustard 1998).

Moderate stream flows and a lower gradient channel make the lower sections of Reach 1 particularly well-suited for char and trout spawning and rearing. Substrate throughout this section was comprised primarily of cobbles and gravels, with boulders and LWD providing fish cover. Over-wintering habitat and migration habitat were rated as moderate, with only a few observations of slack water pools.

Abundant patches of gravels with good boulder and LWD cover provide good rearing and spawning habitat in the upper sections of Reach 1. Migration habitat was also good as no barriers to fish passage were noted. Deeper pools were infrequent throughout this section and over-wintering habitat was rated as moderate.

Large organic debris plays a more prominent role in creating habitat diversity in Tenas Creek compared to the lower reaches of Goathorn Creek. Pool areas have formed downstream from logs and root wads, and gravel has been deposited at the tail-outs from these pools, creating more spawning areas. A lower discharge in Tenas Creek has resulted in more low velocity sections suitable for fry rearing compared to the large and fast-flowing Goathorn Creek (Bustard 1998).

4.2.2.3 Four Creek

Four Creek enters directly into Goathorn Creek approximately 4 km upstream from the Tenas Creek/Goathorn Creek confluence. Four Creek has cut down through the valley sidewalls of Goathorn Creek and has adequate flows to support a small resident Dolly Varden population in its upper reaches. For habitat characterisation, the fish-bearing section of the Four Creek mainstem has been divided into five (5) reaches (**Figure 4.2-1**):

- ▶ Reach 1: From Goathorn Creek approximately 150 m upstream to the culvert beneath the Telkwa Coalmine Road that poses a barrier to upstream fish passage for fish from Goathorn Creek;
- ▶ Reach 2: From the top of Reach 1 upstream for approximately 1.8 km to the end of the steeper, more incised section of the mainstem;

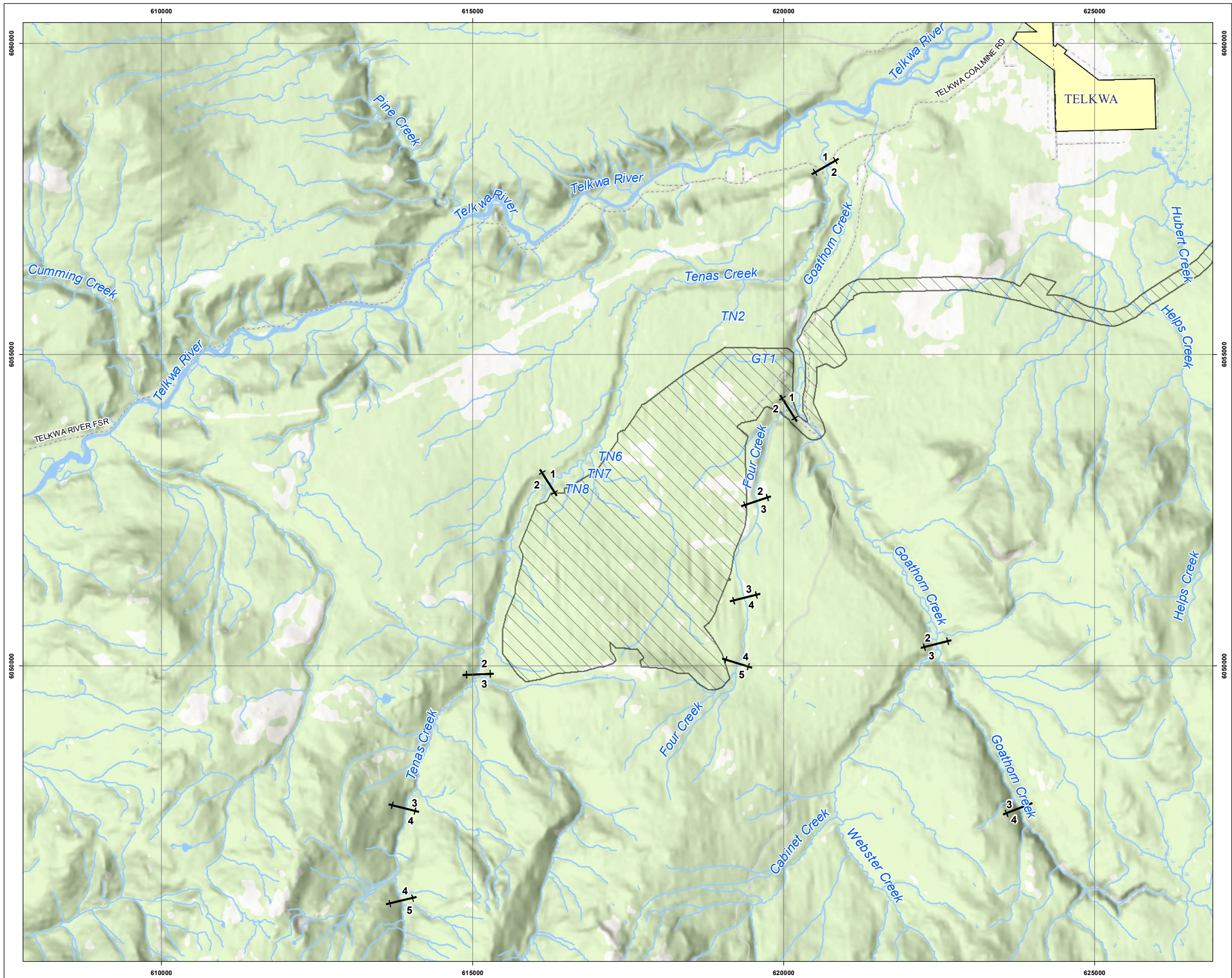
- ▶ Reach 3: From the top of Reach 2 approximately 1.5 km upstream where channel gradients begin to steepen;
- ▶ Reach 4: From the top of Reach 3 approximately 1.1 km upstream to a point where several headwater tributaries converge, and channel gradients steepen; and
- ▶ Reach 5: From the top of Reach 4 for approximately 400 m to the upstream limits of fish presence in the mainstem.

The lower four (4) reaches (reaches 1 to 4) of Four Creek are the sections potentially affected by the Project.

Access for fish moving upstream from Goathorn Creek is restricted to the fan downstream from the culvert at the lower road crossing (Reach 1), approximately 150 m. This section offers potential spawning for steelhead/rainbow trout from Goathorn Creek (Bustard 1998).

Four Creek steepens (4 to 8%) and is entrenched in a steep ravine with unstable slopes for approximately 1.6 km through Reach 2 and onto the bench area that marks the beginning of Reach 3. Reach 2 provides limited complex habitat and no fish have been captured or observed in this section between the fish passage barrier at Telkwa Coalmine Road and the higher quality, lower gradient habitats upstream. Reach 3 provides the best habitat for the resident Dolly Varden population. Substrates in Reach 3 are predominantly gravel and cobbles. Spawning habitat is limited to small patches of suitable gravel throughout the reach. Abundant cover (LWD and boulder) and complex habitat provides good rearing opportunities. Few deep pools provide moderate over-wintering habitat opportunities.

Path: S:\Gis\maps\Projects\103260\103260.mxd; 2-1b_103260_GA_Fish_Tributaries_202121.mxd



Tensas Project

Goathorn Creek and Tensas Creek Tributaries

Legend

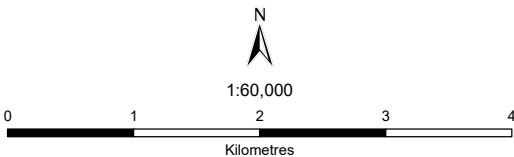
- Project Area
- Resource Road
- Reach Break
- Watercourse
- Waterbody
- Wetland
- Municipal Area

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

- Contains information licensed under the Open Government Licence(s) - British Columbia
- Mine Features: Allegiance Coal, 2018
- Basemap: ESRI World Topographic Map



NAD 1983 UTM Zone 9N
Page Size: 11" x 17"

103260-04 Production Date: Jan 21, 2022 Figure 4.2-1



4.2.2.4 Watercourses Within the Minesite

Three (3) unnamed tributaries to Tenas Creek that flow into the Tenas Creek mainstem from the east are located within the Minesite. For the purposes of the Project these tributaries have been named TN6, TN7, and TN8 (**Figure 4.2-1** above). All three (3) tributaries will have portions of their drainage eliminated by construction of Minesite components. The majority of flows in these tributaries will also be diverted by both non-contact water diversion ditches and contact water interceptor ditches.

4.2.2.4.1 Tenas Tributary TN6

TN6 is a non-fish-bearing tributary of Tenas Creek that drains an area of approximately 3.0 square kilometres (km²) and flows into the Tenas Creek mainstem near the northwest area of the Minesite. Fish from Tenas Creek are unable to access TN6 due to the steep embankment that runs along the east side of the Tenas floodplain (Bustard 1998). TN6 has a discontinuous channel that flows through historical forestry cut blocks and is crossed by an old forest service road. The tributary was dry and the poorly defined channel difficult to locate during field surveys in 2017. Intermittent pools of standing water in the discontinuous channel were sampled for fish in 1996 and no fish were captured or observed (Triton 1997). The channel was completely filled with woody logging debris upstream of the road and the channel became poorly defined with no evidence of scour or surface flows downstream of the forest service road (Triton 1997).

TN6 does not directly support fish or provide fish habitat upstream of its confluence with Tenas Creek. It likely provides flows and allochthonous inputs to Tenas Creek during wetter periods of the year.

4.2.2.4.2 Tenas Tributary TN7

TN7 is a non-fish-bearing tributary of Tenas Creek that drains an area of approximately 2.0 km² and flows into the Tenas Creek mainstem near the northwest area of the mine footprint. Fish from Tenas Creek are unable to access TN7 due to the steep embankment that runs along the east side of the Tenas floodplain (Bustard 1998). TN7 was dry and the poorly defined channel was difficult to locate during field surveys in 2017. Intermittent wetted areas within the discontinuous and poorly defined channel were sampled for fish in 1996 and no fish were captured or observed (Triton 1997).

TN7 does not directly support fish or provide fish habitat upstream of its confluence with Tenas Creek. It likely provides flows and allochthonous inputs to Tenas Creek during wetter periods of the year.

4.2.2.4.3 Tenas Tributary TN8

TN8 is a non-fish-bearing tributary of Tenas Creek that drains an area of approximately 1.2 km² and flows into the Tenas Creek mainstem near the northwest area of the mine footprint. Fish from Tenas Creek are unable to access TN8 due to the steep embankment that runs along the east side of the Tenas floodplain (Bustard 1998). TN8 was dry and the poorly defined channel was difficult to locate during field surveys in 2017. Intermittent wetted areas and areas of slowly flowing water within the discontinuous and poorly defined channel were sampled for fish in 1996 and no fish were captured or observed (Triton 1997).

TN8 does not directly support fish or provide fish habitat upstream of its confluence with Tenas Creek. It likely provides flows and allochthonous inputs to Tenas Creek during wetter periods of the year.

4.2.2.5 Watercourses Conveying Contact Water from the Minesite

Two (2) non-fish-bearing watercourses will be used to convey mine contact water from the storage ponds; one tributary to Tenas Creek (TN2) and one tributary to Goathorn Creek (GT1) (**Figure 4.2-1** above).

4.2.2.5.1 Tenas Tributary TN2

TN2 flows into the Tenas Creek mainstem from the north approximately 3.0 km upstream from the Tenas/Goathorn confluence (**Figure 4.2-1**). It drains an area of approximately 2.3 km² and flows for about 2.8 km from its origin near the proposed storage ponds. Stream gradients near its confluence with Tenas Creek are in excess of 30% and form a barrier to fish from the Tenas Creek mainstem. Upstream of the gradient barrier the watercourse is dry during late summer and winter (Triton 1997, BC MFLNRORD 2019). Due to the absence of flows, the watercourse could not be sampled for fish during field surveys (Triton 1997). As there is an absence of perennial habitat upstream of the gradient barrier, the watercourse has been determined to be not fish-bearing.

4.2.2.5.2 Goathorn Tributary GT1

GT1 flows into the Goathorn Creek mainstem from the west approximately 3.5 km upstream from the Tenas/Goathorn confluence (**Figure 4.2-1**). It drains an area of approximately 1.2 km² and flows for about 1.6 km from its origin near the proposed storage ponds. Stream gradients near its confluence with Goathorn Creek are in excess of 30% and form a barrier to fish from the Goathorn Creek mainstem. Upstream of the gradient barrier the watercourse is dry during late summer and winter (Triton 1997, BC MFLNRORD 2019). Due to the absence of flows, the watercourse could not be sampled for fish during field surveys (Triton 1997). As there is an absence of perennial habitat upstream of the gradient barrier, the watercourse has been determined to be not fish-bearing.

4.2.2.6 Watercourses Crossed by the Tenas Access Corridor (TAC)

Twenty-two (22) watercourses crossed by the proposed TAC were surveyed in the vicinity of the proposed crossing locations (**Appendix 4.6-B**). Of the 22 watercourses, 10 were determined to be fish-bearing (fish presence confirmed or assumed). Of these 10 watercourses, three (3) were rated as having important fish habitat, and the remaining seven (7) as providing marginal fish habitat (**Appendix 4.6-B**). Habitat summaries for the three (3) watercourses providing important habitat are provided in the following subsections.

4.2.2.6.1 Helps Creek

Helps Creek flows into the Bulkley River approximately 6 km downstream from the location of the proposed crossing. The overall habitat was assessed as important, as per criteria provided in the Fish-Stream Crossing Guidebook (BC MFLNRO et al. 2012).

The habitat potential at this location in Helps Creek is primarily for spawning and rearing, while overwintering appears limited (**Appendix 4.6-B**). Flows appear seasonal along the reach as there were some dewatered sections with gentle gradients less than (<) 5%. Bed substrates were mostly gravel and cobbles. There were few deep pools present along the assessed reach with an average residual pool depth of 0.22 m. Moderate total cover for fish were provided mostly by small woody debris (SWD), LWD, overhanging vegetation, undercut banks, as well as some boulders and a few deep pools. The reach was mostly dry at the time of the assessment and is likely dry for most of the fall and winter (**Appendix 4.6-B**).

4.2.2.6.2 *Four Creek*

The proposed crossing of Four Creek is located where the current Telkwa Coalmine Road crosses the mainstem approximately 150 m upstream of Goathorn Creek. The current road crossing consists of an 1,800 mm non-embedded culvert that is perched at most flows and poses a barrier to fish passage. The overall habitat was assessed as important, as per the criteria provided in the Fish-Stream Crossing Guidebook (BC MFLNRO et al. 2012).

The habitat potential at the proposed crossing location is primarily for rearing, while spawning and over-wintering appear to be moderate downstream of the crossing (**Appendix 4.6-C**). Flow appears perennial and bed substrate is mostly gravel and cobbles with some sands, which provides spawning opportunities for salmonids. There are several deep pools with an average residual pool depth of 0.38 m. Abundant cover for fish was provided mostly by deep pools and boulders as well as some overhanging vegetation and undercut banks. The perennial flow and presence of deep pools make this important fish habitat (DWB 2018).

4.2.2.6.3 *Tributary to Goathorn Creek (GT2)*

The proposed TAC crosses a tributary to Goathorn Creek located immediately upstream from its confluence with the Goathorn Creek mainstem (**Figure 4.2-1**). There are currently two (2) 600 mm non-embedded culverts which are perched at low flow and poorly oriented at the crossing location (DWB 2018). The overall habitat was assessed as important, as per the criteria provided in the Fish-Stream Crossing Guidebook (BC MFLNRO et al. 2012).

The habitat potential at the crossing location provides good rearing and spawning, while over-wintering appears to be relatively limited (DWB 2018). Flow appears seasonal. Bed substrates are mostly gravel and cobbles with some sands that provide spawning habitat for salmonids. There are several pools along this reach, but very few are deep. Adequate cover for fish is provided mostly by overhanging vegetation and undercut banks. Despite ephemeral flows, the presence of several pools, good spawning substrates, and adequate cover make this important habitat. The culverts at the current crossing are poorly oriented, causing much erosion which is consequently creating blockages in the culverts themselves (DWB 2018).

4.2.3 Fish Subcomponent

4.2.3.1 *Fish Communities*

Fish communities of Tenas Creek and Goathorn Creek were dominated by steelhead/rainbow trout and Dolly Varden during sampling events in October 2017 and June 2018 **Table 4.2-1**. A small number of juvenile coho salmon were also captured in lower Goathorn Creek in 2017, but not in 2018. A steelhead carcass was observed in lower Goathorn Creek (downstream of the Aveling Coalmine Road) in 2018. Catch-per-unit-effort (CPUE) for steelhead/rainbow trout was higher in 2017 than 2018 in both Tenas and Goathorn creeks. Dolly Varden CPUE was similar in both years in both streams.

The only fish species present upstream of Reach 1 in Four Creek is Dolly Varden. Steelhead/rainbow trout were captured in Reach 1 in 2020. Dolly Varden CPUE in Four Creek was similar in 2018 and 2020.

Steelhead, migratory rainbow trout, are known to be present in both Goathorn and Tenas creeks; however, there is no way to differentiate between migratory and non-migratory forms without seeing spawning adults. A spawning survey for adult steelhead could not be undertaken in 2018 due to high water levels and turbid conditions during the spawning season. Historical reports by Bustard et al. (1985) assumed that all rainbow trout in the Goathorn and Tenas systems were potentially steelhead and estimated a spawning population

size of 159 adults. Mapping exercises presented in the Bustard reports suggested that most steelhead spawning likely took place in the lower 5 km of Tenas Creek, and the lower 2 km of Goathorn Creek.

In the Bulkley River, fish species diversity was higher in 2018 than in 2017; however, total CPUE was similar among years. Steelhead/rainbow trout were the dominant species in both years. Coho salmon CPUE was higher in 2017 than in 2018, and reflects the outmigration of smolts, which likely occurred prior to the June 2018 sampling event.

In the Telkwa River, coho salmon were dominant in 2018, while steelhead/rainbow trout dominated the catch in 2017. Total CPUE was higher in 2018 than 2017. Sampling in 2018 was complicated by high water levels, which made sampling in the Telkwa River impossible.

Table 4.2-1: Summary of Electrofishing Catch Per Unit Effort in Watercourses Potentially Affected by the Project, 2017-2020

Watercourse	Year	Species	CPUE (fish/100 second)
Bulkley River	2017	Coho salmon	1.65
		Lamprey	0.15
		Steelhead/rainbow trout	2.17
		Sucker (general)	0.33
	2018	Chinook salmon	0.29
		Coho salmon	0.26
		Dolly Varden	0.13
		Lamprey (general)	0.13
		Longnose sucker	0.43
		Minnow (general)	0.5
		Northern pikeminnow	0.04
		Steelhead/rainbow trout	2.37
		Sucker (general)	0.04
		White sucker	0.2
Four Creek	2018	Dolly Varden	0.88
	2020	Dolly Varden	0.82
		Steelhead/rainbow trout	0.66
Goathorn Creek	2017	Coho salmon	0.19
		Dolly Varden	0.39
		Steelhead/rainbow trout	2.13
	2018	Dolly Varden	0.38
		Steelhead/rainbow trout	0.63
Telkwa River	2017	Coho salmon	0.56
		Dolly Varden	0.2
		Mountain whitefish	0.16

Watercourse	Year	Species	CPUE (fish/100 second)
	2018	Steelhead/rainbow trout	1.77
		Coho salmon	1.57
		Dolly Varden	0.36
		Steelhead/rainbow trout	1.16
Tenas Creek	2017	Dolly Varden	1.17
		Steelhead/rainbow trout	1.62
	2018	Dolly Varden	1.71
		Steelhead/rainbow trout	0.78
Unnamed Tributary	2018	No fish caught	0

Fish have been recorded in three (3) watercourses crossed by the proposed TAC: Helps Creek, a tributary to Helps Creek, and Four Creek. Cutthroat trout (*O. clarkii*) and Dolly Varden have been historically observed in Helps Creek near the proposed crossing location and coho salmon and steelhead have been recorded further downstream near the Bulkley River (BC MOE 2018). One (1) Dolly Varden and several small salmonids were observed in Helps Creek during the 2018 field survey (DWB 2018). Rainbow trout have been historically observed in the tributary to Helps Creek (BC MOE 2018). Dolly Varden were captured throughout much of the Four Creek mainstem. Coho salmon, steelhead/rainbow trout have been captured in Reach 1 of Four Creek.

Salmon spawning surveys were conducted in August, October, and November 2018 to identify potential critical habitat for chinook and coho salmon in receiving environment waters. Aerial and ground surveys for chinook in August 2018 did not identify any fish, redds, carcasses, or sign of spawning. A single fin from a large, unidentified fish was found in Goathorn Creek just downstream from the Tenas Creek confluence; however, it could not be determined which species it came from or how long it had been there.

An aerial survey was completed in October 2018 for coho salmon. Communication with a DFO biologist on the same day suggested that due to the low water levels in 2018, it could be too early to find spawners (Finnegan 2018). In addition, the biologist confirmed that coho spawn mainly in the upper Telkwa River and adults are unlikely to be present in Goathorn Creek.

A ground survey of lower Goathorn Creek was subsequently undertaken in early November to look for signs of coho spawning. No fish, redds, carcasses, or other signs of fish were seen, despite the presence of suitable coho spawning habitat. The low water levels present in the Bulkley River watershed throughout late summer and early fall may have altered the timing and distribution of spawning adults in those systems. Salmon are known to be “triggered” to move onto their spawning grounds by changes in water temperature and flow, and the anomalous flows during the 2018 spawning season may have caused them to remain in larger rivers downstream until later in the season. The ground survey took place after the peak of spawning typically occurs; however, signs of spawning (e.g., redds, carcasses) would still have been present in the stream. No substantial flooding or weather events occurred between the aerial survey and the ground survey that could have flushed out salmon carcasses and made redds difficult to identify.

Although spawning surveys did not turn up any sign of chinook or coho salmon in 2018, it would be premature to say this isolated sample event precludes the use of Goathorn and Tenas creeks by these species.

4.2.3.2 Fish Biology

Detailed results of fish sampling are provided in the baseline report compiled for the Project (**Appendix 4.1-C**). The following subsections provide a summary of fish biology characteristics for the fish species observed in watercourses potentially affected by the Project.

4.2.3.2.1 Steelhead/Rainbow Trout

Steelhead/rainbow trout were the only species captured in enough abundance to complete meaningful analyses of fish health. There were significant differences in mean length, weight, and condition of steelhead/rainbow trout among sites sampled in 2017 and 2018. The mean length of steelhead/rainbow trout was significantly longer at Tenas Creek sites than other sites in the Project Area. The smallest steelhead/rainbow trout were captured in the Bulkley River. These differences were likely due to the large number of young-of-year (YOY) steelhead/rainbow trout captured on the larger rivers. Steelhead/rainbow trout are spring spawners, spawning in mid- to late-May in most northern streams, and emerging some weeks later (depending on temperature) (McPhail 2007). In Tenas and Goathorn creeks, which are smaller, colder systems, the mean size tended to be larger because YOY had likely not emerged from the gravel at the time of the June sampling period and were therefore caught in smaller numbers.

Similarly, the mean weight of steelhead/rainbow trout was significantly different among sites and was highest in Reach 1 of Tenas Creek. The differences in mean weight among sites was less pronounced than the differences in mean length because the weight of YOY fish in the field was difficult to measure due to the small size of fish and the large inaccuracies introduced by added water on the scales.

In contrast, the mean condition factor (a measure of relative weight and health of fish) was significantly higher in the Bulkley River than in Reach 1 of Tenas Creek. This was likely due to the higher water temperatures (and therefore, productivity) of the Bulkley River relative to the smaller streams in the Project Area.

Weight-length regressions for steelhead/rainbow trout were compared among sites as another measure of relative fish health. There was no statistically significant effect of the interaction between length and site on weight, which indicates the length-weight relationship is similar among sites. The highest weight-at-length for steelhead/rainbow trout occurred in the Telkwa River, while the lowest occurred in the Bulkley River.

The mean age of steelhead/rainbow trout differed significantly among sites, with fish captured in Goathorn Creek being substantially younger than fish from the Bulkley River. However, these results are not representative of all fish captured from these sites. Age data were collected mainly from those fish sacrificed for metals analysis and were not generally collected from the YOY fish sampled.

Length-at-age of all steelhead/rainbow trout captured was modelled and estimated.

The linear model best described the relationship between fork length and age for the steelhead/rainbow trout analyzed. All fish sampled for aging structures fell between one (1) and three (3) years of age, which makes estimating asymptotic size statistically difficult.

In general, the results of steelhead/rainbow trout comparisons among sites reflect the differences in habitat conditions (i.e., smaller, colder headwater streams versus larger, warmer rivers). While differences in fish size and condition exist among sites, these can mostly be attributed to differences in habitat conditions and the timing of sampling.

4.2.3.2.2 Dolly Varden

Dolly Varden were captured at all sites in the Project Area; however, they were only captured in numbers sufficient for statistical analysis at five locations (Reach 1 and Reach 2 of Tenas Creek, Reach 3 and Reach 4 of Four Creek, and the Telkwa River). In contrast to steelhead/rainbow trout, there were no significant differences among sites in the mean length or mean weight of Dolly Varden.

Few Dolly Varden were captured in watercourses other than Four Creek, compared with steelhead/rainbow trout. In Four Creek, a resident Dolly Varden population is present above the fish migration barrier at the Telkwa Coalmine Road crossing approximately 150 m upstream from Goathorn Creek, which marks the downstream boundary of Reach 2. No fish were captured in Reach 2 upstream of the road crossing in 2018 or 2020; this section of channel has a steeper gradient, is heavily incised and has low habitat value. Dolly Varden in Four Creek predominantly reside in reaches 3 and 4.

Length- frequency distributions for fish captured in Tenas Creek showed the majority fell into the 80 to 100 mm size range. Few Dolly Varden under 60 mm were captured in Tenas Creek, and the largest fish fell into the 150 to 160 mm size range. In Goathorn Creek, the majority of Dolly Varden captured fell into the 50 to 60 mm size range. A single large (approximately 400 mm) adult Dolly Varden was observed in lower Goathorn Creek during the June 2018 sampling event; however, it was not captured or measured. Dolly Varden captured in Four Creek in 2020 ranged between 33- and 187-mm. Mean condition factor for Dolly Varden did not differ significantly between watercourses.

4.2.3.2.3 Coho Salmon

Juvenile coho salmon were captured mainly in the Telkwa and Bulkley rivers in 2017 and 2018. Two (2) individuals were captured in lower Goathorn Creek in 2017, while none were captured in Goathorn Creek in 2018 due to higher water levels and the lack of spawning habitat for coho in tributaries.

There were significant differences among sites in the mean length and weight of coho salmon; however, most of these differences could be attributed to the lack of sampling in the Telkwa River in 2018, which skews the size range by including only fish measured at the end of the growing season. Length-frequency distributions for the four (4) sites where the majority of coho were captured show that almost all the fish captured were under 100 mm in length. In the Telkwa River, where the most coho were captured, two (2) modes in the distribution suggest two (2) age classes, which is consistent with coho salmon life history, wherein juveniles spend one (1) to two (2) years in freshwater before migrating to the ocean.

There were no significant differences in coho salmon condition factor among sites. Similarly, when weight was regressed against length and compared among sites, there were no significant differences in the relationship between weight and length among sites and no significant differences in weight-at-length among sites.

4.2.3.3 Tissue Metals

Detailed results of fish tissue metals sampling and analysis are provided in the baseline report compiled for the Project (**Appendix 4.1-C**). The following paragraphs provide a summary of fish tissue metals for steelhead/rainbow trout in watercourses potentially affected by the Project.

Analysis and Quality Assurance/Quality Control results for tissue metals are presented in Appendices 11-D and 11-E of the baseline report (**Appendix 4.1-C**). Tissue metal concentrations for steelhead/rainbow trout captured in the Bulkley River, Telkwa River, Goathorn Creek, and Tenas Creek were analyzed in October 2017 and June 2018.

BC's tissue quality guideline for selenium is based on whole-body concentration and is reported for dry weight: 4 micrograms (μg)/g. An interim guideline for muscle tissue has also been established at the same concentration (BC MOE 2014). To compare selenium concentrations from tissue samples collected in the study area, the BC guideline was converted to a wet weight (wwt) measurement using an average moisture concentration of 78% (moisture content in samples ranged from 76% to 81.3% and averaged 78.3%). The resulting approximate guideline was 0.88 mg/kg wwt.

Selenium concentrations in muscle tissue collected from steelhead/rainbow trout in the LSA ranged from 0.208 mg/kg to 0.710 mg/kg in 2017 and 0.176 mg/kg to 0.99 mg/kg in 2018. The average across all samples was 0.396 mg/kg in 2017 and 0.503 mg/kg in 2018. Two (2) samples exceeded the interim BC tissue quality guideline for selenium in fish muscle tissue in 2018, both of which were in Tenas Creek. However, the interim guideline applies only to the mean concentration (of at least eight (8) tissue samples) of selenium, which was lower than the guideline at all sites.

Tissue mercury concentrations did not exceed Health Canada guidelines (0.5 mg/kg wwt; Health Canada 2007) for any of the samples tested. Mercury concentrations ranged from 0.0097 mg/kg to 0.0681 mg/kg in 2017 and 0.0117 mg/kg to 0.0629 mg/kg in 2018.

4.2.3.4 Fish Abundance

Fish surveys were completed in September 2020 to determine fish abundance, distribution, and habitat use of the resident Dolly Varden population in the mid-reaches of Four Creek. Fish density ranged between 23 fish/100 square metres (m^2) in the lower areas of Reach 4 and the upper areas of Reach 3 to 38 fish/100 m^2 in the mid and lower areas of Reach 3. CPUE ranged from 1.1 to 1.8 fish/100 second (sec.) and 1.3 to 2.2 fish/100 sec. in these areas, respectively.

Approximately one-third of the fish captured during abundance sampling were YOY Dolly Varden. Dolly Varden fry were captured primarily in shallow riffle sections while parr and mature fish were captured in deeper run and pool habitat. Based on catches and calculated densities and applying these to the fish habitats in reaches 3 and 4, the resident Dolly Varden population is estimated at approximately 1,300 fish. This estimate is slightly higher, but similar to results of fish abundance sampling completed in 1997 (Bustard 1998).

5. ASSESSMENT OF PROJECT-RELATED EFFECTS

The information provided within this subsection includes:

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

5.1 Potential Project-related Interactions with the Fish and Fish Habitat Valued Component (VC)

This subsection focuses the assessment on those interactions with potential to adversely affect the Fish and Fish Habitat VC. Project-related interactions between the Fish and Fish Habitat VC and identified Project activities are considered. 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 Fish and Fish Habitat VC as outlined in **4. Existing Conditions**. Each potential interaction is rated using the terms provided in **Table 5.1-1**. Based on the evaluation, potential interactions between the Project and the Fish and Fish Habitat VC were carried forward into the assessment to determine the effects of the interaction.

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

Term	Definition
No Interaction	Project activity will not interact with the Fish and Fish Habitat Valued Component (VC), no adverse effect is expected; no further consideration is warranted.
Interaction	Interaction between the Project activity and Fish and Fish Habitat 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 Fish and Fish Habitat VC subcomponents. Interactions expected to result in potential effects on the Fish and Fish Habitat VC are discussed further in **5.2 Potential Project-related Effects**. When no interaction between the Project and a subcomponent is anticipated, or the interaction is considered minor (i.e., not expected to have a substantive influence on the short- or long-term integrity of the subcomponent as the effect would not be measurable or detectable using the identified Indicator) the interaction is not considered further in the assessment.

Fish habitat attributes such as surface water quality, habitat availability, substrate composition, over-wintering and rearing habitat, fish cover, and habitat complexity are required to support fish populations. These attributes provide the conditions necessary to support healthy and functioning freshwater aquatic ecosystems.

Table 5.1-2: Interactions between Fish and Fish Habitat Subcomponents and the Tenas Project

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

Project Activities	Fish and Fish Habitat Subcomponents	
	Fish Habitat	Fish
Construction of Explosives Magazine (storage building)	X	X
Employment and labour		
Operation		
Mining the open pit (soil salvaging, drilling and blasting, excavation of material, dewatering, loading, hauling, unloading)	X	X
Operation of Surface Water Management Infrastructure including channels and ponds (sedimentation, control, management, storage)	X	X
Maintain and use Bypass Road and quarries from the Minesite to the Rail Infrastructure	X	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	X
Maintain storage piles for overburden, rock separated from coal in Coal Processing Plant, and stockpiles for topsoil and vegetation management	X	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		

Project Activities	Fish and Fish Habitat Subcomponents	
	Fish Habitat	Fish
Maintain Explosives Magazine (Storage Facilities)		
Progressive reclamation		
Employment and labour		
Decommissioning and Reclamation		
Dismantle and remove mining equipment and facilities (including powerline, Rail Infrastructure)	X	X
Transportation of equipment, materials, and personnel		
Reclamation and closure activities at Minesite	X	X
Reclamation and closure of Bypass Road and haul roads, including quarries		
Reclamation and closure of permanent bridge over Goathorn Creek	X	X
Reclamation and closure of powerlines		
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		

5.1.1 Department of Fisheries and Oceans Canada (DFO) Pathways of Effects

Prior to implementation of mitigation, Project-related activities may result in several potential effects to Fish and Fish Habitat via known Pathways of Effects (PoE) (DFO 2018). DFO has developed a series PoE flowcharts that define land-based and in-water activities and the associated potential effects. The PoEs relevant to the Project include:

- ▶ vegetation clearing;
- ▶ use of industrial equipment;
- ▶ excavation;
- ▶ grading;
- ▶ change in timing, duration, and frequency of flow;
- ▶ fish passage issues;
- ▶ placement of material structures in water;
- ▶ use of explosives; and
- ▶ water extraction.

5.2 Potential Project-related Effects

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

Two (2) Project-specific potential effects have been identified to inform the assessment of the effects of the Project on the Fish and Fish Habitat VC:

- ▶ Change in fish habitat – change in the areal extent of available fish habitat due to the destruction or alteration of fish habitat, changes in baseflows, degradation of water quality, or creation of barriers to fish passage; and
- ▶ Change in fish health – change in health, abundance, or the condition of fish due to direct effects, stranding, or degradation of water quality.

Change in fish habitat is described within the Fish Habitat subcomponent while change in fish health is discussed in the Fish subcomponent. While a change in fish habitat and a change in fish health are identified as potential effects for the Fish and Fish Habitat VC, these are comprised of several contributing potential effects. Using the DFO PoE model (DFO 2018) and the DFO activities identified in Section 5.1.1 above, changes in fish habitat and fish health were determined to be associated with:

- ▶ change in habitat structure and cover;
- ▶ change in sediment concentrations;
- ▶ change in water temperature;
- ▶ change in food and nutrient concentrations;
- ▶ change in mortality of fish and eggs;
- ▶ change in contaminant concentrations;

- ▶ change in base flows;
- ▶ displacement or stranding of fish; and
- ▶ change in migration and access to habitats.

5.2.1 Fish Habitat Subcomponent

Interactions of the Project with the Fish Habitat subcomponent are expected to occur primarily during the Construction Phase, and during Decommissioning and Reclamation Phase activities. These comprise physical changes to fish habitat, changes in flow regimes (due to water diversion), and changes in water quality. While minor fluctuations in water quality and flow are expected occur during the Operation and Post-closure phases, the primary effect on fish habitat will be assessed for the Construction Phase. The effects of changes in water quality and flows on fish will be carried forward through the assessment.

This subsection describes the nature of the potential effects of the Project on the Fish Habitat subcomponent during the Construction Phase. Mitigation measures for each potential effect are described in 5.3.

5.2.1.1 Change in Fish Habitat

Construction activities have the potential to alter and reduce the availability of fish habitat within the Minesite footprint, in areas downstream of the Minesite, and in watercourses near proposed roads. Reduction in available habitat can impair the ability of the system to maintain current levels of fish production. This section assesses effects on fish habitat that may result from construction-related interactions listed in **Table 5.1-2**.

As noted above, using the DFO PoE model (DFO 2018) and the DFO activities identified in 5.1.1 above, the potential effect of a change in fish habitat was determined to be associated with the following:

- ▶ change in habitat structure and cover;
- ▶ change in sediment concentrations;
- ▶ change in water temperature;
- ▶ change in food and nutrient concentrations;
- ▶ change in contaminant concentrations;
- ▶ change in base flows; and
- ▶ change in migration and access to habitats.

Each of the above potential effects is described in the subsections below.

5.2.1.1.1 Change in Habitat Structure and Cover

The productive capacity of fish habitat is affected by the area, complexity, stability, types of habitats present, and the timing and consistency of flows. Instream physical structures (e.g., rock, woody debris, and vegetation) provide fish with shelter from swift currents, cover from predators and important habitat for specific life-stages or activities (e.g., foraging sites, spawning sites). The important habitat types contributing to the productive capacity of freshwater fish habitat are:

- ▶ Over-wintering habitat consists of pools, deep runs, and off-channel habitats that maintain high dissolved oxygen concentrations and do not freeze to bottom during the winter months. These habitats are important to fish. They allow fish to survive the cold winter water temperatures with lower energy expenditure, and they are commonly limiting habitat types within streams;
- ▶ Spawning and rearing habitat requirements differ for each fish species that occupies a watercourse or water body. Elements of spawning habitats common to most fish species include substrate composition, water quality, depth, water velocity, and cover. Important features of rearing habitats include water velocity, cover, depth, food supply, predator presence, and competition for habitat (i.e., space limitations, particularly important for territorial salmonids). Both spawning and rearing habitat are commonly the limiting factor for fish populations and therefore, loss or degradation of these habitat types are often directly linked to the productive capacity of fish habitat;
- ▶ Cover habitat serves to protect fish from predators, high flow conditions, and other competitive fish. Functioning cover habitat is provided mainly by complex substrates such as boulders and cobbles, overhanging vegetation, LWD, deep pools, and undercut banks. Although these attributes contribute mainly to rearing habitat, they are equally as important in providing habitat for spawning, foraging, and over-wintering for some fish species; and
- ▶ Riparian areas adjacent to watercourses provide indirect benefits to fish and are also considered fish habitat. The inputs of LWD from riparian habitats into streams affects the structure and cover provided by fish habitat. LWD contributes to natural channel processes that maintain regular stream sinuosity and help to create pools, undercut banks, and riffles. LWD also provides fish with instream cover from predators, regulates stream energy during high flow conditions, and prevents downstream bed load movement. In addition, small and large woody debris provide sources of organic carbon to aquatic invertebrates and improve substrate habitat for aquatic invertebrates, an important source of food for salmonids (Keeley and Slaney 1996). If riparian vegetation is removed, LWD replacement ceases which can adversely affect stream ecosystem function.

Project activities such as clearing and grubbing in riparian areas, instream and riparian works associated with road works and watercourse crossings, infilling of watercourses to accommodate mine components, and the diversion of watercourses and site runoff have the potential to physically alter or eliminate fish habitat.

Clearing and grubbing, and road construction activities have the potential to cause changes or loss in fish habitat structure where they occur near or across watercourses. Direct instream works, such as the installation or replacement of road crossings have the potential to physically alter the structure of important habitat features, such as over-wintering pools and spawning areas. In addition, instream work may require the removal of cover structures such as LWD, boulders, undercut banks or instream vegetation. At the reach (homogenous linear sections of a stream channel) level of a stream, habitat condition increases with the number of LWD pieces and percent wood cover in pools (Johnston and Slaney 1996). Good quality habitat for salmonids is considered to be pools with greater than 20% wood cover and channels with more than two pieces of LWD per bankfull channel width (the width of the wetted channel at the 1 in 2-year high water event). Removal of LWD, boulders or undercut banks can serve to reduce the productive capacity of habitat near Project development areas.

Clearing of riparian vegetation next to watercourses can affect the quality of habitat by reducing available refuge from predators, eliminating temperature-regulating shade from streamside vegetation, and decreasing allochthonous nutrient inputs to the stream that come from insect and leaf litter drop. Destabilized stream banks can result in increased erosion and the potential introduction of suspended sediments into the watercourse. In addition, erosion in cleared upland areas can also lead to increased instream sediment deposition. This may affect the benthic community and/or developing fish embryos, and reduce the habitat available for juvenile, over-wintering fish, and other aquatic organisms.

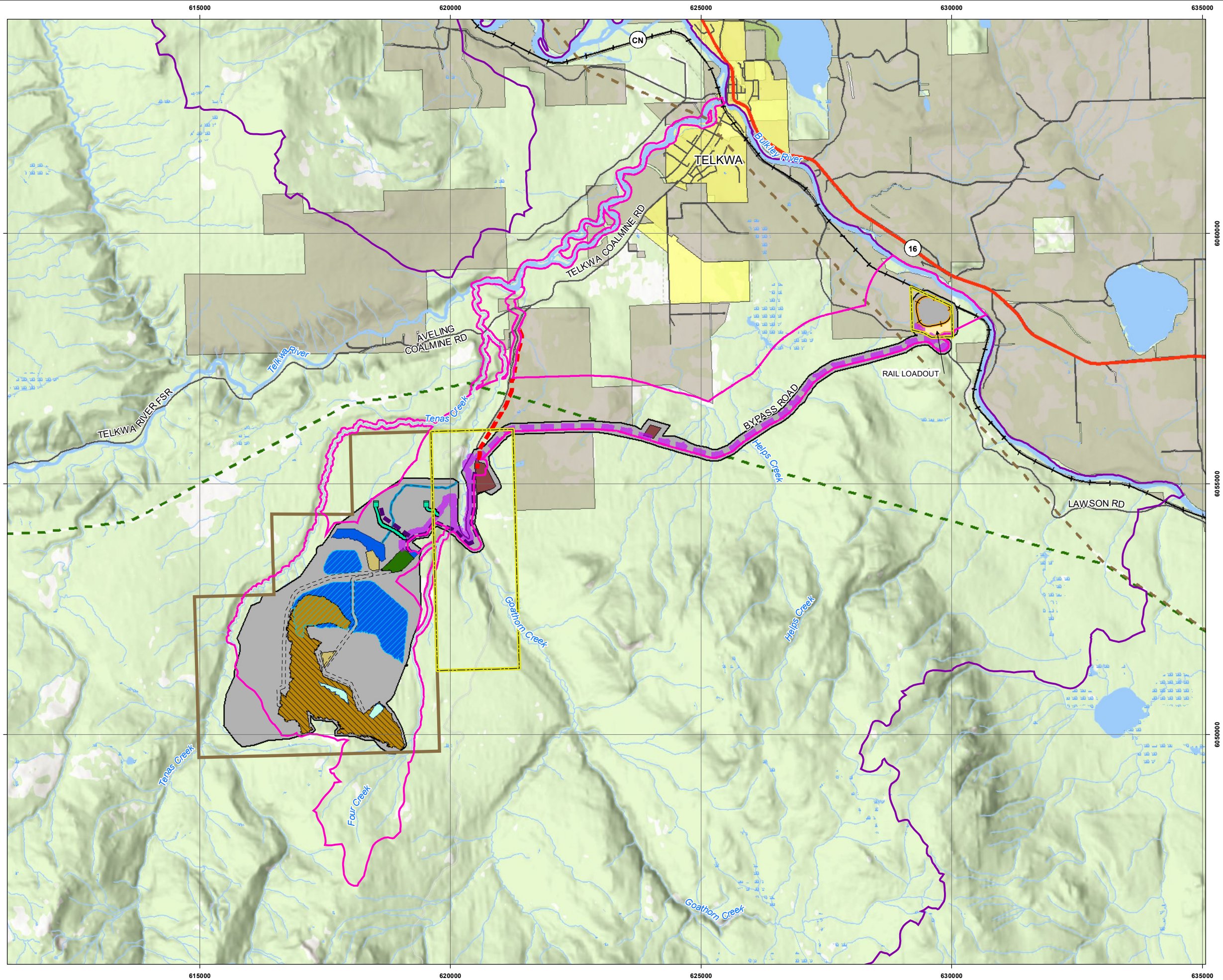
The primary changes in fish habitat structure are expected to arise from the infill and diversion of water currently conveyed in tributaries to Tenas Creek and Four Creek that are located within the Minesite footprint (**Figure 5.2-1**). These watercourses are not fish-bearing; however, they do provide flows and allochthonous inputs to downstream fish-bearing waters and are; therefore, considered fish habitat under the federal *Fisheries Act* (Section 2.1). **Table 5.2-3** provides a summary of the channel measurements and habitat quality in each tributary. All these watercourses were dry, intermittent, and/or dewatered at the time of habitat survey (Triton 1997; **Appendix 4.1-C**). While the loss of these tributaries represents approximately 9,900 m² of stream habitat, these tributaries are not fish-bearing and likely flow for only short periods throughout the year.

Table 5.2-1: Channel and Habitat Summaries for Tenas Creek Tributaries within Mine Footprint (Triton 1997)

Watercourse	Mean Channel Width (m)	Channel Length (m)	Channel Area (m ²)	Habitat Quality Observations
TN6	1.7	4,850	8,245	- Channel was primarily dewatered with intermittent, standing, isolated pools with no channel visible downstream of crossing at the time of sampling (September 1996). The watercourse runs through the cut block and the channel of the watercourse was generally filled with silt and LWD. Short section was wetted alongside the service road at time of observation. Upstream of the road the channel was dry. - Poor habitat quality.
TN7	0.8	750	600	- Small leaf filled pools dammed by small wood and debris. - Poor habitat quality.
TN8	1.2	910	1,092	- Dry channel. Channel filled with LWD. - Poor habitat quality.
Totals	n/a	6,510	9,937	n/a

Notes: LWD=loose woody debris; m=metre; m²=square metre; n/a=not applicable

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Tenas Project

Mine Footprint and Infrastructure

Legend

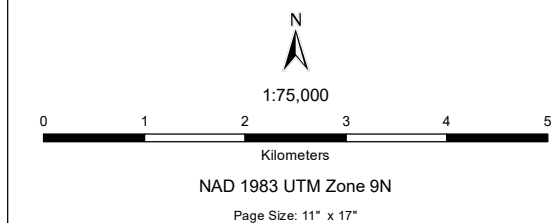
Aquatic Resources and Fish and Fish Habitat Local Study Area	Existing 25 kV Power Line
Aquatic Resources and Fish and Fish Habitat Regional Study Area	25 kV Power Line
Rail Line	Haul Road
Highway	Rail Loop
Road	Discharge Path
Watercourse	Tenas Access Corridor
Wetland	Backfill Area
Waterbody	Control and Plant Sedimentation Pond
Municipal Area	Explosive Infrastructure
General Private Property	Management Pond
138 kV Transmission Line	Mine Infrastructure Complex
500 kV Transmission Line	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



103260-04	Production Date: Sep 09, 2021	Figure 5.2-1
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5.2.1.1.2 *Change in Sediment Concentrations*

Sediment can enter a watercourse from point sources during instream and riparian works associated with road construction, mine site infrastructure construction, or when infilling watercourses to facilitate safe construction of Minesite components. Additionally, sediments can enter watercourses adjacent to or downstream of exposed soils at road crossings during the post-construction period while vegetation is re-establishing. Uncontrolled or chronic sedimentation can degrade downstream habitats resulting in a reduction in complex substrates, egg survival, and invertebrate productive capacity.

High levels of fine sediment can simplify bed features, decrease populations of macroinvertebrates, cover incubating eggs; and fill in pools used for cover, over-wintering, and staging or holding areas. Riparian habitats are important natural biofilters, protecting aquatic environments from excessive sedimentation, polluted surface runoff, and erosion.

In watercourses where sediment loads are elevated, many aquatic organisms have adapted to short-term exposure to low and moderate concentrations of sediments (Waters 1995). As a result, the environmental effects of sediment deposition on habitat productive capacity is directly proportional to the volume of sediment introduced to the receiving waters, the depth of deposition, the type of habitat affected by deposition, the importance of affected habitat to fish, and the sensitivity of the fish species present.

5.2.1.1.3 *Change in Water Temperature*

In addition to providing LWD to streams and rivers, riparian vegetation provides shade and helps regulate water temperatures. Land use activities and development projects can remove or alter riparian vegetation, thereby affecting thermal regulation of streams, primarily due to an increase in warming from solar radiation. To moderate water temperature, stream surfaces should have 60 to 80% shade throughout the day (Castelle et al. 1994); this level of shading can be achieved through the preservation of appropriate riparian buffer widths.

Water withdrawal and diversion, and wastewater discharge associated with mine construction and operation activities can alter base flows that may result in changes to stream temperature. Water temperature can have direct effects on the physical and biological composition of a watercourse. Salmonids can experience changes in reproductive activity, growth, and mortality rates due to increased water temperatures. Optimum temperature ranges for Dolly Varden are 8.0-16.0°C for rearing. Optimum temperature ranges for steelhead/rainbow trout are 16.0-18.0°C for rearing and 1.0-15.5°C for spawning (BC MOE 2001). High temperatures also encourage the microbial breakdown of organic matter which in turn can lead to depleted levels of dissolved oxygen in the water column (Dissmeyer 1994).

The clearing of vegetation next to watercourses can reduce or eliminate the temperature regulating effect of riparian vegetation. A change in water temperature could result where riparian vegetation clearing associated with TAC upgrades near watercourse crossings and riparian areas within the Project's footprint. Water temperature may also be affected through the introduction of warmer discharges of wastewater.

5.2.1.1.4 *Change in Food and Nutrient Concentrations*

The primary Project activity that could affect food and nutrient contributions is riparian vegetation clearing. A mixture of deciduous and coniferous riparian vegetation provides inputs of food and nutrients to the aquatic food web. Insects that fall from streamside vegetation become food for many aquatic organisms and leaf litter provides year-round inputs of nutrients (particularly carbon) for fish and aquatic invertebrates. Woody debris provides a source of organic carbon and improves substrate habitat for aquatic invertebrates, an important source of food for salmonids (Johnston and Slaney 1996). Disturbances that result in the

removal of the riparian vegetation can change the type and amount of insects and litter that enter the stream. When riparian vegetation is modified, food and nutrient inputs can be altered (Murphy and Meehan 1991).

5.2.1.1.5 Change in Contaminant Concentrations

Construction activities may release sediment to downgradient streams and Minesite water containing metals and other constituents may be discharged or seep into fish-bearing watercourses during any phase of the Project. These discharges have the potential to adversely affect water quality and aquatic life through toxic effects or by altering conditions for growth for aquatic organisms (Murphy and Meehan 1991)

The primary discussion around Project effects to water quality is included in **S4.0-C5 Aquatic Resources VC**. To avoid redundancy, this discussion has not been repeated here. As they relate to fish, water quality issues are considered in relation to established objectives for aquatic species. All water flowing into fish-bearing streams during Construction, Operation, Decommissioning and Reclamation, and Post-Closure phases, whether flowing from the mine sediment/control ponds or from direct mine runoff, will either:

- ▶ adhere to water quality parameter concentrations as set out in the Canadian Water Quality Guidelines for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment [CCME] 2014); or
- ▶ meet site performance objectives (SPOs), which are 'predictive' site-specific water quality objectives for a quantifiable receiving environment parameter or attribute, developed by a qualified professional, using a rigorous scientific process (e.g., CCME 2002; BC MOE 2013, BC MECCS 2016 and 2021), with the intent to guide management decisions and mitigation actions for a regulated activity at a specific location (e.g., compliance with an effluent limit at a final discharge point).

Levels of six (6) water quality parameters – aluminum, cadmium, cobalt, nitrite, selenium, and thallium – are predicted to be above provincial water quality guidelines and will have SPOs. Exceedances of the selenium, aluminum, cadmium and thallium SPOs are expected in winter months for a period of years in post-closure in select sections of streams within the LSA. However all streams are expected to meet SPOs in long-term Post-closure (i.e. 2100). Provincial water quality objectives will be met for all water quality parameters in watercourses outside the LSA, except for aluminum, which is naturally elevated and exceeds the water quality guideline in the baseline data in the Telkwa and Bulkley rivers.

5.2.1.1.6 Change in Base Flows

The Project is anticipated to affect stream flows in Tenas and Four creeks due to the diversion of water from within and around the mine footprint and for Minesite use. The effects are anticipated to vary depending on Project stage; however, the level of the effect is expected to vary seasonally and across years within each respective phase of the Project.

Fluvial systems are physically and biologically complex, and consequently understanding instream flow needs for fish is important when changes to flows are anticipated. Fish production in streams is considered to be a function of flow (Lewis et. al. 2004). Fish abundance and diversity are driven primarily by physical habitat availability, which is causally related to flow. Water quality and invertebrate production, also causally related to flow, may have an effect on fish.

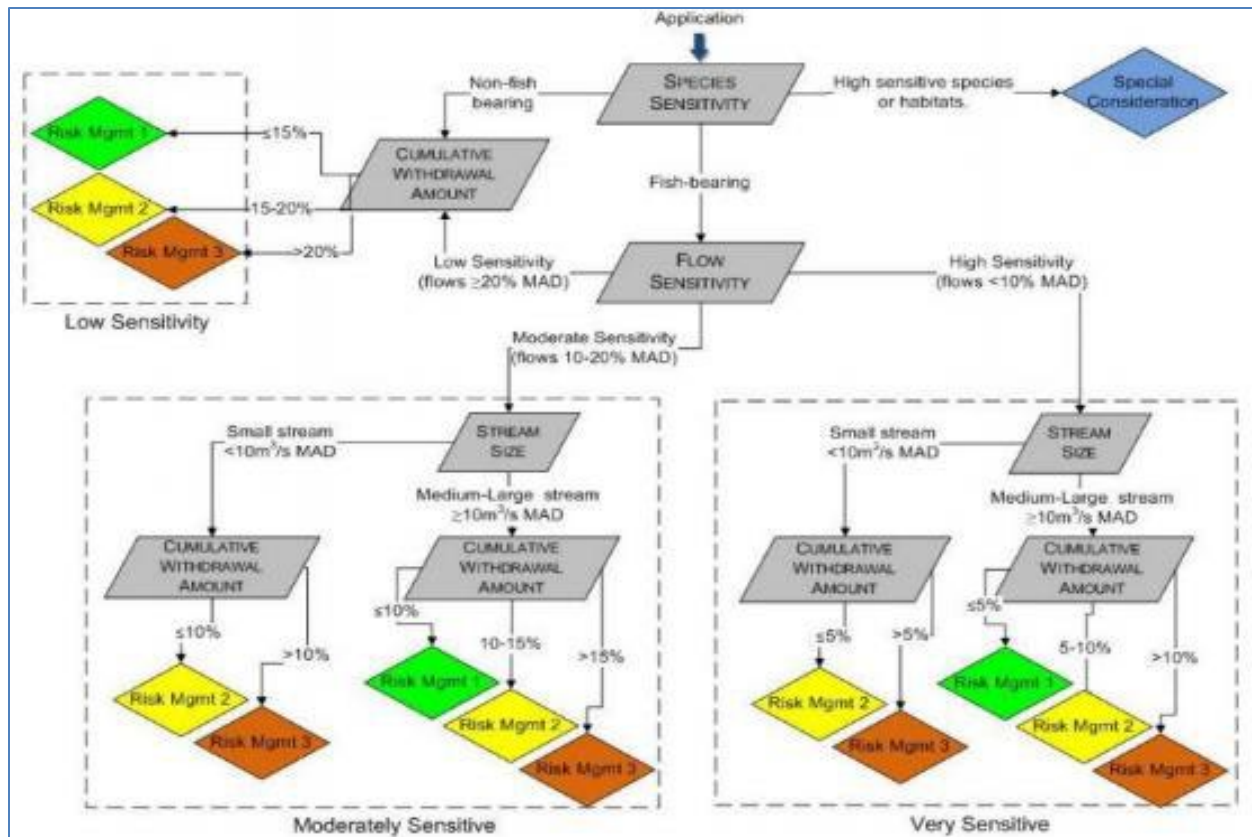
Contact water diverted from tributaries within the mine footprint that flows into Tenas Creek will be diverted through the management and sedimentation ponds and discharged into Goathorn Creek downstream of

the Minesite footprint (**Figure 5.2-1**). Site drainage previously reporting to Four Creek will be diverted through the water management ponds and discharged into Goathorn Creek. Diversion channels for non-contact water will divert some of Four Creek watershed that would enter the open pit, around this structure to the south. Another diversion channel is constructed south of the open pit and East Management Pond to control the flow into these structures. Further information on the Minesite water management see the **Minesite Water Management Plan (S13.0-C11) (MWMP)**.

An assessment of risk level associated with the proposed changes to base flows in Tenas Creek and Four Creek was completed using the BC EFN Policy (BC MFLNRO 2014). The policy defines environmental flow needs as the volume and timing of water flow required for the proper functioning of the aquatic ecosystem of the stream. Flow conditions are expected to vary temporally and spatially throughout the duration of the Project in both watercourses.

The BC EFN policy provides a process to assess risk to aquatic habitats using the Instream Flow Methodology, which is a requirement of the BC WSA (BC MFLNRO 2014). Stream sensitivity to changes in flow are determined on a month-by-month basis based on daily or monthly natural flows as a percentage of long-term mean annual discharge (MAD) (**Figure 5.2-2**). Risk is assessed for each month based on proposed cumulative withdrawals and assigned a risk management level between 1 and 3 accordingly:

- ▶ Risk Management Level 1 - there is sufficient natural water availability for the proposed withdrawal period and cumulative water withdrawals are below the specified threshold described in the Environmental Risk Management Framework;
- ▶ Risk Management Level 2 - the aquatic environment is flow-limited for the proposed withdrawal period; or cumulative water withdrawals are greater than a specified threshold of concern. Reconnaissance level fish and fish habitat effects assessment is required to assess the potential impacts to fish habitat; and
- ▶ Risk Management Level 3 - the aquatic environment may be very flow-limited for the proposed period of withdrawal. Detailed flow assessments are required to determine the nature and extent of potential effects on fish habitat.



Source: British Columbia Ministry of Forests, Lands, and Natural Resource Operations (BC MFLNRO) 2014

Figure 5.2-2: EFN Policy Stream Sensitivity and Risk Management Process

Predicted flows were modeled at three (3) locations (nodes) in Tenas Creek:

- ▶ WQS01 – upstream of the Minesite footprint;
- ▶ WQS02 – immediately downstream of the Minesite footprint;
- ▶ WQS22 – immediately upstream of the location where diverted Tenas Creek flows will be discharged back into Tenas Creek; and
- ▶ WQS04 – immediately downstream of the location where diverted Tenas Creek flows will be discharged back into Tenas Creek.

The predicted changes from baseline flows at each of the prediction nodes in Tenas Creek during the Construction, Operation, and Post-closure phases of the Project are shown in **Table 5.5-2**. Changes to flows during the Decommissioning and Reclamation Phase will be less than those changes occurring during the Post-closure Phase; therefore, the larger predicted changes during the Post-closure Phase were used for EFN analysis for Decommissioning and Reclamation, and Post-closure phases. Based on the results of modeling, WQS04, the node furthest downstream, is expected to be most affected by the Project, with a modeled maximum decrease of 7.6% mean monthly flows during the Operation Phase (**Table 5.5-2**). The largest predicted increases in flows occur during winter months at WQS04 with up to an additional 3% increase in discharge from January through March during Post-closure.

Table 5.2-2: Environmental Flow Needs (EFN) Risk Analysis at WQS04 in Tenas Creek

Month	Mean discharge (m ³ /s)	Mean discharge as % of MAD ¹	Flow Sensitivity	Construction Phase		Operation Phase		Post-closure Phase	
				Proposed flow change %	Risk Mgmt. Level ²	Proposed flow change %	Risk Mgmt. Level ²	Proposed flow change %	Risk Mgmt. Level ²
Jan	0.028	4%	High	-0.24	2	-1.70	2	3.00	n/a
Feb	0.028	4%	High	-0.26	2	-1.70	2	3.00	n/a
Mar	0.028	4%	High	-0.28	2	-1.70	2	3.00	n/a
Apr	0.736	112%	Low	-0.13	1	-8.40	1	-5.50	1
May	3.373	515%	Low	-0.01	1	-7.20	1	-5.60	1
Jun	1.827	279%	Low	-0.01	1	-5.80	1	-4.30	1
Jul	0.351	54%	Low	-0.04	1	-6.30	1	-4.70	1
Aug	0.076	12%	Mod	-0.17	2	-6.90	2	-3.50	2
Sep	0.513	78%	Low	-0.03	1	-6.50	1	-5.00	1
Oct	0.612	93%	Low	-0.03	1	-6.80	1	-5.10	1
Nov	0.266	41%	Low	-0.18	1	-7.30	1	-4.80	1
Dec	0.030	5%	High	-0.45	2	-2.20	2	1.80	n/a

Notes: %=percent; m³/s=cubic metres per second; MAD=Mean Annual Discharge; Mgt=Management

¹ MAD for Tenas Creek at WQS04=0.0.655 m³/s

² As determined using the British Columbia (BC) Environmental Flow Needs (EFN) methods (British Columbia Ministry of Forests, Lands, and Natural Resource Operations [BC MFLNRO] 2014)

Predicted flows were also modelled at four (4) locations (nodes) in Four Creek:

- ▶ WQS03 – at the upstream extent of predicted Minesite influences on Four Creek flows;
- ▶ WQS21 - immediately downstream of the proposed water diversion location;
- ▶ WQS20 – approximately 600 m downstream of WQS21; and
- ▶ WQS03-DS - downstream of WQS20 and approximately 250 m upstream of the Goathorn Creek confluence with Four Creek.

Changes to flows during the Decommissioning and Reclamation Phase will be less than those changes occurring during Post-closure Phase; therefore, the larger predicted changes during the Post-closure Phase were used for EFN analysis for the Decommissioning and Reclamation, and Post-closure phases. Based on the results of modelling, WQS21, the node located immediately downstream of the proposed water diversion location, will likely be most affected by the Project, with an average modelled decrease of 25% in mean monthly flows in the winter during the Post-Closure Phase (**Table 5.2-3**). The largest predicted increases in average flows occur in early fall at WQS21 with an additional 35% increase in discharge during Operations. Using the EFN Risk Management Process, predicted flow diversions were determined to result in a Risk Management Level 3 for at least one (1) or more of the nodes for each given season and Project phase in Four Creek (**Table 5.2-3** and **Table 5.2-4**). Detailed studies were carried out to better understand the potential changes on seasonal available habitat for Dolly Varden and steelhead in Four Creek.

Predicted flow changes were assessed to result in a Risk Management Level 1 during spring, early summer, and fall in Tenas Creek, and Risk Management Level 2 during winter months and late summer. Therefore, current studies and understanding of fish use were determined to meet or exceed reconnaissance level studies recommended in the EFN Management Process.

Table 5.2-3: Environmental Flow Needs (EFN) Risk Analysis at WQS21 in Four Creek

Month	Mean discharge (m ³ /s)	Mean discharge as % of MAD ¹	Flow Sensitivity	Construction Phase		Operation Phase		Post-closure Phase	
				Proposed flow change %	Risk Mgmt. Level ²	Proposed flow change %	Risk Mgmt. Level ²	Proposed flow change %	Risk Mgmt. Level ²
Jan	0.001	8%	High	-0.40	2	-19.70	3	-25.00	3
Feb	0.001	8%	High	-0.43	2	-19.80	3	-25.00	3
Mar	0.001	8%	High	-0.46	2	-19.90	3	-25.00	3
Apr	0.101	559%	Low	-0.15	1	25.80	n/a	27.50	n/a
May	0.069	384%	Low	-0.05	1	36.80	n/a	34.30	n/a
Jun	0.010	54%	Low	-0.15	1	34.00	n/a	31.50	n/a
Jul	0.010	57%	Low	-0.10	1	34.50	n/a	31.20	n/a
Aug	0.004	24%	Low	-0.33	1	25.90	n/a	22.90	n/a
Sep	0.014	79%	Low	-0.08	1	35.00	n/a	32.60	n/a
Oct	0.006	33%	Low	-0.22	1	31.50	n/a	29.30	n/a
Nov	0.002	11%	Mod	-0.63	2	-1.00	2	-2.90	2
Dec	0.001	8%	High	-0.74	2	-21.00	3	-25.00	3

Notes: %=percent; m³/s=cubic metres per second; MAD=Mean Annual Discharge; Mgt=Management

¹ MAD for Four Creek at WQS21=0.018 m³/s

² As determined using British Columbia (BC) Environmental Flow Needs (EFN) methods (British Columbia Ministry of Forests, Lands, and Natural Resource Operations [BC MFLNRO] 2014)

Table 5.2-4: Environmental Flow Needs (EFN) Risk Analysis at WQS20 in Four Creek

Month	Mean discharge (m ³ /s)	Mean discharge as % of MAD ¹	Flow Sensitivity	Construction		Operations		Post-Closure	
				Proposed flow change %	Risk Mgmt. Level ²	Proposed flow change %	Risk Mgmt. Level ²	Proposed flow change %	Risk Mgmt. Level ²
Jan	0.001	7%	High	-0.67	2	-19.20	3	-22.30	3
Feb	0.001	7%	High	-0.72	2	-19.30	3	-22.30	3
Mar	0.001	7%	High	-0.77	2	-19.40	3	-22.30	3
Apr	0.103	542%	Low	-0.25	1	24.30	n/a	27.00	n/a
May	0.071	373%	Low	-0.09	1	34.90	n/a	33.40	n/a
Jun	0.010	52%	Low	-0.25	1	32.10	n/a	30.90	n/a
Jul	0.010	55%	Low	-0.16	1	32.60	n/a	30.60	n/a
Aug	0.004	23%	Low	-0.56	1	24.30	n/a	23.20	n/a
Sep	0.015	77%	Low	-0.13	1	33.20	n/a	31.80	n/a
Oct	0.006	32%	Low	-0.38	1	29.80	n/a	28.90	n/a
Nov	0.002	11%	Mod	-1.06	2	-1.40	2	-1.30	2
Dec	0.001	7%	High	-1.25	2	-20.40	3	-22.30	3

Notes: %=percent; m³/s=cubic metres per second; MAD=Mean Annual Discharge; Mgt=Management

¹Mean Annual Discharge (MAD) for Four Creek at WQS20 = 0.019 m³/s

²As determined using the BC EFN methods (BC MFLNRO 2014)

5.2.1.1.6.1 Instream Flow Assessment (IFA)

An 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 each node, flows were modelled for baseline and all Project phases for hydraulic conditions important for fish (i.e., stream depth, width, water velocity, substrate) and the Area Weighted Suitability (AWS) of habitat, calculated by applying Dolly Varden and steelhead life-stage specific Habitat Suitability Index (HSI) curves to these hydraulic conditions. HSI curves are the biological component of habitat simulation tools used to evaluate instream flow management trade-offs (e.g., physical habitat simulation models). The percentage change in average monthly AWS, expressed in metres squared per reach, during biologically relevant time-periods was used to assess the potential effects of predicted flow changes on fish habitat during each Project phase relative to baseline.

The hydraulic habitat component of the IFA linked a hydraulic engineering model to fish HSI curves for Dolly Varden and steelhead based on water depth, velocity, and bed particle size. The System for Environmental Flow Analysis (SEFA) software (Payne et al. 2013), which is a well-established standard application used in hydraulic-habitat analysis was used to model changes in AWS associated with modelled changes in flows. SEFA is a software program that builds hydraulic habitat models to determine how fish habitat quantity and quality vary as functions of stream discharge. This is consistent with the objectives of the BC EFN Policy.

Modeling analyses focused on Dolly Varden and steelhead. Dolly Varden are found throughout the fish-bearing reaches of Four Creek, and steelhead/rainbow trout have been captured and observed in the lower 250 m of Four Creek (Reach 1) (see 4.2).

HSI curves for Dolly Varden were compiled from two sources (Washington Department of Fish and Wildlife, 2016, Avanti Mining Inc. 2011) and steelhead HSI curves were compiled using BC Hydro water use planning curves (BC Hydro 2001).

The hydrology data used to support the IFA analyses were developed using various sources, including regional hydrometric stations with long-term records, local hydrometric stations with short-term records, and other local data collected specifically to support the IFA analyses. Local hydrometric records collected as part of the baseline characterization were extended using long-term regional station records. The water and load balance model developed individual calibrated rainfall-runoff models for each stream based on the extended local records and used changes in catchment area and groundwater baseflow contributions from the Project to evaluate relative change in pre-mining streamflow conditions. The model inputs include temperature and precipitation, which included adjustments for climate change through 2100. (see **Appendix 1.0-E SRK, Tenas Project Water and Load Balance Modeling Report of S1.0 Overview of Project Proponent Description of the EAC Application**). Additional details on the hydrologic characterisations are provided in **Appendix 1.0-R SRK, Tenas Project Hydrometeorological Report of S1.0 Overview of Project Proponent Description of the EAC Application**).

The IFA study design followed guidelines provided by Lewis et al. (2004) and Hatfield et al. (2007). Separate hydraulic habitat models were developed in SEFA for each identified life history stage for both Dolly Varden and steelhead. Each modeled stream reach was defined by relatively homogenous hydro-geomorphic (macrohabitat) conditions (i.e., stream morphology, gradient, substrate, and discharge). This delineation of stream reaches was used to limit the inherent errors associated with attempting to predict complex instream flow conditions with simplified models.

Discreet macrohabitat-reaches (i.e., hydro-geomorphic sections) were identified in each watercourse based on detailed habitat mapping (Bustard 1998). Delineated macro-reaches were further characterized and subdivided into mesohabitat units (i.e., runs, pools, riffles) during field surveys.

Transects were established in select mesohabitat units within each macro-reach to collect the data required for the development and calibration of hydraulic habitat models. Detailed channel cross-section, water surface elevation, substrate composition, and vertical depth and water velocity profiles were collected during initial survey visits to each transect. Only water surface elevations were collected at each transect during repeat visits over the range of flows necessary to calibrate the models. A representative stream discharge was collected for each modeled stream reach during each repeat visit.

Stream-transect data used to develop the IFA models were collected during the 2019 and 2020 field programs. In total, nine transects were established in reaches 1, 3, and 4 of Four Creek. The five transects in reaches 3 and 4 were combined to establish flow-habitat relationships. Once calibrated, each hydraulic habitat model was run using a hydrological time-series that included baseline and all Project phases.

5.2.1.1.6.1.1 Flow-Habitat Relationships

The results of simulated flow-habitat relationships across each reach are presented in **Figures 5.2-4 to 5.2-6** below.

5.2.1.1.6.1.1.1 Reach 1

In Reach 1 of Four Creek, habitat quality (as indicated by AWS) increased across the range of monthly simulated flows for steelhead spawning and rearing parr (**Figure 5.2-4**). Steelhead rearing fry habitat increased exponentially at very low flows given the suitability of fry to shallow water with lower velocities, and AWS fell to below 0.5 m²/m at water velocities of approximately 0.2 m³/s.

Dolly Varden habitat quality increased across the range of monthly flows as they increase for rearing, spawning, and overwintering life history stages (**Figure 5.2-5**).

5.2.1.1.6.1.1.2 Reach 3 and 4

In reaches 3 and 4 of Four Creek, habitat quality increased across the range of monthly flows for rearing, spawning, and overwintering life history stages for Dolly Varden (**Figure 5.2-6**). AWS was low for Dolly Varden spawning across the range of observed flows during field surveys (<0.05 square metres per metre [m²/m] at 0.1 cubic metres per second [m³/s]).

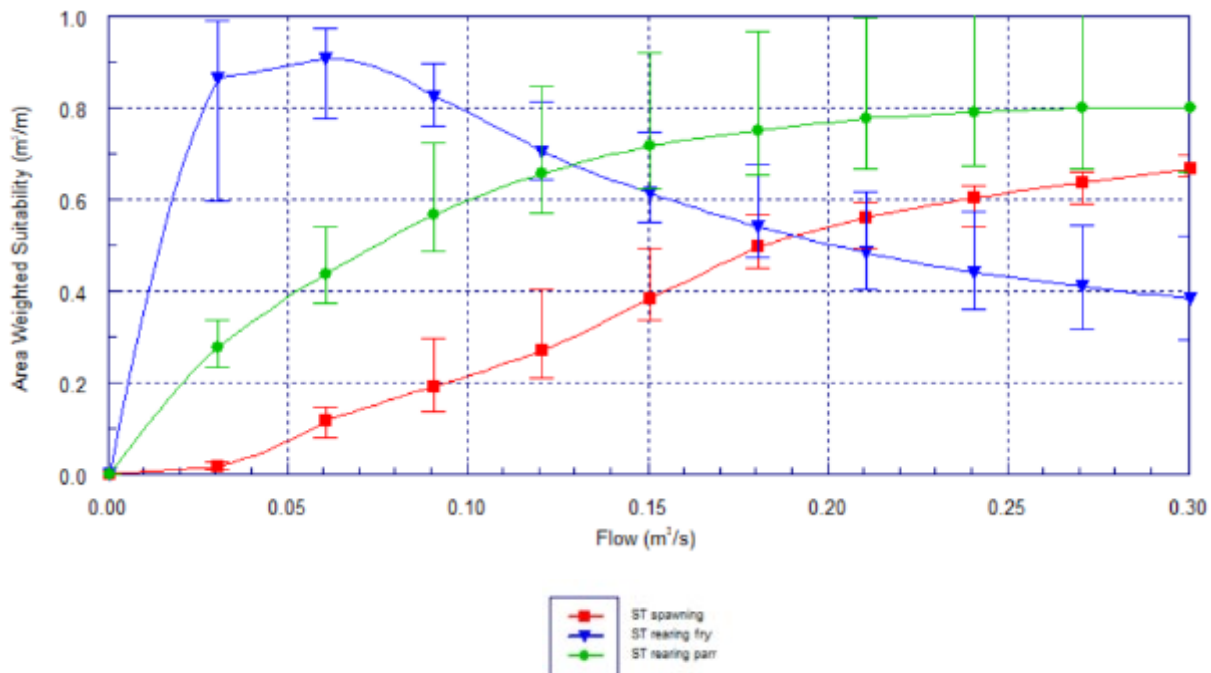


Figure 5.2-3: Steelhead habitat (Area Weighted Suitability [AWS]) as a function of flow, Reach 1, Four Creek

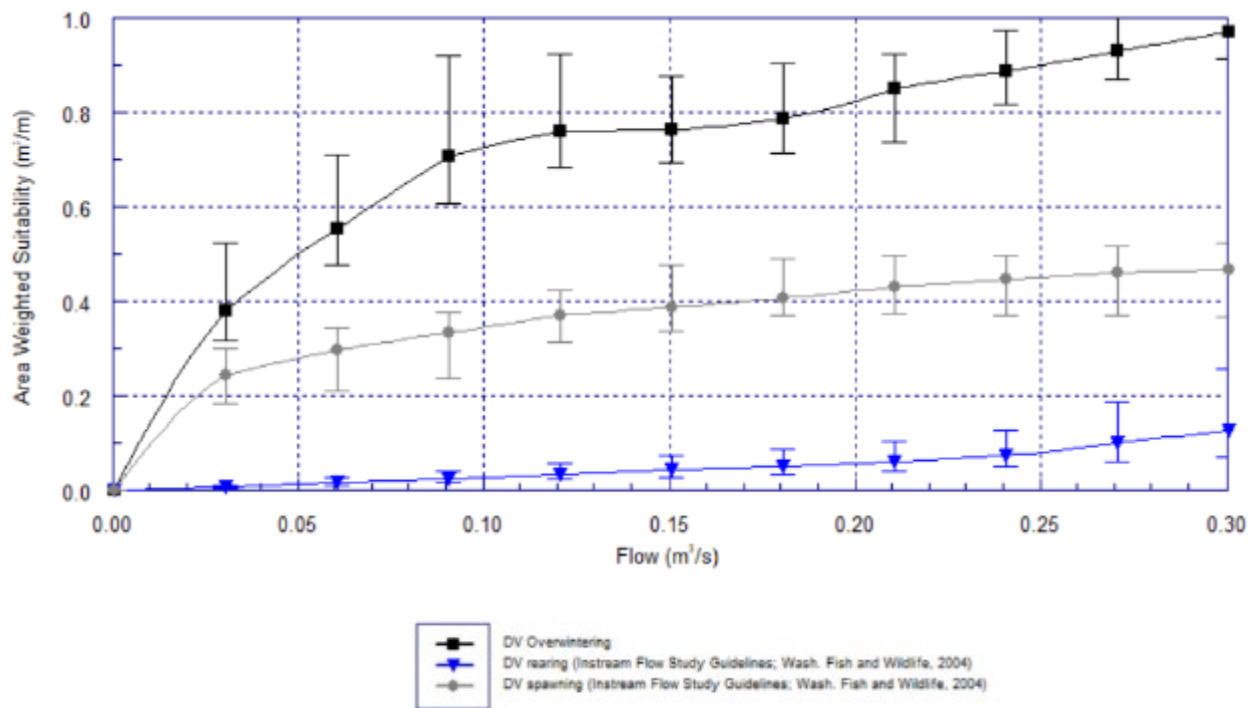


Figure 5.2-4: Dolly Varden habitat (Area Weighted Suitability [AWS]) as a function of flow, Reach 1, Four Creek

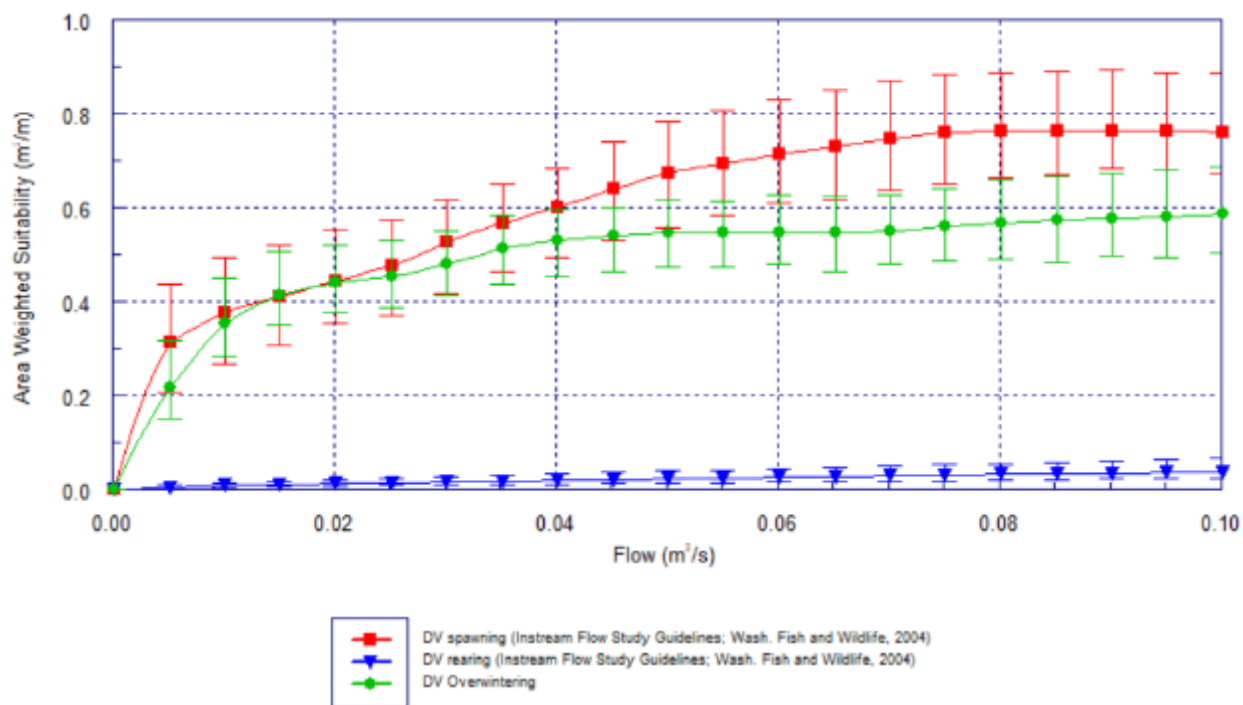


Figure 5.2-5: Dolly Varden habitat (Area Weighted Suitability [AWS]) as a function of flow, Reach 3 and 4, Four Creek

5.2.1.1.6.1.2 Project Changes To Habitat During Average Hydrological Conditions

5.2.1.1.6.1.2.1 Reach 1

In Reach 1, the largest modeled percentage changes in AWS are for Dolly Varden rearing habitat during the Operation, Decommissioning and Reclamation and Post-closure phases of the Project (as high as a 24% reduction during critical flow periods), and for steelhead spawning habitat during the Operation, Decommissioning and Reclamation, and Post-closure phases of the Project (up to 47% reduction during Operation) (**Table 5.2-8**). For both of these species/life history stages, high percentage changes are attributable to the relatively low, existing baseline availability of habitat (<2.0 m² and <27 m², respectively). Steelhead parr and fry rearing habitat is the only habitat type provided in substantial amounts in Reach 1 due to shallow water depths and low seasonal flows -- as high as 89.0 m² for rearing steelhead parr and 244.5 m² for rearing steelhead fry).

5.2.1.1.6.1.2.2 Reach 2

Reach 2 is located immediately upstream of the fish passage barrier at the Telkwa Coal Mine Road, which marks the upstream limit for anadromous fish. Only Dolly Varden have been captured or observed above this barrier. All Dolly Varden observations/captures have occurred in reaches 3 to 5. No Dolly Varden have been captured or observed in Reach 2. Reach 2 is a lower habitat quality, steeper gradient, entrenched reach between the anadromous Reach 1 downstream and the more suitable resident Dolly Varden habitat in reaches 3 and 4 upstream. For the purposes of the IFA, flow-habitat relationships for the more productive reaches 3 and 4 have been conservatively applied to Reach 2.

The largest changes in AWS in Reach 2 are for Dolly Varden spawning during critical low flow periods during the Post closure phase of the Project (42-44%), and for overwintering during critical low flow periods during Operation, Decommissioning and Reclamation and Post-closure (20-29%) (Table 5.2-9).

5.2.1.1.6.1.2.3 Reaches 3 and 4

Reaches 3 and 4 represent the most suitable habitat for resident Dolly Varden observed in Four Creek. All observations and captured specimens have occurred within these two (2) reaches, and the lower gradient, complex channel provides the best habitat along the length of the creek.

Similar to Reach 2, the largest changes in AWS in Reach 3 are for Dolly Varden spawning during critical low flow periods during the Operation, Decommissioning and Reclamation, and Post closure phases of the Project (37-44%), and for overwintering during critical low flow periods during Operation, and Post-closure (20-29%) (Table 5.2-9).

The largest changes in AWS in Reach 4 are for Dolly Varden spawning during critical low flow periods during the Operation, Decommissioning and Reclamation, and Post closure phases of the Project (20-27%), and for overwintering during critical low flow periods during Operations Decommissioning and Reclamation, and Post closure phases of the Project (15-18%) (Table 5.2-9).

5.2.1.1.6.1.2.3.1 Aggregate Predicted Habitat Changes in Four Creek due to Flow Reductions

Aggregate predicted habitat changes across all four (4) study reaches were as follows: net AWS of fish habitat increased from baseline levels across all phases of the Project except for during Construction, in which a net reduction of 2.0 m² of weighted suitable habitat represents a <1.0% loss (Table 5.2-9). This net gain in habitat during Operation, and Post-closure is attributable to modeled increases in summer low flows and mean monthly flows during the fall, early winter, and early spring periods.

Net reductions in AWS occur across all reaches supporting Dolly Varden during the critical low flows during spawning and overwintering; up to 23% for both life history stages (114 m² and 76 m², respectively). It is predicted that through creation and enhancement of fish habitat, that will be described in a habitat offsetting plan developed for the Project, net productivity for the resident Dolly Varden population can effectively be offset and remain unaffected.

Table 5.2-5: Changes in Weighted Suitable Area Across Project Phases and Species Life History Stages – Four Creek

Reach	Reach Surface Area (m²)	Life History Stage1	Period	CHANGES IN WEIGHTED SUITABLE AREA ACROSS PROJECT PHASES															
				Construction				Operation				Decommissioning and Reclamation				Post-closure			
				Mean WSA (m²)		Change		Mean WSA (m²)		Change		Mean WSA (m²)		Change		Mean WSA (m²)		Change	
				Baseline	Predicted	m²	%	Baseline	Predicted	m²	%	Baseline	Predicted	m²	%	Baseline	Predicted	m²	%
1	1,085	DV Spawning	Sep 1 - May 15	53.5	53.4	-0.1	0%	70.5	65.4	-5.1	-7%	79.0	74.0	-5.1	-6%	83.1	80.4	-2.7	-3%
		critical low flows	Jan 1 - Mar 31	10.4	10.3	-0.1	-1%	10.4	10.1	-0.4	-3%	10.4	10.8	0.4	4%	10.4	10.9	0.4	4%
		DV Rearing	May 1 - Oct 1	0.9	0.9	-0.0	0%	1.5	1.3	-0.3	-18%	1.8	1.6	-0.2	-13%	2.0	1.8	-0.2	-11%
		critical low flows	Jul 15 - Aug 15	0.4	0.4	-0.0	-1%	0.5	0.4	-0.1	-24%	0.5	0.4	-0.1	-24%	0.4	0.3	-0.1	-24%
		DV Overwintering	Oct 1 - Mar 31	24.3	24.0	-0.3	-1%	27.0	24.1	-2.9	-11%	27.5	26.1	-1.4	-5%	28.1	27.0	-1.0	-4%
		critical low flows	Jan 1 - Mar 31	15.9	15.7	-0.2	-1%	15.9	15.4	-0.5	-3%	15.9	16.5	0.6	4%	15.9	16.5	0.6	4%
		ST Spawning	Sep 1 - May 15	0.4	0.4	-0.0	-1%	6.6	3.5	-3.1	-47%	14.9	9.3	-5.7	-38%	26.7	17.7	-9.0	-34%
		critical low flows	Jan 1 - Mar 31	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%
		ST rearing fry	May 1 - Oct 1	227.0	226.8	-0.2	0%	244.5	241.8	-2.7	-1%	242.1	244.3	2.2	1%	240.7	242.4	1.6	1%
		critical low flows	Jul 15 - Aug 15	179.5	179.2	-0.3	0%	186.8	173.0	-13.9	-7%	186.9	173.2	-13.7	-7%	179.5	167.6	-11.9	-7%
		ST rearing parr	Oct 1 - Mar 31	49.2	49.1	-0.1	0%	70.2	61.5	-8.8	-12%	80.4	71.0	-9.4	-12%	89.0	79.5	-9.6	-11%
		critical low flows	Jan 1 - Mar 31	28.5	28.3	-0.1	0%	31.1	26.1	-5.0	-16%	31.1	26.2	-4.9	-16%	28.5	24.2	-4.3	-15%
2	5,520	DV Spawning	Sep 1 - May 15	481.7	481.6	-0.1	0%	577.0	654.3	77.3	13%	641.7	740.4	98.7	15%	716.3	873.2	156.9	22%
		critical low flows	Jan 1 - Mar 31	169.9	169.2	-0.7	0%	169.9	135.8	-34.1	-20%	169.9	126.2	-43.7	-26%	169.9	127.4	-42.5	-25%
		DV Rearing	May 1 - Oct 1	10.0	10.0	0.0	0%	13.4	16.7	3.3	25%	15.0	18.4	3.4	23%	16.7	20.1	3.3	20%
		critical low flows	Jul 15 - Aug 15	6.8	6.8	-0.0	0%	7.2	9.3	2.0	28%	7.2	8.9	1.6	22%	6.8	8.3	1.5	22%
		DW Overwintering	Oct 1 - Mar 31	166.3	166.1	-0.3	0%	174.5	183.6	9.2	5%	177.9	183.4	5.4	3%	181.2	188.7	7.4	4%
		critical low flows	Jan 1 - Mar 31	112.9	112.4	-0.5	0%	112.9	90.2	-22.7	-20%	112.9	83.8	-29.0	-26%	112.9	84.6	-28.2	-25%
3	6,000	DV Spawning	Sep 1 - May 15	527.3	527.1	-0.2	0%	632.2	714.4	82.3	13%	705.1	815.0	109.9	16%	790.2	959.5	169.3	21%
		critical low flows	Jan 1 - Mar 31	189.0	187.7	-1.3	-1%	189.0	152.1	-36.9	-20%	189.0	145.4	-43.7	-23%	189.0	146.9	-42.1	-22%
		DV Rearing	May 1 - Oct 1	10.9	10.9	0.0	0%	14.6	18.2	3.6	25%	16.7	20.0	3.3	20%	18.2	21.8	3.6	20%
		critical low flows	Jul 15 - Aug 15	7.5	7.5	-0.0	0%	8.0	10.1	2.1	26%	8.0	9.8	1.8	22%	7.5	9.2	1.6	22%
		DW Overwintering	Oct 1 - Mar 31	182.6	182.1	-0.5	0%	191.7	201.1	9.4	5%	195.5	202.3	6.8	3%	199.2	208.2	9.1	5%
		critical low flows	Jan 1 - Mar 31	125.6	124.7	-0.9	-1%	125.6	101.1	-24.5	-20%	125.6	96.6	-29.0	-23%	125.6	97.6	-28.0	-22%
4	5,005	DV Spawning	Sep 1 - May 15	328.5	328.3	-0.1	0%	393.8	445.0	51.2	13%	439.2	507.6	68.4	16%	492.2	597.6	105.4	21%
		critical low flows	Jan 1 - Mar 31	117.7	116.9	-0.8	-1%	117.7	94.7	-23.0	-20%	117.7	90.6	-27.2	-23%	117.7	91.5	-26.2	-22%
		DV Rearing	May 1 - Oct 1	6.8	6.8	0.0	0%	9.1	11.3	2.3	25%	10.4	12.5	2.0	20%	11.3	13.6	2.3	20%
		critical low flows	Jul 15 - Aug 15	4.7	4.7	-0.0	0%	5.0	6.3	1.3	26%	5.0	6.1	1.1	22%	4.7	5.7	1.0	22%
		DW Overwintering	Oct 1 - Mar 31	113.8	113.4	-0.3	0%	119.4	125.3	5.9	5%	121.8	126.0	4.2	3%	124.1	129.7	5.6	5%
		critical low flows	Jan 1 - Mar 31	78.2	77.7	-0.6	-1%	78.2	62.9	-15.3	-20%	78.2	60.2	-18.1	-23%	78.2	60.8	-17.4	-22%
Totals	17,610	DV Spawning	Sep 1 - May 15	1,391.0	1,390.4	-0.6	0%	1673.4	1879.1	205.7	12%	1865.0	2136.9	271.9	15%	2081.7	2510.7	429.0	21%
		critical low flows	Jan 1 - Mar 31	487.1	484.1	-3.1	-1%	487.1	392.7	-94.4	-19%	487.1	372.9	-114.2	-23%	487.1	376.7	-110.4	-23%
		DV Rearing	May 1 - Oct 1	28.7	28.7	-0.0	0%	38.5	47.5	9.0	23%	43.9	52.4	8.5	19%	48.3	57.3	9.0	19%
		critical low flows	Jul 15 - Aug 15	19.4	19.3	-0.0	0%	20.7	26.1	5.3	26%	20.7	25.1	4.4	21%	19.4	23.4	4.1	21%
		DW Overwintering	Oct 1 - Mar 31	487.0	485.6	-1.4	0%	512.5	534.1	21.6	4%	522.8	537.8	15.0	3%	532.5	553.6	21.1	4%
		critical low flows	Jan 1 - Mar 31	332.6	330.5	-2.1	-1%	332.6	269.6	-63.0	-19%	332.6	257.1	-75.5	-23%	332.6	259.6	-73.0	-22%
Net Loss of weighted usable area				1,906.7	1,904.7	-2.0	0%	2224.5	2460.8	236.3	11%	2431.7	2727.2	295.5	12%	2662.5	3121.7	459.2	17%

Notes: %=percent; DV=Dolly Varden m²=square metre; ST=steelhead trout WSA=Weighted Suitable Area

5.2.1.1.7 *Change in Migration and Access to Habitats*

The maintenance of migration corridors and access to specific habitats is essential to many types of freshwater fish. Unimpeded access to spawning, over-wintering, and rearing habitats is essential to salmonids during inter-river migrations (Prince 1991 *in* McPhail 2007; Scott and Crossman 1998), as well as when moving between rivers and lakes, often when water levels are low and over distances from a few kilometres to several hundred kilometres (McPhail 2007). Dolly Varden begin spawning migrations in spring when water levels are high and declining. After spawning, they generally move rapidly back to over-wintering habitats by September or October (McPhail 2007).

Project activities that inhibit the natural movements of fish can limit access to key habitats and reduce the overall productive capacity of fish habitat. The diversion of flows during all phases of the project is the primary Project activity that has the potential to inhibit fish movement.

5.2.2 Fish Subcomponent

Project activities have the potential to affect fish health, condition, and mortality rates, which in turn may have an effect on fish abundance. Activities throughout all Project phases have the potential to affect fish health (including mortality), condition, and abundance. These potential changes are assessed in consideration of the interactions (activities) of the Project from Construction through the Post-closure Phases of the Project.

As noted above in **5.2**, using the DFO PoE model (DFO 2018) and the DFO activities identified in **5.1.1** above, potential effects on fish were determined to be associated with the following:

- ▶ change in sediment concentrations;
- ▶ change in water temperature;
- ▶ change in food and nutrient concentrations;
- ▶ change in mortality of fish and eggs;
- ▶ change in contaminant concentrations; and
- ▶ displacement or stranding of fish.

These potential adverse effects on the fish subcomponent are accounted for in the assessment of fish health, condition, and abundance, and are considered in the following sections as they relate to specific Project activities. Construction activities that can cause harm to fish, decrease fish health, and condition, or increase fish mortality include the following, and are discussed in the subsections below:

- ▶ activities that cause increased sedimentation;
- ▶ water extraction/diversion;
- ▶ use of industrial equipment instream;
- ▶ use of explosives; and
- ▶ activities that degrade water quality.

Project activities occurring through the Operation, Decommissioning and Reclamation, and Post-closure phases of the Project primarily have the potential to affect water quality through water containing metals and other parameters seeping or being discharged directly and/or indirectly into fish-bearing waters. A

detailed discussion of Project effects on water quality is provided in **S4.0-C3 Surface Water VC** and **S4.0-C5 Aquatic Resources VC**.

5.2.2.1 Change in Fish Health

5.2.2.1.1 Activities Causing Increased Sediment Concentrations

Sediment concentrations may be increased during Construction activities such as site clearing, construction of channels and ponds, stream crossing construction, installation of discharge structures, as well as construction activities or overburden storage that occur in proximity to watercourses. High levels of turbidity and suspended sediments can have both lethal and sub-lethal effects on fish. It can affect the ability to feed, increase susceptibility to predation, suppress immune function and reproduction, and in extreme levels cause the direct mortality of fish. The severity of these effects is dependent on both the concentration and duration of exposure to elevated levels of suspended sediments (Waters 1995, Birtwell 1999). Changes in fish health due to prolonged increases in sediment concentrations may include community-level alterations to future fish populations such as changes fish condition, species composition, and relative abundance.

5.2.2.1.2 Water Extraction/Diversion

Pumps may be used to divert flows around work areas during isolation of watercourses and to withdraw water from streams for Minesite activities. Many pumps draw water at velocities greater than the burst speed of most fish, and thus can suck fish into the pump screen or into the impeller. The impingement of fish against the intake screen or entrainment of fish in the pump generally results in mortality.

Dewatering of watercourses during isolation for construction works or for diversion of watercourses, may cause fish to become stranded. Isolation activities can dewater downstream areas of streams and strand fish or developing embryos, depending on the timing of the activity. Stress and mortality might also occur if isolated pools are created during Project activities, which can trap fish and expose them to decreased water quality, increased temperatures, and predation.

5.2.2.1.3 Use of Industrial Equipment Instream

Instream activities may require construction equipment to be present within the channel during mine site construction, diversion channel installation, or road crossing installation. As such, there is a risk of direct mortality to fish species present within the work area. This includes direct crushing of fish, destruction of eggs and ova in substrates, and disturbance of channel substrates that may contain alevin.

5.2.2.1.4 Use of Explosives

Explosives may be used during the construction of mine infrastructure and the TAC. The use of explosives in or near watercourses can cause lethal and sub-lethal effects on fish. Shock waves from underwater explosions can kill fish or damage swim bladders and other internal organs (Canadian Association of Petroleum Producers et al. 2005). Although most mortality occurs from underwater blasts, blasting activities near fish habitat can induce pressure waves with enough energy to cause injury or mortality. In addition, the introduction of by-products from the blasting materials, such as ammonia, can lead to fish mortalities if blast residues are released in sufficient quantities (Wright and Hopky 1998).

5.2.2.1.5 *Activities that Degrade Water Quality*

Construction activities may release toxic substances to area streams. Mine water containing metals, sulphates and other constituents may be discharged or seep into fish-bearing watercourses during any phase of the Project. These discharges have the potential to affect water quality for aquatic life through toxic effects or by altering conditions for growth of aquatic organisms (e.g., through nutrient addition). A detailed discussion of Project effects on water quality is provided in the **S4.0-C3 Surface Water VC** and **S4.0-C5 Aquatic Resources VC**. Prolonged or permanent changes in water quality may result in community-level alterations to future fish populations such as changes fish condition, species composition, and relative abundance.

5.3 Mitigation Measures

This subsection describes mitigation measures consistent with the definition provided by BC EAO (2013). These mitigation measures include applicable standards, guidelines, and BMPs supported by specific guidance documents, as well as Project-specific measures and measures specific to Fish and Fish Habitat, designed to mitigate potential adverse effects. The measures are summarized in **Table 5.3-2**.

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 to-date for Project infrastructure and mining equipment, and a commitment to progressive reclamation. Project mitigation measures that are relevant to minimizing a potential Project-related effect on the Fish and Fish Habitat VC are described below in **5.3.1** to **5.3.8** below.

As not all effects can be addressed through design, additional mitigation measures specific to the Fish and Fish Habitat VC and tailored to Project features are described in **5.3.9** to **5.3.18**. Adverse effects identified in the DFO PoEs that cannot be mitigated through the relocation, redesign, or application of other migration measures are carried forward into the effects assessment. These mitigation measures that are applicable to the Fish and Fish Habitat VC are based on proven and accepted mitigation used on other similar approved projects in BC that had comparable potential adverse effects on Fish and Fish Habitat, as well as standard industry guidelines and BMPs such as those listed in **2.5 Best Management Practices (BMPs)**. The additional mitigation measures are expected to be feasible and effective in a timely manner following implementation. No uncertainties have been identified at this time.

The intent of the identified mitigation measures is to break the activity pathways that lead to adverse environmental effects on fish habitat productive capacity and fish health. The approach to mitigation has been developed in a manner that follows DFO's Fish and Fish Habitat Protection Policy (DFO 2019b). The policy's objective is to ensure that harmful impacts to fish and fish habitat are avoided, and where avoidance is not possible, harmful effects are effectively counterbalanced through offsetting that provides a positive contribution to the aquatic ecosystem.

The policy establishes a net gain in the productivity of habitat as a guiding principle in DFO's review of development projects. It also outlines a hierarchy of measures through which the no net loss principle is applied. In order of preference, this hierarchy establishes that a proponent must:

- ▶ maintain without disruption, the natural productive capacity of the habitats potentially affected by avoiding any loss or alteration through redesign or alternate site selection;

- ▶ mitigate potential damages using reliable techniques (e.g., road crossing methods appropriate to a specific watercourse) and measures (e.g., sediment and erosion control), contingency plans, environmental protection, and monitoring plans (wherever practical); and
- ▶ consider offsetting options in instances where it is not possible to maintain the existing productive capacity of fish habitats.

This hierarchy has been followed throughout the planning and design of the Project.

Mitigation measures tailored to Project features that are applicable to the Fish and Fish Habitat VC have been incorporated into the various management plans for the Project, including the following:

- ▶ **Construction Environmental Management Plan (S13.0-C4) (CEMP);**
- ▶ **MWMP;**
- ▶ **Metal Leaching (ML)/ARD Management Plan (S13.0-C12) (ML/ARDMP);**
- ▶ **Reclamation and Closure Plan (S13.0-C15) (RCP);**
- ▶ **Surface Erosion Protection and Sediment Control Plan (S13.0-C17) (SEPSCP);**
- ▶ **Fuel Management and Spill Control Plan (S13.0-C7) (FMSCP); and**
- ▶ **Mine Emergency Response Plan (S13.0-C9) (MERP).**

The management plans provide guidance as per the current practices for minimizing changes to environmental and socio-economic values, including the Fish and Fish Habitat VC. The management plans provide direction on sequencing, monitoring, and adaptive management and the mitigation measures outlined in each plan are expected to be timely and effective following implementation.

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 open pit, stockpiles for run-of-mine 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 component footprints to limit the clearing of vegetation and the salvage of reclamation materials (surface soil, woody debris, and overburden). For example, the Minesite buildings will be built in areas previously cleared by forestry activity;
- ▶ Minimize the length of haul roads, access roads, and rail line where possible. Use or improve existing roads where practical;
- ▶ Utilize a loop design configuration for the rail that requires half the space and subsequent footprint compared to 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 percent (%) of non-coal material back into the open pit; and
- ▶ Place processed rock from the CPP within the management ponds versus a separate permanent pile to avoid any potential ARD from this material and reduce the Project footprint.

5.3.2 Avoid Sensitive Environments

The following apply to sensitive environments:

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

5.3.3 Reclamation Measures

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

- ▶ Use progressive reclamation techniques to limit the amount of disturbance at any given time (e.g., by sequencing the open pit and stockpiles to the extent feasible, backfilling of open pit where possible, directly placing reclamation materials, and placing excavated materials on previously disturbed areas;
- ▶ Salvage reclamation materials (surface soil, woody debris, and overburden) for later use in accordance with the **RCP**;
- ▶ Vegetate all temporary surface soil and overburden stockpiles to minimize the potential for erosion and sediment generation, to prevent subsequent effects to 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 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;
- ▶ Potentially acid generating (PAG) material deposited in the management ponds will be flooded to prevent acid mine drainage but will also be covered with an engineered cover consisting of non-PAG rock, overburden, and surface soils to allow for terrestrial revegetation;
- ▶ Majority of open pit features (e.g., highwalls and footwalls) are covered/resurfaced/recontoured with non-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 such as **Wildlife Management Plan (S13.0-C21) (WMP)**, **Vegetation Management Plan (S13.0-C1) (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 mitigation measures refer to transport measures:

- ▶ Build, maintain, and use the TAC for hauling processed coal to the Rail Infrastructure for the duration of all Project phases after the Construction Phase to minimize traffic on existing, residential roads;
- ▶ Build, maintain, and use the TAC for transport of personnel, goods, and services for the duration of all Project phases after the Construction Phase to minimize traffic on existing, residential roads;
- ▶ Repair and/or replace and/or upgrade existing FSRs or private roads that will be used as part of the TAC;
- ▶ Repair and replace new and existing culverts as required for all Project related transport corridors including the TAC;
- ▶ Design and build a permanent clear span bridge over Goathorn Creek and Helps Creek and its related tributaries to provide vehicular access to the Project that will be controlled by TCL;
- ▶ Use buses and/or vans for employees and contractors as much as practical to reduce the risk of traffic incidents, and to reduce noise and fugitive dust emissions generated by the Project. Bussing options to Witset and/or Houston to be provided (if requested and based on sufficient employees in these locations) to facilitate potential employees accessing employment opportunities with the Project;
- ▶ Use dust suppression agents on the rail cars to reduce fugitive dust emissions;
- ▶ Cover super B-train trucks when hauling processed coal from 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 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 water for the CPP and equipment washbays before withdrawing additional water from streams);
- ▶ Incorporate a contingency 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, and Decommissioning and Reclamation, and Post-closure Phases to limit the consumption of water through evaporation losses.

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

The following mitigation measures apply to preventing potential ARD:

- ▶ Identify and segregate PAG material while mining the open pit, and place PAG material in management ponds and submerge PAG material under a minimum of 1.0 metre (m) of water within an average of six (6) months after excavation but no longer than 12 months and under at least two (2) m of water once the management pond has met its PAG material storage requirements (North Management Pond is completed first, followed by the East Management Pond and finally the West Management Pond) to prevent potential ARD and subsequent effects on surface water quality;
- ▶ Place approximately a one (1) to two (2) m layer of non-PAG rock on top of the submerged PAG material below the active water level of the respective management pond, followed by approximately one (1) to three (3) m layer of overburden to create a dry landform above water, followed by an approximately 30 centimetre (cm) layer of reclamation materials (surface soil) to reduce evaporative losses from the management ponds and provide a landscape more similar to pre-Project development;
- ▶ No PAG material will be used in construction of any external piles, pads, roads, embankments, buttresses, or for backfilling the open pit, to prevent potential ARD and subsequent effects on surface water quality;
- ▶ Open pit walls will be covered by non-PAG material to limit oxygen and water ingress into the open pit walls and provide a neutralizing effect on the open pit wall material below;
- ▶ Some of the open pit walls will be flooded with water to further reduce the likelihood of ARD from the covered open pit walls;
- ▶ Establish a material geochemical testing program for future Project exploration drillholes and Operation Phase blast holes as part of the blasting program to verify PAG versus non-PAG materials. Maintain a PAG geological model while the open pit is being mined to reflect any changes observed;
- ▶ Maintain a database of geochemical testing results and material placement to avoid the incorrect placement of PAG material and potential ARD with subsequent effects on surface water quality;

- ▶ Establish a material tracking system to document the location and type of material being excavated and hauled to avoid misplacement of material and/or remediate any misplacement that may occur;
- ▶ Controlled open pit wall blasting will be conducted on both the highwall and footwall to limit the amount of damage to the open pit wall to minimize the potential for particle size reduction and provide pathways for water and oxygen to enter the open walls prior to them being covered;
- ▶ Majority of material near the open pit footwall will not be blasted again to minimize the potential of water and oxygen accessing this material;
- ▶ Progressive reclamation will be undertaken to reduce the infiltration of water and oxygen into the open pit walls by placing non-PAG rock and overburden on the open pit walls once mining is completed for an open pit wall section in question and people operating equipment have moved at least 100 m away from proposed backfilling operation. Furthermore, this non-PAG material is expected to provide a permanent high neutralization potential (NP) water source to prevent ARD generation from PAG material present in the open pit walls; and
- ▶ Provide annual reports to British Columbia Ministry of Energy, Mines and Low Carbon Innovation (BC MEMLI) and BC MECCS and designated Indigenous groups summarizing the results of geochemical testing.

The following mitigation measures for minimizing potential 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 characterized 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 ML once this occurs.

5.3.8 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 blast 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.

5.3.9 Instream Work Windows

- ▶ When feasible, Construction Phase activities will be scheduled to occur within the reduced risk instream work window (**Table 5.3-1**) unless the watercourse is dry or frozen to the bottom at the time of construction, or if work can occur outside of the high-water mark or is approved by the appropriate regulatory authorities. Reduced risk instream work windows are designed to protect sensitive fish life-stages with a focus on spawning and egg incubation periods. For habitats that do not support spawning or are not migration corridors for spawners, the work window is less relevant;
- ▶ In planning Construction Phase timing for the Project, TCL will consult the Skeena Region Bulkley TSA reduced risk instream work windows (BC MOE 2020) (**Table 5.3-1**);
- ▶ In watercourses such as the Telkwa River where both spring and fall spawners are present, there is no regionally-specific reduced risk instream work window. Where work is planned in these watercourses, a best timing window will be determined by a qualified fisheries biologist, based on the species present and habitat at the proposed construction location; and
- ▶ If work needs to be completed outside of reduced risk windows provided in **Table 5.3-1**, TCL will work closely with regulatory agencies to mitigate and monitor for potential effects of increased fish mortality risk at watercourses where construction activities will fall outside of the reduced risk instream works window.

Table 5.3-1: Reduced Risk Instream Work Windows for the Bulkley Timber Supply Area (TSA) in the Skeena Region

Fish Species	Month ¹											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coho Salmon												
Pink Salmon												
Chinook Salmon ²												
Steelhead												
Rainbow Trout												
Dolly Varden												

Notes:

¹ Green shading denotes the period of reduced risk for instream works

² Reduced risk windows for chinook salmon have been adopted from the Morice TSA as there are no defined windows for the Bulkley TSA (British Columbia Ministry of Environment [BC MOE] 2020).

5.3.10 Instream Work Procedures

- ▶ Work in or near watercourses will adhere to the guidelines in the Riparian Management Area Guidebook (GovBC 1995) and the Standards and Best Practices for Instream Works (British Columbia Ministry of Water, Land, and Air Protection [BC MWLAP] 2004);

- ▶ For work on or adjacent to fish-bearing watercourses, guidance found in the Fish-Stream Crossing Guidebook (BC MFLNRO et al. 2012) will be implemented;
- ▶ Works during high water will be avoided, and work carried out during substantial rain events will be minimized;
- ▶ Work within the channel will be minimized to the extent practical;
- ▶ Construction activities within the channel will be monitored full-time during start-up by an appropriate qualified person(s); and
- ▶ Riprap, rock, or other material placed on the banks or within the active channel are to be free of debris and fines.

5.3.11 Fish Salvage

- ▶ At watercourse crossings a fish salvage operation will be conducted where instream works or isolation of the work area within the watercourse will occur;
- ▶ A Fish Collection Permit from BC MFLNRORD is required for fish salvage activities. The Fish Collection Permit will be obtained in accordance with applicable terms and conditions; and
- ▶ Contractors will notify TCL to obtain written authorization 72-hours before construction of any watercourse crossings or diversions that require fish salvage activities.

5.3.12 Clearing and Grubbing and Riparian Setbacks

- ▶ Clearing and grubbing will be avoided within 15 m of a watercourse until construction is ready to proceed (within 30 days);
- ▶ While clearing and grubbing near watercourses, runoff patterns will be monitored and temporary road kickout channels, sumps, and swales will be installed to direct water into vegetated areas;
- ▶ Clearing of extra temporary workspaces will be prohibited within a minimum of 30 m or within established setbacks if greater than 30 m of a watercourse to protect riparian areas;
- ▶ If a working surface is unstable, clearing equipment will not be permitted within the riparian buffer, unless approved by an Environmental Coordinator. Following clearing, the riparian buffer will remain intact (i.e., consisting of low-lying understory vegetation);
- ▶ Trees will be felled away from watercourses or wetlands. Materials, woody debris, or surface soil inadvertently deposited below the high watermark of a watercourse will be removed immediately; and
- ▶ Trees, shrubs, or herbaceous vegetation will not be removed within the streambank area unless it is part of an approved watercourse crossing.

5.3.13 Design and Construction of Watercourse Crossing Structures

- ▶ Currently there are 11 water crossings for the Project which includes Goathorn Creek and Helps Creek and associated tributaries. During the Construction Phase these stream crossings will be reviewed to determine if any can be removed.
- ▶ Clear-span bridges will be installed for fish bearing streams with abutments located outside of the bankfill water level of the stream. Clear span bridges will be built as slab, composite, steel, or other approved alternative depending on the watercourse width, and the bridge width and span required. The following apply to clear-span bridges:

- ▶ Equipment used for site preparation, or construction, will be situated in a dry stream channel or operated from the top of the bank;
- ▶ The bridge and its approach roads will not produce a back-water effect or increase the head of the stream;
- ▶ The hydraulic capacity of the bridges will be designed to be equivalent of the hydraulic capacity of the stream channel, or will be capable of accommodating a 1 in 200-year maximum daily flow;
- ▶ The height of the underside of the bridges will be adequate to provide the free passage of flood debris and ice flows;
- ▶ Appropriate channel kickouts will be installed on the approach roads at least 50 m upslope of the bridge crossing, where topography allows, to direct sediment-laden water into the forest and away from the watercourse;
- ▶ If channels must connect directly to the watercourse, they will be lined with erosion control material (e.g., small grade rock, rolled erosion matting or equivalent). Silt fence is not considered to be an appropriate BMP method for channels or areas with flowing water;
- ▶ Downcutting upstream of a bridge abutment from road runoff will be minimized by installing erosion control and armoring on the bridge approaches. Gravel will be applied to the road surface at the bridge approaches to minimize sediment tracking onto the bridge deck;
- ▶ Bridge decks will have splash guards to minimize the quantity of sediment-laden water and soil materials directly entering the watercourse from the bridge deck. Periodic maintenance and cleaning of the bridge decks will occur to remove sediment materials. This will be done in a manner that prevents accumulated sediment from falling into the watercourse;
- ▶ The approaches to the bridges will be graded upwards towards the bridge, or the bridge will be on a grade to minimize the amount of water that is present on the bridge surface;
- ▶ Culverts will be designed, and installation overseen by a qualified professional. The following apply to the installation and maintenance of culverts:
 - ▶ The equipment used for site preparation, or for installation, construction, maintenance, or removal of the culvert, is situated in a dry stream channel or operated from the top of the bank outside of the stream;
 - ▶ Culverts will not be used for fish-bearing streams;
 - ▶ The culvert inlet and outlet will incorporate measures to protect the structure and the stream channel against erosion;
 - ▶ The culvert capacity will be equivalent to the hydraulic capacity of the stream channel, or will be capable of passing the 1 in 200-year maximum daily flow without the water level at the culvert inlet exceeding the top of the culvert;
 - ▶ Where feasible, culverts will have a minimum equivalent diameter of 600 millimetre (mm), as per Section 39 (1) of the Water Sustainability Regulation, B.C. Reg. 11/2021 (GovBC 2021);
 - ▶ During culvert installation, site isolation techniques will be used for non-fish bearing watercourses which are flowing and have connectivity to a fish-bearing stream. Site isolation may be required for Non-classified Drainages (NCD) as well, depending on the flow and proximity to fish bearing watercourses; and
 - ▶ If topography allows, inlet and outlet pools will be constructed to reduce water velocity resulting from the culvert installation.

5.3.14 Erosion and Sediment Control

- ▶ Sediment and erosion control measures will be implemented in accordance with the **SEPCP** and the **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 waterbody crossings) in accordance with the **MWMP**.

5.3.15 Beaver Dam Removal

- ▶ If beaver dams or lodges will be disturbed, a Section 11 In-stream Works Notification will be submitted 45 days prior to commencing beaver dam removal;
- ▶ Where beaver dam removal is required, a registered trapper will be contacted (or a licensed/registered nuisance trapper), a General Wildlife Permit for Beaver Dam Removal and a Wildlife Sundry Permit will be obtained, and the requirements of the Standards and Best Practices for In-stream Works (BC MWLAP 2004) will be followed; and
- ▶ The beaver dam will be breached slowly to avoid the rapid release of water that could cause fish entrapment and/or erosion of the bed and banks and subsequent siltation of downstream waters.

5.3.16 Water Withdrawal or Diversion

- ▶ Where water withdrawal or diversion is required, the necessary approvals will be in place and TCL and their contractors will follow conditions of the approvals. Pump intakes will not disturb the streambed. The intakes of pumps required for dewatering will be screened as per DFO guidelines when placed in fish-bearing waterbodies.

5.3.17 Hazardous Materials and Refueling

- ▶ Hydrocarbon storage and refueling stations will be located at least 30 m from the stream on level ground. Double-walled hydrocarbon (fuel, glycol, and lubricant) tanks will be used at most locations in addition to other spill controls for any single-walled hydrocarbon (fuel, glycol, and lubricant) tanks. In the absence of double-walled tanks, secondary containment must be used;
- ▶ 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;
- ▶ The Project, including along the TAC and Rail Infrastructure, will have spill kits strategically located around site and on TCL and contractor vehicles to allow an immediate response to fuel spills, oil leaks, hydraulic line ruptures and accidental spills of hazardous materials. Refueling and lubrication of equipment will not be conducted within 30 m of a watercourse and, where stationary equipment cannot be relocated beyond 30 m of a watercourse, it will be situated in a designated area that has been bermed and lined with an semi-impermeable barrier of sufficient size to provide secondary containment for liquids stored; and
- ▶ Vehicles and equipment will be clean and free of leaks prior to working in proximity to a watercourse and checked routinely.

5.3.18 Restoration and Reclamation

- ▶ The bed and banks of retained watercourses will be returned as close as practical to their original preconstruction slope, substrate composition, and height. Watercourses will not be realigned or straightened nor have their hydraulic characteristics changed; and
- ▶ Disturbed banks and riparian areas will be seeded with an approved native grass mixture or planted with shrubby riparian species. The Environmental Coordinator will determine onsite, whether other restoration methods (e.g., soil wraps, brush layers, and matting) need to be applied to stabilize the banks, in consultation with other Qualified Professionals (QPs), if required.

5.3.19 Summary of Mitigation Measures

A summary of the mitigation measures to avoid or reduce potential Project-related adverse effects on the Fish and Fish Habitat VC, organized by potential effect and contributing activities within the Project phases, is provided in **Table 5.3-2**. 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 5.3-2: Summary of Potential Effects and Mitigation Measures for Fish and Fish Habitat Valued Component (VC)

Potential Effect	Contributing Activities* within the Project Phases (C, O, D, P)	Proposed Mitigation Measure	Applicable VC Subcomponent	Residual Effect (Yes/No)
Change in Fish Habitat	▪ All Activities (C) ▪ Mining the Tenas Open pit (O) ▪ Surface water management (O) ▪ Spillway operation(O) ▪ Storage pile maintenance (O) ▪ Removal and dismantling of mining equipment and facilities (D) ▪ Reclamation and closure of Project (D) ▪ Reclamation and closure of Goathorn Creek bridge (D)	▪ Limit Project footprint and Project Area ▪ Avoid sensitive environments ▪ Reclamation measures (Refer to RCP) ▪ Project footprint boundaries ▪ Transport measures ▪ Project use of water ▪ Management of ML/ARD (Refer to ML/ARDMP) ▪ Blasting measures ▪ Instream work windows ▪ Instream work procedures ▪ Clearing, grubbing and riparian setbacks (Refer to CEMP) ▪ Design and construction of watercourse crossing structures (Refer to CEMP) ▪ Erosion and sediment control (Refer to SEPSCP, CEMP and MWMP) ▪ Water withdrawal or diversion ▪ Hazardous materials and re-fueling (Refer to FMSCP) ▪ Restoration and reclamation ▪ Beaver dam removal	Fish Habitat	Yes

Potential Effect	Contributing Activities* within the Project Phases (C, O, D, P)	Proposed Mitigation Measure	Applicable VC Subcomponent	Residual Effect (Yes/No)
Change in Fish Health	- All Activities (C) - Mining the Tenas Open pit (O) - Surface water management (O) - Spillway operation (O) - Storage pile maintenance (O) - Material handling systems (O) - Removal and dismantling of mining equipment and facilities (D) - Reclamation and closure of Project (D) - Reclamation and closure of Goathorn Creek bridge (D) - Post-mining systems and monitoring (D, P)	- Limit Project footprint and Project Area - Avoid sensitive environments - Reclamation measures (Refer to RCP) - Project footprint boundaries - Transport measures - Project use of water - Management of ML/ARD (Refer to ML/ARDMP) - Instream work windows - Instream work procedures - Fish salvage - Clearing, grubbing and riparian setbacks (Refer to CEMP) - Design and construction of watercourse crossing structures (Refer to CEMP) - Erosion and sediment control (Refer to SEPSCP and MWMP) - Water withdrawal or diversion - Hazardous materials and re-fueling (Refer to FMSCP and MERP) - Restoration and reclamation	Fish	No

Notes: C, O, D, P represent Project Phases: (C)onstruction, (O)peration, (D)ecommissioning 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; 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 Fish and Fish Habitat 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 Fish and Fish Habitat VC. The approach to assessing residual Project effects on the Fish and Fish Habitat VC follows the methodology outlined in **S3.0 Assessment Methodology** of the **EAC Application**. A residual effect related to change in fish habitat was predicted for the Fish Habitat subcomponent (**Table 5.3-2** above). Residual effects were not predicted for the Fish subcomponent when mitigation and BMPs are in place. Therefore, the potential effect of change in fish health was not further characterized and was not carried through to the significance determination.

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 above in **5.2**, the assessment focuses on Construction, Operation, Decommissioning and Reclamation, and Post-closure phases. Residual effects are then characterised based on the combined predicted residual effect for these phases. The assessment

includes a determination of Likelihood, Significance and the Level of Confidence associated with the prediction.

5.4.1 Description of Evaluation Criteria

5.4.1.1 Residual Effects Characteristics

Residual effects on the Fish Habitat subcomponent have been characterized 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 the Fish Habitat subcomponent

Residual Effect Characteristic	Definition	Rating
Magnitude	Size or severity of the residual effect – generally measured in terms of the proportion of the fish and fish habitat affected within the Local Study Area (LSA), relative to the range of natural variation	Low – no measurable effect on the function of fish habitat; or a measurable adverse environmental effect on the function of fish habitat with low sensitivity Moderate – measurable effect on the function of fish habitat with moderate sensitivity High – measurable effect on the function of fish habitat with high sensitivity or critical habitat for <i>Species at Risk Act</i>, SC 2002, c 29 (Government of Canada [GovCan] 2002) (SARA)-listed species
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 – effect is limited to portion of the LSA or all of the LSA Regional – effect is limited to portion of Regional Study Area (RSA) or all of the RSA Beyond Regional – effect extends beyond the RSA
Duration	Length of time over which the residual effect is expected to persist.	Short-term – residual effect restricted to the season in which Construction occurs and for the six months following during which restoration and reclamation is typically completed Medium-term – residual effect extends beyond the Construction Phase and restoration/reclamation but not beyond four (4) years or one (1) generation of most species Long-term – residual effect extends beyond four years or one generation of species in the system 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

Residual Effect Characteristic	Definition	Rating
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 – a residual effect that diminishes to baseline conditions. Partially reversible – a residual effect that partially diminishes to baseline conditions. Irreversible – a residual effect that will not diminish to baseline conditions
Context	The extent to which fish and fish habitat 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. No listed species present. Moderate – Subcomponent has moderate resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or an intermediate level of historic or ongoing anthropogenic or natural disturbance with the capacity to assimilate more change. Presence of blue-listed species High – Subcomponent has weak resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or a high level of historic or ongoing anthropogenic or natural disturbance. Presence of red-listed or <i>Species at Risk Act</i> (SARA)-listed species

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

The residual effects classification and associated prediction in changes to the measurement indicators provide the foundation for the determination of significance. Significance is defined the Fish Habitat subcomponent.

A change in fish habitat is considered significant if:

- ▶ A Harmful Alteration, Disturbance and/or Destruction (HADD) of fish habitat that is not offset and has a measurable effect on fish habitat productivity. This is defined as an adverse effect on fish habitat that is Moderate to High in Magnitude, a Geographic Extent that is Local or greater, a Duration of Medium to Long-term, is Continuous, not Fully Reversible, and Moderate to High in Context.

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

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

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

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

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

5.4.2 Fish Habitat Subcomponent

5.4.2.1 Change in Fish Habitat

5.4.2.1.1 Change in Habitat Structure

Where permanent loss of fish habitat productivity is anticipated (i.e., infilling of watercourses, watercourse diversions that eliminate stream habitat within the mine footprint), residual effects of construction activities are predicted to occur.

With the use of appropriate crossing methods, mitigation measures, and BMPs that effectively avoid or limit changes in habitat structure that could result in a HADD of fish habitat, no residual effects are predicted to occur at watercourse crossings along the proposed TAC.

Changes in habitat structure due to diversion of flows from Tenas Creek tributaries and from changes in base flows in Four Creek are predicted to result in residual effects. To quantify predicted areal extent of fish habitat loss due to Project activities and the resulting potential HADD, calculated habitat areas of the non-fish-bearing tributaries to Tenas Creek that will be eliminated due to the infill and diversion of water have been combined with estimated loss of usable habitat in Four Creek resulting from the reduction of baseline flows due to the development of the open pit and subsequent loss of groundwater flows. The total area of affected fish habitat is predicted to be 10,128 m², of which 9,937 m² is non-fish-bearing habitat in tributaries to Tenas Creek. This area represents the areal extent of potential HADD of fish habitat resulting from the Project (**Table 5.4-2**).

Table 5.4-2: Predicted Changes in Habitat Structure

Watercourse	Project Activity	Residual Effect	Habitat type	Area (m ²)
Four Creek	Water diversion/management	Reduction of base flows	Dolly Varden spawning habitat	115
			Dolly Varden overwintering habitat	76
Tenas Tributary TN6	Water diversion/mine infrastructure development	Loss of base flows/infilling	Non fish-bearing habitat	8,245
Tenas Tributary TN7	Water diversion/mine infrastructure development	Loss of base flows/infilling	Non fish-bearing habitat	600
Tenas Tributary TN8	Water diversion/mine infrastructure development	Loss of base flows/infilling	Non fish-bearing habitat	1,092
Total				10,128

Note: m²=square metre

5.4.2.1.2 Change in Sediment Concentrations

Although potential effects on fish habitat through sedimentation and erosion were identified, residual effects are not anticipated provided effective mitigation and BMPs are implemented and maintained. It is anticipated that temporary elevations of sediment levels in local watercourses may occur during Construction, but that sediment concentration levels will return to baseline levels immediately following Construction activities.

5.4.2.1.3 Change in Water Temperature

Although potential effects on fish habitat through potential changes in water temperature were identified, residual effects are not anticipated from loss of shading or mine discharges when the mine water management plan, mitigation measures and BMPs are implemented.

5.4.2.1.4 Change in Food and Nutrient Concentrations

Although potential effects on fish habitat through potential changes in food and nutrient concentrations were identified, residual effects are not anticipated when mitigation measures and BMPs are in place.

5.4.2.1.5 Change in Water Quality

Potential effects on fish habitat resulting from changes in water quality were identified and residual changes to water quality parameters are predicted to remain throughout all phases of the Project including the Post-closure Phase.

5.4.2.1.6 Change in Base Flows

Potential effects on fish habitat through changes in base flows were identified in Four Creek throughout all phases of the Project. Predicted reductions in the available usable fish habitat during critical low flow periods for Dolly Varden life history stages were identified.

5.4.2.1.7 Change in Access to Fish Habitats and Migration

Although potential effects on fish through potential changes in access to fish habitats were identified, any fish passage issues will be very temporary in nature and passage will be reinstated immediately following completion of instream construction activities. Residual effects are not anticipated when mitigation and BMPs are implemented and maintained.

5.4.2.2 Residual Effects Characteristics**5.4.2.2.1 Change in Fish Habitat**

Residual effects on fish habitat comprise the diversion and infilling of Tenas Creek tributaries TN6, TN7, and TN8 within the mine footprint, and the loss of wetted usable fish habitat within the Four Creek mainstem resulting from the development of the open pit and subsequent reduction of groundwater seepage and resultant decrease in baseflow conditions during low flow seasons such as winter.

Infilling of the Tenas Creek tributaries represents a loss of 9,937 m² (**Table 5.4-2**) of non-fish bearing habitat providing flows and allochthonous inputs to Tenas Creek only. The effects on fish habitat in these Tenas Creek tributaries is predicted to be Adverse, Low in Magnitude local in Geographic Extent, Permanent, Continuous, Irreversible, and has a Low Context (**Table 5.4-3**). Infilling of fish habitat within the Tenas Creek tributaries is considered a HADD under section 32 of the *Fisheries Act* and will need to be offset as required by the *Fisheries Act* and Fish and Fish Habitat Protection Policy Statement (DFO 2019a).

Table 5.4-3: Summary of Effect Characteristics Ratings for Change in Fish Habitat - Tenas Creek Tributaries

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	Low	Habitat is not fish-bearing habitat that provides flows, food, and nutrients to downstream fish habitat in Tenas Creek
Geographic Extent	Local	No measurable effects will occur outside of the Local Study Area (LSA)
Duration	Permanent	The effect will last in perpetuity
Frequency	Continuous	The effect occurs during construction and will remain through the Post-Closure Phase
Reversibility	Irreversible	The effects on the habitat are permanent and will not return to baseline conditions
Context	Low	Habitat is not fish-bearing and provides marginal flows to downstream fish habitat only

Reduction of wetted usable fish habitat in the Four Creek mainstem includes an estimated loss of 191 m² of spawning and overwintering habitat for the residential population of Dolly Varden. This represents a 23 % loss of overwintering and spawning habitat during the winter low flow period during the Decommissioning and Reclamation, and Post-Closure phases of the Project. These habitat losses are considered a HADD under Section 32 of the *Fisheries Act* and will need be offset as required by the *Fisheries Act* and Fish and Fish Habitat Protection Policy Statement (DFO 2019). These changes to fish habitat in the Four Creek mainstem are considered to be High in Magnitude, Local, Permanent, Continuous, Irreversible, and has a High Context.

Table 5.4-4: Summary of Effect Characteristics Ratings for Change in Fish Habitat - Four Creek Mainstem

Residual Effects Characteristic	Rating	Rationale for Rating
Magnitude	High	Habitat effects are on important overwintering and spawning habitat for a isolated resident fish population.
Geographic Extent	Local	No measurable effects will occur outside of the Local Study Area (LSA)
Duration	Permanent	The effect will last in perpetuity
Frequency	Continuous	The effect occurs during construction and will remain through the Post-Closure Phase
Reversibility	Irreversible	The effects on the habitat are permanent and will not return to baseline conditions
Context	High	Affected habitat is for a resident fish population above a barrier to fish passage

5.4.2.3 Likelihood

Adverse residual effects on fish habitat are considered Likely. The Project is predicted to result in changes to fish habitat, through change in habitat structure, change in water quality, and change in base flows.

5.4.2.4 Significance Determination

Project-related activities, during all Project phases, are predicted to result in residual effects on fish habitat productivity that are **Not Significant**. Habitat effects in Tenas Creek tributaries TN6, TN7, and TN8 have a Low Magnitude, will not be affecting fish-bearing habitats, and will be offset through the creation of higher quality, fish-bearing habitat in compliance offset requirements set out by the *Fisheries Act* and Fish and Fish Habitat Protection Policy Statement (DFO 2019a). While the habitat effect in Four Creek is high in Magnitude, Permanent, Continuous, Irreversible, and High in Context, the habitat loss associated with diversion of flows in Four Creek will also be offset and therefore will not represent a HADD that is not offset. The Level of Confidence of this prediction is High. Changes to fish habitat can be quantified and losses to fish habitat productivity will be offset as required by the *Fisheries Act*. Details of offsetting for habitat effect in Tenas Creek tributaries and the Four Creek mainstem is provided in a fish habitat offsetting plan (**Appendix 4.6-D**), and will be submitted to DFO along with the application for an authorization to cause a HADD

5.5 Summary of Project-related Residual Adverse Effects and Significance

A summary of potential residual effects on Fish and Fish Habitat is presented in **Table 5.5-1**. The residual effects related to change in fish habitat are rated **Not Significant** given that all permanent, adverse habitat effects will be offset through the creation of higher quality, fish-bearing habitat in compliance offset requirements set out by the *Fisheries Act* and Fish and Fish Habitat Protection Policy Statement (DFO 2019a). The **Fish Habitat Offsetting-Phase 1 Feasibility Planning**, prepared by Hemmera, is provided in **Appendix 4.6-D**. Based on the determination of **Not Significant** for all residual effects listed in **Table 5.5-1** it is concluded that there is no potential for a significant residual effect(s) on the Fish and Fish Habitat VC. All residual effects, **Significant** or **Not Significant**, are carried forward into the cumulative effects assessment.

Table 5.5-1: Summary of Residual Adverse Effects for Fish Habitat

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
Change in Fish Habitat	- All Activities (C) - Surface water management (O) - Removal and dismantling of mining equipment and facilities (D) - Reclamation and closure of Project (D)	- Limit Project footprint and Project Area - Avoid sensitive environments - Reclamation measures (Refer to RCP) - Project footprint boundaries - Transport measures - Project use of water - Management of ML/ARD (Refer to ML/ARDMP) - Erosion and sediment control (Refer to SEPSCP, CEMP and MWMP) - Water withdrawal or diversion - Restoration and reclamation	H	LSA	PT	CF	IR	H	NS	L	H

Notes: C, O, D, P represent Project phases: Construction (C), Operation (O), Decommissioning and Reclamation (D), Post-closure (P)

C=Chapter; S=Section; ML/ARD=metal leaching/acid rock drainage; ML/ARDMP=Metal Leaching (ML)/Acid Rock Drainage (ARD) Management Plan (S13.0-C12); MWMP=Minesite Water Management Plan (S13.0-C11); SEPSCP=Surface Erosion Prevention and Sediment Control Plan (S13.0-C17)

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

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

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

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

Reversibility: Reversible (FR), Partially Reversible (PR), Irreversible (IR)

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

Likelihood: Likely (L), Unlikely (UL)

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

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

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

6. CUMULATIVE EFFECTS ASSESSMENT (CEA) – FISH HABITAT

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

The environmental effects of past and existing projects and activities are captured in the baseline conditions (i.e., existing environment; **4.2 Existing Conditions**). Thus, the likelihood of cumulative effects due to ongoing and reasonably foreseeable future projects is the focus of this CEA.

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

6.1 Potential Cumulative Effects

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

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

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

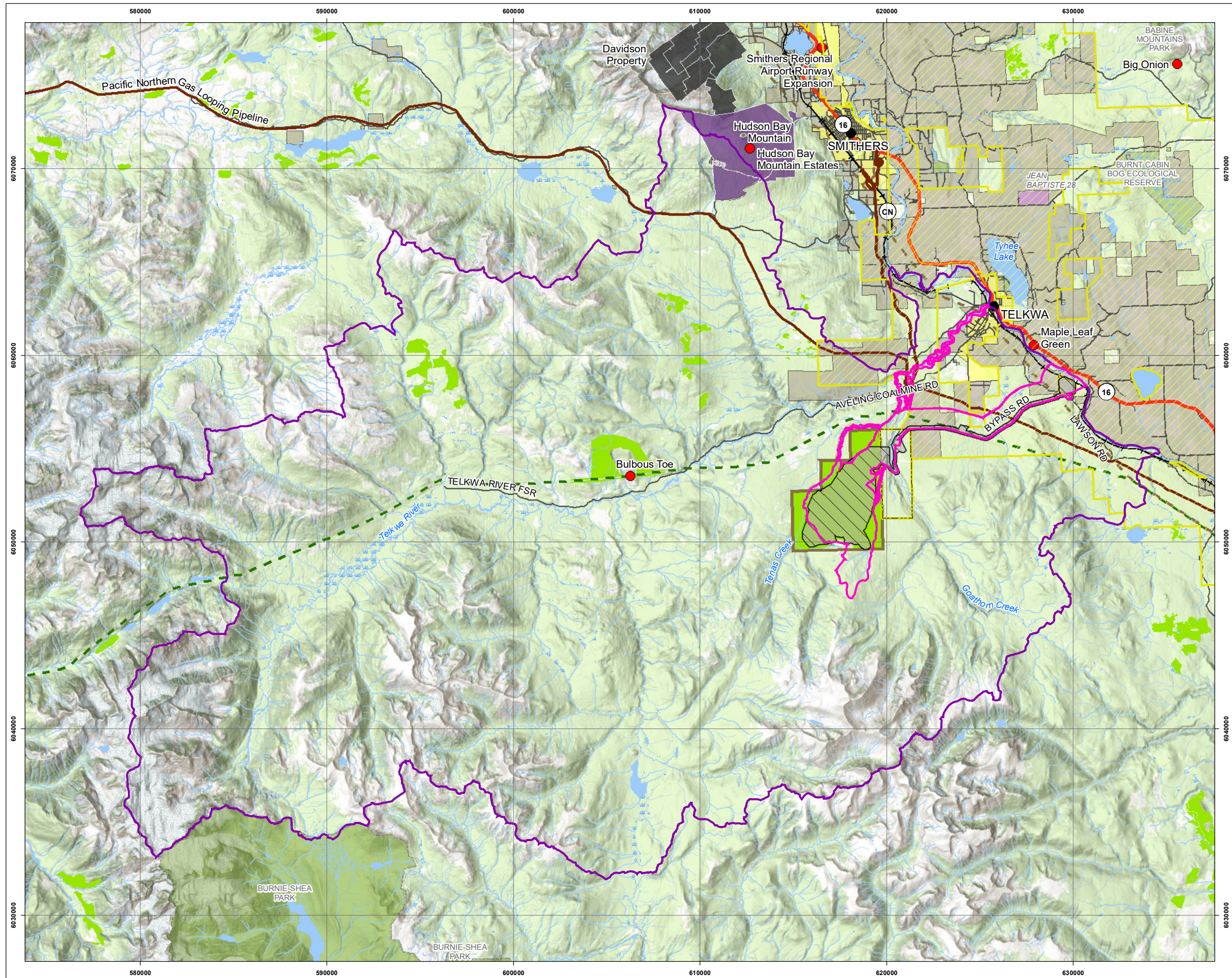
Spatial information is not available for some future projects and most activities. The location and level of the residual effects from reasonably foreseeable projects is not known, so the cumulative effect assessment is qualitative. The following projects and activities are expected to have residual effects on Fish Habitat within or extending into the Fish and Fish Habitat 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 right-of-way (ROW) at watercourse crossings and may also necessitate instream works depending on the selection of crossing methods. This has the potential to interact cumulatively with the Project residual effects and result in additional fish habitat losses where the pipeline crosses watercourses;
- ▶ 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 interact with effects of riparian clearing associated with the Project;

- ▶ **Forestry Activities:** The Fish and Fish Habitat RSA is located within the Bulkley TSA. It is estimated that 6,977 hectares (ha) of forest within the Vegetation RSA will be harvested between 2021 and 2073 (**S4.0-C7 Vegetation VC** of the **EAC Application**). This conservative estimate does not account for reforestation or natural forest succession over time, where young and mature forest are expected to transition to mature and Old Growth Forest, respectively, over the course of the Project lifespan (approximately 51 years). In addition, this value overestimates the extent of disturbance, as all future forestry activities are expected to be conducted with consideration of provincial and regional biodiversity and Old Growth Forest management objectives. These forestry activities may contribute to the alteration/loss of riparian vegetation within the Fish and Fish Habitat RSA; and
- ▶ **Agricultural Activities:** Agricultural land uses (e.g., cultivation, tame pasture/hay) are present within the Fish and Fish Habitat RSA, in the eastern portion. The current areal extent of agricultural activity within the Fish and Fish Habitat RSA is not expected to change. However, ongoing agricultural activities may require additional water use and could result in further decreases in base flows in watercourses within the RSA.

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Tenas Project

Map of Projects and Activities for Cumulative Effects Assessment

Legend

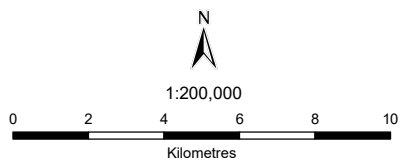
- | | |
|----------------------------|--|
| ● Project | ▭ Tenas Coal Licenses |
| ● City/Town | ▭ Telkwa Coal Limited Private Property |
| — Rail Line | ▭ Project Area |
| — Highway | ▭ Aquatics and Fish & Fish Habitat Local Study Area |
| — Road | ▭ Aquatics and Fish & Fish Habitat Regional Study Area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

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



NAD 1983 UTM Zone 9N

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TELKWA COAL
LIMITED

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6.1.1 Changes in Fish Habitat

The predicted changes to fish habitat as a result of the Project are not expected to extend beyond the LSA. The only activity that is likely to occur within the LSA is forestry. The *Fisheries Act* prohibits the HADD of fish habitat and DFO reiterates this requirement in its Fish and Fish Habitat Protection Policy Statement (DFO 2019a). In order to meet this requirement, proposed developments must fully avoid, mitigate, or offset for residual effects that cause negative impacts to fish habitat productivity. Accordingly, the Project location and design has considered the *Fisheries Act* and associated policy statement, and after offsetting, no cumulative residual effects to the productivity of fish habitat as a result of changes in habitat structure are identified. Offsetting measures will be described in the Project's Fish Habitat Offsetting Plan (**Appendix 4.6-D**) and this plan will be included in the Project's application for an authorization under the *Fisheries Act*.

6.1.2 Additional Mitigation Measures

The projects and activities included in the CEA (see **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 [see **5.3**]) is not considered to be necessary to avoid or minimize the predicted cumulative effects on the Fish and Fish Habitat VC.

6.1.3 Cumulative Effects and Characterisation of Significance

The interactions between the predicted Project residual effect (see **5.5**) and the residual effects of other projects and activities (**Table 6.1-1**) were reviewed to determine potential cumulative effects on the Fish and Fish Habitat VC.

Cumulative effects on the Fish Habitat subcomponent were 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 fish habitat are predicted to be Low in Magnitude. The only interactions between the Project and other activities are limited to forestry activities within the LSA. All changes in fish habitat resulting in a change in habitat productivity will be offset as stipulated within the *Fisheries Act*, and a net increase in habitat productivity is predicted.

Cumulative effects for changes in fish habitat are limited to the LSA and will not extend downstream into the Telkwa or Bulkley rivers. The Duration of cumulative effects is predicted to be Short-term and Infrequent, as current forestry practices include mitigations to avoid clearing next to watercourses and to reclaim and restore disturbed riparian areas. Cumulative changes in fish habitat are expected to be Partially Reversible as restoration and reclamation activities are undertaken for forestry related riparian impacts. The Context of cumulative effects of forestry activities are expected to be Low as High value riparian habitats are required to have buffers maintained on either side of watercourses. The Likelihood is High that cumulative effects of forestry activities on the Fish Habitat subcomponent is expected to be **Not Significant**.

The Level of Confidence of this prediction is High. Changes to fish habitat can be quantified and losses to fish habitat productivity will be offset as required by the *Fisheries Act*. Forest practices and mitigations to retain and maintain riparian areas next to watercourses are well established and known to be effective at maintaining riparian function.

Table 6.1-2: Summary of Cumulative Effects on Fish Habitat Subcomponent

Cumulative Effects	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effects Characterisation								
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance	Level of Confidence
Changes in Fish Habitat	- Forestry activities (C, O, D, P) - Project-related activities as outlined in Table 5.1-2 (C, O, D, P)	L	LSA	ST	IF	PR	L	L	NS	H

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

Magnitude: None (N), Low (L), Moderate (M), High (H)

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

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

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

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

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

Likelihood: Unlikely (UL), Likely (L)

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

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

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

6.2 Summary of Cumulative Effects Assessment (CEA)

The following residual effects of the Project on the Fish and Fish Habitat VC were carried forward to the CEA:

- ▶ change in fish habitat.

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 reduce the overall availability of fish habitat in the RSA and any change in fish habitat resulting from these projects/activities were expected to be **Not Significant**. Considering this, the cumulative effects are not expected to alter the availability and amount of fish habitat in the RSA and are expected to be **Not Significant**.

Future forestry activities are expected to have the greatest contribution to cumulative effects on the Fish Habitat VC; however, this is expected to be mitigated with the implementation of existing forestry-related biodiversity and riparian management objectives. As such, the cumulative effect on Fish Habitat VC is expected to be **Not Significant (Table 6.4-1)**.

Table 6.2-1: Summary of Cumulative Effects on Fish and Fish Habitat Valued Component (VC)

VC Subcomponent	Potential Cumulative Effect	Contributing Activities within the Project Phases (C, O, D, P)	Cumulative Effect (Yes/No)	Significant (Yes/No)
Fish Habitat	Change in fish habitat	- Forestry Activities (C, O, D, P) - Project-related activities as outlined in Table 5.1-2 (C, O, D, P).	No	No

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

7. SUMMARY OF EFFECTS ASSESSMENT FOR FISH AND FISH HABITAT VALUED COMPONENT (VC)

With mitigation measures in place, and the required habitat offsetting, there are no predicted, un-offset HADDs to fish habitat due to the Project. Changes in water quality parameters will meet established objectives for the protection the environment or SPOs developed for the Project. Therefore, potential residual effects on the Fish and Fish Habitat VC were rated Low in Magnitude and **Not Significant**.

Reasonably foreseeable projects in the area may have overlapping effects on Fish and Fish Habitat. However, based on the location of these projects and the type of projects, overlapping effects are expected to be minimal. All measurement indicators are expected to remain below relevant guidelines and thresholds and no cumulative HADDs to fish habitat are predicted. Cumulative effects on Fish and Fish Habitat were assessed based on provincial and federal guidelines which prohibit releases of deleterious substances, legislate thresholds for water quality, and prohibit net total loss of fish habitat productivity. Therefore, cumulative effects on the Fish and Fish Habitat VC were predicted 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 Fish and Fish Habitat 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. Three (3) types of monitoring should be implemented:

- ▶ compliance monitoring to document implementation of environmental protection measures and construction of offsetting measures in accordance with final designs;
- ▶ environmental monitoring to detect alterations in receiving environments (water quality, fish abundance/composition, fish tissue, and health); and
- ▶ habitat effectiveness monitoring for 10 years (with surveys in Years 1, 2, 3, 5, 7 and 10 Post-construction) to track and document the effectiveness of offsetting measures.

Assessing adherence to the conditions of the paragraph 35(2)(b) *Fisheries Act* authorization will be a key feature of these monitoring components.

The purpose of compliance monitoring is to confirm that offsetting measures are implemented according to the offsetting plan and the terms and conditions of the *Fisheries Act* authorization. Compliance monitoring will take place during construction of the mine and offsetting features. 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 construction;
- ▶ any changes in the design necessary to adapt to unanticipated conditions;
- ▶ technical issues that arise during construction and how they were addressed;
- ▶ confirmation that all offsetting components meet design requirements; and
- ▶ confirmation that relevant terms and conditions of the *Fisheries Act* authorization are met.

Any anticipated substantial changes to the design of offsetting features will be submitted to DFO in writing prior to implementation.

Environmental monitoring will detect alterations to the receiving environment, including changes to fish tissue, health, abundance, and habitat use as compared to changes occurring at reference sites. Additional monitoring of fish health will be triggered 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.

Effectiveness monitoring following construction will confirm that offsetting habitats are functioning as intended. Specific success criteria, monitoring methods, and measurable parameters will be tailored to each

of the offsetting measures and will adhere to the requirements outlined in a *Fisheries Act* authorization from DFO. Monitoring will focus on physical stability, biological integrity, and fish use of the offset habitats. This will be achieved by monitoring a number of quantitative and qualitative criteria over a 10-year period. Field surveys will be completed in Years 1, 2, 3, 5, 7 and 10 following the completion of offset construction. If it is determined that the success criteria are not met after Year 10 of the monitoring program, an adaptive work plan will be developed, and additional monitoring or offsetting may be undertaken in consultation with DFO, Indigenous groups, and stakeholders until success criteria are met. Monitoring will continue until the habitat offsetting measures are determined to be functioning as intended.

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 Fish and Fish Habitat 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 Indigenous groups. A list of management plans relevant to the Fish and Fish Habitat VC include:

- ▶ **Chemicals and Materials, Storage, Transfer, and Handling Plan (S13.0-C3) (CMSTHP);**
- ▶ **CEMP;**
- ▶ **Discharge Management Plans (S13.0-C5) (DMP);**
- ▶ **Explosives Management Plan (S13.0-C6) (EMP);**
- ▶ **FMSCP;**
- ▶ **MERP;**
- ▶ **MWMP;**
- ▶ **ML/ARDMP;**
- ▶ **RCP;**
- ▶ **SEPSCP; and**
- ▶ **Waste Management Plan for Refuse and Emissions (S13.0-C20) (WMPRE).**

8.2 Follow-up

Where mitigation measures are not deemed to be successful, adaptive management techniques will be employed. Findings during monitoring, as well as revised BMPs, improved scientific methods, and regulatory changes will be incorporated into the environmental management plans 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 environmental assessment, 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 science-based, site-specific water quality performance objectives, and water

quantity thresholds will be identified through modeling 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;
- ▶ compliance monitoring will be used 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;
- ▶ biotic response monitoring will follow 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;
- ▶ published and science-based water quality guidelines developed by the Project; and
- ▶ published water quality guidelines will be adhered to where possible.

For parameters that do not meet water quality guidelines, SPOs will be used, per BC MECCS guidance.

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