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Blackwater Gold Project Application for Authorization under Paragraph 35(2)(b) of the Fisheries Act (Non-Emergency Situations)

Palmer Project #
2006501

Prepared For
BW Gold Ltd.

June 20, 2022

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June 20, 2022

Fish and Fish Habitat Protection Program
Fisheries and Oceans Canada, Government of Canada

To whom it may concern,

Re: Blackwater Gold Project Application for Authorization under Paragraph 35(2)(b) of the Fisheries Act (Non-Emergency Situations)
Project #: 2006501

The Blackwater Project received Environmental Assessment Certificate #M19-01 under the 2002 *Environmental Assessment Act* on June 21, 2019, and an Environmental Assessment Decision Statement under the *Canadian Environmental Assessment Act, 2012* on April 15, 2019.

Palmer is pleased to submit the attached revised Application for Authorization for the Blackwater Project. This revised Application has been prepared in accordance with Schedule 1 of Authorizations Concerning Fish and Fish Habitat Protection Regulations and is intended to fulfill the information requirements for an application for an authorization under paragraph 35(2)(b) of the *Fisheries Act* (1985) for works, undertakings and activities associated with the Blackwater Project that are likely to result in the harmful alteration, disruption or destruction (HADD) of fish habitat.

This application does include direct habitat losses that result from the deposition of a deleterious substance into waterbodies beneath the tailings storage facilities C and D (excluding dam footprints), the low-grade and high-grade ore stockpiles, the upper waste stockpile, and the environmental control dam. However, the offsetting for these habitat losses is addressed by the previously submitted MDMER Schedule 2 Compensation Plan, which was also revised and resubmitted to ECCC on April 20, 2022.

This document describes how BW Gold Ltd. proposes to offset residual losses to fish habitat. It describes proposed mine development, existing fish and fish habitat, the effects assessment and residual effects, and proposed offsetting measures aimed at restoring, creating and enhancing fish habitat.

If you or technical reviewers have any questions about this report, please feel free to contact Rick Palmer at 604-629-9075 or at rick.palmer@pecg.ca.

Yours truly,

Palmer

<original signed by>

Rick Palmer, M.Sc., R.P.Bio.
President, Senior Fisheries Biologist

Executive Summary

BW Gold Ltd. (BW Gold), a wholly owned subsidiary of Artemis Gold Inc., proposes to develop the Blackwater Project (the Project), an open pit gold mine, in central British Columbia, approximately 112 kilometres (km) southwest of Vanderhoof, and approximately 160 km west-southwest of Prince George. The proposed mine consists of an open pit, ore processing facilities, a Tailings Storage Facility (TSF), a freshwater supply system, waste rock dumps and stockpiles, camps, a transmission line, and access roads.

The Blackwater Project received Environmental Assessment Certificate #M19-01 under the 2002 *Environmental Assessment Act* on June 21, 2019, and an Environmental Assessment Decision Statement under the *Canadian Environmental Assessment Act*, 2012 on April 15, 2019.

Based on comprehensive baseline and risk studies, BW Gold has minimized predicted impacts of the Project on fish and fish habitat through design, refinement, and mitigation measures. However, some residual loss of fish habitat is predicted to occur as a result of Project development, so the Project will require an Authorization under Paragraph 35(2)(*b*) of the *Fisheries Act*, and an amendment of Schedule 2 of the Metal and Diamond Mining Effluent Regulations (MDMER).

This Application has been prepared in accordance with Schedule 1 of Authorizations Concerning Fish and Fish Habitat Protection Regulations and is intended to fulfill the information requirements for an application for authorizations under paragraph 35(2)(b) of the *Fisheries Act* (1985) for works, undertakings and activities associated with the Blackwater Project that are likely to result in the harmful alteration, disruption, or destruction (HADD) of fish habitat. The HADD of fish habitat is expected to result from direct overprinting of instream habitat area, upstream habitat isolation, downstream flow alteration, and linear corridor riparian loss.

This application does consider preparatory works that are associated with direct habitat losses that result from the deposition of a deleterious substance into waterbodies within the tailings storage facilities C and D (excluding dam footprints), the low-grade and high-grade ore stockpiles, the upper waste stockpile, and the environmental control dam. However, the offsetting for these losses are addressed by the previously submitted MDMER Schedule 2 Compensation Plan.

The Blackwater Project mine site is located within the Nechako River basin. All of the proposed mine site is located in the upper reaches of the Davidson Creek and Creek 661 watersheds. Davidson Creek drains the majority of the Blackwater Project and empties into Chedakuz Creek just north of Tatelkuz Lake, which is a large lake near the headwaters of Chedakuz Creek. Creek 661 drains portions of the east side of the mine area and drains into Chedakuz Creek upstream of Tatelkuz Lake.

Measures taken to avoid Project effects on fish and fish habitat include clustering and massing mine facilities, avoiding the Blackwater River watershed and its environmental and heritage values, avoiding any direct footprint effects to Kokanee (*Oncorhynchus nerka*) habitat, and maximizing the use of existing access routes and disturbed areas for linear corridors. Despite the application of avoidance and mitigation measures, some loss of Rainbow Trout (*O. mykiss*) habitat is predicted to occur as a result of the Project development.

To quantify habitat loss subject to offsetting, baseline fish habitat data gathered during the Environmental Assessment (EA) process was analyzed using four methods:

- Calculation of the areal extent (surface area) of affected instream habitat (in m^2) using stream channel measurements collected during baseline field programs, and spatial analysis using Geographical Information System (GIS) software;
- Habitat Evaluation Procedure (HEP) to calculate Habitat Units (HU), a metric that integrates habitat quality with quantity.
- Calculation of the riparian habitat (in m^2) using stream buffers applied to stream segments, based on fish-bearing status assessed during baseline field programs; and
- Instream flow modelling using the System for Environmental Flow Analysis (SEFA) that is also used to calculate HUs specifically related to changes in streamflow occurring in Davidson Creek, downstream of the mine footprint.

The HEP process has been widely used across North America as a reliable model for quantifying habitat loss, including in recent environmental assessments for similar projects in British Columbia and elsewhere in Canada. It provides a means of quantifying biologically relevant habitat loss (or gain) by taking into account the habitat preferences and requirements of a species at varying life stages. The HU values calculated by the HEP form the basis for the habitat balance (i.e., gain:loss ratio) calculation. Impacts to riparian habitat were determined based on the predicted areas of disturbance or loss of vegetation within stream-side buffers that reflect the type of vegetation and the suitability and sensitivities of adjacent, in-stream habitats.

In this Application, BW Gold seeks a Section 35(2)(b) *Fisheries Act* authorization for the following loss of fish habitat:

- The assessment predicts a loss of 96,071 m^2 of instream habitat, 73,711 Rainbow Trout HU, 372 Food and Nutrient HU, and 500,480 m^2 of riparian area in Davidson Creek; 25,770 m^2 of instream habitat, 15,345 Rainbow Trout HU, and 284,159 m^2 of riparian area in the Creek 661 watershed; and 13,647 m^2 of riparian area in the Tatelkuz Lake Tributary watershed. These losses are due to both construction of mine infrastructure and the resultant mine footprint and upstream isolation of the affected watersheds.
- The assessment predicts a total residual loss of 860 Rainbow Trout HU and 563 Kokanee HU in Davidson Creek and Creek 661, respectively, due to instream flow changes caused by a loss of watershed area due to the placement of the mine footprint.
- The assessment predicts a loss of 4,700 m^2 of riparian habitat due to construction of linear infrastructure corridors.

Overall, the predicted habitat loss totals 121,841 m^2 of instream area, 90,581 combined HU, and 802,986 m^2 of riparian area.

Potential flow losses that would occur in Davidson Creek without flow augmentation to meet the Instream Flow Needs (IFN) include 16,722 Rainbow Trout HU and 2,140 Kokanee HU. This habitat loss is not expected to occur in reality, as flow augmentation within Davidson Creek will occur in accordance with the IFN. This potential loss can be considered to be offset by the FWSS in-situ at a 1:1 ratio.

To offset the residual impacts outlined above, BW Gold and Palmer have identified and developed detailed designs for fish habitat offsetting measures that address known limitations to fisheries productivity in the identified watersheds. Offsetting measures aim to alleviate productivity bottlenecks and to restore and enhance degraded habitat, and were developed based on a screening analysis that applied criteria as outlined in federal and provincial policies and guidelines.

Six habitat offsetting measures were selected for inclusion in this Offsetting Plan out of the many potential measures considered for overall Project offsetting. These six measures are:

1. Murray Creek Ranchland Stream Restoration and Enhancement (Off-site)
    a) Murray Creek Mainstem;
    b) East Murray Creek; and
    c) West Murray Creek.
2. Greer Creek Ranchland Stream Restoration and Enhancement (Off-site)
    a) Lower Greer;
    b) Middle Greer; and
    c) Upper Greer.
3. Creek 661 Off-channel Overwintering Pond (On-site).
4. Flow Augmentation in Davidson Creek from the freshwater reservoir and Freshwater Supply System (On-site).
5. Lake 15/16 Connector Channel (On-site).
6. Complementary Measures.

The proposed offsetting measures focus on providing habitat benefits for Rainbow Trout and Chinook Salmon (*O. tshawytscha),* as well as the other species that are part of the diverse fish community in the watersheds within which the offsets are located. Rainbow trout is the dominant fish species identified in the upper reaches of the Davidson Creek and Creek 661 watersheds and the most widely distributed sport-fish species in the RSA. Chinook Salmon will not be directly impacted by the Project but are known to use numerous streams in Nechako River watershed for spawning. Therefore, Chinook Salmon are used as a representative species for Pacific Salmon in the habitat accounting for offsetting measures. Both Rainbow Trout and Chinook Salmon are traditionally and culturally important to Indigenous people and important recreational fish species in BC. Salmonid populations, particularly Pacific Salmon, have shown evidence of decline in the upper Fraser River watershed, which has direct, negative impacts on food security and health of the affected First Nations. The proposed offsetting measures are biologically relevant and provide a high likelihood of counterbalancing losses in the long term, while providing benefits to important fish populations.

The offsetting measures selected incorporate 'in-kind' offsetting (i.e., creation of habitats that support Rainbow Trout life stages that are directly affected by losses). The offsetting measures also include "out-of-kind" offsets in the ranchland streams that will benefit Rainbow Trout and Pacific salmon species to and address bottlenecks in salmonid productivity.

For each offsetting measure, gains in instream area, HU, and riparian area were calculated. The HEP was applied to calculate the net gain of instream habitat from the offsetting measures to ensure comparable quantification to net impacts. The HU were calculated in a consistent manner to describe habitats in the Project area that will be affected by mine infrastructure, including tailings dams, and for habitats that will be constructed and/or enhanced through implementation of offsetting measures. Use of a consistent accounting system to assess existing and future habitat conditions facilitates the quantitative comparison between HU losses due to the Project actions and HU gains through the implementation of the above-named compensation measures.

The predicted losses will be offset by the creation of 15,550 m^2 of new instream habitat and the restoration and enhancement of 196,714 m^2 of existing degraded stream habitat, totalling 212,264 m^2 of instream area. This will result in the gain of 98,881 Rainbow Trout HU and 72,764 Chinook Salmon HU in offsetting areas, as well as 12,876 HU of equivalent habitat value from complementary measures. A total of 569,433 m^2 of riparian area will be created. This provides an offsetting ratio (gain:loss) of approximately 1.74:1 for instream area, 2.03:1 for instream habitat (as habitat units) and 0.71:1 for riparian area.

Construction costs for the offsetting measures, rounded to the nearest $1,000, were determined by Onsite Engineering Ltd. which is supporting drafting and engineering oversight, and NEWSS, a local ecological restoration organization, based on the detailed design drawings. The total cost to construct the proposed offsetting measures is approximately $13,588,000 which includes the 15% contingency fund of $1,772,000. Additionally, $1,014,327 will be allocated for Complementary Measures, resulting in a total offsetting cost of $14,602,327

Table of Concordance

Table C.1: A list of Requirements as Specified in Schedule 1 of Authorizations Concerning Fish and Fish Habitat Protection Regulations under the Fisheries Act

Section	Information and Documents to be Provided	Concordance
1	The applicant's and, if applicable, their representative's name, address, and telephone number.	Section 2
2	A detailed description of the proposed work, undertaking or activity and, if applicable, a detailed description of the project of which the proposed work, undertaking or activity is a part, including:	Section 3
2a	the purpose of the proposed work, undertaking or activity and, if applicable, the project;	Section 3.1
2b	the associated infrastructure;	Section 3.1
2c	any permanent or temporary structure involved;	Section 3.1
2d	the construction methods, building materials, explosives, machinery, and other equipment that will be used.	Section 3.1
3	If physical works are proposed, the project engineering specifications, scale drawings and dimensional drawings.	Section 3.2, Appendices A & B
4	A description of the phases and the schedule of the proposed work, undertaking or activity and, if applicable, a description and schedule of the project of which the proposed work, undertaking or activity is a part.	Section 3.3
5	A description of the location of the proposed work, undertaking or activity and, if applicable, of the location of the project of which the proposed work, undertaking or activity is a part, including:	Section 3.4
5a	geographic coordinates;	Section 3.4
5b	a small-scale site plan identifying the general location and boundaries;	Figure 3-1
5c	a large-scale site plan indicating the size and spatial relationship of the planned facilities, infrastructure and other components and of any existing structures, landmarks, water sources or water bodies and other geographic features;	Figures 3-2 & 3-3, Appendix A
5d	the name of any watersheds, water sources and water bodies that are likely to be affected and the geographic coordinates of the water sources and water bodies.	Table 3-2
6	The name of the community nearest to the location and the name of the county, district or region and the province in which the proposed work, undertaking or activity will be carried on.	Section 3.4
7	A description and the results of any consultations undertaken in relation to the proposed work, undertaking or activity, including with Indigenous communities or groups and the public.	Section 4
8	A detailed description of the fish and fish habitat found at the location of the proposed work, undertaking or activity and within the area likely to be affected by the proposed work, undertaking or activity, including:	Section 5
8a	the type of water source or water body;	Section 5.1
8b	the characteristics of the fish habitat and how those characteristics directly or indirectly support fish in carrying out their life processes;	Section 5.4
8c	the fish species that are present and an estimate of the abundance of those species;	Section 5.5 & 5.6

Section	Information and Documents to be Provided	Concordance
8d	a description of how the information provided under paragraphs (a) to (c) was obtained, including the sources, methods and sampling techniques used.	Section 5.2 & 5.3
9(1)	A detailed description of the likely effects of the proposed work, undertaking or activity on fish and fish habitat. The description must include:	Section 6
9(1)(a)	the fish species that are likely to be affected and the life stages of the individuals of those species;	Section 6
9(1)(b)	the extent and type of fish habitat that is likely to be affected;	Section 6.2
9(1)(c)	the probability, magnitude, geographic extent and duration of the likely effects on fish and fish habitat;	Section 6.2
9(1)(d)	a description of how the information provided under paragraphs (a) to (c) was obtained, including the sources, methods and sampling techniques used.	Section 6.2
9(2)(a)	A detailed description of how the effects referred to in subsection (1) are likely to result in the death of fish or the harmful alteration, disruption or destruction of fish habitat;	Section 6.2
9(2)(b)	A detailed description of the extent of the elements referred to in paragraph (a).	Section 6.2
10	A detailed description of the measures and standards that will be implemented, including an analysis of the expected effectiveness of those measures and standards, to:	Section 7
10a	avoid the death of fish or to mitigate the extent of their death;	Section 7.1, 7.2, & 7.3
10b	avoid or mitigate the harmful alteration, disruption or destruction of fish habitat.	Section 7.1
11	A detailed description of the monitoring measures that will be implemented to assess the effectiveness of the measures and standards referred to in section 10.	Section 7.2, Appendix H
12	A detailed description of the contingency measures that will be implemented if the measures and standards referred to in section 10 do not meet their objectives.	Section 7, Appendix H
13	A quantitative and detailed description of the death of fish referred to in subsection 9(2) after the measures and standards referred to in paragraph 10(a) are implemented.	Section 8.1
14	A quantitative and detailed description of the harmful alteration, disruption or destruction of fish habitat referred to in subsection 9(2) after the measures and standards referred to in paragraph 10(b) are implemented.	Section 8.2 & 8.4
15	The number of habitat credits that the applicant plans to use to offset the harmful alteration, disruption or destruction of fish habitat referred to in section 14, as well as the number of any certificate referred to in paragraph 42.02(1)(b) of the Act.	Section 9
16	A detailed description of a plan to offset the harmful alteration, disruption or destruction of fish habitat referred to in section 14 that were not offset by the habitat credits referred to in section 15, including:	Section 10
16a	the geographic coordinates of the location where offsetting measures will be implemented;	Section 10.4, Appendices M & N
16b	a small-scale site plan identifying the general location and boundaries of the location where the measures will be implemented;	Figure 10-1, Appendices M & N
16c	a detailed description of the measures and how those measures will meet their objectives;	Section 10.4 to 10.7
16d	a detailed description of the monitoring measures that will be implemented to assess the effectiveness of the measures referred to in paragraph (c);	Section 10.9.3, Appendix P

Section	Information and Documents to be Provided	Concordance
16e	a detailed description of the contingency measures and associated monitoring measures that will be implemented if the measures referred to in paragraph (c) do not meet their objectives;	Section 10.10
16f	a detailed description of any adverse effects on fish and fish habitat that could result from the implementation of the plan;	Section 10.9.1
16g	a detailed description of the measures and standards that will be implemented to avoid or mitigate the adverse effects and how those measures will meet their objectives;	Section 10.9, Appendix O
16h	the timeline for the implementation of the plan;	Section 10.8
16i	an estimate of the cost of implementing each element of the plan;	Section 10.11
16j	if the implementation of the plan requires access to lands, water sources or water bodies that are not owned by the applicant, a description of the steps that are proposed to be taken to obtain the authorization required for the applicant, the Department of Fisheries and Oceans and anyone authorized to act on the Department's behalf to access the lands, water sources or water bodies in question.	Section 10.4.1

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1. Introduction

1.1 Purpose and Report Organization

BW Gold Ltd. (BW Gold) proposes to construct and operate the Blackwater Project (the Project), an open-pit gold and silver mine located 112 kilometres (km) southwest of Vanderhoof, and approximately 160 km west-southwest of Prince George, British Columbia (BC).

The Blackwater Project received Environmental Assessment Certificate #M19-01 under the 2002 *Environmental Assessment Act* on June 21, 2019, and an Environmental Assessment Decision Statement under the *Canadian Environmental Assessment Act*, 2012 on April 15, 2019.

Before construction of certain works can commence, the Project requires an Authorization under Paragraph 35(2)(*b*) of the *Fisheries Act* and an amendment of Schedule 2 of the Metal and Diamond Mining Effluent Regulations (MDMER). The amendment to Schedule 2 of the MDMER specifically applies to the loss of fish habitat in tailings impoundment areas (TIAs) resulting from the placement of mine waste. A separate fish habitat compensation plan for the unavoidable loss of fish habitat caused by the placement of mine tailings within the TIA and waste rock in waste rock storage area for the Blackwater Project has been prepared. The *Fisheries Act* Authorization application presented in this document will address all other effects on fish and fish habitat resulting from Project components and activities.

This Application has been prepared in accordance with Schedule 1 of Authorizations Concerning Fish and Fish Habitat Protection Regulations, and is intended to fulfill the information requirements for an application for authorization under paragraph 35(2)(b) of the *Fisheries Act* (1985) for works, undertakings and activities associated with the Blackwater Project that are likely to result in the harmful alteration, disruption, or destruction (HADD) of fish habitat not addressed by the MDMER Schedule 2 Compensation Plan. The HADD of fish habitat is expected to result from direct overprinting of instream habitat area, upstream habitat isolation, downstream flow alteration, and linear corridor riparian loss.

A Conceptual Fisheries Mitigation and Offsetting Plan was prepared as part of the Environmental Assessment (EA) Application/Environmental Impact Statement (the Application/EIS), which outlined project activities, effects, and offsetting measures proposed at the time of the Application/EIS submission (AMEC, 2014a; Appendix.5.1.2.6C of the Application/EIS). The Conceptual Fisheries Mitigation and Offsetting Plan was updated based on comments received from Indigenous Nations, Fisheries and Oceans Canada (DFO) and the BC Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (MFLNRORD) and was divided into two plans: an Offsetting Plan for the *Fisheries Act* Authorization and a Compensation Plan for the amendment to Schedule 2 of the MDMER.

Following this introduction (Section 1), this document includes the following sections:

- Section 2 provides the proponent's (BW Gold) contact information;
- Section 3 describes the proposed work, undertakings and activities associated with the Project including the Project phases and schedule, Project location, and name of the community closest to the Project;
- Section 4 provides a summary of the consultation efforts to date;
- Section 5 includes a description of fish and fish habitat in the Project area and in the affected watersheds in particular;

- Section 6 outlines the anticipated effects on fish and fish habitat as a result of the Project, including a quantitative assessment of the impact to fish habitat;
- Section 7 describes avoidance and mitigation measures;
- Section 8 provides a quantitative assessment of residual effects to fish and fish habitat after implementation of avoidance and mitigation measures and standards;
- Section 9 describes habitat credits that may be used to offset the residual effects to fish and fish habitat; and,
- Section 10 includes a detailed description of the offsetting plan, as well as monitoring measures that will be implemented to assess the effectiveness of offsetting measures, and contingency measures.

1.2 Legislative Background

The previous owner of the Project, New Gold Inc. (New Gold), received an Environmental Assessment Certificate #M19-01 (Certificate) on June 21, 2019, under the *Environmental Assessment Act* (2002) and a Decision Statement on April 15, 2019, under the *Canadian Environmental Assessment Act* (CEAA, 2012). In August 2020, BW Gold acquired the mineral tenures, assets, and rights to the Blackwater Project that were previously held by New Gold, including the Certificate and Decision Statement.

As part of the Environmental Assessment (EA) process, an effects assessment was completed, including for fish and fish habitat, which were identified as Valued Components (VCs). It was determined through this assessment that the Project will likely result in HADD of fish habitat, as defined by the federal *Fisheries Act*.

1.3 Legislative Context

The Project will cause a HADD of fish habitat associated with mine components and will affect fish and fish habitat in association with the deposition of deleterious substances (i.e., mine tailings and waste rock) into fish-bearing portions of Davidson Creek and Creek 661. These impacts to fish and fish habitat will require both an Authorization under Paragraph 35(2)(*b*) of the *Fisheries Act* and an amendment of Schedule 2 of the MDMER.

1.3.1 Fisheries Act – Section 35

The *Fisheries Act* was updated in 2019 as part of the Government of Canada's Review of Environmental and Regulatory Processes initiative. Amendments introduced at this time reinstated protection for all fish and fish habitat, including prohibition of HADD of fish habitat and the death of fish by means other than fishing.

The *Fisheries Act* prohibits the carrying out of any work, undertaking or activity, other than fishing, that results in the death of fish (Subsection 34.4(1)), and/or HADD of fish habitat (Subsection 35(1)). If a project cannot avoid, or is likely to cause, death of fish and/or HADD of fish habitat, then a Section 35(2)(b) *Fisheries Act* Authorization is required.

1.3.2 Schedule *2* – Metal and Diamond Mining Effluent Regulations

Using a natural water body frequented by fish for mine waste disposal requires an amendment to Schedule 2 of the MDMER. Obtaining an amendment to Schedule 2, which designates waterbodies affected by mine waste as TIAs, requires federal legislative action. The MDMER was enacted in 2002 under Subsections 34(2), 36(5), and 38(9) of the *Fisheries Act* to regulate the deposition of mine effluent, waste rock, tailings, low-grade ore, and overburden into natural waters frequented by fish. Regulations under the MDMER are administered by ECCC.

An amendment to Schedule 2 of the MDMER will be required to designate portions of stream channels impacted by mine waste as TIAs. These stream channels include portions of Davidson Creek within the Tailings Storage Facility (TSF) and the portions of tributaries to Davidson Creek and Creek 661 under the low-grade and high-grade ore stockpiles, the overburden and non-acid-generating (NAG) waste rock storage facilities, and the environmental control dam (ECD) as TIAs.

Subsection 27.1(1) of the MDMER Division 4 – Tailings Impoundment Areas describes the requirement to submit a Compensation Plan to the Minister of the Environment and Climate Change and obtain approval for the plan. Subsection 27.1(2) states that the purpose of the Compensation Plan is to offset the loss of fish habitat resulting from the deposition of any deleterious substance into a TIA and identifies the required components of the Compensation Plan.

The Compensation Plan was submitted to ECCC in February 2021, revised based on Indigenous Nations review and resubmitted April 20, 2022, and is under review at the time of writing this document.

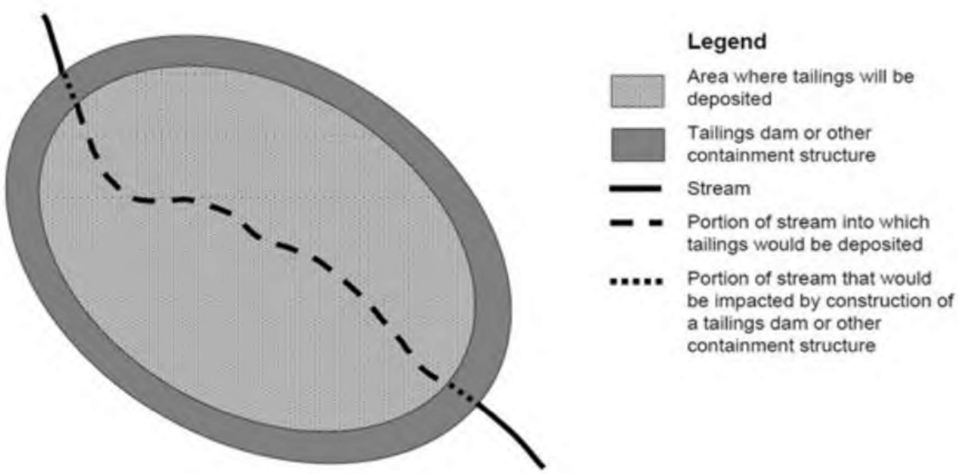
1.3.3 Regulatory Division of Instream Areas Affected by the Project

Environment and Climate Change Canada's (ECCC) *Guidelines for the Assessment of Alternatives for Mine Waste Disposal: Annex 2* describe that in situations where a tailings impoundment area is established in a stream valley, as is the case for the Blackwater Project, two separate fish habitat compensation/offsetting plans are required:

- Subsection 35(2) of the Fisheries Act requires fish habitat offsetting to compensate for the losses of fish habitat associated with the construction of the works themselves, such as the footprint of a tailings dam or other containment structures; and
- Section 27.1 of the MDMER requires fish habitat compensation to offset losses of fish habitat associated the deposition of a deleterious substance into the waterbody(ies) that are added to Schedule 2.

Figure 1-1 illustrates the typical division of fish habitat compensation areas between the two regulatory processes.

Stream areas included in this Offsetting Plan for *Fisheries Act* Subsection 35(2) Authorization and those included in the separate Compensation Plan for Section 27.1 of the MDMER are presented in Section 8. Section 8 also includes a detailed description of the stream segments that will be affected by the Project and included in this *Fisheries Act* Authorization application.



Source: ECCC Guidelines for the assessment of alternatives for mine waste disposal: annex 2 (available at: https://www.canada.ca/en/environment-climate-change/services/managing-pollution/publications/guidelines-alternatives-mine-waste-disposal/annex-2.html)

Figure 1-1. Fish Habitat Compensation Requirements in Typical Tailings Impoundment Areas.

2. Proponent Contact Information

Section 2 of this report contains the required information (see also Table C-1) as specified in:

"Section 1. The applicant's and, if applicable, their representative's name, address and telephone number." [Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 1]

The contact persons applying for the *Fisheries Act* Authorization on behalf of BW Gold and their authorized representative are:

Name and Address of Owner
BW Gold Ltd.
Suite 3083 – 595 Burrard Street
Vancouver, BC
V7X 1L3

Authorized Contact Person
Ryan Todd
Vice President, Environment and Social Responsibility
Telephone: 604 329 8179
Email: rtodd@artemisgoldinc.com

Blackwater Community Office
139- 1st Street East, P.O. Box 440
Vanderhoof, BC
V0J3A0
Email: office.blackwater@artemisgoldinc.com

3. Proposed Works, Undertakings and Activities

Section 3 of this report contains the required information (see also Table C-1) as specified in:

"Section 2. A detailed description of the proposed work, undertaking or activity and, if applicable, a detailed description of the project of which the proposed work, undertaking or activity is a part, including
(a) the purpose of the proposed work, undertaking or activity and, if applicable, the project;
(b) the associated infrastructure;
(c) any permanent or temporary structure involved; and
(d) the construction methods, building materials, explosives, machinery and other equipment that will be used."
[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 2]

3.1 Blackwater Project Overview

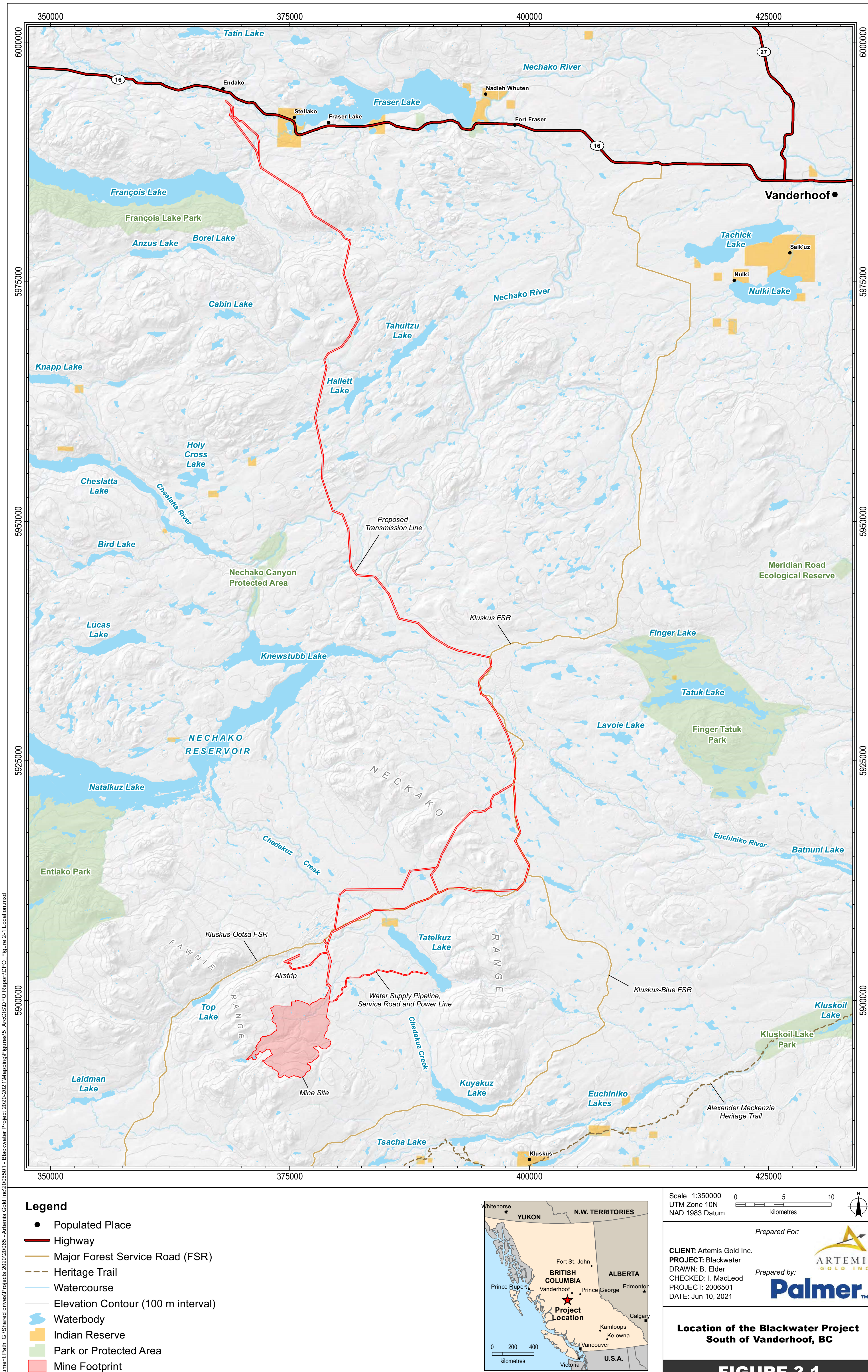
This section provides an overview of the Project including the principal mine components and associated infrastructure that have the potential to affect fish and fish habitat in the Project area. Additional details on the principal mine components are available in the *Blackwater Gold Project Initial Project Description* (Initial Project Description; ERM 2020), the *NI 43-101 Technical Report on Pre-Feasibility Study* (Pre-Feasibility Study; Artemis 2020), and in Section 2 (Project Overview) of the Application/EIS.

The Project is a gold and silver open-pit mine with associated ore processing facilities with a proposed initial milling capacity of 15,000 tonnes per day (t/d; 5.5 million tonnes per annum [Mtpa]) for the first five years of operation. After the first five years, the milling capacity will increase to 33,000 t/d (12 Mtpa) for the next five years of operation, and to 55,000 t/d (20 Mtpa) until the end of the planned mine life. Gold and silver will be recovered by a combination circuit of gravity and whole ore leaching to produce a gold-silver doré. The mine life is expected to be 23 years, including processing of a low-grade stockpile.

Several main components comprise the Project:

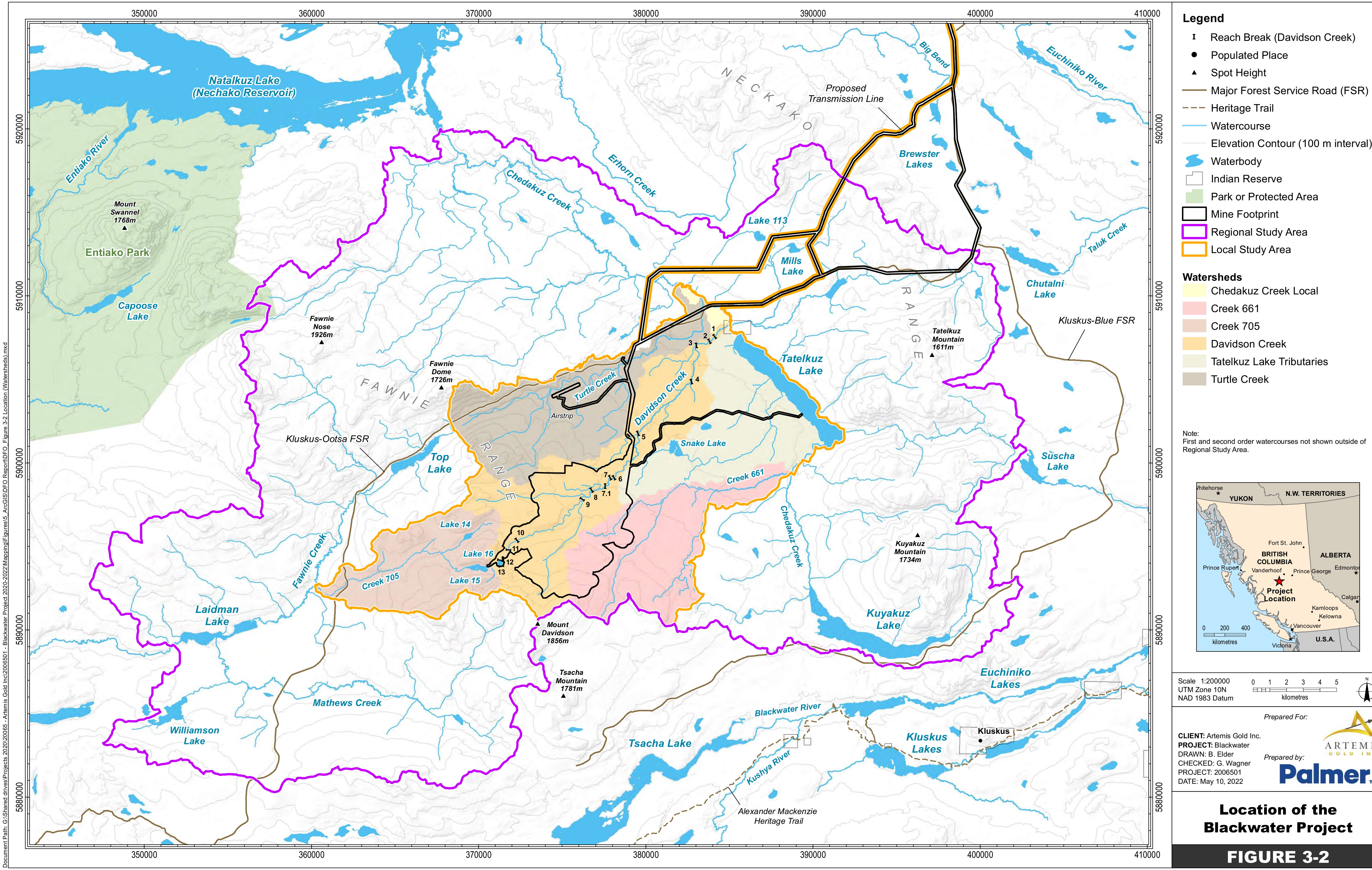
- Mine site;
- A freshwater reservoir and water management pond;
- Freshwater Supply System (FWSS) and associated infrastructure;
- Electrical transmission line and associated access, borrow, and laydown areas;
- Airstrip; and
- Mine access road.

General Arrangement drawings, showing the location of the mine infrastructure and their planned development over the life of mine, are provided in Appendix A. The Project location, landmarks, waterbodies, and other geographical features in the wider area, are presented in Figure 3-1 The Project location relative to the Davidson Creek and Creek 661 watersheds is presented in Figure 3-2. The site plan showing the proposed mine site component locations is presented in Figure 3-3.



Location of the Blackwater Project South of Vanderhoof, BC

FIGURE 3-1



Legend
Reach Break (Davidson Creek)
Populated Place
Spot Height
Major Forest Service Road (FSR)
Heritage Trail
Watercourse
Elevation Contour (100 m interval)
Waterbody
Indian Reserve
Park or Protected Area
Mine Footprint
Regional Study Area
Local Study Area
Watersheds
Chedakuz Creek Local
Creek 661
Creek 705
Davidson Creek
Tatelkuz Lake Tributaries
Turtle Creek
Note:
First and second order watercourses not shown outside of Regional Study Area.
Whitehorse
YUKON
N.W. TERRITORIES
Fort St. John
BRITISH COLUMBIA
ALBERTA
Prince Rupert
Vanderhoof
Prince George
Edmonton
Project Location
Calgary
Kamloops
Kelowna
Vancouver
Victoria
U.S.A.
0 200 400
kilometres
Scale 1:200000
UTM Zone 10N
NAD 1983 Datum
0 1 2 3 4 5
kilometres
Prepared For:
CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: G. Wagner
PROJECT: 2006501
DATE: May 10, 2022
ARTEMIS GOLD INC
Prepared by:
Palmer
Location of the Blackwater Project
FIGURE 3-2
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350000
360000
370000
380000
390000
400000
410000
5920000
5910000
5900000
5890000
5880000
Natalkuz Lake (Nechako Reservoir)
Entiako River
Mount Swannel 1768m
Entiako Park
Capoose Lake
Fawnie Nose 1926m
Fawnie Dome 1726m
FAWNIE RANGE
Kluskus-Ootsa FSR
Top Lake
Fawnie Creek
Laidman Lake
Williamson Lake
Mathews Creek
Chedakuz Creek
Erhorn Creek
NECKAKO RANGE
Proposed Transmission Line
Big Bend
Euchiniko River
Brewster Lakes
Lake 113
Mills Lake
Taluk Creek
Chutalni Lake
Kluskus-Blue FSR
Tatelkuz Mountain 1611m
Tatelkuz Lake
Turtle Creek
Airstrip
Davidson Creek
Snake Lake
Creek 661
Creek 705
Lake 14
Lake 16
Lake 15
Süscha Lake
Kuyakuz Mountain 1734m
Kuyakuz Lake
Chedakuz Creek
Mount Davidson 1856m
Tsacha Mountain 1781m
Euchiniko Lakes
Blackwater River
Tsacha Lake
Kluskus Lakes
Kluskus
Kushya River
Alexander Mackenzie Heritage Trail

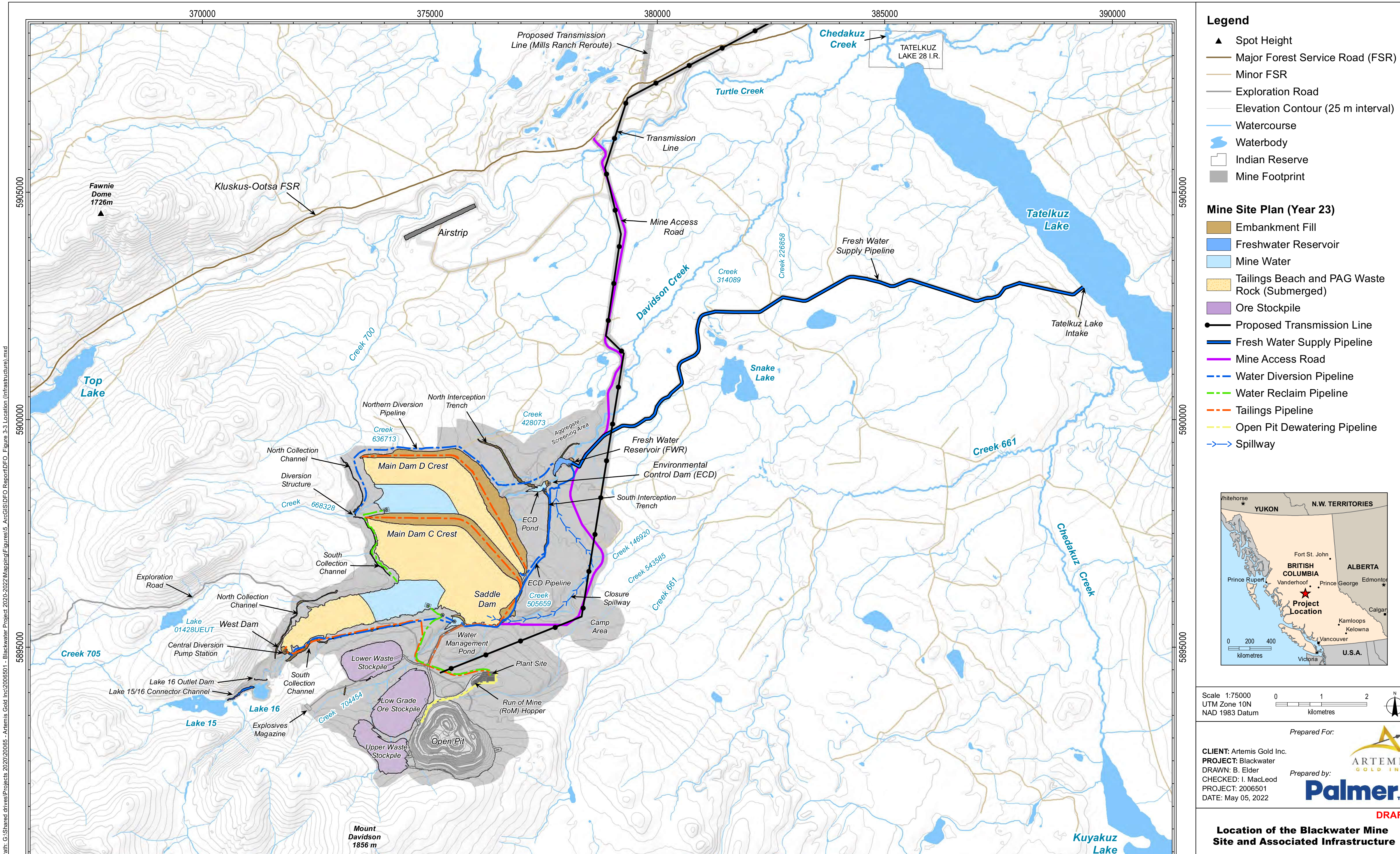

FIGURE 3-3 Location of the Blackwater Mine Site and Associated Infrastructure

The mine site contains the following Project components:

- The open pit and dewatering system;
- TSF, dams, spillways and barge reclaim system;
- TSF seepage collection system, including environmental control dam and plunge pool;
- Freshwater reservoir;
- Waste rock and overburden storage facilities, including surface water diversions;
- Low grade ore, high grade ore and live ore stockpiles, including diversion channel, low permeability foundation and seepage collection system;
- Water management infrastructure including ponds, dams, ditches, foundation drains, pipelines and structures for managing surface water;
- Southern, Central, and Northern diversions;
- Mine water treatment plants, ponds, pumps and piping;
- Process plant buildings (mill, reagent, adsorption, crushing and grinding circuits and gold room);
- Reclaim conveyors;
- Elution and refinery building;
- Whole ore leach tanks;
- Borrow areas and quarries;
- Sand and gravel screening and cement batch plant;
- Fire suppression system;
- Ancillary buildings including truck shop, warehouse, administrative building, mine dry and emergency services building;
- Soil stockpiles;
- Groundwater wells for potable and firewater use;
- Domestic sewage treatment system;
- Incinerator system;
- Waste management handling facilities (hazardous and non-hazardous (recyclable) waste storage and off-site shipment);
- Soil bioremediation cell;
- Electrical distribution system, including pole line, electrical substation and portable substations;
- Temporary Construction phase power plant and emergency standby power plant;
- Satellite, telecommunications and security systems;
- Main truck shop;
- Administration and emergency services buildings;
- Laboratory;
- Explosives storage and emulsion plant;
- Fuel farm;
- Permanent camp;
- Helipad;
- Haul roads and other site access roads;
- Portions of the Mine Access Road; and
- Portions of the electrical transmission line.

Components off the mine site include:

- Portions of the Mine Access Road;
- Portions of the electrical transmission line;
- Portions of the freshwater supply system (FWSS), including service road, overhead power distribution line and stepdown transformers, pipeline, booster pump stations, borrow, equipment and material laydown areas, water intake and pumping stations, and
- Transmission line access roads, borrow, equipment and laydown areas.

Descriptions of major on- and off-site mine components are provided in the following sections. Design drawings and site plans for components with potential to affect instream areas (including the freshwater intake, freshwater reservoir, pipeline crossings, diversion channels, and road crossings) are provided in Appendix B.

3.1.1 Tailing Storage Facility

The primary design objectives for the TSF are to:

- Have minimal long-term environmental effects;
- Provide reliable and durable long-term containment with low maintenance and monitoring requirements; and
- Be able to safely and effectively contain tailings and potentially acid generating and metal leaching potential (PAG/ML) waste rock produced over the life of the mine.

The TSF is designed to permanently store 334 Mt of tailings, in addition to 467 Mt of PAG and NAG waste rock (PAG1, PAG2 and NAG3[1]). The TSF design considers the following requirements:

- Permanent, secure and total confinement of all solid waste materials within engineered disposal facilities;
- Control, collection and removal of free-draining liquids from waste rock and tailings during Operations for recycling as process water to the maximum extent practicable;
- Prevention of acid rock drainage (ARD) and minimization of metal leaching (ML) from potentially reactive tailings and waste rock;
- Inclusion of monitoring features for all aspects of the facility to confirm performance goals are achieved and design criteria and assumptions are met; and
- Staged development of the facility over the life of the mine.

The TSF comprises two adjacent sites, TSF C and TSF D. The Pre-Feasibility Study included a shift of the Main Dam C downstream relative to its location in the Project's Application/EIS (New Gold 2014) to:

- Simplify water management during early Operations;
- Optimize initial capacity and haul distances;
- Improve constructability due to more gentle terrain; and
- Use the existing drivable trails network to facilitate construction to the extent practicable.

The ultimate TSF footprint remains largely unchanged from the footprint reviewed and assessed during the EA, and the TSF general arrangement is shown in Figure 3-3.

The TSF embankments will be engineered, water-retaining, zoned earthfill/rockfill dams with compacted low-permeability core zones and appropriate filter/transition zones. A total of four embankments will be constructed across the two sites: the Main Dam D, the Main Dam C, the Saddle Dam, and the West Dam. The dam construction materials balance is integrated with the mine plan to limit the need for additional external borrow material sources following initial site establishment and early TSF construction. Several borrow sources should be available in the vicinity of the TSF basin, including pit-run granular fill materials

[1] *PAG1 is potentially acid generating and has a neutralization potential ratio (NPR) of less than or equal to 1.0; PAG2 has an NPR of greater than 1.0 and less than or equal to 2.0; NAG3 is non-acid generating with an NPR > 2.0 and Zinc ≥ 1,000 ppm*

for the dam shell, fine-grained glacial till for the core zone, and aggregate materials that could be crushed and/or screened to produce desirable quantities and grain size distributions for engineered fill materials.

TSF C will be constructed first to provide storage capacity for process plant start-up. TSF C is designed to contain up to approximately 17 years of tailings and the first six years of PAG/NAG3 waste rock. It includes a storage allowance for the supernatant pond to provide a continuous source of process water for mill operations. The first stage of the Main Dam C will be constructed to provide sufficient capacity for a start-up pond up and to impound tailings and PAG/NAG3 waste rock generated during the first year of Operations, with additional capacity to contain the Inflow Design Flood (IDF). The Main Dam C will be raised annually thereafter through year 15 using centerline construction methods to reach an ultimate elevation of approximately 1,353 metres above sea level (masl).

The West Dam will be constructed in a single stage to an elevation of 1,353 masl in approximately Year 6 to constrain the western extent of TSF C. A saddle dam will also be required on the southeastern side of TSF C beginning in approximately Year 6 and will be raised annually with the Main Dam C. The dam raise schedule includes consideration for several downstream step-outs of the shell zone, which are designed to support several staged vertical raises of the embankment. Each raise is designed to provide enough storage for the following year of Operations, a sufficient supernatant pond allowance ranging from approximately 2 to 10 Mm^3 (which is aligned with the staged capital expansion of the mill facilities), and additional capacity to store the IDF.

The TSF D will be formed by constructing the Main Dam D adjacent to and downstream of TSF C beginning in Year 5 to provide additional storage capacity for PAG/NAG3 waste rock and tailings. Filling of TSF D will begin in Year 7 following two years of initial construction. The facility is designed to contain PAG/NAG3 waste rock generated between Years 7 and 18 and up to approximately six years of tailings beginning Year 17 when TSF C reaches design capacity. The Main Dam D will be raised by centreline method beginning in Year 7 reaching an ultimate elevation of 1,340 masl.

Tailings from the process plant will be delivered by gravity through a pipeline to either TSF C or TSF D. Expansions to the tailings distribution system will coincide with expansions to the mill facilities and to provide sufficient tailings distribution capacity at each stage of mine development. An additional pipeline extending to TSF C will be constructed in a suitable location to allow for emergency discharge of tailings to the TSF. Tailings will initially be discharged into TSF C from one or more points on the west side of the facility with PAG/NAG3 waste rock deposited directly upstream of the Main Dam C during the first six years of Operations to enhance stability on the upstream side of the dam. The tailings distribution system will be extended along the crest of the Main Dam C during Year 6 to allow for tailings discharge from the dam crest beginning in Year 7 to cover submerged PAG/NAG3 waste rock and manage the location of the supernatant pond. The tailings distribution system will be extended along the crest of the Main Dam D in approximately Year 16 to allow for tailings discharge from the dam crest beginning in approximately Year 17 to cover submerged PAG/NAG3 waste rock. Process water recovered following discharge of tailings to TSF D will be pumped to the supernatant pond in TSF C for reuse in ore processing.

Geotechnical instrumentation will be installed during construction along representative instrumentation planes within the West Dam, Main Dam C, Saddle Dam, and Main Dam D. The geotechnical instrumentation will consist of vibrating wire piezometers, slope inclinometers, settlement and movement monitoring points. Instrumentation will be installed within the foundations, embankment fill, and on embankment crests. Instrumentation monitoring will be carried out routinely during construction and operation. Daily measurements will be taken and analyzed during construction to monitor the response of the embankment fill and the foundation from the loading of the embankment fill. The operational monitoring systems will be connected to an automated data acquisition system that provides real-time access to the monitoring data.

3.1.2 Low-Grade Ore and High-Grade Ore Stockpiles

When ore is mined from the pit, it will be delivered to the crusher; the run-of-mine (ROM) stockpile located next to the crusher; the low-grade ore stockpile; or the high-grade ore stockpile (Figure 3-3). The low-grade ore and high-grade ore stockpiles are co-located and will receive ore that is of lower grade than that which will be delivered directly to the crusher or the ROM stockpile.

The stockpiled ore (low grade and high grade) is planned to be re-handled back to the crusher during the mine life. Processing of the high-grade ore stockpile would be completed earlier than the low-grade ore stockpile. Under the current mine plan, the ore stockpiles will reach their greatest total volume in Year 9 of mining operations. The stockpiles will be designed to be meet the BC Mine Waste Rock Pile Research guidelines (Sections 10.1.6 and 10.6.7 of the Code).

Current estimates have up to 111 Mt of ore (combined low-grade and high grade), with the majority being low-grade stored at the stockpiles.

Ore is classified as PAG with a relatively short lag time to acid production. The ore stockpiles are expected to generate acidic drainage with elevated metals until the ore is processed. Therefore, the stockpiled ore will be placed on a low-permeability foundation with surface water and seepage collection and monitoring systems. The drainage will be collected, neutralized with lime, and discharged to the TSF.

3.1.3 Overburden and Non-Acid Generating Waste Rock Storage Facilities

Stockpiles are planned for surplus NAG waste materials from the open pit in the waste rock storage facility. Overburden and NAG waste not used in the construction of the TSF will be placed in either the upper waste stockpile or the lower waste stockpile. The stockpiles will be designed to meet the BC Mine Waste Rock Pile Research guidelines (Sections 10.1.6 and 10.6.7 of the Code). These stockpiles are shown in Figure 3-3.

The upper waste stockpile will be located directly west of the pit limits and will store overburden waste materials. The lower waste stockpile will be located 1.5 km northwest of the pit limits and will store of NAG waste rock and overburden.

The waste rock storage facility stockpile layouts are designed to minimize surface water control requirements. Foundation drains will be installed in areas of existing drainage lines or when excessive seeps or springs are encountered during clearing and grubbing. Non-contact surface water will be diverted around the waste rock storage facilities during Operations and Closure and will be field-fit with the advancing fill platforms. Water that infiltrates through the waste rock storage facilities will be collected in ditches near the toe of the waste rock storage facilities and routed to a sediment basin before discharge to the TSF.

3.1.4 Water Management Structures

The water management facilities will be developed by identifying the size and position of the planned mine site facilities and establishing estimated catchment area boundaries based on the mine site development concept. All drainage from the mine will flow by gravity into the TSF to simplify water management, spill control and mine closure. Water within the Project area, except clean water diversions, will collect runoff from the mine site area and recycle process water to the maximum practicable extent. The tailings and mine water management plan will include the following strategies:

- Manage sediment mobilization and erosion by installing sediment controls prior to land disturbance and limiting land disturbance to the minimum practicable extent.
- Include appropriate temporary erosion and sediment control measures or use Best Management Practices (BMPs) prior to and during initial land disturbance.
- Use water within the Project area by collecting and managing site runoff from disturbed areas, maximizing the recycle of process water, and storing water within the TSF to the maximum practicable extent.
- Include staged engineered diversions (Southern, Central and Northern diversions) to allow diversion of upstream flows from significant undisturbed catchment areas around the TSF to the Fresh Water Reservoir (FWR). Flow diversions will be operated as part of the mine site water balance and will be used for ore processing or Davidson Creek instream flow needs as required.
- During operations, drainage from the low-grade, high-grade and coarse ore stockpiles may become acidic with elevated metals content; this drainage will be collected from the base of lined pads beneath the stockpiles and neutralized with lime to increase the pH and precipitate metals before discharge to the TSF. Pit water is predicted to be of neutral pH with relatively low metals content during operations; it will be pumped to a small holding/monitoring pond, which will overflow to the TSF or be treated/released to a permitted discharge location in the downstream receiving environment.
- Collect recoverable TSF seepage during operations and post closure until the pit lake overflows or the water is acceptable for direct discharge to Davidson Creek.

Components of the Mine Water Management are described in the following sub-sections.

3.1.4.1 Southern Diversion

The Southern Diversion will be located up-gradient of TSF D and will be constructed during the initial construction period to divert upstream flows around mine infrastructure and the TSF. The Southern Diversion intake structure will consist of a small (i.e., less than 5 m high) concrete intake structure to submerge the water conveyance pipeline. The intake structure will include a gated sluice pipe to clean out sediment accumulation and a spillway sized to convey an appropriate design peak flow in the event that the water conveyance pipeline and gated sluice pipe became inoperable. The spillway will consist of a wide broad-crested weir capable of passing the design storm while maintaining sufficient freeboard. Flows will be conveyed around mine facilities within the water conveyance pipe and discharged to the FWR. The pipeline will be relocated and extended in Year 6 during construction of TSF D. The ditches to convey flows to the intake structure will be shallow trapezoidal shaped ditches with erosion resistant material placed over a non-woven geotextile, which will help prevent erosion of any underlying fine soils.

3.1.4.2 Central Diversion System

The Central Diversion System will be constructed to divert freshwater around the TSF to the downstream receiving environment or to water transfer points where the captured flows can be pumped to the Water Management Pond. The Central Diversion will consist of a small berm to impound water within Davidson Creek upstream of the TSF area, and skid-mounted pump systems and water conveyance pipeline to route flows to the Southern Diversion or around the TSF area to the FWR. The Central Diversion intake infrastructure will initially be located near the existing exploration access road during initial Project construction and will be relocated in approximately Year 6 to the west of the West Dam following its construction. The berm will be less than approximately 5 m high and constructed of locally borrowed overburden materials. A second flow-through berm will be constructed of screened gravel and cobble-sized materials upstream of the water collection area to limit fish access from upper Davidson Creek.

3.1.4.3 Northern Diversion System

The primary function of the Northern Diversion System will be to divert freshwater around the TSF and provide water to the FWR through a gravity pipeline system.

The Northern Diversion will be located up-gradient of TSF D and will be constructed in approximately Year 6 to divert upstream flows around the TSF. The Northern Diversion intake structure design will be similar to the Southern Diversion intake structure design, consisting of a small (i.e., less than 5 m high) concrete intake structure to submerge the water conveyance pipeline. The intake structure will include a gated sluice pipe to clean out sediment accumulation and a spillway sized to convey an appropriate design peak flow in the event that the water conveyance pipeline and gated sluice pipe became inoperable. The spillway will comprise a broad-crested weir capable of passing the design storm while maintaining sufficient freeboard. Flows will be conveyed around the mine facilities within the water conveyance pipe to the FWR. The ditches to convey flows to the intake structure will be shallow trapezoidal shaped ditches with erosion resistant material placed over a non-woven geotextile, which will help prevent erosion of any underlying fine soils.

3.1.4.4 Fresh Water Reservoir

The FWR is an in-creek water reservoir that will be created by constructing an approximately 14 m high dam across Davidson Creek. The reservoir will have a storage capacity of up to approximately 400,000 m^3. The purpose of the FWR will be to maintain a suitable source of fresh water to support mine operations and to provide water to lower Davidson Creek as required to reduce the Project's potential impacts on fish and fish habitat. The FWR will receive inflows from the following sources:

- Direct precipitation on the FWR and runoff from its contributing catchment area;
- Diverted flows from undisturbed areas upgradient of the TSF that will be conveyed around the TSF to the FWR;
- Mine contact water that is suitable for release to the downstream receiving environment; and
- Fresh water from Tatelkuz Lake supplied by the FWSS.

Water release from the FWR will be controlled by a discharge structure, including temperature and flow measurement devices. A spillway will route storm flows through the reservoir and around the dam.

3.1.4.5 Freshwater Supply System (FWSS)

The FWSS will pump water from Tatelkuz Lake to the FWR. The FWSS will provide freshwater for ore processing in the mill as required and water to offset flow reductions in lower Davidson Creek caused by capture of contact water in the TSFs and associated water management infrastructure and to meet instream flow needs for downstream fisheries. The FWSS is described in more detail in Section 3.1.1.2.

3.1.4.6 Water Management Pond and Discharge Pipeline

The WMP's main objective will be to provide fresh make-up water to support ore processing. The WMP will be constructed downslope of the Open Pit and stockpiles area and within the ultimate footprint of TSF C to manage runoff from contributing areas and water pumped from collection points.

The WMP will be formed using natural topography enclosed by construction of three geomembrane-lined earthfill berms on the West, North, and East sides of the pond. Each berm is designed with a crest elevation of 1,325 masl, with the pond basin invert at an average elevation of 1,308 masl. The basin and berms will be fully geomembrane-lined up to 1,324.5 masl providing a total water storage capacity of 825,000 m3 at this elevation.

The WMP stored water volume will be managed via pumping systems and two secondary outflow mechanisms designed to maintain dam safety. The pumping systems will provide the primary control of water level within the WMP on a day-to-day basis. A culvert at the West Berm will provide supplemental outflow capacity to the TSF supernatant pond during periods of elevated runoff, such as during freshet. Larger storm inflows up to the 1-in-200-year, 24-hour return period storm event will be managed by an emergency spillway constructed along the left abutment of the North Berm.

The primary function of the WMP Discharge Pipeline will be to convey water from the WMP to the FWR beginning in late Year -2 or early Year -1.

The pipeline will discharge into the FWR at approximately elevation 1,155 masl, which is below the normal operating level of the FWR. The WMP discharge pipeline will be installed during the preproduction phase to allow diversion of lows around the TSF construction area, if required, and will be operated until the end of Year +12.

3.1.4.7 Water Reclaim System

Water reclaimed from the supernatant pond at TSF C will be delivered to the reclaim water tank at the mill. The reclaim water system will initially comprise a barge-mounted pump station and reclaim water pipeline. The reclaim barge will be anchored on the southern side of the TSF C supernatant pond throughout operations, and tailings will be selectively discharged to the TSF to maintain the location of the supernatant pond. The reclaim water system in TSF C will be twinned in Year 5 and a third parallel system will be added in Year 10. In addition, a barge-mounted pump station will be added to TSF D in Year 16 to convey supernatant water from TSF D to TSF C.

3.1.4.8 Seepage Collection Structures

<u>Interim Environmental Control Dam</u>

A seepage collection pond, the interim ECD, will be created downstream of the Main Dam C at a topographic low point in Davidson Creek. This pond will provide containment for seepage and mine-affected surface water runoff downstream of TSF C prior to construction of TSF D. The interim ECD will be equipped with a spillway for dam safety purposes and include a pump-back system and pipeline to convey collected seepage back to TSF C.

Environmental Control Dam

The primary seepage collection point downstream of the TSF following construction of TSF Dam D will be located approximately 1km downstream at a topographic low point in Davidson Creek, upstream of the FWR. This pond will be created by constructing an approximately 12 m high Environmental Control Dam (ECD) across Davidson Creek. The pond behind the dam will be fed by the southern and northern interception trenches. The primary pump-back system at the ECD is designed to convey flows to TSF D and maintain the pond at a minimum water level. The ECD design will also include a spillway for dam safety purposes. The ECD will have an embankment drain system, seepage collection sump and monitoring device, and secondary pump-back system to collect and recycle seepage.

3.1.4.9 Mine Operations Water Supply

Water for mine operations will be sourced by collecting runoff from the mine site area and recycling process water to the maximum practicable extent. All mine site contact water during operations and closure will drain by gravity to the TSF. Seepage from the TSF and WRSFs will also be collected and directed to the TSF. The mine operations water supply sources will include:

- Runoff from catchment areas above the TSF, other than runoff captured by the Northern, Central or Southern diversions;
- Direct precipitation onto the TSF and contact water runoff from mine site facilities;
- Water recycled from the TSF supernatant ponds and the water management pond;
- Groundwater and surface water from open pit dewatering and depressurization;
- Water extracted from groundwater wells within the mine site area;
- Runoff water from undisturbed areas diverted around the mine facilities to the FWR; and
- Fresh water pumped from Tatelkuz Lake.

Water stored in the TSF C start-up pond will be the primary water source for processing at the start of mine operations. An adequate volume of water within TSF C will be maintained throughout operations to provide a continuous source of water for mill operations. Runoff water accumulating in TSF D beginning in Year 5 will be conveyed to TSF C (via the pump system at the interim ECD) as necessary to control the rate of inundation of PAG/NAG3 waste rock and to maintain sufficient freeboard to manage the IDF. Once tailings deposition in TSF D commences in Year 17, process water conveyed with the tailings slurry will be transferred from TSF D to the TSF C pond prior to being reclaimed to the mill to support ore processing. Additional makeup water, if required, will be provided from the Southern, Central and Northern diversions.

3.1.4.10 Water Treatment Plants

At the start of operations, water treatment plants will be installed to provide water management flexibility by allowing the release of excess water should it accumulate on site. During post-closure, mine-affected water is expected to require treatment before discharge to the environment. Treatment will continue until it is no longer needed to meet water quality requirements in EAC certificate #M19-01 (June 21, 2019) for EAC

Condition #26 (Water Quality Management) and EAC Condition #28 (Chedakuz Creek and Tatelkuz Lake Surface Water Quality Monitoring Plan), and EMA effluent discharge permit requirements.

3.1.5 Power Supply

A new approximately 135 km, 230 kilovolt (kV) overland transmission line will connect the Project to the BC Hydro grid at the Glenannan substation located near the Endako mine, 65 km west of Vanderhoof. The incoming transmission line will terminate at the site main substation adjacent to the main process facilities. The anticipated maximum connected load is 110 megawatt (MW) for the fully expanded Project. Commissioning of power to the mine site is planned for Year -1, prior to commissioning of mine operations. Further detail on the off-site transmission line is provided in Section 3.1.1.2. Emergency power will be available from a standby power station.

3.1.6 Buildings

A variety of buildings will be constructed on site to support mine operations, including process plant buildings (e.g., mill building, crusher facility buildings), offices, a laboratory, equipment maintenance buildings, and worker accommodations.

3.1.7 Mine Site Roads

Mine site roads will be necessary to provide access to the plant, accommodation, truck-shop, explosives store and other ancillary facilities. Depending on frequency of use and safety considerations, these roads may be single or double-laned with variable width to accommodate anticipated traffic.

3.1.8 Borrow Sources

There are potential borrow source locations within the mine site. The following areas have been identified as potential borrow sources:

- Approximately 500,000 m^3 of material could be generated from excavations at the plant site;
- Several suitable borrow sources should be available within 2 km of the Main Dam C;
- In excess of 3 Mm^3 of materials could be sourced from a site approximately 5 km north of the plant site alongside the new mine access road;
- In excess of 3 Mm^3 of sand and gravel materials are available from an Esker deposit located approximately 10 km from the plant site area straddling the mine access road; and
- Additional borrow sources may be identified during site preparation and the materials assessed for suitability for use in construction (e.g., open pit stripping).

3.1.9 Project Components Located off the Mine Site

The following Project components are located fully or partially off the Mine Site and will have interactions with fish and fish habitat.

3.1.9.1 Freshwater Supply System

The FWSS is designed to augment flows in middle and lower Davidson Creek. The FWSS consists of a water supply pipeline, an outlet at the FWR, booster pumpstation(s), and connections to the FWR outlet works. The intake and pipeline system will pump water from Tatelkuz Lake via a pipeline to the FWR built in Davidson Creek downstream of the TSF. Controlled release of water from the FWR will be used to supplement flows in Davidson Creek during portions of Operations and Closure phases. The FWSS, as designed, has sufficient capacity to meet instream flow needs (IFN; further information on IFN is provided in Section 8.4.1.4 and Appendix C) for Rainbow Trout and Kokanee in Davidson Creek.

The life of mine water balance (Knight Piésold 2021a), which is reflective of optimizations made to the project since the Application/EIS, indicates that under average climate conditions, the FWSS is not required to meet IFN during Construction and the first five years of Operations. During this time, the FWR will be used to meet IFN without the need to withdraw water from Tatelkuz Lake. Mitigation of effects to Tatelkuz Lake and Chedakuz Creek due to pumping of water by the FWSS was identified as an important consideration for project implementation during, and subsequent to, the Application/EIS, and this consideration is reflected in Decision Statement condition 3.10 and 3.16 and provincial EAC condition #31.

When considering the range of potential climate scenarios, under a drier than average year, the FWSS is predicted to have a 25% likelihood of being needed within the first five years of Operations. For this reason, combined with the interest in minimizing impacts to Tatelkuz Lake and Chedakuz Creek, BW Gold is proposing to construct the FWSS to supplement flows starting in Year 6. Before that time, the mine will use the FWR and outlet system to maintain flows in Davidson Creek, at or above a temporary minimum flow threshold (Palmer 2022; Appendix D). Monitoring data on flows, temperature, and other biophysical elements collected during the first five years of Operations will be used to drive adaptive management and implementation of the pipeline after this period. The intake and pipeline system is predicted to be consistently needed from Year 6 of Operations through Closure, providing approximately 10% to 40% of total annual IFN flows under average conditions.
The FWSS is comprised of the following components:

- An intake facility on the western shoreline of Tatelkuz Lake, including screened pipes, a pump station, a laydown area, and any required bank protection; the intake will be a land-based, permanent, wet-well concrete structure on the shoreline of Tatelkuz Lake;
- A 14 km-long pipeline and associated pump booster station, maintenance access roads, and transmission line extending from Tatelkuz Lake to the FWR in Davidson Creek immediately downstream of the ECD;
- A temperature and flow control system that will contain multiple outlets at varying elevations to accommodate seasonal water temperature requirements for Davidson Creek. The outlets are designed to feed through the Temperature and Flow Control Chamber to assist with flow and temperature regulation.

The FWSS pipeline and access road will traverse the Davidson Creek and Creek 661 watersheds and will cross tributaries to Tatelkuz Lake that enter from the south. A total of eight watercourses will be crossed, with the pipeline buried at five of the crossings. At three crossings, the pipeline will be attached to a clear-span bridge structure. One booster pump station will be required to pump water from Tatelkuz Lake to the

FWR. The right of way (ROW) for the proposed pipeline is 10 m wide and has an area of 21.1 ha. An access road will parallel the pipeline alignment along existing logging roads, with some new construction required. The remainder of the pipeline will parallel the mine access road.

Water from the FWSS will be stored within the FWR prior to release to Davidson Creek. The FWR includes multiple outlets at varying elevations to accommodate seasonal water temperature requirements for Davidson Creek. The outlets are designed to feed through the Temperature and Flow Control Chamber to assist with flow and temperature regulation. In addition, an ultrasonic flow meter will be installed on the pipes upstream of the outlet valves to accurately measure flows.

The FWR will be in middle Davidson Creek, downstream of the ECD. This reservoir will be created by constructing an approximately 14 m-high dam and will have an estimated storage volume of 400,000 m^3. The dam for the FWR will be located at the top of Reach 6 and will back-flood Davidson Creek upstream to the ECD.

3.1.9.2 Transmission Line

An approximately 135 km, 230 kV overland transmission line will be constructed to connect the Project to the BC Hydro grid at the Glenannan substation located near the existing Endako mine, 65 km west of Vanderhoof. The transmission line has been routed to follow existing linear infrastructure (roads and transmission lines) to avoid increasing disturbance within remaining areas of intact forests as much as practicable.

Overall, the transmission line will cross 119 drainages, of which 39 are confirmed fish-bearing, seven were assigned default fish-bearing ratings, and 73 were assessed as non-fish-bearing, non-classified drainages, or not watercourses (ERM 2017).

3.1.9.3 Airstrip

An airstrip may be constructed to the north of the mine. This airstrip would be accessed via an access road branching from the new Mine Access Road. The airstrip will not be located near any aquatic habitat.

3.1.9.4 Roads

A 15.6 km long new Mine Access Road will be constructed, starting at km 124.5 of the Kluskus-Ootsa FSR and terminating at the Mine Site. The Mine Access Road will be 5 m wide during Construction and up to 10 m wide upon completion. It will cross five permanent fish-bearing streams and four non-classified drainages. Fish-bearing stream crossings will be constructed with permanent clear-span bridges.

Construction of new access roads will be required for the transmission line. An off-site road will also be needed for the FWSS to access the pumping station on Tatelkuz Lake. The FWSS pipeline routing follows existing roads where possible, but some new road construction will be required for water pipeline maintenance and monitoring.

An airstrip access road, approximately 500 m in length, will also be constructed if the airstrip is built. The access road will cross three watercourses, via two existing crossing structures and one new clear-span bridge.

3.2 Engineering Drawings and Specifications

Section 3.2 of this report contains the required information (see also Table C-1) as specified in:

"Section 3. If physical works are proposed, the project engineering specifications, scale drawings and dimensional drawings."
[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 3]

General Arrangement drawings for the mine, showing the location of the mine infrastructure and their planned development over the life of mine, are provided in Appendix A.

3.3 Project Phases and Schedule

Section 3.3 of this report contains the required information (see also Table C-1) as specified in:

"Section 4. A description of the phases and the schedule of the proposed work, undertaking or activity and, if applicable, the project of which the proposed work, undertaking or activity is a part."
[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 4]

The proposed mine plan includes two years of construction followed by a 23-year operations phase. Open pit mining is expected to run from Year 1 through Year 18. Low-grade ore will be stockpiled and processed from approximately Year 10 through Year 23 of operations.

Reclamation of areas not reclaimed by the end of the mine life will occur following mine closure except where these areas are needed to support Closure and Post-Closure activities. Table 3-1 shows the scheduled phasing of the Project.

The final Project schedule with calendar dates will be set following receipt of a *Fisheries Act* Authorization from DFO, amendment of Schedule 2 of the MDMER to include portions of Davidson Creek and Creek 661 as tailings impoundment areas, and a positive final investment decision by BW Gold's Board of Directors.

Table 3-1. Blackwater Project Phases and Schedule.

Project Phase	Duration	Project Year
Construction[1]	2 years	Year -2 and Year -1[1]
Open Pit Operations[1]	18 years	Year 1 to Year 18[1]
Low-Grade Ore Stockpile Rehandle[1]	5 years	Year 19 to Year 23[1]
Reclamation and Closure[2]	24 years	Year 24 to Year 47
Post-Closure[2]	n/a [3]	Year 47 onwards [3]

Notes:
1 - The timing of these phases is based on Pre-Feasibility Study (Artemis 2020)
2 - The timing of these phases is estimated
3 - Post-Closure monitoring and maintenance will continue until the long-term environmental objectives are achieved.

3.3.1 Construction

Construction activities associated with the mine site are listed in approximate chronological order based on the Initial Project Description (ERM 2020), the Pre-Feasibility Study (Artemis 2020), and Application/EIS (some activities will overlap):

- Clear and grub the initial pit phases, the ex-pit haul road, plant and primary crusher site and portions of the ore stockpiles and upper waste stockpile;
- Construct mine site roads and water management structures;
- Prepare stockpile pads and Main Dam C construction;
- Construct water diversion and management structures and the starter dam for tailings storage facility;
- Establish construction camp and services and the explosives magazine;
- Construct borrow pits and starter pit;
- Deliver construction rock to the process area (for use in the conveyor pads) and to the Main Dam C;
- Stockpile high-grade ore on the run-of-mine (ROM) pad and live ore stockpile for use in mill commissioning;
- Stockpile low-grade ore in the low-grade and high-grade stockpiles for storage until later in mine life;
- Deliver excess mined overburden to the upper waste stockpile; and
- Construct the water treatment plant as well as the plant, processing, and tailings infrastructure.
- A Sediment and Erosion Control Plan (SECP) will be implemented during the Construction phase of the Project as required by provincial EA condition #13.

Preparatory works within areas subject to a Schedule 2 amendment (i.e., TIAs), will be completed primarily during the Construction phase (Appendix E), and include:

- Vegetation clearing within the TSF including riparian vegetation (Year -2);
- Construction of the diversion works including the Davidson Creek Diversion System, Central Diversion System (CDS), and Mine Area Creek Diversion (Years -1 and -2);
- Construction of a Sediment Control Pond (SCP) and the associated inlet channels (Year -1);
- Main Dam C – Excavation of cut-off-trench and initial fill placement (Year -2) followed by Main Dam C Stage 1 construction to 1,273 masl (Year -1);
- TSF C Pond – Initiation of the starter pond upstream of the Diversion Berm (Year -2);
- Disposal of potentially acid generating (PAG) and metal leaching (ML) (PAG/NAG3) waste rock in designated disposal area located between the Diversion Berm and Main Dam C (Year -1);
- Tailings distribution pipeline constructed from processing facility to the west side TSF C (Year -1);
- Construction of the Interim ECD, pond and pumpback system (Year -1);
- Construction of the Water Management Pond (WMP) (Year -1); and
- Low-Grade Ore (LGO) Stockpile:
- Vegetation clearing, grubbing, and surface preparation as required (Year -2)
- Construction of water management systems, including non-contact water diversions, contact water
- collection channels, LGO Collection Pond, stockpile sub-grade preparation, and associated liner systems (Year -1)
- Stockpiling of LGO Stockpile (lower grade ore) to 1,440 masl (Year -1)
- Stockpiling of LGO Stockpile Pile A (higher grade ore) to 1,440 masl (Year -1)

Construction activities associated with the linear development components of the Project include:

- Tree-removal, clearing, grading, topsoil storage, and placement of materials for mine access roads, transmission line access roads;
- Installation of stream crossings along roads where required;
- Construction of the water intake pump house and the intake in Tatelkuz Lake;
- Tree and vegetation clearing and management along the transmission line ROW; and
- Installation of transmission line poles and cable stringing.

3.3.2 Operations

The Operations phase of the Project will focus on ore extraction and processing. Ore will be removed from the open pit, transported to the mill, and processed. Tailings will be disposed of into the TSF. Project activities during the Operations phase include:

- Progressive expansion of pit and ore stockpile areas;
- Drilling, blasting, and excavating ore and rock from the open pit and borrow pits;
- Processing the ore, which entails crushing and feeding the crushed ore into a cyanide leach gold-silver recovery mill;
- Waste rock and tailings management (waste rock and over-burden will be segregated by type and placed in designated storage areas, tailings will be placed in TSF sites C and D);
- Raising of the Main Dams C and D, as required;
- Water management including construction of an ECD that will capture seepage and surface runoff from the TSF D (this water will be pumped back to the TSF) and treatment and discharge of site water;
- Tree-removal, clearing, grading, top-soil storage, and placement of materials for the FWSS access road, pump-house, booster pump stations and pipeline;
- Construction of the FWSS pipeline and stream crossings where required;
- Operation of the FWSS to meet mill make-up water requirements and instream flow needs in Davidson Creek;
- Maintenance of the water management system;
- Progressive reclamation of the over-burden storage areas and waste-rock dumps;
- Hazardous materials management (waste, explosives, spills), camp and offices waste management; and
- Site infrastructure and roads maintenance.

The Pre-Feasibility Study (Artemis 2020) and the Initial Project Description (ERM 2020) contains further detail on the activities that will take place during the Operations phase.

Preparatory works within areas subject to a Schedule 2 amendment (i.e., TIAs), scheduled for completion during the Operations phase (Appendix E) include:

- Works related to the tailing distribution systems and pipelines to convey tailings to the TSF;
- ECD construction (Year +5);
- Staged construction of the West Dam to form the western limit of TSF C (beginning Year +6); and

- Construction of the Upper Waste Stockpile in the late stages of mine operations (beginning in approximately Year +11).

3.3.3 Closure/Decommissioning

Project Construction and Operation will be undertaken in a manner that contributes to early planning for life-of-mine progressive reclamation and mine closure and reclamation to the extent possible. A Reclamation and Closure Plan will be submitted with the joint *Mines Act* and *Environmental Management Act* permits application to the BC Ministry of Energy, Mines, and Low Carbon Innovation and the BC Ministry of Environment and Climate Change Strategy.

The primary objective of Closure and Reclamation Plan is to return the mine site to a self-sustaining landscape that satisfies end land use objectives developed in collaboration with Indigenous Nations and government regulators. Reclamation objectives will consider land and resource management objectives and strategies in the Vanderhoof Land and Resource Management Plan. Methods to achieve end land use will include soil management and use, landform design, decommissioning and site preparation, revegetation prescriptions for specified ecotype targets, and seeding and planting densities.

Mine facilities will be reclaimed according to the approved Reclamation and Closure Plan and accepted practices at the time of Closure and in a manner that maintains long-term geochemical and physical stability. All buildings not needed beyond Closure will be removed, disturbed lands will be rehabilitated, and the property will be returned to otherwise functional use according to approved reclamation plans. Site infrastructure required for water management following Closure will be maintained and operated according to the approved Closure water management plans.

The Reclamation and Closure Plan and follow-up monitoring and compliance reporting will include proposed performance standards, management, and monitoring strategies to verify reclamation success, and a timeline for reclamation and monitoring activities, along with reclamation research programs. The plan will include strategies for temporary closure and premature closure. The plan will emphasize soil, vegetation, and wildlife habitat reclamation, and provide a cross-reference to relevant management plans. A Closure and Post-Closure Water Quality Management Plan will be developed.

Conceptual end land use objectives will be included in the joint Application for *Mines Act* and *Environmental Management Act* permit application and confirmed in the final Reclamation and Closure Plan.

3.3.4 Post-Closure

The Post-Closure phase will commence once the open pit has been backfilled with water and water quality monitoring demonstrates that water can be discharged downstream into Davidson Creek. Activities in the Post-Closure phase include:

- Monitoring of reclamation activities throughout the mine area and at off-site locations;
- Treating site contact water before discharge to Davidson Creek; and
- Decommissioning of the FWSS and any other related water management infrastructure once the pit is filled and water is released downstream to Davidson Creek.

3.4 Project Location

Section 3.4 of this report contains the required information (see also Table C-1) as specified in:

"Section 5. A description of the location of the proposed work, undertaking or activity and, if applicable, of the location of the project of which the proposed work, undertaking or activity is a part, including
(a) geographic coordinates;
(b) a small-scale plan identifying the overall location and boundaries;
(c) a large-scale site plan indicating the size and spatial relationship of the planned facilities, infrastructure and other components and of any existing structures, landmarks, water sources or water bodies and other geographic features; and
(d) the name of any watersheds, water sources and water bodies that are likely to be affected and the geographic coordinates of the water sources and water bodies.
Section 6. The name of the community nearest to the location and the name of the county, district or region and the province in which the proposed work, undertaking or activity will be carried on."
[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 5]

The Blackwater Project is in the Nechako River watershed, in central BC, approximately 112 km southwest of Vanderhoof and 160 km west-southwest of Prince George. The universal transverse Mercator (UTM) coordinates for the centroid of the proposed mine site are 5893000 N and 375400 E (NAD 83 Zone 10). A large-scale plan showing the proposed mine site facilities and other components (linear corridors), as well as landmarks, waterbodies, and other geographical features in the wider area, is shown in Figure 3-1. The location of the Project within the Davidson Creek and Creek 661 watersheds in the Chedakuz Creek watershed, a tributary of the Nechako Reservoir, is shown in Figure 3-2. A small-scale site plan indicating the size and spatial relationship of the proposed mine site components within the Davidson Creek and Creek 661 watersheds is shown in Figure 3-3. Waterbodies in the vicinity of the Project, based on the waterbodies identified in the aquatics Local Study Area (LSA), specific to the mine site[2] in the Application/EIS, and their UTM coordinates are listed in Table 3-2.

The mine site is accessed by vehicle via the Kluskus FSR, the Kluskus-Ootsa FSR and an exploration access road, which connects to the Kluskus-Ootsa FSR at kilometre (km) 142.5. BW Gold is planning to build a new approximately 15.6 km access road to the mine site, which will replace the existing exploration access road. The Kluskus FSR joins Highway 16 approximately 10 km west of Vanderhoof. Driving time from Vanderhoof to the mine site is about 2.5 hours. Access via helicopter is available from nearby heli-bases.

Based on information from the Canadian Environmental Assessment Agency regarding the Environmental Impact Statement, the Project has the potential to affect Indigenous rights and Treaty rights and related interests of the following Indigenous Groups:

- Lhoosk'uz Dené Nation (Kluskus);
- Ulkatcho First Nation;
- Nazko First Nation;

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[2] *This mine site aquatics LSA included watersheds potentially affected by the mine site, excluding off-site effects associated with linear infrastructure.*

- Nadleh Whut’en First Nation;
- Saik’uz First Nation (Stellako);
- Skin Tyee Nation;
- Stellat’en First Nation;
- Tsilhqot’in National Government; and
- Métis Nation of British Columbia.
- Nee-Tahi-Buhn Band

The nearest Reserve to the Project is Indian Reserve No. 28 (Tatelkuz Lake) of the Lhoosk’uz Dené Nation.

Other communities within 100 km of the Project are:

- Endako;
- Engen;
- Fort Fraser;
- Fraser Lake; and
- Nulki.

Table 3-2. Waterbodies in the Mine Site Aquatic Local Study Area of the Blackwater Project.

Waterbody Name	Description	Location Description within the mine site aquatic Local Study Area (LSA)[1]	UTM Zone 10[2]	
			Easting	Northing
Davidson Creek	Davidson Creek flows northeast into lower Chedakuz Creek upstream of the Turtle Creek confluence.	The boundary of the LSA is defined by the western and southern boundaries of the Davidson Creek watershed	380730	5903190
Lower Chedakuz Creek	Lower Chedakuz Creek flows out of the Tatelkuz Lake at its north end, and flows to the Nechako Reservoir.	Lower Chedakuz Creek flows between Tatelkuz Lake and the confluence with Turtle Creek. The LSA boundary is defined by the eastern bank of Lower Chedakuz Creek.	385088	5907939
Middle Chedakuz Creek	Middle Chedakuz Creek flows from Kuyakuz Lake to Tatelkuz Lake.	The northern portion of middle Chedakuz Creek from the confluence with Creek 661 downstream to Tatelkuz Lake is within the LSA.	389154	5900008
Tatelkuz Lake	Largest Lake in the LSA, approximately 9 km long by 1 km wide, with a surface area of 910 ha and mean depth of 21.4 m.	The LSA boundary is defined by the southern and eastern shores of Tatelkuz Lake.	389073	5904125
Tatelkuz Lake Tributaries	The Tatelkuz Lake Tributaries drain northeast into the west side of Tatelkuz Lake.	The tributaries are located in the north-eastern end of the LSA.	-	-
Creek 661	Creek 661 drains the northeast side of Mount Davidson from the Project mine site towards middle Chedakuz Creek upstream of Tatelkuz Lake.	Creek 661 and tributaries are distributed around the centre and southern end of the LSA.	381210	5898005
Turtle Creek	Turtle Creek flows northeast into lower Chedakuz Creek.	The main tributary of Turtle Creek is Creek 700, which drains to the west from the Project site. The LSA boundary is defined by the northwestern and western boundaries of the Creek 700 watershed.	376428	5904596
Creek 705	Creek 705 drains the southwest slope of Mount Davidson into Fawnie Creek, a tributary of the Entiako River. Lake 14 and Lake 15 are headwater lakes of Creek 705.	The LSA boundary is defined by the northwestern and southern boundaries of the Creek 705 watershed.	366051	5894520
Lake 01682LNRS (Lake 16)	Headwater Lake of Davidson Creek having a circular basin of approximately 9.2 ha, and mean depth of 5.5 m.	Lake 16 is located in the western end of the LSA, near the drainage divide between the Chedakuz and Fawnie Creek watersheds.	371261	5894062

Waterbody Name	Description	Location Description within the mine site aquatic Local Study Area (LSA)[1]	UTM Zone 10[2]	
			Easting	Northing
Lake 01538UEUT (Lake 15)	Headwater Lake of Creek 705, located in the Fawnie Creek watershed (of which the Creek 705 watershed is a sub-watershed).	Lake 15 is Reach 7 of Creek 705, located in the western end of the LSA.	369888	5893794
Lake 01428UEUT (Lake 14)	Headwater Lake of Creek 705, located in the Fawnie Creek watershed (of which the Creek 705 watershed is a sub-watershed).	Lake 14 is located in the western end of the LSA.	369320	5895648
Snake Lake	Snake Lake is in the Tatelkuz Lake Tributaries watershed	Snake Lake is approximately in the centre of the LSA.	381549	5900972

Notes: 1 – More information on the aquatic local and regional study areas (LSA and RSA) defined in the Application/EIS is provided in Section 3.1. 2 – Geographic coordinates represent an approximate midpoint of the listed waterbodies.

4. Consultation

Section 4 of this report contains the required information (see also Table C-1) as specified in:

"Section 7. A description and the results of any consultations undertaken in relation to the proposed work, undertaking or activity, including with Indigenous communities or groups and the public."
[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 7]

BW Gold is committed to communicating clearly and openly about the planning of the Project, and to soliciting and incorporating feedback received through its consultation process. Since conception of the Project, BW Gold and the previous owner New Gold Inc. have regularly consulted regulatory agencies, Indigenous Nations and local communities, and the public through a combination of site field tours, community meetings, and through the framework of the EA process (Table 4-1).

4.1 Consultation Record

The Blackwater mine site is located within the traditional territories of Lhoosk'uz Dené Nation (LDN), Ulkatcho First Nation (UFN), Skin Tyee Nation (STN), Tŝilhqot'in Nation (TN), and Métis Nation British Columbia (MNBC; CEAA 2019a). Other Project components, including the existing Kluskus and Kluskus-Ootsa Forest Service Roads (FSRs) and proposed transmission line, cross the traditional territories of the above-noted Indigenous groups and the Saik'uz First Nation (SFN), Stellat'en First Nation (StFN), Nadleh Whut'en First Nation (NWFN), Nazko First Nation (NFN), and Nee-Tahi-Buhn Band (NTBB).

In addition to consultations carried out by BW Gold and New Gold Inc., federal and provincial agencies conducted consultation processes for the Project. The Canadian Environmental Assessment Agency consulted Indigenous groups during the federal EA process to fulfill Canada's duty to consult under CEAA 2012 (CEAA 2019a). The Lhoosk'uz Dené Nation, Ulkatcho First Nation, and the Saik'uz First Nation, Stellat'en First Nation, and Nadleh Whut'en First Nation (collectively the Carrier Sekani First Nations) were consulted with high depth[3]. The Nazko First Nation was consulted with normal depth[4], based on the overlap of the transmission line route with the Nazko First Nation's traditional territory. Skin Tyee Nation, Tsilhqot'in Nation, Métis Nation British Columbia, and the Nee-Tai-Buhn Band were provided with notification[5] during the federal EA process.

Throughout the provincial EA process, the BC Environmental Assessment Office (EAO) consulted the LDN, UFN, and the Carrier Sekani First Nations (CSFNs) according to the deeper end of the consultation spectrum described in 2004 by the Supreme Court of Canada in Haida Nation v. British Columbia (Minister

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[3] Deep level consultation occurs for strong aboriginal rights claims (including title), the potential for negative impacts on the claimed aboriginal right or title and the potential infringement of a proven aboriginal right, or when the title or treaty right is high, and includes the opportunity to make submissions, formal participation in the decision-making process, and the provision of written reasons that indicate how the concerns raised by Indigenous groups were considered and taken into account.

[4] Normal level consultation is required when there is a likely impact on a reasonable claim or a reasonable probability of an infringement of a proven aboriginal right or title, or treaty right.

[5] Indigenous groups with weak or limited claims or minor potential for infringement of an Aboriginal Interest may be given notice of the pending decision or activity, disclose information, and provide an opportunity to discuss any issues raised in response to the notice.

of Forests). The EAO consulted with STN, Tsilhqot'in National Government, NTBB, Cheslatta Carrier Nation (CCN) and Yekooche First Nation (YFN) at the lower end of the Haida consultation spectrum (EAO 2019). The Project is supported by the LDN and UFN, who submitted letters of support for the Project towards the completion of the EA process.

Valuable insight into fish habitat compensation opportunities has been provided by Indigenous Nations through field reconnaissance visits, community meetings and technical workshops. Several fisheries-related meetings and site visits were conducted from 2016 to 2022 to engage and consult with regulators, third party reviewers, and Indigenous Nations (Table 4-1). Feedback and input on fish habitat offsetting measures were integrated into the final selected offsets to align with provincial, federal, and Indigenous Nations fisheries management objectives.

Table 4-1. Summary of Fish Habitat Offsetting-related Meetings and Site Visits, Blackwater Project, 2016-2020.

Date(s)	Meeting/Site Visit, Location, Objectives	Attendance
05-Jan-2016	Discuss DFO comments received during Application/EIS review	New Gold, Palmer, DFO
20-May-2016	Overview of Fish Offsetting Plan, Vancouver	New Gold, Palmer, FLNRO, DFO, CEAA
07-Jul-2016	Fisheries Offsetting, New Gold Office Vanderhoof	New Gold, SFN, NWFN
17-Oct-2016	Fisheries Offsetting – Sturgeon Research, Phone	Palmer, Freshwater Fisheries Society
27-Oct-2016	Fisheries Offsetting – Sturgeon Research, Phone	Palmer, Freshwater Fisheries Society, UBC
22-Jul-2016	Present and discuss potential offsetting projects	Meeting with CSFN
04-Nov-2016	Present offsetting options and solicit feedback	Meeting with DFO
24-Nov-2016	Complementary Measures – Nechako Sturgeon Recovery Geomorphic Discussion, UBC	Palmer, MOE, UBC
30-Nov-2016	Fisheries Offsetting Tour, Vanderhoof	New Gold, Palmer, SFN, NW FN, DFO, NEWSS
1-Dec-2016	Habitat suitability curves in the IFN assessment, Prince George	Meeting with DFO (Phone), FLNRO
30-Jan-2017	Lessons learned from Mount Milligan Overwintering Ponds, Teleconference	Palmer, DFO
17-Feb-2017	Meeting with Dennis Ableson (consultant for Saik'uz, Nadleh Whut'en and Stellat'en FN) to discuss options for offsetting, Teleconference	Palmer, Terra Quatics

Date(s)	Meeting/Site Visit, Location, Objectives	Attendance
14-Mar-2017	Fisheries Offsetting Update, Vancouver	New Gold, Palmer, ERM, CEAA, DFO
25-Apr-2017	Fisheries Offsetting Update, Prince George	New Gold, Palmer, FLNRO
25-Apr-2017	Fisheries Offsetting Update, Prince George	New Gold, Palmer, CSFN
8-May-2017	Fisheries Offsetting Update, Williams Lake	New Gold, Palmer, LDN, UFN
7-Jun-2017	Fisheries Offsetting Update, Vancouver	Working Group Meeting
22-Jun-2017	Fisheries Offsetting Update	New Gold, Palmer, DFO
06-Mar-2019	Provided NWFN, SFN and StFN with supporting materials requested during their review of the draft consultation summary reports (covering reporting periods: 1) August 13, 2016 to August 31, 2017; and 2) September 1, 2017 to August 10, 2018). Materials provided included April 25, 2017 Fisheries Offsetting Meeting Minutes (June 19, 2017 email)	NWFN, SFN, StFN, and BW Gold
06-Nov-2020	Provided an update to multiple account analysis report to support MDMER Schedule 2 amendment. Provided a memorandum detailing fish habitat areas within the Project footprint which would be identified on Schedule 2 of the MDMER. Provided information related to submission logistics and timing (to be submitted to Environment and Climate Change Canada in Q1 2021), E-mail	NWFN, SFN, StFN, and BW Gold
06-Nov-2020	Provided update regarding timing of submission of various documents in support of permits, including those in support of the Schedule 2 amendment, E-mail	LDN, UFN, and BW Gold
23-Nov-2020	Provided update regarding timing of submission of various documents in support of permits, including those in support of the Schedule 2 amendment, Email	NWFN, SFN, StFN, and BW Gold
02-Dec-2020	Provided a Project update and an update on Schedule 2 amendment process and timing of submission. Provided an overview of why the Schedule 2 amendment is needed. Discussed setting a follow-up technical meeting, Teleconference	LDN, UFN, and BW Gold
18-Dec-2020	Provided overview of Schedule 2 amendment process and requirements, explained proposed compensation plan, planned timing of submission and scheduled a follow-up meeting for January 15, 2021, Teleconference	LDN, UFN and their technical advisors, and BW Gold
12-Jan 2021	Provided update regarding timing of submission of various documents in support of permits, including those in support of the Schedule 2 amendment, Email	NWFN, SFN, StFN, and BW Gold

Date(s)	Meeting/Site Visit, Location, Objectives	Attendance
15-Jan-2021	Fisheries Compensation Plan Update presented details of the fish habitat compensation plan that will be submitted in support of the Schedule 2 amendment. Teleconference	LDN, UFN and their technical advisors, BW Gold, and Palmer
19-Jan-2021	Provided notes of January 15, 2021 meeting to LDN and UFN as well as action item, Email	LDN, UFN, and BW Gold
14-May-2021	Blackwater Fisheries Offsetting Meeting, to discuss proposed fisheries offsetting measures, solicit feedback and input, answer questions, and discuss opportunities for collaboration.	LDN, UFN, technical advisors, BW Gold, and Palmer
8, 14, 21, and 26-Jul-2021	Series of meetings to discuss the Schedule 2 amendment process, including the Fish Habitat Compensation Plan and the Assessment of Alternatives.	LDN, UFN, and CSFNs and their technical advisors, ECCC, DFO, BW Gold, and Palmer
07 and 25-Oct-2021	Two meetings to discuss the Schedule 2 amendment Fish Habitat Compensation Plan and the Application for *Fisheries Act* Authorization.	LDN, UFN, and CSFNs and their technical advisors, FLNRORD, BW Gold, and Palmer
23-Nov-2021	Meeting to discuss technical aspects of the Schedule 2 amendment Fish Habitat Compensation Plan and the Application for *Fisheries Act* Authorization.	LDN, UFN, and CSFNs and their technical advisors, BW Gold, and Palmer
08-Jun-2021, 14-Jun-2021, 21-Jun-2021, 26-Jun-2021	Series of meetings for consultations on the proposed authorization for mine waste disposal under the Metal and Diamond Effluent Regulations (MDMER), including the Assessment of Alternatives and the Compensation Plan	CSFNs, UFN, LDN, and their technical advisors, ECCC, DFO, BW Gold, Palmer
07 and 25-Oct-2021, 23-Nov-2021, 06, 09, and 13-Dec-2021, 06, 10, and 26-Jan-2022, 03, 16, and 23-Feb-2022, 20 and 27-Apr-2022, 04 and 11- May-2022,	Series of regular meetings to discuss technical aspects of the Project's fisheries offsetting, including the Compensation Plan and the *Fisheries Act* Authorization Application. Numerous topics were discussed, feedback was provided, and revisions were incorporated into offsetting planning.	CSFNs, UFN, LDN, and their technical advisors, ECCC, DFO, BW Gold, Palmer, additional participation from regulators or other experts to address specific topics.
17-May-2022	Site tour of Murray Creek with LDN and UFN consultants Keefer Ecological Services	LDN, UFN's Technical Advisor, BW Gold and NEWSS

Notes: LDN- Lhoosk'uz Dené Nation, UFN – Ulkatcho First Nation, SFN – Saik'uz First Nation, StFN – Stellat'en First Nation, NWFN Nahleh Whut'en First Nation, STN – Skin Tyee Nation, NFN – Nazko First Nation, TNG – Tsilhqot'in National Government, ECCC – Environment and Climate Change Canada, DFO – Fisheries and Oceans Canada, FLNRORD – Ministry of Forests, Lands, Natural Resource Operations, and Rural Development.

5. Description of Fish and Fish Habitat

Section 5 of this report contains the required information (see also Table C-1) as specified in:

"Section 8. A detailed description of the fish and fish habitat found at the location of the proposed work, undertaking or activity and within the area likely to be affected by the proposed work, undertaking or activity, including
(a) the type of water source or water body;
(b) the characteristics of the fish habitat and how those characteristics directly or indirectly support fish in carrying out their life processes;
(c) the fish species that are present and an estimate of the abundance of those species; and
(d) a description of how the information provided under paragraphs (a) to (c) was obtained, including the sources, methods and sampling techniques used."
[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 8]

The baseline studies on fish and fish habitat in the Local and Regional Study Areas of the Project are described in baseline reports (Appendix 5.1.2.6A and 6B of the Application/EIS). A summary of the results of the baseline reports is provided in the following sections. Additionally, detailed descriptions of the aquatic habitat at proposed offset sites are provided in Section 10.3.

5.1 Mine Site Aquatic Local and Regional Study Areas

Baseline studies for the Project commenced in 2011. A mine site aquatic Local Study Area (LSA) was defined that encompassed the region near the mine site where direct effects of mine activities were anticipated. The mine site aquatic LSA contains the following streams and lakes (Figure 3-2):

- Davidson Creek;
- Creek 661;
- Turtle Creek;
- Chedakuz Creek (from its confluence with Creek 661 downstream to its confluence with Turtle Creek);
- Tatelkuz Lake and its unnamed tributaries that enter from the southwest;
- Creek 700 in the Turtle Creek watershed;
- Creek 705 in the Fawnie Creek watershed;
- Lake 01682LNRS (Lake 16) in the Davidson Creek watershed;
- Lake 01538UEUT (Lake 15) in the Creek 705 watershed;
- Lake 01428UEUT (Lake 14) in the Creek 705 watershed; and
- Snake Lake in the Tatelkuz Lake Tributaries watershed.

The aquatic Regional Study Area (RSA) for the Project encompasses the area surrounding the mine site aquatic LSA and includes the waterbodies and watercourses in which direct and indirect effects may occur. The aquatic RSA comprises the entire Chedakuz Creek drainage and part of the Fawnie Creek drainage. The aquatic RSA contains the following streams and lakes (Figure 3-2):

- Kuyakuz Lake and its tributaries;

- Middle Chedakuz Creek between Kuyakuz Lake and Tatelkuz Lake, and its tributaries;
- Lower Chedakuz Creek between the confluence of Turtle Creek and the Nechako Reservoir, and all tributaries flowing into that stretch of the creek from the north-east and north-west;
- Tributaries to Chedakuz Creek between the outlet of Tatelkuz Lake and the confluence with Turtle Creek, including Davidson and Turtle creeks and those streams that drain Lake 113 and Mills Lake; and,
- Upper Fawnie Creek watershed from Laidman Lake upstream to Top Lake, and upstream of the headwaters of Creek 705 and Matthews Creek.

5.2 Fish and Fish Habitat Assessment Methods

Fish habitat and fish communities within the mine site aquatic LSA were assessed through field studies and reviews of existing information. For the mine site aquatic RSA, fish habitat and fisheries resources were characterized using existing information only. Information reviews utilized primary and secondary information sources, and covered studies conducted between 1977 and 2010. Baseline field studies of streams and lakes in the mine site aquatic LSA followed provincial and federal standards and guidelines. Studies included sampling of aquatic biota (fish and other aquatic organisms), collection of continuous stream temperature, lake bathymetry and physical limnology data, habitat assessments, spawning surveys, and DNA microsatellite analysis to determine relatedness of same-species fish populations in adjacent watersheds. Field studies spanned multiple years (2011–2013) and seasons. Different methods, including electrofishing, gillnetting, minnow trapping, and angling, were employed to conduct stream and lake fish sampling and inventory. The methods for conducting information reviews and field assessments are further detailed in the Fish and Aquatic Resources Baseline Reports (Appendix 5.1.2.6A&B of the Application/EIS).

5.3 Baseline Information Validation

The baseline information used to characterize and describe fish and fish habitat subject to HADD is based primarily on data collected between 2011 and 2013 (AMEC 2013a). Given the potential for change between the 2011-2013 baseline study period and present (e.g., from natural events, anthropogenic activities, climate change), the information may not necessarily be representative of current conditions. The potential for change in fish and fish habitat conditions was first assessed qualitatively at a landscape-level with the aim of identifying anthropogenic activities and watershed-wide changes that had the potential to cause alterations in aquatic habitat conditions such stream flow, stream temperature, water chemistry, and physical habitat. Following this qualitative evaluation, a quantitative evaluation was undertaken of long-term datasets of water quantity, water temperature, and water quality, as well as direct comparison of aspects of fish habitat, including stream channel dimensions and habitat quantity.

The findings of the qualitative assessment are:

- Within the mine site (area as defined in Schedule A of the Project's BC Environmental Assessment Certificate, # M19-01) anthropogenic activity has been limited since baseline data collection. No physical work has been conducted in-stream or within riparian areas (i.e., within 15 m of watercourses) in the mine site since the baseline studies. BW Gold (and predecessor company New Gold) has conducted exploration activities over the last several years, and the exploration has all been completed under the supervision of an environmental monitor. There have been no reports of incidents associated with this work which could have the potential to cause impacts to fish or fish habitat. There is no evidence of any significant natural events which could cause changes to fish habitat (flood events, landslides, fires etc.) within the mine footprint since baseline data were collected.

- Downstream of the mine site, the following information is relevant to potential for changes in fish and fish habitat:
  - Riparian and upland vegetation has been cleared by private landowners adjacent to Reaches 1 and 2 of Davidson Creek (the first two km of the creek, approximately), within an area of range tenure that is outside of BW Gold's control. The removal of vegetation was evident from aerial imagery and verified during field visits in 2021. The clearing is believed to have occurred during the period of late 2020 to early 2021. Throughout the affected area, riparian vegetation has been cleared up to the top of bank, although some sections of willow (*Salix* species) remain. While this activity is outside of BW Gold's control, and downstream of the mine footprint, it represents a change that could potentially alter aquatic habitat conditions in lower Davidson Creek, including stream morphology, sediment loads, erosion, nutrient inputs, and/or stream temperature.
  - A 1,273-hectare forest fire in 2017 (BC Fire Identifier G40664) overlapped with approximately 1,900 linear metres of Reach 4 of Davidson Creek. However, the 30-metre riparian buffer along the length of Davidson Creek within the fire area was almost entirely maintained with some sections maintaining greater than 100-metres of forested riparian buffer.

To quantitively assess if the baseline information remains representative, analysis of available datasets for the Project site was conducted and is presented in Appendix F. The analysis included long-term continuous or semi-continuous datasets, as well as direct comparison of recent fish habitat measurements (2017, 2021) to baseline measurements collected by AMEC (2011- 2013; AMEC 2013). The analysis (Appendix F) indicated that conditions have not changed significantly in the decade since the baseline studies were conducted.

Overall, the weight of evidence indicates that current instream conditions are broadly similar to those during the initial baseline data collection period. The landscape-level evaluation suggests limited change in the watershed, although some downstream riparian changes were noted, and the quantitative assessment found no major trends or differences since baseline studies were conducted. Based on these findings, the fish habitat information presented in the following sections is considered adequate to support the quantification of HADD of fish habitat, described in Section 8.4.

5.4 Fish Habitat

Fish habitat that may be affected by the Blackwater Project is described in the Fish and Aquatic Resources Baseline Reports (Appendix 5.1.2.6A&B of the Application/EIS), and the Fish and Fish Habitat Effects Assessment (Section 5.3.8 and Section 5.3.9 of the Application/EIS). The following sections summarize the information from those reports that is pertinent to the potential HADD of fish habitat (i.e., fish habitat within the mine site aquatic LSA). Detailed description of the Davidson Creek and Creek 661 watersheds are provided in the subsections below since these areas encompass the majority of the potential mine impacts subject to *Fisheries Act* Authorization. Summaries of the fish habitat in other watersheds within the Mine Site LSA are also provided.

Fish and fish habitat in the RSA (e.g., Kuyakuz Lake and its tributaries, Chedakuz Creek outside the LSA boundaries, and waterbodies in the upper Fawnie Creek watershed) are described in the baseline reports and are not summarized here. This is because no significant residual effects or HADD of fish habitat are anticipated in these areas.

5.4.1 Davidson Creek Watershed

Fish habitat in Davidson Creek and its tributaries is described in Section 5.8.1 of the 2011-2012 Fish and Aquatic Resources Baseline Report (Appendix 5.1.2.6A&B of the Application/EIS).

Most of the Project infrastructure will be located in the upper Davidson Creek watershed. Lake 16 is the headwater lake of Davidson Creek (Figure 3-3). Two headwater tributaries, Creek 688328 and Creek 704454, enter Davidson Creek in the upper watershed. Mainstem Davidson Creek was divided into three sections for the purposes of the baseline studies and effects assessment.

Lower Davidson Creek (Reaches 1 to 4): This section of Davidson Creek extends approximately 6 km upstream from the confluence with Chedakuz Creek and has riffle-pool morphology. The substrate contains abundant, suitably sized gravels for Kokanee (*Oncorhynchus nerka*) and Rainbow Trout (*O. mykiss*) spawning. These reaches also have stable banks, deep pools, and good channel and hydraulic habitat complexity from large woody debris, which contribute to high-quality habitat for fry and juvenile Rainbow Trout rearing. Existing land use in these reaches includes cattle grazing and forestry, which have influenced sections of the creek. Within the LSA, lower Davidson Creek provides approximately 6% of the available Kokanee spawning habitat[6]. In the Davidson Creek watershed specifically, lower Davidson Creek (Reaches 1 to 4) is the only area that supports Kokanee spawning.

Middle Davidson Creek (Reaches 5 to 8): This section is approximately 11 km long, and is characterized by riffle and glide habitat, with fewer pools than in the Lower Davidson Creek. Cobbles and boulders are the dominant substrates, with spawning gravels present in isolated pockets. Habitat quality for Rainbow Trout spawning/egg incubation is good but only fair for summer rearing and overwintering due to the limited pool habitat. Existing land use in these reaches includes forestry. Based on field observations and sampling (see Section 5.5), no Kokanee spawning occurs in Middle Davidson Creek.

Upper Davidson Creek (Reaches 9 to 12): This section is approximately 6 km long and is dominated by glides and runs. As a result, the lower habitat complexity and paucity of pools reduces the suitability for rainbow trout spawning and juvenile rearing in Upper Davidson Creek compared to middle and lower sections of Davidson Creek. A cascade acts as an upstream barrier to fish at the bottom of Reach 11. This cascade prevents Rainbow Trout present in the middle and lower reaches of Davidson Creek and trout that migrate up from Tatelkuz Lake from accessing habitat upstream of Reach 10.

Only the resident Rainbow Trout population in Lake 16 uses habitat in Reaches 11 and 12 of Davidson Creek. Lake-resident Rainbow Trout can migrate downstream over the cascade barrier.

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[6] *Based on spawning habitat areas estimated for streams in the LSA (Appendix 5.1.2.6A of the Application/EIS)*

Streamflow in Davidson Creek has been measured by Knight Piésold at station H2 (Knight Piésold 2021b), located in upper Davidson Creek near the planned FWR (Figure 3-3). This station has recorded data from 2011-2020. Only seasonal measurements are available from May to November because hydrometric instrumentation is removed during the winter to avoid damage caused by ice. The hydrograph from Davidson Creek indicates that peak flows typically occur in May and June and are generally caused by snowmelt during spring freshet (Figure 5-1). Following peak flows in the spring, flows recede throughout summer months and into the fall. The effect of summertime rainstorms are evident through the presence of secondary streamflow peaks that occur throughout the summer. Another secondary streamflow peak is evident in the late fall, most likely driven by fall rainstorms or early season snowfall and snowmelt. Although observed data are not present during the winter, groundwater-dominated low flows sustain streamflow throughout the winter months until temperatures rise and snow begins to melt in the spring (Knight Piésold 2014, 2021b).

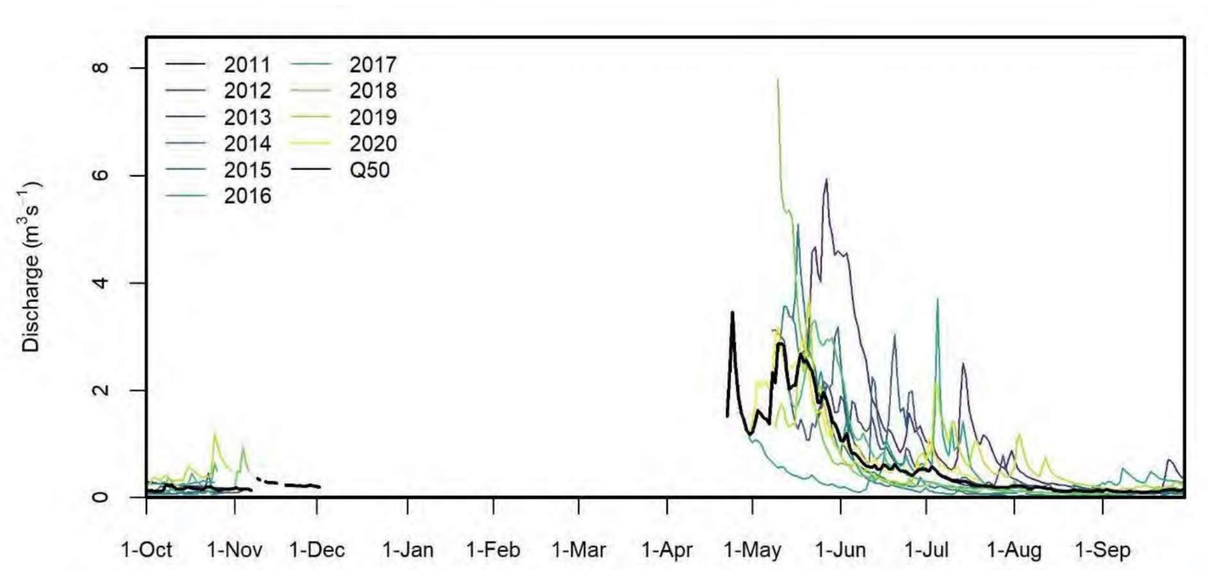

Figure 5-1. Daily Streamflow Recorded at Hydrometric Station H2 in Davidson Creek.

Lake 16 is the headwater lake of Davidson Creek, near the summit of Mount Davidson. It has a circular shoreline with a perimeter of 1,667 m, a maximum depth of 16.3 m, and a surface area of 91,860 m^2. The lake is deep enough to stratify thermally in summer. The bathymetry of Lake 16 is shallow, which creates a large littoral area relative to its total surface area (62% of total area). The lake has one inlet located on the southwest shoreline, and one outlet to Davidson Creek exiting at the northeast corner of the lake.

The lower reaches of the headwater tributaries to Davidson Creek provide limited spawning and rearing habitat for Rainbow Trout. Habitat in these reaches is typically riffle-pool morphology. Cover is abundant and consists of large woody debris, overhanging vegetation, and under-cut banks. Farther upstream, substrates are more embedded with silt and fine organics, and habitat quality for Rainbow Trout decreases accordingly. There are few pools with sufficient depth and flow to support overwintering fish. For these reasons, the upper watershed contains limited spawning and overwintering habitat for Rainbow Trout. Stream spawning habitat accessible for Rainbow Trout from Lake 16 is less than 50 m^2. A further limiting factor, consistent with other streams in the area, is the cooler than optimal temperatures for Rainbow Trout and Kokanee. These temperatures are due to the northern aspects of many of the streams in the headwaters of Davidson Creek, and the influence of groundwater, which contributes approximately 90% or more of stream flow over 9 months of the year in Davidson Creek (Knight Piésold 2014).

The headwater tributaries (Creek 704454 and Creek 688328), and another small tributary in the upper watershed (Creek 636713), provide some summer rearing habitat for fry and juvenile Rainbow Trout, mainly in the lower sections, but they provide little to no habitat for the other life stages (i.e., spawning, overwintering, adult foraging) of this species due to low water levels in summer and winter freeze-up to the substrate.

5.4.2 Creek 661 Watershed

Fish habitat in Creek 661 and its tributaries is described in Section 5.8.3 of the 2011-2012 Fish and Aquatic Resources Baseline Report (Appendix 5.1.2.6A&B of the Application/EIS).

The Creek 661 watershed lies to the east of the Davidson Creek watershed and flows into Chedakuz Creek, upstream of Tatelkuz Lake. The Creek 661 Watershed covers an area of 6,740 ha on the eastern flanks of Mount Davidson. From a shallow headwater pond (1,550 masl), as well as three headwater tributary sources (Creek 505659, Creek 146920, and Creek 543585), Creek 661 flows northeast in its upper reaches and east in its lower reaches for a total length of 24 km, not including several tributaries.

Mount Davidson is situated in the Nechako uplift and, like other watersheds on Mount Davidson, the landscape of the Creek 661 watershed was shaped by glacially eroded volcanic bedrock and characterized by moderately sloping topography. The surficial geology of the Creek 661 watershed is primarily morainal diamicton, most dominantly basal till, with a sandy to silty clay matrix and boulder-sized clasts (Diaklow and Levson 1997). In the general area, the thin deposits at topographic highs expose striated clasts in the rocky uplands, and relatively thick deposits of glaciofluvial sand and gravel are present at the edges of spillway channels and outwash plains. The main channel of Creek 661 consists of 12 reaches which exhibit different morphological features along the stream length, as described in Appendix 5.1.2.6A of the Baseline Report for the Blackwater Project. Reach 1 (2.2%; 3.5 km) flows through a small, incised valley. Reach 2 (1.7%; 800 m) flows through wetland complexes. Reach 3 (1.8%; 3.2 km) demonstrates a wandering stream pattern. Reach 4 (0.4%; 1.4 km) flows as a sinuous meandering channel with ponds in the mid-section attributed to beaver activity. Reaches 5 to 8 (2.6-5.9%; 8.2 km) flow straight, confined by a prominent valley, with some step-pool morphology in steeper sections of Reach 7. Reach 9 is a small headwater lake and, upstream, Reach 10-11 (<1%; 1.3 km) have poorly defined channels as they flow through wetland complexes. Reach 12 (9%; 800 m) flows at a steep gradient with no visible channel.

The lower section of Creek 661 (Reaches 1 to 3) is approximately 7.5 km long and has high quality (i.e., suitably sized and unembedded) spawning gravels providing approximately 11% of the available Kokanee spawning habitat in the LSA[7]. This section is also used by Rainbow Trout for spawning. Above Reach 3, habitat is used only by Rainbow Trout, primarily for rearing. Spawning habitat is limited upstream in Reach 4, as the substrate upstream is generally too large for trout spawning.

[7] *Based on spawning habitat areas estimated for streams in the LSA (Appendix 5.1.2.6A of the Application/EIS)*

Creek 661 is fed by three headwater tributaries: Creek 505659, Creek 146920, and Creek 543585. Habitat in the lower reaches of Creek 505659 is suitable for all life stages of Rainbow Trout. Riffle habitat is predominant, with abundant stream cover as well as suitable spawning gravels. Habitat in Creek 146920 and Creek 543585 is only suitable for summer rearing due to low water levels in summer and winter freeze-up to the substrate.

Several tributaries extend from the mainstem of Creek 661 including: Creek 505659, a tributary with two branches that originate in headwater wetlands west of Creek 661 near the proposed mine site and converge prior to entering Reach 5 of Creek 661; and two smaller tributaries (Creek 543585 and Creek 885275) that flow from the west into Reach 5 of Creek 661. The main branch of Creek 505659 has 7 reaches that flow through a small, incised valley for 2.5 km and a mean gradient of 2.6%, and the other branch (Creek 146920) is morphologically similar.

Mean bankfull widths and depths across the 12 reaches of Creek 661 range from 0 m to 3.96 m and 0.14 m to 0.51 m, respectively. Glides, riffles, and pools are abundant, but proportion of each habitat type vary by reach. Bed material is composed predominantly of gravel and cobble substrate with infrequent deposits of fine sediment in low gradient sections. Coniferous forest and shrub vegetation dominate the canopy which is typically in excess of 20%, providing adequate riparian cover along the stream's length. Cover is also provided by small woody debris, large woody debris, deep pools, and/or off-channel ponds, particularly in the lower reaches.

Creek 661 and its tributaries provide a diversity of fish habitat supportive of all Rainbow Trout life stages. Baseline habitat assessments of Creek 661 indicate that overwintering habitat is rated as 27% good, 27% fair, 27% poor, and 18% none; rearing habitat as 81% good, 9% fair, and 9% none; spawning habitat 28% good, 36% fair, 18% poor, and 18% none; and migrating habitat as 64% good, 19% fair, 9% poor, and 9% none. There are no barriers to upstream fish passage in Creek 661 until the end of Reach 11. No visible channel exists in Reach 12.

Adjacent to Creek 661, Creek 505659, its first-order tributary (Creek 146920), and Creek 543585 exhibit similar habitat features and quality. Dominated by riffles with abundant stream cover and suitable spawning substrates, Reaches 1 to 3 of Creek 505659 are rated fair to good for overwintering, rearing, spawning, and migrating. However, Reach 2 is poorly suited to fish migration due to a bankfull depth of only 10 cm and all habitat quality attributes decrease upstream in Reach 3 to poor. Creek 543585 contains habitat that is good for migration and rearing but poor for overwintering and spawning due to substrate dominated by fines, while Creek 885275 is generally not supportive of salmonids because habitat quality is rated as completely absent for all four salmonid life stages.

Water quality sampling was conducted at three long-term monitoring sites (WQ3-WQ5) within the Creek 661 watershed and the results are presented in the Project Surface Water and Sediment Quality 2011-2013 Baseline Report (AMEC 2013c). On average, site water was soft (17.2-33.6 mg/L as $CaCO_3$), near neutral to slightly alkaline (pH 7.09-7.57), and moderately sensitive to well buffered against acid inputs (13.8-38.6 mg/L $CaCO_3$) as characterized by the (working) BC WQGs (AMEC 2013c) at the time of the report. Background total Aluminum (total and dissolved), Cadmium, Silver, and Zinc concentrations exceeded BC and/or CCME water quality guidelines for the protection of aquatic life (AMEC 2013c) at one or multiple sites based on the mean concentrations. Chromium (total and VI) and Iron also occasionally exceeded their respective guidelines based on 95^{th} percentile values. A single whole-body exceedance of the BC tissue residue guideline for methylmercury (MeHG) concentration (AMEC 2013b) was observed in a fish captured in August 2012.

Dissolved oxygen measured in September 2011/2012 was greater than 10 mg/L in both lower and upper Creek 661, and winter dissolved oxygen readings (March 2012) were 9.9 mg/L in Reach 4 of Creek 661 and 10.8 mg/L in Reach 2 of Creek 505659. Temperatures ranged from 0 in winter months to <15 in summer months, with a several-degree increase sometimes occurring in upper reaches relative to lower reaches in warmer months.

Monthly streamflow in Creek 661 has been modelled from 1980 to 2020 at site 661-1, near its confluence with Chedakuz Creek (Knight Piésold 2021a). According to these modelled flows, peak flows occur in May, likely caused by snow-melt driven runoff as part of the spring freshet (Figure 5-2). Streamflow recedes during the rest of the summer, with occasional secondary peaks caused by summertime rainstorms. During the fall and winter months, low flows persist until the spring when temperatures begin to rise and snow starts to melt.

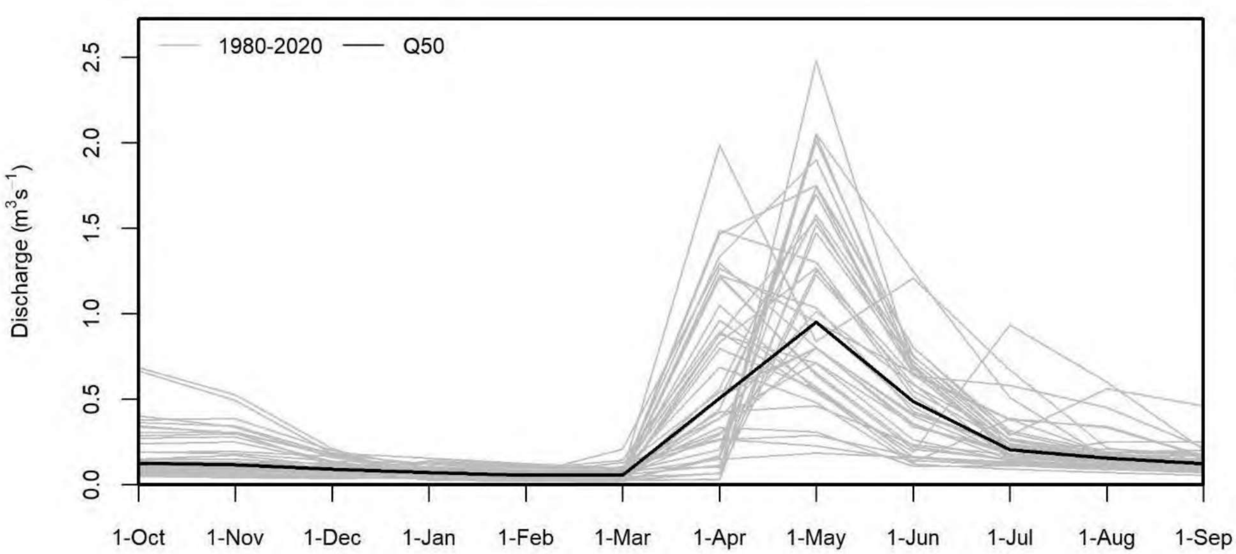

Figure 5-2. Median Monthly Streamflow Modelled at Hydrometric Station 661-1 in Creek 661.

Notes: Q-50 is the long-term median streamflow

Adult Rainbow Trout and Kokanee are suspected to overwinter in Tatelkuz Lake and then emigrate to various reaches of Creek 661 to spawn. While juvenile Rainbow Trout are distributed throughout the majority of reaches and rear in Creek 661 for at least a year, the presence of Kokanee is seasonal since adults die shortly after spawning in the fall and emerging Kokanee fry migrate downstream immediately after ice break-up. Fish sampling conducted in 2011/2012 found the stream-wide mean CPUE for electrofishing (8,138 seconds effort) was 1.1 fish/100 seconds, and minnow trapping CPUE was comparatively low, ranging from 0.01-0.07 fish/trap-hour (458 hours effort). Although Rainbow Trout used most reaches of Creek 661, abundances decreased with upstream distance. Kokanee, by contrast, are understood to only use Reaches 1 to 3 for spawning and egg incubation. For instance, a total of 6,006 Kokanee and 734 Kokanee redds were observed in Reaches 1 to 3 during ground surveys conducted in

2011 and there was no evidence Kokanee presence observed upstream of Reach 4. The same result occurred in 2021, with no Kokanee observed upstream of Reach 4.

5.4.3 Turtle Creek Watershed

Fish habitat in Turtle Creek and its tributaries is described in Section 5.8.2 of the 2011-2012 Fish and Aquatic Resources Baseline Report (Appendix 5.1.2.6A&B of the Application/EIS, AMEC 2013a). The Turtle Creek watershed lies west of the Davidson Creek watershed. The creek has one named headwater tributary, Creek 700. The lower to middle reaches of Turtle Creek are dominated by low-gradient pools and glides and contain numerous beaver dams. As a result of beaver activity, multiple wetlands have formed, particularly in the lower half of the watershed. The substrate is dominated by fines, and spawning gravels for Rainbow Trout are present only in isolated pockets in the middle and lower reaches. These spawning gravels are generally of poor quality due to the dominance of fines. The beaver dam ponds and other impounded areas provide ideal juvenile rearing habitat, due to the abundant cover created by overhanging vegetation, deep pools, and woody debris.

5.4.4 Tatelkuz Lake and Tributaries

Tatelkuz Lake is a long, narrow and relatively large (910 ha surface area) dimictic lake with a maximum depth of 33.7 m. It has a relatively small littoral zone (11% of lake area) and is relatively steep along its shorelines. The shoreline is dominated by fines and gravels. The mean annual lake level is approximately 927.60 masl. Annual variation in lake level is 0.80 m with levels highest in May and lowest in January/February, although total lake elevation changes over the previous 40 years were 2.0 m. Monthly lake elevation changes range from 0.2 m in February to 1.5 m in May.

Fish habitat in Tatelkuz Lake tributaries is described in Section 5.8.5 of the 2011-2012 Fish and Aquatic Resources Baseline Report (Appendix 5.1.2.6A&B of the Application/EIS, AMEC 2013a). The Tatelkuz Lake Tributaries watershed lies between Davidson Creek and Creek 661 watersheds. Streams in the Tatelkuz Lake Tributary watershed are typically narrow, shallow, and low gradient and support only limited rearing habitat. Spawning habitat is absent in most of these streams and there is little to no overwintering habitat.

5.4.5 Chedakuz Creek

Fish habitat in Chedakuz Creek and its tributaries is described in Section 5.8.6 of the 2011-2012 Fish and Aquatic Resources Baseline Report (Appendix 5.1.2.6A&B of the Application/EIS, AMEC 2013a). Middle Chedakuz Creek (from the confluence of Creek 661 to Tatelkuz Lake) and lower Chedakuz Creek (from the outlet of Tatelkuz Lake to the confluence with Turtle Creek) are within the LSA of the Project. Lower Chedakuz Creek has diverse habitat, with regularly alternating patterns of glides, riffles, and pools. Abundant gravels provide good quality spawning habitat for Rainbow Trout and Kokanee. Lower Chedakuz Creek provides approximately 65% of the available Kokanee spawning habitat in the LSA[8]. The habitat is also suitable for juvenile Rainbow Trout rearing with deep pools and instream vegetation providing cover. Chedakuz Creek provides approximately 30% of Rainbow Trout spawning habitat and 25% of rearing

[8] *Based on spawning habitat areas estimated for streams in the LSA (Appendix 5.1.2.6A of the Application/EIS)*

habitat in the LSA. Abundant off-channel habitat also exists in the form of side-channels, sloughs, and wetlands.

5.4.6 Creek 705 Watershed

Fish habitat in Creek 705 and its headwater lakes is described in Sections 5.8.4, 5.9.2, and Section 5.9.3 of the 2011-2012 Fish and Aquatic Resources Baseline Report (Appendix 5.1.2.6A&B of the Application/EIS, AMEC 2013a). The Creek 705 watershed flows southwest into Fawnie Creek. Besides the two headwater lakes (Lake 14 and Lake 15), Creek 705 is fed by several small unnamed tributaries downstream of the confluence of the two lake outlets. The lower to middle reaches of Creek 705 contain good quality habitat for Rainbow Trout spawning, rearing, and overwintering. Spawning habitat quality in the upper watershed, ranges from good to poor depending on the availability of suitably sized gravel substrates. However, there are areas of habitat with suitable spawning gravels at the outlets of both headwater lakes, which may be used by lake-resident adults.

5.5 Fish Community

The fish community in the Blackwater Project mine site LSA is detailed in the following sections of the Application/EIS:

- Section 5.10 of the Fisheries Baseline Report for 2011-2012 (Fish Communities);
- Section 5.1.2.6.3.2 of the Aquatic Baseline Report (Fish); and
- Section 5.3.8.2 of the Fish Effects Assessment (Valued Component Baseline).

A summary of the fish communities is provided below.

Twelve fish species were captured or observed in streams and lakes of the mine site LSA during baseline studies conducted in 2011, 2012, and 2013 (Table 5-1 and Table 5-2). Rainbow Trout are the most ubiquitous species in the LSA and were present in every watercourse and waterbody sampled except Snake Lake. Longnose Sucker were the second most common species, followed by Mountain Whitefish, and then Kokanee. The remaining nine species were each present in only one to three waterbodies.

More information on fish species richness in the Project area can be found in Section 5.1.2.6.3.2.2 of the Application/EIS.

Table 5-1. Fish Species Present in the Mine Site LSA.

Common Name	Scientific Name	BC Fish Species Code
Rainbow Trout	*Oncorhynchus mykiss*	RB
Longnose Sucker	*Catostomus catostomus*	LSU
Mountain Whitefish	*Prosopium williamsoni*	MW
Kokanee	*Oncorhynchus nerka*	KO
Largescale Sucker	*Catostomus macrocheilus*	CSU
Northern Pikeminnow	*Ptychocheilus oregonensis*	NSC
Burbot	*Lota lota*	BB
Slimy Sculpin	*Cottus cognatus*	CCG
Lake Chub	*Couesius plumbeus*	LKC
Brassy Minnow	*Hybognathus hankinsoni*	BMC
White Sucker	*Catostomus commersonii*	WSU
Longnose Dace	*Rhinichthys cataractae*	LNC

Source: Application/EIS – Assessment of Potential Environmental Effects, Section 5.3.8, Table 5.3.8-4 (New Gold 2014)

Of the 12 fish species identified in the LSA, none are identified as at-risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC; COSEWIC 2020).

Brassy Minnow, however, is blue-listed according to the BC Conservation Data Centre (BC CDC 2020). Blue-listed taxa are classified as sensitive or vulnerable and are considered at-risk, but are not extirpated, endangered or threatened. Brassy Minnow is a blue-listed species because its distribution in BC is disjunct, with isolated populations in the lower Fraser Valley and in the Nechako Lowlands near Vanderhoof and Prince George: this is believed to make them vulnerable to human activities or natural events.

Table 5-2. Fish Species Detected in the Streams and Lakes of the Mine Site LSA.

Stream/Lake	RB	LSU	MW	KO	CSU	NSC	BB	CCG	LKC	BMC	WSU	LNC	Total Species
Davidson Creek	X	-	X	X	-	-	-	-	-	-	-	-	3
Turtle Creek	X	-	-	-	-	-	-	-	-	-	-	-	1
Creek 661	X	-	-	X	-	-	-	-	-	-	-	-	2
Creek 705	X	X	X	-	-	-	X	-	-	-	-	-	4
Chedakuz Creek	X	X	-	X	-	-	-	X	-	-	-	X	5
Lake 01682LNRS	X	-	-	-	-	-	-	-	-	-	-	-	1
Lake 01538UEUT	X	X	-	-	-	-	-	-	-	-	-	-	2
Lake 01428UEUT	X	X	-	-	-	-	-	-	-	-	-	-	2
Snake Lake	-	-	-	-	-	-	-	-	X	-	-	-	1
Tatelkuz Lake	X	X	X	X	X	X	X	X	-	X	X	-	10
Subtotal	9	5	3	4	1	1	2	2	1	1	1	1	-

Notes: An "X" indicates fish species detected. A dash "-" indicates a fish species not detected.

Source: Application/EIS – Assessment of Potential Environmental Effects, Section 5.3.8, Table 5.3.8-5 (New Gold 2014)

5.5.1 Rainbow Trout

Section 5.10.1.2 of the Fish and Aquatic Resources 2011-2012 Baseline Report (Appendix 5.1.2.6A&B of the Application/EIS, AMEC 2013a) provides a detailed description of the Rainbow Trout populations in the Blackwater LSA, including relative abundance and life history, population structure and number of populations, and population-specific information by watershed. Rainbow Trout is the predominant species in streams of the Blackwater LSA and was also the most common species captured or observed during surveys of stream crossings along the Project's linear corridors.

There are an estimated seven populations of Rainbow Trout in the LSA: two in Davidson Creek, three in Creek 705, one in Creek 661, and one in Turtle Creek. Genetic testing indicates the intra-population differences are approximately 10 times greater than the inter-population differences which is consistent with Rainbow Trout populations across BC and Alberta (Taylor 2012).

In Davidson Creek, Rainbow Trout come from two semi-separate populations, both of which utilize stream reaches affected by the mine site footprint:

- A migratory population that resides in Tatelkuz Lake/Chedakuz Creek but spawns and rears in Davidson Creek downstream of a cascade barrier in Reach 11; and
- A resident population in Lake 16 that spawns in Reach 11 or 12 of Davidson Creek, upstream of barrier.

In spring, many adult Rainbow Trout from Tatelkuz Lake and Chedakuz Creek migrate up Davidson Creek to spawn. The spawning period is typically during May and June, after which most adults return to Tatelkuz Lake and Chedakuz Creek where they remain until the following spring due to greater resources and higher water temperatures, when the cycle is repeated. Rainbow Trout can spawn multiple times in a lifetime. Davidson Creek contributes an estimated 20% of the annual recruitment of Rainbow Trout in Tatelkuz Lake with the remaining 80% coming equally from Turtle Creek and Creek 661 (Section 5.1.2, Aquatic Baseline of the Application/EIS, AMEC 2013a).

Fry emerge from the spawning gravels after several weeks of incubation (the timing of emergence is water temperature dependent). Rainbow Trout fry (age 0^+) and juveniles rear in middle and lower Davidson Creek and their tributaries for one or two summers before migrating downstream to Tatelkuz Lake. They spend the next few years (typically 3 to 5 years) foraging and rearing in the lake until they reach sexual maturity and can make the annual spring migration to spawning habitat. No adult Rainbow Trout or Rainbow Trout older than 3 years of age were captured in Davidson Creek(Appendix 5.1.2.6A of the Application/EIS). Densities of juveniles (3.7 fish per 100 m^2 in Davidson Creek) were below BC provincial bio-standards (9.7 fish per 100 m^2) in the majority of streams in the LSA.

The resident Rainbow Trout population in Lake 16 is isolated from the downstream migratory population, owing to an upstream barrier cascade at the bottom of Reach 11 of Davidson Creek. The barrier impedes upstream passage of fish from the migratory population (Tatelkuz Lake); however, fish from the resident population (Lake 16) can move downstream over the cascade and mix with the migratory population. Stream spawning habitat for the headwater lake population is limited to small patches (less than 50 m^2) of gravel in Reach 11 of Davidson Creek, or upstream of the Lake in small tributaries.

Adult Rainbow Trout also move into Creek 661 and Turtle Creek in the spring for spawning, and the fry and juveniles of these migratory populations use the pools and glides of Creek 661 and the numerous beaver ponds in Turtle Creek to rear and forage. Migratory Rainbow Trout from Fawnie Creek as well as resident Rainbow Trout populations in Lake 15 and Lake 14 use spawning habitat in Creek 705. Therefore, fry and juveniles that use Creek 705 in summer for rearing are a mixture of these three populations.

5.5.2 Kokanee

Kokanee are seasonally the most abundant fish species in lower Davidson Creek, lower Creek 661, and in Chedakuz Creek in summer (July/August), when they move from Tatelkuz Lake and Kuyakuz Lake and enter creeks to spawn. The stream reaches that support Kokanee spawning are located downstream of the Project and will not be directly affected by the project footprint.

Kokanee live in lakes and migrate out of these residence lakes to spawn in tributary streams. Spawning takes place in late summer and fall. Within the LSA and RSA, Kokanee reside in Tatelkuz Lake and Kuyakuz Lake, respectively, and spawn in lower Davidson Creek, lower Creek 661, and Chedakuz Creek. In Davidson Creek, Kokanee spawning is limited to the lower four reaches, which extends approximately 6 km upstream from the mouth of Davidson Creek. In Creek 661, Kokanee spawn as far upstream as Reach 3 (approximately 7.5 km upstream from Tatelkuz Lake). In middle Chedakuz Creek, Kokanee spawn in the mainstem between Kuyakuz Lake and the Creek 661 confluence. In lower Chedakuz Creek, they use mainstem habitat downstream of Tatelkuz Lake to at least the Turtle Creek confluence.

Adult Kokanee die within several weeks of spawning, and the eggs incubate in the gravel over winter. Kokanee fry emerge from the gravels of Davidson Creek, Creek 661, and Chedakuz Creek after ice break-up, and immediately migrate to their residence lake. Once the fry have out-migrated and the adult spawners have died, Kokanee are not present in any creek until the following summer and fall.

Section 5.10.1.1 of the Fish and Aquatic Resources 2011-2012 Baseline Report (Appendix 5.1.2.6A&B of the Application/EIS, AMEC 2013a) provides a detailed description of the relative abundance, life history, and population structure of Kokanee in the Blackwater LSA.

5.5.3 Mountain Whitefish

Mountain Whitefish were found in Tatelkuz Lake during baseline surveys, comprising approximately 3% (26,000 individuals) of all fish in the lake. Mountain Whitefish in the LSA generally spawn in tributary streams in late fall. Based on known habitat requirements, spawning of Mountain Whitefish could occur in the littoral zone of Tatelkuz Lake or in Chedakuz Creek. The absence of evidence for lake spawning and the steep gravel/cobble littoral zone of Tatelkuz Lake suggests the use of Chedakuz Creek for spawning. However, fall and spring spawning surveys within the LSA indicated low usage of Chedakuz Creek tributaries (including Davidson Creek) for Mountain Whitefish spawning. For example, fall spawning surveys in Davidson Creek resulted in no catches of adult Mountain Whitefish in channel-spanning hoop-nets. Sampling effort in streams using other sampling methods (e.g., backpack electrofishing and netting) resulted in very low catches of Mountain Whitefish compared to other species, with immature[9] fish

[9] *McPhail (2007) cites literature that suggests Mountain Whitefish with a fork length of less the 150 mm are juvenile and greater than 200 mm are mature.*

dominating catches. Low utilization of Davidson Creek by Mountain Whitefish is likely due to the low suitability of available habitat for Mountain Whitefish spawning in the fall due to its shallow (typically 0.3 m wetted depth and 0.6 m residual pool) and slow flowing nature. Therefore, it is likely that most Mountain Whitefish residing in Tatelkuz Lake spawn in the main channel of Chedakuz Creek because it is the main inlet and outlet of the lake and is the largest stream in the immediate vicinity of the lake. Habitat in lower Chedakuz Creek immediately downstream of Tatelkuz Lake is deeper and faster that other streams in the LSA (e.g., 1 m residual pool depth). Middle Chedakuz Creek is the most likely spawning location for fish from Tatelkuz Lake because newly emerged fry would be washed downstream into Tatelkuz Lake thereby replacing mortalities and maintaining the population. Mountain Whitefish were observed in low numbers in lower Creek 705 (Appendix 5.1.2.6A of the Application/EIS).

5.5.4 Other Fish Species

Northern Pikeminnow was the fifth most common species captured or observed in Tatelkuz Lake in July 2013, comprising 1.5% (or 11,600 fish) of the total number of fish estimated to be in Tatelkuz Lake (Section 5.1.2.6.3.2.4.4 of the Application/EIS). Captured individuals ranged from 62 to 495 mm and 8 to 14 years old for individuals that were aged. This species is likely the dominant predator of the Tatelkuz Lake fish community.

Northern Pikeminnow were not captured during the stream surveys conducted in 2011 and 2012. No Northern Pikeminnow were captured during the spring hoop net survey conducted in Davidson Creek, Creek 661 and Turtle Creek in 2011. Northern Pikeminnow of Tatelkuz Lake likely spawn in Chedakuz Creek upstream of Tatelkuz Lake, or in Tatelkuz Lake itself, because no Northern Pikeminnow were captured during a spring hoop net survey conducted in Davidson Creek, Creek 661 and Turtle Creek in 2011.

Three Sucker species have been captured in the LSA: White, Largescale, and Longnose Sucker. Juveniles and adults of all three species, up to 470 mm in length, have been captured in Tatelkuz Lake. Longnose Sucker was the most abundant Sucker species (approximately 14,000 fish) in Tatelkuz Lake during baseline surveys. No Largescale or White Suckers have been captured in streams around the mine site (Davidson Creek or tributaries); however, Longnose Sucker were captured in the two headwater lakes of Creek 705 (Lakes 14 and 15) suggesting possible stream utilisation in Creek 705. Spawning Suckers from Tatelkuz Lake likely use middle and lower Chedakuz Creek given the presence of suitable habitat and absence of adults in other streams during spring spawner surveys and summer juvenile surveys.

Burbot were caught in low numbers in Creek 705 in 2011 and in Tatelkuz Lake in 2013, comprising less than 0.1% of the species captured in multiple years of baseline surveys. Four individuals were captured in lower Creek 705 during spring Rainbow Trout spawning, suggesting a feeding movement from a nearby lake, possibly Laidman Lake. One 5-year-old individual (323 mm and 195g) was caught in Tatelkuz Lake during sampling in July 2013. Based on size and age at maturity from other studies it is not clear if this was a juvenile or mature specimen. No Burbot have been captured in Davidson Creek, Turtle Creek, or Creek 661.

Several other species were also observed in the Project area. Slimy Sculpin and Longnose Dace were captured in Chedakuz Creek. Snake Lake, a headwater lake in the Tatelkuz Lake tributaries, contained only Lake Chub. Brassy Minnow, a provincially blue-listed species, are present in Tatelkuz Lake, along with Largescale Sucker, Northern Pikeminnow, and Longnose Dace; none of these species were detected in the remaining lakes and streams in the LSA and RSA.

5.6 Limitations to Fisheries Productivity

5.6.1 Kokanee

Kokanee only use the streams in the Project area for spawning. When the fry emerge, they quickly migrate to their resident lakes. Kokanee spawning habitat is present in lower Davidson Creek, lower Creek 661, and in Chedakuz Creek above and below Tatelkuz Lake. Therefore, the limiting factor for Kokanee productivity in the RSA is likely the carrying capacity of their residence lakes (i.e., Tatelkuz and Kuyakuz lakes). This would be dictated by the availability of suitable thermal habitat for rearing, foraging, and overwintering, and prey densities dictated by nutrient cycling and subsequent seasonal production of phytoplankton and zooplankton populations.

5.6.2 Rainbow Trout

Unlike Kokanee, Rainbow Trout fry and juveniles spend at least one year rearing in Davidson Creek or Creek 661 before moving downstream to mature in Chedakuz Creek or Tatelkuz and Kuyakuz lakes. The productivity of Rainbow Trout populations can be limited by the survival of the youngest life stages (Korman et al. 2012). Hence Rainbow Trout productivity in the Project area is most likely limited by habitat availability in their natal streams.

The productivity of Rainbow Trout in the Project area appears to depend on the survivorship and growth of fry and juveniles rearing and overwintering in Davidson Creek and Creek 661, as an estimated 100% of the annual recruitment of Rainbow Trout in Tatelkuz Lake comes from Davidson Creek, Turtle Creek, and Creek 661 (Appendix 5.1.2.6A of the Application/EIS, AMEC 2013a). The availability and suitability of overwintering habitat is likely a physical feature limiting Rainbow Trout productivity in Davidson Creek and Creek 661. These findings are consistent with research in other BC watersheds where the factor limiting salmonid densities is most often attributed to the availability of adequate overwintering habitat rather than to the amount of summer rearing habitat (Bustard and Narver 1975).

6. Description of Potential Effects on Fish and Fish Habitat

Section 6 of this report contains the required information (see also Table C-1) as specified in:

"Section 9(1). A detailed description of the likely effects of the proposed work, undertaking or activity on fish and fish habitat. The description must include:
(a) the fish species that are likely to be affected and the life stages of the individuals of those species;
(b) the extent and type of fish habitat that is likely to be affected;
(c) the probability, magnitude, geographic extent and duration of the likely effects on fish and fish habitat; and
(d) a description of how the information provided under paragraphs (a) to (c) was derived, including the methodologies used."
[Schedule 1, Subsection 9(1)]

"9(2) A detailed description of
(a) how the effects referred to in subsection (1) are likely to result in the death of fish or the harmful alteration, disruption or destruction of fish habitat; and
(b) the extent of the elements referred to in paragraph (a)."
[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, Subsection 9(2)]

Fish and Fish Habitat was selected as a VC for consideration in the effects assessment (Section 5.3.1 of the Application/EIS). The potential effects of the Project on fish and fish habitat are described in detail in the Application/EIS (Section 5.3.8).

The Effects Assessments for Fish and Fish Habitat were used as a basis to identify those effects that could constitute HADD of fish habitat or cause death of fish by means other than fishing, as well as to identify further avoidance and mitigation measures, where appropriate. Rainbow Trout and Kokanee were selected as the key indicator species to evaluate potential effects to fish and fish habitat. Potential effects on fish and fish habitat from Construction, Operations, and Closure of the mine site were identified based on guidance from the DFO Pathways of Effects (DFO, 2014).

6.1 Project Modifications during EA

Changes to the design of the Project were proposed by the previous owners (New Gold) after initiation of the formal review of the Application/EIS in January 2016, and in response to comments from the EA Working Group (WG). The key changes were:

- Elimination of the East waste rock dump (East Dump) and addition of the materials to the West waste rock dump (West Dump); and
- Additional water treatment during the Project's Operations phase including:
  - Construction and operation of a water treatment plant to recycle site contact water from the TSF for mill use; and
  - Construction and operation of a water treatment plant to treat and discharge surplus site contact water into Davidson Creek.

The implications of the design changes on the Fish and Fish Habitat effects assessment provided in the Application/EIS were evaluated (ERM 2016). Where a linkage between the Project changes and the Fish and Fish Habitat VC was identified, an assessment of whether the Project changes resulted in material changes to the effects assessments in the Application/EIS was completed. The updated effects assessment (ERM 2016) concluded:

- Overall, the change in potential effects to fish and fish habitat due to removal of the East Dump are expected to result in a neutral or positive change compared to the assessment provided in the Application/EIS. As such, there are no changes to the conclusions of the Fish and Fish Habitat Effects Assessment due to removal of the East Dump because no additional fish habitat is affected; and
- The implications of changes in Water Treatment and Water Management Optimization were assessed in terms of potential effects on fish and fish habitat due to changes in surface water flow, and water temperature and concluded that flow- and temperature-related potential effects to fish and fish habitat due to Project design changes are neutral or positive compared to the assessment provided in the Application/EIS.

6.2 Summary of Fish and Fish Habitat Potential Effects

The Application/EIS assessed direct and indirect effects of the Project on fish and fish habitat, including:

- Direct loss of fish and fish habitat under the mine site footprint;
- Indirect reduction in growth, survival and recruitment of fish due to isolation of fish populations upstream of the mine site footprint;
- Indirect reduction in growth, survival and recruitment of fish and indirect reduction in habitat quality and quantity downstream of the mine site due to flow changes;
- Indirect reduction in growth, survival and recruitment of fish due to changes in downstream water quality, temperature, and suspended solid concentrations due to working in or around water;
- Direct mortality of fish due to instream work during Construction, spills during Operations, or blasting in the mine site; and
- Loss of riparian vegetation associated with the construction of mine components or linear stream crossings.

The Application/EIS considered all components of the Project including:

- Mine site;
- FWSS;
- Mine access road;
- Airstrip; and
- Transmission line and associated access roads.

The Compensation Plan required for Schedule 2 amendment identified and provides compensation for the loss of fish habitat directly affected by the deposit of mine tailings within the tailings storage facilities, seepage from the TSF behind the ECD, the low-grade ore stockpile (consisting of co-located low- and high-grade ore stockpiles), and storage of waste rock in the upper waste rock stockpiles. This loss of instream habitat is therefore not addressed in this Offsetting Plan and will not be carried forward in this document.

This Section 35(2)(b) Fisheries Act Authorization Application addresses multiple direct and indirect potential effects on fish and fish habitat. These potential effects include instream habitat losses not subject to Schedule 2 amendment, upstream habitat isolation, downstream changes in flow, water quality alteration, or direct mortality. A summary of anticipated potential effects of the Project is presented in the following sections.

6.2.1 Instream Habitat Loss

The mine site components potentially affecting instream habitat were divided in the Environmental Assessment into seven categories:

- Site infrastructure and site roads: warehouses and materials storage buildings, administrative buildings, construction lay-down area, truck stop, explosives facilities, Construction and Operations camps and maintenance buildings, camp waste management system, and haul roads;
- Open pit;
- Ore-processing area: plant site, mill and processing area, core logging area, crusher and conveyor and low-grade ore stockpile;
- TSF (C and D);
- Waste rock dump;
- Water Management System, including seepage collection ponds and ditches, diversion ditches, TSF dams and spillways, FWR and an ECD; and
- Borrow areas: including the sand and gravel screening plant.

All of these mine site components are located in the Davidson Creek and Creek 661 Watersheds. The LSA includes all streams and lakes that could be directly or indirectly affected by construction, operation, and closure of the mine site, the FWSS and the airstrip. The watersheds affected include Davidson Creek, Creek 661, Turtle Creek, Tatelkuz Lake, and Chedakuz Creek.

6.2.1.1 Davidson Creek and its Headwater Streams and Lake 01682LNRS

The majority of the mine site components, including the open pit, TSFs C and D, Waste Rock Dump, low-grade stockpile, the FWR, water management systems, and the majority of the mine access road will be located in the Davidson Creek watershed. The specific mine site components located in each reach of the Davidson Creek watershed are;

- Davidson Creek in the upper and middle reaches: West Dam will be built at the top of Reach 11 and will isolate Reach 12 upstream. The TSF Main Dam C will be located in the lower extent of Reach 10. The TSF Main Dam D will be centred in Reach 9. Reach 8 of Davidson Creek (immediately downstream of the TSF Main Dam D) will be dewatered. The dam for the FWR will be located at the top of Reach 6 and will back-flood all of Reach 7 and the lower half of Reach 7.1 upstream to the ECD. All Rainbow Trout life stages are potentially affected in the upper and middle reaches of Davidson Creek (Section 5.4.1 Davidson Creek Watershed; Section 5.5.1.1 Rainbow Trout).
- Davidson Creek downstream of the dam for the FWR (Reaches 1 to 6) will be impacted by flow changes due to water diversions, alteration of upstream watershed areas (and subsequent runoff volumes), and capture of run-off by various mine and water management infrastructure components. Construction of the mine infrastructure will also have the potential to increase Total Suspended Solids (TSS) in these reaches. All Rainbow Trout life stages are potentially affected in the lower reaches of Davidson Creek

(Section 5.4.1 Davidson Creek Watershed; Section 5.5.1.1 Rainbow Trout), as well as spawning Kokanee (Section 5.5.1.2 Kokanee).

- Davidson Creek tributaries including Creek 668328, Creek 636713 and the lower reaches of Creek 704454 will be intercepted by the TSF Main Dam D. Rearing stages of Rainbow Trout are potentially affected in these tributaries (Section 5.4.1 Davidson Creek Watershed; Section 5.5.1.1 Rainbow Trout).
- Creek 704454 and its tributaries are within the footprint of the open pit. These streams will be dammed, diverted, or dewatered. Rearing stages of Rainbow Trout are potentially affected in these tributaries (Section 5.4.1 Davidson Creek Watershed; Section 5.5.1.1 Rainbow Trout).
- Upstream habitat in the upper reaches of Creek 668328, as well as Lake 16 will be isolated from habitat in Davidson Creek. All Rainbow Trout life stages are potentially affected in Lake 16 (Section 5.4.1 Davidson Creek Watershed; Section 5.5.1.1 Rainbow Trout).
- Preparatory works associated with TIAs will be completed in Davidson Creek mainstem Reaches 8, 9, 10 and 11, and in subsections of Davidson Creek tributaries (see Section 8.4.1.3 Riparian Habitat Quality). These works are described in Appendix E.

6.2.1.2 Creek 661 and its Headwater Tributaries

Portions of the open pit, the construction and operations camps, plant site, a portion of the TSF D wall, and portions of the FWSS pipeline and mine access road are within the Creek 661 watershed. The instream habitat within the Creek 661 watershed affected by the mine are:

- Headwater portions of Creek 543585 are within the mine footprint and are considered to be lost due to roads and lay down areas for the water management system.
- Creek 505659 and Creek 146920 and its tributaries will be dammed, diverted, or dewatered and eventually covered with fill as foundations.
- The upper reaches of Creek 505659 will be intercepted by the TSF Main Dam C.
- Creek 661, into which Creek 543585, Creek 505659, and Creek 146920 flow, will be affected by flow changes.
- All Rainbow Trout life stages are potentially affected Creek 661 (Section 5.4.2 Creek 661 Watershed; Section 5.5.1.1 Rainbow Trout). Preparatory works in the Creek 661 watershed associated with TIAs are limited to small sections of reaches 6 and 7 of Creek 505659 (see Section 8.4.1.3 Riparian Habitat Quality). These works are described in Appendix E.

6.2.1.3 Turtle Creek and its Headwater Tributaries

The airstrip, airstrip access road, and small sections of the mine access road and transmission line ROWs traverse the Turtle Creek watershed. Instream habitat at the stream crossings associated with these linear developments necessary for mine development may be affected during construction, maintenance, and closure activities. All Rainbow Trout life stages are potentially affected in the Turtle Creek Watershed (Section 5.4.3 Turtle Creek Watershed; Section 5.5.1.1 Rainbow Trout), as well as spawning and rearing Kokanee (Section 5.5.1.2 Kokanee).

6.2.1.4 Tatelkuz Lake

The FWSS intake structure will be located on the western shoreline of Tatelkuz Lake and will draw water from the lake during mine Construction, Operations and Closure phases. Adult Rainbow Trout are potentially affected in Tatelkuz Lake (Section 5.4.4 Tatelkuz Lake and Tributaries; Section 5.5.1 Rainbow Trout), as well as all life stages of Kokanee (Section 5.5.2 Kokanee), all life stages of Mountain Whitefish (Section 5.5.3 Mountain Whitefish), and several other fish species (Section 5.5.4 Other Fish Species).

6.2.1.5 Tatelkuz Lake Tributaries

The FWSS pipeline and access road will cross various tributaries to Tatelkuz Lake that enter from the south. Instream habitat at the stream crossings associated with this pipeline and access road may be affected during construction, maintenance, and closure activities.

6.2.1.6 Chedakuz Creek

Chedakuz Creek is the receiving watercourse for run-off from Davidson Creek, Creek 661, and Turtle Creek watersheds, and may be impacted by cumulative flow changes in these tributaries. All life stages of Rainbow Trout are potentially affected in Chedakuz Creek (Section 5.4.5 Chedakuz Creek; Section 5.5.1.1 Rainbow Trout), as well as adult Kokanee and their migrating fry (Section 5.5.1.2 Kokanee), all life stages of adult Mountain Whitefish (Section 5.5.1.3 Mountain Whitefish), and several other fish species (Section 5.5.1.4 Other Fish Species).

6.2.2 Potential Effects of the Freshwater Supply System

Starting from Year 6 of Operations and throughout the Closure phase, the FWSS will be operational. Water from Tatelkuz Lake will be pumped to the FWR built at the bottom of Reach 7 in Davidson Creek. While the FWSS is required to provide freshwater for processing facility, it is also designed to supplement flow in Davidson Creek to meet instream flow requirements for Rainbow Trout and Kokanee. There are five potential effects from the FWSS on fish and fish habitat:

- Physical footprint of the intake structure on the shoreline of Tatelkuz Lake;
- Changes in water surface elevation (WSE) of Tatelkuz Lake due to the volume of water pumped from Tatelkuz Lake;
- Changes in stream flow in Chedakuz Creek between the outlet of Tatelkuz Lake and the confluence with Davidson Creek;
- Stream crossings along the water pipeline corridor; and
- Physical footprint of the FWR at the mine site.

The potential effects from each of these sources are outlined below.

6.2.2.1 Intake Structure

During the Construction phase, potential effects may result from building the laydown area and the footprint of the pumping facility near the shoreline of Tatelkuz Lake. Within the lake, there may be an effect on fish habitat caused by the construction and operation of two 610 mm intake pipes. Implementation of the appropriate mitigation measures (described in Section 5.3.9.3.4.1.2 of the Application/EIS), including the use of intake screens consistent with DFO guidelines, is anticipated to be highly effective for eliminating or, at most, leaving only negligible residual effects to fish habitat as a result of the Tatelkuz Lake Intake Structure footprint. Accordingly, the only potential effects from the intake structure carried forward to the residual effects assessment are associated with riparian habitat loss.

6.2.2.2 Changes in Water Surface Elevation of Tatelkuz Lake

Water withdrawals from Tatelkuz Lake, and associated changes in lake water surface elevation (WSE), may result in the loss of littoral fish habitat around the perimeter of the lake. To assess the potential effect of changes in Tatelkuz Lake levels, littoral habitat mapping and bathymetric mapping of Tatelkuz Lake was conducted. This change in water surface elevation is small (less than 0.11 m in a 1:50 dry year) relative to baseline mean annual (0.80 m) and maximum (2.0 m) fluctuations in lake levels. Overall changes in the upper 1 m of littoral fish habitat during Operations compared to baseline are estimated to be less than 1% during an average year and less than 2.5% during a 1:50 dry year. No effects to spawning habitat, including spawning habitat for mountain whitefish, are anticipated from this activity. Predicted changes during Closure are similar to Operations: less than 1% change during an average year and less than 2% change during a 1:50 dry year (Section 5.3.9 of the Application/EIS). Post-closure conditions will return to baseline conditions because pumping of water from Tatelkuz Lake will cease and the diversion from the Creek 661 Watershed to the Davidson Creek Watershed will be insignificant in terms of the drainage area flowing into Tatelkuz Lake. No mitigation measures were therefore identified as there are no anticipated effects to fish from the water withdrawal.

Adult Rainbow Trout are potentially affected in Tatelkuz Lake (Section 5.4.4 Tatelkuz Lake and Tributaries; Section 5.5.1.1 Rainbow Trout), as well as all life stages of Kokanee (Section 5.5.1.2 Kokanee), all life stages of Mountain Whitefish (Section 5.5.1.3 Mountain Whitefish), and several other fish species (Section 5.5.1.4 Other Fish Species).

6.2.2.3 Flow changes in Chedakuz Creek

Water withdrawn from Tatelkuz Lake as part of the FWSS will reduce flows in lower Chedakuz Creek between the lake outlet and the confluence with Davidson Creek. During Operations and Closure phases when the FWSS is operating, flows in lower Chedakuz Creek will be reduced, particularly between Tatelkuz Lake and the confluence with Davidson Creek (a 900 m section). This will result in the maximum reduction of 2% in Rainbow Trout spawning habitat in spring; an increase in total Rainbow Trout fry rearing habitat in summer and fall; and no more than 2% reduction in juvenile Rainbow Trout rearing and Kokanee spawning habitat. In winter the physical change in the creek depth is a reduction of 2-3 centimetres (cm) in a wide and deep channel. Overall, any reduction was less than 5% and below thresholds for significant residual effects and therefore no effect to Rainbow Trout or Kokanee using lower Chedakuz Creek is likely to occur. All life stages of Rainbow Trout are potentially affected in Chedakuz Creek (Section 5.4.5 Chedakuz Creek; Section 5.5.1.1 Rainbow Trout), as well as adult Kokanee and their migrating fry (Section 5.5.1.2 Kokanee), all life stages of adult Mountain Whitefish (Section 5.5.1.3 Mountain Whitefish), and several other fish species (Section 5.5.1.4 Other Fish Species).

6.2.2.4 Freshwater Pipeline

The total length of the FWSS pipeline is approximately 20 km. There are eight fish bearing streams that will be crossed along the pipeline and pipeline access road ROW.

The eight fish bearing watercourses along the FWSS pipeline will be crossed by open-cut trenches or clear span bridges, which after the implementation of mitigation measures, including those in DFO's Interim Code of Practice: temporary stream crossings, will not result in the permanent loss of instream habitat, but will result in the loss of riparian vegetation due to clearing for the 10 m wide pipeline ROW.

Without mitigation, potential effects of the FWSS pipeline include temporary or permanent loss of habitat if closed-bottomed crossing structures are used, and increased erosion and sediment transport. Successful implementation of mitigation measures (described in Section 5.3.9.3.4.3.2 of the Application/EIS) are expected to be highly effective at minimizing or eliminating residual effects to instream habitat. Three of nine stream crossings will be new crossings, and riparian habitat loss at these crossings was carried forward to the HADD assessment.

6.2.2.5 Freshwater Reservoir

Effects of the FWR on fish and fish habitat will occur during Construction, Operation and Closure phases of the Project. During Closure, the reservoir will be replaced by a wetland, and during Post-closure the wetland will be used as a passive water treatment facility for discharge from the TSF.

Direct loss of habitat will occur under the footprint of the reservoir during Construction, and this has been carried forward to the assessment of HADD of fish habitat. Other potential effects of the reservoir are decreased riparian vegetation and increased TSS caused by erosion, as well as potentially increased nutrient concentrations from Tatelkuz Lake water introduced via the FWSS. With the exception of increased nutrient inputs, mitigation measures (Section 5.3.9.3.4.4.2 of the Application/EIS) will minimize or eliminate these potential effects. There are no mitigation measures proposed for potentially higher nutrient inputs, as concentrations are known to be within acceptable limits to fish and successfully support Rainbow Trout and Kokanee in Tatelkuz Lake.

All Rainbow Trout life stages are potentially affected in the lower reaches of Davidson Creek downstream of the FWR (Section 5.4.1 Davidson Creek Watershed; Section 5.5.1.1 Rainbow Trout), as well as spawning Kokanee (Section 5.5.1.2 Kokanee).

6.2.3 Potential Effects of the Mine Access Road

There are five permanent watercourses and four non-classified drainages along the new mine access road ROW. All five permanent watercourses are either confirmed or assumed to be Rainbow Trout-bearing streams: one on an unnamed tributary of Turtle Creek; one on an unnamed tributary of Davidson Creek; two on the Davidson Creek mainstem; and one on Creek 505659. The four non-classified drainages do not support fish or provide fish habitat.

Without mitigation, potential effects include temporary or permanent loss of habitat if closed-bottomed crossing structures are used; loss of riparian habitat; increased erosion; and sediment transport. Mitigation measures are discussed in Section 7.1 Mine Design and Best Management Practices.

6.2.4 Potential Effects of the Airstrip and Airstrip Access Road

The airstrip is located on land and will not affect fish or fish habitat. However, the airstrip access road will cross three tributaries to Turtle Creek. Only one of these streams is fish-bearing while the other tributaries are non-classified drainages and are non-fish bearing. Two existing crossing structures will be retained and a single clear-span bridge will be constructed at one crossing site.

Without mitigation, potential effects include temporary or permanent loss of habitat if closed-bottomed crossing structures are used; loss of riparian habitat; increased erosion; and sediment transport. Mitigation measures are discussed in Section 7.1 Mine Design and Best Management Practices.

6.2.5 Potential Effects of the Transmission Line

Overall, the transmission line crosses 119 drainages, of which 39 are confirmed fish-bearing, seven were assigned default fish-bearing status, and 73 were assessed as non-fish-bearing, non-classified drainages, or were not watercourses (ERM 2017). Access roads will be required for construction and maintenance of the transmission line, and existing roads will be used wherever possible. Some new road construction may be required, and new road construction will avoid watercourse crossings wherever possible.

Although there are potential effects associated with transmission line construction, they are not quantified in this report and will be addressed in a separate Request for Review to be submitted to DFO. As such, effects related to the transmission line are not discussed further or carried forward to the quantification of residual effects in this application.

6.2.6 Potential Effects on Rainbow Trout Productivity

Productivity of Rainbow Trout in Davidson Creek and Creek 661 will be negatively affected by construction of the Project. However, quantifying the potential reduction of Rainbow Trout productivity in these creeks due to the Project was not considered in the Application/EIS and nor is it attempted here. This is because such an analysis would require not only a detailed understanding of the natural variability of the Rainbow Trout population in both creeks, but also a detailed understanding of the physical factors (e.g., temperature, flow, substrate composition) and biological factors (e.g., benthic invertebrate prey availability, parasite and disease rates, density-dependent competition for food and territories) influencing the growth, survival, and reproductive rates of these Rainbow Trout populations.

In absence of quantitative modelling, qualitative inferences have been made about the potential effects of the Project on Rainbow Trout productivity in Davidson Creek and Creek 661 based on the proportion of affected and unaffected habitats in both watersheds and the likely importance of affected habitats to the long-term sustainability of the populations. Potential effects of the Project on Rainbow Trout productivity within Davidson Creek and Creek 661 were assessed qualitatively in a separate memorandum, provided in Appendix G. A summary table (Table 1, Appendix G) compares the abundance and proportion of affected and unaffected Rainbow Trout fry rearing, juvenile rearing and overwintering habitat units in the Davidson Creek and Creek 661 watersheds.

Based on the assessment completed in Appendix G, BW Gold does not expect that the Project will affect the sustainability or substantially reduce the long-term productivity of Rainbow Trout in the LSA. This conclusion is based on the contention that Rainbow Trout will continue to be able to utilize habitat in the middle and lower reaches of Davidson Creek and Creek 661 for all of their life processes, that none of the habitat types affected by the Project infrastructure are not also found elsewhere in the watersheds, and that the Project will not have a disproportionate effect on any one habitat type used by any particular Rainbow Trout life stage.

7. Measures and Standards

Section 7 of this report contains the required information (see also Table C-1) as specified in:

"Section 10. A detailed description of the measures and standards that will be implemented, including an analysis of the expected effectiveness of those measures and standards, to

(a) avoid the death of fish or to mitigate the extent of their death; or
(b) avoid or mitigate the harmful alteration, disruption or destruction of fish habitat."

[Schedule 1, section 10]

"Section 11. A detailed description of the monitoring measures that will be implemented to assess the effectiveness of the measures and standards referred to in section 10."

[Schedule 1, section 11]

"Section 12. A detailed description of the contingency measures that will be implemented if the measures and standards referred to in section 10 do not meet their objectives."

[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 12]

The Project design, Aquatic Resources Management Plan (Section 12.2.1.18.4.2 of the Application/EIS), Fish Salvage Plan (Section 12.2.1.18.4.21 of the Application/EIS), and Fish and Fish Habitat sections of the Application/EIS (Sections 5.3.8 and 5.3.9 of the Application/EIS) identify the avoidance and mitigation measures that will be implemented to eliminate or minimize the potential effects to fish and fish habitat. The TSF also underwent a formal alternative assessment process, which included quantitative consideration of environmental factors (Appendix 2.5A of the Application/EIS).

The Project's Construction Environmental Management Plan (CEMP), which includes an analysis of the expected effectiveness of measures and standards that will be implemented, monitoring measures that will be implemented to assess the effectiveness of the measures and standards, and contingency measures that will be implemented if the measures and standards do not meet their objectives is presented in DFO IR Memo # 8 in Appendix H1.

Avoidance and mitigation measures have been a key part of the planning and design process of the Project since the early mine planning stages, including the following design principles:

- Early identification and avoidance of key sensitive areas in the Project area;
- Clustering, which refers to locating facilities as closely together as possible to minimize the spatial extent of the Project footprint. The clustered facilities comprise the TSF, open pit, waste rock dumps, stockpiles, and all other mine site facilities;
- Minimizing the number of watersheds potentially affected by locating the TSF and all mine site facilities within the Davidson Creek and Creek 661 watersheds;
- Avoidance of the Blackwater River watershed, a designated Heritage River with important natural, cultural and recreational values; and
- Avoidance of direct footprint effects to Kokanee habitat.

7.1 Mine Design and Best Management Practices

'Mitigation by design' is a key part of the mine planning process and the following is a summary of some key mitigation measures and design features that have been incorporated into the mine plan and design.

7.1.1 Construction Phase

- Constructing mine infrastructure using a staged approach, with TSF C built earlier and TSF D built later, to accommodate tailings storage needs. This approach will simplify water management and reduce potential effects during construction;
- Locating the mine and processing components upslope of the ECD to manage TSS and other water chemistry parameters;
- Developing a Sediment and Erosion Control Management Plan, which will limit release of suspended solids;
- Using Best Management Practices (BMPs) and an adaptive management approach to minimize the volume and maintain quality of contact water;
- Constructing the central and southern surface water diversions to route water around the TSF and minimize site contact water volume;
- Phasing sediment control to match the main construction activities: 1) land clearing and grading; 2) TSF construction; 3) open pit development;
- Timing of instream work in fish-bearing streams to occur during the 'Reduced Risk Timing Windows' when and where possible;
- Salvaging fish from watercourses prior to the start of instream works;
- Using existing disturbed areas and corridors for infrastructure to the extent possible; and
- Using clear-span bridges or open-bottom culverts for crossings of fish-bearing streams.

7.1.2 Operations and Closure Phases

- Constructing mine infrastructure using a staged approach, with TSF C built earlier and TSF D built later, to accommodate tailings storage needs. This approach will simplify water management and minimize the potential effect on downstream flows in Davidson Creek;
- Minimizing water use by recycling water in the TSF for use in the mill and by capturing, collecting and pumping seepage back to the TSF. This minimizes potential disturbances to the aquatic environment from water withdrawals and releases;
- Treating and releasing water to Davidson Creek to minimize the amount of flow augmentation needed from Tatelkuz Lake via the FWSS;
- Constructing northern surface water diversions to route water around the TSF and minimize site contact water volume;
- Constructing seepage interception trenches and the ECD downstream of the TSF D dam. These will collect seepage from the TSF and route it to the ECD and back to the TSF via pumping;
- Mitigating direct mortality of fish by the FWSS by using appropriately sized screens per DFO guidelines at end of pipe; extending intake pipes out into lake to prevent entrainment of sediment and aquatic organisms; regularly removing and cleaning fish screens; and

7.1.3 Post-Closure Phase

- Operating the FWSS and other water management infrastructure in the Davidson Creek watershed, until the monitoring demonstrates that treated water can be discharged to Davidson Creek; and

- Allowing run-off and seepage from reclaimed areas to flow in the Creek 661 watershed only if it meets site-specific water quality objectives.

7.2 Construction Environmental Management Program

A Project-wide environmental management program will be implemented during all Project phases. This program will describe (among other things), environmental protection measures and best management practices to minimize potential impacts to the aquatic environment, including:

- Spill prevention and emergency response;
- Erosion and sediment control measures;
- Construction phasing;
- Fish salvage, timing, and water management;
- Surface water quality; and
- Environmental monitoring during construction.

The Project's CEMP, developed to meet BC EA Condition #13 and included in the joint *Mines Act* and *Environmental Management Act* permits application, is provided in Appendix H2.

7.3 Pre-Disturbance Fish Salvage

BW Gold proposes to conduct fish salvages and relocations in affected streams within upper and middle Davidson Creek and within headwater streams of Creek 661. Affected streams in the Davidson Creek Watershed will include the upper and middle sections of the mainstem, Creek 688328, Creek 704454 and various tributary streams. Affected streams in Creek 661 Watershed will include Creek 505659, Creek 146920, and various tributary streams.

In accordance with federal EA Condition # 3.2.1, a fish salvage and relocation plan has been developed prior to construction. The current version of the plan was developed in consultation with Indigenous groups and other relevant authorities. The Fish Salvage Plan is provided in Appendix I. The plan describes the overall salvage approach, including geographic extent, timing, personnel requirements, capture methods, and release locations.

Once finalized, the plan will be implemented prior to conducting any activity resulting in the HADD of fish habitat. Fish salvage and relocation will be conducted by a team comprised of qualified individuals, including a Registered Professional Biologist, who have experience in all aspects of the proposed work. The fish salvage and relocation plan specifies non-lethal techniques that include backpack electrofishing, minnow trapping, and beach seining, as applicable for the habitat being salvaged. The plan will be refined and finalized, after a site reconnaissance conducted by the lead biologist and team members prior to conducting the salvage. The main fish collection method will use multiple-pass electrofishing with blocking nets in 100 m sections until no more fish are captured. Minnow traps will then be placed within each section and fished over a 24-hr period to catch any residual fish that were not collected during electrofishing. Other methods, such as beach seining, may also be used to best suit the channel size, substrate and specific habitat identified for salvage.

Fish salvage efforts will be staged according to the construction schedule and will be subject to approval by the BC MFLNRORD and DFO and will be subject to the conditions of those approvals.

8. Residual Harmful Alteration, Disruption, or Destruction of Fish Habitat

Section 8 of this report contains the required information (see also Table C-1) as specified in:

"Section 13. A quantitative and detailed description of the death of fish referred to in subsection 9(2) after the measures and standards referred to in paragraph 10(a) are implemented."

[Schedule 1, section 13]

14 A quantitative and detailed description of the harmful alteration, disruption or destruction of fish habitat referred to in subsection 9(2) after the measures and standards referred to in paragraph 10(b) are implemented."

[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 14]

8.1 Summary of Assessment of Potential Death of Fish after Implementation of Measures and Standards

Following the implementation of measures and standards to avoid the death of fish or to mitigate the extent of their death (Sections 7.2 and 7.3), the death of fish from Project activities is not anticipated and therefore BW Gold is not applying for authorization of the death of fish under Paragraph 34.4(2)b. Unexpected death of fish due to project activities (e.g., permitted salvage activities) will be reported as stipulated in the fish salvage permit or activities associated with the *Fisheries Act* authorization for the purpose of HADD, Paragraph 35(2)(b).

8.2 Summary of Residual HADD Requiring Authorization

Based on the implementation of avoidance and mitigation measures and knowledge of the fish habitat in the Project area, no direct effects to instream fish habitat are anticipated from the construction and operations of the airstrip, the mine access road, and components of the FWSS. The only residual effects that are anticipated to remain after the implementation of avoidance and mitigation measures are related to direct loss of habitat under the mine site footprint, isolation of habitat upstream of the mine site footprint, flow alterations downstream of the mine site footprint, and riparian losses along linear corridors.

The following effects of the Project on fish and fish habitat were identified and will be carried through to an assessment of HADD of fish habitat:

- Direct habitat loss from physical works
  - Loss of instream habitat and riparian vegetation in Davidson Creek and Creek 661 watersheds beneath the mine footprint
- Preparatory works inside proposed TIAs
  - Physical works inside the areas that are subject to amendment of Schedule 2 of the MDMER, resulting in HADD prior to the deposition of deleterious substances (i.e., tailings, waste rock, ore), including works, undertakings or activities required to prepare and construct the Tailings Storage Facilities, Ore Stockpile areas, Environmental Control Dam such as site clearing and isolation, stream diversions, stream infills, etc. These works are addressed under the

MDMER Compensation Plan and therefore offsetting for these works is not included in the Offsetting Plan (see Section 8.3).

- Upstream Habitat Isolation
  - Habitat isolation in the upper headwaters of Davidson Creek (Reaches 11 and 12) and tributaries (including upper reaches of Creek 668328, Creek 636713 and Creek 704454) upstream of the West Dam, TSF Dam C, TSF Dam D, and ore stockpiles;
- Downstream Flow Changes
  - Flow reductions in Creek 661 and tributaries (Creek 505659 and Creek 146920) downstream the mine site infrastructure; and
  - Flow alterations in Davidson Creek (Reaches 1 to 6).
- Linear Corridor Riparian Losses

8.3 HADD addressed through MDMER Compensation

The following effects associated with deposition of deleterious substances were identified and carried through to the residual habitat loss section of the Compensation Plan prepared for a MDMER Schedule 2 amendment:

- Direct habitat loss
  - Loss of instream habitat in Davidson Creek and Creek 661 watersheds beneath the footprint of the TSF (not including instream habitat beneath the footprints of the Main Dam C and D embankments), the low-grade and high-grade ore stockpiles, the upper waste stockpile, and the ECD.
  - Loss of streamside riparian vegetation adjacent to the instream areas lost due to deleterious substance placement.
- Preparatory works associated within the areas subject to Schedule 2 (i.e., within the footprints of the TSF, the low-grade and high-grade ore stockpiles, the upper waste stockpile, and the ECD).

The MDMER Schedule 2 process is a mechanism for listing water bodies frequented by fish to Schedule 2 of the MDMER to designate them as tailings impoundment areas. This process permits deposition of tailings in a waterbody. The MDMER process does not authorize the HADD resulting from conversion of fish-bearing waterbodies to TIAs. This HADD includes the physical preparatory works in the waterbody, and ultimately, the complete loss of the waterbody as fish habitat inside the footprint of a TIA (e.g., TSF, stockpile, or waste storage area).

As such, BW Gold is applying for Authorization of the physical preparatory works, and subsequent direct habitat loss, associated with the TIAs. However, offsetting for this HADD is not proposed in the Offsetting Plan (Section 10), because the Compensation Plan, submitted to ECCC for the Schedule 2 process covers the offsetting requirement. The Compensation Plan proposes stream habitat restoration and enhancement, and creation of overwintering ponds in the Mathews Creek watershed, which is located south of the Project area and supports Rainbow Trout and other fish species. The proposed measures compensate for (i.e., offset for) the loss of fish habitat in the mine site associated with Tailings Impoundment Areas (57,773 m^2; Table 8-1), through the restoration/creation of habitat that will benefit the fish community at Mathews Creek (59,734 m^2; Table 8-2).

Table 8-1. Summary of Instream Area Subject to Schedule 2 Amendment at the Mine Site

Watershed	Stream	Length (m)	Instream Habitat Area Lost (m^2)
Davidson Creek	Davidson Creek Mainstem	6,743	22,148
	Davidson Creek Tributaries	3,366	2,983
	Creek 704454 Mainstem	4,775	13,070
	Creek 704454 Tributaries	5,684	7,928
	Creek 668328 Mainstem	2,573	6,443
	Creek 668328 Tributaries[1]	109	0
	Creek 636713 Mainstem	2,280	2,575
	Creek 636713 Tributaries	1,486	1,445
Davidson Creek Watershed Subtotal		**27,016**	**56,592**
Creek 661	Creek 505659 Mainstem	585	432
	Creek 505659 Tributaries	619	749
Creek 661 Watershed Subtotal		**1,204**	**1,181**
Totals		**28,220**	**57,773**

Notes:

1. *Creek 668328 Tributaries affected by the placement of deleterious substances include only two non-visible channel segments that offer no fish habitat value.*

Table 8-2. Summary of Instream Habitat Area Restoration/Creation in Mathews Creek Proposed as Compensation for Loss of Habitat Inside TIAs at the Mine Site

Offsetting Measure	Length (m)[1]	Instream Habitat Area Restored/Created (m^2)
Mathews Creek Restoration and Enhancement	5,008	31,810
Mathews Creek Pond 1	106	7,409
Mathews Creek Pond 2	90	7,500
Mathews Creek Pond 3	148	13,015
Totals	**5,352**	**59,734**

Notes:

1. *Length values for the three ponds represent the length of longest axis of the pond.*

8.4 HADD requiring Offsetting

The purpose of this section is to present a quantitative assessment of the HADD of fish habitat associated with the Project that BW Gold is required to offset. Avoidance and mitigation measures will be implemented to reduce the overall Project effects on fisheries; however, the construction of the Project will result in an unavoidable permanent loss of fish habitat in the upper reaches of Davidson Creek and its headwater tributaries, and in the upper reaches and headwater tributaries of Creek 505659 in the Creek 661 watershed (see Section 8.4.1.3 Riparian Habitat Quality).

To inform regulatory decisions, a quantification of the areal extent and suitability-adjusted estimate of habitat loss are presented here. Bradford et al. (2014) outlined a decision-support framework for managing residual effects to fish and fish habitat that should be informed by:

- The nature of the impact of the Project on fish and fish habitat
- The temporal and spatial scales and intensity of the impact; and
- The type of fish habitat or species that will be exposed to the Project's impacts. Some form of classification scheme utilizing habitats and potential species could be used to reflect regional priorities.

Where residual loss of fish habitat will occur, these impacts should be counterbalanced by gains through offsetting (described in Section 10). Methods to quantify lost productivity are important because they are an improvement on qualitative or judgment-based approached (Bradford et al. 2014). In addition, quantification of residual habitat loss provides a comparable accounting of habitat losses and gains.

The assessment of habitat loss outlined in this section benefits from a thorough understanding of fish and fish habitat in the area, based on substantial baseline data collection (summarized in Section 5 of this report). There is sufficient information on the availability and use of affected fish habitat to inform a robust assessment of the effect of habitat losses on fish production.

This assessment of residual habitat loss focuses on impacts to the only species encountered in the upper reaches of Davidson Creek and Creek 661 – Rainbow Trout. Impacts to Kokanee due to downstream flow alterations are also considered, although no habitat used by Kokanee will be affected by direct habitat loss. Rainbow Trout are also largely the focus of the offsetting plan, providing a direct counterbalance between losses and gains to fish communities in the area.

8.4.1 Methods for Quantification of Habitat Loss

As outlined by DFO (2013c), development of common spatial units or 'estimates of equivalency' is required between the consequences of habitat loss and the offsetting benefits. The assessment of habitat loss from the Project substances was completed using four methods:

- Calculation of the areal extent (surface area) of affected instream habitat (in m^2) using stream channel measurements collected during baseline field programs, and spatial analysis using GIS software;
- Habitat Evaluation Procedure (HEP) to calculate Habitat Units (HU), a metric that integrates habitat quality with quantity (equivalent to m^2 of 'usable' instream habitat);
- Calculation of the riparian habitat (in m^2) using stream buffers applied to stream segments, based on fish-bearing status assessed during baseline field programs; and
- Instream flow modelling using the System for Environmental Flow Analysis (SEFA) that is also used to calculate HUs specifically related to changes in streamflow.

8.4.1.1 Instream Habitat Area

Calculation of habitat area is required as a first step for the HEP method and provides a straight-forward measure of habitat loss. However, it does not incorporate an index of suitability related to habitat quality.

Site-specific baseline information was used as the foundation of the quantification of habitat losses. As outlined in the baseline reports (Appendix 5.1.2.6A&B of the Application/EIS, AMEC 2013a and 2013b), stream channel measurements and spatial analysis using GIS were used to quantify total habitat. This GIS spatial information was then overlaid on the mine site footprint over the BC standard 1:20,000 scale Freshwater Atlas stream and waterbody network coverage.

As described in the Instream Flow Study for the Project (Appendix 5.1.2.6D of the Application/EIS*),* each stream segment and affected water body was delineated and categorized by the Freshwater Atlas code, stream order, stream classification, type of impact, and fish presence/absence data. Stream segment lengths were measured using GIS software, and total instream habitat area for each stream segment was determined using the length multiplied by average channel measurements from field data. Surface water areas for water bodies and lakes were derived using GIS software and verified using shoreline perimeter data collected during baseline bathymetric surveys.

These results provided the areal extent of habitat affected and formed the basis of the HEP evaluation.

8.4.1.2 Habitat Evaluation Procedure

Overview of HEP

The Habitat Evaluation Procedure (HEP) methodology was originally developed by the U.S. Fish and Wildlife Service and has been widely used across North America as a reliable model for quantifying habitat loss. HEP is a valuable method to quantify biologically relevant habitat loss or gain, by taking into account the habitat preferences and requirements of a species at varying life stages. This method of habitat quantification facilitates an effective comparison of habitat losses with different potential compensation opportunities, regardless of habitat type.

HEP provides an objective method to characterize the quality of habitat, and it also standardizes the habitat quality ratings relative to other habitats that have different physical characteristics (e.g., lake versus streams). This allows affected habitat to be standardized and evaluated as a single unit. Considering the importance of maintaining fish communities in these systems, it is important to understand the suitability of the lost habitat and relate this to the habitat gains that are proposed through offsetting plans.

The HEP evaluation (USFWS 1980) is generally used when there is a direct loss of habitat, and a value of this habitat to the species that use it for all or part of their life history is required for assessing impacts. The HEP is based on the concept that habitat value for a selected species/life stage can be described by a Habitat Suitability Index (HSI). An HSI is a habitat quality rating that is assigned on a scale of 0 (no value) to 1 (optimum value) for a given species/life stage of interest (USFWS 1980). HSI models use a combination of quantitative and qualitative information, synthesized from published literature and site-specific professional observations, to describe how different habitat variables influence habitat quality for each species/life stage of interest.

The HEP derives a dimensionless Habitat Unit (HU) by multiplying affected area (m^2) by a dimensionless habitat- and species/life stage-specific HSI value. The HEP allows standardization of habitat quality ratings relative to other habitats, such as lakes and streams, even if they have different physical characteristics. This ultimately allows the habitats to be evaluated as a single group for habitat accounting (i.e., gains versus losses). Additional assumptions of the HEP include:

1. An area of interest typically possesses different habitat types and classes;
2. That each habitat type/class has a measurable area;
3. Each habitat type/class may have a different suitability for each species and life stage of animal that utilizes that area; and
4. HSI models assume that there is a positive relationship between the suitability index and habitat carrying capacity (USFWS 1981).

Project-Specific Implementation of HEP

The Instream Flow Study (Appendix 5.1.2.6D of the Application/EIS), as well as Annex C of the Fisheries Mitigation and Offsetting Plan that was previously submitted (Appendix 5.1.2.6C of the Application/EIS), describes the process for establishing HSI models for this Project. The original methodology and subsequent modifications are described in detailed in the technical memorandum *Habitat Evaluation Procedure (HEP) for Blackwater Project – Fisheries Offsetting Plan* (Palmer 2021), provided in Appendix J.

AMEC (2014b) developed a habitat classification system to support the use of HSI models for Rainbow Trout. Seven mesohabitat types were identified during baseline assessment in the Project footprint: cascades, riffles, glides, pools, and three additional habitat types (i.e., "tributary", "other", and "lake") to describe the remaining habitat diversity not represented by the first four habitat types. A "tributary" type was used to describe small first-, second-, and third-order tributaries to mainstem creeks; an "other" type was used to describe habitat provided by off-channel areas such as back-flooded beaver dams, and wetlands; and a "lake" type was used to describe different lake habitats (AMEC 2014b). Each of the seven habitat types were then further categorized into more-detailed habitat classes by AMEC (2014b).

Application of the habitat classification system resulted in the identification of 19 discrete habitat classes in the Project area. Subsequent assessment of potential off-site compensation options necessitated defining two additional habitat classes to better describe existing conditions at those locations, resulting in a total of 21 unique habitat classes. Detailed descriptions of the habitat types and classes are provided in Appendix J.

Five life stages of Rainbow Trout were considered for inclusion in the HEP:

- Spawning and Egg Incubation;
- Fry Summer Rearing;
- Juvenile Summer Rearing;
- Adult Summer Foraging; and
- Overwintering.

A non-fish bearing HSI index called the "Food and Nutrient Production HSI" has also been included to account for the unavoidable HADD of non-fish-bearing habitat in headwater areas. The Food and Nutrient HSI is intended to reflect fish production by integrating primary (i.e., periphyton) and secondary (i.e., benthic invertebrates) production from the aquatic environment with allochthonous inputs from the riparian zone (e.g., terrestrial insects, leaf litter, fine organic debris). The Food and Nutrient HSI was used exclusively for non-fish bearing streams (i.e., S6 streams), and was not applied to non-visible channels (NVC) or non-classified drainages (NCD). This was because these features are hydraulically disconnected from fish habitat, and the associated inputs from these features do not have the potential to benefit fish and fish habitat downstream. The Food and Nutrient HSI was not included for fish-bearing streams (i.e., S1 through S4), because the contribution of food and nutrients in fish-bearing streams is assumed to be inherently accounted for through the fish species and life stage HSIs. As described in the Fisheries Mitigation and Offsetting Plan (FMOP; Appendix 5.2.1.6C of the Application), Food and Nutrient Production was assigned a habitat suitability rating of 0.25 for tributary streams (AMEC 2014a). Further detail on the application of the Food Hand Nutrient HSI is provided in Appendix K.

For each of the 21 habitat classes, specific HSI values were established for each of the five life stages of Rainbow Trout, based on the system developed by AMEC (2014b) and using guidance from Raleigh et al. (1984). Briefly, a five-point habitat suitability rating system was used, ranging from 0 to 1. Shifts in habitat suitability were represented by increments of 0.25, as shown in Table 8-3. It is important to note that the HSI model was not given any *a priori* weighting for a particular habitat type or life stage of fish. For example, spawning habitat was not given any more importance than overwintering habitat.

Table 8-3. Habitat Suitability Ratings and Definitions.

Habitat Suitability Rating	Definition
0	Unsuitable
0.25	Below Average Quality
0.50	Average Quality
0.75	Above-average Quality
1.0	Optimal Quality

Source: AMEC 2014b

HU values were calculated by multiplying the species- and life stage-specific HSI values by the length and width (i.e., the area) of a given channel unit, as shown in Equation 1.

Equation 1

$$HU_{u_i,sp_j,ls_k} = HSI_{u_i,sp_j,ls_k} * L_{u_i} * W_{u_i}$$

Where:
HU = Habitat unit
HSI = Habitat Suitability Index
L = Unit Length
W = Unit Bankfull Width
u_i = Habitat mapping mesohabitat unit i
sp_j= species j
ls_k= life stage k

8.4.1.3 Riparian Habitat Area

In the Fisheries Mitigation and Offsetting Plan (Appendix 5.1.2.6C of the Application/EIS), a Food and Nutrient Habitat Suitability Index (HSI) value was assigned to address riparian inputs. However, in discussion with DFO, it was agreed that a more straightforward and transparent approach to riparian habitat accounting should be applied to both losses and gains. Riparian habitat area loss calculation in this document was therefore based on affected channel or shoreline length, channel width, and the fish-bearing status of the affected waterbodies, using baseline assessments of fish presence.

Fish Bearing Status

As per definitions provided in the Fish and Aquatic Resources Baseline Reports (Appendix 5.1.2.6A&B of the Application/EIS, AMEC 2013a and 2013b), waterbodies were assigned the following 'fish-bearing status' categories based on field data:

- "Confirmed" indicates that the waterbody was surveyed and fish were captured;
- "Unconfirmed" indicates that the waterbody was either not surveyed with no available fish presence information available (typically small, headwater, first- and second-order streams), or surveyed and no fish were captured, but that fish presence could not be conclusively ruled out;
- "Non-fish bearing" indicates that fish presence was conclusively ruled out.

In most cases, "unconfirmed" fish-bearing status was due to the low density of juvenile Rainbow Trout in streams of the mine site LSA compared with BC provincial standards (Keeley et al. 1996; Koning and Keeley 1997).

- Non-fish bearing waterbodies with defined channels were classified as S5 (>3 m wide, and non-fish-bearing based on lack of connectivity, the presence of downstream barriers, or reach gradients of >20%) or S6 (<3 m wide, and non-fish-bearing based on lack of connectivity, the presence of downstream barriers, or reach gradients of >20%) using BC Forest Practice Code stream-identification methods (BC MOF 1995 and 1998).

Riparian Zone Width (RZW)

The Land Development Guidelines for the Protection of Aquatic Habitat (DFO 1993) identify a 15 m buffer (referred to as "leave-strips") as appropriate for fish-bearing waterbodies.

In BC, the *Forest and Ranges Practices Act* (*FRPA*) and the Riparian Areas Regulations (RAR) (formed under the BC *Fish Protection Act*), are commonly used standards for determining riparian buffers. Under the *FRPA*, which sets the requirements for tree harvesting, road building and grazing, the Riparian Management Area (RMA) for streams is based on fish presence and stream width. The RMA consists of the Riparian Reserve Zone (RRZ), which is immediately adjacent to both sides of the stream, and beyond that, a Riparian Management Zone (RMZ). In general, harvesting within the RRZ is not permitted and there are restrictions on harvesting within the RMZ.

Under the RAR, which relates to development near aquatic habitats, the riparian "zone of sensitivity" ranges from 5 m to 30 m depending on channel type and the nature of large woody debris.

Application of Buffers

As discussed in Section 8.4.1.3, there are a variety of guidance documents that provide varying riparian area buffer widths based on numerous factors, including fish presence or absence. Therefore, buffer widths of varying dimensions were applied to various stream segments and lake shorelines based on their known or assumed fish-bearing status as described in Section 8.4.1.3.

A functional riparian zone of 15 m from bankfull channel limits around all confirmed fish-bearing waterbodies (i.e., streams, ponds, and lakes) was applied to be consistent with guidance from DFO (i.e., 30 m total riparian zone width for streams). Accordingly, the total riparian width was 30 m along fish-bearing streams and 15 m around the shoreline of fish-bearing lakes and ponds (buffer applied to waterbody perimeter).

For waterbodies that had "unconfirmed" fish-bearing status, the applied riparian buffer was 5 m from the bankfull channel limits (i.e., 10 m total riparian zone width for streams) to account for the potential for fish utilization and riparian contributions to downstream reaches. Accordingly, the total riparian width was 10 m along streams, and 5 m around the shoreline of lakes and ponds, respectively (buffer applied to waterbody perimeter).

Drainage features that were not classified as streams and were assigned no fish habitat value in the Application/EIS (e.g., non-classified drainages [NCD[10]] and terrain features with no visible channel[11] [NVC]) were excluded from the riparian buffer calculations. The Food and Nutrient HSI was also, therefore, not applied to NVC's or NCD's, as these features are hydraulically disconnected from fish habitat, and the associated inputs from these features do not have the potential to benefit fish and fish habitat downstream.

Linear Corridors

For linear corridors (e.g., roads, freshwater supply system pipeline, airstrip) the riparian area loss was calculated as follows (Equation 2).

Equation 2

$$Riparian\ Area\ (Lost) = N\ \times ROW \times RZW$$

Where:

N = the number of impacted (new) stream crossings;
ROW = the width of the linear feature Right of Way; and
RZW = the Riparian Zone Width based on the fish-bearing status (defined above).

New crossings that were identified by GIS mapping but, when visited in the field, were NCDs or NVCs, were not considered. Existing crossings were not included in the linear corridor riparian area impact calculations.

8.4.1.4 System for Environmental Flow Analysis (SEFA)

The volume and timing of streamflow is critical for support of the Rainbow Trout and Kokanee populations that use stream habitat affected by the Project. These impacts were quantified by AMEC (2015), who conducted an instream flow study as a part of the baseline programs. The instream flow study involved using the System for Environmental Flow Analysis (SEFA) to develop relationships between streamflow and fish habitat for relevant species and life stages of fish using information for Rainbow Trout and Kokanee (Table 8-4). Separate SEFA models were constructed for Davidson Creek and Creek 661. The streamflow – fish habitat model developed for Davidson Creek was also used by AMEC to support the development of IFN for the FWSS.

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[10] *A non-classified drainage is a watercourse that does not meet any of the following criteria:*

- *a continuous channel bed of at least 100 m in length, or,*
- *a continuous channel bed of less than 100 m in length, where:*
  - *the continuous channel bed is known to contain fish,*
  - *the continuous channel bed flows directly into a fish stream or a lake known to contain fish, or,*

the continuous channel bed flows directly into a domestic water intake. (BC MOF 1998)

[11] *No visible channel indicates a complete absence of scoured channel definition. These features are typically found in the bottom of dry draws or depressions, consisting entirely of terrestrial, upland vegetation.*

Table 8-4. Species, life stages and periodicity for Davidson and 661 Creeks as reported by AMEC (2015).

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainbow Trout	Juvenile overwintering	■■■■	■■■■	■■■■	■■□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	■■■■
	Juvenile rearing and migration	□□□□	□□□□	□□□□	□□■■	■■■■	■■■■	■■■■	■■■■	■■■■	■■■■	■■■■	□□□□
	Adult migration and spawning	□□□□	□□□□	□□□□	□□□□	□□■■	■■■■	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□
	Egg incubation	□□□□	□□□□	□□□□	□□□□	□□□□	■■■■	■■■■	■■□□	□□□□	□□□□	□□□□	□□□□
Kokanee	Adult migration and spawning	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	■■■■	■■■■	□□□□	□□□□	□□□□	□□□□
	Egg incubation	■■■■	■■■■	■■■■	■■□□	□□□□	□□□□	□□■■	■■■■	■■■■	■■■■	■■■■	■■■■

AMEC's study involved extensive field programs during 2011, 2012, and 2013. The field data collection completed in 2011-2013 for the SEFA model involved establishment of stream transects that were measured repeatedly at different flows. Measurements included water surface elevation, substrate composition, and vertical depth and water velocity profiles, which were used to develop detailed channel cross sections. This allowed for development of calibrated hydraulic habitat relationships for modelled sections of the creeks.

Initially, AMEC developed site specific habitat suitability curves (HSCs) for their analysis that were adapted from curves developed using province-wide data provided by Ron Ptolemy, Instream Flow Specialist, BC Ministry of Environment (AMEC Foster Wheeler, 2016). However, upon subsequent review of this work in 2017, Palmer identified potential biases in these project-specific curves because they were generated using fish presence observations at low flows only. Therefore, the SEFA models were updated using the provincial HSCs. Additional information regarding the development of these SEFA models is provided in AMEC (2015).

The SEFA models used the provincial HSCs in conjunction with the hydraulic models to produce fish habitat -streamflow relationships for each stanza[12] in the affected streams (Figure 8-1). These relationships were used to quantify how changes in streamflow affect fish habitat using a metric called area weighted suitability (AWS). The AWS is the product of the cross-sectional area of a reach and its habitat suitability and is roughly analogous to the HUs used to quantify fish habitat loss as a part of this study.

Since AMEC's work was conducted, additional hydrometric data from Davidson Creek have been collected. These data have been used to update the baseline hydrological model (Knight Piésold 2021b) and have resulted in a different understanding of the baseline hydrology for Davidson Creek. Subsequently, the understanding of the amount of fish habitat available in Davidson Creek under baseline conditions has changed. Therefore, the IFN was updated as a part of this submission in accordance with the following three principles:

- To maintain a minimum of 90% of available habitat (AWS) under average baseline conditions;
- To reduce the occurrence of naturally occurring low flows that may limit fish populations; and
  To minimize potential impacts to habitat in Tatelkuz Lake and Chedakuz Creek due to water withdrawals from Tatelkuz Lake.

[12] *A 'stanza' is a time period associated with a key life history stage for a species of fish. For example, the stanza for Rainbow Trout adult migration and spawning runs from mid-May to the end of June of each year. More detail on stanzas is provided in Appendix C.*

Further information regarding the updated IFN is provided in Appendix C.

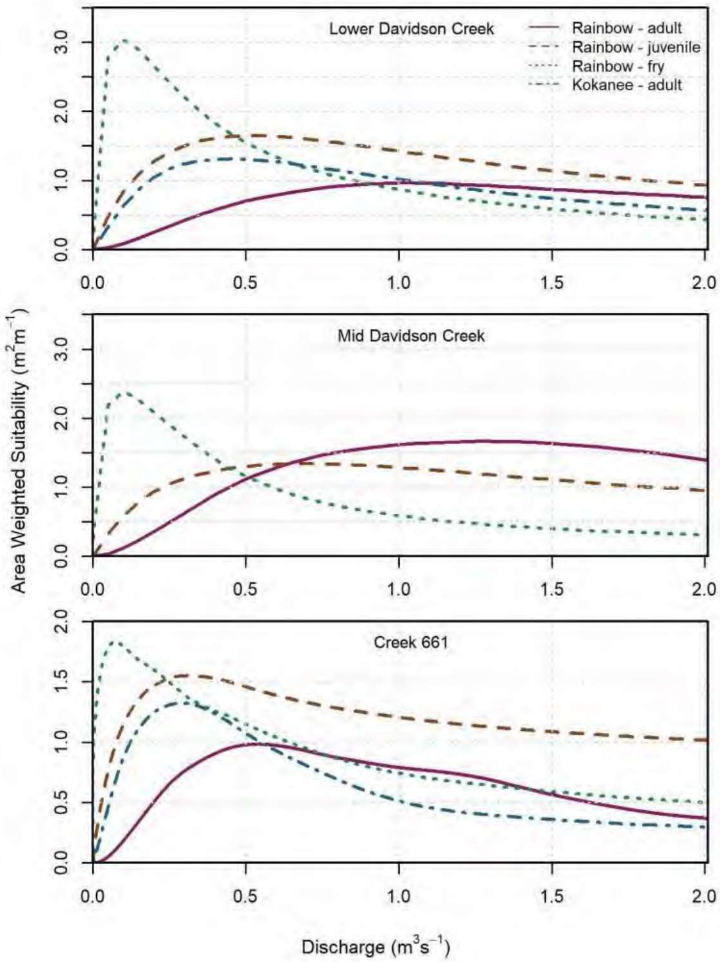


Figure 8-1. Streamflow – fish habitat relationships developed using SEFA to quantify changes in habitat caused by streamflow alterations.

The clearing of riparian vegetation in Reaches 1 and 2 of lower Davidson Creek (Section 5.3) may affect channel geometry and the hydraulic component (i.e., depths and velocities) of the instream flow model. Potential changes in channel geometry from the riparian clearing include channel widening, which would be expected to reduce the quality of instream habitat. Since the instream flow model is based on field measurements that were collected prior to the removal of riparian vegetation, the modelled habitat loss for lower Davison Creek is considered conservative (i.e., an overestimate). Habitat quality has likely been reduced due to the loss of a riparian buffer, relative to when the model was developed. Therefore, the modelled incremental loss of habitat due to flow alterations is likely greater, than if the modelling were to be updated for the current conditions (i.e., for the current scenario where Reaches 1 and 2 of Davidson Creek lack riparian vegetation). For this reason, the SEFA model was not updated for lower Davidson Creek.

Middle Davidson Creek

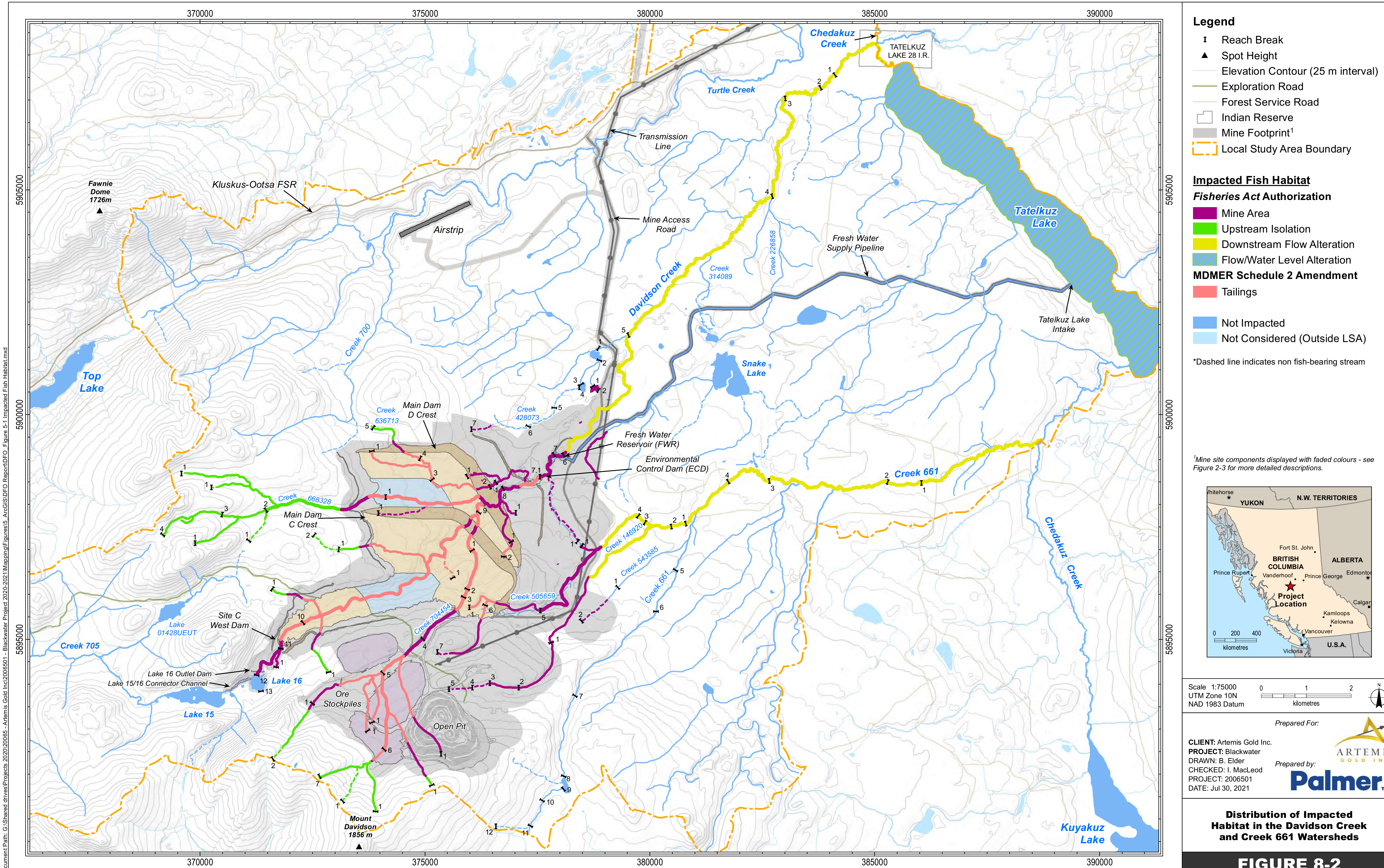
Middle Davidson Creek (Reaches 5 to 8) is 10,179 m long and is located directly downstream of the proposed mine infrastructure (Figure 8-2). This reach will have a flow regime that is controlled by IFN releases from the FWSS. This section of Davidson Creek only supports Rainbow Trout because Kokanee are known to only use lower Davidson Creek (i.e., Reaches 1 to 4), and only for spawning and egg incubation.

The habitat value for this reach, quantified using the AWS over the relevant time periods that different species/life-stages utilized the relevant creek, was determined as the average habitat available over the 40-year baseline timeseries. The units of AWS are m^2/m; to represent the habitat value for the entire reach, they were multiplied by the reach length. Given that flow conditions vary from year to year, AWS values also vary. Therefore, the baseline habitat value was determined using the average of the 40-year timeseries of flow that represents baseline conditions. From this, the IFN was developed to maintain an adequate proportion of habitat value in each of the stanzas (Figure 8-3) The IFN was developed by optimizing flows to maintain a minimum of 90% AWS when compared to the long-term, 40-year average of baseline conditions, Any residual habitat loss between the IFN and the baseline conditions were accounted for in the habitat loss offsetting calculations, and are included in the offset ratios detailed in the FAAA.

This approach coupled the timeseries of simulated baseline monthly flow data for Davidson Creek (Knight Piésold 2021a) with the SEFA-derived streamflow-habitat relationships to generate a 40-year habitat timeseries for each stanza that is representative of historical baseline conditions. The use of a 40-year timeseries is beneficial as it incorporates the considerable hydrological variability that is expected from year to year during the mine life. For this analysis, streamflow in middle Davidson Creek was represented using watershed model node H2, which is located at approximately the same location as the outlet of the FWR.

To estimate what the flows would be without flow augmentation, monthly flows were prorated based on upstream watershed area. At node H2, the contributing area of Davidson Creek will be reduced from 44.9 km^2 to 9.6 km^2; therefore, the timeseries of baseline monthly flows were multiplied by a factor of 0.21 (i.e., 21% of the upstream watershed area would remain with the mine) to estimate what they would be in this unmitigated scenario.

These baseline habitat timeseries were then compared against habitat timeseries developed by coupling the streamflow-habitat relationships to streamflow defined by the IFN and the unmitigated scenario. The difference between the AWS available under baseline conditions and the AWS available under the IFN and unmitigated scenario represent the expected useable habitat loss that would result in Davidson Creek. A separate timeseries analysis was conducted for the relevant timing windows that are associated with each biological stanza.



Distribution of Impacted Habitat in the Davidson Creek and Creek 661 Watersheds

FIGURE 8-2

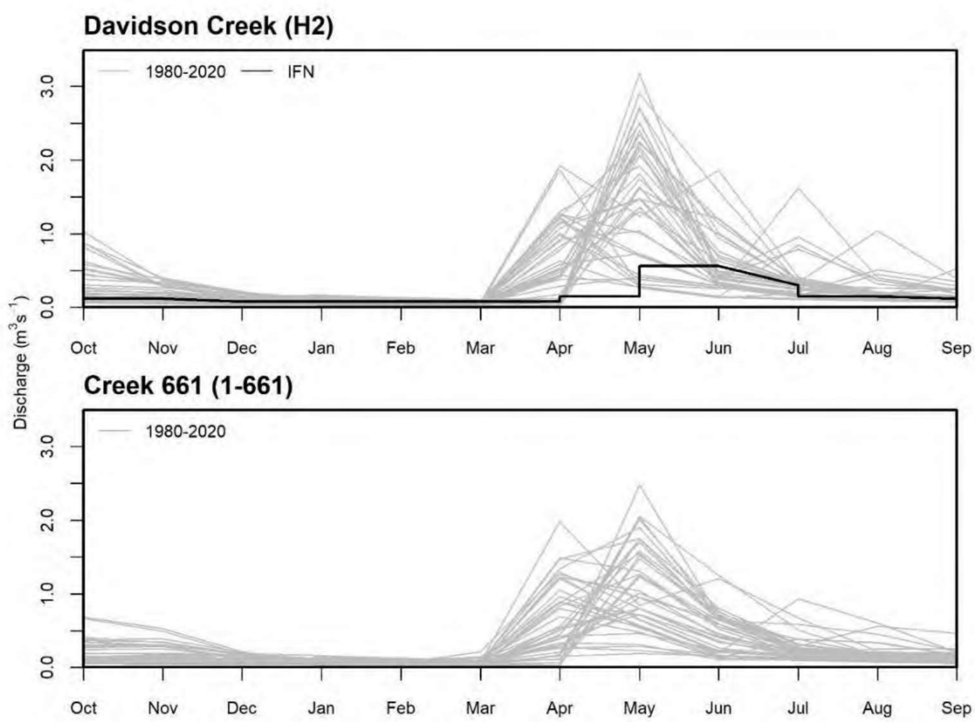


Figure 8-3. Long-term monthly modelled baseline streamflow for Davidson Creek and Creek 661

No SEFA models were developed to quantify overwintering habitat in Davidson Creek and Creek 661. This was because SEFA is unable to quantify habitat conditions under ice cover. However, because the IFN proposed for Davidson Creek will fully recreate median baseline flows during the overwintering period, median habitat conditions during overwintering will be replicated.

<u>Lower Davidson Creek</u>

Lower Davidson Creek (Reaches 1 to 4) is 5,169 m long and is located further downstream from middle Davidson Creek (Figure 8-2). Under operation of the FWSS and/or FWR, this section will exhibit a semi-natural flow regime that represents the combination of IFN releases plus surface and groundwater inputs entering Davidson Creek downstream of the mine infrastructure. This section of Davidson Creek provides Kokanee and Rainbow Trout habitat. Habitat value in lower Davidson Creek was quantified using the same timeseries analysis approach detailed for middle Davidson Creek.

To estimate what the flows would be without flow augmentation, monthly flows were prorated based on watershed area. At node 4-DC, located in Reach 4 of lower Davidson Creek, the contributing area of Davidson Creek will be reduced from 71.3 km^2 to 35.6 km^2; therefore, the timeseries of baseline monthly flows were multiplied by a factor of 0.50 to estimate what they would be in this unmitigated scenario.

Streamflow at this location was defined using watershed model node 4-DC. The flows at 4-DC are expected to be more variable due to runoff contributions and groundwater inputs to Davidson Creek that are generated below the mine footprint, between station H2 and 4-DC. Therefore, the expected flows in lower Davidson Creek when the IFN is being met were estimated considering these additional streamflow inputs.

This was done by subtracting the modelled baseline flows at H2 from 4-DC for each month in the 40-year baseline timeseries to determine the proportion of streamflow at 4-DC that contributed by groundwater and/or tributaries downstream of H2. These downstream flow contributions were then added to the IFN to develop an estimate of lower Davidson streamflow during mine operation. Like in middle Davidson Creek, no losses to overwintering habitat were predicted during this period because the IFN was defined using median flow conditions.

Creek 661

The portions of Creek 661 where habitat loss was quantified using SEFA are as follows (Figure 8-2):

- A 7,525 m section upstream of the confluence of Creek 661 and Chedakuz Creek (Reaches 1 to 3) that provides Kokanee and Rainbow Trout habitat.
- An additional 2,330 m section upstream of the limit of Kokanee habitat and downstream of the Creek 146920 and Creek 543585 tributary streams (Reaches 4 and 5) that provides Rainbow Trout habitat.

Habitat value in these portions of Creek 661 was quantified using the same timeseries analysis approach used for middle and lower Davidson Creek. Streamflow at this location was defined using 40 years of monthly baseline hydrology for the watershed model node 1-661. The contributing area to node 1-661 is 56 km^2, and the mine footprint occupies 10.8 km^2 of its headwaters. Therefore, the baseline hydrology was corrected by a factor of 0.81 to estimate the impacted flow regime under the mine development scenario for all 40-years of the baseline dataset (Figure 8-3). Then, the baseline and affected streamflow timeseries were used to quantify the changes in habitat available under the affected mine scenario using the same timeseries analysis approach detailed for middle and lower Davidson Creek.

Additional portions of Creek 146920 (Reach WID # 2870) and Creek 505659 (Reach WID # 2790, 2800, 2810, 2820, 3450, and 2831) are also downstream of the mine footprint and will be affected by reductions in flow (Figure 8-4 and Figure 8-5). However, given the small size of these tributary streams and the relatively high magnitude of flow alterations expected on these reaches, these reaches are unlikely to contain adequate flow to support fish with the Project. Therefore, the habitat loss from these sections were conservatively quantified using HEP, which assumes that all instream habitat will be destroyed. These reaches are included in the habitat loss quantifications presented in Section 8.1.1.2.

8.4.2 Quantification of Habitat Loss

8.4.2.1 Mine Footprint and Upstream Isolation

This section presents a quantification of fish habitat loss in the areas beneath the mine footprint and in upstream isolation areas. Habitat loss was quantified both by surface area (m^2) to provide context and transparency for the habitat calculations, as well as by HU. The HUs form the basis of the compensation calculations because they include measures of habitat suitability. Riparian losses are presented as the amount of area (m^2) impacted by mine operations.

A summary of affected watercourses and their locations is provided in Table 8-5. Habitat losses by stream section, including instream habitat area (m^2), HUs by Rainbow Trout life stage, and riparian area (m^2), are summarized in Table 8-6. Detailed calculation values for each lost segment from Table 8-6 are provided in Appendix L. Figure 8-4 and Figure 8-5 show the spatial distribution of waterbodies that will be permanently lost.

Most of the affected habitat (79% of the total instream area) is located in the upper reaches of Davidson Creek and its headwater tributaries. The remaining habitat is in the upper reaches of the Creek 661 watershed. As described in Section 8.4.1.4, portions of Creek 146920 and Creek 505659 (and its tributary) in the Creek 661 watershed are also included in the loss calculation, due to loss of upstream catchment area run-off under the mine footprint.

Davidson Creek supports habitat for all life stages of Rainbow Trout, except for adult summer foraging. Adult Rainbow Trout only use habitat in Davidson Creek and Creek 661 watersheds to spawn, not to forage. They return to Tatelkuz Lake in late-June immediately after spawning; therefore, no adult summer foraging HUs were calculated.

Kokanee do not use the stream areas lost under the mine footprint or in upstream isolation areas. Kokanee are predicted to only be impacted by downstream flow alteration, which is discussed in Section 8.4.2.2.

In the Davidson Creek watershed, a total of 96,071 m^2 of instream habitat will be lost (Table 8-5). A total of 73,711 Rainbow Trout HU will be lost, comprised of 6,635 spawning and egg incubation HUs, 23,708 fry summer rearing HUs, 27,170 juvenile summer rearing HUs, and 16,199 overwintering HUs. The Davidson Creek watershed will also be subject to a loss of 372 Food and Nutrient HU. A total of 500,480 m^2 of riparian area will also be lost in the Davidson Creek watershed.

In the Creek 661 watershed, a total of 25,770 m^2 of instream habitat will be lost (Table 8-5). A total of 15,345 Rainbow Trout HUs will be lost, comprised of 3,555 spawning and egg incubation HUs, 3,018 fry summer rearing HUs, 7,589 juvenile summer rearing HUs, and 1,183 overwintering HUs. A total of 284,159 m^2 of riparian area will also be lost in the Creek 661 watershed.

A portion of an unnamed tributary to Snake Lake in the Tatelkuz Lake Tributaries watershed will also be lost. This stream does not support Rainbow Trout; therefore, no Rainbow Trout HUs are calculated. However, 13,647 m^2 of riparian area adjacent to this reach will be lost (Table 8-5).

Table 8-5. Summary of Instream and Riparian Habitat Losses Under the Mine Footprint and Isolated Upstream of the Mine Footprint, Quantified Using HEP Analysis

Watershed	Stream	Length (m)	Instream Area (m^2)	Rainbow Trout Habitat Units						Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m^2)
				Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Total (All Life Stages)	Spawning / Egg Incubation		
Creek 661	Creek 661 Tributaries	794	0	0	0	0	0	0	0	0	0	0
	Creek 146920	6,841	9,452	0	0	2,362	0	0	2,362	0	0	98,369
	Creek 505659	7,974	14,653	3,555	3,018	5,115	0	1,183	12,871	0	0	181,333
	Creek 505659 Tributaries	507	1,665	0	0	112	0	0	112	0	0	4,457
Creek 661 Watershed Total		**16,116**	**25,770**	**3,555**	**3,018**	**7,589**	**0**	**1,183**	**15,345**	**0**	**0**	**284,159**
Davidson Creek	Davidson Creek Mainstem	3,847	16,958	4,013	8,026	5,978	0	4,240	22,257	0	0	115,405
	Davidson Creek Tributaries	8,157	11,659	0	852	1,634	0	852	3,338	0	144	39,316
	Creek 636713	3,086	14,265	0	2,681	4,114	0	2,681	9,476	0	0	28,634
	Creek 636713 Tributaries	1,089	2,302	0	0	179	0	0	179	0	0	10,063
	Creek 688328	5,342	7,991	1,689	2,954	2,049	0	1,140	7,832	0	0	108,065
	Creek 688328 Tributaries	6,965	4,091	0	0	1,206	0	0	1,206	0	0	48,803
	Creek 704454	3,231	8,117	933	3,683	4,087	0	1,774	10,476	0	0	70,125
	Creek 704454 Tributaries	6,518	8,641	0	0	2,411	0	0	2,411	0	228	76,834
	Creek 428073	632	22,047	0	5,512	5,512	0	5,512	16,536	0	0	3,235
Davidson Creek Watershed total		**38,867**	**96,071**	**6,635**	**23,708**	**27,170**	**0**	**16,199**	**73,711**	**0**	**372**	**500,480**
Tatelkuz Lake Tributary	Unnamed	1,365	-	0	0	0	0	0	0	0	0	13,647
Grand Total		**56,348**	**121,841**	**10,190**	**26,726**	**34,759**	**0**	**17,382**	**89,056**	**0**	**372**	**798,286**

Table 8-6. Detailed List of Instream and Riparian Habitat Losses Under the Mine Footprint and Isolated Upstream of the Mine Footprint, by Stream Segments, Quantified using HEP.

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m^2)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
Downstream Flow Loss	Creek 661	Creek 146920	1	Confirmed Fish-Bearing	2870	S3	1,979	3,265	0	0	816	0	0	0	0	59,366
	Creek 661	Creek 505659	1	Confirmed Fish-Bearing	2790	S3	463	1,951	1,699	614	0	0	0	0	0	13,895
	Creek 661	Creek 505659	2	Confirmed Fish-Bearing	2800	S3	358	1,333	763	354	529	0	397	0	0	10,730
	Creek 661	Creek 505659	3	Confirmed Fish-Bearing	2810	S3	636	3,144	1,093	2,050	786	0	786	0	0	19,065
	Creek 661	Creek 505659	4	Confirmed Fish-Bearing	2820	S3	219	411	0	0	103	0	0	0	0	6,557
	Creek 661	Creek 505659	5	Confirmed Fish-Bearing	3450	S3	1,180	2,218	0	0	1,109	0	0	0	0	35,394
	Creek 661	Creek 505659	5	Confirmed Fish-Bearing	2831	S3	6	9	0	0	4	0	0	0	0	172
Mine Footprint	Creek 661	Creek 146920	1	Unconfirmed Fish-Bearing	3730	S3	1,794	2,907	0	0	727	0	0	0	0	17,943
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	3731	S3	534	865	0	0	216	0	0	0	0	5,340
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	2880	S3	160	259	0	0	65	0	0	0	0	1,600
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	3720	S3	617	999	0	0	250	0	0	0	0	6,165
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	2891	S3	82	133	0	0	33	0	0	0	0	823
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	2892	S3	53	86	0	0	21	0	0	0	0	529
	Creek 661	Creek 146920	3	Unconfirmed Fish-Bearing	2900	S4	660	938	0	0	234	0	0	0	0	6,603
	Creek 661	Creek 146920	4	Non-Fish-Bearing	2910	NCD	406	0	0	0	0	0	0	0	0	0
	Creek 661	Creek 146920	5	Non-Fish-Bearing	2930	NCD	69	0	0	0	0	0	0	0	0	0
	Creek 661	Creek 146920	5	Non-Fish-Bearing	2920	NCD	348	0	0	0	0	0	0	0	0	0
	Creek 661	Creek 146920	5	Non-Fish-Bearing		NCD	107	0	0	0	0	0	0	0	0	0
	Creek 661	Creek 146920	5	Non-Fish-Bearing	2860	NCD	32	0	0	0	0	0	0	0	0	0
	Creek 661	Creek 505659	5	Confirmed Fish-Bearing	2832	S3	2,378	3,615	0	0	1,807	0	0	0	0	71,348
	Creek 661	Creek 505659	6	Unconfirmed Fish-Bearing	2840	S4	668	648	0	0	324	0	0	0	0	6,681
	Creek 661	Creek 505659	6	Unconfirmed Fish-Bearing	3440	S4	357	347	0	0	173	0	0	0	0	3,573
	Creek 661	Creek 505659	6	Unconfirmed Fish-Bearing	2850	S4	147	143	0	0	71	0	0	0	0	1,471
	Creek 661	Creek 505659	7	Unconfirmed Fish-Bearing	3432	S4	107	72	0	0	18	0	0	0	0	1,071
	Creek 661	Creek 505659	7	Unconfirmed Fish-Bearing	2770	S4	1138	762	0	0	191	0	0	0	0	11,376
	Creek 661	Creek 505659	7	Non-Fish-Bearing	2760	NVC	317	0	0	0	0	0	0	0	0	0

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m^2)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
	Creek 661	Creek 505659 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	2940	-	135	163	0	0	41	0	0	0	0	1,346
	Creek 661	Creek 505659 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	2950	-	235	284	0	0	71	0	0	0	0	2,348
	Creek 661	Creek 505659 Tributary	-	Non-Fish-Bearing	W104	-	137	1,218	0	0	0	0	0	0	0	763
	Creek 661	Creek 661 Tributary	2	Non-Fish-Bearing	2990	NVC	794	0	0	0	0	0	0	0	0	0
	Davidson Creek	Creek 428073	-	Unconfirmed Fish-Bearing	W41	-	632	22,047	0	5,512	5,512	0	5,512	0	0	3,235
	Davidson Creek	Creek 636713	1	Unconfirmed Fish-Bearing	1370	S3	123	189	0	0	94	0	0	0	0	1,233
	Davidson Creek	Creek 636713	1	Unconfirmed Fish-Bearing	1412	S3	1,027	1,571	0	0	785	0	0	0	0	10,267
	Davidson Creek	Creek 636713	2	Unconfirmed Fish-Bearing	1380	S3	33	50	0	0	25	0	0	0	0	325
	Davidson Creek	Creek 636713	3	Unconfirmed Fish-Bearing	1390	S4	9	12	0	0	6	0	0	0	0	94
	Davidson Creek	Creek 636713	3	Unconfirmed Fish-Bearing	1391	S4	72	96	0	0	48	0	0	0	0	724
	Davidson Creek	Creek 636713	3	Unconfirmed Fish-Bearing	3880	S4	210	279	0	0	139	0	0	0	0	2,098
	Davidson Creek	Creek 636713	5	Unconfirmed Fish-Bearing	1362	S4	70	81	0	0	20	0	0	0	0	696
	Davidson Creek	Creek 636713	5	Unconfirmed Fish-Bearing	3840	S4	311	364	0	0	91	0	0	0	0	3,110
	Davidson Creek	Creek 636713	-	Unconfirmed Fish-Bearing	W44	-	461	10,722	0	2,681	2,681	0	2,681	0	0	2,382
	Davidson Creek	Creek 636713 Tributary	0	No Data (Default Unconfirmed Fish-Bearing)	1470	-	28	22	0	0	6	0	0	0	0	280

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m²)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m²)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
	Davidson Creek	Creek 636713 Tributary	0	No Data (Default Unconfirmed Fish-Bearing)	1479	-	40	32	0	0	8	0	0	0	0	404
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1430	-	52	42	0	0	10	0	0	0	0	524
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1440	-	65	52	0	0	13	0	0	0	0	649
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1450	-	362	289	0	0	72	0	0	0	0	3,617
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1460	-	183	146	0	0	37	0	0	0	0	1,831
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3850	-	12	10	0	0	2	0	0	0	0	121
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1449	-	44	36	0	0	9	0	0	0	0	444
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1459	-	89	71	0	0	18	0	0	0	0	885
	Davidson Creek	Creek 636713 Tributary	1	Unconfirmed Fish-Bearing	1482	S4	15	15	0	0	4	0	0	0	0	154
	Davidson Creek	Creek 636713 Tributary	-	Non-Fish-Bearing	W96	-	142	1,355	0	0	0	0	0	0	0	789
	Davidson Creek	Creek 636713 Tributary	-	Non-Fish-Bearing	W100	-	57	232	0	0	0	0	0	0	0	365
	Davidson Creek	Creek 688328	1	Confirmed Fish-Bearing	1571	S3	234	612	168	367	205	0	153	0	0	7,012
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1581	S3	251	461	153	260	115	0	99	0	0	7,536

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m²)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m²)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1592	S3	443	813	270	459	203	0	175	0	0	13,297
	Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1602	NVC	1,120	0	0	0	0	0	0	0	0	0
	Davidson Creek	Creek 704454	1	Confirmed Fish-Bearing	1732	S3	279	1,105	33	516	771	0	268	0	0	8,385
	Davidson Creek	Creek 704454	4	Confirmed Fish-Bearing	1772	S3	265	725	0	286	494	0	171	0	0	7,957
	Davidson Creek	Creek 704454	4	Confirmed Fish-Bearing	1760	S3	767	2,095	0	827	1,428	0	495	0	0	23,010
	Davidson Creek	Creek 704454	5	Confirmed Fish-Bearing	1780	S3	462	2,879	771	1,761	952	0	720	0	0	13,846
	Davidson Creek	Creek 704454	5	Confirmed Fish-Bearing	1781	S3	117	480	129	293	159	0	120	0	0	3,511
	Davidson Creek	Creek 704454	6	Unconfirmed Fish-Bearing	3382	S3	25	43	0	0	21	0	0	0	0	254
	Davidson Creek	Creek 704454	7	Unconfirmed Fish-Bearing	1721	S4	18	11	0	0	6	0	0	0	0	185
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1800	S4	1,059	1,239	0	0	310	0	0	0	0	10,587
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3420	S4	801	857	0	0	214	0	0	0	0	8,009
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1882	S4	366	340	0	0	85	0	0	0	0	3,661
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1883	S4	160	149	0	0	37	0	0	0	0	1,600
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3371	S4	357	332	0	0	83	0	0	0	0	3,570
	Davidson Creek	Creek 704454 Tributary	2	Unconfirmed Fish-Bearing	1831	S4	125	134	0	0	33	0	0	0	0	1,250
	Davidson Creek	Davidson Creek Mainstem	6	Confirmed Fish-Bearing	813	S3	84	437	150	275	121	0	117	0	0	2,523

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m²)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m²)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
	Davidson Creek	Davidson Creek Mainstem	7	Confirmed Fish-Bearing	820	S2	231	1,154	0	460	761	0	288	0	0	6,945
	Davidson Creek	Davidson Creek Mainstem	7.1	Confirmed Fish-Bearing	830	S2	788	4,415	1,005	1,767	950	0	763	0	0	23,652
	Davidson Creek	Davidson Creek Mainstem	8	Confirmed Fish-Bearing	842	S3	48	337	99	199	124	0	111	0	0	1,446
	Davidson Creek	Davidson Creek Mainstem	8	Confirmed Fish-Bearing	843	S3	8	53	16	31	20	0	17	0	0	228
	Davidson Creek	Davidson Creek Mainstem	8	Confirmed Fish-Bearing	851	S3	19	132	39	78	49	0	43	0	0	568
	Davidson Creek	Davidson Creek Mainstem	8	Confirmed Fish-Bearing	860	S3	384	2,686	786	1,583	987	0	882	0	0	11,526
	Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	731	S3	72	395	110	235	147	0	131	0	0	2,169
	Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	870	S3	113	615	172	365	228	0	203	0	0	3,376
	Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	880	S3	12	64	18	38	24	0	21	0	0	353
	Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	890	S3	586	3,201	894	1,903	1,188	0	1,058	0	0	17,584
	Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	3800	S3	38	208	58	124	77	0	69	0	0	1,144
	Davidson Creek	Davidson Creek Mainstem	10	Confirmed Fish-Bearing	3812	S3	293	869	666	245	140	0	105	0	0	8,780
	Davidson Creek	Davidson Creek Mainstem	11	Confirmed Fish-Bearing	712	S4	158	324	0	109	185	0	71	0	0	4,727
	Davidson Creek	Davidson Creek Mainstem	11	Confirmed Fish-Bearing	3830	S4	51	105	0	35	60	0	23	0	0	1,533
	Davidson Creek	Davidson Creek Mainstem	12	Confirmed Fish-Bearing	670	S3	900	1,837	0	542	858	0	316	0	0	27,005
	Davidson Creek	Davidson Creek Mainstem	12	Confirmed Fish-Bearing	680	S3	17	35	0	10	16	0	6	0	0	507

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m²)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m²)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
	Davidson Creek	Davidson Creek Mainstem	12	Confirmed Fish-Bearing	690	S3	45	91	0	27	43	0	16	0	0	1,339
	Davidson Creek	Davidson Creek Tributary	1	Non-Fish-Bearing	1320	NVC	1,816	0	0	0	0	0	0	0	0	0
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1330	S4	39	57	0	0	14	0	0	0	0	388
	Davidson Creek	Davidson Creek Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1500	-	83	66	0	0	17	0	0	0	0	829
	Davidson Creek	Davidson Creek Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3780	-	60	48	0	12	12	0	12	0	0	602
	Davidson Creek	Davidson Creek Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3790	-	264	211	0	0	53	0	0	0	0	2,641
	Davidson Creek	Davidson Creek Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3799	-	40	32	0	0	8	0	0	0	0	404
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1510	S4	1,020	765	0	0	191	0	0	0	0	10,203
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1922	S4	228	219	0	0	55	0	0	0	0	2,277
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1961	S4	362	565	0	0	141	0	0	0	0	3,622
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1972	S4	79	124	0	0	31	0	0	0	0	793
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1981	S4	273	322	0	0	80	0	0	0	0	2,729
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1992	S4	114	135	0	0	34	0	0	0	0	1,142
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	2000	S4	299	346	0	0	87	0	0	0	0	2,985
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	2010	S4	19	22	0	0	5	0	0	0	0	189

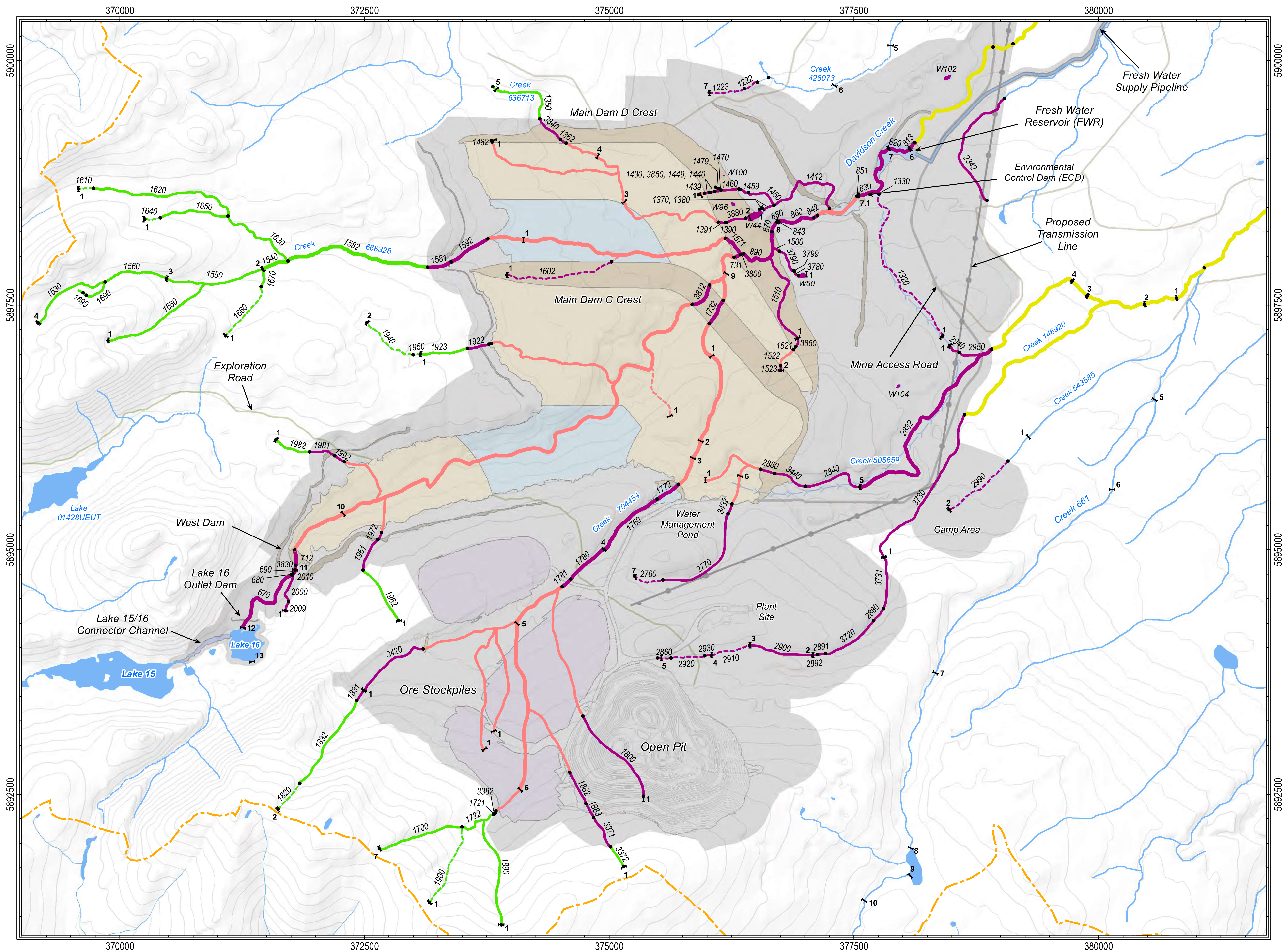
Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m²)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m²)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	2009	S4	105	122	0	0	31	0	0	0	0	1,053
	Davidson Creek	Davidson Creek Tributary	2	No Data (Default Unconfirmed Fish-Bearing)	1521	-	40	30	0	0	7	0	0	0	0	397
	Davidson Creek	Davidson Creek Tributary	2	No Data (Default Unconfirmed Fish-Bearing)	1523	-	51	39	0	0	10	0	0	0	0	514
	Davidson Creek	Davidson Creek Tributary	2	No Data (Default Unconfirmed Fish-Bearing)	3860	-	94	70	0	0	18	0	0	0	0	937
	Davidson Creek	Davidson Creek Tributary	7	Non-Fish-Bearing	1222	S6	154	169	0	0	0	0	0	0	42	1,538
	Davidson Creek	Davidson Creek Tributary	7	Non-Fish-Bearing	1223	S6	370	407	0	0	0	0	0	0	102	3,696
	Davidson Creek	Davidson Creek Tributary	-	Unconfirmed Fish-Bearing	W50	-	236	3,361	0	840	840	0	840	0	0	1,258
	Davidson Creek	Davidson Creek Tributary	-	Non-Fish-Bearing	W102	-	208	2,631	0	0	0	0	0	0	0	1,119
	Tatelkuz Lake Tributary	Tatelkuz Lake Tributary	1	Non-Fish-Bearing	2342	-	1,365	0	0	0	0	0	0	0	0	13,647
Upstream Area	Davidson Creek	Creek 636713	5	Unconfirmed Fish-Bearing	1350	S4	770	901	0	0	225	0	0	0	0	7,705
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1540	S3	282	517	172	292	129	0	112	0	0	8,466
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1582	S3	1,522	2,790	926	1,576	697	0	601	0	0	45,655
	Davidson Creek	Creek 688328	3	Unconfirmed Fish-Bearing	1550	S4	1,026	1,436	0	0	359	0	0	0	0	10,258
	Davidson Creek	Creek 688328	4	Unconfirmed Fish-Bearing	1530	S4	907	780	0	0	195	0	0	0	0	9,068
	Davidson Creek	Creek 688328	4	Unconfirmed Fish-Bearing	1560	S4	677	582	0	0	146	0	0	0	0	6,773
	Davidson Creek	Creek 688328 Tributary	0	Unconfirmed Fish-Bearing	1699	-	42	30	0	0	7	0	0	0	0	425

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m²)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m²)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
	Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1610	NVC	156	0	0	0	0	0	0	0	0	0
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1620	S4	1,556	1,338	0	0	334	0	0	0	0	15,555
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1630	S4	850	731	0	0	366	0	0	0	0	8,502
	Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1640	NVC	161	0	0	0	0	0	0	0	0	0
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1650	S4	728	655	0	0	164	0	0	0	0	7,278
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1670	S4	197	151	0	0	38	0	0	0	0	1,966
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1680	S4	1,188	962	0	0	241	0	0	0	0	11,879
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1690	S4	320	224	0	0	56	0	0	0	0	3,198
	Davidson Creek	Creek 688328 Tributary	2	Non-Fish-Bearing	1660	NVC	647	0	0	0	0	0	0	0	0	0
	Davidson Creek	Creek 704454	7	Unconfirmed Fish-Bearing	1722	S4	409	246	0	0	123	0	0	0	0	4,092
	Davidson Creek	Creek 704454	7	Unconfirmed Fish-Bearing	1700	S4	889	533	0	0	133	0	0	0	0	8,885
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1890	S3	1,137	3,332	0	0	833	0	0	0	0	11,370
	Davidson Creek	Creek 704454 Tributary	1	Non-Fish-Bearing	1900	S6	876	911	0	0	0	0	0	0	228	8,761
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3372	S4	243	226	0	0	57	0	0	0	0	2,433
	Davidson Creek	Creek 704454 Tributary	2	Unconfirmed Fish-Bearing	1832	S4	1,048	1,121	0	0	280	0	0	0	0	10,475
	Davidson Creek	Creek 704454 Tributary	3	Non-Fish-Bearing	1820	NVC	346	0	0	0	0	0	0	0	0	0
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1923	S4	493	473	0	0	118	0	0	0	0	4,929
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1962	S4	638	995	0	0	249	0	0	0	0	6,377

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m²)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m²)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1982	S4	381	450	0	0	112	0	0	0	0	3,812
	Davidson Creek	Davidson Creek Tributary	2	Non-Fish-Bearing	1940	NVC	616	0	0	0	0	0	0	0	0	0
	Davidson Creek	Davidson Creek Tributary	2	Non-Fish-Bearing	1950	NVC	75	0	0	0	0	0	0	0	0	0
Total							**56,348**	**121,841**	**10,190**	**26,726**	**34,759**	**0**	**17,382**	**0**	**372**	**798,286**

Notes:

1. *Reach numbers are based on the Reach Breaks defined in Appendix 5.1.2.6A of the Application/EIS (New Gold 2014)*
2. *The Water Feature Identifier (WFID) is a unique number assigned to identify a water feature segment (including streams, ponds, and lakes)*
3. *Stream Class ratings are based on those assigned in Appendix 5.1.2.6A of the Application/EIS (New Gold 2014) following the BC Forest Practices Code classification system. S3 streams are fish-bearing with a channel width of 1.5 ≥ 5 m. S4 streams are fish-bearing with a channel width < 1.5 m. S6 streams are non-fish-bearing with a width < 3 m. NVC refers to non-visible channels that do not support fish habitat. NCD refers to a non-classified drainage that does not support fish habitat. A dash "-" indicates that no stream classification was assigned in the Application/EIS dataset.*
4. *Channel lengths and areas rounded to the nearest metre*



Legend

- Reach Break
- Segment Break
- Elevation Contour (25 m interval)
- Exploration Road
- Forest Service Road
- Mine Footprint
- Local Study Area Boundary

Impacted Fish Habitat

***Fisheries Act* Authorization**

- Mine Area
- Upstream Isolation
- Downstream Flow Alteration

MDMER Schedule 2 Amendment

- Tailings
- Not Impacted
- Not Considered (Outside LSA)

Notes:
1. Segment number refers to unique Water Feature Identifier (WFID).
2. Dashed line indicates Non Fish-bearing status.

*Mine site components displayed with faded colours - see Figure 2-3 for more detailed descriptions.

Scale 1:38000
UTM Zone 10N
NAD 1983 Datum

0 0.5 1
kilometres

Prepared For:

ARTEMIS GOLD INC

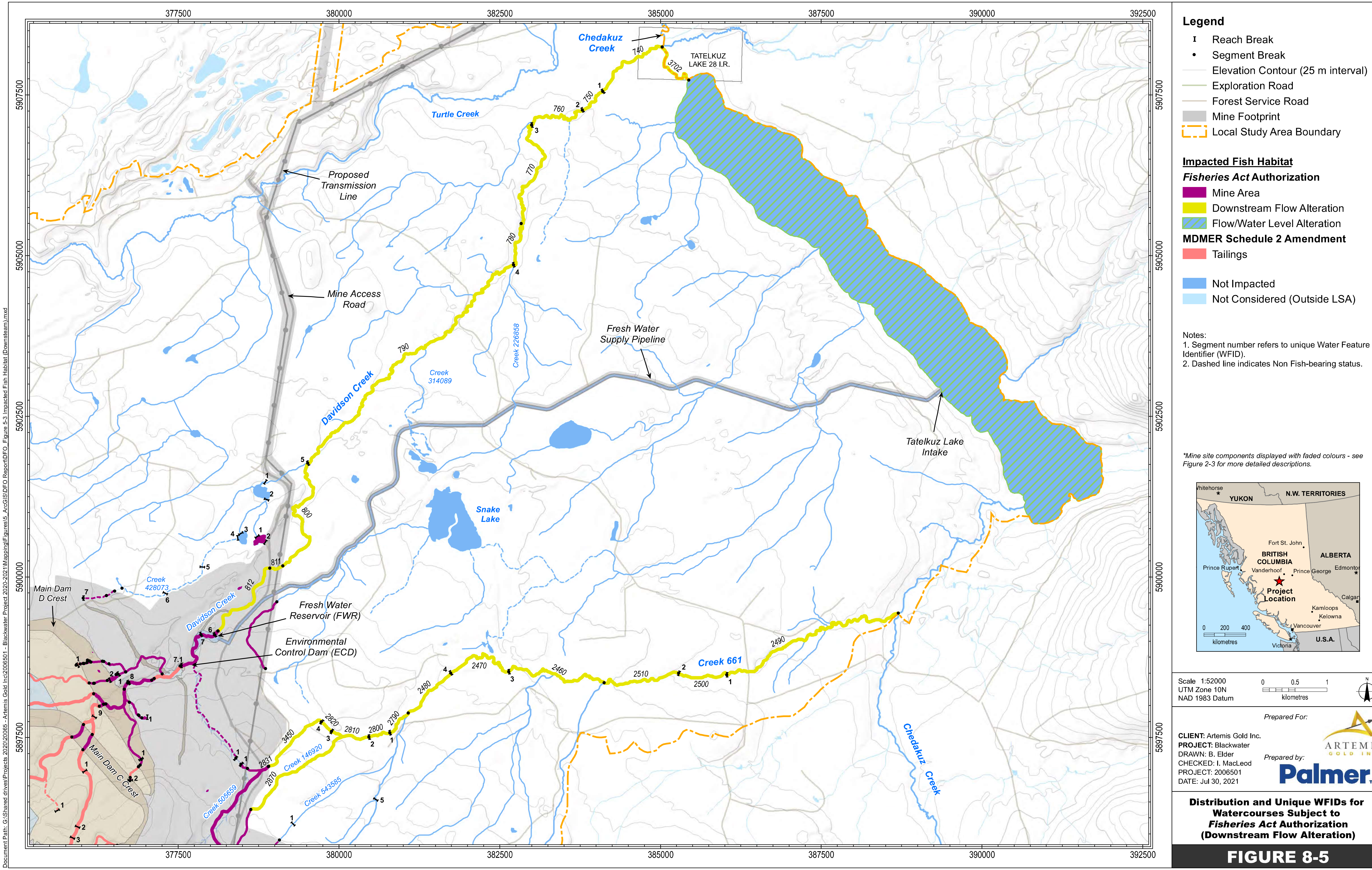
CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Jul 30, 2021

Prepared by:

Palmer

Distribution and Unique WFIDs for Watercourses Subject to *Fisheries Act* Authorization (Mine Area and Upstream Isolation)

FIGURE 8-4


Legend
Reach Break
Segment Break
Elevation Contour (25 m interval)
Exploration Road
Forest Service Road
Mine Footprint
Local Study Area Boundary
Impacted Fish Habitat
Fisheries Act Authorization
Mine Area
Downstream Flow Alteration
Flow/Water Level Alteration
MDMER Schedule 2 Amendment
Tailings
Not Impacted
Not Considered (Outside LSA)
Notes:
1. Segment number refers to unique Water Feature Identifier (WFID).
2. Dashed line indicates Non Fish-bearing status.
*Mine site components displayed with faded colours - see Figure 2-3 for more detailed descriptions.
Chedakuz Creek
TATELKUZ LAKE 28 I.R.
Turtle Creek
Proposed Transmission Line
Mine Access Road
Fresh Water Supply Pipeline
Tatelkuz Lake Intake
Davidson Creek
Creek 314089
Creek 226858
Snake Lake
Creek 428073
Main Dam D Crest
Fresh Water Reservoir (FWR)
Environmental Control Dam (ECD)
Creek 661
Creek 146920
Creek 543585
Creek 505659
Main Dam C Crest
Chedakuz Creek
Whitehorse
YUKON
N.W. TERRITORIES
Fort St. John
BRITISH COLUMBIA
ALBERTA
Prince Rupert
Vanderhoof
Prince George
Edmonton
Project Location
Kamloops
Kelowna
Vancouver
Victoria
U.S.A.
kilometres
Scale 1:52000
UTM Zone 10N
NAD 1983 Datum
Prepared For:
ARTEMIS GOLD INC
CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Jul 30, 2021
Prepared by:
Palmer
Distribution and Unique WFIDs for Watercourses Subject to Fisheries Act Authorization (Downstream Flow Alteration)
FIGURE 8-5
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8.4.2.2 Downstream Flow Alteration

As described in Section 3.1.9 (Freshwater Supply System), the life of mine water balance (Knight Piésold 2021a) indicates that under average climate conditions, the FWSS is not required to meet IFN in Davidson Creek during Construction and the first five years of Operations. When considering a range of potential climate scenarios, under the scenario of a drier than average year there is a 25% likelihood that the IFN in Davidson Creek may not be met during the first 5 years of Operations. From Year 6 of Operations through Closure, the FWSS is predicted to be consistently needed to provide approximately 10% to 40% of total annual IFN flows under average conditions. Therefore, downstream flow alteration was quantified by calculating hypothetical unmitigated habitat losses (i.e., without operation of the FWSS) in Davidson Creek after Year 6 of Operations.

The hypothetical habitat losses that would occur in Davidson Creek after Year 6 of Operations without flow augmentation provided by the FWR or FWSS to meet the IFN in Davidson Creek are outlined in Table 8-7. However, this potential habitat loss of 21,103 HU is not expected to occur in reality, because flows within Davidson Creek will be augmented in accordance with the IFN.

Table 8-7. Difference in HUs Between the Unmitigated Flow Scenario and the IFN in Davidson Creek.

Affected Stream Section	**Rainbow Trout Life Stage[1]**			**Kokanee Life Stage**
	Fry Summer Rearing	Juvenile Summer Rearing	Adult[2]	Adult[2]
Lower Davidson Creek	0	1,097	2,646	2,140
Middle Davidson Creek	4,632	5,413	5,175	NA
Sub-Totals	**4,632**	**6,510**	**7,821**	**2,140**
Species Totals	**18,963**			**2,140**
Grand Total	**21,103**			

Notes:

1. *Overwintering habitat losses are not quantified using SEFA.*
2. *Adult life stages consider foraging, migration, and spawning.*

The residual habitat loss between baseline conditions and the IFN for Davidson Creek and the anticipated habitat loss in Creek 661 are presented in Table 8-8 and shown in Figure 8-5. This estimate of residual loss is based on the assumption that the IFN in Davidson Creek will be met during all climate conditions. There is no flow augmentation proposed for Creek 661, so the residual loss values are reflective of the unmitigated expected loss of flow in the modelled reaches.

Due to the optimization of the timing of streamflow and the non-linear nature between streamflow and fish habitat (Figure 8-1), reductions in streamflow that are associated with the IFN are expected to result in relatively minor impacts to fish and fish habitat in Davidson Creek and Creek 661. In Davidson Creek, the IFN reduces variability in streamflow and eliminates naturally low flow conditions in late summer, early fall, and winter that are habitat limiting (see Appendix C for further discussion). Although the flows in Davidson Creek are less under the IFN than during baseline conditions, the magnitude and timing of IFN flows are designed to provide the least change to habitat quantity and quality in Davidson Creek and, therefore, the greatest opportunity to maintain fish production in the middle and lower reaches. In Creek 661, the flow reductions are expected to be relatively small (i.e., 19% reduction annually compared to baseline) that results in the change in HU's observed in Table 8-8.

No loss of riparian habitat downstream of the mine footprint is anticipated following flow augmentation in Davidson Creek.

Table 8-8. Residual habitat loss in HUs between IFN and baseline flows (Davidson Creek) and expected habitat loss in Creek 661.

Affected Stream Section	Rainbow Trout Life Stage[1]			Kokanee Life Stage
	Fry Summer Rearing	Juvenile Summer Rearing	Adult[2]	Adult[2]
Lower Davidson Creek	0	0	0	5
Middle Davidson Creek	0	396	0	NA
Creek 661	0	458	6	558
Sub-Totals	**0**	**854**	**6**	**563**
Species Totals	**860**			**563**
Grand Total	**1,423**			

Notes:

1. *Overwintering habitat losses are not quantified using SEFA.*
2. *Adult life stages consider foraging, migration, and spawning.*

8.4.2.3 Linear Corridors

The eight fish-bearing watercourse crossings and the pumping station installation associated with the FWSS, the five fish-bearing watercourse crossings associated with the mine access road, and the one fish-bearing crossing associated with the airstrip access road all have the potential to result in temporary or permanent loss of riparian habitat.

Table 8-9 shows the riparian losses associated with the linear corridors. Riparian habitat loss is assumed to be permanent within the 10 m corridor of the eight fish-bearing stream crossings associated with the FWSS plus the 15 m riparian buffer width on each side of these eight streams for a total of 2,400 m^2. Riparian habitat loss associated with pumping station for the FWSS is conservatively estimated to be 500 m^2, based on current design. Riparian habitat loss associated with the five fish-bearing stream crossings associated with the mine access road is estimated to be 1,500 m^2 based on a 10 m RoW plus a 15 m buffer width on each side of each stream. Riparian habitat loss associated with the airstrip access road (assumed to be 10 m wide) is 300 m^2 at its one fish-bearing stream crossing. Table 8-9 shows the riparian losses associated with the linear corridors.

Table 8-9. Riparian losses associated with linear corridors

Component	Number of Fish-Bearing Stream Crossings	RoW Width Within Riparian Buffer (m)	Riparian Buffer Width[1] (m^2)	Riparian Area Loss (m^2)
FWSS Pipeline	8	10	15	2,400
FWSS Pump station	n/a	n/a	n/a	500
Mine Access Road	5	10	15	1,500
Airstrip Access Road	1	10	15	300
Totals	**13**	**-**	**-**	**4,700**

Notes:

1. *Riparian buffer width is applied to both sides of the stream (e.g., a 15 m buffer results in 30 m of total riparian buffer width).*

RoW = Right of Way

9. Habitat Credit

Section 9 of this report contains the required information (see also Table C-1) as specified in:

"Section 15. The number of habitat credits that the applicant plans to use to offset the harmful alteration, disruption or destruction of fish habitat referred to in section 14, as well as the number of any certificate referred to in paragraph 42.02(1)(b) of the Act."

[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 15]

BW Gold does not have habitat credits to use towards offsetting the unavoidable HADD of fish habitat caused by construction, operation, and closure of the Project. Therefore, an offsetting plan (Section 10) has been developed to counterbalance the HADD of fish habitat.

10. Offsetting Plan

Section 10 of this report contains the required information (see also Table C-1) as specified in:

"Section 16. A detailed description of a plan to offset the harmful alteration, disruption or destruction of fish habitat referred to in section 14 that were not offset by the habitat credits referred to in section 15, including

(a) the geographic coordinates of the location where offsetting measures will be implemented;

(b) a small-scale site plan identifying the general location and boundaries of the location where the measures will be implemented;

(c) a detailed description of the measures and how those measures will meet their objectives;

(d) a detailed description of the monitoring measures that will be implemented to assess the effectiveness of the measures referred to in paragraph (c);

(e) a detailed description of the contingency measures and associated monitoring measures that will be implemented if the measures referred to in paragraph (c) do not meet their objectives;

(f) a detailed description of any adverse effects on fish and fish habitat that could result from the implementation of the plan;

(g) a detailed description of the measures and standards that will be implemented to avoid or mitigate the adverse effects and how those measures will meet their objectives;

(h) the timeline for the implementation of the plan;

(i) an estimate of the cost of implementing each element of the plan; and

(j) if the implementation of the plan requires access to lands, water sources or water bodies that are not owned by the applicant, a description of the steps that are proposed to be taken to obtain the authorization required for the applicant, the Department of Fisheries and Oceans and anyone authorized to act on the Department's behalf to access the lands, water sources or water bodies in question. This information is not required if the applicant is Her Majesty in right of Canada, Her Majesty in right of a province or the government of a territory."

[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 16]

BW Gold has designed the Project, to the extent possible, to avoid HADD of fish habitat and death of fish through project design, refinement and mitigation. Despite these efforts, HADD of fish habitat in the Davidson Creek and Creek 661 watersheds is unavoidable. Specifically, HADD of fish habitat will include habitat loss directly under the mine footprint and in upstream isolation areas, and alteration of downstream habitat. Offsetting measures are necessary to counterbalance the resulting unavoidable HADD of fish habitat.

This Offsetting Plan has been prepared in accordance with DFO's guiding principles, as outlined in its *Measures to Protect Fish and Fish Habitat* (DFO 2019). It also aligns with guidance provided in the *Applicant's Guide Supporting the "Authorizations Concerning Fish and Fish Habitat Protection Regulations"* (DFO 2020), as well as provincial fisheries management objectives and prioritizes measures that address existing limitations on fisheries productivity within and beyond the Project area.

Two broad fisheries management objectives were used to guide development of potential offsetting measures:

- Protect and increase freshwater fish stocks; and
- Rehabilitate habitat used by freshwater fish.

The proposed offsetting measures focus on providing habitat benefits for Rainbow Trout and Chinook Salmon (*Oncorhynchus tshawytscha),* as well as the other species that are part of the diverse fish community in the watersheds within which the offsets are located. Rainbow trout is the dominant fish species identified in the upper reaches of the Davidson Creek and Creek 661 watersheds and the most widely distributed sport-fish species in the RSA. Chinook Salmon will not be directly impacted by the Project but are known to use numerous streams in Nechako River watershed for spawning. Therefore, Chinook Salmon are used as a representative species for Pacific Salmon in the habitat accounting for offsetting measures. Both Rainbow Trout and Chinook Salmon are important recreational fish species in BC and are culturally important to Indigenous people. The proposed offsetting measures are biologically relevant and provide the greatest likelihood of counterbalancing losses in the long term.

10.1 Offsetting Alternatives

Since the initiation of baseline aquatic studies in 2011, more than 30 candidate opportunities for fish habitat offsetting have been identified through a comprehensive and systematic review of undisturbed and previously impacted aquatic ecosystems in the region encompassing the Project. The Conceptual Fisheries Mitigation and Offsetting Plan (AMEC 2014a; Appendix 5.1.2.6C of the Application/EIS) documents a comprehensive identification and evaluation of 19 on-site[13] and 12 off-site offsetting options, and describes options determined most likely to provide direct benefits to the fisheries affected by the Project, and to the people relying on these fisheries for sport, commercial, or traditional purposes. Additional offsetting opportunities were identified since the submission of the Application/EIS, including six options proposed by the Carrier Sekani First Nations (PECG 2017), and one option proposed by the Ulkatcho First Nation. Other options, including ranchland stream restoration in the Vanderhoof agricultural district, and overwintering ponds, were identified in 2016 and 2017 through consultation with the Nechako Environment and Water Stewardship Society (NEWSS).

Feasibility assessments were conducted for the options presented and field evaluations were conducted for potentially feasible options. However, many of the evaluated options were not carried forward due to constraints associated with access, low likelihood of biological success, jurisdictional and property ownership issues, technical feasibility, and long-term sustainability. Evaluation of offsetting options carried forward to detailed design considered DFO's hierarchy of preferences, feedback from Indigenous nations, technical feasibility, biological relevance, certainty in success (risk of failure), and relative cost.

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[13] *Offsetting measures within the LSA are considered "on-site", whereas those outside of the LSA boundaries are considered "off-site".*

10.2 Selection of Offsetting Measures

Section 10.2 of this report contains the required information (see also Table C-1) as specified in:

Section 16(a) the geographic coordinates of the location where offsetting measures will be implemented; (b) a small-scale site plan identifying the general location and boundaries of the location where the measures will be implemented;

[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 16]

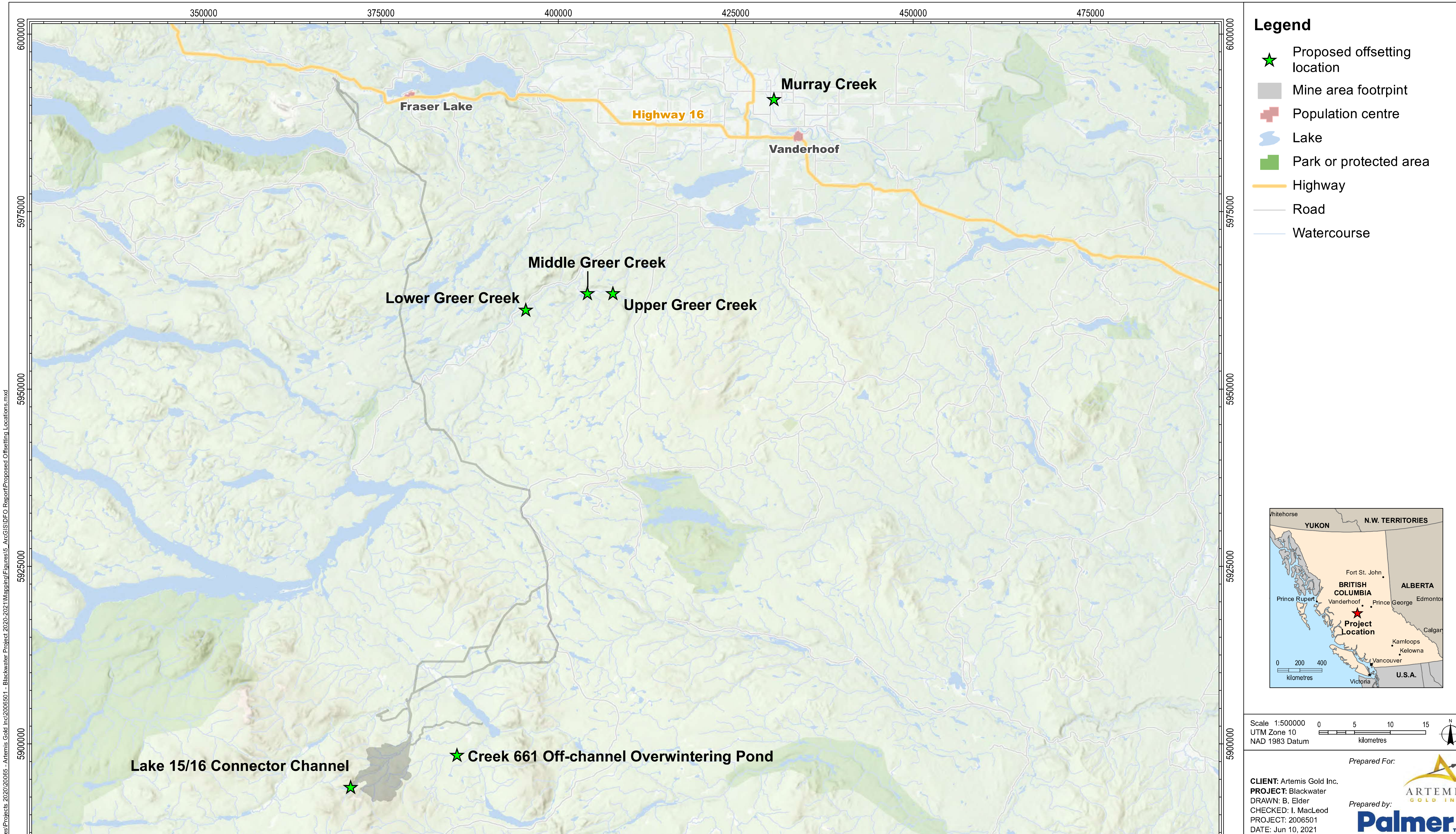
Six habitat offsetting measures were selected for inclusion in this Offsetting Plan out of the nearly 30 potential options considered for overall Project offsetting. These five measures are:

1. Ranchland Stream Restoration and Enhancement in the Murray Creek watershed (Off-site) including:
   a. Murray Creek Mainstem;
   b. East Murray Creek; and

      West Murray Creek.
2. Ranchland Stream Restoration and Enhancement in the Greer Creek watershed (Off-site) including:
   a. Lower Greer; and
   b. Middle Greer.
   c. Upper Greer
3. Creek 661 Off-channel Overwintering Pond (On-site);
4. Flow Augmentation in Davidson Creek from the FWR and FWSS (On-site); and
5. Lake 15/16 Connector Channel (On-site); and
6. Complementary Measures

The general location of each of the constructed offsetting measures is shown in Figure 10-1. An overview of the existing conditions at each of the proposed offsetting sites and a detailed description of the proposed offsetting measures are provided in the following subsections.

The offsetting measures selected incorporate both ‘in-kind’ offsetting (i.e., creation of habitats that support Rainbow Trout life stages that are directly affected by losses) and the creation of habitat to address bottlenecks in Rainbow Trout productivity. The offsetting measures also include “out-of-kind” offsets in the ranchland streams that will benefit Rainbow Trout and Pacific salmon species, for which Chinook Salmon are used as a representative species in the habitat accounting. The offsetting measures target salmonid populations in the upper Fraser River region that are an important traditional and cultural resource for local First Nations. These fish populations have shown evidence of decline, which has direct, negative impacts on food security and health of the affected First Nations.



Proposed Offsetting Locations

FIGURE 10-1

Overview aerial photography is provided for the offsetting sites in Appendix M. Detailed design drawings for the proposed habitat offsetting measures are presented in Appendix N. A detailed description of the methodology used for evaluating habitat gains is provided in Appendix J. General considerations for mitigating adverse effects during the implementation of each offsetting measure are provided in a Construction Environmental Management Plan (CEMP) in Appendix O and site-specific Erosion and Sediment Control (ESC) plans have been developed in Appendix N (e.g., Sheets 1824-3-9-006 and 1824-3-9-007). An Effectiveness Monitoring Plan is provided in Appendix P to detail the approach to monitoring the successful implementation of the offsetting measures. The complementary measures research proposal is provided in Appendix Q.

10.3 Offsetting Sites Existing Conditions

10.3.1 Fish Habitat Assessment and Background Information Review Methods

The selected offset measures were first identified as potential offset opportunities in 2012, and field studies to characterise the existing habitat conditions and fish community at the various sites were conducted in 2011-2013 (for the on-site measures), 2016, 2017, 2020, and 2021. Field data collection included fish habitat assessment, aerial photograph interpretation, aerial photograph and digital elevation mapping using an Unmanned Aerial Vehicle (UAV; drone), water chemistry sampling, and fish sampling. Baseline monitoring was initiated to document flow, water quality and stream temperatures. Geomorphic channel surveys were completed at key sites to support the design of habitat offsetting efforts. Fish habitat assessments were conducted using the *Fish Habitat Assessment Procedures* (Johnston and Slaney 1996), the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory* (RIC 2001), or a HEP-specific field data sheet, described in Appendix J. Background review of publicly available information accessed from the BC Fisheries Information Summary System (FISS), local knowledge, and regional fish habitat data provided by NEWSS, was also completed to help inform the field program objectives and restoration approach.

In October 2020 and May 2021, Palmer completed UAV flights of Murray and Greer Creek and visually assessed portions of the restoration area on foot to determine if disturbance indicators had changed since 2016/2017 UAV flight and field assessment. The 2020/2021 drone imagery was compared to 2016 and 2017 imagery to document any recent ecological or morphological changes along Murray and Greer creeks, as described in Appendix BJ.

10.3.2 Ranchland Streams

10.3.2.1 Ranchland Streams History

The Nechako Plateau, within which the offset sites are located, has undergone extensive historical disturbance in association with farming and cattle ranching (NEWSS 2016; W. Salewski, pers. comm.). An influx of people to the region throughout the 20th century was driven by readily available land and government policies to encourage settlement and land-clearing.

Arranging leases and establishing ownership of parcels of government-owned land were historically contingent on requirements to clear a percentage of the land within a parcel. Clearing and seeding of up to 80% of a parcel of land over a 20-year period was required for the land occupant to obtain title to the land (NEWSS 2016; W. Salewski, NEWSS, pers. comm.).

Over time, grazing by cattle “can affect the riparian environment by changing, reducing, or eliminating vegetation, and/or entire riparian areas through channel widening, channel aggrading, or lowering of the water table” (Platts 1991). “Generally in grazed areas, stream channels contain more fine sediment, streambanks are more unstable, [and] banks are less undercut … than for streams in ungrazed areas” (Armour 1977; Behnke and Zarn 1976; Platts 1983).

Historical policy of mandating land clearing for farming and ranching led to widespread loss of aquatic habitat, including small streams, riparian areas, and wetlands. Ongoing farming and ranching activity has prevented the reestablishment of sensitive streamside areas throughout the Nechako Valley (W. Salewski, NEWSS, pers. comm.). Sections of watercourses where impacts of decades of cattle ranching on aquatic habitat persist include large portions of Murray and Greer Creeks, which are described in the following subsections (

Figure 10-1).

In the Murray and Greer Creek areas, extensive impacts are the result of several decades of agricultural land use. Although habitat improvements in the region have been made through restoration initiatives undertaken by NEWSS in Murray Creek, and many landowners are committed to introducing sustainable farming practices, the Murray and Greer Creek watersheds continue to be significantly impacted by disturbances attributed to both historical and ongoing agricultural activities. This is particularly apparent through land clearing that has occurred over an estimated 34% of the watershed, predominantly in the middle reaches of Murray Creek (Owens et al. 2018).

The abundance and complexity of vegetation at the margins of streams is indicative of high riparian environmental quality and its removal can have negative impacts on fish communities and aquatic resources. Reduced organic matter inputs and increased sedimentation is often inversely correlated with benthic invertebrate/primary producer abundance and diversity. Since invertebrates constitute a critical part of fish diet, shifts in the composition and availability of this resource can limit the local density and growth of fish. Fish also seek refuge in complex stream habitats provided by ample canopy cover, large woody debris, deep pools, and undercut banks. Reduced habitat complexity is associated with increased risk to wildlife predation, reduced prey availability, and for fish such as trout, reduced territories for feeding. In addition, elevated sediment in surface water from eroding stream banks can cause adverse health effects on fish survival, development, growth, and reproduction, for instance, by directly causing physical damage to gills and interrupting gas exchange, by influencing water quality parameters (e.g., pH, temperature, dissolved oxygen, metals, etc.), among other short- and long-term effects (Kemp et al., 2011).

10.3.2.2 Murray Creek Existing Conditions

Murray Creek enters the north bank of the Nechako River within the town limits of Vanderhoof. The watershed is over 12,000 ha in size and the stream flows south for nearly 13 km from its headwaters. The branched headwaters originate from flat, forested terrain to the northeast, although the majority flows through Agricultural Land Reserve (ALR). Before entering the Nechako River, Murray Creek passes through a small patch of forest and under the Yellowhead Highway. The Nechako River flows eastward to Prince George, where it joins the Fraser River and eventually drains into the Pacific Ocean.

Murray Creek is located in the Sub-boreal Pine Spruce Moist Cool biogeoclimatic zone (AMEC, 2014; EIS, Appendix 5.1.2.5A). Coniferous forest, broadleaf forest, mixed-wood forest, shrub land, and grassland make up 2.5%, 49.6%, 2.0%, 0.4%, 11.7%, and 0.3% of the watershed, respectively (Owens et al., 2019). Sedimentary strata and igneous rock in this region are overlain by Tertiary volcanic rocks characterized by basalts and dacites with glaciofluvial and glaciolacustrine deposits common to the Cache Creek and Takla groups. Various tills and alluvium are 1 m to 10 m thick but dominated by alluvial deposits of sand and gravel material (Hastings et al., 1999; Wetherup and Struik, 1996). An estimated 2.5% of the watershed comprises aquatic environments, mostly comprised of Murray Creek and its tributaries.

The portion of the Murray Creek that will be the target of restoration and enhancement includes two upstream reaches, described herein as east Murray Creek and west Murray Creek, that flow together and become the Murray Creek mainstem (Appendix M1).

The entire Murray Creek offsetting area is characterized by a poorly defined channel that flows through pasture with heavily disturbed, sloping banks. The stream exhibits predominantly glide morphology along the relatively flat topography. The limited riparian vegetation is dominated by grasses and small shrubs, likely due to significant grazing and land clearing. While much of the stream is <0.5% gradient, existing land-use structures (e.g., culverts) have rendered the stream upwards of 5% in affected locales. These structures, along with beaver activity, have created scoured pools, backwatering, and wetlands containing standing water with instream vegetation. Except for some remaining off-channel trees, which provide little in the way of cover, the riparian area is cleared (AMS, 2014; DWB, 2014).

Field- and desktop-based assessments of the Murray Creek mainstem were conducted in 2017 and 2021 (Palmer 2017 and 2021, unpublished data). Approximately 1.9 km of the Murray Creek mainstem was assessed (35% of the total stream length), which corresponds with the proposed offset area. The Murray Creek mainstem had over-widened bankfull channel widths that ranged from 11.3 m to 12.1 m, with an average of 11.9 m. Wetted widths were highly variable, ranging from 0.9 m to 15.0 m, with an average of 3.5 m. Water depths were generally shallow, with an average depth of 0.4 m. Channel substrates were dominated by fines (i.e., particles of less than 2 mm diameter). Riparian vegetation was dominated by grasses, with few shrubs and small trees intermittently present. Evidence of cattle trampling, and anthropogenic impacts was widespread.

West Murray Creek was assessed along a 265 m-long reach (2.7% of the total stream length), which corresponds to the proposed offset area. West Murray Creek had a mean bankfull channel width of 8.7 m, a mean wetted width of 3.0 m, and a mean wetted depth of 0.3 m (Palmer 2017 and 2021, unpublished data). The substrate is generally dominated by fine sediment with small patches of cobble in locally scoured areas. Riparian vegetation is dominated by grasses, with some patches of deciduous trees present.

East Murray Creek was assessed along a 782 m-long reach (7.1% of the total stream length), which corresponds to the proposed offset area. East Murray Creek had a mean channel width of 9.0 m, a mean wetted width of 4.2 m, a mean wetted depth of 0.35 m, with water depths reaching 1.5 m in some scoured pools. Fine sediment deposits in low-gradient areas were abundant, reflecting the regional surficial topography and likely exacerbated by surrounding agricultural land use. In areas with steeper gradients, gravel and cobble are present but sparse (DWB 2014).

The habitat quality for salmonids is generally poor within the immediate vicinity of the proposed offset measures. The predominance of fine substrate to medium-sized sand is not suitable for salmonid spawning. Although some shallow pools provide cover for fish, cover for fish is generally low. The limited riparian canopy offers little protection against solar heating. In addition to unstable banks that contribute to sediment loading, sedge constriction and culvert crossings have resulted in impaired flow and fish passage impediments that limit access to better quality habitat that exists upstream (DWB 2014).

Streamflow in Murray Creek has been measured by the Water Survey of Canada at Station 08JC006 in Vanderhoof, B.C. This station has data recorded from 1962-1974. Only seasonal measurements are available from May to November, likely because hydrometric instrumentation was removed during the winter to avoid damage caused by ice. The drainage area for this station is 125 km^2. The hydrograph from Murray Creek indicates that peak flows typically occur in May and are due to runoff generated from snowmelt (Figure 10-2). Following peak flows in the spring, flows recede to low flow conditions that exist throughout summer months. Additionally, the impacts of summertime rainstorms are evident through the presence of secondary streamflow peaks that occur throughout the summer. During some years, another secondary streamflow peak is evident in the late fall, most likely driven by fall rainstorms or early season snowfall and subsequent snowmelt. Streamflow is likely sustained by groundwater inputs throughout the winter months until temperatures rise and snow begins to melt in the spring.

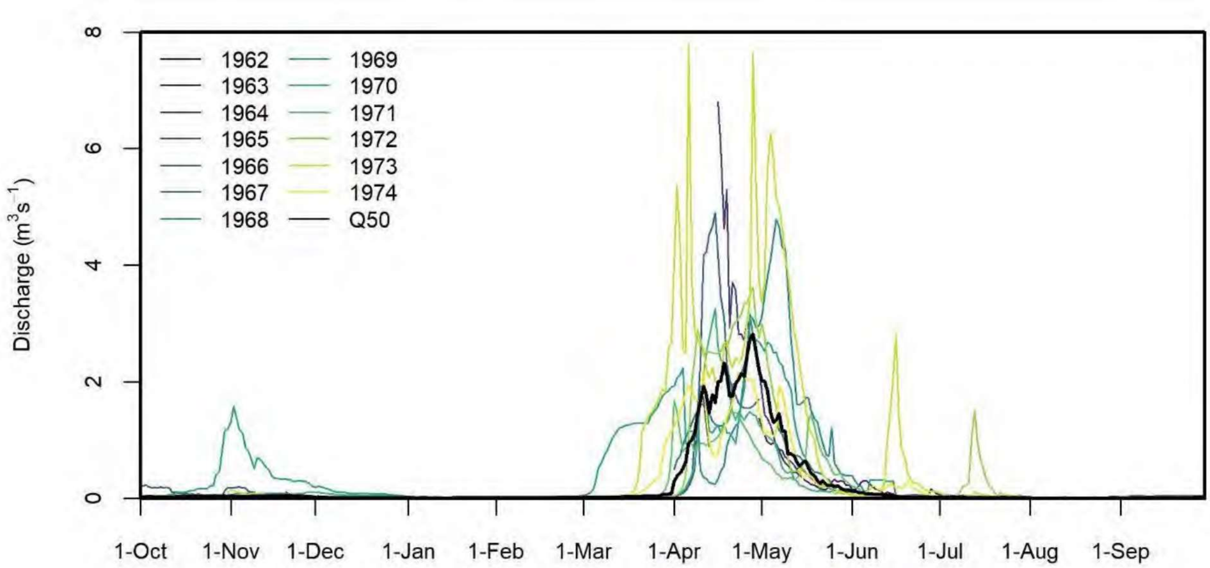


Figure 10-2. Daily Streamflow Recorded at Hydrometric Station 08JC006 in Murray Creek.

In-situ water quality parameters measured during fish sampling by PECG (October 2016, September 2021, unpublished data) for east Murray Creek and Murray Creek mainstem were generally within ranges suitable to sustain aquatic life and were as follows: temperature = 3.0 to 10.3 ; pH = 7.31 to 7.72; dissolved oxygen = 4.36 mg/L to 10.64 mg/L; and specific conductivity = 137.9 S/cm to 391.2 S/cm. However, given the lack of canopy cover and stagnant water, dissolved oxygen saturation and water temperatures in the summer may locally fluctuate to levels that are sub-optimal for fish health.

CCME surface water quality sampling information is not available for Murray Creek, although the suspended sediment and bed sediment quality (e.g., organic pollutants, labile metals, nutrients) has been investigated (Owens et al., 2018). Concentrations of summed polychlorinated biphenyls (ΣPCB) and summed polybromated diphenyl ethers (ΣPBDE), as well as persistent organochlorine pesticides, were detected in trace amounts but low compared to nearby Stoney Creek and Clear Creek and below values suspected to be harmful to fish. Metals that exceeded their threshold effect limit (TEL) in suspended sediment and/or bed sediment include Zinc, Nickel, Manganese, Iron, Copper, Chromium, and Arsenic, while Zinc, Manganese, and Arsenic also exceeded their probable effect limit (PEL).

Records of Chinook Salmon, Lake Chub (*Couesius plumbeus*), Rainbow Trout, Sculpin species, Bridgelip Sucker (*Catostomus columbianus*), Longnose Sucker (*Catostomus catostomus*), and Redside Shiner (*Richardsonius balteatus*) in Murray Creek were found in the FISS database (BC FISS; records date from 2008-2015). During fish salvage operations conducted prior to culvert replacement at the Larson Road crossing (upstream the proposed restoration area), Lake Chub, juvenile Chinook Salmon, and Rainbow Trout were captured via minnow trap and dip net (AMS, 2015). Fish sampling conducted by PECG in 2016 and 2017 using minnow traps resulted in the capture of juvenile Chinook Salmon, Redside Shiner in the Murray Creek mainstem, an unidentified Sucker, and Lake Chub in east Murray Creek (PECG 2016 and 2017, unpublished data).

Disturbances resulting from cattle grazing are evident within various land parcels as trampled banks and the general absence of adequate riparian vegetation. Consequently, the channels in these areas are poorly defined and sedges and grasses provide only minimal cover that could limit fish productivity. Stagnant water resulting from land use structures (e.g., culverts, fords, etc.) are susceptible to impaired water quality (e.g., increased temperature and decreased dissolved oxygen) outside ranges. Metals within bed sediments are at concentrations that may impact the benthic community, and this could negatively affect fish and facilitate dietary exposure to metals.

10.3.2.3 Greer Creek Existing Conditions

Greer Creek is a major tributary to the Nechako River. The drainage covers an area of 41,000 ha and extends 60 km inland from the Greer Creek-Nechako River confluence approximately 50 km southwest of Vanderhoof (NFCP, 2005). In its headwaters, Greer Creek is fed by the outflows of several lakes (e.g., Johnson Lake (1193 masl), Paddle Lake (1157 masl), and Home Lake (1089 masl)) that converge upstream of Greer Creek Falls (~12 m). Nulki Peak to the southeast and Mount Hobson to the southwest confine the upper portions of Greer Creek, which flows north through forested terrain at a relatively steep slope through a prominent valley which runs generally parallel to the Kluskus FSR. In the lower watershed, Greer Creek meanders westward at a modest gradient until it enters the Nechako River.

The Greer Creek watershed is part of the Nechako Lowland ecoregion. Dominated by the Sub-boreal Spruce biogeoclimatic zone (EIS Appendix 5.1.2.5A), the vegetation reflects this classification. The area is comprised of 5.0% water bodies, 87.8% coniferous forest, 0.4% broadleaf forest, 0.2% mixed-wood, 3.0% shrubland, and 0.2% grassland. Jurassic to Cretaceous sedimentary strata and Mesozoic igneous rock are overlain by extensive cover of Tertiary volcanic rocks and glacial deposits, and soil originate from gray basal or colluviated sandy till parent material (Calvert and Andrews, 2014; Gateuille et al., 2019).

Large seasonal fluctuations in flow and substantial sediment production from eroded glacio-fluvial/glacio-lacustrine material in the steep upper stream segments occur in Greer Creek annually (NFCP 2005). Alluvial sediments typical of recurrent floodplain deposition occur in the lower watershed, as indicated through opportunistic examination and auger holes (<1.2 m) completed during reconnaissance activities (PECG 2017, unpublished data)..Approximately 9.3% (3,812 ha) of the Greer Creek watershed is land use area, comprised of logging (1,556 ha total; 82 ha recent), agriculture (699 ha), and rangeland (1557 ha) (Rex Environmental Services 2003).

The primary disturbance to Greer Creek is the result of historical and ongoing agricultural activities. Impacts include land clearing, localized trampling, and farm machinery crossings which have resulted in the collapse of channel banks, increased local and downstream in-stream sedimentation, and reduced riparian vegetation which, consequently, may also reduce inputs of woody debris. The source of the sediment in Greer Creek originates mainly from channel banks (65-70%) and agricultural soils (~25%), particularly during freshet, and this probably reflects land management practices (Gateuille et al. 2019).

The upper reaches of Greer Creek watershed are relatively undisturbed, although evidence of logging in the watershed is evident from satellite imagery. At a relatively high gradient (3%), the upper reaches of Greer Creek exhibits a riffle- or step-pool morphology. There is an abundance of riffle habitat, cobble/boulder substrates, and forest cover making it more conducive to fish spawning and rearing compared with the lower watershed (Tredger, Yaworski, & Ptolemy, 1984). Greer Creek plateaus above Greer Creek Falls and extends beyond numerous productive headwater lakes. The waterfall prevents upstream fish passage, although upstream resident Rainbow Trout populations exist in the headwaters.

The stream reaches selected for offsetting are located in the lower portion of the Greer Creek watershed. These reaches are identified as Lower Greer Creek, Middle Greer Creek, and Upper Greer Creek (Appendix

M2, M3, and M4). These reaches encompass historically disturbed areas that have been impacted by agricultural/ranch land-use activities. The downstream boundary of Lower Greer Creek begins slightly upstream from its confluence with Nechako River and the stream runs parallel to the Kennedy Dam Road for 4.6 km. Non-contiguous with Lower Greer Creek (approximately 13 km upstream), the boundary of Middle Greer Creek begins adjacent to the homestead of the primary ranch landowner in the area. The reach is 3.1 km long and contiguous with Upper Greer Creek, which extends an additional 8.7 km upstream. Several tributaries branch from the main channel, including Micks Creek, which extends north from its confluence downstream of the Middle Greer Creek lower boundary, as well as a tributary that extends south towards Harlow Lake from the Middle Greer Creek offset reach.

The presence of cutbanks, point bars, and oxbow lakes throughout Greer Creek are consistent with the meandering stream pattern across the offsetting area described above. The bankfull widths across the study area range from 10 m to 15 m. However, beaver activity is frequent and, as such, stream widths and water depths may be locally variable and not necessarily dependent on flow conditions. Medium grain-size sand is the dominant substrate in the lower floodplain, and silt-clay content is low (8%) relative to geographically similar Nechako River tributaries. High sediment loads associated with erosion in the floodplain coincide with freshets, and this effect is likely exacerbated by bank/bed destabilization associated with land-use activities in the lower watershed (Gateuille et al., 2019).

The stream structure has been described as predominantly glide at high flows (e.g., 3.4 m^3/s; Tredger, Yaworski, & Ptolemy, 1984), reflecting the generally low gradient (0.3%) of the lower watershed. However, some riffle-pool habitats are present during periods of lower flow, as observed by Palmer in 2017. The stream in this area is generally exposed with little cover provided by in-stream large woody debris, cobble/boulder substrates, or vegetation. Furthermore, the dominance of medium grain-sized sand is not conducive to salmonid spawning (e.g., lacking coarser gravel substrates, pool/riffle morphology). In its current state, habitat adjacent to land-use activities in the lower watershed is generally poor quality, with some moderate-quality overwintering and rearing habitat.

In-situ water quality measurements of pH, conductivity, dissolved oxygen, and temperature were within ranges suitable to sustain aquatic life. CCME surface water quality sampling information is not available for Greer Creek, although the suspended sediment and bed sediment quality (e.g., organic pollutants, labile metals, nutrients) has been investigated upstream the confluence with Nechako River (Owens et al. 2018). Channel bottom sediment ΣPCB, ΣPBDE, herbicides and fungicides (e.g., hexachlorobenzene (HCB), 4,40-dichlorodiphenyldichloroethylene (DDE), Organophosphorus and phenoxy acid compounds) were either below the detection limit or detected in trace amounts well below federal and provincial guidelines for the protection of aquatic life. On at least one sampling occasion, the Zinc, Manganese, Iron, Copper, Chromium, and Arsenic TEL and the Arsenic and Manganese PEL was exceeded for suspended sediment. Manganese was the only TEL exceedance in bed sediment. Compared with geographically similar Nechako River tributaries, Greer Creek had better sediment quality, coincident with lower nutrient/organic content. At a discharge rate of 3.18 m^3/s, the TSS concentration was measured to be 19 mg/L (Gateuille et al. 2019). However, as particulate, metals in this fraction are likely not immediately bioavailable to fish residing in the water column.

A hydrometric station was installed in Greer Creek during the fall of 2020 by Palmer. Continuous stage measurements are currently being recorded at the station; however, the rating curve has not yet been developed, so streamflow records are not yet available. Based on monthly estimates from the Omineca Water Tool (2015), peak flows in Greer Creek occur in May, caused by snowmelt during spring freshet.

Flows then recede throughout the rest of the summer months, with summertime rainstorms causing secondary streamflow peaks. During the fall and winter, streamflow recedes to groundwater-dominated low flow conditions until temperatures rise and snow begins to melt in the spring. The drainage area of Greer Creek near its mouth is approximately 409 km^2.

Juvenile Chinook Salmon were captured in Greer Creek via minnow trapping by Palmer in fall 2017 (PECG, 2017 unpublished data). Historical records (1980-1998) indicate the presence of Sculpin species, Chinook Salmon, Coho Salmon (*Oncorhynchus kisutch*), Sockeye Salmon (*Oncorhynchus nerka*), Rainbow Trout, Mountain Whitefish, Largescale Sucker, Longnose Sucker, Leopard Dace (*Rhinichthys falcatus*), Longnose Dace, Northern Pikeminnow, and Redside Shiner at various locations within the watershed.

Reconnaissance conducted by DFO in 1985 (Tredger, Yaworski, & Ptolemy, 1984) identified Rainbow Trout parr below Greer Creek Falls. The origin of this population is unclear. They may be Rainbow Trout that overwinter immediately below Greer Creek Falls, emigrate from downstream locations within or outside Greek Creek watershed, or are from isolated stocks in the headwaters (lakes and streams) above Greer Creek Falls (DFO 1980).

10.3.3 Creek 661 Existing Conditions

A detailed description of Creek 661 fish habitat is provided in Section 5.4.2.

10.3.4 Davidson Creek Existing Conditions

A detailed description of Davidson Creek fish habitat is provided in Section 5.4.1.

10.3.5 Lake 15 and Lake 16 Existing Conditions

Lake 01538UEUT (shortened identifier, Lake 15) and Lake 01682LNRS (shortened identifier, Lake 16) are situated within the mine LSA. As a result, comprehensive baseline data are available regarding fish, fish habitat, and fisheries resources and sections 10.3.5.1 and 10.3.5.2 draw from publicly available baseline documents prepared as part of the EA process (see AMEC, 2012 *Project Description Summary*; AMEC, 2013a *Appendix 5.1.2.6A*; AMEC, 2013b *Appendix 5.1.2.2A*; AMEC, 2014 *Appendix 5.1.2.5A*; AMEC, 2015 *Appendix 5.1.3;* CEAA, 2019 *Blackwater Gold Project: Environmental Assessment Report*).

10.3.5.1 Lake 15

Lake 15 is the smaller of two headwater lakes in the Creek 705 watershed (a Fawnie Creek sub-watershed), covering a surface area of 357,375 m^2 at an elevation of 1,346 masl on the northwestern aspect of Mount Davidson (Figure 3-3). At the margins of the Chedakuz Creek-Fawnie Creek drainage divide, it is situated south of Lake 14 (Creek 705 watershed) and west of Lake 16 (Davidson Creek watershed) but is ultimately part of the Fawnie Creek watershed.

Lake 15 feeds Creek 705 which flows west and meets the northeast-flowing part of Fawnie Creek, roughly 8 km downstream of Top Lake. Downstream of the confluence, Fawnie Creek flows northwestward through a series of narrow lakes before entering Entiako River, which flows northeastward to Natalkuz Lake, part of the Nechako Reservoir. The Nechako River continues eastward to Prince George, where it joins the Fraser River and flows southward to its mouth in Georgia Strait in Vancouver.

Mount Davidson is situated in the Nechako Plateau, a region moderately sloping terrain shaped by glacially eroded volcanic bedrock. Specifically, in the vicinity of Lake 15, the surficial geology is composed of primarily morainal diamicton, most dominantly basal till, with a sandy to silty clay matrix and boulder-sized clasts (Diaklow and Levson, 1997). Deposits of cobble, boulder, and fines of bed material have resulted from a combination of glacial/fluvial/glaciofluvial processes, similar to the proposed mine site.

The region encompassing Lake 15 is classified as an Engelmann Spruce-Subalpine Fir Nechako Moist Very Cold biogeoclimatic zone and the surrounding riparian vegetation of comprised of mature conifers, shrubs, herbs, and mosses. Aquatic plants are abundant along the perimeter of the lake and are dominated by sedges (*Carex* spp.) and horsetail (*Equisetum* spp.).

Two small non-continuous tributaries, one at each the western and eastern end of the lake, and upper Creek 705 flow into Lake 15. Lake 15 is drained by a single channel to the mainstem of Creek 705 at its western end. Downstream of Lake 15, Creek 705 drains to Fawnie Creek and is divided into five reaches (Reaches 1 to 5).

Multiple tributaries join Creek 705 along its length, including Creek 606013 that extends upstream to Lake 14. Upstream of Lake 15, the main Creek 705 channel extends for an additional five reaches (Reach 7 to Reach 12) to the Creek 705 headwaters. Lake 15 is considered Reach 6 of Creek 705. Good-quality habitat for all life histories of salmonids is available across the watershed, including habitat suitable for overwintering in Lake 15.

Lake 15 has an irregular, arrowhead-like shape with two distinct basins in the east-to-west direction. Various outcrops and bays defining its perimeter. The basins are intersected by two islands, and two additional smaller islands are located and the west end of the lake near the outflow. The lake is shallower than Lake 16, reaching a maximum depth (11.6 m) in the east basin. However, the steeper littoral zone of Lake 15 compared to Lake 16, particularly in the deeper east basin, makes the average depths and surface-to-volume ratios of Lake 15 (mean Lake 15 depth = 5.54 m; surface-to-volume ratio = 0.18) similar to Lake 16. The proportion of the Lake 15 littoral zone is just over half of the overall surface area. Light is penetrable to near-bottom depths (1% euphotic zone depth of 10.8 m in August) and the large surface-to-volume ratio provide conditions for development of a robust phytoplankton community to form the basis of the aquatic food-chain in the lake. The bed material of the littoral zone is mainly dominated by gravels and sub-dominated by boulder/fines substrates.

A weak thermocline persisted in Lake 15 at depths between 4 m and 6 m in August of 2011 but not in September of 2012. This suggests that the summer thermocline may weaken in early fall. In June, August, and September (2011/2012) temperatures ranged from 9.7°C to 15.8°C and dissolved oxygen ranged from 3.6 mg/L to 9.3 mg/L, depending on the depth of the measurement. In the winter, the lake retains dissolved oxygen concentrations of more than 7.0 mg/L within 3 m from surface. These conditions provide overwintering habitat suitable for Rainbow Trout.

Lake 15 baseline water quality and sediment quality sampling was conducted at a proposed long-term monitoring site (WQ24) in 2012/2013 and compared against respective guidelines set at the time of the report (see Blackwater Gold Project 2013 Baseline Report). In-situ measurements of pH were slightly alkaline (pH 7.1 to 8.0), and conductivity ranged from 34 S/cm to 43 S/cm. Like other headwater lakes, the water was analytically determined to be soft (minimum 16.2 mg/L, maximum 60.0 mg/L as $CaCO_3$) and surface water and sediment concentrations of metals were generally low. Dissolved Iron and total Cadmium in the surface water and Mercury in the sediment were the only metals carried forward as metals of potential concern based on mean concentrations. However, occasional exceedances of other metals (e.g., Manganese) occurred in grab samples but were attributed to large temporal variability in TSS and Total

Dissolved Solids (TDS) concentrations, coincident fluctuations in other water quality attributes such as alkalinity.

Creek 705 is suspected to support three populations of Rainbow Trout. These include one population in each of the headwater lakes and resident population in Fawnie Creek. Overwintering adult Rainbow Trout of Lake 15 (the 705 Headwater South population) are known to migrate to Reach 4, Reach 5, and Reach 6 of Creek 705 to spawn in the spring and juveniles rear in the upper reaches of Creek 705 and its tributaries (AMEC 2013a). Despite the mean gill netting CPUE being slightly lower in Lake 15 (mean = 30.0 fish/100 m^2/day, n = 5, SE = 8.2) compared with Lake 16, there was little evidence of a difference between the two lakes in terms of the density of Rainbow Trout. Unlike Lake 16, two Rainbow Trout (0.8 fish per 100 trap hours) and 265 juvenile Longnose Suckers (34.7 fish per 100 trap hours) were captured using minnow traps. Besides Rainbow Trout and Longnose Sucker, no other fish species were captured or observed in Lake 15.

Historically, Knight Piésold monitored Lake 15 water levels, as well as streamflow in the streams downstream of the lakes. In Lake 15, streamflow and water level were monitored at the lake's outlet at station L6B. Station L6B was active from May to October during 2013 and 2014 (Knight Piésold 2021a). Lake levels are generally highest in May and corresponded with peak flows, which are due to runoff generated from snow-melt during the spring freshet. Following high water levels and peak flows during the spring, water levels decrease and streamflow recedes to low flow conditions during the summer months. Hydrological characterizations from the Omineca Water Tool (2015) indicate that zero flow conditions often occur at the outlet of Lake 15 during late summer and winter.

10.3.5.2 Lake 16

Lake 16 has a surface area of 91,860 m^2 at an elevation of 1,345 masl and is located near the Chedakuz Creek-Fawnie Creek drainage divide in the Davidson Creek watershed., upstream and southwest of the proposed mine site. Davidson Creek flows northeast through the proposed mine site and then runs along the eastern flanks of Mount Davidson for the remainder of its length. At its terminus, Davidson Creek flows into Chedakuz Creek below the outflow from Tatelkuz Lake but upstream the Turtle Creek-Chedakuz confluence. Chedakuz Creek continues to the Nechako Reservoir and into the Nechako River, which eventually meets the Fraser River in Prince George.

Mount Davidson is situated in the Nechako Plateau, a region moderately sloping terrain shaped by glacially eroded volcanic bedrock. Specifically, in the vicinity of Lake 16, the surficial geology is composed of primarily morainal diamicton, most dominantly basal till, with a sandy to silty clay matrix and boulder-sized clasts (Diaklow and Levson, 1997). Deposits of cobble, boulder, and fines of bed material have resulted from a combination of glacial/fluvial/glaciofluvial processes, similar to the proposed mine site.

The region encompassing Lake 16 is classified as an Engelmann Spruce-Subalpine Fir Nechako Moist Very Cold biogeoclimatic zone. The surrounding landscape is forested, comprised of conifers, shrubs, herbs, and mosses. Two small islands, located near the north and south shores, are also well-vegetated. Along the perimeter of the lake (1667 m in length), aquatic plants are common (e.g., *Elodea* spp. and *Equisetum* spp.).

Lake 16 is fed by a small unnamed tributary at the southwest end. The lake drains to Davidson Creek at its northeast corner. Downstream of Lake 16, 12 reaches have been delineated in the mainstem of Davidson

Creek, of which Reach 11 and Reach 12 are relevant to fish in Lake 16 ; Rainbow Trout that reside Lake 16 are use these reaches for spawning.

Lake 16 has a circular basin with shallow, uniform slopes. The maximum depth is at its center (16.3 m; mean depth of 5.54 m). The gentle slopes create a wide 6 m contour that persists offshore and, therefore, the littoral zone is relatively large, covering 62% (57419 m^2; 0.18 surface volume ratio) of the lake's surface area.

The majority of the bed material in the littoral area is dominated by cobble, with lesser contributions of boulder and gravel substrates. Minimal amounts of fines/gravel (7%) are present but are exclusively located at the north end of the lake. Light is penetrable to near-bottom depths (the 1% euphotic zone depth of 15 m was 14.9 m). Accordingly, phytoplankton biomass and density in the littoral zone was high compared to similar lakes with smaller, more turbid littoral zones (e.g., Lake 15).

The pelagic habitat of Lake 16 thermally stratifies in the summer. For instance, a thermocline existed at depths of 3.0 m to 6.0 m (temperature range 4.5°C to 14.5°C) and 6.0 m to 8.0 m (temperature range 5.0°C to 12.1°C) in August (2011) and September (2012), respectively. During the same sampling events, the dissolved oxygen concentration was measured to be 0.1 mg/L to 9.5 mg/L and 0.1 mg/L to 10.2 mg/L and inversely correlated with depth. Dissolved oxygen concentrations below 4 m depth were generally less than 5.8 mg/L and were deemed unfavourable for overwintering. Anoxic conditions existed at the greatest depths near the water-substrate interface. However, overwintering habitat was otherwise rated as fair to good based on measurements of dissolved oxygen.

Lake 16 baseline water quality and sediment quality sampling was conducted at a proposed long-term monitoring site (WQ23) in 2012/2013 and compared against respective guidelines set at the time of the report (see Blackwater Gold Project 2013 Baseline Report). In-situ measurements of pH were near neutral (pH 6.8-7.7), and conductivity ranged from 42-67 S/cm. Like other headwater lakes, the water was analytically determined to be soft (minimum 16.4 mg/L, maximum 30.7 mg/L as $CaCO_3$) and surface water and sediment concentrations of metals were generally low. Only Iron (maximum dissolved concentration = 4.32 mg/L) frequently exceeded its surface water guideline for the protection of aquatic life. Single exceedances of total Arsenic and Nickel guidelines were attributed to variable increases in TSS concentrations. Mercury was the only metal to exceed its sediment quality guideline based on mean concentrations (mean Mercury = 0.38 g/g). Coincidently, a single total mercury exceedance of Health Canada's tissue residue guideline was observed in one Rainbow Trout liver (0.518 mg/kg).

Rainbow Trout that reside in Lake 16 comprise one of at least two distinct Davidson Creek spawning populations that are distinguished from those that overwinter downstream in Tatelkuz Lake. Specifically, Rainbow Trout that overwinter in Lake 16 spawn in the unnamed inflow tributary, or in Reach 11 and Reach 12 of Davidson Creek. While Rainbow Trout in Lake 16 may access spawning habitat in other reaches of Davidson Creek, they would not be able to return to Lake 16 and their progeny would not contribute to annual recruitment in Lake 16 because of the impassable steep cascade that defines the boundary between Reach 10 and Reach 11.

Seventeen Rainbow Trout were captured using a combination of sinking gill nets (total effort 2.9 hours; CPUE = 55.1 fish/100 m2/day) and floating gill nets (total effort 4.0 hours; CPUE = 15.9 fish/100 m^2/day) in 2012. Based on CPUE per unit area, Rainbow Trout were more abundant compared with Lake 15 but less abundant compared with Lake 14. High densities of juveniles were captured (electrofishing) in Reach 11 and Reach 12 (CPUE 0.73-3.65) relative to reaches that are immediately downstream the cascade, suggesting origins in Lake 16 rather than Tatelkuz Lake. Other than Rainbow Trout, no other fish species were captured or observed in Lake 16.

Historically, Knight Piésold monitored Lake 16 water levels, as well as streamflow in the downstream watercourses. In Lake 16, water level was monitored at station L5 and streamflow was measured at station H10 in Davidson Creek, 2.7 km downstream of the lake's outlet. Stations H10 and L5 were active from May to October during 2012 to 2014 (Knight Piésold 2021a). Lake levels are generally highest in May and correspond with peak flows, which are snow-melt driven. Following high water levels and peak flows during the spring, water levels decrease and streamflow recedes to low flow conditions during the summer months. Hydrological characterizations from the Omineca Water Tool (2015) indicate that zero flow conditions often occur at the outlet of Lake 16 during late summer and winter.

10.4 Detailed Description of Offsetting Projects

Section 10.4 of this report contains the required information (see also Table C-1) as specified in:

Section 16(c). a detailed description of the measures and how those measures will meet their objectives;

Section 16(j). if the implementation of the plan requires access to lands, water sources or water bodies that are not owned by the applicant, a description of the steps that are proposed to be taken to obtain the authorization required for the applicant, the Department of Fisheries and Oceans and anyone authorized to act on the Department's behalf to access the lands, water sources or water bodies in question.

[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 16]

The five proposed Offsetting Projects (i.e., rangeland stream restoration/enhancement, Creek 661 off-channel overwintering pond construction, flow augmentation in Davidson Creek, Lake 15/16 connector channel, and complementary measures) are described in detail in the following sections. Calculations of habitat gains are provided in areal extent (i.e., in square metres) and in HU for relevant life stages of Rainbow Trout and Chinook salmon.

10.4.1 Ranchland Stream Restoration and Enhancement

Stream restoration and enhancement are proposed along Murray Creek and Greer Creek (Appendix M1 to D4; Appendix J, Sheets 1824-3-9-003 to 1824-3-9-007 (Murray); 1824-3-4-003 to 1824-3-4-008 (Lower Greer); 1824-3-7-003 to 1824-3-7-007 (Middle Greer); 1824-3-8-003 to 1824-3-8-010 (Upper Greer)). These creeks are part of the Nechako River watershed and have been impacted by past and current agricultural practices, particularly cattle grazing.

Opportunities for both restoration and enhancement of fish habitat are widespread along Murray and Greer Creek. For proposed works in Murray and Greer Creeks (Lower, Middle and Upper), BW Gold is working with the Nechako Environment Water Stewardship Society (NEWSS), a non-profit organization that facilitates the rehabilitation and enhancement of stream ecosystems in the Nechako River Agricultural Belt.

A number of existing geomorphological and aquatic impacts along the ranchland streams were documented through field surveys and analysis of high-resolution imagery (<10 cm) acquired by an Unmanned Aerial Vehicle (UAV, drone). The impacts to fish habitat can be grouped into four categories:

- Cattle trampled banks and stream bed;
- Farm machinery crossings;

- Exposed channel banks; and
- Flow obstructions/impediments.

The objectives and proposed restoration/enhancement techniques to improve degraded habitat associated with each impact are outlined in Table 10-1. Typical details for the proposed restoration are presented in Appendix B (e.g., Sheets 1824-3-9-006 and 1824-3-9-007)). Cattle exclusion fencing is proposed for properties where active ranching is expected to continue. The exclusion fencing will require periodic maintenance but will be important for the long-term success of instream and riparian restoration/enhancement measures along these streams. Discussions on long-term land securement are ongoing between Artemis, landowners, and regulators to ensure that these measures are maintained. Artemis has provided regular updates on land securement to First Nations and will continue to do so as the process continues. Portable, solar-powered, cattle watering stations will be made available outside of the exclusion areas. Summer watering troughs and insulated wells for winter watering locations and details are presented within the Murray Creek and Greer Creek drawing packages (Appendix B). The specific restoration/enhancement objectives and rationale for each stream are detailed in the following sub-sections.

Table 10-1. Common Geomorphological and Aquatic Habitat Impacts along Greer Creek and Murray Creek with Proposed Restoration Techniques

Aquatic Impact	Description	Example Photo	Restoration Objectives	Proposed Restoration and Enhancement Techniques
Cattle Trampled Banks and Bed	Cattle have trampled channel banks and bed while grazing and watering, which has led to a lack of a defined channel, over-widening, fine sediment input, and/or lack of riparian vegetation.		• Restore and maintain a channel with a natural shape, dimensions, and bed material, such that water flow and sediment transport are in a natural balance; and • Maintain opportunities for cattle to water and cross streams, at pre-selected and managed/controlled locations.	• 'Off-channel' watering systems; • Cattle exclusion fencing; • Reconstruction of natural bankfull channel, using a combination of earth fill and strategic woody debris placement (to promote channel-edge sedimentation); • Brush layers; • Riparian plantings (e.g., live stakes and potted plants); • Targeted excavation of anomalous in-stream accumulations of fine sediment; and • Localized placement of gravels and boulders on channel bed.
Farm Machinery Crossings	Tractors and other farm machinery cross the channel through shallow sections or at haphazard culvert crossings, which has degraded the channel banks and bed.		• Maintain opportunities for farm machinery to cross streams, at pre-selected and managed/controlled locations; and • Identify opportunities to install clear-span bridges or embedded culverts.	• Restrict crossing sites to a minimum required key locations; • Install culverts or bridges, where possible; • Re-sculpt the channel banks immediately upstream/downstream of the crossing; and • Plant natural riparian vegetation and brush layers immediately upstream/downstream of the crossings.
Exposed Channel Banks	Hydraulic erosion and/or lack riparian vegetation has led to exposed and commonly over-steepened channel banks, resulting in channel instability (rapid bank erosion, bank slumping) and increased inputs of fine sediment into the channel.		• Restore natural meander migration rates through re-establishment of riparian vegetation on re-graded banks.	• Re-grade banks to a gentler side slope, to allow bank/riparian vegetation to re-establish; • Plant natural brush layers; • Plant natural riparian vegetation; • Install cattle exclusion fencing along erosion-prone outer banks of meanders (consider redirecting cattle to controlled access points along inner bank or straight sections); and • Proactively accommodate meander migration trend, where possible, with wider riparian buffer or low-use set-back area.
Flow Obstructions/ Impediments	Natural (e.g., beaver) and anthropogenic woody debris jams (small and large), vehicle crossings, and in-channel aquatic vegetation has caused upstream impoundment, excess sedimentation, and fish passage issues.		• Remove in-stream obstructions that are anthropogenic and impede or prevent fish passage or cause extensive and/or prolonged backwatering.	• Remove anthropogenic flow impediments.

10.4.1.1 Murray Creek

Stream restoration and enhancement is proposed along 2.9 km of Murray Creek in multiple reaches (east Murray Creek, west Murray Creek, and Murray Creek mainstem) where degraded habitat has been identified (Appendix M1; Appendix B, Sheets 1824-3-9-003 to 1824-3-9-007). These reaches are contiguous and generally similar in condition and are treated as one unit for habitat analysis and accounting.

The impacts of agricultural activity, in particular extensive cattle trampling, has resulted in a need to re-establish natural channel dimensions throughout the proposed works. For the most part, the proposed channel planform resembles existing conditions.

Gravel and boulder clusters are proposed throughout the proposed works to improve in-stream cover, diversify substrates, and increase spawning potential. Furthermore, woody debris placement is proposed along east Murray Creek, west Murray Creek, and Murray Creek mainstem to improve cover and provide refuge during high flows.

Fencing is proposed along both sides of the channel throughout the entire area of proposed works. Vehicle and cattle crossings as well as off-channel watering sites (located outside of the fencing) are proposed at strategic locations identified by the landowners.

Riparian plantings are proposed where land adjacent to the stream is bare of vegetation or has minimal vegetation cover. This will ensure that all instream habitat benefits from fully functioning riparian buffers. The riparian plantings will improve bank stability, increase shade, provide allochthonous (i.e., from outside the channel) food sources, and increase overhanging cover extending up to 15 m from the stream bank. A site-specific characterization of the existing plant communities at the offsetting sites will be conducted in 2022. The main objectives of this survey will include assessment of existing vegetation diversity and abundance, evaluation of existing conditions that may influence the success of planting, and documentation of invasive, agronomic, or at-risk plant species. A site-specific planting plan developed by a qualified professional will be developed in advance of offset construction that includes a detailed description of existing plant communities and proposed ground preparations, planting locations, species, and densities. The generally bare riparian areas are proposed to be enhanced with a combination of native seed mix and native shrub plantings whereas the areas with sparse shrub cover are only proposed to be seeded. Densely vegetated areas and areas with standing water are proposed to be retained and protected by fencing. The plant selection was based on field reconnaissance, aerial photograph interpretation, multiple years of drone imagery, common vegetation community summaries described in BC’s Wetland Identification Guide (Mackenzie and Moran 2004) and BC’s Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

10.4.1.2 Greer Creek

Three restoration reaches are proposed for Greer Creek, labelled as Lower, Middle, and Upper, as described in the follow subsections (Appendix M2 to M4). The downstream boundary of Lower Greer Creek begins slightly upstream its confluence with Nechako River and the stream runs generally parallel to the Kennedy Dam Road for 4.6 km. Non-contiguous with Lower Greer Creek (approximately 13 km upstream), the boundary of Middle Greer Creek begins adjacent to the homestead of the primary ranch landowner in the area. The reach is 3.2 km long and contiguous with Upper Greer Creek, which extends an additional

8.7 km upstream. These reaches are spread over a large portion of Greer Creek and have a wide variety in existing conditions and are treated as separate units for habitat analysis and accounting.

Lower Greer Creek

Cattle trampled banks and streambeds are more localized along Lower Greer Creek than along Murray Creek. In many cases, only one bank has been impacted. Minimal channel narrowing and bank regrading are proposed (Appendix B, 1824-3-4-003 to 1824-3-4-008) to rehabilitate impacted areas. The proposed planform is unchanged from the existing planform.

Bed material throughout the reach is naturally dominated by gravels. Further, gravel placement is proposed in strategic areas to support additional spawning habitat. These gravels will range from 20 to 80 mm to cover the range of preferred spawning gravels for Rainbow Trout (average 21 to 75 mm diameter) and Chinook Salmon (average 16 to 54 mm diameter) (Kondolf and Wolman 1993). Boulder clusters and woody debris are proposed throughout the reach to improve cover and provide refuge during high flows.

Cattle-exclusion fencing is proposed throughout the proposed works. One vehicle/cattle crossing is proposed near the upstream end of the proposed works and three off-channel watering sites (located outside of the fencing) are proposed on alternating sides of the channel.

Riparian plantings are proposed where land adjacent to the stream is bare of vegetation or has minimal vegetation cover. This will ensure that all instream habitat benefits from fully functioning riparian buffers. The riparian plantings will improve bank stability, increase shade, provide allochthonous food sources, and increase overhanging cover extending up to 15 m from the stream bank. The generally bare riparian areas are proposed to be enhanced with a combination of native seed mix and native shrub plantings whereas the areas with sparse shrub cover are only proposed to be seeded. Densely vegetated areas, and areas with standing water, are proposed to be retained and protected by fencing. The plant selection was based on field reconnaissance, aerial photograph interpretation, multiple years of drone imagery, common vegetation community summaries described in BC's Wetland Identification Guide (Mackenzie and Moran 2004) and BC's Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

Middle Greer Creek

Cattle-trampled banks and streambeds are localized and, in many cases, only one bank has been impacted in Middle Greer Creek. Minimal channel narrowing and bank regrading are proposed along the main channel (Appendix B, 1824—3-7-003 to 1824-3-7-007) to rehabilitate impacted areas. Re-establishment of natural channel dimensions is proposed for the entire length of a small tributary draining Harlow Lake. No changes are proposed to channel planform. Gravel and boulder clusters are proposed throughout the proposed works to improve in-stream cover and spawning potential. Woody debris is proposed throughout the proposed works to improve cover and provide refuge during high flows.

Cattle-exclusion fencing is proposed along both sides of the channel. Two vehicle/cattle crossing and four off-channel watering sites (located outside of the fencing) are proposed at strategic locations identified by the landowner.

Riparian plantings are proposed where land adjacent to the stream is bare of vegetation or has minimal vegetation cover. This will ensure that all instream habitat benefits from fully functioning riparian buffers. The riparian plantings will improve bank stability, increase shade, provide allochthonous food sources, and increase overhanging cover extending up to 15 m from the stream bank. The generally bare riparian areas are proposed to be enhanced with a combination of native seed mix and native shrub plantings whereas the areas with sparse shrub cover are only proposed to be seeded. Densely vegetated areas, and areas with standing water, are proposed to be retained and protected by fencing. The plant selection was based on field reconnaissance, aerial photograph interpretation, multiple years of drone imagery, common vegetation community summaries described in BC's Wetland Identification Guide (Mackenzie and Moran 2004) and BC's Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

Upper Greer Creek

Degraded habitat has been identified throughout Upper Greer Creek (Appendix B, 1824-3-8-003 to 1824-3-8-010). Cattle-trampled banks and streambeds are localized and, in many cases, only one bank has been impacted. Minimal channel narrowing and bank regrading are proposed along the main channel to rehabilitate impacted areas. No changes are proposed to channel planform. Upper Greer has a dynamic planform with multiple recent meander cut-offs (e.g., oxbow lakes) and several locations where similar avulsions are imminent. Along segments where avulsions are likely, channel narrowing and/or bank regrading have not been proposed. Gravel and boulder clusters are proposed throughout the proposed works to improve in-stream cover and spawning potential. Woody debris is proposed throughout the proposed works to improve cover and provide refuge during high flows.

Cattle-exclusion fencing is proposed along both sides of the channel. Two vehicle/cattle crossing and six off-channel watering sites (located outside of the fencing) are proposed at strategic locations identified by the landowner.

Riparian plantings are proposed where land adjacent to the stream is bare of vegetation or has minimal vegetation cover. This will ensure that all instream habitat benefits from fully functioning riparian buffers. The riparian plantings will improve bank stability, increase shade, provide allochthonous food sources, and increase overhanging cover extending up to 15 m from the stream bank. The generally bare riparian areas are proposed to be enhanced with a combination of native seed mix and native shrub plantings whereas the areas with sparse shrub cover are only proposed to be seeded. Densely vegetated areas, and areas with standing water, are proposed to be retained and protected by fencing. The plant selection was based on field reconnaissance, aerial photograph interpretation, multiple years of drone imagery, common vegetation community summaries described in BC's Wetland Identification Guide (Mackenzie and Moran 2004) and BC's Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

10.4.1.3 Ranchland Streams Access

The majority of the land identified for the ranchland offsetting projects is privately owned (fee-simple), with some short stream restoration segments located on Crown land. As a key step towards securing access to the land, landowner input was sought and included in the stream restoration and enhancement designs, and the design drawings submitted as part of this application (Appendix B) were reviewed and approved by the private landowners.

BW Gold has acquired certain portions of the Murray Creek properties and has been granted Statutory Rights of Way (SROWs) and licence agreements over other portions. The SROWs were agreed upon with the landowners and give BW Gold (or their designates) legal authority to access the lands to build, monitor, and maintain the offsetting works. A key advantage of the SROWs is that they are 'on-title', which means that even if the land ownership were to change, the SROW remains in place, such that any new landowner(s) would be bound thereby. The SROWs protect the long-term viability of the works by providing a legally binding agreement whereby the SROW applies to the land parcel itself because it's included in the land title, rather than being tied to any one landowner. As an additional layer of land protection, corresponding licence agreements, which contain substantively the same terms as the SROWs, were obtained for the Murray Creek properties.

Artemis is in the process of finalizing similar SROWs and licences for the Greer Creek properties, which will secure rights to build, monitor, and maintain the offsetting works.

For the portions of the ranchland stream restoration and enhancement located on Crown land, a Licence of Occupation will be obtained from the province to allow access for construction. Part of the Murray Creek watershed is within the Agricultural Land Reserve, which is an area designated for agriculture, and regulated by the Provincial Agricultural Land Commission.

10.4.2 Creek 661 Off-Channel Overwintering Pond Construction

The paucity of overwintering habitat has been identified in the baseline studies as a key factor limiting fish production in the Davidson Creek and Creek 661 watersheds. To address this limitation, BW Gold proposes to construct an off-channel overwintering pond in the Creek 661 watershed (Appendix B, Sheets 1824-3-10-003 to 1824-3-10-005). The location and physical characteristics of the proposed pond have been specifically designed to maximize the quality of overwintering refuge for Rainbow Trout by targeting areas of naturally high groundwater table and through-flow for minimizing winter ice cover thickness, maximizing dissolved oxygen concentrations, while incorporating deep water (>2 m), cobble/boulder substrates, and overhead cover.

The pond has an irregular shape and contains a peninsula that is strategically positioned to increase habitat diversity. The proposed pond is positioned and shaped such that it minimizes the risk of sedimentation (infilling) and avulsion (channel cut-off) during floods. The connector channel is positioned to meet the main creek in a natural scour zone, along a relatively stable meander, to reduce the potential for sedimentation and isolation. Large woody debris (anchored with boulders) will also be positioned along the shoreline of the pond. The pond will contain shallow water (0 m to 1 m depth) 'shoals' lined with cobble, and deeper (1 m to 5 m depth) areas. The pond design was guided, through consultation with DFO during development of the conceptual offsetting plan, by those successfully implemented at the nearby Mount Milligan Project to address similar limitations in Rainbow Trout overwintering habitat.

A 'leaky bank' is proposed to separate the pond and adjacent channel along a segment of an up-valley portion of pond shoreline. The leaky bank is composed of coarse gravels that allow for some throughflow of water from Creek 661 into the pond. The morphology and stone gradation of the leaky bank has been designed to allow 0.8 L/s of throughflow, which will provide benefits to the pond but maintain flows in Creek 661 (wintertime low 100 L/s and mean annual discharge 300 L/s). Incorporating a leaky bank into the design of the overwintering pond aligns with the objectives and approaches of overwintering habitat creation outlined in the *Fish Habitat Rehabilitation Procedures* (BC MOELP 1997).

The leaky bank has several key functions: i) to improve dissolved oxygen concentrations within the off-channel pond by encouraging through-flow of surface water (a small hydraulic gradient maintained through the leaky bank will drive slow water movement); ii) to discourage fine sediment accumulation within the pond and its connector channel through periodic flushing; and iii) to limit meander migration that could lead to channel avulsions that could isolate the pond. An area akin to a 'forebay' in a stormwater management pond is proposed on the downstream side of the leaky bank to help induce deposition of fine sediment that enters the pond through periodic overbank flow during floods. An interceptor channel, excavated below the naturally high groundwater table, will concentrate groundwater discharge into the pond throughout the year, particularly during winter months.

Riparian plantings are proposed along the periphery of all ponds to ensure full riparian benefits to in-pond aquatic habitat. The proposed plantings include a native seed mix and shrub plantings around the periphery of the pond and aquatic (emergent) plantings in the gentle, shallow shoreline area. The plant selection was based on field reconnaissance, drone imagery, common vegetation community summaries described in BC's Wetland Identification Guide (Mackenzie and Moran 2004) and BC's Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

10.4.3 Flow Augmentation in Davidson Creek from the FWSS

To offset the potential flow-related adverse effects in Davidson Creek, a freshwater reservoir (FWR) and Freshwater Supply System (FWSS) will augment flows in Davidson Creek downstream of the mine footprint. The FWSS will consist of a pipeline that will pump water from Tatelkuz Lake starting in Year 6 of Operations. The FWR will be adjacent to Davidson Creek and will store water sourced from Tatelkuz Lake and from natural run-off from the upper portions of Davidson Creek. Water would then be released from the storage reservoir, from Year 6 of Operations onwards, into Davidson Creek so that a streamflow regime downstream of the TSF will meet a defined instream flow needs (IFN) schedule. The IFN identifies the timing of the streamflow rate in Davidson Creek that would be required to provide adequate instream habitat to Rainbow Trout and Kokanee throughout the year (Appendix C).

The development of the FWSS system, and the flows that it will supply to lower Davidson Creek, were informed by an Instream Flow Study that estimated fish habitat as a function of streamflow using a metric called area weighted suitability (AWS, expressed in metres squared and equivalent to habitat units; Appendix 5.1.2.6D of the Application/EIS). The AWS is the product of the cross-sectional area of a reach and its habitat suitability. The streamflow – fish habitat model developed for Davidson Creek was also used to develop of instream flow needs (IFN) that are designed to provide the flows necessary such that the hydraulic conditions are suitable for Rainbow Trout and Kokanee. The IFN also includes a period of flushing flows in the spring to maintain the quality of spawning gravels in Davidson Creek (refer to Appendix C for further information on the IFN).

The streamflow-habitat models for Davidson Creek were coupled with a 40-year streamflow timeseries to generate a long-term timeseries of fish habitat available under baseline conditions, unmitigated conditions (i.e., no FWR and FWSS), and under the IFN. The difference between the habitat available under unmitigated conditions and the habitat available under the IFN represent the expected habitat loss that would result in Davidson Creek which the FWR and FWSS will offset.

Reduction of stream flow of a magnitude that will cause fish habitat area loss in Davidson Creek downstream of the mine site facilities is not expected to occur during the Construction phase. Run-off from the Davidson Creek catchment area upstream of each of the mine site will be diverted around the construction sites by coffer dams, diversion channels, or pumps. This will allow construction of works in the dry and will maintain flows downstream. Once the TSF Main Dam D is completed, the FWSS will be operational and will provide water from Tatelkuz Lake to augment flows in middle and lower reaches of Davidson Creek. A barrier to prevent fish from entering the FWSS facility from the downstream reaches of Davidson Creek will be specified during the detailed design phase.

10.4.4 Lake 15/16 Connector Channel

BW Gold proposes to divert water from Lake 16 in the headwaters of the Davidson Creek watershed into Lake 15 in the headwaters of the adjacent Creek 705 watershed. Lake 16 (the headwater lake of Davidson Creek) is approximately 500 m east of Lake 15 (one of two headwater lakes of Creek 705) (Appendix B, Sheets 1824-3-12-003 to 1824-3-12-005). Both watersheds eventually drain into the Nechako River and there is evidence of fish movement, over time, between these two lakes. Genetic studies on Rainbow Trout from the watersheds and lakes support the conclusion that the drainage divide between Lake 15 and Lake 16 is minor; “The inter-watershed similarity between some fish suggest that these two watersheds have, in the past, or perhaps currently during exceptionally high-water years, been connected such that fish may move between them” (Annex 5.10-10 of Appendix 5.1.2.6A of the Application/EIS). Further discussion on potential ancillary effects from this proposed intra-basin transfer is provided in Palmer (2016c).

A dam will be constructed at the existing Lake 16 outlet into Davidson Creek upstream of the West Dam to prevent outflow into Reach 12 of Davidson Creek. The Lake 16 outlet dam has been designed to maintain a minimum water level in Lake 16 (1,344.2 masl as measured on September 6, 2016; representative of a typical low water level). Lake 16 is approximately 0.4 m higher in elevation than Lake 15, resulting in a natural hydraulic gradient between the two lakes. Natural lake level elevations were measured in Lake 16 and Lake 15 (Knight Piésold 2021b. Lake 16 stage increased by as much as 0.3 m over the 1-year monitoring period, compared to 0.2 m in Lake 15. This minor discrepancy is likely explained by the smaller water surface area and catchment size of Lake 16 relative to those of Lake 15. Lake 16 and Lake 15 water levels fluctuate roughly in phase with one another; however, Lake 16 responds more quickly to snow melt and/or precipitation events, which increases the hydraulic gradient in the spring/early summer and lowers it in mid/late summer. This minimizes or eliminates two potential ancillary effects to fish in the new lake: 1) It does not increase lake water levels from baseline condition, thereby preventing the flooding of upland area and reducing the potential for mercury release into the aquatic food web; and 2) It avoids the flooding of existing lake shoreline habitat and spawning habitat in the one small tributary that enters Lake 16 on its southern shoreline.

The productivity of the Lake 16 Rainbow Trout population is more likely to be maintained (or possibility increased) if the Rainbow Trout have access to the Lake 15 watershed, which contains additional habitat suitable for spawning and foraging. To connect Lake 16 and Lake 15, a naturalized channel is proposed (Appendix B, Sheets 1824-3-12-003 to 1824-3-12-005). This new channel will create new fish habitat, provide permanent fish passage between the two lakes, an increase the amount of habitat available to Rainbow Trout in Lake 16. To do this, BW Gold will extend an arm of Lake 16 in its northwest corner, with an outlet to a gravel-bed channel that will flow into Lake 15. The extended arm and outlet channel will allow fish passage in both directions between the Lake 16 and Lake 15. The new lake arm will have an irregular width with deep habitat (1.5 m), shallower cobble shoals, and woody debris structures and boulders to increase habitat diversity and cover. The naturalized lake outlet will intercept the naturally high groundwater table (1,344 to 1,346 masl as measured on June 30, 2013), which will potentially augment low flow within the outlet channel.

The outlet channel will have a sinuous planform, along a 10 m-wide floodplain, and a water surface gradient of approximately 0.3%. Some backwatering of Lake 15 into the channel is expected, the extent of which will vary in accordance with natural lake level fluctuations. The channel will be approximately 1.4 m wide and 0.3 m deep. Water will flood a constructed and vegetated floodplain on either side of the channel during high flows. Small gravels will be placed along the channel bed, with embedded large wood incorporated along the outer banks of pools to increase habitat cover and diversity. Cobble and boulder keystones will be placed at the arm outlet to mimic natural lake outlet conditions and to improve overall habitat stability.

Surface flow continuity is anticipated to be maintained all year, with the expectation of periods of snow and ice cover. Natural lake level fluctuations may result in Lake 16 water levels below 1,344.1 masl, which may lead to occasional periods of discontinuous or no flow from August to October. However, this period is outside of key Rainbow Trout migratory periods (i.e., late April to July). Channel dimensions, materials, and gradients have been specifically designed to mimic conditions observed along a nearby tributary draining into a pond located midway between lakes 15 and 16, identified as Pond A (Appendix B).

10.4.5 Complementary Measures

10.4.5.1 Complementary Measures Criteria

Fisheries and Oceans Canada (DFO; 2019) states that complementary measures, such as data collection and scientific research related to maintaining or enhancing fish habitat, may comprise up to 10% of required offsetting. Complementary measures must fill knowledge gaps regarding fish and fish habitat to inform fisheries management projects and restoration priorities. Additionally, complementary measures must be consistent with the following guiding principles of habitat offsetting authorized under the *Fisheries Act*, where relevant:

- Measures to offset should support fisheries management objectives and give priority to the restoration of degraded habitat.
- Benefits from measures to offset should balance the adverse effects resulting from the works, undertakings, or activities.
- Measures to offset should provide additional benefits to the ecosystem.
- Measures to offset should generate self-sustaining benefits over the long term.

The complementary measures research proposal described herein aligns with these criteria in the following ways:

- A key goal of the research is to further understanding of the watershed-scale stressors that are affecting fish and fish habitat.
- The research team consists of local university professors and will be supported by a scientific advisory group of local scientists, First Nations, and resource managers that focus on the upper Fraser River watershed region.
- Research topics will be refined by the research team to align with fisheries management objectives and issues that are relevant in the region.
- The proposed research will produce publicly available data and knowledge that can be used to support and inform conservation and remediation efforts that will benefit the local ecosystems over the long term.

- The funding that will be provided to support this research will advance knowledge in ways that would not otherwise be possible or realistic based on current financial and research constraints.

10.4.5.2 Complementary Measures Rationale and Description

DFO's Policy for applying measures to offset adverse effects on fish and fish habitat under the Fisheries Act states that complementary measures should only be considered in exceptional circumstances such as in remote, pristine areas where there is a lack of information about fish and fish habitat, including their conservation and protection and where measures to offset are limited.

Application of complementary measures is determined on a case-by-case basis, in consultation with DFO. The following are required for DFO to make their determination on the applicability of complementary measures:

- A sound rationale describing why other measures to offset are not appropriate for fulfilling the entire offset requirement,
- A detailed plan outlining how the proposed complementary measure will be carried out, evaluated, and communicated, will both be required.

Rationale

Prior to the selection of complementary measures as a suitable offsetting measure, significant efforts were made to assess the potential of every available alternative. The process for identification of suitable offsetting projects that are feasible, self-sustaining, biologically relevant, and acceptable to First Nations, regulators, and other stakeholders has been extensive. Conceptual planning and screening of offsetting measures has been ongoing since the start of baseline work on this project over a decade ago. Numerous consultation discussions with First Nations, their consultants, and other community members have been conducted to identify candidate projects. Field surveys and desktop evaluations have been conducted for 30+ candidate sites to assess feasibility. The resulting shortlist of suitable offsetting measures is limited, as many options failed the screening process due to a multitude of reasons, including low likelihood of biological success, jurisdictional and property ownership issues, engineering constraints, and lack of self-sustaining results. Those measures that passed the screening process were carried forward in the offsetting plan, but a potential need for supplementary offsetting was identified.

The complementary measures proposal provides a limited amount of additional offsetting value (approximately 7.5% of the total, rather than the maximum potential value of 10%), while funding research and driving First Nations engagement (see Section 10.5.4 Complementary Measures). The proposal is specifically targeted at addressing existing fisheries management information gaps in a highly valued and heavily impacted region of the upper Fraser River watershed. The proposal will result in advancement of the state of the science, foster First Nations involvement in fisheries science through a steering committee and with research positions, and will aid in understanding watershed-level stressors on threatened fish populations.

Description

Palmer, in collaboration with researchers from the University of Northern British Columbia, have developed a complementary measures research proposal that addresses gaps in the current understanding of how different watershed-level stressors are affecting fish. This complementary research program is based on the premise that future conservation and remediation initiatives should target the environmental variables that have the greatest influence on fish productivity to have the greatest chance at positively influencing fish communities and fish habitat.

The research program is focused in two main watercourses (Davidson Creek and the Stellako-Nautley Rivers) to leverage existing data collection networks. Given the similarity in the physiography, climate, and historical watershed disturbances across the western portion of the upper Fraser River watershed, the findings from these studies are expected to be generalizable across the entire region. The salmonid populations in the upper Fraser River region are an important traditional and cultural resource for local First Nations. The declining fish populations have direct, negative impacts related to food security and health of the affected First Nations. This complementary measure will help fill data gaps that are critical to fisheries science and help address issues related to the management of salmonids as a food source.

The research program consists of four complementary, multi-disciplinary projects that will be conducted at the watershed scale and are generally relevant to fisheries management in the upper Fraser River watershed:

- Thermal ecology of Rainbow Trout in the Stellako River
  This research program will be led by Dr. Eduardo Martins of University of Northern British Columbia (UNBC). The program will characterize the spatio-temporal variability in water temperature of the Stellako River and quantify the subsequent energetic costs of thermoregulation of Rainbow Trout using both field data and laboratory analyses. The findings will inform how freshwater fishes may respond to changes in water temperatures caused by climate or land-use change, and will inform the management of Rainbow Trout fisheries. In addition, the proposed research has the potential to inform how changes to the watershed may affect the development of Sockeye Salmon embryos and fry.
- Impacts of fine sediment on salmonid habitats in the Nautley watershed
  This research program will be led by Dr. Phil Owens of UNBC. The objective of the program will be to investigate fine sediment and associated contaminant dynamics in two key sub-watersheds of the Nautley River watershed. The findings will identify the source of the sediment and any associated contaminants using chemical analysis and fingerprinting techniques, and will inform management practices and policy advice such as soil protection measures and riparian buffers.

  Past and future trajectory of the hydroclimate and water temperatures in the Nautley River Watershed
  This research program will be led by Dr. Stephen Déry of UNBC. The objective of the study is to evaluate a new technique to estimate streamflow in ungauged basins using temperature data and to characterize the past and potential future impacts of climate change on the hydrology and water temperatures of the Nautley River Watershed. This study will produce predictions of how stream temperature and streamflow regimes may change in the future, which will allow for more informed planning and decision-making regarding fisheries and aquatic resources management.
- Improved methods for quantifying the effects of land-use change on fish
  This research program will be led by a collaboration of scientists from Palmer. The objective of the study is to demonstrate new modelling approaches that quantify how watershed-scale environmental changes affect fish habitat, and to use this framework to conduct a sensitivity analysis to identify the environmental variables to which rearing and spawning fish are most sensitive. This study will produce information to inform the development of restoration and management activities that target the environmental variables that have the greatest impact on fish production.

A key component of the proposed project is the creation of an Advisory Group, which may contribute traditional knowledge, provide oversight and direction to the project, and/or provide an avenue to coordinate engagement and the dissemination of research. Key Advisory Group members may include representatives from the Lhoosk'uz Dené First Nation, Ulkatcho First Nation, Nadleh Whut'en First Nation, Saik'uz First Nation, and Stellat'en First Nation, the Nazko First Nation, and the Provincial and Federal governments.

The full complementary measures research proposal is included in Appendix Q.

10.5 Quantification of Habitat Offset Gains

10.5.1 Instream Habitat Area

Calculation of habitat area is required as a first step for the HEP method and provides a straight-forward measure of habitat loss and gains. However, it does not incorporate an index of suitability related to habitat quality.

For the habitat restoration and enhancement work, stream channel measurements and spatial analysis using GIS and AutoCAD were used to quantify total existing habitat. Changes to instream area (i.e., by narrowing channel sections as part of restoration of cattle-trampled areas) were assessed from the detailed design drawings (Appendix N) and incorporated into the GIS-based area calculation process.

For the newly constructed Creek 661 off-channel overwintering pond and the Lake 15/16 connector channel, new instream habitat area was calculated from the detailed design drawings using AutoCAD.

10.5.2 Habitat Evaluation Procedure

A detailed description of the HEP approach to quantification of habitat offsetting gains is provided in the technical memorandum *Habitat Evaluation Procedure (HEP) for Blackwater Project – Fisheries Offsetting Plan* (Palmer 2021), provided in Appendix J. An overview of the HEP process is provided in Section 5.1.2.1. Assessment and calculation methods varied slightly to account for site-specific differences in species presence, data availability, and habitat quality. A description of the offsetting-specific methodology is provided here.

HU were calculated for Rainbow Trout and Chinook Salmon life stages in a consistent manner to describe habitats in the Project area that will be lost or isolated, as well as for habitats that will be constructed, restored, and/or enhanced through implementation of offsetting measures. There are two lines of reasoning that support of the inclusion of multiple species in the habitat equivalency calculations:

- First, inclusion of multiple species is reflective of the fact that the assessed systems support multiple fish species. The standard HEP is applied consistently, whether it is an impacted watercourse or offsetting watercourse, to provide a habitat suitability assessment of representative fish species that occur in each affected stream; and
- Second, the two species include in the offsetting gains calculations (i.e., Rainbow Trout and Chinook Salmon) occupy different ecological niches due to differences in habitat preferences and timing of life stages of both species. They do not significantly overlap temporally or spatially in habitat use.

For these reasons, the habitat restoration and enhancement will benefit both species in distinct ways which supports determining separate offsetting HUs for each species. Further evidence supporting offsetting habitat accounting for both Chinook Salmon and Rainbow Trout is reviewed in more detail in Section 2.2 of the attached memo (Appendix R) written to address the DFO Information Request #17.

10.5.2.1 Desktop- and Field-based Assessments of Habitat

Standard Approach

Habitat in the offsetting areas was evaluated using both field surveys and desktop-based analysis of high-quality aerial imagery, digital elevation models, and GIS-based maps.

Field crews conducted HEP habitat mapping on all stream reaches in Murray and Greer Creeks identified in 2017 for offsetting measures to quantitatively document existing conditions before the implementation of restoration treatments. Field survey procedures and a field data sheet were developed to collect the pertinent information needed to run the HEP habitat calculator.

Restoration reaches in the Murray Creek and Greer Creek were assessed in 2017 to document existing conditions for the purposes of applying HEP. 100% of stream habitats in most reaches were surveyed, and all habitat parameters were measured for each identified stream habitat unit.

Deviations from the Standard Approach

Greer Creek

In Greer Creek, field crews did not survey a short reach (160 m) of the tributary draining from Harlow Lake (part of the Middle Greer Creek reach). As a solution, desktop habitat mapping methods were applied to account for existing habitat conditions. The desktop assessment used Google Earth Pro (version 7.3.0.3832), photographs of the tributary taken by field crews, and observations recorded in field notebooks to describe the existing habitat in the relatively short restoration segment. No ground-truthing of the desktop generated existing conditions in Harlow Lake tributary data has been conducted to date.

Upper Greer Creek was added to the restoration reaches in 2021. Existing aerial photography was not of sufficient resolution to be useful to determine habitat quality. An estimation of the restoration potential for Upper Greer was, therefore, made using a representative reach approach that relied on the extrapolation of data from the geomorphologically similar section of Middle Greer Creek. Further detail is provided in Appendix J.

Murray Creek

Channel reaches and bankfull dimensions along Murray Creek were established based on a combination of cross-sectional surveys at representative sites, field observations during reconnaissance walks (documented with ground-based photographs), and scrutiny of high-resolution imagery and topographic data sources. The cross-sectional survey data and associated field observations were used to calibrate desktop-based interpretation of (i) UAV-acquired orthophotography from 2016, 2020, and 2021, during low-flow conditions; (ii) Google Earth satellite imagery from various years, most notably during a moderate flood (bankfull to partial inundation of floodplain) in 2013); and (iii) a UAV-based digital surface model (DSM) from 2016, during low-flow conditions. Bankfull dimensions, assumed to represent 'channel-forming' flow conditions (i.e., high water mark), were based on indicators defining the principal limit of scour, including abrupt changes in bank vegetation, material, and slope (Harrelson et al., 1994).

The bankfull channel geometry of Murray Creek is poorly defined, impacted and irregularly reconfigured by historical and ongoing agricultural activities (e.g., cattle trampling, fords, localized bank armouring, etc.), such that typical field indicators of bankfull dimensions are missing or unreliable. Systematic interpretation of remotely sensed data, field-checked at various locations, enabled more realistic and accurate characterization of bankfull dimensions. Bankfull width measurements were completed at regular intervals along west Murray Creek (20 m intervals) and the Murray Creek mainstem (50 m intervals) to establish reach-averaged estimates. Reach-averaged bankfull widths account for natural variability in channel width and anthropogenic influence that compromise meaningful site-specific measurement. It is important to acknowledge that one or more low-flow channels with better definition have formed along portions of the bankfull channel, but their characteristics are more irregular, controlled by vegetation and transient bed materials. Actual bankfull dimensions form the basis for the design of channel restoration and establishment of a more stable, self-sustaining channel.

10.5.2.2 Index of Alteration

The characteristics of the streams lost due to Project development and those included in the offsetting restoration/enhancement projects (i.e., Murray and Greer creeks) are different. This difference is driven largely by the ongoing destructive effects of cattle activity (e.g., trampling and grazing streamside vegetation, eroding banks) and ranching (e.g., vehicle crossings of watercourses, anthropogenic stream alteration). These ongoing destructive activities are not present at the mine site, resulting in a fundamental dissimilarity between the lost and restored/enhanced streams.

The habitat value of the stream segments lost due to Project development was quantified using a site-specific HEP method. Broadly, the HEP calculation relies on identifying stream mesohabitat (e.g., riffle, glide, pool) type and classification to assign habitat suitability values for fish life stages. The result is an estimate of the overall habitat value for a given undisturbed stream segment.

To evaluate the potential habitat gains at all offsetting sites in a manner that allowed for comparison with the mine-site habitat losses, the same mesohabitat type/classification HEP method was applied. However, to accurately quantify the fish habitat value of the significantly disturbed ranchland offsetting streams, adaptation of the HEP method by including an Index of Alteration (IA) term was needed.

Palmer developed an IA that describes the relative level of habitat alteration in stream habitats used by Rainbow Trout. The IA assessment considers five habitat parameters that were identified based on their significance to the evaluation species: 1) riparian vegetation; 2) riparian stream banks; 3) stream channel stability; 4) stream substrate; and 5) cover. Within the five habitat parameters, 14 distinct variables that describe specific aspects of the five habitat parameters, were developed for scoring for the HEP to be applied to both existing and future restored conditions in each stream reach of interest. These 14 variables were scored for each identified stream unit based on the results of the field and desktop assessments.

The IA is a value, ranging from 0 to 1, that was calculated as the sum of the habitat parameters divided by 5 (Equation 3). The resulting IA value for each segment was multiplied by each unaltered HSI value for each affected life stage of Rainbow Trout to determine the degraded habitat unit value. A detailed description of the IA habitat parameters and variables and their calculation is available in Appendix J. The use of an IA in our habitat quantification and evaluation, including an example, is reviewed in more detail in Sections 2.3 and 2.4 of the attached memo (Appendices Q1 and Q2) written to address the DFO Information Request #17 for the authorization application File 21-HPAC-01447.

Equation 3

$$IA_{u_i} = (RV_{u_i} + RB_{u_i} + CC_{u_i} + S_{u_i} + C_{u_i})/5$$

Where:

IA = Index of Alteration

RV = Riparian Vegetation score

RB = Riparian Bank score

CC = Channel Condition score

S = Substrate score

C = Cover score

For the restoration sites where cattle grazing is impacting existing fish habitat, the IA reflects the lower suitability of the degraded fish habitat that is not captured by the unadjusted HEP. For consistency of analysis, the IA calculation was also applied to the created habitats in the Lake 15/16 Connector Channel and the Creek 661 Off-Channel Pond, using the same post-completion predictive approach employed for the ranchland streams.

The IA-adjusted HUs calculated for the offsetting sites are directly comparable to HUs lost from Project-related activities because the Project HUs are from undisturbed stream segments which were assumed to have an IA of 1.

10.5.2.3 Evaluation of Future Conditions

Future habitat conditions for the channels and off-channel ponds were predicted by a fisheries biologist. The desktop HEP habitat mapping process was repeated while considering habitat conditions after implementation of habitat creation or restoration measures. This desktop HEP method relied on the high-quality ortho-mosaic mapping and detailed design drawings that incorporated the suite of proposed restoration prescriptions.

For each habitat segment, professional judgement was used to predict changes to the existing habitat (e.g., depth, width, spawning quality, canopy closure, etc.) that are expected post-construction or restoration. These predicted changes were evaluated using the same process as was used to assess existing conditions, and this formed the basis for the HEP assessment of habitat gains.

10.5.2.4 HEP Assessment

HEP analysis was completed for Murray and Greer Creek restoration/enhancement, construction of the Lake 15/16 connector channel, and the Creek 661 off-channel overwintering pond construction. Rainbow Trout was selected as an evaluation species for the Creek 661 off-channel overwintering ponds and the Lake 15/16 connector channel; and Rainbow Trout and Chinook Salmon were selected as evaluation species for the Murray and Greer creek restoration/enhancement sites. Habitat gains associated with the evaluation species/life stages were quantified using the same or comparable methods as for habitat losses.

Habitat gains (in HU) were calculated for the same five life stages of Rainbow Trout that were included in the mine site losses HEP:

- Spawning and Egg Incubation;
- Fry Summer Rearing;
- Juvenile Summer Rearing;
- Adult Summer Foraging; and
- Overwintering.

Habitat gains (in HU) for the Murray and Greer Creek offsetting areas were calculated for four life stages for Chinook Salmon that are applicable to the freshwater portion of their life cycle:

- Spawning and Egg Incubation;
- Fry Summer Rearing;
- Juvenile Summer Rearing, and
- Overwintering.

Habitat gains in Murray and Greer Creeks were calculated by subtracting pre-restoration habitat conditions from expected restored conditions to determine the net gain of HU achieved from implementation of restoration treatments. For the Creek 661 off-channel overwintering pond and the Lake 15/16 connector channel, none of the proposed features have been built to date; thus, only the future restored conditions analyses are applicable. Therefore, only the habitat gains resulting from the construction of new habitat were assessed.

The habitat value of each habitat component was calculated by multiplying the HSI of the species and life stages of interest by the length of the unit, the bankfull width (or the total wetted area for the off-channel ponds), and the IA described above (Equation 4).

The total habitat value of each habitat component was calculated by summing the combined HU for each life stage in each mesohabitat in each reach of Murray and Greer creeks that will be restored (

Equation 5).

For habitats that are newly constructed (i.e., the pond and the connector channel), the is the net habitat gain. Where the restoration is an improvement to existing degraded habitat (i.e., the Murray and Greer creek channel restoration/enhancement), the gains are calculated by the difference between restored and existing conditions (Equation 6).

Equation 4

$$HU_{u_i,sp_j,ls_k} = HSI_{u_i,sp_j,ls_k} * L_{u_i} * W_{u_i} * IA_{u_i}$$

Where:
HU = Habitat unit
HSI = Habitat Suitability Index
L = Unit Length

W = Unit Bankfull Width
IA = Index of Alteration

Equation 5

$$HU_{reach} = \sum_{i=1}^{n} HU_{u_i} \sum_{j,k} HU_{u_i, sp_j, ls_k}$$

Where:
n = the total number of mesohabitat units in the reach
u_i = Habitat mapping mesohabitat unit i
sp_j = species j
ls_k = life stage k

Equation 6

$$HU_{gains} = HU_{restored} - HU_{existing}$$

10.5.3 Riparian Habitat Area

Along linear habitat areas, (i.e., Murray and Greer creeks, and the Lake 15/16 connector), riparian plantings are proposed where land adjacent to the stream is bare or has minimal vegetation cover. The riparian plantings are proposed to extend up to 15 m from the stream bank. Additional information on these riparian planting areas can be found in Sections 10.4.1 and 10.4.4. The total area of the proposed riparian plantings was calculated in GIS.

For the Creek 661 overwintering pond, the riparian area gains were calculated in AutoCAD as the sum of the area of the gentle, shallow shoreline above the high water mark, and the area of proposed riparian plantings that extends approximately 10 m beyond the periphery of the pond. Further details on the gentle, shallow shoreline and riparian plantings can be found in Section 10.4.2.

For the portion of Davidson Creek with augmented flow, no change to riparian vegetation will occur and, therefore, no changes in riparian area were calculated.

10.5.4 Complementary Measures

The offset habitat value provided by complementary measures can comprise up to 10% of the required amount of offsetting. Calculation of the equivalent habitat value of the complementary measures derives from the ratio of the proposed cost of the complementary measures work and the anticipated cost of the offsetting work.

The proposed cost of offsetting for the Blackwater project is $13,590,000 (described in further detail in Section 10.11), which corresponds to a total habitat gain of 171,675 Rainbow Trout and Chinook Salmon habitat units. The total estimated cost of the proposed complementary measures proposal is $1,014,327 which is 7.5% of the value of the other proposed offsetting. Therefore, the corresponding value of the proposed complementary measures is equivalent to 12,876 habitat units (i.e., 7.5% of 171,675 HU, Table 10-2).

Table 10-2. Calculation of complementary measures value.

Program	Cost	Proportion of Offsetting Construction Cost	Offset Habitat Units	Proportion of Total Offset Habitat Units
Offsetting Programs	$13,590,000	-	171,675	-
Complementary Measures	$1,014,327	7.5 %	12,876	7.5 %
Totals	**$14,604,327**	**-**	**184,551**	**-**

10.6 Habitat Gains from Proposed Offsetting Measures

10.6.1 Murray Creek

The proposed restoration and enhancement of 2.9 km and 32,722 m^2 of Murray Creek will result in a gain of 38,641 instream HU ('usable' instream habitat) for Rainbow Trout and Chinook Salmon life stages, due to improved channel hydraulics, bed substrates, and cover. Of the total HU gain, Rainbow Trout will gain 19,652 HU and Chinook Salmon will gain 18,989 HU. Table 10-3 provides a detailed breakdown of the instream and riparian area and life-stage-specific HU gained by the restoration/enhancement. The proposed narrowing of sections of channel, as a means of restoring more functional habitat in areas over-widened by cattle trampling, will result in a net reduction of 8,041 m^2 of wetted area, with a total post-restoration area of 24,681 m^2. This overall decrease in stream area is balanced by the gain in habitat quality assessed with HEP, since a reduction in stream area is required to improve the overall habitat quality of Murray Creek. Riparian vegetation will be restored/enhanced in sections with limited riparian vegetation such that instream aquatic biota receive the full benefit of riparian habitat. As such, the riparian habitat gain will be 115,576 m^2.

10.6.2 Greer Creek

The proposed restoration and enhancement of 4.6 km and 57,697 m^2 of lower Greer Creek, 3.2 km and 27,776 m^2 of middle Greer Creek, and 8.7 km and 89,463 m^2 of upper Greer Creek will result in a gain of 107,994 instream HU ('usable' instream habitat) for Rainbow Trout and Chinook Salmon life stages, due to improved channel hydraulics, bed substrates, and cover. Table 10-3 provides a detailed breakdown of the instream and riparian area and life-stage-specific HU gained by the restoration/enhancement of each of the three reaches. Of the total HU gain, Rainbow Trout will gain 54,189 HU and Chinook Salmon will gain 53,805 HU. The proposed narrowing of sections of channel, as a means of restoring more functional habitat in areas over-widened by cattle trampling, will result in a net reduction of 2,904 m^2 of wetted area. This overall decrease in stream area is balanced by the gain in habitat quality assessed with HEP, since a reduction in stream area is required to improve the overall habitat quality of Greer Creek. Riparian vegetation will be restored/enhanced in sections with limited riparian vegetation such that instream aquatic biota receive the full benefit of riparian habitat. As such, the riparian habitat gain will be 440,529 m^2 for all of Greer Creek.

Table 10-3. Habitat Gains from Habitat Construction Offsetting Measures - Area, Habitat Units by Life Stage, and Riparian Area.

Offsetting Measure	Length (m)	Pre-Restoration Area (m2)	Post Restoration Area (m)	Net Area Change[1] (m^2)	Rainbow Trout Habitat Units					Chinook Salmon Habitat Units				Rainbow Trout HU Total	Chinook Salmon HU Total	HU Total	Riparian Area (m^2)
					Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Over-wintering				
Murray Creek	2,944	32,722	24,681	-8,041	1,093	1,219	5,652	6,629	5,059	1,640	5,649	6,084	5,616	19,652	18,989	38,641	115,576
Greer Creek – Lower	4,615	57,697	53,876	-3,821	1,208	788	4,031	4,288	3,334	1,169	4,479	4,197	5,384	13,649	15,229	28,878	119,191
Greer Creek – Middle	3,168	27,776	26,921	-856	961	788	4,758	5,942	4,459	1,047	4,906	5,860	5,784	16,908	17,597	34,505	91,738
Greer Creek – Upper	8,673	89,463	91,236	1,773	1,280	3,526	7,135	6,802	4,889	1,280	7,059	6,840	5,800	23,632	20,979	44,611	229,600
Creek 661 Pond	95	n/a	5,867	5,867	0	1,031	4,123	0	4,123	0	0	0	0	9,277	0	9,277	5,080
Lake 15/16 Connector	676	n/a	9,683	9,683	144	76	5,831	3,893	5,819	0	0	0	0	15,763	0	15,763	8,248
Complementary Measures	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12,876	n/a
Totals	**20,171**	**207,658**	**212,264**	**4,605**	**4,686**	**7,428**	**31,530**	**27,554**	**27,683**	**5,136**	**22,093**	**22,981**	**22,584**	**98,881**	**72,794**	**184,551**	**569,433**

Notes:

1. The loss of area in the Murray and Greer creek channels is the result of narrowing the over-widened existing banks that have been trampled by cattle. The decrease in instream area is balanced by the increase in habitat quality, demonstrated by the net gain of habitat units.

10.6.3 Creek 661 Pond

The Creek 661 off-channel overwintering pond will result in the gain of 5,867 m^2 of pond habitat area, equivalent to 9,277 Rainbow Trout HU ('usable' pond habitat). The habitat provided by the pond is expected to support Rainbow Trout fry rearing, juvenile rearing, and overwintering. Riparian vegetation will be created around the entirety of the pond shoreline such that in-pond aquatic biota receive the full benefit of riparian habitat. As such, riparian habitat gain will be 5,080 m^2.

10.6.4 Lake 15/16 Connector Channel

The Lake 15/16 connector channel will result in the gain of 676 m of watercourse length and 9,683 m^2 of habitat area, equivalent to 15,763 HU Rainbow Trout ('usable' habitat). The habitat provided by the connector channel is expected to support Rainbow Trout fry rearing, juvenile rearing, adult foraging, and overwintering, with some potential to support spawning. Riparian vegetation will be created along the length of the channel such that in-channel aquatic biota receive the full benefit of riparian habitat. As such, riparian habitat gain will be 8,248 m^2.

10.6.5 Complimentary Measures

Complementary measures are expected to provide 12,876 HU of equivalent offsetting value. This amount of habitat unit equivalency was calculated as described in detail in Section 10.5.4.

10.6.6 Summary

Overall, the proposed offsetting habitat construction measures and complementary measures will result in the creation of 15,550 m^2 of new habitat area, restoration and enhancement of 196,714 m^2 of existing habitat area, a gain of 185,507 HU, and creation of 569,433 m^2 of riparian area. The habitat gains from the proposed offsetting measures for life stages of Rainbow Trout and Chinook Salmon are provided in Table 10-3 of this application.

10.7 Habitat Balance

A habitat balance has been prepared to summarize the predicted impacts to fish habitat from the losses of instream habitat, upstream habitat isolation, downstream flow alteration, and riparian losses associated with the mine site and associated linear developments and the potential gains from proposed fish habitat offsetting measures (Table 10-4).

The predicted losses of 121,841 m^2 of instream habitat will be offset by the creation of 15,550 m^2 of new instream habitat and the restoration and enhancement of 196,714 m^2 of existing degraded stream habitat, totalling 212,264 m^2 of instream area. This provides an offsetting ratio (gain:loss) of approximately 1.74:1 for instream area.

A total of 89,916 Rainbow Trout HU, 563 Kokanee HU, and 372 Food and Nutrient HU will be lost in the Davidson Creek and Creek 661 watersheds. This will be offset for at an approximately 2.03:1 ratio by the gain of 98,881 Rainbow Trout HU and 72,794 Chinook Salmon HU in offsetting areas, as well as 12,876 HU of equivalent habitat value from complementary measures.

Potential flow losses that would occur in Davidson Creek without the operations of the FWR and FWSS to meet the IFN include 16,722 Rainbow Trout HU and 2,140 Kokanee HU. This habitat loss is not expected to occur in reality, as the FWSS will augment flows within Davidson Creek in accordance with the IFN. This potential loss can be considered to be offset by the FWR and FWSS in-situ at a 1:1 ratio. As discussed in Section 8.4.2.2, a small amount of residual HADD is expected and is included in the overall loss calculation.

The offsetting measures support local fisheries management objectives and local restoration priorities, and balance Project impacts. The offsetting measures incorporate both ‘in-kind’ offsetting (i.e., creation of habitats that support Rainbow Trout life stages that are directly affected by losses) and the creation of habitat to address identified bottlenecks in Rainbow Trout productivity. The proposed offsetting plan includes the creation of off-channel ponds that will provide overwintering habitat, which is currently a likely limiting factor in Rainbow Trout production in the Davidson Creek and Creek 661 watersheds, as described in Section 5.6. The offsetting measures also include “out-of-kind” offsets in the ranchland streams that will benefit Rainbow Trout and Pacific salmon species, for which Chinook Salmon are used as a representative species in the habitat accounting. Furthermore, as described in Section 0, time lag in offsetting impacts can be minimized by initiating offsetting construction in conjunction with early project construction.

Much of the habitat that will be permanently destroyed or altered supports fry summer rearing and adult spawning (egg incubation) for Rainbow Trout in the Davidson Creek watershed. However, these habitats are limited in quality and productive capacity compared the habitats in the lower watershed (Section 5.5.1 Rainbow Trout). Most of the upper headwater tributaries in Davidson Creek watershed make limited contributions to downstream fisheries, based on low habitat use by all life stages of Rainbow Trout. Habitat losses for Kokanee will be limited, as shown by the low residual HU losses calculated using SEFA. While other fish species (e.g., Mountain Whitefish) have been identified in the affected portions of Davidson Creek and Creek 661, their relative abundances were very low, in comparison with Rainbow Trout and Kokanee. No other fish species have been documented using major portions of Davidson Creek or Creek 661, with only low numbers of Mountain Whitefish found in the lower reaches of Davidson Creek, therefore other species were not included in the habitat balance.

The offsetting plan will benefit fish production for fisheries valued by local Indigenous Nations and recreational anglers. The off-site offsetting habitats (i.e., ranchland streams) are located in watersheds that support a variety of fish species, including Pacific Salmon, Mountain Whitefish, Sucker species, Sculpin species, Dace species, and others. Although the HEP analysis focuses solely on Rainbow Trout and Chinook Salmon, the positive effects of the offsetting measures will be multiplied among the other species present in these watersheds, since they will also benefit from the restoration and enhancement of existing poor-quality habitat.

Riparian vegetation restoration, and the habitat it supports, will help to maintain the productivity of adjacent and downstream fish habitat. Riparian habitat provides cover for fish, moderates fluctuations in water temperature, contributes allochthonous inputs, stabilizes banks and helps maintain overall channel morphology. Riparian habitat also has indirect value to fish habitat productivity by protecting water quality, temperature, and stream hydrology, although these indirect values are more important in highly disturbed watersheds. In recognition of these important ecological functions, riparian habitat restoration, creation or enhancement is integrated into all proposed in-stream habitat offsetting opportunities. Detailed reference site information will be obtained during a 2022 summer vegetation assessment (Appendix S). Data will be provided after this assessment is completed and used to develop updated, site-specific construction planting plans.

Table 10-4. Habitat Balance.

Impacted Streams	Assessment Method[1]	Habitat Units Lost		Food and Nutrient Production	Riparian Area (m^2)
		Rainbow Trout	Kokanee		
Davidson Creek	HEP	22,257	0	0	115,405
	SEFA	396	5	0	0
Davidson Creek Tributaries	HEP	3,338	0	144	39,316
Creek 636713	HEP	9,476	0	0	28,634
Creek 636713 Tributaries	HEP	179	0	0	10,063
Creek 688328	HEP	7,832	0	0	108,065
Creek 688328 Tributaries	HEP	1,206	0	0	48,803
Creek 704454	HEP	10,476	0	0	70,125
Creek 704454 Tributaries	HEP	2,411	0	228	76,834
Creek 428073	HEP	16,535	0	0	3,235
Tatelkuz Lake Tributary	HEP	0	0	0	13,647
Creek 661	HEP	0	0	0	0
	SEFA	464	558	0	0
Creek 661 Tributaries	HEP	0	0	0	0
Creek 146920	HEP	2,362	0	0	98,369
Creek 505659	HEP	12,871	0	0	181,333
Creek 505659 Tributaries	HEP	112	0	0	4,457
Linear Corridors	n/a	n/a	n/a	0	4,700
Sub-Total Losses	**HEP / SEFA**	**89,916**	**563**	**372**	**802,986**
Total Losses	**HEP + SEFA**	**90,851**			**802,986**

Habitat Offsets	Habitat Units Gained		Riparian Area (m^2)
	Rainbow Trout	Chinook Salmon	
Murray Creek	19,652	18,989	115,576
Greer Creek – Lower	13,649	15,229	119,191
Greer Creek – Middle	16,908	17,597	91,738
Greer Creek – Upper	23,632	20,979	229,600
Creek 661 Pond	9,277	0	5,080
Lake 15/16 Connector	15,763	0	8,248
Sub-Total Gains	98,881	72,794	569,433
Complementary Measures	12,876		n/a
Total Gains	**184,551**		**569,433**

Overall Ratios (Gains:Losses)	Habitat Units	Riparian Area
	2.03:1	**0.71:1**

Notes:

1. *HEP was used to quantify habitat lost under the mine footprint or due to upstream isolation. SEFA was used to quantify habitat losses associated with downstream flow alteration.*

The offsetting ratio of approximately 0.71:1 for the gain:loss of riparian habitat is based on area-for-area accounting, which, unlike habitat units for instream habitat, does not incorporate the quality of the habitat. A less than 1:1 ratio for riparian habitat area (m^2) arises for the following reasons:

- Small, tributary streams in the Davidson Creek and Creek 661 watersheds have a disproportionately large riparian area, when compared to larger streams and ponds in the Project area;
- The creation of the off-channel pond does not provide the same opportunity for riparian habitat creation as would the buffer of a linear watercourse. The planned re-vegetation of the shoreline and incorporation of aquatic (emergent) plantings in the shoreline area and large woody debris structures will fully buffer the pool and provide the maximum benefit of riparian habitat to in-water habitat; and
- Riparian habitat gains along offset habitats were applied only for the segments (sections) where mapped riparian treatments (e.g., brush layers, rootwad/boulder complexes) are proposed. Sections with existing riparian vegetation where other habitat enhancements are proposed were not included, although overall habitat productivity will be improved.

An area-for-area accounting of riparian habitat losses and gains is not necessarily appropriate, given that this approach does not incorporate the suitability and sensitivity of fish habitat supported by adjacent riparian habitat. The majority of impacts to riparian habitat are expected to occur within the upper Davidson Creek watershed, alongside small headwater streams supporting low densities of Rainbow Trout. The contribution of the riparian habitat in the upper Davidson Creek watershed to adjacent and downstream fish habitat productivity would therefore be relatively low. In comparison, the contributions of riparian habitat to fish habitat productivity are anticipated to be much higher in association with the proposed offsetting measures in the ranchland stream areas, which has higher potential for fisheries productivity (higher fish species diversity and density).

Based on these factors, the proposed instream habitat area offsetting ratio of approximately 1.74:1, the HU ratio of 2.03:1, and the riparian area ratio of approximately 0.71:1 (ratio of area gained to area lost) is appropriate in counterbalance the effects of habitat loss.

10.8 Offsetting Timeline

Section 10.8 of this report contains the required information (see also Table C-1) as specified in:

Section 16(h). the timeline for the implementation of the plan;
[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 16]

The timing of proposed habitat offsetting relative to predicted impacts is an important consideration, given the potential for a time lag between loss of habitat and the establishment of functioning offsetting habitats.

The impacts associated with the works requiring the *Fisheries Act* Authorization will commence during mine construction and continue progressively over the life of the mine. As such, BW Gold proposes to commence implementation of the offsetting measures involving habitat creation or restoration/enhancement during Project construction, at approximately the same time that the instream impacts commence.

Offsetting habitat construction and restoration/enhancement is currently planned to begin either in Fall 2022 or Winter 2022-2023. Specific timing of the construction work will be determined in consultation with DFO and provincial regulators and will be accordance with least-risk timing windows, as appropriate. Construction will be phased, with a focus on construction of off-channel features such as overwintering ponds occurring in winter conditions and instream works occurring during low-flow periods (July-September). The works will progress in a manner that generally achieves the principle of no net loss, such that the works are constructed in parallel with habitat loss. A detailed schedule of implementation will be developed based on timing of the *Fisheries Act* Authorization, Project permit timing more generally, and Project financing, and will also conform to fisheries timing window restrictions. Instream works (and associated impacts) subject of this application are scheduled to begin on the Project site in Fall 2022 or Winter 2022-2023, following receipt of the *Fisheries Act* Authorization. At this time, the mine may also be in the early Construction phase (pending required approvals) and instream impacts will be initially limited. Since the proposed offsetting measures are located partially on Crown Land and partially on private land that will have SROWs established and landowner approval of the activities, implementation can begin rapidly following a decision to proceed.

The complementary measures research program will be completed over a 3-year period. This period is expected to begin shortly after receiving *Fisheries Act* Authorization. A detailed schedule is provided in Appendix E.

The constructed habitats will provide nearly the full value in habitat units described in Section 10.6 within one year of their individual completion, with the exception of some habitat value associated with riparian vegetation planting and establishment, which will be realized as the planted vegetation community develops over time. Uncertainty related to when exactly the full value of the offsetting measures will be realized is accounted for by the designed habitat balance of 2.03:1 (HU gains:losses), which means that more than double the value of habitat impacted will be created at offset sites. This provides confidence that offsetting will “counterbalance particular adverse effects on fish and fish habitat resulting from particular works, undertakings or activities” as described in the DFO Applicant’s Guide (DFO 2019). There are therefore no additional measures necessary to account for time lag between impacts and offsetting.

BW Gold proposes to construct the offsetting works in a way that provides a net benefit to fisheries in the region. This intent will be readily achievable, given that the impacts would occur progressively over life of mine.

10.9 Monitoring and Adaptive Management

10.9.1 Potential Effects of Offsetting Implementation

Section 10.9.1 of this report contains the required information (see also Table C-1) as specified in:

Section 16(f). a detailed description of any adverse effects on fish and fish habitat that could result from the implementation of the plan;

[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 16]

Potential effects of offsetting implementation are described below, in two sub-sections. The first describes the potential effects of habitat construction works, specifically the ranchland stream restoration/enhancement, Creek 661 pond construction, and Lake 15/16 connector channel. The second describes the potential effects of the operation of the FWSS.

10.9.1.1 Construction of offsetting components

Construction of offsetting measures has the potential to result in temporary, localized adverse effects to the environment. Potential effects to fish and fish habitat due to construction of the offsets may include:

- Fish injury or mortality, as a result of:
  - Crushing/smothering of free-swimming fish or fish eggs by equipment or materials, or
  - Fish stranding due to dewatering.
- Changes to fish habitat, due to:
  - Altered water depth and water velocity due to discharge changes during flow diversion around isolated areas with pumps or constructed diversion channels. Alteration of stream flows could cause small-scale scour or deposition of sediments and change channel morphology.
  - Introduction of deleterious substances into fish habitat. Deleterious substances could include suspended sediment from increased erosion due to vegetation removal and soil stockpiling, or hazardous materials such as hydrocarbons from spills or leaking equipment and containers.
  - Blocking of fish movement during migratory periods, thereby limiting access to key habitats or food sources.

10.9.1.2 Operation of the FWSS

During Operations and Closure phases, the FWSS will be operational. Water from Tatelkuz Lake will be pumped to the FWR built at the bottom of Reach 7 in Davidson Creek. There are three sources of potential effects from the FWSS operation, described below. Potential effects from construction of the FWSS are identified and addressed in Section 6 and are not further described here.

- Changes in Davidson Creek water quantity and temperature;
- Changes in water surface elevation (WSE) of Tatelkuz Lake due to the volume of water pumped from Tatelkuz Lake; and
- Changes in stream flow in Chedakuz Creek;

<u>Changes in Davidson Creek water quantity and quality</u>

<u>Water quantity</u>

During operation of the FWR and FWSS, the flow regime in Davidson Creek will vary from baseline conditions. However, the FWR and FWSS will be operated such that water released from the storage reservoir into Davidson Creek downstream of the TSF will meet a defined instream flow needs (IFN) schedule. The IFN identifies the timing of the streamflow rate in Davidson Creek that would be required to provide adequate habitat to Rainbow Trout and Kokanee throughout the year. Further detail on the IFN is provided in Appendix C. As previously described, the FWR and FWSS is anticipated to offset the majority of potential flow loss at a 1:1 ratio in Davidson Creek. A small amount of residual loss, in comparison with baseline conditions, has been identified and is accounted for in the habitat balance, described in Section 10.7.

<u>Water temperature</u>

The controlled release of water into Davidson Creek has the potential to increase the surface water temperature beyond the range of natural variability, particularly in September and October when Kokanee are spawning. This temperature increase has the potential to increase the rate of egg development of Kokanee such that the alevins emerge too early in spring, thus reducing annual recruitment.

To address this concern, an analysis was conducted to define the current (i.e., 2014-2020) normal range of surface water temperature in middle to lower Davidson Creek and to compare this with the modelled temperature of water released from the FWR, particularly during September and October (Knight Piésold 2021b). The purpose was to determine whether the temperature in middle to lower Davidson Creek will be increased to the extent that egg development and spawning success of Kokanee might be affected. This analysis is provided in Appendix T.

Based on model output for FWR releases, the mean monthly average daily temperature in the FWR is estimated to be 12.6ºC in September and 7.7ºC in October, with the maximum daily temperature estimated to be 15.5ºC in September and 11.5ºC in October (Knight Piésold 2021b). The predicted monthly mean temperatures are approximately 2ºC higher than the mean monthly maximum daily average temperatures in Davidson Creek for September (Table 3 of Appendix T), and approximately 1ºC higher for October (Table 4 of Appendix T). However, a newly optimized watershed model for the project has more natural run-off reporting to Davidson Creek during Years 1-5, potentially resulting in stream temperatures closer to baseline levels downstream of the FWR.

Water released from the FWR will be suitable to support aquatic life and will be within the water quality limits established by applicable permits. Ongoing monitoring of water quality at the discharge point and in Davidson Creek downstream will be conducted in accordance with the Project's Aquatic Effects Monitoring Plan (AEMP) and trigger-based adaptive management will be employed to maintain water quality. As such, there is no anticipated negative effect due to water quality from operation of the FWR and FWSS.

Changes in Surface Water Elevation of Tatelkuz Lake

Historical models conducted during the Application/EIS process showed water withdrawals from Tatelkuz Lake, and associated changes in lake water surface elevation (WSE), may result in the loss of littoral fish habitat around the perimeter of the lake. To estimate potential habitat loss due to possible changes in Tatelkuz Lake levels, littoral habitat mapping and bathymetric mapping of Tatelkuz Lake was conducted. This potential change in water surface elevation is expected to be small (less than 0.11 m in a 1:50 dry year) relative to baseline mean annual (0.80 m) and maximum (2.0 m) fluctuations in lake levels. Overall changes in the upper 1 m of littoral fish habitat during Operations compared to baseline are estimated to be less than 1% during an average year and less than 2.5% during a 1:50 dry year. No effects to spawning habitat, including spawning habitat for Kokanee or mountain whitefish, are anticipated from this activity. Changes during Closure are similar to Operations: less than 1% change during an average year and less than 2% change during a 1:50 dry year (Section 5.3.9 of the Application/EIS). Post-closure conditions will return to baseline conditions because pumping of water from Tatelkuz Lake will cease and the diversion from the Creek 661 Watershed to the Davidson Creek Watershed will be insignificant in terms of the drainage area flowing into Tatelkuz Lake.

Actual changes to Tatelkuz Lake water levels are likely to be lower than the predictions above on the basis that withdrawals of water from Tatelkuz Lake are not proposed until Year 6. Additionally, BW Gold has made changes to the project to maximize water recycle on-site, improve and increase water diversion around the site to increase return of water to Davidson Creek, and added water treatment and discharge starting at the beginning of operations. These changes have the net effect of increasing return of water to Davidson Creek thereby reducing reliance on pumping water from Tatelkuz Lake. No mitigation measures were, therefore, identified as there are no anticipated effects to fish from the water withdrawal.

Detailed monitoring of Tatelkuz Lake is required as part of Condition 3.16 of the CEAA Decision Statement and Condition 31 of Schedule B of the EA Certificate. A Tatelkuz Lake Protection Plan (TLPP) will be implemented in accordance with these conditions to evaluate potential changes to Tatelkuz Lake fish and fish habitat over time and to guide adaptive management.

Flow changes in Chedakuz Creek

During Operations and Closure phases, water withdrawn from Tatelkuz Lake when the FWSS is operating will reduce flows in lower Chedakuz Creek , particularly between Tatelkuz Lake and the confluence with Davidson Creek (a 900 m long section). Hydrological modelling completed during the Application/EIS indicated this withdrawal will result in the maximum reduction of 2% in Rainbow Trout spawning habitat in spring; an increase in total Rainbow Trout fry rearing habitat in summer and fall; and no more than 2% reduction in juvenile Rainbow Trout rearing and Kokanee spawning habitat in fall. In winter, the predicted change in the creek depth is a reduction of 2-3 centimetres (cm) in a wide (mean of 25.7 m) and deep (mean of 0.64 m) channel. The historical modelling these predictions are based on is now considered a conservative over-estimate. Overall, the predicted reduction was less than 5% and below thresholds for significant residual effects and, therefore, no effect to fish habitat in lower Chedakuz Creek was anticipated to occur.

Since 2015, the baseline hydrology has been updated and the mine plan now proposes to divert more runoff that originates in the upper portion of the Davidson Creek catchment around the TSF, increase water recycled on site and treat and discharge water from the start of Operations. These changes result in more water originating from the upper portions of Davidson Creek to contribute downstream to meet the IFN, thus reducing the demand on the volume of water from Tatelkuz Lake. The increased freshwater diversions reduce the amount of water that will need to be withdrawn from Tatelkuz Lake to support IFN. Given this, and that fact that pumping from Tatelkuz Lake is not planned to commence until Year 6, the previously analyzed timeseries of habitat conditions from Chedakuz Creek represent a over-estimate of the necessary water withdrawals from Tatelkuz Lake, and subsequently, the effect on Rainbow Trout and Kokanee habitat in Chedakuz Creek. Detailed monitoring of fish and fish habitat in Chedakuz Creek to evaluate potential effects is required as part of Condition 3.16 of the CEAA Decision Statement.

10.9.1.3 Changes to groundwater levels or Creek 661 flows associated with the Creek 661 Off-Channel Overwintering Pond

Impacts to groundwater levels within the alluvial valley of Creek 661 will occur from construction of the Creek 661 Overwintering Pond (OWP). The impacts will be limited to 0.17 L/s (0.17% of Creek 661 winter baseflows) of groundwater seepage into the OWP in the most conservative scenario (i.e., assuming the highest hydraulic conductivity likely for surficial soils in the alluvial valley ['clean' sand]). Groundwater seepage into the OWP is meant to help regulate the thermal regime and dissolved oxygen levels within the pond, especially during winter. Any storage of groundwater seepage into the OWP is temporary and will be released into Creek 661 at the outlet of the OWP such that no baseflow is lost from the creek-valley system. It is estimated that the OWP will only intercept groundwater seepage related to Creek 661 for approximately 120 m, limiting the area of influence of local groundwater levels and potential effects to Creek 661 flows. No impact to the baseflow of Creek 661 or local groundwater levels is anticipated even under the unlikely condition that the soils in the alluvial valley where the OWP is proposed are all ‘clean’ sand.

Additional details are provided in a memo included as Appendix U (Blackwater Gold Project Application for a Fisheries Act Authorization DFO Adequacy Review Letter – Information Request #14 Groundwater

Seepage in Creek 661 DFO File: 21-HPAC-01447), including quantification of estimated groundwater seepage from Creek 661 into the proposed OWP for the Project.

10.9.2 Measures and Standards During Offsetting Implementation

Section 10.9.2 of this report contains the required information (see also Table C-1) as specified in:

Section (g). a detailed description of the measures and standards that will be implemented to avoid or mitigate the adverse effects and how those measures will meet their objectives;

[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 16]

Palmer has developed a CEMP which describes mitigation measures to reduce or avoid adverse effects during construction of offsetting measures (Appendix O). Potential, unmitigated, adverse effects associated with implementation of offsetting measures are listed in Table 10-5 below with associated mitigation measures summarized from the CEMP. Residual adverse effects to the environment are not anticipated after implementation of mitigation measures, and the offsetting construction will have an overall positive effect on aquatic habitat.

Compliance with the CEMP to minimize risks to fish and fish habitat during construction of the offsetting works will be managed by conducting construction monitoring. A QEP will monitor the in-water work to document compliance with environmental protection measures and inspect and report on erosion and sediment control measures. Field inspections will be conducted periodically before, during, and after construction and during high precipitation events to document and photograph site conditions associated with offsetting works. A qualified professional with experience in the supervision of channel restoration projects (e.g., fluvial geomorphologist, habitat restoration specialist) will visit the sites at critical times during construction to ensure all elements of offsetting works are completed according to design specifications, and to assist with field-fit modifications, where required.

Key elements of construction requiring environmental supervision include, but are not limited to, the following:

- Implementation of functional erosion and sediment control measures, including flow by-pass measures;
- Removal of existing vegetation within, and protection of vegetation in close proximity to, the works areas and access routes;
- Establishment of key profile (elevation) points and channel and pond dimensions;
- Installation of habitat cover features (e.g., root wads, boulders, brush layers, live stakes); and
- Construction of transitions to the upstream and downstream tie-in points.

Table 10-5. Potential Effects and Mitigations Associated with Implementation of Offsetting Measures.

Potential Effects		CEMP Key Mitigation Summary
Vegetation	Invasive species introduction.	• Identify and remove invasive species currently present, where achievable and where the benefits to fish habitat will outweigh the risks of required disturbance. • Clean all equipment and materials before arrival at site. • Re-vegetate disturbed areas after construction with native species only.
Fish and Fish Habitat	Fish injury or mortality.	• Work in-stream during the regional Reduced Risk Work Window for fish when and where possible. • Conduct fish salvage in advance of construction and maintain isolation of salvaged areas from the main streamflow for the duration of the work. • Follow DFO guidance for screening on pump intakes.
	Altered stream flows changing downstream habitat.	• Maintain downstream flows with diversion pumps. • Control pump discharge to dissipate water velocity. • Prevent channel erosion with splash pad or similar measures • Develop a contingency plan for pump failure. • Prevent sediment-laden water from entering the aquatic environment.
Wildlife	Bird nest disturbance during vegetation clearing.	• Adhere to breeding bird timing windows • Conduct a pre-clearing bird nest survey. • Apply no-go buffers around any nests which are present.
	Human-wildlife conflict.	• Maintain the site free of wildlife attractants • Discourage wildlife from inhabiting work areas. • Utilize wildlife-proof waste containers. • Prevent staff from interacting with wildlife. • Prohibit hunting or fishing at site.
	Disturbance of reptiles and amphibians during project construction.	• Conduct a pre-construction reptile and amphibian survey and potentially a salvage (where required and in accordance with necessary salvage authorizations), install exclusion fencing as recommended by a qualified environmental professional (QEP), and monitor for effectiveness of the salvage and fencing.

Surface Water Quality	Erosion and mobilization of sediment into the receiving environment.	• The Contractor will develop and implement an Erosion and Sediment Control Plan (ESCP) including a detailed description of measures for erosion and sediment control.
		• Project-specific measures outlined in engineering drawings include the following:
		  ■ Conduct pond excavation in winter when groundwater levels are low and soils are frozen.
		  ■ Install rig matting on soft or wet ground.
		  ■ Complete all in-stream works in isolation from stream flows.

Potential Effects		CEMP Key Mitigation Summary
		■ Treat sediment-laden water with Siltsoxx or similar. ■ Cover exposed soil with biodegradable erosion control blankets. ■ Install fibre rolls or sediment control fencing where appropriate. ■ Place stockpiled materials at least 15 m from the top of bank ■ Re-establish in-stream flows in a controlled manner to minimize sedimentation. • Water quality monitoring for turbidity and other parameters as per regulatory requirements or permit conditions (as applicable) will be conducted on site by a QEP. • Work will be stopped and ESC measures will be adjusted as needed if turbidity or total suspended solids (TSS) levels are above guidelines
	Hazardous material (e.g., hydrocarbons) release into the receiving environment.	• The Contractor will develop and implement a Spill Prevention and Emergency Response Plan (SP&ERP) to prevent spills and other accidents or malfunctions. • Water quality monitoring for hydrocarbons and other parameters as per regulatory requirements or permit conditions (as applicable) will be conducted on site by a QEP. • In the event that a hazardous materials release is observed in the receiving environment, implement spill response protocols as described in the SP&ERP and report to Emergency Management BC's spill reporting line if appropriate.

10.9.3 Effectiveness Monitoring

Section 10.9.3 of this report contains the required information (see also Table C-1) as specified in:

Section 16(d). a detailed description of the monitoring measures that will be implemented to assess the effectiveness of the measures referred to in paragraph (c)

[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 16]

In accordance with DFO's guidelines (Smokorowski et al. 2015), three main types of monitoring will be conducted to monitor the success of this Offsetting Plan: *compliance monitoring, functional monitoring,* and *effectiveness monitoring*. Adaptive management is the process of responding to and alleviating any identified deficiencies or failures in offsetting works, based on the results of monitoring.

Compliance monitoring (as partially described above in Section 10.9.2) will involve monitoring by a qualified environmental professional (QEP) during construction to ensure that environmental protection measures and best management practices detailed in the CEMP (Appendix O) are implemented as required and that habitat features are constructed in accordance with the Offsetting Plan and the design drawings. *Functional* monitoring will involve post-construction inspection and multiple follow-up evaluations to ensure morphological stability of the channel/ponds and the functionality of the constructed fish habitat, based on a qualitative and quantitative monitoring program. *Effectiveness monitoring* is the most rigorous, science-based monitoring, with the purpose of ensuring that offsetting measures are functioning as designed using Before-After-Control-Impact (BACI) design or Control-Impact (CI) methods to assess habitat use by fish.

The Effectiveness Monitoring Plan (EMP; Appendix P) describes the site-specific monitoring plans, although consultation with DFO and other relevant stakeholders or regulators may be conducted to refine the key indicators for monitoring and the criteria for evaluating ‘ecological functionality’.

Summaries of the proposed site-specific monitoring methods for the offsetting sites are provided in the following subsections. Detailed description of the effectiveness monitoring plan components and success criteria for each offsetting measure are provided in the EMP (Appendix P).

10.9.3.1 Constructed Offsetting Measures

The effectiveness monitoring approach for the constructed habitat offsetting measures (i.e., ranchland stream restoration/enhancement, Creek 661 pond construction, and Lake 15/16 connector channel construction) are broadly similar. The objective of these components of the EMP is to quantitatively determine the success of the constructed and restored/enhanced habitats to provide fish habitat as designed following construction. A Control-Impact design will be used for newly created habitats (where ‘before’ conditions are not available for assessment), where the created offsetting habitat will be compared to reference habitat. A Before-After-Control-Impact approach will be used for the ranchland stream restoration/enhancement, where habitat conditions will be compared to both pre-construction conditions and to a reference habitat.

Proposed monitoring activities will be undertaken in summer and winter in Years 1, 3, 5, and 10 after completion of the offsets and at suitable reference sites. These sampling programs will assess:

- Fish utilization (including species presence/absence, relative abundance, and size-class distribution);
- Surface water quality (i.e., temperature, pH, conductivity, turbidity, and dissolved oxygen concentration);
- Physical stability and hydraulic function (i.e., assessment of side slopes, channel banks, placed fish habitat features, and hydraulic characteristics); and
- Riparian vegetation success (i.e., survivorship and percent cover)
- Winter habitat conditions, including habitat assessment, fish utilization, and surface water quality.

Ground-level photographs and aerial drone imagery will be recorded to assist in long-term tracking of the constructed habitat conditions.

10.9.3.2 Davidson Creek Flow Augmentation

The effectiveness monitoring component for Davidson Creek flow augmentation focuses on assessment of fish community metrics, specifically related to the evaluation of key life-history stages for Rainbow Trout and Kokanee. The metrics that will be monitored to assess the effectiveness of flow augmentation in Davidson Creek are as follows:

- Kokanee fry outmigration assessment, including dissolved free amino acid sampling (DFAA; related to salmonid homing to natal streams);
- Rainbow Trout spawner and redd abundance;
- Young-of-year and juvenile Rainbow Trout abundance;
- Kokanee adult spawner and redd abundance, including sampling for DFAA; and
- Rainbow Trout overwintering habitat quality and availability;

Effectiveness monitoring field programs are proposed for spring, summer, and winter in Years 1, 3, 5, 7, 9, and 11 after completion of the offset measures. The monitoring frequency is based on a four-year return period for Kokanee. Three areas will be monitored in lower Davidson Creek between Reaches 1 to 6. The Davidson Creek monitoring program will closely follow and build upon the baseline data collected for the creek in 2021 and 2022.

10.9.4 Adaptive Management

An adaptive management approach will be developed to identify the need for remedial measures, further mitigation, or offsetting measures. The monitoring program is designed to include various metrics for assessing fisheries productivity and habitat structural integrity and quality. For example, monitoring will include measurements of channel morphology and fish habitat features, monitoring of water quality, sampling of fish communities, and riparian vegetation assessments. Maintenance (on an as-needed basis) may include selective irrigation, identification and removal of invasive species, documentation and replacement of unsuccessful plantings, stabilization of erosion sites, and mitigation of animal intrusion or damage. The monitoring program will be deemed successful when habitat offsetting sites have reached the defined criteria for determining success, and thus, when the goal of counterbalancing habitat loss has been achieved.

10.10 Contingency Measures

e) a detailed description of the contingency measures and associated monitoring measures that will be implemented if the measures referred to in paragraph (c) do not meet their objectives;

Through discussion with local stakeholders and NEWSS, Palmer has identified and established the feasibility of additional conceptual-level contingency offsetting opportunities, should any of the offsetting measures discussed above not meet their success criteria provided in the EMP (Appendix P). For instance, NEWSS has identified additional ranchland streams/reaches where habitat improvements may be warranted. Additional off-channel habitat could also be created along the proposed Mathews Creek ranchland stream restoration/enhancement (proposed as compensation habitat for the ECCC Schedule 2 Amendment) or within the Creek 661 Watershed. Contingency funding amounting to 15% of the total offsetting construction, monitoring and maintenance costs is incorporated into the offsetting cost estimate (Table 10-6). An overview of the select contingency options is provided below.

10.10.1 Additional Overwintering Ponds

Within the Creek 661 watershed, two additional overwintering pond candidate sites have been identified and are located:

- Adjacent to the main branch of Creek 661, approximately 3 km upstream of the proposed Creek 661 Overwintering Pond; and
- Adjacent to a tributary of Creek 661 that joins with the main branch of Creek 661 approximately 5 km downstream of the proposed Creek 661 Overwintering Pond.

In the Mathews Creek watershed, one additional overwintering pond candidate site has been identified and is located between Laidman Lake and the Kluskus-Ootsa FSR, downstream of the proposed off-channel overwintering ponds and channel restoration/enhancement site compensation measures proposed for the ECCC Schedule 2 Amendment.

These sites have good access from existing exploration and/or forestry roads, require few tree removals, and have a naturally high groundwater table. Proposed ponds at these sites would be deep (>2 m) and would incorporate cobble/boulder substrates and overhead cover (riparian vegetation, rootwads), similar to the creation of overwintering ponds proposed in Section 10.4.2 of this Offsetting Plan. The ponds would have irregular shapes and will be positioned such that they minimize the risk of sedimentation (infilling) and avulsion (channel cut-off) during floods.

10.10.2 Murray Creek Restoration and Enhancement

Additional ranchland stream reaches have been identified in the vicinity of the Murray Creek restoration/enhancement areas described in Section 10.4.1.1, as opportunities for restoration and enhancement. Similar to other ranchland streams identified above, agricultural activity has led to cattle trampled banks and bed, farm machinery crossings, exposed channel bank, and lack of riparian vegetation, which has negatively impacted fish habitat. Restoring additional portions of Murray Creek would involve localized restoration of natural channel dimensions, riparian plantings, cattle exclusion fencing, 'off-channel' watering, localized placement of boulders and gravels, restricted machinery sites, and removal of unnatural flow impediments.

10.11 Offsetting Cost Estimate

Section 10.11 of this report contains the required information (see also Table C-1) as specified in:

Section 16(i): an estimate of the cost of implementing each element of the plan;
[Authorizations Concerning Fish and Fish Habitat Protection Regulations, Schedule 1, section 16]

Construction costs for the offsetting measures, rounded to the nearest $1,000, were determined by Onsite Engineering Ltd. which is supporting drafting and engineering oversight, and NEWSS, a local ecological restoration organization, based on the detailed design drawings (Appendix N). The total cost to construct the proposed offsetting measures is approximately $13,588,000 which includes the 15% contingency fund of $1,772,000 (Table 10-6). Additionally, $1,014,327 will be allocated for Complementary Measures, resulting in a total offsetting cost of $14,602,327.

Table 10-6. Estimated Construction, Monitoring and Maintenance Costs for the Proposed Offsetting Measures.

Offsetting Measure		Construction Costs	Monitoring and Maintenance Costs	Contingency Costs (15%)
Stream Restoration and Enhancement Construction	Murray Creek	$2,127,000	$464,000	$389,000.00
	Lower Greer Creek	$1,827,000	$446,000	$341,000.00
	Middle Greer Creek	$1,430,000	$359,000	$268,000.00
	Upper Greer Creek	$2,643,000	$665,000	$496,000.00
Off-channel Pond Construction	Creek 661 Pond	$370,000	$185,000	$83,000.00
Stream Channel Construction	Lake 15/16 Connector	$698,000	$602,000	$195,000.00
Offsetting Sub-total Costs		$9,095,000	$2,721,000	$1,772,000.00
Total Offsetting Construction and Monitoring Costs		$13,588,000		
Complementary Measures		$1,014,327		
Total Offsetting Cost		$14,602,327		

11. Certification

This report was prepared, reviewed, and approved by the undersigned:

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