Palmer™

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5
Tel: 604-629-9075 | www.pecg.ca

Blackwater Gold Project
Fish Habitat Compensation Plan

Pursuant to Section 27.1 of the Metal and Diamond Mining Effluent Regulations

Palmer Project #
2006501

Prepared For
BW Gold Ltd.

June 3, 2021

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5
Tel: 604-629-9075 | www.pecg.ca

June 3, 2021

Claude Asselin, ing., M. Ing.
Senior Program Engineer, Environmental Protection Branch
Environment and Climate Change Canada, Government of Canada

Dear Claude Asselin,

Re:
Blackwater Gold Project
Fish Habitat Compensation Plan
Pursuant to Section 27.1 of the Metal and Diamond Mining Effluent Regulations

Project #: 2006501

Palmer is pleased to submit the attached Compensation Plan for fish habitat at the Blackwater Project, in support of an application for amendment to Schedule 2 of the Metal and Diamond Mining Effluent Regulation (MDMER).

This report has been prepared in accordance with Section 27.1 of the MDMER. This Compensation Plan specifically offsets losses to fish habitat that result from the deposition of a deleterious substance into waterbodies beneath the Site C and D tailings storage facilities (excluding dam footprints), the low-grade and high-grade ore stockpiles, and the upper overburden stockpile. Other mine impacts and offsetting, specific to the *Fisheries Act* Authorization will be detailed in the separate Offsetting Plan that will accompany the application for Authorization.

This Compensation Plan 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 compensation 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,

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. (Artemis), 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.

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 the Project development, so the Project will require both 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 will be required to designate portions of Davidson Creek within the TSF and the portions of tributaries to Davidson Creek and Creek 661 under the Overburden and Ore Stockpiles as Tailings Impoundment Areas (TIAs).

This document presents the Blackwater Project Fisheries Compensation Plan (Compensation Plan) to avoid, mitigate, and offset the loss of fish habitat resulting from the deposit of a deleterious substance into the TIAs, in accordance with Section 27.1 of the MDMER. Offsetting specific to the *Fisheries Act* Authorization will be detailed in the separate Offsetting Plan that will accompany the application for Authorization.

The Blackwater Project mine site is located within the Nechako River basin. All of the proposed mine site is located in the upper extents 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, 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.

This Compensation Plan focuses on the only fish species encountered in the affected upper reaches of Davidson Creek and Creek 661 – rainbow trout (*Oncorhynchus mykiss*).

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 (*O. nerka*) habitat, and maximizing the use of existing access routes and disturbed areas for linear corridors. Complete avoidance of fish habitat loss was determined unfeasible through an alternatives assessment. Despite the application of avoidance and mitigation measures, some loss of rainbow trout habitat is predicted to occur as a result of the Project development.

To quantify habitat loss subject to the Schedule 2 amendment process, baseline fish habitat data gathered during the Environmental Assessment (EA) process was analyzed using three 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; and
- 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.

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. The assessments predict a loss of 48,435 m^2 of instream area, 47,125 rainbow trout HU, and a loss of 45.3 hectares of riparian habitat alongside fish-bearing watercourses.

To offset the residual impacts outlined above, BW Gold and Palmer have identified and developed detailed designs for fish habitat compensation measures that address known limitations to fisheries productivity in the affected watersheds. Compensation measures aim to alleviate productivity bottlenecks as well as 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.

Two associated compensation measures are proposed to offset instream and riparian habitat loss:

1. Mathews Creek channel restoration/enhancement; and
2. Mathews Creek off-channel pond creation.

The HEP was applied to calculate the net gain of instream habitat from the compensation measures, in order to ensure comparable quantification to net impacts. HU were calculated in a consistent manner to describe habitats in the Project area that will be located beneath the TIAs, as well as for habitats that will be constructed and/or enhanced through implementation of compensation 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.

Total gains of 26,364 m^2 of instream habitat, 92,859 rainbow trout HU, and 7.6 hectares of riparian habitat are predicted. This provides a compensation gain:loss ratio of approximately 1.97:1 for instream habitat (as habitat units), and approximately 0.17:1 for riparian habitat. Detailed information on the habitat balance and the quality of lost and gained instream and riparian habitat is available in Section 6.7.

Table of Contents

List of Figures

List of Tables

List of Appendices

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 previous owner of the Project, New Gold Inc. (New Gold), received 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*, 2012. In August 2020, BW Gold acquired the mineral tenures, assets and rights in 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 process that the Project will likely result in harmful alteration, disruption or destruction (HADD) of fish habitat, as defined by the federal *Fisheries Act*.

Before construction of certain works can commence, the Project requires both an amendment of Schedule 2 of the Metal and Diamond Mining Effluent Regulations (MDMER) and an Authorization under Paragraph 35(2)(*b*) of the *Fisheries Act*. 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. *The Fisheries Act* Authorization application will address all other effects on fish and fish habitat resulting from Project activities.

A Conceptual Fisheries Mitigation and Offsetting Plan was prepared as part of the EA Application (the Application), which outlined project activities, effects, and offsetting measures proposed at the time of the Application submission (AMEC, 2014a; Appendix.5.1.2.6C of the Application). The Conceptual Fisheries Mitigation and Offsetting Plan was updated based on comments received from Indigenous nations, Fisheries and Oceans Canada (DFO) and the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (MFLNRORD) and 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.

This Compensation Plan presents the approach to avoid, mitigate, and offset the loss of fish habitat resulting from the deposition of a deleterious substance into a TIA, in accordance with Section 27.1 of the MDMER. Offsetting specific to the *Fisheries Act* Authorization will be detailed in the separate Offsetting Plan that will accompany the application for Authorization.

Following this introduction (Section 1), this document provides an overview of the proposed work, undertakings and activities associated with the Project (Section 2). Section 3 provides a description of fish and fish habitat in the Project area and in the TIAs in particular. Section 4 outlines the anticipated effects on fish habitat as a result of the Project, including a quantitative assessment of the tailings deposit on fish

habitat, as well as an outline of avoidance and mitigation measures (Section 4.2). Section 5 outlines the assessment of residual effects to fish habitat, and the proposed compensation measures are presented in Section 6.

1.2 Proponent Contact Information

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

1.3 Environmental Regulations and Policy

The Project 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, as well as potentially causing HADD and the death of fish associated with other mine components. 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.

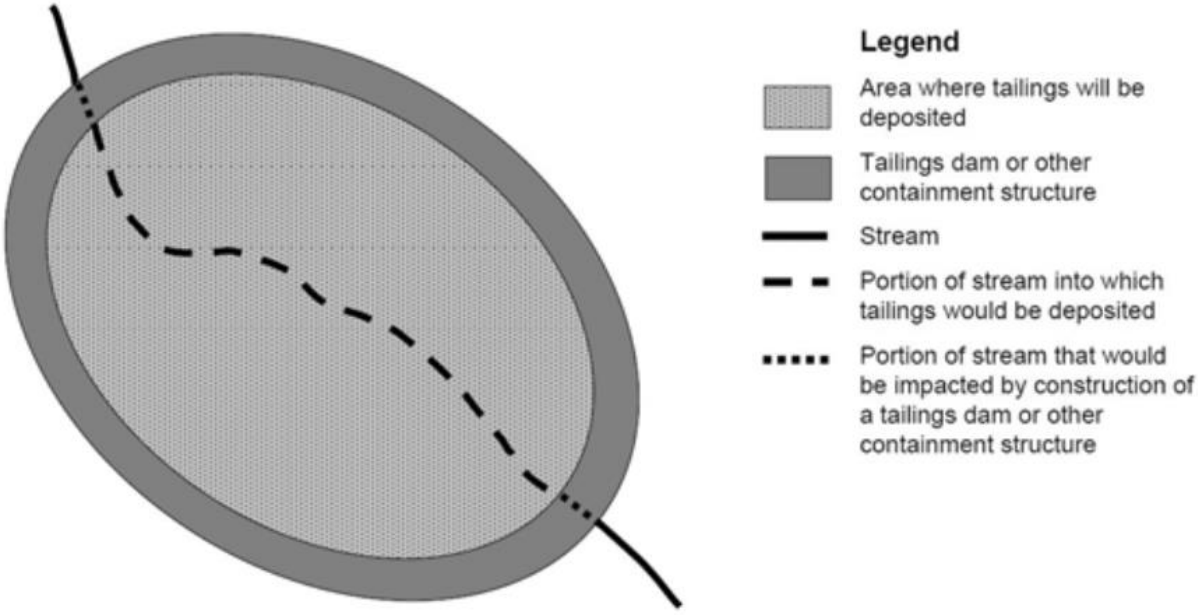
Environment and Climate Change Canada's (ECCC) *Guidelines for the Assessment of Alternatives for Mine Waste Disposal: Annex 2* describe that in situations where a tailings impoundment area is established in a stream valley, as is the case for the Blackwater Project, two separate fish habitat compensation/offsetting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

- 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; and
- 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 structure.

Figure 1-1 illustrates the typical division of fish habitat compensation areas.

Stream areas included in this Compensation Plan for Section 27.1 of the MDMER and those included in a separate Offsetting Plan for *Fisheries Act* Subsection 35(2) Authorization are shown in Figure 5-1. Section

5 includes a detailed description of the stream segments that will be affected by deposition of a deleterious substance.



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

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 and death of fish.

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 (Subsection 35(1)). If a project cannot avoid, or is likely to cause, death of fish and/or HADD, then a *Fisheries Act* Authorization is required.

An application for an Authorization will be prepared in accordance with the information requirements outlined in Schedule 1 of the Authorizations Concerning Fish and Fish Habitat Protection Regulations, enacted under the *Fisheries Act*, to address HADD and death of fish that are anticipated to result from the construction of mine infrastructure and are not addressed by this Compensation Plan.

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 lists waterbodies designated as TIAs, requires federal legislative action. The MDMER were 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 affected water bodies. 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, and the overburden and non-acid-generating (NAG) waste rock storage facilities as TIAs.

As required by ECCC for the Schedule 2 amendment process, BW Gold has assessed alternatives for tailings, waste rock, and low-grade ore deposition. A report documenting the alternatives assessment will be submitted under separate cover.

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 required components and relevant section references are presented in Table 1-1.

Table 1-1. MDMER Subsection 27.1(2) Compensation Plan Requirements

Section 27.2(2) Compensation Plan Requirement	Document Section Reference
A description of the location of the tailings impoundment area and of fish habitat that will be affected by the deposit	Section 3
A quantitative impact assessment of the deposit on fish habitat	Sections 4 and 5; Appendix A
A description of the measures to be taken to offset the loss of fish habitat	Section 6; Appendix C
A description of the measures to be taken during the planning and implementation of the Compensation Plan to mitigate any potential adverse effects on fish habitat that could result from the plan's implementation	Section 6.9; Appendix D
A description of the measures to be taken to monitor the plan's implementation	Section 6.9; Appendix E
A description of the measures to be taken to verify the extent to which the plan's purpose has been achieved	Section 6.9; Appendix E
The time required to implement the plan that allows for the achievement of the plan's purpose within a reasonable time	Section 6.8
An estimate of the cost of implementing each element of the plan	Section 6.11; Appendix F

Subsection 27.1(3) specifies the requirement for the owner or operator of a mine to submit an irrevocable letter of credit (LOC) to cover the plan's implementation costs, which shall be payable upon demand on the declining balance of the implementation costs. It is BW Gold's understanding that the LOC may be provided subsequent to submission of this Compensation Plan, when costs to implement the Plan are known.

1.4 Consultation

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 1-2).

The Blackwater mine site is located within the traditional territories of Lhoosk'uz Dené Nation (LDN) and Ulkatcho First Nation (UFN), and the Schedule 2-related impacts will occur in the traditional territories of these two Indigenous Nations. Other Project components, including the existing Kluskus and Kluskus-Ootsa Forest Service Roads (FSRs) and proposed transmission line, cross the traditional territories of Nadleh Whut'en First Nation (NWFN), Saik'uz First Nation (SFN), and Stellat'en First Nation (StFN; collectively, the Carrier Sekani First Nations) and Nazko First Nation (NFN). Throughout the EA process, the BC Environmental Assessment Office (EAO) consulted these Indigenous Groups 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 of Forests). The EAO consulted with Skin Tyee Nation, Tsilhqot'in National Government, Nee Tahi Buhn Band, Cheslatta Carrier Nation and Yekooche First Nation 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 fisheries 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 2021 to engage and consult with regulators, third party reviewers, and Indigenous Nations (Table 1-2). Feedback and input on fisheries compensation measures should align with provincial, federal, and Indigenous Nations fisheries management objectives.

Table 1-2. Summary of Fisheries 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 EA 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
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	NWFN, SFN, StFN, and BW Gold

Date(s)	Meeting/Site Visit, Location, Objectives	Attendance
	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)	
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
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

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.

2. Proposed Works, Undertakings and Activities

2.1 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 *Assessment of Alternatives for the Blackwater Gold Project for Mine Waste Disposal* (Assessment of Alternatives; 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 EA Application.

The Project is a greenfield gold and silver open-pit mine and 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;
- Freshwater Supply System (FWSS) and associated infrastructure;
- Electrical transmission line and associated access, borrow, and laydown areas;
- Airstrip; and
- Mine access roads.

2.1.1 Project Location

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 2-1. The location of the Project within the sub-watersheds of the Nechako River watershed, is shown in Figure 2-2. A small-scale site plan indicating the size and spatial relationship of the proposed mine site components is shown in Figure 2-3. Waterbodies in the vicinity of the Project, based on the waterbodies identified in the aquatics Local Study Area (LSA), specific to the mine site[1] in the EA, and their UTM coordinates are listed in Table 2-1.

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

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) 124.5. BW Gold is planning to build a new approximately 14 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 Aboriginal rights and Treaty rights and related interests of the following Aboriginal Groups:

- Lhoosk'uz Dené Nation;
- Ulkatcho First Nation;
- Nazko First Nation;
- Nadleh Whut'en First Nation;
- Saik'uz First Nation;
- Skin Tyee Nation;
- Stellat'en First Nation;
- Tsilhqot'in National Government; and
- Métis Nation of British Columbia.

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.

Legend

- Populated Place
- Highway
- Major Forest Service Road (FSR)
- Heritage Trail
- Watercourse
- Elevation Contour (100 m interval)
- Waterbody
- Indian Reserve
- Park or Protected Area
- Mine Footprint

Scale 1:350000
UTM Zone 10N
NAD 1983 Datum

0 5 10
kilometres

N

Prepared For:

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Feb 22, 2021

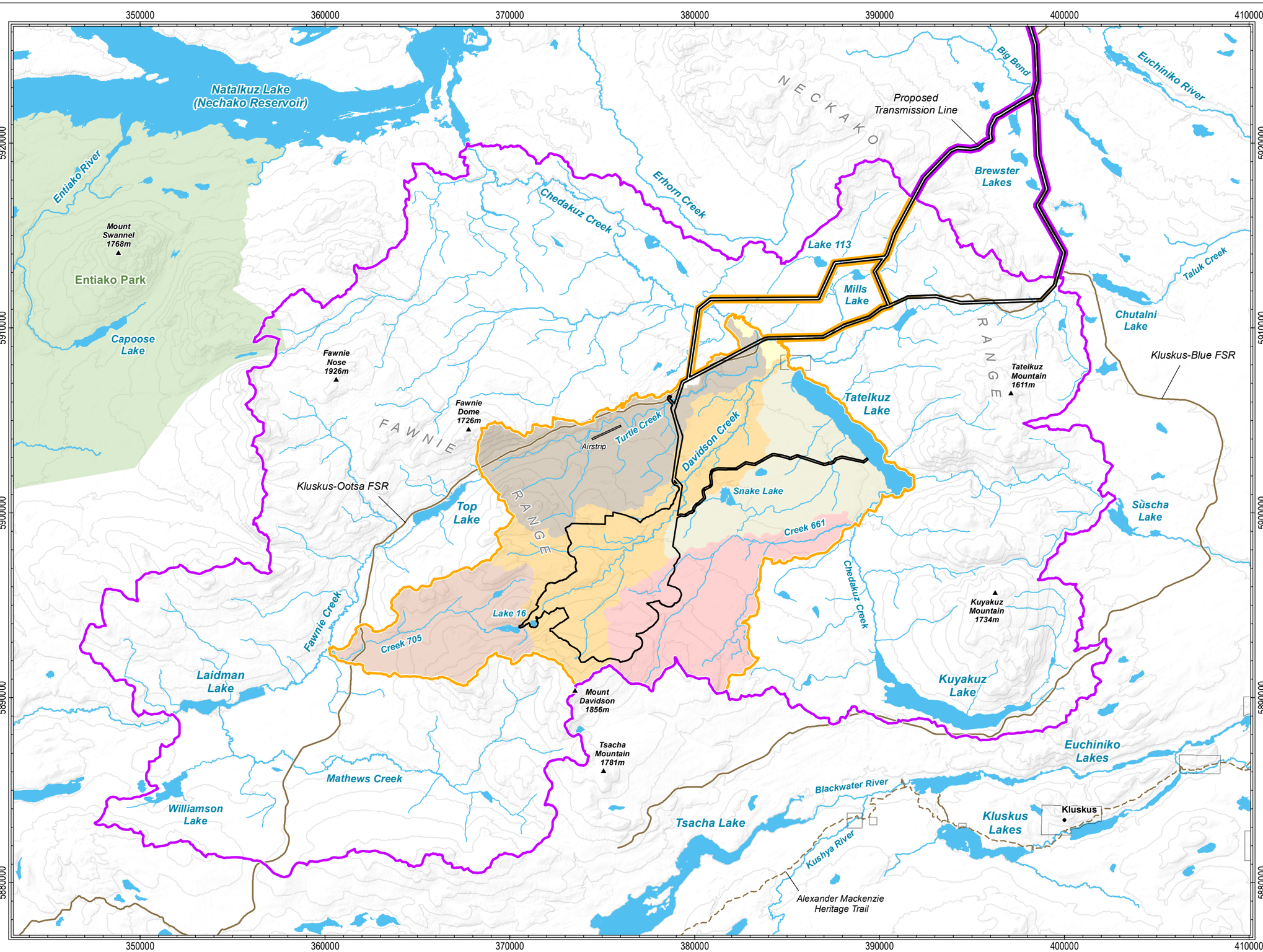
Prepared by:

Palmer

Location of the Blackwater Project South of Vanderhoof, BC

FIGURE 2-1

Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project 2020\Mapping\Figures\5_ArcGIS\ECCC Report\Figure 2-1 Location.mxd



Legend

- 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.

Scale 1:200000
UTM Zone 10N
NAD 1983 Datum

0 1 2 3 4 5
kilometres

N

Prepared For:

ARTEMIS GOLD INC

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Feb 22, 2021

Prepared by:

Palmer™

Location of the Blackwater Project in the Davidson Creek and Creek 661 watersheds

FIGURE 2-2

Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project 2020\Mapping\Figures\5_ArcGIS\ECCC Report\Figure 2-2 Location (Watersheds).mxd

370000 375000 380000 385000 390000

5905000 5900000 5895000

Proposed Transmission Line (Mills Ranch Reroute)
Chedakuz Creek
TATELKUZ LAKE 28 I.R.
Turtle Creek
Transmission Line
Fawnie Dome 1726m
Kluskus-Ootsa FSR
Airstrip
Mine Access Road
Tatelkuz Lake
Creek 226858
Fresh Water Supply Pipeline
Creek 314089
Davidson Creek
Tatelkuz Lake Intake
Creek 700
Top Lake
Snake Lake
Aggregate Screening Area
ECD Diversion Structure
Creek 428073
Creek 636713
Diversion Ditch
Fresh Water Reservoir (FWR)
Creek 661
Diversion Structure
Site D Tailings
Environmental Control Dam (ECD)
Site D Tailings Pond
Creek 668328
ECD Diversion Structure
ECD Pond
Site C Main Dam
Truck Shop and Mine Offices
Diversion Ditch
Site D Main Dam
Creek 146920
Creek 543585
Exploration Road
Site C Tailings Pond
Camp Area
Creek 661
Site C Tailings
Creek 505659
Site C West Dam
Lake 01428UEUT
Creek 104454
Diversion Structure
NAG & Lower Overburden Stockpile
Creek 705
Plant Site
Conveyor Platform
Lake 16
Low-grade Ore Stockpile
High-grade Ore Stockpile
Lake 15
Explosives Magazine
Open Pit
Diversion Structures
Upper Overburden Stockpile
Mount Davidson 1856 m
Chedakuz Creek
Kuyakuz Lake

Legend

- Spot Height
- Major Forest Service Road (FSR)
- Minor FSR
- Exploration Road
- Elevation Contour (25 m interval)
- Watercourse
- Waterbody
- Indian Reserve
- Mine Footprint

Mine Site Plan

- Dam
- Tailings Pond
- Embankment
- Tailings Beach
- PAG Waste Rock
- Open Pit
- Stockpile Area
- Mine Infrastructure
- Camp Area
- Aggregate Screening Area
- Trench
- Proposed Transmission Line
- Mine Access Road
- Fresh Water Supply Pipeline
- Diversion Pipeline
- Diversion Ditch

*Haul roads and mine site infrastructure roads not displayed.

Scale 1:75000
UTM Zone 10N
NAD 1983 Datum

0 1 2
kilometres

N

Prepared For:

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Feb 22, 2021

Prepared by:

Palmer

Location of the Blackwater Mine Site and Associated Infrastructure

FIGURE 2-3

Document Path: G:\Shared drives\Projects 2020\200065 - Artemis Gold Inc\2006501 - Blackwater Project 2020\Mapping\Figures\5_ArcGIS\ECCC Report\Figure 2-3 Location (Infrastructure).mxd

Table 2-1. 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	
			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, 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 mine 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	
			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 EA Application is provided in Section 3.1

2.1.2 Principal Mine Components and Infrastructure

The mine components and infrastructure are described in detail in the Assessment of Alternatives (ERM 2020a) and the Pre-Feasibility Study (Artemis 2020). A list of each component is provided below, with additional detail provided for components that may interact with fish and fish habitat and are subject to the MDMER Schedule 2 amendment process.

2.1.2.1 Project Components Located on the Mine Site

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;
- Airstrip and airstrip access road;
- Helipad; and
- Haul roads and site access roads.

The mine site will be located in the headwaters of Davidson Creek and Creek 661, with the majority of the footprint falling within the upper watershed of Davidson Creek.

The TSF, low-grade and high-grade ore stockpiles, and the overburden and NAG waste rock storage facilities (i.e., the mine components that are subject to the Schedule 2 amendment process) are described in the following sections. Additional detail is available in the Assessment of Alternatives (ERM 2020a) and the Pre-Feasibility Study (Artemis 2020).

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[2]). 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 Site C and TSF Site D. The Pre-Feasibility Study includes a of shift of the Site C Main Dam downstream relative to its location in the Project's EA Application (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 unchanged from the footprint reviewed and assessed during the EA, and the TSF general arrangement is shown in Figure 2-3.

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

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 Site D Main Dam, the Site C Main Dam, the Site C East (Saddle) Dam, and the Site C 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 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 Site C will be constructed first to provide storage capacity for process plant start-up. TSF Site C is designed to contain up to approximately 17 years of tailings and the first six years of PAG/NAG3 waste rock and includes a storage allowance for the supernatant pond to provide a continuous source of process water for mill operations. The first stage of the Site C Main Dam 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 Site C Main Dam 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 Site C 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 Site C. A saddle dam (the Site C East Dam) will also be required on the southeastern side of TSF Site C beginning in approximately Year 6 and will be raised annually with the Site C Main Dam. 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 Site D will be formed by constructing the Site D Main Dam adjacent to and downstream of TSF Site C beginning in Year 5 to provide additional storage capacity for PAG/NAG3 waste rock and tailings. Filling of TSF Site 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 Site C reaches design capacity. The Site D Main Dam 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 Site C or TSF Site 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 Site 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 Site C from one or more points on the west side of the facility with PAG/NAG3 waste rock deposited directly upstream of the Site C Main Dam 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 Site C Main Dam 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 Site D Main Dam 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 Site D will be pumped to the supernatant pond in TSF Site C for reuse in ore processing.

Geotechnical instrumentation will be installed during construction along representative instrumentation planes within the Site C West Dam, Site C Main Dam, Site C East Dam, and Site D Main Dam. The geotechnical instrumentation will consist of vibrating wire piezometers, slope inclinometers, settlement and movement monitoring points, and it 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.

The full extent of the Site C TSF overlays the upper reaches[3] of the Davidson Creek mainstem (portions of Reaches 10 and 11 and unnamed tributaries), Creek 704454 (portions of Reaches 1 to 4), and Creek 505659 (portions of Reaches 6 and 7, and an unnamed tributary).

The full extent of the Site D TSF overlays the Davidson Creek mainstem (portions of Reaches 9 and 10 and unnamed tributaries), Creek 704454 (lower portion of Reach 1), Creek 668328 (portions of Reaches 1 and 2 and unnamed tributaries), Creek 636716 (portions of Reaches 2 to 5 and unnamed tributaries).

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 2-3). 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.

Low grade ore will be stockpiled north of the open pit. Low grade ore was characterized into two categories: low grade and high grade based on the Net Smelter Return (NSR; defined as the dollar value in a block in $/t). Low grade ore between $13.00/t and $16.50/t NSR would be stored in the low-grade ore stockpile. Material between $16.50 and $27.50/t NSR would be sent to the high-grade ore 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.

The ore stockpiles will be built on the hillside, each on 4 x 20 m lifts. Each stockpile is planned at a 3H:1V overall slope, the low-grade stockpile from the 1,420 masl elevation to the 1,510 masl elevation, the high-grade stockpile from the 1,405 masl elevation to the 1,480 masl elevation. Under the current mine plan, the ore stockpiles will reach their greatest total volume in Year 9 of mining operations. The stockpiles will be

[3] *Reach boundaries defined the EA Application are shown on Figure 2-3 and are further described in Section 3.3.*

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 and the ore stockpiles are expected to generate acidic drainage with elevated metals until the ore is processed. 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, then neutralized with lime, prior to discharge to the TSF.

The low-grade and high-grade ore stockpiles are located in the upper reaches of the Creek 704454 watershed. The low-grade ore stockpile footprint, at its largest extent, overlaps portions of Reaches 5 and 6 of Creek 704454 and unnamed tributary streams. The high-grade ore stockpile overlaps a portion of Reach 5 of Creek 704454 and one unnamed tributary stream.

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 overburden stockpile or the lower NAG and overburden 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 2-3.

The upper overburden stockpile will be located directly west of the pit limits, is planned on 6 x 20 m lifts dumped out at angle of repose (1.3H:1V) and will store solely overburden waste materials. It is planned at a 4.5H:1V overall slope from the 1,490 to 1,620 masl elevation.

The lower NAG and overburden stockpile will be located 1.5 km northwest of the pit limits and is planned on 5 x 20 m lifts dumped out at angle of repose and will store of NAG waste rock and overburden. It is planned at a 4H:1V overall slope from the 1,370 to the 1,470 masl elevations.

The overburden and NAG 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.

The upper overburden stockpile is located in the upper headwaters of Creek 704454. The footprint overlaps portions of Reaches 6 and 7 of Creek 704454 and portions of two first order tributaries to Creek 704454.

The lower NAG and overburden stockpile is located between the Davidson Creek and Creek 704454 catchments and does not overlap any mapped stream segments.

2.1.2.2 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.

Freshwater Supply System

The FWSS is proposed to augment flow reductions in middle and lower Davidson Creek, and will also supply the mine site water needs. The system will pump water from Tatelkuz Lake to the freshwater reservoir built in Davidson Creek downstream of the TSF. Controlled release of water from the reservoir will be used to supplement flows in Davidson Creek during Operations and Closure phases. During Operations, the freshwater reservoir will also supply make-up water to the mill for mineral processing. The FWSS, as designed, has sufficient capacity to meet both instream flow needs of Davidson Creek and the mine site requirements .

The FWSS comprises the following major components:

- An intake facility on Tatelkuz Lake, including screened pipes, a pump station, a laydown area, and any required bank protection;
- A 14 km-long pipeline and associated pump booster station, maintenance access roads, and transmission line extending from Tatelkuz Lake to the freshwater reservoir in Davidson Creek immediately downstream of the environmental control dam;
- The freshwater reservoir; and
- A temperature and flow control system.

The intake structure will be located on the western shoreline of Tatelkuz Lake. The water intake is envisaged to be via a land-based, permanent, two level, wet-well concrete structure on the Tatelkuz Lake shoreline.

The FWSS pipeline and access road 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 bridge structure. One booster pump station will be required to reach the freshwater reservoir. 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 parallels the mine access road.

The freshwater reservoir will be in mid-Davidson Creek, downstream of the environmental control dam. 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 freshwater reservoir will be located at the top of Reach 6 and will back-flood Davidson Creek upstream to the environmental control dam.

Information regarding how the FWSS system will be used to offset fish habitat will be included in the *Fisheries Act* Authorization application.

2.1.2.3 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) and avoid increasing disturbance within remaining areas of intact forests as much as practicable.

Overall, the transmission line crosses 119 drainages, of which 39 are confirmed fish-bearing, 7 were assigned default fish-bearing ratings, and 73 were assessed as non-fish-bearing, non-classified drainages, or not watercourses (ERM 2017).

2.1.2.4 Roads

A new Mine Access Road will be constructed, starting at about km 124.5 of the Kluskus-Ootsa FSR and terminating at the Mine Site.

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

2.1.3 Project Timeline

The proposed mine plan includes two years of construction followed 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 2-2 shows the scheduled phasing of the Project.

Table 2-2. 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.

2.1.3.1 Construction

Construction activities associated with the mine site are listed in approximate chronological order based on the Assessment of Alternatives (ERM 2020a), the Pre-Feasibility Study (Artemis 2020), and EA (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 overburden piles;
- Construct mine site roads and water management structures;
- Prepare stockpile pads and Site C Dam 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 Site C Dam;
- 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 overburden 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 (Appendix 2.2A-5 of the EA Application).

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*;*
- 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;
- 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.

2.1.3.2 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, processed, and disposed of into the TSF. Project activities during the Operations phase include:

- Progressive expansion of pit and 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 Site C and D TSF dams, as required;
- Water management including construction of an environmental control dam that will capture seepage and surface runoff from the Site D TSF (this water will be pumped back to the TSF) and treatment and discharge of site water;
- 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 Assessment of Alternatives (ERM 2020a) contains further detail on the activities that will take place during the Operations phase.

2.1.3.3 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.

The primary objective of Closure and reclamation initiatives 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 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 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.

2.1.3.4 Post-Closure

The Post-Closure phase will commence once the open pit has been backfilled with water and water treatment 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; and
- 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 quality is released into downstream Davidson Creek.

3. Description of Fish and Fish Habitat

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 EA Application). Although this Compensation Plan applies only to those areas subject to the Schedule 2 amendment, relevant information in the baseline reports for the mine site as a whole is summarized here to provide context.

3.1 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 are anticipated. The mine site aquatic LSA contains the following streams and lakes (Figure 2-3):

- 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 south;
- 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 in which both direct and indirect effects may occur and comprises the entire Chedakuz Creek drainage and part of the Fawnie Creek drainage. The aquatic RSA contains the following streams and lakes (Figure 2-3):

- Kuyakuz Lake and all its tributaries;
- Middle Chedakuz Creek between Kuyakuz Lake and Tatelkuz Lake, and all 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 Mathews Creek.

Separate study areas were defined for the transmission line and roads, and watercourse crossings along these linear corridors were assessed during baseline studies. These study areas are not relevant to the Schedule 2 amendment and are not considered further.

3.2 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 EA Application).

3.3 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 EA Application), and the Fish and Fish Habitat Effects Assessment (Section 5.3.8 and Section 5.3.9 of the EA Application). The following sections summarize the most pertinent information from those reports, i.e., the descriptions of fish habitat in the mine site aquatic LSA. 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 as no Schedule 2 impacts are anticipated in these areas.

Detailed description of the areas subject to Schedule 2 amendment in relation to these watersheds is provided in Section 4.1.

3.3.1 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 EA Application).

Most of the Project infrastructure will be built in the upper Davidson Creek watershed. Lake 16 is the headwater lake of Davidson Creek (Figure 2-2). 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, Davidson Creek provides approximately 6% of the available kokanee spawning habitat.

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 are present in the lower section of the creek. Cobbles and boulders form the dominant substrate, with spawning gravels present in more 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.

Upper Davidson Creek (Reaches 9 to 12): This section is approximately 6 km long and is dominated by glides and runs. As a result, habitat complexity and suitability for spawning and juvenile rearing is lower than in the middle and lower sections of Davidson Creek. A cascade acts a partial barrier to fish at the bottom of Reach 11 and prevents fish passage for rainbow trout that migrate up from Tatelkuz Lake. Only the resident rainbow trout population in Lake 16 uses habitat in Reaches 11 and 12 of Davidson Creek. Those rainbow trout can migrate downstream over the cascade barrier. Based on the watercourses in the LSA, Davidson Creek provides approximately 25% of the rearing habitat and 16% of the spawning habitat for rainbow trout.

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 some 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 decreases. There are limited pools with sufficient depth and flow to support overwintering fish. The upper watershed contains limited spawning and overwintering habitat. Stream spawning habitat for rainbow trout in 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. This is due to the northern aspects of many of the streams, and the influence of groundwater, which contributes approximately 90% or more of stream flow over 9 months of the year (KP 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.

3.3.2 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 EA Application).

The Creek 661 watershed lies to the east of the Davidson Creek watershed and flows into Chedakuz Creek, which drains into Tatelkuz Lake. Creek 661 is fed by three headwater tributaries: Creek 505659, Creek 146920, and Creek 543585. 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. This section is used by kokanee and rainbow trout for spawning. Above Reach 3, the habitat appears to be used only by rainbow trout, primarily for rearing. Spawning habitat is limited upstream of Reach 4, as the substrate upstream is generally too large for trout spawning. 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.

3.3.3 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 EA Application). 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 and are generally of poor quality. The beaver dam ponds and other unimpounded areas provide ideal juvenile rearing habitat, due to the abundant cover created by overhanging vegetation, deep pools, and woody debris.

3.3.4 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 EA Application). 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.

3.3.5 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 EA Application). 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. The habitat is also highly 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 habitat in the LSA. Abundant off-channel habitat also exists in the form of side-channels, sloughs, and wetlands.

3.3.6 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 EA Application). 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.

3.4 Fish Community

The fish communities in the Blackwater Project mine site LSA is detailed in the following sections of the EA Application:

- 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.

3.4.1 Fish Community

Twelve fish species were captured or observed in streams and lakes of the mine site LSA during baseline studies in 2011, 2012, and 2013 (Table 3-1 and Table 3-2). Rainbow trout are the most ubiquitous species in the LSA and were present in every watercourse and waterbody 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 EA Application.

Table 3-1. 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: EA Application – Assessment of Potential Environmental Effects, Section 5.3.8, Table 5.3.8-4 (New Gold 2014)

Of these species, only brassy minnow is classified as sensitive or vulnerable according to the BC Conservation Data Centre (BC CDC 2020). 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. Blue-listed taxa are at-risk, but are not extirpated, endangered or threatened. None of these species are identified as at-risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC; COSEWIC 2020).

Table 3-2. 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: EA Application – Assessment of Potential Environmental Effects, Section 5.3.8, Table 5.3.8-5 (New Gold 2014)

3.4.1.1 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 EA Application) 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 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 reside in stream reaches affected by Schedule 2 impacts:

- A migratory population that resides in Tatelkuz Lake/Chedakuz Creek but spawn and rear 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, adult rainbow trout from Tatelkuz Lake and Chedakuz Creek migrate up Davidson Creek to spawn. The spawning period is typically during May-June, after which the adults return to Tatelkuz Lake

and Chedakuz Creek where they remain until the following spring when the cycle is repeated. Rainbow trout can spawn multiple times in a lifetime. Davidson Creek contributes an estimated 20% of the 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 EA Application).

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 eventually 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, and densities of juveniles were below BC provincial bio-standards 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 a partial 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. 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.

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.

3.4.1.2 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. These stream reaches that support kokanee spawning are located downstream of the Project and will not be directly affected by Schedule 2 instream losses.

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 creek, 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 EA Application) provides a detailed description of the relative abundance, life history, and population structure of kokanee in the Blackwater LSA.

3.4.1.3 Other Fish Species

Mountain whitefish were found in Tatelkuz Lake during baseline surveys, comprising an estimated 3% (26,000 individuals) of the 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. Furthermore, fall and spring spawning surveys within the LSA indicate very low usage of Chedakuz Creek tributaries for whitefish spawning. For example, Davidson Creek is typically unsuitable for 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 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 because newly-emerged fry would be washed downstream into Tatelkuz Lake. Mountain whitefish were observed in low numbers in lower Creek 705 (Appendix 5.1.2.6A of the EA Application).

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 EA Application). Captured individuals ranged from 62 to 495 mm and 8-14 years old for individuals that were aged. This species is likely the dominant predator of the Tatelkuz Lake fish community. Pikeminnow were not captured during the stream surveys conducted in 2011 and 2012. No 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 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 is a juvenile or mature specimen. No burbot have been captured in Davidson and Turtle Creeks and 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, all of which were not detected in the remaining lakes and streams in the LSA and RSA.

3.5 Limitations to Fisheries Productivity

3.5.1 Kokanee

Kokanee only use the streams in the Project area for spawning, and when the fry emerge they quickly migrate to their resident lakes. There is abundant kokanee spawning habitat in lower Davidson Creek, lower Creek 661, and in Chedakuz Creek above and below Tatelkuz Lake. The limiting factor on kokanee productivity in the RSA is likely the availability of habitat, including food supply and nutrient levels, in their resident lakes (i.e., Tatelkuz and Kuyakuz).

3.5.2 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 fish populations is most often limited by the survival of the youngest life stages, 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 highly depend on the survivorship and growth of fry and juveniles rearing and overwintering in Davidson Creek and Creek 661. The availability and suitability of overwintering habitat is likely the physical feature limiting rainbow trout productivity in Davidson Creek and Creek 661. This is 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).

4. Fish and Fish Habitat Effects Assessment Summary

Fish and Fish Habitat was selected as a VC for consideration in the effects assessment (Section 5.3.1 of the EA Application). The potential effects of the Project on fish and fish habitat are described in detail in the EA Application (Section 5.3.8). The EA considered both direct and indirect effects, 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 effects assessments for Fish and Fish Habitat were used as a basis to identify those effects that could constitute HADD, or cause death of fish, as well as to identify further 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 from Construction, Operations, and Closure of the mine site were identified based on guidance from the DFO Pathways of Effects (DFO 2014).

This Compensation Plan identifies multiple direct and indirect potential effects on fish and fish habitat. However, only the effect of loss of fish habitat directly beneath areas subject to Schedule 2 amendment (i.e., TSF, the low-grade and high-grade ore stockpiles, and the upper overburden stockpile) will be carried forward to the quantitative habitat loss assessment (Section 5) and will be included in the compensation assessment (Section 6). Offsetting for all other effects to fish and fish habitat, including those identified in Section 4.1 related to instream habitat losses not subject to Schedule 2 amendment, upstream habitat isolation, downstream changes in flow, water quality alteration, or direct mortality, will be addressed in the *Fisheries Act* application for Authorization Offsetting Plan.

A summary of anticipated potential effects specific to the placement of deleterious substances, which is subject to Schedule 2 amendment, is presented in the following sections.

4.1 Summary of Fish and Fish Habitat Potential Effects

4.1.1 Potential Effects of Deleterious Substance Placement on the Mine Site

The mine site components associated with the placement of deleterious substances are located in the Davidson Creek and Creek 661 watersheds. Other watersheds in the mine site aquatic LSA, including Turtle Creek, Tatelkuz Lake and tributaries, Chedakuz Creek, and Creek 705, will not be directly affected by the placement of deleterious substances. The affected watersheds include:

Davidson Creek Watershed

The majority of the deleterious substance placement will occur in the Davidson Creek watershed. Potential unmitigated effects of deleterious substance placement on fish and fish habitat include:

- Davidson Creek in the upper and middle reaches: The TSF, comprising Site C and Site D tailings storage, includes portions of Reaches 8, 9, 10, and 11, of the Davidson Creek mainstem. These stream segments will be infilled for tailings placement.
- Portions of Davidson Creek tributaries including Creek 668328 (portions of Reaches 1 and 2), Creek 636713 (portions of Reaches 3 and 4) and Creek 704454 (Reaches 1 to 4) will be infilled for tailings placement.
- Portions of Reaches 4 to 7 of Creek 704454 and its unnamed tributaries are within the footprints of the stockpile areas. These streams will be dammed, diverted, or dewatered and eventually covered with fill as foundations.
- Loss of streamside riparian vegetation adjacent to the instream areas lost due to deleterious substance placement.
- Middle and lower Davidson Creek (Reaches 1 to 6) downstream of the TSF and other mine components, including the environmental control dam and freshwater reservoir, will be impacted by flow changes due to water diversions, alteration of watershed areas (and subsequent runoff volumes) and capture of run-off by various infrastructure components. Placement of deleterious substances will also have the potential to alter water chemistry and increase Total Suspended Solids (TSS) in these reaches.
- Upstream habitat in the upper reaches of Creek 668328, Creek 636713, Creek 704454, Davidson Creek, and unnamed tributaries, as well as Lake 16 will be isolated from downstream habitat in the watershed. However, Lake 16 is already isolated from upstream fish passage by a barrier located in Reach 11.
- Placement of deleterious substances has the potential to result in direct fish mortality.

Rainbow trout are the only species that have been identified in the stream habitat subject to Schedule 2 amendment. Kokanee are seasonally present in the lower reaches of Davidson Creek and will therefore not be directly affected by placement of deleterious substances. Indirect effects, such as changes to water flow and chemistry, may affect Kokanee; however, these effects will be addressed in the *Fisheries Act* application for Authorization.

Creek 661 Watershed

Placement of deleterious substances in the Creek 661 will be limited to the headwater reaches that are located in the Site C tailings storage. Potential unmitigated effects of deleterious substance placement on fish and fish habitat include:

- Portions of Reaches 5 and 6 of Creek 505659 and an unnamed tributary will be infilled for tailings placement in the Site C tailings storage.
- Loss of streamside riparian vegetation adjacent to the instream areas lost due to deleterious substance placement.
- Downstream reaches of Creek 505659, Creek 146920, and Creek 661 will be impacted by flow changes due to water diversions, alteration of watershed areas (and subsequent runoff volumes) and capture of run-off. Placement of deleterious substances will also have the potential to alter water chemistry and increase TSS in these reaches.
- Placement of deleterious substances has the potential to result in direct fish mortality

Rainbow trout are the only species that have been identified in the stream habitat subject to Schedule 2 amendment. Kokanee are seasonally present in the lower reaches of Creek 661 and will therefore not be directly affected by placement of deleterious substances. Indirect effects, such as changes to water flow and chemistry, may affect Kokanee; however, these effects will be addressed in the *Fisheries Act* application for Authorization.

4.2 Summary of Avoidance and Mitigation Measures

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

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 to minimize the spatial extent of the Project footprint. The TSF, open pit, waste rock dumps, stockpiles, and all other mine site facilities are clustered as closely together as possible in the headwaters of Davidson Creek and Creek 661;
- 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.

4.2.1 Mitigation Measures

'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:

Construction Phase

- Constructing mine infrastructure using a staged approach, with TSF Site C built earlier and TSF Site D built later, as needed. This approach will simplify water management and reduce potential effects during construction;
- Locating the mine and processing components upslope of the environmental control dam 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' 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.

Operations and Closure Phases

- Constructing mine infrastructure using a staged approach, with TSF Site C built earlier and TSF Site D built later, as needed. 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 environmental control dam downstream of the TSF D dam. These will collect seepage from the TSF and route it to the environmental control dam 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
- Following DFO guidelines for the use of explosives in or near fish-bearing waters as required.

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.

4.3 Summary of Fish and Fish Habitat Residual Effects

Based on the implementation of avoidance and mitigation measures and knowledge of the fish habitat in the Project area, the only residual effects that are anticipated to remain after the implementation of avoidance and mitigation measures are related to direct loss of habitat, upstream habitat isolation, and downstream flow alterations from the mine site footprint.

The following effects from deleterious substance placement were identified and will be carried through to the residual habitat loss section of this Compensation Plan:

- 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 Site C and D dam embankments), the low-grade and high-grade ore stockpiles, and the upper overburden stockpile.
  - Loss of streamside riparian vegetation adjacent to the instream areas lost due to deleterious substance placement.

In addition, the following effects from deleterious substance placement were identified and will be carried through to an assessment of HADD or death of fish in the *Fisheries Act* Authorization application:

- 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) and Lake 16;
- Downstream Flow Changes
  - Flow reductions and loss of habitat in Creek 661 and tributaries (Creek 505659 and Creek 146920) downstream and under the footprint of the mine site infrastructure; and
  - Flow alterations in Davidson Creek (Reaches 1 to 6).

5. Habitat Loss Assessment

The purpose of this section is to present an assessment of the habitat losses subject to Schedule 2 amendment associated with the deposition of a deleterious substance. The losses of fish habitat in these portions of the streams into which mine waste or deleterious substances (e.g., tailings, waste rock) are proposed to be deposited will be compensated for, as described in Section 6 of this document.

Avoidance and mitigation measures will be implemented to reduce the overall Project effects on fisheries; however, the placement of tailings and rock into the areas subject Schedule 2 amendment (i.e., the TSF, the low-grade and high-grade ore stockpiles, and the upper overburden stockpile) will result in an unavoidable permanent loss of fish habitat in the affected upper reaches of Davidson Creek and headwater tributaries (Davidson Creek watershed); and in the upper reaches and tributaries of Creek 505659 in the Creek 661 watershed. The location of these stream segments is shown on Figure 5-2.

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 that a decision-support framework should be informed by:

- The nature of the impact of the Project on fish and fish habitat, assessed by temporal and spatial scales and intensity; 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 compensation (described in Section 6.0). 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 account 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 3.0 of this report). There is sufficient information on the availability and use of affected fish habitat to inform a robust assessment of habitat loss.

This assessment of residual habitat loss focuses on impacts to the only species encountered in the affected upper reaches of Davidson Creek and Creek 661 – rainbow trout. Rainbow trout are also largely the focus of the compensation plan, providing a direct counterbalance between losses and gains to fish communities in the area.

5.1 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 compensation benefits. The assessment of habitat loss from the proposed placement of deleterious substances was completed using three 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' in-stream habitat); and
- 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.

5.1.1 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 EA Application), 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 EA Application*),* 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.

Stream segments affected by the placement of a deleterious substance were identified by mapping those watercourses within the footprints of the areas subject to Schedule 2 amendment (i.e., TSF, the low-grade and high-grade ore stockpiles, and the upper overburden stockpile). Stream segments located elsewhere on the site (i.e., beneath the dam embankments or other site infrastructure or isolated upstream of these) were analyzed separately for the *Fisheries Act* application for Authorization. Habitat loss mapping for this areal analysis was conducted using mine component arrangement polygons for the end of Year 18, because this phase represents the maximum footprint of all mine site facilities over the life of the Project.

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

5.1.2 Habitat Evaluation Procedure

5.1.2.1 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 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 compensation plans.

The HEP evaluation (USFWS 1980) is generally used when there is a direct loss of habitat, and a value of this habitat 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 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 (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).

5.1.2.2 Project-Specific Implementation of HEP

The Instream Flow Study (Appendix 5.1.2.6D of the EA Application), as well as Annex C of the Fisheries Mitigation and Offsetting Plan that was previously submitted (Appendix 5.1.2.6C of the EA Application), 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 Compensation Plan* (Palmer 2020), provided in Appendix A.

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. Each of the seven habitat types were then further categorized into more-detailed habitat classes by AMEC (2014b). Identified stream habitat types included the four following mesohabitats: cascades, riffles, glides, and pools. Three additional habitat types were utilized to describe the remaining diversity of fish habitat "not represented by the four mesohabitat types" (AMEC 2014b). A "tributary" type was used to describe small first-, second-, and third-order tributaries to mainstem creeks; an "other" type that describes habitats afforded by off-channel areas such as back-flooded beaver dams, and wetlands; and a "lake" category that describes different lake habitats (AMEC 2014b).

The type/class categorization 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, resulting in a total of 21 unique habitat classes. Detailed descriptions of the habitat types and classes are provided in Appendix A.

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.

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 5-1. It is important to note that the HSI model was not given any *a priori* weighting for particular habitat type or life stage of fish. For example, spawning habitat was not given any more importance than overwintering habitat.

Table 5-1. 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

5.1.3 Riparian Habitat Area

In the Fisheries Mitigation and Offsetting Plan (Appendix 5.1.2.6C of the EA Application) 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 approach to riparian habitat accounting should be applied to both losses and gains. Per DFO, this would provide a more transparent accounting system for each of the Project impacts (losses) and Offsetting Plans (gains).

The functional riparian zone around waterbodies (i.e., streams, ponds, and lakes) was applied to be consistent with guidance from DFO, as 15 m from bankfull channel limits, for all confirmed fish-bearing waterbodies. For waterbodies that were non-fish bearing, or had “unconfirmed” fish-bearing status, the applied riparian buffer was 5 m from the bankfull channel limits. Accordingly, the total riparian width was 30 m or 10 m along streams, and 15 m or 5 m around the shoreline of lakes and ponds (buffer applied to perimeter). For waterbodies with no available fish presence information (typically small, headwater, first- and second-order streams), a default “unconfirmed” fish-bearing status was applied, with a 5 m riparian buffer conservatively applied to both sides of the stream.

Drainage features that were not classified as streams and were assigned no fish habitat value in the EA (e.g., NCDs[4] and terrain features with no visible channel[5] [NVC]) were excluded from the riparian buffer calculations.

As per definitions provided in the Fish and Aquatic Resources Baseline Reports (Appendix 5.1.2.6A&B of the EA Application), waterbodies were assigned the following ‘fish-bearing statuses’ based on field data:

[4] *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)

[5] *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.*

- "Confirmed" indicates that the waterbody was surveyed for fish and fish habitat and that fish were captured;
- "Unconfirmed" indicates that the stream was surveyed for fish and fish habitat but no fish were captured; and
- Non-fishing bearing waterbodies were classified as S6 (<3 m wide, and non-fish bearing based on lack of connectivity, the presence of downstream barriers, or reach gradients of >20%) (BC MOF 1995 and 1998).

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 to BC provincial standards (Keeley et al. 1996; Koning and Keeley 1997). The application of these riparian zone widths is appropriate for the type of low productivity systems found in these headwaters, and is in-line with federal and provincial guidelines. 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. The RRZ for non-fish bearing reaches is zero. 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.

Considering these legislative standards, and that waterbodies having unconfirmed fish bearing status have potential to support fish (albeit at low densities and perhaps only seasonally), the 10 m riparian zone width (5 m buffer on each side) was chosen. The same buffer was applied to non-fish bearing waterbodies, to account for the value of the riparian vegetation to downstream fish habitat.

Within areas subject to Schedule 2 amendment, the riparian area was identified by applying the 15 m riparian buffer on both sides of a watercourse (i.e., 30 m total riparian zone width) to all affected fish-bearing waterbodies. Where waterbodies were unconfirmed or non-fish bearing, the 5 m buffer (i.e., 10 m riparian zone width*)* was applied to account for the potential for fish utilization (in the case of unconfirmed), and potential riparian contributions to downstream reaches.

5.2 Quantification of Habitat Loss

This section presents a quantification of fish habitat loss in the areas subject to Schedule 2 amendment. Habitat loss was quantified both by surface area (in m^2) to provide context and transparency for the habitat calculations, as well as HU. HU will form the basis of the compensation calculations, as they provide an inherent measure of suitability. Riparian losses (and gains) are presented in area impacted (gained; m^2).

A summary of affected watercourses and their locations is provided in Table 5-2. Habitat losses, including instream habitat area in m^2, habitat units by rainbow trout life stage, and riparian area (in m^2), are summarized in Table 5-3. A detailed breakdown of the stream segments lost is provided in Table 5-4. Figure 5-1 and Figure 5-2 show the distribution of waterbodies that will be permanently lost.

Most of the affected habitat 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, namely Creek 505659 and a tributary stream.

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 habitat value was calculated.

In the Davidson Creek watershed, a total of 47,511 m^2 of instream habitat will be lost (Table 5-3). A total of 46,881 rainbow trout HU will be lost, comprising 14,447 spawning and egg incubation HU, 12,752 fry summer rearing HU, 14,106 juvenile summer rearing HU, and 5,576 overwintering HU. A total of 444,865 m^2 of riparian area will also be lost.

In the Creek 661 watershed, a total of 930 m^2 of instream habitat will be lost (Table 5-3). This habitat supports 246 HU of juvenile summer rearing habitat. No other life stages are supported by this habitat. A total of 8,635 m^2 of riparian area will also be lost.

Table 5-2. Locations of Watercourses Subject to Schedule 2 Amendment

Watershed	Stream Name	Unique Identifier (WFID)[1]	Coordinates (UTM Zone 10 N)			
			Upstream Extent		Downstream Extent	
			Easting	Northing	Easting	Northing
Davidson Creek	Davidson Creek Mainstem (upper)	700, 710, 711, 3813, 3820	371794	5894963	375686	5897345
	Davidson Creek Mainstem (lower)	720, 732, 3811	376074	5897737	376173	5897854
	Unnamed Tributary to Davidson Creek	1910	375615	5896370	375432	5896872
	Unnamed Tributary to Davidson Creek	1931	374090	5897039	375080	5896726
	Unnamed Tributary to Davidson Creek	1971	372694	5895245	372718	5895542
	Unnamed Tributary to Davidson Creek	1991	372524	5895854	372633	5895505
	Unnamed Tributary to Davidson Creek	1522	376753	5896829	376803	5896977
	Creek 704454 Mainstem (upper)	1710, 1711, 1782, 3380, 3381, 3890	373845	5892328	374519	5894622
	Creek 704454 Mainstem (middle)	1733, 1740, 1750, 1771	375550	5895556	375960	5897111
	Creek 704454 Mainstem (lower)	1732	376180	5897602	376154	5897775
	Unnamed Tributary to Creek 704454	1790, 3400, 3401, 3410	374665	5893454	374472	5894595
	Unnamed Tributary to Creek 704454	3390, 3391	374512	5892935	374172	5893371
	Unnamed Tributary to Creek 704454	1850, 1860	373823	5893144	373853	5894197
	Unnamed Tributary to Creek 704454	1870, 3460, 3470	373730	5892959	373827	5894194
	Unnamed Tributary to Creek 704454	1811, 1840	373405	5894078	374062	5894278
	Creek 668328 Mainstem	1572, 1591	373642	5898111	376057	5898113
	Unnamed Tributary to Creek 668328	1601	374873	5897864	375106	5898014
	Unnamed Tributary to Creek 668328	1603	373955	5897808	374022	5897798
	Creek 636713 Mainstem	1340, 1361, 1392, 1399, 1400, 1409	374865	5899032	375888	5898458
	Unnamed Tributary to Creek 636713	1490, 1481, 1482	373819	5899133	375097	5898854
Creek 661	Creek 505659 Mainstem	2780, 3432, 3872	376330	5895719	376478	5895843
	Creek 505659 Tributaries	2960	375978	5895712	376427	5895866

Notes:

1. The Water Feature Identifier (WFID) is a unique number assigned to identify a water feature (including streams, ponds, and lakes)

Table 5-3. Summary of Instream Area and Habitat Units Subject to Schedule 2 Amendment

Watershed	Stream	Length (m)	Instream Habitat Area (m^2)	Rainbow Trout Habitat by Life Stage (HU)					Total Habitat Units (HU)	Riparian Area (m^2)
				Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering		
Davidson Creek	Davidson Creek Mainstem	5,654	16,264	11,369	4,714	3,200	0	2,133	21,416	169,586
	Davidson Creek Tributaries	2,645	2,206	0	0	552	0	0	552	20,571
	Creek 704454 Mainstem	4,698	12,522	1,301	4,306	5,324	0	1,904	12,835	98,747
	Creek 704454 Tributaries	4,960	7,166	0	0	1,934	0	0	1,934	49,596
	Creek 668328 Mainstem	2,552	6,281	1,776	3,731	2,022	0	1,538	9,067	76,535
	Creek 668328 Tributaries[1]	350	0	0	0	0	0	0	0	0
	Creek 636713 Mainstem	1,564	1,696	0	0	732	0	0	732	15,641
	Creek 636713 Tributaries	1,419	1,371	0	0	343	0	0	343	14,188
Davidson Creek Watershed Subtotal		23,842	47,506	14,446	12,751	14,107	0	5,575	46,879	444,864
Creek 661	Creek 505659 Mainstem	245	180	0	0	59	0	0	59	2,445
	Creek 505659 Tributaries	619	749	0	0	187	0	0	187	6,190
Creek 661 Watershed Subtotal		864	929	0	0	246	0	0	246	8,635
Totals		24,706	48,435	14,446	12,751	14,353	0	5,575	47,125	453,499

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 5-4. Detailed List of Stream Segments, Habitat Area, HU, and Riparian Area Subject to Schedule 2 Amendment

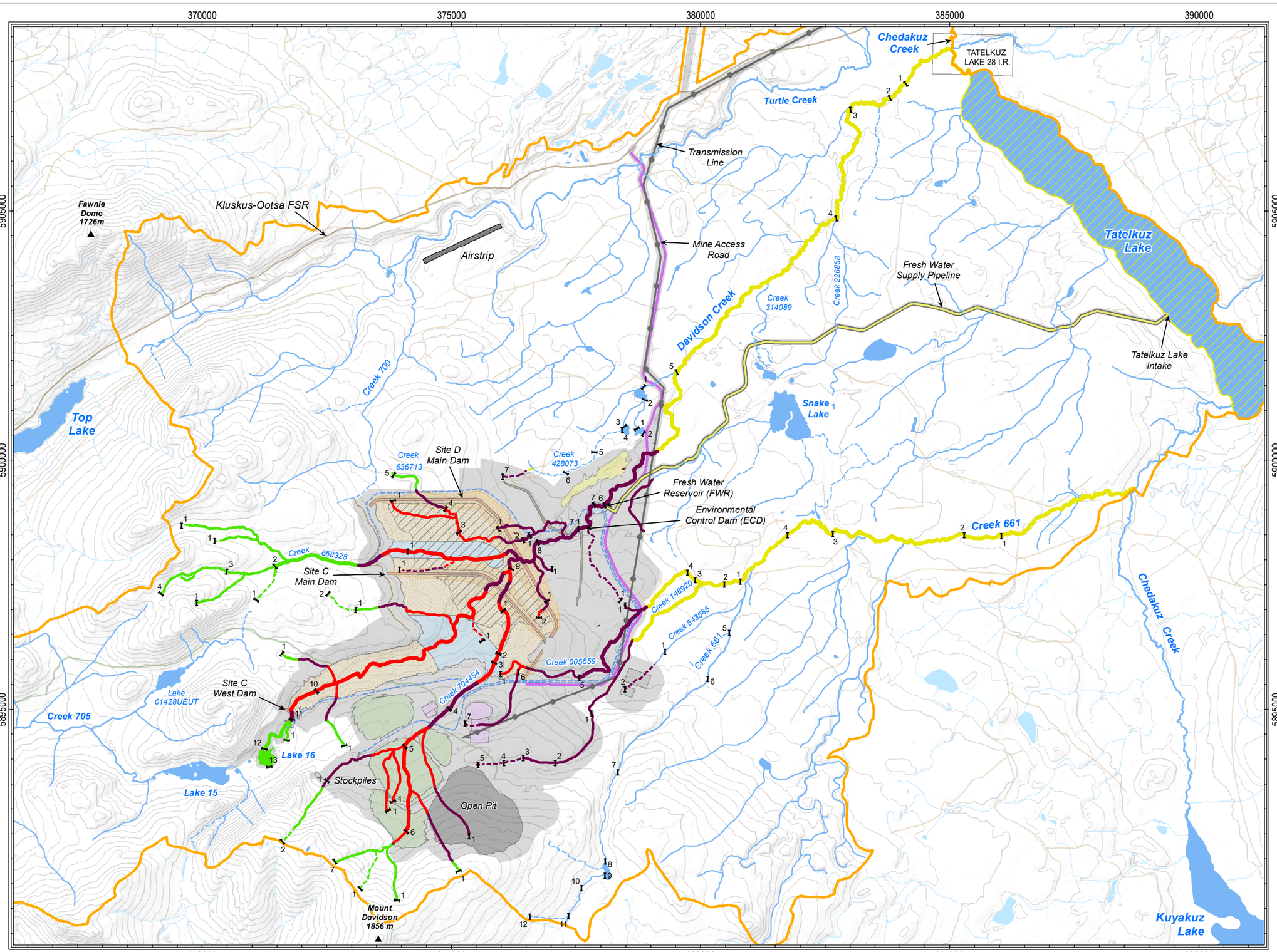
Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)	Rainbow Trout Habitat Units by Life Stage (HU)					Total Habitat Units (HU)	Riparian Area (m^2)
								Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering		
Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	732	S3	31	167	47	100	62	0	55	264	920
Davidson Creek	Davidson Creek Mainstem	10	Confirmed Fish-Bearing	700	S3	2,714	8,054	6,172	2,272	1,299	0	974	10,716	81,410
Davidson Creek	Davidson Creek Mainstem	10	Confirmed Fish-Bearing	720	S3	58	172	131	48	28	0	21	228	1,734
Davidson Creek	Davidson Creek Mainstem	10	Confirmed Fish-Bearing	3811	S3	90	267	204	75	43	0	32	355	2,695
Davidson Creek	Davidson Creek Mainstem	10	Confirmed Fish-Bearing	3813	S3	2,020	5,996	4,595	1,691	967	0	725	7,978	60,609
Davidson Creek	Davidson Creek Mainstem	10	Confirmed Fish-Bearing	3820	S3	97	286	220	81	46	0	35	381	2,895
Davidson Creek	Davidson Creek Mainstem	11	Confirmed Fish-Bearing	710	S4	279	573	0	194	327	0	126	647	8,375
Davidson Creek	Davidson Creek Mainstem	11	Confirmed Fish-Bearing	711	S4	365	749	0	253	428	0	165	846	10,948
Davidson Creek	Davidson Creek Tributary	2	No Data (Default Unconfirmed Fish-Bearing)	1522	-	172	129	0	0	32	0	0	32	1,715
Davidson Creek	Davidson Creek Tributary	1	Non-Fish-Bearing	1910	NVC	587	0	0	0	0	0	0	0	0
Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1931	S4	1,190	1,143	0	0	286	0	0	286	11,904
Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1971	S4	300	467	0	0	117	0	0	117	2,995
Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1991	S4	396	467	0	0	117	0	0	117	3,957
Davidson Creek	Creek 636713 Mainstem	3	Unconfirmed Fish-Bearing	1392	S4	923	1,228	0	0	614	0	0	614	9,233
Davidson Creek	Creek 636713 Mainstem	4	Unconfirmed Fish-Bearing	1340	S4	261	117	0	0	29	0	0	29	2,610
Davidson Creek	Creek 636713 Mainstem	4	Unconfirmed Fish-Bearing	1400	S4	85	38	0	0	10	0	0	10	846
Davidson Creek	Creek 636713 Mainstem	5	Unconfirmed Fish-Bearing	1361	S4	16	18	0	0	5	0	0	5	158
Davidson Creek	Creek 636713 Mainstem	4	Unconfirmed Fish-Bearing	1399	S4	195	260	0	0	65	0	0	65	1,953
Davidson Creek	Creek 636713 Mainstem	4	Unconfirmed Fish-Bearing	1409	S4	84	35	0	0	9	0	0	9	841
Davidson Creek	Creek 636713 Tributary	1	Unconfirmed Fish-Bearing	1499	S4	34	14	0	0	4	0	0	4	338

Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)	Rainbow Trout Habitat Units by Life Stage (HU)					Total Habitat Units (HU)	Riparian Area (m^2)
								Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering		
Davidson Creek	Creek 636713 Tributary	1	Unconfirmed Fish-Bearing	1481	S4	1,183	1,159	0	0	290	0	0	290	11,831
Davidson Creek	Creek 636713 Tributary	1	Unconfirmed Fish-Bearing	1490	S4	202	198	0	0	49	0	0	49	2,019
Davidson Creek	Creek 688328 Mainstem	1	Confirmed Fish-Bearing	1572	S3	2,046	5,354	1,468	3,208	1,790	0	1,338	7,804	61,367
Davidson Creek	Creek 688328 Mainstem	2	Confirmed Fish-Bearing	1591	S3	506	927	308	523	232	0	200	1,263	15,168
Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1601	NVC	282	0	0	0	0	0	0	0	0
Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1603	NVC	68	0	0	0	0	0	0	0	0
Davidson Creek	Creek 704454 Mainstem	1	Confirmed Fish-Bearing	1732	S3	179	706	21	330	493	0	171	1,016	5,360
Davidson Creek	Creek 704454 Mainstem	1	Confirmed Fish-Bearing	1733	S3	162	639	19	299	446	0	155	919	4,852
Davidson Creek	Creek 704454 Mainstem	2	Confirmed Fish-Bearing	1740	S3	960	3,158	463	1,263	674	0	498	2,899	28,789
Davidson Creek	Creek 704454 Mainstem	3	Confirmed Fish-Bearing	1750	S3	195	667	155	398	189	0	152	895	5,837
Davidson Creek	Creek 704454 Mainstem	4	Confirmed Fish-Bearing	1771	S3	509	1,391	0	549	948	0	328	1,826	15,278
Davidson Creek	Creek 704454 Mainstem	5	Confirmed Fish-Bearing	1782	S3	585	2,399	643	1,467	793	0	600	3,503	17,554
Davidson Creek	Creek 704454 Mainstem	6	Unconfirmed Fish-Bearing	1710	S3	380	642	0	0	321	0	0	321	3,798
Davidson Creek	Creek 704454 Mainstem	6	Unconfirmed Fish-Bearing	1711	S3	556	940	0	0	470	0	0	470	5,562
Davidson Creek	Creek 704454 Mainstem	6	Unconfirmed Fish-Bearing	3890	S3	260	439	0	0	220	0	0	220	2,601
Davidson Creek	Creek 704454 Mainstem	6	Unconfirmed Fish-Bearing	3380	S3	585	988	0	0	494	0	0	494	5,846
Davidson Creek	Creek 704454 Mainstem	6	Unconfirmed Fish-Bearing	3381	S3	327	553	0	0	276	0	0	276	3,270
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3410	S4	58	67	0	0	17	0	0	17	575
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1790	S4	868	1,015	0	0	254	0	0	254	8,679
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3400	S4	52	61	0	0	15	0	0	15	521
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3401	S4	213	249	0	0	62	0	0	62	2,132
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1840	S4	255	571	0	0	286	0	0	286	2,551

Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)	Rainbow Trout Habitat Units by Life Stage (HU)					Total Habitat Units (HU)	Riparian Area (m^2)
								Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering		
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1811	S4	450	482	0	0	120	0	0	120	4,501
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1850	S4	182	259	0	0	65	0	0	65	1,824
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1860	S4	924	1,311	0	0	328	0	0	328	9,235
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3470	S3	126	238	0	0	59	0	0	59	1,257
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1870	S3	1,064	2,012	0	0	503	0	0	503	10,644
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3460	S3	195	369	0	0	92	0	0	92	1,950
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3390	S4	478	444	0	0	111	0	0	111	4,777
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3391	S4	95	88	0	0	22	0	0	22	950
Creek 661	Creek 505659 Mainstem	6	Unconfirmed Fish-Bearing	3872	S4	56	54	0	0	27	0	0	27	561
Creek 661	Creek 505659 Mainstem	7	Unconfirmed Fish-Bearing	2780	S4	172	115	0	0	29	0	0	29	1,717
Creek 661	Creek 505659 Mainstem	7	Unconfirmed Fish-Bearing	3432	S4	17	11	0	0	3	0	0	3	167
Creek 661	Creek 505659 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	2960	-	619	749	0	0	187	0	0	187	6,190
Totals						**24,706**	**48,435**	**14,446**	**12,751**	**14,353**	**0**	**5,575**	**47,125**	**453,499**

Notes:

1. *Reach numbers are based on the Reach Breaks defined in Appendix 5.1.2.6A of the EA Submission (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 EA Submission (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. NVC refers to non-visible channels that do not support fish habitat. A dash "-" indicates that no stream classification was assigned in the EA dataset.*
4. *Channel length rounded to the nearest metre*



Legend

- Reach Break
- Spot Height
- Elevation Contour (25 m interval)
- Indian Reserve
- Mine Footprint[1]
- Local Study Area Boundary

Impacted Fish Habitat

- Tailings (Schedule 2)
- Mine Area
- Upstream Isolation
- Downstreams Flow Alteration
- Flow/Water Level Alteration
- Not Impacted
- Not Considered (Outside LSA)

***Dashed line indicates non fish-bearing stream**

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

Scale 1:75000
UTM Zone 10N
NAD 1983 Datum

0 1 2
kilometres

N

Prepared For:

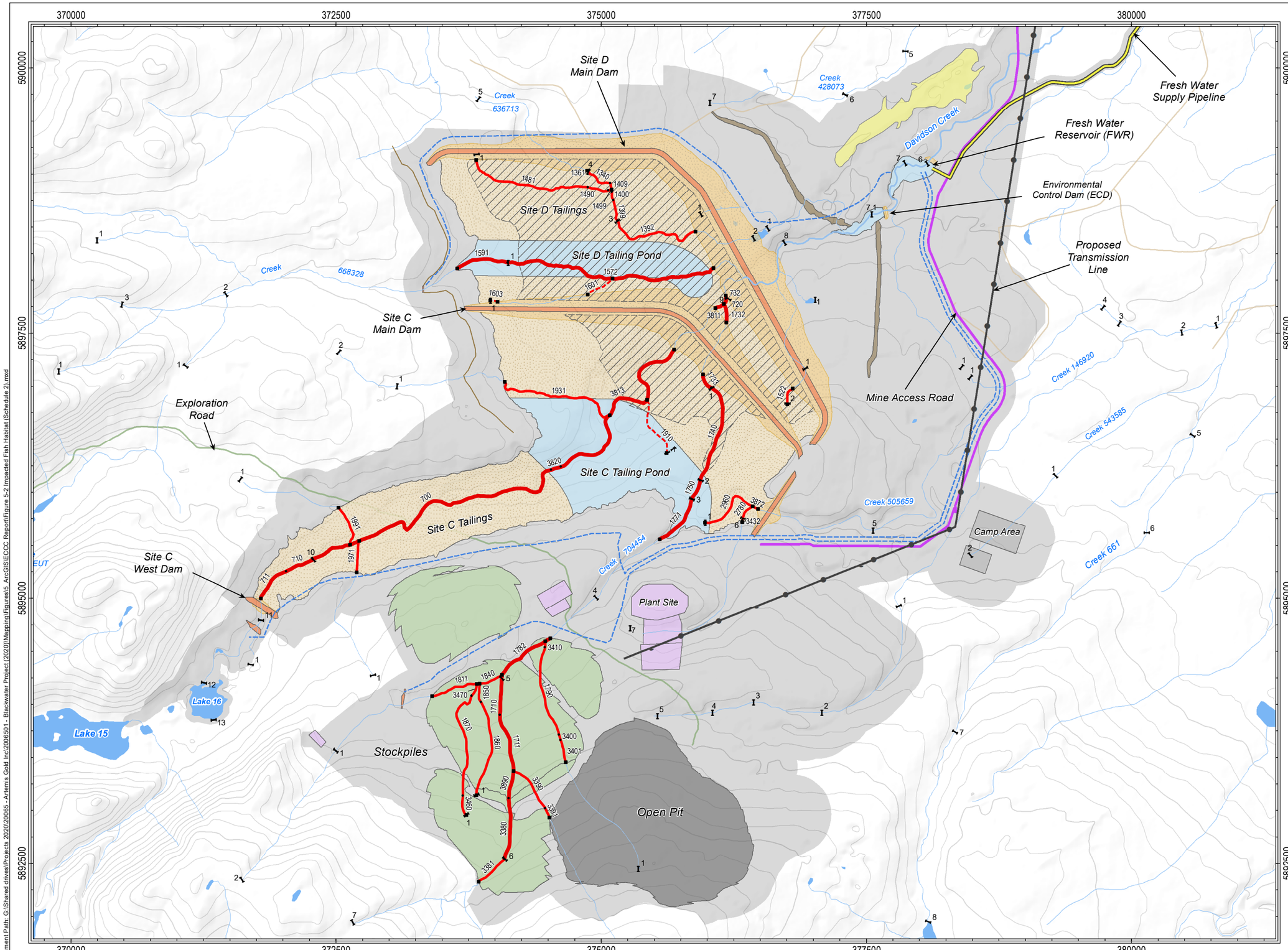
CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Feb 22, 2021

Prepared by:

Palmer

Distribution of impacted habitat in the Davidson Creek and Creek 661 Watersheds

FIGURE 5-1



Legend

- Impacted Fish Habitat (Schedule 2)*
- Non Fish-bearing Stream (Schedule 2)
- Segment Group Break
- Segment Break
- Reach Break
- Elevation Contour (25 m interval)
- Forest Service Road
- Exploration Road
- Watercourse
- Waterbody
- Mine Footprint

* Segment number refers to unique Water Feature Identifier (WFID).

Mine Site Plan

- Dam
- Tailings Pond
- Embankment
- Tailings Beach
- PAG Waste Rock
- Open Pit
- Stockpile Area
- Mine Infrastructure
- Camp Area
- Aggregate Screening Area
- Trench
- Proposed Transmission Line
- Mine Access Road
- Fresh Water Supply Pipeline
- Diversion Pipeline
- Diversion Ditch

Scale 1:35000
UTM Zone 10N
NAD 1983 Datum

0 0.5 1
kilometres

N

Prepared For:

BW GOLD LTD
a subsidiary company of Artemis Gold Inc

CLIENT: BW Gold Ltd.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Jan 11, 2021

Prepared by:

Palmer

Distribution of Schedule 2 impacted habitat in the Blackwater LSA

FIGURE 5-2

Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project (2020)\Mapping\Figures\5_ArcGIS\ECCC Report\Figure 5-2 Impacted Fish Habitat (Schedule 2).mxd

6. Compensation Measures

BW Gold has designed the Project, to the extent possible, to avoid HADD and death of fish through project design, refinement and mitigation. Despite these efforts, residual habitat loss subject to Schedule 2 amendment (as described in Section 5) is unavoidable. Compensation measures are necessary to counterbalance the resulting unavoidable habitat loss.

This Compensation 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 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 compensation measures:

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

The proposed compensation measures focused on the development of habitat gains for rainbow trout, as this is the only fish species identified in the upper reaches of the Davidson Creek and Creek 661 watersheds. Rainbow trout is an important recreational fish species in BC and is culturally important to Indigenous people. The proposed compensation measures are biologically relevant and provide the greatest likelihood of counterbalancing losses in the long term.

An overview of each of the proposed compensation measures is provided in the following subsections. Overview aerial photography is provided for the compensation sites in Appendix B. Detailed Design Drawings for the proposed habitat compensation measures are presented in Appendix C. General and site-specific considerations for mitigating adverse effects during the implementation of each compensation measure are provided in a Construction Environmental Management Plan (CEMP) in Appendix D. An Effectiveness Monitoring Plan is provided in Appendix E to detail the approach to monitoring the successful implementation of the compensation measures.

6.1 Compensation Alternatives

Since the initiation of Project baseline aquatic studies in 2011, more than 30 candidate opportunities for fish habitat compensation 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 EA Application) documents a comprehensive identification and evaluation of 19 on-site[6] and 12 off-site compensation options, and describes options determined most likely to provide direct benefits to the

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

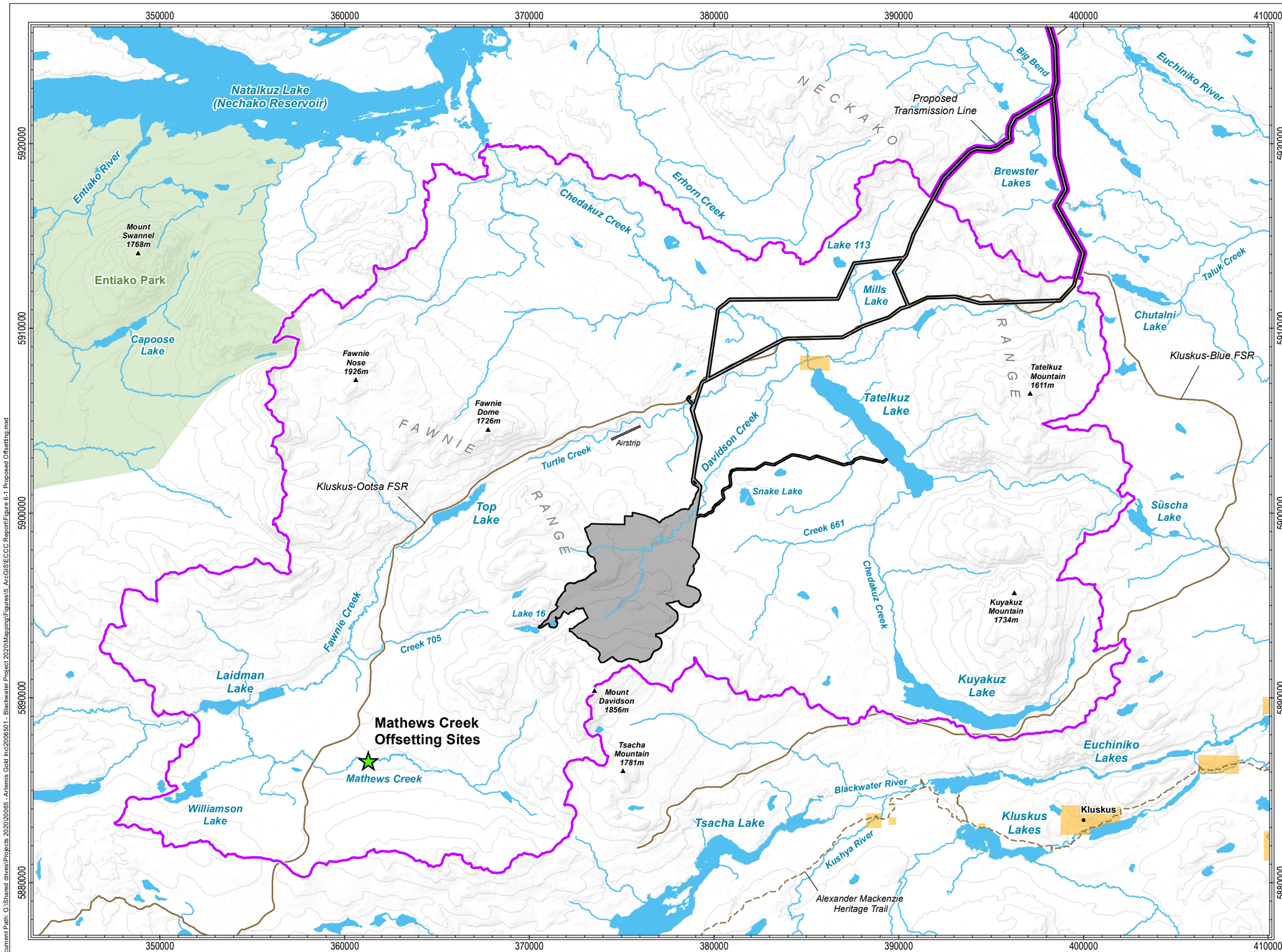
fisheries affected by the Project, and to the people relying on these areas for fishing. Additional compensation candidates were identified since the submission of the EA Application, including six options proposed by the Carrier Sekani First Nations (PECG 2017), and one option proposed by the Ulkatcho 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). Evaluation of offsetting options to be 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.

6.2 Selection of Compensation Measures for the MDMER Schedule 2 Compensation Plan

Two compensation measures were selected for inclusion in the MDMER Schedule 2 Compensation Plan out of the many potential compensation measures considered for overall Project compensation. These two associated measures are:

1. Mathews Creek channel restoration/enhancement; and
2. Mathews Creek off-channel pond creation.

The compensation measures are situated approximately 16 km southwest of the mine site in the Mathews Creek watershed. (Figure 6-1). Mathews Creek drains into Laidman Lake, which is located in the Fawnie Creek watershed. The Fawnie Creek watershed contains portions of the Blackwater LSA, including Creek 705 and Lakes 14 and 15, and drains into the Entiako River.



Legend

- Offsetting Site
- 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

Scale 1:200000
UTM Zone 10N
NAD 1983 Datum

0 1 2 3 4 5
kilometres

N

Prepared For:

ARTEMIS GOLD INC

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Feb 22, 2021

Prepared by:

Palmer™

Proposed offsetting locations

FIGURE 6-1

Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project 2020\Mapping\Figures\5 ArcGIS\ECCC Report\Figure 6-1 Proposed Offsetting.mxd

6.3 Compensation Sites Existing Conditions

6.3.1 Fish Habitat Assessment and Background Information Review Methods

Mathews Creek was first identified as a compensation opportunity in 2012, and field studies to characterise the existing habitat conditions and fish community were conducted in 2013, 2016, 2017, and 2020. 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 streamflow 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 compensation 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 A. 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, Palmer completed a drone flight of the Mathews Creek valley and visually assessed portions of the restoration area on foot to determine if disturbance indicators had changed since the 2016/2017 UAV flight and field assessment. The 2020 drone imagery was compared to 2016 and 2017 drone imagery to document any recent ecological or morphological changes along Mathews Creek, as described in Appendix A.

6.3.2 Mathews Creek History

The Nechako Plateau 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, 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, pers. comm.). One section of watercourse where impacts of decades of cattle ranching on aquatic habitat persist is a mid-elevation reach of Mathews Creek, which drains the southwestern flank of Mount Davidson (Figure 6-1).

Mathews Creek was first visited by European settlers shortly after World War II (late 1940s), when a float plane pilot working in the area spotted and landed on Laidman Lake (Laidman Lake Lodge, 2013). Since then, human activity in the Mathews Creek watershed has altered its natural condition. Anthropogenic influences largely stem from agricultural activity, forest harvesting, mineral exploration and recreational fishing (Palmer Environmental Consulting Group [PECG] 2013).

In Mathews Creek, extensive impacts are the result of several decades of agricultural land use (PECG 2013). Historical aerial photographs reveal that construction of the Mathews Creek Ranch and land clearing in support of cattle ranching began between 1964 and 1975. Use of the floodplain for hay harvesting likely began in 1975 and continued until 1991, during which period drainage ditches were excavated along the valley bottom and in toe-slope positions. The drainage ditches increased the efficiency of land drainage, particularly in the spring, maximizing accessibility for cattle grazing. The ditching has also lowered the groundwater table within the valley bottom alluvium, altering the natural soil moisture regimes and transforming areas of wet meadow and riparian fens into drier meadow ecosystems. Extensive cattle trampling of the floodplain and channel banks, where deterrent fences were absent or unmaintained, destabilized channel banks and has increased local and downstream sedimentation.

Non-agricultural anthropogenic disturbances have contributed less to impacts to the aquatic and riparian ecosystems of Mathews Creek and its tributaries (PECG 2013). Extensive clear-cut forestry has occurred in the watershed, including on the lower valley sides adjacent to Mathews Creek between 1975 and 1991. This has mainly altered woody debris supply to intermittent headwater tributaries and has potentially increased stream temperatures and decreased hydrological response time slightly. Also, a number of bridges and culverts were constructed across Mathews Creek and its tributaries to provide forestry road access.

6.3.3 Mathews Creek Existing Conditions

Mathews Creek watershed is approximately 180 km^2 and located in the Nechako Plateau of central British Columbia. Mathews Creek originates near treeline on the southwest flank of Mount Davidson (1,862 masl) and flows generally westward and northwestward through open and forested valleys to its mouth at Laidman Lake (~1,000 masl), which defines its confluence with Fawnie Creek. 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. Nechako River continues eastward to Prince George, where it joins Fraser River and flows southward to its mouth in Georgia Strait in Vancouver.

Mathews Creek watershed is situated within a region of gently rolling to hilly terrain, with more subdued topography than exists in the Coast Mountains about 100 km to the west. A clayey to sandy till dominates the surficial geology within the watershed (Plouffe et al. 2004). Glaciofluvial sand and gravel is widespread,

however, along the lower valley sides adjacent to Mathews Creek and along the headwater tributary containing a small lake. Modern alluvial deposits fill most valley bottom areas, largely derived from upstream glaciofluvial deposits exposed in cut-banks. In the vicinity of the compensation measures, the level floodplain is composed of fine sand, interbedded with silt and organic material.

At the farthest downstream extent of Mathews Creek, the channel exhibits an unconfined, sinuous pattern as it flows across the gentle alluvial fan-delta to its mouth at Laidman Lake. It is relatively wide and shallow, with well-defined pool-riffle morphology and a gravel bed. Only a small deposit of sediment extends into Laidman Lake at its mouth, indicating that sediment transport rates are modest (PECG 2013).

Between the ranch and Laidman Lake, Mathews Creek flows through a boulder-dominated canyon near Laidman Lake, and a broad, valley-bottom meadow closer to the ranch (PECG 2013). The canyon reach is in a relatively narrow and deep valley incised into adjacent glaciofluvial and till deposits. It is relatively wide and shallow, with a complex of pool-riffle-run habitat. Cobbles and boulders, derived mainly from several high, unstable cut-banks along the reach, dominate the bed and protrude above the water surface during low to moderate flows. Large woody debris extends into the channel along some portions of the banks, derived from fallen coniferous trees that line both sides of the channel. The valley-bottom meadow reach is partly confined with an irregular meander pattern. The low gradient and local abundance of beaver dams (approximately 12 along its upstream end) minimize flow velocities and maintain a deep channel dominated by run and pool habitats. Channel substrates are mostly sand with minor amounts of gravel. In-stream large woody debris is uncommon, as the channel is bound by mostly open herb meadows, some of which continue to be cleared for hay harvesting.

In the immediate vicinity of the compensation measures, the Mathews Creek channel exhibits an unconfined, tortuous meander pattern as it flows across a very broad, level valley bottom, within which past agricultural activity has been most intense of all reaches. Its gradient is low (~0.1%), and riffles are rare to non-existent. In-stream habitats are dominated by long runs (approx. 58% of channel, on average), with small pools situated at the apices of sharp meanders (approx. 42% of channel, on average). Most drops in water elevation along the reach occur in association with the numerous observed beaver dams. Bed material is dominantly sand, with fine gravels exposed along local flow constrictions formed by collapsed banks, where velocities are higher. Little in-stream large woody debris was identified where agricultural land use predominates and natural, shrubby riparian vegetation has been removed or trampled by cattle. Moderate to abundant fish cover is provided by deep pools and in-stream vegetation, with isolated accumulations of small woody debris and collapsing, undercut banks also noted. Deep pools may provide overwintering habitat depending on local groundwater inputs and winter temperatures. However, the lack of gravel substrate indicates that rainbow trout spawning is unlikely supported along this reach.

Immediately upstream of the former Mathews Creek Ranch and the proposed compensation area, the broad, gentle valley bottom is dominated by a mosaic of shrubs and herb fens, with black spruce scattered along the tops of banks providing some forested canopy cover (PECG 2013). Functional large woody debris is common. Overhanging vegetation is abundant, with boulders, in-stream vegetation and woody debris providing additional cover.

Farther upstream in the headwater reaches, the gradient of Mathews Creek increases, instream habitat includes a complex assemblage of riffles, run, and pools, cover for fish is dominated by overhanging vegetation and undercut banks, and land cover is dominated by forest (PECG 2013).

Water chemistry sampling indicated that water quality in Mathews Creek is suitable to support aquatic life (PECG 2013). Parameters measured *in-situ* (i.e., dissolved oxygen, pH, conductivity, water temperature) were all within CCME and provincial guidelines. Nutrient concentrations both upstream and downstream of the compensation areas were low, indicating that agricultural land use in the middle and upper reaches of the watershed are not contributing to increased nitrogen levels in Mathews Creek. No pesticides or herbicides were detected in the water quality samples. Guidelines exceedances of total iron and total copper were detected downstream of the compensation area.

Streamflow in Mathews Creek has been measured by Knight Piesold at station H12, located at the FSR approximately 3 km downstream of the proposed compensation work area. Hydrometric instrumentation is removed from the channel during winter months to avoid damage caused by ice; therefore, only seasonal measurements are available. The hydrograph from Mathews Creek indicates that peak flows typically occur in May and are due to runoff generated as a part of spring freshet (Figure 6-2). 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. Beaver dams regulate water levels along much of the creek and maintain upstream deep impoundments during periods of low discharge. Although observed data are not present during the winter, groundwater-dominated low flows likely persist throughout the winter months until temperatures rise and snow begins to melt in the spring.

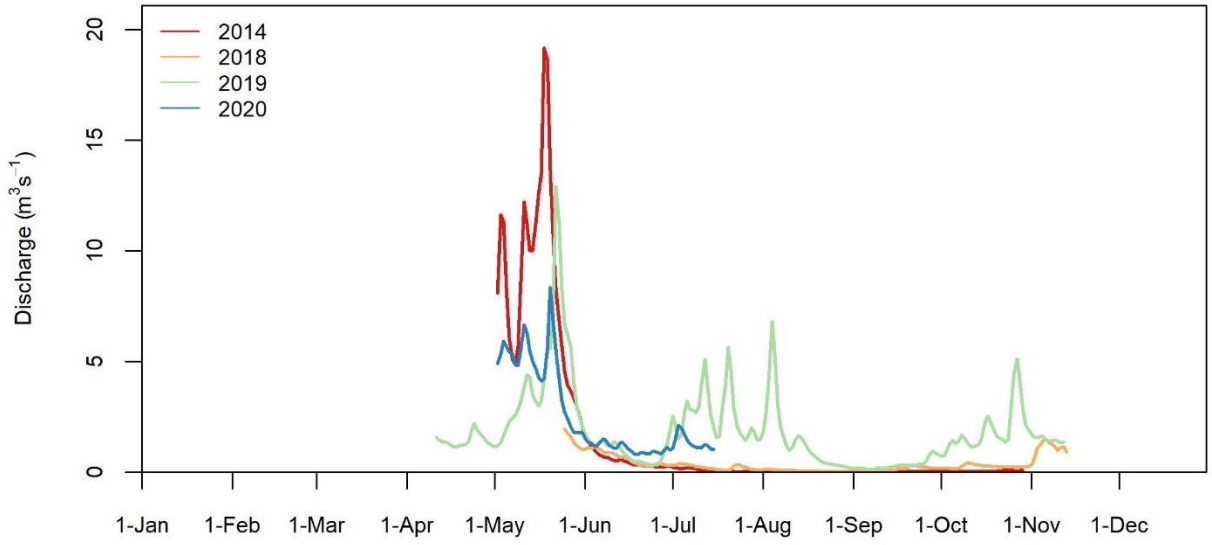


Figure 6-2. Daily Streamflow Recorded at Hydrometric Station H12 in Mathews Creek.

Burbot (*Lota lota*), brassy minnow (*Hybognathus hankinsoni*), slimy sculpin (*Cottus cognatus*), longnose dace (*Rhinichthys cataractae*), rainbow trout, and white sucker (*Catostomus commersonii*) were captured in Mathews Creek during fisheries sampling (electrofishing and minnow trapping) in the fall of 2013 (PECG 2013). Longnose dace, lake chub (*Couesius plumbeus*), and rainbow trout were captured in the lower section of Mathews Creek, near the Kluskus FSR crossing during fish sampling efforts (electrofishing and minnow trapping) conducted in early October 2016 (PECG 2013).

Rainbow trout and burbot were the most dominant species captured in Mathews Creek, with low abundances of white sucker, longnose dace, brassy minnow, and slimy sculpin also present throughout the watershed. Fish sampling conducted in 2013 found that catch per unit effort (CPUE) for all fish was highest downstream of the compensation area (3.42 individuals/100s electrofishing), lowest in the immediate vicinity of the compensation area (0.49 individuals/100s electrofishing), and intermediate in adjacent reaches (1.30 [downstream reach] and 0.83 [upstream reach] individuals/100s electrofishing, respectively; PECG 2013).

Anthropogenic changes along Mathews Creek have affected local, upstream and downstream habitat productive capacities. Fish utilization near the Mathews Creek Ranch is likely reduced from its natural condition due to a lack of habitat structural complexity (e.g., riparian vegetation, large woody debris and stable, undercut banks) that provides fish cover and substrate for periphyton and benthic invertebrates, and from locally high suspended sediment concentrations from the erosion of trampled and collapsed banks. Fine substrates have been associated with reductions in benthic invertebrate and periphyton abundance and diversity (Wood and Armitage 1997), and lower salmonid growth and survival rates (Suttle et al. 2004).

The current sparse riparian canopy also increases predation from birds and mammals and raises water temperatures through reduced shading. Allocthonous inputs including nutrients and food from riparian vegetation have been reduced along and thus downstream of the reach. Large woody debris disbursement, which provides organic carbon, fish protective cover, benthic invertebrate habitat and the facilitation and maintenance of complex stream features (e.g., scour pools, undercut banks), is largely absent.

The aquatic impacts to fish habitat can be generally grouped into four categories:

- Cattle trampled banks and bed;
- Dilapidated bridge crossings;
- Exposed channel banks; and
- Flow obstructions/impediments.

6.4 Detailed Description of Habitat Compensation Projects

The two proposed Offsetting Projects 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. The proposed compensation is located on land owned by BW Gold and on adjacent Crown Land.

6.4.1 Mathews Creek Restoration and Enhancement

Stream restoration and enhancement is proposed along 4.6 km of Mathews Creek in multiple reaches where degraded habitat has been identified (Appendix C, Sheets 1824-3-1-003 to 1824-3-1-006). Mathews Creek is part of the Nechako River watershed, and has been impacted by past agricultural practices, particularly land clearing and cattle grazing.

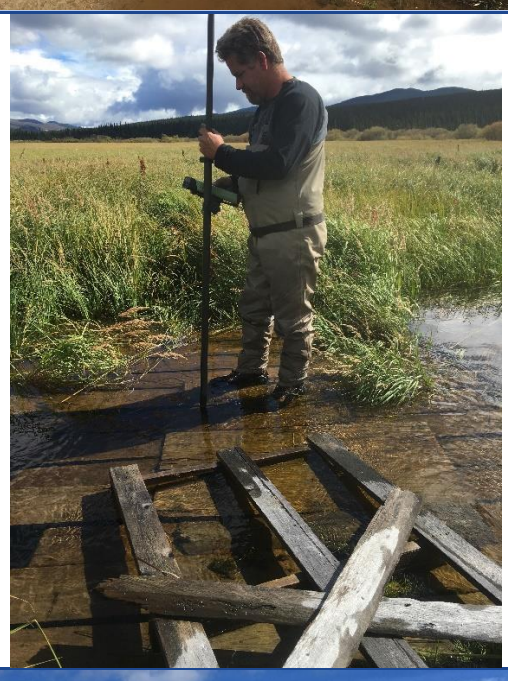
The impacts of agricultural activity, in particular cattle trampling, is primarily concentrated along the north bank, thus most of the proposed restoration/enhancement occurs along the north bank. Common issues and proposed restoration techniques are summarized in Table 6-1. Restoration of natural channel dimensions is proposed for the upstream segments near the ranch buildings, where exposed banks and over-widening are observed. Cattle trampling becomes more localized further downstream of ranch buildings. The local rise in the groundwater table in recent years, associated with beaver activity in downstream segments, poses construction challenges (e.g., soft ground, dewatering). Proposed restoration/enhancement treatments requiring heavy machinery (e.g., excavators) is limited to upstream (drier) segments and downstream segments that are above the groundwater table. Riparian plantings are proposed for the majority of segments to improve bank stability, provide aquatic food sources, and increase overhanging cover. Four failing cattle and small vehicle crossings and farm machinery debris are proposed to be removed.

Bed material in the area of proposed works is naturally dominated by sands. Therefore, placement of gravel materials on the streambed to support spawning habitat is not proposed, due to the expected infilling of interstitial spaces by fine sand and silt, which would limit suitability to support spawning habitat.

BW Gold owns (fee-simple) the majority of the land along the section of Mathews Creek to be restored and enhanced, although some portions of the compensation habitat are located on the adjacent Crown Land. To date, BW Gold (and the previous owners, New Gold) have excluded cattle from the property and engaged in discussions with provincial range officers to explore options for permanent cattle exclusion and off-channel watering within the adjacent Crown Land areas.

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, provide aquatic 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, areas with standing water, and small tributaries are proposed to be retained and protected. 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.

Table 6-1. Common Geomorphological and Aquatic Habitat Impacts along Mathews Creek and 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 • Exclude livestock from property	• 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/careful excavation of anomalous in-stream accumulations of fine sediment; and • Localized placement of boulders on channel bed.
Dilapidated Bridge Crossings	Small machinery and livestock historically crossed Mathews Creek at haphazard wooden crossings, which has degraded the channel banks and bed and negatively impacted fish passage.		• Maintain opportunities for small machinery and pedestrians to cross Mathews Creek at one managed/controlled location; and • Remove dilapidated crossings.	• Restrict crossing to one existing wooden crossing near the ranch buildings (i.e., upstream extent of works) • Re-sculpt the channel banks immediately upstream/downstream of the removed crossings; and • Plant natural riparian and brush layers immediately upstream/downstream of the crossings.
Exposed Channel Banks	Hydraulic erosion and/or lack of bank or 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; 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), and anthropogenic materials (e.g., failed crossing structures) has caused upstream impoundment, excess sedimentation, and fish passage issues.		• Remove in-stream obstructions that are unnatural and impede or prevent fish passage, or cause extensive and/or prolonged backwatering (habitat impact).	• Remove unnatural flow impediments.

6.4.2 Mathews Creek Off-Channel Ponds

The lack of overwintering habitat has been identified in the baseline studies as a key limiting factor for fish in the Project area (as described in Section 3.5.2). To help address this limitation, BW Gold proposes to construct three off-channel ponds in the Mathews Creek watersheds to provide overwintering habitat, as well as habitat for other life stages (Appendix C, Sheets 1824-3-1-008 to 1824-3-1-011). Locations and physical characteristics of each of the ponds have been specifically designed to maximize the quality of overwintering refuge provided by the ponds by targeting areas of naturally high groundwater table and through-flow for minimizing winter ice cover thickness, maximizing dissolved oxygen, and incorporating deep water (i.e., greater than 2 m), cobble/boulder substrates, and overhead cover.

The ponds have irregular shapes, contain peninsulas and islands and are strategically positioned to increase habitat diversity. Each 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, such as a pool 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 ponds. The ponds contain shallow water (0 to 1 m depth) 'shoals' lined with cobble, and deeper (1 to 5 m depth) areas. The pond designs were guided, through consultation with DFO during development of the conceptual offsetting plan, by those successfully implemented at the nearby Mount Milligan Project to address 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 at Pond #1 and Pond #2. The leaky bank is composed of coarse gravels that allow for some throughflow of water from Mathews Creek into the pond. The morphology and stone gradation of the leaky bank has been designed to allow 0.4 to 0.8 L/s of throughflow, which will provide benefits to the pond but maintain sufficient flows in Mathews Creek (baseflow is greater than 100 L/s). Incorporating a leaky bank into the design of two overwintering ponds 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 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. 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. The local channel geometry and near-surface groundwater table at Pond #3 precludes the use of a leaky bank. Furthermore, due to the high groundwater table throughout the Mathews Creek valley, groundwater interceptor channels to concentrate groundwater discharge into the ponds are not required.

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, 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.

Furthermore, ponds proposed in the Mathews Creek watershed will be incorporated into proposed valley bottom wetland restoration complexes designed by BW Gold's consultants. A gentle, shallow shoreline was incorporated into the Mathews Creek ponds to support transitional emergent vegetation growth in surrounding wetland restoration areas.

6.4.3 Long-term Preservation of Compensation Measures

The Mathews Creek habitat compensation areas consist of areas both on land owned by BW Gold and on Crown land which is also a range tenure area. BW Gold will protect the compensation works from ongoing cattle disturbances following the creation of the compensation measures for the duration of time that the Tailings Impoundment Area is in use.

For the portions of the compensation areas on private land, BW Gold will not have cattle on the property.

For the portions of the compensation areas on Crown land, BW Gold has been working with MFLNRORD on protective measures that could be implemented.

BW Gold has been informed by MFLNRORD that in order to obtain a new range tenure, a potential tenure holder would need to own or lease associated lands within 10 km of the range tenure. All nearby cattle operations currently have their own range tenures. MFLNRORD has confirmed that at this time, there is no possibility of a potential range tenure in the area of the compensation works.

As a further backstop, MFLNRORD has committed to placing a Notice of Interest (NOI) over the Crown land area containing the Mathews Creek compensation measures. The NOI will indicate a land tenure conflict when future land status reports are accessed for the area and would identify the compensation area as an area that is undergoing watershed and riparian restoration. A note to file will also be added to indicate that it is not in the best interests of the area to have cattle on these tenures/incompatible use.

6.5 Quantification of Habitat Compensation Gains

6.5.1 Instream Habitat Area

Calculation of strict 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.

For the Mathews Creek 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 C) and incorporated into the GIS-based area calculation process.

For the newly-constructed Mathews Creek off-channel ponds, no pre-existing habitat can be mapped. Instream habitat area was calculated from the detailed design drawings using AutoCAD.

6.5.2 Habitat Evaluation Procedure

A detailed description of the HEP approach to quantification of habitat compensation gains is provided in the technical memorandum *Habitat Evaluation Procedure (HEP) for Blackwater Project – Fisheries Compensation Plan* (Palmer 2020), provided in Appendix A. An overview of the HEP process is provided in Section 5.1.2.1.

HU were calculated for rainbow trout life stages in a consistent manner to describe habitats in the Project area that will be located beneath the TIAs, as well as for habitats that will be constructed and/or enhanced through implementation of compensation measures. However, assessment and calculation methods varied slightly to account for site-specific differences in data availability and habitat quality. A description of the compensation-specific methodology is provided here.

6.5.2.1 Desktop- and Field-based Assessments of Habitat

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

Initial desktop HEP habitat mapping of existing conditions in Mathews Creek was prepared in 2017, using the open-source program QGIS (version 2.18.12), and high-resolution aerial photography to delineate and measure existing stream habitats into types. Most habitat parameters such as habitat type and class, substrates, cover, and canopy closure, etc. were estimated from ‘zooming in’ on the aerial photography, while parameters such as average wetted width were enumerated by measuring distances in QGIS. These assessments were confirmed by ground-truthing surveys.

Palmer field crews conducted multiple site assessments that included physical habitat mapping of stream reaches selected for potential compensation measures to describe pre-restoration habitat conditions and support that assessment of existing HU. Ground-truthing surveys assessed existing habitat conditions and the results were subsequently used to re-evaluate the desktop generated results. Parameter values were adjusted for all units based on the ground-truthing results.

In the summer and autumn of 2017, a drone survey was completed of the Mathews Creek restoration area. In addition, a ground-based HEP survey was completed on two portions of Mathews Creek. Due to flooding and accessibility issues, the entire portion of the creek was not surveyed. In autumn 2020, a drone survey was completed over the entire restoration area and an orthomosaic image and a digital elevation model

were generated. Portions of the restoration area were visually assessed on foot to determine if disturbance indicators had changed since the 2017 assessment.

Datasets from 2017 and 2020 were qualitatively and quantitatively compared to identify any differences. First, the two sets of aerial drone imagery were overlaid and a visual assessment of changes to channel morphology was conducted by an experienced fluvial geomorphologist. Differences in channel pattern, riparian vegetation, anthropogenic or natural disturbance, and canopy closure were noted, and their locations were recorded.

Next, a desktop HEP analysis was conducted. This involved overlaying the reach breaks identified in 2017 on to the 2020 orthomosaic imagery. Parameters that could be measured using the imagery (wetted width, bankfull channel width, channel thread, instream cover for fish, riparian vegetation presence and category, canopy closure over the stream channel, off-stream habitat presence, and disturbance indicators) were recorded. Bankfull width was measured using cross sections of the digital elevation model to identify bank edges. Five measurements of bankfull and wetted width were taken and were averaged for each reach. These digitally measured values were compared with ground-verified measurements.

Overall, the qualitative and quantitative comparisons between the 2017 and 2020 datasets indicate that the assessed reaches of Mathews Creek have remained largely unchanged. No evidence of significant channel morphology change was found. Differences in beaver dam locations and off-channel habitat extent were identified when comparing the 2017 and 2020 datasets. Off-channel habitat identified in the 2020 imagery was likely present during the 2017 assessment, but not identified due to lower image resolution collected in 2017. Quantitative assessment of channel conditions showed some variation in channel measurements, but these are within the typical level of variability expected with in-channel measurements. Riparian vegetation, instream cover, and disturbance indicators identified in the 2017 HEP ground survey generally matched the 2020 desktop analysis.

6.5.2.2 Index of Alteration

Conditions in the Mathews Creek watershed are severely degraded/altered, with trampled/unstable banks, excessive sedimentation, lack of coarse substrates, and lack of riparian vegetation (PECG 2016). Therefore, quantification of the habitat value for existing stream habitats required an additional index to reflect the degraded conditions that would not be captured in the original HEP model.

Palmer developed an Index of Alteration (IA) that describes the relative level of habitat alteration in stream habitats used by rainbow trout. The IA assessment considers five habitat parameters: 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 were developed for scoring in order for the HEP to be applied to both existing and future restored conditions in each stream reach of interest.

These 14 variables within the five habitat parameters were scored for each identified stream unit based on the results of the field and desktop assessments. The IA is the mean score and was multiplied by each unaltered HSI value for each affected life stage of rainbow trout to determine the degraded habitat unit

value. The IA was calculated as the sum of the habitat parameters divided by 5 (Equation 2). A detailed description of the IA habitat parameters and variables and their calculation is available in Appendix A.

Equation 2

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

Where:
RV = Riparian Vegetation score
RB = Riparian Bank score
CC = Channel Condition score
S = Substrate score
C = Cover score

6.5.2.3 Evaluation of Future Conditions

Future habitat conditions for the Mathews Creek channel 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 restoration measures. This desktop HEP method relied on the high-quality orthomosaic mapping and detailed design drawings that incorporate 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-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.

6.5.2.4 HEP Assessment

HEP analysis was completed for the Mathews Creek restoration/enhancement and the Mathews Creek off-channel pond construction. As previously described, rainbow trout was selected as the evaluation species for both compensation measures, since it is the only salmonid species historically captured in Mathews Creek and it is the only species that will be directly impacted by the loss of habitat under the tailings and waste rock areas. Habitat gains (in HU) were calculated for the five life stages of rainbow trout that were included in the mine site losses HEP.

Habitat gains in Mathews Creek were calculated by comparing pre-restoration habitat conditions to expected restored conditions to determine the net gain of HU achieved from implementation of restoration treatments. For the Mathews Creek Off-channel Ponds, 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 times (or the total wetted area for the off-channel ponds), by the IA described above (Equation 3).

The total habitat value of each habitat component was calculated by summing the combined HU for each life stage in each mesohabitat (Equation 4). For habitats that are newly constructed (i.e., the off-channel ponds), the HU_{reach} is the net habitat gain.

Where the restoration is an improvement to existing degraded habitat (i.e., the Mathews Creek channel restoration/enhancement), the gains are calculated by the difference between restored and existing conditions (Equation 5).

Equation 3

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

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

Equation 4

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

Where:
n = the total number of mesohabitat units in the reach

Equation 5

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

6.5.3 Riparian Habitat Area

Along Mathews Creek, 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 the riparian plantings can be found in Section 6.5. The total area of the proposed riparian plantings along Mathews Creek was calculated in GIS.

For the proposed Mathews Creek off-channel ponds, the riparian area gains were calculated in AutoCAD as the sum of the area of the gentle, shallow shoreline 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 6.4.2.

6.6 Habitat Gains from Proposed Compensation Measures

The proposed restoration and enhancement of 4.6 km Mathews Creek will result in a gain of 24,542 instream HU ('usable' instream habitat) for rainbow trout life stages, due to improved channel hydraulics, bed substrates, and cover. Of this gain, 1,531 HU will be fry summer rearing, 8,261 HU will be juvenile summer rearing, 8,551 HU will be adult foraging, and 6,199 HU will be overwintering. No spawning habitat will be created or affected by the proposed works. 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 1,560 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 Mathews Creek. Riparian vegetation will be restored/enhanced along the entirety of the proposed channel works such that instream aquatic biota receive the full benefit of riparian habitat. As such, the riparian habitat gain will be 48,467 m^2.

The off-channel ponds will result in the gain of 27,924 m^2 of pond habitat area, equivalent to 68,317 HU ('usable' pond habitat). The habitat provided by the ponds is expected to support rainbow trout fry rearing, juvenile rearing, adult foraging, and overwintering. Riparian vegetation will be restored/enhanced around the entireties of the pond shorelines such that in-pond aquatic biota receive the full benefit of riparian habitat. As such, riparian habitat gain will be 27,705 m^2. Table 6-2 provides a detailed breakdown of the instream and riparian area and life-stage-specific HU gained by the construction of each of the three ponds.

Overall, the proposed compensation measures will result in the creation of 26,364 m^2 of habitat area, 92,859 HU, and 76,172 m^2 of riparian area. The habitat gains from the proposed compensation measures for life stages of rainbow trout are provided in Table 6-2.

Table 6-2. Habitat Gains from Compensation Measures - Area, Habitat Units by Life Stage, and Riparian Area

Offsetting Measure	Area Gain (m^2)	Rainbow Trout Habitat Units					HU Totals	Riparian Area (m^2)
		Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Overwintering		
Mathews Creek Restoration and Enhancement	-1,560[1]	0	1,531	8,261	8,551	6,199	24,542	48,467
Mathews Creek Pond 1	7,409	0	1,394	5,578	5,578	5,578	18,128	9,850
Mathews Creek Pond 2	7,500	0	1,411	5,646	5,646	5,646	18,349	6,750
Mathews Creek Pond 3	13,015	0	2,449	9,797	9,797	9,797	31,840	11,105
Totals	**26,364**	**0**	**6,785**	**29,282**	**29,572**	**27,220**	**92,859**	**76,172**

Notes:

1. *The loss of area in the Mathews Creek channel 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.*

6.7 Habitat Balance

A habitat balance has been prepared to summarize the predicted impacts to fish habitat from the losses of instream habitat requiring MDMER Schedule 2 amendment and the potential gains from proposed fish habitat compensation measures (Table 6-3).

A total of 47,125 rainbow trout HU will be lost in areas subject to Schedule 2 amendment in Davidson Creek and Creek 661. This will be compensated for at an approximately 1.97:1 ratio by the gain of 92,859 rainbow trout HU in the Mathews Creek channel and off-channel ponds.

The compensation measures support local fisheries management objectives and local restoration priorities, and balance Project impacts. The compensation measures incorporate both 'in-kind' offsetting (i.e., creation of habitats that support rainbow trout life stages that are affected by losses) and the creation of habitat to address identified bottlenecks in rainbow trout productivity. The proposed compensation plan includes the creation of off-channel ponds that will provide overwintering habitat, which is currently a limiting factor in rainbow trout production, as described in Section 3.5.2. Furthermore, as described in Section 6.8, time-lag in compensating for impacts can be minimized by initiating compensation measures before losses occur.

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 upper Davidson Creek watershed. However, these habitats are limited in quality and productive capacity, compared the habitats in the lower watershed. 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. No other fish species have been identified in the affected portions of Davidson Creek and Creek 661, so only rainbow trout will be directly impacted.

The compensation plan provides additional benefits to fisheries productivity. The compensation habitats are located in a watershed that supports a variety of fish species, including burbot, brassy minnow, slimy sculpin, longnose dace, and white sucker. Although the HEP analysis focuses solely on rainbow trout, the positive effects of the compensation measures will be multiplied among the other species present in Mathews Creek, since they will also benefit from the creation of new habitat and the restoration and enhancement of existing poor-quality habitat.

Riparian vegetation, and the habitat it supports, helps to maintain the productivity of adjacent and downstream fish habitat. Riparian habitat provides shading for cover, 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 compensation opportunities.

The compensation ratio of approximately 0.17:1 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 upper portions of the Davidson Creek and Creek 661 watersheds have a disproportionately large and poor-quality riparian area, when compared to larger streams and ponds located lower in a watershed;
- The creation of off-channel ponds 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 wetland zones 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 Mathews Creek 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 compensation along Mathews Creek, which has higher potential for fisheries productivity (higher fish species diversity and densities).

Based on these factors, the proposed instream habitat compensation ratio of approximately 1.97:1 (ratio of HU gains to losses) and the riparian area ratio of approximately 0.17:1 (ratio of area gained to area lost) is appropriate in counterbalance the effects of habitat loss.

Table 6-3. Habitat Balance

Impacted Streams	Habitat Units Lost	Riparian Area (m^2)
Davidson Creek Mainstem	21,416	169,586
Davidson Creek Tributaries	552	20,571
Creek 704454 Mainstem	12,835	98,747
Creek 704454 Tributaries	1,934	49,596
Creek 668328 Mainstem	9,067	76,535
Creek 668328 Tributaries	0	0
Creek 636713 Mainstem	732	15,641
Creek 636713 Tributaries	343	14,188
Creek 505659 Mainstem	59	2,445
Creek 505659 Tributaries	187	6,190
Total Losses	**47,125**	**453,499**

Habitat Offsets	Habitat Units Gained	Riparian Area (m^2)
Mathews Creek Restoration and Enhancement	24,542	48,467
Mathews Creek Pond 1	18,128	9,850
Mathews Creek Pond 2	18,349	6,750
Mathews Creek Pond 3	31,840	11,105
Total Gains	**92,859**	**76,172**
Ratios (Gains:Losses)	**Instream Area**	**Riparian Area**
	1.97:1	**0.17:1**

6.8 Compensation Timeline

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

The impacts associated with the works requiring the Schedule 2 amendment will commence during mine construction and continue over the life of the mine. As such, BW Gold proposes to commence implementation of the compensation measures on Mathews Creek during construction, before the impacts commence. Timing to implement will depend on timing of the Schedule 2 listing, Project permit timing more generally, and Project financing, and will also conform to fisheries timing window restrictions. Since the proposed compensation measures are located partially on land owned by BW Gold and partially on some adjacent Crown Land, implementation can begin rapidly following a decision to proceed.

Compensation measure construction will begin in summer 2022 (Year -2) and is forecast to be completed by spring 2023 (Year -1). The compensation habitat will provide nearly the full value in habitat units described in Section 6.5 immediately upon completion, with the exception of some habitat value associated with riparian vegetation establishment, which will be realized as the planted vegetation community develops over time. During this time, the mine will be under construction and Schedule 2 impacts will be limited. Tailings deposition and use of Schedule 2 stockpile areas is not scheduled to occur until Year 1 (Knight Piésold Ltd. 2021; ERM 2020b). Uncertainty related to when exactly the full value of the compensation measures will be realized is accounted for by the designed habitat balance of 1.97:1 (HU gains:losses), which means that nearly double the habitat impacted will be created at Mathews Creek. This provides confidence that compensation 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 2020). There are therefore no additional measures necessary to account for time lag between impacts and offsetting.

BW Gold proposes to construct the compensation 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.

6.9 Potential Effects and Mitigations Associated with Implementation of Compensation Measures

Implementation of compensation measures in Mathews Creek has the potential to result in temporary, localized adverse effects to the environment. Potential effects of the project to fish and fish habitat could include:

- Fish injury or mortality as a result of crushing/smothering by equipment or materials, fish stranding due to dewatering, or 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.
- Changes to fish habitat due to altered stream flows caused by velocity and discharge changes during flow diversion around isolated areas with pumps or constructed diversion channels. Alteration of stream flows could cause scour or deposition of sediments and change channel morphology.

Palmer has developed a CEMP which describes mitigation measures to reduce or avoid adverse effects (Appendix D). Potential, unmitigated, adverse effects associated with implementation of compensation measures are listed in Table 6-4 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 project will have an overall positive effect on aquatic habitat in Mathews Creek.

Table 6-4. Potential Effects and Mitigations Associated with Implementation of Compensation Measures

Potential Effects		**CEMP Key Mitigation Summary**
Vegetation	Invasive species introduction.	■ Remove invasive species currently present. ■ Clean all equipment and materials before arrival at site. ■ Re-vegetate after construction with native species only.
Fish and Fish Habitat	Fish injury or mortality.	■ Work in-stream only during the regional Reduced Risk Work Window for fish (rainbow trout specifically in Mathews Creek). ■ 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 for 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 salvage, install exclusion fencing, 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. - 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 qualified environmental professional (QEP). ■ Work will be stopped if turbidity or total suspended solids (TSS) levels are above guidelines work will be stopped and ESC measures will be adjusted as needed.
	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.

6.10 Monitoring and Adaptive Management

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

Compliance monitoring will involve monitoring by a qualified environmental professional (QEP) during construction to ensure that environmental protection measures and best management practices detailed in the Construction Environmental Monitoring Plan (CEMP; Appendix D) are implemented as required and that habitat features are constructed in accordance with the MDMER Schedule 2 amendment Compensation Plan and compensation 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 compensation 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 E) describes the site-specific monitoring plans, although consultation with ECCC, DFO, and other relevant stakeholders or regulators may be conducted to refine the key indicators for monitoring and the criteria for evaluating 'ecological functionality'.

An adaptive management approach will be adopted in order to periodically identify the need for any further mitigation or compensation 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, 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 concluded when habitat compensation sites have reached the defined criteria for determining success, and thus, when the goal of counterbalancing habitat loss has been achieved.

In addition to the aforementioned monitoring efforts, construction monitoring in accordance with the CEMP will also be implemented to minimize risks to fish and fish habitat during construction of the compensation works. 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 to document and photograph site conditions associated with compensation works. A qualified professional with experience in the supervision of channel restoration projects (e.g., fluvial geomorphologist, habitat restoration specialist) will visit the site at critical times during construction to ensure all elements of compensation 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 area and access route;
- Establishment of key profile (elevation) points and channel 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.

6.11 Cost Estimate

Construction costs for the Mathews Creek restoration/enhancement and the construction of the Mathews Creek off-channel ponds were determined by Onsite Engineering Ltd. (Table 6-5), which is supporting drafting and engineering oversight, based on the detailed design drawings (Appendix C). Detailed cost breakdowns and assumptions used for the cost estimates are provided in Appendix F. The total cost to construct the proposed compensation measures is approximately $4,899,000, including 15% contingency.

Table 6-5. Estimated Construction Costs for the Proposed Compensation Measures

Compensation Measure		Construction Costs
General Construction Materials, Access, and Services	All Sites	$2,325,414.20
Off-channel Ponds Construction	Mathews Creek Ranch Pond 1	$352,719.25
	Mathews Creek Ranch Pond 2	$263,345.75
	Mathews Creek Ranch Pond 3	$450,078.88
Stream Restoration and Enhancement Construction	Mathews Creek	$868,304.62
Cost Subtotal		$4,259,862.70
15% Contingency		$638,979.41
Total Offsetting Cost		$4,898,842.11

7. Certification

This report was prepared, reviewed and approved by the undersigned:

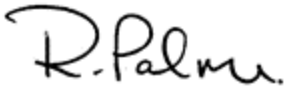
Prepared By:

Ian MacLeod, B.Sc., R.P.Bio., P.Biol.
Senior Fisheries Biologist

Reviewed By:

Robin McKillop, M.Sc., P.Geo., CAN-CISEC
Principal, Geomorphologist & Habitat Restoration Specialist

Approved By:



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

8. References

AMEC. 2014a. Blackwater Gold Project, Fisheries Mitigation and Offsetting Plan.

AMEC, GeoSim Services Inc., NorWest Corporation, Knight Pieshold Consulting. 2014b. Blackwater Gold Project, British Columbia – NI 43-101 Technical Report on Feasibility Study. Prepared for New Gold, January 14 2014.

Armour, C. L. 1977. Effects of deteriorated range streams on trout. U. S. Bureau of Land Management, Idaho State Office, Boise, Idaho.

Artemis Gold Inc. (Artemis). 2020. NI 43-101 Technical Report on Pre-feasibility Study.

Austin, M.A. and Eriksson, A. 2009. The Biodiversity Atlas of British Columbia. 135 pp.

Avison Management Services Ltd (Avison). 2013a. Fish and fish habitat inventory: New Gold Blackwater Project. Prepared for New Gold Inc. by Avison Management Services, Vanderhoof, BC. February 2013. [Annex 5.10-5 Survey of Transmission Line and Access Road Stream Crossings, 2012, in Appendix 5.1.2.6A of the Application]

Avison Management Services Ltd (Avison). 2013b. Fish and fish habitat inventory: New Gold Blackwater Project. Prepared for New Gold Inc. by Avison Management Services, Vanderhoof, BC. December 2013. [Annex 5.8-1 Survey of Transmission Line Stream Crossings, 2013, in Appendix 5.1.2.6B of the Application]

Behnke, R. J. and M. Zarn. 1976. Biology and management of threatened and endangered western trouts. U. S. Forest Service General Technical Report RM-28.

Bradford, M.J., Koops, M.A., Randall, R.G. 2014. Science advice on a decision framework for managing residual impacts to fish and fish habitat. Can. Sci. Ad. Secret. 2014/112.

British Columbia Conservation Data Centre (BC CDC). 2020. BC Species and Ecosystems Explorer. Available at https://a100.gov.bc.ca/pub/eswp/ (accessed 2020).

British Columbia Ministry of Environment, Lands and Parks (BC MOELP). 1997. Fish Habitat Rehabilitation Procedures. Prepared by Watershed Restoration Program, Technical Circular no. 9. 313pp.

British Columbia Ministry of Forests (BC MOF). 1995. Riparian Management Area Guidebook. Forest Practice Code of British Columbia. Province of British Columbia. Victoria, BC. 68pp.

British Columbia Ministry of Forests (BC MOF). 1998. Forest Practices Code. Fish Stream Identification Guidebook. August 1998. Available at: https://www.for.gov.bc.ca/hfd/library/FFIP/BCMoF1998.pdf

British Columbia Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO), B.C. Ministry of Environment (BC ENV), and Fisheries and Oceans Canada (DFO). 2012. Fish-stream crossing guidebook. Rev. ed. For. Prac. Invest. Br. Victoria, B.C

British Columbia Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO). 2014. Forest and Range Practices Act BMPs. Guidelines and Best Management Practices (BMPs). Available at: https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/natural-resource-standards-and-guidance/best-management-practices.

Bustard D.R., and Narver, D.W. 1975. Aspects of the winter ecology of juvenile coho salmon (Oncorhynchus kisutch) and steelhead trout (Salmo gairdneri). Journal of the Fisheries Research Board of Canada. 32: 667-680.

Canadian Environmental Assessment Act (CEAA). 2012, c. 19, s. 52.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2020. Wildlife species assessments. Available at https://cosewic.ca/index.php/en-ca/status-reports.

Environmental Assessment Office (EAO), 2019. Summary Assessment Report for Blackwater Gold Mine Project (Blackwater). May 17, 2019.

Environment Canada. 2011. “Guidelines for the Assessment of Alternatives for Mine Waste Disposal”.

ERM. 2017. Blackwater Gold Project: Effects Assessment of Proposed Change to Transmission Line Alignment Addendum Report. March 2017. Prepared for New Gold Inc. by ERM Consultants Canada Ltd.: Vancouver, B.C.

ERM. 2020a. Blackwater Gold Project: Assessment of Alternatives for the Blackwater Gold Project for Mine Waste Disposal. Prepared for BW Gold Ltd. by ERM Consultants Canada Ltd.: Vancouver, BC

ERM. 2020b. Blackwater Gold Project Initial Project Description. Prepared for BW Gold Ltd.by ERM Consultants Canada Ltd.: Vancouver, BC.

Fisheries and Oceans Canada (DFO). 1993. Land Development Guidelines for the Protection of Aquatic Habitat. Available at: http://www.dfo-mpo.gc.ca/Library/165353.pdf.

Fisheries and Oceans Canada (DFO). 2013a Fisheries Protection Policy Statement.

Fisheries and Oceans Canada (DFO). 2013b. Fisheries Productivity Investment Policy: A Proponent’s Guide to Offsetting.

Fisheries and Oceans Canada (DFO). 2013c. Science Advice on Offsetting Techniques for Managing the Productivity of Freshwater Fisheries.

Fisheries and Oceans Canada (DFO). 2013d. An Applicant’s Guide to Submitting an Application for Authorization under Paragraph 35(2)(b) of the Fisheries Act. November 2013.

Fisheries and Oceans Canada (DFO). 2014. Pathway of Effects. Available at: http://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/index-eng.html.

Fisheries and Oceans Canada (DFO). 2016. Measures to Avoid Causing Harm to Fish and Fish Habitat. Available at: http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html.

Fisheries and Oceans Canada (DFO). 2019. Measures to Protect Fish and Fish Habitat. Available at: https://dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.htmlGovernment of British Columbia. 1996. Mines Act. RSBC 1996 c293.

Fisheries and Oceans Canada (DFO). 2020. Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act*. Available at: https://www.dfo-mpo.gc.ca/pnw-ppe/reviews-revues/policies-politiques-eng.html

Government of British Columbia. 1997. Rock Drain Research Program. Final Report. March 1997.

Government of British Columbia. 2002a. British Columbia Environmental Assessment Act.

Government of British Columbia. 2003. Environmental Management Act. SBC 2003, c53.

Government of British Columbia. 2018. British Columbia Environmental Assessment Act. SBC 2018, c51.

Government of Canada. 1996. Fisheries Act. RSBC 1996 c 149.

Government of Canada, 2002. Metal and Diamond Mining Effluent Regulations. SOR/2002-222.

Johnston, N.T., and P.A. Slaney. 1996. Fish Habitat Assessment Procedures. Watershed Restoration Technical Circular No. 8, Revised April 1996.

Keeley, E.R., P.A. Slaney, and D. Zaldokas. 1996. Estimates of production benefits for salmonid fishes from stream restoration initiatives. Province of British Columbia, Ministry of Environment, Lands and Parks and Ministry of Forests. Watershed Restoration Management Report No. 4: 22p

Knight Piésold Ltd. (KP). 2014. Estimated Percent Groundwater Contribution to Streamflow during Baseline Conditions in the Blackwater Gold Project Study Area. (Ref. No. VA101-457/8-A.01). May 15, 2014.

Knight Piésold Ltd. (KP). 2021. Tailinhs Storage Facility General Arrangement (End of Year 1) – DRAFT. Prepared for Artemis Gold Inc. April 23, 2021.

Koning, C.W. and E.R. Keeley. 1997. “Salmonid Biostandards for Estimating Production Benefits of Fish Habitat Rehabilitation Techniques.” In: P. Slaney and D. Zaldokas (eds.), Watershed Restoration Program Technical Circ. No. 9, 1997, Chapter. British Columbia Ministry of Environment, Lands and Parks, and British Columbia Ministry of Forests, Victoria, BC.

Laidman Lake Lodge, 2013. About Laidman Lake Ecolodge: Extended information on our our [sic] history.

Mackenzie, W.H. and Moran, J. R. 2004. Wetlands of British Columbia: A Guide to Identification. British Columbia Ministry of Forests. Land Management Handbook No. 52.

Nechako Environment & Water Stewardship Society (NEWSS). 2016. Land Use in the Nechako Valley. Retrieved from: http://www.newssociety.org/newss_history.html

New Gold. 2014. Blackwater Project: Application for Environmental Assessment.

Palmer Environmental Consulting Group (PECG). 2013. Blackwater Project: Fish and Fish Habitat Baseline Assessment and Compensation Program, Mathews Creek Watershed Rehabilitation Project. Prepared for AMEC Environment & Infrastructure, Burnaby, by Palmer Environmental Consulting Group Inc., Vancouver, BC. 8 November 2013.

Palmer Environmental Consulting Group (PECG). 2016a. Assessment of potential effects of the proposed Blackwater Mine Project activities on four additional fish species. Memorandum to New Gold Inc., February 08, 2016.

Palmer Environmental Consulting Group (PECG). 2016b. Blackwater Project, Provincial EA Comments. Supporting technical information on Instream Flow Methodology and Fisheries. Memorandum to New Gold Inc., March 22, 2016.

Palmer Environmental Consulting Group (PECG). 2016c. Blackwater Project: Technical Response to Additional data or Information Requirements as outlined in the Canadian Science Advisory Secretariat Science Response 2015/031- Review of Proposed Intra-Basin Transfers as Part of the Environmental Impact Statement for the Blackwater Mine Project. Memorandum to New Gold Inc., February 02, 2016.

Palmer Environmental Consulting Group (PECG). 2017. Review of Fisheries Offsetting options put forward by the Carrier Sekani First Nations (CSFN). Memorandum prepared for New Gold Inc., September 7, 2017.

Palmer. 2020. Habitat Evaluation Procedure (HEP) for Blackwater Project – Fisheries Compensation Plan. Tom Gast and Associated Environmental Consultants.

Platts, W. S. 1991. Livestock Grazing. American Fisheries Society Special Publication 19: 389-423.

Platts, W. S. 1983. Vegetation requirements for fisheries habitats. Pages 184-188 *in* S. B. Monsen and N. Shaw, compilers. Managing intermountain rangelands- improvement of range and wildlife habitats. USDA Forest Service, General Technical Report INT, 157.

Plouffe, A., Levson, V.M. and Mate, D.J., 2004. Surficial geology, Nechako River, British Columbia. Geological Survey of Canada, Map 2067A, scale 1:250,000.

QGIS Development Team, 2020. QGIS (version 2.18.12) Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org.

Raleigh, R.F., Hickman, T., Solomon, R.C., Nelson, P. 1984. Habitat Suitability Information: Rainbow Trout. FWS/OBS-82/10.6. January 1984. U.S. Fish and Wildlife Service.

Resources Inventory Committee (RIC). 2001. Reconnaissance (1:20,00) Fish and Fish Habitat Inventory: Standards and Procedures - Version 2.0. Prepared by the BC Fisheries Information Services Branch.

Salewski, W. 2020. Personal Communications.

Smokorowski, K.E., M.J. Bradford, K.D. Clarke, M. Clement, R.S. Gregory, and R.G. Randall. 2015. Assessing the effectiveness of habitat offset activities in Canada: monitoring design and metrics. Can. Tech. Rep. Fish. Aquat. Sci. 3132. 48 p.

Suttle, K.B., Power, M.E., Levine, J.M. and NcNeely C., 2004. How fine sediment in riverbeds impairs growth and survival of juvenile salmonids. Ecological applications 14(4): 969:974.

Taylor E.B. 2012. Microsatellite DNA analysis of populations of rainbow trout (Oncorhynchus mykiss) in the Tatelkuz Lake Watershed, Interior British Columbia. Prepared for New Gold Inc. by the Department of Zoology, University of British Columbia, Vancouver, BC. April 5, 2012.

United States Fish and Wildlife Service. 1980. Habitat Evaluation Procedures (HEP). ESM 102. U.S. Fish and Wildlife Service, Division of Ecological Services, Washington, D.C. March 31, 1980

United States Fish and Wildlife Service. 1981. Standards for the Development of Habitat Suitability Index Models. ESM 103. U.S. Fish and Wildlife Service, Division of Ecological Services, Washington, D.C. April 10, 1981.

Wood, P.J. and Armitage, P.D., 1997. Biological effects of fine sediment in the lotic environment. Environmental Management 21(2): 203-217.

Appendix A

Habitat Evaluation Procedure (HEP) for Blackwater Project Fisheries Offsetting Plan

Habitat Evaluation Procedure (HEP) for Blackwater Project – Fisheries Compensation Plan

Memo # and Date: 20180207PECG, First Draft October 10, 2017, RV January 29, 2021

Project: Blackwater Mine

Client: Palmer/BW Gold Ltd.

Office: Vancouver, BC
Canada

Submitted by: Thomas Gast & Associates Environmental Consultants
P.O. Box 1137
Arcata, CA 95518

Contact Person: Thomas Gast, Principal Scientist
Phone: 707-822-8544
Email: tgast@tgaec.com
Website: www.tgaec.com

Contents

Table of Equations

Table of Tables

Introduction

BW Gold Ltd. (BW Gold) is proposing to construct and operate the Blackwater Gold Project (The Project), an open pit gold/silver mine located approximately 110 kilometres (km) southwest of Vanderhoof, British Columbia, Canada. Despite implementation of best management practices, and avoidance and mitigation measures applied to all Project phases, loss of fish habitat will be an unavoidable consequence of this Project being enacted.

Before construction can commence, the Project will require both 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 Project will result in the deposit of deleterious substances (*i.e*. mine tailings and waste rock) into fish-bearing portions of Davidson Creek and Creek 661. This will require an amendment to designate portions of Davidson Creek and Creek 661 as Tailings Impoundment Areas (TIAs).

A compensation plan has been developed that presents the approach for avoidance, mitigation and compensation measures for both habitat losses within the TIAs (*i.e.* Schedule 2 impacts). Habitat losses resulting from other Project infrastructure are addressed under a separate *Fisheries Act* Application for Authorization and Offsetting Plan. Habitat losses are separated between the two different types of infrastructure to facilitate separate applications.

This Memo addresses Schedule 2 habitat losses and gains – specifically those losses associated with fish habitat beneath the TSF and waste rock dump and those gains proposed to offset them.

Compensation measures will be constructed to offset the loss of fish habitat caused by the Blackwater Project. Compensation measures target the creation, restoration, or enhancement of fish habitat, promote the recovery of sensitive fish species, and are recognized by the community, local First Nations, and/or government agencies as regionally important priorities.

Proposed compensation measures include:

- restoration of riverine fish habitat in the Mathews Creek watershed; and
- construction of three off-channel ponds in the Mathews Creek watershed.

The primary purpose of habitat compensation measures is to ensure that any Project-related reduction in fish habitat due to the permanent alteration or destruction of habitat is offset by habitat created, enhanced, or restored. In order to assess the adequacy of proposed compensation measures, an accounting method is required that allows comparison of habitats lost and gained, while also taking into consideration the varying quality of habitats lost and gained for different species and life-stages of evaluation species.

The U.S. Fish and Wildlife Service Habitat Evaluation Procedure (HEP) was used to quantify fish habitat (USFWS 1980; USFWS 1981) lost through mine construction and operation as well as fish habitat gained by stream restoration. This Memo describes the Habitat Evaluation Procedure metric, habitat variables, and calculation methods.

Proposed Compensation Measures Evaluated

1. **Stream Restoration in Mathews Creek**
2. **Off-channel Ponds connected to Mathews Creek**

Methods

HEP allows the comparison of relative habitat quality and quantity either spatially (*i.e*. different location at same point in time) or temporally (*i.e.* same location at different point in time). The combination of these two analyses allows the impact of proposed land management activities to habitat quality and quantity to be quantified (USFWS 1980).

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), with HSI being 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). 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 are based on the assumption that there is a positive relationship between the suitability index and habitat carrying capacity (USFWS 1981).

Habitat Evaluation Procedure

HEP analyses are based on the calculation of dimensionless habitat units (HU) for each evaluation species. The number of HUs in a given reach of interest is determined by multiplying the total area of available habitat (m^2) by a species- and life stage-specific HSI (quantity * quality) (USFWS 1980).

HUs were calculated in a consistent manner to describe habitats in the Project area that will be located beneath the TIAs, as well as for habitats that will be constructed and/or enhanced through implementation of compensation 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.

Selection of Evaluation Species and Lifestage

HEP evaluation species are used “to quantify habitat suitability and determine the changes in the number of available HU’s” (USFWS 1980). An evaluation species can be a one species or a group of species, as well as one or more species life stage (USFWS 1980).

Two primary approaches for selecting an evaluation species include 1) choosing species with high public interest, economic value, or both; and/or 2) selection of species based on ecosystem importance (USFWS 1980). Wherever practicable, evaluation species that represent both economic and ecological importance should be selected, as land management activities typically impact both realms. Rainbow trout are the only species present in the upper reaches of Davidson Creek, in reaches affected by the TIA. Rainbow trout are also the only salmonid species that have been historically captured in Mathews Creek.

Rainbow trout were chosen to be the only indicator species for the assessment of Schedule 2 losses and compensation measures, because of their high abundance and dominance in regional fish communities, their significance to local and First Nations fisheries, and their presence in the upper reaches of Davidson Creek and Creek 661 under the TIA footprint (AMEC 2014). In addition, rainbow trout are also abundant and provide a significant fishery the region.

Rainbow trout life stages that will be affected by The Project were selected based on results of baseline field studies and include the following: spawning/egg incubation, fry summer rearing, juvenile summer rearing, adult summer foraging, and overwintering life stages (AMEC 2014).

Habitat Classification system- Types and Classes

AMEC (2014) developed a habitat classification system to support the use of HSI models for rainbow trout (Table 1). Field studies in Davidson Creek and Creek 661 (flowing through The Project footprint) helped to identify the seven mesohabitat types present in The Project footprint as well as the habitat classes assigned to each habitat type (AMEC 2014).

Identified stream habitat types included the following mesohabitats: cascades, riffles, glides, and pools. Three additional habitat types were utilized to describe the remaining diversity of fish habitat "not represented by the four mesohabitat types" (AMEC 2014). A "tributary" type was used to describe small first-, second-, and third-order tributaries to mainstem creeks; an "other" type that describes habitats afforded by off-channel areas such as back-flooded beaver dams, and wetlands; and a "lake" category that describes different lake habitats (AMEC 2014).

Each of the identified seven habitat types were then further categorized into habitat classes to describe the diversity of habitats present across The Project footprint area as well as "all habitats that will be protected, constructed, rehabilitated or enhanced as part of the mitigation and offsetting measures" AMEC (2014). AMEC initially identified 19 discrete habitat classes to be included in the habitat classification system. In addition, unique aquatic habitats found in several ranchland streams selected for compensation measures necessitated defining two additional habitat classes to better describe existing conditions:

Glide 4 — Areas of slow flowing, moderately shallow water with fine substrates, low habitat complexity

Other 3 Shallow, low gradient (near zero) habitat, wetland-like with undefined channel, or multiple-thread channels, fine sediment dominated substrates, low cover, LWD lacking or absent, overhead canopy lacking.

Palmer/TGAEC subsequently added these two new habitat classes to the existing classification system resulting in a total of 21 unique habitat classes.

Table 1. Definitions for Habitat types and classes

Habitat Type	Habitat Class	Definition and Habitat Characteristics
Cascade	1	Steep, stepped riffles of bedrock or emergent cobbles/boulders, fast-flowing water, turbulent, shallow, gradients >4%
Riffle	1	Turbulent, fast-flowing water, shallow, moderate gradient, spawning gravels extensive, dominant substrate are gravels, low cover and habitat complexity.
	2	Turbulent, fast-flowing water, shallow, moderate gradient, pockets of spawning gravels, dominant substrates are cobbles or boulders, moderate cover and habitat complexity.
	3	Turbulent, fast-flowing water, shallow, moderate gradient, no spawning gravels, dominate substrates are cobbles or boulders, high cover and habitat complexity
Glide	1	Fast-flowing, non-turbulent water, pool tailouts, moderately-shallow, spawning gravels extensive, dominant substrates are gravels, low cover and habitat complexity
	2	Fast-flowing, non-turbulent water, pool tailouts, moderately-shallow, pockets of spawning gravels, dominant substrates are cobbles or boulders, moderate cover and habitat complexity
	3	Fast-flowing, non-turbulent water, pool tailouts, moderately-shallow, no spawning gravels, dominant substrates are cobbles or boulders, high cover and habitat complexity or areas of slow flowing, deep water with fine substrates
	4	Areas of slow flowing, moderately shallow water with fine substrates, low habitat complexity
Pool	1	Areas of slower, deeper water, concave bottom profile, deposition of fines, water gradient near 0%, good pool depth (>0.50 m), abundant cover, high LWD and overhead cover
	2	Areas of slower, deeper water, concave bottom profile, deposition of fines, water gradient near 0%, moderate pool depth (0.3 to 0.5 m), moderate cover, moderate LWD and overhead cover
	3	Areas of slower, deeper water, concave bottom profile, deposition of fines, water gradient near 0%, low pool depth (<0.3 m), low cover, low LWD and overhead cover
Other	1	Off-channel habitat, >2 m deep, abundant cover, high LWD and overhead cover abundance, substrates widely variable
	2	Beaver dams, open water wetland complexes, shallow <2 m, low gradient, fine substrates, variable cover
	3	Shallow, low gradient (near zero) habitat, wetland-like with undefined channel, or multiple-thread channels, fine sediment dominated substrates, low cover, LWD lacking or absent, overhead canopy lacking.
Tributary	1	Second or third-order headwater streams or tributaries with riffle-pool morphology, variable cover, juvenile rearing habitat only
	2	First-order headwater streams or tributaries with riffle-pool morphology, variable cover, juvenile rearing habitat only
	3	First- or second-order headwater streams or tributaries, or small third-order tributaries (lower valley) with large channel morphology, low gradient wetland habitats, intermittent channel features, fine substrates, juvenile rearing habitat only
	4	Ephemeral, headwater or tributary streams, no visible channel and/or non-classified drainage, non-fish-bearing
Lake	1	Shallow littoral habitat, <3 m deep, greatest light penetration, high productivity (benthic and aquatic macrophyte communities), juvenile rearing and adult foraging habitat
	2	Deep littoral habitat, 3 m to 6 m deep, low light penetration, moderate to low productivity, juvenile rearing and adult foraging habitat
	3	Pelagic habitat, deep water habitat >6 m deep, low productivity, juvenile rearing and adult foraging habitat

Habitat Suitability Index Models

An HSI model predicts the capacity of a given habitat to support a selected species/species life-stage. 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. HSI models are composite scores of the suitability of multiple habitat variables, and for each habitat variable suitability ranges from 0 (unsuitable) to 1 (fully supporting of the species). A five-point suitability rating system was used with shifts in habitat suitability measured in increments of 0.25 (Table 2). As part of applying HEP, AMEC (2014) established HSI values for rainbow trout for each identified habitat class, using guidance from Raleigh et al. (1984) (Table 3).

We applied the same HSI models to evaluate the value of habitats lost due to creation of the TIA and the value of habitats that will be gained or constructed as part of the proposed compensation measures in order to maintain consistency of analyses.

Habitat Mapping

During 2017, Palmer field crews conducted physical habitat mapping on stream reaches selected for potential compensation measures in order to describe pre-restoration habitat conditions and quantify the number of existing habitat units. Current conditions in ranchland stream corridors, however, are severely degraded/altered, with trampled/unstable banks, excessive sedimentation, lack of coarse substrates, and lack of riparian vegetation (PECG 2016). Quantification of the habitat value for existing stream habitats, therefore, required an additional index to reflect the degraded conditions.

Table 2. Habitat Suitability Ratings and Definitions (AMEC 2014).

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

Table 3. Habitat suitability ratings for different life stages of Rainbow Trout (AMEC 2014); Glide "4" and Other "3" habitat classes with defined suitabilities added by PECG/TGAEC 2017.

		RAINBOW TROUT LIFESTAGE				
Habitat Type	**Class**	**Spawning / Egg Incubation**	**Fry Summer Rearing**	**Juvenile Summer Rearing**	**Adult Summer Foraging**	**Overwintering**
Cascade	3	0.00	0.00	0.00	0.00	0.00
Riffle	1	0.50	0.50	0.00	0.00	0.00
	2	0.25	0.75	0.25	0.00	0.25
	3	0.00	0.50	0.75	0.00	0.25
Glide	1	1.00	0.25	0.00	0.00	0.00
	2	0.50	0.50	0.25	0.00	0.25
	3	0.00	0.25	0.50	0.00	0.25
	4	0.00	0.25	0.00	0.00	0.00
Pool	1	0.00	0.25	1.00	0.00	0.75
	2	0.00	0.25	0.75	0.00	0.25
	3	0.00	0.25	0.25	0.00	0.00
Other	O1	0.00	0.25	1.00	0.00	1.00
	O2	0.00	0.25	0.25	0.00	0.25
	O3	0.00	0.00	0.00	0.00	0.00
Tributary Streams	T1	0.00	0.00	0.50	0.00	0.00
	T2	0.00	0.00	0.25	0.00	0.00
	T3	0.00	0.00	0.25	0.00	0.00
	T4	0.00	0.00	0.00	0.00	0.00
Lake	L1	0.00	0.00	0.75	0.50	0.75
	L2	0.00	0.00	0.75	0.75	1.00
	L3	0.00	0.00	0.50	0.75	1.00

Palmer/TGAEC developed an Index of Alteration (IA) that describes the relative level of habitat alteration in stream habitats utilized by rainbow trout. The IA assessment considers five habitat parameters: 1) riparian vegetation; 2) riparian stream banks; 3) stream channel stability; 4) stream substrate; and 5) cover.

The five habitat parameters are scored for each identified stream habitat unit. The IA is the mean score and is multiplied by each unaltered HSI value for each affected life stage of rainbow trout to determine the degraded habitat unit value.

Existing Conditions Surveys

Field crews conducted HEP habitat mapping on stream reaches identified for compensation 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.

In 2017, field crews could not access Mathews Creek to conduct a full HEP survey of existing conditions, but were able to conduct a shorter survey for the purposes of ground-truthing for desk-top habitat mapping of existing conditions.

Desk-top HEP habitat mapping of existing conditions in Mathews Creek utilized the open source program QGIS (version 2.18.12), and high resolution aerial photography to delineate and measure existing stream habitats into types. Most habitat parameters such as habitat type and class, substrates, cover, and canopy closure, etc. were estimated from zooming in on the aerial photography, while parameters such as average wetted width were enumerated by measuring distances in QGIS. Depths were estimated from the water shading in the aerial photos (darker shading assumed to be deeper water).

As previously mentioned, field crews visited Mathews Creek in 2017 for the purpose of ground-truthing the desktop habitat mapping results. Two ground-truthing reaches were assessed for existing habitat conditions and subsequently, the desktop generated results were revisited, and parameter values adjusted for all units based on the ground-truthing results.

In the summer and autumn of 2017, a drone survey was completed of the Mathews Creek restoration area. In addition, a ground-based HEP survey was completed on two portions of Mathews Creek. Due to flooding and accessibility issues, the entire portion of the creek was not surveyed. In autumn 2020, a drone survey was completed over the entire restoration area and an orthomosaic image and a digital elevation model were generated. No ground-based surveys were completed in 2020. Portions of the restoration area were visually assessed on foot to determine if disturbance indicators had changed since the 2017 assessment.

Datasets from 2017 and 2020 were qualitatively and quantitatively compared. First, the two sets of aerial drone imagery were overlaid and a visual assessment of changes to channel morphology was conducted by an experienced fluvial geomorphologist. Differences in channel pattern, riparian vegetation, anthropogenic or natural disturbance, and canopy closure were noted, and their locations were recorded.

Next, a desktop HEP analysis was conducted. This involved overlaying the reach breaks identified in 2017 on to the 2020 orthomosaic imagery. Parameters that could be measured using the imagery (wetted width, bankfull channel width, channel thread, instream cover for fish, riparian vegetation presence and category, canopy closure over the stream channel, off-stream habitat presence, and disturbance indicators) were recorded. Bankfull width was measured using cross sections of the digital elevation model to identify bank edges. Five measurements of bankfull and wetted width were taken and were averaged for each reach. These digitally measured values were compared with ground-verified measurements. Relative percent differences (RPD) were calculated for each reach.

Overall, the qualitative and quantitative comparisons between the 2017 and 2020 datasets indicate that the assessed reaches of Mathews Creek have not significantly changed. No evidence of significant channel morphology change was found. Differences in beaver dam location and off-channel habitat extent were identified when comparing the 2017 and 2020 datasets. Off-channel habitat identified in the 2020 imagery was likely present during the 2017 assessment, but not identified due to lower image resolution collected in 2017. Quantitative assessment of channel conditions showed some variation in channel measurements, but these are within the typical level of variability expected with in-channel measurements. Mean RPDs were 18.4 % for bankfull width and 25.7 % for wetted width and ranged from 0-46%. Riparian vegetation, instream cover, and disturbance indicators identified in the 2017 HEP ground survey generally matched the 2020 desktop analysis

Restored Conditions Survey (future conditions) - Ranchland Streams

A fisheries biologist predicted future restored conditions for the Mathews Creek reach with proposed compensation measures. We used a desk-top approach to repeat the HEP habitat mapping surveys while visualizing habitat conditions after implementation of restoration measures. This desk-top HEP method relied on the acquisition of several data sources for each restoration reach:

1) The same HEP data sheet used by field crews;
2) Spreadsheet files containing the existing conditions HEP survey data entered from the field data sheets;
3) A geo-referenced set of aerial photos (“map-book”) showing the locations of each existing conditions habitat unit, the locations for each specific restoration prescription (numbered “segments”), and the locations within habitat units for various instream habitat enhancements (e.g.: placements of large woody debris (LWD), boulders, and gravel); and
4) A set of engineering-level design plans for all restoration segments. Proposed restoration for each reach typically included multiple actions drawn from a suite of restoration prescriptions. Prescriptions included: reconstruction of the stream channel bed, and/or bank regrading; restoration of natural channel width; LWD placement for channel narrowing; LWD and rootwad placement for channel deflection; woody debris placement for habitat enhancement; installation of live willow stakes on stream banks; installation of brush layers on stream banks; riparian tree plantings; and, boulder-cluster and gravel placements in channel.

The restored conditions desktop survey proceeded upstream through the previously delineated habitat, considering each habitat unit in sequence. For each habitat unit, we assessed the existing conditions data, assessed proposed restoration treatments on design sheets, (if any - some segments were designated for no restoration), and cross-referenced the locations of specific on the ground measures using the map-book and restoration design sheets. Professional judgement was used to predict changes to the existing habitat (e. g.: depth, width, spawning quality, canopy closure, etc.) that would likely occur at an arbitrary future time (~10 years) post-restoration. Estimates for restored habitat parameters were then entered onto the HEP field data sheet unit by unit.

In some cases, implementation of restoration appeared likely to create multiple new habitat units where there was a single existing unit identified. In order to locate the newly formed units (post-restoration), we used Google Earth Pro and the UTM coordinates from the existing habitat surveys to locate the stream reach of interest. Google Earth place-marks were used to demarcate the new habitat unit boundaries, and the Google Earth path-measuring tool was used to discern the new unit lengths.

Restored Conditions Survey (future conditions) - Newly Constructed Habitats

The HEP was also applied to proposed compensation measures that will create new off-channel ponds in the Mathews Creek watershed. None of these proposed features have been built to date; thus, only the future restored conditions analyses are applicable. We used the same HEP field data sheet as was developed for the Mathews Creek analyses to assess post-construction habitat conditions of each proposed off-channel pond.

Habitat Assessment of Altered Habitat

Literature Review

A prerequisite to assessing the degraded Mathews Creek stream habitats for the purposes of planning restoration is understanding which habitat variables are most important to each life stage of rainbow trout. Livestock grazing was a common land management activity in the Mathews Creek valley and was practiced in the compensation area until approximately 2012. Over time grazing “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; Benke and Zarn 1976; Platts 1983). Evidence of grazing was seen in the 2017 field surveys.

Resident rainbow trout habitat in streams flowing through grazed areas can become degraded, “with lack of instream cover, lack of overhead canopy and stream aggradation being common problems” (Flosi et al. 2010). The lack of instream cover components negatively affects both juveniles and adults, as “juvenile steelhead and chinook abundance in streams has been directly correlated with the abundance and quality of cover” (Bjornn and Resier 1991).

In addition to cover complexity, Raleigh et al. (1984) described other key habitat parameters for adult and juvenile rainbow trout being pool habitat availability, pool class (because pools differ in the amount and quality of escape cover, winter cover, and resting areas that they provide), and average depth (although depth is not as critical habitat parameter for juveniles).

Following a literature review for habitat requirements of stream-dwelling salmonids, five habitat assessment categories were identified based on their significance to the evaluation species rainbow trout: instream cover, stream substrate, riparian vegetation, riparian banks, and stream channel stability.

Variables used to determine index of alteration

Fourteen distinct variables were developed for scoring within five essential habitat parameters in order for the HEP to be applied to both existing and future restored conditions in each stream reach of interest (Table 4).

- Riparian Vegetation consisted of two scoring variables: Canopy Closure and Dominant Vegetation Type. The presence (or lack) of a well formed vegetative canopy in ranchland streams is an overall indicator of riparian zone health and is a feature that impacts water temperatures (shade), terrestrial food inputs, and cover from avian and terrestrial predators. Dominant vegetation type can further characterize the relative degree riparian zone impairment from grazing practices.
- Riparian Bank assessments considered three variables: Percent Vegetated Banks, Sediment Transport, and Bank Composition. Relative stream bank stability was assessed from the amount of vegetative cover present, the type of substrate forming the stream banks, and whether there is active sediment transport occurring to the stream channel.
- Channel Stability assessed three variables: Number of Active Channels, Bank-full Width/depth Ratio, and Anthropogenic Disturbance. The relative degree of channel alteration/channel stability was assessed by measuring width/depth ratios at bank-full stage, observing whether there was a braided (multiple thread) channel versus a single thread channel, and the presence/absence of land management or other human activities that could destabilize the stream channel such as recent grazing activity, the presence of road crossings, instream livestock watering areas, inorganic debris in the stream, etc.
- Stream Substrate scored three variables: Percent of Fine Sediment, Dominant Particle Size, and Spawning Habitat Quality. The relative deposition of fine sediments and dominant particle size are key indicators of watershed health and spawning habitat quality, especially in the low-gradient, heavily grazed ranchland streams. Chronic fine sediment sources such as eroding stream banks caused by livestock trampling can negatively impact multiple different life stages of rainbow trout.

- Instream Cover consisted of three variables: Percent unit covered, Shelter Rating, and Off-Channel Habitat Access. The relative amounts and types of structural cover present were identified by Raleigh et al. (1984 & 1986) as one of the more critical habitat features for multiple life stages of both rainbow trout. Percent unit covered is a parameter that assumes an overhead view to estimate the proportion of the overall habitat unit with structural cover. "A cover area of ~ 25% of the total stream area provides adequate cover for adult trout; a cover area of ~ 15% is adequate for juveniles (Raleigh 1984). Shelter rating is a qualitative index to describe the relative complexity of cover types present, ranging from 0 (none), 1 (low), 2 (medium), to 3 (high).

Table 4. Habitat variables and HSI scores used in the Index of Alteration.

VARIABLES	SCORING FROM RAW HABITAT DATA	POINTS	TOTAL
	1. Riparian Vegetation		8 points possible
V1	Canopy Closure: (0-20% = 0 pt.; 20-40%= 1 pt.; 40-60% = 2 pt.; 60-80% = 3 pt.; 80-100% = 4 pt.)	0-4	
V2	Dominant Veg Type (determine for each bank): none/grasses=0 pt.; shrubs/brush = 1 pt.; hardwoods/conifer= 2 pt.	0-2 (x 2) = 4	
	2. Riparian Banks		18 points possible
V3	Percent banks vegetated (L+R banks): (0-20% = 0 points; 20-40%= 1 point; 40-60% = 2 pt.; 60-80% = 3 pt.; 80-100% = 4 pt.)	0-4 (x 2)= 8	
V4	Sediment inputs (for each L + R bank): yes = 0 pt.; no = 4 points	0-4 (x 2)= 8	
V5	Bank Composition dominant particle size (L & R banks): (artificial or fines = 0 pt.; gravel/cobble, boulder, bedrock/hardpan = 1 pt.)	0-1 (x 2) = 2	
	3. Channel stability		8 points possible
V6	Single thread (= 1 pt.) vs multiple thread (= 0 pt.)	0-1	
V7	Bank-full width/depth ratio: (>60 - Very High, = 0 pt.; 40-60 - High, = 0 pt.; 12-40 - Medium, = 1 pt.; < 12 - Low, = 3 pt.).	0-3	
V8	Disturbance types- Yes = 0, No = 4	0-4	
	4. Substrate		8 points possible

V9	Estimate percent fines: < 5 % = 4 pt.; 5-25%= 3 pt.; 25-50% = 2 pt.; 50-75% = 1 pt.; > 75% = 0 pt.	0-4	
V10	Spawning quality (none = 0 pt.; poor = 1 pt.; good = 2 pt.)	0-2	
V11	Dominant particle size (Fines/Sand= 0; Gravel= 1; Cobble/Boulder/Bedrock = 2)	0-2	
	5. Cover		10 points possible
V12	Shelter Rating (0= 0 pt.; 1 = 1 pt.; 2=3 pt.; 3 = 3 pt.)	0-3	
V13	Percent Unit covered: (0%=0 pt., 0-5%=1 pt., 5-10%=2 pt., 10-15%=3 pt., 15-20%=4 pt., >20%=5 pt.)	0-5	
V14	Off channel habitat- (Yes, perennial access = 2 pt.; yes seasonal access = 1 pt.; no= 0 pt.)	0-2	

The presence of, and access to, off-channel rearing habitats is included in the cover assessment for Mathews Creek due to the frequent presence of beaver activity. Beaver dams can create opportunities for high quality rearing and refugia habitat in wetland like areas adjacent to and overlapping the stream channel (Bryant 1984).

Habitat Value

The habitat value of each mesohabitat unit was calculated by multiplying the HSI of the species and life-stages of interest times the length of the unit times the bankfull width times the Index of Alteration (Equation 1).

Equation 1

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

Where:

HU = Habitat unit

HSI = Habitat Suitability Index

L = Unit Length

W = Unit Bankfull Width

IA = Index of Alteration

u_i = Habitat mapping mesohabitat unit i

sp_j= species j

ls_k= life-stage k

The Index of Alteration is calculated as the sum of the habitat parameters divided by 5 (Equation 2).

Equation 2

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

Where:

RV = Riparian Vegetation score

RB = Riparian Bank score

CC = Channel Condition score

S = Substrate score

C = Cover score

Each of the habitat parameter values are calculated using the scoring from the habitat variables in Table 4 (Equations 3-7).

Riparian Vegetation

Equation 3

$$RA_{u_i} = (V1_{u_i} + V2lb_{u_i} + V2rb_{u_i})/8$$

Where:

lb = left bank

rb = right bank

Riparian Bank

Equation 4

$$RB_{u_i} = (V3lb_{u_i} + V3rb_{u_i} + V4lb_{u_i} + V4rb_{u_i} + V5lb_{u_i} + V5rb_{u_i})/18$$

Channel Condition

Equation 5

$$CC_{u_i} = (V6_{u_i} + V7_{u_i} + V8_{u_i})/8$$

Substrate

Equation 6

$$S_{u_i} = (V9_{u_i} + V10_{u_i} + V11_{u_i})/8$$

Cover

Equation 7

$$C_{u_i} = (V12_{u_i} + V13_{u_i} + V14_{u_i})/10$$

The total habitat value of each reach was calculated by summing the combined HU of each mesohabitat (Equation 8).

Equation 8

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

Where:

n = the total number of mesohabitat units in the reach

For habitats that are destroyed or newly constructed the HU_{reach} is the habitat loss or gain. Where the restoration is an improvement of existing degraded habitat, the gains are calculated by difference between restored and existing conditions (Equation 9).

Equation 9

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

Literature Cited

AMEC Environment and Infrastructure (AMEC). 2014. Blackwater Gold Project: Fisheries Mitigation and Offsetting Plan (FMOP). Prepared for New Gold Inc., Vancouver, British Columbia. 567 p.

Armour, C. L. 1977. Effects of deteriorated range streams on trout. U. S. Bureau of Land Management, Idaho State Office, Boise, Idaho.

Behnke, R. J. and M. Zarn. 1976. Biology and management of threatened and endangered western trouts. U. S. Forest Service General Technical Report RM-28.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. American Fisheries Society Special Publication 19: 83-138.

Bryant, M. D. 1984. The role of beaver dams as coho salmon habitat in southeast Alaska streams, p. 183-192 *In* J. M. Walton, and D. B. Houston [ed.] Proceedings of the Olympic Wild Fish Conference, March 23-25, 1983, Port Angeles, WA.

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 2010. California salmonid stream habitat restoration manual. 4th Edition. Volume 1, Parts I-VIII, Appendices A-S. California Department of Fish and Game, Wildlife and Fisheries Division, Sacramento, California. 525p.

Hillman, T. W., Griffith, J. S., & Platts, W. S. 1987. Summer and winter habitat selection by juvenile Chinook salmon in a highly sedimented Idaho stream. Transactions of the American Fisheries Society, *116*(2), 185-195.

Murray, C. B., & Rosenau, M. L. 1989. Rearing of juvenile chinook salmon in nonnatal tributaries of the lower Fraser River, British Columbia. Transactions of the American Fisheries Society, *118*(3), 284-289.

Platts, W. S. 1983. Vegetation requirements for fisheries habitats. Pages 184-188 *in* S. B. Monsen and N. Shaw, compilers. Managing intermountain rangelands- improvement of range and wildlife habitats. USDA Forest Service, General Technical Report INT, 157.

Platts, W. S. 1991. Livestock Grazing. American Fisheries Society Special Publication 19: 389-423.

Raleigh, R. F., T. Hickman, R. C. Solomon, and P. C. Nelson. 1984. Habitat suitability information: Rainbow trout. U.S. Fish Wildl. Serv. FWS/OBS-82/10.60. 64 pp.

Raleigh, R.F., W.J. Miller, and P.C. Nelson. 1986. Habitat suitability index models and instream flow suitability curves: Chinook salmon. United States Fish and Wildlife Service, Biological Report 82(10.122). 64pp.

Roper, B. B., Scarnecchia, D. L., & La Marr, T. J. 1994. Summer distribution of and habitat use by Chinook salmon and steelhead within a major basin of the South Umpqua River, Oregon. Transactions of the American Fisheries Society, *123*(3), 298-308.

Palmer Environmental Consulting Group (PECG). 2016. Field Assessment of Fisheries Offsetting Sites-Findings and Recommendations. Memorandum prepared for New Gold, Inc. Prepared by I. Mencke, PECG, Vancouver, BC. 90 p.

U.S. Fish and Wildlife Service (USFWS). 1980. Habitat Evaluation Procedures (HEP). U.S. Department of Interior, Fish and Wildlife Service. Division of Ecological Services. ESM 102.

U.S. Fish and Wildlife Service (USFWS). 1981. Standards for the development of habitat suitability index models for use in the Habitat Evaluation Procedures. U.S. Department of Interior, Fish and Wildlife Service, Division of Ecological Services. ESM 103.

Appendix B

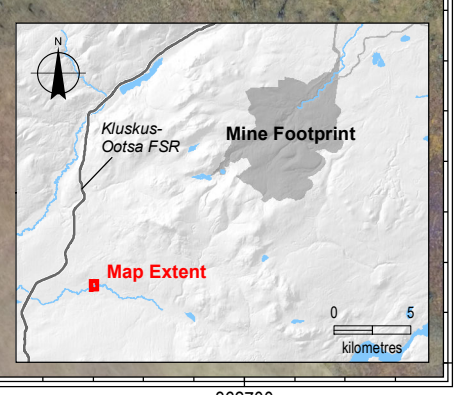
Overview Aerial Images for Offsetting Sites

362400 362500 362600 362700

5887200 5887100 5887000 5886900 5886800 5886700

Mathews Creek
Pond 1

Mathews Creek



Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project (2020)\Mapping\Figures\5_ArcGIS\ECCC Appendix\AppendixA1_MathewsOWP1.mxd

CLIENT: BW Gold Ltd.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Jan 12, 2021

BW GOLD LTD
a subsidiary company of Artemis Gold Inc
Palmer

0 10 20 30 40
metres

Scale 1:1500
UTM Zone 10N
NAD 1983 Datum

N

Legend
- Watercourse Centreline
- Pond Outline (Approximate)
- Flow Direction (White Arrow)

Data Sources:
1) Watercourse - Palmer
2) Imagery (2017) - DWB Consulting Services Ltd.

DRAFT

Mathews Creek Off-channel Pond 1

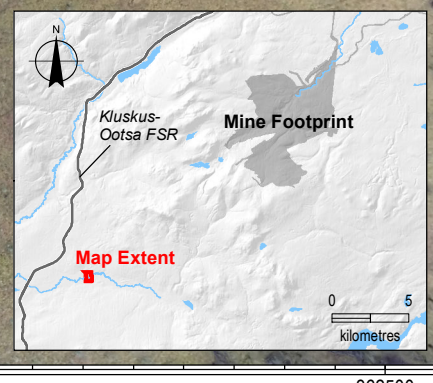
Appendix B-1

362200 362300 362400 362500

5887000 5886900 5886800 5886700 5886600 5886500

Mathews Creek
Pond 2

Mathews Creek



Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project (2020)\Mapping\Figures\5_ArcGIS\ECCC Appendix\AppendixA2_MathewsOWP2.mxd

CLIENT: BW Gold Ltd.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Jan 12, 2021

BW GOLD LTD
a subsidiary company of Artemis Gold Inc
Palmer

0 10 20 30 40
metres

Scale 1:1500
UTM Zone 10N
NAD 1983 Datum

N

Legend
- Watercourse Centreline
- Pond Outline (Approximate)
- Flow Direction (White Arrow)

Data Sources:
1) Watercourse - Palmer
2) Imagery (2017) - DWB Consulting Services Ltd.

DRAFT

Mathews Creek Off-channel Pond 2

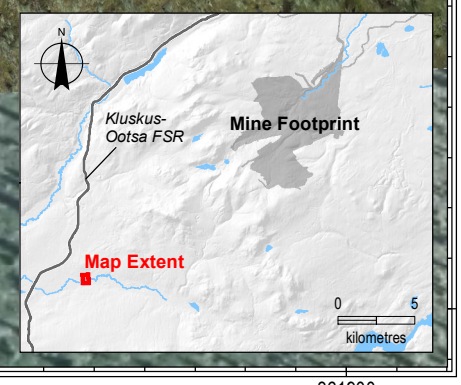
Appendix B-2

361600 361700 361800 361900

5887000 5886900 5886800 5886700 5886600 5886500

Mathews Creek
Pond 3

Mathews Creek



361600 361700 361800 361900

Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project (2020)\Mapping\Figures\5_ArcGIS\ECCC Appendix\AppendixA3_MathewsOWP3.mxd

CLIENT: BW Gold Ltd.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Jan 12, 2021

BW GOLD LTD
a subsidiary company of Artemis Gold Inc
Palmer

0 10 20 30 40
metres

Scale 1:1500
UTM Zone 10N
NAD 1983 Datum

N

Legend
- Watercourse Centreline
- Pond Outline (Approximate)
- Flow Direction (White Arrow)

Data Sources:
1) Watercourse - Palmer
2) Imagery (2017) - DWB Consulting Services Ltd.

DRAFT

Mathews Creek Off-channel Pond 3

Appendix B-3

361500 361750 362000 362250 362500 362750 363000

5887250

5887000

5886750

5886500

Mathews Creek Ranch

Upstream extent of work

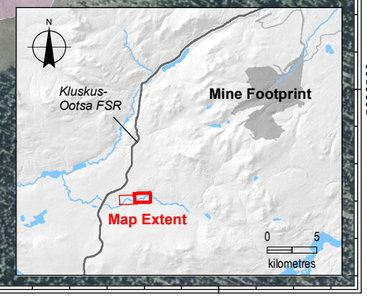
Mathews Creek Pond 1

Mathews Creek Pond 2

Mathews Creek Pond 3

Mathews Creek

Service Layer Credits:



Document Path: G:\Shared drives\Projects 2020\2006501 - Artemis Gold Inc\2006501 - Blackwater Project (2020)\Mapping\Figures\5. ArcGIS\ECCC Appendix\Appendix\A4_MathewsCreek.mxd

CLIENT: BW Gold Ltd.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Jan 12, 2021

BW GOLD LTD
a subsidiary company of Artemis Gold Inc
Palmer

0 25 50 75 100
metres

Scale 1:4000
UTM Zone 10N
NAD 1983 Datum

N

Legend

- Watercourse Centreline
- Pond Outline (Approximate)
- Flow Direction (White Arrow)

Data Sources:
1) Watercourse - Palmer
2) Imagery (2017) - DWB Consulting Services Ltd.

DRAFT

Mathews Creek Offsetting Measures (East)

Appendix B-4

360000 360250 360500 360750 361000 361250 361500

5887000

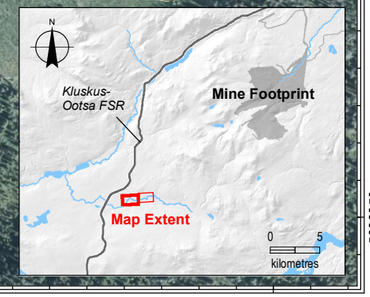
5886750

5886500

5886250

Mathews Creek

Downstream extent of work



Service Layer Credits:

Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project (2020)\Mapping\Figures\5 ArcGIS\ECCC Appendix\Appendix\Appendix\A4_MathewsCreek.mxd

CLIENT: BW Gold Ltd.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Jan 12, 2021

BW GOLD LTD
a subsidiary company of Artemis Gold Inc
Palmer

0 25 50 75 100
metres

Scale 1:4000
UTM Zone 10N
NAD 1983 Datum

N

Legend
- Watercourse Centreline
- Pond Outline (Approximate)
- Flow Direction (White Arrow)

Data Sources:
1) Watercourse - Palmer
2) Imagery (2017) - DWB Consulting Services Ltd.

DRAFT

Mathews Creek Offsetting Measures (West)

Appendix B-5

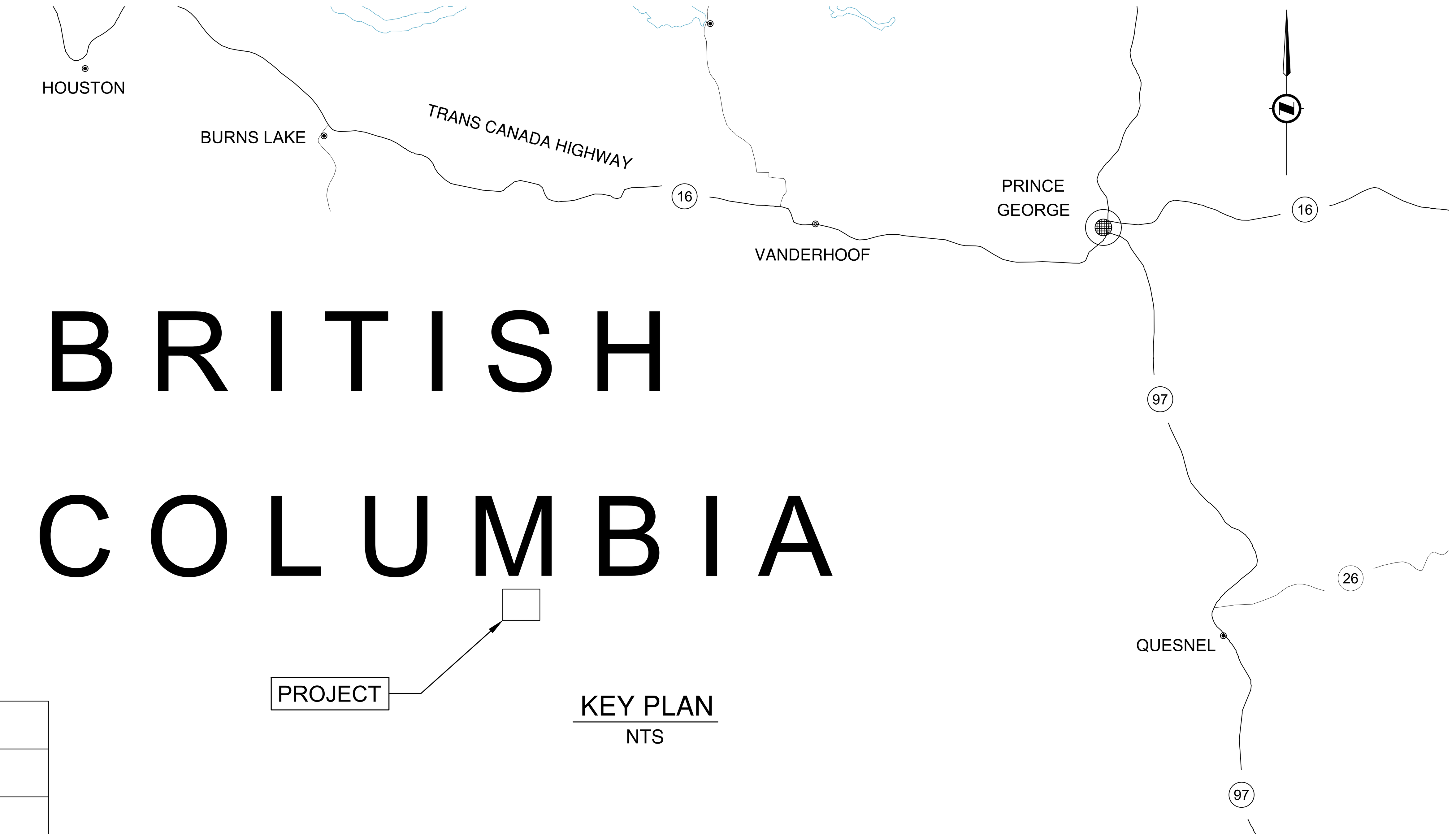
Appendix C

Habitat Offsetting Detailed Design Drawings

ARTEMIS GOLD INC.

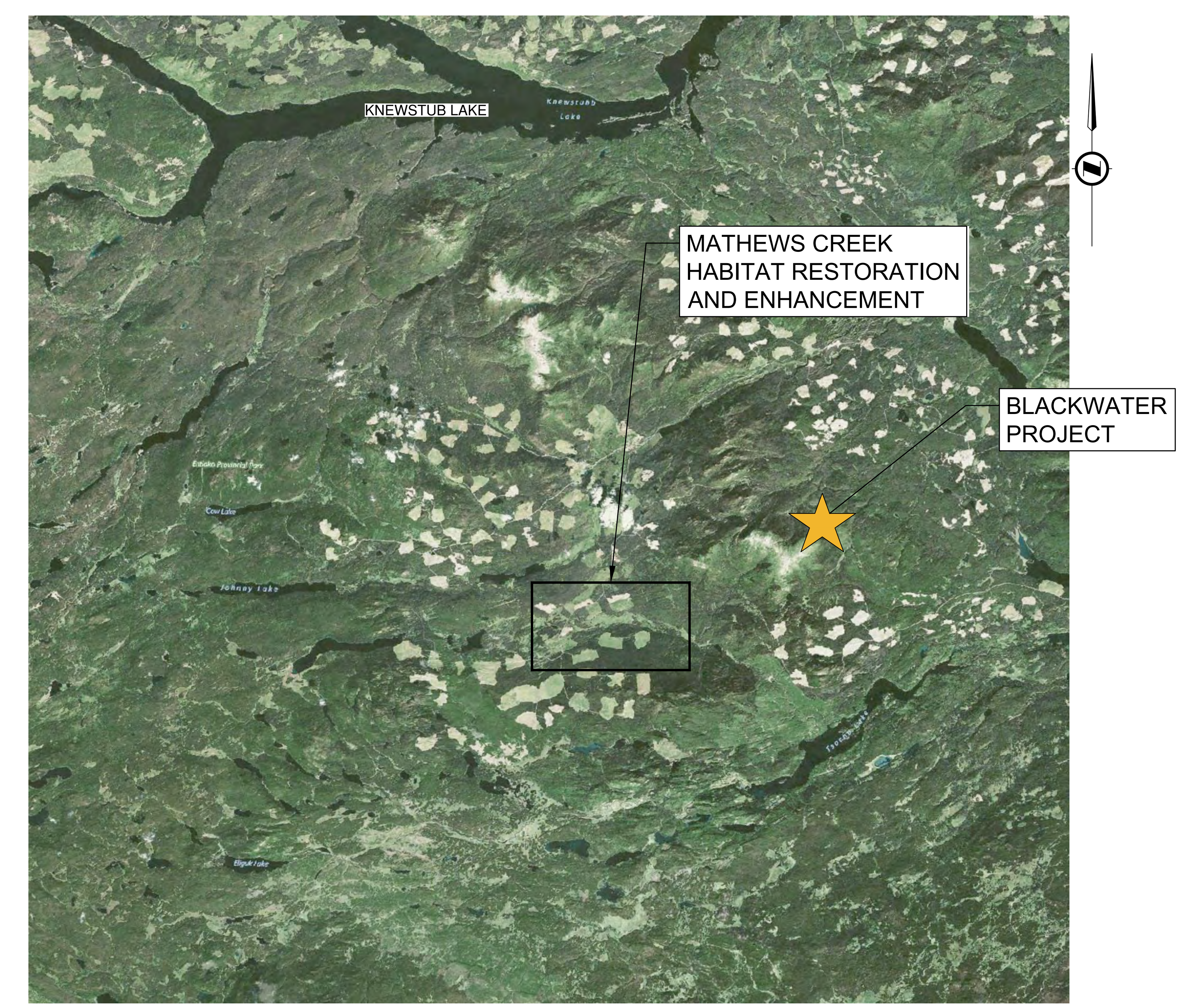
BLACKWATER PROJECT -
SCHEDULE 2 FISHERIES OFFSETTING PLAN
MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT

ISSUED FOR REVIEW



KEY PLAN
NTS

DRAWING INDEX	
SHEET No.	SHEET TITLE
1824-3-1-001	TITLE PAGE
1824-3-1-002	GENERAL NOTES
1824-3-1-003	OVERALL PLAN SHEET 1 OF 4
1824-3-1-004	OVERALL PLAN SHEET 2 OF 4
1824-3-1-005	OVERALL PLAN SHEET 3 OF 4
1824-3-1-006	OVERALL PLAN SHEET 4 OF 4
1824-3-1-007	STANDARD DETAILS SHEET 1 OF 1
1824-3-1-008	OVERWINTERING POND #1 - SHEET 1 OF 3
1824-3-1-009	OVERWINTERING POND #2 - SHEET 2 OF 3
1824-3-1-010	OVERWINTERING POND #3 - SHEET 3 OF 3
1824-3-1-011	OVERWINTERING POND TYPICAL DETAILS
1824-3-1-012	ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR CHANNEL WORKS
1824-3-1-013	SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR CHANNEL WORKS
1824-3-1-014	WORK AREA ISOLATION MEASURES & PLANTING NOTES FOR CHANNEL WORKS
1824-3-1-015	ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR OVERWINTERING PONDS
1824-3-1-016	SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR OVERWINTERING PONDS
1824-3-1-017	WORK AREA ISOLATION MEASURES & PLANTING NOTES FOR OVERWINTERING PONDS



LOCATION PLAN
NTS

PREPARED FOR:

ARTEMIS GOLD INC

DESIGNED BY:

Palmer™
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
PH.: 250-562-2252 FAX: 866-235-6943

NOT FOR CONSTRUCTION

LAYDOWNS & ACCESS ROADS

- ALL LAYDOWNS AND ACCESS ROADS ARE TEMPORARY IN NATURE AND ARE ONLY REQUIRED FOR THE DURATION OF CHANNEL/POND WORKS. GRASS AND PATHS DISTURBED DURING CONSTRUCTION ARE TO BE RESTORED TO THEIR ORIGINAL CONDITION PRE-CONSTRUCTION TO THE BEST OF THE CHOSEN CONTRACTOR'S ABILITIES AFTER ALL WORKS ARE COMPLETED.
- FINAL LOCATION, SIZE, AND SPECIFICATIONS OF THE PROPOSED LAYDOWN AREA AND ACCESS ROADS ARE TO BE REFINED BY THE SELECTED CONTRACTOR AS REQUIRED. DEPENDING ON CONDITIONS AT THE TIME OF CONSTRUCTION ACCESS MAY BE A VARIETY OF RIG MATS, FROZEN GROUND, OR BUILT UP GRAVEL ACCESS ROADS WITH GEOGRID.
- AVOID/MINIMIZE DISTURBANCE TO EXISTING HERITAGE FEATURES
- AVOID DISTURBANCE TO ADJACENT PRIVATE PROPERTY

GENERAL STREAM NOTES

- BASED ON THE ONLINE TOOL (https://OWT.BCWATERTOOL.CA) THE WINTERTIME LOW FLOW IS ESTIMATED TO BE 0.1 m3/sec WITH A MEAN ANNUAL DISCHARGE OF ~0.5 m3/sec
- WATER SURFACE ELEVATIONS IN THE CHANNEL/PONDS WERE ESTIMATED BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND UNMANNED AERIAL VEHICLE (I.E. DRONE) SURVEY, CONDUCTED BY DWB CONSULTING SERVICES LTD
- NOTE THAT THERE IS EXTENSIVE BEAVER ACTIVITY, WITH NUMEROUS CHANNEL-SPANNING DAMS, ALONG MATHEWS CREEK. AS SUCH, WATER DEPTHS MAY BE LOCALLY HIGHER THAN EXPECTED BASED SOLELY ON LOCAL FLOW CONDITIONS.
- NOTE THAT THE GROUNDWATER TABLE IS RELATIVELY HIGH ACROSS THE FLAT VALLEY BOTTOM OF MATHEWS CREEK, CONTROLLED IN THE ALLUVIUM COMPRISING THE FLOODPLAIN BY THE WATER SURFACE ELEVATION ALONG THE CHANNEL (WHICH MAY BE LOCALLY AFFECTED BY BEAVER ACTIVITY).

FLOODPLAIN SOILS

- NO DRILLING OR TEST PITTING HAS BEEN COMPLETED TO INVESTIGATE SOILS WITHIN THE VALLEY BOTTOM FLOODPLAIN SEDIMENTS WHERE CHANNEL/POND WORKS ARE PROPOSED.
- OPPORTUNISTIC EXAMINATION OF FLOODPLAIN SOILS IN ERODED CREEK BANKS AND HAND AUGER HOLES (<1.2m DEEP) INDICATES ALLUVIAL SEDIMENTS TYPICAL OF RECURRENT FLOODPLAIN DEPOSITION: FINE SAND AND SILT WITH LOCALIZED GRAVELS AND ORGANICS. SOILS TEND TO BECOME WETTER DOWNSTREAM OF THE FORMER HOMESTEAD, AS FLOODPLAIN HEIGHT ABOVE THE CHANNEL DROPS AND BEAVER ACTIVITY INCREASES.

SURVEY NOTES

DATUM: NAD 83 (CSRS) 2002.0

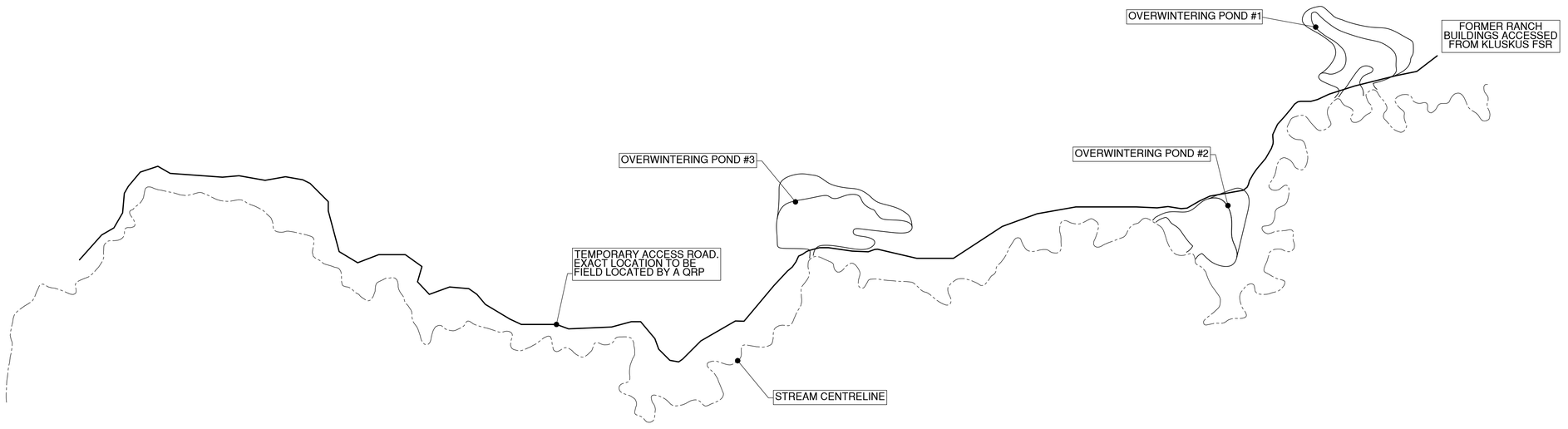
UTM ZONE: 10

THE SURVEY DATA USED TO CREATE THE TIN SURFACE FOR THIS DESIGN WAS PROVIDED TO ONSITE ENGINEERING LTD. BY PALMER ENVIRONMENTAL CONSULTING GROUP. ALL SURVEY DATA WAS COLLECTED BY DWB CONSULTING SERVICES LTD. SEPTEMBER 1-5, 2016, MAY 1-5, 2017, AND JUNE 24-28, 2017.

DESIGN TEAM

ENGINEERING - ONSITE ENGINEERING LTD. MICHAEL FOSTER, P.ENG.

GEOMORPHOLOGY/ENVIRONMENTAL/SEDIMENT AND EROSION CONTROL - PALMER
ROBIN MCKILLOP, MSc, P.GEO. AND DAN MCPARLAND, MSc, P.GEO.



OVERVIEW

BC One Call
Click or Call Before You Dig
1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE:

DESIGNED: DM & RM
DRAWN: JL
CHECKED: MF
SURVEYED: -
DATE: JAN 2020

Palmer™
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

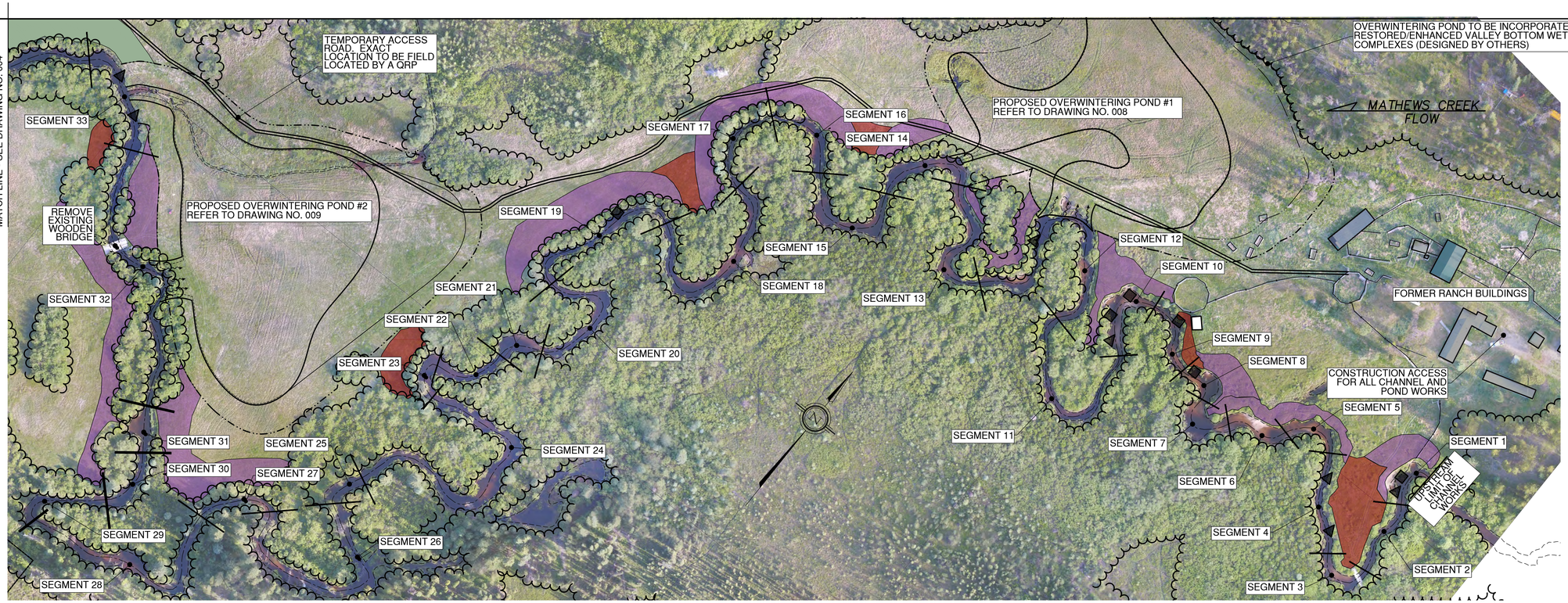
ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
Phone: 250-562-2252
Fax: 1-866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN
MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT
GENERAL NOTES

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 002
SHEET: 2 OF 17 REV C

U:\Projects\1824\39\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3- Mathews Creek Title Page and Notes.dwg
DATE: 25/11/2020 5:12 PM BY: Jesse Lutz



NOT FOR CONSTRUCTION

ABBREVIATIONS (TREATMENT DETAILS SHOWN ON SHEETS 007)

ISSUES
- CT - Cattle Trampled
- UV - Unvegetated
- VC - Vehicle Crossing
- FO - Flow Obstruction

CHANNEL MORPHOLOGY (Viewing Downstream):
- RBK - Right Bank
- LBK - Left Bank
- BED - Channel Bed

TREATMENTS
REGRADING:
- BankR - Bank Regrading: Detail 1A
- NW - Restoration of Natural Channel Width: Detail 1B

WOODY DEBRIS:
- WDnarrow - Channel Narrowing: Detail 2A
- WDhabitat Enhancement:
  - » ▲ - ROOTWAD: Detail 2D
  - » ■ - LOG: Detail 2C

BANK TREATMENTS:
- BL - Brush Layers: Detail 3B

BED MATERIALS:
- BC - Boulder Cluster: Detail 4A
  - »

LEGEND

- APPROXIMATE WATERLINE
- APPROXIMATE CHANNEL CENTRE LINE
- EXISTING EDGE OF EXTENSIVE TREES AND SHRUBS
- APPROXIMATE LIMIT OF DISTURBANCE
- EXISTING WOODEN FENCE
- EXISTING BUILDING
- CHANNEL SEGMENT BREAK LINES
- SEED MIX 1
- SEED MIX 2
- SHRUB CLUSTER 1
- SHRUB CLUSTER 2

MATHEWS CREEK RANCH - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT NORTHING	UPSTREAM LIMIT EASTING	DOWNSTREAM LIMIT NORTHING	DOWNSTREAM LIMIT EASTING	SEGMENT LENGTH (m)	EXISTING CHANNEL MORPHOLOGY & ISSUES	PROPOSED RESTORATION AND ENHANCEMENT TREATMENTS	SPECIFICATIONS	NOTES
1	5886984.619	362802.067	5886968.215	362800.051	21.8	RBK: CT & UV	RBK: NW, BL & WDhabitat	BANKFULL WIDTH: 9.5m	
2	5886968.215	362800.051	5886936.436	362805.815	33.6	RBK: UV	BED: BC		
3	5886936.436	362805.815	5886932.304	362788.744	27.2	RBK: CT & UV	RBK: WDnarrow		EXISTING CROSSING TO REMAIN
4	5886932.304	362788.744	5886966.174	362762.258	44.3	RBK: CT & UV	RBK: BL, WDhabitat & BankR		
5	5886966.174	362762.258	5886961.246	362742.139	25.7	RBK: CT & UV	RBK: NW & BL - BED: BC	BANKFULL WIDTH: 9.5m	
6	5886961.246	362742.139	5886949.139	362721.063	26.8	RBK: CT & UV	RBK: NW & BL	BANKFULL WIDTH: 9.0m	
7	5886949.139	362721.063	5886950.182	362705.432	29.5	RBK & LBK: CT - RBK: UV	RBK: NW & BL	BANKFULL WIDTH: 11.0m	
8	5886950.182	362705.432	5886954.022	362691.459	17.3	RBK: CT & UV	RBK: NW, BL & WDhabitat - BED: BC	BANKFULL WIDTH: 10.0m	
9	5886954.022	362691.459	5886968.099	362664.138	33.8	RBK: UV	RBK: WDhabitat		
10	5886968.099	362664.138	5886942.149	362665.841	37.2	RBK: CT & UV	RBK: NW, BL & WDhabitat	BANKFULL WIDTH: 10.0m	
11	5886942.149	362665.841	5886938.613	362635.225	86.0	N/A	N/A		
12	5886938.613	362635.225	5886929.434	362599.966	111.2	RBK: CT & UV	RBK: NW, BL & WDhabitat	BANKFULL WIDTH: 10.0m	'LEAKY' BANK FOR OVERWINTERING POND #1 IS WITHIN THIS SEGMENT. SEE DRAWING NO. 009 FOR DETAILS.
13	5886929.434	362599.966	5886956.227	362566.457	61.6	RBK: CT	RBK: WDnarrow		
14	5886956.227	362566.457	5886933.733	362544.667	44.2	RBK: CT & UV	RBK: BankR, LS		OVERWINTERING POND #1 OUTLET IS WITHIN THIS SEGMENT. SEE DRAWING NO. 009 FOR DETAILS.
15	5886933.733	362544.667	5886921.694	362518.156	55.2	RBK & LBK: CT & UV	LBK: WDnarrow		
16	5886921.694	362518.156	5886928.476	362484.831	39.3	RBK: CT & UV	RBK: WDnarrow		
17	5886928.476	362484.831	5886896.059	362493.207	40.8	RBK: UV	N/A		
18	5886896.059	362493.207	5886864.980	362479.183	94.2	N/A	N/A		
19	5886864.980	362479.183	5886814.045	362457.179	71.2	RBK: UV	RBK: WDhabitat		
20	5886814.045	362457.179	5886788.956	362471.948	61.1	N/A	N/A		
21	5886788.956	362471.948	5886776.533	362459.070	19.4	RBK: CT & UV	RBK: WDnarrow		
22	5886776.533	362459.070	5886756.111	362440.890	31.6	N/A	N/A		
23	5886756.111	362440.890	5886743.805	362447.673	18.9	RBK: UV	N/A		
24	5886743.805	362447.673	5886698.598	362445.861	130.0	N/A	N/A		
25	5886698.598	362445.861	5886681.840	362442.919	18.2	RBK: CT & UV	RBK: BL & BankR		
26	5886681.840	362442.919	5886662.190	362424.002	107.0	N/A	N/A		
27	5886662.190	362424.002	5886642.384	362402.153	33.2	RBK: UV	N/A		
28	5886642.384	362402.153	5886596.614	362347.902	102.1	N/A	N/A		
29	5886596.614	362347.902	5886622.446	362366.123	38.2	LBK: UV	N/A		
30	5886622.446	362366.123	5886647.990	362365.753	28.4	N/A	N/A		
31	5886647.990	362365.753	5886664.665	362354.338	20.2	RBK & LBK: UV - LBK: CT	LBK: WDnarrow		
32	5886664.665	362354.338	5886745.820	362280.513	125.8	RBK & LBK: UV	N/A		EXISTING CROSSING TO BE REMOVED. 'LEAKY BANK' FOR OVERWINTERING POND #2 IS WITHIN THIS SEGMENT. SEE DRAWING NO. 009 FOR DETAILS.
33	5886745.820	362280.513	5886764.784	362242.644	48.6	RBK: CT & UV	RBK: BL, WDhabitat & BankR		OVERWINTERING POND #2 OUTLET IS WITHIN THIS SEGMENT. SEE DRAWING NO. 009 FOR DETAILS.

NOTES:
1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND AERIAL DRONE PHOTOGRAMMETRY, CONDUCTED ON MAY 1-5, 2017 & JUNE 24-28, 2017. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE AND TREELINE INTERPRETED FROM PHOTOGRAMMETRY AND RTK GPS POINTS.
3. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD. DESIGN BY PALMER ENVIRONMENTAL CONSULTING GROUP INC.
4. BANKFULL CHANNEL DIMENSIONS ARE TO BE CONFIRMED BY ENVIRONMENTAL INSPECTOR FOR BankR AND NW TREATMENTS
5. LOCAL CHANNEL GRADIENTS ARE TO BE MAINTAINED THROUGHOUT STUDY AREA REGARDLESS OF PROPOSED BANK AND BED TREATMENTS
6. REFER TO RIPARIAN RESTORATION AND ENHANCEMENT DETAILS (DRAWING 007) FOR SEGMENTS WHERE UNVEGETATED (UV) HAS BEEN IDENTIFIED AS AN ISSUE
7. REFER TO DRAWING 013 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS
8. REFER TO DRAWING 007 FOR RIPARIAN RESTORATION AND ENHANCEMENT DETAILS

BC One Call Click or Call Before You Dig 1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE: 1:1,000 (0, 20, 60m)

NOTE:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASURMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	DM & RM
DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2020

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
Phone: 250-562-2252
Fax: 1-866-235-6943

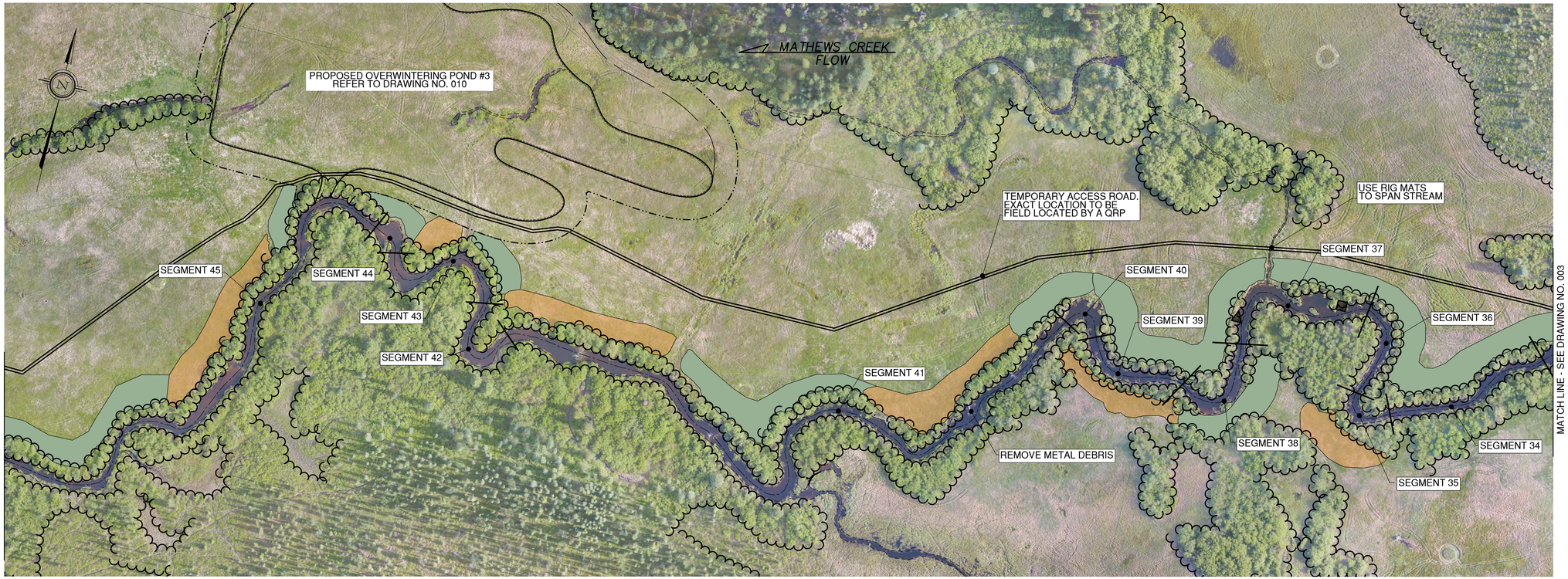
ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN
MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERALL SITE PLAN SHEET 1 OF 4

PALMER PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 003
SHEET: 3 OF 17
REV C

U:\Projects\1824\3\9\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek OA Layouts and OWPs.dwg
DATE: 04/01/2021 10:14 AM BY: Jesse Lutz

NOT FOR CONSTRUCTION



LEGEND

- APPROXIMATE WATERLINE
- APPROXIMATE CHANNEL CENTRE LINE
- EXISTING EDGE OF EXTENSIVE TREES AND SHRUBS
- EXISTING WOODEN FENCE
- APPROXIMATE LIMIT OF DISTURBANCE
- EXISTING BUILDING
- CHANNEL SEGMENT BREAK LINES
- SEED MIX 1
- SEED MIX 2
- SHRUB CLUSTER 1
- SHRUB CLUSTER 2

NOTES:

1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND AERIAL DRONE PHOTOGRAMMETRY, CONDUCTED ON MAY 1-5, 2017 & JUNE 24-28, 2017. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE AND TREELINE INTERPRETED FROM PHOTOGRAMMETRY AND RTK GPS POINTS.
3. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD. DESIGN BY PALMER ENVIRONMENTAL CONSULTING GROUP INC.
4. BANKFULL CHANNEL DIMENSIONS ARE TO BE CONFIRMED BY ENVIRONMENTAL INSPECTOR FOR BankR AND NW TREATMENTS
5. LOCAL CHANNEL GRADIENTS ARE TO BE MAINTAINED THROUGHOUT STUDY AREA REGARDLESS OF PROPOSED BANK AND BED TREATMENTS
6. REFER TO RIPARIAN RESTORATION AND ENHANCEMENT DETAILS (DRAWING 007) FOR SEGMENTS WHERE UNVEGETATED (UV) HAS BEEN IDENTIFIED AS AN ISSUE
7. REFER TO DRAWING 013 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS
8. REFER TO DRAWING 007 FOR RIPARIAN RESTORATION AND ENHANCEMENT DETAILS

ABBREVIATIONS (TREATMENT DETAILS SHOWN ON SHEETS 007)

CHANNEL MORPHOLOGY (Viewing Downstream):
RBK - Right Bank
LBK - Left Bank
BED - Channel Bed

ISSUES
CT - Cattle Trampled
UV - Unvegetated
VC - Vehicle Crossing
FO - Flow Obstruction

TREATMENTS
REGRADING:
NW - Restoration of Natural Channel Width: Detail 1B

WOODY DEBRIS:
WDnarrow - Channel Narrowing: Detail 2A
WDhabitat Enhancement:
» ▲ - ROOTWAD: Detail 2D
» ▩ - LOG: Detail 2C

BANK TREATMENTS:
BL - Brush Layers: Detail 3B

MATHEWS CREEK RANCH - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT NORTHING	UPSTREAM LIMIT EASTING	DOWNSTREAM LIMIT NORTHING	DOWNSTREAM LIMIT EASTING	SEGMENT LENGTH (m)	EXISTING CHANNEL MORPHOLOGY & ISSUES	PROPOSED RESTORATION AND ENHANCEMENT TREATMENTS	SPECIFICATIONS	NOTES
34	5886764.784	362242.644	5886726.331	362183.239	73.8	RBK: UV	N/A		
35	5886726.331	362183.239	5886731.916	362167.073	24.9	LBK: UV	N/A		
36	5886731.916	362167.073	5886768.025	362163.742	42.6	RBK: UV	N/A		
37	5886768.025	362163.742	5886740.606	362113.593	75.7	RBK: CT & UV	RBK: NW, BL & WDhabitat	BANKFULL WIDTH: 9.5m	
38	5886740.606	362113.593	5886717.506	362092.997	46.9	RBK & LBK: UV - LBK: CT	LBK: WDnarrow		
39	5886717.506	362092.997	5886728.512	362051.635	48.2	RBK & LBK: UV	N/A		
40	5886728.512	362051.635	5886731.887	362037.247	22.1	RBK: CT & UV	RBK: WDnarrow		
41	5886731.887	362037.247	5886669.003	361803.290	326.3	RBK: UV	N/A		METAL DEBRIS TO BE REMOVED
42	5886669.003	361803.290	5886680.068	361789.939	45.1	N/A	N/A		
43	5886680.068	361789.939	5886692.100	361747.283	63.1	RBK: UV	N/A		
44	5886692.100	361747.283	5886701.004	361736.491	15.0	RBK: CT & UV	RBK: NW & BL	BANKFULL WIDTH: 9.0m	
45	5886701.004	361736.491	5886505.770	361561.529	362.1	RBK: UV	N/A		OVERWINTERING POND #3 OUTLET IS WITHIN THIS SEGMENT. SEE DRAWING NO. 010 FOR DETAILS. LOCALIZED AND FIELD-FIT PLACEMENT OF VBR (DETAIL 3C, DRAWING 007) ON THE RIGHT BANK MAY BE REQUIRED IN THE VICINITY OF THE CONFLUENCE

BC One Call Click or Call Before You Dig 1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE: 1:1,000 (0, 20, 60m)
NOTE: DRAWING SCALE MAY BE DISTORTED WITH PRINTING. ALL MEASURMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED: DM & RM
DRAWN: JL
CHECKED: MF
SURVEYED: -
DATE: JAN 2020

Palmer™
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
Phone: 250-562-2252
Fax: 1-866-235-6943

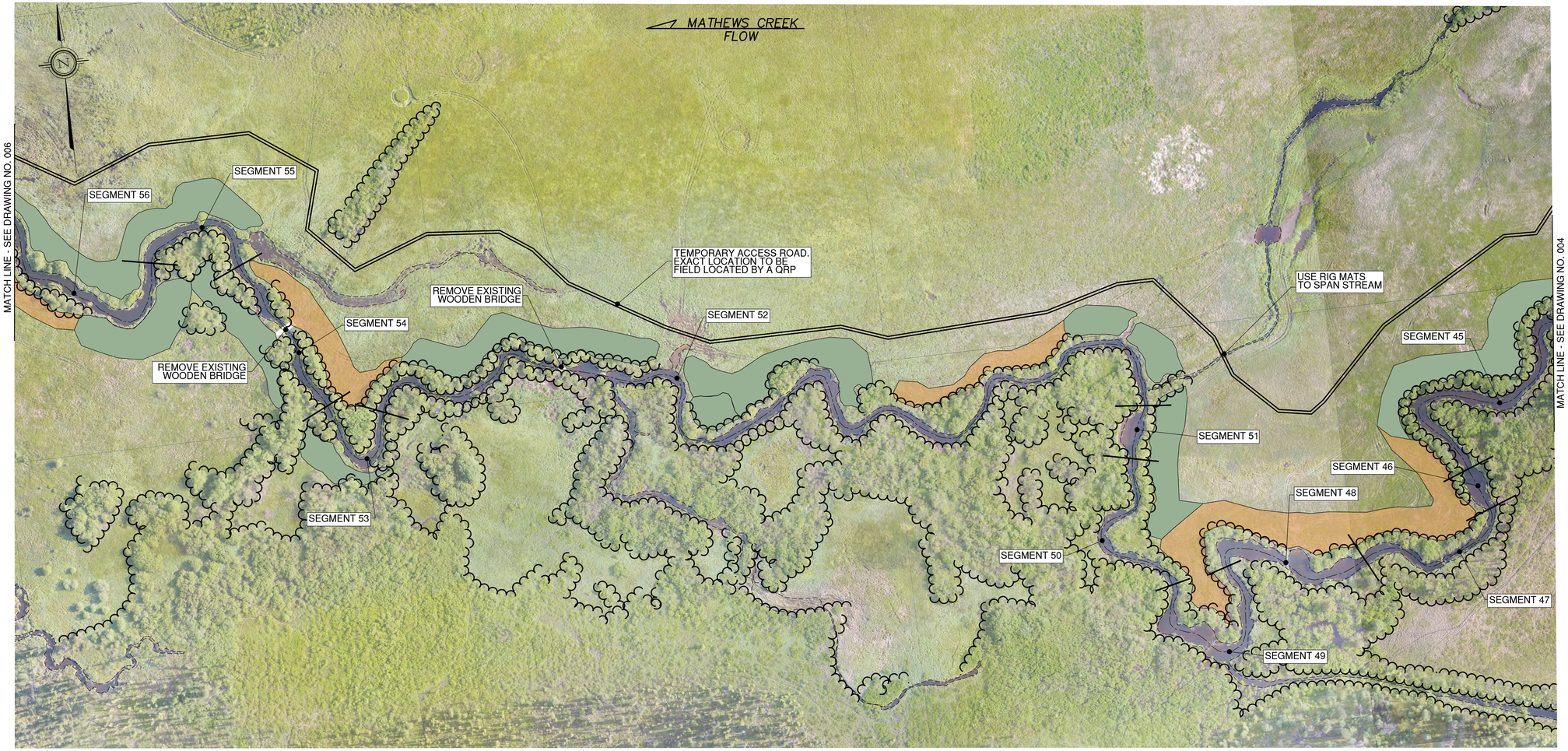
ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN
MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERALL SITE PLAN SHEET 2 OF 4

PALMER PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 004
SHEET: 4 OF 17
REV C

U:\Projects\1824\3\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek OA Layouts and OWPs.dwg
DATE: 04/01/2021 10:14 AM BY: Jesse Lutz

NOT FOR CONSTRUCTION



MATHEWS CREEK RANCH - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT NORTHING	UPSTREAM LIMIT EASTING	DOWNSTREAM LIMIT NORTHING	DOWNSTREAM LIMIT EASTING	SEGMENT LENGTH (m)	EXISTING CHANNEL MORPHOLOGY & ISSUES	PROPOSED RESTORATION AND ENHANCEMENT TREATMENTS	SPECIFICATIONS	NOTES
45	5886701.004	361736.491	5886505.770	361561.529	362.1	RBK: UV	N/A		
46	5886505.770	361561.529	5886487.924	361568.922	19.3	RBK: CT & UV	RBK: WDnarrow		
47	5886487.924	361568.922	5886472.483	361512.827	71.6	RBK: UV	N/A		
48	5886472.483	361512.827	5886476.215	361453.596	72.3	RBK: CT & UV	RBK: WDnarrow		
49	5886476.215	361453.596	5886471.054	361429.299	88.6	N/A	N/A		
50	5886471.054	361429.299	5886527.083	361418.464	82.2	RBK: UV	N/A		
51	5886527.083	361418.464	5886549.144	361426.455	23.7	RBK & LBK: UV - LBK: CT	LBK: WDnarrow		
52	5886549.144	361426.455	5886584.491	361100.237	442.5	RBK: UV	N/A		FAILED WOODEN BRIDGE TO BE REMOVED
53	5886584.491	361100.237	5886590.056	361076.763	53.6	N/A	N/A		
54	5886590.056	361076.763	5886654.180	361045.826	72.9	RBK & LBK: UV	N/A		EXISTING CROSSING TO BE REMOVED
55	5886654.180	361045.826	5886659.891	361008.441	56.3	RBK: UV	N/A		
56	5886659.891	361008.441	5886691.606	360937.908	118.8	RBK & LBK: UV	N/A		

ABBREVIATIONS (TREATMENT DETAILS SHOWN ON SHEETS 007)

CHANNEL MORPHOLOGY (Viewing Downstream):

RBK - Right Bank
LBK - Left Bank
BED - Channel Bed

ISSUES

CT - Cattle Trampled
UV - Unvegetated
VC - Vehicle Crossing
FO - Flow Obstruction

TREATMENTS

WOODY DEBRIS:
WDnarrow - Channel Narrowing: Detail 2A

LEGEND

- APPROXIMATE WATERLINE
- APPROXIMATE CHANNEL CENTRE LINE
- EXISTING EDGE OF EXTENSIVE TREES AND SHRUBS
- EXISTING WOODEN FENCE
- APPROXIMATE LIMIT OF DISTURBANCE
- EXISTING BUILDING
- CHANNEL SEGMENT BREAK LINES
- SEED MIX 1
- SEED MIX 2
- SHRUB CLUSTER 1
- SHRUB CLUSTER 2

NOTES:

1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND AERIAL DRONE PHOTOGRAMMETRY, CONDUCTED ON MAY 1-5, 2017 & JUNE 24-28, 2017. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE AND TREELINE INTERPRETED FROM PHOTOGRAMMETRY AND RTK GPS POINTS.
3. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD. DESIGN BY PALMER ENVIRONMENTAL CONSULTING GROUP INC.
4. BANKFULL CHANNEL DIMENSIONS ARE TO BE CONFIRMED BY ENVIRONMENTAL INSPECTOR FOR BankR AND NW TREATMENTS
5. LOCAL CHANNEL GRADIENTS ARE TO BE MAINTAINED THROUGHOUT STUDY AREA REGARDLESS OF PROPOSED BANK AND BED TREATMENTS
6. REFER TO RIPARIAN RESTORATION AND ENHANCEMENT DETAILS (DRAWING 007) FOR SEGMENTS WHERE UNVEGETATED (UV) HAS BEEN IDENTIFIED AS AN ISSUE
7. REFER TO DRAWING 013 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS
8. REFER TO DRAWING 007 FOR RIPARIAN RESTORATION AND ENHANCEMENT DETAILS

BC One Call Click or Call Before You Dig 1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE: 1:1,000 (0, 20, 60m)

NOTE:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASURMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	DM & RM
DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2020

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
Phone: 250-562-2252
Fax: 1-866-235-6943

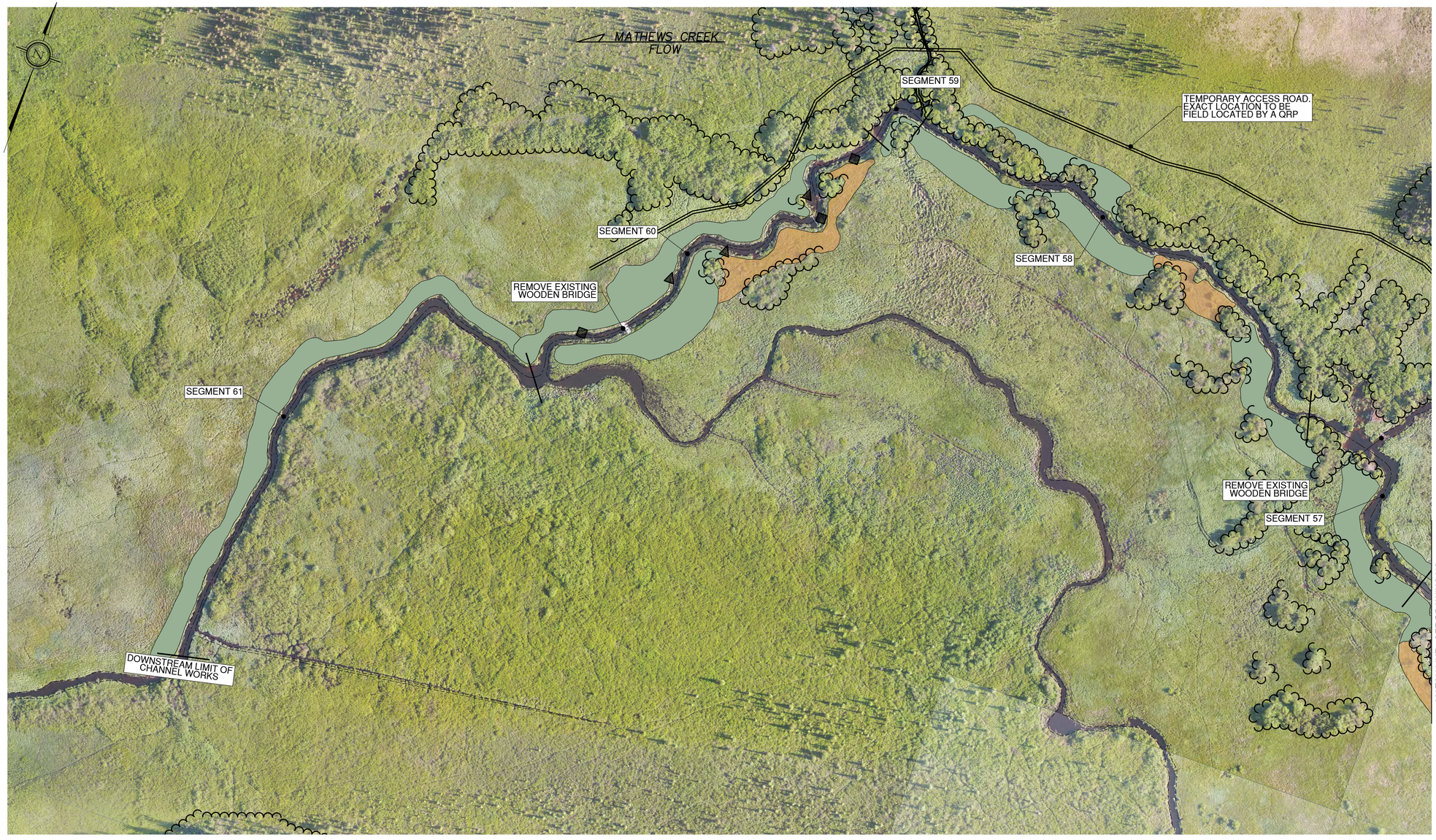
ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN
MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERALL SITE PLAN SHEET 3 OF 4

PALMER PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 005
SHEET: 5 OF 17
REV C

U:\Projects\1824\3\9\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek OA Layouts and OWPs.dwg
DATE: 04/01/2021 10:14 AM BY: Jesse Luz

NOT FOR CONSTRUCTION



ABBREVIATIONS (TREATMENT DETAILS SHOWN ON SHEETS 007)

CHANNEL MORPHOLOGY (Viewing Downstream):

RBK - Right Bank
LBK - Left Bank
BED - Channel Bed

ISSUES

CT - Cattle Trampled
UV - Unvegetated
VC - Vehicle Crossing
FO - Flow Obstruction

TREATMENTS

WOODY DEBRIS:
WDnarrow - Channel Narrowing: Detail 2A

WDhabitat Enhancement:
» ▲ - ROOTWAD: Detail 2D
» ▨ - LOG: Detail 2C

LEGEND

- APPROXIMATE WATERLINE
- APPROXIMATE CHANNEL CENTRE LINE
- EXISTING EDGE OF EXTENSIVE TREES AND SHRUBS
- EXISTING WOODEN FENCE
- APPROXIMATE LIMIT OF DISTURBANCE
- EXISTING BUILDING
- CHANNEL SEGMENT BREAK LINES
- SEED MIX 1
- SEED MIX 2
- SHRUB CLUSTER 1
- SHRUB CLUSTER 2

NOTES:

1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND AERIAL DRONE PHOTOGRAMMETRY, CONDUCTED ON MAY 1-5, 2017 & JUNE 24-28, 2017. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE AND TREELINE INTERPRETED FROM PHOTOGRAMMETRY AND RTK GPS POINTS.
3. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD. DESIGN BY PALMER ENVIRONMENTAL CONSULTING GROUP INC.
4. BANKFULL CHANNEL DIMENSIONS ARE TO BE CONFIRMED BY ENVIRONMENTAL INSPECTOR FOR BankR AND NW TREATMENTS
5. LOCAL CHANNEL GRADIENTS ARE TO BE MAINTAINED THROUGHOUT STUDY AREA REGARDLESS OF PROPOSED BANK AND BED TREATMENTS
6. REFER TO RIPARIAN RESTORATION AND ENHANCEMENT DETAILS (DRAWING 007) FOR SEGMENTS WHERE UNVEGETATED (UV) HAS BEEN IDENTIFIED AS AN ISSUE
7. REFER TO DRAWING 013 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS
8. REFER TO DRAWING 007 FOR RIPARIAN RESTORATION AND ENHANCEMENT DETAILS.

BC One Call Click or Call Before You Dig 1-800-474-6886

MATHEWS CREEK RANCH - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT NORTHING	UPSTREAM LIMIT EASTING	DOWNSTREAM LIMIT NORTHING	DOWNSTREAM LIMIT EASTING	SEGMENT LENGTH (m)	EXISTING CHANNEL MORPHOLOGY & ISSUES	PROPOSED RESTORATION AND ENHANCEMENT TREATMENTS	SPECIFICATIONS	NOTES
57	5886691.606	360937.908	5886747.902	360864.276	110.2	N/A	N/A		
58	5886747.902	360864.276	5886816.602	360652.061	242.4	RBK: UV	N/A		
59	5886816.602	360652.061	5886802.358	360634.131	31.0	N/A	N/A		
60	5886802.358	360634.131	5886646.560	360522.565	226.6	RBK & LBK: CT & UV	RBK & LBK: BL, WDhabitat & BankR		EXISTING CROSSING TO BE REMOVED
61	5886646.560	360522.565	5886472.006	360413.068	267.9	RBK: UV	N/A		

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE: 1:1,000 (0, 20, 60m)

NOTE:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASURMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	DM & RM
DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2020

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
Phone: 250-562-2252
Fax: 1-866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN
MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERALL SITE PLAN SHEET 4 OF 4

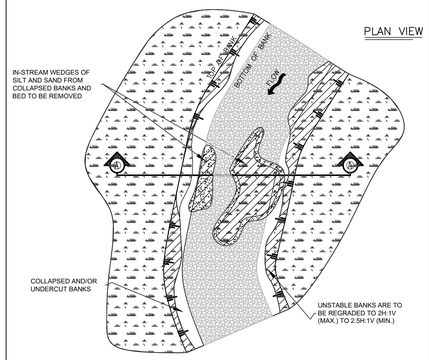
PALMER PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 006
SHEET: 6 OF 17
REV C

U:\Projects\1824\3\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek OA Layouts and OWPs.dwg
DATE: 04/07/2021 10:14 AM BY: Jesse Lutz

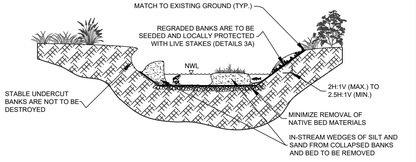
NOT FOR CONSTRUCTION

DETAIL 1A
RECONSTRUCTION OF CHANNEL BED AND/OR BANK REGRADING (BankR)
N.T.S.

PLAN VIEW

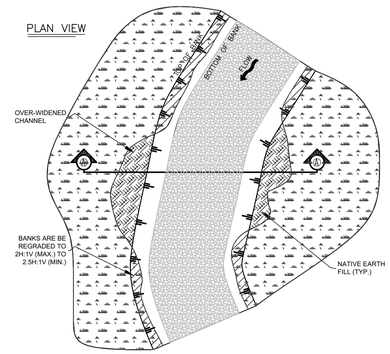


SECTION A-A



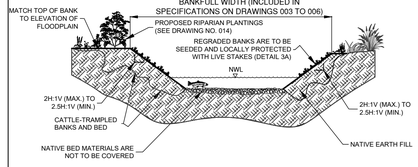
DETAIL 1B
RESTORATION OF NATURAL CHANNEL WIDTH (NW)
N.T.S.

PLAN VIEW



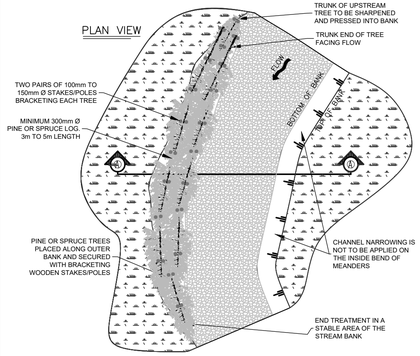
PROPOSED RIPARIAN PLANTINGS (SEE DRAWING NO. 003 TO 006)

SECTION A-A

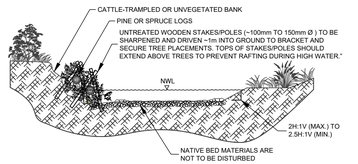


DETAIL 2A
WOODY DEBRIS CHANNEL NARROWING (WDnarrow)
N.T.S.

PLAN VIEW

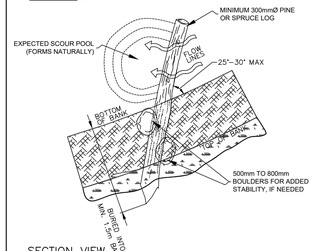


SECTION A-A

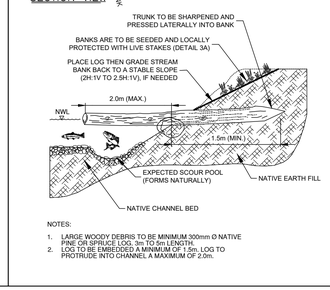


DETAIL 2B
WOODY DEBRIS CHANNEL DEFLECTION (WDdeflect)
N.T.S.

PLAN VIEW



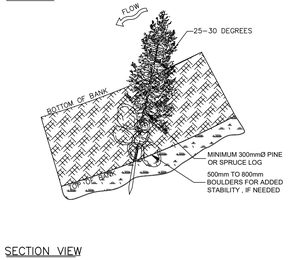
SECTION VIEW



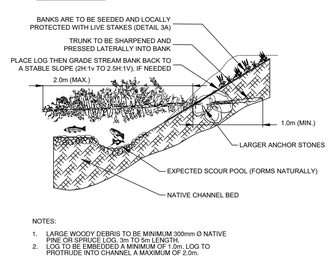
NOTES:
1. LARGE WOODY DEBRIS TO BE MINIMUM 300mm Ø NATIVE PINE OR SPRUCE LOG, 3m TO 5m LENGTH.
2. LOG TO BE EMBEDDED A MINIMUM OF 1.5m. LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 2C
WOODY DEBRIS HABITAT ENHANCEMENT (WDhabitat): LOG
N.T.S.

PLAN VIEW



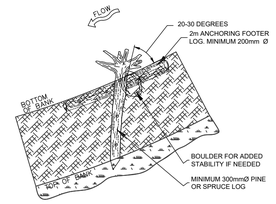
SECTION VIEW



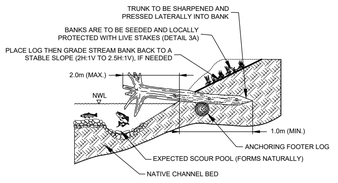
NOTES:
1. LARGE WOODY DEBRIS TO BE MINIMUM 300mm Ø NATIVE PINE OR SPRUCE LOG, 3m TO 5m LENGTH.
2. LOG TO BE EMBEDDED A MINIMUM OF 1.0m. LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 2D
WOODY DEBRIS HABITAT ENHANCEMENT (WDhabitat): ROOTWAD
N.T.S.

PLAN VIEW



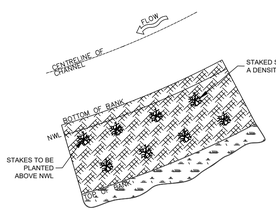
SECTION VIEW



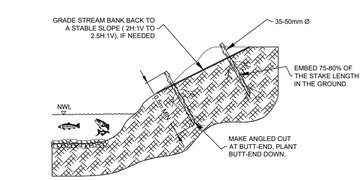
NOTES:
1. LARGE WOODY DEBRIS TO BE MINIMUM 300mm Ø NATIVE PINE OR SPRUCE LOG, 3m TO 5m LENGTH.
2. LOG TO BE EMBEDDED A MINIMUM OF 1.0m, LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 3A
BANK TREATMENT: LIVE STAKES (LS)
N.T.S.

PLAN VIEW



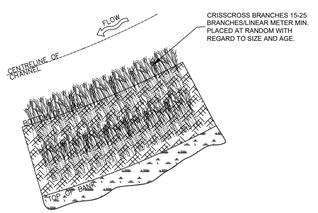
SECTION VIEW



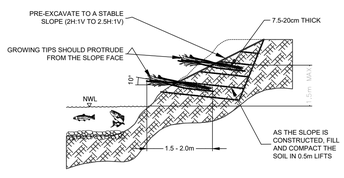
NOTES:
1. LIVE STAKINGS TO BE: -DORMANT LIVE STAKE CUTTING, (LIVE DOGWOOD AND WILLOW) -35-50mm DIA., WITH ANGLE CUT BASE, AND BLUNT CUT TOP. STAKE LENGTH TO BE 600-800mm.
2. TAMP ANGLE CUT BASE INTO SOIL AT RIGHT ANGLE TO SLOPE. ENSURE 75-80% OF LENGTH OF CUTTING IS EMBEDDED INTO SOIL. -TAMP TOPSOIL FIRMLY AROUND BASE.
3. SOAK LIVE STAKES FOR MINIMUM OF 24 HOURS PRIOR TO INSTALLATION.

DETAIL 3B
BANK TREATMENT: BRUSH LAYERS (BL)
N.T.S.

PLAN VIEW



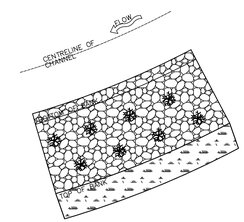
SECTION VIEW



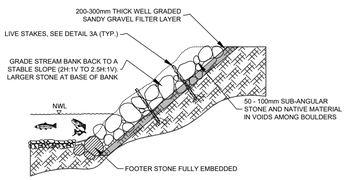
NOTES:
1. COVER BRUSHLAYER IMMEDIATELY WITH 0.15m (6") OF FILL SOIL, WATER AND COMPACT USING A VIBRATORY TAMPER.
2. BRUSH LAYERS WILL BE NATIVE WILLOW AND DOGWOOD SPECIES.
3. THE NUMBER OF LAYERS (I.E. LIFTS) WILL BE CONFIRMED BY THE INSPECTOR IN THE FIELD. IN GENERAL, BANKS <1m HIGH REQUIRE ONE LAYER, BANKS 1m TO 2m HIGH REQUIRE TWO LAYERS, AND BANKS >2m REQUIRE THREE LAYERS.

DETAIL 3C
BANK TREATMENT: VEGETATED BOULDER REVETMENT (VBR)
N.T.S.

PLAN VIEW

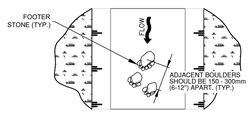


SECTION VIEW

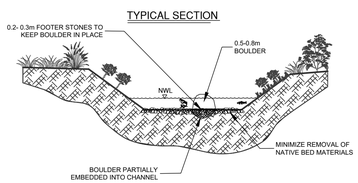


NOTES:
1. BOULDERS SHOULD BE ROUNDED TO SUB-ANGULAR.
2. GRADATION SHOULD BE WELL GRADED AND AHDERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE CLASS 25kg (MEDIAN GRAIN SIZE OF 260mm, MAXIMUM GRAIN SIZE OF 450mm).
3. INSTALLATION SHOULD ADHERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE GUIDANCE " RIPRAP INSTALLATION GUIDE"
4. BOULDERS ARE TO BE INDIVIDUALLY PLACED (I.E. NO DUMPING) TO MAXIMIZE INTERLOCKING. VOIDS ARE TO BE FILLED WITH SMALLER GRAVELS AND NATIVE MATERIALS.
5. THE BOULDER REVETMENT CAN BE FORMED IN LIFTS OR LIVE STAKE CAN BE INSERTED IF CARE IS TAKEN TO LEAVE SUFFICIENT VOIDS.
6. FILTER FABRIC SHOULD NOT BE USED.

DETAIL 4A
BED TREATMENT: BOULDER CLUSTERS (BC)
N.T.S.



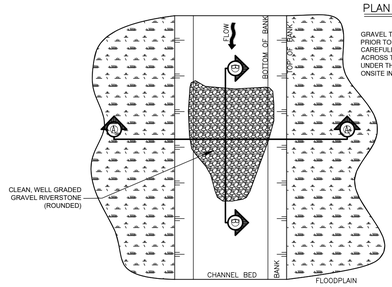
TYPICAL SECTION



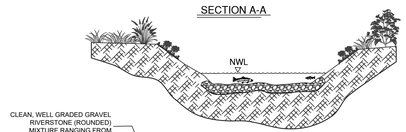
NOTES:
1. BOULDER SHOULD BE 0.5-0.8m STONE.
2. BOULDERS ARE NOT TO BE PLACED IN DEPOSITIONAL ZONES.
3. BOULDERS SHOULD OCCUPY LESS THAN 1/5 OF THE CHANNEL WIDTH AFTER PARTIAL EMBEDMENT.
4. BOULDERS SHOULD BE A MINIMUM OF TWO STONE SIZES AWAY FROM THE CHANNEL'S BANKS.

DETAIL 4B
BED TREATMENT: GRAVEL PLACEMENT (GP)
N.T.S.

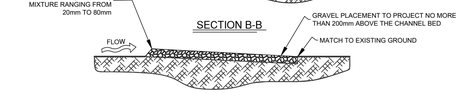
PLAN VIEW



SECTION A-A



SECTION B-B



NOTES:
1. ONSITE INSPECTOR WILL NEED TO ENSURE NO FISH OR EGGS ARE PRESENT PRIOR TO PLACEMENT.
2. GRAVEL PLACEMENT SHOULD BE COMPLETED AT LOW FLOWS.

REMOVAL OR REGRADING
NATIVE VEGETATION
NWL NORMAL WATER LEVEL
NATIVE BED MATERIAL
NATIVE EARTH
SILT AND SAND

BC One Call
Click or Call Before You Dig
1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE:

NOTE:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASURMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	DM & RM
DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2020

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
PH.: 250-562-2252 FAX: 866-235-6943

NEW GOLD C/O PALMER

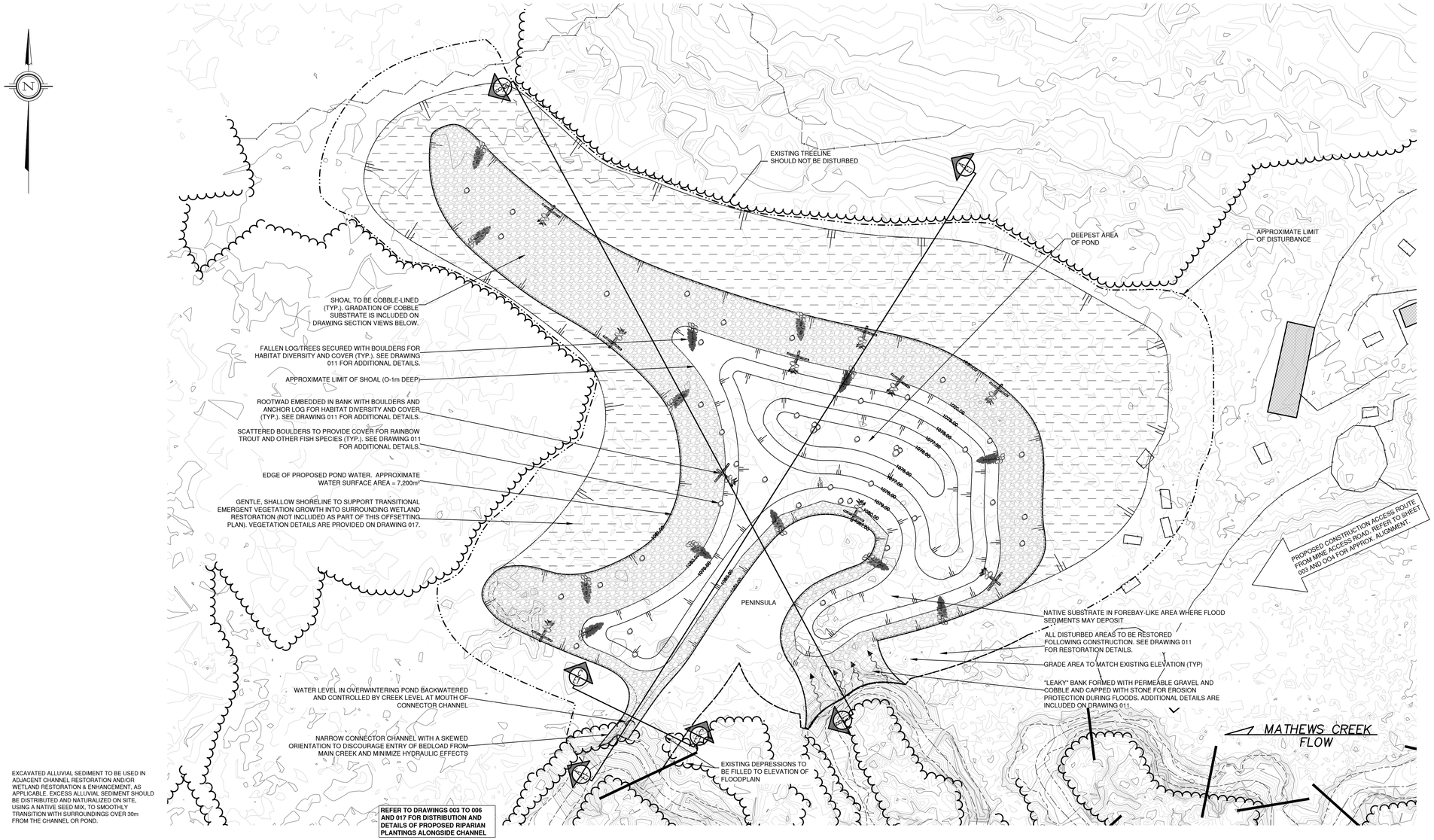
BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN
MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT
STANDARD DETAILS SHEET 1 OF 1

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 007
SHEET: 7 OF 17
REV C

U:\Projects\1824\3\9\Blackwater Fisheries Offsetting\AutoCAD\11 Mathews Creek\1824-3- Mathews Creek Details.dwg
DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

NOT FOR CONSTRUCTION

TEMPORARY STOCKPILE & LAYDOWN AREA TO BE LOCATED BY CONTRACTOR >30m FROM CHANNEL OR POND IN NATURAL CLEARING (I.E. AREA WITHOUT EXTENSIVE TREES/SHRUBS). LOCATIONS TO BE DETERMINED ON SITE (NOT SHOWN)



EXCAVATED ALLUVIAL SEDIMENT TO BE USED IN ADJACENT CHANNEL RESTORATION AND/OR WETLAND RESTORATION & ENHANCEMENT, AS APPLICABLE. EXCESS ALLUVIAL SEDIMENT SHOULD BE DISTRIBUTED AND NATURALIZED ON SITE, USING A NATIVE SEED MIX, TO SMOOTHLY TRANSITION WITH SURROUNDINGS OVER 30m FROM THE CHANNEL OR POND.

REFER TO DRAWINGS 003 TO 006 AND 017 FOR DISTRIBUTION AND DETAILS OF PROPOSED RIPARIAN PLANTINGS ALONGSIDE CHANNEL

LEGEND

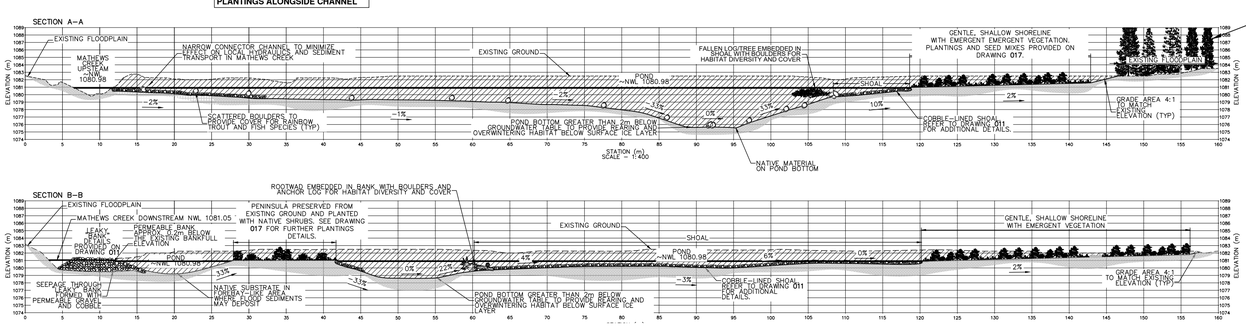
- APPROXIMATE WATERLINE AT TIME OF SURVEY
- APPROXIMATE CHANNEL CENTRE LINE
- EXISTING EDGE OF EXTENSIVE TREES AND SHRUBS
- EXISTING WOODEN FENCE
- EXISTING BUILDING
- APPROXIMATE LIMIT OF DISTURBANCE
- APPROXIMATE LIMIT OF PROPOSED SHOAL
- PROPOSED SHALLOW SHORELINE
- PROPOSED COBBLE
- PROPOSED CONIFEROUS TREE
- PROPOSED ROOTWAD
- PROPOSED BOULDER

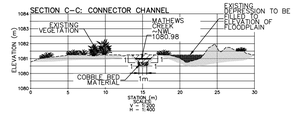
DESIGN OBJECTIVES & PURPOSE

OVERWINTERING HABITAT IS A KEY LIMITING FACTOR IN FISHERIES PRODUCTIVITY IN THE WATERSHED. THE PROPOSED OVERWINTERING POND IS SITUATED AT A LOCATION WITH NATURALLY HIGH GROUNDWATER TABLE AND THROUGH-FLOW TO MINIMIZE WINTER ICE COVER THICKNESS AND MAXIMIZE DISSOLVED OXYGEN. DEEP WATER (>2m), COBBLE/BOULDER SUBSTRATES AND OVERHEAD COVER ARE INCORPORATED INTO THE POND DESIGN TO MAXIMIZE THE HABITAT QUALITY. LOCAL INCLUSION OF GENTLE, SHALLOW SHORELINE WILL SUPPORT TRANSITIONAL GROWN OF EMERGENT VEGETATION INTO SURROUNDING WETLAND RESTORATION (NOT INCLUDED AS PART OF THIS OFFSETTING PLAN).

DESIGN TARGETS

- WATER SURFACE AREA OF 7,200m².
- MIN. POND DEPTH OF 2m.
- WOODY DEBRIS AND BOULDER FISH HABITAT FEATURES.





REFER TO DETAIL 011 FOR ADDITIONAL CONNECTOR CHANNEL DETAILS.

NOTES:

1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND AERIAL DRONE PHOTOGRAMMETRY, CONDUCTED ON MAY 1-5, 2017 & JUNE 24-28, 2017. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE AND TREELINE INTERPRETED FROM PHOTOGRAMMETRY AND RTK GPS POINTS.
3. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD. DESIGN BY PALMER ENVIRONMENTAL CONSULTING GROUP INC.
4. REFER TO DRAWING 011 FOR TYPICAL DETAILS FOR PROPOSED SALVAGED CONIFEROUS TREE, ROOTWAD, BOULDER, CONNECTOR CHANNEL AND LEAKY BANK.
5. REFER TO DRAWING 015 TO 017 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS.
6. REFER TO DRAWING 015 TO 017 FOR RIPARIAN RESTORATION AND ENHANCEMENT DETAILS.

BC One Call Click or Call Before You Dig 1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE: 0 20 60m, 1:1,000

NOTE: DRAWING SCALE MAY BE DISTORTED WITH PRINTING. ALL MEASURMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	DM & RM
DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2020

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
Phone: 250-562-2252
Fax: 1-866-235-6943

ARTEMIS GOLD INC.

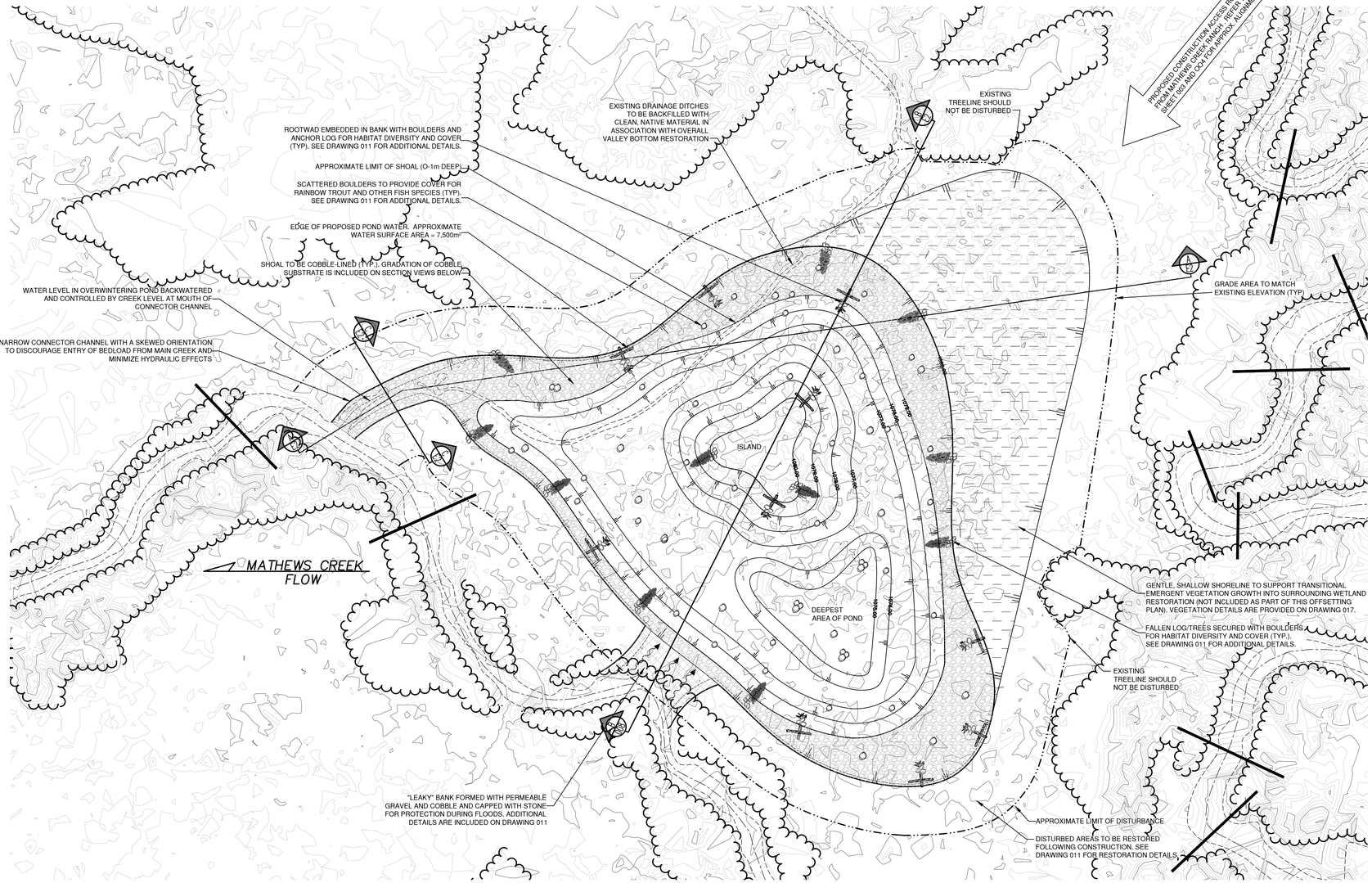
BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN
MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERWINTERING POND #1 - SHEET 1 OF 3

PALMER PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 008
SHEET: 8 OF 17 REV C

U:\Projects\1824\3\0\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek OA Layouts and OWPs.dwg
DATE: 04/01/2021 10:14 AM BY: Jesse Lutz

NOT FOR CONSTRUCTION

TEMPORARY STOCKPILE & LAYDOWN AREA TO BE LOCATED BY CONTRACTOR >30m FROM CHANNEL OR POND IN NATURAL CLEARING (I.E. AREA WITHOUT EXTENSIVE TREES/SHRUBS). LOCATIONS TO BE DETERMINED ON SITE (NOT SHOWN)



REFER TO DRAWINGS 003 TO 006 AND 017 FOR DISTRIBUTION AND DETAILS OF PROPOSED RIPARIAN PLANTINGS ALONGSIDE CHANNEL

LEGEND

- APPROXIMATE WATERLINE AT TIME OF SURVEY
- APPROXIMATE CHANNEL CENTRE LINE
- EXISTING EDGE OF EXTENSIVE TREES AND SHRUBS
- EXISTING WOODEN FENCE
- EXISTING BUILDING
- APPROXIMATE LIMIT OF DISTURBANCE
- APPROXIMATE LIMIT OF PROPOSED SHOAL
- PROPOSED SHALLOW SHORELINE
- PROPOSED COBBLE
- PROPOSED CONIFEROUS TREE
- PROPOSED ROOTWAD
- PROPOSED BOULDER

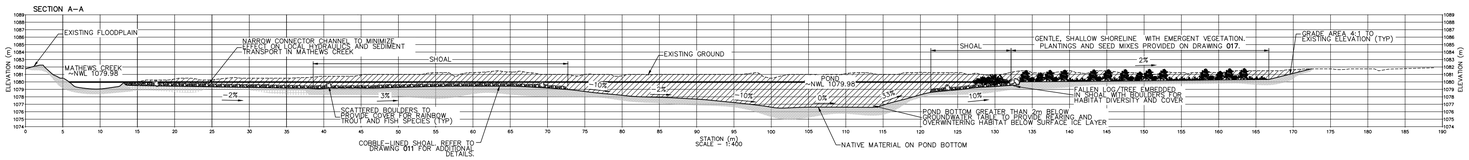
DESIGN OBJECTIVES & PURPOSE

OVERWINTERING HABITAT IS A KEY LIMITING FACTOR IN FISHERIES PRODUCTIVITY IN THE WATERSHED. THE PROPOSED OVERWINTERING POND IS SITUATED AT A LOCATION WITH NATURALLY HIGH GROUNDWATER TABLE AND THROUGH-FLOW TO MINIMIZE WINTER ICE COVER THICKNESS AND MAXIMIZE DISSOLVED OXYGEN. DEEP WATER (>2m), COBBLE/BOULDER SUBSTRATES AND OVERHEAD COVER ARE INCORPORATED INTO THE POND DESIGN TO MAXIMIZE THE HABITAT QUALITY. LOCAL INCLUSION OF GENTLE, SHALLOW SHORELINE WILL SUPPORT TRANSITIONAL GROWN OF EMERGENT VEGETATION INTO SURROUNDING WETLAND RESTORATION (NOT INCLUDED AS PART OF THIS OFFSETTING PLAN).

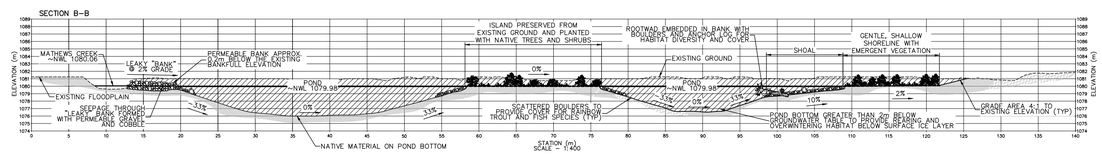
DESIGN TARGETS

- WATER SURFACE AREA OF 7,500m².
- MIN. POND DEPTH OF 2m.
- WOODY DEBRIS AND BOULDER FISH HABITAT FEATURES.

SECTION A–A

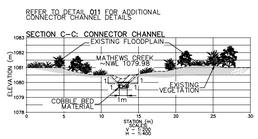


SECTION B–B



REFER TO DETAIL 011 FOR ADDITIONAL CONNECTOR CHANNEL DETAILS

SECTION C–C: CONNECTOR CHANNEL



EXCAVATED ALLUVIAL SEDIMENT TO BE USED IN ADJACENT CHANNEL RESTORATION AND/OR WETLAND RESTORATION & ENHANCEMENT, AS APPLICABLE. EXCESS ALLUVIAL SEDIMENT SHOULD BE DISTRIBUTED AND NATURALIZED ON SITE, USING A NATIVE SEED MIX, TO SMOOTHLY TRANSITION WITH SURROUNDINGS OVER 30m FROM THE CHANNEL OR POND.

NOTES:

1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND AERIAL DRONE PHOTOGRAMMETRY, CONDUCTED ON MAY 1-5, 2017 & JUNE 24-28, 2017. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE AND TREELINE INTERPRETED FROM PHOTOGRAMMETRY AND RTK GPS POINTS.
3. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD. DESIGN BY PALMER ENVIRONMENTAL CONSULTING GROUP INC.
4. REFER TO DRAWING 011 FOR TYPICAL DETAILS FOR PROPOSED CONIFEROUS TREE, ROOTWAD, BOULDER AND CONNECTOR CHANNEL.
5. REFER TO DRAWING 015 TO 017 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS.
6. REFER TO DRAWING 015 TO 017 FOR RIPARIAN RESTORATION AND ENHANCEMENT DETAILS.

BC One Call — Click or Call Before You Dig — 1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPRD
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE: 1:500 (0, 10, 30m)

NOTE: DRAWING SCALE MAY BE DISTORTED WITH PRINTING. ALL MEASURMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	DM & RM
DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2020

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
Phone: 250-562-2252
Fax: 1-866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN

MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT

OVERWINTERING POND #2 - SHEET 2 OF 3

PALMER PROJECT NO. 2006501

OEL PROJECT NO. 1824-3-1

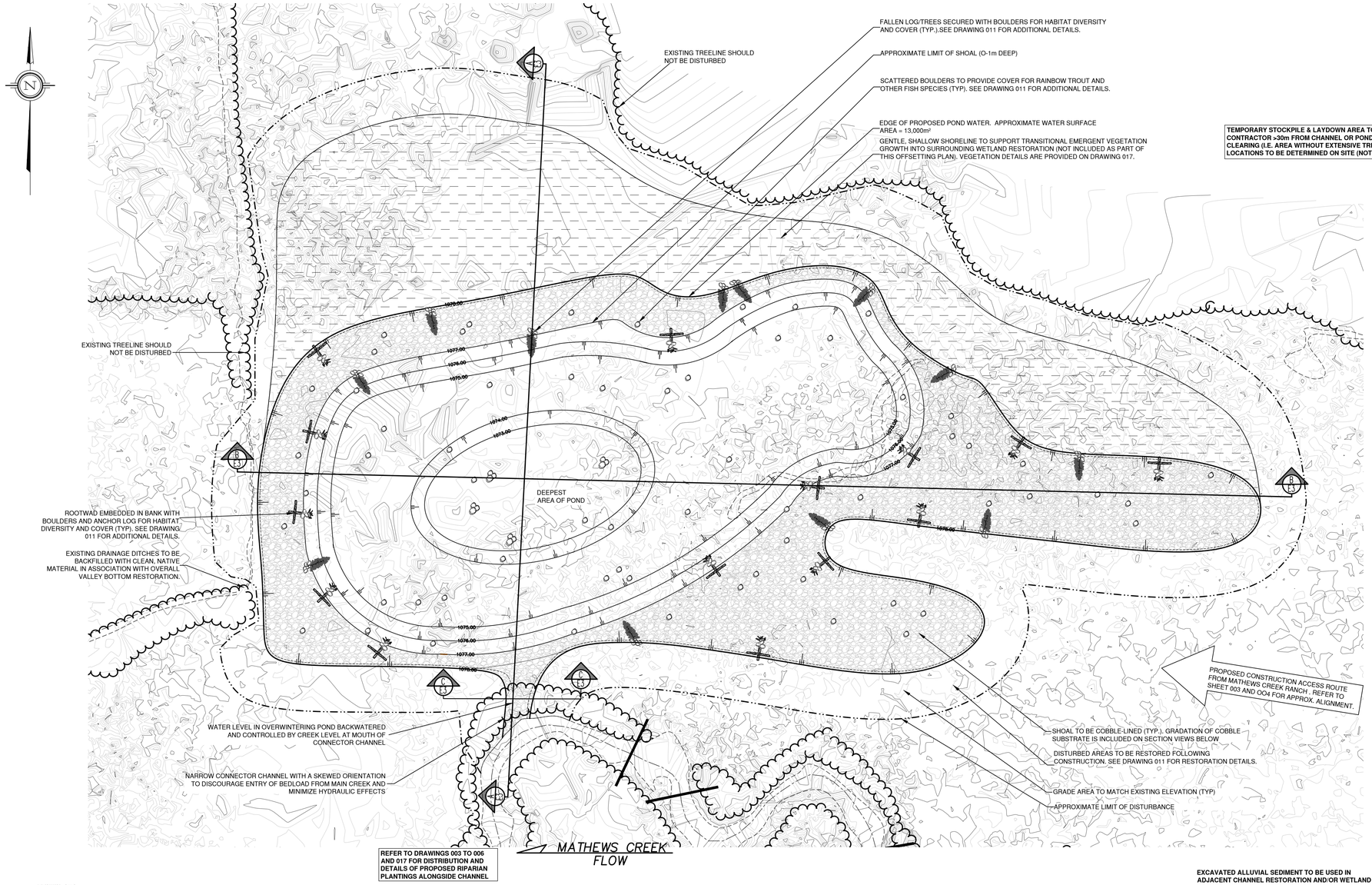
DRAWING NO. 009

SHEET: 9 OF 17

REV C

U:\Projects\1824\3\0\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek OA Layouts and OWPs.dwg
DATE: 04/01/2021 10:14 AM BY: Jesse Lutz

NOT FOR CONSTRUCTION

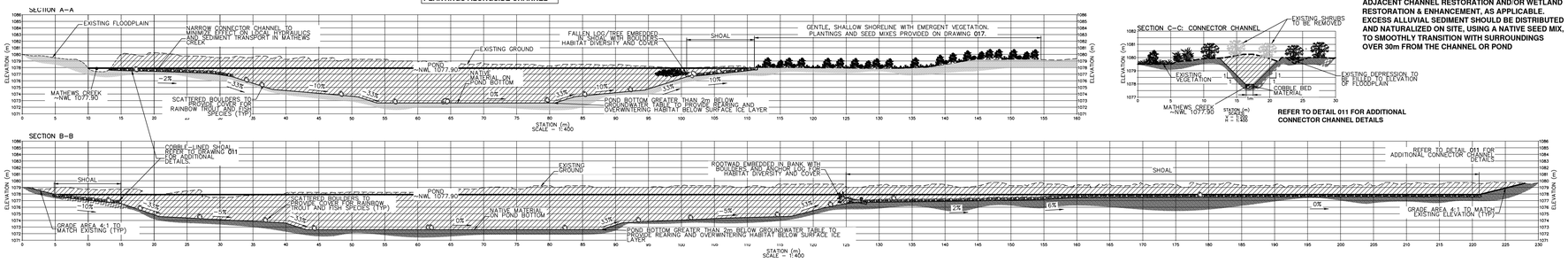


TEMPORARY STOCKPILE & LAYDOWN AREA TO BE LOCATED BY CONTRACTOR >30m FROM CHANNEL OR POND IN NATURAL CLEARING (I.E. AREA WITHOUT EXTENSIVE TREES/SHRUBS). LOCATIONS TO BE DETERMINED ON SITE (NOT SHOWN)

LEGEND

- APPROXIMATE WATERLINE AT TIME OF SURVEY
- APPROXIMATE CHANNEL CENTRE LINE
- EXISTING EDGE OF EXTENSIVE TREES AND SHRUBS
- APPROXIMATE LIMIT OF DISTURBANCE
- APPROXIMATE LIMIT OF PROPOSED SHOAL
- PROPOSED SHALLOW SHORELINE
- PROPOSED COBBLE
- PROPOSED CONIFEROUS TREE
- PROPOSED ROOTWAD
- PROPOSED BOULDER

REFER TO DRAWINGS 003 TO 006 AND 017 FOR DISTRIBUTION AND DETAILS OF PROPOSED RIPARIAN PLANTINGS ALONGSIDE CHANNEL



EXCAVATED ALLUVIAL SEDIMENT TO BE USED IN ADJACENT CHANNEL RESTORATION AND/OR WETLAND RESTORATION & ENHANCEMENT, AS APPLICABLE. EXCESS ALLUVIAL SEDIMENT SHOULD BE DISTRIBUTED AND NATURALIZED ON SITE, USING A NATIVE SEED MIX, TO SMOOTHLY TRANSITION WITH SURROUNDINGS OVER 30m FROM THE CHANNEL OR POND

REFER TO DETAIL 011 FOR ADDITIONAL CONNECTOR CHANNEL DETAILS

DESIGN OBJECTIVES & PURPOSE

OVERWINTERING HABITAT IS A KEY LIMITING FACTOR IN FISHERIES PRODUCTIVITY IN THE WATERSHED. THE PROPOSED OVERWINTERING POND IS SITUATED AT A LOCATION WITH NATURALLY HIGH GROUNDWATER TABLE AND THROUGH-FLOW TO MINIMIZE WINTER ICE COVER THICKNESS AND MAXIMIZE DISSOLVED OXYGEN. DEEP WATER (>2m), COBBLE/BOULDER SUBSTRATES AND OVERHEAD COVER ARE INCORPORATED INTO THE POND DESIGN TO MAXIMIZE THE HABITAT QUALITY. LOCAL INCLUSION OF GENTLE, SHALLOW SHORELINE WILL SUPPORT TRANSITIONAL GROWN OF EMERGENT VEGETATION INTO SURROUNDING WETLAND RESTORATION (NOT INCLUDED AS PART OF THIS OFFSETTING PLAN).

DESIGN TARGETS

- WATER SURFACE AREA OF 13,000m².
- MIN. POND DEPTH OF 2m.
- WOODY DEBRIS AND BOULDER FISH HABITAT FEATURES.

NOTES:

1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND AERIAL DRONE PHOTOGRAMMETRY, CONDUCTED ON MAY 1-5, 2017 & JUNE 24-28, 2017. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE AND TREELINE INTERPRETED FROM PHOTOGRAMMETRY AND RTK GPS POINTS.
3. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD. DESIGN BY PALMER ENVIRONMENTAL CONSULTING GROUP INC.
4. REFER TO DRAWING 011 FOR TYPICAL DETAILS FOR PROPOSED SALVAGED CONIFEROUS TREE, ROOTWAD, BOULDER, CONNECTOR CHANNEL AND LEAKY BANK.
5. REFER TO DRAWING 015 TO 017 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS.
6. REFER TO DRAWING 015 TO 017 FOR RIPARIAN RESTORATION AND ENHANCEMENT DETAILS.

BC One Call Click or Call Before You Dig 1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE: 0 10 30m 1:500

NOTE: DRAWING SCALE MAY BE DISTORTED WITH PRINTING. ALL MEASURMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	DM & RM
DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2020

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
Phone: 250-562-2252
Fax: 1-866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN

MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT

OVERWINTERING POND #3 - SHEET 3 OF 3

PALMER PROJECT NO. 2006501

OEL PROJECT NO. 1824-3-1

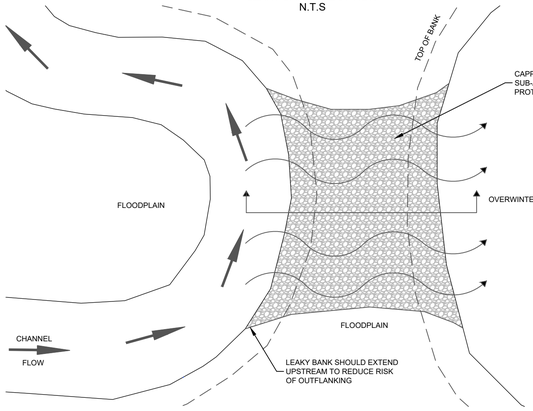
DRAWING NO. 010

SHEET: 10 OF 17 REV C

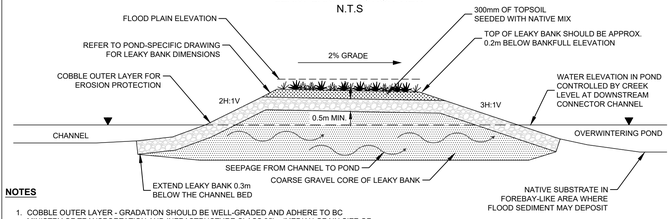
U:\Projects\1824\3\9\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek OA Layouts and OWPs.dwg
DATE: 04/01/2021 10:14 AM BY: Jesse Lutz

NOT FOR CONSTRUCTION

DETAIL A
LEAKY BANK - PLAN VIEW
N.T.S



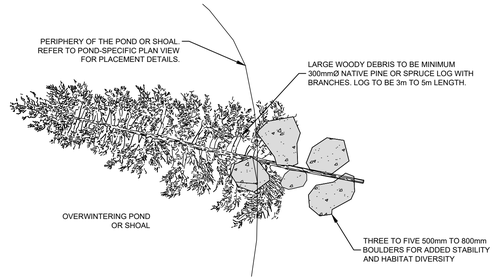
LEAKY BANK - SECTION VIEW
N.T.S



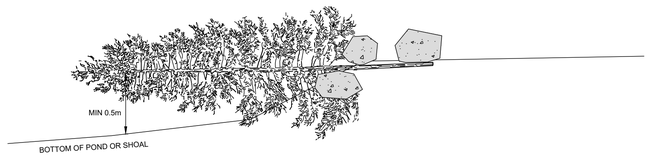
NOTES

1. COBBLE OUTER LAYER - GRADATION SHOULD BE WELL-GRADED AND ADHERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE CLASS 25kg (MEDIAN GRAIN SIZE OF 260mm, MAXIMUM GRAIN SIZE OF 450mm). THE LAYER SHOULD BE 0.5m THICK, AT MINIMUM.
2. GRAVEL CORE - WELL-GRADED MIXTURE RANGING FROM 20mm TO 80mm.

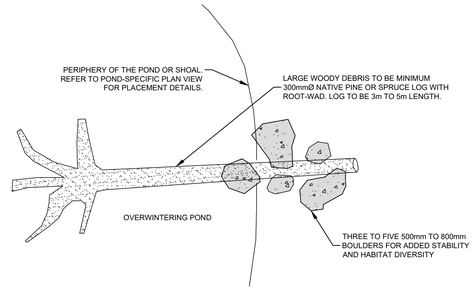
DETAIL B
CONIFEROUS TREE PLACEMENT - PLAN VIEW
N.T.S



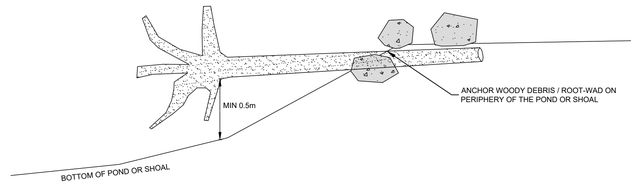
CONIFEROUS TREE PLACEMENT - SECTION VIEW
N.T.S



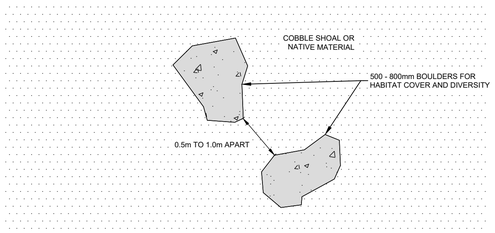
DETAIL C
ROOT-WAD PLACEMENT - PLAN VIEW
N.T.S



ROOT-WAD PLACEMENT - SECTION VIEW
N.T.S

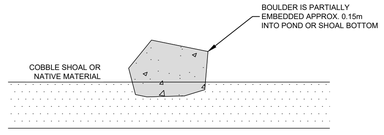


DETAIL D
BOULDER PLACEMENT - PLAN VIEW
N.T.S

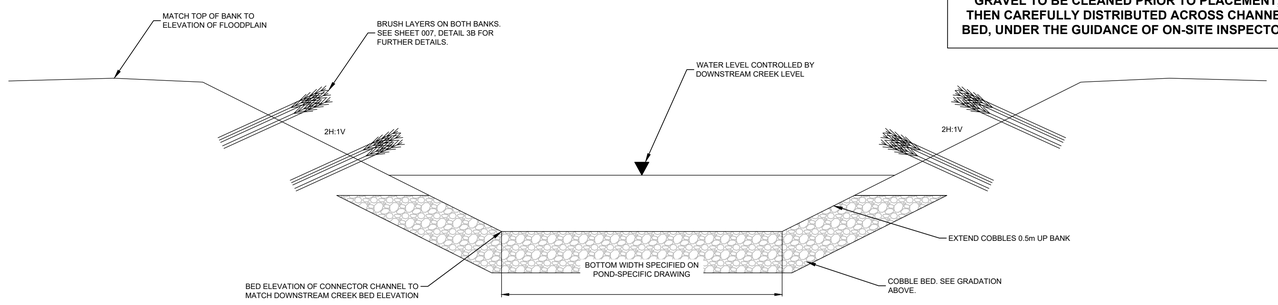


REFER TO POND-SPECIFIC PLAN VIEW DRAWING FOR NUMBER OF BOULDERS TO BE PLACED AT A GIVEN LOCATION

BOULDER PLACEMENT - SECTION VIEW
N.T.S



DETAIL E
CONNECTOR CHANNEL - SECTION VIEW
N.T.S



OVERWINTERING POND - GRADATION FOR SHOAL AND CONNECTOR CHANNEL

%PASSING BY NOMINAL DIAMETER
20% 200-250mm
30% 100-200mm
30% 50-100mm
20% 10-50mm

THICKNESS FOR SHOAL: 250mm

MATERIALS SHOULD BE ROUNDED TO SUB-ANGULAR.

GRAVEL TO BE CLEANED PRIOR TO PLACEMENT, THEN CAREFULLY DISTRIBUTED ACROSS CHANNEL BED, UNDER THE GUIDANCE OF ON-SITE INSPECTOR.

BC One Call
Click or Call Before You Dig
1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE:

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASUREMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	RM & DM
DRAWN:	AB
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2021

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
PH.: 250-562-2252 FAX: 866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN

MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT

OVERWINTERING POND TYPICAL DETAILS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 011
SHEET: 11 OF 17
REV C

U:\Project\1824\3\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek - ESC Plans.dwg
DATE: 25/11/2020 5:12 PM BY: Andrew Brabandt

NOT FOR CONSTRUCTION

CHANNEL WORKS - EROSION & SEDIMENT CONTROL AND WORK AREA ISOLATION - NOTES:

INTRODUCTORY STATEMENT

- THE EROSION & SEDIMENT CONTROL PLAN HAS BEEN DEVELOPED TO ENSURE ESTABLISHMENT AND MAINTENANCE OF ALL NECESSARY ENVIRONMENTAL PROTECTION MEASURES BEFORE, DURING AND AFTER CHANNEL RESTORATION AND ENHANCEMENT WORKS. IT ALSO ALLOWS THE CONTRACTOR, OVERSEEN BY AN ENVIRONMENTAL INSPECTOR, THE FLEXIBILITY TO OPTIMIZE THE MEASURES FOR THE MOST EFFECTIVE SEQUENCE AND APPROACH FOR IMPLEMENTATION. RATHER THAN PRESCRIBING EXACTLY WHERE AND WHEN DIFFERENT MEASURES ARE TO BE USED, TYPICAL LAYOUTS FOR ENVIRONMENTAL PROTECTION AND WORK-AREA SITE ISOLATION ARE PROVIDED TO MAKE CLEAR WHAT OPTIONS ARE AVAILABLE TO THE CONTRACTOR. AN ENVIRONMENTAL INSPECTOR FAMILIAR WITH THE EROSION & SEDIMENT CONTROL PLAN WILL BE AVAILABLE ON SITE TO ANSWER QUESTIONS AND PROVIDE GUIDANCE TO THE CONTRACTOR.

SECTION 1: SITE MANAGEMENT

1. EROSION AND SEDIMENT CONTROL (ESC) MEASURES WILL BE IMPLEMENTED PRIOR TO, AND MAINTAINED DURING THE CONSTRUCTION PHASES, TO PREVENT ENTRY OF SEDIMENT INTO THE WATER, ALL DAMAGED EROSION AND SEDIMENT CONTROL MEASURES SHOULD BE REPAIRED AND / OR REPLACED WITHIN 48 HOURS OF INSPECTION.
2. DISTURBED AREAS WILL BE MINIMIZED TO THE EXTENT POSSIBLE, AND TEMPORARILY OR PERMANENTLY STABILIZED OR RESTORED AS THE WORK PROGRESSES.
3. ALL IN-WATER AND NEAR WATER EARTHWORKS WILL BE CONDUCTED IN THE DRY AND / OR WITHIN AN ISOLATED WORK AREA WITH APPROPRIATE EROSION AND SEDIMENT CONTROLS. SPECIFIED PLACEMENTS OF BOULDERS, GRAVEL, AND LARGE WOOD MAY BE MADE IN / NEAR WATER WITHOUT COMPLETE ISOLATION IF NOT ASSOCIATED WITH EARTHWORK.
4. THE EROSION AND SEDIMENT CONTROL STRATEGIES OUTLINED ON THE PLANS ARE NOT STATIC AND MAY NEED TO BE UPGRADED / AMENDED AS SITE CONDITIONS CHANGE TO MINIMIZE SEDIMENT LADEN RUNOFF FROM LEAVING THE WORK AREAS. IF THE PRESCRIBED MEASURES ON THE PLANS ARE NOT EFFECTIVE IN PREVENTING THE RELEASE OF DELETERIOUS SUBSTANCE, INCLUDING SEDIMENT, THEN ALTERNATIVE MEASURES MUST BE IMPLEMENTED IMMEDIATELY TO MINIMIZE POTENTIAL ECOLOGICAL IMPACTS. ADDITIONAL ESC MEASURES TO BE KEPT ON SITE AND USED AS NECESSARY.
5. AN ENVIRONMENTAL MONITOR WILL ATTEND THE SITE TO INSPECT ALL NEW CONTROLS, AS WELL AS ON A REGULAR BASIS, OR FOLLOWING RAIN / SNOW MELT EVENTS, TO MONITOR ALL WORKS, AND IN PARTICULAR WORKS RELATED TO EROSION AND SEDIMENT CONTROLS, DE-WATERING, RESTORATION, AND IN / NEAR-WATER WORKS. SHOULD CONCERNS ARISE ON SITE, THE ENVIRONMENTAL MONITOR WILL CONTACT THE APPROPRIATE REGULATORY OFFICER AS WELL AS THE PROPONENT.
6. ALL ACTIVITIES, INCLUDING MAINTENANCE PROCEDURES, WILL BE CONTROLLED TO PREVENT THE ENTRY OF PETROLEUM PRODUCTS, DEBRIS, RUBBLE, CONCRETE, OR OTHER DELETERIOUS SUBSTANCES INTO THE WATER. VEHICULAR REFUELING AND MAINTENANCE WILL BE CONDUCTED A MINIMUM OF 30 METERS FROM THE WATER.
7. THE PROPONENT / CONTRACTOR SHALL MONITOR THE WEATHER FOR THE DURATION OF CONSTRUCTION TO ENSURE THAT THE WORKS WILL BE CONDUCTED DURING FAVORABLE WEATHER CONDITIONS. SHOULD AN UNEXPECTED STORM OR SNOWMELT ARISE, THE CONTRACTOR WILL REMOVE ALL UNFIXED ITEMS FROM THE CHANNEL AND FLOOD PLAIN THAT WOULD HAVE THE POTENTIAL TO CAUSE A SPILL OR AN OBSTRUCTION TO FLOW, E.G., FUEL TANKS, PORTA-POTTIES, MACHINERY, EQUIPMENT, CONSTRUCTION MATERIALS, ETC.
8. ALL DE-WATERING SHALL BE TREATED AND RELEASED TO THE ENVIRONMENT AT LEAST 15 METERS FROM A WATERCOURSE OR POND AND ALLOWED TO DRAIN THROUGH A FILTER BAG AND WELL-VEGETATED AREA. NO DE-WATERING EFFLUENT SHALL BE SENT DIRECTLY TO ANY WATERCOURSE, POND, FOREST, OR ALLOWED TO DRAIN ONTO DISTURBED SOILS WITHIN THE WORK AREA. THESE CONTROL MEASURES SHALL BE MONITORED FOR EFFECTIVENESS AND MAINTAINED OR REVISED TO MEET THE OBJECTIVE OF PREVENTING THE RELEASE OF SEDIMENT-LADEN WATER.
9. ALL ACCESS TO THE POND WORK AREA SHALL BE FROM THE NORTH SIDE OF THE WATERCOURSE. NO EQUIPMENT OR VEHICLES ARE PERMITTED TO CROSS THROUGH THE WATERCOURSE.
10. ESC MEASURES ARE TO REMAIN IN PLACE AND IN WORKING ORDER UNTIL ALL ON-SITE CONSTRUCTION IS COMPLETED.
11. AREAS WHICH REMAIN DISTURBED FOR MORE THAN 30 DAYS SHALL BE STABILIZED USING SEED, APPROVED EROSION CONTROL BLANKETS, OR SIMILAR APPROVED EQUIVALENT. IF CONDITIONS AREN'T SUITABLE FOR SEED APPLICATION, AN EROSION CONTROL BLANKET WILL BE USED IN ITS PLACE. SEE EROSION CONTROL BLANKET TYPICAL DETAIL ON SHEET 13.
12. NO EROSION AND SEDIMENT CONTROL MEASURE SHALL CONTAIN ANY PLASTIC, EVEN IF IT IS BIODEGRADABLE.
13. THE CONTRACTOR MUST HAVE SUITABLE PUMPING CAPABILITIES ON SITE AT ALL TIMES TO FACILITATE CONSTRUCTION ACTIVITIES IN THE DRY.
14. WORKS SHOULD BE COMPLETED IN STAGES TO REDUCE THE DURATION OF DISTURBED AREAS.
15. CONTRACTOR IS NOT TO DISPOSE OF ANY OF THE MATERIAL USED IN THE PEA GRAVEL METER BAGS INTO THE CHANNEL OR SURROUNDING AREA. ALL PEA GRAVEL BAGS ARE TO BE REMOVED OFF OF SITE.
16. TEMPORARY STAGING AREAS ARE TO BE SITUATED MORE THAN 15 METERS FROM THE WATERCOURSE. ALL MAJOR OVERNIGHT STAGING / STOCKPILING AREAS WILL BE A MINIMUM OF 30 METERS AWAY FROM THE WATERCOURSE. CONTRACTOR TO MONITOR WEATHER FORECASTS TO ENSURE MACHINES AND MATERIALS ARE REMOVED WHEN THE INCLEMENT WEATHER IS ANTICIPATED. STOCKPILE HEIGHTS WILL BE KEPT BELOW 1.5 METERS IN HEIGHT.

SECTION 2: CONSTRUCTION TIMING

17. TO PROTECT LOCAL FISH POPULATIONS DURING THEIR SPAWNING, NURSERY AND MIGRATORY PERIODS, IN-WATER ACTIVITIES MAY ONLY OCCUR DURING THE TIME PERIOD OF JULY 15 TO APRIL 15 (OF THE FOLLOWING YEAR). IN ACCORDANCE WITH THE OMINECA REGION LEAST-RISK TIMING WINDOW FOR RAINBOW TROUT. CHANNEL WORKS ARE BEST COMPLETED IN LATE SUMMER / EARLY FALL, WHEN FLOWS ARE LOW AND THERE IS NO ICE. EXCAVATION AND NATURALIZATION OF OVERWINTERING PONDS IS BEST COMPLETED IN WINTER WHEN THE GROUND SURFACE IS FROZEN AND THE GROUNDWATER LEVEL IN THE ALLUVIAL FLOODPLAIN SOILS IS LOW.

SECTION 3: FISH RELOCATION

18. FISH STRANDED WITHIN THE WORK AREA SHALL BE CAPTURED AND RELEASED LIVE IN SUITABLE HABITAT DOWNSTREAM OF THE WORK AREA UNDER THE SUPERVISION OF A QUALIFIED AQUATIC BIOLOGIST. A PERMIT FROM MOFLNRORD IS REQUIRED.

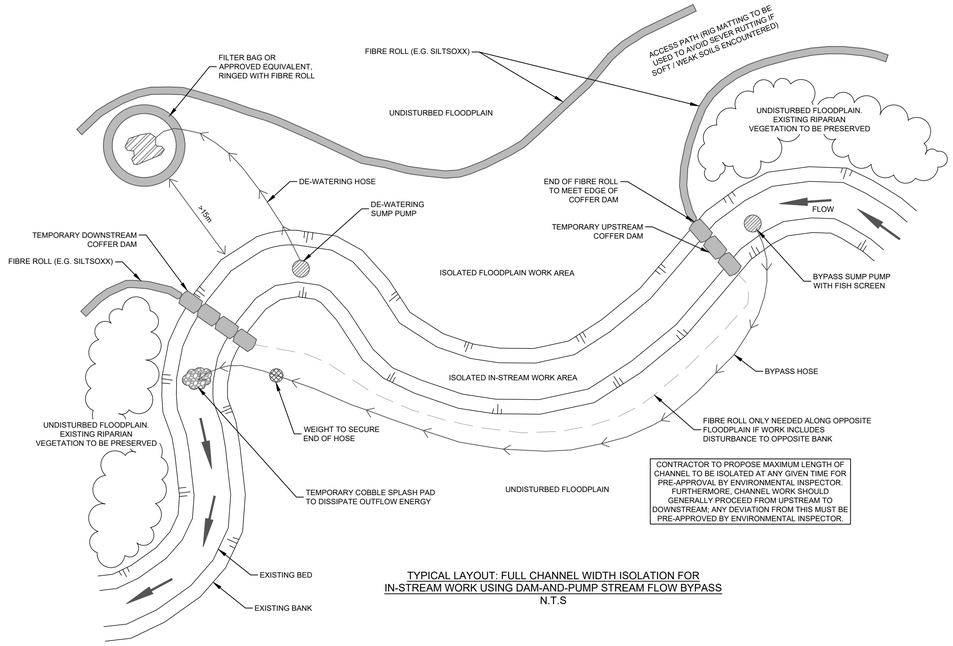
GENERAL STAGING PLAN FOR IN-CHANNEL WORK:

1. INSTALL FIBRE ROLLS ALONG ACCESS ROAD WHEN IT IS WITHIN 15m OF THE WATERCOURSE. ENSURE ENDS OF FIBRE ROLLS ARE POSITIONED TO TIE-IN WITH EDGES OF COFFER DAMS.
2. LAY DOWN RIG MATS ALONG ANY PORTIONS OF THE FLOODPLAIN ACCESS ROUTE WHERE THE SOILS ARE OBSERVED OR EXPECTED TO BE SOFT / WEAK, PRIOR TO EQUIPMENT ACCESS.
3. INSTALL UPSTREAM AND DOWNSTREAM COFFER DAMS IN A CONTROLLED MANNER TO REDUCE DISTURBANCE OF CHANNEL BED / BANKS AND RELEASE OF SEDIMENTS INTO CHANNEL.
4. INSTALL BYPASS PUMP AND HOSE TO BYPASS STREAM FLOW AROUND ISOLATED WORK AREA.
5. ALLOW A QUALIFIED PROFESSIONAL TO CONDUCT FISH RESCUE AND SALVAGE, AS PER PERMIT CONDITIONS, AND LIVE RELEASE ANY FISH FROM THE ISOLATED AREA INTO THE DOWNSTREAM CHANNEL.
6. INSTALL DE-WATERING PUMP, HOSE, AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DE-WATER CURRENT WORK AREA. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
7. PERFORM REQUIRED CHANNEL / BANK RESTORATION AND ENHANCEMENT WORKS, AS PER DESIGN SPECIFICATIONS.
8. REMOVE THE DE-WATERING PUMP AND ASSOCIATED EQUIPMENT, THEN SLOWLY REMOVE THE TEMPORARY COFFER DAMS TO REINTRODUCE FLOW GRADUALLY BACK INTO THE RESTORED CHANNEL.
9. RECONFIGURE THE POSITIONS AND EXTENTS OF THE FIBRE ROLLS AND RIG MATS, AS NECESSARY, TO RE-ESTABLISH ENVIRONMENTAL PROTECTION MEASURES PRIOR TO MOVING DOWNSTREAM TO THE NEXT IN-CHANNEL WORK AREA.
10. REPEAT FROM STEP 1, AS NECESSARY, AS CHANNEL WORKS ARE COMPLETED FROM UPSTREAM TO DOWNSTREAM.

***NOTE: TEMPORARY EROSION & SEDIMENT CONTROL MEASURES TO BE REMOVED ONCE AREA STABILIZED ,ALL DISTURBED RIPARIAN/FLOODPLAIN AREAS, INCLUDING BUT NOT LIMITED TO ACCESS ROADS AND LAYDOWN AREAS, TO BE SEEDED/RESTORED AS NEEDED TO PRE-EXISTING CONDITIONS OR BETTER.

WORK AREA ISOLATION NOTES

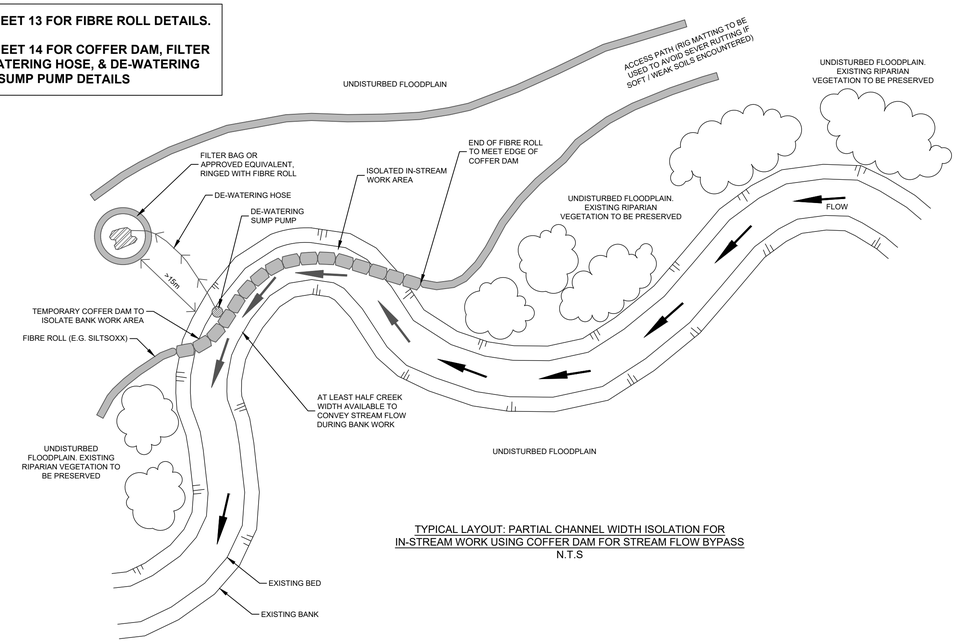
- INSTALL IN-STREAM PUMP OR INTAKE LINE OF REMOTE PUMP IN POOL LOCATED UPSTREAM OF WORK AREA. PROVIDE SCREENING TO PREVENT FISH FROM ENTERING INTO PUMP INTAKE . GO TO https://www.dfo-mpo.gc.ca/pnw-ppa/codes/screen-ecran-eng.html FOR APPROPRIATE SIZING OF FISH SCREEN. DIG TEMPORARY SUMP UPSTREAM IF NO NATURAL POOL EXISTS. DISCHARGE WATER THROUGH OR INTO AN ENERGY DISSIPATER INTO THE WATERCOURSE SUFFICIENTLY DOWNSTREAM TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- INSTALL UPSTREAM COFFER DAM WITH IMPERVIOUS LINER ACROSS WATERCOURSE AND MATCH WITH EXISTING CREEK BANKS. CENTER OF COFFER DAM TO BE DEPRESSED 0.150m
- WATER COLLECTED WITHIN THE ISOLATED WORK AREA TO BE PUMPED AROUND THE CONSTRUCTION SITE, DISCHARGED THROUGH A FILTER BAG LOCATED WITHIN THE FLOODPLAIN AS REMOTE FROM THE WATERCOURSE AS POSSIBLE AND SUFFICIENTLY DOWNSTREAM TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- AT THE END OF THE DAY THE STREAM MUST BE STABILIZED AND FREE FLOWING OR PUMPING MUST BE SUPERVISED.
- IN GENERAL ALL IN-STREAM CONSTRUCTION TO BE COMPLETED IN THE DRY. FISH EVACUATION PLAN MUST BE SUBMITTED AND APPROVED BY MOFLNRORD PRIOR TO COMMENCEMENT OF THE PROJECT. FISH RESCUE SHALL BE CONDUCTED FROM ISOLATED WORK AREAS BY A QUALIFIED INDIVIDUAL WITH A VALID PERMIT IN ACCORDANCE WITH THE BRITISH COLUMBIA STANDARDS AND BEST PRACTICES FOR IN-STREAM WORKS.
- INSTALL UPSTREAM COFFER DAM CONSISTING OF DOUBLE LINE WALL OF PEA GRAVEL BAGS COMPLETE WITH A LAYER OF IMPERMEABLE LINER SECURED BETWEEN THEM ACROSS WATERCOURSE AND MATCH EXISTING BANKS. DOWNSTREAM PEA GRAVEL BAGS SHALL BE INSTALLED TO PREVENT MIGRATION OF SILT AND SEDIMENT INTO THE ACTIVE STREAM FLOW. ENSURE COFFER DAM INSTALLATION IS EFFECTIVELY ISOLATING THE WORK AREA.
- IN-STREAM WORK IS TO START AT THE UPSTREAM LIMIT OF CONSTRUCTION AND BE COMPLETED SIMULTANEOUSLY WITH EXCAVATION SUCH THAT UNPROTECTED EXPOSURE IS MINIMIZED.
- DISTURBANCE CAUSED BY CONSTRUCTION EQUIPMENT ALONG THE BANK OR EDGE OF CREEK SHALL BE MINIMIZED BY THE USE OF RUBBER TRACKED EQUIPMENT, WOODEN MATS, OR OTHER APPROVED PROTECTIVE MEASURES.



TYPICAL LAYOUT: FULL CHANNEL WIDTH ISOLATION FOR IN-STREAM WORK USING DAM-AND-PUMP STREAM FLOW BYPASS
N.T.S

REFER TO SHEET 13 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 14 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS



TYPICAL LAYOUT: PARTIAL CHANNEL WIDTH ISOLATION FOR IN-STREAM WORK USING COFFER DAM FOR STREAM FLOW BYPASS
N.T.S

BC One Call
Click or Call Before You Dig
1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE:

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASUREMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	RM & DM
DRAWN:	AB
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2021

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
PH.: 250-562-2252 FAX: 866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN

MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT

ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 012
SHEET: 12 OF 17
REV C

U:\Project\1824\3\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek - ESC Plans.dwg
DATE: 25/11/2020 5:12 PM BY: Andrew Brabandt

NOT FOR CONSTRUCTION

SEDIMENT CONTROL BARRIERS

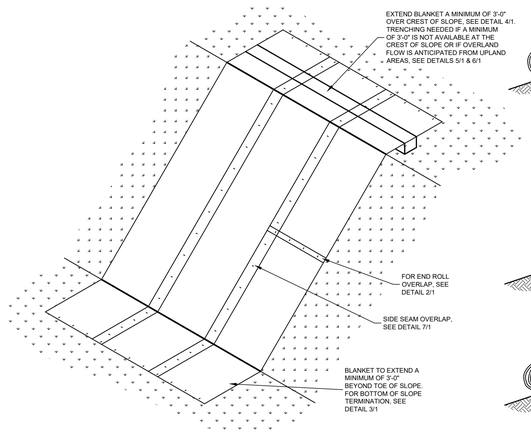
OPTION 1 - FIBRE ROLL

- FIBRE ROLL (E.G FILTREXX SILTSOXX OR APPROVED EQUIVALENT), FILLED WITH WOOD CHIPS, ARE THE PREFERRED TYPE OF SEDIMENT CONTROL BARRIER.
- MIN. DIAMETER = 300mm
- FIBRE ROLLS TO BE REGULARLY INSPECTED FOR TEARS OR HOLES, AND REPAIRED / REPLACED AS NEEDED TO MAINTAIN FUNCTION.
- FIBRE ROLLS MAY BE RE-USED IN A DIFFERENT LOCATION, ONLY IF THEY REMAIN FREE OF TEARS / HOLES, HAVE NOT LOST ANY OF THEIR CONTENTS, AND STILL MAINTAIN THE MINIMUM DIAMETER.
- REMOVE ALL SURFACE OBSTRUCTIONS GREATER THAN 50mm FROM THE GROUND PRIOR TO PLACING FIBRE ROLLS.
- TYPICAL FIBRE ROLL INSTALLATION DETAILS ARE SHOWN ON THIS SHEET FOR A FILTREXX SILTSOXX FIBRE ROLL. THE CONTRACTOR MAY USE THIS BRAND OF FIBRE ROLL OR AN APPROVED EQUIVALENT.

OPTION 2 - SEDIMENT CONTROL FENCE

- SEDIMENT CONTROL FENCE SUPPLIES SHOULD BE AVAILABLE ON SITE FOR USE IN CASES WHERE SURFACE PONDING OCCURS AND ADDITIONAL SILTATION CONTROL IS WARRANTED BEYOND WHAT THE FIBRE ROLLS CAN PROVIDE.
- GEOTEXTILE TO BE NON-WOVEN WITH A MINIMUM EQUIVALENT OPENING SIZE OF 0.15mm AND A MAXIMUM EQUIVALENT OPENING SIZE OF 0.25mm.
- NON-WOVEN GEOTEXTILE TO HAVE A HORIZONTAL OVERLAP OF 1 METER AT JOINTS.
- TYPICAL SEDIMENT CONTROL FENCE INSTALLATION DETAILS ARE SHOWN ON THIS SHEET. THESE DETAILS REPRESENT IDEAL SCENARIOS. ACTUAL SITE CONDITIONS MAY VARY AND SEDIMENT CONTROL FENCE INSTALLATION SHOULD BE TAILORED FOR EACH SITE.

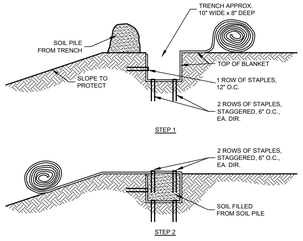
EROSION CONTROL BLANKET - TYPICAL DETAILS



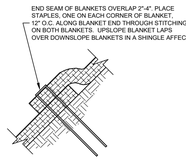
SLOPE DETAIL
NO SCALE — 1/1

OVER SLOPE CREST METHOD
NO SCALE — 4/1

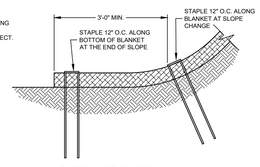
DO NOT NEED TO TRENCH BLANKET IN IF IT CAN BE EXTENDED A MINIMUM OF 3'-0" OVER THE CREST OF THE SLOPE.



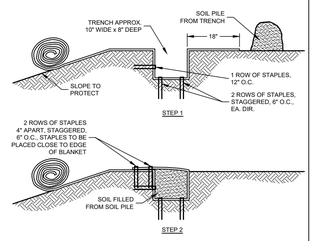
SLOPE TRENCHING METHOD "A"
NO SCALE — 5/1



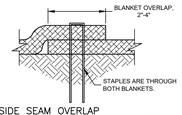
END ROLL OVERLAP
NO SCALE — 2/1



BOTTOM OF SLOPE TERMINATION
NO SCALE — 3/1



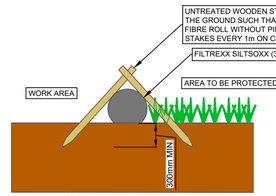
SLOPE TRENCHING METHOD "B"
NO SCALE — 6/1



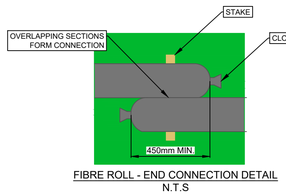
SIDE SEAM OVERLAP STAPLE DETAIL
NO SCALE — 7/1

EROSION CONTROL BLANKETS

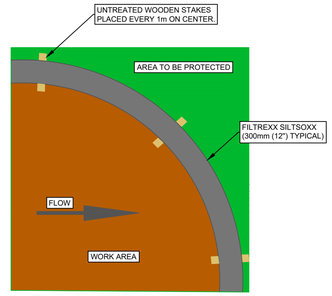
- BIODEGRADABLE EROSION CONTROL BLANKETS (E.G WOVEN JUTE, COIR MESH, GREAT LAKES ASPEN, ETC) TO BE AVAILABLE ON SITE IN CASE THEY ARE NEEDED TO HELP MITIGATE EROSION OF TEMPORARILY EXPOSED SOILS ON THE FLOODPLAIN AND / OR ALONG THE POND SHORELINES
- DRAWINGS SHOWN ON THIS SHEET ILLUSTRATE TYPICAL INSTALLATION DETAILS FOR AN AMERICAN EXCELSIOR CURLEX NETFREE SLOPE PROTECTION EROSION CONTROL BLANKET. THE CONTRACTOR MAY USE THIS BRAND OF EROSION CONTROL BLANKET OR AN APPROVED EQUIVALENT.



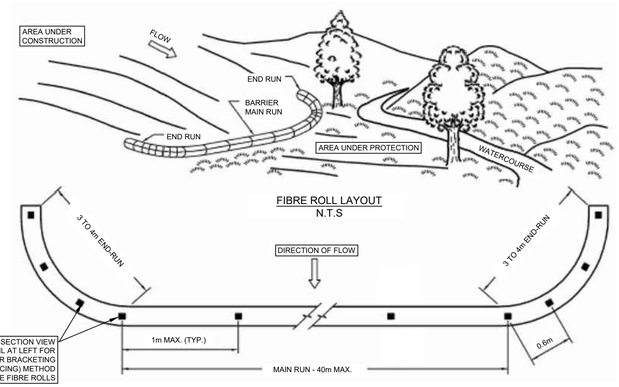
FIBRE ROLL - SECTION VIEW
N.T.S



FIBRE ROLL - END CONNECTION DETAIL
N.T.S

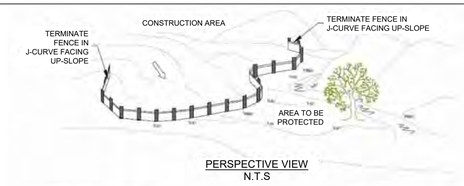


FIBRE ROLL - PLAN VIEW
N.T.S

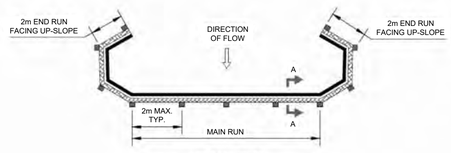


FIBRE ROLL LAYOUT
N.T.S

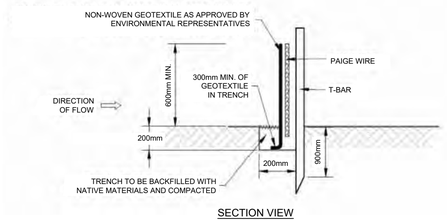
FIBRE ROLL LAYOUT - PLAN VIEW
N.T.S



PERSPECTIVE VIEW
N.T.S

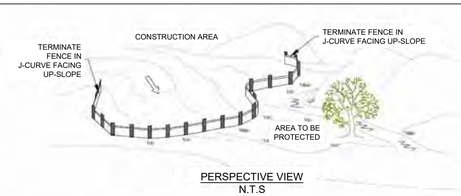


PLAN VIEW
N.T.S

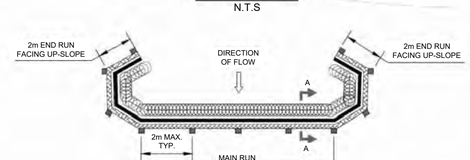


SECTION VIEW
N.T.S

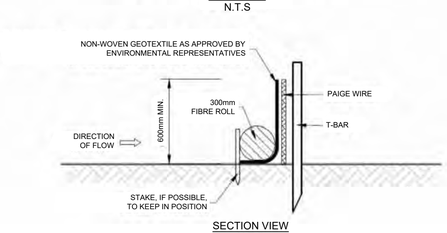
SEDIMENT CONTROL FENCE - UNFROZEN CONDITIONS



PERSPECTIVE VIEW
N.T.S



PLAN VIEW
N.T.S



SECTION VIEW
N.T.S

SEDIMENT CONTROL FENCE - FROZEN CONDITIONS

BC One Call — Click or Call Before You Dig — 1-800-474-6886

U:\Projects\1824\3\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek - ESC Plans.dwg
DATE: 25/11/2020 5:12 PM BY: Andrew Brabandt

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE:

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASUREMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	RM & DM
DRAWN:	AB
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2021

Palmer™
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
PH.: 250-562-2252 FAX: 866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN

MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT

SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 013
SHEET: 13 OF 17
REV C

NOT FOR CONSTRUCTION

WORK AREA ISOLATION MEASURES

METRE BAG COFFER DAM

- FOR ISOLATION OF THE FULL CHANNEL WIDTH (DAM-AND-PUMP STREAM-FLOW BYPASS) OR ONLY A PORTION OF THE CHANNEL WIDTH (PASSIVE STREAM-FLOW BYPASS FOR SINGLE-BANK WORK) FOR IN-CHANNEL WORK.
- 1-2 TIER, SINGLE-STACK METRE BAG COFFER DAM PREFERRED GIVEN MINIMAL DISTURBANCE; PYRAMID-STACK METRE BAG COFFER DAM MAY BE NECESSARY IN DEEPER-WATER SCENARIOS.
- METRE BAGS SHOULD BE FILLED WITH PEA GRAVEL AND SHOULD NOT BE OVER-FILLED.
- A WATERPROOF MEMBRANE IS REQUIRED OVER THE PEA-GRAVEL METRE BAGS. THE WATERPROOF MEMBRANE MUST BE KEYED IN UNDER THE BARRIER TO MINIMIZE LEAKAGE.
- COFFER DAM MAY BE CONSTRUCTED OF SMALLER PEA-GRAVEL SANDBAGS OR OTHER SUITABLE EQUIVALENT. SEE BELOW FOR DETAILS.

PEA GRAVEL COFFER DAM

- CAN BE USED AT THE DISCRETION OF THE ENVIRONMENTAL REPRESENTATIVE FOR ISOLATION OF CHANNELS IN LOW-FLOW, SHALLOW WATER CONDITIONS WHEN LOCAL WORKS CAN BE COMPLETED WITHIN A FAVORABLE WEATHER WINDOW AND / OR THE CHANNEL IS LOCALLY TOO NARROW OR AWKWARD FOR THE USE OF METRE BAGS.

DE-WATERING SUMP PUMP

- FOR TEMPORARY MAINTENANCE OF DRY OR SHALLOWER CONDITIONS WITHIN AN ISOLATED IN-CHANNEL WORK AREA.
- A PUMP WITH A MINIMUM RECOMMENDED PUMPING CAPACITY OF 2000GPM MUST BE USED.
- DURING ELEVATED FLOWS APPROACHING BANK-FULL DEPTH, ALL PUMPING WILL BE STOPPED AND COFFER DAMS WILL BE TEMPORARILY REMOVED TO ALLOW FLOWS TO PASS UNOBSTRUCTED.

DE-WATERING FILTER BAG RINGED WITH FILTREXX SILTSOXX (OR APPROVED EQUIVALENT)

- FOR CONTROLLED DEPOSITION OF FINE SEDIMENT PUMPED OUT OF AN ISOLATED IN-CHANNEL WORK AREA, AWAY FROM THE WATERCOURSE.
- PLACE FILTER BAG (3.5m X 5.0m TERRAFIX ENVIROBAG OR APPROVED EQUIVALENT) ON A LEVEL, STABILIZED AREA OF THE FLOODPLAIN, ON VEGETATED GROUND > 15m AWAY FROM THE CHANNEL. FILTREXX SILTSOXX (300mm (12") DIAMETER) OR APPROVED EQUIVALENT TO BE PLACED AROUND THE FILTER BAG.
- ISOLATED SECTION OF CHANNEL TO BE PUMPED AND DE-WATERED INTO FILTER BAG.
- REPLACE UNIT WHEN HALF FULL OF SEDIMENT OR WHEN SEDIMENT HAS SIGNIFICANTLY REDUCED THE FLOW RATE OF PUMP DISCHARGE.
- ALLOW SEDIMENT BAG TO DRY IN DESIGNATED SEDIMENT DRYING AREA AND THEN RE-USE THE SEDIMENT AS PART OF BANK RESTORATION OR DISPOSE OF IT OFF SITE UNDER DIRECTION OF THE ON-SITE ENVIRONMENTAL REPRESENTATIVE.

PLANTING NOTES

SITE PREPARATION:

- EXISTING WOODY VEGETATION TO BE RETAINED AND PROTECTED TO THE GREATEST EXTENT FEASIBLE.
- EXISTING HERBACEOUS VEGETATION IS TO BE MOWED OR SCYTHED TO 15cm IN HEIGHT BEFORE PLANTING AND / OR SEEDING.
- SOIL IS TO BE SCARIFIED WITH A SHALLOW VERTICAL TILL PLOW WHERE SEEDING IS PROPOSED. SCARIFICATION SHOULD BE PARALLEL TO THE STREAM TO MINIMIZE SURFACE RUNOFF.

PLANT MATERIAL:

- PLANT MATERIAL MUST BE LOCALLY SOURCED AND SPECIES MUST BE NATIVE TO THE REGION.
- PLANT STOCK MUST BE INSPECTED UPON DELIVERY TO ENSURE THAT THE MATERIAL CONSISTS OF APPROPRIATE NATIVE SPECIES IN GOOD CONDITION
- SHRUBS TO BE CONTAINER GROWN OR BARE ROOT AND RANGING FROM 0.4m TO 1.0m IN HEIGHT.
- SEEDS OF THE SUGGESTED MIXTURE OR SIMILAR BLEND TO BE MIXED BEFORE THE APPLICATION.
- LIVE STAKES TO BE 35 TO 50mm IN DIAMETER AND 1 TO 1.5m IN LENGTH. SOAKED FOR A MINIMUM OF 24 HOURS BEFORE INSTALLATION. TIPS OF LIVE STAKES CAN BE SEALED TO MINIMIZE RISK OF DISEASE.
- BRUSH LAYERING CUTTINGS TO BE A MINIMUM OF 10mm IN DIAMETER AND 1.5 TO 2.0m IN LENGTH.

PLANTING DENSITY:

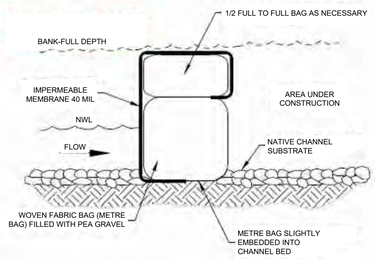
- SHRUBS TO BE PLANTED 1 SHRUB PER m² IN CLUSTERS OF 6 INDIVIDUAL SHRUBS. EACH SHRUB CLUSTER SHOULD COMPRISE A MINIMUM OF 2 SPECIES. SHRUB CLUSTERS ARE TO BE SCATTERED APPROXIMATELY 12m APART.
- SEED MIX IS TO BE APPLIED AT A RATE OF 20 kg/ha.
- LIVE STAKES TO BE PLANTED 2 LIVE STAKES PER m².
- BRUSH LAYER CUTTINGS TO BE DENSELY PACKED, SIDE-BY-SIDE, TO A THICKNESS OF 20cm TO FORM A CONTINUOUS LAYER ACROSS THE FULL LENGTH OF THE LIFT.

TIMING:

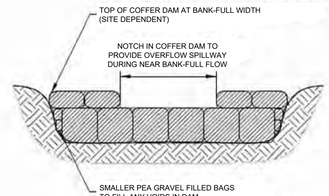
- PLANTING OF WOODY MATERIAL SHOULD BE COMPLETED IN THE SPRING (APRIL TO MAY) OR FALL (SEPTEMBER TO OCTOBER).
- SEEDING SHOULD BE COMPLETED IMMEDIATELY AFTER THE PLANTING OF WOODY VEGETATION.

TENDING:

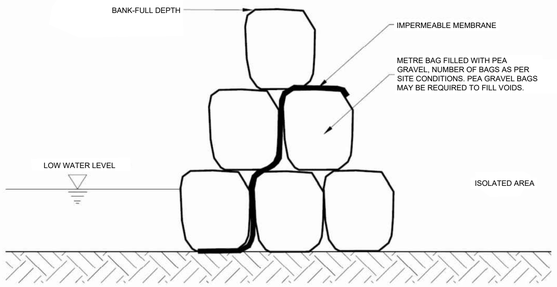
- ALL PLANTINGS SHOULD BE WATERED IMMEDIATELY AFTER INSTALLATION.
- ALL PLANTINGS SHOULD BE WATERED DURING PERIODS OF NATURAL DROUGHT CONDITIONS (ESPECIALLY FROM LATE SPRING TO THE END OF SUMMER) FOR THE FIRST GROWING SEASON.



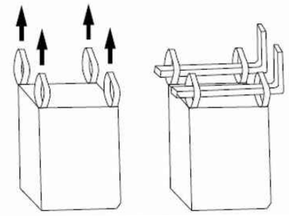
METRE BAG COFFER DAM - SECTION
N.T.S



METRE BAG COFFER DAM - PROFILE
N.T.S

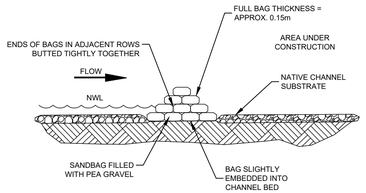


METRE BAG WATERPROOF ISOLATION BARRIER - SECTION
N.T.S

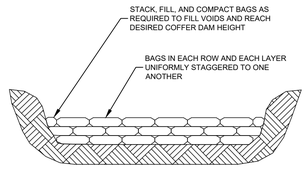


1m X 1m X 1m SYNTHETIC FIBRE BAGS WITH HEAVY DUTY LIFTING LOOPS SUITABLE FOR CARRYING PEA GRAVEL TO CONSTRUCT A TEMPORARY COFFER DAM. SUPPLIED BY ENVIRO-PACK MATERIAL HANDLING INC. OR APPROVED EQUIVALENT

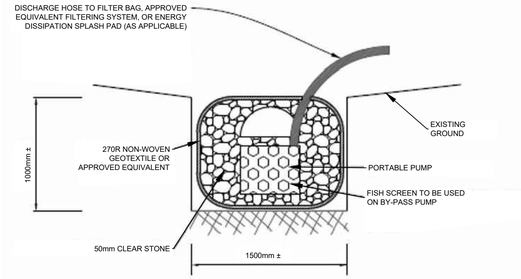
PEA GRAVEL METRE BAG HANDLING
N.T.S



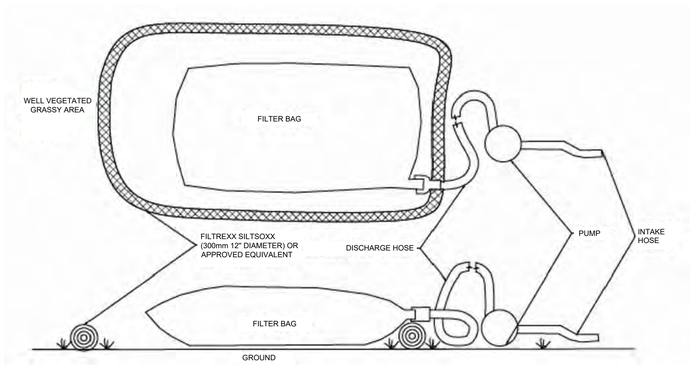
PEA GRAVEL BAG COFFER DAM - SECTION
N.T.S



PEA GRAVEL BAG COFFER DAM - PROFILE
N.T.S



DE-WATERING SUMP PUMP DETAIL
N.T.S



DE-WATERING FILTER BAG WITH FILTREXX SILTSOXX - PLAN & PROFILE
N.T.S

PLANT LIST - CHANNEL RIPARIAN AREAS

PLANTING TYPES	COMMON NAME	SCIENTIFIC NAME	QUANTITY
SEED MIX 1 - MOIST FLOODPLAIN (SM1)	SAND DROPSEED	SPOROBOLUS CRYPTANDRUS	DRY SEED MIXED BY WEIGHT TO 3.5kg FOR SM1 AREAS AND 17.5kg FOR SC1 AREAS (21kg TOTAL)
	JUNE GRASS	KOELERIA MACRANTHA	
	FRINGED BROME	BROMUS CILATUS	
	TUFTED HAIRGRASS	DESCHAMPSIA CESPITOSA	
	SLENDER WHEATGRASS	ELYMUS TRACHYCAULUS SSP. SUBSECUNDUS	
	AMERICAN VETCH	VICIA AMERICANA	
	THICKSPIKE WILDRYE	ELYMUS LANCEOLATUS	
	FOWL BLUEGRASS	POA PALUSTRIS	
SEED MIX 2 - WET FEN (SM2)	NORTHERN BEAKED SEDGE	CAREX UTRICULATA	DRY SEED MIXED BY WEIGHT TO 18.8kg FOR SM2 AREAS AND 51.0kg FOR SC2 AREAS (69.8kg TOTAL)
	WATER SEDGE	CAREX AQUATILIS	
	SLENDER SEDGE	CAREX LASIOCARPA	
	SITKA SEDGE	CAREX STICHENSIS	
SHRUB CLUSTER 1 - MOIST FLOODPLAIN (SC1) [PLAN WITH SEED MIX 1]	SASKATOON	AMELANCHIER ALNIFOLIA	42
	NOOTKA ROSE	ROSA NUTKANA	42
	RED ELDERBERRY	SAMBUCUS RACEMOSA	42
	SITKA MOUNTAIN-ASH	SORBUS SITCHENSIS	42
	BEAKED HAZELNUT	CORYLUS CORNUTA	42
SHRUB CLUSTER 2 - WET FEN (SC2) [PLANT WITH SEED MIX 2]	PACIFIC NINEBARK	PHYSOCARPUS CAPITATUS	121
	SALMONBERRY	RUBUS SPECTABILIS	121
	HIGHBUSH-CRANBERRY	VIBURNUM EDULE	121
	HARDHACK	SPIRAEA DOUGLASII	121
	BOG WILLOW	SALIX PEDICELLARIS	121
LIVE STAKE 1 - MOIST FLOODPLAIN (LS1)	RED-OSIER DOGWOOD	CORNUS STOLONIFERA	75
	SCOULER'S WILLOW	SALIX SCOULERIANA	75
	COYOTE WILLOW	SALIX EXIGUA	75
	GEYER'S WILLOW	SALIX GEYERIANA	75
LIVE STAKE 2 - WET FEN (LS2)	RED-OSIER DOGWOOD	CORNUS STOLONIFERA	50
	PACIFIC WILLOW	SALIX LASIANDRA	50
	HOOKER'S WILLOW	SALIX HOOKERIANA	50
	SITKA WILLOW	SALIX SITCHENSIS	50
BRUSH LAYERING CUTTINGS (BLC)	RED-OSIER DOGWOOD	CORNUS STOLONIFERA	2000
	PACIFIC WILLOW	SALIX LUCIDA SPP. LASIANDRA	2000
	HOOKER'S WILLOW	SALIX HOOKERIANA	2000
	COYOTE WILLOW	SALIX EXIGUA	2000

BC One Call
Click or Call Before You Dig
1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE:

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASUREMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	RM & DM
DRAWN:	AB
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2021

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
PH.: 250-562-2252 FAX: 866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN

MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT

WORK AREA ISOLATION MEASURES & PLANTING NOTES FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 014
SHEET: 14 OF 17
REV C

U:\Projects\1824\3\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek - ESC Plans.dwg
DATE: 2021\1\2020 5:12 PM BY: Andrew Brakenhoff

NOT FOR CONSTRUCTION

OVERWINTERING PONDS - EROSION & SEDIMENT CONTROL AND WORK AREA ISOLATION - NOTES:

INTRODUCTORY STATEMENT

- THE EROSION & SEDIMENT CONTROL PLAN HAS BEEN DEVELOPED TO ENSURE ESTABLISHMENT AND MAINTENANCE OF ALL NECESSARY ENVIRONMENTAL PROTECTION MEASURES BEFORE, DURING AND AFTER EXCAVATION AND NATURALIZATION OF THE OVERWINTERING PONDS. IT ALSO ALLOWS THE CONTRACTOR, OVERSEEN BY AN ENVIRONMENTAL INSPECTOR, THE FLEXIBILITY TO OPTIMIZE THE MEASURES FOR THE MOST EFFECTIVE SEQUENCE AND APPROACH FOR IMPLEMENTATION. RATHER THAN PRESCRIBING EXACTLY WHERE AND WHEN DIFFERENT MEASURES ARE TO BE USED, TYPICAL LAYOUTS FOR ENVIRONMENTAL PROTECTION AND WORK-AREA SITE ISOLATION ARE PROVIDED TO MAKE CLEAR WHAT OPTIONS ARE AVAILABLE TO THE CONTRACTOR. THE PONDS WILL BE EXCAVATED AND NATURALIZED IN COMPLETE ISOLATION FROM THE ADJACENT CHANNEL AND ONLY CONNECTED AT THE VERY END, IN A GRADUAL AND CONTROLLED MANNER, TO MINIMIZE POTENTIAL FOR SUSPENSION AND OUTFLOW OF SETTLED SEDIMENT. AN ENVIRONMENTAL INSPECTOR FAMILIAR WITH THE EROSION & SEDIMENT CONTROL PLAN WILL BE AVAILABLE ON SITE TO ANSWER QUESTIONS AND PROVIDE GUIDANCE TO THE CONTRACTOR.
- EXCAVATION AND NATURALIZATION OF OVERWINTERING PONDS TO BE COMPLETED IN WINTER, WHEN GROUNDWATER LEVELS ARE RELATIVELY LOW AND ALLUVIAL FLOODPLAIN SOILS ARE FROZEN AND AT LEAST PARTLY SNOW-COVERED AT SURFACE, TO OPTIMIZE EARTHWORKS AND SEDIMENT MANAGEMENT.

SECTION 1: SITE MANAGEMENT

1. EROSION AND SEDIMENT CONTROL (ESC) MEASURES WILL BE IMPLEMENTED PRIOR TO, AND MAINTAINED DURING THE CONSTRUCTION PHASES, TO PREVENT ENTRY OF SEDIMENT INTO THE WATER, ALL DAMAGED EROSION AND SEDIMENT CONTROL MEASURES SHOULD BE REPAIRED AND / OR REPLACED WITHIN 48 HOURS OF INSPECTION.
2. DISTURBED AREAS WILL BE MINIMIZED TO THE EXTENT POSSIBLE, AND TEMPORARILY OR PERMANENTLY STABILIZED OR RESTORED AS THE WORK PROGRESSES.
3. ALL IN-WATER AND NEAR WATER EARTHWORKS WILL BE CONDUCTED IN THE DRY AND / OR WITHIN AN ISOLATED WORK AREA WITH APPROPRIATE EROSION AND SEDIMENT CONTROLS. SPECIFIED PLACEMENTS OF BOULDERS, GRAVEL, AND LARGE WOOD MAY BE IN / NEAR WATER WITHOUT COMPLETE ISOLATION IF NOT ASSOCIATED WITH EARTHWORK.
4. THE EROSION AND SEDIMENT CONTROL STRATEGIES OUTLINED ON THE PLANS ARE NOT STATIC AND MAY NEED TO BE UPGRADED / AMENDED AS SITE CONDITIONS CHANGE TO MINIMIZE SEDIMENT LADEN RUNOFF FROM LEAVING THE WORK AREAS. IF THE PRESCRIBED MEASURES ON THE PLANS ARE NOT EFFECTIVE IN PREVENTING THE RELEASE OF DELETERIOUS SUBSTANCE, INCLUDING SEDIMENT, THEN ALTERNATIVE MEASURES MUST BE IMPLEMENTED IMMEDIATELY TO MINIMIZE POTENTIAL ECOLOGICAL IMPACTS. ADDITIONAL ESC MEASURES TO BE KEPT ON SITE AND USED AS NECESSARY.
5. AN ENVIRONMENTAL MONITOR WILL ATTEND THE SITE TO INSPECT ALL NEW CONTROLS, AS WELL AS ON A REGULAR BASIS, OR FOLLOWING RAIN / SNOW MELT EVENTS, TO MONITOR ALL WORKS, AND IN PARTICULAR WORKS RELATED TO EROSION AND SEDIMENT CONTROLS, DE-WATERING, RESTORATION, AND IN / NEAR-WATER WORKS. SHOULD CONCERNS ARISE ON SITE, THE ENVIRONMENTAL MONITOR WILL CONTACT THE APPROPRIATE REGULATORY OFFICER AS WELL AS THE PROPONENT.
6. ALL ACTIVITIES, INCLUDING MAINTENANCE PROCEDURES, WILL BE CONTROLLED TO PREVENT THE ENTRY OF PETROLEUM PRODUCTS, DEBRIS, RUBBLE, CONCRETE, OR OTHER DELETERIOUS SUBSTANCES INTO THE WATER. VEHICULAR REFUELING AND MAINTENANCE WILL BE CONDUCTED A MINIMUM OF 30 METERS FROM THE WATER.
7. THE PROPONENT / CONTRACTOR SHALL MONITOR THE WEATHER FOR THE DURATION OF CONSTRUCTION TO ENSURE THAT THE WORKS WILL BE CONDUCTED DURING FAVORABLE WEATHER CONDITIONS. SHOULD AN UNEXPECTED STORM OR SNOWMELT ARISE, THE CONTRACTOR WILL REMOVE ALL UNFIXED ITEMS FROM THE CHANNEL, POND, AND FLOOD PLAIN THAT WOULD HAVE THE POTENTIAL TO CAUSE A SPILL OR AN OBSTRUCTION TO FLOW, E.G., FUEL TANKS, PORTA-POTTIES, MACHINERY, EQUIPMENT, CONSTRUCTION MATERIALS, ETC.
8. ALL DE-WATERING SHALL BE TREATED AND RELEASED TO THE ENVIRONMENT AT LEAST 15 METERS FROM A WATERCOURSE OR POND AND ALLOWED TO DRAIN THROUGH A FILTER BAG AND WELL-VEGETATED AREA. NO DE-WATERING EFFLUENT SHALL BE SENT DIRECTLY TO ANY WATERCOURSE, POND, FOREST, OR ALLOWED TO DRAIN ONTO DISTURBED SOILS WITHIN THE WORK AREA. THESE CONTROL MEASURES SHALL BE MONITORED FOR EFFECTIVENESS AND MAINTAINED OR REVISED TO MEET THE OBJECTIVE OF PREVENTING THE RELEASE OF SEDIMENT-LADEN WATER.
9. ALL ACCESS TO THE POND WORK AREA SHALL BE FROM THE EAST END OF THE VALLEY. NO EQUIPMENT OR VEHICLES ARE PERMITTED TO CROSS THROUGH THE WATERCOURSE.
10. THE CONTRACTOR SHALL INSTALL FIBRE ROLLS AND / OR SEDIMENT CONTROL FENCING AS REQUIRED TO CONTROL THE DISCHARGE OF EXPOSED SOIL OR TEMPORARY PILE(S) OF EXCAVATED SOILS OR, SOILS AND GRANULAR MATERIAL TO BE USED DURING CONSTRUCTION.
11. ESC MEASURES ARE TO REMAIN IN PLACE AND IN WORKING ORDER UNTIL ALL ON-SITE CONSTRUCTION IS COMPLETED.
12. AREAS WHICH REMAIN DISTURBED FOR MORE THAN 30 DAYS SHALL BE STABILIZED USING SEED, APPROVED EROSION CONTROL BLANKETS, OR SIMILAR APPROVED EQUIVALENT. IF CONDITIONS AREN'T SUITABLE FOR SEED APPLICATION, AN EROSION CONTROL BLANKET WILL BE USED IN ITS PLACE. SEE EROSION CONTROL BLANKET TYPICAL DETAIL ON SHEET 16.
13. NO EROSION AND SEDIMENT CONTROL MEASURE SHALL CONTAIN ANY PLASTIC, EVEN IF IT IS BIODEGRADABLE.
14. THE CONTRACTOR MUST HAVE SUITABLE PUMPING CAPABILITIES ON SITE AT ALL TIMES TO FACILITATE CONSTRUCTION ACTIVITIES IN THE DRY.
15. WORKS SHOULD BE COMPLETED IN STAGES TO REDUCE THE DURATION OF DISTURBED AREAS.
16. CONTRACTOR IS NOT TO DISPOSE OF ANY OF THE MATERIAL USED IN THE PEA GRAVEL METER BAGS INTO THE CHANNEL, POND, OR SURROUNDING AREA. ALL PEA GRAVEL BAGS ARE TO BE REMOVED OFF OF SITE.
17. TEMPORARY STAGING AREAS ARE TO BE SITUATED MORE THAN 15 METERS FROM THE WATERCOURSE OR POND. ALL MAJOR OVERNIGHT STAGING / STOCKPILING AREAS WILL BE A MINIMUM OF 15 METERS AWAY FROM THE WATERCOURSE OR POND. CONTRACTOR TO MONITOR WEATHER FORECASTS TO ENSURE MACHINES AND MATERIALS ARE REMOVED WHEN THE INCLEMENT WEATHER IS ANTICIPATED. STOCKPILE HEIGHTS WILL BE KEPT BELOW 1.5 METERS IN HEIGHT.
18. TEMPORARY STOCKPILES OF EXCAVATED ALLUVIAL SEDIMENT ARE TO BE KEPT AS SMALL AS POSSIBLE (<1.5 METER HEIGHT) BY ENSURING REDISTRIBUTION OF MATERIAL AROUND FORMER HOMESTEAD, OR OFFSITE HAULAGE, KEEPS PACE WITH EXCAVATION.

SECTION 2: CONSTRUCTION TIMING

19. EXCAVATION AND NATURALIZATION OF OVERWINTERING PONDS TO BE COMPLETED IN WINTER, WHEN GROUNDWATER LEVELS ARE RELATIVELY LOW AND ALLUVIAL FLOODPLAIN SOILS ARE FROZEN AND AT LEAST PARTLY SNOW-COVERED AT SURFACE, TO OPTIMIZE EARTHWORKS AND SEDIMENT MANAGEMENT.
20. TO PROTECT LOCAL FISH POPULATIONS DURING THEIR SPAWNING, NURSERY AND MIGRATORY PERIODS, IN-WATER ACTIVITIES MAY ONLY OCCUR DURING THE TIME PERIOD OF JULY 15 TO APRIL 15 (OF THE FOLLOWING YEAR), IN ACCORDANCE WITH THE OMINECA REGION LEAST-RISK TIMING WINDOW FOR RAINBOW TROUT. CHANNEL WORKS ARE BEST COMPLETED IN LATE SUMMER / EARLY FALL, WHEN FLOWS ARE LOW AND THERE IS NO ICE. EXCAVATION AND NATURALIZATION OF OVERWINTERING PONDS IS BEST COMPLETED IN WINTER WHEN THE GROUND SURFACE IS FROZEN AND THE GROUNDWATER LEVEL IN THE ALLUVIAL FLOODPLAIN SOILS IS LOW.

SECTION 3: FISH RELOCATION

21. FISH STRANDED WITHIN THE WORK AREA SHALL BE CAPTURED AND RELEASED LIVE IN SUITABLE HABITAT DOWNSTREAM OF THE WORK AREA UNDER THE SUPERVISION OF A QUALIFIED AQUATIC BIOLOGIST. A PERMIT FROM MOFLNRORD IS REQUIRED.

GENERAL STAGING PLAN FOR OVERWINTERING POND CONSTRUCTION AND CONNECTION TO ADJACENT CREEK:

EXCAVATION AND NATURALIZATION OF POND

1. INSTALL FIBRE ROLLS ALONG ACCESS ROAD WHEN IT IS WITHIN 15m OF THE WATERCOURSE. ENSURE ENDS OF FIBRE ROLLS ARE POSITIONED TO TIE-IN WITH EDGES OF COFFER DAMS.
2. LAY DOWN RIG MATS ALONG ANY PORTIONS OF THE FLOODPLAIN ACCESS ROUTE WHERE THE SOILS ARE OBSERVED OR EXPECTED TO BE SOFT / WEAK, PRIOR TO EQUIPMENT ACCESS.
3. INSTALL FIBRE ROLLS AROUND PERIMETER OF TEMPORARY STOCKPILE AREA TO FULLY ISOLATE IT FROM SURROUNDINGS.
4. INSTALL FIBRE ROLLS AROUND PERIMETER OF OVERWINTERING POND EXCAVATION LIMITS TO FULLY ISOLATE EXCAVATION AND NATURALIZATION AREA FROM SURROUNDINGS.
5. STRIP AND SALVAGE TOPSOIL WITHIN LIMITS OF EXCAVATION AREA FOR LATER USE IN ASSOCIATION WITH RESTORATION/SEEDING OF DISTURBED AREAS.
6. BEGIN EXCAVATION FROM SECTION OF POND SHORELINE FARTHEST FROM ACCESS ROUTE, ACCORDING TO TYPICAL LAYOUT DETAILS ON THIS SHEET, WITH EQUIPMENT FULLY INSIDE THE POND LIMITS AND AT NO TIME POSITIONED OUTSIDE THE POND LIMITS.
7. INSTALL DE-WATERING PUMP, HOSE AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DRAW DOWN WATER WITHIN CURRENT WORK AREA TO THE EXTENT NECESSARY. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
8. PROCEED WITH EXCAVATION IN A DELIBERATE AND SYSTEMATIC MANNER, PROGRESSIVELY DEEPER AND TOWARD ACCESS, SUCH THAT LITTLE TO NO MOVEMENT OF EQUIPMENT IS REQUIRED ON CUT BENCHES/SLOPES AND ALL MATERIAL HANDLING IS CONCENTRATED IN ONE AREA AROUND ACCESS ROUTE. DE-WATERING SYSTEM TO BE MOVED, AS NEEDED, DURING PROGRESSIVE EXCAVATION.
9. INSTALL WOOD AND BOULDER HABITAT FEATURES, ACCORDING TO TYPICAL DETAILS ON SHEETS, 007, 011, AND DESIGN DETAILS ON SHEETS 008 TO 010, PREFERABLY AS EXCAVATION PROCEEDS AS OPPOSED TO AFTER FULL COMPLETION OF EXCAVATION.
10. REMOVE ANY RIG MATS THAT WERE USED WITHIN THE POND LIMITS AND RE-USE ELSEWHERE OR TRANSPORT OFF-SITE.

CONSTRUCTION OF "LEAKY BANK":

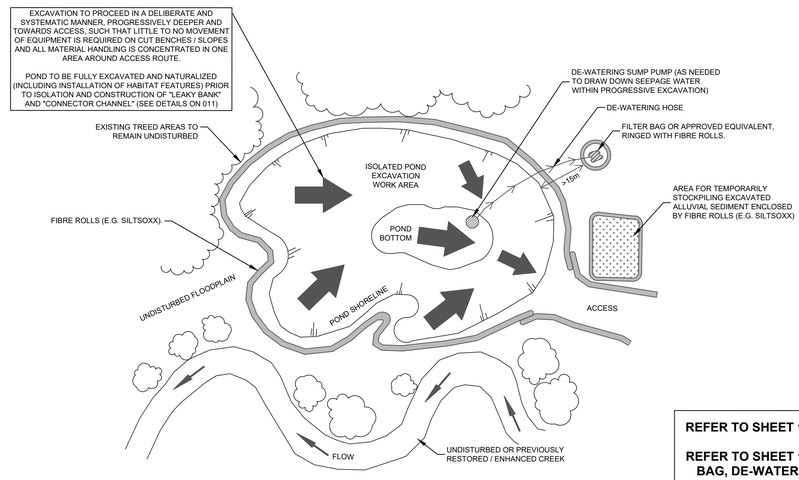
1. INSTALL COFFER DAMS AT EDGES OF CHANNEL AND POND IN A CONTROLLED MANNER TO REDUCE DISTURBANCE TO BED/BANKS AND RELEASE OF SEDIMENTS INTO WATER. ENSURE ENDS OF FIBRE ROLLS ON FLOODPLAIN MEET EDGES OF COFFER DAM AT BANK.
2. ALLOW A QUALIFIED PROFESSIONAL TO CONDUCT FISH RESCUE AND SALVAGE, AS PER PERMIT CONDITIONS, AND LIVE RELEASE ANY FISH FROM THE ISOLATED AREA INTO THE DOWNSTREAM CHANNEL.
3. INSTALL DE-WATERING PUMP, HOSE AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DE-WATER CURRENT WORK AREA. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE OR POND, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
4. PROGRESSIVELY EXCAVATE THE FLOODPLAIN TO THE SPECIFIED WIDTH AND DEPTH SLIGHTLY BELOW THE CHANNEL BED, BEGINNING AT THE POND SHORELINE AND MOVING TOWARD THE CHANNEL. CAREFULLY PLACE THE GRAVEL-COBBLE MIXTURE TO FORM THE CORE OF THE 'LEAKY BANK'. SEE THIS SHEET AND SHEET 011 FOR DETAILS.
5. COVER THE 'LEAKY BANK' WITH COBBLE GRADATION SPECIFIED ON SHEET 011, ENSURING THE CORRECT CREST ELEVATION.
6. CAP THE 'LEAKY BANK' WITH 300mm OF TOPSOIL AND NATIVE SEED MIX AS PER DETAILS ON SHEET 011.
7. REMOVE THE DE-WATERING PUMP AND ASSOCIATED EQUIPMENT, THEN SLOWLY REMOVE THE TEMPORARY COFFER DAMS TO INTRODUCE FLOW GRADUALLY BACK INTO THE BANK AREA. SEEPAGE WILL BEGIN TO MOVE THROUGH THE 'LEAKY BANK' INTO THE ISOLATED POND.
8. RECONFIGURE THE POSITIONS AND EXTENTS OF THE FIBRE ROLLS AND RIG MATS, AS NECESSARY, TO RE-ESTABLISH ENVIRONMENTAL PROTECTION MEASURES PRIOR TO MOVING TO THE NEXT WORK AREA.

CONSTRUCTION OF "CONNECTOR CHANNEL":

1. INSTALL COFFER DAMS AT EDGES OF CHANNEL AND POND IN A CONTROLLED MANNER TO REDUCE DISTURBANCE TO BED/BANKS AND RELEASE OF SEDIMENTS INTO WATER. ENSURE ENDS OF FIBRE ROLLS ON FLOODPLAIN MEET EDGES OF COFFER DAM AT BANK.
2. ALLOW A QUALIFIED PROFESSIONAL TO CONDUCT FISH RESCUE AND SALVAGE, AS PER PERMIT CONDITIONS, AND LIVE RELEASE ANY FISH FROM THE ISOLATED AREA INTO THE DOWNSTREAM CHANNEL.
3. INSTALL DE-WATERING PUMP, HOSE AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DE-WATER CURRENT WORK AREA. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE OR POND, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
4. PROGRESSIVELY EXCAVATE THE FLOODPLAIN TO THE SPECIFIED WIDTH AND DEPTH, BEGINNING AT THE POND SHORELINE AND MOVING TOWARD THE CHANNEL.
5. INSTALL THE BRUSH LAYERS IN LIFTS, AS PER DESIGN DETAILS ON SHEET 007. CAREFULLY PLACE THE GRAVEL SUBSTRATE ALONG THE BOTTOM OF THE CONNECTOR CHANNEL. SEE SHEETS 011 FOR DETAILS.
6. REMOVE THE DE-WATERING PUMP AND ASSOCIATED EQUIPMENT, THEN SLOWLY REMOVE THE TEMPORARY COFFER DAMS TO GRADUALLY CONNECT MAIN CREEK TO POND AND ALLOW THROUGH-FLOW.
7. RECONFIGURE THE POSITIONS AND EXTENTS OF THE FIBRE ROLLS AND RIG MATS, AS NECESSARY, TO RE-ESTABLISH ENVIRONMENTAL PROTECTION MEASURES PRIOR TO MOVING TO THE NEXT WORK AREA.

WORK AREA ISOLATION NOTES

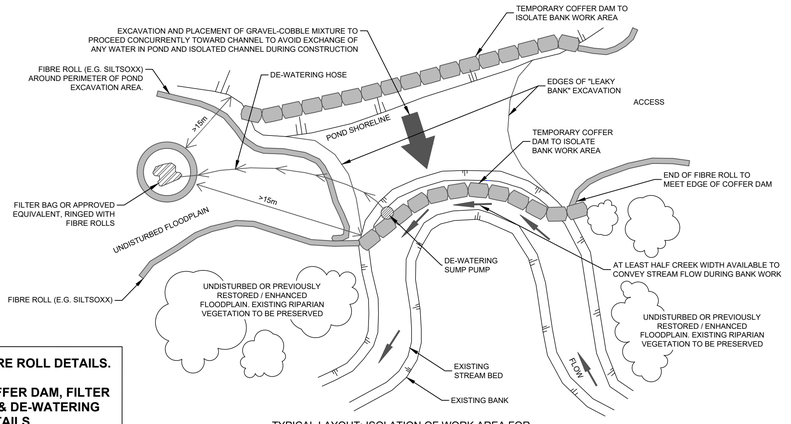
- INSTALL COFFER DAM WITH IMPERVIOUS LINER AGAINST BANKS AND ALONG CHANNEL BED, IN APPROXIMATE CRESCENT SHAPE, TO FULLY ISOLATE BANK WORK AREA.
- WATER COLLECTED WITHIN THE ISOLATED WORK AREA TO BE PUMPED OUTSIDE THE IMMEDIATE WORK AREA, DISCHARGED THROUGH A FILTER BAG LOCATED WITHIN A VEGETATED PORTION OF THE FLOODPLAIN AS REMOTE FROM THE WATERCOURSE AND POND AS POSSIBLE (MIN. >15m) TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- AT THE END OF THE DAY THE WATERCOURSE MUST BE STABILIZED AND FREE FLOWING OR PUMPING MUST BE SUPERVISED.
- IN GENERAL ALL IN-STREAM CONSTRUCTION TO BE COMPLETED IN THE DRY, OR AT LEAST FOLLOWING FULL ISOLATION OF THE WORK AREA. FISH EVACUATION PLAN MUST BE SUBMITTED AND APPROVED BY MOFLNRORD PRIOR TO COMMENCEMENT OF THE PROJECT. FISH RESCUE SHALL BE CONDUCTED FROM ISOLATED WORK AREAS BY A QUALIFIED INDIVIDUAL WITH A VALID PERMIT IN ACCORDANCE WITH THE BRITISH COLUMBIA STANDARDS AND BEST PRACTICES FOR IN-STREAM WORKS.



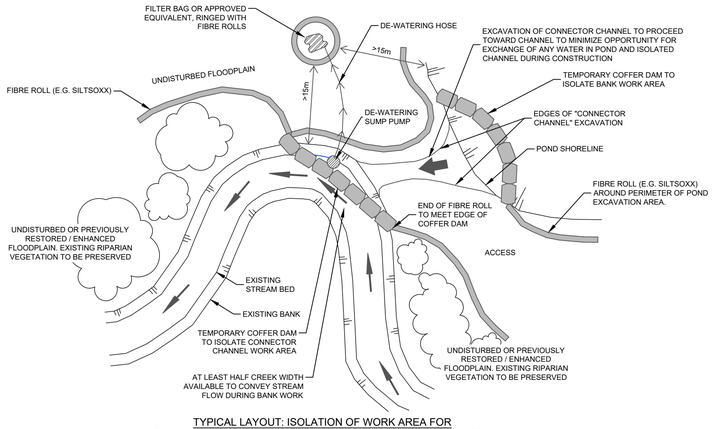
TYPICAL LAYOUT: ISOLATION AND PROGRESSIVE EXCAVATION OF OVERWINTERING POND
N.T.S

REFER TO SHEET 16 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 17 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS



TYPICAL LAYOUT: ISOLATION OF WORK AREA FOR OVERWINTERING POND "LEAKY BANK" CONSTRUCTION
N.T.S



TYPICAL LAYOUT: ISOLATION OF WORK AREA FOR OVERWINTERING POND "CONNECTOR CHANNEL" CONSTRUCTION
N.T.S

BC One Call Click or Call Before You Dig 1-800-474-6886

U:\Projects\1824\3\0\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek - ESC Plans.dwg
DATE: 2021/1/22/2020 5:12 PM BY: Andrew Brabant

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE:

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASUREMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	RM & DM
DRAWN:	AB
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2021

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
PH.: 250-562-2252 FAX: 866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN

MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT

ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR OVERWINTERING PONDS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 015
SHEET: 15 OF 17
REV C

NOT FOR CONSTRUCTION

SEDIMENT CONTROL BARRIERS

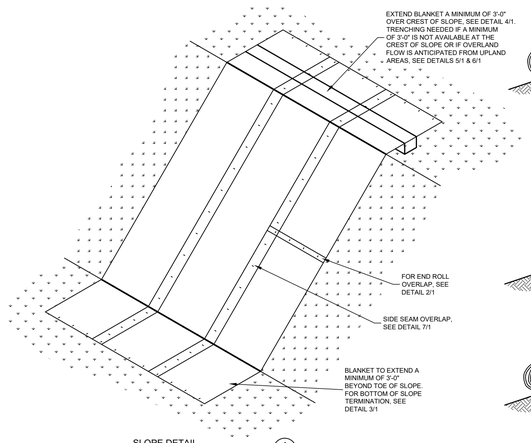
OPTION 1 - FIBRE ROLL

- FIBRE ROLL (E.G FILTREXX SILTSOXX OR APPROVED EQUIVALENT), FILLED WITH WOOD CHIPS, ARE THE PREFERRED TYPE OF SEDIMENT CONTROL BARRIER.
- MIN. DIAMETER = 300mm
- FIBRE ROLLS TO BE REGULARLY INSPECTED FOR TEARS OR HOLES, AND REPAIRED / REPLACED AS NEEDED TO MAINTAIN FUNCTION.
- FIBRE ROLLS MAY BE RE-USED IN A DIFFERENT LOCATION, ONLY IF THEY REMAIN FREE OF TEARS / HOLES, HAVE NOT LOST ANY OF THEIR CONTENTS, AND STILL MAINTAIN THE MINIMUM DIAMETER.
- REMOVE ALL SURFACE OBSTRUCTIONS GREATER THAN 50mm FROM THE GROUND PRIOR TO PLACING FIBRE ROLLS.
- TYPICAL FIBRE ROLL INSTALLATION DETAILS ARE SHOWN ON THIS SHEET FOR A FILTREXX SILTSOXX FIBRE ROLL. THE CONTRACTOR MAY USE THIS BRAND OF FIBRE ROLL OR AN APPROVED EQUIVALENT.

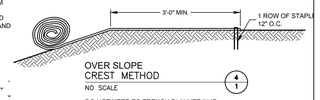
OPTION 2 - SEDIMENT CONTROL FENCE

- SEDIMENT CONTROL FENCE SUPPLIES SHOULD BE AVAILABLE ON SITE FOR USE IN CASES WHERE SURFACE PONDING OCCURS AND ADDITIONAL SILTATION CONTROL IS WARRANTED BEYOND WHAT THE FIBRE ROLLS CAN PROVIDE.
- GEOTEXTILE TO BE NON-WOVEN WITH A MINIMUM EQUIVALENT OPENING SIZE OF 0.15mm AND A MAXIMUM EQUIVALENT OPENING SIZE OF 0.25mm.
- NON-WOVEN GEOTEXTILE TO HAVE A HORIZONTAL OVERLAP OF 1 METER AT JOINTS.
- TYPICAL SEDIMENT CONTROL FENCE INSTALLATION DETAILS ARE SHOWN ON THIS SHEET. THESE DETAILS REPRESENT IDEAL SCENARIOS. ACTUAL SITE CONDITIONS MAY VARY AND SEDIMENT CONTROL FENCE INSTALLATION SHOULD BE TAILORED FOR EACH SITE.

EROSION CONTROL BLANKET - TYPICAL DETAILS

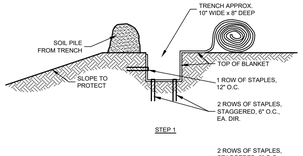


SLOPE DETAIL
NO SCALE — 1/1

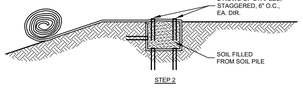


OVER SLOPE CREST METHOD
NO SCALE — 4/1

DO NOT NEED TO TRENCH BLANKET IN IF IT CAN BE EXTENDED A MINIMUM OF 3'-0" OVER THE CREST OF THE SLOPE.

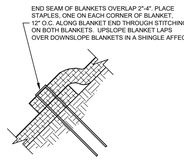


STEP 1

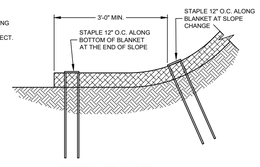


STEP 2

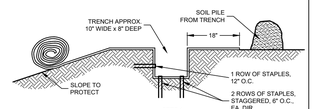
SLOPE TRENCHING METHOD "A"
NO SCALE — 5/1



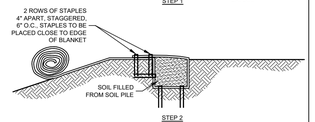
END ROLL OVERLAP
NO SCALE — 2/1



BOTTOM OF SLOPE TERMINATION
NO SCALE — 3/1

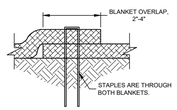


STEP 1



STEP 2

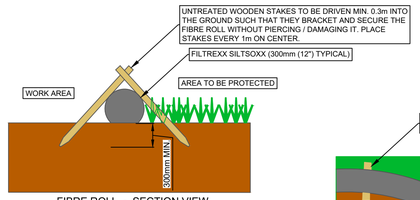
SLOPE TRENCHING METHOD "B"
NO SCALE — 6/1



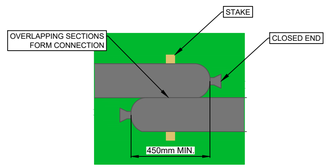
SIDE SEAM OVERLAP STAPLE DETAIL
NO SCALE — 7/1

EROSION CONTROL BLANKETS

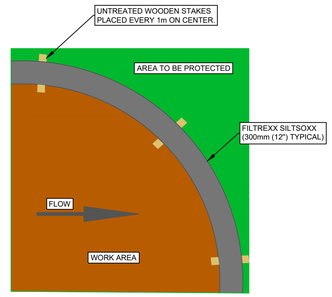
- BIODEGRADABLE EROSION CONTROL BLANKETS (E.G WOVEN JUTE, COIR MESH, GREAT LAKES ASPEN, ETC) TO BE AVAILABLE ON SITE IN CASE THEY ARE NEEDED TO HELP MITIGATE EROSION OF TEMPORARILY EXPOSED SOILS ON THE FLOODPLAIN AND / OR ALONG THE POND SHORELINES
- DRAWINGS SHOWN ON THIS SHEET ILLUSTRATE TYPICAL INSTALLATION DETAILS FOR AN AMERICAN EXCELSIOR CURLEX NETFREE SLOPE PROTECTION EROSION CONTROL BLANKET. THE CONTRACTOR MAY USE THIS BRAND OF EROSION CONTROL BLANKET OR AN APPROVED EQUIVALENT.



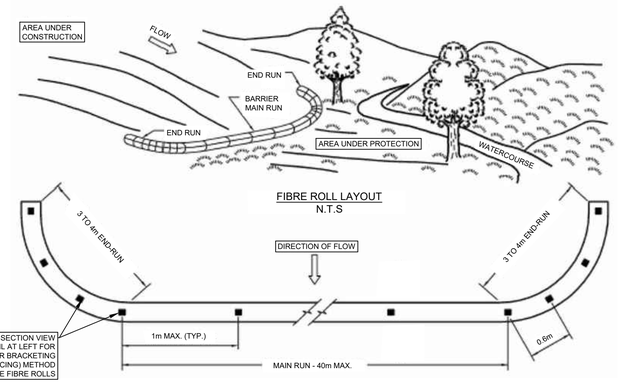
FIBRE ROLL - SECTION VIEW
N.T.S



FIBRE ROLL - END CONNECTION DETAIL
N.T.S

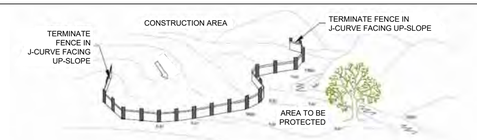


FIBRE ROLL - PLAN VIEW
N.T.S

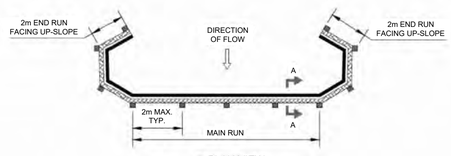


FIBRE ROLL LAYOUT
N.T.S

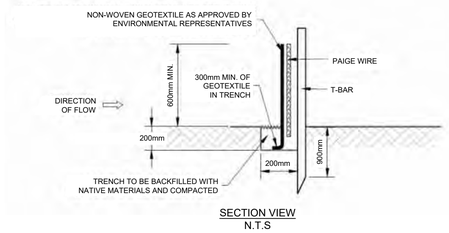
FIBRE ROLL LAYOUT - PLAN VIEW
N.T.S



PERSPECTIVE VIEW
N.T.S

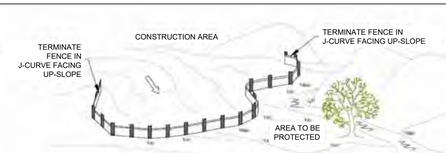


PLAN VIEW
N.T.S

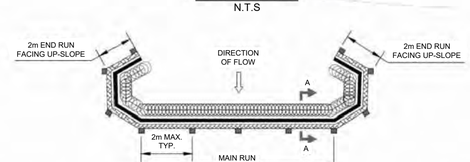


SECTION VIEW
N.T.S

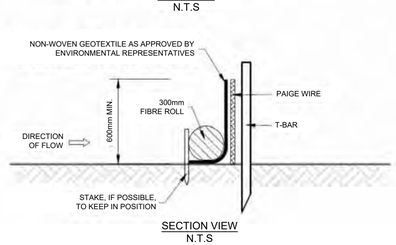
SEDIMENT CONTROL FENCE - UNFROZEN CONDITIONS



PERSPECTIVE VIEW
N.T.S



PLAN VIEW
N.T.S



SECTION VIEW
N.T.S

SEDIMENT CONTROL FENCE - FROZEN CONDITIONS

BC One Call — Click or Call Before You Dig — 1-800-474-6886

U:\Projects\1824\3\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek - ESC Plans.dwg
DATE: 25/11/2020 5:12 PM BY: Andrew Brabandt

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE:

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASUREMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	RM & DM
DRAWN:	AB
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2021

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
PH.: 250-562-2252 FAX: 866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN

MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT

SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR OVERWINTERING PONDS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 016
SHEET: 16 OF 17
REV C

NOT FOR CONSTRUCTION

WORK AREA ISOLATION MEASURES

METRE BAG COFFER DAM

- FOR ISOLATION OF THE FULL CHANNEL WIDTH (DAM-AND-PUMP STREAM-FLOW BYPASS) OR ONLY A PORTION OF THE CHANNEL WIDTH (PASSIVE STREAM-FLOW BYPASS FOR SINGLE-BANK WORK) FOR IN-CHANNEL WORK, OR SECTION OF POND SHORELINE FOR CONNECTION TO CHANNEL.
- 1-2 TIER, SINGLE-STACK METRE BAG COFFER DAM PREFERRED GIVEN MINIMAL DISTURBANCE; PYRAMID-STACK METRE BAG COFFER DAM MAY BE NECESSARY IN DEEPER-WATER SCENARIOS.
- METRE BAGS SHOULD BE FILLED WITH PEA GRAVEL AND SHOULD NOT BE OVER-FILLED.
- A WATERPROOF MEMBRANE IS REQUIRED OVER THE PEA-GRAVEL METRE BAGS. THE WATERPROOF MEMBRANE MUST BE KEYED IN UNDER THE BARRIER TO MINIMIZE LEAKAGE.
- COFFER DAM MAY BE CONSTRUCTED OF SMALLER PEA-GRAVEL SANDBAGS OR OTHER SUITABLE EQUIVALENT. SEE BELOW FOR DETAILS.

PEA GRAVEL COFFER DAM

- CAN BE USED AT THE DISCRETION OF THE ENVIRONMENTAL REPRESENTATIVE FOR ISOLATION OF CHANNELS IN LOW-FLOW, SHALLOW WATER CONDITIONS WHEN LOCAL WORKS CAN BE COMPLETED WITHIN A FAVORABLE WEATHER WINDOW AND / OR THE CHANNEL IS LOCALLY TOO NARROW OR AWKWARD FOR THE USE OF METRE BAGS.

DE-WATERING SUMP PUMP

- FOR TEMPORARY MAINTENANCE OF DRY OR SHALLOWER CONDITIONS WITHIN AN ISOLATED IN-CHANNEL / POND WORK AREA.
- A PUMP WITH A MINIMUM RECOMMENDED PUMPING CAPACITY OF 2000GPM MUST BE USED.
- DURING ELEVATED FLOWS APPROACHING BANK-FULL DEPTH, ALL PUMPING WILL BE STOPPED AND COFFER DAMS WILL BE TEMPORARILY REMOVED TO ALLOW FLOWS TO PASS UNOBSTRUCTED.

DE-WATERING FILTER BAG RINGED WITH FILTREXX SILTSOXX (OR APPROVED EQUIVALENT)

- FOR CONTROLLED DEPOSITION OF FINE SEDIMENT PUMPED OUT OF AN ISOLATED IN-CHANNEL / POND WORK AREA, AWAY FROM THE WATERCOURSE OR POND
- PLACE FILTER BAG (3.5m X 5.0m TERRAFIX ENVIROBAG OR APPROVED EQUIVALENT) ON A LEVEL, STABILIZED AREA OF THE FLOODPLAIN, ON VEGETATED GROUND > 15m AWAY FROM THE CHANNEL. FILTREXX SILTSOXX (300mm (12") DIAMETER) OR APPROVED EQUIVALENT TO BE PLACED AROUND THE FILTER BAG.
- ISOLATED SECTION OF CHANNEL TO BE PUMPED AND DE-WATERED INTO FILTER BAG
- REPLACE UNIT WHEN HALF FULL OF SEDIMENT OR WHEN SEDIMENT HAS SIGNIFICANTLY REDUCED THE FLOW RATE OF PUMP DISCHARGE
- ALLOW SEDIMENT BAG TO DRY IN DESIGNATED SEDIMENT DRYING AREA AND THEN RE-USE THE SEDIMENT AS PART OF BANK RESTORATION OR DISPOSE OF IT OFF SITE UNDER DIRECTION OF THE ON-SITE ENVIRONMENTAL REPRESENTATIVE

PLANTING NOTES

SITE PREPARATION:

- APPLY 10cm OF TOPSOIL TO THE "AREA OF DISTURBANCE" ALONG THE PERIPHERY OF THE POND, INCLUDING THE TOP OF THE "LEAKY BANK(S)".

PLANT MATERIAL:

- PLANT MATERIAL MUST BE LOCALLY SOURCED AND SPECIES MUST BE NATIVE TO THE REGION.
- PLANT MATERIAL TO BE INSPECTED UPON DELIVERY TO ENSURE THAT THE MATERIAL CONSISTS OF APPROPRIATE NATIVE SPECIES IN GOOD CONDITION
- SHRUBS TO BE CONTAINER GROWN OR BARE ROOT AND RANGING FROM 0.4m TO 1.0m IN HEIGHT.
- DRY SEEDS OF THE SUGGESTED MIXTURE OR SIMILAR BLEND TO BE MIXED BEFORE THE APPLICATION
- AQUATIC PLANTS TO BE GROWN IN PLUGS. PLUGS TO BE ROLLED IN CLAY SOIL BEFORE PLANTINGS OR EQUIVALENT METHOD TO HELP ANCHOR THE PLANTINGS.

PLANTING LOCATIONS:

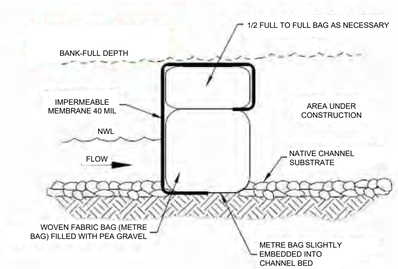
- SHRUBS AND SEED MIX TO BE PLANTED WITHIN THE "AREA OF DISTURBANCE" AROUND THE PERIPHERY OF THE POND
- THE TOP OF THE "LEAKY BANK" IS TO BE PLANTED WITH SEED MIX ONLY (NO SHRUBS).
- AQUATIC PLANTS TO BE PLANTED IN THE "SHALLOW SHORELINE" (i.e. EMERGENT VEGETATION) AREA.

PLANTING DENSITY:

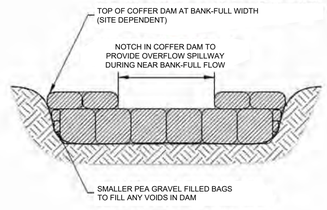
- SHRUBS TO BE PLANTED 1 SHRUB PER m² IN CLUSTERS OF 4 INDIVIDUAL SHRUBS. EACH SHRUB CLUSTER SHOULD COMPRISE A MINIMUM OF 2 SPECIES. SHRUB CLUSTERS ARE TO BE SCATTERED APPROXIMATELY 2m APART.
- SEED MIX IS TO BE APPLIED AT A RATE OF 20 kg/ha.
- AQUATIC PLANTS TO BE PLANTED 4 PLUGS OF A SINGLE SPECIES PER m². PLUG CLUSTERS SHOULD BE SCATTERED APPROXIMATELY 1m APART. CLUSTER TYPES SHOULD BE INTERSPERSED THROUGHOUT THE "SHALLOW SHORELINE" AREA.

TIMING:

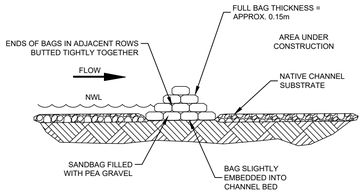
- PLANTING OF WOODY MATERIAL SHOULD BE COMPLETED IN THE SPRING (APRIL TO MAY) OR FALL (SEPTEMBER TO OCTOBER).
- SEEDING SHOULD BE COMPLETED IMMEDIATELY AFTER THE PLANTING OF WOODY VEGETATION.
- PLANTING OF AQUATIC PLUGS TO BE COMPLETED IN SPRING (APRIL TO MAY).



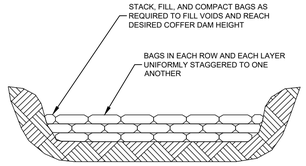
METRE BAG COFFER DAM - SECTION
N.T.S



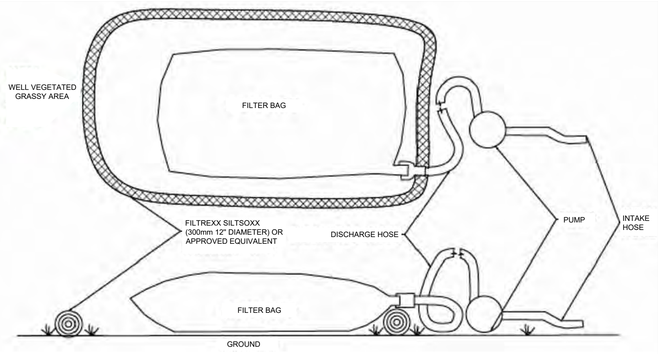
METRE BAG COFFER DAM - PROFILE
N.T.S



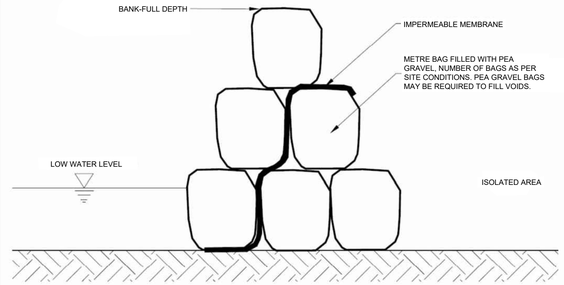
PEA GRAVEL BAG COFFER DAM - SECTION
N.T.S



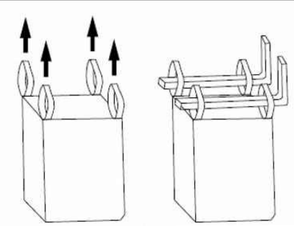
PEA GRAVEL BAG COFFER DAM - PROFILE
N.T.S



DE-WATERING FILTER BAG WITH FILTREXX SILTSOXX - PLAN & PROFILE
N.T.S

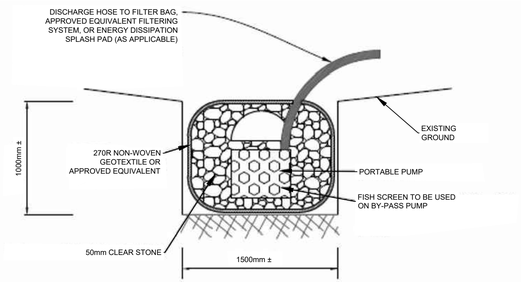


METRE BAG WATERPROOF ISOLATION BARRIER - SECTION
N.T.S



1m X 1m X 1m SYNTHETIC FIBRE BAGS WITH HEAVY DUTY LIFTING LOOPS SUITABLE FOR CARRYING PEA GRAVEL TO CONSTRUCT A TEMPORARY COFFER DAM. SUPPLIED BY ENVIRO-PACK MATERIAL HANDLING INC. OR APPROVED EQUIVALENT

PEA GRAVEL METRE BAG HANDLING
N.T.S



DE-WATERING SUMP PUMP DETAIL
N.T.S

PLANT LIST - POND 1

PLANTING TYPES	COMMON NAME	SCIENTIFIC NAME	QUANTITY
SEED MIX (RIPARIAN PLANTINGS)	SAND DROPSEED	SPOROBOLUS CRYPTANDRUS	DRY SEED MIXED BY WEIGHT TO 8.4kg
	JUNE GRASS	KOELERIA MACRANTHA	
	FRINGED BROME	BROMUS CILATUS	
	TUFTED HAIRGRASS	DESCHAMPSIA CESPITOSA	
	SLENDER WHEATGRASS	ELYMUS TRACHYCAULUS SSP. SUBSECUNDUS	
	AMERICAN VETCH	VICIA AMERICANA	
	THICKSPIKE WILDRYE	ELYMUS LANCEOLATUS	
	FOWL BLUEGRASS	POA PALUSTRIS	
SHRUBS (RIPARIAN PLANTINGS)	SCOULER'S WILLOW	SALIX SCOULERIANA	262
	HOOKER'S WILLOW	SALIX HOOKERIANA	262
	DWARF BIRCH	BETULA GLANDULOSA	262
	SITKA ALDER	ALNUS VIRIDIS SSP. SINUATA	262
AQUATIC PLANTS (SHALLOW WATER PLANTINGS)	MARSH CINQUEFOIL	COMARUM PALUSTRE	700
	SOFT-STEMMED BULRUSH	SCHOENOPLECTUS TABERNAEMONTANI	750
	WAPATO (ARROWHEAD)	SAGITTARIA LATIFOLIA	700
	SWOLLEN BEAKED SEDGE	CAREX ROSTRATA	700
	ROCKY MOUNTAIN POND-LILY	NUPHAR POLYSEPAIA	700
	WATER SEDGE	CAREX AQUATILIS	700
	AMERICAN WATER-PLANTAIN	ALISMA TRIVIALE	700
	NARROW-LEAVED BUR-REED	SPARGANIUM ANGUSTIFOLIUM	700

PLANT LIST - POND 2

PLANTING TYPES	COMMON NAME	SCIENTIFIC NAME	QUANTITY
SEED MIX (RIPARIAN PLANTINGS)	SAND DROPSEED	SPOROBOLUS CRYPTANDRUS	DRY SEED MIXED BY WEIGHT TO 8.5kg
	JUNE GRASS	KOELERIA MACRANTHA	
	FRINGED BROME	BROMUS CILATUS	
	TUFTED HAIRGRASS	DESCHAMPSIA CESPITOSA	
	SLENDER WHEATGRASS	ELYMUS TRACHYCAULUS SSP. SUBSECUNDUS	
	AMERICAN VETCH	VICIA AMERICANA	
	THICKSPIKE WILDRYE	ELYMUS LANCEOLATUS	
	FOWL BLUEGRASS	POA PALUSTRIS	
SHRUBS (RIPARIAN PLANTINGS)	SCOULER'S WILLOW	SALIX SCOULERIANA	265
	HOOKER'S WILLOW	SALIX HOOKERIANA	265
	DWARF BIRCH	BETULA GLANDULOSA	265
	SITKA ALDER	ALNUS VIRIDIS SSP. SINUATA	265
AQUATIC PLANTS (SHALLOW WATER PLANTINGS)	MARSH CINQUEFOIL	COMARUM PALUSTRE	300
	SOFT-STEMMED BULRUSH	SCHOENOPLECTUS TABERNAEMONTANI	350
	WAPATO (ARROWHEAD)	SAGITTARIA LATIFOLIA	350
	SWOLLEN BEAKED SEDGE	CAREX ROSTRATA	300
	ROCKY MOUNTAIN POND-LILY	NUPHAR POLYSEPAIA	300
	WATER SEDGE	CAREX AQUATILIS	300
	AMERICAN WATER-PLANTAIN	ALISMA TRIVIALE	300
	NARROW-LEAVED BUR-REED	SPARGANIUM ANGUSTIFOLIUM	300

PLANT LIST - POND 3

PLANTING TYPES	COMMON NAME	SCIENTIFIC NAME	QUANTITY
SEED MIX (RIPARIAN PLANTINGS)	NORTHERN BEAKED SEDGE	CAREX UTRICULATA	DRY SEED MIXED BY WEIGHT TO 11.55kg
	WATER SEDGE	CAREX AQUATILIS	
	SLENDER WHEATGRASS	CAREX LASIOCARPA	
	SITKA SEDGE	CAREX STICHENSIS	
	NORTHERN BEAKED SEDGE	CAREX UTRICULATA	
SHRUBS (RIPARIAN PLANTINGS)	SCOULER'S WILLOW	SALIX SCOULERIANA	380
	HOOKER'S WILLOW	SALIX HOOKERIANA	380
	DWARF BIRCH	BETULA GLANDULOSA	342
	SITKA ALDER	ALNUS VIRIDIS SSP. SINUATA	342
AQUATIC PLANTS (SHALLOW WATER PLANTINGS)	MARSH CINQUEFOIL	COMARUM PALUSTRE	655
	SOFT-STEMMED BULRUSH	SCHOENOPLECTUS TABERNAEMONTANI	700
	WAPATO (ARROWHEAD)	SAGITTARIA LATIFOLIA	700
	SWOLLEN BEAKED SEDGE	CAREX ROSTRATA	655
	ROCKY MOUNTAIN POND-LILY	NUPHAR POLYSEPAIA	655
	WATER SEDGE	CAREX AQUATILIS	655
	AMERICAN WATER-PLANTAIN	ALISMA TRIVIALE	655
	NARROW-LEAVED BUR-REED	SPARGANIUM ANGUSTIFOLIUM	655

BC One Call
Click or Call Before You Dig
1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	NOV 26, 2020	JLC	MF
B	ISSUED FOR CLIENT REVIEW	JAN 8, 2021	JL	MF
C	ISSUED FOR DFO REVIEW	JAN 22, 2021	JL	MF

ARTEMIS GOLD INC

SCALE:

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASUREMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	RM & DM
DRAWN:	AB
CHECKED:	MF
SURVEYED:	-
DATE:	JAN 2021

Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE ENGINEERING LTD.
NORTHERN OPERATIONS
3661 15TH AVENUE
PRINCE GEORGE, BC V2N 1A3
PH.: 250-562-2252 FAX: 866-235-6943

ARTEMIS GOLD INC.

BLACKWATER PROJECT - SCHEDULE 2 FISHERIES OFFSETTING PLAN

MATHEWS CREEK HABITAT RESTORATION AND ENHANCEMENT

WORK AREA ISOLATION MEASURES & PLANTING NOTES FOR OVERWINTERING PONDS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-3-1
DRAWING NO. 017
SHEET: 17 OF 17
REV C

U:\Projects\1824\3\9\Blackwater Fisheries Offsetting\AutoCAD\1 Mathews Creek\1824-3 - Mathews Creek - ESC Plans.dwg
DATE: 2021/1/12/20/3 5:12 PM BY: Andrew Brainard

Appendix D

Construction Environmental Management Plan

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5
Tel: 604-629-9075 | www.pecg.ca

Blackwater Project

MDMER Schedule 2
Fisheries Compensation
Construction Environmental Management Plan

Palmer Project #
2006501

Prepared For
BW Gold Ltd

January 29, 2021

Table of Contents

List of Tables

1. Introduction

Palmer has prepared this Construction Environmental Management Plan (CEMP) on behalf of BW Gold Ltd. (BW Gold) to provide environmental guidance on activities related to the construction of fisheries compensation habitat at Mathews Creek as part of the Compensation Plan for the Blackwater Project (the Project).

The Project is a proposed open-pit gold and silver mine located 160 km southwest of Prince George and 110 km southwest of Vanderhoof in British Columbia (BC). The Project received a Decision Statement on April 15, 2019 under the *Canadian Environmental Assessment Act*, 2012, and Environmental Assessment Certificate #M19-01 (Certificate) on June 21, 2019 under the *Environmental Assessment Act* (2002). As part of the EAC Application, an effects assessment was completed for fish and fish habitat, which were identified as Valued Components (VCs). It was determined through this process that the Project will likely result in the death of fish or a harmful alteration, disruption, or destruction of fish habitat (HADD), as defined by the federal *Fisheries Act.*

Before construction can commence, the Project will require both an amendment of Schedule 2 of the Metal and Diamond Mining Effluent Regulations (MDMER) and an Authorization under Paragraph 35(2)(*b*) of the *Fisheries Act*. The amendment to Schedule 2 of the MDMER specifically applies to the loss of fish habitat in tailings impoundment areas resulting from the placement of mine waste. *The Fisheries Act* authorization will address all other effects on fish and fish habitat resulting from Project activities.

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

This CEMP outlines the environmental protection measures and mitigation proposed to minimize risk to local and downstream fish and fish habitat during the construction of the compensation habitat proposed in the Compensation Plan for MDMER Schedule 2 amendment. A separate CEMP has been prepared for the *Fisheries Act* Authorization Offsetting Plan. In addition, all other Project-wide environmental management plans and commitments will be adhered to, in addition to this CEMP, during the construction of the compensation measures.

1.1 Proposed Habitat Compensation Measures

The Compensation Plan includes two separate measures in the Mathews Creek watershed to offset the loss of fish habitat resulting from Project activities:

- Mathews Creek Stream Restoration and Enhancement
  - Restoration and enhancement of fish habitat in Mathews Creek to address impacts from cattle-trampled banks and bed, historical riparian vegetation clearing, dilapidated bridge crossings, exposed banks, and flow obstructions/impediments.
- Mathews Creek Off-channel Ponds
  - The construction of three ponds on Mathews Creek to help address the availability of overwintering habitat as a limiting factor for rainbow trout abundance in the study area.

A detailed description of the proposed compensation measures is available in Section 6.5 of the Compensation plan and a summary is provided here.

1.1.1 Mathews Creek Restoration and Enhancement

Mathews Creek is part of the Nechako River watershed and has been impacted by past and current agricultural practices, particularly cattle grazing. A number of existing geomorphological and aquatic impacts at the creek were documented, including:

- Cattle trampled banks and bed;
- Farm machinery crossings;
- Exposed channel banks; and
- Flow obstructions/impediments.

Stream restoration and enhancement is proposed along 4.6 km of Mathews Creek in multiple reaches where degraded habitat has been identified. Restoration techniques will include reconstruction of the natural bankfull channel using earth fill and woody debris placement, riparian vegetation plantings, targeted excavation of sediment, placement of boulders on the channel bed, and removal of anthropogenic materials.

Riparian plantings are proposed for the majority of segments to improve bank stability, provide aquatic food sources, and increase overhanging cover. Four failing cattle and small vehicle crossings and farm machinery debris are proposed to be removed.

1.1.2 Mathews Creek Off-channel Ponds

BW Gold proposes to construct three off-channel ponds in the Mathews Creek watershed to provide, among other things, overwintering habitat for rainbow trout and other fish. Locations and physical characteristics of each of the ponds have been designed to maximize the quality of overwintering refuge provided by the ponds by targeting areas of naturally high groundwater table and through-flow for minimizing winter ice

cover thickness, maximizing dissolved oxygen, and incorporating deep water (i.e., greater than 2 m), cobble/boulder substrates, and overhead cover.

The ponds have irregular shapes, contain peninsulas and islands and are strategically positioned to increase habitat diversity. Each 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, such as a pool 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 ponds. The ponds contain shallow water (0 to 1 m depth) 'shoals' lined with cobble and deeper (1 to 5 m depth) areas.

A 'leaky bank' is proposed to separate the pond and adjacent channel along a segment of an up-valley portion of pond shoreline at Pond #1 and Pond #2. The leaky bank is composed of coarse gravels that allow for some throughflow of water from Mathews Creek into the pond.

Riparian plantings are proposed along the periphery of the ponds. The proposed plantings include a native seed mix and shrub plantings around the periphery of the pond and aquatic plantings in the gentle, shallow shoreline area.

Ponds proposed in the Mathews Creek watershed will be incorporated into proposed valley bottom wetland restoration complexes designed by BW Gold's consultants. A gentle, shallow shoreline was incorporated into the Mathews Creek ponds to support transitional emergent vegetation growth in surrounding wetland restoration areas.

1.2 Regulatory Setting

The following documents were referenced to develop the CEMP:

- Schedule B Table of Conditions for an Environmental Assessment Certificate (BC EAO, 2019);
- Environmental Assessment Decision Statement (IAAC, 2019);
- *Measures to Protect Fish and Fish Habitat* (DFO 2019);
- *Interim Code of Practice: End-of-Pipe Fish Protection Screens for Small Water Intakes in Freshwater* (DFO 2020);
- *Standard and Best Practices for Instream Works* (BC Ministry of Water, Land and Air Protection, 2004);
- *A Users' Guide to Working in and Around Water* (BC Ministry of Environment 2004).

2. General Best Practices

Habitat compensation measures for Mathews Creek involve instream and riparian area restoration/enhancement work, which has the potential to adversely affect local and downstream fish and fish habitat during the construction phase. Both compensation measures will follow a number of overarching General Best Practices that should be applied during construction:

- Marking and flagging of construction boundaries and sensitive areas, including footprint boundaries, sensitive ecological habitat areas (e.g., riparian zones), and sensitive habitat features (e.g., nests or dens), prior to commencement of construction.
- Minimizing removal of riparian vegetation to complete work and provide access to the watercourse.
- Covering disturbed slopes as soon as possible.
- Cleaning machinery prior to arrival on site and checking daily to detect leaks before the start on construction.
- Completing oiling, refueling or maintenance of machinery a minimum of 30 metres from the watercourse top of bank.
- Scheduling construction activities associated with instream work to occur during low-flow conditions and within identified fisheries timing windows.
- Salvaging and stockpiling topsoil to be reused in a way that reduces erosion risk for subsequent reapplication during final grading and restoration.
- Ensuring that all material (e.g., boulders) placed in the channel is clean of any substances deleterious to aquatic life.
- Supervising of all instream works by a qualified environmental professional (QEP) experienced in stream restoration and protection of aquatic habitat.
- Restoring all disturbed areas to the satisfaction of the QEP and BW Gold.

3. Access Management

The existing Kluskus Forest Service Road will be used to access the habitat compensation sites, which are located on land owned by BW Gold and adjacent range tenure Crown Land. Access to the habitat compensation sites will therefore be restricted and only authorized contractors will be allowed on the sites. Signage will be increased and/or improved to mark construction traffic entry points. The Contractor will be responsible for producing a traffic management plan, which will be included in its Environmental Protection Plan. Additional details are provided in the Access Management Plan developed by BW Gold.

4. Vegetation and Invasive Plant Management

Mitigation measures for vegetation removal and to prevent and control the potential introduction and spread of invasive plants include the following:

- Clean earth-moving equipment to remove any foreign soil and vegetation prior to entering the construction area.
- Fully remove and properly dispose of noxious weeds and other invasive plants that are present at the habitat compensation sites, as appropriate.
- Bag or tarp noxious weeds and other invasive plants, plant parts, and seeds before transporting to a designated disposal site (e.g., landfill).
- Ensure that erosion controls and water management are in place to prevent sediment and contaminants (e.g., oil, fuel, concrete) from entering vegetated areas.
- Remove trees in accordance with jurisdictional legislation and ensure appropriate wildlife timing windows are adhered to, including breeding bird timing restrictions for vegetation clearing.
- Use native vegetation for site restoration and erosion control or use alternative methods until re-planting with native vegetation can occur.

5. Waste Management and Handling of Deleterious Substances

5.1 General Wastes

A regular disposal program will be implemented to prevent the accumulation of construction-related wastes. The Contractor will ensure that upon completion of each day's work, and upon completion of substantial portions of construction works, all waste or other materials that may potentially impact Mathews Creek are removed to a stable location and secured.

Sanitary facilities provided for the use of workers shall be secured to ensure they are stable and shall be located at least 15 m from top of bank of any waterbody.

5.2 Hazardous Waste and Contaminated Material

If hazardous materials are required for construction, the Contractor will be responsible for ensuring that all relevant personnel are adequately trained for the handling and transport of Dangerous Goods and Controlled Products. Disposal of hazardous waste generated during works must be disposed in compliance with the *British Columbia Hazardous Waste Regulation* of the *Environmental Management Act.* Hazardous materials used during works – including Dangerous Goods as defined under the *Transportation of Dangerous Goods Act* and Controlled Products as defined under the *Occupational Health & Safety Regulation* (BC Regulation 296/97) pursuant to the *Workers Compensation Act* – should be stored and handled to avoid loss, and to allow containment and recovery in the event of a spill in accordance with all applicable legislation.

In the event that construction activities encounter possible contaminated materials, including contaminated soils, the Contractor shall stop all work in the vicinity of the possible hazardous materials until further direction is provided.

5.3 Hydrocarbon Products and Equipment

General mitigation measures for hydrocarbon products and equipment are as follows:

- Equipment, vehicles, and machinery shall be in good operating condition, free of leaks, and excess oil and grease, and are to be inspected regularly.
- All hydraulic machinery working in and around a watercourse will use environmentally sensitive hydraulic fluids that are non-toxic to aquatic life and are readily or inherently biodegradable, wherever feasible.
- Servicing and refueling of equipment (including refilling of small field containers) shall be undertaken a minimum of 30 m away from the top of bank of any watercourse.
- Storage of fuels and petroleum products will comply with safe operating procedures [e.g., A Field Guide to Fuel Handling, Transportation and Storage (BC Ministry of Water, Land, and Air Protection 2002)] and include containment facilities.

- Equipment maintenance and repair sites will be located on flat, stable ground, at least 15 m away from the top of bank of environmentally sensitive areas such as watercourses.
- The Contractor should always have on site and, if necessary, follow a written Spill Prevention and Emergency Response Plan.

6. Spill Prevention and Emergency Response

To prevent the occurrence and minimize the impacts of potential spills, accidents or malfunctions, a Spill Prevention and Emergency Response Plan will be developed by the Contractor and implemented, as needed. Copies should be on site and readily available at all times. The plan should address issues such as procedures required to prevent spills and accidents, as well as appropriate responses for specific events to minimize potential effects. Regular inspections by the QEP should be conducted to ensure adherence to the plan. If standards are followed and care is taken by work crews, risks and effects will be minimized.

Any spill of reportable quantities of a substance that is toxic, polluting, or deleterious to aquatic life should be reported to the Emergency Management BC 24-hour phone line (Northwest Region: 250.615.4800). It will be the responsibility of the Contractor to implement all activities in accordance with applicable legislative requirements.

7. Human-Wildlife Conflict

To avoid human-wildlife encounters during construction, the following mitigation measures will be implemented:

- Ensure all habitat compensation sites do not contain wildlife attractants such as food, garbage, or other materials with a strong and attracting odor;
- Subcontractors will discourage birds and wildlife from inhabiting work areas (e.g., machinery, temporarily stored materials, and other construction infrastructure). Inspection of work areas will occur regularly to identify wildlife attempting to nest as early as possible. Crews will be instructed to notify the QEP of wildlife nesting/inhabitation attempts. Discouraging wildlife nesting may include installing exclusion measures (fences) and manually sweeping and maintaining equipment and construction infrastructure to discourage wildlife activity on the infrastructure and scaring the wildlife away;
- Where garbage containers are required, ensure containers are inaccessible to wildlife (i.e., through the use of bear-proof garbage containers) and are disposed of on a regular basis (e.g., weekly) or when needed (i.e., full);
- Do not touch, feed, collect, harm or harass wildlife;
- Hunting and/or fishing is not allowed on or near the habitat compensation sites.

8. Erosion and Sediment Control

The Contractor will submit an Erosion and Sediment Control Plan (ESCP) to BW Gold for approval at least two weeks prior to the start of construction. The ESCP will align with the principles, layouts, details and specifications outlined as part of the detailed design drawing package for Mathews Creek channel/pond works (Appendix C of the Compensation Plan). The ESCP will contain specific mitigation measures to minimize sedimentation in Mathews Creek that could be caused by:

- Initial flow diversion.
- Dewatering of the instream work areas, including scouring/erosion at pump intake and outlet.
- Discharge of seepage water from the dewatered area resulting from isolation structure leakage, groundwater infiltration, or rainfall.
- General construction activities within the dewatered area or near the watercourse, including those relating to access.
- Restoration of stream flows following completion of instream works.

The Contractor's ESCP will provide a detailed description of control measures or structures to minimize erosion and sedimentation, including:

- Limit vegetation clearing to the minimum area necessary for construction and access to avoid exposed soils.
- Establish one stabilized entry/exit point to instream work area to minimize disturbed soils.
- Minimize disturbance to ground cover within the construction area to the extent possible.
- Divert creek water around the instream work areas. Control diversion pump discharge to dissipate velocities and prevent channel bed and bank erosion through the use of a splash pad or similar structure.
- Install sediment barriers such as fibre rolls (e.g., Siltsoxx) or sediment control fencing at all drainages to Mathews Creek.
- Stabilize/cover disturbed earth using erosion control measures such as erosion control blankets.
- Stockpile materials in a stable area at least 15 m from the watercourse top of bank.
- Discharge silty water to a contained part of the site and allow it to infiltrate to ground.
- Plant riparian vegetation on disturbed areas as soon as possible after construction.
- Only undertake construction works during favourable weather conditions.
- Ensure supervision of instream and near-water works by a QEP.

8.1 Project-Specific Erosion and Sediment Control Measures

Specific erosion and sediment control measures for the construction of the Mathews Creek off-channel ponds and the restoration of Mathews Creek, as outlined on engineering design drawings prepared by Palmer and Onsite Engineering Ltd (Appendix C of the Compensation Plan), include:

- Pond excavation is planned to be completed in winter when groundwater levels are low and soils are frozen, in order to minimize sedimentation. However, work may occur outside of this period with additional erosion and sediment control measures in place.
- Prior to equipment access, and to minimize soil disturbance, rig matting to be installed where ground is, or anticipated to be, soft or wet.
- All instream works will be completed in isolation of Mathews Creek. Site isolation will be completed using a meter bag cofferdam filled with pea gravel and wrapped with an impervious membrane. In low water conditions, pea gravel-filled sandbags with membrane may be used.
- Water level within isolated instream work areas may be drawn down using sump pumps. Dewatering filter bags encircled with Siltsoxx will be used to treat this sediment-laden water prior to discharging to ground.
- Temporarily exposed soils will be covered using a biodegradable erosion control blanket (e.g., woven jute/coir mesh) or as recommended by the QEP.
- Potential transport of sediment will be managed through the installation of sediment barriers such as fibre rolls (e.g., Filtrexx Siltsoxx) or sediment control fencing.
- All stockpiled material will be placed at least 15 m away from the top of bank of any watercourses and will be encircled with Siltsoxx to avoid sediment transport.
- Flow will be connected to / re-established with Mathews Creek in a controlled manner to minimize sedimentation.

All erosion and sediment control measures must be established prior to starting any works that may result in sediment mobilization.

9. Construction Phasing

The contractor will submit a Construction Phasing Plan (CPP) to BW Gold for approval at least two weeks prior to the commencement of work. The CCP will align with the proposed sequencing outlined as part of the detailed design drawing package for Mathews Creek channel/pond works (Appendix C of the Compensation Plan). The CPP will outline the approach that will be taken with respect to project phases, water drawdown/diversion, fish salvage timing, and other construction considerations. Instream work and stream isolation will occur in phases, as determined by the contractor at the outset of the project.

The QEP will provide environmental regulators (DFO, Environment and Climate Change Canada [ECCC], BC Ministry of Environment and Climate Change Strategy [ENV]) with two weeks advance notice prior to the start of construction. The following sequence of events is proposed to be applied in each phase at the compensation sites as appropriate:

- Complete fish removal and relocation in accordance with the Fish Salvage plan (Section 10).
- Once the QEP indicates the initial fish salvage is complete, install water management (Section 10) and erosion and sediment control measures (Section 8).
- Commence instream work area dewatering. Supplemental fish salvages will be conducted during this period if residual fish are identified, or anticipated to be present.
- Complete construction of stream restoration/enhancement in isolation of flow from Mathews Creek, including all grading and instream feature installations as detailed on design drawings.
- Restore stream flows gradually to minimize potential sedimentation to Mathews Creek, while monitoring channel and bank stability and water quality.
- Complete any required bank stabilization or restoration to pre-disturbance conditions.
- Once instream work is complete, remove any fish stopnets to allow fish passage through the work area.
- Remove temporary erosion and sediment controls (e.g., silt fences) following project completion, once disturbed areas have been stabilized.

Instream channel works are proposed to be generally completed from upstream to downstream, such that new restoration/enhancement works are not at risk of minor sedimentation. This planned sequencing of activities is subject to modification based on input from the Contractor, BW Gold, and environmental regulators.

10. Fish Salvage, Timing and Water Management

10.1 Fish Salvage

A fish salvage will be conducted by the QEP at each habitat compensation site, within each segment of isolated channel, prior to the start of instream works. Because instream works will be staged, a fish salvage will be conducted in advance of each stage prior to isolation and water diversion.

At each site, stopnets will be installed at the upstream and downstream extent of the instream work area. The nets will be anchored to the stream banks and weighted at the bottom to prevent fish from entering the instream work area during construction works. The area between the nets will be systematically fished using a variety of capture methods (e.g., seine netting, minnow trapping, dip netting, and backpack electrofishing) to ensure removal of all fish. All captured fish will be identified, measured for length, and released downstream of the instream work area (i.e., downstream of the downstream stopnet) in similar habitat. The fish salvage may continue during water diversion if there is the potential that fish may still be present within the instream work area.

Fish stopnets will remain in place for the duration of the instream work, and the QEP will periodically check the nets to ensure they are preventing fish from entering the instream work area. If stopnets become breached during the project (e.g., due to high creek water levels or net failure), instream works will stop until the nets are re-secured and additional fish salvages are undertaken. The QEP will also assess the need for supplementary fish salvaging during instream works.

Fish salvaging will be conducted in accordance with conditions outlined in the provincial *Scientific Fish Collection* permit from FLNRORD. A Species-At-Risk-Act (SARA) permit is not required, as there are no SARA-listed fish species present in Mathews Creek.

10.2 Timing

The timing for the construction of the instream components of the Mathews Creek habitat compensation will follow standard instream construction timing restrictions and best practices, during low-flow conditions, and within the timing window of least risk to fish and fish habitat. It should be noted that instream water levels in Mathews Creek may locally remain relatively deep, even during low-flow conditions, in association with transient impoundments by beaver dams.

Components of compensation measures that are not considered instream (e.g., construction of overwintering ponds prior to connection with Mathews Creek) may be completed outside of timing restrictions provided works are in isolation of Mathews Creek flow and erosion and sediment control measures are implemented. Connection of above-stream works to Mathews Creek will be completed during timing restrictions.

As the compensation habitat has been designed to restore habitat utilized by rainbow trout, the Reduced Risk Work Window for the Omineca Region (July 15 to April 15) for this species will be followed

(Government of BC, 2004). Consultation with DFO will occur to determine if adjustments are needed to the recommended timing windows prior to the commencement of construction. The QEP will work with the contractor to ensure that all instream works are completed as quickly as possible within this timing window, to minimize risk to fish and fish habitat.

10.3 Water Management

All instream habitat compensation measures in Mathews Creek is intended to be undertaken 'in the dry' or within an isolated work area with appropriate erosion and sediment controls. Isolation of instream work areas will involve the installation of a barrier system (i.e., a cofferdam). The contractor will implement best practices to ensure that water at each compensation site is properly managed to ensure no adverse effects to fish in Mathews Creek, including:

- Ensuring creek flow downstream of instream work areas is maintained at all times.
- Ensuring water diversion (i.e., bypass) pumps have sufficient capacity to divert instream flows.
- Screening pump intake(s) and minimizing velocity to prevent impingement or entrainment of fish, in accordance with the DFO *Interim Code of Practice: End-of-pipe fish protection screens for small water intakes in freshwater*.
- Controlling pump discharge to dissipate velocities and prevent channel bed and bank erosion through the use of a temporary splash pad or similar structure.
- Developing a contingency plan to address pump failure and to ensure water diversion operations can continuously control the flow. Isolation and pumping operations should consider future weather events.
- Collecting and discharging any sediment-laden water, including seepage that may collect within the isolated work area, to an appropriate area as outlined in the contractor Erosion and Sediment Control Plan (Section 8) or as directed by the QEP.

Water drawdown in the instream work area should occur at such a rate that the QEP has sufficient time to salvage fish. Drawdown plans should allow for some variation in the time required to complete the fish salvage, as removal efficiency can be variable due to water depth, presence of woody debris, and other factors.

11. Wildlife

11.1 Breeding Birds

The typical breeding bird window is from April 1 to July 31 in the Omineca region. However, based on local expertise, conditions at the compensation sites (i.e., high elevation), and variability in snow and climate conditions, a mid-April to mid-August window will be followed. Scheduling of vegetation clearing with potential to disturb or harm resident and migratory birds or their active nests should take place outside this window (i.e., should only be completed between August 15 and April 15). This is to prevent contravention of the federal *Migratory Birds Convention Act* and pursuant *Migratory Birds Regulations*, as well as Section 34 of the provincial *Wildlife Act*. The onsite QEP will have final authority on when to conduct vegetation clearing and nest surveys.

If any localized vegetation clearing associated with access to the Mathews Creek habitat compensation sites is required and must be conducted during the breeding bird season, an active bird nest survey should be conducted prior to the start of work by a QEP familiar with local avifauna and behaviours associated with nesting and territorial establishment of bird species that may be encountered.

If an active nest is found (i.e., a nest occupied by a bird or its eggs, or if a bird is near the nest and displays signs of breeding or rearing activity), radial buffers based on provincial best management practices will be implemented. No vegetation clearing will be permitted within the target buffer area until the nest is determined to be inactive.

11.2 Reptiles and Amphibians

A salvage of reptiles and amphibians within the work areas will be conducted prior to the start of construction, in coordination with the fish salvage activity described in Section **Error! Reference source not found.**. A *Wildlife Act* permit will be obtained prior to conducting the salvage, which authorizes the live capture and release of native turtle and amphibian species. The permit also allows live capture of non-native reptile and amphibian species and mandates their humane euthanization.

Prior to construction, a sweep of the area will be conducted by the QEP who is familiar with the life histories of reptiles and amphibian species that may be present in the area. Temporary exclusion fencing will be placed to surround the work area and prevent ingress by these species. Exclusion fencing materials and installation methods can be similar to those required for erosion and sediment control (Section 7).

The QEP will conduct regular visual inspections of the exclusion fencing and will alert the Contractor to any identified deficiencies. The QEP will also regularly monitor the construction areas to ensure wildlife is not present.

12. Surface Water Quality

Water quality in Mathews Creek will be tested regularly by the onsite QEP to ensure compliance with BC Approved Water Quality Guidelines (BC ENV 2019) and environmental permit conditions (e.g., *Water Sustainability Act* Approval; DFO *Fisheries Act* Authorization) as applicable (Table 1).

Water quality monitoring will be conducted prior to instream works to establish baseline conditions, as well as during and after construction, or release of any materials from the project area. Water testing and visual assessment will be conducted at the start and end of each shift during construction at a minimum interval of every four hours, and with supplementary samples taken during changes in construction activity or at the discretion of the QEP.

Water quality monitoring parameters include turbidity (visual and with a turbidity meter), pH, temperature, and dissolved oxygen (using a multi-parameter meter), and hydrocarbon sheens from oil and grease (visual). Water quality monitoring stations will be established once the construction area has been determined, but will include a minimum of one station upstream and downstream of the construction area to establish background and exposure water quality values.

Direct measurement of total suspended solids (TSS) is not feasible outside a laboratory setting. Turbidity, measured using nephelometric turbidity units (NTU), can be directly measured in-situ using a turbidity meter and will therefore be used as a proxy for directly measuring levels of TSS. If TSS exceedances are suspected, a confirmatory sample can be taken for laboratory analysis.

If turbidity or TSS guidelines are exceeded as a result of construction activities, work will be halted and erosion and sediment control measures will be adjusted as needed to reduce sediment inputs. If pH guidelines are exceeded or hydrocarbons are detected in waterways, control measures will be implemented (e.g., bubbling with carbon dioxide to control high pH or implementing spill response protocols to contain hydrocarbons, as described in Section 5).

Table 1. Water Quality Guidelines.

Parameter	Guidelines
Turbidity	- Change from background of 8 Nephelometric Turbidity Units (NTU) at any one time for a duration of 24 h in all waters during clear flows or in clear waters - Change from background of 2 NTU at any one time for a duration of 30 d in all waters during clear flows or in clear waters - Change from background of 5 NTU at any time when background is 8 - 50 NTU during high flows or in turbid waters - Change from background of 10% when background is >50 NTU at any time during high flows or in turbid waters
Total Suspended Solids	- Change from background of 25 mg/L at any one time for a duration of 24 h in all waters during clear flows or in clear waters - Change from background of 5 mg/L at any one time for a duration of 30 d in all waters during clear flows or in clear waters - Change from background of 10 mg/L at any time when background is 25 - 100 mg/L during high flows or in turbid waters - Change from background of 10% when background is >100 mg/L at any time during high flows or in turbid waters
pH	- 6.5 to 9.0: unrestricted change permitted within this range. This component of the freshwater guidelines should be used cautiously if the pH change causes the carbon dioxide concentration to decrease below a 10 µmol/L minimum or exceed a 1,360 µmol/L maximum, as these concentrations may be toxic to fish.
Oil and Grease	- Not detectable by sight or smell

13. Archaeological Chance Finds

Archaeological sites (both recorded and unrecorded) are protected under the *Heritage Conservation Act* and must not be altered or damaged without a permit from the Archaeology Branch. All workers involved in ground disturbance and construction must be aware that activities must be halted if archaeological materials are encountered, and the Archaeology Branch contacted at (250) 953-3334 for direction. BW Gold has a chance find procedure which will be provided to and followed by the construction contractor.

14. Environmental Monitoring During Construction

All instream works will be monitored by a QEP to ensure environmental mitigation measures described in this CEMP have been implemented and are functioning as intended to protect aquatic and terrestrial habitat. The environmental monitoring program will include:

- Ensuring Spill Prevention and Emergency Response measures are implemented and spill kits and other measures are on-site.
- Confirming machinery is clean and leak-free while on site.
- Ensuring erosion and sediment control measures are constructed, installed and maintained appropriately for the full duration of construction works.
- Monitoring diversion works to ensure pumps are in proper working condition and downstream flow is maintained at all times.
- Ensuring water quality is within BC guidelines for the protection of freshwater aquatic life.
- Ensuring diversion pump intakes are screened for fish and aquatic species in accordance with the DFO *Interim Code of Practice: End-of-pipe fish protection screens for small water intakes in freshwater*.
- Notifying the QEP and BW Gold in the event of an environmental incident or non-compliance with any of the terms or conditions of water quality guidelines or environmental permit conditions.
- Stopping work authorized if deemed necessary by the QEP to address risks to the environment.

The QEP will work with BW Gold's mine environmental staff to ensure that the environmental monitoring program is completed satisfactorily during construction.

15. Site Restoration

At the end of the project, all equipment, supplies, and non-biodegradable materials will be removed from the site. Disturbed areas will be re-graded to a stable angle and returned as closely as possible to their natural state. Restoration of disturbed areas will involve riparian planting, in accordance with the design drawings provided in Appendix C of the Compensation Plan.

Disturbed areas that are not planted will be protected from surface erosion by re-seeding with an approved seed mixture and/or installing biodegradable erosion control blankets. All seeding and planting shall be planned to allow establishment before the end of growing season; the recommended timing is in the fall during September and October, or spring during March and April, when most plants are dormant.

16. Post-Construction Reporting

A detailed environmental monitoring report will be prepared by the QEP after habitat compensation construction has been completed, which will summarize:

- Permit number(s);
- Instream works undertaken;
- Timing of the works;
- Total instream area directly affected;
- Frequency of monitoring;
- Water quality sampling and accompanying results along with a description of any levels higher than permitted and what immediate steps were taken (if applicable);
- Representative site photographs;
- Any non-compliance with the terms and conditions of the permits; and
- A description of any environmental incidents, non-compliance or other difficulties, and how these were addressed and reported.

17. Certification

This report was prepared, reviewed and approved by the undersigned:

Prepared By:

Jason Baird, B.Sc., B.Tech., R.P.Bio.
Aquatic Biologist

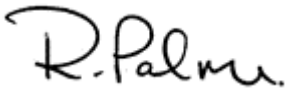
Reviewed By:

Ian MacLeod, B.Sc., R.P.Bio., P.Biol.
Senior Fisheries Biologist

Reviewed By:

Robin McKillop, M.Sc., P.Geo., CAN-CISEC
Principal, Geomorphologist & Habitat Restoration Specialist

Approved By:



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

18. References

AMEC. 2014. Blackwater Gold Project, Fisheries Mitigation and Offsetting Plan.

BC EAO (BC Environmental Assessment Office). 2019. Environmental Assessment Certificate #M19-01 Schedule B Table of Conditions. Available at: https://www.projects.eao.gov.bc.ca/p/588511c0aaecd9001b82522a/project-details;currentPage=1;pageSize=10;sortBy=-datePosted;ms=1609888329872.

BC ENV (BC Ministry of Environment and Climate Change Strategy). 2019. Approved Water Quality Guidelines. BC Ministry of Environment, Victoria, BC. Available at: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines.

BC Ministry of Environment. 2009. A Users' Guide to Working In and Around Water. Understanding the Regulation Under British Columbia's Water Act. 40 p.

BC MWLAP (BC Ministry of Water, Land, and Air Protection). 2002. A Field Guide to Fuel Handling, Transportation, and Storage 3rd Ed. 46 p.

BC Ministry of Water, Land and Air Protection. 2004. Standards and Best Practices for Instream Works. Ecosystem Standards and Planning, Biodiversity Branch. March 2004. 174 p.

DFO (Fisheries and Oceans Canada). 2020. Interim Code of Pratice: End-of-Pipe Fish Protection Screens for Small Water Intakes in Freshwater. Available at: https://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html

DFO (Fisheries and Oceans Canada). 2019. Measures to Protect Fish and Fish Habitat. Available at: https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html.

DFO (Fisheries and Oceans Canada). 1995. Freshwater intake end-of-pipe fish screen guideline. Ottawa: Department of Fisheries and Oceans. 27 pp.

Government of BC. 2004. Terms and Conditions for Changes in and About a Stream Specified by MWLAP Habitat Officers, Omineca Region. Version 1.1. Available at: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/working-around-water/regional-terms-conditions-timing-windows.

IAAC (Impact Assessment Agency of Canada). 2019. Environmental Assessment Decision Statement. Available at: https://iaac-aeic.gc.ca/050/evaluations/document/129205?culture=en-CA.

PECG (Palmer Environmental Consulting Group). 2013. Blackwater Project: Fish and Fish Habitat Baseline Assessment and Compensation Program, Mathews Creek Watershed Rehabilitation Project. Prepared for AMEC Environment & Infrastructure, Burnaby, by Palmer Environmental Consulting Group Inc., Vancouver, BC. 8 November 2013.

Appendix E

Effectiveness Monitoring Plan

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5
Tel: 604-629-9075 | www.pecg.ca

Blackwater Project

MDMER Schedule 2
Fisheries Compensation
Effectiveness Monitoring Plan

Palmer Project #
2006501

Prepared For
BW Gold Ltd

June 2, 2021

Table of Contents

List of Tables

1. Introduction

BW Gold Ltd. (BW Gold) proposes to construct and operate the Blackwater Project (the Project), an open-pit gold and silver mine located 160 km southwest of Prince George and 110 km southwest of Vanderhoof in British Columbia (BC).

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

As part of the EAC Application, an effects assessment was completed for fish and fish habitat, which were identified as Valued Components (VCs). It was determined through this process that the Project will likely result in the death of fish or a harmful alteration, disruption, or destruction of fish habitat (HADD), as defined by the federal *Fisheries Act*.

Before construction can commence, the Project will require both an amendment of Schedule 2 of the Metal and Diamond Mining Effluent Regulations (MDMER) and an Authorization under Paragraph 35(2)(*b*) of the *Fisheries Act*. The amendment to Schedule 2 of the MDMER specifically applies to the loss of fish habitat in tailings impoundment areas resulting from the placement of mine waste. *The Fisheries Act* authorization will address all other effects on fish and fish habitat resulting from Project activities.

A Conceptual Fisheries Mitigation and Offsetting Plan was prepared as part of the Environmental Assessment Application, which outlined Project activities, effects, and offsetting measures proposed at the time of the Application submission (AMEC, 2014; Appendix.5.1.2.6C of the Application). The Conceptual Offsetting Plan has been updated based on comments received from Fisheries and Oceans Canada (DFO) and the Ministry of Forests, Lands and Natural Resource Operations and Rural Development and separated into two plans: an Offsetting Plan for the *Fisheries Act* Authorization and a Compensation Plan for the amendment to Schedule 2 of MDMER. This Effectiveness Monitoring Plan (EMP) addresses monitoring of fish habitat creation and restoration that is proposed in the Compensation Plan for MDMER Schedule 2 amendment. A separate EMP has been prepared for the *Fisheries Act* Authorization Offsetting Plan.

The Compensation Plan applies DFO's guiding principles, as outlined in its *Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act* (DFO, 2019), and primarily focuses on restoring/enhancing degraded fish habitat as stated in paragraph 34.1(1)(f) of the *Fisheries Act*. The Compensation Plan includes two separate measures in the Mathews Creek watershed to offset the loss of fish habitat resulting from Project activities:

- Mathews Creek Stream Restoration/Enhancement

- Restoration and enhancement of fish habitat in Mathews Creek to address impacts from cattle-trampled banks and bed, historic riparian vegetation clearing, dilapidated crossings, exposed banks, and flow obstructions/impediments.

- Off-channel Ponds
  - The construction of three off-channel ponds connected to Mathews Creek to help address the availability of overwintering habitat as a limiting factor for rainbow trout abundance in the study area.

The EMP for the Compensation Plan for Mathews Creek proposes a multi-disciplinary approach involving both qualified biological and fluvial geomorphological specialists evaluating habitat compensation success. This EMP outlines three approaches to ensure offsetting success, based on a review of monitoring methods described by DFO (Braun et al. 2019):

- A *compliance-based approach* using an on-site environmental monitor and qualified environmental professionals (QEPs) during construction to ensure that environmental protection measures and best management practices are implemented as required and that habitat features are constructed in accordance with the MDMER Schedule 2 amendment Compensation Plan and design drawings. Post-construction surveys and/or photographic documentation will also be completed to ensure design specifications were correctly implemented.
- A *functionality-based approach*, using post-construction inspection and multiple follow-up evaluations by QEPs to ensure morphological stability of the channel/ponds and the functionality of the constructed fish habitat, based on a qualitative and quantitative monitoring program.
- An *effectiveness-based* approach, using Before-After-Control-Impact (BACI) design or Control-Impact (CI) methods to assess habitat use by fish.

1.1 Proposed Compensation Measures

A detailed description of the proposed compensation measures is available in Section 6.5 of the Compensation Plan, a summary of which is provided below.

1.1.1 Mathews Creek Restoration and Enhancement

Mathews Creek is part of the Nechako River watershed and has been impacted by past and current agricultural practices, particularly cattle grazing. A number of existing geomorphological and aquatic impacts at the creek were documented, including:

- Cattle trampled banks and bed;
- Farm machinery crossings;
- Exposed channel banks; and
- Flow obstructions/impediments.

Stream restoration and enhancement is proposed along 4.6 km of Mathews Creek in multiple reaches where degraded habitat has been identified. Restoration techniques will include reconstruction of the natural bankfull channel using earth fill and woody debris placement, riparian vegetation plantings, targeted excavation of sediment, placement of boulders on the channel bed, and removal of anthropogenic materials.

Riparian plantings are proposed for the majority of segments to improve bank stability, provide aquatic food sources, and increase overhanging cover. Four failing cattle and small vehicle crossings and farm machinery debris are proposed to be removed.

1.1.2 Mathews Creek Off-channel Ponds

BW Gold proposes to construct three off-channel ponds in the Mathews Creek watershed to provide, among other things, overwintering habitat for rainbow trout and other fish. Locations and physical characteristics of each of the ponds have been designed to maximize the quality of overwintering refuge provided by the ponds by targeting areas of naturally high groundwater table and through-flow for minimizing winter ice cover thickness, maximizing dissolved oxygen, and incorporating deep water (i.e., greater than 2 m), cobble/boulder substrates, and overhead cover.

The ponds have irregular shapes, contain peninsulas and islands and are strategically positioned to increase habitat diversity. Each 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, such as a pool 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 ponds. The ponds contain shallow water (0 to 1 m depth) ‘shoals’ lined with cobble and deeper (1 to 5 m depth) areas.

A ‘leaky bank’ is proposed to separate the pond and adjacent channel along a segment of an up-valley portion of pond shoreline at Pond #1 and Pond #2. The leaky bank is composed of coarse gravels that allow for some throughflow of water from Mathews Creek into the pond.

Riparian plantings are proposed along the periphery of the ponds. The proposed plantings include a native seed mix and shrub plantings around the periphery of the pond and aquatic plantings in the gentle, shallow shoreline area.

Ponds proposed in the Mathews Creek watershed will be incorporated into proposed valley bottom wetland restoration complexes designed by BW Gold’s consultants. A gentle, shallow shoreline was incorporated into the Mathews Creek ponds to support transitional emergent vegetation growth in surrounding wetland restoration areas.

1.2 Objectives

The EMP's overall objective is to ensure all conditions of the provincial EAC and federal Decision Statement are met with respect to offsetting fish habitat impacts as a result of the Project. With this in mind, the specific objectives of this EMP are to:

1. Monitor the construction of the compensation habitat to ensure habitat features/components are constructed in accordance with the design drawings and guide the Contractor through any required field-fit refinements.

2. Certify that habitat compensation measures are correctly constructed according to design drawings through the completion of final surveys and/or photographic documentation following construction. Field measurements will be compared to design drawing specifications to ensure the areal extent of created or restored habitat is consistent with the Compensation Plan habitat balance.

3. Complete a three-year, post-construction effectiveness monitoring program to evaluate the form and function of completed compensation measures to ensure these habitats are successfully maintaining their constructed form and are progressing effectively in attaining their intended habitat function.

This EMP outlines the metrics and assessments that will be used to determine whether the compensation measures function as designed in creating / restoring / enhancing fish habitat.

2. Methodology

2.1 Monitoring Approach

Each of the habitat compensation measures has been designed to create, restore and/or enhance specific fish habitat, with some compensation measures providing habitat for different life stages, primarily rearing and overwintering. The following effectiveness monitoring components will be used to evaluate the success of the compensation habitat at 1, 3, 5, and 10 years after implementation:

1. Physical Stability and Hydraulic Function:
   (a) Channel bed and bank/shoreline stability
   (b) Substrate condition
   (c) Habitat feature stability (e.g., large woody debris [LWD], boulders)
   (d) Flow and water levels

2. Water Quality:
   Assessed against applicable water quality standards (i.e., BC Ministry of Environment and Climate Change Strategy Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture)

3. Fish Utilization:
   (a) Presence/absence
   (b) Relative abundance and biomass
   (c) Size-class distribution

4. Riparian Vegetation:
   (a) Survivorship
   (b) Percent cover

Each of these monitoring components will be assessed according to success criteria described below and timelines described in Section 3.0 to fulfill the longer-term habitat function objective.

2.2 Success Criteria

Using the monitoring components discussed above, the success of each compensation measure at achieving its objective will be assessed using a number of qualitative and quantitative metrics or indicators. These include:

1. Physical stability and hydraulic function:
   (a) Compensation habitat shows no significant signs of bed erosion, bank/shoreline failure or habitat feature (e.g., large woody debris) movement that may affect habitat functionality.
   (b) Compensation pond habitat remains hydraulically connected to its mainstem channel.

(c) Flow and water levels are consistent with design to provide fish habitat and/or maintain habitat function, in consideration of natural fluctuations in flow and water levels.

2. Water quality:
   (a) Water quality at compensation habitat meet guidelines for the protection of aquatic life, particularly for the intended habitat function (e.g., rearing, overwintering)

3. Fish utilization:
   (a) Presence/Absence
      (i) Compensation habitat provides intended habitat function for rainbow trout of various life stages (rearing, overwintering) relative to reference site.

   (b) Relative abundance and biomass
      (i) Rainbow trout relative abundance and biomass at compensation habitat is comparable to reference site.

   (c) Size-class distribution
      (i) Rainbow trout size classes at compensation habitat are comparable to reference site.

4. Riparian vegetation survival
   (a) No more than 30% mortality of planted riparian vegetation, by the summer of the third year after planting.
   (b) Year-over-year increase in general vegetation cover

Sampling at a reference site is required to compare success criteria of the newly created or restored habitat against background data, in order to properly assess whether compensation efforts are achieving objectives. In order to ensure habitat conditions (e.g., habitat quality, flow/morphology, biophysical characteristics) at the reference site is similar to the compensation site, candidate reference sites will be selected in the field prior to conducting the monitoring program.

Overall compensation habitat success will be measured against the intended habitat function using these monitoring approaches and success criteria, and will depend on fulfilling objectives for each compensation measure.

3. Habitat Compensation Measures EMP

3.1 Mathews Creek Restoration and Enhancement

A component of the Compensation Plan is the restoration and enhancement of fish habitat in Mathews Creek. The creek has been degraded by past agricultural practices, primarily cattle grazing and land clearing. Mathews Creek is within the Nechako watershed and provides rearing habitat for rainbow trout. Restoration plans will involve exclusion of cattle within the riparian area, riparian plantings, and the restoration of stream channels and banks.

3.1.1 Monitoring Approach

The EMP will quantitatively assess the effectiveness of the creek restoration efforts through measurable parameters such as physical stability and function, water quality, fish utilization, and riparian vegetation success (Table 3-1). To quantitatively measure the success of the Mathews Creek restoration plan, a BACI study design will be implemented at sites on the creek where restoration will occur, as well as an appropriate reference site to account for variability in physical characteristics, water quality and biological conditions over a ten-year period. A suitable reference site with comparable biophysical characteristics will be selected prior to conducting the monitoring program.

Physical stability and hydraulic function of compensation habitat and the reference site will be assessed to document any potential changes in bed, banks, and installed habitat features (e.g. boulders, brush layers, woody debris). Representative photographs will be taken prior to construction, immediately following completion, and during each subsequent site visit. Photographs should be collected from the same vantage point and with the same field of view to allow for time series comparison.

Water quality *in-situ* data (i.e., temperature, conductivity, pH, and dissolved oxygen) collected during site assessments will be used to determined whether creek conditions are suitable for rainbow trout based on BC Approved Water Quality Guidelines.

Rainbow trout utilization of the compensation habitat will be assessed through the collection of presence/absence, relative abundance, biomass, and size-class distribution (age or length-frequency) data at each sample site. Fish sampling techniques may include minnow trapping, single-pass electrofishing, or a combination of methods and will be consistent throughout the monitoring program.

Riparian vegetation will be assessed for survivorship and vegetation percent cover. Plantings will be initially inspected following installation to document the species, diversity, and vigour of the plantings. Follow-up inspections will be conducted once-yearly at 1, 3, 5, and 10 years following planting to record the survivorship and general vegetation cover. As a large number of shrubs, herbaceous vegetation, and aquatic plants will be planted over a large areal extent, the survivorship and ground cover assessment will be conducted using a subsampling approach at a number of vegetation plots. Representative photos will

be taken of identified growth or survival issues as well as of the planted vegetation during each visit to illustrate growth over time.

The number of sampled sites will be determined based on the extent of compensation areas within each site within the Mathews Creek watershed.

Sampling for the physical stability and hydraulic function, water quality, fish utilization, and riparian vegetation components is proposed once per monitoring year (1, 3, 5 and 10 years after implementation) in summer, with additional sampling in winter of monitoring years for water quality, and is based primarily on the regional life cycle of rainbow trout.

3.1.2 Success Criteria

Success criteria for the Mathews Creek habitat restoration will be used to determine whether the restored habitat in the creek is physically stable, has water quality that is within guidelines, is being utilized by rainbow trout, and that planted riparian vegetation is established and growing (Table 3-1).

Indicators of physical stability and hydraulic function include no indications of anomalously severe erosion or sedimentation along the channel bed and banks or within the vicinity of constructed habitat features (except where locally intended in association with woody debris placements). Repeat channel cross-sections will be measured at benchmarked locations representative of the diversity of local morphology, especially in areas of complete earth works (e.g., bank regrading), to help substantiate visual interpretations.

Indicators of adequate water quality include parameters that are consistent and within guidelines for the protection of aquatic life.

Fish utilization indicators include assessing whether abundance, biomass, and size-class distribution of rainbow trout are comparable to reference sites and that fish are ultimately utilizing the restored areas.

No more than 30% mortality of plantings after the third year and increases in the vegetation percent cover between monitoring years will be used as the indicators of the success of planted riparian vegetation.

Table 3-1. Success Criteria for the Mathews Creek Channel and Bank Restoration

Parameter	Measurable Parameter(s)	Metrics/Indicators	Monitoring Frequency
Physical Stability and Hydraulic Function	Physical stability	Bed, bank, and constructed habitat features (boulders, brush layers, woody debris) show no significant signs of erosion, migration or sedimentation that may impact habitat functionality. Repeat cross-sectional measurements at representative sites will help substantiate visual interpretations.	Summer in years 1, 3, 5, and 10 following completion
	Flow	Restored habitat remains wetted with sufficient flow for use by rainbow trout	
Water Quality	BC ENV water quality guidelines	Water quality meets BC ENV guidelines for the protection of freshwater aquatic life	Summer and winter years 1, 3, 5, and 10 following completion
Fish Utilization	Presence/Absence	Restored areas provide habitat for rainbow trout of various life stages relative to pre-restoration and reference site data	Summer in years 1, 3, 5, and 10 following completion
	Abundance/Biomass	Rainbow trout relative abundance and biomass in compensation area is comparable to pre-restoration and reference site data	
	Size-class distribution	Rainbow trout size classes are comparable to pre-restoration and reference site data	
Riparian Vegetation	Survivorship	No more than 30% mortality of planted riparian vegetation after the third year	Summer in years 1, 3, 5, and 10 following planting
	Vegetation percent cover	Increase in the percent cover between monitoring years	

3.2 Off-channel Ponds

To address overwintering habitat availability as a key limiting factor in rainbow trout abundance, the construction of three off-channel ponds in the Mathews Creek watershed has been proposed as a component of the Compensation Plan. The ponds have been designed to maximize the quality of overwintering refuge for rainbow trout by providing through-flow, which minimizes ice cover thickness and maximizes dissolved oxygen, as well as incorporating cobble/boulder substrates and instream cover. The main objective of this component of the compensation plan is to increase overwintering habitat; however,

an added benefit of this compensation measure is the provision of summer rearing habitat for rainbow trout fry and juveniles.

3.2.1 Monitoring Approach

The objective of the EMP is to quantitatively determine the success of the three off-channel ponds in the Mathews Creek watershed in providing fish habitat as designed following construction. A Before-After-Control-Impact (BACI) design does not apply to newly created habitat where no habitat existed previously, therefore a Control-Impact design will be used, where the created compensation habitat will be compared to reference habitat. A suitable reference site with comparable biophysical characteristics will be selected prior to conducting the monitoring program.

Measurable parameters, including the physical stability and hydraulic function, water quality, fish utilization, and riparian vegetation at the constructed ponds (Table 3-2) will be documented at each pond and at the reference site over a ten-year period. Representative photographs will be taken prior to construction, immediately following completion, and during each subsequent site visit. Photographs will be collected from the same vantage point and with the same field of view to allow for time series comparison.

Monitoring of physical stability and flow will include detailed site evaluations to document any alterations to side slopes, shoreline and large woody debris stability (slumping, erosion, substrate deposition/scouring), and hydraulic function (connectivity to mainstem channels and water depth during periods of high and low flow).

Water quality *in-situ* data (i.e., temperature, conductivity, pH, dissolved oxygen) will be used to determined whether conditions are suitable for rainbow trout rearing and overwintering and will be compared to BC Approved Water Quality Guidelines. Particular attention will be placed on assessing sufficient dissolved oxygen through the winter months.

The utilization of the ponds by rainbow trout as both overwintering and summer rearing habitat will be assessed using standardized methods (e.g., minnow trapping, under-ice gillnet sampling, or electrofishing if feasible). Presence/absence, relative abundance, biomass, and size-class distribution (age- or length-frequency) data from fish in each pond will be assessed. The collection of these data, and the methods used, may need to be re-evaluated during winter sampling to ensure fish health during cold weather. A consistent sampling method will be used at all sites for the duration of the monitoring program.

Riparian vegetation will be assessed for survivorship and vegetation percent cover. Plantings will be initially inspected following installation to document the species, diversity, and vigour of the plantings. Follow-up inspections will be conducted in years 1, 3, 5, and 10 following planting to record the survivorship and general vegetation cover. As a large number of shrubs, herbaceous vegetation, and aquatic plants will be planted over a large areal extent, the survivorship and ground cover assessments will be conducted using a subsampling approach at a number of vegetation plots. Representative photos

will be taken of identified growth or survival issues as well as of the planted vegetation during each visit to illustrate growth over time.

Sampling for the physical stability and hydraulic function, water quality, fish utilization, and riparian vegetation components is proposed once per monitoring year (1, 3, 5, and 10 years after implementation) in summer, with additional sampling in winter of monitoring years for fish utilization and water quality, and is based primarily on the regional life cycle of rainbow trout.

3.2.2 Success Criteria

The off-channel ponds compensation measure has been designed to provide overwintering habitat for all life stages of rainbow trout as well as summer rearing habitat for rainbow trout within the Mathews Creek watershed. Physical stability and hydraulic function, fish utilization, water quality, and planted riparian vegetation success will be monitored and assessed against design objectives. A summary of success criteria for these parameters is outlined in Table 3-2.

Indicators of physical stability and hydraulic function include no indications of bank slumping or LWD movement, remaining hydraulically connected to the Mathews Creek mainstem, and consistent water depth and through-flow in the pond.

Indicators of adequate water quality include parameters that are consistent and within guidelines for the protection of aquatic life with an emphasis on ensuring sufficient dissolved oxygen through the winter months for overwintering habitat.

Fish utilization indicators include determining presence and assessing whether abundance, biomass, and size-class distribution of rainbow trout are increasing within-site and are comparable to reference sites.

No more than 30% mortality of plantings after the third year and increases in the vegetation percent cover between monitoring years will be used as the indicators of the success of planted riparian vegetation.

Table 3-2. Success Criteria for Mathews Creek Off-channel Ponds

Monitoring Component	Measurable Parameter(s)	Metrics/Indicators	Monitoring Frequency
Physical Stability and Hydraulic Function	Bed and shoreline stability	Constructed ponds and outlet channel show no significant signs of slumping/erosion or habitat feature (e.g., large woody debris) movement that may affect habitat functionality	Summer in years 1, 3, 5, and 10 following completion
	Connectivity to mainstem habitats	Ponds remain hydraulically connected to Mathews Creek mainstem with no barriers to fish passage	
	Water depth and flow	Water depths and through-flow remain consistent and at a level which will provide habitat for fish during periods where ice cover is present	
Water Quality	BC ENV water quality guidelines	Water quality in constructed ponds meet guidelines, particularly during the overwintering period	Summer and winter of years 1, 3, 5, and 10 following completion
Fish Utilization	Presence/Absence	Constructed ponds provide overwintering and rearing habitat for rainbow trout of various life stages relative to reference site	Summer and winter of years 1, 3, 5, and 10 following completion
	Abundance and Biomass	Rainbow trout relative abundance and biomass in constructed ponds is comparable to reference site	
	Size-class distribution	Rainbow trout size classes are comparable to reference site	
Riparian Vegetation	Survivorship	No more than 30% mortality of planted riparian vegetation after the third year	Summer in years 1, 3, 5, and 10 following completion
	Vegetation percent cover	Increase in the percent cover between monitoring years	

4. Adaptive Management and Reporting

The monitoring program will also incorporate adaptive management if compensation habitat deficiencies are identified (i.e., do not meet success criteria outlined in Sections 3.1.2 and 3.2.2), and will include recommending alternate or additional remedial measures, if necessary, to achieve offsetting objectives and EAC and Decision Statement conditions. The determination of whether a compensation site is not functioning as designed will be based on monitoring data, assessment of results, and professional judgment on the part of the QEP. Regulators, however, will have final authority on whether the compensation measures, as a whole or in each of its components, have achieved its objective of offsetting fish habitat losses.

If regulators deem that the compensatory fish habitat is not progressing effectively towards functioning as designed, they may direct specific remedial actions to ensure Project conditions are met. If, at the end of the first three years of monitoring, it appears that remedial work is not likely to achieve offsetting objectives, BW Gold (in consultation with ECCC) would propose alternative compensatory works or modifications to existing works. If remedial measures are implemented, monitoring may be required for longer than the total ten-year period proposed here.

The data collected using the methods described above will be summarized in an annual monitoring report for each monitoring year of the monitoring program (1, 3, 5, and 10 years after implementation). Results will be interpreted by comparing data from the compensation sites with data collected pre-Project (Mathews Creek Restoration and Enhancement compensation measure only) and from a reference (control) site(s). In addition, data interpretation will be based on comparisons of the current year's data with those of previous monitoring years to illustrate trends, if any.

The annual monitoring reports will discuss and interpret results for each compensation site to determine whether or not a particular site is meeting the success criteria (e.g., rainbow trout relative abundance is comparable to reference site) for each monitoring component (e.g., fish utilization). Additionally, the reports will discuss whether the compensation measures are generally progressing effectively in achieving the habitat function intended by the design (i.e., temporal improvements in habitat).

5. Certification

This report was prepared, reviewed and approved by the undersigned:

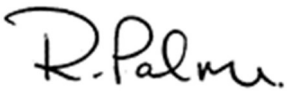
Prepared By:

Jason Baird, B.Sc., B.Tech., R.P.Bio.
Aquatic Biologist

Reviewed By:

Ian MacLeod, B.Sc., R.P.Bio., P.Biol.
Senior Fisheries Biologist

Approved By:



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

6. References

AMEC. 2014. Blackwater Gold Project, Fisheries Mitigation and Offsetting Plan.

Canadian Environmental Assessment Act (CEAA). 2012, c. 19, s. 52.

DFO (Fisheries and Oceans Canada). 2012. Assessing the effectiveness of fish habitat compensation activities in Canada: monitoring design and metrics. DFO Can. Sci. Advis. Sec. Sci Advis. Rep. 2-12/060.

DFO (Fisheries and Oceans Canada). 2019. Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act. December 2019. 24 p.

Braun, D.C., Smokorowski, K.E., Bradford, M.J., and Glover, L. 2019. A Review of Functional Monitoring Methods to Assess Mitigation, Restorations, and Offsetting Activities in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/057. Vii + 75 p.

Smokorowski, K.E., M.J. Bradford, K.D. Clarke, M. Clement, R.S. Gregory, and R.G. Randall. 2015. Assessing the effectiveness of habitat offset activities in Canada: monitoring design and metrics. Can. Tech. Rep. Fish. Aquat. Sci. 3132. 48 p.

Appendix F

Offsetting Plan Quantity and Cost Estimates

Project:	Artemis - Blackwater Mine - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch Engineered Cost Estimate	Date: January 22, 2021
Prepared by: Onsite Engineering Ltd.		
Item	**Description**	**Cost**
Mob/Demob	Mobilize and Demoblize Common Material & Equipment to Site	$ 354,753.00
Materials	Common Materials Used for Construction, Sediment Control on Creek and Ponds	$ 1,347,163.00
Site Access	Construct Access to Creek and Pond Sites Using Access Mats to Prevent Soil Disturbance	$ 59,398.20
Mathews Creek	Total Cost of Construction of 61 Segments on Mathews Creek	$ 868,304.62
Overwintering Pond 1	Total Cost of Construction of Overwintering Pond 1	$ 352,719.25
Overwintering Pond 2	Total Cost of Construction of Overwintering Pond 2	$ 263,345.76
Overwintering Pond 3	Total Cost of Construction of Overwintering Pond 3	$ 450,078.88
Services	Environmental and Engineering Services Through Construction and Final Documentation	$ 564,100.00
	SubTotal Costs	**$ 4,259,862.70**
	Contingency (15%)	**$ 638,979.41**
	Total Cost	**$ 4,898,842.11**

Assumptions:

All work is completed sequentially, machinery is brought to site once and all creek and pond work is completed
All work is completed sequentially, common materials used for all construction (i.e. pumps, access mats, etc…)
Crew travel & LOA allowance is included in the separate costs for the Creek and Ponds
6 person crew of operators and labourers
6 hour cycle time from Prince George for Lowbed and materials
Cost of specific materials and their mobilization to site included in the separate costs for the Creek and Ponds
Misc. supplies taken to site during crew transportation by pickups

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - Mob/Demob, Common Equipment & Materials, Install Access Mats					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mobilize/Demobilize Equipment and Materials to Site	CAT336F Series Excavator to and from site	lowbed8	hr	12	$ 148.96	$ 1,787.52
	CAT336F Series Excavator to and from site	lowbed8	hr	12	$ 148.96	$ 1,787.52
	Excavator with specific attachment for lifting rig mats (to site twice - setup,remove mats)	lowbed8	hr	24	$ 148.96	$ 3,575.04
	Cat 320E Series Excavator to and from site	lowbed8	hr	12	$ 148.96	$ 1,787.52
	Volvo A30G Articulated truck to and from site	lowbed8	hr	12	$ 148.96	$ 1,787.52
	Volvo A30G Articulated truck to and from site	lowbed8	hr	12	$ 148.96	$ 1,787.52
	CAT D8T Crawler Tractor to and from site	lowbed8	hr	12	$ 148.96	$ 1,787.52
	CAT D8T Crawler Tractor to and from site	lowbed8	hr	12	$ 148.96	$ 1,787.52
	Access Mats to and from Site (99 loads of 40 rig mats each way = 198 loads)	lowbed8	hr	1188	$ 148.96	$ 176,964.48
	2 Pumps to and from site	lowbed8	hr	12	$ 148.96	$ 1,787.52
	Pea Gravel to Site for Sand Bags (35 loads of 10m3/load)	Gravel Truck - Riprap	hr	210	$ 112.98	$ 23,725.80
	Sediment Control Fencing Material to site (2 loads)	lowbed8	hr	12	$ 148.96	$ 1,787.52
	Shipping of all AIL sediment control products to site. Assume 38 loads.	AIL FOB Site	load	38	$ 3,000.00	$ 114,000.00
	Crew Transportation Setup/Decommision Rig Mats - 4 crew x 15 days	Crew Allowance	day	60	$ 340.00	$ 20,400.00
						$ -
					Sub Total Mob and Demob	**$ 354,753.00**
Common Materials & Equipment	2 - 6" Dewatering Pumps for 4 months	6" Dewatering Pump	month	8	$ 1,902.00	$ 15,216.00
	200' suction hose for 4 months (100' each pump)	6" Suction Hose	month-ft	800	$ 4.65	$ 3,720.00
	600' discharge hose for 4 months (300' each pump)	6" Discharge Hose	month-ft	2400	$ 4.55	$ 10,920.00
	Access Mats to prevent damage to ground for 125 days - 5400m x 7.32m = 3,950 mats	Access Mat	day	493750	$ 2.00	$ 987,500.00
	Pea Gravel to Site for Sand Bags	Pea Gravel	m3	250	$ 58.43	$ 14,607.50
	1m x 1m x 1m bag	1m x 1m x 1m bag	bag	300	$ 42.85	$ 12,855.00
	Sand bags	Sand bags	bag	300	$ 1.50	$ 450.00
	Filtrexx SiltSoxx 12" Dimaeter	Filtrexx SiltSoxx 12" Diameter	ft	74750	$ 2.75	$ 205,562.50
	Sediment Control Fencing Material	Sediment Control Fence	ft	22425	$ 2.00	$ 44,850.00
	Untreated Wooden Stakes	Untreated Wooden Stakes	bundle	200	$ 45.86	$ 9,172.00
	Impermeable Membrame 40mil	Impermeable Membrane 40mil	m2	300	$ 9.00	$ 2,700.00
	Dewatering Filter Bag	Dewatering Filter Bag	bag	30	$ 130.00	$ 3,900.00
	Mirafi 180N Non-woven geotextile	Mirafi 180N Non-woven geotextile	roll	30	$ 572.00	$ 17,160.00
	Terrafix 270R NonWoven Geotextile	Terrafix 270R NonWoven Geotextile	roll	10	$ 1,300.00	$ 13,000.00
	Biodegradable Erosion Control Blanket	Biodegradable Erosion Control Blanket	roll	30	$ 160.00	$ 4,800.00
	Staples	Staples	box	10	$ 75.00	$ 750.00
						$ -
					Sub Total Common Materials & Equipment	**$ 1,347,163.00**
Construct and Deactivate Site Access and Place Rig Mats for Main Access Road to End or Project	Excavator with specific attachment for lifting rig mats and placing/removing	CAT336F Series Excavator	hr	180	$ 246.41	$ 44,353.80
	Labourers	Labourer	hr	360	$ 41.79	$ 15,044.40
						$ -
					Sub Total Construction Access to all Sites	**$ 59,398.20**

Assumptions:

This table calculates the cost to supply all the equipment and common materials to site
Large pumps, dewatering sandbags, etc… used throughout site during construction
This table also calculates the cost to construct site access using access mats to reduce ground disturbance

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - Overwintering Pond 1					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Crew Transportation - 6 workers x 21 Days	Crew Allowance	Person - Day	126	$ 340.00	$ 42,840.00
	Haul Local Logs with Branches	lowbed8	hr	16	$ 148.96	$ 2,383.36
	Haul Large Boulders to site - 15 loads	Gravel Truck - Riprap	hr	90	$ 112.98	$ 10,168.20
	Haul cobbles to site - 105 loads	Gravel Truck - Riprap	hr	630	$ 112.98	$ 71,177.40
	Plants to site - 1 load	lowbed8	hr	6	$ 148.96	$ 893.76
					Sub Total Mob and Demob	**$ 127,462.72**
Materials	Large Boulders as Anchors and Boulder Clusters	Boulders	m3	150	$ 61.59	$ 9,238.50
	Pine or Spruce Trees for Banks	Pine or Spruce Tree	tree	20	$ 100.00	$ 2,000.00
	Cobbles for Shoals	Cobbles	m3	1047.5	$ 61.59	$ 64,515.53
	Riparian and Aquatic Plants	Riparian Plants	each	300	$ 4.29	$ 1,287.00
	Riparian and Aquatic Plants	Aquatic Plants	each	300	$ 5.00	$ 1,500.00
	Seeding	Seed	bag	5	$ 130.00	$ 650.00
					Sub Total Materials	**$ 79,191.03**
Construction Assumed 21 days	Move Material Using Excavators and Rock Trucks	Pond Productivity	m3	20,600	$ 5.51	$ 113,506.00
	Smooth placed materials	CAT D8T Crawler Tractor	hr	30	$ 273.55	$ 8,206.50
	Place cobbles	CAT336F Series Excavator	hr	40	$ 246.41	$ 9,856.40
	Place Trees & Logs with Boulder Anchors and Boulder Clusters	CAT336F Series Excavator	hr	30	$ 246.41	$ 7,392.30
	Place Trees & Logs, Seed, and Plants	Labourer	hr	170	$ 41.79	$ 7,104.30
					Sub Total	**$ 146,065.50**
					Total Estimated Cost Overwintering Pond 1	**$ 352,719.25**

Assumptions:

This sheet calculates the cost to construct Overwintering Pond 1
All equipment and common materials have already been delivered to site
Expected construction time is 15 days based on machine productivity and volume of pond
Cobbled Shoals are 0.25m thick
A large spruce or pine log can be sourced from a local cut block from a forestry license. 4 hour cycle time.
Hauled by lowbed due to branches and/or rootwads. 5 per load.
Plants delivered in 1 load. Used lowbed8 cost for delivery to be conservative, may be different truck type

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - Overwintering Pond 2					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Crew Transportation - 6 workers x 16 Days	Crew Allowance	Person - Day	96	$ 340.00	$ 32,640.00
	Haul Local Logs with Branches	lowbed8	hr	16	$ 148.96	$ 2,383.36
	Haul Large Boulders to site - 12 loads	Gravel Truck - Riprap	hr	72	$ 112.98	$ 8,134.56
	Haul cobbles to site - 70 loads	Gravel Truck - Riprap	hr	420	$ 112.98	$ 47,451.60
	Plants to site - 1 load	lowbed8	hr	6	$ 148.96	$ 893.76
						$ -
					Sub Total Mob and Demob	**$ 91,503.28**
Materials	Large Boulders as Anchors and Boulder Clusters	Boulders	m3	120	$ 61.59	$ 7,390.80
	Pine or Spruce Trees for Banks	Pine or Spruce Tree	tree	20	$ 100.00	$ 2,000.00
	Cobbles for Shoals	Cobbles	m3	692.5	$ 61.59	$ 42,651.08
	Riparian and Aquatic Plants	Riparian Plants	each	200	$ 4.29	$ 858.00
	Riparian and Aquatic Plants	Aquatic Plants	each	200	$ 5.00	$ 1,000.00
	Seeding	Seed	bag	5	$ 130.00	$ 650.00
					Sub Total Materials	**$ 54,549.88**
Construction Assumed 16 days	Move Material Using Excavators and Rock Trucks	Pond Productivity	m3	16,500	$ 5.51	$ 90,915.00
	Smooth placed materials	CAT D8T Crawler Tractor	hr	30	$ 273.55	$ 8,206.50
	Place cobbles	CAT336F Series Excavator	hr	30	$ 246.41	$ 7,392.30
	Place Trees & Logs with Boulder Anchors and Boulder Clusters	CAT336F Series Excavator	hr	20	$ 246.41	$ 4,928.20
	Place Trees & Logs,Seed, and Plant	Labourer	hr	140	$ 41.79	$ 5,850.60
					Sub Total	**$ 117,292.60**
					Total Estimated Cost Overwintering Pond 2	**$ 263,345.76**

Assumptions:

This sheet calculates the cost to construct Overwintering Pond 2
All equipment and common materials have already been delivered to site
Expected construction time is 16 days based on machine productivity and volume of pond
Cobbled Shoals are 0.25m thick
A large spruce or pine log can be sourced from a local cut block from a forestry license. 4 hour cycle time.
Hauled by lowbed due to branches and/or rootwads. 5 per load.
Plants delivered in 1 load. Used lowbed8 cost for delivery to be conservative, may be different truck type

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - Overwintering Pond 3					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Crew Transportation - 6 workers x 27 Days	Crew Allowance	Person - Day	162	$ 340.00	$ 55,080.00
	Haul Local Logs with Branches	lowbed8	hr	16	$ 148.96	$ 2,383.36
	Haul Large Boulders to site - 20 loads	Gravel Truck - Riprap	hr	120	$ 112.98	$ 13,557.60
	Haul cobbles to site - 142 loads	Gravel Truck - Riprap	hr	852	$ 112.98	$ 96,258.96
	Plants to site - 1 load	lowbed8	hr	6	$ 148.96	$ 893.76
						$ -
					Sub Total Mob and Demob	**$ 168,173.68**
Materials	Large Boulders as Anchors and Boulder Clusters	Boulders	m3	200	$ 61.59	$ 12,318.00
	Pine or Spruce Trees for Banks	Pine or Spruce Tree	tree	20	$ 100.00	$ 2,000.00
	Cobbles for Shoals	Cobbles	m3	1420	$ 61.59	$ 87,457.80
	Riparian and Aquatic Plants	Riparian Plants	each	250	$ 4.29	$ 1,072.50
	Riparian and Aquatic Plants	Aquatic Plants	each	250	$ 5.00	$ 1,250.00
	Seeding	Seed	bag	5	$ 130.00	$ 650.00
					Sub Total Materials	**$ 104,748.30**
Construction Assumed 27 days	Move Material Using Excavators and Rock Trucks	Pond Productivity	m3	25,500	$ 5.51	$ 140,505.00
	Smooth placed materials	CAT D8T Crawler Tractor	hr	30	$ 273.55	$ 8,206.50
	Place cobbles	CAT336F Series Excavator	hr	50	$ 246.41	$ 12,320.50
	Place Trees & Logs with Boulder Anchors and Boulder Clusters	CAT336F Series Excavator	hr	40	$ 246.41	$ 9,856.40
	Place Trees & Logs,Seed, and Plant	Labourer	hr	150	$ 41.79	$ 6,268.50
					Sub Total	**$ 177,156.90**
					Total Estimated Cost Overwintering Pond 3	**$ 450,078.88**

Assumptions:

This sheet calculates the cost to construct Overwintering Pond 3
All equipment and common materials have already been delivered to site
Expected construction time is 27 days based on machine productivity and volume of pond
Cobbled Shoals are 0.25m thick
A large spruce or pine log can be sourced from a local cut block from a forestry license. 4 hour cycle time.
Hauled by lowbed due to branches and/or rootwads. 5 per load.
Plants delivered in 1 load. Used lowbed8 cost for delivery to be conservative, may be different truck type

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - Services					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Services Through Construction Assumed Construction Time = 125 Days	Environmental Monitoring	Environmental Monitor	Day	125	$ 2,000.00	$ 250,000.00
	Professional Engineer or Designate - 1 site visit per week	Engineer	Day	25	$ 3,000.00	$ 75,000.00
	First Aid on Site	ETV	Day	125	$ 700.00	$ 87,500.00
					Sub Total Construction Services	**$ 412,500.00**
Post Construction Monitoring	Post Construction Environmental Monitoring	Junior Environmental	LS	30	$ 1,250.00	$ 37,500.00
	Post Construction Environmental Monitoring	Senior Environmental	LS	21	$ 1,850.00	$ 38,850.00
	Post Construction Environmental Monitoring	Vehicle and Equipment	LS	15	$ 350.00	$ 5,250.00
					Sub Post Construction Monitoring	**$ 81,600.00**
Engineering and Environmental Final Documentation	Engineering Documentation	Record Drawings	LS	1	$ 10,000.00	$ 10,000.00
	Environmental Permitting & Final Documentation	Permitting & Documentation	LS	1	$ 60,000.00	$ 60,000.00
					Sub Total Documentation	**$ 70,000.00**
					Total Estimated Cost Services	**$ 564,100.00**

Assumptions:

This sheet calculates the cost of all services engineering, environmental, & first aid services for the duration of the project
Day rates includes mob/demob to site and all required equipment

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - Mathews Creek Total Treatment Cost														Date: January 22, 2021		
Segment	Segment Length (m)	RBK Treatment Cost						LBK Treatment Cost			Bed Cost	Expected Isolation Cost		Additional Cost		Segment Cost
		BankR	NW	WDnarrow	WDhabitat	LS	BL	BankR	WDnarrow	BL	BC	Partial	Full	Cost	Comment	
1	21.80		$ 5,090.40		$ 8,981.68		$ 5,440.34					$ 2,171.23				$ 21,683.65
2	33.64										$ 2,418.28					$ 2,418.28
3	27.24			$ 8,138.24												$ 8,138.24
4	44.25	$ 10,640.14			$ 8,981.68		$ 11,042.90					$ 4,407.19				$ 35,071.91
5	25.72		$ 6,005.73				$ 6,418.61				$ 2,418.28	$ 2,561.65				$ 17,404.27
6	26.81		$ 6,260.25				$ 6,690.62					$ 2,670.21				$ 15,621.09
7	29.54		$ 6,897.72				$ 7,371.91					$ 2,942.11				$ 17,211.75
8	17.27		$ 4,032.62		$ 4,490.84		$ 4,309.85				$ 2,418.28	$ 1,720.05				$ 16,971.64
9	33.78				$ 4,490.84											$ 4,490.84
10	37.24		$ 8,695.70		$ 13,472.52		$ 9,293.50					$ 3,709.01				$ 35,170.74
11	85.95	No Work on this Section						No Work on this Section								$ -
12	111.16		$ 25,956.35		$ 4,490.84		$ 27,740.76					$ 11,071.27				$ 69,259.21
13	61.55			$ 18,388.73												$ 18,388.73
14	44.18	$ 10,623.31				$ 6,312.24						$ 4,400.22				$ 21,335.78
15	55.20								$ 16,491.60							$ 16,491.60
16	39.26			$ 11,729.35												$ 11,729.35
17	40.77	No Work on this Section						No Work on this Section								$ -
18	94.24	No Work on this Section						No Work on this Section								$ -
19	71.20				$ 4,490.84											$ 4,490.84
20	61.14	No Work on this Section						No Work on this Section								$ -
21	19.43			$ 5,804.92												$ 5,804.92
22	31.57	No Work on this Section						No Work on this Section								$ -
23	18.87	No Work on this Section						No Work on this Section								$ -
24	130.02	No Work on this Section						No Work on this Section								$ -
25	18.17	$ 4,369.07					$ 4,534.45					$ 1,809.69				$ 10,713.21
26	106.98	No Work on this Section						No Work on this Section								$ -
27	33.22	No Work on this Section						No Work on this Section								$ -
28	102.14	No Work on this Section						No Work on this Section								$ -
29	38.22	No Work on this Section						No Work on this Section								$ -
30	28.40	No Work on this Section						No Work on this Section								$ -
31	20.22								$ 6,040.94							$ 6,040.94
32	125.76	Existing Crossing to be Removed						Existing Crossing to be Removed						$ 10,000.00	Removal Existing Crossing	$ 10,000.00
33	48.55	$ 11,674.10			$ 8,981.68		$ 12,115.99					$ 4,835.46				$ 37,607.24
34	73.77	No Work on this Section						No Work on this Section								$ -
35	24.92	No Work on this Section						No Work on this Section								$ -
36	42.56	No Work on this Section						No Work on this Section								$ -
37	75.66		$ 17,666.94		$ 8,981.68		$ 18,881.48					$ 7,535.55				$ 53,065.66
38	46.87								$ 14,002.92							$ 14,002.92
39	48.23	No Work on this Section						No Work on this Section								$ -
40	22.10			$ 6,602.61												$ 6,602.61
41	326.29	Metal Debris to Be Removed from This Section						Metal Debris Removed from This Section						$ 5,000.00	Removal Metal Debris	$ 5,000.00
42	45.05	No Work on this Section						No Work on this Section								$ -
43	63.05	No Work on this Section						No Work on this Section								$ -
44	15.01		$ 3,504.90				$ 3,745.85					$ 1,494.96				$ 8,745.71
45	362.06	No Work on this Section						No Work on this Section								$ -
46	19.33			$ 5,775.05												$ 5,775.05
47	71.57	No Work on this Section						No Work on this Section								$ -
48	72.34			$ 21,612.36												$ 21,612.36
49	88.56	No Work on this Section						No Work on this Section								$ -
50	82.15	No Work on this Section						No Work on this Section								$ -
51	23.68								$ 7,074.66							$ 7,074.66
52	442.52	Failed Wooden Bridge to be Removed						Failed Wooden Bridge to be Removed						$ 10,000.00	Removal Wooden Bridge	$ 10,000.00
53	53.61	No Work on this Section						No Work on this Section								$ -
54	72.86	Existing Crossing to be Removed						Existing Crossing to be Removed						$ 10,000.00	Removal Existing Crossing	$ 10,000.00
55	56.29	No Work on this Section						No Work on this Section								$ -
56	118.78	No Work on this Section						No Work on this Section								$ -
57	110.23	No Work on this Section						No Work on this Section								$ -
58	242.34	No Work on this Section						No Work on this Section								$ -
59	30.96	No Work on this Section						No Work on this Section								$ -
60	226.57	$ 54,479.93			$ 26,945.04		$ 56,542.13	$ 54,479.93	$ 67,690.23	$ 56,542.13			$ 23,702.03			$ 340,381.43
61	267.86	No Work on this Section						No Work on this Section								$ -
Total Length:	4808.71	m														
															Total Cost Mathews Creek Treatments:	$ 868,304.62

Assumptions: This worksheet calculates the total cost for the work on each of the sections of Mathews Creek

The length of each section of Mathews Creek is multiplied by the linear cost of each treatment proposed for that section
Where partial or full dewatering is expected to be required for construction, that cost is also calcuated for each section on a linear basis
Additional cost is added for removal of metal material or existing bridges/crossings

Treatment	**Description**
BankR	Bank Regrading - Detail 1A
NW	Restoration of Natural Channel Width - Detail 1B
WDnarrow	Woody Debris Channel Narrowing - Detail 2A
Wddeflect	Woody Debris Channel Deflection - Detail 1B
WDHabitat	Woody Debris Habitat Enhancement: Log & Rootwad - Detail 2C & 2D
LS	Bank Treatment: Live Stakes - Detail 3A
BL	Bank Treatment: Brush Layers - Detail 3B
BC	Bed Treatment: Boulder Clusters - Detail 4A

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - Mathews Creek Treatment Costs			Date: January 22, 2021
Treatment	**Description**	**Unit**	**$/unit**
BankR	Bank Regrading - Detail 1A	linear m	$ 240.46
NW	Restoration of Natural Channel Width - Detail 1B	linear m	$ 233.50
WDnarrow	Woody Debris Channel Narrowing - Detail 2A	linear m	$ 298.76
WDhabitat	Woody Debris Habitat Enhancement: Log & Rootwad - Detail 2C & 2D	Log	$ 4,490.84
LS	Bank Treatment: Live Stakes - Detail 3A	linear m	$ 142.88
BL	Bank Treatment: Brush Layers - Detail 3B	linear m	$ 249.56
BC	Bed Treatment: Boulder Clusters - Detail 4A	Cluster	$ 2,418.28
Partial	Partial Isolation of a Segment of Mathews Creek to allow work to proceed	linear m	$ 99.60
Full	Full Isolation of a Segment of Mathews Creek to allow work to proceed	linear m	$ 104.61

Assumptions: This table summarizes the calculated cost of each treatment type on the Mathews Creek Sections
Most costs are per linear metre, Boulder Clusters and WDhabitat are per occurrence.

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - BankR Treatment - Detail 1A					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Crew Transportation - 6 workers x 2 Days	Crew Allowance	Person - Day	12	$ 340.00	$ 4,080.00
						$ -
						$ -
						$ -
						$ -
					Sub Total Mob and Demob per 100m	**$ 4,080.00**
Materials	Seeding	Seed	bag	5	$ 130.00	$ 650.00
						$ -
					Sub Total Materials per 100m	**$ 650.00**
Complete Bank Regrading Assumed 2 Days	Remove Silt/Sand wedges	CAT336F Series Excavator	hr	20	$ 246.41	$ 4,928.20
	Pull-back unstable banks	CAT320 Series Excavator	hr	20	$ 168.09	$ 3,361.80
	Loading (End haul)	CAT336F Series Excavator	hr	10	$ 246.41	$ 2,464.10
	Hauling Material	Volvo A30G Articulated truck	hr	20	$ 191.00	$ 3,820.00
	Spreading or Stockpiling Material	CAT D8T Crawler Tractor	hr	10	$ 273.55	$ 2,735.50
	Seeding & Miscellaneous	Labourer	hr	48	$ 41.79	$ 2,005.92
					Sub Total Regrading per 100m	**$ 19,315.52**
					Total Estimated Cost per 100m Bank Regrading	**$ 24,045.52**
					Total Estimated Cost per linear metre of Bank Regrading (BankR) - Detail 1A	**$ 240.46**

Assumptions:

This table calculates the cost to complete bank regrading on a 100m section of Mathews Creek
The cost is then divided by 100 to calculate a linear m cost for bank regrading
All equipment and common materials have already been delivered to site
Seed brought to site by crew in pickups

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - NW Treatment - Detail 1B					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Crew Transportation - 6 workers x 2 Days	Crew Allowance	Person - Day	12	$ 340.00	$ 4,080.00
	Plants to site - 1 load	lowbed8	hr	6	$ 148.96	$ 893.76
						$ -
						$ -
						$ -
					Sub Total Mob and Demob per 100m	**$ 4,973.76**
Materials	Seeding	Seed	bag	5	$ 130.00	$ 650.00
	Riparian and Aquatic Plants	Riparian Plants	each	20	$ 4.29	$ 85.80
	Riparian and Aquatic Plants	Aquatic Plants	each	20	$ 5.00	$ 100.00
					Sub Total Materials per 100m	**$ 835.80**
Complete Bank Restoration of Natural Width Assumed 2 Days	Replace and rebuild banks	CAT320 Series Excavator	hr	24	$ 168.09	$ 4,034.16
	Loading (End haul)	CAT336F Series Excavator	hr	24	$ 246.41	$ 5,913.84
	Hauling Material	Volvo A30G Articulated truck	hr	24	$ 191.00	$ 4,584.00
	Seeding & Miscellaneous	Labourer	hr	72	$ 41.79	$ 3,008.88
					Sub Total Bank Restoration per 100m	**$ 17,540.88**
					Total Estimated Cost per 100m Bank Restoration	**$ 23,350.44**
					Total Estimated Cost per linear metre of Bank Restoration to Natural Width (NW) - Detail 1B	**$ 233.50**

Assumptions:

This table calculates the cost to restore the banks to a natural stream width on a 100m section of Mathews Creek
The cost is then divided by 100 to calculate a linear m cost for restoring the natural stream width
All equipment and common materials have already been delivered to site
Seed brought to site by crew in pickups
2 Riparian and 2 aquatic plants per m. Plants delivered in 1 load. Used lowbed8 cost for delivery to be conservative, may be different truck type

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - WDnarrow Treatment - Detail 2A					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Crew Transportation - 6 workers x 2 Days	Crew Allowance	Person - Day	12	$ 340.00	$ 4,080.00
	Haul Local Logs with Branches	lowbed8	hr	16	$ 148.96	$ 2,383.36
	Haul Riprap to site - 2 loads	Gravel Truck - Riprap	hr	12	$ 112.98	$ 1,355.76
						$ -
						$ -
					Sub Total Mob and Demob per 100m	**$ 7,819.12**
Materials	Riprap for upstream	Riprap - Class 25kg	m3	20	$ 61.59	$ 1,231.80
	Pine or Spruce Trees for Banks	Pine or Spruce Tree	tree	20	$ 100.00	$ 2,000.00
	100 to 150 mm poles	100 to 150 mm poles	each	200	$ 10.00	$ 2,000.00
						$ -
						$ -
					Sub Total Materials per 100m	**$ 5,231.80**
Place Riprap and Trees Assumed 2 Days	Place Riprap	CAT336F Series Excavator	hr	10	$ 246.41	$ 2,464.10
	Place Trees with Anchors	CAT336F Series Excavator	hr	42	$ 246.41	$ 10,349.22
	Place Trees with Anchors	Labourer	hr	96	$ 41.79	$ 4,011.84
					Sub Total Placing Riprap and Trees per 100m	**$ 16,825.16**
					Total Estimated Cost per 100m Bank Woody Debris Narrowing	**$ 29,876.08**
					Total Estimated Cost per linear metre of Woody Debris Narrowing (Wdnarrow) - Detail 2A	**$ 298.76**

Assumptions:

This table calculates the cost to place riprap and trees on a 100m section of Mathews Creek
The cost is then divided by 100 to calculate a linear m cost for placing riprap and trees
All equipment and common materials have already been delivered to site
Spruce and pine logs 10m to 15m long can be sourced from local cut blocks - 4 hour round trip.
2 logs/trees per 10m = 20 trees. 5 trees per load = 4 loads
Hauled by lowbed due to branches
Trees can be bucked, branches removed manually at site as needed
Biodegradable rope and 100-150 mm poles brought to site with crew in pickups

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - WDhabitat Treatment - Detail 2C & 2D					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Haul Local Logs with Branches	lowbed8	hr	4	$ 148.96	$ 595.84
	Plants to site - 1 load	lowbed8	hr	6	$ 148.96	$ 893.76
						$ -
						$ -
						$ -
					Sub Total Mob and Demob	**$ 1,489.60**
Materials	Pine or Spure Tree	Pine or Spruce Tree	tree	1	$ 100.00	$ 100.00
	Seeding	Seed	bag	1	$ 130.00	$ 130.00
	Riparian and Aquatic Plants	Riparian Plants	each	20	$ 4.29	$ 85.80
	Riparian and Aquatic Plants	Aquatic Plants	each	20	$ 5.00	$ 100.00
					Sub Total Materials	**$ 415.80**
Place Tree or Rootwad Assumed 4 hours	Place Trees or Rootwad with Boulder Anchors	CAT336F Series Excavator	hr	4	$ 246.41	$ 985.64
	Place Trees or Rootwad with Boulder Anchors	Volvo A30G Articulated truck	hr	4	$ 191.00	$ 764.00
	Place Trees or Rootwad and Seed	Labourer	hr	20	$ 41.79	$ 835.80
					Sub Total Place Tree or Rootwad	**$ 2,585.44**
					Total Estimated Cost to Place 1 Tree or Rootwad (WDhabitat) - Detail 2C & 2D	**$ 4,490.84**

Assumptions:

This table calculates the cost to place wither one log (tree) or rootwad in Mathews Creek.
As it is a short time period, it is assumed that all equipment and labour is on site. Therefore crew transportation cost is not included.
It is also assumed that boulders are already on site, as only a few are needed and they can be taken from stockpiles used for other sections.
The cost to source the 1 tree is included.
A large spruce or pine log can be sourced from a local cut block from a forestry license. 4 hour cycle time.
Hauled by lowbed due to branches and/or rootwads.
Trees can be bucked, branches removed as (if) required manually at site
Seed brought to site with crew in pickups.
2 Riparian and 2 aquatic plants per m. Plants delivered in 1 load. Used lowbed8 cost for delivery to be conservative, may be different truck type

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - LS Treatment - Detail 3A					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Crew Transportation - 6 workers x 1 Day	Crew Allowance	Person - Day	6	$ 340.00	$ 2,040.00
	Plants to site - 1 load	lowbed8	hr	6	$ 148.96	$ 893.76
						$ -
						$ -
						$ -
					Sub Total Mob and Demob per 100m	**$ 2,933.76**
Materials	Live Stakes	Live Stakes	bundle	10	$ 320.00	$ 3,200.00
	Riparian and Aquatic Plants	Riparian Plants	each	20	$ 4.29	$ 85.80
	Riparian and Aquatic Plants	Aquatic Plants	each	20	$ 5.00	$ 100.00
					Sub Total Materials per 100m	**$ 3,385.80**
Regrade Banks & Place Live Stakes Assumed 1 Day	Regrade Banks as needed	CAT320 Series Excavator	hr	30	$ 168.09	$ 5,042.70
	Place Stakes	Labourer	hr	70	$ 41.79	$ 2,925.30
					Sub Total Regrading per 100m	**$ 7,968.00**
					Total Estimated Cost per 100m Live Stakes	**$ 14,287.56**
					Total Estimated Cost per linear metre of Live Stakes (LS) - Detail 3A	**$ 142.88**

Assumptions:

This table calculates the cost to regrade banks and place live stakes on a 100m section of Mathews Creek
The cost is then divided by 100 to calculate a linear m cost for regrading banks and placing live stakes
All equipment and common materials have already been delivered to site
Live stakes can be brought to site in crew pickups
2 Riparian and 2 aquatic plants per m. Plants delivered in 1 load. Used lowbed8 cost for delivery to be conservative, may be different truck type

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - BL Treatment - Detail 3B					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Crew Transportation - 6 workers x 1 Day	Crew Allowance	Person - Day	6	$ 340.00	$ 2,040.00
	Transport all bundles of branches to site	lowbed8	hr	6	$ 148.96	$ 893.76
	Plants to site - 1 load	lowbed8	hr	6	$ 148.96	$ 893.76
						$ -
						$ -
					Sub Total Mob and Demob per 100m	**$ 3,827.52**
Materials	Bundles of Branches	Brush (Criss-cross branches)	bundle	50	$ 320.00	$ 16,000.00
	Riparian and Aquatic Plants	Riparian Plants	each	20	$ 4.29	$ 85.80
	Riparian and Aquatic Plants	Aquatic Plants	each	20	$ 5.00	$ 100.00
					Sub Total Materials per 100m	**$ 16,185.80**
Regrade Banks & Place Brush Layers	Regrade Banks as needed	CAT320 Series Excavator	hr	12	$ 168.09	$ 2,017.08
	Place Brush	Labourer	hr	70	$ 41.79	$ 2,925.30
					Sub Total Regrading per 100m	**$ 4,942.38**
					Total Estimated Cost per 100m Placing Brush Layers	**$ 24,955.70**
					Total Estimated Cost per linear metre of Brush Layers (BL) - Detail 3B	**$ 249.56**

Assumptions:

This table calculates the cost to regrade banks and place brush layers on a 100m section of Mathews Creek
The cost is then divided by 100 to calculate a linear m cost for regrading banks and placing brush layers
All equipment and common materials have already been delivered to site
2 Riparian and 2 aquatic plants per m. Plants delivered in 1 load. Used lowbed8 cost for delivery to be conservative, may be different truck type

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - BC Treatment - Detail 4A					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob						$ -
						$ -
						$ -
						$ -
						$ -
					Sub Total Mob and Demob	**$ -**
Materials						$ -
						$ -
						$ -
					Sub Total Materials	**$ -**
Place Boulders in Stream (Assumed 4 hours)	Place Boulders	CAT336F Series Excavator	hr	4	$ 246.41	$ 985.64
	Place Boulders	Volvo A30G Articulated truck	hr	4	$ 191.00	$ 764.00
	Place Boulders	Labourer	hr	16	$ 41.79	$ 668.64
					Sub Total Placing Boulders	**$ 2,418.28**
					Total Estimated Cost Placing 1 Boulder Cluster (BC) - Detail 4A	**$ 2,418.28**

Assumptions:

This table calculates the cost to place one boulder cluster in Mathews Creek
As it is a short time period, it is assumed that all equipment and labour is on site. Therefore crew transportation cost is not included.
It is also assumed that boulders are already on site, as only a few are needed and they can be taken from stockpiles used for other sections.

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - Partial Dewatering of 1 Bank					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Crew Transportation - 6 workers x 1 Day	Crew Allowance	Person - Day	6	$ 340.00	$ 2,040.00
						$ -
						$ -
						$ -
						$ -
					Sub Total Mob and Demob per 100m	**$ 2,040.00**
Materials						$ -
						$ -
						$ -
					Sub Total Materials per 100m	**$ -**
Partial Dewatering Assumed 1 Day	Place Pumps, Large Bags	CAT336F Series Excavator	hr	24	$ 246.41	$ 5,913.84
	Place hoses, smaller bags, fibre rolls	Labourer	hr	48	$ 41.79	$ 2,005.92
					Sub Total Dewatering per 100m	**$ 7,919.76**
					Total Estimated Cost per 100m Partial Dewatering	**$ 9,959.76**
					Total Estimated Cost per linear metre of Partial Dewatering	**$ 99.60**

Assumptions:

This table calculates the cost to partially dewater a 100m section of Mathews Creek (i.e. dewater 1 bank for construciton)
The cost is then divided by 100 to calculate a linear m cost for partial dewatering
All equipment and common materials have already been delivered to site

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included

Blackwater - Schedule 2 Fisheries Offsetting Plan - Mathews Ranch - Engineered Cost Estimate - Full Dewatering of the Stream					Date: January 22, 2021	
Item	**Description**	**Equipment/Item**	**Units**	**Amount**	**Unit Cost ($/unit)**	**Cost**
Mob and Demob	Crew Transportation - 6 workers x 1 Day	Crew Allowance	Person - Day	6	$ 340.00	$ 2,040.00
						$ -
						$ -
						$ -
						$ -
					Sub Total Mob and Demob per 100m	**$ 2,040.00**
Materials						$ -
						$ -
						$ -
					Sub Total Materials per 100m	**$ -**
Full Dewatering Assumed 1 Day	Place Pumps, Large Bags	CAT336F Series Excavator	hr	24	$ 246.41	$ 5,913.84
	Place hoses, smaller bags, fibre rolls	Labourer	hr	60	$ 41.79	$ 2,507.40
					Sub Total Full Dewatering per 100m	**$ 8,421.24**
					Total Estimated Cost per 100m Bank Regrading	**$ 10,461.24**
					Total Estimated Cost per linear metre of Full Dewatering	**$ 104.61**

Assumptions:

This table calculates the cost to fully dewater a 100m section of Mathews Creek
The cost is then divided by 100 to calculate a linear m cost for full dewatering
All equipment and common materials have already been delivered to site

Equipment and Labour Rates: Interior Appraisal Manual effective December 15, 2020 / Blue Book
Other costs from local suppliers
GST not included