



Blackwater Gold Project

Follow-up Programs for Condition 3.16 of the Blackwater Mine Project Decision Statement Issued under Section 54 of the Canadian Environmental Assessment Act, 2012

August 29, 2022

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August 29, 2022

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ACRONYMS AND ABBREVIATIONS

The terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

AEMP	Aquatic Effect Monitoring Program
ANOVA	Analysis of Variance
BC	British Columbia
BW Gold	BW Gold LTD.
CEA Agency	Canadian Environmental Assessment Agency
DS	Decision Statement
Ds	Secchi Depth
EA	Environmental Assessment
FWSS	Freshwater Supply System
HSI	Habitat Suitability Index
IFN	Instream Flow Needs
New Gold	New Gold Inc.
POPC	Parameter of Potential Concern
Project	Blackwater Gold Project
RIC	Resources Information Committee
UAV	Unmanned Aerial Vehicle
YOY	Young of Year
Z1%	Euphotic Depth

1. INTRODUCTION

The Blackwater Gold Project (Project) received a Decision Statement (DS) on April 15, 2019, under the Canadian Environmental Assessment Act, 2012 (CEA Agency 2019) and an Environmental Assessment Certificate #M19-01 on June 21, 2019, under the 2002 Environmental Assessment Act (EAO 2019).

Condition 3.16 of the DS requires BW Gold Ltd. (BW Gold) to develop a Fish and Fish Habitat Follow-up Program as follows:

- 3.16** The Proponent shall develop, prior to construction and in consultation with Indigenous groups and relevant authorities, a follow-up program to verify the accuracy of the environmental assessment and determine the effectiveness of the mitigation measures as it pertains to fish habitat in Tatelkuz Lake and Chedakuz Creek. The Proponent shall implement the follow-up program from construction through decommissioning and shall apply conditions 2.9 and 2.10 when implementing the follow-up program.

Condition 2.9 of the DS requires follow-up programs to verify the accuracy of the environmental assessment (EA), determine whether modified or additional mitigation measures are required, and timely implementation if required.

Condition 2.10 of the DS requires consultation with Indigenous groups on the follow-up programs regarding opportunities for participation in their implementation.

1.1 Purpose and Objectives

The purpose of the Fish and Fish Habitat Follow-up Program described herein is to fulfill condition 3.16 of the federal DS, including:

- Conduct, prior to the commissioning of the freshwater supply system (FWSS) as the main mitigation measure for loss of water in Davidson Creek, fish habitat quantity and quality surveys in the Tatelkuz Lake littoral zone. [Condition 3.16.1]
- Monitor the Tatelkuz Lake littoral zone from the commissioning of the freshwater supply system until decommissioning. [Condition 3.16.2]
- Monitor water flows in lower Chedakuz Creek between Tatelkuz Lake and the confluence with Davidson Creek during the open water season from construction until decommissioning. [Condition 3.16.3]

To achieve these objectives, the Fish and Fish Habitat Follow-up Program is designed to first determine baseline conditions for each of the indicators described above. These indicators will then be monitored during different phases of the Project to determine if variation from baseline conditions is occurring. Monitoring of instream flow needs (IFN) in Davidson Creek due to changes in flow from the operation of the FWSS is part of the Aquatic Effects Monitoring Plan (AEMP) currently being developed. This plan will assess potential project-related changes to nutrient concentrations and water chemistry that may affect aquatic resources such as benthic invertebrates and periphyton communities.

As stated in Condition 2.9, an additional purpose of this program is to verify the accuracy of the environmental assessment. Verification will be accomplished by comparing monitoring results with original baseline results.

The follow-up programs for Condition 3.16 and Condition 2.9 described herein will evolve over time in response to the results of the monitoring, changing conditions or development at the Project, updates to methods, and through consultation with Indigenous groups, regulators, or other stakeholders. This process of continuous improvement with changing conditions and the potential implementation of mitigation is identified as adaptive management and will be developed as specified by Condition 2.5 and Condition 2.6 of the DS (See **Section 6 Adaptive Management** below).

1.2 Applicable Guidance

This plan for monitoring variation in baseline conditions and determining the effectiveness of the mitigation measures 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.

The following broad fisheries management objective was used to guide the development of effectiveness monitoring of mitigation measures:

- Protect and increase freshwater fish lake and stream habitat.

The proposed mitigation measures focus on maintaining fish habitat in Tatelkuz Lake and lower Chedakuz Creek. This lake and stream system is a culturally important area to Indigenous groups.

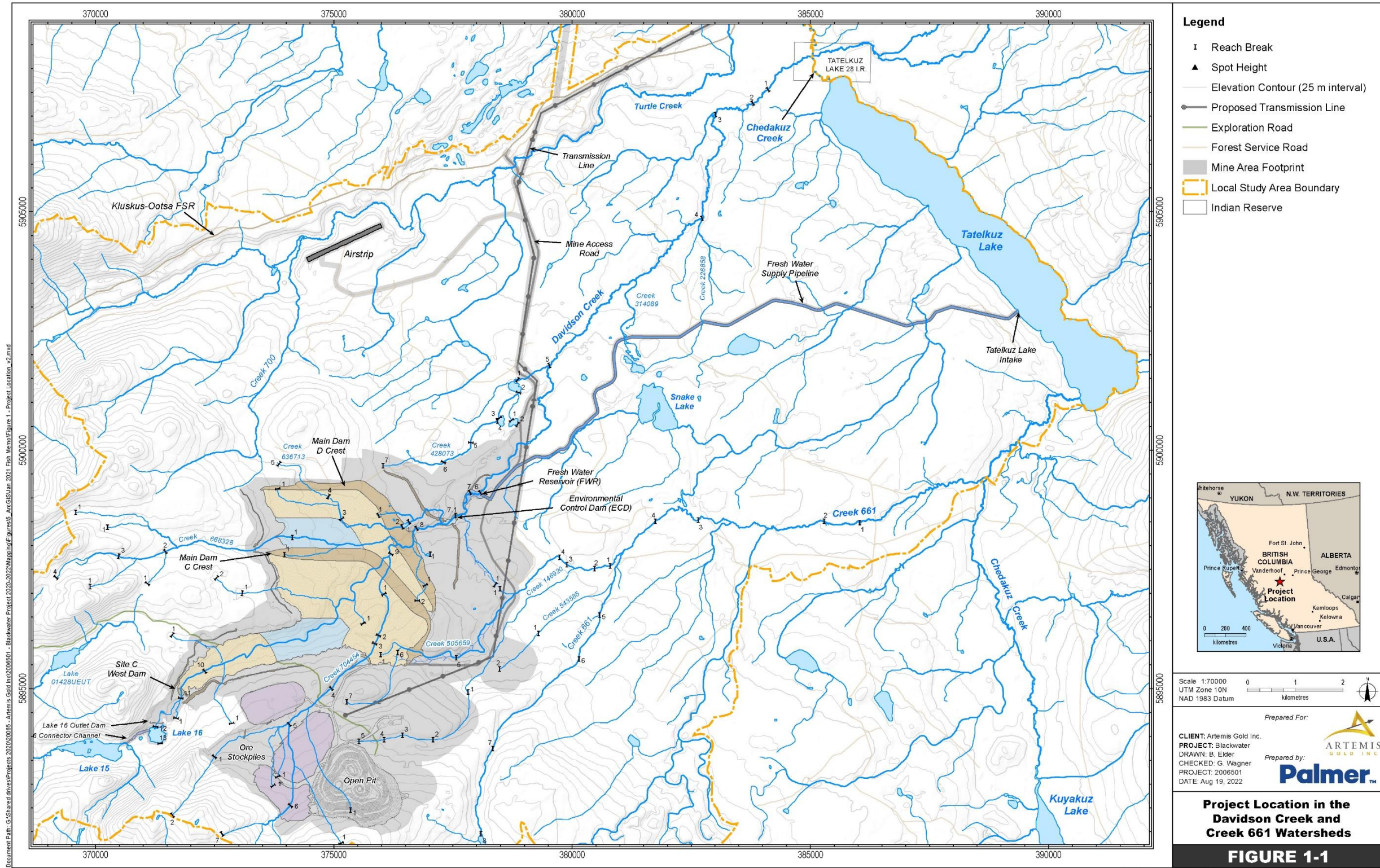
1.3 Condition 3.16.1 – Tatelkuz Lake Littoral Zone Surveys Prior to Operations

The first follow-up program condition of the Decision Statement is 3.16.1 which requires BW Gold to:

Conduct, prior to the commissioning of the freshwater supply system, fish habitat quantity and quality surveys in the Tatelkuz Lake littoral zone.

The Project will cause a reduction in water flow in Davidson Creek due to infrastructure overlaying portions of the upper watershed. This flow reduction will be mitigated in part via an FWSS that will pump water from Tatelkuz Lake to a freshwater storage reservoir adjacent to Reach 6 of Davidson Creek via a pipeline (**Figure 1-1**). The freshwater storage reservoir also will collect and store water from the upper portions of Davidson Creek, non-contact water, and mine contact water that is suitable for release. This water will be released into Davidson Creek from Year 1 of Operations onwards. Water will be pumped from Tatelkuz Lake starting in Year 6 of Operations.

One potential reason for this monitoring requirement in the Decision Statement is to determine whether the loss of water from Tatelkuz Lake will have any effects on fish habitat in the littoral zone (i.e., near shore area) of the lake. This condition requires the collection of baseline information on fish habitat quality and quantity for the Tatelkuz Lake littoral zone that can be monitored subsequently during Operations (**Section 1.4 Condition 3.16.2 - Tatelkuz Lake Littoral Zone Monitoring During Operations**).



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Figure 1-1. Project Location in the Davidson Creek and Creek 661 Watersheds

1.4 Condition 3.16.2 - Tatelkuz Lake Littoral Zone Monitoring During Operations

The second follow-up program condition of the Decision Statement is 3.16.2 which requires BW Gold to:

Monitor the Tatelkuz Lake littoral zone from the commissioning of the freshwater supply system until decommissioning.

A potential reason for this monitoring requirement in the Decision Statement is to compare Tatelkuz Lake littoral zone fish habitat quality and quantity during active FWSS pumping with baseline levels measured previously (**Section 1.3 Condition 3.16.1 – Tatelkuz Lake Littoral Zone Surveys Prior to Operations**). Results from this comparison can be used to determine whether the loss of water from Year 6 of Operations onwards has any effects on littoral zone fish habitat quality and quantity in the lake. Fish habitat monitoring will be performed in conjunction with hydrological monitoring of lake levels during pumping. This hydrological monitoring is important to first determine if the surface level of the lake is being affected by FWSS pumping to a measurable degree above natural variation. The water surface elevation of Tatelkuz Lake is determined by measuring the difference between the water level elevation and at least one of the four permanent benchmarks established around the lake (See **Section 2.1.1 Tatelkuz Lake Limnology**).

1.5 Condition 3.16.3 – Lower Chedakuz Creek Monitoring During All Project Phases

The third follow-up program condition of the Decision Statement is 3.16.3 which requires BW Gold to:

Monitor water flows in Chedakuz Creek between Tatelkuz Lake and the confluence with Davidson Creek during the open water season from construction until decommissioning.

This condition refers to the section of lower Chedakuz Creek that flows from the outlet of Tatelkuz Lake, downstream to its confluence with Davidson Creek. One potential reason for this monitoring requirement in the Decision Statement is to determine whether the loss of water in the upper Creek 661 Watershed from Project Construction and Operations and direct loss of water from Tatelkuz Lake during FWSS pumping (Year 6 onwards) will have any detectable effects on water levels downstream of the lake. Any water loss in Tatelkuz Lake will have a potential effect on water levels and may affect fish habitat in this section of lower Chedakuz Creek. Baseline hydrological and fish habitat information obtained prior to Construction will be compared with water levels and habitat during Operations. Similar to Condition 3.16.2 (**Section 1.4 Condition 3.16.2 – Tatelkuz Lake Littoral Zone Monitoring During Operations**), this hydrological monitoring is important to determine if the water level in the creek is being affected by the Project footprint and by FWSS pumping to a measurable degree above natural variation.

2. FOLLOW-UP PROGRAM 3.16.1: TATELKUZ LAKE LITTORAL ZONE SURVEYS PRIOR TO OPERATIONS

2.1 Background and Approach

A Tatelkuz Lake littoral zone study, initiated in 2021, satisfies Condition 3.16.1 of the Decision Statement. For this study, seasonal limnological measurements of the lake are taken along with fish habitat surveys along selected littoral areas. The purpose of these measurements is to characterize fish habitat quantity and quality in the littoral zone of Tatelkuz Lake.

Littoral areas were selected at eleven locations (**Figure 2-1**) distributed around the lake that correspond to baseline-identified littoral habitat classes. Sites are also located near lake inlets, the outlet to lower Chedakuz Creek, and the planned FWSS intake location. Some sites are co-located with historical capture locations of Brassy Minnow (*Hybognathus hankinsoni*) a littoral-dwelling fish species that will be used to monitor littoral habitat suitability. Brassy Minnow is targeted for the following reasons:

- Brassy Minnow is a BC listed species of conservation concern that uses littoral habitat in Tatelkuz Lake for its entire life history;
- Brassy Minnow have been captured in multiple areas of the lake, with the highest catch close to the proposed FWSS intake; and
- Brassy Minnow growth, survival, and recruitment are vulnerable to the effects of water level reductions and habitat drying (Falke et al. 2010).

The proposed littoral habitat monitoring program development will assess the extent and quantity of unique littoral habitat types in Tatelkuz Lake. The littoral habitat information will be used to assess habitat suitability for Brassy Minnow using the lacustrine Habitat Suitability Index (HSI) developed by Golder (2008) and the area for each of eleven unique littoral habitat types identified by AMEC (2013). Habitat quantity and quality data will be compared to baseline habitat information from AMEC (2013) and will serve as the updated baseline littoral habitat information to be used for monitoring from the commissioning of the FWSS.

2.2 Study Design

General descriptions of the sampling locations and methods are provided in the following sub-sections. Sampling locations and methods are based on those used for the original baseline information that is presented in the Fish and Aquatic Resources 2011-2012 Baseline Report for Tatelkuz Lake fish habitat (AMEC 2013, Appendix 5.1.2.6A, Section 5.9.4).

2.2.1 Tatelkuz Lake Limnology

To support the Tatelkuz Lake littoral zone studies, seasonal (i.e., spring, summer, fall, winter) physical limnological surveys will be conducted at four sites on Tatelkuz Lake (**Figure 2-1**). Spring survey timing is planned to coincide with freshet, while summer and fall survey timing is planned to coincide with fish and fish habitat assessments. At each site, sampling includes:

- Vertical profiles at 1.0 m intervals for temperature (°C), pH, conductivity (µS/cm), and dissolved oxygen (mg/L) at four established locations in Tatelkuz Lake (**Figure 2-1; Table 2-1**) identified by AMEC (2013).

- Winter profiles are taken under ice, including measurement of ice thickness (m) and snow depth (m).
- Winter *in situ* water quality is measured at the four fish and fish habitat sampling locations (**Figure 2-1**) to determine overwintering dissolved oxygen, a habitat suitability metric for Brassy Minnow.
- Collection of surface water samples for analysis of epilimnetic total phosphorus (mg/L) and total nitrogen (mg/L); and
- Secchi depths by lowering the Secchi disc over the shaded side of the boat recording the depth at which the disc disappears from sight and the depth at which it reappears.

Sampling frequency is described in **Section 2.4 Frequency and Duration**, with data collected in 2021 and early 2022 summarized in **Section 2.3.1 Tatelkuz Lake Limnology**. The Tatelkuz Lake limnology endpoints will include several physical water measurements and winter snow and ice measurements (**Table 2-2**).

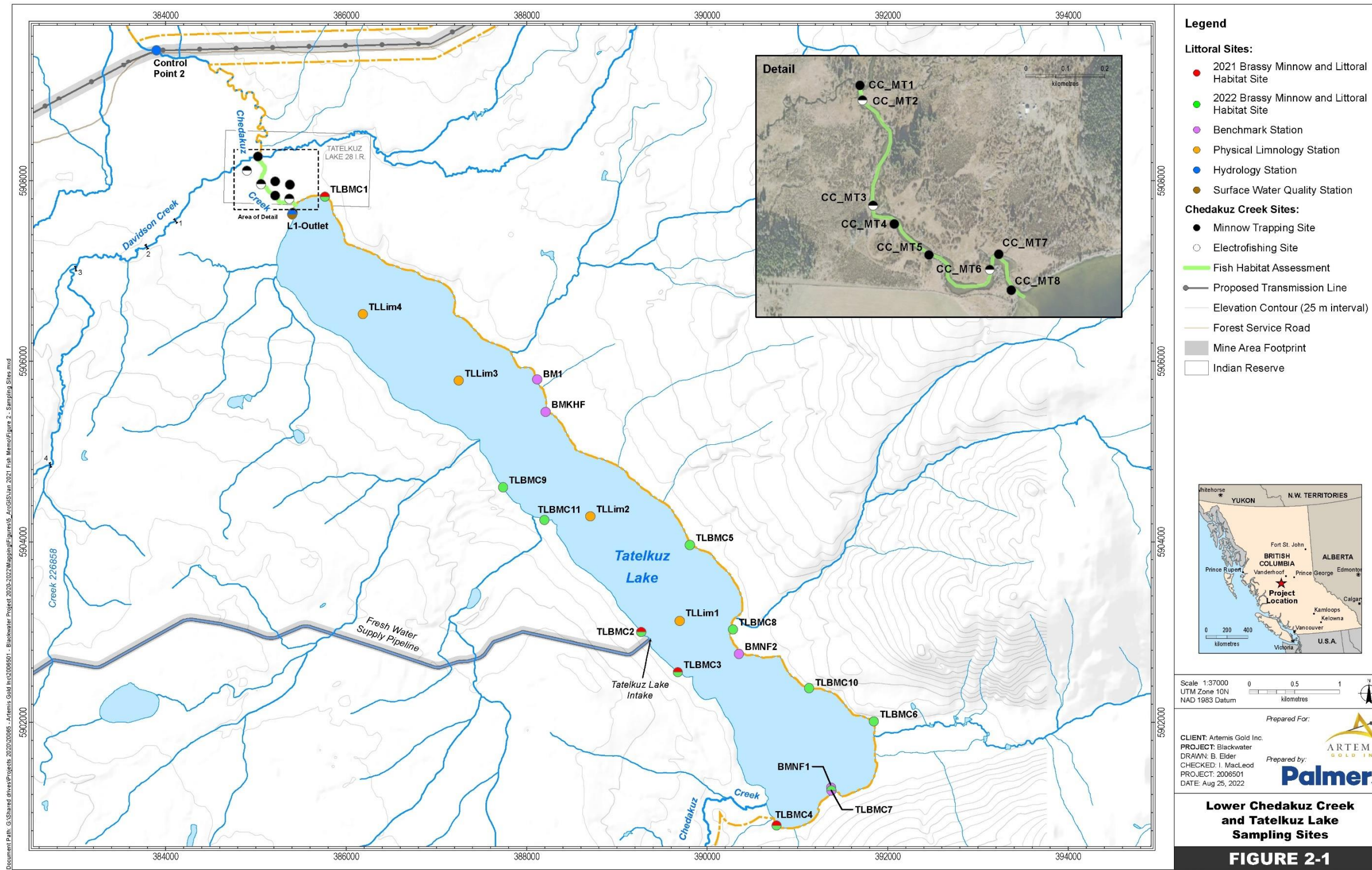


Figure 2-1. Lower Chedakuz Creek and Tatalkuz Lake Sampling Sites

Table 2-1. Tatelkuz Lake Littoral Habitat and Limnology Sampling Site Names, 2021-2022

Station Type	Station ID	Palmer Alt. Site Code	AMEC Site Code ¹	AMEC Fishing Site Code ¹	Littoral Habitat Type ²	Elevation (MASL)	UTM E	UTM N
Brassy Minnow/ Littoral Habitat	TLBMC1*	TLLit1	TL-1	A1MT1-6	Cg-St	-	385764	5907822
Brassy Minnow/ Littoral Habitat	TLBMC2*	TLLit2	TL-14	-	Cg-Sh	-	389268	5903003
Brassy Minnow/ Littoral Habitat	TLBMC3*	TLLit3	TL-13	F2MT1-6	Bc-Sh	-	389674	5902558
Brassy Minnow/ Littoral Habitat	TLBMC4*	TLLit4	-	I2MT7-12	Fg-Sh	-	390766	5900859
Brassy Minnow/ Littoral Habitat	TLBMC5	TLLit5	TL-4	F1MT7-12	Gf-St	-	389807	5903965
Brassy Minnow/ Littoral Habitat	TLBMC6	TLLit6	TL-7	-	Gf-Sh	-	391845	5902013
Brassy Minnow/ Littoral Habitat	TLBMC7	TLLit7	TL-10	-	Cb-Sh	-	391375	5901246
Brassy Minnow/ Littoral Habitat	TLBMC8	TLLit8	TL-5	G1MT1-6	Gc-Sh	-	390285	5903031
Brassy Minnow/ Littoral Habitat	TLBMC9	TLLit9	TL-19	E2MT13-18	Gc-St	-	387737	5904604
Brassy Minnow/ Littoral Habitat	TLBMC10	TLLit10	TL-6	H1MT7-12	Cb-St	-	391128	5902380
Brassy Minnow/ Littoral Habitat	TLBMC11	TLLit11	TL-18	E1MT1-6	Bc-St	-	388194	5904242
Benchmark Station	BMNF1	-	-	-	-	929.47	391372	5901279
Benchmark Station	BMNF2	-	-	-	-	928.381	390351	5902760
Benchmark Station	BMKHF	-	-	-	-	928.467	388209	5905440
Benchmark Station	BM1	-	-	-	-	928.633	388115	5905799

BLACKWATER GOLD PROJECT

Follow-up Programs for Condition 3.16 of the Blackwater Mine Project
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Station Type	Station ID	Palmer Alt. Site Code	AMEC Site Code ¹	AMEC Fishing Site Code ¹	Littoral Habitat Type ²	Elevation (MASL)	UTM E	UTM N
Benchmark Station	Control Point 2	-	-	-	-	926.295	383919	5909388
Physical Limnology	TLLim1	-	TL1	-	-	-	389694	5903124
Physical Limnology	TLLim2	-	E2	-	-	-	388704	5904283
Physical Limnology	TLLim3	-	TL2	-	-	-	387247	5905786
Physical Limnology	TLLim4	-	WQ21	-	-	-	386184	5906523

* 2021 littoral habitat and brassy minnow stations

MASL = metres above sea level

UTM = Universal Transvers Mercator, NAD83 Datum, Zone 10U

Table 2-2: Measurement and Assessment Endpoints for Tatelkuz Lake Limnology Prior to Operations

Measurement Endpoint	Assessment Endpoint
Physical limnology	Temperature (°C), pH, conductivity (µS/cm), dissolved oxygen (mg/L), phosphorous (mg/L), nitrogen (mg/L), Secchi Depth
Winter ice conditions	Ice thickness (cm), snow depth (cm), littoral winter dissolved oxygen (mg/L)

2.2.2 Littoral Fish and Fish Habitat

The summer littoral fish habitat assessments follow the baseline methods of AMEC (2013) which were completed using the 'Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador' (Bradbury et al 2001). Planned limnological and littoral fish habitat studies will use the same methods:

- A total of 11 littoral sites will be surveyed (**Figure 2-1; Table 2-1**) to compare each of the eleven unique littoral habitat types identified by AMEC (2013), including;
 - Measurement of habitat characteristics at 1 m intervals along transects, from above the high-water mark to 3 m water depth (following AMEC [2013] methods), including:
 - Water depth measurement;
 - Distances from high water mark, toe of the bank and wetted edge;
 - Using a 0.5 x 0.5 m quadrat, characterization of:
 - Substrate (i.e., identification of dominant and subdominant substrate types along the transect); and
 - Littoral plant community (i.e., percent emergent, submerged, floating-leaved or free-floating macrophytes) and identification of other key habitat features (e.g., woody debris, percent cover for fish).
 - In situ water quality measurement, including surface water temperature (°C), pH, conductivity (µS/cm), and dissolved oxygen (mg/L) at each sampling location.
 - Capture of fish using beach seining, as per standardized methods for monitoring the distribution and relative abundance of a fish species related to Brassy Minnow (Macnaughton et al. 2019). To ensure that fish density and biomass estimates can be compared across sites and between years, sampling at each site will use a consistent methodology:
 - One pass with a beach seine per site;
 - Sampling a minimum wetted area of 100 m²;
 - Use of a standardized beach seine length and mesh size;
- Drone-based field survey and orthoimagery of Tatelkuz Lake shoreline at all habitat assessment locations; and
- Lake elevation levels will be collected at the time of the littoral habitat assessments using either a benchmark survey or elevation information collected by the external consultant responsible for hydrological monitoring.

Fish sampling for the larval life stage will occur in June during the expected spawning and hatching window and in August to capture other life stages during the summer stratification of the lake. Habitat sampling will be conducted during the August sampling period when littoral vegetation is expected to be at its maximum extent. The sampling frequency is described in **Section 2.4 Frequency and Duration**, with data collected in 2021 and early 2022 summarized in **Section 2.3.2 Littoral Fish and Fish Habitat**. The summer littoral fish and fish habitat survey measurement endpoints will include the assessment of fish habitat conditions, habitat suitability, and fish abundance (**Table 2-3**).

In 2021, preliminary littoral fish habitat assessments included the sampling detailed above at only four sites (**Figure 2-1; Table 2-1**). Two Brassy Minnow sampling programs were completed in 2021. The first was in June to capture the spawning and hatching time, and larval abundance of Brassy Minnow using larval light traps deployed at night and dipnets during the day to match the sampling methodology of Falke et al. (2010). The second sampling program occurred in late summer. This program included:

- Minnow trap sampling in September at the four established Brassy Minnow sampling and habitat assessment locations (**Figure 2-1**)
- Paired traps set at three depth strata (0.5 m, 1.0 m, and 3.0 m) at each of the four stations and soaked for approximately 24 hours. Beach seining sets of approximately 15 m were completed at each station.

Results from these preliminary programs were used to determine the optimal method for littoral fish sampling in Tatelkuz Lake is beach seining.

Table 2-3: Measurement and Assessment Endpoints for the Littoral Fish and Fish Habitat Assessment in Tatelkuz Lake

Measurement Endpoint	Assessment Endpoint
Habitat conditions	Water temperature (°C), pH, conductivity (µS/cm), dissolved oxygen (mg/L)
Habitat suitability	Water depth (cm), substrate type, plant community (percent emergent), habitat cover (percent cover), lake elevation
Fish abundance	Catch Per Unit Effort (CPUE) and fish density (fish/100 m ²) for each identified species

2.3 Data Analysis

Power analyses have been performed, as appropriate, to support a study design that will allow for between-year comparisons and longer-term trend analysis. Between-year comparison (i.e., paired comparison between two separate annual datasets) will be completed to identify statistical differences in mean values using Analysis of Variance (ANOVA), or if the data are not normally distributed the equivalent non-parametric statistical test (e.g., Wilcoxon Signed-Rank Test). All statistical analyses will be performed using the R statistical system (R Core Team 2011). The significance level (α) = 0.05 will be used for all statistical tests, except as noted in specific analyses. In addition, year-over-year change will be assessed qualitatively, by comparing with the baseline data.

For a longer time scale (i.e., five years and onwards), non-parametric Mann-Kendall temporal trends testing will be used to determine if there are significant temporal trends in any given monitoring metric, and if so, the direction and statistical significance of the temporal trend. The sensitivity of the Mann-Kendall trends test increases with an increasing number of time steps (i.e., consecutive years of data) and it is considered that somewhere between five- and ten-time steps are a minimum requirement. Therefore, trend analyses will begin following the fifth year of this monitoring program.

2.3.1 Tatelkuz Lake Limnology

Data from the four sites will be statistically compared for a 'site' effect using a single-factor Analysis of Variance (ANOVA) and Tukey's post-hoc comparison if the data are normally distributed, or an equivalent non-parametric test if not.

Vertical lake profiles were collected seasonally in June, September, November 2021 and March 2022 to capture the seasonal lake turnover and mixing and the depth and water quality parameters during lake stratification. The parameters recorded were temperature (°C), conductivity and specific conductance ($\mu\text{S}/\text{cm}$), dissolved oxygen (mg/L and %), pH, and secchi depth (i.e., water transparency). Epilimnetic water samples were collected to measure seasonal nutrient levels (i.e., total phosphorus and total nitrogen) to monitor the trophic state of Tatelkuz Lake.

For physical water quality parameters stratified in the lake, the mean value and range for each stratification zone (i.e., epilimnion, thermocline and hypolimnion) was calculated. If no stratification was present, the mean parameter for the full vertical profile was used. The average depth range of each stratification zone also was recorded. Vertical profile plots of temperature, dissolved oxygen and conductivity were produced for each sampling event. A vertical profile plot comparison of dissolved oxygen and temperature for the four 2021-2022 sampling events is presented in **Figure 2-2**. Mean, near-surface (i.e., epilimnetic), open-water period nutrient and 1% euphotic depth (using secchi depth) also will be calculated for comparison.

The data collected from the vertical profile water quality sampling will be compared spatially (between sites) and temporally using the appropriate hypothesis test for an analysis of variance (e.g., single-factor ANOVA) depending on the distribution and variance range of the data, followed by the appropriate post-hoc test (e.g., Tukey's HSD). If there is no evidence of significant spatial trends then future monitoring programs will use one site instead of four. Data will be compared seasonally and annually, following 5 years of monitoring data. A non-parametric temporal trends analysis will be completed using a Mann-Kendall trends test.

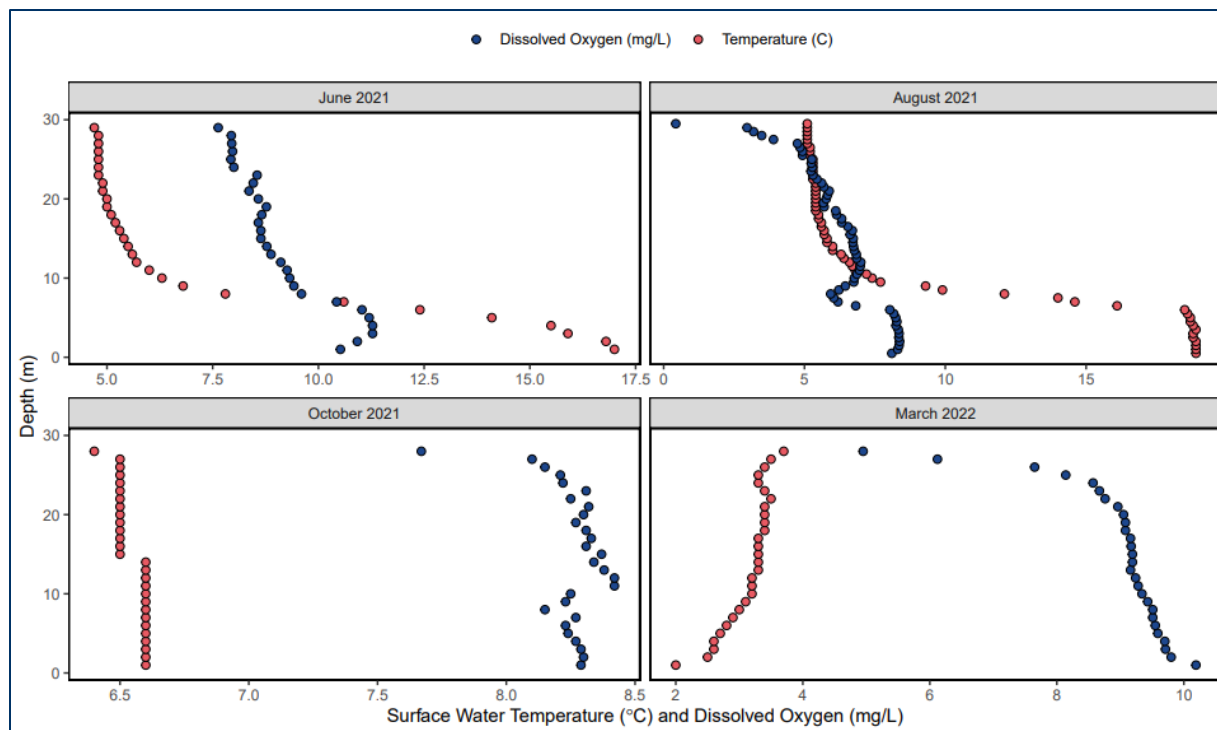


Figure 2-2. Depth vs Temperature (°C) and Dissolved Oxygen (mg/L) at TL LIM 1 in June 2021, August 2021, October 2021, and March 2022.

Secchi depth, (D_s), is used to calculate the light extinction coefficient (k) for non-turbid water and 1% euphotic depth ($Z_{1\%}$) using the formula (Parsons et al. 1984):

$$k = \frac{1.7}{D_s}$$

$Z_{1\%}$, the depth to which 1% of surface light irradiance extends into the water column, is the point where gross photosynthetic production in the water column is equal to gross respiration and, therefore, is the maximum depth at which photosynthesis and net carbon fixation occur. $Z_{1\%}$ was calculated according to the formula (Parsons et al., 1984):

$$Z_{1\%} = \frac{4.6}{k}$$

A summary of the results from the 2021 and winter 2022 physical limnology sampling in Tatalkuz Lake is presented in Table 2-4.

Table 2-4. 2021 and Winter 2022 Physical Limnology Results from Vertical Profile Sampling in Tatalkuz Lake

Date	Temp. Range (C)	DO Range (mg/L)	Conductivity Range	Specific Conductivity Range	pH Range	Secchi Depth (m)	1% Euphotic Depth ($Z_{1\%}$)	Thermocline Depth (m)
Jun 22, 2021	4.7 - 16.9	6.5 - 12.1	85.6 - 112.7	113.9 - 113.0	8.02 - 8.34	3.27	8.85	1 - 15

Date	Temp. Range (C)	DO Range (mg/L)	Conductivity Range	Specific Conductivity Range	pH Range	Secchi Depth (m)	1% Euphotic Depth (Z _{1%})	Thermocline Depth (m)
Aug 10, 2021	5.1 - 18.9	0.4 - 9.0	116.8 - 226.7	252.3 - 256.7	8.48 - 8.64	4.20	11.5	8 - 10
Oct 28, 2021	6.4 - 6.8	5.2 - 9.0	169.4 - 174.1	261.7-281.8	7.64 -7.65	3.5	9.39	-
Mar 3, 2022	1.9 - 3.7	4.2 - 10.7	68.0 - 74.4	118.3 - 126.3	6.3 - 7.2	-	-	-

2.3.2 Littoral Fish and Fish Habitat

2.3.2.1 Drone Orthoimage Maps

Orthoimages of the littoral and riparian habitat at each of four littoral 2021 monitoring stations in Tatelkuz Lake (**Figure 2-1**) were collected using an unmanned aerial vehicle (UAV). These images were used to produce updated baseline aerial orthoimage maps of each site for comparison to on-the-ground habitat information from the 2021 baseline program and the original 2013 baseline information collected by AMEC (2013).

2.3.2.2 Tatelkuz Lake Littoral Habitat Assessment

Unique habitat types and recorded habitat characteristics collected during the shoreline transects will be used to determine the total area and abundance (%) of these habitat types to be used for long-term monitoring. The habitat information will also be used to assess the suitability of delineated habitat areas for Brassy Minnow using the lacustrine HSI for Brassy Minnow presented in

Table 2-5 (Golder 2008). Brassy Minnow HSI will be calculated using the following equation:

$$HSI_{BMC} = average(V_1 + V_2 + V_3 + V_4 + V_5 + V_6 + V_7)$$

where HSI_{BMC} is the Brassy Minnow habitat suitability index.

Table 2-5. Lacustrine Habitat Suitability Index of Brassy Minnow

Variable		Excellent (SI=1.0)	Above Average (SI=0.75)	Average (SI=0.5)	Below Average (SI=0.25)	None (SI=0.0)
V ₁	substrate ¹	G, S & CS		C and R	Bd, Bo	
V ₂	cover	submergent and emergent plants		woody debris, rock		

Variable		Excellent (SI=1.0)	Above Average (SI=0.75)	Average (SI=0.5)	Below Average (SI=0.25)	None (SI=0.0)
V ₃	spawning	quiet, shallow, well-vegetated areas	-	-	-	no suitable material
V ₄	depth (m)	≤10		>10		
V ₅	% littoral zone cover	>50	>30 to 50	>20 to 30	>0 to 20	0
V ₆	Late winter dissolved oxygen (mg/L) ²	≥2		<2		
V ₇	pH	6 to 9		5.5 to <6		<5.5 or >9

¹ Bd = bedrock, Bo = boulder (> 256 mm), C = cobble (> 64 to 256 mm, rounded), R = rubble (> 64 to 256 mm, angular), G = gravel (> 2 to 64 mm), S = sand (> 0.06 to 2.0 mm) and CS = clay/silt (≤ 0.06 mm) includes detritus (Bradbury et al. 1999). The distinction between cobble and rubble is that cobble material has a smooth rounded shape while rubble is material in the same size range, but with sharp angular corners.

² Late winter dissolved oxygen (DO) criteria are based on the assumption that if measured late winter DO is greater than the indicated concentration, DO is not limiting at any time of the year, and if measured late winter DO is less than the indicated concentration, DO may be limiting in winter but not during the open-water period. In addition, since DO is not measured in all areas within a watercourse or waterbody, there may exist some local areas where late winter DO is greater than the measured concentration.

The habitat features, extent and area will be compared with the littoral habitat information in the baseline study completed by AMEC (2013) in order to provide an updated baseline dataset from which long-term monitoring plans, triggers and adaptive management can be based. Changes in habitat type, area and suitability will be assessed using field-based methods supported by post-hoc GIS-based analysis. Quantitative analysis between years using a suitable parametric or non-parametric statistical test (e.g., single-factor or two-factor ANOVA with Tukey's HSD post-hoc test) will be used to compare habitat types by area and Brassy Minnow Habitat suitability unique habitat type between years. Once the minimum sample size of 5 years is satisfied, changes will be monitored using a non-parametric Mann-Kendall trends analysis. Habitat and environmental metrics will be related to Brassy Minnow abundance data using a suitable hypothesis test or mixed effect modelling approach (e.g., generalized linear mixed effect model).

2.3.2.3 Tatelkuz Lake Littoral Fish Assessment

Littoral Community Composition

Littoral fish captured at four sites in Tatelkuz Lake in 2021 are presented in **Table 2-6**. Four fish species were captured using beach seines and minnow traps at the four locations surveyed in 2021, with Brassy Minnow (36 total) and Northern Pikeminnow (33 total) being the most prevalent. Fish density calculations for each site are possible only for beach seine results, and this standardized method will be used for long-term monitoring (see **Section 2.1.2 Littoral Fish and Fish Habitat**).

Table 2-6. Littoral Fish Species Captured in Tatelkuz Lake, 2021

Method	Site	Fish Species					CPUE fish/m ²	Density (fish/100 m ²)
		BMC	NSC	Sculpin	Sucker	Total		
BS	TLBMC1	5	0	0	0	5	0.07	6.7

Method	Site	Fish Species					CPUE fish/m ²	Density (fish/100 m ²)
		BMC	NSC	Sculpin	Sucker	Total		
BS	TLBMC2	3	1	0	0	4	0.05	5.3
BS	TLBMC3	12	20	1	10	43	0.57	57.3
BS	TLBMC4	5	2	9	5	21	0.28	28.0
							CPUE fish/24 hr/trap	
MT	TLBMC1	0	1	1	1	3	0.54	
MT	TLBMC2	3	5	5	4	17	3.20	
MT	TLBMC3	8	3	1	1	13	2.67	
MT	TLBMC4	0	1	1	5	7	1.47	

TLBMC1 – 2021 site at north end of Tatelkuz Lake

BS = beach seine

CPUE = Catch-per-unit-effort

TLBMC2 – 2021 site adjacent to FWSS intake (north)

MT = minnow trap

TLBMC3 – 2021 site adjacent to FWSS intake (south)

BMC = Brassy Minnow

TLBMC4 – 2021 site at south end of Tatelkuz Lake

NSC = Northern Pike Minnow

Site Selection Power Analysis

A power analysis was completed using Brassy Minnow CPUE data from the 2021 beach seine survey and beach seine CPUE data for the related Western Silvery Minnow (*Hybognathus argyritis*) from standardized field sampling methods for the Western Silvery Minnow (Macnaughton et al. 2019). The sample size calculation was completed using the 'Counts per Unit' sample size tool in JMP® statistical software (2021) using the mean baseline CPUE pooled between both datasets (0.095 fish/m²), alpha = 0.05, power = 0.8 and effect size of 30%. This power analysis produced a minimum sample size of n=11. Therefore, 11 littoral habitat monitoring stations will be monitored in 2022 (**Figure 2-1**), which matches the 11 unique habitat types identified by AMEC (2013). At each habitat monitoring station, Brassy Minnow sampling using beach seining will be completed twice per year, June for larval fish and August-September for adult fish.

2.4 Frequency and Duration

The monitoring programs for Tatelkuz Lake littoral fish and fish habitat conditions and habitat suitability prior to Operations will continue to establish updated baseline conditions from which to compare future monitoring efforts related to EA Condition 3.16.2 (**Section 3 Follow-up Program 3.16.2: Tatelkuz Lake Littoral Zone Monitoring During Operations**). The baseline conditions program will allow the comparison of conditions prior to pumping water from Tatelkuz Lake by the FWSS to ensure no changes to baseline conditions occur during Operations pumping.

Monitoring frequency of the Tatelkuz Lake littoral fish and fish habitat conditions and habitat suitability after Year 6 of Operations (i.e., after the start of FWSS pumping) is described in **Section 3.4 Frequency and Duration that applies to EA Condition 3.16.2. Under the EA Condition 3.16.2 Follow-up Program**. Littoral fish habitat will be monitored once annually in late summer (July or August) until the start of, and during the Construction phase. Annual monitoring will provide updated baseline littoral habitat information.

3. FOLLOW-UP PROGRAM 3.16.2: TATELKUZ LAKE LITTORAL ZONE MONITORING DURING OPERATIONS

The Tatelkuz Lake Littoral Zone Monitoring Program during Operations will match the field and data analysis methods described in **Section 1.3 Condition 3.16.1 – Tatelkuz Lake Littoral Zone Surveys Prior to Operations**. Following the review of the 2021-2022 data by key stakeholders adjustments to the monitoring methodology, frequency and locations can be made to the Operational monitoring plans.

3.1 Background and Approach

The monitoring programs planned for Operations will be based on those started in 2021 and refined in 2022. The Operations monitoring programs will be designed in order to satisfy Condition 3.16.2 of the EA Certificate. This monitoring will include seasonal limnological measurements of the lake as well as fish and fish habitat surveys in the littoral areas previously selected. Spring survey timing is planned to coincide with freshet, while summer and fall survey timing is planned to coincide with fish and fish habitat assessments. Original baseline information is presented in the Fish and Aquatic Resources 2011-2012 Baseline Report for Tatelkuz Lake fish habitat (AMEC 2013, Appendix 5.1.2.6A, Section 5.9.4).

3.2 Study Design

3.2.1 Tatelkuz Lake Limnology

The following seasonal limnological measurements will be taken for comparison with baseline water property information from deeper parts of the lake that will influence littoral zone fish habitats:

- Vertical profiles up and down at 1.0 m intervals for temperature (°C), pH, conductivity (µS/cm), and dissolved oxygen (mg/L) at four established locations in Tatelkuz Lake (**Figure 2-1; Table 2-1**) identified by AMEC (2013).
 - 2022 Winter profiles to be taken under ice, including measurement of ice thickness (m) and snow depth (m).
 - Additional Winter *in situ* water quality to be taken at the four fish and fish habitat sampling locations to determine overwintering dissolved oxygen, a habitat suitability metric for Brassy Minnow.
- Collection of surface water samples for analysis of epilimnetic total phosphorus (mg/L) and total nitrogen (mg/L); and
- Secchi depths by lowering the Secchi disc over the shaded side of the boat recording the depth at which the disc disappears from the site and the depth at which it reappears from the site.

Sampling frequency is described in **Section 3.4 Frequency and Duration**. The Tatelkuz Lake limnology endpoints will include several physical water measurements and winter snow and ice measurements (**Table 3-1**).

Table 3-1: Measurement and Assessment Endpoints for Tatelkuz Lake Limnology During Operations

Measurement Endpoint	Assessment Endpoint
Physical limnology	Temperature (°C), pH, conductivity (µS/cm), dissolved oxygen (mg/L), phosphorous (mg/L), nitrogen (mg/L), Secchi Depth
Winter ice conditions	Ice thickness (cm), snow depth (cm), littoral winter dissolved oxygen (mg/L)

3.2.2 Littoral Fish and Fish Habitat

Summer and fall littoral fish habitat assessments will include the following measurements for comparison with baseline information:

- Drone-based field survey and orthoimagery of Tatelkuz Lake shoreline at the four established Brassy Minnow sampling and habitat assessment locations (**Figure 2-1; Table 2-1**) are representative of the unique littoral habitat types identified by AMEC (2013). Ground surveys will verify the littoral habitat description completed in 2013.
- Measurement of habitat characteristics at 1 m intervals along transects, from shore to 3 m water depth (following AMEC [2013] methods), including:
 - Water depth measurement and elevation using a benchmark survey;
 - Distances from high water mark, toe of the bank and wetted edge;
 - Using a 0.5 x 0.5 m quadrat:
 - Substrate characterization (i.e., identification of dominant and subdominant substrate types along the transect); and
 - Littoral plant community characterization (i.e., percent emergent, submerged, floating-leaved or free-floating macrophytes) and identification of other key habitat features (e.g., woody debris, percent cover for fish).
- In situ water quality measurement, including surface water temperature (°C), pH, conductivity (µS/cm), and dissolved oxygen (mg/L) at each sampling location.
- Beach seine sets of approximately 15 m will be completed at each station, with captured fish identified to species and a subset measured.

Fish and fish habitat sampling will occur in June (i.e., larval life stage) and August (i.e., other life stages), during the summer stratification of the lake. Littoral vegetation is expected to be at its maximum extent during this period. Sampling frequency is described in **Section 3.4 Frequency and Duration**. The summer littoral fish habitat survey measurement endpoints will include an assessment of fish habitat suitability (**Table 3-2**).

Table 3-2: Measurement and Assessment Endpoints for the Littoral Fish Habitat Assessment in Tatelkuz Lake

Measurement Endpoint	Assessment Endpoint
Habitat conditions	Water temperature (°C), pH, conductivity (µS/cm), dissolved oxygen (mg/L)
Habitat suitability	Water depth (cm), substrate type, plant community (percent emergent), habitat cover (percent cover),
Fish abundance	Catch Per Unit Effort (CPUE) and fish density (fish/100 m ²) for each identified species

3.3 Data Analysis

Data analysis methodologies for littoral habitat monitoring during operations will match or be based on the methods described in **Section 2.1.2 Littoral Fish and Fish Habitat**.

3.4 Frequency and Duration

The monitoring programs for Tatelkuz Lake littoral fish and fish habitat conditions and habitat suitability will start in Year 6 of Operations at the start of water withdrawal from Tatelkuz Lake. The monitoring will continue for all remaining phases of the Project following Year 6 of Operations. Starting from Year 6 of Operations, monitoring for Condition 3.16.2 will be conducted annually for the duration of Operations. Monitoring frequency of all Condition 3.16.2 components for Closure and Post-Closure phases will be determined near the end of the Operations phase and will depend on monitoring results during that phase.

4. FOLLOW-UP PROGRAM 3.16.3 – LOWER CHEDAKUZ CREEK MONITORING DURING ALL PROJECT PHASES

4.1 Background and Approach

Water flows in lower Chedakuz Creek have been monitored by Knight Piésold Consulting since 2012 (Knight Piésold 2020). Data from this monitoring program will be used to satisfy Condition 3.16.3 of the Decision Statement requiring monitoring of flows in lower Chedakuz Creek. In addition, fish and fish habitat has been assessed in lower Chedakuz Creek to validate the EA conclusions (Condition 3.16).

Original baseline information is presented in the Fish and Aquatic Resources 2011-2012 Baseline Report for lower Chedakuz Creek temperatures (AMEC 2013, Appendix 5.1.2.6A, Section 5.1) and fish habitat (AMEC 2013, Appendix 5.1.2.6A, Section 5.8.1). Stream flows for lower Chedakuz Creek were not measured for the EA.

4.2 Study Design

4.2.1 Lower Chedakuz Creek Discharge

A water flow monitoring station has been in place in lower Chedakuz Creek near the outlet of Tatelkuz Lake since 2012. This station measures the discharge stage, with discharge measurements compared against a

data logger station located downstream of the confluence with Davidson Creek. These flow measurements encompass the section of lower Chedakuz Creek described in Condition 3.16.3. The location of the hydrology station (L1-Outlet) is presented in **Figure 2-1**.

Standard techniques are employed at the hydrometric station to manually measure streamflow. A minimum of five stage-discharge measurements are collected annually at different flow conditions in order to validate developed empirical relationships (i.e., rating curves) between water level and streamflow. Discharge measurements are collected during the winter months at monitoring stations where site conditions allow, typically from late October to early April. For each station, the rating curves are used to convert continuous stage data into continuous streamflow and, from this information, specific hydrologic parameters such as runoff and unit yield are calculated.

Hydrometric data will be provided in a consistent, industry-standard manner so that it can be easily integrated into common analytical workflows using R or other similar tools, including the fasstr package. This standardization will facilitate analysis for the Nations through standardized tools and allow incorporation into larger datasets to help understand hydrological processes in the Project area and enable management decisions related to the mine in the context of ongoing climate change.

Sampling frequency is described in **Section 4.4 Frequency and Duration**. The lower Chedakuz Creek discharge endpoints will include stream depth and flow velocity to develop rating curves (**Table 4-1**).

Table 4-1: Measurement and Assessment Endpoints for Lower Chedakuz Creek Discharge

Measurement Endpoint	Assessment Endpoint
Discharge	Stream depth (cm) and flow velocity (cm/s)

4.2.2 Lower Chedakuz Creek Water Quality

Sampling will be conducted quarterly at the hydrology station site (**Figure 2-1**). Additionally, 5-in-30-day sampling will be performed during the spring freshet. Water sampling will be completed to align with biological sampling. Sampling methods will follow best practices as outlined in *British Columbia Field Sampling Manual* (BC MWLAP 2013). Samplers will always practice clean sampling techniques including wearing clean vinyl gloves while handling samples at each station.

For stream sampling, water samples will be collected in areas of laminar flow, if present and when it is safe to do so, to minimize suspended particulates. Stream samples will be collected by facing upstream and submerging the laboratory-certified, clean general parameter sample bottle below the surface until filled. The general parameter bottle will then be used to fill the other sample bottles by decanting the collected water.

All samples will be field filtered and/or preserved in the field according to the analytical laboratories protocols. Samples will be stored in coolers on ice and/or refrigerated until shipped to an accredited

analytical laboratory for sample analysis. Collected water quality samples will be analyzed for general physical/ion parameters, nutrients and organics, cyanide, and total and dissolved metals at a Canadian Association for Laboratory Accreditation (CALA)-accredited laboratory. The lower Chedakuz Creek water quality endpoints will include these parameters (**Table 4-2**).

Table 4-2: Measurement and Assessment Endpoints for the Littoral Fish Habitat Assessment in Tatelkuz Lake

Measurement Endpoint	Assessment Endpoint
Water quality	Physical/ion parameters, nutrients and organics, cyanide, total metals, dissolved metals

4.2.3 Lower Chedakuz Creek Fish and Fish Habitat

4.2.3.1 Field Methods – Overview

A fish and fish habitat inventory will be conducted in lower Chedakuz Creek to update the baseline information from the EA. This set of surveys will include the following tasks:

- Measuring mean monthly discharge for the hydrology station (L1-Outlet) located at the outlet of Tatelkuz Lake into lower Chedakuz Creek (**Figure 2-1**), to produce a hydrograph showing the annual mean monthly discharge.
- Water quality measurements in lower Chedakuz Creek as part of the AEMP Plan (ERM 2022) for comparison with results from the original environmental assessment.
- A Fish Habitat Assessment Procedures (FHAP; Johnston and Slaney, 1996) Level 1 survey will be completed in the portion of lower Chedakuz Creek between the outlet of Tatelkuz Lake and the confluence with Davidson Creek (**Figure 2-1**), including measurement of channel dimensions, substrate percent composition, channel disturbance, and instream cover for fish.
- Drone-based orthoimagery is to be collected for the reach of lower Chedakuz Creek between the outlet of Tatelkuz Lake and the confluence with Davidson Creek to establish high-level baseline habitat conditions. This drone imagery will be compared to previous imagery to assess whether the channel morphology of lower Chedakuz Creek has changed significantly and whether the hydraulic relationships contained within the SEFA model remain valid. FHAP data will be used to verify the habitat description completed in 2013 by AMEC (2013).
- Fish sampling will be completed using minnow traps to estimate the distribution and abundance of immature and small-bodied fish species at eight sites (**Figure 2-1**), matching the original locations assessed by AMEC (2013).
- Closed-site backpack electrofishing with block nets at the three locations to estimate relative abundance (**Figure 2-1**).
- A winter habitat assessment will be conducted from early February to early March. Depending on the conditions at the selected monitoring locations in lower Chedakuz Creek the following information will be recorded:
 - Water depth (m)
 - Ice depth (m)

- Snow depth (m)
- Measurement of temperature (°C), pH, conductivity (µS/cm), and dissolved oxygen (mg/L) at selected locations within lower Chedakuz Creek;
- Bank walk Kokanee spawner surveys will be repeated to determine the abundance of spawners in the section of lower Chedakuz Creek between the Tatelkuz Lake outlet and the confluence with Davidson, as well as locations and habitat characteristics of sections of high spawning activity.

4.2.3.2 Field Methods – Summer Fish and Fish Habitat

Electrofishing surveys will be conducted at the three sites in lower Chedakuz Creek, as shown in **Figure 2-1**. At each site, sampling will include:

- Three-pass depletion electrofishing of stream sections 100 m² in area, isolated with block nets;
- Identification of species and collection of length, weight, and body condition data for all fish captured;
- Measurement of channel dimensions and calculation of mean values of bankfull width, wetted width, water depth, and gradient, based on the FHAP survey; and,
- In-situ water quality measurements (i.e., temperature, dissolved oxygen, pH, and conductivity).

Sampling will occur in late July, during the period after Rainbow Trout Young of Year (YOY) emergence and before the arrival of spawning Kokanee adults. At each site, sampling effort, electrofisher specifications, and catches will be recorded. Catch per unit effort (CPUE), relative abundance (number of fish per unit effort) and density metrics (number of fish per m²) will be calculated and analyzed.

FHAP fish habitat surveys will be completed on lower Chedakuz Creek (**Figure 2-1**) and will include delineation of mesohabitat units (e.g., riffle, run, pool) and measurement of key habitat components such as channel dimensions, stream morphology, cover, vegetation, substrate composition and riparian habitat information.

The summer fish inventory measurement endpoints will include an inventory of the fish community and fish health (**Table 4-3**).

Table 4-3: Measurement and Assessment Endpoints for the Lower Chedakuz Creek Summer Fish Assessment

Measurement Endpoint	Assessment Endpoint
Fish inventory	Catch Per Unit Effort (CPUE) and fish density (fish/100 m ²) for each identified species, population structure
Fish health	Length, weight, condition
Fish habitat	Mesohabitat unit boundaries, channel dimensions, stream morphology, cover, vegetation, substrate composition, riparian habitat

4.2.3.3 Field Methods – Kokanee Spawner Survey

Kokanee and redds will be counted weekly over a four-week period by a two-person crew hiking upstream between the confluence of Davidson Creek and lower Chedakuz Creek and the outlet of Tatelkuz Lake. By walking upstream, the crew will reduce the startle response of fish, which are usually oriented head-first into the flowing water. This method increases the probability of accurately counting fish.

Both live and dead kokanee will be counted in separate categories. Live fish will be classified as migrating/holding, spawning, or spent, depending on their behaviour. Migrating fish are those swimming steadily, usually upstream. Holding fish are those paired and occupying a station. Spawning fish are those paired and engaged in courtship behaviour with one or more mates, or actively digging or guarding a redd. Spent fish are those observed in pools and backwaters or drifting downstream along the stream margins with clear damage to body and fins.

Fish in each of the four classes will be counted individually by each crew member and then the two sets of counts compared at the end of a survey section. The set with the larger numbers will be selected as the best representative of the number of fish in that reach. Dead fish will be measured for post-orbital hypural and fork length (mm) and internally inspected to determine spawning success.

Information will be recorded for the start and end location of the survey as measured by GPS, water temperature (°C), dissolved oxygen (mg/L), pH, conductivity (µS/cm), creek width (m), redd habitat type (glide, riffle, or pool) based on FHAP (Johnston and Slaney 1996), and dominant and subdominant substrate in redds based on RIC standards (BC FISB 2001).

Concurrent with the visual survey, a drone-based survey also will be completed. This survey will provide a permanent record of spawning activity. Drone-based and visual surveys will be performed once each week over the four-week peak spawning period for comparison of the two survey methods' accuracy for estimating spawner numbers and redds.

Kokanee spawner counts, redd counts, and length measurements will be used to evaluate the relative abundance and density of spawners and redds, and size at maturity. The Kokanee bank walk visual assessment measurement endpoints will include assessment of fish and redd abundance and size at maturity (**Table 4-4**).

Table 4-4: Measurement and Assessment Endpoints for Kokanee Spawning Bank Walk

Measurement Endpoint	Assessment Endpoint
Fish abundance	The relative number of adult spawners and their density observed in each survey reach
Redd abundance	The relative number of redds and their density observed in each survey reach
Fish size at 100% maturity	Length and age at 100% maturity of Kokanee returning to Davidson Creek

4.3 Data Analysis

Several of the fish and fish habitat surveys described in **Section 4.2 Study Design** were conducted in lower Chedakuz Creek in 2021. A summary of the results of these surveys is presented in the following sections.

4.3.1 Lower Chedakuz Creek Discharge

The mean monthly discharge for each year of record between 2011-2020 was calculated for the hydrology station (L1-Outlet) located at the outlet of Tatelkuz Lake into lower Chedakuz Creek (**Figure 2-1**), to produce a hydrograph showing the annual mean monthly discharge (**Figure 4-1**, Knight Piésold 2020). Freshet in lower Chedakuz Creek typically starts in late March and peaks in late May or mid June. Low flows occur from late summer through to March each year.

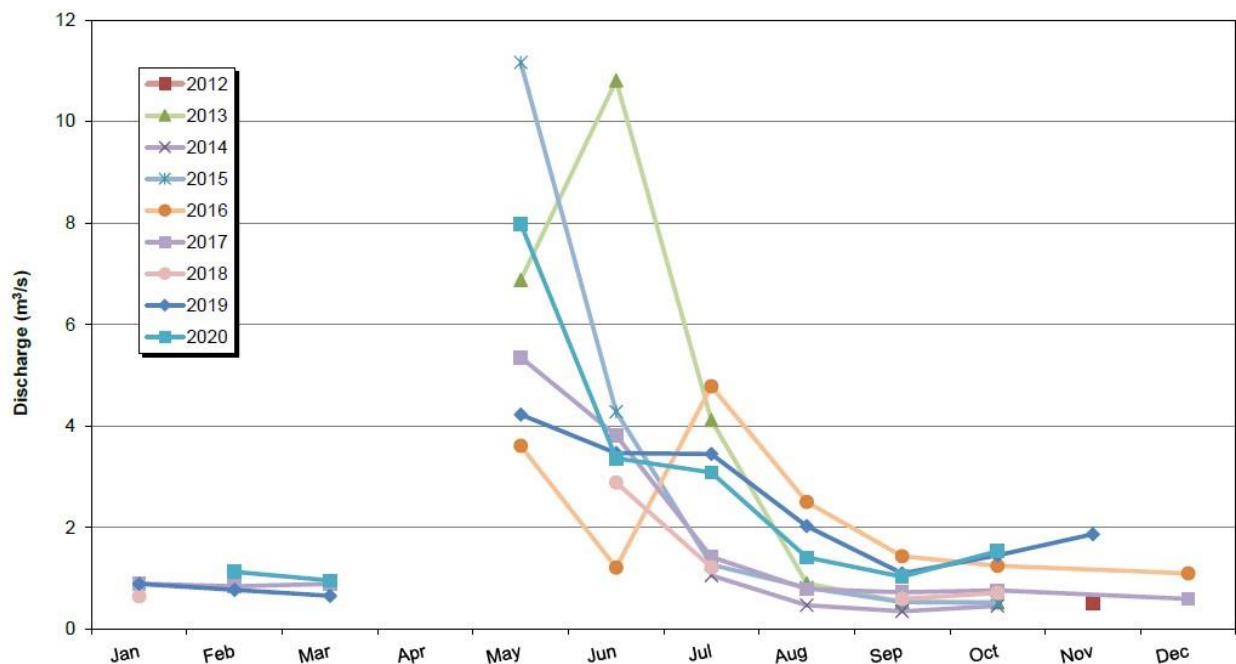


Figure 4-1. Mean Monthly Discharge for the Tatelkuz Lake Outlet to Lower Chedakuz Creek, 2012-2020, from Knight Piésold (2020)

The discharge hydrographs for the Tatelkuz Lake outlet to lower Chedakuz Creek were converted to daily unit runoff to allow for the comparison of unit runoff and peaks between years within a catchment. This metric will be used at the lake outlet hydrology station to monitor flows in lower Chedakuz Creek prior to and during the operation of the FWSS (see **Section 2.3 Frequency and Duration**).

4.3.2 Lower Chedakuz Creek Water Quality

Water quality measurements in lower Chedakuz Creek will be compared with results from the original environmental assessment. Each water quality metric will be monitored to determine if significant changes occur in lower Chedakuz Creek compared to reference sites or over time (ERM 2022).

4.3.3 Lower Chedakuz Creek Fish and Fish Habitat

In 2021 minnow trapping effort at eight sites (**Figure 2-1**) in the section of lower Chedakuz Creek between the Tatelkuz Lake outlet and Davidson Creek confluence caught a total of 98 fish over 251 trap-hours for an overall CPUE of 0.39 fish-per-trap-hour. A summary of catch by site is presented in **Table 4-5**.

Table 4-5. Catch-per-unit-effort from fishing effort using minnow traps at eight sites in Lower Chedakuz Creek in 2021

Site	Date	Species	Catch (# of fish)	Effort (trap-hours)	CPUE (# of fish per trap-hour)
CCMT1	July 30, 2021	Sculpin sp.	1	33.33	0.03
CCMT2	July 30, 2021	Sucker sp.	15	33.67	0.45
CCMT3	July 30, 2021	RB	1	34.67	0.03
CCMT4	July 30, 2021	Sucker sp.	1	34.97	0.03
CCMT5	July 30, 2021	-	0	35.23	0
CCMT6	July 30, 2021	BMC, RB, Sculpin sp.	8	36.93	0.22
CCMT7	July 30, 2021	Sculpin sp. Sucker sp. Dace sp.	48	37.2	1.29
CCMT8	July 30, 2021	Sculpin sp. Dace sp.	24	38.47	0.62

Sculpin sp.=unidentified sculpin species, sucker sp.=unidentified suck species, dace sp.=unidentified dace spaces, BMC = Brassy Minnow, RB=Rainbow Trout.

4.3.3.1 Population Structure

Length frequency results for the 2021 fish sampling in lower Chedakuz Creek have not yet been processed and analyzed. Population structures of fish will be assessed using length frequency distributions and length-age regressions. The length frequency distributions between control and impact sites will be compared using a two-level Kolmogorov-Smirnov Test to test whether the distribution was the same across the two groups being compared. A minimum of 20 individual length measurements will be considered the minimum required to provide the statistical power required for the Kolmogorov-Smirnov Test. Length and length-at-age will be monitored to determine if significant reduction occurs in lower Chedakuz Creek compared to reference sites (ERM 2022).

4.3.3.2 Fish Condition

The length/weight data from reference sites and from historical data (Appendix 2-O, Fish and Aquatic Resources 2011 – 2012 Baseline Report; Appendix 2-P, Fish and Aquatic Resources 2013 Baseline Report) will be combined and a normal reference range will be calculated using specific length increments and the associated average weight data.

Relative condition (K_n) will be used as the metric for condition and will be calculated by comparing the measured weight to the expected weight from the measured length as:

$$K_n = \frac{W}{W_E}$$

where W = measured fish weight (g) and W_E = expected fish weight (g).

Relative condition will be statistically compared between reference and impact sites (ERM 2022). Significance will be assumed when $p < 0.05$. Fish condition will be monitored to determine if significant reduction occurs in lower Chedakuz Creek compared to reference sites (ERM 2022).

4.3.3.3 *Fish Habitat*

Fish habitat data gathered from FHAP surveys and past Reconnaissance (1:20,000) Fish and Fish Habitat Site Card (RIC 2001) surveys will be compared each year. Assessments will include comparison of channel dimensions, overall mesohabitat composition, start and end points of individual mesohabitat units, channel substrate composition, riparian woody debris presence, cover abundance and composition, disturbance indicators, and riparian vegetation condition.

In 2021 only some key habitat characteristics were measured at the three lower Chedakuz Creek fish habitat sites (**Figure 2-1**). A summary of the habitat metrics collected in 2021 is presented in **Table 4-6**. Lower Chedakuz Creek at the three sites has a large channel averaging a 15.6 m channel width and 13.8 m wetted width, dominated by fines with some gravel substrate. The stream banks at two of the three sites have been disturbed by cattle.

4.3.3.1 *Fish and Fish Habitat Change Monitoring*

A System for Environmental Flow Analysis (SEFA) model was used to estimate the amount of stream habitat loss in lower Chedakuz Creek due to water loss due to planned FWSS pumping (Palmer 2021). This same SEFA model will be used in conjunction with ongoing lower Chedakuz Creek streamflow monitoring data to quantify actual changes in physical habitat compared to baseline conditions. Development of follow-up program trigger responses (**Section 6.1 Follow-up Program Trigger Response**) during Construction and Operations will be based on variation observed from baseline conditions during pre-Operations monitoring.

Table 4-6. Summary Table of 2021 Lower Chedakuz Creek Fish Habitat Information.

Site ID	Sampling Date	Morphology	B _r W (m)	WW (m)	Res. Pool (m)	Bed Materials	Stream Cover (%)	WD (%)	Undercut Bank (%)	Disturbance	Instream Vegetation
CCMT6	29/07/22	LC	18.5	13.20	0.24	Fg	M	D	T	Beaver Trampled banks	N
CCMT2	29/07/22	LC	12.1	12.1	0.87	Fg	T	T	T		V
CCMT3	29/07/22	LC	16.2	16.2	0.27	Fg	T	T	T	Trampled banks	

LC=large channel morphology, B_rW= channel width measured at the top of bank, WW=wetted width of the channel, Res. Pool = residual pool depth, WD= woody debris, Fg=finest dominant and gravel subdominant substrate classes using the specifications of RIC (2001)

4.3.4 Kokanee Spawner Surveys

Kokanee spawner surveys for the section of lower Chedakuz Creek between the outlet of Tatelkuz Lake and the confluence with Davidson Creek were completed in fall 2021 using weekly bank-walk and UAV-based surveys. Lower Chedakuz Creek has a large channel morphology with shallow depth, low cover and complexity, low gradient and short riparian vegetation. These habitat features are suitable for UAV-based spawner surveys, that were completed each week. No Kokanee spawners were observed during bank-walk and UAV surveys in this section of lower Chedakuz Creek in fall 2021 despite the timing matching that of AMEC (2013) when spawners and redds were observed within this reach.

In 2022 the Kokanee spawner counts for this section of lower Chedakuz Creek will be used to determine Kokanee spawner escapement. Peak Kokanee spawner counts also will be used to determine density by linear stream length (# of fish/linear m) and by stream area (# of fish/m²) to match the baseline methods of AMEC (2013).

4.4 Frequency and Duration

The monitoring programs for potential impacts lower Chedakuz Creek fish abundance, fish health, fish habitat and kokanee spawner populations will start in Year 6 of Operations at the start of water withdrawal from Tatelkuz Lake. Prior to Year 6, pre-construction and pre-pumping surveys will be completed to establish a recent baseline dataset to enable comparison. The monitoring will continue for all remaining phases of the Project following Year 6 of Operations.

Starting from Year 6 of Operations the frequency of Condition 3.16.3 monitoring will be annual for all sampling components.

Monitoring frequency of all Condition 3.16.3 components for Closure and Post-Closure phases will be determined near the end of the Operations phase and will depend on monitoring results during that phase.

5. IMPLEMENTATION SCHEDULE

Follow-up Programs 3.16.1 (Tatelkuz Lake littoral habitat before Operations), 3.16.2 (Tatelkuz Lake littoral habitat during Operations), and 3.16.3 (lower Chedakuz Creek monitoring during all project phases) were initiated in 2021-2022 through field programs to select sites, refine field sampling methods, and collect baseline data prior the start of Construction and Operation.

One year of monitoring will occur for follow-up program 3.16.1 to provide updated baseline conditions prior to water withdrawal from Tatelkuz Lake. The Tatelkuz Lake littoral fish and fish habitat monitoring program (Condition 3.16.2) will be ongoing throughout the life of the Project starting from Year 6 of Operations. The surface water quality and flow monitoring in lower Chedakuz Creek (Condition 3.16.3) will occur during all project phases, with the exception of the 5-in-30 sampling.

6. ADAPTIVE MANAGEMENT

The follow-up programs for Condition 3.16 described herein will evolve over time in response to the results of the monitoring, changing conditions or development at the Project, updates to methods, and through consultation with Indigenous groups, regulators, or other stakeholders. This process of continuous improvement with changing conditions is referred to as adaptive management.

Conditions 2.5 and 2.6 in the federal DS identify requirements for follow-up programs:

- “2.5 The Proponent shall, where a follow-up program is a requirement of a condition set out in this Decision Statement, have a Qualified Professional, where such a qualification exists for the subject matter of the follow-up program, determine, as part of the development of each follow-up program and in consultation with the party or parties being consulted during the development, the following information:*
- 2.5.1 the follow-up activities that must be undertaken by a qualified individual;*
 - 2.5.2 the methodology, location, frequency, timing and duration of monitoring associated with the follow-up program;*
 - 2.5.3 the scope, content, format and frequency of reporting of the results of the follow-up program;*
 - 2.5.4 the levels of environmental change relative to baseline conditions that would require the Proponent to implement modified or additional mitigation measure(s), including instances where the Proponent may require Designated Project activities to be stopped; and*
 - 2.5.5 the technically and economically feasible mitigation measures to be implemented by the Proponent if monitoring conducted follow-up as part of the follow up program shows that the levels of environmental change referred to in condition 2.5.4 have been reached or exceeded.*
- 2.6 The Proponent shall update and maintain the follow-up and adaptive management information referred to in condition 2.5 during the implementation of each follow-up program in consultation with the party or parties being consulted during the development of each follow-up program.”*

Thus, an adaptive management framework has been incorporated into the follow-up programs. **Figure 6-1** identifies the components of the adaptive management framework.

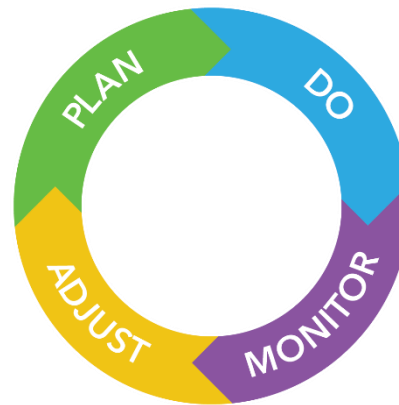


Figure 6-1. Adaptive Management Framework

Plan: In collaboration with the Indigenous groups, further refine and plan Follow-up Programs 3.16.1, 3.16.2 and 3.16.3.

Do: Implement Follow-up Programs 3.16.1, 3.16.2 and 3.16.3.

Monitor: BW Gold will review and update the follow-up programs over the life of the Project. This will include:

- Review of the programs in terms of effectiveness in detecting changes with the monitoring program;
- Recommendations provided by a qualified individual and Indigenous groups on the monitoring plan; and
- Engagement tracking to record input from Indigenous groups.

Adjust: BW Gold will adjust the follow-up programs (e.g., study design, field methods, data analysis methods, and reporting) based on program findings, as well as input and feedback from Indigenous groups.

6.1 Follow-up Program Trigger Response

To determine 'the levels of environmental change relative to baseline conditions that would require the Proponent to implement modified or additional mitigation measure(s)' (DS Condition 2.5.4) entails establishing levels (i.e., triggers), that when reached, trigger a response action.

Changes in the monitoring metrics for fish populations (e.g., fish abundance and spawner escapement), may reflect natural variability and it is challenging to pinpoint whether a significant change is attributable to mine activities (namely, water withdrawal from Tatelkuz Lake). Establishing triggers provides an early-warning system, allowing sufficient time to investigate root causes, increase monitoring, and take preventative action (i.e., implement modified or additional mitigation measure(s)).

Statistical analyses will be used to evaluate changes over time. Analyses will allow for between-year comparisons and longer-term trend analysis. Between-year comparison (i.e., paired comparison between two

separate annual datasets) will be completed to identify statistical differences in mean values. In addition, year-over-year change will be assessed qualitatively, by comparing with the baseline data.

For a longer time scale (i.e., five years and onwards), non-parametric Mann-Kendall temporal trends testing will be used to determine if there are significant temporal trends in any given monitoring metric, and if so, the direction and statistical significance of the temporal trend. The sensitivity of the MK trends test increases with an increasing number of time steps (i.e., consecutive years of data) and it is considered that somewhere between five-and-ten-time steps are a minimum requirement. For the first four years of monitoring, temporal trends analysis will not be possible, however, a Trigger Action Response Plan for fish habitat endpoints has been established that is based on triggers for flow and temperature. This is outlined in the AEMP for the Project.

Table 6-1 identifies triggers and responses for adaptive management related to fish population monitoring as part of follow-up programs 3.16.2 and 3.16.3. There are no triggers proposed for follow-up program 3.16.1, as the study will be completed prior to Construction and Operations.

Table 6-1 Adaptive Management Triggers and Responses

Trigger	Response
No trend in monitoring metric (i.e., stable over time) or upward trend (e.g., increase in fish habitat suitability)	Inform Indigenous groups No change to mitigation measures Consider a reduction in the frequency of monitoring
Downward trend monitoring metric (e.g., decrease in fish habitat suitability)	Inform Indigenous groups Identify potential causes and additional studies to test hypotheses Implement modified or additional mitigation measures Monitor post-implementation of the modified or additional mitigation measures and communicate results Evaluate if new mitigation or fish offsetting measures are required

In the case of negative adverse effects to littoral fish habitat that deviate from the predictions of the EA, there are limited additional mitigation measures available. Flow augmentation from the FWR/FWSS can be controlled to reduce the volume of water being withdrawn from Tatelkuz Lake. However, if agreed-upon adaptive measures in response to triggers related to the monitoring metrics outlined in this follow-up program prove insufficient, new mitigation or fish offsetting measures might be required.

7. REPORTING

DS Conditions 2.11, 2.12 and 2.13 set out annual reporting requirements related to the implementation of conditions in the DS. Condition 2.14 sets out information sharing requirements related to the annual reports. Reporting will commence when BW Gold begins to implement the conditions set out in the DS. Requirements in DS Conditions 2.11 – 2.14 are presented below.

DS Condition 2.11 requires:

“The Proponent [BW Gold] shall, commencing in the reporting year during which the Proponent begins the implementation of the conditions set out in this Decision Statement, prepare an annual report that sets out:

- 2.11.1 the activities undertaken by the Proponent in the reporting year to comply with each of the conditions set out in this Decision Statement;*
- 2.11.2 how the Proponent complied with condition 2.1;*
- 2.11.3 for conditions set out in this Decision Statement for which consultation is a requirement, how the Proponent considered any views and information that the Proponent received during or as a result of the consultation, including a rationale for how the views have, or have not, been integrated;*
- 2.11.4 the information referred to in conditions 2.5 and 2.6 for each follow-up program;*
- 2.11.5 the results of the follow-up program requirements identified in conditions 3.14, 3.15, 3.16, 4.5, 5.5, 6.11, 6.12, 6.13, 6.14, 8.18.6, 8.20.5, 8.21, and 8.22 if required;*
- 2.11.6 any update made to any follow-up program in the reporting year;*
- 2.11.7 any modified or additional mitigation measures implemented or proposed to be implemented by the Proponent, as determined under condition 2.9 and rationale for why mitigation measures were selected pursuant to condition 2.5.4; and*
- 2.11.8 any change(s) to the Designated Project in the reporting year.”*

DS Condition 2.12 requires: *“The Proponent [BW Gold] will provide the draft annual report to Indigenous groups, no later than June 30 following the reporting year to which the annual report applies. BW Gold will consult Indigenous groups on the content and findings in the draft annual report.”*

DS Condition 2.13 requires: *“The Proponent [BW Gold], in consideration of any comments received from Indigenous groups pursuant to condition 2.12 shall revise and submit to the Agency [Impact Assessment Agency of Canada] and Indigenous groups a final annual report, including an executive summary in both official languages, no later than September 30 following the reporting year to which the annual report applies.”*

DS Condition 2.14 requires: *“The Proponent [BW Gold] shall publish on the Internet, or any medium which is publicly available, the annual reports and the executive summaries referred to in conditions 2.11 and 2.13.*

The Proponent shall keep these documents publicly available for 25 years following the end of decommissioning of the Designated Project. The Proponent shall notify the Agency and Indigenous groups of the availability of these documents within 48 hours of their publication.”

DS Condition 2.15 requires: *“When the development of any plan is a requirement of a condition set out in this Decision Statement, the Proponent [BW Gold] shall submit the plan to the Agency and to Indigenous groups prior to construction, unless otherwise required through the condition.”*

8. SUMMARY

The follow-up programs herein have been developed to fulfill DS condition 3.16. This condition pertains to monitoring the littoral fish habitat in Tatelkuz Lake before Operations, monitoring the littoral fish habitat in Tatelkuz Lake during Operations, and monitoring lower Chedakuz Creek during all Project Phases. The follow-up programs cover data collection during pre-construction (2021-2022), through to decommissioning.

Information from these programs will be used for comparison during long-term monitoring over the life of the Project to determine the accuracy and effectiveness of mitigation measures, as set out in Condition 2.9. Depending on the long-term monitoring results compared with threshold values for the monitoring metrics used, modified or additional mitigation measures may be required in conjunction with subsequent monitoring.

9. REFERENCES

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