Tulsequah Chief Mine Water Quality Monitoring Plan – 2021 (Year 2)

Ministry of Energy, Mines and Low Carbon Innovation

SLR Project No: 204.03386.00000

May 7, 2021

TULSEQUAH CHIEF MINE WATER QUALITY MONITORING PLAN – 2021 (YEAR 2)

TULSEQUAH CHIEF MINE

ATLIN, BRITISH COLUMBIA

SLR Project No: 204.03386.00000

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May 7, 2021

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1.0 INTRODUCTION AND OBJECTIVES

SLR Consulting (Canada) Ltd (SLR) was retained by the Ministry of Energy, Mines and Low Carbon Innovation (EMLI) to develop and implement a water quality monitoring plan (WQMP) for the Tulsequah Chief Mine (TCM). On April 9, 2021 SLR met with EMLI and Taku River Tlingit First Nation (TRTFN) to discuss the draft WQMP (Version 1), specifically ensuring collaboration with TRTFN, reviewing the number of sampling sites and locations, collection of discharge data, and schedule. In addition, based on the discussion, two addendums to the 2021 WQMP program will be provided at a later date for EMLI's consideration. This draft report (Version 2) presents the WQMP for 2021 (Year 2).

The Tulsequah Chief Mine (herein referred to as the site) is located approximately 120 kilometres (km) south of Atlin, British Columbia (BC) and 65 km northeast of Juneau, Alaska on the east bank of the Tulsequah River (Drawing 1). The site is in the traditional territory of the TRTFN. Historical mining activities occurred at the site by Cominco between 1947 and 1957, which left a legacy of acid rock drainage (ARD) issues (SRK Consulting (SRK) and SNC Lavalin (SNC), 2020). Cominco closed the mine in 1957 and it lay dormant until 1987 when Cominco entered a joint venture with Redfern Resources Ltd. (Redfern), who became sole owner in 1992 (SRK and SNC, 2020). Between 1987 and 2009 operational activities were executed by Redfern and included various pre-mine development and exploratory drilling activities. In 2010, the site was acquired by Chieftain Metals Ltd., whose operational activities also included various pre-mine development and construction activities, including the construction of a water treatment facility but did not bring the mine into production. In June of 2015 the site entered long term care and maintenance.

The Tulsequah River is the primary receiver of mine water discharges from the Tulsequah Chief Mine both during its operational phases and now. Risks to the aquatic environment caused by the mine have been a long-standing concern and were characterized by SLR through the completion of an aquatic ecological risk assessment (AERA) (2017). The 2017 AERA evaluated the potential impacts and risks to aquatic receptors within the Tulsequah River in four zones that included the mainstem, braided channels and tributaries surrounding the mine site. SLR predicted potential unacceptable risks to aquatic life for the area immediately adjacent to the Tulsequah Chief Mine discharge point (i.e., from the Lower Workings) to approximately 2.5 km downstream within the mainstem and side channels of the Tulsequah River.

In 2020, SLR, and its team partner, Minnow Environmental Inc. (Minnow) were awarded a five year contract by the EMLI to develop and implement a program to assess and monitor the requirements and the effectiveness of the proposed Closure and Remediation Plan (SRK and SNC, 2020) at the site, and to address potential risks to aquatic life in the Tulsequah River and Camp Creek (i.e., receiving environment). The overall program is comprised of four main tasks:

1. Development and implementation of a water quality monitoring program (WQMP) for the receiving environment;
2. Development and implementation of an aquatic effects monitoring program (AEMP) for the receiving environment;
3. Development of science based environmental benchmarks for the Tulsequah River downstream of the site discharges; and
4. Development of post remediation water quality monitoring program (PRMP) and recommendations for further work.

As part of the first year of the existing contract, our team has completed the current report that presents the 2021-2022 WQMP workplan and budget for the site. The WQMP will be implemented in May 2021 (Year 2 of the project), and will be conducted each year until the end of year 2024, and will provide information on changes in water quality over the period during which the remedial measures are implemented at the site. The WQMP design and associated costs may vary in any given year and may be refined based on the results and the needs of the overall program (e.g., baseline characterization, derivation of SBEB, AEMP support).

The main objectives of the 2021 WQMP are to:

- Characterize water quality in the Tulsequah River upstream and in receiving waters downstream of any mine influence and in key tributaries (Camp Creek, Shazah Creek and Rogers Creek) to support the derivation of the SBEB and to support future reclamation activities and mine water discharge options;
- Collect sufficient data in the mainstem at historical sampling locations (W10, W46, W51 and W32) to assess temporal and seasonal trends in contaminants of potential concern (COPCs); and
- Characterize water quality in mainstem and side channel habitats to support the AEMP in determining whether water quality within the Tulsequah mainstem and side channels, downstream of the mine discharges, negatively affects the aquatic receiving environment.

2.0 SUMMARY OF BASELINE WATER QUALITY CONDITIONS

The first task completed by SLR to support the development of the WQMP was to compile the existing surface water quality data for both the receiving environment and effluent discharges into a database and prepare a water quality characterization report. This task was completed in February 2021 and the findings have been presented to EMLI under separate cover (SLR, 2021). A summary of the main findings is presented below.

Surface water quality data for both the receiving environment and effluent discharges (e.g., reports, datasets, laboratory analytical reports) were provided to SLR by BC EMLI. Data provided to SLR by BC EMLI was uploaded from the Tulsequah Chief Water Quality database (2005-2020), which included data provided by the TRTFN (2019 and 2020) and data provided from the BC and Alaska Joint Water Quality Program for Transboundary Waters (2017-2018). In addition, data compiled in 2016 as part of the AERA (SLR 2017) and data collected by SNC Lavalin (rev1 data 2019-2020) was also incorporated into the database.

The available effluent and surface water data were compiled into a project specific ESdat database. Effluent data were available for a total of 218 samples collected from 4 sampling locations. Surface water data for the receiving environment were available for a total of 907 samples obtained from 85 sampling locations.

The surface water samples entered in ESdat were analyzed for one or more of the following parameters or groups of parameters: pH, hardness, total suspended solids (TSS), dissolved organic carbon (DOC), alkalinity, major anions, nutrients and total and dissolved metals. The surface water quality data were compared to the long-term British Columbia Ministry of the Environment and Climate Change Strategy (ENV) or Canadian Council of Ministers of the Environment (CCME) water quality guidelines (WQGs) for the protection of aquatic life to COPCs.

The following 22 parameters exceeded the applicable guidelines and were identified as COPCs: pH, fluoride (F), nitrate (as N), sulphate (SO4), aluminum (Al), antimony (Sb), arsenic (As), beryllium (Be), cadmium (Cd) chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), selenium (Se), silver (Ag), thallium (Tl), uranium (U) and zinc. Among these COPCs, aluminum (total & dissolved), total chromium, dissolved copper, total iron and total zinc had the highest frequency of exceedances (>50%) in source waters (Zone 1), which suggests that a portion of the metal loadings to the Tulsequah River are derived from natural sources.

Downstream of the site in all exposure Zones (2, 3, 4) aluminum, chromium, copper, iron, mercury and zinc had a greater than 50% frequency of exceedances. The highest frequency of COPC exceedances (100%) was observed for aluminum (total & dissolved), cadmium, copper iron, lead, zinc (total & dissolved) and fluoride in the effluent zone with a greater than 75% frequency of exceedances observed for pH, arsenic, beryllium, chromium, cobalt, dissolved iron and mercury.

An analysis of seasonal variation could only be conducted for five key mainstem locations (W10, W46, NMW, W51 and W32) for which sufficient data was available. Analysis indicated that generally the concentrations of COPCs were lowest during the winter and spring and highest in the summer and fall. A summary of temporal trends in the mainstem showed that the concentrations of some COPCs showed increasing trends in all zones including aluminum, chromium and iron. Dissolved copper showed no trend or a decreasing trend, as did dissolved zinc, selenium and sulphate.

A high level of uncertainty was associated with the spatial and temporal data resolution due to the fact that:

- There are a limited number of samples with DOC results in both the mainstem and side channel locations. The updated BC WQG for dissolved copper require DOC to calculate the WQG value. In the absence of DOC the lowest default DOC is used. This likely results in an overly conservative WQG value for dissolved copper;
- Chromium in water occurs as trivalent or hexavalent forms as reflected by the water quality guidelines referring to these two forms of the metal. The surface water samples in the ESdat database were analyzed for total chromium and conservatively compared against the lower BC WGQ for hexavalent chromium. Consequently, there is a high level of uncertainty with using the total chromium data to represent hexavalent chromium concentrations in surface water; and
- There was a limited number of samples with TSS data, particularly in the mainstem locations, however samples containing the highest metal concentrations appear to be associated with elevated TSS; correlations between TSS and metals should be further evaluated.

It was also apparent in the assessment of the baseline data that there was a lack of data collected in the side channel areas where receptors of concern (fish and benthos) would reside. Gartner Lee (2007) identified that much of the Tulsequah River mainstem was a migration corridor providing temporary refuge habitat for salmonids and other local fish species. The mainstem did not provide high value habitat such as rearing or spawning habitat (Gartner Lee 2007). However, there were seasonally defined, clear water side channels along some sections of the Tulsequah River floodplain, mostly located south of the site on the west side of the river valley but some are located on the east side and downstream of the site. The Gartner Lee (2007) report did not provide an evaluation of habitat quality within side channels located along the eastern portion of the Tulsequah River, adjacent to the site. However, SLR investigated the side channel habitat along the east banks of the Tulsequah River during the AERA adjacent to the site in 2016 (SLR, 2017). Clear water side channels can (but not always) consist of pool, riffle and glide type habitat and provide stable habitat throughout much of the year. These two distinct aquatic environments offer different types and quality of habitat for both resident and migratory fish. Both Gartner Lee (2007) and SLR's (2017) evaluation of the habitat agreed that compared with the mainstem, the clear water side channels have the potential to provide higher quality fish habitat. Both mainstem and side channel habitats need further examination during the WQMP and the AEMP.

The recommended approach that SLR proposes for addressing these limitations and to meet the main objectives of the WQMP is presented in Section 3.0 below.

3.0 MONITORING PROGRAM

The 2017 AERA (SLR, 2018), the baseline surface water quality report (SLR, 2021), the Closure and Reclamation Plan for the Tulsequah Chief Mine Site (SRK and SNC, 2020) and the Tulsequah River Aquatic Monitoring Plan (TRTFN, 2020) along with historical mine aquatic studies conducted by Gartner Lee (2007, 2008) were consulted in the development of the 2021 WQMP. A description of the locations, sampling frequency and methodology are presented in Sections 3.1 to 3.5.

3.1 Selected Monitoring Locations

The primary focus of the WQMP is to continue monitoring COPC concentrations in both the mainstem and side channels within the four key exposure zones of the Tulsequah River (see Drawing 2). Sampling is also proposed to obtain additional water quality characterization for Camp Creek, Rogers Creek and Shazah Creek for development of the SBEB background concentrations and/or to inform closure and reclamation activities that may be associated with Camp Creek and Rogers Creek (SRK and SNC, 2020). The seven areas proposed for sampling include the following:

- <u>Zone 1</u> – *Reference Zone* is immediately North of all mine related sources. It should be noted that a tailings storage facility was proposed in zone 1, east of Shazah slough during Mine operation. Also, located in zone 1 is a camp, airstrip and fuel tanks. Tailings have never been placed in the proposed tailings storage facility location nor will they be during closure and reclamation of the site.
- <u>Zone 2</u> – *Zone of Discharge* is surrounded by the main portion/infrastructure associated with the site that contains the water treatment plant, waste rock, portals, and exfiltration pond.
- <u>Zone 3</u> - *Impacted Near Zone* is approximately 1 km south of the mine and contained the proposed waste rock storage area for the site for potentially acid generating (PAG) and non-acid generating (NAG) waste rock piles. Discussions with EMLI on April 16, 2021 clarified that although it was the intent of the Mine to move waste rock to these locations, that waste rock had never been moved to zone 3. The waste rock found at the site remains in place within zone 2. It also includes the confluence of Rogers Creek with the Tulsequah River. This zone was identified as having the potential for the largest number of receptors / highest quality habitat of the impacted zones.
- <u>Zone 4</u> – *Impacted Far Zone* is approximately 2.5 km south of the mine and is the farthest downstream receiving environment assessed in the 2016 AERA. It includes Rogers Slough, fed by the Tulsequah River and characterized by high quality fish habitat for both resident and migratory fish.
- <u>Shazah Creek</u> - is a first order tributary within Zone 1 and a reference creek for developing the SBEB. The creek also flows from the upper slopes of Mount Eaton in the north end of the mountain (approximately 12.5 km) into Shazah Slough and Shazah Wetland and eventually to the

Tulsequah River just south of the airstrip. Shazah Creek and the wetland/slough complex have been characterized as high-quality fish habitat.

- Camp Creek - Flows from the central upper slopes of Mount Eaton within Zone 2 (approximately 2.54 km) past the upper workings and connects with unnamed creek, cascading down a steep slope with many waterfalls past the 5900 level and lower workings (5400 and 5200 adits) before discharging to the Tulsequah River. It is believed that the upper level workings (5900 adit, 6400 portal and 6500 portals) discharge water containing COPCs overland into Camp Creek (SRK and SNC, 2020). Camp Creek has been identified as one of the options considered for site water discharge from the upper and lower underground workings.
- Rogers Creek – Flows from the upper slopes on the south end of Mount Eaton within Zone 3 (approximately 4.25 km), cascading down a steep slope with many waterfalls between the proposed historical non-acid generating (NAG) and potentially acid generating (PAG) waste rock locations. The lower end of the creek may provide fish habitat, but it is unlikely to extend beyond 500 m east of the Tulsequah River as barriers to fish movement appear to exist.
- Effluent zone- includes the 5200 and 5400 portal outflows; the exfiltration pond (SE-2) which receives contaminated water from 5200 and 5400 portals, waste rock piles, and surface site run-off.

The 2021 sampling locations are presented below in Table 1, and on Drawings 3 to 7. Up to six sampling locations are proposed within each zone. Many of these sampling locations were identified as a top priority in the 2020 TRTFN AMP monitoring plan and continue to remain high priority sampling locations. The 2021 WQMP will complement the current TRTFN AMP program and ongoing discussions will occur with the TRTFN which may result in revisions to the proposed sampling locations in future monitoring years to reduce duplication of effort. Based on our most recent discussions with TRTFN, EMLI and ENV regarding expectations for the SBEB, and closer examination of the details within the Closure and Reclamation Plan (2020), the final WQMP has been revised to meet all study objectives with a high level of confidence that sufficient data will be collected for developing the SBEB and to inform EMLI about future discharge options in all seasons in this complex and unique environment. In developing the WQMP, attempts have been made to choose key historical locations in the mainstem in each exposure zone (W10, W46, W51 and W32) that were initially established by Tulsequah Chief Mine (formerly Redfern Mine), are still accessible, and are unlikely to be moved as a result of climate events, construction, operation and/or closure activities, and should increase the likelihood of repeatability over time. However, a key focus of the WQMP is to collect samples within exposure zones, so that if a location does move over time, the data will remain representative of that particular zone. If new side channels become evident during the program in 2021, alternative locations may be required and will be chosen in consultation with TRTFN and EMLI to support the original sampling rationale. The revised and final WQMP sample locations for 2021 are provided in Table 1 and sample locations are provided in Drawings 3 to 7.

Two sampling locations have been proposed in the mainstem (W10/Tul-00, SW21-1) and one in the side channel (SW21-2) upstream of mine influences in Zone 1. One of the stations (W10/Tul-00) is a historical station that will build upon the existing database and allow for ongoing trend analysis. To capture any influences from the lime sludge pit, fuel storage and airstrip area, one station has been placed immediately downstream of the area (Tul-03). Two side-channel locations SW16-1 and Tul-06/SW16-3 have been identified in Zone 1 where side channel aquatic habitat has been observed. This data is high priority to the TRTFN and will assist with the development of the AEMP and will further our understanding of the side channel characteristics and allow for reference comparisons to side channels downstream of the site. The remaining sampling locations in all exposure zones downstream of the site include one historical station which will continue to build upon the existing database and allow for trend analyses to be conducted at two or three sampling locations, as presented in Table 1. Sample locations are intended to characterize COPC concentrations in mainstem and high-quality side channel habitat where aquatic ecological receptors (e.g., fish and benthos) spend the majority of their time. Most side channels were situated along the east bank of the Tulsequah River that appear to be most influenced by the site, and therefore warrant additional characterization in 2021.

Information on baseline water quality is limited in the key tributaries surrounding and/or interacting with the mine site. Shazah Creek, Camp Creek and Rogers Creek have been identified as waterbodies of interest for background water quality in locations upstream of mine influence during the WQMP. In addition, sample locations downstream of mine influence, particularly in Camp Creek have been included to assess potential impacts from surface runoff and seepage from underground workings and to assess water quality to support future reclamation activities and mine water discharge options. The reference locations in the creeks will be valuable for the development of the SBEB to assess natural background concentrations of COPCs and will be used to inform future reclamation activities and discharge options at the site. To accommodate this need, additional sampling locations are proposed in the three creek locations described below (Table 1, Drawings 3 to 6).

Shazah Creek is one of the largest tributaries originating from the top of Mount Eaton on the north end of the mountain (Drawing 3). The creek appears to have a more moderate gradient in comparison to other creeks in the area that interact with the site. It has also been identified as a key tributary for high quality fish habitat in the study area (Gartner Lee, 2007). The creek also flows through a slough and wetland area before crossing the airstrip access road to where it discharges into the Tulsequah River just downstream and south of the airstrip. Two sampling locations have been proposed in Shazah Creek. Location W27 established in the historical database, has been identified as an important reference site for examining natural concentrations in COPCs located above any mine influence in the preliminary development of the SBEBs. Tul-16 was established by the TRTFN as a reference site that also would capture any influences from the airstrip/ access road and may provide an indication of whether water quality is altered downstream of the Shazah Slough or Shazah Wetland complex.

A total of four sample locations have been proposed in Camp Creek (Table 1, Drawing 4) in order to obtain a better understanding of the potential impacts associated with the future use of Camp Creek as an optional discharge location, as proposed by the SNC closure plan. One station has been proposed upstream of any mine influence and is a reference location (CC-04) which can also be used in the development of the SBEB, CC-03 is located downstream of the upper workings (6500, 6400 level portals), CC-02 is located downstream of the 5900 level Adit, and CC-01 is located in the lower portion of Camp Creek before Camp Creek discharges to the Tulsequah River. It is SLR's understanding that water quality samples collected in Camp Creek are limited to the upper workings, and uncertainties regarding water quality, flows and assimilative capacities in the creek have not been addressed. While field crews are collecting samples, observations of aquatic receptors will be noted and the AEMP will confirm whether this creek is fish bearing as part of the 2022 AEMP program. The combination of water quality and AEMP data will facilitate ongoing monitoring of potential risks to aquatic receptors as remedial activities are carried out at the site and as discharge options are determined.

Rogers Creek was identified as a key tributary of interest by the TRTFN and ENV to investigate the use of the shallow aquifer at the Rogers Creek Fan as a potential future discharge option for consideration. Two sampling locations have been proposed in Rogers Creek. SW21-6 is a reference location upstream of site and access road influence and Tul-17 is located at the mouth of Rogers Creek at the confluence of the

Tulsequah River which would capture any mine influences from Zone 3 in Rogers Creek around the proposed NAG/PAG sites.

SLR and the TRTFN recommends continued monitoring of the effluent. Four main effluent point sources (Drawing 7) have been identified as an important part of the ongoing closure and reclamation sampling program since reclamation options for the site with respect to water management have not yet been determined. Samples should be collected from three previous locations identified as potential sources of COPCs in the Baseline Water Quality report (SLR, 2021) and one that was identified in the Closure and Reclamation Plan (SRK and SNC, 2020). The four locations would include the 5200 Portal, the 5400 Portal, the 5900 Adit and the Exfiltration Pond (SE-2). While baseline data was not collected at 5900 Adit, the Closure and Reclamation Plan Report (2020) did indicate it was high in COPCs and proposed to manage water exiting the 5900 Adit through Camp Creek. SLR believes more data is required on this potential source of contamination arising from the upper workings (5900 Adit).

Proposed sampling locations and the rationale behind their selection are provided in Table 1 and in Drawings 3 to 7. Sampling locations may be adjusted after the first field program depending on the consistency of the results and the ability of the crew to safely access the proposed sampling locations.

Table 1: Revised Summary of Proposed Sampling Locations for the 2021 WQMP at the Tulsequah Chief Mine (TCM) Site

Sample ID		Priority	Area	Rationale	Description
TRTFN WQMP	SLR WQMP	1= High 2=Low			
-	SW21-1	1	Zone 1 (6 locations)	New location, for SBEB and reference comparison for water quality in mainstem	Tulsequah River, Upstream of site W10/TUL00 in mainstem channel – Above TCM and Airstrip
TUL-00	W10	1		Historical station to build upon existing database. Will be used to support SBEB development.	Tulsequah River, Upstream TCM and airstrip (same station as TUL-00) mainstem channel.
-	SW21-2	1		New location, for SBEB & AEMP: To provide reference monitoring locations for higher quality side channel aquatic habitat	Side channel on West bank of Tulsequah River– Above TCM and Airstrip
TUL-03	-	2		To provide WQ data on potential influences from Airstrip and Borrow Pit Area	Tulsequah River mainstem prior to outflow of Shazah Creek immediately downstream of airstrip
-	SW16-1	1		For AEMP: To provide reference monitoring locations for higher quality side channel aquatic habitat	Side Channel West Bank Shazah influence downstream of airstrip and camp.
TUL-06	SW16-3	1		For AEMP: Priority sampling locations of TRTFN inside channel, to continue providing WQ data on critical and unique fish habitat and to guide AEMP sampling design	Side channel of Tulsequah R. important fish habitat feature downstream of clear water channel on west bank. Is clear water in the fall.
-	W27	1	Zone 1 Shazah Creek (2 locations)	For SBEB; reference comparison for water quality in tributaries	Shazah Creek upstream of wetland area
TUL-16	-	2		To assess and monitor potential impacts of TCM in lower portions of Shazah Cr.	Shazah Creek downstream of access road, airstrip, and borrow pit locations

Sample ID TRTFN WQMP	Sample ID SLR WQMP	Priority 1= High 2=Low	Area	Rationale	Description
-	SW21-3	1	**Zone 2** (5 locations)	New location to support characterization of water quality in mainstem upstream of actual mine site	Tulsequah River mainstem downstream of airstrip and camp, but above Camp Cr and TCM
-	SW21-4	2		New location to support characterization of water quality in mainstem adjacent to site	Tulsequah River mainstem downstream of airstrip and camp, adjacent to TCM
TUL-08	-	2		Supports future AEMP - Priority sampling locations of TRTFN and provides TCM monitoring inside channel habitat	Side Channel habitat downstream of WR pile and TCM. Mainstem just downstream as TR combines with effluent
-	W46	1		Historical station to build upon existing database	Tulsequah River mainstem downstream of TCM
-	W11	1		Historical location - Supports characterization of water quality in mainstem downstream of site	Tulsequah River mainstem downstream of TCM
-	CC-01	2	**Zone 2 Camp Creek** (4 Locations)	New location - Supports characterization of water quality in camp creek and informs future AEMP and Closure/Reclamation Options.	Camp Creek upstream of discharge to Tulsequah River and downstream of lower workings and road
-	CC-02	1		New location - Supports characterization of water quality in camp creek and informs future AEMP and Closure/Reclamation Options.	Camp Creek immediately downstream of upper workings influence (6500, 6400 portals) – Upstream of Road
-	CC-03	1		New location - Supports characterization of water quality in camp creek and informs future AEMP and Closure/Reclamation Options	Camp Creek immediately downstream of upper workings influence (5900 Adits) – Upstream of Road.
-	CC-04	1		New location- Supports characterization of water quality in camp creek and informs future AEMP and Closure/Reclamation Options.	Camp Creek Reference upstream of influence of TCM and Upper Workings
TUL- 17	-	2	**Zone 3 Rogers Creek** (2 locations)	Supports water quality characterization in Rogers Creek and informs future Closure/Reclamation Options	Mouth of Rogers Creek
-	SW21-5	1		New location - Supports water quality characterization in Rogers Creek and informs future Closure/Reclamation Options	Rogers Creek upstream of access road to historical NAG/PAG sites

Sample ID		Priority	Area	Rationale	Description
TRTFN WQMP	SLR WQMP	1= High 2=Low			
	SW21-8	1	**Zone 3** (4 locations)	New Location - Supports characterization of water quality in mainstem	Tulsequah River, mainstem upstream of NAG/PAG site, downstream of TCM within eastern channel
-	W51	1		Historical Station to build upon existing database.	Tulsequah River, mainstem along western stem downstream of all TCM, but likely less impacted (effluent will be flowing down the eastern channels)
-	SW16-8	1		Supports characterization of water quality inside channel upstream of NAG/PAG site	Side Channel upstream of Rogers Ck, within mixing area of effluent from mine
TUL-10	-	1		Supports AEMP and is a priority sampling location of TRTFN AEMP to provide TCM monitoring in areas of moderate quality aquatic habitat	Side Channel habitat downstream of WR pile and TCM and adjacent to confluence with Rogers Ck.
-	SW21-6	1	**Zone 4** (5 locations)	New location - Supports water quality characterization in mainstem areas with moderate to high quality aquatic habitat	Mainstem, far downstream of TCM and adjacent to Rogers Slough
TUL-12	-	2		Supports characterization of water quality in mainstem	Tulsequah River, side channel downstream TCM, distinct from main stem in fall.
-	SW21-7	1		New location - Supports water quality characterization inside channel with moderate to high quality aquatic habitat	Side channel, far downstream of TCM site characterization prior to influences from Polaris site
TUL-11	W32	1		Historical station to build upon existing database & perform trend analyses	Tulsequah River, mainstem far downstream TCM (same as Tul 11)
TUL-15 /Taku3	-	1		Priority sampling locations of TRTFN AEMP and Transboundary Study to provide TCM monitoring in areas of high-quality aquatic habitat	Mainstem far downstream of TCM – furthest location in Zone 4 due east of New Polaris site

Sample ID		Priority	Area	Rationale	Description
TRTFN WQMP	SLR WQMP	1= High 2=Low			
-	SE2	1	**Effluent Zone** (4 locations)	Historical location to build upon existing database and to assess current effluent quality	Exfiltration pond receiving input from 5200 level Adit and the 5400 level Adit
-	5200 Adit	2		Historical sampling location to build upon existing database and to assess current effluent quality.	Seepage from lower workings from 5200 level Adit
-	5400 Adit	2		Historical sampling location to build upon existing database and to assess current effluent quality.	Seepage from lower workings from 5400 Adit
-	5900 Adit	2		Historical sampling location to build upon existing database and to assess current effluent quality.	Seepage from upper workings receiving input from 6400 portal, 6500 portal and 5900 adit. Historically seepage discharged into Camp Creek.

Total Number of Samples to be collected = 32 +3 duplicates + 1 Trip blank + 1 Field Blank = 37 samples per event

AMP – Aquatic Effects Monitoring Program
TCM - Tulsequah Chief Mine
SBEB – Science-based Environmental Benchmarks

3.2 Sampling Frequency and Duration

SLR proposes sampling locations in each of the four exposure zones, the effluent zone and in three key tributaries that include Shazah Creek, Camp Creek and Rogers Creek. A total of 32 samples plus QA/QC samples totalling 37 samples will be collected during each sampling event. A higher frequency of sampling locations is proposed in 2021 to properly characterize the concentrations of COPCs in the areas that are ecologically relevant to the aquatic receptors, allow the capture of seasonal differences within each of the exposure zones, and the current effluent quality for closure and reclamation planning.

As mentioned above in Section 3.1, at least one mainstem location in each zone will coincide with a historical site in the database to allow for continued monitoring of trends in COPC concentrations within each exposure zone. Additional sampling locations in the mainstem are proposed within each zone in support of continued characterization and monitoring data and to act as a backup in case one of the key monitoring locations becomes inaccessible in the future due to glacial/ jokulhlaup events.

Initial screening of the baseline data indicated little to no coverage in the less turbulent, side channel habitats with moderate to high quality aquatic habitat. Within Zones 2 and 3, the side channels along the east bank are likely have higher COPC concentrations compared to the mainstem portion of the Tulsequah River. Additional sampling locations in these side channels will guide the development of the AEMP for 2022 and will be used to inform modifications to future sampling programs.

The addition of sampling locations within each zone will provide a more powerful and robust dataset to assess potential differences in COPC concentrations within exposure zones, within ecologically relevant habitats, and will be used to support the derivation of SBEBs. SLR is recommending that water quality in the mainstem continue to be monitored in four key locations consistent with the highest frequency of samples collected in the database including: W10/TUL-00 (Zone 1), W46 (Zone 2), W51 (Zone 3), W32 (Zone 4).

Sampling includes a reduced list of parameters identified in Section 3.4.2 to focus on key COPCs and to reduce laboratory costs as part of the 2021 WQMP program.

Sampling frequency will consider the seasonal variability in water quality and flow in Tulsequah River and the three creeks. If possible, and as part of the three sampling events for the 2021 WQMP, spot flows may be collected at each sampling location. This will include sampling under both high and low flow conditions to capture the glacial outflows and summer jokulhlaup events (if possible and if safe to do so). SLR has proposed four days for sample collection in the spring (May), summer (July) and fall (September) for the first year of monitoring in 2021. SLR may recommend additional sampling events to further characterize COPC concentrations during low flow and high flow conditions, and to assess the potential influences of climate and meteorological data after the first monitoring program in 2021.

3.3 Site Access

SLR proposes using a helicopter (Jetranger – 4 seater) based out of Atlin (BC) to transport field crews daily to and from the site and to access sampling locations. If necessary, helicopters may be equipped with a basket to accommodate additional water coolers and field gear.

3.4 Sampling Methodology

The collection of grab samples for analytical chemistry will follow appropriate sampling procedures outlined in the most recent version of the BC Field Sampling Manual and/or other sampling guidance documents (ENV 2020; CCME, 1998; ECCC, 2012), following ultra-trace techniques. Sample collection will be completed by an experienced field lead from SLR and a supporting field member from the TRTFN.

3.4.1 *In situ* Field Parameters

Standard *in situ* water quality data will be collected at each of the sampling locations using a hand-held portable YSI ProDSS multimeter. Temperature (°C), dissolved oxygen (mg/l and %), conductivity (µS/cm), pH, oxidation-reduction potential (mV) will be collected at each station. Total water depth at the sampling station and spot flows will be measured immediately after collection of samples. In shallow waterbodies ≤ 2 m *in situ* measurements will be collected at mid-depth. All sample locations will be marked and referenced using a Global Positioning System (GPS).

3.4.2 Analytical Chemistry

If possible, sample collection will start from the reference area (least-contaminated site), moving downstream in the Tulsequah River to the most contaminated site (Zone 2, Zone 3, Zone 4, Camp Creek, Rogers Creek, Zone 1, Shazah Creek). Grab samples will be collected in laboratory supplied containers, mid-depth, by hand or with a sampling pole where it is practical and safe to do so. When sampling near the shore, care will be taken to avoid shore effects from back eddies and seepages from near-shore soils and slow-moving water.

Wearing unlined, powder-free latex or nitryl gloves, sample bottles will be triple rinsed prior to collecting the water sample by plunging the bottle under the water with the opening facing directly down and then by immediately orienting it into the current with the mouth facing up-current and away from the sample collectors hand. Samples requiring filtering (dissolved metals and low-level nutrients) will be conducted immediately in the field upon collection using a 0.45 µm membrane and preserved with the appropriate preservative supplied by the lab. Samples will be stored in a cooler during field collections with ice packs and transported daily to Atlin and stored in refrigerators at the TRTFN office until they can be shipped to the Whitehorse Airport and in turn to Bureau Veritas Laboratories (BVL). This will allow for laboratory analysis to meet maximum holding time of seven days for TSS. Other water quality parameters have holding times of 28 days to 180 days. Quality assurance and quality control will be collected at a frequency of 5-10% of the total number of samples collected in each sampling event and will be discussed in greater detail in Section 3.5. The list of selected monitoring parameters is provided below, and associated detection limits are provided in Table 2.

Laboratory Parameters:

- pH (field and lab);
- Conductivity;
- Hardness (as CaCO3; calculated);
- Total Suspended Solids (TSS);
- Major Anions and Nutrients (fluoride, chloride sulphate, Nitrate + Nitrite as N, Total/Dissolved Phosphorus, Total Ammonia (as N);
- Dissolved organic carbon (DOC);
- Trivalent and hexavalent chromium; and
- Total and dissolved metals.

Table 2: Summary of Selected Laboratory Water Quality Monitoring Parameters and Associated Detection Limits

PARAMETER	INSTRUMENT AND/OR LABORATORY DETECTION LIMIT	PARAMETER	LABORATORY DETECTION LIMIT
Physical Parameters		Total & Dissolved Metals	
pH	Reported to 0.01 pH units	Aluminum (Al)	5 µg/L
Temperature	0.5 C	Antimony (Sb)	0.2 µg/L
Specific Conductance	2 µS/cm	Arsenic (As)	0.5 µg/L
Total Hardness (as CaCO3)	1 mg/L	Barium (Ba)	5 µg/L
Total Suspended Solids (TSS)	2 mg/L	Beryllium (Be)	0.1 µg/L
		Bismuth (Bi)	0.5 µg/L
		Boron (B)	5 µg/L
		Cadmium (Cd)	0.01 µg/L
		Calcium (Ca)	50 µg/L
Major Anions		Chromium*(Cr)	Unspeciated: 0.5 µg/L; Hexavalent: 1 µg/L Trivalent 1 µg/L
Alkalinity – Total	1 mg/L	Cobalt (Co)	0.1 µg/L
Fluoride (F-)	100 µg/L	Copper (Cu)**	0.4 µg/L
Sulphate (SO42-)	1000 µg/L	Iron (Fe)	10 µg/L
Chloride (Cl)	100 µg/L	Lead (Pb)	0.2 µg/L
		Lithium (Li)	1 µg/L
		Magnesium (Mg)	100 µg/L
		Manganese (Mn)	0.2 µg/L
		Mercury(Hg)	0. 0001 µg/L
Nutrients		Molybdenum (Mo)	0. 1 µg/L
Nitrite as N	0.02 mg/L	Nickel (Ni)	0.4 µg/L
Nitrate as N	0.02 mg/L	Potassium (K)	100 µg/L
Ammonia Nitrogen	0.02 mg/L	Selenium(Se)	0. 5 µg/L
	Other: 0.005 mg/L	Silicon (Si)	50 µg/L
Phosphorous – Total	In Lakes: 0.002 mg/L	Silver (Ag)	0.05 µg/L
	Other: 0.005 mg/L	Sodium (Na)	100 µg/L
		Strontium (Sr)	0.4 µg/L
Organics		Thallium (Tl)	0.02 µg/L
Dissolved Organic Carbon (DOC)	0.5 mg/L	Tin (Sn)	0.2 µg/L
		Titanium (Ti)	10 µg/L
		Uranium (U)	0.02 µg/L
		Vanadium (V)	4 µg/L
.		Zinc (Zn)**	4 µg/L

* Measure unspeciated first, if >1 µg/L then also measure hexavalent and trivalent.

** The low detection limits indicated for aluminum, copper, and zinc apply to water with <1 NTU turbidity or dissolved analysis.

3.5 Quality Assurance /Quality Control (QA/QC) Program

In Canada, laboratories may seek voluntary accreditations from the Canadian Association for Laboratory Accreditation (CALA) and the Standards Council of Canada (SCC). Both organizations promote high standards of defensibility and scientific excellence through programs that incorporate blind proficiency testing and regular on-site audits of the laboratory's management system. The advantage to the proponent of using an accredited laboratory is being confident that the results of analytical measurements are accurate and precise. All samples will be tested BVL that is accredited to both CALA and ISO 17025 standards as well as upholding other international standards of quality.

Quality assurance and quality control (QA/QC) is important in every aspect of a sampling program from program design through the field work and laboratory analyses and finally to interpretations of results. To assess the reliability and the accuracy of the data collected during the field program, SLR has developed the following QA/QC program for the project:

3.5.1 Sample Collection

All samples will be collected in accordance with the procedures outlined in this sampling plan. All samples are to be uniquely labelled using waterproof labels provided by the lab as per Table 1 of this sampling plan. Each label will contain the sample ID, client/project number, sampling date/time, parameters, and whether the sample was preserved/field filtered or not. Control of the samples will be maintained using laboratory chain of custody forms.

3.5.2 Field Duplicates

SLR will collect field duplicates (or blind field duplicates) during the field program. The purpose of the field duplicates is to assess sampling and analyses precision.

The field duplicate will consist of a second sample collected in the same manner from the same location as the original sample and stored in separate laboratory containers. The sample will be given a unique identifier to prevent the laboratory from being aware of its similar origin. Field duplicates will be collected one for every ten samples (10% frequency) as per standard protocols.

3.5.3 Field and Trip Blanks

The purpose of the analyses of field and trip blanks is to determine if samples may have been cross contaminated or otherwise impacted during transportation between the laboratory and the sites and/or during sampling activities.

Trip blanks are water samples prepared using distilled water placed in laboratory supplied containers prior to departing for the field investigation. The trip blanks will be brought to each location by the field team for the duration of the assessment at each site.

A field blank is similar to a trip blank; however, the sample is not prepared until the field team is on-site and prepared to begin water sampling. One field blank will be collected during each sampling event during the 2021 field program.

3.5.4 Laboratory Quality Control

Laboratory quality assurance/quality control measures will be implemented as part of the water quality programs in 2021 and may include the following measures:

- RPD Between Duplicates - paired analysis of a separate portion of the same sample. Used to evaluate results variability for the same measurement;
- Matrix Spike - a sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference;
- QC Standard - a sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy;
- Spiked Blank - a blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy;
- Method Blank - a blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination;
- Certified Reference Material - a sample with a known concentration of the analytes of interest. Used to assess analytical process and provide information on instrument or calibration issues; and,
- Laboratory Control Sample - a sample with known concentration of analyte in it. Used to assess accuracy.

4.0 DATA ANALYSIS AND REPORTING

SLR will upload the laboratory data directly into the ESdat database as the data becomes available, and prepare a concise, integrated annual report summarizing and characterizing the data collected during the three sampling events in 2021. ESdat is a data management system that can be used to import, analyze and report data. The main function of ESdat is to provide a database containing laboratory analytical results and field information that can be filtered, trends can be assessed, and outputs produced in Microsoft Excel format. ESdat is also able to store spatial data (i.e., coordinates, monitoring zones) to support figures and drawings.

The updated annual WQMP report will include an overview of the program objectives, methods, inventory of all the data collected in 2021, summarize all data available at the time of reporting, and provide an interpretation of the results. The annual report will be used to refine the WQMP for the subsequent monitoring year in 2022 after the first year of data has been assessed. The main components of the final report are discussed in the following sections.

4.1 Summary Statistics

Summary statistics will be prepared for each parameter for the samples within the mainstem portion of the Tulsequah to gain an understanding of all current COPCs and exceedances of the guidelines at the site and will include existing and new data. Summary statistics will also be calculated for reference area (Zone 1), the effluent zone, Creek locations(Camp Creek, Shazah Creek and Rogers Creek) and exposure zones immediately downstream of mine site (Zones 2, 3, and 4). Water quality data will be interpreted in relation to the reference data and/or baseline data.

The following summary statistics will be prepared based on the number of data points:

- Minimum concentration;
- Minimum detection;
- Maximum concentration;
- Maximum detection;
- Average concentration;

- Median concentration;
- Standard deviation;
- 25th, 75th, 90th and 95th percentiles by season (i.e., spring, summer, fall);
- Number of guideline exceedances;
- Number of guideline exceedances (Detects Only);
- Frequency of guideline exceedances; and
- Frequency of guideline exceedances (Detects Only).

4.2 Comparisons to Guidelines

Water quality results will be compared against the most recent WQGs as presented in the Baseline Water Quality Report (SLR, 2021) and includes the:

- BC Approved Water Quality Guidelines for the protection of freshwater aquatic life (AWF) (BC ENV, 2019);
- BC Working Water Quality Guidelines AWF (BC ENV, 2021); and
- Canadian Water Quality Guidelines AWF (CCME 1999 and updates).

The comparisons to the above WQGs will confirm/refine the COPCs identified in the baseline surface water quality report (SLR, 2021).

The data collected in 2021 will support the application of a site-specific dissolved copper guideline (using site-specific DOC) and will confirm whether trivalent or hexavalent chromium are COPCs. The data will also allow for correlation analysis of TSS with the COPCs, determine if TSS plays a significant for elevated COPC concentrations downstream of the site, and determine which COPCs are most sensitive to TSS.

Water quality parameters analysed in the creeks will be compared to guidelines to determine if any of the key COPCs are present and/or elevated. It will be critical to characterize the quality of the water in the creeks and all effluent sources on site prior to remediation activities. It is anticipated that the additional data collected during the 2021 WQMP will support preliminary SBEB derivation.

4.3 Trend Analysis

Trends in COPC concentrations will be evaluated for the surface water data collected from the historical stations in the mainstem (W10, W46, W51 and W32) using the seasonal Kendall test. Although the Kendall test can account for some minor gaps in data collection, trend analysis is far more effective and statistically rigorous when continuous, monthly monitoring is conducted at consistent sampling locations with longer periods of record (Meals et al., 2011).

The seasonal Kendall test is a non-parametric test that determines if there is a monotonic (single-direct) trend in COPC concentrations at a station over time. This analysis tests the null hypothesis of no trend against the alternative hypothesis of a significant trend and was used to identify COPC concentration trends over time at each surface water sampling station. To deal with differences between seasons, the test separately tests for trends in each season, and then combines the results into one overall test. Results assess whether there is a trend over time for a particular station, blocking out seasonal differences in the pattern of change (Helsel and Frans 2006).

Univariate seasonal Kendall tests will be computed for each COPC at each of the five stations using 'AESscripts' package provided by Practical Stats LLC in R statistical software (R Core Team 2020). Results of the tests are signified by S, tau, p-value, intercept, and slope, which are interpreted to indicated if a

COPC concentration at a station is significantly increasing or significantly decreasing over time irrespective of seasonal influence. A result of no trend will indicate that concentrations cannot be determined as either increasing or decreasing over time with statistical confidence.

Boxplots will also be prepared for select COPCs using R Core Team 2020 to visually present seasonal trends. The boxplots will be used to display the data distribution within each season. Each boxplot will present the 25th percentile (bottom of the box), the median (middle line in the box), the 75th percentile (top of the box), and whiskers (two lines outside the box that extend to the highest and lowest observations).

4.4 Data Quality Assessment (QA/QC)

A data quality assessment will be conducted to determine whether the quality control measures met the current data quality objectives (DQOs) of the study. The DQOs will be met when: the result of the relative percent difference (RPD) between lab/field duplicates are less than 20%; when method blanks, field blanks and trip blanks are within 5% of the detection limit of the sample; when certified reference material recoveries are between 80-120%; when laboratory control sample recoveries are between 75-125%; when matrix spike recoveries are between 80-120%; when quality control standards are between 70-130%; and when spiked blanks are between 80-120%.

5.0 SCHEDULE

A spring (May), summer (July), and fall (September) WQMP sampling event will be conducted in Year 2 (2021). Each sampling event will require four days to collect the 37 samples from the five proposed areas.

WQMP data collected from 2021 will be reported in an annual summary report submitted by November 30th, 2021.

The WQMP workplan for Year 2 was developed based on the compilation of historical water quality data between 2005 – 2020 in the Tulsequah Chief Mine Baseline Water Quality Report (SLR 2021). Preparation of Year 3 WQMP and AEMP workplans and budgets will incorporate additional data collected during the monitoring program conducted by TRTFN in 2020/2021 and the WQMP annual summary report for Year 2. The WQMP workplan and budget will be submitted on February 28, 2022. The AEMP workplan will be submitted on January 30, 2022 and will be implemented over the three-year period from 2022 (Year 3) to 2025 (Year 5).

The SBEB workplan will be prepared in 2021 (Year 2) and submitted by March 15, 2022, incorporating results from Year 1 of the WQMP.

The schedule to complete the WQMP and submission of deliverables during Year 2 is provided in Table 3.

Table 3: Program task and deliverables for Year 2

Task	Program tasks / deliverables	COMPLETION Date
A-1 A-2 A-3	Site Visit WQMP Spring Freshet Site Visit WQMP Summer Site Visit WQMP Fall	May/early June 2021 July 2021 September 2021
B	WQMP Annual Summary Report	Nov 30, 2021
C	Year 3 WQMP Workplan and Budget	February 28, 2022
D	Aquatic Effects Monitoring Program (AEMP) workplan	Jan 30, 2022
D	Science-Based Environmental Benchmarks (SBEB) workplan	Mar 15, 2022

All deliverable documents (draft and final) will be provided electronically for EMLI and relevant stakeholder review.

6.0 BUDGET AND ASSUMPTIONS

The estimated cost for Year 2 of the 5-year Water Quality Monitoring Program (WQMP) is **$245,165**, excluding taxes. The estimated costs are presented in Table 4. If requirements change during the work, SLR will bring this to EMLI's attention and seek prior approval for any changes to the cost and/or scope of work.

In developing the WQMP workplan in Year 2 the following assumptions have been made:

- Hourly rates from Schedule "B" – Fees and Expenses were used as per contract GS21MAN0028;
- In addition to the select equipment expenses approved in contract GS21MAN0028, the budget for Year 2 includes the use of a YSI ProDSS 4 m Cable and Sonde (pH/Conductivity/DO/Temperature/ORP/Turbidity) that rents for $157/day or $450/week and a Flow Probe- FH950 Flow Meter and wading rod for $113/day or $352.00/week;
- Helicopter flights in/out of the site have been costed using a 4-seater Bell 206 Jetranger from Discovery Helicopters that can accommodate a maximum passenger (excluding pilot) and gear load of 1000 pounds and uses 114 litres of fuel per hour. Helicopter costs per hour of flight time are based on 2021 rates of $1175 per hour with a 3-hour minimum. WQMP site visits will require the helicopter to remain with the crew on site to move the crew to sampling locations on the Tulsequah River and Camp Creek. Helicopter costs do not include extra hold time charges. Included in the current budget are 3 hours of helicopter time and 3 hours of fuel per day of sampling;
- Helicopter fuel is based on a cost of $1.60 per litre and includes a mix of fuel obtained in Atlin and from tanks already at the mine site. Costs to drop fuel at the mine site are excluded. As per SLR's communication with Discovery Helicopters Ltd. fuel is normally delivered to the mine site;
- All WQMP field work will be conducted by personnel from the Whitehorse, YT office in 2021 (Year 2);
- Hotel costs apply to one SLR crew member not based out of Atlin, assumed 3 nights per sampling event in the spring, summer, and fall;
- Truck rental costs are from Whitehorse airport to Atlin;
- Each site visit (i.e., spring, summer, fall) for the WQMP will be conducted over four 10-hour field days, resulting in 12 days (120 hours) to complete the WQMP in Year 2. Field crew composition will consist of one experienced SLR staff member (Lana van Veen) and one TRTFN member. Lana is a Senior Scientist in SLR's Whitehorse office. Lana supervised and ran the environmental program at the

Tulsequah Chief and Skukum Mine sites, including water quality sampling from both surface and groundwater, hydrology and environmental effects monitoring. Lana's hourly rate will be $149.35. TRTFN costs have been budgeted at $80 per hour;

- There are 20 sampling locations in the Tulsequah River, four in the effluent zone and eight sampling locations in Shazah, Camp, and Rogers creeks. During each of the three field events, 32 samples will be collected plus three field duplicates, one field blank and one trip blank, totalling 111 samples;
- BVL has a depot in Whitehorse and therefore costs were included for shipping samples from Whitehorse;
- Shipping costs are from either Whitehorse airport via Air Canada Cargo or from Atlin to Air Canada Cargo (via courier) to BVL laboratories/suppliers in Vancouver;
- Flight delays and other costs incurred due to extreme weather have been excluded. Similarly, allowance has not been made for extreme weather preventing safe sampling;
- Our team has included a total of two 1-hour meetings at the AEMP design stage, six 1-hour team meetings throughout Year 2, and four 1-hour meetings to discuss SBEB. All meetings will be virtual;
- Historic AEMP data is in a format that can be manipulated and integrated into a project specific database, therefore, no additional costs are proposed to manipulate this data within the current budget;
- Costs include a 3% administration fee, 5% expense mark-up, and a 3% BVL laboratory mark-up;
- All reporting will be authored by SLR's Water Quality Specialists, Celine Totman and Lisa Ramilo, to maintain consistency and familiarity with the project requirements with support from team members with local experience and knowledge of the water quality database. If there is a change in personnel, SLR will advise EMLI and provide resumes to support the substitution.
- It should be noted that access to Camp Creek, especially above the upper workings, may present a substantial challenge for field collections and the safety of the crew will always take precedence over sample collection.

Table 4. Tulsequah Chief Mine WQMP Detailed Budget 2021 (Year 2)

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Project Role	Personnel	Rate	Billing Level	Hours	WQMP Site Visits (Spring, Summer, Fall)	WQMP Annual Summary Report	SBEB, WQMP Workplan and Budget	AEMP Design Plan	Effluent Sampling	Total All Tasks
PROFESSIONAL FEES										
SLR	Cindy Ott	$243.08	13	12.0	1.0	5.0	5.0	1.0		$2,916.96
SLR	Celine Totman	$187.46	9	116.0	4.0	16.0	88.0	8.0		$21,745.36
SLR	Lisa Ramilo	$187.46	10	98.0	10.0	40.0	40.0	8.0		$18,371.08
SLR	Joline Widmeyer	$173.04	8	43.0	5.0	15.0	15.0	8.0		$7,440.72
SLR	Lana van Veen	$149.35	6	228.0	152.0	43.0	33.0			$34,051.80
SLR	Caitlin Blair	$134.93	5	80.0		40.0	40.0			$10,794.40
SLR	Nancy Elliott	$173.04	8	66.0	20.0	18.0	18.0	10.0		$11,420.64
SLR Technical Support	Annabel Till	$85.00	2	20.0		10.0	10.0			$1,700.00
SLR	David Wilson	$209.09	11	0.0						$0.00
TRTFN	Jackie Caldwell	$100	#N/A	30.0	10.0	6.0	6.0	8.0		$3,000.00
TRTFN	Field Technician	$80	#N/A	120.0	120.0					$9,600.00
TRTFN	Field Technician	$80	#N/A	0.0						$0.00
Minnow	Pierre Stecko	$185	#N/A	24.0				24.0		$4,440.00
Minnow	Katharina Batchelar	$130	#N/A	60.0				60.0		$7,800.00
Minnow	Jeff Row	$140	#N/A	8.0				8.0		$1,120.00
Minnow	Patrick Shaefer	$110	#N/A	36.0				36.0		$3,960.00
Minnow	Sarah Latimer	$75	#N/A	16.0				16.0		$1,200.00
	Technical Support Position	$85	#N/A	16.0				16.0		$1,360.00
				Professional Fees Subtotal	***$40,495***	***$30,693***	***$42,696***	***$27,037***	***$0***	***$140,920.96***
DISBURSEMENTS & EXPENSES										
	Item	**Rate**	**Unit**	**Quantity**	**ENTER EXPENSE AMOUNTS EXCLUDING TAXES**					
Mobilization	Travel (charge per km)	$0.55	km	1200.0	1200.0					$660.00
	Per Diem Full Day	$52.00	full day	24.0	24.0					$1,248.00
	Truck rental and gas costs	$1,200.00	per week	4.0	4.0					$4,800.00
	Overnight Accommodation	$200.00	day	12.0	12.0					$2,400.00
				Mobilization Subtotal	***$9,108.00***	***$0.00***	***$0.00***	***$0.00***	***$0.00***	***$9,108.00***
Equipment	Minnow Equipment Rental	$500.00	per day	0.0						$0.00
	Flow Meter	$350.00	week	3.0	3.0					$1,050.00
	YSI ProDSS (pH,cond,DO/temp/ORP/turbidity	$450.00	week	3.0	3.0					$1,350.00
				Equipment Subtotal	***$2,400.00***	***$0.00***	***$0.00***	***$0.00***	***$0.00***	***$2,400.00***
Expenses	Ice	$5.00	bag	16.0	16.0					$84.00
	Filters	$420.00	case of 72	4.0	4.0					$1,764.00
	Sample Courier - Air Canada Cargo from Whitehorse	$500.00	each	3.0	3.0					$1,575.00
	Discovery Helicopter 4 seater Jetranger ($1175/hr)	$3,525.00	3 hrs fly time/day	12.0	12.0					$44,415.00
	Helicopter Fuel Cost (114L per hr @ $1.60 per L)	$547.00	3 hrs fly time/day	12.0	12.0					$6,892.20
	Sample Courier from Atlin to Whitehorse Airport	$500.00	each	3.0	3.0					$1,575.00
				Expenses Subtotal (includes 5% markup)	***$56,305.20***	***$0.00***	***$0.00***	***$0.00***	***$0.00***	***$56,305.20***
				Disbursements & Expenses Subtotal	***$67,813.20***	***$0.00***	***$0.00***	***$0.00***	***$0.00***	***$67,813.20***
BVL LABORATORY COSTS (5-Day TAT unless otherwise specified)										
	Analysis	**Fee**	**Unit**	**Samples**	**ENTER INVOICE AMOUNTS EXCLUDING TAXES**					
Water Analyses	Metals CCME (Aquatic Life) including Hg, Hardness (water), pH (soil)	$90.50	each	222.0	198				24	$20,693.73
	Chromium, Hexavalent	$20.10	each	111.0	99				12	$2,298.03
	Anion Package (Bromide, Chloride, Fluoride, Nitrate, Sulphate)	$47.15	each	111.0	99				12	$5,390.66
	Carbon, Dissolved Organic (DOC)	$18.85	each	111.0	99				12	$2,155.12
	Nitrogen, Ammonia	$15.10	each	111.0	99				12	$1,726.38
	Phosphorous, Total	$18.85	each	111.0	99				12	$2,155.12
	Solids, Total Suspended (TSS)	$12.60	each	111.0	99				12	$1,440.56
	Container Supply and Non-hazardous Disposal Fee	$5.00	Per Sample	111.0	99				12	$571.65
				BVL Laboratory Subtotal	***$32,492.74***	***$0.00***	***$0.00***	***$0.00***	***$3,938.51***	***$36,431.25***
PROJECT TOTAL (Time & Materials basis, excluding Taxes)					**$140,801**	**$30,693**	**$42,696**	**$27,037**	**$3,939**	**$245,165**

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8.0 STATEMENT OF LIMITATIONS

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1. Tulsequah WQMP Year 2-4 May 2021-Final.docx

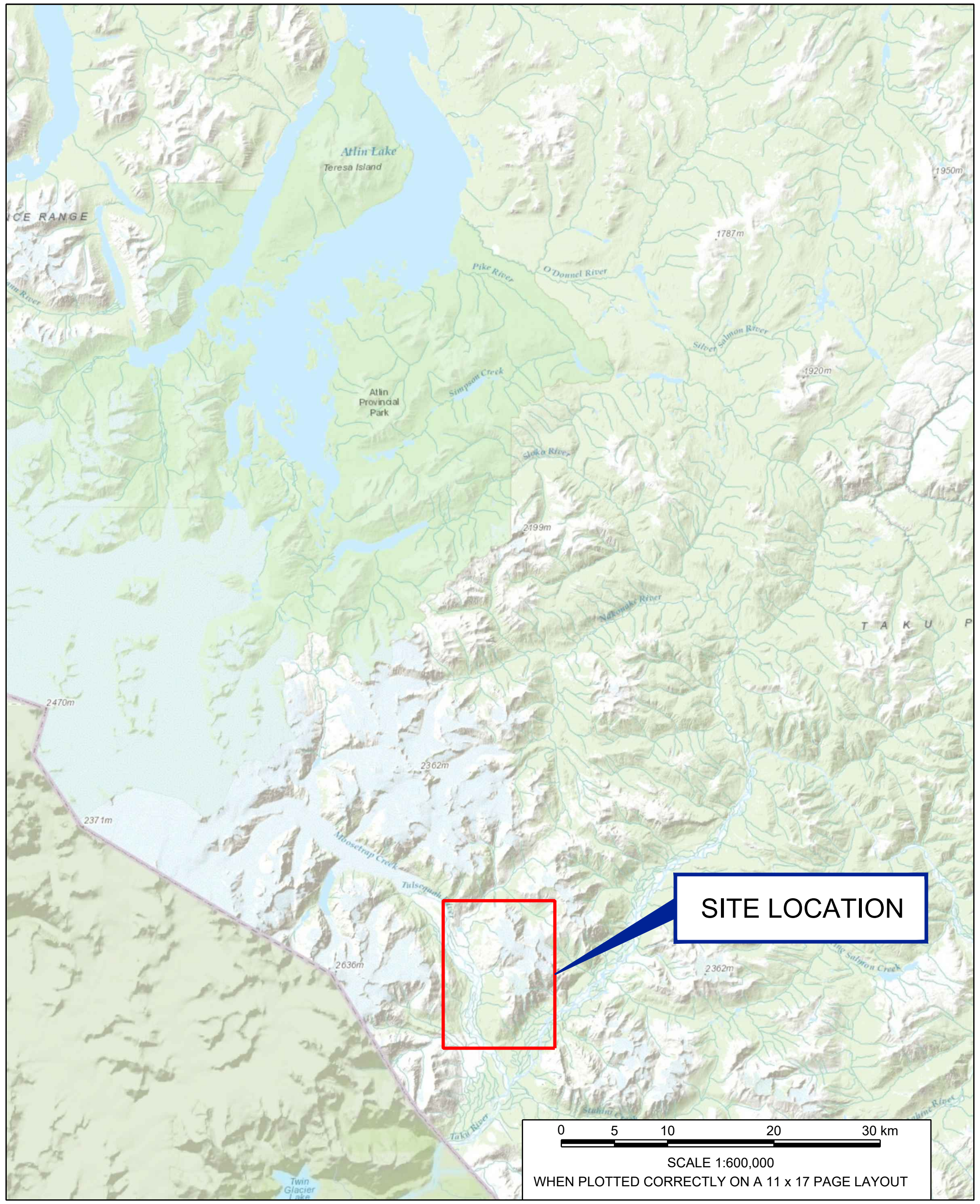
DRAWINGS

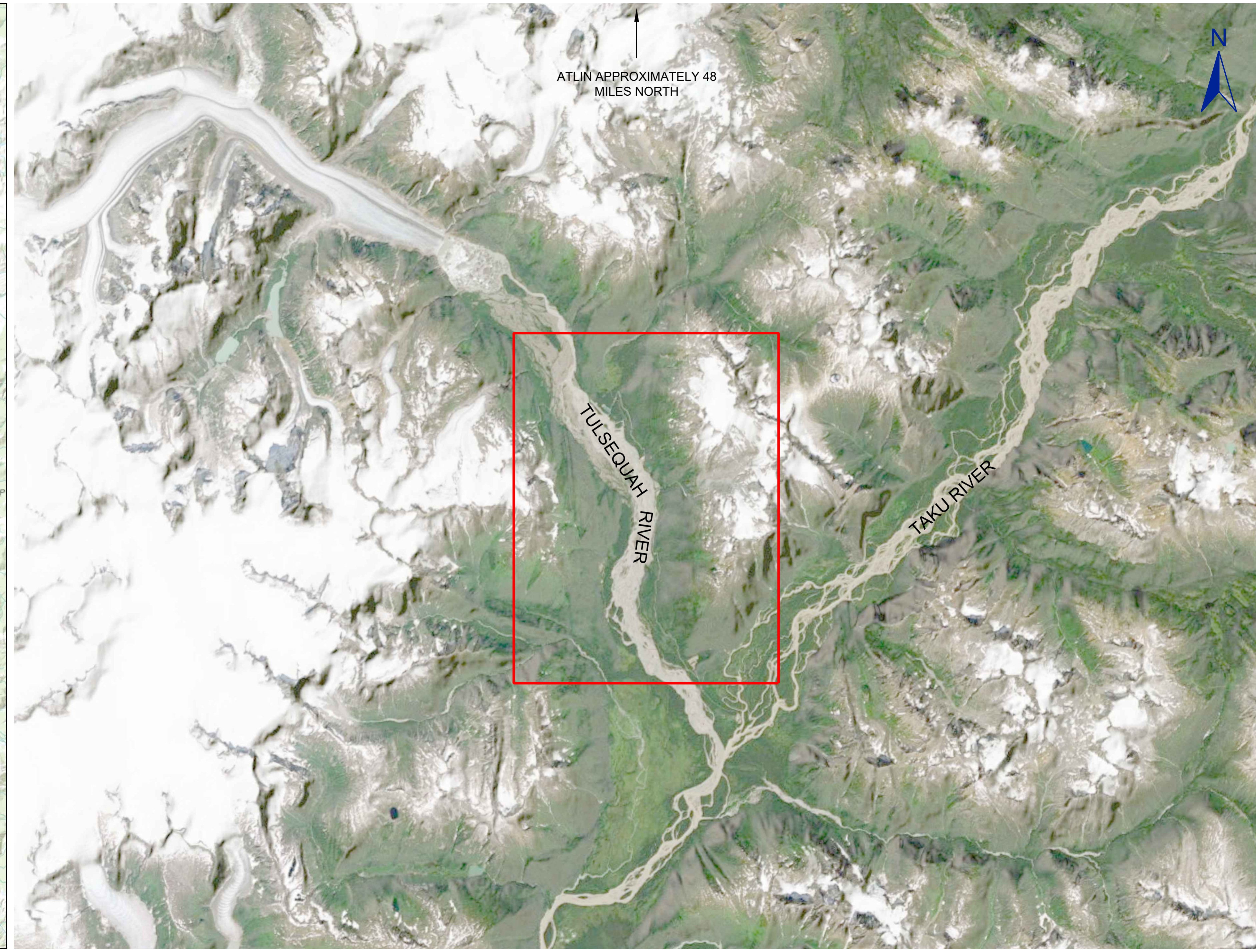
Water Quality Monitoring Plan - 2021

Ministry of Energy, Mines and Low Carbon Innovation

Tulsequah Chief Mine

SLR Project No: 204.03386.00000





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BASEDATA:
Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, and the GIS User Community

LEGEND:
INVESTIGATION BOUNDARY

0 2 4 8 12 km
SCALE 1:200,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 8 U

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

MINISTRY OF ENERGY, MINES AND LOW CARBON INNOVATION
TULSEQUAH CHIEF MINE SITE
ATLIN, BC

TULSEQUAH CHIEF MINE - WATER QUALITY MONITORING PROGRAM

SITE LOCATION AND SURROUNDING LAND USE

Date:	May 4, 2021	Drawing No. 1
Project No.	201.88687.00000	

SLR

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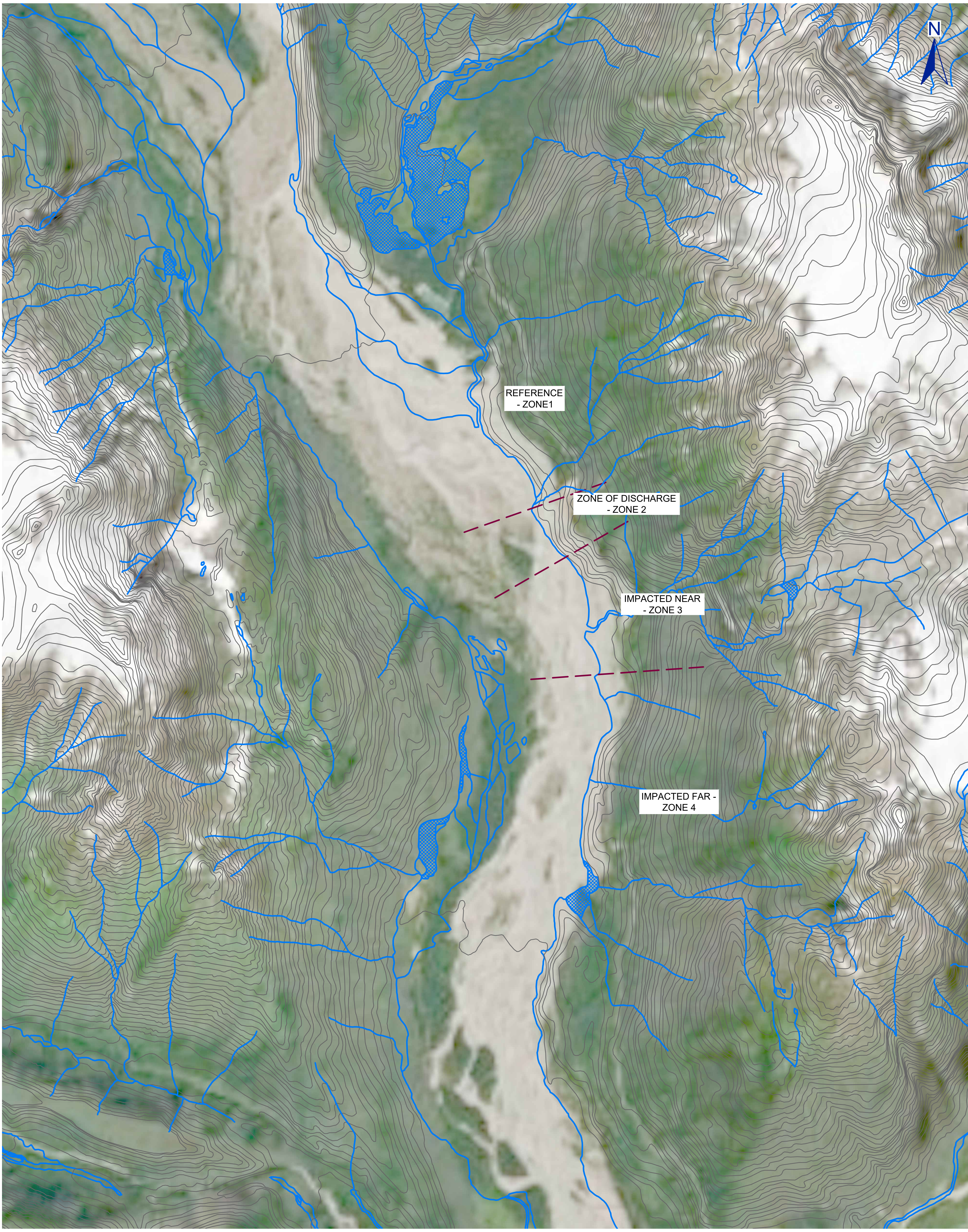

LEGEND:

- ZONE BOUNDARY
- WATERCOURSE (GEOBC)
- WETLAND (GEOBC)
- CONTOUR

NOTES:

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0 0.25 0.5 1 1.5 2 2.5 km

SCALE 1:40,000
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NAD 1983 UTM Zone 8 U

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MINISTRY OF ENERGY, MINES AND LOW CARBON INNOVATION
TULSEQUAH CHIEF MINE SITE
ATLIN, BC

TULSEQUAH CHIEF MINE - WATER QUALITY MONITORING PROGRAM

ZONE LOCATIONS

Date: May 4, 2021	Drawing No. 2
Project No. 201.88687.00000	

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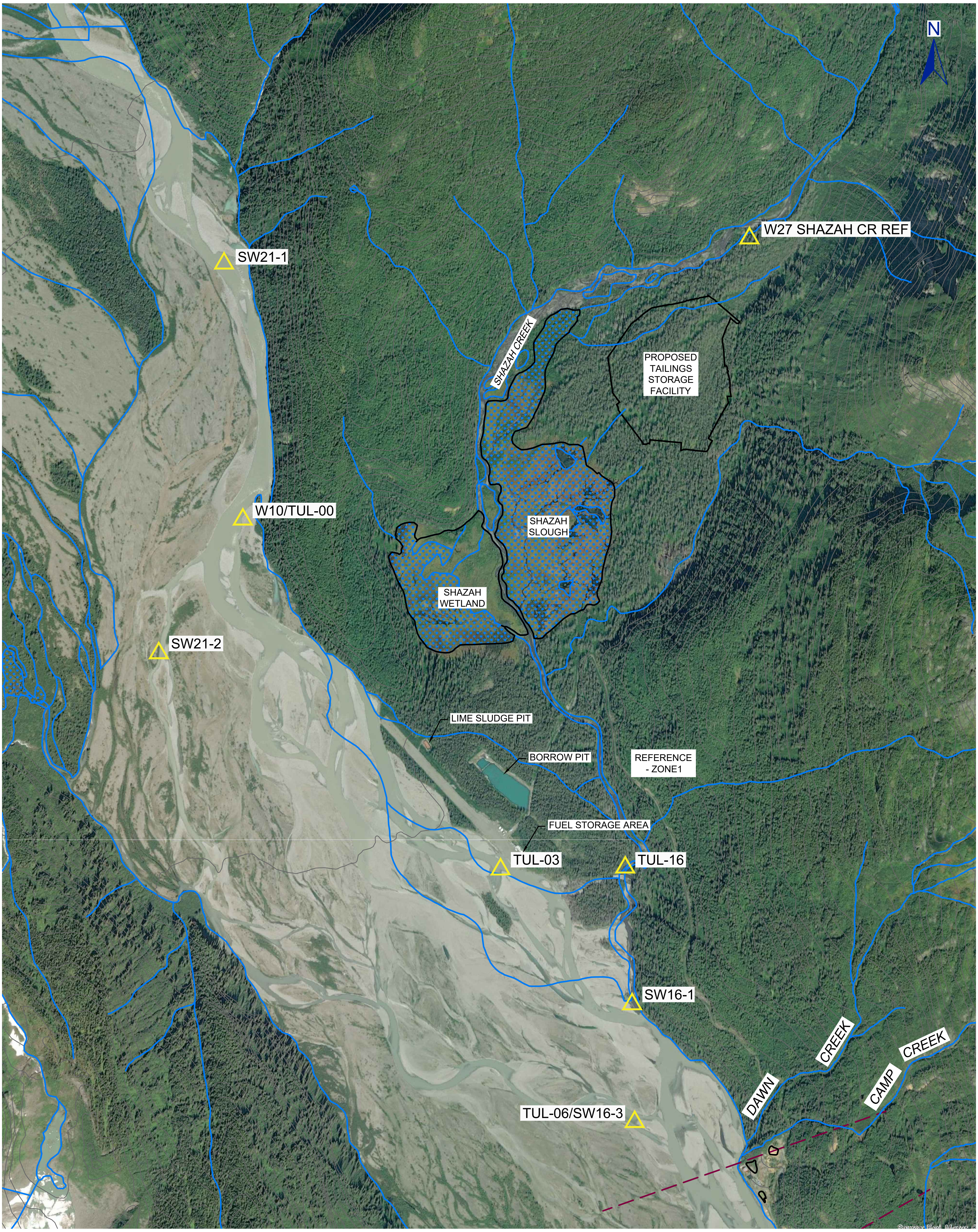

LEGEND:

- ZONE BOUNDARY
- WATERCOURSE (GEOBC)
- WETLAND (GEOBC)
- CONTOUR
- PROPOSED SURFACE WATER SAMPLE

NOTES:

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SW 16-16 RELOCATED TO CURRENT LOCATION

0 0.2 0.4 0.8 1.2 km

SCALE 1:20,000
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MINISTRY OF ENERGY, MINES AND LOW CARBON INNOVATION
TULSEQUAH CHIEF MINE SITE
ATLIN, BC

TULSEQUAH CHIEF MINE - WATER QUALITY MONITORING PROGRAM

TULSEQUAH CHIEF SAMPLE LOCATIONS - ZONE 1

Date:	May 4, 2021	Drawing No. 3
Project No.	201.88687.00000	

SLR

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SW 16-16 RELOCATED TO CURRENT LOCATION

LEGEND:
- ZONE BOUNDARY
- WATERCOURSE (GEOBC)
- CONTOUR
- PROPOSED SURFACE WATER SAMPLE

0 50 100 200 300 m

SCALE 1:5,000
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NAD 1983 UTM Zone 8 U

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MINISTRY OF ENERGY, MINES AND LOW CARBON INNOVATION
TULSEQUAH CHIEF MINE SITE
ATLIN, BC

TULSEQUAH CHIEF MINE - WATER QUALITY MONITORING PROGRAM

TULSEQUAH CHIEF SAMPLE LOCATIONS - ZONE 2

Date: May 4, 2021
Project No. 201.88687.00000
Drawing No. 4

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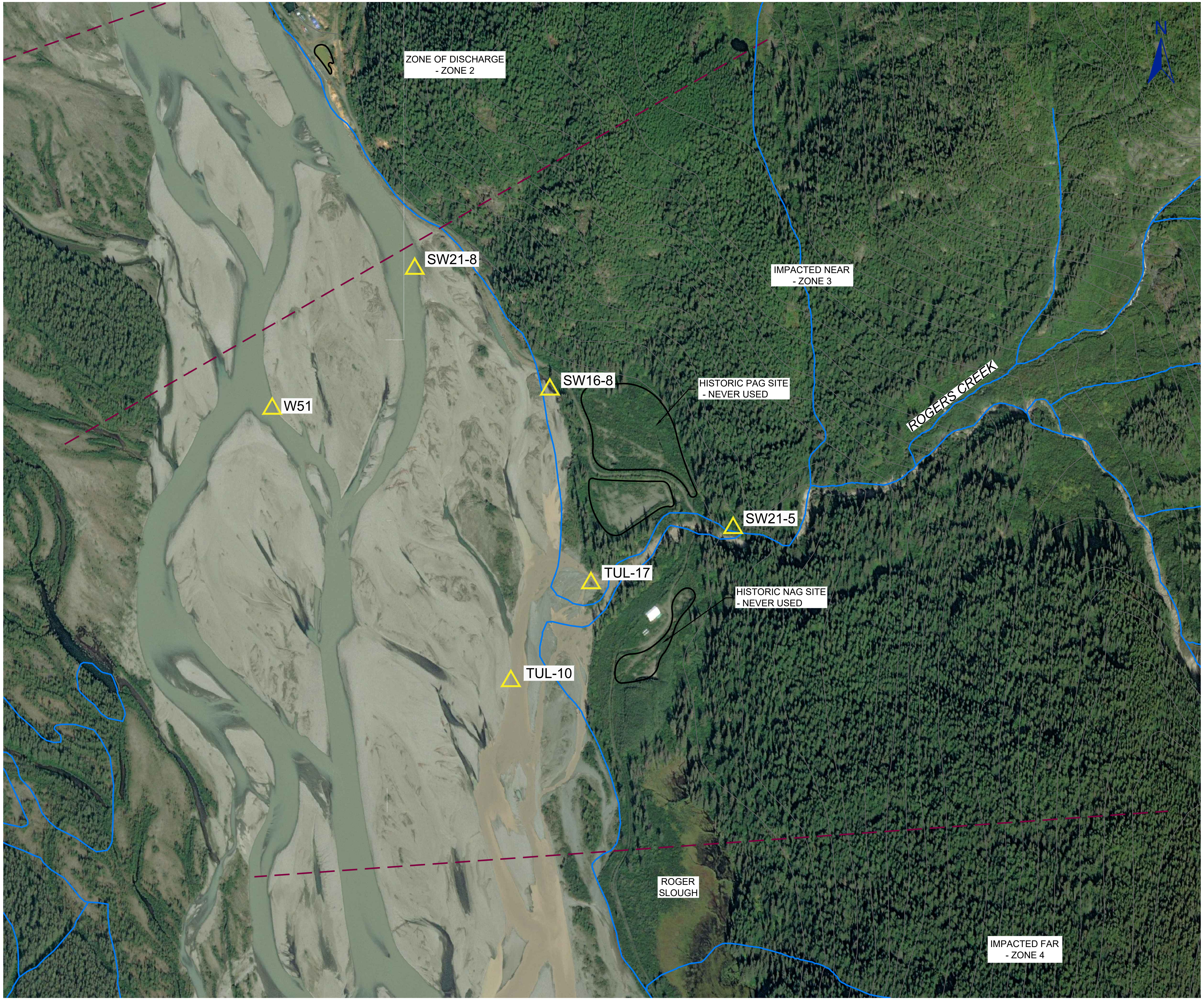

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SW 16-16 RELOCATED TO CURRENT LOCATION

LEGEND:

(dashed line)	ZONE BOUNDARY
(blue line)	WATERCOURSE (GEOBC)
(thin line)	CONTOUR
(triangle)	PROPOSED SURFACE WATER SAMPLE
NAG	NON-ACID GENERATING WASTE ROCK
PAG	POTENTIALLY ACID GENERATING WASTE ROCK

0 50 100 200 300 400 m

SCALE 1:7,500
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
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MINISTRY OF ENERGY, MINES AND LOW CARBON INNOVATION
TULSEQUAH CHIEF MINE SITE
ATLIN, BC

TULSEQUAH CHIEF MINE - WATER QUALITY MONITORING PROGRAM

TULSEQUAH CHIEF SAMPLE LOCATIONS - ZONE 3

Date: May 4, 2021		Drawing No. 5
Project No.	201.88687.00000	

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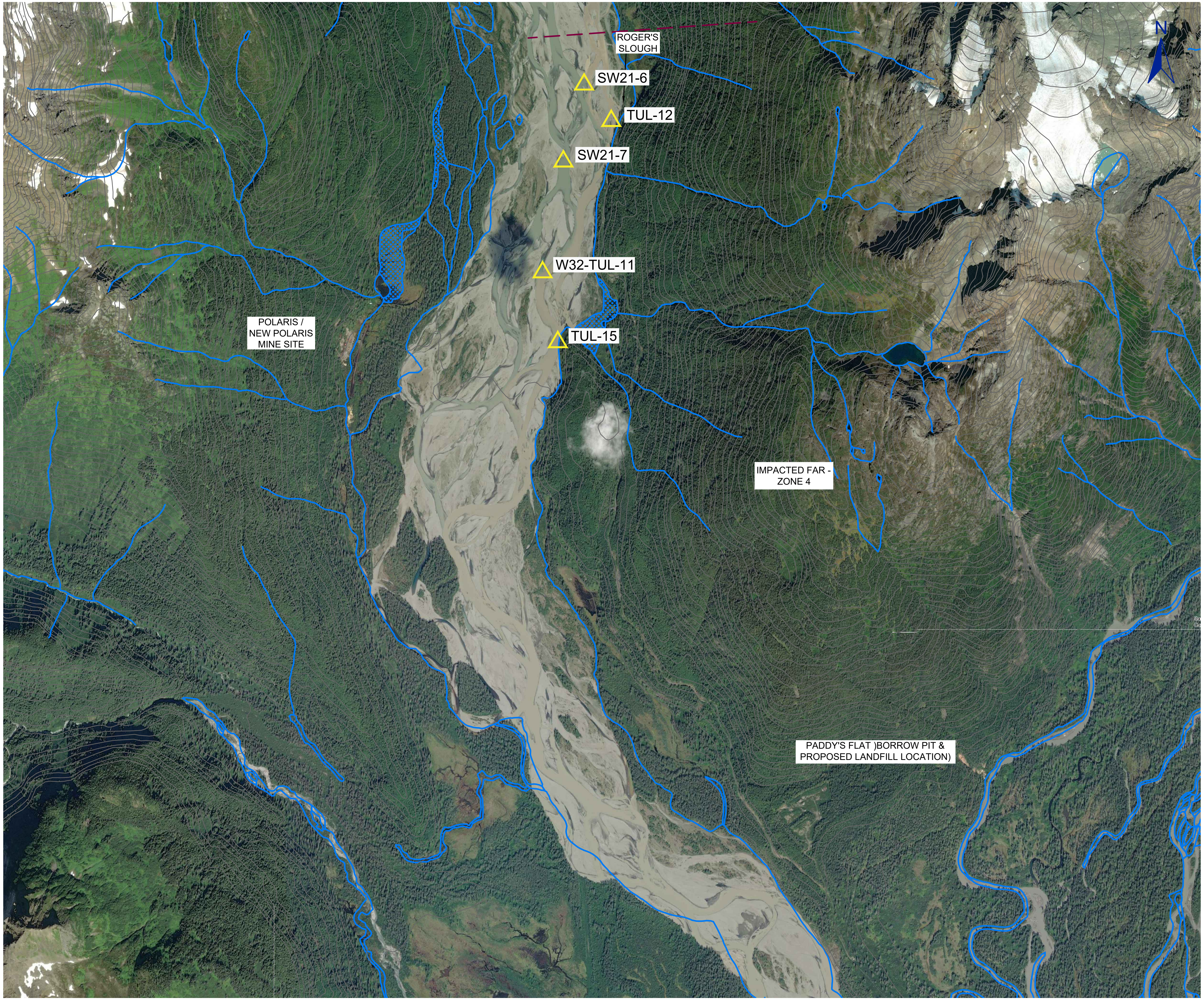

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SW 16-16 RELOCATED TO CURRENT LOCATION

LEGEND:
- ZONE BOUNDARY
- WATERCOURSE (GEOBC)
- WETLAND (GEOBC)
- CONTOUR
- PROPOSED SURFACE WATER SAMPLE

0 0.25 0.5 1.0 1.5 km

SCALE 1:30,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 8 U

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MINISTRY OF ENERGY, MINES AND LOW CARBON INNOVATION
TULSEQUAH CHIEF MINE SITE
ATLIN, BC

TULSEQUAH CHIEF MINE - WATER QUALITY MONITORING PROGRAM

TULSEQUAH CHIEF SAMPLE LOCATIONS - ZONE 4

Date: May 4, 2021	Drawing No. 6
Project No. 201.88687.00000	

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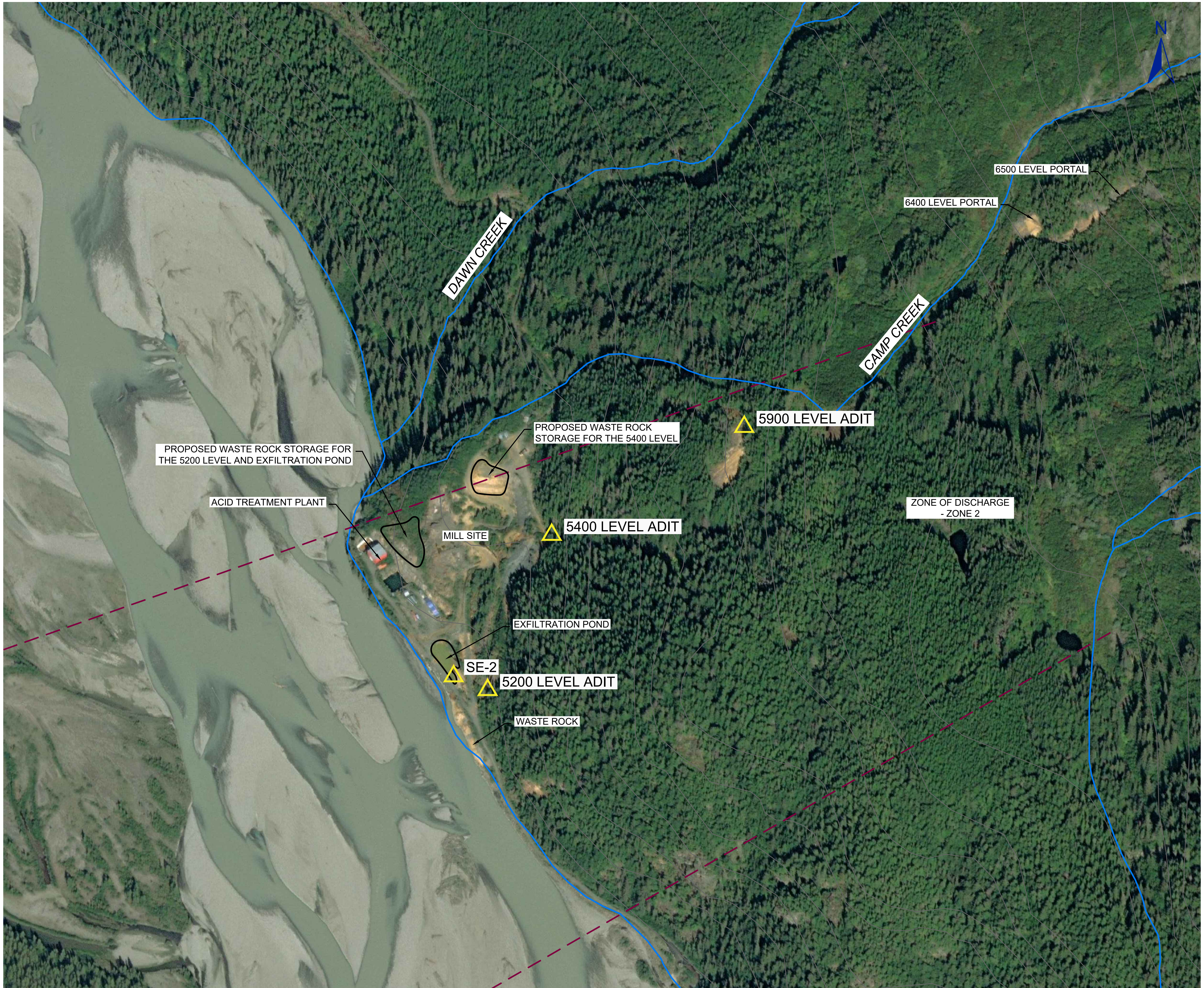

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SW 16-16 RELOCATED TO CURRENT LOCATION

LEGEND:
- ZONE BOUNDARY
- WATERCOURSE (GEOBC)
- CONTOUR
- PROPOSED SURFACE WATER SAMPLE

0 50 100 200 300 m

SCALE 1:5,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 8 U

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MINISTRY OF ENERGY, MINES AND LOW CARBON INNOVATION
TULSEQUAH CHIEF MINE SITE
ATLIN, BC

TULSEQUAH CHIEF MINE - WATER QUALITY MONITORING PROGRAM

TULSEQUAH CHIEF SAMPLE LOCATIONS - EFFLUENT ZONE

Date: May 4, 2021
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