Technical Report No. 23-09

Glacier Creek Aquatic Studies, 2023

by

Dylan Krull

December 2023

Alaska Department of Fish and Game **Habitat Section**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in reports by Habitat Section and the Divisions of Sport Fish and Commercial Fisheries. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm
nanometer	nm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
kilowatt	kW
Kilopascal	kPa
Nephelometric Turbidity Unit	NTU
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not detected	N
no data	ND
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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GLACIER CREEK AQUATIC STUDIES, 2023

By

Dylan Krull

Alaska Department of Fish and Game
Habitat Section, Region I
P.O. Box 110024, Juneau, Alaska, 99811

December 2023

This investigation was fully financed by Constantine Mining, LLC.

Cover: Middle Glacier Creek sample site, photo taken from a helicopter, June 6, 2023.

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Alaska Department of Fish and Game, Habitat Section
P.O. Box 110024, Juneau, Alaska, USA

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ACKNOWLEDGEMENTS

Constantine Mining, LLC. provided financial support for this project. Camp Manager Darsie Culbeck provided logistical support and Environmental Manager Merlin Benner provided Glacier Creek water quality and discharge data and reviewed the draft report.

Alaska Department of Fish and Game Habitat Section Southeast Regional Supervisor Kate Kanouse collaborated on study design. Habitat Biologists Erika King and Jesse Lindgren participated in sample collection and processed periphyton samples. Erika King verified data entry of all samples. Habitat Biologists Claire Delbecq, Flynn Casey, and Nick Jensen sorted benthic macroinvertebrates. Habitat Biologist Greg Albrecht identified benthic macroinvertebrates. Habitat Section Operations Manager Dr. Al Ott, Kate Kanouse, Jesse Lindgren, and Habitat Biologist Olivia Edwards reviewed and edited the report. Thank you all for your contribution.

EXECUTIVE SUMMARY

Constantine Mining, LLC. (Constantine) began exploratory drilling at the Palmer Exploration Project in 2006, located near Haines in Southeast Alaska, and has identified barite, copper, gold, silver, and zinc deposits within the volcanogenic massive sulfide deposit that may support a hard rock mine. Constantine contracted with the Alaska Department of Fish and Game (ADF&G) Habitat Section to study aquatic resources in Glacier Creek, a glacial water body draining the potential mine area. With Constantine, Habitat Section biologists developed a plan to study periphyton, benthic macroinvertebrates, fish, and sediment at two sites in Glacier Creek. We began sampling at these sites in spring 2016 and have continued annually with the goal of documenting baseline aquatic productivity and sediment conditions, which will be useful if Constantine moves forward with a project.

In 2023, we sampled the lower and middle reaches of Glacier Creek on June 6 and 7. Mean chlorophyll *a* density was 5.51 mg/m^2 at Lower Glacier Creek and 4.26 mg/m^2 at Middle Glacier Creek, the greatest values observed at each site since 2016. The 2023 mean benthic macroinvertebrate (BMI) density at Lower Glacier Creek was the greatest observed among all years of data and the mean BMI density at Middle Glacier Creek was like the 2022 density. The BMI communities were dominated by Diptera: Chironomidae insects; which are generally are fast colonizers, easily adapt to changing habitats, and can exercise more than one feeding strategy (Entrekin et al. 2007).

We captured and retained 10 Dolly Varden *Salvelinus malma* in Lower Glacier Creek and 5 Dolly Varden in Middle Glacier Creek; these samples were analyzed for whole body concentrations of arsenic, cadmium, copper, lead, mercury, silver, selenium, and zinc. Most median Dolly Varden element concentrations were greater among the Lower Glacier Creek samples, while arsenic and silver concentrations were often not detected at both sites. Most concentrations were within the ranges observed in whole body Dolly Varden samples collected from reference and mineral exploration sites elsewhere in Alaska (Legere and Timothy 2016).

We sampled fine sediment at each site for aluminum, arsenic, cadmium, copper, iron, lead, mercury, selenium, silver, and zinc. Median element concentrations were generally similar among sites and within the ranges previously observed at the sites. The baseline cadmium, copper, and zinc concentrations were near or above the freshwater sediment guidelines suggested by Buchman (2008).

INTRODUCTION

The Palmer Exploration Project is in the Porcupine Mining District about 55 km north of Haines by air in the southeastern extent of the Saint Elias Mountains near the U.S./Canada border (Figure 1). At the site, placer gold mining in Glacier Creek and its tributaries occurred during the 20th century. In 1969, local prospector Merrill Palmer discovered base-metal sulfides and barite that initiated exploration drill programs by several different companies in the following years, including Constantine in 2006 (Constantine 2015).

The Palmer Prospect consists of two primary deposits: the Palmer Deposit on the south wall of the mountainside on the west side of the valley and the AG Deposit at the head of the valley under the Saksaia Glacier (Figure 1). The project is located on the same volcanogenic massive sulfide belt as Greens Creek Mine on Admiralty Island, about 100 air miles south. Constantine has identified

barite, copper, gold, silver, and zinc as potential mineable resources (Constantine 2015). From 2014–2018, Constantine constructed a 6.73 km single lane gravel road to support mineral exploration on the mountainside in the Glacier Creek valley while conducting exploration activities which continued through 2023.

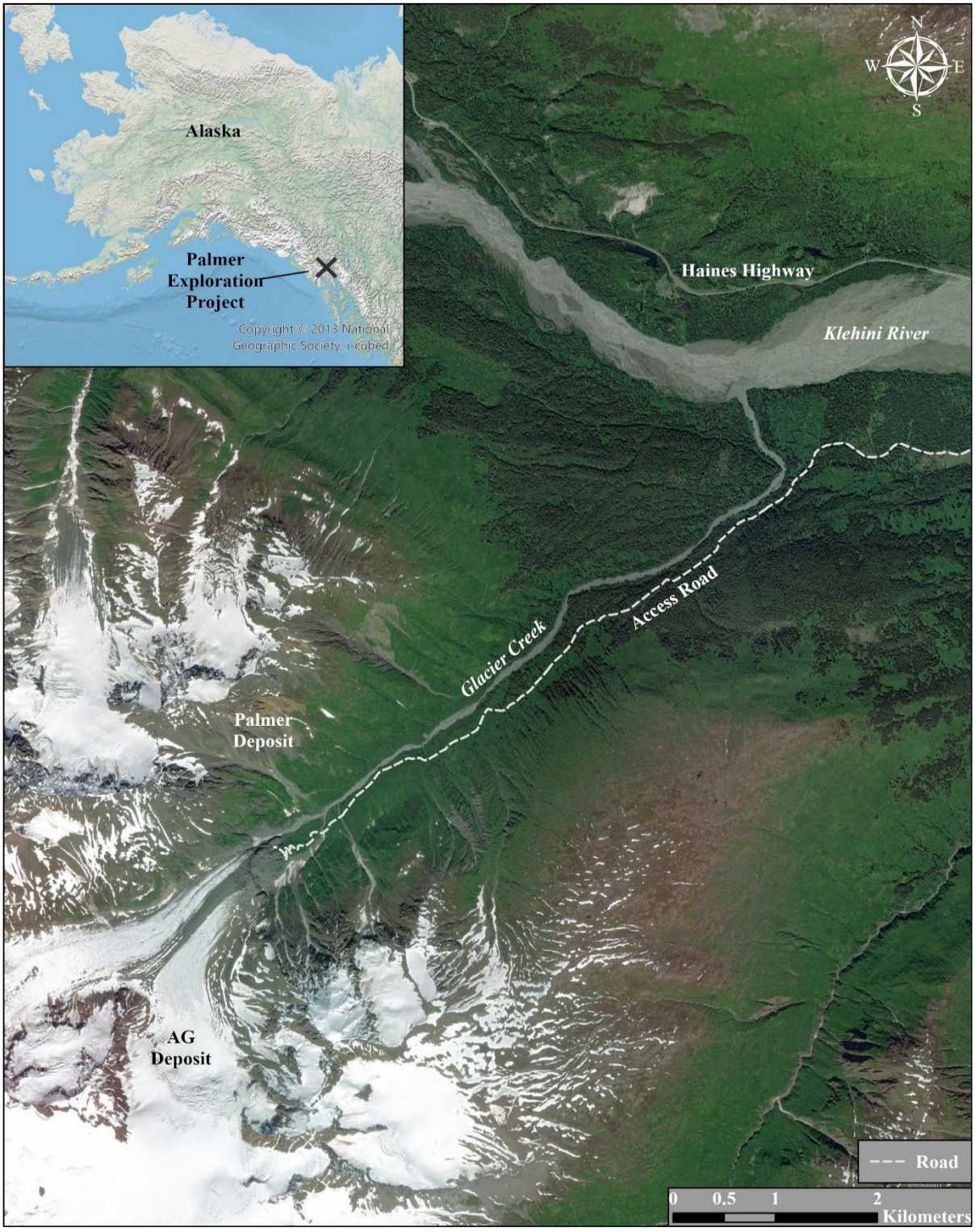

Figure 1.–Palmer Exploration Project area map.

Tetra Tech (2013) and ADF&G biologists documented[a] Dolly Varden in Glacier Creek and three tributaries. In 2016, Constantine contracted with the ADF&G Habitat Section to conduct baseline studies in Glacier Creek. Following review of Constantine's water quality data, Habitat biologists developed a study plan to investigate and document aquatic resources in Glacier Creek. Methodology and sampling design is like aquatic sampling programs at the Greens Creek Mine (Lindgren and King 2023) and Kensington Gold Mine (Timothy and Kanouse 2014), both underground hard rock mines in Southeast Alaska. The study plan includes sampling periphyton, benthic macroinvertebrates, and fish—aquatic resources influenced by water and sediment quality through natural processes—to provide baseline information on aquatic productivity in Glacier Creek. We conducted these studies in spring 2016–2023; sampling results from previous years are presented in Kanouse and Legere (2016), Legere and Kanouse (2017–2018), and Krull (2019–2022).

PURPOSE

The purpose of this investigation and technical report is to document the baseline condition, abundance, and composition of biological communities and sediments in Glacier Creek.

STUDY AREA

Glacier Creek is about 7.5 km long, drains a 39 km^2 watershed between its headwaters at the Saksaia Glacier and confluence with the Klehini River. It contributes about 5% of the total Klehini River drainage area, measured from the former U.S. Geological Survey gage at the Klehini River bridge—about 20 km downstream of the prospect.[b]

Continuous discharge data do not exist for Glacier Creek, but based on the relative size of the Glacier Creek and Klehini River drainage areas, Integral Consulting, Inc.[c] estimated mean Glacier Creek discharge between May and September at 150 ft^3/s. Field staff measured discharge opportunistically from 2015–2018 between June and September ranging 57–471 ft^3/s, with the lowest discharge measured during September. During winter, spring, and fall of 2019 and 2020, Constantine staff collected discharge measurements, 3.36–71.66 ft^3/s, about 2 km upstream of the Middle Glacier Creek sampling site which ranged (A. Cairns, Environmental Manager, Constantine, Vancouver, personal communication).

Constantine's 2008–2014 and 2017–2023 Glacier Creek year-round basic water quality data documents total suspended solids ranging less than 3 mg/L to 2,470 mg/L, turbidity ranging 0.03–2,760 NTU, and pH ranging 6.59–8.33 (DOI 2016; A. Cairns, Environmental Manager, Constantine, Vancouver, personal communication).

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[a] Matthew Kern, Habitat Biologist, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: Glacier Creek investigation trip report; dated 6/26/2014. Unpublished document, can be obtained from the Southeast Regional Supervisor, ADF&G Habitat Section, 802 3rd St, Douglas, AK.

[b] Marcia Greenblatt and Alice Conovitz, Integral Consulting, to Darwin Green, Constantine North. Memorandum: Klehini River and Glacier Creek hydrologic data summary; dated 2/24/2016. Unpublished document, can be obtained from Constantine North, Inc., 800 W. Pender St. Ste. 320, Vancouver, BC, Canada.

[c] Marcia Greenblatt and Alice Conovitz, Integral Consulting, to Darwin Green and Allegra Cairns, Constantine North. Memorandum: Klehini River and Glacier Creek hydrologic data summary–fall 2016 update; dated 12/19/2016. Unpublished document, can be obtained from Constantine North, Inc., 800 W. Pender St. Ste. 320, Vancouver, BC, Canada.

The lower 1 km of Glacier Creek (ADF&G Stream No. 115-32-10250-2077-3151) provides habitat for coho salmon *Oncorhynchus kisutch*, cutthroat trout *O. clarkii*, and Dolly Varden (Giefer and Graziano 2023). We captured Dolly Varden while opportunistically sampling fish use from 2016 to 2023; in October 2019, we documented one pair of adult coho salmon; in 2020 we captured one rainbow trout; in 2021 we captured an adult cutthroat trout during aquatic biomonitoring and an adult coho salmon during the October survey; and in 2022 we captured one adult Dolly Varden in lower Glacier Creek.[d] In 2023, we captured one adult cutthroat trout and one adult Dolly Varden in Glacier Creek at the confluence with Plateau Creek during the October surveys.[e]

Further upstream in the drainage, we captured Dolly Varden 0.6 km upstream of the Christmas Creek confluence, a nonglacial tributary located 4.5 km upstream of the Glacier Creek confluence with the Klehini River; previously, Tetra Tech (2013) and ADF&G documented the upper extent of Dolly Varden below the Christmas Creek confluence. In 2018, we sampled fish use near the upper extent of Glacier Creek but did not capture any.[f]

We completed aquatic biomonitoring sampling at two locations in Glacier Creek: Lower Glacier Creek and Middle Glacier Creek (Figure 2). Site locations have been relatively similar since project inception, but have varied in reach size due to fish availability.

[d] Dylan Krull, Habitat Biologist, to Kate Kanouse, Southeast Regional Supervisor, ADF&G Habitat Section. Memorandum: 2022 Glacier Creek Fish Survey; dated 12/22/2022. Unpublished document, can be obtained from the Southeast Regional Supervisor, ADF&G Habitat Section, 802 3rd St, Douglas, AK.

[e] Dylan Krull, Habitat Biologist, to Kate Kanouse, Southeast Regional Supervisor, ADF&G Habitat Section. Memorandum: 2023 Glacier Creek Fish Survey; dated 12/29/2023. Unpublished document, can be obtained from the Southeast Regional Supervisor, ADF&G Habitat Section, 802 3rd St, Douglas, AK.

[f] Dylan Krull, Habitat Biologist, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: Waterfall and Hangover Creeks fish investigations; dated 10/22/2018. Unpublished document, can be obtained from the Southeast Regional Supervisor, ADF&G Habitat Section, 802 3rd St, Douglas, AK.

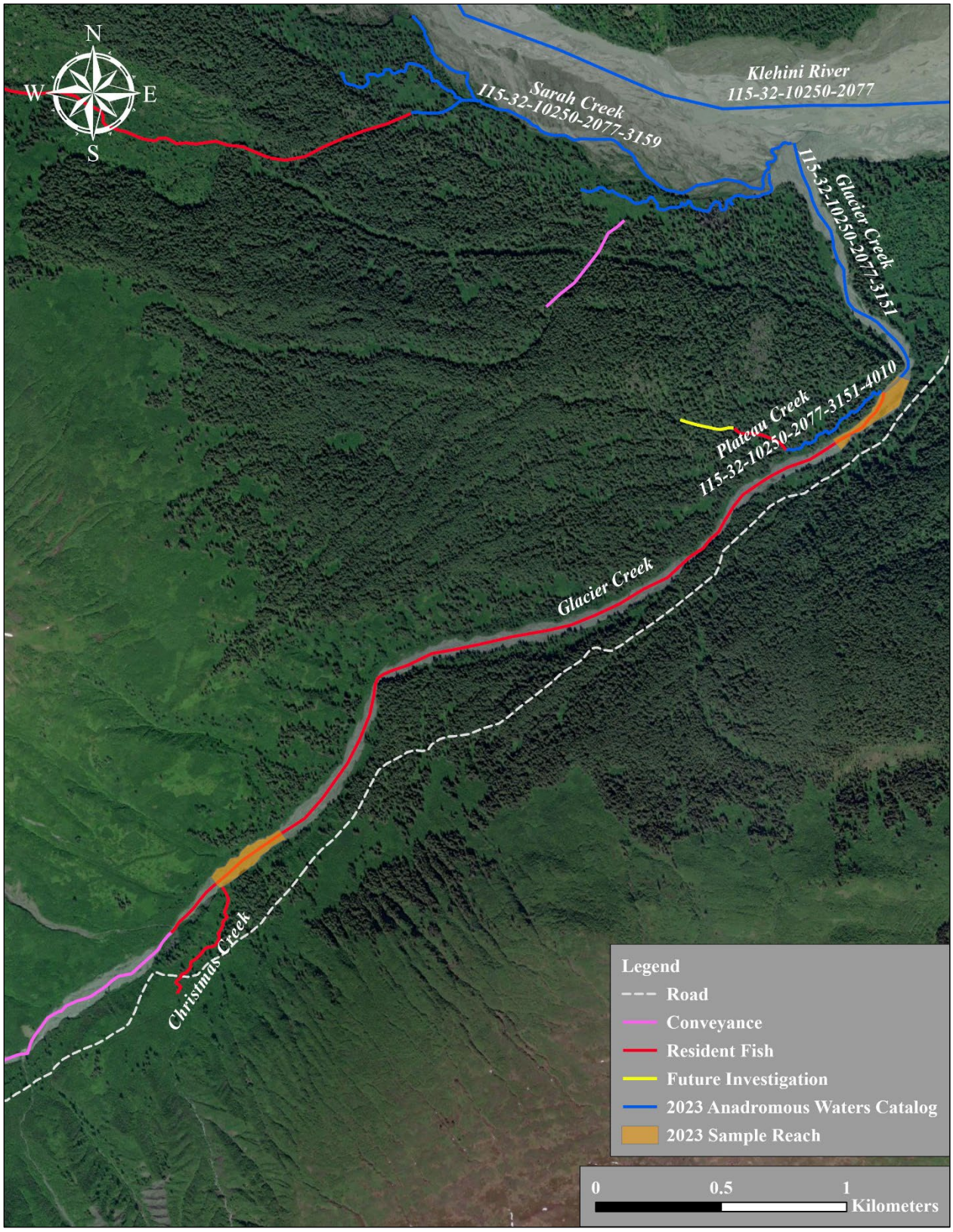

Figure 2.–Glacier Creek sample site map.

Lower Glacier Creek

The Lower Glacier Creek sample site is located at the Glacier Creek bridge near 230 m elevation, about 1.5 km upstream of the Klehini River (Table 1; Figure 3). We accessed the site from the old bridge crossing at the end of Porcupine Road.

Lower Glacier Creek is classified as a medium glacial outwash channel, which exhibit high rates of aggradation and scour resulting in active channels that move throughout the floodplain (Paustian 2010). Comparing stream characteristics of the Lower Glacier Creek sample site 2016–2023, we observed different main channel courses and channel braids each year. In 2023, upstream of the relic bridge, most of the flow was confined to the main channel which flowed down the center of the floodplain. Downstream of the relic bridge, the mainstem flowed along the river left bank with overhanging alders and one braid flowed on the river right side of the active channel. Streambed gradient ranges from 3–6% and the substrate is composed of cobble, gravel, sand, and silt.

In 2023, we sampled a 390 m reach, collecting periphyton, benthic macroinvertebrate, fish, and sediment samples in the dominant channel braid on river right and along the main channel margin upstream of the old crossing.

Table 1.–2023 Lower Glacier Creek sample site location.

	Latitude	Longitude
Upper extent	59.4170	-136.3023
Lower extent	59.4196	-136.2977

Note: WGS84 datum.

Figure 3.–Lower Glacier Creek, looking upstream from the bridge abutment.

Middle Glacier Creek

The Middle Glacier Creek sample site is located near 350 m elevation, about 4.5 km upstream of the Klehini River (Table 2; Figure 4). We accessed the site by helicopter.

Middle Glacier Creek may be characterized as a transitional zone between a cirque channel and a medium glacial outwash channel; both classifications are within the glacial outwash process group and contain a high sediment loads causing lateral channel migration and stream braiding (Paustian 2010). Streambed gradient ranges from 4–8% and the substrate is composed of cobble, gravel, sand, and silt, resulting in large amounts of bedload movement. Comparing stream characteristics of the Middle Glacier Creek sample site 2016–2023, we observe different main channel courses and channel braids each year, a common trait in both channel classifications. In 2023, the main channel flowed from river right at the upper extent of the sampling reach, intercepting Christmas Creek where it enters the Glacier Creek floodplain, to the river left side of the active Glacier Creek channel. A large braid flowed down the river right side throughout the sampling reach.

In 2023, we sampled a 330 m reach from the Christmas Creek confluence downstream. Suitable fish sampling areas were limited due to little viable holding water for fish throughout the site. We collected periphyton, benthic macroinvertebrate, and sediment samples in established channel braids and along the main channel margin and electrofished throughout the sample reach.

Table 2.–2023 Middle Glacier Creek sample site location.

	Latitude	Longitude
Upper extent	59.4005	-136.3447
Lower extent	59.4023	-136.3402

Note: WGS84 datum.

Figure 4.–Aerial view of the Middle Glacier Creek sampling site.

AQUATIC STUDIES

We completed the following studies at two sample sites in Glacier Creek: Lower Glacier Creek and Middle Glacier Creek.

Chlorophyll density and composition

Periphyton is composed of primary producing organisms, such as algae, cyanobacteria, and heterotrophic microbes, and detritus attached to the submerged surfaces of aquatic ecosystems. Algal density and community structure are influenced by water and sediment characteristics through physical, chemical, and biological factors, and disturbances that change throughout the year (Barbour et al. 1999).

Periphyton was sampled in Lower and Middle Glacier Creek to estimate algal density and community composition at each site, using concentrations of chlorophylls *a*, *b*, and *c*. The concentration of chlorophyll *a* (Chl-*a*) pigment in periphyton samples provides an estimate of active algal biomass (density), while concentrations of chlorophyll *b* (Chl-*b*) and chlorophyll *c* (Chl-*c*) pigments estimate the composition of algal organisms present, such as green algae that produce Chl-*b*, and diatoms and brown algae that produce Chl-*c*. The chlorophyll data are used to document baseline primary productivity.

Benthic macroinvertebrate density and community composition

The orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), collectively known as EPT taxa which have complex and short life cycles and many genera are sensitive to changes in water and sediment quality (Barbour et al. 1999). These organisms are secondary producers, feed upon periphyton and other macroinvertebrates, and provide a food source for fish.

Dolly Varden condition and whole body element concentrations

Element bioavailability and bioaccumulation depends on physical and chemical factors and interactions among biological communities (Tchounwou et al. 2012). Resident Dolly Varden samples from Lower and Middle Glacier Creek were analyzed for whole body concentrations of silver (Ag), arsenic (As), cadmium (Cd), copper (Cu), mercury (Hg), lead (Pb), selenium (Se), and zinc (Zn) to document baseline concentrations and variability. These elements were selected based on Constantine's Glacier Creek water sample data and potential target elements identified in the ore body.

Sediment composition and element concentrations

Sediment element concentrations are influenced by a variety of factors, such as geochemical composition and weathering within the watershed, sediment grain size, organic content, and development (Tchounwou et al. 2012). Sediment element concentrations influence aquatic productivity heavy metals in sediments can decrease BMI taxa richness and alter the composition of BMI communities (Qu et al. 2010). Fine sediments were sampled at Lower and Middle Glacier Creek for total organic carbon, acid volatile sulfide, and total concentrations of Ag, aluminum (Al), As, Cd, Cu, iron (Fe), Hg, Pb, Se, and Zn to document baseline conditions and variability. These elements were selected based on Constantine's Glacier Creek water sample data and potential target elements identified in the ore body.

METHODS

We review data sets annually to ensure accuracy and consistency with modifications to methods; corrections and updates are reported in the document and appendices. The most recent technical report presents the current data sets and should be used to analyze data from previous years.

WATER QUALITY

Basic water quality data were collected with a Hanna HI98194 and a Hach 2100P Portable Turbidimeter; both instruments were calibrated per the manufacturer's instructions prior to sampling. Data are provided in Appendix A.

PERIPHYTON: CHLOROPHYLL DENSITY AND COMPOSITION

Sample Collection and Analysis

Sampling methods are adapted from Barbour et al. (1999). Ten smooth, flat, undisturbed, and perennially wetted rocks were collected from submerged cobble in riffle habitats in less than 0.45 m water depth at each sample site and submerged in the creek in the same orientation they were collected. To collect a sample from each rock, a 5 × 5 cm square of high-density foam was held on the sample area; the area around the foam was scrubbed with a toothbrush to remove algae and other organisms outside the sample area. The rock was rinsed by submerging it in the stream while holding the foam in place; the toothbrush also was rinsed in the stream, and between samples.

A 47 mm diameter Type A/E 1 µm glass fiber filter was placed into a Nalgene® filter receptacle attached to a vacuum pump with a gauge. The foam square was removed and the underside of the foam and the sample area were gently scrubbed in a circular pattern with the toothbrush into the filter receptacle. Stream water in a wash bottle was used to rinse loosened periphyton from the foam, rock, toothbrush, and the inside of the filter receptacle onto the filter. The sample area was scrubbed a second time and the rinse cycle was repeated. With most of the water pumped through the filter, maintaining pressure less than 34 kPa, a few drops[g] of saturated magnesium carbonate solution was added to the filter[h] before the sample was pumped dry. The glass fiber filter was removed from the receptacle, folded in half with the sample inside, and wrapped in a white coffee filter for additional moisture absorption. The samples were placed in a sealed, labeled plastic bag with desiccant and stored in a light-proof cooler containing frozen icepacks during transportation; samples were stored in a -20°C freezer in the ADF&G Douglas laboratory until processing.

U.S. Environmental Protection Agency (EPA; 1997) protocol was followed for chlorophyll extraction and measurement, determining instrument and estimated detection limits, and data analysis.[i] Samples were removed from the freezer, cut into small pieces, and placed into individual 15 mL screw cap centrifuge tubes containing 10 mL of 90% buffered acetone. The centrifuge tubes were capped and shaken to ensure complete submersion of the sample. Secured in a vial rack covered with aluminum foil, the samples were stored in a refrigerator for 12–24 hours to allow for saturation and chlorophyll extraction.

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[g] This measurement is not exact as the amount of water and $MgCO_3$ used to create a saturated solution varies and does not affect sample integrity; supernatant solution was used to avoid $MgCO_3$ solids.

[h] To prevent acidification and conversion of chlorophyll to phaeophytin.

[i] Deviations from EPA (1997) include sample storage longer than 3.5 weeks, and cutting sample filters to reduce acetone exposure for laboratory staff (as opposed to homogenization).

The samples were centrifuged for 20 min at 500 relative centrifugal force. Prior to sample measurement, two cuvettes containing 90% buffered acetone were placed into a Shimadzu UV-1800 spectrophotometer to calibrate absorbance of the solvent at wavelengths 664 nm, 647 nm, 630 nm, and 750 nm. Each sample supernatant was decanted into an individual cuvette and absorbance was measured at each wavelength. Each sample was treated with 80 µL of 0.1 N hydrochloric acid for 90 seconds to convert the chlorophyll to phaeophytin, and absorbance was measured at wavelengths 665 nm and 750 nm. To minimize stray light and improve resolution, sample cuvettes were cleaned with a nonabrasive wipe prior to placement in the spectrophotometer.

Trichromatic equations were used to estimate Chl-*a*, Chl-*b*, and Chl-*c* concentrations, correcting for turbidity using the 750 nm absorbance value (APHA 2012, EPA 1997). Chl-*a* concentrations were corrected when phaeophytin was detected. When Chl-*a* was not detected in a sample, the concentration is reported as the spectrophotometer estimated detection limit and the values for Chl-*b* or Chl-*c* are excluded. The 2023 estimated detection limit for Chl-*a* concentration was 0.08 mg/m^2.

Data Presentation

For each site and by year, mean Chl-*a*, Chl-*b*, and Chl-*c* densities are presented in a table. Chl-*a* sample densities and mean proportions of Chl-*a,* Chl-*b,* and Chl-*c* are presented in figures. A comparison of mean Chl-*a* densities among sites is also presented in a figure. The 2016–2023 sample density data are provided in Appendix B.

Benthic Macroinvertebrate Density and Community Composition

Sample Collection and Analysis

Six BMI samples were collected from each site using a Surber stream bottom sampler in riffles and runs with gravel and cobble substrate and varying flow velocities—habitats that support greater BMI densities and taxonomic richness (Barbour et al. 1999). Other habitat types (e.g., pools) were excluded to reduce data variability.

The Surber stream bottom sampler has a 0.093 m^2 sample area and material is captured in a 200 mL cod end, constructed with 300 µm mesh net. After securing the frame on the streambed with the opening facing upstream, rocks within the sample area were scoured with a scrub brush; gravel, sand, and silt were disturbed to about 10 cm depth to dislodge macroinvertebrates into the net. The net was rinsed in the stream to ensure all organisms drifted into the cod end, and each sample was transferred from the cod end to a labeled 500 mL plastic bottle. Samples were preserved in 95% ethanol at a ratio of three parts ethanol to one part sample. Samples exceeding the capacity of the cod end were discarded in the field to minimize detritus and substrate in samples and ensure proper sample preservation.

The samples were processed with an elutriator system with a 0.3 mm sieve to sort macroinvertebrates from debris[j] and organisms were identified to the lowest practical taxonomic

[j] Gordon Willson-Naranjo and Greg Albrecht, Habitat Biologists, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: Benthic macroinvertebrate elutriation trials amendment; dated 12/17/2013. Unpublished document can be obtained from the ADF&G Habitat Section, 802 3rd St, Douglas, AK.

level[k] using Merritt and Cummins (1996) and Stewart and Oswood (2006). Habitat biologists provided quality control of benthic macroinvertebrate enumeration for two samples (i.e., about 17% of the total number of samples).

BMI density was calculated for each sample by dividing the number of macroinvertebrates by 0.093 m^2—the Surber sampling area. Mean density was estimated for each site by calculating the mean density among the six samples. Taxa richness is reported as the number of taxonomic groups identified to the lowest practical level; terrestrial[l] organisms were excluded from all calculations.

Data Presentation

For each site and by year, a table is presented summarizing mean BMI density, total taxa, total EPT taxa, percent EPT insects, and percent Chironomidae insects. BMI densities and community composition are illustrated in figures and BMI density and taxa richness data comparisons among sites are also presented. The 2023 sample data and the 2016–2023 data summaries are provided in Appendix C.

RESIDENT FISH CONDITION

Age, sex, season, maturation, diet, stomach contents, fat reserve, and muscular development affect fish condition. Length and weight data were used to assess fish condition—an index of fish health.

Sample Collection and Analysis

Resident Dolly Varden FL was recorded to the nearest 1 mm and weight to the nearest 0.1 g. Fulton's condition factor (K) was calculated using the equation given in Anderson and Neumann (1996), where the weight (W) of each fish is divided by the cubed length (L), and the product multiplied by 100,000:

$$K = \frac{W}{L^3} \times 100{,}000$$

Data Presentation

For each site the mean fish condition factor of Dolly Varden is presented and compared among sites; 2016–2023 data are provided in Appendix D.

RESIDENT FISH ELEMENT CONCENTRATIONS

Sample Collection and Analysis

Fish were captured using a Smithroot LR-24 backpack electrofisher and 15 resident Dolly Varden were retained.[m,n] The target size range for sample retention was fish measuring 90–130 mm FL, as other Southeast Alaska Dolly Varden sampling programs require (Timothy and Kanouse 2014, Legere and Timothy 2016, Lindgren and King 2023). A 90 mm fish provides the minimum weight requirement for laboratory testing, while a 130 mm fish is 2–3 years old and young enough to

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[k] Insects of the orders Ephemeroptera, Plecoptera, Trichoptera, and Diptera to genus, except nonbiting midges to family Chironomidae, and all others to class or order. Damaged and degraded organisms that cannot be identified are not reported.

[l] Including adult terrestrial insects of the orders Ephemeroptera, Plecoptera, Trichoptera, and Diptera.

[m] In 2016 and 2019, baited minnow traps also were used to capture fish in Lower Glacier Creek.

[n] In 2017, 2018, and 2020, only six samples were retained from Middle Glacier Creek; in 2022 only one sample; in 2021 and 2023 only five samples and were retained due to scarcity of fish.

reasonably conclude it is resident due to sampling timing and location—about 60 km upriver from Chilkat Inlet. Due to general scarcity of fish at both sample sites, all fish captured were retained as samples regardless of size between 2016 and 2019; the sampling reach extent also was contingent on capture efforts each year. In 2020, we discontinued submitting composite samples of two smaller fish due to dilution needed to process samples at the lab resulting in greater method reporting limits. However, in some years we retained larger fish to obtain a minimum of five samples per site.

Wearing latex gloves, each fish was placed in an individually labeled plastic bag. During transport, samples were stored in a cooler with frozen icepacks and in a freezer while onsite. At the ADF&G Douglas laboratory, FL and weight were measured in the sample bags, correcting for bag weight. Samples were stored in a -20ºC freezer in the lab until shipped to a private lab for analyses.

Samples were shipped to ALS Environmental in Kelso, WA in a cooler with frozen icepacks via overnight freight, maintaining written chain of custody documentation. ALS Environmental measured total concentrations of Ag, As, Cd, Cu, Hg, Pb, Se, and Zn in each sample on a dry-weight basis, following EPA (2002) method 1631E for Hg, and EPA (1998) method 6020A[o] for the other elements. The laboratory provided Tier IV quality control information including results for sample duplicates, matrix spikes, standard reference materials, and blanks.

Data Presentation

For each site and by year, Dolly Varden whole body element concentrations are presented in a figure; comparisons of element concentrations data among sites are also presented. A table with the raw data, presenting the mean value for duplicate sample results and 2023 laboratory report are provided in Appendix D.

In 2018, the lab reported greater Ag and As method reporting limits than previous years, largely due to underweight samples (K. Clarkson, Senior Project Manager, ALS Environmental, Kelso, personal communication). Therefore, to avoid misrepresenting sample results below method reporting limits as whole body element concentrations data, element concentrations undetected are illustrated as an empty circle (◦) at the method reporting limit, while measured element concentrations are illustrated as a solid circle (•).

SEDIMENT ELEMENT CONCENTRATIONS

Sample Collection and Analysis

Wearing latex gloves, five samples were collected from sand/silt bars within actively flowing channels and retained the top 4 cm of sediment in glass jars for element analyses and plastic bags for particle size analyses. Samples were stored in a cooler with frozen icepacks in the field and in a hotel refrigerator while in Haines. On June 8, 2023, Constantine staff transported the sediment samples in coolers with ice packs via a courier to ALS Environmental in Whitehorse, Yukon.

ALS Environmental measured total organic carbon, acid volatile sulfide, and total Ag, Al, As, Cd, Cu, Fe, Hg, Pb, Se, and Zn concentrations on a dry-weight basis using methods listed in Table 3.[p]

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[o] In 2016, 2018, and 2019, the same lab used EPA method 200.8 (EPA 1994).

[p] The 2016 Glacier Creek sediment samples were processed by an ALS Environmental lab in Kelso, WA. In 2017–2023, Constantine sent the sediment samples to a different ALS lab in Whitehorse; though methods used by each lab were different, the results are comparable. The parameters analyzed were different between labs; data comparisons between years are presented where applicable.

The laboratory provided quality control results for laboratory controls and blanks.

Table 3.–2023 sediment tests, analytes, and methods.

Test Description	Analyte	Method
Particle size distribution	Particle size determination	ASTM D6913-17 (mod)/SSIR-51 Method 3.2.1
Total organic carbon calculation	Total organic carbon	CSSS (2008) 21.2
Total Carbon by combustion method	Total carbon	CSSS (2008) 21.2 (mod)
Mercury in soil by CVAAS	Hg	EPA 200.2 / 1631 Appendix (mod)
Total Inorganic Carbon by Acetic Acid pH	Inorganic carbon	CSSS (2008) 20.2
Metals in soil by CRC ICPMS	Ag, Al, As, Cd, Cu, Fe, Pb, Se, and Zn	EPA 6020B (mod)
Sulfide, acid volatile	Acid volatile sulfides	EPA 821/R-91-100 (mod)

Data Presentation

For each site and by year, sediment element concentrations data are presented in a figure; mean values are reported when sample duplicate data are available. Consistent with the whole body Dolly Varden element concentration data presentations, sediment element concentrations undetected are illustrated as an empty circle (◦) at the method reporting limit and a solid circle (•) for measured element concentrations.

The data are compared with the threshold effects concentrations (TEC) and the probable effects concentrations (PEC) for inorganics in freshwater sediment guidelines developed by the National Oceanic and Atmospheric Administration (Buchman 2008). The guidelines are based on results of controlled laboratory bioassays, where element concentrations below the TECs rarely affect aquatic life survival and growth, and element concentrations above the PECs can affect aquatic life survival and growth.

Sediment element concentrations data are also compared among sites and presented as a figure. Appendix E contains the 2016–2023 composition and raw element data in a table and the 2023 laboratory report.

RESULTS

LOWER GLACIER CREEK

We sampled Lower Glacier Creek on June 7, 2023, and measured basic water quality at 1145 hours (Table 4).

Table 4.–Lower Glacier Creek water quality data.

Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	pH
06/07/23	4.94	14.89	229	24.6	8.09

Periphyton: Chlorophyll Density and Composition

The 2023 Lower Glacier Creek mean Chl-*a* density was 5.51 mg/m^2, the greatest mean density recorded at this site (Table 5; Figure 5). The samples contained about 89% Chl-*a*, 11% Chl-*c*, and 0% Chl-*b* (Figure 6). Chl-*b* was not detected in 5 samples.

Table 5.–Lower Glacier Creek mean chlorophylls *a*, *b*, and *c* densities.

Sample Date	Chl-*a* (mg/m^2)	Chl-*b* (mg/m^2)	Chl-*c* (mg/m^2)
06/07/16	2.27 ± 1.07	0.00	0.35
06/08/17	1.73 ± 0.89	0.00	0.26
05/30/18	1.25 ± 1.09	0.02	0.24
06/06/19	0.43 ± 0.56	0.01	0.04
06/03/20	3.91 ± 3.03	0.00	0.47
06/16/21	0.77 ± 0.83	0.02	0.24
06/13/22	1.85 ± 1.63	0.00	0.39
06/07/23	5.51 ± 1.75	0.00	0.69

Note: Chl-*a* mean density ± 1 SD.

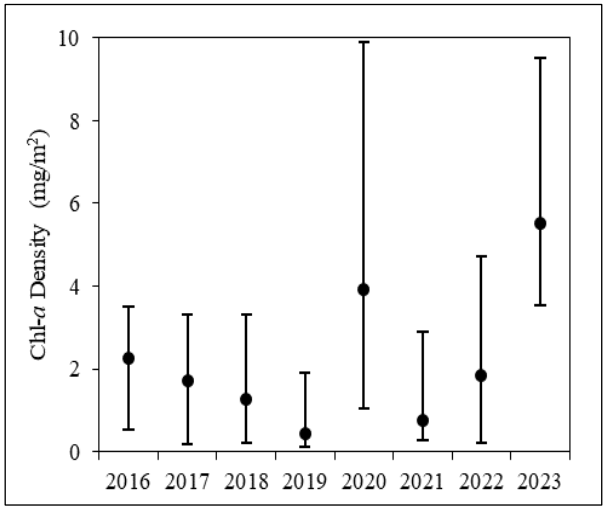

Figure 5.–Lower Glacier Creek chlorophyll *a* densities.

Note: Minimum, mean, and maximum values shown.

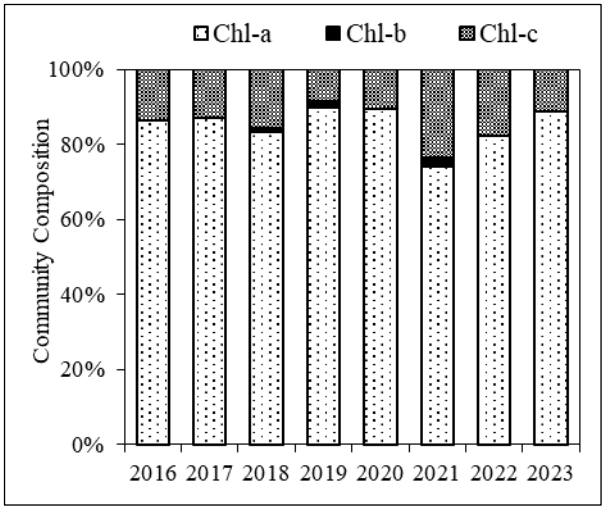

Figure 6.–Lower Glacier Creek mean proportions of chlorophylls *a*, *b*, and *c*.

Benthic Macroinvertebrate Density and Community Composition

Among the 2023 Lower Glacier Creek BMI samples, we identified 12 taxa and estimated mean density at 3,462 BMI/m^2, of which 15% were EPT insects (Table 6; Figures 7, 8). Like previous years, the dominant taxon was Diptera: Chironomidae, representing 85% of the samples.

Table 6.–Lower Glacier Creek benthic macroinvertebrate data summaries.

	06/07/16	06/08/17	05/30/18	06/06/19	06/03/20	06/16/21	06/13/22	06/07/23
Mean BMI density (per m^2)	995	2,136	217	473	754	396	1,136	3,462
Total BMI taxa	17	30	16	12	25	26	30	12
Number of EPT taxa	9	13	10	5	12	12	14	9
Proportion of EPT insects	10%	17%	69%	30%	19%	27%	21%	15%
Proportion of Chironomidae insects	85%	78%	26%	67%	74%	58%	71%	85%

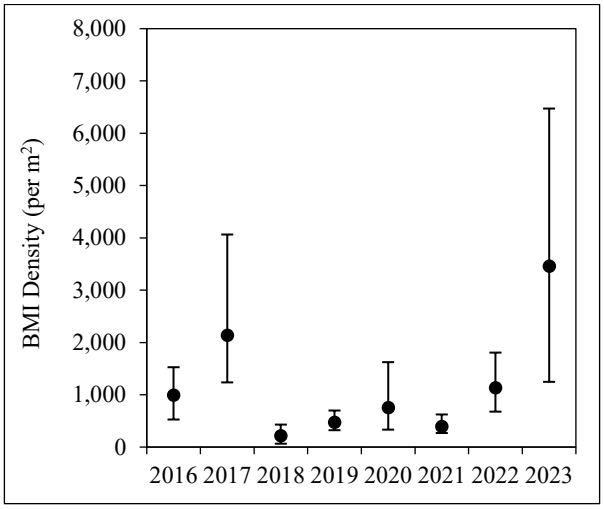

Figure 7.–Lower Glacier Creek benthic macroinvertebrate densities.

Note: Minimum, mean, and maximum values shown.

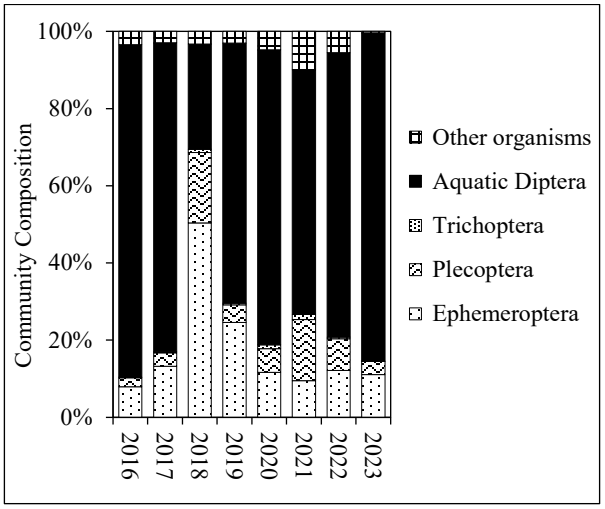

Figure 8.–Lower Glacier Creek mean benthic macroinvertebrate community compositions.

Resident Fish Condition and Element Concentrations

Of the 10 individual whole body Dolly Varden (94–136 mm) samples we retained from Lower Glacier Creek in 2023, mean fish condition was 1.12. We captured several juvenile cutthroat trout throughout our sampling efforts. Among the Lower Glacier Creek whole body Dolly Varden samples in 2023 element concentrations were generally within the ranges of values previously observed (Figure 9). One sample contained an elevated Cu concentration compared to previous years in Lower Glacier Creek, however the value was like those previously observed in samples at Middle Glacier Creek.

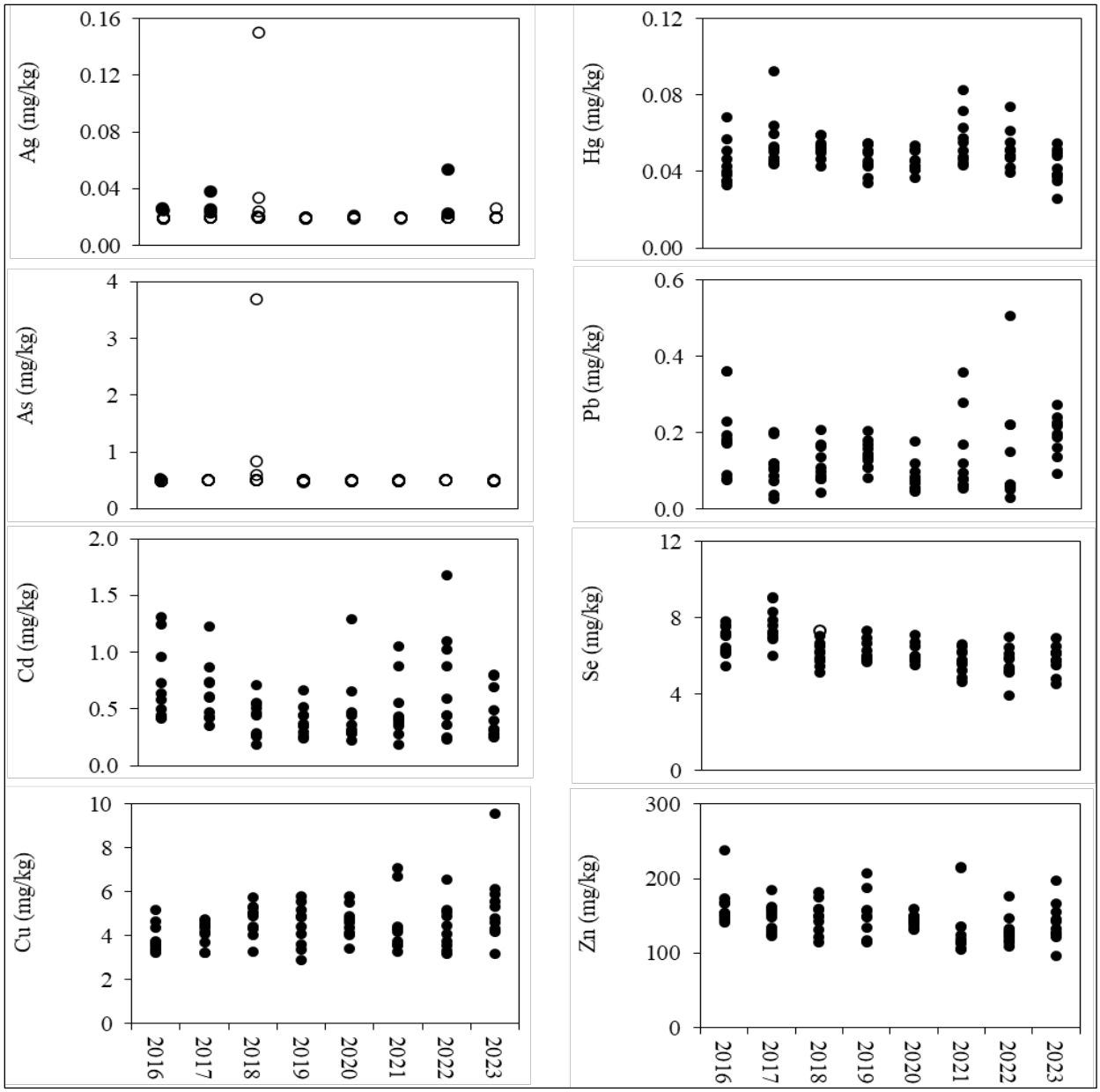

Figure 9.–Lower Glacier Creek whole body Dolly Varden element concentrations.
Note: Element concentrations undetected (o) are presented at the method reporting limit.

Sediment Composition and Element Concentrations

The 2023 Lower Glacier Creek sediment samples included particle sizes less than 9.5 mm. Total organic carbon concentrations were less than 0.315%, and acid volatile sulfide was not detected. The predominant elements were Fe and Al, and the 2023 element concentrations generally were like the 2016–2022 results (Figure 10).

We evaluated the 2023 sediment sample element concentration data against the guidelines for freshwater sediments published in Buchman (2008) and—like the 2016–2022 results—we found Cd, Cu, and Zn concentrations near or above the TEC values, and As, Hg, and Pb concentrations below the TEC values.

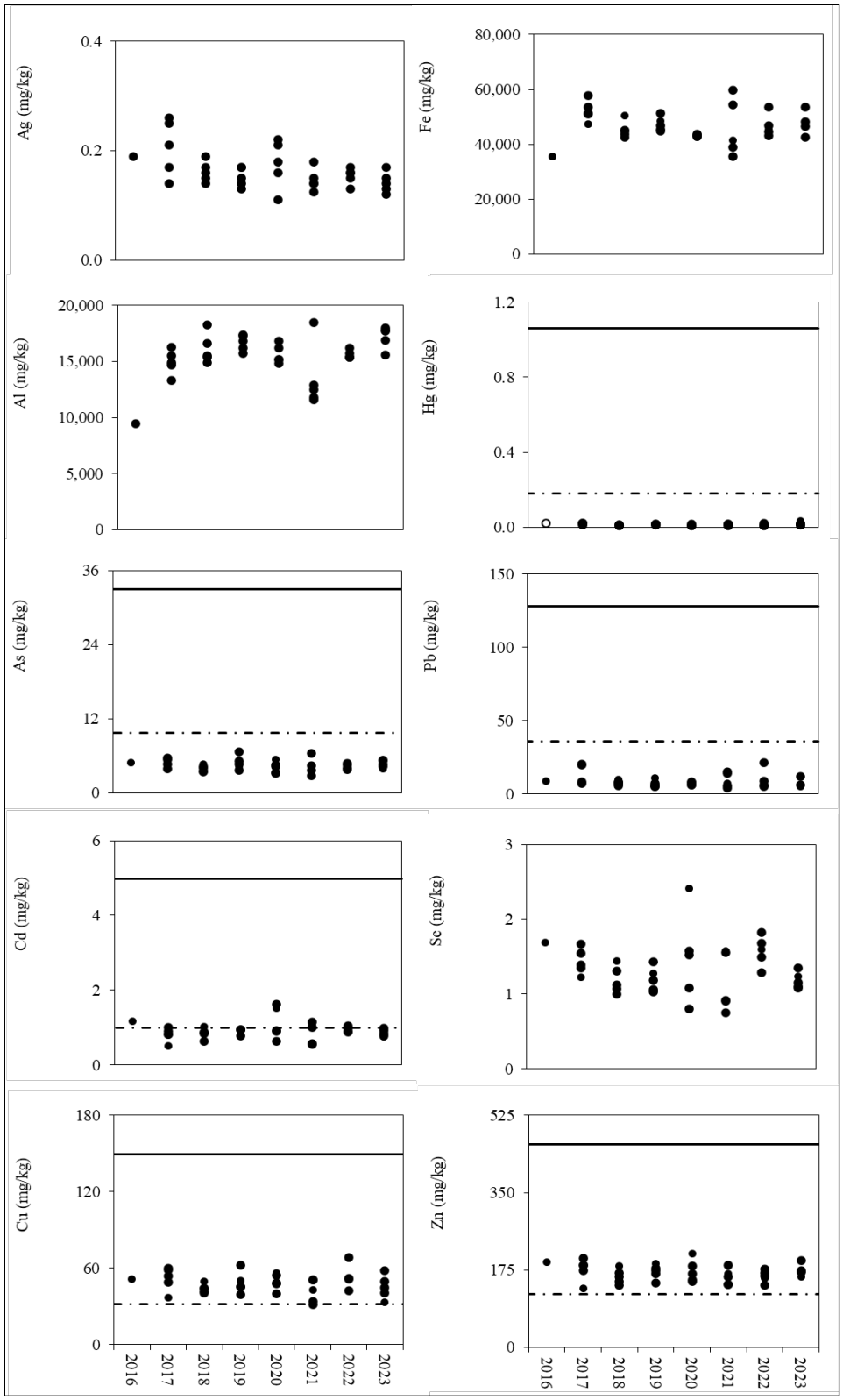

Figure 10.–Lower Glacier Creek sediment element concentrations.

Note: Element concentrations undetected (o) are presented at the method reporting limit. The dashed line represents the TEC and the solid line represents the PEC for freshwater sediments (Buchman 2008); guidelines are not published for Ag, Al, Fe, or Se.

MIDDLE GLACIER CREEK

We sampled Middle Glacier Creek on June 6, 2023, and measured basic water quality at 1324 hours (Table 7).

Table 7.–Middle Glacier Creek water quality data.

Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	pH
06/06/23	4.01	14.22	258	42.6	8.09

Periphyton: Chlorophyll Density and Composition

The 2023 Middle Glacier Creek mean Chl-*a* density was 4.26 mg/m^2, the greatest mean density measured at this site (Table 8; Figure 11). As in previous years, the samples contained about 88% Chl-*a* and 12% Chl-*c*; Chl-*b* was not detected in any samples (Figure 12).

Table 8.–Middle Glacier Creek mean chlorophylls *a*, *b*, and *c* densities.

Sample Date	Chl-*a* (mg/m^2)	Chl-*b* (mg/m^2)	Chl-*c* (mg/m^2)
06/08/16	1.50 ± 1.18	0.00	0.25
06/09/17	0.81 ± 0.45	0.00	0.10
05/31/18	1.76 ± 0.79	0.00	0.29
06/07/19	0.33 ± 0.24	0.01	0.04
06/02/20	1.19 ± 0.89	0.01	0.16
06/15/21	2.03 ± 2.38	0.00	0.25
06/14/22	0.97 ± 0.92	0.00	0.27
06/06/23	4.26 ± 1.85	0.00	0.58

Note: Chl-*a* mean density ± 1 SD.

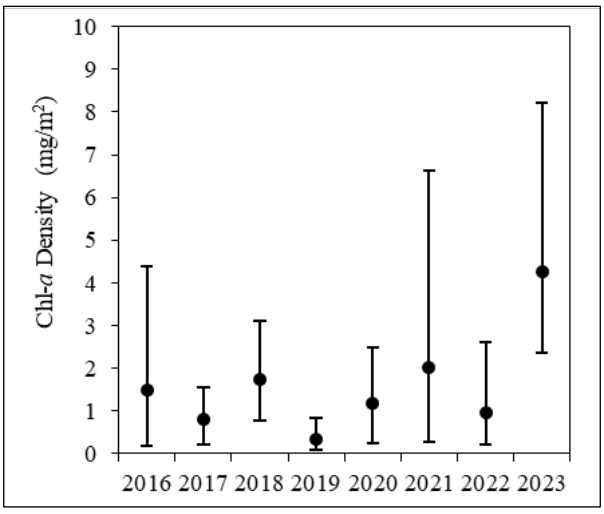

Figure 11.–Middle Glacier Creek chlorophyll *a* densities.

Note: Minimum, mean, and maximum values shown.

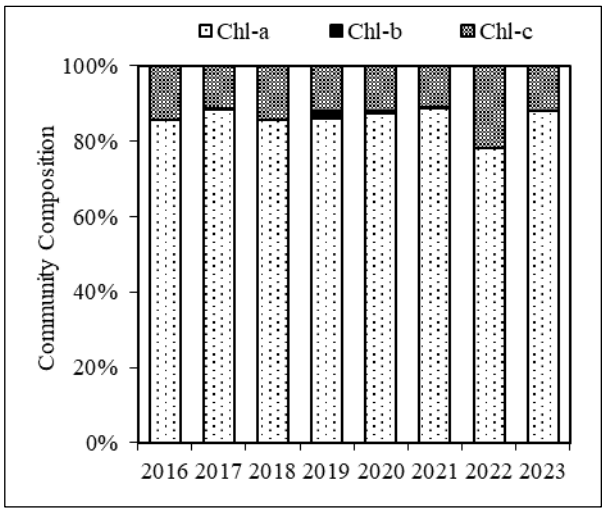

Figure 12.–Middle Glacier Creek mean proportions of chlorophylls *a*, *b*, and *c*.

Benthic Macroinvertebrate Density and Community Composition

Among the 2023 Middle Glacier Creek BMI samples, we identified 17 taxa and estimate mean density at 1,220 BMI/m^2, of which 29% were EPT insects (Table 9; Figures 13, 14). As in previous years, the dominant taxon was Diptera: Chironomidae, representing 70% of the samples.

Table 9.–Middle Glacier Creek benthic macroinvertebrate data summaries.

	06/08/16	06/09/17	05/31/18	06/07/19	06/02/20	06/15/21	06/14/22	06/06/23
Mean BMI density (per m^2)	2,299	593	504	215	754	842	1,192	1,220
Total BMI taxa	22	14	12	11	25	27	25	17
Number of EPT taxa	12	6	5	8	13	11	13	10
Proportion of EPT insects	13%	12%	9%	28%	24%	33%	12%	29%
Proportion of Chironomidae insects	85%	82%	87%	68%	69%	57%	79%	70%

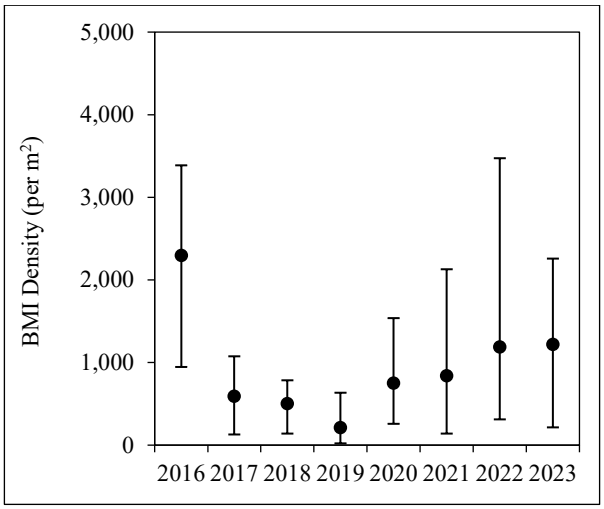

Figure 13.–Middle Glacier Creek benthic macroinvertebrate densities.

Note: Minimum, mean, and maximum values shown.

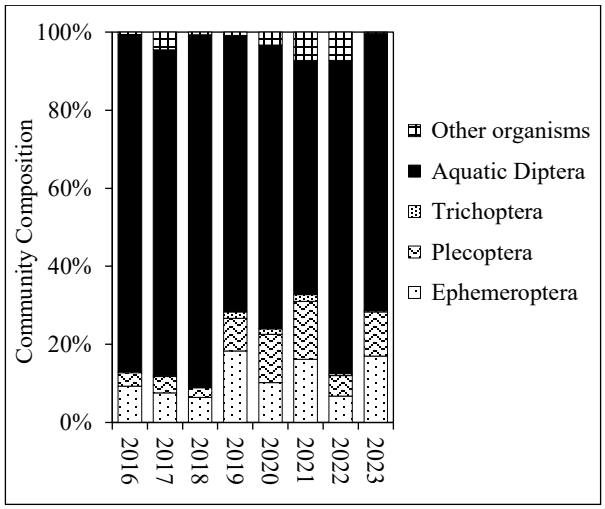

Figure 14.–Middle Glacier Creek mean benthic macroinvertebrate community compositions.

Resident Fish Condition and Element Concentrations

We retained 5 Dolly Varden (95–153 mm) for whole body element analyses from Middle Glacier Creek in 2023, and mean fish condition was 1.3. We were unable to capture additional fish within the sample size range, and we did not capture other fish species. The 2023 whole body Dolly Varden element concentrations generally were within the range of concentrations observed in 2016–2022 (Figure 15). One sample contained elevated Cd and another contained elevated Pb.

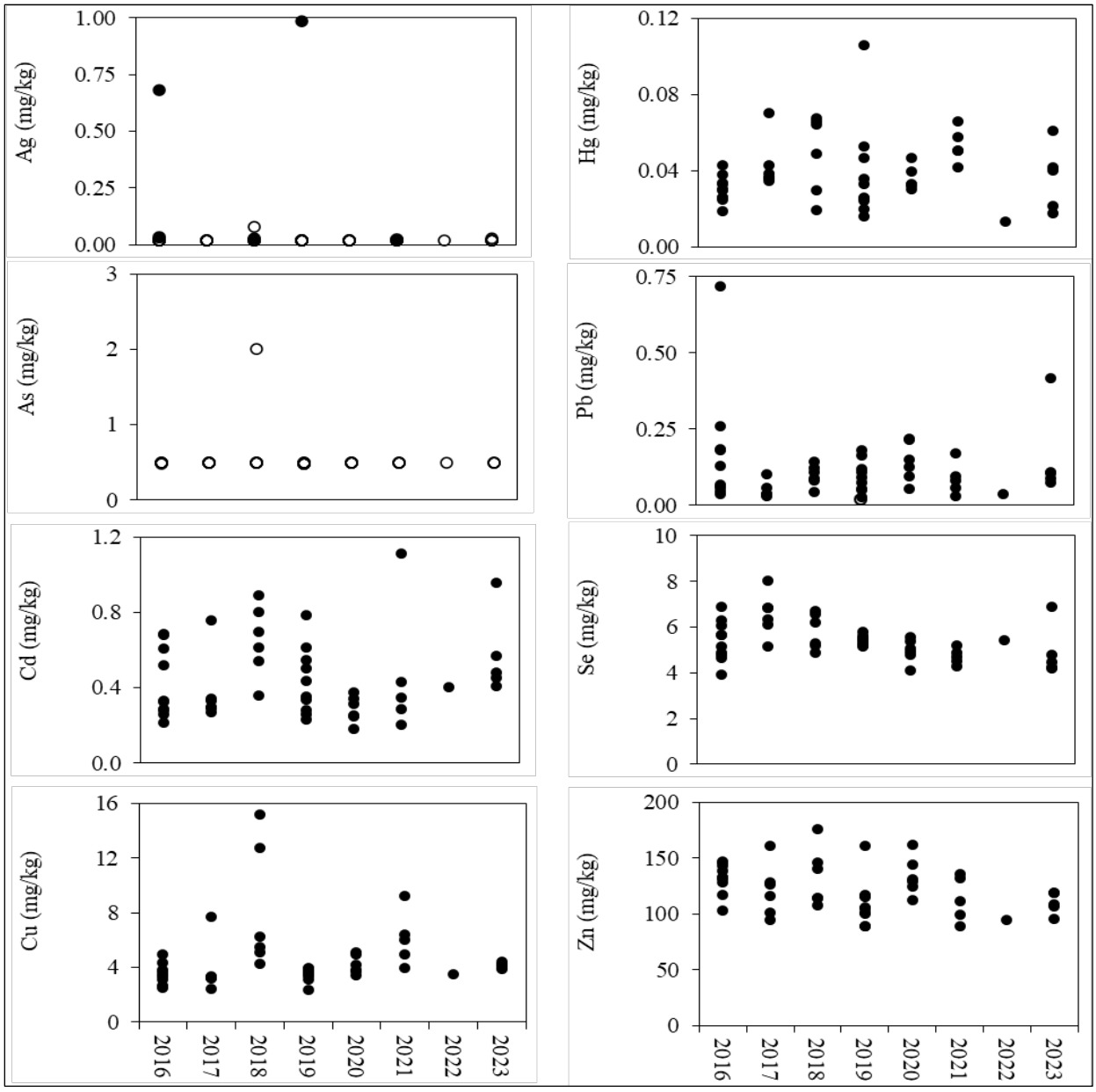

Figure 15.–Middle Glacier Creek whole body Dolly Varden element concentrations.
Note: Element concentrations undetected (o) are presented at the method reporting limit.

Sediment Composition and Element Concentrations

The 2023 Middle Glacier Creek sediment samples largely included particle sizes less than 9.5 mm. Total organic carbon concentrations were less than 0.816%, and acid volatile sulfide was not detected. The predominant elements were Fe and Al, and the 2023 element concentrations generally were similar to the 2016–2022 results; however, Se, Cd, and Al concentrations were elevated compared to prior sample years (Figure 16).

We evaluated the 2023 sediment sample element concentration data against the guidelines for freshwater sediments published in Buchman (2008) and—like the 2016–2022 results—we found Cd, Cu, and Zn concentrations near or above the TEC values, and As, Hg, and Pb concentrations below the TEC values.

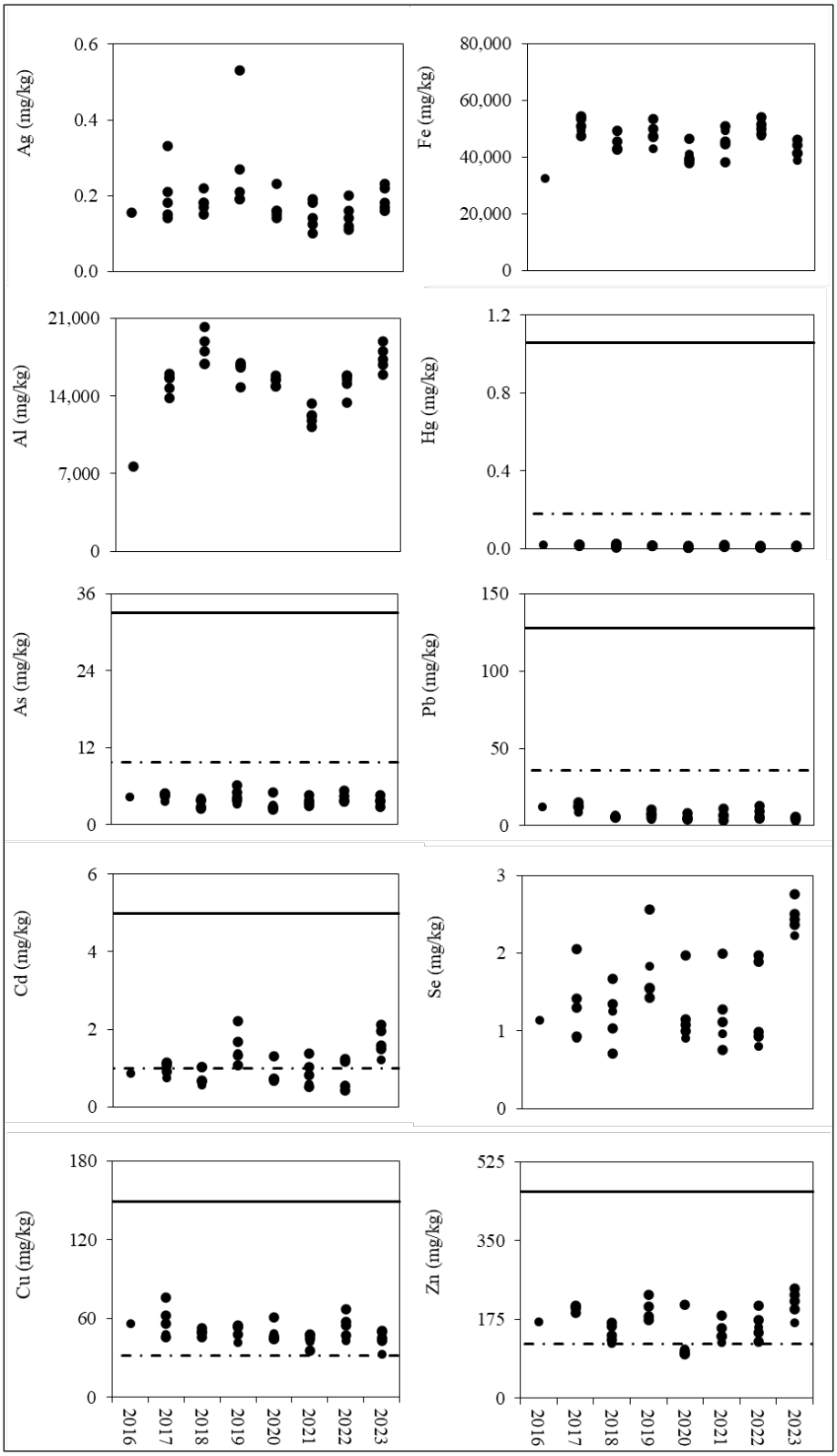

Figure 16.–Middle Glacier Creek sediment element concentrations.

Note: Element concentrations undetected (o) are presented at the method reporting limit. The dashed line represents the TEC and the solid line represents the PEC for freshwater sediments (Buchman 2008); guidelines are not published for Ag, Al, Fe, or Se.

COMPARISON AMONG SITES

Periphyton: Chlorophyll Density and Composition

In 2023, the Lower Glacier Creek mean Chl-*a* density was greater than the Middle Glacier Creek mean density; and both means were greater than the range observed 2016–2022 (Figure 17).

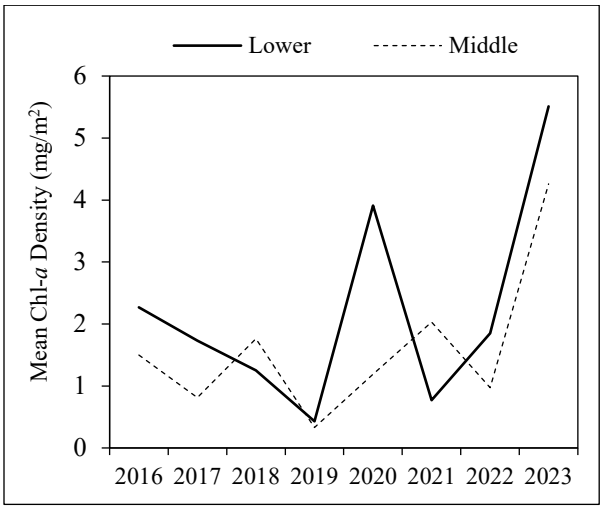

Figure 17.–Glacier Creek chlorophyll-*a* densities.

Benthic Macroinvertebrate Density and Community Composition

In 2023 at Lower Glacier Creek, we documented the greatest BMI density observed and the lowest taxa richness, tied with 2019 (Figures 18, 19). At Middle Glacier Creek, the 2023 mean BMI density was the greatest observed and taxa richness was within the 2016–2022 range. Diptera: Chironomidae insects were the dominant taxon at both sites in 2023, as in most previous years.

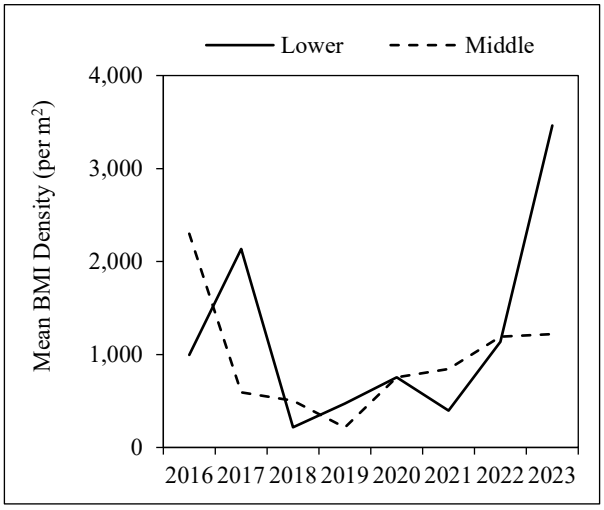

Figure 18.–Glacier Creek mean benthic macroinvertebrate densities.

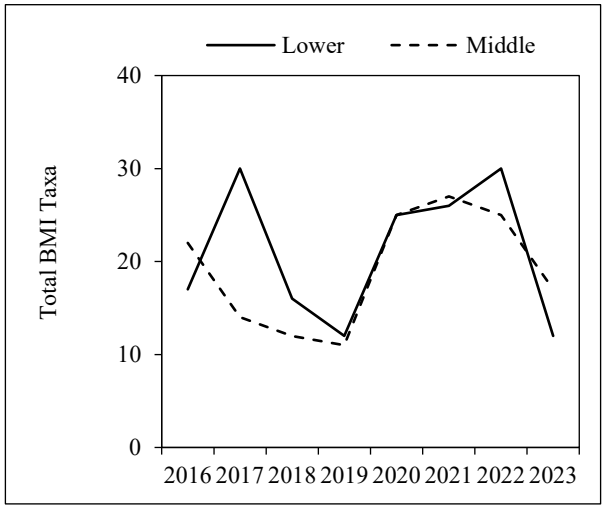

Figure 19.–Glacier Creek benthic macroinvertebrate taxa richness.

Resident Fish Condition and Element Concentrations

Mean fish condition among the 2023 Lower and Middle Glacier Creek Dolly Varden samples was 1.1 and 1.3 at each site, like the 2016–2022 results and other Dolly Varden condition data collected in Southeast Alaska (Lindgren and King 2023).

When we combined the 2016–2023 Dolly Varden element concentration data by site, most median element concentrations were greater among the Lower Glacier Creek samples. Median Ag and As concentrations were similar at both sites, as those elements are often not detected (Figure 20). All concentrations were within the ranges observed in whole body Dolly Varden samples collected from reference and exploration sites elsewhere in Alaska (Legere and Timothy 2016).

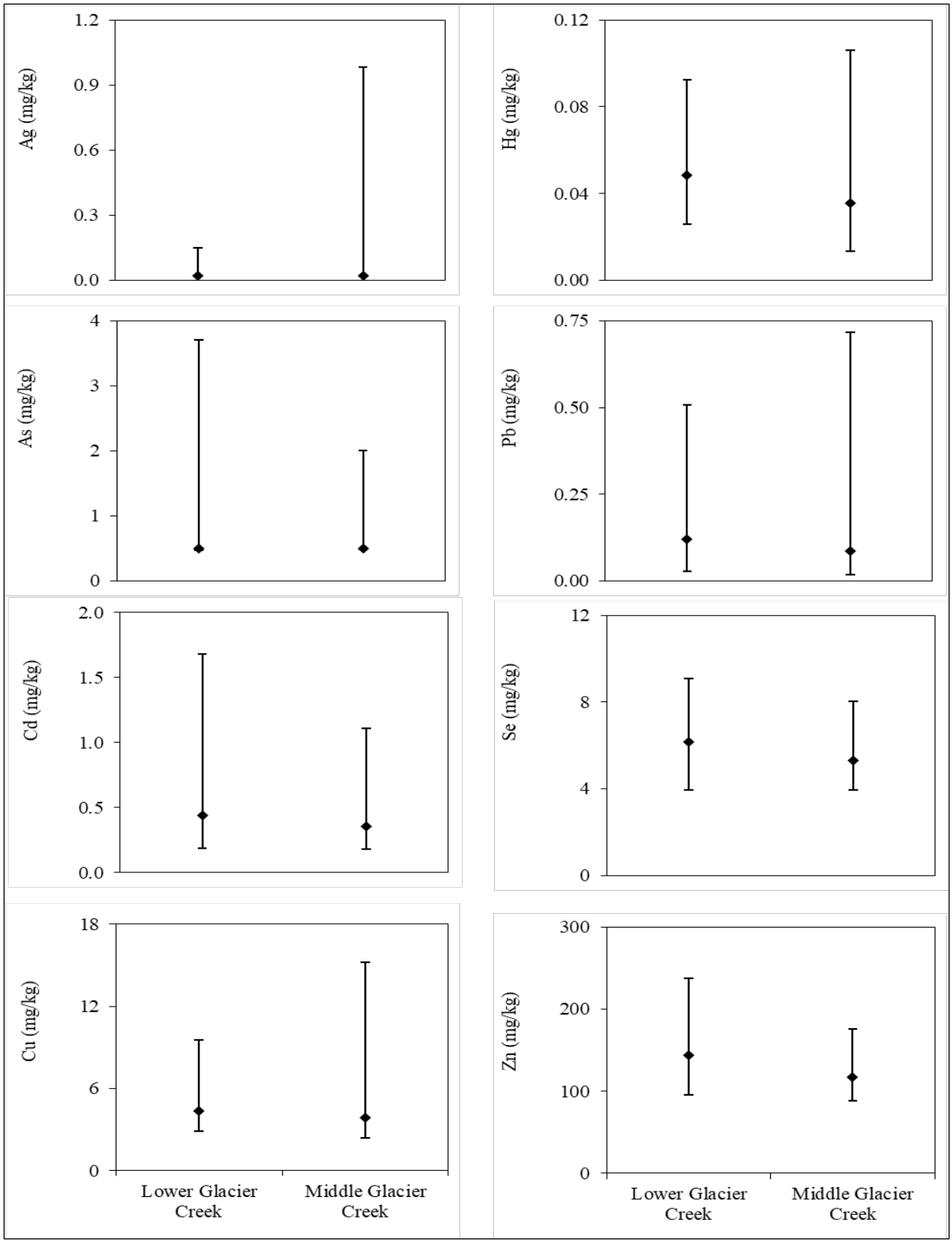

Figure 20.–Glacier Creek whole body Dolly Varden element concentrations, 2016–2023.

Note: Median (♦), minimum, and maximum concentrations presented; element concentrations not detected are included at the method reporting limit.

Sediment Composition and Element Concentrations

The 2016–2023 Lower and Middle Glacier Creek sediment samples were largely composed of sand and silt; total organic carbon was less than 0.816% and acid volatile sulfide was not detected. When we combined the 2016–2023 sediment element concentration data by site, median element concentrations were generally similar among sites (Figure 21).

We evaluated the element concentration data against the guidelines for freshwater sediments published in Buchman (2008). We found Cd, Cu, and Zn concentrations near or above the TEC values, and As, Hg, and Pb concentrations below the TEC values at both sites, like the 2016–2022 results (Figure 21). Guidelines are not published for Ag, Al, Fe, or Se.

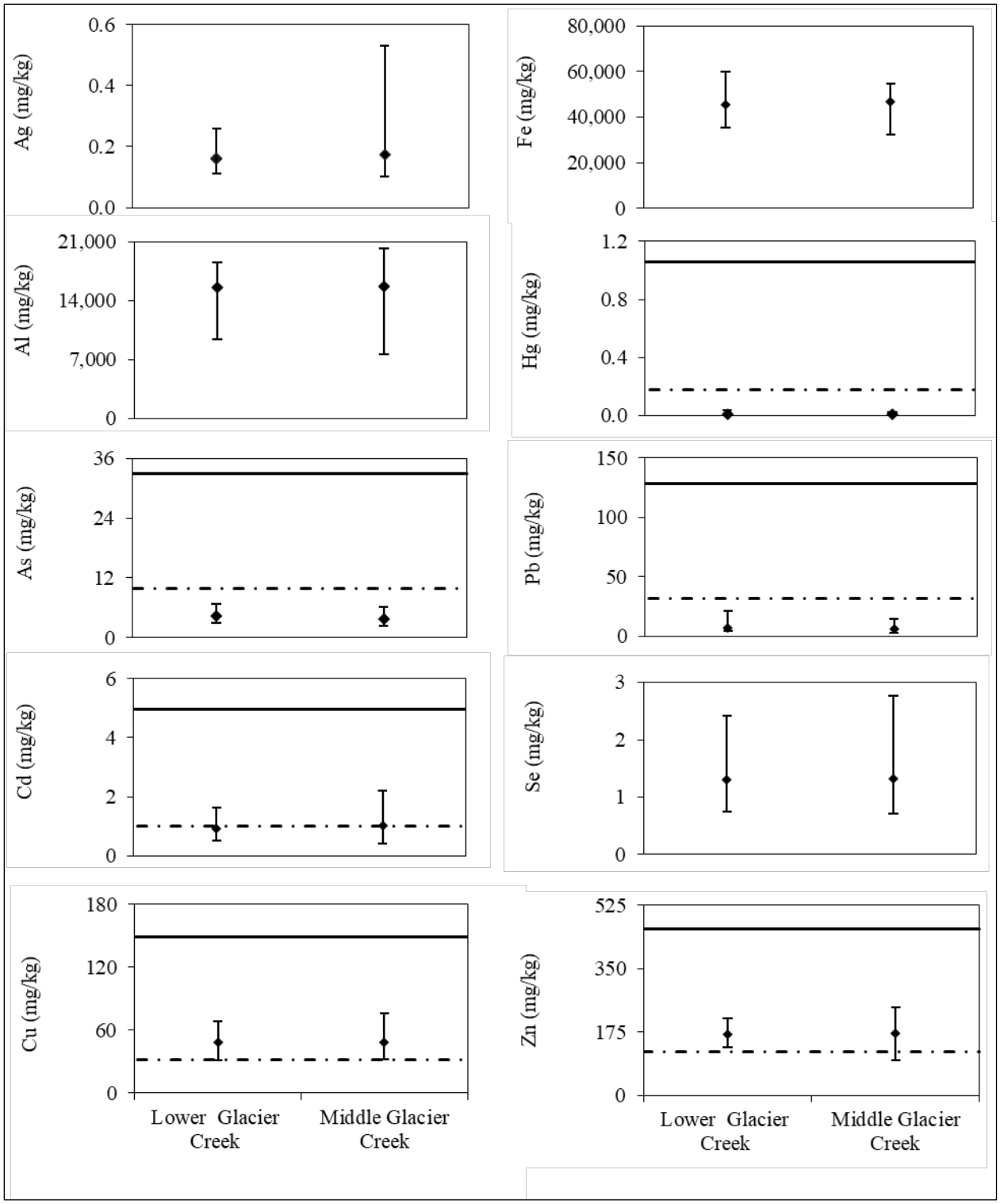

Figure 21.–Glacier Creek sediment element concentrations, 2016–2023.

Note: Median (♦), minimum, and maximum concentrations presented; element concentrations not detected are included at the at the method reporting limit.

Note: The dashed line represents the TEC and the solid line represents the PEC for freshwater sediments (Buchman 2008); guidelines are not published for Ag, Al, Fe, or Se.

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APPENDIX A: WATER QUALITY DATA

Appendix A.1.–Lower Glacier Creek water quality data, 2016–2023.

Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	pH
06/07/16	3.3	12.6	115	126	6[a]
06/08/17	6.5	13.6	129	306	8.32
05/30/18	5.8	10.8	161	17	8.15[b]
06/06/19	6.6	12.4	133.6	11	6.76[c]
06/03/20	5.74	12.02	233	17	7.85
06/16/21	5.12	ND	207	ND	8.20
06/13/22	4.06	10.86	215	52	8.10
06/07/23	4.94	14.89	229	24.6	8.09

[a] We used a colorpHast pH indicator strip with 0.5 unit sensitivity.
[b] Taken by Allegra Cairns on 6/2/2018.
[c] Taken by Allegra Cairns on 6/8/2019.

Appendix A.2.–Middle Glacier Creek water quality data, 2016–2023.

Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	pH
06/08/16	3.1	14.1	129	57	6[a]
06/09/17	3.1	16.7	113	> 1000	8.38
05/31/18	4.1	11.3	182	16	ND
06/07/19	4.0	18.0	126	94	ND
06/02/20	3.44	13.3	246	23	8.14
06/15/21	2.59	ND	197	ND	7.98
06/14/22	3.72	13.11	251	60	8.11
06/06/23	4.01	14.22	258	42.6	8.09

[a] We used a colorpHast pH indicator strip with 0.5 unit sensitivity.

APPENDIX B: CHLOROPHYLL DATA

Appendix B.1.–Lower Glacier Creek chlorophylls *a*, *b*, and *c* densities, 2016–2023.

	06/07/16			06/08/17			05/30/18		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	3.35	0.00	0.47	1.50	0.00	0.17	0.21	0.00	0.08
	3.31	0.00	0.51	1.28	0.00	0.25	1.23	0.00	0.20
	2.56	0.00	0.45	2.89	0.00	0.30	3.31	0.00	0.51
	1.28	0.00	0.29	1.82	0.00	0.20	0.53	0.00	0.08
	3.10	0.00	0.38	1.92	0.00	0.25	0.53	0.00	0.07
	1.97	0.00	0.29	3.31	0.00	0.46	0.96	0.00	0.22
	0.53	0.00	0.11	1.92	0.00	0.24	3.10	0.00	0.53
	2.03	0.00	0.30	**0.19**	ND	ND	1.28	0.00	0.24
	3.52	0.00	0.63	1.39	0.00	0.21	0.43	0.15	0.27
	1.01	0.00	0.09	1.09	0.00	0.22	0.96	0.00	0.15
Mean	2.27	0.00	0.35	1.73	0.00	0.26	1.25	0.02	0.24
Minimum	0.53	0.00	0.09	0.19	0.00	0.17	0.21	0.00	0.07
Maximum	3.52	0.00	0.63	3.31	0.00	0.46	3.31	0.15	0.53

Note: Bold value is the spectrophotometer estimated detection limit, Chl-*a* not detected.

Appendix B.1.–Continued.

	06/06/19			06/03/20			06/16/21		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.43	0.00	0.03	5.23	0.00	0.58	**0.29**	ND	ND
	0.10	ND	ND	6.19	0.00	0.86	0.63	0.06	0.24
	0.53	0.00	0.00	3.66	0.00	0.52	0.36	0.05	0.15
	0.14	0.00	0.00	2.20	0.00	0.23	**0.29**	ND	ND
	0.22	0.05	0.00	1.06	0.00	0.09	2.89	0.00	0.50
	0.10	ND	ND	1.34	0.00	0.11	1.39	0.00	0.32
	0.11	0.01	0.05	1.06	0.00	0.09	**0.29**	ND	ND
	1.92	0.00	0.18	9.90	0.00	1.10	0.32	0.02	0.14
	0.64	0.00	0.01	1.65	0.00	0.20	0.92	0.00	0.11
	0.10	ND	ND	6.84	0.00	0.89	**0.29**	ND	ND
Mean	0.43	0.01	0.04	3.91	0.00	0.47	0.77	0.02	0.24
Minimum	0.10	0.00	0.00	1.06	0.00	0.09	0.29	0.00	0.11
Maximum	1.92	0.05	0.18	9.90	0.00	1.10	2.89	0.06	0.50

Note: Bold value is the spectrophotometer estimated detection limit, Chl-*a* not detected.

Appendix B.1.–Continued.

	06/13/22			06/07/23		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	1.17	0.00	0.19	5.32	0.00	0.73
	0.55	0.00	0.12	4.40	0.00	0.52
	4.72	0.00	0.81	4.91	0.00	0.69
	1.64	0.00	0.34	3.76	0.00	0.51
	0.22	ND	ND	9.51	0.00	0.82
	0.22	ND	ND	6.84	0.00	1.01
	3.80	0.00	0.70	4.81	0.00	0.60
	2.78	0.00	0.53	6.30	0.00	0.75
	2.98	0.00	0.45	5.78	0.00	0.80
	0.37	0.00	0.00	3.52	0.00	0.50
Mean	1.85	0.00	0.39	5.51	0.00	0.69
Minimum	0.22	0.00	0.00	3.52	0.00	0.50
Maximum	4.72	0.00	0.81	9.51	0.00	1.01

Note: Bold value is the spectrophotometer estimated detection limit, Chl-*a* not detected.

Appendix B.2.–Middle Glacier Creek chlorophylls *a*, *b*, and *c* densities, 2016–2023.

	06/08/16			06/09/17			05/31/18		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	1.82	0.00	0.30	0.96	0.00	0.15	1.50	0.00	0.20
	4.38	0.00	0.75	0.75	0.00	0.15	1.92	0.00	0.27
	0.96	0.00	0.10	1.38	0.00	0.08	2.24	0.00	0.41
	1.60	0.00	0.26	1.56	0.00	0.22	2.78	0.00	0.44
	0.19	ND	ND	0.43	0.00	0.00	3.10	0.00	0.51
	1.17	0.00	0.13	0.75	0.00	0.05	0.96	0.00	0.14
	0.96	0.00	0.15	0.50	0.00	0.03	0.78	0.00	0.16
	1.82	0.00	0.27	1.17	0.00	0.23	1.60	0.00	0.25
	0.28	0.00	0.00	0.21	0.02	0.10	1.82	0.00	0.35
	1.82	0.00	0.27	0.43	0.00	0.02	0.85	0.00	0.20
Mean	1.50	0.00	0.25	0.81	0.00	0.10	1.76	0.00	0.29
Minimum	0.19	0.00	0.00	0.21	0.00	0.00	0.78	0.00	0.14
Maximum	4.38	0.00	0.75	1.56	0.02	0.23	3.10	0.00	0.51

Note: Bold value is the spectrophotometer estimated detection limit, Chl-*a* not detected.

Appendix B.2.–Continued.

	06/07/19			06/02/20			06/15/21		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.83	0.00	0.05	**0.25**	ND	ND	6.19	0.00	0.70
	0.18	0.00	0.04	2.43	0.00	0.33	0.64	0.00	0.10
	0.55	0.00	0.02	1.70	0.00	0.17	1.11	0.00	0.08
	0.10	ND	ND	0.28	0.00	0.03	0.85	0.00	0.01
	0.21	0.00	0.02	0.73	0.00	0.07	1.19	0.00	0.13
	0.14	0.01	0.05	0.55	0.00	0.02	2.34	0.00	0.28
	0.18	0.06	0.11	0.96	0.00	0.10	0.64	0.03	0.13
	0.21	0.00	0.00	0.50	0.06	0.20	0.43	0.00	0.00
	0.53	0.00	0.02	2.48	0.00	0.32	**0.29**	ND	ND
	0.32	0.00	0.09	2.06	0.00	0.25	6.62	0.00	0.84
Mean	0.33	0.01	0.04	1.19	0.01	0.16	2.03	0.00	0.25
Minimum	0.10	0.00	0.00	0.25	0.00	0.02	0.29	0.00	0.00
Maximum	0.83	0.06	0.11	2.48	0.06	0.33	6.62	0.03	0.84

Note: Bold value is the spectrophotometer estimated detection limit, Chl-*a* not detected.

Appendix B.2.–Continued.

	06/14/22			06/06/23		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.22	ND	ND	5.45	0.00	0.74
	1.92	0.00	0.28	3.76	0.00	0.54
	0.64	0.00	0.11	8.22	0.00	1.13
	2.62	0.00	0.30	2.39	0.00	0.37
	0.22	ND	ND	5.83	0.00	0.79
	0.22	ND	ND	4.68	0.00	0.65
	0.22	ND	ND	2.75	0.00	0.35
	0.22	ND	ND	4.13	0.00	0.53
	1.69	0.00	0.33	2.35	0.00	0.31
	1.71	0.00	0.31	3.03	0.00	0.35
Mean	0.97	0.00	0.27	4.26	0.00	0.58
Minimum	0.22	0.00	0.00	0.22	0.00	0.00
Maximum	2.62	0.00	0.33	8.22	0.00	1.13

Note: Bold value is the spectrophotometer estimated detection limit, Chl-*a* not detected.

APPENDIX C: BENTHIC MACROINVERTEBRATE DATA

Appendix C.1.–Lower Glacier Creek benthic macroinvertebrate sample data, 2023.

				Sample Number						
Class or Subclass	Order	Family	Genus	1	2	3	4	5	6	**Total**
Insecta	Ephemeroptera	Baetidae	*Baetis*	13	22	70	23	74	3	**205**
		Ephemerellidae	*Drunella*	0	0	2	0	1	0	**3**
		Heptageniidae	*Epeorus*	0	1	0	0	0	0	**1**
			Rhithrogena	0	1	4	0	0	0	**5**
	Plecoptera	Capniidae	*Capnia*	6	2	5	2	3	1	**19**
		Chloroperlidae	*Suwallia*	0	1	9	1	23	6	**40**
		Leuctridae	*Despaxia*	0	1	0	0	0	0	**1**
		Nemouridae	*Zapada*	0	0	2	0	2	0	**4**
		Perlodidae	unidentified	0	0	0	0	1	1	**2**
	Trichoptera	unidentified	unidentified	0	0	1	0	0	0	1
	Diptera	Chironomidae	unidentified	225	133	492	191	496	105	**1642**
		unidentified	unidentified	0	0	1	0	0	0	**1**
	Coleoptera	Staphylinidae	unidentified	1	0	1	4	1	0	**7**
Nematoda	unidentified	unidentified	unidentified	0	0	0	0	1	0	**1**
			Total	**245**	**161**	**587**	**221**	**602**	**116**	**1932**

Appendix C.2.–Lower Glacier Creek benthic macroinvertebrate data summaries, 2016–2023.

	06/07/16	06/08/17	05/30/18	06/06/19	06/03/20	06/16/21	06/13/22	06/07/23
Total BMI taxa	17	30	16	12	25	26	30	12
Number of EPT taxa	9	13	10	5	12	12	14	9
Total counts								
Ephemeroptera	44	158	61	65	49	21	77	214
Plecoptera	13	41	22	12	26	35	52	66
Trichoptera	1	3	1	1	4	3	3	1
Aquatic Diptera	478	955	33	178	322	140	467	1,643
Other organisms	19	35	4	8	20	22	35	8
% Ephemeroptera	8%	13%	50%	25%	11.6%	9.5%	12.1%	11.1%
% Plecoptera	2%	3%	18%	5%	6.2%	15.8%	8.2%	3.4%
% Trichoptera	0.2%	0.3%	0.8%	0.4%	1.0%	1.4%	0.5%	0.1%
% Aquatic Diptera	86%	80%	27%	67%	76.5%	63.3%	73.7%	85.0%
% Other organisms	3%	3%	3%	3%	4.8%	10.0%	5.5%	0.4%
% EPT	10%	17%	69%	30%	19%	27%	21%	15%
% Chironomidae	85%	78%	26%	67%	74%	58%	71%	85%
Total aquatic invertebrates	555	1,192	121	264	421	221	634	1,932
Total terrestrial invertebrates	17	18	13	17	4	29	23	19
Total invertebrates	572	1,210	134	281	425	250	657	1,951
% Sample aquatic	97.0%	98.5%	90.3%	94.0%	99.1%	88.4%	96.5%	99.0%
% Sample terrestrial	3.0%	1.5%	0.0%	6.0%	0.9%	11.6%	3.5%	1.0%
Total sample area (m^2)	0.558	0.558	0.558	0.558	0.558	0.558	0.558	0.558
Mean BMI density (per m^2)	995	2,136	217	473	754	396	1,136	3,462
±1 SD	373	1,015	151	148	463	150	439	2322

Appendix C.3.–Middle Glacier Creek benthic macroinvertebrate sample data, 2023.

				Sample Number						
Class or Subclass	Order	Family	Genus	1	2	3	4	5	6	**Total**
Insecta	Ephemeroptera	Baetidae	*Baetis*	2	16	29	11	14	27	**99**
		Ephemerellidae	*Drunella*	0	0	1	0	0	0	**1**
		Heptageniidae	*Cinygmula*	0	1	0	0	2	0	**3**
			Epeorus	0	0	3	2	0	1	**6**
			Rhithrogena	2	0	0	1	1	3	**7**
	Plecoptera	Capniidae	*Capnia*	0	0	1	1	0	2	**4**
		Chloroperlidae	*Suwallia*	0	1	12	0	7	29	**49**
		Nemouridae	*Zapada*	0	0	2	0	1	2	**5**
		Perlodidae	unidentified	0	10	0	2	7	0	**19**
	Trichoptera	Rhyacophilidae	*Rhyacophila*	0	0	1	0	0	1	**2**
	Diptera	Chironomidae	unidentified	16	33	119	102	59	145	**474**
		Limoniidae	*Gonomyodes*	0	1	2	0	1	0	**4**
		Tipulidae	*Dicranota*	0	1	0	0	1	0	**2**
			Molophilus	0	1	0	0	0	0	**1**
			unidentified	0	0	0	0	1	0	**1**
		unidentified	unidentified	0	1	0	0	1	0	**2**
	Coleoptera	Staphylinidae	unidentified	0	1	0	0	0	0	**1**
Oligochaeta	unidentified	unidentified	unidentified	0	0	0	1	0	0	**1**
			Total	**20**	**66**	**170**	**120**	**95**	**210**	**681**

Appendix C.4.–Middle Glacier Creek benthic macroinvertebrate data summaries, 2016–2023.

	06/08/16	06/09/17	05/31/18	06/07/19	06/02/20	06/15/21	06/14/22	06/06/23
Total BMI taxa	22	14	12	11	25	27	25	17
Number of EPT taxa	12	6	5	8	13	11	13	10
Total counts								
Ephemeroptera	119	25	18	22	43	76	45	116
Plecoptera	45	14	7	10	52	70	35	77
Trichoptera	4	1	0	2	6	8	3	2
Aquatic Diptera	1,107	276	254	85	306	282	534	484
Other organisms	8	15	2	1	14	34	48	2
% Ephemeroptera	9%	8%	6%	18%	10%	16%	6.8%	17.0%
% Plecoptera	4%	4%	2%	8%	12%	15%	5.3%	11.3%
% Trichoptera	0.3%	0.3%	0.0%	1.7%	1.4%	1.7%	0.5%	0.3%
% Aquatic Diptera	86%	83%	90%	71%	73%	60%	80%	71%
% Other organisms	1%	5%	0.7%	0.8%	3.3%	7.2%	7.2%	0.3%
% EPT	13%	12%	9%	28%	24%	33%	12%	29%
% Chironomidae	85%	82%	87%	68%	69%	57%	79%	70%
Total aquatic invertebrates	1,283	331	281	120	421	470	665	681
Total terrestrial invertebrates	19	7	1	4	7	13	59	12
Total invertebrates	1,302	338	282	124	428	483	724	693
% Sample aquatic	98.5%	97.9%	99.6%	96.8%	98.4%	97.3%	91.9%	98.3%
% Sample terrestrial	1.5%	2.1%	0.4%	3.2%	1.6%	2.7%	8.1%	1.7%
Total sample area (m^2)	0.558	0.558	0.558	0.558	0.558	0.558	0.558	0.558
Mean BMI density (per m^2)	2,299	593	504	215	754	842	1,192	1,220
±1 SD	976	392	249	249	484	743	1,261	743

APPENDIX D: RESIDENT FISH DATA AND LABORATORY REPORT

Appendix D.1.–Lower Glacier Creek whole body Dolly Varden element concentrations, 2016–2023.

Sample Date	Length (mm)	Weight (g)	Condition (K)	Ag (mg/kg)	As (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
06/07/16	108	12.7	1.0	<0.019	<0.48	0.429	3.55	0.0466	0.076	7.23	153
06/07/16	68	4.8	1.5	<0.020	<0.50	0.501	3.75	0.0330	0.182	7.60	173
06/07/16	112	17.7	1.3	0.025	<0.48	1.310	3.63	0.0567	0.230	5.48	145
06/07/16	105	15.9	1.4	<0.019	<0.48	0.585	3.23	0.0509	0.078	7.56	150
06/07/16	113	14.3	1.0	<0.020	0.50	0.420	3.42	0.0427	0.177	6.21	154
06/07/16	94	10.8	1.3	<0.019	0.52	0.441	4.35	0.0381	0.195	7.83	167
06/07/16	109	14.6	1.1	0.026	<0.50	1.250	5.20	0.0683	0.362	6.46	238
06/07/16	97	11.2	1.2	<0.019	<0.49	0.641	3.71	0.0401	0.172	6.11	154
06/08/16	93	9.5	1.2	<0.020	<0.49	0.960	3.32	0.0349	0.091	7.04	141
06/08/16	73	4.7	1.2	0.025	0.54	0.730	4.67	0.0353	0.360	6.31	168
06/08/17	133	29.1	1.2	0.023	<0.50	0.727	4.47	0.0599	0.109	6.00	184
06/08/17	113	15.7	1.1	<0.020	<0.50	0.426	3.69	0.0505	0.027	7.01	148
06/08/17	105	12.6	1.1	<0.020	<0.50	0.601	3.23	0.0523	0.038	7.16	134
06/08/17	90	9.2	1.3	0.038	<0.50	1.230	3.24	0.0473	0.088	8.33	123
06/08/17	106	12.8	1.1	<0.020	<0.50	0.606	4.06	0.0532	0.104	9.09	153
06/08/17	175	60.5	1.1	<0.020	<0.50	0.355	4.71	0.0924	0.119	6.90	162
06/08/17	75	5.7	1.4	<0.020	<0.50	0.429	4.77	0.0438	0.202	7.86	157
06/08/17	110	17.3	1.3	0.025	<0.50	0.736	4.35	0.0446	0.074	9.03	126
06/08/17	59, 118[a]	20.2	ND	<0.020	<0.50	0.472	4.20	0.0456	0.119	7.30	160
06/08/17	102, 70[a]	15.6	ND	<0.020	<0.50	0.865	4.55	0.0642	0.196	7.62	130
05/30/18	112	12.3	0.9	<0.020	<0.50	0.183	3.26	0.0511	0.042	5.14	114
05/30/18	66, 65[a]	4.7	ND	<0.034	<0.84	0.458	5.30	0.0467	0.098	5.90	142
05/30/18	109	15.1	1.2	<0.020	<0.50	0.257	4.34	0.0592	0.080	6.70	121
05/30/18	103	11.6	1.1	<0.020	<0.50	0.272	4.05	0.0426	0.108	7.04	132
05/30/18	78, 65[a]	7.0	ND	<0.020	<0.50	0.545	5.03	0.0589	0.136	6.19	182
05/30/18	97	7.8	0.9	<0.020	<0.50	0.558	5.04	0.0529	0.165	6.25	160
05/30/18	61, 63[a]	4.1	ND	<0.15	<3.7	0.710	5.29	0.0511	0.170	7.30	158
05/30/18	92	6.5	0.8	<0.020	<0.50	0.512	5.74	0.0545	0.207	5.47	175
05/30/18	81	4.5	0.8	<0.024	<0.59	0.440	4.43	0.0496	0.080	6.50	150
05/30/18	106	12.2	1.0	<0.020	<0.50	0.284	4.91	0.0530	0.087	5.76	149

[a] Composite sample of two fish.

Appendix D.1.–Continued.

Sample Date	Length (mm)	Weight (g)	Condition (*K*)	Ag (mg/kg)	As (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
06/06/19	122	22.9	1.3	<0.020	<0.50	0.237	4.07	0.0546	0.110	5.83	158
06/06/19	124	22.7	1.2	<0.019	<0.48	0.349	3.63	0.0440	0.082	5.87	117
06/06/19	155	42.5	1.1	<0.020	<0.50	0.514	5.79	0.0510	0.180	6.27	207
06/06/19	97	12.3	1.3	<0.020	<0.50	0.372	5.58	0.0341	0.137	7.32	156
06/06/19	121	20.8	1.2	<0.020	<0.49	0.353	2.87	0.0496	0.144	5.82	116
06/06/19	106	15.0	1.3	<0.019	<0.47	0.259	4.42	0.0540	0.168	6.95	134
06/06/19	105	13.6	1.2	<0.020	<0.49	0.300	3.37	0.0368	0.109	5.95	115
06/06/19	117	19.7	1.2	<0.020	<0.50	0.665	4.86	0.0428	0.206	6.02	150
06/06/19	141	27.1	1.0	<0.019	<0.48	0.440	4.87	0.0457	0.158	6.68	148
06/06/19	126	25.5	1.3	<0.020	<0.50	0.442	5.18	0.0549	0.129	5.69	188
06/03/20	115	14.8	1.0	<0.020	<0.49	0.223	4.15	0.0517	0.053	5.92	149
06/03/20	98	11.2	1.2	<0.020	<0.50	0.657	4.10	0.0412	0.051	5.55	134
06/03/20	110	15.4	1.2	<0.020	<0.50	0.29	4.03	0.0425	0.076	5.72	160
06/03/20	99	11.9	1.2	<0.020	<0.49	0.446	4.77	0.0455	0.178	6.75	132
06/03/20	123	19.9	1.1	<0.019	<0.49	0.467	4.91	0.0458	0.055	5.82	139
06/03/20	113	14.7	1.0	0.021	<0.49	1.29	5.81	0.0429	0.120	6.50	144
06/03/20	107	14.0	1.1	<0.020	<0.50	0.309	4.36	0.0412	0.069	5.95	141
06/03/20	113	15.8	1.1	<0.020	<0.50	0.312	5.49	0.0509	0.085	5.95	143
06/03/20	112	15.6	1.1	<0.020	<0.50	0.359	3.43	0.0369	0.045	7.10	150
06/03/20	122	18.3	1.0	<0.020	<0.50	0.286	4.62	0.0537	0.097	6.00	146
06/16/21	113	13.5	0.9	<0.020	<0.49	1.05	6.69	0.0630	0.278	6.49	214
06/16/21	110	14.9	1.1	<0.020	<0.49	0.873	7.06	0.0476	0.357	5.57	216
06/16/21	142	30.6	1.1	<0.020	<0.49	0.404	4.17	0.0829	0.120	6.17	136
06/16/21	100	13.2	1.3	<0.020	<0.50	0.413	3.63	0.0551	0.094	5.68	124
06/16/21	103	14.2	1.3	<0.019	<0.49	0.375	3.76	0.0465	0.055	5.78	115
06/16/21	137	33.3	1.3	<0.020	<0.49	0.188	3.27	0.0573	0.078	4.66	119
06/16/21	138	27.9	1.1	<0.020	<0.50	0.556	4.41	0.0720	0.080	6.21	136
06/16/21	123	21.8	1.2	<0.020	<0.50	0.276	3.56	0.0430	0.063	6.64	106
06/16/21	149	34.9	1.1	<0.020	<0.50	0.351	4.34	0.0509	0.062	5.26	113
06/16/21	128	23.3	1.1	<0.020	<0.50	0.434	4.31	0.0443	0.170	4.85	105
06/13/22	133	35.5	1.5	<0.020	<0.50	0.447	4.08	0.0511	0.064	3.95	109
06/13/22	148	40.0	1.2	<0.020	<0.50	0.227	3.76	0.0737	0.031	5.14	133
06/13/22	93	9.2	1.1	<0.020	<0.50	0.360	3.31	0.0513	0.062	5.88	127
06/13/22	144	36.4	1.2	<0.020	<0.50	0.443	4.88	0.0482	0.052	5.18	121
06/13/22	113	17.3	1.2	<0.020	<0.50	0.595	3.55	0.0424	0.063	5.40	117
06/13/22	107	17.5	1.4	<0.020	<0.50	1.680	4.48	0.0473	0.220	5.89	124
06/13/22	100	13.2	1.3	0.053	<0.50	0.876	6.58	0.0551	0.507	6.99	176
06/13/22	115	16.5	1.1	<0.020	<0.50	0.254	3.20	0.0612	0.060	5.27	115
06/13/22	107	16.0	1.3	<0.020	<0.50	1.020	5.07	0.0397	0.220	6.47	129
06/13/22	102	13.3	1.3	0.022	<0.50	1.100	5.17	0.0479	0.150	6.13	147

Appendix D.1.–Continued.

Sample Date	Length (mm)	Weight (g)	Condition (*K*)	Ag (mg/kg)	As (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
06/07/23	130	27.9	1.3	<0.020	<0.49	0.281	4.59	0.0350	0.092	4.52	95.8
06/07/23	104	14.0	1.2	<0.020	<0.50	0.323	4.82	0.0516	0.188	5.72	133
06/07/23	136	29.5	1.2	<0.020	<0.49	0.252	3.19	0.0382	0.136	6.96	121
06/07/23	106	13.1	1.1	<0.020	<0.49	0.400	5.57	0.0415	0.273	5.55	197
06/07/23	105	13.8	1.2	<0.020	<0.50	0.270	9.55	0.0259	0.218	6.20	127
06/07/23	103	9.8	0.9	<0.020	<0.49	0.319	4.16	0.0382	0.162	6.17	126
06/07/23	115	14.9	1.0	<0.020	<0.49	0.806	4.31	0.0483	0.228	6.13	146
06/07/23	98	10.6	1.1	0.026	<0.49	0.791	5.31	0.0496	0.240	5.79	143
06/07/23	112	17.6	1.3	<0.020	<0.50	0.487	5.91	0.0374	0.196	6.53	167
06/07/23	94	8.1	1.0	<0.020	<0.50	0.695	6.11	0.0548	0.220	4.81	155

Appendix D.2.–Middle Glacier Creek whole body Dolly Varden element concentrations, 2016–2023.

Sample Date	Length (mm)	Weight (g)	Condition (*K*)	Ag (mg/kg)	As (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
06/08/16	150	36.0	1.1	0.031	<0.48	0.605	3.37	0.0429	0.069	5.66	143
06/08/16	108	15.9	1.3	<0.020	<0.50	0.327	4.33	0.0337	0.183	6.91	147
06/08/16	123	26.5	1.4	<0.020	<0.50	0.683	3.83	0.0301	0.717	5.64	117
06/08/16	73	5.2	1.3	<0.020	<0.49	0.288	4.99	0.0260	0.128	3.94	128
06/08/16	180	66.7	1.1	<0.020	<0.50	0.329	3.11	0.0376	0.061	5.17	132
06/08/16	77	6.0	1.3	<0.020	<0.50	0.215	3.53	0.0259	0.259	4.80	146
06/08/16	83	7.8	1.4	<0.020	<0.50	0.280	3.75	0.0247	0.182	6.05	132
06/08/16	146	31.5	1.0	<0.020	<0.50	0.521	2.50	0.0299	0.062	4.90	103
06/08/16	83	7.0	1.2	<0.020	<0.50	0.678	2.56	0.0328	0.046	4.66	139
06/08/16	70	5.0	1.5	0.682	<0.50	0.257	2.63	0.0184	0.036	6.29	133
06/09/17	154	45.5	1.2	<0.020	<0.50	0.267	3.29	0.0364	0.036	5.14	116
06/09/17	130	24.3	1.1	<0.020	<0.50	0.333	3.23	0.0343	0.056	6.86	95
06/09/17	210	115.0	1.2	<0.020	<0.50	0.758	7.67	0.0701	0.031	6.34	161
06/09/17	141	34.7	1.2	<0.020	<0.50	0.291	3.33	0.0430	0.037	8.02	126
06/09/17	131	24.3	1.1	<0.020	<0.50	0.299	3.26	0.0385	0.100	6.10	128
06/09/17	90	7.4	1.0	<0.020	<0.50	0.343	2.40	0.0361	0.034	6.86	101
05/31/18	171	55.9	1.1	<0.020	<0.50	0.696	15.20	0.0641	0.080	6.56	176
05/31/18	138	28.3	1.1	<0.020	<0.50	0.541	6.22	0.0659	0.044	5.30	114
05/31/18	58, 57[a]	4.2	ND	<0.082	<2.0	0.357	4.25	0.0191	0.087	4.90	114
05/31/18	188	76.2	1.1	0.027	<0.50	0.889	12.70	0.0487	0.143	6.22	140
05/31/18	175	58.1	1.1	<0.020	<0.50	0.612	5.47	0.0296	0.107	5.20	108
05/31/18	100	11.2	1.1	0.029	<0.50	0.802	5.07	0.0676	0.122	6.72	146
06/07/19	65, 65[a]	8.3	ND	<0.020	<0.50	0.501	3.89	0.0157	0.053	5.81	117
06/07/19	72, 70[a]	10.2	ND	<0.020	<0.50	0.615	3.91	0.0241	0.073	5.30	101
06/07/19	141	36.9	1.3	<0.019	<0.48	0.354	3.16	0.0468	<0.019	5.46	116
06/07/19	185	88.4	1.4	<0.020	<0.49	0.785	3.42	0.1060	0.050	5.16	161
06/07/19	67, 69[a]	8.6	ND	<0.020	<0.50	0.438	3.55	0.0199	0.109	5.60	105
06/07/19	166	47.4	1.0	<0.019	<0.48	0.280	3.73	0.0528	0.091	5.47	115
06/07/19	87	8.7	1.3	<0.019	<0.48	0.231	2.39	0.0260	0.028	5.54	89.3
06/07/19	100	14.9	1.5	<0.020	<0.49	0.260	3.41	0.0356	0.163	5.43	99.8
06/07/19	75, 77[a]	11.6	ND	0.984	<0.48	0.337	3.94	0.0254	0.179	5.18	106
06/07/19	75, 75[a]	8.4	ND	<0.019	<0.48	0.547	3.68	0.0331	0.120	5.25	88.6

[a] Composite sample of two fish.

Appendix D.2.–Continued.

Sample Date	Length (mm)	Weight (g)	Condition (K)	Ag (mg/kg)	As (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
06/02/20	141	30.3	1.1	<0.019	<0.49	0.251	3.45	0.0465	0.054	5.38	162
06/02/20	142	35.4	1.2	<0.020	<0.50	0.182	3.73	0.0396	0.127	4.12	125
06/02/20	118	20.1	1.2	<0.020	<0.49	0.344	4.97	0.0327	0.219	5.04	131
06/02/20	108	14.4	1.1	<0.020	<0.49	0.373	5.07	0.0326	0.216	4.81	144
06/02/20	119	18.4	1.1	<0.020	<0.49	0.314	4.19	0.0302	0.094	5.55	112
06/02/20	111	14.6	1.1	<0.019	<0.49	0.249	3.79	0.0326	0.151	4.94	129
06/15/21	140	37.2	1.4	0.022	<0.50	1.11	9.25	0.0503	0.170	5.21	132
06/15/21	148	51.0	1.6	<0.020	<0.50	0.431	4.95	0.0505	0.080	4.30	99.1
06/15/21	158	48.2	1.2	<0.020	<0.49	0.348	6.37	0.0656	0.057	4.87	136
06/15/21	163	54.0	1.2	<0.020	<0.49	0.204	3.95	0.0416	0.031	4.50	89.1
06/15/21	135	32.8	1.3	<0.020	<0.49	0.286	5.99	0.0574	0.095	4.68	111
06/14/22	95	10.0	1.2	<0.020	<0.49	0.400	3.5	0.0132	0.038	5.44	94.3
06/06/23	153	47.2	1.3	0.021	<0.50	0.485	4.20	0.0402	0.110	4.8	119
06/06/23	105	17.9	1.5	<0.020	<0.49	0.453	3.99	0.0215	0.104	4.24	107
06/06/23	148	43.0	1.3	0.022	<0.50	0.958	3.85	0.0416	0.076	4.18	95.4
06/06/23	144	33.7	1.1	0.031	<0.49	0.569	4.16	0.0610	0.416	4.46	109
06/06/23	95	9.9	1.2	<0.020	<0.49	0.406	4.39	0.0178	0.087	6.87	119

ALS Environmental
ALS Group USA, Corp
1317 South 13th Avenue
Kelso, WA 98626
T : +1 360 577 7222
F : +1 360 636 1068
www.alsglobal.com

September 29, 2023 **Analytical Report for Service Request No:** K2310263

Dylan Krull
Alaska Department of Fish and Game
Division of Habitat
802 3rd Street
P.O. Box 110024
Douglas, AK 99811-0024

RE: 2023 Palmer Project Biomonitoring

Dear Dylan,

Enclosed are the results of the sample(s) submitted to our laboratory September 12, 2023
For your reference, these analyses have been assigned our service request number **K2310263.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3376. You may also contact me via email at Mark.Harris@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Mark Harris
Project Manager

ALS Environmental
ALS Group USA, Corp
1317 South 13th Avenue
Kelso, WA 98626
T : +1 360 577 7222
F : +1 360 636 1068
www.alsglobal.com

Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L16-58-R4
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water-	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577- 7222 Fax (360)636- 1068
www.alsglobal.com

ALS Environmental

Client: Alaska Department of Fish and Game
Project: 2023 Palmer Project Biomonitoring
Sample Matrix: Animal Tissue

Service Request: K2310263
Date Received: 09/12/2023

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples for the Tier II level requested by the client.

Sample Receipt:

Fifteen animal tissue samples were received for analysis at ALS Environmental on 09/12/2023. Any discrepancies upon initial sample inspection are annotated on the sample receipt and preservation form included within this report. The samples were stored at minimum in accordance with the analytical method requirements.

Metals:

Method 6020A, 09/27/2023: The Relative Percent Difference (RPD) for the replicate analysis of Lead in sample 2023MGCDV1 was outside the normal ALS control limits. The samples were homogenized, freeze dried, then ground prior to digestion, however this was not sufficient to achieve a completely uniform distribution of these Lead in the tissue.

Approved by Noe D. Davis Date 09/29/2023

Chain of Custody

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CHAIN OF CUSTODY

ALS Environmental

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

SR# 1023263

PAGE 1 OF 2 COC#

PROJECT NAME: 2023 Palmer Project Biomonitoring
PROJECT NUMBER:
PROJECT MANAGER: Dylan Krull
COMPANY NAME: AK Department of Fish & Game
ADDRESS: 802 3rd St
CITY/STATE/ZIP: Douglas, AK 99824
E-MAIL ADDRESS: dylan.krull@alaska.gov
PHONE #: 907-465-6160 FAX #:
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐	Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics Tri☐ Tetra☐ PCP☐	Metals, Total or Dissolved (See List below) 6020A	Cyanide☐ Hex-Chrom☐	(circle) pH, Cond., Cl, SO_4, PO_4, F, NO_2, NO_3, BOD, TSS, TDS, Turb.	(circle) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3, T-Phos	TOX 9020☐ AOX 1650☐ 506☐	Alkalinity☐ CO_3☐ HCO_3☐	Dioxins/Furans 1613☐ 8290☐	Dissolved Gases RSK 175☐ Methane☐ Ethane☐ Ethene☐ CO_2☐				REMARKS
See attachment whole body individual	1 of juvenile samples.	1 for fish											X								X	Hg - 1631 E			

REPORT REQUIREMENTS

- ___ I. Routine Report: Method Blank, Surrogate, as required
- ✓ II. Report Dup., MS, MSD as required
- ___ III. CLP Like Summary (no raw data)
- ___ IV. Data Validation Report
- ___ V. EDD

INVOICE INFORMATION

P.O. # Co
Bill To: Merlin Benner
Merlin@Contaminantmetals.com

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.
___ 5 day
✓ Standard (15 working days)
___ Provide FAX Results

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al (As) Sb Ba Be B Ca (Cd) Co Cr (Cu) Fe (Pb) Mg Mn Mo Ni K (Ag) Na (Se) Sr Tl Sn V (Zn) (Hg)

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: ___ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

please email report to Dylan Krull (dylan.krull@alaska.gov) and Kate Kanouse (kate.kanouse@alaska.gov)

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:		RECEIVED BY:		RELINQUISHED BY:		RECEIVED BY:	
Signature	Date/Time 9/11/2023 @ 7:35a	Signature	Date/Time 9/12/23 0945	Signature	Date/Time	Signature	Date/Time
Printed Name: Nick Jensen	Firm: ADFG	Printed Name: Hayleigh Smith	Firm: ALS	Printed Name	Firm	Printed Name	Firm

Project Name:	2023 Palmer Project Biomonitoring			**Attachment 1 of 2**
Project Manager:	Dylan Krull	Sample Type:	Whole body juvenile Dolly Varden char	
Company Name:	Alaska Department of Fish and Game	Analysis:	EPA 6020A total metals and EPA 1631E Hg,	
Contact Information:	dylan.krull@alaska.gov / 907-465-6160		dry weight basis, report percent solids	

IC23102G3

Matrix	Sample Date	Sample Name	Sample ID	Total Metals	Fork Length (mm)	Weight (g)
Whole Body	6/6/2023	Middle Glacier Creek DV Metals Fish #1	2023MGCDV1	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	153	47.2
Whole Body	6/6/2023	Middle Glacier Creek DV Metals Fish #2	2023MGCDV2	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	105	17.9
Whole Body	6/6/2023	Middle Glacier Creek DV Metals Fish #3	2023MGCDV3	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	148	43.0
Whole Body	6/6/2023	Middle Glacier Creek DV Metals Fish #4	2023MGCDV4	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	144	33.7
Whole Body	6/6/2023	Middle Glacier Creek DV Metals Fish #5	2023MGCDV5	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	95	9.9
Whole Body	6/7/2023	Lower Glacier Creek DV Metals Fish #1	2023LGCDV1	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	130	27.9
Whole Body	6/7/2023	Lower Glacier Creek DV Metals Fish #2	2023LGCDV2	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	104	14.0
Whole Body	6/7/2023	Lower Glacier Creek DV Metals Fish #3	2023LGCDV3	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	136	29.5
Whole Body	6/7/2023	Lower Glacier Creek DV Metals Fish #4	2023LGCDV4	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	106	13.1
Whole Body	6/7/2023	Lower Glacier Creek DV Metals Fish #5	2023LGCDV5	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	105	13.8
Whole Body	6/7/2023	Lower Glacier Creek DV Metals Fish #6	2023LGCDV6	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	103	9.8
Whole Body	6/7/2023	Lower Glacier Creek DV Metals Fish #7	2023LGCDV7	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	115	14.9
Whole Body	6/7/2023	Lower Glacier Creek DV Metals Fish #8	2023LGCDV8	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	98	10.6
Whole Body	6/7/2023	Lower Glacier Creek DV Metals Fish #9	2023LGCDV9	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	112	17.6
Whole Body	6/7/2023	Lower Glacier Creek DV Metals Fish #10	2023LGCDV10	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	94	8.1

PM Mark

Cooler Receipt and Preservation Form

Client AK Dept of Fish and Game Service Request K23 10263

Received: 9/12/23 Opened: 9/12/23 By: HS Unloaded: 9/12/23 By: HS

1. Samples were received via? *USPS* (*Fed Ex*) *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) (*Cooler*) *Box* *Envelope* *Other* _____ *NA*
3. Were custody seals on coolers? NA Y (N) If yes, how many and where? _____
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Temp Blank	Sample Temp	IR Gun	Cooler #/COC ID / NA	Out of temp indicate with "X"	PM Notified If out of temp	Tracking Number NA	Filed
	1.4	IR06				783608546641	

4. Was a Temperature Blank present in cooler? NA Y (N) If yes, notate the temperature in the appropriate column above:
   If no, take the temperature of a representative sample bottle contained within the cooler; notate in the column "Sample Temp":
5. Were samples received within the method specified temperature ranges? NA (Y) N
   If no, were they received on ice and same day as collected? If not, notate the cooler # above and notify the PM. (NA) Y N

If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*

6. Packing material: *Inserts* *Baggies* *Bubble Wrap* (*Gel Packs*) *Wet Ice* *Dry Ice* *Sleeves* _____
7. Were custody papers properly filled out (ink, signed, etc.)? NA (Y) N
8. Were samples received in good condition (unbroken) NA (Y) N
9. Were all sample labels complete (ie, analysis, preservation, etc.)? NA (Y) N
10. Did all sample labels and tags agree with custody papers? NA (Y) N
11. Were appropriate bottles/containers and volumes received for the tests indicated? NA (Y) N
12. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* (NA) Y N
13. Were VOA vials received without headspace? *Indicate in the table below.* (NA) Y N
14. Was C12/Res negative? (NA) Y N
15. Were samples received within the method specified time limit? If not, notate the error below and notify the PM (NA) Y N
16. Were 100ml sterile microbiology bottles filled exactly to the 100ml mark? (NA) Y N Underfilled Overfilled

Sample ID on Bottle	Sample ID on COC	Identified by:

SHORT HOLD

Sample ID	Bottle Count Bottle Type	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, Resolutions: _____

Metals

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1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/06/23
Sample Matrix:	Animal tissue	**Date Received:**	09/12/23

Mercury, Total

Prep Method:	METHOD	Units:	ng/g
Analysis Method:	1631E	Basis:	Dry
Test Notes:			

Sample Name	Lab Code	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
2023MGCDV1	K2310263-001	9.8	10	09/25/23	09/29/23	40.2	
2023MGCDV2	K2310263-002	2.4	2.5	09/25/23	09/29/23	21.5	
2023MGCDV3	K2310263-003	9.7	10	09/25/23	09/29/23	41.6	
2023MGCDV4	K2310263-004	9.9	10	09/25/23	09/29/23	61.0	
2023MGCDV5	K2310263-005	2.4	2.5	09/25/23	09/29/23	17.8	
2023LGCDV1	K2310263-006	2.4	2.5	09/25/23	09/29/23	35.0	
2023LGCDV2	K2310263-007	10.0	10	09/25/23	09/29/23	51.6	
2023LGCDV3	K2310263-008	2.4	2.5	09/25/23	09/29/23	38.2	
2023LGCDV4	K2310263-009	10.0	10	09/25/23	09/29/23	41.5	
2023LGCDV5	K2310263-010	2.4	2.5	09/25/23	09/29/23	25.9	
2023LGCDV6	K2310263-011	2.4	2.5	09/25/23	09/29/23	38.2	
2023LGCDV7	K2310263-012	2.4	2.5	09/25/23	09/29/23	48.3	
2023LGCDV8	K2310263-013	2.4	2.5	09/25/23	09/29/23	49.6	
2023LGCDV9	K2310263-014	2.4	2.5	09/25/23	09/29/23	37.4	
2023LGCDV10	K2310263-015	2.4	2.5	09/25/23	09/29/23	54.8	
Method Blank 1	K2310263-MB1	1.0	1	09/25/23	09/29/23	ND	
Method Blank 2	K2310263-MB2	1.0	1	09/25/23	09/29/23	ND	
Method Blank 3	K2310263-MB3	1.0	1	09/25/23	09/29/23	ND	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/06/23
Sample Matrix:	Animal tissue	**Date Received:**	09/12/23
		Date Extracted:	09/25/23
		Date Analyzed:	09/29/23

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	2023MGCDV1	Units:	ng/g
Lab Code:	K2310263-001MS, K2310263-001DMS	Basis:	Dry
Test Notes:			

				Spike Level		Sample	Spike Result		Percent Recovery		ALS Acceptance	Relative Percent	Result
Analyte	**Prep Method**	**Analysis Method**	**MRL**	**MS**	**DMS**	**Result**	**MS**	**DMS**	**MS**	**DMS**	**Limits**	**Difference**	**Notes**
Mercury	METHOD	1631E	9.6	247	241	40.2	297	278	104	99	70-130	7	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/06/23
Sample Matrix:	Animal tissue	**Date Received:**	09/12/23
		Date Extracted:	09/25/23
		Date Analyzed:	09/29/23

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	2023MGCDV3	Units:	ng/g
Lab Code:	K2310263-003MS, K2310263-003DMS	Basis:	Dry
Test Notes:			

				Spike Level		Sample	Spike Result		Percent Recovery				
Analyte	**Prep Method**	**Analysis Method**	**MRL**	**MS**	**DMS**	**Result**	**MS**	**DMS**	**MS**	**DMS**	**ALS Acceptance Limits**	**Relative Percent Difference**	**Result Notes**
Mercury	METHOD	1631E	10.0	249	249	41.6	284	289	97	99	70-130	2	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	09/29/23

Ongoing Precision and Recovery (OPR) Sample Summary
Total Metals

Sample Name: Ongoing Precision and Recovery (Initial)

Units: ng/g
Basis: NA

Test Notes:

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	5.00	5.41	108	70-130	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	09/29/23

Ongoing Precision and Recovery (OPR) Sample Summary
Total Metals

Sample Name: Ongoing Precision and Recovery (Final)

Units: ng/g
Basis: NA

Test Notes:

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	5.00	5.25	105	70-130	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Animal tissue	**Date Received:**	NA
		Date Extracted:	09/25/23
		Date Analyzed:	09/29/23

Quality Control Sample (QCS) Summary
Total Metals

Sample Name:	Quality Control Sample	Units:	ng/g
Lab Code:		Basis:	Dry
Test Notes:	Tort-3 Solids = 97.4%		

Source: TORT-3

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	292	284	97	70-130	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/06/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023MGCDV1	**Basis:**	Dry
Lab Code:	K2310263-001		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.50	5	09/27/23 16:03	09/26/23	
Cadmium	6020A	**0.477**	mg/Kg	0.020	5	09/27/23 16:03	09/26/23	
Copper	6020A	**4.14**	mg/Kg	0.10	5	09/27/23 16:03	09/26/23	
Lead	6020A	**0.093**	mg/Kg	0.020	5	09/27/23 16:03	09/26/23	
Selenium	6020A	**4.80**	mg/Kg	1.0	5	09/27/23 16:03	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:03	09/26/23	
Zinc	6020A	**113**	mg/Kg	0.50	5	09/27/23 16:03	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/06/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023MGCDV2	**Basis:**	Dry
Lab Code:	K2310263-002		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.49	5	09/27/23 16:13	09/26/23	
Cadmium	6020A	**0.453**	mg/Kg	0.020	5	09/27/23 16:13	09/26/23	
Copper	6020A	**3.99**	mg/Kg	0.098	5	09/27/23 16:13	09/26/23	
Lead	6020A	**0.104**	mg/Kg	0.020	5	09/27/23 16:13	09/26/23	
Selenium	6020A	**4.24**	mg/Kg	0.98	5	09/27/23 16:13	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:13	09/26/23	
Zinc	6020A	**107**	mg/Kg	0.49	5	09/27/23 16:13	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/06/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023MGCDV3	**Basis:**	Dry
Lab Code:	K2310263-003		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.50	5	09/27/23 16:20	09/26/23	
Cadmium	6020A	**0.958**	mg/Kg	0.020	5	09/27/23 16:20	09/26/23	
Copper	6020A	**3.85**	mg/Kg	0.10	5	09/27/23 16:20	09/26/23	
Lead	6020A	**0.076**	mg/Kg	0.020	5	09/27/23 16:20	09/26/23	
Selenium	6020A	**4.18**	mg/Kg	1.0	5	09/27/23 16:20	09/26/23	
Silver	6020A	**0.022**	mg/Kg	0.020	5	09/27/23 16:20	09/26/23	
Zinc	6020A	**95.4**	mg/Kg	0.50	5	09/27/23 16:20	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/06/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023MGCDV4	**Basis:**	Dry
Lab Code:	K2310263-004		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.49	5	09/27/23 16:22	09/26/23	
Cadmium	6020A	**0.569**	mg/Kg	0.020	5	09/27/23 16:22	09/26/23	
Copper	6020A	**4.16**	mg/Kg	0.098	5	09/27/23 16:22	09/26/23	
Lead	6020A	**0.416**	mg/Kg	0.020	5	09/27/23 16:22	09/26/23	
Selenium	6020A	**4.46**	mg/Kg	0.98	5	09/27/23 16:22	09/26/23	
Silver	6020A	**0.031**	mg/Kg	0.020	5	09/27/23 16:22	09/26/23	
Zinc	6020A	**109**	mg/Kg	0.49	5	09/27/23 16:22	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/06/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023MGCDV5	**Basis:**	Dry
Lab Code:	K2310263-005		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.49	5	09/27/23 16:24	09/26/23	
Cadmium	6020A	**0.406**	mg/Kg	0.020	5	09/27/23 16:24	09/26/23	
Copper	6020A	**4.39**	mg/Kg	0.099	5	09/27/23 16:24	09/26/23	
Lead	6020A	**0.087**	mg/Kg	0.020	5	09/27/23 16:24	09/26/23	
Selenium	6020A	**6.87**	mg/Kg	0.99	5	09/27/23 16:24	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:24	09/26/23	
Zinc	6020A	**119**	mg/Kg	0.49	5	09/27/23 16:24	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/07/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023LGCDV1	**Basis:**	Dry
Lab Code:	K2310263-006		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.49	5	09/27/23 16:26	09/26/23	
Cadmium	6020A	**0.281**	mg/Kg	0.020	5	09/27/23 16:26	09/26/23	
Copper	6020A	**4.59**	mg/Kg	0.098	5	09/27/23 16:26	09/26/23	
Lead	6020A	**0.092**	mg/Kg	0.020	5	09/27/23 16:26	09/26/23	
Selenium	6020A	**4.52**	mg/Kg	0.98	5	09/27/23 16:26	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:26	09/26/23	
Zinc	6020A	**95.8**	mg/Kg	0.49	5	09/27/23 16:26	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/07/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023LGCDV2	**Basis:**	Dry
Lab Code:	K2310263-007		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.50	5	09/27/23 16:28	09/26/23	
Cadmium	6020A	**0.323**	mg/Kg	0.020	5	09/27/23 16:28	09/26/23	
Copper	6020A	**4.82**	mg/Kg	0.099	5	09/27/23 16:28	09/26/23	
Lead	6020A	**0.188**	mg/Kg	0.020	5	09/27/23 16:28	09/26/23	
Selenium	6020A	**5.72**	mg/Kg	0.99	5	09/27/23 16:28	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:28	09/26/23	
Zinc	6020A	**133**	mg/Kg	0.50	5	09/27/23 16:28	09/26/23	

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/07/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023LGCDV3	**Basis:**	Dry
Lab Code:	K2310263-008		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.49	5	09/27/23 16:30	09/26/23	
Cadmium	6020A	**0.252**	mg/Kg	0.020	5	09/27/23 16:30	09/26/23	
Copper	6020A	**3.19**	mg/Kg	0.098	5	09/27/23 16:30	09/26/23	
Lead	6020A	**0.136**	mg/Kg	0.020	5	09/27/23 16:30	09/26/23	
Selenium	6020A	**6.96**	mg/Kg	0.98	5	09/27/23 16:30	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:30	09/26/23	
Zinc	6020A	**121**	mg/Kg	0.49	5	09/27/23 16:30	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/07/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023LGCDV4	**Basis:**	Dry
Lab Code:	K2310263-009		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.49	5	09/27/23 16:33	09/26/23	
Cadmium	6020A	**0.400**	mg/Kg	0.020	5	09/27/23 16:33	09/26/23	
Copper	6020A	**5.57**	mg/Kg	0.098	5	09/27/23 16:33	09/26/23	
Lead	6020A	**0.273**	mg/Kg	0.020	5	09/27/23 16:33	09/26/23	
Selenium	6020A	**5.55**	mg/Kg	0.98	5	09/27/23 16:33	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:33	09/26/23	
Zinc	6020A	**197**	mg/Kg	0.49	5	09/27/23 16:33	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/07/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023LGCDV5	**Basis:**	Dry
Lab Code:	K2310263-010		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.50	5	09/27/23 16:35	09/26/23	
Cadmium	6020A	**0.270**	mg/Kg	0.020	5	09/27/23 16:35	09/26/23	
Copper	6020A	**9.55**	mg/Kg	0.10	5	09/27/23 16:35	09/26/23	
Lead	6020A	**0.218**	mg/Kg	0.020	5	09/27/23 16:35	09/26/23	
Selenium	6020A	**6.2**	mg/Kg	1.0	5	09/27/23 16:35	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:35	09/26/23	
Zinc	6020A	**127**	mg/Kg	0.50	5	09/27/23 16:35	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/07/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023LGCDV6	**Basis:**	Dry
Lab Code:	K2310263-011		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.49	5	09/27/23 16:37	09/26/23	
Cadmium	6020A	**0.319**	mg/Kg	0.020	5	09/27/23 16:37	09/26/23	
Copper	6020A	**4.16**	mg/Kg	0.099	5	09/27/23 16:37	09/26/23	
Lead	6020A	**0.162**	mg/Kg	0.020	5	09/27/23 16:37	09/26/23	
Selenium	6020A	**6.17**	mg/Kg	0.99	5	09/27/23 16:37	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:37	09/26/23	
Zinc	6020A	**126**	mg/Kg	0.49	5	09/27/23 16:37	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/07/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023LGCDV7	**Basis:**	Dry
Lab Code:	K2310263-012		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.49	5	09/27/23 16:39	09/26/23	
Cadmium	6020A	**0.806**	mg/Kg	0.020	5	09/27/23 16:39	09/26/23	
Copper	6020A	**4.31**	mg/Kg	0.098	5	09/27/23 16:39	09/26/23	
Lead	6020A	**0.228**	mg/Kg	0.020	5	09/27/23 16:39	09/26/23	
Selenium	6020A	**6.13**	mg/Kg	0.98	5	09/27/23 16:39	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:39	09/26/23	
Zinc	6020A	**146**	mg/Kg	0.49	5	09/27/23 16:39	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/07/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023LGCDV8	**Basis:**	Dry
Lab Code:	K2310263-013		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.49	5	09/27/23 16:45	09/26/23	
Cadmium	6020A	**0.791**	mg/Kg	0.020	5	09/27/23 16:45	09/26/23	
Copper	6020A	**5.31**	mg/Kg	0.098	5	09/27/23 16:45	09/26/23	
Lead	6020A	**0.240**	mg/Kg	0.020	5	09/27/23 16:45	09/26/23	
Selenium	6020A	**5.79**	mg/Kg	0.98	5	09/27/23 16:45	09/26/23	
Silver	6020A	**0.026**	mg/Kg	0.020	5	09/27/23 16:45	09/26/23	
Zinc	6020A	**143**	mg/Kg	0.49	5	09/27/23 16:45	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/07/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023LGCDV9	**Basis:**	Dry
Lab Code:	K2310263-014		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.50	5	09/27/23 16:47	09/26/23	
Cadmium	6020A	**0.487**	mg/Kg	0.020	5	09/27/23 16:47	09/26/23	
Copper	6020A	**5.91**	mg/Kg	0.10	5	09/27/23 16:47	09/26/23	
Lead	6020A	**0.196**	mg/Kg	0.020	5	09/27/23 16:47	09/26/23	
Selenium	6020A	**6.53**	mg/Kg	1.0	5	09/27/23 16:47	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:47	09/26/23	
Zinc	6020A	**167**	mg/Kg	0.50	5	09/27/23 16:47	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/07/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23 09:45
Sample Name:	2023LGCDV10	**Basis:**	Dry
Lab Code:	K2310263-015		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.50	5	09/27/23 16:49	09/26/23	
Cadmium	6020A	**0.695**	mg/Kg	0.020	5	09/27/23 16:49	09/26/23	
Copper	6020A	**6.11**	mg/Kg	0.10	5	09/27/23 16:49	09/26/23	
Lead	6020A	**0.220**	mg/Kg	0.020	5	09/27/23 16:49	09/26/23	
Selenium	6020A	**4.81**	mg/Kg	1.0	5	09/27/23 16:49	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 16:49	09/26/23	
Zinc	6020A	**155**	mg/Kg	0.50	5	09/27/23 16:49	09/26/23	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	NA
Sample Matrix:	Animal Tissue	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ2316903-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.5	5	09/27/23 15:54	09/26/23	
Cadmium	6020A	ND U	mg/Kg	0.020	5	09/27/23 15:54	09/26/23	
Copper	6020A	ND U	mg/Kg	0.10	5	09/27/23 15:54	09/26/23	
Lead	6020A	ND U	mg/Kg	0.020	5	09/27/23 15:54	09/26/23	
Selenium	6020A	ND U	mg/Kg	1.0	5	09/27/23 15:54	09/26/23	
Silver	6020A	ND U	mg/Kg	0.020	5	09/27/23 15:54	09/26/23	
Zinc	6020A	ND U	mg/Kg	0.5	5	09/27/23 15:54	09/26/23	

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project	2023 Palmer Project Biomonitoring	**Date Collected:**	06/06/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23
		Date Analyzed:	09/27/23

Replicate Sample Summary
Total Metals

Sample Name:	2023MGCDV1	**Units:**	mg/Kg
Lab Code:	K2310263-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ2316903-05 Result	Average	RPD	RPD Limit
Arsenic	6020A	0.5	ND U	ND U	ND	-	20
Cadmium	6020A	0.020	0.477	0.485	0.481	2	20
Copper	6020A	0.10	4.14	4.25	4.20	3	20
Lead	6020A	0.020	0.093	0.127	0.110	31 *	20
Selenium	6020A	1.0	4.8	4.8	4.8	<1	20
Silver	6020A	0.020	ND U	0.022	NC	NC	20
Zinc	6020A	0.5	113	125	119	10	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 09/29/23 3:11:13 PM Superset Reference:

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	06/06/23
Sample Matrix:	Animal Tissue	**Date Received:**	09/12/23
		Date Analyzed:	09/27/23
		Date Extracted:	09/26/23

Matrix Spike Summary
Total Metals

Sample Name:	2023MGCDV1	**Units:**	mg/Kg
Lab Code:	K2310263-001	**Basis:**	Dry
Analysis Method:	6020A		
Prep Method:	PSEP Metals		

Matrix Spike
KQ2316903-06

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Arsenic	ND U	18.0	16.6	109	75-125
Cadmium	0.477	5.23	4.98	95	75-125
Copper	4.14	27.7	24.9	95	75-125
Lead	0.093	46.5	49.8	93	75-125
Selenium	4.80	23.0	16.6	110	75-125
Silver	ND U	4.60	4.98	92	75-125
Zinc	113	166	49.8	106	75-125

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Matrix Spike and Matrix Spike Duplicate Data is presented for information purposes only. The matrix may or may not be relevant to samples reported in this report. The laboratory evaluates system performance based on the LCS and LCSD control limits.

Client: Alaska Department of Fish and Game
Project: 2023 Palmer Project Biomonitoring
Sample Matrix: Animal Tissue

Service Request: K2310263
Date Analyzed: 09/27/23

Lab Control Sample Summary
Total Metals

Units:mg/Kg
Basis: Dry

Lab Control Sample
KQ2316903-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Arsenic	6020A	17.2	16.7	103	80-120
Cadmium	6020A	4.79	5.00	96	80-120
Copper	6020A	23.6	25.0	94	80-120
Lead	6020A	46.8	50.0	94	80-120
Selenium	6020A	16.9	16.7	101	80-120
Silver	6020A	4.73	5.00	95	80-120
Zinc	6020A	47.7	50.0	95	80-120

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	09/26/23
		Date Analyzed:	09/27/23

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	K2310263-SRM1	Basis:	Dry
Test Notes:	Dorm-5 Solids = 95.8%		

Source: N.R.C.C. Dorm-5

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	Control Limits	Result Notes
Arsenic	PSEP Tissue	6020A	13.3	13.9	105	10.1 - 16.8	
Cadmium	PSEP Tissue	6020A	0.148	0.140	95	0.113 - 0.186	
Copper	PSEP Tissue	6020A	3.30	3.12	95	2.58 - 4.04	
Lead	PSEP Tissue	6020A	0.058	0.066	114	0.042 - 0.077	
Selenium	PSEP Tissue	6020A	2.40	2.46	103	1.83 - 3.01	
Silver	PSEP Tissue	6020A	0.135	0.128	95	0.097 - 0.179	
Zinc	PSEP Tissue	6020A	28.7	26.8	93	22.2 - 35.6	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2310263
Project:	2023 Palmer Project Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	09/26/23
		Date Analyzed:	09/27/23

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	K2310263-SRM2	Basis:	Dry
Test Notes:	Tort-3 Solids = 97.4%		

Source: N.R.C.C. Tort-3

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	Control Limits	Result Notes
Arsenic	PSEP Tissue	6020A	59.5	64.7	109	44.6-76.0	
Cadmium	PSEP Tissue	6020A	42.3	38.1	90	32.4-52.9	
Copper	PSEP Tissue	6020A	497	442	89	380-623	
Lead	PSEP Tissue	6020A	0.225	0.190	84	0.166-0.292	
Selenium	PSEP Tissue	6020A	10.9	10.6	97	7.9-14.3	
Zinc	PSEP Tissue	6020A	136	122	90	104-170	

Benchsheet

Service Request #: K2310263
Test: Frz Dry
Method: Frz Dry

Run #: 817885
Balance ID: K-Balance-53

Matrix	Lab Code	Tare (g)	Wet Wt. (g)	Tare + Dry Wt. (g)	Dry Weight (g)	% Total Solids	RPD
Animal Tissue	K2310263-001	115.703	45.883	126.888	11.2	24.4	
Animal Tissue	K2310263-002	87.268	16.682	91.433	4.17	25.0	
Animal Tissue	K2310263-003	116.055	41.516	126.642	10.6	25.5	
Animal Tissue	K2310263-004	87.180	32.713	95.252	8.07	24.7	
Animal Tissue	K2310263-005	87.157	9.198	89.190	2.03	22.1	
Animal Tissue	K2310263-006	87.223	26.800	94.328	7.11	26.5	
Animal Tissue	K2310263-007	87.056	13.320	90.132	3.08	23.1	
Animal Tissue	K2310263-008	86.959	28.424	93.790	6.83	24.0	
Animal Tissue	K2310263-009	86.694	12.360	89.304	2.61	21.1	
Animal Tissue	K2310263-010	87.098	12.800	90.044	2.95	23.0	
Animal Tissue	K2310263-011	87.545	9.074	89.673	2.13	23.5	
Animal Tissue	K2310263-012	87.172	13.867	90.509	3.34	24.1	
Animal Tissue	K2310263-013	86.977	9.878	89.173	2.20	22.2	
Animal Tissue	K2310263-014	87.236	16.861	91.385	4.15	24.6	
Animal Tissue	K2310263-015	87.091	7.410	88.721	1.63	22.0	

FreezeDryer ID	Date In	Time In	Date Out	Time Out	Thermometer ID
FreezeDry	9/21/2023	14:37	9/25/2023	11:48	

Cal EQID	Cal Start Value	Cal End Value	Start Date	Start Time	End Date	End Time

Comments: CCL 9/20/23, Reviewed 9/26/23 KL

APPENDIX E: SEDIMENT DATA AND LABORATORY REPORT

Appendix E.1.–Lower Glacier Creek sediment compositions, 2016–2023.

	Particle Size Data						
Sample Date	% Clay	% Silt	% Sand	% Course Material (> 2 mm)	% Total Solids	% Total Organic Carbon	Acid Volatile Sulfide (mg/kg)
06/07/16	4.00	29.17	66.83	0.00	78.6	0.274	ND
06/09/17	1.98	26.67	71.07	0.29	82.3	<0.16	<0.20
06/09/17	1.60	39.31	58.97	0.14	73.3	<0.17	<0.20
06/09/17	0.65	18.35	81.01	0.00	73.9	0.20	<0.20
06/09/17	1.33	27.75	70.31	0.62	77.8	0.25	<0.20
06/09/17	0.38	3.16	95.57	0.62	76.3	<0.16	<0.20
05/30/18	1.16	14.01	84.73	0.10	74.7	0.25	<0.20
05/30/18	1.93	44.25	50.12	3.72	77.7	0.29	0.63
05/30/18	2.04	41.78	56.19	0.00	78.0	<0.27	<0.20
05/30/18	1.05	9.59	85.04	4.32	79.1	<0.20	<0.20
05/30/18	1.44	16.08	81.88	4.32	78.6	<0.20	<0.20
06/06/19	0.29	10.14	89.32	0.00	83.1	0.29	<0.20
06/07/19	0.25	6.83	92.63	0.00	78.2	0.25	<0.20
06/08/19	0.25	8.49	91.16	0.00	74.6	0.250	<0.20
06/09/19	0.31	17.90	81.35	0.00	75.7	0.310	<0.20
06/10/19	0.32	8.51	90.95	0.00	80.1	0.320	<0.20
06/03/20	1.79	29.84	68.36	0.00	77.9	0.498	<0.20
06/03/20	2.35	31.30	64.96	1.38	72.4	0.336	<0.20
06/03/20	1.48	20.59	77.93	0.00	79.6	0.444	<0.20
06/03/20	1.97	24.20	73.78	0.07	83.1	0.203	<0.20
06/03/20	1.77	28.87	69.10	0.07	77.8	0.370	<0.20
06/16/21	2.20	14.50	83.30	0.00	71.8	0.440	<5.0
06/16/21	3.40	30.10	66.50	0.00	76.9	0.418	<5.0
06/16/21	4.20	33.90	61.80	0.10	79.6	0.185	<5.0
06/16/21	2.20	29.40	68.40	0.00	81.2	0.195	<5.0
06/16/21	4.00	2.70	88.60	4.70	80.0	0.269	<5.0
06/13/22	1.00	16.00	83.00	0.00	80.2	0.345	<5.0
06/13/22	1.00	26.40	72.40	0.20	78.1	0.347	<5.0
06/13/22	1.20	18.20	80.10	0.50	80.6	0.299	<5.0
06/13/22	1.00	10.20	85.80	3.00	82.2	0.369	<5.0
06/13/22	1.00	7.10	91.90	0.00	80.9	0.361	<5.0
06/07/23	1.00	8.70	89.50	0.80	76.6	0.278	<5.0
06/07/23	1.00	10.60	88.40	0.00	80.2	0.242	<5.0
06/07/23	1.00	13.70	83.60	1.70	76.8	0.283	<5.0
06/07/23	1.40	7.00	91.10	0.50	75.8	0.315	<5.0
06/07/23	1.00	10.60	87.70	0.70	77.3	0.204	<5.0

Appendix E.2.–Lower Glacier Creek sediment element concentrations, 2016–2023.

Sample	Concentration (mg/kg dry weight)									
Date	Ag	Al	As	Cd	Cu	Fe	Hg	Pb	Se	Zn
06/07/16	0.19	9,460	4.98	1.17	51.1	35,700	<0.020	9.06	1.69	193
06/09/17	0.14	15,500	3.91	0.510	37.0	47,300	0.0120	7.90	1.22	133
06/09/17	0.25	16,300	5.68	0.910	58.5	57,800	0.0194	20.6	1.35	202
06/09/17	0.26	14,700	5.49	1.01	53.6	51,100	0.0204	8.49	1.67	186
06/09/17	0.21	14,900	4.66	0.821	60.1	53,600	0.0144	20.1	1.39	173
06/09/17	0.17	13,300	3.94	0.818	48.9	51,400	0.0135	7.03	1.54	186
05/30/18	0.19	18,300	4.65	1.02	49.3	50,400	0.0125	9.84	1.44	185
05/30/18	0.14	16,600	4.08	0.880	44.4	42,600	0.0079	5.88	1.07	150
05/30/18	0.17	14,900	3.60	0.858	44.1	43,600	0.0119	6.58	1.31	160
05/30/18	0.16	15,400	4.27	0.835	41.6	45,100	0.0142	8.11	1.12	168
05/30/18	0.15	15,500	3.46	0.639	40.7	44,900	0.0092	7.53	1.00	141
06/06/19	0.17	17,300	4.32	0.950	50.4	48,400	0.0172	10.9	1.28	189
06/06/19	0.17	16,800	6.70	0.950	62.4	51,400	0.0131	6.23	1.43	173
06/06/19	0.13	17,400	5.15	0.937	39.3	46,900	0.0174	7.50	1.18	179
06/06/19	0.15	16,200	3.68	0.934	45.3	45,400	0.0156	5.23	1.06	166
06/06/19	0.14	15,700	4.72	0.771	45.2	44,900	0.0111	4.99	1.03	146
06/03/20	0.22	15,200	5.44	1.520	56.3	43,200	0.0125	7.14	2.41	213
06/03/20	0.16	16,200	3.35	0.904	48.0	42,800	0.0109	6.08	1.08	166
06/03/20	0.18	16,800	4.33	1.630	48.4	43,700	0.0164	8.49	1.58	184
06/03/20	0.11	14,800	3.14	0.640	40.1	43,400	0.0103	5.98	0.8	152
06/03/20	0.21	15,200	4.61	0.924	54.3	43,000	0.0097	7.57	1.52	150
06/16/21	0.18	11,800	4.48	1.070	43.1	41,600	0.0161	7.41	1.58	166
06/16/21	0.14	12,500	4.48	1.150	31.6	39,000	0.0100	4.26	1.56	160
06/16/21	0.15	18,500	3.69	0.572	50.7	59,800	0.0192	14.2	0.75	186
06/16/21	0.14	11,600	6.48	0.540	51.0	54,400	0.0158	15.1	0.92	142
06/16/21	0.13	12,900	2.85	1.008	33.9	35,550	0.0140	5.54	0.91	142.5
06/13/22	0.17	15,400	3.89	0.920	67.5	45,500	0.0164	6.90	1.60	156
06/13/22	0.16	15,700	4.75	0.989	52.2	44,700	0.0109	6.21	1.82	168
06/13/22	0.15	16,200	4.53	1.050	51.3	53,600	0.0196	8.57	1.68	178
06/13/22	0.16	15,400	4.04	0.902	42.3	46,800	0.0095	21.7	1.49	161
06/13/22	0.13	15,400	3.81	0.879	68.5	43,300	0.0098	4.98	1.29	140
06/07/23	0.12	16,900	3.94	0.758	33.0	42,500	0.0355	5.19	1.24	159
06/07/23	0.13	15,600	5.34	0.988	40.3	42,600	0.0140	6.26	1.15	189
06/07/23	0.15	18,000	4.28	0.783	44.5	48,200	0.0120	16.3	1.08	173
06/07/23	0.14	17,800	4.68	0.839	49.3	46,500	0.0130	6.45	1.10	171
06/07/23	0.17	17,700	5.34	0.925	57.8	53,600	0.0233	11.8	1.35	196

Appendix E.3.–Middle Glacier Creek sediment compositions, 2016–2023.

	Particle Size Data						
Sample Date	% Clay	% Silt	% Sand	% Course Material (> 2 mm)	% Total Solids	% Total Organic Carbon	Acid Volatile Sulfide (mg/kg)
06/08/16	4.06	31.18	64.76	0.00	80.5	0.491	ND
06/09/17	0.66	11.07	83.97	4.30	82.5	<0.16	<0.20
06/09/17	0.59	16.12	80.79	2.51	80.3	<0.17	<0.20
06/09/17	1.21	28.37	70.36	0.05	76.1	<0.19	0.30
06/09/17	2.30	48.51	49.19	0.00	74.8	0.27	<0.20
06/09/17	2.62	45.51	51.89	0.00	74.7	<0.19	<0.20
05/31/18	1.62	33.75	63.45	1.19	83.8	<0.28	0.40
05/31/18	1.65	26.48	71.45	0.41	80.1	<0.29	<0.20
05/31/18	1.21	10.73	74.57	13.49	77.7	<0.25	<0.20
05/31/18	1.56	25.93	71.89	0.62	75.0	<0.27	<0.20
05/31/18	1.56	15.69	80.82	1.94	71.4	0.37	<0.20
06/06/19	0.49	10.58	84.23	4.68	83.4	0.44	<0.20
06/06/19	1.51	21.39	77.09	0.00	84.1	0.30	<0.20
06/06/19	0.52	9.97	89.51	0.00	82.9	0.37	<0.20
06/06/19	1.14	25.86	73.00	0.00	78.6	0.58	<0.20
06/06/19	0.56	13.64	85.80	0.00	76.2	0.56	<0.20
06/02/20	2.33	39.96	57.09	0.62	75.6	0.26	<0.20
06/02/20	2.37	35.95	61.67	0.00	73.0	0.36	<0.20
06/02/20	2.60	37.46	59.93	0.00	80.3	0.40	<0.20
06/02/20	2.84	42.50	54.30	0.36	71.6	0.42	<0.20
06/02/20	2.72	36.99	60.30	0.00	78.3	0.31	<0.20
06/15/21	3.40	28.70	67.90	0.00	77.7	0.172	<5.0
06/15/21	3.80	4.90	90.90	0.40	80.8	0.257	<5.0
06/15/21	4.60	31.80	59.50	4.10	76.8	0.317	<5.0
06/15/21	2.20	18.60	78.60	0.60	81.5	0.193	<5.0
06/15/21	2.20	32.90	64.90	0.00	80.4	0.320	<5.0
06/14/22	1.0	10.6	88.2	0.2	79.8	0.242	<5.0
06/14/22	0.0	5.0	94.0	1.0	81.8	0.165	<5.0
06/14/22	1.0	8.0	90.0	1.0	83.5	0.143	<5.0
06/14/22	1.0	23.0	76.0	1.0	78.1	0.408	<5.0
06/14/22	1.0	13.3	85.6	0.1	80.2	0.321	<5.0
06/06/23	1.0	8.7	85.0	5.3	79.6	0.646	<5.0
06/06/23	1.0	10.5	85.9	2.6	77.0	0.604	<5.0
06/06/23	1.0	10.8	86.4	1.8	76.6	0.816	<5.0
06/06/23	1.0	14.8	82.3	1.9	78.2	0.570	<5.0
06/06/23	1.0	13.4	84.1	1.5	78.6	0.489	<5.0

Appendix E.4.–Middle Glacier Creek sediment element concentrations, 2016–2023.

Sample	Concentration (mg/kg dry weight)									
Date	Ag	Al	As	Cd	Cu	Fe	Hg	Pb	Se	Zn
06/08/16	0.16	7,650	4.33	0.871	55.8	32,400	<0.020	12.0	1.14	170
06/09/17	0.14	15,700	3.68	0.758	48.1	49,400	0.0094	8.67	0.90	190
06/09/17	0.15	13,800	4.76	0.902	45.5	53,400	0.0179	14.8	0.93	203
06/09/17	0.33	14,700	4.88	1.11	75.6	54,500	0.0161	12.5	2.05	189
06/09/17	0.18	16,000	4.47	1.14	55.7	47,500	0.0210	12.3	1.30	205
06/09/17	0.21	15,600	4.73	1.07	62.1	50,800	0.0181	11.9	1.42	199
05/31/18	0.18	18,000	4.17	0.564	47.4	49,000	0.0072	6.89	1.25	122
05/31/18	0.22	16,900	3.95	1.03	49.6	45,400	0.0260	5.48	1.67	167
05/31/18	0.18	20,200	2.80	0.675	49.1	49,200	0.0079	5.49	1.03	139
05/31/18	0.15	18,900	2.48	0.645	45.6	42,500	0.0093	5.24	0.71	129
05/31/18	0.17	16,900	3.74	1.02	52.8	43,000	0.0118	5.99	1.34	160
06/07/19	0.19	14,800	3.20	1.38	41.6	43,000	0.0133	3.76	1.83	189
06/07/19	0.19	16,600	4.97	1.07	53.5	53,600	0.0140	7.40	1.54	174
06/07/19	0.21	16,800	3.74	1.33	54.2	49,800	0.0128	5.45	1.43	230
06/07/19	0.53	16,700	4.19	2.22	47.6	47,500	0.015	10.4	1.55	181
06/07/19	0.27	17,000	6.14	1.67	54.6	47,000	0.015	7.45	2.56	204
06/02/20	0.14	14,900	3.10	0.646	48.2	41,000	0.0122	5.04	0.91	110
06/02/20	0.15	14,900	2.36	0.687	44.5	37,800	0.0060	4.69	1.00	97
06/02/20	0.16	15,500	2.71	0.726	44.4	38,800	0.0072	5.24	1.15	106
06/02/20	0.23	15,400	4.99	1.300	60.7	46,400	0.0137	8.36	1.97	208
06/02/20	0.16	15,800	2.66	0.716	46.5	39,600	0.0058	3.84	1.08	99
06/15/21	0.13	13,300	3.01	0.594	42.1	49,300	0.0105	7.62	0.97	124
06/15/21	0.10	11,200	2.95	0.818	35.4	38,300	0.0106	3.44	1.11	138
06/15/21	0.19	12,200	3.70	1.02	44.4	45,400	0.0167	6.53	1.28	156
06/15/21	0.14	12,300	3.31	0.516	47.9	50,800	0.0156	11.1	0.75	137
06/15/21	0.18	11,800	4.55	1.38	47.3	44,400	0.0190	7.11	1.99	183
06/14/22	0.12	13,400	3.46	0.552	43.3	47,300	0.013	4.9	0.8	158
06/14/22	0.14	15,500	3.55	0.427	46.9	51,400	0.0071	12.8	0.93	126
06/14/22	0.11	15,800	3.72	0.542	57.4	54,000	0.0098	4.46	0.99	146
06/14/22	0.2	15,800	5.31	1.23	67	49,900	0.0151	9.32	1.97	205
06/14/22	0.16	15,100	4.39	1.17	54.4	48,000	0.0103	5.5	1.89	174
06/06/23	0.16	15,900	3.14	1.21	32.4	38,900	0.0122	2.74	2.23	168
06/06/23	0.23	17,300	3.82	2.11	50.1	41,400	0.0118	3.9	2.43	230
06/06/23	0.22	16,800	4.64	1.95	44.8	41,200	0.0163	5.4	2.76	243
06/06/23	0.18	18,000	3.66	1.58	50.7	44,100	0.0163	5.85	2.5	215
06/06/23	0.17	18,900	2.77	1.5	43.2	46,000	0.0096	4.6	2.37	197

CERTIFICATE OF ANALYSIS

Work Order	: **WR2300488**	Page	: 1 of 8
Client	: **Constantine North Inc.**	Laboratory	: Whitehorse - Environmental
Contact	: Environmental Scientist Merlin Benner	Account Manager	: Ian Chen
Address	: Suite 320 - 800 West Pender St. Vancouver BC Canada V6C 2V6	Address	: #12 151 Industrial Road Whitehorse YT Canada Y1A 2V3
Telephone	: 907 766 2057	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 08-Jun-2023 14:58
PO	: ----	Date Analysis Commenced	: 11-Jun-2023
C-O-C number	: 17774164	Issue Date	: 16-Jun-2023 09:06
Sampler	: ----		
Site	: ----		
Quote number	: VA22-CONI100-001 (Q62329)		
No. of samples received	: 10		
No. of samples analysed	: 10		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Alex Thornton	Analyst	Metals, Burnaby, British Columbia
Brieanna Allen	Production/Validation Manager	Inorganics, Burnaby, British Columbia
Hedy Lai	Team Leader - Inorganics	Inorganics, Saskatoon, Saskatchewan
Hedy Lai	Team Leader - Inorganics	Sask Soils, Saskatoon, Saskatchewan
Janice Leung	Supervisor - Organics Instrumentation	Organics, Burnaby, British Columbia
Maria Painchaud	Laboratory Assistant	Sask Soils, Saskatoon, Saskatchewan
Robin Weeks	Team Leader - Metals	Metals, Burnaby, British Columbia

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
mg/kg	milligrams per kilogram
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
DLM	*Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).*
DUPH	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	2023 LGC S1	2023 LGC S2	2023 LGC S3	2023 LGC S4	2023 LGC S5
					Client sampling date / time	07-Jun-2023 09:30	07-Jun-2023 09:30	07-Jun-2023 09:30	07-Jun-2023 09:30	07-Jun-2023 09:30
						WR2300488-001	WR2300488-002	WR2300488-003	WR2300488-004	WR2300488-005
						Result	Result	Result	Result	Result
Physical Tests										
Loss on ignition @ 550°C	----	E205D/SK	1.0	%		1.3	1.4	1.2	1.4	1.3
Moisture	----	E144/VA	0.25	%		23.4	19.8	23.2	24.2	22.7
pH (1:2 soil:water)	----	E108/VA	0.10	pH units		8.52	8.49	8.60	8.55	8.64
Ash content @ 550°C	----	E205D/SK	1.0	%		98.7	98.6	98.8	98.6	98.7
Particle Size										
Passing (9.5mm)	----	E181/SK	1.0	%		99.9	100	99.5	100	100
Passing (4.75mm)	----	E181/SK	1.0	%		99.7	100	99.1	99.7	100
Passing (19mm)	----	E181/SK	1.0	%		100	100	100	100	100
Passing (25.4mm)	----	E181/SK	1.0	%		100	100	100	100	100
Passing (38.1mm)	----	E181/SK	1.0	%		100	100	100	100	100
Passing (50.8mm)	----	E181/SK	1.0	%		100	100	100	100	100
Passing (76.2mm)	----	E181/SK	1.0	%		100	100	100	100	100
Passing (1.0mm)	----	E182/SK	1.0	%		97.2	99.8	95.2	98.4	93.5
Passing (0.841mm)	----	E182/SK	1.0	%		92.7	98.7	93.1	96.2	90.6
Passing (0.50mm)	----	E182/SK	1.0	%		79.2	95.2	86.6	89.8	81.9
Passing (0.420mm)	----	E182/SK	1.0	%		66.6	81.6	76.6	79.0	72.1
Passing (0.250mm)	----	E182/SK	1.0	%		33.6	46.1	50.3	50.9	46.6
Passing (0.149mm)	----	E182/SK	1.0	%		19.1	25.5	29.8	26.9	26.1
Passing (0.125mm)	----	E182/SK	1.0	%		14.2	18.5	22.9	18.7	19.1
Passing (0.075mm)	----	E182/SK	1.0	%		9.7	11.6	14.7	8.4	11.6
Passing (0.063mm)	----	E182/SK	1.0	%		8.6	10.0	12.8	5.9	9.8
Passing (0.05mm)	----	E182/SK	1.0	%		7.4	8.2	10.7	3.2	7.9
Passing (0.0312mm)	----	E184/SK	1.0	%		4.4	5.0	6.5	2.9	4.6
Passing (0.020mm)	----	E184/SK	1.0	%		3.6	4.1	5.3	2.6	3.8
Passing (0.005mm)	----	E184/SK	1.0	%		<1.0	<1.0	1.0	1.4	<1.0
Passing (0.004mm)	----	E184/SK	1.0	%		<1.0	<1.0	<1.0	1.3	<1.0
Passing (0.002mm)	----	E184/SK	1.0	%		<1.0	<1.0	<1.0	<1.0	<1.0
Grain size curve	----	E185A/SK	-	-		See Attached	See Attached	See Attached	See Attached	See Attached

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	2023 LGC S1	2023 LGC S2	2023 LGC S3	2023 LGC S4	2023 LGC S5
					Client sampling date / time	07-Jun-2023 09:30	07-Jun-2023 09:30	07-Jun-2023 09:30	07-Jun-2023 09:30	07-Jun-2023 09:30
						WR2300488-001	WR2300488-002	WR2300488-003	WR2300488-004	WR2300488-005
						Result	Result	Result	Result	Result
Particle Size										
Passing (2.0mm)	----	E181/SK	1.0	%		99.2	100	98.3	99.5	99.3
Organic / Inorganic Carbon										
Carbon, total [TC]	----	E351/SK	0.050	%		0.883	0.844	0.890	0.943	0.805
Carbon, inorganic [IC]	----	E354/SK	0.050	%		0.605	0.602	0.607	0.628	0.601
Carbon, inorganic [IC], (as CaCO3 equivalent)	----	E354/SK	0.40	%		5.04	5.01	5.06	5.23	5.01
Carbon, total organic [TOC]	----	EC356/SK	0.050	%		0.278	0.242	0.283	0.315	0.204
Organic matter	----	EC356/SK	0.10	%		0.48	0.42	0.49	0.54	0.35
Inorganics										
Sulfides, acid volatile	----	E396/VA	5.0	mg/kg		<5.0	<5.0	<5.0	<5.0	<5.0
Metals										
Aluminum	7429-90-5	E440/VA	50	mg/kg		16900	15600	18000	17800	17700
Antimony	7440-36-0	E440/VA	0.10	mg/kg		0.45	0.50	0.52	0.49	0.56
Arsenic	7440-38-2	E440/VA	0.10	mg/kg		3.94	5.34	4.28	4.68	5.34
Barium	7440-39-3	E440/VA	0.50	mg/kg		129	135	139	175	237
Beryllium	7440-41-7	E440/VA	0.10	mg/kg		0.21	0.21	0.24	0.23	0.26
Bismuth	7440-69-9	E440/VA	0.20	mg/kg		<0.20	<0.20	<0.20	<0.20	<0.20
Boron	7440-42-8	E440/VA	5.0	mg/kg		<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium	7440-43-9	E440/VA	0.020	mg/kg		0.758	0.988	0.783	0.839	0.925
Calcium	7440-70-2	E440/VA	50	mg/kg		26300	23500	29600	27100	28100
Chromium	7440-47-3	E440/VA	0.50	mg/kg		26.7	28.4	31.0	32.8	31.6
Cobalt	7440-48-4	E440/VA	0.10	mg/kg		18.3	19.1	21.0	20.5	25.6
Copper	7440-50-8	E440/VA	0.50	mg/kg		33.0	40.3	44.5	49.3	57.8
Iron	7439-89-6	E440/VA	50	mg/kg		42500	42600	48200	46500	53600
Lead	7439-92-1	E440/VA	0.50	mg/kg		5.19	6.26	16.3	6.45	11.8
Lithium	7439-93-2	E440/VA	2.0	mg/kg		7.3	6.4	7.5	7.4	7.1
Magnesium	7439-95-4	E440/VA	20	mg/kg		14200	12900	14900	14600	14300
Manganese	7439-96-5	E440/VA	1.0	mg/kg		826	708	815	813	801
Mercury	7439-97-6	E510/VA	0.0050	mg/kg		0.0355 DUPH	0.0140	0.0120	0.0130	0.0233
Molybdenum	7439-98-7	E440/VA	0.10	mg/kg		1.92	1.91	1.90	2.02	1.89
Nickel	7440-02-0	E440/VA	0.50	mg/kg		20.6	21.0	22.1	22.9	23.6

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	2023 LGC S1	2023 LGC S2	2023 LGC S3	2023 LGC S4	2023 LGC S5
					Client sampling date / time	07-Jun-2023 09:30	07-Jun-2023 09:30	07-Jun-2023 09:30	07-Jun-2023 09:30	07-Jun-2023 09:30
						WR2300488-001	WR2300488-002	WR2300488-003	WR2300488-004	WR2300488-005
						Result	Result	Result	Result	Result
Metals										
Phosphorus	7723-14-0	E440/VA	50	mg/kg		930	782	1020	920	1020
Potassium	7440-09-7	E440/VA	100	mg/kg		1080	950	1160	1060	1130
Selenium	7782-49-2	E440/VA	0.20	mg/kg		1.24	1.15	1.08	1.10	1.35
Silver	7440-22-4	E440/VA	0.10	mg/kg		0.12	0.13	0.15	0.14	0.17
Sodium	7440-23-5	E440/VA	50	mg/kg		136	144	161	158	168
Strontium	7440-24-6	E440/VA	0.50	mg/kg		66.0	62.8	76.6	72.5	78.5
Sulfur	7704-34-9	E440/VA	1000	mg/kg		1100	2300	2400	1600	3700
Thallium	7440-28-0	E440/VA	0.050	mg/kg		0.066	0.066	0.072	0.072	0.074
Tin	7440-31-5	E440/VA	2.0	mg/kg		<2.0	<2.0	<2.0	<2.0	<2.0
Titanium	7440-32-6	E440/VA	1.0	mg/kg		1330	1480	1840	1780	2070
Tungsten	7440-33-7	E440/VA	0.50	mg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Uranium	7440-61-1	E440/VA	0.050	mg/kg		0.351	0.314	0.346	0.564	0.390
Vanadium	7440-62-2	E440/VA	0.20	mg/kg		98.2	96.8	115	109	120
Zinc	7440-66-6	E440/VA	2.0	mg/kg		159	189	173	171	196
Zirconium	7440-67-7	E440/VA	1.0	mg/kg		1.1	1.2	1.5	1.4	1.8

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	2023 MGC S1	2023 MGC S2	2023 MGC S3	2023 MGC S4	2023 MGC S5
					Client sampling date / time	06-Jun-2023 10:00	06-Jun-2023 10:00	06-Jun-2023 10:00	06-Jun-2023 10:00	06-Jun-2023 10:00
						WR2300488-006	WR2300488-007	WR2300488-008	WR2300488-009	WR2300488-010
						Result	Result	Result	Result	Result
Physical Tests										
Loss on ignition @ 550°C	----	E205D/SK	1.0	%		2.0	1.9	2.2	1.9	1.8
Moisture	----	E144/VA	0.25	%		20.4	23.0	23.4	21.8	21.4
pH (1:2 soil:water)	----	E108/VA	0.10	pH units		8.68	8.50	8.61	8.57	8.67
Ash content @ 550°C	----	E205D/SK	1.0	%		98.0	98.1	97.8	98.1	98.2
Particle Size										
Passing (9.5mm)	----	E181/SK	1.0	%		100	99.5	100	100	100
Passing (4.75mm)	----	E181/SK	1.0	%		99.5	98.9	99.2	100	99.8
Passing (19mm)	----	E181/SK	1.0	%		100	100	100	100	100
Passing (25.4mm)	----	E181/SK	1.0	%		100	100	100	100	100
Passing (38.1mm)	----	E181/SK	1.0	%		100	100	100	100	100
Passing (50.8mm)	----	E181/SK	1.0	%		100	100	100	100	100
Passing (76.2mm)	----	E181/SK	1.0	%		100	100	100	100	100
Passing (1.0mm)	----	E182/SK	1.0	%		78.0	94.1	96.3	89.6	93.4
Passing (0.841mm)	----	E182/SK	1.0	%		71.2	90.3	93.2	85.5	89.5
Passing (0.50mm)	----	E182/SK	1.0	%		50.8	78.9	84.0	73.0	77.9
Passing (0.420mm)	----	E182/SK	1.0	%		44.3	68.9	73.4	64.9	68.3
Passing (0.250mm)	----	E182/SK	1.0	%		27.4	43.0	45.8	43.7	43.4
Passing (0.149mm)	----	E182/SK	1.0	%		18.4	25.4	25.7	28.1	27.6
Passing (0.125mm)	----	E182/SK	1.0	%		15.3	19.4	18.9	22.8	22.2
Passing (0.075mm)	----	E182/SK	1.0	%		9.7	11.5	11.8	15.8	14.4
Passing (0.063mm)	----	E182/SK	1.0	%		8.4	9.6	10.1	14.1	12.5
Passing (0.05mm)	----	E182/SK	1.0	%		7.0	7.6	8.3	12.3	10.5
Passing (0.0312mm)	----	E184/SK	1.0	%		4.1	4.5	5.0	6.8	6.1
Passing (0.020mm)	----	E184/SK	1.0	%		3.4	3.7	4.1	5.5	5.0
Passing (0.005mm)	----	E184/SK	1.0	%		<1.0	<1.0	<1.0	<1.0	1.0
Passing (0.004mm)	----	E184/SK	1.0	%		<1.0	<1.0	<1.0	<1.0	<1.0
Passing (0.002mm)	----	E184/SK	1.0	%		<1.0	<1.0	<1.0	<1.0	<1.0
Grain size curve	----	E185A/SK	-	-		See Attached	See Attached	See Attached	See Attached	See Attached
Passing (2.0mm)	----	E181/SK	1.0	%		94.7	97.4	98.2	98.1	98.5

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	2023 MGC S1	2023 MGC S2	2023 MGC S3	2023 MGC S4	2023 MGC S5
					Client sampling date / time	06-Jun-2023 10:00	06-Jun-2023 10:00	06-Jun-2023 10:00	06-Jun-2023 10:00	06-Jun-2023 10:00
						WR2300488-006	WR2300488-007	WR2300488-008	WR2300488-009	WR2300488-010
						Result	Result	Result	Result	Result
Organic / Inorganic Carbon										
Carbon, total [TC]	----	E351/SK	0.050	%		1.50	1.47	1.70	1.42	1.30
Carbon, inorganic [IC]	----	E354/SK	0.050	%		0.854	0.866	0.884	0.850	0.811
Carbon, inorganic [IC], (as CaCO3 equivalent)	----	E354/SK	0.40	%		7.12	7.21	7.37	7.09	6.76
Carbon, total organic [TOC]	----	EC356/SK	0.050	%		0.646	0.604	0.816	0.570	0.489
Organic matter	----	EC356/SK	0.10	%		1.11	1.04	1.41	0.98	0.84
Inorganics										
Sulfides, acid volatile	----	E396/VA	5.0	mg/kg		<5.0	<5.0	<5.0	<5.0	<5.0
Metals										
Aluminum	7429-90-5	E440/VA	50	mg/kg		15900	17300	16800	18000	18900
Antimony	7440-36-0	E440/VA	0.10	mg/kg		0.44	0.56	0.70	0.45	0.42
Arsenic	7440-38-2	E440/VA	0.10	mg/kg		3.14	3.82	4.64	3.66	2.77
Barium	7440-39-3	E440/VA	0.50	mg/kg		59.5	89.4	141	157	130
Beryllium	7440-41-7	E440/VA	0.10	mg/kg		0.16	0.19	0.19	0.20	0.21
Bismuth	7440-69-9	E440/VA	0.20	mg/kg		<0.20	<0.20	<0.20	<0.20	<0.20
Boron	7440-42-8	E440/VA	5.0	mg/kg		<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium	7440-43-9	E440/VA	0.020	mg/kg		1.21	2.11	1.95	1.58	1.50
Calcium	7440-70-2	E440/VA	50	mg/kg		30600	37700	33400	32000	32400
Chromium	7440-47-3	E440/VA	0.50	mg/kg		35.7	51.7	48.9	46.3	46.1
Cobalt	7440-48-4	E440/VA	0.10	mg/kg		14.2	17.0	16.2	18.5	18.5
Copper	7440-50-8	E440/VA	0.50	mg/kg		32.4	50.1	44.8	50.7	43.2
Iron	7439-89-6	E440/VA	50	mg/kg		38900	41400	41200	44100	46000
Lead	7439-92-1	E440/VA	0.50	mg/kg		2.74	3.90	5.40	5.85	4.60
Lithium	7439-93-2	E440/VA	2.0	mg/kg		7.8	8.9	7.8	8.3	8.2
Magnesium	7439-95-4	E440/VA	20	mg/kg		14200	15300	14400	15300	16000
Manganese	7439-96-5	E440/VA	1.0	mg/kg		664	706	674	674	785
Mercury	7439-97-6	E510/VA	0.0050	mg/kg		0.0122	0.0118	0.0163	0.0163	0.0096
Molybdenum	7439-98-7	E440/VA	0.10	mg/kg		4.00	5.52	5.33	3.52	3.60
Nickel	7440-02-0	E440/VA	0.50	mg/kg		27.7	40.6	36.6	32.3	34.0
Phosphorus	7723-14-0	E440/VA	50	mg/kg		1120	994	996	1040	1020
Potassium	7440-09-7	E440/VA	100	mg/kg		750	750	800	990	1090

Analytical Results

Sub-Matrix: **Soil** (Matrix: **Soil/Solid**)					Client sample ID	2023 MGC S1	2023 MGC S2	2023 MGC S3	2023 MGC S4	2023 MGC S5
					Client sampling date / time	06-Jun-2023 10:00	06-Jun-2023 10:00	06-Jun-2023 10:00	06-Jun-2023 10:00	06-Jun-2023 10:00
Analyte	*CAS Number*	*Method/Lab*	*LOR*	*Unit*		**WR2300488-006**	**WR2300488-007**	**WR2300488-008**	**WR2300488-009**	**WR2300488-010**
						Result	Result	Result	Result	Result
Metals										
Selenium	7782-49-2	E440/VA	0.20	mg/kg		2.23	2.43	2.76	2.50	2.37
Silver	7440-22-4	E440/VA	0.10	mg/kg		0.16	0.23	0.22	0.18	0.17
Sodium	7440-23-5	E440/VA	50	mg/kg		107	97	98	125	142
Strontium	7440-24-6	E440/VA	0.50	mg/kg		75.5	99.4	89.8	81.5	98.1
Sulfur	7704-34-9	E440/VA	1000	mg/kg		1200	1300	1200	1400	1500
Thallium	7440-28-0	E440/VA	0.050	mg/kg		0.060	0.068	0.062	0.069	0.083
Tin	7440-31-5	E440/VA	2.0	mg/kg		<2.0	<2.0	<2.0	<2.0	<2.0
Titanium	7440-32-6	E440/VA	1.0	mg/kg		841	742	876	1060	1140
Tungsten	7440-33-7	E440/VA	0.50	mg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Uranium	7440-61-1	E440/VA	0.050	mg/kg		0.608	0.630	0.500	0.398	0.422
Vanadium	7440-62-2	E440/VA	0.20	mg/kg		88.9	88.6	87.2	97.7	103
Zinc	7440-66-6	E440/VA	2.0	mg/kg		168	230	243	215	197
Zirconium	7440-67-7	E440/VA	1.0	mg/kg		<1.0	<1.0	<1.0	<1.0	<2.0 DLM

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

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QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WR2300488**	Page	: 1 of 21
Client	: **Constantine North Inc.**	Laboratory	: Whitehorse - Environmental
Contact	: Environmental Scientist Merlin Benner	Account Manager	: Ian Chen
Address	: Suite 320 - 800 West Pender St. Vancouver BC Canada V6C 2V6	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	: 907 766 2057	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 08-Jun-2023 14:58
PO	: ----	Issue Date	: 16-Jun-2023 09:18
C-O-C number	: 17774164		
Sampler	: ----		
Site	: ----		
Quote number	: VA22-CONI100-001 (Q62329)		
No. of samples received	: 10		
No. of samples analysed	: 10		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- Method Blank value outliers occur - please see following pages for full details.
- Duplicate outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- Reference Material (RM) Sample outliers occur - please see the following pages for full details.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Soil/Solid**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Method Blank (MB) Values								
Metals	QC-MRG2-983230001	----	Titanium	7440-32-6	E440	1.2 mg/kg B	1 mg/kg	Blank result exceeds permitted value

Result Qualifiers

Qualifier	Description
B	*Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.*

Duplicate (DUP) RPDs								
Metals	WR2300488-001	2023 LGC S1	Mercury	7439-97-6	E510	78.5 % DUP-H	40%	Duplicate RPD does not meet the DQO for this test.

Result Qualifiers

Qualifier	Description
DUP-H	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Reference Material (RM) Sample								
Metals	QC-MRG2-983230003	----	Chromium	7440-47-3	E440	132 % MES	70.0-130%	Recovery greater than upper control limit

Result Qualifiers

Qualifier	Description
MES	*Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).*

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Inorganics : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
HDPE 2023 LGC S1	E396	07-Jun-2023	13-Jun-2023	14 days	6 days	✓	13-Jun-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
HDPE 2023 LGC S2	E396	07-Jun-2023	13-Jun-2023	14 days	6 days	✓	13-Jun-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
HDPE 2023 LGC S3	E396	07-Jun-2023	13-Jun-2023	14 days	6 days	✓	13-Jun-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
HDPE 2023 LGC S4	E396	07-Jun-2023	13-Jun-2023	14 days	6 days	✓	13-Jun-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
HDPE 2023 LGC S5	E396	07-Jun-2023	13-Jun-2023	14 days	6 days	✓	13-Jun-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
HDPE 2023 MGC S1	E396	06-Jun-2023	13-Jun-2023	14 days	7 days	✓	13-Jun-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
HDPE 2023 MGC S2	E396	06-Jun-2023	13-Jun-2023	14 days	7 days	✓	13-Jun-2023	7 days	0 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Inorganics : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
HDPE 2023 MGC S3	E396	06-Jun-2023	13-Jun-2023	14 days	7 days	✓	13-Jun-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
HDPE 2023 MGC S4	E396	06-Jun-2023	13-Jun-2023	14 days	7 days	✓	13-Jun-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
HDPE 2023 MGC S5	E396	06-Jun-2023	13-Jun-2023	14 days	7 days	✓	13-Jun-2023	7 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
HDPE 2023 LGC S1	E510	07-Jun-2023	15-Jun-2023	28 days	8 days	✓	15-Jun-2023	20 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
HDPE 2023 LGC S2	E510	07-Jun-2023	15-Jun-2023	28 days	8 days	✓	15-Jun-2023	20 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
HDPE 2023 LGC S3	E510	07-Jun-2023	15-Jun-2023	28 days	8 days	✓	15-Jun-2023	20 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
HDPE 2023 LGC S4	E510	07-Jun-2023	15-Jun-2023	28 days	8 days	✓	15-Jun-2023	20 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
HDPE 2023 LGC S5	E510	07-Jun-2023	15-Jun-2023	28 days	8 days	✓	15-Jun-2023	20 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
HDPE 2023 MGC S1	E510	06-Jun-2023	15-Jun-2023	28 days	9 days	✓	15-Jun-2023	19 days	0 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Metals : Mercury in Soil/Solid by CVAAS										
HDPE 2023 MGC S2	E510	06-Jun-2023	15-Jun-2023	28 days	9 days	✓	15-Jun-2023	19 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
HDPE 2023 MGC S3	E510	06-Jun-2023	15-Jun-2023	28 days	9 days	✓	15-Jun-2023	19 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
HDPE 2023 MGC S4	E510	06-Jun-2023	15-Jun-2023	28 days	9 days	✓	15-Jun-2023	19 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
HDPE 2023 MGC S5	E510	06-Jun-2023	15-Jun-2023	28 days	9 days	✓	15-Jun-2023	19 days	0 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
HDPE 2023 LGC S1	E440	07-Jun-2023	15-Jun-2023	180 days	8 days	✓	15-Jun-2023	172 days	1 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
HDPE 2023 LGC S2	E440	07-Jun-2023	15-Jun-2023	180 days	8 days	✓	15-Jun-2023	172 days	1 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
HDPE 2023 LGC S3	E440	07-Jun-2023	15-Jun-2023	180 days	8 days	✓	15-Jun-2023	172 days	1 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
HDPE 2023 LGC S4	E440	07-Jun-2023	15-Jun-2023	180 days	8 days	✓	15-Jun-2023	172 days	1 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
HDPE 2023 LGC S5	E440	07-Jun-2023	15-Jun-2023	180 days	8 days	✓	15-Jun-2023	172 days	1 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Metals : Metals in Soil/Solid by CRC ICPMS										
HDPE 2023 MGC S1	E440	06-Jun-2023	15-Jun-2023	180 days	9 days	✓	15-Jun-2023	171 days	1 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
HDPE 2023 MGC S2	E440	06-Jun-2023	15-Jun-2023	180 days	9 days	✓	15-Jun-2023	171 days	1 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
HDPE 2023 MGC S3	E440	06-Jun-2023	15-Jun-2023	180 days	9 days	✓	15-Jun-2023	171 days	1 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
HDPE 2023 MGC S4	E440	06-Jun-2023	15-Jun-2023	180 days	9 days	✓	15-Jun-2023	171 days	1 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
HDPE 2023 MGC S5	E440	06-Jun-2023	15-Jun-2023	180 days	9 days	✓	15-Jun-2023	171 days	1 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2023 LGC S1	E351	07-Jun-2023	14-Jun-2023	----	----		14-Jun-2023	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2023 LGC S2	E351	07-Jun-2023	14-Jun-2023	----	----		14-Jun-2023	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2023 LGC S3	E351	07-Jun-2023	14-Jun-2023	----	----		14-Jun-2023	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2023 LGC S4	E351	07-Jun-2023	14-Jun-2023	----	----		14-Jun-2023	180 days	0 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2023 LGC S5	E351	07-Jun-2023	14-Jun-2023	----	----		14-Jun-2023	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2023 MGC S1	E351	06-Jun-2023	14-Jun-2023	----	----		14-Jun-2023	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2023 MGC S2	E351	06-Jun-2023	14-Jun-2023	----	----		14-Jun-2023	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2023 MGC S3	E351	06-Jun-2023	14-Jun-2023	----	----		14-Jun-2023	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2023 MGC S4	E351	06-Jun-2023	14-Jun-2023	----	----		14-Jun-2023	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2023 MGC S5	E351	06-Jun-2023	14-Jun-2023	----	----		14-Jun-2023	180 days	0 days	✓
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2023 LGC S1	E354	07-Jun-2023	----	----	----		13-Jun-2023	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2023 LGC S2	E354	07-Jun-2023	----	----	----		13-Jun-2023	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2023 LGC S3	E354	07-Jun-2023	----	----	----		13-Jun-2023	----	----	

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2023 LGC S4	E354	07-Jun-2023	----	----	----		13-Jun-2023	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2023 LGC S5	E354	07-Jun-2023	----	----	----		13-Jun-2023	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2023 MGC S1	E354	06-Jun-2023	----	----	----		13-Jun-2023	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2023 MGC S2	E354	06-Jun-2023	----	----	----		13-Jun-2023	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2023 MGC S3	E354	06-Jun-2023	----	----	----		13-Jun-2023	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2023 MGC S4	E354	06-Jun-2023	----	----	----		13-Jun-2023	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2023 MGC S5	E354	06-Jun-2023	----	----	----		13-Jun-2023	----	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2023 LGC S1	E185A	07-Jun-2023	----	----	----		15-Jun-2023	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2023 LGC S2	E185A	07-Jun-2023	----	----	----		15-Jun-2023	365 days	----	

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2023 LGC S3	E185A	07-Jun-2023	----	----	----		15-Jun-2023	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2023 LGC S4	E185A	07-Jun-2023	----	----	----		15-Jun-2023	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2023 LGC S5	E185A	07-Jun-2023	----	----	----		15-Jun-2023	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2023 MGC S1	E185A	06-Jun-2023	----	----	----		15-Jun-2023	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2023 MGC S2	E185A	06-Jun-2023	----	----	----		15-Jun-2023	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2023 MGC S3	E185A	06-Jun-2023	----	----	----		15-Jun-2023	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2023 MGC S4	E185A	06-Jun-2023	----	----	----		15-Jun-2023	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2023 MGC S5	E185A	06-Jun-2023	----	----	----		15-Jun-2023	365 days	----	
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2023 LGC S1	E184	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2023 LGC S2	E184	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2023 LGC S3	E184	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2023 LGC S4	E184	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2023 LGC S5	E184	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2023 MGC S1	E184	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2023 MGC S2	E184	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2023 MGC S3	E184	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2023 MGC S4	E184	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2023 MGC S5	E184	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2023 LGC S1	E182	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2023 LGC S2	E182	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2023 LGC S3	E182	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2023 LGC S4	E182	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2023 LGC S5	E182	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2023 MGC S1	E182	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2023 MGC S2	E182	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2023 MGC S3	E182	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2023 MGC S4	E182	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2023 MGC S5	E182	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2023 LGC S1	E181	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2023 LGC S2	E181	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2023 LGC S3	E181	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2023 LGC S4	E181	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2023 LGC S5	E181	07-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	6 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2023 MGC S1	E181	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2023 MGC S2	E181	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2023 MGC S3	E181	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2023 MGC S4	E181	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2023 MGC S5	E181	06-Jun-2023	13-Jun-2023	----	----		13-Jun-2023	365 days	7 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2023 LGC S1	E205D	07-Jun-2023	----	----	----		13-Jun-2023	365 days	6 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2023 LGC S2	E205D	07-Jun-2023	----	----	----		13-Jun-2023	365 days	6 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2023 LGC S3	E205D	07-Jun-2023	----	----	----		13-Jun-2023	365 days	6 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2023 LGC S4	E205D	07-Jun-2023	----	----	----		13-Jun-2023	365 days	6 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2023 LGC S5	E205D	07-Jun-2023	----	----	----		13-Jun-2023	365 days	6 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2023 MGC S1	E205D	06-Jun-2023	----	----	----		13-Jun-2023	365 days	7 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2023 MGC S2	E205D	06-Jun-2023	----	----	----		13-Jun-2023	365 days	7 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2023 MGC S3	E205D	06-Jun-2023	----	----	----		13-Jun-2023	365 days	7 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2023 MGC S4	E205D	06-Jun-2023	----	----	----		13-Jun-2023	365 days	7 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2023 MGC S5	E205D	06-Jun-2023	----	----	----		13-Jun-2023	365 days	7 days	✓
Physical Tests : Moisture Content by Gravimetry										
HDPE 2023 LGC S1	E144	07-Jun-2023	----	----	----		11-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
HDPE 2023 LGC S2	E144	07-Jun-2023	----	----	----		11-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
HDPE 2023 LGC S3	E144	07-Jun-2023	----	----	----		11-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
HDPE 2023 LGC S4	E144	07-Jun-2023	----	----	----		11-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
HDPE 2023 LGC S5	E144	07-Jun-2023	----	----	----		11-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
HDPE 2023 MGC S1	E144	06-Jun-2023	----	----	----		11-Jun-2023	----	----	

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Moisture Content by Gravimetry										
HDPE 2023 MGC S2	E144	06-Jun-2023	----	----	----		11-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
HDPE 2023 MGC S3	E144	06-Jun-2023	----	----	----		11-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
HDPE 2023 MGC S4	E144	06-Jun-2023	----	----	----		11-Jun-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
HDPE 2023 MGC S5	E144	06-Jun-2023	----	----	----		11-Jun-2023	----	----	
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
HDPE 2023 LGC S1	E108	07-Jun-2023	15-Jun-2023	30 days	8 days	✓	15-Jun-2023	22 days	0 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
HDPE 2023 LGC S2	E108	07-Jun-2023	15-Jun-2023	30 days	8 days	✓	15-Jun-2023	22 days	0 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
HDPE 2023 LGC S3	E108	07-Jun-2023	15-Jun-2023	30 days	8 days	✓	15-Jun-2023	22 days	0 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
HDPE 2023 LGC S4	E108	07-Jun-2023	15-Jun-2023	30 days	8 days	✓	15-Jun-2023	22 days	0 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
HDPE 2023 LGC S5	E108	07-Jun-2023	15-Jun-2023	30 days	8 days	✓	15-Jun-2023	22 days	0 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
HDPE										
2023 MGC S1	E108	06-Jun-2023	15-Jun-2023	30 days	9 days	✓	15-Jun-2023	21 days	0 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
HDPE										
2023 MGC S2	E108	06-Jun-2023	15-Jun-2023	30 days	9 days	✓	15-Jun-2023	21 days	0 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
HDPE										
2023 MGC S3	E108	06-Jun-2023	15-Jun-2023	30 days	9 days	✓	15-Jun-2023	21 days	0 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
HDPE										
2023 MGC S4	E108	06-Jun-2023	15-Jun-2023	30 days	9 days	✓	15-Jun-2023	21 days	0 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
HDPE										
2023 MGC S5	E108	06-Jun-2023	15-Jun-2023	30 days	9 days	✓	15-Jun-2023	21 days	0 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Acid Volatile Sulfide by Colourimetry (5 mg/kg)	E396	986148	1	10	10.0	5.0	✓
Loss On Ignition (550°C)	E205D	986986	1	10	10.0	5.0	✓
Mercury in Soil/Solid by CVAAS	E510	983231	1	10	10.0	5.0	✓
Metals in Soil/Solid by CRC ICPMS	E440	983230	1	14	7.1	5.0	✓
Moisture Content by Gravimetry	E144	983233	1	10	10.0	5.0	✓
Particle Size Analysis - Pipette Method	E184	986390	1	14	7.1	5.0	✓
Particle Size Analysis - Sieve <2mm	E182	986389	1	14	7.1	5.0	✓
pH by Meter (1:2 Soil:Water Extraction)	E108	983232	1	14	7.1	5.0	✓
Total Carbon by Combustion	E351	988382	1	12	8.3	5.0	✓
Total Inorganic Carbon by Acetic Acid pH Standard Curve	E354	986365	1	16	6.2	5.0	✓
Laboratory Control Samples (LCS)							
Acid Volatile Sulfide by Colourimetry (5 mg/kg)	E396	986148	1	10	10.0	5.0	✓
Loss On Ignition (550°C)	E205D	986986	1	10	10.0	5.0	✓
Mercury in Soil/Solid by CVAAS	E510	983231	2	10	20.0	10.0	✓
Metals in Soil/Solid by CRC ICPMS	E440	983230	2	14	14.2	10.0	✓
Moisture Content by Gravimetry	E144	983233	1	10	10.0	5.0	✓
Particle Size Analysis - Pipette Method	E184	986390	1	14	7.1	5.0	✓
Particle Size Analysis - Sieve <2mm	E182	986389	1	14	7.1	5.0	✓
Particle Size Analysis - Sieve >2mm	E181	986391	1	14	7.1	5.0	✓
pH by Meter (1:2 Soil:Water Extraction)	E108	983232	1	14	7.1	5.0	✓
Total Carbon by Combustion	E351	988382	2	12	16.6	10.0	✓
Total Inorganic Carbon by Acetic Acid pH Standard Curve	E354	986365	2	16	12.5	10.0	✓
Method Blanks (MB)							
Acid Volatile Sulfide by Colourimetry (5 mg/kg)	E396	986148	1	10	10.0	5.0	✓
Loss On Ignition (550°C)	E205D	986986	1	10	10.0	5.0	✓
Mercury in Soil/Solid by CVAAS	E510	983231	1	10	10.0	5.0	✓
Metals in Soil/Solid by CRC ICPMS	E440	983230	1	14	7.1	5.0	✓
Moisture Content by Gravimetry	E144	983233	1	10	10.0	5.0	✓
Total Carbon by Combustion	E351	988382	1	12	8.3	5.0	✓
Total Inorganic Carbon by Acetic Acid pH Standard Curve	E354	986365	1	16	6.2	5.0	✓
Matrix Spikes (MS)							
Acid Volatile Sulfide by Colourimetry (5 mg/kg)	E396	986148	1	10	10.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
pH by Meter (1:2 Soil:Water Extraction)	E108 Vancouver - Environmental	Soil/Solid	BC Lab Manual	pH is determined by potentiometric measurement with a pH electrode at ambient laboratory temperature (normally 20 ± 5°C), and is carried out in accordance with procedures described in the BC Lab Manual (prescriptive method). The procedure involves mixing the dried (at <60 ºC) and sieved (10mesh/2mm) sample with ultra pure water at a 1:2 ratio of sediment to water. The pH is then measured by a standard pH probe.
Moisture Content by Gravimetry	E144 Vancouver - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Particle Size Analysis - Sieve >2mm	E181 Saskatoon - Environmental	Soil/Solid	ASTM D6913-17 (mod)	Soil samples are disaggregated and sieved through a 2mm sieve. Material retained on the sieve is then further sieved through a series of sieves. The amount passing through the sieves is measured gravimetrically.
Particle Size Analysis - Sieve <2mm	E182 Saskatoon - Environmental	Soil/Solid	ASTM D6913-17 (mod)	Soil samples are disaggregated and sieved through a 2mm sieve. Material passed through the sieve is then further disaggregated using calgon solution and passed through a series of sieves. The amount passing through the sieves is measured gravimetrically.
Particle Size Analysis - Pipette Method	E184 Saskatoon - Environmental	Soil/Solid	SSIR-51 Method 3.2.1	Soil material is separated from coarse material (>2mm). A specimen is then disaggregated through mixing with Calgon solution. The material is then suspended in solution wherein regular aliquots are taken using a mechanical pipette at specific time intervals. The aliquots are dried and material in suspension determined gravimetrically. The principles of Stokes' Law are applied to determine the amount of material remaining in solution as well as the maximum particle size remaining in solution at the specified time.
Grain Size Report (Attachment) Pipet/Sieve Method	E185A Saskatoon - Environmental	Soil/Solid	SSIR-51 Method 3.2.1	A grain size curve is a graphical representation of the particle sizing of a sample representing the percent passing against the effective particle size.
Loss On Ignition (550°C)	E205D Saskatoon - Environmental	Soil/Solid	CSSS (2008) 28.3 (mod)	Loss On Ignition (LOI) is determined by drying a portion of an air dried and ground sample at 105°C overnight, then igniting at 550°C for 16-20 hours. The weight loss after ignition is reported as % loss on ignition. LOI is reported on a dry weight basis. LOI at 550°C can be used as an estimation of Organic Matter (CSSS 2008).
Total Carbon by Combustion	E351 Saskatoon - Environmental	Soil/Solid	CSSS (2008) 21.2 (mod)	Total Carbon is determined by the high temperature combustion method with measurement by an infrared detector.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total Inorganic Carbon by Acetic Acid pH Standard Curve	E354 Saskatoon - Environmental	Soil/Solid	CSSS (2008) 20.2	Total Inorganic Carbon is determined by acetic acid pH standard curve, where a known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.
Acid Volatile Sulfide by Colourimetry (5 mg/kg)	E396 Vancouver - Environmental	Soil/Solid	EPA 821/R-91-100 (mod)	Acid Volatile Sulfide is determined by colourimetric measurement on a sediment sample that has undergone distillation. Evolved hydrogen sulfide gas trapped and analyzed by the methylene blue colourimetric method.
Metals in Soil/Solid by CRC ICPMS	E440 Vancouver - Environmental	Soil/Solid	EPA 6020B (mod)	This method is intended to liberate metals that may be environmentally available. Samples are dried, then sieved through a 2 mm sieve, and digested with HNO3 and HCl. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Silicate minerals are not solubilized. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. This method does not adequately recover elemental sulfur, and is unsuitable for assessment of elemental sulfur standards or guidelines. Analysis is by Collision/Reaction Cell ICPMS.
Mercury in Soil/Solid by CVAAS	E510 Vancouver - Environmental	Soil/Solid	EPA 200.2/1631 Appendix (mod)	Samples are dried, then sieved through a 2 mm sieve, and digested with HNO3 and HCl, followed by CVAAS analysis.
Total Organic Carbon (Calculated) in soil	EC356 Saskatoon - Environmental	Soil/Solid	CSSS (2008) 21.2	Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon (TIC).

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 Vancouver - Environmental	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Distillation for Acid Volatile Sulfide in Soil	EP396 Vancouver - Environmental	Soil/Solid	EPA 821/R-91-100 (mod)	Sample distillation for Acid Volatile Sulfide analysis.
Digestion for Metals and Mercury	EP440 Vancouver - Environmental	Soil/Solid	EPA 200.2 (mod)	Samples are dried, then sieved through a 2 mm sieve, and digested with HNO3 and HCl. This method is intended to liberate metals that may be environmentally available.
Preparation of Samples for AVS and Metal Sulfide Determination	EPP396 Vancouver - Environmental	Soil/Solid	APHA 4500S2J	Sediment samples are treated with hydrochloric acid within a purge and trap system, where the evolved hydrogen sulfide gas is carried into a basic solution by argon gas for analysis.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Dry and Grind in Soil/Solid <60°C	EPP442 Saskatoon - Environmental	Soil/Solid	Soil Sampling and Methods of Analysis, Carter 2008	After removal of any coarse fragments and reservation of wet subsamples a portion of homogenized sample is set in a tray and dried at less than 60°C until dry. The sample is then particle size reduced with an automated crusher or mortar and pestle, typically to <2 mm. Further size reduction may be needed for particular tests.

QUALITY CONTROL REPORT

Work Order	: **WR2300488**	Page	: 1 of 12
Client	: Constantine North Inc.	Laboratory	: Whitehorse - Environmental
Contact	: Environmental Scientist Merlin Benner	Account Manager	: Ian Chen
Address	: Suite 320 - 800 West Pender St. Vancouver BC Canada V6C 2V6	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	:	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 08-Jun-2023 14:58
PO	: ----	Date Analysis Commenced	: 11-Jun-2023
C-O-C number	: 17774164	Issue Date	: 16-Jun-2023 09:06
Sampler	: ---- 907 766 2057		
Site	: ----		
Quote number	: VA22-CONI100-001 (Q62329)		
No. of samples received	: 10		
No. of samples analysed	: 10		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Alex Thornton	Analyst	Vancouver Metals, Burnaby, British Columbia
Brieanna Allen	Production/Validation Manager	Vancouver Inorganics, Burnaby, British Columbia
Hedy Lai	Team Leader - Inorganics	Saskatoon Inorganics, Saskatoon, Saskatchewan
Hedy Lai	Team Leader - Inorganics	Saskatoon Sask Soils, Saskatoon, Saskatchewan
Janice Leung	Supervisor - Organics Instrumentation	Vancouver Organics, Burnaby, British Columbia
Maria Painchaud	Laboratory Assistant	Saskatoon Sask Soils, Saskatoon, Saskatchewan
Robin Weeks	Team Leader - Metals	Vancouver Metals, Burnaby, British Columbia

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 983232)											
FJ2301360-001	Anonymous	pH (1:2 soil:water)	----	E108	0.10	pH units	9.40	9.51	1.2%	5%	----
Physical Tests (QC Lot: 983233)											
WR2300488-001	2023 LGC S1	Moisture	----	E144	0.25	%	23.4	22.6	3.22%	20%	----
Physical Tests (QC Lot: 986986)											
WR2300488-008	2023 MGC S3	Loss on ignition @ 550°C	----	E205D	1.0	%	2.2	2.2	0.07	Diff <2x LOR	----
Particle Size (QC Lot: 986389)											
VA23B3158-001	Anonymous	Passing (0.05mm)	----	E182	1.0	%	4.4	4.0	0.4	Diff <2x LOR	----
		Passing (0.063mm)	----	E182	1.0	%	5.0	4.6	0.5	Diff <2x LOR	----
		Passing (0.075mm)	----	E182	1.0	%	5.6	5.0	0.6	Diff <2x LOR	----
		Passing (0.125mm)	----	E182	1.0	%	7.9	6.9	0.9	Diff <2x LOR	----
		Passing (0.149mm)	----	E182	1.0	%	9.6	8.5	1.0	Diff <2x LOR	----
		Passing (0.250mm)	----	E182	1.0	%	14.5	13.1	10.5%	15%	----
		Passing (0.420mm)	----	E182	1.0	%	26.8	25.2	6.19%	15%	----
		Passing (0.50mm)	----	E182	1.0	%	31.5	29.8	5.44%	15%	----
		Passing (0.841mm)	----	E182	1.0	%	51.3	49.6	3.50%	15%	----
		Passing (1.0mm)	----	E182	1.0	%	58.0	56.2	3.16%	15%	----
Particle Size (QC Lot: 986390)											
VA23B3158-001	Anonymous	Passing (0.002mm)	----	E184	1.0	%	<1.0	<1.0	0	Diff <2x LOR	----
		Passing (0.004mm)	----	E184	1.0	%	<1.0	<1.0	0	Diff <2x LOR	----
		Passing (0.005mm)	----	E184	1.0	%	<1.0	<1.0	0	Diff <2x LOR	----
		Passing (0.020mm)	----	E184	1.0	%	2.6	2.4	0.2	Diff <2x LOR	----
		Passing (0.0312mm)	----	E184	1.0	%	3.1	2.9	0.2	Diff <2x LOR	----
Organic / Inorganic Carbon (QC Lot: 986365)											
CG2307594-002	Anonymous	Carbon, inorganic [IC]	----	E354	0.050	%	3.86	3.82	1.04%	20%	----
Organic / Inorganic Carbon (QC Lot: 988382)											
WR2300488-001	2023 LGC S1	Carbon, total [TC]	----	E351	0.050	%	0.883	0.851	3.68%	20%	----
Inorganics (QC Lot: 986148)											
WR2300488-001	2023 LGC S1	Sulfides, acid volatile	----	E396	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
Metals (QC Lot: 983230)											
FJ2301360-001	Anonymous	Aluminum	7429-90-5	E440	50	mg/kg	7960	7600	4.66%	40%	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Metals (QC Lot: 983230) - continued											
FJ2301360-001	Anonymous	Antimony	7440-36-0	E440	0.10	mg/kg	0.72	0.68	5.54%	30%	----
		Arsenic	7440-38-2	E440	0.10	mg/kg	7.25	6.80	6.35%	30%	----
		Barium	7440-39-3	E440	0.50	mg/kg	228	212	7.26%	40%	----
		Beryllium	7440-41-7	E440	0.10	mg/kg	0.34	0.31	0.03	Diff <2x LOR	----
		Bismuth	7440-69-9	E440	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Boron	7440-42-8	E440	5.0	mg/kg	5.6	5.7	0.1	Diff <2x LOR	----
		Cadmium	7440-43-9	E440	0.020	mg/kg	0.570	0.524	8.35%	30%	----
		Calcium	7440-70-2	E440	50	mg/kg	51000	58000	12.8%	30%	----
		Chromium	7440-47-3	E440	0.50	mg/kg	18.5	17.8	4.05%	30%	----
		Cobalt	7440-48-4	E440	0.10	mg/kg	6.17	5.69	8.00%	30%	----
		Copper	7440-50-8	E440	0.50	mg/kg	17.5	15.5	12.1%	30%	----
		Iron	7439-89-6	E440	50	mg/kg	19100	18400	4.02%	30%	----
		Lead	7439-92-1	E440	0.50	mg/kg	7.73	7.06	9.08%	40%	----
		Lithium	7439-93-2	E440	2.0	mg/kg	8.6	8.4	0.3	Diff <2x LOR	----
		Magnesium	7439-95-4	E440	20	mg/kg	14300	17000	17.4%	30%	----
		Manganese	7439-96-5	E440	1.0	mg/kg	410	390	5.11%	30%	----
		Molybdenum	7439-98-7	E440	0.10	mg/kg	1.33	1.19	11.4%	40%	----
		Nickel	7440-02-0	E440	0.50	mg/kg	20.4	18.8	7.93%	30%	----
		Phosphorus	7723-14-0	E440	50	mg/kg	697	659	5.57%	30%	----
		Potassium	7440-09-7	E440	100	mg/kg	1090	1060	2.31%	40%	----
		Selenium	7782-49-2	E440	0.20	mg/kg	0.70	0.55	0.15	Diff <2x LOR	----
		Silver	7440-22-4	E440	0.10	mg/kg	0.13	0.12	0.006	Diff <2x LOR	----
		Sodium	7440-23-5	E440	50	mg/kg	170	161	9	Diff <2x LOR	----
		Strontium	7440-24-6	E440	0.50	mg/kg	94.9	105	9.96%	40%	----
		Sulfur	7704-34-9	E440	1000	mg/kg	<1000	<1000	0	Diff <2x LOR	----
		Thallium	7440-28-0	E440	0.050	mg/kg	0.154	0.136	0.018	Diff <2x LOR	----
		Tin	7440-31-5	E440	2.0	mg/kg	<2.0	<2.0	0	Diff <2x LOR	----
		Titanium	7440-32-6	E440	1.0	mg/kg	201	228	12.9%	40%	----
		Tungsten	7440-33-7	E440	0.50	mg/kg	<0.50	<0.50	0	Diff <2x LOR	----
		Uranium	7440-61-1	E440	0.050	mg/kg	0.636	0.619	2.67%	30%	----
		Vanadium	7440-62-2	E440	0.20	mg/kg	38.6	37.2	3.72%	30%	----
		Zinc	7440-66-6	E440	2.0	mg/kg	64.6	57.2	12.1%	30%	----
		Zirconium	7440-67-7	E440	1.0	mg/kg	2.2	2.4	0.1	Diff <2x LOR	----
Metals (QC Lot: 983231)											

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Metals (QC Lot: 983231) - continued											
WR2300488-001	2023 LGC S1	Mercury	7439-97-6	E510	0.0050	mg/kg	0.0355	0.0155	78.5%	40%	DUP-H

Qualifiers

Qualifier	*Description*
DUP-H	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 983233)						
Moisture	----	E144	0.25	%	<0.25	----
Organic / Inorganic Carbon (QCLot: 986365)						
Carbon, inorganic [IC]	----	E354	0.05	%	<0.050	----
Organic / Inorganic Carbon (QCLot: 988382)						
Carbon, total [TC]	----	E351	0.05	%	<0.050	----
Inorganics (QCLot: 986148)						
Sulfides, acid volatile	----	E396	5	mg/kg	<5.0	----
Metals (QCLot: 983230)						
Aluminum	7429-90-5	E440	50	mg/kg	<50	----
Antimony	7440-36-0	E440	0.1	mg/kg	<0.10	----
Arsenic	7440-38-2	E440	0.1	mg/kg	<0.10	----
Barium	7440-39-3	E440	0.5	mg/kg	<0.50	----
Beryllium	7440-41-7	E440	0.1	mg/kg	<0.10	----
Bismuth	7440-69-9	E440	0.2	mg/kg	<0.20	----
Boron	7440-42-8	E440	5	mg/kg	<5.0	----
Cadmium	7440-43-9	E440	0.02	mg/kg	<0.020	----
Calcium	7440-70-2	E440	50	mg/kg	<50	----
Chromium	7440-47-3	E440	0.5	mg/kg	<0.50	----
Cobalt	7440-48-4	E440	0.1	mg/kg	<0.10	----
Copper	7440-50-8	E440	0.5	mg/kg	<0.50	----
Iron	7439-89-6	E440	50	mg/kg	<50	----
Lead	7439-92-1	E440	0.5	mg/kg	<0.50	----
Lithium	7439-93-2	E440	2	mg/kg	<2.0	----
Magnesium	7439-95-4	E440	20	mg/kg	<20	----
Manganese	7439-96-5	E440	1	mg/kg	<1.0	----
Molybdenum	7439-98-7	E440	0.1	mg/kg	<0.10	----
Nickel	7440-02-0	E440	0.5	mg/kg	<0.50	----
Phosphorus	7723-14-0	E440	50	mg/kg	<50	----
Potassium	7440-09-7	E440	100	mg/kg	<100	----
Selenium	7782-49-2	E440	0.2	mg/kg	<0.20	----
Silver	7440-22-4	E440	0.1	mg/kg	<0.10	----
Sodium	7440-23-5	E440	50	mg/kg	<50	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 983230) - continued						
Strontium	7440-24-6	E440	0.5	mg/kg	<0.50	----
Sulfur	7704-34-9	E440	1000	mg/kg	<1000	----
Thallium	7440-28-0	E440	0.05	mg/kg	<0.050	----
Tin	7440-31-5	E440	2	mg/kg	<2.0	----
Titanium	7440-32-6	E440	1	mg/kg	# 1.2	B
Tungsten	7440-33-7	E440	0.5	mg/kg	<0.50	----
Uranium	7440-61-1	E440	0.05	mg/kg	<0.050	----
Vanadium	7440-62-2	E440	0.2	mg/kg	<0.20	----
Zinc	7440-66-6	E440	2	mg/kg	<2.0	----
Zirconium	7440-67-7	E440	1	mg/kg	<1.0	----
Metals (QCLot: 983231)						
Mercury	7439-97-6	E510	0.005	mg/kg	<0.0050	----

Qualifiers

Qualifier	*Description*
B	*Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.*

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 983232)									
pH (1:2 soil:water)	----	E108	----	pH units	6 pH units	99.8	95.0	105	----
Physical Tests (QCLot: 983233)									
Moisture	----	E144	0.25	%	50 %	100	90.0	110	----
Organic / Inorganic Carbon (QCLot: 986365)									
Carbon, inorganic [IC]	----	E354	0.05	%	0.5 %	96.7	90.0	110	----
Organic / Inorganic Carbon (QCLot: 988382)									
Carbon, total [TC]	----	E351	0.05	%	48 %	96.7	90.0	110	----
Inorganics (QCLot: 986148)									
Sulfides, acid volatile	----	E396	5	mg/kg	200 mg/kg	107	70.0	130	----
Metals (QCLot: 983230)									
Aluminum	7429-90-5	E440	50	mg/kg	200 mg/kg	108	80.0	120	----
Antimony	7440-36-0	E440	0.1	mg/kg	100 mg/kg	108	80.0	120	----
Arsenic	7440-38-2	E440	0.1	mg/kg	100 mg/kg	107	80.0	120	----
Barium	7440-39-3	E440	0.5	mg/kg	25 mg/kg	101	80.0	120	----
Beryllium	7440-41-7	E440	0.1	mg/kg	10 mg/kg	104	80.0	120	----
Bismuth	7440-69-9	E440	0.2	mg/kg	100 mg/kg	103	80.0	120	----
Boron	7440-42-8	E440	5	mg/kg	100 mg/kg	93.6	80.0	120	----
Cadmium	7440-43-9	E440	0.02	mg/kg	10 mg/kg	102	80.0	120	----
Calcium	7440-70-2	E440	50	mg/kg	5000 mg/kg	98.7	80.0	120	----
Chromium	7440-47-3	E440	0.5	mg/kg	25 mg/kg	103	80.0	120	----
Cobalt	7440-48-4	E440	0.1	mg/kg	25 mg/kg	101	80.0	120	----
Copper	7440-50-8	E440	0.5	mg/kg	25 mg/kg	99.1	80.0	120	----
Iron	7439-89-6	E440	50	mg/kg	100 mg/kg	119	80.0	120	----
Lead	7439-92-1	E440	0.5	mg/kg	50 mg/kg	103	80.0	120	----
Lithium	7439-93-2	E440	2	mg/kg	25 mg/kg	99.5	80.0	120	----
Magnesium	7439-95-4	E440	20	mg/kg	5000 mg/kg	112	80.0	120	----
Manganese	7439-96-5	E440	1	mg/kg	25 mg/kg	105	80.0	120	----
Molybdenum	7439-98-7	E440	0.1	mg/kg	25 mg/kg	101	80.0	120	----
Nickel	7440-02-0	E440	0.5	mg/kg	50 mg/kg	100	80.0	120	----
Phosphorus	7723-14-0	E440	50	mg/kg	1000 mg/kg	103	80.0	120	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Metals (QCLot: 983230) - continued									
Potassium	7440-09-7	E440	100	mg/kg	5000 mg/kg	102	80.0	120	----
Selenium	7782-49-2	E440	0.2	mg/kg	100 mg/kg	107	80.0	120	----
Silver	7440-22-4	E440	0.1	mg/kg	10 mg/kg	89.2	80.0	120	----
Sodium	7440-23-5	E440	50	mg/kg	5000 mg/kg	104	80.0	120	----
Strontium	7440-24-6	E440	0.5	mg/kg	25 mg/kg	104	80.0	120	----
Sulfur	7704-34-9	E440	1000	mg/kg	5000 mg/kg	98.0	80.0	120	----
Thallium	7440-28-0	E440	0.05	mg/kg	100 mg/kg	104	80.0	120	----
Tin	7440-31-5	E440	2	mg/kg	50 mg/kg	99.0	80.0	120	----
Titanium	7440-32-6	E440	1	mg/kg	25 mg/kg	102	80.0	120	----
Tungsten	7440-33-7	E440	0.5	mg/kg	10 mg/kg	100.0	80.0	120	----
Uranium	7440-61-1	E440	0.05	mg/kg	0.5 mg/kg	97.5	80.0	120	----
Vanadium	7440-62-2	E440	0.2	mg/kg	50 mg/kg	102	80.0	120	----
Zinc	7440-66-6	E440	2	mg/kg	50 mg/kg	101	80.0	120	----
Zirconium	7440-67-7	E440	1	mg/kg	10 mg/kg	90.7	80.0	120	----
Metals (QCLot: 983231)									
Mercury	7439-97-6	E510	0.005	mg/kg	0.1 mg/kg	101	80.0	120	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Inorganics (QCLot: 986148)										
WR2300488-002	2023 LGC S2	Sulfides, acid volatile	----	E396	176 mg/kg	200 mg/kg	89.0	70.0	130	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

					Reference Material (RM) Report				
					RM Target	Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Concentration	RM	Low	High	Qualifier
Physical Tests (QCLot: 986986)									
	RM	Loss on ignition @ 550°C	----	E205D	10.33 %	104	80.0	120	----
Particle Size (QCLot: 986389)									
	RM	Passing (0.05mm)	----	E182	54.08 %	106	90.0	110	----
	RM	Passing (0.063mm)	----	E182	57.14 %	104	90.8	109	----
	RM	Passing (0.075mm)	----	E182	60.15 %	102	91.4	109	----
	RM	Passing (0.125mm)	----	E182	68.19 %	103	92.7	107	----
	RM	Passing (0.149mm)	----	E182	72.05 %	102	93.1	107	----
	RM	Passing (0.250mm)	----	E182	82.27 %	100	94.1	106	----
	RM	Passing (0.420mm)	----	E182	89.94 %	98.6	94.6	105	----
	RM	Passing (0.50mm)	----	E182	91.15 %	99.9	94.7	105	----
	RM	Passing (0.841mm)	----	E182	95.64 %	99.3	94.9	105	----
	RM	Passing (1.0mm)	----	E182	96.31 %	100	94.9	105	----
Particle Size (QCLot: 986390)									
	RM	Passing (0.002mm)	----	E184	22.46 %	103	74.1	126	----
	RM	Passing (0.004mm)	----	E184	25.14 %	104	76.8	123	----
	RM	Passing (0.005mm)	----	E184	26.48 %	104	77.9	122	----
	RM	Passing (0.020mm)	----	E184	41.82 %	103	85.8	114	----
	RM	Passing (0.0312mm)	----	E184	45.61 %	105	88.0	112	----
Particle Size (QCLot: 986391)									
	RM	Passing (19mm)	----	E181	100 %	100	90.0	110	----
	RM	Passing (2.0mm)	----	E181	100 %	100	90.0	110	----
	RM	Passing (25.4mm)	----	E181	100 %	100	90.0	110	----
	RM	Passing (38.1mm)	----	E181	100 %	100	90.0	110	----
	RM	Passing (4.75mm)	----	E181	100 %	100	90.0	110	----
	RM	Passing (50.8mm)	----	E181	100 %	100	90.0	110	----
	RM	Passing (76.2mm)	----	E181	100 %	100	90.0	110	----
	RM	Passing (9.5mm)	----	E181	100 %	100	90.0	110	----
Organic / Inorganic Carbon (QCLot: 986365)									

Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report: RM Target Concentration	Recovery (%): RM	Recovery Limits (%): Low	Recovery Limits (%): High	Qualifier
Organic / Inorganic Carbon (QCLot: 986365) - continued									
	RM	Carbon, inorganic [IC]	----	E354	0.383 %	103	80.0	120	----
Organic / Inorganic Carbon (QCLot: 988382)									
	RM	Carbon, total [TC]	----	E351	1.4 %	100	80.0	120	----
Metals (QCLot: 983230)									
	SCP SS-2	Aluminum	7429-90-5	E440	9817 mg/kg	126	70.0	130	----
	SCP SS-2	Antimony	7440-36-0	E440	3.99 mg/kg	104	70.0	130	----
	SCP SS-2	Arsenic	7440-38-2	E440	3.73 mg/kg	113	70.0	130	----
	SCP SS-2	Barium	7440-39-3	E440	105 mg/kg	116	70.0	130	----
	SCP SS-2	Beryllium	7440-41-7	E440	0.349 mg/kg	122	70.0	130	----
	SCP SS-2	Boron	7440-42-8	E440	8.5 mg/kg	123	40.0	160	----
	SCP SS-2	Cadmium	7440-43-9	E440	0.91 mg/kg	110	70.0	130	----
	SCP SS-2	Calcium	7440-70-2	E440	31082 mg/kg	121	70.0	130	----
	SCP SS-2	Chromium	7440-47-3	E440	101 mg/kg	# 132	70.0	130	MES
	SCP SS-2	Cobalt	7440-48-4	E440	6.9 mg/kg	114	70.0	130	----
	SCP SS-2	Copper	7440-50-8	E440	123 mg/kg	110	70.0	130	----
	SCP SS-2	Iron	7439-89-6	E440	23558 mg/kg	117	70.0	130	----
	SCP SS-2	Lead	7439-92-1	E440	267 mg/kg	118	70.0	130	----
	SCP SS-2	Lithium	7439-93-2	E440	9.5 mg/kg	115	70.0	130	----
	SCP SS-2	Magnesium	7439-95-4	E440	5509 mg/kg	128	70.0	130	----
	SCP SS-2	Manganese	7439-96-5	E440	269 mg/kg	129	70.0	130	----
	SCP SS-2	Molybdenum	7439-98-7	E440	1.03 mg/kg	117	70.0	130	----
	SCP SS-2	Nickel	7440-02-0	E440	26.7 mg/kg	113	70.0	130	----
	SCP SS-2	Phosphorus	7723-14-0	E440	752 mg/kg	98.3	70.0	130	----
	SCP SS-2	Potassium	7440-09-7	E440	1587 mg/kg	115	70.0	130	----
	SCP SS-2	Sodium	7440-23-5	E440	797 mg/kg	108	70.0	130	----
	SCP SS-2	Strontium	7440-24-6	E440	86.1 mg/kg	116	70.0	130	----
	SCP SS-2	Thallium	7440-28-0	E440	0.0786 mg/kg	108	40.0	160	----
	SCP SS-2	Tin	7440-31-5	E440	10.6 mg/kg	107	70.0	130	----
	SCP SS-2	Titanium	7440-32-6	E440	839 mg/kg	111	70.0	130	----
	SCP SS-2	Uranium	7440-61-1	E440	0.52 mg/kg	111	70.0	130	----
	SCP SS-2	Vanadium	7440-62-2	E440	32.7 mg/kg	116	70.0	130	----

Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report: RM Target Concentration	Recovery (%): RM	Recovery Limits (%): Low	Recovery Limits (%): High	Qualifier
Metals (QCLot: 983230) - continued									
	SCP SS-2	Zinc	7440-66-6	E440	297 mg/kg	112	70.0	130	----
	SCP SS-2	Zirconium	7440-67-7	E440	5.73 mg/kg	80.1	70.0	130	----
Metals (QCLot: 983231)									
	SCP SS-2	Mercury	7439-97-6	E510	0.059 mg/kg	103	70.0	130	----

Qualifiers

Qualifier	Description
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: 17 - 774164

Affix ALS barcode label here (lab use only)

Environmental Division Whitehorse

Work Order Reference WR2300488

Telephone : +1 867 668 6689

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM
Company:	ADF&G Habitat Section	Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 1
Contact:	Dylan Krull	Quality Control (QC) Report with Report: ☒ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐ — EMERGENCY: 1 Busine / Same Day (Laboratc
Phone:	907-465-6160	☐ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:		Email 1 or Fax dylan.krull@alaska.gov	For tests that can not be performed according to the service level selec
City/Province:		Email 2 merlin@constantinemetals.com	Analysi
Postal Code:		Email 3	
Invoice To	Same as Report To Merlin Bennett ☐ YES ☐ NO	**Invoice Distribution**	
	Copy of Invoice with Report ☐ YES ☐ NO	Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	
Company:	Constantine Mining LLC	Email 1 or Fax	
Contact:	ap@constantinemetals.com	Email 2	
bcc merlin	**Project Information**	**Oil and Gas Required Fields (client use)**	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	Stream Sediments	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact:	Sampler: Dylan Krull

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	2022 LGC S1	07-06-23	0930	Soil	2	As per quote		
	2022 LGC S2	↓	↓	Soil	2			
	2023 LGC S3			Soil	2			
	2023 LGC S4			Soil	2			
	2023 LGC S5			Soil	2			
	2023 MGC S1	06-06-23	1000	Soil	2			
	2023 MGC S2	↓	↓	Soil	2			
	2023 MGC S3			Soil	2			
	2023 MGC S4			Soil	2			
	2023 MGC S5			Soil	2			

2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION

Frozen ☐ SIF Observa

Ice Packs ☐ Ice Cubes ☐ Custody seal

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C

8°C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPI
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:
D. Krull	7/6/23	1423		8 June 2023	1253	

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 - 774164

Environmental Division Whitehorse
Work Order Reference
WR2300488

Telephone : +1 867 668 6689

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM
Company:	ADF&G Habitat Section	Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3
Contact:	Dylan Krull	Quality Control (QC) Report with Report ☒ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:	907-465-6160	☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Busine / Same Da (Laborato
	Company address below will appear on the final report	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:		Email 1 or Fax: dylan.krull@alaska.gov	For tests that can not be performed according to the service level selec
City/Province:		Email 2 merlin@constantinemetals.com	Analysi
Postal Code:		Email 3	
Invoice To	Same as Report To Merlin Benner ☐ YES ☐ NO	Invoice Distribution	
	Copy of Invoice with Report ☐ YES ☐ NO	Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	
Company:	Constantine Mining LC	Email 1 or Fax	
Contact:	ap@constantinemetals.com	Email 2	
4cc merlin	Project Information	Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center: / PO#	
Job #:	Stream sediments	Major/Minor Code: / Routing Code:	
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact:	Sampler: Dylan Krull

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Indicate Filtered (F), Preserved (P) or Filte	SAMPLES ON HOI	SUSPECTED HAZARD (see Special Instructions)
	2022 LGC S1	07-06-23	0930	Soil	2	As per quote		
	2022 LGC S2	↓	↓	Soil	2			
	2023 LGC S3			Soil	2			
	2023 LGC S4			Soil	2			
	2023 LGC S5			Soil	2			
	2023 MGC S1	06-06-23	1000	Soil	2			
	2023 MGC S2	↓	↓	Soil	2			
	2023 MGC S3			Soil	2			
	2023 MGC S4			Soil	2			
	2023 MGC S5			Soil	2			

2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)	SAMPLE CONDITION
Are samples taken from a Regulated DW System? ☐ YES ☐ NO		Frozen ☐ SIF Observa
Are samples for human consumption/ use? ☐ YES ☐ NO		Ice Packs ☐ Ice Cubes ☐ Custody seal
		Cooling Initiated ☐
		INITIAL COOLER TEMPERATURES °C: 8°C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIP		
Released by: D. Krull	Date: 7/6/23	Time: 1423	Received by:	Date: 8 June 2023	Time: 1253	Received by: 8°C G&C JC ice pk	9 Jun 23	1320

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.