Technical Report No. 22-10

Glacier Creek Aquatic Studies, 2022

by

Dylan Krull

December 2022

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
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

TECHNICAL REPORT NO. 22-10

GLACIER CREEK AQUATIC STUDIES, 2022

By

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December 2022

This investigation was fully financed by Constantine North, Inc.

Cover: Habitat Biologist Erika King admires the Saksaia Glacier valley while waiting for a periphyton sample to drain at the Middle Glacier Creek sample site.

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ACKNOWLEDGEMENTS

Constantine North, Inc. provided financial support for this project. Camp Manager Darsie Culbeck provided logistical support and Environmental Manager Allegra Cairns 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. Former Habitat Biologist William Kane assisted with sampling. Habitat Biologists Erika King and Jesse Lindgren processed periphyton samples and Erika verified data entry of all samples. Habitat Biologist Greg Albrecht identified benthic macroinvertebrates and assisted in periphyton processing. Habitat Section Operations Manager Dr. Al Ott, Kate Kanouse, and Habitat Biologists, Lee McKinley, and Chelsea Clawson reviewed and edited the report. Thank you all for your contribution.

EXECUTIVE SUMMARY

Constantine North, Inc. (CNI) 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. CNI 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 CNI, Habitat Section biologists developed a plan to study periphyton, benthic macroinvertebrates, fish, and sediment at two sites in Glacier Creek, and sampled the sites in spring 2016–2022 documenting baseline aquatic productivity and sediment conditions, which will be useful in the permitting process if CNI moves forward with a project.

In 2022, we sampled the lower and middle reaches of Glacier Creek on June 13 and 14, 1–2 weeks later than most years due to late snow melt. Mean chlorophyll *a* density was 1.85 mg/m^2 at Lower Glacier Creek and 0.97 mg/m^2 at Middle Glacier Creek, both within the ranges observed since 2016. The 2022 mean benthic macroinvertebrate density at each site also was within the ranges observed since 2016, and similar to the 2019 sample results. The macroinvertebrate communities were dominated by Diptera: Chironomidae insects; generally, Chironomidae insects are fast colonizers, easily adapt to changing habitats, and can exercise more than one feeding strategy (Entrekin et al. 2007).

We captured 10 Dolly Varden char *Salvelinus malma* in Lower Glacier Creek and 1 Dolly Varden char 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 char 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 char 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 and found 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); while we find the sediment guidelines useful for evaluating the data, we also recognize organisms respond differently in nature.

INTRODUCTION

The Palmer Exploration Project is located 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 CNI beginning in 2006 (CNI 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. The project is located on the same volcanogenic massive sulfide belt as Greens Creek Mine on Admiralty Island, about 100 air miles south. CNI has identified barite, copper, gold, silver, and zinc as potential mineable resources (CNI 2015). From 2014–2018, CNI

constructed a 6.73 km single lane gravel road to support mineral exploration on the mountainside in the Glacier Creek valley. In 2022, CNI continued exploration activities.

Figure 1.–Palmer Exploration Project area map.

Tetra Tech (2013) and ADF&G biologists have documented[a] Dolly Varden char in Glacier Creek and three tributaries. Beginning in 2016, CNI contracted with the ADF&G Habitat Section to conduct baseline studies in Glacier Creek. Following review of CNI's water quality sample data, Habitat biologists developed a study plan to investigate and document aquatic resources in Glacier Creek, similar to aquatic sampling programs at the Greens Creek Mine (Kane 2022) and Kensington Gold Mine (Timothy and Kanouse 2014), 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 2016–2022; sampling results from previous years are presented in Kanouse and Legere (2016), Legere and Kanouse (2017–2018), and Krull (2019–2021).

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.

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

Benthic macroinvertebrates (BMI) classified in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), collectively known as EPT taxa, 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.

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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.

Dolly Varden char 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). Similar to other studies in Alaska (Legere and Timothy 2016), resident Dolly Varden char 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 CNI'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). Subsequently, sediment element concentrations influence aquatic productivity. 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 CNI's Glacier Creek water sample data and potential target elements identified in the ore body.

STUDY AREA

Glacier Creek is about 7 km long, drains a 39 km^2 watershed between its headwaters at the Saksaia Glacier and confluence with the Klehini River, and 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. 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 57–272 ft^3/s, with the lowest discharge measured during September. During winter, spring, and fall of 2019 and 2020, CNI staff measured discharge about 2 km upstream of the Middle Glacier Creek sampling site which ranged 3.36–71.66 ft^3/s (A. Cairns, Environmental Manager, Constantine North Inc., Vancouver, personal communication).

CNI's 2008–2014 and 2017–2022 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 nephelometric turbidity units (NTU), and pH ranging 6.59–8.33 (DOI 2016; A. Cairns, Environmental Manager, Constantine North Inc., Vancouver, personal communication).

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[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 char (Giefer and Graziano 2022). We captured Dolly Varden char while opportunistically sampling fish use from 2016 to 2022; 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 char in lower Glacier Creek.[d] Further upstream in the drainage, we captured Dolly Varden char 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 char below the Christmas Creek confluence. In 2018, we sampled fish use near the upper extent of Glacier Creek and did not find fish.[e]

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 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 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.

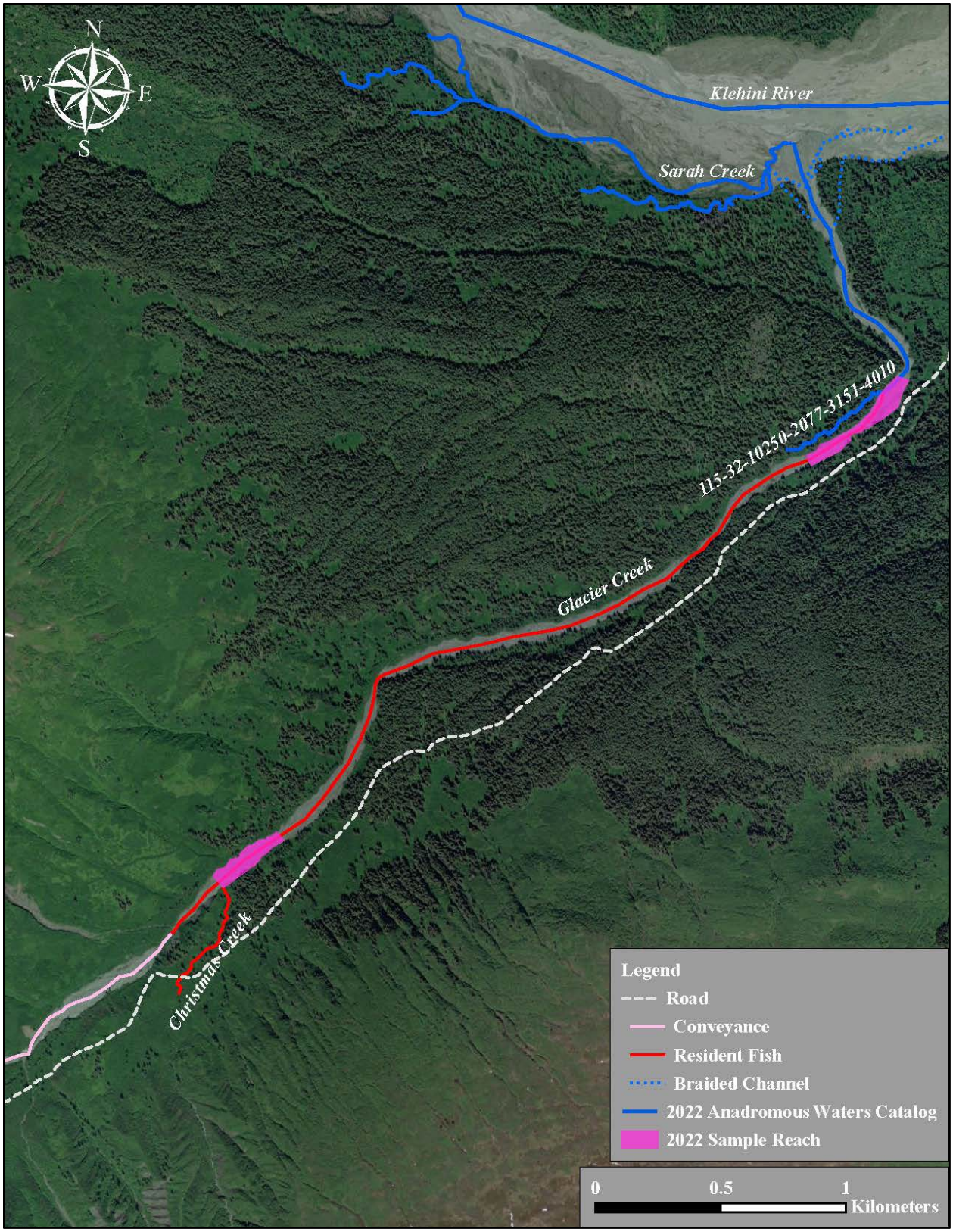

Figure 2.–Glacier Creek sample site map.

Lower Glacier Creek

The Lower Glacier Creek sample site is located at the former 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 a medium glacial outwash channel, which exhibits high rates of aggradation and scour resulting in active channels that move throughout the floodplain (Paustian 2010). Streambed gradient ranges from 3–5% and the substrate is composed of cobble, gravel, sand, and silt. In 2022, we sampled a 513 m reach, the largest reach yet due to high water and few suitable fish sampling areas; we collected 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.

Comparing stream characteristics of the Lower Glacier Creek sample site 2016–2022, we observed different main channel courses and channel braids each year. In 2022, upstream of the old bridge, the main channel flowed down the center of the floodplain with an established braid on river right side which flowed through an overflow culvert in the roadbed and then rejoined the main channel about 100 m downstream of the old bridge crossing. Downstream of the remnant bridge abutment, the main channel flowed on the river right side of the floodplain, with a braid flowing along river left.

Table 1.–2022 Lower Glacier Creek sample site location.

	Latitude	Longitude
Upper extent	59.4165	-136.3043
Lower extent	59.4196	-136.2980

Note: WGS84 datum.

Figure 3.–Lower Glacier Creek, looking downstream from the middle of the sampling reach at the old bridge abutment location.

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 hiking from the access road.

Middle Glacier Creek also is characterized as a medium glacial outwash channel (Paustian 2010). Streambed gradient ranges from 4–8% and the substrate is composed of cobble, gravel, sand, and silt. In 2022, we sampled a 300 m reach from the Christmas Creek confluence downstream; suitable fish sampling areas were limited due to high water and the majority of the stream flow concentrated to a main channel and one large braid, both with little viable holding water for fish. About halfway through the sampling reach, the channels joined, making crossing and fishing difficult. We collected periphyton, benthic macroinvertebrate, and sediment samples in established channel braids and along the main channel margin and electrofished throughout the sample reach.

Comparing stream characteristics of the Middle Glacier Creek sample site 2016–2022, we observe different main channel courses and channel braids each year. In 2022, the main channel flowed primarily down the center of the floodplain and contained a large braid that intercepted Christmas Creek and flowed into the main channel about 100 m downstream of the top of the sampling reach.

Table 2.–2022 Middle Glacier Creek sample site location.

	Latitude	Longitude
Upper extent	59.4006	-136.3447
Lower extent	59.4025	-136.3408

Note: WGS84 datum.

Figure 4.–Confluence of the main channel and braid.

METHODS

Data sets are reviewed 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. The 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[f] of saturated magnesium carbonate solution was added to the filter[g] 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.[h] 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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[f] 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.

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

[h] 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 2022 estimated detection limit for Chl-*a* concentration was 0.22 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 in a figure, and mean proportions of Chl-*a,* Chl-*b,* and Chl-*c* in a figure. A comparison of mean Chl-*a* densities among sites also is presented in a figure. The 2016–2022 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, both 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[i] and organisms were identified to the lowest practical taxonomic

[i] 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[j] using Merritt and Cummins (1996) and Stewart and Oswood (2006). Habitat biologists provided quality control of benthic macroinvertebrate enumeration for two 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[k] 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 also are presented. The 2022 sample data and the 2016–2022 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 char 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 char is presented and compared among sites; 2016–2022 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 11 resident Dolly Varden char were retained.[l,m] The target size range for sample retention was fish measuring 90–130 mm FL, as other Southeast Alaska Dolly Varden char sampling programs require (Timothy and Kanouse 2014, Legere and Timothy 2016, Kane 2022). 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 reasonably conclude it is resident due to sampling timing and location—about 60 km upriver

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[j] 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.

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

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

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

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[n] 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 char whole body element concentrations are presented in a figure; comparisons of element concentrations data among sites also are presented. A table with the raw data, presenting the mean value for duplicate sample results and 2021 laboratory report are 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 17, 2022, CNI staff transported the sediment samples in coolers with ice packs via a courier to ALS Environmental in Whitehorse, BC.

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.[o,]

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

[o] The 2016 Glacier Creek sediment samples were processed by an ALS Environmental lab in Kelso, WA. In 2017–2022, CNI sent the sediment samples to a different ALS lab; 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.–2022 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)
Inorganic carbon as $CaCO_3$ equivalent	Inorganic carbon	Calculation
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 char 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 compared among sites and presented as a figure. Appendix E contains the 2016–2022 composition and raw element data in a table and the 2022 laboratory report.

RESULTS

LOWER GLACIER CREEK

We sampled Lower Glacier Creek on June 13, 2022, and measured basic water quality at 1446 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
06/13/22	4.06	10.86	215	52	8.10

Periphyton: Chlorophyll Density and Composition

The 2022 Lower Glacier Creek mean Chl-*a* density was 1.85 mg/m^2, within the range of the 2016–2021 mean densities (Table 5; Figure 5). The samples contained about 83% Chl-*a*, 17% Chl-*c*, and 0% Chl-*b* (Figure 6). Chl-*a,* Chl-*b,* and Chl-*c* were not detected in 2 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

Note: Chl-*a* mean density ± 1 SD.

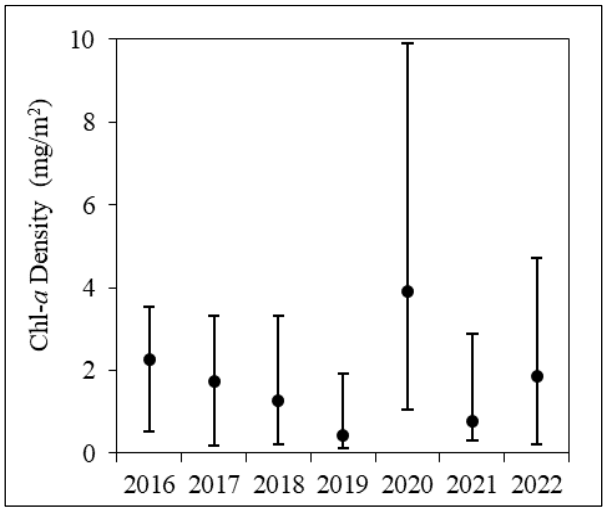

Figure 5.–Lower Glacier Creek chlorophyll *a* densities.

Note: Minimum, mean, and maximum values shown.

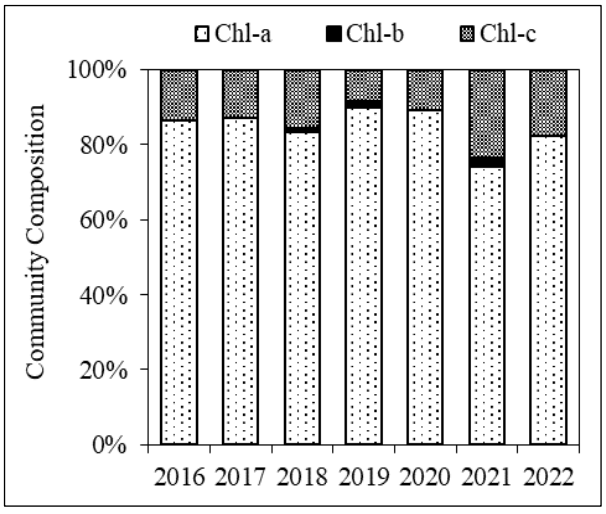

Figure 6.–Lower Glacier Creek mean proportions of chlorophylls *a*, *b*, and *c*.

Benthic Macroinvertebrate Density and Community Composition

Among the 2022 Lower Glacier Creek BMI samples, we identified 30 taxa and estimated mean density at 1,136 BMI/m^2, of which 21% were EPT insects (Table 6; Figures 7, 8). The dominant taxon was Diptera: Chironomidae, representing 71% of the samples, as in previous years.

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
Mean BMI density (per m^2)	995	2,136	217	473	754	396	1,136
Total BMI taxa	17	30	16	12	25	26	30
Number of EPT taxa	9	13	10	5	12	12	14
Proportion of EPT insects	10%	17%	69%	30%	19%	27%	21%
Proportion of Chironomidae insects	85%	78%	26%	67%	74%	58%	71%

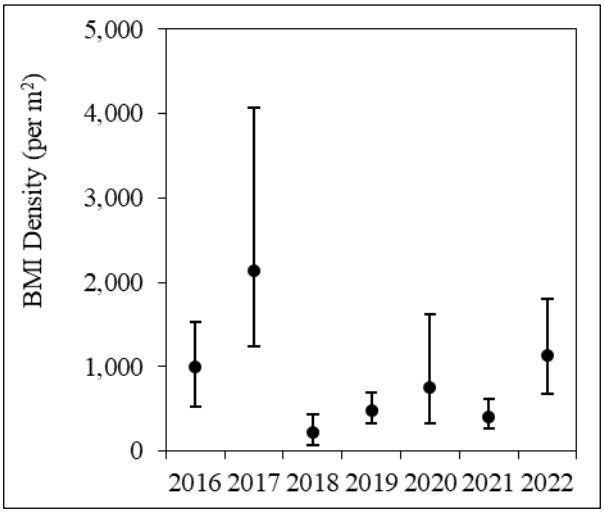

Figure 7.–Lower Glacier Creek benthic macroinvertebrate densities.

Note: Minimum, mean, and maximum values shown.

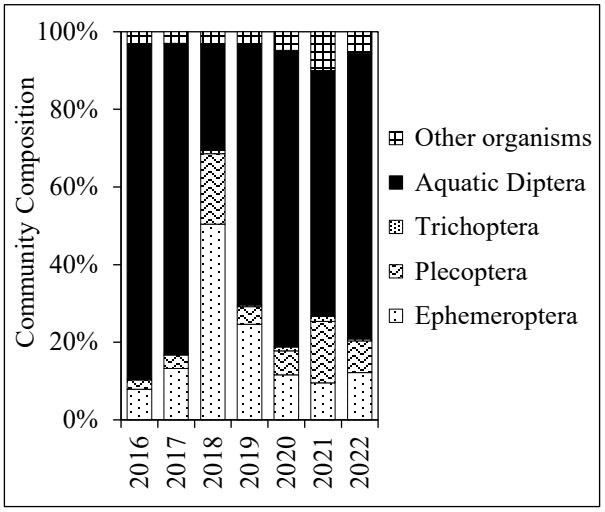

Figure 8.–Lower Glacier Creek mean benthic macroinvertebrate community compositions.

Resident Fish Condition and Element Concentrations

Of the 10 individual whole body Dolly Varden char (93–148 mm) samples we retained from Lower Glacier Creek in 2022, mean fish condition was 1.3, the greatest observed at the site. We did not capture other fish species. Among the Lower Glacier Creek whole body Dolly Varden char samples in 2022 element concentrations were generally within the ranges of values previously observed (Figure 9). One sample contained elevated Ag and Cd values and another sample contained an elevated lead value, all three were the greatest observed values detected in Lower Glacier Creek.

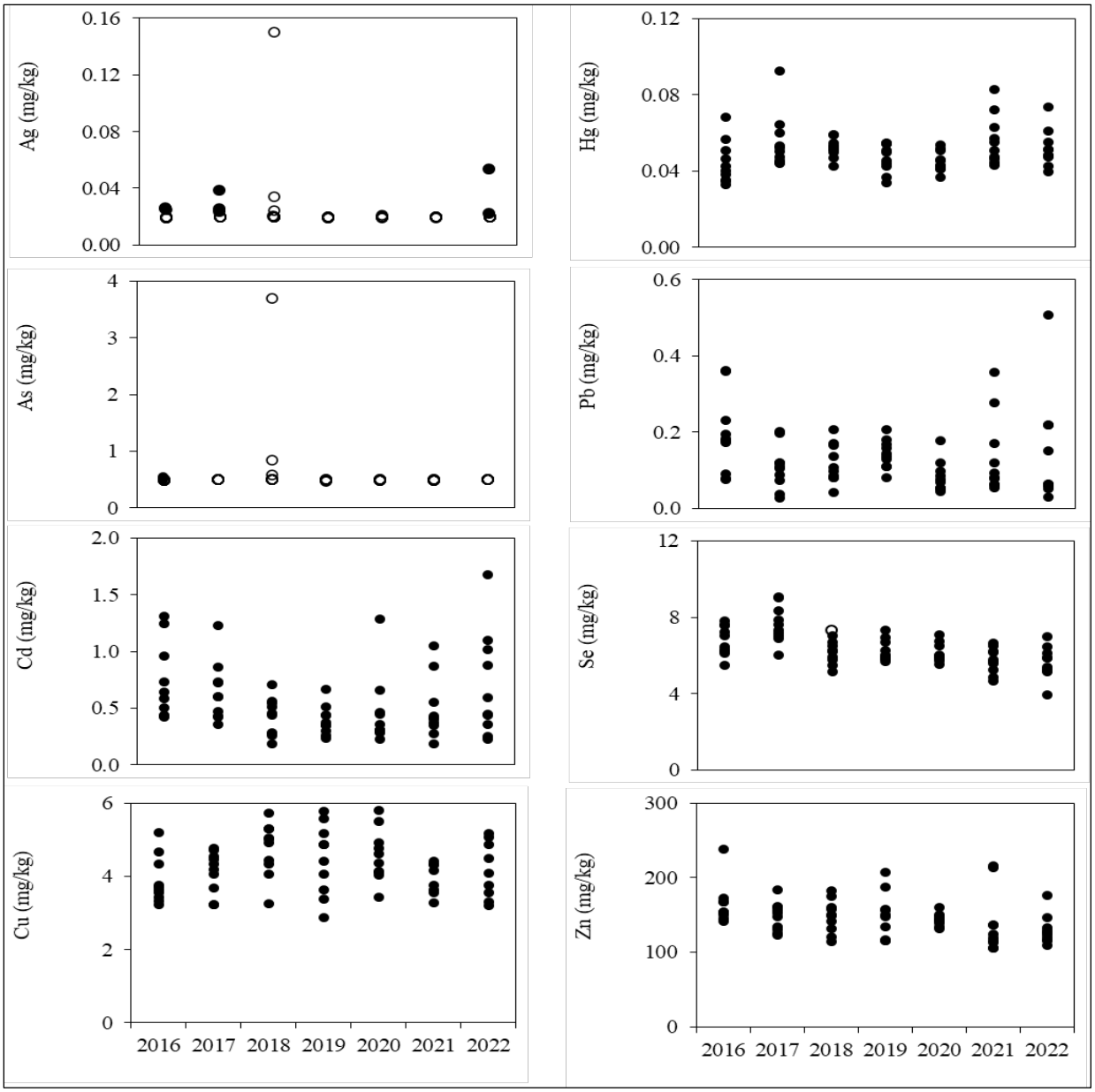

Figure 9.–Lower Glacier Creek whole body Dolly Varden char element concentrations.
Note: Element concentrations undetected (o) are presented at the method reporting limit.

Sediment Composition and Element Concentrations

The 2022 Lower Glacier Creek sediment samples included particle sizes less than 9.5 mm. Total organic carbon concentrations were less than 0.369%, and acid volatile sulfide was not detected. The predominant elements were Fe and Al, and the 2022 element concentrations generally were similar to the 2016–2021 results.

We evaluated the 2022 sediment sample element concentration data against the guidelines for freshwater sediments published in Buchman (2008) and—similar to the 2016–2021 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).

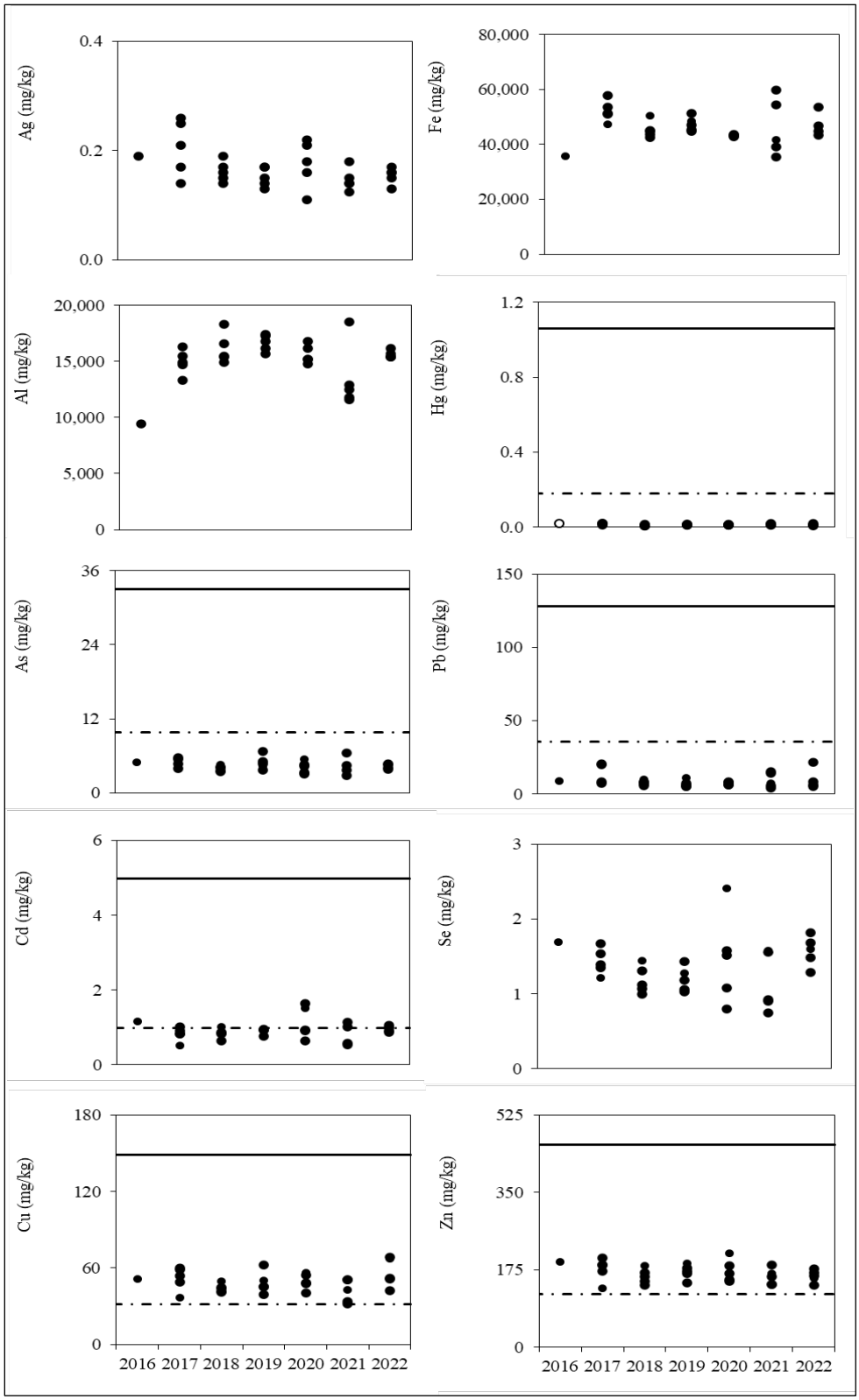

Figure 10.–Lower Glacier Creek sediment element concentrations.

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 14, 2022, and measured basic water quality at 1250 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
06/14/22	3.72	13.11	251	60	8.11

Periphyton: Chlorophyll Density and Composition

The 2022 Middle Glacier Creek mean Chl-*a* density was 0.97 mg/m^2, within the range of the 2016–2021 sample means (Table 8; Figure 11). As in previous years, the samples contained about 78% Chl-*a* and 22% Chl-*c*; Chl-*b* was not detected in any samples (Figure 12) and Chl-*a* and Chl-*c* were not detected in 5 samples.

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

Note: Chl-*a* mean density ± 1 SD.

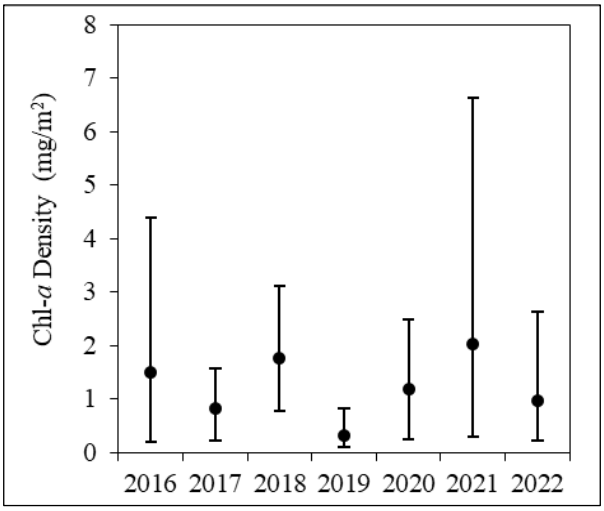

Figure 11.–Middle Glacier Creek chlorophyll *a* densities.

Note: Minimum, mean, and maximum values shown.

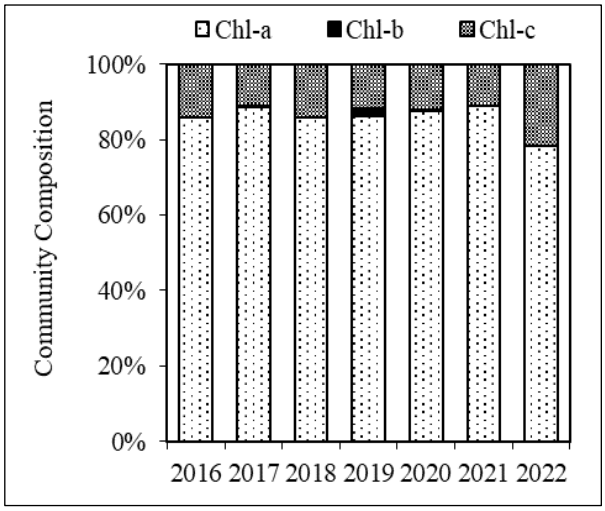

Figure 12.–Middle Glacier Creek mean proportions of chlorophylls *a*, *b*, and *c*.

Benthic Macroinvertebrate Density and Community Composition

Among the 2022 Middle Glacier Creek BMI samples, we identified 25 taxa and estimate mean density at 1,192 BMI/m^2, of which 12% were EPT insects (Table 9; Figures 13, 14). The dominant taxon was Diptera: Chironomidae, representing 79% of the samples, as in previous years.

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
Mean BMI density (per m^2)	2,299	593	504	215	754	842	1,192
Total BMI taxa	22	14	12	11	25	27	25
Number of EPT taxa	12	6	5	8	13	11	13
Proportion of EPT insects	13%	12%	9%	28%	24%	33%	12%
Proportion of Chironomidae insects	85%	82%	87%	68%	69%	57%	79%

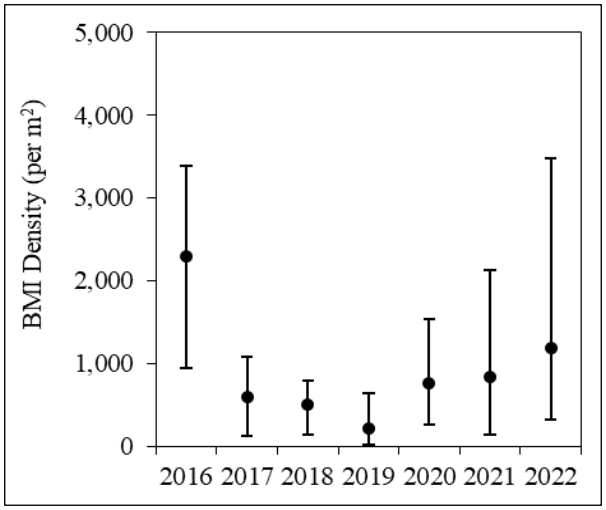

Figure 13.–Middle Glacier Creek benthic macroinvertebrate densities.

Note: Minimum, mean, and maximum values shown.

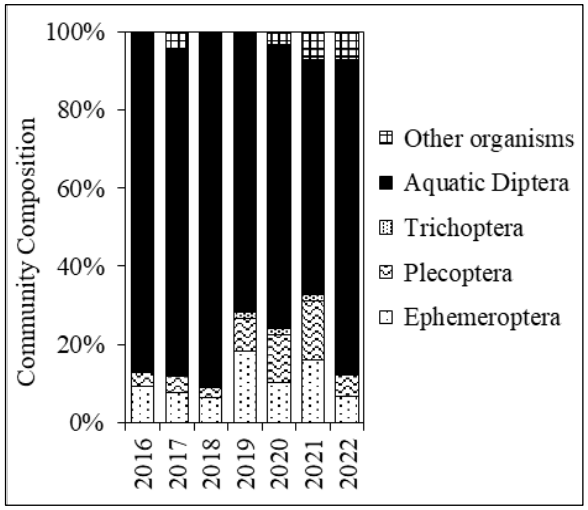

Figure 14.–Middle Glacier Creek mean benthic macroinvertebrate community compositions.

Resident Fish Condition and Element Concentrations

We retained 1 Dolly Varden char (95 mm) for whole body element analyses from Middle Glacier Creek in 2022, and fish condition was 1.2. Despite extensive fishing, we were unable to capture additional fish within the sample size range, and we did not capture other fish species. The 2022 whole body Dolly Varden char element concentrations generally were within the range of concentrations observed in 2016–2021 (Figure 15).

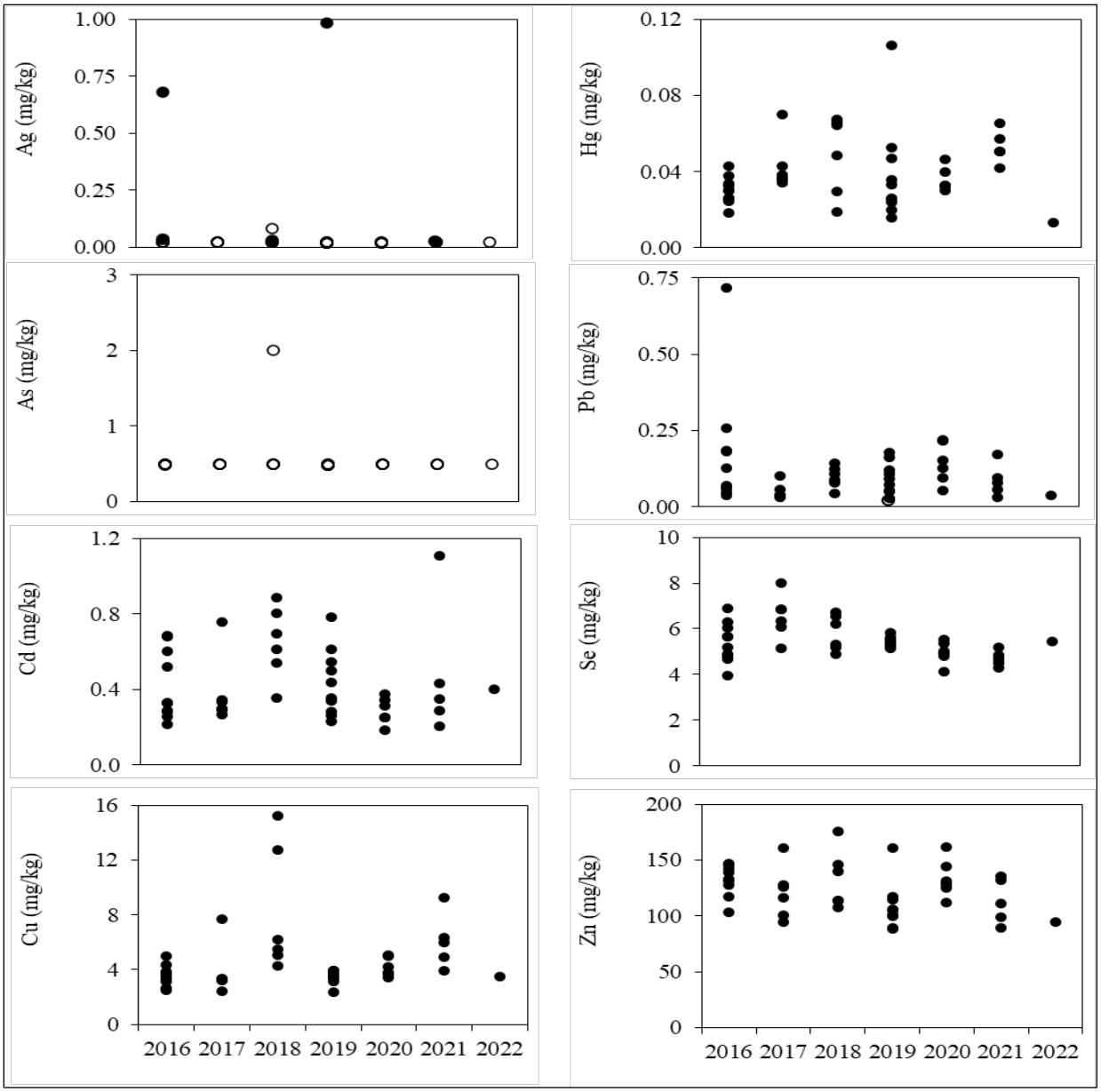

Figure 15.–Middle Glacier Creek whole body Dolly Varden char element concentrations.
Note: Element concentrations undetected (o) are presented at the method reporting limit.

Sediment Composition and Element Concentrations

The 2022 Middle Glacier Creek sediment samples largely included particle sizes less than 9.5 mm. Total organic carbon concentrations were less than 0.408%, and acid volatile sulfide was not detected. The predominant elements were Fe and Al, and the 2022 element concentrations generally were similar to the 2016–2021 results.

We evaluated the 2022 sediment sample element concentration data against the guidelines for freshwater sediments published in Buchman (2008) and—similar to the 2016–2021 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).

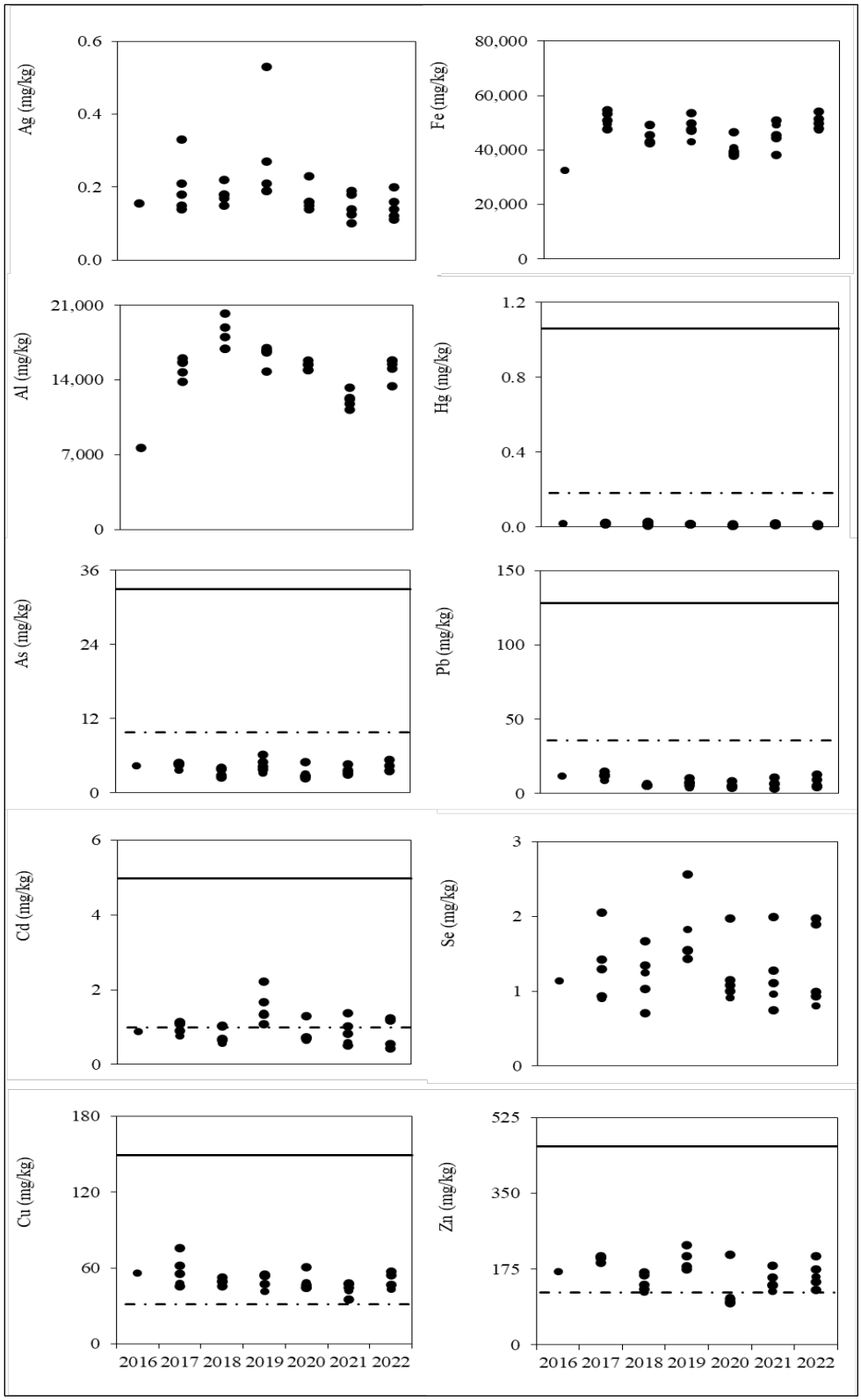

Figure 16.–Middle Glacier Creek sediment element concentrations.

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 2022, the Lower Glacier Creek mean Chl-*a* density was greater than the Middle Glacier Creek mean density; and both means were within the range observed 2016–2021 (Figure 17).

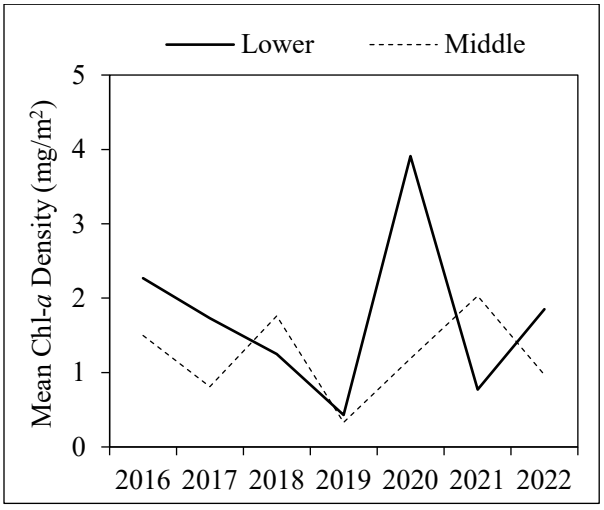

Figure 17.–Glacier Creek Chl-*a* densities.

Benthic Macroinvertebrate Density and Community Composition

In 2022, we documented BMI density and taxa richness at Lower Glacier Creek within the ranges observed 2016–2021 (Figures 18, 19). At Middle Glacier Creek, the 2022 mean BMI density was within the 2016–2021 range. Diptera: Chironomidae insects were the dominant taxon at both sites in 2022, as in most previous years.

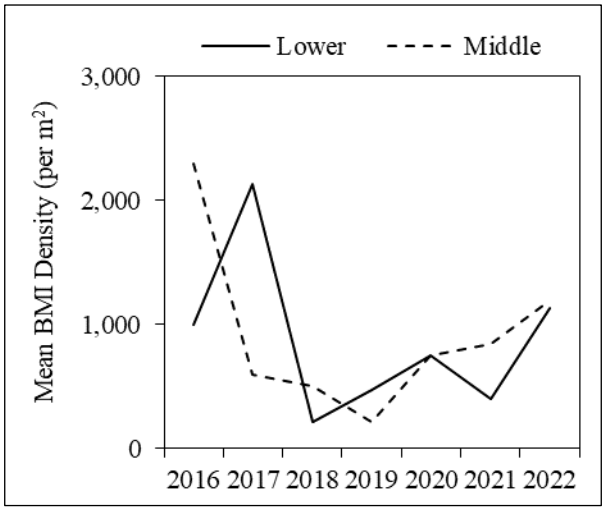

Figure 18.–Glacier Creek mean benthic macroinvertebrate densities.

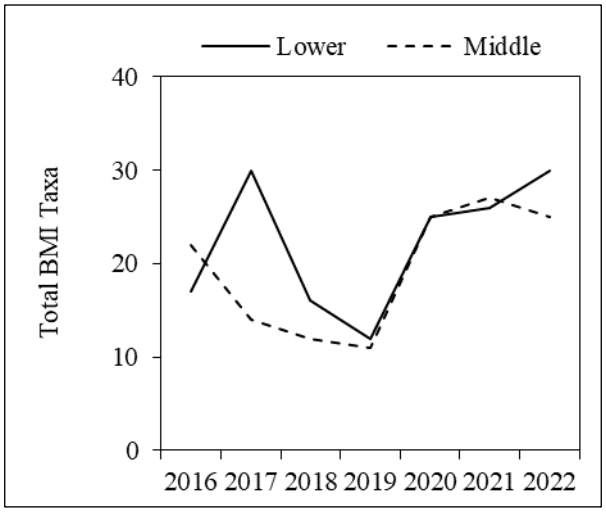

Figure 19.–Glacier Creek benthic macroinvertebrate taxa richness.

Resident Fish Condition and Element Concentrations

Mean fish condition among the 2022 Lower and Middle Glacier Creek Dolly Varden char samples was 1.3 and 1.2 at each site, similar to the 2016–2021 results and other Dolly Varden char condition data collected in Southeast Alaska (Kane 2022).

When we combined the 2016–2022 Dolly Varden char element concentration data by site, median element concentrations were greater among the Lower Glacier Creek samples, except median Ag and As concentrations were similar, as those elements are often not detected (Figure 20). All concentrations were within the ranges observed in whole body Dolly Varden char samples collected from reference and exploration sites elsewhere in Alaska (Legere and Timothy 2016).

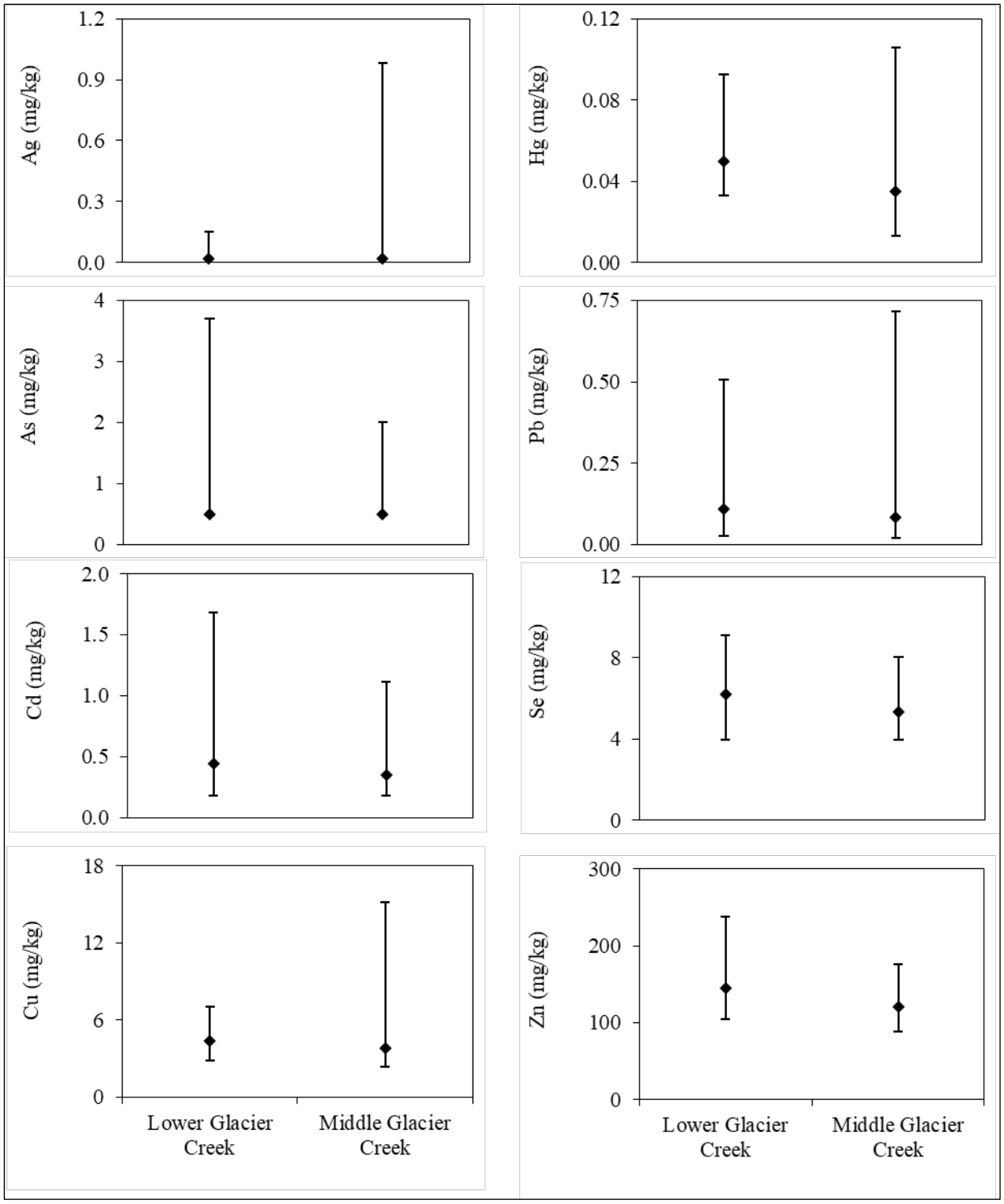

Figure 20.–Glacier Creek whole body Dolly Varden char element concentrations, 2016–2022.

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

Sediment Composition and Element Concentrations

The 2016–2022 Lower and Middle Glacier Creek sediment samples were largely composed of sand and silt; total organic carbon was less than 0.5% and acid volatile sulfide was not detected. When we combined the 2016–2022 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), and similar to the 2016–2021 results 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 (Figure 21). Guidelines are not published for Ag, Al, Fe, or Se.

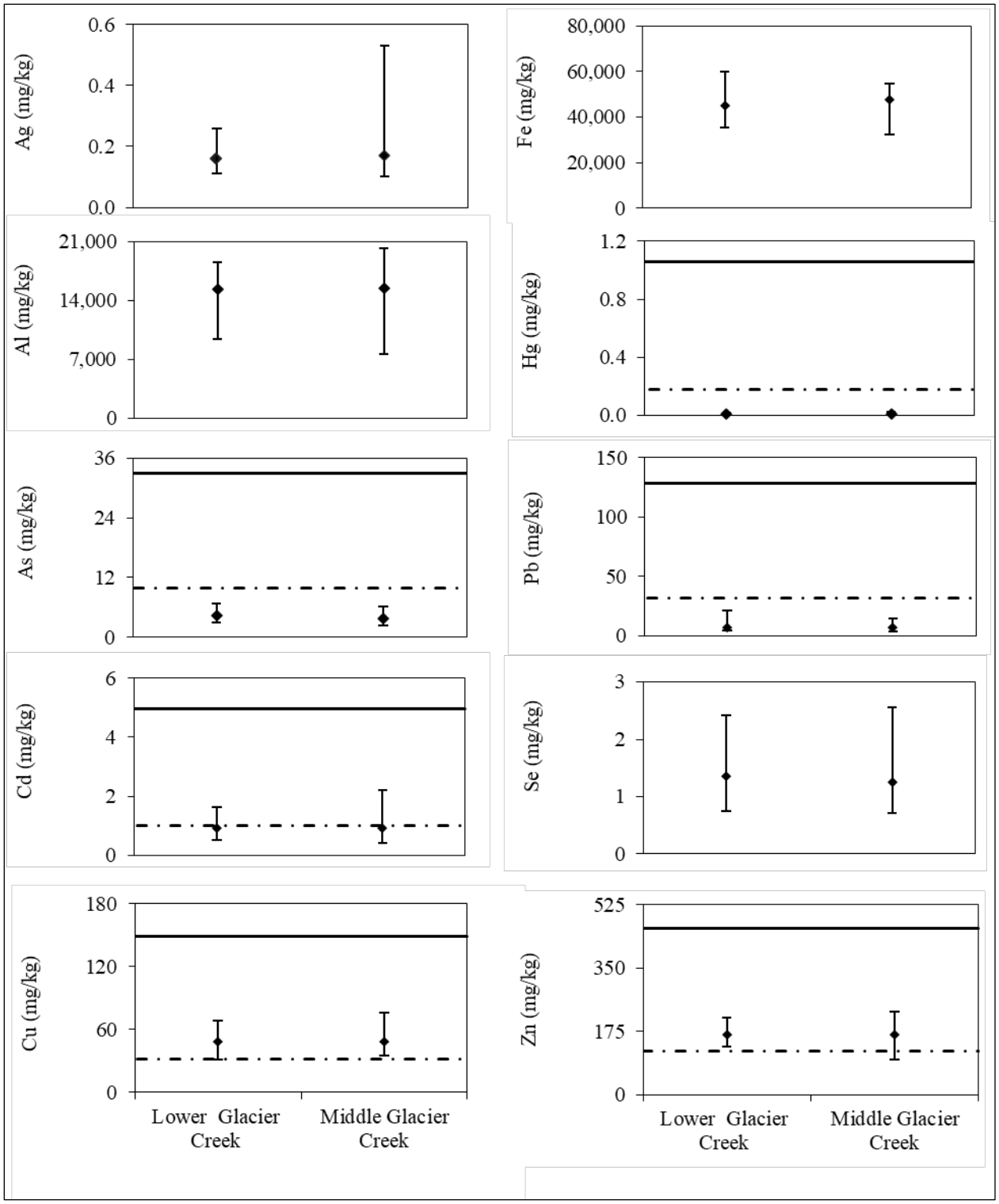

Figure 21.–Glacier Creek sediment element concentrations, 2016–2022.

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, 2016–2022.

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

[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, 2016–2022.

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

[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, 2016–2022.

	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		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*
	1.17	0.00	0.19
	0.55	0.00	0.12
	4.72	0.00	0.81
	1.64	0.00	0.34
	0.22	ND	ND
	0.22	ND	ND
	3.80	0.00	0.70
	2.78	0.00	0.53
	2.98	0.00	0.45
	0.37	0.00	0.00
Mean	1.85	0.00	0.39
Minimum	0.22	0.00	0.00
Maximum	4.72	0.00	0.81

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, 2016–2022.

	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		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*
	0.22	ND	ND
	1.92	0.00	0.28
	0.64	0.00	0.11
	2.62	0.00	0.30
	0.22	ND	ND
	0.22	ND	ND
	0.22	ND	ND
	0.22	ND	ND
	1.69	0.00	0.33
	1.71	0.00	0.31
Mean	0.97	0.00	0.27
Minimum	0.22	0.00	0.00
Maximum	2.62	0.00	0.33

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, 2022.

				Sample Number						
Class or Subclass	Order	Family	Genus	1	2	3	4	5	6	**Total**
Insecta	Ephemeroptera	Baetidae	*Baetis*	14	15	8	11	6	11	**65**
		Ephemerellidae	*Drunella*	0	0	0	0	1	0	**1**
		Heptageniidae	*Cinygmula*	0	0	0	0	1	0	**1**
			Epeorus	0	2	0	0	0	0	**2**
			Rhithrogena	1	1	0	3	2	1	**8**
	Plecoptera	Capniidae	*Capnia*	0	5	2	1	0	0	**8**
		Chloroperlidae	*Suwallia*	1	0	3	4	3	4	**15**
		Leuctridae	*Despaxia*	0	1	0	0	1	0	**2**
		Nemouridae	*Podmosta*	3	0	0	0	0	0	**3**
			Zapada	1	0	1	3	1	14	**20**
		Perlodidae	*Isoperla*	0	0	0	0	3	0	**3**
		unidentified	unidentified	0	0	0	1	0	0	**1**
	Trichoptera	Brachycentridae	*Micrasema*	0	0	0	1	0	0	**1**
		Limnephilidae	*Ecclisocosmoecus*	0	0	0	1	0	0	**1**
		Rhyacophilidae	*Rhyacophila*	0	0	0	1	0	0	**1**
	Diptera	Chironomidae	unidentified	107	136	42	55	39	70	**449**
		Dolichopodidae	unidentified	0	0	1	0	0	0	**1**
		Limoniidae	*Gonomyodes*	1	1	1	0	2	0	**5**
		Psychodidae	*Pericoma*	1	0	0	0	0	0	**1**
		Simuliidae	*Prosimulium*	0	0	0	1	0	1	**2**
		Tipulidae	*Antocha*	0	0	0	0	0	4	**4**
			Gonomyia	0	0	0	0	0	1	**1**
			Pedicia	0	0	0	0	0	1	**1**
			Rhabdomastix	0	0	1	0	0	0	**1**
			Tipula	0	1	0	0	0	1	**2**
	Hemiptera	unidentified	unidentified	1	1	0	1	0	2	**5**
Arachnida	unidentified	unidentified	unidentified	0	1	0	1	3	0	**5**
Entognatha	Collembola	unidentified	unidentified	2	1	1	1	4	1	**10**
Nematoda	unidentified	unidentified	unidentified	0	1	0	0	0	0	**1**
Oligochaeta	unidentified	unidentified	unidentified	3	2	2	0	0	2	**9**
Ostracoda	unidentified	unidentified	unidentified	0	0	1	1	3	0	**5**
			Total	**135**	**168**	**63**	**86**	**69**	**113**	**634**

Appendix C.2.–Lower Glacier Creek benthic macroinvertebrate data summaries, 2016–2022.

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

Appendix C.3.–Middle Glacier Creek benthic macroinvertebrate sample data, 2022.

				Sample Number						
Class or Subclass	Order	Family	Genus	1	2	3	4	5	6	**Total**
Insecta	Ephemeroptera	Baetidae	*Baetis*	24	5	1	1	1	0	**32**
		Ephemerellidae	*Drunella*	1	0	0	0	0	0	**1**
		Heptageniidae	*Cinygmula*	2	0	0	0	0	0	**2**
			Epeorus	2	0	0	0	0	0	**2**
			Rhithrogena	8	0	0	0	0	0	**8**
	Plecoptera	Capniidae	*Capnia*	6	0	0	1	1	1	**9**
		Chloroperlidae	*Suwallia*	0	0	0	1	0	1	**2**
		Leuctridae	*Despaxia*	0	0	1	0	0	0	**1**
		Nemouridae	*Podmosta*	14	0	0	1	0	0	**15**
			Zapada	5	1	0	0	0	0	**6**
		Perlodidae	*Megarcys*	2	0	0	0	0	0	**2**
	Trichoptera	Limnephilidae	*Moselyana*	1	0	0	0	0	0	**1**
		Rhyacophilidae	*Rhyacophila*	1	0	0	0	0	1	**2**
	Diptera	Chironomidae	unidentified	73	315	23	31	32	50	**524**
		Empididae	*Oreogeton*	0	0	0	0	1	0	**1**
		Limoniidae	*Gonomyodes*	1	0	0	1	1	2	**5**
		Simuliidae	*Prosimulium*	3	0	0	0	0	0	**3**
		Tipulidae	*Rhabdomastix*	0	0	0	0	1	0	**1**
	Coleoptera	Staphylinidae	unidentified	0	0	0	1	0	0	**1**
	Hemiptera	Unidentified	unidentified	29	0	0	2	0	1	**32**
Arachnida	unidentified	unidentified	unidentified	2	0	1	0	0	1	**4**
Entognatha	Collembola	unidentified	unidentified	1	1	1	0	0	2	**5**
Nematoda	unidentified	unidentified	unidentified	0	1	0	0	0	1	**2**
Oligochaeta	unidentified	unidentified	unidentified	0	0	1	0	1	0	**2**
Ostracoda	unidentified	unidentified	unidentified	0	0	1	0	1	0	**2**
			Total	**175**	**323**	**29**	**39**	**39**	**60**	**665**

Appendix C.4.–Middle Glacier Creek benthic macroinvertebrate data summaries, 2016–2022.

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

APPENDIX D: RESIDENT FISH DATA AND LABORATORY REPORT

Appendix D.1.–Lower Glacier Creek whole body Dolly Varden char element concentrations, 2016–2022.

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.2.–Middle Glacier Creek whole body Dolly Varden char element concentrations, 2016–2022.

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

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November 09, 2022 **Analytical Report for Service Request No:** K2211569

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

RE: 2022 Palmer Project Biomonitoring

Dear Dylan,

Enclosed are the results of the sample(s) submitted to our laboratory September 21, 2022
For your reference, these analyses have been assigned our service request number **K2211569.**

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

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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
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Client: Alaska Department of Fish and Game
Project: 2022 Palmer Project Biomonitoring
Sample Matrix: Animal Tissue

Service Request: K2211569
Date Received: 09/21/2022

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 level IV requested by the client.

Sample Receipt:

Eleven animal tissue samples were received for analysis at ALS Environmental on 09/21/2022. 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, 11/08/2022: The matrix spike recovery of Zinc for sample Lower Glacier Creek DV Metals Fish #2 was outside control criteria. Recovery in the Laboratory Control Sample (LCS) was acceptable, which indicated the analytical batch was in control. No further corrective action was appropriate.

Approved by Noe D. Diaz Date 11/09/2022

Chain of Custody

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CHAIN OF CUSTODY

ALS Environmental

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SR# _____ PAGE 1 OF 2 COC# _____

PROJECT NAME: 2022 Palmer Project Biomonitoring
PROJECT NUMBER:
PROJECT MANAGER: Dylan Krull
COMPANY NAME: AK Department of Fish & Game
ADDRESS: 802 3rd street
CITY/STATE/ZIP: Douglas, AK, 99824
E-MAIL ADDRESS: dylan.krull@alaska.gov FAX #:
PHONE #: 907-465-6160
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ SIM PAH☐	Volatile Organics 624☐ 8270LL☐ 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 - 8151M 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☐	Hg - 1631 E	REMARKS
See attachment	1 of 1	for			11							X								X			
whole body juvenile fish																							
individual samples																							

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. # Constantine
Bill To: Allegra Cairns
allegra@constantinemetals.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 and Allegra

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

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature:	Signature: Helen Cahurn	Signature:	Signature:
Date/Time: 9/19/22 0930	Date/Time: 9/21/22 10:25	Date/Time:	Date/Time:
Printed Name: Erika King	Printed Name: Helen Cahurn	Printed Name:	Printed Name:
Firm: ADFG	Firm: ALS	Firm:	Firm:

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K2211569

Attachment 1 of 1

Project Name:	2022 Palmer Project Biomonitoring		
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

Matrix	Sample Date	Sample Name	Sample ID	Total Metals	Fork Length (mm)	Weight (g)
✓ Whole Body	6/14/2022	Middle Glacier Creek DV Metals Fish #1	2022MGCDV1	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	95	10.0
Whole Body	6/13/2022	Lower Glacier Creek DV Metals Fish #1	2022LGCDV1	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	133	35.5
Whole Body	6/13/2022	Lower Glacier Creek DV Metals Fish #2	2022LGCDV2	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	148	40.0
Whole Body	6/13/2022	Lower Glacier Creek DV Metals Fish #3	2022LGCDV3	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	93	9.2
Whole Body	6/13/2022	Lower Glacier Creek DV Metals Fish #4	2022LGCDV4	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	144	36.4
Whole Body	6/13/2022	Lower Glacier Creek DV Metals Fish #5	2022LGCDV5	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	113	17.3
Whole Body	6/13/2022	Lower Glacier Creek DV Metals Fish #6	2022LGCDV6	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	107	17.5
Whole Body	6/13/2022	Lower Glacier Creek DV Metals Fish #7	2022LGCDV7	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	100	13.2
Whole Body	6/13/2022	Lower Glacier Creek DV Metals Fish #8	2022LGCDV8	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	115	16.5
Whole Body	6/13/2022	Lower Glacier Creek DV Metals Fish #9	2022LGCDV9	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	107	16.0
Whole Body	6/13/2022	Lower Glacier Creek DV Metals Fish #10	2022LGCDV10	Ag, As, Cd, Cu, Hg, Pb, Se, Zn	102	13.3

PM Mack

Cooler Receipt and Preservation Form

Client AK Department of Fish + Game Service Request K22 11569

Received: 9/21/22 Opened: 9/21/22 By: HC Unloaded: 9/21/22 By: HC

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? 1 front
   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
	2.4					2781 4489 0038	

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 # below 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 100ml sterile microbiology bottles filled exactly to the 100ml mark? (NA) Y N Under filled Overfilled

Sample ID on Bottle	Sample ID on COC	Identified by:

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

Notes, Discrepancies, Resolutions: _____

Total Solids

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

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22 - 06/14/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22
Analysis Method:	Freeze Dry	**Units:**	Percent
Prep Method:	None	**Basis:**	Wet

Total Solids

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
Middle Glacier Creek DV Metals Fish #1	K2211569-001	**26.0**	-	-	1	10/25/22	
Lower Glacier Creek DV Metals Fish #1	K2211569-002	**24.2**	-	-	1	10/25/22	
Lower Glacier Creek DV Metals Fish #2	K2211569-003	**27.1**	-	-	1	10/25/22	
Lower Glacier Creek DV Metals Fish #3	K2211569-004	**25.6**	-	-	1	10/25/22	
Lower Glacier Creek DV Metals Fish #4	K2211569-005	**25.5**	-	-	1	10/25/22	
Lower Glacier Creek DV Metals Fish #5	K2211569-006	**25.5**	-	-	1	10/25/22	
Lower Glacier Creek DV Metals Fish #6	K2211569-007	**26.3**	-	-	1	10/25/22	
Lower Glacier Creek DV Metals Fish #7	K2211569-008	**25.5**	-	-	1	10/25/22	
Lower Glacier Creek DV Metals Fish #8	K2211569-009	**24.7**	-	-	1	10/25/22	
Lower Glacier Creek DV Metals Fish #9	K2211569-010	**24.4**	-	-	1	10/25/22	
Lower Glacier Creek DV Metals Fish #10	K2211569-011	**25.2**	-	-	1	10/25/22	

Metals

ALS Environmental—Kelso Laboratory
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:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13-06/14/22
Sample Matrix:	Animal tissue	**Date Received:**	09/21/22

Mercury, Total

Prep Method: METHOD
Analysis Method: 1631E
Test Notes:

Units: ng/g
Basis: Dry

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
Middle Glacier Creek DV Metals Fish #1	K2211569-001	9.9	1.99	10	11/02/22	11/03/22	13.2	
Lower Glacier Creek DV Metals Fish #1	K2211569-002	10.0	1.99	10	11/02/22	11/03/22	51.1	
Lower Glacier Creek DV Metals Fish #2	K2211569-003	10.0	1.99	10	11/02/22	11/03/22	73.7	
Lower Glacier Creek DV Metals Fish #3	K2211569-004	10.0	1.999	10	11/02/22	11/03/22	51.3	
Lower Glacier Creek DV Metals Fish #4	K2211569-005	9.9	1.99	10	11/02/22	11/03/22	48.2	
Lower Glacier Creek DV Metals Fish #5	K2211569-006	9.8	1.95	10	11/02/22	11/03/22	42.4	
Lower Glacier Creek DV Metals Fish #6	K2211569-007	9.7	1.95	10	11/02/22	11/03/22	47.3	
Lower Glacier Creek DV Metals Fish #7	K2211569-008	9.9	1.98	10	11/02/22	11/03/22	55.1	
Lower Glacier Creek DV Metals Fish #8	K2211569-009	10.0	2.0	10	11/02/22	11/03/22	61.2	
Lower Glacier Creek DV Metals Fish #9	K2211569-010	9.6	1.91	10	11/02/22	11/03/22	39.7	
Lower Glacier Creek DV Metals Fish #10	K2211569-011	9.9	1.98	10	11/02/22	11/03/22	47.9	
Method Blank 1	K2211569-MB1	1.0	0.20	1	11/02/22	11/03/22	ND	
Method Blank 2	K2211569-MB2	1.0	0.20	1	11/02/22	11/03/22	ND	
Method Blank 3	K2211569-MB3	1.0	0.20	1	11/02/22	11/03/22	ND	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal tissue	**Date Received:**	09/21/22
		Date Extracted:	11/02/22
		Date Analyzed:	11/03/22

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	Lower Glacier Creek DV Metals Fish #1	Units:	ng/g
Lab Code:	K2211569-002MS, K2211569-002DMS	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	9.9	250	248	51.1	299	294	99	98	70-130	2	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	11/03/22

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	5.29	106	70-130	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	11/03/22

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	4.75	95	70-130	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Animal tissue	**Date Received:**	NA
		Date Extracted:	11/02/22
		Date Analyzed:	11/03/22

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	283	97	70-130	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/14/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Middle Glacier Creek DV Metals Fish #1	**Basis:**	Dry
Lab Code:	K2211569-001		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.13 J**	mg/Kg	0.49	0.02	5	11/08/22 16:54	11/07/22	
Cadmium	6020A	**0.400**	mg/Kg	0.020	0.004	5	11/08/22 16:54	11/07/22	
Copper	6020A	**3.50**	mg/Kg	0.099	0.030	5	11/08/22 16:54	11/07/22	
Lead	6020A	**0.038**	mg/Kg	0.020	0.003	5	11/08/22 16:54	11/07/22	
Selenium	6020A	**5.44**	mg/Kg	0.99	0.20	5	11/08/22 16:54	11/07/22	
Silver	6020A	**0.009 J**	mg/Kg	0.020	0.008	5	11/08/22 16:54	11/07/22	
Zinc	6020A	**94.3**	mg/Kg	0.49	0.08	5	11/08/22 16:54	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Lower Glacier Creek DV Metals Fish #1	**Basis:**	Dry
Lab Code:	K2211569-002		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.19 J**	mg/Kg	0.50	0.02	5	11/08/22 17:01	11/07/22	
Cadmium	6020A	**0.447**	mg/Kg	0.020	0.004	5	11/08/22 17:01	11/07/22	
Copper	6020A	**4.08**	mg/Kg	0.099	0.030	5	11/08/22 17:01	11/07/22	
Lead	6020A	**0.064**	mg/Kg	0.020	0.003	5	11/08/22 17:01	11/07/22	
Selenium	6020A	**3.95**	mg/Kg	0.99	0.20	5	11/08/22 17:01	11/07/22	
Silver	6020A	**0.019 J**	mg/Kg	0.020	0.008	5	11/08/22 17:01	11/07/22	
Zinc	6020A	**109**	mg/Kg	0.50	0.08	5	11/08/22 17:01	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Lower Glacier Creek DV Metals Fish #2	**Basis:**	Dry
Lab Code:	K2211569-003		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.13 J**	mg/Kg	0.50	0.02	5	11/08/22 16:42	11/07/22	
Cadmium	6020A	**0.229**	mg/Kg	0.020	0.004	5	11/08/22 16:42	11/07/22	
Copper	6020A	**3.76**	mg/Kg	0.10	0.03	5	11/08/22 16:42	11/07/22	
Lead	6020A	**0.030**	mg/Kg	0.020	0.003	5	11/08/22 16:42	11/07/22	
Selenium	6020A	**5.10**	mg/Kg	1.0	0.2	5	11/08/22 16:42	11/07/22	
Silver	6020A	**0.014 J**	mg/Kg	0.020	0.008	5	11/08/22 16:42	11/07/22	
Zinc	6020A	**136**	mg/Kg	0.50	0.08	5	11/08/22 16:42	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Lower Glacier Creek DV Metals Fish #3	**Basis:**	Dry
Lab Code:	K2211569-004		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.11 J**	mg/Kg	0.50	0.02	5	11/08/22 17:03	11/07/22	
Cadmium	6020A	**0.360**	mg/Kg	0.020	0.004	5	11/08/22 17:03	11/07/22	
Copper	6020A	**3.31**	mg/Kg	0.10	0.03	5	11/08/22 17:03	11/07/22	
Lead	6020A	**0.062**	mg/Kg	0.020	0.003	5	11/08/22 17:03	11/07/22	
Selenium	6020A	**5.88**	mg/Kg	1.0	0.2	5	11/08/22 17:03	11/07/22	
Silver	6020A	**0.011 J**	mg/Kg	0.020	0.008	5	11/08/22 17:03	11/07/22	
Zinc	6020A	**127**	mg/Kg	0.50	0.08	5	11/08/22 17:03	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Lower Glacier Creek DV Metals Fish #4	**Basis:**	Dry
Lab Code:	K2211569-005		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.23 J**	mg/Kg	0.50	0.02	5	11/08/22 17:06	11/07/22	
Cadmium	6020A	**0.443**	mg/Kg	0.020	0.004	5	11/08/22 17:06	11/07/22	
Copper	6020A	**4.88**	mg/Kg	0.099	0.030	5	11/08/22 17:06	11/07/22	
Lead	6020A	**0.052**	mg/Kg	0.020	0.003	5	11/08/22 17:06	11/07/22	
Selenium	6020A	**5.18**	mg/Kg	0.99	0.20	5	11/08/22 17:06	11/07/22	
Silver	6020A	**0.018 J**	mg/Kg	0.020	0.008	5	11/08/22 17:06	11/07/22	
Zinc	6020A	**121**	mg/Kg	0.50	0.08	5	11/08/22 17:06	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Lower Glacier Creek DV Metals Fish #5	**Basis:**	Dry
Lab Code:	K2211569-006		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.26 J**	mg/Kg	0.50	0.02	5	11/08/22 17:08	11/07/22	
Cadmium	6020A	**0.595**	mg/Kg	0.020	0.004	5	11/08/22 17:08	11/07/22	
Copper	6020A	**3.55**	mg/Kg	0.10	0.03	5	11/08/22 17:08	11/07/22	
Lead	6020A	**0.063**	mg/Kg	0.020	0.003	5	11/08/22 17:08	11/07/22	
Selenium	6020A	**5.40**	mg/Kg	1.0	0.2	5	11/08/22 17:08	11/07/22	
Silver	6020A	**0.011 J**	mg/Kg	0.020	0.008	5	11/08/22 17:08	11/07/22	
Zinc	6020A	**117**	mg/Kg	0.50	0.08	5	11/08/22 17:08	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Lower Glacier Creek DV Metals Fish #6	**Basis:**	Dry
Lab Code:	K2211569-007		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.39 J**	mg/Kg	0.50	0.02	5	11/08/22 17:10	11/07/22	
Cadmium	6020A	**1.68**	mg/Kg	0.020	0.004	5	11/08/22 17:10	11/07/22	
Copper	6020A	**4.48**	mg/Kg	0.10	0.03	5	11/08/22 17:10	11/07/22	
Lead	6020A	**0.220**	mg/Kg	0.020	0.003	5	11/08/22 17:10	11/07/22	
Selenium	6020A	**5.89**	mg/Kg	1.0	0.2	5	11/08/22 17:10	11/07/22	
Silver	6020A	**0.053**	mg/Kg	0.020	0.008	5	11/08/22 17:10	11/07/22	
Zinc	6020A	**124**	mg/Kg	0.50	0.08	5	11/08/22 17:10	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Lower Glacier Creek DV Metals Fish #7	**Basis:**	Dry
Lab Code:	K2211569-008		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.41 J**	mg/Kg	0.50	0.02	5	11/08/22 17:13	11/07/22	
Cadmium	6020A	**0.876**	mg/Kg	0.020	0.004	5	11/08/22 17:13	11/07/22	
Copper	6020A	**6.58**	mg/Kg	0.099	0.030	5	11/08/22 17:13	11/07/22	
Lead	6020A	**0.507**	mg/Kg	0.020	0.003	5	11/08/22 17:13	11/07/22	
Selenium	6020A	**6.99**	mg/Kg	0.99	0.20	5	11/08/22 17:13	11/07/22	
Silver	6020A	**0.013 J**	mg/Kg	0.020	0.008	5	11/08/22 17:13	11/07/22	
Zinc	6020A	**176**	mg/Kg	0.50	0.08	5	11/08/22 17:13	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Lower Glacier Creek DV Metals Fish #8	**Basis:**	Dry
Lab Code:	K2211569-009		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.19 J**	mg/Kg	0.50	0.02	5	11/08/22 17:15	11/07/22	
Cadmium	6020A	**0.254**	mg/Kg	0.020	0.004	5	11/08/22 17:15	11/07/22	
Copper	6020A	**3.20**	mg/Kg	0.10	0.03	5	11/08/22 17:15	11/07/22	
Lead	6020A	**0.060**	mg/Kg	0.020	0.003	5	11/08/22 17:15	11/07/22	
Selenium	6020A	**5.27**	mg/Kg	1.0	0.2	5	11/08/22 17:15	11/07/22	
Silver	6020A	ND U	mg/Kg	0.020	0.008	5	11/08/22 17:15	11/07/22	
Zinc	6020A	**115**	mg/Kg	0.50	0.08	5	11/08/22 17:15	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Lower Glacier Creek DV Metals Fish #9	**Basis:**	Dry
Lab Code:	K2211569-010		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.30 J**	mg/Kg	0.50	0.02	5	11/08/22 17:18	11/07/22	
Cadmium	6020A	**1.02**	mg/Kg	0.020	0.004	5	11/08/22 17:18	11/07/22	
Copper	6020A	**5.07**	mg/Kg	0.099	0.030	5	11/08/22 17:18	11/07/22	
Lead	6020A	**0.220**	mg/Kg	0.020	0.003	5	11/08/22 17:18	11/07/22	
Selenium	6020A	**6.47**	mg/Kg	0.99	0.20	5	11/08/22 17:18	11/07/22	
Silver	6020A	**0.020 J**	mg/Kg	0.020	0.008	5	11/08/22 17:18	11/07/22	
Zinc	6020A	**129**	mg/Kg	0.50	0.08	5	11/08/22 17:18	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22 10:25
Sample Name:	Lower Glacier Creek DV Metals Fish #10	**Basis:**	Dry
Lab Code:	K2211569-011		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	**0.30 J**	mg/Kg	0.50	0.02	5	11/08/22 17:20	11/07/22	
Cadmium	6020A	**1.10**	mg/Kg	0.020	0.004	5	11/08/22 17:20	11/07/22	
Copper	6020A	**5.17**	mg/Kg	0.10	0.03	5	11/08/22 17:20	11/07/22	
Lead	6020A	**0.150**	mg/Kg	0.020	0.003	5	11/08/22 17:20	11/07/22	
Selenium	6020A	**6.13**	mg/Kg	1.0	0.2	5	11/08/22 17:20	11/07/22	
Silver	6020A	**0.022**	mg/Kg	0.020	0.008	5	11/08/22 17:20	11/07/22	
Zinc	6020A	**147**	mg/Kg	0.50	0.08	5	11/08/22 17:20	11/07/22	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	NA
Sample Matrix:	Animal Tissue	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ2219141-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Arsenic	6020A	ND U	mg/Kg	0.5	0.02	5	11/08/22 16:33	11/07/22	
Cadmium	6020A	ND U	mg/Kg	0.020	0.004	5	11/08/22 16:33	11/07/22	
Copper	6020A	ND U	mg/Kg	0.10	0.03	5	11/08/22 16:33	11/07/22	
Lead	6020A	ND U	mg/Kg	0.020	0.003	5	11/08/22 16:33	11/07/22	
Selenium	6020A	ND U	mg/Kg	1.0	0.2	5	11/08/22 16:33	11/07/22	
Silver	6020A	ND U	mg/Kg	0.020	0.008	5	11/08/22 16:33	11/07/22	
Zinc	6020A	ND U	mg/Kg	0.5	0.08	5	11/08/22 16:33	11/07/22	

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QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22
		Date Analyzed:	11/08/22

Replicate Sample Summary
Total Metals

Sample Name:	Lower Glacier Creek DV Metals Fish #2	**Units:**	mg/Kg
Lab Code:	K2211569-003	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample KQ2219141-05 Result	Average	RPD	RPD Limit
Arsenic	6020A	0.5	0.02	0.13 J	0.11 J	0.12	17	20
Cadmium	6020A	0.020	0.004	0.229	0.224	0.227	2	20
Copper	6020A	0.10	0.03	3.76	3.75	3.76	<1	20
Lead	6020A	0.020	0.003	0.030	0.032	0.031	6	20
Selenium	6020A	1.0	0.2	5.10	5.17	5.14	1	20
Silver	6020A	0.020	0.008	0.014 J	0.015 J	0.015	7	20
Zinc	6020A	0.5	0.08	136	129	133	5	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.

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	06/13/22
Sample Matrix:	Animal Tissue	**Date Received:**	09/21/22
		Date Analyzed:	11/8/22
		Date Extracted:	11/7/22

Matrix Spike Summary
Total Metals

Sample Name:	Lower Glacier Creek DV Metals Fish #2	**Units:**	mg/Kg
Lab Code:	K2211569-003	**Basis:**	Dry
Analysis Method:	6020A		
Prep Method:	PSEP Metals		

Matrix Spike
KQ2219141-06

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Arsenic	0.13 J	17.4	16.6	104	75-125
Cadmium	0.229	5.44	4.98	104	75-125
Copper	3.76	28.9	24.9	101	75-125
Lead	0.030	48.5	49.8	97	75-125
Selenium	5.10	22.3	16.6	103	75-125
Silver	0.014 J	4.87	4.98	97	75-125
Zinc	136	167	49.8	62 N	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: 2022 Palmer Project Biomonitoring
Sample Matrix: Animal Tissue

Service Request: K2211569
Date Analyzed: 11/08/22

Lab Control Sample Summary
Total Metals

Units:mg/Kg
Basis: Dry

Lab Control Sample
KQ2219141-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Arsenic	6020A	17.0	16.7	102	80-120
Cadmium	6020A	5.26	5.00	105	80-120
Copper	6020A	26.2	25.0	105	80-120
Lead	6020A	51.1	50.0	102	80-120
Selenium	6020A	16.8	16.7	101	80-120
Silver	6020A	5.10	5.00	102	80-120
Zinc	6020A	49.8	50.0	100	80-120

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QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	11/7/2022
		Date Analyzed:	11/8/2022

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	KQ2219141-03	Basis:	Dry
Test Notes:	Dorm-4 Solids = 93.8%		

Source: N.R.C.C. Dorm-4

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	Control Limits	Result Notes
Cadmium	PSEP Tissue	6020A	0.299	0.322	108	0.225 - 0.380	
Copper	PSEP Tissue	6020A	15.7	16.3	104	12.2 - 19.4	
Lead	PSEP Tissue	6020A	0.40	0.40	99	0.274 - 0.559	
Selenium	PSEP Tissue	6020A	3.45	3.68	107	2.44 - 4.62	
Silver	PSEP Tissue	6020A	0.0252	0.0270	107	0.0162 - 0.0362	
Zinc	PSEP Tissue	6020A	51.6	51.5	100	39.0 - 65.3	

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Client:	Alaska Department of Fish and Game	**Service Request:**	K2211569
Project:	2022 Palmer Project Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	11/7/2022
		Date Analyzed:	11/8/2022

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	KQ2219141-04	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
Cadmium	PSEP Tissue	6020A	42.3	42.7	101	32.4-52.9	
Copper	PSEP Tissue	6020A	497	494	99	380-623	
Lead	PSEP Tissue	6020A	0.225	0.205	91	0.166-0.292	
Selenium	PSEP Tissue	6020A	10.9	10.7	98	7.9-14.3	
Zinc	PSEP Tissue	6020A	136	133	98	104-170	

Prep Summary Report

Client: Alaska Department of Fish and Game **Service Request:** K2211569
Project: 2022 Palmer Project Biomonitoring
Sample Matrix: Animal Tissue

Metals

Prep Method: PSEP Metals **Extraction Lot:** 409196
Analytical Method: 6020A **Extraction Date:** 11/07/22 14:34

Sample Name	Lab Code	Date Collected	Date Received	Sample Amount	Final Amount	Percent Solids
Middle Glacier Creek DV Metals Fish #1	K2211569-001	6/14/22	9/21/22	0.30400 g	30 mL	
Lower Glacier Creek DV Metals Fish #1	K2211569-002	6/13/22	9/21/22	0.30300 g	30 mL	
Lower Glacier Creek DV Metals Fish #2	K2211569-003	6/13/22	9/21/22	0.30100 g	30 mL	
Lower Glacier Creek DV Metals Fish #3	K2211569-004	6/13/22	9/21/22	0.30100 g	30 mL	
Lower Glacier Creek DV Metals Fish #4	K2211569-005	6/13/22	9/21/22	0.30300 g	30 mL	
Lower Glacier Creek DV Metals Fish #5	K2211569-006	6/13/22	9/21/22	0.30100 g	30 mL	
Lower Glacier Creek DV Metals Fish #6	K2211569-007	6/13/22	9/21/22	0.30100 g	30 mL	
Lower Glacier Creek DV Metals Fish #7	K2211569-008	6/13/22	9/21/22	0.30200 g	30 mL	
Lower Glacier Creek DV Metals Fish #8	K2211569-009	6/13/22	9/21/22	0.30100 g	30 mL	
Lower Glacier Creek DV Metals Fish #9	K2211569-010	6/13/22	9/21/22	0.30300 g	30 mL	
Lower Glacier Creek DV Metals Fish #10	K2211569-011	6/13/22	9/21/22	0.30100 g	30 mL	
Method Blank	KQ2219141-01MB	NA	NA	0.3000 g	30 mL	
Lab Control Sample	KQ2219141-02LCS	NA	NA	0.3000 g	30 mL	
Standard Reference Material	KQ2219141-03SRM	7/12/22	9/21/22	0.30100 g	30 mL	
Standard Reference Material	KQ2219141-04SRM	7/12/22	9/21/22	0.30100 g	30 mL	
Duplicate	KQ2219141-05DUP	6/13/22	9/21/22	0.30100 g	30 mL	
Matrix Spike	KQ2219141-06MS	6/13/22	9/21/22	0.30100 g	30 mL	

APPENDIX E: SEDIMENT DATA AND LABORATORY REPORT

Appendix E.1.–Lower Glacier Creek sediment compositions, 2016–2022.

	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	80.20	0.345	<5.0
06/13/22	1.00	26.40	72.40	0.20	78.10	0.347	<5.0
06/13/22	1.20	18.20	80.10	0.50	80.60	0.299	<5.0
06/13/22	1.00	10.20	85.80	3.00	82.20	0.369	<5.0
06/13/22	1.00	7.10	91.90	0.00	80.90	0.361	<5.0

Appendix E.2.–Lower Glacier Creek sediment element concentrations, 2016–2022.

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	0.95	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	1.52	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	1.63	48.4	43,700	0.0164	8.49	1.58	184
06/03/20	0.11	14,800	3.14	0.64	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	1.07	43.1	41,600	0.0161	7.41	1.58	166
06/16/21	0.14	12,500	4.48	1.15	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	0.54	51.0	54,400	0.0158	15.1	0.92	142
06/16/21	0.125	12,900	2.85	1.008	33.9	35,550	0.0140	5.535	0.905	142.5
06/13/22	0.17	15,400	3.89	0.92	67.5	45,500	0.0164	6.9	1.6	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	1.05	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

Appendix E.3.–Middle Glacier Creek sediment compositions, 2016–2022.

	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

Appendix E.4.–Middle Glacier Creek sediment element concentrations, 2016–2022.

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

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **WR2200569**	Page	: 1 of 8
Client	: **Constantine North Inc.**	Laboratory	: Whitehorse - Environmental
Contact	: Allegra Cairns	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	: 604 329 5982	Telephone	: +1 867 668 6689
Project	: Stream Sediments	Date Samples Received	: 17-Jun-2022 13:00
PO	: ----	Date Analysis Commenced	: 20-Jun-2022
C-O-C number	: ----	Issue Date	: 03-Jul-2022 15:07
Sampler	: Dylan Krull		
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*
Angela Ren	Team Leader - Metals	Metals, Burnaby, British Columbia
Colby Bingham	Quality Systems Coordinator	Inorganics, Saskatoon, Saskatchewan
Hedy Lai	Team Leader - Inorganics	Inorganics, Saskatoon, Saskatchewan
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Metals, Burnaby, British Columbia
Miles Gropen	Department Manager - Inorganics	Inorganics, Burnaby, British Columbia
Robin Weeks	Team Leader - Metals	Organics, Burnaby, British Columbia
Xihua Yao	Laboratory Analyst	Inorganics, Saskatoon, Saskatchewan

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 Unit
%	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.

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	2022 LGC S1	2022 LGC S2	2022 LGC S3	2022 LGC S4	2022 LGC S5
					Client sampling date / time	13-Jun-2022 14:00	13-Jun-2022 14:00	13-Jun-2022 14:00	13-Jun-2022 14:00	13-Jun-2022 14:00
						WR2200569-001	WR2200569-002	WR2200569-003	WR2200569-004	WR2200569-005
						Result	Result	Result	Result	Result
Physical Tests										
loss on ignition @ 550°C	----	E205D	1.0	%		1.3	1.4	1.4	1.4	1.4
moisture	----	E144	0.25	%		19.8	21.9	19.4	17.8	19.1
pH (1:2 soil:water)	----	E108	0.10	pH units		8.30	8.39	8.54	8.56	8.51
ash content @ 550°C	----	E205D	1.0	%		98.7	98.6	98.6	98.6	98.6
Particle Size										
passing (9.5 mm)	----	E181	1.0	%		100	100	100	100	100
passing (4.75 mm)	----	E181	1.0	%		100	100	99.8	99.6	100
passing (19 mm)	----	E181	1.0	%		100	100	100	100	100
passing (25.4 mm)	----	E181	1.0	%		100	100	100	100	100
passing (38.1 mm)	----	E181	1.0	%		100	100	100	100	100
passing (50.8 mm)	----	E181	1.0	%		100	100	100	100	100
passing (76.2 mm)	----	E181	1.0	%		100	100	100	100	100
passing (1.0 mm)	----	E182	1.0	%		99.2	99.1	98.4	90.4	99.2
passing (0.841 mm)	----	E182	1.0	%		97.1	97.6	96.4	85.9	95.7
passing (0.50 mm)	----	E182	1.0	%		90.8	93.4	90.6	72.4	85.1
passing (0.420 mm)	----	E182	1.0	%		83.3	87.8	82.1	64.5	73.3
passing (0.250 mm)	----	E182	1.0	%		63.8	73.3	60.1	43.8	42.6
passing (0.149 mm)	----	E182	1.0	%		39.4	54.2	37.3	26.0	21.3
passing (0.125 mm)	----	E182	1.0	%		31.1	47.8	29.6	20.0	14.1
passing (0.075 mm)	----	E182	1.0	%		17.0	27.4	19.4	11.2	8.1
passing (0.063 mm)	----	E182	1.0	%		13.6	22.6	17.0	9.1	6.7
passing (0.05 mm)	----	E182	1.0	%		10.0	17.3	14.3	6.8	5.2
passing (0.0312 mm)	----	E184	1.0	%		5.5	9.5	8.1	4.0	3.1
passing (0.020 mm)	----	E184	1.0	%		4.5	7.6	6.6	3.3	2.6
passing (0.005 mm)	----	E184	1.0	%		<1.0	1.0	1.2	<1.0	<1.0
passing (0.004 mm)	----	E184	1.0	%		<1.0	<1.0	1.1	<1.0	<1.0
passing (0.002 mm)	----	E184	1.0	%		<1.0	<1.0	<1.0	<1.0	<1.0
grain size curve	----	E185A	-	-		See Attached	See Attached	See Attached	See Attached	See Attached
passing (2.0 mm)	----	E181	1.0	%		100	99.8	99.5	97.0	100

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	2022 LGC S1	2022 LGC S2	2022 LGC S3	2022 LGC S4	2022 LGC S5
					Client sampling date / time	13-Jun-2022 14:00	13-Jun-2022 14:00	13-Jun-2022 14:00	13-Jun-2022 14:00	13-Jun-2022 14:00
						WR2200569-001	WR2200569-002	WR2200569-003	WR2200569-004	WR2200569-005
						Result	Result	Result	Result	Result
Organic / Inorganic Carbon										
carbon, total [TC]	----	E351	0.050	%		0.992	0.989	0.879	0.977	0.950
carbon, inorganic [IC]	----	E354	0.050	%		0.647	0.642	0.580	0.608	0.589
carbon, inorganic [IC], (as CaCO3 equivalent)	----	E354	0.40	%		5.39	5.35	4.83	5.07	4.91
carbon, total organic [TOC]	----	EC356	0.050	%		0.345	0.347	0.299	0.369	0.361
organic matter	----	EC356	0.10	%		0.59	0.60	0.52	0.64	0.62
Inorganic Parameters										
sulfides, acid volatile	----	E396	5.0	mg/kg		<5.0	<5.0	<5.0	<5.0	<5.0
Metals										
aluminum	7429-90-5	E440	50	mg/kg		15400	15700	16200	15400	15400
antimony	7440-36-0	E440	0.10	mg/kg		0.43	0.51	0.42	0.44	0.57
arsenic	7440-38-2	E440	0.10	mg/kg		3.89	4.75	4.53	4.04	3.81
barium	7440-39-3	E440	0.50	mg/kg		141	159	113	110	108
beryllium	7440-41-7	E440	0.10	mg/kg		0.21	0.21	0.21	0.20	0.20
bismuth	7440-69-9	E440	0.20	mg/kg		<0.20	<0.20	<0.20	<0.20	<0.20
boron	7440-42-8	E440	5.0	mg/kg		<5.0	<5.0	<5.0	<5.0	<5.0
cadmium	7440-43-9	E440	0.020	mg/kg		0.920	0.989	1.05	0.902	0.879
calcium	7440-70-2	E440	50	mg/kg		28000	27400	26300	27500	25700
chromium	7440-47-3	E440	0.50	mg/kg		28.5	31.4	29.8	28.6	29.8
cobalt	7440-48-4	E440	0.10	mg/kg		21.6	21.2	25.6	22.5	19.1
copper	7440-50-8	E440	0.50	mg/kg		67.5	52.2	51.3	42.3	68.5
iron	7439-89-6	E440	50	mg/kg		45500	44700	53600	46800	43300
lead	7439-92-1	E440	0.50	mg/kg		6.90	6.21	8.57	21.7	4.98
lithium	7439-93-2	E440	2.0	mg/kg		6.5	6.9	6.8	7.0	6.8
magnesium	7439-95-4	E440	20	mg/kg		12300	12500	13000	12600	12400
manganese	7439-96-5	E440	1.0	mg/kg		706	791	765	769	752
mercury	7439-97-6	E510	0.0050	mg/kg		0.0164	0.0109	0.0196	0.0095	0.0098
molybdenum	7439-98-7	E440	0.10	mg/kg		2.28	2.25	2.03	2.15	2.17
nickel	7440-02-0	E440	0.50	mg/kg		22.7	24.7	23.3	23.0	22.4
phosphorus	7723-14-0	E440	50	mg/kg		814	805	897	989	804
potassium	7440-09-7	E440	100	mg/kg		1070	1120	1060	1080	1160
selenium	7782-49-2	E440	0.20	mg/kg		1.60	1.82	1.68	1.49	1.29

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	2022 LGC S1	2022 LGC S2	2022 LGC S3	2022 LGC S4	2022 LGC S5
					Client sampling date / time	13-Jun-2022 14:00	13-Jun-2022 14:00	13-Jun-2022 14:00	13-Jun-2022 14:00	13-Jun-2022 14:00
						WR2200569-001	WR2200569-002	WR2200569-003	WR2200569-004	WR2200569-005
						Result	Result	Result	Result	Result
Metals										
silver	7440-22-4	E440	0.10	mg/kg		0.17	0.16	0.15	0.16	0.13
sodium	7440-23-5	E440	50	mg/kg		138	138	117	122	110
strontium	7440-24-6	E440	0.50	mg/kg		75.6	74.2	63.0	69.5	64.9
sulfur	7704-34-9	E440	1000	mg/kg		3100	2700	4200	3400	1900
thallium	7440-28-0	E440	0.050	mg/kg		0.060	0.073	0.061	0.058	0.058
tin	7440-31-5	E440	2.0	mg/kg		<2.0	<2.0	<2.0	<2.0	<2.0
titanium	7440-32-6	E440	1.0	mg/kg		1720	1610	1240	1280	1350
tungsten	7440-33-7	E440	0.50	mg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
uranium	7440-61-1	E440	0.050	mg/kg		0.333	0.677	0.289	0.307	0.323
vanadium	7440-62-2	E440	0.20	mg/kg		110	108	120	110	102
zinc	7440-66-6	E440	2.0	mg/kg		156	168	178	161	140
zirconium	7440-67-7	E440	1.0	mg/kg		1.3	1.4	1.0	<1.0	1.0

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

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	2022 MGC S1	2022 MGC S2	2022 MGC S3	2022 MGC S4	2022 MGC S5
					Client sampling date / time	14-Jun-2022 12:00	14-Jun-2022 12:00	14-Jun-2022 12:00	14-Jun-2022 12:00	14-Jun-2022 12:00
						WR2200569-006	WR2200569-007	WR2200569-008	WR2200569-009	WR2200569-010
						Result	Result	Result	Result	Result
Physical Tests										
loss on ignition @ 550°C	----	E205D	1.0	%		1.1	1.0	1.0	1.4	1.4
moisture	----	E144	0.25	%		20.2	18.2	16.5	21.9	19.8
pH (1:2 soil:water)	----	E108	0.10	pH units		8.51	8.62	8.61	8.43	8.42
ash content @ 550°C	----	E205D	1.0	%		98.9	99.0	98.9	98.6	98.6
Particle Size										
passing (9.5 mm)	----	E181	1.0	%		100	100	99.6	100	100
passing (4.75 mm)	----	E181	1.0	%		100	99.6	99.5	99.7	100
passing (19 mm)	----	E181	1.0	%		100	100	100	100	100
passing (25.4 mm)	----	E181	1.0	%		100	100	100	100	100
passing (38.1 mm)	----	E181	1.0	%		100	100	100	100	100
passing (50.8 mm)	----	E181	1.0	%		100	100	100	100	100
passing (76.2 mm)	----	E181	1.0	%		100	100	100	100	100
passing (1.0 mm)	----	E182	1.0	%		98.9	95.1	97.2	98.5	99.6
passing (0.841 mm)	----	E182	1.0	%		95.9	88.9	93.4	97.3	98.6
passing (0.50 mm)	----	E182	1.0	%		86.9	70.5	81.9	93.5	95.6
passing (0.420 mm)	----	E182	1.0	%		76.8	59.4	70.9	87.9	87.6
passing (0.250 mm)	----	E182	1.0	%		50.3	30.7	42.2	73.3	66.6
passing (0.149 mm)	----	E182	1.0	%		28.4	14.5	23.0	49.4	37.1
passing (0.125 mm)	----	E182	1.0	%		21.0	9.1	16.4	41.4	27.1
passing (0.075 mm)	----	E182	1.0	%		11.6	5.0	9.0	23.7	14.3
passing (0.063 mm)	----	E182	1.0	%		9.4	4.0	7.2	19.4	11.2
passing (0.05 mm)	----	E182	1.0	%		6.9	3.0	5.3	14.8	7.9
passing (0.0312 mm)	----	E184	1.0	%		4.0	1.9	3.2	8.3	4.5
passing (0.020 mm)	----	E184	1.0	%		3.3	1.6	2.6	6.7	3.7
passing (0.005 mm)	----	E184	1.0	%		<1.0	<1.0	<1.0	1.1	<1.0
passing (0.004 mm)	----	E184	1.0	%		<1.0	<1.0	<1.0	1.0	<1.0
passing (0.002 mm)	----	E184	1.0	%		<1.0	<1.0	<1.0	<1.0	<1.0
grain size curve	----	E185A	-	-		See Attached	See Attached	See Attached	See Attached	See Attached
passing (2.0 mm)	----	E181	1.0	%		99.8	98.9	99.0	99.3	99.9
Organic / Inorganic Carbon										

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	2022 MGC S1	2022 MGC S2	2022 MGC S3	2022 MGC S4	2022 MGC S5
					Client sampling date / time	14-Jun-2022 12:00	14-Jun-2022 12:00	14-Jun-2022 12:00	14-Jun-2022 12:00	14-Jun-2022 12:00
						WR2200569-006	WR2200569-007	WR2200569-008	WR2200569-009	WR2200569-010
						Result	Result	Result	Result	Result
Organic / Inorganic Carbon										
carbon, total [TC]	----	E351	0.050	%		0.698	0.588	0.601	0.986	0.881
carbon, inorganic [IC]	----	E354	0.050	%		0.456	0.423	0.458	0.578	0.560
carbon, inorganic [IC], (as CaCO3 equivalent)	----	E354	0.40	%		3.80	3.53	3.82	4.81	4.67
carbon, total organic [TOC]	----	EC356	0.050	%		0.242	0.165	0.143	0.408	0.321
organic matter	----	EC356	0.10	%		0.42	0.28	0.25	0.70	0.55
Inorganic Parameters										
sulfides, acid volatile	----	E396	5.0	mg/kg		<5.0	<5.0	<5.0	<5.0	<5.0
Metals										
aluminum	7429-90-5	E440	50	mg/kg		13400	15500	15800	15800	15100
antimony	7440-36-0	E440	0.10	mg/kg		0.34	0.35	0.35	0.54	0.46
arsenic	7440-38-2	E440	0.10	mg/kg		3.46	3.55	3.72	5.31	4.39
barium	7440-39-3	E440	0.50	mg/kg		96.1	102	140	178	135
beryllium	7440-41-7	E440	0.10	mg/kg		0.21	0.54	0.21	0.21	0.22
bismuth	7440-69-9	E440	0.20	mg/kg		<0.20	<0.20	<0.20	<0.20	<0.20
boron	7440-42-8	E440	5.0	mg/kg		<5.0	<5.0	<5.0	<5.0	<5.0
cadmium	7440-43-9	E440	0.020	mg/kg		0.552	0.427	0.542	1.23	1.17
calcium	7440-70-2	E440	50	mg/kg		22400	23500	21100	27800	28000
chromium	7440-47-3	E440	0.50	mg/kg		20.0	22.7	24.8	32.9	32.4
cobalt	7440-48-4	E440	0.10	mg/kg		25.9	26.0	27.3	24.2	21.5
copper	7440-50-8	E440	0.50	mg/kg		43.3	46.9	57.4	67.0	54.4
iron	7439-89-6	E440	50	mg/kg		47300	51400	54000	49900	48000
lead	7439-92-1	E440	0.50	mg/kg		4.90	12.8	4.46	9.32	5.50
lithium	7439-93-2	E440	2.0	mg/kg		6.0	5.9	6.5	7.0	7.0
magnesium	7439-95-4	E440	20	mg/kg		10800	12200	12500	12000	12100
manganese	7439-96-5	E440	1.0	mg/kg		711	763	747	787	712
mercury	7439-97-6	E510	0.0050	mg/kg		0.0130	0.0071	0.0098	0.0151	0.0103
molybdenum	7439-98-7	E440	0.10	mg/kg		0.84	0.92	1.12	2.71	2.88
nickel	7440-02-0	E440	0.50	mg/kg		14.1	17.0	17.2	25.8	24.4
phosphorus	7723-14-0	E440	50	mg/kg		800	865	946	839	803
potassium	7440-09-7	E440	100	mg/kg		1060	1180	1190	1090	1080
selenium	7782-49-2	E440	0.20	mg/kg		0.80	0.93	0.99	1.97	1.89

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	2022 MGC S1	2022 MGC S2	2022 MGC S3	2022 MGC S4	2022 MGC S5
					Client sampling date / time	14-Jun-2022 12:00	14-Jun-2022 12:00	14-Jun-2022 12:00	14-Jun-2022 12:00	14-Jun-2022 12:00
						WR2200569-006	WR2200569-007	WR2200569-008	WR2200569-009	WR2200569-010
						Result	Result	Result	Result	Result
Metals										
silver	7440-22-4	E440	0.10	mg/kg		0.12	0.14	0.11	0.20	0.16
sodium	7440-23-5	E440	50	mg/kg		114	112	129	146	146
strontium	7440-24-6	E440	0.50	mg/kg		55.6	56.3	55.5	75.4	73.2
sulfur	7704-34-9	E440	1000	mg/kg		4800	5200	5600	4000	3400
thallium	7440-28-0	E440	0.050	mg/kg		0.052	0.060	0.054	0.073	0.066
tin	7440-31-5	E440	2.0	mg/kg		<2.0	<2.0	<2.0	<2.0	<2.0
titanium	7440-32-6	E440	1.0	mg/kg		1760	1860	1770	1840	1440
tungsten	7440-33-7	E440	0.50	mg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
uranium	7440-61-1	E440	0.050	mg/kg		0.295	0.288	0.300	0.418	0.430
vanadium	7440-62-2	E440	0.20	mg/kg		113	125	132	117	111
zinc	7440-66-6	E440	2.0	mg/kg		158	126	146	205	174
zirconium	7440-67-7	E440	1.0	mg/kg		1.4	1.5	1.4	1.5	1.2

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

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WR2200569**	Page	: 1 of 19
Client	: **Constantine North Inc.**	Laboratory	: Whitehorse - Environmental
Contact	: Allegra Cairns	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	: 604 329 5982	Telephone	: +1 867 668 6689
Project	: Stream Sediments	Date Samples Received	: 17-Jun-2022 13:00
PO	: ----	Issue Date	: 03-Jul-2022 15:07
C-O-C number	: ----		
Sampler	: Dylan Krull		
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 Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

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
Inorganic Parameters : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
Glass soil jar/Teflon lined cap										
2022 MGC S1	E396	14-Jun-2022	27-Jun-2022	----	----		28-Jun-2022	14 days	14 days	✓
Inorganic Parameters : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
Glass soil jar/Teflon lined cap										
2022 MGC S2	E396	14-Jun-2022	27-Jun-2022	----	----		28-Jun-2022	14 days	14 days	✓
Inorganic Parameters : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
Glass soil jar/Teflon lined cap										
2022 MGC S3	E396	14-Jun-2022	27-Jun-2022	----	----		28-Jun-2022	14 days	14 days	✓
Inorganic Parameters : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
Glass soil jar/Teflon lined cap										
2022 MGC S4	E396	14-Jun-2022	27-Jun-2022	----	----		28-Jun-2022	14 days	14 days	✓
Inorganic Parameters : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
Glass soil jar/Teflon lined cap										
2022 MGC S5	E396	14-Jun-2022	27-Jun-2022	----	----		28-Jun-2022	14 days	14 days	✓
Inorganic Parameters : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
Glass soil jar/Teflon lined cap										
2022 LGC S1	E396	13-Jun-2022	27-Jun-2022	----	----		28-Jun-2022	14 days	15 days	× EHT
Inorganic Parameters : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
Glass soil jar/Teflon lined cap										
2022 LGC S2	E396	13-Jun-2022	27-Jun-2022	----	----		28-Jun-2022	14 days	15 days	× EHT

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
Inorganic Parameters : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
Glass soil jar/Teflon lined cap										
2022 LGC S3	E396	13-Jun-2022	27-Jun-2022	----	----		28-Jun-2022	14 days	15 days	× EHT
Inorganic Parameters : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
Glass soil jar/Teflon lined cap										
2022 LGC S4	E396	13-Jun-2022	27-Jun-2022	----	----		28-Jun-2022	14 days	15 days	× EHT
Inorganic Parameters : Acid Volatile Sulfide by Colourimetry (5 mg/kg)										
Glass soil jar/Teflon lined cap										
2022 LGC S5	E396	13-Jun-2022	27-Jun-2022	----	----		28-Jun-2022	14 days	15 days	× EHT
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
2022 MGC S1	E510	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	28 days	15 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
2022 MGC S2	E510	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	28 days	15 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
2022 MGC S3	E510	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	28 days	15 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
2022 MGC S4	E510	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	28 days	15 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
2022 MGC S5	E510	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	28 days	15 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
2022 LGC S1	E510	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	28 days	16 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										
Glass soil jar/Teflon lined cap										
2022 LGC S2	E510	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	28 days	16 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
2022 LGC S3	E510	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	28 days	16 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
2022 LGC S4	E510	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	28 days	16 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
2022 LGC S5	E510	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	28 days	16 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
2022 MGC S1	E440	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	180 days	15 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
2022 MGC S2	E440	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	180 days	15 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
2022 MGC S3	E440	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	180 days	15 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
2022 MGC S4	E440	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	180 days	15 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
2022 MGC S5	E440	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	180 days	15 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										
Glass soil jar/Teflon lined cap										
2022 LGC S1	E440	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	180 days	16 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
2022 LGC S2	E440	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	180 days	16 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
2022 LGC S3	E440	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	180 days	16 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
2022 LGC S4	E440	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	180 days	16 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
2022 LGC S5	E440	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	180 days	16 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag										
2022 LGC S1	E351	13-Jun-2022	----	----	----		23-Jun-2022	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag										
2022 LGC S2	E351	13-Jun-2022	----	----	----		23-Jun-2022	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag										
2022 LGC S3	E351	13-Jun-2022	----	----	----		23-Jun-2022	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag										
2022 LGC S4	E351	13-Jun-2022	----	----	----		23-Jun-2022	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		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2022 LGC S5	E351	13-Jun-2022	----	----	----		23-Jun-2022	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2022 MGC S1	E351	13-Jun-2022	----	----	----		23-Jun-2022	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2022 MGC S2	E351	14-Jun-2022	----	----	----		23-Jun-2022	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2022 MGC S3	E351	14-Jun-2022	----	----	----		23-Jun-2022	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2022 MGC S4	E351	14-Jun-2022	----	----	----		23-Jun-2022	180 days	0 days	✓
Organic / Inorganic Carbon : Total Carbon by Combustion										
LDPE bag 2022 MGC S5	E351	14-Jun-2022	----	----	----		23-Jun-2022	180 days	0 days	✓
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2022 LGC S1	E354	13-Jun-2022	----	----	----		22-Jun-2022	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2022 LGC S2	E354	13-Jun-2022	----	----	----		22-Jun-2022	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2022 LGC S3	E354	13-Jun-2022	----	----	----		22-Jun-2022	----	----	

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 2022 LGC S4	E354	13-Jun-2022	----	----	----		22-Jun-2022	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2022 LGC S5	E354	13-Jun-2022	----	----	----		22-Jun-2022	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2022 MGC S1	E354	13-Jun-2022	----	----	----		22-Jun-2022	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2022 MGC S2	E354	14-Jun-2022	----	----	----		22-Jun-2022	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2022 MGC S3	E354	14-Jun-2022	----	----	----		22-Jun-2022	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2022 MGC S4	E354	14-Jun-2022	----	----	----		22-Jun-2022	----	----	
Organic / Inorganic Carbon : Total Inorganic Carbon by Acetic Acid pH Standard Curve										
LDPE bag 2022 MGC S5	E354	14-Jun-2022	----	----	----		22-Jun-2022	----	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2022 LGC S1	E185A	13-Jun-2022	----	----	----		24-Jun-2022	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2022 LGC S2	E185A	13-Jun-2022	----	----	----		24-Jun-2022	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 2022 LGC S3	E185A	13-Jun-2022	----	----	----		24-Jun-2022	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2022 LGC S4	E185A	13-Jun-2022	----	----	----		24-Jun-2022	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2022 LGC S5	E185A	13-Jun-2022	----	----	----		24-Jun-2022	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2022 MGC S1	E185A	13-Jun-2022	----	----	----		24-Jun-2022	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2022 MGC S2	E185A	14-Jun-2022	----	----	----		24-Jun-2022	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2022 MGC S3	E185A	14-Jun-2022	----	----	----		24-Jun-2022	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2022 MGC S4	E185A	14-Jun-2022	----	----	----		24-Jun-2022	365 days	----	
Particle Size : Grain Size Report (Attachment) Pipet/Sieve Method										
LDPE bag 2022 MGC S5	E185A	14-Jun-2022	----	----	----		24-Jun-2022	365 days	----	
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2022 MGC S1	E184	13-Jun-2022	----	----	----		21-Jun-2022	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 - Pipette Method										
LDPE bag 2022 MGC S2	E184	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2022 MGC S3	E184	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2022 MGC S4	E184	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2022 MGC S5	E184	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2022 LGC S1	E184	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2022 LGC S2	E184	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2022 LGC S3	E184	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2022 LGC S4	E184	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Pipette Method										
LDPE bag 2022 LGC S5	E184	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 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 2022 MGC S1	E182	13-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2022 MGC S2	E182	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2022 MGC S3	E182	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2022 MGC S4	E182	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2022 MGC S5	E182	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2022 LGC S1	E182	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2022 LGC S2	E182	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2022 LGC S3	E182	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Sieve <2mm										
LDPE bag 2022 LGC S4	E182	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 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 2022 LGC S5	E182	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2022 MGC S1	E181	13-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2022 MGC S2	E181	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2022 MGC S3	E181	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2022 MGC S4	E181	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2022 MGC S5	E181	14-Jun-2022	----	----	----		21-Jun-2022	365 days	7 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2022 LGC S1	E181	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2022 LGC S2	E181	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2022 LGC S3	E181	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 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 2022 LGC S4	E181	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Particle Size : Particle Size Analysis - Sieve >2mm										
LDPE bag 2022 LGC S5	E181	13-Jun-2022	----	----	----		21-Jun-2022	365 days	8 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2022 LGC S1	E205D	13-Jun-2022	----	----	----		23-Jun-2022	365 days	10 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2022 LGC S2	E205D	13-Jun-2022	----	----	----		23-Jun-2022	365 days	10 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2022 LGC S3	E205D	13-Jun-2022	----	----	----		23-Jun-2022	365 days	10 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2022 LGC S4	E205D	13-Jun-2022	----	----	----		23-Jun-2022	365 days	10 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2022 LGC S5	E205D	13-Jun-2022	----	----	----		23-Jun-2022	365 days	10 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2022 MGC S1	E205D	13-Jun-2022	----	----	----		23-Jun-2022	365 days	9 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2022 MGC S2	E205D	14-Jun-2022	----	----	----		23-Jun-2022	365 days	9 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 2022 MGC S3	E205D	14-Jun-2022	----	----	----		23-Jun-2022	365 days	9 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2022 MGC S4	E205D	14-Jun-2022	----	----	----		23-Jun-2022	365 days	9 days	✓
Physical Tests : Loss On Ignition (550°C)										
LDPE bag 2022 MGC S5	E205D	14-Jun-2022	----	----	----		23-Jun-2022	365 days	9 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap 2022 LGC S1	E144	13-Jun-2022	----	----	----		28-Jun-2022	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap 2022 LGC S2	E144	13-Jun-2022	----	----	----		28-Jun-2022	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap 2022 LGC S3	E144	13-Jun-2022	----	----	----		28-Jun-2022	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap 2022 LGC S4	E144	13-Jun-2022	----	----	----		28-Jun-2022	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap 2022 LGC S5	E144	13-Jun-2022	----	----	----		28-Jun-2022	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap 2022 MGC S1	E144	14-Jun-2022	----	----	----		28-Jun-2022	----	----	

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										
Glass soil jar/Teflon lined cap										
2022 MGC S2	E144	14-Jun-2022	----	----	----		28-Jun-2022	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap										
2022 MGC S3	E144	14-Jun-2022	----	----	----		28-Jun-2022	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap										
2022 MGC S4	E144	14-Jun-2022	----	----	----		28-Jun-2022	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap										
2022 MGC S5	E144	14-Jun-2022	----	----	----		28-Jun-2022	----	----	
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
Glass soil jar/Teflon lined cap										
2022 MGC S1	E108	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	30 days	15 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
Glass soil jar/Teflon lined cap										
2022 MGC S2	E108	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	30 days	15 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
Glass soil jar/Teflon lined cap										
2022 MGC S3	E108	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	30 days	15 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
Glass soil jar/Teflon lined cap										
2022 MGC S4	E108	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	30 days	15 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
Glass soil jar/Teflon lined cap										
2022 MGC S5	E108	14-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	30 days	15 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)										
Glass soil jar/Teflon lined cap										
2022 LGC S1	E108	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	30 days	16 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
Glass soil jar/Teflon lined cap										
2022 LGC S2	E108	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	30 days	16 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
Glass soil jar/Teflon lined cap										
2022 LGC S3	E108	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	30 days	16 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
Glass soil jar/Teflon lined cap										
2022 LGC S4	E108	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	30 days	16 days	✓
Physical Tests : pH by Meter (1:2 Soil:Water Extraction)										
Glass soil jar/Teflon lined cap										
2022 LGC S5	E108	13-Jun-2022	29-Jun-2022	----	----		29-Jun-2022	30 days	16 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	540473	1	14	7.1	5.0	✓
Loss On Ignition (550°C)	E205D	536447	2	22	9.0	5.0	✓
Mercury in Soil/Solid by CVAAS	E510	542295	1	19	5.2	5.0	✓
Metals in Soil/Solid by CRC ICPMS	E440	542294	1	19	5.2	5.0	✓
Moisture Content by Gravimetry	E144	542300	1	15	6.6	5.0	✓
Particle Size Analysis - Pipette Method	E184	532857	1	10	10.0	5.0	✓
Particle Size Analysis - Sieve <2mm	E182	532856	1	10	10.0	5.0	✓
pH by Meter (1:2 Soil:Water Extraction)	E108	542296	1	19	5.2	5.0	✓
Total Carbon by Combustion	E351	533877	1	11	9.0	5.0	✓
Total Inorganic Carbon by Acetic Acid pH Standard Curve	E354	533624	2	13	15.3	5.0	✓
Laboratory Control Samples (LCS)							
Acid Volatile Sulfide by Colourimetry (5 mg/kg)	E396	540473	1	14	7.1	5.0	✓
Loss On Ignition (550°C)	E205D	536447	2	22	9.0	5.0	✓
Mercury in Soil/Solid by CVAAS	E510	542295	2	19	10.5	10.0	✓
Metals in Soil/Solid by CRC ICPMS	E440	542294	2	19	10.5	10.0	✓
Moisture Content by Gravimetry	E144	542300	1	15	6.6	5.0	✓
Particle Size Analysis - Pipette Method	E184	532857	1	10	10.0	5.0	✓
Particle Size Analysis - Sieve <2mm	E182	532856	1	10	10.0	5.0	✓
Particle Size Analysis - Sieve >2mm	E181	532855	1	10	10.0	5.0	✓
pH by Meter (1:2 Soil:Water Extraction)	E108	542296	1	19	5.2	5.0	✓
Total Carbon by Combustion	E351	533877	2	11	18.1	10.0	✓
Total Inorganic Carbon by Acetic Acid pH Standard Curve	E354	533624	4	13	30.7	10.0	✓
Method Blanks (MB)							
Acid Volatile Sulfide by Colourimetry (5 mg/kg)	E396	540473	1	14	7.1	5.0	✓
Loss On Ignition (550°C)	E205D	536447	2	22	9.0	5.0	✓
Mercury in Soil/Solid by CVAAS	E510	542295	1	19	5.2	5.0	✓
Metals in Soil/Solid by CRC ICPMS	E440	542294	1	19	5.2	5.0	✓
Moisture Content by Gravimetry	E144	542300	1	15	6.6	5.0	✓
Total Carbon by Combustion	E351	533877	1	11	9.0	5.0	✓
Total Inorganic Carbon by Acetic Acid pH Standard Curve	E354	533624	2	13	15.3	5.0	✓
Matrix Spikes (MS)							
Acid Volatile Sulfide by Colourimetry (5 mg/kg)	E396	540473	1	14	7.1	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.
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.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
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.
Dry and Grind	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.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **WR2200569**	Page	: 1 of 13
Client	: Constantine North Inc.	Laboratory	: Whitehorse - Environmental
Contact	: Allegra Cairns	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	: 604 329 5982	Telephone	: +1 867 668 6689
Project	: Stream Sediments	Date Samples Received	: 17-Jun-2022 13:00
PO	: ----	Date Analysis Commenced	: 20-Jun-2022
C-O-C number	: ----	Issue Date	: 03-Jul-2022 15:07
Sampler	: Dylan Krull		
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*
Angela Ren	Team Leader - Metals	Vancouver Metals, Burnaby, British Columbia
Colby Bingham	Quality Systems Coordinator	Saskatoon Inorganics, Saskatoon, Saskatchewan
Hedy Lai	Team Leader - Inorganics	Saskatoon Inorganics, Saskatoon, Saskatchewan
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Vancouver Metals, Burnaby, British Columbia
Miles Gropen	Department Manager - Inorganics	Vancouver Inorganics, Burnaby, British Columbia
Robin Weeks	Team Leader - Metals	Vancouver Organics, Burnaby, British Columbia
Xihua Yao	Laboratory Analyst	Saskatoon Inorganics, Saskatoon, Saskatchewan

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: 536447)											
SK2203036-004	Anonymous	loss on ignition @ 550°C	----	E205D	1.0	%	14.8	14.7	0.496%	20%	----
Physical Tests (QC Lot: 536449)											
WR2200569-009	2022 MGC S4	loss on ignition @ 550°C	----	E205D	1.0	%	1.4	1.3	0.04	Diff <2x LOR	----
Physical Tests (QC Lot: 542296)											
VA22B3909-003	Anonymous	pH (1:2 soil:water)	----	E108	0.10	pH units	6.28	6.27	0.2%	5%	----
Physical Tests (QC Lot: 542300)											
VA22B3930-001	Anonymous	moisture	----	E144	0.25	%	14.5	17.2	17.2%	20%	----
Particle Size (QC Lot: 532856)											
WR2200569-003	2022 LGC S3	passing (0.05 mm)	----	E182	1.0	%	14.3	13.0	10.0%	15%	----
		passing (0.063 mm)	----	E182	1.0	%	17.0	15.6	8.44%	15%	----
		passing (0.075 mm)	----	E182	1.0	%	19.4	18.0	7.36%	15%	----
		passing (0.125 mm)	----	E182	1.0	%	29.6	28.2	4.81%	15%	----
		passing (0.149 mm)	----	E182	1.0	%	37.3	35.7	4.40%	15%	----
		passing (0.250 mm)	----	E182	1.0	%	60.1	57.8	3.80%	15%	----
		passing (0.420 mm)	----	E182	1.0	%	82.1	80.6	1.81%	15%	----
		passing (0.50 mm)	----	E182	1.0	%	90.6	89.4	1.31%	15%	----
		passing (0.841 mm)	----	E182	1.0	%	96.4	96.1	0.400%	15%	----
		passing (1.0 mm)	----	E182	1.0	%	98.4	98.3	0.122%	15%	----
Particle Size (QC Lot: 532857)											
WR2200569-003	2022 LGC S3	passing (0.002 mm)	----	E184	1.0	%	<1.0	<1.0	0	Diff <2x LOR	----
		passing (0.004 mm)	----	E184	1.0	%	1.1	<1.0	0.1	Diff <2x LOR	----
		passing (0.005 mm)	----	E184	1.0	%	1.2	1.1	0.1	Diff <2x LOR	----
		passing (0.020 mm)	----	E184	1.0	%	6.6	6.0	0.6	Diff <2x LOR	----
		passing (0.0312 mm)	----	E184	1.0	%	8.1	7.4	0.7	Diff <2x LOR	----
Organic / Inorganic Carbon (QC Lot: 533624)											
VA22B3675-001	Anonymous	carbon, inorganic [IC]	----	E354	0.050	%	<0.050	0.123	0.073	Diff <2x LOR	----
Organic / Inorganic Carbon (QC Lot: 533647)											
WR2200569-007	2022 MGC S2	carbon, inorganic [IC]	----	E354	0.050	%	0.423	0.416	0.007	Diff <2x LOR	----
Organic / Inorganic Carbon (QC Lot: 533877)											
CG2207689-002	Anonymous	carbon, total [TC]	----	E351	0.050	%	2.60	2.59	0.266%	20%	----
Inorganic Parameters (QC Lot: 540473)											

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*
Inorganic Parameters (QC Lot: 540473) - continued											
VA22B3675-008	Anonymous	sulfides, acid volatile	----	E396	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
Metals (QC Lot: 542294)											
VA22B3909-003	Anonymous	aluminum	7429-90-5	E440	50	mg/kg	5850	6220	6.09%	40%	----
		antimony	7440-36-0	E440	0.10	mg/kg	16.7	16.5	0.797%	30%	----
		arsenic	7440-38-2	E440	0.10	mg/kg	24.3	24.3	0.0356%	30%	----
		barium	7440-39-3	E440	0.50	mg/kg	118	161	31.3%	40%	----
		beryllium	7440-41-7	E440	0.10	mg/kg	0.30	0.33	0.04	Diff <2x LOR	----
		bismuth	7440-69-9	E440	0.20	mg/kg	3.60	3.53	1.83%	30%	----
		boron	7440-42-8	E440	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		cadmium	7440-43-9	E440	0.020	mg/kg	11.8	12.9	9.01%	30%	----
		calcium	7440-70-2	E440	50	mg/kg	5520	6160	10.8%	30%	----
		chromium	7440-47-3	E440	0.50	mg/kg	29.1	31.1	6.90%	30%	----
		cobalt	7440-48-4	E440	0.10	mg/kg	3.18	3.54	10.8%	30%	----
		copper	7440-50-8	E440	0.50	mg/kg	44.4	46.9	5.47%	30%	----
		iron	7439-89-6	E440	50	mg/kg	12400	12700	2.11%	30%	----
		lead	7439-92-1	E440	0.50	mg/kg	1390	1370	1.11%	40%	----
		lithium	7439-93-2	E440	2.0	mg/kg	7.3	7.7	0.4	Diff <2x LOR	----
		magnesium	7439-95-4	E440	20	mg/kg	3530	3500	0.805%	30%	----
		manganese	7439-96-5	E440	1.0	mg/kg	230	242	5.05%	30%	----
		molybdenum	7439-98-7	E440	0.10	mg/kg	0.69	0.70	2.09%	40%	----
		nickel	7440-02-0	E440	0.50	mg/kg	9.38	10.1	7.20%	30%	----
		phosphorus	7723-14-0	E440	50	mg/kg	1470	1550	5.26%	30%	----
		potassium	7440-09-7	E440	100	mg/kg	600	650	8.11%	40%	----
		selenium	7782-49-2	E440	0.20	mg/kg	0.83	0.94	0.10	Diff <2x LOR	----
		silver	7440-22-4	E440	0.10	mg/kg	4.09	3.97	3.12%	40%	----
		sodium	7440-23-5	E440	50	mg/kg	103	119	17	Diff <2x LOR	----
		strontium	7440-24-6	E440	0.50	mg/kg	37.7	39.8	5.40%	40%	----
		sulfur	7704-34-9	E440	1000	mg/kg	<1000	<1000	0	Diff <2x LOR	----
		thallium	7440-28-0	E440	0.050	mg/kg	1.26	1.27	1.19%	30%	----
		tin	7440-31-5	E440	2.0	mg/kg	9.0	8.8	0.2	Diff <2x LOR	----
		titanium	7440-32-6	E440	1.0	mg/kg	247	248	0.367%	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	5.20	4.96	4.73%	30%	----
		vanadium	7440-62-2	E440	0.20	mg/kg	25.2	25.1	0.566%	30%	----
		zinc	7440-66-6	E440	2.0	mg/kg	1240	1360	9.16%	30%	----

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: 542294) - continued											
VA22B3909-003	Anonymous	zirconium	7440-67-7	E440	1.0	mg/kg	<1.0	<1.0	0	Diff <2x LOR	----
Metals (QC Lot: 542295)											
VA22B3909-003	Anonymous	mercury	7439-97-6	E510	0.0500	mg/kg	0.813	0.783	3.73%	40%	----

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: 542300)						
moisture	---	E144	0.25	%	<0.25	---
Organic / Inorganic Carbon (QCLot: 533624)						
carbon, inorganic [IC]	---	E354	0.05	%	<0.050	---
Organic / Inorganic Carbon (QCLot: 533647)						
carbon, inorganic [IC]	---	E354	0.05	%	<0.050	---
Organic / Inorganic Carbon (QCLot: 533877)						
carbon, total [TC]	---	E351	0.05	%	<0.050	---
Inorganic Parameters (QCLot: 540473)						
sulfides, acid volatile	---	E396	5	mg/kg	<5.0	---
Metals (QCLot: 542294)						
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	---

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 542294) - continued						
sodium	7440-23-5	E440	50	mg/kg	<50	----
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	<1.0	----
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: 542295)						
mercury	7439-97-6	E510	0.005	mg/kg	<0.0050	----

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: 542296)									
pH (1:2 soil:water)	----	E108	----	pH units	6 pH units	99.7	95.0	105	----
Physical Tests (QCLot: 542300)									
moisture	----	E144	0.25	%	50 %	99.8	90.0	110	----
Organic / Inorganic Carbon (QCLot: 533624)									
carbon, inorganic [IC]	----	E354	0.05	%	0.5 %	94.1	90.0	110	----
Organic / Inorganic Carbon (QCLot: 533647)									
carbon, inorganic [IC]	----	E354	0.05	%	0.5 %	94.9	90.0	110	----
Organic / Inorganic Carbon (QCLot: 533877)									
carbon, total [TC]	----	E351	0.05	%	48 %	99.2	90.0	110	----
Inorganic Parameters (QCLot: 540473)									
sulfides, acid volatile	----	E396	5	mg/kg	200 mg/kg	118	70.0	130	----
Metals (QCLot: 542294)									
aluminum	7429-90-5	E440	50	mg/kg	200 mg/kg	107	80.0	120	----
antimony	7440-36-0	E440	0.1	mg/kg	100 mg/kg	112	80.0	120	----
arsenic	7440-38-2	E440	0.1	mg/kg	100 mg/kg	103	80.0	120	----
barium	7440-39-3	E440	0.5	mg/kg	25 mg/kg	106	80.0	120	----
beryllium	7440-41-7	E440	0.1	mg/kg	10 mg/kg	98.2	80.0	120	----
bismuth	7440-69-9	E440	0.2	mg/kg	100 mg/kg	98.6	80.0	120	----
boron	7440-42-8	E440	5	mg/kg	100 mg/kg	97.3	80.0	120	----
cadmium	7440-43-9	E440	0.02	mg/kg	10 mg/kg	103	80.0	120	----
calcium	7440-70-2	E440	50	mg/kg	5000 mg/kg	102	80.0	120	----
chromium	7440-47-3	E440	0.5	mg/kg	25 mg/kg	99.8	80.0	120	----
cobalt	7440-48-4	E440	0.1	mg/kg	25 mg/kg	99.0	80.0	120	----
copper	7440-50-8	E440	0.5	mg/kg	25 mg/kg	100	80.0	120	----
iron	7439-89-6	E440	50	mg/kg	100 mg/kg	105	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	97.9	80.0	120	----
magnesium	7439-95-4	E440	20	mg/kg	5000 mg/kg	107	80.0	120	----
manganese	7439-96-5	E440	1	mg/kg	25 mg/kg	100	80.0	120	----
molybdenum	7439-98-7	E440	0.1	mg/kg	25 mg/kg	102	80.0	120	----
nickel	7440-02-0	E440	0.5	mg/kg	50 mg/kg	98.5	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: 542294) - continued									
phosphorus	7723-14-0	E440	50	mg/kg	1000 mg/kg	102	80.0	120	----
potassium	7440-09-7	E440	100	mg/kg	5000 mg/kg	101	80.0	120	----
selenium	7782-49-2	E440	0.2	mg/kg	100 mg/kg	102	80.0	120	----
silver	7440-22-4	E440	0.1	mg/kg	10 mg/kg	93.3	80.0	120	----
sodium	7440-23-5	E440	50	mg/kg	5000 mg/kg	98.1	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	107	80.0	120	----
thallium	7440-28-0	E440	0.05	mg/kg	100 mg/kg	103	80.0	120	----
tin	7440-31-5	E440	2	mg/kg	50 mg/kg	102	80.0	120	----
titanium	7440-32-6	E440	1	mg/kg	25 mg/kg	96.6	80.0	120	----
tungsten	7440-33-7	E440	0.5	mg/kg	10 mg/kg	106	80.0	120	----
uranium	7440-61-1	E440	0.05	mg/kg	0.5 mg/kg	102	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	98.8	80.0	120	----
zirconium	7440-67-7	E440	1	mg/kg	10 mg/kg	98.3	80.0	120	----
Metals (QCLot: 542295)									
mercury	7439-97-6	E510	0.005	mg/kg	0.1 mg/kg	100	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
Inorganic Parameters (QCLot: 540473)										
VA22B3675-009	Anonymous	sulfides, acid volatile	----	E396	ND mg/kg	200 mg/kg	ND	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: 536447)									
	RM	loss on ignition @ 550°C	----	E205D	6.71 %	99.4	80.0	120	----
Physical Tests (QCLot: 536449)									
	RM	loss on ignition @ 550°C	----	E205D	6.71 %	104	80.0	120	----
Particle Size (QCLot: 532855)									
	RM	passing (19 mm)	----	E181	100 %	100	90.0	110	----
	RM	passing (2.0 mm)	----	E181	100 %	100	90.0	110	----
	RM	passing (25.4 mm)	----	E181	100 %	100	90.0	110	----
	RM	passing (38.1 mm)	----	E181	100 %	100	90.0	110	----
	RM	passing (4.75 mm)	----	E181	100 %	100	90.0	110	----
	RM	passing (50.8 mm)	----	E181	100 %	100	90.0	110	----
	RM	passing (76.2 mm)	----	E181	100 %	100	90.0	110	----
	RM	passing (9.5 mm)	----	E181	100 %	100	90.0	110	----
Particle Size (QCLot: 532856)									
	RM	passing (0.05 mm)	----	E182	49.81 %	103	90.0	110	----
	RM	passing (0.063 mm)	----	E182	54.27 %	99.8	90.8	109	----
	RM	passing (0.075 mm)	----	E182	58.38 %	97.3	91.4	109	----
	RM	passing (0.125 mm)	----	E182	68.06 %	99.5	92.7	107	----
	RM	passing (0.149 mm)	----	E182	72.71 %	98.9	93.1	107	----
	RM	passing (0.250 mm)	----	E182	85.38 %	98.9	94.1	106	----
	RM	passing (0.420 mm)	----	E182	92.78 %	98.3	94.6	105	----
	RM	passing (0.50 mm)	----	E182	93.78 %	100	94.7	105	----
	RM	passing (0.841 mm)	----	E182	97.34 %	99.6	94.9	105	----
	RM	passing (1.0 mm)	----	E182	97.77 %	100	94.9	105	----
Particle Size (QCLot: 532857)									
	RM	passing (0.002 mm)	----	E184	19.34 %	95.5	74.1	126	----
	RM	passing (0.004 mm)	----	E184	21.51 %	97.6	76.8	123	----
	RM	passing (0.005 mm)	----	E184	22.6 %	98.4	77.9	122	----
	RM	passing (0.020 mm)	----	E184	35.27 %	105	85.8	114	----
	RM	passing (0.0312 mm)	----	E184	41.61 %	100	88.0	112	----

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: 533624)									
	RM	carbon, inorganic [IC]	----	E354	0.383 %	95.8	80.0	120	----
Organic / Inorganic Carbon (QCLot: 533647)									
	RM	carbon, inorganic [IC]	----	E354	0.383 %	96.1	80.0	120	----
Organic / Inorganic Carbon (QCLot: 533877)									
	RM	carbon, total [TC]	----	E351	1.4 %	104	80.0	120	----
Metals (QCLot: 542294)									
	SCP SS-2	aluminum	7429-90-5	E440	9817 mg/kg	120	70.0	130	----
	SCP SS-2	antimony	7440-36-0	E440	3.99 mg/kg	106	70.0	130	----
	SCP SS-2	arsenic	7440-38-2	E440	3.73 mg/kg	110	70.0	130	----
	SCP SS-2	barium	7440-39-3	E440	105 mg/kg	109	70.0	130	----
	SCP SS-2	beryllium	7440-41-7	E440	0.349 mg/kg	107	70.0	130	----
	SCP SS-2	boron	7440-42-8	E440	8.5 mg/kg	124	40.0	160	----
	SCP SS-2	cadmium	7440-43-9	E440	0.91 mg/kg	106	70.0	130	----
	SCP SS-2	calcium	7440-70-2	E440	31082 mg/kg	110	70.0	130	----
	SCP SS-2	chromium	7440-47-3	E440	101 mg/kg	122	70.0	130	----
	SCP SS-2	cobalt	7440-48-4	E440	6.9 mg/kg	110	70.0	130	----
	SCP SS-2	copper	7440-50-8	E440	123 mg/kg	109	70.0	130	----
	SCP SS-2	iron	7439-89-6	E440	23558 mg/kg	109	70.0	130	----
	SCP SS-2	lead	7439-92-1	E440	267 mg/kg	104	70.0	130	----
	SCP SS-2	lithium	7439-93-2	E440	9.5 mg/kg	106	70.0	130	----
	SCP SS-2	magnesium	7439-95-4	E440	5509 mg/kg	114	70.0	130	----
	SCP SS-2	manganese	7439-96-5	E440	269 mg/kg	116	70.0	130	----
	SCP SS-2	molybdenum	7439-98-7	E440	1.03 mg/kg	110	70.0	130	----
	SCP SS-2	nickel	7440-02-0	E440	26.7 mg/kg	111	70.0	130	----
	SCP SS-2	phosphorus	7723-14-0	E440	752 mg/kg	102	70.0	130	----
	SCP SS-2	potassium	7440-09-7	E440	1587 mg/kg	122	70.0	130	----
	SCP SS-2	sodium	7440-23-5	E440	797 mg/kg	110	70.0	130	----
	SCP SS-2	strontium	7440-24-6	E440	86.1 mg/kg	105	70.0	130	----
	SCP SS-2	thallium	7440-28-0	E440	0.0786 mg/kg	109	40.0	160	----
	SCP SS-2	tin	7440-31-5	E440	10.6 mg/kg	112	70.0	130	----
	SCP SS-2	titanium	7440-32-6	E440	839 mg/kg	121	70.0	130	----
	SCP SS-2	uranium	7440-61-1	E440	0.52 mg/kg	109	70.0	130	----
	SCP SS-2	vanadium	7440-62-2	E440	32.7 mg/kg	116	70.0	130	----

Sub-Matrix:

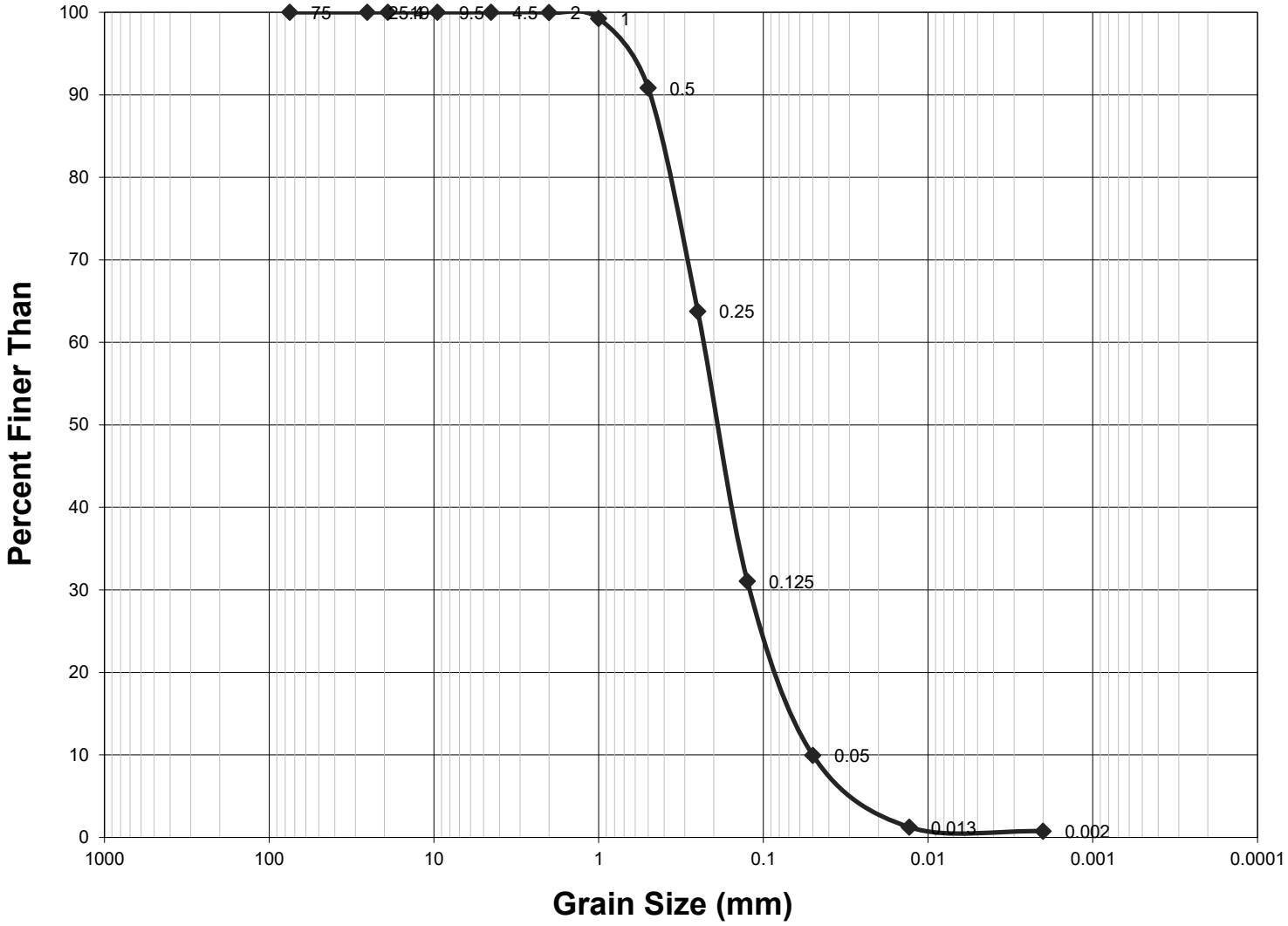
					Reference Material (RM) Report				
					RM Target	Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Concentration	RM	Low	High	Qualifier
Metals (QCLot: 542294) - continued									
	SCP SS-2	zinc	7440-66-6	E440	297 mg/kg	106	70.0	130	---
	SCP SS-2	zirconium	7440-67-7	E440	5.73 mg/kg	94.8	70.0	130	---
Metals (QCLot: 542295)									
	SCP SS-2	mercury	7439-97-6	E510	0.059 mg/kg	99.5	70.0	130	---

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CONI100
Project:
Sample ID: 2022LGCS1
Lab ID: WR2200569001

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	0
Coarse Sand	2.0mm - 4.75mm	0
Medium Sand	0.425mm - 2.0mm	9
Fine Sand	0.075mm - 0.425mm	74
Fines	< 0.075mm	17

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	0
Sand	0.05mm - 2mm	90
Silt	0.002mm - 0.05mm	9
Clay	< 0.002mm	1

Texture Sand

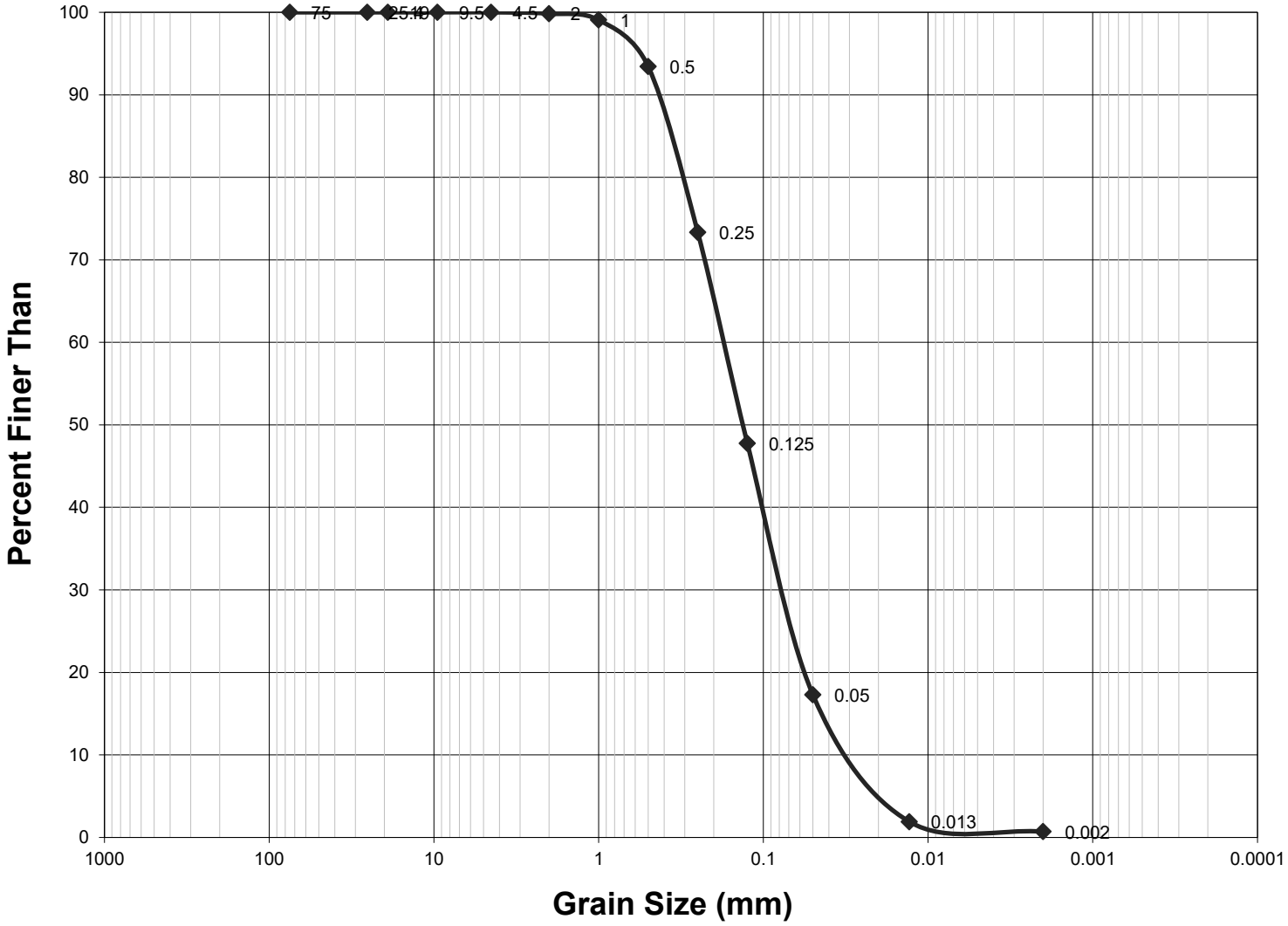
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CONI100
Project:
Sample ID: 2022LGCS2
Lab ID: WR2200569002

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	0
Coarse Sand	2.0mm - 4.75mm	0
Medium Sand	0.425mm - 2.0mm	6
Fine Sand	0.075mm - 0.425mm	66
Fines	< 0.075mm	27

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	0
Sand	0.05mm - 2mm	83
Silt	0.002mm - 0.05mm	17
Clay	< 0.002mm	1
Texture	Loamy sand	

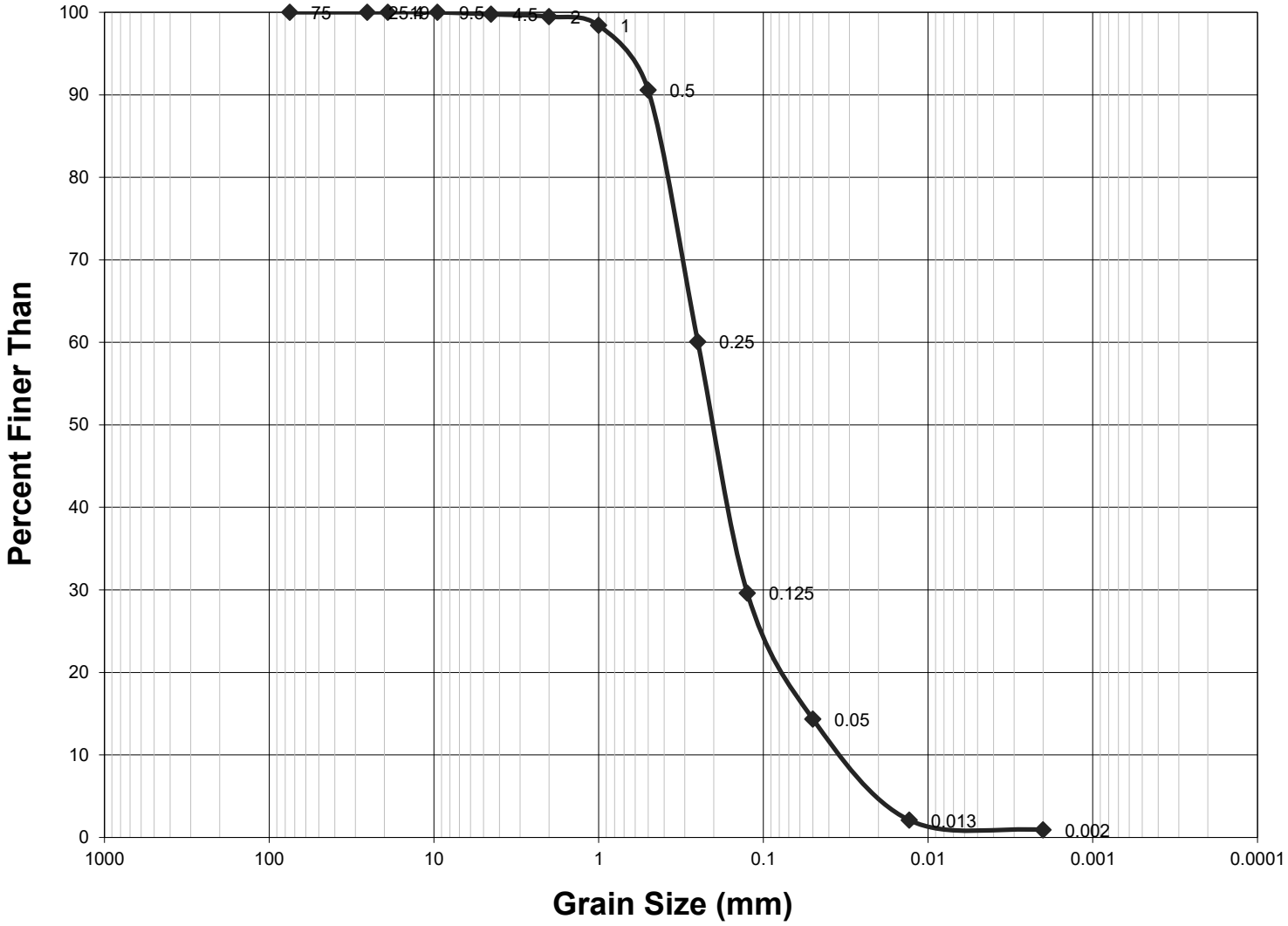
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CONI100
Project:
Sample ID: 2022LGCS3
Lab ID: WR2200569003

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	0
Coarse Sand	2.0mm - 4.75mm	0
Medium Sand	0.425mm - 2.0mm	9
Fine Sand	0.075mm - 0.425mm	71
Fines	< 0.075mm	19

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	1
Sand	0.05mm - 2mm	85
Silt	0.002mm - 0.05mm	13
Clay	< 0.002mm	1

Texture Sample contains material greater than 4.75mm. T

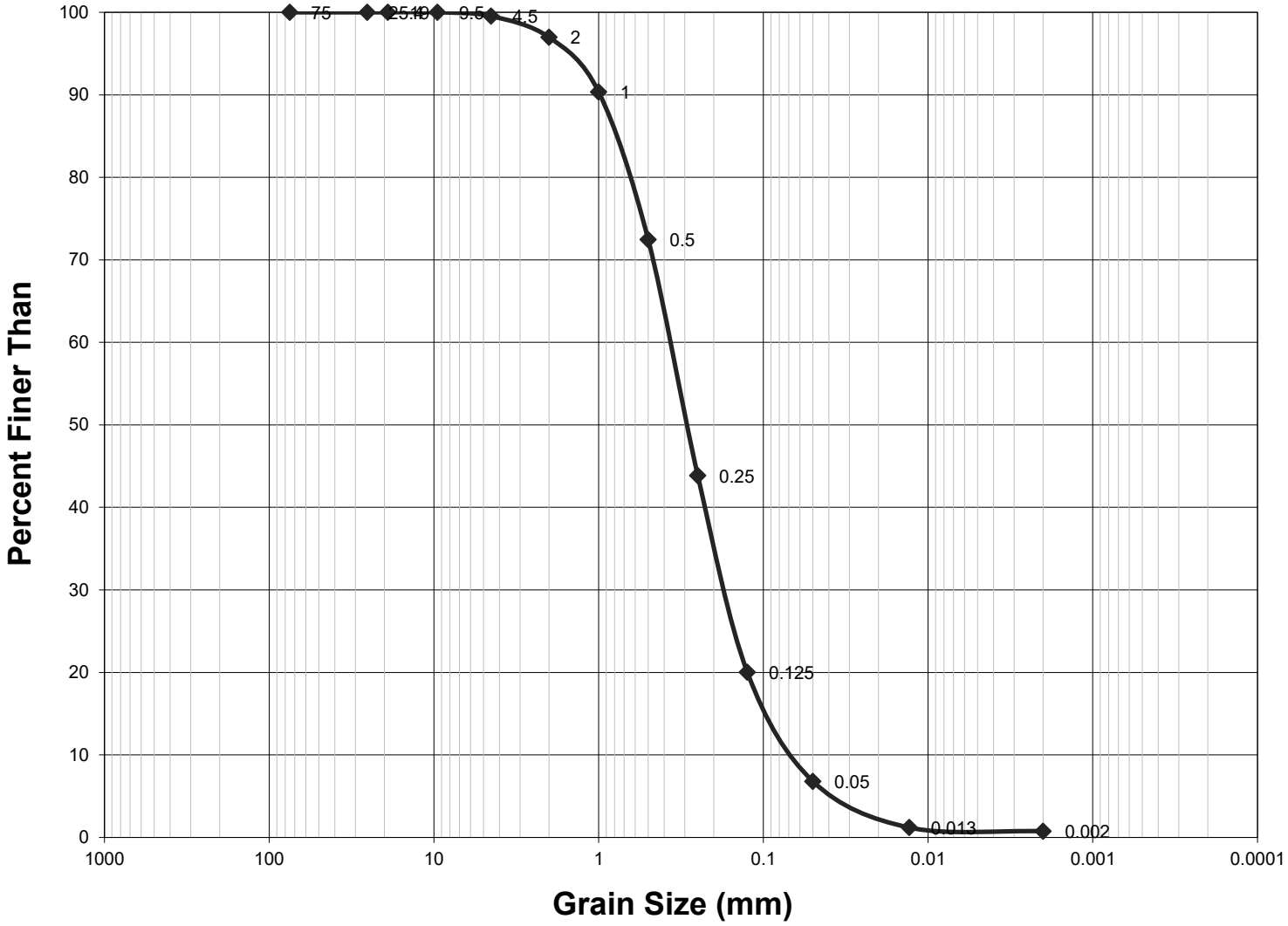
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CONI100
Project:
Sample ID: 2022LGCS4
Lab ID: WR2200569004

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	0
Coarse Sand	2.0mm - 4.75mm	3
Medium Sand	0.425mm - 2.0mm	25
Fine Sand	0.075mm - 0.425mm	61
Fines	< 0.075mm	11

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	3
Sand	0.05mm - 2mm	90
Silt	0.002mm - 0.05mm	6
Clay	< 0.002mm	1

Texture Sample contains material greater than 4.75mm. T

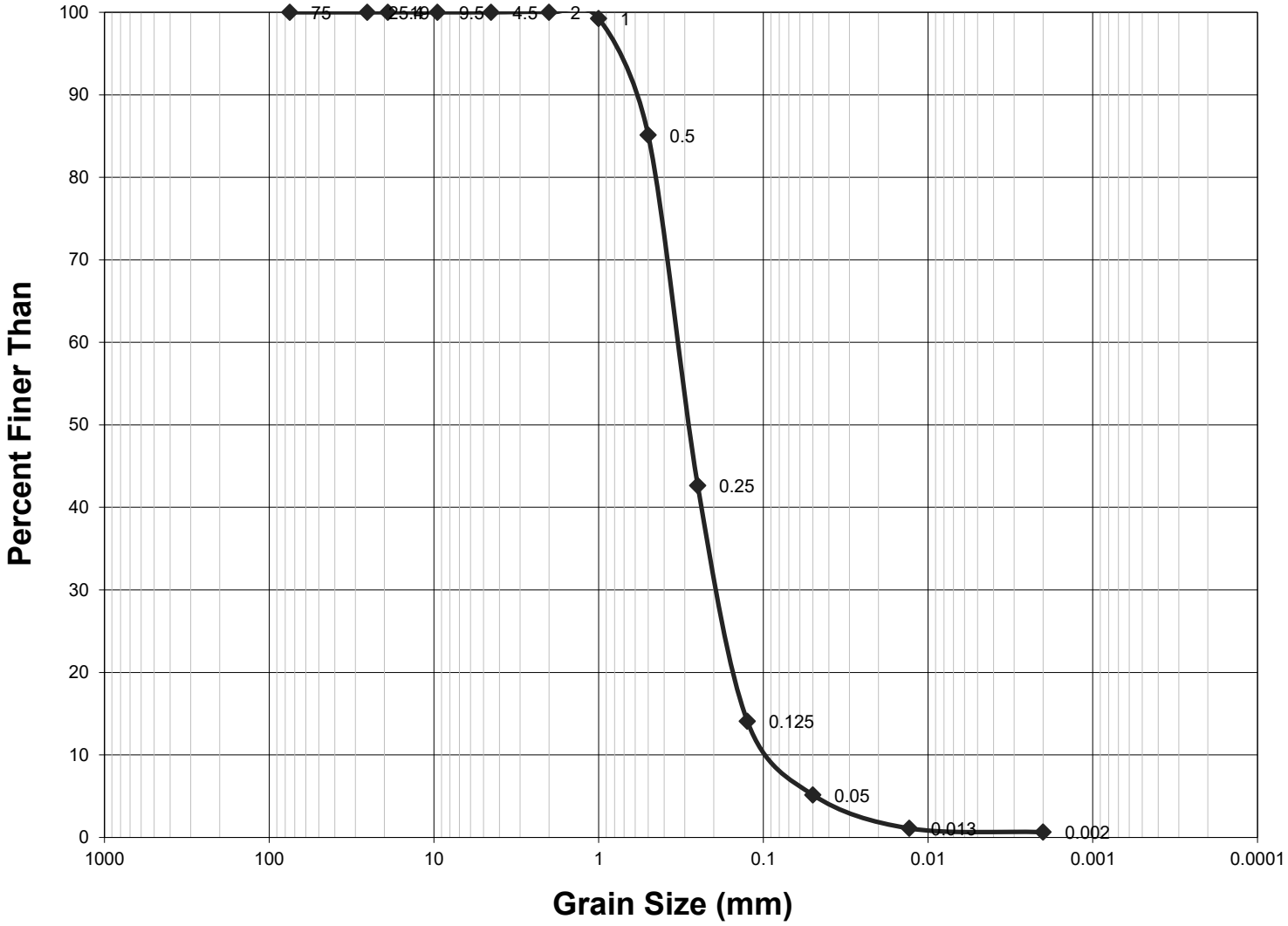
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CONI100
Project:
Sample ID: 2022LGCS5
Lab ID: WR2200569005

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	0
Coarse Sand	2.0mm - 4.75mm	0
Medium Sand	0.425mm - 2.0mm	15
Fine Sand	0.075mm - 0.425mm	77
Fines	< 0.075mm	8

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	0
Sand	0.05mm - 2mm	95
Silt	0.002mm - 0.05mm	5
Clay	< 0.002mm	1

Texture Sand

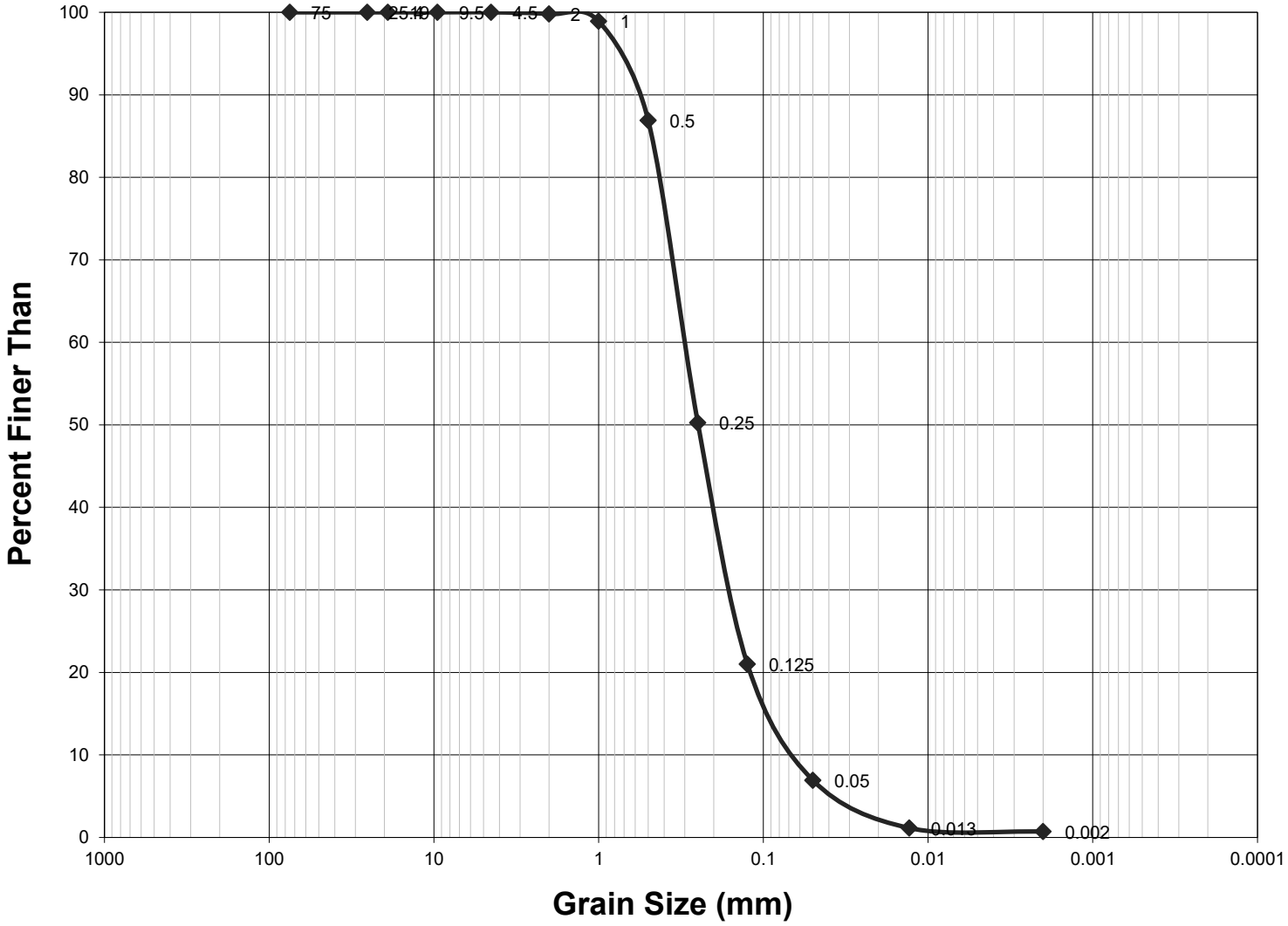
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CONI100
Project:
Sample ID: 2022MGCS1
Lab ID: WR2200569006

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	0
Coarse Sand	2.0mm - 4.75mm	0
Medium Sand	0.425mm - 2.0mm	13
Fine Sand	0.075mm - 0.425mm	75
Fines	< 0.075mm	12

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	0
Sand	0.05mm - 2mm	93
Silt	0.002mm - 0.05mm	6
Clay	< 0.002mm	1

Texture Sand

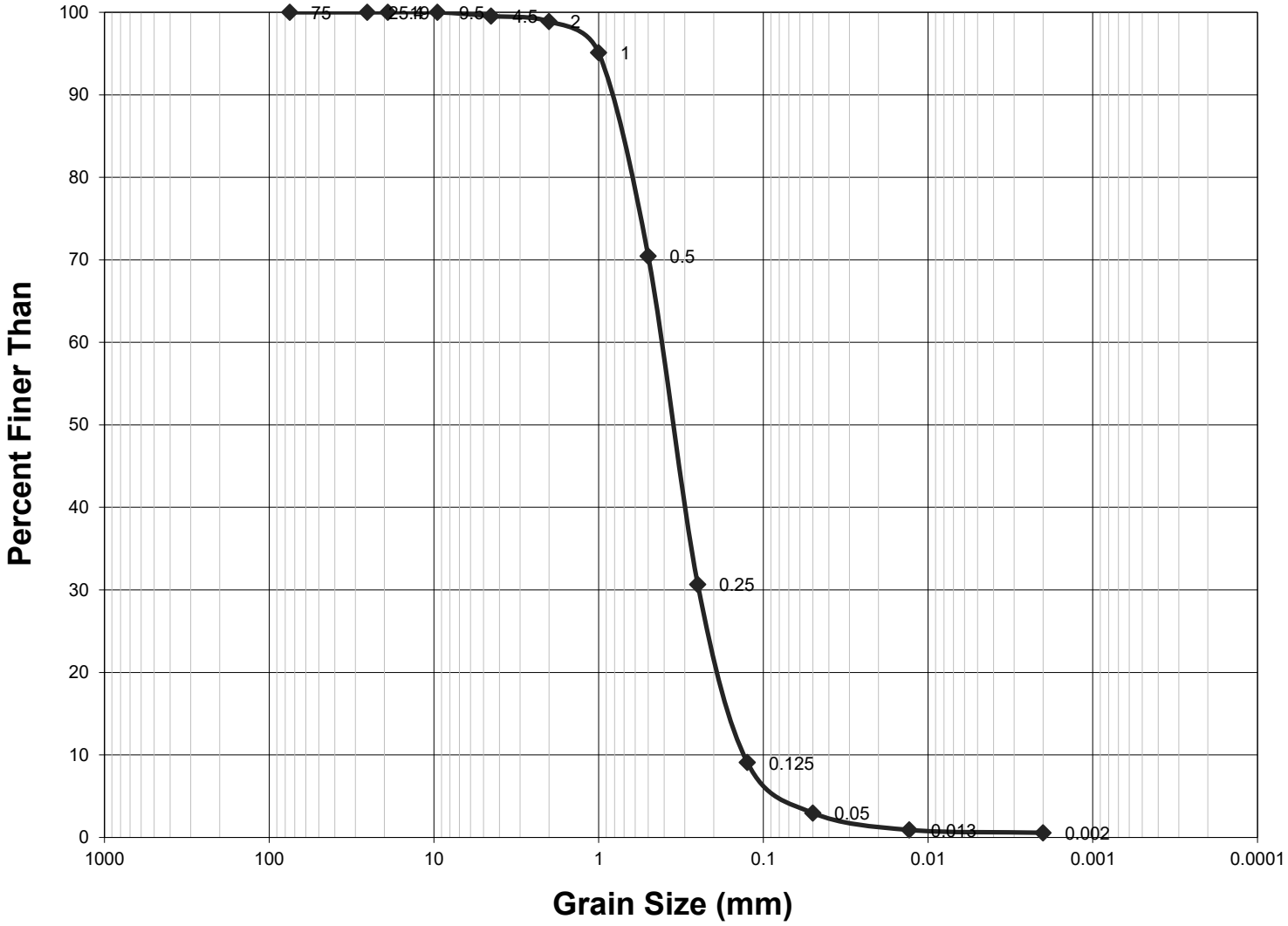
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CONI100
Project:
Sample ID: 2022MGCS2
Lab ID: WR2200569007

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	0
Coarse Sand	2.0mm - 4.75mm	1
Medium Sand	0.425mm - 2.0mm	28
Fine Sand	0.075mm - 0.425mm	65
Fines	< 0.075mm	5

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	1
Sand	0.05mm - 2mm	96
Silt	0.002mm - 0.05mm	2
Clay	< 0.002mm	1

Texture Sample contains material greater than 4.75mm. T

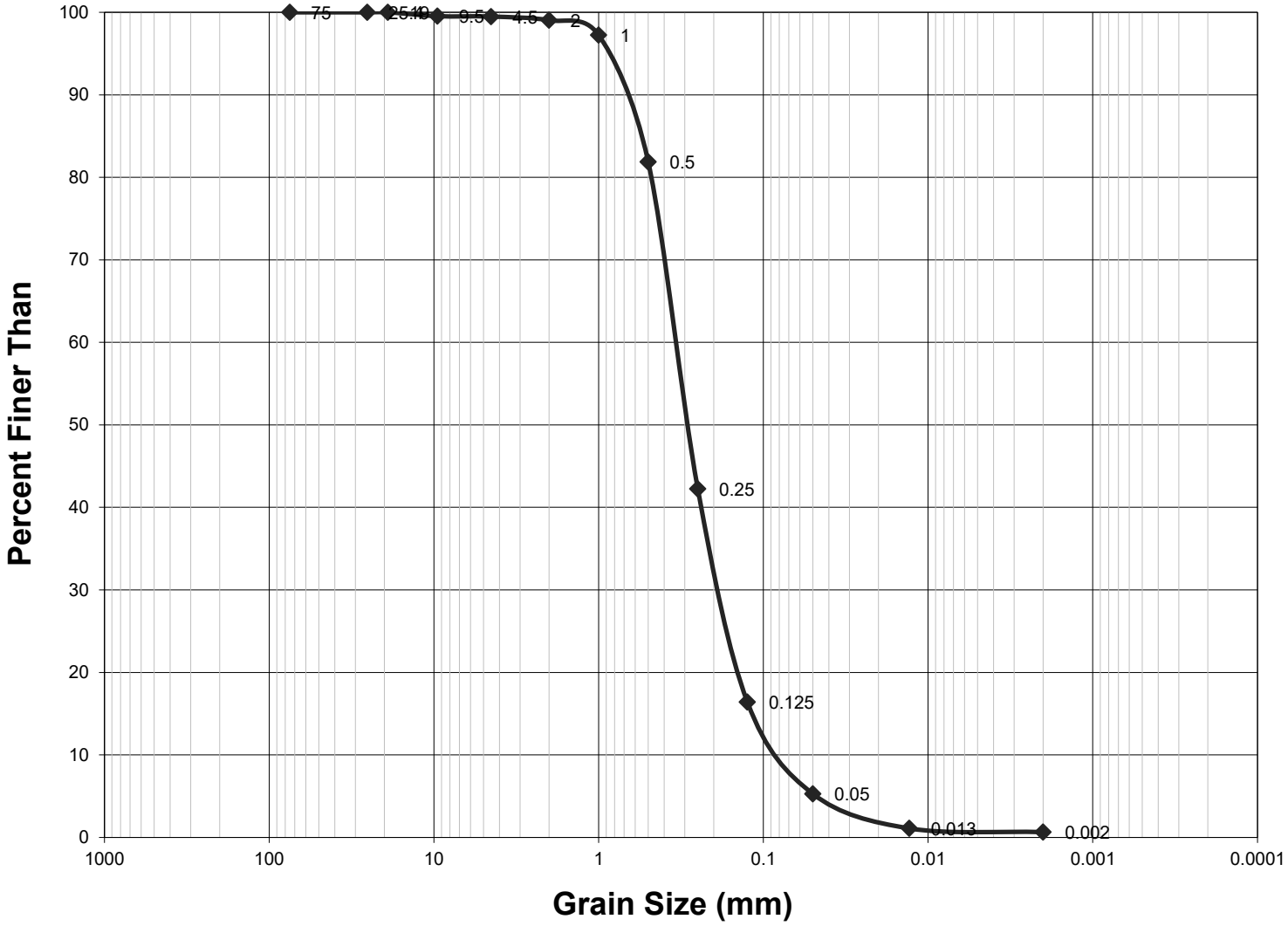
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CONI100
Project:
Sample ID: 2022MGCS3
Lab ID: WR2200569008

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	1
Coarse Sand	2.0mm - 4.75mm	0
Medium Sand	0.425mm - 2.0mm	17
Fine Sand	0.075mm - 0.425mm	73
Fines	< 0.075mm	9

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	1
Sand	0.05mm - 2mm	94
Silt	0.002mm - 0.05mm	5
Clay	< 0.002mm	1

Texture Sample contains material greater than 4.75mm. T

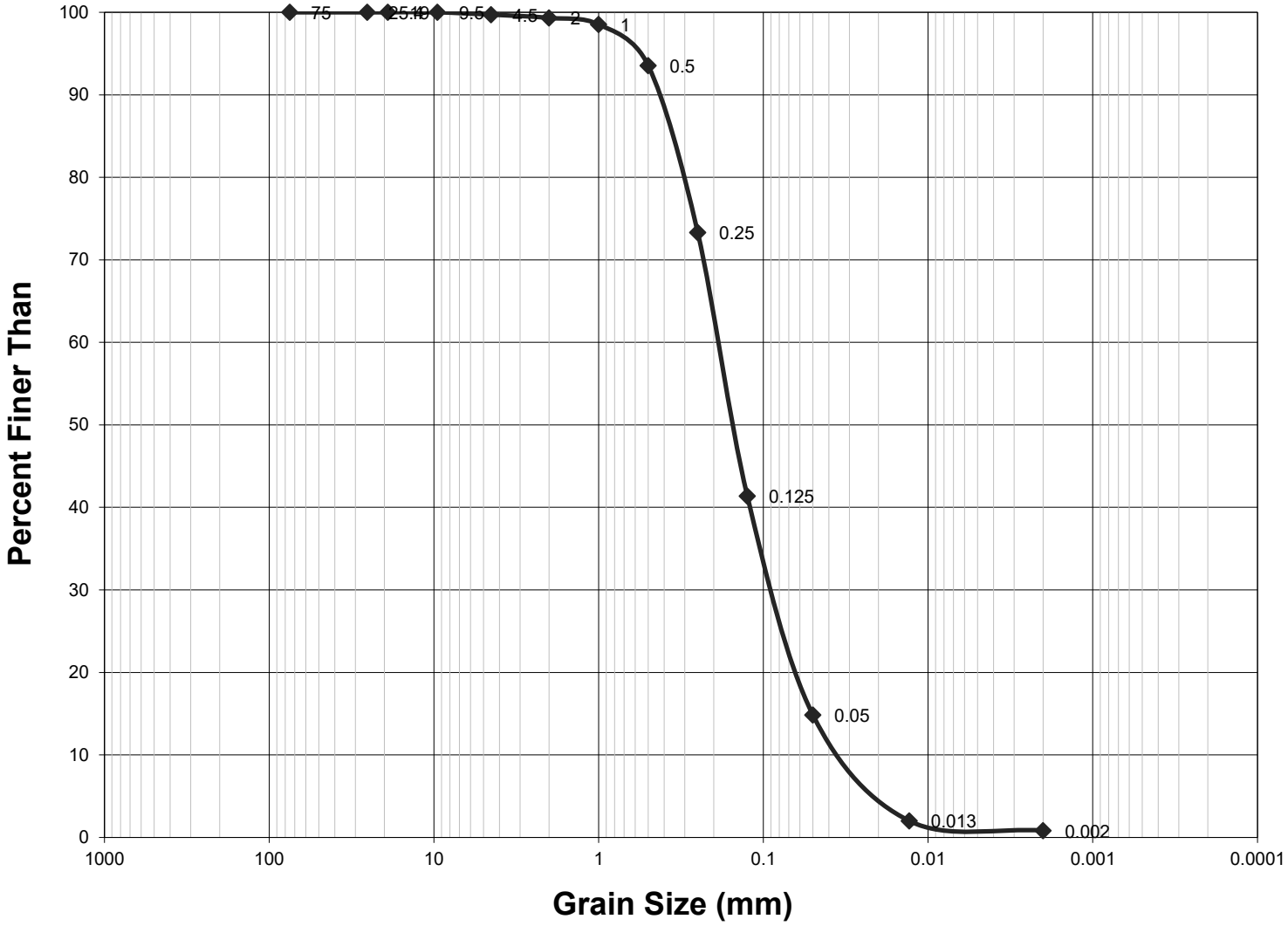
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CONI100
Project:
Sample ID: 2022MGCS4
Lab ID: WR2200569009

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	0
Coarse Sand	2.0mm - 4.75mm	0
Medium Sand	0.425mm - 2.0mm	6
Fine Sand	0.075mm - 0.425mm	70
Fines	< 0.075mm	24

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	1
Sand	0.05mm - 2mm	84
Silt	0.002mm - 0.05mm	14
Clay	< 0.002mm	1

Texture Sample contains material greater than 4.75mm. T

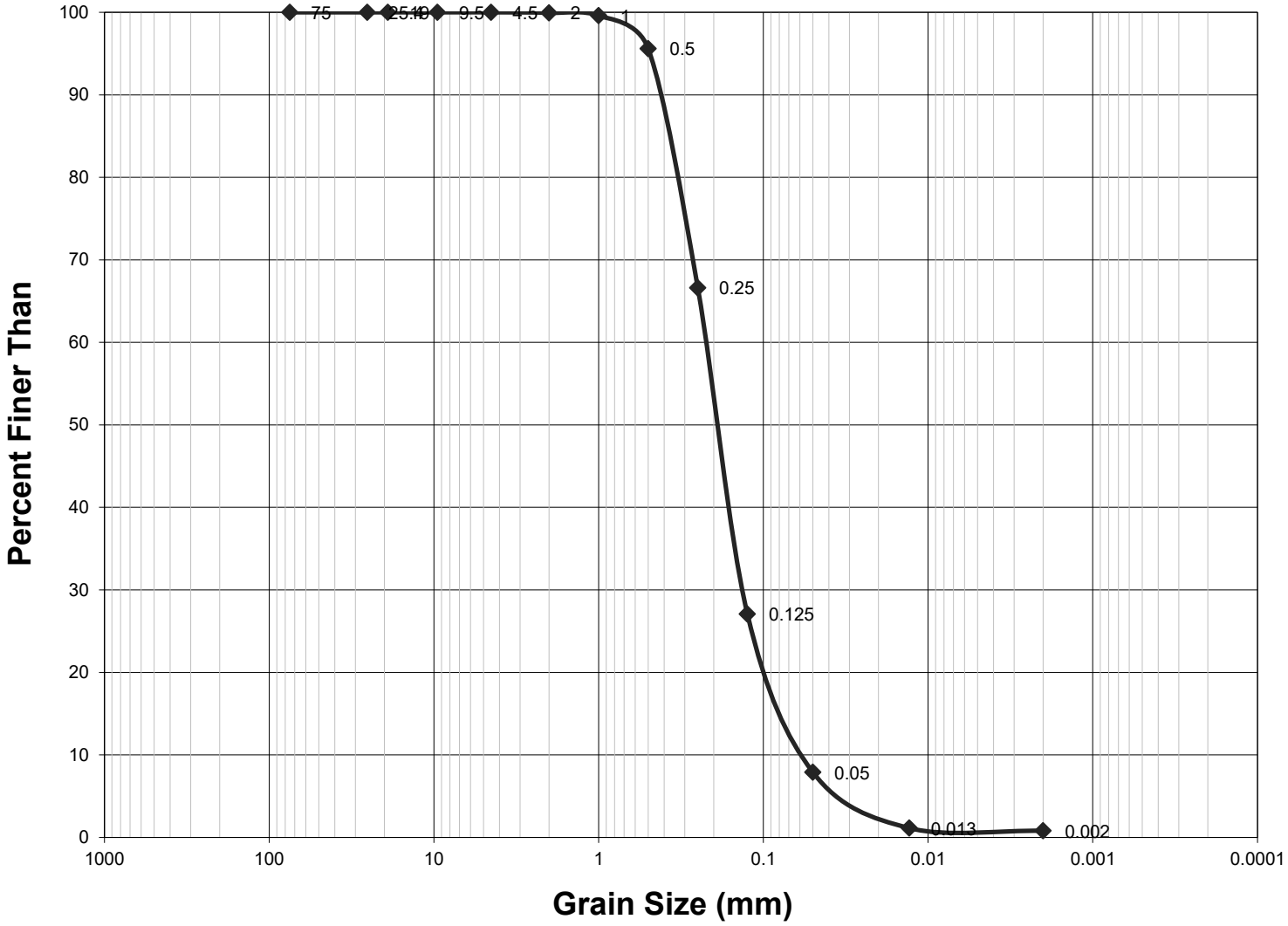
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CONI100
Project:
Sample ID: 2022MGCS5
Lab ID: WR2200569010

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	0
Coarse Sand	2.0mm - 4.75mm	0
Medium Sand	0.425mm - 2.0mm	4
Fine Sand	0.075mm - 0.425mm	81
Fines	< 0.075mm	14

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	0
Sand	0.05mm - 2mm	92
Silt	0.002mm - 0.05mm	7
Clay	< 0.002mm	1

Texture Sand

Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Environmental

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

COC Number: 15 -

Page

Environmental Division
Whitehorse
Work Order Reference
WR2200569

Telephone : +1 867 668 6689

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (T
Company:	ADFG Habitat Section	Invoice Distribution	☑ PDF ☑ EXCEL ☑ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Dylan Knull	Quality Control (QC) Report with Report	yes	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - conta
Address:	PO Box 110024 Juneau, AK 99811	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge -
Phone:	907-465-6160	Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT ar
		Email 1 or Fax	dylan.Knull@alaska.gov	Specify Date Required for E2,E or P:
		Email 2	allegra@constantinemetals.com	Analysis Request
Invoice To	Aris Morfopoulos	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Presen
	Suite 320, 800 W. Pender St. Vanou	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	
Company:	Constantine Mining LLC	Email 1 or Fax	aris@constantinemetals.com	
Contact:	Aris@constantinemetals.com	Email 2	allegra@constantinemetals.com	
Project Information		Oil and Gas Required Fields (client use)		
ALS Quote #:	Q62329	Approver ID:	Cost Center:	
Job #:	Stream Sediments	GL Account:	Routing Code:	
PO / AFE:		Activity Code:		
LSD:		Location:		
ALS Lab Work Order # (lab use only)		ALS Contact: Carla Fuginski	Sampler: Dylan Knull	

AS PER QUOTE Q2329

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 Contain
	2022 LGC S1	13-06-22	14:00	Soil	2
	2022 LGC S2	↓	↓	Soil	2
	2022 LGC S3			Soil	2
	2022 LGC S4			Soil	2
	2022 LGC S5			Soil	2
				~~Soil~~	
	2022 MGC S1	14-06-22	12:00	Soil	2
	2022 MGC S2			Soil	2
	2022 MGC S3			Soil	2
	2022 MGC S4			Soil	2
	2022 MGC S5			Soil	2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System?	Please select criteria from drop-down list
Are samples for human drinking water use?	Please select criteria from drop-down list

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐		SIF Observations	Yes ☐	No ☐
Ice packs	Yes ☑	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
5					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)			
Released by: D. Knull	Date: 6/14/22	Time: 1458	Received by: JC	Date: JUNE 17	Time: 07	Received by:	Date:		Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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NA-FM-9328ev09Front04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

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

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 -

Page

Environmental Division Whitehorse

Work Order Reference WR2200569

Telephone : +1 867 668 6689

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	ADFG Habitat Section	Invoice Distribution	☑ PDF ☑ EXCEL ☑ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Dylan Knull	Quality Control (QC) Report with Report	yes	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT and surcharge
Address:	PO Box 110024 Juneau, AK 99811	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT and surcharge
Phone:	907-465-6160	Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax	dylan.knull@alaska.gov	Specify Date Required for E2, E or P:
		Email 2	allegra@constantinemetals.com	Analysis Request
Invoice To	Aris Morfopoulos	**Invoice Distribution**		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P)
	Suite 320, 800 W. Pender St. Vancou	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	
Company:	Constantine Mining LLC	Email 1 or Fax	aris@constantinemetals.com	
Contact:	Aris@constantinemetals.com	Email 2	allegra@constantinemetals.com	
Project Information		**Oil and Gas Required Fields (client use)**		
ALS Quote #:	Q62329	Approver ID:	Cost Center:	
Job #:	Stream Sediments	GL Account:	Routing Code:	
PO / AFE:		Activity Code:		
LSD:		Location:		
ALS Lab Work Order # (lab use only)		ALS Contact: Carla Fuginski	Sampler: Dylan Knull	

AS PER QUOTE Q2329

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
	2022 LGC S1	13-06-22	14:00	Soil	2
	2022 LGC S2	↓	↓	Soil	2
	2022 LGC S3			Soil	2
	2022 LGC S4			Soil	2
	2022 LGC S5			Soil	2
				~~Soil~~	
	2022 MGC S1	14-06-22	12:00	Soil	2
	2022 MGC S2			Soil	2
	2022 MGC S3			Soil	2
	2022 MGC S4			Soil	2
	2022 MGC S5			Soil	2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client use)
Are samples taken from a Regulated DW System?	Please select criteria from drop-down list
Are samples for human drinking water use?	Please select criteria from drop-down list

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐			SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☑	No ☐		Custody seal intact	Yes ☐	No ☐	
Cooling Initiated	☐						

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C	
5			4°C (avg 7	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)			
Released by: D. Knull	Date: 6/14/22	Time: 1455	Received by: JC	Date: JUNE 17	Time: 0900	Received by: ice pack JC JUN 18 2022	Date:	Time: 12pm	

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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NA-FM-0328e v09 FrontOA January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

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

JUN 18 2022