Technical Report No. 19-06

Aquatic Studies at Kensington Gold Mine, 2018

By

Greg Albrecht

February 2019

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

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 the Divisions of Habitat, 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

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
inch of mercury	inHg
Kilopascal	kPa
Nephelometric Turbidity Unit	NTU
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
etalii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
idest (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)	'
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. 19-06

AQUATIC STUDIES AT KENSINGTON GOLD MINE, 2018

by

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February 2019

This investigation was fully financed by Coeur Alaska, Inc.

Cover: Habitat Biologist Dylan Krull snorkeling in Johnson Creek below the barrier falls.

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This document should be cited as:
Albrecht, G. 2019. Aquatic studies at Kensington Gold Mine, 2018. Alaska Department of Fish and Game, Technical Report No. 19-06, Douglas, AK.

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ACKNOWLEDGEMENTS

Coeur Alaska, Inc. provided financial support and Kensington Gold Mine environmental staff Kevin Eppers, Pete Strow, Ryan Bailey, Collin Wigfield-Gorka, and Kelsey Stockert provided logistical support and discharge and water quality data.

Division of Habitat staff assisted with both field and office work. Habitat Biologist Johnny Zutz planned and lead the field studies, collected and entered data, and prepared data presentations. Habitat Biologists Dylan Krull, Evan Fritz, Kate Kanouse, and Nicole Legere and Program Technician Katrina Lee assisted with data collection. Ms. Kate Kanouse, Ms. Legere, and Mr. Fritz verified data entry, and Mr. Fritz helped process periphyton samples. Ms. Kanouse prepared the Executive Summary, Division of Habitat Operations Manager Dr. Al Ott, Ms. Kanouse, and Ms. Legere reviewed and edited the report, and Ms. Legere prepared the maps and the report for publication. Matthew Kern of Alder Grove Farm identified benthic macroinvertebrates.

Thank you all for your contribution.

EXECUTIVE SUMMARY

Since 2011, the Alaska Department of Fish and Game (ADF&G) Division of Habitat has completed the aquatic resource monitoring the U.S. Forest Service (USFS) and Alaska Department of Environmental Conservation (ADEC) require for Coeur Alaska Inc.'s (Coeur) Kensington Gold Mine. This partnership provides ADF&G the opportunity to gather and review data throughout the year, and help identify, assess, and resolve issues at the mine as they arise.

The National Weather Service (2019) reports Juneau experienced warmer and drier conditions in 2018 than normal, with annual precipitation (142 cm) about 10% below normal and snowfall (220 cm) about 24% below normal.

Since August 2011, Coeur staff sampled surface waters monthly in and around the tailings treatment facility (TTF) for ammonia, chlorophyll *a*, nitrate, nitrite, organic carbon, phosphorus, potassium, and sulfur to investigate the cause of recurring algal blooms in the TTF (unpublished data obtained from K. Eppers, Environmental Manager, Coeur Alaska, Inc., Juneau). Sample sites included the TTF, upstream of the TTF at the outlet of Upper Slate Lake,[a] the TTF water treatment plant effluent (Outfall 002), and downstream of Outfall 002 in East Fork Slate Creek[b]. During 2018, chlorophyll *a* concentrations in the TTF were similar to concentrations observed since 2013, and lower than observed 2011–2012. For the first time, phosphorus concentrations in the TTF and Upper Slate Lake were elevated during the year and greater than most concentrations observed at each site since 2013, and nitrite was detected in the TTF July–September. In the Outfall 002 effluent, ammonia, nitrate, potassium, and sulfur concentrations continued to be greater than in Upper Slate Lake. Organic carbon concentrations usually were greater in Upper Slate Lake, as in previous years.

The July 2018 mean chlorophyll *a* density among periphyton samples collected at each site was similar to mean densities observed since 2011. We also sampled periphyton in Lower Slate Creek and East Fork Slate Creek in early May to continue monitoring for changes that may occur from the TTF and found similar mean chlorophyll *a* densities compared to previous spring sampling results at each site.[c,d]

The spring 2018 mean benthic macroinvertebrate density at each site was lower than previous years, except at East Fork Slate Creek and Upper Johnson Creek where we observed similar mean densities.[e] While the 2018 mean benthic macroinvertebrate density at each Lower Sherman Creek sample site remained lower than most previous years, we observed the greatest proportions of insects classified under the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT) since 2011.

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[a] Coeur's water quality monitoring station MLA, upstream of mine development and operations.

[b] Coeur's water quality monitoring station SLA.

[c] Not required.

[d] Greg Albrecht, Habitat Biologist, to Kate Kanouse, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: 2018 Kensington Gold Mine periphyton trip report amended; dated 2/12/2019. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

[e] Greg Albrecht, Habitat Biologist, to Kate Kanouse, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: 2018 Kensington Gold Mine BMI trip report amended; dated 2/12/2019. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

Beginning in winter 2013/2014, Coeur staff observed a white substance occasionally present on the Sherman Creek streambed below Outfall 001, which persisted September 2014–May 2017 and occasionally thereafter. We have worked with Coeur and ADEC staffs to investigate the cause and extent of the white substance, and in spring 2015, 2016, and 2018 we sampled benthic macroinvertebrates upstream and downstream of Outfall 001 to document abundance and community composition. Compared to the 2015 and 2016 sample results, in 2018 we observed a lower mean benthic macroinvertebrate density and similar or greater proportions of EPT insects at each site.[f] Among the samples collected at Lower Sherman Creek Sample Point 1, we observed a similar mean density as in 2011 and 2017.

We observed weak pink salmon *Oncorhynchus gorbuscha* returns in the lower reaches of Slate, Johnson, and Sherman Creeks in 2018, consistent with weak parent year returns in 2016.[g] We counted the fewest adult salmon in Lower Slate Creek, where low stream flows throughout the spawning season limited fish passage. We cannot quantify marine survival factors influencing adult salmon returns, so we are unable to attribute changes in adult salmon abundance to construction or operation of the Kensington Gold Mine.

The geometric mean particle size of pink salmon spawning gravel in Lower Slate Creek has increased by several millimeters at both sample sites since we began sampling in 2011.[h]

Most element concentrations in the 2018 sediment samples were within the ranges observed at each site since 2011.[i] Of note, we observed greater arsenic concentrations in East Fork Slate Creek, Upper Slate Creek, and Lower Johnson Creek compared to previous years at each site. Arsenic, copper, nickel, and zinc concentrations at all sampling sites remain near or above the guidelines for freshwater sediments (Buchman 2008), including the upstream reference site in Upper Slate Creek. In addition, cadmium concentration was above the guideline in East Fork Slate Creek and chromium concentration was above the guideline in Upper Slate Creek, as in previous years. While we find sediment guidelines useful for evaluating the sample data, we recognize organisms may respond differently in nature.

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[f] Greg Albrecht, Habitat Biologist, to Kate Kanouse, Acting Regional Supervisor, ADF&G Division of Habitat. Memorandum: 2018 Kensington Gold Mine Sherman Creek trip report; dated 1/15/2019. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

[g] Greg Albrecht, Habitat Biologist, to Kate Kanouse, Acting Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: 2018 Kensington Gold Mine adult salmon counts; dated 1/15/2019. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

[h] Johnny Zutz, Habitat Biologist, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: 2018 Kensington Gold Mine Slate Creek spawning substrate; dated 11/7/2018. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

[i] Johnny Zutz, Habitat Biologist, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: 2018 Kensington Gold Mine sediment sampling trip report; dated 11/14/2018. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

INTRODUCTION

The Kensington Gold Mine is located near Berners Bay in Southeast Alaska (Figure 1), about 72 km north of Juneau and 56 km south of Haines within the City and Borough of Juneau and the Tongass National Forest (Tetra Tech Inc. et al. 2004a, 2004b). The mine is owned and operated by Coeur Alaska, Inc., a wholly owned subsidiary of Coeur Mining Inc.

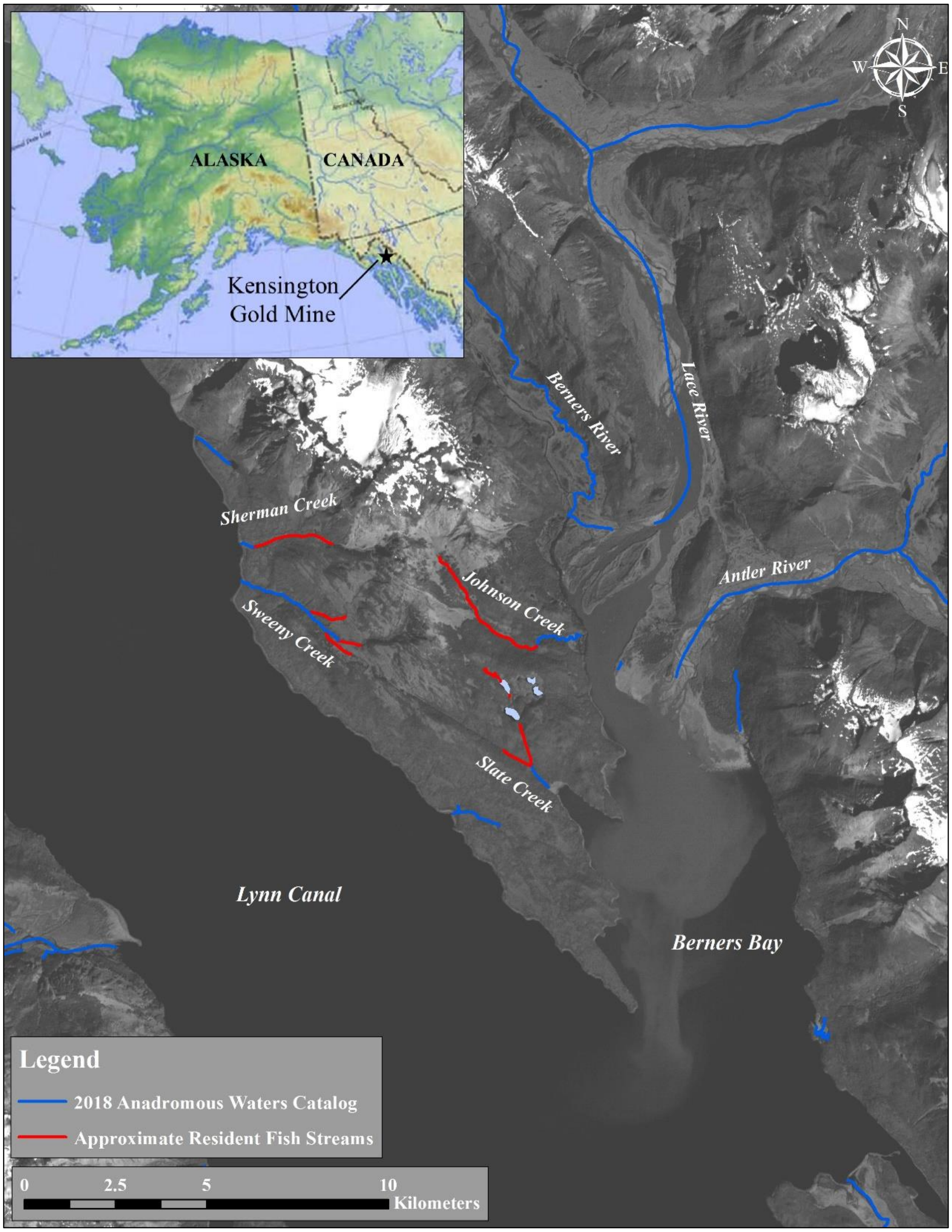

Figure 1.–Kensington Gold Mine project area map.

The underground mine began producing gold concentrate for export on June 24, 2010. Tailings are disposed underground as paste backfill and in the TTF as slurry through a pipeline from the mill. Mine infrastructure is located in three drainages that support resident and anadromous fish: the TTF and water treatment plant in the Slate Creek drainage; the waste rock pile, camp, and mill facilities in the Johnson Creek drainage; and the waste rock pile and mine water treatment plant in the Sherman Creek drainage.

Contractors gathered aquatic data for the Kensington Gold Mine from the late 1980s through 2005, which provided a basis for Division of Habitat permit decisions, Plan of Operations monitoring requirements (Coeur 2005), the U.S. Environmental Protection Agency (USEPA) National Pollutant Elimination Discharge System Permit No. AK-005057-1, and the ADEC Alaska Pollutant Elimination System (APDES) Permit No. AK0050571.[j] Monitoring reports during project development and operations are in Aquatic Science Inc. (2006, 2007, 2008, 2009a, 2009b, 2009c, 2009d, 2011), Timothy and Kanouse (2012, 2013, 2014), Kanouse (2015), Brewster (2016), Kanouse and Zutz (2017), and Zutz (2018). Results of the TTF environmental monitoring studies completed during project operation are in Willson-Naranjo and Kanouse (2016), and results of fish and fish habitat investigations in the Slate and Spectacle Lakes drainages are in Albrecht (2018).

The Division of Habitat has completed the aquatic studies required for the Kensington Gold Mine in Slate, Johnson, and Sherman Creeks since 2011. The APDES Permit requires sampling periphyton, benthic macroinvertebrates (BMI), and sediment. We assess stream health using estimates of chlorophyll density and composition, BMI density and community composition, pink salmon spawning substrate composition, and sediment element concentrations. The Division of Habitat also completes the adult salmon counts required in the project Plan of Operations (Coeur 2005).

PURPOSE

This technical report summarizes the 2018 aquatic study data and documents the condition of biological communities and sediments in Slate, Johnson, and Sherman Creeks near mine development and operations. This report satisfies the aquatic study requirements in the project Plan of Operations (Coeur 2005) and APDES Permit AK0050571.

AQUATIC STUDIES

We completed the Kensington Gold Mine aquatic studies required in the project Plan of Operations (Coeur 2005) and APDES Permit AK0050571 (Table 1).

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[j] Contractor reports are listed in Zutz (2018).

Table 1.–2018 aquatic studies required by the Plan of Operations and APDES permit.

Location	Description	Aquatic Study	Frequency
Lower Slate Creek	1 km reach between the stream mouth in Slate Cove and a 25 m waterfall.	Chlorophyll density and composition	1/year
		Benthic macroinvertebrate density and composition	1/year
		Adult salmon counts	Seasonally
		Spawning substrate composition	1/year
		Sediment composition and element concentrations	1/year
West Fork Slate Creek	A tributary to Lower Slate Creek, upstream of a waterfall and mine influence.	Chlorophyll density and composition	1/year
		Benthic macroinvertebrate density and composition	1/year
East Fork Slate Creek	A tributary to Lower Slate Creek, 1 km reach between the TTF plunge pool and waterfall at Lower Slate Creek.	Chlorophyll density and composition	1/year
		Benthic macroinvertebrate density and composition	1/year
		Sediment composition and element concentrations	1/year
Upper Slate Creek	A tributary to Upper Slate Lake and upstream of mine influence.	Chlorophyll density and composition	1/year
		Benthic macroinvertebrate density and composition	1/year
		Sediment composition and element concentrations	1/year
Lower Johnson Creek	1.5 km reach between the stream mouth in Berners Bay and a 30 m waterfall.	Adult salmon counts	Seasonally
		Sediment composition and element concentrations	1/year
Upper Johnson Creek	Upstream of Bridge #2 to the headwaters, adjacent to the upper camp and mill bench.	Benthic macroinvertebrate density and composition	1/year
Lower Sherman Creek	360 m reach between the stream mouth in Lynn Canal and a 15 m waterfall.	Chlorophyll density and composition	1/year
		Benthic macroinvertebrate density and composition	1/year
		Adult salmon counts	Seasonally
		Sediment composition and element concentrations	1/year

STUDY AREA

Slate Creek Drainage

Slate Creek drains a 10.5 km^2 watershed into Slate Cove on the northwest side of Berners Bay (Coeur 2005; Figure 2). Two waterfalls at the confluence of East and West Forks, about 1 km upstream of the mouth of Lower Slate Creek, prevent upstream fish migration. East Fork Slate Creek flows between the TTF dam plunge pool and the waterfall at Lower Slate Creek. Coeur operates the TTF in Lower Slate Lake and discharges TTF water treatment plant effluent (Outfall 002)[k] to East Fork Slate Creek. Upstream of the TTF, a concrete dam diverts water from Upper Slate Lake through a diversion pipeline and into East Fork Slate Creek at the TTF dam plunge pool, bypassing the TTF. Upper Slate Creek is the inlet to Upper Slate Lake.

[k] Outfall 002 began discharging to East Fork Slate Creek in December 2010.

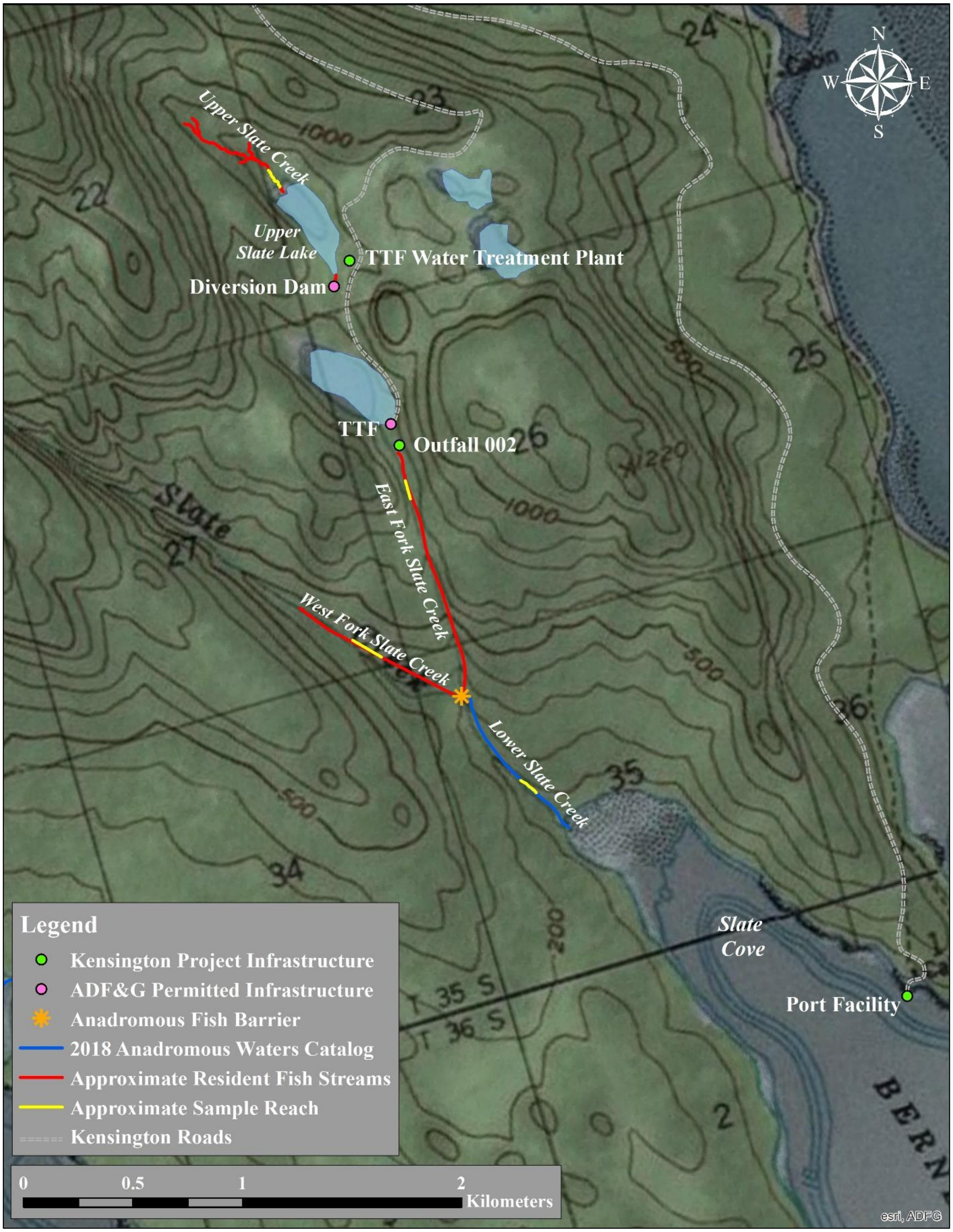

Figure 2.–Slate Creek map.

Lower Slate Creek

Lower Slate Creek provides spawning habitat for chum *O. keta*, coho *O. kisutch*, and pink salmon, and eulachon *Thaleichthys pacificus*, and rearing habitat for coho salmon (Stream No. 115-20-10030; Johnson and Blossom 2018). We also have documented juvenile Dolly Varden char *Salvelinus malma* and adult cutthroat trout *O. clarkii* in the system (Timothy and Kanouse 2012).

Lower Slate Creek is a mixture of water from the East and West Forks, Outfall 002, and Upper Slate Lake. We sample periphyton, BMIs, pink salmon spawning substrate, and sediment at Sample Point 1 (SP1; Figure 3) and pink salmon spawning substrate at Sample Point 2 (SP2; Figure 4), both a moderate gradient (2–6%) mixed control channel type (Paustian 2010), and count adult salmon throughout Lower Slate Creek.

Figure 3.– Lower Slate Creek at SP1.

Figure 4.–Lower Slate Creek at SP2.

West Fork Slate Creek

West Fork Slate Creek (Figure 5) provides habitat for Dolly Varden char (Timothy and Kanouse 2014) and is not influenced by the mine. We sample periphyton and BMIs about 600 m upstream of the waterfall at Lower Slate Creek in a cobble-dominated moderate gradient mixed control channel (Paustian 2010).

Figure 5.–West Fork Slate Creek.

East Fork Slate Creek

East Fork Slate Creek (Figure 6) provides rearing habitat and a corridor for Dolly Varden char and threespine stickleback *Gasterosteus aculeatus* (Kanouse and Zutz 2017) emigrating from Upper Slate Lake, currently via the diversion pipeline and formerly via Lower Slate Lake. East Fork Slate Creek is a mixture of discharge from Outfall 002 and tannic Upper Slate Lake water. We sample periphyton, BMIs, and sediments in East Fork Slate Creek within 200 m downstream of the TTF in a moderate gradient bedrock contained channel (Paustian 2010) where angular cobble substrate is dominant.

Figure 6.–East Fork Slate Creek.

Upper Slate Creek

Upper Slate Creek (Figure 7) provides habitat for Dolly Varden char (Albrecht 2018) and is not influenced by the mine. We sample periphyton, BMIs, and sediments in Upper Slate Creek within 75 m of Upper Slate Lake in a moderate gradient mixed control channel (Paustian 2010).

Figure 7.–Upper Slate Creek.

Johnson Creek Drainage

Johnson Creek drains a 14.6 km^2 watershed to the Lace River on the northwest shore of Berners Bay (Coeur 2005; Figure 8). A 30 m waterfall about 1.5 km upstream of the Lower Johnson Creek mouth prevents upstream fish migration. Middle Johnson Creek is the 2.5 km reach between the waterfall and Jualin Road Bridge #2. Upper Johnson Creek is the reach upstream of Jualin Road Bridge #2 to the headwaters.

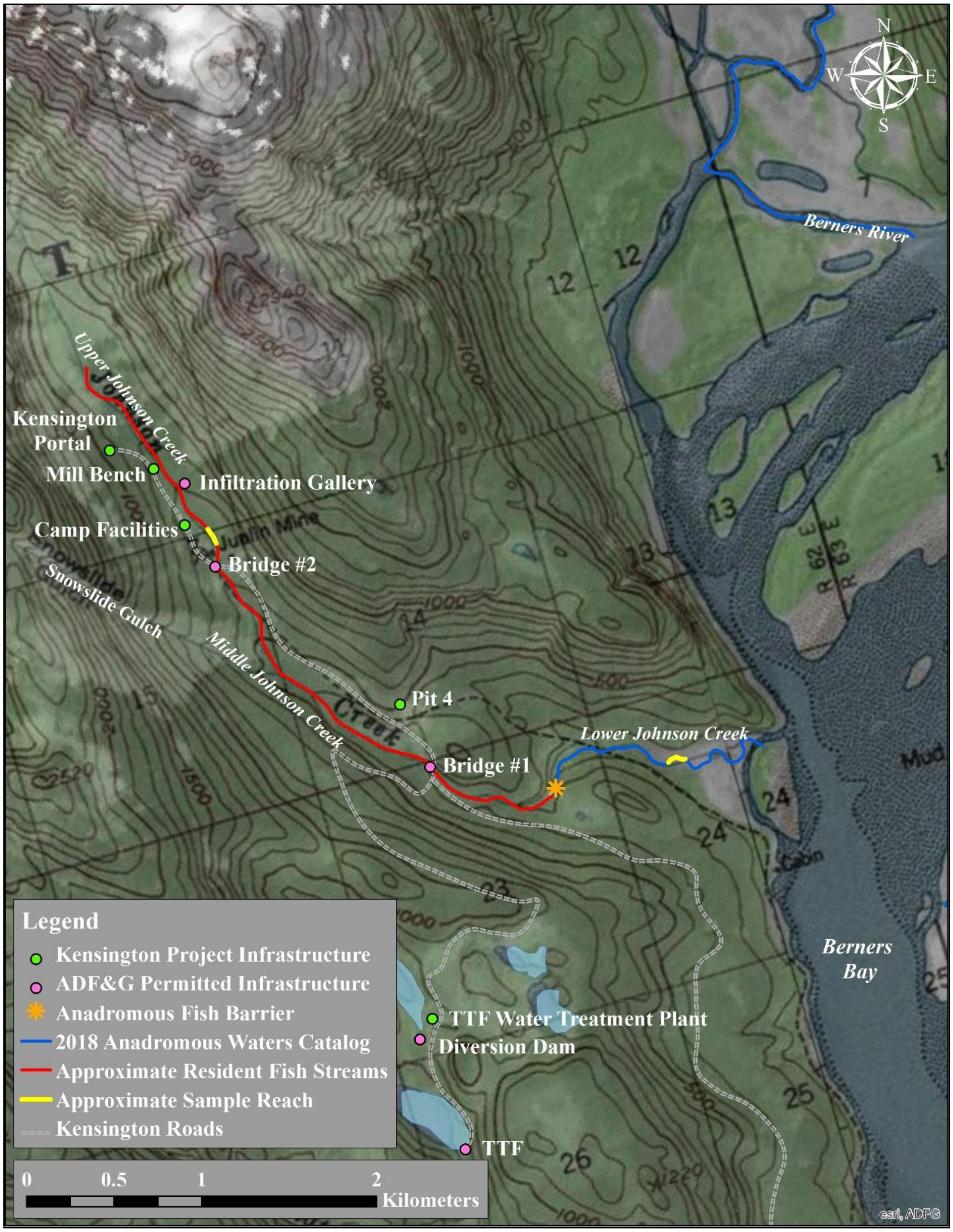

Figure 8.–Johnson Creek map.

Lower Johnson Creek

Lower Johnson Creek provides spawning habitat for chum, coho, and pink salmon, and rearing habitat for coho salmon (Stream No. 115-20-10030; Johnson and Blossom 2018). We also have documented Dolly Varden char and cutthroat trout in the system (Timothy and Kanouse 2012).

Lower Johnson Creek is a mixture of drainages near and from mine infrastructure in Middle[1] and Upper Johnson Creeks. We sample sediment about 600 m upstream from the mouth in a moderate width low gradient (less than 2%) floodplain channel (Paustian 2010) and count adult salmon throughout Lower Johnson Creek (Figure 9).

Figure 9.–Aerial view of Lower Johnson Creek.

Upper Johnson Creek

Upper Johnson Creek provides habitat for Dolly Varden char (Timothy and Kanouse 2012) and flows adjacent to the camp facilities, mill bench, Kensington and Jualin adits, and the waste rock pile. Water is collected through an infiltration gallery in Upper Johnson Creek near the mill bench to support the camp. We sample BMIs about 50 m upstream of Jualin Road Bridge #2 (Figure 10) where the stream is a medium width mixed control channel (Paustian 2010) with boulder and cobble substrate.

Figure 10.–Upper Johnson Creek.

[1] Mine facilities include the domestic wastewater treatment plant, warehouse, reclamation material and acid-generating rock storage piles, bridges, and Pit 4; drainages include Snowslide Gulch, the domestic wastewater outfall, and storm water discharges; aquatic studies are not required in Middle Johnson Creek.

Sherman Creek Drainage

Sherman Creek drains a 10.84 km^2 watershed to the east shore of Lynn Canal (Coeur 2005; Figure 11). A 15 m waterfall about 360 m upstream from the Lower Sherman Creek mouth prevents upstream fish migration. Middle Sherman Creek is the 2 km reach between the waterfall and the Comet Beach Road bridge. Upper Sherman Creek is the reach upstream of the bridge to the headwaters.

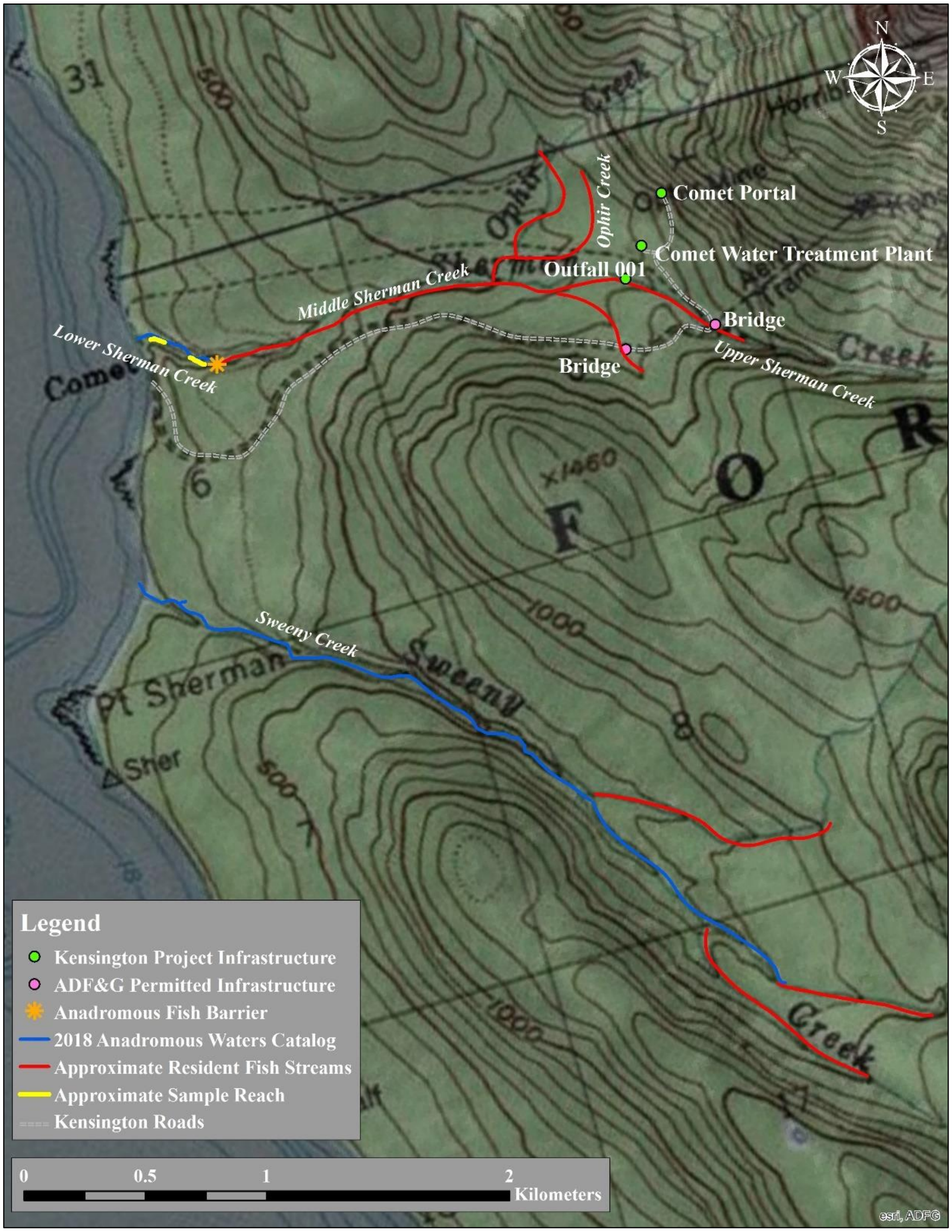

Figure 11.–Sherman Creek map.

Lower Sherman Creek

Lower Sherman Creek provides spawning habitat for chum and pink salmon (Stream No. 115-31-10330; Johnson and Blossom 2018). We also have documented juvenile Dolly Varden char in the system (Timothy and Kanouse 2012). Lower Sherman Creek is a mixture of drainages near and from mine infrastructure in Middle Sherman Creek[m] and its tributaries. We sample periphyton, BMIs, and sediment in a moderate gradient medium width mixed control channel (Paustian 2010) at Sample Point 1 (SP1; Figure 12), periphyton and BMIs at Sample Point 2, a similar channel type (SP2; Figure 13), and count adult salmon throughout Lower Sherman Creek to the barrier falls (Figure 14).

Figure 12. Lower Sherman Creek at SP1.

Figure 13.–Lower Sherman Creek at SP2.

[m] Mine facilities include the Comet water treatment plant, waste rock pile, bridges and culverts; drainages include Ivanhoe Creek, Ophir Creek, South Fork Sherman Creek, and Comet water treatment plant Outfall 001; aquatic studies are not required in Middle or Upper Sherman Creeks.

Figure 14.–Lower Sherman Creek barrier falls.

Sampling Locations

Table 2 presents the coordinates for each sample site, and Tables 3–5 present the coordinates for adult salmon count reach markers in Lower Slate Creek, Lower Johnson Creek, and Lower Sherman Creek.

Table 2.–2018 aquatic study sample sites.

Location	Sample Site	Latitude	Longitude
Lower Slate Creek	Periphyton and benthic macroinvertebrates	58.7905	-135.0345
	Adult salmon counts	Table 3	
	Spawning substrate		
	Sample Point 1	58.7905	-135.0345
	Sample Point 2	58.7920	-135.0360
	Sediment composition and element concentrations	58.7905	-135.0345
West Fork Slate Creek	Periphyton and benthic macroinvertebrates	58.7993	-135.0457
East Fork Slate Creek	Periphyton and benthic macroinvertebrates	58.8045	-135.0381
	Sediment composition and element concentrations	58.8053	-135.0383
Upper Slate Creek	Periphyton and benthic macroinvertebrates	58.8189	-135.0415
	Sediment composition and element concentrations	58.8189	-135.0416
Lower Johnson Creek	Adult salmon counts	Table 4	
	Sediment composition and element concentrations	58.8235	-135.0024
Upper Johnson Creek	Benthic macroinvertebrates	58.8407	-135.0450
Lower Sherman Creek	Periphyton and benthic macroinvertebrates		
	Sample Point 1	58.8687	-135.1415
	Sample Point 2	58.8674	-135.1381
	Adult salmon counts	Table 5	
	Sediment composition and element concentrations	58.8687	-135.1413

Note: Coordinates in WGS84 datum.

Table 3.–Lower Slate Creek adult salmon count reach markers.

Location	Latitude	Longitude
100 m	58.7884	-135.0324
200 m	58.7893	-135.0337
300 m	58.7905	-135.0349
400 m	58.7915	-135.0359
500 m	58.7922	-135.0361
600 m	58.7930	-135.0368
700 m	58.7936	-135.0379
800 m	58.7944	-135.0384
900 m	58.7953	-135.0385
Falls	58.7964	-135.0389

Table 4.–Lower Johnson Creek adult salmon count reach markers.

Location	Latitude	Longitude
Lace	58.8215	-135.0010
Mouth	58.8236	-134.9987
Trap	58.8235	-135.0007
#4	58.8236	-135.0039
#7	58.8243	-135.0072
#10	58.8254	-135.0109
Power House	58.8259	-135.0148
Log Falls	58.8258	-135.0168
#15	58.8252	-135.0190
Falls	58.8243	-135.0201

Table 5.–Lower Sherman Creek adult salmon count reach markers.

Location	Latitude	Longitude
50 m	58.8687	-135.1416
100 m	58.8687	-135.1408
150 m	58.8684	-135.1401
200 m	58.8682	-135.1394
250 m	58.8679	-135.1388
300 m	58.8675	-135.1383
350 m	58.8673	-135.1374
Falls	58.8671	-135.1367

Sampling Schedule

Table 6 presents the dates we collected data in 2018 by site.

Table 6.–2018 aquatic studies sampling schedule.

Aquatic Study	Lower Slate	West Fork Slate	East Fork Slate	Upper Slate	Lower Johnson	Upper Johnson	Lower Sherman	Middle Sherman
Periphyton	5/3	---	5/3	---	---	---	---	---
	8/7	7/25	7/24	7/25	---	---	7/24	---
Benthic macroinvertebrates	5/3	5/3	5/3	5/2	---	5/4	5/2	5/2
Adult salmon counts	7/25–	---	---	---	7/24–	---	7/24–	---
	10/29	---	---	---	10/29	---	8/24	---
Spawning substrate	6/28	---	---	---	---	---	---	---
Sediment element concentrations	6/28	---	6/29	6/28	6/29	---	6/29	---

Note: Gray highlighted cells indicate the sampling was not required by the APDES permit or Plan of Operations.

METHODS

We annually review data sets to ensure accuracy and consistency with methods modifications, and report corrections and updates 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.

Periphyton: Chlorophyll Density and Composition

Requirement APDES 1.5.3.5.2

Periphyton is composed of primary producing organisms such as algae, cyanobacteria, heterotrophic microbes, and detritus, attached to the submerged surfaces of aquatic ecosystems. Algal density and community structure are influenced by water and sediment quality through physical, chemical, and biological disturbances that change throughout the year (Barbour et al. 1999). 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*) estimate the composition of algal organisms present, such as green algae that produce chlorophyll *b*, and diatoms and brown algae that produce chlorophyll *c*.

The APDES permit requires monitoring periphyton chlorophyll density and composition in Lower Slate Creek, East Fork Slate Creek, and Lower Sherman Creek annually between late-June and early-August and not within three weeks following peak discharge to detect changes over time. The APDES permit also requires monitoring at reference sites in West Fork Slate Creek and Upper Slate Creek at the same time to detect variations due to natural factors, such as mineral seeps, climate, and stream flow.

Sample Collection and Analysis

We collected 10 smooth, flat, undisturbed, and perennially wetted rocks from submerged cobble in riffle habitats in less than 0.45 m water depth at each sample site and submerged the rocks with the sample area facing up. We held a 5 × 5 cm square of high-density foam on the sample area and scrubbed around the foam with a toothbrush to remove algae and other organisms outside the sample area, then rinsed the rock by dipping it in the stream while holding the foam in place. We also rinsed the toothbrush in the stream.

We placed a 47 mm diameter Type A/E 1 µm glass fiber filter into a Nalgene® filter holder attached to a vacuum pump with a gauge, then removed the foam square and scrubbed the underside of the foam and the sample area with the toothbrush into the filter holder. We used stream water in a wash bottle to rinse the loosened periphyton from the foam, rock, toothbrush, and the inside of the filter holder onto the filter. We scrubbed the sample area a second time and repeated the rinse cycle. We pumped most of the water through the filter, maintaining pressure less than 34 kPa, and added a few drops[n] of saturated magnesium carbonate solution ($MgCO_3$) to the filter[o] before pumping the sample dry. We removed the glass fiber filter, folded it in half with the sample on the inside, and wrapped it in a white coffee filter to absorb additional water. We placed the samples in a sealed, labeled plastic bag with desiccant and stored the samples in a light-

[n] 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. We used supernatant solution to avoid $MgCO_3$ solids.

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

proof cooler containing frozen icepacks during transportation, in a camp freezer while onsite, and in a –20 °C ADF&G Douglas laboratory freezer until processing.

We followed USEPA (1997) protocol for chlorophyll extraction and measurement, determining instrument and estimated detection limits, and data analysis.[p] We removed the samples from the freezer, cut them into small pieces, and placed the filter pieces for each sample into individual 15 mL screw cap centrifuge tubes containing 10 mL of 90% buffered acetone. We capped the centrifuge tubes and shook each tube vigorously to submerge the filter pieces, placed them in a rack, covered them with aluminum foil, and stored them in a refrigerator overnight to extract the chlorophyll.[q]

The following day, we centrifuged the samples for 20 min at 363 rcf, individually decanted the supernatant into a cuvette, and measured each sample absorbance at wavelengths 664 nm, 647 nm, 630 nm, and 750 nm using a Shimadzu UV-1800 Spectrophotometer. We used 90% buffered acetone to correct for absorbance of the solvent. We treated each sample with 80 µL of 0.1 N hydrochloric acid to convert the chlorophyll to phaeophytin, and measured absorbance at wavelengths 665 nm and 750 nm.

We used trichromatic equations to estimate Chl-*a*, Chl-*b*, and Chl-*c* concentrations, and corrected Chl-*a* concentrations when phaeophytin was detected. When Chl-*a* was not detected in a sample, we report the concentration at the spectrophotometer estimated detection limit and do not report values for Chl-*b* or Chl-*c*. The 2018 estimated detection limit for Chl-*a* concentration was 0.19 mg/m^2.

Data Presentation

For each site and by year, we present mean Chl-*a*, Chl-*b*, and Chl-*c* densities in a table, Chl-*a* densities in a figure, and mean proportions of Chl-*a*, Chl-*b*, and Chl-*c* in a figure. We provide the 2011–2018 data in Appendix A. Periphyton sampling during April is not required by the APDES permit or Plan of Operations, and we include the annual data in Appendix A.

BENTHIC MACROINVERTEBRATE DENSITY AND COMMUNITY COMPOSITION

Requirement APDES 1.5.3.2

BMIs 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 on periphyton and other macroinvertebrates, and provide a food source for fish.

The APDES permit requires monitoring BMI density and community composition in Lower Slate Creek, East Fork Slate Creek, Upper Johnson Creek, and Lower Sherman Creek annually between late-March and late-May after spring breakup and before peak snowmelt to detect changes over time. The APDES permit also requires monitoring at reference sites in West Fork Slate Creek and Upper Slate Creek at the same time to detect variations due to natural factors.

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[p] Except we stored the samples longer than 3.5 weeks, we centrifuged the samples at 363 relative centrifugal force (rcf) rather than 500 rcf, and we cut the sample filters, rather than homogenize them, to reduce acetone exposure for laboratory staff.

[q] We allowed samples to steep for at least 12 h and not more than 24 h.

Sample Collection and Analysis

We opportunistically collected 6 BMI samples from each site using a Surber stream bottom sampler in riffles and runs with cobble substrate and different flow velocities—habitats that support greater BMI densities and taxonomic richness (Barbour et al. 1999). We do not sample other habitat types (e.g. pools) to reduce variability of the data.

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 0.3 mm mesh net. After securing the frame on the substrate, we scrubbed rocks within the sample area with a brush and disturbed gravels, sand, and silt to about 10 cm depth to dislodge macroinvertebrates into the net. We rinsed the net in the stream to ensure all organisms floated into the cod end, transferred each sample from the cod end to labeled 500 mL plastic bottles, and preserved the samples in 95% ethanol at a ratio of three parts ethanol to one part sample. We discarded samples when sediment overfilled the cod end.

Contractor Matt Kern of Alder Grove Farm used an elutriator system and 0.5 mm and 0.3 mm sieves to sort macroinvertebrates from debris,[r,s] and identified organisms to the lowest practical taxonomic level[t] using Merritt and Cummins (1996) and Stewart and Oswood (2006). Habitat Biologists provided quality control by verifying macroinvertebrate identification of 5 samples.

We calculated BMI density (per m^2) for each sample by dividing the number of macroinvertebrates by 0.093 m^2, the Surber sampling area. We estimated mean BMI density for each site by calculating the mean density among the 6 samples. We report taxa richness as the number of taxonomic groups identified to the lowest practical level, and exclude terrestrial[u] organisms from all calculations.

Shannon Diversity (*H*) and Evenness (*E*) Indices provide measures of taxonomic diversity and abundance equality. We calculate these indices using the following equations given in Magurran (1988):

$$H = -\sum_{i=1}^{S} (P_i \ \log_{10} P_i)$$

and

$$E = \frac{H}{\log_{10} S},$$

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[r] 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 Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

[s] Katrina Lee, Administrative Assistant, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: Benthic macroinvertebrate sample enumeration procedures; dated 6/28/2016. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

[t] Insects of the orders Ephemeroptera, Plecoptera, Trichoptera, and Diptera to genus, except nonbiting midges to family Chironomidae, and all others to class or order.

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

where P_i is the number of macroinvertebrates per taxonomic group divided by the total number of macroinvertebrates in the sample, and S is the number of taxonomic groups in the sample.[v] A single taxa macroinvertebrate community has an H value of 0, which increases with the number of taxa (richness) and abundance equality (evenness). The Evenness calculation normalizes the H value to a number between 0 and 1, with an E value of 1 indicating all taxa are equally abundant.

Data Presentation

For each site and by year, we present a table summarizing mean BMI density, total taxa, total EPT taxa, percent EPT, and mean Shannon Diversity and Evenness scores, and illustrate mean densities in a figure. Appendix B includes the 2011–2018 data summaries.

Adult Salmon Counts

Requirement Plan of Operations

The Plan of Operations (Coeur 2005) requires weekly surveys of adult chum, coho, and pink salmon in Lower Slate Creek, Lower Johnson Creek, and Lower Sherman Creek throughout the spawning season.

Sample Collection

We surveyed Slate Creek, Johnson Creek, and Sherman Creek downstream of fish migration barriers once per week between mid-July and late-August and counted the number of adult pink salmon, chum salmon, and carcasses. We surveyed Slate and Sherman Creeks by foot and Johnson Creek by helicopter. We also surveyed Slate and Johnson Creeks by foot once per week from late-September through October to count the number of adult coho salmon and carcasses. To improve coho salmon observations, we snorkeled and recorded underwater videos with a GoPro in large pools and around large woody debris, habitats where adult coho salmon tend to concentrate.

We began each survey at the stream mouth, moving upstream by section and ending at the fish migration barrier. Slate Creek is sectioned in 100 m reaches, Johnson Creek by landmarks, and Sherman Creek in 50 m reaches. A team of two biologists independently recorded the number of live fish and carcasses by species in each section during the foot and aerial surveys, using polarized glasses as necessary to improve visibility. We also recorded weather and flow conditions during each survey.

We used the average of the two biologists' counts to estimate the total number of fish by species for each reach and survey, and rounded down all intermediate numbers to whole numbers in the calculations.

Data Presentation

For each site, we present figures of the weekly adult pink salmon count and pink salmon distribution, and provide the 2011–2018 counts by species in a table. Incomplete surveys are identified in the figures in bold. The 2018 data and 2011–2018 pink salmon counts by statistical week are in Appendix C.

Spawning Substrate Composition

Requirement APDES 1.5.3.5.1

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[v] Assuming all taxonomic groups are represented.

The APDES permit requires annually sampling pink salmon spawning substrate during early-July at Lower Slate Creek SP1 and SP2 to detect change in composition over time. We calculate the geometric mean particle size, an index of substrate textural composition, for each sample and among samples collected at each site each year.

Sample Collection

We collected four sediment samples at two locations in Lower Slate Creek using a McNeil sampler, which has a 15 cm basal core diameter and 25 cm core depth. We selected sample sites with substrate measuring less than 10 cm, the maximum gravel size used by pink salmon (Lotspeich and Everest 1981, Kondolf and Wolman 1993), and where the stream gradient was less than 3% (Valentine, B. E. 2001. Unpublished. Stream substrate quality for salmonids: Guidelines for Sampling, Processing, and Analysis. California Department of Forestry and Fire Protection, Coast Cascade Regional Office, Santa Rosa, CA). We pushed the McNeil sampler into the substrate until the sample core was buried, then transferred the sediments to a bucket. We wet-sieved samples onsite using sieve sizes 101.6, 50.8, 25.4, 12.7, 6.35, 1.68, 0.42, and 0.15 mm and measured the contents of each sieve to the nearest 25 mL by the volume of water displaced in 600 mL and 1 L plastic beakers.[w] We transferred the fines that passed through the 0.15 mm sieve to Imhoff cones, allowed 10 min settling time, and measured the sediment volume to the nearest 1 mL using the Imhoff cone gradations.

For the fines that pass through the 0.15 mm sieve, we converted sediment wet weights to dry weights using standards identified by Zollinger (1981). For all other sediments, we converted wet weights to dry weights using a correction factor derived from Shirazi et al. (1981), assuming a gravel density of 2.6 g/cm^3 (Aquatic Science Inc. 2011). We calculated the geometric mean particle size (d_g) using methods developed by Lotspeich and Everest (1981), where the midpoint diameter of particles retained in each sieve (d) are raised to a power equal to the decimal fraction of volume retained by that sieve (w), and multiplied the products of each sieve size to obtain the final product,

$$d_g = d_1^{w1} \times d_2^{w2} \times d_3^{w3} \ldots d_n^{wn}$$

Data Presentation

We present a table of the geometric mean particle sizes (GMPS) for the 2011–2018 data at each site. The 2011–2018 data are in Appendix D.

Sediment Composition and Element Concentrations

Requirement APDES 1.5.2

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 benthic aquatic productivity, and heavy metals in sediments can decrease BMI taxa richness and change the composition of BMI communities (Qu et al. 2010).

The APDES permit requires annually sampling fine sediments in Lower Slate Creek, East Fork Slate Creek, Upper Slate Creek, Lower Johnson Creek, and Lower Sherman Creek for particle size, total solids, total volatile solids, total sulfide, total organic carbon, and total concentrations

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[w] Except we measure the contents of the 0.15 mm sieve to the nearest 1 mL using an Imhoff cone.

of silver (Ag), aluminum (Al), arsenic (As) cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), selenium (Se), and zinc (Zn).

Sample Collection and Analysis

Wearing latex gloves, we opportunistically collected submerged sand and silt at each site within actively flowing channels and retained the top 4 cm of sediment in three glass jars provided by the laboratory.[x] We stored the samples in a cooler with frozen icepacks during transport and in an ADF&G Douglas laboratory fridge until we shipped them to the ALS Environmental laboratory in Kelso, WA for analyses.

We shipped the samples in a cooler with frozen icepacks via overnight air freight, and maintained written chain of custody documentation. ALS Environmental measured particle size, total solids, total volatile solids, total sulfide, total organic carbon, and total concentrations of Ag, Al, As, Cd, Cr, Cu, Hg, nickel (Ni), Pb, Se, and Zn on a dry-weight basis using the methods listed in Table 7.[y] The laboratory provided Tier II quality assurance and quality control information, including results for matrix spikes, sample blanks, and sample duplicates.

Table 7.–Sediment tests, analytes, and methods.

Test Description	Analyte	Method
Standard test method for particle-size analysis of soils	Particle size determination	ASTM D422
Puget Sound Estuary Program sediment total organic carbon	Total organic carbon	PSEP TOC
Total solids on liquids, modified for solids	Total solids	160.3 Modified
Puget Sound Estuary Program sediment sulfide	Total sulfide	PSEP Sulfide
Total volatile solids, modified for solids	Total volatile solids	160.4 Modified
Mercury in solid or semisolid waste	Hg	7471B
Determination of trace elements in waters and wastes by ICP/MS	Ag, Al, As, Cd, Cr, Cu, Ni, Pb, Se, Zn	200.8

Data Presentation

We present two figures for each site, the 2018 sample concentrations and results by analyte for the 2011–2018 data.[z] We compare the 2011–2018 data in the second figure with the Screening Quick Reference Tables for inorganics in freshwater sediment guidelines compiled by the National Oceanic and Atmospheric Administration (Buchman 2008), specifically the threshold effects concentrations (TEC) and the probable effects concentrations (PEC). The guidelines are based on results of controlled laboratory bioassays, wherein 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. We provide the 2011–2018 sediment composition and element concentration data by site and the 2018 laboratory report in Appendix E.

[x] In 2015, we discontinued sieving sediments during collection to avoid washing contaminants from the sample.

[y] The AECOM Environmental Toxicology lab in Fort Collins, CO completed the 2011–2013 sediment sample analyses, and the ALS Environmental lab in Kelso, WA has completed the sediment sample analyses since 2014.

[z] When the laboratory provides duplicate sample results, we present the mean value.

RESULTS

SLATE CREEK

Lower Slate Creek

Periphyton: Chlorophyll Density and Composition

The 2018 Lower Slate Creek mean chlorophyll *a* density was 4.21 mg/m^2, within the range observed 2011–2017 (Table 8; Figure 15). Figure 16 presents the mean proportion of chlorophylls *a*, *b*, and *c* each year.

Table 8.–Lower Slate Creek mean chlorophylls *a*, *b*, and *c* densities.

	07/29/11	07/25/12	07/31/13	07/30/14	07/28/15	07/26/16	07/24/17	08/07/18
Chl-*a* (mg/m^2)	5.15	2.31	12.59	3.97	2.16	5.26	2.30	4.21
Chl-*b* (mg/m^2)	0.43	0.05	0.00	0.85	0.10	0.21	0.23	0.04
Chl-*c* (mg/m^2)	0.26	0.18	1.64	0.30	0.21	0.62	0.23	0.63

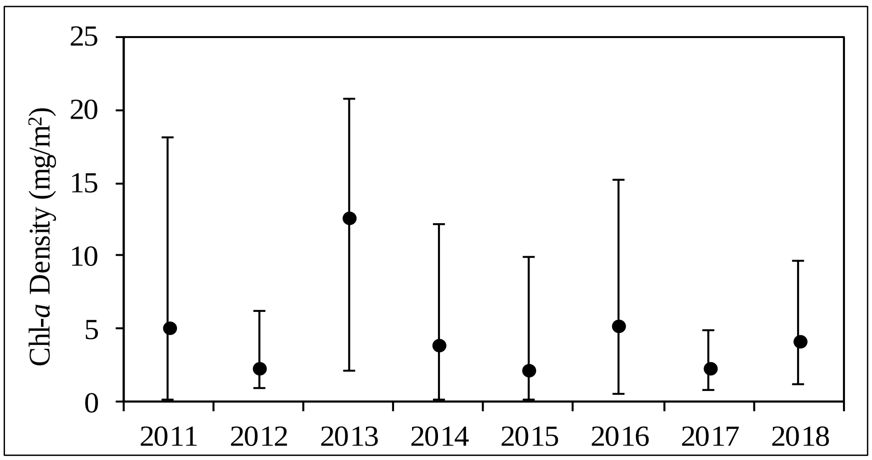

Figure 15.–Lower Slate Creek mean chlorophyll *a* densities.
Note: Minimum, mean, and maximum values presented.

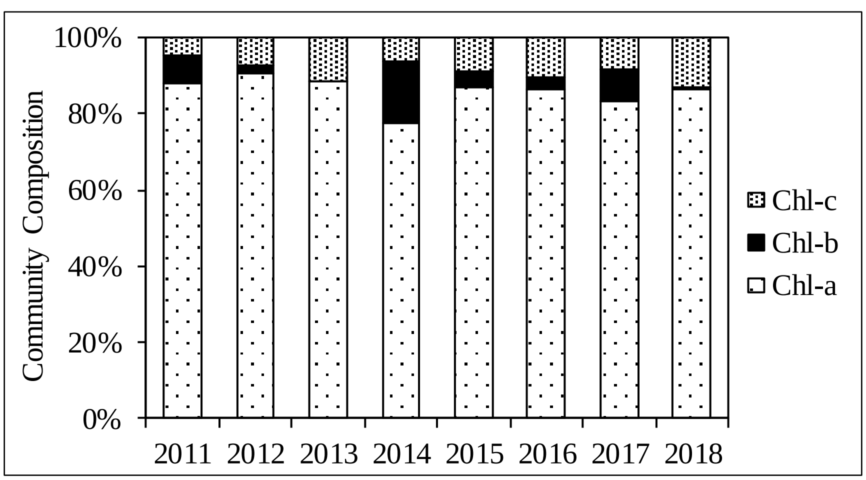

Figure 16.–Lower Slate Creek mean proportions of chlorophylls *a*, *b*, and *c*.

Benthic Macroinvertebrate Density and Community Composition

Among the 2018 Lower Slate Creek BMI samples, we identified 17 taxa and estimate mean density at 482 BMI/m^2, of which 45% were EPT insects; BMI mean density and taxa richness were lower than observed 2011–2017 (Table 9; Figure 17). The Shannon Diversity and Evenness scores were greater than most years due primarily to fewer Diptera (nonbiting midges) present. The dominant taxon was Clitellata: Oligochaeta (worms), representing 40% of the samples.

Table 9.–Lower Slate Creek BMI data summaries.

	05/04/11	05/02/12	04/30/13	04/30/14	04/27/15	04/26/16	04/25/17	05/03/18
Mean BMI density (per m^2)	2,057	3,154	2,581	4,136	3,407	3,394	1,308	482
Total BMI taxa	29	32	27	32	26	24	27	17
Number of EPT taxa	13	17	16	17	13	11	13	9
% EPT	14%	38%	51%	19%	24%	15%	50%	45%
Shannon Diversity score	0.51	0.69	0.85	0.64	0.70	0.65	0.81	0.81
Evenness score	0.48	0.58	0.70	0.52	0.58	0.57	0.73	0.84

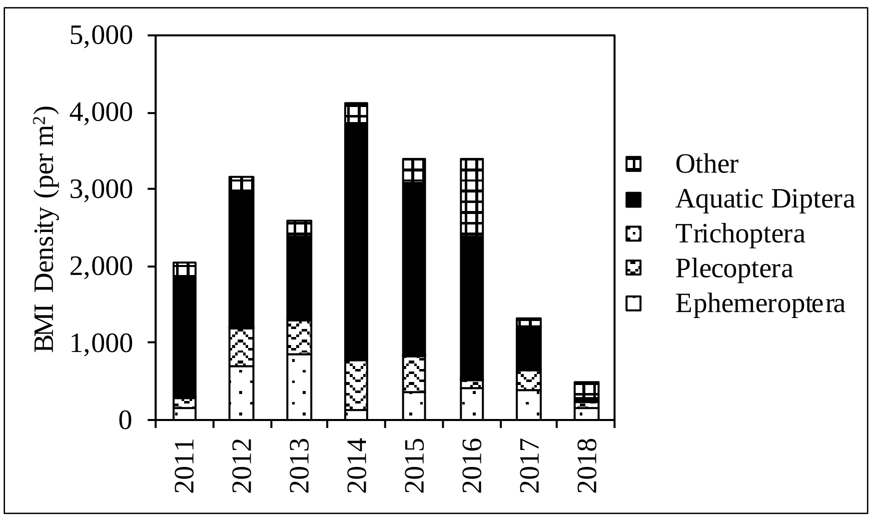

Figure 17.–Lower Slate Creek BMI mean densities and community compositions.

Adult Salmon Counts

We counted 4 pink salmon and 1 coho salmon in Lower Slate Creek during the 2018 spawning season (Table 10).[aa] Figure 18 shows pink salmon counts for each survey. The weekly distribution data for pink salmon by reach is in Appendix C.1.

Table 10.–Lower Slate Creek adult salmon counts.

	2011	2012	2013	2014	2015	2016	2017	2018
Pink salmon	6,254	7,272	3,337	41	7,580	79	7,416	4
Chum salmon	59	1	1	0	13	45	1	0
Coho salmon	0	0	26	5	0	2	5	1

[aa] We did not survey on July 31 due to low water preventing fish passage.

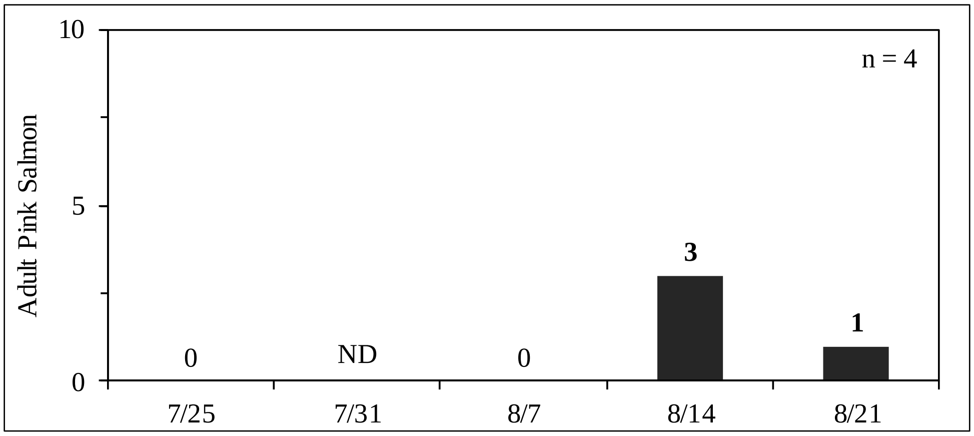

Figure 18.–2018 Lower Slate Creek weekly pink salmon count.
Note: Bold numbers indicate incomplete surveys.

Spawning Substrate Composition

Sample Points 1 and 2

The GMPS among samples collected at each Lower Slate Creek site was 14.5 mm at SP1 and 17.3 mm at SP2, within the ranges previously observed (Table 11).

Table 11.–Lower Slate Creek spawning substrate geometric mean particle sizes (mm).

	2011	2012	2013	2014	2015	2016	2017	2018
Sample Point 1	10.3	10.8	14.2	12.9	13.3	13.6	14.7	14.5
Sample Point 2	11.1	11.2	13.2	16.5	17.5	11.6	13.0	17.3

Sediment Element Concentrations

The 2018 Lower Slate Creek sediment sample contained element concentrations within the ranges observed 2011–2017, and the As, Cu, Ni, and Zn concentrations remain above NOAA's freshwater sediment guidelines (Buchman 2008). Figure 19 presents the 2018 results and Figure 20 presents the 2011–2018 data.

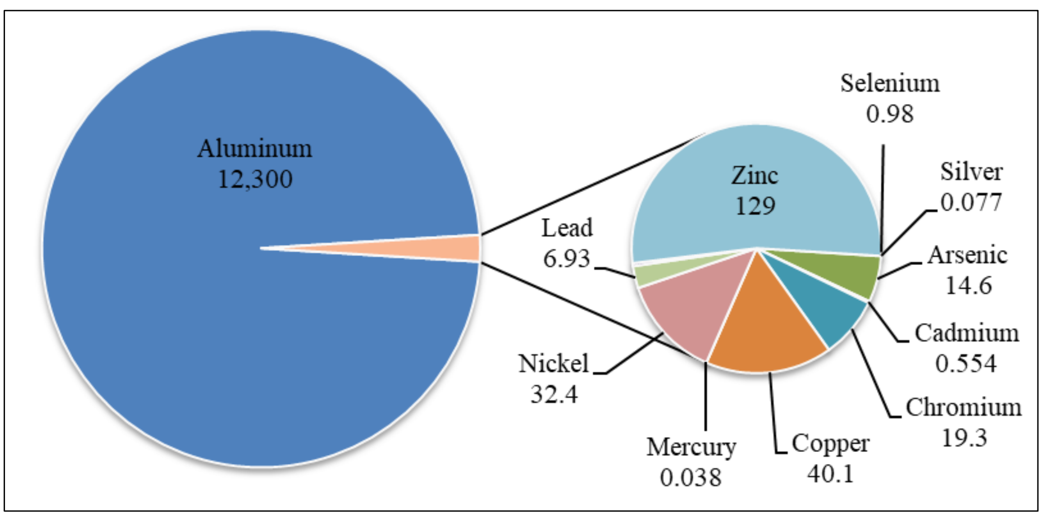

Figure 19.–2018 Lower Slate Creek sediment element concentrations (mg/kg).

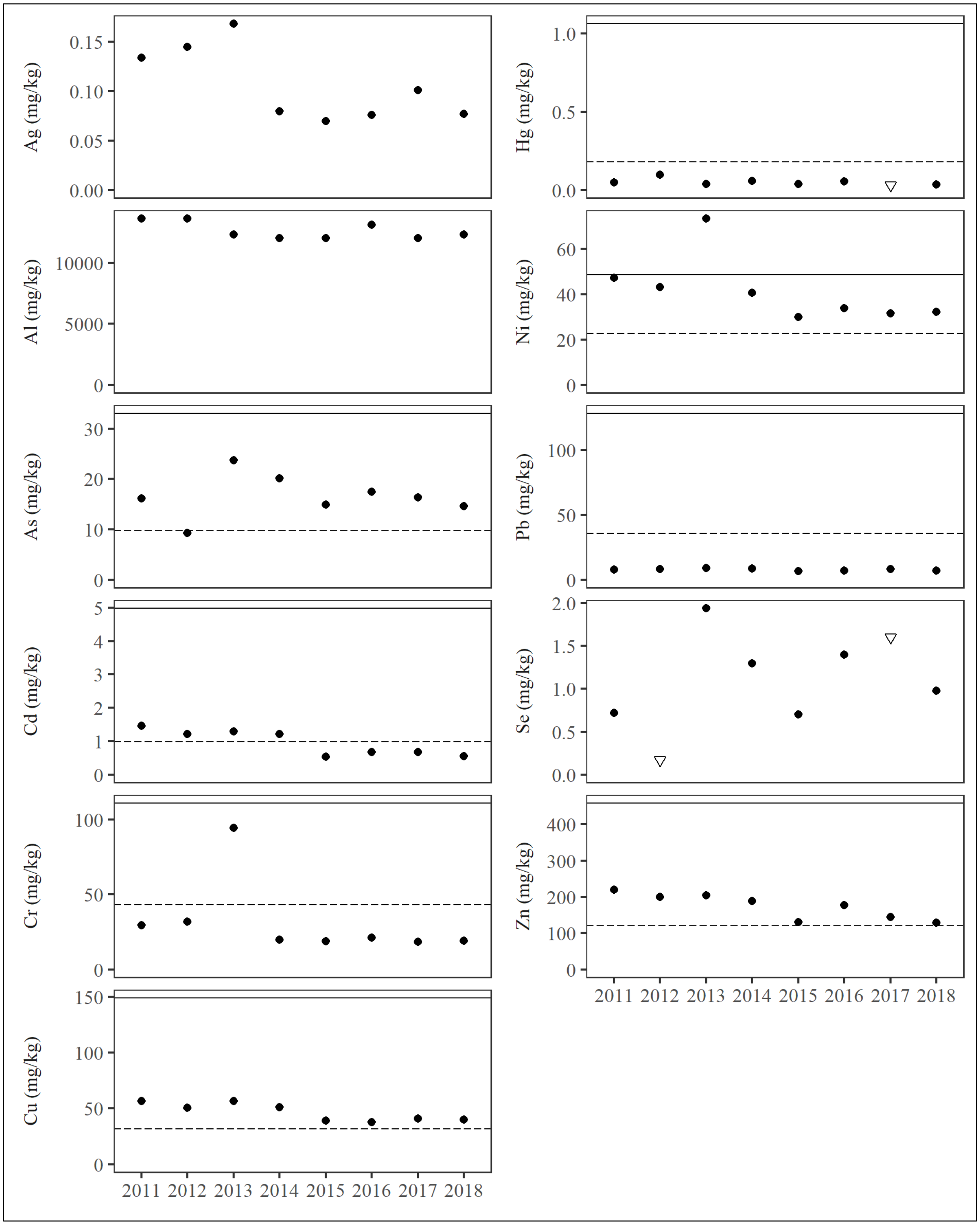

Figure 20.–Lower Slate Creek sediment element concentrations.

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

West Fork Slate Creek

Periphyton: Chlorophyll Density and Composition

The 2018 West Fork Slate Creek mean chlorophyll *a* density was 3.85 mg/m^2, within the range observed 2011–2017 (Table 12; Figure 21). Figure 22 presents the mean proportion of chlorophylls *a*, *b*, and *c* each year.

Table 12.–West Fork Slate Creek mean chlorophylls *a*, *b*, and *c* densities.

	07/29/11	07/25/12	07/31/13	07/30/14	07/28/15	07/26/16	07/24/17	07/25/18
Chl-*a* (mg/m^2)	3.92	1.01	4.22	0.77	0.92	4.93	4.96	3.85
Chl-*b* (mg/m^2)	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
Chl-*c* (mg/m^2)	0.27	0.10	0.61	0.06	0.06	0.66	0.85	0.74

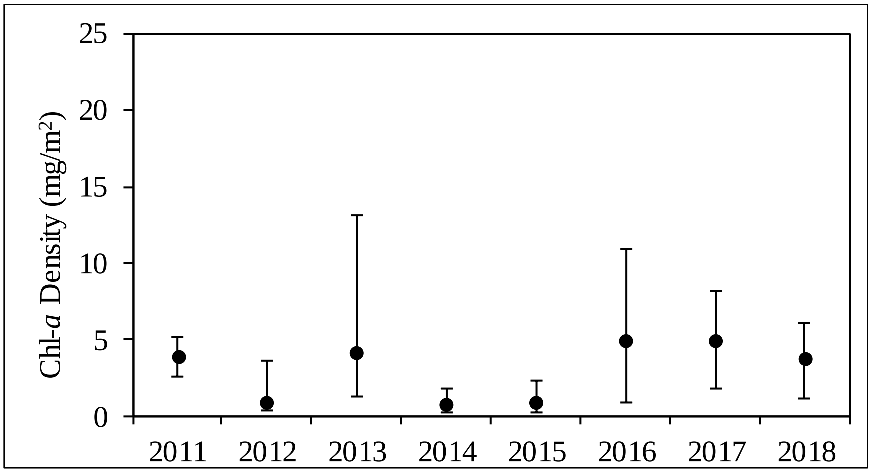

Figure 21.–West Fork Slate Creek mean chlorophyll *a* densities.
Note: Minimum, mean, and maximum values presented.

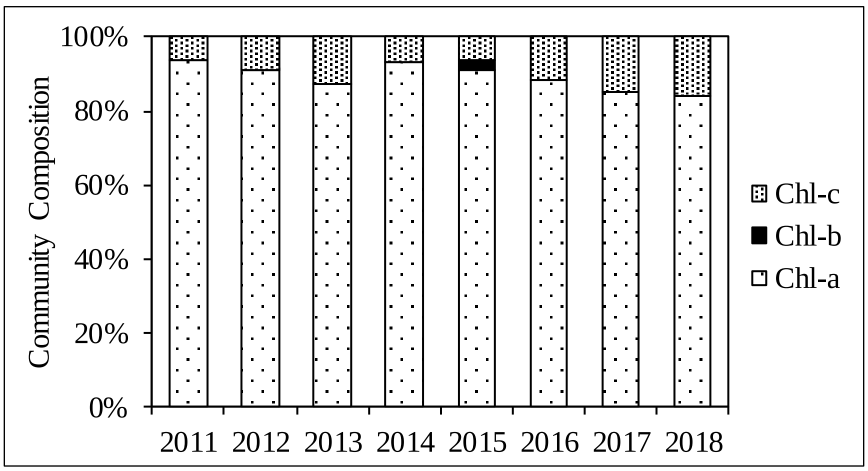

Figure 22.–West Fork Slate Creek mean proportions of chlorophylls *a*, *b*, and *c*.

Benthic Macroinvertebrate Density and Community Composition

Among the 2018 West Fork Slate Creek BMI samples, we identified 18 taxa and estimate mean density at 328 BMI/m^2, of which 84% were EPT insects (Figure 3). BMI mean density and taxa richness were lower than observed 2011–2017 (Table 13; Figure 23), and the proportion of EPT insects was similar to previous years. The Shannon Diversity scores were similar to previous years, and the dominant taxa were Ephemeroptera: *Baetis* and *Cinygmula*, representing 15% and 33% of the samples.

Table 13.–West Fork Slate Creek BMI data summaries.

	05/04/11	05/02/12	04/30/13	04/30/14	04/27/15	04/26/16	04/25/17	05/03/18
Mean BMI density (per m^2)	502	1,819	2,446	973	2,634	1,470	885	328
Total BMI taxa	21	31	28	29	28	25	21	18
Number of EPT taxa	11	21	18	17	16	15	13	12
% EPT	80%	80%	90%	71%	82%	77%	82%	84%
Shannon Diversity score	0.63	0.84	0.73	0.91	0.82	0.72	0.78	0.72
Evenness score	0.78	0.71	0.61	0.79	0.71	0.69	0.78	0.83

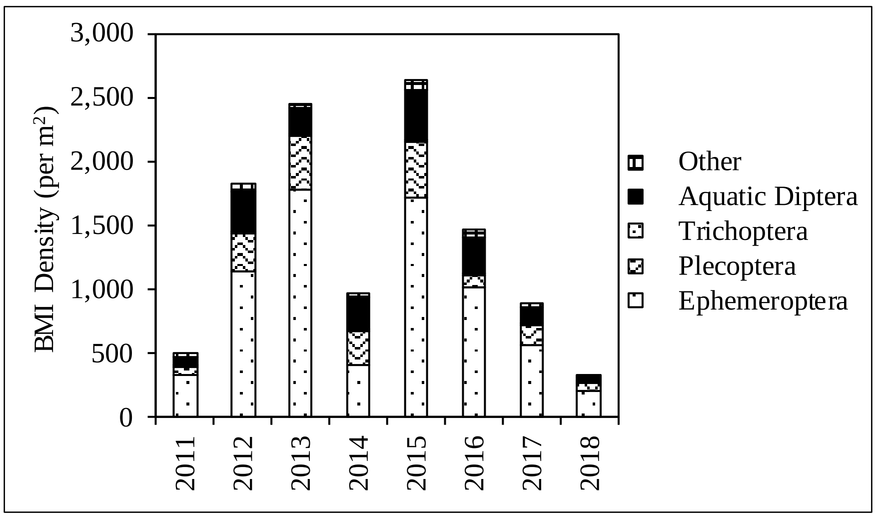

Figure 23.–West Fork Slate Creek BMI mean densities and community compositions.

East Fork Slate Creek

East Fork Slate Creek discharge is dependent on Upper Slate Lake discharge, routed through the diversion pipeline bypassing the TTF, and Outfall 002 effluent discharge from the TTF water treatment plant. The July 2018 mean daily discharge[bb] records for East Fork Slate Creek show flow was consistently low throughout the month (Figure 24). Median discharge three weeks prior to sampling periphyton was 1.9 ft^3/s (Figure 25).

[bb] Calculated by combining the diversion pipeline Parshall flume and TTF water treatment plant Outfall 002 mean daily discharge data (unpublished data obtained from K. Eppers, Environmental Manager, Coeur Alaska, Inc., Juneau).

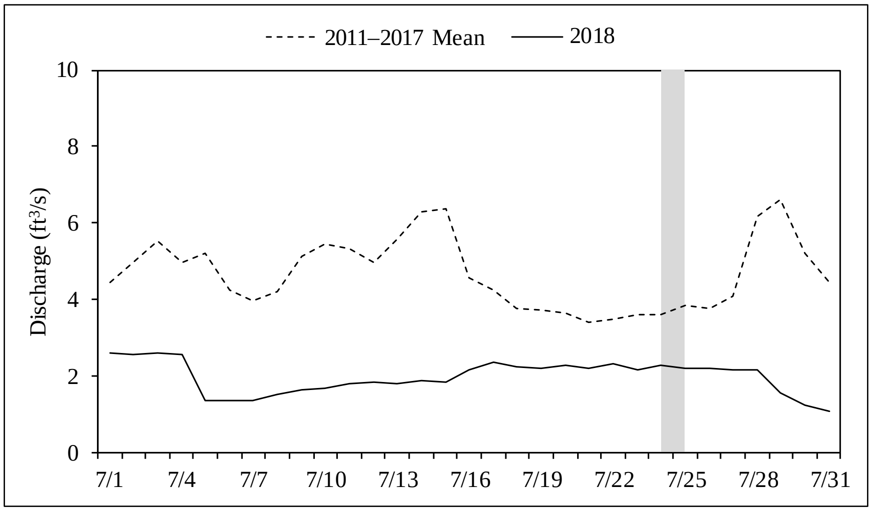

Figure 24.–July 2018 East Fork Slate Creek mean daily discharges.
Note: 2018 periphyton sampling days highlighted in gray.
Source: Unpublished data, Coeur Alaska, Inc., Juneau, AK.

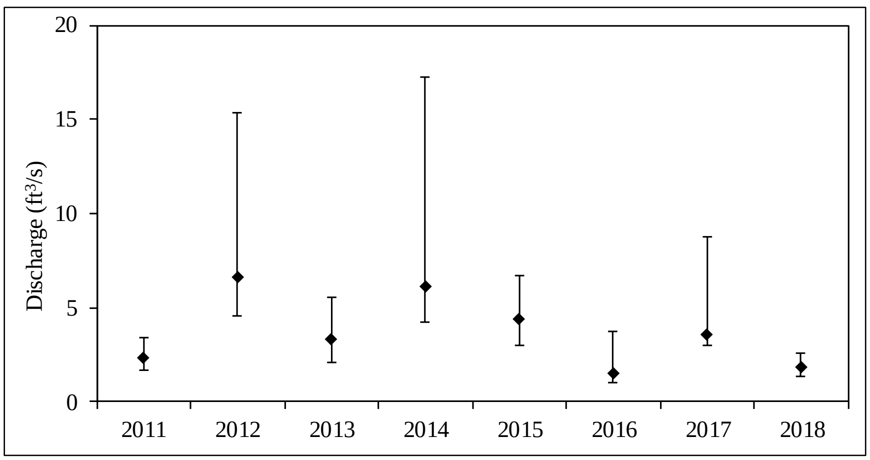

Figure 25.–East Fork Slate Creek mean daily discharges three weeks prior to sampling periphyton in July.
Note: Minimum, median, and maximum mean daily discharges.
Source: Unpublished data, Coeur Alaska, Inc., Juneau, AK.

Periphyton: Chlorophyll Density and Composition

The 2018 East Fork Slate Creek mean chlorophyll *a* density was 1.67 mg/m^2, within the range observed 2011–2017 (Table 14; Figure 26). Figure 27 presents the mean proportion of chlorophylls *a*, *b*, and *c* each year.

Table 14.–East Fork Slate Creek mean chlorophylls *a*, *b*, and *c* densities.

	07/28/11	07/24/12	07/30/13	07/30/14	07/27/15	07/25/16	07/25/17	07/24/18
Chl-*a* (mg/m^2)	8.84	5.08	2.28	0.27	1.56	1.21	0.64	1.67
Chl-*b* (mg/m^2)	1.56	0.57	0.06	0.02	0.00	0.00	0.00	0.00
Chl-*c* (mg/m^2)	0.24	0.18	0.20	0.03	0.15	0.15	0.06	0.16

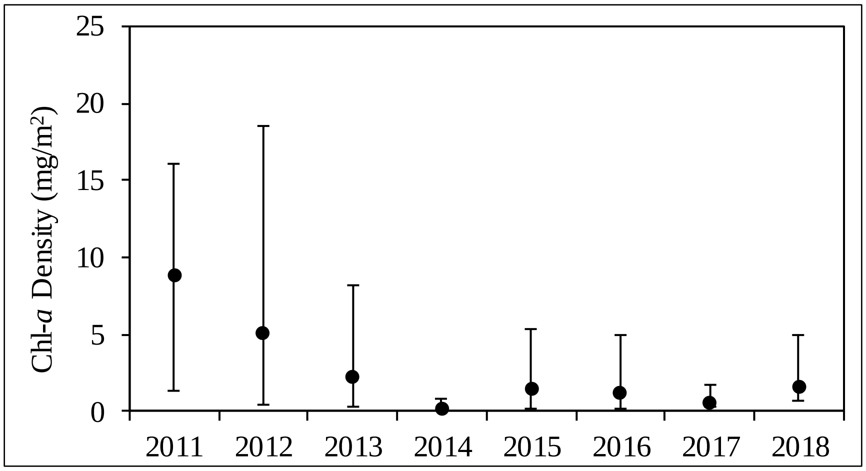

Figure 26.–East Fork Slate Creek mean chlorophyll *a* densities.
Note: Minimum, mean, and maximum values presented.

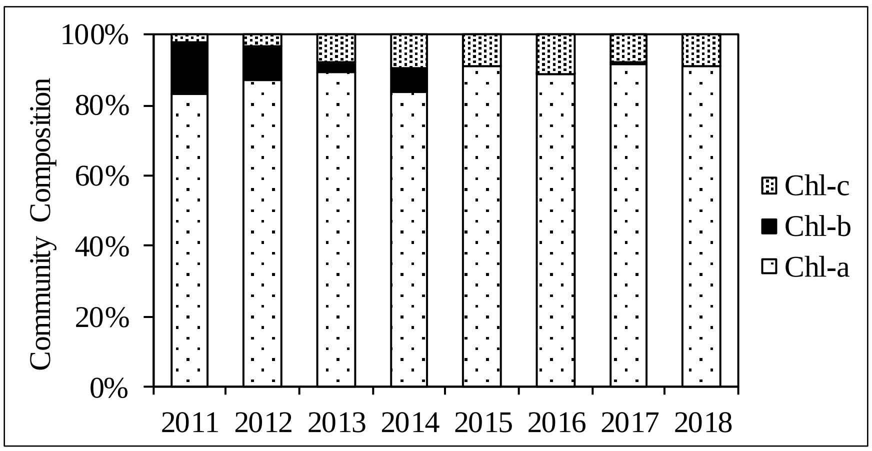

Figure 27.–East Fork Slate Creek mean proportions of chlorophylls *a*, *b*, and *c*.

Benthic Macroinvertebrate Density and Community Composition

Among the 2018 East Fork Slate Creek BMI samples, we identified 26 taxa and estimate mean density at 3,588 BMI/m^2, of which 8% were EPT insects, all within ranges observed 2011–2017 (Table 15; Figure 28). The Shannon Diversity and Evenness scores were similar to previous years, and the dominant taxon was Bivalvia: *Pisidium* (pea clams), representing 54% of the samples.

Table 15.–East Fork Slate Creek BMI data summaries.

	05/12/11	04/27/12	04/29/13	04/30/14	04/29/15	04/25/16	04/27/17	05/03/18
Mean BMI density (per m^2)	4,688	4,633	9,407	2,048	3,854	2,002	6,783	3,588
Total BMI taxa	27	33	33	24	28	21	27	26
Number of EPT taxa	15	17	17	9	16	11	13	15
% EPT	19%	23%	3%	2%	18%	28%	11%	8%
Shannon Diversity score	0.64	0.78	0.57	0.70	0.92	0.92	0.62	0.54
Evenness score	0.54	0.61	0.47	0.63	0.72	0.78	0.51	0.46

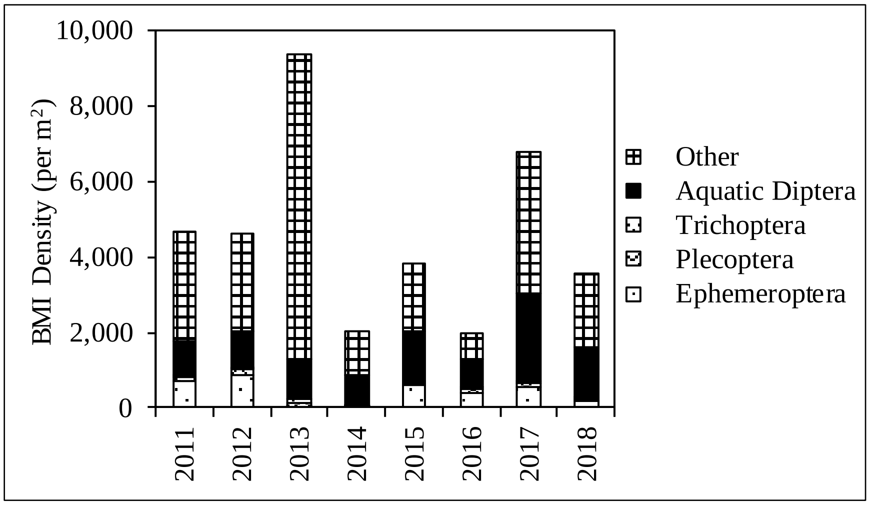

Figure 28.–East Fork Slate Creek BMI mean densities and community compositions.

Sediment Element Concentrations

The 2018 East Fork Slate Creek sediment sample contained a greater As concentration and lower Cr concentration than previous years. All other element concentrations were within the ranges observed 2011–2017. The As, Cd, Cu, Ni, and Zn concentrations remain above NOAA's freshwater sediment guidelines (Buchman 2008). Figure 29 presents the 2018 results and Figure 30 presents the 2011–2018 data.

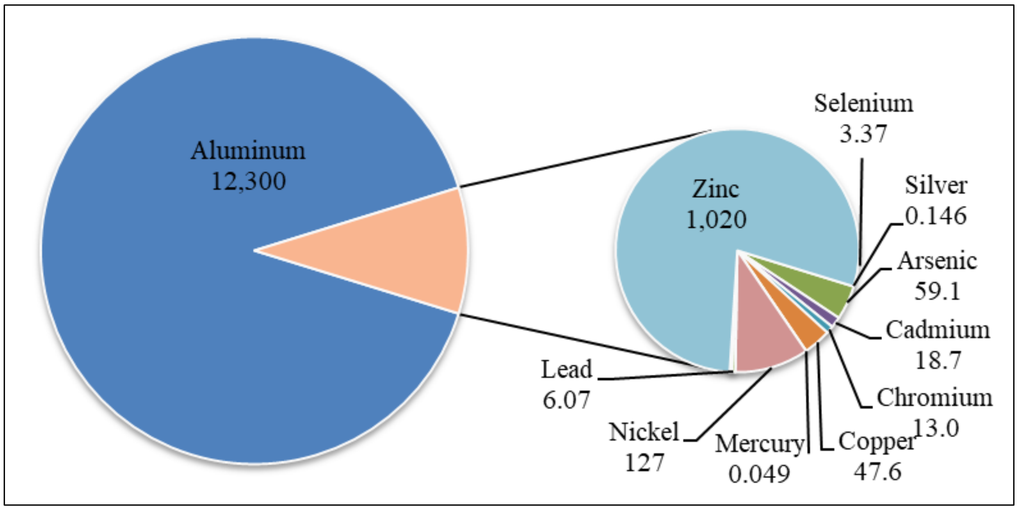

Figure 29.–2018 East Fork Slate Creek sediment element concentrations (mg/kg).

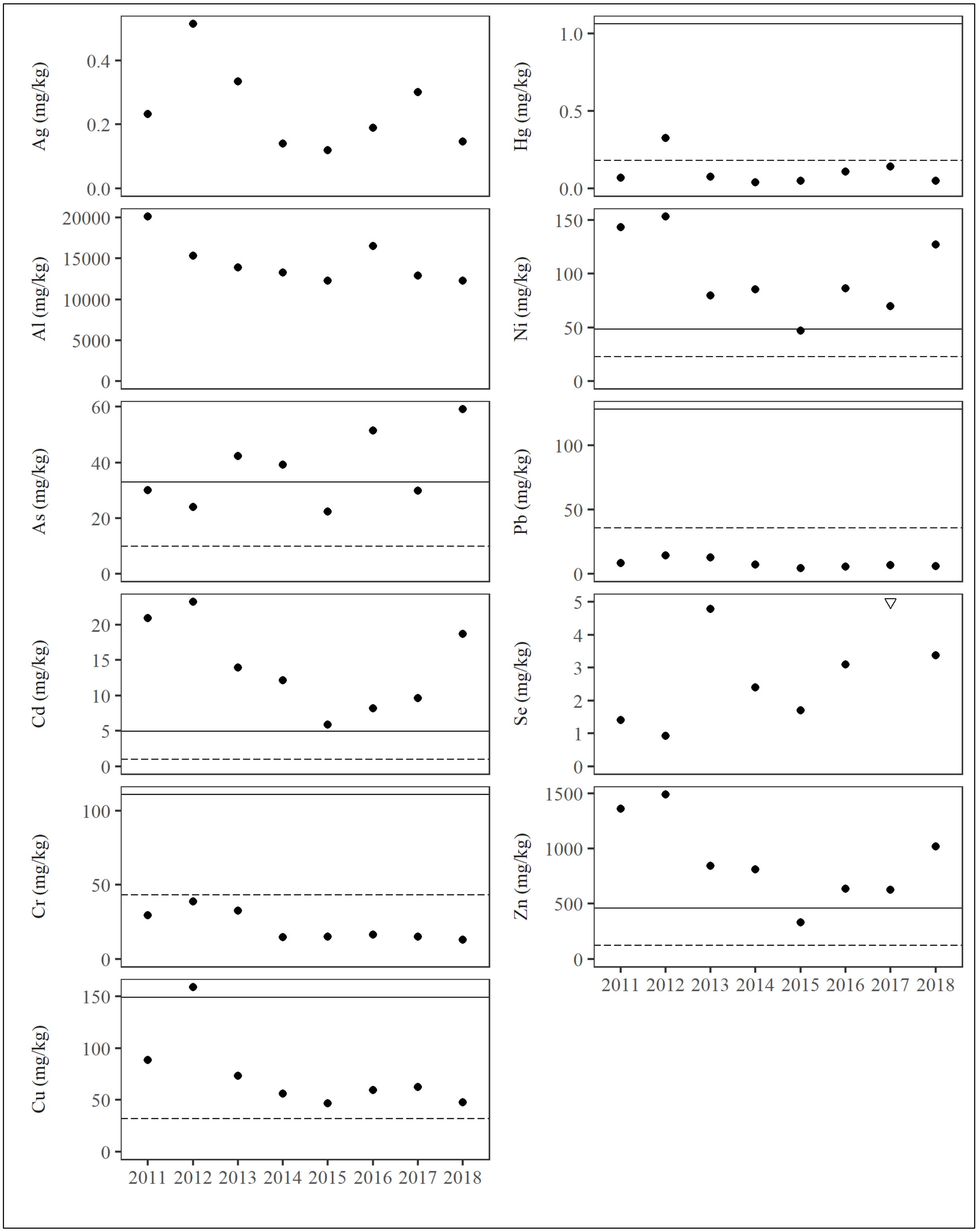

Figure 30.–East Fork Slate Creek sediment element concentrations.

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

Upper Slate Creek

Periphyton: Chlorophyll Density and Composition

The 2018 Upper Slate Creek mean chlorophyll *a* density was 2.57 mg/m^2, within the range observed 2011–2017 (Table 16; Figure 31). Figure 32 presents the mean proportion of chlorophylls *a*, *b*, and *c* each year.

Table 16.–Upper Slate Creek mean chlorophylls *a*, *b*, and *c* densities.

	07/29/11	07/24/12	07/30/13	07/30/14	07/27/15	07/25/16	07/24/17	07/25/18
Chl-*a* (mg/m^2)	0.76	1.26	2.13	1.09	0.63	3.86	0.83	2.57
Chl-*b* (mg/m^2)	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
Chl-*c* (mg/m^2)	0.05	0.07	0.13	0.06	0.09	0.42	0.04	0.36

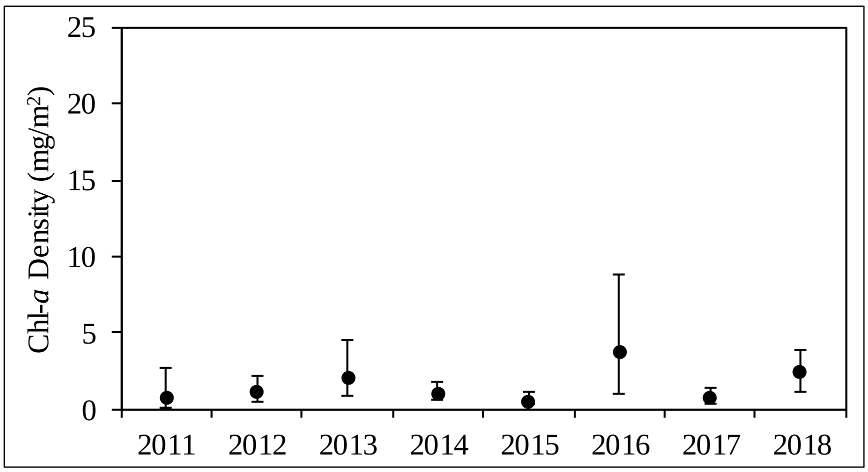

Figure 31.–Upper Slate Creek mean chlorophyll *a* densities.
Note: Minimum, mean, and maximum values presented.

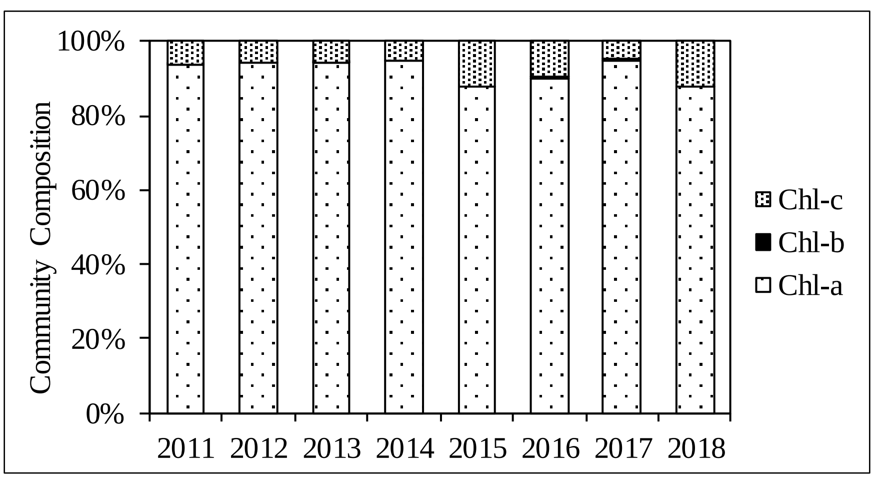

Figure 32.–Upper Slate Creek mean proportions of chlorophylls *a*, *b*, and *c*.

Benthic Macroinvertebrate Density and Community Composition

Among the 2018 Upper Slate Creek BMI samples, we identified 31 taxa and estimate mean density at 1,548 BMI/m^2, of which 68% were EPT insects (Table 17; Figure 33). BMI mean density was lower than observed 2011–2017 and the proportion of EPT insects was similar to previous years. The Shannon Diversity and Evenness scores were within the ranges previously observed. The dominant taxa were Diptera: Chironomidae and Ephemeroptera: *Cinygmula*, representing 28% and 24% of the samples.

Table 17.–Upper Slate Creek BMI data summaries.

	05/12/11	04/27/12	04/29/13	04/28/14	04/29/15	04/25/16	04/27/17	05/02/18
Mean BMI density (per m^2)	2,523	2,256	2,880	3,125	3,776	2,398	2,029	1,548
Total BMI taxa	33	39	34	36	31	28	30	31
Number of EPT taxa	18	21	20	20	19	15	19	18
% EPT	63%	68%	72%	63%	68%	68%	61%	68%
Shannon Diversity score	0.97	1.04	1.02	1.03	0.98	1.06	0.96	0.92
Evenness score	0.76	0.79	0.78	0.76	0.74	0.82	0.73	0.75

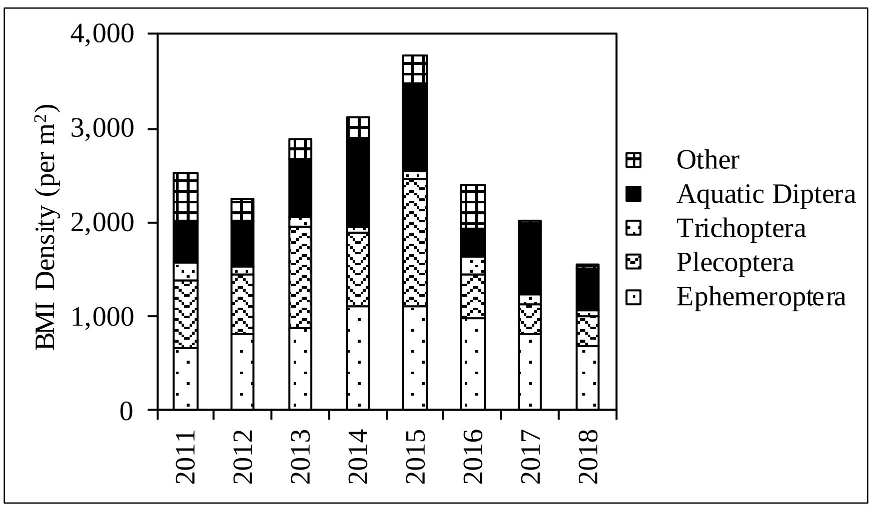

Figure 33.–Upper Slate Creek BMI mean densities and community compositions.

Sediment Element Concentrations

The 2018 Upper Slate Creek sediment sample contained greater As and Cd concentrations than previous years and concentrations of other elements were within the ranges observed 2011–2017. The As, Cr, Cu, and Ni concentrations remain above NOAA's freshwater sediment guidelines (Buchman 2008) and the Zn concentration was above the guideline for the first time since 2012. Figure 34 presents the 2018 results and Figure 35 presents the 2011–2018 data.

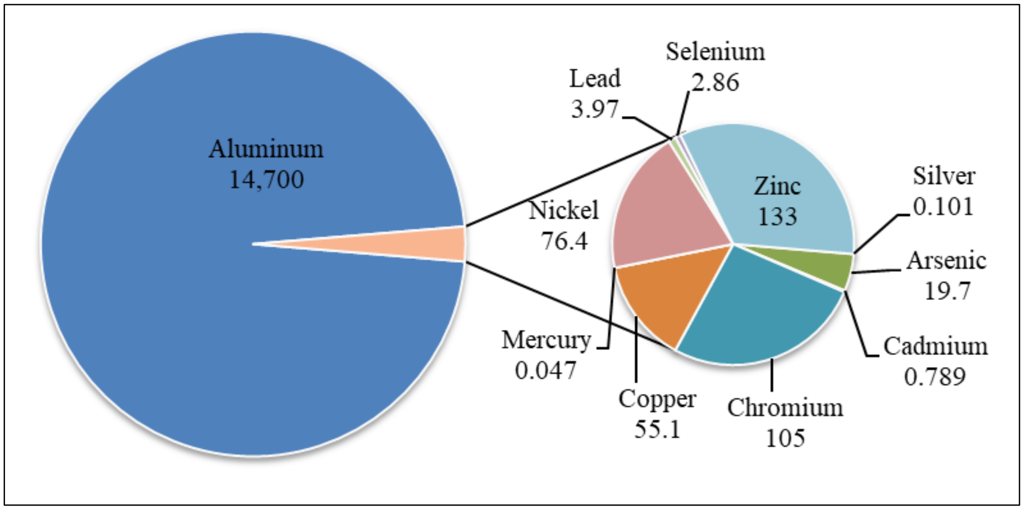

Figure 34.–2018 Upper Slate Creek sediment element concentrations (mg/kg).

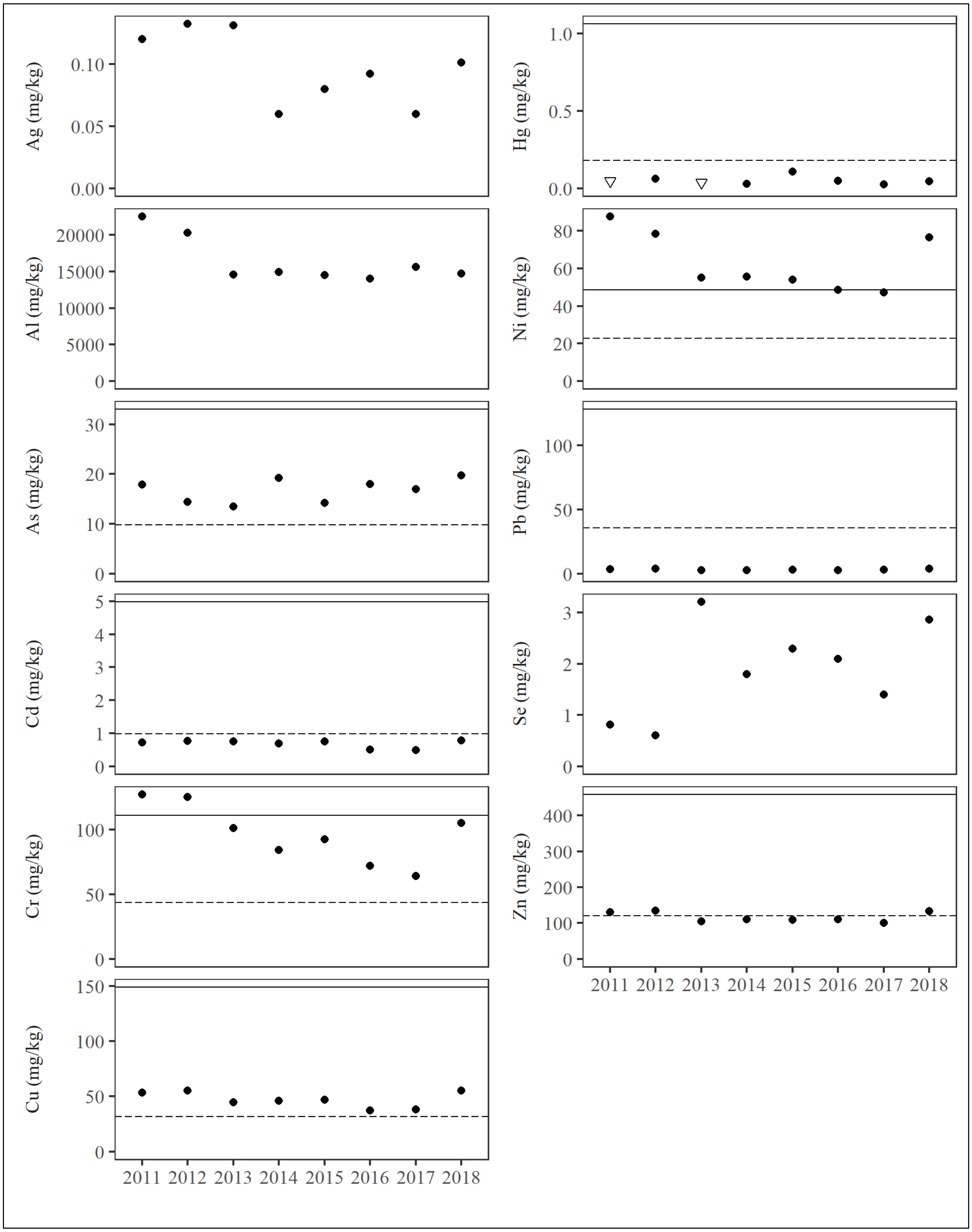

Figure 35.–Upper Slate Creek sediment element concentrations.

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

JOHNSON CREEK

Lower Johnson Creek

Adult Salmon Counts

We counted 434 pink salmon,[cc] 2 chum salmon, and 36 coho salmon in Lower Johnson Creek during the 2018 spawning season (Table 18). Figure 36 shows pink salmon counts for each survey and Figure 37 displays pink salmon distribution by reach.

Table 18.–Lower Johnson Creek adult salmon counts.

	2011	2012	2013	2014	2015	2016	2017	2018
Pink salmon	17,499	5,016	8,186	189	51,325	428	23,239	434
Chum salmon	21	99	17	3	0	39	0	2
Coho salmon	33	90	64	107	88	24	83	36

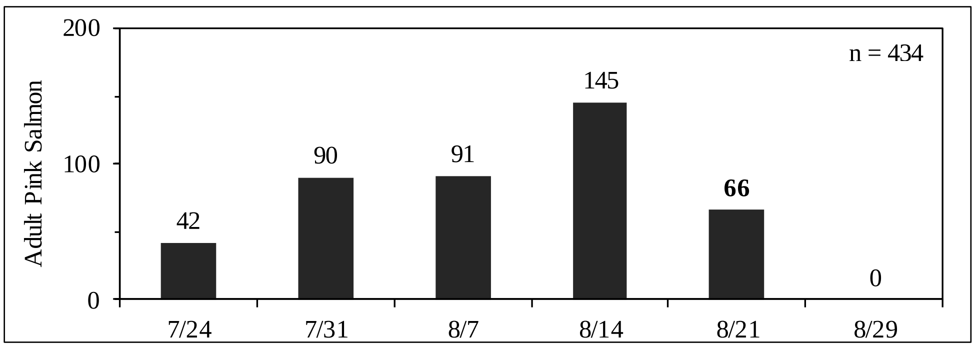

Figure 36.–2018 Lower Johnson Creek weekly pink salmon count.
Note: Bold number indicates incomplete survey.

[cc]Fog prevented counting fish upstream of the Log Falls marker on August 21.

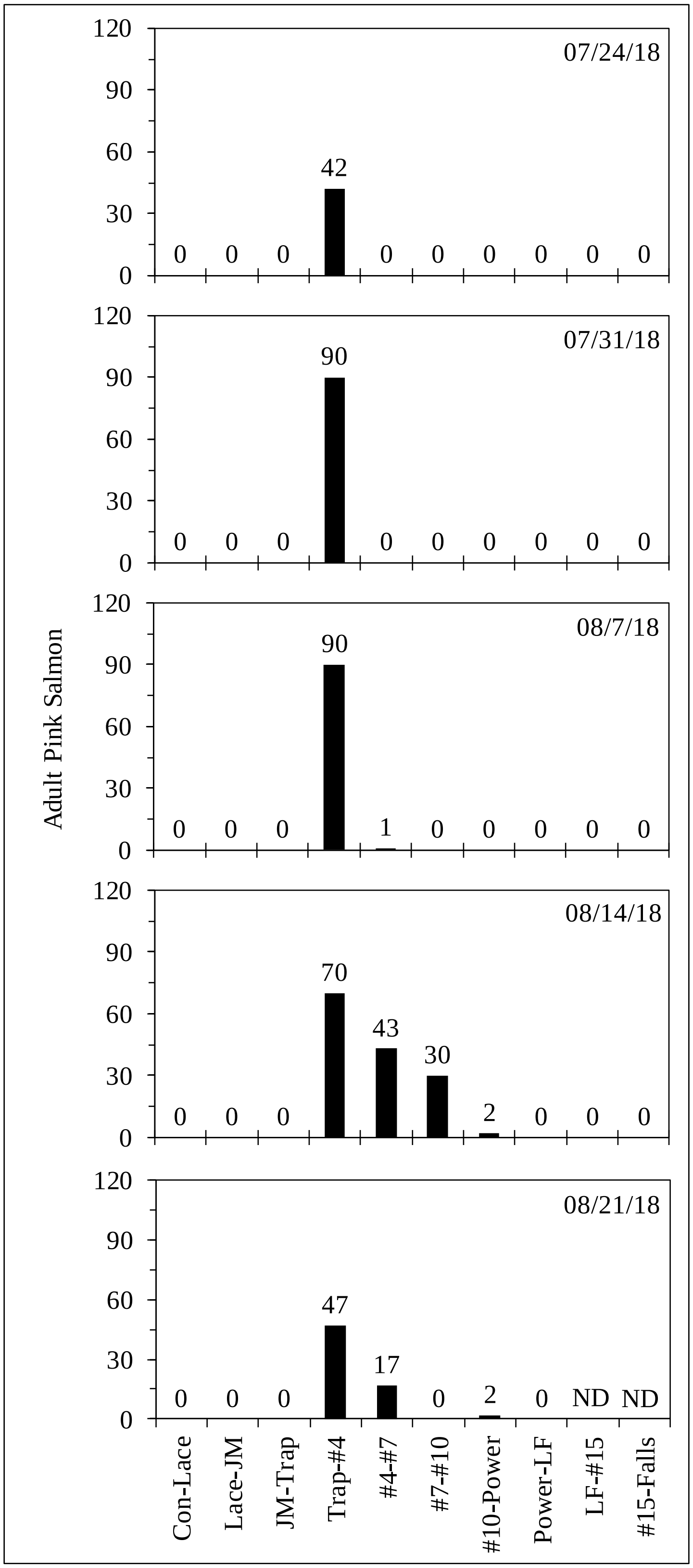

Figure 37.–2018 Lower Johnson Creek weekly pink salmon distribution.

Sediment Element Concentrations

The 2018 Lower Johnson Creek sediment sample contained greater Al, As, and Pb concentrations than previous years and all other concentrations were within the ranges observed 2011–2017. Se concentration was not detected at the method reporting limit for the eighth year in a row. The As and Cu concentrations remain above NOAA's freshwater sediment guidelines (Buchman 2008), and the Ni concentration was above the guideline for the first time since 2012. Figure 38 presents the 2018 results and Figure 39 presents the 2011–2018 data.

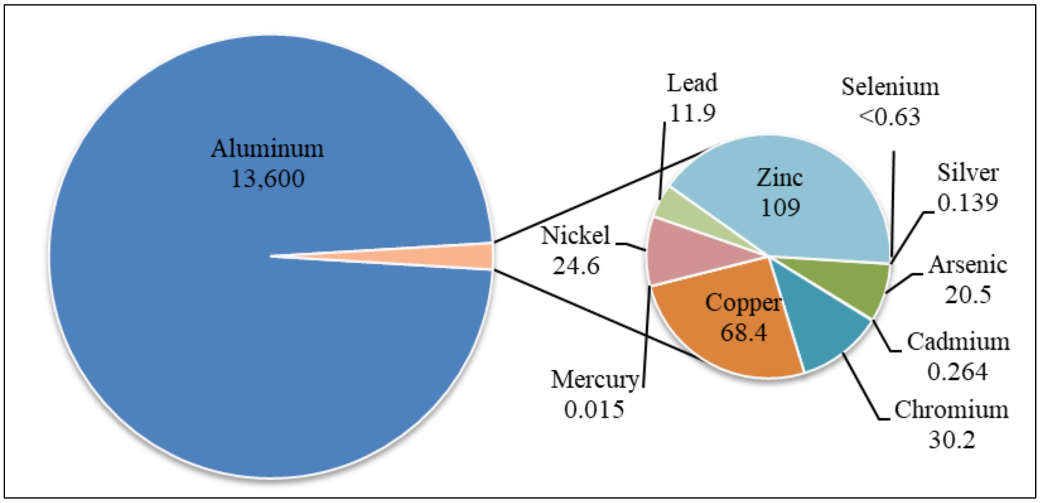

Figure 38.–2018 Lower Johnson Creek sediment element concentrations (mg/kg).

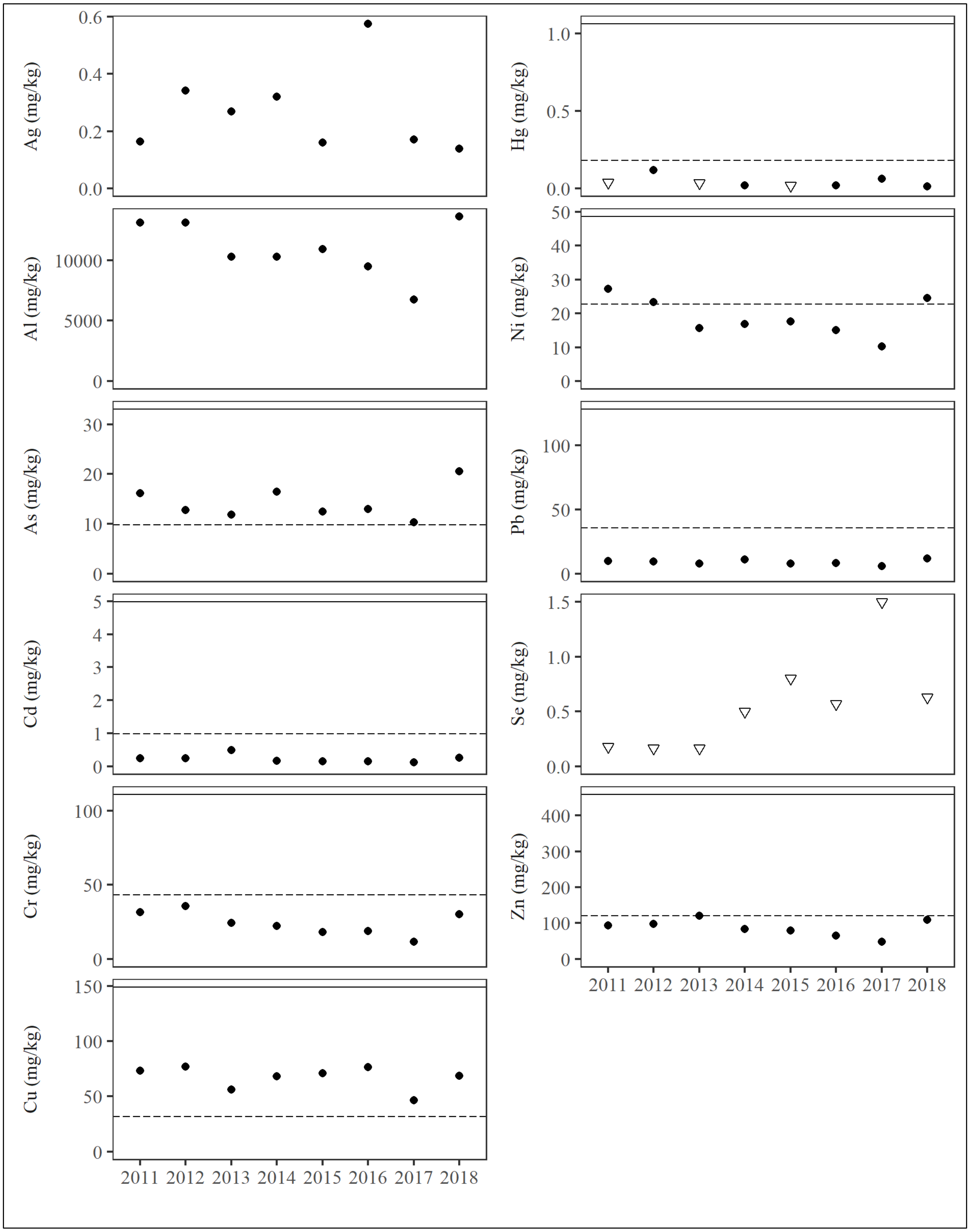

Figure 39.–Lower Johnson Creek sediment element concentrations.

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

Upper Johnson Creek

Benthic Macroinvertebrate Density and Community Composition

Among the 2018 Upper Johnson Creek BMI samples, we identified 31 taxa and estimate mean density at 2,996 BMI/m^2, of which 67% were EPT insects; all within ranges observed 2011–2017 (Table 19; Figure 40). The Shannon Diversity and Evenness scores also were within the ranges previously observed. The dominant taxa were Diptera: Chironomidae and Ephemeroptera: *Baetis*, both representing 31% of the samples.

Table 19.–Upper Johnson Creek BMI data summaries.

	05/03/11	04/26/12	04/29/13	04/29/14	04/28/15	04/27/16	04/26/17	05/04/18
Mean BMI density (per m^2)	3,735	3,968	5,265	2,658	2,789	3,681	2,901	2,996
Total BMI taxa	24	28	34	32	28	32	33	31
Number of EPT taxa	14	14	24	21	17	21	19	20
% EPT	55%	64%	65%	69%	71%	71%	51%	67%
Shannon Diversity score	0.76	0.81	0.74	0.74	0.87	0.88	0.68	0.81
Evenness score	0.66	0.68	0.59	0.59	0.71	0.70	0.55	0.66

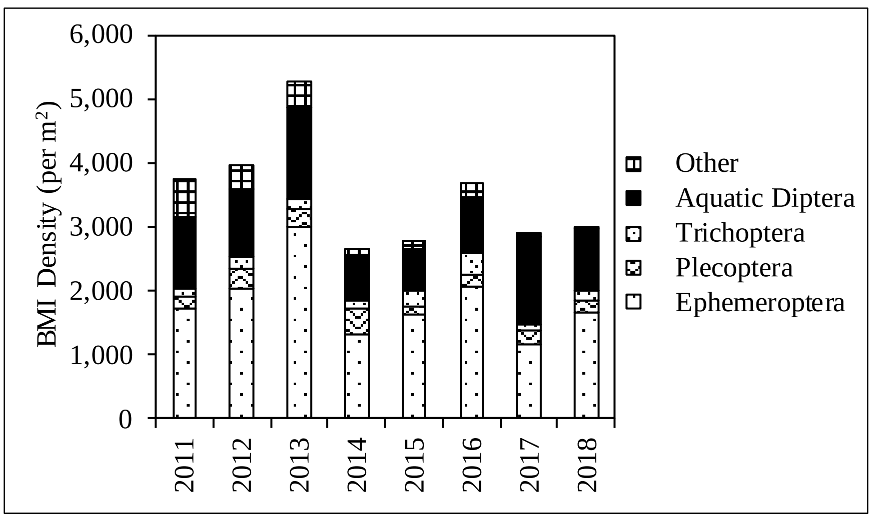

Figure 40.–Upper Johnson Creek BMI mean densities and community compositions.

SHERMAN CREEK

Lower Sherman Creek

Periphyton: Chlorophyll Density and Composition

Sample Point 1

The 2018 Lower Sherman Creek SP1 mean chlorophyll *a* density was 2.64 mg/m^2, within the range observed 2011–2017 (Table 20; Figure 41). Figure 42 presents the mean proportion of chlorophylls *a*, *b*, and *c* each year.

Table 20.–Lower Sherman Creek SP1 mean chlorophylls *a*, *b*, and *c* densities.

	07/28/11	07/26/12	07/29/13	07/28/14	07/27/15	07/25/16	07/25/17	07/24/18
Chl-*a* (mg/m^2)	7.60	2.54	3.69	1.34	1.36	3.70	3.86	2.64
Chl-*b* (mg/m^2)	0.69	0.93	0.00	0.00	0.00	0.74	0.00	0.00
Chl-*c* (mg/m^2)	0.49	0.08	0.51	0.18	0.17	0.33	0.56	0.33

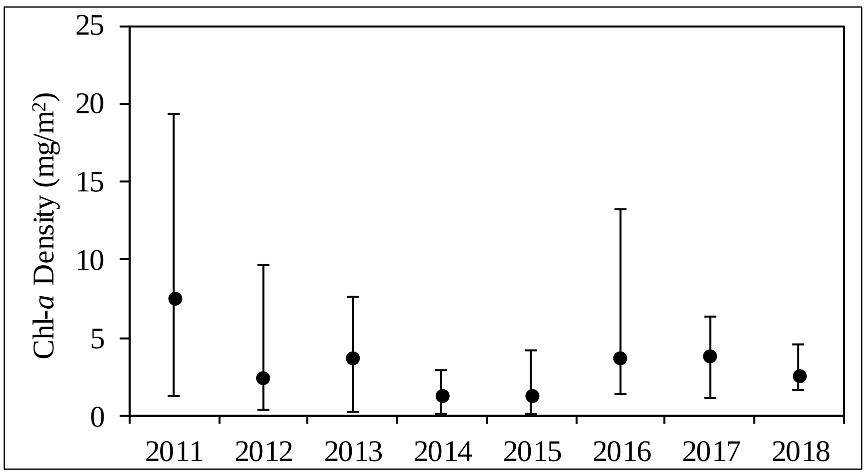

Figure 41.–Lower Sherman SP1 mean chlorophyll *a* densities.
Note: Minimum, mean, and maximum values presented.

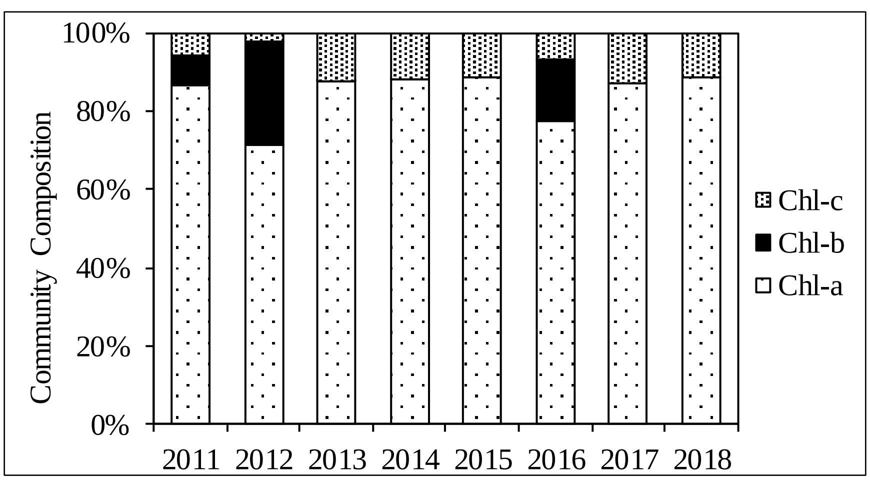

Figure 42.–Lower Sherman SP1 mean proportions of chlorophylls *a*, *b*, and *c*.

Sample Point 2

The 2018 Lower Sherman Creek SP2 mean chlorophyll *a* density was 1.49 mg/m^2, within the range observed 2011–2017 (Table 21; Figure 43). Figure 44 presents the mean proportion of chlorophylls *a*, *b*, and *c* each year.

Table 21.–Lower Sherman Creek SP2 mean chlorophylls *a*, *b*, and *c* densities.

	07/28/11	07/26/12	07/29/13	07/28/14	07/27/15	07/25/16	07/25/17	07/24/18
Chl-*a* (mg/m^2)	5.61	0.67	2.87	1.32	1.62	1.42	1.15	1.49
Chl-*b* (mg/m^2)	0.02	0.01	0.00	0.00	0.15	0.04	0.00	0.00
Chl-*c* (mg/m^2)	0.32	0.09	0.32	0.12	0.27	0.19	0.12	0.19

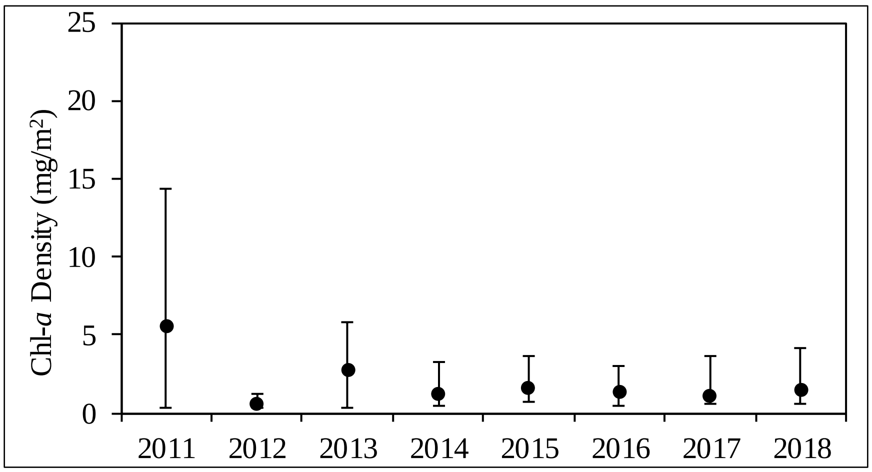

Figure 43.–Lower Sherman SP2 mean chlorophyll *a* densities.
Note: Minimum, mean, and maximum values presented.

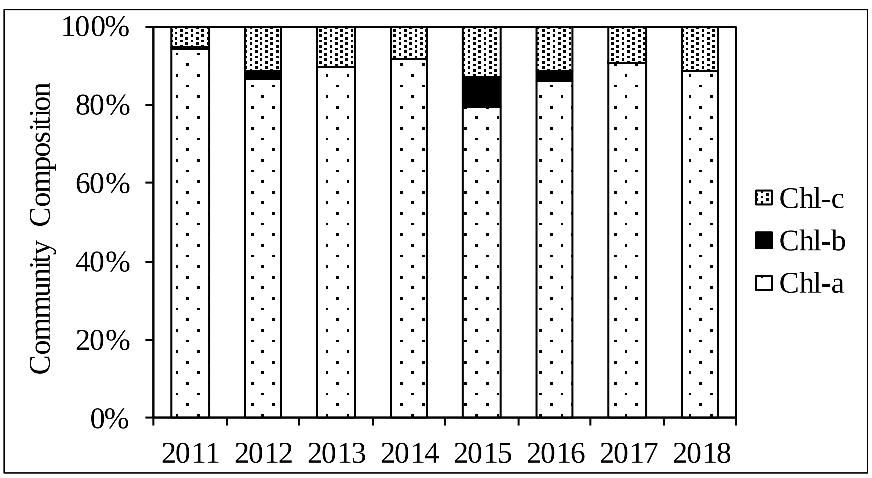

Figure 44.–Lower Sherman SP2 mean proportions of chlorophylls *a*, *b*, and *c*.

Benthic Macroinvertebrate Density and Community Composition

Sample Point 1

Among the 2018 Lower Sherman Creek SP1 BMI samples, we identified 26 taxa and estimate mean density at 912 BMI/m^2, of which 69% were EPT insects (Table 22; Figure 45). BMI mean density was lower than observed 2011–2017 and the proportion of EPT insects was the greatest observed due to fewer Oligochaeta and more Ephemeroptera: *Baetis*, the dominant taxon (45%). The Shannon Diversity and Evenness scores were within the ranges previously observed.

Table 22.–Lower Sherman Creek SP1 BMI data summaries.

	05/04/11	04/30/12	05/01/13	04/29/14	04/28/15	04/27/16	04/26/17	05/02/18
Mean BMI density (per m^2)	1,118	2,733	1,796	3,023	1,651	6,839	1,009	912
Total BMI taxa	26	31	28	30	26	26	25	26
Number of EPT taxa	15	18	16	13	13	13	13	16
% EPT	32%	66%	64%	14%	27%	4%	31%	69%
Shannon Diversity score	0.76	0.74	0.85	0.71	0.84	0.32	0.81	0.73
Evenness score	0.71	0.62	0.71	0.57	0.70	0.27	0.69	0.71

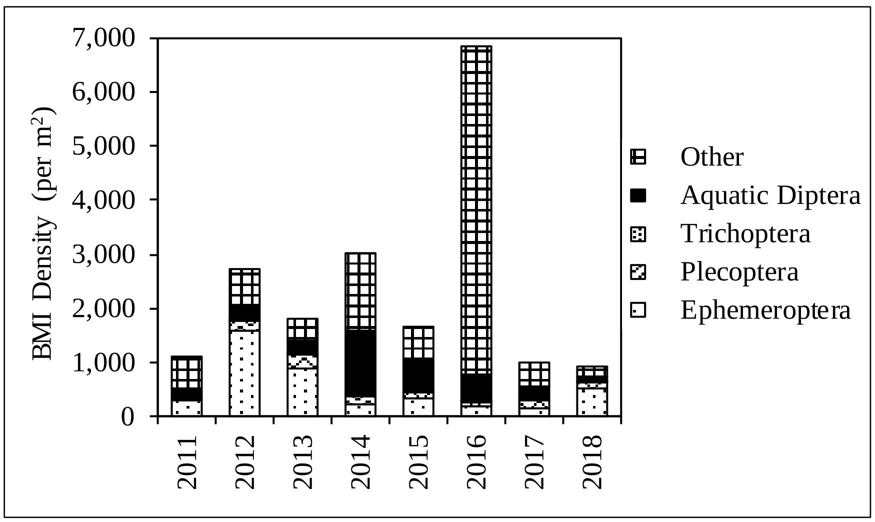

Figure 45.–Lower Sherman Creek SP1 BMI mean densities and community compositions.

Sample Point 2

Among the 2018 Lower Sherman Creek SP2 BMI samples, we identified 21 taxa and estimate mean density at 973 BMI/m^2, of which 88% were EPT insects, the greatest proportion observed since 2011 (Table 23; Figure 46). BMI mean density and the Shannon Diversity and Evenness scores were within the ranges previously observed, and the dominant taxon was Ephemeroptera: *Baeits*, representing 63% of the samples.

Table 23.–Lower Sherman Creek SP2 BMI data summaries.

	05/03/11	04/30/12	04/30/13	04/29/14	04/28/15	04/27/16	04/26/17	05/02/18
Mean BMI density (per m^2)	1,651	2,823	3,385	1,185	1,609	1,873	428	973
Total BMI taxa	30	37	39	28	23	23	26	21
Number of EPT taxa	17	26	25	16	13	13	14	18
% EPT	76%	79%	72%	12%	25%	12%	28%	88%
Shannon Diversity score	0.93	0.70	0.84	0.70	0.77	0.53	0.84	0.61
Evenness score	0.76	0.57	0.65	0.62	0.66	0.49	0.80	0.57

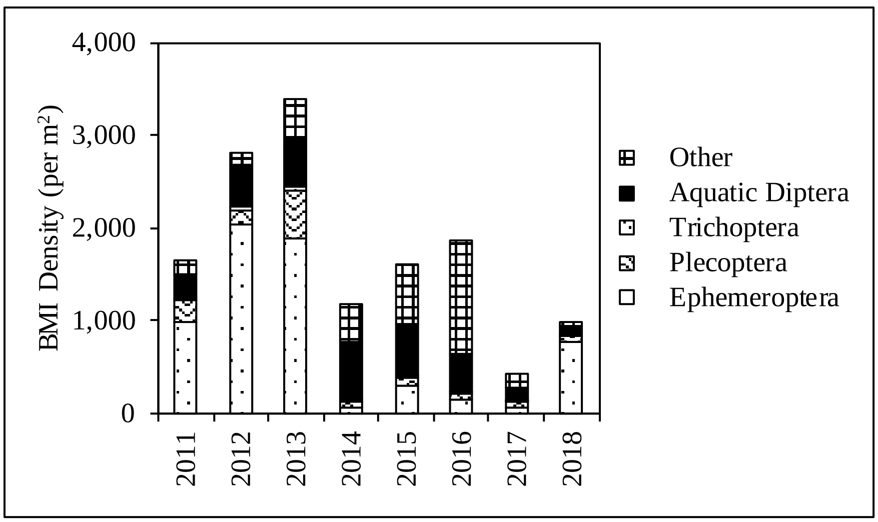

Figure 46.–Lower Sherman Creek SP2 BMI mean densities and community compositions.

Adult Salmon Counts

We counted 86 pink salmon and 7 chum salmon in Lower Sherman Creek during the 2018 spawning season (Table 24). Figure 47 shows pink salmon counts for each survey and Figure 48 displays pink salmon distribution by reach.

Table 24.–Lower Sherman Creek adult salmon counts.

	2011	2012	2013	2014	2015	2016	2017	2018
Pink salmon	4,605	1,608	4,981	70	2,798	26	5,690	86
Chum salmon	0	0	12	0	1	5	122	7

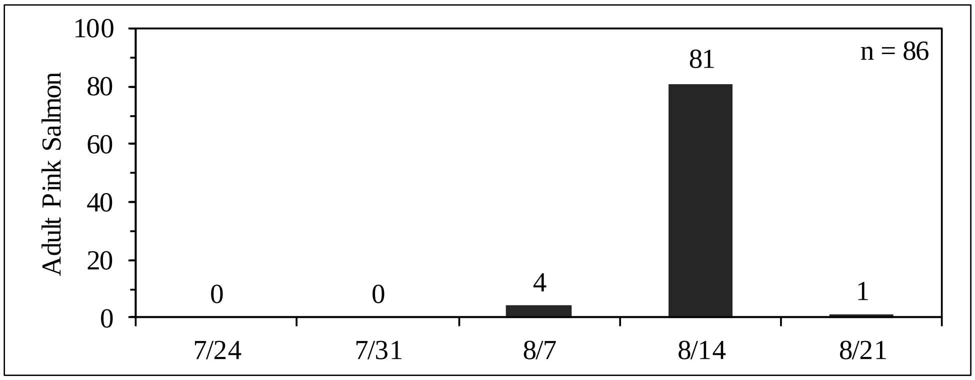

Figure 47.–2018 Lower Sherman Creek weekly pink salmon count.

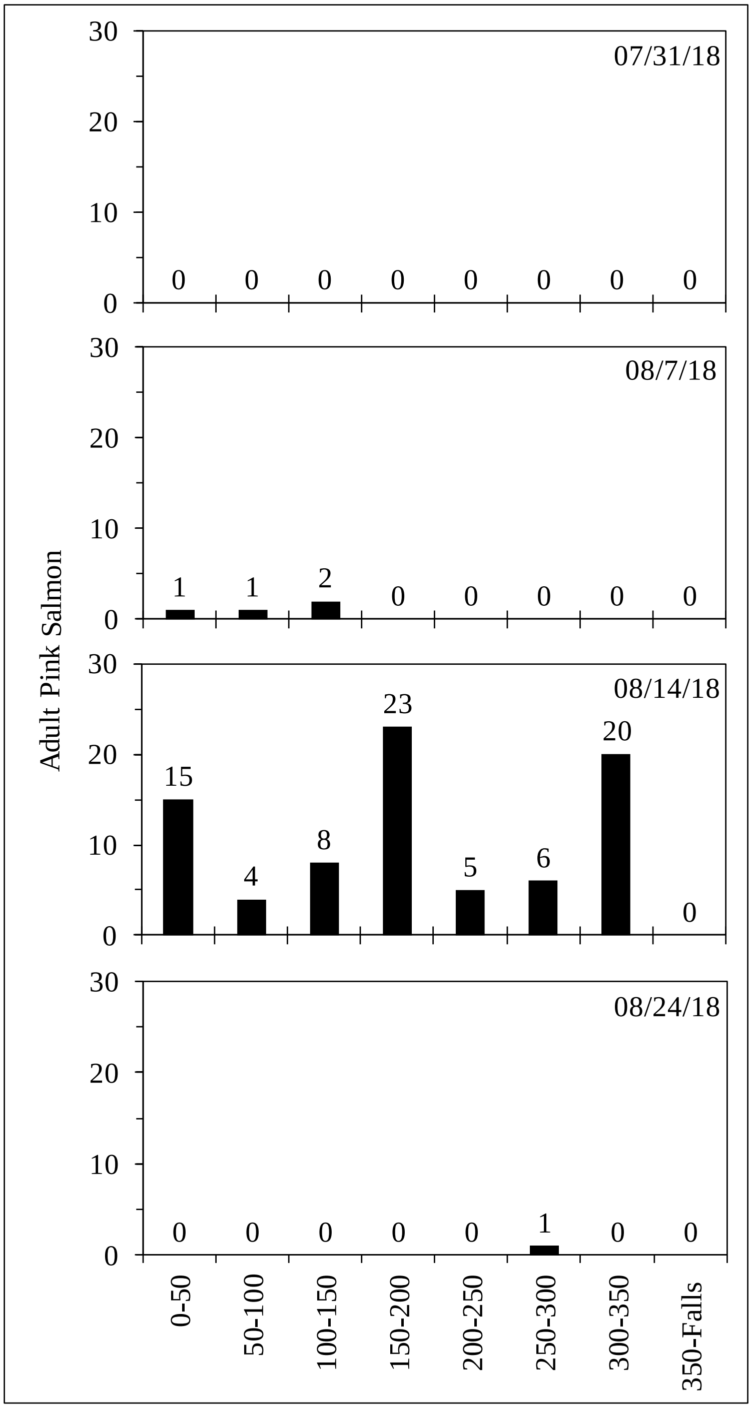

Figure 48.–2018 Lower Sherman Creek weekly pink salmon distribution.

Sediment Element Concentrations

The 2018 Lower Sherman Creek sample contained element concentrations within ranges observed 2011–2017. Hg and Se concentrations were below the method reporting limits. The As, Cu, and Ni concentrations remain above NOAA's freshwater sediment guidelines (Buchman 2008). Figure 49 presents the 2018 results and Figure 50 presents the 2011–2018 data.

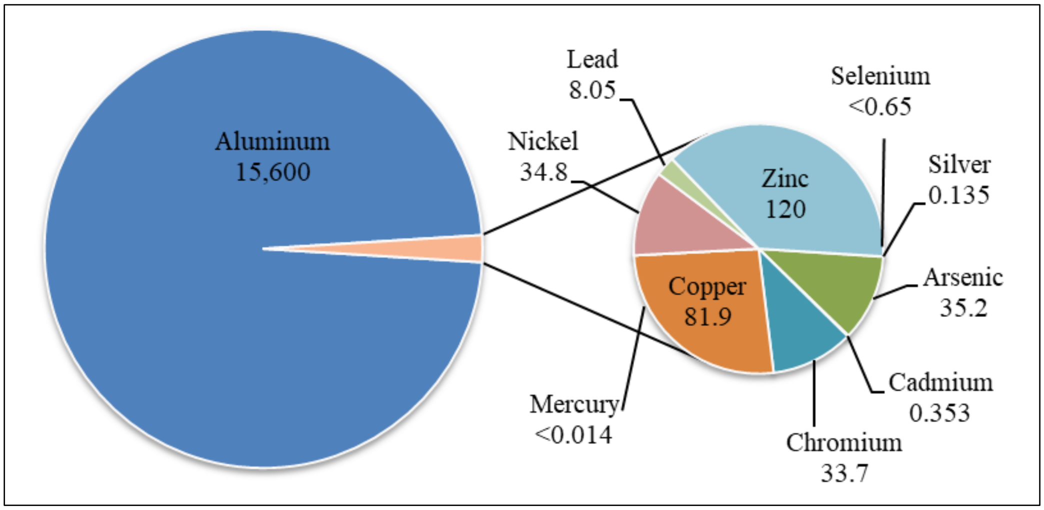

Figure 49.–2018 Lower Sherman Creek sediment element concentrations (mg/kg).

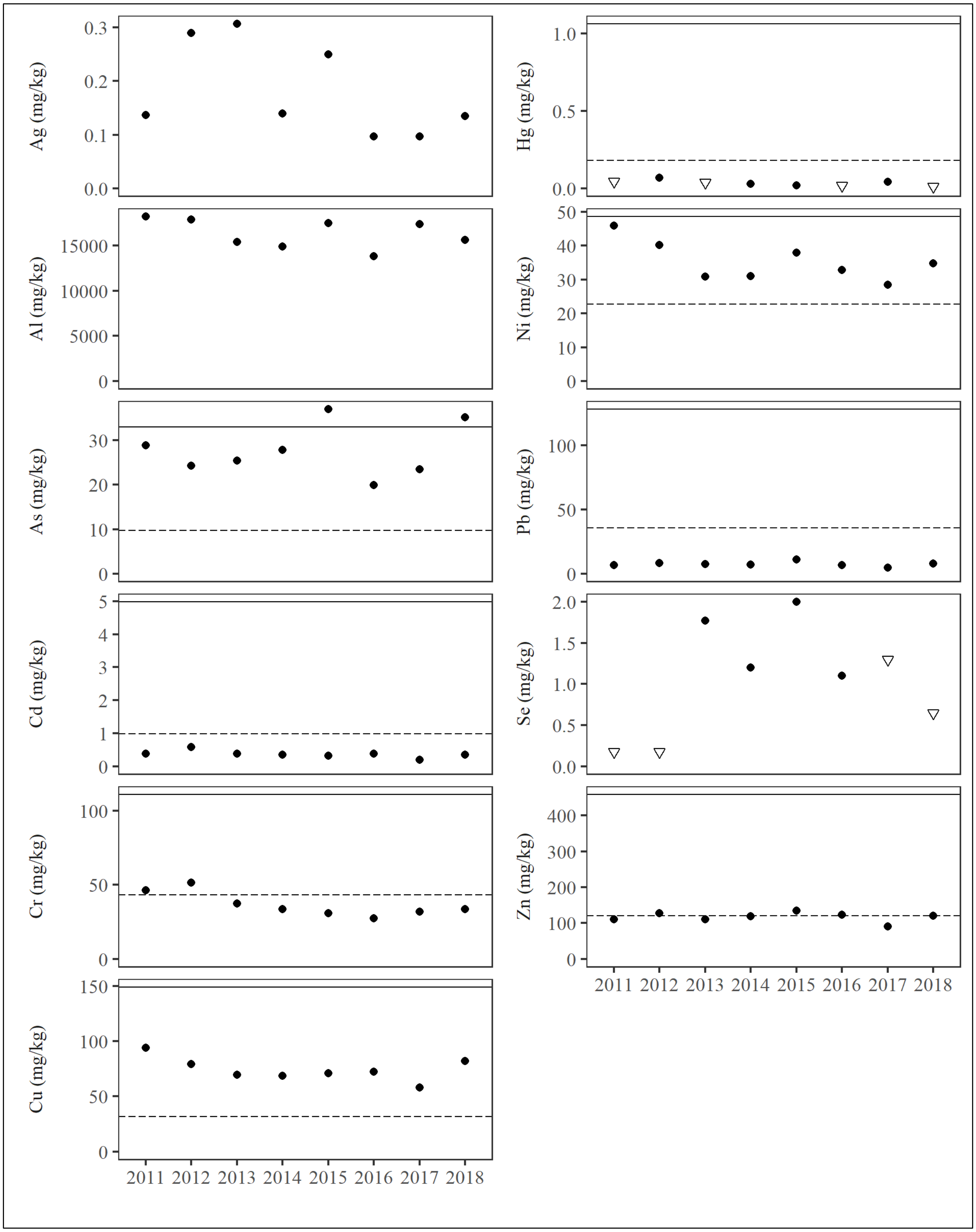

Figure 50.–Lower Sherman Creek sediment element concentrations.

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

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APPENDIX A: CHLOROPHYLL DATA

Appendix A.1.–Lower Slate Creek chlorophylls *a*, *b*, and *c* densities, 2011–2018.

	07/29/11			07/25/12			07/31/13		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.21	0.05	0.00	1.60	0.13	0.07	14.10	0.00	1.56
	1.28	0.02	0.11	4.06	0.00	0.39	20.72	0.00	3.11
	0.85	0.01	0.07	2.03	0.00	0.18	10.89	0.00	1.01
	3.31	0.08	0.25	0.96	0.00	0.04	17.84	0.00	2.66
	11.85	3.11	0.30	2.56	0.04	0.22	2.14	0.00	0.24
	18.05	0.42	0.91	0.92	0.00	0.01	6.09	0.00	0.95
	0.72	0.13	0.00	1.49	0.13	0.13	15.49	0.00	1.99
	0.43	0.05	0.00	2.35	0.12	0.19	12.71	0.00	1.58
	8.54	0.39	0.58	6.19	0.05	0.54	11.32	0.00	1.87
	6.30	0.03	0.38	0.96	0.00	0.06	14.63	0.00	1.46
mean	5.15	0.43	0.26	2.31	0.05	0.18	12.59	0.00	1.64
maximum	18.05	3.11	0.91	6.19	0.13	0.54	20.72	0.00	3.11
minimum	0.21	0.01	0.00	0.92	0.00	0.01	2.14	0.00	0.24

	07/30/14			07/28/15			07/26/16		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.00	0.00	0.00	0.45	0.10	0.01	0.60	0.00	0.12
	9.29	3.22	0.48	3.06	0.00	0.28	15.27	0.00	2.14
	1.45	0.00	0.23	0.95	0.09	0.04	6.41	0.00	0.97
	12.18	5.27	0.38	0.85	0.00	0.06	2.35	0.00	0.22
	0.75	0.00	0.05	0.72	0.13	0.00	9.51	0.76	0.88
	4.70	0.00	0.67	2.24	0.44	0.12	2.88	0.66	0.20
	2.88	0.00	0.49	9.93	0.00	1.13	3.52	0.00	0.40
	1.82	0.00	0.15	**0.19**	ND	ND	2.03	0.00	0.28
	0.73	0.00	0.07	2.88	0.14	0.28	5.34	0.67	0.36
	5.87	0.00	0.51	0.32	0.01	0.00	4.70	0.00	0.65
mean	3.97	0.85	0.30	2.16	0.10	0.21	5.26	0.21	0.62
maximum	12.18	5.27	0.67	9.93	0.44	1.13	15.27	0.76	2.14
minimum	0.00	0.00	0.00	0.19	0.00	0.00	0.60	0.00	0.12

	07/24/17			05/03/18			08/07/18		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	3.84	0.33	0.19	ND	ND	ND	2.35	0.00	0.42
	1.71	0.00	0.27	ND	ND	ND	3.31	0.00	0.56
	1.60	0.00	0.26	0.11	0.01	0.05	7.16	0.00	1.27
	2.14	0.00	0.41	0.33	0.00	0.02	3.63	0.00	0.59
	2.14	0.06	0.09	2.14	0.42	0.17	1.17	0.00	0.19
	4.91	1.86	0.16	1.10	0.00	0.15	3.10	0.08	0.26
	0.87	0.00	0.14	0.18	0.00	0.04	4.45	0.00	0.61
	2.14	0.00	0.36	ND	ND	ND	9.61	0.30	1.21
	1.60	0.05	0.11	1.55	0.00	0.19	1.50	0.00	0.26
	2.01	0.00	0.32	ND	ND	ND	5.77	0.00	0.91
mean	2.30	0.23	0.23	0.90	0.07	0.10	4.21	0.04	0.63
maximum	4.91	1.86	0.41	2.14	0.42	0.19	9.61	0.30	1.27
minimum	0.87	0.00	0.09	0.11	0.00	0.02	1.17	0.00	0.19

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

Appendix A.2.–West Fork Slate Creek chlorophylls *a*, *b*, and *c* densities, 2011–2018.

	07/29/11			07/25/12			07/31/13		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	2.52	0.00	0.19	1.15	0.00	0.04	4.70	0.00	0.74
	4.70	0.00	0.43	0.41	0.00	0.08	1.39	0.00	0.16
	2.78	0.00	0.26	0.53	0.00	0.02	13.14	0.00	2.19
	3.35	0.00	0.04	0.64	0.00	0.16	4.38	0.00	0.47
	4.27	0.00	0.25	3.62	0.00	0.24	1.28	0.00	0.11
	4.91	0.00	0.42	0.85	0.00	0.14	3.10	0.00	0.50
	3.95	0.00	0.27	0.96	0.01	0.07	3.74	0.00	0.53
	3.10	0.00	0.25	0.41	0.00	0.08	2.03	0.00	0.33
	4.38	0.00	0.39	0.60	0.00	0.12	5.02	0.00	0.67
	5.23	0.00	0.20	0.96	0.00	0.06	3.40	0.00	0.36
mean	3.92	0.00	0.27	1.01	0.00	0.10	4.22	0.00	0.61
maximum	5.23	0.00	0.43	3.62	0.01	0.24	13.14	0.00	2.19
minimum	2.52	0.00	0.04	0.41	0.00	0.02	1.28	0.00	0.11

	07/30/14			07/28/15			07/26/16		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.32	0.00	0.01	1.34	0.00	0.21	7.48	0.00	1.16
	0.19	0.00	0.00	0.92	0.00	0.01	4.70	0.00	0.71
	0.75	0.00	0.05	0.77	0.02	0.03	3.22	0.00	0.25
	0.88	0.00	0.00	0.54	0.05	0.00	5.34	0.00	0.61
	1.60	0.00	0.19	**0.19**	ND	ND	2.67	0.00	0.34
	0.23	0.00	0.03	1.64	0.00	0.04	3.31	0.00	0.45
	0.41	0.00	0.00	2.35	0.00	0.21	4.27	0.00	0.44
	0.33	0.00	0.02	0.53	0.12	0.00	0.92	0.00	0.01
	1.18	0.00	0.13	0.56	0.00	0.06	10.89	0.00	1.64
	1.82	0.00	0.15	0.32	0.05	0.00	6.51	0.00	0.95
mean	0.77	0.00	0.06	0.92	0.03	0.06	4.93	0.00	0.66
maximum	1.82	0.00	0.19	2.35	0.12	0.21	10.89	0.00	1.64
minimum	0.19	0.00	0.00	0.19	0.00	0.00	0.92	0.00	0.01

	07/24/17			07/25/18		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	5.13	0.00	0.60	1.17	0.00	0.22
	5.13	0.00	0.96	4.17	0.00	0.86
	1.82	0.00	0.19	2.35	0.00	0.32
	3.95	0.00	0.83	5.02	0.00	0.93
	5.87	0.00	1.22	5.55	0.00	1.22
	8.22	0.00	1.38	4.91	0.00	1.12
	8.22	0.00	1.58	3.10	0.00	0.53
	3.74	0.00	0.53	1.71	0.00	0.24
	2.78	0.00	0.33	4.38	0.00	0.75
	4.70	0.00	0.92	6.09	0.00	1.16
mean	4.96	0.00	0.85	3.85	0.00	0.74
maximum	8.22	0.00	1.58	6.09	0.00	1.22
minimum	1.82	0.00	0.19	1.17	0.00	0.22

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

Appendix A.3.–East Fork Slate Creek chlorophylls *a*, *b*, and *c* densities, 2011–2018.

	07/28/11			07/24/12			07/30/13		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	9.51	2.16	0.24	11.53	3.24	0.28	8.12	0.00	0.67
	9.18	0.02	0.20	0.41	0.04	0.04	**0.24**	ND	ND
	1.28	0.03	0.00	0.88	0.00	0.05	1.07	0.03	0.07
	5.13	1.15	0.11	0.50	0.00	0.03	0.32	0.07	0.00
	16.02	0.18	0.44	3.42	0.00	0.11	0.64	0.10	0.00
	8.86	1.94	0.70	0.64	0.08	0.05	5.02	0.16	0.35
	4.70	0.70	0.13	18.58	0.00	0.66	0.43	0.00	0.03
	16.13	5.35	0.28	13.67	2.32	0.57	6.41	0.11	0.50
	4.91	0.49	0.12	0.69	0.00	0.00	0.32	0.00	0.00
	12.71	3.59	0.15	0.43	0.00	0.00	**0.24**	ND	ND
mean	8.84	1.56	0.24	5.08	0.57	0.18	2.28	0.06	0.20
maximum	16.13	5.35	0.70	18.58	3.24	0.66	8.12	0.16	0.67
minimum	1.28	0.02	0.00	0.41	0.00	0.00	0.24	0.00	0.00

	07/30/14			07/27/15			07/25/16		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.14	0.00	0.00	0.85	0.00	0.12	0.23	0.00	0.03
	0.64	0.00	0.07	**0.19**	ND	ND	4.91	0.00	0.69
	0.05	ND	ND	1.92	0.00	0.09	0.75	0.00	0.05
	0.75	0.14	0.10	0.96	0.00	0.09	1.42	0.00	0.14
	0.05	ND	ND	1.60	0.00	0.22	0.85	0.02	0.17
	0.37	0.00	0.00	5.34	0.00	0.55	1.56	0.00	0.12
	0.05	ND	ND	2.14	0.00	0.09	0.64	0.00	0.08
	0.11	0.00	0.00	0.37	0.00	0.00	**0.19**	ND	ND
	0.53	0.00	0.01	0.92	0.00	0.11	0.87	0.00	0.02
	0.05	ND	ND	1.28	0.00	0.08	0.64	0.00	0.06
mean	0.27	0.02	0.03	1.56	0.00	0.15	1.21	0.00	0.15
maximum	0.75	0.14	0.10	5.34	0.00	0.55	4.91	0.02	0.69
minimum	0.05	0.00	0.00	0.19	0.00	0.00	0.19	0.00	0.02

	07/25/17			05/03/18			07/24/18		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.56	0.00	0.00	5.23	0.00	0.76	0.64	0.00	0.00
	0.51	0.00	0.00	0.87	0.00	0.02	2.14	0.00	0.12
	0.27	0.03	0.00	3.10	0.00	0.43	1.39	0.00	0.00
	0.41	0.00	0.08	0.41	0.00	0.08	0.75	0.00	0.02
	0.96	0.00	0.00	1.07	0.00	0.1	4.91	0.00	0.92
	0.85	0.00	0.15	ND	ND	ND	0.69	0.00	0.00
	0.32	0.00	0.08	8.65	0.00	1.02	0.88	0.00	0.05
	1.74	0.00	0.16	ND	ND	ND	1.61	0.00	0.11
	0.32	0.00	0.08	2.98	0.00	0.26	2.71	0.00	0.36
	0.46	0.00	0.00	ND	ND	ND	0.96	0.00	0.00
mean	0.64	0.00	0.06	3.19	0.00	0.38	1.67	0.00	0.16
maximum	1.74	0.03	0.16	8.65	0.00	1.02	4.91	0.00	0.92
minimum	0.27	0.00	0.00	0.41	0.00	0.02	0.64	0.00	0.00

Note: Bold values are the spectrophotometer estimated detection limit, chlorophyll *a* not detected.

Appendix A.4.–Upper Slate Creek chlorophylls *a*, *b*, and *c* densities, 2011–2018.

	07/29/11			07/24/12			07/30/13		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.41	0.00	0.00	2.03	0.00	0.14	1.82	0.00	0.27
	0.32	0.00	0.04	0.96	0.00	0.09	0.85	0.01	0.07
	0.96	0.01	0.07	0.75	0.00	0.00	2.94	0.00	0.13
	0.11	0.00	0.00	0.50	0.00	0.03	1.39	0.00	0.12
	2.67	0.00	0.26	2.03	0.00	0.14	2.99	0.00	0.11
	0.28	0.00	0.00	1.07	0.00	0.14	4.59	0.00	0.20
	0.60	0.00	0.12	0.55	0.00	0.02	0.85	0.00	0.01
	1.14	0.00	0.01	1.71	0.00	0.06	2.03	0.00	0.20
	0.53	0.00	0.00	2.14	0.00	0.12	0.85	0.00	0.00
	0.60	0.00	0.02	0.83	0.00	0.00	2.94	0.00	0.20
mean	0.76	0.00	0.05	1.26	0.00	0.07	2.13	0.00	0.13
maximum	2.67	0.01	0.26	2.14	0.00	0.14	4.59	0.01	0.27
minimum	0.11	0.00	0.00	0.50	0.00	0.00	0.85	0.00	0.00

	07/30/14			07/27/15			07/25/16		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.92	0.00	0.11	0.37	0.00	0.08	1.15	0.00	0.07
	1.20	0.00	0.07	0.64	0.00	0.08	8.86	0.00	1.12
	1.52	0.00	0.06	0.64	0.00	0.07	1.52	0.00	0.06
	1.82	0.00	0.15	0.51	0.00	0.06	5.34	0.00	0.93
	0.85	0.00	0.00	0.43	0.00	0.08	2.85	0.00	0.14
	0.64	0.00	0.01	0.55	0.00	0.28	1.01	0.00	0.09
	1.18	0.00	0.07	0.64	0.00	0.02	4.81	0.00	0.40
	0.96	0.00	0.00	0.64	0.00	0.08	2.40	0.16	0.21
	0.64	0.00	0.01	0.69	0.00	0.00	4.49	0.00	0.36
	1.17	0.00	0.12	1.17	0.00	0.13	6.19	0.00	0.79
mean	1.09	0.00	0.06	0.63	0.00	0.09	3.86	0.02	0.42
maximum	1.82	0.00	0.15	1.17	0.00	0.28	8.86	0.16	1.12
minimum	0.64	0.00	0.00	0.37	0.00	0.00	1.01	0.00	0.06

	07/24/17			07/25/18		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.43	0.00	0.00	3.95	0.00	0.67
	1.06	0.00	0.00	3.31	0.00	0.73
	0.64	0.00	0.00	1.82	0.00	0.13
	0.50	0.00	0.03	2.88	0.00	0.37
	0.96	0.00	0.00	2.24	0.00	0.14
	1.17	0.00	0.03	1.17	0.00	0.03
	1.07	0.00	0.14	3.52	0.00	0.55
	0.64	0.00	0.00	2.56	0.00	0.35
	0.32	0.01	0.00	1.60	0.00	0.41
	1.47	0.00	0.23	2.67	0.00	0.18
mean	0.83	0.00	0.04	2.57	0.00	0.36
maximum	1.47	0.01	0.23	3.95	0.00	0.73
minimum	0.32	0.00	0.00	1.17	0.00	0.03

Appendix A.5.–Lower Sherman Creek SP1 chlorophylls *a*, *b*, and *c* densities, 2011–2018.

	07/28/11			07/26/12			07/29/13		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	1.28	0.00	0.05	1.07	0.00	0.14	4.06	0.00	0.38
	5.34	0.00	0.36	2.88	0.87	0.16	5.55	0.00	0.73
	5.98	0.00	0.54	0.41	0.04	0.04	**0.24**	ND	ND
	3.84	0.10	0.48	2.67	1.27	0.00	4.67	0.00	0.55
	15.59	3.98	0.17	0.60	0.00	0.12	7.69	0.00	0.89
	11.11	2.64	0.28	1.07	0.00	0.11	7.37	0.00	0.62
	19.33	0.00	1.65	3.63	1.56	0.03	**0.24**	ND	ND
	7.26	0.00	0.74	9.61	4.12	0.08	2.67	0.00	0.35
	1.92	0.04	0.19	2.99	1.43	0.02	0.75	0.03	0.08
	4.38	0.17	0.44	0.43	0.00	0.06	ND	ND	ND
mean	7.60	0.69	0.49	2.54	0.93	0.08	3.69	0.00	0.51
maximum	19.33	3.98	1.65	9.61	4.12	0.16	7.69	0.03	0.89
minimum	1.28	0.00	0.05	0.41	0.00	0.00	0.24	0.00	0.08

	07/28/14			07/27/15			07/25/16		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	2.46	0.00	0.30	0.28	0.00	0.03	3.31	0.52	0.31
	0.74	0.00	0.10	**0.19**	ND	ND	4.27	0.00	0.76
	0.19	0.00	0.00	0.92	0.00	0.11	1.39	0.00	0.16
	0.92	0.00	0.14	0.64	0.00	0.01	2.14	0.00	0.37
	0.83	0.00	0.15	2.67	0.00	0.31	2.28	0.00	0.32
	2.99	0.00	0.47	0.79	0.00	0.00	13.24	6.47	0.31
	1.39	0.00	0.17	2.78	0.00	0.32	2.78	0.13	0.23
	2.46	0.00	0.25	**0.19**	ND	ND	2.24	0.00	0.31
	0.45	0.01	0.04	4.17	0.00	0.49	3.31	0.12	0.35
	0.96	0.00	0.16	1.01	0.00	0.09	2.03	0.20	0.17
mean	1.34	0.00	0.18	1.36	0.00	0.17	3.70	0.74	0.33
maximum	2.99	0.01	0.47	4.17	0.00	0.49	13.24	6.47	0.76
minimum	0.19	0.00	0.00	0.19	0.00	0.00	1.39	0.00	0.16

	07/25/17			07/24/18		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	5.02	0.00	0.68	2.88	0.00	0.36
	5.13	0.00	0.93	3.95	0.00	0.50
	2.35	0.00	0.28	2.14	0.00	0.38
	2.99	0.00	0.40	2.43	0.00	0.23
	4.49	0.00	0.64	2.56	0.00	0.36
	3.84	0.00	0.55	2.06	0.00	0.15
	6.30	0.00	1.05	1.82	0.00	0.20
	4.06	0.00	0.63	4.58	0.00	0.63
	1.10	0.00	0.05	2.24	0.00	0.35
	3.31	0.00	0.39	1.71	0.00	0.15
mean	3.86	0.00	0.56	2.64	0.00	0.33
maximum	6.30	0.00	1.05	4.58	0.00	0.63
minimum	1.10	0.00	0.05	1.71	0.00	0.15

Note: Bold values are the spectrophotometer estimated detection limit, chlorophyll *a* not detected.

Appendix A.6.–Lower Sherman Creek SP2 chlorophylls *a*, *b*, and *c* densities, 2011–2018.

	07/28/11			07/26/12			07/29/13		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	3.10	0.00	0.26	1.05	0.04	0.12	1.07	0.00	0.14
	6.30	0.19	0.62	0.64	0.00	0.11	3.84	0.00	0.34
	4.59	0.00	0.38	0.73	0.00	0.07	0.96	0.00	0.15
	0.32	0.00	0.00	0.50	0.07	0.10	4.81	0.00	0.49
	13.88	0.00	0.54	**0.34**	ND	ND	5.77	0.00	0.78
	7.37	0.00	0.46	0.51	0.00	0.06	0.32	0.02	0.10
	1.50	0.00	0.09	0.96	0.00	0.16	4.70	0.00	0.44
	14.31	0.00	0.59	0.37	0.00	0.00	3.52	0.00	0.35
	0.85	0.00	0.01	1.28	0.00	0.09	0.53	0.00	0.02
	3.84	0.00	0.25	**0.34**	ND	ND	3.20	0.00	0.43
mean	5.61	0.02	0.32	0.67	0.01	0.09	2.87	0.00	0.32
maximum	14.31	0.19	0.62	1.28	0.07	0.16	5.77	0.02	0.78
minimum	0.32	0.00	0.00	0.34	0.00	0.00	0.32	0.00	0.02

	07/28/14			07/27/15			07/25/16		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.74	0.00	0.10	0.69	0.00	0.00	1.50	0.00	0.17
	1.38	0.00	0.18	0.96	0.00	0.00	2.03	0.00	0.30
	2.83	0.00	0.15	0.85	0.00	0.11	0.43	0.00	0.13
	3.31	0.00	0.31	1.28	0.00	0.16	2.98	0.00	0.38
	0.75	0.00	0.06	2.14	0.00	0.24	0.96	0.00	0.09
	0.85	0.03	0.08	3.63	0.65	0.43	1.28	0.04	0.26
	0.85	0.00	0.01	0.96	0.07	0.03	1.71	0.00	0.22
	1.39	0.00	0.16	2.14	0.78	1.30	1.92	0.35	0.16
	0.43	0.01	0.04	1.07	0.00	0.14	0.41	0.00	0.08
	0.69	0.00	0.07	2.46	0.00	0.24	0.96	0.00	0.06
mean	1.32	0.00	0.12	1.62	0.15	0.27	1.42	0.04	0.19
maximum	3.31	0.03	0.31	3.63	0.78	1.30	2.98	0.35	0.38
minimum	0.43	0.00	0.01	0.69	0.00	0.00	0.41	0.00	0.06

	07/25/17			07/24/18		
mg/m²	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.75	0.00	0.05	0.96	0.00	0.09
	0.85	0.01	0.07	1.38	0.00	0.21
	0.88	0.00	0.05	1.60	0.00	0.17
	0.69	0.00	0.07	0.53	0.00	0.02
	3.70	0.00	0.46	1.50	0.00	0.26
	0.69	0.00	0.07	1.60	0.00	0.23
	0.64	0.00	0.07	0.64	0.00	0.11
	1.82	0.00	0.20	4.17	0.00	0.58
	0.92	0.00	0.11	0.96	0.00	0.09
	0.55	0.00	0.02	1.60	0.00	0.15
mean	1.15	0.00	0.12	1.49	0.00	0.19
maximum	3.70	0.01	0.46	4.17	0.00	0.58
minimum	0.55	0.00	0.02	0.53	0.00	0.02

Note: Bold values are the spectrophotometer estimated detection limit, chlorophyll *a* not detected.

APPENDIX B: BENTHIC MACROINVERTEBRATE DATA

Appendix B.1.–Lower Slate Creek BMI data summary, 2011–2018.

	05/04/11	05/02/12	04/30/13	04/30/14	04/27/15	04/26/16	04/25/17	05/03/18
Total BMI Taxa	29	32	27	32	26	24	27	17
Total EPT Taxa	13	17	16	17	13	11	13	9
Total BMI Counted	1,148	1,760	1,200	2,308	1,901	1,894	730	269
Ephemeroptera	85	387	400	73	196	225	219	84
Plecoptera	70	274	203	352	258	61	145	37
Trichoptera	2	8	6	17	6	3	3	0
Aquatic Diptera	862	975	503	1,711	1,268	1,038	308	32
Other	129	116	88	155	173	567	55	116
% Ephemeroptera	7%	22%	33%	3%	10%	12%	30%	31%
% Plecoptera	6%	16%	17%	15%	14%	3%	20%	14%
% Trichoptera	0.2%	0.5%	0.5%	0.7%	0.3%	0.2%	0.4%	0.0%
% Aquatic Diptera	75%	55%	42%	74%	67%	55%	42%	12%
% Other	11%	7%	7%	7%	9%	30%	8%	43%
% EPT	14%	38%	51%	19%	24%	15%	50%	45%
% Chironomidae	72%	53%	35%	68%	64%	51%	36%	11%
Shannon Diversity Score	0.51	0.69	0.85	0.64	0.70	0.65	0.81	0.81
Evenness Score	0.48	0.58	0.70	0.52	0.58	0.57	0.73	0.84
Total Sample Area (m^2)	0.558	0.558	0.465	0.558	0.558	0.558	0.558	0.558
Mean BMI/m^2	2,057	3,154	2,581	4,136	3,407	3,394	1,308	482
±1 SD	1,046	1,849	551	3,592	2,458	1,667	436	461
Terrestrial Invertebrates	0	4	0	1	3	88	1	0
Juvenile Fish	1	0	0	1	0	0	0	1

Appendix B.2.–West Fork Slate Creek BMI data summary, 2011–2018.

	05/04/11	05/02/12	04/30/13	04/30/14	04/27/15	04/26/16	04/25/17	05/03/18
Total BMI Taxa	21	31	28	29	28	25	21	18
Total EPT Taxa	11	21	18	17	16	15	13	12
Total BMI Counted	280	1,015	1,365	543	1,470	820	494	183
Ephemeroptera	181	634	991	223	956	564	311	115
Plecoptera	41	166	233	150	243	55	94	37
Trichoptera	3	11	10	15	10	10	2	2
Aquatic Diptera	35	175	118	136	215	151	77	22
Other	20	29	13	19	46	40	10	7
% Ephemeroptera	65%	63%	73%	41%	65%	69%	63%	63%
% Plecoptera	15%	16%	17%	28%	17%	7%	19%	20%
% Trichoptera	1%	1%	0.7%	3%	0.7%	1%	0.4%	1%
% Aquatic Diptera	13%	17%	9%	25%	15%	18%	16%	12%
% Other	7%	3%	1%	3%	3%	5%	2%	4%
% EPT	80%	80%	90%	71%	82%	77%	82%	84%
% Chironomidae	10%	15%	7%	22%	12%	18%	14%	10%
Shannon Diversity Score	0.63	0.84	0.73	0.91	0.82	0.72	0.78	0.72
Evenness Score	0.78	0.71	0.61	0.79	0.71	0.69	0.78	0.83
Total Sample Area (m^2)	0.558	0.558	0.558	0.558	0.558	0.558	0.558	0.558
Mean BMI/m^2	502	1,819	2,446	973	2,634	1,470	885	328
±1 SD	410	1,009	777	482	1,400	703	592	140
Terrestrial Invertebrates	2	0	0	0	1	7	0	2
Juvenile Fish	0	0	0	0	0	0	0	0

Appendix B.3.–East Fork Slate Creek BMI data summary, 2011–2018.

	05/12/11	04/27/12	04/29/13	04/30/14	04/29/15	04/25/16	04/27/17	05/03/18
Total BMI Taxa	27	33	33	24	28	21	27	26
Total EPT Taxa	15	17	17	9	16	11	13	15
Total BMI Counted	2,616	2,585	5,249	1,143	1,792	1,117	3,785	2,002
Ephemeroptera	387	490	19	9	274	227	310	99
Plecoptera	70	73	45	10	36	42	58	33
Trichoptera	28	23	66	3	14	40	33	21
Aquatic Diptera	507	547	598	454	633	398	1,281	732
Other	1,624	1,451	4,521	667	835	410	2,103	1,117
% Ephemeroptera	15%	19%	0.4%	0.8%	15%	20%	8%	5%
% Plecoptera	3%	3%	0.9%	0.9%	2%	4%	2%	2%
% Trichoptera	1%	0.9%	1%	0.3%	0.8%	4%	1%	1%
% Aquatic Diptera	19%	21%	11%	40%	35%	36%	34%	37%
% Other	62%	56%	86%	58%	47%	37%	56%	56%
% EPT	19%	23%	2%	2%	18%	28%	11%	8%
% Chironomidae	17%	15%	10%	35%	28%	26%	21%	31%
Shannon Diversity Score	0.64	0.78	0.57	0.70	0.92	0.92	0.62	0.54
Evenness Score	0.54	0.61	0.47	0.63	0.72	0.78	0.51	0.46
Total Sample Area (m^2)	0.558	0.558	0.558	0.558	0.465	0.558	0.558	0.558
Mean BMI/m^2	4,688	4,633	9,407	2,048	3,854	2,002	6,783	3,588
±1 SD	1,081	1,325	3,830	952	837	469	2,365	1,984
Terrestrial Invertebrates	3	1	0	0	5	11	0	0
Juvenile Fish	0	0	0	0	0	0	0	0

Appendix B.4.–Upper Slate Creek BMI data summary, 2011–2018.

	05/12/11	04/27/12	04/29/13	04/28/14	04/29/15	04/25/16	04/27/17	05/02/18
Total BMI Taxa	33	39	34	36	31	28	30	31
Total EPT Taxa	18	21	20	20	19	15	19	18
Total BMI Counted	1,408	1,259	1,607	1,744	2,107	1,338	1,132	864
Ephemeroptera	368	454	492	622	622	554	460	383
Plecoptera	401	349	604	429	758	252	172	175
Trichoptera	116	48	55	44	44	104	62	33
Aquatic Diptera	248	273	338	518	517	169	406	258
Other	275	135	118	131	166	259	32	15
% Ephemeroptera	26%	36%	31%	36%	30%	41%	41%	44%
% Plecoptera	29%	28%	38%	25%	36%	19%	15%	20%
% Trichoptera	8%	4%	3%	3%	2%	8%	5%	4%
% Aquatic Diptera	18%	22%	21%	30%	25%	13%	36%	30%
% Other	20%	11%	7%	8%	8%	19%	3%	2%
% EPT	63%	68%	72%	63%	68%	68%	61%	68%
% Chironomidae	15%	20%	19%	28%	22%	11%	34%	28%
Shannon Diversity Score	0.97	1.04	1.02	1.03	0.98	1.06	0.96	0.92
Evenness Score	0.76	0.79	0.78	0.76	0.74	0.82	0.73	0.75
Total Sample Area (m^2)	0.558	0.558	0.558	0.558	0.558	0.558	0.558	0.558
Mean BMI/m^2	2,523	2,256	2,880	3,125	3,776	2,398	2,029	1,548
±1 SD	1,173	1,321	1,049	660	1,174	520	1,143	574
Terrestrial Invertebrates	1	0	0	1	3	6	3	1
Juvenile Fish	0	0	0	0	0	0	0	0

Appendix B.5.–Upper Johnson Creek BMI data summary, 2011–2018.

	05/03/11	04/26/12	04/29/13	04/29/14	04/28/15	04/27/16	04/26/17	05/04/18
Total BMI Taxa	24	28	34	32	28	32	33	31
Total EPT Taxa	14	14	24	21	17	21	19	20
Total BMI Counted	2,084	2,214	2,938	1,483	1,556	2,054	1,619	1,672
Ephemeroptera	962	1,139	1,680	740	917	1,160	651	935
Plecoptera	114	163	147	217	58	97	113	97
Trichoptera	59	118	95	68	137	198	54	80
Aquatic Diptera	619	586	799	407	366	476	773	542
Other	330	208	217	51	78	123	28	18
% Ephemeroptera	46%	51%	57%	50%	59%	56%	40%	56%
% Plecoptera	6%	7%	5%	15%	4%	5%	7%	6%
% Trichoptera	3%	5%	3%	5%	9%	10%	3%	5%
% Aquatic Diptera	30%	27%	27%	27%	24%	23%	48%	32%
% Other	16%	9%	7%	3%	5%	6%	2%	1%
% EPT	55%	64%	65%	69%	71%	71%	51%	67%
% Chironomidae	29%	26%	27%	26%	22%	22%	46%	31%
Shannon Diversity Score	0.76	0.81	0.74	0.74	0.87	0.88	0.68	0.81
Evenness Score	0.66	0.68	0.59	0.59	0.71	0.70	0.55	0.66
Total Sample Area (m^2)	0.558	0.558	0.558	0.558	0.558	0.558	0.558	0.558
Mean BMI/m^2	3,735	3,968	5,265	2,658	2,789	3,681	2,901	2,996
±1 SD	1,918	2,305	2,512	2,017	858	1,025	1,056	1,430
Terrestrial Invertebrates	1	1	1	4	1	2	6	1
Juvenile Fish	0	0	0	0	0	0	0	0

Appendix B.6.–Lower Sherman Creek SP1 BMI data summary, 2011–2018.

	05/04/11	04/30/12	05/01/13	04/29/14	04/28/15	04/27/16	04/26/17	05/02/18
Total BMI Taxa	26	31	28	30	26	26	25	26
Total EPT Taxa	15	18	16	13	13	13	13	16
Total BMI Counted	624	1,525	1,002	1,687	921	3,816	563	509
Ephemeroptera	157	876	499	114	175	101	88	293
Plecoptera	36	103	135	97	67	41	72	48
Trichoptera	7.0	14	6	18	6	9	16	11
Aquatic Diptera	89	160	131	648	326	273	123	51
Other	335	372	231	810	347	3,392	264	106
% Ephemeroptera	25%	58%	50%	7%	19%	3%	16%	58%
% Plecoptera	6%	7%	13%	6%	7%	1%	13%	9%
% Trichoptera	1%	0.9%	0.6%	1%	1%	0.2%	3%	2%
% Aquatic Diptera	14%	11%	13%	38%	35%	7%	22%	10%
% Other	54%	24%	23%	48%	38%	89%	47%	21%
% EPT	32%	66%	64%	14%	27%	4%	31%	69%
% Chironomidae	6%	8%	12%	33%	33%	7%	13%	7%
Shannon Diversity Score	0.76	0.74	0.85	0.71	0.84	0.32	0.81	0.73
Evenness Score	0.71	0.62	0.71	0.57	0.70	0.27	0.69	0.71
Total Sample Area (m^2)	0.558	0.558	0.558	0.558	0.558	0.558	0.558	0.558
Mean BMI/m^2	1,118	2,733	1,796	3,023	1,651	6,839	1,009	912
±1 SD	1,000	1,410	247	936	718	1,398	168	408
Terrestrial Invertebrates	1	0	14	1	14	21	1	0
Juvenile Fish	10	12	0	8	0	77	0	11

Appendix B.7.–Lower Sherman Creek SP2 BMI data summary, 2011–2018.

	05/03/11	04/30/12	04/30/13	04/29/14	04/28/15	04/27/16	04/26/17	05/02/18
Total BMI Taxa	30	36	39	28	23	23	26	21
Total EPT Taxa	17	26	25	16	13	13	14	18
Total BMI Counted	921	1,573	1,889	661	898	1,045	239	543
Ephemeroptera	548	1,143	1,049	31	163	84	37	427
Plecoptera	137	77	299	40	47	32	25	39
Trichoptera	14	26	18	7	13	10	5	13
Aquatic Diptera	143	254	289	354	315	224	88	43
Other	79	75	234	229	360	695	84	21
% Ephemeroptera	60%	73%	56%	5%	18%	8%	15%	79%
% Plecoptera	15%	5%	16%	6%	5%	3%	10%	7%
% Trichoptera	2%	2%	1%	1%	1%	1%	2%	2%
% Aquatic Diptera	16%	16%	15%	54%	35%	21%	37%	8%
% Other	9%	5%	12%	35%	40%	67%	35%	4%
% EPT	76%	79%	72%	12%	25%	12%	28%	88%
% Chironomidae	11%	15%	14%	48%	33%	20%	24%	6%
Shannon Diversity Score	0.93	0.70	0.84	0.70	0.77	0.53	0.84	0.61
Evenness Score	0.76	0.57	0.65	0.62	0.66	0.49	0.80	0.57
Total Sample Area (m^2)	0.558	0.558	0.558	0.558	0.558	0.558	0.558	0.558
Mean BMI/m^2	1,651	2,823	3,385	1,185	1,609	1,873	428	973
±1 SD	927	1,174	1,471	769	748	982	219	370
Terrestrial Invertebrates	1	2	18	1	10	4	2	1
Juvenile Fish	0	0	14	0	0	6	0	13

Appendix B.8.–Middle Sherman Creek below Outfall 001 BMI data summary, 2015, 2016, and 2018.

	04/28/15	04/27/16	05/02/18
Total BMI Taxa	21	22	23
Total EPT Taxa	12	12	15
Total Aquatic BMI Counted	379	552	144
Ephemeroptera	212	199	63
Plecoptera	10	17	16
Trichoptera	5	5	6
Aquatic Diptera	93	223	46
Other	59	108	13
% Ephemeroptera	56%	36%	44%
% Plecoptera	3%	3%	11%
% Trichoptera	1%	0.9%	4%
% Aquatic Diptera	25%	40%	32%
% Other	16%	20%	9%
% EPT	60%	40%	59%
% Chironomidae	24%	38%	28%
Shannon Diversity Score	0.77	0.64	0.79
Evenness Score	0.74	0.62	0.84
Total Sample Area (m^2)	0.558	0.558	0.558
Mean BMI/m^2	679	989	258
±1 SD	201	274	110
Terrestrial Invertebrates	10	11	1
Juvenile Fish	0	0	0

Appendix B.9.–Middle Sherman Creek above Outfall 001 BMI data summary, 2015, 2016, and 2018.

	04/28/15	04/27/16	05/02/18
Total BMI Taxa	32	30	22
Total EPT Taxa	22	20	17
Total BMI Counted	2,551	1,017	305
Ephemeroptera	1,800	582	151
Plecoptera	362	158	74
Trichoptera	33	26	19
Aquatic Diptera	230	122	43
Other	126	129	18
% Ephemeroptera	71%	57%	50%
% Plecoptera	14%	16%	24%
% Trichoptera	1%	3%	6%
% Aquatic Diptera	9%	12%	14%
% Other	5%	13%	6%
% EPT	86%	75%	80%
% Chironomidae	7%	11%	14%
Shannon Diversity Score	0.80	0.90	0.90
Evenness Score	0.62	0.74	0.85
Total Sample Area (m^2)	0.558	0.558	0.558
Mean BMI/m^2	4,572	1,823	547
±1 SD	987	530	275
Terrestrial Invertebrates	7	6	0
Juvenile Fish	0	0	0

APPENDIX C: ADULT SALMON DATA

Appendix C.1.–2018 Lower Slate Creek weekly adult pink salmon count by reach.

	07/25/18		07/31/18		08/07/18		08/14/18		08/21/18	
Stream Reach	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass
0-100 m	0	0	ND	ND	0	0	0	0	0	0
100-200 m	0	0	ND	ND	0	0	2	0	0	0
200-300 m	0	0	ND	ND	0	0	0	0	0	0
300-400 m	0	0	ND	ND	0	0	1	0	0	0
400-500 m	0	0	ND	ND	0	0	0	0	0	0
500-600 m	0	0	ND	ND	0	0	0	0	0	0
600-700 m	0	0	ND	ND	0	0	0	0	1	0
700-800 m	0	0	ND	ND	0	0	0	0	0	0
800-900 m	0	0	ND	ND	0	0	0	0	0	0
900-Falls	0	0	ND	ND	0	0	ND	ND	ND	ND
Total	0	0	ND	ND	0	0	**3**	**0**	**1**	**0**

Note: Bold numbers indicate incomplete surveys.

Appendix C.2.–2018 Lower Slate Creek weekly adult coho salmon count by reach.

	09/27/18		10/05/18		10/10/18		10/23/18		10/29/18	
Stream Reach	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass
0-100 m	1	0	0	0	0	0	0	0	0	0
100-200 m	0	0	0	0	0	0	0	0	0	0
200-300 m	0	0	0	0	0	0	0	0	0	0
300-400 m	0	0	0	0	0	0	0	0	0	0
400-500 m	0	0	0	0	0	0	0	0	0	0
500-600 m	0	0	0	0	0	0	0	0	0	0
600-700 m	0	0	0	0	0	0	0	0	0	0
700-800 m	0	0	0	0	0	0	0	0	0	0
800-900 m	0	0	0	0	0	0	0	0	0	0
900-Falls	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	0	0	0	0	0

Appendix C.3.–2018 Lower Johnson Creek weekly adult pink salmon count by reach.

	07/24/18		07/31/18		08/07/18		08/14/18		08/21/18		08/29/18	
Stream Reach	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass
Con-Lace	0	0	0	0	0	0	0	0	0	0	0	0
Lace-JM	0	0	0	0	0	0	0	0	0	0	0	0
JM-Trap Site	0	0	0	0	0	0	0	0	0	0	0	0
Trap-Site #4	42	0	90	0	90	0	70	0	47	0	0	0
Site #4-Site #7	0	0	0	0	1	0	43	0	17	0	0	0
Site #7-Site #10	0	0	0	0	0	0	30	0	0	0	0	0
Site #10-PH	0	0	0	0	0	0	2	0	2	0	0	0
PH-LF	0	0	0	0	0	0	0	0	0	0	0	0
LF-Site #15	0	0	0	0	0	0	0	0	ND	ND	0	0
Site #15-Falls	0	0	0	0	0	0	0	0	ND	ND	0	0
Total	42	0	90	0	91	0	145	0	**66**	**0**	0	0

Note : Bold numbers indicate incomplete surveys.

Appendix C.4.–2018 Lower Johnson Creek weekly adult chum salmon count by reach.

	07/24/18		07/31/18		08/07/18		08/14/18		08/21/18		08/29/18	
Stream Reach	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass
Con-Lace	0	0	0	0	0	0	0	0	0	0	0	0
Lace-JM	0	0	0	0	0	0	0	0	0	0	0	0
JM-Trap Site	0	0	0	0	0	0	0	0	0	0	0	0
Trap-Site #4	0	0	1	0	0	0	0	0	0	0	0	0
Site #4-Site #7	0	0	1	0	0	0	0	0	0	0	0	0
Site #7-Site #10	0	0	0	0	0	0	0	0	0	0	0	0
Site #10-PH	0	0	0	0	0	0	0	0	0	0	0	0
PH-LF	0	0	0	0	0	0	0	0	0	0	0	0
LF-Site #15	0	0	0	0	0	0	0	0	ND	ND	0	0
Site #15-Falls	0	0	0	0	0	0	0	0	ND	ND	0	0
Total	0	0	2	0	0	0	0	0	**0**	**0**	0	0

Note : Bold numbers indicate incomplete surveys.

Appendix C.5.–2018 Lower Johnson Creek weekly adult coho salmon count by reach.

	09/27/18		10/05/18		10/10/18		10/23/18		10/29/18	
Stream Reach	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass
Con-Lace	ND	ND	0	0	0	0	0	0	0	0
Lace-JM	ND	ND	0	0	0	0	0	0	0	0
JM-Trap Site	4	0	3	0	0	0	0	0	0	0
Trap-Site #4	0	0	0	0	0	0	ND	ND	0	0
Site #4-Site #7	0	0	0	0	1	0	ND	ND	2	0
Site #7-Site #10	2	0	2	0	9	0	ND	ND	6	0
Site #10-PH	1	0	0	0	0	0	ND	ND	3	0
PH-LF	0	0	0	0	0	0	ND	ND	0	0
LF-Site #15	0	0	0	0	0	0	ND	ND	2	0
Site #15-Falls	ND	ND	ND	ND	ND	ND	ND	ND	1	0
Total	**7**	**0**	**5**	**0**	**10**	**0**	**0**	**0**	14	0

Note : Bold numbers indicate incomplete surveys.

Appendix C.6.–2018 Lower Sherman Creek weekly adult pink salmon count by reach.

	07/24/18		07/31/18		08/07/18		08/14/18		08/21/18	
Stream Reach	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass
0-50 m	0	0	0	0	1	0	15	0	0	0
50-100 m	0	0	0	0	1	0	4	0	0	0
100-150 m	0	0	0	0	2	0	8	0	0	0
150-200 m	0	0	0	0	0	0	23	0	0	0
200-250 m	0	0	0	0	0	0	5	0	0	0
250-300 m	0	0	0	0	0	0	6	0	1	0
300-350 m	0	0	0	0	0	0	20	0	0	0
350-Falls	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	4	0	81	0	1	0

Appendix C.7.–2018 Lower Sherman Creek weekly adult chum salmon count by reach.

	07/24/18		07/31/18		08/07/18		08/14/18		08/21/18	
Stream Reach	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass	Count	Carcass
0-50 m	0	0	0	0	0	0	2	0	0	0
50-100 m	0	0	0	0	0	0	2	0	0	0
100-150 m	0	0	0	0	0	0	1	0	0	0
150-200 m	0	0	0	0	0	0	1	0	0	0
200-250 m	0	0	0	0	0	0	0	0	0	0
250-300 m	0	0	0	0	0	0	0	0	0	0
300-350 m	0	0	0	0	0	0	0	0	1	0
350-Falls	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	6	0	1	0

Appendix C.8.–Lower Slate Creek adult pink salmon count by statistical week, 2011–2018.

Statistical Week No.	2011	2012	2013	2014	2015	2016	2017	2018
29	ND	0	0	0	ND	ND	0	ND
30	**0**	0	7	0	12	0	0	0
31	0	364	66	2	487	0	7	ND
32	369	1,106	604	14	1,769	1	386	0
33	763	3,152	864	13	1,783	0	**477**	**3**
34	1,394	2,331	1,199	12	1,543	64	2,818	**1**
35	1,646	318	472	0	850	12	**1,340**	ND
36	1,807	1	97	ND	527	**2**	1,811	ND
37	229	0	27	ND	575	ND	577	ND
38	46	ND	1	ND	32	ND	ND	ND
39	0	ND	ND	ND	2	ND	0	ND
40	ND	ND	ND	ND	ND	ND	ND	ND

Note : Bold numbers indicate incomplete surveys.

Appendix C.9.–Lower Johnson Creek adult pink salmon count by statistical week, 2011–2018.

Statistical Week No.	2011	2012	2013	2014	2015	2016	2017	2018
29	ND	0	59	ND	ND	ND	109	ND
30	1	73	200	44	4,512	0	1,222	42
31	180	411	2,250	48	568	6	3,291	90
32	1,891	753	1,456	84	17,517	154	2,272	91
33	3,850	1,698	1,873	2	19,028	125	3,364	145
34	5,264	1,816	1,557	11	5,444	15	4,010	**66**
35	1,350	198	545	0	2,057	95	5,165	0
36	3,712	60	149	ND	1,238	33	1,775	0
37	670	7	97	ND	702	ND	1,587	ND
38	436	0	ND	ND	249	ND	**288**	ND
39	145	ND	ND	ND	10	ND	**156**	ND
40	ND	ND	ND	ND	ND	ND	**0**	ND

Note : Bold numbers indicate incomplete surveys.

Appendix C.10.–Lower Sherman Creek adult pink salmon count by statistical week, 2011–2018.

Statistical Week No.	2011	2012	2013	2014	2015	2016	2017	2018
29	ND	0	2	ND	ND	ND	0	ND
30	1	2	164	0	120	0	4	0
31	298	9	860	6	38	0	61	0
32	773	97	979	40	348	0	778	4
33	1,049	285	765	10	723	0	1,076	81
34	397	521	549	4	334	**0**	730	1
35	157	521	785	10	ND	24	941	ND
36	870	145	624	0	413	**2**	781	ND
37	**416**	25	232	ND	648	ND	841	ND
38	609	3	21	ND	159	ND	478	ND
39	**35**	ND	ND	ND	15	ND	ND	ND
40	ND	ND	ND	ND	ND	ND	ND	ND

Note : Bold numbers indicate incomplete surveys.

APPENDIX D: SPAWNING SUBSTRATE DATA

Appendix D.1.–Lower Slate Creek SP1 pink salmon spawning substrate data, 2011–2018.

Sample	Sample	Volume (mL/L) Retained Each Sieve (mm)									
Date	No.	101.6	50.8	25.4	12.7	6.35	1.68	0.42	0.15	Imhoff	GMPS
08/17/11	1	0	0	470	260	340	425	225	20	22.0	9.8
08/17/11	2	750	70	460	250	200	280	100	25	8.0	14.0
08/17/11	3	525	280	240	210	290	440	100	70	20.5	12.2
08/17/11	4	0	0	250	340	495	1425	525	55	68.0	5.2
07/09/12	1	1,050	140	140	280	190	395	95	15	24.0	10.6
07/09/12	2	0	0	200	225	140	325	140	15	24.0	8.2
07/09/12	3	0	515	310	225	250	580	240	27	65.0	12.8
07/09/12	4	0	570	510	260	290	750	435	53	54.0	11.8
07/02/13	1	0	400	460	430	320	365	145	25	66.0	15.4
07/02/13	2	0	150	400	250	245	515	225	36	53.0	9.8
07/02/13	3	0	800	325	320	255	445	205	25	60.0	18.0
07/02/13	4	0	275	565	385	245	495	250	19	28.0	13.5
07/01/14	1	600	420	375	225	235	320	165	22	57.0	15.5
07/01/14	2	0	50	350	300	175	225	25	7.5	41.0	14.0
07/01/14	3	0	100	510	465	275	420	250	38	52.0	11.0
07/01/14	4	400	275	260	220	225	375	225	19	51.0	11.2
07/06/15	1	0	75	300	350	325	350	325	70	42.0	8.2
07/06/15	2	0	225	350	400	325	525	300	24	20.5	10.8
07/06/15	3	0	150	475	150	150	200	50	6	6.5	19.6
07/06/15	4	0	275	400	225	275	375	150	16	17.0	14.6
07/05/16	1	0	175	600	300	375	625	100	25	34.0	12.8
07/05/16	2	0	500	375	375	300	700	100	50	26.0	14.6
07/05/16	3	0	275	300	475	725	500	100	25	15.0	12.9
07/05/16	4	0	100	725	250	300	500	125	25	15.0	13.9
07/06/17	1	0	625	400	425	400	600	300	62	47.0	13.7
07/06/17	2	0	550	275	350	250	575	275	44	34.0	13.3
07/06/17	3	0	775	200	325	300	575	175	14	13.0	17.6
07/06/17	4	0	550	325	325	400	525	250	44	25.0	14.0
06/28/18	1	0	700	150	200	150	300	100	18	7.5	23.2
06/28/18	2	700	275	250	450	300	375	125	13	6.0	14.5
06/28/18	3	0	100	500	375	400	625	250	50	33.0	9.9
06/28/18	4	0	250	400	350	450	700	225	66	39.0	10.3

Appendix D.2.–Lower Slate Creek SP2 pink salmon spawning substrate data, 2011–2018.

Sample	Sample	Volume (mL/L) Retained Each Sieve (mm)									
Date	No.	101.6	50.8	25.4	12.7	6.35	1.68	0.42	0.15	Imhoff	GMPS
08/17/11	1	1,050	130	305	210	205	350	200	20	11.5	11.0
08/17/11	2	0	120	320	405	335	740	415	85	53.0	7.3
08/17/11	3	0	400	350	295	290	540	200	40	17.5	13.4
08/17/11	4	0	100	450	580	320	390	160	15	25.0	12.8
07/09/12	1	0	250	380	270	260	475	195	23	46.5	11.8
07/09/12	2	600	75	395	295	180	375	135	15	18.5	12.0
07/09/12	3	0	450	340	370	340	590	295	30	18.0	12.8
07/09/12	4	0	0	320	460	285	545	300	28	16.5	8.3
07/02/13	1	0	310	490	440	505	640	410	35	107.5	9.8
07/02/13	2	0	420	270	240	215	560	150	34	42.0	13.1
07/02/13	3	0	550	885	375	290	570	290	45	108.0	15.0
07/02/13	4	0	785	230	340	240	580	330	30	46.5	14.8
07/01/14	1	0	1225	450	495	305	760	300	12	110.0	17.7
07/01/14	2	0	450	250	250	200	300	100	11	65.0	16.5
07/01/14	3	0	850	480	200	175	490	175	30	106.0	18.4
07/01/14	4	0	150	350	200	225	300	120	15	20.0	13.3
07/06/15	1	0	75	175	325	425	475	50	6	5.5	10.7
07/06/15	2	500	825	225	225	175	250	50	11	8.0	28.9
07/06/15	3	300	225	500	200	175	300	50	15	21.5	18.1
07/06/15	4	275	100	200	200	150	225	100	22	9.0	12.2
07/05/16	1	0	300	275	400	350	525	100	25	26.0	13.1
07/05/16	2	0	0	200	600	575	550	150	25	30.0	9.0
07/05/16	3	0	0	100	1150	450	650	100	25	26.0	10.1
07/05/16	4	125	275	575	525	450	475	150	25	39.0	14.3
07/06/17	1	0	0	675	600	550	525	350	82	47.0	9.8
07/06/17	2	0	300	300	650	475	500	375	60	28.0	10.8
07/06/17	3	0	525	450	500	475	400	50	5	3.0	19.7
07/06/17	4	0	375	375	550	475	625	325	58	22.0	11.7
06/28/18	1	0	450	575	475	600	625	175	28	14.0	14.9
06/28/18	2	725	325	400	400	300	375	150	22	18.0	15.4
06/28/18	3	700	525	500	275	225	200	100	28	12.0	23.1
06/28/18	4	0	575	400	250	375	725	125	20	8.0	15.6

Note: GMPS = Geometric mean particle size.

APPENDIX E: SEDIMENT DATA AND LAB REPORT

Appendix E.1.–Sediment compositions, 2011–2018.

Sample Date	Particle Size Data: % Clay	% Silt	% Sand	% Coarse material (> 2 mm)	% Total Solids	% Total Volatile Solids	Total Sulfide (mg/kg)	% Total Organic Carbon
Lower Slate Creek								
10/03/11	2.0	4.0	94.0	0.4	78.00	3.38	ND	2.04
07/03/12	2.0	0.0	98.0	0.1	79.22	3.37	ND	1.67
07/02/13	2.0	2.0	96.0	0.0	74.57	1.63	ND	1.67
07/28/14	2.3	3.8	91.8	0.9	75.3	3.28	<1.3	0.58
07/06/15	1.8	3.1	72.2	22.8	83.5	ND	<1.2	0.473
07/05/16	0.0	23.1	55.1	21.8	70.3	7.70	<2.5	0.585
07/07/17	1.5	6.9	84.5	7.1	59.6	2.80	<3.2	0.494
06/28/18	1.5	3.3	69.6	25.6	64.2	3.00	<2.9	0.416
East Fork Slate Creek								
10/03/11	10.0	4.0	86.0	1.7	60.17	7.81	ND	11.00
07/10/12	40.0	34.0	26.0	0.0	23.72	28.54	ND	16.70
07/01/13	6.0	12.0	82.0	0.0	43.66	13.30	ND	18.30
07/30/14	3.8	21.1	75.0	0.1	65.5	6.21	<1.5	1.84
07/07/15	2.3	6.9	82.3	8.5	76.2	ND	<1.3	0.792
07/06/16	3.5	24.8	53.7	18.0	21.0	31.40	<6.8	13.0
07/07/17	34.9	32.2	28.8	4.0	18.9	32.50	<9.0	16.3
06/29/18	1.5	6.5	53.5	38.5	74.8	6.70	<1.8	1.75
Upper Slate Creek								
10/06/11	4.0	2.0	94.0	0.0	72.10	4.12	ND	5.46
07/02/12	2.0	0.0	98.0	0.3	79.58	2.90	ND	3.74
07/01/13	4.0	0.0	96.0	0.2	74.21	2.73	ND	5.50
07/30/14	4.3	8.2	87.5	0.0	72.4	3.88	<1.4	0.87
07/07/15	1.5	0.2	31.9	66.3	76.5	ND	<1.3	1.04
07/06/16	0.0	2.9	73.1	24.0	62.9	5.00	<2.2	2.14
07/07/17	3.0	4.6	89.9	2.5	72.7	3.45	<2.4	0.84
06/28/18	2.7	5.3	80.6	11.4	67.6	4.10	<2.7	0.815
Lower Johnson Creek								
10/03/11	2.0	2.0	96.0	0.0	74.28	2.01	ND	0.89
07/02/12	8.0	0.0	92.0	0.0	77.67	2.55	ND	1.19
07/01/13	2.0	2.0	96.0	0.3	73.21	0.90	ND	1.08
07/30/14	2.9	4.8	91.4	0.2	73.7	1.93	<1.4	0.26
07/06/15	0.4	1.1	41.9	56.6	80.0	ND	<1.3	0.376
08/08/16	5.1	25.4	69.4	0.0	71.9	2.40	<2.5	0.422
07/07/17	4.1	20.8	72.6	2.5	57.6	4.60	<3.3	1.6
06/29/18	2.8	5.6	89.4	2.2	77.6	2.35	<2.5	0.483
Lower Sherman Creek								
10/04/11	2.0	2.0	96.0	0.1	73.15	2.75	ND	0.54
07/03/12	4.0	0.0	96.0	0.1	78.55	3.05	ND	0.82
07/01/13	2.0	2.0	96.0	0.6	75.66	0.75	ND	0.61
07/28/14	3.4	6.5	89.9	0.3	76.7	2.50	<1.3	0.35
07/07/15	1.8	3.0	86.1	9.0	76.2	ND	<1.3	0.399
07/06/16	0.1	0.9	71.2	27.8	80.5	3.10	<2.4	0.322
07/07/17	1.5	5.4	67.0	26.1	76.5	2.00	<2.5	0.288
06/29/18	2.3	2.5	88.9	6.3	69.3	2.50	<2.6	0.294

Appendix E.2.–Sediment element concentrations, 2011–2018.

Sample	Concentration (mg/kg dry weight)									
Date	Ag	Al	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Lower Slate Creek											
10/03/11	<0.267	13,600	16.2	1.46	29.4	56.7	<0.136	47.4	7.79	0.720	220
07/03/12	<0.250	13,600	9.31	1.22	32.0	50.7	<0.122	43.2	8.45	<0.500	200
07/02/13	<0.246	12,300	23.7	1.29	94.5	56.7	<0.122	73.4	9.14	1.94	205
07/28/14	0.08	12,000	20.1	1.21	20.0	51.1	0.06	40.8	8.78	1.3	189
07/06/15	0.07	12,000	14.9	0.53	18.9	39.1	0.04	30.0	6.86	0.7	131
07/05/16	0.079	12,800	17.0	0.735	20.4	39.8	0.057	35.2	7.16	1.3	173
07/07/17	0.101	12,000	16.4	0.681	18.3	40.9	<0.031	31.7	8.16	<1.6	145
06/28/18	0.077	12,300	14.6	0.554	19.3	40.1	0.038	32.4	6.93	0.98	129
East Fork Slate Creek											
10/03/11	<0.335	20,100	30.0	20.9	29.5	88.4	<0.188	143	8.50	1.41	1,360
07/10/12	<0.739	15,300	24.0	23.2	38.9	159.0	<0.369	153	14.2	<1.48	1,490
07/01/13	<0.425	13,900	42.2	13.9	32.7	73.4	<0.216	79.8	12.5	4.79	844
07/30/14	0.14	13,300	39.1	12.1	14.6	55.7	0.04	85.3	6.94	2.4	812
07/07/15	0.12	12,300	22.3	5.87	15.1	46.7	0.05	46.8	4.48	1.7	333
07/06/16	0.190	16,500	51.5	8.20	16.5	59.5	0.109	86.1	5.54	3.1	634
07/07/17	0.30	12,900	29.9	9.65	15.0	62.3	0.143	69.9	6.61	<5.0	625
06/29/18	0.146	12,300	59.1	18.7	13.0	47.6	0.049	127	6.07	3.37	1,020
Upper Slate Creek											
10/06/11	<0.278	22,500	17.9	0.722	127	53.4	<0.169	87.5	3.37	0.809	130
07/02/12	<0.256	20,300	14.4	0.776	125	55.4	<0.126	78.4	4.05	0.606	134
07/01/13	<0.256	14,600	13.5	0.750	101	44.6	<0.131	55.0	2.70	3.21	105
07/30/14	0.06	14,900	19.2	0.69	84.2	45.8	0.03	55.7	2.86	1.8	111
07/07/15	0.08	14,500	14.2	0.76	92.2	47.0	0.11	54.0	3.17	2.3	109
07/06/16	0.092	14,000	18.0	0.507	71.7	37.0	0.051	48.5	2.69	2.1	111
07/07/17	0.060	15,600	17.0	0.490	64.1	38.1	0.030	47.3	3.06	1.4	101
06/28/18	0.101	14,700	19.7	0.789	105	55.1	0.047	76.4	3.97	2.86	133
Lower Johnson Creek											
10/03/11	<0.266	13,100	16.2	0.238	31.5	73.1	<0.133	27.3	9.76	<0.533	93.3
07/02/12	0.342	13,100	12.8	0.250	35.5	76.8	<0.123	23.4	9.45	<0.493	97.3
07/01/13	0.269	10,300	11.9	0.492	24.4	56.1	<0.122	15.7	8.00	<0.481	121
07/30/14	0.32	10,300	16.5	0.16	22.2	68.2	0.02	16.9	10.9	<0.5	83.4
07/06/15	0.16	10,900	12.5	0.15	18.1	71.1	<0.02	17.7	8.04	<0.8	79.7
08/08/16	0.574	9,470	13.0	0.150	18.9	76.3	0.020	15.1	8.41	<0.57	65.7
07/06/17	0.172	6,730	10.3	0.115	11.7	46.2	0.064	10.3	5.96	<1.5	48.0
06/29/18	0.139	13,600	20.5	0.264	30.2	68.4	0.015	24.6	11.9	<0.63	109
Lower Sherman Creek											
10/04/11	<0.259	18,200	28.9	0.389	46.2	94.0	<0.157	45.9	6.70	<0.517	110
07/03/12	0.289	17,900	24.3	0.578	51.4	79.1	<0.124	40.2	8.43	<0.512	128
07/01/13	0.306	15,400	25.4	<0.520	37.4	69.4	<0.133	30.9	7.39	1.77	111
07/28/14	0.14	14,900	27.9	0.360	33.6	68.4	0.03	31.1	6.97	1.2	119
07/07/15	0.25	17,500	37.0	0.32	30.9	70.8	0.02	38.0	11.0	2.0	134
07/06/16	0.097	13,800	19.9	0.388	27.5	72.5	<0.020	32.9	6.6	1.1	123
07/06/17	0.097	17,400	23.5	0.194	31.8	58.1	0.045	28.5	4.69	<1.3	90.2
06/29/18	0.135	15,600	35.2	0.353	33.7	81.9	<0.014	34.8	8.05	<0.65	120

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July 30, 2018

Analytical Report for Service Request No: K1806293

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

RE: Coeur AK Biomonitoring

Dear Kate,

Enclosed are the results of the sample(s) submitted to our laboratory July 05, 2018
For your reference, these analyses have been assigned our service request number **K1806293.**

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 3356. You may also contact me via email at Kurt.Clarkson@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

for Kurt Clarkson
Sr. 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. See case narrative.
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. See case narrative.
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

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Client: Alaska Department of Fish and Game
Project: Coeur AK Biomonitoring
Sample Matrix: Sediment

Service Request: K1806293
Date Received: 07/05/2018

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt:

Five sediment samples were received for analysis at ALS Environmental on 07/05/2018. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

Metals:

Method 200.8: The Relative Percent Difference (RPD) for the replicate analysis of Lead in sample KGM-LSC was outside the normal ALS control limits. The variability in the results was attributed to the heterogeneous character of the sample. Standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

General Chemistry:

No significant anomalies were noted with this analysis.

Approved by ______________________ Date 07/30/2018

Chain of Custody

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ALS Environmental

CHAIN OF CUSTODY

90443

002

SR# K1806293

COC Set____of____

COC#________

Page 1 of 1

1317 South 13th Ave, Kelso, WA 98626 Phone (360) 577-7222 / 800-695-7222 / FAX (360) 636-1068
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Project Name: Coeur AK Biomonitoring
Project Number:
Project Manager: Johnny Zutz
Company: Coeur AK / ADF&G
Address: 802 3rd St, Douglas, AK 99824
Phone #: 907-465-6474
email:
Sampler Signature: [signature]
Sampler Printed Name: Johnny Zutz

CLIENT SAMPLE ID	LABID	SAMPLING Date	SAMPLING Time	Matrix	NUMBER OF CONTAINERS	160.4 Modified / TVS (7D)	PSEP Sulfide / PSEP Sulfide	PSEP TOC / PSEP TOC T (14D)	7471B / Hg (28D)	200.8 / Metals T (180D)	ASTM D422 / Part Size	160.3 Modified / TS (999D)	1 160.4 mod.-TVS	2	3	4	5	Remarks
1. KGM - LSC		6/28/18	11:30	Soil	3	X	X	X	X	X	X	X	X					
2. KGM - USC		6/28/18	13:11	Soil	3	X	X	X	X	X	X	X	X					
3. KGM - LSH		6/29/18	10:15	Soil	3	X	X	X	X	X	X	X	X					
4. KGM - EFSC		6/29/18	13:40	Soil	3	X	X	X	X	X	X	X	X					
5. KGM - LJC		6/29/18	12:00	Soil	4	X	X	X	X	X	X	X	X					
6.																		
7.																		
8.																		
9.																		
10.																		

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.#
Bill To: Coeur AK
keppers@coeur.com

Turnaround Requirements

__ 24 hr. __ 48 hr.
__ 5 Day
✓ Standard

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

Special Instructions/Comments:

*Indicate State Hydrocarbon Procedure: AK CA WI Northwest Other____(Circle One)

RE #5: 500mL sample jar broke, replaced with two 250mL jars.
RE #4: 2oz bottle broke, replaced w/ 9oz bottle (zinc acetate).

	Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature	[signature]	[signature]				
Printed Name	Johnny Zutz	Doore				
Firm	ADF&G	ALS				
Date/Time	7/3/18 10:00	7/6/18 1010				

ALS

PC KC

Cooler Receipt and Preservation Form

Client Coeur AK Service Request *K18* 06293

Received: 7/5/18 Opened: 7/5/18 By: [signature] Unloaded: 7/5/18 By: [signature]

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? one, front

   If present, were custody seals intact? (Y) N If present, were they signed and dated? (Y) N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID (NA)	Tracking Number NA	Filed
2.4	2.2	5.0	4.8	-0.2	392		7816 9615 7111	

4. Packing material: *Inserts* *Baggies* *(Bubble Wrap)* *(Gel Packs)* *Wet Ice* *Dry Ice* *Sleeves* ______
5. Were custody papers properly filled out (ink, signed, etc.)? NA (Y) N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA (Y) N

   If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA (Y) N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA (Y) N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA (Y) N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* (NA) Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* (NA) Y N
12. Was C12/Res negative? (NA) Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

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

Notes, Discrepancies, & Resolutions: ______

7/25/16

Page ____ of ____

Total Solids

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ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game		**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring		**Date Collected:**	06/28/18 - 06/29/18
Sample Matrix:	Sediment		**Date Received:**	07/5/18
Analysis Method:	160.3 Modified		**Units:**	Percent
Prep Method:	None		**Basis:**	As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
KGM-LSC	K1806293-001	**64.2**	-	1	07/09/18 14:44	
KGM-USC	K1806293-002	**67.6**	-	1	07/09/18 14:44	
KGM-LSH	K1806293-003	**69.3**	-	1	07/09/18 14:44	
KGM-EFSC	K1806293-004	**74.8**	-	1	07/09/18 14:44	
KGM-LJC	K1806293-005	**77.6**	-	1	07/09/18 14:44	

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project	Coeur AK Biomonitoring	**Date Collected:**	06/29/18
Sample Matrix:	Sediment	**Date Received:**	07/05/18
		Date Analyzed:	07/09/18

Replicate Sample Summary
Inorganic Parameters

Sample Name:	KGM-LJC	**Units:**	Percent
Lab Code:	K1806293-005	**Basis:**	As Received

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1806293-005DUP Result	Average	RPD	RPD Limit
Solids, Total	160.3 Modified	-	77.6	77.5	77.6	<1	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.

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/28/18 - 06/29/18
Sample Matrix:	Sediment	**Date Received:**	07/5/18
Analysis Method:	160.4 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	Dry, per Method

Solids, Total Volatile

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
KGM-LSC	K1806293-001	**3.00**	0.10	1	07/09/18 12:00	
KGM-USC	K1806293-002	**4.10**	0.10	1	07/09/18 12:00	
KGM-LSH	K1806293-003	**2.50**	0.10	1	07/09/18 12:00	
KGM-EFSC	K1806293-004	**6.70**	0.10	1	07/09/18 12:00	
KGM-LJC	K1806293-005	**2.30**	0.10	1	07/09/18 12:00	
Method Blank	K1806293-MB	ND U	0.10	1	07/09/18 12:00	

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project	Coeur AK Biomonitoring	**Date Collected:**	06/29/18
Sample Matrix:	Sediment	**Date Received:**	07/05/18
		Date Analyzed:	07/09/18

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	KGM-LJC	**Units:**	Percent
Lab Code:	K1806293-005	**Basis:**	Dry, per Method

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1806293-005DUP Result	Average	RPD	RPD Limit
Solids, Total Volatile	160.4 Modified	0.10	2.30	2.40	2.35	4	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.

General Chemistry

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www.alsglobal.com

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	6/28/2018
Sample Matrix:	Sediment	**Date Received:**	7/5/2018
		Date Analyzed:	716/2018

Particle Size Determination
ASTM D422

Sample Name: KGM-LSC
Lab Code: K1806293-001

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	No.3/4"(19.0 mm)	0.0000	99.58
Gravel (9.50 mm)	No.3/8"(9.50 mm)	2.4414	96.43
Gravel, Medium	No.4 (4.75 mm)	6.3388	88.26
Gravel, Fine	No.10 (2.00 mm)	10.7610	74.38
Sand, Very Coarse	No.20 (0.850 mm)	13.5857	56.91
Sand, Coarse	No.40 (0.425 mm)	22.0247	28.58
Sand, Medium	No.60 (0.250 mm)	11.0653	14.34
Sand, Fine	No.140 (0.106 mm)	6.4906	6.00
Sand, Very Fine	No.200 (0.0750 mm)	0.9134	4.82

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	6.77
0.005 mm	1.51
0.001 mm	0.00

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	6/28/2018
Sample Matrix:	Sediment	**Date Received:**	7/5/2018
		Date Analyzed:	7/16/2018

Particle Size Determination
ASTM D422

Sample Name: KGM-USC
Lab Code: K1806293-002

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	**No.3/4"(19.0 mm)**	0.0000	98.61
Gravel (9.50 mm)	**No.3/8"(9.50 mm)**	0.0000	98.61
Gravel, Medium	**No.4 (4.75 mm)**	2.4151	95.55
Gravel, Fine	**No.10 (2.00 mm)**	5.4531	88.64
Sand, Very Coarse	**No.20 (0.850 mm)**	16.5636	67.78
Sand, Coarse	**No.40 (0.425 mm)**	28.1373	32.35
Sand, Medium	**No.60 (0.250 mm)**	13.0593	15.90
Sand, Fine	**No.140 (0.106 mm)**	5.3409	9.18
Sand, Very Fine	**No.200 (0.0750 mm)**	0.9219	8.01

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	8.79
0.005 mm	2.74
0.001 mm	0.00

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	6/29/2018
Sample Matrix:	Sediment	**Date Received:**	7/5/2018
		Date Analyzed:	7/16/2018

Particle Size Determination
ASTM D422

Sample Name: KGM-LSH
Lab Code: K1806293-003

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	**No.3/4"(19.0 mm)**	0.0000	99.20
Gravel (9.50 mm)	**No.3/8"(9.50 mm)**	0.0000	99.20
Gravel, Medium	**No.4 (4.75 mm)**	0.1188	99.06
Gravel, Fine	**No.10 (2.00 mm)**	4.6573	93.67
Sand, Very Coarse	**No.20 (0.850 mm)**	18.8945	71.92
Sand, Coarse	**No.40 (0.425 mm)**	31.4451	35.74
Sand, Medium	**No.60 (0.250 mm)**	16.4038	16.86
Sand, Fine	**No.140 (0.106 mm)**	9.1805	6.30
Sand, Very Fine	**No.200 (0.0750 mm)**	1.3333	4.76

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	7.58
0.005 mm	2.26
0.001 mm	0.00

ALS Group USA, Corp.
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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	6/29/2018
Sample Matrix:	Sediment	**Date Received:**	7/5/2018
		Date Analyzed:	7/16/2018

Particle Size Determination
ASTM D422

Sample Name: KGM-EFSC
Lab Code: K1806293-004

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	**No.3/4"(19.0 mm)**	0.0000	98.20
Gravel (9.50 mm)	**No.3/8"(9.50 mm)**	0.0000	98.20
Gravel, Medium	**No.4 (4.75 mm)**	7.4907	88.99
Gravel, Fine	**No.10 (2.00 mm)**	22.3969	61.46
Sand, Very Coarse	**No.20 (0.850 mm)**	20.7653	35.81
Sand, Coarse	**No.40 (0.425 mm)**	12.5581	20.30
Sand, Medium	**No.60 (0.250 mm)**	4.7188	14.47
Sand, Fine	**No.140 (0.106 mm)**	3.8886	9.66
Sand, Very Fine	**No.200 (0.0750 mm)**	1.3584	7.98

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	8.02
0.005 mm	1.46
0.001 mm	0.00

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	6/29/2018
Sample Matrix:	Sediment	**Date Received:**	7/5/2018
		Date Analyzed:	7/16/2018

Particle Size Determination
ASTM D422

Sample Name: KGM-LJC
Lab Code: K1806293-005

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	**No.3/4"(19.0 mm)**	0.0000	99.88
Gravel (9.50 mm)	**No.3/8"(9.50 mm)**	0.0000	99.88
Gravel, Medium	**No.4 (4.75 mm)**	0.5769	99.20
Gravel, Fine	**No.10 (2.00 mm)**	1.2218	97.77
Sand, Very Coarse	**No.20 (0.850 mm)**	11.1563	84.62
Sand, Coarse	**No.40 (0.425 mm)**	31.2269	47.83
Sand, Medium	**No.60 (0.250 mm)**	21.2849	22.76
Sand, Fine	**No.140 (0.106 mm)**	9.7052	11.32
Sand, Very Fine	**No.200 (0.0750 mm)**	2.5207	8.36

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	11.47
0.005 mm	2.78
0.001 mm	0.00

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	6/29/2018
Sample Matrix:	Sediment	**Date Received:**	7/5/2018
		Date Analyzed:	7/16/2018

Particle Size Determination
ASTM D422

Sample Name: KGM-LJC
Lab Code: K1806293-005DUP

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	No.3/4"(19.0 mm)	0.0000	99.90
Gravel (9.50 mm)	No.3/8"(9.50 mm)	0.0000	99.90
Gravel, Medium	No.4 (4.75 mm)	0.0000	99.90
Gravel, Fine	No.10 (2.00 mm)	1.6169	98.00
Sand, Very Coarse	No.20 (0.850 mm)	12.3908	83.44
Sand, Coarse	No.40 (0.425 mm)	33.0046	44.63
Sand, Medium	No.60 (0.250 mm)	21.3581	19.51
Sand, Fine	No.140 (0.106 mm)	8.3222	9.73
Sand, Very Fine	No.200 (0.0750 mm)	1.9478	7.44

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	10.41
0.005 mm	3.13
0.001 mm	0.00

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/28/18 - 06/29/18
Sample Matrix:	Sediment	**Date Received:**	07/5/18
Analysis Method:	PSEP Sulfide	**Units:**	mg/Kg
Prep Method:	Method	**Basis:**	Dry

Sulfide, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Date Extracted	Q
KGM-LSC	K1806293-001	ND U	2.9	1	07/05/18 20:38	7/5/18	
KGM-USC	K1806293-002	ND U	2.7	1	07/05/18 20:38	7/5/18	
KGM-LSH	K1806293-003	ND U	2.6	1	07/05/18 20:38	7/5/18	
KGM-EFSC	K1806293-004	ND U	1.8	1	07/05/18 20:38	7/5/18	
KGM-LJC	K1806293-005	ND U	2.5	1	07/05/18 20:38	7/5/18	
Method Blank	K1806293-MB	ND U	1.0	1	07/05/18 20:38	7/5/18	

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QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project	Coeur AK Biomonitoring	**Date Collected:**	06/28/18
Sample Matrix:	Sediment	**Date Received:**	07/05/18
		Date Analyzed:	07/05/18

Triplicate Sample Summary
General Chemistry Parameters

Sample Name:	KGM-LSC	**Units:**	mg/Kg
Lab Code:	K1806293-001	**Basis:**	Dry
Analysis Method:	PSEP Sulfide		
Prep Method:	Method		

Analyte Name	MRL	Sample Result	Duplicate K1806293-001DUP Result	Triplicate K1806293-001TRP Result	Average	RSD	RSD Limit
Sulfide, Total	3.0	ND	ND	ND	NC	NC	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.

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QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/28/18
Sample Matrix:	Sediment	**Date Received:**	07/05/18
		Date Analyzed:	07/5/18
		Date Extracted:	07/5/18

Duplicate Matrix Spike Summary
Sulfide, Total

Sample Name:	KGM-LSC	**Units:**	mg/Kg
Lab Code:	K1806293-001	**Basis:**	Dry
Analysis Method:	PSEP Sulfide		
Prep Method:	Method		

		Matrix Spike K1806293-001MS			Duplicate Matrix Spike K1806293-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Sulfide, Total	ND U	960	1080	89	880	1080	81	28-175	9	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:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Analyzed:**	07/05/18
Sample Matrix:	Sediment	**Date Extracted:**	07/05/18

Lab Control Sample Summary
Sulfide, Total

Analysis Method:	PSEP Sulfide	**Units:**	mg/Kg
Prep Method:	Method	**Basis:**	Dry
		Analysis Lot:	597533

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1806293-LCS	320	370	87	39-166

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/28/18 - 06/29/18
Sample Matrix:	Sediment	**Date Received:**	07/5/18
Analysis Method:	PSEP TOC	**Units:**	Percent
Prep Method:	ALS SOP	**Basis:**	Dry, per Method

Carbon, Total Organic (TOC)

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Date Extracted	Q
KGM-LSC	K1806293-001	**0.416**	0.050	1	07/06/18 12:45	7/6/18	
KGM-USC	K1806293-002	**0.815**	0.050	1	07/06/18 12:45	7/6/18	
KGM-LSH	K1806293-003	**0.294**	0.050	1	07/06/18 12:45	7/6/18	
KGM-EFSC	K1806293-004	**1.75**	0.050	1	07/06/18 12:45	7/6/18	
KGM-LJC	K1806293-005	**0.483**	0.050	1	07/06/18 12:45	7/6/18	
Method Blank	K1806293-MB	ND U	0.050	1	07/06/18 12:45	7/6/18	

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project	Coeur AK Biomonitoring	**Date Collected:**	06/28/18
Sample Matrix:	Sediment	**Date Received:**	07/05/18
		Date Analyzed:	07/06/18

Triplicate Sample Summary
General Chemistry Parameters

Sample Name:	KGM-LSC	**Units:**	Percent
Lab Code:	K1806293-001	**Basis:**	Dry, per Method
Analysis Method:	PSEP TOC		
Prep Method:	ALS SOP		

Analyte Name	MRL	Sample Result	Duplicate K1806293-001DUP Result	Triplicate K1806293-001TRP Result	Average	RSD	RSD Limit
Carbon, Total Organic (TOC)	0.050	0.416	0.407	0.425	0.416	2	27

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:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/28/18
Sample Matrix:	Sediment	**Date Received:**	07/05/18
		Date Analyzed:	07/6/18
		Date Extracted:	07/6/18

Duplicate Matrix Spike Summary
Carbon, Total Organic (TOC)

Sample Name:	KGM-LSC	**Units:**	Percent
Lab Code:	K1806293-001	**Basis:**	Dry, per Method
Analysis Method:	PSEP TOC		
Prep Method:	ALS SOP		

		Matrix Spike K1806293-001MS			Duplicate Matrix Spike K1806293-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Carbon, Total Organic (TOC)	0.416	3.90	3.53	99	3.94	3.61	98	69-123	1	27

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.

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QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Analyzed:**	07/06/18
Sample Matrix:	Sediment	**Date Extracted:**	07/06/18

Lab Control Sample Summary
Carbon, Total Organic (TOC)

Analysis Method:	PSEP TOC	**Units:**	Percent
Prep Method:	ALS SOP	**Basis:**	Dry, per Method
		Analysis Lot:	597683

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1806293-LCS	0.584	0.603	97	74-118

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Metals

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

Client: Alaska Department of Fish and Game
Service Request: K1806293
Project: Coeur AK Biomonitoring
Date Collected: 06/28/18 11:30
Sample Matrix: Sediment
Date Received: 07/05/18 10:10

Sample Name: KGM-LSC
Basis: Dry
Lab Code: K1806293-001

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	200.8	**11300**	mg/Kg	140	500	07/16/18 06:32	07/09/18	
Arsenic	200.8	**13.6**	mg/Kg	0.34	5	07/10/18 13:54	07/09/18	
Cadmium	200.8	**0.493**	mg/Kg	0.014	5	07/10/18 13:54	07/09/18	
Chromium	200.8	**16.9**	mg/Kg	0.14	5	07/10/18 13:54	07/09/18	
Copper	200.8	**36.8**	mg/Kg	0.068	5	07/10/18 13:54	07/09/18	
Lead	200.8	**5.67**	mg/Kg	0.034	5	07/10/18 13:54	07/09/18	
Mercury	7471B	**0.042**	mg/Kg	0.028	1	07/13/18 09:49	07/11/18	
Nickel	200.8	**28.7**	mg/Kg	0.14	5	07/10/18 13:54	07/09/18	
Selenium	200.8	**0.99**	mg/Kg	0.68	5	07/10/18 13:54	07/09/18	
Silver	200.8	**0.078**	mg/Kg	0.014	5	07/10/18 13:54	07/09/18	
Zinc	200.8	**116**	mg/Kg	0.34	5	07/10/18 13:54	07/09/18	

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/28/18 13:11
Sample Matrix:	Sediment	**Date Received:**	07/05/18 10:10
Sample Name:	KGM-USC	**Basis:**	Dry
Lab Code:	K1806293-002		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	200.8	**14700**	mg/Kg	130	500	07/16/18 06:37	07/09/18	
Arsenic	200.8	**19.7**	mg/Kg	0.32	5	07/10/18 14:03	07/09/18	
Cadmium	200.8	**0.789**	mg/Kg	0.013	5	07/10/18 14:03	07/09/18	
Chromium	200.8	**105**	mg/Kg	0.13	5	07/10/18 14:03	07/09/18	
Copper	200.8	**55.1**	mg/Kg	0.063	5	07/10/18 14:03	07/09/18	
Lead	200.8	**3.97**	mg/Kg	0.032	5	07/10/18 14:03	07/09/18	
Mercury	7471B	**0.047**	mg/Kg	0.013	1	07/13/18 09:55	07/11/18	
Nickel	200.8	**76.4**	mg/Kg	0.13	5	07/10/18 14:03	07/09/18	
Selenium	200.8	**2.86**	mg/Kg	0.63	5	07/10/18 14:03	07/09/18	
Silver	200.8	**0.101**	mg/Kg	0.013	5	07/10/18 14:03	07/09/18	
Zinc	200.8	**133**	mg/Kg	0.32	5	07/10/18 14:03	07/09/18	

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/29/18 10:15
Sample Matrix:	Sediment	**Date Received:**	07/05/18 10:10
Sample Name:	KGM-LSH	**Basis:**	Dry
Lab Code:	K1806293-003		

Total Metals

Analyte Name	Analysis Method	Result		Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	200.8	**15600**		mg/Kg	130	500	07/16/18 06:38	07/09/18	
Arsenic	200.8	**35.2**		mg/Kg	0.33	5	07/10/18 14:06	07/09/18	
Cadmium	200.8	**0.353**		mg/Kg	0.013	5	07/10/18 14:06	07/09/18	
Chromium	200.8	**33.7**		mg/Kg	0.13	5	07/10/18 14:06	07/09/18	
Copper	200.8	**81.9**		mg/Kg	0.065	5	07/10/18 14:06	07/09/18	
Lead	200.8	**8.05**		mg/Kg	0.033	5	07/10/18 14:06	07/09/18	
Mercury	7471B	ND	U	mg/Kg	0.014	1	07/13/18 09:57	07/11/18	
Nickel	200.8	**34.8**		mg/Kg	0.13	5	07/10/18 14:06	07/09/18	
Selenium	200.8	ND	U	mg/Kg	0.65	5	07/10/18 14:06	07/09/18	
Silver	200.8	**0.135**		mg/Kg	0.013	5	07/10/18 14:06	07/09/18	
Zinc	200.8	**120**		mg/Kg	0.33	5	07/10/18 14:06	07/09/18	

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/29/18 13:40
Sample Matrix:	Sediment	**Date Received:**	07/05/18 10:10
Sample Name:	KGM-EFSC	**Basis:**	Dry
Lab Code:	K1806293-004		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	200.8	**12300**	mg/Kg	120	500	07/16/18 06:40	07/09/18	
Arsenic	200.8	**59.1**	mg/Kg	0.30	5	07/10/18 14:09	07/09/18	
Cadmium	200.8	**18.7**	mg/Kg	0.012	5	07/10/18 14:09	07/09/18	
Chromium	200.8	**13.0**	mg/Kg	0.12	5	07/10/18 14:09	07/09/18	
Copper	200.8	**47.6**	mg/Kg	0.060	5	07/10/18 14:09	07/09/18	
Lead	200.8	**6.07**	mg/Kg	0.030	5	07/10/18 14:09	07/09/18	
Mercury	7471B	**0.049**	mg/Kg	0.012	1	07/13/18 09:59	07/11/18	
Nickel	200.8	**127**	mg/Kg	0.12	5	07/10/18 14:09	07/09/18	
Selenium	200.8	**3.37**	mg/Kg	0.60	5	07/10/18 14:09	07/09/18	
Silver	200.8	**0.146**	mg/Kg	0.012	5	07/10/18 14:09	07/09/18	
Zinc	200.8	**1020**	mg/Kg	30	500	07/16/18 06:40	07/09/18	

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Superset Reference:

ALS Group USA, Corp.
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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/29/18 12:00
Sample Matrix:	Sediment	**Date Received:**	07/05/18 10:10
Sample Name:	KGM-LJC	**Basis:**	Dry
Lab Code:	K1806293-005		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	200.8	**13600**	mg/Kg	130	500	07/16/18 06:42	07/09/18	
Arsenic	200.8	**20.5**	mg/Kg	0.32	5	07/10/18 14:12	07/09/18	
Cadmium	200.8	**0.264**	mg/Kg	0.013	5	07/10/18 14:12	07/09/18	
Chromium	200.8	**30.2**	mg/Kg	0.13	5	07/10/18 14:12	07/09/18	
Copper	200.8	**68.4**	mg/Kg	0.063	5	07/10/18 14:12	07/09/18	
Lead	200.8	**11.9**	mg/Kg	0.032	5	07/10/18 14:12	07/09/18	
Mercury	7471B	**0.015**	mg/Kg	0.013	1	07/13/18 10:00	07/11/18	
Nickel	200.8	**24.6**	mg/Kg	0.13	5	07/10/18 14:12	07/09/18	
Selenium	200.8	ND U	mg/Kg	0.63	5	07/10/18 14:12	07/09/18	
Silver	200.8	**0.139**	mg/Kg	0.013	5	07/10/18 14:12	07/09/18	
Zinc	200.8	**109**	mg/Kg	0.32	5	07/10/18 14:12	07/09/18	

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Superset Reference:

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ1809085-03		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Aluminum	200.8	ND U	mg/Kg	2.0	5	07/16/18 06:29	07/09/18	
Arsenic	200.8	ND U	mg/Kg	0.5	5	07/10/18 13:47	07/09/18	
Cadmium	200.8	ND U	mg/Kg	0.020	5	07/10/18 13:47	07/09/18	
Chromium	200.8	ND U	mg/Kg	0.20	5	07/10/18 13:47	07/09/18	
Copper	200.8	ND U	mg/Kg	0.10	5	07/10/18 13:47	07/09/18	
Lead	200.8	**0.155**	mg/Kg	0.05	5	07/10/18 13:47	07/09/18	
Nickel	200.8	ND U	mg/Kg	0.20	5	07/10/18 13:47	07/09/18	
Selenium	200.8	ND U	mg/Kg	1.0	5	07/10/18 13:47	07/09/18	
Silver	200.8	ND U	mg/Kg	0.020	5	07/10/18 13:47	07/09/18	
Zinc	200.8	ND U	mg/Kg	0.5	5	07/10/18 13:47	07/09/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ1809086-03		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Mercury	7471B	ND U	mg/Kg	0.02	1	07/13/18 09:46	07/11/18	

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Superset Reference:

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project	Coeur AK Biomonitoring	**Date Collected:**	06/28/18
Sample Matrix:	Sediment	**Date Received:**	07/05/18
		Date Analyzed:	07/10/18 - 07/16/18

Replicate Sample Summary
Total Metals

Sample Name:	KGM-LSC	**Units:**	mg/Kg
Lab Code:	K1806293-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1809085-01 Result	Average	RPD	RPD Limit
Aluminum	200.8	140	11300	13300	12300	16	30
Arsenic	200.8	0.34	13.6	15.6	14.6	14	30
Cadmium	200.8	0.014	0.493	0.614	0.554	22	30
Chromium	200.8	0.14	16.9	21.6	19.3	25	30
Copper	200.8	0.069	36.8	43.4	40.1	17	30
Lead	200.8	0.034	5.67	8.18	6.93	36 *	30
Nickel	200.8	0.14	28.7	36.0	32.4	22	30
Selenium	200.8	0.69	0.99	0.96	0.98	2	30
Silver	200.8	0.014	0.078	0.076	0.077	3	30
Zinc	200.8	0.34	116	142	129	21	30

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.

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Superset Reference:

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project	Coeur AK Biomonitoring	**Date Collected:**	06/28/18
Sample Matrix:	Sediment	**Date Received:**	07/05/18
		Date Analyzed:	07/13/18

Replicate Sample Summary
Total Metals

Sample Name:	KGM-LSC	**Units:**	mg/Kg
Lab Code:	K1806293-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1809086-01 Result	Average	RPD	RPD Limit
Mercury	7471B	0.024	0.042	0.033	0.038	25 #	20

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ALS Group USA, Corp.
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QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/28/18
Sample Matrix:	Sediment	**Date Received:**	07/05/18
		Date Analyzed:	07/10/18 - 07/16/18
		Date Extracted:	07/9/18

Matrix Spike Summary
Total Metals

Sample Name:	KGM-LSC	**Units:**	mg/Kg
Lab Code:	K1806293-001	**Basis:**	Dry
Analysis Method:	200.8		
Prep Method:	EPA 3050B		

Matrix Spike
KQ1809085-02

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	11300	12300	300	356 #	70-130
Arsenic	13.6	88.3	74.0	101	70-130
Cadmium	0.493	7.95	7.40	101	70-130
Chromium	16.9	48.8	29.6	108	70-130
Copper	36.8	75.5	36.9	105	70-130
Lead	5.67	76.1	74.0	95	70-130
Nickel	28.7	103	74.0	100	70-130
Selenium	0.99	72.5	74.0	97	70-130
Silver	0.078	7.28	7.40	97	70-130
Zinc	116	187	74.0	97	70-130

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

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

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Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Collected:**	06/28/18
Sample Matrix:	Sediment	**Date Received:**	07/05/18
		Date Analyzed:	07/13/18
		Date Extracted:	07/11/18

Matrix Spike Summary
Total Metals

Sample Name:	KGM-LSC	**Units:**	mg/Kg
Lab Code:	K1806293-001	**Basis:**	Dry
Analysis Method:	7471B		
Prep Method:	Method		

Matrix Spike
KQ1809086-02

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Mercury	0.042	0.770	0.695	105	80-120

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.

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QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Analyzed:**	07/10/18 - 07/16/18
Sample Matrix:	Sediment		

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1809085-04

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Aluminum	200.8	7130	10100	71	42-124
Arsenic	200.8	179	161	111	66-122
Cadmium	200.8	228	225	101	70-117
Chromium	200.8	147	144	102	66-123
Copper	200.8	174	174	100	71-119
Lead	200.8	121	111	109	71-129
Nickel	200.8	98.3	98.3	100	65-121
Selenium	200.8	214	206	104	64-122
Silver	200.8	47.5	45.5	104	66-124
Zinc	200.8	204	207	99	67-125

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Client:	Alaska Department of Fish and Game	**Service Request:**	K1806293
Project:	Coeur AK Biomonitoring	**Date Analyzed:**	07/13/18
Sample Matrix:	Sediment		

Lab Control Sample Summary
Total Metals

Units: mg/Kg
Basis: Dry

Lab Control Sample
KQ1809086-04

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Mercury	7471B	8.68	12.0	72	60-139