Technical Report No. 18-02

# Aquatic Studies at Kensington Gold Mine, 2017

**By**

**Johnny Zutz**

**February 2018**

**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, $\chi^2$, 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. 18-02*

# AQUATIC STUDIES AT KENSINGTON GOLD MINE, 2017

by

Johnny Zutz

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Division of Habitat, Southeast Region
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February 2018

This investigation was fully financed by Coeur Alaska, Inc.

Cover: Lace River east of Kensington Gold Mine.

Technical Reports are available through the Alaska State Library, Alaska Resources Library and Information Services (ARLIS) and on the Internet: http://www.adfg.alaska.gov/index.cfm?adfg=habitat_publications.main. This publication has undergone editorial and peer review.

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# ACKNOWLEDGEMENTS

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

Several Division of Habitat staff assisted with this project. Habitat Biologists Greg Albrecht, Evan Fritz, Dylan Krull, and Nicole Legere assisted with data collection. Mr. Albrecht processed periphyton samples and verified data entry. Division of Habitat Operations Manager Dr. Al Ott and Habitat Biologist Kate Kanouse reviewed and edited the report, Southeast Regional Supervisor Jackie Timothy reviewed and edited the Executive Summary, and Ms. Legere prepared the report for publication. Matthew Kern of Alder Grove Farm identified benthic macroinvertebrates.

Thank you all for your contribution.

# EXECUTIVE SUMMARY

The Alaska Department of Fish and Game (ADF&G) Division of Habitat completes 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 reports Juneau received near normal rainfall (158 cm) with total snowfall (169 cm) about 30% below normal during 2017 (K. Vaughan, Observation Program Leader, National Weather Service, Juneau, personal communication).

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 algal blooms in the TTF. 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 2017, phosphorus and chlorophyll *a* concentrations in the TTF were similar to concentrations observed since 2013, and lower than observed 2011–2012. In the Outfall 002 effluent, ammonia, nitrate, potassium, and sulfur concentrations continued to be greater than background Upper Slate Lake concentrations. Organic carbon concentrations were typically greatest in Upper Slate Lake and nitrite was not detected in any of the samples, as in previous years.

The July 2017 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 April 2017 to continue monitoring for changes that may occur from the TTF, and found a similar mean chlorophyll *a* density compared to previous spring sampling results at each site.[c]

The 2017 mean benthic macroinvertebrate density at each site was similar to previous years, except in East Fork Slate Creek and Lower Sherman Creek. At East Fork Slate Creek, we observed the second largest mean density since we began sampling in 2011 due to more Diptera and pea clams present. At both Lower Sherman Creek sample sites, the benthic macroinvertebrate communities included fewer insects and other organisms overall than most previous years, resulting in the lowest mean density observed at each site since 2011.

We observed strong pink salmon *Oncorhynchus gorbuscha* returns in the lower reaches of Slate, Johnson, and Sherman Creeks in 2017, consistent with parent year returns in 2015. In Lower Sherman Creek, we observed the greatest number of returning pink and chum salmon *O. keta* since we began surveying in 2011. We cannot quantify marine survival factors impacting adult salmon returns, so we are unable to attribute changes in adult salmon abundance to construction or operation of the Kensington Gold Mine. We continue to recommend the USFS and Berners Bay working group discontinue the spawning salmon survey requirement.

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[a] Coeur's water quality monitoring station MLA.

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

[c] Not required.

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, and the 2017 sampling results were within the range of values observed 2011–2016.

Most element concentrations in sediment samples from each site were similar to or less than previous results. Arsenic, copper, and nickel concentrations at most sampling sites remain near or above the guidelines for freshwater sediments (Buchman 2008), including the upstream reference site in Upper Slate Creek. As in previous years, zinc concentration was above the guideline in Lower Slate Creek, zinc and cadmium concentrations were above the guidelines in East Fork Slate Creek, and chromium concentration was above the guideline in Upper Slate Creek. While we find sediment guidelines useful for evaluating the sample data, we also recognize organisms can respond differently in nature.

We did not sample resident fish populations or submit sediment samples to a private laboratory for 10-day chronic toxicity testing as these studies are no longer required by ADEC.

Habitat biologists investigated fish use and fish habitat in the Slate Lakes and Spectacle Lakes drainages in fall 2017 and published the study results in Albrecht (2018).

# 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.

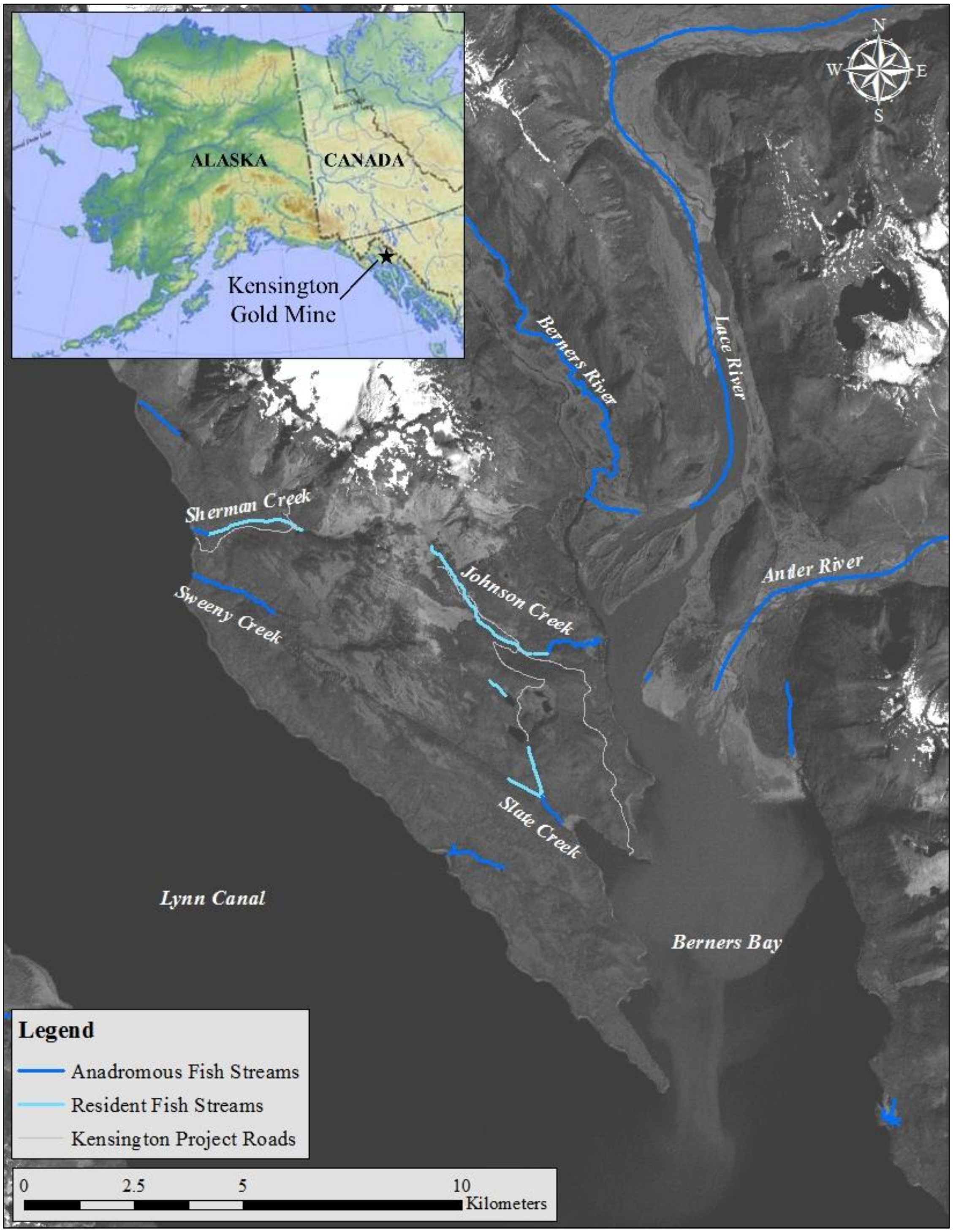


Figure 1.–Kensington Gold Mine project area map.

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 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. Contractor reports include Aquatic Science Inc. (1998, 1999, 2000, 2001a, 2001b, 2002, 2004), Archipelago Marine Research Ltd. (1991), Dames and Moore (1991), Earthworks Technology, Inc. (2002), EVS Environment Consultants (2000), HDR Alaska, Inc. (2003), Kline (2001, 2003a, 2003b, 2003c, 2003d, 2005), Konopacky Environmental (1992a, 1992b, 1993a, 1993b, 1993c, 1995, 1996a, 1996b, 1996c, 1996d), Pentec Environmental (1990, 1991), and Steffen Robertson and Kirsten Consulting Engineers and Scientists (1997). Monitoring reports include Aquatic Science Inc. (2006, 2007, 2008, 2009a, 2009b, 2009c, 2009d, 2011), Brewster (2016), Kanouse (2015), Kanouse and Zutz (2017), and Timothy and Kanouse (2012, 2013, 2014). 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, sediment element concentrations, and pink salmon spawning substrate composition. 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 2017 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).

Table 1.–2017 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 about 1 km upstream of the mouth of Lower Slate Creek prevent upstream fish migration to the East and West Forks. West Fork Slate Creek is on river right[d]. East Fork Slate Creek is on river left and 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) 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.

[d] The terms “river right” and “river left” reference looking downstream.

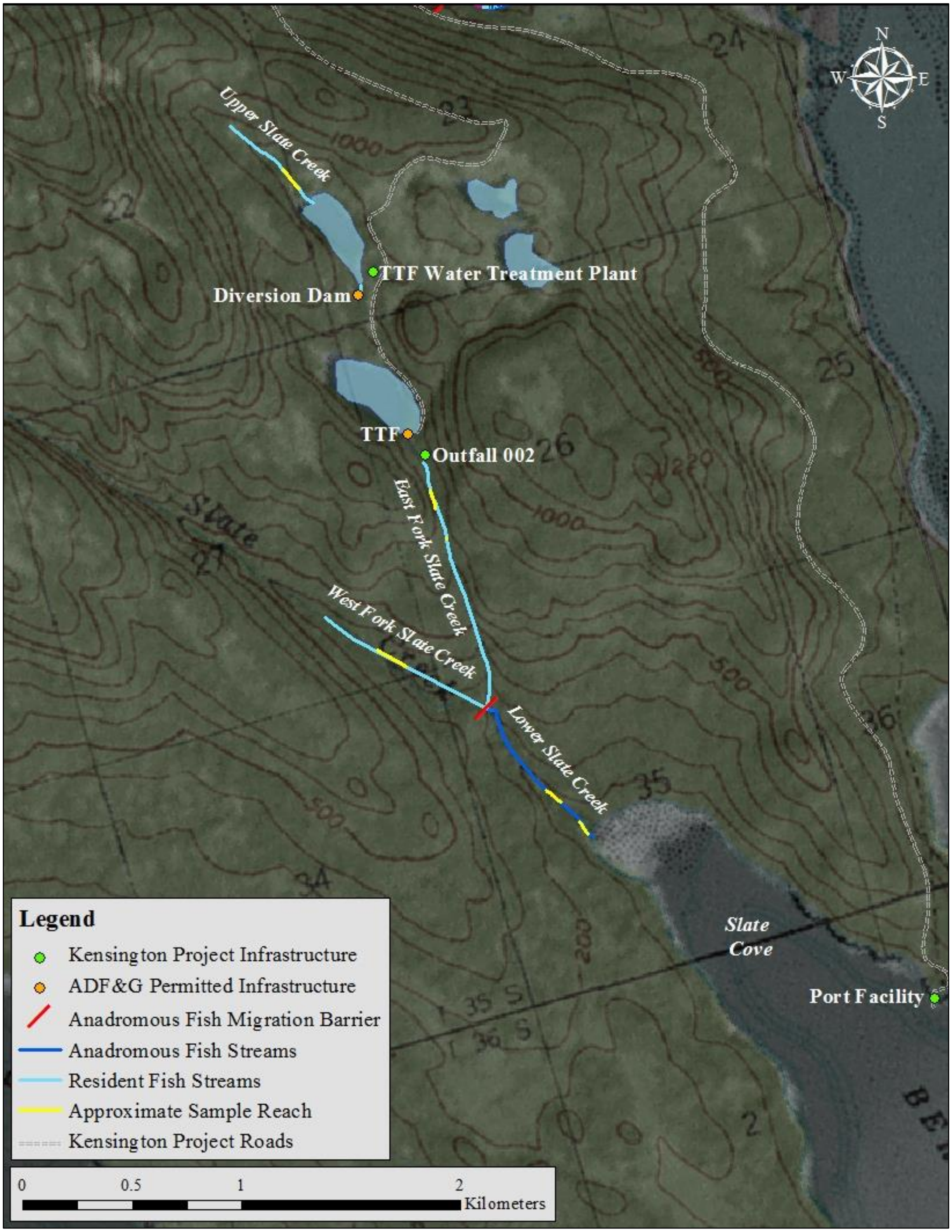


Figure 2.–Slate Creek map.

### *Lower Slate Creek*

Lower Slate Creek provides spawning habitat for chum, coho *O. kisutch*, and pink salmon, and eulachon *Thaleichthys pacificus*, and rearing habitat for coho salmon (Stream No. 115-20-10030; Johnson and Blossom 2017). We have also 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 waters 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), pink salmon spawning substrate at Sample Point 2 (SP2), and count adult salmon throughout Lower Slate Creek.

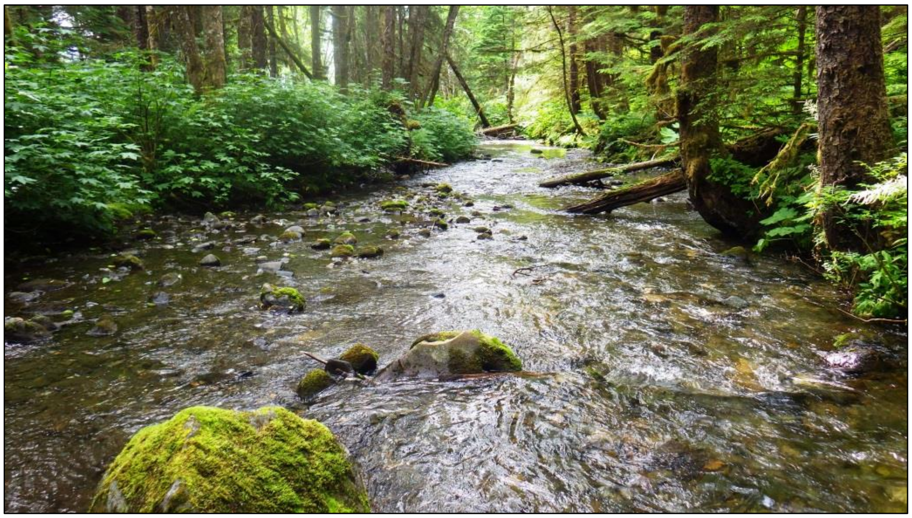

Figure 3.–Lower Slate Creek SP1.

### *West Fork Slate Creek*

West Fork Slate Creek (Figure 4) 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.

Figure 4.–West Fork Slate Creek.

***East Fork Slate Creek***

East Fork Slate Creek (Figure 5) provides 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 waters from Outfall 002 and Upper Slate Lake. We sample periphyton, BMIs, and sediments in East Fork Slate Creek within 200 m downstream of the TTF.

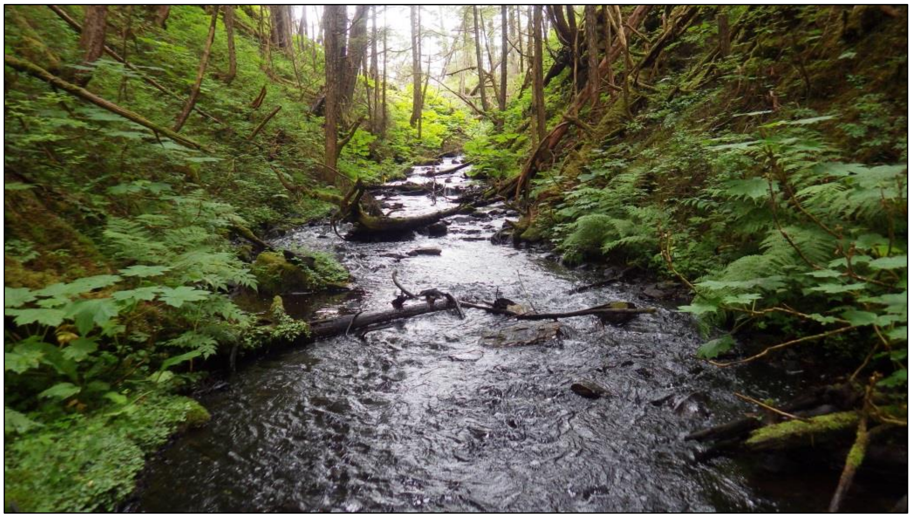

Figure 5.–East Fork Slate Creek.

***Upper Slate Creek***

Upper Slate Creek (Figure 6) provides habitat for Dolly Varden char (Kanouse and Zutz 2017) and is not influenced by the mine. We sample periphyton, BMIs, and sediments in Upper Slate Creek within 100 m of Upper Slate Lake.

Figure 6.–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 7). A 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.

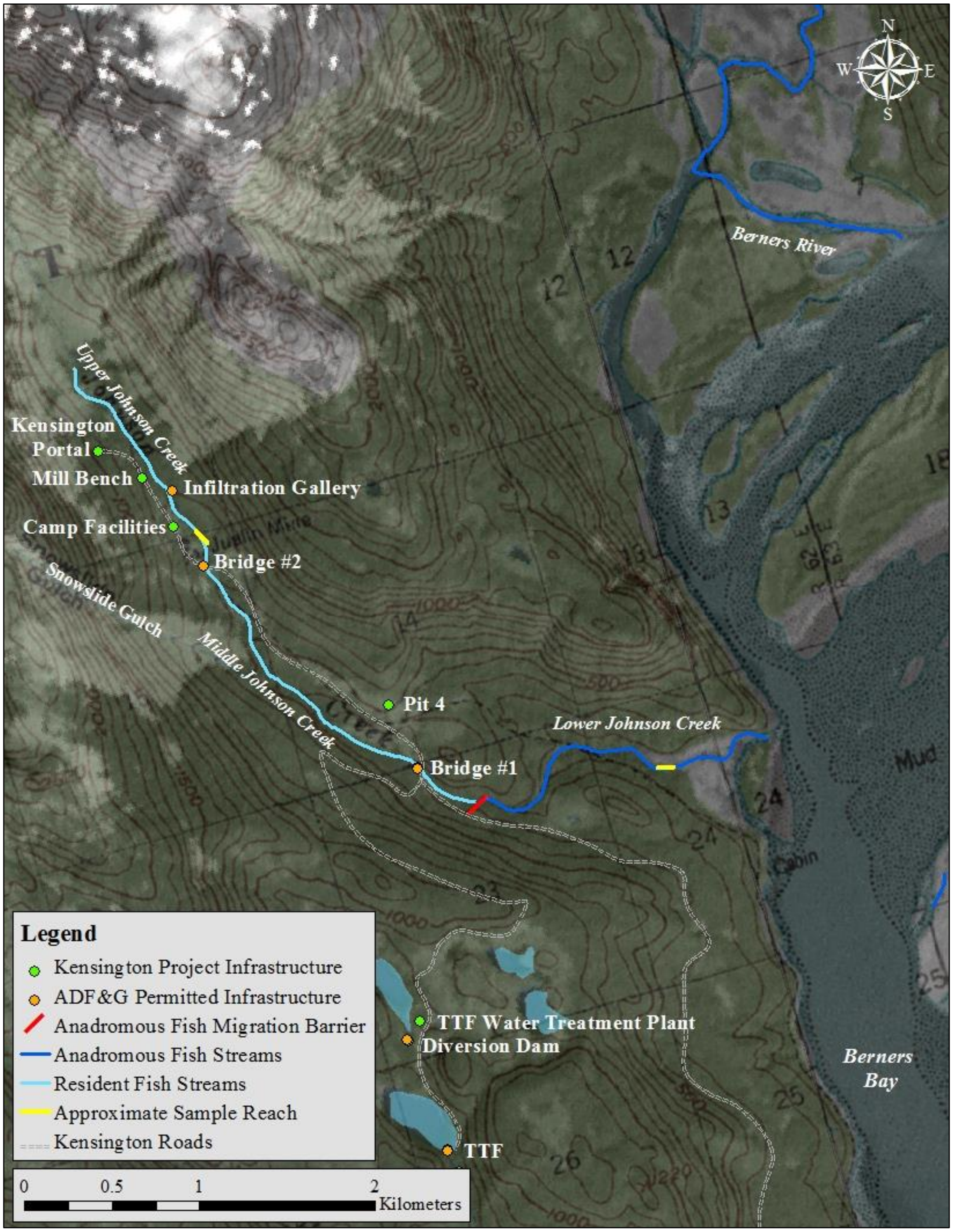


Figure 7.–Johnson Creek map.

### *Lower Johnson Creek*

Lower Johnson Creek provides spawning and rearing habitat for chum, coho, and pink salmon (Stream No. 115-20-10030; Johnson and Blossom 2017). We have also documented juvenile 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[e] and Upper Johnson Creeks. We sample sediment about 600 m upstream from the mouth and count adult salmon throughout Lower Johnson Creek (Figure 8).


Figure 8.–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. An infiltration gallery collects water from Upper Johnson Creek near the mill bench to support the camp. We sample BMIs about 50 m upstream of Bridge #2 (Figure 9).

Figure 9.–Upper Johnson Creek.

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[e] 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 10). A 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.

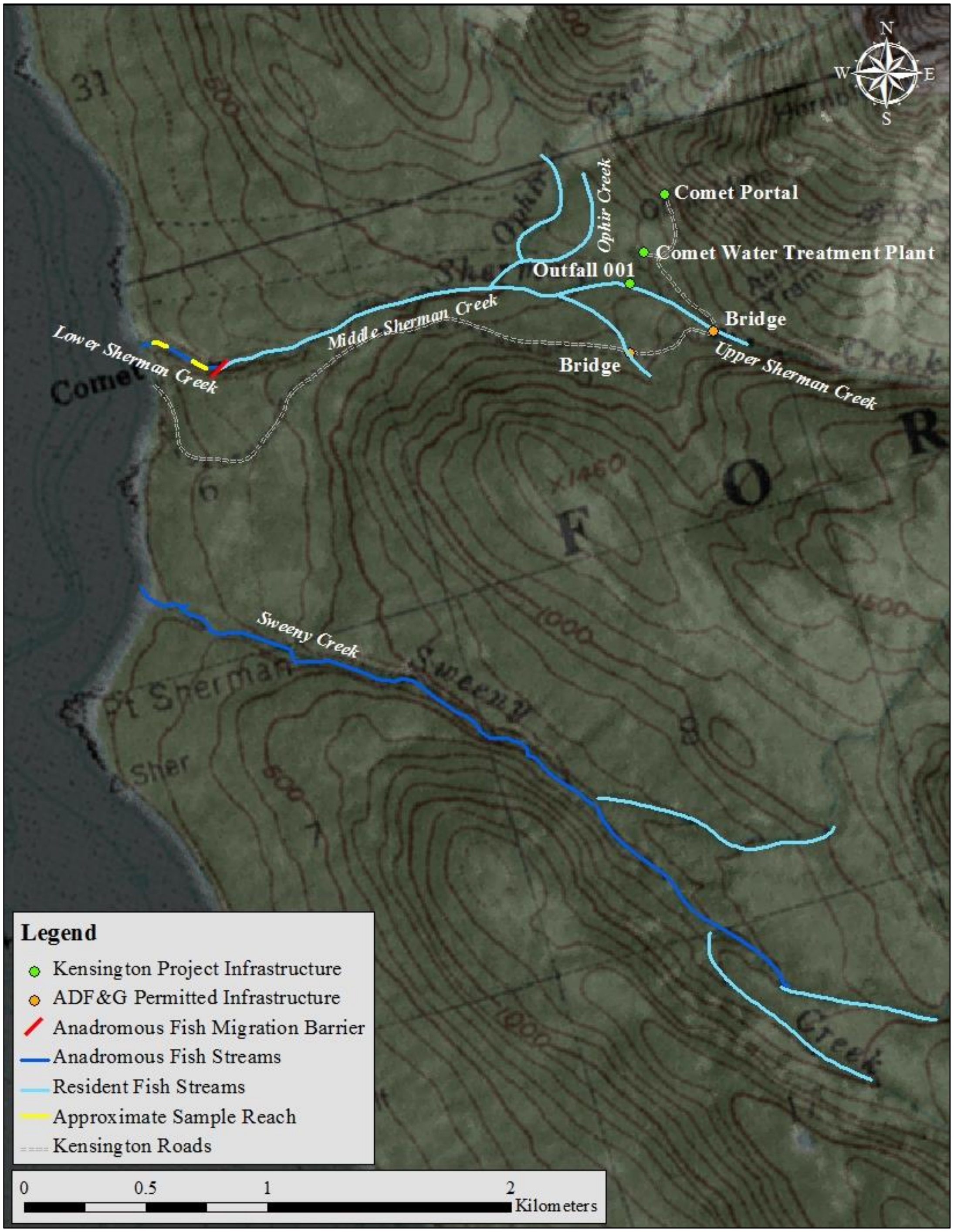


Figure 10.–Sherman Creek map.

### *Lower Sherman Creek*

Lower Sherman Creek provides spawning habitat for chum and pink salmon (Stream No.115-31-10330; Johnson and Blossom 2017). We have also 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[f] and its tributaries. We sample periphyton and BMIs at Sample Points 1 and 2 (SP1, SP2), sediment at SP1, and count adult salmon throughout Lower Sherman Creek (Figures 11, 12).

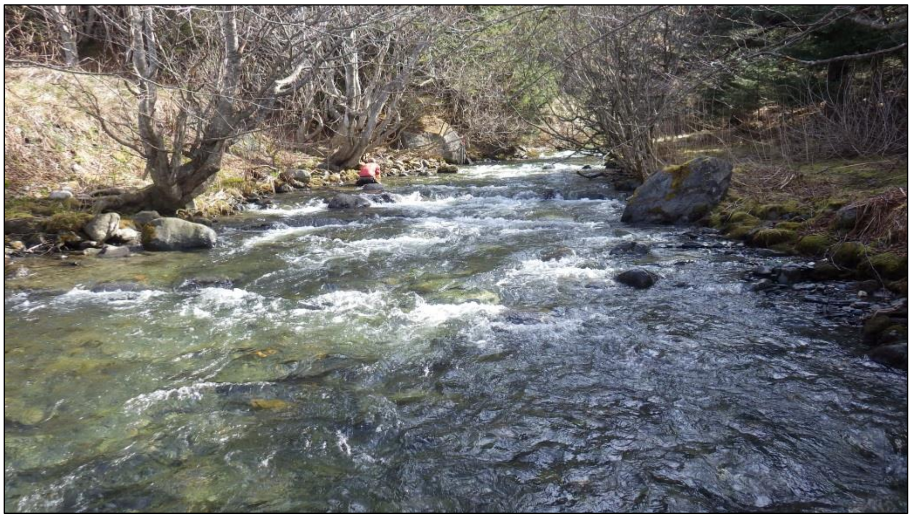

Figure 11.–Lower Sherman Creek SP1.

Figure 12.–Lower Sherman Creek SP2.

[f] 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.

## 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.–2017 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 | 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 | -134.1408 |
| 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 2017 by site.

Table 6.–2017 aquatic studies sampling schedule.

| Aquatic Study | Lower Slate | West Fork Slate | East Fork Slate | Upper Slate | Lower Johnson | Upper Johnson | Lower Sherma |
|---|---|---|---|---|---|---|---|
| Periphyton | 4/25 | --- | 4/27 | --- | --- | --- | --- |
| | 7/24 | 7/24 | 7/25 | 7/24 | --- | --- | 7/25 |
| Benthic macroinvertebrates | 4/25 | 4/25 | 4/27 | 4/27 | --- | 4/26 | 4/26 |
| Adult salmon counts | 7/18– | --- | --- | --- | 7/18– | --- | 7/18– |
| | 10/26 | --- | --- | --- | 11/2 | --- | 9/21 |
| Spawning substrate | 7/6 | --- | --- | --- | --- | --- | --- |
| Sediment element concentrations | 7/7 | --- | 7/7 | 7/7 | 7/6 | --- | 7/6 |

*Note:* Periphyton sampling in April is not required by the Plan of Operations or APDES permit.

# 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. In this report, we

- rounded down fish counts by reach for the 2011 adult salmon count data consistent with calculations used in other years; and
- identified incomplete adult salmon surveys in each data set.

## PERIPHYTON: CHLOROPHYLL DENSITY AND COMPOSITION

### Requirement APDES 1.5.3.5.2

Periphyton is composed of primary producing organisms such as algae, cyanobacteria, and heterotrophic microbes, and detritus, attached to the submerged surfaces of aquatic ecosystems. Algal density and community structure are influenced by water and sediment 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 top of each rock and scrubbed the area around the foam with a toothbrush to remove algae and other organisms outside the covered area, then rinsed the rock by dipping it in the stream while holding the foam in place.

We placed a 47mm Type A/E 1 µm glass fiber filter into a Nalgene® filter holder attached to a vacuum pump with a gauge, removed the foam square, and scrubbed the sample area using a rinsed toothbrush into the filter holder. We used stream water in a wash bottle to rinse the loosened periphyton from the rock, the toothbrush, and the inside of the filter holder onto the filter. We repeated the scrub and rinse cycle a second time. We pumped most of the water through the filter, maintaining pressure less than 34 kPa, and added a few drops[g] of saturated magnesium carbonate solution[h] to the filter before pumping the sample dry. We removed the

[g] This measurement is not exact as the amount of water and magnesium carbonate used to create a saturated solution varies. We used supernatant solution to avoid magnesium carbonate solids.

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

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

We followed USEPA (1997) protocol for chlorophyll extraction and measurement, determining instrument and estimated detection limits, and data analysis.[i] 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% acetone. We capped the centrifuge tubes and shook each sample vigorously[j] before placing them in a rack, covering them with aluminum foil, and storing them in a refrigerator overnight to extract the chlorophyll.[k] The following day, we centrifuged the samples for 20 min at 1,600 rpm, 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. Prior to measuring samples, we inserted two cuvettes with 90% acetone to zero the machine and correct for the absorbance of the solvent. We treated each sample with 80 μL of 0.1 N hydrochloric acid[l], waited 90 s, and measured absorbance at wavelengths 665 nm and 750 nm.

We entered absorbance values into trichromatic equations to estimate chlorophylls *a*, *b*, and *c* density ($mg/m^2$), and corrected for turbidity using the 750 nm absorbance value (APHA 2012, USEPA 1997). We corrected chlorophyll *a* concentrations when phaeophytin was detected. If chlorophyll *a* was not detected in a sample, we report the concentration at the estimated detection limit and did not report values for chlorophylls *b* or *c*; the 2017 estimated detection limit for chlorophyll *a* concentration was 0.08 $mg/m^2$. We round all values to two decimal places.

### Data Presentation

For each site and by year, we present a table of mean chlorophylls *a*, *b*, and *c* density, illustrate mean chlorophyll *a* density and mean proportion of chlorophylls *a*, *b*, and *c* in figures, and provide the 2011–2017 data in Appendix A. Periphyton sampling during April is not required by the APDES permit or Plan of Operations, and we include the 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 an important 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

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[i] Except we stored the samples longer than 3.5 weeks and we cut the sample filters, rather than homogenize them, to reduce acetone exposure for laboratory staff.

[j] To ensure all filter pieces are submerged.

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

[l] To convert the chlorophyll to phaeophytin.

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.

**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—habitat that supports 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 300 µm meshes. 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.[m] We rinsed the net in the stream to ensure all organisms floated into the cod end of the Surber sampler, 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 all samples where 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,[n,o] and identified organisms to the lowest practical taxonomic level[p] using Merritt and Cummins (1996) and Stewart and Oswood (2006). Habitat Biologist Greg Albrecht 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[q] 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):

[m] We spend about the same amount of time collecting each sample (e.g. 5 minutes) and prefer to have the same person collecting all samples at each site for consistency.

[n] 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.

[o] 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.

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

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

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

and

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

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.[r] 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, illustrate mean density in a figure, and provide the 2011–2017 data summary in Appendix B.

## 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 mid-September 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.[s] 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.

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[r] Assuming all taxonomic groups are represented.

[s] We no longer conduct three concurrent foot surveys in Johnson Creek to estimate our annual mean aerial count underestimation, as the surveys are not required.

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 by distribution, and provide the 2011–2017 count by species in a table. Incomplete surveys are identified in bold. The 2017 data and pink salmon count by statistical week 2011–2017 are in Appendix C.

## SPAWNING SUBSTRATE COMPOSITION

### Requirement APDES 1.5.3.5.1

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.[t] 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,

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

### Data Presentation

For each site and by year, we present a table of the geometric mean particle sizes (GMPS) and include the 2011–2017 data in Appendix D.

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

## SEDIMENT COMPOSITION AND ELEMENT CONCENTRATIONS

### Requirement APDES 1.5.2

Sediment metals 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), 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 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 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.[u] 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, Fe, Hg, Pb, Se, and Zn on a dry-weight basis using the methods listed in Table 7. 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 |

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

## Data Presentation

We present two figures for each site, the 2017 sample concentrations and results by analyte for the 2011–2017 data.[v] We compare the 2011–2017 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 (NOAA; Buchman 2008), specifically the threshold effects concentrations (TEC) and the probable effects concentrations (PEC). The guidelines are based on results of controlled laboratory bioassays (MacDonald et al. 2000), 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 2011–2017 sediment composition and element concentration data by site and the 2017 laboratory report in Appendix E.

v When the laboratory provides duplicate sample results, we present the mean value.

# RESULTS

## Slate Creek

### Lower Slate Creek

#### *Periphyton: Chlorophyll Density and Composition*

The 2017 Lower Slate Creek mean chlorophyll *a* density was 2.30 mg/m$^2$, within the range observed 2011–2016 (Table 8; Figure 13). Figure 14 presents the mean proportion of chlorophylls *a*, *b*, and *c* each year.

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

| | 7/29/11 | 7/25/12 | 7/31/13 | 7/30/14 | 7/28/15 | 7/26/16 | 7/24/17 |
|---|---|---|---|---|---|---|---|
| Chl-*a* (mg/m$^2$) | 5.15 | 2.31 | 12.59 | 3.97 | 2.16 | 5.26 | 2.30 |
| Chl-*b* (mg/m$^2$) | 0.43 | 0.05 | 0.00 | 0.85 | 0.10 | 0.21 | 0.23 |
| Chl-*c* (mg/m$^2$) | 0.26 | 0.18 | 1.64 | 0.30 | 0.21 | 0.62 | 0.23 |

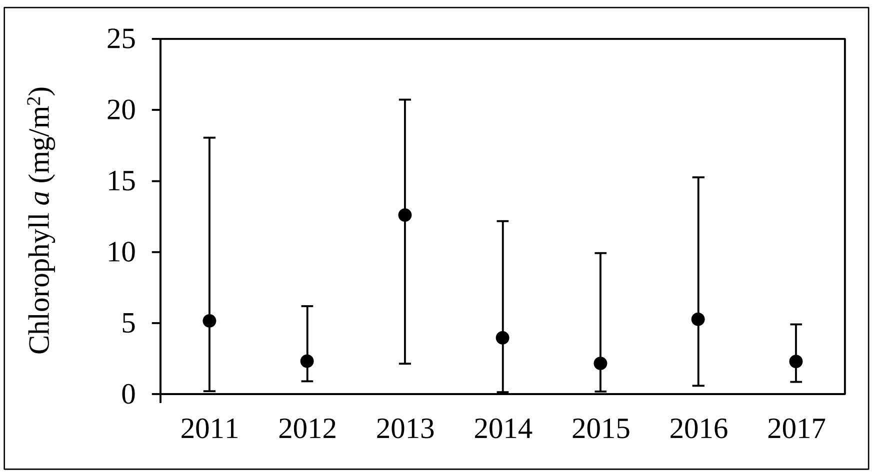


Figure 13.–Lower Slate Creek mean chlorophyll *a* densities.
*Note:* Minimum, mean, and maximum values presented.

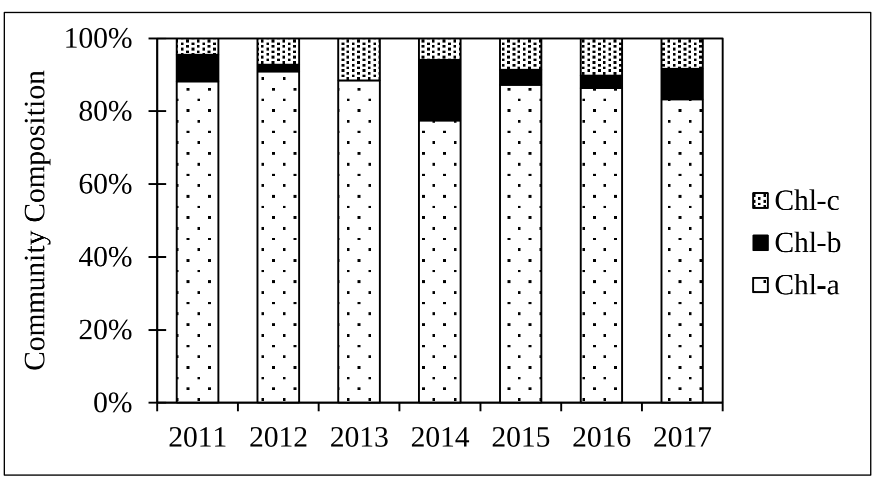


Figure 14.–Lower Slate Creek mean proportions of chlorophylls *a*, *b*, and *c*.

### ***Benthic Macroinvertebrate Density and Community Composition***

Among the 2017 Lower Slate Creek BMI samples, we identified 27 taxa and estimate mean density at 1,308 BMI/$m^2$, of which 50% were EPT insects, the lowest BMI density observed since 2011 due to fewer Diptera insects and other organisms present (Table 9; Figure 15). The Shannon Diversity and Evenness scores were greater than previous years, and the dominant taxa were Diptera: Chironomidae and Plecoptera: *Suwallia*, representing 36% and 17% of the samples, unlike previous years when samples usually contained more than 50% Chironomidae.

Table 9.–Lower Slate Creek BMI data summaries.

| | 5/4/11 | 5/2/12 | 4/30/13 | 4/30/14 | 4/27/15 | 4/26/16 | 4/25/17 |
|---|---|---|---|---|---|---|---|
| Mean BMI density (per $m^2$) | 2,057 | 3,154 | 2,581 | 4,136 | 3,407 | 3,394 | 1,308 |
| Total BMI taxa | 29 | 32 | 27 | 32 | 26 | 24 | 27 |
| Number of EPT taxa | 13 | 17 | 16 | 17 | 13 | 11 | 13 |
| % EPT | 14% | 38% | 51% | 19% | 24% | 15% | 50% |
| Shannon Diversity score | 0.51 | 0.69 | 0.85 | 0.64 | 0.70 | 0.65 | 0.81 |
| Evenness score | 0.48 | 0.58 | 0.70 | 0.52 | 0.58 | 0.57 | 0.73 |

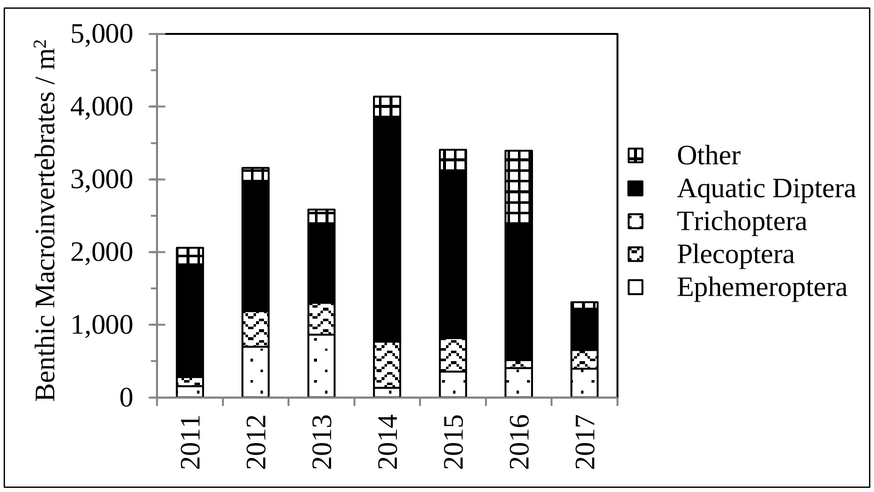


Figure 15.–Lower Slate Creek mean BMI densities and community compositions.

### *Adult Salmon Counts*

We counted 7,416 pink salmon, 1 chum salmon, and 5 coho salmon in Lower Slate Creek during the 2017 spawning season (Table 10).[w] Figure 16 shows pink salmon counts for each survey and Figure 17 displays pink salmon distribution by reach.

Table 10.–Lower Slate Creek adult salmon counts.

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

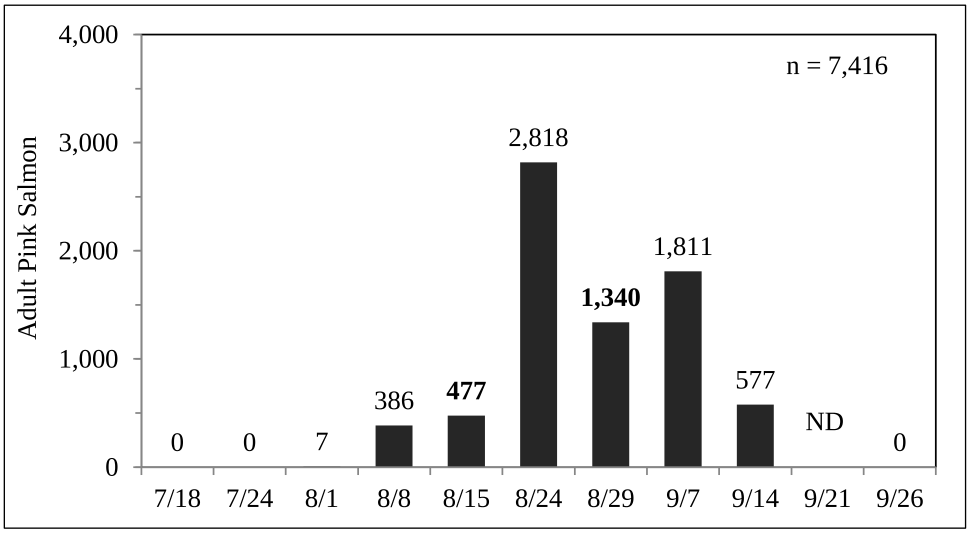


Figure 16.–2017 Lower Slate Creek weekly pink salmon count.
*Note*: Bold numbers indicate incomplete surveys.

[w] We ended the 8/15/17 and 8/29/17 foot surveys early due to bear activity.

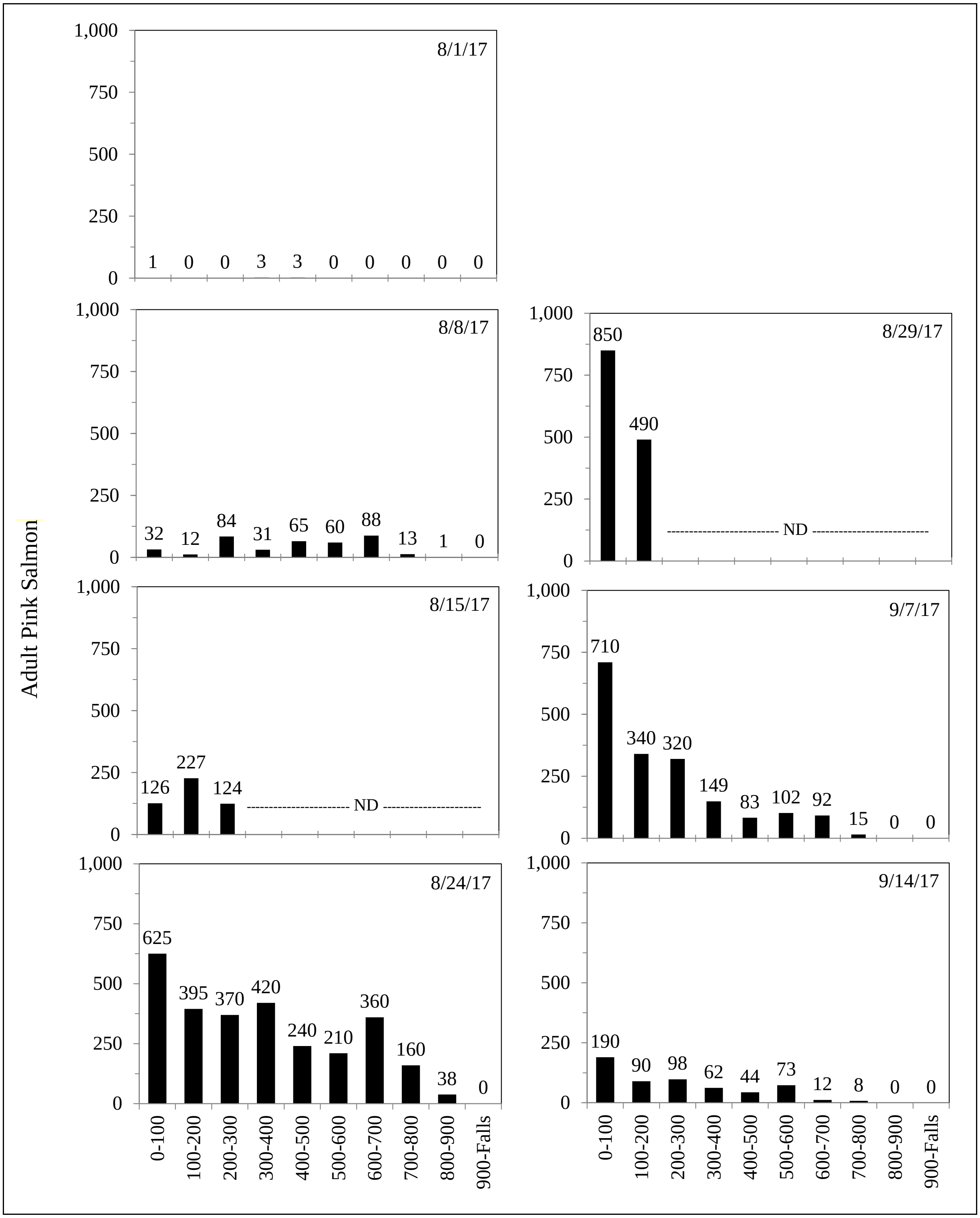

Figure 17.–2017 Lower Slate Creek weekly pink salmon distribution.

### *Spawning Substrate Composition*

**Sample Points 1 and 2**

The GMPS among pink salmon spawning substrate samples collected at each Lower Slate Creek site was 14.7 mm at SP1, and 13.0 mm at SP2. The SP1 GMPS was the greatest value observed since 2011, and the SP2 GMPS was within the range of sizes previously observed (Table 11).

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

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

### *Sediment Element Concentrations*

The 2017 Lower Slate Creek sediment sample contained a lower Cr concentration than previous years and other element concentrations were within the ranges observed 2011–2016, except Hg and Se concentrations were below the method reporting limits. The As, Cu, Ni, and Zn concentrations remain above NOAA's freshwater sediment guidelines (Buchman 2008). Figure 18 presents the 2017 results and Figure 19 presents the 2011–2017 data.

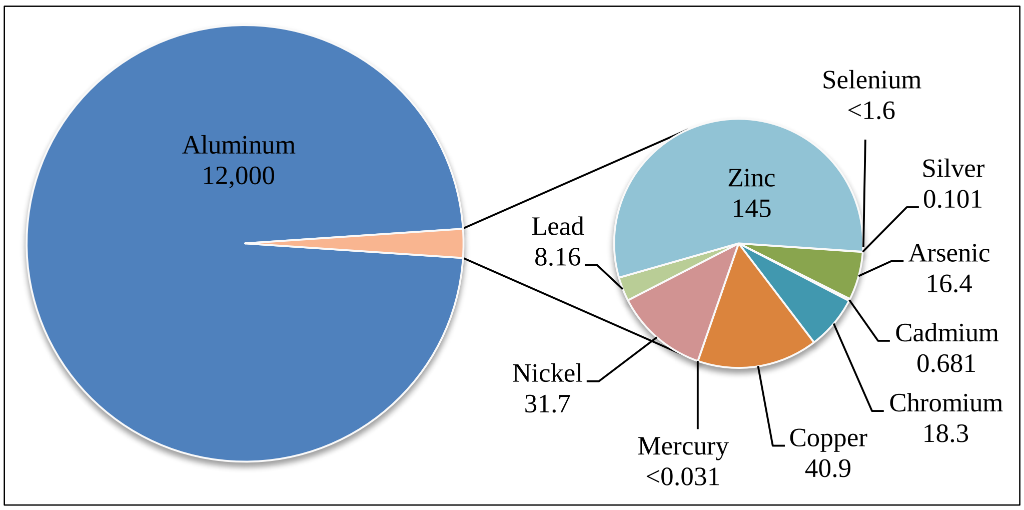


Figure 18.–2017 Lower Slate Creek sediment element concentrations (mg/kg).

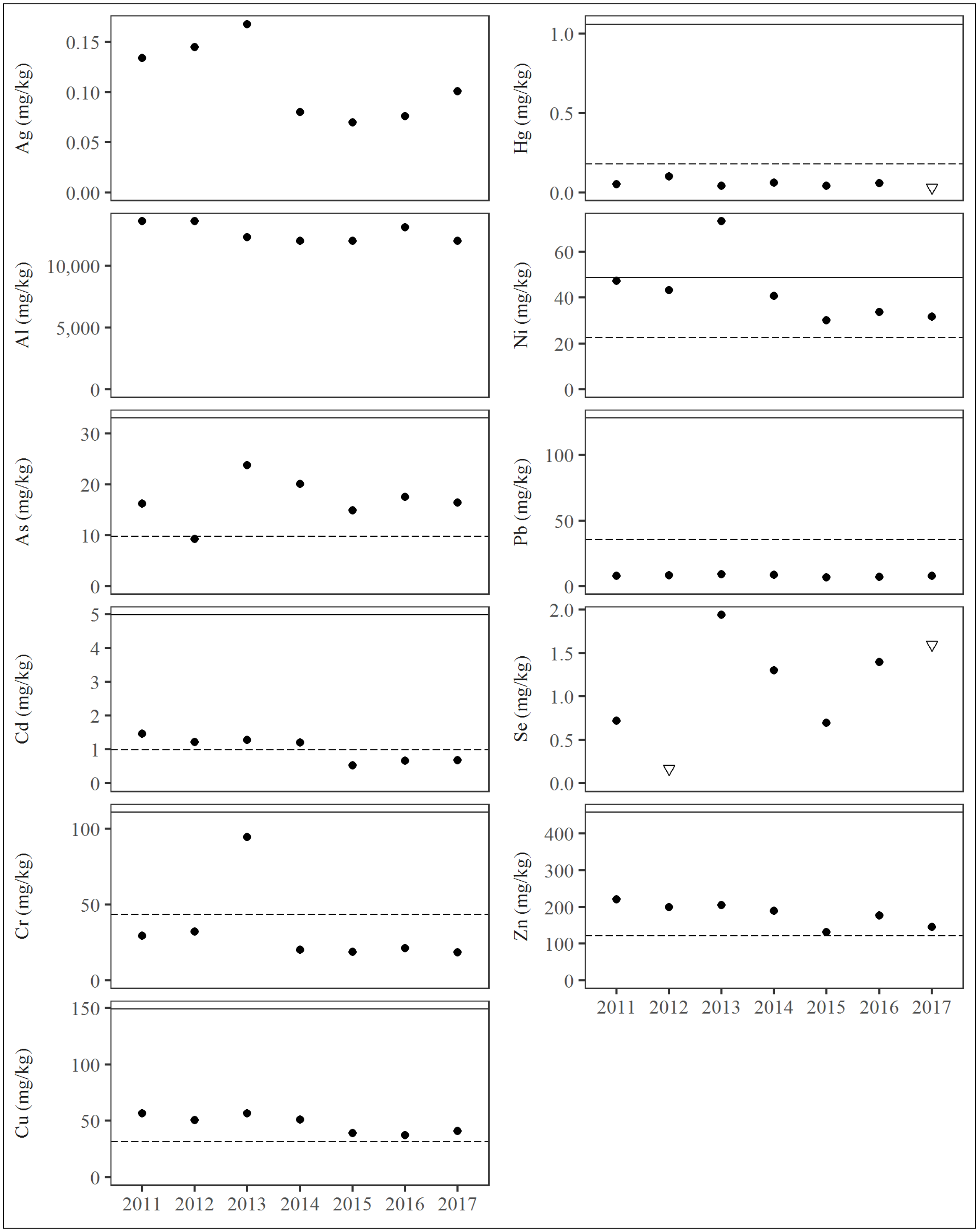


Figure 19.–Lower Slate Creek sediment element concentrations.

*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 2017 West Fork Slate Creek mean chlorophyll *a* density was 4.96 mg/m$^2$, the greatest observed since 2011 and similar to the 2016 density (Table 12; Figure 20). Figure 21 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.

| | 7/29/11 | 7/25/12 | 7/31/13 | 7/30/14 | 7/28/15 | 7/26/16 | 7/24/17 |
|---|---|---|---|---|---|---|---|
| Chl-*a* (mg/m$^2$) | 3.92 | 1.01 | 4.22 | 0.77 | 0.92 | 4.93 | 4.96 |
| Chl-*b* (mg/m$^2$) | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 |
| Chl-*c* (mg/m$^2$) | 0.27 | 0.10 | 0.61 | 0.06 | 0.06 | 0.66 | 0.85 |

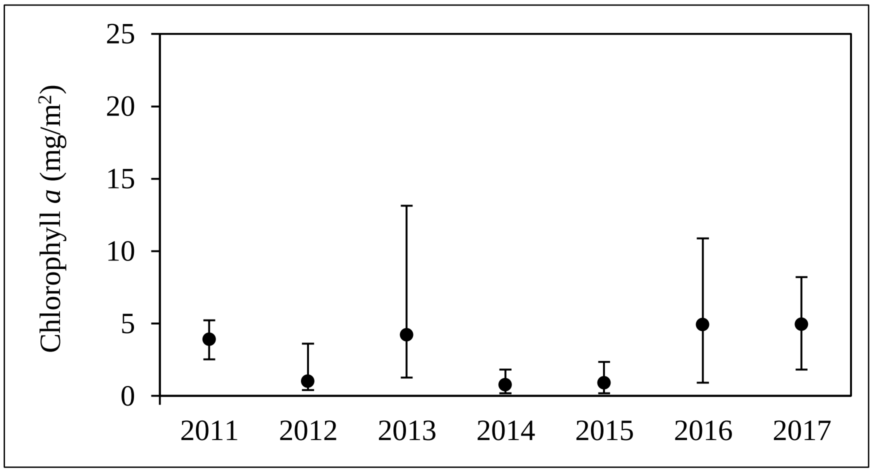


Figure 20.–West Fork Slate Creek mean chlorophyll *a* densities.
*Note:* Minimum, mean, and maximum values presented.

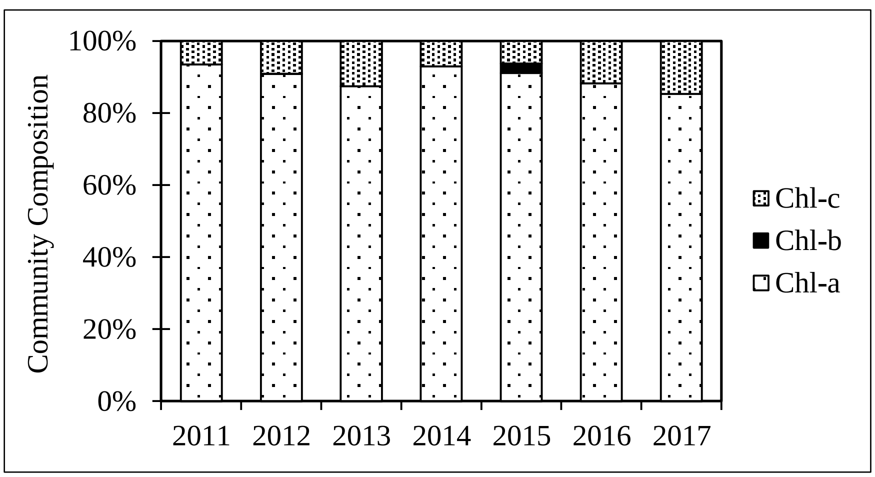


Figure 21.–West Fork Slate Creek mean proportions of chlorophylls *a*, *b*, and *c*.

### *Benthic Macroinvertebrate Density and Community Composition*

Among the 2017 West Fork Slate Creek BMI samples, we identified 21 taxa and estimate mean density at 885 BMI/m$^2$, of which 82% were EPT insects, all within ranges observed 2011–2016 (Table 13; Figure 22). The Shannon Diversity and Evenness scores were also similar to previous years, and the dominant taxa were Ephemeroptera: *Baetis* and *Cinygmula*, each representing 26% of the samples.

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

| | 5/4/11 | 5/2/12 | 4/30/13 | 4/30/14 | 4/27/15 | 4/26/16 | 4/25/17 |
|---|---|---|---|---|---|---|---|
| Mean BMI density (per m$^2$) | 502 | 1,819 | 2,446 | 973 | 2,634 | 1,470 | 885 |
| Total BMI taxa | 21 | 31 | 28 | 29 | 28 | 25 | 21 |
| Number of EPT taxa | 11 | 21 | 18 | 17 | 16 | 15 | 13 |
| % EPT | 80% | 80% | 90% | 71% | 82% | 77% | 82% |
| Shannon Diversity score | 0.63 | 0.84 | 0.73 | 0.91 | 0.82 | 0.72 | 0.78 |
| Evenness score | 0.78 | 0.71 | 0.61 | 0.79 | 0.71 | 0.69 | 0.78 |

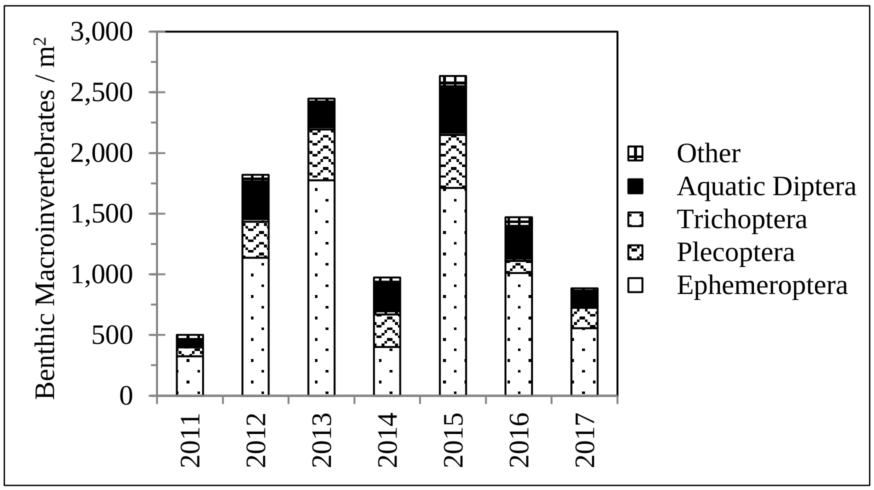


Figure 22.–West Fork Slate Creek mean BMI densities and community compositions.

## 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[x] from the TTF water treatment plant. The July 2017 mean daily discharge[y] records for East Fork Slate Creek show the greatest flows occurred during the first few days of the month and peaked at 8.7 ft$^3$/s on July 3 (Figure 23). Median discharge three weeks prior to sampling periphyton was 3.6 ft$^3$/s (Figure 24).

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

[y] 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 Superintendent, Coeur Alaska, Inc., Juneau).

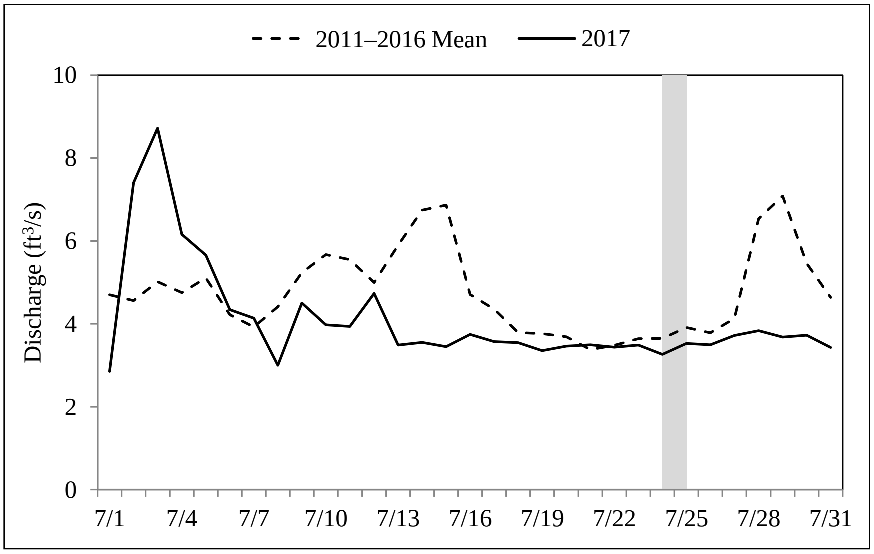


Figure 23.–July 2017 East Fork Slate Creek mean daily discharges.
*Note:* 2017 periphyton sampling days highlighted in gray.
*Source*: Unpublished data, Coeur Alaska, Inc., Juneau, AK.

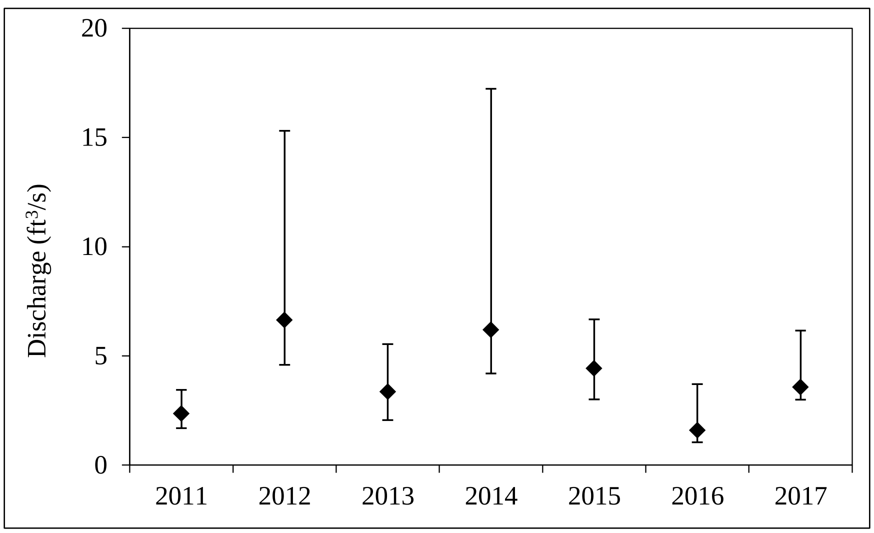


Figure 24.–East Fork Slate Creek mean daily discharges three weeks prior to sampling periphyton in July.
*Note:* Minimum, median, and maximum mean daily discharges.
*Source*: Unpublished data, Coeur Alaska, Inc., Juneau, AK.

### *Periphyton: Chlorophyll Density and Composition*

The 2017 East Fork Slate Creek mean chlorophyll *a* density was 0.64 mg/m$^2$, the second lowest observed since 2011 (Table 14; Figure 25). Figure 26 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.

| | 7/28/11 | 7/24/12 | 7/30/13 | 7/30/14 | 7/27/15 | 7/25/16 | 7/25/17 |
|---|---|---|---|---|---|---|---|
| Chl-*a* (mg/m$^2$) | 8.84 | 5.08 | 2.28 | 0.27 | 1.56 | 1.21 | 0.64 |
| Chl-*b* (mg/m$^2$) | 1.56 | 0.57 | 0.06 | 0.02 | 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 |

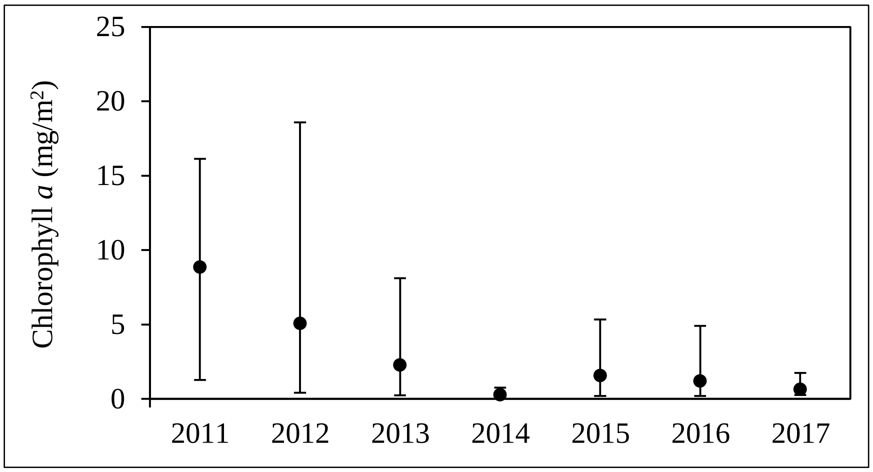


Figure 25.–East Fork Slate Creek mean chlorophyll *a* densities.
*Note:* Minimum, mean, and maximum values presented.

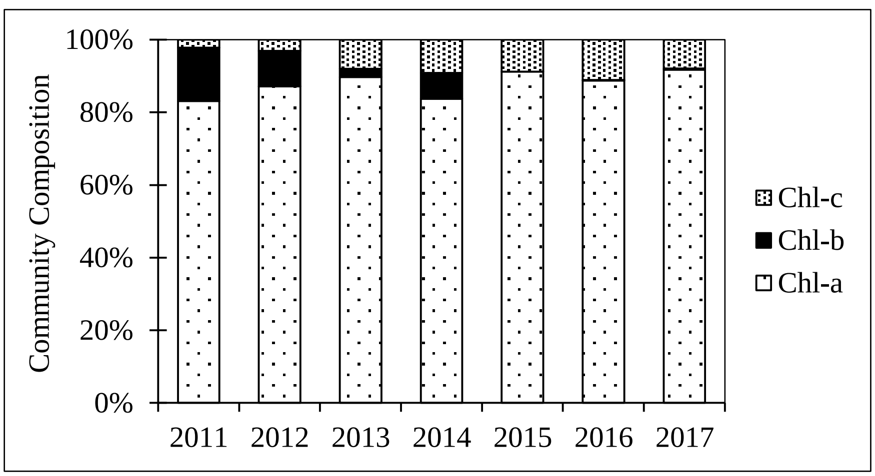


Figure 26.–East Fork Slate Creek mean proportions of chlorophylls *a*, *b*, and *c*.

### *Benthic Macroinvertebrate Density and Community Composition*

Among the 2017 East Fork Slate Creek BMI samples, we identified 27 taxa and estimate mean density at 6,783 BMI/$m^2$, of which 11% were EPT insects, the second largest mean density observed since 2011 due to more Diptera and pea clams present (Table 15; Figure 27). The Shannon Diversity and Evenness scores were also within ranges previously observed and the dominant taxon was Bivalvia: *Pisidium*, representing 53% of the samples.

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

| | 5/12/11 | 4/27/12 | 4/29/13 | 4/30/14 | 4/29/15 | 4/25/16 | 4/27/17 |
|---|---|---|---|---|---|---|---|
| Mean BMI density (per $m^2$) | 4,688 | 4,633 | 9,407 | 2,048 | 3,854 | 2,002 | 6,783 |
| Total BMI taxa | 27 | 33 | 33 | 24 | 28 | 21 | 27 |
| Number of EPT taxa | 15 | 17 | 17 | 9 | 16 | 11 | 13 |
| % EPT | 19% | 23% | 2.5% | 2.0% | 18% | 28% | 11% |
| Shannon Diversity score | 0.64 | 0.78 | 0.57 | 0.70 | 0.92 | 0.92 | 0.62 |
| Evenness score | 0.54 | 0.61 | 0.47 | 0.63 | 0.72 | 0.78 | 0.51 |

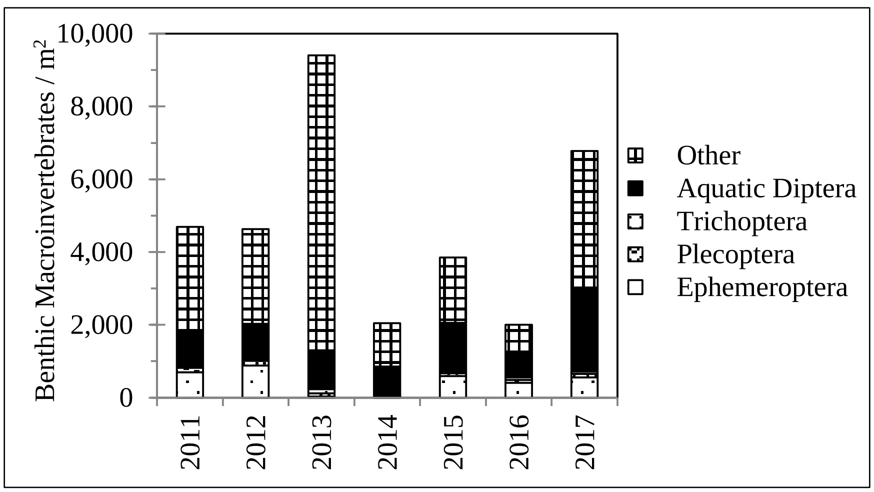


Figure 27.–East Fork Slate Creek mean BMI densities and community compositions.

### *Sediment Element Concentrations*

Element concentrations in the 2017 East Fork Slate Creek sediment sample were within the ranges observed 2011–2016, except Se concentration which was below the method reporting limit. The As, Cd, Cu, Ni, and Zn concentrations remain above NOAA's freshwater sediment guidelines (Buchman 2008). Figure 28 presents the 2017 results and Figure 29 presents the 2011–2017 data.

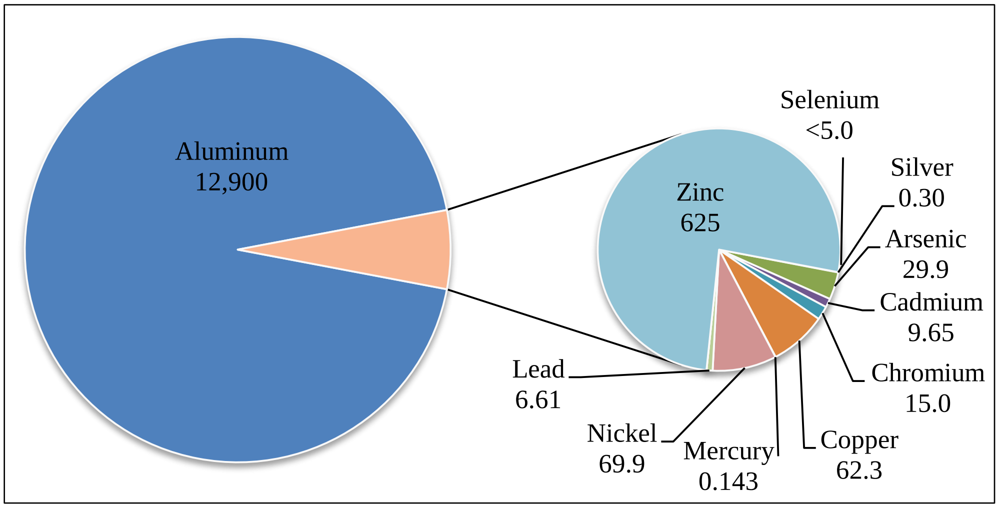


Figure 28.–2017 East Fork Slate Creek sediment element concentrations (mg/kg).

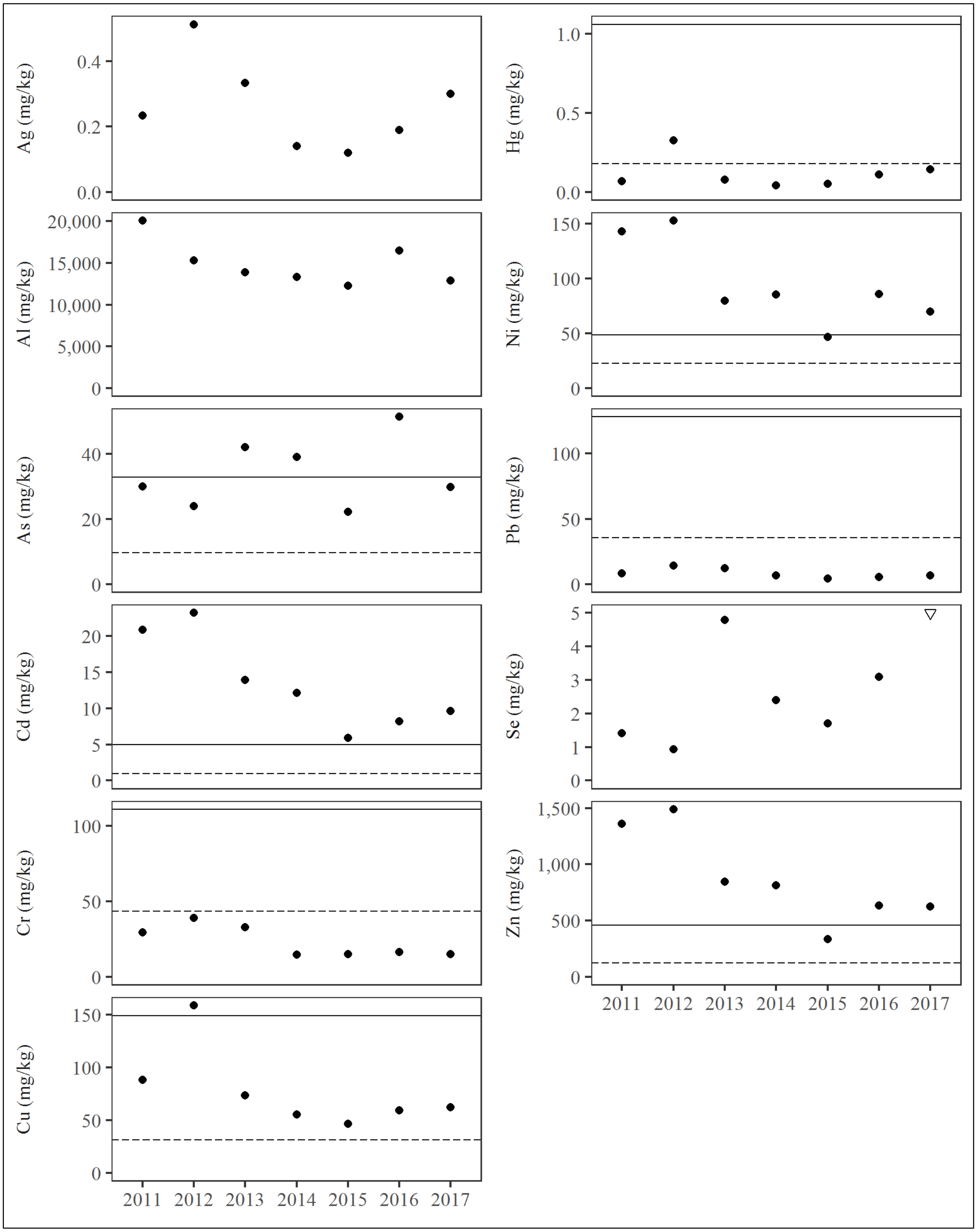


Figure 29.–East Fork Slate Creek sediment element concentrations.

*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 2017 Upper Slate Creek mean chlorophyll *a* density was 0.83 $mg/m^2$, within the range observed since 2011 (Table 16; Figure 30). Figure 31 presents the mean proportion of chlorophylls *a*, *b*, and *c* each year.

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

| | 7/29/11 | 7/24/12 | 7/30/13 | 7/30/14 | 7/27/15 | 7/25/16 | 7/24/17 |
|---|---|---|---|---|---|---|---|
| Chl-*a* ($mg/m^2$) | 0.76 | 1.26 | 2.13 | 1.09 | 0.63 | 3.86 | 0.83 |
| Chl-*b* ($mg/m^2$) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 |
| Chl-*c* ($mg/m^2$) | 0.05 | 0.07 | 0.13 | 0.06 | 0.09 | 0.42 | 0.04 |

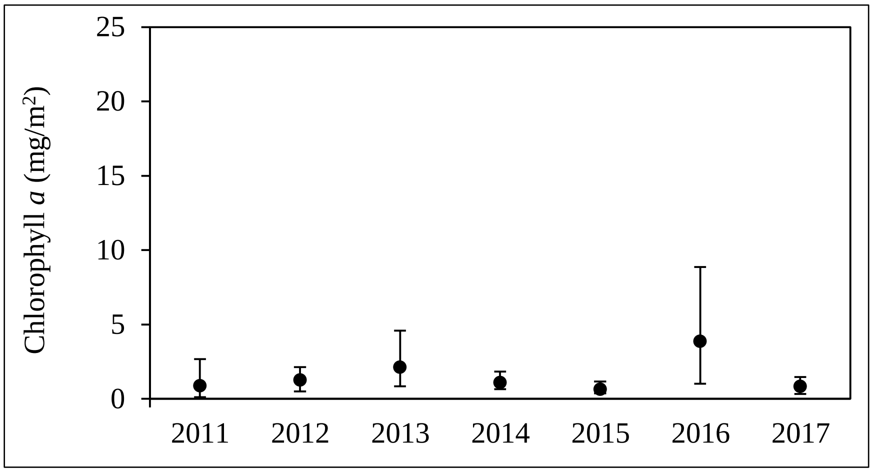


Figure 30.–Upper Slate Creek mean chlorophyll *a* densities.
*Note:* Minimum, mean, and maximum values presented.

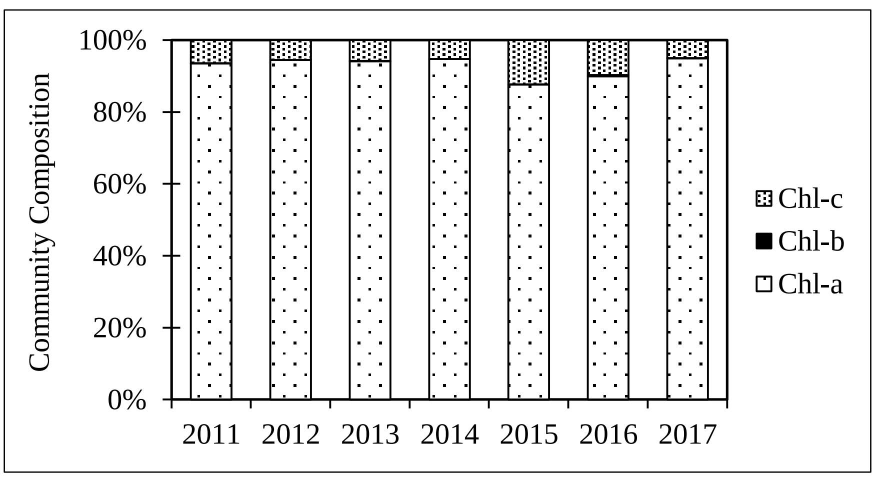


Figure 31.–Upper Slate Creek mean proportions of chlorophylls *a*, *b*, and *c*.

### *Benthic Macroinvertebrate Density and Community Composition*

Among the 2017 Upper Slate Creek BMI samples, we identified 30 taxa and estimate mean density at 2,029 BMI/m$^2$, of which 61% were EPT insects, the lowest BMI density and %EPT observed since 2011 (Table 17; Figure 32). The Shannon Diversity and Evenness scores were also lower than previous years. The dominant taxa were Diptera: Chironomidae and Ephemeroptera: *Baetis*, representing 34% and 20% of the samples.

Table 17.–Upper Slate Creek BMI data summaries.

| | 5/12/11 | 4/27/12 | 4/29/13 | 4/28/14 | 4/29/15 | 4/25/16 | 4/27/17 |
|---|---|---|---|---|---|---|---|
| Mean BMI density (per m$^2$) | 2,523 | 2,256 | 2,880 | 3,125 | 3,776 | 2,398 | 2,029 |
| Total BMI taxa | 33 | 39 | 34 | 36 | 31 | 28 | 30 |
| Number of EPT taxa | 18 | 21 | 20 | 20 | 19 | 15 | 19 |
| % EPT | 63% | 68% | 72% | 63% | 68% | 68% | 61% |
| Shannon Diversity score | 0.97 | 1.04 | 1.02 | 1.03 | 0.98 | 1.06 | 0.96 |
| Evenness score | 0.76 | 0.79 | 0.78 | 0.76 | 0.74 | 0.82 | 0.73 |

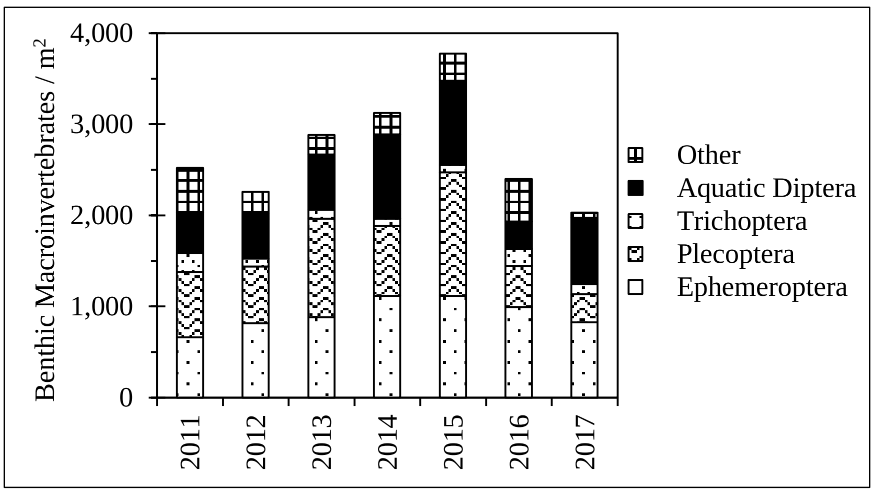


Figure 32.–Upper Slate Creek mean BMI densities and community compositions.

### *Sediment Element Concentrations*

The 2017 Upper Slate Creek sediment sample contained lower concentrations of Cd, Cr, Hg, Ni and Zn than previous years and concentrations of other elements were within the ranges observed 2011–2016. The As, Cr, Cu, and Ni concentrations remain above NOAA's freshwater sediment guidelines (Buchman 2008). Figure 33 presents the 2017 results and Figure 34 presents the 2011–2017 data.

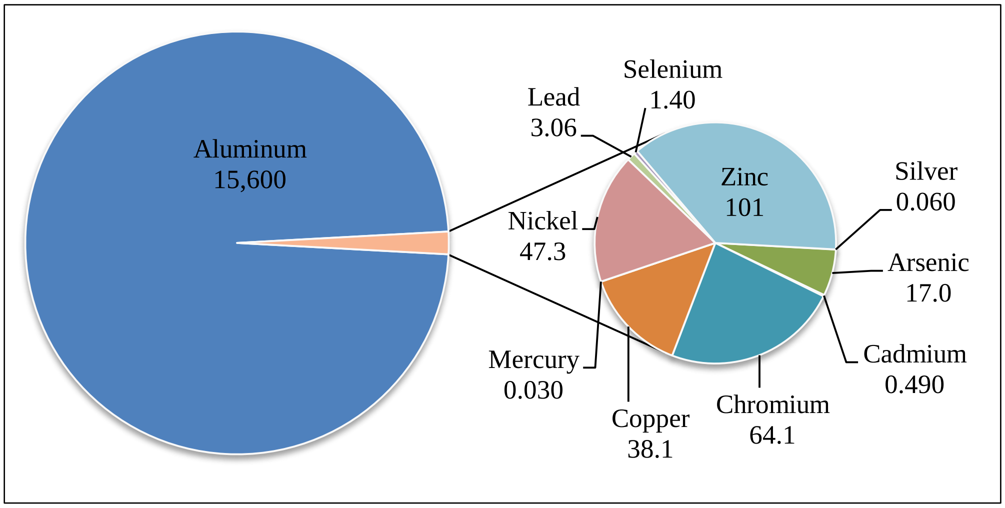


Figure 33.–2017 Upper Slate Creek sediment element concentrations (mg/kg).

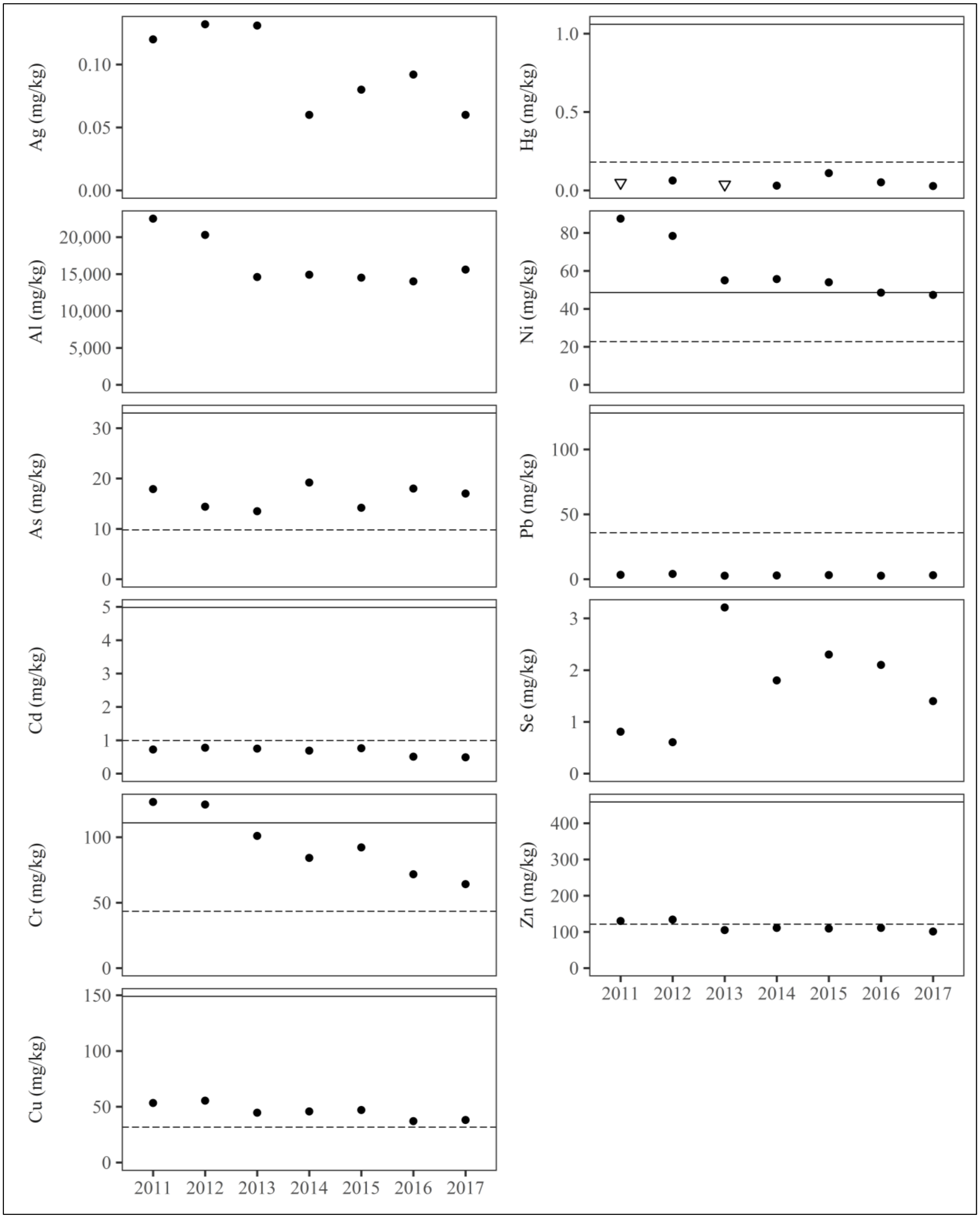


Figure 34.–Upper Slate Creek sediment element concentrations.

*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 23,239 pink salmon[z] and 83 coho salmon in Lower Johnson Creek during the 2017 spawning season (Table 18). Figure 35 shows pink salmon counts for each survey and Figure 36 displays pink salmon distribution by reach.

Table 18.–Lower Johnson Creek adult salmon counts.

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

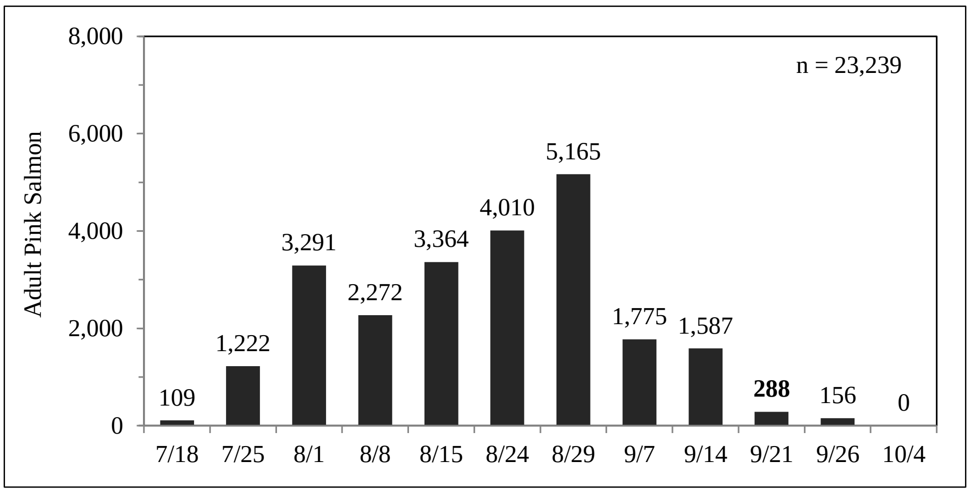


Figure 35.–2017 Lower Johnson Creek weekly pink salmon count.
*Note*: Bold numbers indicate incomplete surveys.

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[z] Our last aerial survey was on 9/21/17, though we also observed pink salmon on 9/26/17 and 10/4/17 during coho salmon foot surveys. On 9/21/17, fog prevented counting fish between Marker #7 and Marker #10.

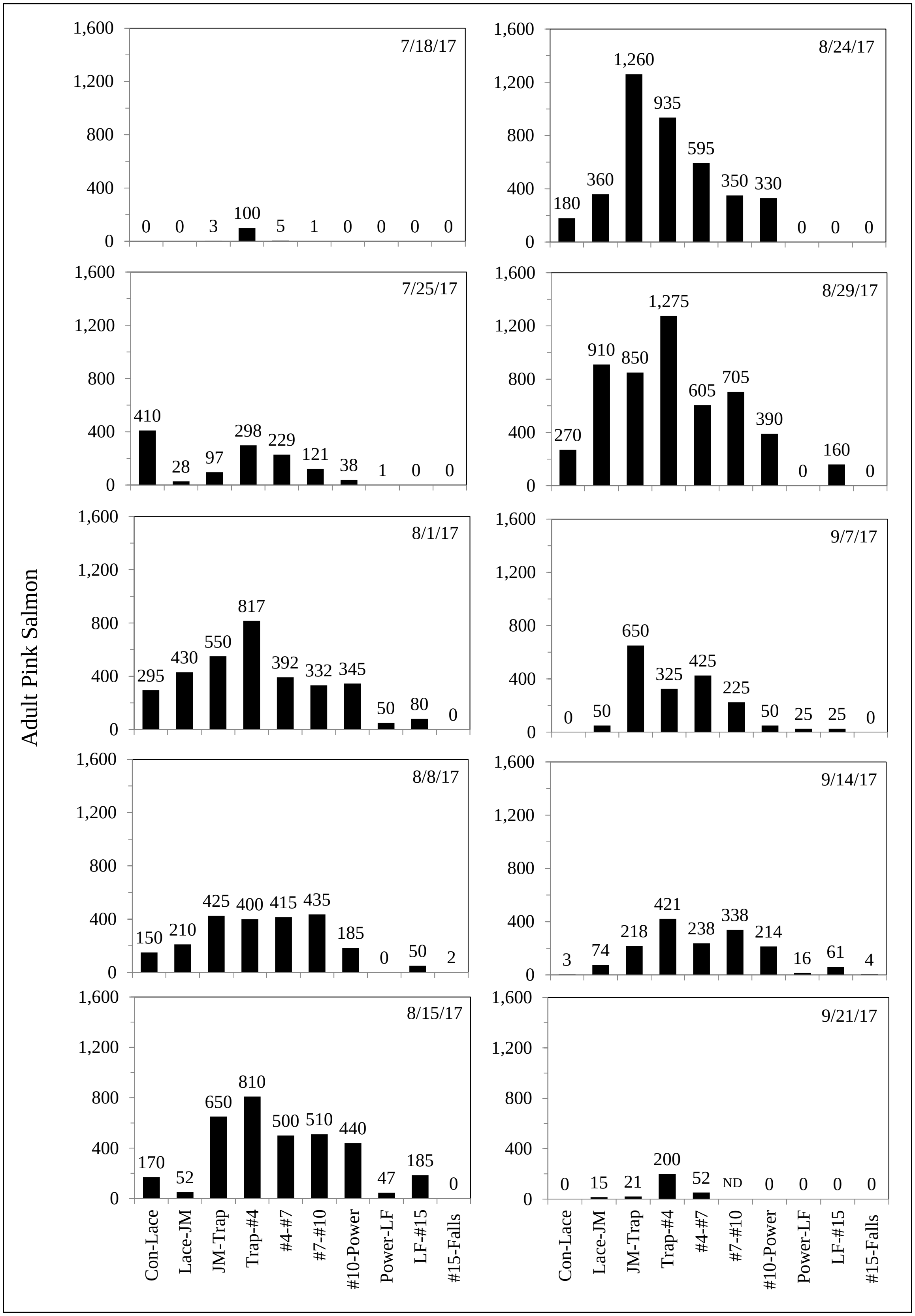


Figure 36.–2017 Lower Johnson Creek weekly pink salmon distribution.

### ***Sediment Element Concentrations***

The 2017 Lower Johnson Creek sediment sample contained Ag and Hg concentrations within the ranges observed 2011–2016, and concentrations of all other elements were lower than previous years. Se concentration was not detected at the method reporting limit for the seventh year in a row. As and Cu concentrations remain above NOAA's freshwater sediment guidelines (Buchman 2008). Figure 37 presents the 2017 results and Figure 38 presents the 2011–2017 data.

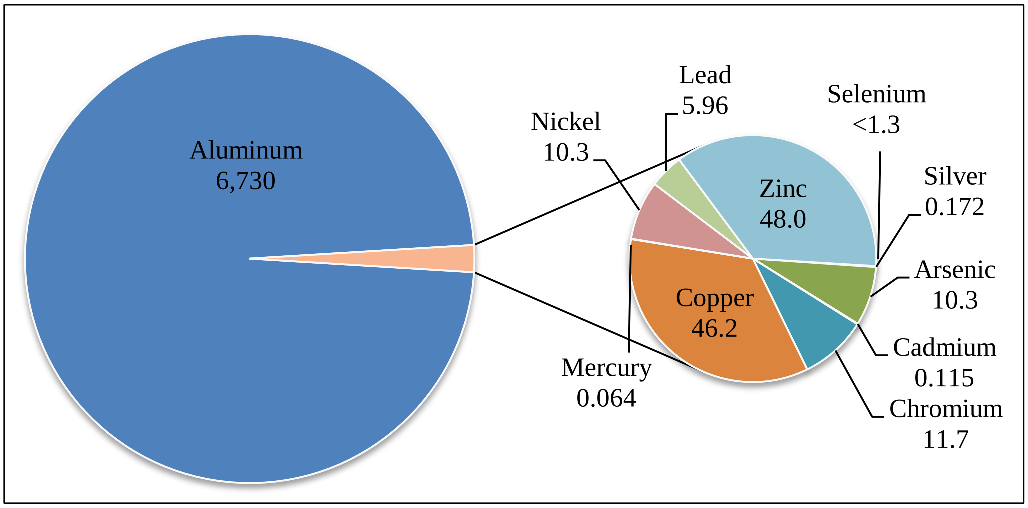


Figure 37.–2017 Lower Johnson Creek sediment element concentrations (mg/kg).

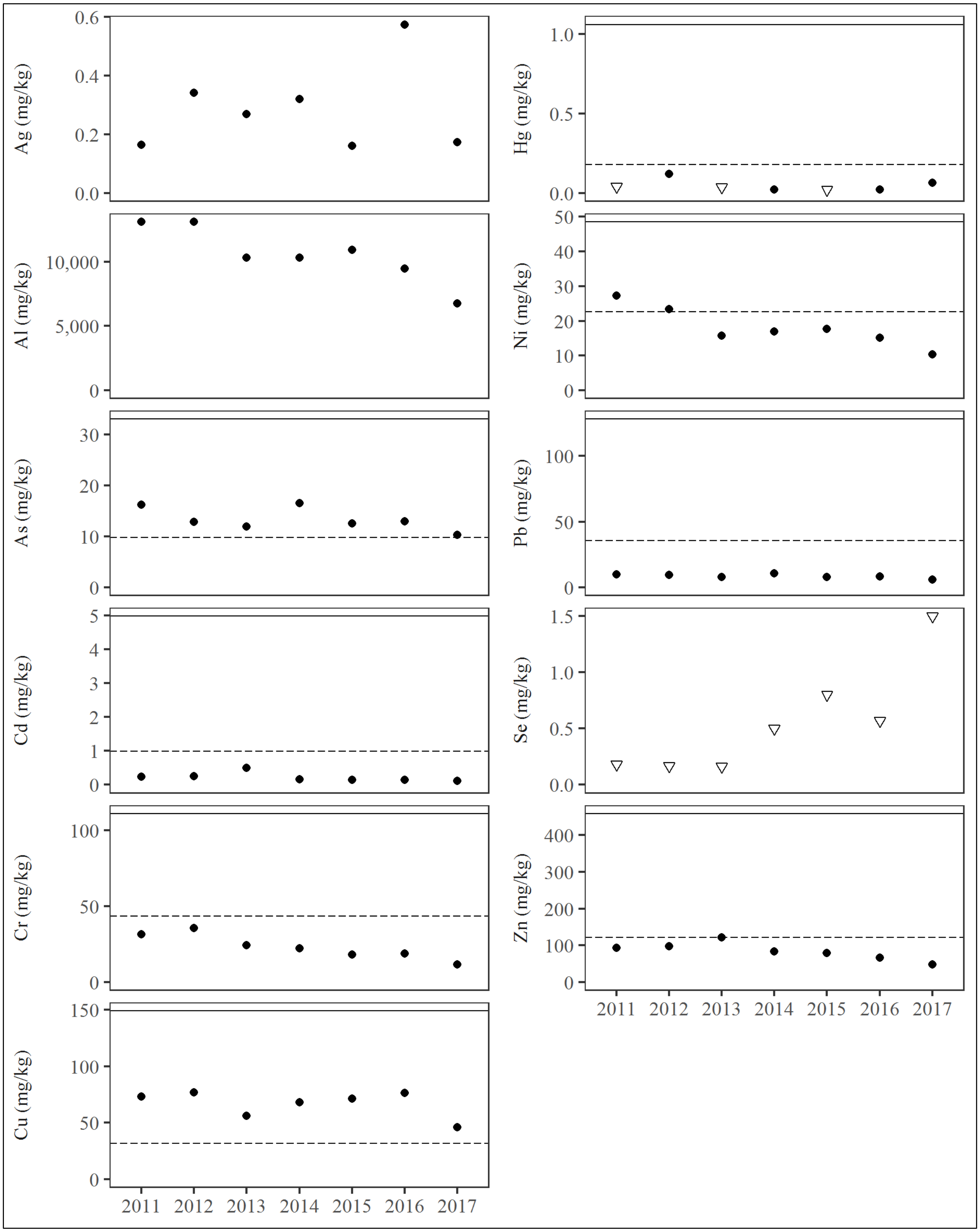


Figure 38.–Lower Johnson Creek sediment element concentrations.

*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 2017 Upper Johnson Creek BMI samples, we identified 33 taxa and estimate mean density at 2,901 BMI/m$^2$, of which 51% were EPT insects, the lowest %EPT observed since 2011 due to fewer EPT and more Diptera insects present (Table 19; Figure 39). The Shannon Diversity and Evenness scores were also the lowest observed, and the dominant taxon was Diptera: Chironomidae, representing 46% of the samples.

Table 19.–Upper Johnson Creek BMI data summaries.

| | 5/3/11 | 4/26/12 | 4/29/13 | 4/29/14 | 4/28/15 | 4/27/16 | 4/26/17 |
|---|---|---|---|---|---|---|---|
| Mean BMI density (per m$^2$) | 3,735 | 3,968 | 5,265 | 2,658 | 2,789 | 3,681 | 2,901 |
| Total BMI taxa | 24 | 28 | 34 | 32 | 28 | 32 | 33 |
| Number of EPT taxa | 14 | 14 | 24 | 21 | 17 | 21 | 19 |
| % EPT | 55% | 64% | 65% | 69% | 71% | 71% | 51% |
| Shannon Diversity score | 0.76 | 0.81 | 0.74 | 0.74 | 0.87 | 0.88 | 0.68 |
| Evenness score | 0.66 | 0.68 | 0.59 | 0.59 | 0.71 | 0.70 | 0.55 |

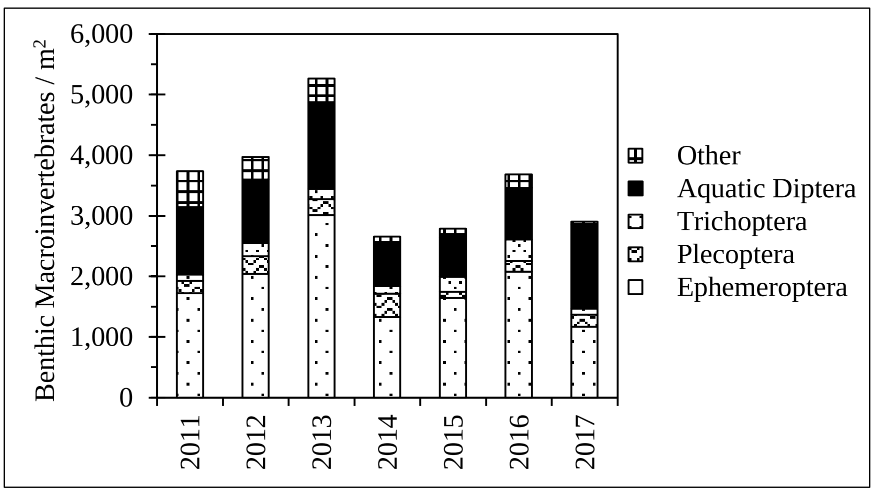


Figure 39.–Upper Johnson Creek mean BMI densities and community compositions.

## SHERMAN CREEK

### Lower Sherman Creek

#### *Periphyton: Chlorophyll Density and Composition*

**Sample Point 1**

The 2017 Lower Sherman Creek SP1 mean chlorophyll *a* density was 3.86 $mg/m^2$, within the range observed since 2011 (Table 20; Figure 40). Figure 41 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.

| | 7/28/11 | 7/26/12 | 7/29/13 | 7/28/14 | 7/27/15 | 7/25/16 | 7/25/17 |
|---|---|---|---|---|---|---|---|
| Chl-*a* ($mg/m^2$) | 7.60 | 2.54 | 3.69 | 1.34 | 1.36 | 3.70 | 3.86 |
| Chl-*b* ($mg/m^2$) | 0.69 | 0.93 | 0.00 | 0.00 | 0.00 | 0.74 | 0.00 |
| Chl-*c* ($mg/m^2$) | 0.49 | 0.08 | 0.51 | 0.18 | 0.17 | 0.33 | 0.56 |

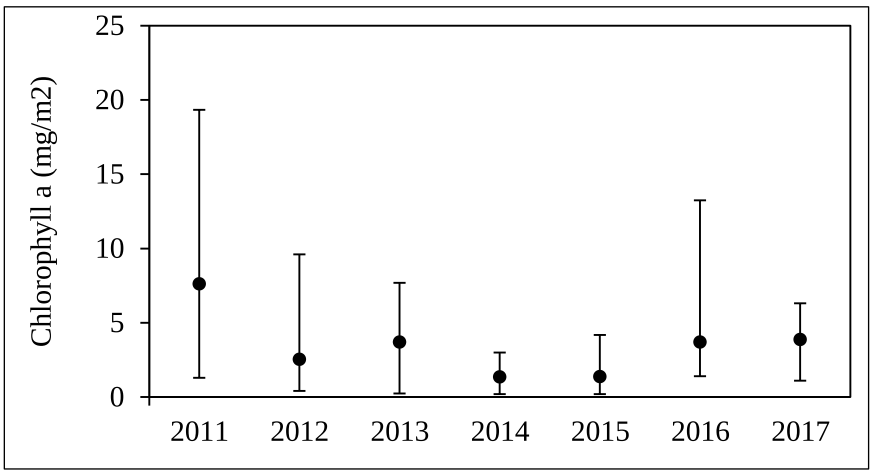


Figure 40.–Lower Sherman SP1 mean chlorophyll *a* densities.
*Note:* Minimum, mean, and maximum values presented.

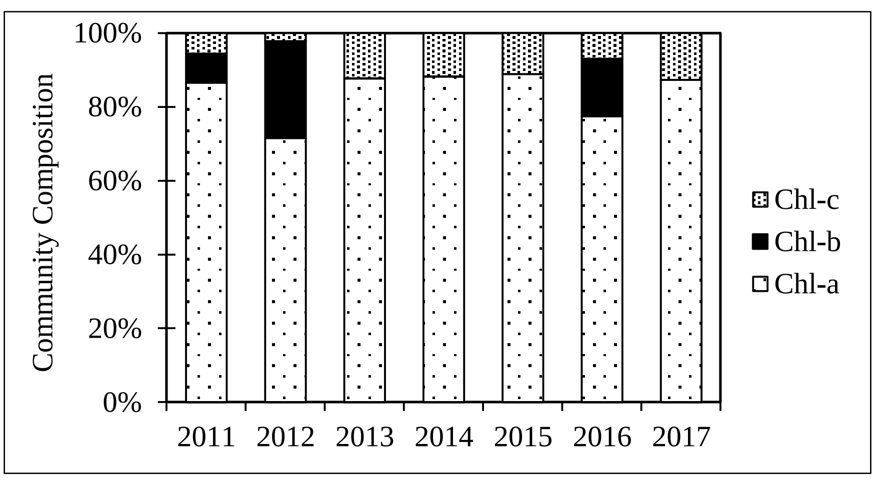


Figure 41.–Lower Sherman SP1 mean proportions of chlorophylls *a*, *b*, and *c*.

### Sample Point 2

The 2017 Lower Sherman Creek SP2 mean chlorophyll *a* density was 1.15 mg/m$^2$, the second lowest observed and similar to densities observed since 2014 (Table 21; Figure 42). Figure 43 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.

| | 7/28/11 | 7/26/12 | 7/29/13 | 7/28/14 | 7/27/15 | 7/25/16 | 7/25/17 |
|---|---|---|---|---|---|---|---|
| Chl-*a* (mg/m$^2$) | 5.61 | 0.67 | 2.87 | 1.32 | 1.62 | 1.42 | 1.15 |
| Chl-*b* (mg/m$^2$) | 0.02 | 0.01 | 0.00 | 0.00 | 0.15 | 0.04 | 0.00 |
| Chl-*c* (mg/m$^2$) | 0.32 | 0.09 | 0.32 | 0.12 | 0.27 | 0.19 | 0.12 |

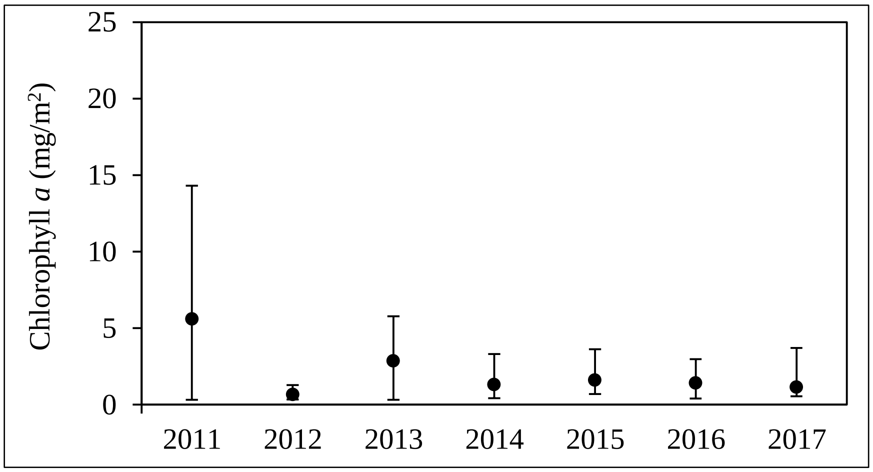


Figure 42.–Lower Sherman SP2 mean chlorophyll *a* densities.
*Note:* Minimum, mean, and maximum values presented.

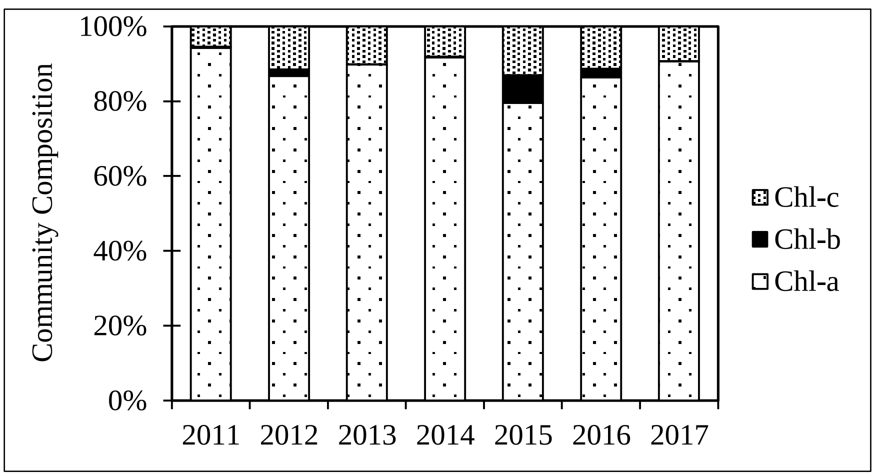


Figure 43.–Lower Sherman SP2 mean proportions of chlorophylls *a*, *b*, and *c*.

### Sample Point 1

Among the 2017 Lower Sherman Creek SP1 BMI samples, we identified 25 taxa and estimate mean density at 1,009 BMI/$m^2$, of which 31% were EPT insects, similar to the 2011 sample results and the lowest density observed since 2011 (Table 22; Figure 44). The Shannon Diversity and Evenness scores were within ranges previously observed and the dominant taxon was Annelida: Oligochaeta, representing 43% of the samples.

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

| | 5/4/11 | 4/30/12 | 5/1/13 | 4/29/14 | 4/28/15 | 4/27/16 | 4/26/17 |
|---|---|---|---|---|---|---|---|
| Mean BMI density (per $m^2$) | 1,118 | 2,733 | 1,796 | 3,023 | 1,651 | 6,839 | 1,009 |
| Total BMI taxa | 26 | 31 | 28 | 30 | 26 | 26 | 25 |
| Number of EPT taxa | 15 | 18 | 16 | 13 | 13 | 13 | 13 |
| % EPT | 32% | 66% | 64% | 14% | 27% | 4% | 31% |
| Shannon Diversity score | 0.76 | 0.74 | 0.85 | 0.71 | 0.84 | 0.32 | 0.81 |
| Evenness score | 0.71 | 0.62 | 0.71 | 0.57 | 0.70 | 0.27 | 0.69 |

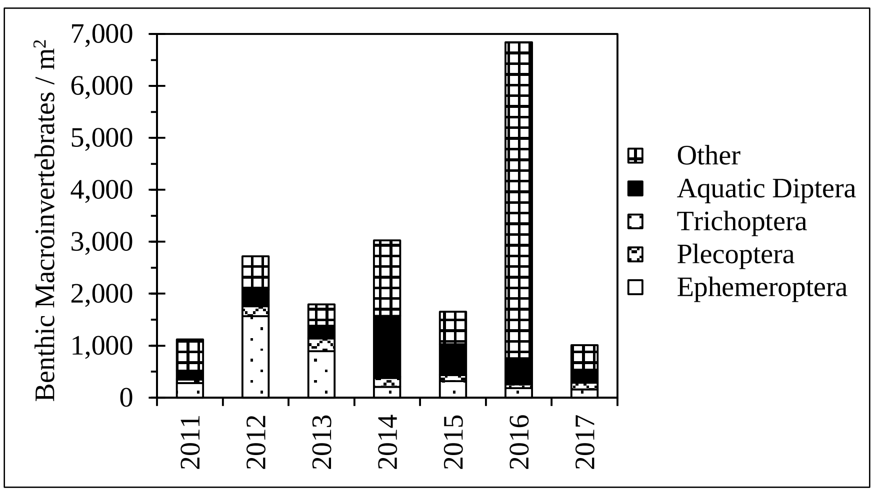


Figure 44.–Lower Sherman Creek SP1 mean BMI densities and community compositions.

**Sample Point 2**

Among 2017 Lower Sherman Creek SP2 BMI samples, we identified 26 taxa and estimate mean density at 428 BMI/m$^2$, of which 28% were EPT insects, the lowest BMI density observed since 2011 (Table 23; Figure 45). The Shannon Diversity score was within the range previously observed, the Evenness score was the greatest observed, and the dominant taxa were Annelida: Oligochaeta and Diptera: Chironomidae, representing 27% and 24% of the samples.

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

| | 5/3/11 | 4/30/12 | 4/30/13 | 4/29/14 | 4/28/15 | 4/27/16 | 4/26/17 |
|---|---|---|---|---|---|---|---|
| Mean BMI density (per m$^2$) | 1,651 | 2,823 | 3,385 | 1,185 | 1,609 | 1,873 | 428 |
| Total BMI taxa | 30 | 37 | 39 | 28 | 23 | 23 | 26 |
| Number of EPT taxa | 17 | 26 | 25 | 16 | 13 | 13 | 14 |
| % EPT | 76% | 79% | 72% | 12% | 25% | 12% | 28% |
| Shannon Diversity score | 0.93 | 0.70 | 0.84 | 0.70 | 0.77 | 0.53 | 0.84 |
| Evenness score | 0.76 | 0.57 | 0.65 | 0.62 | 0.66 | 0.49 | 0.80 |

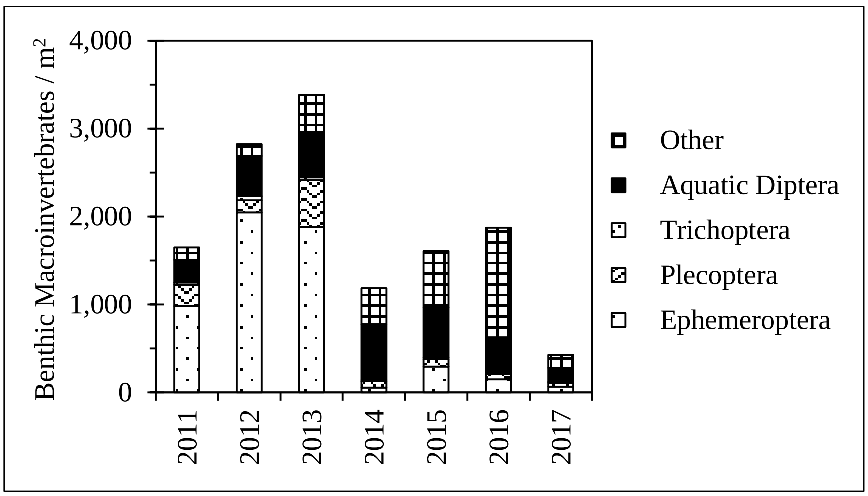


Figure 45.–Lower Sherman Creek SP2 mean BMI densities and community compositions.

### *Adult Salmon Counts*

We counted 5,690 pink salmon and 122 chum salmon in Lower Sherman Creek during the 2017 spawning season (Table 24). Figure 46 shows pink salmon counts for each survey and Figure 47 displays pink salmon distribution by reach.

Table 24.–Lower Sherman Creek adult salmon counts.

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

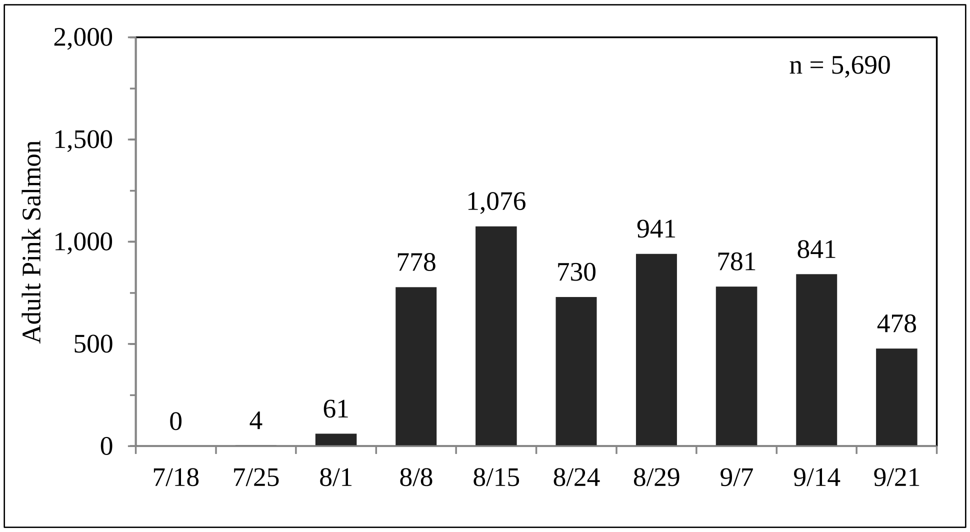


Figure 46.–2017 Lower Sherman Creek weekly pink salmon count.

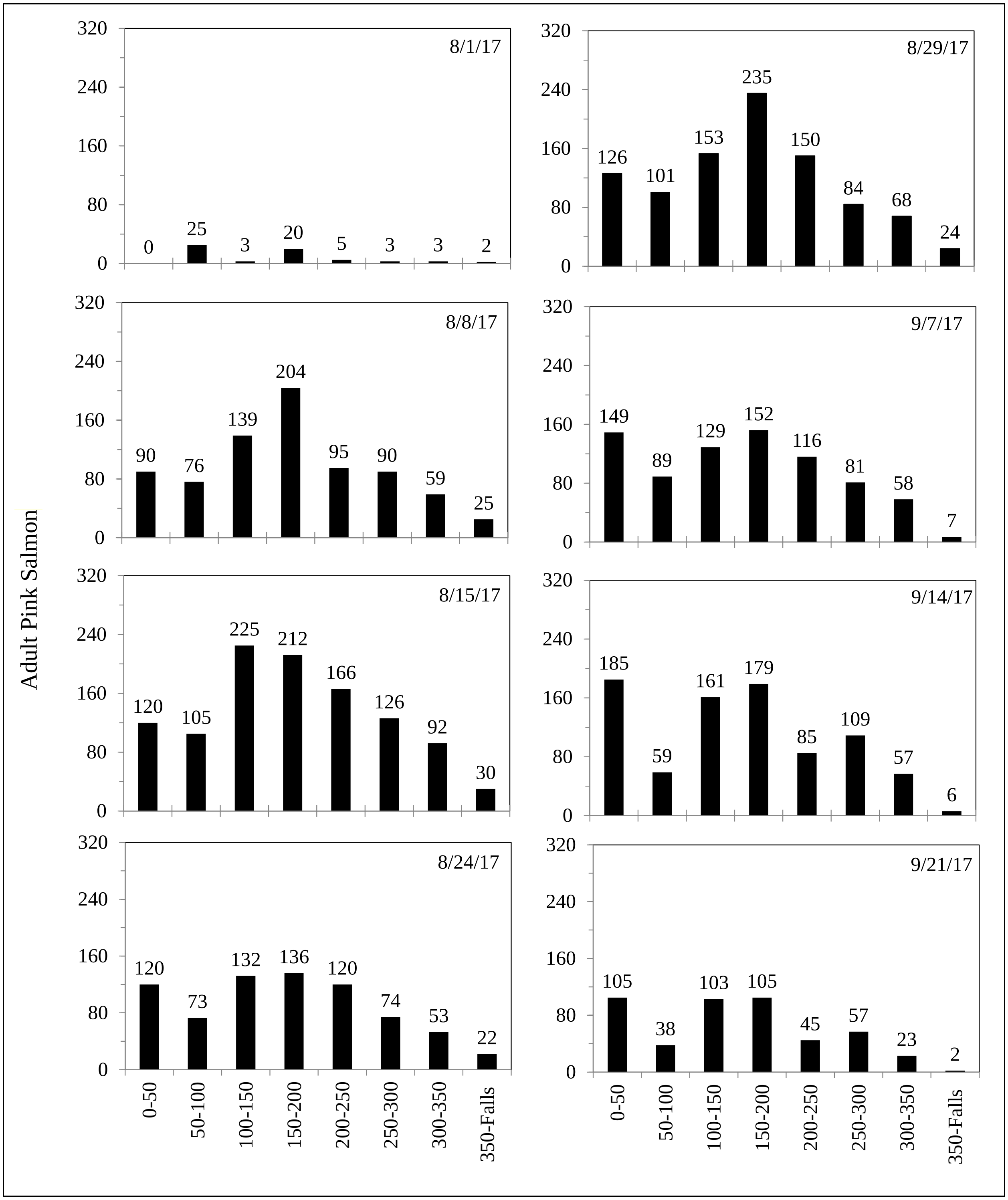


Figure 47.–2017 Lower Sherman Creek weekly pink salmon distribution.

### *Sediment Element Concentrations*

The 2017 Lower Sherman Creek sediment sample contained lower concentrations of Cd, Cu, Ni, Pb and Zn than previous years and other element concentrations were within the ranges observed 2011–2016. Se concentration was below the method reporting limit. The As, Cu, and Ni concentrations remain above NOAA's freshwater sediment guidelines (Buchman 2008). Figure 48 presents the 2017 results and Figure 49 presents the 2011–2017 data.

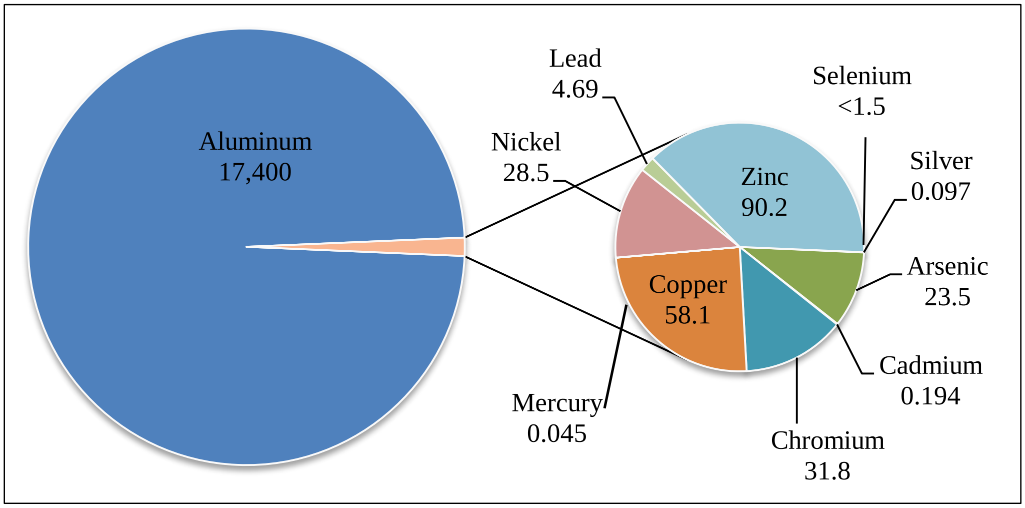


Figure 48.–2017 Lower Sherman Creek sediment element concentrations (mg/kg).

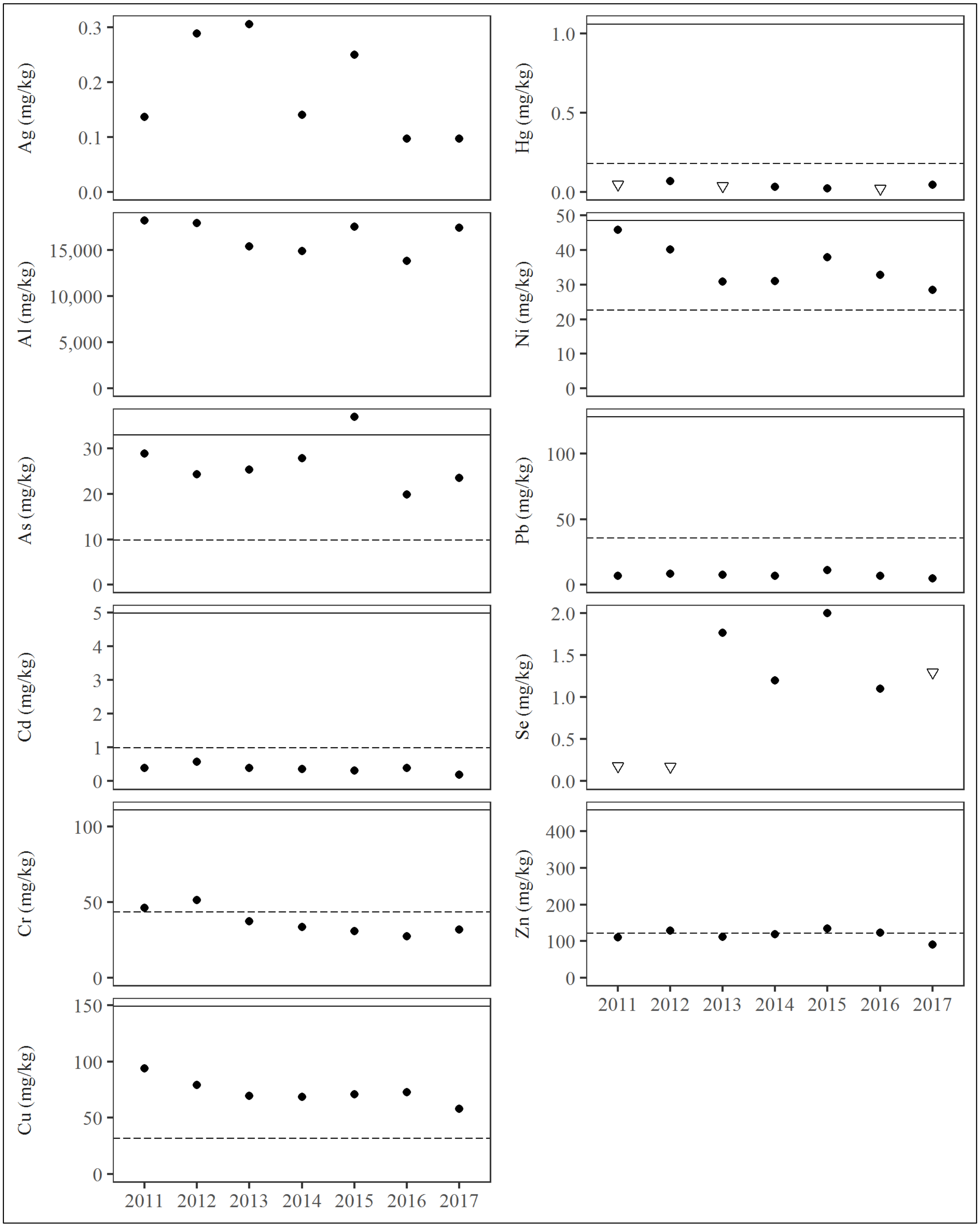


Figure 49.–Lower Sherman Creek sediment element concentrations.

*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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[aa] This publication is actually the resident fish survey report.
[bb] This publication is actually the invertebrate tissue analysis.
[cc] Actually published February 2010.

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# APPENDIX A: PERIPHYTON DATA

Appendix A.1.–Lower Slate Creek chlorophylls *a*, *b*, and *c* densities, 2011–2017.

| | July 2011 | | | July 2012 | | | July 2013 | | | July 2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | 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 | 0.00 | 0.00 | 0.00 |
| | 1.28 | 0.02 | 0.11 | 4.06 | 0.00 | 0.39 | 20.72 | 0.00 | 3.11 | 9.29 | 3.22 | 0.48 |
| | 0.85 | 0.01 | 0.07 | 2.03 | 0.00 | 0.18 | 10.89 | 0.00 | 1.01 | 1.45 | 0.00 | 0.23 |
| | 3.31 | 0.08 | 0.25 | 0.96 | 0.00 | 0.04 | 17.84 | 0.00 | 2.66 | 12.18 | 5.27 | 0.38 |
| | 11.85 | 3.11 | 0.30 | 2.56 | 0.04 | 0.22 | 2.14 | 0.00 | 0.24 | 0.75 | 0.00 | 0.05 |
| | 18.05 | 0.42 | 0.91 | 0.92 | 0.00 | 0.01 | 6.09 | 0.00 | 0.95 | 4.70 | 0.00 | 0.67 |
| | 0.72 | 0.13 | 0.00 | 1.49 | 0.13 | 0.13 | 15.49 | 0.00 | 1.99 | 2.88 | 0.00 | 0.49 |
| | 0.43 | 0.05 | 0.00 | 2.35 | 0.12 | 0.19 | 12.71 | 0.00 | 1.58 | 1.82 | 0.00 | 0.15 |
| | 8.54 | 0.39 | 0.58 | 6.19 | 0.05 | 0.54 | 11.32 | 0.00 | 1.87 | 0.73 | 0.00 | 0.07 |
| | 6.30 | 0.03 | 0.38 | 0.96 | 0.00 | 0.06 | 14.63 | 0.00 | 1.46 | 5.87 | 0.00 | 0.51 |
| mean | 5.15 | 0.43 | 0.26 | 2.31 | 0.05 | 0.18 | 12.59 | 0.00 | 1.64 | 3.97 | 0.85 | 0.30 |
| max | 18.05 | 3.11 | 0.91 | 6.19 | 0.13 | 0.54 | 20.72 | 0.00 | 3.11 | 12.18 | 5.27 | 0.67 |
| min | 0.21 | 0.01 | 0.00 | 0.92 | 0.00 | 0.01 | 2.14 | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 |

| | July 2015 | | | July 2016 | | | April 2017 | | | July 2017 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* |
| | 0.45 | 0.10 | 0.01 | 0.60 | 0.00 | 0.12 | 3.63 | 0.00 | 0.30 | 3.84 | 0.33 | 0.19 |
| | 3.06 | 0.00 | 0.28 | 15.27 | 0.00 | 2.14 | 4.59 | 0.10 | 0.56 | 1.71 | 0.00 | 0.27 |
| | 0.95 | 0.09 | 0.04 | 6.41 | 0.00 | 0.97 | 1.17 | 0.06 | 0.32 | 1.60 | 0.00 | 0.26 |
| | 0.85 | 0.00 | 0.06 | 2.35 | 0.00 | 0.22 | 4.38 | 0.11 | 0.52 | 2.14 | 0.00 | 0.41 |
| | 0.72 | 0.13 | 0.00 | 9.51 | 0.76 | 0.88 | 8.86 | 0.00 | 1.29 | 2.14 | 0.06 | 0.09 |
| | 2.24 | 0.44 | 0.12 | 2.88 | 0.66 | 0.20 | 1.71 | 0.00 | 0.31 | 4.91 | 1.86 | 0.16 |
| | 9.93 | 0.00 | 1.13 | 3.52 | 0.00 | 0.40 | 2.99 | 0.00 | 0.44 | 0.87 | 0.00 | 0.14 |
| | **0.19** | ND | ND | 2.03 | 0.00 | 0.28 | 1.71 | 0.00 | 0.16 | 2.14 | 0.00 | 0.36 |
| | 2.88 | 0.14 | 0.28 | 5.34 | 0.67 | 0.36 | 3.63 | 0.00 | 0.53 | 1.60 | 0.05 | 0.11 |
| | 0.32 | 0.01 | 0.00 | 4.70 | 0.00 | 0.65 | ND | ND | ND | 2.01 | 0.00 | 0.32 |
| mean | 2.16 | 0.10 | 0.21 | 5.26 | 0.21 | 0.62 | 3.63 | 0.03 | 0.49 | 2.30 | 0.23 | 0.23 |
| max | 9.93 | 0.44 | 1.13 | 15.27 | 0.76 | 2.14 | 8.86 | 0.11 | 1.29 | 4.91 | 1.86 | 0.41 |
| min | 0.19 | 0.00 | 0.00 | 0.60 | 0.00 | 0.12 | 1.17 | 0.00 | 0.16 | 0.87 | 0.00 | 0.09 |

*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, 2011–2017.

| | July 2011 | | | July 2012 | | | July 2013 | | | July 2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | 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 | 0.32 | 0.00 | 0.01 |
| | 4.70 | 0.00 | 0.43 | 0.41 | 0.00 | 0.08 | 1.39 | 0.00 | 0.16 | 0.19 | 0.00 | 0.00 |
| | 2.78 | 0.00 | 0.26 | 0.53 | 0.00 | 0.02 | 13.14 | 0.00 | 2.19 | 0.75 | 0.00 | 0.05 |
| | 3.35 | 0.00 | 0.04 | 0.64 | 0.00 | 0.16 | 4.38 | 0.00 | 0.47 | 0.88 | 0.00 | 0.00 |
| | 4.27 | 0.00 | 0.25 | 3.62 | 0.00 | 0.24 | 1.28 | 0.00 | 0.11 | 1.60 | 0.00 | 0.19 |
| | 4.91 | 0.00 | 0.42 | 0.85 | 0.00 | 0.14 | 3.10 | 0.00 | 0.50 | 0.23 | 0.00 | 0.03 |
| | 3.95 | 0.00 | 0.27 | 0.96 | 0.01 | 0.07 | 3.74 | 0.00 | 0.53 | 0.41 | 0.00 | 0.00 |
| | 3.10 | 0.00 | 0.25 | 0.41 | 0.00 | 0.08 | 2.03 | 0.00 | 0.33 | 0.33 | 0.00 | 0.02 |
| | 4.38 | 0.00 | 0.39 | 0.60 | 0.00 | 0.12 | 5.02 | 0.00 | 0.67 | 1.18 | 0.00 | 0.13 |
| | 5.23 | 0.00 | 0.20 | 0.96 | 0.00 | 0.06 | 3.40 | 0.00 | 0.36 | 1.82 | 0.00 | 0.15 |
| mean | 3.92 | 0.00 | 0.27 | 1.01 | 0.00 | 0.10 | 4.22 | 0.00 | 0.61 | 0.77 | 0.00 | 0.06 |
| max | 5.23 | 0.00 | 0.43 | 3.62 | 0.01 | 0.24 | 13.14 | 0.00 | 2.19 | 1.82 | 0.00 | 0.19 |
| min | 2.52 | 0.00 | 0.04 | 0.41 | 0.00 | 0.02 | 1.28 | 0.00 | 0.11 | 0.19 | 0.00 | 0.00 |

| | July 2015 | | | July 2016 | | | July 2017 | | |
|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* |
| | 1.34 | 0.00 | 0.21 | 7.48 | 0.00 | 1.16 | 5.13 | 0.00 | 0.60 |
| | 0.92 | 0.00 | 0.01 | 4.70 | 0.00 | 0.71 | 5.13 | 0.00 | 0.96 |
| | 0.77 | 0.02 | 0.03 | 3.22 | 0.00 | 0.25 | 1.82 | 0.00 | 0.19 |
| | 0.54 | 0.05 | 0.00 | 5.34 | 0.00 | 0.61 | 3.95 | 0.00 | 0.83 |
| | **0.19** | ND | ND | 2.67 | 0.00 | 0.34 | 5.87 | 0.00 | 1.22 |
| | 1.64 | 0.00 | 0.04 | 3.31 | 0.00 | 0.45 | 8.22 | 0.00 | 1.38 |
| | 2.35 | 0.00 | 0.21 | 4.27 | 0.00 | 0.44 | 8.22 | 0.00 | 1.58 |
| | 0.53 | 0.12 | 0.00 | 0.92 | 0.00 | 0.01 | 3.74 | 0.00 | 0.53 |
| | 0.56 | 0.00 | 0.06 | 10.89 | 0.00 | 1.64 | 2.78 | 0.00 | 0.33 |
| | 0.32 | 0.05 | 0.00 | 6.51 | 0.00 | 0.95 | 4.70 | 0.00 | 0.92 |
| mean | 0.92 | 0.03 | 0.06 | 4.93 | 0.00 | 0.66 | 4.96 | 0.00 | 0.85 |
| max | 2.35 | 0.12 | 0.21 | 10.89 | 0.00 | 1.64 | 8.22 | 0.00 | 1.58 |
| min | 0.19 | 0.00 | 0.00 | 0.92 | 0.00 | 0.01 | 1.82 | 0.00 | 0.19 |

*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, 2011–2017.

| | July 2011 | | | July 2012 | | | July 2013 | | | July 2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | 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 | 0.14 | 0.00 | 0.00 |
| | 9.18 | 0.02 | 0.20 | 0.41 | 0.04 | 0.04 | **0.24** | ND | ND | 0.64 | 0.00 | 0.07 |
| | 1.28 | 0.03 | 0.00 | 0.88 | 0.00 | 0.05 | 1.07 | 0.03 | 0.07 | **0.05** | ND | ND |
| | 5.13 | 1.15 | 0.11 | 0.50 | 0.00 | 0.03 | 0.32 | 0.07 | 0.00 | 0.75 | 0.14 | 0.10 |
| | 16.02 | 0.18 | 0.44 | 3.42 | 0.00 | 0.11 | 0.64 | 0.10 | 0.00 | **0.05** | ND | ND |
| | 8.86 | 1.94 | 0.70 | 0.64 | 0.08 | 0.05 | 5.02 | 0.16 | 0.35 | 0.37 | 0.00 | 0.00 |
| | 4.70 | 0.70 | 0.13 | 18.58 | 0.00 | 0.66 | 0.43 | 0.00 | 0.03 | **0.05** | ND | ND |
| | 16.13 | 5.35 | 0.28 | 13.67 | 2.32 | 0.57 | 6.41 | 0.11 | 0.50 | 0.11 | 0.00 | 0.00 |
| | 4.91 | 0.49 | 0.12 | 0.69 | 0.00 | 0.00 | 0.32 | 0.00 | 0.00 | 0.53 | 0.00 | 0.01 |
| | 12.71 | 3.59 | 0.15 | 0.43 | 0.00 | 0.00 | **0.24** | ND | ND | **0.05** | ND | ND |
| mean | 8.84 | 1.56 | 0.24 | 5.08 | 0.57 | 0.18 | 2.28 | 0.06 | 0.20 | 0.27 | 0.02 | 0.03 |
| max | 16.13 | 5.35 | 0.70 | 18.58 | 3.24 | 0.66 | 8.12 | 0.16 | 0.67 | 0.75 | 0.14 | 0.10 |
| min | 1.28 | 0.02 | 0.00 | 0.41 | 0.00 | 0.00 | 0.24 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 |

| | July 2015 | | | July 2016 | | | April 2017 | | | July 2017 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* |
| | 0.85 | 0.00 | 0.12 | 0.23 | 0.00 | 0.03 | **0.19** | ND | ND | 0.56 | 0.00 | 0.00 |
| | **0.19** | ND | ND | 4.91 | 0.00 | 0.69 | 0.64 | 0.00 | 0.07 | 0.51 | 0.00 | 0.00 |
| | 1.92 | 0.00 | 0.09 | 0.75 | 0.00 | 0.05 | 0.21 | 0.08 | 0.06 | 0.27 | 0.03 | 0.00 |
| | 0.96 | 0.00 | 0.09 | 1.42 | 0.00 | 0.14 | 0.28 | 0.00 | 0.03 | 0.41 | 0.00 | 0.08 |
| | 1.60 | 0.00 | 0.22 | 0.85 | 0.02 | 0.17 | 0.21 | 0.16 | 0.23 | 0.96 | 0.00 | 0.00 |
| | 5.34 | 0.00 | 0.55 | 1.56 | 0.00 | 0.12 | 0.32 | 0.00 | 0.09 | 0.85 | 0.00 | 0.15 |
| | 2.14 | 0.00 | 0.09 | 0.64 | 0.00 | 0.08 | **0.19** | ND | ND | 0.32 | 0.00 | 0.08 |
| | 0.37 | 0.00 | 0.00 | **0.19** | ND | ND | 0.87 | 0.00 | 0.14 | 1.74 | 0.00 | 0.16 |
| | 0.92 | 0.00 | 0.11 | 0.87 | 0.00 | 0.02 | 0.43 | 0.00 | 0.12 | 0.32 | 0.00 | 0.08 |
| | 1.28 | 0.00 | 0.08 | 0.64 | 0.00 | 0.06 | 3.42 | 0.00 | 0.49 | 0.46 | 0.00 | 0.00 |
| mean | 1.56 | 0.00 | 0.15 | 1.21 | 0.00 | 0.15 | 0.68 | 0.03 | 0.15 | 0.64 | 0.00 | 0.06 |
| max | 5.34 | 0.00 | 0.55 | 4.91 | 0.02 | 0.69 | 3.42 | 0.16 | 0.49 | 1.74 | 0.03 | 0.16 |
| min | 0.19 | 0.00 | 0.00 | 0.19 | 0.00 | 0.02 | 0.19 | 0.00 | 0.03 | 0.27 | 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, 2011–2017.

| | July 2011 | | | July 2012 | | | July 2013 | | | July 2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | 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 | 0.92 | 0.00 | 0.11 |
| | 0.32 | 0.00 | 0.04 | 0.96 | 0.00 | 0.09 | 0.85 | 0.01 | 0.07 | 1.20 | 0.00 | 0.07 |
| | 0.96 | 0.01 | 0.07 | 0.75 | 0.00 | 0.00 | 2.94 | 0.00 | 0.13 | 1.52 | 0.00 | 0.06 |
| | 0.11 | 0.00 | 0.00 | 0.50 | 0.00 | 0.03 | 1.39 | 0.00 | 0.12 | 1.82 | 0.00 | 0.15 |
| | 2.67 | 0.00 | 0.26 | 2.03 | 0.00 | 0.14 | 2.99 | 0.00 | 0.11 | 0.85 | 0.00 | 0.00 |
| | 0.28 | 0.00 | 0.00 | 1.07 | 0.00 | 0.14 | 4.59 | 0.00 | 0.20 | 0.64 | 0.00 | 0.01 |
| | 0.60 | 0.00 | 0.12 | 0.55 | 0.00 | 0.02 | 0.85 | 0.00 | 0.01 | 1.18 | 0.00 | 0.07 |
| | 1.14 | 0.00 | 0.01 | 1.71 | 0.00 | 0.06 | 2.03 | 0.00 | 0.20 | 0.96 | 0.00 | 0.00 |
| | 0.53 | 0.00 | 0.00 | 2.14 | 0.00 | 0.12 | 0.85 | 0.00 | 0.00 | 0.64 | 0.00 | 0.01 |
| | 0.60 | 0.00 | 0.02 | 0.83 | 0.00 | 0.00 | 2.94 | 0.00 | 0.20 | 1.17 | 0.00 | 0.12 |
| mean | 0.76 | 0.00 | 0.05 | 1.26 | 0.00 | 0.07 | 2.13 | 0.00 | 0.13 | 1.09 | 0.00 | 0.06 |
| max | 2.67 | 0.01 | 0.26 | 2.14 | 0.00 | 0.14 | 4.59 | 0.01 | 0.27 | 1.82 | 0.00 | 0.15 |
| min | 0.11 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.85 | 0.00 | 0.00 | 0.64 | 0.00 | 0.00 |

| | July 2015 | | | July 2016 | | | July 2017 | | |
|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* |
| | 0.37 | 0.00 | 0.08 | 1.15 | 0.00 | 0.07 | 0.43 | 0.00 | 0.00 |
| | 0.64 | 0.00 | 0.08 | 8.86 | 0.00 | 1.12 | 1.06 | 0.00 | 0.00 |
| | 0.64 | 0.00 | 0.07 | 1.52 | 0.00 | 0.06 | 0.64 | 0.00 | 0.00 |
| | 0.51 | 0.00 | 0.06 | 5.34 | 0.00 | 0.93 | 0.50 | 0.00 | 0.03 |
| | 0.43 | 0.00 | 0.08 | 2.85 | 0.00 | 0.14 | 0.96 | 0.00 | 0.00 |
| | 0.55 | 0.00 | 0.28 | 1.01 | 0.00 | 0.09 | 1.17 | 0.00 | 0.03 |
| | 0.64 | 0.00 | 0.02 | 4.81 | 0.00 | 0.40 | 1.07 | 0.00 | 0.14 |
| | 0.64 | 0.00 | 0.08 | 2.40 | 0.16 | 0.21 | 0.64 | 0.00 | 0.00 |
| | 0.69 | 0.00 | 0.00 | 4.49 | 0.00 | 0.36 | 0.32 | 0.01 | 0.00 |
| | 1.17 | 0.00 | 0.13 | 6.19 | 0.00 | 0.79 | 1.47 | 0.00 | 0.23 |
| mean | 0.63 | 0.00 | 0.09 | 3.86 | 0.02 | 0.42 | 0.83 | 0.00 | 0.04 |
| max | 1.17 | 0.00 | 0.28 | 8.86 | 0.16 | 1.12 | 1.47 | 0.01 | 0.23 |
| min | 0.37 | 0.00 | 0.00 | 1.01 | 0.00 | 0.06 | 0.32 | 0.00 | 0.00 |

Appendix A.5.–Lower Sherman Creek SP1 chlorophylls *a*, *b*, and *c* densities, 2011–2017.

| | July 2011 | | | July 2012 | | | July 2013 | | | July 2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | 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 | 2.46 | 0.00 | 0.30 |
| | 5.34 | 0.00 | 0.36 | 2.88 | 0.87 | 0.16 | 5.55 | 0.00 | 0.73 | 0.74 | 0.00 | 0.10 |
| | 5.98 | 0.00 | 0.54 | 0.41 | 0.04 | 0.04 | **0.24** | ND | ND | 0.19 | 0.00 | 0.00 |
| | 3.84 | 0.10 | 0.48 | 2.67 | 1.27 | 0.00 | 4.67 | 0.00 | 0.55 | 0.92 | 0.00 | 0.14 |
| | 15.59 | 3.98 | 0.17 | 0.60 | 0.00 | 0.12 | 7.69 | 0.00 | 0.89 | 0.83 | 0.00 | 0.15 |
| | 11.11 | 2.64 | 0.28 | 1.07 | 0.00 | 0.11 | 7.37 | 0.00 | 0.62 | 2.99 | 0.00 | 0.47 |
| | 19.33 | 0.00 | 1.65 | 3.63 | 1.56 | 0.03 | **0.24** | ND | ND | 1.39 | 0.00 | 0.17 |
| | 7.26 | 0.00 | 0.74 | 9.61 | 4.12 | 0.08 | 2.67 | 0.00 | 0.35 | 2.46 | 0.00 | 0.25 |
| | 1.92 | 0.04 | 0.19 | 2.99 | 1.43 | 0.02 | 0.75 | 0.03 | 0.08 | 0.45 | 0.01 | 0.04 |
| | 4.38 | 0.17 | 0.44 | 0.43 | 0.00 | 0.06 | ND | ND | ND | 0.96 | 0.00 | 0.16 |
| mean | 7.60 | 0.69 | 0.49 | 2.54 | 0.93 | 0.08 | 3.69 | 0.00 | 0.51 | 1.34 | 0.00 | 0.18 |
| max | 19.33 | 3.98 | 1.65 | 9.61 | 4.12 | 0.16 | 7.69 | 0.03 | 0.89 | 2.99 | 0.01 | 0.47 |
| min | 1.28 | 0.00 | 0.05 | 0.41 | 0.00 | 0.00 | 0.24 | 0.00 | 0.08 | 0.19 | 0.00 | 0.00 |

| | July 2015 | | | July 2016 | | | July 2017 | | |
|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* |
| | 0.28 | 0.00 | 0.03 | 3.31 | 0.52 | 0.31 | 5.02 | 0.00 | 0.68 |
| | **0.19** | ND | ND | 4.27 | 0.00 | 0.76 | 5.13 | 0.00 | 0.93 |
| | 0.92 | 0.00 | 0.11 | 1.39 | 0.00 | 0.16 | 2.35 | 0.00 | 0.28 |
| | 0.64 | 0.00 | 0.01 | 2.14 | 0.00 | 0.37 | 2.99 | 0.00 | 0.40 |
| | 2.67 | 0.00 | 0.31 | 2.28 | 0.00 | 0.32 | 4.49 | 0.00 | 0.64 |
| | 0.79 | 0.00 | 0.00 | 13.24 | 6.47 | 0.31 | 3.84 | 0.00 | 0.55 |
| | 2.78 | 0.00 | 0.32 | 2.78 | 0.13 | 0.23 | 6.30 | 0.00 | 1.05 |
| | **0.19** | ND | ND | 2.24 | 0.00 | 0.31 | 4.06 | 0.00 | 0.63 |
| | 4.17 | 0.00 | 0.49 | 3.31 | 0.12 | 0.35 | 1.10 | 0.00 | 0.05 |
| | 1.01 | 0.00 | 0.09 | 2.03 | 0.20 | 0.17 | 3.31 | 0.00 | 0.39 |
| mean | 1.36 | 0.00 | 0.17 | 3.70 | 0.74 | 0.33 | 3.86 | 0.00 | 0.56 |
| max | 4.17 | 0.00 | 0.49 | 13.24 | 6.47 | 0.76 | 6.30 | 0.00 | 1.05 |
| min | 0.19 | 0.00 | 0.00 | 1.39 | 0.00 | 0.16 | 1.10 | 0.00 | 0.05 |

*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, 2011–2017.

| | July 2011 | | | July 2012 | | | July 2013 | | | July 2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | 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 | 0.74 | 0.00 | 0.10 |
| | 6.30 | 0.19 | 0.62 | 0.64 | 0.00 | 0.11 | 3.84 | 0.00 | 0.34 | 1.38 | 0.00 | 0.18 |
| | 4.59 | 0.00 | 0.38 | 0.73 | 0.00 | 0.07 | 0.96 | 0.00 | 0.15 | 2.83 | 0.00 | 0.15 |
| | 0.32 | 0.00 | 0.00 | 0.50 | 0.07 | 0.10 | 4.81 | 0.00 | 0.49 | 3.31 | 0.00 | 0.31 |
| | 13.88 | 0.00 | 0.54 | **0.34** | ND | ND | 5.77 | 0.00 | 0.78 | 0.75 | 0.00 | 0.06 |
| | 7.37 | 0.00 | 0.46 | 0.51 | 0.00 | 0.06 | 0.32 | 0.02 | 0.10 | 0.85 | 0.03 | 0.08 |
| | 1.50 | 0.00 | 0.09 | 0.96 | 0.00 | 0.16 | 4.70 | 0.00 | 0.44 | 0.85 | 0.00 | 0.01 |
| | 14.31 | 0.00 | 0.59 | 0.37 | 0.00 | 0.00 | 3.52 | 0.00 | 0.35 | 1.39 | 0.00 | 0.16 |
| | 0.85 | 0.00 | 0.01 | 1.28 | 0.00 | 0.09 | 0.53 | 0.00 | 0.02 | 0.43 | 0.01 | 0.04 |
| | 3.84 | 0.00 | 0.25 | **0.34** | ND | ND | 3.20 | 0.00 | 0.43 | 0.69 | 0.00 | 0.07 |
| mean | 5.61 | 0.02 | 0.32 | 0.67 | 0.01 | 0.09 | 2.87 | 0.00 | 0.32 | 1.32 | 0.00 | 0.12 |
| max | 14.31 | 0.19 | 0.62 | 1.28 | 0.07 | 0.16 | 5.77 | 0.02 | 0.78 | 3.31 | 0.03 | 0.31 |
| min | 0.32 | 0.00 | 0.00 | 0.34 | 0.00 | 0.00 | 0.32 | 0.00 | 0.02 | 0.43 | 0.00 | 0.01 |

| | July 2015 | | | July 2016 | | | July 2017 | | |
|---|---|---|---|---|---|---|---|---|---|
| mg/m² | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* | Chl-*a* | Chl-*b* | Chl-*c* |
| | 0.69 | 0.00 | 0.00 | 1.50 | 0.00 | 0.17 | 0.75 | 0.00 | 0.05 |
| | 0.96 | 0.00 | 0.00 | 2.03 | 0.00 | 0.30 | 0.85 | 0.01 | 0.07 |
| | 0.85 | 0.00 | 0.11 | 0.43 | 0.00 | 0.13 | 0.88 | 0.00 | 0.05 |
| | 1.28 | 0.00 | 0.16 | 2.98 | 0.00 | 0.38 | 0.69 | 0.00 | 0.07 |
| | 2.14 | 0.00 | 0.24 | 0.96 | 0.00 | 0.09 | 3.70 | 0.00 | 0.46 |
| | 3.63 | 0.65 | 0.43 | 1.28 | 0.04 | 0.26 | 0.69 | 0.00 | 0.07 |
| | 0.96 | 0.07 | 0.03 | 1.71 | 0.00 | 0.22 | 0.64 | 0.00 | 0.07 |
| | 2.14 | 0.78 | 1.30 | 1.92 | 0.35 | 0.16 | 1.82 | 0.00 | 0.20 |
| | 1.07 | 0.00 | 0.14 | 0.41 | 0.00 | 0.08 | 0.92 | 0.00 | 0.11 |
| | 2.46 | 0.00 | 0.24 | 0.96 | 0.00 | 0.06 | 0.55 | 0.00 | 0.02 |
| mean | 1.62 | 0.15 | 0.27 | 1.42 | 0.04 | 0.19 | 1.15 | 0.00 | 0.12 |
| max | 3.63 | 0.78 | 1.30 | 2.98 | 0.35 | 0.38 | 3.70 | 0.01 | 0.46 |
| min | 0.69 | 0.00 | 0.00 | 0.41 | 0.00 | 0.06 | 0.55 | 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, 2011–2017.

| | 5/4/11 | 5/2/12 | 4/30/13 | 4/30/14 | 4/27/15 | 4/26/16 | 4/25/17 |
|---|---|---|---|---|---|---|---|
| Total BMI Taxa | 29 | 32 | 27 | 32 | 26 | 24 | 27 |
| Total EPT Taxa | 13 | 17 | 16 | 17 | 13 | 11 | 13 |
| Total BMI Counted | 1,148 | 1,760 | 1,200 | 2,308 | 1,901 | 1,894 | 730 |
| Ephemeroptera | 85 | 387 | 400 | 73 | 196 | 225 | 219 |
| Plecoptera | 70 | 274 | 203 | 352 | 258 | 61 | 145 |
| Trichoptera | 2 | 8 | 6 | 17 | 6 | 3 | 3 |
| Aquatic Diptera | 862 | 975 | 503 | 1,711 | 1,268 | 1038 | 308 |
| Other | 129 | 116 | 88 | 155 | 173 | 567 | 55 |
| % Ephemeroptera | 7% | 22% | 33% | 3% | 10% | 12% | 30% |
| % Plecoptera | 6% | 16% | 17% | 15% | 14% | 3% | 20% |
| % Trichoptera | 0.2% | 0.5% | 0.5% | 0.7% | 0.3% | 0.2% | 0.4% |
| % Aquatic Diptera | 75% | 55% | 42% | 74% | 67% | 55% | 42% |
| % Other | 11% | 7% | 7% | 7% | 9% | 30% | 8% |
| % EPT | 14% | 38% | 51% | 19% | 24% | 15% | 50% |
| % Chironomidae | 72% | 53% | 35% | 68% | 64% | 51% | 36% |
| Shannon Diversity Score (H) | 0.51 | 0.69 | 0.85 | 0.64 | 0.70 | 0.65 | 0.81 |
| Evenness Score (E) | 0.48 | 0.58 | 0.70 | 0.52 | 0.58 | 0.57 | 0.73 |
| Total Sample Area ($m^2$) | 0.558 | 0.558 | 0.465 | 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 |
| ±1 SD | 1,046 | 1,849 | 551 | 3,592 | 2,458 | 1,667 | 436 |
| Terrestrial Invertebrates | 0 | 4 | 0 | 1 | 3 | 88 | 1 |
| Juvenile Fish | 1 | 0 | 0 | 1 | 0 | 0 | 0 |

Appendix B.2.–West Fork Slate Creek BMI data summary, 2011–2017.

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

Appendix B.3.–East Fork Slate Creek BMI data summary, 2011–2017.

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

Appendix B.4.–Upper Slate Creek BMI data summary, 2011–2017.

| | 5/12/11 | 4/27/12 | 4/29/13 | 4/28/14 | 4/29/15 | 4/25/16 | 4/27/17 |
|---|---|---|---|---|---|---|---|
| Total BMI Taxa | 33 | 39 | 34 | 36 | 31 | 28 | 30 |
| Total EPT Taxa | 18 | 21 | 20 | 20 | 19 | 15 | 19 |
| Total BMI Counted | 1,408 | 1,259 | 1,607 | 1,744 | 2,107 | 1,338 | 1,132 |
| Ephemeroptera | 368 | 454 | 492 | 622 | 622 | 554 | 460 |
| Plecoptera | 401 | 349 | 604 | 429 | 758 | 252 | 172 |
| Trichoptera | 116 | 48 | 55 | 44 | 44 | 104 | 62 |
| Aquatic Diptera | 248 | 273 | 338 | 518 | 517 | 169 | 406 |
| Other | 275 | 135 | 118 | 131 | 166 | 259 | 32 |
| % Ephemeroptera | 26% | 36% | 31% | 36% | 30% | 41% | 41% |
| % Plecoptera | 29% | 28% | 38% | 25% | 36% | 19% | 15% |
| % Trichoptera | 8.2% | 4% | 3% | 3% | 2% | 8% | 5% |
| % Aquatic Diptera | 18% | 22% | 21% | 30% | 25% | 13% | 36% |
| % Other | 20% | 11% | 7% | 8% | 8% | 19% | 3% |
| % EPT | 63% | 68% | 72% | 63% | 68% | 68% | 61% |
| % Chironomidae | 15% | 20% | 19% | 28% | 22% | 11% | 34% |
| Shannon Diversity Score (H) | 0.97 | 1.04 | 1.02 | 1.03 | 0.98 | 1.06 | 0.96 |
| Evenness Score (E) | 0.76 | 0.79 | 0.78 | 0.76 | 0.74 | 0.82 | 0.73 |
| Total Sample Area ($m^2$) | 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 SD | 1,173 | 1,321 | 1,049 | 660 | 1,174 | 520 | 1,143 |
| Terrestrial Invertebrates | 1 | 0 | 0 | 1 | 3 | 6 | 3 |
| Juvenile Fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Appendix B.5.–Upper Johnson Creek BMI data summary, 2011–2017.

| | 5/3/11 | 4/26/12 | 4/29/13 | 4/29/14 | 4/28/15 | 4/27/16 | 4/26/17 |
|---|---|---|---|---|---|---|---|
| Total BMI Taxa | 24 | 28 | 34 | 32 | 28 | 32 | 33 |
| Total EPT Taxa | 14 | 14 | 24 | 21 | 17 | 21 | 19 |
| | | | | | | | |
| Total BMI Counted | 2,084 | 2,214 | 2,938 | 1,483 | 1,556 | 2,054 | 1,619 |
| Ephemeroptera | 962 | 1,139 | 1,680 | 740 | 917 | 1160 | 651 |
| Plecoptera | 114 | 163 | 147 | 217 | 58 | 97 | 113 |
| Trichoptera | 59 | 118 | 95 | 68 | 137 | 198 | 54 |
| Aquatic Diptera | 619 | 586 | 799 | 407 | 366 | 476 | 773 |
| Other | 330 | 208 | 217 | 51 | 78 | 123 | 28 |
| | | | | | | | |
| % Ephemeroptera | 46% | 51% | 57% | 50% | 59% | 56% | 40% |
| % Plecoptera | 6% | 7% | 5% | 15% | 4% | 5% | 7% |
| % Trichoptera | 3% | 5% | 3% | 5% | 9% | 10% | 3% |
| % Aquatic Diptera | 30% | 27% | 27% | 27% | 24% | 23% | 48% |
| % Other | 16% | 9% | 7% | 3% | 5% | 6% | 2% |
| | | | | | | | |
| % EPT | 55% | 64% | 65% | 69% | 71% | 71% | 51% |
| % Chironomidae | 29% | 26% | 27% | 26% | 22% | 22% | 46% |
| | | | | | | | |
| Shannon Diversity Score (H) | 0.76 | 0.81 | 0.74 | 0.74 | 0.87 | 0.88 | 0.68 |
| Evenness Score (E) | 0.66 | 0.68 | 0.59 | 0.59 | 0.71 | 0.70 | 0.55 |
| | | | | | | | |
| Total Sample Area ($m^2$) | 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 |
| ±1 SD | 1,918 | 2,305 | 2,512 | 2,017 | 858 | 1,025 | 1,056 |
| | | | | | | | |
| Terrestrial Invertebrates | 1 | 1 | 1 | 4 | 1 | 2 | 6 |
| Juvenile Fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Appendix B.6.–Lower Sherman Creek SP1 BMI data summary, 2011–2017.

| | 5/4/11 | 4/30/12 | 5/1/13 | 4/29/14 | 4/28/15 | 4/27/16 | 4/26/17 |
|---|---|---|---|---|---|---|---|
| Total BMI Taxa | 26 | 31 | 28 | 30 | 26 | 26 | 25 |
| Total EPT Taxa | 15 | 18 | 16 | 13 | 13 | 13 | 13 |
| Total BMI Counted | 624 | 1,525 | 1,002 | 1,687 | 921 | 3,816 | 563 |
| Ephemeroptera | 157 | 876 | 499 | 114 | 175 | 101 | 88 |
| Plecoptera | 36 | 103 | 135 | 97 | 67 | 41 | 72 |
| Trichoptera | 7.0 | 14 | 6 | 18 | 6 | 9 | 16 |
| Aquatic Diptera | 89 | 160 | 131 | 648 | 326 | 273 | 123 |
| Other | 335 | 372 | 231 | 810 | 347 | 3,392 | 264 |
| % Ephemeroptera | 25% | 58% | 50% | 7% | 19% | 3% | 16% |
| % Plecoptera | 6% | 7% | 13% | 6% | 7% | 1% | 13% |
| % Trichoptera | 1% | 0.9% | 0.6% | 1% | 1% | 0.2% | 3% |
| % Aquatic Diptera | 14% | 11% | 13% | 38% | 35% | 7% | 22% |
| % Other | 54% | 24% | 23% | 48% | 38% | 89% | 47% |
| % EPT | 32% | 66% | 64% | 14% | 27% | 4% | 31% |
| % Chironomidae | 6% | 8% | 12% | 33% | 33% | 7% | 13% |
| Shannon Diversity Score (H) | 0.76 | 0.74 | 0.85 | 0.71 | 0.84 | 0.32 | 0.81 |
| Evenness Score (E) | 0.71 | 0.62 | 0.71 | 0.57 | 0.70 | 0.27 | 0.69 |
| Total Sample Area ($m^2$) | 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 |
| ±1 SD | 1,000 | 1,410 | 247 | 936 | 718 | 1,398 | 168 |
| Terrestrial Invertebrates | 1 | 0 | 14 | 1 | 14 | 21 | 1 |
| Juvenile Fish | 10 | 12 | 0 | 8 | 0 | 77 | 0 |

Appendix B.7.–Lower Sherman Creek SP2 BMI data summary, 2011–2017.

| | 5/3/11 | 4/30/12 | 4/30/13 | 4/29/14 | 4/28/15 | 4/27/16 | 4/26/17 |
|---|---|---|---|---|---|---|---|
| Total BMI Taxa | 30 | 36 | 39 | 28 | 23 | 23 | 26 |
| Total EPT Taxa | 17 | 26 | 25 | 16 | 13 | 13 | 14 |
| Total BMI Counted | 921 | 1,573 | 1,889 | 661 | 898 | 1,045 | 239 |
| Ephemeroptera | 548 | 1,143 | 1,049 | 31 | 163 | 84 | 37 |
| Plecoptera | 137 | 77 | 299 | 40 | 47 | 32 | 25 |
| Trichoptera | 14 | 26 | 18 | 7 | 13 | 10 | 5 |
| Aquatic Diptera | 143 | 254 | 289 | 354 | 315 | 224 | 88 |
| Other | 79 | 75 | 234 | 229 | 360 | 695 | 84 |
| % Ephemeroptera | 60% | 73% | 56% | 5% | 18% | 8% | 15% |
| % Plecoptera | 15% | 5% | 16% | 6% | 5% | 3% | 10% |
| % Trichoptera | 2% | 2% | 1% | 1% | 1% | 1% | 2% |
| % Aquatic Diptera | 16% | 16% | 15% | 54% | 35% | 21% | 37% |
| % Other | 8.6% | 4.8% | 12% | 35% | 40% | 67% | 35% |
| % EPT | 76% | 79% | 72% | 12% | 25% | 12% | 28% |
| % Chironomidae | 11% | 15% | 14% | 48% | 33% | 20% | 24% |
| Shannon Diversity Score (H) | 0.93 | 0.70 | 0.84 | 0.70 | 0.77 | 0.53 | 0.84 |
| Evenness Score (E) | 0.76 | 0.57 | 0.65 | 0.62 | 0.66 | 0.49 | 0.80 |
| Total Sample Area ($m^2$) | 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 |
| ±1 SD | 927 | 1,174 | 1,471 | 769 | 748 | 982 | 219 |
| Terrestrial Invertebrates | 1 | 2 | 18 | 1 | 10 | 4 | 2 |
| Juvenile Fish | 0 | 0 | 14 | 0 | 0 | 6 | 0 |

# APPENDIX C: ADULT SALMON DATA

Appendix C.1.–2017 Lower Slate Creek weekly adult pink salmon count by reach.

| | 7/18/2017 | | 7/24/2017 | | 8/1/2017 | | 8/8/2017 | | 8/15/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| 0-100 m | 0 | 0 | 0 | 1 | 1 | 1 | 32 | 2 | 126 | 15 |
| 100-200 m | 0 | 0 | 0 | 0 | 0 | 2 | 12 | 0 | 227 | 14 |
| 200-300 m | 0 | 0 | 0 | 1 | 0 | 1 | 84 | 1 | 124 | 8 |
| 300-400 m | 0 | 0 | 0 | 0 | 3 | 0 | 31 | 0 | ND | ND |
| 400-500 m | 0 | 0 | 0 | 0 | 3 | 2 | 65 | 5 | ND | ND |
| 500-600 m | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 4 | ND | ND |
| 600-700 m | 0 | 0 | 0 | 0 | 0 | 0 | 88 | 1 | ND | ND |
| 700-800 m | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | ND | ND |
| 800-900 m | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | ND | ND |
| 900-Falls | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ND | ND |
| Total | 0 | 0 | 0 | 2 | 7 | 6 | 386 | 13 | **477** | **37** |

| | 8/24/2017 | | 8/29/2017 | | 9/7/2017 | | 9/14/2017 | | 9/26/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| 0-100 m | 625 | 42 | 850 | 83 | 710 | 102 | 190 | 114 | 0 | 0 |
| 100-200 m | 395 | 34 | 490 | 79 | 340 | 27 | 90 | 67 | 0 | 0 |
| 200-300 m | 370 | 41 | ND | ND | 320 | 44 | 98 | 67 | 0 | 0 |
| 300-400 m | 420 | 40 | ND | ND | 149 | 16 | 62 | 50 | 0 | 0 |
| 400-500 m | 240 | 23 | ND | ND | 83 | 19 | 44 | 17 | 0 | 0 |
| 500-600 m | 210 | 23 | ND | ND | 102 | 21 | 73 | 33 | 0 | 0 |
| 600-700 m | 360 | 21 | ND | ND | 92 | 8 | 12 | 9 | 0 | 0 |
| 700-800 m | 160 | 2 | ND | ND | 15 | 1 | 8 | 2 | 0 | 0 |
| 800-900 m | 38 | 0 | ND | ND | 0 | 0 | 0 | 0 | 0 | 0 |
| 900-Falls | 0 | 0 | ND | ND | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 2,818 | 226 | **1,340** | **162** | 1,811 | 238 | 577 | 359 | 0 | 0 |

*Note* : Bold numbers indicate incomplete surveys.

Appendix C.2.–2017 Lower Slate Creek weekly adult chum salmon count by reach.

| | 7/18/2017 | | 7/24/2017 | | 8/1/2017 | | 8/8/2017 | | 8/15/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| 0-100 m | 0 | 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 | 1 | 0 | 0 | 0 | ND | ND |
| 400-500 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ND | ND |
| 500-600 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ND | ND |
| 600-700 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ND | ND |
| 700-800 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ND | ND |
| 800-900 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ND | ND |
| 900-Falls | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ND | ND |
| Total | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | **0** | **0** |

| | 8/24/2017 | | 8/29/2017 | | 9/7/2017 | | 9/14/2017 | | 9/26/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| 0-100 m | 0 | 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 | ND | ND | 0 | 0 | 0 | 0 | 0 | 0 |
| 300-400 m | 0 | 0 | ND | ND | 0 | 0 | 0 | 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 | 0 | 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 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 |

*Note* : Bold numbers indicate incomplete surveys.

Appendix C.3.–2017 Lower Slate Creek weekly adult coho salmon count by reach.

| | 9/26/2017 | | 10/4/2017 | | 10/11/2017 | | 10/20/2017 | | 10/26/2016 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| 0-100 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 100-200 m | 0 | 0 | 0 | 0 | 1 | 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 | 1 | 0 |
| 500-600 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 600-700 m | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 700-800 m | 0 | 0 | 1 | 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 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 2 | 0 |

Appendix C.4.–2017 Lower Johnson Creek weekly adult pink salmon count by reach.

| | 7/18/2017 | | 7/25/2017 | | 8/1/2017 | | 8/8/2017 | | 8/15/2017 | | 8/24/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| Con-Lace | 0 | 0 | 410 | 0 | 295 | 0 | 150 | 0 | 170 | 10 | 180 | 50 |
| Lace-JM | 0 | 0 | 28 | 3 | 430 | 3 | 210 | 0 | 52 | 9 | 360 | 40 |
| JM-Trap Site | 3 | 0 | 97 | 3 | 550 | 0 | 425 | 0 | 650 | 18 | 1,260 | 12 |
| Trap-Site #4 | 100 | 0 | 298 | 2 | 817 | 0 | 400 | 10 | 810 | 55 | 935 | 30 |
| Site #4-Site #7 | 5 | 0 | 229 | 3 | 392 | 5 | 415 | 10 | 500 | 16 | 595 | 18 |
| Site #7-Site #10 | 1 | 1 | 121 | 7 | 332 | 10 | 435 | 10 | 510 | 73 | 350 | 20 |
| Site #10-PH | 0 | 0 | 38 | 2 | 345 | 2 | 185 | 25 | 440 | 78 | 330 | 12 |
| PH-LF | 0 | 0 | 1 | 3 | 50 | 0 | 0 | 6 | 47 | 20 | 0 | 0 |
| LF-Site #15 | 0 | 0 | 0 | 3 | 80 | 7 | 50 | 5 | 185 | 45 | 0 | 0 |
| Site #15-Falls | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Total | 109 | 1 | 1,222 | 26 | 3,291 | 27 | 2,272 | 66 | 3,364 | 324 | 4,010 | 182 |

| | 8/29/2017 | | 9/7/2017 | | 9/14/2017 | | 9/21/2017 | | 9/26/2017 | | 10/4/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| Con-Lace | 270 | 0 | 0 | 0 | 3 | 58 | 0 | 49 | ND | ND | ND | ND |
| Lace-JM | 910 | 100 | 50 | 12 | 74 | 48 | 15 | 390 | ND | ND | ND | ND |
| JM-Trap Site | 850 | 50 | 650 | 30 | 218 | 42 | 21 | 170 | 42 | 0 | 0 | 0 |
| Trap-Site #4 | 1,275 | 30 | 325 | 32 | 421 | 24 | 200 | 145 | 16 | 0 | 0 | 0 |
| Site #4-Site #7 | 605 | 30 | 425 | 30 | 238 | 36 | 52 | 65 | 29 | 0 | 0 | 0 |
| Site #7-Site #10 | 705 | 75 | 225 | 13 | 338 | 20 | ND | 42 | 60 | 0 | 0 | 0 |
| Site #10-PH | 390 | 25 | 50 | 0 | 214 | 21 | 0 | 200 | 9 | 0 | 0 | 0 |
| PH-LF | 0 | 10 | 25 | 0 | 16 | 12 | 0 | 5 | 0 | 0 | 0 | 0 |
| LF-Site #15 | 160 | 5 | 25 | 0 | 61 | 27 | 0 | 4 | 0 | 0 | 0 | 0 |
| Site #15-Falls | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 2 | ND | ND | ND | ND |
| Total | 5,165 | 325 | 1,775 | 117 | 1,587 | 288 | **288** | 1,072 | **156** | **0** | **0** | **0** |

*Note* : Bold numbers indicate incomplete surveys.

Appendix C.5.–2017 Lower Johnson Creek weekly adult coho salmon count by reach.

| | 9/26/2017 | | 10/4/2017 | | 10/11/2017 | | 10/20/2017 | | 10/26/2017 | | 11/2/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| Con-Lace | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Lace-JM | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| JM-Trap Site | 0 | 0 | 1 | 0 | 33 | 0 | 0 | 0 | 13 | 0 | 1 | 0 |
| Trap-Site #4 | 0 | 0 | 3 | 0 | 8 | 0 | 0 | 0 | 1 | 0 | 27 | 0 |
| Site #4-Site #7 | 0 | 0 | 0 | 0 | 4 | 0 | 1 | 0 | 1 | 0 | 4 | 0 |
| Site #7-Site #10 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 0 |
| Site #10-PH | 0 | 0 | 0 | 0 | 7 | 0 | 2 | 0 | 2 | 0 | 4 | 0 |
| PH-LF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ND | ND | 0 | 0 |
| LF-Site #15 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | ND | ND | 1 | 0 |
| Site #15-Falls | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Total | 0 | 0 | 4 | 0 | 56 | 0 | 5 | 0 | **18** | **0** | 38 | 0 |

*Note* : Bold numbers indicate incomplete surveys.

Appendix C.6.–2017 Lower Sherman Creek weekly adult pink salmon count by reach.

| | 7/18/2017 | | 7/25/2017 | | 8/1/2017 | | 8/8/2017 | | 8/15/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| 0-50 m | 0 | 0 | 0 | 0 | 0 | 0 | 90 | 16 | 120 | 16 |
| 50-100 m | 0 | 0 | 1 | 0 | 25 | 1 | 76 | 3 | 105 | 27 |
| 100-150 m | 0 | 0 | 0 | 0 | 3 | 3 | 139 | 6 | 225 | 20 |
| 150-200 m | 0 | 0 | 2 | 0 | 20 | 4 | 204 | 16 | 212 | 31 |
| 200-250 m | 0 | 0 | 1 | 0 | 5 | 1 | 95 | 2 | 166 | 11 |
| 250-300 m | 0 | 0 | 0 | 0 | 3 | 0 | 90 | 12 | 126 | 11 |
| 300-350 m | 0 | 0 | 0 | 0 | 3 | 0 | 59 | 3 | 92 | 24 |
| 350-Falls | 0 | 0 | 0 | 0 | 2 | 0 | 25 | 0 | 30 | 0 |
| Total | 0 | 0 | 4 | 0 | 61 | 9 | 778 | 58 | 1076 | 140 |

| | 8/24/2017 | | 8/29/2017 | | 9/7/2017 | | 9/14/2017 | | 9/21/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| 0-50 m | 120 | 21 | 126 | 21 | 149 | 4 | 185 | 26 | 105 | 50 |
| 50-100 m | 73 | 11 | 101 | 29 | 89 | 11 | 59 | 30 | 38 | 52 |
| 100-150 m | 132 | 15 | 153 | 10 | 129 | 11 | 161 | 21 | 103 | 64 |
| 150-200 m | 136 | 20 | 235 | 32 | 152 | 29 | 179 | 36 | 105 | 44 |
| 200-250 m | 120 | 13 | 150 | 23 | 116 | 26 | 85 | 21 | 45 | 37 |
| 250-300 m | 74 | 10 | 84 | 18 | 81 | 51 | 109 | 45 | 57 | 18 |
| 300-350 m | 53 | 5 | 68 | 5 | 58 | 11 | 57 | 8 | 23 | 6 |
| 350-Falls | 22 | 0 | 24 | 0 | 7 | 0 | 6 | 0 | 2 | 0 |
| Total | 730 | 95 | 941 | 138 | 781 | 143 | 841 | 187 | 478 | 271 |

Appendix C.7.–2017 Lower Sherman Creek weekly adult chum salmon count by reach.

| Stream Reach | 7/18/2017 | | 7/25/2017 | | 8/1/2017 | | 8/8/2017 | | 8/15/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| 0-50 m | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 4 | 0 |
| 50-100 m | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 7 | 0 |
| 100-150 m | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 13 | 0 |
| 150-200 m | 0 | 0 | 0 | 0 | 3 | 0 | 9 | 0 | 19 | 0 |
| 200-250 m | 0 | 0 | 0 | 0 | 1 | 0 | 5 | 0 | 7 | 0 |
| 250-300 m | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 5 | 0 |
| 300-350 m | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 7 | 0 |
| 350-Falls | 0 | 0 | 0 | 0 | 1 | 0 | 5 | 0 | 0 | 0 |
| Total | 0 | 0 | 2 | 0 | 5 | 0 | 47 | 0 | 62 | 0 |

| Stream Reach | 8/24/2017 | | 8/29/2017 | | 9/7/2017 | | 9/14/2017 | | 9/21/2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass | Count | Carcass |
| 0-50 m | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50-100 m | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 100-150 m | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 150-200 m | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 350-Falls | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Appendix C.8.–Lower Slate Creek adult pink salmon count by statistical week, 2011–2017.

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

| Statistical Week No. | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| 29 | ND | 0 | 59 | ND | ND | ND | 109 |
| 30 | 1 | 73 | 200 | 44 | 4,512 | 0 | 1,222 |
| 31 | 180 | 411 | 2,250 | 48 | 568 | 6 | 3,291 |
| 32 | 1,891 | 753 | 1,456 | 84 | 17,517 | 154 | 2,272 |
| 33 | 3,850 | 1,698 | 1,873 | 2 | 19,028 | 125 | 3,364 |
| 34 | 5,264 | 1,816 | 1,557 | 11 | 5,444 | 15 | 4,010 |
| 35 | 1,350 | 198 | 545 | 0 | 2,057 | 95 | 5,165 |
| 36 | 3,712 | 60 | 149 | ND | 1,238 | 33 | 1,775 |
| 37 | 670 | 7 | 97 | ND | 702 | ND | 1,587 |
| 38 | 436 | 0 | ND | ND | 249 | ND | **288** |
| 39 | 145 | ND | ND | ND | 10 | ND | **155** |
| 40 | ND | ND | ND | ND | ND | ND | **0** |

*Note* : Bold numbers indicate incomplete surveys.

Appendix C.10.–Lower Sherman Creek adult pink salmon count by statistical week, 2011–2017.

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

| 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 | 0 | 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 |

Appendix D.2.–Lower Slate Creek SP2 pink salmon spawning substrate data, 2011–2017.

| 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 | 1050 | 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 | 107.8 | 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 |

# APPENDIX E: SEDIMENT DATA AND LAB REPORTS

Appendix E.1.–Sediment compositions, 2011–2017.

| 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 |
| 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 |
| 07/07/17 | 34.9 | 32.2 | 28.8 | 4.0 | 18.9 | 32.50 | <9.0 | 16.3 |
| 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 |
| 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 | 28.1 | 66.8 | 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 |
| 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 | 67.04 | 26.1 | 76.5 | 2.00 | <2.5 | 0.288 |

Appendix E.2.–Sediment element concentrations, 2011–2017

| Sample | Concentration (mg/kg dry weight) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Ag | Al | As | Cd | Cr | Cu | Hg | Ni | Pb | Se | Zn |
| Lower Slate Creek | | | | | | | | | | | |
| 10/03/11 | 0.134 | 13,600 | 16.2 | 1.46 | 29.4 | 56.7 | 0.0502 | 47.4 | 7.79 | 0.720 | 220 |
| 07/03/12 | 0.145 | 13,600 | 9.31 | 1.22 | 32.0 | 50.7 | 0.0994 | 43.2 | 8.45 | <0.170 | 200 |
| 07/02/13 | 0.168 | 12,300 | 23.7 | 1.29 | 94.5 | 56.7 | 0.0402 | 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 |
| East Fork Slate Creek | | | | | | | | | | | |
| 10/03/11 | 0.233 | 20,100 | 30.0 | 20.9 | 29.5 | 88.4 | 0.0692 | 143 | 8.50 | 1.41 | 1,360 |
| 07/10/12 | 0.513 | 15,300 | 24.0 | 23.2 | 38.9 | 159.0 | 0.3270 | 153 | 14.2 | 0.934 | 1,490 |
| 07/01/13 | 0.334 | 13,900 | 42.2 | 13.9 | 32.7 | 73.4 | 0.0774 | 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 |
| Upper Slate Creek | | | | | | | | | | | |
| 10/06/11 | 0.120 | 22,500 | 17.9 | 0.722 | 127 | 53.4 | <0.0489 | 87.5 | 3.37 | 0.809 | 130 |
| 07/02/12 | 0.132 | 20,300 | 14.4 | 0.776 | 125 | 55.4 | 0.0625 | 78.4 | 4.05 | 0.606 | 134 |
| 07/01/13 | 0.131 | 14,600 | 13.5 | 0.750 | 101 | 44.6 | <0.0380 | 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 |
| Lower Johnson Creek | | | | | | | | | | | |
| 10/03/11 | 0.164 | 13,100 | 16.2 | 0.238 | 31.5 | 73.1 | <0.0386 | 27.3 | 9.76 | <0.181 | 93.3 |
| 07/02/12 | 0.342 | 13,100 | 12.8 | 0.250 | 35.5 | 76.8 | 0.119 | 23.4 | 9.45 | <0.167 | 97.3 |
| 07/01/13 | 0.269 | 10,300 | 11.9 | 0.492 | 24.4 | 56.1 | <0.0354 | 15.7 | 8.00 | <0.163 | 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 |
| Lower Sherman Creek | | | | | | | | | | | |
| 10/04/11 | 0.137 | 18,200 | 28.9 | 0.389 | 46.2 | 94.0 | <0.0455 | 45.9 | 6.70 | <0.178 | 110 |
| 07/03/12 | 0.289 | 17,900 | 24.3 | 0.578 | 51.4 | 79.1 | 0.0681 | 40.2 | 8.43 | <0.174 | 128 |
| 07/01/13 | 0.306 | 15,400 | 25.4 | 0.390 | 37.4 | 69.4 | <0.0384 | 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 |

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August 28, 2017

**Analytical Report for Service Request No:** K1707282

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 12, 2017
For your reference, these analyses have been assigned our service request number **K1707282.**

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 3293. You may also contact me via email at Shar.Samy@alsglobal.com.

Respectfully submitted,

**ALS Group USA, Corp. dba ALS Environmental**

Shar Samy, Ph.D.
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 | L14-51 |
| Florida DOH | http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm | E87412 |
| Hawaii DOH | http://health.hawaii.gov/ | - |
| ISO 17025 | http://www.pjlabs.com/ | L16-57 |
| Louisiana DEQ | http://www.deq.louisiana.gov/page/la-lab-accreditation | 03016 |
| Maine DHS | http://www.maine.gov/dhhs/ | WA01276 |
| Minnesota DOH | http://www.health.state.mn.us/accreditation | 053-999-457 |
| Nevada DEP | http://ndep.nv.gov/bsdw/labservice.htm | WA01276 |
| New Jersey DEP | http://www.nj.gov/dep/enforcement/oqa.html | WA005 |
| New York - DOH | https://www.wadsworth.org/regulatory/elap | 12060 |
| North Carolina DEQ | https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification | 605 |
| Oklahoma DEQ | http://www.deq.state.ok.us/CSDnew/labcert.htm | 9801 |
| Oregon – DEQ (NELAP) | http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx | WA100010 |
| South Carolina DHEC | http://www.scdhec.gov/environment/EnvironmentalLabCertification/ | 61002 |
| Texas CEQ | http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html | T104704427 |
| Washington DOE | http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html | C544 |
| Wyoming (EPA Region 8) | https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water- | - |
| Kelso Laboratory Website | www.alsglobal.com | NA |

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

# Case Narrative

**ALS Environmental—Kelso Laboratory**
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**ALS ENVIRONMENTAL**

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request No.:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Received:** | 07/12/17 |
| **Sample Matrix:** | Sediment | | |

**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. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), and Matrix/Duplicate Matrix Spike (MS/DMS).

**Sample Receipt**

Five sediment samples were received for analysis at ALS Environmental on 07/12/17. 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.

**General Chemistry Parameters**

Particle Size Determination by ASTM Method D422:
A significant difference exists between the percent passing 75 micron sieve analysis result of 38.73 and the 74 micron hydrometer analysis result of 67.17. Both results should be relatively closer together but the sample contained high concentration of organic matter, wood, which interfered with the hydrometer analysis.

No other anomalies associated with the analysis of these samples were observed.

**Total Metals**

No anomalies associated with the analysis of these samples were observed.

**Approved by**____________________________________

# Chain of Custody

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ALS Environmental

# CHAIN OF CUSTODY 79923

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SR# K1707282

COC Set____of____

COC#________



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: Kate Kanouse
Company: Coeur Alaska / AK Dept. of Fish and Game
Address: 802 3rd St, Douglas, AK 99824
Phone #: (907) 465-4290
email: kate.kanouse@alaska.gov
Sampler Signature: [signature]
Sampler Printed Name: Kate Kanouse

| CLIENT SAMPLE ID | LABID | SAMPLING Date | SAMPLING Time | Matrix | NUMBER OF CONTAINERS | 7D PSEP Sulfide / PSEP Sulfide | 14D PSEP TOC / PSEP TOC T | 28D 7471B / Hg | 180D 200.8 / Metals T | 180D ASTM D422 / Part Size | 999D 160.3 Modified / TS | 1 160.4 mod-TVS | 2 | 3 | 4 | 5 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. KGM-USC | | 7/7/17 | 1000 | soil | 3 | X | X | X | X | X | X | X | | | | | |
| 2. KGM-EFSC | | 7/7/17 | 0900 | soil | 3 | X | X | X | X | X | X | X | | | | | |
| 3. KGM-LSC | | 7/7/17 | 1100 | soil | 3 | X | X | X | X | X | X | X | | | | | |
| 4. KGM-LSH | | 7/6/17 | 1000 | soil | 3 | X | X | X | X | X | X | X | | | | | |
| 5. KGM-LJC | | 7/6/17 | 1330 | soil | 3 | 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 Alaska
~~Kevin eppers~~
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)

| | Relinquished By: | Received By: | Relinquished By: | Received By: | Relinquished By: | Received By: |
|---|---|---|---|---|---|---|
| Signature | [signature] | [signature] | | | | |
| Printed Name | Kate Kanouse | Les Kennedy | | | | |
| Firm | ADF&G | ALS | | | | |
| Date/Time | 7/10/17 0700 | 7/12/17 1010 | | | | |

ALS

PC Shaw

## Cooler Receipt and Preservation Form

Client Coeur / Alaska D. of Fish & Wildlife (ca 7/12/17) Service Request K17 07282

Received: 7/12/17 Opened: 7/12/17 By: ca Unloaded: 7/12/17 By: ca

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

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

| Raw Cooler Temp | Corrected Cooler Temp | Raw Temp Blank | Corrected Temp Blank | Corr. Factor | Thermometer ID | Cooler/COC ID NA | Tracking Number NA | Filed |
|---|---|---|---|---|---|---|---|---|
| 1.2 | 1.1 | 5.7 | 5.6 | -0.1 | 364 | 79923 | 7871 3344 2665 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

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:***

# Total Solids

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

**ALS Group USA, Corp.**
**dba ALS Environmental**

Analytical Report

| | | | | |
|---|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | | **Date Collected:** | 07/06/17 - 07/07/17 |
| **Sample Matrix:** | Sediment | | **Date Received:** | 07/12/17 |
| **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-USC | K1707282-001 | **73.1** | - | 1 | 07/13/17 09:59 | |
| KGM-EFSC | K1707282-002 | **18.9** | - | 1 | 07/13/17 09:59 | |
| KGM-LSC | K1707282-003 | **59.6** | - | 1 | 07/13/17 09:59 | |
| KGM-LSH | K1707282-004 | **76.5** | - | 1 | 07/13/17 09:59 | |
| KGM-LJC | K1707282-005 | **57.6** | - | 1 | 07/13/17 09:59 | |

**ALS Group USA, Corp.**
**dba ALS Environmental**

QA/QC Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project** | Coeur AK Biomonitoring | **Date Collected:** | 07/07/17 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 |
| | | **Date Analyzed:** | 07/13/17 |

## Replicate Sample Summary
## Inorganic Parameters

| | | | |
|---|---|---|---|
| **Sample Name:** | KGM-USC | **Units:** | Percent |
| **Lab Code:** | K1707282-001 | **Basis:** | As Received |

| Analyte Name | Analysis Method | MRL | Sample Result | Duplicate Sample K1707282-001DUP Result | Average | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|
| Solids, Total | 160.3 Modified | - | 73.1 | 72.2 | 72.7 | 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.

# General Chemistry

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

**ALS Group USA, Corp.**
**dba ALS Environmental**

Analytical Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 07/06/17 - 07/07/17 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 |
| **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-USC | K1707282-001 | **3.30** | 0.10 | 1 | 07/13/17 14:05 | |
| KGM-EFSC | K1707282-002 | **32.5** | 0.10 | 1 | 07/13/17 14:05 | |
| KGM-LSC | K1707282-003 | **2.80** | 0.10 | 1 | 07/13/17 14:05 | |
| KGM-LSH | K1707282-004 | **2.00** | 0.10 | 1 | 07/13/17 14:05 | |
| KGM-LJC | K1707282-005 | **4.60** | 0.10 | 1 | 07/13/17 14:05 | |
| Method Blank | K1707282-MB | ND U | 0.10 | 1 | 07/13/17 14:05 | |

**ALS Group USA, Corp.**

**dba ALS Environmental**

QA/QC Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project** | Coeur AK Biomonitoring | **Date Collected:** | 07/07/17 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 |
| | | **Date Analyzed:** | 07/13/17 |

## Replicate Sample Summary
## General Chemistry Parameters

| | | | |
|---|---|---|---|
| **Sample Name:** | KGM-USC | **Units:** | Percent |
| **Lab Code:** | K1707282-001 | **Basis:** | Dry, per Method |

| Analyte Name | Analysis Method | MRL | Sample Result | Duplicate Sample K1707282-001DUP Result | Average | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|
| Solids, Total Volatile | 160.4 Modified | 0.10 | 3.30 | 3.60 | 3.45 | 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.

**ALS Group USA, Corp.**
dba ALS Environmental
**Analytical Report**

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 7/7/2017 |
| **Sample Matrix:** | Sediment | **Date Received:** | 7/12/2017 |
| | | **Date Analyzed:** | 8/22/2017 |

**Particle Size Determination**
**ASTM D422**

**Sample Name:** KGM-USC
**Lab Code:** K1707282-001

**Gravel and Sand**
**(Sieve Analysis)**

| Description | Sieve Size | Weight (g) | Percent Passing |
|---|---|---|---|
| Gravel (19.0 mm) | No.3/4"(19.0 mm) | 0.0000 | 99.93 |
| Gravel (9.50 mm) | No.3/8"(9.50 mm) | 0.0000 | 99.93 |
| Gravel, Medium | No.4 (4.75 mm) | 0.6444 | 98.87 |
| Gravel, Fine | No.10 (2.00 mm) | 0.8289 | 97.51 |
| Sand, Very Coarse | No.20 (0.850 mm) | 10.6548 | 79.94 |
| Sand, Coarse | No.40 (0.425 mm) | 32.7035 | 26.01 |
| Sand, Medium | No.60 (0.250 mm) | 11.2582 | 7.44 |
| Sand, Fine | No.140 (0.106 mm) | 1.2507 | 5.38 |
| Sand, Very Fine | No.200 (0.0750 mm) | 0.1438 | 5.14 |

**Silt and Clay**
(Hydrometer Analysis)

| Particle Diameter | Percent Passing |
|---|---|
| 0.074 mm | 7.60 |
| 0.005 mm | 2.98 |
| 0.001 mm | 0.22 |

**ALS Group USA, Corp.**
dba ALS Environmental
**Analytical Report**

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 7/7/2017 |
| **Sample Matrix:** | Sediment | **Date Received:** | 7/12/2017 |
| | | **Date Analyzed:** | 8/22/2017 |

## Particle Size Determination
## ASTM D422

**Sample Name:** KGM-EFSC
**Lab Code:** K1707282-002

### Gravel and Sand
### (Sieve Analysis)

| Description | Sieve Size | Weight (g) | Percent Passing |
|---|---|---|---|
| **Gravel (19.0 mm)** | **No.3/4"(19.0 mm)** | 0.0000 | 99.62 |
| **Gravel (9.50 mm)** | **No.3/8"(9.50 mm)** | 0.0000 | 99.62 |
| **Gravel, Medium** | **No.4 (4.75 mm)** | 0.1885 | 98.76 |
| **Gravel, Fine** | **No.10 (2.00 mm)** | 0.6073 | 95.99 |
| **Sand, Very Coarse** | **No.20 (0.850 mm)** | 2.9450 | 81.97 |
| **Sand, Coarse** | **No.40 (0.425 mm)** | 1.8157 | 73.32 |
| **Sand, Medium** | **No.60 (0.250 mm)** | 1.7592 | 64.94 |
| **Sand, Fine** | **No.140 (0.106 mm)** | 4.1075 | 45.38 |
| **Sand, Very Fine** | **No.200 (0.0750 mm)** | 1.3948 | 38.73 |

### Silt and Clay
(Hydrometer Analysis)

| Particle Diameter | Percent Passing |
|---|---|
| **0.074 mm** | 67.17 |
| **0.005 mm** | 34.93 |
| **0.001 mm** | 15.67 |

**ALS Group USA, Corp.**
dba ALS Environmental
**Analytical Report**

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 7/7/2017 |
| **Sample Matrix:** | Sediment | **Date Received:** | 7/12/2017 |
| | | **Date Analyzed:** | 8/22/2017 |

## Particle Size Determination
## ASTM D422

**Sample Name:** KGM-LSC
**Lab Code:** K1707282-003

### Gravel and Sand
### (Sieve Analysis)

| Description | Sieve Size | Weight (g) | Percent Passing |
|---|---|---|---|
| **Gravel (19.0 mm)** | **No.3/4"(19.0 mm)** | 0.0000 | 99.87 |
| **Gravel (9.50 mm)** | **No.3/8"(9.50 mm)** | 0.0000 | 99.87 |
| **Gravel, Medium** | **No.4 (4.75 mm)** | 0.9228 | 98.20 |
| **Gravel, Fine** | **No.10 (2.00 mm)** | 2.9257 | 92.92 |
| **Sand, Very Coarse** | **No.20 (0.850 mm)** | 12.7776 | 69.86 |
| **Sand, Coarse** | **No.40 (0.425 mm)** | 15.0891 | 42.63 |
| **Sand, Medium** | **No.60 (0.250 mm)** | 12.6329 | 19.83 |
| **Sand, Fine** | **No.140 (0.106 mm)** | 7.7953 | 5.76 |
| **Sand, Very Fine** | **No.200 (0.0750 mm)** | 0.6946 | 4.51 |

### Silt and Clay
(Hydrometer Analysis)

| Particle Diameter | Percent Passing |
|---|---|
| **0.074 mm** | 8.42 |
| **0.005 mm** | 1.49 |
| **0.001 mm** | 0.00 |

**ALS Group USA, Corp.**
dba ALS Environmental
**Analytical Report**

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 7/6/2017 |
| **Sample Matrix:** | Sediment | **Date Received:** | 7/12/2017 |
| | | **Date Analyzed:** | 8/22/2017 |

**Particle Size Determination**
**ASTM D422**

**Sample Name:** KGM-LSH
**Lab Code:** K1707282-004

**Gravel and Sand**
**(Sieve Analysis)**

| Description | Sieve Size | Weight (g) | Percent Passing |
|---|---|---|---|
| Gravel (19.0 mm) | No.3/4"(19.0 mm) | 0.0000 | 99.22 |
| Gravel (9.50 mm) | No.3/8"(9.50 mm) | 0.7809 | 97.94 |
| Gravel, Medium | No.4 (4.75 mm) | 4.3641 | 90.81 |
| Gravel, Fine | No.10 (2.00 mm) | 10.3475 | 73.89 |
| Sand, Very Coarse | No.20 (0.850 mm) | 15.6631 | 48.54 |
| Sand, Coarse | No.40 (0.425 mm) | 12.8319 | 27.77 |
| Sand, Medium | No.60 (0.250 mm) | 7.4910 | 15.64 |
| Sand, Fine | No.140 (0.106 mm) | 6.7232 | 4.76 |
| Sand, Very Fine | No.200 (0.0750 mm) | 0.7955 | 3.47 |

**Silt and Clay**
(Hydrometer Analysis)

| Particle Diameter | Percent Passing |
|---|---|
| 0.074 mm | 6.85 |
| 0.005 mm | 1.46 |
| 0.001 mm | 0.00 |

**ALS Group USA, Corp.**
dba ALS Environmental
**Analytical Report**

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 7/6/2017 |
| **Sample Matrix:** | Sediment | **Date Received:** | 7/12/2017 |
| | | **Date Analyzed:** | 8/22/2017 |

**Particle Size Determination**
**ASTM D422**

**Sample Name:** KGM-LJC
**Lab Code:** K1707282-005

**Gravel and Sand**
**(Sieve Analysis)**

| Description | Sieve Size | Weight (g) | Percent Passing |
|---|---|---|---|
| **Gravel (19.0 mm)** | **No.3/4"(19.0 mm)** | 0.0000 | 99.56 |
| **Gravel (9.50 mm)** | **No.3/8"(9.50 mm)** | 0.0000 | 99.56 |
| **Gravel, Medium** | **No.4 (4.75 mm)** | 0.0332 | 99.49 |
| **Gravel, Fine** | **No.10 (2.00 mm)** | 1.0291 | 97.50 |
| **Sand, Very Coarse** | **No.20 (0.850 mm)** | 3.9245 | 89.89 |
| **Sand, Coarse** | **No.40 (0.425 mm)** | 8.9256 | 72.60 |
| **Sand, Medium** | **No.60 (0.250 mm)** | 11.2597 | 50.79 |
| **Sand, Fine** | **No.140 (0.106 mm)** | 13.8053 | 24.05 |
| **Sand, Very Fine** | **No.200 (0.0750 mm)** | 2.5589 | 19.09 |

**Silt and Clay**
(Hydrometer Analysis)

| Particle Diameter | Percent Passing |
|---|---|
| **0.074 mm** | 24.87 |
| **0.005 mm** | 4.06 |
| **0.001 mm** | 0.00 |

**ALS Group USA, Corp.**
dba ALS Environmental
**Analytical Report**

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 7/6/2017 |
| **Sample Matrix:** | Sediment | **Date Received:** | 7/12/2017 |
| | | **Date Analyzed:** | 8/22/2017 |

**Particle Size Determination**
**ASTM D422**

**Sample Name:** KGM-LJC
**Lab Code:** K1707282-005DUP

**Gravel and Sand**
**(Sieve Analysis)**

| Description | Sieve Size | Weight (g) | Percent Passing |
|---|---|---|---|
| **Gravel (19.0 mm)** | **No.3/4"(19.0 mm)** | 0.0000 | 99.80 |
| **Gravel (9.50 mm)** | **No.3/8"(9.50 mm)** | 0.0000 | 99.80 |
| **Gravel, Medium** | **No.4 (4.75 mm)** | 0.0531 | 99.67 |
| **Gravel, Fine** | **No.10 (2.00 mm)** | 0.7049 | 97.91 |
| **Sand, Very Coarse** | **No.20 (0.850 mm)** | 2.5402 | 91.55 |
| **Sand, Coarse** | **No.40 (0.425 mm)** | 6.6888 | 74.82 |
| **Sand, Medium** | **No.60 (0.250 mm)** | 8.6232 | 53.24 |
| **Sand, Fine** | **No.140 (0.106 mm)** | 10.8019 | 26.22 |
| **Sand, Very Fine** | **No.200 (0.0750 mm)** | 2.1601 | 20.81 |

**Silt and Clay**
(Hydrometer Analysis)

| Particle Diameter | Percent Passing |
|---|---|
| **0.074 mm** | 35.78 |
| **0.005 mm** | 0.00 |
| **0.001 mm** | 0.00 |

**ALS Group USA, Corp.**
**dba ALS Environmental**

Analytical Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 07/06/17 - 07/07/17 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 |
| **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-USC | K1707282-001 | ND U | 2.4 | 1 | 07/13/17 21:10 | 7/13/17 | |
| KGM-EFSC | K1707282-002 | ND U | 9.0 | 1 | 07/13/17 21:10 | 7/13/17 | |
| KGM-LSC | K1707282-003 | ND U | 3.2 | 1 | 07/13/17 21:10 | 7/13/17 | |
| KGM-LSH | K1707282-004 | ND U | 2.5 | 1 | 07/13/17 21:10 | 7/13/17 | |
| KGM-LJC | K1707282-005 | ND U | 3.3 | 1 | 07/13/17 21:10 | 7/13/17 | |
| Method Blank | K1707282-MB | ND U | 1.0 | 1 | 07/13/17 21:10 | 7/13/17 | |

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project** | Coeur AK Biomonitoring | **Date Collected:** | NA |
| **Sample Matrix:** | Sediment | **Date Received:** | NA |
| | | **Date Analyzed:** | 07/13/17 |

## Triplicate Sample Summary
## General Chemistry Parameters

| | | | |
|---|---|---|---|
| **Sample Name:** | Batch QC | **Units:** | mg/Kg |
| **Lab Code:** | K1707052-001 | **Basis:** | Dry |
| **Analysis Method:** | PSEP Sulfide | | |
| **Prep Method:** | Method | | |

| Analyte Name | MRL | Sample Result | Duplicate K1707052-001DUP Result | Triplicate K1707052-001TRP Result | Average | RSD | RSD Limit |
|---|---|---|---|---|---|---|---|
| Sulfide, Total | 6.4 | 10.9 | 13.2 | 8.7 | 10.9 | 20 | 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**

QA/QC Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | N/A |
| **Sample Matrix:** | Sediment | **Date Received:** | N/A |
| | | **Date Analyzed:** | 07/13/17 |
| | | **Date Extracted:** | 07/13/17 |

## Duplicate Matrix Spike Summary
## Sulfide, Total

| | | | |
|---|---|---|---|
| **Sample Name:** | Batch QC | **Units:** | mg/Kg |
| **Lab Code:** | K1707052-001 | **Basis:** | Dry |
| **Analysis Method:** | PSEP Sulfide | | |
| **Prep Method:** | Method | | |

| | | Matrix Spike K1707052-001MS | | | Duplicate Matrix Spike K1707052-001DMS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Analyte Name** | **Sample Result** | **Result** | **Spike Amount** | **% Rec** | **Result** | **Spike Amount** | **% Rec** | **% Rec Limits** | **RPD** | **RPD Limit** |
| Sulfide, Total | 10.9 | 750 | 920 | 80 | 780 | 930 | 82 | 28-175 | 3 | 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:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Analyzed:** | 07/13/17 |
| **Sample Matrix:** | Sediment | **Date Extracted:** | 07/13/17 |

## Lab Control Sample Summary
## Sulfide, Total

| | | | |
|---|---|---|---|
| **Analysis Method:** | PSEP Sulfide | **Units:** | mg/Kg |
| **Prep Method:** | Method | **Basis:** | Dry |
| | | **Analysis Lot:** | 553505 |

| Sample Name | Lab Code | Result | Spike Amount | % Rec | % Rec Limits |
|---|---|---|---|---|---|
| Lab Control Sample | K1707282-LCS | 300 | 360 | 85 | 39-166 |

**ALS Group USA, Corp.**
**dba ALS Environmental**

Analytical Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 07/06/17 - 07/07/17 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 |
| **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-USC | K1707282-001 | **0.841** | 0.050 | 1 | 07/17/17 13:10 | 7/17/17 | |
| KGM-EFSC | K1707282-002 | **16.3** | 0.050 | 1 | 07/17/17 13:10 | 7/17/17 | |
| KGM-LSC | K1707282-003 | **0.494** | 0.050 | 1 | 07/17/17 13:10 | 7/17/17 | |
| KGM-LSH | K1707282-004 | **0.288** | 0.050 | 1 | 07/17/17 13:10 | 7/17/17 | |
| KGM-LJC | K1707282-005 | **1.60** | 0.050 | 1 | 07/17/17 13:10 | 7/17/17 | |
| Method Blank | K1707282-MB | ND U | 0.050 | 1 | 07/17/17 13:10 | 7/17/17 | |

**ALS Group USA, Corp.**

**dba ALS Environmental**

QA/QC Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project** | Coeur AK Biomonitoring | **Date Collected:** | 07/07/17 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 |
| | | **Date Analyzed:** | 07/17/17 |

## Triplicate Sample Summary
## General Chemistry Parameters

| | | | |
|---|---|---|---|
| **Sample Name:** | KGM-USC | **Units:** | Percent |
| **Lab Code:** | K1707282-001 | **Basis:** | Dry, per Method |
| **Analysis Method:** | PSEP TOC | | |
| **Prep Method:** | ALS SOP | | |

| Analyte Name | MRL | Sample Result | Duplicate K1707282-001DUP Result | Triplicate K1707282-001TRP Result | Average | RSD | RSD Limit |
|---|---|---|---|---|---|---|---|
| Carbon, Total Organic (TOC) | 0.050 | 0.841 | 0.846 | 0.843 | 0.843 | <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.

**ALS Group USA, Corp.**
**dba ALS Environmental**

QA/QC Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 07/07/17 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 |
| | | **Date Analyzed:** | 07/17/17 |
| | | **Date Extracted:** | 07/17/17 |

## Duplicate Matrix Spike Summary
## Carbon, Total Organic (TOC)

| | | | |
|---|---|---|---|
| **Sample Name:** | KGM-USC | **Units:** | Percent |
| **Lab Code:** | K1707282-001 | **Basis:** | Dry, per Method |
| **Analysis Method:** | PSEP TOC | | |
| **Prep Method:** | ALS SOP | | |

| | | Matrix Spike K1707282-001MS | | | Duplicate Matrix Spike K1707282-001DMS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Analyte Name** | **Sample Result** | **Result** | **Spike Amount** | **% Rec** | **Result** | **Spike Amount** | **% Rec** | **% Rec Limits** | **RPD** | **RPD Limit** |
| Carbon, Total Organic (TOC) | 0.841 | 4.16 | 3.40 | 98 | 4.32 | 3.57 | 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.

**ALS Group USA, Corp.**
**dba ALS Environmental**

QA/QC Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Analyzed:** | 07/17/17 |
| **Sample Matrix:** | Sediment | **Date Extracted:** | 07/17/17 |

## Lab Control Sample Summary
## Carbon, Total Organic (TOC)

| | | | |
|---|---|---|---|
| **Analysis Method:** | PSEP TOC | **Units:** | Percent |
| **Prep Method:** | ALS SOP | **Basis:** | Dry, per Method |
| | | **Analysis Lot:** | 553861 |

| Sample Name | Lab Code | Result | Spike Amount | % Rec | % Rec Limits |
|---|---|---|---|---|---|
| Lab Control Sample | K1707282-LCS | 0.577 | 0.603 | 96 | 74-118 |

# Metals

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

Analytical Report

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

**Service Request:** K1707282
**Date Collected:** 07/07/17 10:00
**Date Received:** 07/12/17 10:10

**Sample Name:** KGM-USC
**Lab Code:** K1707282-001

**Basis:** Dry

## Total Metals

| Analyte Name | Analysis Method | Result | Units | MRL | Dil. | Date Analyzed | Date Extracted | Q |
|---|---|---|---|---|---|---|---|---|
| Aluminum | 200.7 | **15700** | mg/Kg | 2.3 | 2 | 07/24/17 16:21 | 07/13/17 | |
| Arsenic | 200.8 | **17.5** | mg/Kg | 0.58 | 5 | 07/21/17 12:40 | 07/13/17 | |
| Cadmium | 200.8 | **0.454** | mg/Kg | 0.023 | 5 | 07/21/17 12:40 | 07/13/17 | |
| Chromium | 200.8 | **61.4** | mg/Kg | 0.23 | 5 | 07/21/17 12:40 | 07/13/17 | |
| Copper | 200.8 | **36.9** | mg/Kg | 0.12 | 5 | 07/21/17 12:40 | 07/13/17 | |
| Lead | 200.8 | **3.17** | mg/Kg | 0.058 | 5 | 07/21/17 12:40 | 07/13/17 | |
| Mercury | 7471B | **0.028** | mg/Kg | 0.023 | 1 | 07/14/17 09:30 | 07/13/17 | |
| Nickel | 200.8 | **47.2** | mg/Kg | 0.23 | 5 | 07/21/17 12:40 | 07/13/17 | |
| Selenium | 200.8 | **1.4** | mg/Kg | 1.2 | 5 | 07/21/17 12:40 | 07/13/17 | |
| Silver | 200.8 | **0.056** | mg/Kg | 0.023 | 5 | 07/21/17 12:40 | 07/13/17 | |
| Zinc | 200.8 | **99.7** | mg/Kg | 0.58 | 5 | 07/21/17 12:40 | 07/13/17 | |

# ALS Group USA, Corp.
**dba ALS Environmental**

Analytical Report

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

**Service Request:** K1707282
**Date Collected:** 07/07/17 09:00
**Date Received:** 07/12/17 10:10

**Sample Name:** KGM-EFSC
**Lab Code:** K1707282-002

**Basis:** Dry

## Total Metals

| Analyte Name | Analysis Method | Result | | Units | MRL | Dil. | Date Analyzed | Date Extracted | Q |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 200.7 | **12900** | | mg/Kg | 10 | 2 | 07/24/17 16:31 | 07/13/17 | |
| Arsenic | 200.8 | **29.9** | | mg/Kg | 2.5 | 5 | 07/21/17 12:50 | 07/13/17 | |
| Cadmium | 200.8 | **9.65** | | mg/Kg | 0.10 | 5 | 07/21/17 12:50 | 07/13/17 | |
| Chromium | 200.8 | **15.0** | | mg/Kg | 1.0 | 5 | 07/21/17 12:50 | 07/13/17 | |
| Copper | 200.8 | **62.3** | | mg/Kg | 0.50 | 5 | 07/21/17 12:50 | 07/13/17 | |
| Lead | 200.8 | **6.61** | | mg/Kg | 0.25 | 5 | 07/21/17 12:50 | 07/13/17 | |
| Mercury | 7471B | **0.143** | | mg/Kg | 0.098 | 1 | 07/14/17 09:34 | 07/13/17 | |
| Nickel | 200.8 | **69.9** | | mg/Kg | 1.0 | 5 | 07/21/17 12:50 | 07/13/17 | |
| Selenium | 200.8 | ND | U | mg/Kg | 5.0 | 5 | 07/21/17 12:50 | 07/13/17 | |
| Silver | 200.8 | **0.30** | | mg/Kg | 0.10 | 5 | 07/21/17 12:50 | 07/13/17 | |
| Zinc | 200.8 | **625** | | mg/Kg | 2.5 | 5 | 07/21/17 12:50 | 07/13/17 | |

**ALS Group USA, Corp.**
**dba ALS Environmental**

Analytical Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 07/07/17 11:00 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 10:10 |
| **Sample Name:** | KGM-LSC | **Basis:** | Dry |
| **Lab Code:** | K1707282-003 | | |

## Total Metals

| Analyte Name | Analysis Method | Result | Units | MRL | Dil. | Date Analyzed | Date Extracted | Q |
|---|---|---|---|---|---|---|---|---|
| Aluminum | 200.7 | **12000** | mg/Kg | 3.2 | 2 | 07/24/17 16:41 | 07/13/17 | |
| Arsenic | 200.8 | **16.4** | mg/Kg | 0.80 | 5 | 07/21/17 12:53 | 07/13/17 | |
| Cadmium | 200.8 | **0.681** | mg/Kg | 0.032 | 5 | 07/21/17 12:53 | 07/13/17 | |
| Chromium | 200.8 | **18.3** | mg/Kg | 0.32 | 5 | 07/21/17 12:53 | 07/13/17 | |
| Copper | 200.8 | **40.9** | mg/Kg | 0.16 | 5 | 07/21/17 12:53 | 07/13/17 | |
| Lead | 200.8 | **8.16** | mg/Kg | 0.080 | 5 | 07/21/17 12:53 | 07/13/17 | |
| Mercury | 7471B | ND U | mg/Kg | 0.031 | 1 | 07/14/17 09:36 | 07/13/17 | |
| Nickel | 200.8 | **31.7** | mg/Kg | 0.32 | 5 | 07/21/17 12:53 | 07/13/17 | |
| Selenium | 200.8 | ND U | mg/Kg | 1.6 | 5 | 07/21/17 12:53 | 07/13/17 | |
| Silver | 200.8 | **0.101** | mg/Kg | 0.032 | 5 | 07/21/17 12:53 | 07/13/17 | |
| Zinc | 200.8 | **145** | mg/Kg | 0.80 | 5 | 07/21/17 12:53 | 07/13/17 | |

**ALS Group USA, Corp.**
**dba ALS Environmental**

Analytical Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 07/06/17 10:00 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 10:10 |
| **Sample Name:** | KGM-LSH | **Basis:** | Dry |
| **Lab Code:** | K1707282-004 | | |

## Total Metals

| Analyte Name | Analysis Method | Result | | Units | MRL | Dil. | Date Analyzed | Date Extracted | Q |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 200.7 | **17400** | | mg/Kg | 2.6 | 2 | 07/24/17 16:43 | 07/13/17 | |
| Arsenic | 200.8 | **23.5** | | mg/Kg | 0.65 | 5 | 07/21/17 12:56 | 07/13/17 | |
| Cadmium | 200.8 | **0.194** | | mg/Kg | 0.026 | 5 | 07/21/17 12:56 | 07/13/17 | |
| Chromium | 200.8 | **31.8** | | mg/Kg | 0.26 | 5 | 07/21/17 12:56 | 07/13/17 | |
| Copper | 200.8 | **58.1** | | mg/Kg | 0.13 | 5 | 07/21/17 12:56 | 07/13/17 | |
| Lead | 200.8 | **4.69** | | mg/Kg | 0.065 | 5 | 07/21/17 12:56 | 07/13/17 | |
| Mercury | 7471B | **0.045** | | mg/Kg | 0.025 | 1 | 07/14/17 09:38 | 07/13/17 | |
| Nickel | 200.8 | **28.5** | | mg/Kg | 0.26 | 5 | 07/21/17 12:56 | 07/13/17 | |
| Selenium | 200.8 | ND | U | mg/Kg | 1.3 | 5 | 07/21/17 12:56 | 07/13/17 | |
| Silver | 200.8 | **0.097** | | mg/Kg | 0.026 | 5 | 07/21/17 12:56 | 07/13/17 | |
| Zinc | 200.8 | **90.2** | | mg/Kg | 0.65 | 5 | 07/21/17 12:56 | 07/13/17 | |

**ALS Group USA, Corp.**
**dba ALS Environmental**

Analytical Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 07/06/17 13:30 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 10:10 |
| **Sample Name:** | KGM-LJC | **Basis:** | Dry |
| **Lab Code:** | K1707282-005 | | |

## Total Metals

| Analyte Name | Analysis Method | Result | Units | MRL | Dil. | Date Analyzed | Date Extracted | Q |
|---|---|---|---|---|---|---|---|---|
| Aluminum | 200.7 | **6730** | mg/Kg | 3.1 | 2 | 07/24/17 16:46 | 07/13/17 | |
| Arsenic | 200.8 | **10.3** | mg/Kg | 0.77 | 5 | 07/21/17 13:00 | 07/13/17 | |
| Cadmium | 200.8 | **0.115** | mg/Kg | 0.031 | 5 | 07/21/17 13:00 | 07/13/17 | |
| Chromium | 200.8 | **11.7** | mg/Kg | 0.31 | 5 | 07/21/17 13:00 | 07/13/17 | |
| Copper | 200.8 | **46.2** | mg/Kg | 0.15 | 5 | 07/21/17 13:00 | 07/13/17 | |
| Lead | 200.8 | **5.96** | mg/Kg | 0.077 | 5 | 07/21/17 13:00 | 07/13/17 | |
| Mercury | 7471B | **0.064** | mg/Kg | 0.033 | 1 | 07/14/17 09:42 | 07/13/17 | |
| Nickel | 200.8 | **10.3** | mg/Kg | 0.31 | 5 | 07/21/17 13:00 | 07/13/17 | |
| Selenium | 200.8 | ND U | mg/Kg | 1.5 | 5 | 07/21/17 13:00 | 07/13/17 | |
| Silver | 200.8 | **0.172** | mg/Kg | 0.031 | 5 | 07/21/17 13:00 | 07/13/17 | |
| Zinc | 200.8 | **48.0** | mg/Kg | 0.77 | 5 | 07/21/17 13:00 | 07/13/17 | |

**ALS Group USA, Corp.**
**dba ALS Environmental**

Analytical Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | NA |
| **Sample Matrix:** | Sediment | **Date Received:** | NA |
| **Sample Name:** | Method Blank | **Basis:** | Dry |
| **Lab Code:** | KQ1709629-01 | | |

## Total Metals

| Analyte Name | Analysis Method | Result | Units | MRL | Dil. | Date Analyzed | Date Extracted | Q |
|---|---|---|---|---|---|---|---|---|
| Aluminum | 200.7 | ND U | mg/Kg | 2 | 2 | 07/24/17 16:17 | 07/13/17 | |
| Arsenic | 200.8 | ND U | mg/Kg | 0.5 | 5 | 07/21/17 12:33 | 07/13/17 | |
| Cadmium | 200.8 | ND U | mg/Kg | 0.020 | 5 | 07/21/17 12:33 | 07/13/17 | |
| Chromium | 200.8 | ND U | mg/Kg | 0.20 | 5 | 07/21/17 12:33 | 07/13/17 | |
| Copper | 200.8 | ND U | mg/Kg | 0.10 | 5 | 07/21/17 12:33 | 07/13/17 | |
| Lead | 200.8 | ND U | mg/Kg | 0.05 | 5 | 07/21/17 12:33 | 07/13/17 | |
| Nickel | 200.8 | ND U | mg/Kg | 0.20 | 5 | 07/21/17 12:33 | 07/13/17 | |
| Selenium | 200.8 | ND U | mg/Kg | 1.0 | 5 | 07/21/17 12:33 | 07/13/17 | |
| Silver | 200.8 | ND U | mg/Kg | 0.020 | 5 | 07/21/17 12:33 | 07/13/17 | |
| Zinc | 200.8 | ND U | mg/Kg | 0.5 | 5 | 07/21/17 12:33 | 07/13/17 | |

**ALS Group USA, Corp.**
**dba ALS Environmental**

Analytical Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | NA |
| **Sample Matrix:** | Sediment | **Date Received:** | NA |
| **Sample Name:** | Method Blank | **Basis:** | Dry |
| **Lab Code:** | KQ1709462-01 | | |

## Total Metals

| Analyte Name | Analysis Method | Result | Units | MRL | Dil. | Date Analyzed | Date Extracted | Q |
|---|---|---|---|---|---|---|---|---|
| Mercury | 7471B | ND U | mg/Kg | 0.02 | 1 | 07/14/17 08:25 | 07/13/17 | |

# ALS Group USA, Corp.

**dba ALS Environmental**

QA/QC Report

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

**Service Request:** K1707282
**Date Collected:** 07/07/17
**Date Received:** 07/12/17
**Date Analyzed:** 07/21/17 - 07/24/17

## Replicate Sample Summary
## Total Metals

**Sample Name:** KGM-USC
**Lab Code:** K1707282-001

**Units:** mg/Kg
**Basis:** Dry

| Analyte Name | Analysis Method | MRL | Sample Result | Duplicate Sample KQ1709629-03 Result | Average | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|
| Aluminum | 200.7 | 2.3 | 15700 | 15400 | 15600 | 2 | 30 |
| Arsenic | 200.8 | 0.57 | 17.5 | 16.5 | 17.0 | 6 | 30 |
| Cadmium | 200.8 | 0.023 | 0.454 | 0.526 | 0.490 | 15 | 30 |
| Chromium | 200.8 | 0.23 | 61.4 | 66.8 | 64.1 | 8 | 30 |
| Copper | 200.8 | 0.11 | 36.9 | 39.2 | 38.1 | 6 | 30 |
| Lead | 200.8 | 0.057 | 3.17 | 2.95 | 3.06 | 7 | 30 |
| Nickel | 200.8 | 0.23 | 47.2 | 47.4 | 47.3 | <1 | 30 |
| Selenium | 200.8 | 1.1 | 1.4 | 1.4 | 1.4 | <1 | 30 |
| Silver | 200.8 | 0.023 | 0.056 | 0.063 | 0.060 | 10 | 30 |
| Zinc | 200.8 | 0.57 | 99.7 | 103 | 101 | 3 | 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.

QA/QC Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project** | Coeur AK Biomonitoring | **Date Collected:** | 07/07/17 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 |
| | | **Date Analyzed:** | 07/14/17 |

## Replicate Sample Summary
## Total Metals

| | | | |
|---|---|---|---|
| **Sample Name:** | KGM-USC | **Units:** | mg/Kg |
| **Lab Code:** | K1707282-001 | **Basis:** | Dry |

| Analyte Name | Analysis Method | MRL | Sample Result | Duplicate Sample KQ1709462-13 Result | Average | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|
| Mercury | 7471B | 0.023 | 0.028 | 0.031 | 0.030 | 12 | 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**

QA/QC Report

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

**Service Request:** K1707282
**Date Collected:** 07/07/17
**Date Received:** 07/12/17
**Date Analyzed:** 07/21/17 - 07/24/17

## Matrix Spike Summary
## Total Metals

**Sample Name:** KGM-USC
**Lab Code:** K1707282-001

**Units:** mg/Kg
**Basis:** Dry

**Matrix Spike**
KQ1709629-04

| Analyte Name | Method | Sample Result | Result | Spike Amount | % Rec | % Rec Limits |
|---|---|---|---|---|---|---|
| Aluminum | 200.7 | 15700 | 14800 | 505 | -178 # | 70-130 |
| Arsenic | 200.8 | 17.5 | 136 | 126 | 94 | 70-130 |
| Cadmium | 200.8 | 0.454 | 13.1 | 12.6 | 101 | 70-130 |
| Chromium | 200.8 | 61.4 | 115 | 50.5 | 106 | 70-130 |
| Copper | 200.8 | 36.9 | 104 | 63.1 | 107 | 70-130 |
| Lead | 200.8 | 3.17 | 128 | 126 | 99 | 70-130 |
| Nickel | 200.8 | 47.2 | 168 | 126 | 96 | 70-130 |
| Selenium | 200.8 | 1.4 | 123 | 126 | 97 | 70-130 |
| Silver | 200.8 | 0.056 | 12.4 | 12.6 | 98 | 70-130 |
| Zinc | 200.8 | 99.7 | 231 | 126 | 104 | 70-130 |

**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**

QA/QC Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Collected:** | 07/07/17 |
| **Sample Matrix:** | Sediment | **Date Received:** | 07/12/17 |
| | | **Date Analyzed:** | 07/14/17 |
| | | **Date Extracted:** | 07/13/17 |

## Matrix Spike Summary
## Total Metals

| | | | |
|---|---|---|---|
| **Sample Name:** | KGM-USC | **Units:** | mg/Kg |
| **Lab Code:** | K1707282-001 | **Basis:** | Dry |
| **Analysis Method:** | 7471B | | |
| **Prep Method:** | Method | | |

**Matrix Spike**
KQ1709462-14

| Analyte Name | Sample Result | Result | Spike Amount | % Rec | % Rec Limits |
|---|---|---|---|---|---|
| Mercury | 0.028 | 0.599 | 0.570 | 100 | 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.

Printed 8/9/2017 3:02:55 PM

Superset Reference:

**ALS Group USA, Corp.**
**dba ALS Environmental**

QA/QC Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Analyzed:** | 07/24/17 |
| **Sample Matrix:** | Sediment | | |

## Lab Control Sample Summary
## Total Metals

**Units:** mg/Kg
**Basis:** Dry

**Lab Control Sample**
KQ1709629-05

| Analyte Name | Analytical Method | Result | Spike Amount | % Rec | % Rec Limits |
|---|---|---|---|---|---|
| Aluminum | 200.7 | 6530 | 7930 | 82 | 39-161 |

**ALS Group USA, Corp.**
**dba ALS Environmental**

QA/QC Report

| | | | |
|---|---|---|---|
| **Client:** | Alaska Department of Fish and Game | **Service Request:** | K1707282 |
| **Project:** | Coeur AK Biomonitoring | **Date Analyzed:** | 07/21/17 |
| **Sample Matrix:** | Sediment | | |

## Lab Control Sample Summary
## Total Metals

**Units:** mg/Kg
**Basis:** Dry

**Lab Control Sample**
KQ1709629-05

| Analyte Name | Analytical Method | Result | Spike Amount | % Rec | % Rec Limits |
|---|---|---|---|---|---|
| Arsenic | 200.8 | 101 | 98.5 | 102 | 69-145 |
| Cadmium | 200.8 | 151 | 146 | 104 | 73-127 |
| Chromium | 200.8 | 181 | 182 | 99 | 71-130 |
| Copper | 200.8 | 104 | 106 | 98 | 75-125 |
| Lead | 200.8 | 135 | 130 | 104 | 72-127 |
| Nickel | 200.8 | 144 | 149 | 97 | 73-127 |
| Selenium | 200.8 | 157 | 154 | 102 | 68-132 |
| Silver | 200.8 | 43.0 | 40.9 | 105 | 66-134 |
| Zinc | 200.8 | 185 | 191 | 97 | 70-130 |

**ALS Group USA, Corp.**
**dba ALS Environmental**

QA/QC Report

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

**Service Request:** K1707282
**Date Analyzed:** 07/14/17

## Lab Control Sample Summary
## Total Metals

**Units:** mg/Kg
**Basis:** Dry

### Lab Control Sample
KQ1709462-05

| Analyte Name | Analytical Method | Result | Spike Amount | % Rec | % Rec Limits |
|---|---|---|---|---|---|
| Mercury | 7471B | 8.22 | 7.10 | 116 | 51-149 |